WORLD METEOROLOGICAL ORGANIZATION

Guide
to Marine Meteorological Services

Third edition

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NOTE

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FOREWORD

The realization that specialized meteorological information and services are required to meet the often complex requirements of diverse marine user groups, prompted the former Commission for Marine Meteorology (CMM) to prepare a comprehensive *Guide to Marine Meteorological Services,* for the assistance of Members. The guide provides a complement to the *Manual on Marine Meteorological Services* (WMO-No. 558), which itself contains standard and recommended practices to be applied by Members in the provision of such services. The first edition of this *Guide* was published in 1977, and a second revised edition, in 1982.

The eleventh session of CMM (Lisbon, April 1993) recognized that many technical and structural developments and advances had taken place in this field over the ensuing decade, not least the implementation of the Global Maritime Distress and Safety System (GMDSS), and that it was therefore time to undertake another thorough revision of the guide. A draft, fully revised, version of the guide was prepared by Mr D. Linforth (Australia), with additional input provided by members of the CMM Working Group on Marine Meteorological Services. This draft was then extensively reviewed by members of -*a.* number of working groups and subgroups of the Commission, before being presented to the twelfth session of CMM (Havana, March 1997) for adoption. Formal approval for the publication of this third edition was given by the forty-ninth session of the WMO Executive Council in June 1997. Subsequently, the advent in particular of the new Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), through a merger of CMM and the joint IOC/WMO Committee for IGOSS, necessitated some small editorial revisions to the guide, which were carried out by the Secretariat.

I am confident that this fully revised, third edition of the *Guide to Marine Meteorological Services* reflects the growth and breadth of the requirements of all marine user groups for such services, as well as the many advances in technology, process understanding, and analysis and forecast techniques in this field over the past two decades. I expect that it will continue to provide valuable assistance to Members in the further development of their national marine meteorological services.

On behalf of the World Meteorological Organization, I would like to express my gratitude and appreciation to Mr Linforth, and to all the other experts who have contributed to the preparation of this new edition to the *Guide.*

(G. O. P. Obasi)
Secretary-General

INTRODUCTION

Weather information has always been vital for the safety and efficient operation of marine industries, particularly transport and fishing. When the electric telegraph and scientific advances in the mid-nineteenth century allowed weather forecasts to be made with some reliability, the primary purpose for the establishment of National Meteorological Offices was the provision of forecasts to the marine community. Visual signals were displayed at ports to warn ships of impending storms.

The first international conference on marine meteorology, held in Brussels in 1853, agreed on a uniform method of taking nautical and meteorological observations on board ships. The observations, obtained through the voluntary cooperation of merchant shipping, were then processed into climatological information for use by shipping. Thus began a form of service in which the user himself contributes to the basic dataset.

Early in the twentieth century wireless telegraphy allowed regular communication between ship and shore and weather broadcasts to shipping began. The First International Convention for the Safety of Life at Sea called for the coverage of all shipping lanes and fishing grounds with weather information to be broadcast by radio; governments agreed to share responsibilities for these broadcasts over the oceans. The late twentieth century saw advances in radio technology, such as narrow-band direct printing, digital selective calling and satellite broadcasting. These techniques are used in the Global Maritime Distress and Safety System, inaugurated in 1992 following the amendment of the International Convention for the Safety of Life at Sea. This requires continued international cooperation and uniformity of presentation of the information provided.

Climatological information has always been in demand from the marine community. An international system for the exchange of marine climatological data and the regular publication of annual climatological summaries was established in 1963. With advances in computer tachnology for the handling of large datasets, and the transfer of data by diskette, two global centres for the collection of climatological data derived from observations from ships were established in 1993.

Economy and efficiency in shipping and fishing operations have become increasingly important, and many specialized marine meteorological services have developed. Weather routeing of ships advises of the most economic route to take in view of forecast weather. Specialized marine meteorological information, forecasts and advice are provided for use in the planning of coastal development projects. Detailed specific weather services are required for offshore oil and gas drilling and extraction operations and, frequently, for higher speed passenger services by hovercraft, hydrofoil and catamaran. The development of containerized cargo has reduced the turnaround time of ships in port, but increased the demand for forecasting services in large ports to optimize the efficiency of port operations.

The internationally agreed methods of providing services to the marine community around the world are described in the *Manual on Marine Meteorological Services* (WMO-No. 558). The purpose of this *Guide* is to complement the *Manual* by:

(a) Describing the requirements for the various types of service;

(b) Explaining the rationale for the agreed methods of providing services; and,

(c) Giving guidance on how to go about setting up and maintaining marine meteorological services.

It follows the same structure as the *Manual on Marine Meteorological Services* and cross references are provided to relevant sections of the *Manual.*

General services which satisfy a large number of users are most often provided at public expense. Specialized services for individual organizations are often provided for a charge. In many countries they are provided by private companies. In both cases emphasis is placed on: *(a)* The need for consultation with users to ensure that
the services provided are those required; and, *(a)* The need for continued evaluation and monitoring to ensure that the standard of service is maintained and that it keeps abreast of changing requirements.

CHAPTER 1

MARINE METEOROLOGICAL SERVICES

1.1 Introduction

Broadly speaking, marine meteorological services have two functions:

(a) To serve international shipping, fishing and other marine activities on the high seas; and,

(b) To serve the various activities which take place in coastal and offshore areas and on the coast itself.

A marine meteorological programme embraces a wide range of activities. In the preparation of analyses, synopses, forecasts and warnings, knowledge is required of the present state of the atmosphere and the ocean surface, as well as the climate of the region. In addition, other types of forecasts which refer to special elements and phenomena, such as waves, storm surges, sea ice and ice accretion must be based on relevant observational data.

Thus, with such a strong requirement for observational data, the recruitment of voluntary observing ships, the training of shipboard and shore personnel, the development of marine communication systems, the reception, distribution and archiving of observations must all be considered as a major part of a marine meteorological programme which permits the two functions to be fully supported and implemented.

In addition, each part of a marine meteorological programme should have a monitoring system so that the programme can be evaluated at regular intervals. Monitoring is necessary to ensure that the services provided continue to meet the requirements of users.

1.2 Requirements for marine meteorological information

Marine operations are sensitive to environmental conditions. Generally, extreme values of waves, wind and visibility increase the risk to the safety of the vessel or sea structure and to the persons involved in the operation. Less extreme values, even if safety is not threatened, will affect the efficiency, effectiveness or comfort of the operation. The usefulness of a warning or a forecast depends on the accuracy of the prediction, its timeliness, i.e. the number of hours or days in advance of the event that the forecast can be provided, and the ability of the user to react to the information.

For each major user group the importance of each element to their operations and the details of desired forecasts of each element, including some understanding of the warning time necessary for the extremes of each element concerned, should be determined.

1.2.1 *Marine operations on the high seas*

1.2.1.1 WIND AND WAVES

Ocean-going ships are built to resist the forces of wind, waves and storms. However, a mechanically driven ship cannot maintain its speed and course in all weather and sea conditions. To prevent a ship from experiencing the excessive shocks of slamming into waves, or excessive rolling in adverse wave conditions, speed has to be reduced or its course changed, or both. In severe storms speed reductions can be considerable, and a ship may have to ride out the storm without making appreciable headway.

The optimum heading on which a ship should be placed under severe weather conditions depends on the design of the ship, its size, cargo and conditions of loading. A ship with heavy deck cargo is handled differently from, say, a tanker, whilst the master of a passenger ship considers the comfort of his passengers and endeavours to reduce the angle of roll. In all cases the expected time of arrival at the destination is of interest and will be affected by the weather conditions. Late arrival carries economic penalties for the shipping company. Some ports can only be reached at high tide, and missing a tide means a wait of 12 hours for the next. In order to take appropriate measures, the master should receive timely and regular information on the wind and sea conditions he is likely to encounter. Several hours may be required to prepare a ship at sea for extreme conditions. However, outlooks of possible storm developments for a period three to five days in advance and regularly updated information are welcomed. They enable the ship's master to take any precautionary measures considered necessary, including altering course to avoid the worst of the weather, and to make appropriate assessments of his expected time of arrival.

The determination of a shipping route across the ocean based on a least-time track taking into account marine climatological data, load-line rules and medium-range forecasts of wind and wave conditions is a specific application of this information and is dealt with under 'Ship weather routeing', Chapter 2, paragraph 2.6 of this *Guide*.

Information about waves less than two metres high is normally not required for ocean-going ships. Information about areas where waves are, or are expected to be, two metres or higher is important, since a large number of ships are affected by these waves. Forecasts and warnings should describe areas where waves are, or will be, higher than a threshold value and should include wave direction and period. Information on swell systems which are crossing other systems of wind waves is also important. This information can best be provided in chart form.

1.2.1.2 VISIBILITY

Poor visibility is a major hazard to all vessels because of the increased danger of collision. Information should be

included on areas where visibility is observed or is predicted to be less than six nautical miles (10 kilometres).

Information concerning reduced visibility is desirable at least six hours before it is expected to occur. Although it is not always possible to provide these predictions through lack of data, there may be sufficient information to describe existing and persisting areas of reduced visibility. This can be of use to ships which are heading toward those areas.

Information concerning higher ranges of visibility is of interest to fast-moving vessels, such as hovercraft, hydrofoils and fast cargo ships, as well as loaded supertankers and loaded bulk carriers whose inertia prevents rapid speed reductions. A ship has no brakes, it can only reverse engines to slow down.

1.2.1.3 CLOUD AND PRECIPITATION

Forecasts of cloud cover are not so important, but forecasts of precipitation are needed insofar as visibility is significantly reduced. Forecasts of heavy snowfall and rain are needed for cargo protection. Information regarding precipitation is also needed in connection with ice accretion.

1.2.1.4 AIR AND SEA TEMPERATURE

Forecasts of air and sea temperature, together with the prevailing wind are required when there is a risk of ice accretion. These elements are also important for cargo ventilation particularly in regions of upwelling of colder water from the lower depths.

1.2.1.5 OCEAN CURRENTS

Information on ocean currents is used in navigation, fishing operations and search and rescue operations. Climatological sea-surface current charts showing frequencies of current speeds and directions should be used in conjunction with actual information available on currents.

1.2.1.6 ICE ACCRETION

The accumulation of ice on the superstructure and deck equipment of vessels, even large ones, may seriously affect safety and operational efficiency. Icing on aerials, for example, may make radio and radar equipment inoperative. On small vessels icing presents a much greater hazard. The weight of ice reduces freeboard and stability, and in storm conditions leads to a risk of capsizing. Fishing vessels operating in polar seas are especially vulnerable; supercooled drops of rain, drizzle or fog droplets are dangerous conditions. Warnings should be issued for these conditions as far in advance as possible and should include estimates of the rate of accumulation of ice.

1.2.1.7 SEA ICE

Sea ice can present a hazard to all classes of shipping. Depending on the area and time of year, advice on the distribution, character and movement of ice is required with as much advance notice as possible. In general, ship movements through areas with sea ice require specialized support services such as ice breakers, observed ice cover maps and forecasts, in addition to normal weather and sea broadcasts.

1.2.1.8 ICEBERGS

The position of icebergs at specified times with estimated size, speed and direction of movement are required. During the ice season the south-eastern, southern and south-western limits of regions of icebergs in the vicinity of the Grand Banks of Newfoundland are monitored for the purpose of informing passing ships of the extent of this dangerous region. The guidelines for this international ice patrol service are laid down in the International Convention for the Safety of Life at Sea (known as the SOLAS Convention).

1.2.1.9 SPECIAL SERVICES

In addition to gale and storm warnings, and weather bulletins for shipping on the high seas, special services may be needed to provide guidance to navigators. Such services, which may be provided for a fee, may be given operationally before departure, or en route, or before and during arrival.

1.2.2 *Care of cargo and passengers*

When environmental conditions reach certain critical values, precautionary measures have to be taken to protect the cargo. The cargo may be damaged by sweating when temperatures in the containers or in the holds fall below the dew point. Very high humidity can cause damage to hygroscopic cargo, such as jute, wool, cotton, hides, etc. Deck cargo can be damaged by wind, waves and spray. In addition, the condition of the cargo when loaded, e.g. whether the cargo is damp or dry, hot or cold, and changing conditions of air and water temperature and humidity as the ship proceeds along its route are important.

Wind, waves and precipitation affect loading and off-loading cargo and the handling of ships. Rainfall, even when light, can make the footing treacherous and delay the transfer of cargo. Ship movements in harbours and channels may be affected by anomalous water levels caused by wind stress.

The care of passengers involves both their welfare and entertainment activities. Daily forecasts of the state of the sea in view of rolling and pitching of the ship, precipitation, sky condition, air temperature, etc. are required. Sunshine is important to passengers on cruise ships.

1.2.3 *Fishery operations*

Fishermen require information relating to the three main activities:

(a) Travel to and from fishing grounds;
(b) Locating and catching the fish; and,
(c) Care and transport of the catches.

The importance of meteorological information depends mainly upon the species fished, the fishing area and methods, and the ship's size and equipment. Elements of greatest interest are wind, sea, swell, weather, sea-ice, as well as sea- and sub-surface temperature.

1.2.4 *Ocean research operations*

Ocean research operations include a wide range of activities with differing critical values of marine environmental elements. In general, wind and waves are most significant in planning operations, although other elements may also be of interest. In most instances a more detailed forecast is required than for other marine operations. On some research voyages it may be necessary to assign meteorologists to provide the advice required.

1.2.5 *Offshore oil-drilling and mining operations*

1.2.5.1 GENERAL

Offshore operations require highly specialized information, tailored to a particular geographical location and to the kind of operation involved. The marine meteorologist needs to work closely with the operations manager.

1.2.5.2 WAVES AND WIND

Waves and wind are important for all three phases of offshore mining:

(a) The drilling from a specially constructed rig;
(b) The construction of off-shore platforms; and,
(c) Operation of the platforms.

During drilling, the tolerance for side-to-side movement of drilling equipment as the result of wave action is approximately ten per cent of the water depth. Platforms will move up and down on the larger waves. The period of pitch and roll of a drilling ship is a critical factor, and waves with a period at or near that value can lead to hazardous pitch and roll due to resonance effects.

Wind contributes to the pitch and roll of a drilling rig, and high winds make working conditions difficult. Wind direction may also be an important element as wind shifts may necessitate careful adjustment of anchor cables.

The construction of offshore platforms is particularly vulnerable to winds and waves. Usually the platform is constructed onshore and towed to the site. Whilst underway, waves of two to three metres or higher, depending upon the design of the platform, necessitate lowering the legs or taking evasive action by moving the platform to shelter. A warning of at least two hours in advance is necessary to permit lowering the legs in time. A warning time of 24 hours or more is necessary for operational decisions such as when to start the tow to the site. Once on location the legs are lowered and the structure raised above the direct influence of the waves.

Swell can be as important as wind waves in these operations and information about swell, especially from tropical cyclones, is also required. Warnings of anomalous or freak waves should also be given if possible. Warnings of severe thunderstorms are also required, when very strong winds, although of relatively short duration, may cause damage.

Once erected, the operation of the platform usually involves the transport of personnel and equipment by helicopter, and aviation-type forecasts of wind, low cloud, visibility and altimeter setting are required. Warnings of very severe storms and tropical cyclones are necessary as evacuation of all essential or non-essential personnel may be required before the occurrence of severe conditions.

1.2.5.3 ICE ACCRETION

Warnings of ice accretion and, if possible, of its estimated rate of accumulation are required for all phases of offshore mining.

1.2.5.4 CURRENTS AND TIDES

Information is required on the actual sea currents at different depths during drilling in some sea areas, and when platforms are being moved into final positions. Information on bottom currents, including tidal flow, may be important in some cases, depending on soil type and bottom inclination. Information on tidal surges is also becoming important.

1.2.5.5 SEA ICE AND ICEBERGS

In some areas with ice cover the safety of drilling and mining operations is strongly dependent on ice conditions. A forecast of first ice appearance is of considerable value. A sea ice forecast should include information on fast ice edge position, areal extent of ice cover, drift of ice floes and icebergs, and size and thickness of ice floes.

If unfavourable ice conditions are expected, one of the following decisions may be taken:

(a) Dismount the drilling unit and withdraw to shelter;
(b) Continue work until some threshold ice load is reached;
(d) Continue work on a stationary platform while undertaking active methods of mitigating ice loads.

1.2.6 *Recreational boating*

1.2.6.1 WINDS AND WAVES

Boats used for recreation come in many sizes and shapes and are manned in many instances by people relatively unfamiliar with the dangers inherent in boat operations. Critical wind speeds and wave heights are sometimes lower for these generally smaller craft than for commercial shipping. They are sensitive to gustiness and wind shifts as well as mean wind speed. Wind waves, especially high waves with short periods (a choppy sea), and to a lesser extent long swell, can be a danger to these small craft. Near the coast, where these boats generally

operate, wind waves also depend on the irregularity of the coastline, the water depth, the atmospheric stability, and surface currents or tidal streams.

1.2.6.2 THUNDERSTORMS AND SQUALLS

Small craft are especially vulnerable to sudden changes in the weather associated with thunderstorms and violent cold fronts. The rapid development and movement of these phenomena make them an extreme hazard. Particularly vulnerable are the very small boats on enclosed waters such as bays and harbours.

1.2.6.3 FOG

As small craft usually lack radar, poor visibility is a great danger in dense traffic areas such as estuaries, harbours and some coastal areas.

1.2.7 *Search and rescue*

When a vessel is known to have sunk or to be in serious trouble (e.g. fire on board a large vessel or engine breakdown on a small craft), a search will be mounted by the appropriate authorities to rescue any survivors. On a large vessel, survivors will have taken to smaller lifeboats.

As small craft will drift with sea and tidal currents, an indication of drift is important in search and rescue operations along with forecasts of winds and waves. Sea-surface temperature may also be required, as small craft may capsize and this element is an important factor in determining survival time in the water.

1.2.8 *Dynamically-supported craft*

Dynamically-supported craft such as hydrofoil vessels and hovercraft which are operating in coastal and offshore waters are particularly sensitive to changes in wave conditions. Wind also affects operations. The operating limits for wind and waves will vary with the type and size of craft. Because of their higher speed, information on higher ranges of visibility is required.

1.2.9 *Coastal community activities*

1.2.9.1 GENERAL

Coastal areas are often heavily populated, people being attracted by trade, industry, fisheries, recreation, and, in some countries, retirement to a place near the sea. These communities need protection from the hazards of the sea and its storms. They need to be warned of the particular hazards described below.

1.2.9.2 STORM SURGES

A storm surge causes the sea level to rise considerably higher than normal high tide along the coast. It is due to the dynamic effects of wind stresses and atmospheric pressure falls associated with a tropical cyclone or a severe extra-tropical cyclone. The surge may be increased if it moves into a narrowing estuary or gulf. Storm surges and resulting flooding have caused considerable damage and loss of life in coastal communities. Sufficient advance warning is required for coastal defence measures and possible evacuation of the population to be effected.

Abnormally low water levels due to the effects of wind stress — so-called negative surges — may affect marine operations in coastal areas, estuaries or at entrances to harbours. Information is also needed about such deviations in water-level.

1.2.9.3 TSUNAMIS

A tsunami is a long wave resulting from an underwater seismic disturbance. It can travel for many thousands of kilometres across an ocean. Its height is not generally perceptible in the open ocean, but when the wave reaches the continental slope and shallower water, its height may increase enormously and, as it runs up on land, it can sweep away whatever lies in its path with devastating force. The effects of tsunamis are felt most frequently on coasts bordering the Pacific Ocean and a warning system has been established at the U.S. National Weather Service's Pacific Tsunami Warning Centre in Honolulu, in order to provide advice on tsunami to Pacific-rim countries. Charts of travel times are also available. The requirement is then to translate the general warning into a specific warning of time of arrival at a particular locality.

The exact height of the wave as it runs up on shore depends greatly on the shape of the shore line and its slope, as well as on the shape of the ocean bottom, so it is not generally possible to give a quantitative estimate of the height of the wave at a specific point. The warning of a significant tsunami should result in the rapid evacuation of all low-lying areas in its path.

1.2.9.4 HARBOUR SEICHES

A seiche is a standing wave generated by a force with a period the same as, or resonant with, the natural period of oscillation of an enclosed, or almost enclosed, body of water. In general, changes of atmospheric pressure or of wind may generate seiches in lakes or bays, but in harbours most seiches are generated by oscillations in water level transmitted from the open sea. Warnings may be required for the occurrence of seiches in excess of some critical value.

1.2.9.5 SURF AND BREAKERS

High breaking waves can cause damage to structures built near the sea and cause coastal erosion. Warnings will be required when such waves are expected to exceed a critical value.

Surf forecasts may be required for popular surfing beaches. A prediction should include maximum height and direction of breakers, together with the wind which affects the way the waves break. When high breakers are predicted lifeguard stations may be assigned additional personnel or the beach may be closed.

1.2.10 *Pollution of the sea*

1.2.10.1 GENERAL

Pollution of the sea is the introduction to the sea of harmful substances resulting from human activity. The most commonly perceived pollution is that due to oil spills, but pollution may also result from industrial discharges into rivers which find their way to the sea, human and other domestic waste, pesticides and nuclear waste. Beaches, coastal vegetation, animal life and coastal dwellings need to be protected from such forms of pollution.

Information will be required on existing and predicted wind, waves and tidal or wind-generated currents to allow the prediction of the spread, movement and concentration of the pollutant. Information may also be required on the areal extent of sea ice and its drift.

1.2.10.2 POWER GENERATORS AND INDUSTRIAL PLANT COOLING SYSTEMS

Cooling systems on the shore discharge hot water into the sea, relying on its efficient dispersal. Anomalous tides may reduce the capability of cooling systems in the tidal reaches of a coastal area and forecasts of the wind effects on tides may be needed.

1.2.11 *Requirements for long-term planning and design information*

Long-term planning for marine operations is based on climatological probabilities. For example, a ferry service may not be economically viable if storms and high waves are too frequent. Ships, other marine vessels and marine structures have to be designed to withstand the strongest forces likely to be encountered.

Marine climatological data are required to provide the requisite advice and consultations should be held between designers and marine meteorologists on the use of climatological data.

1.3 Organization of marine meteorological services

Although a National Meteorological Service (NMS) may be organized in various ways, a general approach to the implementation of marine meteorological services can be recommended as follows:

(a) Develop and carry out programmes for the training of marine meteorologists and technical support personnel;

(b) Consider the types of weather sensitive marine activities such as:
(i) Fisheries;
(ii) Recreational boating;
(iii) Pollution;
(iv) Hydrofoil, hovercraft or similar services;
(v) Oil drilling and exploration; and,
weather-related threats such as:
(i) Storm surges;
(ii) Tsunamis;
(iii) Coastal structures vulnerable to high waves;
(iv) Harbours subject to seiches and other water level changes; (v) Coasts vulnerable to erosion;

(c) Contact users and in consultation with them iden tify their requirements. Users usually include:
(i) Government department for fisheries;
(ii) Fishermen's organisations;
(iii) Authorities responsible for safety of life at sea, including coastal waters; (iv) Authorities responsible for combatting marine pollution; (v) Operators of ferry, hydrofoil, hovercraft or similar services; (vi) Oil drilling and shipping companies; and, (vii) Authorities responsible for protection of the coastal populations from, among others, storm surges, high waves, tsunamis;
(viii) Harbour control authorities;

(d) Design a service programme to provide products which satisfy the requirements;

(e) Determine the need for any additional data and processing facilities necessary for the preparation of these service products and arrange for their acquisition (including establishment of voluntary observing ships as described in Chapter 6 of this ***Guide);***

(f) Arrange for the provision of service products;

(g) Arrange for a monitoring system to ensure that service products meet the requirements and continue to do so;

(h) Arrange for the collection and checking of meteorological logbooks, the processing of marine climatological data and the identification of statistical tabulations to be supplied;

(*Ii*) Identify requirements for additional research into:
(i) Forecast techniques; (ii) Sensors and related equipment;

(j) Ensure adequate representation of the National Meteorological Service in organizations, both national and international, in efforts to improve marine services;

(k) Ensure that adequate attention is given to meteorology and elements of physical oceanography in marine navigation schools. Also ensure that these subjects are included in the examination syllabi for navigating officers.

1.4 International coordinating arrangements

The basis of international arrangements regarding the provision of marine meteorological services is given in the **WMO** *Technical Regulations* **(WMO-No. 49),** Volume 1, Chapter C.l, entitled 'Meteorological services to marine activities'. It is important that shipping operators are able to obtain the same services from different countries in the same way, whether the ship is sailing on the high seas or is in port. The various

procedures which must be adhered to are specified **in the** *Manual on Marine Meteorological Services* (WMO-No. 558) which forms part of the *Technical Regulations.* The *Manual* contains both standard practices, which are mandatory, and use the verb 'shall', and recommended practices, which use the verb 'should'. International coordination for activities in marine meteorology are shown in the following examples:

1.4.1 *The WMO Voluntary Observing Ships' Scheme*

Under the SOLAS Convention ships are required to report any phenomena or weather conditions which constitute a serious hazard to the safety of navigation. Selected ships also contribute, on a voluntary basis, a regular series of weather observations. These observations provide the basis of warnings and weather forecasts of benefit to shipping, and also are used in the compilation of climatological atlases. The Voluntary Observing Ships' Scheme, which is explained in detail in Chapter 6 of this *Guide,* demonstrates the cooperation between meteorologists and the marine community including shipping and fisheries.

1.4.2 *Methods of observation of marine elements*

There is no doubt that uniformity must exist in the observation of meteorological elements and those of the sea surface. Although instruments used may be different, observing sea stations (mobile ships as well as platforms) should measure exactly the same parameters which describe the state of the atmosphere or ocean at the time of measurement. It is very difficult to meet this requirement in a routine observational programme and, internationally, there must be a regular exchange of information, experiences and views to keep uniformity of measurement at an acceptable level. The requirement also applies to observing stations in coastal and offshore areas. International exchanges of information encourage the use of recent advances in instrument technology, including automation of the measurements. The subject is further explained in Chapter 6 of this *Guide* and in **Part II, Chapter 4** of **the** *Guide* ***to*** *Meteorological Instruments and Methods of Observation* **(WMO-No. 8)**

1.4.3 *Preparation of synoptic weather information*

For the preparation of meteorological warnings, synopses and forecasts for marine areas, National Meteorological Services make use of the basic information which is exchanged over the Global Telecommunications System (GTS). This includes, *inter alia,* ships' weather reports, reports from drifting and moored buoys, and products issued by the World, Regional and National Meteorological Centres. In addition satellite information is available from most Centres. The issue and exchange of basic information amongst National Meteorological Services is coordinated by WMO under the World Weather Watch (WWW) Programme.

1.4.4 *Issue of weather and sea bulletins*

The SOLAS Convention, administered by the International Maritime Organisation (IMO), requires weather and sea bulletins to be broadcast for the high seas. The WMO coordinates the marine areas for which these bulletins are issued in such a way that all areas which are frequented by shipping are covered by this meteorological service. Details of the WMO system are explained in Chapter 2 of this *Guide.* WMO collaborates with IMO with regard to the international implications of the SOLAS Convention.

1.4.5 *Coordination of marine meteorological broadcasts*

It is important that the times of broadcast of forecasts be published and known to ships, and that only one broadcast is made to a given area at a time. The WMO coordinates the times of broadcast by satellite to various ocean areas. Broadcasts by radio-telegraphy or radio-telephony should be in accordance with a definite timetable, and made during the hours of duty of a ship's radio operator. More detail can be found in Chapter 2 of this *Guide.*

1.4.6 *International system of visual storm warning signals*

Visual storm warning signals displayed in port or along the coast are the oldest means of warning shipping of an imminent gale or storm. An international system was developed and put into use early in the twentieth century by the International Meteorological Organisation and was adopted for continued use by WMO. It is included in the consolidated list of visual port signals which is the responsibility of the International Association of Lighthouse Authorities (IALA). Further details can be found in Chapter 4 of this *Guide.*

1.4.7 *Services for maritime search and rescue operations*

The International Convention on Maritime Search and Rescue, which is administered by IMO, contains provisions for obtaining meteorological information as well as information on sea conditions during search and rescue operations. However, information is also obtainable through the routine WMO system of marine weather forecasts; additional information or more detailed forecasts may be required by a Rescue Coordination Centre. Arrangements should be made for the provision of such information when required. Further information is given Chapter 2 of this *Guide.*

1.4.8 *Port Meteorological Officers*

Port Meteorological Officers (PMOs) fulfil a highly important role in the liaison between NMSs and the

shipping community. Their functions are truly international in nature — wherever a ship may find itself in the world, it must be able to obtain the assistance it needs to serve as a meteorological observing station, and also must be able to obtain the information about the marine meteorological services available in the country, region and abroad. International coordination is arranged by WMO; for further information see Chapter 6 of this *Guide.*

1.4.9 *Sea ice information services*

Regional coordination of sea ice services has been established in some areas of the world where sea ice is a problem, e.g. North America and northwest Europe. A common numerical ice reporting code, integrated data broadcasts and similar shipping control regulations are used. In special situations icebreaker dispositions are also integrated, all for the common aim of supporting marine traffic. WMO has been instrumental in the development of an international terminology for sea ice, sea ice codes and a set of chart symbols for international use. A format for the archival of sea-ice data in digital form (SIGRID) has been developed for data sent to the Global Digital Sea Ice Data Bank (GDSIDB).

1.4.10 *Marine pollution*

A Marine Pollution Emergency Response Support System (MPERSS) was introduced in 1994 on a trial basis to coordinate meteorological support for operations to combat pollution in international waters. Further information can be found in Chapter 2 and Chapter 4 of this *Guide.*

1.4.11 *Exchange of marine climatological observations*

Data extracted from ships' meteorological logbooks are internationally exchanged under a WMO Programme which was instituted by Resolution 35 (Cg-IV). The international coordinating arrangements include two global collecting centres and eight marine data centres. The collection and exchange of other data observed by ships, such as surface currents and drift obtained from ships' set, and observations of freak waves, are also coordinated by WMO under similar systems. Marine climatological activities are closely coordinated with the World Climate Programme (WCP) of WMO. These include the processing of older historical data, for which the Historical Sea-Surface Temperature Data (HSSTD) Project has provided a highly useful contribution. The international coordinating arrangements are described in Chapter 3 of this *Guide.*

In order to satisfy needs for combined use of meteorological and oceanographic data, close collaboration exists between the programmes conducted by WMO and those conducted by the Intergovernmental Oceanographic Commission (IOC) which coordinates the functions of oceanographic data centres. The Joint WMO/IOC Commission for Oceanography and Marine Meteorology (JCOMM) collects, archives and exchanges oceanographic data. The Global Ocean Observing System (GOOS) is an initiative of IOC, with which WMO is collaborating, to establish a comprehensive system of oceanographic observations.

1.4.12 *Training in marine meteorology*

Training in marine meteorology is part of the education and training programme of WMO. It consists of education in marine meteorology and physical oceanography at universities and other training centres, as well as training in practical applications. These applications may be forecasting for specific marine areas, such as the work of PMOs, marine climatology. International coordination amongst WMO Member countries facilitates either visits to well-established marine meteorological operational centres or missions of experts to conduct training where necessary. This important programme is further explained in Chapter 7 of this *Guide.*

CHAPTER 2

MARINE METEOROLOGICAL SERVICES FOR THE HIGH SEAS

2.1 Introduction

2.1.1 *The Global Maritime Distress and Safety System (GMDSS)*

The Global Maritime Distress and Safety System (GMDSS) has been agreed internationally within the International Maritime Organization (IMO) by amendment to the SOLAS Convention. Earlier systems for distress and safety relied on a ship in distress communicating by radio-telegraphy with other ships in the area, which would than come to its assistance. With the advent of more reliable communications and, in particular, satellite communication the new system relies on a ship in distress communicating with a Rescue Coordination Centre on shore, which then institutes and coordinates search and rescue operations. A brief history of the development of the GMDSS and a glossary of terms used can be found in the *Manual on Marine Meteorological Services* (WMO-No. 558), Part I BIS, Appendix I-IBIS.

For the purposes of the GMDSS the oceans and seas of the world have been divided into four sea areas: *Sea area* A7 is the area within the radio-telephone coverage of at least one VHF coast station in which continuous Digital Selective Calling (DSC) alerting is available. DSC is a technique using digital codes enabling a radio station to establish contact with, and transfer information to, another station or group of stations, and complying with the relevant recommendations of the International Radio Consultative Committee (CCIR); *Sea area A2* is an area, excluding sea area Al, within the radio-telephone coverage of at least one MF coast station in which continuous DSC alerting is available;

Sea area A3 is an area, excluding seas areas Al and A2, within the coverage of an INMARSAT geostationary satellite in which continuous alerting is available;

Sea area A4 is an area outside sea areas Al, A2 and A3, which are areas are in polar regions. Ships are required to carry the appropriate equipment for the sea area(s) in which they will be travelling. Most of the high seas areas of the world are in sea area A3.

Under the GMDSS, high seas, weather and sea bulletins are broadcast by satellite, using the INMARSAT Safety Net service with the Enhanced Group Calling System (EGC). The EGC allows a bulletin to be broadcast to all ships with the relevant receiving equipment in:

(a) A standard area, or,

(b) A rectangular area delineated by latitude and longitude by the sender, or,

(*c*) A circular area delineated by a central point and radius by the sender.

Forecasts are broadcast in English to standard areas. Warnings may be broadcast to rectangular or circular areas to ensure that ships receive only warnings relevant to them.

2.1.2 *NAVTEX*

Sea area A2 is serviced in some parts of the world (mostly in the northern hemisphere) by the NAVTEX service. This service is the coordinated broadcast and automatic reception on 518 kHz of maritime safety information by means of narrow-band direct-printing telegraphy using the English language. As a common frequency is used, a group of (say) six stations will broadcast sequentially for five-minute periods over the course of each half-hour. The messages are printed out automatically on receiving equipment on the bridge of a ship.

Forecasts and warnings broadcast by NAVTEX refer predominantly to coastal waters, and NAVTEX is further mentioned in Chapter 4, paragraph 4.2.1.5 of this *Guide.*

2.1.3 *Other radio communications*

Provision is made for broadcast and reception by means of VHF DSC, HF DSC and MF DSC. Full details of the radio communications required internationally in the various sea areas can be found in Regulations 6 to 11 of Chapter IV of the SOLAS Convention. An NMS may have to prepare and/or issue warnings and routine forecasts for transmission by an HF-direct-printing telegraphy maritime safety information service for areas where such a service is provided for ships engaged exclusively on voyages in such areas.

2.1.4 *Other services*

While weather and sea bulletins constitute the basic service for the high seas, other forms of services have been introduced on an international basis to meet the requirements of various marine interests. These services include: special information in support of maritime search and rescue operations; broadcasts of weather charts by radiofacsimile; provision of marine climatological information, including summaries; provision of services to high seas fishing; combatting marine pollution; provision of expert meteorological advice, and; information in marine meteorological matters. A description of these services is dealt with in this chapter, except those procedures relating to the preparation and supply of marine climatological summaries are described in Chapter 3 of this *Guide.*

2.2 Weather and sea bulletins

2.2.1 *General*

The bulletins are classified into the four following groups:

(a) Bulletins for the high seas in a given area issued by the Meteorological Service which is officially responsible for the transmission of meteorological and related geophysical information for that area;

(b) Bulletins issued by a Meteorological Service for coastal areas;

(c) Bulletins issued primarily to meet naval requirements;

(d) Bulletins for a given area in the high seas issued by Meteorological Services which are not officially responsible for the transmission of meteorological and related geophysical information for that area;

Weather and sea bulletins for the high seas are intended to provide information on various weather systems that occur over a wide area, their expected movements and further development, and their associated weather and sea conditions. They also contain warnings for those conditions that are a hazard for operational marine activities.

2.2.2 *Areas of responsibility*

The establishment of areas of responsibility is coordinated by the WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), formerly CMM, in consultation with Regional Associations and approved by the Executive Council.

The oceans of the world have been divided into 16 areas, known as METAREAS, and designated Members of WMO are responsible for broadcasting, by INMARSAT satellite, all weather and sea bulletins for the high seas of each of these areas. The NMSs of these Members are known as Issuing Services. An Issuing Service may arrange to receive from other NMSs forecasts and warnings for part of its area of responsibility for incorporation in the complete forecast for the whole area. These contributing services are known as Preparation Services.

The Issuing Service is responsible for composing the complete broadcast bulletins on the basis of input from the relevant Preparation Services and for monitoring the broadcasts of information to its designated area of responsibility. Where appropriate information, data or advice from a Preparation Service for a given METAREA is not available, it is the responsibility of the Issuing Service for that area to ensure that complete broadcast coverage for the area is maintained. An Issuing Service may agree with a Preparation Service on an appropriate format for the attribution of the forecast and warning information provided by the Preparation Service.

A map showing the METAREAS, Issuing Services and Preparation Services can be found in Annex 2. A.

The METAREAS are identical with NAVAREAS used by the International Hydrographical Organization (IHO) for the broadcast of navigational warnings.

If it so wishes, an Issuing Service may extend the area of coverage of weather and sea bulletins beyond its METAREA, if it so wishes, to meet national requirements. In this case, the area of coverage has to be specified in the text of each broadcast so that ships are quite clear as to the area covered by the bulletin. Similarly, a Preparation Service may extend its area of coverage to meet national requirements, provided the area of coverage is clearly specified in the information supplied to the Issuing Service.

Whenever an Issuing Service is no longer able to provide the services for its area of responsibility, the relevant Member should inform the Secretary-General at least six months in advance. Whenever a Preparation Service is no longer able to provide forecasts and/or warnings for part of a METAREA, it should inform the relevant Issuing Service which should try to make alternative arrangements. The Secretary-General should also be informed of changes in Preparation Services.

Any amendments to the area of responsibility, or proposal for the introduction of a change in an NMSs' responsibility for an area, has to have the approval of the Executive Council based on a recommendation by JCOMM. Before drawing up any such recommendation the Commission will obtain comments from the NMSs directly concerned with the proposed amendment as well as the comments of the president(s) of the Regional Association(s) concerned.

Because of the congruence of the METAREAs with the NAVAREAs of the IHO, it would be hoped that it would not become necessary to amend them.

2.2.3 *Form and content of bulletins*

In accordance with the principle of starting with the most important information, weather bulletins for the high seas have the following mandatory format: Part 1 Warnings; Part 2 Synopsis of major features of the surface weather chart and, as far as possible, significant characteristics of corresponding sea-surface conditions; Part 3 Forecasts;

Everyone receiving a bulletin must be able to immediately recognize the form of the bulletin, the sequence of information it contains and the actual contents of the message. Thus each country issuing these bulletins must adhere strictly to this format.

The following parts *may* be added or issued separately: Part 4 Analysis and/or prognosis in I AC **FLEET** code form; Part 5 Selection of reports from sea stations; Part 6 Selection of reports from land stations.

With the widespread use of radio-facsimile, very few ships now make use of analyses or prognoses in coded form.

The most important element in the bulletin are the warnings, which must indicate clearly the area to which each warning applies. When there is no warning in effect, that fact must be mentioned in Part 1 of the bulletin by the statement "Warning nil" or "No warnings". Thus the recipient is in no doubt as to whether a warning is, or is not, current.

The synopsis in Part 2 usually gives a description of the position and movement of weather systems for the entire area of responsibility. In subtropical and tropical regions where the general weather situation often shows a seasonal pattern which remains unchanged for a number of days or longer, the synopsis is often reduced to a simple indication, for example "northeast trade flow". The date and time of the weather chart which the synopsis describes has to be given. The synopsis should use terms familiar to mariners and avoid technical phraseology which only meteorologists can understand. If possible the synopsis should also contain existing significant characteristics of sea-surface conditions, e.g. rough seas, high swell, areas of fog, drifting ice, etc.

The forecasts in Part 3 are usually for a period of 24 hours, and the actual period of validity of each forecast must be stated. As the capability for forecasting for longer periods increases, forecasts for a further 12 or 24 hours may be added, but in more general terms so that the message does not become too long, and the cost of transmission become too great.

The forecasts must include wind speed and direction, visibility when less than 6 nautical miles (10 kilometres), ice accretion where relevant and waves from sea and swell. As units of measurement vary around the world, a choice of units in the forecasts is available as follows:

Wind speed may be given in knots, or metres per second, or Beaufort force. Visibility may be given in nautical miles or kilometres or given in descriptive terms. Wave heights may be given in metres or feet or in descriptive terms. In the synopsis in Part 2 the speed of movement of weather systems may be given in knots or metres per second. The important thing is that the quantitative unit must be included in the text of the message so that the recipient is in no doubt about the magnitude of the element. However, wind direction and direction of movement of weather systems must be given in compass points and not in degrees.

It is usual for the area of responsibility to be subdivided for the forecasts in Part 3, as this aids clarity to the recipient and allows concentration on the area where the ship happens to be. The subdivisions may vary with the weather situation, or be fixed in every bulletin. They may be indicated by latitudes and longitudes, or fixed areas may be indicated by names or numbers, which shortens the message and aids comprehension by the reader. However, fixed names or numbers need to be well-publicized so that all mariners know the areas to which they refer. Sub-areas and their indications are shown for each country in, *Information for Shipping* — Volume D (WMO-No. 9).

Some Issuing Services divide their METAREA into subdivisions and issue a complete bulletin of Parts 1, 2 and 3 for each subdivision. This may well be the case where Preparation Services are contributing to the bulletin, as their contributions for particular areas can be incorporated into the complete bulletin with the minimum of delay.

An NMS may issue warnings and forecasts as part of a National SafetyNET service to meet national obligations under SOLAS. These broadcasts may be made in languages other than English. To allow mariners all over the world to understand the terminology in weather and sea bulletins, uniformity of terms is highly desirable. The multilingual list of terms used in weather and sea bulletins, given in Annex 2.B of this Chapter, provides the necessary guidance to achieve the required uniformity.

Examples showing ways of composing the various mandatory parts of a weather and sea bulletin are given in Annex 2.C of this Chapter.

2.2.4 *Warnings*

Warnings must be issued when winds are expected to reach gale force (Beaufort force 8) or higher. Storm warnings are issued when the wind is expected to reach Beaufort force 10. In tropical areas, hurricane or typhoon warnings may be issued when the wind is expected to reach Beaufort force 12. Warnings may be issued of winds expected to reach Beaufort force 7, these warnings are more common in coastal waters where craft tend to be smaller. Warnings may also be issued for ice accretion or for high swells.

Warnings must be issued immediately when the need becomes apparent, without waiting for the next routine weather and sea bulletin. Thus warnings may have to be issued separately from a bulletin. All warnings must include the date and time of issue. Warnings of gale force or stronger winds should indicate the type, location and expected movement of the disturbance causing them, with the central pressure of a low pressure system. The warning must also indicate clearly the extent of the affected area, the expected wind speed and direction. It should also include the expected sea and swell conditions.

Because systems causing gales and storms are often fast-moving, it is advisable to update warnings every six hours, for as long as necessary, to keep the mariner up to date with the position and movement of the disturbance. In very fast-changing situations it may be necessary to update warnings more frequently than on a six-hourly basis.

It is necessary to satisfy both aims of providing all essential information, yet providing it as briefly as possible.

'Tropical cyclone' is defined in the WMO *International meteorological vocabulary* (WMO-No. 182) as a

generic term for a non-frontal synoptic scale cyclone originating over tropical or subtropical waters with organised convection and definite cyclonic surface wind circulation. However, the classification of tropical cyclones for warning purposes is left to the Regions concerned, and the terminology used by individual countries is based on long-standing national practices. Regional practices where tropical cyclones may be encountered are described in Annex 2.D of this Chapter. Examples of warnings follow:

(a) For an extratropical storm:

Warning NR208, Tuesday 23 April 1996 at 1930 UTC issued by Meteo France;

General synopsis, Tuesday 23 April 1996 at 12 UTC;

Low 990 46 north and 38 west slow moving with little change at first then moving southerly and filling slowly Wednesday afternoon and isolated a new low 995 in the west of Azores;

West of Faraday;

Continuing to 24 April at 12 UTC;

Southerly 8 but 9 at first;

Altair;

Continuing to 25 April at 00 UTC;

Southerly 7 or 8 decreasing in west Wednesday afternoon;

East of Alice;

From 24 April at 15 UTC to 25 April at 12 UTC; Southeast 8.

(b) For a tropical cyclone (issued by Hong Kong, China):

Tropical storm Winona (9312);

Radius of gale force winds is 50 NM;

Synopsis (261800 GMT) and 24 hour forecast;

At 261800 GMT tropical storm Winona (9312) with central pressure 995 hPa and max winds 35 kt was centred within 90 NM of 17.8 N 115.7 E and is forecast to be very slow moving for the next 12 hours;

Forecast position at 271800 GMT 18.5N 115.4E;

Significant swell/high seas;

Radius of seas over 6 m from centre of Winona is 50 NM;

Swell S to SW and SW up from 4 m over the northern part of the South China Sea;

Thunderstorms/severe weather;

Frequent heavy squally showers within 150 NM from centre of Winona;

Scattered squally showers and thunderstorms over sea areas south of 10 N;

sea fog/reduced visibility;

Visibility 2 000 m in heavy squally showers and thunderstorms.

2.2.5 *Selection of reports from sea and land stations*

Although the charts broadcast by radiofacsimile show the current and forecast positions of depressions and fronts, and although the forecasts describe the expected weather, wind and sea conditions, many shipmasters like to know the actual weather, wind and sea conditions which other ships are experiencing in nearby areas. When a storm area is approaching a ship, the shipmaster would like to know the actual wind speed and the sea and swell in that area so that he can navigate with greater assurance by allowing for the roll and pitch movements which are expected. However shipmasters take notice of storm warnings and will avoid such areas affected, hence ship reports from storm areas become very sparse.

Similarly shipmasters like to be informed of the actual boundaries of fog areas over cold currents or advection fog near continents. Ship reports from a fog area and beyond help the shipmaster to make some assessment of probable delays and late arrival in port.

Reports from sea stations include not only moving ships, but also lightships and ocean weather stations. The report should include the ship's position and time of observation, cloudiness, wind, visibility, present and past weather, air pressure, air and sea temperature and waves.

Reports from land stations along a coast are also of great interest to a shipmaster. The reports should be for a fixed selection of stations, in a fixed order, indicated by means of the international station index number. These reports should include time of observation, cloudiness, wind, visibility, present and past weather, air pressure and sea and swell.

2.2.6 *Broadcasts of weather and sea bulletins by satellite*

2.2.6.1 GENERAL

Each Issuing Service is responsible for arranging for the broadcast by INMARSAT Enhanced Group Calling System (EGC) of all weather and sea bulletins, and warnings issued separately, for that part of its METAREA not covered by NAVTEX broadcasts. The Issuing Service makes arrangements with a Coast Earth Station (CES) for the broadcasts. As several CESs serve each ocean area, Issuing Services may negotiate with the various CES operators to obtain the most favourable tariff, taking into account the costs and ease of transmission of the bulletins from the Issuing Service to the CES. Packet-switched X25 data services are an economical means of sending bulletins to a CES.

Weather and sea bulletins must be broadcast at least twice daily. The broadcast schedules are published in *Information for Shipping* — Volume **D** (WMO-No. 9).

Some METAREAs are covered by more than one INMARSAT satellite as a ship's INMARSAT terminal

can be attuned to only one satellite at a time. The satellite used for routine weather and sea bulletins is chosen by the Issuing Service and publicized so that ships know which satellite to use to receive the bulletins. Unscheduled warnings, however, need to be broadcast over all satellites covering the warning area to ensure that all ships receive such warnings. This requires the use of two CESs.

2.2.6.2 ADDRESSING OF MESSAGES

The Issuing Service is also responsible for ensuring that the correct EGC system message addressing formats are inserted at the beginning of the message for broadcast. The address formats are described in the *Manual on Marine Meteorological Services,* Volume I Part 1, Appendix 1-4 BIS. It is emphasized that the operation of the CES is completely automated; if the address format is incorrect the bulletin will not be broadcast.

The address for weather and sea bulletins for an entire METAREA is very simple; the number of the METAREA is inserted for the address code. Warnings may be addressed to a circular area specified by centre and radius.

Weather and sea bulletins and warnings broadcast under the GMDSS are to be made in English, and hence the presentation code is that for International Alphabet Number 5, odd parity.

2.2.6.3 PRIORITY

Four priority codes are available for EGC System messages:

ROUTINE;
SAFETY;
URGENT;
DISTRESS.

The latter three of these priorities correspond to the use in radio-telephony of SECURITE, PAN PAN and MAYDAY respectively to indicate the degree of urgency of the message.

URGENT and DISTRESS messages cause the INMARSAT terminal aboard ship to emit warning beeps until the message is read. To avoid overuse of this facility, with annoyance to ship's officers, URGENT priority is only given to warnings due to tropical cyclones. All other warnings, and routine weather and sea bulletins are sent with SAFETY priority.

The text of all bulletins and warnings should begin with the word SECURITE or PAN PAN according to whether the message is being sent with SAFETY or URGENT priority. These words are added by the radio operator in radio-telephony broadcasts, but must be added by the Meteorological Service in the automated INMARSAT system.

2.2.6.4 REPEAT BROADCASTS

There is provision in the EGC System address formats for messages to be repeated at specified intervals. For scheduled broadcasts of weather and sea bulletins, for which the times of broadcast are well-publicized, no repetition is necessary. For unscheduled broadcasts of warnings, the message should be repeated once at an interval of six minutes. If a ship's INMARSAT happens to be occupied when it is first broadcast, it is almost certain to be received on the repeated broadcast. Tests have shown that the chance of a ship missing both broadcasts is very low.

2.2.6.5 MONITORING OF BROADCASTS

Because the INMARSAT system is highly automated, it is essential that Issuing Services monitor the broadcasts which they originate to check that nothing has gone wrong. Monitoring is done by means of an EGC INMARSAT receiver in the operations area of the Issuing Service. Procedures need to be in place to notify the relevant CES immediately of the non-broadcast of a bulletin or warning.

The operation of the INMARSAT system is very fast; the interval between sending a message to a CES and its receipt on all ships in the area is usually only a minute or two.

2.2.7 *Broadcast of weather and sea bulletins by radio-telegraphy and radio-telephony*

The GMDSS was implemented on 1 February 1992, from which time all new vessels covered by the SOLAS Convention were required to install INMARSAT satellite receivers if they were to sail in sea area A3. To allow time for existing vessels to be so equipped, broadcasts by radio-telegraphy continued until 1999.

As most ships have only one radio operator, who cannot be on duty 24 hours a day, weather and sea bulletins have to be broadcast during the watch-keeping hours of radio operators on ships in the area. As a ship's radio-operator can listen to the broadcast from only one station at a time, broadcasts should not, as far as possible, be made from two stations to the same or adjacent areas at the same time.

Many countries also broadcast weather and sea bulletins for the high seas by radio-telephony, for the benefit of smaller craft, e.g. ocean-going yachts, which have neither radio operators nor satellite reception equipment.

Detailed schedules of meteorological broadcasts by radio-telegraphy and radio-telephony for the high seas are contained in *Information for Shipping* — Volume D (WMO-No. 9). This publication gives the particulars of the radio stations, the times of broadcasts, the frequencies used and the areas covered by the bulletins. Advice by Members to the Secretariat of changes to these details is reflected in periodic updates of Volume D.

Major changes in the issue, form and content of the bulletins, or the discontinuance of a bulletin, should be announced by members well before, preferably six months before, the effective date of change to enable all users to be notified in time.

Warnings issued between the times of routine broadcasts of bulletins should be broadcast immediately on receipt by the coast radio station. This particularly applies to the first warning of a tropical cyclone of storm

or hurricane intensity. Ships need to be advised immediately of the imminence of dangerous weather. The warning should be repeated at the end of the next silence period.

All coast radio stations maintain a three-minute period of silence every half-hour. This is to allow any distress message to be heard. For radio-telegraphy, the three minutes begin at 15 minutes and 45 minutes after each hour; for radio-telephony the three minutes begin on the hour and half-hour.

The transmission procedures as defined in the ITU Radio Regulations are shown in Annex 2.E of this Chapter.

In the case of voice broadcasts by radio-telephony care is needed in preparing the text, and in the speed of reading it, to ensure that users can absorb the forecast, particularly when it is read only once.

2.2.8 *Coordination with the navigational warning system*

NAVAREA warnings are long-range warning broadcasts of navigational hazards issued by the area coordinator for a NAVAREA. NAVAREAs are the same as the METAREAs referred to in paragraph 2.2.2 above. It is highly desirable that current meteorological warnings be included in the NAVAREA warning broadcasts, or at least that both types of warnings be broadcast within the same listening period between two periods of silence.

In a NAVAREA, ships may be listening to the NAVAREA station only during the two scheduled periods per day for NAVAREA warnings. At other times they would be listening to a very distant station and would therefore only receive NAVAREA storm warnings at scheduled times. The routine broadcast schedule of meteorological weather and sea bulletins should thus be maintained, and the need for listening to regular meteorological broadcasts in addition to scheduled NAVAREA broadcasts should be impressed on shipmasters.

