The conductivity, temperature, depth (CTD) rosette package deployed at the CARIACO station. The rosette is used to collect discrete water samples at different depths throughout the water column of the eastern Cariaco Basin (down to 1310 m).

(Photo credit: Jaimie Rojas)
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LOICZ in brief

LOICZ aims to provide science that contributes towards understanding the Earth system in order to inform, educate and contribute to the sustainability of the world’s coastal zone. LOICZ is a Core Project of the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimensions Programme on Global Environmental Change (IHDP). The LOICZ IPO is hosted by the Institute of Coastal Research at the Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research, which is part of the Helmholtz Association of National Research Centres. LOICZ research as outlined in the Science Plan and Implementation Strategy, SPIS, is organised around five themes:

- Vulnerability of coastal systems and hazards to society
- Implications of global change for coastal eco-systems and sustainable development
- Human influences on river-basin-coastal zone interaction
- Biogeochemical cycles of coastal and shelf waters
- Towards coastal system sustainability by managing land-ocean interactions

The Science Plan and Implementation Strategy is available electronically on the LOICZ website and in hard copy at the LOICZ IPO. As a temporary priority the project focuses on scientific hotspots of Earth system change, currently Arctic Coasts, Urbanized Coasts and Megacities, River Mouth Systems including Deltas and Estuaries and Islands.

This newsletter is also available online at www.loicz.org.
The CARIACO Ocean Time-Series program was established in the Cariaco Basin off the coast of Venezuela (10° 30’N, 64° 40’W; Figure 1) in November 1995 with support from the Venezuelan Fondo Nacional de Ciencia, Tecnología e Investigación (FONACIT) and the National Science Foundation (NSF). The fundamental scientific goal of the program is to understand the relationships between hydrography, community composition, primary production, microbial activity, terrigenous inputs, particle fluxes, and element cycling in the water column, and how variation in these processes are preserved in sediments accumulating in this anoxic basin. The program serves the ocean carbon and biogeochemistry, ocean ecology and biodiversity, and paleoclimate research communities by maintaining an ecosystem observation framework for the study of variability and trends bridging monthly to millennial time scales. The CARIACO time series allows ground-truthing of a variety of climate proxies and satellite observations (Black et al., 2011; Lorenzoni et al., 2011), and a refinement of ocean physics, chemistry, and ecological models. The program includes capacity building and outreach efforts in the US and internationally that focus on the relationships between ocean biogeochemistry, ecology, and a changing planet.

Since 1995, CARIACO has conducted over 200 core cruises, 35 sediment trap recovery-redeployment cruises, and 36
microbial-biogeochemistry process cruises. Additional cruises have addressed spatial and seasonal variability. The observations collected to date identify major gaps in current knowledge that specifically require a long time series of measurements. Here we summarize the major findings of this study.

The role of ocean carbon and biogeochemistry time series in a global climate observatory

It has been proposed that we are approaching a “state shift” in the global biosphere (Barnosky et al., 2012). Time series of ocean biogeochemistry and ecological observations play a critical role in documenting and evaluating mechanisms whereby marine ecosystems respond to even subtle changes in climate (Taylor et al., 2002; Chavez et al., 2003; Hoegh-Guldberg and Bruno, 2010; Le Quéré et al., 2010). We expect that changes in temperature, circulation, and ocean chemistry will lead to profound changes in top-down and bottom-up controls of marine ecosystems (Doney et al., 2009; Hofmann et al., 2011). However, identifying regime shifts and understanding causes of change in complex systems are difficult conceptual and statistical problems. Time-series studies already have clearly demonstrated interannual to decadal-scale variability in ocean biogeochemical processes (e.g. Muller-Karger et al., 2010; Lomas et al., 2010; Le Quéré et al., 2010; Chavez et al., 2011; Karl et al., 2012; Racault et al., 2012). The Intergovernmental Panel on Climate Change Fourth Assessment Report confirms that many environmental processes showed increased variability in the second half of the 20th century when compared to earlier instrumented records (IPCC, 2007).

Nonetheless, Spencer et al. (2012) and Henson et al. (2010) highlight the difficulties of detecting trends in marine ecosystems due to natural or human-induced climate change using the relatively short (10-20 years) in situ or satellite-based ocean biogeochemistry time series available today. Another significant problem with reconstructing longer historical ecological records is uneven data quality and inconsistencies in methods used by different studies over time. For example, an alarming decline in marine phytoplankton biomass of 1% per year in over 70% of the global ocean over the past century was inferred by Boyce et al. (2010), who mixed satellite imagery and century-long shipboard records of water clarity (Secchi depths). This interpretation was questioned because of biases between data derived from different methods (Mackas, 2011; Rykaczewski and Dunne, 2011; McQuatters-Gallop, 2011). The problem of misinterpretation of marine ecological observations has long been recognized (e.g. Karl and Dore, 2001). Ocean biogeochemistry time series, like CARIACO, were established to help avoid these issues and to develop elements of large-scale observatory programs (IMBER, 2005; POGO, 2012).

Studying ecosystem responses to climate change

The oceanographic community is actively engaged in studying the fundamental mechanisms by which climate change impacts nutrient, carbon, and oxygen fluxes in the ocean (e.g. Keeling and Garcia, 2002; Helly and Levin, 2004; Sarmiento et al., 2004; Muller-Karger et al., 2005; Diaz and Rosenberg, 2008; Jahnke, 2010; Cai et al., 2010). The Cariaco Basin is an important location to study such processes because of its wind-driven upwelling, high carbon and nutrient fluxes, hypoxia, anoxia, and preservation of climate signals in the sediment that reflect annual to millennial variations over the entire Atlantic Ocean (Redfield et al., 1963; Richards, 1975; Hughen et al. 1996a and b; Haug et al., 2003; Lea et al., 2003; Black et al., 2007; Muller-Karger et al., 2010; and many others). CARIACO also provides an opportunity for studying biogeochemical cycling under hypoxic and anoxic redox conditions that occur naturally and may develop in other regions (Stramma et al., 2010; Chan et al., 2008; Gilbert et al. 2010; Deutsch et al. 2011). Also of great interest is the impact of climate change and human activities on ecosystem biogeochemistry including the interaction between bottom-up (Frederiksen et al., 2006; Mozetiˇc et al., 2012) and top-down (Frank et al., 2005; Casinia et al., 2009) ecological forcing. Nearly two decades of Cariaco Basin study have advanced our understanding of the role of continental margins in ocean biogeochemical cycling and the particular importance of this basin for biogeochemistry, paleoclimate, and future climate scenario studies. A Web of Science search reveals that at least 286 papers have been published on the Cariaco Basin in the last 20 years, with 85% of these in just the last 10 years. Our joint Venezuela-U.S. program collects data on hydrography, meteorology, nutrient and carbonate chemistry, phyto- and bacterioplankton standing stocks, primary production, sinking and suspended particulate matter, bio-optical, and other biogeochemical parameters in the Cariaco Basin. Sampling frequency is at least monthly or better. In the early years (1995-1999) we expected and found the region to be subject to regular cycles of upwelling of nutrient-rich waters driven by seasonal intensification of the Trade Winds. Coastal winds are normally strongest from December through May and relax for the remainder of the year. The December-May upwelling supports ~70% of the annual net primary production (NPP). Most NPP occurs in the upper 60 m of the water column, where chlorophyll-α concentrations (Chl-α) have averaged 56 mg m⁻² during productive periods and less than ~27 mg m⁻² otherwise.

In 2000, we began to recognize that variations in many properties that we had previously thought to be “noise” were actually features of the seasonal cycle, such as a secondary upwelling peak related to major adjustments throughout the Caribbean in July-August (Muller-Karger et al., 2010). This process has implications for regional fisheries (Rueda-Roa, 2012). Substantial interannual variability and trends are, however, observed in many parameters (Taylor et al., 2012). The Trade Winds have weakened (~1.9% yr⁻¹) and so has upwelling intensification (Figure 2). By 2010, average annual sea surface temperature (SST) was 1.0°C higher than in 1995. Intensifying stratification and decreased upwelling were accompanied by declining Chl-α (∆Chl-α = -2.8±0.5% yr⁻¹) and NPP (∆NPP =
Phytoplankton taxon dominance shifted from diatoms, dinoflagellates, and coccolithophorids to smaller taxa (Mutshinda et al., 2013). N fixation rates have accelerated (Montes et al., 2013) and N* (defined as in Gruber and Sarmiento, 1997) has increased (Figure 2). Surface /CO$_2$ has increased (/CO$_2$sea = +2 ±0.47 μatm yr$^{-1}$) while decadal trends in salinity, pH, TCO$_3$, nTCO$_3$, TA and nTA are less apparent due to high seasonal and interannual variability (Astor et al., 2013). Mean zooplankton biomass in the upper 200 m has increased from <500 mg m$^{-3}$ (dry wt) in 2002-2005 to nearly 700 mg m$^{-3}$ in 2006-2011, consistent with an observed upward trend in the phaeo/Chl-a ratios (1.1% yr$^{-1}$).

The Spanish sardine (Sardinella aurita) fishery off NE Venezuela, which supplies >90% of the Caribbean small pelagic fish catch, decreased from >80,000 metric tons in 1988 to 40,000-60,000 metric tons yr$^{-1}$ between 1989 and 2004, and then to <15,000 metric tons yr$^{-1}$ since 2005 (Griffiths and Simpson, 1967; FAO Fisheries Global Information System, 2012; see Taylor et al., 2012). Based on the NOAA National Centers for Environmental Prediction (NCEP) meteorology reanalysis fields, we estimate that seasonal zonal and meridional excursions of the Intertropical Convergence Zone (ITCZ) have expanded since 1995, and the precipitation index over northern South America has increased (m = +0.04 mm yr$^{-1}$) (Taylor et al., 2012). Our results suggest a strengthening of the ITCZ and a northeasterly progression of the ITCZ center of action by over 600 km, which probably results from a poleward expansion of the atmospheric Hadley circulation. The Hadley process dominates the tropics, affecting the behavior of the ITCZ and of the North Atlantic Oscillation (NAO) (Quan et al., 2004).

We hypothesize that these large-scale climate changes drive the hydrographic, biogeochemical, and other ecological changes observed in the Cariaco Basin. They explain the weaker Trade Winds over the Cariaco Basin, weakened seasonal upwelling, and increased rainfall in the Caribbean Sea. Our observations are consistent with global wind surveys from 1991 to 2008, which show declining mean wind speeds and wave heights in the southern Caribbean (Young et al., 2011). These local changes reflect large-scale change. For example, Lee et al. (2011) hypothesized that the warming of the Atlantic Ocean over the past 50-70 years is due to an increase in the heat influx from the Indian Ocean. Häkkinen et al. (2011) found that this period experienced more frequent mid-latitude atmospheric blocking patterns, reduced intensity of the Westerlies, and a weakened ocean gyre.

Large-scale air-ocean interaction processes clearly affect ecosystem structure, function, and the carbon cycle in the Cariaco Basin. Yet to quantify the interaction between such complex larger-scale and regional oceanographic processes, to improve estimates of uncertainty in the trends, and to differentiate natural variability from human impact, repeated and frequent observations must be carried out over longer time periods.

Figure 2: Trends in (A) sea surface temperature (SST) and in SST annual minima (broken line), (B) mixed layer depth (MLD) and MLD annual maximum (broken line), (C) N$^*$ in the σ$_{θ}$ = 25.0-25.5 kg.m$^{-3}$ isopycnal layer (~0-100 m), (D) [Chl-a] and integrated PP (0-100 m). r and p-values are shown within solid and broken line boxes or colored text for the corresponding trendline. (E) Integrated diatom density (0-100 m) showing diatom abundance medians for 1996-2004 and 2005-2011.

Impact of ecosystem state changes on the settling flux of particulate matter

The CARIACO Ocean Time-Series also provides an ideal platform to study the fundamental biogeochemical and ecological processes that link the euphotic zone (upper 100 m), the twilight zone (100 to 300 m), and deeper remineralization and sedimentation processes as modified along an oxic/anoxic gradient. Data from drifting sediment traps deployed on 10 occasions between 2007 and 2009 at 50 and 100 m, together with that from our moored sediment trap at 150 m, show that vertical particulate organic C (POC), particulate N (PN), CaCO$_3$, and opal fluxes in the upper 100 m are an order of magnitude higher than at the oxic-anoxic interface (~250 m) (Montes et al., 2012). In the upper 100 m, the flux of biogenic particles is closely coupled with phytoplankton biomass and productivity. However, the relationship over time between surface Chl-a or NPP and fluxes below 200 m requires further

-1.5±0.3% yr$^{-1}$ (Figure 2). Phytoplankton taxon dominance shifted from diatoms, dinoflagellates, and coccolithophorids to smaller taxa (Mutshinda et al., 2013). N fixation rates have accelerated (Montes et al., 2013) and N$^*$ (defined as in Gruber and Sarmiento, 1997) has increased (Figure 2). Surface /CO$_2$ has increased (/CO$_2$sea = +2 ±0.47 μatm yr$^{-1}$) while decadal trends in salinity, pH, TCO$_3$, nTCO$_3$, TA and nTA are less apparent due to high seasonal and interannual variability (Astor et al., 2013). Mean zooplankton biomass in the upper 200 m has increased from <500 mg m$^{-3}$ (dry wt) in 2002-2005 to nearly 700 mg m$^{-3}$ in 2006-2011, consistent with an observed upward trend in the phaeo/Chl-a ratios (1.1% yr$^{-1}$).
examination. While Chl-α concentrations have been declining and phytoplankton have shifted to smaller taxa over the past decade, vertical fluxes have gradually increased. Sediment traps deployed near the oxic/anoxic interface (~225 m) measured POC fluxes varying from ~3 to 240 mgC m⁻² d⁻¹ between 1996 and 2010. During this period, POC fluxes to 225 m increased by 1.2 (± 0.5) mgC m⁻² d⁻¹ yr⁻¹ (~1% yr⁻¹). Total settling mass, PN, CaCO₃, and opal fluxes increased by 2.8 ± 0.9, 1.3 ± 0.5, 6.0 ± 0.8, 2.4 ± 0.6 % yr⁻¹, respectively. No long-term trends are apparent in terrigenous mineral fluxes or C/N ratios. At the Bermuda Atlantic Time-series Study (BATS) site, export fluxes also have accelerated over the same period (Lomas et al., 2010). Enhanced export fluxes coinciding with declines in diatoms and coccolithophores at the CARIACO and BATS sites are clearly inconsistent with the idea that plankton with heavy mineral frustules/tests preferentially drive vertical export (the “ballast theory”; Armstrong et al., 2002). Other observations from the equatorial Pacific Ocean, Arabian Sea, and Sargasso Sea have demonstrated that small cells contribute significantly to vertical fluxes by means of aggregation and consumption/egestion by zooplankton (Richardson and Jackson, 2007; Lomas and Moran, 2011). At this point we can only speculate that increased export rates at our site are due to variations in herbivory and higher aggregation frequencies. Both would be induced by shifts in community structure. Nevertheless, observations from station CARIACO and far-ranging biomes challenge Bopp et al.’s (2005) prediction that selection for smaller phytoplankton taxa by a warming ocean will lower carbon sequestration efficiency of the “biological carbon pump”.

