

Methods Timeline

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CalCOFI Time Series data are over 67 years old. New adopted practices, methods, software and hardware are thoroughly tested to maintain dataset continuity as the program & science evolves. Core measurements are maintained and many new measurements added. CTD temperature sensors, for example, provide data at a much higher resolution than a 20 bottle hydrocast equipped with reversing thermometers pre-9308 (Aug 1993).

Although the CTDs casts on CalCOFI started in 1990, CTD-rosette casts did not replace bottles-on-wire hydro casts completely until Aug 1993 (9308). In 2004, LTER joined the CalCOFI cruises, expanding the seawater analyses, adding new measurements.

Changes of standard practices, methods, software, & equipment will be tabulated here, particularly those affecting the hydrographic data or other data products.

CalCOFI Methods Timeline

Cruise/Date	Measurement, Equipment, Method	Changes	Comments
	Methods Timeline Started		This page is 'dynamic' so new items will be added whenever new methods, measurements, equipment are implemented. Older changes will be added as time-permits and they are remembered.
1708SR	CCE-LTER ISUS upgraded to fw v3	ISUS upgraded to firmware v3	Seabird acquired Satlantic and took several month to get ISUS service online. Once done, they upgraded the CCE-LTER MBARI-ISUS v2 to firmware v3. Allows easy in-house or at-sea calibration.
1708SR	Oxygen Stable Isotope	Seawater samples collected for OSI	5ml of seawater collected from two depths (10m & 50m) on 18 stations
1701RL 1704SH	LARS rosette	24-btl LARS rosette used	Even though RV Reuben Lasker & FSV Bell M Shimada do not have a LARS CTD deployment system, the height clearance allows the use of the LARS rosette. SIO-CalCOFI will use this rosette as primary unless the height clearance becomes a problem, such as on RV Ocean Starr.
1611SR	First RV Sally Ride	SIO RV Sally Ride used for CalCOFI	RV Sally Ride used for the first time to do CalCOFI station work; acoustics operational but not calibrated
1611SR	RINKO III Optode	RINKO III Oxygen sensor deployed	Optode used on non-basin stations deeper than 500m, where altimeter was not needed
1611SR	Seawater samples	Domoic Acid & Th-234	Collected ancillary seawater & deploy insitu pumping system
pre-1611SR	ISUS (Frank's) Repaired	Peter Frank's ISUS repaired & upgraded to firmware v3	ISUS was not working so it was sent to Satlantic who repaired it and upgraded the firmware to v3

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1609SR	New research vessel	SIO RV Sally Ride test for CalCOFI	Shakedown cruise for RV Sally Ride to do CalCOFI - new LARS, epoxy-coated rosette deployed
1609SR	LARS epoxy-coated rosette	First use of new 24-bottle rosette	24-btl white epoxy coated aluminum rosette deployed with stainless steel LARS support
1607OS	Seawater Samples	Domoic Acid samples collected	Ancillary seawater sample collection
1604SH	Nutrient Analysis	New (returning) in-house nutrient chemist	Nutrients run by SIO-CalCOFI analyst DGS
1507OC	Underway Measurements	RV Oceanus MET system logs data into individual data files; combined data are unavailable unless merged manually	Unlike other UNOLS vessels, particularly SIO RV New Horizon, the underway TSG & meteorological data are logged at 1Hz into individual files. A combined data file will have to be generated post-cruise by merging individual sensor data files using the common UTC timestamp. Software pending...
1504NH	Underway Measurements	PCO ₂ and pH measurements added to CCE-LTER suite	
1504NH	Nutrient Analysis	Standard matrix; sample vials	Standards now prepared in low nutrient seawater (collected from the end of lines 93.3 or 90.0 and processed with UV light, filtration and aged before use). New 30 mL polypropylene tubes in use.
06 Aug 2014	calcofi.org	calcofi.org 2014 online	Developmental site web.calcofi.org replaces Joomla 1.5 calcofi.org; Joomla 3+ fully implemented. calcofi.org old site moved to old.calcofi.org
1402SH	Nutrient Analysis	New in-house Nutrient Technician	Nutrients run by SIO-CalCOFI analyst LJE.
1402SH	NCOG DNA/RNA	NCOG sample collection started	NCOG DNA/RNA samples collected at ~4 depths (10m, chl max, 170m, 515m)
1311NH	DIC measurments	Sampling expands	Dissovled inorganic carbon samples are now drawn at more locations along the cruise track with 14 profile and 8 additional surface water stations per cruise.
1211NH	Rinko Oxygen Optode	RINKO III Optode deployed	RINKO III Oxygen Optode sensor replaced 2nd SBE43 oxygen sensors on stations where the altimeter was not needed - non-basin stations deeper that 500m.
01Mar2013	web.calcofi.org website update	Upgrading calcofi.org to latest Joomla	web.calcofi.org started to migrate calcofi.org 1.5 to 3.0; to improve responsiveness with new dynamic templates - desktop, tablet, and smartphone auto-formatting. Security improvements, auto-updating, jQuery & other new features of version 3.+
1207OS	Nutrient Analysis	New in-house Nutrient Technician	Nutrients run by former ODF chemist, now a SIO-CalCOFI analyst MTM.

