Title

A Framework for Ocean Observation for the Next Generation - expanding quantifiable methods and Best Practices

Acronym

FOO-BP

Summary/Abstract (max. 250 words)

The complexity of ocean observing systems is rapidly increasing as requirements for simultaneous biological, physical, and chemical observations emerge to inform new societal requirements. There are many examples in biogeochemistry and biology with new exciting outcomes, but these may not be comparable quantitatively because of variations in observation methods. Moving toward consistent, quantitative science outcomes is essential to address challenging global issues of changing climate, etc. For this, a major capability needed is access to and the ability to use rigorously tested methods in ocean observing. Such “Best Practices” (BP) have helped promote activity across disciplinary boundaries, as well as supporting training of new observers and analysts. They support reproducibility of science and the transmission of key methods across regions. Fundamentally, the use of BP underpins science at a global scale.

Future use of autonomous, intelligent technologies for observations and linking information to users also drives the need for “standard” BP, such as the development of sensor independent protocols to move directly from sensors and data aggregation devices to appropriate databases/users. The increasing use of big data also drives the need for standard protocols for data preparation and insertion into models. As a SCOR WG, we will develop and test a future facing framework, understanding how BP can be more easily adopted and support multi-disciplinary research, engaging with past SCOR WG chairs in a coordinated effort to validate the framework. We will offer this framework for both present and future SCOR WGs and the broader ocean observing research efforts.

Scientific Background and Rationale (max. 1250 words)

Our vision is to increase efficiency, reproducibility, and global interoperability of the ocean observing value chain by defining a new paradigm, a “Framework”, providing the ocean observing community with a unified, sustained, and readily accessible knowledge base of interdisciplinary best practices (BP), facilitating community consensus through active engagement including a peer reviewed publication of ocean BP. Future use of autonomous, intelligent technologies for observations and linking information to users will further drive the need for “standard” BP as more machine interoperability and artificial intelligence will become part of observation systems in the next decade. The Framework will address current methods

and encompass the rapidly changing research capabilities occurring with new generations of sensors, platforms and information flow.

Ocean observing systems/infrastructures must be capable of converting raw data into usable information and knowledge products stored in repositories that are readily accessible to scientists. The methodologies and BP associated with large-scale observing systems engage all aspects of the end-to-end information processes ranging from defining and implementing observation plans to the deposition of high-quality data in repositories and effective distribution to scientists and other users. This needs to cover scientific and societal needs, including citizen science, marine, coastal and fisheries management, marine safety, education, national security.

The Framework defined by this SCOR WG addresses the end to end value chain from sensors/instruments to science research access. It will include repository infrastructures, means of community engagement and training methodologies that will expand skills in developed/developing countries, underpinning science at a global scale. It will build upon the base of existing BP from SCOR WGs, large scale networks and experience of individual researchers.

The Framework has three core elements: (1) a sustained, advanced archiving and communication system; (2) a community environment for BP documentation, evolution and adoption; and (3) methods and collaborations for training and professional advancement. This recognizes that to preserve their value, BP need to be reliably archived, accessible, searchable, and comparable across disciplines (e.g. EOVs). Advancing technologies can be adopted in knowledge representation, linked data, natural language processing, and document archiving (https://www.oceanbestpractices.net/), where key documents of the global observing communities can be easily accessed. This will have an impact, e.g., on the development of QA/QC methods which have seen significant efforts in diverse projects from SCOR WG142, the European JERICO project, IOOS' QARTOD and others that have not consistently converged. The Framework will provide community mechanisms for dialogues to facilitate defining and publishing BP that can synthesize methods. One aspect of this effort is the recently created Research Topic in Frontiers of Marine Science, which the proposed WG will expand to become a place of commentary and dialog. The third element of the Framework is training - a two way process including feedback that can support evolution and expansion in use of BP. This will be done with the related SCOR capacity committee and major organizations, such as JCOMMOCG, IODE, POGO, to ensure that SCOR (and POGO) programs are providing BP for observations and feedback from their use.