2.3 Meteorological services in support of maritime search and rescue

2.3.1 *Maritime search and rescue*

Under the GMDSS, Rescue Coordination Centres (RCCs) are responsible for coordinating search and rescue of ships in distress in each NAVAREA. The success of a search and rescue operation depends to a large extent on the meteorological information available to the RCC. Survivors may be aboard an open small boat which will drift with the wind, waves, tides and currents and search areas may be extensive if the position of the survival craft is not known with any degree of accuracy. It may be extremely difficult to see a small craft in conditions of poor visibility.

The use made of meteorological information by a RCC is shown in the relevant extracts from the IMO Search and Rescue Manual reproduced at Annex 2.F of this Chapter.

2.3.2 *Marine meteorological supporting services*

The procedures which should be followed when providing marine meteorological services to maritime search and rescue operations are described in Volume I, Part I, paragraph 3.2 of the *Manual on Marine Meteorological Services.*

In an emergency situation, meteorological information will be required quickly and procedures should be in place for an NMS to provide the required information to an RCC as quickly as possible when a request is received. This requires the RCC to be kept informed of the addresses of relevant forecasting centres and the available means of communication. It is recommended that there is agreement between the NMS and the RCC on the standard format of the information that is required. This saves time when a request is initiated. The parameters required will include:

Atmospheric pressure;
Surface winds;
Sea and swell;
Surface visibility;
Ice accretion;
Sea ice;
Icebergs;
Precipitation and cloud cover, including height of cloud base;
Air temperature;
Humidity;
Sea-surface temperature;
Surface currents;
Tidal current deviation;
Bar conditions;
Surf and breakers;
Storm surge; and,
Water discolouration.

It is useful practice to supply the RCC with routine weather and sea bulletins, so that, in an emergency, the RCC has at least a general forecast of the weather in the area while waiting for the response to a request for more specific advice. On many occasions, when the weather is benign, the routine bulletins will be sufficient for RCC purposes.

2.4 Provision of information by radiofacsimile

Radiofacsimile dissemination of weather charts and plain language warnings is an effective means of serving marine users. However, the dissemination of radiofacsimile charts cannot be considered as a substitute for weather and sea bulletins or warnings broadcasts. The charts provide graphic information on the current and forecast weather situation, which aids comprehension of the forecasts and warnings contained in the bulletins. Naturally, the positions of highs, lows and fronts on the analyses provided by radiofacsimile should agree with those described in the bulletin issued at about the same time by the same national weather service.

Detailed schedules of radiofacsimile broadcasts are contained in *Information for Shipping* — Volume D (WMO-No. 9). This publication gives the particulars of the radio stations, the times of broadcasts, the frequencies used and the areas covered by the charts. Major changes in broadcast times or types and areas of coverage of the charts, should be announced by Members well before, preferably six months before, the effective date of change to allow all users to be notified in time. Changes should be notified to the Secretariat for incorporation in the periodic updates of Volume D.

The usefulness of the service depends on strict adherence to the scheduled broadcast times. Some radio-facsimile receivers need manual fine tuning adjustment to ensure optimal reception, and for this reason, ships officers expect transmission to begin at the scheduled time. Some countries use computer control of transmission to ensure accurate timekeeping.

The standard facsimile charts intended specifically for marine use usually include surface analyses and prognoses, waves and swell or combined wave height, sea ice and sea-surface temperature. The name of the projection should be indicated on the chart, and an indication of latitude and longitude at a spacing of not less than ten degrees is needed for the user to quickly ascertain the position of weather systems.

Suitable projections, scales and legends together with recommendations for preparation to ensure maximum clarity on reception are given in the *Manual,* Volume I, Part I, paragraphs 4.2.2 to 4.2.4.

Standard symbols for the graphic representation of data, analyses and forecasts appear in Attachment II.4 of the *Manual on Global Data-processing System* (WMO-No. 485). Symbols and depictions used on radio-facsimile charts for marine purposes can be found in the *Manual on Marine Meteorological Services,* Volume I, Part I, Appendix 1-4. Some sample charts for marine use appear in Annex 2.G to this Chapter.

2.5 Services to small vessels on the high seas

Small vessels are extremely vulnerable to hazardous weather and sea conditions on the high seas. In many cases of sudden deterioration in weather there is no time to take refuge in a safe port or go to leeward coastal waters. Small vessels usually do not have a radio-telegraphy operator or satellite reception equipment, and are reliant on radio-telephony for communications. Thus weather and sea bulletins for the high seas should be broadcast by voice radio-telephony for the benefit of these small craft.

Those planning voyages in small vessels are advised to obtain from an NMS the climatological and oceanographic conditions of the route, or the sea area, well before the voyage, as well as the actual situation just before departure. A departure can be deferred if hazardous or unfavourable meteorological conditions prevail or are expected in the sea area or on the route. Sometimes those undertaking such a voyage may make arrangements with a meteorological service to be supplied with special forecasts en route at their expense. Ocean yacht races may require special services, and the organisers of such races should make the requisite arrangements with NMSs well in advance. Often yachts in such races are accompanied by a mother ship equipped with satellite receiving terminals, and this ship passes forecasts and warnings on to participants in the race.

2.6 Ship weather routeing

2.6.1 *General*

About 90 per cent of world commerce is carried by ships, and it is of the greatest importance to ship owners that the costs of carrying these goods are kept to a minimum, i.e. the time taken on the voyage is minimized, and that storms which can cause damage to the cargo are avoided. One way of reducing costs is the application of meteorology to navigation; this has been applied by shipmasters for a very long time. Broadly speaking there are two applications: climatology and specific forecasts at the time of the voyage.

2.6.2 *The use of climatology in navigation*

Routes selected for climatological reasons can be applied on ocean crossings where the weather is settled for a lengthy period. Generally speaking this will be the case in tropical and subtropical latitudes between about 30°N and 25°S. The actual weather from day to day very often agrees with that expected climatologically for the time of year. The major threat is from seasonal tropical cyclones. In these latitudes, however, there is increasing interest in routeing a ship according to the day to day variation in sea currents, as even a small saving in time can be worth a considerable amount of money.

In higher latitudes use can be made of climatological information on factors such as wind, temperature, visibility, ocean currents, ice and wave heights. The data are displayed in numerical or graphic form in climatological atlases, on CD-ROMs or other computer readable media.

2.6.3 *Weather routeing*

Weather routeing is an advisory service prepared by a shore-based meteorological organization (commercial or government operated) which is offered to ships crossing ocean areas where a variety of routes can be chosen depending on weather conditions, sea ice, ocean determining currents, load-line zones and state of loading. The objectives of weather routeing include determining routes designed to minimize crossing time, damage or fuel consumption. For passenger cruise ships weather routeing may be used to maximize the amount of sunshine. At present most ship weather routeing services select 'least-time routes' which also offer minimum damage, assuming that it is possible to construct such a route.

In weather routeing, use is made of the most recent analyses and forecasts of upper-air circulation, surface weather and waves. Based on the latest information on ocean currents, icebergs, tropical cyclones and the speed performance of the ship, routeing advice is issued which can be tailored to the requirements of the user. The greater the deviation from the route which would have been selected on the basis of climatology, the greater will be the advantage of weather routeing.

The analyses and prognoses of surface weather and waves received on board ship by radiofacsimile enable experienced masters to do a limited form of on-board weather routeing. For best results, however^ it is preferable to pay for a special advisory weather routeing service during the voyage.

A ship route is selected, in general, once the flow pattern and the relative intensities of the depressions are established. In practice this is a subjective choice, depending on the routeing officer's experience and the requirements of the shipowner or charterer. For a westward passage on the North Atlantic, for instance, a choice can be made between passing north or south of the British Isles. One must, however, always weigh the time lost by any deviation against the gain in time due to sailing in better wave conditions.

Even weather routeing cannot avoid all heavy weather. Intense storms near the point of departure or destination cannot be avoided except by delaying departure or by slowing down. This has to be done in the case of very heavy weather or with vulnerable cargo.

In general, the most successful routeing advice is generated when the flow pattern at the 500 hPa level is persistent. Clear-cut routes are difficult to advise when complex, transitional changes occur in weather patterns. In such cases a 'strategic' track may be recommended initially until the weather situation is clarified. Such a track must, if necessary, permit a temporary deviation to either north or south.

2.6.4 *Provision of the routeing advice*

In practice the shipowner, master or charterer will contact the weather routeing office sufficiently in advance to departure in order to provide information on the time of sailing of the ship, its speed, destination, type of cargo, stability details and other data of importance for the planning of the route to be recommended. The ship weather routeing officer will then prepare the routeing advice. The initial briefing on the routeing advice may be given in person, by telephone or by facsimile.

In addition to the recommended route shipmasters usually receive the forecast development of the weather situation. Regular communication between ship and weather routeing office is essential, the ship providing at regular intervals (preferable at 00 and 12 UTC) information about its position and weather, and the routeing office sending information on expected weather developments, wind and waves and any consequential amendment to the recommended route. If the ship is part of the WMO Voluntary Observing Ship Scheme, the actual weather conditions can be taken from the ship's observation SHIP report.

2.6.5 *Evaluation of the routeing advice*

Shipping companies need to know whether the service is worthwhile, i.e. whether the costs of the routeing service are less than the benefits gained by following the recommended route. From the beginning of ship weather readings, efforts have been made to quantify the success or failure of the services.

The results of a routeing advice can be visualized by constructing a least-time route. In order to construct such a route the following data are needed:

(a) Accurate analysed wave charts, showing sea and swell with their respective heights and period, preferably at six-hour intervals; and,

(b) The speed performance of the ship, represented as speed versus wave height/period graph for head, beam and following seas.

Weather routeing services have been available to shipping for more than 30 years and experience of the service can be summarized in the following conclusions:

(a) Weather routeing for the purpose of achieving a least-time ocean crossing also reduces weather damage to ship and cargo;

(b) The greatest benefits are obtained during the winter months of December, January and February in the northern hemisphere and June, July and August in the southern hemisphere;

(c) Mean time gains on westbound voyages are larger than those on eastbound voyages as following waves, which do not have so much influence on the ship's performance, are predominant on eastbound voyages;

(d) Advised routes depend on the varying weather on, or near, the Great Circle routes. In summer when waves are predominantly low, the Great Circle is the most economic route.

The effect of routeing on the operational costs of a ship is mainly reflected in fuel and lubricating oil costs. A possible saving of 12 per cent in fuel has been calculated.

2.7 Provision of marine climatological information

The original requirements for marine climatological data came from shipping, in planning trade routes, but there are now many other users, e.g. offshore mining, ferry, catamaran, hydrofoil and hovercraft services. Climatological data were first presented in chart form which marine users found most suitable, but it is now provided in graphic and statistical forms, and in computer compatible format. Climatological charts can be collated into atlases and, increasingly, new advanced computer readable media technology is being used for the display of climatological data in chart, graphic and statistical form.

Climatological data may be provided by NMSs, other government authorities or scientific institutes. The collection, exchange, archival and display of marine climatological data is described more fully in Chapter 3 of this *Guide.*

2.8 **Services for fisheries on the high** seas

2.8.1 *Fisheries management*

A number of environmental factors affect Fish and they must be taken into account in the management and long-term planning of fishing operations. Fisheries research is largely taken up with the investigation of these factors. Environmental factors can affect:

(a) Behaviour, distribution, migration and aggregation of fish;
(b) Yield and catch;
(c) Wintering place;
(d) Fishing period;
(e) Year class-strength; and,
(J) Spawning eggs and larvae.

Among the environmental factors, the following oceanographic and meteorological factors are important:

(a) Sea surface temperature;
(b) Sea temperature gradient, both horizontal and vertical;
(c) Salinity;
(d) Temperature/salinity relation;
(e) Oxygen;
(*f*) Water colour;
(g) Currents; *(h)*
Watermasses.

Sea temperature is an environmental factor of great importance for fishing; it affects nearly all the characteristics of fish listed above, which in turn determine the commercial viability of fishing grounds. Both the spatial and temporal distribution of surface temperature and water temperature at depth are of great interest, as are the respective variability and any anomalous characteristics.

Some fish live and feed close to the surface of the sea, others live for the most part on or near the bottom. Some shellfish may be dredged from the bottom. Diving operations to collect some shellfish such as abalone are very sensitive to even low swells.

2.8.2 *Operational fishing*

While local meteorological offices can brief fishermen before they set out, the main meteorological support for operational high seas fishing can be provided to fisheries and fishermen by means of the regular weather and sea bulletins, provided that they can receive them. Few, if any, fishing craft will have radio-telegraphy operators, leaving radio-telephony as the prime means of communication. As its cost decreases, satellite reception equipment may be installed, at least on larger vessels.

Only a small percentage of fishing vessels are equipped with radiofacsimile receivers, but those which are so equipped will have greatest interest in charts displaying:

(a) Actual and forecast surface weather;
(b) Actual and forecast sea and swell;
(c) Actual and forecast sea ice;
{d) Surface water temperature.

Forecast charts have traditionally extended to 24 hours, but fishermen are very interested in forecast charts extending to four or five days. These forecast charts are now possible, at least for surface wind, sea and swell.

A large part of the fishing areas are situated in northern temperate and near-polar regions, where there are great dangers in winter from storms, ice accretion on vessels and sea ice. A further danger comes from dense fog banks, mainly in the spring and summer, mostly over cold waters. Moreover, the fishing areas are generally situated far away from the general shipping routes and meteorological observations are usually very sparse. Fishing vessels do not usually transmit meteorological observations in order to avoid revealing their position to competitors. These factors add to the difficulty in forecasting for these areas.

The most effective meteorological service is from a meteorologist aboard a fishing vessel or support ship located in the fishing area, provided he/she is backed up with adequate data and communications. The meteorologist will require surface, upper air data and satellite imagery, as well as charts broadcast by radiofacsimile from a land-based weather centre. The advantages of this kind of meteorological service include:

(a) Better mutual understanding and confidence between fishermen and the meteorologist;
(b) The meteorologist can monitor weather development continuously; and,
(c) The forecast area is rather limited and thus the advice can be very specific and effective.

Such special services to a particular fishing fleet or company may well be provided as a commercial service.

2.8.3 *Sea surface and subsurface ocean temperature*

The water temperature of the oceans and its spatial and temporal variability are determined by a great number of oceanographic and meteorological factors. In the main, these are:

(a) Advection;
(b) Radiation balance;
(c) Heat exchange with the atmosphere;
(d) Mixing of different water layers;
(e) Up welling of water from deeper layers;
(f) Freezing and melting of ice; and,
(g) Precipitation.

Heavy storms usually cause a lowering of the sea surface temperature, either by mixing of warm surface water with deeper cold waters, or by horizontal movement of surface water bringing about intensified upwelling from deeper water.

Sea temperature and its variability in space and time is one of the most important meteorologically influenced oceanographic environmental factors for fisheries. It is also very difficult to forecast.

Few countries yet forecast sea surface or subsurface temperature. It is best done using a computer model — an ocean mixed layer model which is driven by wind stress and heat fluxes from an atmospheric model has been developed to this end.

Analyses of observations of sea surface and subsurface temperature are issued by several countries. They are usually based on average temperatures over the previous five to ten days. The analyses should be on the highest possible resolution commensurate with the available data. An example of a sea-surface temperature analysis is shown in Annex 2.H.

The observations used for the analyses may be from ships (which measure sea surface temperature in a variety of ways — bucket, engine intake or hull sensor), or from satellites. It has to be remembered that satellites measure the temperature of the very top or 'skin' of the sea; ships engine intake or hull sensors measure the temperature at a depth of hundreds of centimetres. The difference between the two measurements can be significant, particularly in calm tropical oceans. Thus techniques have to be used to homogenize the two types of observations if they are both used in an analysis.

Sea-temperature analyses may be disseminated in various ways: to the fishing fleet by radiofacsimile, or in the form of coded analyses by radio; and to fishing authorities or companies on shore by facsimile.

2.8.4 *Fishing forecasts*

Fishery authorities and scientists are very interested in longer range weather forecasts and climate forecasts, particularly of changes in sea-surface temperature and other meteorological and oceanographic parameters that have an impact on:

(a) Fish catches;
(b) Fishing grounds;
(c) Distribution of fish;
(d) Fishing periods;
(e) Abundance of species.

Fishing forecasts can be derived from current or recent sea temperature analyses, including anomaly analyses, by means of statistical relationships and regression equations. Trend assessments of sea surface temperature and long-term weather prognoses may lead to prognoses of oceanographic parameters which, in turn can be used to derive fishing forecasts based on statistical relations. Long-range forecasts (up to several months) of sea-surface temperature and sea-surface temperature anomalies have been prepared using statistical methods.

2.8.5 *Planning and contact with fishery authorities*

Contact with representatives of local fishermen and fishery authorities, preferably by means of regular meetings, is essential for the planning and review of the services offered to the industry, such as the content and period of validity of forecasts and broadcast schedules. National boat shows are a useful means of making contact with individual fishermen. It is necessary to keep the service up to date both with advances in meteorology and with the changing requirements of the industry.

Meteorological and climatological factors also play a role in the design and construction of fishing vessels.

2.8.6 *Meteorological support for fisheries research*

The main areas of fisheries research are directed to:

(a) Stocktaking of traditional commercial species of fish and fishing grounds;
(b) Discovery of new fishing grounds;
(c) Exploitation of fish species which are not yet in use;
(d) Development of technologies necessary for the above research work; and,
(e) Fishing forecasts.

Greatest interest is in weather prognoses for longer time intervals (medium and long-range forecasts), as well as climate prognoses. These prognoses are important not only with regard to the changes in the energy balance of the oceans, but also with regard to the connected changes of, among others, oceanographic parameters such as ice coverage, sea currents and up welling areas.

Meteorological consultation and advice is essential for the planning of research projects involving research vessels in operations in regions of extreme weather conditions, e.g. the Antarctic. In such cases, extensive use should be made of climatological material.

2.9 Services for marine pollution emergency response operations

Marine pollution on the high seas is most likely to arise from accidents to oil tankers and consequent oil spills. While oil spills on the high seas far from land are not generally a cause for concern, they can take place in international waters but sufficiently close to shore as to threaten coastlines and therefore justify emergency response operations. To coordinate meteorological support for such operations, CMM at its eleventh session in 1993 set up a Marine Pollution Emergency Response Support System (MPERSS) on a trial basis.

Under this system those Members who have undertaken responsibility for the broadcast of high seas weather and sea bulletins (Responsible Members in paragraph 2.2.2 above) are Area Meteorological Coordinators (AMCs) responsible for meteorological support for marine pollution emergency response operations for their area of responsibility in the high seas. In providing this support they may arrange for assistance from other Members in the area, known as Supporting Services.

The support provided includes:

(a) Basic forecasts and warnings for the area concerned;

(b) Observation, analysis and forecasting of meteorological and oceanographic elements required as input to models to predict the movement and dispersion of the pollution; these include surface wind, waves, currents, air temperature and water temperature;

(c) The operation of such models; and,

(d) Access to national and international telecommunications facilities.

An AMC must advise the marine pollution emergency response authority of the support facilities which the AMC and/or the Supporting Services can provide. It should also coordinate with that authority the means of communication for advice of a pollution incident and for the meteorological response. This information must be kept up to date. Pollution incidents on the high seas requiring emergency response are not expected to occur very often, but when they do a rapid response from the AMC will be required. The international waters where pollution incidents are most likely to threaten coasts include the Mediterranean Sea, the Caribbean Sea and the South China Sea.

2.10 Information services and expert advice

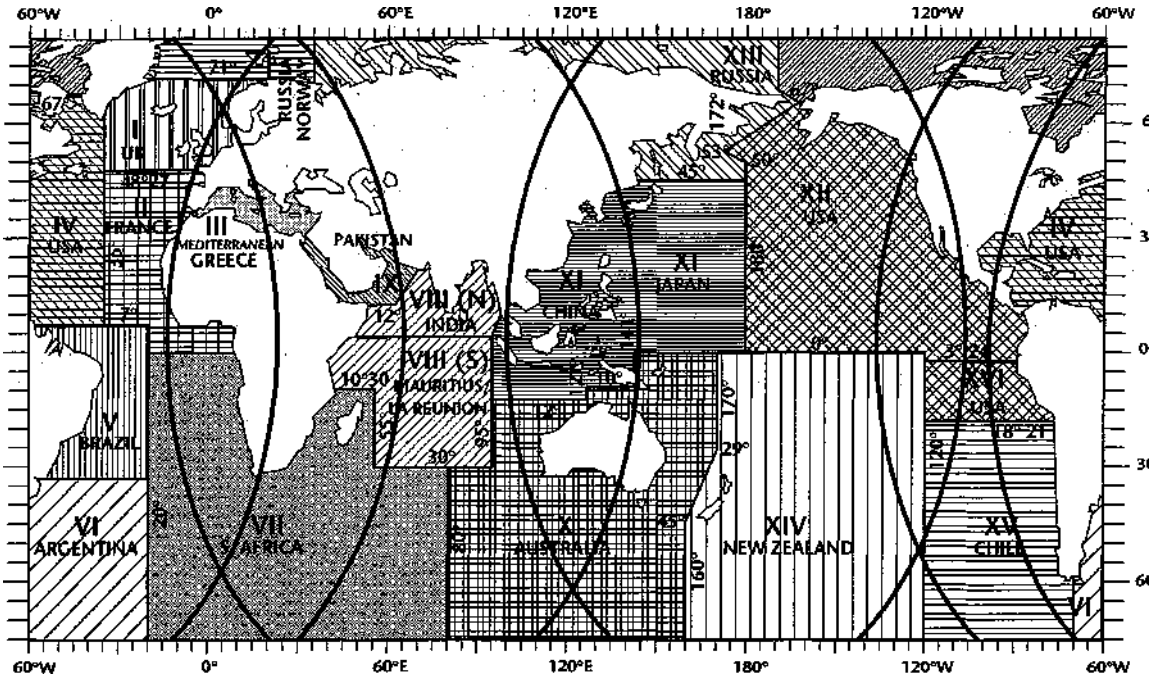
Meteorological Services are asked on occasion to supply information in connection with official investigations of accidents; insurance claims for casualties or cargo damage; and for similar purposes. Such information may relate to actual weather and sea conditions which prevailed on specific dates, as well as to the forecasts and other particulars of weather information which had been supplied by the Meteorological Service. In some cases, meteorological personnel may be called upon to interpret the weather information and offer expert advice.

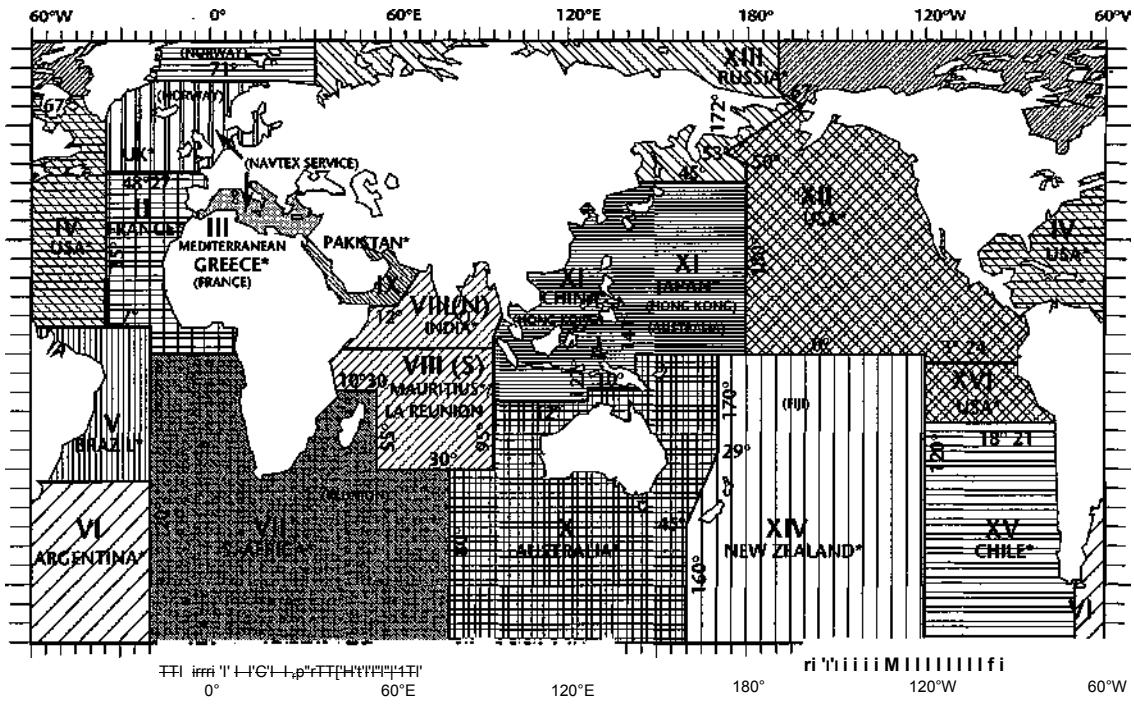
The supply of information in cases with legal or commercial implications will be at the discretion of national authorities and will be governed by national legislation or practices. However, with a view to facilitating the supply of information where this is decided, the records of marine meteorological data and information should be preserved in a suitable form.

ANNEX 2.A

AREAS OF RESPONSIBILITY AND DESIGNATED NATIONAL METEOROLOGICAL SERVICES FOR THE ISSUE OF WARNINGS AND WEATHER AND SEA BULLETINS FOR THE GMDSS

(Annex to Section 2.2.2)





*Denotes a Preparation and Issuing Member () Denotes a Preparation Member

ANNEXE 2.B

MULTILINGUAL LIST OF TERMS USED IN WEATHER AND SEA BULLETINS

LISTE MULTILINGUE DES TERMES UTILISES DANS LES BULLETINS DE METEOROLOGIE MARITIME

LISTA MULTILINGUE DE TERMINOS UTILIZADOS EN LOS BOLETINES METEOROLOGICOS Y MARINOS

MHOrOiI3I>IHHbEft LTEPEHEHb TEPMHHOB, HCIIOJIb3yEMbIX B METEOPOJIOrHHECKHX H MOPCKHX EKWIJIETEHJLX

ENGLISH	FRANgAIS	ESPANOL	PYCCKHH
Standards of time	Unites de temps	Unidades de tiempo	EjTHHHII.a BpeMeHH
Coordinated Universal Time (UTC) Zone time Summer time Local time	Temps universel coordonne (UTC) Heure du fuseau Heure d'ete Heure locale	Tiempo universal coordinado (UTC) Hora zona Hora de verano Hora local	MoKflVHapOflHOe CKOOpflHHH-poBaHHoe BpeMfl (MCB) noacHoe BpeMa JleTHee BpeMH MecTHoe BpeMfl
Periods of time	Periodes de temps	Periodos de tiempo	nepHoaw BpeMeHH
Six hours	Six heures	Seis horas	IIIeCTB HaCOB
Twelve hours	Douze heures	Doce horas	JlBeHafliiaTb HacoB
Eighteen hours	Dix-huit heures	Dieciocho horas	BoceMHa^iiaTb qacoB
Twenty-four hours	Vingt-quatre heures	Veinticuatro horas	flBafliiaTb neTbipe naca
Thirty-six hours	Trente-six heures	Treinta y seis horas	TpnfliiaTb ruecTb nacoB
Forty-eight hours	Quarante-huit heures	Cuarenta y ocho horas	CopoK BOceMb nacoB
Today	Aujourd'hui	Hoy	CeroflHa
Tomorrow	Demain	Mariana	3aBTpa
Next few days	Les prochains jours	Los proximos dias	GieayiomHe HeaawibKO flHefi
Morning	Matin	Mariana	YTpo
Evening	Soir	Tarde, noche	Beiep
Midday	Midi	Mediodia	HonfleHb
Afternoon	Apres-midi	Tarde, noche	nooie no/ryflHH
Day	Jour	Dfa	fleHb
Night	Nuit	Noche	HoHb
Sunrise	Lever du soleil	Orto	Bocxofl
Sunset	Coucher du soleil	Ocaso	3axofl
Preliminary terms	Termes preliminaires	Terminos preliminares	npeaBapirrenbHbie TepMHHbi
Forecast Further outlook	Prevision Evolution ulterieure probable	Prevision, pronostico Evoluci6n probable	nporH03 BepoHTHaa aBOJnouira, *Ranh*-HeHiirae nepcneKTHBbi
General inference	Situation generate et evolution	Perspectivas futuras	06mHii BHBoa
General statement	Situation generate	Situacion general	06niee onncaHHe no/icoiceHHfl
Long-range forecast	Prevision a longue echeance	Prevision a largo plazo	JlonrocpoHHbiii nporH03
Medium-range forecast	Prevision a moyenne echeance	Prevision a medio plazo	IIporH03 cpeflHeit 3a6naro-BpeMeHHOCTH
Short-range forecast	Prevision a courte echeance	Prevision a corto plazo	KpaTKOcpoMHbiK nporH03
Synoptic situation	Situation synoptique	Situacion sinoptica	CHHonTHHecKoe nono^ceHHe, CHHonTHMecKaa cHTyaima
Warning	Avis	Aviso	IIpeflynpoKaeHHe

1	2	3	4
Terms of **position**	Termes de position	Terminos de position	TepMHHM nOJIOiKeHHH
Degrees	Degres	Grados	IpaflycH
Latitude	Latitude	Latitud	IHnpoTa
Longitude	Longitude	Longitud	*JlORTOTa*
Quadrant	Quadrant	Cuadrante	KBanpaHT
Hemisphere	Hemisphere	Hemisferio	IlonymapHe
North	Nord	Norte	CeBep
South	Sud	Sur	lOr
East	Est	Este	BOCTOK
West	Ouest	Oeste	3anafl
District	District	Distrito	PaiioH
Parallel	Parallele	Paralelo	LlapaxiTiejib
Meridian	Meridien	Meridiano	MepHUHaH
Square	Carre	Cuadrado	KBanpaT
Bearing	Relevement	Rumbo	Ile^eHr
Direction	Direction	Direction	HanpaBneHHe
Track	Trajectoire, route	Trayectoria	riyTB, TpaeKTopHfl
Area	Zone	Area, zona	*06nacTh,* paiioH, 30Ha
Line	Ligne	Linea	JIHHHH
Storm warnings	Avis **de temp£te**	Avisos de temporales	HlTopMOBbie npeflynpeacaeHHH
Gale warning	Avis de coup de vent	Aviso de viento duro	IIlTOpMOBoe npenynpeacfleHHe
Storm warning	Avis de tempete	Aviso de temporal	IIlTopMOBoe npeaynpeacjieHHe
Hurricane warning	Avis d'ouragan	Aviso de huracan	Ilpeflynpe^cfleHHe 06 yparaHe
Blizzard	Blizzard	Blizzard, ventisca	BnH33apa
Tropical storms	**Cyclones tropicaux**	**Ciclones tropicales**	TponiraecKHe inropMbi
Tropical cyclone	Cyclone tropical	Ciclon tropical	TponHHecKHH ITHIOIOH
Hurricane	Ouragan	Huracan	YparaH
Tornado	Tornade	Tornado	TopHaflO
Typhoon	Typhon	Tifon	TaaqbyH
Baguio	Baguio	Baguio	Earaiio
Willy-willy	Willy-willy	Willy-willy	*Bmum-muum*
Pressure systems	**Systemes de pression**	**Sistemas de presion**	BapirqecKHe cHcxeMbi
Area of low pressure	Zone de basses pressions	Area de bajas presiones	06/iacTb HH3Koro flaBTieiiHJi
Low	Depression	Depresion barometrica	IIHIOIOH
Trough	Creux barometrique	Vaguada	JIo>K6HHa
Area of high pressure	Zone de hautes pressions	Area de altas presiones	06/iacTb BbicoKoro flaB^eHHH
High	Anticyclone	Anticiclon	AHTHirHK./IOH
Ridge (of high pressure)	Dorsale, crete barometrique	Cresta de alta presion	Ipe6eHb (BbicoKoro *j&BJiewvi)*
Belt of high pressure	Ceinture de hautes pressions	Cinturon de altas presiones	IlOHC BblCOKOrO flaBTieHHfl
Belt of low pressure	Ceinture de basses pressions	Cinturon de bajas presiones	rioflc HH3Koro aaB^eHHii
Col	Col barometrique	Collado	Cefl/ioBHHa
Hyperbolic point	Point hyperbolique	Punto hiperbolico	rknep6o;iHHecKafl TOHKa
Cyclolysis	Cyclolyse	Ciclolisis	II,HK^OnH3
Cyclogenesis	Cyclogenese	Ciclogenesis	H,HKi[oreHe3
Anticyclolysis	Anticyclolyse	Anticiclolisis	*AHTKimKJlOmi3*
Anticyclogenesis	Anticyclogenese	Anticiclogenesis	AHTHU,HKJI0reHe3
Air mass	**Nomenclature des** masses	**Nomenclatura de las** masas	KjiaccndiHKaniHfl
nomenclature	**d'air**	**de** aire	B03ftyinHbrx Mace
Air mass	Massed'air	Masa de aire	Bo3flyniHafl Macca
Stable air mass	Masse d'air stable	Masa de aire estable	ycTOHHHBaH *Bosjijuiuaa.* Macca
Unstable air mass	Masse d'air instable	Masa de aire inestable	HeycToKHHBaH B03ji,yiUHafl Macca
Cold air	Air froid	Aire frio	Xo/roflHHH B03flyx

1	2	3	4
Air mass nomenclature	Nomenclature des masses	Nomenclatura de las masas	KziaccH<bHKaii;Hfl
(contd.)	d'air (suite)	de aire (cont.)	B03flyUlHHX MaCC (npOflCWDK.)
Arctic air	Air arctique	Aire artico	ApKTHHeCKKH B03/JVX
Antarctic air	Air antarctique	Aire antartico	AHTapKTHMeCKHH B03flVX
Polar air	Air polaire	Aire polar	Ilo^HpHblH B03ffVX
Warm air	Air chaud	Aire caliente, aire calido	TeruiBrH B03ayx
Tropical air	Air tropical	Aire tropical	TponHHecKHft Bosayx
Subtropical air	Air subtropical	Aire subtropical	Cy6TponH[tecKHfi[B03flyx
Equatorial air	Air equatorial	Aire ecuatorial	SKBaTOpHaJIbHblft B03JTVX
Maritime air	Air maritime	Aire marftimo	MopCKOft B03flyx
Continental air	Air continental	Aire continental	KoHTHHeHTaflbHblH B03flyX
Winter monsoon	Mousson d'hiver	Monzon de invierno	3HMHHJI MyccoH
Summer monsoon	Mousson d'ete	Monzon de verano	JleTHHft MyCCOH
Front	Nomenclature	Nomenclatura	IGiaccJHpHKairjfH
nomenclature	des fronts	de los frentes	(ppOHTOB
Front	Front	Frente	<J>pOHT
Polar front	Front polaire	Frente polar	no^apHbrti (ppoHT
Cold front	Front froid	Frente Mo	XoflOflHblft (ppOHT
Secondary cold front	Front froid secondaire	Frente frio secundario	BTOpHHHblH XO/IOflHblfi (ppOHT
Warm front	Front chaud	Fente caliente	*TeimuPL* dppoHT
Occlusion	Occlusion	Oclusion	OKKJIK)3Hfl
Cold occlusion	Occlusion a caractere de front froid	Oclusion fria	OKKUK)3Hfl no THny xo^oflHoro (ppoHTa
Warm occlusion	Occlusion a caractere de front chaud	Oclusion caliente	OKKmo3KH no THny Terworo (ppoHTa
Upper front	Front en altitude	Frente en altura	BepxHHll d>poHT
Intertropical front	Front intertropical	Frente intertropical	BHyTpHTponHHecKHft (ppoHT
Frontal wave	Onde frontale	Onda frontal	3>poHTa;ibHafl BO/ma
Frontogenesis	Frontogenese	Frontogenesis	$poHToreHe3
Frbntolysis	Frontolyse	Frontolisis	OpOHTOnH3
Weather	**Temps**	**Tiempo**	**Iloroffa**
Precipitation	*Precipitation*	*Precipitacion*	*OcadKu*
Rain	Pluie	Lluvia	*Royaab*
Freezing rain	Pluie se congelant	Lluvia engelante	3aMep3aiomHil flo»cab
Rain and snow mixed	Pluie et neige melees	Lluvia y nieve mezcladas	*RoyKRh* co CHeroM
Supercooled rain	Pluie surfondue	Lluvia subfundida	Ilepeoxna^caeHHbili flOJKflb
Snow	Neige	Nieve	CHer
Snow pellets	Neige roulee	Nieve granulada	CHOKHaH Kpyna
Snow grains	Neige en grains	Cinarra, gragea	CHOKHbie 3epna
Drizzle	Bruine	Llovizna	Mopocb
Hail	Grele	Granizo	Ipa3
Diamond dust	Poudrin de glace	Polvillo de hielo	AjiMa3HaH nbmb
Ice pellets	Granules de glace	Granulos de hielo	*Jlensma.fi* Kpyna
Small hail	Gresil	Granizo menudo	He6o;ibiiioJi rpaa
Shower	Averse	Chubasco	JlHBeHb
Visibility	*Visibilite*	*Visibilidad*	*BuduMocmb*
Fog	Brouillard	Niebla	TyMaH
Mist	Brume	Neblina	flbiMKa
Haze	Brume seche	Calima	Mraa
Duststorm	Tempete de poussiere	Tempestad de polvo	IlbmbHaa 6ypa
Sandstorm	Tempete de sable	Tempestad de arena	IlecqaHafl 6ypa
Spray	Embruns	Rociones	BoflaHaa nbwb
Drifting snow	Chasse-neige basse	Ventisca baja	Il03eM0K
Blowing snow	Chasse-neige elevee	Ventisca alta	HH30Baa MeTejib

Weather (eontd.)	**Temps** (suite)	**Tiempo** (cont.)	Ilorofta (npoflo/i>K.)
Miscellaneous	*Divers*	*Misceldneos*	*JIpnojmumejihHue mepMunu*
Cloud	Nuage	Nube	06/iaKO
Clearing up	Se dissipant	Despejando(se)	UpoHCHeHHe
Line squall	Grain en ligne	Turbonada en lmea	JlHHeiiHbiH niKBa^
Whirlwind	Tourbillon de vent	Remolino de viento	BHxpt Boflиffloii
Water-spout	Trombe marine	Tromba marina	cMepn
Frost, freezing	Gelee, gel	Helada	Mop03, 33MOp030K
Rime	Givre blanc	Cencellada blanca	H3MOp03b
Glaze	Givre transparent	Cencellada transparente	ToJiojiefl
Smoke	Fumee	Humo	flbIM
Thunderstorm	Orage	Tormenta	Tposa
Thunder	Tonnerre	Trueno	TpoM
Lightning	Eclair	Relampago	Mo^fHHJI
Wind	**Vent**	**Viento**	**ReTep**
General terms	*Termes generaux*	*Terminos generates*	*06mue mepMUHbi*
Beaufort scale	Echelle de Beaufort	Escala Beaufort	IllKaita Boqbopxa
Calm	Calme	Calma	Hlxiiffb THXHH
Light air	Tres legere brise	Ventolina	Bexep HerKHH
Light breeze	Legere brise	Flojito (viento), brisa muy debil	Bexep
Gentle breeze	Petite brise	Flojo (viento), brisa debil	Gia6biii Bexep
Moderate breeze	Jolie brise	Bonancible (viento), brisa moderada	yMepeHHbrfl; Bexep
Fresh breeze	Bonne brise	Fresquito (viento), brisa fresca	CBe^cHil Bexep
Strong breeze	Vent frais	Fresco (viento), brisa fuerte	CHTibHbift Bexep
Near gale	Grand frais	Freseachon, viento fuerte	KpenKKK Bexep
Gale	Coup de vent	Viento duro	OneHb KpenKHH Bexep
Strong gale	Fort coup de vent	Viento muy duro	IIIxopM
Storm	Tempete	Tormenta,tempestad, temporal	CHnbHbiil nixopM — 6ypa
Violent storm	Violente tempete	Temporal duro, borrasca	*yKecTOKHft* nixopM
Hurricane	Ouragan	Huracan	VparaH
Gust	Rafale	Rafaga, racha	IIopbiB
Squall	Grain	Turbonada	IIlKBa^
Sea breeze	Brise de mer	Brisa de mar	MopCKOfl[6pH3
Land breeze	Brise de terre	Brisa de tierra	EeperoBOH 6pH3
Prevailing wind	Vent dominant	Viento dominante	TocnoflcxBytoinHH Bexep
Shift of wind	Saute de vent	Salto de viento	IIoBopox Bexpa H3MeHeHHe
Veering (clockwise change in direction)	Rotation du vent (dans le sens des aiguilles d'une montre)	Cambio de direccion (en el sentido de las agujas del reloj)	HanpaBneHHii Bexpa no HacoBoH cxpe/LKe
Backing (counter-clockwise change in direction)	Rotation du vent (dans le sens contraire des aiguilles d'une montre)	Cambio de direccion (en el sentido contrario de las agujas de reloj)	H3MeHeHHe HanpaBnenHH Bexpa npoxHB nacoBofi cxpe/ucH
Local names	*Noms locaux*	*Nombres locales*	*Mecmuue uanpaeneuwi*
Trade winds (trades)	Alizes	Vientos alisios (alisios)	FlaccaxH
Bora	Bora	Bora	Bopa
Mistral	Mistral	Mistral	Miicxpajib
Sirocco	Sirocco	Siroco	CHpOKKO
Gregale	Gregal	Gregal	Tperanb
Levanter	Levante	Levante	TIeBaHxe, K»KHbifl; Bexep
Norther	Norther	Nortada	CeBepHbiH Bexep

1	2	3	4
Ice*	Glace*	Hielo*	Jlen*
Bergy bit	Fragment d'iceberg	Tempanito	06ZIOMOK aiic6epra
Brash ice concentration	Concentration en brash (sarrasins)	Concentration de escombro de hielo	CrmoHeHHOCTb ;ie,nflHOH KaniH
Fast ice	Banquise cotiere	Hielo fijo	npHnaii
First-year ice	Glace de premiere annee	Hielo del primer ano	OflHaneTHHe *jihRbi*
Flaw	Breche de separation	Grieta	*TLonoca* TepToro *m>Ra*
Floe	Roe	Bandejon	He^HHoe none
Frazil	Frasil	Cristales de hielo	HeaHHtie *mnhi*
Grease ice	Sorbet	Hielo grasoso	Jle/iflHoe *can.o*
Grey ice	Glace grise	Hielo gris	Cepufl *neR*
Grey-white ice	Glace blanchatre	Hielo gris bianco	Cepo-6e;ibiH nefl
Growler	Bourguignon	Grufion	KycoK aftc6epra
Hummocked ice	Glace hummockee	Hielo amonticulado	TopocHCTbrii *neR*
Iceberg	Iceberg	Tempano	Aiic6epr
Ice boundary	Ligne de demarcation des glaces	Frontera del hielo	JleflOBaa rpaHHiia
Ice edge	Lisiere de glace	Borde del hielo	KpoMKa *jihRa*
Ice field	Champ de glace	Campo de hielo	CKon^eHHe flpeJi(pyioin.ero ^bfla
Ice limit	Limite des glaces	Limite del hielo	KpafiHHfl rpaHHiia *Jibna*
Ice patch	Banc de glace	Manchon de hielo	naTHO *nhjxa*
Ice rind	Glace vitree	Costra de hielo	CmiiiHKa
Ice shelf	Plateau de glace	Meseta de hielo	IIIeTibcboBbrii *nejxauK*
Level ice	Glace plane	Hielo piano	POBHBIH *nejs,*
New ice	Nouvelle glace	Hielo nuevo	Hana;ibHbie BHAM nbflOB
Nilas	Nilas	Nilas	*Hwiac*
Pack ice	Banquise	Hielo a la deriva	flpeftcpyioinHfi: *KZR*
Pancake ice	Glace en crepes	Hielo panqueque	BnHHHaTbiii *neji*
Polynya	Polynie	Polinia	*UoJlblHbSl*
Rafted ice	Glace entassee ou empilee	Hielo sobre escurrido	HaaioeHHbrii *nep,*
Shore lead	Chenal cotier	Canal costero	npH6pe>KHafl npora^HHa
Shuga	Shuga	Shuga	Illyra
Slush	Gadoue	Pasta o grumo	CHe>Kypa
Young ice	Jeune glace	Hielo j oven	Mo/ioflbie ^bflbi
Miscellaneous nautical terms	**Termes nautiques divers**	**Terminos nauticos diversos**	Pa3Hbie MopcKHe TepMHHbl
Sea	Mer	Mar	Mope
Sea level	Niveau de la mer	Nivel del mar	VpoBeHb Mops
Horizon	Horizon	Horizonte	ropH30HT
Tsunamis	Tsunamis	Tsunamis	LlyHaMH
Swell	Houle	Mar de fondo	3H6B
Tide	Maree	Marea	MopCKOft npHHHB H OTTDfB
Surge	Lame de fond	Oleada	Boma *(6on.buiasi),* HaroH
Surf	Deferlement	Resaca	npH6oft
Breakers	Brisants	Rompientes	BypyHbi
Wave	Vague	Ola	Bo;raa
Wavelet	Vaguelette	Ola pequefia	He6o/ibniaH Bo/ma

* Readers are referred to publication WMO-No. 259 which contains a complete sea-ice nomenclature.

1	2	3	4
General descriptive terms	**Termes descriptifs generaux**	**Terminos descriptivos generales**	06m,He orrHcaTe^bHMe TepMHHM
Slight	Faible (leger)	Leve	He3Ha-qHT.embHbTH
Moderate	Mode-re	Moderado	yMepeHHbiH
Violent	Violent	Violento	)KeCTOKHH
Heavy	Fort (gros)	Fuerte	*TaMejihm*
Strong	Fort	Fuerte	*CwibJSbiA*
Dry	Sec	Seco	CyxoH
Damp	Humide	Humedo	BTra^KHbift
In patches	Par plaques, en bancs	En bancos	B Kycicax, naTHaMH
Extensive	Etendu	Extenso	06uiHpHHia, npocTpaHHbiit
Low	Bas	Baja	HH3KHH
High	Haut, eleve	Alta	BblCOKHH
Rough	Forte	Duro	BypHbiit
Recurve	Se recourber	Recurvarse	IIOBOpaHHBaTb
Quickly	Rapidement	Rapidamente	Bbicxpo
Slowly	Lentement	Lentamente	MejyieHHO
Filling up	Se comblant	Llenandose	3ano;meHHe
Increasing	Croissant, augmentant	Aumentando	VBe^HHeHMe
Decreasing	Decroissant, diminuant	Disminuyendo	YMeHbuieHHe
Breaking up	Se dissolvant	Disipandose	Pa3pymeHHe
Poor	Mauvais	Malo	Hnoxoii
Good	Bon	Bueno	XoponiHit
Spreading	S'etendant	Extendiendose	PacnpocTpaHeHHe
Occasional	Qccasionnel	Ocasional	CnyHaHHbiii
Continuous	Continu	Continuo	HenpepMBHHH, npoAOTDKHTejibHb
Intermittent	Intermittent	Interrnitente	ripepblBHCTblH
At times	De temps a autre	A veces	HHorga, BpeMeHaMH
Immediately	Immediatement	Immediatamente	HeMefl^eHHo, HenocpeflCTBeHHO
Early	Tot	Temprano	PaHO
Late	Tard	Tarde	Il03flH0
Later	Plus tard, par la suite	Luego, mas tarde	IIo3^ce

ANNEX 2.C

EXAMPLES OF HIGH SEAS FORECASTS

(Reference: paragraph 2.2.3)

1. Example where the forecast in Part 3 is divided into a number of standard sub-areas.

Securite

National Meteorological Service Athens Marine Meteorological Centre Weather and Sea Bulletin for Shipping For Metarea 3 Date and time of issue 30/3/96/2000 UTC

Part 1 Gale/storm warning No gale

Part 2 Synoptic situation

Synopsis of surface weather chart 301500 UTC Barometric lows 1006 hPa centred over central Italy and Tunisia are moving eastwards

Part 3 Forecast

Forecast for 24 hours from 302200 to 312200 UTC

North Adriatic

Temporarily cloudy rain East northeast 4 soon north Slight to moderate Moderate

Central Adriatic

Temporarily cloudy rain Variable 4 later north Slight to moderate Moderate

South Adriatic

Temporarily cloudy rain South southeast 4 locally up to 5 later north Moderate Moderate locally poor

Boot

Temporarily cloudy rain thunderstorm Southwest 4 to 5 later north Moderate Moderate

Ionio

Locally cloudy rain thunderstorm South southwest 5 locally 6 Moderate locally rough Moderate locally poor

Patraikos Korinthiakos

Locally cloudy rain probable thunderstorm soon southwest 5 Moderate Moderate locally poor

Kithira Sea

Locally cloudy rain thunderstorm soon west 5 soon southwest 5 locally 6 Moderate soon locally rough Good locally Moderate

Melita Gabes

Cloudy rain thunderstorm later fair Southwest 5 soon northwest Moderate Moderate

Sidra

Locally cloudy probable shower rain South southwest 5 to 6 Moderate to rough Moderate

Southwest Cretan

Locally cloudy thunderstorm later west northwest 5 over west part south southwest 5 to 6 Moderate over west part up to rough Moderate

Southeast Cretan Ierapetra Sea Delta

Locally cloudy shower later fair West to northwest 5 later southwest Moderate Moderate

Taurus

Locally cloudy West 4 Moderate Moderate

Crusade

Locally cloudy West northwest 4 Moderate Moderate Cretan Karpathio

Kastellorizo Sea

Locally cloudy shower later West 4 to 5 soon southwest Moderate Moderate

South Aegean Ikario Samos Sea

Locally cloudy rain later West to southwest 5 later south southwest 5 locally 6 Moderate later locally rough Moderate

Rodos Sea

Locally cloudy shower later West southwest 4 to 5 Moderate Moderate

Saronicos South Evvoicos

Locally cloudy rain later South southwest 3 locally 4 soon 4 to 5 Slight to moderate soon moderate Good to moderate

Central Aegean

Locally cloudy rain later Southwest 4 soon south 5 later locally 6 Moderate later locally rough Moderate

Thermaicos

Locally cloudy rain later Variable 3 to 4 soon south 4 Slight to Moderate Moderate locally in the morning poor

North Aegean Thrakico Marmara

Locally cloudy probable rain Variable 3 to 4 soon south 4 to 5 later locally 6 Slight to moderate soon moderate later locally rough Moderate locally poor

Black Sea

Locally cloudy rain West 4 to 5 soon south Moderate Moderate locally poor Outlook for 12 hours from 312200 to 011000 UTC Northerly winds are expected to prevail over west Hellenic Seas

Western Mediterranean Sea Marine Weather Bulletin issued by Meteo-France Part 1 Storm warning Warning NR 132

Part 2 General synopsis, Saturday 30 March 1996 at 1200 UTC

Low 1003 hPa near Gulf of Genova, moving southeast and filling Sunday

High 1023 hPa North Canary Islands moving northeast

Part 3 Area forecasts to Monday 01 April at 0000 UTC

East of Cabrera

Northerly 3 or 4, veering gradually southerly tomorrow. Slight or Moderate Scattered rain

Baleares
Variable 3 to 5, becoming southerly tomorrow. Slight or Moderate Scattered rain or showers
Minorque
North or northwest 5 to 7, locally 4 or 5 in southwest, veering southerly 3 to 5 tomorrow. Moderate locally rough in northeast decreasing
Lion
Northwesterly 5 to 7 temporarily 7 or 8 tonight, decreasing 3 to 5 tomorrow midday, then backing southwest later. Moderate or locally rough decreasing
West of Provence
North or northwest 8, decreasing 4 to 6 tomorrow midday then backing west 3 to 5 later. Moderate or rough decreasing
East of Provence
Mainly northwesterly 5 to 7 locally variable 4 to 6 in far east decreasing 3 to 5 tomorrow morning then veering westerly later. Moderate or locally rough decreasing
Ligure, North of Corse
Northwesterly 4 to 6, occasionaly 7 tonight, becoming variable 2 to 4 tomorrow midday. Moderate or locally rough decreasing
South of Corse
Westerly 4 to 6, occasionally 7 near Bonifacio, veering west of northwest 3 or 4 tomorrow. Moderate or locally rough decreasing
Sardaigne
Northwesterly 4 to 6 temporarily 6 or 7 in north tonight, backing westerly 3 or 4 tomorrow afternoon. Moderate or rough Scattered rain
Maddalena
West or northwest 3 to 5, becoming variable 2 to 4 later. Slight or Moderate
Elbe
Variable 2 to 4, temporarily northeast 4 or 5 in late night. Slight
Alger
Westerly 4 to 6, temporarily 7 in west at first decreasing 3 to 5 later. Rough Isolated showers
West of Cabrera
Westerly 4 to 6, backing southwest 5 or 6 at the end. Moderate
Annaba
West or northwest 4 to 6, temporarily 7 near Cape Teulada tomorrow, becoming variable 2 to 4 later. Moderate Isolated showers
Tunisie
West or northwest 4 to 6 increasing locally 7 near Sardinia tomorrow. Moderate Isolated showers
Carbonara
Westerly 3 to 5, becoming variable 2 to 4 later. Slight or Moderate
Lipari, Circeo
Variable 1 to 3, becoming northwesterly 3 to 5 tomorrow. Slight.

