Report of the Technical Committee on Monitoring

The Technical Committee on Monitoring (hereafter MONITOR) met in Yeosu, Korea, from 18:00 to 20:00 on October 19, 2014 and from 14:00 to 18:55 on October 22, 2014. Prior to the meetings, a MONITOR briefing book, containing the draft agenda and information regarding agenda items, was circulated to MONITOR members. The briefing book was updated and recirculated several times prior to the meeting on October 22, 2014, as new information on agenda items was provided.

Sunday, October 19, 2014

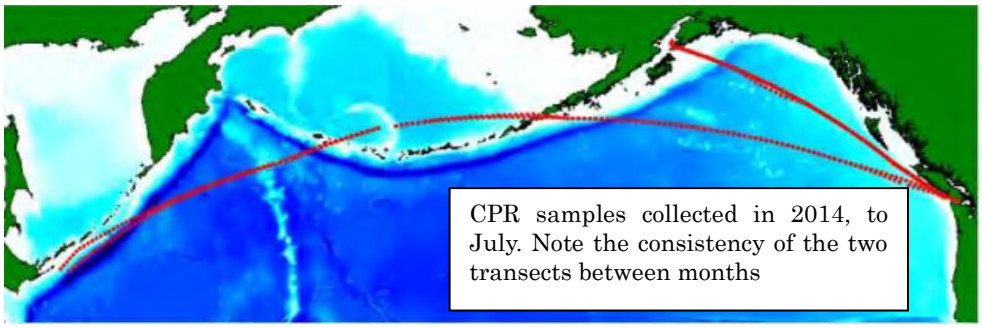
AGENDA ITEM 1
MONITOR Chair, Dr. Jennifer Boldt, called the meeting to order, participants introduced themselves, and the agenda was reviewed and adopted (*MONITOR Endnotes 1* and *2*).

AGENDA ITEM 2
Advisory panels' reports

a. Status of Pacific CPR program and advisory panel and activities of SAHFOS and GACS

CPR Program
Dr. Sonia Batten provided an update on North Pacific CPR activities. The main points of her presentation included:

1. The Survey is currently enjoying a stable period both in terms of operations and funding. During the 2014 field season there were no operational issues, both transects were sampled as normal and while we are awaiting the return of the final set of samples no issues with sampling have been reported. Ships and technicians are all in place for next year.



2. During 2014 we submitted a proposal to the North Pacific Research Board as part of their Long Term Monitoring program, initiated this year, and were successful. This will contribute to the North Pacific CPR funding Consortium from mid-2014 to mid-2019, with the possibility of up to 15 years additional funding in 5 year increments, pending review. Together with the long term monitoring support from the Exxon Valdez Oil Spill Trustee Council (to 2016, also with the possibility of renewal in 5 year increments) and the JSPS and JAMSTEC funding achieved by Dr. Chiba (to 2016 and 2018, respectively) there is now considerable long-term support for north Pacific CPR activities. While the Canadian DFO continues to renew its support annually there is no indication that support will not continue into the future.
3. There were several presentations based on CPR-related work at the PICES 2014 meeting:
   - BIO Paper Session, Oct. 23
     – "*Pseudo-nitzschia diversity in the North Pacific from Continuous Plankton Recorder surveys*" (Rowena Stern, Vera Trainer, Stephanie Moore and Sonia Batten)
   - S4, Oct. 24
     – "*Big YES to sustainable ecosystem management and why NO to sustainable monitoring efforts? – gap*

between demand and supply in Japanese case" (Sanae Chiba)
– "*The role of plankton time-series in managing our seas in a climate of macroecological change*" (Abigail McQuatters-Gollop (Invited), SAHFOS)
– "*The North Pacific Continuous Plankton Recorder survey*" (Sonia Batten, SAHFOS)

- The CPR project pages on the PICES website will be updated over the next 6–9 months as part of the North Pacific Research Board (NPRB) funding to include within-year status reports. Instrumentation data, publication list and plankton data will continue to be available. http://www.pices.int/projects/tcprsotnp/default.aspx

GACS

Dr. Sonia Batten provided an update on Global Alliance of CPR Surveys (GACS) activities. GACS continues to develop its database, website, and data products and progress can be followed at www.globalcpr.org . New CPR surveys are in planning or early implementation stages in the Indian Ocean, Mediterranean and south of Brazil. To facilitate training of CPR technicians and analysts, there is a proposal to hold a joint SCOR/POGO/PICES workshop on CPR operation and sample analysis to be held in India as part of the IIOE-2 (International Indian Ocean Experiment-2) initiative. While only trainees from developing countries would be eligible for funding to attend from SCOR/POGO, PICES may offer additional support to PICES members. This proposal is being discussed at the 2014 PICES annual meeting.

GACS has contributed selected zooplankton data and reviewed current status and trends from its global database, including the North Pacific CPR survey, to the Global Environment Facility funded "Trans-boundary Waters Assessment Programme". CPR data are part of the Open Ocean section. The final report is currently in review and will be released in early 2015. More details and reports as they become available can be found at http://www.geftwap.org/water-systems/open-ocean

GACS held its 4th annual Board of Governance Meeting in September 2014. At the end of the meeting Dr. Sonia Batten was appointed as Chair of GACS for the next three years.

AP-CPR

Dr. Phillip Mundy provided a report of the Advisory Panel on *Continuous Plankton Recorder in the North Pacific*. The North Pacific CPR continues to build a unique set of observations on zooplankton species composition that is invaluable for understanding the extent and effects of global climate change in the North Pacific. Information from NP CPR is made available in a timely manner and it supporting a growing legacy of scientific publications. NP CPR exemplifies the benefits derived from PICES' fostering of cooperation and communication among nations in North Pacific marine science. The Advisory Panel recommended to MONITOR that it be dissolved (disbanded) with its functions being addressed as a standing agenda item on the MONITOR agenda.

Action: MONITOR discussed the advice from the AP-CPR and recommended to Science Board:

1. Disbanding the CPR AP with thanks and appreciation for the invaluable service of its chair and members in the cause of establishing the North Pacific Continuous Plankton Recorder as the premier example of PICES role and capabilities in fostering international cooperation and collaboration in monitoring the status of the North Pacific marine ecosystems.
2. The addition of the following to MONITOR TOR: "Review and advise Science Board on outcomes and annual operations of the North Pacific Continuous Plankton Recorder to include providing technical advice on parameters to be measured and possible linkages to other marine monitoring initiatives and programs in the North Pacific and elsewhere."
3. Appointment of Dr. Sonia Batten as *ex-officio* member of MONITOR representing Sir Alister Hardy Foundation for Ocean Science.

b. Status of CREAMS w. POC

Dr. Vyacheslav Lobanov provided a report of the CREAMS/PICES Advisory *Panel on East Asian Marginal Seas*. There were many AP activities in 2014, including several AP meetings, joint cruises, workshops, and a

summer school. Planned activities for 2015 include more joint cruises, workshops, summer schools, AP meetings, and completion of a report on Oceanography of the Yellow and East China Sea. The AP proposed an extension to the deadline for completion of EAST-II Report "Oceanography of the Yellow and East China Sea" to the end of 2015. In addition, the AP proposed continuation of the AP-CREAMS for the period of 2015–2019.

Action: MONITOR discussed the AP-CREAMS proposals and recommended to Science Board:
1. the continuation of the AP-CREAMS through 2019, as their activities are valuable to PICES, such as fostering international cooperation and collaboration on science, monitoring activities, and outreach.
2. to extend the deadline of the EAST-II Report to the end of 2015, as this is a valuable report for which some more time is required.

c. Report on the meetings on FUTURE

It was noted that AP meetings were not held at PICES-2014; rather there was a joint FUTURE-AP meeting where reports from expert groups were presented. Updates at the MONITOR meeting were, therefore, not provided for most APs. Dr. Mundy provided a report of the AP-SOFE (*MONITOR Endnote 3*) and proposed a mechanism for providing advice to FUTURE on the process of producing the NPESR.

Action: MONITOR discussed and recommended the proposal of a mechanism (*e.g.*, Study Group), with a limited life span, to discuss how to produce the NPESR, how to deliver it, and possibly make recommendations on who would deliver it. Dr. Mundy's "Advice to FUTURE on the Process of Producing of the North Pacific Ecosystem Status Report" could form a basis/start of this group. This was re-visited at the MONITOR meeting on October 22, 2014.

AGENDA ITEM 3
PICES-2014 information

a. Information for Sessions and Workshops

1. Dr. Sanae Chiba co-convened a BIO/MONITOR/TCODE Topic Session (S4) titled "*Use of long time series of plankton to inform decisions in management and policy concerning climate, ecosystems and fisheries*", Friday, October 24, 2014. There were 9 speakers, including 2 invited speakers: Dr. Martin Lindegren ("*Climate variability and interacting trophic control in the southern California Current*") and Dr. Abigail McQuatters-Gollop ("*The role of plankton time-series in managing our seas in a climate of macroecological change*").

2. Dr. Sei-Ichi Saitoh co-convened a POC/MONITOR Topic Session (S9) titled "*Variability in advection and its biological consequences for Subarctic and Arctic ecosystems*", Tuesday, October 21, 2014. There were 16 speakers, including invited speaker Dr. Georgina Gibson ("*The relative importance of advective vs. in-situ processes to mesozooplankton biomass on the Eastern Bering Sea shelf*").

3. Dr. Jack Barth co-convened a MONITOR Workshop (W4) titled "*Networking ocean observatories around the North Pacific*", Friday, October 17, 2014. There were 8 oral presentations and one poster as well as an open discussion period. The invited speaker was Dr. Holger Brix ("*COSYNA, the Coastal Observing System for Northern and Arctic Seas – A regional, European perspective and the global coast*"). One result of the workshop discussion was a broad agreement among participants that the operators of coastal observing systems around the North Pacific would benefit from meeting on a regular basis and developing an evolving set of "best practices", and share "what works and what does not work." Dr. Barth proposed that there be a mechanism by which this could occur.

Action: MONITOR discussed this proposal and recommended to Science Board the formation of an Advisory Panel for *Developing Best Practices and Common Data Protocols for Coastal Ocean Observing Systems* (AP-COOS). Dr. Barth volunteered to prepare TOR, a briefing, and recommendation of some

potential members for the MONITOR meeting on Wednesday, October 22, 2014, and inform the Chair of TCODE. MONITOR members discussed this again at the October 22, 2014 meeting and were to suggest possible names of members for the potential new ocean observing AP.

b. Judges for the best presentation award and other business

MONITOR was delegated by Science Board Chairman, Dr. Thomas Therriault, to judge had five oral presentations (S4 and S9) and one poster presentation (W4). Where the pool of oral presentations or posters was very small, it was left to the discretion of the Committee to decide whether or not there was a presentation considered worthy of an award. Judging guidelines and eligibility for presentations were provided to MONITOR members in the MONITOR briefing book.

Session convenors were reminded that they must complete and submit a brief Session report before the completion of the Annual Meeting. Contact information, report formats, and example reports were provided to committee members in the MONITOR briefing book.

Wednesday, October 22, 2014

AGENDA ITEM 4
FUTURE science product priorities

To help set the direction for the next phase of FUTURE, the MONITOR Committee discussed potential FUTURE Science product priorities. Information on FUTURE objectives, MONITOR's roles in AP-SOFE, and a list of FUTURE expert groups was provided to MONITOR committee members in the MONITOR briefing book.

MONITOR welcomed Dr. Therriault to discuss the transition from an AP structure to a steering committee. MONITOR members discussed the high priority of products that are short-term outlooks and forecasts (days to one or two years) that refer to smaller geographic areas that are inherently testable. Dr. Jack Barth pointed out questions that address coastal systems at smaller scales are important in FUTURE question 2, and not just in terms of anthropogenic forcing. (Question: 2. How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future?)

AGENDA ITEM 5
Relations with specific international organizations/programs

There were 15 presentations from scientists representing international and national organizations.

a. Dr. Maciej Telszewski highlighted the work of The International Ocean Carbon Coordination (IOCCP), including SOCAT (Surface Ocean CO_2 Atlas), interior ocean observations, ocean acidification, and a Framework for Ocean Observing aiding the future of marine biogeochemistry observations (*MONITOR Endnote 4*). In addition, he requested PICES support for an upcoming summer course "Instrumenting our oceans for better observation: a training course on biogeochemical sensors", planned for June 2015 in Kristineberg, Sweden. The primary goal of the course will be to generate a "Best Practices" guide, which provides easy-to-follow steps on usage of autonomous biogeochemical sensors (*MONITOR Endnote 4*).

Recommendation: MONITOR committee members supported the request from IOCCP for PICES to support 2 to 3 researchers to join their sensor training course (agreement from 12 MONITOR members (and with no objections) was acquired through email after the October 22, 2014 meeting).

b. Dr. Sanae Chiba provided an update on the GOOS (Global Ocean Observing System) Workshop on Essential Ocean Variables for Biology and Biogeochemistry, Townsville, Australia, November 2013 (*MONITOR Endnote 5*). The CPR survey, due to its low-cost and manageable features, is currently the only

feasible method for collecting data both phytoplankton and zooplankton diversity on the global scale. Global Alliance of CPR Surveys (GACS), therefore, could provide one of the frameworks for monitoring biology. It is anticipated that PICES will continue to play an active role in GOOS for two reasons: 1) the championing of two PICES-associated candidate pilot projects, *i.e*., the North Pacific CPR project, which is a contributing project of GACS, and CalCOFI; 2) through the activities of MONITOR, as its task includes to serve as a forum for coordination and development of inter-regional and the North Pacific components of GOOS, and to facilitate method development and inter-comparison workshops to promote calibration, standardization and harmonization of data sets.

c. and *d.* Dr. Toshio Suga provided an update on the Ocean Observations Panel for Climate (OOPC): Contributing to the GCOS and GOOS Assessment Processes. The OOPC is sponsored by Global Climate Observing System (GCOS), GOOS, and World Climate Research Program (WCRP), which are, in turn, sponsored by the United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Oceanographic Commission (IOC), World Meteorological Organization (WMO), United Nations Environment Programme (UNEP), and the International Council for Scientific Unions (ICSU). OOPC delivers scientific advice and requirements to JCOMM (Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology.

GCOS (established in 1992) provides comprehensive information on the global climate system. GCOS has defined a list of Essential Climate Variables (ECVs) that are both technically and economically feasible for systematic observation and global implementation, and whose observations meet important requirements of the UNFCCC and the IPCC. A GCOS Status Report will be completed in 2015 and a new implementation plan will be completed in late 2016.

