



**PROCEDURES AND GUIDELINES FOR
GLOBAL AND REGIONAL INTERCOMPARISONS OF MARINE METEOROLOGICAL AND
OCEANOGRAPHIC INSTRUMENTS**

Version 2.0

GAO Zhanke^{1,3}, JIANG Fan^{1,3}, YUAN Lingling^{1,3}, Etienne Charpentier², SUN Jingli^{1,3}, JIANG Qiu^{1,3}, Chen Fangfang^{1,3}, Champika Gallage²

¹ National Center of Ocean Standards and Metrology (NCOSM)

² World Meteorology Organization (WMO)

³ WMO-IOC Regional Marine Instrument Center for Asia-Pacific (RMIC/AP)

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Executive Summary

Due to the importance of international comparability of measurements, WMO (for marine meteorological instruments) and/or IOC (for oceanographic instruments), from time to time arranges for international and regional comparisons of instruments. Such intercomparisons or evaluations of instruments and observing systems may be very lengthy and expensive. Rules are therefore been proposed so that coordination will be effective and assured. This document contain general guidelines and should, when necessary, be supplemented by specific working rules for each intercomparison.

1.0 Introduction

Intercomparisons of marine meteorological and oceanographic instruments and observing systems, together with agreed quality-control procedures, are essential for the establishment of compatible data sets. All intercomparisons should be planned and carried out carefully in order to maintain an adequate and uniform quality level of measurements of each meteorological variable. Many marine meteorological and oceanographic quantities cannot be directly compared with metrological standards and hence to absolute references — for example visibility, cloud-base height and Acoustic Doppler Current Profiler (ADCP). For such quantities, intercomparisons are of primary value.

Comparisons or evaluations of instruments and observing systems may be organized and carried out at the following levels:

- (a) International comparisons, in which participants from all interested countries may attend in response to a general invitation;
- (b) Regional intercomparisons, in which participants from countries of a certain region (for example, WMO Regions or GOOS Regional Alliances) may attend in response to a general invitation;
- (c) Multilateral and bilateral intercomparisons, in which participants from two or more countries may agree to attend without a general invitation;
- (d) National intercomparisons, within a country.

2.0 Procedures for global and regional intercomparisons of marine meteorological and oceanographic Instruments

2.1 Issue being addressed

Because of the importance of international comparability of measurements, WMO (for marine meteorological instruments) and/or IOC (for oceanographic instruments), from time to time arranges for international and regional comparisons of instruments. Such intercomparisons or evaluations of instruments and observing systems may be very lengthy and expensive. Rules are therefore been proposed so that coordination will be effective and assured. This document contain general guidelines and should, when necessary, be supplemented by specific working rules for each intercomparison (see for example the relevant chapters of the CIMO Guide, WMO No. 8).

2.2 Procedures

2.2.1 Global Ocean Observing System (GOOS) Observations Coordination Group(OCG), WMO Standing Committee on Measurements, Instrumentation and Traceability(SC-MINT), GOOS Regional Alliances

(GRAs), Regional (Marine) Instrument Centers (RICs/RIMCs) and each programmes may submit the proposal to organize the global and regional intercomparisons.

2.2.2 Following consultation with the OCG or SC-MINT, and the Chair of OCG or SC-MINT will consider the approval of the proposal, if possible seek appropriate financial resources and ad hoc group in support of the activity, and include it in the WMO and IOC work programme.

2.2.3 OCG, or SC-MINT should make inquiries as to the willingness of one or more Members/Member States to act as a host country and as to the interest of Members/Member States in participating in the intercomparison.

2.2.4 When at least one Member/Member State has agreed to act as host country and a reasonable number of Members/Member States have expressed their interest in participating, an organizing committee should be established by the Chair of OCG or SC-MINT in consultation with the heads of the constituent bodies concerned, if appropriate.

2.2.5 Before the intercomparison begins, the organizing committee should agree on its organization, for example, at least on the main objectives, place, date and duration of the intercomparison, conditions for participation, data acquisition, processing and analysis methodology, plans for the publication of results, intercomparison rules, and the responsibilities of the host(s) and the participants.

2.2.6 The host should nominate a project leader who will be responsible for the proper conduct of the intercomparison, the data analysis, and the preparation of a final report of the intercomparison as agreed upon by the organizing committee. The project leader will be a member ex officio of the organizing committee.

