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A Word from the Editor

Dear Ocean Carbon & Biogeochemistry Community,

Happy New Year! It's barely reasonable time for that but we at IOCCP wish you a fruitful and productive year ahead.

I start this Conveyor in a very similar tone as I started the last one, which we published...in January 2013. Three years ago. IOCCP accomplished a lot throughout these three years and we had no shortage of issues to raise with you and points to make, but one thing we lacked was sufficient office staff. It has changed this January and at least for the next three years, IOCCP Conveyor will be a quarterly event.

In this issue we do not attempt to make up for these three years of weaker communication. Instead we decided to update you on events and issues that took place over the past quarter or so, as if we were up and running the Conveyor without any substantial pause.

We hope to be able to complement your existing awareness with additional relevant information increasing the community's coordination and collaboration capabilities.

We are looking forward to working with you all in 2016!

Maciej Telszewski

Changes in the IOCCP Office

We are very pleased to announce that after more than three years of fundraising we have been able to appoint a new IOCCP Project Officer! We had announced the position in August 2015 and within a month of application period we received a somewhat surprisingly large number of outstanding applications. The final decision was made in early October 2015 and Dr Artur Palacz has been appointed effective 1 January 2016.

Artur holds a B.Sc. in Geosciences & Astrophysics from Jacobs University in Bremen, Germany (2006) and a Ph.D. in Oceanography from the University of Maine in Orono, Maine, USA (2011). He took advantage of this transdisciplinary education to explore innovative approaches to combining multi-platform ocean observations with ecosystem model results while contributing to numerous national and international, regional and global projects. His scientific interests and contributions range from cold-water coral biology and trace metal biogeochemistry, through ecosystem modeling, to the development of decision-support tools for marine resource management. As an oceanographer he gained a broad perspective on a critical issue of data collection and synthesis, which often hinders the development of reliable biogeochemical and ecosystem model projections needed to provide scientific advice to local, regional and global ocean management – a perspective lacking so far from the IOCCP Project Office.

In his most recent employment as a researcher at the National Institute of Aquatic Resources, Technical University of Denmark (DTU-Aqua), Copenhagen, Denmark (2012-2015), Artur gained experience in coordinating international and cross-sector data synthesis efforts (EU VECTORS project) or designing decision-support tools (EU EURO-BASIN project for the North Atlantic). He has also been providing scientific advice to three working groups of the International Council for the Exploration of the Sea (ICES).

Very broadly, at IOCCP Artur will contribute to our mission of coordination and communication services for carbon and biogeochemistry observing community.

You will hear from him via email (a.palacz@ioccp.org) and over time via other means of communication.

Please join me in welcoming Artur on board IOCCP!!!


Maciej Telszewski

IOCCP in the AtlantOS project

AtlantOS As some might recall, in 2011 IOCCP core funding was altered which resulted in significant staff reduction in the Project Office. Searching for diversification of funding to bring the staff numbers to the level allowing for an un-interrupted fulfilment of our core mission, IOCCP became involved (in 2013) in a proposal answering to the EU Horizon-2020 call BG-8-2014: *Developing in-situ Atlantic Ocean Observations for a better management and sustainable exploitation of the maritime resources.*

The proposal was successful and the project called AtlantOS started on 1 April 2015. IOCCP is one of the 62 project beneficiaries that include research institutes, universities, marine service providers, multi-institutional organisations, international partners and the private sector from 18 countries. The EU funding secured through AtlantOS, allowed us to employ a Project Officer (previous article) and added a small activity budget to be used for activities related to the AtlantOS project.

IOCCP's role in AtlantOS will be primarily focused on delivering tasks listed below. Although the tasks have to be initially regionally focused, their scope is by all means global and the idea is to apply newly developed procedures and protocols to the global coordination efforts and vice-versa.

 Identification of major scientific and societal challenges that require sustained ocean biogeochemistry variable observations in the Atlantic Ocean region

We will facilitate a formal and coordinated international dialogue between the observing community, the societal stakeholder community (representatives of policy-making entities across

European administration with interest vested in marine environment) and the funders as to what ocean observing requirements for marine biogeochemistry exist in the Atlantic. The IOCCP will compile the available information on societal and scientific requirements for long-term observations assuring the sustained development of the human population within the region. The observing system based on selected requirements has to provide information allowing to ensure sustained ocean services and improve our response capabilities to issues impacting human health and security. These requirements will also have to reflect the needs of policy-making community so that information collected through observations will generate a strong evidence base for decision-making.

