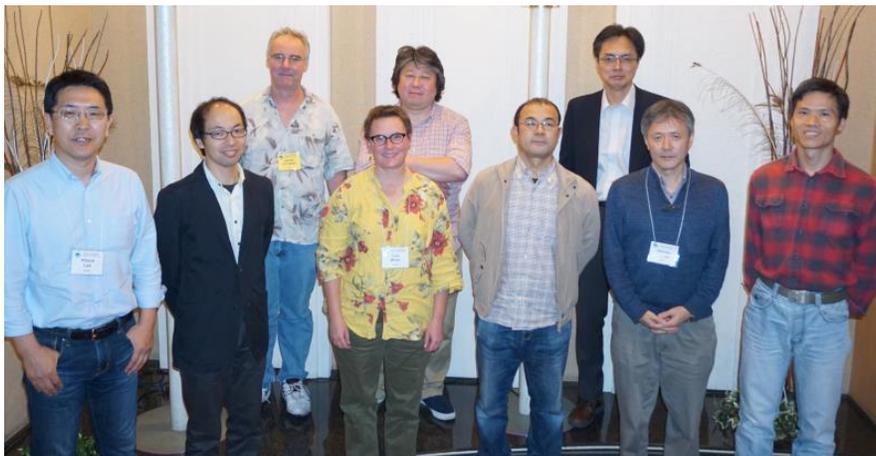


## Report of the Section on *Carbon and Climate*

The meeting of the Section on *Carbon and Climate* (S-CC) was held from 09:00–17:00 on October 27, 2018 at the PICES Annual Meeting in Yokohama, Japan. Drs. James Christian and Tsuneo Ono acted as meeting chairs. Nine members were present, representing Canada, China, Japan, and Korea (*S-CC Endnote 1*). The meeting agenda was adopted unanimously (*S-CC Endnote 2*).



S-CC meeting participants at PICES-2018, Yokohama, Japan. Back row, from left: James Christian, Toru Suzuki, Masao Ishii; front row, from left: Kitack Lee, Shin-ichiro Nakaoka, Lisa Miller, Tsuneo Ono, Akihiko Murata, Zhongyong Gao.

### AGENDA ITEM 2

#### **Acidification/deoxygenation synthesis**

The PICES Special Publication “*Ocean Acidification and Deoxygenation in the North Pacific Ocean*” is now substantially completed. The draft report was shown to the members of the FUTURE Scientific Steering Committee and the Science Board who expressed approval. The list of Lead Authors and Contributing Authors was shown to the membership so that anyone who thinks that they should (or should not) have been included can speak up. The plan is to circulate the current draft to all members and all non-member Lead or Contributing Authors, with a deadline of late November or early December for any revisions. The document will then go out for community review, and be finalized in January or February 2019.

### AGENDA ITEM 3

#### **Sensor intercomparison activity**

Dr. Ono gave a brief report on planned and ongoing activities regarding intercalibration of pH and  $p\text{CO}_2$  sensors. Initial attempts to obtain funding for a sensor intercomparison experiment were unsuccessful. A new proposal will be submitted this year, with the intention that the experiment would be conducted in January or February 2021. The details of the planned experiment were outlined in the 2017 Annual Report, and have changed very little. The proposed schedule has slipped about one year, assuming that the second application for funds is successful. The grant application will request funding for participation of all interested groups in Japan and about five from abroad; other foreign groups are invited to participate if they can pay their own

travel expenses. Dr. Masao Ishii noted the need for high-quality data to define the true state of the carbon system as a reference point. Dr. Lisa Miller asked what sort of perturbations are anticipated; Dr. Ono replied that the experimental facility does not really accommodate strong perturbations: the initial experiment will test the sensors only under stable seawater composition, although diel temperature fluctuations are expected. Dr. Akihiko Murata inquired whether Argo floats could be included. The tank volume is sufficient to accommodate these, although shipping costs may prove prohibitive. Dr. Miller commented that many instruments are not really designed to be used outdoors in winter conditions. There was some discussion of involving manufacturers at the early stages, and concern that they may try to influence the published results.

