DRAFT MINUTES OF POGO-10

CONCEPCION, CHILE

January 6 to 8, 2009

Tuesday, 06 January

The POGO Executive Committee met at COPAS (Centre for Oceanographic Research of the South Pacific) in the morning to finalise plans for the POGO-10 plenary meeting. At the same time, the other participants made a guided tour of the University of Concepción campus including the COPAS (Centre for Oceanographic Research of the South Pacific), other facilities and the art gallery Pinacoteca. After lunch, and a group photograph taken on the campus of the University, the participants assembled at Hotel El Araucano for the start of the meeting proper.

Inauguration: Chair Carina Lange

Tony Haymet opened the meeting. **Carina Lange** welcomed all participants to Chile, to Concepción, and to the University of Concepción on behalf of COPAS and SHOA. She thanked Monica Sorondo for providing logistical support.

CN Patricio Carrasco, Deputy Director of SHOA also welcomed the participants. He noted that it was ten years since a group of marine scientists had met in Paris to discuss improved coordination and better implementation of ocean observations. The result was POGO. He then gave a brief overview of SHOA, which has various national responsibilities and services (IOC, SCOR, IHO and expert working groups, such as El Niño, tsumani warning systems and Antarctic science), and represents Chilean interests in many ocean-related international organizations, as well as being very active in ocean research and monitoring of South East Pacific. The Director of SHOA is the president of CONA.

Approval of Minutes of the Ninth Meeting of POGO: The minutes of POGO-9, which had been distributed and made available for amending beforehand, were accepted as a true and correct record of that meeting.

Introduction of new POGO Chair: Tony Haymet. The outgoing Chairman turned meeting over to incoming Chair **Dr. Suyehiro**, who spoke about the importance of adapting to new realities (such as the fluctuating price of oil, which had obliged his institute to cut back on sea time for its fleet). He emphasised the need for international cooperation in marine science. In this connection he thanked Chilean authorities (SHOA) for facilitating oceanographic work by Japanese colleagues in Chilean waters, and thanked Chilean colleagues for their participation in Japanese oceanographic expeditions. He mentioned capacity building as a successful activity of POGO and believed the

outreach effort should be broadened in scope, giving as an example a successful Japanese national art contest, with an oceanographic theme, for school children. It was important to improve ocean observing networks, of which the new Japanese cabled observatories provided an example of what might be done. Sea bed monitoring systems could help in anticipation of earthquakes. POGO should communicate to the general public that oceanographers are working at fundamental and exciting frontiers.

POGO had an important role to play in advocating an ocean observation system that was multi-disciplinary, including biology and solid Earth observations. POGO should continue to do what it is good at, at the same time emphasising the transition from observation to prediction, implying dialogue with theoreticians.

Adoption of Agenda: Kiyoshi Suyehiro. The agenda was adopted with minor changes.

Remarks by outgoing member of Executive Committee: Jan de Leeuw addressed the group on the occasion of his rotating off the POGO Executive Committee. Capacity building remained important, especially in the Southern hemisphere, to ensure global-scope observations. Initially, IOC and SCOR had been partners in capacity building, but subsequently, IOC support of POGO capacity building effort had been withdrawn. However, POGO had continued in collaboration with SCOR. In the last few years, substantial support has been provided by the Nippon Foundation, through the NF-POGO Visiting Professorship programme and the new NF-POGO Centre of Excellence in BIOS, Bermuda. We should extend the centre at Bermuda, and if possible, establish a second centre elsewhere in the world, in recognition of the need for further capacity building. Perhaps the IOC might decide to resume its support for capacity building through POGO.

One of his initial responsibilities in POGO had been to represent ocean interests at the then fledgling GEO. At the first GEO meeting, he was practically the only representative for the oceans. There, he noticed how the space community and the meteorological community each spoke with a single voice, inspiring him to see the need for improved coordination within the ocean community, a realisation that led to the formation of Ocean United. It is an informal forum created by POGO to speak with a common voice for oceans, especially within GEO. At the 2007 GEO Summit in Cape Town, POGO was able to lead a very successful outreach and media event, thanks to support from the Sloan Foundation, and with collaboration from other members from Ocean United.

The new International Cruise Information Database was an important initiative. It was essential to improve partnerships with industry, for the benefit of ocean observations. The European Ferrybox project was a successful example. Perhaps all new ships (including commercial ones) should include an internal ferry box and perhaps CPR. It was necessary to improve biological observations, as well as measurements within the ocean sediments, an important component of global biota. New insights were emerging on the various roles played by marine microbial biota at the global scale. There were many unknowns, for example the response of ocean biota to ocean acidification. It was timely to enhance microbial observations through eco-genomics.

Procedure for Election of Next Chairman: Kyoshi Suyehiro informed the committee about the procedure for election of the next POGO Chair. As was customary, Jan de Leeuw, the member rotating off the Executive, had been asked earlier to convene a Nomination Committee for this

purpose. The successor to Suyehiro would be elected before the end of POGO-10. Jan de Leeuw was open to receive nominations at any time before the election.

Follow up to Actions from POGO-9: Tony Haymet reported on actions from POGO 9 according to the POGO tradition to review performance of POGO against Action Items identified at the previous meeting.

Support of NF-POGO Centre of Excellence in Bermuda: Dr Haymet was very proud of the progress on this front. The scholars from the developing countries at the CofE made an excellent group. He urged everyone to drop in at Bermuda to meet them. He thanked Tony Knap, NF and all who helped bring this initiative to fruition.

Improved interactions with GEO for enhancing mutual effectiveness: Much had been achieved here, although some uncertainties remained.

Budget requirement for establishing a global, integrated, multi-disciplinary ocean observation system: Some progress had been made and would be reported on, later on in the meeting.

GEO success stories for narrative of benefit and impact of POGO-supported observing elements: POGO was optimistic that some excellent elements of ocean observations could be highlighted in this way, for example ChloroGIN and Argo.

Update the POGO website: This had been done with style by VLIZ, and would be launched later in the meeting.

GOOS Advocacy: Shubha Sathyendranath and Howard Roe had been nominated to join the GOOS outreach and advocacy group.

Observer to GOOS Scientific Steering Committee: John Gunn had been nominated as POGO representative to GOOS Steering Committee, but he had now moved on to a new job.

IOC Reform: POGO had provided feedback to IOC on IOC reform in response to a letter of request from the Chairman of IOC. Howard Roe attended the Executive Committee meeting to present POGO recommendations.

National-level advocacy for ocean observations: Many POGO Directors had increased efforts for advocacy at national levels for continued, sustained and expanded ocean observations for societal benefits.

Cruise Information Database: POGO Directors had provided support timely information on planned cruises to the ICID, but there was still room for improvement.

Promote media reports: Many POGO Directors had also promoted media reports on ocean observations.

Advocacy for Time Series: POGO had taken up advocacy of the value of time series observations of

various types, and supported such observations, for example through coordinated proposals and by POGO support of Ocean SITES.

Engage new Executive Director: POGO had been fortunate to engage Trevor Platt and supporting team, hosted by PML.

Hire communicators on a case-by-case basis: POGO had effectively used communicators for outreach activities as and when required.

Seek synergies with seafloor observatories: No initiatives had been started directly on this topic, but it was noted that a dialogue had been initiated with the International Seabed Authority, on cooperation in capacity building.

GEO BON (GEO Biodiversity Observation Network): Jan de Leeuw reported on this new global partnership to help collect, manage, analyse, report and share data on the status of the world's biodiversity. Whereas biodiversity is defined according to Convention on Biological Diversity as "The variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems", its usage according to GEO BON includes "Variation in composition, structure and functioning at the ecosystem, species and genetic levels of biological organisation". Biodiversity is identified as one of the nine societal benefit areas of GEO.