2. Example where the area is divided into a few sub-areas and all three Parts are given for each sub-area.
Securite
High Seas Forecast for waters 28/50 South between 129/170 East issued by the Bureau of Meteorology, Melbourne for 24 hours from 04172300Z
Part 1 Gale/storm warning
Melbourne Gale 04172000Z for area within 240 nm of low (see situation) over western and southern semicircles.
Part 2 Synoptic situation
At 04172000Z complex low with main centre 1006 hPa 41S 15 IE slow-moving, complex centre expected to be near 40S 156E at 182300Z. Low is cradled by a ridge extending from 30S 130E to high 1031 hPa 42S 132E to 50S 148E to 44S 170E. Western section of ridge/high moving east about 10 knots with eastern section slow-moving.
Part 3 Forecast
Within 250 nm of High/120 nm Ridge Variable wind to 15 knots. Slight sea. Low/moderate swell
Rest northeast of Ridge
Clockwise wind around low of 10/20 knots in the northern Tasman and near ridge with slight/moderate sea. Wind increassing to 20/30 knots near low except in northern quadrant with moderate/rough sea, but reaching 35 knots in gale area with very rough sea. Moderate swell, heavy at times in gale area.
Rest west of Western Ridge/High
Northerly quarter wind 10/20 knots with slight/moderate sea increasing to 20/30 knots in far southwest, particularly tonight and tomorrow, with moderate/rough sea. Moderate swell southwards.

Weather Melbourne
Securite
High Seas Forecast for waters Equator to 28S, 142 to 170E issued by the Bureau of Meteorology, Brisbane for 24 hours from 04172300Z
Part 1 Gale/storm warning
Nil **Part 2 Synoptic situation**
Situation at 171800Z
Broad trough from 5S155E to 28S159E expected to be at 5S152E to 28S168E by 181800Z
Part 3 Forecast
North of 10S
Variable winds 5/1Q knots. Seas smooth to slight. Scattered showers and thunderstorms.
Elsewhere east of trough
E to NE winds 15 to 20 knots. Seas moderate. Scattered showers and thunderstorms. Some rain areas in the north close to the trough.
West of trough
SE to E winds 10/15 knots with slight seas. Scattered showers and thunderstorms close to trough, isolated near Queensland coast.

Weather Brisbane

Securite

High Seas Forecast 10/12S, 90/100E, 12/30S 90/125E, 30/50S 80/129E for 24 hours from 04172300Z **Part 1**

Gale/storm warning

Gale warning south 50S090E 40S097E 50S125E

Part 2 Synoptic situation

Situation 1800Z

Refer warning

Ridge 25S080E to 27S110E to high 1030 40S132E

Tropical low 1006hPa near 19S111E moving SW atlOKN **Part**

3 **Forecast**

Within 200nm ridge

Variable winds to 15kn slight seas Low/mod swell

Within 150nm of tropical low

Clockwise winds 15/25kn, possibly reaching 25/3 Okn within 6nm Mod/rough seas Mod swell

Remainder north ridge

NE/SE winds 15/25kn Mod seas Mod/heavy swell grading 25/33Kn within 180nm warning area Rough seas Heavy swell.

Weather Perth

Securite

High Seas Forecast Equator to 10S between 100/125E and southward to the coast between 125/142E for 24 hours from 04172300Z

Part 1 Gale/storm warning

Nil **Part 2 Synoptic situation**

Situation 1800Z

Easterly flow

Part 3 Forecast

South of 7S Slight to moderate seas Easterly winds 15 knots Isolated storms

North of 7S Slight seas. Variable winds 10 knots Isolated storms

Weather Darwin

High Seas forecast

National Weather Service Washington DC/NHC Miami Meteorological Operations Division/NMC 2300 UTC Aug 11

Pan Pan

Pacific Ocean N of 30N and E of a line from the Bering Strait to 50N 160E

Synopsis valid 1800 UTC Aug 11 Forecast valid 0600 UTC Aug 13

Warnings

Gale 41N 169E 1005 mb moving NE 25 kt. Winds 25 to 35 kt seas 8 to 14 ft within 300 ran N and 540 nm E semicircles. Forecast Gale 52N 174W 995 mb. Forecast winds 35 to 45 kt seas 10 to 18 ft within 480 nm of the S semicircle. Elsewhere winds 25 to 35 kt seas 8 to 14 ft within 420 nm N and 600 nm S semicircles.

Synopsis and forecasts

Low 59N 147W 1010 mb moving E 20 kt. Winds 20 to 30 kt Seas 8 to 14 ft within 480 nm over S quadrant. Forecast Low and associated conditions inland. Low 32N 174W 1017 mb drifting S 10 kt and weakening. Winds 20 to 30 kt Seas 8 to 12 ft within 300 nm of the N semicircle and E quadrant. Forecast low dissipated.

Low 33N 159E 1000 mb nearly stationary, winds to 25 kt. Seas o 12 ft within 240 nm of centre, forecst low 34N 160E 1005 mb. forecst winds 20 to 30 kt Seas 8 to 14 ft within 660 nm in NE quadrant. Forecast area of winds 20 to 25 kt Seas 8 to 12 ft over forecast waters between 34N and 43N E of 128W

High 44N 150W 1031 mb with ridges to 55N 170E and 45N DOW. High drifting SSW forecast high 39N 158W 1030 mb with ridges to 32N 175E and 50N 140W

Areas of fog visibility below 1 nm between 40N and50NWof 160W

Pacific N of Equator to 30N E of MOW

Synopsis 1800 UTC Wed Aug 11 Forecast valid 0600 UTC Fri Aug 13

Warnings

Hurricane Fernanda 14.6N 123.1W 2100 UTC Aut 11 moving W 18 kt. Maximum sustained winds 125 kt gusting to 150 kt. Tropical storm force winds and seas 12 ft or greater within 100 nm of center. Forecast hurrican 15.4N 132.6W. Request 3 hourly ship reports 300 nm radius center. See latest advisory.

Tropical depression Eight-E 12.5N 88.5W 21000 UTC Aug 11 moving WNW 10 kt. Maximum sustaind winds 20 kt gusting to 30 kt seas 8 to 10 ft within 120 nm of center, forecast depression diss-pated by 0300 UTC Aug 12. Request 3 hourly ship reports 300 nm radius center. See latest advisory.

Synopsis and Forecast

Except as noted in warnings. Wind 25 to 33 kt seas 8 to 12 ft within 150 nm radius of Fernanda. EPac N of 20N W of 125W Wind 25 to 30 kt seas to 10 ft. Remainder of EPac wind less than 25 kt seas less than 8 ft.

Convection valid as of 1500 UTC Aug 11

Numerous within 120 nm of Fernanda. Scattered moderte to stron with 300 nm of center S semicircle. Withing 180 nm of center N semicircle. Scattered moderate within 45 nm of depression Scattered moderate to strong 14N to 20N between 103Wandl08W

Scattered moderate ION to 13N between 90W and 95W...within i degree radiusof 12N 99W Intertropic convergence zone 8N 79W 8N MOW Convection Scattered moderate isolated strong 180 nm wide E of 90W...between 95W and 99W...240 nm wide W of 132W. Scattered moderate 180nm wide 126W to 132W

ANNEX 2.D

TERMINOLOGY USED IN STORM WARNINGS IN REGIONS WHERE TROPICAL CYCLONES MAY BE ENCOUNTERED

(Reference: paragraph 2.2.4)

The following information details the terminology used for tropical cyclones in the various WMO Regions. All Regions follow the content and order of items for warnings for the high seas as specified in the *Manual on Marine Meteorological Services,* Volume 1, Part I, paragraph 2.2.3.3. Additional information may be provided as indicated.

Region I

(Source: *Tropical Cyclone Operational Plan for the Southwest Indian Ocean,* 2000, WMO/TD-No. 577) Tropical cyclones are classified in marine bulletins for the high seas as:

	Wind speed*
(i) Tropical depression	<34 knots
(ii) Moderate tropical storm	34-47 knots
(iii) Severe tropical storm	48-63 knots
(iv) Tropical cyclone	64-90 knots
(v) Intense tropical cyclone	91-115 knots
(vi) Very intense tropical cyclone	>115 knots

* Maximum sustained wind speed near the centre of the circulation, averaged over 10 minutes

Warnings issued for the high seas are:
(i) Near gale warning
(ii) Gale warning
(iii) Storm warning
(iv) Tropical cyclone warning

The warning shall be preceded by information concerning the origin of the warning, such as the time of the data (synoptic chart, satellite imagery, etc.) on which the warning was based.

Region II (East Asia)

(Source: *Typhoon Committee Operational Manual, Meteorological Component,* 2000, WMO/TD-No. 196) Tropical cyclones are classified as:

	Wind speed*
(i) Tropical depression	<34 knots
(ii) Tropical storm	34-47 knots
(iii) Severe tropical storm	48-63 knots
(iv) Typhoon	>63 knots

* Maximum sustained wind near the centre, averaged over 10 minutes as read from an anemogram or the 3 minutes determined with a non-recording anemometer or estimated wind at sea by mariners using the Beaufort scale.

Region II (Bay of Bengal and the Arabian Sea)

(Source: *Tropical Cyclone Operational Plan for the Bay of Bengal and the Arabian Sea,* 2000, WMO/TD-No. 84) Tropical cyclones are classified as:

	Wind speed*
(i) Depression or tropical depression	<34 knots
(ii) Cyclonic storm	34-47 knots
(iii) Severe cyclonic storm	48-63 knots
(iv) Severe cylonic storm with a core of hurricane winds	>63 knots

* Maximum average surface wind speed averaged over 10 minutes as read from an anemogram or the 3 minutes determined with a non-recording anemometer or estimated wind at sea by mariners using the Beaufort scale.

Region IV

(Source: *Regional Association IV Hurricane Operational Plan,* 2000, WMO/TD-No. 494) Tropical cyclones are classified as:

	Wind speed*
(i) Tropical depression (ii) Tropical storm (iii) Hurricane	<34 knots 34-63 knots >63 knots

* Maximum average surface wind, one-minute mean

Region V

(Source: *Tropical Cyclone Operational Plan for the South Pacific and South-east Indian Ocean,* 2000, WMO/TD-No. 292)
Tropical cyclones are classified as:

	Wind speed*
(i) Tropical depression (ii) Tropical cyclone (iii) Hurricane	<34 knots 34 knots or more >63 knots

* Surface wind averaged over 10 minutes

The form and content of high seas warnings is:
(a) Bulletin heading and identification code;
(b) Type of warning (GALE, STORM, HURRICANE);
(c) Office issuing warning;
(d) Date and time of reference (UTC);
(e) Type of disturbance (TROPICAL CYCLONE) and (from Australia) estimated central pressure;
if) Location of disturbance (latitude and longitude);
(g) Location confidence estimate (GOOD/FAIR/POOR)
(h) Direction (in compass points) and speed of movement in knots of the tropical cyclone;
(z) Expected location at 12 and (from Nadi) 24 hours hence;
(j) Extent of affected area;
(k) Wind speed (knots) in various sections of affected area and (from Australia) sea and swell state;
(0 Further intensity changes if any;
(m) Request to shipping for three hourly weather and Radar rain reports; and,
(n) Office issuing next warning if handing over responsibility.

ANNEX 2.E

SAFETY SIGNAL AND MESSAGES

(Extract from *ITU Radio Regulations,* 1982-1986, Chapter IX, Article 40)

(Reference: paragraph 2.2.7)

Section III. Safety Signal and Messages

3221 § 13. (1) In radiotelegraphy, the safety consists of three repetitions of the group TTT, the individual letters of each group and the successive groups being clearly separated from each other. It shall be sent before the call.

3222 (2) In radiotelephony, the safety signal consists of the word "SECURITE" pronoun ced clearly as in French, spoken three time and transmitted before the call.

3223 § 14. (1) The safety signal indicates that the station is about to transmit a message contain ing an important navigational or important meteorological warning.

3224 (2) The safety signal and call shall be sent on one or more of the international distress frequencies (500 kHz, 2 182 kHz, 156.8 kHz) or on any other frequency which may be used in case of distress.

3225 (3) The safety message which follows the call should be sent on a working frequency. A suitable announcement to this effect shall be made at the end of the call.

3226 (4) In the maritime mobile service, safety messages shall generally be addressed to all stations. In some cases, however, they may be addressed to a particular station.

3227 § 15. (1) With the exception of messages transmitted at fixed times, the safety signal, when used in the maritime mobile, shall be transmitted towards the end of the first avail able period of silence (see No. 3080 for radiotelegraphy and No. 3052 for radiotele phony); the message shall be transmitted immediately after the period of silence.

3228 (2) In the cases prescribed in Nos. 3328, 3331 and 3335, the safety signal and the message which follows it shall be trans mitted as soon as possible, and shall be repeated at the end of the first period of silence which follows.

3229 § 16. All stations hearing the safety signall shall listen to the safety message until they are satisfied that the message is of no concern to them. They shall not make any transmission likely to interfere with the message.

NOTE: The Radio Regulations referred to above are reproduced in the next column.

Radio Regulations referred to in Section III of Article 40 (RR 1982)

3038 § 19. (1) In order to increase the safety of life at sea and over the sea, all stations of the maritime mobile service normally keeping watch frequencies in the authorized bands between 415 kHz and 526.5 kHz shall, during their hours of service, take the necessary measures to ensure watch on the international distress frequency 500 kHz for three minutes twice an hour beginning at x h 15 and x h 45 Coordinated Universal Time (UTC) by an operator using headphones or a loudspeaker.

3052 § 23. In order to increase the safety of life at sea and over the sea, all stations of the maritime mobile service normally keeping watch on frequencies in the authorized bands between 1 605 kHz and 2 850 kHz shall, during their hours of service, and as far as possible, take steps to keep watch on the international distress carrier frequency 2 182 kHz for three minutes twice each hour beginning at x h 00 and x h 30 Coordinated Universal Time (UTC).

3328 (3) Meteorological warning messeages for the maritime mobile service shall be transmitted without delay. They shall be repeated at the end of the first silence period which follows their receipt (see Nos. 3038 and 3052) as well as during the next appropriate broadcast as indicated in the List of Radiotermination and Special Service Stations. They shall be preceded by the safety signal and sent on the appropriate frequencies (see No. 3224).

3331 §5. (1) Messages orignating in mobile stations and containing information concerning the presence of cyclones shall be transmitted, with the least possible delay, to other mobile stations in the vicinity and to the appropriate authorities at the first point of the coast with which contact can be established. Their transmission shall be preceded by the safety signal.

3335 § 7. Messages containing information concerning the presence of dangerous ice, dangerous wrecks, or any other imminent danger to marine navigation, shall be transmitted as soon as possible to other ship stations in the vicinity, and to the appropriate authorities at the first point of the coast with which contact can be established. These transmissions shall be preceded by the safety signal.

ANNEX 2.F

METEOROLOGICAL ASPECTS OF MARITIME SEARCH AND RESCUE

(Extract from *IMO Search and Rescue Manual,* 1993)

(Reference: paragraph 2.3.1)

Part 2, C **General**

3.5 Adjustment of probability area and search area

3.5.1

3.5.1.1
received must be given careful consideration and the location of the search area changed if new information causes an adjustment of the probability area.

3.5.2 Meteorological conditions

3.5.2.1 In adverse weather conditions, ships or other craft in distress will often require an extensive search because of the possible inaccuracy of the last known position. An analysis of the weather and sea conditions along the route will assist in the determination of the probability area.

3.5.3 The captain's known experience and company policy

3.5.3.1 The stated opinion and experiences of the captain, or the company policy, may determine his reaction in a particular emergency. In this connection, the owners or agent should be consulted as they may be able to provide valuable information to assist location.

3.5.4 Liferaft drift and datum

3.5.4.1 When a search is conducted for survivors in a liferaft, the effect of wind, current and tide will need to be taken into account (see 3.5.5 for leeway drift of craft other than liferafts). The estimated position of the liferaft at a particular time is referred to as "datum". This displacement from the distress scene will become greater as time passes.

3.5.4.2 The term *drift* as used in SAR is the movement of a floating object due to the following factors:

1. ***Offshore sea currents*** - These may be ascertained from hydrographic tables and charts;
2. ***Tidal or rotary currents*** - In coastal waters, currents change in direction and velocity as the tides change. They may be ascertained from current tables, current charts and pilot charts but local knowledge will also be of great value;
3. ***Wind current*** - This is a current created by a sustained wind blowing over the surface of the sea. The exact effect of wind in creating local wind currents is not clear, but it is generally assumed that, after 6 or 12 hours with the wind in a constant direction, a local surface sea current is generated. The estimated mean wind velocity and direction for the previous 24 to 48 hours should be ascertained from ships in the vicinity of the distress scene. The direction and velocity of a local wind current can be found from Tables 3-1 and 3-2 (see 3.5.4.3);

Table 3-1

Relation of direction of wind current to wind

Latitude	Divergence of wind current from wind direction
North of 10°N	30° to the right
10°N to 10°S	0°
South of 10°S	30° to the left

Table 3-2

Velocity of wind current in nautical per day

Baufort scale	Wind in knots	Wind current in nautical miles per day
1	1-3	2
2	4-6	4
3	7-10	7
4	11-16	11
5	17-21	16
6	22-27	21
7	28-33	26

Swells - The condition of the sea surfact is the result of waves and swells, i.e. waves that are formed by local winds and swell systems that have been formed by distant winds. A swell, once set in motion, tends to maintain its original direction for as long as it continues in deep water, regardless of changes in direction of local winds. Several swells, of which the one with the greatest height between trough and crest is the primary system, may occur at the same time. Such swells may come from the same or different directions, but irrespective of a swell's horizontal velocity there is little horizontal movement of water. The effect of swells on drift is usually negligible, although at low wind speeds there may be some movement in the direction in which the swells are moving; *Leeway* - This is the

5. effect of winds pushing the liferaft through the water. The liferaft leeway is usually within 45° on either side of the downwind direction.

In view of the variation in construction and size of liferafts, the uncertainty of the number of people on board and whether a canopy or drogue has been deployed, the drift of individual types of liferaft may vary considerably.

Figure 3-7 represents approximate drift characteristics for all types of fully occupied inflatable liferafts of various capacities:

1 without drogue;
2 with an improved ballast system;
3 with drogue;
4 with drogue but with canopy not deployed.

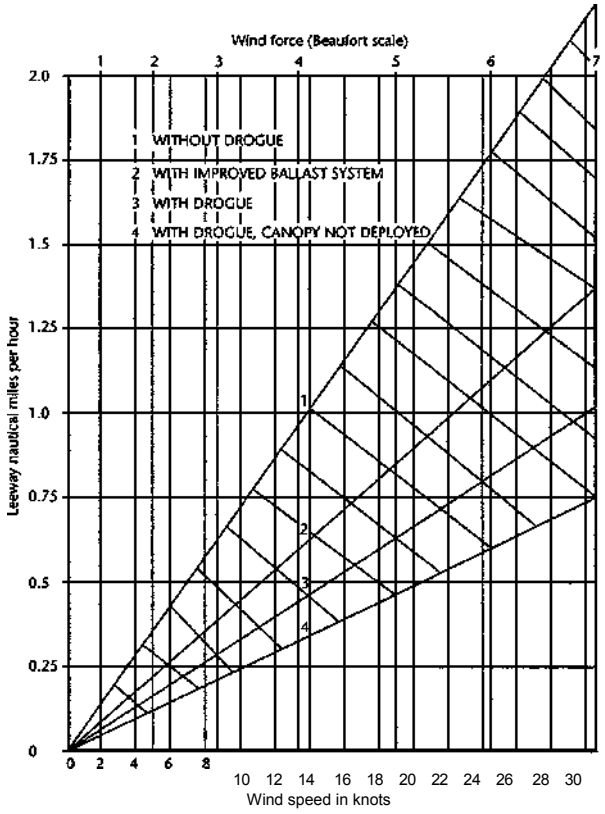


Figure 3-7 — Liferaft leeway

Because of the possible variations of liferaft configurations, the boundaries of the above drift values given by 1 and 4 in the figure represent approximate limits for liferaft drift. However, it should be noted that for an unoccupied, partially occupied or waterlogged liferaft, the drift may fall outside the parameters shown. 3.5.4.3 After consideration of the various factors affecting drift, the effect of drift may be determined by vector addition as shown in Figure 3-8. Since all the drift elements are acting simultaneously on the drifting object, its actual path will be along the resultant drift line. The lengths of the vectors used in search planning are measured in units of distance. In any one solution the same distance scale must be used for all vectors.

Therefore, it should be thoroughly understood that even though some sources give drift information as speeds or velocities, these must all be converted to the distance covered in the same time interval as the rest of the vectors used in the solution.

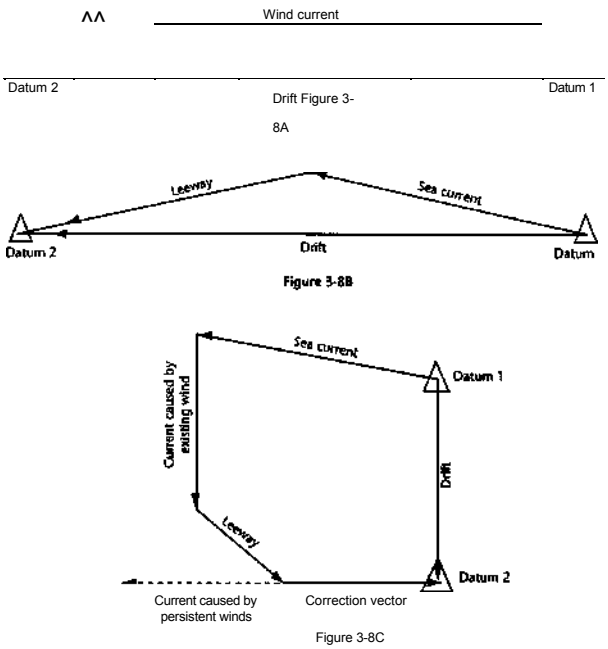


Figure 3-8 — Effect of drift

The general case

In most cases vectors will be used as shown in Figure 3-8A.

In areas of persistent winds A problem exists in areas of persistent winds because sea current must usually be obtained from charts or atlases which are derived from averaging past shipboard observations of drift (set and drift in the nautical sense). In regions dominated by persistent winds (those where the winds blow from the same quadrant 75 per cent of the time as determined by a wind rose, e.g. trade winds areas), such observations are biased by the presence of persistent wind current as part of the observed sea current. Wind roses can usually be found on pilot charts or in appropriate atlases. Unless sea current for these regions is obtained from some more exact source which is not biased by the persistent wind current, e.g. special sea current charts based on the average hydrography ofr the area, the method for obtaining a resultant drift vector, as illustrated in Figure 3-8A, breaks down.

When sea currents must be obtained from sources derived from shipboard observations of drift for regions of persistent winds, two significant possibilities exist:

When the winds have been blowing persistently within their normal range of direction *and speed,* the drift vector may be found by omitting the wind current effect from the vector diagram and simply using a sea current vector and a leeway vector as shown in Figure 3-8B. Most cases will fall into this category.

When the winds have been blowing outside their normal range of direction *or speed* for

24 hours or more, the situation is more complex. In this case it is necessary to introduce an additional vector into the calculation instead of omitting one. This is called a correction vector. It is designed to subtract the effect of the persistent wind from the sea current. It is found by computing the wind driven current which would be caused by the persistent wind *and then reversing its direction.* The best estimate of the most persistent direction and speed should be used in the calculation. See Figure 3-8C. In one area of persistent winds, oceanographers have pre-calculated the correction vectors for SAR authorities. The search area should be expanded and

3.5.4.4
corrected for drift as shown in Figure 3-3 and Figure 3-6.

3.5.5 Leeway for vessels other than liferafts

3.5.5.1 Leeway, as a percentage of wind speed, for various kinds of vessels is given in Table 3-3. The table is reasonably accurate with wind speeds up to 40 knots.

Table 3-3
Leeway for vessels other than liferafts

Type of craft	Leeway speed as a percentage of wind speed
Surfboards	**2%**
Heavy-displacement, deep-draught sailing vessels	**3%**
Medium-displacement sailboats, fishing vessels such as trawlers, trollers, tuna boats, etc.	**4%**
Large cabin cruisers	**5%**
Light-displacementt cabin cruisers, outboards, etc.	**6%**

3.5.6 Parachute drift

3.5.6.1 When a survivor bails out of an aircraft, the position where he ultimately lands may differ considerably from the position where his parachute opened. Table 3-4 shows how his landing position is governed by the parachute-opening altitude and by the influence of the force and direction of the wind on his parachute during his descent. Since wind force and direction may vary considerably at different altitudes, the average wind between parachute-opening altitude and surface should be used. Bail-out and parachute-opening altitudes are not usually the same, so that if the parachute-opening altitude is not known, it will have to be estimated on the basis of the prevailing circumstances. (Most military parachutes have automatic opening devices which activate between 3 000 and 3 600 metres (10 000 to 12 000 feet)).

Table 3-4
Parachute drift table

Distanct in nautical miles of landing position downwind from position of parachute-opening							
Parachute-opening height	*Wind in knots*						
	10	**20**	**30**	**40**	**50**	**60**	**70**
9 000 **m (30** 000 **ft)**	**3.7**	**7.4**	11.1	**14.7**	**18.4**	**22.1**	25.8
6 100 **m (20** 000 **ft)**	**2.7**	**5.3**	**8.0**	**10.7**	13.3	**16.0**	**18.7**
4 300 **m (14** 000 **ft)**	**1.9**	**3.8**	**5.7**	**7.7**	**95**	**11.4**	**13.3**
3 050 **m** (10 000 **ft)**	**1.4**	**2.8**	**4.2**	**5.7**	**7.0**	**8.3**	**9.7**
2 400 **m (8** 000 **ft)**	**1.2**	**2.3**	**3.5**	**4.6**	**5.8**	**6.9**	**8.1**
1 800 **m (6** 000 **ft)**	**0.9**	**1.7**	**2.6**	**3.5**	**4.4**	**5.2**	**6.1**
1 200 m (4 000 **ft)**	**0.6**	**1.2**	**1.8;**	**2.4**	**3.0**	**3.5**	**4.1**
600 **m (2** 000 **ft)**	**0.3**	**0.6**	**0.9**	**1.5**	**1.5**	**1.8**	**2.1**

3.5.7 Direction-finder bearings

3.5.7.1 ***Directionfinders (DF).*** When there are direction-finding stations in the area, every effort should be made to obtain a fix or a bearing. The search can then be concentrated.

3.5.8 Reports from vessels

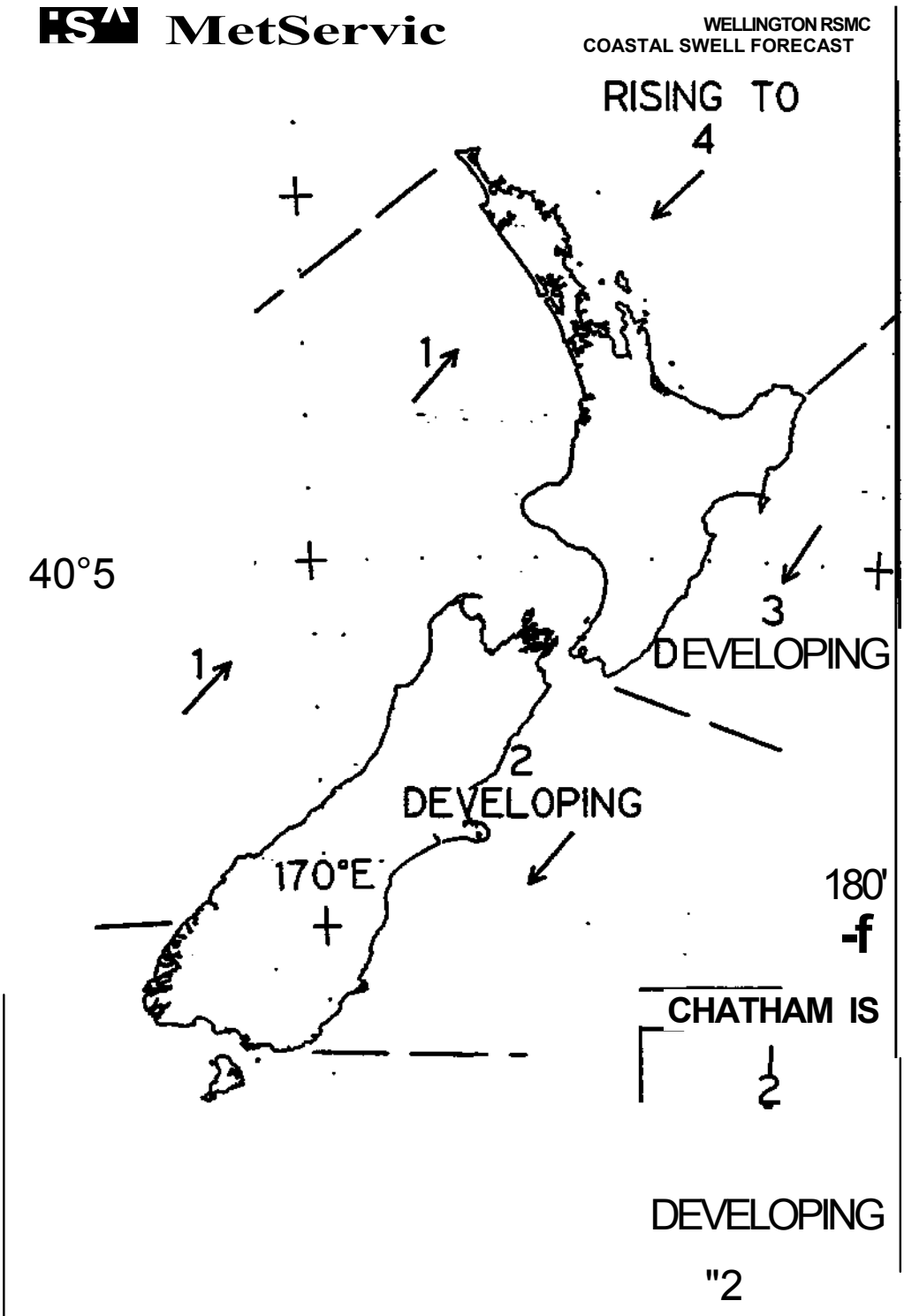
3.5.8.1 Vessels on passage may give valuable assistance in locating a target by keeping a look-out or listening for radio signals from ships or other craft or emergency position-indicating radio beacons. Vessels fitted with DF hearing signals from the target should be requested to report their own position and DF bearings of the signals.

3.5.8.2 *En route* hearing emergency position-indicating radio beacons should be requested to report the position and time where the signals were first heard, where they had their greatest strength and where the signals faded.

ANNEX 2.G

EXAMPLE OF A RADIOFACSIMILE CHARTS FOR MARINE PURPOSES

(Reference: paragraph 2.4)

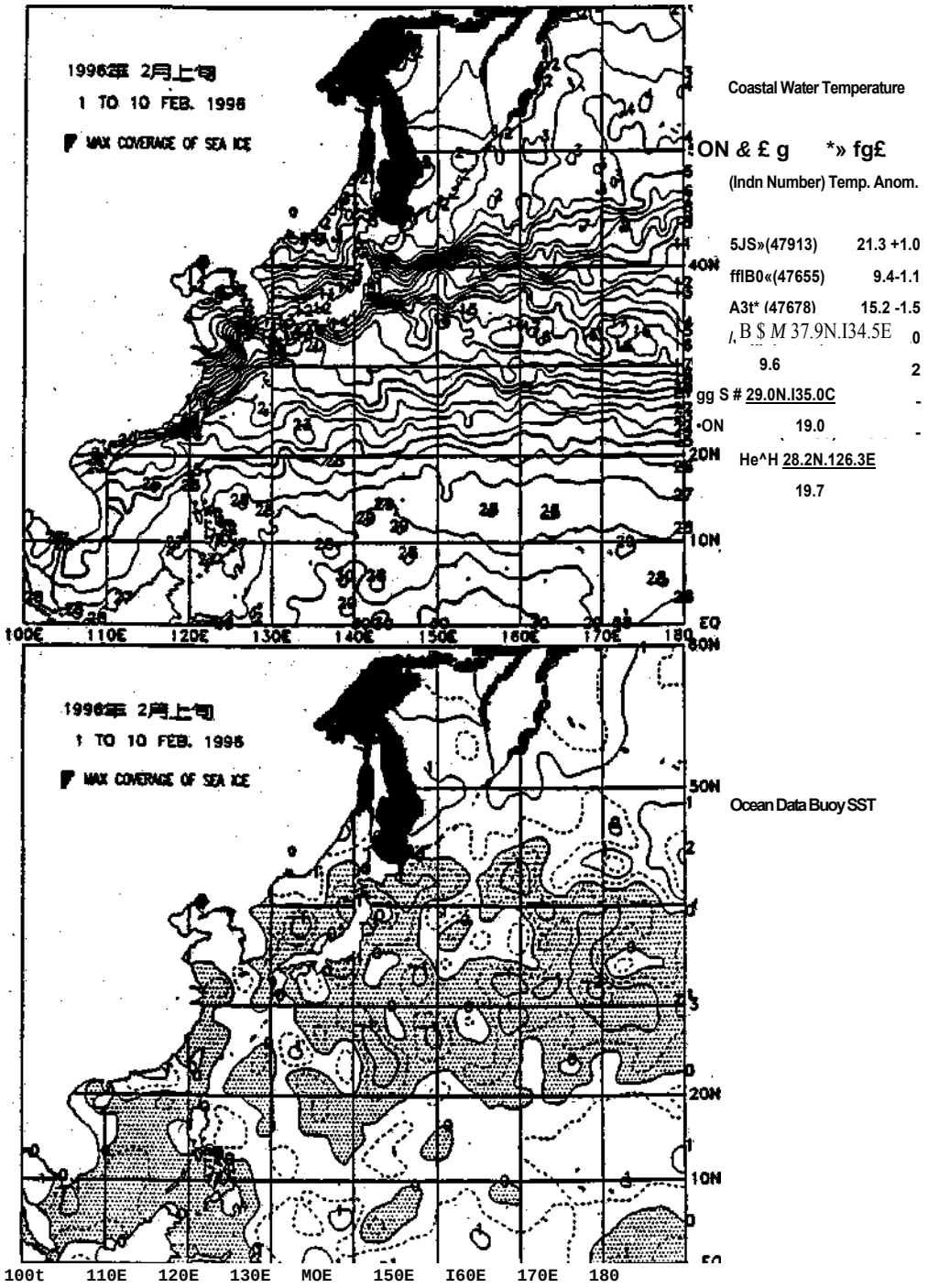


ANNEX 2.H

EXAMPLES OF SEA-SURFACE TEMPERATURE ANALYSIS

(Reference: paragraph 2.83)

Source: *Monthly Ocean Report*, February 1996 issued by JMA



CHAPTER 3

MARINE CLIMATOLOGY

3.1 Introduction

Preparation of climatological charts and atlases for oceans became possible in the second half of the nineteenth century when ships' observations, recorded in special meteorological logbooks, started to become available in rapidly increasing numbers. For over 100 years these charts and atlases mainly for use by shipping were prepared nationally, obliging countries to ask for observations stored in other countries to supplement their own data sets.

The proposal for international exchange of marine data and for the preparation of marine climatological summaries originated at the third session of JCOMM (formerly CMM) in 1960 and was finally adopted by Fourth Congress in 1963. The objective was to establish a joint effort of all maritime nations in the preparation and publication of climatological statistics and charts for the oceans. The underlying idea was thatTall observations collected from ships of whatever nationality should be included. Eight countries, each with a specific ocean area of responsibility, were designated to process the data in prescribed forms and regularly publish the climatological summaries.

To improve the flow of the observational data, JCOMM at its eleventh session in 1993 decided on the establishment of two global data collecting centres and this decision was ratified by Executive Council at its forty-fifth Session in 1993.

Marine climatology today supports transportation, engineering and the basic and applied sciences with data and information about the environment from tens of metres below, to a few tens of metres above the sea surface. The interest in climate change and studies of air-sea interaction have increased the demand for marine climatological data. A comprehensive account of the uses of marine climatology can be found in the *Guide to the Applications of Marine Climatology* (WMO-No781).

The basic sources of data are ships, buoys, satellite, aircraft and a few other specialized sensing systems such as land-based radar. New technology is having a significant impact on the traditional methods in marine climatology. Telecommunications advances have led to an increase in the amount of data captured automatically and a decrease in manual key entry requirements. High density computer readable media for use on large computers is now the standard method of data exchange. Computers allow for automated quality control and data validation. Automation in analysis and mapping allows derived quantities such as heat, heat flux, wind stress and atmospheric refractivity to be computed from operationally available data. Data can be used in computer models to generate fields of sea-surface temperature, pressure and wind. As well as provision on paper-based media, data can also be provided on computer readable media for analysis on personal computers. Advances in computer technology allows a vast amount of data to be provided on one disc and the data can be displayed in chart, map or graphic form.

3.2 Marine climatological summaries

3.2.1 *General*

The establishment of the international exchange and processing arrangements described above for the 'Marine Climatological Summaries Scheme', as it is called, required the cooperation of all maritime countries participating in the WMO Voluntary Observing Ships' Scheme, i.e. those which have recruited selected, supplementary or auxiliary ships (see Chapter 6 of this *Guide)*

In this scheme the oceans and seas are divided into areas of responsibility and eight Members (known as Responsible Members) have assumed responsibility to prepare marine climatological summaries without cost to WMO. Data from fixed ship stations within the area are also included. In order to prepare these summaries, the global collection centres supply Responsible Members surface observations in an internationally accepted format from all Members operating voluntary observing ships and/or fixed ship stations in their respective areas of responsibility.

The international procedures governing the Marine Climatological Summaries Scheme have the status of Technical Regulations within WMO and are included in the *Manual on Marine Meteorological Services,* Volume I, Part I, Section 5.

3.2.2 *Members responsible for the preparation of summaries*

The responsible Members and the areas allotted to them are shown in Annex 3.A to this Chapter. The boundaries of the areas of responsibility are kept under review by JCOMM. Adjustments, however, should be kept to a minimum.

Climatological summaries are prepared for a number of small areas called 'representative areas', and for fixed ship stations within the assigned area of responsibility. The representative areas were selected on the basis of the density of available data, climatic gradients and factors such as the position of fixed ship stations and island stations. There is a reasonable distribution of representative areas according to all areas of responsibility. An example of the representative areas in one area of responsibility is shown in Annex 3.B to this Chapter. The Area Indices System is also explained in Annex 3.B.

All responsible Members are represented on the JCOMM's Data Management Coordination Group,

which keeps the Marine Climatological Summaries Scheme under review, particularly with regard to the rapidly changing technology in the processing, storage and supply of large volumes of data.

3.2.3 *Global Collecting Centres (GCCs)*

Two responsible Members (Germany and the United Kingdom) operate Global Collecting Centres (GCCs), which receive ships' observations from all Members. These centres then supply the data to the Responsible Members. Two centres are maintained so that a data set will still be available in the event of some catastrophe happening at one Centre.

GCCs ensure that minimum quality control has been applied to the data, and then supply, every three months, data to the Responsible Members relevant to each one's area of responsibility. They will also provide a global data set to those Responsible Members who wish to receive it.

The data are then sent to both GCCs, i.e. two copies of each data set are required, one for each centre. The data should be dispatched at three-monthly intervals. The Member sending the data should notify the GCCs of the dispatch of the data and provide details of the order in which the data are sorted.

3.2.4 *The flow of observational data to Responsible Members*

Marine meteorological observations are recorded onboard most ships in special meteorological logbooks provided by NMSs. Members operating voluntary observing ships and/or fixed ship stations should arrange for the provision of a suitable form of meteorological logbook. Details of the layout of the logbook are to be found in Chapter 6, paragraph 6.8.1 of this *Guide.*

The observations are transferred from the logbooks to a computer-compatible medium, in a standard internationally agreed format. Every effort should be made to apply minimum quality control to the data. Details of this transfer and associated quality control are to be found in paragraphs 3.2.8 and 3.2.9 below.

An increasing number of ships are being equipped with a personal computer and software which stores the observations on computer readable media in the internationally agreed format. This avoids a source of possible errors in the manual data transfer from logbook to the computer-compatible medium.

3.2.5 *Preparation of marine climatological summaries*

The detailed procedures for the preparation of marine climatological summaries are described in the *Manual on Marine Meteorological Services,* Volume I, Part I, Section 5.3. Summaries are prepared in both tabular and chart form and normally include air and sea surface temperature, dew-point temperature, visibility, weather, wind direction and speed, atmospheric pressure, clouds and waves. A necessary minimum number of observations is specified before a mean can be calculated for a given area. Routine publication of annual summaries ceased in 1981, although they are available on request and Responsible Members may still publish them if they wish. Decadal climatological summaries are prepared for each decade 1961-70, 1971-80, 1981-90. In view of the importance ascribed to this work by the former CMM, Members are encouraged to continue publishing these summaries.

3.2.6 *Availability of summaries and observational data*

Responsible Members keep the Secretariat informed of the availability of their marine climatological data and published summaries so that an inventory can be compiled annually and circulated to Members for information.

Responsible Members will make available, on request, copies of the data at the cost of copying. The data will be on computer readable media in the international exchange format, unless another format has been agreed between the requesting and Responsible Members.

Orders for marine climatological summaries or for observational data should be addressed directly to the Responsible Member concerned and not to the Secretariat.

3.2.7 *Data exchange formats*

It is essential to use standard data formats to facilitate international exchange of data for climatological purposes, particularly when so much of the processing is automated. The standard format for provision of data to Responsible Members is the International Maritime Meteorological Tape (IMMT) format. Any form of data exchange on computer readable media may be used, such as diskettes, provided the format of the data complies with the details as set out in Annex 3.C to this Chapter. The technology for data transfer is changing rapidly and the means of data exchange needs to keep up with the current technology.

A second format which may be used for national and bilateral exchange of data is set out in Annex 3.D. Any alternative format must only be used by mutual agreement between the two Members which are exchanging data.

Members wishing to exchange their observational data on other computer readable media or in print-outs in the case of very small numbers of observations should arrange for their exchange on a bilateral basis.

3.2.8 *The Historical Sea Surface Temperature Data Project*

Because of the importance of the sea temperature in climatic change, the Historical Sea Surface Temperature Data Project has compiled a comprehensive, homogeneous set of sea surface temperature data for the period from 1861 to 1960 (i.e. for the century preceding the

beginning of the Marine Climatological Summaries Scheme). The results can be consulted in the *User's Guide to the Data and Summaries of the Historical Sea Surface Temperature Data Project* (MMROA Report No. 13, WMO/TD-No. 36).

Members with historical data which have not been included in the Project should send those data to GCCs in the IMMT format. The data should be accompanied by documentation describing the source of the data, the precision of the original observations and conversion algorithms. For example, if the original observations recorded the visibility as poor, moderate, or good, an explanation is needed on how these terms are expressed in distances of kilometres.

3.2.9 *Quality control*

3.2.9.1 GENERAL

The accuracy of data is of primary importance to climatological computations and scientific investigations. It is essential that marine data are quality controlled before exchange. Quality control consists of checking of the content, including identification groups, of observational data to ensure its accuracy. Quality control procedures for climatological data in general are described in the *Guide to Climatological Practices* (WMO-No. 100). Quality control has been incorporated in WMO's CLICOM (CLImate COMputing) programme and can be used for small marine data sets. A discussion of quality control of marine data can be found in Chapter 3 of *Guide to the Applications of Marine Climatology* (WMO-No 781).

However, errors can occur when:

(a) Misreading an on-board instrument, a sensor malfunction, or in entering the observation in the logbook;

(b) Transcribing the data on to computer readable media.

In the event that data are taken from **SHIP** reports on the GTS, errors can arise in transmission.

3.2.9.2 MINIMUM QUALITY CONTROL

The primary responsibility for the quality control of data rests with the NMS where the data originated. All Members should make every effort to apply the minimum quality control procedures described in Annex 3.E before dispatching the data to the GCCs. This quality control includes checks that the observation of each element is within the possible range, and that the change in position between observations is within reasonable limits, and that call sign and country code have been included. There is space in the IMMT format for 20 quality control flags. These indicators show whether the element that has been flagged is doubtful or whether it has been corrected. A problem which often arises is deciding whether an observation is an error or an actual extreme value. Generally care should be exercised in correcting doubtful values; suspect observations may be real extremes of special meteorological interest.

Meteorological logbooks can be scrutinized manually before data transfer to eliminate obvious observational and recording errors. However the minimum quality control should be carried out after transfer to computer readable media to allow for transcription errors. The quality control is best carried out automatically by computer and software are available for this purpose.

It is of the utmost importance that Members should make adequate provision for quality control of data to ensure that they are as free from error as possible. GCCs ensure that this minimum quality control has been carried out and that further quality control may be applied to the data by the Responsible Members.

3.3 Special marine climatological information

In addition to the elements in the IMMT format which are used in the production of standard marine climatological summaries, there are other observations of interest to many marine interests. Two specific observation systems which have been instituted relate to freak waves and to sea-surface current data.

3.3.1 *Reports of freak waves*

The occurrence of unusual waves and the occasional distress to vessels that may follow has been noted at times over many years, but accurate observations are rare. A freak wave may be defined as a wave of very considerable height ahead of which there is a deep trough. It is the unusual steepness of the wave which is its outstanding feature and which makes it dangerous to shipping. All marine observers, at fixed or mobile stations, are encouraged to observe and report any such occurrences.

Guidelines for reporting freak waves can be found in Chapter 6, Annex 6.C of this *Guide.* Procedures for the dealing with reports of freak waves are given in the *Manual on Marine Meteorological Services,* Volume I, Parti, Section 6.2.1

3.3.2 *Exchange of sea-surface current data obtained from ships' set and drift*

To increase our knowledge and prepare climatic charts of the general surface circulation of the oceans, more information is required on sea-surface currents. The current can be derived from the ship's set and drift as this does not require special instrumentation; any ship willing to participate can contribute to the database. Guidelines for giving instructions to vessels for the collection of these data are included in Chapter 6, Annex 6.D of this *Guide.*

The International Surface Current Data Centre (ISCDC) is located in the United Kingdom. The ISCDC receives data on computer readable media and completes quality control on receipt. The NMSs may wish to check their observations before passing them onto the ISCDC. The procedures covering the collection and exchange of

these data, and the functions of the ISCDC are given in the *Manual on Marine Meteorological Services,* Volume I, Part I, Section 6.2.2.

Every year the ISCDC provides a copy of the stored data to the World Data Centres for Oceanography and will also, for a small fee for data retrieval, provide copies of the stored data upon request.

33.3 *Special techniques for other parameters*

Requirements arise for information on other parameters, or for more detailed analyses of some parameters included above. Waves are among the most complex and important elements at the surface of the sea. In addition to visual observations from ships, they can be measured by wave recorders on fixed platforms. Wave climatologies are often derived by means of hindcasts, whereby all available historical data (predominantly wind data) is re-analysed for input into suitable wind and wave computer models for calculation of the wave characteristics. More information on these techniques can be found in the *Guide to Wave Analysis and Forecasting* (WMO-No. 702) and in the *Guide to the Applications of Marine Climatology* (WMO-No. 781).

The extreme value of elements such as wind, wind gusts and waves is of great interest for coastal engineering and there are statistical means of estimating the extreme value from a set of observations. However the problem is that in an extreme weather event* sensors are often destroyed or damaged, while the feedback signal to a satellite is so attenuated that it is impossible to determine a reliable extreme value. Thus a set of observations may not indicate the true extremes which have been experienced.

Sea-surface temperature, radiant flux, cloud and some wind data can be extracted from special satellite data sets. A far greater coverage of sea surface temperature data can be obtained by satellite than from ships which mostly travel regular shipping lanes. However, observations from ship and from satellite are not directly compatible. The satellite measures the temperature of the very top of the sea, the ship measures the temperature from a few centimetres down to several metres. The two measurements can be very different, particularly in calm weather. Special techniques have been developed to homogenize the two types of observation.

The requirement for a climatology of some elements, required more for global climate studies than marine purposes alone, is not yet able to be satisfied, e.g. for precipitation over the ocean.

3.4 Presentation of climatological data

3.4.1 *General*

Climatological data can be presented in many different forms. They can be shown as long-term averages or as mean values for particular months. They usually include frequencies of occurrence of extremes or other values which are thought to be critical with respect to particular operations. Analyses can disclose statistical relationships between parameters such as wind speed and direction, wave height and period, fog and air/sea temperature difference, etc. Optimum time and space scales are often dictated by the necessary statistical tests for homogeneity of data applied with a realistic understanding of the requirements. Even so, the factor of data availability often forces compromise. Automated treatment of marine data allows the objective production of analysed charts and gridded data fields. This allows easier compilation of climatological summaries over greater time spans. A comprehensive treatment of the analysis, presentation and interpretation of marine climatological data can be found in the *Guide to the Applications of Marine Climatology* (WMO-No. 781).

Marine data comes from many varied sources and periods from varied instruments. Care needs to be taken in the combination of data from varied sources, and prime attention must be given to consistency and continuity, and to scrutiny of historical data, especially when long periods are being considered. Care must be taken with the combination of standard and non-standard period statistics, as well as with the use of satellite, buoy and ocean weather station data as reference levels or with extrapolation into data-sparse regions.

3.4.2 *Climatological charts*

The layout for marine climatological summary charts for representative areas is shown in the *Manual on Marine Meteorological Services,* Volume I, Part I, Appendix 1.9. There are many other ways of displaying the data in chart form, and several NMSs have published marine climatological charts and atlases based on data observed in periods since 1860. These charts were prepared primarily to serve marine navigation, but contain useful information for fisheries and other marine operations. Data are usually presented for individual months as an average over the entire period for which data were available. The Mercator projection has usually been used, but others may be employed for special requirements. These charts may also include numerical data, graphs, isopleths and other additional data presentation.

Elements covered by these charts may include, among others:

(a) Surface wind: Frequency distribution of wind speeds on the eight points of the compass (wind rose); wind directions, mean vector of wind speed and prevailing wind direction; frequencies of light winds, gales and storms; bivariate normal statistics;

(b) Surface currents: The same presentation as for wind, including frequencies of currents exceeding certain speeds;

(c) Waves (sea and swell): Wave charts of frequencies of total wave height, usually the higher or a combination of sea and swell. Swell charts depict frequencies of short, medium and long swell in four or eight directions (compass points). Wave charts based on data observed since 1949 (when a new code allowed more detail to be given in ships'

observations of waves) give frequencies of waves exceeding given height limits in various directions and sometimes also indications of wave periods.

(d) Visibility: Frequencies of visibility of less than 1 km (fog) and other ranges;

(e) Precipitation and cloud cover: Precipitation given as frequencies or percentages of the number of hours during which precipitation was observed. Frequencies of various degrees of cloud cover (total and low) and heights;

if) Temperatures, air and sea surface: Isotherms at regular intervals, mean values and standard deviations of the frequency distribution for small areas; percentage occurrence of critical threshold values;

(g) Humidity: Mean values of dew-point temperature; various statistics involving relative humidity, wet bulb and dew point;

(h) Air pressure; pressure systems: Isobars and, on some atlases, frequencies of deep extratropical cyclones with depiction of storm tracks;

(*i*) Tropical cyclones: Frequencies of occurrence, tracks of individual cyclones, distribution for the months of the year, intensities and intensity changes during the life history of a cyclone;

(j) Sea ice and icebergs: The geographical distribution of different types of sea ice and of icebergs for each month, charts of probability of various positions of ice edge and boundaries of ice patterns with different ice compactness, ice convergence and divergence zones;

(k) Derived quantities: Heat flux, transport data, refractivity, superstructure icing potential, atmospheric stability.