Six new coastal observation stations are planned to be initiated in the next year around Japan. These will be maintained by the Japan Fisheries Research Agency except one by the local city authority. They will cover the whole length of Japan from Hokkaido to the far south; most will use the Kimoto SPS-14 pH sensor.

AGENDA ITEM 4

**Ocean Networks Canada sensor technology workshop**

Ocean Networks Canada (ONC) hosted a workshop on sensor technology in Victoria in February 2018. Dr. Christian hosted the workshop along with Dr. Akash Sastri from ONC (BIO, WG 37, AP-NPCOOS). S-CC members from Canada (Christian, Miller) and Japan (Nakaoka, Ono) attended along with scientists from Canada, Germany, the UK, and the US. Mr. Tsunoda from the Sasakawa Peace Foundation attended and the Foundation partially funded the travel of the Japanese participants. A publication in *Frontiers in Marine Science* is in preparation and is expected to be published by March 2019. Dr. Ishii requested that IOCCP (see *S-CC Endnote 3* for definitions of abbreviations) be informed of the progress of this publication.

AGENDA ITEM 5

**GOA-ON workshop in Hangzhou in 2019**

Dr. Minhan Dai was unable to attend, but Dr. Fei Chai (Second Institute of Oceanography, Hangzhou, China) made a brief presentation on the GOA-ON workshop that he and Dr. Dai will host in Hangzhou in early 2019. This will be the fourth such workshop. The first, in Seattle in 2012, was attended by S-CC members from all PICES member countries except Russia. Subsequent workshops were held in the UK in 2013 and Australia in 2016. The forthcoming workshop is to be held in Hangzhou, April 14–18, 2019; the details are to be released to the community this week. Drs. Dai and Chai request PICES sponsorship of this workshop and financial support in the amount of \$5000. This request is supported by the membership and Drs. Christian and Ono will take it to the parent committees.

AGENDA ITEM 6

**International Symposium on “Ocean Acidification - Dialogues between Scientists and Stakeholders”**

This symposium, to be held in Tokyo on Sunday, October 28, 2018, is convened by the Sasakawa Peace Foundation. S-CC members Richard Feely (USA) and Ishii (Japan) are keynote speakers. Dr. Ono will moderate a panel discussion and Dr. Christian will be a participant in the panel. Dr. Ono gave a brief introduction to the purpose and objectives of the symposium. The Foundation is one of the largest non-governmental groups funding ocean science in Japan. The goal of the symposium is to promote dialogue between scientists and stakeholders, and to communicate the current state of ocean acidification science to the broader public and stakeholders.

## AGENDA ITEM 7

**New IOC “Carbon Think Tank”**

Drs. Ishii and Miller reported on IOC-led efforts to create a new carbon-focused group, whose exact structure is yet to be determined. Previously, SOLAS and IMBeR had joint working groups on Surface Ocean and Interior Ocean carbon observations. At last year’s International CO<sub>2</sub> Conference in Switzerland, IOCCP, SOLAS and IMBeR joined with WCRP, CLIVAR and GCP to discuss a new ocean carbon group. IOC approved this in principle at their Executive Council meeting in July 2018. IOC working groups normally have a lifetime of 10 years, so this one could comprise one of the flagships of the planned “decade of ocean science”. The proposed formal name (IOC Working Group on Integrated Ocean Carbon Research) is somewhat long and convoluted; for the time being, it is being referred to as the “Carbon Think Tank”. Members have been proposed who will represent a variety of allied organizations including IOCCP, IMBeR and SOLAS; the chairs are not yet decided.