There are two kinds of GOOS: 1. System GOOS, which is a collaborative system of sustained observations, and 2. Program GOOS that supports the development and coordination GOOS *(i.e*., advocacy, capacity development, promote participation). The Framework for Ocean Observing (FOO), now under OOPC, reports on ocean component of GCOS and physics portion of GOOS, and physics to WCRP world climate research program. In 2014, a template for specification of ECVs/EOVs was developed, updated and sent out to experts. There will be a GOOS Strategic Mapping (2015/2016) and OceanObs conference in 2019.

e. Dr. Toshio Suga provided an overview of Argo status and enhancements. In September 2014, 31 nations were contributing data from 3,579 floats from all ocean basins in support of the global array. A number of new national initiatives or donor programmes are gradually showing progress: Brazil, South Africa, Mexico, Indonesia, Russia, Vietnam, Oman, Turkey, Maghreb, and Lebanon. A design for Global Argo is in draft stage with the same mission but also with double the sampling in Western Boundary Currents and equatorial regions, enhanced sampling in marginal seas, and sampling in seasonal ice zones.

Emerging missions include: 1.) Deep Argo to close full-ocean depth budgets of heat, freshwater, and steric sea level, plus a broad range research and operational applications; planning pilots and a global array are underway in community input is needed; 2.) Bio Argo to fill the data gap, establish regional BGC budget, extract long term properties and feed couple GCM biogeochemistry models; ~250 floats already carry oxygen (QC and sensor stability is still work in progress), Nitrate, pH, and bio-optical sensors will be a subset of Argo floats (*e.g*., regional pilot in SO: SOCCOM).

The highest stress is currently on Argo's data system: distribution of ever more complex parameters while maintaining quality in core profile and trajectory data is not working – new resources are needed. The largest challenges facing Argo include: to sustain these essential and valuable observations across scientific generations and despite shrinking national resources and to achieve international consensus on deployment of Argo float inside EEZs. In addition, Argo needs countries to contribute high quality CTD data as soon as possible for re-calibration of Argo data. Please inform Argo about cruises that might be used by other countries to deploy floats. Argo Information Centre (AIC) is run on annual contributions from a few countries and needs contributors to Argo to support the AIC.

f. Dr. Hee-Dong Jeong provided an update of North East Asian Regional Global Ocean Observing System (NEAR-GOOS). NEAR-GOOS is one of 13 GOOS Regional Alliances, whose co-coordinating committee met October 10–11, 2013. NEAR-GOOS operates cross basin climate monitoring between Russia and Japan Sea of Okhotsk and a Japan Sea Ferry boat monitoring project from Korean coast to Dok-do. Future plans are to use more ships of opportunity, such as ferries and LNG carriers.

g. and *h.* Dr. Jack Barth provided an update of the Northwest Association of Networked Ocean Observing Systems (NANOOS; see *MONITOR Endnote 7,* USA country report) and the Ocean Observatories Initiative (OOI; *MONITOR Endnote 7,* USA country report).

i. Dr. David Checkley provided an update on Southern California's Coastal Ocean Observing System (SCCOOS). The Integrated Ocean Observing System (IOOS) is the U.S. contribution to the Global Ocean Observing System. SCCOOS is one of 11 regional associations that comprise IOOS, which cover all U.S. waters. SCCOOS's area of observation is from Point Conception (Santa Barbara, CA) to the US/Mexico border. The SCCOOS mission is to manage an "end-to-end" coastal ocean observing system (including data collection, data management, data dissemination, numerical model simulations and forecasts, produce development, and user outreach and facilitation) to benefit users in four broad areas: coastal hazards, ecosystems and climate, marine operations, and water quality. Some goals include: 1) to promote safe recreational use of beaches and provide warnings of wave and tide-induced coastal inundation; 2) To monitor climate trends and environmental effects on the Southern California Bight by collecting physical, chemical, and biological time series; 3) to advance integrated, customized products that are critical for safe and efficient navigation, search and rescue, and oil spill response; 4) to provide monitoring, tracking, and prediction tools for harmful algal blooms, outfall and stormwater plumes, and surfzone contaminants.

j. Dr. Sei-ichi Seitoh provided an update on Ecosystem Studies of Subarctic Seas (ESSAS), an IMBER regional program. The goal of ESSAS is to compare, quantify, and predict the impact of climate variability and global change on the productivity and sustainability of Sub-Arctic marine ecosystems. In 2014, the ESSAS Annual Science Meeting was held in Copenhagen, Denmark, from April 7–9. Seventy-two participants from 10 countries attended with 46 presentations and 12 posters during half or 1-day sessions on: a) Danish Research in Sub-Arctic Seas; b) General Contributed Papers; c) Paleo-ecology of Sub-Arctic Seas; d) Biology and Ecology of Arctic Cods.

At the 2014 ICES ASC, the joint session (Q) was co-sponsored by ESSAS, the ICES WG on Oceanic Hydrography, SICCME and PICES: "*Physical and biological consequences of North Atlantic circulation patterns*", A Coruña Spain on September 17, 2014. The session consisted of 8 oral presentations and 4 posters. There were 4 talks on the Arctic-Subarctic (2 from the Pacific sector and 2 from the Atlantic), 2 on the MOW and 2 on upwelling off Iberia. At PICES-2014, Dr. Franz Mueter (representing ESSAS) co-convened POC/MONITOR Topic Session (S9) "*Variability in advection and its biological consequences for Subarctic and Arctic ecosystems*".

An AMO special volume in *Journal of Marine Systems* was published in May 2014 with 10 papers covering driving mechanisms, physical oceanographic responses and impacts on ecosystems. The NESSAR (Norwegian IPY project) special issue in JMS was published in February 2014 with 13 papers describing studies conducted on the physics and biology of Arctic Fronts.

ESSAS submitted a Belmont Forum proposal entitled "*Resilience and adaptive capacity of Arctic marine systems under a changing climate*". This was an application for a synthesis grant for mid-2015 to mid-2018 and activities would include a synthesis of information on 1) variability and trends in advection, temperature, sea-ice dynamics, and ocean acidification and how they may affect future marine ecosystems; 2) how Arctic fish populations and their prey may respond to multiple environmental stressors comparing and contrasting the impacts in the Atlantic and Pacific sectors of the Arctic; and 3) effects on resource management and socio-economic impacts.

The ESSAS ASM will be held in Seattle, Washington, from June 15–17, 2015, in conjunction with a new University of Washington program entitled The Future of Ice. There will be a 2- to 2½-day symposium on The Role of Sea Ice with sessions on sea ice and its effects on the marine environments of the Arctic and Subarctic, paleo considerations, glacial ice and impacts on humans and coastal communities. The effects of climate variability and change will play a large role in the meeting.

k. Dr. Matt Baker provided an update on the North Pacific Research Board's (NPRB) long-term monitoring program. The goal of the program is to support new or existing time-series research to enhance understanding of baseline and current states and to predict ecosystem responses to changing ocean conditions. NPRB has defined long-term monitoring programs as: "those that aid in understanding ecosystem variability and the effect of variability on subsistence or commercial marine resources." NPRB has funded programs to support long-term monitoring, process studies and retrospective analyses through its Annual Request for Proposals (RFP) and Integrated Ecosystem Research Programs (IERPs). Examples include biophysical moorings, Seward Line data collection (physics, chemistry, metazooplankton, seabird and marine mammal communities), CPR, and Chukchi ecosystem moorings. The NPRB has recognized long term monitoring as essential to retrospective analyses and understanding key processes and mechanisms.

l. Dr. Hyoung Chul Shin provided an update of the Pacific Arctic Group (PAG). The Pacific Arctic Group (PAG) is a consortium of institutes and individuals having a Pacific perspective on Arctic science. PAG serves as a Pacific Arctic regional partnership to plan, coordinate, and collaborate on science activities. The four PAG principal science themes are climate, contaminants, human dimensions and structure and function of Arctic ecosystems. Examples of current PAG activities include: 1) sharing information on annual field activities in the Pacific Arctic region; 2) continued development and implementation of long-term monitoring activity such as the Distributed Biological Observatory (DBO); 3) undertake a Pacific Arctic regional, multidisciplinary synthesis of scientific findings in the marine region relevant to ongoing scientific objectives at the core of the PAG; and 4) project development and sampling in the Chukchi Borderland and Canada Basin region to investigate climate, oceanography, air–sea ice interactions, physical oceanography, and modeling. PAG activities and topics in high priority to highlight in the ICARPIII planning process include data sharing and publications, continued development of a Chukchi Borderland/Arctic Basin Environmental Observing system, development of a coordinated sea ice/atmospheric sampling effort, physical and ecosystem modeling of oceanographic and atmospheric data, and PAG synthesis activities. All the presentations and documents associated with PAG meetings are available at the PAG website: http://pag.arcticportal.org/ under "documents".

m. Dr. Phillip Mundy provided an update of the Arctic Council PAME. PAME is a Protection of Arctic Marine Environment working group which works on arctic shipping guidelines and implementing the ecosystem approach to management across international boundaries. All PICES countries now have formal status at Arctic Council since May 2014. Japan, Korea and China were given permanent observer status, and all three have active research programs.

n. Dr. Boldt provided a summary of MONITOR-related component/activities within the framework for enhanced collaboration between PICES and NOWPAP. The joint PICES-NOWPAP Study Group on *Scientific Cooperation in the North Pacific Ocean* (SG-SCOOP) met on October 15 and 16, 2014 at PICES-2014 to discuss the Terms of Reference and the assembly of a report. SG-SCOOP reports directly to Science Board.

o. CeNCOOS activities were presented by Dr. Steven Bograd in a poster at the Poster Session.

p. Dr. Jack Barth presented a proposal to establish an Advisory Panel on *Coastal Ocean Observing Systems* (as discussed at the MONITOR meeting on October 19, 2014; see *MONITOR Endnote 6*.

Comparisons and inter-calibrations would be made possible through this collaboration. This AP was generally endorsed as a good activity for MONITOR.

Action: MONITOR discussed the proposal and recommended the formation of an Advisory Panel on *Coastal Ocean Observing Systems* (AP-COOS) [later renamed to Advisory Panel on *North Pacific Coastal Ocean Observing Systems* (AP-NPCOOS)]. The AP would report to both the MONITOR and TCODE committees. The initial term would be for 5 years, with possibility for renewal.

Purpose: To provide a forum and mode of communication for the 'operators' of coastal observing systems around the North Pacific that would meet on a regular basis to develop and continually improve a set of 'best practices' by sharing experiences on successes and failures in development and deployment of observing resources.

AGENDA ITEM 6
Report on POMA

MONITOR members briefly reviewed the POMA, including past award recipients.

AGENDA ITEM 7
PICES 25th Anniversary

The approaching 25th Anniversary of PICES (2016) was discussed. MONITOR members had already provided comments and suggestions for anniversary meeting ideas to Science Board. No further ideas were provided.

AGENDA ITEM 8
Proposals for PICES-2015 MONITOR workshops, topic sessions, and inter-sessional meetings

MONITOR members were instructed by Dr. Boldt to rank proposals (log on to PICES website) for discussion. Below are the proposals MONITOR agreed to support. A late submission by Drs. Sung Yong Kim (Korea) and Jack Barth (USA) for a workshop on "*Best Practices for and Scientific Progress from Coastal Ocean Observing Systems*" for PICES-2015 was also evaluated by the Committee.

Topic Sessions for PICES-2015
- P-1 *The 2014/15 El Niño and anomalous warming of the North Pacific: What happened?*
- P-10 *Ocean Acidification Observation Network for the Arctic and sub-Arctic Pacific Oceans*

Workshops for PICES-2015
W-5 *Monitoring and assessment of environmental quality of radioactivity in the North Pacific*

PICES/ICES (S-CCME) Inter-sessional Workshop in 2015
- a 2½-day workshop to be convened by Anne Hollowed (USA), Francisco Werner (USA), Kirstin Holsman (USA), Michio Kawamiya (Japan), Trond Kristinsen (ICES), Brian MacKenzie (ICES), August 2015 (Princeton?, USA)

Recommendations: MONITOR supports proposals P1 and P10 and the inter-sessional workshop (Hollowed *et al.*) for PICES-2015. MONITOR also supports W5 and the workshop proposal on "*Best Practices for and Scientific Progress from Coastal Ocean Observing Systems*") for PICES-2015.

AGENDA ITEM 9
Updates to country reports of relevant monitor/observation activities

See *MONITOR Endnote 7* for country reports.

AGENDA ITEM 10
Other business

a. Dr. Mundy provided an overview and recommendations for producing the North Pacific Ecosystem Status Report. He briefly reviewed the report entitled "*Advice to FUTURE on the process of producing the North Pacific Ecosystem Status Report*, 2009–2014", dated October 24, 2014 (see the report of Science Board, *SB Endnote 5* for a proposal to establish a Study Group on the *North Pacific Ecosystem Status Report*).

Recommendation: MONITOR discussed and supported the proposed SG-NPESR, and recommended it to Science Board.

b. Proposed theme sessions for ICES 2015 ASC

ICES Proposal 3: "*Ecosystem monitoring in practice*" (Convenors: Elena Eriksen, Ralf van Hal, Sven Gastauer or or PICES convenor). Linkges to ICES SSG: The session is proposed by WGISUR and WGFAST which fall under the SSGIEOM – SCICOM Steering Group on Integrated Ecosystem Observation and Monitoring.

ICES Proposal 10: "*CIA on the loose*" (Convenors: Jesper H. Andersen, Laura Uusitalo, Jan Tjalling van der Wal). Linkges to ICES SSG: SICCME. Further, we envisage a presentation from the TACIA project focusing on potential cumulative effects of multiple human pressures on higher trophic levels (fish, birds and marine mammals) in the sea west off Greenland – TACIA is as far as we know the first study on cumulative effects in the Arctic.

ICES Proposal 16: "*How to hit an uncertain, moving target: achieving GES under the MFSD*" (Convenors: Graham Pierce, Henn Ojaveer, Mark Tasker, Antonina dos Santos). Linkges to ICES SSG: Implementation of the MSFD is increasingly ubiquitous in ICES science and advice, with many EGs having ToRs specifically addressing MSFD issues. This proposal arises from the SIBS/SSGEPD open session held at the 2014 ASC. The issues discussed in this open session require urgent resolution to ensure that MSFD targets are met according to the proposed timetable. The topic is both a high priority within ICES and one on which many members of the ICES community may be expected to be able to contribute.

Recommendation: MONITOR reviewed the ICES 2015 ASC theme session proposals and recommend that PICES support sessions #3, 10, and 16.

