Minutes POGO – 8 Meeting, 17 – 19 Jan, 2006

Venue: IOCAS, Qingdao, China
17 January, Wednesday Morning

Inauguration

Prof. Sun Song, Director of the host laboratory, the Institute of Oceanology, Chinese Academy of Sciences (IOCAS), opened the meeting at 0830 by introducing a distinguished panel of Chinese guests representing the city, province, Chinese Academy of Science, IOCAS and the First Institute of Oceanography (FIO) who had assembled to welcome POGO to Qingdao. He continued by introducing the POGO Chairman, Prof. Jan de Leeuw and Executive Director, Dr Shubha Sathyendranath of POGO who were also seated on the podium. Short welcoming speeches were made by: the City Governor, Mr. Yan Qijun; the Director of the Bureau of Resources & Environment, Dr. Fu Baijie; the Deputy Director, Bureau of International Cooperation of the Chinese Academy of Sciences, Mr. Ge Mingyi, the Vice Chairman of the Division of Science and Technology, Shandong Province, Dr. Li Naisheng and the former Director of IOCAS Prof. Jianghai Xiang. A key point from the presentations was that China hoped to work hand in hand with other countries of the world for the peaceful exploitation and better understanding of the oceans by the promotion of marine observations, education and research. The POGO Chairman responded by saying that it was an honour to hold the POGO meeting in Qingdao, one of the major focal points for marine science in the world and home to more than 5 large institutes including FIO, which had recently joined POGO and the hosts of the meeting, IOCAS. He expected the meeting would make solid progress in addressing ways in which ocean observations could be given a higher profile in the developing plans of GEO, which was the main focus of the meeting, and concluded by thanking the honoured speakers and the hosts.

Introductory Session: Chair: Jan de Leeuw

Prof de Leeuw welcomed four new members (FIO; Flanders Marine Institute,VLIZ; British Antarctic Survey, BAS; and Sir Alister Hardy Foundation for Ocean Science, SAHFOS), other POGO member institutions, participants from other institutions in Qingdao and representatives of other oceanographic institutions and international organisations. In particular he welcomed José Achache from GEO and David Farmer representing Ocean United; their presence was crucial to the success of the meeting and he hoped that a clear message could be passed to GEO from the ocean community by the end of the meeting. Attention was drawn to the pending submission of a proposal to the Nippon Foundation to establish a Centre of Excellence in Ocean Observation, which if successful would double the capacity building work of POGO. The meeting was informed that the new Chairman, Prof Tony Haymet, would take over later in the meeting and the new Executive Director, Dr Philip (Chris) Reid was introduced. The IOCAS, was thanked for hosting the meeting and for the excellent preparations. A tour de table of self introductions followed (see Annex 1).

Minutes of POGO 7 and Agenda for POGO 8

The minutes were approved and the Agenda adopted without comment. Day one consisted of a series of presentations around 4 themes:

1. GEO and the Oceans: Setting the Goals of the Meeting
2. Climate Change and Long-Term Ocean Observations

3. Climate Change, Ecosystems and Bio-diversity
4. Emerging Issues and Observing Strategies

followed by a public lecture by Yves Desaubies.

Day 2 followed a similar pattern with presentations on 2 themes:

1. Disasters and Food from the Sea
2. Oceans United

and discussions in the afternoon on:

1. A message to GEO and
2. Synthesis of message to GEO,

followed by a public lecture by Mike Meredith at the end of the day.

Day 3 included a follow-up of Actions from the previous meeting, Capacity Building and POGO business, including the budget, changes in the Secretariat and finalising the Action items. The meeting concluded with a public lecture by Jim Baker.

GEO and the Oceans: Setting the Goals of the Meeting - Chair Howard Roe

Howard set the scene for the meeting by welcoming José Achache and Michael Rast from GEO and the opportunity this gave to develop links between POGO and GEO for the future and especially to promote the importance of the oceans, sustained observing systems and capacity building at the GEO Ministerial.

Key-Note Address: GEOSS: To Understand Trends, Forecast Evolutions, and Inform Decisions. José Achache GEO Secretariat

In his introduction José Achache emphasised that existing ocean observing systems should already be seen as a fundamental part of the Global Earth Observation System of Systems (GEOSS). The ocean component is one of many constituent regional and local in situ networks and space-based systems. The aim of GEOSS is to combine data from these different sources and platforms (ocean, terrestrial and atmospheric) so that earth observations can be shared in standard interoperable formats.

The GEOSS 10 year implementation plan adopted in February 2005 (http://www.earthobservations.org/docs/10-Year%20Implementation%20Plan.pdf) is based around 9 areas of benefit to society. It is intended that GEOSS will provide the necessary institutional mechanisms to develop a coordinated, comprehensive and sustained global observing system with a high political visibility. The plan was based on issues that are close to the heart of Ministers and their citizens; it is not driven by science. Oceans do not appear explicitly, but are implicit in practically all societal benefit areas.

A primary aim of GEOSS is that single data sets or coordinated observations would be able to serve many communities. Because of this GEOSS recognized a need to foster multidisciplinary research. Examples of applications of sea-level change using altimetry, improved hurricane forecasting and ice thickness were given. Developments directed to address cross-cutting issues e.g. forecasting global emerging diseases such as cholera, which can be related to sea-surface temperature were cited.

The Group on Earth Observations (GEO) is tasked with the implementation of GEOSS. Established in July 2003, GEO is an international organization with 66 Member Countries, the European Commission and 46 participating organizations. GEO is

supported by a secretariat of 16 staff in Geneva and has a Ministerial summit every two years (next, 30 November 2007, Cape Town, South Africa).

Ocean observations can contribute to many GEO societal benefit areas and transverse areas but in particular integrated global water management covering: power generation, irrigation, flood and drought prevention and sea level rise and its consequences. Poor knowledge of the global water budget and its contribution to sea level rise and a need for a seamless water and climate prediction system is identified as a priority issue by the Global Climate Observing System Implementation Plan (GCOS IP).

José Achache stated that 'the ocean community had not been successful in promoting the. importance of the oceans in climate change in contrast to biodiversity, which has been well addressed by CoML or of the potential return that ocean observing systems could bring. There is a real opportunity for the involvement of the ocean community in the development of systems interoperability within GEO including technical specifications for the collection, processing, storing QA and dissemination of data and products and to help build GEO as a web portal and clearing house. His final point noted the need for full and open exchange of data with data and products delivered with minimum time delay and free of charge (or at cost of production) for research and education. He concluded by stressing that GEO was a voluntary process whose success depends on the goodwill of member and participating organizations. He also noted the need to involve new actors – private operators of observing systems who are needed to support the system by providing value added information to users such as insurance companies, investment banks, private foundations and citizens if we are to achieve the goal of providing "the right information to the right people at the right time to make the right decisions".

Introductory remarks on GEO and the oceans: David Farmer (Dean, URI), Ocean Ambassador to GEO

An Ocean Ambassador project was set up by POGO with support from the Sloan Foundation, to improve the links between the ocean community and GEO. In his role as Ocean Ambassador to GEO, David Farmer visited GEO in Geneva in August 2006 to develop closer links between GEO and the ocean community. During the visit it was clear that GEO needs the ocean community and vice versa. To improve co-ordination of interactions between the ocean community and GEO, POGO had taken the lead in establishing an informal consortium (Ocean United) of international organisations with ocean interests. Ocean United helps the ocean community to speak with a common voice in the GEO process. David Farmer called upon the ocean community to provide task leaders and participants to various relevant tasks identified by GEO in its workplan. With Jim Baker's help Ocean United provided a co-ordinated response to the draft GEO workplan for 2007-2009, which had been incorporated into the revised GEO workplan. Effective participation by the ocean community in GEO will require close engagement with GEO experts and sustained participation in GEO activities.

Early thoughts on message to GEO from the Ocean community: Jan de Leeuw, POGO Chairman

Jan noted that the 9 societal areas of GEO are all treated as equal, but questioned – are they in balance? Rapid climate change may in fact be the overriding priority issue e.g. future flooding of low countries, with sea level rise the most threatening consequence of climate warming. In the next 100 years many major economies are vulnerable but

predictions vary widely so politicians are confused or reluctant to take the initiative in tackling climate change. Jan de Leeuw considered the requirements to improved prediction of long term sea level rise – appropriate observations, assembling and reanalysis of data, better understanding of processes leading to flood prediction. He concluded that slowly developing risks such as flooding require long term observation to determine trends and noted the value of the Argo and ice observing programmes. Hence it is critical to secure long-term funding for sustained observation of the oceans. Since many variables have to be measured, an integrated and coordinated approach to data acquisition and sharing is essential.

Climate Change and Long-Term Ocean Observations – Chair Fangli Qiao

Attention was drawn to a World Climate Research Programme Workshop held at IOC/UNESCO France 6-9 June 2006 that outlined necessary observations (handout made available).

Four presentations were made under this theme heading (see Annex 2):

1. Rapid Climate Change by Ed Hill (Director NOCS, Understanding the role of the oceans.
2. Living on 30% of the planet: How can we understand the role of the global ocean and best manage its impacts? Bob Weller (Chair, Physical. Oceanography, WHOI).
3. Rising Sea Levels-What do we know and what more must we do? Andrew Willmott (Director, POL).
4. Why do we need an in situ observing system? Yves Desaubies (Representing IFREMER).

Summaries of the lectures and associated questions are included in Annex 2 and PDF copies of the Powerpoint presentations for these and subsequent lectures are available on the POGO website:
(http://www.ocean-partners.org/meetings/P8_agendapresentations.htm).

17 January, Wednesday Afternoon:

Climate Change, Ecosystems and Bio-diversity - Chair Kiyoshi Suyehiro

Three presentations were made under this theme heading (see Annex 2):

5. Are North Atlantic plankton responding to climate change? Philip (Chris) Reid, Former Director, SAHFOS, Executive Director, POGO.
6. Does ocean life care about increasing carbon dioxide in the atmosphere? Nick Owens (Director, PML).
7. For what problems can we move now from experimental to routine observation of marine life? From the experience of the Census of Marine Life Program. Jesse Ausubel, Sloan Foundation.

Emerging Issues and Observing Strategies - Chair Tony Knap

Three presentations were made under this theme heading including the first Public Lecture at the end of the day (see 2) and a short presentation by Lisa Shaffer on the Southern Ocean:

8. What can we learn from a bottom-up approach? Bruce Howe/Uwe Send
9. Are ocean observations relevant to business? Tony Knap (Director, BIOS)

First Public Lecture: Development of Marine Core Services in Europe: from Global to Regional Ocean Monitoring: Yves Desaubies, IFREMER

10. Presented at the end of the day's proceedings (see Annex 2 for summary).

Why observe the Southern Ocean? Lisa Shaffer (Scripps Inst.)

