A joint project of Scientific Committee on Oceanic Research and Intergovernmental Oceanographic Commission of UNESCO and an affiliate program of the Global Carbon Project

The IOCCP Conveyor No. 35, June 2016

A Word from the Editor

Dear Ocean Carbon & Biogeochemistry Community,

We have had a very busy four months at IOCCP, with several major meetings and significant activities across the board. In this issue of the Conveyor we try to synthesise the most globally relevant outcomes as well as plans for the nearest future.

In February, *Ocean Sciences Meeting* with the usual amount of side meetings organized on "both" sides of the main conference; in March *Global Climate Observation: The Road to the Future* Conference; and in May the *3rd GOA-ON Science Workshop* were all very well attended by the core ocean carbon and biogeochemistry community and IOCCP was heavily involved in organizing and providing input to these events. Significant progress was also made in the development of the Global Ocean Observing System Essential Ocean Variables, Global Climate Observing System Implementation Plan and Global Ocean Acidification Observing Network Implementation Strategy. And again IOCCP was involved for the biogeochemistry observations.

All of the efforts listed above and described in the remainder of this issue of the Conveyor benefited very

strongly from community-wide engagement and it is really pleasant to see how our community with a little bit of coordination manages to accomplish so many tasks with everyone involved having a day-job to attend before their community service.

In the northern hemisphere most of us will switch to a much lower gear if not to neutral in a few weeks and hence the whole machinery will slow down somewhat. It seems that we all deserve it!

I hope you will find the rest of this issue useful!

Maciej Telszewski

11th Session of the IOCCP Scientific Steering Group: meeting and report published

The Eleventh Session of the IOCCP Scientific Steering Group (SSG) was held on 20 February 2016 in the Residence Inn Marriott in New Orleans, LA, USA.

Toste Tanhua (Chair) was joined by eight members of the SSG, the Project Director and one guest representing IOC-UNESCO and GOOS. The Chair provided a brief overview of the many on-going activities that IOCCP was engaged in over the previous 10 months since the Tenth Session. The meeting was focused primarily on long term planning and developing/shaping the long term strategy for the community. Discussions related to each theme were initiated with an overview presentation given by the responsible SSG expert. The full meeting report with 45 specific action items is published and available for download as PDF from the IOCCP website at http://www.ioccp.org/index.php/documents/meeting-reports. The IOCCP will execute these specific actions over the course of the next 2 years and in most cases collaboration with a wide range of partners is envisaged so that a full community engagement is achieved.

Maciej Telszewski

Rotations in the IOCCP SSG

The end of 2015 and beginning of 2016 brought in a few changes in the composition of the IOCCP SSG. Two SSG members, Laura Lorenzoni (Time Series Efforts) and Todd Martz (Instruments and Sensors) rotated off at the end of 2015.

On behalf of the IOCCP and the entire community we would like to extend our sincere gratitude to Laura and Todd for their consistent and devoted service as the IOCCP SSG in the past years. We recognize their great contribution in support of IOCCP's mission to move towards a sustained global observation network for marine biogeochemistry. We wish them both all the very best in their future endeavors and we look forward to their ongoing involvement in the ocean carbon and biogeochemistry community.

At the same time we want to give our warm welcome to four of our colleagues who accepted our invitation and joined the SSG in January 2016:

- **Dr Björn Fiedler** (Kiel, Germany) assumed responsibilities related to Time Series Efforts.
- **Dr Douglas Patrick Connelly** (Southampton, UK) assumed responsibilities related to Instruments and Sensors.
- **Dr Cristian A. Vargas** (Conception, Chile) to strengthen IOCCP's coordination in Latin and South America through Ocean Acidification – related activities.
- **Dr Siv Kari Lauvset** (Bergen, Norway) to strengthen IOCCP's coordination in Ocean Interior Synthesis Activities allowing for an overlap with Are Olsen who will rotate off the SSG at the end of 2016.

All new SSG members can be characterized as outstanding contributors to local and regional coordination efforts in their fields of specialty. We hope to be able to utilize their energy and expertize to expand their efforts to the global arena. I am sure that many of you will soon hear from Siv, Doug, Cristian or Björn with regards to the many activities they proposed for IOCCP for the coming years. In order to facilitate the communication and coordination among

our community, we would like you to get a better idea of who the new IOCCP SSG members are and how they perceive their role in IOCCP. We, therefore plan a series of articles in which we will introduce the new SSG members. Their initial tasks as IOCCP experts are described in corresponding chapters of the IOCCP SSG report.

Maciej Telszewski and Artur Palacz

New IOCCP SSG member profile: Cristian Vargas

This article is the first of a series of new IOCCP SSG member profiles. With the *4th International Symposium on the Ocean in a High CO_2 World* and the *3rd GOA-ON Science Workshop* still fresh in our minds, we want to start with introducing Dr. Cristian Vargas who will strengthen the IOCCP's coordination in Latin and South America through Ocean Acidification – related activities.