MONITOR Endnote 1

MONITOR participation list

Members

Jack A. Barth (USA)
Jennifer L. Boldt (Canada, MONITOR Chair)
Dr. Sanae Chiba (Japan, MONITOR Vice-Chair)
In-Seong Han (Korea)
Charles Hannah (Canada)
Sung Yong Kim (Korea)
Vladimir V. Kulik (Russia)
Vyacheslav B. Lobanov (Russia)
Phillip R. Mundy (USA)
Young Jae Ro (Korea)
Sei-Ichi Saitoh (Japan)
Dr. Hiroya Sugisaki (Japan)

Ex-officio member

Sonia Batten (AP-CPR, SAHFOS)

Observers

Matt Baker (NPRB)
Harold (Hal) Batchelder (PICES)
David Checkley (SCCOOS)
Kim Juniper (Ocean Networks Canada)
Yoshioki Oozeki (Japan, Oct. 19)
Laura Richards (PICES Chair)
Hyoung Chul Shin (PAG)
Toshio Suga (Argo, GOOS, GCOS)
Kazuaki Tadokoro (Japan)
Thomas Therriault (Science Board Chair)
Maciej Telszewski (IOCCP)
and others, not signed in

MONITOR Endnote 2

MONITOR meeting agenda

October 19, 2014

1. Welcome, Introductions and Sign-in, and adoption of agenda (Boldt)
2. Advisory Panels' reports:
   a. Status of Pacific CPR program and Advisory Panel and activities of SAHFOS and GACS (Mundy, Batten, McQuatters-Gollop)
   b. Status of CREAMS w. POC (Lobanov)
   c. Report on the meetings on FUTURE
      i. AICE (Kulik)
      ii. COVE (Lobanov)
      iii. SOFE (Mundy)
3. PICES 2014 annual meeting information:
   a. Information for:
      i. S4 (Chiba),
      ii. S9 (Saitoh)
      iii. W4 (Barth)
      iv. S1 (see Dr. Jacquelynne King's talk at 14:00, Monday, October 20, 2014)
   b. Judges for the best presentation award (Boldt) and other business

October 22, 2014

4. FUTURE science product priorities (MONITOR members)
5. Relations with specific international organizations/programs
   a. IOCCP (Telszewski) (20 minutes)
   b. GOOS (Chiba) (5 minutes)
   c. GOOS (Suga) (5 minutes)
   d. GCOS (Suga) (5 minutes)
   e. Argo (Suga) (5 minutes)
   f. NEAR-GOOS (Jeong) (5 minutes)
   g. NANOOS (Barth) (5 minutes)
   h. Ocean Observatories Initiative (OOI) (Barth) (5 minutes)
   i. SCCOOS (Checkley/Koslow) (5 minutes)
   j. ESSAS (Saito) (5 minutes)
   k. NPRB (Baker) (5 minutes)
   l. PAG (Shin) (5 minutes)
   m. Arctic Council PAME (Mundy) (5 minutes)
   n. MONITOR-related component/activities within the framework for enhanced collaboration between PICES and NOWPAP (Boldt) (5 minutes)
   o. CeNCOOS (Bograd) (see poster)
   p. AP-COOS proposal (Barth)
6. Report on POMA (Boldt)
7. PICES 25th Anniversary reminder (Boldt)
8. Proposals for PICES 2015 MONITOR workshops, topic sessions, and inter-sessional meetings (MONITOR members)
   a. "The 2014/15 El Niño and anomalous warming of the North Pacific: What happened?" proposed by Howard Freeland and Bill Peterson
   b. "Best Practices for and Scientific Progress from Coastal Ocean Observing Systems" Co-Convenors: Sung Yong Kim (Korea, MONITOR) and Jack Barth (USA, MONITOR).
   c. Others?
9. Updates to country reports of relevant monitor/observation activities (Please note: presentations will be limited to 10 minutes)
   Canada (Boldt, Hannah)

China (Li, Zhao, Zhang)
Japan (Chiba, Saitoh, Sugisaki)
Korea (Han, Kim, Ro)
Russia (Kulik, Lobanov)
United States (Barth, Napp, Mundy)
NOTE: National reports and power points – posted to PICES MONITOR's web page (?)

10. Other business
    a. NPESR (Mundy)
    b. ICES proposed theme sessions
11. Adjorn

MONITOR Endnote 3

Report of the AP-SOFE, 2013 – 2014

Since the 2013 Annual meeting in Nanaimo, SOFE planned and conducted a session at the FUTURE Open Science Meeting on the Kohala Coast, Hawaii. The session consisted of nine contributed and invited papers "Challenges in Communicating Science and Engaging the Public." All papers addressed how to overcome difficulties in turning scientific information into actionable management advice, as well as a variety of methods used to gain the confidence of consumers of management advice. Some examples from the session were 9 – 12 month ahead forecasts of salmon abundance in southeast Alaska and the Columbia River (USA), 1 – 4 week ahead forecasts of the timing of arrival of salmon into the Yukon River (USA), and real time cell phone accessible wave height nowcasts to advise fishing operations in coastal waters of Japan. At the Open Science Meeting SOFE participated in discussions with the FUTURE Review Team on accomplishments and governance issues of FUTURE. SOFE subsequently reviewed the report of the Review Team and reported the results of the review to Science Board. SOFE supported accepting the recommendations and also suggested that the SB give deference to the leadership of FUTURE in implementing the recommendations. SOFE is also participating in production of the Progress in Oceanography Special Publication on the FUTURE Open Science Meetings by providing manuscript from the SOFE workshop. The advice of SOFE on production of the North Pacific Ecosystem Status Report NPESR presented by SOFE to MONITOR, FUTURE and the Science Board in Nanaimo (2013) has been tabled pending further discussions in Science Board.

MONITOR Endnote 4

International Ocean Carbon Coordination Project

by Maciej Telszewski

The complexity of the marine carbon cycle and its numerous connections to carbon's atmospheric and terrestrial pathways means that a wide range of approaches have to be used in order to establish it's qualitative and quantitative role in the global climate system. The International Ocean Carbon Coordination Project coordinates this highly diverse set of activities and facilitates the development of globally acceptable strategies, methodologies, practices and standards homogenizing efforts of the research community and scientific advisory groups as well as integrating the ocean carbon science into globally integrated earth system observing networks. This short update highlights main activities of the IOCCP for years 2013-2015.

Surface Ocean CO_2 ATlas - SOCAT

IOCCP's coordination of the Surface Ocean CO_2 Atlas (SOCAT) continues as an activity carried out by a dedicated subset of the international marine carbon research community. SOCAT aims to improve access to surface water CO_2 data by regular releases of quality controlled, synthesis and gridded fCO_2 (fugacity of carbon dioxide, similar to partial pressure) data products for the global oceans and coastal seas. SOCAT version 1 was publicly released in 2011, version 2 in 2013. Version 2 has 10.1 million surface water fCO_2 data from 2660 data sets between 1968 and 2011.

About 1940 files with data from 1957 to 2013 have been submitted for version 3 between July 2013 and March 2014. Most data providers followed requests from SOCAT and the wider marine carbon community to submit data directly to CDIAC. The data submissions include many updates of data submitted to earlier SOCAT versions (990 files), as data providers have implemented recommendations and feedback from SOCAT quality control. Roughly 950 new files, corresponding to 4 million fCO_2 values, have been submitted. About 550 of the 950 files originate from 2011 to 2013. Version 3 extends the data set to December 2013 and includes CO_2 measurements from alternative sensors and platforms.

IOCCP Sensor Summer School 2015

In recent years ocean technology has leaped to the aid of scientists by providing them with cost-effective tools that can take measurements of essential biogeochemical variables autonomously, *i.e*., sensors on autonomous platforms. These autonomous measurements are complementary to efforts carried out by traditional ship-based sampling, with the aim of improving data coverage worldwide. Yet, despite these options becoming more readily available, there is still a gap between the technology (investigators and technicians that deploy these technologies) and the end-user. This is born as much out of lack of training, lack of in-depth knowledge, and lack of community coordination. There is also a disconnect between data gathering by autonomous chemical sensors and data quality, which is a major obstacle as these sensors are already being deployed on autonomous platforms in several different projects in several ocean areas. Indeed, the Panel for Integrated Coastal Observation (PICO-I) pointed out that while some of the required technologies are mature, the implementation on a global scale may be limited by lack of common standards and protocols and/or calibrated and validated algorithms for translating data into useful information.

To this end, the IOCCP will hold its first course on autonomous biogeochemical sensors with the aim to promote and enhance the utilization of these sensors, and to teach users common best practices of use and data reporting. IOCCP is the ideal coordinating body to help organize such course, as the key word in the current era is ‘global’. The need for such course was identified by the scientific community which felt that there exists an urgent necessity to address the usage of autonomous biogeochemical sensors to carry out time-series work, complement existing autonomous platforms, expand our current observational network, and ensure that the data being collected can serve both scientific and societal needs. While many biogeochemical parameters cannot yet be directly characterized to the accuracy and precision required for climate research, there are several autonomous sensor technologies which can tackle some essential biogeochemical variables with the quality required, and they are mature enough to be implemented within regular monitoring platforms. These technologies include oxygen, sensors, nutrients, carbon dioxide and pH. There is also a need to integrate (and standardize) sensor methodologies, including quality control, data reporting and calibration protocols. A ‘global biogeochemical sensor network’, which fills the current gaps that exist in ocean observing, is needed to understand changes in marine biogeochemical cycles and ecosystems. Such network should be integrated with existing sampling programs so that it has the necessary synergy to make it useful to the current scientific objectives. Incorporating autonomous sensors into existing platforms that take regular, high quality, discrete measurements (*i.e*., time-series stations) is also one approach to validation.

Summer course “Instrumenting our oceans for better observation: a training course on biogeochemical sensors” is being planned for June 2015 in Kristineberg, Sweden. The primary goal of the course will be to generate a “Best Practices” guide, which provides easy-to-follow steps on usage (including preparation, deployment, recovery and basic data reporting, processing and quality) of autonomous biogeochemical sensors. This includes:

a. Essential instrument know-how (instrument communication, sensor data QC, biofouling prevention, *etc*.)
b. User recommendations
c. Site-specific recommendations
d. Troubleshooting
e. Data management, quality and reporting

The Integrated Framework for Sustained Ocean Observing (FOO)

Biogeochemical Essential Ocean Variables

During the last 18 months the IOCCP lead the efforts of the Biogeochemistry Panel of GOOS. Great progress was made towards developing a community vetted set of Essential Ocean Variables. Several international experts gave support to the work of the Panel and a wide range of ocean users is being currently consulted for their input into the final list. Tasks accomplished so far include the following: (i) compilation (and update as needed) of the available information on societal and scientific requirements regarding marine biogeochemistry parameters necessary for inclusion into the FOO as EOVs; (ii) consultation with programmatic and institutional partners on their requirements for the multidimensional feasibility assessment of the proposed parameters. It is important that observing, modeling and sensor/instrument developing communities continue being involved; (iii) a multidimensional feasibility assessment of the proposed parameters built on the FOO recommendations and a written summary of the results for inclusion into the Global Climate Observing System Implementation Plan; (iv) a summary publication of the multidimensional feasibility assessment of the marine biogeochemistry parameters necessary for inclusion into the FOO as EOVs.

After an initial pooling of experts and a period of collective work coordinated by IOCCP aimed at tasks (i) and (ii), the IOCCP through it's funds received from the Global Ocean Observing System (GOOS) organized an expert meeting which was carried out side by side with the Biology and Ecosystem Panel meeting.

The First Technical Workshop of Biogeochemistry and Biology and Ecosystem Panels was held in Townsville, Australia from November 13–16, 2013. During this workshop the GOOS Biogeochemistry Panel sought advice from technical experts to assist with tasks (iii) and (iv). Authors of the FOO specifically point out to the fact that a large part of the current global ocean observing system is driven by climate observing requirements. The reality is that there are more societal and scientific drivers for ocean observations than climate (and weather). Guided by the FOO, discussions about additional scientific questions and societal benefits that require sustained ocean observations were the first step in the EOV defining process. The following three overarching requirements, each divided into two main questions were agreed upon and became the baseline for further considerations:

1. The role of ocean biogeochemistry in climate
2. Human impacts on ocean biogeochemistry
3. Ocean ecosystem health

In the second step, efforts focused on listing the necessary measurements needed to address each question. Unless specifically mentioned, during this phase the attention focused on the variable itself and not as much on the required frequency or resolution of each measurement. This aspect was the subject of considerations during the development of the EOV Specification Sheets (SS). The readiness of the measurement was also taken into account. The FOO specifically requires including all measurements considered critical, even those that are not feasible for implementation at the moment due to technical obstacles. By doing so, the FOO process seeks to trigger innovation by advocating development of technologies needed for the fit-for-purpose observing system. Also, no division between coastal and open ocean was made as this aspect will also be reflected in the SS with regards to measurement frequencies, resolution etc. Experts from modelling and observing communities were active throughout the process during this phase of the workshop. It is envisaged that future EOV consultation process will also include both communities.

The assessment leading to the final list of 9 EOVs was based on the feasibility versus impact scoring and expert discussions and is described in the draft report available from IOCCP website. The FOO proposes assessing each EOV according to its readiness level in three categories: Requirements Processes, Coordination of Observational Elements and Data Management and Information Products. All these, plus much more meta-data type of information divided into several subcategories, are included in the newly developed EOV Specification Sheet. Specification sheets for each Biogeochemical EOV are also available from IOCCP website: http://www.ioccp.org/foo.

Currently, IOCCP is in the process of implementing comments and requests from individual experts who responded to our call announced through our website, during the Town Hall meeting organized during the OSM'14 in Honolulu, USA, and during the Webinar given by Tanhua and Telszewski last June (fully recorded webinar with Q&A session is also available from our website). Very soon we will submit the proposed list of biogeochemical EOVs to several programs and panels for approval (*e.g*. GO-SHIP, CLIVAR, IMBER, SOLAS, IOCCG, GEOTRACES and more). Following the programmatic consultation phase, the GOOS Steering Committee will be asked to approve the final set and finally the GOOS approved set of EOVs will be presented at the IOC General Assembly for endorsement. At this stage the list will be "frozen" and updates will be performed every several years (to be specified).