Plans for a 3 day workshop to draft the SOOS in Bremen, October 2007 were outlined. POGO was invited to officially endorse the concept of SOOS. Michael Meredith will gather input from POGO members. Links with other groups including CLIVAR were also recommended.

In the evening a banquet was hosted by IOCAS with speeches by Jan de Leeuw and Sun Song, Director of IOCAS.

18 Jan, Thursday, Morning

Disasters and Food from the Sea - Chair Peter Herzig

Four presentations were made under this theme heading (see Annex 2):

10. Tsunami warning: Kiyoshi Suyehiro (Executive Director, JAMSTEC)
11. Fisheries and Ocean Observations: Shailesh Nayak (Director, INCOIS)
12. How to Improve Data Management and Distribution: Lesley Rickards, Chair IODE, Deputy Director, BODC
13. Ocean Observations, Present Status and Strategy for the Future: Mike Johnson, Director, NOAA Office of Climate Observations

Ocean United: – Chair Sun Song

Four presentations were made under this theme heading (see Annex 2):

14. World Climate Research Programme - developing knowledge and tools for application : John Church, Chair World Climate Research Programme
15. GCOS: Ed Harrison Ocean Observations Panel for Climate
16. GOOS including Coastal GOOS: Keith Alverson, Director, GOOS Project Office
17. JCOMM, Satellite observing elements (SST, Ocean Colour, Altimeter): Jean-Louis Fellous, Co-president, JCOMM, CEOS Executive Secretary

A Group photo was taken prior to lunch.

18 Jan, Thursday, Afternoon

Discussion of Message to GEO and Related Actions - Chair Tony Haymet, POGO Chairman

Collecting the strands and the Message to GEO: Jim Luyten and Howard Roe

The ocean community is already a part of GEO and needs to engage proactively to contribute to the tasks outlined in the GEO work plan, identifying connections, issues of interoperability, data standards and quality assurance etc. Products related to societal benefits need to be distinguished and individuals nominated to participate in existing tasks as well as to develop new initiatives. This is not extra work – much of it is already being done. It needs to be a two-way dialogue with invitations from GEO. As a community we have to do more to convince Government agencies and citizens that the oceans are a critical part of the Earth System. A sustained and funded communication effort needs to be developed. New ways need to be identified to improve the situation

especially by quantifying social benefits. The GEO secretariat has offered help with this, which will also have a positive effect on national efforts. It is not possible to do everything and the community needs to prioritise a wish list that can then be augmented. The Ministerial meeting will provide an opportunity to catch their attention with exemplars of key ocean observations that address societal benefits. We should use GEO to provide advocacy at the highest levels that emphasises the importance of sustainability. Jim Baker identified the following key issues:

1. improve satellite data bandwidth
2. cross domain land/ocean intercalibration
3. fusion of global surface products e.g. global water and energy.

Discussion:

Yves Desaubies commented that there was too much focus on observations rather than products. Uve Send noted the need to move national commitments from research to operational funding. José Achache drew attention to the need to nominate individuals who could contribute to the GEO plan. Cindy Clark enquired about progress in communication plans at GEO and about plans to promote Earth Observations. José Achache responded that the GEO outreach plan had just been published with a focus on the Ministerial and highlighted a need for successful exemplars of ocean observation. Tony Haymet. gave an example of how the 5-day weather forecast in the Southern Hemisphere has improved dramatically due to satellite observations. Shailish Nayak outlined an application from India of satellite data for improving fisheries. Lisa Schaeffer suggested using an offshore energy example. Howard Roe advocated CoML, which is stunning in terms of developing technology and has a range of societal applications as well as being exciting and eye catching. Nick Owens drew attention to the problem of ocean acidification. Jan de Leeuw suggested giving biological examples from CoML to help establish protected areas and to add a biological Argo programme to the existing Argo programme to link biology, physics and chemistry. Ed Hill gave an example of a forecast by the UK Met Office of the exceptionally cold 2005 winter based on Argo data with strong societal relevance for fuel savings and health. Tony Knap gave an example of using ocean observations to improve forecasting hurricanes. Howard Roe agreed that Argo would be a fine example of a mature observing system with a strong relevance to the developing world. Shailish Nayak drew attention to coastal communities that are likely to be affected by coastal erosion and inundation. It is a problem that affects large numbers of people, which links in with other problems, such as tsunami storm surge and the health of coastal ecosystems. John Church mentioned the importance of seasonal to interannual climate prediction.in Australia, Brazil and Indonesia for droughs, floods and fires and a link to malaria occurrence in Botswana. Uwe Send indicated that the danger of tsunamis occurring is in the mind of many governments, noting that there is no tsunami system around Europe. We need a synergy between tsunami and other observing systems. Greg Ayres drew attention to the fact that there are multiple Societal benefits from assimilation of data enabling prognostic assessments, however there is no relevant task for this in GEO. Chris Reid suggested the Continuous Plankton Recorder survey is a long-term operational exemplar that has demonstrated wide socioeconomic relevance for fisheries, regional assessments, climate change, indicators and ecosystem health. Yves Desaubies mentioned the importance of forecasting systems for algal blooms, ship routing, ice cover, ship safety oil spill detection and detection of illegal discharges. Kim Marshall-Brown drew attention to prioritisation issues. The 2004 tsunami completely

changed the appreciation of the power of the oceans. We need to consider how to approach the Ministers in a simply understood way with numbers.

Chair Summary

This is part of POGO's job and not for IOC or Ocean United. We are willing to take up the challenge to produce an agreed list from the many suggested examples that POGO can recommend to GEO. On communication: we are doing a lot, but not managing to convince decision makers that they need to give more money (twice the amount of current spending).

Comments:

Shubha Sathyendranath suggested addressing the question back to institutes to ask: "Who will you dedicate to communicate the importance of ocean observations?".

Jan de Leeuw, as a member of the Marine Board of the European Science Foundation, noted that we have people doing excellent jobs and they are busy, but to unify and bring to a higher level a dedicated person is needed to address this issue. We need to steer and know who is the appropriate person to address in an institute – it is the only way to get action at a higher level. Part of someone's time should be made available in the POGO secretariat for this.

Uwe Send mentioned that money for a person to publicise our work would be well spent.

Kiyoshi Suyehiro indicated that there is a problem of reliability of predictions made today as a number of them are not coherent. Who will authorise and outline the accuracy and uncertainty? The press often get stories wrong even if given the correct information.

Tony Haymet noted that there are three forms of communication and suggested that information at the local level via the Executive to IOC should be caucused by email after circulating.

Yves Desaubies drew attention to the importance of translating information into different languages.

Kim Marshal-Brown noted that she was already busy responding to institutional requests, especially on climate change. If we want the POGO agenda to be promoted we will need a dedicated person.

José Achache emphasised the need for coordinated communication to be passed through to GEO. Argo seems a good examplar, emphasising the efficiency of how 26 countries join together to improve understanding of El Niño. A second examplar could be CoML as it is eye catching. The basis would be for these two examplars to work in a coordinated fashion with other components of GEO.

It is important to have someone in the POGO Secretariat who can achieve good coordination with press officers. The priority should be placed on logistics as this will really make a good step forward; it is also important to have eyecatching pictures.

David Farmer agreed that it is good to be able to learn from examples that have worked well, and CoML is a spectacular case. How does the Census organise multilingual information? It is distributed around world on the web. PR work is coordinated with meetings. The key is to choose 1st class people to get the message out to the media.

Jan de Leeuw wrapped up the session noting that 2 of the 3 issues addressed to POGO had been covered and that a lot of ideas had been put forward for the upcoming Ministerial. He briefly touched another issue: "Where are the champions in our community, identified with the label POGO?", as per the Ambassador function of David Farmer and Jim Baker and noted a need for a data person as an Ambassador.

Synthesis of Message to GEO - Chair Howard Roe

Questions to be addressed:
What is the message from the ocean community to GEO?
What are the actions required?
What follow-up can be envisaged to the Ocean Ambassador Project?

The chairman first worked through the various relevant tasks in the GEO Work plan (page 59 in the Blue Book of tabled papers) as a first iteration to develop points of contact for the GEO Tasks (see Friday morning minutes). The first priority was to identify Task leaders although contributors to the tasks were also needed. For the final day of the meeting participants were asked to identify the top 3 tasks where POGO could make a difference and to try to identify participants in the data management and capacity building working group and the Ambassadors to the GEO secretariat.

Specific points made include:

- Page 75 EC-06-01 Integrated Global Carbon Observation:Tony Knap suggested POGO should be involved to cover Acidification. Jim Baker responded that WCRP already actively representing the Ocean Community.
- Page 75 Ecosystem classification: Shuba Sathyendranath reported that OBIS is mentioned and that Nick Owens in his presentation earlier provided an extended summary of work done last year in ANTARES. The ocean community was active in 2006 with Tom Malone producing the GOOS Coastal Panel report.
- GEOSS IPY: Jim Sanderson noted that a number of programmes are taking observations in the Arctic. There will be a meeting at WMO on space and legacy aspects of IPY and part of the GCOS office will be involved.
- Note was made of progress towards establishing an Argo/ocean observation programme office and that Keith Alverson had produced a revised outline for Programme Office support.

José Achache and Michael Rast left the meeting after this session and thanked Tony Haymet for the opportunity to participate. José was encouraged by everything he had heard and by the proposed contributions to GEO. He said that they will bring major added value, but will not cost much to re-orientate institute activities. Leads for GEO Tasks are in the driver's seat; points of contact can be decided later. Finally, regarding the ambassadors, he asked for POGO to nominate representatives in due course to the 4 proposed GEO (Task Force) committees. The internal GEO contact will be Mike Rast. He left with a good feeling and with an understanding of the value of GEO to POGO and was glad that he was able to attend POGO 8.

At this point in the proceedings Jesse Ausubel presented a short underwater movie clip of Orca whales produced by Jacque Pepin for a Galatee film, which will provide good publicity for marine science.

19. Second Public Lecture: Variability and Change in the Southern Ocean: Mike Meredith (BAS, UK)

Presented at the end of the day's proceedings (see Annex 2 for summary).

18:00 Left by bus for second banquet in a brewery hosted by FIO and via FIO building.

