RCN: OceanObsNetwork

Annual Report for 2014

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1. Overview.

The goal of the RCN OceanObsNetwork [RCN] is to foster a broad, multi-disciplinary dialogue, enabling more effective use of ocean observing systems, consistent with national and international efforts, to inform societal decisions.

To achieve this goal, the RCN has defined a series of objectives:

- Motivate commitments to sustaining ocean and marine observing systems
- Stimulate inter-disciplinary cooperation for both observations and analyses
- Facilitate open exchange of ocean data
- Promote interoperability
- Improve the flow of critical ocean observation information to key stakeholders
- Stimulate capacity building and retention in ocean and marine observations community

The RCN will also consider related issues such as integration of space-based and in-situ measurements, and innovative concepts in sensors, information systems and user interfaces. The network members may propose additional subjects.

See Appendix I for the complete RCN Terms of Reference.

The RCN consists of senior ocean scientist from the US and other countries from a number of ocean science disciplines. The RCN members and volunteers are listed in Appendix II.

Detailed information on meetings and reports are provided in the Appendix III.

The following paragraphs highlight the RCN activities for 2013/14.

2. Working Environment.

The RCN operates primarily through electronic information exchange. Its members use websites, discussion fora and other tools for communication and collaboration.

The RCN meets three times per year, two virtual meetings and an annual in-person meeting. In 2014, the virtual meetings were held in May 22 and October 24. The face-to-face meeting will be held in San Francisco on December 14, prior to the start of the AGU meeting.

The RCN Plenary reviews and comments on Working Group (WG) reports prior to their public release and forwarding to appropriate parties. Coordination of the RCN activities with existing networks is facilitated by RCN members whose organizations are participating in those networks.

3. Working Groups.

The RCN is primarily a forum to address issues of enhancing ocean observation and information and the challenges of multi-disciplinary research across the ocean sciences. It is not a body

chartered to undertake new scientific research. Issues engaged by the RCN are addressed by the body as a whole (Plenary) or through working groups constituted by the RCN. A working group generally focuses on one of the RCN objectives and produces a report clearly identifying the issues, approaches, impacts and recommendations for achieving the objective(s).

Working groups have a defined term of operation, generally nine months (renewable), to assess issues and then submit their recommendations for review by the Plenary. The reviewed recommendations will be provided to international, national and program level organizations for consideration and possible implementations.

Members of the RCN and other invited experts constitute working groups. They operate under a Working Group Terms of Reference that include objectives, a schedule, an operations modality and a list of deliverables. Network members may serve on multiple working groups. In their deliberations, the working groups may invite external experts to make presentations and provide background on issues being addressed.

Five working groups were active or in initiation phase in 2014.

A. The Open Data Working Group

A working group report was issued on May 30 2013. This report analyzed the current situation and challenges for open data and then made recommendations for greater expansion and acceptance of the open data paradigm. A decision was made by the working group to publish a peer-reviewed paper on open data and recommendations for expansion of data access. The paper was reviewed and was resubmitted with changes during 2014. The WG is awaiting notification of status as of the date of this report.

B. The Outreach and Education Working Group

The working group was started mid-August of 2012 and continues the webinars series, "the Blue Marvel - Ocean Mysteries". The webinars are available for viewing and access through the RCN website (www.oceanrcn.org). The webinar presentations – dates and speakers - are summarized in the events list of Section 7 of this report.

C. The RSS-In-situ Working Group

This working group is addressing how to integrate future satellite measurements with future measurements from in-situ ocean observing systems to study ocean/coastal processes. The timeframe for technology being examined is 2020 and after. The subject addresses both observations and the coupling of data with models for improving the understanding of the complex coastal environment with its combination of ocean, rivers and weather interactions. A draft report is under review and will be issued in early 2015.

D. Support for BIO- TT

The RCN worked with the Interagency Ocean Observation Committee's (IOOC) Biological Integration and Observation (BIO) Task Team in organizing a workshop with the goal to identify and prioritize additional crosscutting biological and ecosystem observational needs (beyond the existing 6 IOOS biological core variables). Bringing together a broad range of ocean biologists, the workshop provided a forum for identifying and prioritizing needs along with understanding the maturity of observation techniques for measuring key biological essential ocean variables.

E. Sensor Working Group

A working group is being formed to look at sensors that can support the emerging biology essential ocean variables. The charter is under discussion and the objectives are still subject to change.

F. Citizen Science Working Group

A working group started in November 2104 that will look at existing citizen science activities and areas for which further emphasis can be placed.

4. Outreach and Dissemination.

In addition to the webinars mentioned above, RCN members participated in a variety of national and international meetings such as the OES Oceans 2014 in St Johns, Canada, the AGU and EGU and along with interfacing with project activities focused on interoperability such as the Ocean Data Interoperability Platform (ODIP) program. Presentations were given, and papers released as part of the proceedings. Papers and selected presentations are available on the RCN website.

5. Web Outreach.

The following websites provide information regarding RCN activities:

- Oceanmysteries.net (webinar advertising and registration).
- Oceanobsnetwork.org (IODE) (will be updated soon)
- https://sites.google.com/site/oceanobservingrcn/ (CSIRO)

6. Events and activities.

Date 2014	Activity	Reference
January 13	GEO Meeting	Blue Planet meeting, coastal zone meeting
January 13	Webinar Series	Lisa Levin presentation
February 20	Webinar Series	John Delaney presentation
February 24-28	AGU oceans	Presentation plus RCN coordination
March 10-13	Oceanology International	Sensor and platform SOA discussions
March 25	Webinar Series	Wally Fulweiler presentation
April 28	Coordination meeting	Coordination with ODIP
April 29	EGU	RCN presentation, Coordination with European project COOPEUS,
May 13	Meeting	Sensor Requirements planning
May 21	Meeting	BIO-TT coordination (often over 4 months)
May 22	RCN Meeting	Spring meeting via webex
July 15	Webinar Series	Lorenzo Ciannelli presentation
August 6	ODIP Meeting	Interoperability
September 16-18	Oceans Meeting 2014	RCN presentation – OES coordination
September 30	Webinar Series	Richard Camilli presentation
October 16	RS-In-situ WG	Report and recommendations review
October 16	Webinar Series	Edie Widder presentation
October 24	RCN Meeting	Fall meeting via webex
November 4-6	BIO-TT workshop	Coordination - IEEE OES management
November 12	Webinar Series	Oscar Schofield presentation
November 24	Citizen Science WG	Kick-off meeting
December 14	RCN Meeting	Meeting – in person – at San Francisco

Appendix I – RCN Terms of Reference.

Background

The oceans provide many important functions within the Earth system including strong coupling with weather and climate dynamics, providing food and energy resources, supporting trade and commerce, offering extensive stabilization for variations in our environment and being a resource for biodiversity. The need for improved coordination in ocean observations is more urgent now given the issues of climate change, sustainable food sources and increased need for energy. Ocean researchers must work across disciplines to provide policy makers with clear and understandable assessments of the state of the ocean.

New technologies and approaches are emerging to vastly improve ocean observations. Cabled observatories are an example of a paradigm shift, providing a relative abundance of power and bandwidth for observations covering scales from cm to km and times from seconds to decades. Sensors traditionally only available in laboratories can now be adapted for in-situ observations. The potential for interdisciplinary collaboration is significant. The Oceans RCN is a forum to address these issues and develop recommendations on key topics of ocean observation and information.

Goal

The goal of the RCN is to foster a broad, multi-disciplinary dialogue, enabling more effective use of ocean observing systems, consistent with national and international efforts, to inform societal decisions.

Objectives

To achieve this goal, the RCN has defined a series of objectives:

- Motivate commitments to sustaining ocean and marine observing systems
- Stimulate inter-disciplinary cooperation for both observations and analyses
- Facilitate open exchange of ocean data
- Promote interoperability
- Improve the flow of critical ocean observation information to key stakeholders
- Stimulate capacity building and retention in ocean and marine observations community

The RCN will also consider related issues such as integration of space-based and in-situ measurements, and innovative concepts in sensors, information systems and user interfaces. Additional subjects may be proposed by the network members.