## AGENDA ITEM 8

**Collaborating organizations and agencies**

Dr. Miller gave a brief update on SOLAS. Jessica Gier has been appointed Executive Director, after the departure of Emilie Brévière in 2017. Dr. Gier is based at the SOLAS International Project Office at GEOMAR in Kiel, Germany. The nodal office at the Marine Environmental Laboratory in Xiamen is still active and is staffed by project officer Li Li. A SOLAS Open Science Conference will be held in Sapporo, Japan on April 21–25, 2019. SOLAS is requesting PICES co-sponsorship and funding of \$5000. Drs. Christian and Ono will take this request to the parent committees. The SOLAS position statement on geoengineering research was released in spring 2018. A workshop on this topic will be held in Sapporo preceding the Open Science Conference. A commentary on SOLAS-related remote sensing science has been published in *Elementa* (Neukermans *et al.*, 2018, doi: 10.1525/elementa.331), based on a symposium held in Frascati, Italy in 2016. A second workshop on SOLAS-related remote sensing science was held in Washington, DC, in June 2018. Another workshop is planned to be held in Asia, time and place still undetermined; SOLAS would like to encourage participation from Asian national space agencies. There is an initiative to coordinate time-series stations conducting integrated atmosphere and ocean observations. A major integrated observatory is being established in the Cape Verde Islands and will be run by the GEOMAR – Helmholtz Centre for Ocean Research (Germany). A discussion of such time-series stations will be held in Sapporo. The 7th SOLAS Summer School was held in Corsica in summer 2018; PICES sponsored two students from Canada. SOLAS mailing lists have been ‘reset’ due to new European privacy laws; anyone who was previously on these lists needs to manually re-subscribe.

Dr. Nakaoka gave a brief update on SOCAT. SOCAT v. 6 was released in June 2018. There are around 23.3 million equilibrator data and an additional 4.8 million sensor data. The sensor data are mainly from moored buoys. The North Pacific accounts for 2.9 million data not counting sensor data. Dr. Nakaoka showed a plot of how the North Pacific fraction of the total data has varied over time. Historically it averages about 13% but currently it is less than 10%. Quite a few locations have data in all 12 months of the year, especially near the coast of Japan and the U.S. and Canadian west coast. The distribution of data across years is similar, *i.e.*, the regions where there is complete seasonal coverage are also regions where there is some documentation of interannual variability. Data submission for v. 7 will close December 31, with quality checks to be completed by March 2019. The goal is to achieve a precision of 2 µatm.

Dr. Minhan Dai (China) was unable to attend. Dr. Fei Chai (China) presented an update on GOA-ON in his absence. Dr. Dai has resigned from the Executive Council; Dr. Kitack Lee (Korea) is still a member. The last

face to face meeting of the EC was held in Sopot, Poland. The meeting spent a lot of time on regional hubs. There are regional hubs for North America, South America, Africa, the Western Pacific (the newest one), and the Pacific Islands. The Western Pacific hub has limited participation from PICES countries. Dr. Chai thinks PICES and S-CC can play an important facilitation role, bringing together scientists from different countries. Dr. Lee thinks we need to consider carefully what sort of data each country possesses, and suggested to convene a symposium and/or produce a synthesis paper among the western Pacific PICES member countries. The Western Pacific hub has done four training workshops, focused on coral reefs. The North American hub met in Victoria October 17–18; S-CC members Christian (Canada), Feely (USA), and Miller (Canada) attended.

Dr. Murata gave a brief update on the progress of SCOR Working Group 147 (Towards comparability of global oceanic nutrient data (COMPONUT)), which is in its final year. S-CC members Dai (China), Dickson (USA), Kozyr (USA) and Murata (Japan) are Associate Members. An extension of the WG has been requested, to fund writing workshops in early 2019, so that the group can publish results and conclusions from the 2018 nutrient intercalibration exercise and complete the new GO-SHIP manual. Two new batches of reference material have been bottled since the 2017 PICES Annual Meeting (CH and CI) and are available for purchase; both are Atlantic water. Cumulatively, Pacific samples account for about 80% of those distributed.

Dr. Murata gave a brief update on BGC-Argo. The North Pacific is a somewhat sparse region at present for BGC-Argo floats. JAMSTEC has three floats with nitrate sensors and six with pH sensors to be deployed in the coming year (December 2018– June 2019). BGC-Argo floats cost around \$100K (up to \$200K with the full suite of sensors), compared to around \$20K for conventional floats.