Identification of biogeochemical Essential Ocean Variables (EOVs) for the Atlantic Ocean observing system and multidimensional feasibility assessment of the observing system capabilities based on proposed EOVs and available infrastructure

The set of biogeochemical Essential Ocean Variables (EOVs) identified in the wider GOOS context will be utilized here and possible additional scientific and societal ocean/climate-related issues will be highlighted for the Atlantic Ocean.

In the process we will consult with programmatic and institutional partners as well as representatives of all observing networks across the AtlantOS on their requirements for the spatial, temporal and resolution requirements. We will also gather information on national capabilities, aspirations and impediments within the EU and throughout other coastal states of the Atlantic region to identify gaps and opportunities.

Each observational network supports measurements of a range of variables with varying time and space sampling resolution and accuracy, and intrinsic trade-offs based on strategy and capacity. We will perform a multidimensional feasibility assessment of the proposed EOVs with observing, modeling and sensor/instrument developing communities involved. Such assessment, built on recommendations of the Framework for Ocean Observing, will reveal the current state of the Atlantic Ocean observing system for biogeochemistry and its fitness-for-purpose by

highlighting duplications, gaps, cross-fertilization opportunities and more.

Coordination of technological improvements in the observing system elements and end-user training on the usage of new observing technologies

We proposed to aid the development and full integration of new technologies into the Atlantic Ocean observing system in two ways: first by coordinating the development of standards, best practices guides and data quality protocols for new observing technologies for biogeochemistry and second by hands-on training of the European and Pan-Atlantic end-users to provide capability enhancement into the future.

Support for system optimization at the data and information flow level and the information production and delivery-to-user level

As the outputs of AtlantOS, data and information products will be the interface between our work and its users. Many modeling, data assimilation, synthesis, and assessment activities that will provide added value to observations have to meet specific user requirements for information. Ocean information products will have to support both research and decision-making in diverse areas such as climate studies and adaptation, disaster warning and mitigation, commerce, and ecosystem-based management.

There is a need to quantify and optimize how clearly and completely all biogeochemical EOVS data sets compiled under AtlantOS are identified, described, and documented. In addition, we propose to develop data usage metrics to reflect the level of demand for and breadth of uses for different data and information types. Such quantification will allow for improvements in data access, quality, and products. Such metrics, tested within AtlantOS, could then be promoted globally and become an integral part of the continuing cycle of assessing and updating the requirements, the measurement approaches and the data and information products themselves.

AtlantOS WP1 Workshop in Copenhagen

On January 14-15th 2016, leaders of AtlantOS Work Package 1 (WP1): Observing system requirements and design studies, met at the headquarters of the International Council for the Exploration of the Sea (ICES) in Copenhagen, Denmark, to discuss progress on the outstanding tasks laid out in front of WP1 for the initial phase of the project.

For 11 participants from several institutions from around the Atlantic, including IOCCP, the first task was to agree on the requirements for sustained ocean observations of the Atlantic. Major societal drivers of sustained ocean observing in the Atlantic basin were identified, together with the major Atlantic phenomena that are required to be monitored to achieve these societal goals. It was agreed that requirements for sustained ocean observations are to be described through the concept of Essential Ocean Variables (EOVs), expressed separately for the physical, biological and biogeochemical realms. Among other things, IOCCP is providing specifications of biogeochemical EOVs and the associated observing elements operating in the Atlantic.

On Day 2 of the meeting, the focus was shifted to the other task at hand, namely planning the analysis of the capacities and gaps of the present Atlantic Ocean Observing System. Here IOCCP is taking the lead on identifying the critical gaps that need to be filled on the level of biogeochemical observations.

Maciej Telszewski and Artur Palacz

IOCCP and the GCOS Implementation Plan 2016

During the past 12 months the IOCCP significantly contributed to the Status Report on the Global Observing System for Climate (available from <http://www.wmo.int/gcos>). Several IOCCP SSG members took the responsibility to lead individual sections of the Report. IOCCP's input is most significant in sections describing oceanic essential climate variables related to biogeochemistry (nutrients, ocean acidity, carbon dioxide partial pressure, oxygen and tracers) and sections dealing with the observing networks that carry out

biogeochemical observations (SOO network, GO-SHIP, biogeochemical floats, mooring arrays and ship-based time series). Additionally, IOCCP made important contributions to an overall ocean observing section introduction and summary.