MONITOR Endnote 5

Report on the Global Ocean Observing System Workshop on Essential Ocean Variables for Biology and Biogeochemistry

Townsville, Australia November 2013

by David Checkley, Sanae Chiba and Masao Ishii

Introduction

GOOS, the Global Ocean Observing System, held the First Technical Experts Workshop for the GOOS Biology and GOOS Biogeochemistry Panels from November 13–15, 2013, at the Australian Institute of Marine Science (AIMS), Cape Cleveland, Townsville, Australia to discuss Essential Ocean Variables (EOVs) for biology and biogeochemistry. The workshop was sponsored by European Commission FP7 GEOWOW project, AIMS, the Intergovernmental Oceanographic Commission of UNESCO, and GOOS.

The Framework for Ocean Observing (FOO, *1*) resulted from a working group formed after OceanObs'09 in Venice, Italy, in 2009. The need for coordinated ocean observing in all disciplines was clearly articulated at OceanObs'09. The resulting working group was comprised of representatives of the major disciplines and institutions involved in global ocean observing. EOVs are proposed within the FOO, similar to existing Essential Climate Variables. Three Observing System Panels are proposed within the FOO, for Physics, Biology, and Biogeochemistry. Each panel would propose EOVs that, in turn, would be addressed (*e.g*., observing technologies, data, and data products) by Technical Advisory Groups. The GOOS workshop in November, 2013, was the first after the FOO was published to discuss biology and biogeochemistry EOVs.

The workshop objectives included identification of (a) major scientific and societal challenges that require ocean biology and biogeochemistry observing, (b) candidate EOVs, and (c) pilot projects. The three-day workshop included plenary (joint) and separate sessions of the Biogeochemistry and Biology groups.

This was the first gathering of technical experts prior to establishment of the GOOS Biology Panel. The Biology group consisted of 11 participants, including DC and SC. The GOOS Biogeochemistry group was organized based on The International Ocean Carbon Coordination Project (IOCCP). It consisted of 22 participants, including MI.

Biology Group

Biology, including ecology and ecosystems, does not lend itself to simple descriptors, and the related challenges are diverse and vary regionally. An implicit requisite in identifying themes and EOVs is that they vary over space and, especially, time, particularly in regard to climate change and other human activities. Four themes arose: productivity, biodiversity, ecosystem services, and human activities. These themes, in turn, require a suite of EOVs. The ten candidate EOVs that ranked highest are listed below, each with its associated biological theme.

Potential Biological EOV	**Biological Theme**
Chlorophyll	Productivity (primary)
Coral Cover	Biodiversity
Mangrove Area	Productivity (primary)
Harmful Algal Blooms	Ecosystem Services
Zooplankton (biomass, abundance)	Productivity (food web)
Salt Marsh Area	Productivity (primary)
Large Marine Vertebrates (abundance, distribution)	Biodiversity
Seagrass Area	Productivity (primary)
Large Marine Vertebrates (tags and tracking)	Productivity (food web)
Zooplankton (krill)	Productivity (food web)

We emphasize that this is a list of candidate biology EOVs and thus only a starting point for discussion.

A novel idea of Essential Ocean Samples (EOSs) was proposed. It was advocated that samples should be collected and preserved for future analysis using methods perhaps as yet unknown. In particular, the rapid development of genomic, transcriptomic, and proteomic analytical methods supports the concept of EOSs. Thus, samples easily collected and stored may prove valuable in years and decades to come when analyzed using existing and novel methods.

A number of candidate pilot projects were discussed. These included a synthesis of tagging and tracking of Large Marine Vertebrates to assess ecosystem health, deriving an EOV from Continuous Plankton Recorder (CPR) data, helping promote an 'omics-based biodiversity observing network, and using data from the California Cooperative Oceanic Fisheries Investigations (CalCOFI) in an inverse analysis to determine minimal observing requirements hence EOVs. Below, we briefly expand on the CPR and CalCOFI pilots.
The CPR survey, due to its low-cost and manageable features, is currently the only feasible method for collecting data both phytoplankton and zooplankton diversity on the global scale. An international community, consisting of scientists of nine countries conducting monitoring surveys using the CPR in their respective target regions, established the Global Alliance of Continuous Plankton Recorder Surveys (GACS, *2*) in 2011, with the aim of enhancing the CPR monitoring network from basin to global scales to enable the global comparison of variability of plankton diversity. We expect GACS could provide one of the frameworks for monitoring biology. The proposed biology pilot project would be to determine biology EOV or EOVs appropriate for use with data from the GACS.

CalCOFI (*3*) was established in 1949 to investigate the marine ecosystem of the Pacific sardine (*Sardinops sagax*) off California and basis for the long-term fluctuations in sardine. Now in its 66th year, CalCOFI is the longest ship-based study of a marine ecosystem and has contributed valuably to our understanding of sardine fluctuations and other phenomena, ranging from physics to biology and biogeochemistry. The pilot project proposed by the Biology group would investigate the question, What subset of knowledge (*e.g.*, EOVs) measured in CalCOFI provides the optimal balance between efficiency (*e.g.*, cost and operation) and inference (*e.g.*, about specific characteristics of the ecosystem, from overall health to the production of specific fish populations, such as sardine)? In essence, this is an inverse analysis problem, for which the suite of CalCOFI observations is well suited due to its extensive environmental and fishery independent time series, and fisheries-dependent time series datasets.

Six working groups were suggested in the interim: primary production, zooplankton, LMVs, habitats, human impacts, and water quality. A GOOS Biology Panel will be established to continue the process begun with the publication of the FOO and continued at the Townsville workshop.

We anticipate that PICES will continue to play an active role for two reasons. First, championing of the two PICES-associated candidate pilot projects, *i.e.*, the North Pacific CPR project, which is a contributing project

of GACS, and CalCOFI. Second, through the activities of MONITOR, as its mandate includes to serve as a forum for coordination and development of inter-regional and the North Pacific components of GOOS, and to facilitate method development and inter-comparison workshops to promote calibration, standardization and harmonization of data sets.

Biogeochemistry Group

The Biogeochemical group is associated with the IOC-SCOR International Ocean Carbon Coordination Project (IOCCP). The Biogeochemistry group members included experts from the modelling and observing communities of the ocean biogeochemistry. The discussion by the Biogeochemistry group also started by identifying key scientific and societal questions that require sustained observations of ocean biogeochemistry variables to answer. In the second step, a set of candidate biogeochemical EOVs were selected by first listing the fundamental measurements needed to address each question and second summing up the rank of priority for each of the variables over these questions by taking into account both their impact and feasibility.

The major societal and scientific needs and questions identified are:

1. The role of ocean biogeochemistry in climate
   - 1.1 How is the ocean carbon content changing?
   - 1.2 How does the ocean influence cycles of non-CO_2 greenhouse gases?

2. Human impacts on ocean biogeochemistry
   - 2.1 How large are the ocean's "dead zones" and how fast are they changing?
   - 2.2 What are rates and impacts of ocean acidification?

3. Ocean ecosystem health
   - 3.1 Is the biomass of the ocean changing?
   - 3.2 How does eutrophication and pollution impact ocean productivity and water quality?

The EOVs nominated for biogeochemistry are:

i. Oxygen
ii. Macro nutrients (nitrate, nitrite, ammonium, phosphate and silicic acid)
iii. Carbonate system (dissolved inorganic carbon, total alkalinity, pH and pCO_2)
iv. Transient tracers (*e.g.*, chlorofluorocarbons and SF_6)
v. Suspended particulate matter (inorganic and organic)
vi. Particulate matter export (inorganic and organic)
vii. Nitrous oxide
viii. Carbon-13 isotopic ratio of dissolved inorganic carbon
ix. Dissolved organic matter (dissolved organic nitrogen, phosphorus and carbon)

A draft report for the workshop of the Biogeochemistry Panel is available at IOCCP (*4*). Input from the wider community has been invited so that the FOO implementation becomes a truly open and transparent process through community consultation.

Concluding Remarks

A detailed report of the First Technical Experts Workshop for the GOOS Biology and GOOS Biogeochemistry Panels will soon be available. Significant progress was made during the three-day workshop. However, the workshop was only a start. As articulated in the Framework for Ocean Observing, the framework's successful implementation will require community involvement and support.

Next steps include constitution of the GOOS Biology and Biogeochemistry Panels. These panels will continue to discuss potential biology and biogeochemistry EOVs, solicit community input, and ultimately propose EOVs and associated Technical Advisory Groups.

Success of the FOO requires the support of the observing community. PICES, including MONITOR, is an important member of that community. We look forward to its continued participation in the implementation of the FOO.

References

1. *A Framework for Ocean Observing*. By the Task Team for an Integrated Framework for Sustained Ocean Observing, UNESCO 2012, IOC/INF-1284,
doi: 10.5270/OceanObs09-FOOhttp://www.oceanobs09.net/foo/FOO_Report.pdf
2. http://globalcpr.org
3. http://calcofi.org
4. http://www.ioccp.org/foo
5. *Report of the First Workshop of Technical Experts for the Global Ocean Observing System (GOOS) Biology Panel: Identifying Ecosystem Essential Ocean Variables (EOVs)*. IOC/GOOS-Biol-1/1, Paris, February 2014.

Participants in the First Technical Experts Workshop for the GOOS Biology and GOOS Biogeochemistry Panels.

MONITOR Endnote 6

Proposal to establish an Advisory Panel on *Coastal Ocean Observing Systems* (AP-COOS)
[later renamed to Advisory Panel on *North Pacific Coastal Ocean Observing Systems* (AP-NPCOOS)]

by
Ken Denman (Univ. Victoria, Ocean Networks Canada), Jack Barth (Oregon State University, MONITOR), S. Kim Juniper (Univ. Victoria, Ocean Networks Canada), Jae Hak Lee (Korea Institute for Ocean Science and Technology), and Hidekatsu Yamazaki (Tokyo University of Marine Science and Technology)

Building on a successful workshop held at the 2014 PICES Annual Meeting – (W4) "*Networking Ocean Observatories around the North Pacific*" – and ongoing interest by the MONITOR Committee, we propose that PICES establish an Advisory Panel on *Coastal Ocean Observing Systems* (AP-COOS). There is broad agreement that the 'operators' of coastal observing systems around the North Pacific would benefit from meeting on a regular basis and developing an evolving set of 'best practices' – basically sharing experiences on 'what works and what does not work.' AP-COOS would report to both the MONITOR and TCODE committees. The initial term would be for 5 years, with possibility for renewal. Once the AP-COOS working format has been established, it may be advisable to make contact with similar entities within ICES and IOC.

Examples of topics to be considered for best practices for coastal ocean observing systems include:

- Observing platforms (cabled nodes, autonomous vehicles, moorings, profilers, shore-based instruments, *etc*.),

- Sensors and sensor calibration; including physical, optical, biogeochemical, bioacoustics, sensors,
- Data quality control,
- User interfaces to data and information products; user interfaces will vary depending on their intended audience, *e.g.*, observatory operators, scientists, ocean users,
- Data delivery to users, in particular numerical modelers,
- Data archiving.

Suggested Terms of Reference:

1. Develop and advise about best practices for coastal ocean observing systems;
2. Convene workshops/sessions to engage those involved in coastal ocean observing systems from around the North Pacific;
3. Advise on linkages between coastal ocean observing systems and both PICES activities (*e.g.*, FUTURE science program, NPESR) and open-ocean observatories (*e.g.*, Argo).

Suggested membership: Co-chairs, one each from the eastern and western sides of the North Pacific; 10–12 members from inside and outside PICES, for example:

- Jack Barth (USA, MONITOR)
- Sung Yong Kim (Korea, MONITOR)
- S. Kim Juniper (Canada)
- Hidekatsu Yamazaki (Japan)
- Vyacheslav Lobanov (Russia)
- China
- TCODE

MONITOR Endnote 7

Country Reports

Canada

I. Interesting Observations in 2014

A. Warm water in the North Pacific,

B. *Velella velella* invasion in June.

1. *V. velella* is a cosmopolitan genus of free-floating hydrozoans that live on the surface of the open ocean.
2. Wide scale beachings from California to British Columbia in August 2014 (Figure 1).
3. The interest in finding *V. velella* so close to shore (or on shore) in British Columbia is that they occupy warm, temperate to tropical waters of open ocean/high seas. Their presence in Canadian waters indicates anomalous oceanic wind and/or surface currents. The last beachings of *V. vellela* were in 2006, in an area from Tofino to Dixon Entrance.

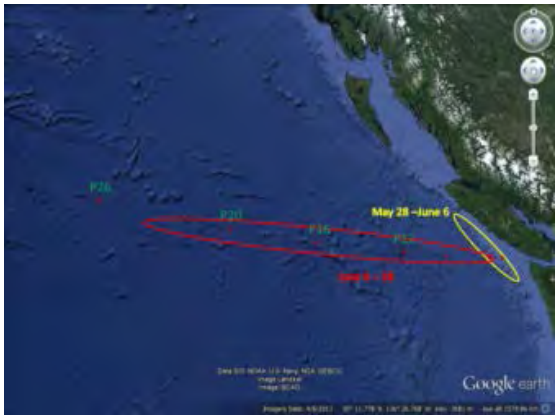


Figure 1. Research vessel siting of the Line P and La Perouse Zooplankton monitoring programs; estimated 30-50 individuals/m^2. Figure from M. Galbraith (DFO).

II. Observational programs

A. Monitoring by research vessel surveys (physical/chemical/biological/fisheries oceanography), ongoing

1. Line P: continuing at 3 surveys/year (February, May/June, August/September). Run by DFO/IOS, but extensive participation by university and international scientists. Areas of emphasis: hydrography, biogeochemistry, plankton dynamics (http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/line-p/index-eng.html).
2. NE Pacific continental margin: continuing at ~4 surveys per year, covering outer coast of Vancouver Island and parts of Queen Charlotte Sound/Hecate Strait. Areas of emphasis: time series of zooplankton and hydrography (nutrients, O_2, T, S, pH), and their links to climate variability and trends (Table 1).
3. Strait of Georgia: continuing at 4 surveys per year, with intensified sampling in 2010 and 2011. Areas of emphasis: hydrography and circulation, nutrients, phytoplankton, vertical flux of organic matter and contaminants.
4. Bowie Seamount: Offshore MPA (established 2008). A baseline video/ROV survey of the habitat and fauna of the upper ~200m has been completed (http://www.pac.dfo-mpo.gc.ca/oceans/protection/mpa-zpm/bowie/index-eng.html).