Several factors are driving the opportunity and the timing for creating this proposed WG. The OceanObs'19 organizers have defined BP as a major cross cutting theme in their program vision for the next decade. Also, the Framework for Ocean Observing (FOO) is creating a FOO2.0 with the major technical evolution being the introduction of BP as a global tool for advancing ocean observing. We believe the upcoming UN Decade of Ocean Science will similarly have a component of BP creation and implementation. Also, the

movement to global scale observations with a new generation of high productivity sensors is creating a big data environment for ocean observing which needs to be addressed in a consistent manner. The proposed WG is scoped to support all of these efforts through formulation of the Framework and its work with the research community[1].

Past SCOR WGs have produced BP documents, but these are often not archived, published or sustained. For example, the WG142 description has no discussion of sustaining the work. What happens five years from now when the technology has changed, will SCOR need to fund another effort to update DO QC? We propose a WG that will support the capacity to continuously develop and exchange emerging BP. Many current SCOR WGs plan to produce best-practice manuals and will benefit from guidance. We will support this vision by engaging with SCOR WG chairs to test the Framework. We will review all past and present SCOR WG outputs with the support of their chairs and communicate BP outcomes to wider ocean observation communities. We will use these as test cases for assessment (and maturing) of the Framework. The results will be published and community reviewed as an overarching article written by the WG as well as a series of contributed papers in the Frontiers in Marine Science Ocean Best Practices peer-reviewed Research Topic (RT) to disseminate high-quality methodologies over the entire range of ocean observing. We note that the new Research Topic in Frontiers is also a means for academic researchers to gain peer reviewed recognition for career advancement. Thus, one WG outcome will be a 'special issue' of Frontiers. A broader impact will come from the Framework facilitating both the mechanical and cultural movement toward BP documentation.

The WG will focus on global interoperability and long-term usability through use of BP. The underlying principles of this SCOR WG is to provide:

- A long-term Framework for access to observation methods and community building including training in the use of best practices as living documents
- Open access, central sustained Repository for BP with natural language processing for easy cross disciplinary search
- Persistent identifiers (DOI) for easy BP citation and means of discovery through common web tools
- Peer reviewed journal papers with corresponding entry of full BP document in Repository.
- Means for Community Dialogue, through the Journal and the Repository.
- Support of training and implementation of BP, particularly in developing countries

[1] With these goals, the WG is collaborating with AtlantOS partners and groups of UNESCO/IOC including the global observing networks of the JCOMM OCG, in diverse ocean disciplines to populate a BP repository and to address the utility of the BP process for their communities. The AtlantOS partners and associates currently include the GOOS Regional Alliances, GEOMAR, Ifremer, IO PAS, MARUM, PML, UPMC, WHOI and others. In addition, projects are contributing their experience and documentation including, for example, FixO3, JERICO, GROOM, IOOS, ONC, IMOS and EMSO.

We will build upon IODE's existing capability, both in infrastructure, sustainability and its content of over 200 existing BP. Then expand the infrastructure with new search mechanisms and portable web accessibility based on ontologies[2] that service different ocean research disciplines. We will work with BP creators through a help desk to enter BPs into the repository and link IODE with existing BP repositories ensuring a global and consistent network environment. The creation and support of community tools and service is a core part of the strategy, including training, which needs to be both web and in-person training designed in a flexible format that can be quickly learned and practical.

Given the planned OceanObs19, the FOO evolution and the emphasis on integrated global and regional ocean observing systems, as well as the new evolution into expert machine observations and the necessity for cost effective, accurate, reproducible data and observing methods, there is an urgent need for easily accessible BP which can be queried, reproduced and updated.

Terms of Reference (max. 250 words)

1. Define a future facing Framework supporting multi-disciplinary research through broadly accepted and documented best practices
2. Test and evolve the framework in collaboration with SCOR WGs using best practices and methodologies from SCOR WGs and EOV formulations
3. Support the Community vision by contributing to the FOO2.0 development in best practices and the OceanObs'19 planning and evolution
4. Create and evaluate a training program in observation methods with a focus on developing countries
5. Support mechanisms and community engagement through a peer reviewed journal research topic in Best Practices in Ocean Observing.
6. Coordinate with IOC organizations and major observation organizations, including JCOMM OCG networks for sustained implementation

Working plan (logical sequence of steps to fulfil terms of reference, with timeline. Max. 1000 words)

2019:

Within 2 months of the acceptance of the WG, we will contact the chairs of the initial eight SCOR WG listed in the Appendix, depending on their availability, to be Associate Members. We will work with these chairs to plan a small