This Report tries to provide a full account of how well climate is currently being observed in support of IPCC and UNFCCC. It provides a basis for identifying the actions required to reduce gaps in knowledge (expression of which will be published as a GCOS Implementation Plan in 2016), and allows to assess where progress is being made, and where progress is lacking (progress against 2010 GCOS Implementation Plan is assessed). Since 2012, when the Framework for Ocean Observing identified the need for more integrated marine biogeochemistry observations, IOCCP was asked to lend its expertise and community-wide network to contribute to this multi-domain effort. Past year was when the actual report writing took place and the final product was presented during the COP 21 in Paris in December 2015.

Specific details on individual parameters and networks can be found in the Report but the very general conclusion is that observation of the ocean has progressed substantially through deployment of buoy networks, autonomous sub-surface measurement systems and space-based remote sensing, which complement longer-established and still-essential ship-based programmes. It is now taking place under revised arrangements for scientific guidance and advice, provided by GOOS and its three panels, including one for biogeochemistry (led by IOCCP). The last few years have seen rapid development of chemical and bio-optical sensors, with increasing levels of readiness for deployment on Argo floats, gliders and moorings. Currently 7% of floats are equipped with oxygen sensors and a smaller number of floats sense nitrate and pH.

Progress in recent years has also been made on data collection and support, for example through establishment of SOCAT and work towards GLODAPv2. Organisation of observing activities has taken place through formation of the Global Ocean Acidification Observing Network. The considerable progress made in establishing observational

capabilities and systems provides a basis for reconsidering the specification of the related ECVs during preparation of the 2016 Implementation Plan (GCOS 2016 IP).

The GCOS 2016 IP is where the importance of this activity lies for biogeochemistry community. The Implementation Plan will be published in 2016 and it is already clear that much stronger emphasis will be placed on marine biogeochemical observations for the system to be able to truly observe climate variability globally. IOCCP has a major role to play there as almost revolutionary progress was made in our observational capacity in terms of marine biogeochemistry and strategic utilization of these technological developments needs to be structured and aligned with the rest of global climate observing system.

One way to get involved in this process could be through active participation in conference **Global Climate Observation: the Road to the Future** which will be held from 2-4 March 2016 at the Royal Academy of Arts and Sciences, Amsterdam, Netherlands to allow producers and users of climate observations and other stakeholders the opportunity to discuss the current monitoring of the Essential Climate Variables (ECVs) and to highlight possible new areas for ECVs. These discussions will provide a key input into the new GCOS Implementation Plan.

Maciej Telszewski

GOA-ON Executive Meeting on Data Portal and Synthesis Products

The Executive Council of the Global Ocean Acidification Observing Network (GOA-ON) met at the IAEA Environment Laboratories in Monaco, 19-20 November, to discuss the development of ocean acidification data portal and data synthesis products.

Discussions related to ocean acidification data portal were based on an earlier meeting (1-2 June 2015) held in Monaco's IAEA labs. This two-expert meeting explored possibilities to create a joint portal for access to global ocean acidification data within the framework GOA-ON. Invited experts discussed the way forward

to (1) extend and update the current GOA-ON inventory and (2) propose a web portal interface for ocean acidification metadata retrieval. The group discussed the advantages and shortcomings of existing data portal systems, the use of common controlled vocabularies, useful search filters, metadata standards and interoperability between different data providers. The longer-term goal of creating a one-stop portal to ocean acidification data with adequate search facilities was also discussed.

With the above developments in mind the GOA-ON Executive Council agreed on developing a central site for products of the variability in ocean acidification (primarily carbonate mineral saturation states and pH) across a range of temporal and spatial scales, including: (1) decadal trends in pH and aragonite saturation state from long-term time series sites, (2) seasonal changes in pH and aragonite saturation state at the growing number of observing sites in recent years (moored and ship-based time series), and (3) global distributions focused initially on aragonite saturation state of the kind produced by Jiang et al (2015).

The Executive Council also discussed planning of the Third GOA-ON Science Workshop to be held in Hobart, Australia, 8-10 May 2016. The workshop will follow the Fourth Symposium on the Ocean in a High CO₂ World in Hobart. The two meetings are a significant opportunity to bring together the international community to further the development of regional collaborations, data products, and closer integration of key biological variables into GOA-ON.