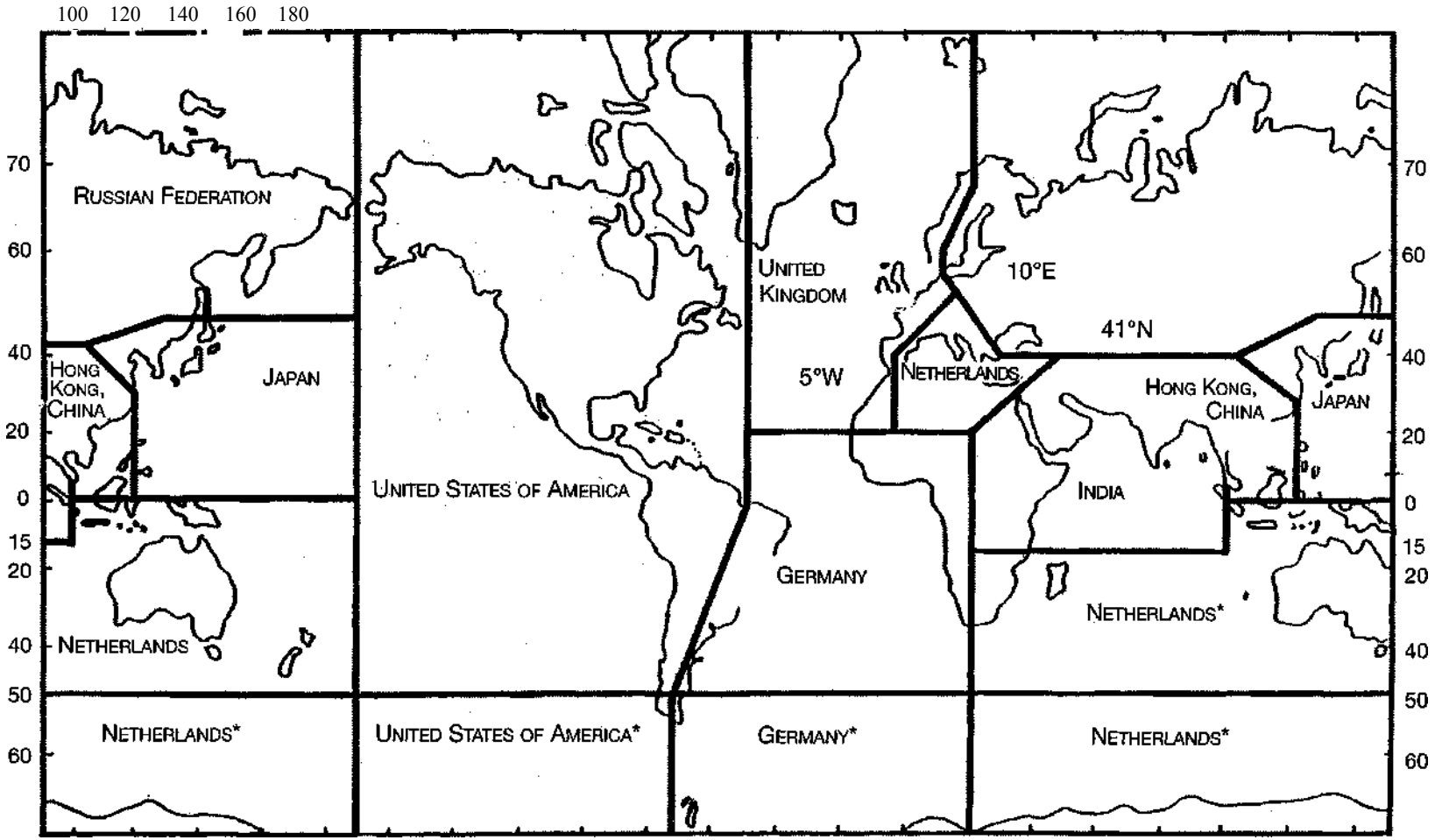
3.4.3 *Atlases and CD-ROMs*

Modern computer technology allows a vast amount of data to be provided on one computer compatible media and the data can be displayed in chart, map or graphic form. CD-ROMs are becoming available which display marine climatological data in at least some of the ways described in paragraph 3.4.2 above.

ANNEX 3A **AREAS OF RESPONSIBILITY AND**

RESPONSIBLE MEMBERS FOR CLIMATOLOGICAL SUMMARIES

(Reference paragraph 3.2.2)



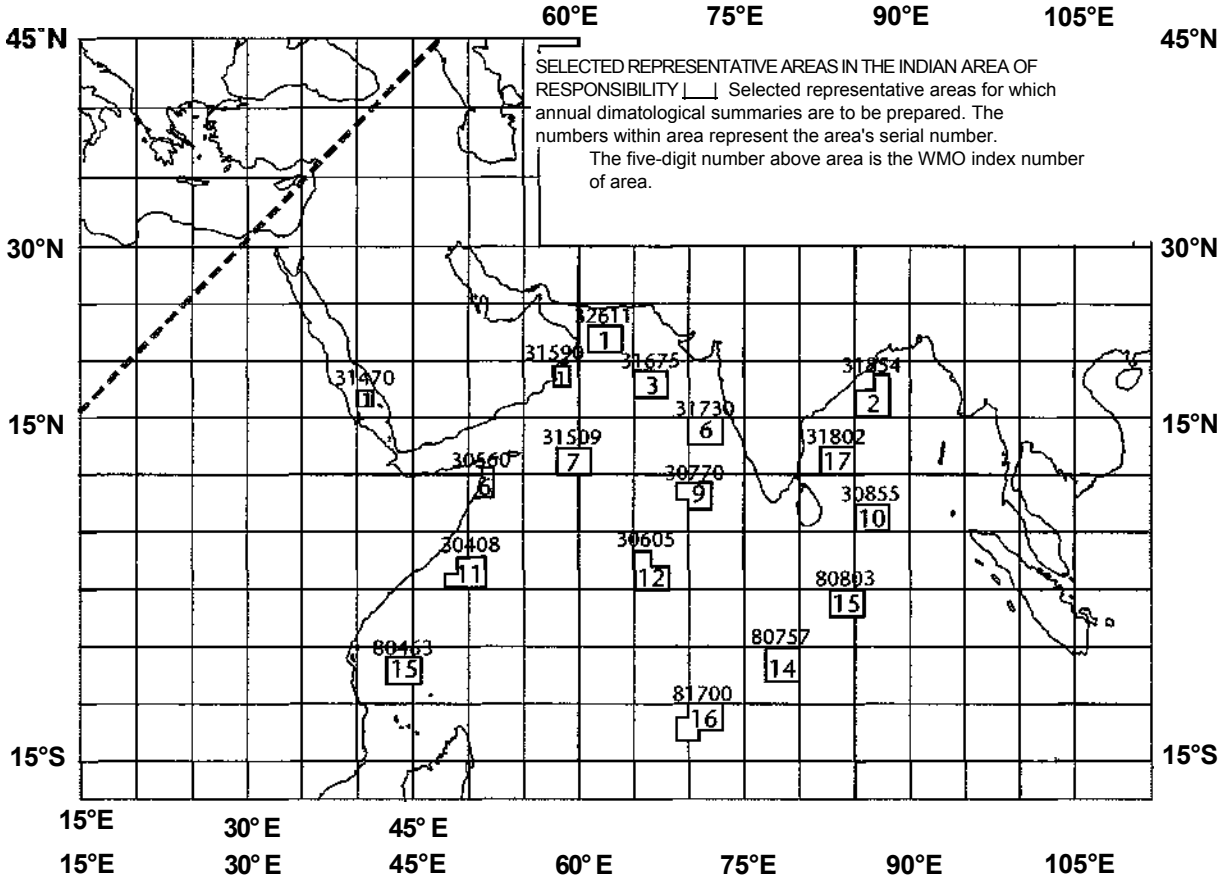
* The Russian Federation is responsible for the compilation of a complete data set and the preparation of the summaries for these sea areas.

ANNEX 3.B

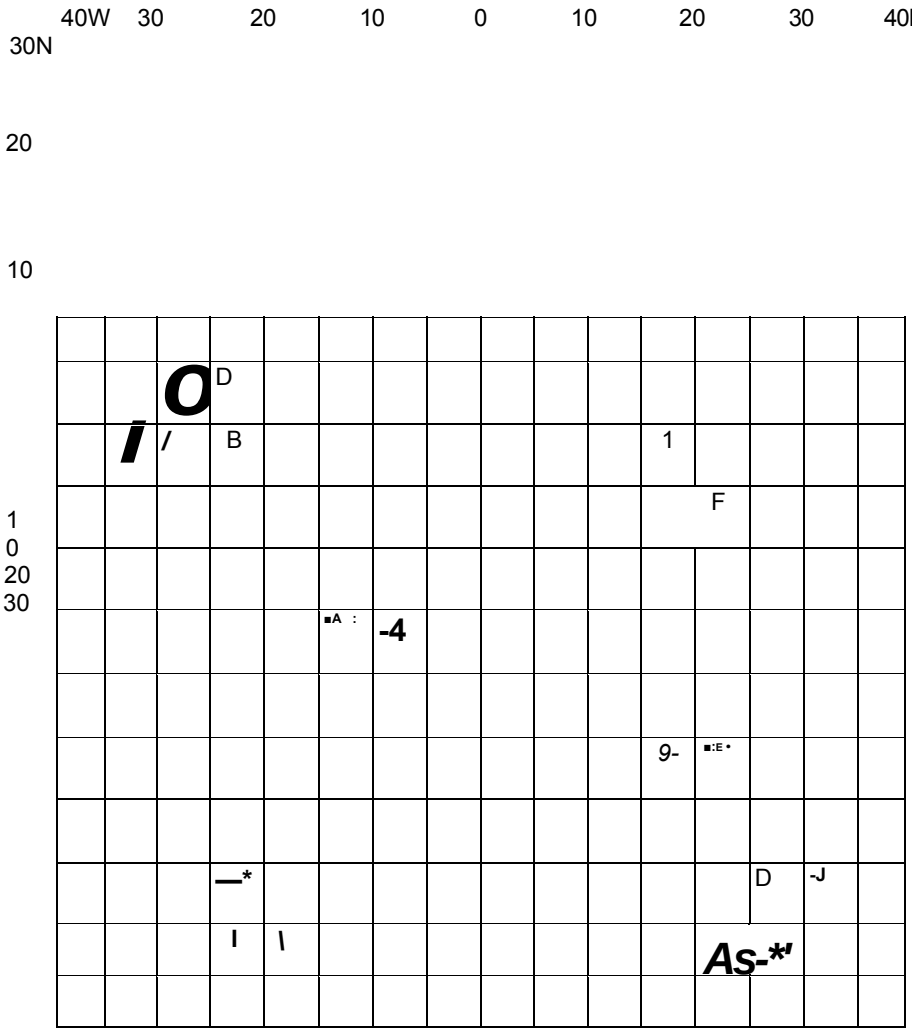
AN EXAMPLE OF A SELECTED REPRESENTATIVE AREA INCLUDED IN THE MARINE CLIMATOLOGICAL SUMMARIES

(Reference paragraph 3.2.2)

a. The Indian Area of Responsibility



AREAS INDICES SYSTEM FOR MARINE CLIMATOLOGICAL SUMMARIES



Representative area A shall be coded : 00037

B 01288

C 51281

D 81288

E : 80187

F 31149

The following area indices systems shall'be used:

(a) A selected representative area shall be indicated with reference to the position in the area of the 1-degree square corner which is nearest (1) to the Equator and (.2) to the Greenwich meridian, in that sequence;

(b) A five-figure code shall be used for area index;

(c) The first figures of the code — QL_aL_0 — shall indicate the 10-degree square in which this 1-degree square is situated, where:

(i) The first figure shall be octant (code 3300);

(ii) The second figure shall be tens of the latitude of the 10-degree square;

(iii) The third figure shall be the tens of the longitude of the 10-degree square.

(d) The fourth and fifth figures of the code shall be the number of the 1-degree square within the 10-degree square as indicated in the above ^figure.

ANNEX 3.C

LAYOUT FOR THE INTERNATIONAL MARITIME METEOROLOGICAL TAPE (IMMT)

[VERSION IMMT-1]

(See paragraph 3.2.7)

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
		i-j-	Format/temperature indicator	3=IMMT format with temperatures in tenths of °C 4=IMMT format with temperatures in halves of °C 5=IMMT format with temperatures in whole °C
2	2-5	AAAA	Year UTC	Four digits
3	6-7	MM	Month UTC	01-12 January to December
4	8-9	YY	Day UTC	01-31
5	10-11	GG	Time of observation	Nearest whole hour UTC, WMO specifications
6	12	Qc	Quadrant of the globe	WMO code table 3333
7	13-15	La^a^a	Latitude	Tenths of degrees, WMO specifications
8	16-19	^o^o^o^o	Longitude	Tenths of degrees
9	20		Cloud height (h) and v measuring indicator	0 - h and VV estimated 1 - h measured, VV estimated 2 - h and VV measured 3 - h estimated, VV measured
10	21	h	Height of clouds	WMO code table 1600
11	22-23	VV	Visibility	WMO code table 4377
12	24	N	Cloud amount	Oktas, WMO code table 2700; show 9 where applicable
13	25-26	dd	True wind direction	Tens of degrees, WMO code table 0877; show 00 or 99 where applicable
14	27	i_w	Indicator for wind speed	WMO code table 1855
15	28-29	ff	Wind speed	Tens and units of knots or metres per second, hundreds omitted; values in excess of 99 knots are to be indicated in units of metres per second and i_w encoded accordingly; the method of estimation or measurement and the units used (knots or metres per second) are indicated in element 14
16	30	s_n	Sign of temperature TTT Air temperature	WMO code table 3845 Tenths of degrees Celsius
17	31-33			
18	34	s_t	Sign of dew-point temperature	0 - positive or zero measured dew-point temperature 1 - negative measured dew-point temperature 2 - iced measured dew-point temperature 5 - positive or zero computed dew-point temperature 6 - negative computed dew-point temperature 7 - iced computed dew-point temperature
19	35-37	TjTjjTj	Dew-point temperature PPPP	Tenths of degrees Celsius
20	38-41		Air pressure ww Present weather	Tenths of hectopascals
21	42-43			WMO code table 4677

NOTE: Blanks entered into a record represent missing data

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
22	44	W_1	Past weather	W_2 Past weather WMO code table 4561
23	45	N_h	Amount of lowest clouds	WMO code table 4561
24	46			As reported for C_L or, if no C_L cloud is present, for C_M, in oktas; WMO code table 2700
25	41	C_L	Genus of C_L clouds	WMO code table 0513
26	48	C_M	Genus of C_M clouds	WMO code table 0515
27	4f	C_H	Genus of C_H clouds.	WMO code table 0509
28	5ft	s_a	Sign of sea-surface temperature	WMO code table 3845
29	51-53	$T_WT_WT_W$	Sea surface temperature	Tenth of degrees Celsius
30	54		Indicator for sea-surface temperature measurement	0 - Bucket thermometer 1 - Condenser inlet 2 - Trailing thermistor 3 - Hull contact sensor 4 - 'Through hull' sensor 5 - Radiation thermometer 6 - Bait tanks thermometer 7 - Others
31	55		Indicator for wave measurement	Shipborne wave recorder: • Wind sea and swell estimated; - Wind sea. and swell measured; • Mixed wave measured, swell estimated; • Other combinations measured and estimated Buoy: - Wind sea and swell measured; - Mixed wave measured, swell estimated; ■ Other combinations measured and estimated Other measurement system: - Wind sea and swell measured; • Mixed wave measured, swell estimated; ■ Other combinations measured and estimated
32		P_WP_W	Period of wind waves or of measured waves	Whole seconds; show 99 where applicable in accordance with Note (3) under specification of P_WP_W in the *Manual on Codes*
33	56-57 58-59	H_WH_W	Height of wind waves or of measured waves	Half-metre values. Examples: Calm or less than V^m to be encoded 00; $3^1/_2$ m to be encoded 07; 7m to be encoded 14; $11^1/_2$ m to be encoded 23
35		d_w *i* d_w j	Direction of predominant swell waves	Tens of degrees, WMO code table 0877; encoded 00 or 99 where applicable. Blanks = No observation of waves attempted
34	60-61 62-63	$P_{wl}P_{wl}$	Period of predominant swell waves	Whole seconds; encoded 99 where applicable (see under element 32)
		Hw l H_w l	Height of predominant swell waves	Half-metre values (see under element 33)
36	64-65	I_s	Ice accretion on ships	WMO code table 1751
37	66	E_SE_S	Thickness of ice accretion	In centimetres
38	67-68	R_s	Rate of ice accretion	WMO code table 3551
39	69		Source of observation	0 - Unknown 1 -Logbook 2 - Telecommunication channels 3 - Publications (National) 4 - Logbook 5 - Telecommunication channels 6 - Publications (International data exchange)
40	70			
41	71		Observation platform	0 - unknown 1 - Selected ship

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
41 *(Cont'd)*				2 - Supplementary ship 3 - Auxiliary ship 4 - Automated station/data buoy 5 - Fixed sea station 6 - Coastal station 7 - Aircraft 8 - Satellite 9 - Others ....
42	72-78		Ship identifier	Ship's call sign or other identifier encoded as follows: 7 characters call sign Columns 72-78 6 characters call sign Columns 72-77 5 characters call sign Columns 72-76 4 characters call sign Columns 72-75 3 characters call sign Columns 72-74
43	79-80		Country which has recruited the ship	According to numbers assigned by WMO
44	81		National use	
45	**82**		Quality control indicator	0 - No quality control (QC) 1 - Manual QC only 2 - Automated QC only (no time-sequence checks) 3 - Automated QC only (inc. time sequence checks) 4 - Manual and automated QC (superficial; no automated time-sequence checks) 5 - Manual and automated QC (superficial; including time-sequence checks) 6 - Manual and automated QC (intensive, including automated time-sequence checks) 7 & 8 - Not used 9 - National system of QC (information to be furnished to WMO)
46	**83**		Weather data indicator	1 - Manual 4 - Automatic: If present and past weather data included Code tables 4677 and 4561 used If 7 - Automatic: present and past weather data included Code tables 4680 and 4531 used
47		i_R	Indicator for inclusion or omission of precipitation data	WMO code table 1819
48	85-87	RRR	Amount of precipitation which has fallen during the period preceding the time of observation, as indicated by t_R	WMO code table 3590
49		t_R	Duration of period of reference for amount of precipitation, ending at the time of the report	WMO code table 4019
50		s_w	Sign of wet-bulb temperature	0 - positive or zero measured wet-bulb temperature 1 - negative measured wet-bulb temperature 2 - iced measured wet-bulb temperature 5 - positive or zero computed wet-bulb temperature 6 - negative computed wet-bulb temperature 7 - iced computed wet-bulb temperature
51	90-92	$T_bT_bT_b$	Wet-bulb temperature	In tenths of degree Celsius, sign given by element 50
52	93	a	Characteristic of pressure tendency during the three hours preceding the time of observation	WMO code table 0200
53	94-96	ppp	Amount of pressure tendency at station level during the three hours preceding the time of observation	In tenths of hectopascal

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
54	97		True direction of resultant displacement of the ship during three hours preceding the time of observation	WMO code table 0700
55	98		Ship's average speed made good during the three hours preceding the time of observation	WMO code table 4451
56 57	99-100	$d_{w2}d_{W}2$	Direction of secondary swell waves	Tens of degrees, WMO code table 0877; encoded 00 or 99 where applicable. Blanks = No observation of waves attempted
	101-102	Pw2^w2	Period of secondary swell waves	Whole seconds; encoded 99 where applicable (see under element 32)
58	103-104	$H_{w2}H_{w2}$	Height of secondary swell waves	Half-metre values (see under element 33)
59	105	Cj	Concentration or arrangement of sea ice	WMO code table 0639
60	106	Sj	Stage of development	WMO code table 3739
61	107	bj	Ice of land origin	WMO code table 0439
62	108	Dj	True bearing of principal ice edge	WMO code table 0739
63	109	Zj	Present ice situation and trend of conditions over preceding three hours	WMO code table 5239
64	110	FM 13 code version IMMT version Ql	Quality control indicator for (h)	0 = previous to FM 24-V 1 = FM 24-V 2 = FM 24-VI Ext. 3 = FM13-VH 4 = FM13-VIII 5 = FM 13-VIII Ext. 6 = FM13-K 7 = FM13-IXExt. 8=FM13-X,etc. 9 = FM13-XI
65	111			0 = previous IMMT 1 = IMMT-1 (this version) 2 = IMMT-2 (next version) 3 = IMMT-3, etc.
66	112			0 - no quality control (QC) has been performed in this element 1 - QC has been performed; element appears to be correct 2 - QC has been performed; element appears to be inconsistent with other elements 3 - QC has been performed; element appears to be doubtful 4 - QC has been performed; element appears to be erroneous 5 - The value has been changed as a result of QC 6-8 Reserve 9 - The value of the element missing
67	113	Q_2	QC indicator for (VV)	- idem -
68	114	Q_3	QC indicator for (clouds: elements 12,24-27)	- idem -
69	115	Q_4	QC indicator for (dd)	- idem -
70	116	Q_5	QC indicator for (ff)	- idem -
71	117	Q_6	QC indicator for (TTT)	- idem -
72	118	Q_7	QC indicator for ($T_dT_dT_d$)	- idem -

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
73	119	Q_g	QC indicator for (PPPP)	- idem -
74	120	Q9	QC indicator for (weather: elements 21-23)	- idem -
75	121	Q_{l0}	QC indicator for ($T_WT_WT_W$)	- idem -
76	122	Qj*1*	QC indicator for (P_WP_W)	- idem -
77	123	Q_{l2}	QC indicator for (H_WH_W)	- idem -
78	124	Q_{l3}	QC indicator for (swell: elements 34-36, 56-58)	- idem -
79	125	Q_{l4}	QC indicator for (i_RRRRt_R)	-idem-
80	126	Q_{l5}	QC indicator for (a)	- idem -
81	127	Ql_6	QC indicator for (ppp)	- idem -
82	128	Q_{l7}	QC indicator for (D_s)	- idem -
83	129	Qj_8	QC indicator for (v_s)	- idem -
84	130	Ql9	QC indicator for (Tl,T(JT|J)	- idem -
85	131	Q20	QC indicator for ships' position	- idem -

ANNEX 3.D

LAYOUT FOR THE IMMT FOR POSSIBLE USE IN NATIONAL AND BILATERAL EXCHANGE

(See paragraph 3.2.7)

Element No.	*Element*	*Character No.*
	Format and temperature indicator (ij) (Same as Col. 1 of IMMPC)	
2	AA	2-3
3	MM	4-5
4	YY	6-7
5	GG	8-9
6	i_w	10
1	Q	11
8	'-a'-al-a	12-14
9	'-o'-o'-o	15-17
10	Indicator for h and W	18
11	h	19
	Qi	20
12	**W**	21-22
	Q_2	23
13	*U*	24
	Q_3	
14	dd	25-26
	Q_4	27
15	ff	28-29
	Q_5	30
16	S_n	31
17	TTT	32-34
	Q_6	35
18	Sign of reported wet-bulb or dew-point temperature	36
19	Wet-bulb/dew-point temperature	37-39
	Q_7	40
20	pppp	41-44
	Q_8	45
21	**WW**	46-47
22	W!	48
23	W_2	49
	Q_9	50
24	N_h	51
25	C_L	52
26	^cM	53
27	C_H	54
	Q_3	55

Element No.	*Element*	*Character No.*
28	s_n	56
29	' w ' w ' w	57-59
	Q10	60
30	Indicator for SST measurement	61
31	Indicator for wave measurement	62
32	P P ' w^rw	63-64
	Q11	65
33	H_WH_W	66-67
	Q12	68
34	^{d}w1^{d}w1	69-70
35	^{P}w1 ^{P}w1	71-72
36	$H_{w1}H_{w1}$	73-74
	Q13	
37	Is	75
38	E_SE_S	76-77
39	Rs	78
40	Source of observation	79
41	Observation platform	80
42	Ship identifier	81-87
43	Country which has recruited ship	88-89
44	Quality control indicator	**90**
45	"x	**91**
46	National use	92
47	I'R	93
48	**RRR**	**94-96**
	Q14	**97**
49	tR	**98**
50	Sign of computed wet-bulb or dew-point temperature	**99**
51	Computed wet-bulb or •point temperature	**100-102**
52	a	**103**
	Q15	**104**
53	ppp	**105-107**
	Q16	**108**
54	D_s	**109**
	Q17	**110**
55	V_s	**111**
	Ql8	112
56	^{c_1}w2^w2	113-114
57	P_W2Pw2	115-116
58	Hw2Hw2	117-118
	Q13	119

Element No.	*Element*	*Character No.*
59	Ci	120
60	Si	121
61	bi	122
62	Di	123
63	Zi	124

Quality control indicators **(Qj to Q_{18})** for elements indicated in brackets

Q_1 (h)	20
Q_2(W)	23
Q_3 (clouds: elements 13, 24-27	55
Q_4(dd)	27
Q_5(ff)	30
Q_6 (TTT)	35
Q7 (wet bulb/dew point)	40
Q_8 (PPPP)	45
Q_9 (weather: elements 21, 22, 23)	50
$Q_{1}o(^{T}wT_wT_w)$	60
Q_{11} (P_wPw)	65
Q_{12} (H_wH_w)	68
Q_{13} (swell: elements 34-36, 56-58)	119
$Q_{14}(i_RRRRt_R)$	97
$Q_{15}O$)	104
Q_{16} (PPP)	108
Q_{17} (D_s)	110
Q_{18} (V_S)	112

Specifications for quality control indicators Qi to Q^ g

0	No quality control (QC) has been performed on this element
1	QC has been performed; element appears to be correct
2	QC has been performed; element appears to be inconsistent with other element
3	QC has been performed; element appears to be doubtful
4	QC has been performed; element appears to be erroneous
5	The value has been changed as a result of QC
6-8	Reserve
9	The value of the element is missing

ANNEX 3.E

MINIMUM QUALITY CONTROL STANDARDS

(MQCS - III (version 3, May 2000)

NOTE: See specification for quality-control indicators Qj to Q_{20} at the end of this appendix
A = space (ASCCI 32)

Element	*Error*	*Action*
1 2	i_T # 3-5	Correct manually, otherwise A
3 4	AAAA * valid year	Correct manually otherwise reject
5 6	MM # 01-12	Correct manually otherwise reject
7	YY # valid day of month	Correct manually otherwise reject
	G # 00-23	Correct manually otherwise reject
	Q# 1,3, 5,7 Q = A	Correct manually and $Q_{20} = 5$, otherwise $Q_{20} = 4$ $Q_{20} = 2$
	$L_aL_aL_a$ * 000-900 $L_aL_aL_a$ = AAA	Correct manually and $Q_{20} = 5$, otherwise $Q_{20} = 4$ $Q_{20} = 2$
But	$L_0L_0LoL_0$ * 0000-1800 LOLQLQLQ= AAAA	Correct manually and Q20 = 5, otherwise $Q_{20} = 4$ $Q_{20} = 2$
	$L_aL_aL_a$ = LQLoLQLo = AAA(A)	Correct manually otherwise reject

Time sequence checks

	Change in latitude > 0.77hr	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 0.77hr when lat. 00-39.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 1.07hr when lat. 40-49.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 1.47hr when lat. 50-59.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 2.07hr when lat. 60-69.9	Correct manually otherwise $Q_{20} = 3$
o	Change in longitude > 2.77hr when lat. 70-79.9	Correct manually otherwise $Q_{20} = 3$
y	h * 0-9, A	No checking
10	h=A	Correct manually and Qi = 5, otherwise Qi = 4 Qi = 9
11	VV * 90-99, AA VV = AA	Correct manually and $Q_2 = 5$, otherwise $Q_2 = 4$ $Q_2 = 9$
12	N * 0-9, A, / N<Nh	Correct manually and $Q_3 = 5$, otherwise Q3 = 4 Correct manually and Q3 = 5, otherwise Q3 = 2
13	dd * 00-36, 99, AA dd = AA, // dd versus ff dd = 00,ff=00	Correct manually and $Q_4 = 5$, otherwise Q4 = 4 $Q_4 = 9$
	dd*00,ff=00	Correct manually and Q4 or Q5 = 5 otherwise $Q_4 = Q_5 = 2$ Correct manually and Q4 or Q5 = 5 otherwise $Q_4 = Q_5 = 2$
14	i_w* 0,1,3,4	Correct manually, otherwise Q5 = 4
15	ff> 80 knots ff=AA,//	Correct manually and Q5 = 5, otherwise Q5 = 3 $Q_5 = 9$
16	s_n # 0, 1	Correct manually, otherwise Qg = 4

Element	*Error*	*Action*
17	TTT = AAA, /// If-25> TTT >40 then when Lat. < 45.0	$Q_6 = 9$
	TTT <-25	$Q_6 = 4$
	TTT > 40	$Q_6 = 3$
	when Lat. >= 45.0	
	TTT <-25	$Q_6 = 3$
	TTT > 40	$Q_6 = 4$
TTT versus humidity parameters		
	TTT < WB (wet bulb)	Correct manually and $Q_6 = 5$, otherwise Qg = $Q_{19} = 2$
	TTT < DP (dew point)	Correct manually and $Q_6 = Q_7 = 5$, otherwise $Q_6 = Q_7 = 2$
18	s_t* 0,1,2,5,6,7	Correct manually, otherwise $Q_7 = 4$
19	DP>WB	Correct manually and $Q_7 = 5$, otherwise $Q_7 = Q_{19} = 2$
	DP > TTT	Correct manually and $Q_7 = 5$, otherwise $Q_7 = Q_6 = 2$
	WB = DP = AAA	$Q_7 = 9$
20	930 > PPPP > 1050 hPa	Correct manually and Qg = 5, otherwise Q§ = 3
	870 > PPPP > 1070 hPa	Correct manually and $Q_8 = 5$, otherwise *Qg* = 4
	PPPP = AAAA	$Q_8 = 9$
21	ww = 22-24, 26, 36-39, 48, 49, 56, 57, 66-79, 83-88, 93, 94 and latitude < 20° ww = AA, //	Correct manually and Qg = 5, otherwise $Q_9 = 4$
	$W_T = W_2 = 7$ and latitude <20°	$Q_9 = 9$
22, 23	Wj=W_2	Correct manually and Q9 = 5, otherwise Q9 = 4
	W_1=W_2=A,/	Correct manually and $Q_9 = 5$, otherwise $Q_9 = 4$
		$Q_9 = 9$
24,25, 26, 27	N = 0, A, 9 and NhCLCMCH * A	
	s_s * 0, 1	Correct manually and $Q_3 = 5$, otherwise Q3 = 4
28	$T_WT_WT_W$=AAA///	Correct manually otherwise $Q_{JQ} = 4$
29	if-2.0 > $T_WT_WT_W$ > 37.0 then when Lat. < 45.0	Qio = 9
	TTT < -2 0	
	$T_WT_WT_W$>37.0 when Lat. >= 45.0	Control manually and $Q_{10} = 5$, otherwise Qin = 4
	TTT <-2.0	Control manually and $Q_{10} = 5$, otherwise Q10 = 3
	TTT > 37.0	Control manually and $Q_{10} = 5$, otherwise Q10 = 3
	Indicator ^ 0-7, A	Control manually and $Q_{10} = 5$, otherwise $Q_{10} = 4$
30	Indicator * 0-9, A	Correct manually, make it A if not correctable
31	20<P_WP_W<30 P_WP_W >30	Correct manually, make it A if not correctable
32	and * 99 P_WP_W = AA, //	Qu = 3
	35 < H_WH_W < 50	Qll=4
	H_WH_W > = 50 H_WH_W = AA,//	Qn=9
33	$d_{wl}d_{wl}$* 00-36, 99, AA swell *i* = $swell_2$ = A	Ql2 = 3 Ql2 = 4 Ql2 = 9
34	25 < P_wiP_wi < 30 $P_{wl}P_{wl}$ >30 and * 99	Correct manually and $Q_{13} = 5$, otherwise $Q_{13} = 4$ Ql3 = 9
35	35 < $H_{wl}H_{wl}$ < 50	Ql3 = 3
	H_wiH_wi->= 50	Ql3 = 4
36	I_s * 1-5, A	Ql3 = 3 Ql3 = 4
37	E_SE_S * 00-99, AA	Correct manually, otherwise A
38		Correct manually, otherwise AA

Element	*Error*	*Action*
39	R_s * 0-4,A Source	Correct manually, otherwise A
40	^ 0—6 Platform *	Correct manually, otherwise A
41	0-9 No call sign	Correct manually, otherwise A
42	No country code	Insert manually, otherwise reject
43		Insert manually
44	Q * 0-6, 9	No quality control
45	i_x*l-7	Correct manually, otherwise A
46	i_R = 0-2 and RRR = 000, ///, AAA i_R = 3 and RRR * 000, ///, AAA i_R = 4 and RRR *///, AAA i_R*0-4	Correct manually, otherwise A
47	RRR * 001-999 and i_R = 1, 2	Correct manually, otherwise Qj_4 = 4 Correct manually, otherwise Q_{14} = 2
	t_R0-9	Correct manually, otherwise Q_{14} = 2 Correct manually, otherwise Q_{14} = 4
48	s_w *0,1,2,5,6,7,9	Correct manually and Q_{14} = 5, otherwise Q_{14} = 2
49	WB<DP	Correct manually and Q_{14} = 5, otherwise Q_{14} = 4
50	WB = ///, AAA	Correct manually, otherwise Q_{19} = 4
51	WB > TTT	Correct manually and Q_{19} = 5, otherwise Q_{19} = Q_7 = 2 Qi9 = 9
	a * 0-8, A a = 4 and ppp * 000	Correct manually and Q_{19} = 5, otherwise Q_{19} = Q_6 = 2
52	a = A	Correct manually and Q_{15} = 5, otherwise Q_{15} = 4 Correct manually and Q_{15} = 5, otherwise Q_{15} = Q_{16} = 2 Ql5 = 9
	150 < ppp <250 ppp > 250	Correct manually and Q_{16} = 5, otherwise Q_{16} = 3
53	ppp = AAA	Correct manually and Q^ = 5, otherwise Q_{16} = 4 Ql6 = 9
	D_s * 0-9, A , D_S = A,/	Correct manually and Q17 = 5, otherwise Q17 = 4 Qi7 = 9
54	V_s ± 0-9, A V_S = A,/	Correct manually and Qjg = 5, otherwise Qjg = 4 Ql8 = 9
55	$d_{w2}d_{w2}$* 00-36,99	Correct manually and Q_{13} = 5, otherwise Q_{13} = 4
	25<$P_{w2}P_{w2}$<30	Ql3 = 3
56	$P_{w2}P_{w2}$>30and*99	Ql3 = 4
57	35 < $H_{w2}H_{w2}$ < 50	Qi3 = 3
	$^{H}w2^{H}w2$ >= 50 q *	Ql3 = 4
58	0-9, A sj * 0-9, A	Correct manually, otherwise A
	bi*0-9,A Dj * 0-9,	Correct manually, otherwise A
59	A Zi * 0-9, A	Correct manually, otherwise A
60		Correct manually, otherwise A
61		Correct manually, otherwise A
62		Correct manually, otherwise A
63		

Specifications for quality control Indicators Qj to Q_2Q

No quality control (QC) has been performed on this element

QC has been performed; element appears to be correct

QC has been performed; element appears to be inconsistent with other elements

QC has been performed; element appears to be doubtful

QC has been performed; element appears to be erroneous

The value has been changed as a result of QC

Element	*Error*	*Action*
6,7	Reserved for GCCs	
8	Reserve	
9	The value of the element is missing	

Use of flag 6:
The GCCs wil set the flag to 6 if the flag has been set to 1 by the Contributing member and the GCCs find it not in accordance with the MQCS.

Use of flag 7:
The GCCs wil set the flag to 7 if the flag had been set to 5 by the Contributing member andnthe GCCs find it no in accordance with the MQCS.

CHAPTER 4

MARINE METEOROLOGICAL SERVICES FOR COASTAL AND OFFSHORE AREAS

4.1 Introduction

Coastal areas geographically constitute a transition between land and sea. The areas are not defined in terms of exact geographical boundaries, as they depend on the topography inland and to sea. At many coasts the meteorological conditions are different from those experienced further inland. Coastal waters may extend up to 100 km offshore, and the presence of the coast, as well as the relative shallowness of the waters, give rise to changes of atmospheric and ocean conditions which can be hazardous to the safety of shipping and small craft.

Meteorological forecasting for coastal and offshore areas requires a special knowledge of, and better still, a personal experience of coastal climates and the various phenomena of the ocean-atmosphere environment which are typical of the coast in question. The forecaster also needs to be aware of those aspects of the weather and sea conditions that are important to people who live and work on the coast or who ply near and offshore waters.

Forecasts for coastal waters need to contain information on waves and, in some cases, sea-surface temperature and the likelihood of ice. These forecasts do not only serve the national community but also the international shipping which may make use of them as well. At the other extreme, recreational boating in very small open boats is subject to hazards from winds and waves which are of no concern to a large vessel.

Services are required not only for the coastal waters but also for people living right on the coast who are subject to a greater frequency of strong winds and gales than those living even a short distance inland. They need to be warned of storm surges and tsunamis, and are also interested in finding out about surf conditions on open beaches and conditions at harbour entrances.

In addition to the general weather forecasts there are many activities in coastal areas which require special information and forecasts of meteorological and sea-surface conditions. Such services may be given at the special request of a user and details of the service are then determined by mutual agreement.

4.2 General services

Five categories of general services for coastal and offshore areas can be listed: (a) Issue of coastal weather and sea bulletins; *(Jb)* Sea ice bulletins, where appropriate;

(c) Data information services;

(d) Climatological services; and,

(e) Marine meteorological expert advice.

In developing a marine meteorological service programme the issue of coastal weather and sea bulletins should have a high priority, as it is a service which satisfies the basic needs of shipping, fisheries and all other activities in the coastal area. In order to forecast local conditions as accurately as possible, a network of observing stations needs to be developed at the coast and in offshore waters. This network needs to be relatively dense as wind and sea conditions vary over short distances due to the effect of coastal topography including headlands, promontories, cliffs, bays and coves, and offshore islands.

The data from these stations need to be preserved and stored in a central place as they form the basis of a climatological description of the coastal area. Forecasting and climatology should be developed at the same time — known climatology is a great aid to more accurate forecasting.

The issue of sea ice bulletins are particularly well developed in countries at higher latitudes. These bulletins are described in *Sea ice information services in the world* (WMO-No. 574) and are therefore not included in this *Guide.*

4.2.1 *Coastal weather and sea bulletins*

4.2.1.1 ESTABLISHMENT OF SERVICES

In arranging for coastal weather and sea bulletins, the following steps, among others, will need to be taken:

(a) To make an assessment of the kind of activities which will benefit from this service e.g. international shipping at harbour approaches or other areas of high shipping density, coastal sea trade, fishing, ocean exploration activities, recreational boating, coastal engineering, marine pollution monitoring;

(b) To determine, by consultation with representatives of user communities, the thresholds of meteorological and sea wave parameters to be used as criteria for the issue of warnings (beyond those agreed for storms and gales) or be mentioned in the synopsis and/or forecast, e.g. wind speed, strength of gusts, wave height, swell period and direction, visibility, squalls;

(c) To arrange for an adequate observing network in the area. Lighthouses and other suitable observation points at the coast can be equipped with the necessary instrumentation, however wind and wave conditions offshore can be markedly different from those right on the coast. Other possibilities are: recruitment of ships regularly employed in the coastal trade as selected, supplementary or auxiliary ships, cooperation of fishing vessels for a simplified observing programme, automatic weather stations on offshore islets or rocks, observations from offshore oil-drilling platforms,

observations taken from regular catamaran services on a cooperative basis, deployment of wave-rider or other meteorological data buoys. As far as possible there should be standardization of the averaging time for instrumented wind observations and standardization of the height of the anemometer;

(d) To arrange for the necessary on-the-job training of marine forecasters;

(e) To determine the extent of the coastal area and the size of sub-areas for which weather and sea bulletins will be issued; these will be governed by the meteorological characteristics of the area and the weather-sensitive activities taking place;

(*f*) To determine the means by which users will be able to receive the bulletins, and arrange a dissemination scheme;

(*g*) To publicize details of the service and the means by which it may be obtained so that potential users are informed of its availability;

(h) To inform WMO of the details of broadcasts of coastal weather and sea bulletins, and of subsequent changes, for publication in *Information for Shipping* (WMO-No. 9), Volume D;

(*i*) To maintain liaison with the various users of the service to ensure that it remains relevant to changing requirements. Liaison between forecasters and users is also important to ensure that the product is relevant to the user.

4.2.1.2 AREAS AND BOUNDARIES FOR BULLETINS

Because of the variation in winds, waves and weather in coastal waters, the weather and sea bulletins cover finer details than those issued for the high seas, which cover far greater areas. The landward boundary of an area for which a coastal bulletin is given is usually the coastline itself. But this line may be very irregular, and bays, estuaries, island barriers or reef barriers may make it hard to define just where the coastline is. A practical approach is to divide the coastal area into a number of sub-areas which are of significance to the local traffic. For instance, one sub-area could cover the approaches to an important harbour, another could cover local fishing grounds. Significant differences in meteorological conditions would also constitute an important factor in determining the sub-areas.

Seaward boundaries of coastal areas are not defined in any general way. They depend on a number of factors, such as the extent to which coastal traffic and activities extend out into the sea or ocean, the vicinity of other countries, the availability of observational data, the weather and sea conditions themselves and other considerations of a practical and sometimes legal nature. For this reason, the *Manual on Marine Meteorological Services* does not specify seaward boundaries, but their specification is left to the country concerned. Each Member, therefore, in notifying WMO of its programme of coastal weather and sea bulletins, should include in the specifications of this programme the exact boundaries of the area or sub-area of coastal waters for which a particular bulletin is issued. These areas are usually indicated on a map which is published in *Information for Shipping* — Volume D (WMO-No. 9).

4.2.1.3 CONTENT OF BULLETINS

Although coastal bulletins may be issued primarily for national interests, they are also used by international shipping, and for this reason in Volume I, Part II, Section 2 of the *Manual on Marine Meteorological Services*, the contents of coastal weather and sea bulletins are specified. Coastal bulletins do not have to be divided into Parts 1, 2 and 3, but they should still follow the order of presentation of information: warnings, synoptic situation, forecasts. As coastal waters form part of a high seas area there should, as far as possible, be consistency between the forecasts and warnings for the coastal waters and the relevant high seas area. Naturally the forecast for coastal waters gives more detail for the smaller area than the high seas forecast.

In the synoptic situation it is useful to give the position of a feature such as a tropical storm or a cold front at a particular time, and its speed and direction of movement. It is then possible for the user to calculate when it is likely to reach his/her location.

Due to the effect of the coast itself, and its topography, winds on the coast and over near-coastal waters often differ markedly from those over the open sea. Information on coastal winds can be found in *Coastal Winds* by E. P. Veselov (MMROA Report No. 21, WMO/TD-No. 275).

It is not usually possible to forecast the precise wind and wave conditions in every bay or gulf along the coast, both for reasons of length of the forecast, and of inability to forecast the differences due to the topography. The small craft operator needs to use his/her local knowledge to determine the likely conditions in such areas given the general forecast for the coastal section.

4.2.1.4 EXAMPLES OF COASTAL WEATHER AND SEA BULLETINS

Examples of coastal weather and sea bulletins are given in Annex 4. A of this Chapter.

4.2.1.5 DISSEMINATION OF COASTAL WEATHER AND SEA BULLETINS

Coastal weather and sea bulletins should be broadcast on the NAVTEX service where this operates, and at publicized scheduled times by radio-telephony by coast radio stations. In some areas of high shipping density without NAVTEX broadcast by INMARSAT Enhanced Group Calling System may be required. NAVTEX is described in Chapter 2, paragraph 2.1.2 of this *Guide.*

However, most small craft are not equipped with the receiving facilities for the above types of broadcast. Thus the bulletins should also be broadcast by public

radio broadcasting stations in coastal areas which can be received on small craft in coastal waters. They can also be included in automatic telephone recorded information services which can be accessed by fishermen before they set out or with the growing use of mobile telephones, also accessed from offshore. They can be included in automatic facsimile services, whereby users with facsimile can dial in to receive the bulletins. Facsimile services also allow users to receive weather charts which are always of great interest. They should be included in television weather segments for the information of people planning marine activities. Broadcasting systems are available which provide a direct read-out of the bulletin on a relatively inexpensive receiver. Visual display by beacons or flags at appropriate coastal places is another means of informing small craft offshore of the onset imminent dangerous conditions.

4.2.2 *Warnings*

Warnings of hazardous meteorological phenomena are essential for the security of all kinds of marine activities. They form the first and most important part of weather and sea bulletins, but it is important to issue warnings as soon as a meteorological hazard is foreseen and not wait for the next routine issue of a bulletin. Forecasting centres thus need to function 24 hours a day.

4.2.2.1 TYPES OF WARNING

Warnings must be issued for:

(a) Tropical cyclones and associated phenomena;
(b) Gales and storms;
(c) Ice accretion.

Warnings should also be issued when:

(a) Visibility is 1 nautical mile or less;
(b) There are unusual or hazardous sea-ice conditions;
(c) Storm-induced water level changes.

Warnings which may be issued for national purposes include:

(a) Strong winds;
(b) High seas and swell;
(c) Tsunamis;
(d) Violent convective phenomena such as thunder-squalls and squall lines.

TROPICAL CYCLONES

Special warning and alert systems are instituted in countries where tropical cyclones present a potential hazard to safety of life and shipping in coastal areas. Forecasting the path and intensity of a cyclone as it approaches the coast can be difficult and many aids, and computer programmes suitable for small computers, have been developed to assist in the task. Advice can be found in *Operational Techniques for Forecasting Tropical Cyclone Intensity and Movement* (WMO-No. 528). While the position of the centre of a cyclone (or of an extra-tropical depression) is usually given in latitude and longitude in high seas warnings designed for large ships at sea, for coastal waters it should be given by distance and bearing from well-known coastal locations. This is because fishermen and other users of coastal waters forecasts are not so familiar with latitude and longitude. Examples of tropical cyclone warnings are shown at Annex 4.B of this Chapter.

STORMS, GALES AND STRONG WINDS

Warnings are to be given of storm force winds (Beaufort force 10+) and gales (Beaufort force 8 and 9); these are of concern to all activities in coastal waters. Many smaller craft operate in coastal waters for which lower wind speeds constitute a hazard and warnings are usually required for strong winds (Beaufort force 6 and 7). Depending on the special national requirements warnings of even lower wind speeds may be necessary. The frequency of fresh to strong winds needs to be considered — warnings of wind speeds which are encountered on most days will be issued so frequently as to lose their effectiveness. Thus the lower limit of wind speed for warning depends on the wind climatology and national requirements. Examples of coastal wind warnings are given in Annex 4.C of this Chapter.

ICE ACCRETION AND FREEZING RAIN

Warnings of ice accretion are given when the forecast wind force is Beaufort force 6 or more, the water temperature less than 2°C, and the air temperature well below freezing. Most cases of icing occur with high wind speeds producing sea spray or when vessels are shipping water. 'Black frost' resulting from supercooled water droplets (fog) is less frequent but far more dangerous, as the developing ice is compact and very adherent. Black frost is commonly observed with strong winds, fog, low air temperatures and relatively high water temperatures. Rare cases of icing by freezing rain have also been observed. Consultation with users may reveal a requirement for warning of freezing rain. Generally ice accretion warnings are issued in context with gale, near-gale or strong wind warnings. An example is given in Annex 4.D of this Chapter. Advice on forecasting ice accretion can be found in *Forecast Techniques for Ice Accretion on Different Types of Marine Structures, including Ships, Platforms and Coastal Facilities* by R. G. Jessup (MMROA Report No. 15, WMO/TD-No. 70).

LOW VISIBILITY

Visibility is measured, or more often estimated, at coastal stations, lighthouses, and aboard ships. Fog and mist are the most common causes of reduced visibility, but thick haze, smoke and heavy rain can also constitute a hazard. The visibility limit

requiring a warning can be determined in consultation with users, but one nautical mile is a common value. Methods of forecasting fog at sea can be found in *La Prevision du Brouillard en Mer* by M. Tremant (MMROA Report No. 20 and WMO/TD-No. 211). An example of a warning of low visibility is given in Annex 4.E of this Chapter.

SEA ICE

Warnings against sea ice are broadcast in the form of ice bulletins, containing information on the coastal sea-ice situation. Observations on sea ice are reported from ships, radar stations, coastal observing stations and from aircraft and satellites by means of remote sensing. Advice on forecasting sea ice can be found in *Methods of Ice Forecasting* (MMROA Report No. 23). An example of a sea ice covering warning is given in Annex 4.F of this Chapter.

STORM INDUCED WATER LEVEL CHANGES

The most common and most dangerous storm-induced water level change is the storm surge generated by a tropical cyclone. Lives are more often lost in the flooding of low-lying coastal areas from a storm surge than lost from the destructive winds of the cyclone itself. The low atmospheric pressure itself will cause a rise in water levels. Techniques have been developed for forecasting the likely height of a storm surge, which must take into account the time and height of the tide when the surge is expected to arrive. A storm surge arriving at low tide will cause less damage than one at high tide. Storm surges can also be generated by intense extra-tropical depressions, particularly when the sea is being driven along a narrowing gulf. An example of a storm surge warning is given in Annex 4.G of this Chapter.

HIGH SEA AND SWELL

While the mean wave height is directly related to the mean wind speed, it also depends on the length of time the wind has been blowing and the fetch over which the waves can be generated. Near the coast, other factors are the water depth, the direction of the wind relative to the coastline and surface currents or tidal streams. Some harbours become difficult of access if high seas are running outside. Tourist resorts with surf beaches may need warning of dangerous high swell. The need for warnings of high sea and swell will be determined by local requirements. An example of a high surf warning is given in Annex 4.H of this Chapter.

TSUNAMIS

Tsunamis are generated by underwater seismic activity. They can cause enormous destruction and loss of life. Until methods of earthquake prediction are perfected, a tsunami warning cannot be given until the earth movement has actually occurred. A warning system is usually in operation in maritime countries where seismic activity is common. This system provides a rapid response as there may be less than an hour between the earth movement and the arrival of a tsunami.

Tsunamis can travel across oceans as a barely detectable wave at sea and wreak destruction on a distant coast. As the tsunami takes some hours to cross the waters of the Pacific, there is time to warn the distant coast. A tsunami warning system for the Pacific has been in operation for many years at the U.S. National Weather Service's Pacific Tsunami Warning Centre in Honolulu, which warns Pacific-rim countries on seismic activity and the generation of tsunamis. Travel times have been calculated from most likely tsunami generating points. Most countries in the Pacific are members of the Intergovernmental Coordination Group of the IOC's International Tsunami Warning Programme in the Pacific. On receipt of a warning from Honolulu that a tsunami is on its way, it is still essential to take immediate action to warn coastal communities. An example of a tsunami warning is given in Annex 4.1 of this Chapter.

VIOLENT CONVECTIVE PHENOMENA

Many vessels in coastal waters, particularly small craft, are vulnerable to squalls from thunderstorms and squall lines, waterspouts, and severe lightning. Such phenomena are short-lived, generated very quickly and very difficult to predict more than two or three hours ahead. The violent nature of the phenomenon often becomes first apparent from observation on radar. Thus the warning system needs to have a means of very rapid dissemination to people likely to be affected.

4.2.2.2 FORM AND CONTENT OF WARNINGS

The content of a warning must describe the dangerous weather that is expected and when and where it is expected. Thus the minimum content of such warnings is that they should mention the:

(a) Type of warning;
(b) Date and time of issue;
(c) Extent of affected area;
{d) When the dangerous element is expected.

Users also like to know how long the dangerous conditions are expected to persist. Thus formulas such as 'moderation is expected tonight', or 'strong winds are expected to continue for another two days' should be included if possible.

Where the warning is of cyclones, storms, gales or strong winds, it is useful to add information on;

(a) The type of disturbance (e.g. low, front);
(b) The location of the disturbance by distance and direction from a well-known coastal location;

(c) The direction and speed of movement of the disturbance; and,

(d) The expected position of the disturbance in, say, 24 hours.

Warnings need to give essential information, but not be overlong; most are read out over radio or automatic telephone. There is a limit on how much information can be absorbed by the listener. As stated in paragraph 2.2.3.4.2 of Volume I, Part I of the *Manual on Marine Meteorological Services,* 'Warnings shall be as brief as possible and, at the same time, clear and complete'.

4.2.2.3 PROCEDURES FOR ISSUING WARNINGS

Warnings should be issued as soon as the likelihood of the hazard is recognized. For most of the types of warnings described in paragraph 4.2.2.1, warnings can be issued up to 24 hours ahead, although in rapidly developing meteorological situations the lead time can be much less. Tsunami warnings often have to be issued with little lead time. Violent convective weather, e.g. severe squalls, can be forecast only a short time ahead. Particularly in these cases, speed is required in transmission of the warning to those likely to be affected. Facsimile is the best means of sending warnings to radio and television stations and other recipients. Arrangements need to be made with radio stations for the 'broadcast of the first issue of a warning immediately on receipt. The message may be headed: Priority — for immediate broadcast'. They need to be sent to authorities such as harbour control, emergency services and others responsible for the safety of life and property. Warnings broadcast by coastal radio stations should be repeated at set intervals.

4.2.2.4 SPECIAL WARNING SYSTEMS

Warnings to people living on the coast may need to incorporate more than meteorological information. Storm surges causing flooding may require input from hydrological authorities. Emergency services may need to advise people as to what they should do. Rather than have people receive different messages at different times, it is preferable to incorporate all the requisite information in the one message. This will require cooperation between several national authorities, and the extent to which this is practicable will depend on the circumstances in each country.

Different arrangements exist in the various maritime countries for the collection of data by a particular discipline or authority, the processing into a service product and the delivery of the information to the user. The marine meteorologist, when engaged in such activities, must be sufficiently cognisant of physical oceanography and of environmental processes occurring in coastal regions, so that he/she understands the purpose and value of the end product and the significance of his/her own contribution to it.