19 January, Friday Morning

POGO News and Information Group: Cindy Clark

The Chair of the N&I group, which mirrors the POGO executive structure, provided an overview of activities over the last year. Limited progress had been made on the two action items from the last meeting (page 42 Blue Book), with only three organisations placing material on the website, NIOZ, CSIRO and SCRIPPS. Listed products of the group included: a POGO brochure, the Beagle brochure (page 262 Blue Book), a draft communiqué on POGO 7 and an email outreach to Ocean United and GEO. Feedback to the group on these activities has been very limited and was actively requested. The members of the group have only limited ability to contribute to POGO as they are already heavily involved as media and public information centres for their own institutes and it is clear that POGO is not doing enough to communicate ocean science. There are plans to improve the content and visuals on the web site in the coming year. A need for a dedicated half time POGO Commmunication person to lead the N&I group and to develop leverage within GEO was identified; and opinions on the idea and suggestions of how such a post might be funded was noted by Jim Baker. Jesse Ausubel suggested that the idea proposed at POGO 7 of producing a short animated film should be implemented in the coming year, that 15 to 20 representative figures should be put together and that POGO should work with a major magazine to prepare an article illustrating ocean observations. The Secretariat will be hosting the slides (with clear credits and copyright), possibly place this on the web site and make available high quality images for the media when requested. Stan Wilson proposed that POGO should host a virtual library of stock video footage for TV. It was noted that hosting an image library is a big commitment. Action for the N&I Group: to explore how they can work jointly on communications with GEO.

Information Sharing; data from Research Vessels: Shubha Sathyendranath

This session was presented by Shubha as Jan de Leeuw was indisposed. It was recognised at POGO 6 in Brest that there was a need to improve availability and share information on planned cruises by member's research vessels to facilitate possibilities for collaboration and berth sharing. A committee met in December 2005 to develop plans, which were adopted at POGO 7 when members agreed to progress a website on shared cruise information. This international database and web site is intended to address the need to improve information sharing, on pre-planned, planned, current and past cruises and related databases to enhance awareness of opportunities to improve cost effectiveness of cruises and to improve data mining. Strong support for the initiative was given by CoML, IOC, JCOMM and SCOR. CoML in particular declared an interest if the database could be implemented quickly and it was decided to progress as a joint POGO/CoML initiative. Tenders were invited in 2006, evaluated by appropriate experts, including NOAA, and the tender from a group called SeaDataNet was selected. A proposal submitted to the Sloan Foundation to support the development was successful. Total costs in 2007 will be $70k (US dollars) with a contribution in 2007 from the Sloan Foundation of $45k (US dollars) and hoped for support from Mike Johnson, NOAA to make up the difference. Future support will need to come from interested parties. A contract needs to be placed with the proposers and the success of the project will then depend on the commitment of laboratory contact points in providing a steady stream of information.

Yves Desaubies queried if the information provision will be via a standard form. Lesley Rickards, a member of the SeaDataNet group and POGO member replied, "Yes and as simple as possible". The work will build on the existing SeaDataNet system (involves 4-5 POGO partners) and other databases that already exist and will focus initially on vessels >60m long. An urgent need to make data available asap was stressed as the Sloan Foundation wants the first version up and running in March 2007. A discussion on potential contact points followed, including the University of Delaware for cruise information from the USA. Lesley indicated that in the first instance, until input to the database is online and interactive, data should be made available in spreadsheet form. It was recommended that the web site should carry important news items on up-coming cruises and vessels. Yves Desaubies noted that it will be a challenge in the future to keep up-to-date when changes in schedules are often rapid. In response Lesley indicated that in the long-term all institutes will use their own database with a common data format, but that this will not happen tomorrow. Finally, it was noted that the database will be of real value to funding agencies and Uwe Send indicated that this is the first step, but it is now time to initiate a discussion on cruise sharing and bartering.

China is proposing to circumnavigate the globe with a research vessel, which opens up many opportunities for interaction and is asking for ideas for research to be undertaken on the cruise, including launching Argo floats. Jianhai Xiang indicated that a new research vessel for Chinese scientists is under construction.

Draft Message to GEO: Howard Roe

Developing on the discussions held the previous day, names of nominated contact points were identified for each of the GEO Tasks (volunteer committees) relevant to POGO. A message to GEO built on the discussions held at POGO 8 will be sent to José Achache as soon as possible after POGO 8. Jim Baker indicated that it was a real opportunity for the community to achieve political recognition of ocean observation programmes such as CPR, Argo, OCEAN sites that could be promoted by Ministers in their own countries. Tony Haymet proposed that representative members in Europe attend GEO meetings at low cost to act as ambassadors to monitor the flow of information to the task groups.

Initial Presentation of POGO Budget: Tony Haymet

Tony Haymet expressed his gratitude on behalf of the membership for the contribution that Howard Roe had made to POGO prior and subsequent to establishment and for serving as incoming chair, chair and past chair over the last six years. His contributions have increased over recent years at the same time as shepherding the launch of the new UK NERC research ship, James Cook to launch. The Chairman hoped that Howard would continue to work with POGO in an ambassadorial role. In response Howard indicated that he was delighted with the way that POGO was developing and he wished to thank Lisa Shaffer, the first Executive Director and Shubha Sathyendranath for the support that they had both given him.

The chairman noted that past budgetary difficulties, because of an insufficient income, had been overcome by a 10% increase in fees agreed at POGO 7, by the addition of new members and by maximising external earnings including funds from the Sloan Foundation for the cruise database. A balanced budget for 2007 was proposed that includes a rolling reserve fund with each item identified to highlight new expenditure. $10k (US dollars) for additional activities linked to capacity building and $20k (US

dollars) to lubricate links with GEO. A full report of how the funds are spent will be made at POGO 9.

Tony Knapp asked if POGO has a strategy on getting new members. Tony Haymet replied that a list of people who have been approached and have indicated an interest is held by the Secretariat and that Shubha has been successful in convincing members to join individually or in consortia. It was noted that the Canadian contribution to the secretariat had been as a salary contribution to the secretariat at BIO.

Presentation by Robert Nigmatulin
Director, P.P.Shirshov Institute of Oceanology

In introducing himself Robert indicated that he had been elected to the Directorship by the staff of the laboratory and had recently taken up his post. His background was far from oceanography, in heat and mass transfer, and his research had focussed on supercompression to initiate thermal fusion in valves. A similar accumulation of energy occurs as a key process when micro-bubbles rupture in waves and micro-drops are entrained in air and by turbulent transfer to the atmosphere. He had previously been a politician in the Russian Duma where he had been a member of an ecological commission.

Robert then outlined work on global ocean observations at Shirshov which cover physics, biology, geology and technology. The institute deploys 9 ships of which 3 are large (>6000 tonnes). Funding the maintenance of this considerable fleet is a problem and income is supplemented by including paying tourist passengers to Antarctica on some vessels at the same time as undertaking observations and science. A section across 60° N is occupied each year to monitor heat and freshwater exchange between the Atlantic and Arctic. Two major north-south transects of the Atlantic were carried out in 2006 and measurements of ocean atmosphere interactions made in collaboration with Germany and the UK Met Office to determine heat and mass transfer. An exciting development in tsunami related activities was the identification of acoustic gaps in subduction zones around the Pacific: the Aleutian, Cascade mounts, Central Kuril and Zond seismic gaps. These are dangerous locations for the origin of major tsunamis by the release of energy from earthquakes. He rounded off his presentation by noting his pleasure at being able to attend POGO.

Capacity Building / Southern Hemisphere – Chair Hu Dunxin

Vietnam Training Programme sponsored by POGO

Shubha Sathyendranath reported on this programme, initiated at the Brest meeting to try and encourage training in south Asia. A course on remote sensing/ocean colour, entirely funded by POGO was executed last year in Vietnam (See Blue Book Page 178). This led to a ful-fledged proposal to the Visiting Professorship Programme for 2007, at a higher level but on the same subject, funded by the Nippon Foundation.

POGO-SCOR Visiting Fellowships for Oceanographic Observations

The POGO-SCOR Fellowship Programme was used to fund some 9 Fellowships in 2006, at a total cost of about 40k US$ (including a SCOR contribution of 10.5k US$). The programme is budgeted to continue in 2007. Some 75 scientists have been trained so far

under this scheme. The Executive recommended that the programme for 2007 should include targeted Fellowships for on-board training on AMT cruises.

Nippon Foundation – POGO Visiting Professorship Programme: Transition to Phase 2: Shubha Sathyendranath

See report in the Blue Book page 144. In 2007 the programmes will be held in Vietnam and Tunisia. Two of the planned four years have been completed and it is hoped that they will continue as part of a broader capacity building programme within the context of the developing plans for a Nippon-POGO Centre of Excellence.

Discussions have been held with the Nippon Foundation that have focussed the plans for the Nippon Foundation – POGO Centre of Excellence at an existing well-established POGO institute in a developed country (see page 261 Blue Book). The initiative will provide long term support for oceanographic training over a 4 to 5 year period. A letter was received by Shubha at POGO 8 from Nippon informing her that they would like to receive a full proposal by 31st January. A proposal for $0.5m (US dollars) will be submitted following which a call for proposals from members will be issued (see http://www.ocean-partners.org/documents/NF-POGO-COE-Announce.pdf). A committee will be set up to review the proposals and select the best candidate institution. A strong response from members with submission of a number of high-quality proposals is needed.

Tony Knapp indicated that BBSR has a strong interest in bidding for the project and there are opportunities for training on regular cruises from Bermuda for mooring deployment and other measurements. Uwe Send, Tony Haymet, Ed Hill and Nick Owens (speaking on behalf of PMSP) indicated that their laboratories would also be submitting proposals.

Howard Roe indicated that the training provided could also include postgraduate qualifications equivalent to MSc level. The packages offered will be at the discretion of the host institution. The Nippon Foundation wants clear evidence of a return in kind from the hosts, evidence of multi-disciplinarity and networking.

Austral Summer Institute, University of Concepción: Shubha Sathyendranath

See pages 215 to 248 Blue Book for a report on the work undertaken by this Summer Institute, which has trained 213 graduate and senior undergraduate students from South and Central America over the last 7 years. A letter was received (page 249 Blue Book) requesting the support of POGO. Recommended for support and adopted.

Support for implementation of SEREAD in the South Pacific: Shubha Sathyendranath

A letter requesting support toward educational capacity building at school level with a focus on Argo was received from Julie Hall, NIVA New Zealand. Recommended for support and adopted.

Iran National Centre for Oceanography (INCO) training programme on coastal oceanography in the southern Caspian Sea: Shubha Sathyendranath

An excellent proposal was received (see page 258 Blue Book). The Executive recommended that support at a modest level for the training, which will be provided by Prof.Charitha Pattiaratchi from Australia, should be provided. This recommendation was adopted. Details of costings for the three proposals above are included in the 2007 POGO budget.