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01May2012	dev.calcofi.org blog started	SIO-CalCOFI Technical Group developmental blog started.	For metadata: documenting changes in software, data-processing methods, formats, products, & practices.
1203SH	Nutrient Analysis	Instrument and analyst change, new Seal QuAAtro Analyzer purchased.	Transitioned to in-house nutrient analysis on new Seal QuAAtro Nutrient Analyzer, nutrients run by SIO-CalCOFI analyst DNF. Replacing sample analysis by ODF chemist on an AA3 analyzer. Standards now prepared in artificial seawater. NO3 data calculated using regression coefficients from ISUS voltage vs NO3 for 1202NH & 1203SH look nearly identical.
1203SH	atsea.calcofi.org blog online	Setup to keep notes during quarterly cruises, particularly those related to data, equipment, & generally noteworthy.	Connected-linked to CalCOFI's Twitter feed
1202NH	Nutrient Analysis	Last cruise where nutrients were run by ODF chemist on an AA3 analyzer.	
1202NH+	Data Processing	IEH retired as primary data processing file format. Sta.csvs and casts.csv adopted.	After parallel-processing (IEH & csv file format) 1104, 1108, 1110 cruise data. Sta.csvs & casts.csv data processing is being used to process, merge, quality-control, publish all hydrographic data. IEH-format is a data product along with the hydrographic database.
1108	All measurements & data products	Hydrographic data are processed using both old & new methods and compared.	The cruise is once again processed twice, in parallel, using the IEH old-school method and the new csv-format method. GTool development & refinement continues as sta.csvs & casts.csv formats are improved. Final data products are compared for agreement. This is the first cruise to generate data products using new csv-database data processing methods not based on IEHs.
1104	GTool Matlab program developed	SIO-CalCOFI Technical Team implement a new graphical matlab tool to point-check CalCOFI hydrographic data	MGS, in cooperation with the CCTG, develops GTool to replace Andyplots, our legacy method to visually inspect all bottle data on one figure. CTD continuous data are plotted with bottle parameters to cross-check and eliminate fliers.

Cruise/Date	Measurement, Equipment, Method	Changes	Comments
1104	All measurements; data products	Hydrographic data are processed using both old & new methods and compared.	The cruise is processed twice, in parallel, using the IEH old-school method and the new csv-format method. GTool, a matlab plotting & data-quality control program script, is developed to ingest CTD & sta.csvs to graphically assess CTD & bottle data-quality. Final data products are compared for agreement. This should be the last cruise processed using 00/20/22 & IEHs.
1101	Reported standard level O2	CTD primary or secondary oxygen sensor bottle--corrected measurements are reported instead of interpolated standard level (ISL) oxygen values	Pertains to final, standard-level bottle data reported in all data products - with the reliability of the SBE 43 oxygen sensors and consistently high data quality when calibrated bi-yearly (twice/year) and bottle-corrected. Bottle-corrected CTD primary or secondary oxygen values (whichever sensor is performing better that cast) are reported instead of interpolated (calculated) standard level bottle oxygen values.
1101	Data storage format, ieh phase out begins; all measurements affected	Sta.csv & casts.csv implementation begins, replacing 00/20/22 & IEH data process methodology. IEH-method is used as CSV-method is developed.	Bottle data & CTD data processing up til now have been relatively separate although data-quality cross-check are common. Other than CTD temperatures, all hydrographic data reported in IEHs or hydrographic database are bottle sample measurements. In 2011, our new data processing strategy merges the bottle & CTD starting at seawater sample collection. CESL generates individual sta.csvs combining CTD & bottle data immediately after seawater sample collection. Casts.csv is also generated and contains station specific information, replacing the Station Cast Description & Weather files (stacst & weather).
1101	DECODR	DECODR migration to the new sta.csv and casts.csv data-processing scheme in full development	DECODR (Data Entry & Compile Oceanographic Data Reports) program modules are adapted to process either old or new hydrographic data formats. Sta.csvs & casts.csv adaptations are implemented and different data products are generated directly or by generating an IEH first then data products.
0901	DIC measurements resume	DIC (dissolve inorganic carbon) sampling resume after a hiatus.	DIC, aka Keeling, samples were commonly taken on two CalCOFI stations but the new sampling scheme covers several additional stations and depths.
2008	Nutrient Analysis	Began ammonium analysis	Nutrient analysis expanded to include ammonium.