B. Ecosystem process surveys (including some surveys used for species stock assessments)

See poster FIS-P1, Boldt *et al*., "*Pelagic ecosystem monitoring in British Columbia, Canada*"

1. Small mesh multi-species survey: annual; west coast Vancouver Island (1973–present), Queen Charlotte Sound (1998–present); abundance and trends of shrimp and other species (*e.g*., eulachon).
2. Juvenile and adult Pacific salmon marine surveys: multiple surveys annually; Strait of Georgia (1997–present); west coast Vancouver Island (1998–present), Queen Charlotte Sound (1998–present); Central and Northern British Columbia (1998–2012); zooplankton and oceanographic data (Table 1).
3. La Perouse pelagic ecosystem survey: annual; daytime acoustic-trawl survey; west coast Vancouver Island (2012–present; presence data for 1982–2011); zooplankton, oceanographic data (Table 1).
4. Juvenile herring and nearshore pelagic survey: annual; Strait of Georgia (1992–present) and Central British Columbia (1992–2011); zooplankton and oceanographic data (Table 1).
5. Night time pelagic species and Pacific sardine survey: annual night-time trawl survey; west coast of Vancouver Island (2006–present); zooplankton, oceanographic data, and recently daytime acoustic, marine mammal, and seabird observations (Table 1).

C. Fishery-independent stock assessment and species at risk surveys

Fishery-independent surveys carried out either annually or at regular intervals for a number of harvested species (hake, multispecies groundfish, invertebrates) or species-at-risk. Increasing use of acoustics and underwater video, and increasing effort to collect and incorporate environmental information. Main surveys include:

1. Groundfish bottom trawl surveys: biennial; in even numbered years west coast of Vancouver Island (2004–present), and west coast Haida Gwaii (2006–present), in odd numbered years Hecate Strait (1984–present) and Queen Charlotte Sound (2003–present); oceanographic and oxygen data.
2. Pacific hake acoustic survey: biennial (was triennial); west coast North America, Southern California to Dixon Entrance (1977–present) (Table 1).
3. Other fish surveys: Pacific halibut (longline), sablefish (longline), lingcod (dive), rockfish (video), *etc.*
4. Salmon abundance (freshwater): estimates of adult salmon leaving and juvenile salmon arriving at the ocean are obtained annually in many rivers.
5. Dungeness crab trap survey: twice annually; Strait of Georgia (1988–present).
6. Green sea urchin dive survey: biennial; northeast Vancouver Island (1995–present); southeast Vancouver Island (2008–present).
7. Marine mammal surveys: throughout British Columbia.
8. Intertidal clam surveys: some annual series for abundance/trends (Heiltsuk Manila clam surveys 2000–present; Haida razor clam surveys 1994–present; Seal Island butter clam triennial surveys 1940–present).
9. Inshore shrimp assessment surveys: index areas surveyed annually until 2012, now biennial surveys (1998–present).
10. Prawn trap surveys: semi-annual, spawner index, Howe Sound (1985–present).
11. Species At Risk monitoring surveys for Northern Abalone: index sites monitored on five-year rotation, abundance and trends (various start dates, some as early as 1978–present).

12. Species At Risk monitoring surveys for Olympia Oyster: index sites to be monitored on five-year rotation, abundance and trends (2009–present).

D. Aquatic invasive species surveys

1. Aquatic Invasive Species intertidal monitoring surveys: annual surveys with shifting geographic focus to eventually provide baseline information coastwide (2006–present).
2. Aquatic Invasive Species European Green Crab trap surveys: annual surveys with shifting geographic focus, annual monitoring of Pipestem Inlet, Barkley Sound, tagging and depletion studies (2006–present).

E. Argo profiling drifters

Canada has been very active in this successful international program (ref. PICES-2009 presentations by Dr. Howard Freeland, S7-5645 and 5646). Since the start of the program, Canada has deployed many floats; Argo now has over 3579 floats active globally (see http://www.argo.ucsd.edu/).

F. North Pacific Continuous Plankton Recorder

Canada has contributed financial support since 2008 for the North Pacific CPR program plus hosts a local sorting center (at the Institute of Ocean Sciences), and collaborates with project lead, Dr. Sonia Batten, on some of the analyses and publications (see http://pices.int/projects/tcprsotnp/).

G. Cabled undersea observatory networks (VENUS and NEPTUNE)

The 'inland seas' component (VENUS) has nodes in the Strait of Georgia (since 2008) and in Saanich Inlet (since 2006–2007). These are now fully operational (see http://www.venus.uvic.ca for more detailed description and on-line access to data).

The 'offshore' component (NEPTUNE Canada) is a part of a broader US/Canada NEPTUNE network. The Canadian component (see www.neptunecanada.ca and www.oceannetworks.ca) is an elliptical loop extending from southern Vancouver Island across the continental shelf and slope to Endeavour Ridge. The framework was installed in summer 2009.

H. Acoustic tracking systems for biota

The Ocean Tracking Network (OTC) assumed ownership of three acoustic receiver lines in British Columbia: Queen Charlotte Strait, Juan de Fuca Strait, and the northern Strait of Georgia. These were formerly known at the Pacific Ocean Shelf Tracking project (POST). There were 88 receivers over 35 deployments uploaded to the OTN member's portal, September 2013. The acoustic receiver lines use acoustic-transmitting tags to track the movements of various marine biota. The data is available to members on the OTN website: http://otncanada.org/; http://oceantrackingnetwork.org/http://www.postcoml.org/.

I. British Columbia Shore Station Oceanographic Program

The British Columbia Shore Station Oceanographic Program (often referred to as the BC lighthouse data) began in 1914. Sea surface temperatures and salinities have been monitored daily at lighthouses on the west coast of Canada. Observations are logged and forwarded monthly to the Institute of Ocean Sciences where they are quality controlled and archived (http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/lighthouses-phares/index-eng.html).

III. Information synthesis and communication

A. A DFO "State of the Ocean" report was prepared annually (1999–2014) by a Fisheries Oceanography Working Group made up of DFO and university scientists. Annual reports, including those for 2013, are available: http://www.pac.dfo-mpo.gc.ca/science/oceans/reports-rapports/state-ocean-etat/index-eng.html.

Table 1. Pelagic ecosystem monitoring programs in British Columbia, Canada. SWCVI = southwest coast of Vancouver Island; WCVI = west coast of Vancouver Island; SOG = Strait of Georgia; BC = British Columbia; CC = Central Coast; CTD = Conductivity, Temperature, Depth (and other variables) recorder; TrawlRBR = Conductivity, Temperature, Depth (and other variables) recorder attached to the midwater trawl net. Table from FIS-P1 Poster, Boldt *et al*.

	La Perouse Plankton	La Perouse Pelagics	Night Time Pelagics	Hake	Salmon	Juvenile Herring
Years	1979–2014	2012–2014 (presence data 1968–2012)	2006–2014 (except 2007)	1995–2014 (earlier for some areas)	1998–2014 (trawl)	1992–2014 (except 1995)
General timing	May–June, September	Late July-Mid Aug	Mid July–Mid Aug	Mid Aug–Mid Sept	Mar., May, June/ July, Sept, Oct	Sept
Frequency	Twice per year	Annual	Annual	Biennial/ annual	Biennial/ annual, area-dependent	Annual
Area	WCVI (Shelf and offshore	La Perouse, (SWCVI) offshore	WCVI, offshore (some inlets)	WC North America offshore	BC offshore, inlets, SOG	SOG, CC (some years)
Time	Day and night	Day	Night	Day	Day	Night
Type	Zooplankton, hydrographic, acoustic	Acoustic/ trawl	Trawl	Acoustic/ trawl	Trawl/seine (purse, beach)	Seine
Net	Zooplankton	Midwater trawl	Midwater trawl	Midwater trawl	Midwater trawl; seines	Small purse seine
Physics	CTD, Water samples	CTD, Trawl RBR	CTD, Trawl RBR	Trawl RBR	CTD, Trawl RBR	CTD
Zooplankton	Bongo, multinet, acoustics	Bongo, acoustics	Bongo, acoustics	Acoustics	Bongo	Small bongo
Net camera	No	Half time	No	Yes	Some	No
Species sampled	All zooplankton	All, focus on herring	All, focus on sardine	All, focus on hake	All, focus on salmon	All, focus on herring
Diet	No	All fish	All fish	Hake	Salmon	Some fish
Demersal	No	Occasional	No	Occasional	Occasional	No
Mammal obs.	Yes (sporadic)	No	Yes	No	No	No
Seabird obs.	No	No	Yes (2014)	No	No	No

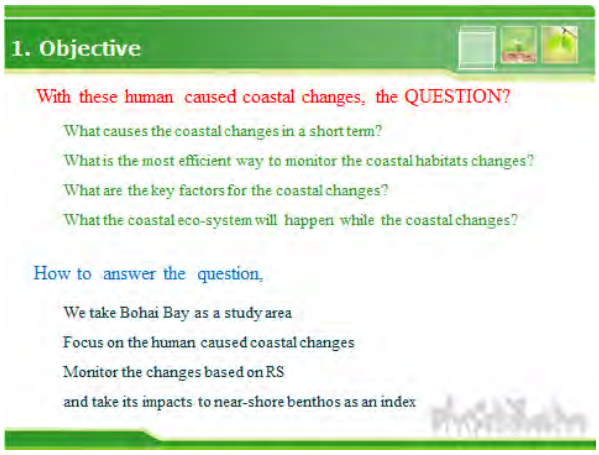
China

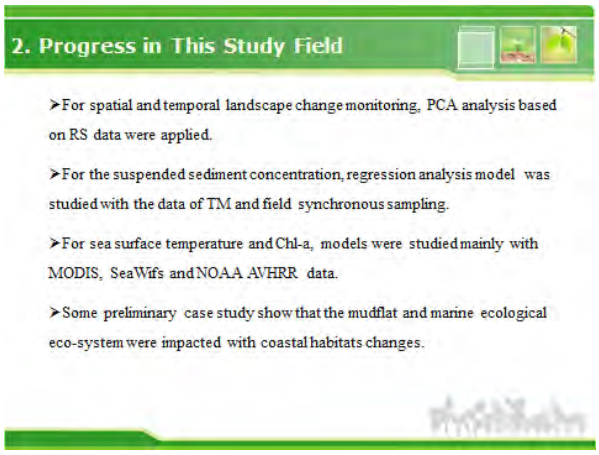
Human Caused Coastal Habitats Changes Monitored based on Remote Sensing and its Impacts to Near-shore Ecosystem – Bohai Bay as an Example

by Zhang Zhaungzhuang and Li Jilong
Chinese Academy of Fishery Science

At the beginning, this presentation gives the general situation of Coastal Habitats Changes Caused by Human beings in the world. Taking Bohai Bay as the interested area of study, it then applied the methods of segmentation (Multi-resolution) and classification with nine year's (dated in 1987, 1997, 2005, 2006, 2007, 2008, 2009, 2010 and 2011) Landsat TM remote sensing data to detect the coastal habitats spatial and temporal changes. The marine ecosystem survey data were also collected and processed to find the changes of macro benthos species composition, abundance, biomass, diversity and dominant species within the same period. The results show that there is a close relation between the macro benthos diversity degradation and mudflat and shallow sea losses.

The presentation for this report was provided after the MONITOR Committee meetings.



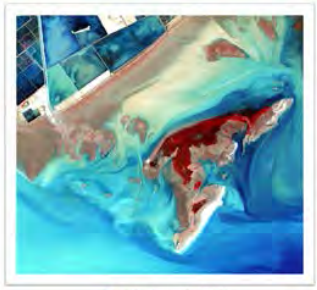


3.Overall Information of the Study Area

Coastal changes in Bohai Bay West Coast,1992 Vs 2012

1. Bohai Sea , a semi-closed sea, located to northeast of China main land
2. Bohai Bay is in the west part of Bohai Sea with Haihe River as main fresh water input
3. It used to be a key traditional fishing ground for shrimp, crabs and fish, particularly, the shell-fish habitat
4. Tianjin, a metropolis, and Huanghua city are located to its west coast with insufficient land resources
5. Heavily coast solidification and sea reclamation project were practiced along Bohai Bay in recent 10 years

3.Overall Information of the Study Area



Satellite image in 1987

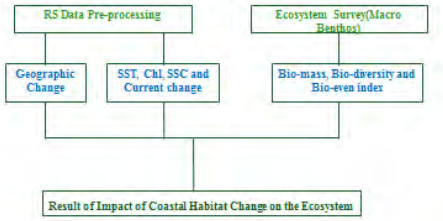
Take Caofeidian area as an example:

There are 4 rivers flowing into shallow sea, supplying sufficient freshwater and abundant nutrient, it used to be a famous habitat for fish.

There're many tidal inlets connecting with open seas outside Caofeidian. These tidal inlets are the migration channel for fishes, such as pike, yellow croakers and mullet, for spawning, feeding and overwintering.

4. Data and Methods

Flow Chart for Coastal Habitat Changes and Impact to Near-shore Ecosystem



4. Data and Methods

Data used for the Study

TM Data were used for geographic change monitoring

2000.06.18	2003.08.14	2005.05.15
2006.05.02	2007.04.03	2008.03.04
2009.05.26	2010.05.13	2011.05.16

Landsat TM used in Caofeidian Area

1987.5.14	1997.4.23	2005.5.15
2006.5.2	2007.4.3	2008.3.4
2009.5.26	2010.5.13	2011.8.20

Landsat TM used in Bohai Bay West Coast

Data	Data
Landsat-TM	1986.06.08
Landsat-TM	1996.05.31
Landsat-TM	2000.09.02
Landsat-TM	2001.07.16
Landsat-TM	2007.05.14
Landsat-TM	2009.06.04
ALOS	2006.03.15

Landsat TM used in Yellow River Delta

MODIS data from NASA were used for SST, Chl-a monitoring monthly average data, from 2003 to May, 2011

Inshore currents data are simulated by jointed project, conducted by Resources and Environment Center of CAFS and Hebei Fisheries Research Institute.

4. Data and Methods

Method for RS Data Pre-processing

Reflectivity Calculation

$$L_\lambda = \text{gain} \cdot DN + \text{bias}$$

$$\rho = \frac{\pi \cdot L_\lambda \cdot d^2}{ESUN_\lambda \cdot \cos(\theta)}$$

Note
L_λ Radiance
DN grey level of picture element;
gain
bias
ρ apparent reflectance of ground features
d Day astronomical unit distance
ESUN solar irradiance
θ solar zenith angle

Geometric correction

Based on TM images in 2009; 25 control points selected; applying quadratic polynomial models and bilinear interpolation;

Band selection and color composition

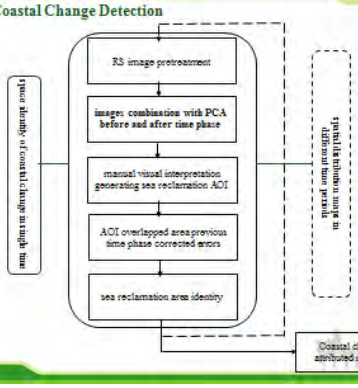
Band 543 were selected for obtain color images.

