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. 37, April 2017

A Word from the Editors

Dear Ocean Carbon & Biogeochemistry Community,

With only three months passed since the beginning of 2017, we at IOCCP already have a lot to report on. In this issue of the Conveyor you will find out how (and why) IOCCP decided to enter 2017 with important internal changes, which will last much longer than our typical New Year resolutions!

Adoption of a new co-chairmanship system (we introduce our second co-Chair: Masao Ishii in this issue), as well as a significant update of IOCCP Terms of Reference, are both results of an expanded scope of our activities aimed at including coordination of activities related to GOOS Essential Ocean Variables for Biogeochemistry. We are excited to inform you about these changes as we believe they will help us to provide you with more adequate and efficient coordination and communication services.

Moreover, we will update you on globally relevant outcomes of the major activities we were involved with recently. At the end of November, we held a workshop on setting biogeochemical observing targets in the Atlantic - a successful prototype for conducting such an exercise on a global scale. In December, we helped members of the Latin America ocean acidification research community gather precious hands-on experience during the technical workshop on carbonate system measurements in Ensenada, Mexico – an event we hope will be mimicked across the globe in the future. In February, IOCCP co-

organized and took active part in a series of workshops and meetings. Most importantly, IOCCP SSG held its two-day annual meeting devoted to reviewing the 2016 work and planning the activities for the months to come.

Finally, we want to address in detail two important issues that the biogeochemistry observing community is facing today: (i) sustainability of carbonate system data submission and archival in the CDIAC transition period, and (ii) usage of Certified Reference Materials (CRMs) for nutrients.

We hope that you will find this issue of the Conveyor useful.

Maciej Telszewski & Artur Palacz

XII Session of the IOCCP Scientific Steering Group

The XII Session of the IOCCP Scientific Steering Group was held on 6-7 February 2017, at the Roz and Cal Kovens Conference Center, Florida International University Biscayne Bay Campus, Florida, USA. Ten SSG members were joined by two PO staff and four guests (representing IOC-UNESCO, GOOS and individual observing networks).

Beyond discussions related to the many exciting activities related to individual IOCCP themes, the group focused on a few overarching developments that shape the global perspective on current and future requirements for ocean observing, and which provide context for ongoing and future IOCCP activities. One such event was the verification of the 2016 GCOS Implementation Plan in Marrakech during the COP-22 in November 2016. IOCCP was heavily involved in writing the ocean chapters in the 2016 GCOS IP and Toste Tanhua presented relevant elements of the Plan at COP-22. The connection between climate and ocean observing systems is clearly on the intergovernmental agenda and with the COP decisions being implemented on the political and governance levels, the IOCCP's contributions are going to be soon realized through a top-down (requirements-funding-implementation) structures on top of, traditional for IOCCP, bottom-up (scientific questions – observing capacities – information products) efforts. Another overarching issue discussed in Miami is the UN Agenda 2030 and particularly its ocean related Sustainable Development Goal 14 (SDG14): *Conserve and Sustainably use the Oceans, Seas and Marine Resources for Sustainable Development* (https://sustainabledevelopment.un.org/sdg14). As the development of targets and indicators for SDG14 is an ongoing process, the IOCCP community should provide organized and/or individual input to further these concepts allowing to progress the underlying science and monitoring efforts. The soonest opportunity to do so comes in a form of 'Ocean Conference: Our Oceans, Our Future: Partnering for the Implementation of SDG14', to be held on 5-9 June 2017, in New York, USA. Finally, the Panel noted the important implications of the recent developments with regards to the G7 Science and Technology Ministers setting ocean observation as a priority for the future of the oceans. This process started with the meeting in Tsukuba in 2016, followed by the Tsukuba Communiqué. Recommendations from the G7 ocean working group for the ocean observing system are being actively influenced by leaders of the major observing networks with hope that they will become implementable action items for the seven economies and beyond.

With these high level political agendas and many exciting technological developments furthering our capacity to observe the intertwined complexity of the ocean systems, the IOCCP plans to take full advantage of all the opportunities for promoting ocean biogeochemistry observations as providing critical underlying information necessary for assessing the past, current and potential future variability and potential impact of this variability on current and future human and nature wellbeing.

Full report from the XII session together with detailed action items will be available soon from our website.