Cristian comes from Chile where he also began his scientific career with a degree in Marine Biology from Universidad Austral de Chile, followed by a PhD in Oceanography from the Universidad de Concepción in 2002. His doctoral thesis was on plankton communities in the ecosystems of the fjords of northwestern Sweden and their role in carbon flows. Since then his interests and scientific expertise have widened tremendously and are now focused on biological oceanography and carbon and biogeochemical cycles, but also encompass areas such as aquatic ecosystem metabolism, plankton ecology as well as local and global anthropogenic impacts on ecosystems.

Currently, Cristian is an Associate Professor in the Faculty of Environmental Sciences of the Universidad of Concepcion (UC) in Chile, where he also serves as the Director of the Center for the Study of Multiple-Drivers on Marine Socio-Ecological Systems (MUSELS). Since 2009 he has led a number of ocean acidification-related scientific programs in Chile and has been involved in the formation and is now Co-Chair of the Latin-American Ocean Acidification Network (LAOCA), about which you could read extensively in our previous issue of the Conveyor. Cristian is strongly connected with the international community and serves as a member of an Executive Council of the Global Ocean Acidification Observing Network (GOA-ON).

Cristian has carried out pioneering studies in South America that associate the observational carbonate system information with laboratory experiments on micro- and mesocosm set-ups under multiples stressors (e.g. pCO_2, temperature, and others). Cristian has been also a leading PI in the Millennium Institute of Oceanography, focused mostly in the area of inorganic carbon chemistry in oxygen minimum zones (OMZ) and open ocean waters. His laboratory is completely equipped for high-quality measurements of pH, total alkalinity, and dissolved organic (DOC) and inorganic carbon (DIC) as well as a number of autonomous biogeochemical sensors (SEAFAETs). As such this lab constitutes a reference laboratory at a national level. He has authored more than 50 research publications dealing with carbon fluxes and carbon cycling in coastal waters.

In the framework of IOCCP activities, Cristian will support the connection between local (e.g. LAOCA) and global (GOA-ON and IOCCP) programs, as well as data management in South America for the production of global syntheses and data products. Finally, Cristian will give us the essential knowledge on the personal and institutional structure of the Latin American community working on Ocean Acidification issues.

We welcome Cristian on board IOCCP and look forward to working closely with him towards strengthening IOCCP's coordination of ocean acidification related activities.

Artur Palacz

4th International Symposium on the Ocean in a High CO_2 World and the 3rd GOA-ON Science Workshop

The *4th International Symposium on the Ocean in a High-CO_2 World* was held in Hobart, Australia, on 3-6 May 2016. Ocean Acidification researchers from all around the world presented research and discussed recent developments in the field. Themes included organism response, ecological effects, changing carbonate chemistry, multiple-stressors, and ocean acidification and society. The Symposium highlights and news were transmitted to the global public via Twitter (#OHCO2W and #oceanacidification) and the Ocean Acidification International Coordination Centre (OA-ICC) news stream, augmenting the many media articles and interviews. Further information, including the programme and abstracts is available from the Symposium website (http://www.highco2-iv.org/).

The *3rd Science Workshop of the Global Ocean Acidification Observing Network (GOA-ON)* was held on 8-10 May 2016, immediately after the Symposium, taking advantage of the great concentration of interested scientists. The IOCCP co-sponsored and was actively involved in the organization of this event which brought together 135 participants from 37 countries who spent three days furthering the development and implementation of an integrated network for the detection and attribution of ocean acidification and ecosystem response. The Workshop covered the following issues:

- Update on GOA-ON status and linkages to other global programs
- Development of regional hubs that will facilitate capacity building
- Requirements for biology and ecosystem response measurements
- Discussion of modeling connections, observational challenges and opportunities for synergistic approach
- Advances in technologies, data management and products development
- Discussion on the specific needs for data and information products
- Launch of the GOA-ON Mentorship Program

The parameters required for the detection of the chemical signals of ocean acidification were defined at previous GOA-ON science workshops, however designing of the biological component of a global observing system proves more difficult and was a subject of many discussions during the meeting. Key biological variables, and the theoretical framework linking physical –chemical changes to biological responses were introduced, along with input from the GOOS Biology and Ecosystems Panel and the GOOS Biogeochemistry Panel with regards to the Essential Ocean Variables. Breakout groups, based on specific environments, discussed and recommended components of a biological monitoring system that is feasible throughout the system, but would still meet the GOA-ON detection and attribution goals as described in the GOA-ON Requirements and Governance Plan available from the GOA-ON website.

Extending the monitoring capacity to regions that are currently under-represented is a major challenge, specifically in coastal regions. Through plenary presentations and break-out discussions the organizers attempted at identifying the regional needs for ocean acidification information products, particularly for policy makers in Africa, large areas of Asia, and South America. Participants discussed the existing observing efforts within geographic regions, in the context of the science, societal and policy needs of each region. The formation of regional hubs for the ongoing coordination of effort was encouraged, using the Latin American Network (LAOCA) as a case study. Technical groupings (e.g. specific instruments) and ecosystem groupings (e.g. coral reefs) were also discussed. These hubs could provide regional coordination, sharing of resources and expertise, and capacity building opportunities.