A GEO BON Steering committee was formed in January 2008. In April 2008, an international workshop was held in Potsdam. During this meeting, a revised draft GEO BON concept document was developed, working groups established, and a GEO BON implementation plan drafted. In November 2008, an overview of the implementation plan was presented at GEO V.

GEO BON is conceived as a network of partners coordinated with GBIF. Why do we need GEO BON? Biodiversity continues to be lost (Millennium Assessment, 2005). The index currently incorporates data on 555 terrestrial species, 323 freshwater species, and 267 marine species around the world. We do not have a full set of tools at hand either to provide relevant and timely biodiversity and ecosystems data to users (e.g., Governments, researchers, international conventions and assessments, NGOs and public), or to prioritise and target interventions and evaluate success.

What are the problems? The data are patchy (Geo-spatial gaps, taxonomic and thematic gaps, inconsistency in space time and quality). Furthermore, access is limited: many more data are collected than are used. A key constraint is interoperability. Access requires data sharing policies and protocols. Some of the inputs from the ocean community at the GEO BON meeting in Potsdam (Germany) were reflected in the GEO BON Concept document, but were missing from the implementation plan.

GEO BON would provide a global, scientifically robust framework for observations on the detection of biodiversity change, coordinating the data collection and the delivery of information.

Jesse Ausubel commented that notwithstanding the difficulties of sampling the ocean due to the large spatial scales, vast progress had been made in last decade. The differences in citations on marine and terrestrial biodiversity do not yet reflect this. Many terrestrial publications on biodiversity deal with very small areas, and do not lead to a global picture. DIVERSITAS has a terrestrial forest focus, which is reflected in its reports.

It was recommended that GEO BON should have two co-chairs, one each from the marine and terrestrial communities, as a way of keeping the marine perspective in the foreground. Ideally, the replacement for Doug Muchoney should be qualified in marine science.

Karen Wiltshire endorsed these comments and wondered about the possibility of combining existing databases. Jan de Leeuw pointed out that there are many small databases that are not in the MarBEF database. The problem is partly technical and partly lack of willingness. Jesse Ausubel re-iterated these difficulties. Substantial efforts had been made to enter data into OBIS and MarBEF databases, but the task is still not complete. Some 3000 to 5000 databases exist, covering microbes to fish. Howard Roe endorsed the need for a marine co-chair in GEO BON.

Proposed action: Nominate a co-chair for GEO BON.

GEO Task SAFARI (Societal Applications of Fisheries Applications of Remotely-sensed Imagery): Trevor Platt reported on this new GEO programme. Its origins could be traced to the collapse of fishery in eastern Canada (1992), which had a major socio-economic impact. What could remote sensing contribute to discussions on the cause of this problem? It was decided to establish a time series of chlorophyll and temperature for the Canadian zone of the NW Atlantic Ocean using remotely-sensed data, to be used as a tool for future research and decision making. A prospectus was published in 1996. In 1997, SeaWIFS data began to flow, marking the point at which collection of time series data could begin. After some years, the results were analysed according to the prospectus published in 1996. The analysis amounted to an operational test of the Cushing (match-mismatch) hypothesis. Survival of larval haddock was shown to be related to timing of Spring bloom for phytoplankton (Platt et al. 2003). Other successful applications of ocean-colour remote sensing have been made to fisheries problems, notably from Japan, India and South Africa. The SAFARI programme, funded by the Canadian Space Agency (CSA), is a GEO initiative to coordinate and increase such applications on a world scale, in support of ecosystem-based management.

GEO Task ChloroGIN (Chlorophyll Globally-integrated Network): Shubha Sathyendranath reviewed recent progress in this programme, which is seen as a success story within GEO (EC-06-07). It aims to promote in situ measurement of chlorophyll in combination with satellite-derived estimates and associated products. At present, there are regional centres in Latin America, South Africa and India. An Asian centre is under discussion. The centres are linked to the chlorogin.org global server, which is hosted at PML. In addition, JRC (EC, Ispra) and INCOIS (India) are serving data, especially to the African continent.

During 2008, the programme was showcased at Oceanology International (London), at EuroGOOS (Exeter), at DevCoCast (Paris), at GEOCoast (Athens) and at the DevCoCast training session (Accra, Ghana). In September 2007, the JRC sponsored an ocean-colour training course in

Mombasa, Kenya. The course attracted some 65 applicants. ChloroGIN has been selected as a demonstration project under the EU FP7 DevCoCast.

At present, activities under the ChloroGIN initiative rely on minimal resources and on voluntary contributions from many members of the network. There are few opportunities to compete for major funding. Resources are needed urgently to ensure minimal capability at regional sites (for example, access to HPLC equipment in the Latin-American component, Antares), to hold a progress meeting for Antares and to hold a full ChloroGIN meeting. PML has taken the lead in submitting a proposal to the EU (endorsed by POGO and GEO), with partners from Europe and Africa. If other GEO member states would recognise ChloroGIN as a priority, it could increase the prospects for national funding, strengthen existing activities and attract additional nations to the network.

Proposed Action: find resources to support ChloroGIN activities in Latin America.

Recent Developments in Marine Sciences in Germany: Peter Herzig spoke about the status of marine science in Germany, which has 14 centres in 11 cities for marine research. A German Marine Research Consortium (KDM) was started in 2004: it is the central management organisation for marine sciences in Germany acting on behalf of marine sciences at the political and decision maker level. Head office in Berlin has a managing director and two scientific officers (2009). Mandates of member institutions range from polar research, blue ocean research and coastal zone research. Their collective mission is to understand the physical, chemical, biological and geological processes in the ocean. The project Marine research 2020 is directed to the role of the oceans in global change, human impact on marine ecosystems, marine resources, plate tectonics and natural disasters.

The infrastructure includes research vessels *Sonne*, *Meteor*, *Polarstern* and *Maria S. Merian*, as well as deep-sea submersibles. The consortium has Memoranda of Understanding with Ifremer and NOCS. It has an annual budget of 350 to 400 million Euros and employs some 3500 people.

Karen Wiltshire added that Polarstern, already over 25 years old, will be replaced by a new ship Aurora Borealis, envisaged to be 3-4 times larger than Polarstern. The AWI has on its agenda that future Polarstern cruises will be labelled as POGO cruises.

Introduction to POGO budget for 2009: Kiyoshi Suyehiro introduced briefly the budget for the year just started. This item would reappear on the agenda later in the meeting.

In the evening of January 6, participants were invited to a reception at the Naval Base in Talcahuano, hosted by Servicio Hidrográfico y Oceanográfico de la Armada (SHOA), POGO member from Chile.

07 Jan, Wednesday

Some Topical Observational Programmes and Developments: Chair Tony Knap

Marine Biodiversity beyond CoML and 2010: Jesse Ausubel drew attention to the CoML highlights report. Although observations and observing systems for microbes to whales, near shore to abyssal plains are all advancing, an area of current emphasis is tagging and telemetry of larger animals on continental shelves and in the open ocean. His talk dealt first with maturation of biologging systems and with animals as vehicles for ocean sensors; next, it covered challenges, especially visualisation; finally, it addressed vision and needs.

One of the interesting aspects of working with animals is that they pass through physical barriers, for example from Pacific through Aleutians into Bering Sea. Tracking in conjunction with bathymetry shows elephant seals foraging on Cortez Bank, southern California. Animals can be used to observe difficult environments such as the Arctic. Narwhal tagged in Canada and Greenland provide temperature profiles. Seals map the Southern Ocean (Biuw et al. PNAS 2007). Seals have been producing oceanographic data from different habitats, such as CTD profiles collected at the time of the Wilkins Ice Shelf collapse. It would be difficult to devise a cost-effective observing system to capture such a transient and unpredictable phenomenon.