Land mask

NDWI=(B2-B4)/(B2+B4)
water is positive, soil and vegetation negative;
To separate water from land.

4. Data and Methods

Method for Coastal Change Detection



4. Data and Methods

PCA analysis for Geographic Change Classification

(1) Based on original images matrix X to calculate covariance matrix $\sum x$;

(2) Characteristic equation $|\lambda I - \sum x| = 0$ to calculate every eigen value λ_i (i=1,2,3……)of the covariance matrix $\sum x$, and sorting as $\lambda_1 \geq \lambda_2 \geq \ldots\ldots \geq \lambda_n$;

(3) Based on eigen value λ to calculate the relevant eigenvector v_i;

$v_i = (v_{1i}, v_{2i}, \ldots, v_{ni})^T$;

(4) Take transformational matrix $A = U^T$ and obtain new image matrix Y after principal component transformation.

$$Y = \begin{pmatrix} u_{11} & \cdots & u_{1n} \\ \vdots & & \vdots \\ u_{n1} & \cdots & u_{nn} \end{pmatrix} X = U^T X$$

After principal component transformation of the TM images, new image matrix Y is obtained, in which vectors are called 1st principal component, 2nd principal component ..... 7th principal component.

Since before transform the results, the main information of two images focus on the first 3 components, the last 3 components reflects different information of the 2 images, the last components are selected to automatically find spatial distribution of the sea reclamation

4. Data and Methods

SSC SST Changes

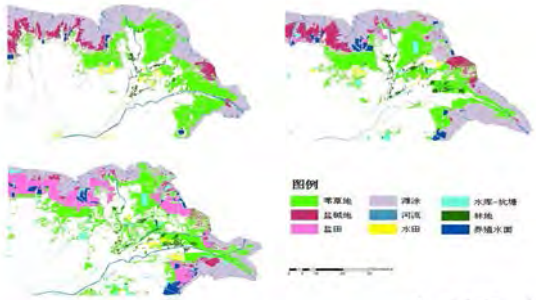
Suspended solid concentration in surface water were calculated with TM data band 3. The modal was expressed as follows:

$$SSC = 104.481 + 32.557 * \ln b3$$

In which:
SSC means suspended sediment concentration;
B3 means apparent 3-band spectral reflectance values by Landsat-TM satellite.

5. Results

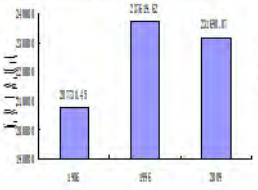
(1) Coastal Changes for Yellow River Delta



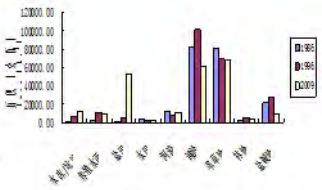
Wetland distribution map of the Yellow River Delta in 1986, 1996, 2006

5. Results

(1) Coastal Changes for Yellow River Delta



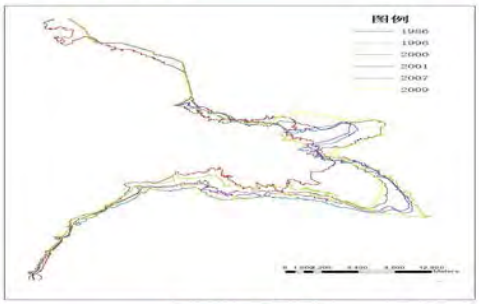
The area variety of the Yellow River Delta wetland



The variations for different types of wetland

5. Results

(1) Coastal Changes for Yellow River Delta

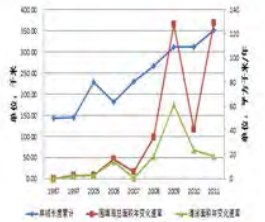


The changes of coastline from 1986-2009 in Yellow River Delta

5. Results

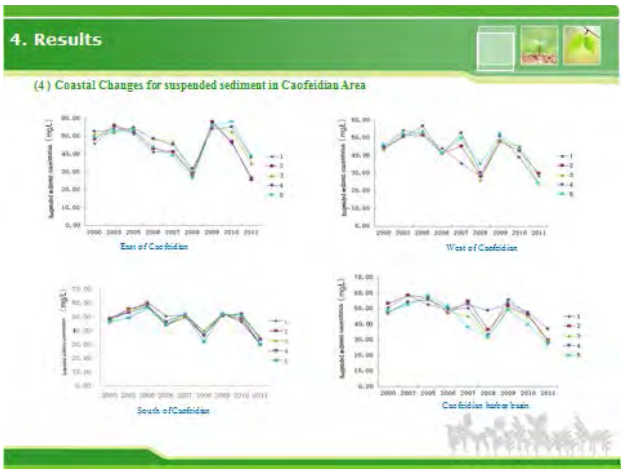
(2) Coastal Changes for West Coast-Tianjin

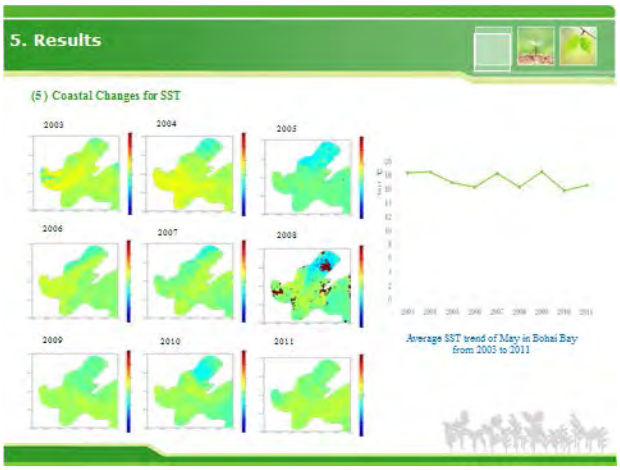
Spatial-temporal changes sea reclamation in Bohai Bay Tianjin region from 1887 to 2011

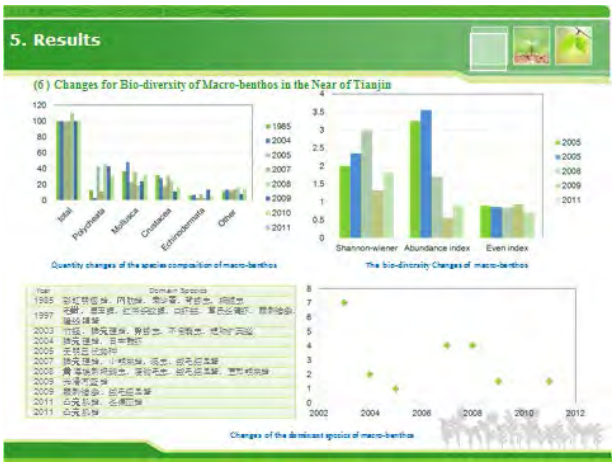


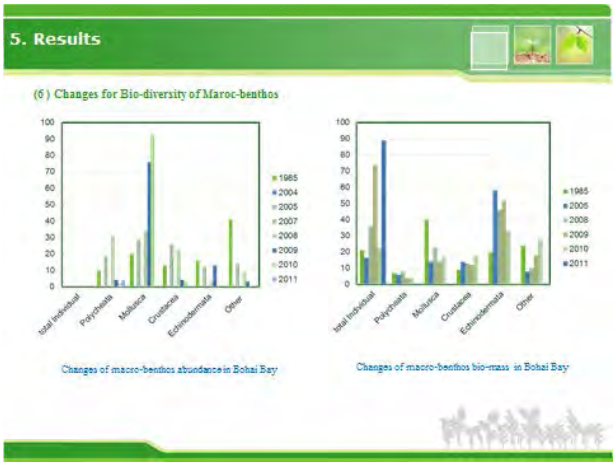
Annual length of the coastline and change of sea reclamation and tidal area in Bohai Bay Tianjin region from 1887 to 2011

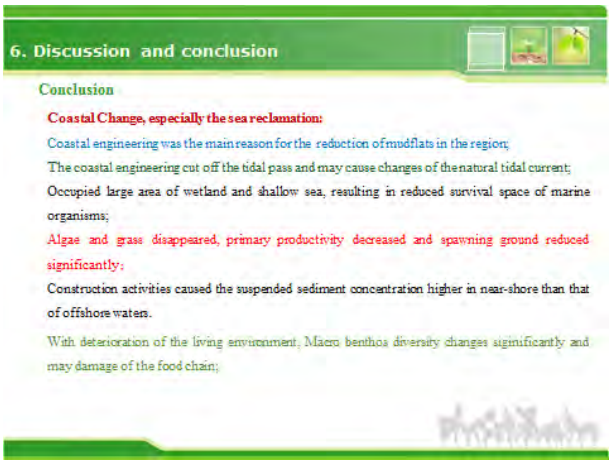

5. Results
(3) Coastal Changes for North Coast- Caofeidian
Remote sensing image of 1987
Remote sensing image of 2011
Sea reclamation areas in different time periods
Variation trend of mudflat areas

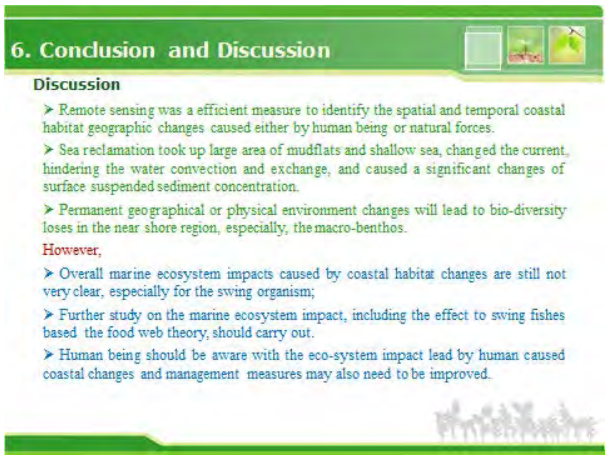

4. Results
(4) Coastal Changes for suspended sediment in Caofeidian Area
East of Caofeidian
West of Caofeidian
South of Caofeidian
Caofeidian harbor basin

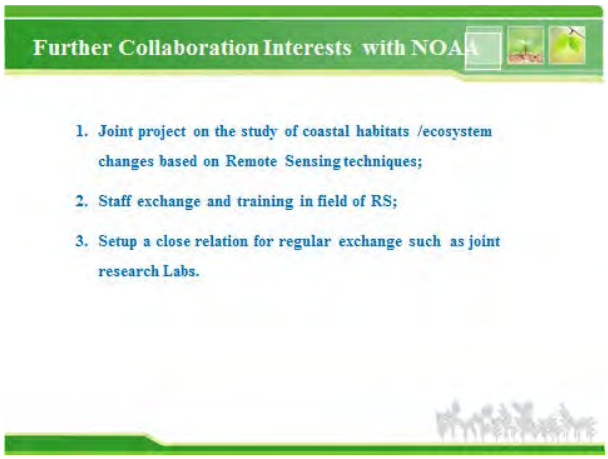

5. Results
(5) Coastal Changes for SST
2003
2004
2005
2006
2007
2008
2009
2010
2011
Average SST trend of May in Bohai Bay from 2003 to 2011


5. Results
(6) Changes for Bio-diversity of Macro-benthos in the Near of Tianjin
Tidal
Polychaeta
Mollusca
Crustacea
Echinodermata
Other
Shannon-wiener
Abundance index
Even index
Quantity changes of the species composition of macro-benthos
The bio-diversity Changes of macro-benthos
Changes of the dominant species of macro-benthos


5. Results
(6) Changes for Bio-diversity of Maroc-benthos
Total Individual
Polychaeta
Mollusca
Crustacea
Echinodermata
Other
Changes of macro-benthos abundance in Bohai Bay
Changes of macro-benthos bio-mass in Bohai Bay


6. Discussion and conclusion
Conclusion
Coastal Change, especially the sea reclamation:
Coastal engineering was the main reason for the reduction of mudflats in the region;
The coastal engineering cut off the tidal pass and may cause changes of the natural tidal current;
Occupied large area of wetland and shallow sea, resulting in reduced survival space of marine organisms;
Algae and grass disappeared, primary productivity decreased and spawning ground reduced significantly;
Construction activities caused the suspended sediment concentration higher in near-shore than that of offshore waters.
With deterioration of the living environment, Macro benthos diversity changes significantly and may damage of the food chain;





Japan

Report from JAMSTEC
by Sanae Chiba

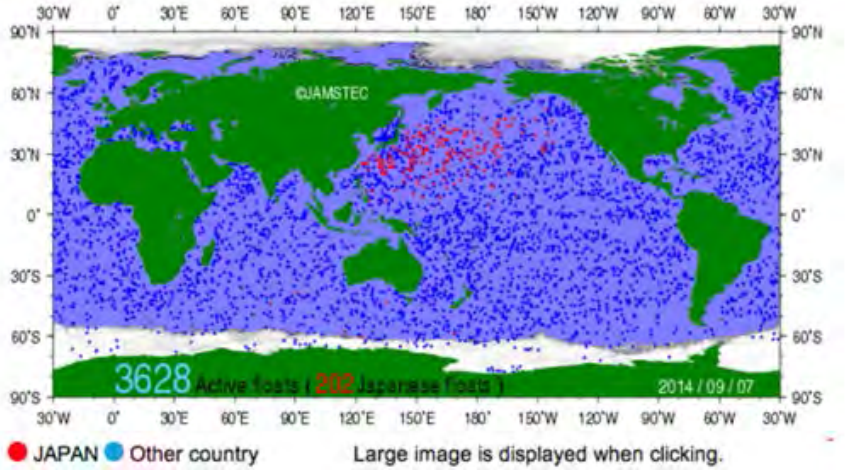
Organizational Change

Dr. Sanae Chiba reported that substantial structural change was made in April 2014 when JAMSTEC's new 5-yr midterm plan started. In the new organization scheme, the section RCGC (Research and developmental Center for Global Change) is in charge of variety of ocean observation programs. Conventional monitoring projects as shown below are succeeded and under operation by RCGC. These projects yet are mainly limited to physical, chemical and atmospheric observation. JAMSTEC has had no rigid background/history for long-lasting biological/ecosystem monitoring programs in context of global change study although it has extensively promoted studies on deep-sea biology.