The GOA-ON Pier2Peer mentoring programme was launched. Participants signed up as either mentors or mentees and were matched so as to form a global collaborative network for sharing expertise and experience. Such sharing consists of consultation over scientific questions or techniques, discussion of experiment/study design, sharing of relevant scientific articles and opportunities.

More information is available from the GOA-ON website http://www.goa-on.org/ and on the Workshop-dedicated page here.

Kim Currie

IOCCP Position Paper on Global Ocean Biogeochemistry Data Management

Triggered by adverse developments in the US Department of Energy (DoE) related to funding of data management activities lying in the center of global ocean marine biogeochemistry observing community and based on the long-lasting need to update several protocols and procedures utilized by data management system, a Position Statement was written by members of the IOCCP SSG and the former IOCCP SSG Chair, Dr. Christopher Sabine.

Some emphasis in this document is placed on our current situation but the major focus is on providing the initial direction for the way forward into the future. The Statement highlights the vulnerability of the current global ocean carbon and biogeochemistry data management system that relies too heavily on individual data managers and institutions. It further suggests establishing a system of Global Data Assembly Centers for ocean biogeochemistry leading to more uniform and cost-effective data management strategies, and allowing to facilitate a more resilient system for future development of the data synthesis and assessment products.

Following a unanimous endorsement of the Statement by the SSG members, IOCCP will act on it in the coming years by supporting and contributing to the development of activities aimed at implementing strategies described in the Statement. Below we copy the full Position Statement, which you can also view and download as PDF from our site HERE.

The international ocean biogeochemistry community is mainly using and depending upon one global data center, the Carbon Dioxide Information Analysis Center ocean trace gases section (CDIAC-Oceans) at the U.S. Department of Energy's Oak Ridge National Laboratory, USA. CDIAC-Oceans provides data management support for ocean carbon measurements from Repeat Section cruises, VOS/SOOP lines, time series and moorings data, has accommodated most community requests for data archival and data access and has also actively engaged with the science community, supporting large synthesis projects like SOCAT, the LDEO Database, GLODAP, CARINA, PACIFICA and GLODAPv2. The cut of funding support for the ocean trace gases section of CDIAC puts in jeopardy the uninterrupted data management that the ocean biogeochemical data community has come to rely upon as well as the trust and recognition from the scientific community that CDIAC-Oceans has built though decades of interactions. The loss of CDIAC-Oceans will have a negative impact on ocean carbon data submissions and reduction in value added products.

The uncertainty of funding for CDIAC highlights the vulnerability of a system that relies too heavily on individual data managers or institutions. At the same time, it provides an opportunity to review the requirements for modern data access and data management systems that have evolved significantly during the last decades and which currently are not being met through the CDIAC infrastructure. Operational data management systems that (a) provide automated data ingestion, (b) conform to modern standards for data and metadata, (c) utilize standard vocabularies, (d) have easy-to-use data access tools, and (e) provide stable data citations are driven not only by user requirements, but also by funding and government agencies as they promote open access to data. In the discussion of CDIAC funding and the vulnerability of ocean biogeochemistry data, we see a strong opportunity to implement a data management infrastructure that can thrive in the modern world of integrated science data.

A modern data management infrastructure needs to be established in which existing data centers (e.g. CDIAC, CCHDO, BCO-DMO, PANGAEA, NCEI) and data from various other networks (e.g. OceanSites, Argo) can be integrated through interoperable discovery and access services. This is essential for providing access to data, while at the same time ensuring that credit for data creation and data synthesis products is appropriately assigned. We propose to mimic the successful data management

approach implemented for the Argo profiling float network (http://www.argodatamgt.org). The Argo network addresses national funding agency requirements of having data housed in specific locales by setting up two Global Data Assembly Centers (GDACs), one in the US and one in Europe. Data holdings are mirrored between the data centers and can be accessed through either one. This redundancy makes access to the data collection, by nature, more resilient.

We suggest establishing a system of Global Data Assembly Centers for ocean biogeochemistry (e.g. GDAC-OBGC) where two initial GDACs are established, each with specific roles and responsibilities. The two GDACS will be complementary systems that will leverage the unique capabilities of each, to provide a complete solution for data ingestion, data quality control, data access, data citation and data archival.

A strong focus will be on interoperable access of standards compliant carbonate system data and metadata, irrespective of where they are archived. In addition, it is paramount that support for automated data ingestion, both for real time and delayed mode sources, be integrated into the data management workflow. This is crucial to being able to keep pace with the higher volume of data now being generated by autonomous platforms. First order quality control checks built into the automated ingestion streams can further reduce the quality control burden. By providing interoperable access, and adhering to standards and conventions, this framework will make future data synthesis products and activities much more efficient than with the current non-centralized data management system.

Another important emphasis of the GDAC will be an external review process by ensuring that (a) data are being quality assured and controlled according to community agreed standards, (b) direct feedback is given to the data source, (c) duplicates are being identified and resulting issues are resolved, (d) metadata are complete according to community agreed best practices or existing standards, (e) data and metadata are available through interoperable services, (f) reports are made to IODE and JCOMM Committees on data management status and activities, (g) data citation practices as outlined by the Research Data Alliance (RDA) and DataCite are incorporated, (h) data requests and searches from users can be reproduced and (i) there is clear tracking of the complete data lifecycle for each dataset. The last three bullet points are often overlooked but are increasingly becoming more important to ensure that PIs get credit for data they create and that users/reviewers can reproduce the exact data requests for data that is referenced in scientific publications.