Maciej Telszewski

New IOCCP Terms of Reference!

The IOCCP was established as a standing project of SCOR and IOC-UNESCO in 2005 when the coordination capabilities of a small advisory panel shared between the two organizations no longer met the needs of the community. The complexity of the marine carbon cycle and its numerous connections to carbon's atmospheric and terrestrial pathways meant that a wide range of types of observations had to be made in order to establish its qualitative and quantitative role in the global climate system. The initial Terms of Reference for IOCCP provided guidance for the SSG on how to coordinate this myriad of activities focused on carbon observations and related data management.

Over the past decade the IOCCP was recognized as a successful model, however our ever-increasing understanding of the inter-correlation of marine carbon cycle with carbon-related biogeochemical parameters demands a coordinated, comprehensive biogeochemistry observing system that serves the current needs for information related to issues like ocean acidification, ocean deoxygenation, eutrophication and more. Our coordination activities have naturally expanded to incorporate these issues and we decided that it's time for us to re-define the project's ToRs to reflect the current coordination needs of the marine carbon and biogeochemistry community as defined by their requests for action from IOCCP. The updated ToRs were approved by our sponsors and are available for read and download from our website at:
http://www.ioccp.org/index.php/about-us/tors

Maciej Telszewski

Co-chairmanship system introduced by IOCCP SSG

Masao Ishii and Toste Tanhua (IOCCP Co-Chairs) during annual IOCCP dinner, Baires Grill, Miami, FL, USA.

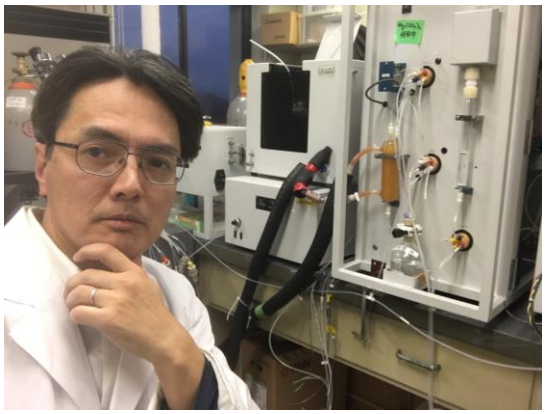
Following the discussions held over the past year, and to meet the demands of the expanding scope of IOCCP's activities, the IOCCP SSG has also decided to introduce a co-chairmanship system starting in January 2017. In this issue we want to introduce Dr. Masao Ishii who has kindly agreed to join Toste Tanhua in taking responsibility as a co-Chair. Up till now, Masao served as the SSG member responsible for Interior Ocean Observations, and he will also remain in that role over the coming year. Please read on below to find out more about Masao from our "SSG Profile" column.

Artur Palacz

New co-Chair of IOCCP SSG: Masao Ishii

Dr. Masao Ishii has served as the IOCCP SSG member since 2011. Starting this year he will lead us through challenges and opportunities laid out ahead of IOCCP as a co-Chair.

Masao is a senior scientist in the Meteorological Research Institute (MRI) of Japan Meteorological Agency (JMA) where his managerial role is as a Head of the 3rd Laboratory of Department of Oceanography and Geochemistry, which has a long history of ocean carbon cycle studies.



Masao Ishii in his lab.

Growing up in 1960s and 1970s in Japan, he used to be a boy who loved to commune with nature, and increasing environmental problems related to the country's rapid economic growth were wringing his heart. A chemist by training, studying kinetics and dynamics of chemical reactions on metal ions in solution, Masao started his career as a sea-going oceanographer in late 1980s when international projects JGOFS and WOCE were launched. Masao has moved into developing and using automated instruments for seawater CO_2 system measurements and studying ocean carbon cycle and biogeochemistry based on shipboard observations. As one of the most senior scientists at MRI-JMA, Masao with his research group runs an oceanographic and marine meteorological observation network, collects data on national to global scales, and develops data information products for the benefit of management, decision and policy makers. His main regions of interest are the western North Pacific and the western equatorial Pacific, with occasional detour to the Southern Ocean and the Arctic.