The classical stoichiometry for marine particles (C:N:P=106:16:1) is based, in part, on work carried out in the Cariaco Basin (Redfield et al., 1963). While sinking particulate C/N ratios currently appear relatively constant with time, they do change significantly with depth. Sinking particles we collect at 150 m have Redfield-like ratios, but these increase with depth to 400 m due to the preferential removal of N and P relative to C. This is consistent with alkaline phosphatase and aminopeptidase release rates of PO₄³⁻ and amino acids measured in sinking and suspended materials in the basin (Taylor et al., 2009). The ratios remain relatively constant below 400 m, suggesting little selective removal of elements with remineralization in anoxic waters despite the loss of sinking particle mass. We also use other ratios to interpret ecosystem changes. Near-surface (75-100 m) dissolved Si:N of sinking particle mass. We also use other ratios to interpret ecosystem changes. Near-surface (75-100 m) dissolved Si:N ratios decrease but when terrigenous input is higher.

The oxic-anoxic interface and microbial dynamics

Large fluctuations also occur in properties in the transition between the oxic and anoxic subsurface ecosystems, such as the thickness of the suboxic zone (0 to 80 m) and the first depth with detectable H₂S (typically >250 m; Figure 3). Fluctuations in anoxic zone concentrations of dissolved iron and manganese are apparently associated with heavy rains and seem buffered by mineral precipitation in deep waters (Li et al. 2011). This is consistent with our observations of near-bottom plumes of terrigenous sediments on the shelf along the southern margin of the basin (Lorenzoni et al., 2012). Such large fluctuations in fundamental geochemical properties were not expected when CARIACO began. They reflect variations in the physical setting that influence local ecology. Monteiro et al. (2011) pointed out that coastal hypoxia in many systems is strongly affected by changes in oxygen levels in offshore water masses coupled with changes in circulation patterns. In the Cariaco Basin, this drives dramatic fluctuations in the depth of the O₂/H₂S interface. Astor et al. (2003) showed that intrusions of oxygenated Subtropical Underwater over the sill occurred several times per year in the early years of the series. Samodurov et al. (2013) show that these intrusions ceased after 2004. In 2011, we saw evidence of new intrusions (deep O₂ enrichments, PO₄³⁻ depletions, shifts in first appearance of H₂S), but we still don’t understand whether processes driving these also affect surface properties simultaneously. The transition in 2004 took place at the same time as the shift in phytoplankton composition and in other parameters (Figure 2).

Through time series observations we have established that these transitional waters (O₂/H₂S interface and redoxcline) support dynamic microbial communities, and these in turn significantly influence carbon and nutrient biogeochemical cycling. In addition to specialized Bacteria and Archaea, the redoxcline is enriched in viruses and unique assemblages of protozoa, many of which harbor symbiotic prokaryotes (Taylor et al., 2003; Lin et al. 2006, 2007, 2008; Edgcomb et al., 2011a,b; Orsi et al., 2011, 2012). Details of the roles of these parasites, predators and symbiotic associations in Basin biogeochemistry are poorly known.

We have also observed that total particulate phosphorus (TPP) is enriched within the redoxcline. Preliminary measurements suggest that this suspended particulate P is highly labile, relative to more detratal and authigenic P phases in waters above and below it. POC/PO₄ ratios decrease to <200 within the redoxcline, indicating material fresher than outside the redoxcline (POC/POP >300). This implies that microbial activity both increases fixed organic C (e.g., Taylor et al., 2001, Reintaler et al., 2010) and also influences P cycling in a manner that we have yet to fully comprehend. These observations suggest that in situ chemosynthetic production or POC advection supplement vertical carbon flux into this layer. Figure 3 illustrates chemical zonation and distributions of chemosynthetic activity across the oxic and anoxic por-
tions of the water column through which materials sink to the bottom. We now have substantial evidence that chemooautotrophs are active and abundant in the redoxcline. Chemooautotrophic bacterial production between 250 and 450 m (redoxcline) can be the same order of magnitude as euphotic zone NPP. Heterotrophic carbon demand here frequently exceeds POC delivered to this layer from above (Taylor et al., 2001, 2006). While we have balanced flux estimates of reductants and oxidants, we still don’t know or understand all measured biological demands (Li et al. 2012) or reaction pathways used by these chemooautotrophs. We have focused on H₂S and SO₄²⁻ consumption and formation of sulfur intermediates, and iron and manganese cycling. Thiosulfate and sulfate exhibit maxima near the interface and elemental sulfur appears to be rapidly cycled within the redoxcline (Figure 3; Li et al., 2010). We hypothesize that oxidation of reduced sulfur occurs at the expense of metal oxides and nitrate in anoxic waters and seek to study how these processes are linked and dependent on outside inputs. We also hypothesize that a cryptic sulfur cycle may be regenerating reduced S through sulfate reduction of organic matter (Canfield et al., 2010).

We have used terminal restriction fragment length polymorphism (T-RFLP) and fluorescent in situ hybridization (FISH) to vertically profile bacterial community structure among sites, and over time to resolve effects of redox and nutrient gradients, terrestrial inputs, and disturbance due to lateral intrusions (Lin et al., 2008). FISH studies of community structure revealed that α-, γ-, ε-proteobacteria and Archaea are more abundant across the redoxcline, where heightened chemooautotrophy occurs (Lin et al. 2006, 2007). Abundances of ε-proteobacteria and Archaea increase during incubations of redoxcline water with SO₄²⁻ or SO₃²⁻ additions. Preliminary TRFLP data from anoxic waters reveal organisms affiliated with Burkholderia, a methylo troph and possibly a methanotroph. The Cariaco Basin is rich in methane and has high methane oxidation rates below the interface (Ward et al. 1987; Kessler et al. 2005a,b), consistent with FISH distributions of β-proteobacteria. Examining vertical-temporal distributions of prokaryotic clades is important for understanding formation of various biomarkers. Continued observations will help quantify and explain relationships between biogeochemical processes and microbial community structure.

Climate proxy development and calibration
The above observations show the importance of CARIACO in the interpretation of the quantity and composition of particles settling to the bottom of the Basin, both for understanding impacts of climate change on the biological pump (Stemmann and Boss, 2012) as well as paleoclimate studies. Understanding and modeling future climate change relies heavily on our understanding of past rates and magnitudes of natural climate variability. Detecting climate-scale change requires high-quality records that span several decades to millennia (Sarmiento et al., 2004; Henson et al., 2010). The sediments of the Cariaco Basin are one of the few climate archives that can be used to study past climate changes occurring on annual to decadal time scales (Black et al., 2007, 2009, 2011). These sediments preserve an unparalleled, high resolution record of past climate, hydrography, and hydrology of the Atlantic Ocean and tropical regions of the Americas (Haug et al., 2001, 2003; Peterson et al., 2000; Peterson and Haug, 2006; Lea et al., 2003; Hughen et al., 2004). Long hydraulic residence times (Deuser, 1973) and decomposition of sinking organic material generated by high surface productivity (often > 1 gC m⁻² d⁻¹) within the Cariaco Basin induce anoxia below about 250 m. As a result, no macro-organisms disturb the seabed and an excellent, undisturbed sediment record is preserved in this natural sediment trap. We have conducted ecological studies of plankton groups to further understand proxies important in paleoclimate work (Tedesco and Thunell, 2003a,b). Numerous collaborations are underway to examine a wide range of climate proxies used to study paleotemperatures, terrigenous sediment sources, past changes in the hydrologic cycle (i.e., movements of the ITCZ), past redox and pH levels, and other processes. We have now directly validated recent climate signals, preserved in sediments deposited between 1995 and 2009 (Black et al., 2011). For example, the carbon isotopic composition of planktonic foraminifera captured in sediment traps and time-equivalent benthic sediment material record the identical rate of change in ¹³C associated with the oceanic uptake of anthropogenically-derived CO₂ (the Suess Effect; Figure 4). This example of validating sediment record proxies illustrates the value of the time series for creation of pre-instrumental climate records. We seek to now improve the accuracy of quantifying climate variations modulated by phenomena such as changes in the position of the ITCZ (Peterson and Haug, 2006; Chiang, 2009; Taylor et al., submitted).
anthropogenic CO₂. b) Mauna Loa annual average show a trend with identical slopes associated with the rise of
and symbols) and Cariaco Basin water pCO₂ (black line). Both
US, and other countries. The five Venezuelan institutions led
strong collaborations between scientists in Venezuela, the
The CARIACO Ocean Time-Series owes its success to the
inter-institutional and international collaboration, and teamwork
The basis for success: inter-institutional and internation-
fast climate signals, and those from other local areas. This is
primarily focused on ocean and land processes. They are bi-
from the CARIACO Basin, which is the site of the longest
is highly sensitive to changes in the Earth’s climate.
standard for success in an international program.
CARIACO data and sample distribution policy
Hydrographic, biological, and chemical data from the CARIACO
project are placed on a local server at a website from the Uni-
versidad Simón Bolívar, Venezuela, with a Spanish interface
(http://cariaco.ws), and at the USF (http://imars.usf.edu/
Relevance and Future Activities
Our hypotheses and approach are designed to study the car-
bon cycle and ecosystem dynamics in a tropical continental
margin that is affected alternately by upwelling and riverine
input, which in turn are affected by long-term processes op-
erating at the regional to global scales. Because of its anoxic
characteristics, CARIACO contributes to our knowledge of
decomposition and recycling of particles as part of the biol-
ological pump process and of the production of oxygen min-
imum zones in the ocean. This is timely since there is evidence
that the oceans are becoming more hypoxic. More generally, con-
tinental margins play a fundamental role in ocean biogeo-
chemical cycles, receiving, producing and recycling material
from the ocean and land. They are biologically and geochemi-
cally active areas of the biosphere, exchanging large amounts
of material with the open oceans. The long-term CARIACO
time series observations are also critical for the proper inter-
pretation of paleoclimate records, including sediments depos-
ited at the bottom of the Cariaco Basin and those from other
locations. This project brings together a unique multidisci-
plinary and international workforce to provide the intellect to
address these issues.

The CARIACO Time-Series contributes to the development of
a growing global observatory focused on measuring biogeo-
chemical and ecological processes and understanding the
impacts of large-scale changes in the Earth system. CARIACO
is an IGBP-LOICZ (Land-Ocean Interactions in the Coas-
tal Zone) program with objectives relevant for the broader
The students and members of our technical support team in Venezuela have developed a Facebook page for CARIACO. This shows the enthusiasm for the program in the region and helps to further broaden the impacts of the project (see http://www.facebook.com/pages/Proyecto-Cariaco/151819241596140).

The CARIACO Ocean Time-Series depends on support from the Venezuelan government for Venezuelan scientists and from the US for their counterpart in the US. The CARIACO program is supported through standard grants that span 3-5 years. The program is presently under review for renewal.

Acknowledgements

The Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT, Venezuela, Grant 96280221) and Fondo Nacional de Ciencia y Tecnología (FONACIT, Venezuela, Grant 2000001702) to RV, the National Science Foundation (NSF, Grants OCE-0752139, OCE-9216626, OCE-9729284, OCE-9401537, OCE-9729697, OCE-9415790, OCE-9711318, and OCE0963028 to FMK; OCE-9415790, OCE-9711318, OCE-9730278 and OCE-0118491, OCE-0326175, and OCE-0752014 to MIS and GTT; OCE-0752014 and OCE-1039503 to RT), and NASA (NASA Grants NAG5-6448 and NAS5-97128 to FMK) supported this work. We are indebted to the personnel of the Fundación La Salle de Ciencias Naturales, Estación de Investigaciones Marinas, Isla Margarita (FLASA/EDIMAR) who have been responsible for the collection, analysis, and quality control of the data presented here, and the crew of the R/V Hermano Ginés for their enthusiasm and professional support. In particular we thank Dr. Pablo Mandazen (Hermano Ginés [1912-2011], FLASA founder) for his confidence in our activities.

CARIACO nurtures scientific cooperation with Venezuela. Because of accelerated offshore oil and gas development, scientists in Venezuela are eager to train in oceanographic techniques using the CARIACO infrastructure, and to use this facility to conduct basic and applied research. Venezuelan funding for local scientists to participate and for regional cruises is an important incentive to continue this program. Y. Astor and colleagues have produced a methods manual in Spanish and English (Astor et al., 2011) that is now used by other researchers in South America. CARIACO involves six major Venezuelan institutions in logistics planning, fieldwork, and data analysis, and has provided hands-on training to many international students. Over thirty-five theses and dissertations have been completed at different academic levels, and many Venezuelan and U.S. high school students have completed internships and term projects linked to CARIACO, including six POGO/SCOR fellows (Partnership for Observation of the Global Oceans, Scientific Committee on Oceanic Research), four of whom have participated in the Centre of Excellence (CoE) in Observational Oceanography based at the Bermuda Institute of Ocean Sciences (BIOS).

CARIACO a model for national ocean observing programs in Central/South America under the umbrella of the Antares network (http://dels-old.nas.edu/oceans/casestudies/antares_network.shtml) promoted by the Nippon Foundation and POGO. The Intergovernmental Oceanographic Commission (IOC/UNESCO) has also recognized and rewarded this effort (http://www.unesco.org/new/en/natural-sciences/ioc-oceans/infocus-oceans/features). We have developed scientific and technical links between CARIACO, BATS, HOT, and various other Ocean Carbon and Biogeochemistry (OCB) Program efforts (Church et al., in press 2013).
References


McQuatters-Gollop, A. et al., 2011. Nature 472, 10.1038/nature09950


You will find the CARIACO project description under LOICZ Affiliated Activities on page 19.
Preannouncement for the Scientific Highlight addressing a new frontier of coastal and shelf development

In the upcoming volume of LOICZ INPRINT 2013/2 Kira Gee and Benjamin Burkhard will discuss aspects of resilience of a coastal-marine social-ecological system in light of global sustainability. Their research is based on a case study approach for the installation of Offshore Wind Farms in the North Sea continental shelf region.