The observations are now beginning to show societal benefits and to lead to high-profile articles. Documentation of persistent leatherback turtle migrations presents opportunities for conservation. Fine scale behaviour of large whales in Stellwagen Banks Sanctuary provided information that led to recommendations for changes in shipping lanes. The observing system is accreting data needed to optimise sanctuary design and management.

On the technology side, new acoustic receivers with underwater modems do not need to be recovered for at least 5 years. Halifax lines have been able to monitor a total of 34 Atlantic salmon in transit through the Bay of Fundy. Grey seal bioprobes near Sable Island reveal habitat patterns, relevant from the point of view of fisheries management. Elephant seal searching and foraging highlight the importance of the transition zone chlorophyll front. Integration of physical and biological information produces insights about both animal and ocean behaviour. Diving behaviour of elephant seals provides information on temperature profiles that can be used to map eddies associated with their behaviour. Some of the best examples of integration of biological and physical profiles come from the Southern Ocean. Merging Argo and biologged data allow improved coverage of the ocean by combining the advantages of the two types of profile. A new generation of animal tags allows two-way communication with tagged animals.

A major difficulty is to integrate data collected by a variety of means. The database growing very fast: 234 datasets with over 2,260,000 records from all over the world. The principal challenge now is data visualisation, and seamless switching between maps at multiple scales of resolution. There is a need to merge various types of data and to animate them. Aggregation in Google Earth allows some of these challenges to be addressed. Integrated habitat modelling that requires a transition from data to information remains difficult. The Google Earth display system holds great promise as an aid in visualisation.

Although the links between the IOC and CoML are increasing, there is still a need to improve coordination between data systems for different disciplines and with external entities, such as GEO and Google Earth. The biological observing field and associated visualisation are growing so quickly that there is now a need for a regular forum on these topics. There is still inadequate information on the cost of expanding the observing system. Excellence of visualisation products might be a strong point in convincing society to invest in ocean observation, and perhaps POGO could take an appropriate leadership role.

SCAR Report on Southern Ocean Observation System: Mike Meredith reported on progress with the Southern Ocean Observing System (SOOS). Collaboration from POGO had been requested at POGO-8. Support from various sources including POGO, Sloan Foundation and WCRP was acknowledged. The global reach of the Southern Ocean makes a convincing argument for sustained observations. It is a critical part of the global thermohaline circulation. The change in zonally-integrated ocean heat content since 1955 is largest in the Southern Oceans. It is an important term in global heat budget, but the Southern Ocean is still undersampled compared with the rest of the world ocean. Also, the Southern Ocean is a key region for uptake of anthropogenic carbon dioxide, but it has now been suggested (Le Quéré et al.) that the carbon sink there might be weakening. These results have been challenged, highlighting the need for more observations to reduce uncertainties. There are also strong biological arguments for SOOS. For example, krill stocks in key parts of the Southern Ocean are in steep decline. We need to understand the cause and the implications. The many potential users of data from a SOOS include the research community, resource managers, policy makers, IPCC, local planners, tourism operators, shipping, weather forecasters and educators.

Designers of SOOS have defined the spatial scope of SOOS as circumpolar, from the Subtropical Front to coast or ice shelf grounding line, with a time scale is from days to decades. Longer term proxies from ice and sediment cores are critical, but lie outside the scope of SOOS. The domain of interest is from sea surface to seafloor, including bathymetry, ocean and sea ice, air-sea flux (but not upper atmosphere), and sub-ice shelf cavity (not glacial ice itself). Considering the system that is already in place, and the 5 to 10 year vision, an ideal system should be available by 2030. The scope of SOOS is multidisciplinary (physics, biology, biogeochemistry, bathymetry and surface meteorology). Argo coverage is good. Some difficult areas are those covered by ice. But modified floats are being used to profile under ice in Weddel Sea. Tagging of marine mammals has come of age: miniaturised CTDs on elephant seals provide invaluable coverage, complementing that from Argo data. Quality of data from tagged animals is not yet as good as that from Argo (consequence of need to miniaturise the devices), but is improving. Continuous plankton recorder tows from Hosie et al. show more than 70% coverage of the Southern Ocean from October to May. The principal weakness in the data record is that non-physical observations are rarely made.

The SOOS plan is expected to be published in March 2009, and the implementation to start the following month. The programme will address six key questions. These are: the role of the Southern Ocean in the global freshwater balance; stability of Southern Ocean overturning; stability of the Antarctic ice sheet; future uptake of carbon dioxide by the Southern Ocean; future of Antarctic sea ice; and impacts of climate change on Antarctic ecosystems. To achieve this, the programme will include existing elements, such as repeat WOCE sections, profiling floats (including under ice floats), sensors carried by tagged animals, sea ice observations, surface

meteorology, surface drifters and ecological monitoring. It will also incorporate new elements, such as improved profiling floats, time series from expendable moorings, routine surveys from supply ships, a network of capable gliders, and relevant modelling studies.

SOOS has support from international programmes of relevance (SCAR, SCOR, GOOS, CoML, POGO, WCRP, JCOMM, GCOS). POGO was an early supporter and continuing endorsement by POGO is requested. The POGO community could help by circulating details of the planning document and providing feedback.

Proposed Action: POGO to continue to endorse SOOS.

Ship of Opportunity Observations and Ferry Box: David Hydes reviewed the value of ships of opportunity enhancing the range of time and space scales over which data are collected. The term FerryBox refers to data collected from ferry ships that operate regular routes in many areas of the world, on which boxes of sensors that work automatically are installed. Data from suitable routes allow areas of sea to be boxed in to provide boundary conditions for numerical models. The concept was developed within EuroGOOS to collect physical, chemical and biological data using commercial ships. The SCOR working group OceanScope, led by Tom Rossby aims to expand and integrate existing volunteer observing ship programmes.

The EU FP5 Ferry box project covered some eight routes in the period 2002 – 2005. By October 2008 the number of lines had been further increased. In practice, access to engine room water inlet is required, sensors are deployed in this water supply and data are logged for transmittal in real time using satellite system. The data are displayed on the world-wide web.

With respect to the flux of carbon dioxide across the sea surface, the net signal is only about 2% of the total, so extensive and sustained observations are vital to reduce uncertainty. Ferry box programmes have revealed considerable inter-annual variability in air-sea flux of carbon dioxide and a possible decrease with time in the magnitude of the oceanic sink for carbon dioxide. The CarbOcean North Atlantic observing system promises to refine these figures.

OceanSITES and Changing Times: Bob Weller summarised the Changing Times Workshop (La Jolla, November 2008), an international ocean biogeochemistry workshop supported by OceanSITES and POGO. The proceedings are covered in IOCCP Report Number 11. OceanSITES has a project office operating at JCOMMOPS. It is working towards a minimal global network of comparable time series sites, measurements to include physical properties, carbon dioxide, oxygen, nitrate and downwelling radiometry.

The workshop had convened scientists conducting marine geochemical time series to discuss issues of mutual concern, including data management. A perception had developed during the meeting that not all the biogeochemical time series represented at the workshop would fit the OceanSITES definition of acceptable time series and that therefore the programme was too exclusive. This view was to be countered by emphasising the goal of OceanSITES (focus on ocean carbon system) and by recognising the utility of other time series programmes, while at the same time pointing out the gap that OceanSITES seeks to fill. All could benefit by developing common methodologies and operating methods.