Over the years, Masao's work at the Oceanography and Geochemistry Research Department lead to development of several methods for measurements and data analysis, as well as construction of numerical models to clarify and support the prediction of oceanic phenomena. Over the past couple of decades many of these developments found its way to the main stream of the global community. Masao played a pivotal role leading the Japanese community and at the same time connecting local developments with efforts worldwide.

Masao has served as IOCCP SSG member for the past 6 years (2011-2016) in which role he heavily influenced the processes related to projects such as SOCAT (Pacific Group), GLODAP, GO-SHIP (Executive Group), RECCAP (chapter leader) and other. He has been an active member of the PICES Section on Carbon and Climate since 2008, and IMBER SSC member since 2015. Masao also has great scientific and programmatic understanding of issues related to deoxygenation, nutrients cycling, ocean acidification and marine pollution.

The IOCCP SSG chose Masao as it's scientific co-Chair unanimously. His past active contributions to strategies and implementation efforts were always very generous and his coordination skills as an informal connection between the Japanese marine biogeochemistry community and its global counterpart has proved fruitful and efficient.

We welcome Masao in his new role at IOCCP and look forward to the close and fruitful cooperation between Masao and Toste throughout 2017. We are thrilled to have IOCCP under the leadership of these two excellent scientists!

Maciej Telszewski and Artur Palacz

Update on CDIAC-Oceans

Last fall it was confirmed that the Carbon Dioxide Information Analysis Center (CDIAC), the primary climate-change data and information analysis center of the U.S. Department of Energy (DOE) will cease operations on September 30, 2017. We feel obliged to inform the community about the consequences of this development and steps that are being taken to minimize potential damage.

First of all: No data or information will be lost! Data, numerical data packages (NDPs), data synthesis product pages, utilities and DOI landing pages will continue to be accessible until CDIAC will cease operations. CDIAC-Oceans' data and services are currently transferred to NOAA's National Centers for Environmental Information (NCEI) where they will be long-term archived and made available through the newly funded Ocean Carbon Data System (OCADS).

OCADS is responsible for hosting and providing access to ocean carbon data as previously done by the Ocean component of the Carbon Dioxide Information Analysis Center (CDIAC-Oceans) and Alex Kozyr, former CDIAC responsible for CDIAC-Oceans, started working at NCEI as a NOAA affiliate staff member and is supporting the global ocean carbon data management as before.

The main aim is to have the transition as smooth as possible for users, but some changes are inevitable. NCEI will adopt a framework that not only is capable of managing rich metadata information for ocean carbon data but also can be integrated with the broader data management system at NCEI.

The changes will affect data submission and data access. For data submission, a new user-friendly metadata entry interface allowing data providers to input their metadata and upload their data files is being developed by colleagues at NOAA-PMEL and it will be in place by late 2017. Data discovery and access will be given through NCEI's Geoportal which means that formerly used CDIAC's Mercury data/metadata search engine and access portal will be replaced. (N.B. PIs can also submit underway data to SOCAT where archival at NCEI will be guaranteed).

Our community hopes that currently anticipated budgetary cuts to the science programs in the US will not have a negative effect on the newly funded OCADS and we would like to thank NOAA's Climate Program, Ocean Acidification Program and NCEI for their support and for ensuring long-term availability of CDIAC-Oceans inventory!

For further information on the transition please visit:
https://www.nodc.noaa.gov/oceanacidification/ocads/transition.html
or OCADS at:
https://www.nodc.noaa.gov/ocads/

Benjamin Pfeil & The IOCCP Office

Setting biogeochemical observing targets

With ongoing advances in observing technology, and a set of Biogeochemical Essential Ocean Variables (EOVs) already in place, priorities for designing an optimum observing system for marine biogeochemistry are now shifting towards a system-wide definition of a set of accepted observing targets for biogeochemical phenomena and EOVs developed in a process driven by relevant scientific and societal requirements.

In the context of the EU AtlantOS Project, IOCCP started its work towards defining quantifiable targets for the biogeochemical element of the observing system. As with the development of EOVs we hope for a wide community input over time. The first step of this effort was to focus on the Atlantic Ocean before expanding the process to other basins.

The goal of the workshop on "Setting Observing Targets for Biogeochemical Observing System in the Atlantic" was to respond to the challenge of setting observing targets while simultaneously taking into account the myriad of spatio-temporal scales of the distinct biogeochemical phenomena of interest and the complex array of corresponding observing elements.