4.2.3 *Visual storm signals*

Visual storm warning signals along the coast have been used ever since meteorological forecasting became possible. Their use has declined with the development of radio communications as radio receivers have become small enough to be carried on small vessels. Nevertheless there are small fishing boats with no communication facilities aboard and visual storm warning display systems continue in some countries. The signals should conform to the International System of Visual Storm Warning Signals which is included as Annex 4. J of this Chapter.

4.2.4 *Coordination with the navigational warning system*

It is desirable that the broadcast of meteorological warnings and warnings of navigational hazards in coastal waters be coordinated, so that users receive all relevant information on hazards at about the same time. This will require coordination between the Meteorological Service, the authority responsible for issuing navigational warnings and the coast radio station(s).

4.2.5 *Data information and climatological services*

Many people carrying out activities in coastal areas have an interest in current meteorological observations as well as the forecast and warning service. Electronic display systems, linked by landline to a forecasting centre, can be installed in harbourfront areas. The information is then kept up to date from the central computerized database. Some display systems have a touch screen facility which allows the user to call up the particular observations required. The cost of electronic displays can sometimes be offset by the inclusion of advertisements.

Data from observing stations established for the specific purpose of marine meteorological services for coastal and offshore areas should be preserved and stored in an easily retrievable form. They may be used in establishing the climatology of the area. The provision of climatological services is described in Section 4.5 below.

4.2.6 *Marine meteorological expert advice*

Meteorological Services are asked on occasion to supply information in connection with official investigations of insurance claims on casualties, cargo damage, structural damage to buildings and other constructions in coastal or offshore areas, and for other similar purposes. Such information may relate to actual weather and sea conditions which prevailed on specific dates, as well as to the forecasts and other particulars of weather information which had been supplied by the Meteorological Service. In some cases, meteorological personnel may be called upon to interpret the weather information and offer expert advice.

The supply of information in cases with legal or commercial implications will be at the discretion of national authorities and will be governed by national legislation or practices. However, with a view to facilitating the supply of information where this is decided, the records of marine meteorological data and information should be preserved in a suitable form.

4.3 Specialized services

Meteorological Services may be requested to provide a special forecast service, either as a regular activity or to assist in a given operation at sea or on the coast. Regular services may be for a segment of the community or a large number of users, e.g. recreational boating, heavily congested shipping areas, surf beaches, fishing grounds; or they may be for specific commercial purposes, e.g. oil drilling platforms, hovercraft or hydrofoil services. Services may be required for a limited period, e.g. for construction activity on or just off the coast, or for a yacht race.

Services provided to a specific organisation are usually done so on a commercial basis, whereby the precise service to be provided and the associated charges are negotiated with the client. The agreed service should not promise detail and precision in the forecasts which goes beyond forecasting capability.

4.3.1 *Operations related to oil drilling platforms*

The general requirements of meteorological services for oil drilling and mining operations are described in paragraph 1.2.5. in Chapter 1 of this *Guide.*

The requirements for forecasts for the platform or drilling rig site may include:

(a) Wind direction and speed at 10 metres and at the height of the helicopter deck within an accuracy of 5 knots;
(b) Direction and height of sea and swell within an accuracy of 1 decimetre;
(c) Periods of sea and swell within an accuracy of 1 second;
(d) Significant weather phenomena;
(*e*) Ceiling;
(*f*) Visibility;
(g) Air temperature;
(h) Sea surface temperature;
(*i*) Ice accretion on constructions;
(j) Deviation of tidal heights; and,
(k) Temperature and current at different depths.

The threshold values for different phases of operations may vary considerably. Usually bulletins are issued two or three times a day to cover normal operations and to keep the operator aware of the current weather development. A suggested format for such a bulletin (for guidance only) is given in Annex 4.K of this chapter. For more critical operations a temporary special service may be agreed upon, including particular threshold values for the operation in question, as well as the content, form and mode of dissemination of the forecasts.

In addition to forecasts for the platform site, forecasts for the supply service involving helicopters and supply ships are usually also requested. The requirements for these services will normally be similar to those of the general aviation and coastal transport in the area, but special services may be required by the operator in certain areas.

Good telecommunications and the establishment of consultation between the operator and the responsible forecasting office are very important for satisfactory service. This is particularly the case during critical phases (e.g. during construction of a platform) when a forecaster may have to be placed on the site of the operations in order to facilitate the liaison.

Observations from the platform or rig are essential to a satisfactory forecasting service. Many platforms are equipped with very sophisticated data collection systems which require lengthy and expensive data processing before practical results can be obtained. The observations are then too late to be of use to the forecaster. However, it should be possible, by manual or automated means, to obtain regular synoptic observations from the platform or rig. The obligation to undertake standard observations at standard times has become an obligation under the Mining Permit in many countries.

4.3.2 *Special transport in coastal areas*

The term 'special transport' applies to a wide range of operations in coastal and offshore waters. It includes:

(a) Towing and installation of highly complex production platform and harbour facilities;
(b) Salvage of damaged ships;
(c) Pipelaying and cabling operations;
(d) Dredging;
(e) Yacht races; and,
if) Deployment of buoys.

In most cases a special forecasting and warning service is required for a limited period and is negotiated between the client and the Meteorological Service. Many countries charge for this type of special service.

The requirements will vary with the type of activity and local climatology. They usually include:

(a) Wind direction and wind speed with an accuracy of 5 knots;
(b) Direction and height of sea and swell with an accuracy of half a metre;
(c) Weather such as thunderstorms and squalls;
(d) Air and sea-surface temperature;
(e) Visibility;
(*f*) Deviations of tidal heights;
(g) Currents; and, *(h)* Ice accretion.

Where the transportation occurs in areas subject to ice, additional requirements include: *(a)* Ice edge position;

(b) Spatial variation of ice concentration;
(c) Significant ice phenomena.

The limitations of the meteorological forecast should be made clear to the client, who may expect a greater precision and accuracy than is possible.

The agreement between the Meteorological Service and the client should be clear on:

(a) The times of issue of meteorological information;
(b) The means of communication of the information to the client;
(c) The observations to be provided from the area of operations, and the means of communication; and,
(d) The telephone numbers of persons to be informed in an emergency.

In many cases a request will be made for a meteorological briefing for those who are to carry it out before the operation begins. An exchange of names between those carrying out the operation and the meteorological forecasters concerned often helps engender trust and confidence by the client in the service. For critical operations the client may request that a meteorologist be present at the operation to provide on-the-spot advice. In this case it is necessary to ensure that there are reliable communications to the forecasting office so that the meteorologist on the spot has access to the requisite meteorological data and charts.

4.3.3 *Dynamically-supported craft*

Fast craft such as hydrofoils, hovercraft and catamarans are more sensitive to wind and waves than ordinary craft of the same size. According to the IMO *Code for Safety of Dynamically-Supported Craft,* a definition of the worst intended environmental conditions should be provided for in the certification of the craft. Reliable weather forecasts should also be available for the area of operation.

In many countries the ordinary weather and sea bulletins and warnings are regarded as a sufficient forecasting service for normal operations. However, due to the speed of these craft, visibility is especially important to their operation. Special dissemination of forecasts to the terminals, rapid exchange of observations, and facilities for consultations between the captains of the craft and the forecasting offices are also often provided.

Special forecasting services for dynamically-supported craft may also be provided, usually as a commercial service to the operating company. The details of the service are negotiated between the operator and the Meteorological Service, and will be determined by the local climatology and characteristics of the coastal area.

Matters usually considered include:

(a) Forecast for weather and sea conditions to be supplied at port of departure;
(b) Forecasts valid for the approaches to the port of destination to be supplied at the port of departure;
(c) Arrangements for weather reports at given intervals and exchange without delay of reports of dangerous phenomena;
(d) Arrangements for observations and transmission of the reports;
(*e*) Facilities for exchange of reports, forecasts and warnings between meteorological offices concerned;*(f)* Warning criteria.

Criteria adopted in some areas for issue of a warning are wave height above 1.3 metres or wind speed above 12 metres per second or visibility less than one kilometre.

4.3.4 *Marine pollution*

Incidents involving the spilling of oil or other pollutants constitute a hazard for coastal areas and communities. Actions necessary to contain the area of pollution, to minimize its effects and to clean up the affected area require meteorological services of a special form. Such pollution incidents usually call for immediate action and it is essential that pre-arrangements be made between the meteorological service and the pollution control authority so that the Meteorological Service can be alerted and the required information provided with minimum delay.

The first thing that the pollution control authority will want to know is the likely movement of the pollutant. The most likely pollutant is oil and computer models have been developed to predict the movement of the oil. The meteorological input required by these models includes the forecast surface wind, waves and currents, air temperature and water temperature. The model may be operated by the meteorological authority, or by the pollution control authority according to national arrangements.

The wind forecast required is usually quite detailed and on a fine scale. Computer models developed to predict the wind field in coastal areas from the general wind field can be of assistance here.

If it is expected that the pollutant will ultimately affect the coast, and perhaps threaten coastal communities and installations, the on-scene commander of the clean-up operations will require forecasts and warnings related to the safe and efficient deployment of the personnel and equipment involved in the clean-up.

Tidal current systems may affect forecasts of fog and temperature in the coastal zone, as well as the movement of the pollutant. Thus the marine meteorologist needs to be acquainted with tidal currents along the coast.

Frequent direct communications with the on-scene commander will be required during clean-up operations. Providing that good communications are available back at the meteorological centre, sending a meteorologist to the operations centre enables close liaison to be maintained.

The meteorological response to pollution incidents in international waters where coasts may be threatened is covered by the Marine Pollution Emergency Response

Support System (MPERSS) described in paragraph 2.9 in Chapter 2 of this *Guide.* Incidents may also occur in the national waters of adjacent countries, and it is valuable if the organisation, responsibility and procedures in neighbouring countries are known in advance, so that the meteorological service can be coordinated as much as possible.

In addition to making arrangements for services to be activated when incidents arise, maritime countries should establish centres or groups of expertise which can provide the appropriate advice at other times. This may be done in support of national planning for prevention of marine pollution, or for operations purposes, such as the guidance of oil tankers or to assist other marine activities constituting a pollution threat. Meteorological Services may be required to provide advice in the formulation of such national plans to prevent and control marine pollution.

4.3.5 *Fishing operations*

Fishing vessels in coastal and offshore waters are usually small. Therefore they are very weather dependent and vulnerable to wind, waves and swell. They are at risk in poor visibility in shallow water or in dense traffic areas. Ice and ice-accretion in polar or near-polar areas may affect vessels there. Winds of Beaufort force 6 may be a hazard to small craft.

Generally the warnings and bulletins issued for general shipping in coastal and offshore areas are sufficient for fishing operations. However, there should be consultation between the Meteorological Service and representative fishermen to ensure that the service, as far as possible, meets their requirements. Bulletins should be issued at least twice-daily and at times appropriate to the working hours of fishermen, so that they can receive the latest forecast before setting out. Forecasts are also used in planning activities a day or two ahead, and outlooks beyond the usual 24 to 36 hour period of the forecast may be required.

While on shore fishermen can hear the bulletins over radio or television, or by dialling an automatic telephone weather service. Some fishermen may be equipped with facsimile and can access an automatic facsimile service. While at sea, they may still be able to receive radio broadcasts, or access telephone services by mobile telephone. It needs to be made clear to fishermen that not all weather developments can be predicted far in advance. Although the forecast may be favourable when they set out, they still need to listen for warnings which may be issued of imminent adverse weather.

Some small vessels, however, may not be equipped with any electronic means of communication. Visual storm warning signals at harbour entrances or on prominent headlands can, at least, warn fishermen of the imminence of dangerous weather.

While observations from fishermen would be of great interest to the meteorological forecasters, they can be difficult to obtain. When the weather is rough the fisherman is too busy ensuring the safety of his craft to take and report weather observations. Reports will only be received if the cost of communication is not borne by the fishermen.

4.3.6 *Recreational boating and small craft*

Very small craft are usually used for recreational boating, and these are very weather-dependent. Crews of such small craft are often very inexperienced and frequently ignore the weather. While much recreational boating takes place in the comparatively sheltered waters of bays and estuaries, strong winds and squalls are still a hazard. Many accidents are due to inexperience and ignorance of the speed with which hazardous weather can arise. A programme using clear publications and training courses may be needed to educate people on the dangers they face. This may be run in conjunction with the rescue authorities who have to take action when these craft get into trouble. It will need to cover such simple points as strengthening sea breezes in the afternoon, the likelihood of late thunderstorms on hot, humid mornings, and other local phenomena known to the meteorologists.

Bulletins for recreational boating should be issued at least twice daily at the same time as the issue of forecasts to the general public, and should be given wide coverage on radio and television. Likewise, they should be included in automatic recorded telephone weather services. If facsimile machines are in widespread use, they can be included on an automatic facsimile service.

Warnings need to be issued of strong winds, and particularly squalls from thunderstorms or fronts. The latter can often only be issued at short notice and arrangements need to be made with radio stations to broadcast these immediately on receipt and to repeat them frequently until the danger is past. A message cancelling the warning may need to be sent to radio stations.

Personal or telephone contact with a meteorological office before departure is very useful and should be encouraged if the likely demand will not overburden the staff on duty in the office. These briefings enable the forecaster to give more details than can be broadcast by a radio station, and also to give comments on the confidence in the forecast.

Some special advices may be issued for certain aspects of sailing activities. During sailing regattas the crews are interested in exact wind forecasts as well as actual wind information. Detailed bulletins may be requested, particularly where the coast is irregular, and very different wind conditions may exist in different areas. Wind and gust forecasts and forecasts of expected wind shifts should be as precise and detailed in time and place as possible. The issue of such bulletins may be given by telephone or facsimile to individuals or yachting clubs and regatta coordination centres. Sometimes the attendance of a meteorologist is requested at a regatta coordination centre to meet specific needs. An

example of a forecast for recreational boating is given in Annex 4.L of this Chapter.

4.4 Wave **information services**

4.4.1 *Deep water waves*

General forecasts of sea and swell conditions are required to be included in forecasts for coastal and offshore waters. However, many specific users have a requirement for more detailed information on waves. A distinction needs to be made between 'deep water' waves and waves in 'transitional' and 'shallow' depths. Deep water waves are those for which the depth *(d)* of the sea is greater than half the length (L) of the waves ($d > {}^1/_2 L$). In offshore areas with a water depth of 100 metres or more, most wave systems generated by winds up to about Beaufort force 9 can be treated as 'deep water' waves. For water depths of 200 metres or more, waves generated in the more severe storms can be treated as 'deep water' waves. For 'deep water' waves the various wave forecasting methods for the open oceans can be applied.

Waves can be generated by winds in the area (these are known as sea waves) and by distant storms (these are known as swell waves). The height of sea waves depends not only on the wind speed, but also the fetch (the distance over which the winds have been blowing), and the duration (the length of time the winds have been blowing). Forecasting methods for sea waves are based on an analysis of the wind field, over the past few hours, at the actual observation time, and over the period of the prognosis. The quality of this analysis will depend on the density and quality of observations, and will be complemented by observations of pressure and wind from ships, buoys and offshore platforms. Analysis and forecasting are enhanced if reports of visual wave observations are also received from the area. The reports of wave heights help to check the computations of waves on the basis of the wind field.

Swell waves can be forecast by an analysis and prognosis of the distant swell-generating storm, and the use of techniques for calculating the attenuation of the swell as it moves towards the forecast area.

The *Guide to Wave Analysis and Forecasting* (WMO-No. 702), provides detailed guidance on the development of manual wave analysis and forecasting methods. It contains various examples for the computation of significant wave height, the probable maximum height, the mean wave period and the range of wave periods to be expected in a given wave system. In a number of countries empirical methods have been developed for application to the particular sea area of interest.

The significant wave height is the average height of the highest one-third of the waves; it approximates the wave height which would be estimated by a manual observer. It should be remembered that the heights of individual waves can vary considerably from the significant wave height. It can be expected that one wave in a thousand will be 1.89 times the significant wave height. A thousand waves will usually pass in about three hours, and as most storms last at least this long, at least one of these high waves will be experienced; this justifies the inclusion of a prediction of a probable maximum wave height.

Computer models for the prediction of waves have been developed, and some of these can be run on personal computers. Some models will produce the predicted wave height from the combined sea and swell, which is what the user is usually interested in. However, the quality of the output of the model is very dependent on the quality of the initial analysis of the wind field, and this, in turn, depends on the density and quality of the observations.

The effect of sea ice on waves should not be overlooked. High waves in a partially ice-covered sea may cause an ice storm, an extremely dangerous marine meteorological phenomenon.

4.4.2 *Wave conditions near or at the coast*

When waves run into waters of shallower depth the wave pattern and the appearance of the waves are modified. Water of a depth less than half the wave length but more than one twenty-fifth of the wave length ($ {}^1/_{25} L < d < {}^1/_2 L$) is of transitional depth. For sea areas of depths to, say, 20 metres, the comparatively short waves generated by light and moderate winds may still be treated as 'deep water' waves, but the longer waves generated by gales and storms are influenced by the sea bottom and the water depth must be taken into consideration. In 'shallow' water, where $d < {}^1/_{25} L$, the depth must be taken into account in all waves.

When waves run into 'shallow' water modifications of the wave pattern take place due to refraction, shoaling and breaking of wave crests. In the vicinity of coasts waves can also be reflected and complex wave interference patterns may result. Unevenness of the sea floor, with variations in the depth of the water, also adds to the complexity of wave motion in 'shallow' water. This complexity makes forecasting of waves in 'shallow' water very difficult, if not impossible.

However, detailed information on waves close to the coast is required more for design purposes than for real-time operations. Such information is required for the construction of harbour entrances, offshore platforms, shore protection works and for assessing the viability of transport services. The estimate of the highest waves likely to occur with a return period of, say, 100 years (to ensure structures have sufficient safety factors) is of great interest as is the frequency of rough weather which will impede or prevent operations.

For these applications a knowledge of the 'deep water' waves as they approach the coast from a certain distance is necessary. Thus a Meteorological Service may be asked to provide daily charts of the wind fields over the open ocean or sea and, if available, analyses of wave patterns. Computer models are available which will compute the wave patterns from the wind field and

sea bottom topography. As with forecasting of deep water waves, the quality of the model output will depend on the quality of the wind field input. Observations from wave recording instruments at suitable places are of great value in order to check on the quality of output of the model.

4.4.3 *Organization of wave information services*

In setting up a wave information service for coastal and offshore areas, the following steps will need to be taken gradually to develop this activity:

(a) On the basis of a survey of prevailing weather conditions over a wide ocean area off the coast, to determine the locations from where, ideally, regular ship observations of air pressure, wind, waves and swell would be needed to prepare synoptic analyses of the wind field and the associated 'deep water' wave patterns;

(b) To arrange for the collection of additional ship reports where needed, for instance through the recruitment of local shipping or fishing traffic for the making of these observations;

(c) To select, bearing in mind the characteristics of the different types of wave recorders described in the *Guide to Wave Analysis and Forecasting* (WMO-No. 702) and install wave recording instruments at strategic places near the coast, either as buoy stations, or at drilling platforms or the coasts of islands or other suitable protruding landmarks;

(d) To arrange, if possible, for the receipt and assimilation of remotely-sensed observations of waves, e.g. from radar or synthetic aperture radar altimetry data;

(e) To analyse the 'deep water' wave patterns off the coast twice daily or once daily as the situation demands, and to provide users with relevant information from these chart. The information may be disseminated in several ways:

(i) Inclusion in weather and sea bulletins;

(ii) Provision of copies of wave charts to users upon request and display of charts in ports;

(iii) Communication by facsimile or telephone of wave characteristics at specific locations off the coast to those users who request it;

(f) To obtain information on bottom topography for calculating wave height in shallower coastal waters;

(g) If sufficient computing facilities are available, to obtain or develop a wave forecast model;

(h) To prepare wave prognosis charts using atmospheric prognosis charts, and, if available, computer models, for the sea area of interest, and to disseminate this information in the ways mentioned under *(e)* above;

(*i*) To arrange regular evaluation of the quality of the wave information provided; and,

(j) To ensure that the records of wave recording instruments in the coastal area, or copies of these if the instruments are operated by other authorities, are stored at the national data centre (see paragraph 4.5). It will be appreciated if an inventory of these data holdings is communicated to the international wave data centres which operate under the World Oceanographic Data Centres and are coordinated by the Intergovernmental Oceanographic Commission (IOC).

4.5 Coastal marine climatology

4.5.1 *Network of stations*

A basic requirement of all NMSs is to be able to provide the necessary data and statistics for a description of the climate of the country. Thus the *Manual on the Global Observing System* (WMO-No. 488), Volume I, Part III, paragraph 2.7.1 specifies that each Member shall establish in its territory a network of climatological stations. The network should give a satisfactory representation of the climatic characteristics of the coast as well as the coastal and offshore areas for which the Member concerned is providing marine meteorological services (see *Manual on Marine Meteorological Services,* Volume I, Part II, paragraph 2.2.7).

Coastal synoptic stations selected as part of the coastal marine climatological network should, as far as possible, be representative of the general sea area in the vicinity of the station. This often presents some difficulty because of the complicated structure of the coastline in many areas. Wind, in particular, can vary markedly along the coast, and clifftop sites should be avoided due to the eddies and updraughts often found there. Anemometers should be sited on open level ground with good exposure, particularly to the sea; wind can decrease significantly even a short distance from the shoreline. Urban sites should not be selected as they are rarely representative of the open coast. Salt can cause problems with wet-bulb thermometers at coastal sites and the wick may need changing more frequently than at inland stations. The thermometer screen needs to be very firmly anchored, so that vibration in gales does not shake down the index of the minimum thermometer.

The number of coastal stations may not be sufficient for an adequate description of the climate. The often complicated structure of the coastline makes it difficult to extrapolate the wind regime or the pattern of ocean waves found at one location on the coast in relation to another different locality. Thus, for coastal engineering, and for all other studies and operations which need information on the probability of wind speeds, temperatures or waves that exceed a given threshold value at a particular location in a coastal area, special measurements should be arranged to obtain the desired series of observations at the location itself. While the user may require results in less than the several years required to establish climatological values, at least the differences between the particular location and the nearest climatological station can be established.

In most countries a number of different authorities may set up coastal observing stations, these include:

hydrographic, oceanographic and beach protection authorities; national planning authorities, universities; other research institutions; and also, if offshore oil drilling is a possibility, mining authorities. In conjunction with these other authorities a survey should be made of the existing sites where climatological observations are made. This may reveal localities where observations are badly needed for climatological purposes. A development plan should then be drawn up which describes in detail the locations at the coast or offshore where a future station should be installed, the elements which should be measured or observed, and the various phases of implementation. Such a plan would also be necessary if technical assistance is needed.

It is desirable that all coastal climatological data should be stored in one national data bank whose location should be determined by decision-makers. However, if it is to be located within the NMS agreements should be made with the other authorities to send a copy of their data to the national data centre. Information should also be obtained on the type and exposure of the instruments. The important condition is that there should be close cooperation between the Meteorological Service and the other authorities and the data should all come to the national data centre.

An essential criterion for a climatological station is that it should provide a long and uninterrupted series of observations over a period of many years. A period of ten years is often quoted as a workable minimum. Thus, apart from meteorological and hydrographic considerations, other concerns should include easy access to the site, the arrangements for maintenance of the instruments and the communication of the data from the station. As most stations will be automated or semi-automated, particularly in sparsely inhabited coastal areas, or on small offshore islands, technical personnel should be available for maintenance of the station and provision should be made for their transport. Automatic stations need to have their sensors calibrated at least once a year. An additional problem in tropical regions is that instruments, or parts thereof, may have to be replaced rather often because of unfavourable environmental conditions, e.g. high humidity, corrosion by salt, insects. In the financial planning of coastal climatological stations sufficient allowance must be made for the costs of maintenance.

A coastal climatological station may consist of a combination of measuring sites where different elements are measured or observed; however, the observations should be sufficiently representative of the location as a whole so that they can be related one to the other in a statistical description of the 'climate' of the location. One may for instance lay out a wave-rider buoy at some distance from the coast and compare its data with those of an anemometer station at the coast. Sea temperatures may also be measured at some distance from the meteorological stations. A tidal gauge might be placed at still another location.

4.5.2 *Data handling*

The data from a coastal climatological station may be received in the national data centre in the form of a handwritten logbook, as teletype messages, or from automated stations in computer-compatible readable media. Data at a manually-operated station may be entered into a terminal for polling by a central computer. Receipt in a computer-compatible format saves the time and labour involved in manually transcribing logbooks.

For computer-compatible form standard formats are preferred. Since the elements being observed may differ from standard synoptic elements especially with regard to exposure, recording interval, averaging time and observation time, formats and codes should be designed which are simple (from the observer's point of view), but sufficiently flexible to allow for a wide variety of observing practices. It is important that the stored data contains information on observing details, instrument types and exposure as many non-standard data will be handled.

All data received at a national data centre should be subject to quality control which is more easily carried out by automated means. Manual scrutiny of logbooks should be restricted to the minimum necessary for transferring the data to computer file. Normally this involves checking for legibility and the entry of mandatory data for computer processing (e.g. date/time, position, station identifier etc.). On the other hand, scrutiny and editing may also involve transcribing complete observations from a non-standard or unsuitable logbook or log sheet to a standard form and include scrutiny of individual elements — encoding, correcting or deleting data as necessary. In the last case provision should be made for quality control indicators to be inserted after (or referring to) each element checked. A typical example of a form designed for transcribed coastal marine data is shown in Annex 4.M.

Quality control on data on computer files should include, as a minimum, the following checks:

(a) Logical checks for admissible data;

(b) Range checks for impossible values;

(c) Internal consistency checks. Additional checks are desirable, including:

(a) Range checks for unlikely or extreme values (based on climatology);

(b) Time series checks (e.g. to query sudden changes);

(c) Spatial checks (checking against observations already made in the vicinity of the station in question).

Computer programs exist which will carry out these types of quality control. In general, the quality control process will include converting data to standard units and adjusting measurements to standard height. Quality control markers appropriate to each element should be stored with the data. Where resources allow, data queried in the quality control process may be further scrutinized manually they may thereafter be

accepted, rejected or retained as doubtful, quality control markers being amended accordingly.

Finally the data should be archived by station/area in an efficient form suitable for rapid retrieval and statistical processing. Back-up copies of all data stored on magnetic media should be maintained and kept in a separate location to the original copy. In the case of a disaster at the national data centre, the back-up copies will still be available. To facilitate exchange of coastal climatological data the use of IOC General Format 3 is recommended especially when setting up new systems which are not constrained by established archiving methods. This format is described in Annex 1 of the IOC Manuals and Guides No. 9: *The IOC General Magnetic Tape Format for the International Exchange of Oceanographic Data.* Part 1 gives the technical specification and Part 2 the code tables.

4.5.3 *Climatological services*

Once the data from coastal stations are included in the national data centre, the services provided by the centre are the same as those for all other climatological stations. As specified in the *Manual on Marine Meteorological Services,* Volume I, Part II, paragraph 2.2.7.2, an up-to-date directory of climatological stations in coastal areas should be maintained and, in addition, a data inventory should be prepared at regular intervals. Statistical summaries of data, particularly in ports, are of great value to shipping. Further information is given in Chapter 3 of this *Guide.*

Climatological data for coastal and offshore waters will be sought for many reasons, including the development of a new port, the establishment of a new ferry, hovercraft, hydrofoil or similar service, the development of a coastal tourist resort, engineering to reduce coastal erosion.

4.5.4 *International arrangements*

In several parts of the world a number of countries cooperate in regional studies of air-sea interaction. These studies require an exchange of climatological data from coastal areas amongst the participating countries. Arrangements are also made under the World Climate Programme (WCP) for the international exchange, on a global basis, of data from selected climatological stations, and coastal climatological stations are included under these arrangements.

ANNEX 4.A **EXAMPLES OF COASTAL**

WEATHER AND SEA BULLETINS

(Reference paragraph 4.2.1.4)

METEO

FRANCE DIRECTION INTERREGIONALE POUR METEO-FRANCE / NORD

STATION METEOROLOGIQUE DU HAVRE

Quai des Abeilles 76600 LE HAVRE

Telephone : 35 42 21 06 Telecopie : 35 41 31 19

BULLETIN METEOROLOGIQUE POUR ANTIFER. NR 2

ORIGINE METEO-FRANCE, STATION DU HAVRE
LE VENDREDI 21 OCTOBRE 1994 A 15 HEURES 30

1 - MENACE **DE GRAND FRAIS VOIRE COUP DE VENT (A CONFIRMER) DE SUD-OUEST SAMEDI SOIR.**

2 - SITUATION GENERALE :

DEPRESSION 980 HPA AU LARGE DE L'IRLANDE SE DECALANT VERS L'EST ET DIRIGEANT UN COURANT DE SUD PUIS SUD-OUEST MODERE SE RENFORCANT CES PROCHAINES 36 HEURES.

3 - PREVISIONS POUR CET APRES-MD3I ET LA NUIT PROCHAINE :

. TEMPS : ECLAIRCIES CET APRES-MIDI, RETOUR A UN TEMPS COUVERT PUIS FAIBLEMENT PLUVIEUX CETTE NUIT. . VENT : DE SUD 15-20 ND, FORCE 4 A 5, POUVANT ATTEINDRE PASSAGEREMENT 25 ND, FORCE 6 CET APRES-MIDI, MOLLISSANT TEMPORAIREMENT 10-15 ND, FORCE 3 A 4 EN FIN DE NUIT. . MER : H 1/3 : CHENAL : SE CREUSANT 070-090 CM. EVITAGE ET APPONTEMENT : 050-070 CM. . VISI: DEVENANT VOISINE DE 5 MILLES CETTE NUIT.

4 - PROBABDLITES POUR DEMAIN. LE SAMEDI 22 OCTOBRE 1994 :

. TEMPS : COUVERT ET FAIBLEMENT PLUVIEUX DEVENANT A GRAINS U APRES-MIDI. . VENT : DE SUD 15-20 ND, FORCE 4 A 5, TOURNANT PROGRESSIVEMENT AU SUD-OUEST EN SE RENFORCANT 25 A 30 ND, FORCE 6 A 7 AVEC RAFALES EN SOIREE. MENACE DE COUP DE VENT (FORCE 8) LA NUIT. . MER : H 1/3 :
CHENAL : SE CREUSANT 150-180 CM LE SOIR, 200-220 CM LA NUIT ? EVITAGE : SE CREUSANT 100-150 CM LE SOIR, 200 CM LA NUIT ? APPONTEMENT : SE CREUSANT 110-130 CM, 150 CM LA NUIT SUF/ANTE. . VISI: 3 A 5 MILLES DEVENANT SUPERIEURE A 5 MILLES HORS GRAINS **L'**APRES-MIDI.

5 - TENDANCE ULTERIEURE :

.. DIMANCHE 23 OCTOBRE :
VENT DE SUD-OUEST MOLLISSANT FORCE 6 A 7 PUIS FORCE 5 A 6 L'APRES-MIDI.

FIN DE BULLETIN ...NM...

REPONDEUR MARINE : 36 68 08 76 pour la cote et le rivage
36 68 08 08 pour le large (2,19 F/mm) MINITEL : **36 15 METEO**

METEO
FRANCE

STATION METEOROLOGIQUE DE DUNKERQUE

Place du Minck 59140 DUNKERQUE

Telephone : 28 66 45 25 Telecopie : 28 65 10 64

BULLETIN METEO MARINE COTE GRIS-NEZ / FRONTIERE BELGE POUR PORT AUTONOME DE DUNKERQUE

ORIGINE METEO-FRANCE, STATION DE DUNKERQUE LE
MARDI25 OCTOBRE 1994 A 08 HEURES

1 - AVIS DE GRAND FRAIS FORCE 7 EN COURS JUSQU'A 18H00.

2 - SITUATION GENERATE :

RAPEDE COURANT DE SUD-OUEST DIRIGE PAR LA DEPRESSION DE 985 HPA CENTREE AU NORD MMEDIAT DE L'ECOSSE.

3 - PREVISIONS POUR LA TOURNEE DU MARDI 25 OCTOBRE 1994 :

. TEMPS : NUAGEUX AVEC PLUIE, PUIS AVERSES PARFOIS ORAGEUSES.
. VENT: SECTEUR SUD-OUEST FORCE 5 A 6 (20/25 ND), PUIS TEMPORAIREMENT FORCE 6 A 7 (25/30 ND) RAFALES SOUS GRAINS. . MER: DEVENANT AGITEE, FORTE AU SUD DE LA ZONE. . VISI: VOISINE DE 5 MILLES, REDUITE SOUS GRAINS. . T° MAXIMALE : 13 A 14°C.

4 - PROBABILITES POUR LA NUTT DU MARDI 25 AU MERCREDI26 OCTOBRE 1994 :

. TEMPS : A GRAINS.
. VENT : DE SUD-OUEST IRREGULIER MOLLISSANT FORCE 4 A 5 (15/20 ND).
. MER : DEVENANT PEU AGITEE A AGITEE.
. VISI: VOISINE DE 5 MILLES, REDUITE SOUS GRAINS.
. T° MINIMALE : 08 A 10°C.

5 - TENDANCE ULTERIEURE POUR LA TOURNEE DU MERCREDI 26 OCTOBRE 1994 :

SUD-OUEST FORCE 4 A 6 (15/25 ND).

6 - OBSERVATIONS DU SEMAPHORE DE DUNKERQUE CE TOUR A 07H00 LOCALES :

. VENT : SUD 14 NOEUDS.
. MER: PEU AGITEE.
. VISI: 10 MILLES NAUTIQUES.
. TEMPERATURE: 08°C.
. PRESSION : 999 **HPA.**

FIN DE BULLETIN

REPONDEUR MARINE: 36 68 08 59 pour la cote et le rivage
36 68 08 08 pour ie large (2,19 F/mm) MINITEL : 36 15 METEO

MINISTERE DES TRAVAUX PUBLICS
DE LA FORMATION PROFESSIONNELLE
ET DE LA FORMATION DES CADRES

DIRECTION DE LA METEOROLOGIE NATIONALE

CENTRE NATIONAL DE PREVISIONS

SERVICE DE METEOROLOGIE MARITIME

BULLETIN METEOROLOGIOUE POUR LA NAVIGATION ET LA PECHE COTIERE

BULLETIN DU 19/09/94 1230UTC

AVIS DE : GRAND FRAIS EN COURS

ZONE MENACEE : DETROIT

INDICATION DU PHENOMENE : VENT ATTEIGNANT FORCE 6 A 7

SITUATION METEOROLOGIOUE LE 19/09/94 A 0600UTC

FLUX D'EST A NORD-EST SUR LE PAYS.

PREVISION PAR ZONE VALABLE JUSOU'AU 20/09/94 A 0600UTC

MEDITERANEE :
VENT : E FORCE 3 A 4.
VISIBILITE : 4 MILES
MER: AGITEE

DETROIT :
VENT :E FORCE 6 A 7.
VISIBILITE : 4 MILES
HOULE : MODERE
MER : AGITEE

NORD MAROC :
VENT : E A NE FORCE 3 A 4.
VISIBILITE : 4 MILES REDUITE A 2 PAR BRUME.
HOULE : WNW 1.50 A 2.00M
MER : AGITEE

CENTRE MAROC :
VENT : E A NE FORCE 3 A 4.
VISIBILITE : 4 MILES REDUITE A 2 PAR BRUME.
HOULE : NW 1.50 A 2.00M
MER : AGITEE

SUP MAROC :
VENT : NE FORCE 3 A 4.
VISIBILITE : 4 MILES REDUITE A 2 PAR BRUME.
HOULE : NNW 1.50 A 2.00M
MER : AGITEE

ANEXO (1)

(MODELO DE PRONOSTICO GENERAL PARA EL LITORAL)

DIRECCION DE HIDROGRAFIA Y NAVEGACION DE LA MARINA

PRONOSTICO ESTADO DEL TIEMPO NAVEGACION MARITIMA LINEA DE COSTA

HASTA LAS 100 MILLAS OESTE

FECHA :. 16SETIEMBRE 1994
PERIODO : 0000/2400 HORAS K

ZONA 03/05 GRADOS SUR

NUBOSIDAD : NUBLADO POR ESTRATOCUMULOS ENTRE 750/900 METROS, ALTOCUMULOS ENTRE 3000/3500 METROS K GRADUALMENTE NUBLADO PARCIAL AL MEDIODIA K TEMPORALMENTE DESPEJADO

VISIBILIDAD : 12/16 KILOMETROS K

DIRECCION Y VELOCIDAD DEL VIENTO : 160/180 GRADOS CON 04/08 NUDOS K TEMPORALMENTE 220/260 GRADOS EN HRAS DE LA TARDE

ESTADO DEL MAR : 0 KINTERMITENTE 1

ZONA 05/13 GRADOS SUR

NUBOSIDAD *:* CUBIERTO POR ESTRATOS ENTRE 240/330 METROS ESTRATOCUMULOS ENTRE 450/750 METROS, ALTOCUMULOS ENTRE 3200/3300 METROS K SECTOR PAITA/CHIMBOTE VARIANDO A NUBLADO AL MEDIODIA K RESTO DEL AREA TEMPORALMENTE NUBLADO EN HORAS DE LA TARDEK

VISIBILIDAD : 06/10 KILOMETROS K NIEBLA LIGERA K GRADUALMENTE MEJORANDO AL MEDIODIA K HORIZONTE BRUMOSO

DIRECCION Y VELOCIDAD DEL VIENTO : 160/180 GRADOS CON 08/10 NUDOS K TEMPORALMENTE CALMA A VIENTO LIGEROS VARIABLES ENTRE 0400/0800 HORAS K

ESTADO DEL MAR : 2 K INTERMITENTE 3/4

ZONA 13/19 GRADOS SUR

NUBOSIDAD : NUBLADO POR ESTRATOS/ESTRATOCUMULOS ENTRE 300/600 METROS K VARIANDO A NUBLADO PARCIAL EN HORAS DE LA TARDEK

VISIBILIDAD : 06/10 KILOMETROS K BRUMOSO/NIEBLA LIGERA

DIRECCION Y VELOCIDAD DEL VIENTO : 120/160 GRADOS CON 10/14 NUDOS K TEMPORALMENTE RAFAGAS 16/20 NUDOS EN HORAS DE LA TARDE K

ESTADO DEL MAR; 3 K INTERMITENTE 4

Chucuito, 15 Setiembre 1994

ANNEX 4.B **EXAMPLE OF A TROPICAL CYCLONE WARNING FOR COASTAL AREAS**

(Reference paragraph 4.2.2.1)

Sample Port Warning message issued by ACWC Bombay on 8-11-82

Port Warning

Class: XXW Storm (Brief and General Ports)

Office of crisis: Weather Colaba Code time: 0430 hrs 1ST Date: 8-11 -82

Service Instruction: Storm No. of addresses:

No. of words:

A) Severe cyclonic storm with a core of hurricane winds with estimated Central Pressure 990 mb lies centred at 2330 hrs 1ST of 7th Nov. about 475 km Southwest of Bombay. System likely move NEly direction and cross South Gujarat coast, North Maharashtra coast between Alibag and Bulsar during early morning of 9th Nov.

I) Address

Port Officials at Talaja to Bharuch.

Text A+ Hoist Local cautionary signal No. III.

II) Port Officer Bhavnagar

A+ Replace present signal by Great Danger signal No. VIII.

III) Port Office Porbandar to Veraval

Text A+ Keep Local cautionary signal No. **III** hoisted.

IV) Address Port Officials Diu to Alibag

Text A+ Replace present signal by Great Danger signal No. X.

V) Address: Port Officials Revdanda to Marmagao

Text A+ Keep Local cautionary signal No. **Ill** hoisted.

VI) For Port without signals

1) Port Clerk Incharge Bhagwa to Ulwa/Belapur.

A+ Markedly squally weather with very rough to high seas likely along off your Port during next 24 hrs.

ANNEX 4.C EXAMPLES OF A WIND WARNING FOR COASTAL WATERS

■■(Reference paragraph 4.2.2.1)

MARINE FORECASTS FOR THE GREAT LAKES AND THE ONTARIO PORTION OF THE ST. LAWRENCE RIVER ISSUED BY ENVIRONMENT CANADA FROM THE REGIONAL WEATHER CENTRE IN THUNDER BAY AT 10.30 AM EDT TUESDAY 13 TUNE 2000 FOR THE PERIOD ENDING AT 10.30 AM WEDNESDAY WITH AN OUTLOOK FOR THE FOLLOWING 24 HOURS. THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 6.30 PM TODAY.

WESTERN LAKE SUPERIOR
..SMALL CRAFT WIND WARNING IN EFFECT..
..SMALL CRAFT THUNDERSTORM ADVISORY ISSUED..

WIND EASTERLY 10 TO 15 KNOTS INCREASING TO SOUTHEAST 15 TO 25 THIS EVENING AND VEERING TO SOUTHERLY WEDNESDAY MORNING. FAIR. A FEW SHOWERS OR THUNDERSTORMS DEVELOPING OVERNIGHT AND ENDING WEDNESDAY MORNING. WAVES LESS THAN 1 METRE BUILDING TO 1 TO 2 THIS EVENING. HIGHER WINDS AND WAVES NEAR THUNDERSTORMS.

WEATHER INFORMATION FOR SOUTH CHINA COASTAL WATERS

WARNINGS:
GALE FORCE WINDS IN NAN'AO, SHANWEI, SOUTH OF HONG KONG AND SHANGCHUAN DAO.
STRONG WINDS IN HONG KONG ADJACENT WATERS.

WEATHER SITUATION:
AN INTENSE NORTHEAST MONSOON PERSISTS OVER THE SOUTH CHINA COASTAL WATERS.
MEANWHILE, A BROAD CLOUD BAND IS BRINGING UNSETTLED WEATHER TO THE REGION.

AREA FORECASTS FOR THE NEXT 24 HOURS

HONG KONG ADJACENT WATERS: EAST FORCE 6, FORCE 7 AT FIRST. SOME RAIN. ROUGH SEAS.

NAN'AO AND SHANWEI: EAST TO NORTHEAST FORCE 7 TO 8. SCATTERED SQUALLY SHOWERS AND THUNDERSTORMS. ROUGH TO VERY ROUGH SEAS.

SOUTH OF HONG KONG AND SHANGCHUAN DAO: EAST FORCE 7. UP TO FORCE 8 AT FIRST.
OCCASIONAL SQUALLY SHOWERS AND THUNDERSTORMS. ROUGH TO VERY ROUGH SEAS.

OUTLOOK FOR THE FOLLOWING 24 HOURS
EASTERLY WINDS OF FORCE 6. SQUALLY SHOWERS AND THUNDERSTORMS IN WEST AT FIRST.

IDW00V00
BUREAU OF METEOROLOGY
AREA05:

Strong Wind Warning
for Victorian coastal waters west of Cape Otway

Issued at 0430 on Wednesday the 25th of October 2000

Southerly winds of 20/25knots, reaching 30 knots at times. Winds moderating to 15/20knots during today. Seas of 2 to 3 metres abating to 1 to 2 metres later. Southwesterly swell of 2 to 3 metres. 2:31:11:11:00

BT

ZCZC

PAN PAN=

MESSAGE FOR NAVAREA XI(IOR) ISSUED BY NMC, BEIJING

AT 1015UTC OCT. 25 2000=

MESSAGE IS UPDATED EVERY 06 HOURS=

SYNOPSIS VALID 0600UTC OCT. 25=

FORECAST VALID 0600UTC OCT. 26=

WARNING=

TY 0019(0019)YAGI 975HPA AT 25.IN 124.5E MOVING NW 12KM/H AND MAX WINDS 33M/S NEAR CENTER SEAS UP TO 9.5M AND RADIUS OF 30KTS 350KM AND RADIUS OF 50KTS 100KM

FORECAST FOR 260600UTC AT 25.3N 121.7E 980HPA MAX WINDS 30M/S NEAR CENTER=

SUMMARY=
COLD FRONT FROM 50N 143E TO 47N 142E 42N 137E 41N 131E=
LOW 1004HPA AT UN 135E MOVING W SLOWLY=
N WINDS FROM 10 TO 16M/S SEAS UP TO 3.5M OVER BOHAI SEA AND YELLOW SEA AND NORTH OF EAST CHINA SEA AND SOUTHEAST OF SOUTH CHINA SEA AND SOUTHWEST OF SEA OF JAPAN=
WINDS FROM 10 TO 18M/S SEAS UP TO 4.0M OVER NORTH AND EAST OF SEA OF JAPAN AND SEA EAST OF JAPAN=
WINDS FORM 16 TO 33M/S SEA UP TO 11.0M OVER SOUTH OF EAST CHINA SEA AND TAIWAN STRAIT AND SEA EAST OF TAIWAN=
WINDS FROM 10 TO 16M/S SEA UP TO 3.5M OVER SEA EAST OF PHILIPPINES=
HORIZONTAL VISIBILITY LESS THAN 10KM OVER SOUTH OF EAST CHINA SEA AND TAIWAN STRAIT AND BASHI CHANNEL AND SEA EAST OF TAIWAN=
HORIZONTAL VISIBILITY LESS THAN 10KM OVER SOUTH OF SEA OF JAPAN AND SEA SOUTH AND EAST OF JAPAN=
HORIZONTAL VISIBILITY LESS THAN 10KM OVER ANDAMAN SEA AND NORTH OF GULF OF THAILAND AND SEA WEST OF SUMETERA AND SEA SOUTH OF JAWA AND LAUT JAWA AND LAUT MALUKU AND LAUT BANDA AND SEL. MAKASSAR=

FORECAST=
N WINDS FROM 10 TO 16M/S SEAS UP TO 3.5M OVER BOHAI SEA AND YELLOW SEA AND EAST CHINA SEA AND KOREA STRAIT AND SEA OF JAPAN=
SW WINDS FROM 8 TO 14M/S SEAS UP TO 3.0M OVER SEA SOUTH OF JAPAN=
WINDS FROM 14 TO 28M/S SEAS UP TO 8.0M OVER SEA EAST OF TAIWAN AND TAIWAN STRAIT AND EAST CHINA SEA=

BULLETIN - IMMEDIATE BROADCAST REQUESTED
SPECIAL MARINE WARNING...CORRECTED NATIONAL
WEATHER SERVICE KEY WEST FL 1115 PM EDT THU
APR 13 2000

THE NATIONAL WEATHER SERVICE IN KEY WEST HAS ISSUED A

* SPECIAL MARINE WARNING FOR...
  - THE GULF OF MEXICO COASTAL WATERS
  FROM EAST CAPE SABLE TO CHOKOLOSKEE 20 TO 60 NM OUT

* UNTIL MIDNIGHT EDT

* THIS INCLUDES PORTIONS OF THE COASTAL WATERS OF MONROE COUNTY (FLORIDA KEYS).

* AT 1115 PM...KEY WEST DOPPLER RADAR INDICATED A WATERSPOUT NEAR 60 MILES WEST OF EAST CAPE SABLE. MOVEMENT WAS NORTH NEAR 15 MPH. THE WATERSPOUT WAS ASSOCIATED WITH A CLUSTER OF STRONG STORMS MOVING NORTH THROUGH THE GULF WATERS 40 TO 60 MILES WEST OF CAPE SABLE. CONDITIONS WILL REMAIN FAVORABLE FOR ADDITIONAL WATERSPOUTS TO FORM IN THE WARNING AREA. ALSO...WrND GUSTS TO 35 KNOTS ARE EXPECTED NEAR THE STRONGER STORMS.

  BOATERS SHOULD BE ALERT FOR WATERSPOUT ACTIVITY. TAKE IMMEDIATE EVASIVE ACTION IF THREATENED. THE BEST COURSE OF ACTION IS TO MOVE AWAY FROM THE WATERSPOUT AT A 90 DEGREE ANGLE FROM ITS APPARENT MOVEMENT.

fTHmi* *->3!) 201800

2 10 0 *3!$mm* 2 10 0 6B#0 *0ft?m*

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so/*7hsx*±<*D&m& fty&m 50mm itwm* 3511
*30/yh$X*±.<*D&m.&* ¥& 2 0 0$tS
2 *4mrmft\~*>bttft:<Dfk*:mM8 0 J ? v* 1^1-5 n,&^
"?n 2 1015B#
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***WffiBilfc* 3 0 N 1 2 7 E 3 4 N 1 2 7 E 3 8 N 1 4 0 E**
3 9 N 1 5 0 E 4 0 N 1 6 0E 3 8 N 1 6 8 E

WWJP81 RJTD 201800

VITAL WARNING FOR NAHANAVTEX AREA
201800UTC ISSUED AT 202100UTC
TYPHOON 9918 BART (9918) 965HPA AT 24. IN 125. 2E ALMOST STATIONARY
POSITION GOOD
MAX WINDS 70 KNOTS NEAR CENTER
RADIUS OF OVER 50 KNOT WINDS 50 MILES SE SIDE AND 35 MILES ELSEWHERE
RADIUS OF OVER 30 KNOT WINDS 200 MILES
EXPECTED MAX WINDS 80 KNOTS NEAR CENTRE FOR NEXT 24 HOURS
FORECAST POSITION FOR 210600UTC AT 24. 3N 126. 2E WITH 50 MILES RADIUS OF 70 PERCENT PROBABILITY CIRCLE
FORECAST POSITION FOR 211800UTC AT 24. 9N 127. IE WITH 90 MILES

RADIUS OF 70 PERCENT PROBABILITY CIRCLE
OUTLOOK POSITION FOR 221800UTC AT 26. ON 128. WITH 160 MILES
STATIONARY FRONT FROM 30N 127E TO 34N 127E 38N 140E 39N 150E
40N 160E 38N 168E
TYPHOON WARNING SEA SOUTH OF OKINAWA WITH MAX WINDS 80 KNOTS,
SOUTHERN PART OF EAST CHINA SEA WITH 70 KNOTS
STORM WARNING SEA EAST OF OKINAWA WITH 50 KNOTS
GALE WARNING SEA AROUND AMAMI WITH 40 KNOTS
NEXT WARNING WILL BE ISSUED BEFORE 210300UTC=

ANNEX 4.D **EXAMPLES OF A WARNING OF ICE**

ACCRETION

(Reference paragraph 4.2.2.1)

FPCN20 CWQT 172323
MARINE FORECASTS FOR THE GREAT LAKES AND THE ONTARIO PORTION OF THE ST. LAWRENCE RIVER ISSUED BY ENVIRONMENT CANADA FROM THE REGIONAL WEATHER CENTRE IN THUNDER BAY AT 6.30 PM EST MONDAY 17 JANUARY 2000 FOR THE PERIOD ENDING AT 6.30 PM TUESDAY WITH AN OUTLOOK FOR THE FOLLOWING 24 HOURS.

THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 3.00 AM TUESDAY

NOTE..THE SMALL CRAFT WARNING PROGRAM IS ACTIVE FROM MAY 01 TO OCTOBER 31.

WINDS ARE FOR MID LAKE. WAVE HEIGHTS ARE FOR OFFSHORE AND ARE FORECAST FROM TROUGH TO CREST. NEARSHORE WINDS AND WAVES MAY VARY CONSIDERABLY DUE TO SHORELINE EFFECTS.

EASTERN LAKE SUPERIOR. ..FREEZING
SPRAY WARNING IN EFFECT..
WIND SOUTHEAST 25 TO 30 KNOTS DIMINISHING TO 15 TO 25 NEAR DAWN THEN TO VARIABLE 10 TO 15 IN THE MORNING. WIND INCREASING TO NORTHWEST 15 TO 25 AROUND MIDDAY. SNOW. FREEZING SPRAY ENDING THIS EVENING.
WAVES 2 TO 3 METRES LOWERING TO NEAR 1 IN THE MORNING.
OUTLOOK..STRONG NORTHWESTERLIES.

Warning issued by JMA on 22 January 2000

WWJP85 RJTD 221200
VITAL WARNING FOR KUSHIRO NAVTEX AREA
221200UTC ISSUED AT 221500UTC
STEEP PRESSURE GRADIENT CONTINUES
GALE WARNING SEA EAST OF SAKHALIN, SEA EAST OF HOKKAIDO, SEA OFF KUSHIRO WITH MAX WINDS 35 KNOTS
WARNING(NEAR GALE) SEA OFF ABASHIRI, SOYA KAIKYO, SEA OFF HIDAKA. TSUGARU KAIKYO, EASTERN SEA OFF SANRIKU
WARNING(ICTNG) SEA EAST OF SAKHALIN, SEA OFF ABASHIRI, SOYA KAIKYO, SEA EAST OF HOKKAIDO, SEA OFF KUSHIRO
NEXT WARNING WILL BE ISSUED BEFORE 222100UTC =

ANNEX 4.E EXAMPLES OF A WARNING OF LOW VISIBILITY

(Reference paragraph 4.2.2.1)

SOUTH OF NEW ENGL AND...FROM THE GREAT SOUTH CHANNEL TO HUDSON
CANYON INCLUDING THE WATERS SOUTH OF MARTHAS VINEYARD AND
NANTUCKET ISLAND...OUT TO ONE THOUSAND FATHOMS

...GALE WARNING...