In achieving these objectives, the RCN will motivate new research outcomes, provide wider visibility for the value and impacts of ocean observations and encourage a new generation of scientists to focus on the oceans and their challenges.

Operations and Working Methods

The RCN is primarily a forum to address issues of enhancing ocean observation and information. It is not a body chartered to undertake new scientific research. Issues engaged by the RCN will be addressed by the body as a whole (Plenary) or through working groups (WG) constituted by the

RCN. A working group will generally focus on one of the objectives cited above and will produce a report clearly identifying the issues, approaches, impacts and recommendations for achieving the objective(s).
Working groups will have a defined term of operation, generally six months (renewable), to assess issues and then submit their recommendations for review by the Plenary. The reviewed recommendations will be provided to international, national and program level organizations for consideration and possible implementations. Working Groups will be constituted by members of the network and other invited experts. They will create Terms of Reference including objectives, a schedule, an operations modality and a list of deliverables. Network members may serve on multiple working groups. In their deliberations, the working groups may invite external experts to make presentations and provide background on issues being addressed.
The RCN working environment will be as follows:

1. The RCN will operate primarily through electronic information exchange. The RCN will have websites, discussion forum and other tools for communication and collaboration.
2. The RCN will meet three times per year, two virtual meetings and an annual in-person meeting.

3. The RCN Plenary will review and comment on the WG reports prior to their forwarding to appropriate parties.
4. The RCN will work closely with existing coordination bodies and mechanisms for ocean and marine observations. Coordination with existing networks will be facilitated by members of the Steering Committee and senior network members whose organizations are participating in existing networks such as those under UNESCO IOC and GEO.

Outputs

The RCN will develop and deliver reports covering subjects that support achieving the objectives above. The reports will identify issues, approaches and recommendations for achieving the objectives.

Participation

The RCN will be a long-term international forum on observatories, data, modeling and information for scientists and users of ocean information. Broad participation of physical, biological, and biogeochemical oceanographers in the RCN is essential. Inclusion of nonscientist end users and decision makers in the RCN is strongly encouraged. A list of current participants is maintained by the project office. Additional network membership may include scientists from current observing systems and also data and information users from government, industry and education and research institutions. These will initially be solicited though contacts by the Steering Committee and the senior network members.

Appendix II – OceanObsNetwork Members and Participants.

First Name	Last Name	Organization	E-mail address
Simon	Allen	CSIRO	simon.allen@csiro.au
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Jim	Yoder	WHOI	jyoder@whoi.edu

Appendix III - Minutes of RCN Meetings

A. Minutes of the Ocean Observations Research Coordination Network Virtual Meeting

– May 22 2014

Minutes of Meeting
Attendees – Eric Delory, Paul DiGiacomo, James Gallagher, Eileen Hofmann, Bob Houtman, Roger Longhorn, Gonzalo Maovarez, Paola Materia, Kate Moran, John Orcutt, Francoise Pearlman, Jay Pearlman, Mary Jane Perry, Iain Shepherd, Heidi Sosik, Martin Visbeck, Sandy Williams, Dawn Wright, Jim Yoder

Agenda
The North Atlantic - Iain Shepherd, EC
"Sustained Ocean Observations in the Atlantic" - Martin Visbeck, GEOMAR
The North Atlantic Observations – a discussion, Eileen Hoffman
The GEO Coastal Zone Community of Practice – Hans-Peter Plag
Working group activities – Gallagher/Orcutt, Hofmann and Yoder.
Next Meetings: Sept/October Webex (Date TBA); Dec 14 2014 in person – San Francisco

Presentations and Discussions
Martin Visbeck - "Sustained Ocean Observations in the Atlantic from Networks to Integrated Systems".
Martin Visbeck of GEOMAR at Kiel, Germany provided an overview of the importance of oceans and the factors driving the ocean environment. He introduced the Ocean Health Index as a means of gauging the ocean conditions. As expected, there is a lot of variability among topics (subgroups) from 10 to 87 on a scale of 100.
Martin then discussed directions in ocean observation including the development of essential ocean variables and the evolution of readiness levels.
The North Atlantic initiative, a collaboration of the EU, US and Canada, was agreed to in the Galway Statement of 2013. A call to support a North Atlantic Observing was issued in 2014. A response to the call entitled "AtlantOS" was presented by Martin with emphasis on key areas necessary for an innovative and comprehensive integrated observation system. These key areas include (along with activity leads):

WP1	Observing Systems	Fischer, Vittis, Legler
WP2	Ship based Observations	Drinkwater,Lherminier, Baringer
WP3	Autonomous Observations	Claustre, Boeflaus, Schofield
WP4	Coastal Processes	Horsburgh, Farcy, Willis
WP5	Regional Processes	Speich, Karstensen, de Young
WP6	Innovations and Sensors	Mowlem, Delory, Pearlman
WP7	Data Flow	Pouliquen, Waldmann
WP8	Societal Benefits	Pinardi, Nolan
WP9	System Evaluation	LeTraon, Visbeck
WP10	Communication	Fritz, Larkin, Avery/Crago

In the question period following the presentation, Martin was asked if AtlantOS is a cyclic (evolutionary) approach. He responded that it is about one and a half cycles of a long-term development. He was asked if the proposed sensor development resources complement other sensor developments in Europe. He confirmed that is the intent. Specifically, Martin Visbeck said that AtlantoS will address sensors on Argos floats and gliders, leveraging and integrating ongoing projects. John Orcutt pointed out that there is open data for the North Atlantic from the OOI Pioneer Array in the Mid Atlantic Bight with streaming data from buoys. He would like to work with the EU effort. Martin said that he is working with Bob Weller on OOI data from the Pioneer array now.

Iain Shepherd reiterated the importance of the North Atlantic Initiative from the perspective of the European Commission. The Commissioners are supportive of both the European elements of the initiative and the benefits that will come from collaboration across the Atlantic, in the northern hemisphere and eventually expanded to the southern hemisphere. In addition to the observation theme, other areas of emphasis include ocean literacy, polar research and improved understanding of ocean resources and management. The Commission plans to invest 57M€ Euros in blue growth. A memo some providing background is given in Attachment 1.
In the discussion, it was noted that OOI has the pioneer array in the Mid Atlantic and additional capabilities are being put in the area near Greenland. Data sharing among these US and other European systems should be seriously considered in the joint programs.
Eileen Hoffman gave an informal presentation on activities relating to research for biogeochemistry and biology that could contribute to the North Atlantic cooperation. Last summer the workshop was in Woods Hole on multidisciplinary work and revealed interest in the Arctic and N. Atlantic System. It included European Commission people and scientists from Canada. With the Galway statement, NSF expressed interest in defining science projects that support a better understanding of the Atlantic. This question was addressed recently in a workshop held in April in Washington DC with international participation. The workshop was a joint planning effort to define a roadmap of the path forward for science research. The output would be used by the EC and the NSF for planning of future calls for research. The plan is being drafted by the organizers and will be circulated to the workshop attendees for review shortly. A workshop on July 21 will be the next opportunity for broad discussion on the North Atlantic and related science plans.
During questions it was asked if similar discussions will be held at the IMBER meeting in Bergen in June. Eileen said there is a session that would be appropriate. Also, there was a question about whether the list of workshop participants and the agenda are available. Eileen said that they are and will provide a link to the Arctic-NA website.
Hans-Peter Plag gave an update on the GEO Coastal Zone Community of Practice (CoP); the webpage is www.czcp.org. The CoP is part of the Blue Planet GEO activities and is focused in Task SB-01 Task C4. Subject areas for the task include Global Cyber Infrastructure, Observational requirements for coastal impacts – seafloor topography under ice shelves for example as it may affect coastal flooding due to global warming and rapid sea level rise. Hans-Peter reviewed each of the subtasks (see attachment 2 for description). He asked for contributors to help with the development of a case study on the response of coastal systems to sea level rise. This would be a one-year study to be presented at the Blue Planet meeting in 2015.
Hans-Peter mentioned that there is consideration of holding the 2015 or 2016 meeting of Blue Planet in the US. The schedule and location of the meetings will be discussed at a Blue Planet