Participants of the AtlantOS WP1 workshop on Setting Observing Targets for Biogeochemical Observing System in the Atlantic, held in Sopot, Poland.

The workshop, held on 29 November – 1 December 2016 at the Institute of Oceanology of the Polish Academy of Sciences (IO PAN) in Sopot, Poland,

brought together 15 experts (and two remote participants) in biogeochemical observations and modelling from several countries around the Atlantic: Brazil, United States, Norway, Ireland, United Kingdom, Belgium, France, Germany and Poland. During three days of hard work the workshop participants managed to fulfil the following goals:

- Define what an observing target is in the context of the biogeochemistry observing system
- Decide on phenomena for which to set observing targets (based on the list of phenomena developed earlier in the project)
- Set observing targets for biogeochemical phenomena (described by relevant EOVs)

The concept of defining phenomena-based targets is different but complementary to setting a more pragmatic observing network-based target of say, deploying an X number of platforms in a given basin. Phenomena-based targets offer the advantage of setting a target that responds directly to a given scientific question. Also, a combination of several observing networks can relate to such a target allowing to utilize their relevant capacities like specific spatial and temporal resolution, measurements accuracy or parameters observed. One example of such a (proposed) target is to **"establish the baseline number of OMZs (with 3D distribution of oxygen levels within them) in the Atlantic Ocean".** To this end, adequate EOVs (e.g. Oxygen, Nitrous Oxide) need to be measured on spatio-temporal scales matching those on which the phenomenon of hypoxia operates. Meeting this phenomenon-based target will provide a direct answer to a key scientific question of "How large are the ocean's 'dead zones' and how fast are they changing?".

Comparing the targets developed during this workshop with the current observing capabilities will furthermore enable a comprehensive gap analysis aimed at providing recommendations for designing optimized and enhanced Atlantic Ocean observing system. The outcomes of the workshop will not only inform the project deliverables, but will also be further socialized with the community for input and expansion to other basins.

An important lesson from the workshop is the need to simultaneously account for the requirements in collocated physical and biological measurements necessary to observe and model a given biogeochemical phenomenon. Proper consideration of targets related to measuring all relevant EOVs is fundamental to developing an optimal sampling design. Such a multidisciplinary approach would further promote synergies between the observing networks and communities traditionally confined to a single discipline – a prerequisite to a successful implementation of any phenomenon-based target.

The next step in this process is for IOCCP to engage in applying a similar workshop format to set observing targets in the Pacific Ocean domain. We hope for a fruitful collaboration with the North Pacific Marine Science Organization (PICES) community, which has shown interest in collaborating on such an exercise for the benefit of the global ocean observing system.

Artur Palacz & Maciej Telszewski

Technical Workshop on Carbonate System Measurements for members of LAOCA

From December 3 to 11, a little more than a year after its kick-off meeting back in December 2015, Latin-American Ocean Acidification Network (LAOCA) members were invited to take part in an exciting training workshop on gaining hands-on laboratory experience in appropriate high-precision chemical techniques and protocols related to carbonate system measurements. The workshop was held at the Instituto de Investigaciones Oceanológicas, Universidad Autónoma de Baja California, in Tijuana-Ensenada, México.

Organized by IOCCP and the International Atomic Energy Agency (IAEA), with co-sponsorship from the Millennium Institute of Oceanography (IMO) and the Center for the Study of Multiple-Drivers on Marine Socio-Ecological Systems (MUSELS), the workshop proved very successful in terms of meeting the demands of the community and testing a basic model

for holding similar training workshops elsewhere in the world in the future.

Participants of the Technical Workshop on Carbonate System Measurements, Tijuana-Ensenada, Mexico.

With representation from 8 Latin American and Caribbean countries participating in LAOCA, the course was designed to train 14 participants and therefore significantly strengthen the analytical capacity in the region. All of the participants were selected based on their current role in their laboratories indicating their active, full-time involvement with relevant analytical duties in the field and in their laboratories.