2.2.7 When the organizing committee has decided to carry out the intercomparison at sites in different host countries, each of these countries should designate a site manager. The responsibilities of the site managers and the overall project management will be specified by the organizing committee.

2.2.8 The Secretary-General of WMO and/or the Executive Secretary of IOC is/are invited to announce the planned intercomparison to Members/Member States as soon as possible after the establishment of the organizing committee. The invitation should include information on the organization and rules of the intercomparison as agreed upon by the organizing committee. Participating Members/Member States should observe these rules.

2.2.9 All further communication between the host(s) and the participants concerning organizational matters will be handled by the project leader and possibly by the site managers unless other arrangements are specified by the organizing committee.

2.2.10 Meetings of the organizing committee during the period of the intercomparison could be arranged, if necessary.

2.2.11 After completion of the intercomparison, the organizing committee shall discuss and approve the main results of the data analysis of the intercomparison and shall make proposals for the utilization of the results within the marine meteorological or oceanographic community.

2.2.12 The final report of the intercomparison, prepared by the project leader and approved by the organizing committee, should be submitted to OCG or SC-MINT, and published in the WMO and IOC Technical Reports if appropriate.

3.0 Guidelines for global and regional intercomparisons of marine meteorological and oceanographic Instruments

3.1 Basic Information

3.1.1 The guidelines are complementary to item 4, assume that an organizing committee has been set up for the intercomparison.

3.1.2 Since all intercomparisons differ to some extent from each other, these guidelines should be considered as a generalized checklist of tasks. They should be modified as situations so warrant, keeping in mind the fact that fairness and scientific validity should be the criteria that govern the conduct of WMO and IOC intercomparisons and evaluations. Final reports and others may refer the Final Report of Pilot Intercomparison Project for Seawater Salinity Measurements

(https://library.wmo.int/index.php?lvl=notice_display&id=17098#.YKNomHDDoYE)

3.2 Objectives of the intercomparison

The organizing committee should examine the achievements to be expected from the intercomparison and identify the particular problems that may be expected. It should prepare a clear and detailed statement of the main objectives of the intercomparison and agree on any criteria to be used in the evaluation of results. The organizing committee should also investigate how best to guarantee the success of the intercomparison, making use of the accumulated experience of former intercomparisons, as appropriate.

3.3 Place, date and duration

3.3.1 The host country should be requested by the WMO or IOC Secretariat to provide the organizing committee with a description of the proposed intercomparison site and facilities (location(s), environmental and climatological conditions, major topographic features, and so forth). It should also nominate a project leader

3.3.2 The organizing committee should examine the suitability of the proposed site and facilities, propose any necessary changes, and agree on the site and facilities to be used. A full site and environmental description should then be prepared by the project leader. The organizing committee, in consultation with the project leader, should decide on the date for the start and the duration of the intercomparison.

3.3.3 The project leader should propose a date by which the site and its facilities will be available for the installation of equipment and its connection to the data-acquisition system. The schedule should include a period of time to check and test equipment and to familiarize operators with operational and routine procedures.

3.4 Participation in the Intercomparison

3.4.1 The organizing committee should consider technical and operational aspects, desirable features and preferences, restrictions, priorities, and descriptions of different instrument types for the intercomparison.

3.4.2 Normally, only instruments in operational use or instruments that are considered for operational use in the near future by Members/Member States should be admitted. It is the responsibility of the participating Members/Member States to calibrate their instruments against recognized standards before shipment and to provide appropriate calibration certificates. Participants may be requested to provide two identical instruments of each type in order to achieve more confidence in the data. However, this should not be a condition for participation.

3.4.3 The organizing committee should draft a detailed questionnaire in order to obtain the required information on each instrument proposed for the intercomparison. The project leader shall provide further details and complete this questionnaire as soon as possible. Participants will be requested to specify very clearly the hardware connections and software characteristics in their reply and to supply adequate documentation.

3.4.4 The chairperson of the organizing committee should then request:

- (a) Report and communication with OCG or SC-MINT ,and cooperate with the WMO Secretary-General and/or the IOC Executive Secretary to invite officially Members/Member States (who have expressed an interest) to participate in the intercomparison. The invitation shall include all necessary information on the rules of the intercomparison as prepared by the organizing committee and the project leader;
- (b) The project leader to handle all further contact with participants.