[2] a set of concepts and categories in a subject area that shows their properties and the relations between them

workshop in early 2019 whereby the core WG will meet to discuss a SCOR BP Framework and the chairs will be invited as part of a larger contingent to give feedback on the repository and how to update the current processes to be more effective (these will be “use cases”). This would be co-funded through the European AtlantOS and INTAROS projects, GOOS, IODE, JCOMM. During this meeting, we would plan the next steps leading up to Ocean Obs19, whereby we would (awaiting confirmation) present a white paper and a workshop on best practices Framework and implementation. Attendance at this meeting would be co-funded by WG members institutions but may need support for 1 or 2 members through SCOR (developing countries or emerging researchers)

2020:

Approach other SCOR WGs that haven’t identified best practices as an output to assess whether this work could be of relevance to them. This would also be done in the context of essential ocean variables and the relevant best practices within the SCOR context. Identifying any key gaps and encourage SCOR WGs or potential new SCOR WGs to address these as part of their capacity development plans.

Work with SCOR, POGO and other training and outreach institutions to define and document a training program for best practices with a focus on developing countries

2020/2021:

We would focus on producing the special issue of Frontiers in Marine Science, focused on SCOR WGs, this would include a workshop with the relevant SCOR WG chairs (past and present). This would involve multiple papers from various ocean observing communities

We will do a formal release of the Framework with a request for community feedback and then incorporate this feedback into an update and formally documented version.

Introduce the Framework approach to IOC and evaluate the potential for long term sustainability of the Framework. This will include a decadal Vision Paper on observation methodologies and practices.

During the three-year period we would work with SCOR to support all future WGs having a plan for archiving and disseminating their BP, this would be through the WGs capacity development programs.

Between meetings we would have monthly skype calls between the SCOR WG to discuss activities, update and feedback, we would include the large community on a quarterly basis. We would continue to advocate oceanbestpractices.net at relevant conferences and workshops. We would also work with the related SCOR capacity committee to ensure that SCOR (and POGO) programs are providing best practices for observations and also request feedback from them (as laid out below)

Deliverables (state clearly what products the WG will generate. Should relate to the terms of reference. Max 250 words). A workshop is not a deliverable. Please note that SCOR prefers that publications be in open-access journals.

- A decadal Vision Paper on observation methodologies and practices in response to the evolving and future use of autonomous, intelligent technologies for observations and linking information to users.
- A Framework for future creation and deposition of BP in a sustained repository and community outreach and capacity development of BP within the SCOR context.
- An increase from 200 to 500 in the number of archived, accessible BP on the oceanbestpractices.net repository
- Significantly enhanced search and access capabilities for best practices across disciplines including, for example, the access to measuring oxygen developed under IOCCP, BioArgo and other networks.
- Expansion of content in a peer-reviewed journal on Ocean Observing Best Practices as well as a special issue based on SCOR WGs best practices,
- An element of BP introduced into the POGO Centre of excellence and the FOO 2.0 evolution
- Products to support the training of best practices in different ocean observing methods.

Capacity Building (How will this WG build long-lasting capacity for practicing and understanding this area of marine science globally. Max 1500 words)

As discussed, the capacity-building aspect of this WG is a key, overarching part of the ToR. We would work closely with the SCOR Committee on Capacity Building, as well as other activities such as the POGO Centre of excellence and summer schools run by IMBER, SOLAS, GEOTRACES, etc. It may be in some cases ‘best practices’ are not optimal due to costs and so we may need to consider a second level of best practices. Hence, we will also target the GOOS Regional Alliances and other observing programs which have developing countries contributing (such as IIOE2) to understand how different regional observing programs deal with BP, in particular in regions with developing countries. We will work with these communities to ensure training and access to best practices and also to get feedback as to the appropriateness. It is essential that emerging and mid-career scientists and technicians have access to these best practices and give feedback on the functionality of them, this can only be done through utilising them. We will move access to web based tools including iPads and iPhone. This will be

complemented by social media support. This way, people have these as tools when they get back from training and can continue using the information and experience of the training as well as giving feedback. The BP repository will be available as a DVD as the most up-to-date version at the end of the training.