.OVERNIGHT...E WINDS 25 TO 35 KT. SEAS 11 TO 14 FT. SCATTERED
SHOWERS AND TSTMS. VISIBILITY BELOW 1 NM IN RAIN AND FOG.
.WED...E PORTION...SE WINDS DIMINISHING TO 15 TO 25 KT.
W PORTION...NE WINDS DIMINISHING TO 10 TO 20 KT. SEAS SUBSIDING TO
9 TO 13 FT THROUGHOUT. VSBY OCCASIONALLY BELOW 1 NM IN
SHOWERS...RAIN...AND FOG.
.WED NIGHT...WINDS BECOMING E TO NE 10 TO 15 KT THROUGHOUT. SEAS
SUBSIDING TO 7 TO 10 FT. RAIN AND FOG DIMINISHING. VSBY
OCCASIONALLY BELOW 1 NM.
.THU...E TO NE WINDS 10 KT OR LESS. SEAS 6 TO 9 FT. MORNING FOG.
$$

warning issued by JMA on 24 September 2000

WWJP84 RJTD 240600
VITAL WARNING FOR OTARU NAVTEX AREA
240600UTC ISSUED AT 240900UTC
DEVELOPING LOW 1004HPA AT 41N 137E MOVING ENE 10 KNOTS
LOW 1004HPA AT 36N 142E MOVING NNE 15 KNOTS
GALE WARNING TSUGARU KAIKYO, SEA OFF HIYAMA AND TSUGARU WITH MAX WINDS 40 KNOTS,
SOYA KAIKYO, SEA WEST OF HOKKAIDO, SEA OFF SOUTHERN COAST OF MARITIME PROVINCE,
SEA OFF AKITA, SEA OFF SADO WITH 35 KNOTS

WARNING(NEAR GALE) SEA WEST OF SAKHALIN, SEA OFF NOTO

WARNING(DENSE FOG) TSUGARU KAIKYO, SEA OFF HIYAMA AND TSUGARU
POOR VISIBILITY 0.3 MILES OR LESS IN PLACES NEXT WARNING WILL BE
ISSUED BEFORE 241500UTC =

t7*MM2 &**) 141800 1 5 0O3H#«$I

1 5B0 6B#0 0#3§*

m±mm¥m (*/h«go. *3 mm*

z.<n¥&<n%tfmimfti 6 p 0 3B#£-e-e-r

WSWJP72 RJTD 141800

IMPORTANT WARNING FOR MOJINAVTEX AREA
141800UTC ISSUED AT 142100UTC
WARING (DENSE FOG) SEA OFF SOUTHERN COAST OF MARITIME
PROVINCE, SEA OFF NOTO POOR VISIBILITY 0.3 MILES OR LESS IN PLACES
NEXT WARNING WILL BE ISSUED BEFORE 241500UTC =

ANNEX 4E **EXAMPLES OF A WARNING**

OF SEA-ICE

(Reference paragraph 4.2.2.1)

EXAMPLE 1

FICN01 CWIS 061500
ICE HAZARD BULLETIN FOR THE GULF OF ST LAWRENCE ISSUED BY ENVIRONMENT CANADA FROM CANADIAN ICE SERVICE IN OTTAWA AT 1500 UTC TUESDAY 6 FEBRUARY 1996.

ICE WARNINGS FOR AREAS OF STRONG ICE PRESSURE ALONG THE WEST COAST OF NEWFOUNDLAND AND ALONG THE SOUTH SHORE OF THE ST LAWRENCE RIVER ARE IN EFFECT UNTIL WEDNESDAY MORNING.

ICE EDGE AT 1500 UTC ESTIMATED FROM THE CAPE BRETON COAST NEAR 4555N 5950W TO 4530N 5930W TO 4550N 5850W TO 4630N 5900W TO THE NEWFOUNDLAND COAST NEAR 4740N 5905W

MARINERS ARE ADVISED TO OBTAIN FURTHER INFORMATION BEFORE ENTERING THE ICE AREA. FOR MORE ICE INFORMATION, PLEASE CONTACT CANADIAN ICE SERVICE FROM ENVIRONMENT CANADA AT PHONE 613-996-1550 OR FAX AT 613-947-9160.

ENDMT

EXAMPLE 2

FICN02 CWIS 061500
ICE HAZARD BULLETIN FOR EAST NEWFOUNDLAND WATERS AND THE LABRADOR COAST ISSUED BY ENVIRONMENT CANADA FROM CANADIAN ICE SERVICE IN OTTAWA AT 1500 UTC TUESDAY 6 FEBRUARY 1996.

ICE WARNINGS FOR THE UNUSAL INTRUSION OF ICE OVER THE GRAND BANKS WELL REMAIN IN EFFECT FOR THE NEXT 24 HOURS.

ICE EDGE AT 1500 UTC ESTIMATED FROM THE NEWFOUNDLAND COAST NEAR 4640N 5310W TO 4545N 5240WTO4610N 5040W TO 4730N 4930W TO 4920N 4920W TO 5500N 5320W THEN NORTHWARD.

MARINERS ARE ADVISED TO OBTAIN FURTHER INFORMATION BEFORE ENTERING THE ICE AREA. FOR MORE ICE INFORMATION, PLEASE CONTACT CANADIAN ICE SERVICE FROM ENVIRONMENT CANADA AT PHONE 613-996-1550 OR FAX AT 613-947-9160.

END MT

ANNEX 4.G EXAMPLES OF

WARNINGS OF A STORM SURGE

((Reference paragraph 4.2.2.1!)

HAWAIIAN WATERS
;6 PM HST SAT APR 1 2000

..GALE WARNINGS ARE EFFECTIVE AT *6* PM HST FOR ALL HAWAIIAN CHANNEL WATERS DDE TO STRONG AND GUSTY TRADE WINDS...

. CAUTION IS ADVISED FOR KAHULUI AND HILO HARBORSDUE TO A NORTH SWELL THAT MAY CAUSE MODERATE HARBOR SURGES TONIGHT AND SUNDAY...

. A SMALL CRAFT ADVISORY REMAINS IN EFFECT FOR THE REMAINING HAWAIIAN WATERS DUE TO STRONG AND GUSTY TRADE WINDS.. .

...A HIGH SURF ADVISORY REMAINS INEFFECTEQR ALL NORTH AND WEST SHORES...

ANEXO (3)|

{MODELO ©E AVISO *BE* OLEAITE IRREGULAR PARA IiOS PUERTOS DEL LITORAL)

PROMOTOR : DTRECOION DE HIDROGRAFIA Y NAVEGACION

GAPITANIAS ©EPUERTO

OFICINA DE INFORMACION DE LA MARINA
CAPITAMAS DE PUERTO EN LA COSTA NORTE
DEFENSAOViL

AVISO ESPECIAL N° a

©GURRENCIA ©E OLEA3E IRREGULAR

ZONA;
COSTA SUR/CENTRO/WORTE

BORA DE INICIO :
APROXTMADAMENTE ENTRE 072000/080000 HORAS LOCAL

TIPO/INTENSIDAD :
OLEAJE IRREGULAR LIGERO INCREMENTANDOSE ACELERADAMENTE A OLEAJE IRREGULAR MODERADO/FUERTE CON INTERMITENCIAS DE MUY FUERTE A PARTIR DE 080600 HORAS K TOMAR MAXIMAS PRECAUCIONES ESPECIALMENTE CON EMBARCACIONES PEQUENAS Y ESTRUCTURAS COSTERAS K A PARTIR DIA 10 DISMINUYENDO GRADUALMENTE K ESTIMASE CONDICIONES NORMALES A PARTIR DEL DIA 12 K.

DURACION : 4 DIAS K CAPITANIAS DE PUERTO REQUIERESE CONFIRMACION INICIO E INTENSIDAD DEL EVENTO K CONTINUARASE INFORMANDO K.

Chucuito, 07 Agosto 1994 /

ADVICE AND WARNING ISSUED FOR STORM TIDE EVENT — 13 JULY 1995

STORM TIDE ADVICE FOR GULF ST VINCENT AND SPENCER GULF
Bureau of Meteorology Adelaide
Issued at 10.25 am on Thursday, 13/07/95

The Bureau advises that strong winds and low atmospheric pressure will cause tides in Gulf St Vincent and Spencer Gulf to be higher than predicted by tide tables during this afternoon and evening.

Tide levels are expected to exceed 3.75 metres at the Port Adelaide Outer Harbour Gauge (local gauge datum) between about 4 pm and 7 pm today.

We will continue to monitor the situation and the next advice will be issued at 2 pm.

ANNEX 4.H EXAMPLES OF A WARNING OF HIGH SURF

(Reference paragraph 4.2.2.1)

SIGNIFICANT SWELL/HIGH SEAS

RADII OF SEAS OVER 6M, 10M, 14M FROM CENTRE OF YAGI ARE 120, 60 30NM.
SWELL N 4-5 M OVER SEAS NEAR TAIWAN AND LUZON STRAIT? SE 3-4 M OVER EAST CHINA SEA.

THUNDERSTORMS/SEVERE WEATHER
FREQUENT SQUALLY(SQ) SHOWERS(SH) AND THUNDERSTORMS (TS) OVER SEAS NEAR TAIWAN.
SCATTERED SQ SH TS OVER LUZON STRAIT AND SEAS NEAR PHILIPPINES.

SEA FOG/REDUCED VISIBILITY
VIS DOWN TO 500 M IN SQ SH TS.

FZUS76 KPQR 250934 ORZ001-002-PZZ250-
255-WAZ021-252300-

MARME WEATHER STATEMENT
NATIONAL WEATHER SERVICE PORTLAND OR
230 AM PDT TUE APR 25 2000

...HEAVY SURF ADVISORY ISSUED FROM CAPE SHOALWATER TO NEWPORT...

THE NATIONAL WEATHER SERVICE HAS ISSUED A HEAVY SURF ADVISORY FROM CAPE SHOALWATER WASHINGTON TO NEWPORT OREGON. LARGE OCEAN WAVES REPORTED BY THE BUOY ABOUT 300 MILES WEST OF ASTORIA WILL BE MOVING INTO THE COASTAL BEACHES AROUND MIDDAY

SWELLS OF 19 TO 22 FT WILL REACH THE BUOYS NEAR THE COAST BY EARLY AFTERNOON FROM NEWPORT TO CAPE SHOALWATER. THESE LARGE WAVES WILL CONTAIN SUFFICIENT ENERGY TO PRODUCE AREAS OF BEACH EROSION.

WAVES OF THIS SIZE ARE ALSO CAPABLE OF ROLLING LARGE LOGS ALONG THE BEACH AND THROWING DEBRIS WELL UP THE BEACH. PERSONS ARE URGED TO USE CAUTION ALONG THE BEACHES TODAY AS SNEAKERS WAVES ARE POSSIBLE AT ANYTIME.

THE LARGE SEAS WILL SUBSIDE THIS EVENING WITH THR THREAT OF BEACH EROSION ENDING. FZUS76 KPQR 252201 ORZ001-002-PZZ250-255-WAZ021-261200-

NAVIGATION WARNING - URGENT

From: Shipping Forecaster
Weather Bureau **Tel. 012 309 3794**
Private Bag X097 **Fax. 012 309 3990**
Pretoria 0001
To: Duty Officer, Hyorographic Office
Fax. 021 787 2228

Subject: Warning of Expected Abnormal Wave Conditions.

Abnormally high waves are possible in the Agulhas Current between Algoa Bay and Port St Johns spreading northwards.

Warning valid: immediate - until 20 July 1200 UTC

QZA30 FAPR 300830

WEATHER BULLETIN FOR COASTAL WATERS UP TO 50 NAUTICAL MILES SEAWARD. ISSUED AT 08:30 UTC BY THE SOUTH AFRICAN WEATHER BUREAU ON THE 30TH OF OCTOBER 2000 VALID FROM 301000 TO 302200 UTC. WIND IN KNOTS, SEA AND SWELL IN METRES.

Note the wind speeds quoted here are the expected average speeds. Individual gusts may exceed these values by a factor of up to 1.5. Wave heights are also average heights which may be accompanied by individual waves 1.5 to 2.0 times higher.

Only when swell and/ or wind wave height exceed 2.5m will sea state be mentioned.

GALE WARNINGS:

1. WALVIS BAY TO THE ORANGE RIVER: SE 35 at times in the south.
2. ORANGE RIVER TO CAPE AGULHAS: SE 35-40 between Cape Point and Cape Columbine.

CUNENE RIVER TO WALVIS BAY:
WIND : SW 10-15, becoming NW 10 in the south later.
VIS : Good, but moderate in light rain at times in the extreme north.

WALVIS BAY TO THE ORANGE RIVER:
WIND : NW 10 in the north, otherwise S/SW 15 but SE 30 in the south where reaching 35 at times.
VIS : Good.
SEA : Rough in the south.

ORANGE RIVER TO CAPE AGULHAS:
WIND : SE 25-30, reaching 35-40 between Cape Point and Cape Columbine.
VIS : Good.
SEA : Rough to very rough.
SWELL : S/SE 2.5-3.0m in the south at first.

CAPE AGULHAS TO EAST LONDON:
WIND : SW 20-25, but SE 15 west of Plettenberg Bay, reaching 25 in the Agulhas area.
VIS : Poor in showers, clearing in the west later.
SEA : Moderate to rough.
SWELL : S/SE 3.5m, moderating somewhat later.

URF OBSERVATIONS AT SELECTED OAHU BEACHES
NATIONAL WEATHER SERVICE HONOLULU HI 2 PM
HST THU APR 13 2000 MID AFTERNOON

BEACH	HEIGHTS	REMAE
EHUKAI	3 TO 5	2 PM
SUNSET	4 TO 6	7 AM
MAKAPUU	3 TO 4	2 PM
SANDY BEACH	2 TO 3	2 PM
DIAMOND HEAD	1T0 2	7AM
WAIKIKI	1T0 2	2 PM
ALA MOANA	1T0 2	2 PM
NANAKULI	1T0 2	2 PM
MAILI BEACH	3	2 PM
MAKAHA	3 TO 4	2 PM

SURF ALONG NORTH SHORES WILL INCREASE TO HEIGHTS OF 6 TO 8 FT TODAY THEN WILL GRADUALLY DECREASE TO HEIGHTS OF 3 TO 6 FT ON FRIDAY.

SURF ALONG WEST SHORES WILL BE 3 TO 6 FT TODAY THEN WILL DECREASE TO HEIGHTS OF 2 TO 4 FT ON FRIDAY

SURF ALONG SOUTH AND EAST SHORES WILL BE 1 TO 3 FT TODAY THROUGH FRIDAY.

ANNEX 4.I **EXAMPLES**

OF A TSUNAMI WARNING

(Reference paragraph 4.2.2.1)

t7*7"t$65 *Sm* 171225

¥/£8^2£ 1 7B2 1P#2 5# aUfcJ?5S*

WEJP65 RJTD 171225

FOR KUSHIRO NAVTEX AREA
EMERGENCY TSUNAMI WARNING
TSUNAMI EXPECTED
PACIFIC COAST OF HOKKAIDO
PACIFIC COAST OF NE HONSHU
ISSUED FROM JMA TOKYO AT 171225 UTC=

***iTViite* *y3>> 171225**

¥fi£8*£2£ 1 7B0 0B#2 8# *Ul-&*EaUfci&f&

¥/&8^2£l 7B2 1P#2 5# 3MfcJr3S*

WEJP85 RJTD 171225

FOR KUSHIRO NAVTEX AREA
FOLLOWING WARNING IS VALID NOW
TSUNAMI EXPECTED
PACIFIC COAST OF HOKKAIDO
PACIFIC COAST OF NE HONSHU
ISSUED FROM JMA TOKYO AT 171225 UTC=

t7*7ti64 *->39 171225

¥J&8^2£ 1 702 1B#2 5# ^Jffg^

WEJP64 RJTD 171225

FOR OTARU NAVTEX AREA
EMERGENCY TSUNAMI WARNING
TSUNAMI EXPECTED
PACIFIC COAST OF HOKKAIDO
PACIFIC COAST OF NE HONSHU
ISSUED FROM JMA TOKYO AT 171225 UTC=

i?nm m> 171225

¥i&8^2£ 1 7B0 0P#2 8# {lIl-MFK&*#S

¥$8*P2£ 1 7B2 lf$2 5# m^if^^

WEJP84 RJTD 171225

FOR OTARU NAVTEX AREA
FOLLOWING WARNFNG IS VALID NOW
TSUNAMI EXPECTED
PACIFIC COAST OF HOKKAIDO
PACIFIC COAST OF NE HONSHU
ISSUED FROM JMA TOKYO AT 171225 UTC=

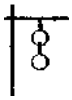
tr?t$63 *y30 171225

mm mm

¥/£8*£2£ 1 7B2 li$2 5# m&JTf£^

ANNEX 4 J INTERNATIONAL SYSTEM OF VISUAL STORM WARNING SIGNALS

(Reference paragraph 4.2.3)

Day signals	*Description of wind force*	*Night signals*	*Remarks*
0	Near gale any direction	H—i—	This signal applies to wind Beaufort force 7 (28-33 kt) (see Note (2) *b)*
	Gale or storm commencing in the NW quadrant		
	Gale or storm commencing in the SW quadrant		The cones apply to wind of Beaufort force 8 (34-10 kt) or more (see Note (2) c)
	Gale or storm commencing in the NE quadrant	T	
	Gale or storm commencing in the SE quadrant	T	
	Wind is expected to veer (clockwise change in direction)		Flags may be of any suitable colour
E	Wind is expected to back (counterclockwise change in direction)		
	Hurricane (or local synonym) with wind of Beaufort force 12 (64 kt and above) from any direction		

Legend

O *White*
\# *Green*
• *Red*

NOTES: (1) More than one day signal may be hosted simultaneously if desired, e.g.:

(a) To indicate a gale commencing in the SW quadrant and veering (in this case, the original direction is indicated by the cones);

(b) To indicate the direction of an expected near gale (in this case, the ball is hoisted together with the appropriate cones).

(2) Additional signals may be used to meet local requirements:

(a) Provided their appearance and specifications are distinct from those of the international signals;

(b) Or, additionally, to force 6 (22-27 kt) if local circumstances, e.g. fishing activities, etc. require such a lower hmit;

(c) Or, additionally, to force 7 (28-33 kt) if local circumstances necessitate the indication of wind direction.

.ANNEX 4.K

SUGGESTED STANDARD FORMAT FOR WEATHER FORECASTS — OFFSHORE PLATFORMS

(Reference paragraph 4.3.1)

0 Source, data, destination (rig name or number)

1. Synoptic situation (including explicit mention of warnings)

2.1 Forecast for selected times up to h+12 hours

2.1.1 Wind direction

2.1.2 Wind speed and maximum wind gust at 10 m (knots or m s^{-1})

2.1.3 Wind speed and maximum wind gust at requested level (knots or m s^1) (usually 50 m)

2.1.4 Sea wave mean period (in s)
Sea wave maximum height (in m or ft)*
Sea wave extreme height during storm periods (in m or ft)**

2.1.5 Swell direction (in compass-points) if angle between sea and swell is at least 30 degrees or if swell period differs significantly from sea wave period
Swell significant wave height (in m or ft)
Swell mean period (in s)

2.1.6 Combined significant wave height/combined maximum wave height

2.1.7 Weather elements (fog, thunderstorm, rain, etc.)

2.1.8 Cloud amount

2.1.9 Visibility to be divided into 10 km and above, or below 10 km (or equivalent in n.mi). In the latter case, the visibility range to be specified as much as possible

2.1.10 Air temperature in degrees Celsius (on request) Sea-surface temperature in degrees Celsius (on request)

2.1.11 Icing risk (on request)

2.2 Forecast (h+12) +12 hours

2.2.1 to 2.2.11 2.1.1 to 2.1.11 will be given

2.3 Forecast (h+24) +24 hours

2.3.1 to 2.3.8 2.1.1 to 2.1.7 plus 2.1.11 will be given, thus no cloud amount, visibility, temperature to

2.4 Outlook (h+48) +24 hours (+24 hours +24 hours) in general terms

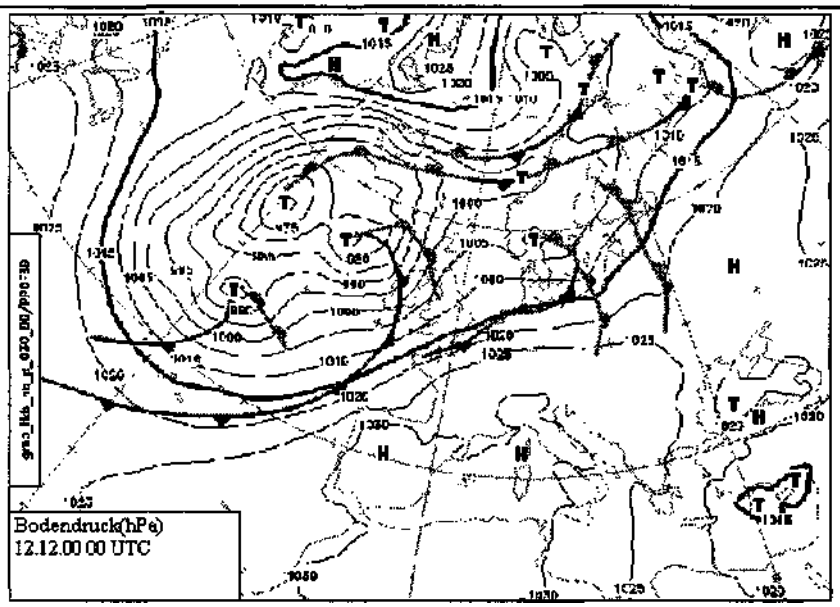
The maximum wave height is defined as the probable height of the highest wave height within a period of 20 minutes. The extreme wave height is defined as the probable height of the highest wave height within a period of three minutes.

ANNEX 4.L **EXAMPLES OF A FORECAST FOR**

RECREATIONAL BOATING

(Reference paragraph 4.3.6)

AN : Volker.wagner@dwd.de
FAX-Nr. :
Anzahl der Seiten : 2



Vorhereagen: FISCHER (N57 22 E005 17)

Datum	Zeit	Wiid/Boeii	See	DiLnung	Wetter	Luft/W.
	UTC	DirBft	m	Dir m		°C
11.12.	**06**	SW 5-6/6-7	1	SW-W 2		9/9
	12	S5	2.5		Regen	*9S9*
	18	W7/8-9	1_ 2	SW2	Regen	10/9
12.12.	**00**	W-NW 5/8-9		SW2		*9S9*
	06	SE-S 2-3	0.5	SW1.5		*919*
	12	SE-S6/7	0.5	SW1.5	Regen	*9!9*
	18	SW-W 2-3/7-8	1	SW1.5	Regen	10/9
13.12.	**00**	SE 6-7/7-8	1.5		Regen	*9!9*
	06	S-SW7/9	3.5		Regen	10/9
	12	S-SW 7-8/9	3.5	S1.5	Regen	9/9
	18	SW *5-619*	3	S-SW 2.5	Regenschauer	*919*
14.12.	**00**	W6-7/8	1.5	W2.5	Regenschauer	9/9
	06	SW 3-4/7-8	0.5	W2		9/9
	12	S3-4	0.5	W2	Regensehauer	**8/9**
	18	S2-3	0.5	SW-W 2	Regenschauer	**8/9**
15.12.	**00**	SW-W 0-2	0.5	W1.5	Regenschauer	8/9
	06	SW2-3	0.5	W1.5		8/9
	12	SE-S 4-5	0.5	W2		**8/9**
	18	SE-S 4-5	2.5		Regen	8/9
16.12.	**00**	W4-5	0.5	W2.5	Regenschauer	*9f9*
	06	SE-S 4-5	0.5	W2	Regenschauer	8/9
	12	E-SE4-5	0.5	W2	Regenschauer	8/9
	18	E-SE4	0.5	W1.5	Regenschauer	8/9

Yorhereagen: SUEDL.OSTS.(N54 22 E015 43)

Datum	Zeit	WbuLBoeii	See	Wetter	Luft/W.
	UTC	DirBtl	m		°C
11.12.	**06**	W4-5	0.5	Regen	8/8
	12	SW-W5	0.5		8/8
	18	S-SW 5-6/6-7	1	Regen	8/8
12.12.	**00**	SW-W 7/8-9	2	Regen	8/8
	06	W6-7/8-9	1.5	Regen	8/8
	12	SW-W 4/7-8	0.5	Regen	8/8
	18	SW-W3-4	0.5	Regen	8/8
■ 13.12.	**00**	SW-W 4-5	0.5	Regen	8/8
	06	SW5	0.5	Regen	8/8
	12	SW 6-7/8	2	Regen	8/8
	18	SW 5-6/7-8	2		8/8
14.12.	**00**	SW6/7	2		8/8
	06	SW-W 5-6/8	1.5	Regenschauer	8/8
	12	SW-W 5-6/6-7	1	Regen	8/8
	18	SW-W 5-6/6-7	1	Regen	8/8
15.12.	**00**	S-SW 4-5/6-7	0.5		7/8
	06	S-SW 4-5	0.5	Regen	7/8
	12	SW4-5	0.5	Regen	7/8
	18	SW4-5	0.5	Regen	7/8
16.12.	**00**	SW5	0.5	Regenschauer	7/8
	06	SW 5-6/6-7	1	Regen	7/8
	12	S-SW 5-6/7	1		6/8
	18	S 5-6/6-7	**1**	Regen	5/8

Guten Torn ! / Hilger Erdmaiui, Dipl-Met.

BULLETIN - EAS ACTIVATION REQUESTED
SPECIAL MARINE WARNING NATIONAL
WEATHER SERVICE MOBILE AL 417 AM CDT
MON APR 24 2000

THE NATIONAL WEATHER SERVICE IN MOBILE HAS ISSUED A

* SPECIAL MARINE WARNING FOR THE COASTAL WATERS-
  MOBILE BAY
  PENSACOLA TO PASCAGOULA OUT TO 20 NM

* UNTIL 500 AM CDT

* AT 417 AM CDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A
  THUNDERSTORM ALONG A LINE EXTENDING FROM 29 MILES NORTH OF MOBILE
  BAY TO 19 MILES NORTHWEST OF MOBILE BAY TO 17 MILES NORTHWEST OF
  MOBILE BAY..MOVING EAST AT 35 MPH.

MARINERS CAN EXPECT STRONG GUSTY WINDS...LOCALLY HIGH WAVES AND
FREQUENT CLOUD TO WATER LIGHTNING STRIKES. IF POSSIBLE...BOATERS
SHOULD SEEK SAFE HARBOR IMMEDIATELY UNTIL THIS STORM PASSES.

INTENSE LIGHTNING IS OCCURRING WITH THIS STORM. IF CAUGHT ON THE OPEN
WATER STAY BELOW DECK IF POSSIBLE...KEEP AWAY FROM UNGROUNDED METAL
OBJECTS.

REPORT SEVERE WEATHER TO THE MARINE PATROL OR COAST GUARD. THEY WILL
RELAY YOUR REPORT TO THE NATIONAL WEATHER SERVICE FORECAST OFFICE IN
MOBILE.

RECREATIONAL BOATING FORECAST FOR LAKE NIPIGON LAKE OF THE WOODS AND NORTH CHANNEL ISSUED BY ENVIRONMENT CANADA FROM THE REGIONAL WEATHER CENTRE IN THUNDER BAY AT 5.30 AM EDT TUESDAY 13 JUNE 2000 FOR THE PERIOD ENDING AT 5.30 AM WEDNESDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT NOON TODAY.

THE RECREATIONAL BOATING FORECAST AND WARNING PROGRAM IS ACTIVE UNTIL OCTOBER 31.

FORECAST CONDITIONS ARE FOR MID LAKE.

WIND SOUTHEAST 10 TO 15 KNOTS. FAIR TODAY. SCATTERED SHOWERS OR THUNDERSTORMS DEVELOPING OVERNIGHT.

BULLETIN - EAS ACTIVATION REQUESTED
SPECIAL MARINE WARNING NATIONAL
WEATHER SERVICE MIAMI FL 751 AM EDT FRI
APR 14 2000

THE NATIONAL WEATHER SERVICE IN MIAMI HAS ISSUED A

* SPECIAL MARINE WARNING FOR...
  COASTAL WATERS FROM EAST CAPE SABLE TO CHOKOLOSKEE OUT 20 NM

* UNTIL 945 AM EDT

* AT 751 AM EDT NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A
  LARGE CLUSTER OF STRONG THUNDERSTORMS 15 MILES SOUTHWEST OF
  SHARK POINT WEST OF EAST CAPE SABLE MOVING NORTHEAST AT 15 KT.
  NUMEROUS THUNDERSTORMS WERE ALSO REDEVELOPING FURTHER TO THE
  SOUTHWEST AND MOVING TOWARD THE AREA.

  THESE STRORMS AREA CAPABLE OF PRODUCING VERY FREQUENT AND DEADLY
  CLOUD-TO-WATER LIGHTNING...WINDS 35 KNOTS OR GREATER...LOCALLY ROUGH
  SEAS AND POSSIBLE WATERSPOUTS.

THUNDERSTORMS THREATEN BOATER SAFETY WITH GUSTY WINDS IN EXCESS OF 35 KNOTS...ROUGH SEAS AND DEADLY LIGHTNING. YOUR BEST COURSE OF ACTION IS TO SEEK SAFE HARBOR...BUT IF YOU ARE CAUGHT ON THE OPEN WATER-STAY BELOW DECK OR KEEP A LOW PROFILE AND KEEP AWAY FROM UNGROUNDED METAL OBJECTS. ALL SHOULD WEAR FLOTATION DEVICES.

LAT...LON 2521 8142 2513 8124 2596 8075 2607 8102

ANNEX 4.M

EXAMPLE OF A FORMAT FOR TRANSCRIBED COASTAL MARINE DATA

(Reference paragraph 4.5.2)

Met.0.3 Form 1

WEATHER OBSERVATIONS FROM O F > D = INSTALLATIONS

STATION NAME	Latitude deg. min.	Longitude ,E i or deg. min. iW	BLOCK NUMBER	ANEMOMETER HEIGHT	UNITS ANEMO/BAR	BAROMETER HEIGHT	UNITS PRESSURE	BAR REDUCTION	UNITS WIND SPEED	WIND METHOD	WAVE METHOD	TIME ZONE	SEA TEMP METHOD	TEMP UNITS	MONTH	YEAR	SHEET NO.
1 2 3 4 5 6 7 8 9 10	11 12 13 14	IS 16 17 18 19	20 21 22 23	24 25 26	27	28 29 30	31	32	33	34	35	36	37	38	39 40	41 42 43 44	

DAY OF MONTH	TIME hours mins.	wir- direction' fg	JD speed ■ fg	W height' fg	IND WAV period fg	ES Max. height' fg	SWE direction ■ fg	LL WAVES height? fg	period' fg	VISIBILITY	fg	TEMPERATURE dry bulb ' fg wet bulb ' fg sea surf ' fg	PRESSURE P P P P ' fg	Z CLOUD	iff. COVER	£ PRESENT (ff WEATHER
1	2 3 4 5 6	7 8 9	10 11 12	13 14	15 16	17 18	21 22 23	24 25	26 27	28	35	36 37 38 39	40 41 42 43	44 45 46 47	48 49 50 51 52	53	54	55 56

Met.O./Carto/D.O./2689 fg , :flag : value accepted and transcribed ; value deleted ■■ value amended : value transcribed but suspect Transcribed by . Date .

;.D. *Press, Met. O. Bracknell* Punched by ..... Date

CHAPTER 5

MARINE METEOROLOGICAL SERVICES FOR MAIN PORTS AND HARBOUR AREAS

5.1 Introduction

While the major concern of marine meteorology is the safe passage of ships over the high seas, meteorological services have become increasingly important in ports and harbours. This is because many activities in ports and harbours are weather sensitive and the faster turnaround of ships in port means that delays due to weather must be kept to a minimum. Ports most in need of meteorological services are those with a relatively high proportion of adverse weather — fog, gales, rain and squalls — and with a high volume of traffic leading to congestion in the harbour area and approaches.

A number of ports have instituted various services aimed at improving the efficiency of operations in port and reducing the danger, or loss of life and property due to hazardous weather conditions. Depending on the size of a port and the types of trade, a whole spectrum of activities may take place with each activity requiring a distinct set of marine meteorological services.

Every port or harbour is different in size, layout and the kind of weather experienced, so that there are a great variety of individual requirements for local marine meteorological services. The provision of marine meteorological services in ports usually involves different local authorities, the organisation of which inevitably varies from one port to another. However, there are certain general principles which may be applied to the provision of forecasting and warning services for ships entering or leaving ports and for ships loading or unloading in port. Members are encouraged to follow the same general procedure as specified in Volume I, Part III of the *Manual on Marine Meteorological Services* when issuing port weather and sea bulletins. A similar format adopted in most ports will facilitate the interpretation of these bulletins by mariners thus enhancing their usefulness.

The services of Port Meteorological Officers (PMOs) are traditionally the main element of meteorological support for ships in port. As the requirements for marine meteorological services in ports increase, PMOs are gradually assuming more responsibilities beyond their liaison work. The duties of a PMO in connection with the WMO Voluntary Observing Ships' Scheme are discussed in Chapter 6 of this *Guide*. Duties which a PMO may undertake as a contribution to port marine meteorological services are discussed in paragraph 5.4.1 of this Chapter.

5.2 Requirements for services

5.2.1 *General*

Marine meteorological services for main ports and harbours usually cater for the needs of all, or some, of the following:

(a) Ships' movements (entering, leaving or moving about the port);
(b) Container handling, container safety and warehousing, including the safety of cranes and lifting gear;
(c) Embarkation/disembarkation of passengers, especially by tender;
(d) Refuelling operations;
(e) Loading of barges;
(f) Dredging or cleaning operations;
(*g*) Ship building and other construction works;
(*h*) Port engineering projects;
(*i*) Icebreaking services in ports and port entrances;
(j) Marine pollution combatting operations in port areas; *(k)* Rescue operations;
(*l*) Industries, commerce, litigation and insurance; (*m*) Waterborne recreational activities.

To ensure a coordinated approach in the provision of marine meteorological services for main ports and harbours, offices or units should be specifically identified to provide these services. Preferably there should be forecasting offices located in ports or port meteorological officers stationed there. However a forecasting office located outside the port can provide these services provided there are efficient communications between the port and this forecasting office.

Only those services which are required should be provided, there is no point in providing services for which there is little, if any, demand. Thus there needs to be consultation with relevant groups such as port and harbour authorities, ships' masters, pilots, dockyard personnel, port works engineers, container terminal and warehouse operators, shipping companies and insurance companies. Based on these consultations the Meteorological Service will be able to formulate the procedures to provide services of a general nature catering for the majority of the user groups, or of a specialized nature tailored to meet any particular need of an individual user group or both types of service.

As far as possible the service required by the user should be provided where and when he requires it. However, it is important to point out to users the inherent limitation of the services, such as lack of data or an unavoidable time lag in issuing bulletins. This will prevent users from having unrealistically high expectations of the services to be provided. It this is not done, alienation of the users might occur if services fall short of their expectations. Particularly when resources available to the Meteorological Service are limited, there is no reason why charges should not be made for a specialized service to a particular user.

To provide some of the services, the Meteorological Service may need the assistance of other

agencies or authorities in obtaining the necessary observational data, or for communications support. Lighthouse personnel under the port authority may be a useful source of weather information in the vicinity of harbour approaches. Tidal information may be available from port works' engineers or oceanographic institutes. A Meteorological Service may find that a lot of the data needed are already available in one form or another. Its role is then to coordinate the collection of these data and to make this information available to marine user groups in a convenient manner.

5.2.2 *Observations in real-time*

Adequate observational data are the basis for the provision of effective marine meteorological services. In addition to the data normally required for synoptic weather forecasting, local observational data in the harbour and surrounding areas enable forecasters to have a better grasp of the evolving weather situation in and near the harbour in the face of a changing synoptic pattern. In large harbour areas and approaches there is often a need for observations or measurement of visibility, temperature, precipitation, wind, swell, currents and water level at various locations to provide information on the distribution of these elements in the harbour area. Information on visibility or ice conditions in the different approaches to a port, for example, helps shipmasters decide the appropriate course to take.

Radar observation of precipitation may form the basis of a warning service giving short-range forecasts of thunderstorms, squalls and heavy rain which affect loading operations and various engineering projects in port. Observations of tidal level can *be* operationally useful when large ships with deep draughts move through channels of shallow water. Abnormal water levels sometimes also affect dockyard operations. The types of data the Meteorological Service needs will *be* largely related to the requirements of forecasting services for the different users.

When required -by users the observational data should be included in bulletins issued on a near real-time basis. Some users cannot wait for the regular broadcasts which may be given at intervals of several hours. Arrangements may need to be made for users to have access to the data by means of an automatic recorded telephone service or automatic dial-in facsimile service, or the types of display described in paragraph 5.4.6. Computer and telecommunications technology makes it possible to electronically display observations such as the plan of a harbour to users. A charge may well be made for this service.

5.2.3 *Forecasting*

A forecasting and warning service is very important for operations in many large ports. A knowledge of expected winds, sea and visibility helps the planning of movement of ships into, out of, or within the harbour. Weather conditions affect docking operations. When a tropical cyclone is threatening a particular port, the forecast movement of the cyclone will affect a shipmaster's decision to take evasive action by going to sea or to ride it out in the harbour.

Cargo handling is affected by high winds which can damage cranes and lifting gear. Some cargo cannot be handled in rain or in extremes of temperature. General forecasts are not always adequate because local topography tends to have considerable influence on the distribution of wind speeds and precipitation. Although the increasing use of containers has reduced the labour force at many ports, the forecasting service is still important to stevedoring companies in the rostering of labour. Workers rostered to begin work at a certain hour have to be paid even if unloading cannot take place because of heavy rain or high winds.

Forecasts of wind speed, including gusts, and the state of the sea are required for the planning of operations like the loading of barges, dredging and clearing operations, ship building and other construction works, port engineering projects and marine pollution combatting operations. Forecasts of water levels and tidal currents are also relevant. Most of these operations require warning when wind speeds or waves are expected to exceed some critical value. As these values will vary from port to port; they should be ascertained by consultation with the operators at the port concerned.

The planning of icebreaking operations in ports and port approaches is dependent on forecasts of wind, temperature, wave and swell conditions. Severe storms with strong winds and spray in conditions of negative air temperature may lead to rapid ice accretion and cause ships to sink.

Harbour seiches may lead to irregular ship movements, making berthing difficult and increasing the danger of collisions.

Thus the elements for which forecasts are required may include: (a) Wind direction and speed, and its local name, if

any, such as mistral, bora, sirocco and pampero; ■■(&) Wind gusts; ■(c) Extreme wind speeds during the passage of tropical

cyclones or deep lows in temperate latitudes;

(d) Surf and breakers at harbour entrances;

(e) Wave and swell at harbour entrances, in shipping lanes, and in special channels for deep-draught ships;

(f) Visibility;

(g) Precipitation;

(h) Thunderstorms;

(i) Air temperature;

(j) Relative humidity;

(k) Tidal levels and currents;

(*l*) Water level anomalies due to harbour seiche, river flood, tsunami, storm surge; (m)

Change in water density; and, (ft)

Ice and ice accretion.

5.2.4 *Climatological information services*

Climatological information on meteorological elements and other environmental conditions is needed for a variety of purposes, such as the long-range planning for port construction and maintenance work, loading and unloading of ships and special transports. A common question asked by engineers and shipmasters is the ratio of wet and dry days during various times of the year. Climatological information also serves as background information for forecasters in formulating daily weather forecasts.

Statistical information on the following elements is usually required:

(a) Wind direction and speed and frequency of gusts;
(b) Precipitation;
(c) Visibility;
(d) Air and water temperature (mean and extremes);
(e) Waves (sea and swell); (/)
Currents;
(*g*) Relative humidity; and, *(h)*
Atmospheric pressure.

In some ports further climatological information will be needed on temperature inversions in the atmosphere, water level changes, seiches, etc. In areas affected by tropical cyclones, statistical information on the tracks of tropical cyclones and their effects on the ports will also be required.

Weather observations taken in the port area may be required for legal purposes to settle disputes. Shipping companies sometimes require authoritative certification of weather conditions occurring at the time of loading or unloading of cargoes in connection with insurance claims. Similar requests for information sometimes come from engineering contractors whose work has been adversely affected by weather.

5.3 Data acquisition

Synoptic data will be readily available if port meteorological services are provided by a major forecasting office. However, if the services are provided by a separate office, say in the port area, it will be necessary to ensure that it has the appropriate data available to it. It may be necessary to equip the office with a teleprinter link to the national meteorological data network or directly to the national meteorological centre. However, the office in the port is not usually staffed with a full analysis and forecasting team, and it may be preferable to provide relevant analyses and prognoses, together with limited synoptic data by facsimile from a major forecasting office.

Local meteorological data in the port area and its vicinity may be obtained from a special network of observing stations set up specifically for this purpose. The locations of these stations are chosen to give an idea of the spatial variation of the meteorological elements in the port area. All the stations should be equipped with standard meteorological instruments so that an authoritative data set will be produced by the network. The range of instruments will depend on users' needs and the resources available to the Meteorological Service. Rain gauges and anemometers are the most useful instruments.

If satisfactory sites can be found, automatic weather stations providing direct read-out in the forecasting office can be installed. As far as possible computer and telecommunications technology should be used to facilitate display of the observations on a plan of the harbour area, updated as often as desired. Such displays can be provided in parallel to harbour control and shipping companies possibly for a fee. The number of stations required will depend on the size of the port and variability of the weather over the area, but a port covering around 10 000 hectares could require about four such stations.

Besides the standard measurement of pressure, temperature and wind, automatic instrumentation can be used to measure visibility, including automatic fog detection and visual range in selected directions, say along a shipping channel. Remote read-out can also be obtained from wave-rider buoys and tide gauges. Weather watch radar is very useful, and displays can be provided to harbour control. Doppler radar gives even greater detail on precipitation. Instrumentation can also be used to monitor the water level, particularly in shipping channels.

In areas where weather stations cannot be installed it may be necessary to enlist the help of personnel not belonging to the Meteorological Service to make voluntary observations in addition to their normal duties. Examples of these additional duties include: tide readings from oceanographic institutes, weather reports from lighthouse keepers, and water temperature from harbour patrol boats. Some countries have found that paying a small amount of money in addition to a salary is sufficient as an incentive to get this work done.

5.4 General services

General marine meteorological services provided for main ports and harbour areas usually include the provision of:

(a) Facilities for the Port Meteorological Officer;
(b) Port weather and sea bulletins comprising warnings and, whenever possible, synopses and forecasts;
(c) Information on actual and climatological conditions (on request);
(d) Marine meteorological advice;
(e) Oral briefing to shipping and other users;
(f) Display of information for the benefit of users and the public; and,
(g) Sea-ice services.

5.4.1 *Port Meteorological Officer (PMO) activities*

The main functions of the PMO are concerned with assistance to the WMO Voluntary Observing Ships'

Scheme and the BATHY/TESAC operational programme of the Joint WMO/IOC Integrated Global Ocean Services System (IGOSS). The duties are described in Chapter 6 of this *Guide.*

Because shipmasters and the shipping community in general are in close contact with the PMO, the office of the PMO is a natural place where user groups may obtain various forms of information from the Meteorological Service. In some ports, the office of the PMO relays weather information to port authorities and shipping in port. The information may include forecasts and charts received from a major forecasting office. The information can be displayed in the office and/or handed out to interested parties.

5.4.2 *Port weather and sea bulletins*

5.4.2.1 FORM AND CONTENTS OF PORT WEATHER AND SEA BULLETINS

The format of port weather and sea bulletins should be, as far as possible, on the same lines as those adopted for the high seas, but adjusted to meet local operational requirements taking into account the particular environmental phenomena affecting activities in the area. As stated in the *Manual on Marine Meteorological Services,* Volume I, Part III, paragraph 2.2.2, the bulletins must contain:

(a) Date and local time of reference;
(b) Name of port and harbour area; and,
(c) Warnings, if any. They

should also include:

(a) Synopses of major features of the weather and sea conditions;
(b) Forecasts of marine environmental conditions;
(c) Selected observational data.

Port weather and sea bulletins intended for international use should be provided in the language of the Issuing Member and in English. The language used should be as free as possible from technical terms. The terminology used should be in accordance with the multilingual list of terms used in weather and sea bulletins given in Annex 2.B of this *Guide.*

Port and harbour authorities, shipping agents and other users concerned should be informed on the salient aspects of the services provided and how they can be obtained.

5.4.2.2 WARNINGS

Warnings are intended to reduce loss of life or property which may occur during hazardous weather conditions. It is important that warnings should be issued immediately when the need becomes apparent and, as far as possible, with sufficient lead time to allow people to take action on them.

Thus warnings have to reach those concerned as quickly as possible, by means of telephone, facsimile, radio broadcast, or visual signals. An address list needs to be maintained of those who wish to be advised by telephone or facsimile and some Meteorological Services charge for this service.

The warning must indicate the type of warning, the date and time of issue, the extent of the affected area (if appropriate) and any further indications (e.g. how long the dangerous conditions are expected to continue). Warnings need to be issued when some of the following take place:

(a) Wind and wind gusts (which may make operations of cranes dangerous);
(b) Sea and swell;
(c) Poor visibility;
(d) Heavy precipitation;
(e) Ice accretion;
(*f*) Water level anomalies, such as storm surges;
(g) Harbour seiches; and, *(h)* Tsunami.

The criteria for the issue of a warning will need to be determined in consultation with harbour control authorities and providers and users of services in the port. Examples of warnings for ports are given in Annex 5.A of this Chapter.

5.4.2.3 SYNOPSES AND FORECASTS

When synopses are included in port weather and sea bulletins, they should be brief and include only those weather systems that are going to have a significant influence on the efficient conduct of operations in the port within, or close, to the period of validity of the forecasts. Deep lows in temperate latitudes, winter monsoon surges (in East Asia) and tropical cyclones are examples of features that may be mentioned. Similarly, only those elements which are important to the port concerned should be mentioned in forecasts.

The period of validity of forecasts should be determined in consultation with users, but 24 hours is a common period, with possibly, an outlook for a further 24 hours. The important thing is that the period of validity is clearly indicated at the beginning of the forecast. Examples of port weather and sea bulletins are given in Annex 5.B of this Chapter.

5.4.2.4 DISTRIBUTION OF PORT WEATHER AND SEA BULLETINS

Means of distributing port weather and sea bulletins include:

(a) Facsimile to particular addressees;
(b) Telex;
(c) Dial-in or poll facsimile service;
(d) Automatic recorded telephone service;
(e) Electronic mail;
(f) MF or VHF radio broadcasts;
(g) NAVTEX;
(h) Radiofacsimile broadcasts;
(*i*) Messenger delivery;
(j) Display at strategic locations.

5.4.3 *Observational data and climatological information*

In ports where special observing stations have been set up, arrangements should be made to archive collected data and statistical summaries on a monthly and yearly basis. This may be done by the office responsible for the provision of port marine meteorological services or by the climatological section of the NMS.

The office of the PMO should at least have an inventory of climatological data for the port and surrounding areas so that he can make the necessary arrangements for any user requiring the information. If demand for climatological data is particularly heavy at the PMO's office, he could be equipped with microfiche of the data most in demand and the facilities for providing print-outs of the data. If resources permit, an online connection to a central computer database allows requests for data to be met with minimum delay.

5.4.4 *Marine meteorological advice*

The PMO usually handles relatively simple questions from ships officers concerned with observing practices aboard ships or weather phenomena observed while at sea. In view of the close contact between the PMO and the shipping community, requests for technical information, may be conveyed to the Meteorological Service via the office of the PMO. These requests may sometimes go directly to the office designated to provide port meteorological services. An efficient mechanism should be established so that such requests are swiftly handled by the appropriate sections/departments of the NMS. It is usually necessary to maintain close consultation with the user making the request to ascertain the nature of the problem and to ensure that the most appropriate meteorological information is provided.

5.4.5 *Oral briefing*

In some ports, the forecast office can be reached 24 hours a day by telephone. This is considered by many ships' officers to be an invaluable facility to help them plan their activities. Face-to-face briefings are also available in some ports.

The main purpose of the oral briefing is to provide complete environmental information to the recipient, with adequate supporting explanations, essential for the planning and execution of daily operations in the port area, including ships leaving the port. The briefing should be based on a routine forecast and planned around the most significant operational factors. A good briefing is characterized by complete frankness as regards any uncertainties in the assessment of the environmental situation and its development. The recipient should be encouraged to ask questions on any points which are not clear to him and his questions should be carefully answered. It should be remembered that the recipient is not as familiar with technical meteorological terms as the specialist providing the briefing.

Points which should be covered in a briefing include:

(a) The latest charts, satellite imagery and forecasts, reports;

(b) A description of the existing weather and sea conditions within the area of interest, special attention being given to hazardous conditions;

(c) Emphasis on any changes expected in the weather and sea conditions and on specific areas likely to be affected; and,

(d) Mention of hazardous conditions considered possible, although their probability is not sufficiently high to warrant a warning.

The office providing the briefing should have a rapid communication links to the forecasting office serving the port, so that any changes to the forecast or the issue of a warning, are immediately known to the briefer. It is highly desirable that the details of any briefing are recorded.

5.4.6 *Display of information*

In a number of ports and marinas of any size information is regularly displayed in a prominent place for the benefit of port personnel, ships' officers, fishermen, recreational boating enthusiasts and the public. The traditional method of display is a piece on paper pinned to a notice board behind glass to protect it from the weather and vandals, the display being changed regularly by messenger. Electronic means of display in a public place now make it possible for people to obtain information by pressing buttons or touching a screen. The information is then updated quickly from the central computerized database. The cost of electronic displays can sometimes be offset by the inclusion of advertising matter.

Normally the display includes current weather charts and the port weather and sea bulletin. Any warnings should be highlighted so that the reader does not miss them. The display should also include the address of the PMO and the local meteorological office to be contacted in case more weather information is required. If education and training courses in marine meteorology are available, this information might also be included.

If possible, important climatological particulars of the port location and the near coastal areas should also be included in the display. Further information can be given on the transmission times and frequencies of coastal radio and public radio stations broadcasting weather and sea bulletins, as well as other means such as automatic telephone announcement services.

5.4.7 *Sea-ice services*

It is desirable that sea-ice bulletins are issued for main ports and harbour areas, including fairways, during the ice season. These sea-ice bulletins must be coordinated with those issued for coastal and offshore areas in order to ensure complete areal coverage. The contents and issue of these bulletins are usually established in

consultation with local port and harbour authorities and sea ice operational services. The various national practices are described in the publication on *Sea-Ice Information Services in the World* (WMO-No. 574).

5.5 Specialized services

The need for specialized services will depend on the activities in a port and the particular environmental conditions affecting the port. The requirements should be ascertained by consultation with special user groups. The emphasis these groups place on different meteorological and environmental parameters should be determined. The criteria for information to be included in special bulletins should be agreed upon, taking into account any criteria established by national practices and international conventions. The format of the specialized bulletins will also be as agreed with the users, but it is advisable, as far as possible to follow the broad outline as set out in paragraph 5.4.2 of this Chapter.

Specialized services may be required only for a limited period, e.g. for the particularly weather-sensitive loading or unloading of cargo, or they may be required only in response to an emergency e.g. oil pollution in the port, or an accident to a nuclear-powered ship in port.

ANNEX 5.A

EXAMPLES OF A WARNING FOR A PORT

(Reference paragraph 5.4.2.2)

(i) Canada

FPCN 26 CWHX 200700

MARINE FORECAST FOR HALIFAX HARBOUR AND APPROACHES ISSUED AT 3.00 AM AST SUNDAY 20 JANUARY 1980 FOR TODAY AND MONDAY.

NORTHWESTERLY WINDS 30 KNOTS BACKING AND DIMINISHING TO WESTERLY 20 BY MONDAY EVENING. CLOUDY WITH A FEW FLURRIES TODAY. SUNNY WITH CLOUDY PERIODS MONDAY. VISIBILITY 2 TO 5 IN FLURRIES. TERMPATURE NEAR MINUS 2 THIS AFTERNOON AND NEAR MINUS 12 TONIGHT.

(ii) France

DE METEO LE HARVE, LE ....

A U ATTENTION DE LA VIGIE D'ANTIFER ET DES ABEILLES

AVIS DE TEMPETE : MELANCE D'AGGRAVATION POUVANT ATTEINDRE LE GRAND FRAIS FORCE 7 BEAUFORT (28/33 NOEUDS) DE SECTEUR NORD-OUEST A OUEST AU COURS DE LA JOURNEE DE DEMAN

SITUATION GENERALE : LA SITUATION METEO EST LIEE A L'APPROCHE PAR L'OUEST D'UN MINIMUM DE PRESSION DONT LA TRAJECTOIRE EST ACTUELLEMENT ENVISAGEE AU SUD DE NOTRE REGION

PREVISIONS POUR LA NUIT DU.....AU.....