"Establishing the Resilience of a Coastal-marine Social-ecological System to the Installation of Offshore Wind Farms"

This article will deal with offshore wind farming as a contentious new form of use and a prominent driver of change across Europe. Drawing on the results of the research programme “Coastal Futures” in Northern Germany, we use the west coast of Schleswig-Holstein as a case study to describe the potential impacts of offshore wind farming on the sea and the seascape. Using individual wind turbines, wind farms and the west coast as geographical scales, we show that offshore wind farm construction can act as a threshold that could push the coastal and marine system into a new state. We particularly focus on the emergence of a new cultural landscape in the sea, which contrasts – and in some cases conflicts – with more traditional views of marine use. The article explores the potential impact of this transition across scales on the marine environment and the west coast region, arguing that it could lead to growth and innovation if the renewable energy theme is understood as an added value rather than a competitor. Factors that could contribute to such positive perception (e.g. siting, facilitating public discourse) are explored.

Read more about developments in continental shelf regions in the brief report of the IMBER – LOICZ Continental Margins Working Group (CMWG) on page 37/38.
The Cariaco Basin, located within the continental shelf of Venezuela, is an anoxic, 1,400 m deep basin whose sediments serve as a natural recorder of climate variability. The CARIACO Ocean Time-Series program was initiated in November 1995 with funding from the Venezuelan CONICIT (now FONACIT) and the US National Science Foundation. The primary objective is to study the relationship between surface biogeochemical processes and the vertical fluxes of carbon and nutrients in a continental margin setting influenced by seasonal upwelling. Ultimately, CARIACO scientists seek to understand how meteorological and upper ocean hydrographic conditions affect primary production, dissolved inorganic carbon, CO2 fugacity, bacterial productivity and respiration, and vertical particle fluxes, and how variation in these is reflected in the sediment settling at the bottom. This sediment stores a long and fine record of past climate change.

In CARIACO scientists seek to address carbon and nutrient fluxes at a tropical continental margin. They take advantage of the quiescent and anoxic nature of deeper waters in this basin, which effectively serves as a natural sediment trap. In this system, large-scale processes influence surface water-column characteristics, and in turn lead to the formation of varved sediments within the anoxic deeper waters of the basin.

The data are being collected at a time series station located at 10° 30' N and 64° 40' W on a monthly basis aboard R/V "Hermano Ginés", operated by the Fundación La Salle de Ciencias Naturales de Venezuela (FLASA) out of its Estación de Investigaciones Marinas de Margarita (EDIMAR).

Several institutions have a strong partnership in science conducted at CARIACO. From Venezuela, FLASA EDIMAR scientists work closely with their neighboring colleagues at the Universidad de Oriente (both on Margarita Island and in Cumaná, Venezuela). The Universidad Simón Bolivar distributes satellite observations and conducts bacterial analyses. The Instituto Venezolano de Investigaciones Científicas (IVIC) is engaged in collecting dissolved nutrient observations, developing strategies for molecular biology observations, and designing a national database of the oceanographic data collected by CARIACO. In the United States, the University of South Florida’s College of Marine Science works closely with EDIMAR and the various other groups to provide overall project coordination and science logistics and direction for CARIACO. The University of South Carolina (USC; Robert Thunell) and State University of New York (SUNY; Mary Scranton and Gordon Taylor) also participate in the Program.

Among many measurements, this interdisciplinary project collects the following observations: Every month, EDIMAR and the University of South Florida (USF) collect core measurements. Continuous profiles of temperature are recorded, salinity, oxygen, beam attenuation coefficients, and fluorescence using a CTD. Scientists take samples for chlorophyll, particle absorption, phytoplankton taxonomy, HPLC pigment, dissolved organic carbon (DOC), particulate organic carbon (POC), pH, alkalinity, bacteria, discrete oxygen and salinity, and nutrients. Samples are collected from the surface to the bottom. The USC component is responsible for sediment trap recovery/redeployment cruises using in May and November of each year. Traps are deployed at five depths, and each trap integrates flux over 13 consecutive two-week periods. The SUNY component measures bacteria numbers, bacteria production, bacterial respiration (as acetate uptake) and chemosynthesis throughout the oxic and anoxic zones of the water column.

The EDIMAR and USF CARIACO team also makes a series of bio-optical and remote sensing measurements every month. This includes hyperspectral reflectance of the surface, multispectral reflectance profiles, and various inherent optical properties of the water (absorption coefficient measurements of phytoplankton, detritus, and colored dissolved organic matter). These measurements are compared with satellite data, which help to understand the spatial scales of upwelling plumes and of sediment plumes from land, and how these change in time. Satellite data are offered to the public using a variety of web interfaces and tools.

Meteorological data (winds) and tidal excursions are measured at Margarita Island (Punta de Piedras), Cumaná, La Guaira, and Carupano along the Venezuelan coast.

There is now a unique dataset collected monthly at the CARIACO station since 1995 that combines taxonomy (by microscopy), phytoplankton pigment concentrations, bio-optical measurements, and a wide range of environmental data.

The CARIACO Ocean Time-Series Program is part of LOICZ. It is also part of the Antares network of coastal and marine time series of the Americas (http://antares.ws) and of the global Chlorophyll Globally Integrated Network (ChloroGIN). Antares and ChloroGIN are part of the Group on Earth Observations (GEO Task EC-09-01c: Regional Networks for Ecosystems).
Results

The CARIACO research team has obtained monthly data from dedicated cruises since November 1995, allowing them to assess the short term, seasonal, and longer-term changes in the various parameters being measured.

Over the past 18 years the Trade Winds and associated upwelling intensity have decreased. Average annual sea surface temperature has risen >1.0°C. Net primary production declined and phytoplankton taxon dominance shifted from diatoms, dinoflagellates, and coccolithophorids to smaller taxa. Zooplankton biomass, fCO2, and the vertical flux of particulate matter have increased. The depth of the last appearance of oxygen, first appearance of sulfide, and thickness of the suboxic zone where both oxygen and sulfide are low have fluctuated as a result of variability in the frequency and intensity of intrusions of denser, oxygenated water entering over the sills. Changes to a northward migration of the Intertropical Convergence Zone (ITCZ) over the past 18 years are attributed.

The science of CARIACO helps to understand the collapse of the sardine fishery and catastrophic weather events seen in the last decade in the region, and ultimately helps to understand better how climate changed in the past by examining the sediments found at the bottom. This will help understanding the kind of changes being seen in ocean production and land runoff in the future as climate changes are felt in this region of the Caribbean Sea and northern South America.
Recovery of the sediment trap array deployed at the CARIACO site. The array is turned around every six months. Helping the recovery are Rick Cole (left), Aitzol Arrellano (center) and Jay Law (right) (Photo: Eric Tappa)

Read more about CARIACO on the LOICZ project website:

Read more on the CARIACO project website in English: http://www.imars.usf.edu/CAR/index.html

Read more on project website in Spanish: http://cariaco.ws/

Podcast and Slideshow: Diary of dirt. Un cuento sobre el clima. by Ari Daniel Shapiro
Ari Daniel Shapiro produces the Ocean Gazing podcast for COSEE NOW.

Frank Muller-Karger is an oceanographer at the University of South Florida where he directs the Institute for Marine Remote Sensing. He says, “If we’re seeing something today that may have been similar to what we saw in the past, we can understand which way the planet is going to change in the future.” Muller-Karger is using both the seafloor and satellites to figure out our past and future climate. And he’s working hand in hand with a country that’s very special to him. Have a listen.

The work described in this episode was funded by the National Science Foundation and the Venezuelan government.

Slideshow:
http://coseenow.net/podcast/2010/08/dirt/

Podcast: http://coseenow.net/podcast/tag/cariaco-basin/
New affiliate project:

Ocean Strategic Services beyond 2015

Project Name: Ocean Strategic Services beyond 2015
Acronym: OSS2015
Principal Investigator: Dr. Odile Hembise, ACRI-ST
Duration: November 1, 2011 – October 31, 2014
Project Website: www.oss2015.eu

Overview of OSS2015

The first level of GMES applications in the marine area is mostly represented by the "upstream" services of the Marine Core Service. The current MyOcean offering of products and services for biogeochemistry has limitations that prevent a full uptake by the potential users. The present project intends to address these issues through a range of R&D activities designed to offer a set of solutions that shall benefit the Marine Core Service beyond 2015. The outcomes of the project are expected to benefit both the upstream and downstream services of the MCS.

OSS2015 is focused on nowcast, forecast and climatology of the biogeochemical properties of the ocean mixed layer. OSS2015 addresses the fusion of satellite ocean colour data (multispectral radiance of the sea surface) and in situ measurements from autonomous platforms (buoys, drifters, gliders,...) through assimilation into bio-geophysical models. OSS2015 project aims are to develop marine biogeochemistry products and services not currently available through MyOcean, the precursor service of the operational forecast and analysis component of the European Marine Core Service (MCS) – the upstream marine service of GMES.

Context

The context of activities developed by OSS2015 is:

- Data assimilation in numerical biogeochemical model is a natural extension of physical oceanography techniques applied to ocean biology;
- Extensive biological in situ data sets are becoming available, thanks to the increasing number of bio-floats deployment;
- Decadal scales satellite ocean colour time series are now available;
- Data assimilation in numerical model is now considered a viable approach to ocean properties characterization.

The main objectives are subdivided in three areas:

- The derivation of 3-D and 4-D representations of biogeochemical variables from the integration of gliders and floats in situ data and EO satellite data into cutting-edge numerical biogeochemical and bio-optical models. The models, assimilation schemes and output products from the models will be tested at two pilot sites located in the Mediterranean and in the North Atlantic.
- The generation and validation of satellite derived global time series of advanced biogeochemical products (POC, NPP, PFT, PSD) for carbon cycle science
- The implementation of a prototype platform of "on-demand" services for product generation and distribution.

This system of services will be tested and demonstrated with the new biogeochemistry products developed during the project. OSS2015 will also analyse the social and economic benefits and value of the products and services generated by the project.

Expected final results

Objective 1: Develop and validate new tools for integration and/or assimilation of both EO and in situ data in biogeochemical models

OSS2015 is combining state-of-the-art bio-profiler and Earth Observation data in order to relate remotely detected surface optical properties and chlorophyll to their vertical distribution.

OSS2015 is developing assimilation schemes to ingest Earth Observation and in situ ocean colour data into cutting-edge numerical biological and biogeochemical models. Beyond the evaluation of these assimilation schemes, a very important outcome will be the optimisation of in situ observation strategies using models and EO or EO data alone. This last point is directly in line with the requirements of environmental agencies in regard to the design of an in situ observation network consistent with other means of monitoring.

The expected final results are:

- Improved understanding of the relationship between optical and biogeochemical surface information and its vertical distribution
Objective 2: Develop and validate new products relevant to the biogeochemistry of the ocean
The expected final result of OSS2015 is to generate advanced biogeochemistry products and to deliver a complete and rigorously validated 15 year time series at global scale.

Objective 3: Develop an “on-demand” information, elaboration and distribution system
The expected final result of OSS2015 is to develop a flexible product generation / data dissemination process that responds to user requirements and developing technologies. OSS2015 will prototype a data service relevant to marine ecosystem health assessment based on Chlorophyll, NPP (net primary Production), PSD (Index of particle size distribution), POC (Particulate Organic Carbon) and PFT (Phytoplankton functional types). OSS2015 is thus designed to continue the dialogue with users in order to be adapted to the needs. The development of a new web-based platform will permit “on-demand” feature. The platform of services aims at developing the use of persistent digital identifiers for scientific data. Assigning of DOI (Digital Object Identifier) will contribute to the assessment of the usefulness of the level of usage of data products and will permit the citation of data sets in the literature.

Results obtained after one year
The objectives of the first year were mostly dedicated to research work focused on several fields of activities.

Bio-optical assimilation
Three activities have been performed by NURC and DEU:
- a. Deriving vertical profile of water radiances and the corresponding IOPs
- b. Research works on deconvolution of these IOP into biogeochemical components
- c. Setting-up the HOPS model in the Ligurian Sea
An illustration of the setting-up of the HOPS model in the Ligurian Sea is provided in the figure below.

Integration of in situ, satellite & models
- Derivation of optimal in situ deployment scenario (LOV / UPMC)
- Overview of global distribution of factors limiting primary and export production (GEOMAR)
**List of partners**

The partners that are member of the OSS2015 consortium are:

1. ACRI-ST, France (the Coordinator)
2. Université Pierre et Marie Curie, France, on behalf of the GIS COOC
3. ARGANS Limited, United Kingdom
4. NATO undersea Research Center, Italy
5. Frontier Economics, United Kingdom
6. Université du Littoral Côte d’Opale, France
7. University College Cork – National University of Ireland, Cork, body incorporated under Charter with its seat at Western Road, Cork, Ireland
8. GEOMAR, Germany
9. Dokuz Eylül Üniversitesi, Turkey
10. Daithi O’Murchu Marine Research Station, Ireland

**Contact:**
os2015-sc@acri-st.fr

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 282723.

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**New marine products**

- Primary Production: Implementation and Processing of two different approaches to assess PP at global scale; inter-comparison of these two different approaches
- PFT algorithm: Improvement of the PHYSAT method for the inversion of different phytoplankton groups
- Inversion of IOPs: Improvement of the Loisel and Stramki (2000)’s model for the inversion of the backscattering coefficient

In parallel to research activities, the following support activities have been performed:

**In situ and satellite data management**

- A geo-database with an easy to use search interface has been made available to the team partners
- INSPIRE Directive principles in regard to in-situ data management have been analysed and started to be implemented
- A database of all EO products required by the team has been made available to the team partners, including an up-to-date reprocessed data set of MERIS, MODIS, SeaWiFS

**Interaction with users**

- The End User’s needs have been thoroughly analysed so that relevant products/service can be generated and demonstrated
- Links have been established with MCS and EEA/GISC
- A workshop gathering several FP7 downstream services projects is under preparation and will be held early next year.

**Scientific networking and outreach**

- A Public web site has been developed
- Scientific networking has been established since the start of the project, with publication/presentations in 28 different events
FIELD_AC A Summary

The FIELD_AC Project (FP7 Space call, European Union research) has shown the limits of wind–wave–current–water quality predictions in coastal areas. In these areas the effect of the land discharge and the non-linearities due to topobathymetric gradients affect the results to a point where the errors may be significantly larger than for deeper waters. And it is however in such coastal domains where accurate and reliable predictions are mostly needed to satisfy the multiple activities taking place in the littoral.