POGO Capacity Building: A view from the South: Wolfgang Schneider, Director, Graduate Studies, University of Concepción

Capacity building programmes have been carried out over the past 7 years at the University of Concepción and the Center of Oceanographic Research in the eastern South Pacific (COPAS), focussing primarily on graduate training. The University, which hosts a UNESCO-IOC chair in oceanography, has 400 postgraduate and undergraduate students in marine science and awards PhDs in Oceanography. The success of the PhD programme can be gauged from the current employment of the postgraduates, which is diverse covering the whole of the Americas. Austral Summer Institutes with international lecturers primarily from Germany and the USA and funded from a range of sources including POGO have been an important part of the work of the University. The 2007 course covers: Methane Biogeochemistry, Geophysics and Remote Sensing and Ocean-Land Interaction. Grading of the ASI courses by participants has been very positive. The university is looking for new funding to continue the ASI initiative and plans to improve by training sessions in applied marine science, organise the Austral Summer Institute in 2008 and promote a Latin America-Europe School of Oceanography by developing a series of standard curricular modules with European partner universities at PhD level. New partner universities from any country are welcome to join. Funding has to be obtained for this partner initiative and the Chilean government has to be convinced of the need to replace the research vessel with a state of the art successor.

Capacity building efforts at IOCAS: J-H. Xiang presented by Sun Song

Established in 1950, IOCAS is the oldest and most important ocean science institute in China. Biotechnology, Aquaculture and Physical Oceanography are housed in the main building; a second building has piped seawater facilities and the site also hosts a museum of biological specimens for the whole of China. Accomodation is also available for postgraduate students. The institute operates a research vessel of 2300 tonnes, will take delivery of a new vessel in a short time and also has a ship of 1000 tonnes. Staffed by 1100 people, with 50 research professors and 100 associated professors, the institute is authorised to award PhDs in marine science.

Research is organised into 4 key laboratories:

1. Marine biotechnology and biomedicine
2. Dynamic processes in the marine environment
3. Ocean circulation and waves
4. Geology

The institute has two active centres that transfer knowledge to companies covering the aquaculture of kelp, shrimp, bivalves and especially scallop. Environmental problems including disease can be serious and red tides are frequent, therefore a model has been developed to predict their occurrence. Giant jellyfish that occur in the Yellow Sea and China Sea are a major problem for fishermen. Work also covers physical dynamics and modelling with applications to offshore oil and gas. Abilities in ocean observation are

weak with one offshore platform. A lot of surveys are undertaken, but not systematically and there are problems of conflict with aquaculture. The laboratory participates in meetings of ISOM, the International research ship operators and its research vessel is available to share with other institutes. Research in the Antarctic is mainly focussed on krill with a circum Antarctic cruise every 3 years. Finally, the institute provides international training in biotechnology with 20 people trained over the last 5 years.

Prior to lunch members were given a conducted tour of IOCAS.

19 January, Friday Afternoon

POGO Business – Chair Shailesh Nayak

Before starting the session the Chairman expressed thanks to the Director and staff of IOCAS for the excellent guided visit prior to lunch.

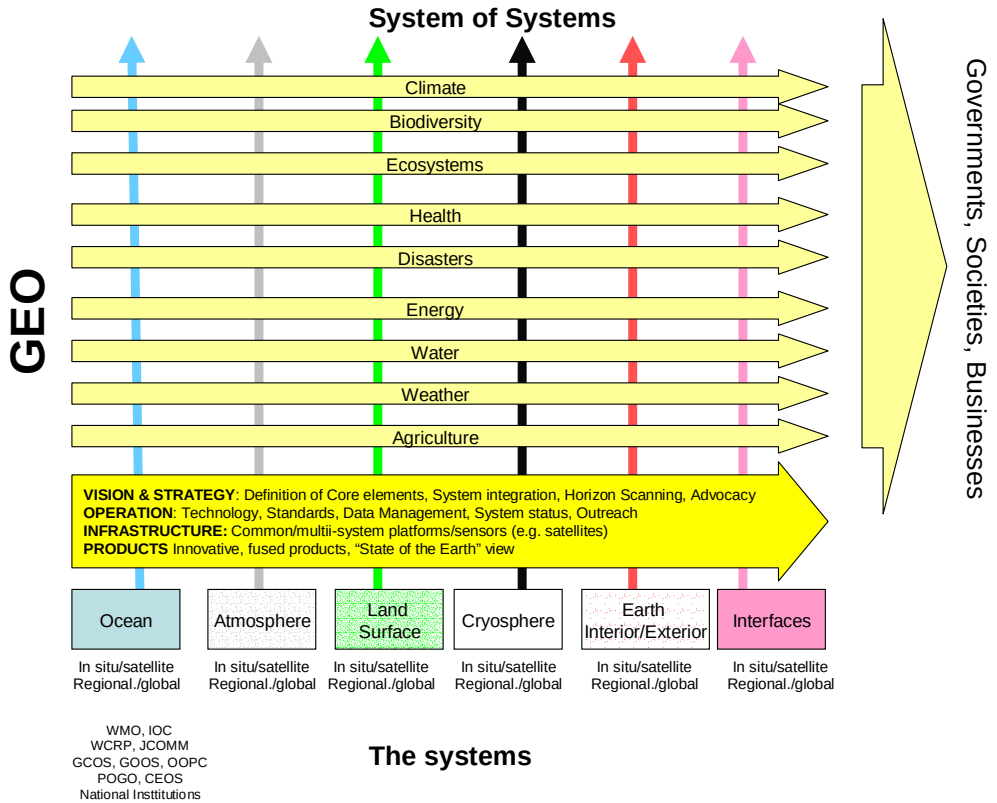
POGO 8 Actions, Review of actions from POGO-7: Tony Haymet

The Chair outlined the proposed actions for POGO 8 plus the addition of a new 7th action by Tony Knap and after discussion moved to accept. Carried without change (see Annex 3). The discussion first focussed around the GEO Actions.

Ed Hill presented a matrix diagram mapping the 9 socioeconomic benefit areas of GEO against the oceans and the other components of the system of systems and the resulting products that are fed to Governments and society.

The fifth action includes support for an ocean demo. that may include a short film at the Ministerial with $25k (US dollars) allocated.

Howard Roe referred to previous cost benefit studies including NERC research and the Australian Antarctic programme, which highlight the importance of ocean science.



Action six is to ensure that the ocean community is speaking with one voice and properly represented at preparatory and main meetings of GEO. The effectiveness of POGO in Ocean United is down to contributions from key ambassadors. Yves Desaubies asked for an explanation of Ocean United. Shubha Sathyendranath replied that it is the Ocean community speaking with one common voice that is recognised by GEO; JCOMM and GOOS are included.

Action items from POGO 7

Of the 15 Actions (see page 41 Blue Book) proposed last year POGO has delivered and worked effectively on 12. On the data actions it was noted that Argo is working well, but this is not the case for Expendable Baythythermograph (XBT) and temperature data. The problems of handling data in real time were highlighted by both Ed Hill and Mike Meredith. Yves Desaubies said that GOOS was working in real time, but that the data is not corrected. John Church noted that given the key role of the oceans in climate it was necessary to re-emphasise the importance of following the procedures in Actions 1 to 3. It was proposed that the actions on data should be reconsidered by the Executive to suggest possible changes. Bruce Howe proposed that support for Orion should be made. The Chair noted that past practice has been not to comment on national programmes.

Election of Incoming Chair: Howard Roe

By tradition POGO has elected the chair 2 years before they take up post. After canvassing the Executive proposed Kiyoshi Suyehiro, Director of JAMSTEC. He was accepted by acclamation as there were no other nominations. Tony Haymet will write to inform and congratulate him on his election.

POGO Business, changes in the Secretariat: Tony Haymet

Shubha Sathyendranath will be leaving POGO next year. Her talents were much appreciated and Tony Haymet hoped that she would attend POGO 9 where a final vote of thanks can be made. Jesse Ausubel praised Shubha for her mix of management and diplomatic skills and wished to personally thank her. Shubha appreciated the kind comments and said that it had been great working for POGO, the best of it has been getting to know a lot of very nice people. Shailesh Nayak noted that he too was very proud of Shubha as a window to the outside world.

Shubha's place will be taken by Chris Reid, who's location in Europe will make it easier to interact with GEO. Nick Owens wished to place on record that PMSP has offered to host the secretariat in Plymouth with provision of offices in kind and will support a 0.6 assistant for Chris Reid in 2007. The Chair proposed that this excellent offer should be accepted as it provides a focal point for POGO into the foreseeable future.

Revised Budget:

A balanced budget of 290k (US dollars) was adopted and carried unanimously.

POGO 9: Tony Haymet

The Chair outlined procedures for selecting candidates to host POGO annual meetings, including balancing northern and southern hemispheres, and expressed his pleasure when introducing Tony Knap who had been selected to host POGO 9 a few years ago. Chile will host POGO 10 in 2009 unless a particular event makes it preferable to select another

institution. After an introduction to BIOS the proposal to host POGO 9 in Bermuda was accepted with one abstension from Tony Knap.

Tony Knap briefly introduced the Bermuda Institute of Ocean Sciences, which was formed 100 years ago with a long history of global observations, courtesy of Henry Stommel, plus biogeochemical time series. The institute is based on a small island that is a British colony with the highest Gross Domestic Produce (GDP) in the world and has excellent transport links. The dates proposed for the next annual POGO meeting are 9 - 11 January 2008. At this time of the year the weather averages 24°C (75° F) with water temperatures of 19-20° C (66-68 ° F) and bright sunny skies. Plans are to accommodate members in the Grotto Bay Hotel with rooms at BIOS for any students who may attend. A taxi boat will link to the institute. It is proposed to have an Executive meeting on the 8th and to hold a golf championship after or during the meeting.

Ocean United

Confusion over this group exists with some members, so Shubha Sathyendranath outlined for clarification how the group had started in November 2005 at a GEO meeting. A side meeting was organised by Jan de Leeuw to bring together all international people who had an interest in the oceans and GEO to try and get them to speak with a common voice. The resulting informal group that has subsequently grown was christened Ocean United (see page 27 Blue Book). Boram Lee at IOC maintains the list of involved people and organisations. Nothing is binding and there are no rules, but it provides a useful way of presenting a combined message to GEO. POGO acts as the voice of Ocean United with Jim Baker and David Farmer as ambassadors to react. This new mechanism has brought the ocean community together in an informal but effective way.

Jan de Leeuw

Tony Haymet thanked the outgoing Chair Jan de Leeuw for the way he had transformed POGO over the last few years and especially for making the oceans more apparent to GEO. On many occasions he has dropped his research to take on a POGO baton and has worked tirelessly on our behalf. Tony remarked that he feels blessed that he will have Jan's advice for the next 2 years. He asked members to join with him in thanking Jan in his absence.