Maciej Telszewski

Launch of the Latin American Ocean Acidification Network (LAOCA)



We are excited to report the launch of the Latin American Ocean Acidification Network (LAOCA Network) - a regional counterpart of the Global Ocean Acidification Observing Network (GOA-ON). On December 15th, 2015, a group of 24 scientists from seven Latin-American countries, including Argentina, Brazil, Chile, Colombia, Ecuador,

Mexico and Peru, met at the city of Concepcion in Chile to establish the LAOCA.

This regional workshop was co-funded by the International Atomic Energy Agency (IAEA) through the Ocean Acidification International Coordination Centre (OA-ICC), the Intergovernmental Oceanographic Commission (IOC-UNESCO), the Center for the Study of Multiple-Drivers on Marine Socio-Ecological Systems (MUSELS), and the Millennium Institute of Oceanography (IMO) from Chile. During two days the group of scientists discussed the strengths and weaknesses of each country in relation to ocean acidification research, and also defining the mission and goals of the LAOCA Network:

- to synthesize the information about ocean acidification impacts in Latin-America,
- to encourage the implementation, maintenance, and calibration of long-term datasets of carbonate chemistry in Latin-America,
- training of LAOCA members in various aspects of research (e.g. observation, experimentation, and modelling),
- to standardize chemical analytical techniques and protocols for experimentation in order to enhance data quality and homogeneity,
- to establish a regional node for the articulation and communication amongst local, regional, and global research and coordination programs (e.g. Brazilian Ocean Acidification Network (BrOA), IMO, GOA-ON and IOCCP),
- to determine and evaluate local and regional scenarios of Ocean Acidification for different types of marine ecosystems (e.g. estuaries, coastal area, open ocean, etc.),
- to enhance student exchange and to facilitate access to infrastructure and equipment among institutions and LAOCA member countries,
- to design an outreach strategy for communicating ocean acidification-related issues to various audiences,
- to promote the development of cooperation projects between member countries of LAOCA, and,
- to promote the inclusion of Ocean Acidification to the political agendas of member countries, and even through the pursuit of cooperation agreements among LAOCA member countries.



Figure 1: Participants of the LAOCA kick-off meeting, December 15, 2015, Concepcion, Chile.

Finally, scientists defined the LAOCA **Executive Council**, which will be co-chaired by **Leticia da Cunha**, (Universidade do Estado do Rio de Janeiro – UERJ, Brazil; Co-leader of BrOA); **Nelson A. Lagos** (Centro de Investigación e Innovación para el Cambio Climático (CiiCC), Universidad Santo Tomás, Chile; Member of the OA–ICC advisory board and SOLAS-IMBER WG in Ocean Acidification, SIOA) and **Cristian A. Vargas** (Universidad de Concepción, Chile; Member of the Executive Scientific Council at GOA-ON and IOCCP).

In addition, the Executive Council includes representatives from each country participating in LAOCA: Rodrigo Kerr (Universidade Federal de Rio Grande (FURG), Brasil), Patricio Manríquez (Centro de Estudios Avanzados en Zonas Aridas (CEAZA), Chile), Patricia Castillo-Briceño (The Escuela Superior Politécnica del Litoral (ESPOL), Ecuador), Alberto Acosta (Universidad de Bogotá Jorge Tadeo Lozano (UTADEO), Colombia), Michelle Graco (Instituto del Mar del Perú (IMARPE), Perú), Alejandro Bianchi (Servicio de Hidrografía Naval (SHN), Argentina) and José Martín Hernández-Ayón (Universidad Autónoma de Baja California (UABC), México).

A first meeting, which will be focused on scientific plans and development of the on-the-ground collaboration scheme during the first year of operation of LOACA is planned for May 2016.

LOACA Executive Council

Release of the Global Ocean Data Analysis Product version 2 (GLODAPv2)

glodap_{v2} In January 2016 we witnessed the release of a new interior ocean carbon relevant data product: GLObal Ocean Data Analysis Project version 2 (GLODAPv2)! It includes all data from the original GLODAP, data from CARINA and PACIFICA, and data from 168 new cruises – all in all data from 724 cruises covering 1972 to 2013 (Fig. 2).

(iii) a mapped climatology of (ii) consisting of global 3D fields of the seawater distribution of CO₂ chemistry and other parameters.