Participants were divided into four groups (max. 4 participants in each group) to provide each participant with first-hand experience in handling the equipment and analytical procedures for each respective measurement (i.e. pH, total alkalinity (TA), and dissolved inorganic carbon (DIC)). The following hardware was made available to workshop participants:

- Colorimetric system (20 mL, manual) and infrared system (2 mL, LICOR-7000) for DIC analysis;
- Potentiometric system for measurements of total alkalinity. Additionally, an automatic alkalinity titration system Apollo Sci. Tech. was be shipped from Chile, courtesy of Cristian Vargas' Lab.
- Spectrophotometric system for pH measurements.
- 1 SeapHOx and 1 SeaFET sensor

Apart from hands-on exercises, lectures on the design of the observing system, data management practices and carbonate system calculations were included to allow the participants to understand a wider context of making measurements and collecting data.

Upon completion of the training course, participants gained increased knowledge in the following aspects:

- Observing system design based on their needs in the framework of internationally accepted protocols (e.g. Framework for Ocean Observing, Essential Ocean Variables) and data management procedures based on established data products such as the Surface Ocean CO_2 Atlas (SOCAT) and Global Ocean Data Analysis Project (GLODAP) with explicit focus on the need for ancillary parameters (i.e. temperature, salinity, nutrients, barometric pressure and more)
- Monitoring carbonate chemistry, including detailed methodology for measurements of potentiometric and spectrophotometric pH, TA with an open cell titration method, and DIC, the use of certified reference materials, analytical know-how such as the typical sample volume required, and specific challenges related to each method.
- Advantages and disadvantages of the different platforms for carbonate system measurements, such as moored surface sensors, gliders, underway measurements, and discrete water samples; requirements for handling, maintenance, calibration and validation of specific platforms and instruments.
- The use of carbonate system calculating tools including error propagation.

This workshop paved the way for what, we hope, will be a series of training courses on carbonate system measurements, which would increase the regional capacity to observe changes in marine biogeochemistry in a globally comparable way.

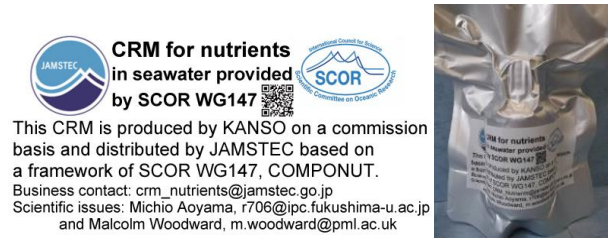
Maciej Telszewski & Artur Palacz

IOCCP encourages the use of Certified Reference Material for nutrients

There is a strong requirement for observation-based quantitative assessments of changes in ocean biogeochemistry, for instance to inform about the rate of ocean acidification, rate of de-oxygenation, or storage of anthropogenic carbon. Neither would have been possible without analytical techniques and procedures that follow from community-agreed best practices, and the use of certified reference materials (CRMs). Knowledge of changes in ocean productivity and remineralization processes is essential to correctly interpret observations of other changes. However, up until recently inconsistency in nutrient measurements between different groups of analysts due to lack of CRMs has largely hampered quantitative assessments of changes in ocean nutrient distribution on large scales.

Recently, the SCOR working group #147 "Towards comparability of global oceanic nutrient data" (COMPONUT), through the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), have begun to provide certified reference materials for nutrients in seawater with a new, favourable cost structure, making them more accessible and affordable for the global science and research community.

The CRM is produced by KANSO Co. Ltd. (Kanso Technos), Japan, on a commission basis, using treated natural seawater, and quality control procedures related to ISO GUIDE 34. KANSO has been accredited under the Accreditation System of National Institute of Technology and Evaluation (ASNITE) as a Certified Reference Materials Producer (CRMP) since 2011 (Accreditation No.: ASNITE 0052 R). The certified values are arithmetic means of the results of randomly selected 30 bottles from each batch (measured in duplicates) analyzed by KANSO Co., Ltd. and JAMSTEC using the colorimetric method (continuous flow analysis, CFA, method). The certified values of SCOR-JAMSTEC CRMs are traceable to the International System of Units (SI) through an unbroken chain of calibrations. For nitrate, nitrite and phosphate values, Japan Calibration Service System (JCSS) of Chemicals Evaluation and Research Institute (CERI) and the National Metrology Institute of Japan (NMIJ) standard solutions with stated uncertainties are used. For silicate values, silicon standard solution produced by Merck KGaA and silicon standard solution (SRM3150) of National Institute of Standards and Technology (NIST), each having stated uncertainties, are used.