Working Group composition (as table). Divide by Full Members (10 people) and Associate Members, taking note of scientific discipline spread, geographical spread, and gender balance. (max. 500 words)

- *Full Members (no more than 10, please identify chair(s))*

Name	Gender	Place of work	Expertise relevant to proposal
1 Juliet Hermes, co-chair	Female	SAEON, South Africa,	Physical ocean observing BP and capacity development
2 Cristian Muñoz-Mas, Co-Chair	Male	SOCIB, Spain	Technical ocean observing and interoperability
3 Ana Lara Lopez	Female	IMOS, Australia	BP in all areas of observing systems, Chief Scientist of IMOS
4 Pier Luigi Buiteigieg	Male	AWI, Germany	Ontologies, data systems, BP Arctic observing
5 Tang Hairong	Female	NCOSM, China	BP in WMO and JCOMM systems
6 Emma Heslop	Female	GOOS, France	BP in international observing systems and GOOS RA
7 Johannes Karstensen	Male	GEOMAR, Germany	BP in mooring observing systems, physical

			oceanography
8 Jay Pearlman	Male	IEEE, France	BP coordination, ocean information systems and AtlantOS
9 Pauline Simpson	Female	IODE, Cayman Islands	IODE and BP database
10 Maciej Telszewski	Male	IOCCP, Poland	BP of biogeochemical observing systems

- Associate Members (no more than 10)

Name	Gender	Place of work	Expertise relevant to proposal
1 Mark Bushnell	Male	IOOS, US	QA/QC
2 Frank Muller-Karger	Male	U. South Florida, US	Biological observing BP
3 Rachel Przeslawski	Female	Australian Geoscience, Australia	Biological observing BP
4 Sophie Seeyave	Female	POGO, UK	International observing systems and capacity development
5 Chairs of the	various	various	various

WG listed in the Appendix (to be invited)			
6			
7			
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Working Group contributions (max. 500 words)

- Juliet Hermes is currently the JCOMM OCG vice chair focussing on standards and BP and has considerable knowledge of the various BP involved in the major global observing systems. Juliet also has good knowledge of observing systems and capacity development within Africa and other Indian Ocean rim countries.
- Cristian Cristian Muñoz-Mas is a senior technician and brings sea going expertise to the working group.Cristian's areas of expertise cover the whole range of the data life cycle, ranging from data acquisition (including field operations, oceanograhic instrumentation, survey and moorings design), processing, analysis, QA/QC, data/metadata integration, visualization and dissemination.
- Ana Lara Lopez specializes in long term ecological research and runs the BP for IMOS, she recently produced an overview of BP utilised throughout the Australian ocean observing system.
- Pier Luigi Buiteigieg focuses on technologies for discovery and access including semantic searches, natural language processes as well as wiki-based options. He also has a focus on Arctic observing systems
- Tang Hairong is the lead for ocean best practices as part of the regional marine instrumentation centre for Asia.
- Emma Heslop is the representative for BP within GOOS and works with all of the global observing systems, as well as connecting with the GOOS regional alliances and hence has good knowledge of and support to BP within developing countries' observing systems. Emma has been instrumental in the design and promotion of the Essential Ocean Variables best practices.

- Johannes Karstensen is the lead for Ocean Sites and is driving the BP for global mooring arrays. Johannes is the editor of the BP Journal Research Topic in Frontiers of Marine Science.
- Jay Pearlman leads the AtlantOS work package on BP and has considerable experience with BP of all ocean observing systems, as well as a good understanding of the database and technologies
- Pauline Simpson is the key person for the database of ocean best practices and to represent IODE within the working group.
- Maciej Telszewski leads the integrating of carbon and biogeochemistry observations into the multidisciplinary global ocean observing system through direct and active interaction GOOS, specifically leading the GOOS Biogeochemistry Panel and with IOC-WMO JCOMM. Maciej has a specific focus on marine biogeochemistry observations, and has been strongly involved in the development of the Essential Ocean Variables specification sheets, designing an approach to setting observing targets and metrics for biogeochemical observations, promoting and designing standards and best practices for observations and data management and finally active promoting of data interoperability standards across domains and disciplines.

Relationship to other international programs and SCOR Working groups (max. 500 words)

Most or all of the current SCOR WGs are based on exciting science and it is an appropriate time to support a WG that supports these efforts, and focuses on solving methodological and conceptual problems that hinder research. We would leverage the support of SCOR to enhance the approach to past and present SCOR working groups' best practices and create sustainability into the future. We would also utilize all of SCOR's outreach activities (POGO, cruises, summer schools, visiting scientists etc) to promote best practices and gain feedback from the community.