The implementation of the above framework will facilitate continuation of the data synthesis and assessment products such as GLODAP, SOCAT and create a foundation for additional data products, including the integration of data such as time series data and coastal data. In addition, the implementation of such a framework will support compatible efforts internationally, providing a cohesive process toward more uniform data management strategies within the ocean biogeochemistry community. In the long term, such efforts will provide a significant cost savings by reducing data management overhead as well reducing the data management burden on individual scientists.

IOCCP SSG

2016 Ocean Sciences Meeting

During the Ocean Science Meeting in New Orleans in February, IOCCP co-organized two Town Hall meetings with the aim of informing the community of recent developments and to get community input. One of the Town Hall meetings were on the Global Ocean Ship-based Hydrographic Investigations program (GO-SHIP) where Bernadette Sloyan (GO-SHIP co-chair) informed about recent developments, including the possibility to participate in the GO-SHIP program on shorter lines that are repeated at high frequency but without full depth or full suite of level-1 variables; such cruises are now welcome to join the GO-SHIP community as either associate GO-SHIP lines, or High Frequency GO-SHIP, details of which can be

found on the GO-SHIP website, http://www.go-ship.org/Documents.html.

During another Town Hall meeting, the GOOS Panels; i.e. the Physics Panel (OOPC), the Biogeochemistry Panel (led by IOCCP) and the Biology and Ecosystems Panel, presented their efforts aiming at defining and describing on a set of Essential Ocean Variables (EOVs). Particularly the new Bio/Eco Panel reported on a lot of new developments in that field with an initial first take on some key EOVs for that panel. The Town Hall was reasonable well attended and valuable input from the community was received by the panels. This input will be utilized during the ongoing refinement of the EOV description process captured in EOV Specification Sheets. The ever-increasing complexity of ocean observing triggered by our ever-increasing understanding of the interconnections between the physical, biogeochemical and biological phenomena is reflected in the complexity of EOV definition. This is a very active field of research for the GOOS Panels, and in particular for IOCCP which is playing a leading role for biogeochemistry.

The latest versions of the biogeochemical EOVs can be found at the IOCCP website; http://www.ioccp.org/index.php/foo. Note that these are still being modified, mainly for consistency between EOV specifications across EOVs and panels. We are, as always, interested in getting feedback on the work EOVs; if you have any comments please contact the IOCCP.

Toste Tanhua

Measurement of pCO_2 on the Ship-Of-Opportunity Programme (SOOP-CO_2) operations meeting

The establishment of a coordinated global surface CO_2 observing system including ships of opportunity (SOOP) is challenging as the operation of the sophisticated instruments and data reduction is personnel intensive, and requires high levels of skill. Rather than having a single entity maintaining the systems, the ad hoc network is comprised of many investigators. To facilitate information exchange and facilitate best practices the NOAA sponsored SOOP-CO2 consortium held an operations meeting in Miami, FL, USA in January 2016. The exchange was deemed very worthwhile with a consensus that these meeting should be held biennial and be inclusive to all operators of underway pCO_2 systems. The IOCCP agreed to support this workshop in the future to allow for global participation.

The SOOP-CO_2 operations meeting was focused on training in system hardware and software, and data reduction procedures of the underway pCO_2 systems. The venue also served for information exchange between the different groups that ended up taking center stage with fruitful discussion of intricacies of operations, issues encountered and "tricks of the trade". All participants used the community designed systems that are assembled by General Oceanics, Inc. (GO), and are commonly designated as the "gold standard" of underway pCO_2 systems. Its overall design, its infrared analyzer, temperature and pressure sensors along with four reference gases are such that instrumental accuracies of better than 1 µatm for water pCO_2 and 0.2 ppm in air phase XCO_2 can be obtained.

The first part of the meeting focused on hardware and included an active engagement with four representatives of GO. Continual improvements in components, user demands and changes due to changing OEM part supplies means that there are appreciable differences between different units. Major changes in hardware have been adding Fluke temperature sensors, additional/better pressure sensors, and upgrades to the GO board controlling chiller and pumps. R. Cook (owner, GO) mentioned that interface issues with third party instruments and peripheral equipment are the primary inquiry that they get from customers.

Product support by GO is found lacking by several investigators. Moreover, replacement parts are deemed expensive or not compatible with the system operated due to changes in OEM parts such as pumps, flow meters and valves. Gas flowmeters, in particular, appear susceptible to moisture and failure prone (e.g. the flowmeter on the secondary equilibrator indicating amount of air drawn into the system). Several of the GO units are at the end of their

lifespan (estimated at 5-years of continuous use) and users are inquiring with GO regarding refurbishing systems. GO is set up to do so but at a relatively high price. Spare parts provided by GO seemed expensive. Many can be obtained from other sources at lower cost but some, such as the air circulation pumps are custom designed. Also, due to heavy use at sea and high accuracy requirements costly quality parts are used.