A white paper was to be prepared for OceanObs09. It would deal with the global time series and discuss also issues of overarching interest to the biogeochemical community.

Proposed Action: Continue to endorse OceanSITES, but recommend that its scope be broadened and that clear links be stablished with other time series programmes.

In discussion of this item, Ed Harrison spoke on the value of combining spatial time series with point time series and on the need to enhance capacity so that more groups could meet minimum requirements of time series stations. Several members spoke to the need to broaden the scope of admissibility within OceanSITES.

New vision for GOOS and its interactions with POGO: Ralph Rayner reported on recent thinking within GOOS. Systematic observations of the ocean had been started by Cmdr. Mathew Fontaine Maury. More than 150 years ago he set out a plan to organise accumulated information from ships' logs. The Brussels conference organised by Maury in 1853 established basic principles of operational oceanography and meteorology. Common standards were developed and principles of free data exchange were accepted.

GOOS started in 1990. By then operational meteorology was already firmly established. World Weather Watch, combining observing systems, telecommunications and data processing is a mature programme that started as a WMO initiative. On the other hand, operational oceanography is still in its infancy. GODAE was a successful demonstration project for open ocean observations. Corresponding improvements have been made in understanding of coastal processes, and of biogeochemical and of biological processes.

GOOS has an open ocean implementation plan and a coastal plan that is not yet an implementation plan. In the last few years, integration of satellite data with in situ data has improved, and various regional initiatives, with varying degrees of maturity, have developed. The new vision for GOOS includes enhancing the connections with POGO, LME, UNEP, SCOR, ICES, and with all stakeholders in the marine, governmental and academic communities, as well as with the maritime industries (value added service providers, end users), with non-marine end-user industries. Connections have to be made across thematic initiatives to deliver wider societal and business benefits. There is a need to improve connection to GEO.

It is important to make the case for operational oceanography in the context of economic outcomes and environmental outcomes, and of societal benefits. Advocacy and outreach to politicians, industry, the media and the public are critical; the advocacy should convey the urgency of key problems. Clear goals and objectives are required. Internationally agreed and endorsed implementation plans supported by all stakeholders are essential. The process has to be simplified to optimise delivery, or at least avoid making them more complex. Duplication of effort should be avoided. The initial open ocean observing system has to be completed and sustained. Prototype core systems have to be transitioned to sustained operational systems.

GOOS looks to POGO for endorsement of agreed plans in GOOS/GCOS; undertaking research to support emerging science/technology requirements; building and testing prototype operational

systems and supporting transition to operational use.

Relevance for POGO of G8 Meeting in Japan: Kiyoshi Suyehiro referred to Paragraph 31/72 of the G8 Hokkaido Toyako Summit Leaders Declaration 8 July 2008 "To respond to the growing demand for Earth observation data, we will accelerate efforts within the Global Earth Observation System of Systems (GEOSS), which builds on the work of UN specialized agencies and programs, in priority areas, *inter alia*, climate change and water resources management, by strengthening observation, prediction and data sharing. We also support capacity building for developing countries in earth observations and promote interoperability and linkage with other partners."

In the media room at the summit, there were displays on "Tangible Earth", which covered The Living Planet; Global Warming and Climate Change; Earth Observation and Disaster Prevention; Our Vulnerable Society; and Good News on Adaptation. The specific attention given to earth observation is clearly beneficial to POGO.

Mirai Cruise Plans: Toshiro Saino informed the meeting about the cruise plans of the vessel Mirai for the next three years, and welcomed collaboration. The cruises are directed at the ecosystem and biogeochemical response to climate change. Dr Saino also described a new primary productivity profiler, and showed the results from long-term deployment of the instrument.

New Developments at GEO: José Achache had prepared a talk on Building Further the Contribution of POGO to GEOSS in 2009-2011. It was delivered, in his absence, by Shubha Sathyendranath. With a view to Society's need for informed decision making, the principal goals of GEO are to coordinate and sustain earth observation, to provide easier and more open data access and to foster the use of GEOSS through science, applications and capacity building. The Cape Town declaration had reinforced such an approach. The GEO priorities for 2009-2011 include the following: Complete, populate and broaden the use of GEOSS Information Systems, such as GEONETCast, the GEO Portal and the Virtual Constellations, all of which are relevant to the oceans; In Africa, demonstrate the value of connecting systems, examples being ChloroGIN Africa and SAFARI; Enhance work on the freshwater cycle (HARON); consolidate GEOBON (relevance of Census of Marine Life) and ensure the Transition from Research to Operations of sustained key systems, such as Argo.

This list of priorities resonates strongly on the POGO agenda, and there are many reasons therefore why POGO and GEO should continue to collaborate.

Observational Needs of Models: Chair Robert Nigmatulin

Observational Needs for Global Ocean Models: Keiko Takahashi spoke about the value of ultra-high resolution for global atmosphere and global ocean simulation. The JAMSTEC Earth Simulation Center has an oceanic circulation simulation model with a horizontal resolution of 10 km. Sea surface temperature output shows that eddies are well resolved. Antarctic circulation also shows several fine eddies. High vertical resolution is important, especially to reproduce the day/night SST oscillations. It enhances the SST warming during breaks in the Madden-Julian Oscillation. Results for 301 vertical levels for mean SST compare very well with observations. Atmospheric circulation simulation at 10 km resolution leads to precipitation patterns that compare

well with observations. High resolution improves typhoon simulation in waters around Japan.

An upgraded Earth Simulator with much better capabilities is being introduced, with a view to multi-scale simulation for the GEO environment (MSSG). The scalability of the simulations will allow for simulations at scales of seasonal to annual, days to weeks, and minutes to hours. Results presented on Google Earth show for example temperature distribution at very high resolution within a city scape. In the ocean component of the MSSG, simulations at scales as fine as 1 km can be made. The grand challenge is seamless simulations between multiple scales, allowing for seamless simulation between weather and climate.

Modellers need more observational data to support simulation of extreme events with ultra high resolution. It is vital to observe effectively. High-density 3D observations are useful, and 4D data-assimilation/ensemble simulations can be used to select the target regions to be observed.

Observational Needs for Ocean Climate Models, a Biological Perspective: Corinne Le Quéré had prepared a talk on this topic, and in her absence it was delivered by Trevor Platt. The focus was on decadal changes in physical climate and in the global carbon cycle. There is a decadal increase in the airborne fraction of anthropogenic carbon dioxide that is underestimated by models. Perhaps the efficiency of carbon dioxide sinks (land and ocean) has decreased over past 50 years, but coupled models do not reveal such a change. Observations of oceanic carbon dioxide are required to constrain the models used to predict future climate. The flux of carbon dioxide across the sea surface depends on wind stress, which has increased strongly in the Southern Ocean during the last 40 years. But the expected increase in the carbon dioxide sink is not reflected in the observations. Model results show that natural carbon from the deep ocean is coming to the surface because of increased winds, and that surface ocean acidification is enhanced accordingly (an effect not observed, at least so far). Observations suggest that coupled carbon-climate models do not capture the feedbacks between climate and oceanic carbon dioxide. But at present the data cover only 27% of the ocean surface. More observations are required to reduce uncertainty.

The observations need include repeated measurements of the partial pressure of carbon dioxide in the ocean (seasonal cycle should be resolved, winter data are essential); monitoring of a second carbonate variable (pH, dissolved inorganic carbon or alkalinity) to detect ocean acidification; and full water column sampling of dissolved inorganic carbon, oxygen and nutrients every ten years on a core network of lines (oxygen is especially important).