coordination meeting later this year. Dawn Wright expressed interest in the Blue Planet meeting in the US and was willing to suggest locations for the meeting. Paul DiGiacomo added that he has formed a new IOCCG working group on water quality. The first meeting will be held on June 14. The second meeting will be held in Geneva in April 2015.
Working Group Reports –
Jim Yoder noted that a draft report for the Remote Sensing-In Situ working group is being circulated for review. The report uses a coastal –river influx use case to look at the challenges and benefits of combined observation and modeling. Jim mentioned an upcoming meeting between WHOI and IFREMER that may include a discussion on the subject.
John Orcutt said that the Open Data working group is planning to submit a paper for peer-reviewed publication of the updated discussions and findings of the working group. He asked if others would like to review the paper prior to submission. Dawn expressed interest.
Eileen Hofmann reviewed the activities on the multi-disciplinary working group. More recently there have been discussions about participating in a workshop to address data and observation availability and definitions of essential ocean variables. There was a teleconference on May 21 with Samantha Simmons from IOCCP on Ocean Variables. This is the US assistance to agencies on multidisciplinary variables. Further information will be available by the next RCN meeting.
Jay Pearlman reminded RCN members that the next webex meeting will be in September/October and the Annual meeting will be in San Francisco on December 14 2014, just prior to the AGU. The Webex in September/October will include John Orcutt giving a presentation on OOI and Oscar Schofield on gliders.
Jay expressed his appreciation to the presenters and thanked all of the participants for joining the meeting. The meeting was adjourned.

Attachment 1
EUROPEAN COMMISSION
MEMO
Brussels, 24 May 2013
Marine research in the European Union and the Atlantic
The European Union, the United States and Canada today signed the "Galway Statement on Atlantic Ocean Cooperation" with the aim of furthering research into the workings of the Atlantic Ocean and its interaction with the Arctic. The alliance will build on existing bilateral cooperation agreements and projects with the aim of developing and advancing a shared vision for the Atlantic. For the European Union, the Statement was signed by European Commissioner for Research, Innovation and Science Máire Geoghegan-Quinn and European Commissioner for Maritime Affairs and Fisheries Maria Damanaki. For the United States the Statement was signed by Dr. Kerri-Ann Jones, Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs. For Canada, Senator David Wells signed on behalf of Edward Fast, Canadian Minister of International Trade and Minister for the Asia-Pacific Gateway.
Here is a summary of relevant facts and projects related to trans-Atlantic marine research cooperation.
Why is there a need for a new initiative?
Existing cooperation is coordinated mainly through bilateral science and technology agreements, or takes place within the framework of international fora with the risk that efforts may become fragmented. One of the aims of the initiative is to obtain an overview of activity, spot gaps and then explore what new opportunities for cooperation may exist. European countries have mapped

their research activity and needs within the context of the SEAS-ERA project, which has produced a draft report on marine research priorities for the European Atlantic sea basin. However, as the report notes, Atlantic research cannot be seen from a European perspective alone and there is a need for co-operation with the United States, Canada and other countries.
What examples can you give of existing bilateral cooperation?
The European Commission's in-house science service, the Joint Research Centre, and the U.S. National Oceanic and Atmospheric Administration (NOAA) agreed in May 2012 to strengthen cooperative science activities in the areas of climate, weather, oceans and coasts. The agreement focused on four projects for near term implementation: climate data records, space weather, tsunami modeling and fisheries research.
European and North American researchers cooperated in the framework of the Basin-scale Analysis, Synthesis and Integration (BASIN) initiative to develop a joint research agenda the area of ocean ecosystems in support of the Global Earth Observation System. In Europe, work is continuing in the context of the EURO-BASIN project, which aims to understand and predict the population structure and dynamics of key plankton and fish species of the North Atlantic and shelf seas, and assess the impacts of climate variability on North Atlantic marine ecosystems and their goods and services. Canadian researchers took part in the first leg of the MyOcean ocean monitoring and forecasting project funded under the European Union's seventh framework research program (FP7). Under the auspices of ERA-Can, the organization encouraging Canadian participation in FP7, an event will also be held later this year on Arctic and Marine Research Infrastructure.
How much does the EU spend on marine and maritime research?
Since 2002, through its framework research programs, the European Union has invested over two billion euro in more than one thousand marine research projects. In addition, the 27 EU Member States invest individually in marine and maritime research. In total, the EU collectively spends about €2 billion a year in this area.
What is the EU doing on ocean observation and seabed mapping?
Through its Marine Knowledge 2020 initiative, the EU is setting up a process for integrating national marine data and marine forecasting capacities into a sustainable seamless open access system to benefit researchers, public authorities and private industry. Prototypes are already operational and these will be extended through continuations of the European Marine Observation and Data Observation (EMODnet) and Copernicus (formerly GMES) programs. EMODnet has completed its first pilot phase and is now moving into a second operational phase whereby more than 100 European bodies are working together to deliver access to bathymetric, geological, physical, chemical, biological and human activity data and data products through a set of internet portals. The marine service of COPERNICUS provides access to observations from space and also an ocean forecasting system through a separate portal.
A related international initiative is the Group on Earth Observation (GEO) and its Blue Planet Task, which aims to improve ocean observation at global level and assess the effectiveness of the climate adaptation measures (such as those related to vulnerability and impacts of sea-level rise). Blue Planet Task is very relevant to the implementation of ocean observation systems in the Atlantic as many GEO partners and organizations in countries on both sides of the ocean are actively participating in this initiative.
Does the EU have any projects related to the Atlantic and climate change?
The North Atlantic Ocean is one of the most important drivers for global ocean circulation. Global climate variability is also triggered by changes in the North Atlantic sea surface state. The

quality of climate predictions therefore depends on good knowledge of northern sea surface temperatures and sea ice distributions.

The changing Arctic environment strongly influences the Atlantic Ocean. The EU project Arctic Tipping Points demonstrated how diminishing sea ice extent and warming Arctic sea surface temperature cause a northward move of important Atlantic fish species. The Ice2sea project determined the contribution of glaciers and ice-sheets (Greenland, Antarctica) to global sea level rise, partly caused by a warming of Atlantic ocean streams. The project cooperated with related projects in US and Canada (SEARISE, IMBIE). The four-year NACLIM project, supported with an EU grant of €8.6 million, aims to investigate and quantify the predictability of climate in the North Atlantic/European sector. It involves 17 partners, including from Norway and Iceland. NACLIM cooperates also with U.S. projects in particular regarding ocean circulation observations (OSNAP).

NACLIM follows on from the EU-funded four-year THOR project that concluded in November 2012. THOR investigated the dynamics of the Atlantic Ocean's circulation and its impact on Europe's climate.

What about projects aimed at exploring the sea's potential?

The three year MARINE FUNGI project, due to end in April 2014, hopes to identify natural marine products for the treatment of cancer. It also investigates the cultivation of marine fungi for the efficient production of natural products in the laboratory and also in large-scale cultures, avoiding harm to the natural environment. The therapeutic focus of MARINE FUNGI, led by the Helmholtz Zentrum für Ozeanforschung in Kiel, Germany, is the development of novel anti-cancer compounds.

A team of international scientists led by Limerick Institute of Technology in Ireland is investigating innovative solutions to overcome existing bottle-necks associated with culturing marine organisms in order to sustainably produce high yields of value-added products for the pharmaceutical, cosmetic and industrial sectors. The three-year BAMMBO project is due to end in February 2014.

Researchers in the PHARMASEA project, due to end in 2016, is seeking to identify new marine microbial strains from extreme environments to evaluate their potential as new drug leads, antibiotics or ingredients for nutrition or cosmetic applications. Scientists from the UK, Belgium, Norway, Spain, Ireland, Germany, Italy, Switzerland and Denmark will work together to collect and screen samples of mud and sediment from huge, previously untapped, oceanic trenches. The large-scale, four-year project is backed by more than €9.5 million of EU funding and brings together 24 partners from 14 countries from industry, academia and non-profit organizations.