FIELD_AC has advanced in the state of the art regarding the individual models (parameterizations for meteo-models, wave current interaction terms, bed and free surface shear stresses, role of offshore boundary conditions, etc) and produced a new level of results directly applicable to applications such as “when to close a beach after storm” due to polluted water quality or “what is the safe time interval” to transport concrete “caissons” to a harbour construction site. Our results have also benefited the codes used by the partner institutions in research and commercial contacts for coastal problems in Europe, America and Australia.

We have assessed the quality of high resolution oceanographic predictions for four coastal sites (the Catalan coast, Venice Gulf, Liverpool Bay and the German Bight) using the observations available in the coastal observatories of these four field sites. The role of such observations has proven to be of high value for calibrating our modelling suites and for the eventual validation for given storm events. We have also benefited from two intensive FIELD_AC campaigns at the Catalan coast, our bench mark test site for running the different models from the partners using the same drivers and the same topo-bathymetrics settings.

The advances obtained should allow a more reliable simulation of hydrodynamic variables (water velocity, wave height, etc) and the processes linked to them. We have illustrated such an approach with the dispersion of sediment and salinity plumes (figure 1) and the resulting coastal water quality and ecologic status.

These advances stem from a careful coupling of high resolution models that has shown how the use of high resolution fully coupled meteo-hydrodynamic models may lead to significantly different results, where the in situ measurements have proven to be more accurate. Our results have also shown the need to increase spatial resolution and pay particular attention to the land-ocean boundary for which satellite images do not provide accurate enough or frequent enough results and where the role on in situ measurements remains critical. We have also addressed the issue of mutual interactions between “parent” and “child” numerical domains or between meteorological and oceanographic processes. The benefits from FIELD_AC achievements will affect operational forecasting (time scale of order days) and climatic scale analysis and therefore illustrate the wide range of potential applications.

Figure 1: Sample simulation of suspended sediment concentration in the upper ocean layer off the Barcelona coast. The picture shows the concentration (Kg/m^3) near the Besos river mouth for four classes of sediment. This Catalan coast pilot site corresponds to the bench mark test case in the FIELD_AC project.

New affiliated project:

Social capital and adaptation to sea-level rise on small islands (PhD thesis)

A new PhD project has been affiliated to LOICZ. The study is carried out by Jan Petzold (Institute of Geography – University of Hamburg, Germany, CliSAP Centre of Excellence, supervised by Prof. Dr. Beate M.W. Ratter) and matches on the LOICZ Hotspot ‘Islands at Risk’.

An extended introduction to this study can be found under Young LOICZ on page 41.

CoastColour and SeaSWIR User Consultation Meeting

Darmstadt, Germany, 09.-10.05.2013

Objective: The recent results of the CoastColour and SeaSWIR projects will be communicated to the scientific and broader coastal user community. Feedback from coastal scientists, managers and other stakeholder will be gathered, and future possibilities with the upcoming Sentinels will be discussed. Recommendations for further scientific work, requirements for new sensors and for exploitation of Earth Observation data for coastal zones will be formulated. These will be addressed to the Space Agencies and research funding organisations.

Meeting website: http://www.coastcolour.org/UCM_IV.html
Registration: please send an Email to office@coastcolour.org.

www.coastcolour.org/index.html

http://seaswir.vgt.vito.be/

ICAN 6: Expanding Participation in Coastal Web Atlas Development and Use

Victoria, Canada, 16-17 June 2013

The 6th International Coastal Atlas Network Workshop (ICAN 6) will be held at the University of Victoria, Canada from 16-17 June 2013, in advance of CoastGIS 2013. The theme of this year’s workshop is Expanding Participation in Coastal Web Atlas Development and Use.

Since March 2013 ICAN is an official Project of the International Oceanographic Data & Information Exchange (IODE) programme of UNESCO’s Intergovernmental Oceanographic Commission (IOC). The workshop will provide an opportunity to discuss how the ICAN community will share its knowledge and aid capacity building among IOC member states in relation to coastal and marine atlases. Moreover, ICAN has seen its membership grow in the last two years and currently has extensive membership along the North and South American Pacific coasts. We look forward to hearing about atlas developments in these regions. Key activities at the ICAN-6 workshop will include:

• exploring the opportunities for ICAN in an IODE context and how to build synergies with other IOC projects;
• discussion of coastal atlas training needs and how ICAN members can contribute;
• Atlas Stories – presentations from Atlas developers and users from North and South American Pacific coasts and beyond
• an Atlas Showcase providing an opportunity for atlas developers to present their atlases
• a small “workshop within a workshop” for atlas technical developers on how to become a new node in the ICAN interoperability demonstrator, version 3.
• a small “workshop within a workshop” focussing on Volunteered Geographical Information (VGI) and its implications for coastal atlases
• development of an ICAN work plan for the period 2013-2015

This workshop follows on 2011’s successful workshop ICAN 5: Coastal Atlases as Engines for Coastal & Marine Spatial Planning, held at IODE headquarters in Oostende, Belgium, in September 2011, as well as four previous workshops held in 2006, 2007, 2008 and 2009 in Cork, Ireland, Oregon, USA, Copenhagen, Denmark and Trieste, Italy respectively.

There is no registration fee for this ICAN event, but those interested in participating need to register via the IODE website by Friday, May 24, 2013. Further details of the workshop will be published at http://icoastalatlas.net. For any enquiries email n.dwyer@ucc.ie
A range of accommodation options are available. More information at: http://coinatlantic.ca/index.php/venue/accomodations

ICAN 6 is co-organized by Ned Dwyer and Kathrin Kopke of the Coastal and Marine Research Centre, Ireland, Prof. Dawn Wright of ESRI, USA, Roger Longhorn of EUCC, Belgium and Rosaline Canessa of University of Victoria. The ICAN 6 workshop is sponsored in part by ESRI, with additional support from IODE, and the University of Victoria.
One backbone of LOICZ: Affiliated Activities

LOICZ aims to provide a framework to encourage the fullest participation of multi-national, regional, and national research activities in its global research. These activities shall contribute to the achievement of the goals, aims and objectives outlined in the LOICZ Science Plan and Implementation Strategy (SPIS). A way we accomplish this is to actively engage with the international research community concerned with natural and social sciences on Global Environmental Change in the coastal zone. LOICZ is a forum to assimilate, synthesize and integrate the outputs of the research community. It provides an opportunity to communicate, discuss and disseminate these outputs making them available to the global audience of scientific peers, the general public, and decision-makers in policy and practice. Information on Affiliated Activities is held in a central database that is accessible online through the LOICZ website. It provides basic information and regular updates to the wider global community as well as to LOICZ for its assessment and synthesis task and its reporting requirements.

We encourage coastal scientists to seek affiliation of their research project/s, PhD thesis or capacity-building activities to LOICZ and to become a member of the global science community and network of researchers and practitioners. Since 1993, more than 400 individual activities from all over the world have already been involved in this LOICZ research portfolio.

We particularly encourage early stage researchers from PhD student to Post-Doc level to seek affiliation of their projects. LOICZ acknowledges that much of the work contributing to coastal Earth System science is being carried out by young scientists. Therefore LOICZ wants to support these efforts by enhancing their visibility and introduction to scientific peers in the global research community. Affiliated early stage research will thus contribute to the global research portfolio and its products and information will also feed into the global LOICZ synthesis in equal measure with the larger affiliated projects.

Affiliation will give early stage scientists comprehensive information about the variety of scientific activities in their field and allow them to foster their network with senior scientists and the global research community. They may also have easier access to participation in workshops, conferences and meetings organized by LOICZ that relate to their own work. By promoting their individual research on a global platform, early stage researchers will be given the opportunity to contribute to LOICZ aims and objectives directly.

Application for affiliation of scientific work at PhD and Post Doc level needs the same set of principle information and delivery of appropriate documents (e.g. thesis outline instead of a project proposal if applicable). In addition to and guarantee a good conduct in quality control LOICZ kindly asks for a co-signature and professional affiliation details of the supervising scientist. The review conducted by the LOICZ scientific peers will apply the same standards as for senior projects. Detailed information on the affiliation procedure is available on the LOICZ website in the ‘Projects’ section http://www.loicz.org/projects/index.html

LOICZ Priorities and Synthesis of Affiliated Activities

Following the evaluation in 2010 and the Open Science Conference in Yantai, China in 2011 new scientific directions are emerging in LOICZ. Future focus will be on hotspots of vulnerable coastal zones and societies mainly in the Arctic, in river mouths and deltas, in islands and urbanized coastal areas. The synthesis is an opportunity to share your related research findings with the global LOICZ community and value your contribution to coastal and global change research. Please notice that we are in the stage replacing the old LOICZ database with a new content management like system. Further information on new arrangements can be found in this LOICZ Inprint on page 43.

Call for affiliation of research activities

LOICZ seeks to expand its network of scientists by endorsing research activities concerned with any of its priority topics on a global, regional or national level.

Within these topics LOICZ strives to develop:

• Methodologies or models that allow data assimilation, processing and synthesis, including up and/or down scaling;
• Scenarios of change and/or response to change in socio-ecological systems;
• Scientific context for the evaluation of existing policies and structures;
• Globally applicable tools for scientific synthesis, decision support and structure development; and
• Dissemination interfaces to provide information and assist sustainable coastal development on appropriate scales.

To achieve this, LOICZ is calling for proposals to bring high quality research activities into the LOICZ cluster of Affiliated Activities. As well as fundamental science projects, LOICZ also looks for projects that have a multidisciplinary perspective, especially combining natural and social sciences. Projects can focus on global, regional or local scales and address coastal sciences and/or coastal management questions. Projects that collaborate with other Earth System Science Partnership (ESSP) elements, especially with other Core Projects of IHDP and IGBP, are sought in particular. Also projects that synthesize and analyze already available research outcomes or involve dissemination and outreach that will lead to better public knowledge are welcome. LOICZ particularly encourages affiliation of early stage research at PhD and Post-doc level. Details about projects already affiliated to LOICZ can be found on the LOICZ website.

Call for affiliation of research activities

Although LOICZ cannot offer funding to Affiliated Activities, its endorsement provides the following benefits:

1. Support in the state of proposal for funding
2. Promotion of the project and associated activities, its contributing team, outputs and outcomes through the LOICZ website and/or newsletter
3. Contribution to workshops, conferences and meetings organized by LOICZ and hence establishment of linkages to other projects operating in similar fields and/or addressing similar issues
4. Access to a wide circle of information related to funding and the science community that is available through the LOICZ database
5. Principle Investigators of Affiliated Activities are offered a Corresponding Membership to the LOICZ Scientific Steering Committee (does not apply to PhD level). This appointment is subject to annual review

Researchers whose work fits into the LOICZ portfolio are encouraged to submit proposals to the LOICZ IPO any time. The required form is accessible after registration to the LOICZ project database and additional information can be obtained from the LOICZ website or via contacting the LOICZ IPO.
Megacities in the Coastal Zone

Outcomes of the workshop in Norwich in April 2010 have now been published!

Roland von Glasow & Tim Jickells

Megacities and large urban agglomerations are usually defined as having more than 10 million inhabitants and are characterised by a particularly high population density. More than 10% of the world’s population live in megacities, and this proportion is expected to increase in coming decades. Even though a very large number of megacities are located at the coast, there has not been a systematic consideration of the additional pressures and effects that the location of this juxtaposition of land and ocean has. To address this, a SOLAS/IGAC/LOICZ fast track initiative held a workshop in Norwich in April 2010 sponsored by IGBP/SCOR. The attending scientists had expertise in various aspects of atmospheric and marine physics and chemistry as well as in marine biology. The focus of the workshop was on the physical and biogeochemical interactions between the atmosphere, the land and the ocean in and around coastal megacities. These relate to air and water quality as well as regional climate and hence directly affect human wellbeing. In the workshop we were able to identify what we believe to be the following most important environmental issues: Effects on the self-cleansing capability of the atmosphere (in the megacity and its outflow); Greenhouse gases: sources, atmospheric lifetime; Pollution and health; Coastal eutrophication and resulting effects including on fisheries; Atmospheric circulation/mixing; Hydrological cycle; Radiative forcing caused by the Megacities in the Coastal Zone. The outcomes of this workshop have now been published: von Glasow et al, “Megacities and Large Urban Agglomerations in the Coastal Zone: Interactions Between Atmosphere, Land, and Marine Ecosystems”, AMBIO 2013, 42:13-28, DOI 10.1007/s13280-012-0343-9.
Ecological Economics

Coastal Ecosystems and Changing Economic Activities: Challenges for Sustainability Transition along Chinese and South Asian Coasts

Joyashree Roy\(^1\), Preeti Kapuria, Satabdi Datta, Indrila Guha, Rajarshi Banerji, Sandhya Rao, Giasuddin Miah, Shang Chen, Jingmei Li, Tao Xia, Janaka Ratnasiri, P.B. Terney Pradeep Kumar, Chinthaka Samarawickrama Lokuhetti

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Abstract

Coastal ecosystems have been altered primarily induced by anthropogenic interventions. There has occurred a genuine conflict between traditional livelihood practices and present day profit augmenting commercial practices. Historically coastal ecosystems have been altered by humans to harvest provisioning services and cultural and amenity services. Expanding demand for flow of these services are in close contest between themselves and across other service flows: regulatory service and supporting service. This project aims to inventorise economic activities with corresponding ecosystem service flows along with changing resilience level. Resilience will be connected to climate variability. Goal is to assess and create among multiple actors the scientific understanding of value of ecosystem services. A decision matrix will be prepared to facilitate policy making process for sustainability transition.

Keywords: Coastal Ecosystem, Economic activity, Sustainability transition.

I. Introduction

Alteration in coastal ecosystems at any degree, resulting out of either natural forces or human interventions poses threats to the resilience of human and environmental coastal systems (Klein et al 1998; Turner et al 1998; Turner and Daily 2008). In this context the concept of ‘sustainability transition’, which can be characterized as a long term, multi-dimensional and fundamental transformation processes through which systems shift to a more sustainable state (Markard et al 2012) becomes a relevant yardstick for managing the coastal ecosystem. More than a third of the world’s populations live in coastal areas and small islands that comprise 4% of the Earth’s total land area (UNEP, 2006). According to (UNEP 2005) Report, at the global level, coastal population densities are 2.6 times larger than that of inland areas and well-being level of coastal communities is on average much higher than their inland counterparts. Coastal zones yield 90% of global fisheries (Crossland et al., 2005; Coastal Fluxes in the Anthropocene) and approximately 38 million people are directly engaged in fisheries and trading of fish products (UNEP, 2006). Tourism a flourishing sector provides employment and income earning opportunities to a substantial number of people residing in these areas.