The meeting finished early at 16:20 and was followed at 17:00 by the final Public Lecture.

20. Third Public Lecture: Marine Biodiversity, Management and Ocean Observations James Baker, Former Director of NOAA and Chair of the US Natural History Museum. (see Annex 2 for summary).

After the lecture Yves Desaubies, Mike Meredith and James Baker were invited onto the stage to receive a thank you presentation from Sun Song. This was followed by a Farewell Banquet, hosted by IOCAS.

Annex 1: List of participants
Annex 2: Lecture summaries
Annex 3: POGO 8 Actions

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Annex 2 Summaries of lecture presentations at POGO 8

1. Rapid Climate Change – fact or fiction? Ed Hill, (Director NOCS)

A background to increased concerns over the possibility of rapid climate change (RCC) were outlined where the climate changes faster than the current understanding of the underlying physics or the impacts are faster than man can adapt. Characteristics of RCC were split into four:

1. occurs within decades
2. has a critical transition threshold
3. includes a mechanism to communicate changes over a wider geographical area
4. has a flywheel to keep in the altered state for a period of time.

Possible triggers might include for example, the disruption of the thermohaline circulation by melting of ice sheets, shifts in atmospheric circulation modes, weakened natural carbon sinks and release of gas hydrates. If freshwater forcing increases rapidly in the North Atlantic the overturning will gradually decrease until a threshold is reached when the system will jump to a new state and stay there for some time returning to the pre. Such hysteresis is shown in intermediate complex models, but very complex general ocean circulation models are not good at reproducing similar effects. Similar rapid changes have occurred before in the Pleistocene as in the 8.2k Younger Dryas event. But it was queried whether the past is a guide to the future. Ensembles general circulation models do show a gradual reduction in the over turning circulation, but recover if continued for longer than 500 years. If a critical threshold of 700ppm CO2 is reached they do not recover. On present evidence the North Atlantic has freshened over the last 40 years and the Rapid programme section at 25 N suggests a reduction in the overturning circulation of 30%, but it is not clear if this is real. On past evidence a rapid reversal to cold temperatures would have a major social and economic impact. The potential risks need to be identified by removing uncertainties in understanding the processes and strategies developed to adapt to local high impact events.

2. Living on 30% of the planet: How can we understand the role of the global ocean and best manage its impacts? Bob Weller (Chair, Physical. Oceanography, WHOI)

It is necessary to connect science and observation directly to social and economic issues e.g. ocean observing informs predictability of diseases such as malaria. The oceans hold the key to interdecadal variability in for example precipitation and evaporation that are crucial for agriculture and forest fires and also govern the direction of storm tracks. Ocean observations are essential to understand and forecast this variability. Time series stations (Ocean Sites??) with high vertical resolution are important. Priorities in the next 2 years should be to complete the global tropical ocean array – these are multi mission, multi-disciplinary arrays but on too few monitoring sites. There is a need for better coordination, especially. for deep moorings and tsunamis – such moorings should be made multipurpose. Critical needs are increased analysis, decreased costs for data telemetry and capacity building. On a 5-year timescale the global tropical array must be operational with major progress on

a global ocean reference station array. Increased real time data flow, internationally coordinated deployment plans and coordination to achieve interoperability of interpolations from ocean, land and space observations is needed. A 2-year goal is to deliver international partnership in the Indian Ocean, International support for extra tropical arrays, International agreements on ship use and on improved data bandwidth and capacity building. A 5 year goal would be to achieve a global ocean plan for national commitments and responsibilities (WMO equivalent) and to address issues of inter-calibration, data quality and bandwidth and provide improved analysis. Technical developments are also required to address severe environments. There is an opportunity in GEO to stimulate the development of the above goals in a truly global context. It is hoped that measurements taken at Ocean Sites will make it possible for people on Earth to see that ocean forcing is a strong player in their lives. A question from Howard Roe addressed the readiness of biological sensors and power issues – is the technology there yet – response 'on the cusp'.

3. Rising Sea Levels-What do we know and what more must we do? Andrew Willmott (Director, POL)

Sea level rise is a major scientific issue as many large coastal cities may be impacted. Understanding why it is rising and by how much in the future is important. There is currently difficulty in distinguishing between natural and anthropogenic change. Sea level rise has accelerated since the 19th century and increased by 3mm per year in the 1990s. Half the increase can be attributed to thermal expansion, but the source of the remaining rise is unclear and is probably a consequence of poor information on the thermal heat content of the top 2000m of the water column. Understanding and proper prediction of tsunamis and storm surges cannot come without copious data with a high sampling frequency. The importance of GLOSS was emphasised, with identification of gaps in the CORE sampling network including access to high frequency data from China.
An Indian Ocean early warning system is being established and VLIZ is establishing a System on the Northwest African coast. Coverage otherwise in Africa and South America is challenging and POGO could help develop local scientific and technical expertise in developing countries to complete the component parts of the network. GLOSS now consists of the Permanent Service for Mean Sea Level (PSMSL) for monthly and annual data, a Fast data centre (e.g. for Tsunami warning) and Delayed mode data centre. Through delivery of local expertise GLOSS is founder component of GOOS, success with GLOSS may point to how well GOOS can develop – both GLOSS and GOOS will be major components of GEO. Progress limited by bureaucracy, national security and data commercialisation.
Question – it was noted that with the launch of satellite altimetry it was thought that tide gauges would become less important when in fact it is the reverse and it was suggested that the GLOSS implementation plan be revisited?

4. Why do we need an in situ observing system? Yves Desaubies (Representing IFREMER)

Long term ocean observations are indispensable to measure essential variables (temp, salinity, sea level, ice coverage, colour, pH and CO_2, nutrients, trace elements, phytoplankton etc) at a wide range of scales and on a diversity of platforms. The data is needed to provide key inputs to climate change, to facilitate forecasts of e.g.

hurricanes and for a range of other applications. Argo was highlighted as a success story which has demonstrated large changes in salinity, temperature and circulation. The unknown source of recent positive sea level anomalies that may be attributable to salinity change, deep ocean temperature, glacial isostatic readjustment or other cause was again noted. Note was also made of the apparent reduction in sea temperature in the last two years, which so far cannot be explained. The Argo program is ongoing: US Argo 2006-2011, EU – proposal to be submitted under FP7 – requiring funding by Member states. Issues include transition to operational status and need to look at standards, deployment platforms, management and supporting infrastructures as well as programme direction, project office(s), technical coordination etc. Call for better CTD calibration and inter-calibration and transfer of high quality data to national data Centres in Europe. Issues for POGO are funding and sustainability, the need for multi-use of data (report once use often), cost efficient data handling and management and inclusion of research vessels in the global observing system. Benefits to GEOSS are reductions in loss of life, human health, improved management of energy, improved background to climate change, better weather, water resource and environmental and biodiversity management.
Question/comment – Oceanographers need to be better at highlighting uncertainty in results to the public.

5. Are North Atlantic plankton responding to climate change? Philip (Chris) Reid, Former Director, SAHFOS, Executive Director, POGO.

Plankton are sensitive indicators of environmental change, play a key role in climate change through the transfer of large quantities of CO_2 to the deep ocean by a process known as the biological pump and are vulnerable to increasing ocean acidification. Results from the >75 year old Continuous Plankton Recorder (CPR) survey were presented that show a marked step wise increase in the Phytoplankton Colour index (PCI, a visual estimate of chlorophyll calibrated with SeaWiFS) around the mid 1980s equivalent to a 60% annual increase in chlorophyll in the Northeast Atlantic. There were parallel changes in zooplankton, fish, benthos and hydrodynamics and at about the same time a northerly movement of warmer water plankton in the eastern Atlantic of 1000 km in only 40 years. Evidence of this nature would not have been possible without application of standard techniques over a long period and emphasises the importance of preserving long-term data sets. Many of the changes seen in the plankton are correlated with mean Northern Hemisphere temperature. This relationship suggests that the change around 1988 is possibly a response, on an ocean basin scale, to global warming. In concluding remarks it was pointed out that planktonic ecosystems in the North Atlantic are changing rapidly, but there is little information available to determine what is happening to the composition of the plankton elsewhere in the world. It was noted that there is an urgent need to establish new regional CPR programmes and other plankton monitoring programmes with associated instrumentation under the auspices of GEO and GOOS with application of new technology when possible. The oceans play a crucial role in the carbon cycle and the plankton as part of this through photosynthesis and in the biological pump. Understanding the oceans is of high priority for mankind.
Message to GEO: Establish new regional CPR programmes and other plankton monitoring programmes with associated instrumentation with application of new technology when possible

6. Does ocean life care about increasing carbon dioxide in the atmosphere? Nick Owens (Director, PML)

Evidence of ocean acidification – the other CO_2 problem. There has been a 30% increase in the concentration of hydrogen ions in the oceans over the last 200 years and sea water will soon reach a pH that has not been experienced for 20 million years. This rapid change is likely to lead to dissolution of organisms with calcareous body parts including warm and deep water corals and especially aragonitic species, with knock on effects for other organisms. A recent CHLOROGIN workshop to build a worldwide network of chlorophyll measurements, that included GEO as a sponsor, could be a template for further POGO capacity building activity. Remote sensed chlorophyll measurements have already demonstrated applicability in advising on potential fishing areas in India. The Atlantic Meridional Transect (AMT) was shown as a demonstration of a highly successful observation programme that has led to 69 PhDs and has focussed on quantifying variability in the biological carbon pump. Future needs are: further experimentation of consequences of ocean acidification, sustained ocean observations with standard protocols and embedding of results in models.
Message for GEO – a need for further research on likely consequences of acidification and a need for sustained observations, and consistent protocols.

Question: Is the change reversible? Yes over time.

7. For what problems can we move now from experimental to routine observation of marine life? From the experience of the Census of Marine Life Program. Jesse Ausubel, Sloan Foundation

Using illustrations from a range of projects from CoML the presentation emphasised that animals have a key role to play in the operational system of systems in parallel with remote sensing. A combination of new technologies and consistent repeated protocols spanning very large areas should be utilised to observe the biodiversity of the oceans within GEOSS including:

1. Near shore multiple sites for benthos as per NaGISA project
2. Far migrations by tagging and telemetry of air breathing vertebrates, sharks, fish and squid 'living ARGO floats' .
3. Microbial populations as sensitive indicators of change, including the rare biosphere (>20000 bacteria in one litre based on DNA sequencing).
4. Ecosystem scale studies: Tagging of migratory animals on continental shelves monitored by acoustic curtains.
5. OBIS should be used as a repository for all spatially referenced marine bio-data (currently contains 13 million records).