Example of a nutrient CRM produced by KANSO

JAMSTEC have opened a web-site http://www.jamstec.go.jp/scor/ and a mailing list, crm_nutrients@jamstec.go.jp, to offer the CRM bottles for sale to the global community. The price for the CRMs through JAMSTEC is significantly reduced with a cost of 6700 JPY per bottle, approximately 60 USD. The SCOR International Working Group #147, and JAMSTEC, requests that users of the lower priced SCOR-JAMSTEC CRMs submit their final nutrient data to an internationally recognized, publicly available data repository. It is important that the associated metadata should also include a description of how the SCOR-JAMSTEC CRMs were used.

IOCCP strongly encourages nutrient analysts to utilize the CRMs, particularly for open ocean work where changes in ocean nutrients are expected to be small but consequential. With the goal of making CRM usage part of standard operating procedures, IOCCP will furthermore recommend that CRMs for nutrients become a requirement for all GO-SHIP cruises.

We urge the community to be pro-active about bearing the costs using the CRMs, by accounting for them already at the project proposal stage. IOCCP believes that the cost and effort of using CRM routinely is a small price to pay for the benefit of having globally homogenous nutrient measurements available for a wide range of applications.

Toste Tanhua, Michio Aoyama, Rik Wanninkhof, Maciej Telszewski & Artur Palacz

Relevant links:

SCOR-JAMSTEC CRMSs:
http://www.jamstec.go.jp/scor/
ASNITE:
http://www.nite.go.jp/en/iajapan/asnite/
JCSS:
http://www.nite.go.jp/en/iajapan/jcss/outline/index.html
CERI:
http://www.cerij.or.jp/ceri_en/sitemap/sitemap_menu.html
NMIJ:
https://www.nmij.jp/english/service/C/,
https://www.nmij.jp/english/service/C/CRM_Catalog_(JE)160901.pdf
Merck KGaA silicon standard solution:
https://www.merckmillipore.com/GB/en/product/Silicon-standard-solution,MDA_CHEM-170236
NIST SRM 3150:
https://www-s.nist.gov/srmors/view_detail.cfm?srm=3150

Upcoming Events

- Global Ocean Acidification Observing Network (GOA-ON) Executive Meeting, 25-27 April 2017, Paris, France; by invitation only.
- Eighth meeting of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) Observations Coordination Group (JCOMM OCG-8), 22-25 May 2017, Qingdao, China, http://www.jcomm.info/index.php?option=com_oe&task=viewEventRecord&eventID=1919; by invitation only.
- 2017 Ocean Carbon & Biogeochemistry Summer Workshop, 26-29 June 2017, Woods Hole, MA, USA, http://web.whoi.edu/ocb-workshop/; poster abstract submission will be available in May.
- 10th International Carbon Dioxide Conference, 21-25 August 2017, Interlaken, Switzerland; http://www.icdc10.unibe.ch/; Abstract submission closed.
- IOCCP workshop on Marine Carbon and Biogeochemistry Data Management and Synthesis (ICDC10 side event), 23 August 2017, Interlaken, Switzerland, http://www.icdc10.unibe.ch/program/side_meetings; half-day registration for ICDC10 required, register by emailing IOCCP at ioccp@ioccp.org, with your name and affiliation.
- 19th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2017), 27 – 31 August 2017, Dübendorf, Switzerland, https://www.empa.ch/web/ggmt2017/; Registration and abstract submission opens in April 2017, abstract submission deadline: 2 June 2017.
- 8th Global Ocean Observing System (GOOS) Regional Forum Meeting (GRF-8), 5-7 September 2017, Singapore, Singapore; http://www.jcomm.info/index.php?option=com_oe&task=viewEventRecord&eventID=1973, by invitation only.
- GODAE OceanView Summer School "New Frontiers in Operational Oceanography", 2-13 October 2017, Mallorca, Spain, https://www.godae-oceanview.org/outreach/education-training/gov-summer-school-2017/; Applications are closed.
- AGU Fall Meeting, 11-15 December 2017, New Orleans, LA, USA, https://fallmeeting.agu.org/2017/; Session proposal deadline: 19 April 2017, abstract submission deadline: 2 August 2017.

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