II. The specific project objectives are:

1. Identification and characterisation of the coastal ecosystems
2. Identification and understanding of the traditional and new economic activities and also the actors along the coast line and changing pattern through first hand recall method, and mapping to ecosystem services
3. Preparation of Inventory of ecological functions based economic activities as well as otherwise and resilience level.
4. Generation of historical data on climate parameters in order to predict future scenarios for each specific study site.
5. Application of stakeholder behaviour analysis in ecology–economy interaction framework

III. Relevance to the APN’s Science and Policy Agendas

The proposed project will identify through interaction of scientists, policy makers and other stakeholders the most vulnerable coastal system based economic activities in four APN countries. It will identify good and bad practices in selected coastal systems while responding to local and global changes. The project fits into the science agenda as it aims to study changing activities in selected coastal systems, associated communities and their lifestyle, natural and manmade hazards, risks to ecosystems and human systems and map the data base to identify most vulnerable coastal communities. Development of indicators and guidelines will provide information for policy processes on how best to manage these global changes in a coastal social ecological system context to inform longer term transition to sustainability.
Inception workshop:

Participants in the Inception Workshop at Peerless Inn, Kolkata (Clockwise from front row right: Dr. Shang Chen, Dr Ramesh Ramachandran, Prof. Joyashree Roy, Dr. Janaka Ratnasiri, Prof. Md. Giasuddin Miah, Ms. Satabdi Datta, Dr. P.B. Terney Pradeep Kumara, Mr. Tao Xia, Ms. Preeti Kapuria, Mr. Chinthaka Samarawickrama Lokuhetti, Dr. Indrila Guha, Dr. Purvaja Ramachandran, Dr. Jingmei Li, Mr. Rajarshi Banerji)  (Photo: Dr. Sayantan Sarkar)

Any international and multidisciplinary research effort needs to create a shared common understanding/vision about the key words and framework of the study from the very beginning. Given that the proposed research is policy research as well, involvement of policy makers through knowledge sharing has been the primary focus. The participants met representatives of policy making bodies in proposed coastal study sites location on the first day to have hands on experience of theoretical frameworks and get policy makers’ perspective, and challenges. The second day was for presentation of national understanding of the coastal system through disciplinary lenses and projected climate change within the project perimeter.

The third day all worked together in mixed groups to co-design the study scope given the uniform understanding of coastal ecosystem services lens and sustainability transition lens. In literature many global lists of coastal ecosystems exist but are not all applicable/characterise study country coastal characteristics. So through group work the list of coastal ecosystems for participating countries were specified. The groups identified the following list of Asian Coastal Ecosystem Types.

**Asian Ecosystem Types**

- Estuarine
- Deltaic
- Mangroves
- Intertidal Zones
- Sand dunes
- Sand Beaches
- Coral reefs
- Spit, Barrier Beaches
- Rocky Shoreline
- Mud flat
- Muddy beach
- Lagoon
- Arid – Terrestrial
- Sea grass bed

The Inception workshop is meant for participation and discussion on: ecosystem services in ecological economics framework, framing of research questions, hypothesis and methodology for analysis and work time line with deliverables. Participants felt that workshop goals were achieved and helped in getting closer to a shared understanding of key concepts. Involvement of policy makers and the LOICZ SSC chairperson made them interested in the proposed research output. From Government of India Ministry of Environment and Forest we have received a request to share with them the research results.
Acknowledgements

We thank Dr Ramesh Ramachandran, Director, National Centre for Sustainable Coastal Management, India and Purvaja Ramachandran, Scientist, Institute for Ocean Management, Anna University, India for being present at the workshop and for making very positive contributions through presentation on ongoing efforts at the ministry level and comments on possible synergies. We also acknowledge with thanks Dr Somnath Bhattacharyya, Person responsible for implementation of ICZM in the State and Mr Soumen Pal the officer at Digha Shankarpur Development Authority for their valuable time to guide the researchers in site selection.

References


Preparing for a transition to Future Earth

The upcoming LOICZ 24th SSC Meeting, August 19-23, 2013 will be hosted by the LOICZ Regional Node Latin America, Rio, Brazil. Considerable parts of the meeting will focus on making strategic outlooks on the steps to be taken in transition from an IGBP/IHDP core project to a “LOICZ in FUTURE EARTH” project. A report will be published in INPRINT 2013/2.

Background is the official letter directed to current Earth system research projects incl. LOICZ from the Future Earth Implementation Management Project Board (IMPB), on behalf of the Science and Technology Alliance for Global Sustainability and the Science Committee Chairs of Diversitas, IGBP, IHDP and WCRP (dated 14 March 2013).

The board and science committees of current programmes confirm that all projects are invited to become part of the new research initiative “Future Earth”.

Extracted (and slightly edited) from the original letter it is underlined that “...Future Earth provides an exciting research agenda for sustainability which encourages the broad range of disciplines to work together on some of the most important problems facing humanity. It demands both disciplinary and interdisciplinary thinking, the bottom-up inspiration and innovation of the science community, together with an emphasis on the co-design of agendas and stakeholder-engagement throughout the research process. The Alliance will work closely with the Future Earth Governing Council to establish a more stable funding base to manage the programme than is available today, and seek new sources of research funding to ensure resourcing is commensurate with our ambition.

...the goal is

• to ensure that Future Earth provides strengthened opportunities for the GEC projects to deliver excellent science, contributing to the Future Earth agenda.
• it is recognised that projects are at different stages of development and readiness to transition to Future Earth ...

A phased approach is suggested leaving it to the projects when best to transition (or not to join).

Among the critical factors for the projects to be considered (thus also for LOICZ during transition and to be tabled at the SSC are:

• Scientific readiness to contribute to Future Earth – meaning the extent to which a project could help refine and deliver the Future Earth research agenda, and benefit from a closer clustering with other projects and new activities.
• The strategic benefits of working in a more interdisciplinary environment, contributing to research on sustainability, where co-design and stakeholder engagement are emphasised. (it will be key to assess as to what extent a project already operates in this way, or along which kind of strategy over the next few years to embrace these major Future Earth design principles. In conclusion this refers to defining continued means of co-design)
• The organisational and financial stability of the project, noting that both stable and not fully stable projects may benefit from an earlier transition.

The latter point is particularly critical for projects (incl. LOICZ) which during this already challenging transition need to relocate and underline their current and future added value for the global research and users as well as the Future Earth community.

LOICZ welcomes these questions and takes it as an opportunity to evaluate its current position and future potential to provide for a meaningful transition into this challenging new framework. This includes to build on and maintain the strength and networks gained with the current Earth system programmes and our scientific sponsors so far.
LOICZ Regional Nodes

LOICZ South Asia Regional Node

We are pleased to announce Dr. Purvaja Ramachandran, as the new Coordinator of the LOICZ South Asia Regional Node.

Purvaja Ramachandran is the Division Chair and Scientist G (Futuristic Research), at the National Centre for Sustainable Coastal Management (NCSCM), Ministry of Environment and Forests, Chennai, India. Her expertise includes climate change, coastal sediment cell dynamics, shoreline management plan and integrated coastal zone management. Purvaja received her PhD for her work on greenhouse gas fluxes from mangrove ecosystems of South India. She was awarded the DAAD Fellowship at the Max-Planck-Institut für terrestrische Mikrobiologie, Marburg to study methanogenic processes in paddy and mangrove ecosystems. Her research expanded further into measurement of other trace gases: N2O and CO2 and their biogeochemical processes. Purvaja was a Fellow of the “Hanse-Wissenschaftskolleg, HWK” (2007-2008) where her research focused on the Carbon and Nitrogen Cycle in Mangrove Ecosystems in addition to assessing the impact of monsoon-driven surface ocean processes on coral reef systems of the Andaman Islands. This study was conducted at the “Zentrum für Marine Tropenökologie, ZMT”, Bremen, Germany as part of the HWK Fellowship. Purvaja’s current research focus at NCSCM is to undertake measurements and develop an inventory of trace gas fluxes and carbon sequestration in mangroves and seagrass ecosystems of India.

Activity at LOICZ South Asia Regional Node

The fourth IGCP 588: ‘Preparing for Coastal Change’ conference

in Chennai, India
20th May 2013 (Monday) – 24th May 2013 (Friday)

Venue: Hotel GRT Grand, Chennai
Organising committee:
S. Srinivasalu (AU), Adam Switzer (EOS), R. Ramesh (NCSCM), M.S. Pandian (PU), Jonathan M.P (IPN)

Coastal areas are dynamic and fast changing environments. They are home to billions of people worldwide and provide areas of unique natural importance. Over millennia, changes in relative sea level, geological processes and extreme events such as storms and tsunamis, have shaped and changed Earth’s coastlines. More recently, human activities such as coastal development and agriculture have affected coastlines through deposition and erosion, and through relative sea-level rise as a result of anthropogenic climate change. As such coastal change is of considerable local and global interest, not only within the geological realm, but also in terms of socioeconomic and biodiversity impacts.

The 4th annual conference of IGCP588 will be held in Chennai, India. We invite submissions on topics including: catastrophic coastal events (storms and tsunamis); subsiding deltas; sea-level change in the tropics; coastal dynamics; coastal processes and human adaption; coastal resilience, coastal resources (offshore windmills, renewable energy, offshore mining) and other topics in coastal science.

Chennai

Chennai, one of the metropolitan cities in India is a true reflection of this country’s diversity. Chennai has flourished into a charming and welcoming city and the city encourages all forms of development. Covering an area of 200 km2 with the Bay of Bengal to the east, the city is the gateway to the rest of South India and the fourth largest city in India with a population of around six million.
Early bird registration          March 30 2013

Submission of abstract deadline (extended until April 15)       March 30 2013

Notifications of selection of Abstracts for Oral Presentations       April 20 2013

End of discounted registration period          April 30 2013

Deadline for full payment of fieldtrip fee          April 30 2013

Deadline for submission of full papers for session special issues To be announced at the meeting

Any further information can be obtained from the Secretariat and igcp588chennai@gmail.com and on the LOICZ website:

http://www.coastal-change.org/

**Publications**

**New publication**: from LOICZ SSC member Julius Agbola with Mario Uchimiya, Isao Kudoa, Masato Osawa & Kazuo Kido in Elsevier’s “Estuarine, Coastal and Shelf Science”

*Seasonality and environmental drivers of biological productivity on the western Hokkaido coast, Ishikari Bay, Japan*

Read more:


**New publication**: from LOICZ SSC member Jiun-Chuan Lin with Hsu-Cheng Hsu in Elsevier’s “Tourism Management Perspectives”

*Benefits beyond boundaries: A slogan or reality? A case study of Taijiang National Park in Taiwan*

Read more and view full text:

The ‘Integrated Marine Biogeochemistry and Ecosystem Research’ project (IMBER, www.imber.info) recently convened its third IMBIZO (28-31 January 2013, National Institute of Oceanography, Goa, India) titled ‘The future of marine biogeochemistry, ecosystems and societies’. IMBIZO means a gathering in Zulu, and IMBER runs these “gatherings” biannually, with a format of three concurrent but interacting workshops designed to synthesize information on topical research areas in marine science.

Multi-dimensional approaches to the challenges of global change in continental margins, open ocean systems, and dependent human societies were explored. The proven IMBIZO format facilitated linkages between biogeochemistry, ecosystems and human sciences research by providing the 120 interdisciplinary researchers and students with the opportunity to discuss three new topics of marine research:

Workshop 1 focused on Biogeochemistry-ecosystem interactions on changing continental margins. Continental margins are key ecosystems in the context of the Anthropocene, as they attract a large proportion of the human population and are consequently subject to multiple anthropogenic stressors, in addition to highly variable natural forcings. Integrated research approaches were discussed, covering issues including detailed time series observations, continuous monitoring, multiple scale modelling of marine biogeochemistry and ecosystems, oceanic health indicators, and governance of resilient and/or sustainable social-ecological systems and their resources. The challenge is to detect the onset of deviations from natural variation that may lead to deleterious effects on CM ecosystems. Stronger integration of researchers in natural sciences, social sciences and humanities, and improved interactions with practitioners and decision makers are key to addressing the challenges identified in continental margins in a changing global environment. The workshop also underlined the close interlinkages between coastal (incl. land-based) processes and drivers and the continental shelves.

Workshop 2 focused on Impacts of anthropogenic perturbations on the functioning of the microbial carbon pump (MCP) at molecular to food web scales. The dynamics and diversity of the pathways for oceanic carbon storage and export, and their role in the regulation of atmospheric CO2 concentration, and food web structure and productivity over different time scales were discussed. The efficiency of the MCP is mainly governed by the nutrient and oxygen conditions of the ecosystem, while bacteria actively regulate carbon sequestration. The key role of the MCP in determining food web structure suggests that minor alterations could cause major shifts in overall ecosystem functioning, especially in a changing global environment.

Workshop 3 focused on ‘Understanding and forecasting human-ocean-human interactions, drivers and pressures, with respect to global change’. Several anthropogenic drivers (e.g., fisheries and greenhouse gas emissions) and their impacts on marine ecosystems at different scales and locations were discussed with regard to the vulnerability and adaptation of the related human communities, and to the governance responses and methodologies to mitigate and adapt to global change. It is apparent that local issues depend on local, regional and global drivers and improved interdisciplinarity between natural and human sciences and stronger links to policy makers and society at large are needed to address these. A disconnect exists between science and policy, as well as between public perception and the ‘reality’ of global change and its potential impacts. Presentations and discussions featured the latest state of conceptual and applied research both in IMBER and LOICZ and underlined the mutual benefit of close collaboration on topics such as vulnerability, resilience and governance of marine and coastal resources and services.

Syntheses of the ideas and concepts and new scientific discoveries from IMBIZO III will be forthcoming in special issues of journals. More information and the presentations given at IMBIZO III are available at: www.imber.info/index.php/Meetings/IMBIZO/IMBIZO-III.

1 IMBIZO III was funded as a EUR-OCEANS conference
The annual meeting of the IMBER ‘Human Dimensions Working Group’ (HDWG) (24-26 January, 1 February) aimed to further develop the ADApT Framework (‘Assessment from Description, Appraisal and Typology’). ADApT is a rapid integrated assessment and decision support tool to respond to global change in coastal regions. It is based on a global database of case studies that will take into account the highly interconnected natural and human systems of today. It will enable decision makers and local actors to triage and improve their response to global change, to make decisions efficiently for transitions towards coastal sustainability, and to evaluate where to most effectively invest funds to “reduce” vulnerability and enhance resilience of coastal peoples to global change. The WG finished its meeting with a working plan to complete the first phase of ADApT by 2015.

