

# Oceans and Society: Blue Planet Kick-off Symposium

Ilhabela, Sao Paulo, Brazil  
November 19-21, 2012

## Abstracts & List of Participants



**GEO Task "Oceans and Society: Blue Planet"  
Kick-Off Symposium**  
19-21 November 2012  
Hotel Itapemar, Ilhabela Island, Sao Paulo State, Brazil  
2nd Announcement

The Symposium will bring together current and prospective participants in the new GEO Marine Task SB-01 "Oceans and Society: Blue Planet". It will take place just prior to the GEO-IX Plenary in Poz do Iguaçu, Brazil (22<sup>nd</sup> - 23<sup>rd</sup> November 2012), to allow participants to attend both events.

**Oral presentations by invited speakers only**

**Session Conveners**

**Abstracts**  
Call for poster abstracts:  
**Deadline 1st September 2012**

**Themes**

**Organising Committee**

**Themes**

Global Ocean Information Coordination and Access  
Operational Systems for Monitoring of Marine and Coastal Ecosystems  
Capacity Building

Applications of Earth Observations and Information to Sustainable Fishery and Aquaculture Management  
Global Operational Ocean Forecasting Network

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# 1 ADVANCES OF INLAND WATER REMOTE SENSING IN BRAZIL

**Claudio Barbosa**

National Institute for Space Research (INPE), Brazil

The challenges for monitoring water quality in a country with continental dimensions such as Brazil are enormous. Here we face a variety of water types distributed in several aquatic ecosystems spanning from arid to tropical environments and from pristine to man-made reservoirs. These aquatic environments require satellite sensors with suitable spatial, spectral and temporal resolution. In Brazil, there is a large number of inland aquatic ecosystems, formed by hydroelectric reservoirs and by the extensive floodplain of the Amazon basin with more than 10,000 lakes and through which circulates approximately 12% of the earth's fresh water. In these cases, an approach based on satellites, complemented by in situ collections, offers considerable potential.

In this context, we will outline the research efforts undertaken in the last 8 years, by researchers from the Earth Observation Directorate of INPE, in monitoring and mapping the optically active components in optically complex inland waters. Examples of empirical and semi-empirical approaches integrating Landsat TM/ETM+, MERIS, Hyperion and airborne hyperspectral (Spectir) data, as well as, our early efforts to measure the inherent optical properties and analytical models will be presented.

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## 2 A PROPOSAL FOR FISHERIES MANAGEMENT AND CONSERVATION DORYTEUTHIS PLEI (TEUTHIDA: LOLIGINIDAE) IN THE NORTH COAST OF SÃO PAULO STATE, BRAZIL

**Diogo D. Barcellos**

Fisheries Ecosystems Laboratory, Department of Biological Oceanography, Institute Oceanographic, University of São Paulo

During all months of the year are caught immature individuals of the species *Doryteuthis plei* as by-catch by shrimp trawlers, but also the kind of study has been suffering human impacts such as degradation and mischaracterization of habitat caused by increasing urbanization, introduction of exotic species through ballast water of ships port, tourism and pollution. There are recent studies on the biology, fisheries and ecological importance of *D. plei* in the region of São Sebastião Island, which can serve as a basis to support the management of its local exploitation. Since in a global context, due to overfishing and other anthropogenic effects, a large number of species have been included in the red list of threatened species of the International Union for Conservation of Nature - IUCN, the objective of this study is to promote the management of fishing and conservation of the squid *D. plei* on the northern coast of São Paulo. Some measures for fisheries management and conservation are proposed, including: restriction of fishing licenses, allowing only residents or native fishermen involved in squid fishing for a period equal to or greater than 10 years; delimitation capture squid with mantle length greater than 140 mm; to open the bag of trawl in a tank with water collected from the environment, select the target species of shrimp and discard the environment squid with mantle length lower than the allowed minimum standard; creation of a research group to monitor fisheries management, study the abundance of the population focus, promote expeditions to identify spawning sites and prohibit fishing in these locations, promote environmental education events and other conservation actions. It is expected that with the handling measures proposed here are implemented to conserve *D. plei* in the study region and other regions where the population is suffering impacts.

### 3 STUDY OF THE CH<sub>4</sub> CONCENTRATIONS ON THE BRAZILIAN COAST

**Luana S. Basso<sup>1</sup>; Viviane F. Borges<sup>1</sup>; Luciana V. Gatti<sup>1</sup>; Alexandre Martinewski<sup>1</sup>; Lucas G. Domingues<sup>1</sup>; Caio S.C. Correia<sup>1</sup>; John B. Miller<sup>2</sup>; Humberto R. da Rocha<sup>3</sup>; Emanuel U.Gloor<sup>4</sup>**

<sup>1</sup>Instituto de Pesquisas Energéticas e Nucleares, Brazil; <sup>2</sup>NOAA/ESRL, Boulder, USA; <sup>3</sup>IAG/USP, São Paulo, Brasil; <sup>4</sup>University of Leeds, Leeds, United Kingdom

Since 2000 atmospheric measurements of CH<sub>4</sub> were started with aircraft vertical profiles in four sites in Brazilian Amazon Basin, Santarém (SAN: 02°S; 54°W), 2010 in Rio Branco (RBA: 10°S, 68°W), Alta Floresta (ALF: 8°S, 56°W) and Tabatinga (TAB: 4°S, 64°W), to calculate the CH<sub>4</sub> flux in this region. In this method was needed to calculate the background concentration, using SF<sub>6</sub>, as a tracer of air masses (Draxler et al., 2012), due it is an anthropogenic gas, as the concentration obtained in the Amazon is the same found in the coast. We also started flask measurements in three sites located in the Brazilian coast, Arembepé (ABP: 12°S, 38°W) between 2006-2010 and since 2010 in Salinópolis (SAL: 1°S, 47°W) and Natal (NAT: 5°S, 35°W), these results represent the CH<sub>4</sub> concentrations over the oceans, because the sampling was made in locations in front of the sea, so didn't have influence of the continental area. Figure 1 show the temporal series for all sites, and the concentrations of two global stations of NOAA/ESRL network, Ascension Island (ASC: 8°S, 14°W) and Barbados (RBP: 13°N, 59°W), representing the South and North Hemisphere. It is also observed that CH<sub>4</sub> concentrations of ALF, RBA, SAN, TAB and SAL, are between the RBP and ASC and the ABP and NAT concentrations are closer to the ASC. Analyzing the back trajectories of air masses, simulated by HYSPLIT model (Miller et al., 2007) for each day and sampling site, arriving in ALF, RBA, SAN, TAB and SAL, we found that the air masses received influence of both the North and the South Hemisphere, in agreement with the concentrations obtained in the study sites. The back trajectories that arrived in ABP and NAT have a homogeneous pattern, from the South Atlantic Ocean with latitude below of the ASC, which is consistent with the concentrations obtained in these sites that are near than ASC.

#### References

- Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website: (<http://ready.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, Silver Spring, MD.
- Miller, J.B.; Gatti, L.V.; D'amelio, M.T.S.; Crowell, A.M.; Dlugokencky, E.J.; Bakwin, P.; Tans, P.P. 2007. Airborne measurements indicate large methane emissions from the eastern amazon basin, *J. Geophys. Res.*, 34 (10).

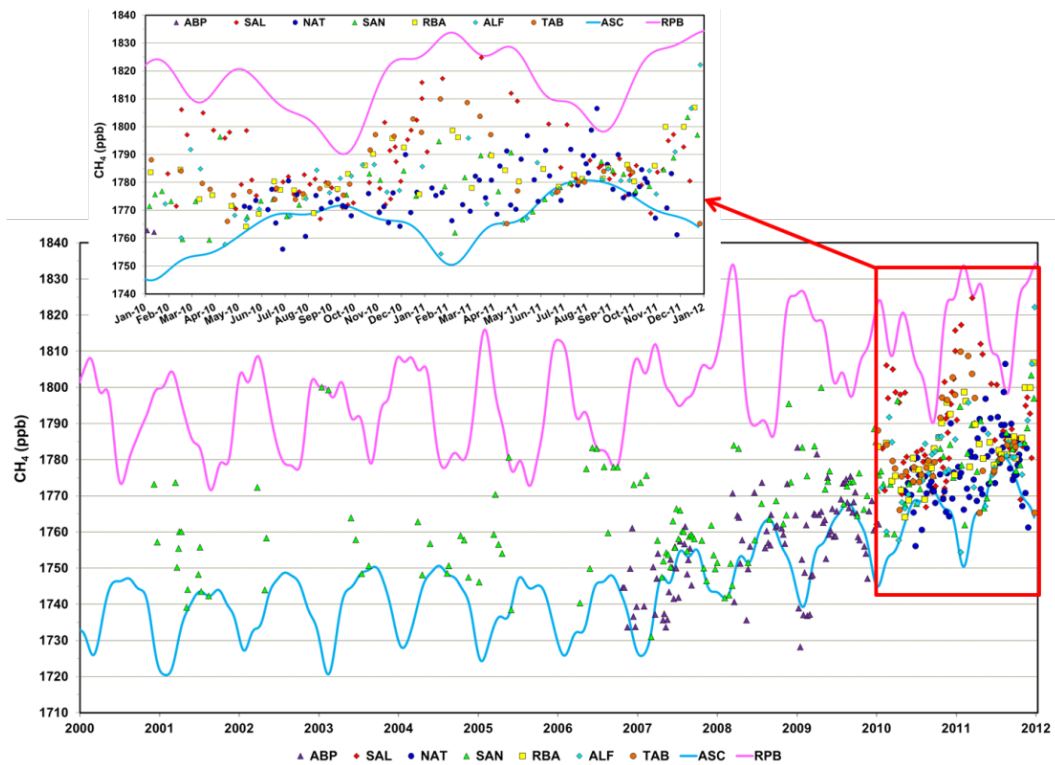


Figure 1: CH<sub>4</sub> temporal series between 2000 and 2011 for all sample sites and ASC and RPB.

## 4 SF<sub>6</sub> BRAZILIAN BACKGROUND CONCENTRATION

**Luana S. Basso<sup>1</sup>; Viviane F. Borges<sup>1</sup>; Luciana V. Gatti<sup>1</sup>; Alexandre Martinewski<sup>1</sup>; Lucas G. Domingues<sup>1</sup>; Caio S.C. Correia<sup>1</sup>; John B. Miller<sup>2</sup>; Emanuel U.Gloor<sup>3</sup>**

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Between 2006 and 2010, atmospheric measurements of SF<sub>6</sub> was started in the Brazilian coast, in Arembepé (ABP: 12°S, 38°W) and since January 2010 in Salinópolis (SAL: 1°S, 47°W) and May of the same year in Natal (NAT: 5°S, 35°W). All these sites are located in the Brazilian coast and these results represent the SF<sub>6</sub> concentrations over the oceans, because the sampling was made in locations in front the sea, so that there have not influence of the continental area in the results.

The temporal series for all these sites could be observed in Figure 2, as well the concentrations of two stations of NOAA/ESRL global air sampling network, Ascension Island (ASC: 8°S, 14°W) and Barbados (RPB: 13°N, 59°W). It is possible to be observed that SF<sub>6</sub> concentrations in ABP, NAT and SAL are closer of the measured values in the global stations, ASC and RPB, in most of the studied period, additionally the concentrations of this gas showed a continuous increasing, between 2006 and 2011.

The concentrations in ABP and NAT are closer to ASC concentrations, and the SAL concentrations are between the RPB and ASC. Analysing the back trajectories of air masses, simulated by the HYSPLIT model (Draxler et al., 2012) for each day and sampling site, were observed that the trajectories of the air masses arrived in ABP and NAT have a homogeneous pattern, from the South Atlantic Ocean with latitude below of the ASC, this pattern is consistent with the concentrations obtained in these sites, that are near than those obtained in ASC, indicating that in the South Atlantic Ocean the SF<sub>6</sub> concentrations are homogeneous. The air masses arrived in SAL received influence of both the North and the South Hemisphere, in agreement with the concentrations obtained in this site.

### References

Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website: (<http://ready.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, Silver Spring, MD.

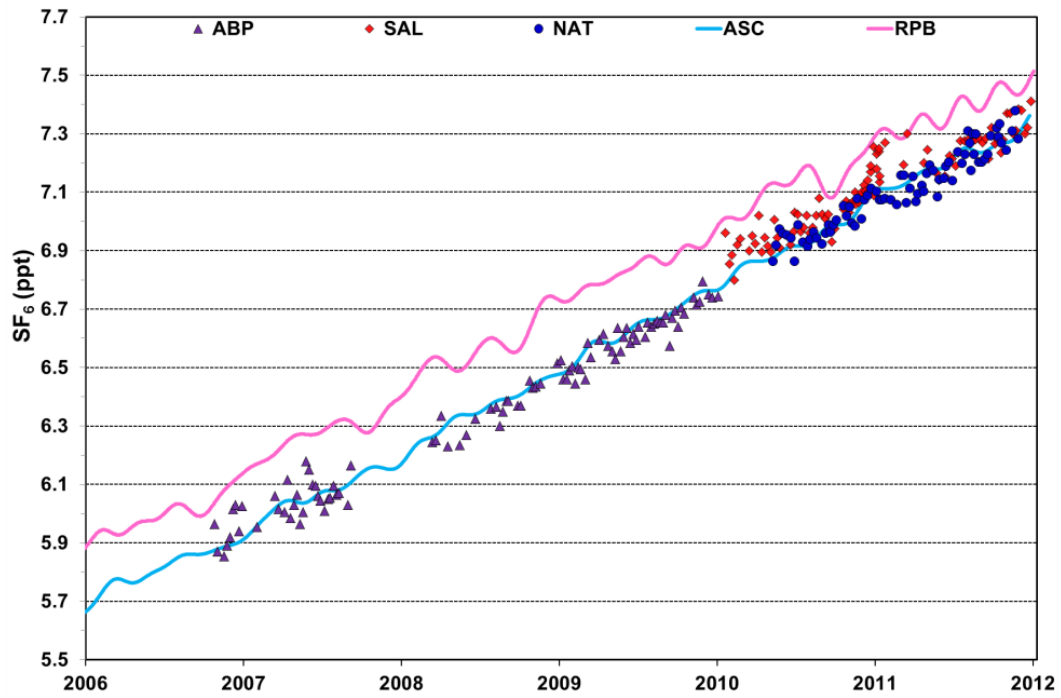


Figure 2: SF<sub>6</sub> temporal series between 2006 and 2011 for all sample sites and for the two stations of NOAA network, ASC and RPB.