A live access server with on demand integration of tracks & oceanography is already available in TOPP serving ~150 pelagic species. The Bio community is keen and ready to join in the GEOSS implementation. Bio and robotic systems (such as ARGO) are highly complementary – and biosystems are 'replaceable' at relatively low cost. The ocean community needs to prepare detailed proposals for deployment and management, including schedules and cost estimates, with promised outcomes, outputs, and measures of success agreed by both producers and consumers of the information with demonstrations of integration with other aspects of GOOS-GEOSS.

Message to GEO:
Near-shore: Endorse standard protocols for reference sites
Migratory species: Endorse emergent ocean tracking network both to understand animal behaviour and to help describe physical state of oceans
Microbial populations: Promote shift to routine monitoring, including rare biosphere
Shelf ecosystems: Incorporate ocean acoustic remote sensing
Deep Ocean: Endorse standard protocol for reference sites
Data: Endorse OBIS repository for spatially referenced biological data

8. What can we learn from a bottom-up approach? Bruce Howe/Uwe Send

Details were presented of the Ocean Research Interactive Observatory Networks (ORION), a proposed long-term, sustained and interactive programme that focuses the science, technology, education and outreach of an emerging network of science driven coastal, regional and global ocean observing systems. Planning started 10 years ago with multidisciplinary science drivers especially for climate change and its impact and to help understand the oceans role in storing anthropogenic carbon. The system uses transformative cyber infrastructure integrating data and models for science and its applications. No major funding achieved as yet, but it is expected that proposals to NSF will come on stream for the next 6 years. The proposed system includes a Regional Cabled Observatory (NEPTUNE) with 2000 km of cable and up to 10 kW at each station a gigawatt link and 2 way communication with a dual civil and military role. Volcanism, sea floor spreading and methane hydrates are included in the proposed programme of observation. Neptune Canada has funded $80m a vertical profile mooring with core instruments that will include mass spectrometry and genomics directly in the ocean coupling ocean dynamics with food webs.
Question/Comment. Planning and standards need to be interoperable with other systems.

Uwe Send continued the presentation focussing on OceanSITES a worldwide system of long-term, deepwater fixed site observatories measuring dozens of variables and monitoring the full depth of the ocean from air-sea interactions down to 5,000 meters. He noted that the general need for time series is clear and generally accepted and that fixed observation (time series) sites fill a gap in GOOS. A brochure sponsored by POGO GOOS CLIVAR was made available that can be ordered from http://www.oceansites.org/ . At present most sites run by single PIs; the intention is to sustain them into the long-term to provide data and products. Critical need for ship time for servicing and need to develop ship bartering system.
Question/comment.

1. POGO International Ship Database will be launched in 2007 and can be used for ship bartering.
2. Important that web portal system is integrated into GEO system.

Message to GEO:
Develop sustained support for OceanSITES.
Telemetry system needs to be in place to deliver data in real time.
Standardise approaches.
Incorporate new systems e.g. gliders and systems for under ice.
Globally coordinated data management perhaps modelled on Argo.

Interaction with users of products
Provision of products and indicators on the state of health of the ocean

9. Are ocean observations relevant to business? Tony Knap (Director, BIOS)

For business a stronger case has to be made about the ocean and climate. It was noted that funding for Station S, budget – the longest time series in history, is still coming from research. Most businesses think that climate is related to the atmosphere and that ocean issues are mostly fisheries and pollution. There is also a feeling in parts of the community that we know enough and it is down to politics now - (US Foundation). Anything that can be demonstrated to affect the financial markets is important. Need to convince that if the mean changes the extremes of events will change. Examples were shown of ocean impacts on e.g. agriculture, airlines, energy generations etc. A focus was placed on re-insurance where a clear advantage could be demonstrated by having a better knowledge of ocean physics during hurricane development. After Hurricane Katrina a lot of re-insurance companies were in trouble. Worldwide insured catastrophe losses have risen substantially. To provide a service to the industry a Risk Prediction Initiative has been started to support research on natural hazards and to transform science into knowledge that sponsors can use to assess risk. Proxy and archival research will be supported to help understand the history of past hurricane evolution. Business is interested in greater ocean observations but are in business by having a competitive edge and do not want to make their information public; it is up to Governments to provide data for the 'Greater good'. Businesses will develop to create added value.
Comment/Question: Noted that data from the Princeton Ocean model was meant to be public, but difficulty had been experienced in obtaining.

10. Public Lecture 1: Development of Marine Core Services in Europe: from Global to Regional Ocean Monitoring: Yves Desaubies

The chair expressed great pleasure to see so many students; a translation was provided by Sun Song.

The development of Marine Core Services in Europe: from Global to Regional Ocean Monitoring (GMES a joint effort between EU community and ESA) was outlined in the presentation. GMES Marine Core Services combines *in situ* and satellite data with models to provide ocean monitoring, analysis, forecast and hind-cast. Used to provide reports on the status of the oceans for policy makers for European Marine Directives. Data is assimilated into models from a variety of sources, alltim SST ice, ocean colour.
In situ ARGO XBT CTD with ECMWF forcing fields. New technologies such as gliders being applied and all data freely available. A strong research and development programme is included. Global quarter degree NEMO-LIM simulation 1958-2000 are resolving eddies and fronts, boundary currents, coastal upwelling and sea ice cover, thickness. Nesting and ecosystem model systems. Organised around 8 centres. Customers are national Meteorological centres for whom a range of operational products are produced. New project starts in 2008-2011 with a number of issues still to be resolved.
Question/comment:

1. What is the biggest challenge, predictability, money, people? Presently adequately funded although results still not fully accepted, skilled people possibly a problem, but major difficulty is computing, which is huge.
2. What is the status of ecosystem, chlorophyll models? At present off line. The next stage is the carbon cycle validated by chlorophyll remote sensing.

11. Tsunami warning: Kiyoshi Suyehiro (Executive Director, JAMSTEC)

The Tsunami disaster of 2004 with >230000 dead is within the context of 8 tsunamis with a mortality of >1000 since 1900 and typhoons, floods and earthquakes which take far more lives. In Japan there is a good tsunami information and warning system in place with information provided on TV with an international system in place in the Pacific. A similar system is being worked on for the Indian Ocean. A need for more R&D and timely and accurate information with greater accuracy and reliability so that false alarms are not generated and that is used by and is useful to people was stressed. This includes improved knowledge of bathymetry and seismic information that takes the crustal structure into account in the area where earthquakes occur. Plans are in hand to establish an ocean floor cable network system offshore Hokkaidko in the Japanese seismogenic zone with open access to data. Cooperation will be developed with ORION and NEPTUNE. An outline of a proposed global system to be developed over the next 10 years was outlined with real time sharing of data in 2 years and data assimilation in 5 years. In conclusion tsunamis are generated in the oceans and attack populated coastal areas strongly connected with earthquake mechanisms, crustal structure, seafloor bathymetry and plate motions, all of which require in-situ seafloor observations and monitoring.

12. Fisheries and Ocean Observations: Shailesh Nayak (Director, INCOIS)

A case study of how fishing yields can be improved using remote sensed chlorophyll and temperature ocean observation data and education of local fishermen off Goa/Kerala was outlined. Twice weekly forecasts with a 70% success rate are produced for the 7 million fishermen in India. The total catch is the same, but the time taken per trip is reduced with considerable savings in fuel. Coloured maps of potential fishing zones based on integrated data on chlorophyll SST and winds, with text in the local language, are produced and presented on electronic display boards, by radio and in information kiosks. By the end of the year the information will be passed directly to the fishing boats. Algal blooms are also reported. An outline of a proposed Indian Ocean observing system using a variety of floats (including Argo), 2 vessels and ~20 real-time tide gauges, in partnership with the USA and Japan, was outlined. A total of 8 tsunami buoys are planned and 4 are already in place. The above are complemented by two Indian satellites producing ocean data measurements (colour monitor and scatterometer) with a calibration site 30km off the west coast of India. Satellite data has been used to evaluate the recovery of coral reefs and mangroves post the 2004 tsunami. A strong focus has been placed on database management.

Question/comment:

Is Quiksat colour and scatterometer data being provided in real time? No, but it could be, as could information from other sensors by bilateral agreements. Approval has been obtained to buy a CPR and tender for analysis.

13. How to Improve Data Management and Distribution: Lesley Rickards, Chair IODE, Deputy Director, BODC

A comprehensive presentation was given outlining what data systems are in place now for research and operational use, what has been learned and how to improve efficiency and effectiveness in the future. Why are marine data important? – They underpin research, modelling, monitoring and assessments and are fundamental to processes that control our environment. Irreplaceable and unique (certainly in time), but spatial and temporal coverage still very poor, can be extremely expensive to collect and ensure that maximum benefit is derived: capture once, use many times. It is important to manage what already have and get the most out of it.

Data policies

Need to maximize the use of the data and make it as freely available as possible whilst still protecting IP rights of scientists. Suggestion that can cite in same way as papers to give credit to originators. WMO Resolution 40, IOC Data Exchange policy – promotes free and open access to data, ICES – new data policy

Archiving

World Data Center System set up under IXIE (IGY) 52 Centres in 12 countries overall, 3 for oceanography China, USA, Russia and for Marine Environmental Data hosted by Germany (newcomer). Solar, geophysical and related environmental data. PSMSL – 50,000 station years from 2000 tide gauges, 200 national authorities – 75 year sold in 2008. National data Centres – over 60 established by IOC/IODE over last 40 years- varied data holdings, approx 50% relevant to GOOS, 40% links with science programmes e.g. CLIVAR, Argo, GLOBEC. But no one stop shop to say what is where. WOCE data system – control based at university of Delaware. CDs produced but not sufficiently well coordinated initially (lat/long and date/time variations).

DATA Discovery

IODE – Ocean portal. Global change master directory – NASA – oceans section.
OBIS – biological and biodiversity data - 13 million locations for 78000 species from 145 interoperable sites, actively seeks out new datasets. Differs as a truly distributed system that is a good step forward. Benefits from clean sheet approach and modern technology, vision driver to make publicly available for research education and management. SEASEARCH (EU) includes cruise data base. Many data systems exist that work well, especially at the programme level – e.g. ARGO, GOSUD, Ocean SITES plus drifting buoys, GTSPP, GLOSS (sea level), CO_2 information analysis Centre etc. Coastal and cable observatories – multidisciplinary, integrated with models and on web in near real time – contribution to global GOOS. Various GIS systems – e.g. MESH.

Current problems

There is no easy way to:

- Discover data of interest
- Assess or indicate quality
- Name variables and attributes
- Handle the variety of data from different disciplines

- Duplication of data and information- many times (but not exactly – QA changes, resolution changes, standardization- lose track of the master data else can bias the data sets), same data from different places look different.