The five-year CORALFISH project, coordinated by the University of Ireland in Galway, concluded in February having studied the interaction between cold water corals, fish and fisheries, in order to develop monitoring and predictive modeling tools for ecosystem based management in the deep waters of Europe and beyond.

To advance knowledge of the functioning of deep-sea ecosystems and their contribution to the production of goods and services, the European Union also funded the three-year HERMIONE project led by the Natural Environment Research Council in the United Kingdom. Gaining this understanding is crucial, because these ecosystems are now being affected by climate change and impacted by man through fishing, resource extraction, seabed installations and pollution.

Attachment 2 Group on Earth Observation Blue Planet Initiative: Task C-4 of the GEO SB-01

Introduction
SB-01-C4 is a Component of Task SB-01: Oceans and Society: Blue Planet
The SB-01 Task Coordinator is Trevor Platt (POGO)
The Point of Contact for this Component SB-01-C4 is Hans-Peter Plag (hpplag@odu.edu)
Related Communities of Practice:

Expected Achievements by 2015
Activity 1: Develop a global coastal zone information system: a global cyber-infrastructure that will provide access to available information on coastal zones and facilitate the collection of new information through crowd sourcing and citizen-science
Activity 1.1: Develop the concept for a comprehensive information system that links a living knowledge base with a virtual stakeholder table and that can enable informed, participatory governance and decision-making.
The outcome of this activity will be a community-vetted white paper describing a general concept for a future information system, with specific focus on governance and decision-making in the coastal zone.
Activity 1.2: Implement the information system and populate the system for selected test-beds in North America, Africa, and potentially other locations.
As a result of this activity, a global cyberinfrastructure will provide a basis for communities in coastal zones to populate the system with their information and to use the system in their deliberations.
Activity 1.3: Utilize the information system for deliberations on a few selected topics such as planning for sea level rise, disaster risk reduction for extreme weather events, and identification of emerging public health risks to demonstrate the usability and value-added of the information system in participatory governance.
This activity will result in assessment reports that evaluate to what extent the information system enables informed participatory governance.
Activity 2: Implement a pilot project in an area-at-risk (e.g. Indonesian Archipelago-South China Sea domain) to demonstrate the added value of ecosystem-based approaches for monitoring and managing the coastal zone. This will be coordinated with GOOS Regional Associations and global/regional networks (see Plan of the Panel for Integrated Coastal Observations)
Activity 3: Assess climate change impacts on island coasts for islands from the Caribbean to the Arctic using SAR data and other relevant data as a demonstrator for the use of space-based observations in the monitoring of climate change impacts. Data for this activity would be sought from CEOS members
Activity 3.1: Develop a description of the assessment detailing the time window to be considered, variables to be used to assess impacts, data needs and analysis approaches, and intended outcomes and reach a consensus between CEOS and a project team on data availability.
The result of this activity is a report providing a basis for the assessment.
Activity 3.2: Carry out the assessment defined in Activity 3.1.
The main outcome of this activity is not the assessment itself but rather a demonstration of how available remote sensing data can be used to assess climate impacts on a ocean-wide scale using slow changes in the coastal zone to base the assessment on.
Activity 4: Assess the observational requirements for decadal forecasts of coastal local sea-level variation and develop a demonstrator forecasting service

Activity 4.1: Develop and implement a system-of-systems model for local sea level (SoSLSL) that can be used to study the predictability of local sea level (LSL) at intra-annual to multi-decadal time scales.
The outcome of this activity will be a open-source modeling framework for LSL that initially will be fully detailed for a few study cases, but can easily be set up for any coastal zone.
Activity 4.2: Use the SoSLSL to assess predictability of LSL depending on data availability. Identify Essential Sea Level Variables, particularly those that would serve the target to ensure early warnings in case of abrupt sea level rise, and define observation specifications for these variables.
This activity will have two main outcomes: (1) an assessment of the predictability of interannual to multidecadal LSL and (2) Essential Sea Level Variables (ESLVs) and specification for their observations.
Activity 4.3: Based on SoSLSL, implement a demonstrator that allows both, predictions of LSL within the range of predictability and queries for "What if" questions to determine LSL trajectories under assumed scenarios for climate change and climate change impacts.
The demonstrator will be available to decision makers and provide a novel way to assess the risk associated with LSL rise.
Activity 5: Assess user needs and observational requirements for coastal water quality (using the GEOSS User Requirements Registry); identify indicators and best practices for coastal water quality, and implement a monitoring service pilot for coastal water quality (with WA-01 and HE-01); disseminate information particularly to under-served communities (with IN-04)
Activity 5.1: Use the proposed Socio-Economic and Environmental Information Needs Knowledge Base (SEE IN KB) to capture water quality goals, targets, indicators and essential variables in deliberations with the relevant user communities.
The main outcome of this activity will be a set of Essential Water Quality Variables (EWQVs) and observation specification for these variables with particular focus on the information needs in the coastal zone.
Activity 5.2: Develop a demonstrator for a coastal water quality service based on observations of the EWQVs with the specific goal to make the information available to underrepresented communities.
The demonstrator will allow assessing data gaps and it will help to assess to what extent the information is of value to societal users, including underrepresented groups.

B. Minutes of the Ocean Observations Research Coordination Network Virtual Meeting

- October 24 2014

Participants: Steve Anderson, Laura Beranzoli, Mairi Best, Eric Delory, Ed Gough, Paul Holthus, Eileen Hofmann, Frank Muller-Karger, Stefano Nativi, John Orcutt, Jay Pearlman, Benoit Pirenne, Dick Schaap, Oscar Schofield, Samantha Simmons, Heidi Sosik, Sandy Williams.

Agenda
1. Samantha (Sam) Simmons of the Marine Mammal Commission will review a recent survey of US Agencies on Essential Ocean Variables for Biology
2. Dick Schaap of SeaDataNet will talk about interoperability uses cases of the Ocean Data Interoperability Platform Project, a joint program of US, Europe and Australia.
3. Oscar Schofield of Rutgers will talk about plans and activities for the OOI Cyberinfrastructure.
4. Paul Holthus of the World Ocean Council will discuss results of the recent meeting on "Changing Oceans and Industry Futures: How will changes to ocean properties and processes affect ocean business?"
4. Citizen Science
A citizen science working group under the guidance of John Orcutt is forming.

Sam Simmons presented the work of the Biological Task Team, focusing on a survey of US Agencies on their needs for ocean biology variables. The IOOS Summit of November 2012 had 25 recommendations of which 8 contained biological elements. BIO-TT was formalized in March 2013 with a 2-year initial term to address assessment of biology needs. Bob Houtman and 10 more members are on the task team, which is led by Samantha (Sam) Simmons. They represent different agencies. Jay and Eileen are included as RCN persons. The objectives of the team include: a. Improve the availability of existing IOOS core biological variables; and b. Identify, and prioritize additional cross-cutting biological and ecosystem variable. Actions were to design and execute a survey (using Survey Monkey) and then organize a workshop to have community inputs. The workshop is planned for Nov 4-6, 2014. The survey was sent to 250 federal employees and had a 33% response rate distributed evenly across the agencies;14 different agencies or departments responded. The survey objective was to identify the top 5 needs that should to be met. It was open ended with some of the responses in text format; this made it hard to compare across agencies. Binning based upon keywords was used to have categories rated high, medium or low. Zooplankton and fish were in high. Benthos, data, and population were high. Chemistry, corals, geography, invertebrates, marine mammals were in medium. In some cases, the needs came from problems such as too few observations, limited resources or data inadequacy. Next steps are to finish writing the report and put them in a query-able format. The workshop to address additional variables and prioritize the broader collections is being held Nov. 4-6, 2014. There will be a follow up effort with IOOS Program Office. The BIO-TT sunset date is March 2015.
Questions: What is done about the country and how does it impact the list?
For example, survey needs were the most basic biological observations. Priorities mirror what is being collected by the groups around the country. The survey lists data as not being available

but often they are available but the looker doesn't know where. Sam indicated that ascertaining availability is part of the assessment process and this will be pursued.
Comment: The hardest variable to measure is sound. It takes decades of observations to determine the change in sound (noise) in the ocean and requires calibrated hydrophones. It may respond to changes in shipping and oil exploration. For example, during the recession the speed of vessels dropped to save fuel costs. That reduced the shipping noise substantially. It may well continue since larger vessels running slow are cheaper to operate than running existing ones fast. Marine Mammals under IOOS can be brought into this study. Ocean Noise Reference Station Network (9 calibrated acoustic monitoring buoys around the US) is a good start. Shipping lanes are marked and need long term acoustic monitoring to learn what the evolution of the sound field is. Eric Delory is working on such instrumentation through NeXOS