The relationship to the other SCOR Working Groups has been highlighted throughout the document and is an integral component of the proposal for this WG. One focus of this SCOR WG is to review all past and present SCOR WG outputs with the support of their chairs and identify descriptions or work which represent BP and take the results to the wider ocean observation communities. The key international programs that this WG relate to have also been discussed throughout document but are, for the most part, represented by the full members and include JCOMM, GOOS, POGO, IOCCP and IODE as well as various regional observing systems.

Key References (max. 500 words)

N/A

Appendix

For each Full Member, indicate 5 key publications related to the proposal.

The relevant publications are mostly in the form of grey literature or institutional reporting, key papers are listed below

- Bakker, E. B. Pfeil, C. S. Landa, S. XU, **M. Telszewski** and others A multi-decade record of high-quality fCO2 data in version 3 of the Surface Ocean CO2 Atlas (SOCAT), May 2016, DOI: 10.5194/essd-2016-15; D. C.
- Bethencourt, M., T.Fernández-Montblanc, A. Izquierdo, M. María González-Duarte, **C. Muñoz-Mas**, Study of the influence of physical, chemical and biological conditions that influence the deterioration and protection of Underwater Cultural Heritage, In Science of The Total Environment, Volumes 613–614, 2018, p98114, ISSN 0048-9697 https://doi.org/10.1016/j.scitotenv.2017.09.007.
- Bork, K., **Karstensen, J**., Visbeck, M. and Zimmermann, A. (2008) *The Legal Regulation of Floats and Gliders - in Quest of a New Regime?.* Ocean Development and International Law, 39 (3). pp. 298-328. DOI 10.1080/00908320802235338.(http://www.sciencedirect.com/science/article/pii/S0048969717323495)
- Bornman, T., L. Atkinson, A. Bernard, P. Cowley, S. Deyzel, W. Goschen, A. Götz, **J. Hermes,** W. Hugo, A. Paterson, C. von der Meden, Reflections on the state of research and technology in South Africa's marine and maritime sectors, 2014: Long Term Marine Research Platforms of the National Research Foundation, Editors: Nikki Funke, Marius Claassen, Richard Meissner and Karen Nortjie, ISBN 978-0-7988-5617-1 http://www.waternet.co.za/aquarius/book.html
- **Heslop, E;** Computer Aided Systems Theory - EUROCAST 2013: 14th International Conference, Las Palmas de Gran Canaria, Spain, February 10-15, 2013. Revised Selected Papers, Part II (pp.341-348) The Impact of New Multi-platform Observing Systems in Science, Technology Development and Response to Society Needs; from Small to Large Scales. **Conference Paper** · February 2013 DOI 10.1007/978-3-642-53862-9_44, ISSN 0302-9743, Publisher: Springer Berlin Heidelberg
- **Karstensen, J**., Edwards, M., Körtzinger, A., Lampitt, R., Llinas, O., Müller, T. J., Send, U., Steinhoff, T. and Villagarcia, M.(2006) *ANIMATE: Quality control of data from multi-disciplinary moorings in the Northeast Atlantic.* In: European Operational Oceanography: Present and Future ; proceedings of 4th International Conference on EuroGOOS, 06.-09.06.2005, Brest, France. . EU Publication, [s.l.], pp. 625-627.
- **Lara-Lopez, A** and Moltmann, T and Proctor, R, "Australia's Integrated Marine Observing System (IMOS): data impacts and lessons learned", *Marine Technology Society Journal*, **50** (3) pp. 23-33. doi:10.4031/MTSJ.50.3.1 ISSN 0025-3324 (2016)
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J. D. (2017)*Overturning in the Subpolar North Atlantic Program: A New International Ocean Observing System.* Bulletin of the American Meteorological Society, 98 (4). pp. 737-752. DOI 10.1175/BAMS-D-16-0057.1.