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0701	Salinity measurement	SalReCap - Salinity Record & Capture program introduced, replacing the PSal (DOS shell executable).	SalReCap, Windows program developed by SIO-CalCOFI, replaces ODF-developed PSal, a DOS executable. Immediate comparisons to CTD salinities during analysis becomes available.
Apr-05	Primary Productivity	New specific activity procedure	The procedure for calculating cruise 14C specific activity for the productivity assay was changed to reflect daily 14C additions averaged over the course of a cruise. The six dark bottles have one milliliter removed, added to ethanolamine spiked scintillation cocktail for counting. Previously specific activity was calculated for a batch of stock and used for the entire cruise. The new method served to check pipeting, inoculation amounts and any changes in volatile 14C stocks.
0411	Ancillary measurements such as HPLC, DOM, Size fractionations, Epifluorescence	LTER affiliation on CalCOFI cruises begins	CCE-LTER (California Current Ecosystem Long Term Ecological Research Site) is established and LTER participation on all CalCOFIs begins. A large suite of additional measurements, particularly seawater samples from the rosette, and PRPOOS vertical plankton tow are added to CalCOFI hydrography.
0310	Oxygen measurement	Autotitrator replaces manual modified Winkler titrations	After substantial assay-comparative testing, an ODF-developed oxygen auto-titrator is used to titrate discrete, rosette-bottle, seawater oxygen samples at-sea. New oxygen data format & data processing module is introduced in DECODR.
0204	CalCOFI Data Report	Last bound hardcopy of the bi-annual CalCOFI Hydrographic Data Report is published, CC Reference 03-01 31 July 2003	CalCOFI Hydrographic Data Reports will continue being published electronically as pdfs for global distribution. Bound hardcopies, sent by mail, to different libraries & institutions will stop.
0104	Chlorophyll measurement	FLog, chlorophyll data logging fluorometer program introduced	Prior to FLog, our 24+hr acetone cold-extracted chlorophyll samples were manually logged by hand to a sample form then key-entered into CODES. FLog records fluorometer values automatically in a data-processing friendly format so no transcription is required.
Jun 2001	Seasave for Windows	Seabird releases Windows versions	Seasoft/Seasave & SBE Data Processing software for Windows 98/NT released by Seabird
2000	CTD Fluorometer	Seapoint Fluorometer	Seapoint Chlorophyll Fluorometer in use.
9807 (Jul 1998)	CTD Seasave	Con file readable by Seasave v5	con files prior to 9807 will not open it Windows SBE Data Processing software v5 or v7

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9308	Temperature measurement	4sec ave (prior to bottle closure) CTD temperatures replace reversing thermometer measurements	CTD temperatures are the only measurement entering the hydrographic timeseries (until 2011 when CTD standard level temperature, salinity, & oxygen replace interpolated values).
9308	Seabird CTD-Rosette w/ 24-10L Niskin-type PVC Bottles	Replace 20 bottle hydro cast & 6 bottle prod cast	10L Niskin-like bottle constructed by Research support have plastic-coated springs, nylon lanyards, Viton or nitrile o-rings. No metal, rubber, or latex come incontact with seawater samples. Bottles are disassembled & 'productivity-cleaned' between cruises.
1993	CTD Fluorometer	SeaTech Fluorometer	1993-2000
1973	Chlorophyll measurement	Began	Discrete chlorophyll analysis was added to the hydrographic dataset.
1961	Nutrient Analysis	Expands beyond phosphate	Nutrient analysis expanded to include silicate, nitrate and nitrite.