The IMBER ‘Data Management Training Course and Workshop’ on 27 January aimed to enhance awareness of the need and benefit of establishing, early in the research process, good data management procedures, as those outlined in the IMBER Data Management Cookbook (www.imber.info/index.php/Science/Working-Groups/Data-Management/Cookbook), and to provide real-world examples of these data management procedures as implemented in IMBER research projects and related activities. Recommendations specific to the management of social science data were also discussed, in relation to the current IMBER emphasis on human-dimension topics. The audience was also invited to present immediate needs and gaps related to the data management in IMBER research projects. There are plans to extend the remit of the Cookbook in order to cover -omics data management and social data management for marine researchers.

Other meetings held in conjunction with IMBIZO III were:
- The annual meeting of the IMBER-LOICZ ‘Continental Margins Working Group’ (CMWG) (24-26 January; see more detailed article elsewhere in this LOICZ INPRINT). The objective was to further develop: a strategic paper on future continental margins research in line with the forthcoming ‘Future Earth’ research initiative (www.icsu.org/future-earth); an updated draft of the Science Plan and Implementation Strategy (SPIS) for IMBER-LOICZ continental margins research, with a stronger ‘human-dimension’ component; and the communication strategy for these activities. The CMWG strategic paper, will be structured around the three overarching scientific themes of the ‘Future Earth Initiative’, and three focus areas: ‘Types, functions and services of margins’, ‘Risks and innovation’, and ‘Governance’. It will draw on three case studies: ‘Deepwater Horizon oil spill’, ‘North Sea wind farming’, and ‘Opening of the Northwest Passage’.

IMBIZO III was sponsored by IMBER, the Indian Council for Scientific and Industrial Research (CSIR), the EUR-OCEANS Consortium, the Norwegian Institute of Marine Research (IMR), the US National Aeronautics and Space Administration (NASA), the Indian National Institute of Oceanography (NIO), the North Pacific Marine Science Organization (PICES), the US Ocean Carbon & Biogeochemistry programme (OCB), the Research Council of Norway (RCN), the Scientific Committee on Oceanic Research (SCOR), and the State Key Laboratory of Estuarine and Coastal Research (SKLEC) of the East China Normal University (ECNU).

Other meetings held in conjunction with IMBIZO III were:
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2 The three ‘Future Earth’ themes are: Dynamic planet; Global development; Transformation towards sustainability
IMBER-LOICZ ContinentalMargins Working Group, meeting 2013

Kon-Kee Liu1, Helmhuth Thomas2, Liuming Hu3, Hartwig Kremer4

1 National Central University, Taiwan, China (Taipei)
2 Dalhousie University, Canada
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4 Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, LOICZ-IPO, Geesthacht, Germany

Continental margins and shelf seas are increasingly subject to fast growing and often conflicting uses claiming sea and sea floor space. A future challenge for interdisciplinary research will be to find informed ways of balancing between protection and trade-offs. This applies to traditional activities such as expanding off-shore oil and gas exploitation as well as future non-renewables such as methane hydrates; however, it also applies to efforts aiming towards adaptation to global and climate change. As a consequence coastal and shelf seas are one of society’s priority frontiers, where new concepts of carbon sequestration and storage, off-shore sea ports and air fields and renewable energy are evaluated and pilot activities developed. The context emerges from the global discourse on adaptation through green (and blue) economy development thus fostering societal transformation to sustainability.

The challenge arising from the risks and opportunities in this new frontier demands the researchers to provide the knowledge needed for society to respond to, cope with and adapt to global environmental and societal changes. It is also for the institutions including markets, civil society and policy to enable collectively the appropriate means of governance that provides the platform for sustainable management and transformation.

In this context the LOICZ-IMBER co-supported Continental Margins Working Group (CMWG) held its 2013 meeting in Goa, India in January in conjunction with the IMBIZO III Meeting (http://www.imber.info/index.php/Meetings/IMBER-Sponsored-and-Endorsed-Meetings/2013/IMBER-IMBIZO-III-28-31-January-2013-Goa-India). Five members of the CMWG, two guests and four members of the International and Regional Project Offices of LOICZ and IMBER attended the meeting (See Table 1).

The objectives of the meeting were:
1. To complete the first full draft of the strategic scientific paper. 2. To set the course for finishing the draft of the Science Plan Implementation Strategy (SPIS) for future continental margins research. 3. To discuss how to publicize the research strategy and to promote the SPIS in the future.

The Working Group spent most of the time working on the strategic paper first by setting the general direction of the paper, structuring the logic of the approach and filling in some details of various parts. The general direction was to set continental margins research agenda in light of the Future Earth Initiative. It was decided that the paper should be structured in terms of the Future Earth framework and illustrate the current and emerging challenges and pressures affecting continental margins as a key domain of future competing sea uses. It was also decided that the strategic paper should serve as the guide for the Science Plan-Implementation Strategy.

Aside from working on the strategic paper, the CMWG also held a joint session with the Human Dimensions Working Group of IMBER co-chaired by Alida Bundy, Marie-Caroline Badjeck, and Moenieba Isaacs. The two working groups exchanged ideas on future development. It was clear that future interaction and collaboration between IMBER and LOICZ in this working group and beyond would be mutually beneficial and a model for Future Earth. The main conclusions of the meeting and actions needed are summarized below:

1. The strategic scientific paper: It is structured around the integrated research framework of the Future Earth Initiative, namely, “Dynamic planet, Global development, and Transformation toward sustainability”. It will address these themes in 3 arenas: Types, functions and services of continental margins, Risks and innovation, and Governance. 3 examples will be provided illustrating shelf sea uses, risks and opportunities: Deepwater Horizon oil spill and its environmental and governance implications, North Sea wind farming as a major investment into renewable energy, and Opening of the Northwest Passage bringing opportunities and risks for transportation and Arctic people. The paper shall be published in a high profile scientific journal. CMWG members currently complete the draft for final review and editing.

2. The continental margins Science Plan-Implementation Strategy: It should be structured according to the strategic scientific paper to contribute to the priorities of the Future Earth Initiative. Material compiled for the early draft will be reviewed to mirror the new structure, and new materials are needed, especially, on the human dimensions of accelerating continental shelf sea use and change. It is desirable to publish the SPIS in a refereed journal, such as the special issue of J. Mar. Systems for IMBIZO III workshop 1. CMWG members will work on the SPIS and aim to complete.
a draft by the end of May 2013 so that it may be viewed by IMBER and LOICZ SSC members.

3. Terms of reference (ToR of the IMBER – LOICZ CMWG): this will be updated to fit the changing landscape of the Earth system sciences, namely, the inauguration of the Future Earth Initiative to which the projects have been invited to contribute with their individual and collective scientific agendas. The CMWG co-chairs will modify the ToR, distribute it for comments, and finalize it for approval by the IMBER and LOICZ SSCs this year.

Members
LIU Kon-Kee (Co-chair)
National Central University, Taiwan, China (Taipei)

THOMAS Helmuth (Co-chair)
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LOICZ SSC Chair
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Save the date !!!

Future Oceans aims to
• highlight IMBER research results;
• promote integrated syntheses;
• develop a plan for the next phase of IMBER science, in the context of the new research initiative - Future Earth

Format
Day 1: Topical workshops that address aspects of IMBER science.
Day 2 – 4: Plenary and contributed sessions highlighting the main achievements of IMBER and forming a basis for planning future initiatives.

Read more on the conference website:
‘Young LOICZ’ within the research network on Global Environmental Change in coastal zones

Through its network of young scientists LOICZ seeks contributions from natural and social sciences dealing with Global Environmental Change (GEC) in the coastal zone. Much of the work in projects, program related initiatives or long term studies contributing to coastal Earth System science is being carried out by young scientists working as students either on master course or PhD and Post-doc level.

In general LOICZ provides an opportunity for scientists to communicate, discuss and disseminate outputs of their research and making them widely available to the audience of scientific peers, the general public, and decision-makers in policy and practice. Means of choices are peer-reviewed articles, content specific volumes in journals, book chapters or grey literature products (as e.g. Research & Studies Reports, policy papers or newsletters). In order to improve visibility of early stage research and to introduce young scientists into the global research community LOICZ support builds upon three major pillars:

1 - Affiliation of PhD studies and early career scientists network to LOICZ

Young scientists are encouraged to affiliate their PhD or Post-doc studies to LOICZ and there is a growing interest. Through their work and studies being generated under the supervision of well-known peers from global research institution contribute to the following issues:
1) achieving the goals, aims and objectives outlined in the LOICZ Science Plan and Implementation Strategy (SPIS) (currently under revision),
2) contributing to the LOICZ hotspots or cross-cutting activities and thereby filling into the overall outcomes in these focal areas,
3) help shaping a future LOICZ fitting into new international research arenas and initiatives, such as the Future Earth initiative (http://www.icsu.org/future-earth).

An actual study contributing to the LOICZ Hotpot on ‘Islands at Risk’ is carried out and outlined by Jan Petzold from the University of Hamburg. His work on ‘Social Capital and Adaptation to Sea-Level Rise on Small Islands’ deals with adaptive capacities in island communities towards climate change and resilience in the coastal zone. An extended introduction to this study can be found on the following page.

Link to the project ‘Social Capital and Adaptation’ on the LOICZ website:

In early 2012 the Association of Polar Early Career Scientists (APECS) joined LOICZ as affiliated research initiative. APECS is an international and interdisciplinary organization for undergraduate and graduate students, postdoctoral researchers, early faculty members, educators and others with interests in Polar Regions and the wider cryosphere. Aims of getting APECS involved in LOICZ is to support an intense interdisciplinary exchange between GEC researchers working on changes in the Artic coastal zones and APECS scientists.

Link to APECS on the LOICZ website:

2 - Contributions to LOICZ related Workshops and Conferences

Associates of LOICZ affiliated projects play a significant role in contributing to workshops, conferences and meetings organized or supported by LOICZ. The LOICZ Open Science Conference held in 2011 in Yantai - China was a show case for linking science not only from different disciplines but also from different stages of career. A single forum for 25 early stage researchers from around the world was designated to enhance capacities for global change mitigation with a focus on Asia-Pacific coastal zones. Apart from taking part in teaching lessons, the young scientists were introduced to the network of global earth system science research and presented and discussed their research at the conference.

3 - Involvement in LOICZ related Master and PhD study courses

Through its training activities for postgraduate and post-doc students LOICZ offers early stage researchers to participate in several Erasmus Mundus programs. These programs provide studentships for young scientists from all over the world to get involved in focused and cutting-edge research. Currently students can apply for two master courses one on ‘Ecohydrology’ coordinated by the University of the Algarve (Portugal), and one on ‘Water and Coastal Management’ coordinated by the University of Cádiz (Spain). Furthermore a course on ‘Maritime Spatial Planning’ will be established. Please find links to the different master courses here: 
Erasmus Mundus Master Courses
• Ecohydrology, URL: http://ecohyd.org/web/
• Water and Coastal Management, URL: http://www2.uca.es/serv/catedra-unesco/erasmusmundus/wacoma/index.htm
• Maritime Spatial Planning (to open in 2013/2014), URL: http://www.uac.pt/msp

A special PhD Course program coordinated at the University of Cádiz (Spain) focuses on ‘Marine and Coastal Management’, URL: http://www2.uca.es/serv/catedra-unesco/erasmusmundus/macoma/index.htm.

In 2011 LOICZ IPO hosted Interns who worked on nutrient budgets and on typology methods. Various SSC members invited and hosted young researchers in LOICZ projects. Furthermore, the LOICZ science community and in particular past and present members of the LOICZ SSC provide research opportunities and a growing number of developed capacity building modules in their respective research fields and at their host institutes or abroad.

Concluding remark
In order to successfully support and further develop an existing network of Global Environmental Change Researchers we believe that it is highly needed and mutually beneficial to build upon early stage expertise and motivation. This will help to increase “capacity building in science, technology and innovation, especially in developing economies and engagement of a new generation of scientists” which is meant to be one major task of the new Future Earth initiative towards a research for global sustainability (http://www.icsu.org/future-earth).

New PhD study and LOICZ affiliated project matches the LOICZ scientific hotspot ‘Islands at Risk’

Social capital and adaptation to sea-level rise on small islands

Jan Petzold (Institute of Geography – University of Hamburg, CliSAP Centre of Excellence, supervised by Prof. Dr. Beate M.W. Ratter)

In the course of the debate about the consequences of global climate change one issue is particularly in the focus of scientific and public attention: sea-level rise. By melting glaciers and ice sheets and thermal expansion of water masses in the last century, a significant rise in sea level has been noted. In future a further increase is expected – whether emissions will be reduced or not (Mimura et al. 2007). Therefore, it is essential to deal with the consequences of this development.

Among the most affected regions from sea-level rise are islands – and small islands in particular (Kelman & West 2009). Thus, before any other environmental change, the most evident problem and probably the “greatest potential threat” (Byrne & Inniss 2002: 10) to small islands is global climate change with its various consequences. An observed sea-level rise of 20cm during the last century already caused coastal land loss. A further rise of several meters would cause major problems not only for flat islands such as the Maldives or Tuvalu with highest elevations less than two meters (Walker & Bellingham 2011: 298). Moreover, sea-level rise causes increased salt water intrusion, flooding of fresh-water wetlands and valuable agricultural zones (Walker & Bellingham 2011: 298; Byrne & Inniss 2002: 9). Further consequences of climate change include increased storm activity, to which small islands are particularly vulnerable (Byrne & Inniss 2002: 9) and changes in precipitation patterns making dry islands drier and influencing composition of vegetation (Walker & Bellingham 2011: 297). This intensifies the problem that small islands already suffer from very limited catchment areas for precipitation, causing widespread water scarcity (Royle 2001: 63).

Due to problems such as very limited natural resources and economic disadvantages on the global market, small islands are often regarded as particularly vulnerable places, not only to environmental stresses. Other scholars, however, suggest that island societies feature a particular socio-cultural resilience, which distinguishes them from continental societies. The suggested vulnerability may even lead not only to particular economic and political conditions but also to particular social structures. Baldacchino (2005: 32) suggests that
“small island territories may be the best sites for seeing the effects, or absence, of a strong social fabric”. Regarding environmental change on small islands, Barnett (2003: 322) points out that “subsistence economies (…) are often more resilient, at least to weather extremes and climatic change, than suggested by their economic structure”. Certainly, small islands represent a very distinct object of research due to their issues of scale as well as issues of isolation (Kerr 2005: 508).