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- Morris, T., **J. Hermes** et al., Large mooring arrays of South Africa, **2017** South African Journal of Science
- **Pearlman, J. PL. Buttigieg, P. Simpson, C. Muñoz, E. Heslop, J. Hermes**, Accessing Existing and Emerging Best Practices for Ocean Observation, a new approach for end-to-end management of best practices, Oceans 2017 – Anchorage, 2017 pp. 1-7.
- Pearlman, F., O. Ferdinand, O. Zielinski, E. Delory, S. Meme, N. Roar Hareide, K. Kvalsund, J. Río, D. Mihai Toma, JF. Rolin, P. Woerther; L. Golmen, E. Reggiani, A. Haeffner, C. Waldmann, **J. Pearlman;** NeXOS, developing and evaluating a new generation of in-situ ocean observation systems ; OCEANS 2017 - Aberdeen
- **Pearlman, J**; Jirka, S.; del Rio, J.; Delory. E.; Frommhold. L.; Martinez, S.; O'Reilly, T., Oceans of Tomorrow sensor interoperability for in-situ ocean monitoring, OCEANS 2016 MTS/IEEE Monterey 2016
- **Pearlman, J**; Schaap, D.; Glaves, H., Ocean Data Interoperability Platform (ODIP): addressing key challenges for marine data management on a global scale, OCEANS 2016 MTS/IEEE Monterey 2016
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- **Simpson, P.**, Pearlman, F. and **Pearlman J.** (eds) (2017) *Evolving and Sustaining Ocean Best Practices Workshop, 15 – 17 November 2017, Intergovernmental Oceanographic Commission, Paris, France: Proceedings*. AtlantOS/ODIP/OORCN Ocean Best Practices Working Group, 74pp.

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Appendix 1

Initial target SCOR WG groups:

SCOR Working Group 154
Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS)

Co-Chairs: Emmanuel Boss (USA) and Anya Waite (Germany)

SCOR Working Group 152
Measuring Essential Climate Variables in Sea Ice (ECV-Ice)
Co-Chairs: Daiki Nomura (Japan), François Fripiat (Belgium), and Brent Else (Canada)

SCOR Working Group 143
Dissolved N2O and CH4 measurements: Working towards a global network of ocean time series measurements of N2O and CH4

Co-chairs: Herman Bange (Germany) and Sam Wilson (USA)

SCOR Working Group 142
Quality Control Procedures for Oxygen and Other Biogeochemical Sensors on Floats and Gliders

Co-chairs: Arne Körtzinger (Germany) and Ken Johnson (USA)

SCOR/IGBP Working Group 138
Modern Planktic Foraminifera and Ocean Changes
Co-chairs: Gerald Ganssen (The Netherlands) and Michal Kucera (Germany)

SCOR Working Group 147
Towards comparability of global oceanic nutrient data (COMPONUT) **Co-chairs:** Michio Aoyama (Japan) and E. Malcolm S. Woodward (UK)

SCOR Working Group 149
Changing Ocean Biological Systems (COBS): How will biota respond to a changing ocean?
Chair: Philip Boyd (Australia)

SCOR Working Group 141
Sea-Surface Microlayers
Co-chairs: Michael Cunliffe (UK) and Oliver Wurl (Germany)

Acronyms:

AWI (Alfred Wegener Institute)

EOVs (Essential Ocean Variables)

GEOMAR (Research Centre for Marine Geosciences)

GOOS (Global Ocean Observing System)

IEEE (Institute of Electrical and Electronics Engineers)

IIOE2 (International Indian Ocean Expedition)

IMBER (Integrated Marine Biogeochemistry and Ecosystem Research Project)

IMOS (Iraqi Marshlands Observation System)

INTAROS (Integrated Artic Observing System)

IOCCP (International Ocean Carbon Coordination Project)

IODE (International Oceanographic Data and Information Exchange Academic & Science>> Ocean Science)

IOOS (Integrated Ocean Observing System)

JCOMM (Joint Technical Commission for Oceanography and Marine Meteorology)

JCOMM OCG (Joint Technical Commission for Oceanography and Marine Meteorology Observations Coordination Group)

JERICO (Joint European Research Infrastructure for Coastal network for Coastal Observatory

NCOSM (National Centre of Ocean Standards and Metrology)

POGO (Polar Orbiting Geophysical Observatory)

QA/QC (Quality Assurance/Quality Control)

QARTOD (Quality Assurance/Quality Control of Real-Time Oceanographic Data)

SAEON (South African Environmental Observation Network)

SCOR WG (Scientific Committee on Oceanic Research Working Group)

SOCIB (The Balearic Islands Coastal Ocean Observing and Forecasting System)

SOLAS (Safety of Life at Sea)