Dick Schaap presented developments in the Ocean Data Interoperability Platform (ODIP). The project is a collaboration of Australia, the Europe and the US. It is a consolidation of regional initiatives (Australian Ocean Data Network, AODN, Sea Data Net and NODC.) ODIP is a community effort to overcome barriers by exploring common standards and interoperability solutions. It will support global infrastructures such as GEOSS, IODE and Pogo. Partners including associate partners were listed in Schaap's presentation. The objectives are a coordination platform. Prototype projects leverage existing regional projects and initiatives. Sharing data between open portals is a target. There were three workshops to date: Ostende (Feb. 2013) San Diego (Dec 2013), and Townsville (Aug 2014) with a fourth to be held in England. Discussions in the recent meetings have been addressing three prototypes, vocabularies, data publishing including both citation and Person identifiers, which are needed as well as DOIs. Looking at the three projects, ODIP 1 prototype establishes interoperability between SeaDataNet, IMOS, and US NODC data discovery. The Prototype 1 is lead by European partners via SeaDataNet, including exchange from SeaDataNet to IODE/ODP and GEOSS, both of which are operational. Pan-European infrastructure started 20 years ago and now includes data tracking mechanism from European resources. 1.5M entries: ISO 19115-19139. DAB is the GEO Broker between SeaDataNet and GEO and IDOE. Research vessels are part of ODIP 2 to ensure interoperability with a common reporting system. R2R has been adopted by partners from US and Australia. ISO Cruise Summary Reports go to Marine National Facility (Australia), SeaDataNet (Europe), and R2R (USA). This tool has been employed by the USA and Australia. Adopting the European elements is now augmented by new technologies including NSF's EarthCube. ODIP 3 prototype is Sensor Observation Service (SOS), SensorML, and O&M profiles for selected sensors on research vessels. Github is a calibration tool followed by an inventory of SOS services. A task is to compile inventory of instrument SensorML records and O&M structures. The collaboration platform is https://github.com/aodn/ODIP. Dissemination of ODIP outcomes are a project website, social media, International conferences, Ocean data Portal, Research Data Alliance, and the Belmont Forum.
Comment from participants: Most people say they are interested in data but actually are interested in data collection.

Oscar Schofield presented an OOI Update on Cyberinfrastructure. He covered the East and West coast Regional Arrays, Cabled Arrays, and the Global Node. Capabilities mapping uses the "uFrame core", which was developed by Raytheon for AWIPS (weather data). It takes data

from the installed instruments and puts them in a repository. Building the drivers from these systems is a major task. Various user groups are involved in this. A big team in San Diego is building the cable drivers. Uncabled drivers are from Raytheon in Portsmouth. The platform drivers are from UW, algorithms from OSU. Iterative development is aggressive since this ends at the end of next year. As an early demonstration (build 1), glider data has gone into the uFrame and come out of the data file. A big focus in November and December will be in asset management and the user interface (visualization) is planned for January. Oscar presented a more detailed schedule. Developments of web-based tools allow sharing. Some of the results are coming from the OOI Education and Public Engagement project centered at Rutgers. OOI Net MREFC is led by Dan Sanshu, the CI Project Manager (Raytheon San Diego). A big review is coming next Monday and Tuesday at NSF.

Paul Holthus of World Ocean Council (WOC) gave a verbal update on the "Changing Oceans and Industry Futures" workshop. This was part of the WOC "Smart Ocean-Smart Industries" flagship program on ships of opportunity. This program fosters and facilitates vessel and platform (cargo ships, fishing boats, cruise ships, ferries, oil rigs) participation in data collecting and interaction with ocean observations/science institutions and programs. Priority areas for this include the Arctic, E Canada. This is part of the overall WOC effort to build collaboration between industry and science, e.g. EU requirement like the Framework 2020 Industry Connection needs this service to link PIs with ocean industries. A recent workshop brought the two communities into contact in Brussels.
Discussion: If WOC can help it will be good. Citizen Observations can use these ships of opportunity. John Orcutt is organizing a working group on Citizen Observations prior to our meeting in San Francisco. There are efforts in Canada and elsewhere on ocean citizen science and developing synergies with programs for voluntary observations by industry, such as the WOC program. E.g. Paul Holthus was at a workshop at Memorial University, St. John's, Newfoundland on Citizen Science for the ocean.
Jay reminded us that the annual meeting is in San Francisco and will be held December 14, 2014, the day before AGU.
Meeting adjourned.

C. Minutes of Ocean Observations Research Coordination Network (RCN) meeting

The meeting was held in San Francisco (at Marriot Marquis Hotel), December 8, 2013

Jay Pearlman introduced the agenda.

1. Welcome, Introductions by Participants and Status Update– Jay Pearlman

2. Geosciences grand challenges – Panel on visions for the ocean – Moderator Mary Jane Perry, University of Maine

   David Conover, NSF, Ken Denman, ONC, Dawn Wright, ESRI

3. Panel on International Cooperation - Moderator Chris Scholin, MBARI

   Maria Uhle, NSF, David Krasa, European Research Council Executive Agency, Ken Denman, ONC, Simon Allen, CSIRO

4. International Collaboration (continued)

   Christoph Waldmann, COOPEUS, Hans-Peter Plag, GEO, Mairi Best EMSO

5. Data Systems Moderator – Albert (Sandy) Williams 3rd, IEEE

   Pierre Bahurel, MyOcean, John Orcutt, OOI, Helen Glaves, ODIP, Mark Parsons, RDA

6. Panel on Sensors/Observations – Biology and Chemistry - Moderator Jim Yoder, WHOI

   Jim Yoder, WHOI, Eric Delory, PLOCAN, Kendra Daly, USF, Ken Johnson, MBARI

7. RCN Plans for 2014 – Moderator Jay Pearlman, IEEE

   Jim Yoder, Eric Delory, Christoph Waldmann, Simon Allen, Sandy Williams

8. Summary – Sandy Williams

Following an overview of RCN activities by Jay Pearlman, the participants introduced themselves (see attachment 1 for attendees).

Geosciences Grand Challenges – A panel Discussion

Mary Jane Perry, University of Maine, introduced the Panel on the Geosciences Grand Challenges. The panel included Dawn Wright, Esri, Ken Denman of Ocean Networks Canada and David Conover, NSF. In her introduction of the panel, Mary Jane noted that from a social and environmental question, there are significant changes in society and science from technological changes, climate changes, human perturbations and even citizen science. From a technical perspective, a major challenge is the uncertainty of calibrations in sensors that put observations in doubt on occasion. This is particularly important for long-term measurements and studies with multiple sensors.

Dawn Wright, Esri Chief Scientist gave the first presentation. Esri is a for-profit company supporting multiple dimensions in Web Map Services (WMS) implementation of ArcGIS for Server implementation. Dawn described Ocean Exploration 2020, a National Forum. Also, the Schmidt Ocean Institute Science Symposium held an Ocean Data Sharing symposium. Grand Challenges included moving seamlessly from data discovery to vision and back. Is vision complete? If not, what is needed? A Grand Challenge is not only discovery of the data but data analysis. As data sets become larger ("big data") and processing becomes more complex, new analyses paradigms are needed. An attractive, though uncommon solution at the moment is to "Stop moving the data to algorithms, but push algorithms TO the data". This can be done by putting software into a Web Browser to perform, for example, ArcGIS analyses online. Dawn

recommends consolidating best practices, which she notes have been published to Resource Center. Sharing analyses as well as data is called a Geoprocessing Package or Service. An interesting example is the Esri GEO Portal, which provides a bridge between the Global Earth Observation System of Systems (GEOSS) and ArcGIS Online user community. GIS tools for Hadoop are to be applied to spatial data (Hadoop is presently a financial application). Another challenge she pointed to is lack of formal accredited academic degrees or curricula in ocean data management.