## 5 DEVELOPING GLOBAL OBSERVATION SYSTEMS FOR HARMFUL ALGAL BLOOMS: EARTH OBSERVATION AND AUTONOMOUS SYSTEMS

**Stewart Bernard**

Council for Scientific and Industrial Research, South Africa

Harmful algal blooms (HABs) are responsible for ecosystem disruption and socio-economic damage in marine and freshwater systems across the globe. There is considerable scope and potential impact from the implementation of GEOSS type systems for bloom observation across a multitude of scales, using both space-based and in situ sensors, and bringing together the interests of GEO, GEOHAB, the IOCCG, and agency/regional/national interests. Briefly, various major types of HABs are reviewed from an earth observation perspective, highlighting the need for ecological context of bloom development and domain-specific demands on ocean colour-based observation. Examples of characteristic HAB events and optimal ocean colour products are shown in illustration of both bloom and ocean colour algorithm types. In addition, the need for complementary autonomous in situ systems is highlighted, focusing on the need for higher frequency and more complex or precisely observed parameters. A GEOSS perspective necessarily requires a focus on low cost, distributable and preferably standardised autonomous hardware, and some of the relevant options, challenges and opportunities are presented. Finally, some suggested mechanisms for implementation are discussed, including related GEO initiatives.

## 6 BACKGROUND OF CO<sub>2</sub> ON THE BRAZILIAN NORTHEAST COAST

**Viviane F. Borges<sup>1</sup>; Luciana V. Gatti<sup>1</sup>; Alexandre Martinewski<sup>1</sup>;  
Luana S. Basso<sup>1</sup>; Lucas G. Domingues<sup>1</sup>; Caio S.C. Correia<sup>1</sup>; John B.  
Miller<sup>2</sup>; Humberto R. da Rocha<sup>3</sup>; Emanuel U.Gloor<sup>4</sup>**

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Between 2006-2010 in Arembepe (ABP: 12°S, 38°W), and since 2010 in Salinópolis (SAL: 1°S, 47°W) and Natal (NAT: 5°S, 35°W), sites on the Brazilian coast, were started atmospheric CO<sub>2</sub> concentrations measurements. Measurements were also performed with vertical profiles in the Amazon Basin - Santarém (SAN: 2°S, 54°W), Rio Branco (RBA: 10°S, 68°W), Alta Floresta (ALF: 8°S, 56°W) and Tabatinga (TAB: 4°S, 64°W). For the calculation of the CO flux (Miller et al., 2007) in the Amazon Basin, was necessary to calculate the Continent background using SF<sub>6</sub> - anthropic gas, as air masses tracer. The results of these sites represent the CO<sub>2</sub> concentrations over the oceans, since the coast sampling was made on the beach, in front the Atlantic Ocean, without continental influence, and in the Amazon Basin the SF<sub>6</sub> concentrations were the same found on the coast. The results obtained were compared with two global stations NOAA/ESRL network results - Ascension Island (ASC: 8°S, 14°W) and Barbados (RBP: 13°N, 59°W) – localized in the Atlantic Ocean, as show Figure 3. It was observed that the CO<sub>2</sub> concentrations in ABP and NAT presented a homogeneous pattern with the ASC concentrations. SAL presented seasonality between the ASC and RBP concentrations, as well SAN, RBA, ALF and TAB. Studies of the air masses back trajectories, simulated by HYSPLIT (Draxler et al., 2012) model, for each day and sample sites, showed that SAL, SAN, RBA, ALF and TAB received influences from North and South Hemispheres. Analyzing the air masses back trajectories in ABP and NAT was observed a homogeneous pattern from the South Atlantic Ocean (SAO), with latitude below of the ASC, indicating that the CO<sub>2</sub> concentrations along the SAO are homogeneous.

### References

Miller, J.B.; Gatti, L.V.; D'amelio, M.T.S.; Crotwell, A.M.; Dlugokencky, E.J.; Bakwin, P.; Tans, P.P. 2007. Airborne measurements indicate large methane emissions from the eastern Amazon basin, *J. Geophys. Res.*, 34 (10).

Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website: (<http://ready.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, Silver Spring, MD.



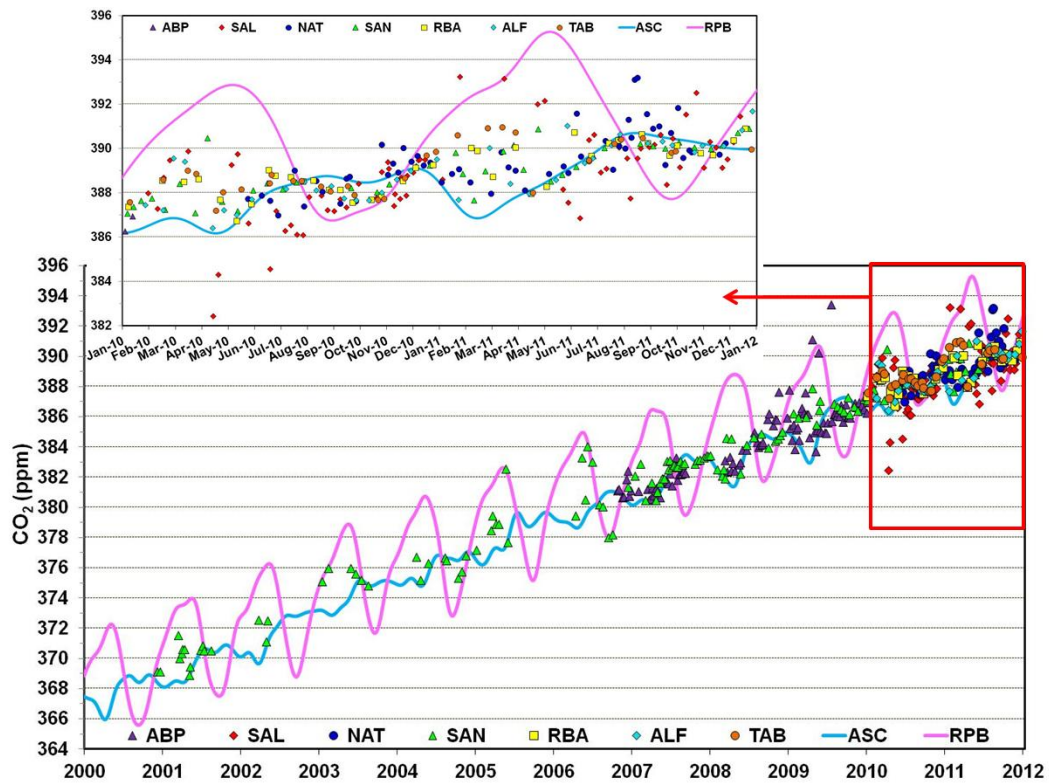


Figure 3: CO<sub>2</sub> temporal series between 2000-2011, for all sample sites and ASC and RPB.

## 7 STUDY OF N<sub>2</sub>O BACKGROUND ON THE BRAZILIAN NORTHEAST COAST

**Viviane F. Borges<sup>1</sup>; Luciana V. Gatti<sup>1</sup>; Alexandre Martinewski<sup>1</sup>;  
Luana S. Basso<sup>1</sup>; Lucas G. Domingues<sup>1</sup>; Caio S.C. Correia<sup>1</sup>; John B.  
Miller<sup>2</sup>; Humberto R. da Rocha<sup>3</sup>; Emanuel U.Gloor<sup>4</sup>**

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N<sub>2</sub>O concentrations by flask sampling on the Brazilian coast were started in 2010 in Salinópolis (SAL: 1°S, 47°W) and Natal (NAT: 5°S, 35°W). In Arembépe (ABP: 12°S, 38°W) measures were performed between 2006-2010. All sampling in these sites were made on the beach and the results represent the N<sub>2</sub>O concentrations over the ocean. In the Amazon Basin were performed, since 2010, measures with aircraft vertical profiles in Rio Branco (RBA: 10°S, 68°W), Alta Floresta (ALF: 8°S, 56°W), Tabatinga (TAB: 4°S, 64°W) and, since 2000, in Santarém (SAN: 2°S, 54°W), for this method was necessary to calculate the background on the Continent to know the N<sub>2</sub>O flux (Miller et al., 2007), using SF<sub>6</sub> as air masses tracer, since in the Amazon Basin, the SF<sub>6</sub> concentrations found were the same that in the coast. The results obtained were compared with two global stations NOAA/ESRL network results - Ascension Island (ASC: 8°S, 14°W) and Barbados (RPB: 13°N, 59°W) – localized in the Atlantic Ocean, as show Figure 4. In SAN, RBA, ALF and TAB were observed that the N<sub>2</sub>O concentrations presented values between ASC and RPB. In ABP and NAT the N<sub>2</sub>O concentrations presented values between ASC and RPB. In SAL was observed that the N<sub>2</sub>O concentrations were higher than ASC and RPB, mainly in 2010, indicating a possible source of the N<sub>2</sub>O. To know the origin of the air masses that arrived in the study sites, were simulated the air masses back trajectories for each day and sample sites by HYSPLIT (Draxler et al., 2012) model. This study showed that SAL, SAN, RBA, ALF and TAB received influences from both: North and South Hemispheres. ABP and NAT had only influence by air masses of the South Atlantic Ocean, being observed a homogeneous air masses pattern with origin below of the ASC latitude.

### References

Miller, J.B.; Gatti, L.V.; D'amelio, M.T.S.; Crotwell, A.M.; Dlugokencky, E.J.; Bakwin, P.; Tans, P.P. 2007. Airborne measurements indicate large methane emissions from the eastern Amazon basin, *J. Geophys. Res.*, 34 (10).

Draxler, R.R. and Rolph, G.D., 2012. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website: (<http://ready.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, Silver Spring, MD.

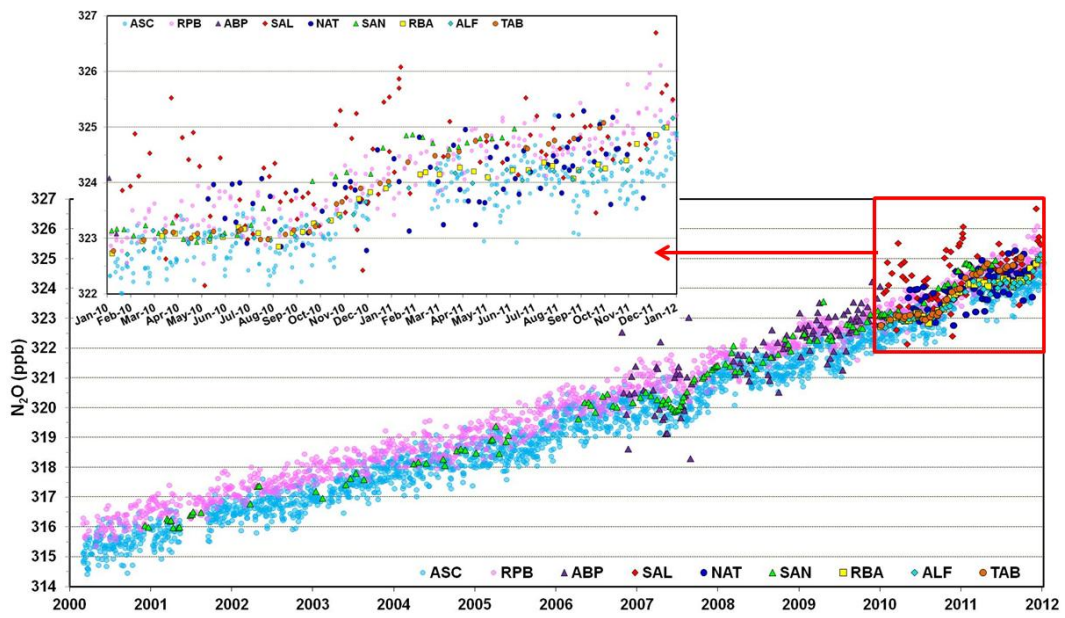


Figure 4: N<sub>2</sub>O temporal series between 2000-2011, for all sample sites and ASC and RPB.

## 8 BRAZILIAN COAST CO BACKGROUND

**Viviane F. Borges<sup>1</sup>; Luciana V. Gatti<sup>1</sup>; Alexandre Martinewski<sup>1</sup>;  
Luana S. Basso<sup>1</sup>; Lucas G. Domingues<sup>1</sup>; Caio S.C. Correia<sup>1</sup>; John B.  
Miller<sup>2</sup>; Humberto R. da Rocha<sup>3</sup>; Emanuel U.Gloor<sup>4</sup>**

<sup>1</sup>Instituto de Pesquisas Energéticas e Nucleares, Brazil; <sup>2</sup>NOAA Climate Monitoring and Diagnostics Laboratory, Boulder, Colorado, USA; <sup>3</sup>IAG/USP, São Paulo, Brasil; <sup>4</sup>University of Leeds, Leeds, United Kingdom

Since 2010 were started atmospheric measurements of the CO concentrations on the Brazilian coast, in Salinópolis (SAL: 1°S, 47°W), Natal (NAT: 5°S, 35°W) and between 2006-2010 in Arembepe (ABP: 12°S, 38°W). The coast samplings were performed on the beach, without continental influence. Measurements were also performed in aircraft vertical profiles on the Amazon Basin - Santarém (SAN: 2°S, 54°W), Rio Branco (RBA: 10°S, 68°W), Alta Floresta (ALF: 8°S, 56°W) and Tabatinga (TAB: 4°S, 64°W), for the calculation of the CO flux (Miller et al., 2007), was necessary to calculate the background on the Continent, using SF<sub>6</sub> - anthropic gas, as air masses tracer, once the SF<sub>6</sub> concentrations on the Amazon Basin were the same found on the coast. The results of these sites represent the CO concentrations over the oceans. The results obtained were compared with two global stations NOAA/ESRL network results - Ascension Island (ASC: 8°S, 14°W) and Barbados (RBP: 13°N, 59°W) – localized in the Atlantic Ocean, as show Figure 5. It was observed that the CO concentrations in ABP and NAT presented a homogeneous pattern with concentrations nearly of ASC. SAL presented the CO concentrations a little above of the ASC and RBP. SAN, RBA, ALF and TAB presented concentrations between of ASC and RBP. Studies of the air masses back trajectories, simulated by HYSPLIT (Draxler and Rolph, 2012) model, for each day and sample sites, showed that SAL, SAN, RBA, ALF and TAB received influences from North and South Hemispheres. ABP and NAT received influences from South Hemisphere and it was observed a homogeneous pattern of the air masses back trajectories from latitude below ASC of the South Atlantic Ocean (SAO). The air masses back trajectories in ABP and NAT analyses shown a homogeneous pattern from the South Atlantic Ocean (SAO) and indicate a homogeneous CO concentration along the SAO.

