



2009 · Issue 1

ISSN 2070-2000

Land-Ocean Interactions in the Coastal Zone

INPRINT

Sea level rise and storms threaten small islands (Photo: Bernhard Glaeser)

Contents

options for improving links between the ecological and social systems, including payments for ecosystem services, and building resilience and adaptive capacity to protect the GBR.

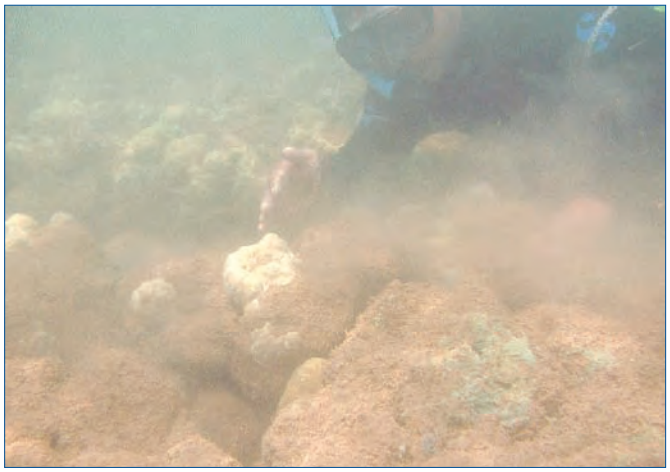
In the ecosystem value section, J. Rolfe (CQU) provided an overview of non-market valuation techniques that are relevant to the Great Barrier Reef, and illustrated some results of recent studies. N. Stoeckl (JCU) reviewed the studies that have estimated economic values associated with ecosystem services in the Great Barrier Reef region. She highlighted gaps in current knowledge that warrant further investigations.

In the threats to the GBR session, K. Fabricius (AIMS) showed that the reefs of the Great Barrier Reef have been losing >0.25 % coral cover per year since ~1970, due to cumulative disturbances. She provided an overview of the main past and present disturbances to the Great Barrier Reef. She discussed how the intensity, frequency and types of threat are continuing to change with increasing CO_2 levels and an exponentially growing human population.

In the ecosystem services overview session, R. Costanza (U. Vermont) demonstrated how an ecosystem services based approach can assess the trade-offs inherent in managing humans embedded in ecological systems. Evaluating trade-offs requires both an understanding of the biophysical magnitudes of ES changes that result from human actions, as well as an understanding of their impact on human well-being, broadly conceived. The state of the art of ES assessment and modeling was discussed, including the potential of integrated ecological economic modeling. A discussion followed among the 70 participants, moderated by G. Lukacs (JCU); the common thread emerged that (1) the GBR ecosystem is not as resilient as we had thought; (2) it is suffering a lot more from human impact than the politicians and tourist brochures say; (3) the assessment of its ecosystem services need much attention; (4) the survival of the GBR depends on co-managing the land and the sea, something which is not done at present and which could be done using ecosystem services as a common currency for the land and the sea. There is no common currency at present; (5) research much focus on the continued supply of ecosystem services to provide a bridge between various disciplines of science and with the human dimension to help ensure the future of the GBR; (6) Major reform across all levels of state and Commonwealth governments to focus on sustaining ecosystem services in the whole GBR ecosystem (land and sea) may be necessary to achieve the above.

Contact: eric.wolanskl@jcu.edu.au

Healthy inshore reef *(Photo: L. McCook)*



Suffocated inshore reef *(Photo: R.H. Richmond)*

Deltas at Risk

Ilan Kelman

From New Orleans to Bangkok, from the Okavango to the Volga, more than 350 million people worldwide live in deltas. At least the same number depends on deltas for their livelihoods plus hundreds of millions more people affect, and are affected by, deltas every day. As an interface between bodies of water and land, along with land deltas and dry deltas, deltas often represent the end of rivers yet are a rich mine on which ecosystems and societies have been built.

Deltas are shaped by physical, biological, and social processes. Physical processes include tides, waves, currents, flow rates, and rainfall. Ecosystems affect erosion, create microclimates, and contribute nutrients and nutrient cycling. People dredge and dig, direct rivers and build structures, introduce and exterminate biota. Different cultures have different perceptions of risks and opportunities while fulfilling different needs and desires for livelihoods and luxuries.

These complexities lead to significant challenges in understanding and managing deltas and their regions of influence. They also highlight the dangers facing deltas. Poorly constructed buildings are raised within the river and coastal floodplains and on delta soils prone to liquefaction during earthquakes. Endangered species find homes in deltas caught between interests vying for protected areas, resource extraction, and subsistence living. Environmental changes far away, for instance deforestation, alter a delta's structure and functions (Restrepo & Syvitski 2006).

To understand, and to develop solutions for, these threats and vulnerabilities, a scoping workshop was held in Boulder, Colorado, USA in September 2007 on "Deltas at Risk" or, more formally, "Dynamics and Vulnerability of River Delta Systems". Research and application challenges from deltas were explored by twenty-five attendees from four continents. From modeling geomorphological dynamics (Kubo et al. 2005) to implementing disaster risk reduction (e.g. O'Brien et al. 2006, for comments on hurricane risk reduction for the Mississippi River delta) to overcoming legal and resource challenges in transboundary regions (e.g., Glantz 2005, for Aral Sea deltas), diverse topics were examined in order to establish the pressing research and application questions and the data and techniques available for tackling those questions.