TEMPS : ATTENUATION DE LTNSTABILITE EN PREMIERE PARTIE DE NUIT PUIS NOUVEL EPISODE PLUVIEUX

VENT : DE SUD-OUEST DOMINANT 18/23 NOEUDS MOLLISSANT 13/18 NOEUDS ET VENANT AU SECTEUR SUD - PASSAGEREMENT 10/15 NOEUDS

AMPLITUDE MOYENNE DES VAGUES : 1,5 A 2 M

CHENAL : S'ETALANT 100/150

EVIT ET APPONT : 060/090

VISIBILITY : REDUITE SOUS PRECIPITATIONS

PROBABILITES POUR LA JOURNEE DU .....

TEMPS COUVERT AVEC PLUIE LAISSANT PLACE A UN TEMPS INSTABLE AVEC AVERSES OU GRAINS

VENT : S'ORIENTANT A OUEST-NORD-OUEST A NORD-OUEST IRREGULIER 20/25 NOEUDS FRAICHISSANT EN COURS DE JOURNEE EN VENANT AU SECTEUR OUEST 25/30 NOEUDS

AMPLITUDE MOYENNE DES VAGUES : 2,5 A 3 M

CHENAL : SE CREUSANT 250/300

EVIT : 150/250 DU NORD AU SUD

APPONT : 080/130 AVEC HOULE DU SUD-OUEST

VISIBILITE : SE REDUISANT SOUS GRAINS OU AVERSES

TENDANCE ULTERIEURE : POURSUITE DE L'AGGRAVATION AVEC GRAND FRAIS OU COUP DE VENT DE SECTEUR NORD. ROTATION ULTERIEURE AU NORD-OUEST A NORD ET AMELIORATION.

ANNEX 5.B

EXAMPLES OF A PORT WEATHER AND SEA BULLETIN

(Reference paragraph 5.4.2.3)

From The Met. Office, Southampton Weather Centre on Thursday 4th August 1994

Forecast for Solent, Spithead, Southampton Water and the Docks

Period 0700 to 1800 Today:

WIND: Variable or southerly force 2 or 3 this morning, becoming southwesterly this afternoon. Strong gusts near to thunderstorms likely.

WEATHER: Some hazy sunshine and scattered thunderstorms. Risk of an isolated fog patch in the Solent.

VISIBILITY: Generally moderate, but a risk of an isolated fog patch in the Solent.

Forecast from 1800 Today until 0700 Tomorrow, Friday:

WIND: Southwesterly force 2 or 3. Winds remaining gusty near to thunderstorms.

WEATHER: Scattered thunderstorms slowly drying out by dawn. Risk of fog patches in the Solent.

VISIBILITY: Moderate or poor, with fog patches.

+++

Sea Area Forecasts for the next 24 hours:

Dover.
Southeasterly 4 or 5, becoming variable 3. Thundery showers, especially later. Moderate with fog patches developing.

Wight, Portland, Plymouth.
Variable becoming westerly 3 or 4. Thundery showers. Moderate with fog patches.

(Forecaster available on 0703-228856)

232991 Docks Board
236270 us

texts

METEO
FRANCE

STATION METEOROLOGIQUE DE SAINT-NAZAIRE

Aerogare 44550 MONTOIRE DE BRETAGNE

Telephone : 40 17 13 17 Telecopie : 40 90 39 37

BULLETIN METEO POUR LES CAPITAINERIES DE DONGES. NANTES ET DE SAINT-NAZAIRE

ORIGINE METEO-FRANCE, STATION DE SAINT-NAZAIRE
LE LUNDI 24 OCTOBRE 1994 A 15 HEURES

1 - AVIS DE GRAND FRAIS NR 6 DE BREST
ENTRE LE HAVRE ET LE SUD VENDEE
LE MARDI 25 OCTOBRE 1994 ENTRE 03 ET 15 HEURES UTC
VENT DE SUD-OUEST ATTEIGNANT 30 ND (7B)
INDICATION COMPLEMENTAIRE : MENACE DE COUP DE VENT (8B) PASSAGER ENTRE BELLE-ILE ET LE HAVRE

2 - SITUATION GENERALE :

MINIMUM PRINCIPAL 985 HPA CENTRE SU L'ECOSSE, SE COMBLANT LENTEMENT, ET QUASI-STATIONNAIRE (990 HPA DEMAIN MARDI A 12H UTC). DEPRESSION SECONDAIRE EN PERIPHERIE DE LA PREMIERE, 995 HPA SE CREUSANT SUR SUD-IRLANDE CETTE NUIT ET SE DECALANT EN MANCHE DEMAIN MATIN. (HEURE DE PASSAGE DES FRONTS): FRONT FROID VER 12H UTC.

3 - EVOLUTION POUR LA NUIT PROCHAENE ET LA TOURNEE DU MARDI 25 OCTOBRE 1994 :

. TEMPS SENSIBLE : RARES AVERSES EN DEBUT DE NUIT, PLUIES PLUS CONTINUES EN SECONDE MOITIE DE NUIT ET DEMAPN MATIN; TRAPNE ACTIVE DEMAIN APRES-MIDIAVEC DE BELLES AVERSES, VOIRE ORAGES LOCAUX EN SOIREE.

. EVOLUTION PAR PERIODE DE 06H :

	18/24	00/06	06/12	12/18
DIRECTION DU VENT	OUEST-SUD-OUEST	SUD-OUEST	* SUD-OUEST	* OUEST-SUD-OUEST
VITESSE DU VENT (ENKT)	15A20KT	15 A 20 KT RAF 27/33	* 18A23KT RAF 30/35	* 15A20KT
VISIBILITE (ENMN)	10A12MN SAUF 2 SOUS AVERSES	8 TEMPORAIREMENT 5 MN		* 12VOIRE2A3MN SOUS GRAINS
ETATDE LAMER	AGITEE * HOULE DE	AGITEE SECTEUR	* AGITEE OUEST 2 A 3 M	* AGITEE
HAUTEURS DES PLUIES	1 A2MM *	2A7MM	* 4A8MM	* 2A4MM

TEMPEATURE MPNIMALE PREVUE : 12°C
TEMPERATURE MAXIMALE OBSERVEE A NANTES : 14°C A SAINT-NAZAIRE: 15°C

PROCHAIN BULLETPN LE 25/10 A 08H00

REPONDEUR MARINE : 36 68 08 44 pour la cote et le rivage
36 68 08 08 pour le large (2,19 F/ mm) MINITEL : **36 15 METEO**

ROYAUME DU MAROC

MINISTERE DES TRAVAUX PUBLICS,
DE LA FORMATION PROFESSIONNELLE
ET DE LA FORMATION DES CADRES

DIRECTION DE LA METEOROLOGIE

NATIONALE

CENTRE NATIONAL DE PREVISIONS

SERVICE DE METEOROLOGIE MARITIME

SPECIAL MOHAMMEDIA

ORIGINS METEO MAROC MERCREDI 21/09/94.

PREVISION P©UR 24 HEURES

TEMPS : PEU A PASSAGEREMENT NUAGEUX AVEC BRUMES ET NUAGES BAS

VENT : N A NW FORCE 4 A 5 VISIBELITE : REDUITE PAR BRUME MER:AGITEE

DATE	HOULEPREVUE	PERIODE	LONGUEUR D'ONDE
0600UTC	1.80 METRES	04 S	024 METRES
1200UTC	1.80 METRES	04 S	024 METRES
180QUTC	1.90 METRES	04 S	024 METRES
0000UTC	1.90 METRES	04 S-	024 METRES

CHAPTER 6

THE WMO VOLUNTARY OBSERVING SHIPS' SCHEME

6.1 Introduction

The international scheme under which ships plying the various oceans and seas of the world are recruited for taking and transmitting meteorological observations is known as the WMO Voluntary Observing Ships' Scheme. The forerunner of the scheme dates back to 1853, the year in which delegates of 10 maritime countries came together at a conference in Brussels, on the initiative of Lieutenant Matthew F. Maury, then director of the U.S. Navy Hydrographic Office, to discuss the establishment of a uniform system for the collection of meteorological and oceanographic data from the oceans and their use for the benefit of shipping. In the twentieth century, the system was recognized in the *International Convention for the Safety of Life at Sea,* which specifies in Regulation 4 of Chapter V — Safety of navigation — that 'the Contracting Governments undertake to encourage the collection of meteorological data by ships at sea and to arrange for their examination, dissemination and exchange in the manner most suitable for the purpose of aiding navigation'.

Voluntary observing ships make a highly important contribution to the Global Observing System of the World Weather Watch. Relevant standard and recommended practices and procedures are contained in Part III,Section 2.2.3 of the *Manual on the Global Observing System* (WMO-No. 544). Although new technological means, such as satellites and automated buoys, are used to gather data from the oceans, voluntary observing ships continue to be the main source of oceanic meteorological information.

From the beginning of such activity shipping has assisted in the scientific exploration of the oceans, as well as in the development of suitable measuring techniques for use by shipborne observers. Nowadays, the cooperation of voluntary observing ships is sought in each of the large-scale scientific experiments conducted by special research vessels in order to furnish the additional data needed for complete analyses of environmental conditions. In addition, the participation of these ships is regularly requested in technical studies and investigations concerning observing methods, such as the measurement of sea-surface temperature, precipitation and wind.

6.2 Classification of voluntary observing ships

6.2.1 *Types of surface synoptic sea stations*

Meteorological observing stations include surface synoptic sea stations of different types. The terminology used in the *Manual on the Global Observing System,* Part III, Section 1 is as follows: Sea stations:

- Fixed sea stations
  - Ocean weather stations
  - Lightship stations
  - Fixed platform stations
  - Anchored platform stations
  - Island and coastal stations
- Mobile sea stations
  - selected ship stations
  - supplementary ship stations
  - auxiliary ship stations
  - ice-floe stations
- Automatic sea stations (Data may be asynoptic when collected by satellite)
  - fixed sea stations
  - mobile sea stations
  - drifting buoy stations

Since this *Guide* emphasizes the mutual collaboration between marine users and meteorologists, only the activities of Meteorological Services with regard to mobile ship stations are described in the following paragraphs. There are three types of mobile ship stations engaged in the WMO Voluntary Observing Ships' Scheme, namely:

(a) Selected ships;
(b) Supplementary ships; and,
(c) Auxiliary ships.

The types of observation normally made by each of these types of ship stations is shown in Table 6.2.

6.2.2 *Selected ships*

A selected ship station is a mobile ship station which is equipped with sufficient certified meteorological instruments for making observations, transmits regular weather reports and enters the observations in meteorological logbooks. A selected ship should have at least a barometer (mercury or aneroid), a thermometer to measure sea-surface temperature (either by the bucket method or other means), a psychrometer (for air temperature and humidity), a barograph and possibly an anemometer.

Selected ships constitute the large majority of voluntary observing ships.

6.2.3 *Supplementary ships*

A supplementary ship station is a mobile ship station equipped with a limited number of certified meteorological instruments for making observations. It transmits regular weather reports and enters the observations in meteorological logbooks.

6.2.4 *Auxiliary ships*

Beyond the shipping lanes normally used by selected or supplementary ships very few observations are available. Ships plying data-sparse areas may be asked to make and transmit weather reports even if they are not

equipped with certified instruments. Such ships are classified as 'auxiliary ships'. Auxiliary ship stations are mobile ship stations, normally without certified meteorological instruments, which transmit reports in a reduced code form or in plain language, either on a routine basis or on request, in certain areas and under certain conditions.

6.2.5 *International list of selected, supplementary and auxiliary ships*

Selected, supplementary and auxiliary ships constitute an important source of marine data. In analysing these data, Meteorological Services should be aware of the type of instrumentation onboard a given ship, or the particular method of observation when several methods are generally in use. To this end WMO compiled the *International List of Selected, Supplementary and Auxiliary Ships* (WMO-No. 47) which is kept up to date through information supplied by Members, and for each ship. The information contained covers such particulars as: *(a)* Name of ship; (6) Call sign;
(c) Vessel type;
(d) Vessel dimensions;
(e) Area or routes the ship normally plies; (*f*) Type of barometer;
(g) Type of thermometer;
(h) Exposure of thermometer;
(*i*) Type of hygrometer or psychrometer;
(j) Exposure of hygrometer or psychrometer;
(k) Method of obtaining sea surface temperature;
(l) Type of barograph;
(m) Various other meteorological instruments used aboard the ship; (*n*) Types of radio equipment, including INMARSAT; (*o*) Height of barometer, in metres, measured from maximum load line; (*p*) Height of anemometer, in metres, measured from maximum load line; and, *(q)* Depth of sea temperature measurement.

The *International List of Selected, Supplementary and Auxiliary Ships* needs to be regularly updated (see the *Manual on the Global Observing System,* Part III, paragraphs 2.2.3.3 and 2.2.3.4) because of frequent changes in the international merchant fleet and changes in the recruitment of auxiliary ships. Members are asked to provide to the WMO Secretariat every quarter, updates of their list of selected, supplementary and auxiliary ships, preferably on computer readable media. This is the most efficient means of keeping the master list updated, as no retyping is required. The Secretariat makes available the master list through its web page (http://www.wmo.ch/web/ddbs/publicat.html). In addition, the Secretariat distributes a hard copy of the master list annually.

Table 6.1 shows the number of selected, supplementary and auxiliary ships during the years 1981-1996.

Table 6.1

Number of Ships belonging to the Voluntary Observing Ships' Scheme

Year	*Selected*	*Supplementary*	*Auxiliary*	*Total*
1981	4827	1637	1034	7498
1982	4877	1513	1084	7474
1983	4830	1637	1050	7517
1984	4968	1567	1155	7690
1985	4875	1480	1363	7718
1986	4760	1514	1313	7587
1987	4642	1470	1274	7386
1988	4438	1420	1344	7202
1989	4664	1436	1439	7539
1990	4645	1412	1434	7491
1991	4647	1434	1369	7450
1992	4608	1332	1422	7362
1993	4512	1374	1430	7316
1994	4092	1386	1197	6675
1995	4124	1332	1270	6726
1996	4171	1311	1270	6752
1997	4187	1285	1287	6759
1998	4230	1375	1457	7062

6.3 Recruitment of voluntary observing shir,

6.3. *Requirement to recruit ships*

According to the *Manual on the Global Observing System,* Volume I, Part III, paragraph 2.2.3.5, each Member shall arrange for the recruitment of ships that are recorded on the national register as mobile sea stations. In fulfilling this obligation, each Member contributes to the common objective of obtaining sufficient coverage of meteorological observations over the sea. While a uniform coverage of the oceans is desirable, this is difficult to achieve in view of the large differences in the density of shipping traffic. This traffic is comparatively dense in the northern hemisphere, but this is not the case in the tropics or in the southern hemisphere. Consequently, greater attention should be given to the recruitment of voluntary observing ships in these areas. A map showing the density of observations received from ships in a typical month in 1996 is shown in Annex 6.A.

Meteorological Services in many countries are required to provide more detailed information of the weather and sea conditions in coastal areas. Some services have successfully recruited ships of local companies to make and transmit observations during their voyage from harbour to harbour along the coast. Such ships may be recruited as supplementary or as auxiliary ships. Their observations have been widely recognized as being of great value.

6.3.2 *Criteria for recruitment*

Several criteria can be used in deciding whether a particular ship should be recruited as a selected, supplementary or auxiliary ship, to satisfy national and

international needs. Questions which should be examined are whether all the necessary intruments can be installed, whether the ship's officers will have the time available for recording and transmitting the observations and whether the necessary regular contact can be established for the receipt of meteorological logbooks. Shipowners and masters are generally very cooperative in these matters; however, it is advisable that these questions be thoroughly discussed at the recruiting stage.

Countries may recruit ships of foreign registry which visit the ports of the recruiting country sufficiently often to permit regular contact. This recruitment is sometimes arranged by the Meteorological Services of the two countries concerned. In order to avoid the entry of duplicate data into the international archiving system, meteorological logbooks from ships of foreign registry should be procured and stored through appropriate arrangements with the Meteorological Service of the country of registry. When a ship of foreign registry is recruited, the Member in whose country the ship is registered should be notified, except in the case when the port in the country of the Member which recruits the ship is considered to be its home port.

For the recruitment of an auxiliary ship, no prior arrangements are required with the Meteorological Service of the country of registry.

Members should establish a suitable organizational unit for the recruitment of voluntary observing ships. This unit should contact shipping agencies to enlist their cooperation, arrange for the provision of instruments, educational information material and other necessary documents ships, arrange for the collection and examination of the ships' meteorological logbooks, arrange for visits to ships, and to examine the various financial questions involved. Port Meteorological Officers can play a large role in the recruitment of ships.

Complaints about meteorological observations from a particular observing ship should be directed to the Member with which the ship is registered. If the ship was recruited by another Member, the Member receiving the complaint should forward it to the Member concerned.

6.4 Meteorological observations from ships

6.4.1 *Danger messages*

The *International Convention for the Safety of Life at Sea,* 1974, in its Regulation 2, Chapter V, concerning the safety of navigation, specifies that ship masters are obliged to issue a danger message when a ship meets with objects or conditions which are of direct danger to navigation. As far as meteorological phenonema are concerned, danger messages should contain information on:

(a) Tropical cyclones (tropical storms) and their development;
(b) Winds of force 10 or above on the Beaufort scale for which no storm warning has been received;
(c) Sub-freezing air temperatures associated with gale force winds causing severe ice accretion on superstructures;
(d) Sea-ice or ice of land origin (e.g. icebergs). Details concerning the contents of danger messages

and their transmission are described in Regulation 3 of Chapter V of the *International Convention for the Safety of Life at Sea.* The information given in these messages directly serves the safety of navigation. Those containing meteorological information are of vital importance to Meteorological Services for the preparation of weather and sea bulletins.

6.4.2 *Surface observations*

6.4.2.1 CONTENT OF SURFACE OBSERVATIONS FROM SHIPS

The elements observed by the various types of voluntary observing ship are shown in Table 6.2.

Table 6.2 Observations made by mobile ships stations

	Selected	*Supple-mentary*	*Auxiliary*
Present and past weather	x	x	x
Wind direction and speed	x	x	x
Cloud amount	x	x	x
Cloud type and height of base	x	x	
Visibility	x	x	x
Temperature	x	x	x
Humidity (dew point)	x		
Atmospheric pressure	x	x	x
Pressure tendency	x		
Ship's course and speed	x		
Sea temperature	x		
Direction, period and height of waves	x		
Sea-ice and/or icing	x	x	x
Special phenomena	x		

Supplementary and auxiliary ships are sometimes asked to add observations of waves to their reports.

6.4.2.2 PROGRAMME FOR SURFACE OBSERVATIONS ON BOARD SHIPS

The basic programme for making surface observations on board ships consists of the following procedures:

(a) Synoptic observations should be made at the main standard times: 0000, 0600, 1200 and 1800 UTC. When additional observations are required, they should be made at one or more of the intermediate standard times: 0300, 0900, 1500 and 2100 UTC;
(b) While taking observations, atmospheric pressure should be read at the exact standard time, the observation of other elements being made within the ten minutes preceding the standard time;
(c) When operational difficulties on board ship make it impracticable to make the synoptic observation at a main standard time, the actual time of observation

should be as near as possible to the main standard times. In special cases, the observations may even be taken one full hour earlier than the main standard time, i.e. at 2300, 0500, 1100 and 1700 UTC. In these cases the actual time of observation should be indicated; however, these departures should be regarded only as exceptions;

(d) When sudden or dangerous weather developments are encountered, observations should be made for immediate transmission without regard to the standard times of observation (see paragraph 6.4.1 above for obligations under the *International Convention for the Safety of Life at Sea);*

(e) Observations should be made more frequently than at the main standard times whenever storm conditions threaten or prevail. Meteorological Services may request more frequent observations for storm warnings, particularly for tropical cyclones. Special observations may also be requested for search and rescue operations or other safety reasons;

(f) When required for scientific studies supplementary observations should be made at intermediate standard times, subject to non-interference with navigation duties;

(g) To ensure the transmission of an observation made at 0300,0900,1500 or 2100 UTC to a coastal radio station, it is desirable that the observation at the next main standard time should be made for climatological purposes, and if possible transmitted in accordance with normal procedures;

(h) Ships' officers should be encouraged to continue taking and reporting observations while the ships are in coastal waters, provided it does not interfere with their duties for the safety of navigation;

(*i*) Transmission of ships' observations by INMARSAT is not constrained by the watchkeeping hours of shipboard radio officers; transmission can be made at any time.

6.4.2.3 OBSERVATION OF SEA AND SWELL

The distinction between two separate wave trains and particularly the distinction between sea and swell can be difficult for an inexperienced observer. Sea waves are systems of waves observed at a different place than within the wind field producing the waves. Swell waves are systems of waves observed at a point remote from the wind field which produced the waves, or observed when the wind field which generated the waves no longer exists.

The distinction between sea and swell can be made on the basis of one of the following criteria:

Wave direction — if the mean direction of all waves of more or less similar characteristics differs 30° or more from the mean direction of waves of different appearance, then the two sets of waves should be considered to belong to separate wave systems.

Appearance and period — when typical swell waves characterized by their regular appearance and long-crestedness arrive approximately, i.e. within 20°, from the direction of the wind, they should be considered as a separate wave system if their period is at least four seconds greater than the period of the larger waves of the existing sea.

More guidance on the observation of waves and swell, as well as the observation of sea ice, can be found in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) Part II, Chapter 4, Marine observations.

6.4.3 *Upper air observations*

In the past very few mobile ship stations were equipped for making upper-air synoptic observations. An automated means of making upper air soundings from a merchant ship has now been developed under the Automated Shipboard Aerological Programme (ASAP). The balloon can be automatically filled and released, and observations received and encoded under the supervision of a ship's officer. However, the number of ships making upper-air observations is still small.

An upper-air synoptic observation consists of one or more of the following elements:

(a) Atmospheric pressure;

(b) Air temperature;

(c) Humidity; and,

(d) Wind speed and direction.

The standard times of upper-air synoptic observations are 0000, 0600, 1200 and 1800 UTC. The actual time of regular upper-air synoptic observations should be as close as possible to 30 minutes before these standard times, and should not fall outside the 45 minutes prior to the standard time. The actual time of a pilot-balloon observation may deviate from this time range if wind observations at considerably greater heights can be achieved.

In the basic programme of upper-air soundings from mobile ships the general objective is to obtain reports from positions which are not more than 1000 km apart and the observations are normally required at 0000 and 1200 UTC. These observations are to be coordinated within the framework of an international programme to ensure that data are obtained from those parts of the oceans where upper-air data are needed. On the other hand, as these observations are scheduled according to circumstances, Members establishing a programme of upper-air observation on board voluntary observing ships should communicate to the Secretariat the following information:

(a) Name and call sign of the ship;

(b) The routes the ship normally plies and the zones in which the upper-air observations will be taken;

(c) The means of communication of the reports, and if coastal radio stations are to be used, the names of these stations;

(d) The scheduled dates of departure and arrival at various ports;

(e) Details of the observing programme scheduled for the voyage;

On receipt, these particulars will be notified by the Secretariat to other Members.

6.4.4 *Sub-surface observations*

Selected ships may also be equipped to make bathythermograph observations during ocean crossings. The use of an expendable bathythermograph (XBT) does not oblige the ship to reduce speed or make course alterations. All arrangements for this type of observation are made within the framework of the Integrated Global Ocean Services System (IGOSS) jointly operated by WMO and IOC.

Procedures for the collection and exchange of BATHY and TESAC (temperature, salinity and current) observations are specified in the *Guide to Operational Procedures for the Collection and Exchange of IGOSS Data* (IOC/WMO *Manuals* and *Guides* No. 3) and the **WMO** *Manual on the Global Telecommunications System,* Volume **1, Part 1,** Attachment 1-1 (WMO-No. 386). The preferred times for **BATHY** and TESAC observations are 0000, 0600, 1200 and 1800 UTC. However observations taken at any time are useful and should be transmitted.

6.4.5 *Special observations*

In relation to international programmes of scientific or economic significance, observations of a special nature are needed from ships at sea and WMO is requested to assist through its Voluntary Observing Ships' Scheme. One such example is the request for observations on locust swarms in the seas around Africa, Arabia, Pakistan and India. This programme, which is of great importance to the agricultural economy in the countries concerned, is described in Annex 6.B of this Chapter.

Another example is the logbook report of freak waves. A freak wave is defined as a wave of very considerable height preceded by a deep trough. It is the unusual steepness of the wave which makes it dangerous to shipping. Favourable conditions for the development of freak waves seem to be strong current flows in the opposite direction to a heavy sea and especially when this occurs near the edge of the continental shelf. The reports may contribute to a mapping of these particularly dangerous areas and to a better understanding of the phenomenon. Guidelines covering the content and form of the report and the forwarding arrangements are described in Annex 6.C of this Chapter (see also Chapter 3, paragraph 3.3.1).

Sea-surface currents are also subject to special observation. These data are derived from measurement of ships' set and drift and form the basis for consideration of the ocean surface current circulation. They are of value to research and climatic studies and are collated by the International Surface Current Data Centre (ISCDC) in the United Kingdom which sends a copy of the stored data to the World Data Centres for Oceanography. In order to improve this database, all vessels are encouraged to obtain and supply such data on a voluntary basis. Details of the form of the report and the forwarding arrangements are given in Annex 6.D of this Chapter (see also Chapter 3, paragraph 3.3.2).

6.4.6 *Coding of observations*

Ships' observations are coded in the international meteorological codes published in the *Manual on Codes,* Volume I (WMO-No. 306). The various code forms are given code names which are sometimes included in the heading of the ship's report. In all cases, however, a 4-letter identification group is used (see code 2582 in the *Manual on Codes).* The identification groups used by ships are shown in Table 6.3.

Table 6.3

Identification groups of codes reported by SHIPS

Code name	*Identification group(s)*	*Content of the code*
SHIP	BBXX	Surface report from a sea station
PILOT SHIP	QQAA, QQBB, QQCC, QQDD	Upper-wind report from a sea station; Parts A, B, C, D respectively Upper-level pressure, temperature, humidity and wind
TEMP SHIP	UUAA, UUBB, UUCC, UUDD	report from a sea station; Parts A, B, C, D respectively Bathy thermal observation
BATHY	JJXX	Observation of temperature, salinity and current from a sea station Report of a
TESAC	KKXX	marine surface observation along a ship's track
TRACKOB	NNXX	

6.4.7 *Automation ofon-board observations*

Automation of shipboard observations have been greatly stimulated by the advent of personal computers and satellite communications. Observations are taken manually in the traditional way and then entered into a personal computer, which may be in the form of a laptop or notebook. The computer programme then:

(a) Provides screen prompts to assist with data entry;

(b) Calculates the true wind, MSL pressure and dew point;

(c) Checks the validity of some data, e.g. month in range 1-12, observations near climatological extremes;

(d) Stores the observation in SHIP code on disc and prints it out for transmission;

(e) Formats the observation in IMMT format (referred to in Chapter 3, paragraph 3.2.7), and stores it on disc or transmits the data to a shore station via a satellite system.

If the ship is equipped with INMARSAT-C, the computer diskette can be placed in the INMARSAT terminal and transmitted without rekeying. In addition manually entering data in a meteorological logbook the diskette of observations in IMMT format is sent periodically to the Meteorological Office.

Another form of automation is the Marine Data Collection Platform (MDCP) which consists of a handheld computer, air temperature and air pressure sensor, transmitter and antenna. The coded **SHIP** observations are entered into the computer and collected by Service Argos satellite. In this case the meteorological logbook still has to be entered manually and returned to the Meteorological Office in the traditional way.

Completely automated shipboard weather stations present difficulties. Proper locations for sensors are not easy to find, particularly for wind and dew point, while equipment for automated measurement of visibility, weather, clouds and wave height cannot be accommodated in the confined space of a ship.

6.5 On-board meteorological instrumentation

6.5.1 *General*

Full guidance on the basic meteorological instruments suitable for use onboard ships making observations under the Voluntary Observing Ships Scheme, together with advice on methods of observations, is provided in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8), Part IT, Chapter 4, Marine observations.

Experience shows that certain features of these meteorological instruments onboard ships require constant attention. The following comments emphasize where special care should be paid and are fully complementary to the general guidance in the above-mentioned *Guide.*

6.5.2 ***Instruments measuring atmospheric pressure***

As the proper installation and operation of mercury barometers at sea has proved very difficult, they are now rarely installed on board ships. The use of precision aneroid barometers on the other hand does not give rise to similar problems. However, because of the zero drift to which these instruments are liable, frequent checking against standing barometers is necessary in order to ensure proper continuous operation. The zero drift of aneroids currently in use is seldom continuous, as the instrument correction remains stable for a rather long period of time, then suddenly drops to another level. Checking procedures should therefore continue routinely even if the correction has remained stable for some time. This checking should be carried out by a PMO whenever possible, preferably at intervals not exceeding three months. A permanent record of all such checks should be attached to the instrument and should include information on the date of the check and the temperature and pressure at which the check was made.

On board small vessels the reduction of the pressure reading to Mean Sea-Level (MSL) may be carried out by the addition of a given reduction constant, or simply by correcting the reading of the scale to give pressure at MSL directly. When the elevation of the barometer varies significantly with the loading of the ship, the use of different reduction constants has to be considered. The draught of very large tankers can vary by as much as 10 metres between a sea-going ballast condition and a fully-loaded condition. If the barometer elevation is great, air temperature may also have to be taken into consideration when preparing reduction tables. At all times the limit of accuracy of the applied reduction should be kept within 0.2 hPa.

Barographs used on board ships should be supplied with an efficient built-in damping device and the instrument should be mounted on shock-absorbing material in a position where it is least likely to be affected by concussion, vibration or movement of the ship. The best results are generally obtained from a position as close as possible to the centre of flotation. The barograph should be installed with the pen arm oriented athwart-ship to minimize the risk of its. swinging off the chart.

6.5.3 ***Instruments measuring wind speed and direction***

In order that wind reports from ships equipped with: instruments are comparable with estimated winds and wind reports from land stations, anemometer readings should be averaged over 10 minutes. It is difficult to estimate 10-minute means by watching the dial of an anemometer. An overestimation of more than 10 per cent is not uncommon. It is therefore preferable that the instrument read-out used for reporting wind velocities be automatically averaged over 10 minutes. If such readouts are not available, careful instructions should be given in order to avoid overestimation.

Due to the flow distortion caused by superstructure, masts and spars, the site of the anemometer sensor has to be carefully selected, preferably as far forward and as high as possible. Wind speed also needs to be corrected for effective height (For further information see *Wind Measurements Reduction to a Standard Level;* R. J. Shearman and A. A. Zelenko (MMROA Report No. 22, WMO/TD-No. 311).

Any anemometer mounted on a ship measures the movement of air relative to the ship and it is essential that the true wind be computed from the relative wind and the ship's velocity. A simple vector diagram may be used, although in practice this can be a frequent source of error. Special slide rules and hand computers are

available and programs can be installed on small digital computers.

6.5.4 *Instruments measuring temperature and humidity*

Temperature and humidity observations should be made by means of a psychrometer with good ventilation and exposed in the fresh airstream on the windward side of the bridge. The use of a louvred screen is not as satisfactory, but if it is used, two should be provided, one secured on each side of the vessel, so that the observation can be made on the windward side. The muslin and wick fitted to a wet-bulb thermometer in a louvred screen should be changed at least once a week, and more often in stormy weather.

Automated or distant-reading thermometers and hygrometers should be sited in a well-ventilated screen with good radiation protection and placed as far as possible from any artificial source of heat. It is advisable to compare the readings with standard psychrometer observations at the windward side of the bridge at regular intervals, particularly when new types of equipment are introduced.

6.5.5 *Instruments measuring sea temperature*

It is important that the temperature of the uppermost thin film of water (measured by infra-red radiometers) should be distinguished from the temperature of the underlying mixed layer. It is the representative temperature of the mixed layer which should be reported by voluntary observing ships.

The 'bucket' instrument method is the simplest and probably the most effective method of sampling this mixed layer, but unfortunately the method can only be used on board small vessels slowly moving. Other methods are:

(a) Intake and tank thermometers, preferably with distant reading display and used only when the ship is moving;
(b) Hull-attached thermometers located forward of all discharges;
(c) Trailing thermometers; and,
(d) Infra-red radiometers.

These instruments are described in Part II, Chapter 4 of the *Guide to Meteorological Instrument and Methods of Observation* **(WMO-No.** 8).

6.6 Transmission of ship's observations to the shore

6.6.1 *INMARSAT*

Ship reports can be readily transmitted to a Coast Earth Station (CES) which has been authorized to accept these reports at no cost to the ship. The NMS of the country operating the CES pays the cost, which is usually less than the cost of a report received via coastal radio. There are a number of such CESs in each satellite footprint and they are listed, together with the area from which they will accept reports in WMO-No. 9, Volume D, Part B, *Coastal Radio Stations Accepting Ships' Weather Reports.* Code 41 is the INMARSAT address which automatically routes the report to the Meteorological Service concerned. To place a limit on the costs incurred by an NMS, a CES may be authorized to accept reports only from ships within a designated area of ocean. These limits should be drawn to the attention of the relevant ship's officers when recruiting a ship under the Voluntary Observing Ships Scheme. A radio operator is not needed to transmit the report, transmission is therefore not restricted to the operator's hours of duty.

6.6.2 *Coast radio stations*

Ship reports can be transmitted by radio-telegraphy to a coastal radio station which has been authorized to accept these reports at no cost to the ship (the costs are met by the country operating the coastal radio station, in many cases by the NMS).

The global plan for the collection of ship reports, and the procedures for the transmission of weather reports to coastal radio stations are described in *Manual on the Global Telecommunications System,* Volume 1, Part 1, Section 2.6 and Attachment 1-1 (WMO-No 386).

Weather reports from mobile ship stations should (without special request) be transmitted from the ship to the nearest coastal radio station situated in the zone in which the ship is navigating. If it is difficult, due to radio propagation conditions or other circumstances, to contact promptly the nearest radio station in the zone in which the ship is navigating, the weather messages should be cleared by applying the following procedures in the order given below:

(a) Transmission to any other coastal radio station in the zone in which the ship is navigating;
(b) Transmission to any coastal radio station in an adjacent zone within the same Region;
(c) Transmission to any coastal radio station in any other zone within the same Region;
(d) Transmission to a coastal radio station in an adjacent zone in a neighbouring Region or failing that, to any other station in neighbouring Region;
(e) Transmission to another ship or an ocean weather station with the function or willing to act as a relay station.

In zones situated along the borderline between two Regions, the order of the procedures for the transmission of ships' weather reports to coastal radio stations, as laid down in subparagraphs *(a), (b),* (c), *(d)* and *(e)* above, may be interchanged subject to agreement between the two Regional Associations involved. Any agreement reached on this matter should specify the limits of the area concerned.

Members may issue instructions to their mobile ship stations to the effect that their weather reports may be transmitted via one of their home coastal radio stations designated for the collection of reports from the zone, if the application of such procedures may facilitate

the efficient contact with coastal radio stations and the clearing of weather messages.

On most voluntary observing ships there is only one radio officer whose watch-keeping hours total eight per day, he/she is therefore not always available at the time when a weather report is ready for transmission. Watch-keeping hours are based on local standard time where the ship happens to be, and these times do not always synchronize with coordinated Universal Time (UTC) used for meteorological observations. It is desirable that watch-keeping hours are chosen so that as many ships' observations at the main standard times (0000, 0600, 1200, 1800 UTC) as possible can be transmitted immediately after the observations are taken.

Observations taken while the radio officer is off-duty should be sent at the first opportunity even with a delay of up to 12 hours. In the southern hemisphere and other areas where few ships' weather reports are available they should be sent up to 24 hours after the time of observation.

In transmitting meteorological reports to coastal radio stations, ships' radio officers follow the regulations which are valid for maritime mobile services, as defined in the ITU Radio Regulations; these are reproduced in Annex 6.E of this Chapter.

Coastal radio stations designated to receive ships' weather reports should, for the purpose of receiving the reports:

(a) Keep a continuous 24-hour watch; or,

(b) Keep a watch for at least 30 minutes beginning at 0000, 0600, 1200 and 1800 UTC daily; a watch should also be kept for a similar minimum time at the beginning of the nearest 'single-operator period' following those standard synoptic hours;

(c) Keep watch for shorter periods (stations with limited hours of operation) than those mentioned under (ft) above when these stations are considered of particular value.

The list of coastal radio stations accepting ships' weather reports, free of charge to the ship, together with their radio addresses and other relevant particulars, is contained in *Coastal Radio Stations Accepting Ships' Weather Reports* (WMO-No. 9), Volume D, Part B. Members responsible for the reception of meteorological reports from ships need to advise the Secretariat of changes to their coastal radio stations so that this publication can be kept up to date.

The ship weather report must be addressed to the telegraphic address of the relevant NMC. The addresses are included in the information published in WMO-No. 9, Volume D, Part B. The address should be preceded by the abbreviation 'OBS' to ensure appropriate handling of the message at the coastal radio station. The coastal radio station must forward the report to the NMC with minimum delay (by telex, landline or other means of electronic communication).

Members whose ships repeatedly encounter difficulties in clearing ships' weather reports with coastal radio stations should communicate promptly with the Member(s) concerned giving full particulars as to dates and times; the presidents of the Commission for Basic Systems and the Commission for Marine Meteorology and the Secretary-General of WMO should also be informed.

6.6.3 *Service Argos*

Service Argos is a system for receipt of data from automatic weather stations by orbiting satellites. It has been used for many years to collect data from drifting buoys, but is also used to collect data from Marine Data Collection Platforms (MDCPs) on board ships. The data are read out from the satellite at one of three ground stations and are then distributed on the GTS.

6.7 Distribution of ships' weather reports over the GTS

Ship weather reports received at an NMC from INMARSAT Coast Earth Stations (CES) and coastal radio stations should be assembled into meteorological bulletins and transmitted Over the GTS with minimum delay. Some Centres transmit a bulletin of available ship weather reports every 15 minutes. The speed of transmission over the GTS has become more important with the advent of INMARSAT, as ship reports which were quickly received at a local coastal radio station may now be received by a CES in a distant country and have to arrive over the GTS. Ship weather reports are also a vital input to global models run at a number of centres, which should receive their data from different parts of the world with minimum delay.

6.8 Meteorological logbooks for ships

6.8.1 *Layout*

The recording of observations in permanent form is obligatory for selected and supplementary ships and recommended for auxiliary ships. On ships where the observations are entered on a personal computer a diskette (or other computer readable media) will be likely be used to record data. Otherwise the observations are recorded in a meteorological logbook. The layout of logbooks is a national responsibility. Generally, the order of parameters recorded in the logbook follows the order of elements in the SHIP code form. Thus the logbook can be used both for recording the synoptic weather report which is to be transmitted and to include additional information required for climatological purposes. For the latter use, the entries are subsequently transferred on to IMMT format (see Chapter 3, paragraph 3.2.7 and Annex 3.C).

Logbooks should contain clear instructions for entering observations. Code books should also be provided, along with logbooks, for ready reference and to correct wrong entries as necessary. It is useful to mark in the logbook those columns which are earmarked for entries to be transmitted as part of the weather report. In some national logbooks, these columns are lightly

shaded or coloured and in others they are inserted in a special frame. Space is often also provided in logbooks to enter the various readings used to compute a meteorological element such as air pressure reduced to sea-level, or actual wind derived from a measured apparent wind and the ship's movement. This will enable a check of the computations carried out on board ship for subsequent quality control of the data during processing for climato-logical purposes.

The size of a meteorological logbook is such that it is possible to enter four days of observations on one sheet, that is 16 observations made at the four main standard times. Ships should be requested to return a completed logbook to the Meteorological Service or PMO which has recruited the ship. The period covered by a logbook should not be more than three months, so that the delay in entering the observations in the climato-logical system is not too great.

Logbooks should be returned with information regarding the ship, the instruments used and other details of a general nature, and space should accordingly be provided for these entries. The name of the master, the observers and the radio officer should also be included, particularly if an incentive programme exists in the country where the ship has been recruited. An example of a page from a meteorological logbook for ships is given in Annex 6.F of this Chapter.

6.8.2 *Supply and return*

To facilitate the supply of meteorological logbooks to ships which do not regularly visit their home ports, Port Meteorological Officers in various ports keep a stock of logbooks of different National Services. In addition, Port Meteorological Officers may also keep stocks of observing and coding instructions in other languages for supply to ships which may require them. As the method of recording observations on diskette becomes widespread, it may also be necessary for Port Meteorological Officers to keep a stock of these for supply to ships.

Completed logbooks are generally considered the property of the NMS which has recruited the ship. As they contain the results of work done on a voluntary basis, they should be kept for a sufficent number of years to permit examination of the original entries. Such an examination is often required to satisfy requests from the ships's officers concerned or from the shipping company. Sometimes, special arrangements are made between countries whereby one country takes care of all recruitment procedures, but the completed logbooks are sent to the country of registration. In such cases, the country which has recruited the ship receives a copy of the completed logbook when so desired.

6.8.3 *Scrutiny of entries*

However clear the instructions relating to entering observations in a logbook, there is always the possibility of errors occurring in entries to a logbook. Completed logbooks must therefore be scrutinized upon receipt and obvious errors corrected. It is of great importance that recurrent types of errors be brought to the attention of the observers concerned so that any misinterpretation of the instructions or erroneous practices in reading instruments or making entries can be corrected. When the logbooks are received by the Port Meteorological Officer, or section of the NMS dealing with voluntary observing ships, a first check should be made as soon as possible to permit a personal conversation with the appropriate ship's officers. Such conversations or written responses commenting on logbooks which have been received constitute an important element of the continuous training of shipborne observers. Without this feedback ship officers would soon become uncertain as to the quality of their work or the implementation of certain observing or coding procedures and, with the inevitable waning of interest, the quality of their observations may deteriorate.

Similar scrutiny and personal liaison is especially important in respect of special observations of, among others, freak waves, sea-surface currents (see Chapter 3, paragraph 3.3 and paragraph 6.4.5 of this Chapter). Without the willing cooperation of marine observers, these non-routine data would not be available.

Ships' officers often include questions on coding matters or on any special phenomena observed by them in the 'remarks' column of the logbook. Response to these questions is important, as this falls within the same spirit of maintaining interest in meteorological work. Some countries have instituted special periodicals for meteorological observers on board their ships in which these questions are discussed and explained (see paragraph 6.11 below).

6.9 **Port Meteorological Officers (PMOs)**

In recruiting voluntary observing ships and assisting them in their meteorological work, direct contact with ships' officers is often needed to provide them with instructive material and other documents, to inspect meteorological instruments on board ships, to collect completed logbooks of observations and, after an initial check, take such corrective action as is possible by personal contact. For this purpose, Port Meteorological Officers (PMOs) with maritime experience should be appointed at main ports.

PMOs are representatives of the Meteorological Service of the country as far as the local contact with maritime authorities is concerned. The role of PMOs is a very important one and the efficiency of the voluntary system of ships' observations often depends on the initiative displayed by these officers. They are in a good position to discuss with ships' officers any problems they have encountered and offer suggestions, bring to their attention any changes in procedures that may have taken place and give them the latest information which they may wish for. Opportunity should also be taken to explain various meteorological and/or oceanographic programmes whenever observations are specially needed

from ships. Meteorological instruments on board ships should be checked and other advice or assistance in meteorological matters should be given by PMOs upon request by the master of any ship, irregardless of its country of registration.

PMOs should also report to the meteorological authorities in their country if the meteorological work carried out on board the ship has not been entirely satisfactory. Members should immediately respond to these reports; when they concern the work carried out under the authority of another Member, the latter should be informed. If action has to be taken following complaints this can best be done through the PMOs who can play a very important role by a tactful approach to the masters and, if constructive criticism is expressed in positive terms, goodwill can be maintained all round.

The scope of the work of PMOs depends largely on the importance of the marine traffic in the particular area served. Before deciding to establish a PMO in a given port, a study must be made of the various services which should be provided. As marine activities develop, a review should be made from time to time to see whether new services should be provided. Guidelines for organizing PMO activities are given in Annex 6.G of this Chapter. Useful information on the role of PMOs can be found in *Proceedings of the International Seminar for Port Meteorological Officers* (1993) (MMROA Report No. 30, WMO/TD-No. 584).

A list of PMOs with their addresses and telephone numbers is contained in WMO-No. 9, Volume D, Part G. The list should be provided nationally to ships' officers to facilitate their contact with PMOs.

6.10 Incentive programme for voluntary observing ships

In recognition of the valuable work done by ships' officers in taking and transmitting meteorological observations and as an incentive to maintaining a high standard of observation many maritime countries have established a national award or certificate system. These systems vary greatly from country to country; in some countries the ships receive the awards, while in other countries awards are made to the individual masters or navigation and radio officers. Sometimes recognition for the meteorological work done on board ships is given in the form of books, charts and other documents presented to the ship.

Members are encouraged to continue the practice of issuing national awards or certificates to selected, supplementary and auxiliary ships recruited by them, or to the ships' personnel, as a sign of their participation in the WMO Voluntary Observing Ships' Scheme.

6.11 Marine meteorological publications produced by National Services for seafarers and marine observers

A number of National Meteorological Services in maritime countries publish magazines directed to the masters and officers of ships participating in the WMO Voluntary Observing Ships' Scheme. Although content and format differ widely, all these periodicals have two goals in common: first to stress the importance of ships' participation in the marine observing programme and second to offer timely marine meteorological information of interest. A list of these periodicals is given in Annex 6.H of this Chapter.

Among the material included in these periodicals are:

(a) Incidents where ships' observations proved particularly useful;
(b) Commendations on active participation in the WMO Voluntary Observing Ships' Scheme;
(c) Hints on observing practices;
(d) Changes in broadcast schedules of weather and sea bulletins or radiofacsimile broadcasts;
(e) Articles on important weather features of particular ocean areas.

Members are encouraged to produce such periodicals and supply them to voluntary marine observers.

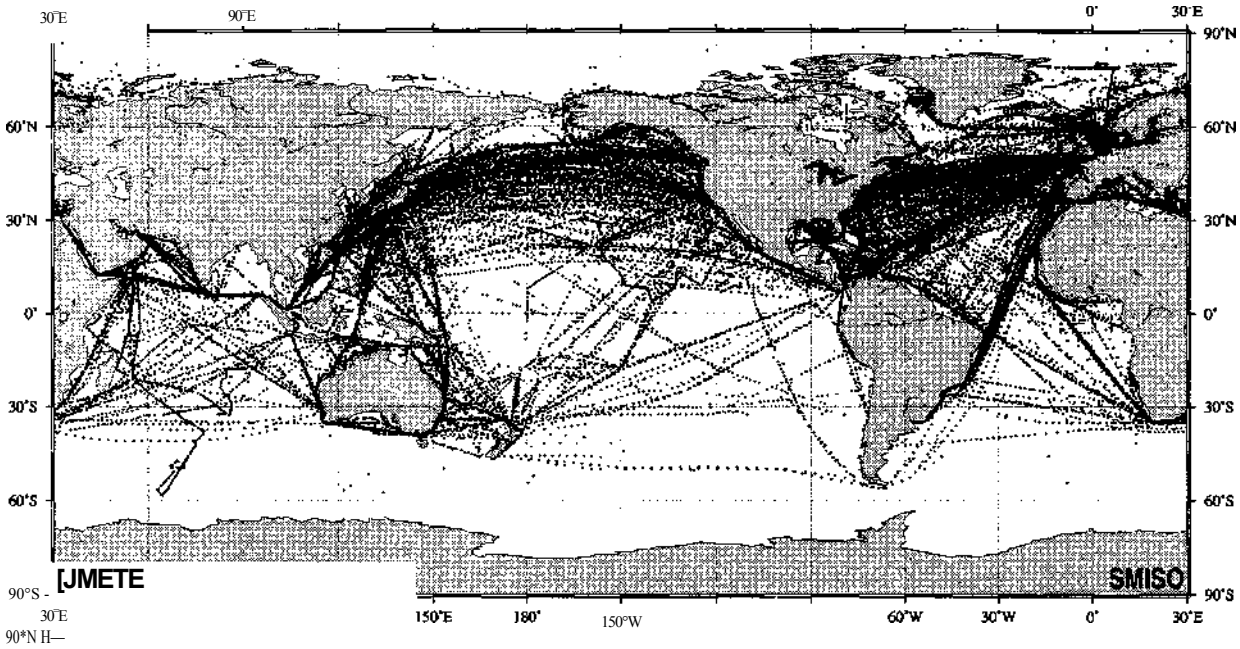
ANNEX 6.A

GEOGRAPHICAL DISTRIBUTION OF SHIPS' WEATHER REPORTS IN A TYPICAL MONTH

(Reference: paragraph 6.3.1)

Mapping position plot chart of data receiving during August 2000

Messages: SHIP Total: 181329



ANNEX 6.B **LOCUST**

REPORTS FROM SHIPS

(Reference: paragraph 6.4.5)

Members concerned should instruct reporting ships, regardless of their nationality, operating in the seas around Africa, Arabia, Pakistan and India, to send by radio, and in plain language, reports on any locusts seen to the Food and Agriculture Organization of the United Nations (FAO) in Rome Telex 610181 FOODAGRI. Costs are paid by the FAO.

Each locust report should contain the following elements:

(a) Date and time (specifying UTC or zone time) when locusts first seen);

(b) Latitude and longitude, if possible to nearest minute, where locusts first seen;

(c) Time and position at which locusts last seen;

(d) Whether *isolated locusts* (seen in flight singly), *locust group(s)* (flying locusts seen intermittently in numbers), *swarm* (flying locusts seen continuously in numbers, over a period of at least a minute), *dense swarm* (obscuring part of horizon or other background), *locusts appearing on board ox floating dead locusts* (isolated, groups or swarms); (e) Colour of locusts (yellow, pink, grey); *if)* Wind direction and speed.

Details of such reports should be entered in the ship's meteorological logbook, even when it has not been possible to send a radio report.

In addition to sending locust reports, ships should be instructed to collect, wherever practicable, specimens of the locusts observed and post them as soon as possible to the Marine Superintendent, Met O(OM), Scott Building, Eastern Road, Bracknell RG12 2PW, United Kingdom.

ANNEX 6.C

GUIDELINES FOR REPORTING OF INFORMATION ON FREAK WAVES AND FOR RECORDING IN METEOROLOGICAL LOGBOOKS, AND AN EXAMPLE OF A SPECIAL LOG SHEET

(Reference paragraph 6.4.5)

(i) Guidelines

It is recommended that the following information be recorded in meteorological logbooks:

(1) *Info rmation on freak waves*

Date: Time: Ship's position

Full description of freak wave (including height and horizontal distance between crest and trough, if possible)
Weather condition: .....
State of sea: .....
Any other factors that may have influenced the state of sea: .....
Any damage sustained by ship: .....

(2) *Information to be attached to freak wave reports by National Meteorological Centres when forwarding them to the Bracknell collecting centre:*

Ship's name: .....
Gross registered tonnage: .....
Ship's radio call-sign: .....

(3) *All freak wave reports and related information received by national centres should be sent onward to the United Kingdom. Meteorological Office, Bracknell, Berkshire, England, for further action.*

FREAK WEATHER REPORT

A freak wave may be defined as a wave of very considerable height, ahead of which there is a deep trough. Thus it is the unusual steepness of the wave which is its outstanding feature and which makes it dangerous to shipping.

ss/mv .....
Call sign .....
Gross tons .....
Date ..... Time ..... GMT
Ship's position .....

DESCRIPTION OF FREAK WAVE

Height ..... m Direction if known .....
Horizontal distance between crest and trough ..... m
Depth of water ..... m (either by sounding or from chart)
Remarks .....

WEATHER CONDITIONS

Wind direction ..... Wind speed ..... knots
Any other weather factor applicable .....

STATE OF SEA

Sea waves: Height ..... m Period ..... sec
Swell waves: Direction ..... Period ..... sec Height ..... m
Any other factor that may have influenced stat of sea (tide, currents, etc.) .....

DAMAGE TO SHIP (if any) .....

Signature of Observer .....

Signature of Master .....

ANNEX 6.D

GUIDELINES FOR THE OBSERVATION AND RECORDING OF SEA CURRENT DATA ON BOARD SHIP, AND AN EXAMPLE OF A SPECIAL LOG SHEET

(Reference paragraph 6.4.5)

(i) Guidelines

1. *Introduction*

The knowledge which we now possess regarding surface currents in the world seas is, for the most part, based on information from current observations taken on board ships.

The systematic collection of surface current information had already begun in the middle of the nineteenth century. The famous Lieutenant Matthew F. Maury of the U.S. Navy was one of the first who saw the importance of gathering wind and current data from ship logbooks. In 1845, he published the first of a series of 'Wind and current charts'.

For constructing current charts, as many observations as possible are required, covering many years. As the variability of loeal currents can be examined only on the basis of a large number of observations, and. as the number needed has not been reached for any place at sea, there is still a great need of current observations, especially from areas less frequented by ships outside the major shipping lanes. More observations are also needed to establish, year to year, variations in currents, as some of these are of great significance for marine science, e.g., the £7 *Nino.* The only way of obtaining enough observations, is by the cooperation of voluntary observers.