### References

Miller, J.B.; Gatti, L.V.; D'amelio, M.T.S.; Crotwell, A.M.; Dlugokencky, E.J.; Bakwin, P.; Tans, P.P. 2007. Airborne measurements indicate large methane emissions from the eastern Amazon basin, *J. Geophys. Res.*, 34 (10).

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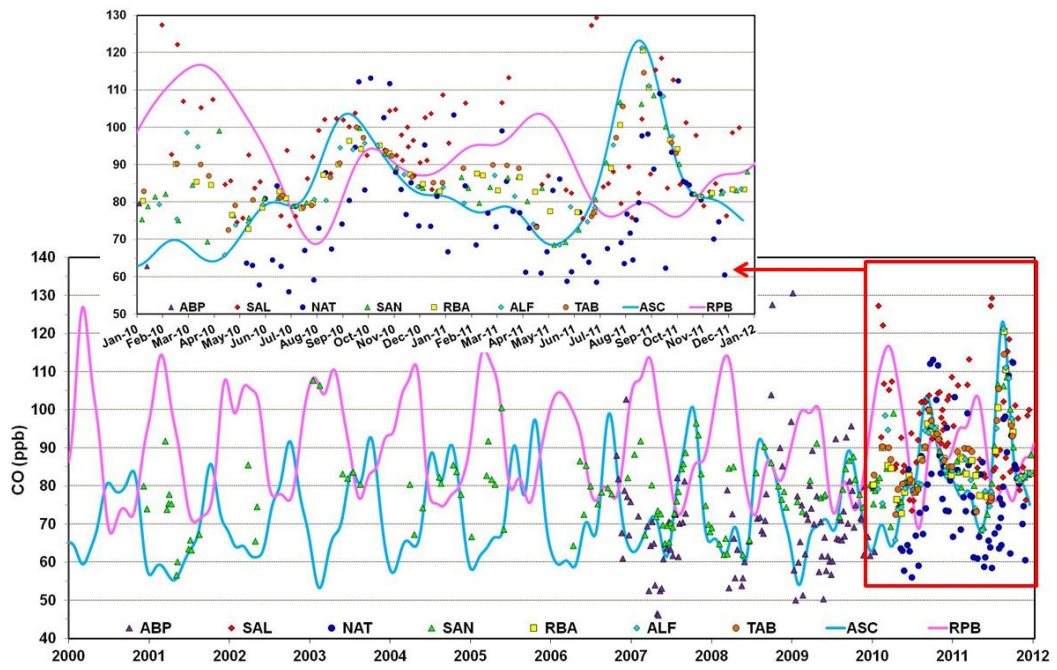


Figure 5: CO temporal series between 2000-2011, for all sample sites and ASC and RPB.

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## 9 CONTRIBUTION TO THE SETUP OF A CHLOROGEN TIMESERIES NODE IN IBERIA AND AFRICAN PORTUGUESE SPEAKING COUNTRIES

**Vanda Brotas**

University of Lisbon, Centre of Oceanography, Portugal

The importance of oceanic observational networks is unquestionable. The organization and maintenance of a successful network is not straightforward, size and common interests are key parameters in this equation. This work presents a proposal for the setup of a ChloroGIN time-series node in Iberia, Azores, Madeira and African Portuguese speaking countries. The main objectives of this network would be:

1. Support ChloroGIN aims, i.e, to promote in situ measurement of chlorophyll in combination with satellite derived estimates
2. Establish a network program of in situ observations on Portuguese coast, Azores, Madeira, Angola, Cape Verde and Mozambique
3. Develop Capacity building and training programs amongst partners and other scientific organizations.

The following institutions were contacted and declared their interest: Universidade de Lisboa (Portugal), Universidade dos Açores (Portugal), Universidade da Madeira (Portugal) Universidade Agostinho Neto (Angola), Instituto Nacional de Desenvolvimento das Pescas nas ilhas de Cabo verde (INDP, Cape Vert), Instituto Nacional de Investigação Pesqueira (Mozambique), Universidade Eduardo Mondlane (Mozambique). During Blue Planet meeting, the involvement of Brazilian institutions will be promoted. There is already a history of common publications with Portugal-Mozambique and Portugal-Brazil, and there is a submitted proposal to FAO involving Portugal and Cape Vert.

University of Lisbon (UL) has a long expertise in marine and estuarine phytoplankton research, being involved in water framework directive, toxic algae studies, biodiversity and validation of ocean colour with in situ pigments data along the Iberian west coast. Presently, UL participates in CoastColour project and Mermaid (Meris Matchup in situ database). UL hosts the recently created OCPortugal group ([ocportugal.org](http://ocportugal.org)), which brings together expertise in different research areas: applied optics, pattern recognition, remote sensing and high-performance computing.

## 10 OPERATIONAL OCEANOGRAPHY IN THE SOUTH ATLANTIC

**Edmo Campos**

Oceanographic Institute of the University of São Paulo, Brazil

Changes in the large scale ocean circulation resulting from changes in Earth's climate is likely to have significant impacts on the oceanic region adjacent to the Brazilian shores, affecting the temperature, salinity and heat content in the upper-layer of the ocean. One can expect that changes in these physical properties will result in alterations of the local climate, with impacts on the hydrological cycle, on the fluvial discharge regimes and on the biological pump and the biogeochemical cycles on the continental shelf. To understand and monitor these impacts and to provide valuable information for forecasting services and for different stakeholders and decision-makers, an operational system for marine and coastal zones is being implemented in the South Atlantic. This operational system is based on the deployment and maintenance of moored systems, long-term repeat hydrography, satellite-based observations and numerical modeling. In this context, some of the most relevant contributions are the Brazilian GOOS moored buoy program, which includes the deployment of an Atlas buoy on 28S, 44W, and the SAMOC Project, a contribution to an international effort to monitor meridional fluxes across a transatlantic section along 34S. The operational modeling effort is based on the implementation and use of a hierarchy of models with downscaling and data assimilation approaches, for ocean forecasting from synoptic to seasonal scales.

# 11 THE OCEANS COMPONENT OF THE MERTON INITIATIVE: TOWARDS A GLOBAL OBSERVING SYSTEM FOR THE HUMAN ENVIRONMENT

## Francisco Chavez and Merton Initiative

Monterey Bay Aquarium Research Institute

The presentation builds on a report generated by an IGPB-sponsored group that met at Merton College, Oxford University in September 2011. The group recognized that as Earth System science advances and matures, it must be supported by robust and integrated (environment, discipline) observation systems that meet the scientific and practical challenges of the 21st Century. In particular the focus was on human components of the observing system. Observing systems are used to quantify biological and environmental condition and change, and include repeated measurements of biological, biogeochemical, physical, hydrological and meteorological parameters of interest. Long-term observations, e.g. over decades, are used to elucidate trends in biological and environmental condition. Observations of the human dimension need to be part of the analysis of change in condition. This includes human appropriation of primary production and its drivers (population density and distribution, associated land-use/land cover change, e.g., patterns of forest clearing for agriculture), human wellbeing, and proposed or implemented policy actions. Integration of the observing systems can predict future biological outcomes of policy actions and land-use patterns. These ideas are clearly relevant for the terrestrial environment but what about the oceans? The oceans have their own internal challenges (fishing, pollution, ocean acidification, climate change) but also influence the atmosphere and terrestrial environments by changes in ocean circulation, chemistry and biology. The presentation will generally introduce the Merton Initiative report and then focus on different aspects of the Oceans Component in support of bio-diversity, ocean health and climate.



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## 12 TOWARD MULTISCALE METHODS FOR MAPPING AND MANAGEMENT MARINE DATA IN BRAZIL

**Luis Conti**

Escola de Artes Ciencias e Humanidades, Universidade de São Paulo, Brazil

Marine and Coastal environments tend to have a highly complex dynamics due to the interaction of multiscale processes. The use of Geographic Information Systems can facilitate understanding such dynamics, since it can provide multiple dataset analyses to gather, display and process large quantities of spatially and temporally related data. However most of current application of GIS and Geoprocessing in Marine sciences has been limited to simple mapping and navigation issues. While terrestrial oriented geoprocessing have been settled on theoretical grounds such as the well-established ideas of landscape ecology or Conservation Biology which deals with behavior of spatial patterns in the environment, the marine and coastal sciences have been struggling with how to deal with rapidly growing bodies of information without such base theories to support it completely. In the last decades, most of the efforts of create multi-scale framework to deal with coastal marine environments have resulted in important achievements and the development of a multispatial geodatabases models providing important step for developing an appropriate assessment and prediction methods for marine and coastal management and it is imperative that such framework should support data management and data accessibility tools.

In case of Brazil and specifically in São Paulo state, several studies involving oceanographic processes and its relation to anthropic occupation has been produced extendedly in the last years. Only in University of São Paulo, more than 75 projects have been carry on with management and of coastal zone of São Paulo State. Although Technical and Scientific works have been published since the 50's but part of all data and information collected have been lost or kept in private issues. During the last decade, however, the academic, military and civil society started to make some efforts in order to normalize and systemize marine data and information in Oceanographic Databases. Some examples such as BNDO (Brazilian Oceanographic Database) coordinated by the Brazilian Navy and BANPETRO (Environmental Marine Database), supported by Petrobrás are two good examples projects aiming the systematization of coastal and marine data into geodetic platforms. A significant benefit of available and proposed geographic information system (GIS) techniques is their ability to collect, structure, and analyze such coastal management relevant spatial information, but development of these programs should not be limited to the management of 'inventories', but also relates to the methodological development, technical solutions and applications that also aims at analyzing such information and the question of multi scale mapping should be on the center of the discussion.

## 13 GEOWOW: A EUROPEAN CONTRIBUTION TO INTEROPERABLE WATER INFORMATION SYSTEMS

**Massimo Craglia, Joost van Bemmelen, Roberto Cossu, Stefano Nativi, Michael Nyenhuis, Albert Fischer, David Richardson**

Joint Research Centre, European Commission, Italy

GEOWOW is a project, co-funded under the European Community's Seventh Framework Programme FP7/2007-2013 under grant agreement no. 282915 in response to call ENV.2011.4.1.3-1 "Interoperable integration of Shared Earth Observations in the Global Context". The project addresses the following objectives:

1. Contributing to the GEOSS Common Infrastructure improving global data discovery and enabling global access to, and use of, Earth Observation data and resources (computing, data handling tools, models. . . ) in the fields of weather, water, and Ocean ecosystems..
2. Developing tools and protocols promoting the implementation of the GEOSS Data Sharing Principles, and the re-use and dissemination of Earth Observation data, whilst addressing identified concerns expressed by data producers.
3. Developing the operational capabilities of the GCI through applications in three areas:
  - a. Weather, with a focus on unified access to EO and forecasting systems for hazard and extreme meteorological events.
  - b. Water, with a focus on hydrological applications and run-off process using in-situ and satellite data.
  - c. Ecosystem, with a focus on the implementation of GOOS by engineering and testing access to Ocean data via the GCI.
4. Enhancing multidisciplinary interoperability.
5. Analysing the benefits of GEOSS for Europe using models linking economy, environment, and society.

The project has identified a number of key requirements coming from the scientific community in the three thematic areas covered by GEOWOW, as well as more generic requirements of users of the GEOSS Common Infrastructure. The poster shows how the project is developing initiatives and technological components to address these requirements and how it contributes to the achievements of the GEOSS targets.

Additional details on the project are provided in the project website: <http://www.geowow.eu>

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## 14 ESTABLISHING LONG-TERM COASTAL OCEAN OBSERVATIONS IN SE BRAZIL

**L.C. da Cunha; Farias, C.O.; Hamacher, C.; Moser, G.; Bastos, M.**

Faculty of Oceanography- Rio de Janeiro State University, Brazil

Coastal ecosystems are among the most vulnerable areas to climate-related impacts such as sea-level rise, increase in sea-surface temperatures, and ocean acidification. Despite their role in the global ocean primary production, coastal ecosystems still lack of long-term observations, especially in tropical areas, including SE Brazil. Another gap identified in coastal areas is constraining their role in the sea-air CO<sub>2</sub> fluxes, i.e. do these areas act as sinks or sources of CO<sub>2</sub> to the atmosphere?

Research groups at the Faculty of Oceanography at UERJ (FAOC-UERJ) are at present interested in establishing long-term biogeochemical observations in a pristine coastal area in SE Brazil (Barra Grande Estuary, Rio de Janeiro State). The Barra Grande Estuary is located at Vila Dois Rios, on the ocean-side of Ilha Grande, and characterized by the presence of dense mangrove forests on its margins. The whole island belongs to the Ilha Grande Regional Park, one of the best preserved Atlantic rain forest areas in SE Brazil. The UERJ runs a laboratory and field sampling facilities at Ilha Grande, the CEADS (Centre for Studies on Sustainable Environmental Development), close to the estuary site. The staff at FAOC-UERJ currently develops different research and education projects (graduate and undergraduate levels) at CEADS. Two current projects aim at studying the processes controlling nutrients and carbon (organic and inorganic) fluxes from land to the coastal ocean through the Barra Grande estuary. Establishing long-term observations in the estuary and at a fixed point in the adjacent coastal ocean will allow us to constrain the seasonal and annual variability of lateral nutrient fluxes, processes controlling primary production, and the sea-air CO<sub>2</sub> transfer. Additionally, marine biogeochemical background data collection and logistic support at CEADS will enable studies focusing on global change effects in the tropical Atlantic coast. Finally, such a scientific program would enhance the capacity building at both Bachelor and Master levels within UERJ students.