Once installed and operating, units function well at sea but there have been several parts that have been problematic. The following issues were mentioned by participants: The EVSCO water distribution valve is prone to leak due to the large orifices needed for the high flow through system. The flow meter on the secondary equilibrator vent is prone to failure, likely due to moisture. The chiller can fail possibly due to moisture entering the Peltier unit, an issue that has been fixed in newer units. It was recommended to improve ease of replacement through better access and wiring connectors.

Discussions on software included both the software to control the pCO_2 instruments and the ones used to perform data reduction and quality control. The Instrument control and data acquisition software is written in National Instrument's LabVIEW®. There are many different instrument control software versions, which for the past several years are carefully documented including version number, with the latest being V10.4. No significant issues have been encountered other than the fact that the software is sometimes customized for each unit because of different user demands. The software operates as a stand-alone application (executable), but this precludes the ability to modify the software in the LabVIEW environment in case other data streams or sensors need to be included. The newer software versions have the ability to output all data in real time which was viewed as desirable by survey technicians on ships to monitor the GO system from their work stations. No software has been written to display data through a graphical interface, though.

A comprehensive data reduction and quality control QC software has been developed by D. Pierrot (AOML) that is optimized for reducing data from the GO system. There is also a utility produced in Excel which reproduces the LI-COR internal calculations from the raw data. This utility can be used to correct for negative water vapor values which occur if the reference channel of the infrared analyzer contains water vapor (e.g. if external or internal desiccant in LI-COR has saturated). Several group members are starting to use the data reduction software that uses visualization and graphical user interfaces for quality control. While the software can ingest and merge the daily files produced the GO system that include additional data streams (e.g. shipboard TSG), many groups still do the initial checks and merging in Excel, and import the resulting .csv file into the data reduction and QC software. An example of the visual interface of the software is shown in Figure 1. Improved documentation will facilitate broader use of this excellent utility. One useful feature is the ability to overlay plots of SST versus time and equilibrator Temperature versus time and align them to determine and correct for offsets caused by the transit times from the seawater intake to the equilibrator.

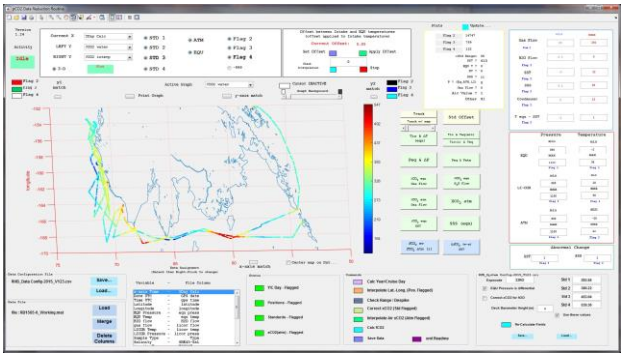

Figure 1. Screen grab of the display of the data reduction program

A series of action items were suggested that will be addressed in the coming year and shared with the community at large to improve interoperability and consistency in operations, servicing and quality control.

1. Conformity of analyses
   - Decide whether to use time and location at the point the water enters the ship or time of equilibration when reporting data
   - Formalize standard ranges of reference standards that will be used
   - Use same analysis sequence
   - Document routine maintenance and replacement schedules
   - Set protocol for air sampling and air QC

2. Improve documentation of procedures
   - Document procedures for checking and QCing SST and SSS
   - Produce a video of startup procedures
   - Produce video on use of data reduction software
   - Complete installation manual

3. Increase communication and recommendations with the manufacturer of systems
   - Advise GO on hardware modification (e.g. ability to adapt cable and tubing runs into dry box by installing mounting plates)
   - Go over GO FAQ list, and suggest additions and corrections
   - Improve understanding of issues and expectations that operators have

4. Establish routine, fixed interval servicing and replacement of components:
   - Replacing internal and external desiccant (magnesium perchlorate) and CO_2 scrubber Malcosorb® [sodium/calcium hydroxide] in the IR analyzers
   - Replacing Nafion® drying tubes
   - Replacing Acrodisc® filters
   - Replacing or cleaning and drying Airline
   - Cleaning underway water line.

5. Work with IOCCP to hold a follow-up meeting including the global community.

The workshop was the first formal interaction of the system operators and was deemed highly effective in exchanging knowledge and forging a common path ahead. It was recommended to have the meetings (at least) biennial and inviting all groups involved in SOOP-CO_2 measurements, possibly seeking travel funds from the NOAA program office and IOCCP. Other means of exchanges on operating issues and lessons learned were encouraged such as establishing a message board/blog post to share common issues in operation.

Rik Wanninkhof

Report of the 7th Session of the JCOMM Observations Coordination Group (OCG)

As IOCCP becomes increasingly involved in biogeochemical observing systems, it is strengthening ties with the Joint IOC-WMO Technical Commission for Oceanography and Marine Meteorology (JCOMM). JCOMM coordinates worldwide marine meteorological and oceanographic services and their supporting observational, data management, services and capacity building programs. As such it directly supports implementation of the global ocean observing system - GOOS.