Biological activity is fundamental to the ocean carbon cycle. The role of community composition is very important and has stimulated the development of a new generation of models called “Dynamic Green Ocean Models”. The descriptor “Green” implies that the autotrophic pool is modelled carefully with respect to community composition by Phytoplankton Functional Types. Biological export of carbon is large and is controlled by processes occurring on time scales of order one week. On the decadal time scale, 80% of changes in biological export are associated with changes in the global sink for carbon dioxide. To refine these models further, we need observations on growth rate of phytoplankton functional types and dependence on temperature and light; foraging strategies and food preferences for zooplankton; respiration and mortality rates; and ecosystem-biogeochemistry interactions.

Generally, the required data (physical and biological) need to span many decades for optimal evaluation of model changes. Global coverage is necessary, and full water column sampling is needed for attribution of changes to particular processes. A white paper on the topic will be prepared by Sathyendranath and Le Quéré for OceanObs'09.

Lessons on coordination from the atmospheric community: Susan Avery spoke on lessons learned from the atmospheric sciences on international collaboration in operational observing systems and research.

The common goal is to provide benefits to society of earth science research and observations. But research and operational services have different needs and different cultures. Earth science needs to study a complex system of interacting systems: Nature responds to change as a whole system, but traditional science is focused on the parts. Data are scattered in quite different formats, unintentionally inaccessible to most, so that interactions amongst different systems are difficult to see. Interaction amongst different disciplines is not the norm. Traditional institutional and geographical boundaries inhibit sustained interaction. The sun and earth form a complex system with characteristic properties (prediction is difficult based only on knowledge of components; there are feedbacks; there are emergent features; and system history cannot be ignored).

There are profound differences between atmosphere and ocean. In particular, for the ocean, the operational need is diffuse and the operational benefit to stakeholders is difficult to justify. In the atmospheric community, WMO provides an international operational framework. Although it is not perfect, it is rather effective and has many features that might be emulated in the oceanic arena (permanent representatives senior figures in their countries; data shared for operational purposes; observing standards and guidelines established; observing system inter-comparisons performed; open data policy, for example in the USA, has created strong private sector for related services; and the operational observing subsystem provides a backbone for research at no cost to the research community). Although the main goal is service to society, a complementary scientific research programme of the highest calibre is essential for the evolution of excellent services.

POGO can profit from the experience of the atmospheric sciences to facilitate the development of operational oceanography by helping to define and clarify the objectives for global ocean networks and data information systems; by articulating the public value and needs of an operational programme in the relevant societal benefit areas; by collaborating with appropriate international organisations; by contributing to the next generation of international science plans; and by advocating a suitable framework for international collaboration on operational observing systems with their essential cyber-infrastructure. One constructive step would be for the next POGO meeting to focus on OceanObs09.

Instituto Español de Oceanografía: Gregorio Parrilla introduced the institute (a new POGO member), which was founded in 1914 by Professor Odón de Buen. It is a public research institution belonging to Ministerio de Ciencia e Innovación. The headquarters are in Madrid, and it has oceanographic centres at Coruna, Gijon, Malaga, Mucia, Palma de Mallorca, Sta Cruz de Tenerife, Santander, Murcia, Vigo and Cadiz with a staff is about 600 people, scientific and technical). The three main areas of research are fisheries, aquaculture, and marine environment. The institute runs six research vessels (one ocean going), and has two under construction. IEO operates a tide gauge

network around Spain, with some of gauges being part of the GLOSS network. The Radiales and RADMED and VALCAN programmes are for time series measurements. The institute is also engaged in pre-operational forecasts. It has been part of the Argo programme from the beginning, and is a member of Euro-Argo. The institute is also active in IODE, GOOS, IBI-ROOS, MedGOOS, Kopernicus, JCOMM and GEOSS.

Google Earth Plus: Tony Haymet reported on his recent interactions with personnel from Google Earth. Ship data and satellite information can be used to create bathymetry maps on the Google template, which is now capable of using depths less than zero. The latest version of Google Earth has an expected launch date of February 2, 2009. The preliminary versions have been very impressive and the response of the Scripps community to the potential of using Google Ocean for data archiving and visualisation has been very positive. It is expected that the final version will be extremely appealing, the impact profound. The system has considerable potential for data integration. It is not known whether there will be an eventual cost for using the service.

New Chilean Research Vessel: Andrés Enríquez introduced the MEDUSA project, relating to the new Chilean research vessel whose design specifications he presented. The requirements are being discussed among the representatives of the navy, scientific community and fishing research institutes to develop a suitable solution. Estimated cost is about 60 million dollars. The ship is being built at the naval ship yard in Talcahuano. The Chilean coast line extends over about 34,000 km, ensuring that there will always be much oceanographic work to do there.

General Discussion: Under the chairmanship of **Jan de Leeuw**, the general discussion started with the talk presented earlier by Susan Avery. The three elements (research, operational observation and predictive modelling) could be costed separately to estimate the cost of an observing system. The system could not be implemented all at once. Susan Avery suggested one focus on the benefits, and that the parts that would provide the greatest return on investment should be the parts to be implemented first. Ralph Rayner stated that a complete cost-benefit analysis was lacking, but that he believed the greatest benefit would be terrestrial, through the effect of the ocean on weather and climate.

Howard Roe took the view that ocean measurements can be easily shown to influence almost all GEO societal benefit areas. An analysis could also be made regarding the cost of not observing the oceans. A useful starting point could be climate. Various members acknowledged the difficulty of finding cost estimates for observing systems in particular countries. Ralph Rayner thought that such estimates did exist for a few countries.

Stan Wilson believed that the central issue was not costs. The important thing is to identify the key variables whose observations are essential to answer the key societal questions. One should take a first-principles approach. For example in weather forecasting one starts with the surface pressure field. By analogy, for the ocean one should start with surface pressure and density fields using Jason and Argo. Neither has yet been operationalised. GLOSS is also relevant, and surface wind stress is available from scatterometer. Sustainability of measurements is fundamental, but scientists are acutely aware of the fragility of continuity in satellite data.

To justify the observing system, Ralph Rayner believed that the key was to focus on a couple of

important benefit areas, and make the case from that basis by showing that the benefits exceed the costs of operation. Stan Wilson pointed out sea level variation as a global example of key importance.

On another topic, Jesse Ausubel considered that visualisation and related issues should stay on the POGO agenda. He raised two potential areas of new scientific interest for ocean observations. The first was the growing impact of human activities on sound in the ocean. The SCOR 50th anniversary meeting had discussed a possible new international cooperative experiment: "International Quiet Ocean Experiment". During a finite period of time, attempts would be made to minimise human-induced noise in the ocean. Models alone could not predict the response of marine life to change in noise: observations are necessary. Increased acoustic background in the ocean is one dimension of global change. Perhaps a working group could be convened to discuss how to achieve sound reduction, and the experiments that would be carried out during the quiet interval. Would POGO be interested to foster the idea of a workshop to discuss such an idea, perhaps in collaboration with SCOR? He would undertake to find the funds.

A second topic that Jesse Ausubel discussed was carbon deep in the Earth. Carbon in the mantle and crust, and their fluxes are still poorly known. There are unusual carbon fluxes on the planets. What about Earth? Some of the methane at hydrothermal vents may have an abiogenic source. There were implications for energy considerations. Is it possible that oil reservoirs could fill from below? In the deepest drill holes (10km), sludge still contains microbes. No hole has penetrated below the limit of life. This is also true for the deepest cores in the ocean. Is there more water tied up in the crust than in the ocean? Is there a great-depth living community? What can a deep carbon programme tell us about the origin of life? Sloan Foundation has encouraged development of a deep carbon observatory. Carnegie Foundation had also been approached. Would POGO be interested in oceanic part? It would be a fundamental research programme rather than a societal benefit programme.