## 15 ENDEAVORING FOR WISE MARICULTURE: SCIENCE INPUT TO POLICY IMPLEMENTATION

**Laura T. David, Roselle Borja, Bayosa Aya Carino, Kristina Cordero,  
Aldwin Almo, Eileen Penaflor**

University of the Philippines Marine Science Institute, Philippines

Mariculture offers a pragmatic solution to the food security of the Philippines. Since it gained popularity in the 70's, however episodic fish kills have plagued this industry. Contributing factors include eutrophication, reduced flushing rates, hypoxia, harmful algal blooms, and warming waters. If the country is to make a concerted effort to secure our source of food, its planning and management of its mariculture needs to be science-based. Currently, there is still no established protocol on how and where these parks will be established. Without science-based guidance, the very industry we are relying on to continue to provide food for the Filipinos will inadvertently contribute to the further demise of our coastal resources. Each fish kill not only affects the mariculture industry but also compromises the ability of the surrounding benthic and pelagic habitat to be resilient to any additional pressures. This research presented here studied the different regions in the Philippines vis-à-vis their physical characteristics to evaluate the level of intensity of mariculture activities that can be maintained per region in the Philippines. The study entailed using historical remotely sensed derived atmospheric and oceanic data which showed that the Philippine waters naturally divided into 11 climate exposure types. National-scale hydrographic models were also analyzed for coarse scale entrainment features. Finally, for specific embayments, flushing rates were also calculated.

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**16** USE OF THE SATELLITE DATA TO STUDY THE TEMPORAL  
EVOLUTION OF MARINE DYNAMICS AND ECOLOGICAL  
RESPONSE TO CHANGES IN THE SOUTH ATLANTIC OCEAN

**Flavia Tavares Delcourt, Milton Kampel, Bertrand Chapron, Antonio  
Juan Gámez**

Instituto Nacional de Pesquisas Espaciais, Brazil

The oceanic circulation in the western South Atlantic Ocean is dominated by the presence of boundary currents from the Anticyclonic Subtropical Gyre. By the joint action of trade winds and the Earth's rotation, a displacement and accumulation of water in the west side of the Atlantic occur. For the same reasons that contribute to the occurrence of certain oceanographic phenomena, such as upwelling, ocean stratification and generation of eddies and meanders, which influence the ecosystems bystanders. The use of the altimeters and sea surface temperature, surface wind, and the chlorophyll sensors on-board of satellites is essential for the development of a spatiotemporal analysis of the variability of those parameters in the South West Atlantic region. The goal of this PhD investigation is to study the variations of the different spatiotemporal scales between the continental shelf and the open ocean, developing a methodology that combines data processing, remote sensing of the marine dynamics and the known biological systems in the Brazilian coast to find the relationships between them and their evolution. The results have led to a classification of the South Atlantic in ecological provinces, based on dynamic characteristics of the time series involved. These provinces are influenced by exogenous events that contribute to the exceptional pattern of the variables, suggesting inter-relationships with physical processes and the El Niño phenomenon.

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## 17 THE ANTARES-UBATUBA COASTAL TIME-SERIES STATION (SP/BRAZIL): NINE YEARS OF IN SITU AND SATELLITE MONITORING

**Natalia de Moraes Rudorff, Maria Laura Zoffoli, Larissa Valerio, Aline de Matos Valério, João Felipe Cardoso dos Santos, Gustavo Prouvot Ortiz, Gabriel Moiano, Milton Kampel, Mayza Pompeu, Salvador Gaeta**

Instituto Nacional de Pesquisas Espaciais (INPE), Brazil

Coastal zones are highly dynamic systems in the interface of ocean-climate and continental processes, and thus highly vulnerable to natural and anthropogenic changes. This complex system embraces important coastal and marine ecosystems and is usually combined with highly populated areas, sharing different activities. It is thus very important to understand the processes regarding these interfaces and monitor the changes and their effects. Ocean colour remote sensing is a powerful tool for environmental monitoring, and the only means to obtain the spatio-temporal distribution of biogeochemical properties in large geographical scales with a high frequency of acquisition. However, the determination of these properties in coastal optically complex waters is a challenge for bio-optical modeling. The ANTARES regional network aims the validation and adjustment of bio-optical models, and the monitoring of climate and anthropogenic changes in coastal zones around Latin America. The present work shows how the ANTARES-Ubatuba station (SP/Brazil) located in the Brazilian southeast continental shelf is being implemented since 2004, with in situ and satellite monthly data collections of radiometric and bio-optical data. We show some of the works that are being developed regarding bio-optical characterization, validation of satellite products, testes of the performance of empirical and semi-analytical models, and time-series analysis of annual and inter-annual variability. The Brazilian southeastern continental is an important environmental and social-economic region with biological protected areas, high tourism activities, local fisheries, aquaculture activities and has one of the greatest natural gas reserves of the Brazilian coast. The ANTARES-Ubatuba monitoring program aims to provide reliable and accurate ocean colour products for the region, as well, as monitor the processes that regulate the distribution of biogeochemical properties, such as the phytoplankton distribution and coloured dissolved organic matter, and detect possible changes that may affect (or be affected by) human activities and the natural environment.

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## 18 VARIABILITY OF UPWELLING INTENSITY AND THE DYNAMICS OF THE POPULATION OF OCTOPUS VULGARIS, NEAR MBOUR

Ousmane Diankha<sup>1</sup> and Modou Thiaw<sup>2</sup>

<sup>1</sup>Laboratoire de Physique de l'Atmosphère et de l'Océan Siméon Fongang (LPAO-SF/ESP-UCAD, Sénégal) <sup>2</sup>Centre de Recherche Océanographique de Dakar-Thiaroye (CRODT, ISRA Sénégal)

The fluctuations of the upwelling intensity and their effects on seasonal, and interannual octopus recruitment near Mbour (13.5-14.5 N and 17-17.5 W, area of octopus catch) are analysed and quantified using data from 1996 to 2005. Octopus recruitment estimated from the Virtual Population Analysis model (VPA) using monthly octopus catch and environmental data, sea surface temperature (SST) derived from satellite, and North Atlantic Oscillation (NAO) index obtained from the National Oceanic Atmosphere Administration (NOAA) website were used.

The results show that upwelling intensity and octopus recruitment are characterized by great seasonal and interannual variability. The highest upwelling intensity is observed in March coinciding with the maximum of octopus recruitment. Inverse and significant correlations between octopus recruitment and SST and between SST and NAO index were calculated. Octopus recruitment and NAO index are positively correlated. Regarding the relationship between these variables, a linear model (lm) with stepwise procedure was used. The seasonal and interannual variability of octopus recruitment is explained by the combined SST and NAO index (87.3

This study suggest that the variable environment should be taken in account in the management and planning of octopus fisheries in order to manage and assess better the octopus resource.

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## 19 THE GEO COASTAL ZONE COMMUNITY OF PRACTICE (CZCP)

**Paul M. DiGiacomo<sup>1</sup>, Hans-Peter Plag, Jose Muelbert**

<sup>1</sup>NOAA, USA)

Global, regional and local trends in natural processes and human demands on coastal ecosystems jeopardize the ability of these ecosystems to support commerce, living resources, recreation and habitation. In this context, improved, integrated and sustained coastal observing capabilities are required to better support user information needs. The Group on Earth Observations (GEO) provides a valuable framework and mechanism to help implement these capabilities, and under the auspices of GEO, a Coastal Zone Community of Practice (CZCP) was initiated in 2006. The CZCP builds on the heritage of the former IGOS Coastal Theme, which provided a strategy for integrated observations across the land-sea interface, and aims to enable broader participation, improved linkage to users, coordinated implementation, and enhanced societal benefits.

The CZCP is a user-driven community of stakeholders, the purpose of which is to develop and execute a strategy, in the framework of GEO, for engaging user groups across the land-sea interface in the development of those elements of GOOS and other observing systems that are required to provide and integrate data on terrestrial, freshwater, marine and atmospheric systems that converge in the coastal zone.

CZCP activities in recent years have included undertaking several regional workshops as part of the series entitled “GEOSS Support for Decision-Making in the Coastal Zone: Managing and Mitigating the Impacts of Human Activities and Natural Hazards in the Coastal Zone”. Other ongoing activities include efforts to facilitate the implementation of coastal GOOS, as well as more broadly support the Blue Planet Task for GEO. Emerging activities being considered include development of a prototype, science-based coastal information system for routine assessments and monitoring of coastal zones in developed and developing nations. This presentation will highlight these and other recent and upcoming activities for the CZCP.



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## 20 INFORMATION FOR A BLUE SOCIETY: PROPOSAL FOR AN INTEROPERABLE MARINE SPATIAL DATA INFRASTRUCTURE – THE CHLOROGEN EXAMPLE

**Samy Djavidnia**

European Maritime Safety Agency (EMSA), Portugal

Our society is currently facing a number of crucial challenges, one of them being the sustainable development of a “green” and “blue” economy for mitigating and adapting to climate change. Within this context, the “Ocean” has been identified as one of the 7 “Critical Issues” at the Rio+20 United Nations Conference on Sustainable Development and is now an integral part of the United Nations Climate Change Conference discussions and negotiations.

Based on the principle that “in order to manage it [a problem], we must be able to measure it”, the availability of observational data and information of our complex ecosystems is essential. Earth Observation, via in-situ and satellite remote sensing, is a powerful tool for collecting environmental data and information, both at local and global scales. While the aspects relative to the science, sensor spatial coverage, type and sustainability of these observations are of fundamental importance, the access and exchange of this data and information is a facet which also deserves special attention. The further development and implementation of an ocean/marine information environment which facilitates the sharing, use and dissemination of data among various stakeholders is a key to addressing sustainable management and protection of oceans and marine resources at a global scale.

The Chlorophyll Global Integrated Network - ChloroGIN - is an international network to assess the state of marine, coastal and inland-water ecosystems. For this purpose it promotes in-water observations in synergy with ocean-colour and other related satellite observations. The network consists of a number of different data providers, each of them collecting, storing, processing, and distributing data independently. This paper will strive to demonstrate that in order to fulfil its objectives, in addition to the science based research development work it already successfully conducts, ChloroGIN should provide an interoperable Spatial Data Infrastructure platform able to integrate and disseminate the different spatial and temporal referenced datasets and services offered by its network in a standardised way. The development of this platform should follow the relevant directives and guidelines as set by the GEOSS 10-Year Implementation Plan and thereby enable ChloroGIN’s network of partners to reach a level of harmonisation and interoperability which is beneficial to all its users and stakeholders.

## 21 STUDY OF SEA LEVEL FLUCTUATION EFFECTS ON ENVIRONMENT OF CASPIAN SEA

**Sh. Eghtesadi, R. Zahedi**

European Maritime Safety Agency (EMSA), Portugal

Our society is currently facing a number of crucial challenges, one of them being the sustainable development of a “green” and “blue” economy for mitigating and adapting to climate change. Within this context, the “Ocean” has been identified as one of the 7 “Critical Issues” at the Rio+20 United Nations Conference on Sustainable Development and is now an integral part of the United Nations Climate Change Conference discussions and negotiations.

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## 22 STUDY OF SEA LEVEL FLUCTUATION EFFECTS ON ENVIRONMENT OF CASPIAN SEA

**Luis Escudero**

Instituto Del Mar Del Peru, Peru

The spatial distribution of monthly chlorophyll-a concentration off the coast of Peru from satellite images derived from Sea-viewing Wide Sensor Field-of-view Sensor (SeaWiFS) for the period September 1997 to December 2010 when the sensor stopped working. The time series of monthly images corresponds to 152 level L3 with spatial resolution of 9 km. The aim of this study is to know the monthly variations in the concentration of chlorophyll-a off the coast of Peru. The highest concentrations of chlorophyll-a ( $> 10 \text{ mg / m}^3$ ) occur from November to April, especially in the area between  $3^\circ\text{S}$  to  $14^\circ\text{S}$  distributed throughout the shelf, from May to October, the lowest observed chlorophyll-a concentrations ( $< 3 \text{ mg / m}^3$ ). During the occurrence of warm events like El Niño, the concentration of chlorophyll-a decrease substantially the entire Peruvian coast. High concentrations of chlorophyll-a are strongly associated with the cold coastal waters (ACF) of the Humboldt Current.

## 23 THE GLOBAL OCEAN OBSERVING SYSTEM AND GEO

**Albert Fischer**

UNESCO/IOC, France

The Global Ocean Observing System (GOOS) has adopted a Framework for Ocean Observing (doi:10.5270/OceanObs09-FOO) developed out of the OceanObs'09 conference (September 2009, Venice, Italy) as guidelines for a restructuring. The goals of GOOS are to engage the wide ocean observations community in: 1. sustaining present observations, 2. expanding to new variables and serving new requirements, and 3. identifying regional priorities, capacity, and addressing gaps. GOOS is harnessing the principles of GEO in improving data infrastructure and interoperability through the European Commission GEOWOW project, and developing information for the science-policy interface through a GEF-funded Transboundary Waters Assessment Programme aimed at bringing information on how the ocean environment and human well-being are linked.