JCOMM is organized in three program areas (PAs) with expert teams that coordinate and recommend standards and procedures for meteo-oceanographic integrated observing, data management, along with services and forecasting systems. JCOMM's observations PA and serves as the JCOMM and GOOS Observations Coordination Group (OCG).

The 7th session of the JCOMM OCG provided an opportunity for representatives of the different networks (Argo, Ocean SITES, GLOSS, Gliders, GO-SHIP, SOT) to interact, provide updates and discuss issues with the programs. An overriding focus of the meeting was the continued interaction and integration of JCOMM with the GOOS Framework for Ocean Observing and updates on Essential Ocean Variables and observing networks Specification Sheets along with a performance tracking system using key performance indicators (KPI). Of particular note were the favorable developments in the glider and OceanSITES networks towards improved coordination, infrastructure, and metadata reporting.

The venue in Majorca hosted by the Mediterranean Institute for Advanced Studies, IMEDEA was a good backdrop for the discussions of the GRAs (GOOS Regional Alliances) that have a coastal focus. Investigators from IMEDEA provided presentations on their effort around the Balearic islands including outreach activities geared to the local island populations. They contribute to the Balearic Islands Coastal Observing and Forecasting System (SBIC) which is an integrated, distributed, cross-

platform system which supplies a flow of ocean data, numerical simulation services and new technology to support operational oceanography within the European and international framework, contributing to the marine and coastal research needs in the context of global change. Its web presence is through "the Mediterranean in one click" medclic (www.medclic.es/en/). The presentations highlighted the unique utility of gliders and HF radar observation in the coastal zones.

Of particular interest to the ocean carbon and biogeochemistry community were the discussions on the new proposal that was put forward by IOCCP to include surface CO_2 observations from ships as part of the JCOMM Ship Observations Team (SOT) to facilitate tracking, closer global collaborations, and network design. The work of the SOT involves voluntary observing ships that perform meteorological observations and ships of opportunity focused on surface observations. In subsequent discussions some of the challenges currently encountered in SOT were brought up and the overall recommendation was to look at the overall structure of the SOT and for the SOT group to make recommendations on improvements to the OCG at its next scheduled teleconference. As part of the recommendations Martin Kramp of the JCOMMOPS office will be distributing a questionnaire to the SOT community on current protocols and needs.

A proposal was also put forth by the Regional Marine Instrument Center RMIC at the South China Sea Environmental Monitoring Center (SCSEMC) to create an inorganic nutrient standard and perform an inter-comparison exercise following their inter-comparison of salinity measurements (http://www.jcomm.info/index.php?option=com_content&view=article&id=326). A discussion ensued regarding the lack of information exchange and discussion between the RMIC and similar inter-comparison studies supported by the IOCCP and other national entities. A recommendation was made for the RMIC and IOCCP to discuss possible collaborations and avoid redundancy for these critical but costly efforts.

As IOCCP biogeochemical interests intersect many of the program areas of JCOMMOPS continued coordination and exchange with JCOMM through the OCG is imperative and the OCG facilitates and encourages these interactions.

Rik Wanninkhof

GCOS Implementation Plan and GCOS Science Conference

The writing of the new Implementation Plan for the Global Climate Observing System (GCOS IP-16) is coming to its final round. While the writing team had its second in-person meeting at the end of May 2016 in Italy, the team is now checking for completeness and consistency of the Plan before it is send out for public review at the end of July; the review will be open from July 25 to September 5. This will be an excellent opportunity for you to review the Plan and contribute in a form of input, edits and suggestions. In the past the actions articulated in the 2004 Implementation Plan have generated significant funding for the global observing system, although primarily so for the satellite-based observations with a smaller trickle to the in-situ observing system. The new, 2016 Plan, if well-articulated and based on realistic needs, will hopefully generate an increased flow of resources to the in-situ observing system. The Plan has a dedicated ocean chapter, where the Essential Climate Variables (ECVs) as well as observing systems are presented and actions for those elements are proposed.

For the Ocean Biogeochemistry part, there are some changes to the ECVs that have been suggested by the writing team. The changes are not revolutionary, but reflect the complexity of ocean biogeochemistry and ever-changing needs. In short, the ocean inorganic carbon (system) is now encompassed in one ECV (Inorganic carbon) as opposed to 4 ECVs in the previous IP (surface ocean acidity, surface ocean pCO_2, interior ocean acidity, and interior ocean pCO_2). There is also the new ECV of nitrous oxide (N_2O), a potent greenhouse gas with significant oceanic sources that could possibly change due to changes in ocean ventilation and circulation.

Leading up to the second writing team meeting, an open science conference was held in Amsterdam in early March, where input from the climate observation community fed into the writing process. The agenda, with downloadable presentations, is available from a dedicated website: http://www.gcos-science.org/pg/programmedetails.aspx. The IOCCP efforts were presented by Toste Tanhua that gave a presentation on "A New Look at the Ocean Biogeochemistry ECVs". In addition, all the talks were streamed live and these talks are available for download or viewing here: http://www.gcos-science.org/livestream/Videostreams.aspx. There were also a number of talks focused on various aspects of climate observations in the ocean and on many aspects of climate observing in general.