Members were invited to a reception at Isidora Cousiño Park, in Lota, hosted by the University of Concepción.

08 January, Thursday

POGO Members' Forum: Chair Jan de Leeuw

OceanObs'09: Ed Harrison reported on progress in the organisation of OceanObs09, to be held in Venice in September, with the goal of developing a community consensus for sustaining and expanding the global observing system for societal benefit. Elements of the meeting include a series of white papers on plans for the coming decade, to be circulated in advance for feedback (more than 130 proposed); plenary papers that will synthesise and present key points of white papers; contributed papers of a more-detailed nature; poster sessions to present white papers in more depth; and daily panel discussions. Final versions of plenary papers and white papers will be published. Endorsement of the meeting by POGO was requested, as well as POGO advocacy over the next decade for the plans developed by the meeting.

Proposed Action: POGO to endorse OceanObs'09.

Update on the International Cruise Information Database: Ed Hill reported on the status of this data base. There are between 150 and 200 research vessels (length greater than 60m) certified for ocean-going work, operated by some 50 research institutes, most of them POGO members. The website for the database was established in May 2007 (www.pogo-oceancruises.org). There is a cruise programme listing, a research vessel listing and an inventory of cruise reports (37000 entries over 40 years). A unique ship code is used in all three data bases. There are nine vessels listed that are less than 60m length.

The priorities for 2009 include working with operators to improve timeliness and content of cruise programme information; launch of the Cruise Programme Database Content Management System (January 2009); launch of the Cruise Summary Report Content Management System and link to the POGO Cruise Information web-site (January 2009); completion and launch the Cruise Summary Report System for searching the database (March 2009); routine maintenance of the system; and feedback to POGO databases from EUROFLEETS project.

Some issues in which POGO could help were to encourage timely submission of cruise programme information; and to give guidance on the minimum ship length to be included in the data base. The goal of having a fully automatic system to populate the data bases had been hampered not all operators hold al the required information in electronic form. An article on the subject is coming out in the AGU publication *Eos*. POGO member institutions' web sites could link to the ICID site, to raise awareness. Various members congratulated the team responsible fr the data bases for their excellent work.

Proposed Action: Ships of length less than 60 m be included when advisable. Key is deep-ocean capability.

Ocean Facilities Exchange Group: Jan de Leeuw introduced the OFEG, a bottom-up approach to research fleet coordination and harmonisation, with members in France, Germany, Netherlands, Norway, Spain and UK. Main objective is exchange of ship time and major equipment based on a bartering system. OFEG meets twice a year for fine tuning of cruise planning and cruise

scheduling. In 2008, some ten barter exchanges were made, equivalent to nearly 300 ship days. Scientific community is encouraged to take advantage of geographic positioning of OFEG vessels. In April 2008, a first roadmap for renewal of OFEG ocean and global class RV fleet was accepted.

OFEG maintains a virtual pool of exchangeable heavy equipment. There is a technical committee OFEG-TECH to discuss issues of mutual concern between nations, include common technical training. There is a website (www.OFEG.org). Among the issues of concern at present are harmonisation of capital investment plans; an ROV working group; pooling of seismic equipment; and insurance related to personal accidents. The next meeting of OFEG is in Texel, 23 and 24 April 2009. These meetings are open to interested parties outside OFEG.

Outreach Activities and Related Topics

BioMarine: Tony Haymet reported on BioMarine, an international forum to convene business, government, civil society and media to advance ocean sustainability. The BioMarine forum 2008 was held in Toulouse and Marseille. It was the major maritime event of the French Presidency of the European Union. The then POGO Chairman was co-chair of the meeting, and POGO had an information stand. Tony Haymet expressed particular appreciation for the collaboration of CoML, and for the personal contributions of Miriam Sibuet and Thecla Keizer.

POGO Outreach Activities: Howard Roe summarised POGO outreach initiatives during 2008. He considered outreach to be one of the most important things that POGO could do. POGO was represented at London Oceanology International (March 11 to 13), for which the help contributed by Ralph Rayner and by Marie-Helene Forget was appreciated. It was also represented at the ESF Marine Board Forum (Ostend, May 14 and 15), which dealt with marine data challenges; from observation to information. Representation at BioMarine has already been mentioned. Outreach needs money. POGO does not have funds to hire a full-time media person. But media experts can be hired for particular events, as was done for the Cape Town Summit. A possible venue to exhibit the POGO and the POGO/Ocean United Stand in 2009 would be the UN Climate Change Conference in Copenhagen (30 November-11 December).

Moving on to interactions with sister organizations, Dr. Roe noted that POGO will participate in the GEO Monitoring and Evaluation WG starting in the Spring of 2009. POGO had provided feedback to IOC questionnaire on reorganisation. POGO had written a letter to IOC stating its views. Howard Roe had attended the IOC Executive Committee in June. The Ocean United website acknowledges POGO for conceiving and launching Ocean United.

Savi Narayan noted that the input from POGO to IOC had been much appreciated. When organisations look to the future, it is important to study challenging inputs. She hoped that POGO would continue to offer constructive inputs to the IOC re-organisation. Within IOCm the discussion was not yet completed. In recent months, in the formal sense, the activity had been at a standstill. Meanwhile, IOC resources had been increased by UNESCO, in response to comments from member states on shrinking resources limiting effectiveness of IOC. The 50-years celebration of IOC would be another opportunity for continued discussion on the future of IOC. Dr. Narayan reiterated that POGO was very welcome within IOC and she looked forward to continued

interactions with POGO.

The UK Marine Bill – International Implications: Jacky Wood reviewed recent developments in marine policy in the UK and in Europe. The European Marine Framework Strategy Directive is becoming the primary driver for targets and objectives. It seeks to protect, preserve and where possible restore biodiversity by 2020. It promotes a dynamic maritime economy in harmony with the environment, supported by sound marine scientific research and technology. The policy includes sustained funding for marine observation and data networks.

In the UK, a Marine Science Coordination Committee has been established that is responsible for writing the first UK Marine Science Strategy. A marine bill white paper had been issued in 2007, intended to bring more coherence to various marine issues such as fisheries and conservation. There is a pervasive theme of ecosystem-based management. The Bill was announced in the Queen's speech in December 2008 and will go through Committee early in 2009. The Bill includes provision for a Marine Management Organisation. The implications for research providers include baseline assessment to support establishment of Marine Conservation Zones; increased sea-bed mapping; long-term monitoring; and a possible requirement to work closer to the shore than in the past. Operational oceanography will gain increasing emphasis, and data management will become even more critical.

POGO Business. Chair: Kiyoshi Suyehiro

Kyoshi Suyehiro presented his direction for POGO for 2009. It could be summarised by "Connect and share in the POGO way", through capacity building; advocacy for ocean observation system; work through observation to prediction; make a multi-disciplinary approach including biology, solid Earth; exploit non-traditional observation platforms such as ships of opportunity; and engage with industry.

The NF-POGO Centre of Excellence: Tony Knap reported on the first year of the Centre of Excellence in Observational Oceanography at the Bermuda Institute of Ocean Sciences. The training programme takes advantage of Hydrostation S, the Bermuda Atlantic Time Series Study, and the excellent research vessel Atlantic Explorer. It stresses development of core skills, hands-on training in observational oceanography, related academic courses including scientific ethics and policy, and workshops presented by visiting scientists. The aim is to teach at least ten students for ten months in each of ten years. Some 69 applications had been received from 36 countries, as well as 25 letters of enquiry from potential applicants who were unavailable in 2008. A rigorous selection procedure had been followed, with participation form the Nippon Foundation itself. Representatives from the Foundation also attended the inauguration in October.