## 24 THE BRAZILIAN COASTAL MONITORING SYSTEM (SiMCoSTA)

**Carlos A. E. Garcia**

Institute of Oceanography Federal University of Rio Grande, Brazil

The spatial distribution of monthly chlorophyll-a concentration off the coast of Peru from satellite images derived from Sea-viewing Wide Sensor Field-of-view Sensor (SeaWiFS) for the period September 1997 to December 2010 when the sensor stopped working. The time series of monthly images corresponds to 152 level L3 with spatial resolution of 9 km. The aim of this study is to know the monthly variations in the concentration of chlorophyll-a off the coast of Peru. The highest concentrations of chlorophyll-a ( $> 10 \text{ mg} / \text{m}^3$ ) occur from November to April, especially in the area between  $3^\circ\text{S}$  to  $14^\circ\text{S}$  distributed throughout the shelf, from May to October, the lowest observed chlorophyll-a concentrations ( $< 3 \text{ mg} / \text{m}^3$ ). During the occurrence of warm events like El Niño, the concentration of chlorophyll-a decrease substantially the entire Peruvian coast. High concentrations of chlorophyll-a are strongly associated with the cold coastal waters (ACF) of the Humboldt Current.

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## 25 PHYTOPLANKTON GROUPS ASSESSMENT FROM REMOTE SENSING DATA IN THE SARGASSO SEA

**Maria Fernanda C. Giannini; Michael W. Lomas**

USP-Centro de Biologia Marinha, Brasil

Remote sensing is a powerful tool to understand ocean processes in a large temporal and spatial scale, especially those related to biogeochemical cycles, as the global carbon flux. For this reason, it is important to assess the phytoplankton community structure and their roles in this processes. A model called PHYSAT was developed in order to identify the variability of phytoplankton community in the global oceans from remote sensing data of radiance. In the present work, the methodology used for PHYSAT was reproduced in a local scale, using the Bermuda Atlantic Time-series Study dataset, and also an analysis was made for the performance of the original PHYSAT in the Sargasso Sea. The time-series data could not reproduce the results of PHYSAT for a local application, once that in a very small spatial scale, the changes in community were not large enough to define specific spectra for different groups, as well as due to the temporal scale of the dataset, which may mask some patterns up. The response of the PHYSAT for the Sargasso Sea showed a general agreement for latitudinal patterns of distribution, however for many local features the model did not perform very well, especially for the small prokaryotic cells, such as *Prochlorococcus*. Further analysis need to be done, in order to better validate the model with in situ data of higher spatial resolution and to be able to develop a regional model of phytoplankton groups dominance for the Sargasso Sea or even for other regions.

## 26 A GLOBAL NETWORK OF TEMPERATURE SECTIONS IN SUPPORT OF CLIMATE STUDIES

**Gustavo Goni**

National Oceanic and Atmospheric Administration, US

The global eXpendable BathyThermograph (XBT) network addresses both scientific and operational goals that contribute to the building of a sustained ocean observing system. The main mission is the collection of upper ocean temperature profiles mostly from volunteer vessels. The XBT deployments are designated by their spatial and temporal sampling goals or modes of deployment (Low Density, Frequently Repeated, and High Density or High Resolution) and sample along repeated, scientifically important transects, on either large or small spatial scales, or at special locations such as boundary currents and chokepoints. These observations are complemented by or complementary to other observational programs, such as Argo, the surface drifter array, pCO<sub>2</sub> system network, satellite altimetry, etc. Multi-national reviews of the XBT network were carried out at the 1999 and 2009 OceanObs Conferences. Given the advances in the Argo program, the global XBT network is now focused on high resolution monitoring of fronts, eddies, boundary currents and heat transport and not exclusively on the broad-scale upper ocean thermal field. We present here the current state of the XBT network and key results of XBT data for climate studies.

## 27 THE GLOBAL ALLIANCE OF CONTINUOUS PLANKTON RECORDER SURVEYS (GACS)

**Hosie, Graham<sup>\*1</sup>, Sonia Batten<sup>2</sup>, Sanae Chiba<sup>3</sup>, Martin Edwards<sup>2</sup>,  
Mitsuo Fukuchi<sup>4</sup>, Julie Hall<sup>5</sup>, Chris Melrose<sup>6</sup>, Erik Muxagata<sup>7</sup>, Nick  
Owens<sup>2</sup>, Anthony Richardson<sup>8</sup>, Sun Song<sup>9</sup>, Hans Verheye<sup>10</sup>, Peter  
Burkill<sup>11</sup>**

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Continuous Plankton Recorders have been deployed as a lower trophic level sampling tool for many decades in the North Atlantic, and have provided a wealth of data used to describe plankton diversity, biogeography, response to climate forcing and influence on upper trophic levels. Other regions of the ocean have since been monitored with CPRs; the Southern Ocean for over 20 years, the north Pacific for over 10 and new surveys have recently been initiated around Australia, New Zealand, Brazil and in the Benguela Current. The CPR has remained the instrument of choice because it offers a cost effective way to routinely sample deep ocean basins and coastal ecosystems seamlessly, and is the only current instrument that does so while measuring biodiversity of both zooplankton and larger phytoplankton. Recognising the need to combine expertise and data to address global issues affecting lower trophic levels (ocean warming, acidification etc.) a Global Alliance of CPR Surveys (GACS) was formed in September 2011. GACS will provide that global perspective using CPR data. It will also allow us to assess changes and events at a local or regional level in a world-wide context. The group has a board of governance comprising members from 9 regional CPR surveys and active working groups to develop a joint database and maintain working standards and methodologies. Other specific aims are to produce a regular ecological status report for global plankton biodiversity, and to provide an interface for plankton biodiversity with other global ocean observation programmes. [www.globalcpr.org](http://www.globalcpr.org).



## 28 RECENT DEVELOPMENTS IN THE CHLOROGEN WEBSITE AND LINKS TO EU INITIATIVES

**Steve Groom**

Plymouth Marine Laboratory, UK

The ChloroGEN web site is maintained and developed by PML on behalf of the ChloroGEN project in support of GEO SB-01 Oceans and Society: Blue Planet, C2 Operational Systems for Monitoring of Marine and Coastal Ecosystems.

The website has recently undergone some changes in terms of look and feel and content. Of particular note has been the establishment of a ChloroGEN-Lakes portal that provided access to full resolution (300m) products from the ESA Medium Resolution Imaging Spectrometer (MERIS) instrument on the Envisat spacecraft. This was done as an “end to end demonstrator” in support of the GEO WA-01 Integrated Water Information (incl. Floods and Droughts), C4 Global Water Quality Products and Services that explicitly mentions expansion of ChloroGEN to lakes. The demonstrator included example lakes in all continents with a focus on lakes where in situ observations are available. Unfortunately contact was lost with Envisat on 8 April since when there have been no images. NASA MODIS 500m products have been produced for some regions and provide limited lake water colour capability.

ChloroGEN has also been supported through a number of European projects. The African component of ChloroGEN has been maintained and expanded through the Europe Africa Marine EO Network (EAMNet) project, part financed by the EC. ChloroGEN is also being used as a test case in a number of projects investigating web based visualisation and data integration using open standards approaches.

This presentation will show the ChloroGEN website, the ChloroGEN-Lakes portal and some of the web-based visualisation demonstrations.

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## 29 EARTH OBSERVATION DATA FOR MARINE CONSERVATION

**Gurney, L.J., Derycke, P., Skoien J., Hoepffner, N., Dubois, G.**

Joint Research Centre, European Commission, Italy

While the application of earth observation data for marine resource and fisheries management has been growing over the past decade, its application to marine conservation issues has been limited. As part of the Biodiversity and Protected Areas Management Program (BIOPAMA) project the Joint Research Centre of the European Commission is extending the development of the Digital Observatory for Protected Areas (DOPA) platform to provide scientific data to serve the conservation community. The project is focused on ACP regions (Africa, Caribbean and the Pacific) with an important capacity building element provided by the International Union for the Conservation of Nature (IUCN). Following the assessment of the needs of end users (at national, regional and local scales), products are being generated to address specific needs with a focus on EO derivatives. With the push to expand the areas under protection globally for the marine habitat from what is currently conserved (less than 3% to 10%) as outlined in Target 11 of the Convention of Biological Diversity, tools which can be used to identify relevant habitats for conservation are in need. With their extensive spatial and temporal coverage satellite remote sensing products provide such data and with appropriate processing can provide useful products by identifying habitats through characterising the environment and providing an assessment of what is conserved as well as the connectivity between such habitats. In addition, identifying ecologically and biologically significant areas (EBSAs), for example high productivity zones/frontal features and linking such features to distribution of protected species. Both applications can be used to highlight areas to be considered to achieve marine resource management objectives. The application of such products are already widely used for exploitation of fisheries resources and such tools can (and should) be applied to achieve conservation goals. As part of the BIOPAMA project, we would like to provide a demonstration of the tools under construction for this initiative.

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## 30 THE GODAE OCEANVIEW TASK TEAMS FOR COASTAL OCEAN SHELF-SEAS (COSS) AND MARINE ECOSYSTEM PREDICTION (MEP)

**Fabrice Hernandez**

IRD / Mercator Océan, France

The GODAE Ocean View (GOV) panel gathers both academic and operational groups focusing on ocean forecasting capabilities, and the ways to build and improve it. The enhancement of the observing, modelling, and end-to-end service capacity are key issues, together with the sustainability concerns, with strong similarities with GEO work plan and targets. The GOV science team is driven by task teams, in particular for the Coastal Ocean Shelf Seas (COSS) and the Marine Ecosystem Prediction (MEP) issues.

The COSS-TT deals with support of multidisciplinary analysis and forecasting of the coastal transition zone, as well as shelf/open ocean exchanges in relation with the larger-scale efforts. Promoting the use of coastal ocean forecasting systems and for coastal applications in a wider community; discuss and foster integration of the varied routine sources of information in coastal ocean forecasting system, like satellite observations, coastal observing systems in terms of science and technology; discuss the key physical and biogeochemical processes which have the greatest impact on modeling and forecasting quality and their utility for applications; discuss and promote state-of-the-art methodology such as two-way coupling, unstructured-grid modeling, downscaling, data assimilation, or array design.

The MEP-TT focuses on the integration of new models and assimilation components into operational systems for ocean biogeochemistry and marine ecosystem monitoring. In order to bridge the gap between the current status of the GODAE OceanView capabilities and new applications in areas such as fisheries management, marine pollution, water quality and carbon cycle monitoring. It has been set up with the goal to define, promote and coordinate actions between developers of operational systems and ecosystem modelling experts, in close connection with IMBER. A work plan from 2010 to 2013 with an assessment/inventory phase, an improvement of tools phase, and a development phase is carried on. Outcomes such as the downscaling from global to regional systems, by provision of biogeochemical boundary conditions and the further development of 2-way biogeochemical coupling in models in order to include and assess bio-physical feedbacks ; and the identification of the essential sets of physical and biogeochemical observations required to constrain the coupled models, with key application like CO<sub>2</sub> monitoring, HABS and fish management are expected.

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## 31 GLOBAL OBSERVATORY OF LAKE RESPONSES TO ENVIRONMENTAL CHANGE (GLOBOLAKES) PROJECT

**Hunter P.D.<sup>1</sup>, Tyler, A.N.<sup>1</sup>, Groom, S.<sup>2</sup>, Dall’Olmo, G.<sup>2</sup>, Tilstone, S.<sup>2</sup>,  
Martinez-Vicente, V.<sup>2</sup>, Merchant, C.M.<sup>3</sup>, MacCallum, S.<sup>3</sup>, Cutler,  
M.<sup>4</sup>, Rowan, J.<sup>4</sup>, Dawson, T.<sup>4</sup>, Maberley, S.C.<sup>5</sup>, Carvalho, L.<sup>6</sup>, Elliot,  
J.A.<sup>6</sup>, Thackery, S.<sup>6</sup>, Miller, C.A.<sup>7</sup> and Scott. E.M.<sup>7</sup>**

<sup>1</sup>University of Stirling, UK; <sup>2</sup>Plymouth Marine Laboratory, UK; <sup>3</sup>University of Edinburgh, UK; <sup>4</sup>University of Dundee, UK; <sup>5</sup>Centre for Ecology and Hydrology, UK; <sup>6</sup>University of Glasgow, UK.

The world’s freshwater ecosystems are vital components of the global biosphere, yet are vulnerable to climate and other human-induced change. There is increasing recognition that lakes play an important role in global biogeochemical cycling and provide key ecosystem services. However, our understanding of how lakes respond to environmental change at a global scale, and how this impacts on their status and function, is hampered by limited information on their chemical, physical and ecological condition. There are estimated to be some 304 million lakes globally, of which over 17,000 are greater than 10 km<sup>2</sup> in surface area. These sheer numbers have militated against the systematic study of lake ecosystems.

GloboLakes is a five-year research programme investigating the state of lakes and their response to climatic and other environmental drivers of change through the realisation of a near-real time satellite based observatory with archive data processing to produce a 20-year time series of observed ecological parameters and lake temperature for over 1000 lakes globally. This will be supported by linked auxiliary data on catchment land-use and meteorological forcing. The ability to monitor a large number of lakes consistently at high frequency and globally will facilitate a paradigm shift in our understanding of how lakes respond to environmental change at different spatial and temporal scales. This talk will introduce the GloboLakes project and outline its scientific ambitions for the next 5 years.

## 32 GOOS-RELATED OCEAN OBSERVATION FOR UNDERSTANDING THE PRESENT AND FUTURE STATUS OF CLIMATE

**Takeshi Kawano**

Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan

Climate change is a serious threat to humans/the Earth's environment, which an urgent measure should be taken against. Global observation of the Earth plays a key role to plan adaptation and mitigation strategies for climate change since it provides fundamental information on the status of the Earth.

JAMSTEC has conducted ship-based repeat hydrographic observation since 1999, reoccupying World Ocean Circulation Experiment (WOCE) Hydrographic Program (WHP) lines mainly in the Pacific Ocean. JAMSTEC is one of major contributors to the International Argo Project deploying approximately 1000 floats for 10 years and running Pacific Argo Regional Center (PARC), which is responsible for quality control and distribution of data in the Pacific region. Also, JAMSTEC has conducted moored buoy observation and been involved in development of tropical moored buoy arrays for monitoring air-sea interaction in the tropical Pacific and Indian Oceans.

The collected observation data are quality-controlled, disseminated to the public and used not only for scientific researches but also for societal purposes such as weather forecast. While continuing in-situ ocean observations, JAMSTEC encourages enhancement of international networks and frameworks for global ocean monitoring and data dissemination.