IOCCP has been active in the process of writing the new Implementation Plan, supporting the Ocean Observations Panel for Climate (OOPC). In the new IP, more than half of the ECVs in the ocean domain are biogeochemistry or biology, reflecting the complexity of the climate system in the ocean.

If you have a chance, make sure to glance through the ocean chapter of the IP-16, and make an effort to check your particular pet variable or system (without losing sight of the larger picture). The writing team will be very grateful for any contribution.

Toste Tanhua

New carbon-relevant dataset products published

Since the beginning of the year we've been informing you about a number of new carbon-relevant dataset products as they came along. Here we provide a summary of what new products are now published and available to the ocean carbon and biogeochemistry community and beyond.

First, we witnessed the release of an **Internally Consistent Dataset of δ13C-DIC (Dissolved Inorganic Carbon) Data in the North Atlantic Ocean**. NAC13v1, as this dataset is referred to in short, is now available for download from the Carbon Dioxide Information Analysis Center (CDIAC) here, prepared by Alex Kozyr. The dataset is currently also under review for publishing in Earth System Science Data (ESSD) by Becker et al.

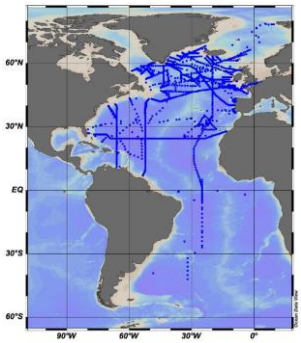

Figure 2: NAC13v1 sample coverage.

The dataset has undergone strict quality control. It includes all in all 6068 samples, originating from oceanographic research cruises that took place between 1981 and 2012. During a primary quality control step based on simple range tests obviously bad data has been flagged. In a second quality control step biases between nearby locations of all cruises were quantified through an elaborate crossover analysis; absolute values of biased cruises were adjusted in the data product. The dataset consists of 29 cruises of which 22 could be compared quantitatively for systematic biases through an adequate crossover study. Adjustments were applied to 10 of the 22 cruises. Based on this analysis the internal consistency of this dataset is estimated to be 0.017‰. Details of the dataset and quality control can be found in the publication under review for ESSD.

In the CDIAC repository the NAC13v1.csv file contains the 13C data, a simple quality flag ('δ13Cf', 2: good, 9: bad/not measured) and a 2nd QC-flag ('δ13Cqc', 1: quality controlled, 0: not quality controlled). The NAC13v1_expocode.csv file contains the allocation of the cruise numbers used in NAC13v1 and their expocodes as well as the respective cruise numbers in the Global Ocean Data Analysis Project version 2 (GLODAPv2). For this analysis some cruises that belong together were condensed to one, e.g. the TTO-NA cruises.

Second, **the Lamont-Doherty Earth Observatory (LDEO) Takahashi Surface pCO_2 database V2015** is now also available at CDIAC: Approximately 10.5 million measurements of surface water pCO_2 made over the global oceans during 1957-2015 have been

processed to make a uniform data file in this Version 2015. Measurements made in open oceans as well as in coastal waters are included. The data assembled include only those measured using equilibrator-CO_2 analyzer systems, and have been quality-controlled based upon the stability of the system performance, the reliability of calibrations for CO_2 analysis and the internal consistency of data. The documentations for the previous versions (V1.0, V2007, V2008, V2009, V2010, 2011, V2012, V2013, and V2014) of our database are available at CDIAC http://cdiac.ornl.gov/ftp/oceans/LDEO_Database/

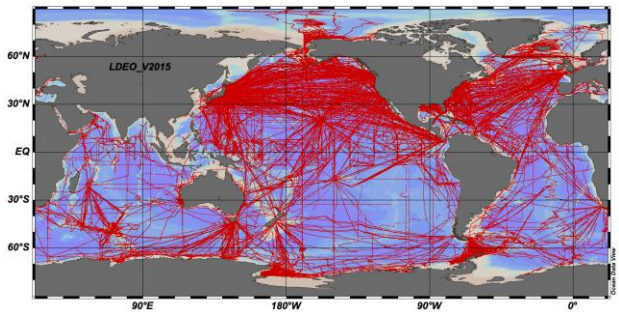

Figure 3: The LDEO (Takahashi) Surface pCO_2 database V2015 sample coverage.

Last but not least, there is **a new global synthesis product of seafloor surficial carbonate**, which follows early work by Archer (1996). To interface with climate and circulation models, ocean substrates data have been gridded from dbSEABED (Information Integration System for Marine Substrates) at the global scale, at a 1/10° resolution. The new mapping suggests lower carbonate contents overall than mapped in earlier works. This may affect modelled budgets for earth-system carbon dioxide and outcomes for ocean acidification.