Dr. Ishii gave a brief presentation on IPCC and preparations for the Sixth Assessment Report. There are three Working Groups and a Task Force on Greenhouse Gas Inventories. New chairs have been appointed for Working Group 1; a scoping meeting was held in May 2017 in Addis Ababa, Ethiopia. Chapter 5 will be on “Global carbon and other biogeochemical cycles and feedbacks”. Chapter 9 is “Ocean, cryosphere and sea level change”; this chapter will contain little biogeochemistry. There are many new topics. Ocean acidification is listed as a topic, but deoxygenation is not specifically mentioned. The author list for Chapter 5 has a better than average representation of oceanographers, compared to the 4th and 5th Assessment Reports. S-CC members Feely and Ishii are the Lead Authors. The final draft is to be submitted to the Technical Support Unit on October 18, 2020, with final publication in April 2021. Cutoff dates for papers to be cited in the Assessment Report are December 31, 2019 (submission) and September 30, 2020 (acceptance).

#### AGENDA ITEM 9

##### **Further discussion of acidification synthesis and steps towards completion**

The current text for the PICES Special Publication was reviewed and logistics of getting to completion discussed. Several members noted that text they had provided was not included. These items will be incorporated and a revised draft circulated in early November. A further comment period will then be offered to S-CC members, Lead and Contributing Authors, and FUTURE SSC and Science Board, before a version for community review is finalized in late November or early December.

## AGENDA ITEM 10

**Further discussion of Section business**

Changes in membership were briefly discussed. Dr. Christian has requested Canadian Governing Council delegates to remove Dr. Johannessen and appoint Dr. Helen Gurney-Smith, but these appointments are still in process.

*S-CC Endnote 1***S-CC participation list**Members

James Christian (Canada, Co-Chair)  
 Zhongyong Gao (China)  
 Masao Ishii (Japan)  
 Kitack Lee (Korea)  
 Lisa Ann Miller (Canada)  
 Akihiko Murata (Japan)  
 Shin-ichiro Nakaoka (Japan)  
 Tsuneo Ono (Japan, Co-Chair)  
 Toru Suzuki (Japan)

Observers

Alex Bychkov (PICES)  
 Fei Chai (China)  
 Jinqiu Du (PICES)  
 Hiroaki Saito (Science Board Chair)

Members unable to attend

Canada: Sophia Johannessen  
 China: Liqi Chen, Minhan Dai, Liyang Zhan, Yumei Zhao  
 Korea: Dong-Jin Kang, Jeong Hee Shim  
 Russia: Andrey Andreev, Pavel Ya. Tishchenko  
 USA: Richard A. Feely, Hernan Eduardo Garcia, Burke Hales, Alexander Kozyr

*S-CC Endnote 2***S-CC meeting agenda**

1. Opening (Christian, Ono)
  - Review and adopt agenda
2. Progress on acidification/deoxygenation synthesis (Christian, Ono)
3. Progress on sensor intercomparison (Ono, Nakaoka)
4. Review of ONC sensor technology workshop (Christian)
5. Proposal for PICES sponsorship of GOA-ON workshop in Hangzhou (Dai)
6. Introduce the “International Symposium on Ocean Acidification - Dialogues between Scientists and Stakeholders”, to be held on Sunday October 28 (Ono)
7. New IOC “Carbon Think Tank” group (Miller, Ishii)
8. Information exchange
  - SOLAS (Miller, Dai)
  - OCADS (Kozyr)
  - SOCAT (Nakaoka)
  - IOCCP (Ishii)

- GOA-ON (Dai)
  - SCOR WG 147 (Murata)
  - BGC ARGO (Murata)
  - IPCC AR6 (Ishii)
9. Further discussion of acidification synthesis and steps towards completion (Christian, Ono)
  10. Further discussion of Section business (Membership, Publications, future activities)
  11. Adjourn

*S-CC Endnote 3*

**Full names of collaborating organizations**

CLIVAR – Climate and Ocean: Variability, Predictability and Change

GOA-ON – Global Ocean Acidification Observing Network

GCP – Global Carbon Project

GOOS – Global Ocean Observing System

IMBeR – Integrated Marine Biosphere Research

IOC – Intergovernmental Oceanographic Commission

IOCCP – International Ocean Carbon Coordination Project

SOLAS – Surface Ocean–Lower Atmosphere Study

WCRP – World Climate Research Programme