Observation Programs of RCGC

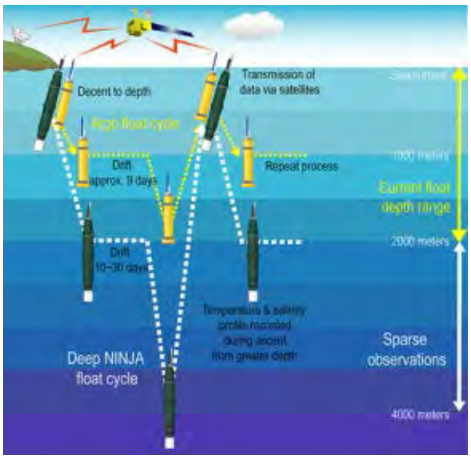
The Pacific Argo Regional Center (http://www.jamstec.go.jp/ARGORC/location_top.html)

The Pacific Argo Regional Center (PARC) has been established as a joint collaboration between the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the International Pacific Research Center (IPRC) at the University of Hawaii, and the Commonwealth Scientific and Industrial Research Organization (CSIRO). The PARC takes on the responsibility to validate all float data in the Pacific through rigorous scrutiny and to derive regional products based on these floats.



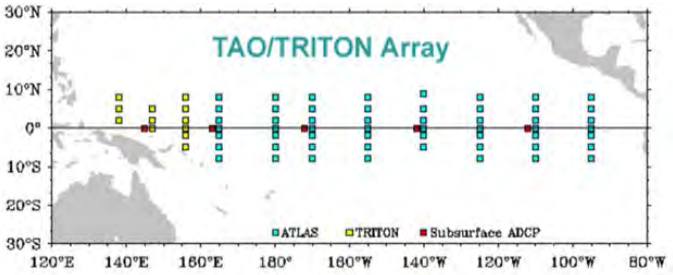
Deep NINJA: Deep ocean observation by deep-sea float (http://www.jamstec.go.jp/ARGO/deepninja/)

JAMSTEC has deployed 14 Deep NINJA floats in collaboration with Tsurumi-Seiki Co., Ltd, primarily in the Southern Ocean in 2014. As of July 25, 2014, these floats have/had continued to operate well and have observed more than 190 oceanic profiles. Notably, one Deep NINJA float (S/N 6) deployed off the Adelie Coast of Antarctica measured deep profiles under sea ice throughout an Antarctic winter and continued to observe seasonal changes of the deep/bottom waters for more than one year. This website introduces the Deep NINJA float itself (some photos at deployment) and provides listings of the Deep NINJA observations. These include the dates and locations of float deployments and observation parameters such as observation cycle and profile depth. Additionally, there are several figures showing observation results, such as float movement trajectories, temporal changes of temperature and salinity profiles as measured by the floats.



TAO and TRITON Project (http://www.pmel.noaa.gov/tao/index.shtml)

Operating moored ocean buoy (TRITON) network to obtain real-time air-sea data in the equatorial western Pacific and eastern Indian Ocean for improved detection, understanding and prediction of El Niño and La Niña.



IOMICS Project: Indian Ocean Moored Buoy Network Initiative for Climate Studies (http://www.jamstec.go.jp/iorgc/iomics/projectoverview/projectoverview_eng.html)

Developed new-type of moored buoy network, which observe sea surface heat flux components and ocean temperature and salinity in the upper layer, to understand mechanism of the Indian Ocean's variation and its importance for global climate system under a cooperative framework among surrounding countries.

Repeat Hydrography (http://www.jamstec.go.jp/iorgc/ocorp/data/post-woce.html, http://www.jamstec.go.jp/rcgc/e/gcpog/)

Repeat hydrography along the WOCE observation lines etc. Observation of chemical tracers, total alkalinity, pH, Ω, and nutrients to accurately quantify influences of global warming and ocean acidification on marine ecosystems, as well as to depict changes of the ocean heat content and the distribution of substances in seawater.

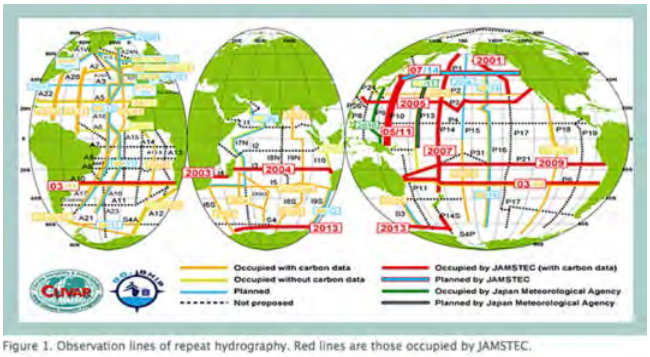


Figure 1. Observation lines of repeat hydrography. Red lines are those occupied by JAMSTEC.

Other Monitoring Programs

Biogeochemical Time-Series (http://www.jamstec.go.jp/rigc/e/ebcrp/)
* The website information is of the organization schemes before April 2014.
Collecting biogeochemical data by shipboard and mooring observations at Station K2 (subarctic) and S1 (subtropical). Sediment trap data have been collected at K2 since the 1990s.

Tohoku Ecosystem-Associated Marine Science (TEAMS) (http://www.jamstec.go.jp/teams/e/index.html)
Monitoring for restoration of ecosystem and fisheries of Tohoku coastal regions after the earthquake and tsunami disaster in 2012.

Studies on the monitoring, evaluation and prediction of biodiversity in Asia (funded by the ministry of environment of Japan)

by Hiroya Sugisaki

Background

At the meeting of Convention on Biological Diversity held in Nagoya, Japan (COP 10) in 2010, "Aichi Target" was endorsed and it is necessary for nation to identify EBSA (Ecologically and Biologically Significant Area) in their territorial sea. Using remote sensing data and field monitoring data, current and future status of biodiversity of various marine ecosystems are analyzed.

Members and research area

This research project has 6 sub-teams studying different ecosystems.
Sub-team 1: General research in Asian sea area (JAMSTEC)
Sub-team 2: Sea weed area (Hokkaido University)
Sub-team 3: Sea grass area (AORI, University of Tokyo)
Sub-team 4: Coral reef (National Institute for Environmental Studies; NIES)
Sub-team 5: Oceanic Zooplankton (FRA)
Sub-team 6: Deep Sea (JAMSTEC)

Identifying EBSA

According to the result of the analysis on the status of ecosystems, their EBSA (Ecologically or Biologically Significant Marine Area) were identified and prioritize the marine protected areas.

Report from Hokkaido University

by Sei-Ichi Saitoh

New *Oshoro-maru* V completed

The R/V *Oshoro-maru* received the first PICES Ocean Monitoring Service Award POMA (in 2008) and new *Oshoro-maru* V was completed on July 28, 2014. On August 1, Hokkaido University had a ceremony for completion of the new ship in Hakodate. R/V *Oshoro-maru* V is larger than *Oshoro-maru* IV, 200 tons in gross tonnage (1598 tons) and 6m overall length (78 m).

Hakodate Research Center for Fisheries and Oceans

A new scientific center, Hakodate Research Center for Fisheries and Oceans, was opened near Hakodate dockyard on June 1, 2014 and a ceremony for completion of this new center. Many academic institutions participate and private companies also enter in this center for promotion academia-industrial-governmental cooperation activities in fisheries and marine sciences.

New satellite for coastal ocean monitoring

JAXA will launch new satellite G-COM-C1 mounted new ocean color sensor SGLI (Second generation GLobal Imager), which has spatial resolution of 250 m for coastal ocean monitoring. JAXA has a plan to launch in spring–summer 2016 almost two years later (http://global.jaxa.jp/projects/sat/gcom_c/index.html).

Korea

Report from NFRDI (National Fisheries Research & Development Institute)

New Ocean Survey
NFRDI has started the Physical feature investigation in the southwestern part of East Sea from 2014 to understand the detailed oceanic physical features and the variation of permanent or seasonal thermoclines and thermal front. This survey is carried out 4 times a year on 103 stations with 11 lines in this year. The measured factors in this survey are temperature, salinity, transparency, sound speed and meteorological factors.

Additional Moored Buoy
NFRDI also constructed the real-time red-tide observation buoy system on late July in 2014 around the southern coast of Korea. This moored buoy measures temperature, salinity, current speed, dissolved oxygen, chl-*a* and meteorological factors with each 30 minute interval on real-time. This buoy system is operated to understand the oceanic conditions around the frequent appearance area of HAB and to detect the outbreak of HAB in the first stage around the southern coast of Korea.

Service the Real-time Oceanographic Data to fishermen
NFRDI operates 28 Real-time Information System for Agriculture environment (RISA) around the coastal area of Korea. This system measures temperature, salinity and dissolved oxygen every 30 minutes at several depths. The data from this system were serviced by internet web-page, mobile web-page and SMS (Short Message Service) until now. NFRDI developed an application program for the smartphone and started the service in October 2014.

Satellite Tracking Buoys and Tagging Experiment
NFRDI deployed 7 satellite tracking buoys to understand the behavior of giant jellyfish around the Yellow Sea and northern East China Sea in summer 2014. NFRDI also carried out the tag experiments with 4 satellite tags in giant jellyfish body around the southern part of Korea and Jeju Island in summer and autumn 2014.

Report from KHOA (Korea Hydrographic and Oceanographic Administration)

Additional HF-Radar and Large-scale Ocean Buoy Stations
KHOA operated 47 tidal stations, 6 ocean stations, 19 moored ocean buoys, 6 HF-radar systems and 1 ocean research station until 2013. In 2014, KHOA constructed 2 additional HF-radar systems around the northern part of Gyeonggi-bay and Gwangyang-bay, which will be operated from December 2014. KHOA also constructing 2 additional large-scale ocean buoys around the northern part of Gyeonggi-bay and Gwangyang-bay, which will be operational in from 2014.

Report from KIOST (Korea Institute of Ocean Science & Technology)

Operation and Construction the Ocean Research Station
KIOST constructed 3 ocean research stations: Ieodo Ocean Research Station, Gageo Ocean Research Station and Yellow Sea Ocean Buoy, until 2013. KIOST also operates 2 ocean research stations, which are Gageo Ocean Research Station and Yellow Sea Ocean Buoy (Ieodo Ocean Research Station was operated by KHOA since 2007). KIOST has plans to construct a new ocean research station around the northwestern area of Korea in late 2015.

Report from KMA (Korea Meteorological Administration)

Additional Oceanic Meteorological Observation System
KMA constructed and operated 10 ocean buoys, 9 light tower observation systems, 6 wave gauges, 38 wave buoys, 17 coastal disaster observation systems, 2 port observation systems, 2 vessel observation systems,

1 research vessel and 1 oceanic weather station until 2013. KMA will additionally construct 1 ocean buoy, 4 wave buoys, 1 coastal disaster observation system, 1 port observation system and 2 vessel observation equipment until late 2014.

Russia

Monitoring Activities at TINRO-Centre

by Vladimir Kulik, Regional Data Center, Vladivostok, Russia

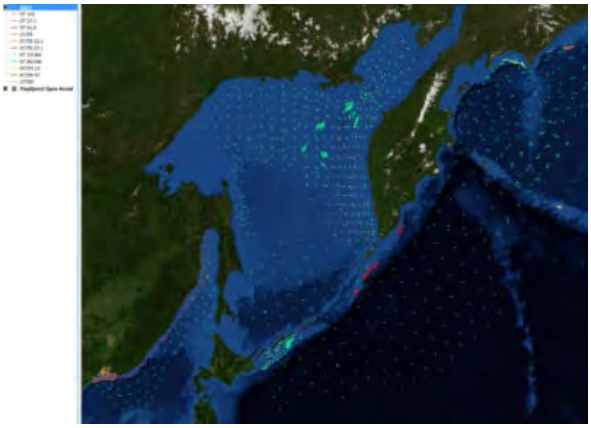


Figure 1. Typical schema of trawl, plankton and CTD stations in the North-Western Pacific as in 2013. The International annual survey for estimating walleye pollock population status in the Bering Sea is not shown.

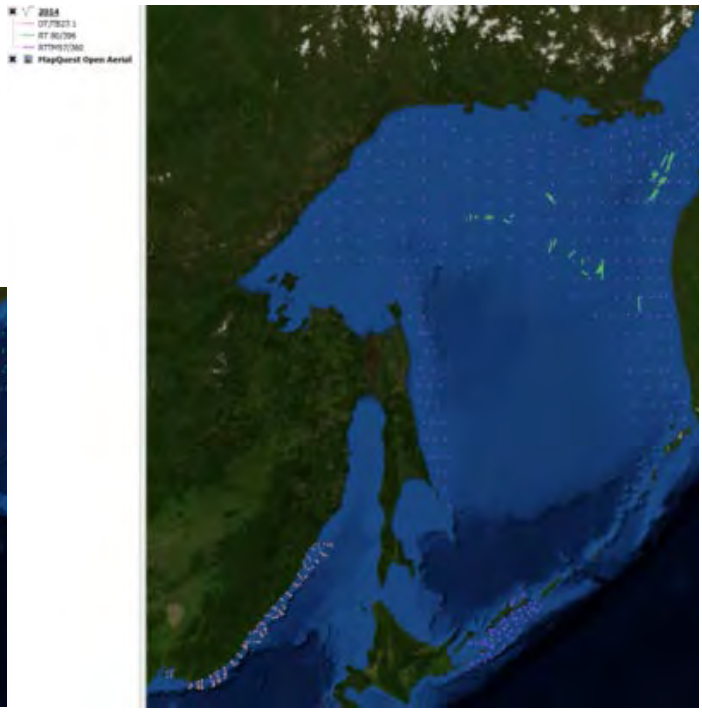


Figure 2. Tracks of trawl stations mostly with plankton and CTD in the beginning or the end of the track in the North-Western Pacific in 2014. Surveys in the open waters are going on and the data will be imported by RDC only at the end of 2014.

Figure 3. Officially registered updated and validated databases by RDC. RDC initiated working group on meta-data exchange between Russian fishery Institutes in the beginning of 2014, but we had not got the official letter approving this activity, yet.

Table 1. The quantities of CTD (to the bottom), plankton (0–200 m) and trawl stations are almost equal.