How to build a global marine data system?
Determine objectives, assess problems in current systems, find solutions but look at the implications, exploit new technologies where they help, new ideas on data handling and usage and to agree on standard practices and protocols – requiring cooperation on a scale not yet seen – no pain no gain. KEY Issue is STANDARDS (see financial sector – cash point machines as analogy).

METADATA
Standards for geo-spatial data ISO 19115/19138. Standards needed for accompanying information – Marine Metadata interoperability project (EMBARI)
International cruise research database to be build by extending existing systems utilizing developments in SeaDataNet (standardized vocabularies) underpinned by well established National Oceanographic Data Centres. Starting now and could extend for future cruise, initially for ships >60m. First version will be available in March. ACTION POGO to provide contacts.

Quality control
At time of collection, during digitization, documentation, storage and archiving, analysis and manipulation, at time of presentation and through use to which they are put.

Data transfer and access
Open source project OPeNDAP – existing technology and freely available. US – IOOS plan for data management and communications DMAC – with links to international community. EU – SeaDataNet End to End Data management E2EDM pilot project – Russian lead. But, even these have different philosophies and need to be able to communicate.

Conclusions
Increasing data recovered as a valuable resource. A culture change is required.
Good data management begins at home. Establish common ways to deliver data of interest, name variables and attributes of data and information, assess or indicate quality of data in our archives and handle data from variety of disciplines.
It is time to stop duplicating copies of data by properly documenting. Build on what exists already and do not create new wheels by convergence of existing systems and links to others e.g. WMO, IPY. Overwhelmed with input and need support.

Message to GEO:
Marine data are an important component within GEO/GEOSS but linkage is currently weak, not a 2-way flow of information. Good communication is the key with provision of a GEO/POGO ocean data champion or ambassador?

Question/comment:
1. How much do operators command and control the system? Lacking.

2. José Achache. Everything you say is true of all data. Why not a data management system. Links weak. A remarkable presentation and welcomes to join and contribute to GEO.

14. Ocean Observations, Present Status and Strategy for the Future: Mike Johnson, Director, NOAA Office of Climate Observations

Require continued global coverage, continuous satellite missions, data sharing and assimilation subsystems, management and development of forecasting products. The organising framework for the GCOS-92 implementation plan was in place as of Sept 2005 and 57% of the network was in place by January 2007. The plan that covers all 6 *in situ* ocean programmes. Progress under the six systems was outlined, including the integration of the tsunami warning buoys into GOOS.

1. Surface drifters
2. Tropical moored buoys
3. Profiling floats
4. XBT lines
5. Tide gauges
6. Ocean sites

GCOS-92 is a GEOSS ocean baseline and G8 commitment with JCOMM in the lead with six implementing panels. Designed for climate but also covers global weather, global and coastal ocean prediction, marine transportation, hazard warning etc. ARGO and Ocean Sites are associated. Annual ocean status reports produced and biweekly climate indices placed on the GOOS web site. The status of the programme is also monitored in near real time and can be interrogated on the web: Test Version 2.00 beta:

http://www.jcommops.org/network_status

The current JCOMM observing platform support Centre is in Toulouse, France. A need to work towards an international global support centre has been agreed with offers to host still open.

Message to GEO:

1. Coordinate contributions through the JCOMM affiliated implementation panels.
2. Share all data in near-real-time.
3. Advocate at the highest levels of governments for adequate, sustained funding to meet implementation targets.
4. A Global Ocean Observing System cannot be achieved with the present level of resources.

Question/comment: Noted that only upper 20% of the ocean is being observed. How should the deep ocean be observed? Boundary currents, sea ice and deep ocean are key gaps in the existing system.

15. World Climate Research Programme - developing knowledge and tools for application : John Church, Chair World Climate Research Programme

An overview of WCRP that started in 1980 presented. A new strategic framework 2005-15 launched to facilitate analysis and prediction of Earth system variability & change for use in an increasing range of practical applications of direct relevance,

benefit and value to society. Called for strengthening of partnerships especially with IGBP, increased focus on end users, added value and greater integration. Research focus very much on IPCC WG1. One example resource is the data product of simulations from 18 global climate change models with >750 users. Study groups established on El Niño, monsoons, seasonal prediction and ocean surges with an especial focus on the causes of recent rapid rises in sea level and CO_2 projections. A set of actions to reduce uncertainty were outlined including maintaining a successor to the Jason satellite and designing and implementing an observation system for the deep ocean (heat exchange) and to extend Argo to have under sea-ice capability. Scope for IPY as driver to implement sustained observing systems for high north and south latitudes. International Repeat Hydrography and Carbon Advisory groups being formed.

Question/comment: Does SPICE extend to the equator? Yes, it is **focussed on the western boundary currents of the equator.**

Message to GEO: Oceans central to the Climate SBA of GEO, Climate SBA underpins many other GEO SBAs. Develop and use indices and need for ongoing instrument development.

16. GCOS: Ed Harrison

Ocean is variable in space and time, even on decadal scales and basins: thus must have sustained global ocean observations, necessary to address key questions. Ocean has been comparatively under observed – story is of variability not trends – need to assess over very large time series to pull out any long term climate level trends. Ocean research community has done the bulk of the work in establishing the system to date, heavily dependant on satellite resources. A growing concern is that further delay in decisions to continue some ocean observing satellites appears likely to lead to gaps in critical time series and/or unavailability of data that is critical for the generation of climate accurate products. Also maintaining the capability to measure solar energy output consistently and from mission to mission is a problem, the ocean community could help lobby. Need to make best use of GTS/WIS to enhance JCOMM and undertake much work on data systems. Ocean analysis, reanalysis and forecast systems are progressing primarily as pilot projects, and need decisions to implement. Systems do not include any important aspects- e.g. of ocean transport, most biogeochemistry aspects, ecosystem measurements. Need to keep the systems going whilst nations work out how to complete and sustain long term observing. Approach of 'sustained research' would appear to be the primary path for at least the next 5 years. Advocacy for the system by the leadership of the ocean research institutions is very important. Career recognition of the contributions of ocean scientists and technologists to the system is needed. Openness to data sharing, including making as many observations available in (near) real time is needed. The importance of creating and identifying uniquely useful data sets needs to be taken up.

Issues for POGO

- Advocacy to complete and maintain systems
- Advocacy for necessary satellite sensors
- Advocacy for real time observations and products
- Advocacy for funding for R&D and pilot projects to enhance initial systems

- Work on how to foster inter-institutional arrangements for future observing systems

Question/comment:
Biggest challenge is deciding what the data is showing e.g. contrasting views of the 8 groups showing results on the MOC.
A second challenges is fitting ecosystems to hydrography.

17. GOOS including Coastal GOOS: Keith Alverson

GOOS comprises:
An open ocean component advised by the Ocean Observations Panel for Climate (OOPC) [with JCOMM/WCRP/GCOS] and implemented by member states and participating organizations usually cooperating through the Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM) and a
A coastal component advised by the GOOS Scientific Steering Committee (GSSC) and implemented through member states and participating organizations usually cooperating through GOOS regional alliances. Of these, the open ocean observing system is more advanced and 57% complete. For the coastal component a strategy and implementation plan are in place. GOOS-IGOOS meeting 13-17 June 2007 at IOC in Paris. A letter will be sent to member states requesting information on the state of their implementation of GOOS for the meeting. The programme now needs to develop with sustained and integrated national ocean observing commitments. And researchers need to be engaged as one of the biggest providers and users of GOOS. See: Alverson and Baker, 2006. Taking the pulse of the Oceans. Science 314, 1657. Major gaps in the system are that only 50% of the climate component is in place, the polar and deep oceans are poorly sampled, developing countries are still poorly represented emphasizing the need for capacity building and non-physical variables (chemistry and biology) very poorly represented.

Future challenges
- Need to bridge research/operational divide.
- Facilitate data archiving.
- Make high quality research measurements widely available.
- Improved outreach and communications.
- Tailor ocean projects and services to local oceanic cultural, social and economic conditions.
- Better engage Governments and the private sector.

Question/comment: Why is progress in implementation slow and is there a timetable, is it down to leadership or money. Not sure it is a single problem. Doing best to implement, but in the end it is up to the signatory states.

18. JCOMM, Satellite observing elements (SST, Ocean Colour, Altimeter): Jean-Louis Fellous

JCOMM is a coordinating, not implementing entity for debate and to provide guidelines and protocols with a mandate to implement the climate component of GOOS via coordination groups. 1. Observation coordination group, 2. Services

coordination group and 3. Data management group. CEOS leads GEO task Cl-06-02 to secure provision of key climate data from satellites – context there are 28 relevant earth observation variables available from satellites of which 6 relate to ocean – mostly still on research mode funding. Aim for 'virtual constellations' of satellite coverage – i.e. improve coordination of future missions, a new JCOM technical report is calling for this. GEO needs to push the space agencies to honour their commitments. If CEOS is the space component of GEOSS could POGO undertake to deliver the *in-situ*/observing component?

19. Second Public Lecture: Variability and Change in the Southern Ocean: Mike Meredith (BAS, UK)

The Southern Ocean is a critical region in the Earth System. It is home to the Antarctic Circumpolar Current (ACC), the world's largest current system, which is responsible for transporting heat, salt, freshwater and nutrients around Antarctica, and distributing them between the major ocean basins. Dense water formation in the Southern Ocean plays a major role in modulating the air-sea exchanges of heat and carbon dioxide, and changes in Southern Ocean circulation and stratification have been implicated in previous profound shifts in global climate. There are many other reasons that the Southern Ocean is of key importance, for example it contains the largest unexploited marine protein resource in the world, it has unique biological diversity, and it is critical to global sea level rise. It is thus of prime importance to quantify and understand changes that occur in the Southern Ocean.

The presentation reviewed predominantly physical changes in the Southern Ocean since observations began, discussed causes where known, and highlighting the significant areas of uncertainty. Profound physical changes observed include a warming of the mid-depth waters of the ACC and the Weddell Gyre, a freshening of the Antarctic Bottom Waters around a large sector of East Antarctica, and very rapid warming and salinification of the upper waters adjacent to the western Antarctic Peninsula. Causes discussed include the known strengthening of the westerly winds over the Southern Ocean, and increasing glacial ice melt input to the oceans. Comment was made on the likely impact of these changes, including to the Southern Ocean ecosystem.

In summary, the talk highlighted the major changes that have occurred, are occurring, and are predicted to continue in the Southern Ocean. The magnitudes can be very large, but the causes and feedbacks are often subtle and complex. Especially important is the evidence that human activity is already fundamentally changing the Southern Ocean. The Southern Ocean is intimately connected with the planetary climate system on a range of timescales, thus changes here are of global significance. Monitoring, understanding and (ultimately) predicting the Southern Ocean is thus of high relevance to everyone.