Ken Denman, Head Ocean Networks Canada (ONC): ONC has the cabled observatory Neptune running out to Endeavour Ridge west of Vancouver Island and the cabled observatory Venus (in the Salish Sea east of Vancouver Island). The network has tracked tsunamis and the Venus observatory observed the tsunami height coming into the Salish Sea. Operational oceanography is being done in the Strait of Georgia. The Arctic Observatory in Cambridge Bay (Canadian Arctic) observes ice thickness (unless a barge is parked over the sensor). There are 5 research themes including: 1) Understanding human-induced change in the Northeast Pacific Ocean; 2) Life in the environments of the Northeast Pacific Ocean and Salish Sea; 3) Interconnections among the seafloor, ocean, and atmosphere; 4) geo hazards**.** The impacts of climate range shifts and the resultant following of ocean life toward suitable habitats is ten times as fast in the ocean as on land; composition of ecosystems will evolve as cold layers move north. In addition, the pH of the oceans is decreasing as CO_2 goes into the upper ocean. These changes are likely to have significant impacts on fisheries with projections that as high as 90% of commercial catch value is at risk in New England and 70% in Alaska. From this perspective, Ken identified a number of Ecosystem Observation Systems concerns. Some of the significant challenges and gaps are in Ocean Physics and Engineering – the needs for more comprehensive and complex measurements. For example, biology needs observations of vertical transport processes. For Ocean Ecology, micro zooplankton populations are tightly coupled to phytoplankton through grazing. Most rates need to be determined continuously and/or automatically, especially 'secondary production' by zooplankton. To meet these challenges, instrumentation requires low power, low maintenance, robustness and reliability.

David Conover, head of Ocean Sciences, NSF: In considering the ocean science challenges, we must address the culture of ocean sciences. Climate change is only one of the big changes we are seeing on the planet. Ecosystem-based management is the base of our regulatory environment. We have to play ecological detective to explain why things change so much and that requires observations to determine how things have changed. The consequences of extreme events need to be examined. The need for observation and analyses grows and the NSF programs must adjust. Hazards Seas is a new NSF program but it will need to be expanded. Ocean acidification research funding is coming to the end at NSF. Constraints moving forward from the NSF perspective include balancing infrastructure and science research. We have new infrastructure and instrumentation but we aren't taking any old infrastructure away. This results in struggles at NSF. The infrastructure fraction of the budget has now exceeded individual investigator support. Direct consideration of what it will cost to operate a program is going to be required. Also how much it costs to maintain the data and digitize and manage the databases will have to be projected.

All federally collected data must be made available to the public and the cost of this will be borne in the future as data quantity expands. 'Web of Science' can find literature anytime, but what about data? We need the 'Web of Data'. Data citation is as much needed as citation of scientific papers. The evaluation metric of how many papers a person has produced needs to be

augmented by how much data has been archived and served. New opportunities are private/public partnerships. James Cameron and Wendy Schmidt have provided resources to science. The ship time is free but nothing else. We need to train citizen scientists. There is an Open ROV initiative where anyone can build his/her own ROV from open source documentation. These ROVs cannot now serve science well but their capabilities will expand with citizen participation.

The Horizon EU 2020 proposal for research in the North Atlantic encourages partnerships between Europeans, Canadians, and Americans. How we function as a community is the final point. The community has a fractionated approach to advancing ocean science. Which priorities can we afford? Funding agencies have to set priorities themselves. But NSF has an AGU Town Hall on this topic at the AGU meeting this Thursday to engage with the science community. An NRC Decadal Survey of Ocean Sciences will make recommendations.

Discussion with Panel and meeting attendees:

In a reflection on Conover's comments, Ken Johnson of MBARI suggested that a paragraph in each NSF proposal should be required to note where the data are to be stored. Hans-Peter Plag of ODU raised the observation that it is people, not technology that is the issue. We have more exposure in risky places. He pointed out that there are more people at risk not just because the hazards are worse but also because there are more people. We depend on electricity, food supplies at stores, and computer infrastructure to survive. David Conover wants to support the situation that Hans-Peter refers to, that we are in a crisis all of us need to take action on, because by the time the danger is a 'no brainer' to the general public it is too late. With respect to observations and ship time, Simon Allen noted that ship time could be made available in Australia. Chris Scholin asked how ship time could be used with NSF proposals when R/V FALKOR time is free? In comparing government and private foundation support, David said that private foundations have the benefit that they do not have to take proposals from everyone; they can solicit proposals from individuals in areas they are specifically interested in.

Panel on International Cooperation

Chris Scholin MBARI Director and microbiologist, moderated for the Panel on International Cooperation. Panel members are: Maria Uhle, NSF; David Krasa, European Research Council Executive Agency; Ken Denman, ONC; and Simon Allen, CSIRO.

Maria Uhle provided an overview of international initiatives for collaboration including the Belmont Forum International Opportunities Fund, NSF Programs such as SAVI and Future Earth. Maria introduced the Belmont Forum as a way to deliver knowledge needed for action to mitigate and adapt to detrimental environmental change and extreme hazardous events. From this perspective, there are three foci:

- Effective integration and coordination mechanisms to address interdependencies and marshal the necessary resources
- Information on the state of the environment, through advanced observing systems
- Assessments of risks, impacts and vulnerabilities, through regional and decadal analysis and prediction

The Belmont members include 16 nations and international organizations. The Forum's International Opportunities Fund includes a number of sponsored research areas; on-going projects are Freshwater Security, Coastal Vulnerability, E-Infrastructures, and others. Future Earth is an international research program focused on global sustainability, addressing Dynamic Planet, Global Development and Transformations towards Sustainability. Ultimately, the program will provide end-to-end capabilities from observations to decision. There is a single secretariat but four or five countries can work together. NSF International Partnerships exist to support science across virtual institutes. Funding is provided to create research partnerships, faculty exchanges, organized workshops; $50k to $400k grants are available for projects like COOPEUS (http://www.coopeus.eu), a joint program of the US and the European Commission. COOPEUS is funded through the NSF "Science Across Virtual Institutes (SAVI)" (www.nsf.gov/savi).

David Krasa of European Research Council Executive Agency (ERCEA) is concerned with building up *in situ* observational capabilities. Copernicus is one of the European drivers of ocean science with remote measurements of salinity among other satellite observations. Observations are delivered under MyOcean, which provides marine resources and seasonal forecasting. This international effort is delivered as a resource to the Group on Earth Observation through GEOSS. Europe is transitioning from the seventh framework projects (FP7) to Horizon 2020, which will last through the end of this decade. FP7 is examining the emergence of the citizen as a new component in earth and environmental observations (through mobile technology). There are four citizen research projects currently being funded (http://citizencyberlab.eu/about/). These include approaches to citizen observation, cheaper sensor technologies, and demonstrations. Horizon 2020 has Blue Planet, which is a program of monitoring the entire Atlantic Ocean. High latitude monitoring is an environmental gap that is important to fill. Other EC activities include COOPEUS, mentioned before by Maria Uhle. January 16, 2014 will have a meeting on Integrated Atlantic Observation (Blue Planet) in Geneva. Bottom up proposals from the research community will be supported in Horizon 2020. Interdisciplinary research will be favored at ERCEA with €13M funding available.

Ken Denman of ONC, in addressing international collaboration, provided information on data access; there were 276,000 visitors to ONC websites, 63% were returnees, 670 days were spent in total online time. A workshop on integrating observatories in the Pacific Ocean that was recommended in June 2013 is being planned. It will establish ways to share data and cooperate in other ways. Private foundations like Moore and Schmidt have supported international programs. ONC has gotten ship time on the R/V FALKOR for an observatory under a glacier as a baseline study.