Through its GCOS/GOOS-related observation and research activities, JAMSTEC has contributed to further understandings of the status of the ocean and the mechanism of climate change and to achievement of GEOSS tasks.

### 33 LONG-TERM OCEANOGRAPHIC MEASUREMENTS: AN OVERVIEW

**Alexandra Kraberg, Karen Helen Wiltshire, Angela Schäfer**

Alfred Wegener Institute for Polar and Marine Research, Biological Station Helgoland, Germany

Time series measurements are a key tool in the detection of long-term changes in the physico-chemical environment and concomitant changes in marine communities. As such they, indirectly, also make a major contribution, towards the management of marine/coastal ecosystem services. In the context of this talk we define time series as any regular, sustained observations, which facilitate the observation of long-term trends. These include not only station-based, long-term point measurements, but also observations from devices onboard ships, floats, satellite data etc.

While all these sources, in their totality, provide enormous potential for the identification and understanding of processes in the marine environment, their management is extremely complex. Different data sources have different formats and often very complex metadata and sometimes different quality control mechanisms. In this presentation we will, using the range of time series resources at the Alfred Wegener Institute, review the types of data available and describe the tools at hand to facilitate their management and analysis. Particularly we will introduce the newly emerging project MaNIDA which aims to create a portal to access and mine information from diverse federated e-infrastructures with an emphasis on national monitoring activities from onboard vessels and stationary observatories. Quality controlled data and data products will be integrated and aggregated together with all other contextual information such as publications to facilitate meaningful, novel analyses of the aggregated data. With a further focus on quality control issues and the development on user support mechanisms the long-term availability of the resource is to be assured.

## 34 THE NF-POGO ALUMNI NETWORK - INTEGRATED OBSERVATIONS OF A CHANGING OCEAN

**Lilian Krug<sup>1</sup>, Sophie Seeyave<sup>2</sup>, Olga Shatova<sup>3</sup>**

<sup>1</sup>University of Algarve, Centre for Marine and Environmental Research, Portugal;<sup>2</sup>Plymouth Marine Laboratory;  
<sup>3</sup>Department of Marine Science, University of Otago, New Zealand

The Nippon Foundation-Partnership for Observation of the Global Oceans Alumni Network for Oceans (NANO) is a global network of NF-POGO scholars, associated professors and researchers that was established in October 2010. NANO aims to maximize the benefits to the alumni from the training they have received, to facilitate active contacts among the alumni and with the training faculty and to promote joint research activities that will build on the training. The NF-POGO training courses and main capacity building initiatives are: i) the Visiting Professorship, a programme where distinguished professors of renowned oceanographic institutes teach young scientists in developing countries; ii) the Centre of Excellence (CofE) in Observational Oceanography which allows scholars from developing countries to receive training from world-class scientists for ten months at the Bermuda Institute of Ocean Sciences and iii) the Regional CofE, where intensive short term training courses are conducted every year in conjunction with the Bermuda Centre of Excellence, at oceanographic institutes in developing countries.

Since 2004, more than 230 early career scientists have participated in one (or more) of the 13 courses held as part of the NF-POGO initiative. NANO network members currently include 150 alumni from 38 countries on 5 continents, as well as 40 top-ranked scientists that are known as NANO “Friends”.

In 2012, NANO launched four joint regional research projects funded by NF and supported by POGO. These regional projects are being undertaken in the Indian sub-Continent, South-East Asia, Latin America, and North-West Africa by alumni from different countries within these particular regions, and with support and advice from NANO Friends. The projects focus on regional monitoring of Harmful Algal Blooms, standardization of photosynthetic pigment analyses, and coastal chemical pollution and erosion issues, respectively.

NANO is held together by a common interest in, and commitment to, ocean science and by the common will to communicate scientific results to the general public. The network now has its own biannual newsletter, which can be downloaded from the NANO website. To learn more about NANO, please visit <[www.nf-pogo-alumni.org](http://www.nf-pogo-alumni.org)>.

## 35 GLOBAL MONITORING OF INLAND WATER QUALITY WITH REMOTE SENSING METHODS

**Tiit Kutser**

Estonian Marine Institute, University of Tartu, Estonia

Lakes are important drinking water as well as fisheries and recreation industry resource in many countries. Increased anthropogenic pressures and changing climate are causing deterioration of this resource. Recent studies show that lakes play very important role in the global carbon cycle yet they are completely ignored in carbon-climate models like those used by the IPCC. Monitoring lake water quality even in regional scale is immense task if only conventional in situ methods are used. Defining the true role of lakes in the global carbon cycle is unrealistic based on in situ sampling results. The presentation gives an overview what has been done in the field of lake remote sensing in order to monitor changes in water quality, what parameters can be mapped from space, what type of sensors are needed for lake remote sensing and what type of sensors will be available in near future. Aspects of global cooperation needed to solve the above mentioned problems will also be discussed.



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## 36 CAPACITY BUILDING FOR OCEANOGRAPHIC RESEARCH IN SRI LANKA – A PARTNERSHIP BETWEEN NARA AND UNIVERSITY OF NOTRE DAME

**I. Lozovatsky and H.J.S Fernando<sup>1</sup>, S.U.P. Jinadasa and Arulanansan  
Kanapathipilla<sup>2</sup>, Hemantha Wijisekera<sup>3</sup>**

<sup>1</sup>University of Notre Dame, USA <sup>2</sup> NARA, Sri Lanka <sup>3</sup> NRL, USA

The National Aquatic Resources Research and Development Agency (NARA) is conducting and coordinating marine research in Sri Lanka. It has established an around-the-clock Ocean Observation and Early Response Centre. However, lack experience on ocean studies and highly-trained personal has limited NARA's capacity to cater the needs Sri Lanka with regard to utilization of various marine resources. Understanding of coastal processes is imperative to minimize risks and impacts of ocean based natural hazards. Some of these disasters as well as fishery and hydrologic resources are predicted to be influenced by perceived climate change. The catastrophe of the December 2004 Tsunami could have been mitigated, if an adequate knowledge of tsunamis and an early warning system existed. Another issue is boundary currents around Sri Lanka, which are related to monsoon dynamic. Their characteristics and dynamics are poorly understood. The fresh/salt water exchanges between the Bay of Bengal and Arabian Sea and the resulting distribution of sea surface temperature and air-sea interaction play an important role on the prediction of monsoon onset and distribution of rainfall. Given the plethora of critical problems pivotal for southern Asia, NARA is poised to be a regional Centre for Indian Ocean studies, and hence capacity building of NARA will have pervasive impacts on regional and international science. University of Notre Dame (UND, USA) has partnered with NARA to help its capacity build through a collaborative program. Funding from internal and external sources are sought to steer the program into a true partnership between US and Sri Lanka institutions. UND has experience in oceanographic and atmospheric research, and is currently conducting studies in China Seas and Atlantic Ocean, with special focus on mesoscale and small-scale ocean processes. Several critical issues related to the Indian Ocean oceanography and climatology has been identified for initial work, focusing on canyon flows, boundary currents and air sea interactions. Exchange visits between UND and NARA has begun, and these visits will soon encompass other US institutions.

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## 37 THE RISING OF THE SEA LEVEL IN THE ZONE COASTAL OF MADAGASCAR THROUGH DATA SATELLITE

**Noasilalaonomenjanahary Ambinintsoa Lucie**

Ministry of Environment and Forest, Madagascar

### **Background**

Madagascar is a big Island between the Indian Ocean and Mozambic Channel. Geographically and biologically isolated for millions of years, Madagascar is home to a vast array of plants and animals found nowhere else in the world, including an estimated 101 endemic mammals, 202 endemic amphibians, 130 endemic birds, 370 endemic reptiles, and approximately endemic vascular plants:

- Trees and bushes: 95% endemic
- Pteridophytes: 50% endemic
- Palm: 100% endemic
- Orchids: 95%

During 2008-2010, the number of the vascular endemic plants submitted in UICN is 1676.

### **State of the zone coastal of Madagascar**

Madagascar as a big Island in Indian Ocean is victim of the rising of the sea. The part west of Madagascar is touched. Many kilometers of the west parts of the zone coastal are already in the sea now. This region named "Menabe". It's a region in the west of Madagascar.

### **The content of the Poster**

We want to show in the Poster the impact of the rising of the sea in this west region of Madagascar, such as:

- The coastal zone of Madagascar through data satellite (map Madagascar)
- 2 coastal zones touched, in the part west through data satellite (map region)
- Some photos in these zones (biodiversity, populations, urban)
- Story of Madagascar in GEO and GEO in Madagascar
- Big points of the Project MADEOS – MADagascar Earth Observation System.

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## 38 IMPORTANCE OF TIME SERIES STUDIES IN OCEANOGRAPHY: EXAMPLE OF THE LATIN-AMERICAN ANTARES NETWORK

**V. Lutz and R. Negri**

Instituto Nacional de Investigación y Desarrollo Pesquero, Argentina

Physical-chemical and biological processes in the ocean occur at a wide range of spatial (millimeters to hundreds of kilometers) and temporal (seconds to decades and beyond) scales. Apart from the natural cycles anthropogenic effects are undeniable, and are affecting the marine biota including fisheries. Phytoplankton, because of their short generation time, are the most vulnerable to variations in the environment acting as sentinels. To follow variations in biomass and structure of the phytoplankton communities long term observations are required. Even more, to monitor these changes at regional or global scale, the concerted effort from different countries is necessary. Hence, the importance of networks of time series studies in the ocean.

Satellite estimations are invaluable in the collection of data at high spatial and temporal scales. Nevertheless, these data need to be validated with high quality field measurements. Besides, satellites only see the surface of the ocean; and furthermore, some relevant properties, such as bio-diversity and physiological rates, cannot be acquired through remote sensing. The best choice consists in a synergy between satellite and in situ observations.

The Antares Latin-American network ([www.antares.ws](http://www.antares.ws)) of coastal time series, now part of the 'Chlorophyll Globally Integrated Network' ([www.chlorogin.org](http://www.chlorogin.org)), was created following that concept. It involves the development of in situ and satellite observations, as well as capacity building. In situ observations of several physical, chemical and biological variables are carried out in 8 countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru and Venezuela). Each station runs its own self-financed project, but a core set of sea surface temperature (SST) and chlorophyll-a data are shared. The network includes among its members advisors from Canada and USA. A system to process and distribute high resolution (MODIS, NASA) satellite information for the areas of the in situ stations was developed by IMARS (USF, USA). Integrated outcomes from the network involve several specialized training courses, and a work in progress joining information of SST and chlorophyll-a from all the centers to evaluate possible trends in these properties at the different biogeochemical provinces represented. Advancements and challenges of carrying out time series observations in Latin-America will be discussed.

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## 39 ABUNDANCE OF SKIPJAK AND YELLOWFIN TUNA SPECIES IN RELATION TO REMOTELY SENSED OCEAN COLOUR AND SST IN SRI LANKAN WATERS

**E.T.S. Madhubhashini<sup>1</sup>, K.K.A.S. Yapa<sup>2</sup>, N. Alahakoon<sup>1</sup> and P.B.T.P.  
Kumara<sup>1</sup>**

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The two most dominant tuna species in Sri Lankan waters are Skipjak and Yellowfin tuna. MODIS aqua data and fish catch data for 2006 are studied to find possible relationships between the oceanographic parameters and fish abundance of the two species. The waters around the island are divided into four regions for convenience and remotely sensed oceanographic parameters, chlorophyll a and SST are studied against available gill net and long line fishing data of the two species within Sri Lanka EEZ in the south west monsoon period.

CPUE (catch per unit effort) for Skipjak tuna is found to be significantly high in the months of July and August in the northwestern and southern ocean regions and that for Yellowfin is lesser in magnitude and does not show a significant monthly variability. Mean chlorophyll a values in the areas with high abundance of Skipjak tuna are found to be in the range  $0.2 - 0.8 \text{ mg m}^{-3}$  with mean SST in the range  $25^\circ\text{C} - 28^\circ\text{C}$ . Yellowfin tuna is found to be abundant in regions with much lower mean chlorophyll a values ( $0.1 - 0.3 \text{ mg m}^{-3}$ ) with mean SST in the range  $27^\circ\text{C} - 30^\circ\text{C}$ .

## 40 REMOTE SENSING APPLICATIONS FOR FISHERIES MANAGEMENT – AN INDIAN PERSPECTIVE

**Meenakumari.B.<sup>1</sup> and Madhu.V.R.<sup>2</sup>**

<sup>1</sup>Indian Council of Agricultural Research, New Delhi; <sup>2</sup>Central Institute of Fisheries Technology, Cochin

Fisheries world over is under increasing pressure with factors related to unsustainable fishing methods, over capacity, pollution, habitat degradation and issues related to climate change. FAO (2010) has reported that nearly 80

In the Indian scenario, the application of remote sensing in fisheries was given much boost after the launch of IRS P4 (Oceansat 1) and wide range of applications related to fisheries were carried out during this period. The development of Potential Fishing Zones (PFZ) using remotely sensed ocean colour and sea surface temperature and identifying using features like thermal boundaries, eddies, rings, gyres and upwelling zones, was the major outcome related to fisheries. This information is now regularly disseminated to fishermen by Indian National Centre for Ocean Information Services (INCOIS). The role of remote sensing for monitoring the extent of mangroves and coral reefs is reported along the Indian coast (Nayak and Bhauguna, 2001). Harmful algal blooms were detected along the Indian coast using sensor specific algorithms (Sarangi et al., 2004) and factors like the rolling chlorophyll anomaly, bloom index and sea surface temperature is used to derive information on harmful algae and advisories are provided in near real time along the Indian coast under the ChloroGIN-IO project.