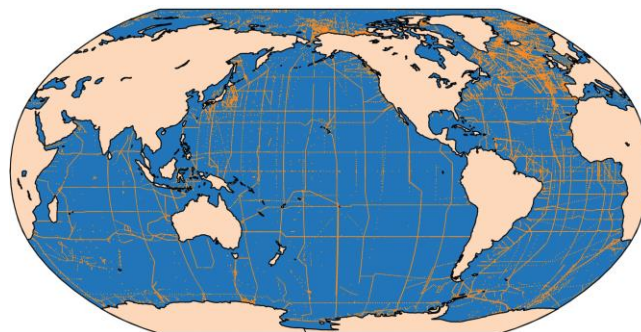


Figure 2: GLODAPv2 global data coverage.



Analysis of GLODAPv2 parameters will allow for quantitative assessment of biogeochemical changes and feedbacks between climate change and the ocean system. GLODAPv2 is the result of a multi-year global team effort funded by EU-IP CARBOCHANGE, US NSF, US-NASA, US DOE, IOCCP and many other projects, programs and organizations.

The procedures and results are extensively documented in the three publications listed at the bottom of the page.

Are Olsen & the GLODAPv2 Team

GLODAPv2 publications:

Olsen, A., R. M. Key, S. van Heuven, S. K. Lauvset, A. Velo, X. Lin, C. Schirnack, A. Kozyr, T. Tanhua, M. Hoppema, S. Jutterström, R. Steinfeldt, E. Jeansson, M. Ishii, F. F. Pérez & T. Suzuki: An internally consistent data product for the world ocean: the Global Ocean Data Analysis Project, version 2 (GLODAPv2), *Earth System Science Data Discussions*, doi:10.5194/essd-2015-42, in review, 2016

Lauvset, S. K., R. M. Key, A. Olsen, S. van Heuven, A. Velo, X. Lin, C. Schirnack, A. Kozyr, T. Tanhua, M. Hoppema, S. Jutterström, R. Steinfeldt, E. Jeansson, M. Ishii, F. F. Pérez, T. Suzuki & S. Watelet: A new global interior ocean mapped climatology: the 1°x1° GLODAP version 2, *Earth System Science Data Discussions*, doi:10.5194/essd-2015-43, in review, 2016

Key, R. M., A. Olsen, S. van Heuven, S. K. Lauvset, A. Velo, X. Lin, C. Schirnack, A. Kozyr, T. Tanhua, M. Hoppema, S. Jutterström, R. Steinfeldt, E. Jeansson, M. Ishii, F. F. Pérez, and T. Suzuki, 2015, Global Ocean Data Analysis Project, version 2 (GLODAPv2), ORNL/CDIAC-162, NDP-093, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, US.

All data included in GLODAPv2 have been evaluated for measurement bias and adjusted appropriately, using a consistent method. The end result is the most comprehensive and rigorously quality controlled ocean interior data product for marine biogeochemistry studies.

GLODAPv2 consist of three elements:

- (i) a data base with original cruise data, as submitted by individual data providers but updated to WOCE Exchange format,
- (ii) a merged data product, with measurement biases removed for key biogeochemical variables, and

Upcoming Events

-  11th Session of the IOCCP SSG, 20 February 2016, New Orleans, LA, USA (by invitation only)
-  21st Meeting of the Global Ocean Observing System (GOOS) Steering Committee Executive, 21 February 2016, New Orleans, LA, USA (by invitation only)
-  2016 Ocean Sciences Meeting, 21–26 Feb 2016, New Orleans, LA, USA; <https://osm.agu.org/2016/>
-  Global Climate Observing System (GCOS) Science Conference: *The Road to the Future*, 2–4 March, 2016, Amsterdam, The Netherlands; <http://www.gcos-science.org/>
-  The 8th Session of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) Observations Coordination Group, 4–6 April 2016, Mallorca, Spain (by invitation only)
-  European Geosciences Union (EGU) General Assembly, 17–22 April 2016, Vienna, Austria; <http://www.egu2016.eu/>
-  The 4th International Symposium on the Ocean in a High-CO₂ World, 3–6 May 2016, Hobart, Australia; <http://www.highco2-iv.org/>
-  Global Ocean Acidification Observing Network (GOA-ON) Science Workshop, 8–10 May 2016, Hobart, Australia; <http://www.highco2-iv.org/workshop-go-a-on>
-  AtlantOS General Assembly, 28–30 June 2016, Kiel, Germany (by invitation only)
-  CLIVAR Open Science Conference, 8–25 September 2016, Qingdao, China; <http://www.clivar2016.org/>; abstract submission deadline: 15 March 2016