Simon Allen of CSIRO said a lot of good ideas are not 'eureka' but 'hmm'. Australia through IMOS has a national, collaborative, research infrastructure funded by the Australian Government. It provides the vehicle through which multiple institutions undertake sustained observing of the marine environment, making all of the data openly available for research and other purposes. IMOS is integrated from the open ocean, onto the shelf and into the coast and across physics, chemistry, and biology. IMOS has been designed to address big science questions posed through a series of Nodes, which bring together the research community and various stakeholders. It has been implemented through a portfolio of technologies and platforms, called Facilities, which are operated by multiple Institutions. All of the data are made available though a single national marine information infrastructure called the Australian Ocean Data Network (AODN). Institutional Connections around Australia have nodes and gliders and this coordination has created a real relationship with other institutions around Australia. There are RADAR connections and SCOOP among many institutions. Connections do go to other places in the world and are included in the National Science and Implementation Plan 2015-2025. R/V Investigator has unused capacity because there are too few Australian ocean scientists. So there is space available and ocean technicians can deploy instruments to make observations for you.

Discussions following Panel Presentations:

Dawn asked Simon if IMOS staff could be approached using the IMOS webpage. Simon will provide connections. Ken Johnson asked if Americans could use the Australian facilities. We in the US have been told to turn off data streams from floats when the floats enter foreign waters. Maria Uhle said it is best to get your sharing arrangements together before seeking Belmont support. A little money in advance can get this started, but every researcher needs to get grants to fund his/her own research, Belmont can only get the collaboration meetings funded. Chris said that there is a proliferation of acronyms, agencies, and other entities that baffle many and asked if there could be a roadmap to name and identify them. Jay asked Maria what international engineering organizations exist. Maria said that without engineers we couldn't get ahead. So Belmont says engineers are included as long as there isn't a bar (e.g., NIH funding would be such a bar).

Lunch

Panel on International Cooperation (continued)

Chris Scholin continued a second round of the Panel on International Collaboration. This panel included: Christoph Waldmann, COOPEUS; Hans-Peter Plag, GEO; and Mairi Best EMSO.

Christoph Waldman, MARUM in University of Bremen, presented the COOPEUS project: the mechanism was proposed in Rome for fostering Transatlantic Cooperation with access to US and EU Research Infrastructures in the environmental field to maximize scientific data exchange. It is one project with aligned EC funded and NSF funded components. It is to have open data access within and across domains. The project is focused on Cyber/E-infrastructure concepts and implementations in five scientific disciplines: Space weather through ionosphere observing radars, ocean observations, biodiversity, solid earth dynamics, and carbon observations. Each has a European Union project and a USA corresponding project. There are 15 partners with 6 from the US and 9 from the EU. The COOPEUS methodology uses common data policies and standards and services. There is a common Research Infrastructures (RI) framework and policies (practices, principles, and policies). There will be an analytical phase, intermediate synthesis, user scenarios, and final synthesis.

User scenarios: selection process is split into different levels, identify scientific needs (integrations of observations, share common methods and tools), look for collocated infrastructures (to address phenomena occurring at the same locations), make use of synergies, and promote concepts that help (unify data quality, data policies and harmonize IPR) with the goal of improving the discovery of data having the highest priority. GEOSS interaction is at three steps: registering of standards, getting the data into GEOSS infrastructure, and providing functionality as a broker for the user community. The role for COOPEUS is to address the challenges on how to maintain visibility of data, preservation, integrity, authenticity, provenance, and privacy.

Mairi Best from EMSO spoke about how data from the Venus observatory can be made available. EMSO is the European research Infrastructure for oceans and there are 21 projects feeding into EMSO and its formation; ESONET and EMSO from Framework 6 and Framework 7 were the most important. EMSO is currently addressing both selection of key observatory sites as well as integration of the community. EMSO nodes are from the Nordic Sea and Arctic to the Mediterranean and Black Sea. There are about a dozen cabled observatories collecting benthic and slope environments. EMSO provides power, communications, sensors and data infrastructure for continuous, high-resolution, near real-time, interactive ocean observations. EMSO consists of a truly multi-and interdisciplinary range of research areas including biology, geology etc. Common design of a generic sensor module across geosciences is a goal, including physical oceanography, biogeochemistry and biology. The EMSO-ERIC [http://www.emso-eu.org/about/emso-eric.html] is a legal entity signed by 10 countries with three more in the works.

Hans-Peter Plag of ODU talked about Blue Planet and how GEOSS can access environmental intelligence for making decisions. Sustainability of development in the coastal zone is one of the front lines of human sustainability. The GEO Coastal Zone Community of Practice (CZCP) brings together experts in an effort to support integrated coastal zone management in the Mediterranean, Africa, and the Caribbean. It started June 2008 in Athens with an initial focus on the Mediterranean. Capacity building and retention in Africa was most important. In the Caribbean, the needs were for an information system that supported a broad range of users, not just the scientists. Services are now part of the coastal zone plan including natural environments such as mangroves coral reefs and estuaries. Hans-Peter emphasized that Oceans and Society together are in Blue Planet.

Data Systems Panel

Sandy Williams, WHOI moderated The Data Systems Panel. Panel members are: Pierre Bahurel, MyOcean, John Orcutt, OOI, Helen Glaves, ODIP, BGS and Mark Parsons, RDA.

Pierre Bahurel gave a presentation of MyOcean (remote by phone). He covered three areas:

The framework for developing operational oceanography in Europe
How operational oceanography users pull the need for observations today
How observations impact operational oceanography products today.

He explained that what was formerly GMES became Copernicus recently. It includes ESA Sentinel 3 and EUMETSAT Operational Satellites. MyOcean includes *in situ* supporting measurements from Euro Argo floats, and Core Services (Marine being the only example that was in our area of interest). Its creation and operation supports needs for observations expressed by users, 3000 users from 1000 organizations in 92 countries. They also wanted sustainability. 50% of them were from the research community. In 2012, there were an average of 30 000 requests/month with 1.1 Tbytes of downloaded data. This was done with a mean reliability of greater than 96 percent. The development of in situ measurements continues. Euro-Argo floats have been successful. They measure salinity and have reduced the salinity error by 70% for 7 days observations. The current program, "MyOcean2" will transition into an EU Marine Service. Activities supporting this cover a wide range including: 1) organization - With EuroGOOS, secure data collection and management at global and regional, and link Copernicus (MyOcean) with other EU initiatives, and EU agencies (e.g. EEA); 2) infrastructures: with the EuroArgo ERIC infrastructure, propose framework for long-term EU support and funding; and 3) services: with the Marine Service, foster User uptake and awareness of EU Member States of the importance of ocean observations.

John Orcutt, SIO, gave a presentation on the OOI cyber infrastructure. The OOI network requires 25 to 30 year sustainability. Cyber infrastructure must facilitate the use of capabilities for deployments in the Argentine Basin, Irminger Sea, Station Papa, Pioneer Array, Chile, and the RSN cabled observatory of Washington State. Data are transmitted between Seattle, Portland, and San Diego at 10GBit/s. OOI is a deployment of 750 instruments of 60 different kinds. The data are disc-stored and real-time transmitted with latencies of only a few seconds. This rate extends from better than 1 Hz out to climate time scales of 25 years. In response to this demand, there is a new course taught at Scripps – Scientific Computing. 25 mostly first year graduate students are taking it.

Helen Glaves of BGS presented background on the Ocean Data Interoperability Platform (ODIP) ODIP in an information/infrastructure Interoperability Program that was 5 years in the making. It uses a multidisciplinary ecosystem level approach, in contrast to a traditional discipline-based approach. This includes the challenges of research data needed from other disciplines to address the science grand challenges involving the oceans. In point of fact, data were already out there. It had cost €1.4B to capture these data in 2011. They need to be reused. But issues to do so include formats, standards, best practice, coordinate systems, and national and organizational policies. E-infrastructure has developed data management infrastructures but requires a common approach to marine data management. ODIP is a jointly EU-US-Australia initiative. The US part is R2R which is an NSF supplement, **IMOS** in Australia, and **IODE** an international collaboration effort. ODIP objectives are:

1) To establish an EU/USA/Australia/IOC-IODE co-ordination platform to facilitate the interoperability of ocean and marine data management infrastructures

2) To demonstrate this co-ordination through the development of several joint EU-USA-Australia-IOC/IODE prototypes that would ensure persistent availability and effective sharing of data across scientific domains, organizations and national boundaries

3) To develop a common approach to marine data management that can be extended to other regions and organizations beyond the original project consortium.