20. Third Public Lecture: The Oceans: Meeting Societal Goals through Global Observing Systems, Business Plans, and Communications: D. James Baker*

The Millennium Development Goals provide a global framework for action focused on human needs for better living standards and sustainable use of natural resources, with special emphasis on the stewardship of the land and ocean. Yet progress in meeting these goals has been slow because of population growth and increased use of natural resources, and now the effects of human-induced global climate change. The ocean community has done well in understanding the causes and effects of, for example, storm surges, floods, El Nino, and fisheries decline, and in taking the first steps towards global ocean observing system with products for industry and government. But much remains to be done as we face a warming, rising, and more acid ocean. We still lack adequate observing and warning systems and much of what we know today is not being effectively translated into useful practical information.

In order to build the necessary public and governmental awareness and understanding and to work closely with private industry, we need to build a business case that shows how information can be delivered, analyzes the costs and risks of not taking action, shows the regulatory and legal frameworks, including new international agreements for the necessary programs, and lays out the necessary funding commitments. The social science of vulnerability needs to be incorporated into our planning. To build awareness of risk and urgency, we must also develop and implement a much larger communications effort including web-based information sources with Wiki- and Google-like technology as well as a broad spectrum of communications media, ranging from the web with blogs and podcasts to print, film, books and video games.

POGO can play a central role in strengthening the partnerships that will be key to success. Existing national and international communications efforts will be the foundation for this effort, as well as partnerships with existing environmental and sustainable development. In the end, the communication of risk and urgency is at the heart of convincing decision-makers to take action so that society can meet the needs of the Millennium Development Goals. The ocean community has the basic material to make a strong case, and POGO can facilitate that action.

*Consultant, Intergovernmental Oceanographic Commission, Unesco, Paris, France, Consultant, the H. John Heinz Center for Science, Economics, and the Environment, Washington, D.C., Member, Census of Marine Life Science Steering Committee

Expanded outline of the lecture by: D. James Baker
The Oceans: Meeting Societal Goals through
Global Observing Systems, Business Plans, and Communications

1. Introduction

(ppt 1) It is a pleasure to be here and to have participated in this excellent and informative conference. I want to thank the Institute of Oceanology for hosting us, and look forward to further collaborations in the future.

I want to focus today on the challenges that society faces as growing populations and economies vie with limited and inequitably distributed natural resources. We must deal with a uniquely 21st century problem – how can 9 to 12 billion people live safely and happily on Earth? The global framework provided in 2000 by the Millennium Development Goals (ppt 2) focuses on human needs for better living standards with special emphasis on stewardship of land and ocean. The ocean is directly related to goals on poverty and hunger, diseases, and environmental sustainability, but to the extent that infrastructure is affected other goals can be influenced by ocean changes. Progress in meeting the goals has been slowed by degraded and stressed ecosystems and natural resources and the onset of human-induced global climate change.

The comprehensive Millennium Ecosystem Assessment has documented, in Living Beyond our Means, (ppt 3) the environmental barriers to achieving the Millennium Development Goals. The findings of the Assessment (ppt 4) show that over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history; that the changes have come at the cost of degradation of many ecosystem services; that there is a high risk of even worse degradation of ecosystem services and negative impacts of global climate change during the first part of this century; and that the challenge of reversing the degradation of ecosystems while meeting increased demands for their services will involve significant changes from business as usual in policies, institutions, and practices.

2. Barriers to meeting the Millennium Goals

There are barriers to meeting the Millennium goals – we know, for example, that increasing concentration of greenhouse gases (ppt 5) will lead to a host of changes in climate affecting food, water, ecosystems – and some of these may come rapidly. Ocean barriers (ppt 6) to meeting development goals range from storm surges, floods, and El Nino to fisheries decline, and now we are seeing a warming, rising, and more acid ocean. In a start to reducing these ocean barriers, we have learned much about how the ocean works (pp7). In situ marine observing platforms cover the ocean (ppt 8) and we have taken the first steps toward operational ocean observing through growing national efforts and the international IOC/WMO/UNEP/ICSU partnership for the Global Ocean Observing System (ppt 9).

We are improving tsunami warnings (ppt 10), providing warnings of El Nino (ppt 11), monitoring sea level rise globally (ppt 12), and even using animals to track temperature and salinity over large parts of the ocean (ppt 13). Earth observing efforts are now being put under a ministerial level coordination – the Global Earth Observing System of Systems (ppt 15, 16) that we have been discussing this week. There is a good steady flow of information, products and services about the ocean to communities, industry, and government.

But much remains to be done. Recent natural disasters have shown that we still have inadequate warming and response. Warming contributes to coral bleaching (ppt 17, 18), as well as to melting of the Arctic ice pack which could endanger the polar bear (ppt 19). Dramatically increased sea level rise (ppt 20) could come from ice cap melting on Greenland (ppt 21). Gaps in data continuity on sea level rise (ppt 22) may occur with lack of commitment to on-going satellite altimeter measurements.

The ocean is becoming more acid, harming the ability of corals and mollusks to build their shells – the ocean's natural mechanisms for recovery will take tens of thousands of years (ppts 23, 24, 25). The German Advisory Council on Global Change has summarized this nicely in their recent report on "The Future Oceans – Warming Up, Rising High, and Turning Sour." (ppt. 26). The Census of Marine Life has sponsored a program to study how well Marine Protected Areas are helping to save coral reefs, but the coverage is well below what is needed (ppt 27). Despite better knowledge of the science, fisheries catch continues to decline (ppt 28).

3. Involving society – social vulnerability

Society is unlikely to act or make commitments unless it feels a sense of urgency, and feels vulnerable. Vulnerability science combines exposure with resilience, and looks to combine social science and natural science to make metrics and indices (ppt. 29). We know that there are uneven impacts when natural disasters occur, and that governments need to find a way to minimize these impacts (ppt 30). Natural system variability can be linked with impacts on social systems and the built environment to make these metrics (ppt 31). The metrics can be used to communicate vulnerability, and associated risk and urgency.

For example, anticipating the response to a hurricane in the southeastern US is shown on the next slide (ppt 32). A map of coastal vulnerability for the US is shown on the next slide (ppt 33), vulnerability that comes both from place-based risk and social ability to respond. A full map of the US vulnerability to environmental hazards, where the social vulnerability is based on socio-economic status, age of families, and density of development is next (ppt 34).

4. Building support for the future

What do we need to do now? To build support for the future (ppt 35), we need to make a "business case" for what we do, showing costs and benefits, including the savings. We also need to build a communications effort to stress the urgency of dealing with ocean issues and to heighten awareness on a scale that has not yet been done. The business case (ppt 36) needs to show what systems are needed for observations and it needs to provide useful and timely information for multiple users. It needs to show that we can put in place a cost-effective system that will pay off with savings. It needs to show what regulatory and legal frameworks are not yet in place, and it must have the funding commitments.

The U.K. Stern report on the economics of climate change has made a strong case for cost savings (ppt 37) with an economic analysis that shows the costs and risks of climate change being something like five percent of global GDP each year, whereas the cost of action can be limited to about one percent of GDP each year. A similar case can be made for ocean observing systems.

The Global Ocean Observing System (GOOS) planning (ppt 38) is helping countries develop operating plans for regional observing systems, and there is active planning going on in Europe, the US, and Australia for regional and national observing systems. Keith Alverson of IOC and I have called for a UNESCO Convention on an integrated ocean observing system that will lead to better understanding of the ocean and at the same time enable the provision of hazard warning, monitoring of climate change, and management of marine and coastal resources.

5. Communicating Urgency and Risk

Given the urgency of the issues, we need to act now (ppt 39). The actions that we take in the next ten to twenty years will have a profound effect on the ocean, climate, and ecosystems in the future. The benefits of strong and early action on ecosystem degradation and climate change outweigh the costs. We have a good start on the ocean issues, with many groups starting to take on the communications issues. But public attention is still focused on disasters like tsunamis or hurricanes and typhoons.

We need to have reliable and easily accessible sources of information, using all the modern techniques of information technology – Wiki for collaboration, Google for search, and multi-institutional input (ppt 40). Our communications strategy needs to have a strong basis in perception of risk (ppt 41). We should have a multi-media approach with the internet, podcasts, blogs, and even video games (ppt 42). Print, film, and books are important. The weekly newsmagazines are responding as you can see from these articles about warming, fisheries, and ocean acidification (ppts 43, 44, 45).

The COMPASS program (ppt 46), a collaboration among SeaWeb, the Monterey Bay Aquarium, and a group of academic scientists, is a good example to follow. COMPASS produces (ppt 47) consensus statements, media training, news media outreach, translation of science, and it tracks legislation. This could be expanded, especially internationally.

6. Role for POGO

I see a strong role for POGO in all of this. POGO (ppt 48) could use what is already in place to develop and implement a communications strategy and host a web-based information source. POGO could partner with specific organizations, such as the International Whaling Commission, the International Commission for the Conservation of Atlantic Tunas, and others to help make a case for urgency. Overall, I believe that a massively increased communications effort is needed with a strong dose of social vulnerability, and carried out in partnerships internationally (ppt 49). I hope that POGO will take up this challenge. In the end, the communication of risk and urgency is at the heart of convincing decision-makers to take action so that society can meet the needs of the Millennium Development Goals. The ocean community has the basic material to make a strong case, and POGO can facilitate that action. The final slide (ppt 50), the lights of earth showing population and energy use, reminds us of the fragility of the planet and the urgency of our issues.

POGO 8 Actions

1. Support nominated POGO representatives for GEO task groups
2. Develop exemplars for GEO cost-benefit analysis: work with Argo and CoML
3. Explore link between GEO communicators and POGO (invitation from José Achache), with the specific view to promote the importance of oceans
4. Support Ocean demo for the GEO ministerial level meeting
5. Advance POGO effectiveness in GEO
6. POGO to continue to promote Ocean United
7. Oceans are integral to the functioning of the Earth System, including climate. Therefore, POGO directors to ramp up advocacy at national levels for continued, sustained and expanded ocean observations for societal benefits
8. POGO members to deliver Cruise Information to data sharing team as quickly as possible
9. POGO to continue to work towards cruise participation among members/nations
10. Endorse the submission of the Nippon Foundation "Centre of Excellence" proposal by Jan 31, 2007.
11. Endorse on-going POGO capacity building activities, and explore ways to enhance such capacity building activities
12. POGO subcommittee* to collect and disseminate information on available software and other resources to facilitate prompt transmission of data for operational use. * Yves Desaubies (Chair), Ed Harrison and Lesley Rickards