3.5 Data acquisition

3.5.1 Equipment set-up

The organizing committee should evaluate a proposed layout of the instrument installation prepared by the project leader and agree on a layout of instruments for the intercomparison. Special attention should be paid to fair and proper siting and exposure of instruments, taking into account criteria and standards of WMO and/or IOC and other international organizations. The adopted siting and exposure criteria shall be documented.

Specific requests made by participants for equipment installation should be considered and approved, if acceptable, by the project leader on behalf of the organizing committee.

3.5.2 Standards and references

The host country should make every effort to include at least one reference instrument in the intercomparison. The calibration of this instrument should be traceable to national ,international standards or IOC Ocean Best Practices. A description and specification of the standard should be provided to the organizing committee. If no recognized standard or reference exists for the variable(s) to be measured, the organizing committee should agree on a method to determine a reference for the intercomparison.

3.5.3 Related observations and measurements

The organizing committee should agree on a list of marine meteorological and oceanographic variables that should be measured or observed at the intercomparison site during the whole intercomparison period. It should prepare a measuring programme for these and request the host country to execute this programme. The results of this programme should be recorded in a format suitable for the intercomparison analysis.

3.5.4 Data-acquisition system

Normally the host country should provide the necessary data-acquisition system capable of recording the required analogue, pulse and digital (serial and parallel) signals from all participating instruments. A description and a block diagram of the full measuring chain should be provided by the host country to the organizing committee. The organizing committee, in consultation with the project leader, should decide whether analogue chart records and visual readings from displays will be accepted in the intercomparison for analysis purposes or only for checking the operation.

The data-acquisition system hardware and software should be well tested before the comparison is started and measures should be taken to prevent gaps in the data record during the intercomparison period.

3.5.5 Data-acquisition methodology

The organizing committee should agree on appropriate data-acquisition procedures, such as frequency of measurement, data sampling, averaging, data reduction, data formats, real-time quality control, and so on. When data reports have to be made by participants during the time of the intercomparison or when data are available as chart records or visual observations, the organizing committee should agree on the responsibility for checking these data, on the period within which the data should be submitted to the

project leader, and on the formats and media that would allow storage of these data in the database of the host. When possible, direct comparisons should be made against the reference instrument.

3.5.6 Schedule of the intercomparison

The organizing committee should agree on an outline of a time schedule for the intercomparison, including normal and specific tasks, and prepare a time chart. Details should be further worked out by the project leader and the project staff.

3.6 Data processing and analysis

3.6.1 Database and data availability

All essential data of the intercomparison, including related marine meteorological and oceanographic data, should be stored in a database for further analysis under the supervision of the project leader. The organizing committee, in collaboration with the project leader, should propose a common format for all data, including those reported by participants during the intercomparison. The organizing committee should agree on near-real-time monitoring and quality-control checks to ensure a valid database.

After completion of the intercomparison, the host country should, on request, provide each participating Member/Member State with a data set from its submitted instrument(s). This set should also contain related marine meteorological and oceanographic, and reference data.

3.6.2 Data analysis

(a) The organizing committee should propose a framework for data analysis and processing and for the presentation of results. It should agree on data conversion, calibration and correction algorithms, and prepare a list of terms, definitions, abbreviations and relationships (where these differ from commonly accepted and documented practice). It should elaborate and prepare a comprehensive description of statistical methods to be used that correspond to the intercomparison objectives.

(b) Whenever a direct, time-synchronized, one-on-one comparison would be inappropriate (for example, in the case of spatial separation of the instruments under test), methods of analysis based on statistical distributions should be considered. Where no reference instrument exists (as for cloud base, meteorological optical range, and so on), instruments should be compared against a relative reference selected from the instruments under test, based on median or modal values, with care being taken to exclude unrepresentative values from the selected subset of data.

(c) Whenever a second intercomparison is established some time after the first, or in a subsequent phase of an ongoing intercomparison, the methods of analysis and the presentation should include those used in the original study. This should not preclude the addition of new methods.

(d) Normally the project leader should be responsible for the data-processing and analysis. The project leader should, as early as possible, verify the appropriateness of the selected analysis procedures and, as necessary, prepare interim reports for comment by the members of the organizing committee. Changes should be considered, as necessary, on the basis of these reviews

(e) After completion of the intercomparison, the organizing committee should review the results and analysis prepared by the project leader. It should pay special attention to recommendations for the utilization of the intercomparison results and to the content of the final report.

3.7 Final report of the intercomparison

3.7.1 The organizing committee should draft an outline of the final report and request the project leader to prepare a provisional report based on it.