In discussion, various members praised the excellent work being done by the Bermuda team. Those who had attended the inauguration all remarked on the very high calibre of the scholars, and of the strong impression left by the entire initiative. Karen Wiltshire noted that a similar effort is being made in Europe, under the One Sea programme. It is devoted to shallow, coastal waters, thus complementing the POGO effort in the open ocean.

POGO Capacity Building: Shubha Sathyendranath reviewed the Capacity Building Activities

undertaken by POGO during 2008. They included the POGO-AMT Fellowship; the NF-POGO Centre of Excellence; and the Austral Summer Institute. In addition, POGO participates in the GEO Capacity Building Committee and the SCOR Capacity Building Committee. In 2008, some sixteen POGO-SCOR Fellowships were awarded. A proposal was developed to award a bursary for marine science students at the University of Cape Town. When the former NF-POGO Visiting Professor programme metamorphosed into the Centre of Excellence, some disappointment was expressed within the community that such a good initiative had been suspended. Subsequently, POGO itself has sponsored more modest visiting professor courses in a responsive mode (in Viet Nam and Iran). This activity is being formalised and called the POGO Visiting Professorship. The AMT Fellowship is seen as the prototype for a possible rotating On-Board Training Fellowship. The POGO budget for capacity building in 2009 is set provisionally at 60,000 Euros.

Budget for an integrated ocean observation system: Shubha Sathyendranath outlined progress on the development of costing the ocean observing system. At the GEO Summit in Cape Town (2007), POGO Directors has stressed the need for a fully-implemented, integrated and multi-disciplinary ocean observation system, estimating the cost at about $3B. Considerable media interest ensued. The cost estimate had been an intelligent guess, based on the known cost of WOCE. It was time for a more detailed calculation. The POGO Secretariat had written various contact points requesting answers to a questionnaire aimed at providing an improved justification for the observing system. So far, these enquiries had led to estimates of $265M for operating and $152M capital costs. But some elements have still not been accounted for. These include cabled observatories; gliders; a bio-optical Argo; a satellite programme; a tsunami warning system; and capacity building. The next step is to complete and refine the costing then to prepare a brief but effective case for support.

COPAS Capacity Building: Silvio Pantoja gave an update on capacity building at the University of Concepción. Its agreement with Woods Hole Oceanographic Institution had just been renewed. There is a UNESCO IOC Chair in Oceanography. The Austral Summer Institute has so far trained about 500 students, about 36% of then from Latin-American countries outside Chile, with funding coming from POGO, IMBER, PAGES, UNESCO and JCOMM for a total of from $40 to70 thousand per annum. Continuity is facilitated through a three-year grant from the Ministry of Education (2008 to 2010). In applied coastal oceanography, the priorities include aquaculture, monitoring and forecasting, and fisheries.

On a relatd topic, **Luis A. Pinto** described a very interesting educational program in South America centred on Argo. School-children adopt a buoy and follow its trajectory as a basis for learning about the ocean. School teachers are also given relevant training.

POGO News and Information Group: Jan Seys reported on progress in the News and Information Group. During 2008, the targets for this group included a redesign of the POGO logo (done, widespread enthusiasm for the new design); design of a POGO brochure in honour of its tenth anniversary (done, new brochure available for print on demand); and a redesign of the POGO website (done, new site was introduced in Concepción). Kim Marshal-Brown and Shubha Sathyendranath have contributed to the logo re-design. Cindy Clark had taken responsibility for the new brochure. The new website has been the responsibility of Jan Seys and a team of programmers at the VLIZ, Belgium. The new website drew universal admiration: it is a major improvement.

Dr. Seys noted that some members of the News and Information Group had not been able to attend POGO-10. Given the importance placed on communication, he expressed the hope that a more complete attendance might be attained at POGO-11. Under the new brand that had been created, priorities would be established for communication and outreach over the next ten years. Trevor Platt was appointed as new chair of the News and Information Group.

Revised POGO Budget: Kiyoshi Suyehiro presented a budget revised according to comments and discussion by members. The budget was accepted by the meeting with the provision that the Secretariat, in consultation with the Executive, would have the flexibility to adjust spending as and when required by circumstances. In the uncertain financial climate of the day, the POGO Directors considered that it would be unwise to implement a deficit budget.

Venue and Dates of POGO-11: The next meeting will be held in Moscow, January, 2010. Dates are to be finalised. The meeting will be hosted by Shirshov Institute of Oceanography. Prof. Nigmatulin made a presentation, inviting POGO to hold its next meeting in Moscow, and the invitation was gratefully accepted.

Venue for POGO-12: The 2011 POGO meeting will be held in Korea, hosted by KORDI.

Venue for future meetings: Expressions of interest to hold future POGO meetings were received from the National Oceanography Centre Southampton and the US Consortium.

Adoption of Actions: Kiyoshi Suyehiro presented a consolidated list of Actions arising from the plenary meeting, from the informal discussions and from the Executive Meeting. They were refined according to further comments from the participants. The final versions as adopted by the meeting are collected in Appendix 1.

Final comments and information: Carina Lange thanked participants for their constructive visit. **Kyoshi Suyehiro** thanked all Chilean colleagues who had contributed to the success of the meeting, and brought the proceedings to a formal close.

In the evening, a public lecture on Argo was delivered on the Campus of the University of Concepción by **Breck Owens**, Woods Hole Oceanographic Institution.

Appendix 1

Proposed Action Items from POGO-10

1. GEO-related actions
    a. GEO BON: Nominate marine co-chair; write to GEO to redress lack of reference to marine biodiversity in implementation plan
    b. Organise visit to Geneva by a POGO/Ocean United delegation led by David Farmer at the earliest opportunity to rejuvenate links with Secretariat
    c. Explore possibility to place an Ocean United representative at GEO Secretariat
    d. Continue to support various GEO Tasks either led by POGO or to which POGO is a contributor
    e. Continue to support POGO participation in various GEO committees, including the monitoring committee, S&T Committee, and the capacity building committee
    f. Advocate that at least one of the GEO Vice Chairs be a marine specialist.

2. Continue to support a WMO-like Organisation for the Oceans

3. Ocean United and related actions
    a. Hold a workshop in 2009, in coordination with GOOS and SCOR to reach out to marine industry, to promote ocean observations from industry platforms
    b. Work in coordination with GOOS and other Ocean United members on outreach activities
    c. Explore possibilities to revive IOC participation in POGO capacity building efforts, especially the fellowship programme, which is now highly underfunded, relative to demand
    d. Continue joint activities in capacity building
    e. Continue to contribute to IOC reorganisation efforts

4. Ocean-SITES and Time Series measurements
    a. Continue to endorse oceanSITES.
    b. Support re-examination of scope of OceanSITES
    c. Recommend that clear links be established with other time series observations that fall outside the scope of OceanSITES (e.g., coastal networks, spatial time-series, repeat measurements without seasonal coverage), forming an overarching time series umbrella (Changing Times) if appropriate

5. ChloroGIN
    a. Continue to support ChloroGIN, including efforts to raise funds for its activities.
    b. Support resourcing HPLC measurements from Antares- ChloroGIN node.