Underlying these objectives is an approach is to bring people together on small projects including use cases in areas such as: inventories of existing standards and policies, workshops to develop interoperability solutions, prototypes for testing, and promoting interoperability more widely. A workshop, the 1st ODIP workshop, was held at Ostend 22-25 Feb. 2013 with 46 participants with 6 topics: Common vocabulary, metadata formats for discovery, and four more. There were 3 tasks selected: ODIP1, Interoperability between Europe, Australia, and US; ODIP2, Interoperability between regional cruise summaries; and ODIP3 Sensors Observation Service and common O&M + Sensor ML profiles. 51 came to the workshop in San Diego.

Mark Parsons of the Research Data Alliance (RDA), which is an international collaboration for creating the culture and technology for an international data infrastructure. RDA's vision is to create bridges in the research community for openness, consensus, balance, and harmonization. It is community driven, and non-profit. The RDA structure consists of interest groups and working groups. The former is a sustained collaboration in technical areas. Interest groups may form working groups to address a specific issue over a period of no more than 18 months. The working groups have goals with specific outcomes. Examples of working groups include: Data Type Registries WG; Persistent Identifier Information Types; Practical Policy; Metadata Standards; Data Categories and Codes; Data Foundations and Terminology; and others. The working groups provide a status to semi-annual RDA Plenaries with meetings in Dublin and Amsterdam in 2014.

Panel on Sensors/Observations – Biology and Chemistry

Jim Yoder moderated the Panel on Sensors/Observations. Panel members included Kendra Daly, Eric Delory, Ken Johnson, and Jim Yoder.

Jim Yoder of WHOI presented information about new satellite sensors: SWOT is a wide swath NASA altimeter. It will produce data giving a measurement of water storage and link into coastal oceanography. SWOT samples three times a month. PACE/OLCI from NASA/ESA is a high spectral resolution radiometer. Its ocean color scanning can detect harmful algal blooms by ultraviolet emissions characteristic of proteins in these organisms. Ocean color

radiometers are in geostationary orbits (S. Korea has GOCI covering the East China Sea, others are planned). This means there is an image every 30 to 60 minutes.

Eric Delory of PLOCAN described the NeXOS project that is part of Framework 7. The four-year project was started recently with a focus on the next generation of in situ ocean sensors (and systems). PLOCAN in the Canary Islands is the coordinator with partners throughout Europe. NeXOS addresses optical and passive acoustic sensors for *in-situ* monitoring of the marine environment and related maritime activities such as environment, fisheries. For example, in addition to support ocean research, fishing activities (RECOPESCA + EAF) need sensors for fishing nets and vessels. NeXOS needs to reduce the cost of observations and enable better cooperation between key sectors. Through a series of work packages, the project will build, integrate, test and deliver sensors that have common standards and improved interoperability for multi-functional (multi-sensor) applications. Main drivers are performance, cost, robustness, and bio fouling resistance. Transversal innovations require materials and production techniques. Demonstrations will be done on vessels, platforms, buoys, gliders, and profilers. Dissemination and outreach will support user interfaces and feedback. GEOSS data sharing principles will be followed. Practical experiences including the successes and failures will be documented.

Kendra Daly of University of South Florida presented challenges and innovations in chemical and biological sensors. Challenges are the need to accelerate sensor development given the long time frames (up to 10 years) to bring sensors to operational status. Few biological and chemical sensors are ready for long-term deployment on observatories. Rigorous field validation is needed for most sensors but collaboration between SeaBird Scientific, Satlantic, and a third commercial partner has tried to address this need. Standards are needed. Commercially available instruments are not as good as people would like. A way to calibrate sensors is needed. Sensors for acidity need temperature as well as pH to be meaningful and people don't always measure temperature or log it. The way the sensors are mounted makes a difference and people don't always indicate mounting method or location. An International Time-Series Methods Workshop in November 28-30, 2012 was so popular that people were turned away. The Wendy Schmidt X-Prizes for two types of pH sensors, one excellent and the other cheap, were offered. Three more Wendy Schmidt X-Prizes are in the works. There is now a 3D holographic camera that works as deep as 6000m. Adaptive sampling for profiling on a mooring is a priority. A deployment at Ocean Station Papa was the Surface Piercing Profiler. The OOI RSN cabled system has a shallow water profiler. Some sensors are fast but some are slow and require stepped profiling to not have measurements smeared. Clearly there are a lot of opportunities in this area.

Discussion following the presentations:

Christoph Waldmann of MARUM was interested in the role of the national metrology office in the US [NIST]. In Europe there is a national metrology project. Optical instruments were helped by NIST. Ken Johnson from MBARI wanted to give us a glass half full picture; we can deploy bio and chemical sensors that work at global or ocean basin scales. Observing system designs must be statistically defensible – large networks of sensors deployed globally. They are disposable and stable for years, low power, low cost, operated through large pressure and temperature ranges, sensitive and precise and include: Argo, BioArgo with oxygen, and biological sensors. All data are open and accessible. These can observe the metabolism of the ocean. O_2 and nitrate observations were reported in Nature for three-year chunks. Now pH

sensors are on floats. There are still challenges in recognition of data publication. Greenland Sea data from the Argo floats were analyzed and published by WHOI without attribution to the source of the data. There is also a need for longer term monitoring; a BioArgo challenge is needed for the five-year picture with global coverage. Simon Allen asked about quality of observations indicating chlorophyll and Mary Jane said that redundancy is the secret and doing it at night helps because there is no photo quenching of fluorescence. Denman asked if there is a sensor for argon. Johnson responded that there is an argon sensor, but it is slow. He believes that oxygen production seasonally at the surface can be used as a surrogate with the belief that production equals consumption and remineralization. There was some discussion between Craig Lee of UW and Ken Johnson about cost of floats vs. cost of ships. Both are needed. Mary Jane Perry asked if there was no call for zooplankton sensors. Eric Delory said he was not aware of any. Dawn asked if we lose 700 floats a year, what the report to the public about them is. Ken pointed out that it is small compared to losses of containers each year.

Working Groups

Simon Allen moderated the panel on Working Groups.

Jim Yoder from WHOI leads the RSS vs. In Situ Working Group. He has formed his group and they have been exchanging emails but he observed that one person writes the report. The satellites have already been spoken of but Jim added that there is a need for a near surface type of Argo float (shallow profiling) to do coastal work.

Eric Delory and Christoph Waldmann lead a Sensor Working Group addressing sensor requirements. It would be worthwhile to compile information about best practices.

Sandy Williams from WHOI and *Simon Allen* from CSIRO reported on the Webinar series where about one Webinar each month is given for free through the web. The purpose is Outreach and Capacity Building but in fact these Webinars have been given by stellar scientists and engineers and serve more as inspirational talks. Alternative strategies have been discussed to entrain youth into science from third world countries where capacity needs to be built. A series based on Open Courseware has been discussed with a lead lecture for such a course given as a Webinar to entrain those who might otherwise not follow a scientific path in college. It was pointed out that there needs to be some type of scientific course locally (at a national level) to sustainably attract such students. And the greatest need for capacity building is in data management where the demand will be greatest in the future. Dawn said the archived Webinars are good.

Summary

Sandy Williams summarized the RCN meeting by remarking that the Grand Challenges talks were inspiring and exciting and that the reports of International Cooperation and Collaboration through various international programs were informative. Progress with the working groups and the great success and data management requirements of modern oceanographic programs was exposed and described. The participants agreed that future face-to-face RCN meetings should continue to be held on the Sunday prior to the AGU Fall meeting in San Francisco.