Significant advances have been made by India to utilize remote sensing data for management of fisheries. Research is now oriented towards species specific forecasts by studying the habitat preference of the species and utilization of remotely sensed data for estimation of stocks is expected to significantly improve the accuracy of the forecasts. Delineation of the coast into zones depending on the environmental factors using remote sensing and GIS will help in predicting areas for conservation and sustainable fishing. Some work has been already carried out to identify areas suitable for shrimp farming. With increasing efforts given to the development of mariculture, maps derived using remotely sensed data and concurrent use of Geographical Information system, which can predict potential areas for cage culture, will be important for further adoption and development of mariculture along the Indian coast. The development of ChloroGIN-IO with facilities for automatic data processing and dissemination in near real time, will greatly help in utilization of remote sensing data in the Indian context. Location specific algorithms for the coastal waters are now being attempted which will significantly enhance the predictive power, accuracy and the utility of remote sensing.

## 41 THE PIRATA RESEARCH ARRAY OF MOORED BUOYS OVER THE TROPICAL ATLANTIC

**Paulo Nobre**

National Institute for Space Research-INPE, Brazil

The PIRATA research array of moored buoys over the Tropical Atlantic coordination and results will be presented. The PIRATA array represents an example of international and national coordination to establish and maintain a basin wide ocean monitoring system in support of ocean and climate sciences and products. The talk covers the mechanisms in place for sustaining the PIRATA array and impacts of the PIRATA real time data sets freely available on the internet on supporting the development of both operational products and research articles about the Atlantic Ocean functioning and its impacts on climate variability over South America and Africa.

**42** BEYOND CHLOROPHYLL FOR PHYTOPLANKTON PHENOLOGY  
AT EPEA TIME-SERIES STATION (38°28'S - 57°41'W  
ARGENTINE SEA -SWAO). A BASELINE STUDY FROM 2000  
TO 2010

**Rubén Negri, Ricardo Silva and Vivian Lutz**

Instituto Nacional de Investigación y Desarrollo Pesquero, Argentina

Variations in the structure of the phytoplankton community were studied together with changes in the chlorophyll-a concentration, in situ and satellite, at the coastal station EPEA, part of the Antares network. Chlorophyll-a (chl<sub>a</sub>) was determined using the fluorometric method, and satellite data from the Antares site ([www.antares.ws](http://www.antares.ws)). Micro-, nano- and ultra-phytoplankton were studied by sedimentation and epifluorescence. Chl<sub>a</sub> did not show a clear seasonality, with values rarely above 2 mg m<sup>-3</sup> (with averages of 1.09 and 1.10 for in situ and satellite respectively), but with some maxima in winter and spring, and a secondary maximum at end of summer.

During winters of 2003, 2004, 2010 microplanktonic diatoms dominated, and the most common species were of the genera: *Guinardia*, *Pseudo-nitzschia* and *Rhizosolenia*; while in 2001, 2002, 2005, 2007 and 2009 nanoplanktonic diatoms of the genera *Leptocylindrus*, *Chaetoceros*, *Asteromphallus* and centric (10 m) were predominant. Within the ultraplankton, although without reaching high concentrations, the most abundant components were cryptophyta, *Skeletonema menzeli* and *Gephyrocapsa oceanica*. Among the winters the year 2000 showed the highest Chl<sub>a</sub> (also the highest for that year) and most of the biomass was composed of the giant diatom *Coscinodiscus wailesii*.

The spring period was more variable, though in general, dinoflagellates and microplanktonic diatoms, mainly of the genera *Ceratium*, *Prorocentrum*, *Guinardia*, *Pseudo-nitzschia* and *Thalassiosira* (musilageous colonies) were in high concentrations. In 2000 and 2004 nanoplanktonic forms were abundant such as *Eutreptiella* and *Dactyliosolen*. 2005 and 2008 showed the highest Chl<sub>a</sub> with particular communities dominated by *Prymnesium* sp. in 2005 and by a diversity of species- where a nanoplanktonic chain-forming *Thalassiosira*, *Emiliana huxleyi* and picoplanktonic coccal forms were abundant- in 2008.

These results show that, although satellite Chl<sub>a</sub> is an important indicator of spatio-temporal variations of biomass, it misses relevant information regarding the variability and richness in phytoplankton sizes and phylogenetic groups, each one having different implications in the pelagic ecosystem.

## 43 OPERATIONAL OCEANOGRAPHY AND ECOSYSTEMS-BASED MANAGEMENT AT FISHERIES AND OCEANS CANADA

**Michael Ott**

Fisheries and Oceans Canada, Canada

In recent years, Fisheries and Oceans Canada (DFO) has been moving toward an ecosystem-based approach to fisheries and habitat management, and to the science underpinning it. The importance of observations, data management, science, modeling, and dissemination in providing timely, accurate, and value-added oceanographic products and services to inform decision-makers has highlighted the need to define the role of operational oceanography at DFO. Scientists at DFO have developed many of the tools and products required, and a national framework for operational oceanography is being developed to coordinate and formalize the delivery of these products and the resulting advice across Canada. This framework will build on our collaborations with other government departments and outside agencies, particularly Environment Canada, National Defence, and the Canadian Space Agency. In addition, client input at all stages of the operational oceanography development cycle will be critical to ensure an efficient and effective ecosystem-based management system responsive to the needs of all Canadians. While challenges remain, particularly in the increasingly accessible Arctic, several advances in operational oceanography are poised to move ecosystem-based ocean management into a new and more established position.



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## 44 THE OCEAN RESEARCH COORDINATION NETWORK – INTERDISCIPLINARY COLLABORATION

**Jay Pearlman**

IEEE, US

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

A National Science Foundation-funded Research Coordination Network is addressing approaches for improving interdisciplinary research capabilities in the ocean sciences. This includes a range of topics:

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

The initial focus areas for the RCN are open data access and outreach/capacity building. There has been a significant trend toward free and open access to data in the last few years. At the GEO Summit in Cape Town, South Africa 2007, the US announced that Landsat data would be available at no charge. The Chinese and Brazilian offered CBERS (satellite) data to Africa at no cost. GMES Sentinel system subsequently offered similar opportunities. Float data from the US (NDBC), JCOMM and OceanSites offer web-based access. The RCN considerations and reporting address these and other issues within the context of globalizing ocean observations and input to discussions that take place through GEO and other international organizations.

## 45 SCOPE AND PURPOSE OF THE “OCEANS AND SOCIETY: BLUE PLANET” TASK

**Trevor Platt**

Plymouth Marine Laboratory, United Kingdom

GEO is structured around a series of Societal Benefit Areas (SBA). There is no SBA that is devoted explicitly or exclusively to oceans. Although there was a considerable marine effort in GEO, it was distributed amongst various SBA, and there was a view that this body of work did not have the collective impact that it might have had. A new marine Task, "Oceans and Society: the Blue Planet" was initiated in 2012 to coordinate the marine elements of GEO and to develop synergies between them, where possible. The Blue Planet Symposium is the kick-off activity for this new Task.

## 46 SATELLITE RECORDS FOR OCEAN CLIMATE AND RELATED APPLICATIONS

**Shubha Sathyendranath<sup>1</sup>, Mark Dowell<sup>2</sup>, Diane Wickland and Trevor Platt<sup>1</sup>**

<sup>1</sup>Plymouth Marine Laboratory, United Kingdom; <sup>2</sup>Joint Research Centre, European Commission, Italy

The Global Climate Observing System has identified a suite of Essential Climate Variables (ECV) that have to be monitored on a routine basis, to meet requirements under the United Nations Framework Convention on Climate Change and to contribute to the reports of the Intergovernmental Panel on Climate Change. Many of the ECV are accessible to remote sensing via satellites, and various international initiatives are underway related to the use of satellite data for climate monitoring and related activities. The Climate Change Initiative (CCI) of the European Space Agency targets a number of ECV, of which four are related to the oceans: sea-surface temperature, ocean colour, sea level and sea ice. The concept of virtual constellations embraced by the Committee on Earth Observation Satellites (CEOS) includes three marine elements: ocean surface topography, ocean surface vector wind and ocean colour radiometry. Each virtual constellation, comprising of space and land-based observing elements, operating in a coordinated fashion, strives to serve the observational requirements of the Group on Earth Observations to meet societal needs. The Carbon Task Force of CEOS has commissioned a report on Carbon from Space that deals with the potential of space observations to monitor pools and fluxes of carbon in the ocean, land and atmospheric domains, in the context of climate change. Recently, CEOS has also established a Working Group on Climate, with the mandate to facilitate the implementation and exploitation of time series of ECV through coordination of existing activities. The presentation will provide an overview of these efforts, highlight links to other initiatives, and identify additional work where needed.

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## 47 CONTRIBUTION OF ZOOPLANKTON FECAL PELLETS TO THE DEEP OCEAN PARTICLE FLUX IN THE SARGASSO SEA ASSESSED USING QUANTITATIVE IMAGE ANALYSIS

**Shatova O., Kowek D., Conte M., Weber JC.**

Department of Marine Science, University of Otago, New Zealand

Zooplankton fecal pellets are an important part of the particle flux because they export carbon from the surface ocean and serve as a nutrient source to deep ocean ecosystems. We analyzed samples from the Oceanic Flux Program (OFP) sediment traps to assess the variability of fecal pellet flux in the Sargasso Sea. The OFP, located 75 kilometers southeast of Bermuda, has continually collected deep ocean particle flux since 1978 and is the longest running deep ocean sediment-trap time series in the world. We used quantitative digital microphotographs of the OFP samples (125-500 $\mu$ m fraction) to assess the contribution of fecal pellets to the mesopelagic particle flux. OFP data was analyzed in conjunction with physical oceanographic data from the Bermuda Testbed Mooring (BTM), and the Bermuda Atlantic Time Series (BATS) programs, that expounds the response of fecal pellet flux to mesoscale physical forcing of the upper ocean. Three mesoscale eddies passed the OFP area in 2007: a cyclonic eddy, a mode water eddy and an anticyclonic eddy. Fecal pellet flux was enhanced during the cyclonic and mode water eddies, but was not enhanced during the anticyclonic eddy despite indications of increased zooplankton biomass from ADCP backscatter intensity data. Fecal pellets size frequency distributions is well modeled by gamma-function, as well as the OFP total mass flux distributions. The fecal pellet size distribution at 1500m depth shows surprisingly little seasonal progression and little change during passage of any of the eddies. Fecal pellet size distribution data at 500m indicates greater sensitivity to mesoscale eddies than fecal pellet size distributional data from 1500m and 3200m. The size distributions are different at different depths which suggest reprocessing of sinking material in the water column by different zooplankton communities from those found in the upper ocean. Fecal pellets contributed 3-9% of total carbon flux, a minimum estimate since fragile fecal pellets disintegrate post-collection. Our work highlights the potential of quantitative digital image analysis for quantitative studies of marine particle flux.

## 48 FISHERIES APPLICATIONS OF REMOTE SENSING DATA: A FARO PERSPECTIVE

**Venetia Stuart**

Bedford Institute of Oceanography, Canada

The SAFARI project was established in 2007, following a request from GEO to facilitate the application of rapidly-evolving satellite technology to fisheries research and management questions. The program was initially funded by the Canadian Space Agency (CSA) for 3 years, after which the SAFARI and ChloroGIN programs were both supported by CSA under the umbrella FARO (Fisheries Applications of Remotely-Sensed Ocean Colour). Satellite ocean colour radiometry is ideal for fisheries applications, because it is the only means of obtaining biological measurements from space. Aspects of fisheries that may benefit from the use of such satellite data include harvesting, stock assessment and management: an overview will be given of various applications that use remote sensing data in these three areas, and a number of case studies for commercial as well as protected marine species will be reviewed. For fisheries (and other) applications it is essential to maintain an uninterrupted stream of well-calibrated, climate quality, ocean-colour data (i.e. Climate Data Records), in order to assess the impact of climate change and variability on marine ecosystems. Ocean colour products, calibration methods and algorithms thus need to be evaluated and inter-compared to maintain quality; this will be the focus of an International Ocean Colour Science meeting to be held in Germany in 2013. The long-term continuity of the ocean colour data stream is being addressed through the CEOS Ocean Colour Radiometry-Virtual Constellation to ensure no future gaps in data continuity.

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## 49 POGO CAPACITY BUILDING

**Sophie Seeyave, Trevor Platt, and Shubha Sathyendranath**

Plymouth Marine Laboratory, United Kingdom

Since its early days, the Partnership for Observation of the Global Oceans (POGO) has strongly emphasized training and education as a central part of its agenda. As a result of its São Paulo declaration of 2001, which drew attention to the world imbalance between Northern and Southern Hemispheres in the capacity to observe the oceans, POGO set up training initiatives for scientists from developing countries. These have, over the years, grown into a comprehensive and renowned capacity building programme, intended primarily for scholars from developing countries. This includes:

The Nippon Foundation-POGO Centre of Excellence in Observational Oceanography, under which ten scientists from developing countries, annually, are supported to study for ten months in an intensive programme related to ocean observations.

The POGO-SCOR Fellowship Programme, annually, under which scientists from developing countries can spend up to three months training in a major oceanographic institution.

The POGO-AMT Fellowship Programme, under which one scientist annually can participate in a major oceanographic cruise, and experience cruise preparation and data analysis.

The POGO Visiting Professor Programme, under which one senior scientist, annually, visits a developing country to conduct training.

The POGO-UCT Bursary Programme under which one African graduate student, annually, is supported to study at the University of Cape Town.

Travel support for participants from developing countries attending Austral Summer Institute courses at the University of Concepcion, Chile.

Some 450 young scientists from 63 countries have received advanced training through POGO capacity-building initiatives, while the massive over-subscription for POGO training schemes provides ample proof that the effort is responding to a genuine need. Since 2010, POGO has been developing a Network of Alumni trained under the joint Nippon Foundation-POGO programmes. The aims of the Network are to maximise the benefits to the alumni from the training they have received; to facilitate active contacts among the alumni and with the training faculty; and to promote joint research activities that will build on the training. The Network comprises over 150 members, has a website and biannual newsletter, and launched, in 2012, four collaborative, regional research projects conducted by the alumni.