6. SOOS
    a. Continue to endorse SOOS, continue to encourage participation of scientists from POGO member institutions in SOOS activities

7. WebSITE
    a. Acknowledging the excellent new POGO website developed by VLIZ as in kind contribution to POGO, complete the refinements to the design based on feedback, and go public with the new site

8. Outreach
    a. Continue outreach efforts on behalf of Ocean United on an opportunistic basis, and within budget constraints

9. Capacity Building
    a. Continue and develop, as discussed, various capacity building efforts led by POGO, including the Fellowship programme, On-board training programme, Visiting Professorships, ASI of UdeC, Studentship at University of Cape Town
    b. Continue to support the NF-POGO CofE in Bermuda and related regional training

10. Scoping and Costing Ocean Observations
    a. Continue to develop and refine the scope and cost of an integrated system for global ocean observations.
    b. Develop integrating themes and priorities based on benefits and readiness, for example, Sea Level measurements

11. OceanObs'09
    a. POGO to endorse the OceanObs'09 meeting in Venice in 2009
    b. Continue contributions to, and involvement in, OceanObs'09
    c. Work towards making integrating and synthesising themes by preparing statement in advance of OceanObs'09, on the global picture

12. International Cruise Information Database
    a. POGO member directors to encourage timely and complete submission of cruise information data to ICID
    b. POGO member directors to encourage ship operators to move to formats that are compatible with ICID, to avoid need for manual intervention
    c. POGO member directors to bear in mind that current database is limited to ships with deep-ocean working capacity.
    d. Provide provision on site to incorporate desirability for access to cruises, for example to service time-series stations.
    e. Collect statistics on the usage and effectiveness of databse

13. News and Information Group
    a. Request for contributions to go from Secretariat to members. Member directors to help populate the new web site

14. Organise and hold POGO-11 in Moscow, preferably in Jan 2010, with a theme of reflection and forward looking after 10 years of POGO

Appendix 2

POGO Members

- Department of Fisheries and Oceans (Canada)
- Bermuda Biological Research Station (Bermuda)
- Bigelow Laboratory for Ocean Sciences (USA)
- British Antarctic Survey (BAS) (UK)
- Chilean Consortium Consisting of

  SHOA (Servicio Hidrográfico y Oceanográfico de la Armada)
  Universidad de Concepción (Dept. of Oceanography and COPAS Center)
- Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Australia)
- Dalhousie University (Canada)
- First Institute of Oceanography (FIO), State Oceanic Administration (FIO) (China)
- Flanders Marine Institute (Belgium)
- French Consortium Consisting of

  IFREMER (Institut Français de Recherche pour l'Exploitation de la MER)
  INSU (L'Institut National des Sciences de l'Univers du CNRS)
- German Consortium consisting of:

  Alfred-Wegener-Institute (AWI)
  Leibniz-Institut für Meereswissenschaften an der Universität Kiel (IFM-GEOMAR)
- Indian National Centre for Ocean Information Services (INCOIS) (India)
- Institute of Oceanology, Chinese Academy of Sciences (IOCAS) (China)
- Institute for Marine Research (Norway)
- Instituto Español de Oceanografía (Spain)
- J. Craig Venter Institute (USA)
- Japan Agency for Marine-Earth Science and Technology (JAMSTEC) (Japan)
- Korea Ocean Research and Development Institute (KORDI) (Korea)
- Marine Research Institute (MA-RE) (South Africa)
- National Institute of Oceanography (India)
- National Oceanic and Atmospheric Administration (NOAA)
- Royal Netherlands Institute of Sea Research (the Netherlands)

- P.P. Shirshov Institute of Oceanology (Russia)
- UK Consortium Consisting of

  National Oceanography Centre (NOC)
  Plymouth Marine Laboratory (PML)
  Proudman Oceanographic Laboratory (POL)
  Scottish Association of Marine Sciences (SAMS)
  Sir Alister Hardy Foundation for Ocean Science (SAHFOS)
- US Consortium Consisting of

  Lamont-Doherty Earth Observatory (LDEO) (USA)
  Scripps Institution of Oceanography (USA)
  Woods Hole Oceanographic Institution (USA)

POGO Executive Committee:

Kiyoshi Suyehiro (JAMSTEC, Japan, Chair)

Tony Haymet (SIO, USA, Past Chair)

Peter Herzig (IFM-GEOMAR, Germany, Incoming Chair)

Carina Lange (UdeC/COPAS, Chile, Member)

Robert Nigmatulin (SIO, Russia, Member)

Trevor Platt (PML, UK, Executive Director)

Shubha Sathyendranath (PML, POGO Secretariat)

Appendix 3
Expansion of Acronyms

Argo: Name, not acronym, of a global array of free-drifting, profiling floats.
ASI: Austral Summer Institute
AWI: Alfred Wegener Institute for Polar and Marine Research
BIOS: Bermuda Institute of Ocean Sciences
ChloroGIN: Chlorophyll Global Integrated Network
CoML: Census of Marine Life
CONA: Comité Oceanográfico Nacional (Chile)
COPAS: Centre for Oceanographic Research of the South Pacific
CPR: Continuous Plankton Recorder
CSA: Canadian Space Agency
DevCoCast: GEONET Cast applications for and by Developing Countries
Diversitas: An international programme of biodiversity science
EUROGOOS: European Global Ocean Observing System
GBIF: Global Biodiversity Information Facility
GCOS: Global Climate Observing System
GEO: Group on Earth Observations
GEO BON: GEO Biodiversity Observation Network
GEONETCast: Data dissemination system of GEOSS
GEOSS: Global Earth Observation System of Systems
GLOSS: Global Sea Level Observing System
GODAE: Global Ocean Data Assimilation Experiment
GOOS: Global Ocean Observing System
HARON: Hydrological Applications and Run-Off Network
IBI-ROOS: Iberia-Biscay-Ireland Regional Operational Oceanographic System
ICES: International Council for Exploration of the Sea
ICID: International Cruise Information Database
IEO: Instituto Español de Oceanografía
IFM-GEOMAR: Leibniz-Institut für Meereswissenschaften an der Universität Kiel
Ifremer: Institut français de recherche pour l'exploration de la mer
IHO: International Hydrographic Organization
IMBER: Integrated Marine Biogeochemistry and Ecosystem Research
IOC: Intergovernmental Oceanographic Commission
IOCCG: International Ocean Colour Coordinating Group
IOCCP: International Ocean Carbon Coordination Project
IODE: International Oceanographic Data and Information Exchange
INCOIS: Indian National Centre for Ocean Information Services
IPCC: Intergovernmental Panel on Climate Change
JAMSTEC: Japan Agency for Marine-Earth Science and Technology
JCOMM: Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS: JCOMM in situ Observing Platform Support Centre
Jason: Joint Altimetry Satellite Oceanography Network
JRC: Joint Research Centre
KDM: German Marine Research Consortium

KORDI: Korean Ocean Research and Development Institute
LME: Large Marine Ecosystems
MarBEF: Marine Biodiversity and Ecosystem Functioning
MedGOOS: Mediterranean Global Ocean Observing System
MEDUSA:
OBIS: Ocean Biogeographic Information System
OceanSITES: Ocean Sustained Interdisciplinary Time series Environment observation System
OFEG: Ocean Facilities Exchange Group
NOCS: National Oceanographic Centre, Southampton
PAGES: Past Global Changes
PML: Plymouth Marine Laboratory
ROV: Remotely Operated Vehicle
SAFARI: Societal Applications of Fisheries Applications of Remotely-sensed Imagery
SCAR: Scientific Committee on Antarctic Research
SCOR: Scientific Committee on Oceanic Research
SeaWiFS: Sea-viewing Wide Field-of-view Sensor
SHOA: Servicio Hidrográfico y Oceanográfico de la Armada
SOOS: Southern Ocean Observation System
UNEP: United Nations Environment Programme
UNESCO: United Nations Educational, Scientific and Cultural Organization
VLIZ: Flanders Marine Institute
WCRP: World Climate Research Programme
WHOI: Woods Hole Oceanographic Institution
WMO: World Meteorological Organization
WOCE: World Ocean Circulation Experiment