By making and reporting observations of currents experienced, the seaman not only gains practical knowledge himself, but benefits shipping generally by adding to our statistical knowledge, so that up-to-date informar tion can be published.

2;. *Methods of ocean^current observations and some definitions* The method of making current observations is to calculate the difference between the dead reckoning (DR) position of the ship after making due allowance for leeway and the position by a reliable astronomical, land, radio, radar, electronic or satellite fix. The result is the set and drift over the ocean floor experienced by the ship during the interval since the previous reliable fix was obtained, and applies to a mean depth of about half the ship's draught.

The *sea of current* is the direction in which it acts; that is the direction toward which it flows. So, the current set is from the DR position to the fix.

The *drift of a current* is the distance measured in nautical miles from the DR position to the fix.

The *leeway* is the angular difference between the ship's course and the ship's direction of movement through the water (i.e., the direction shown by the wake). Leeway occurs when a ship is subjected by the wind to a pressure from a beam. The angle is rarely more than a few degrees, but there is a considerable loss of accuracy in the observation of the current if a realistic allowance is not made for leeway.

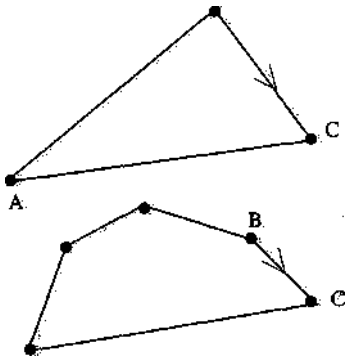
The *"FROM" position* is the true position at the beginning of the stretch over which the current is calculated.

The *"TO " position* is the true position at the end of the stretch over which the current is calculated.

The *dead reckoning (DR) position* is the position of the ship determined by applying to the last well-determined position (the "FROM" position), the run that has since been made, using only the true courses steered (corrected for leeway, if necessary) and the distance run, as determined by log or engine revolutions, *without considering current.* It is important that the true course is corrected for the influence of the wind, so that the difference between the DR position and the true fix is caused-only by the current.

3. *The calculation* B

A: Position,"FROM"



B: "DR" position
C: Position "TO"
A True course steered, corrected for leeway and distance run
A Course and distance made good
BC Current set and drift

When more courses are steered between A and: B, the "DR" position B has to be calculated in steps

The calculation is done in two steps and is based on the following data-First step — Calculation of the DR position Data: *(a)* Position FROM;

(b) Course(s) steered, corrected for possible wind influence without considering current;

(c) The distance, calculated from speed and time, run along each of the course lines without considering current.

Second step — Calculation of the current Data: *(a)* DR position; *(b)* Position TO. It is possible to do both calculations by computer. In this case, it is necessary that all three data for the first step and also the position TO are entered in the logbook by the observer.

The advantages of doing the calculation by computer are that the extra work involved for the observers on board is avoided and that errors in the call-culation are practically eliminated. A disadvantage, however, is that errors in the basic data cannot be discovered and this inevitably leads to incorrectable faulty results. On the other hand, the observer is in a position to check the basic data for possible mistakes; also, he can check if the data are reliable enough for current calculation.

Calculation by computer therefore means an increased responsibility of the observer for entering the basic data correctly and for their reliability. For this reason, it is advisable to always enter the data carefully, and then, to check them.

However, in many cases, the officer will wish to calculate the current for his own interest and use, and this is to be encouraged. When the current is calculated on board, it should be entered in the logbook, along with the data from which it was calculated.

4. *The observation*

The following notes are intended to give practical guidance on the ways in which the most useful observations of currents can be made. The usefulness of an observed current depends largely on its representativeness and its accuracy. Nevertheless, an observation which might normally be rejected as being unlikely to have the desired accuracy might still be of value if it came from an area of sparse shipping, i.e., one about whose currents little was known. The observation of currents is particularly desirable in such areas.

The representativeness and accuracy of current observations are discussed below in more detail:

(a) Representativeness of observed currents Ideally, each observation would represent a single current. In practice, though an observation is made over a distance over which there is likely to be some variation in current. An observation is not required if it is likely to incorporate currents from two different systems. In particular, it is desirable to interrupt an observation when passing a cape, a strait or a current rip, as they are likely to form boundaries between different current systems. Also, observations should not be made with the distance between FROM and TO positions, in excess of about 500 nautical or with the time interval between these positions in excess of about 24 hours. Observations should not be made where there are tidal influences, e.g., on coastal passages.

(b) Accuracy of fixes

The accuracy of current observations depends largely on the accuracy of the two fixes. In general, fixes accurate to within two nautical miles are required. Observations based on noon (sun) positions, derived by running fix, usually have less than the desired accuracy; the accuracy of such fixes depends on a due appreciation of the currents experienced — the very element we are trying to determine. On ther other hand, the fixes derived from observing two or more planets or stars at twilight, are likely to be very suitable for calculating currents. When suitable equipment is available, fixes by such accurate methods as satellite navigation or OMEGA give especially useful current observations;

(*c*) Course

The true course, corrected for compass error, must be used. An error in the DR position, due to an incorrect course, has a direct influence on the current calculation. Therefore, the course must be corrected for leeway, whenever necessary. Estimating the correction for wind is not simple and can only be made by experience. However, at a meteorological service receiving current observations, it is hardly possible to make such corrections, because they are so very dependent on the type of ship and on its draught. If estimation of the leeway is impossible, for example, because of stormy weather, no current observation should be made. When, for some reason, the ship is stopped, it is also better to make no current observation if the wind is more than Beaufort force 3;

(d) Speed

It is of great importance that the speed of the ship *through the water* is known as accurately as possible. An electronic type of log is especially useful. With other, more common, types of log, the speed cannot be determined so precisely, and a compromise between log distance and distance by engine revolutions, making due allowance for slip, possibly gives the best results. The slip depends on several factors (such as draught, loading conditions, sea and swell and the time elapsed since the ship was in dry dock), but some of their effects are often hard to determine;

(e) Changes in course and speed between the FROM and TO positions

Between the FROM and TO positions, it is possible for the course to have been changed one or more times; also, it can happen that different corrections for leeway must be applied over a distance sailed with a constant course. In such circumstances, the distance is divided into parts, each with a constant course and speed through the water. If the current is not calculated on board, but later by computer for each part, each distance must be determined from speed and time noted in the logbook. More than three parts are not acceptable; (*f*) Period between FROM and TO positions

The main considerations are that the period should be long enough for the current to have a measurable effect, yet short enough to make it unlikely that any large variation in current would have occured over the distance covered. Thus, the desirable period depends on the accuracy of available navigational

data. Exceptionally, with very accurate data, e.g., satellite fixes and speed through the water measured by electronic log, the current might justifiably be measured over a period as short as one or two hours. Also, when coasting, a period of a few hours between two shore fixes may be taken. Usually, however, a longer period is desirable and a period of about 12 hours between stellar fixes, determined at dusk and at dawn, for instance, would be very suitable. A period of about 24 hours is necessary when the only positions determined have been by running fix, e.g., noon (sun) positions, but such observations are barely acceptable. Observations from still longer periods are not acceptable. Since observations of current should be independent, period of observation should not overlap.

	DATES, TIMES AND POSITIONS OF SHIP															CURRENT		SHIP					For Office use only
	FROM								TO													
For Office use only	Year	Month	Day (GMT)	Time (GMT) in hours and tenths	Fix (type)	Quadrant	Latitude in degrees and tenths	Hundreds figure Longitude in degrees and tenths	Day (GMT)	Time (GMT) in hours and tenths	Fix (type)	Quadrant	Latitude in degrees and tenths	Hundreds figure Longitude in degrees and tenths	Direction in degrees from true N	Distance (n miles)	Log (type)	For Office use only	Course in degrees from true N	Mean speed in knots	Mean draught	
1	2 3	4 5	6 7	8 9 10	11	12	13 14 15	16 '17 18 19	20 21	22 23 24	25	26	27 28 29	30 31 32 33	34 35 36	37 38	39	40 41 42	43 44 45	46 47	48	49 50 51 52
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ANNEX 6.E **EXTRACT FROM ITU RADIO**

REGULATIONS 1982-86, PART B, CHAPTER 11

(Reference paragraph 6.6.2)

Article 58 Section

III. Ship stations

4052 §5. (1) For the international public corre spondence service, ship stations are divided into four categories:

4053 *a)* stations of the first category: these stations maintain a continuous service;

4054 *b)* stations of the second category: these stations maintain a service for 16 hours a day;

4055 *c*) stations of the third category: these stations maintain a service for 8 hours a day;

4056 *d*) stations of the fourth category: these stations maintain a service the duration of which is either shorter than that of stations of the third category, or is not fixed by these Regulations.

4057 (2) Each administration shall itself determine the rules under which ship stations subject to it are to be placed in one of the above four categories.

4058 §6. (1) Ship stations of the second cate gory shall maintain the following hours of service:

0000-0400
0800-1200 ship's time or zone time,
1600-1800
2000-2200

and, additionally, four hours of service at times to be decided by the administration, master or responsible person, to meet the essential communication needs of the ship, having regard to propagation conditions and traffic requirements.

4059 (2) Ship stations of the third category shall maintain the following hours of service:

0800-1200 ship's time or zone time, two continuous hours of service between 1800 and 2200 h, ship's time or zone time, at times decided by the administration, master or responsible person and, additionally, two hours of service at times decided by the administration, master or responsible person, to meet the essential communication needs of the ship, having regard to propagation conditions and traffic requirements.

4060 (3) Each administration will determine whether ship's time observed by its ships is to be zone time as shown in Appendix 12 (see Nos. 4058 and 4059).

4061 (4) In case of short voyages, these stations shall provide service during the hours fixed by the administrations to which they are subject.

4062 § 7. Ship stations of the fourth category are encouraged to provide service from 0830 to 0930 h, ship's time or zone time.

4063 § 8. (1) Ship stations whose service is not continuous shall not close before:

4064 *a)* finishing all operations resulting from a distress call or from an urgency or safety signal;

4065 *b)* exchanging, so far as practicable, all traffic originating in or destined for coast stations situated with their service area and for ship stations which, being within their service area, have indicated their presence before the actual cessation of work.

4066 (2) Any ship station not having fixed working hours shall inform the coast stations with which it is in communication of the time of closing and the time of reopening its service.

4067 § 9. (1) Any ship station arriving in port, and whose service is therefore about to close, shall:

4068 *a)* notify accordingly the nearest coast station and, if appropriate, the other coast stations with which it generally communicates;

4069 *b)* not close until after the disposal of traffic on hand, unless this conflicts with the regulations in force in the country of the port of call.

4070 (2) On departure from port the ship station shall notify the coast station or stations concerned that its service is reopening as soon as such reopening is permitted by the regulations in force in the country of the port of departure. However, a ship station not having hours of service fixed by these Regulations may defer such notification until the station first reopens its service after departure from port.

APPENDIX 12

Hours of service for ship stations of the second and third categories

(See Articles 26 and 58)

Section I. Table

Hours of service Ship's time or zone time (See No. 4058 and 4059)	
16 hours (HI 6)	8 hours (H8)
from to 0000-0400 h 0800-1200 h 1600-1800h 2000-2200 h plus 4 hours (see No. 4058)	from to 0800-1200 h 1800-2200 h[a]> plus 2 hours (see No. 4059)

[a]) Two continuous hours of service between 1800 and 2200 hours, ship's time or zone time, at times decided by the administration, master or responsible person.

ARTICLE 61

Order of priority of communications in the maritime mobile service and in the maritime mobile-satellite service

4441 The order of priority for communications[1] in the maritime mobile service and the maritime mobile-satellite service shall be as follows, except where impracticable in a fully automated system in which, nevertheless, category 1 shall receive priority:

1. Distress calls, distress messages, and distress traffic.
2. Communications preceded by the urgency signal.
3. Communications preceded by the safety signal.
4. Communications relating to radio direction-finding.
5. Communications relating to the navigation and safe movement of aircraft engaged in search and rescue operations.
6. Communications relating to the navigation, movements and needs of ships and aircraft, and weather observation message destined for an official meteorological service.
7. ETATPRIORITENATIONS — Radiotelegrams relating to the application of the United Nations Charter.
8. ETRATPRIORIATE — Government radiotelegrams with priority and Government calls for which priority has been expressly requested.
9. Service communications relating to the working of the telecommunication service or to communications previously exchanged.
10. Government commuications other than those shown in 8 above, ordinary private communications, RCT[2] radiotelegrams and press radio-telegrams.

ARTICLE 42 **Special services relating to safety**

Section I. Meteorological messages

3312 § 1. (1) Meteorological messages comprise:

3313 *a)* messages addressed to meteorological services officially entrusted with weather forecasts, more specifically for the protection of maritime and air navigation;

3314 *b)* messages from these meteorological services intended specially for:

3315 — ship stations;

3316 — protection of aircraft;

3317 — the public.

3318 (2) The information contained in these messages may be:

3319 *a)* observations taken at fixed times;

3320 *b)* warnings of dangerous phenomena;

3321 *c)* forecasts and warnings;

3322 *d)* statements of the general meteorological situation.

3323 §2. (1) The various NMSs mutually agree to prepare common transmission programmes so as to use the transmitters best situated to serve the regions concerned.

3324 (2) The meteorological observations contained in the classes mentioned in Nos. 3313 and 3316 should be drawn up in an international meteorological code, whether they are transmitted by or intended for mobile stations.

3325 § 3. For observation messages intended for an official meteorological service use shall be made of the frequencies made available for meteorological purposes, in conformity with regional agreements made by the services concerned for the use of these frequencies.

3326 § 4. (1) Meteorological messages specially intended for all ship stations shall in principle be sent in accordance with a definite

4441.1 1 The term *communications* as used in this Article includes radiotelegrams, radiotelephone calls and radiotelex calls.

4441.2 2 RCT (Red Cross Telegram): Telegrams concerning persons protected in time of war by the Geneva Conventions of 12 August 1949.

timetable, and, as far as possible, at times when they can be received by ship stations with only one operator. In radiotelegraphy the transmision speed shall not exceed sixteen words a minute.

3327 (2) During the transmission "to all stations" of meteorological messages intended for stations of the maritime mobile service, all stations of this service whose transmission might interfere with the reception of these messages shall keep silent in order to permit all stations which desire to do so to receive these messages.

3328 (3) Meteorological warning messages for the maritime mobile service shall be transmitted without delay. They shall be repeated at the end of the first silence period which follows their receipt (see Nos. 3038 and 3052) as well as during the next appropriate broadcast as indicated in the List of Radiodetermination and Special Service Stations. They shall be preceded by the safety signal and sent on the appropriate frequencies (see No. 3224).

3329 (4) In addition to the regular information services contemplated in the preceding subparagraphs, administrations shall take the necessary steps to ensure that certain stations shall, upon request, communicate meteorological messages to stations in the maritime mobile service.

3330 (5) The provisions of Nos. 3326 to 3329 are applicable to the aeronautical mobile service, in so far as they are not contrary to more detailed special agreements which ensure at least equal protection to air navigation.

3331 §5. (1) Messages originating in mobile stations and containing information concerning the presence of cyclones shall be transmitted, with the least possible delay, to other mobile stations in the vicinity and to the appropriate authorities at the first point of the coast with which contact can be established. Their transmission shall be preceded by the safety signal.

3332 (2) Any mobile station may, for its own use, listen to messages containing meteorological observations sent out by other mobile stations, even those which are addressed to an NMS.

3333 (3) Stations of the mobile services which transmit meteorological observations addressed to an NMS are not required to repeat them to other stations. However, the exchange between mobile sations, on request, of information relating to the state of the weather is authorized.

3334 § 6. The provisions of Nos. 3326 to 3330 shall apply to notices to mariners.

3335 § 7. Messages containing information concerning the presence of dangerous ice, dangerous wrecks, or any other imminent danger to marine navigation, shall be transmitted as soon as possible to other ship stations in the vicinity, and to the appropriate authorities at the first point of the coast with which contact can be established. These transmissions shall be preceded by the safety signal.

3336 § 8. When thought desirable, and provided the sender agrees, administrations may authorize their land stations to communicate information concerning maritime damage or casualties or information of general interest to navigation to the marine information agencies approved by them and subject to the conditions fixed by them.

ANNEX 6.F **AN EXAMPLE OF A PAGE FROM**

A METEOROLOGICAL LOGBOOK FOR SHIPS

(Reference paragraph 6.8.1)

AN EXAMPLE OF A METEOROLOGICAL LOGBOOK FOR SHIPS (Reference: paragraph 11-1.8.1)

Captain __________________________ Principal Observing Officer______________________________ Radio Officer _______________

Voyage from --- to

YEAR 198 ☐					POSITION OF SHIP								WIND			TEMPERATURE							PRESSURE			PRESSURE CHANGE			WEATHER			CLOUDS				
IF TRANSMITTED BY RADIO ADDRESS TO WHICH SENT	MONTH 01–12	Day of month GMT	GMT	Wind indicator	Ships' report indicator	Latitude (degrees and tenths)	Quadrant	Longitude (degrees and tenths)	Indicator for precipitation group	Indicator for weather group	Height of lowest cloud	Visibility	Total cloud amount	Direction (true) (tens of degrees)	Speed	Group indicator	Sign of temperature in code	Air temperature (degrees and tenths)	Wet bulb (degrees and tenths)	Group indicator	Sign of temperature code	Dew-point (degrees and tenths)	Barometer as read and correction	Group indicator	Corrected pressure	Group indicator	Characteristic	Amount	Present	Group indicator	Past	Group indicator	Amount of low or medium if no low	Type of low	Type of medium	Type of high
GROUP NUMBERS		GROUP 1			GROUP 2		GROUP 3		GROUP 4				GROUP 5			GROUP 6				GROUP 7				GROUP 9		GROUP 10			GROUP 12			GROUP 13				
CODE SYMBOLS		YY	GG	i_w	99	$L_aL_aL_a$	Q_c	$L_oL_oL_oL_o$	i_R	i_x	h	VV	N	dd	ff	1	s_n	TTT		2	s_n	$T_dT_dT_d$		4	PPPP	5	a	ppp	7	ww	W_1W_2	8	N_h	C_L	C_M	C_H
			00		99											1				2				4		5			7			8				
			06		99											1				2				4		5			7			8				
			12		99											1				2				4		5			7			8				
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			12		99											1				2				4		5			7			8				
			18		99											1				2				4		5			7			8				
COLUMN No. 1	2	3	4	5		7	8	9	10	11	12	13	14	15	16		17	18	19		21	22	23		24		25	26		28	29		30	31	32	33

NOTE: Logbook is printed so that these two pages form full record columns 1-56 from left to right when logbook is opened flat.

Height of barometer above sea level---------- feet/metres — (Note any departure from this method in

Method of taking sea temperatures: (a) Rubber bucket (b) Condenser intake (c) Hull sensor -- Remarks Column)

For Office use only	Section indicator	Course of ship	Speed of ship	SEA TEMPERATURE			WIND WAVES			SWELL WAVES									ICE ACCRETION					ICE					REMARKS	Call sign to which sent, frequency (kHz) used and time sent GMT
				Group indicator	Sign of temperature in code	Sea temperature (degrees and tenths)	Group indicator	Period in seconds	Height (in half metres)	Group indicator	Direction from (tens of degrees)	Direction from (tens of degrees)	Group indicator	Period in seconds	Height (in half metres)	Group indicator	Periods in seconds	Height (in half metres)	Group indicator	Type of ice accretion	Thickness of ice (cm)	Rate of ice accretion	Group indicator	Concentration or Arrangement	Stage of development	Ice of land origin	Bearing of ice edge	Ice situation	Shifts of wind, times of start and finish of rainfall, etc. Special phenomena should be entered briefly. Space for additional remarks is provided at the end of this logbook. The Beaufort notation may be used in this column. (See "Marine Observer's Handbook").	
	GROUP 15			GROUP 1.6			GRQUP18			GROUP 19			GROUP 20			GROUP 21			GROUP 22					GROUP 23						
	222	D_s	v_s	0	$n	'w w' w	9	P P	H H	3	$d_{w1}d_{w1}$	$d_{w2}d_{w2}$	4	Pwl^wl	Hwl^wl	5	Pw2fw2	Hw2Hw2	6	I_5	E_SE_S	R_s	IC	c,	Si	b,	D,	z,		
00	222			0			2			3			4			5			6				IC							
06	222			0			2			3			4			5			6				IC							
12	222			0			2			3			4			5			6				IC							
18	222			"			2			3			4			5			6				IC							
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06	222			0			2\			3			4			5			6				IC							
12	222			0			2			3			4			5			6				IC							
18	222			0			2			3			4			5			6				IC							
00	222			0			V			3			4			5			6				IC							
06	222			0			2			3			4			5			6				IC							
12	222			0			2			3			4			5			6				IC							
18	222			0			2			3			4			5			6				IC							
		34	3		3	37		38	39		40	41		42	43		44	45		4	4748	4		5	5	5	5	5	55	56

ANNEX 6.G

GUIDELINES FOR ORGANIZING PORT METEOROLOGICAL OFFICER (PMO) ACTIVITIES

(Reference paragraph 6.9)

1. Introduction

The functions of a Port Meteorological Officer (PMO) cover five broad areas:

(a) Recruitment of ships to take part in the Voluntary Observing Ships' Scheme;
(b) Regular liaison with recruited ships to ensure the highest standard of observations;
(c) Collection of completed ships' meteorological logbooks;
(d) Act as an interface between the meteorological service and the marine community;
(e) In large ports act as a focus for the provision of meteorological services in the port.

1.1 *Personnel requirements*

Each maritime Member of WMO should appoint PMOs with maritime experience at its main ports. Their maritime experience enables them to communicate effectively with the ship's master and other officers. They should also have experience in, and knowledge of, meteorology, theoretical as well as practical. Knowledge of the English language would be an advantage, as most ships' officers whose mother tongue is not English are able to express themselves in this language. The necessary training of PMOs is described in the *Manual on Marine Meteorological Services,* Part **IV,** Section 3.

1.2 *Location of the office of a Port Meteorological Officer*

The office of the PMO should preferably be situated in the centre of the harbour area. This allows the maximum of ships to be visited and facilitates visits by observers from voluntary ships to the PMO's office and gives them access to meteorological information. The PMO will need appropriate transport for instruments and supplies to ships as required.

2. Duties of a Port Meteorological Officer

2.1 *Recruitment of observing ships*

2.1.1 MERCHANT SHIPPING

Recruiting of observing ships should be in the hands of the PMOs, but subject to overall guidance from the relevant section of the NMS. A worldwide distribution of observing ships is the objective to attain and every effort should be made to recruit ships which sail in data-sparse areas, e.g. the oceans of the southern hemisphere.

PMOs normally only recruit ships which are registered in their own country, but ships of other registry may be considered if they are regular callers and if the PMO considers that they would make a useful addition to the voluntary observing fleet.

Points to be considered when recruiting ships are:

(a) Willingness of masters and officers to carry out the voluntary weather observing and reporting in code by radio or INMARSAT throughout the voyage;
(b) Suitability of the ship to carry and care for the instruments.

Permission to recruit a ship should, whenever possible, be obtained from the owners, usually through the marine superintendent of the company and from the master. It is recommended that only a verbal undertaking by a ship's master to carry out the work of an observing ship should be obtained. This service is voluntary, and it is therefore not desirable to create the impression that a formal binding contract will be imposed.

When a ship agrees to participate (or volunteer) in the scheme, the PMO equips the ship with the necessary instruments and stationery. This needs to be done quickly as many ships do not spend much time in port. A list of the instruments issued should be compiled by the PMO and the equipment lent to ships must be as perfect as possible for its purpose.

If the master agrees, a ship should preferably be recruited as a selected ship. If an opportunity occurs a ship should change from being a supplementary ship to being a selected ship again, if the master so agrees.

Suggested lists of instruments and stationery for the various types of observing ships are as follows:

Selected ships

One precision aneroid fitted with a damping cap;
One barograph;
One pyschrometer OR two screens and two sheathed thermometers (1 air, 1 wet bulb) for each screen, plus two spares;
Two sea thermometers for rubber bucket and one or two rubber buckets if that bucket method is to be used for measuring sea-surface temperature;
Meteorological logbooks;
Signal pads;
Barograph charts;
Envelopes;
Plotting charts;
Code and decode for use of shipping;
State of sea card;
Cloud types for observers;
Reduction to mean sea level card;
Dew-point tables; and,
Marine observers guide (if available).

Supplementary ships:

One precision aneroid fitted with a damping cap;
One or two screens and one sheathed thermometer for air temperature for each screen plus one spare;
Meteorological logbooks;
Signal pads;
Envelopes;
Plotting charts;
Code and decode for use of shipping;
State of sea card;
Cloud types for observers;
Reduction to mean sea level card; and,
Marine observers guide (if available).

Auxiliary ships:

Signal pads;
Envelopes;
Aneroid barometer correction card; and,
Code card.

Ships' officers should be asked to keep the Meteorological Service's instruments in good and clean condition. The position for the barometer in a ship's chart room should be chosen with care in consultation with the master. It should be as safe as possible from accidental damage, in a good light and clear of artificial heating. Advice should be given as to the best exposure for the thermometer screen if issued under differing conditions. The screen should be kept white. Special attention should be drawn to the care required in ensuring accurate sea temperature observations.

PMOs should ensure that observing officers understand the importance of reading wet and dry bulb temperatures in any one observation to the same degree of precision. All temperatures are required to be read to the nearest tenth of a degree. When this is not possible and the temperatures are read to the nearest whole degree, the tenth figure is reported as a solidus and not by a zero.

Subject to financial constraints, ships under construction may be supplied with distant reading equipment. PMOs should inform their headquarters of any ships being built in their area which would be suitable, and their respective owners could then be approached by headquarters. Alternatively PMOs should inform superintendents of shipping companies that distant reading equipment is available to ships being built. If interested, they should advise them to write directly to the Meteorological Service volunteering their ships to be so equipped. When the necessary agreements and financial approvals have been obtained, the PMO should be informed. He should then arrange to visit the ship with a technician if necessary to discuss the siting of the instruments.

It is of the greatest importance that the PMO's initial guidance and instruction to newly-recruited observing and radio officers should be as thorough and complete as possible. This will immediately ensure a uniformity in observing technique.

2.1.2 FISHING VESSELS AND SMALL CRAFT

To help extend the collection of marine meteorological data small craft fitted with good communication equipment may be supplied with instruments or they may be recruited as non-instrumental observing ships and requested to report surface weather conditions, whenever possible. They become auxiliary ships under the Voluntary Observing Ships' Scheme.

Large fishing vessels and yachts can supply most valuable meteorological information from important areas from which there are normally very few ships' weather reports.

In ports from which fishing vessels and large yachts sail, the PMOs should do all that is possible to encourage and interest the owners and captains in marine meteorology. The captains should be assured of the usefulness to forecasting centres of their voluntary weather reports.

2.2 *Visits to ships*

Visits and inspections are primarily intended to be occasions for giving encouragement and guidance to marine observers and for thanking them for their work, but they are also the occasion of checking on the continued accuracy of the instruments. Observing ships should, if possible, be visited at intervals of no more than three months and a report made on their instruments. A point to remember when visiting ships is that all the facilities being made available to the visitor are at the discretion and invitation of the ship's staff.

At each inspection any defective National Meteorological Service instruments should be replaced and a receipt should, if possible, be obtained from the master or his senior officer for all instruments issued.

The barometer is probably the most important instrument for weather observing. The reading should be checked by comparison with a precision instrument such as a precision aneroid kept specially for this purpose, which in turn is compared with a standard barometer.

The barometer should be withdrawn from a ship if the difference from standard exceeds 0.3 hPa and is obviously increasing,

It is recommended that a record card is kept for each precision aneroid issued to a ship. On the card is recorded the difference between the precision aneroid and the standard barometer. The difference, however small, should always be entered on a form, so that an accurate record can be kept of the behaviour of each (precision) aneroid. Plus or minus signs should be used to indicate high or low differences: the plus sign when the ship's aneroid is reading higher than standard and the minus sign when the aneroid is lower than standard.

Distant reading equipment, if fitted aboard ships, should be checked at each inspection,

Hand anemometers, if issued to ships, should be returned to the NMS once a year for recalibration and a replacement issued.

In making out reports on instruments, care should be taken to distinguish between Meteorological Service instruments and the ship's own instruments. Where the ship's own instruments are used for observing, the PMO should record this on the visit form. This is necessary to avoid confusion between the property of the NMS and that of the owners or officers.

A standard inspection form should be used for each visit. Space should be available on this form for recording:

(a) Any replacement of instruments;

(b) Full details of any onboard anemometers;

(c) Any instruments which are the property of the ship's owners or officers;

(d) Any instruments supplied by other authorities e.g. XBTs, plankton recorders, which affect the appropriate entry to the *International List of Selected, Supplementary and auxiliary Ships* WMO-No. 47); (*e*) Distance of the thermometer screen from the ship's side and height above sea level. The inspection report should be forwarded to the relevant section of the NMS as soon as possible after the inspection.

On visiting an observing ship, the PMO should ascertain that the necessary logbooks and stationery are on board and that the relevant publications contain up-to-date instructions and amendments. The ship's officers should likewise understand the international meteorological codes and the procedure to be carried out in transmitting weather messages to the meteorological centres ashore through the appropriate stations. Radio officers should be contacted whenever possible.

Courtesy visits should, if possible, be made to voluntary observing ships of other nations when they are in local ports and advice and assistance given as necessary, including supply of stationery if the ship has run out.

2.2.1 WITHDRAWAL OF INSTRUMENTS

It should be the duty of the PMO to recover instruments from ships which cease to observe. When ships cease observing for any reason, the fact should be recorded. PMOs should watch the shipping papers and journals to ascertain, among others, ship sales and change of registry and if these take place abroad they should consider requesting the assistance of the PMO in the relevant country and port.

On receipt of this information, the ship's name will be removed from the national fleet list in the relevant NMS.

When withdrawing instruments care should be taken that instruments which are not the property of the NMS are not included.

2.3 *Collection of ships' meteorological logbooks*

When completed ships normally return their meteorological logbooks to the: NMS, but some may prefer to hand it to a PMO. The latter should see the meteorological logbook of all visiting ships and, if it is full or nearly full, they should forward it to the relevant section of their NMS as soon as possible after collection.

It is important to return completed logbooks from observing ships. When visiting observing ships, a PMO should therefore ascertain that the logbooks have been returned. If the book in current use has been started more than six months previously it should be withdrawn and the officers asked to start a new one. PMOs should take the opportunity, whenever possible, to give any advice as to the method of writing up the logbooks,

PMOs should make a special point of visiting observing ships' crews who appear to have difficulties in completing their logbooks and ascertaining the cause.

It is recommended that all meteorological logbooks received are immediately acknowledged by postcard addressed to the master at the address indicated on the front page of the book. PMOs should ensure that this entry has been completed correctly in the logbook and care taken to distinguish between the owners' and the charterers' address.

It is further recommended that after an initial examination of the book a letter of appreciation and comment is sent by the NMS to the master (not by name) through the owners. The interval between these two communications can amount to as much as three months.

2.4 *General liaison with ships*

A PMOs first duty is the care and supervision of the work of voluntary marine observers and they should give encouragement to the applications by the merchant marine generally of marine meteorology to safe and efficient navigation, comfort of passengers and the care of cargo.

A PMO is the channel use to communicate advice, instruction and correction to marine observers and also the gratitude of the meteorological departments responsible for coordinating the work. Thus a complimentary call by these officers upon the master and officers of a ship should be regarded as more valuable than a letter, but a complimentary card should always be left if it was not possible to see the master. All communications (the fewer letters the better) sent to ships are to be addressed to the master.

PMOs should make themselves familiar with the current international meteorological codes for ships in order to be able to explain it to the masters and officers of the voluntary observing fleet.

Advice and encouragement to voluntary observing officers should be given at every opportunity during visits and, for example, through the medium of any national marine meteorological publications aimed at the voluntary observing ships. 'Letters to the Editor' for these publications should be welcome and should be encouraged from marine observers. PMOs should keep themselves conversant with the content of marine meteorological journals, including those of other Members.

Every encouragement should be given to marine observers and others interested in marine meteorology, to contribute papers or remarks on pertinent subjects, for publication in meteorological journals. Special attention should be directed to the pages, where provided, in the meteorological logbooks for 'additional remarks' and ocean currents. Masters and officers should be encouraged to write descriptions of their experiences not only as regards weather, but of all subjects of scientific interest. It is important that PMOs should maintain contact with their national navigation schools and colleges and give them any advice and assistance they may require.

PMOs of a Meteorological Service should remember that it is their duty to secure by the voluntary service of ships' officers the best possible information on meteorological conditions at sea, but it is also desirable to avoid imposing a workload which may interfere with, or adversely affect the main duties of a ships' officer to become, if excessive, detrimental to his or her main duties.

PMOs should make themselves thoroughly familiar with the scheme of communication for observing ships' routine weather reporting. They should give every encouragement and all necessary advice and instruction to observing ships.

Any difficulties that radio officers may have experienced in reporting by radio through the coastal radio stations should be reported by PMOs to their NMS. These reports should only be after careful enquiry and all relevant details such as the ship's position, radio frequency used, time and station to which addressed, use of correct prefix (such as OBS) should be included.

Attention should be drawn to the 41+ two digit code for ships fitted with INMARSAT. Addressed telexes to Meteorological Services without the code 41+ procedures are chargeable to the ship.

PMOs should explain the use of radio weather bulletins, gale, storm and tropical cyclone warnings issued specially for shipping, and which radio weather bulletins, including facsimile broadcasts are the most suitable for masters and officers. Information on this point should also be given to navigation schools and they should also be informed of the other meteorological services available to mariners.

PMOs should keep in touch with the management and marine superintendent of shipping companies with offices in their area and make regular visits to them.

2.5 *Provision of port meteorological services*

Shipping, fishing and other marine interests should be informed on how weather forecasts can readily be obtained in the port. They should also be kept informed of all meteorological services available to mariners.

Weather information useful to shipping, fishing or small craft should, if possible, be displayed at the Port Meteorological Office and at any other suitable place, such as a Customs' House, Mercantile Marine Office, Pilot Station, Yacht Club, etc. Weather information may include forecasts and charts received from a major forecasting office by facsimile. Alternatively there may be computer facilities to enable the PMO office to interrogate the database at the forecasting office to obtain the particular chart and/or forecast required. In large ports with a network of automatic weather stations the latest observations may be displayed electronically at the PMO's office (see Chapter 5 for more information on services in ports).

The PMO's office may also supply climatological data to ship's officers on request. This may be by photocopying a master set of data for the port and surrounding areas, or printing the data on microfiche if there are frequent requests for data on different areas. A dial-up or online connection to a central computer data base may be worthwhile.

As the first point of contact by ships' officers on meteorological matters, the PMO may be asked for more specific technical information, e.g. on cargo ventilation. If the PMO is unable to answer the query himself, he should transmit it to the appropriate section of the Meteorological Service and ensure that a prompt reply is made.

ANNEX 6.H

MARINE METEOROLOGICAL PUBLICATIONS PRODUCED BY NATIONAL SERVICES AND INTERNATIONAL ORGANIZATIONS OF INTEREST TO SEAFARERS AND MARINE OBSERVERS

(Reference: paragraph 6.11)

Title of Publication	*Editions per year*	*Country of origin*	*Language*
Boletin Climatico Marino	3	Cuba	Sp.
Met Mar	4	France	F
Guide de l'Observateur Meteorologiste en Mer	1	France	F
Der Wetterlotse	6	Germany	German
Newsletter V.O.S. from Hong Kong, China	2	Hong Kong, China	E
Ship and Maritime Meteorology (Fune to Kaijou Kishou)	3	Japan	Japanese
Schip en Werf de Zee	11	Netherlands	Dutch
Meteorologisch Informatie Bulletin Maritiem	4	Netherlands	Dutch
Monthly Weather Summary	12	Qatar	E
Marine Observer	4	United Kingdom	E
IMO News	4	United Kingdom	E
Mariners Weather Log	4	United States	E
Storm Data	12	United States	E
WMO Bulletin	4	Switzerland	E, F, R, S

CHAPTER 7

TRAINING IN MARINE METEOROLOGY

7.1 Introduction

Marine meteorology, which is concerned with the atmosphere over oceanic regions and the interaction between ocean and atmosphere must also take the behaviour of the upper ocean into account. It is therefore so distinct from the study of the behaviour of the atmosphere over land that it must be considered a separate subject with its own requirements for training facilities and programmes both for meteorological personnel engaged in the provision of marine meteorological information including Port Meteorological Officers (PMOs), and the seafarers who interpret this information and/or take and transmit marine observations.

7.2 Classification of personnel requiring training

The types of personnel requiring training in marine meteorology are specified in the *Manual on Marine Meteorological Services,* Part IV as:

(a) Meteorological personnel engaged in observational, forecasting and climatological duties for marine purposes;
(b) PMOs;
(c) Seafarers whilst at sea and in navigational schools;
(d) Marine observers on board ships.

Each class of marine meteorological personnel requires training both in general and marine meteorology up to the various standards required for their particular tasks. The classification and educational requirements for meteorological personnel including the syllabi for training are fully detailed in *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology* (WMO-No.258). The relationship of each type of personnel to the related class level and the extent of training required is broadly illustrated in the following table:

7.3 Training principles and procedures

The principles and procedures governing the training of all classes of meteorological personnel engaged in marine meteorological activities together with those pertaining to PMOs and seafarers are laid down in Part IV of the *Manual on Marine Meteorological Services.* These point out the need for special training centres in some instances, the importance of trained specialist instructors, the involvement of universities and guidance available from WMO publications.

In addition the standards set by the relevant international authorities for the training of ships' officers must be considered. Acording to the *International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978* (IMO publication), the training requirements in marine meteorology of masters and chief mates of ships of 200 gross registered tons or more is as follows:

(a) Demonstrate the ability to understand and interpret a synoptic chart and to forecast area weather, taking into account local weather conditions; Knowledge
(b) of the characteristics of various weather systems, including tropical revolving storms and avoidance of storm centres and dangerous quadrants;
(c) Knowledge of ocean current systems; Ability to use
(d) all appropriate navigational publications on tides and currents, including those in English language; and,

Ability to calculate tidal conditions. Similarly, the
(e) training requirement in marine meteorology for officers in charge of a navigational watch and masters of ships of less than 200 gross registered tons in the above Convention is as follows: ' Knowledge of shipborne meteorological instruments and their application, knowledge of characteristics of various weather

	Marine meteorological personnel		*Training required-*	
Class of meteorological personnel	*Shore-based*	*Sea-going*	*General meteorology*	*Marine meteorology*
Class I	Chief Forecasters		4 years combined (minimum)	8 months** (minimum)
Class II	Forecasters PMOs	Masters Chief Officers	2 years combined	11 months on site (minimum)
Class III	Assistants Technical staff	Deck Officers	8-10 months	2 months Extensive on site
Class IV	Observers	Marine Observers	4 months	1 month Extensive on site

* Includes training periods at sea for deck officers. ** Marine Meteorological Services.

systems, reporting procedures and recording systems and the ability to apply the meteorological information available.

7.4 Training institutions and facilities for meteorological personnel engaged in marine activities

Institutions providing training in marine meteorology for all classes of meteorological personnel engaged in marine activities should be established in maritime countries. These institutions should also have sufficient contact with national oceanographic institutes so that staff from these institutes can be co-opted to give lectures in physical oceanography. Practical training on board ships should be given for both meteorological and physical oceanographic observations. The introduction of marine meteorology and related physical oceanography into university meteorological courses should be encouraged.

7.5 Training institutions and facilities for seafarers

Institutions such as navigation schools which provide training in various aspects of marine operations and navigation to new recruits and advancement trainees should include training in marine meteorology and physical oceanography in their syllabi. There should be facilities for giving practical training in meteorological and oceanographic observations on board ships. Close liaison is required between these institutions and those mentioned in paragraph 7.4 above so that they may keep abreast of the lastest developements in marine meteorology and physical oceanography.

No formal training is necessary for nonprofessional seafarers. Information covering the meteorological and oceanographic subjects relevant to their activities would satisfy their training requirements.

APPENDIX 1

1. SELECTED PUBLICATIONS OF THE WORLD METEOROLOGICAL ORGANIZATION

1. General

WMO-No.

49 *Technical Regulations*, Volume I — General Meteorological Standards and Recommended Practices

182 *International Meteorological Vocabulary*

TD-No. 621 *Proceedings of the International Workshop on Marine Meteorology — 1994*

2. Observations

8 *Guide to Meteorological Instruments and Methods of Observation*

47 *International List of Selected, Supplementary and Auxiliary Ships*

306 *Manual on Codes* Volume I — *International Cloud Atlas*; Volume II — Manual on Observation of Clouds and Other Meteors;

407 Plates

411 *Information on Meteorological and Other Environmental Satellites*

544 *Guide on the Global Observing System* Volume I— Global Aspects; Volume II — Regional Aspects

659 *Manual on the Global Observing System*

750 *Marine Cloud Album*

TD- 31 No. 1 *Guide to Moored Buoys and Other Ocean Data Acquisition Systems*

TD- 64 No. 9 *Wind Measurements Reduction to a Standard Level*

TD- 69 No. 4 *WMO/IOC Technical Conference on Space-based Ocean Observations Proceedings of the WMO/IOC Workshop on Operational Ocean Monitoring Using Surface-Based Radars*

TD- 76 No. 3 *Polar Orbiting Satellites and Applications to Marine Meteorology and Oceano-graphic — Report of the CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing*

TD-No. 840 *Tropical Coastal Winds*

TD-No. 928 *Automatisation de I 'observation en mer*

TD-No. 1009 *The Voluntary Observing Ships Scheme, A Framework Document*

TD-No. 1027 *Proceedings of a Workshop on Mapping and Archiving of Sea Ice Data — The Expanding Role of Radar*

TD-No. 1032 *Oceanographic and Marine Meteorological Observations in the Polar Regions*

WMO-No.

— A Report of the Joint WMO/IOC Technical Commission on Oceanographic and Marine Meteorology

3. Services

9 Volume D — *Information for shipping*

305 *Guide on the Global Data-processing System*

386 *Manual on the Global Telecommunications System* Volume I — Global Aspects; Volume II — Regional Aspects

485 *Manual on the Global Data-processing System* Volume I — Global Aspects; Volume II — Regional Aspects

558 *Manual on Marine Meteorological Services* Volume I — Global Aspects; Volume II — Regional Aspects

595 *The Preparation and Use of Weather Maps by Mariners*

637 702 *Meteorology and Public Safety Guide to Wave Analysis and Forecasting Forecast Techniques for Ice Accretion on different Types of Marine*

TD-No. 70 *Structures, including Ships, Platforms and Coastal Facilities*

La Prevision du Brouillard en Mer

Coastal Winds

TD-No. 211 *Proceedings of the International Seminar for*

TD-No. 275 *Port Meteorological Officers Wind*

TD-No. 584 *Measurements Reduction to a Standard Level*

Meteorological Requirements for Wave

TD-No. 311 *Modelling Storm Surges*

Handbook of Offshore Services Evaluation of

TD-No. 583 *the Highest Wave in a Storm Marpolser 98 — Metocean Services for Marine Pollution*

TD-No. 779 *Emergency Reponse Operations*, Volume I —

TD-No. 850 Research Papers *Marpolser 98 — Metocean*

TD-No. 858 *Services for Marine Pollution Emergency*

TD-No. 959 *Reponse Operations*, Volume II — Review and Information Papers

Estimation of Extreme Wind Wave Heights

TD-No. 960

4. Sea ice

259 *WMO Sea-ice nomenclature* Volume I — Terminology and codes; Volume II — International system of sea-ice symbols

574 *Sea-ice Information Services in the World*

TD-No. 783 *Ice Navigation Conditions in the Southern Ocean*

TD-No. 1032 *Oceanographic and Marine Meteorological Observations in the Polar Regions*

5. Tropical Cyclones

455 *The Quantitative Evaluation of the Risk of Disaster from Tropical Cyclones*

528 *Operational Techniques for Forecasting Tropical Cyclone Intensity and Movement*

618 *Tropical Cyclone Operational Plan for the South-west Indian Ocean*

6. Climatology

100 *Guide to Climatological Practices*

117 *Climatological Normals for* CLIMAT *and* ■GUMAT SHIP *stations for the period 1931-1960*

781 *Guide to Applications of Marine Climatology*

TD-No. 36 *User's Guide to the Data and Summaries of the Historical Sea Surface Temperature Data Project*

TD-No. 933 *The Climate of the Baltic Sea Basin*

TD-No. 957 *Proceedings of the International Workshop on Digitization and Preparation of Historical Marine Data and Metadata*

7. **Training**

240 *Compendium of Training Facilities for Meteorology and Operational Hydrology*

258 *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology*

364 *Compendium of Meteorology for Use by Class I and Class II Meteorological Personnel* Volume II, Part 3 — Marine Meteorology

Compendium of Lecture Notes in Marine Meteorology for Class III and Class IV Personnel

PUBLICATIONS BY OTHER INTERNATIONAL ORGANIZATIONS

IMO *The International Convention for the Safety of Life at Sea* (as amended) *IMO Search and Rescue*

IMO *Manual Manuals and Guides No. 3, Guide to*

IOC *Operational Procedures for the Collection and Exchange oflGOSS Data Manuals and Guides No. 9, Annex 1, The IOC General Magnetic*

IOC *Tape Format for the International Exchange of Oceanographic Data Radio Regulations*

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APPENDIX 2

ORGANIZATIONS AND PROGRAMMES IN INTERNATIONAL MARINE AFFAIRS

The following summarizes the major organizations and programmes involved in the international coordination of marine affairs.

Intergovernmental organizations

The following organizations have a membership from the governments of most maritime countries of the world. They are, in effect, agencies of the United Nations, and are funded by contributions from member countries.

World Meteorological Organization (WMO) — deals with the international coordination in all matters (including observation, forecasting and research) relating to weather and climate. The Secretariat is located in Geneva.

Intergovernmental Oceanographic Commission (IOC) — deals with the international coordination of all matters relating to the oceans of the world. The Secretariat is located in Paris.

International Maritime Organization (IMO) deals with the international coordination of matters relating to international shipping, including safety, pollution and the exchange of technical information. The Secretariat is located in London.

International Hydrographic Organization (IHO) deals with the international coordination of matters relating to hydrographic surveys and the broadcast of warnings of navigational hazards (NAVAREA warnings). The Secretariat is located in Monaco.

Research

International coordination in scientific research is promoted by the *International Council for Science* (ICSU), which coordinates the activities of 20 international unions in the field of natural sciences. One of these Unions is the *International Union of Geodesy and Geophysics* (IUGG) which has seven Associations. The two Associations in the atmospheric and marine field are the *International Association of Meteorology and Atmospheric Sciences* (IAMAS) and the *International Association for the Physical Science of the Ocean* (IAPSO). The ICSU is supported by dues from member organizations grants from private foundations, and grants from UNESCO. The ICSU Secretariat is located in Paris.

Committees, commissions, **panels and groups**

There are a number of smaller bodies set up by one, or more than one, of the intergovernmental and research organization below. These bodies are involved in greater levels of international coordination.

The *Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology* (formerly CMM) — coordinates marine activities is one of eight Technical Commissions of the WMO. It meets approximately every four years and its terms of reference are in the *Basic Documents No. 1* (WMO-No. 15).

Data Buoy Cooperation Panel (DBCP) was set up as the Drifting Buoy Cooperation Panel by WMO and IOC in 1985 to coordinate the supply and deployment of drifting buoys and the receipt and distribution of the data from them. As it now deals with moored, as well as drifting buoys, its name has been changed to Data Buoy Cooperation Panel.

Intersecretariat Committee on Scientific Programmes relating to Oceanography (ICSPRO) serves as a mechanism for strengthening coordination in ocean-science related activities within the United Nations system. Full members have included UNESCO, the United Nations, the Food and Agriculture Organization (FAO), WMO and IMO, the International Atomic Energy Agency (IAEA) and the United Nations Environment Programme (UNEP).

The *Group of Experts on the Scientific Aspects of Marine Environmental Protection* (GESAMP) first met in 1969 and is jointly sponsored by IMO, IOC, FAO, UNESCO, WMO, WHO, IAEA, the UN and UNEP. It provides advice relating to the scientific aspects of marine pollution, prepares periodic reviews of the state of the marine environment with respect to marine pollution and identifies problems requiring attention.

The Committee for the Global Investigation of Pollution in the Marine Environment (GIPME) has been set up jointly by IOC, UNEP and IMO. A joint IOC-UNEP Intergovernmental Panel for GIPME has been established to provide policy guidance to harmonize the implementation of the scientific and management components of IOC and UNEP Regional Seas Programme, and to harmonize the GIPME programme with the Health of the Ocean Module (HOTO) of GOOS.

GCOS/GOOS/WCRP *Ocean Observations Panel for Climate* (OOPC) was established as a follow-on from the Ocean Observing System Development Panel which presented its final report in 1994. Its purpose is the design of the climate module of the GOOS as part of the GCOS.

Scientific Committee on Ocean Research (SCOR) was established by ICSU in 1957 to further international scientific activitity in all branches of oceanic research. It examines problems and identifies elements that would benefit from enhanced international action, including improvement of scientific methods, design of critical experiements and measurement programmes and relevant aspects of science policy.

Programmes

There are a number of programmes of marine activities which are run by one or more of the above organizations.

The International Oceanographic Data and Information Exchange (IODE) is an IOC program for the international exchange of oceanographic data.

The Global Ocean Observing System (GOOS) is a joint IOC/WMO/UNEP/ICSU programme for collecting comprehensive information on the properties and variability of the Earth's ocean system, including its chemical, biological and physical properties. It is run by two committees: an Intergovernmental Committee for GOOS (I-GOOS), which coordinates national support for GOOS implementation, and a GOOS Steering Committee, which coordinates and provides scientific oversight for the design of GOOS. The climate module of GOOS is also the ocean component of the *Global Climate Observing System* (GCOS), also a joint programme of WMO, IOC, UNEP and ICSU.

The Global Sea-level Observing System (GLOSS) is an IOC programme to organize an international network of tide gauges for monitoring sea levels, integrating the data with satellite remote-sensed data on sea-surface topography.

The Global Temperature Salinity Profile Programme (GTSPP) is a joint IODE/JCOMM programme to gather and make available data on the temperature and salinity of the world's oceans.

The Marine Pollution Monitoring System (MARPOLMON) is a programme for monitoring pollution in the oceans of the world.

The Marine Pollution Emergency Response Support System (MPERSS) is a WMO system to coordinate the meteorological input required to combat pollution incidents in international waters.

APPENDIX 3

LIST OF ACRONYMS

AMC	Area Meteorological Coordinator
ASAP	Automated Shipboard Aerological Program
ASC	Area Support Centre (CLICOM)
CCIR	International Radio Consultative Committee
CMM	Commission for Marine Meteorology (now replaced by JCOMM)
CES	Coast Earth Station
DBCP	Data Buoy Cooperation Panel
DSC	Digital Selective Calling System
EGC	Enhanced Group Calling System (of INMARSAT)
FAO	Food and Agriculture Organization of the United Nations
GCC	Global Collecting Centre
GCOS	Global Climate Observing System
GDSIDB	Global Digital Sea-Ice Data Bank
GESAMP	Group of Experts on the Scientific Aspects of Marine Pollution
GIPME	Working Committee for the Global Investigation of Pollution in the Marine Environment
GLOSS	Global Sea Level Observing System
GMDSS	Global Maritime Distress and Safety System
GOOS	Global Ocean Observing System
GTS	Global Telecommunications System
GTSPP	JCOMM-IODE Global Temperature Salinity Profile Programme
HSSTD	Historical Sea-surface Temperature Data Set
IAEA	International Atomic Energy Agency
IALA	International Association of Lighthouse Authorities
ICSPRO	Inter-secretariat Committee on Scientific Programmes Relating to Oceanography (UN-FAO-UNESCO-WMO-IMO-UNEP-IAEA)
ICSU	International Council for Science
IGOSS	Integrated Global Ocean Services System (now replaced by JCOMM)
IHO	International Hydrographic Organization
INMARSAT	International Mobile Satellite System
IMMT	International Maritime Meteorological Tape
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission
ITU	International Telecommunications Union
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
MDCP	Meteorological Data Collection Platform
MMROA	Marine Meteorology and Related Oceanographic Activities
MPERSS	Marine Pollution Emergency Response Support System
MSL	Mean Sea-Level
NMC	National Meteorological Centre
NMS	National Maritime Service
PMO	Port Meteorological Officer
RCC	Rescue Coordination Centre
SCOR	Scientific Committee on Oceanic Research (of ICSU)
SIGRID	Format for the archival of sea-ice data in digital form
SOLAS	Safety of Life at Sea (Convention)
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCP	World Climate Programme
WCRP	World Climate Research Programme (sponsored by WMO, IOC and ICSU)
WMO	World Meteorological Organization
WWW	World Weather Watch

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