## 50 THE GLOBAL OCEAN FORECASTING INITIATIVE (GODAE OCEANVIEW)

**Clemente A. S. Tanajura and the GODAE OceanView Science Team**

Federal University of Bahia, Brazil

The goals and structure of the GODAE OceanView Project will be presented along with a general view of their operational ocean forecasting systems. Today GODAE OceanView systems also include regional domains resolved with very high resolution. Efforts in the development of ocean data assimilation methods as well as applications will be shown, such as sensitivity studies of the ocean analysis to investigate the relative importance of in situ data and remote sensing data.

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## 51 APPLICATION THE EARTH OBSERVATION FOR MONITORING OF COASTAL MARINE ECOSYSTEMS IN VIETNAM

**Hoang Cong Tin, Tong Phuoc Hoang Son**

Curtin University of Technology, Australia

Applications the earth observation in coastal habitat mapping have been becoming essential techniques for evaluating and monitoring of coastal marine ecosystems. The Advanced Land Observing Satellite (ALOS-AVNIR2) data has been applied in monitoring the exist distribution of seagrass meadows, mangroves and agriculture ecosystems. Huong Phong commune belonging to Huong Tra district, Thua Thien Hue province, Vietnam was selected as a pilot site for this study. Through analysis of survey and earth observation data, seagrass meadows, mangroves and agriculture ecosystems were mapped. In particular, these coastal ecosystems were mapped for the first time in Huong Phong commune. The results showed that the total area of seagrass distribution was estimated to be 76.79 hectares, 11.55 hectares mangrove flora and agriculture ecosystems were also evaluated. Regarding spatial distribution, there are three main areas along the coast: Te Island, Sao Island, and Van Quoc Dong.

The data on spatial distribution, qualitative and quantitative characteristics of coastal ecosystems can be considered as fundamental and essential information for the planning, policy making on sustainable developing and utilizing these coastal marine ecosystems under impacts of economic developing and natural disaster pressures.



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## 52 INTEGRATION OF IN-SITU TIME-SERIES DATA AND OCEAN COLOR REMOTE SENSING TO ESTIMATE PRIMARY PRODUCTION AND PHOTOSYNTHETIC PARAMETERS IN THE SARGASSO SEA

**Hoang C. Tin, Michael W. Lomas, Tong P. H. Son, Joji Ishizaka**

Curtin University of Technology, Australia

Estimation of primary production from satellites on both region and global scales is one of the most important goals of international ocean color remote sensing programs. This paper presents data on both surface and vertical distribution phytoplankton biomass, and measured parameters of photosynthetic-irradiance (P-E) curve, which were used to estimate integrated spring season primary production in the Sargasso Sea from 2004-2009. Surface chlorophyll (Chl-a) concentrations in the Sargasso Sea are low but display strong seasonal variations. Satellite and in-situ measurements of Chl-a were well correlated. Underwater light transmission was modeled using a shifted Gaussian model from 69 vertical Chl-a profiles which were collected in the Sargasso Sea. P-E curve parameters were experimentally determined; the maximum photosynthetic rate,  $P_m^B$  ranged from 1.51 to 3.05 ( $\text{mgC mgChl-a}^{-1} \text{h}^{-1}$ ) and the maximum light utilization coefficient,  $\frac{P_m^B}{B}$ , ranged from 0.017 to 0.806 ( $\text{mgC mgChl-a-1Wm-2-1 h-1}$ ). Using these and previously published P-E curve parameters, water-column integrated primary production during the spring bloom season in the Sargasso Sea was estimated using a spectral non-uniform model. Most of the estimated primary production values from model agree well with in-situ observation data ( $\pm 20\%$ ) and there was strong variation over the year. The factors controlling P-E curve parameters, the impact of P-E curve parameters choice on modeling results and the relationship between chlorophyll biomass vertical structure and measured primary production are also discussed.

Thus, determined phytoplankton photosynthesis parameters and remotely-sensing estimated primary production in the low nutrient ocean gyres system such as Sargasso Sea is most essential which aim to understand how the ocean ecosystem responds to the variations of different climate change consequences.

## 53 INTERNATIONAL OCEAN DATA AND INFORMATION EXCHANGE. POLICY AND PRACTICE

**Ariel Hernán Troisi**

Servicio de Hidrografía Naval – Ministerio de Defensa, Argentina

Oceanographic observations are unique: they measure a particular parameter at a given location at a given time and thus can never be reproduced. Ocean data and information exchange is usually presented as a cross-cutting issue involving observations, operational activities as well as research, which reach beyond the tasks of a final data repository. It stands to reason then that almost immediately after the Intergovernmental Oceanographic Commission (IOC) was established within UNESCO in 1961, the International Oceanographic Data and Information Exchange (IODE) program was set up. In the following decades the challenge extended beyond managing large volumes of data, covering not only standards, formats and best practices but also the generation of data products and provision of services to a wider community. Technological developments changed the pace and methodologies, introducing new variables and concepts such as “interoperability”, as well as demanding clear and updated procedures and policies leading to a timely and appropriate access to data and information. The scenario is dynamic; today there are multiple data and information sources available, often requiring the services of data-miners.

## 54 CHALLENGES OF TRAINING AND CAPACITY DEVELOPMENT IN DATA AND MARINE INFORMATION MANAGEMENT IN THE XXIST CENTURY

**Ariel Hernán Troisi**

Servicio de Hidrografía Naval – Ministerio de Defensa, Argentina

Training and capacity development are key to ensure that all interested parties are enabled to participate equitably in observation and research activities, process and analyze data and respond to the needs and requirements of stakeholders. Increasing volumes of data, new data types and formats, data citation/publication, faster communications and requirements in real-time and near-real-time are just examples of the challenges data and information managers have to face on a daily base.

These same issues have become also part of the daily life of forecasters, climatologists and researchers, thus raising the need for data and information management training in academic and operational institutions.

A simple look-around of existing opportunities leads to knowledge-based systems of training courses developed to synthesize the data resources available from operational programs (including for example wind, wave, current, surface temperature, salinity and sea-ice datasets) allowing the assembly, synthesis and display in single software platforms. Furthermore, these courses help demonstrate the enhanced value of multiple observing systems.

Due attention is also given to marine information, ensuring availability and access to scientific e-literature.

Current information and communication technologies are providing new ways to implement these activities, although efforts are still needed to bridge the digital divide.

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## 55 ANTARES UBATUBA TIME SERIES: ANALYSIS OF RADIOMETRIC MEASUREMENTS

**Larissa Valério, Milton Kampel, Salvador Gaeta**

Brazilian National Institute for Space Research (INPE), Brazil

The present work takes part of an oceanographic time-series station (Antares-Ubatuba) located near the coast of Ubatuba (SP/Brazil), with data collected since July of 2006. The Antares project whose initial financial support was provided by IAI, is a regional network, inserted in the global ChloroGIN network and supported by the IOCCG and POGO, involving several countries of Latin America. The monthly time series aims the research of bio-optical and physical parameters with the objective to study long term changes in the coastal ecosystems around South America. Radiometric measurements are made, using two different hyperspectral instruments: the Fieldspec Hand Held (ASD Inc.), and the HyperPro II Profiler (Satlantic Inc.). The first one measures the radiance above water, and the second makes a depth profile of the radiance and irradiance underwater. Employing these two equipments to gather radiometric data, some differences may arise between the resulting surface remote sensing reflectance calculated. This work is a brief description of the procedures used to calculate the surface reflectance and a comparison between the data obtained from these different devices. The procedures follow the Ocean Optics NASA protocol volume III 2003 for radiometric measurements and data analysis. The comparisons are will be made via statistical analysis of the samples including the monthly stations from july July 2006 to July 2011 (5 years, 58 stations). Knowing the possible differences regarding the measurements of radiometric devices may help improve the data acquisition procedures and the quality of field information acquired.

## 56 DEVELOPING A GLOBAL CAPABILITY FOR PREDICTIVE HARMFUL ALGAL BLOOM MODELLING: DREAMS REALITIES

**Lourdes Velo-Suarez**

Woods Hole Oceanographic Institution, United States of America

Harmful Algal Blooms (HABs) cause severe economic and ecological damage in both marine and freshwater environments worldwide. Technological advances have expanded our capabilities not only to detect HABs but also to record how their physical-chemical-biological environment can modulate their population dynamics. However, despite our new observational instrumentation, we still do not completely understand HABs dynamics and we must rely on models to comprehend our data and predict HAB development. Many model approaches have been developed to describe or forecast HABs in the last decades. Such models can range in complexity from single conceptual models or simple analytic equations to very complex 3D numerical simulations. I will present an overview on the wide variety of models that have been used to understand HABs until now. Some examples will be evaluated to illustrate their applicability for specific situations. Advantages and disadvantages of the different approaches will be explored. Although some models have been proved to be very useful, many open questions need still to be resolved while health managers and monitoring organizations are pressing to know more than ever. Future progress in this field includes the integration of a multidisciplinary research community. I will try to highlight and discuss HAB modelling needs and challenges, pragmatic solutions and scientific understanding concerns.

## 57 US OFFICE OF NAVAL RESEARCH WORK ON COASTAL GEOSCIENCES IN THE GULF OF GUINEA

**Augustus Vogel**

Latin America and Sub-Saharan Africa Office of Naval Research Global, USA

In 2007, the Office of Naval Research began investing in the University of Ghana to develop research capability in coastal geosciences. This program was also supported by US Naval Forces Africa, and involved the development of coastal research team, deployment of a directional wave buoy, and establishment of remote sensing expertise in the Department of Marine and Fisheries Science. Since that time, the department has increasingly asserted itself as a national resource for decision makers in Ghana, as well as for regional programs. This presentation will discuss the history of the program, as well as next steps that are being undertaken by the Ghanaians to continue their work.

## 58 REQUIREMENTS FOR GLOBAL IMPLEMENTATION OF THE STRATEGIC PLAN FOR COASTAL GOOS, AND THE GEO GLOBAL HF RADAR TASK

**Zdenka Willis**

US IOOS Program Office, USA

The goal of the Strategic Plan for Coastal GOOS is to develop a plan for sustained provision of data and information to inform Ecosystem Based Approaches (EBAs) for managing human uses of coastal ecosystem goods and services and adapting to climate change. The Coastal GOOS plan will identify priority indicators of ecosystem states (health) to guide the requirements for coastal observing system. Addressing the Coastal GOOS plan priorities will require investments by developed nations in a coordinated global network of national and regional observing systems that are locally relevant and based on interoperable data and information exchange. The United States Integrated Ocean Observing System (IOOS®) is one program that is working to implement the Coastal GOOS by being a user-driven, coordinated network of people, organizations, and technology that generate and disseminate continuous data about our coastal waters, Great Lakes, and oceans supported by strong research and development activities. The United States has been working many years to transition its HF radar network to an operational system and has succeeded in moving from individual radars to a comprehensive national networked tied together through a common data architecture, set of practices and a national plan. Many other nations have begun to deploy HF radars and there is a tremendous amount of informal coordination and collaboration taking place. We believe that we can capitalize on this coordination by coming together more formally under GEO and accelerate the transition of operations of all HF radars through this effort.

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## 59 JAMSTEC CONTRIBUTION TO DATA COLLECTION

**Akiko Yamada**

Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

JAMSTEC plays a leading role not only in scientific observation and research but also in data dissemination.

JAMSTEC opens “Data Search Portal” site where all data collected by ship-based observations and various data products are made available. In collaboration with International Pacific Research Center of University of Hawaii in U.S. (IPRC) and The Commonwealth Scientific and Industrial Research Organisation in Australia (CSIRO), JAMSTEC established Pacific Argo Regional Center (PARC), which is responsible for validating all float data in the Pacific Ocean and deriving regional products based on the floats. All Argo floats data are collected to Global Data Archive Center (GDACs) and distributed within 24 hours of collection. The global tropical moored buoy array is a monitoring tool of ocean/atmosphere status developed and operated under multilateral cooperation. The data obtained by each buoy in the array are transmitted via satellite, processed in each organizations in accordance with the standard determined by the scientific panel of the array, and disseminated within a few days of quality control for real-time data and within one to two years of recovery of buoy for delayed mode data.



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## 60 PHYTOPLANKTON PHENOLOGY AS AN ECOLOGICAL INDICATOR FOR THE PELAGIC SYSTEM IN THE OCEAN

**Li Zhai<sup>1</sup>, Venetia Stuart<sup>1</sup>, Trevor Platt<sup>2</sup> and Shubha Sathyendranath<sup>2</sup>**

<sup>1</sup>Bedford Institute of Oceanography, Canada; <sup>2</sup>Plymouth Marine Laboratory, United Kingdom

Phytoplankton phenology is defined as the seasonal phytoplankton cycle, in which the dominant event is the Spring bloom. The inter-annual fluctuations in the phase of the cycle are important for the marine ecosystem. Phytoplankton phenology, as determined by ocean-colour radiometry, has proved to have a wide variety of applications, including fisheries management, the study of carbon cycles mediated by phytoplankton, and understanding the effect of phytoplankton on the heat budget of the upper ocean. However the time series record that can be recovered from remote sensing is still short (about 15 years). Because the phenology has a physical basis (onset of stratification), we can reconstruct through retrospective physical analyses, the onset of stratification and its relation to phytoplankton phenology, with a view to making both a longer record of phenology.

We show that inter-annual variability of spring blooms and phytoplankton community structure in the central North Atlantic Ocean can be reconstructed from satellite SST data and NAO index using a statistical model. The onset of the spring bloom occurred earlier in high NAO index years when fresh Arctic water was advected south by the strong Ekman transport, leading to enhanced stratification in the study area. The diatoms were more abundant when there was strong vertical mixing and enhanced nutrient supply to the surface, resulting from the positive NAO forcing. The extrapolated spring bloom timing showed later blooms in mid-1980s and earlier blooms in 1990s. The extended time series of phytoplankton community structure between 1985 and 2009 showed a decadal decreasing trend in diatoms and increasing trend in dinoflagellates.

The results of the retrospective phenology could be used for the development of knowledge-based marine ecosystem management, and could be used to develop an ecological partition of the waters off Eastern Canada for use in fisheries applications. For example, the timing of spring bloom has been shown to be an extremely important indicator for the survival of Haddock fish larvae, it influences the hatching times of Northern Shrimp, and is related to the breeding success of marine seabirds.

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