Compared to Archer's atlas of the distribution of calcium carbonate in sediments of the deep sea published in 1996, there is a number of changes in this carbon synthesis product:

- The amount of data available is much greater, now millions of samples and sites.
- The core-top criterion is relaxed (based on arguments involving bioturbation, erosion, management of core over-penetrations in underlying database). More sampling types are included: grabs and dredges, scuba and submersible dives.
- Exposed rock areas (such as the spreading ridges) and Fe-Mn nodule grounds are accounted for.
- Shallow-water areas, which also play a role in ocean carbonate chemistry (Andersson & Mackenzie, 2012) are mapped. Prime amongst the shallow water areas is the "Coral Triangle" area of South East Asia, Indonesia.

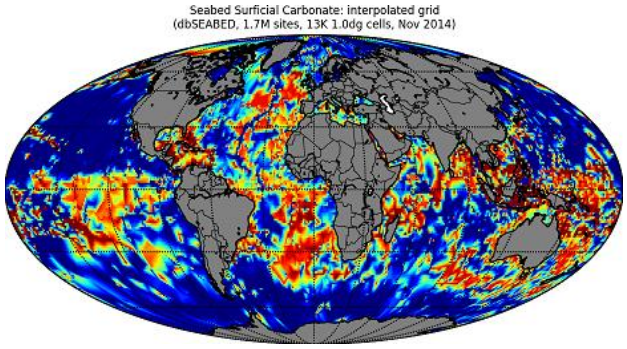

Figure 4: The graphic is a sample showing the global-scale carbonate contents, interpolated using Radial Basis Function methods. Deep blue to dark red, 0 to 100%.

The dbSEABED data are rapidly being extended and new griddings are generated on request. Some geographic data on the regional distributions of skeletal carbonate types and mineralogy are also available from the project. For more information and to view the product, please visit this site.

Furthermore, leads of this mapping project are seeking collaborations with chemical oceanographers. If interested or with any questions, please contact Chris Jenkins (Univ. Colorado, Boulder) at: chris.jenkins@colorado.edu.

References:

Andersson, A.J., Mackenzie, F.T., 2012. "Revisiting four scientific debates in ocean acidification research", Biogeosciences. 9, 893-905, doi:10.5194/bg-9-893-2012.

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Takahashi, T., S.C. Sutherland and A. Kozyr, 2016. "Global Ocean Surface Water Partial Pressure of CO2 Database: Measurements Performed During 1957-2015 (Version 2015)." ORNL/CDIAC-161, NDP-088(V2015). Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, doi: 10.3334/CDIAC/OTG.NDP088(V2015).

Artur Palacz

Upcoming Events

- AtlantOS General Assembly, 28–30 June 2016, Kiel, Germany, https://www.atlantos-h2020.eu/events/2nd-annual-atlantos-meeting/, (registration closed)
- Ocean Carbon and Biogeochemistry Summer School, 25-28 July 2016, Woods Hole, MA, USA, http://web.whoi.edu/ocb-workshop/, registration closed but webcast available from: http://www.whoi.edu/home/whoiBroadcast/livewhoi.html
- OA-ICC Training Course on Ocean Acidification, 5-10 September 2016, Ensenada, Mexico, http://www.ioccp.org/images/Gnews/OA-ICC_OA_course_Mexico_2016.pdf, deadline for nominations: 30 June 2016.
- Colour and Light in the Ocean from Earth Observation (CLEO) Workshop, 6-8 September 2016, Frascati, Italy, http://congrexprojects.com/2016-events/Cleo/home, abstract submission by 21 June 2016.
- 2nd International Workshop on Air-Sea Gas Fluxes: Progress and Future Prospects, 6-9 September 2016, Brest, France, http://www.oceanflux-ghg.org/Workshop, (abstract submission closed)
- Ocean ventilation and deoxygenation in a warming world - discussion meeting, 12-13 September 2016, The Royal Society, London, UK, https://royalsociety.org/events/2016/09/ocean-ventilation/, registration open until max. capacity reached.
- 7th EGO conference on autonomous ocean gliders & their applications, 26-30 September 2016, Southampton, UK, http://conference.noc.ac.uk/ego-conference; abstract submission by 27 June 2016.
- Integrated Carbon Observation System (ICOS) Science Conference, 27-29 September 2016, Helsinki, Finland, https://www.icos-ri.eu/icos-science-conference-2016#, (abstract submission closed)
- CLIVAR Open Science Conference, 8–25 September 2016, Qingdao, China; http://www.clivar2016.org/; (abstract submission closed).
- IMDIS 2016: International Conference on Marine Data and Information Systems, 11-13 October 2016, Gdansk, Poland, http://imdis2016.seadatanet.org/, (abstract submission closed).
- Pan Ocean Remote Sensing Conference (PORSEC), 3-11 November 2016, Fortaleza, Brazil, http://porsec2016.virtual.ufc.br/, abstract submission by 26 June 2016.
- North Pacific Marine Science Organization (PICES) 25th Annual Meeting, November 2-13, 2016, San Diego, CA, USA, http://meetings.pices.int/meetings/annual/2016/pices/scope, (abstract submission closed).

The IOCCP Conveyor is edited by Maciej Telszewski (m.telszewski@ioccp.org) and Artur Palacz (a.palacz@ioccp.org)