3.7.2 The final report of the intercomparison should contain, for each instrument, a summary of key performance characteristics and operational factors. Statistical analysis results should be presented in

tables and graphs, as appropriate. Time-series plots should be considered for selected periods containing events of particular significance. The host country should be invited to prepare a chapter describing the database and facilities used for data-processing, analysis and storage.

3.7.3 The organizing committee should agree on the procedures to be followed for approval of the final report, such as:

- (a) The draft final report will be prepared by the project leader and submitted to all organizing committee members and, if appropriate, also to participating Members/Member States;
- (b) Comments and amendments should be sent back to the project leader within a specified time limit, with a copy to the chairperson of the organizing committee;
- (c) When there are only minor amendments proposed, the report can be completed by the project leader via OCG or SC-MINT to the WMO and IOC Secretariat for publication;
- (d) In the case of major amendments or if serious problems arise that cannot be resolved by correspondence, an additional meeting of the organizing committee should be considered.

3.7.4 The organizing committee may agree that intermediate and final results may be presented only by the project leader and the project staff at technical conferences.

3.8 Responsibilities

3.8.1 Responsibilities of participants

Participants shall be fully responsible for the transportation of all submitted equipment, all import and export arrangements, and any costs arising from these. Correct import/export procedures shall be followed to ensure that no delays are attributable to this process.

Participants shall generally install and remove any equipment under the supervision of the project leader, unless the host country has agreed to do this.

Each participant shall provide all necessary accessories, mounting hardware, signal and power cables and connectors (compatible with the standards of the host country), spare parts and consumables for its equipment. Participants requiring a special or non-standard power supply shall provide their own converter or adapter. Participants shall provide all detailed instructions and manuals needed for installation, operation, calibration and routine maintenance.

3.8.2 Host country support

The host country should provide, if asked, the necessary information to participating Members/Member States on temporary and permanent (in the case of consumables) import and export procedures. It should assist with the unpacking and installation of the participants' equipment and provide rooms or cabinets to house equipment that requires protection from the weather and for the storage of spare parts, manuals, consumables, and so forth.

A reasonable amount of auxiliary equipment or structures, such as towers, shelters, bases or foundations, piers, buoy or offshore platform, should be provided by the host country.

The necessary electrical power for all instruments shall be provided. Participants should be informed of the network voltage and frequency and their stability. The connection of instruments to the data-acquisition system and the power supply will be carried out in collaboration with the participants. The project leader should agree with each participant on the provision, by the participant or the host country, of power and signal cables of adequate length (and with appropriate connectors).

The host country should be responsible for obtaining legal authorization related to measurements in the atmosphere, such as the use of frequencies, the transmission of laser radiation, compliance with civil and aeronautical laws, and so forth. Each participant shall submit the necessary documents at the request of the project leader.

3.8.3 Host country servicing

Routine operator servicing by the host country will be performed only for long-term intercomparisons for which absence of participants or their representatives can be justified. When responsible for operator servicing, the host country should:

- (a) Provide normal operator servicing for each instrument, such as cleaning, chart changing, and routine adjustments as specified in the participant's operating instructions;
- (b) Check each instrument every day of the intercomparison and inform the nominated contact person representing the participant immediately of any fault that cannot be corrected by routine maintenance;
- (c) Do its utmost to carry out routine calibration checks according to the participant's specific instructions.

The project leader should maintain in a log regular records of the performance of all equipment participating in the intercomparison. This log should contain notes on everything at the site that may have an effect on the intercomparison, all events concerning participating equipment, and all events concerning equipment and facilities provided by the host country.

3.9. Rules during the Intercomparison

3.9.1 The project leader shall exercise general control of the intercomparison on behalf of the organizing committee.

3.9.2 No changes to the equipment hardware or software shall be permitted without the concurrence of the project leader.

3.9.3 Minor repairs, such as the replacement of fuses, will be allowed with the concurrence of the project leader.

3.9.4 Calibration checks and equipment servicing by participants, which requires specialist knowledge or specific equipment, will be permitted according to predefined procedures.

3.9.5 Any problems that arise concerning the participants' equipment shall be addressed to the project leader.

3.9.6 The project leader may select a period during the intercomparison in which equipment will be operated with extended intervals between normal routine maintenance in order to assess its susceptibility to environmental conditions. The same extended intervals will be applied to all equipment.