The concept of social capital can be considered as applicable in order to understand the role of social networks and relations of norms and trust in a context of adaptive capacity. The question is if small islands, in fact, show a particularly high social capital, and if this increases island resilience towards climate change. The concept of social capital, especially in the context of geography, is based on the findings of Putnam (1993). He defines social capital as “features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions” (Putnam et al. 1993: 167). The concept found very broad application within the last decades in a wide range of disciplines (Mohan & Mohan 2002). “In the context of local vulnerabilities to flood hazard”, Pelling (1998: 470) characterizes social capital as “both the quantity of social co-operation (for example: whether responses to cope with environmental hazards take place individually within households, or collectively between households), and the quality of this organization (for example: the inclusiveness, transparency and accountability of decision-making institutions)”.

In this thesis I argue that social capital can play an active role for island societies in tackling the challenges imposed by global climate change. However, beyond the currently widespread use of the term “social capital”, as a mere indicator of institutionalized social networks, the concept needs further research and empirical prove. Under which circumstances does social capital develop? How is it framed and can it increase adaptive capacity? Is this something island-specific? If not well integrated in political and economic macro-structures can a high degree of social capital even lead to the failure of adaptation processes?

A comparative analysis of two island case studies will be used to prove, which role social capital can play for the adaptive capacity of small islands. The case studies selection is based on firstly, the relevance of sea-level rise, such as small and low-lying islands, and secondly, on social and political structures featuring a certain degree of autonomy. Expert and stakeholder interviews as well as household surveys will be used in order to analyze how social networks and relationships influence decision-making relating to sea-level rise adaptation measures, and how institutional structures allow for public participation.

References


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LOICZ website and Media

LOICZ Affiliated Portal

We are happy to announce the setup of the new LOICZ Affiliated Portal. The new portal is completely integrated in the LOICZ website so that new users can directly access it for subscribing new projects. Likewise already registered principal investigators can update their personal data and project information and subscribe a new project for affiliation.

http://www.loicz.org/main

Background of the LOICZ Affiliated Project platform

Since 1993 LOICZ offers research projects the opportunity to contribute to the wide network of Earth system researchers working on issues of system change and sustainability in the coastal zone. LOICZ supports this exchange first by offering projects to promote and share scientific results with the wider science community and secondly by providing the necessary infrastructures. Since the early days over 400 international, national and regional projects contributed their invaluable expertise voluntarily to LOICZ via this platform.

In the recent years starting in 2008 the LOICZ database was the major technical means of choice for principal investigators to subscribe their project information and to give their projects a wider visibility. Principal investigators of around 80 affiliated projects (since 2008) used the service to affiliate their research to LOICZ. This motivated us to replace the old database by an improved modern Affiliation Portal.

Current projects including LOICZ Topics can be visited here:
http://www.loicz.org/projects/current/index.html.en

Current projects including LOICZ Hotspots can be visited here:
http://www.loicz.org/projects/hotspots/index.html.en

Past projects can be visited here:
http://www.loicz.org/projects/past/index.html.en

We are looking forward to continued efforts of active project coordinators and managers world wide to affiliate their research to LOICZ. Thanks is due to all recent affiliated projects for their support in sharing project results and activities with the wider community of Global Earth System scientists working on coastal zones.

It took us quite some time to design and integrate the new LOICZ Affiliated Portal into the website. Thanks to all who have supported our work with patience in particular Patrick Kalb-Rottmann (Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research) and Markus Arndt (Consultant Imperia AG).

Starting shot for the LOICZ Affiliated Portal in early March 2013.

From left: Marcus Lange, Barbe Goldberg, Patrick Kalb-Rottmann.
LOICZ feels that it is very important to reach out and include the work of previous SSC members. We had asked former or rotating SSC members to reflect on LOICZ science based on their past involvement and future perspectives. The outcome is nine of so-called “LOICZ Heritage Lectures” which we allocated as Streaming media files on the LOICZ website. Recently, due to internal reasons calling for a reorganisation of this outreach platform we decided to switch from the streaming media technology to a different set up. On January 09th LOICZ has uploaded all Heritage Lectures as “Flash Movies” on You Tube. Now we are very excited that these Heritage Lectures are still available on the LOICZ website and additionally on our LOICZ You Tube Chanel. People interested can still follow the lectures (Audio and video). Looking at the corresponding Power Point Slides they now need to open an extra window for PPT and they need to click forward by themselves.

**Heritage Lecture at LOICZ Open Science Conference 2011, 12-15 September 2011**

- P.M. Syvitski: Deltas Under Climate Change - The Challenges of Adaptation
  
  Deltas Under Climate Change - The Challenges of Adaptation (Part 1)
  
  Deltas Under Climate Change - The Challenges of Adaptation (Part 2)

  
  

**Heritage Lecture at LOICZ 22. SSC Meeting in Yantai, China, 08-10 September 2011**

- Dennis Swaney: Reflections on Some Human Dimensions of Coastal Nutrient Fluxes
  
  Reflections on Some Human Dimensions of Coastal Nutrient Fluxes (Part 1)
  
  Reflections on Some Human Dimensions of Coastal Nutrient Fluxes (Part 2)

**Heritage Lecture at LOICZ 21. SSC Meeting in Mamallapuram, India, 02. - 04. March, 2010**

- Bernhard Glaeser: Beyond Natural Hazards
  
  Bernhard Glaeser: Beyond Natural Hazards (Part 1)
  
  Bernhard Glaeser: Beyond Natural Hazards (Part 2)

**Heritage Lecture at LOICZ Dahlem-Type Workshop in Kjeller, Norway, 15. - 19. June, 2009**

- Bill Dennison: Catalyzing a paradigm shift: Subsustainability of the coastal zone
  
  Catalyzing a paradigm shift: Subsustainability of the coastal zone (Part 1)
  
  Catalyzing a paradigm shift: Subsustainability of the coastal zone (Part 2)

- Kerry Turner: Ecosystem Services and Coastal Zone Management
  
  Ecosystem Services and Coastal Zone Management (Part 1)
  
  Ecosystem Services and Coastal Zone Management (Part 2)
IASC BULLETIN 2013 IS AVAILABLE

Each year the International Arctic Science Committee (IASC) reports on its activities and highlights international Arctic science initiatives in its Bulletin. The 2013 Bulletin is now available for download on the IASC website.

For a digital copy, please use the following link and learn more about the LOICZ affiliated project Arctic Coastal Dynamics (ACD) on page 56.

www.iasc.info/index.php/home/service/media/print

Contact for print version:
Ursula Heidbach
International Arctic Science Committee (IASC)
Telegrafenberg A43, 14473 Potsdam, Germany
Secretariat +49-331-2882214
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www.iasc.info

Have you seen?

• Peter Burbridge: The “So What” and LOICZ
  The “So What” and LOICZ (Part 1)
  The “So What” and LOICZ (Part 2)

• Liana Talaue McManus: Plankton, fluxes & futures
  Plankton, fluxes & futures (Part 1)
  Plankton, fluxes & futures (Part 2)

• Nancy N. Rabalais: Scientist Citizen - Can a Scientist Influence Policy?
  Scientist Citizen - Can a Scientist Influence Policy? (Part 1)
  Scientist Citizen - Can a Scientist Influence Policy? (Part 2)

Heritage lectures on LOICZ website:
http://www.loicz.org/mediacentre/heritage_lectures/index.html.en

Heritage lectures on YouTube:
https://www.youtube.com/user/LOICZchannel
YOUMARES 4

YOUMARES is the name of the international conference of young marine researchers and engineers organized by the working group on 'Studies and Education' of the German Society for Marine Research (DGM).

This event addresses all young marine scientists and engineers from various disciplines of fundamental and applied research, industry and other relevant fields, from Germany, Europe and the rest of the world.

YOUMARES 4
"From coast to deep sea: multiscale approaches to marine sciences"
will take place in the “Alter Landtag” in Oldenburg from 11th to 13th of September 2013 together with this year’s partners, the University of Oldenburg and the Institute of Chemistry and Biology of the Marine Environment (ICBM).

The global job market for marine sciences is quite diverse as the field not only relies on classical basic research but, to a growing proportion, also on politics, economics and applied research. Innovative projects and new technologies are, however, demanding for qualified employees. Young university graduates, inexperienced scientists and engineers might get lost in the jungle of research institutes and small and medium sized companies.

During the annual YOUMARES convention we are providing a platform to present, connect, learn and discuss amongst multiple disciplines and different levels of qualification.

Since 2010 we have successfully conducted three conferences: in the Centre for Marine and Atmospheric Sciences, Hamburg (2010), the German Maritime Museum, Bremerhaven (2011) and together with the Fraunhofer Research Institute for Marine Biotechnology (EMB), Lübeck (2012). The Young Science Committee, a group of master-, PhD-students and young post docs guarantees a well-balanced mixture of fresh input and provides the foundation for the scientific quality of the convention. Participants have the chance to get involved in each of the conference’s tasks: present a poster, give a talk or chair a session. The organizing team itself consists of a group of young dynamic researchers, motivated to prepare another successful YOUMARES.

Along with 14 hot topics, ranging from coral reef ecology over remote sensing and oceanography to sustainable fisheries and aquaculture, YOUMARES 4 offers a great diversity of keynote talks, excursions and seminars to support the interdisciplinary and intercultural communication.

This year’s YOUMARES AWARD is dedicated to the topic of “The coastal ecosystem – between dykes and the high sea”. The award consists of a travelling trophy sponsored by HYDRO-BIOS, free conference participation, and a 10-day course at the HYDRA Institute of Marine Sciences on the Island of Elba, Italy. Student papers of about 5,000 words may be submitted until 20th of July 2013.

An important side event is the meeting “From science into business” - Future challenges for marine scientists and engineers. On September 12th we are inviting under the patronage of the German Association for Maritime Technology (GMT e.V.) to enjoy an evening dedicated to joint projects between scientific institutes and private enterprises.

For more information, e.g. about how to give a talk or hand in your submission for the YOUMARES Award, as well as the latest news, please visit our website at:

www.youmares.net
Interdisciplinary Conference of Young Earth System Scientists 2013

Understanding and Interpreting Uncertainty

22 - 25 September 2013, Hamburg, Germany

Join ICYESS, an international and interdisciplinary conference organised by and for young scientists (Master’s and PhD students as well as young PostDocs). ICYESS brings together scientists from various disciplines including natural, social and political sciences, economics and sustainability research.

The conference is organised by young scientists from various institutes and disciplines from different countries, in close collaboration with the School of Integrated Climate System Sciences (SICSS) and the Young Earth System Scientists community (YESS). It is funded by the Körber Foundation, the German Climate Consortium (DKK) and the Cluster of Excellence CliSAP via SICSS (Hamburg), and supported by the Clusters of Excellence MARUM (Bremen) and Future Ocean (Kiel)

Submission Deadline: June 1, 2013
Contact: icyess2013@yess-community.org

http://meetings.copernicus.org/icyess2013/

Future Megacities in Action - Innovative Solutions for Energy- and Climate-Efficient Urbanisation

Innovative Solutions for Energy- and Climate-Efficient Urbanisation
May 14-16, 2013 in Hamburg (Germany)

Conference website: http://www.future-megacities-2013.org/home.html

The Tsunami and Earthquake impact on Tourism in Miyagi Prefecture and Sanriku Coastline

-An Overview-
Vicente Santiago-Fandiño
v.santiago.f@gmail.com

Abstract
The Pacific coast of Japan and particularly the northeast section suffered a catastrophic experience due to a series of earthquakes and tsunami occurred in March 2011. Great damage resulted in well-known tourist areas and infrastructure along the Sanriku coastline in Miyagi, which was one of the hardest hit prefectures. Most of its tourism facilities, recreation and natural spots, transportation and communication network were devastated and or washed away. Likewise, many protected areas, which included popular beaches and lowlands along this coastline suffered important environmental impacts including erosion, abrasion and deep ecosystem alteration. After more than one year the tourism industry is struggling to come back mainly due to fears by tourists about the radiation left from the Fukushima nuclear plant, feelings of mourning by the Japanese population as well as funding and internationally related conflicts. To bring back tourism the central and local governments are setting-up programs for restoration of infrastructure and facilities, ecotourism activities as well as new large national park, which will connect historical sites, museums and also encourage research amongst many other aspects.

Japan is located along an active seismic area in the Pacific known as the Belt of Fire covering a large expansion including the countries found in the northwest coast of the American continent, most of Oceania and the East coast of Asia.

The northeast coast of the country was hardly hit by the earthquake and tsunami of March 2001. Miyagi (figure 1) was amongst the most affected prefectures including the shared Sanriku coastline expanding for about 600km.

The latter has a characteristic zipper-like coastline known as the Rias Coast known for its natural beauty featuring sandy beaches, cliffs, picturesque small islands covered by pine trees (figure 2), and agricultural lowlands, added to the excellent quality of seafood makes the region to be prime tourist attraction.

The tsunami and earthquake in Miyagi destroyed or badly damaged near 85,000 buildings including apartments and houses amongst others, hundreds of kilometres of roads, large number of protecting sea barriers and beaches along the coast (figure 3). The Police Agency of Japan stated in September 2012 that the human losses neared 9,530 people and 1359 were not accounted for.

Figure 1: Japan and the hardest hit tsunami areas (coloured). Red dot corresponds to the earthquake epicentre. (graphic: Vicente Santiago-Fandiño)

Figure 2: Typical islet in Sanriku covered by Japanese pine trees. (photo: Vicente Santiago-Fandiño)
The Japanese government established the Reconstruction Agency to work as leader and coordinate policies and projects with local governments and municipalities as well as overlook at budgetary aspects. In Miyagi, a 20 years programme encompass reconstruction, restoration and development highlighting ten Priority Recovery Points which include tourism.

Japan has long been a country of great interest to visiting tourists and the tourist industry has become an important sector for the country, representing almost 5% of the GDP, while at a local level the economic impact has been substantial, providing jobs as well as wealth. The industry mainly benefited after the “Visiting Japan Campaign” was launched in 2003, which resulted in an increase of tourists up to 8.3 million, however, from 2007 the number decreased to 6.7 million in 2009 due to the recession in the global economy and the swine flu epidemic. Although in 2010 the numbers picked-up again to more than 8 million, continuing through early February 2011, a reduction of 72.2%, totaling only 6.22 million tourists occurred after the March 11 catastrophe due to concerns of radiation exposure from the damaged Dai-Ichi Nuclear Plant in Fukushima Prefecture. In 2012, the central and local government has campaigned to reassure foreign visitors that the country is safe, resulting in a slow, steady increase of tourism, although the recent territorial dispute between the Japanese and Chinese governments over the Senkaku islands has considerably dampened the number of visitors from neighboring countries.