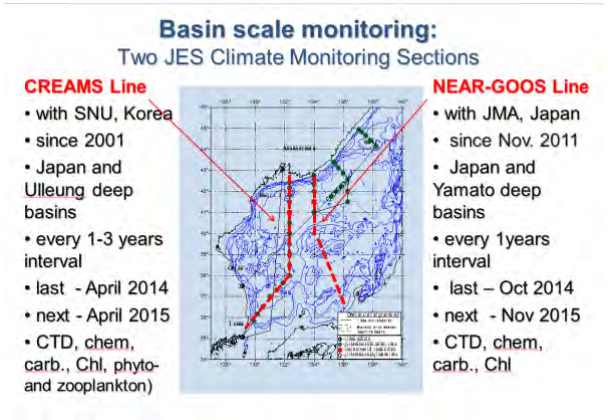
Stations in 2013 stored by RDC on Oct 2014					
	Bering	Okhotsk	Pacific	Japan /East	**Sum**
Bottom	**7**	**107**	**185**	**555**	**854**
0-50	7		185	192	**384**
50-150				168	**168**
150-250		4		60	**64**
250-350		17		48	**65**
350-450		17		27	**44**
450-550		18		37	**55**
550-650		19		14	**33**
650-750		15		9	**24**
750-850		13			**13**
850-950		2			**2**
950-1050		2			**2**
Pelagial	**244**	**472**	**265**	**75**	**1056**
0-50	222	113	161	72	**568**
50-150	20	174	37		**231**
150-250		122	27	2	**151**
250-350	2	40	31		**73**
350-450		21	9	1	**31**
450-550		2			**2**
TOTAL	**251**	**579**	**450**	**630**	**1910**

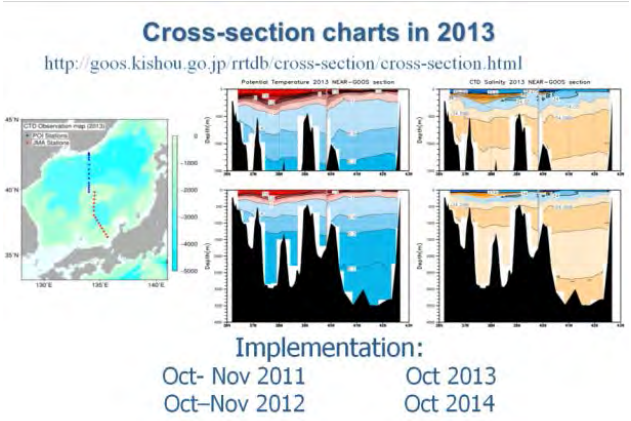
Stations in 2014 stored by RDC on Oct 2014					
	Bering	Okhotsk	Pacific	Japan /East	**Sum**
Bottom				172	**172**
0-50				31	**31**
50-150				49	**49**
150-250				25	**25**
250-350				20	**20**
350-450				13	**13**
450-550				16	**16**
550-650				9	**9**
650-750				9	**9**
Pelagial		326	47		**373**
0-50		32	5		**37**
50-150		140	13		**153**
150-250		129	20		**149**
250-350		21	9		**30**
350-450		4			**4**
TOTAL		**652**	**94**	**344**	**1090**

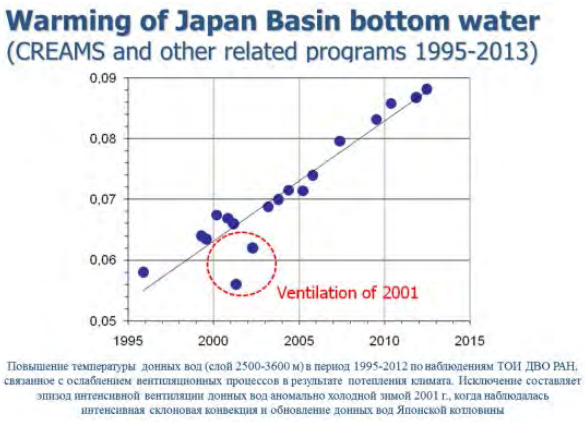
POI monitoring activities in 2014

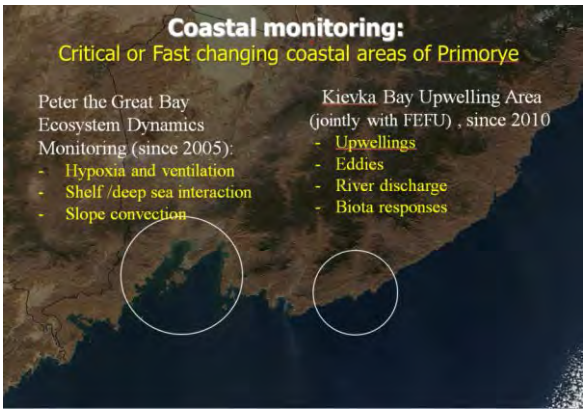
by Vyacheslav B. Lobanov

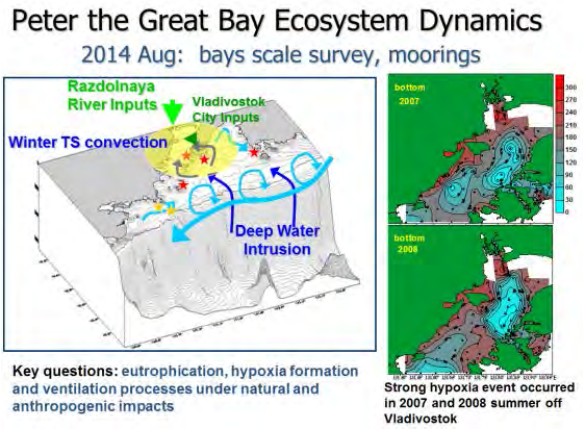
Monitoring takes place in three areas/topics:
Basin Scale: JES response to climatic changes and anthropogenic impacts
Coastal: NW JES areas of critical changes
Fukushima consequences: Radionuclides in Russian waters and western Pacific

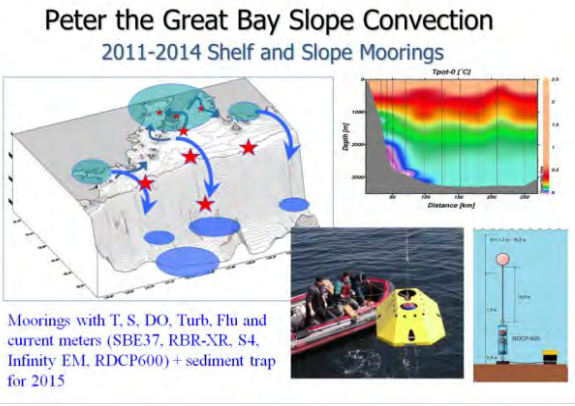


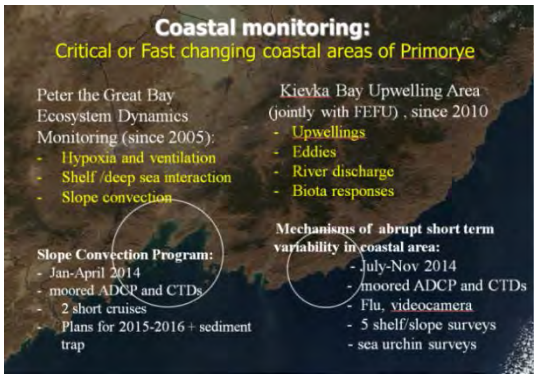


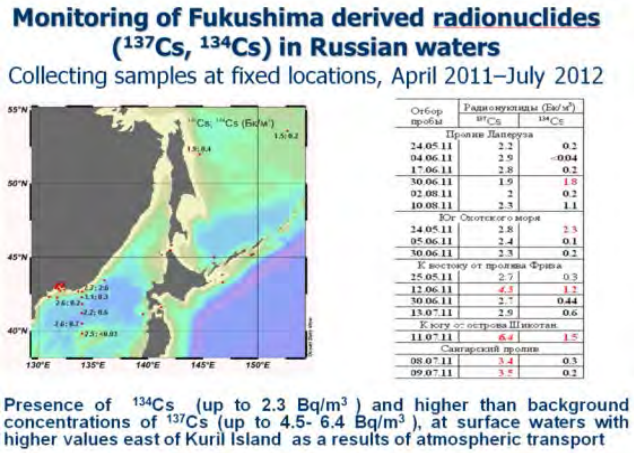












POI monitoring activities in 2014:

Basin scale: JES response to CC and Al

- S-CREAMS (April 2014)
- NEAR-GOOS (October 2014)

Coastal: NW JES areas of critical changes

- Hypoxia formation in PGB
- Primorye upwelling area

Fukushima consequences: Sampling in JES

USA

Final Report of the Alaska Ocean Observing System 2013 – 2014

Phil Mundy reporting for Molly McCammon, AOOS Executive Director

In 2013 – 2014 AOOS[1] continued to grow and innovate in collecting and presenting real-time observationson the coastal and ocean environments of Alaska[2] . AOOS in cooperation with US National Oceanic and Atmospheric Administration (NOAA) and University of Alaska Fairbanks (UAF) have been monitoring ocean acidification in the Gulf of Alaska (GOA) and Bering Sea from moorings using OA sensors. In addition, in the Gulf OA sensors are fitted to gliders and a cruise ship of opportunity[3]. AOOS is supporting an OA forecasting model being developed from and trained by the now rapidly accumulating OA data set. AOOS is also streaming wave data from buoys in the Arctic near the Bering Strait and from Lower Cook Inlet. AOOS is also supporting several observation programs in the Chukchi Sea: a pilot effort to monitor marine mammals in the Chukchi Sea by using acoustic recorders on gliders; shore-based high frequency radars to map sea surface currents; and deployment of a year-round mooring to monitor biological, chemical and physical oceanographic variables – the first of its kind in Alaska waters.

While real-time ocean observations are a core mission at AOOS, with hundreds of real-time sensor feeds from all over Alaska available on the web (Real-Time Sensor Map[4]), enormous strides have been made in serving users by giving them easy and rapid access to historical and near real-time ocean and atmospheric observations from a wide variety of sources. Visualizations and data downloads of historical to near real-time observations from all primary sources (NOAA, NASA, USGS, GINA, and more) are only a few mouse clicks away through the Ocean Data Explorer[5]. Users have access to thousands of ocean observation datasets including salinity, temperature, administrative boundaries, critical habitat areas and social and economic observations, updated monthly, that can be stacked together into a single visualization. In addition the Model Explorer[6] gives users the same capabilities to find and examine an ever-growing body of modeled values for all of Alaska's marine waters. AOOS has many other products that assist users from a wide diversity of user communities, such as oil spill response (CIRT[7]), sea bird research (Seabird Portal[8]), environmental assessment (Research Assets Map and Industry Data Portal[9]), and integrative ecosystem research collaborations (Research Workspace[10]). The best way to learn about the many ways that AOOS meets the needs of users for physical and other scientific data types[11] is to explore the links above.

1 http://www.aoos.org/
2 http://www.aoos.org/overview-of-monitoring-efforts/
3 http://www.aoos.org/new-ocean-acidification-study-launched-in-prince-william-sound/
4 http://www.aoos.org/new-sensor-map/
5 http://www.aoos.org/tutorial_ode/
6 http://portal.aoos.org/models-grids.php
7 http://portal.aoos.org/cirt.php
8 http://axiom.seabirds.net/maps/js/seabirds.php?app=north_pacific#z=3&ll=55.00000,-170.00000
9 http://portal.aoos.org/research-assets.php and http://www.aoos.org/industry-arctic-data/
10 http://www.aoos.org/aoos-ocean-workspace/
11 http://www.aoos.org/aoos-data-resources/

Final Report of the Northwest Association of Networked Ocean Observing Systems (NANOOS), 2013 – 2014

Jack Barth reporting for Jan Newton, NANOOS Executive Director

In 2013–2014 NANOOS http://www.nanoos.org/ continued to carry out (near) real-time observations and modeling of the coastal and ocean environments off the U.S. Pacific Northwest (Washington – WA, Oregon – OR, northern California). NANOOS has grown to include over 50 signatories, with members representing the interests of all the different regions and sectors: industry, government (federal tribal, state, local), non-governmental organizations, education, and research. During 2013–2014, NANOOS made progress for 1) observing systems (shelf, estuaries, shorelines, and currents), 2) modeling (estuaries and shelves), 3) Data management and Communications (DMAC), 4) User Products, and 5) Education and Outreach. These include maintaining the La Push (WA), Newport (OR), and Columbia River (OR) buoys, with both the La Push and Newport moorings measuring parameters related to measuring ocean acidification. For the estuaries, NANOOS maintained moorings in Puget Sound (WA), the Columbia River (OR), Willapa Bay (WA) and South Slough (OR). NANOOS also maintained the Oregon HF radar sites, for measuring ocean surface currents, and the X-band radar site for measuring waves near the Newport (OR) harbor entrance. The numerical circulation modeling and forecasting capabilities were maintained for the open coastal ocean and the Pacific Northwest estuaries. All NANOOS data, data products, and mobile apps are available on the NANOOS Visualization System (NVS): http://nvs.nanoos.org). NANOOS continues to update and receive good feedback on its two mobile phone apps, both available for Apple and Android platforms: TsunamiEvac-NW Mobile App; NVS (NANOOS Visualization System) Assets App (http://www.nanoos.org/mobile_apps/index.php).

Final Report of the Ocean Observatories Initiative (OOI), 2013 – 2014

by Jack Barth, OOI Project Scientist

In 2013–2014, the U.S. National Science Foundation-sponsored Ocean Observatories Initiative (OOI) continued construction of a regional ocean observing system off the U.S. Pacific Northwest. The OOI array off the Pacific Northwest consists of cabled underwater nodes/laboratories, uncabled moorings, and a fleet of 6 underwater gliders. During 2013–2014, the underwater power and data modules were installed on the over 800-km long seafloor cable. This was accomplished using a Remotely Operated Vehicle. Subsequently, the oceanographic platforms (moorings, bottom nodes) and sensors (physical, geological, biological and chemical) were installed at the OOI cabled nodes of interest: Axial Volcano, Hydrate Ridge, Oregon continental slope (~600 m), and Oregon continental shelf (80 m). At the 80-m Oregon shelf site, a benthic experiment package was deployed carrying a full range of sensors including a nearby 4-frequency, upward-looking bioacoustics system, a broadband hydrophone and an underwater camera. Near the coast, two uncabled moorings were installed in 25 m of water off Newport, Oregon, and Grays Harbor, Washington. These surface moorings use a stretchy hose with internal electrical conductors that allows the mooring to stretch to nearly twice its length without breaking and still maintaining power and communication up and down the mooring. The glider array was initiated in early October 2014 and will realize its full 6-glider size by early 2015. The final OOI infrastructure will be completed by spring 2015. After a verification period, all data will be publicly available on the OOI data web site.