Various prefectures in Tohoku, including Miyagi and Iwate, have been important destinations for tourism from other prefectures, particularly along the Sanriku coastline as visitors from overseas are limited comparatively speaking. The domestic tourism industry has played an important part in the prosperity of the local economy, particularly during the summer time when visitors look for high quality seafood, beaches and sightseeing along the coast at Minami Sanriku Kinkasan-Quasi Natural Park and other places of interest (Figures). Special festivals like the Tanabata Matsuri, held in the city of Matsushima, and the scenic beauty of this city are considered to be one of the three most beautiful places in Japan, with more than two million visitors.

The tourism industry of East Tohoku on Miyagi prefecture's coastline suffered direct consequences of the March 11 events as railway lines, roads, beaches and rias, fishing facilities and grounds as well as hotels and ryokans or Japanese-style inns were wiped out.

The remaining infrastructure has played an important role in relief efforts as a large number of people affected by the tsunami and earthquake were given shelter in hotels and inns, following the Disaster Relief Act.

Prior the March 11 events, fisherman, aquaculture practitioners and sea-farmers also benefited from tourism activities as visitors fueled local economies like in Matsushita city by using traditional accommodations (ryokans), hotels and seafood restaurants. Running along the Sanriku coastline, JR Kessenuma railways was another popular attraction but was totally destroyed by the tsunami and is presently being considered for rebuilding, while the Senseki JR line running from Sendai to Ishinomaki city has already been partially rebuilt.

Almost all cities on Miyagi's coastline particularly the sections facing the sea were destroyed by the tsunami of 2011, with the exception of Sendai and Matsushima city, the former due to the size and inland grow while the latter due to the presence of more than 200 islets. In Matsushima, the presence if this number of pine-covered islets makes it to be one of the most beautiful sites in Japan, and although also affected by...
the tsunami and earthquake, the city held a number of local festivals in the summer of 2012 like the above mentioned Tanabata Festival which draw large audiences. However, the turnout of tourists was only a fraction compared to previous years (3.7 million) due mainly to fear of exposure to radiation from The Dai-Chi Fukushima nuclear plant. Furthermore, the feelings of mourning and respect for the deceased throughout the nation is slowing the comeback of the affected area’s domestic tourism industry. Surprisingly, however, foreign tourists from China, Taiwan, South Korea and the USA have been the most common nationals visiting Miyagi’s cities after the catastrophic events.

Miyagi has a number of protected areas as of April 2012 and will further increase or restructure many which certainly would help tourism development.; Moreover, it has produced a tourist guide highlighting aspects such as history, nature, delicacies, festivals, and museums as well as an information campaign to revitalize the tourism industry (figure 5). The guide also provides a link to major tourist cities and towns allowing visitors to see how they are developing and the current status of various areas after the March 11 events. The Japan National Tourism Association also provides useful information about Miyagi Prefecture in this official guide.

The prefectural government has also developed a set of policies to build extensive transportation networks within and outside the prefecture connecting with other destinations in the Tohoku region. The Spring 2013 Sendai-Miyagi Destination Campaign, is a collaboration between the prefectural government and the private sector to attract events and international conferences via new transportation conduits and the establishment of the Sanriku Reconstruction National Park in order to encourage and promote a wide range of research topics on the disaster of March 11.

The initiative to establish the Sanriku Reconstruction (Fukko) National Park, which aims at reconstructing and renovating damaged natural parks (figure 7) due to the March 11 events as well incorporating them all, will be established in consultation with local authorities and citizens. One of the main objectives will be to promote ecotourism, in which the provision of areas for utilizing knowledge and experiences drawn from local culture and lifestyles will be considered, raising awareness and preparedness for natural disasters as well as post-disaster waste management. Furthermore, a long distance nature trail or Tohoku Coast Trail will be designed, utilizing the large existing network of hiking paths, which in some sections will also serve as evacuation routes in cases of natural disasters.

Geo-tours are envisaged to show the rich geology and fossils of the area, and centers for interpretation as well as environmental education and campaigns to raise awareness will be created and organized to teach the concept of the “open field museum” and history of earthquakes and tsunamis in the region. One of the most important and unique points will be the studies and monitoring of tsunami-damaged ecosystems, such as tidal flats and seagrass beds, to assess their potential recovery.

Figure 5: Matsushima City poster for tourists in Sendai airport. (photo: Vicente Santiago-Fandiño)

Figure 6: Ryokan destroyed by the seaside. (photo: Vicente Santiago-Fandiño)

Figure 7: Oya Kaigan park and kessenuma railways line heavily damaged by the tsunami and earthquake. (photo: Vicente Santiago-Fandiño)
Although the tourism industry is still struggling to get by at the local level, there is some effort to rebuild businesses along the coastline, evidenced by the restoration of small and large hotels hotels and ryokans. Although most of the visitors are either professionals, workers or volunteers associated with reconstruction efforts, some larger hotels are also bringing tourists interested in witnessing the unimaginable destruction left behind by the tsunami and the place where some people sacrifice their lives for the benefit of others (figure 8). An international conference was held in Sendai in September 2012 brought the IMF and high-level World Bank officials as well as financial authorities from different countries to show the disaster-hit areas as well as share lessons learned from the experiences, which, in a sense, can be considered a new and novel attraction for the area's tourism trade for the time being.

On the other hand, the Japan Tourism Marketing Company has highlighted the need to develop a Tourism Management Plan to help the tourism industry to recover in hit areas while also developing and improving rescue activities and safety by the local and private sector in the case of the occurrence of large natural disasters.

Acknowledgements

The visit to the stricken areas and present research in Japan was possible thanks to the kind support of a number of individuals and professionals that the author highly appreciates. Special recognition is due to M. Nakayama, President and CEO of Nakayama Industries in Shiga Prefecture, N. Kimura from Kyoto University and C. Yoshimura. Likewise to K. Sakakibara in Tome City (Miyagi ken) and G. Grant (Shiga ken) for having provided valuable comments.

References


Condolesences

It is with deep regret and sadness that we announce the passing of

Carlo Heip
18.11.1945 – 15.02.2013

He was an eminent scientist, an engaged intellectual research leader. He played a pivotal role in the worldwide study and protection of marine biodiversity.

For LOICZ from its early stages onwards Carlo Heip was an important promoter. He recognized the global dimension of this Earth system science project and plaid a critical role in setting up national research agendas that mapped onto the global LOICZ with a focus on Netherlands and Belgium coastal waters.

We will remember him as a generous friend a competent and critical and open colleague and a warm person. In memory of his invaluable contribution to LOICZ and mobilizing this international platform for the national research communities we take the freedom to feature hereunder the interview Carlo Heip gave in the context of the Netherlands and Flanders LOICZ synthesis in 2011.

Interview with Prof. Dr. Carlo Heip


http://www.loicz.org/products/publication/reports/index.html.en

International collaboration
Carlo Heip, initiator and coordinator of the VLANEZO programme that merged with LOICZ in 2002. He describes the origins of the LOICZ-VLANEZO programme.

Heip: Vlanezo arose from the bordering countries’ policy of the European Union. The then Dutch Education minister, Jo Ritzen, initiated and funded two collaborative ventures for sea research. One was NEBROC (Netherlands Bremen Cooperation), and the other was VLANEZO (Flemish-Dutch Cooperation in Coastal Research). The research was managed by NWO (Netherlands Organisation for Scientific Research). VLANEZO focussed on the estuary that the Netherlands and Belgium share, the 160 kilometre-long estuary of the Schelde. The research covered the unique tidal area from Vlissingen to Ghent with tidal differences of up to seven metres at Antwerp and still two metres at the freshwater head of the estuary in Ghent. We wanted to understand the ecology of the estuary and especially to understand the ecological effects of the intertidal flats and the salt marshes.

In the 1990s the Schelde was regularly in the news and not just because of the silting problem and the accessibility of Antwerp ...

There were various problems such as chemical and organic pollution: the untreated wastewater from Brussels was then being discharged into the Schelde via the Zenne tributary. And on top of that there was the dossier about the deepening of the Westerschelde. We examined this from a biomorphological viewpoint, in other words: how do the various aspects affect each other? How do the habitats develop? How does the nitrogen-carbon cycle affect the system? At the start of the twenty-first century, the Schelde was a very damaged ecosystem. The freshwater part up until the border was a stinking anoxic water mass due to the organic pollution. In the saltwater part from the border onwards, the system was less damaged because the anoxic water was diluted with salty seawater. Since the construction of two water treatment plants in Brussels the situation in the Schelde has improved considerably.

What exactly could be investigated in a river that was so strongly polluted?

In the period that the river was anoxic, its ecology was dominated by nitrification, a process due to bacteria that use ammonium instead of the sun as an energy source. These bacteria oxidised ammonium into nitrite and nitrate using considerable quantities of oxygen in the process. We made an extensive study of that chemosynthesis process. The results revealed one advantage of that polluted situation: easily biodegradable organic material and carbon dioxide were removed from the system in a natural process. Now that the anoxic conditions scarcely apply, this no longer occurs.
And which research focussed on the Westerschelde?
A lot was already known about the macrofauna in that area. However, a gap in our knowledge were the microscopic organisms such as nematodes and diatoms. Diatoms, in particular, have a far from easy existence in the Schelde because the river is so turbid. At low tide, they photosynthesise as can be seen from the brown colour of the mudflats. These two studies have led to an enormous increase in our knowledge about organisms in the mudflats. They were found to be a large source of organic material. Birds can benefit from that at low tide and crabs and fish at high tide. They are, in effect, small factories of organic material.

In recent years (during the last Balkenende Cabinet) the Flemish-Dutch conflict about the deepening of the Westerschelde frequently made the news. Emotions often ran high.
Yes, there are proponents and opponents, but what are the facts? We barely know what the effects of deepening the Schelde are. Sediment transport is very difficult to understand and to model. The distance between Vlissingen and Antwerp is about 100 kilometres and some 10 million cubic metres of sediment is being dredged each year. If the process cannot be managed then the Schelde will silt up and Antwerp will lose its harbour function. One thing is certain: deepening the Schelde has created an imbalanced ecosystem. The Schelde is basically too deep for its width. We must examine the consequences of the third deepening of the Schelde, that is just finished now (2011) and where the geomorphological equilibrium point lies. One prediction is that the estuary may change from a multi channel system to a single channel system and that the morphology will be completely transformed. A Schelde without salt marshes and mudflats is beneficial for shipping but not for fish and for wildlife. That would mean that the objectives of Natura 2000 would not be achieved. Wrong decisions will have major economic and ecological consequences.

And then of course there is the coastal defence, the number one priority of water policy.
We have discovered that the plants, and in some cases the animals, are capable of stabilising sediments so that erosion is counteracted. A lot of research has been done on the formation of new salt marshes. A dike is strengthened if it has a salt marsh in front of it and that costs nothing. Islands of Spartina are the first stage of salt marsh formation. Over a period of several decades these islands develop into a new salt marsh that comes to lie in front of the old salt marsh. We have discovered that Spartina cannot grow at location with lugworms as these worms eat all the seeds. The Spartina capture sediments enabling the salt marshes to grow. You get a coastal defence free of charge and without any effort.
2013

Arctic Observing Summit 2013 (AOS 2013)
30 April- 2 May 2013
Vancouver, BC
Hyatt Regency
www.arcticobservingsummit.org

CoastColour and SeaSWIR User Consultation Meeting
09.-10.05.2013, Darmstadt
http://www.coastcolour.org/UCM_IV.html

Fourth Session of the Global Platform for Disaster Risk Reduction
19 - 23 May 2013, Geneva, Switzerland
http://www.preventionweb.net/globalplatform/2013/

The fourth IGCP 588: ‘Preparing for Coastal Change’
Conference in Chennai, India
20th May 2013 (Monday) – 24th May 2013 (Friday)
Contact: igcp588chennai@gmail.com

6th International Coastal Atlas Network Workshop
16-17 June 2013, Victoria, Canada
http://icoastalatlas.net

Joint Assembly Gothenburg: IAHS - IAPSO - IASPEI
"Knowledge for the future"
Gothenburg on 22-26 July 2013
http://www.iahs-iapso-iaspei2013.com/

Construction of artificial lands in the coastal and offshore areas
July 29 to August 3, 2013 in City of Irkutsk
Conference Hall of the Institute of the Earth’s Crust
www.irkutsk2013.crust.irk.ru

9th Baltic Sea Science Congress 2013 - New Horizons for Baltic Sea Science
August 26–30, 2013, in Klaipėda, Lithuania
http://corpi.ku.lt/bssc2013/

8th IAG - International Conference on Geomorphology
"Geomorphology and Sustainability"
27-31 August, 2013, PARIS
http://www.geomorphology-iag-paris2013.com

ESA Living Planet Symposium
09-13 September, Edinburgh
http://www.livingplanet2013.org/index.asp

YOU MARES 4
"From coast to deep sea: multiscale approaches to marine sciences"
11.-13. September 2013
Oldenburg, Germany
www.youmares.net

Interdisciplinary Conference of Young Earth System Scientists 2013
Understanding and Interpreting Uncertainty
22 - 25 September 2013, Hamburg, Germany
www.icyess.eu

Aquaculture Forum Bremerhaven Workshop IV
Developmental Trends and Diversification in European Aquaculture
Bremerhaven on 23 -24 September 3013
http://www.aquaculture-forum.de/en/workshop-iii/program.html

ECSA 53: Estuaries and coastal areas in times of intense change
13 – 17 October 2013, Shanghai, China
http://www.estuarinecoastalconference.com

EMECS 10 - MEDCOAST 2013 JOINT CONFERENCE
30 Oct - 03 Nov 2013, Marmaris, Turkey

International Symposium on Connectivity of Hill, Human and Ocean (CoHHO)
Integrated ecosystem management from Hill to Ocean
26 – 27 November 2013, Kyoto 606-8501, Japan
http://fserc.kyoto-u.ac.jp/cohho/en/
2014

Global Land Project (GLP) 2014 Open Science Meeting (GLP OSM)
19th - 21st March 2014, Berlin, hosted by Humboldt University
www.glp-osm2014.org

Arctic Science Summit Week (ASSW) 2014
Helsinki (Finland) on 7-12 April 2014
include the 2nd Arctic Observing Summit (AOS)

4th iLEAPS Science Conference
Terrestrial ecosystems, atmosphere, and people in the Earth system
12-16 May 2014 Nanjing, China
Conference website: www.ileaps-sc2014.org

Coastal Zone Canada Conference 2014 (CZC2014)
15-19 June 2014, Halifax, Nova Scotia
Halifax, Canada
http://www.czca-azcc.org/

Future Oceans
Open Science Conference
23-27 June 2014, Bergen, Norway

2015

INQUA Congress (International Union for Quaternary Research)
July 27 to August 2, 2015, Nagoya
Good opportunity to have sessions on deltas and Holocene sea-level changes
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