The workshop was hosted by the Institute of Arctic and Alpine Research (INSTAAR; http://instaar.colorado.edu) at the University of Colorado and was sponsored by the Global Water Systems Project (GWSP; http://www.gwsp.org), Land-Ocean Interactions in the Coastal Zone (LOICZ; http://www.loicz.org), and the Community Surface Dynamic Modeling System (CSDMS; http://csdms.colorado.edu). Participant presentations covered theory and practice, with case studies as disparate as the Danube (e.g., Giosan et al. 1999) and the Indus (Giosan et al. 2006). The history of deltas looked back decades and millennia while similar timeframes for the future were considered. Delta demographics, ecosystems, morphology, formation, land-atmosphere-ocean interactions, pollution, governance, and management regimes were covered.

Many basic traits of deltas are the subject of ongoing and needed work, including classification and description methods. Reams of data are available – from three-hourly ocean wave heights to indigenous knowledge digital libraries, from topography and bathymetry to poverty indices and happiness indices - but few databases provide the material on a delta-by-delta basis. And a delta is not isolated. These data are also needed for deltas' catchments and drainage areas.

Scale also emerged as a prominent issue. The appropriate space and time scales for observing and modeling basic delta functions, such as nutrient flows and transformations, are not fully understood. Yet they are needed for establishing baselines to monitor changes along with knowing sources and sinks and being able to correlate micro-scale nutrient changes with macro-scale changes to the delta's morphology and ecology. They would also help to understand the development, lifetime, and devolution of deltas plus deltaic influences on biology and people.

The scales for human interaction with deltas are not well defined either. Activities including river and coastal engineering and farming affect a delta, whether they take place inside or outside the delta. Delta cities create their own microclimates while human-caused climate change has left few deltas, even those isolated from settlements, untouched. Computing power, data, and conceptual understanding are not always sufficient for resolving such scale issues either theoretically or for specific case studies.

The inseparability of humans from their environment, exemplified by the strong shaping of deltas by societies (e.g., Syvitski & Saito 2007) and vice versa (e.g., Rothuis et al. 1998), raised further questions about the data, modeling, and governance and decision processes available for tackling delta vulnerabilities. How could scientific and traditional knowledge bases and techniques be applied to inform and affect individual and collective behavior? How much science and how much tradition are used, and how much of each is needed, for decision analysis and decision-making? How can uncertainties and contrary views be communicated and incorporated without inhibiting delta management? How could human and natural influences and signals be separated in deltas to better understand how they influence each other? How can the available vulnerability work (e.g., Hewitt 2007; Lewis 1999; Wisner et al. 2004) be applied to deltas?

Answering such questions feeds into describing how deltas work and why they are important, which in turn promotes improved management of them (McManus 2002). To make that link, many options are available, covering GIS, role-playing games, participatory processes, inventorying and surveying techniques (for physical, biological, and social processes), expert elicitation, model

coupling techniques, and methods for visualizing observations and model results. Research is also needed for developing, monitoring, and evaluating good practices for applying and combining these options for particular deltaic ecologies and societies.

Many more scientific questions exist, along with the challenges of converting knowledge into policy and action. These are articulated in a LOICZ Reports and Studies volume which is currently in it`s final editing in collaboration with CSDMS (Boulder Colorado) and GWSP in Bonn. This Volume "Dynamics and Vulnerability of Delta Systems" (No. 35 is soon available on the LOICZ website) has been developed by the workshop participants in order to set the agenda for future delta research and application of resulting knowledge products. That way, a coherent, comprehensive, and doable plan will be available, not only for adding to delta science but also for ensuring that the science is useful and useable.

References

Giosan, L.; Bokuniewicz, H.; Panin, N. & Postolache, I. (1999): Longshore sediment transport pattern along the Romanian Danube delta coast. *Journal of Coastal Research* 15 (4): 859–871.

Giosan, L.; Constantinescu, S.; Clift, P.D.; Tabrezd, A.R.; Danish, M. & Inam, A. (2006): Recent morphodynamics of the Indus delta shore and shelf. *Continental Shelf Research* 26 (14): 1668–1684.

Glantz, M.H. (2005): Water, climate, and development issues in the Amu Darya basin. *Mitigation and Adaptation Strategies for Global Change* 10 (1): 23–50.

Hewitt, K. (2007): Preventable disasters: addressing social vulnerability, institutional risk, and civil ethics. *Geographische Rundschau*: International Edition 3 (1): 43–52.

Kubo, Y.; Syvitski, J.P.M.; Hutton, E.W.H. & Paola, C. (2005): Advance and application of the stratigraphic simulation model 2D-SedFlux: From tank experiment to geological scale simulation. *Sedimentary Geology* 178: 187–195.

Lewis, J. (1999): Development in disaster-prone places: studies of vulnerability. *Intermediate Technology Publications*, London.

McManus, J. (2002): Deltaic responses to changes in river regimes. *Marine Chemistry* (79): 155–170.

O'Brien, G.; O'Keefe, P.; Rose, J. & Wisner, B. (2006): Climate change and disaster management. *Disasters* 30 (1): 64–80.

Overeem, I. & Syvitski, J.P.M. (in press): Dynamics and Vulnerability of Delta Systems. LOICZ Reports & Studies, No. 35. GKSS Research Centre, Geesthacht.

Restrepo, J. D. & Syvitski, J.P.M. (2006): Assessing the effect of natural controls and land use change on sediment yield in a major Andean river: the Magdalena drainage basin, Colombia. Ambio (35): 65–74.

Rothuis, A.J.; Nhan, D.K.; Richter, C.J.J. & Ollevier, F. (1998): Rice with fish culture in the semi-deep waters of the Mekong Delta, Vietnam: interaction of rice culture and fish husbandry management on fish production. *Aquaculture Research* 29 (1): 59–66.

Syvitski, J.P.M. & Saito, Y. (2007): Morphodynamics of deltas under the influence of humans. *Global and Planetary Change* 57: 261–282.

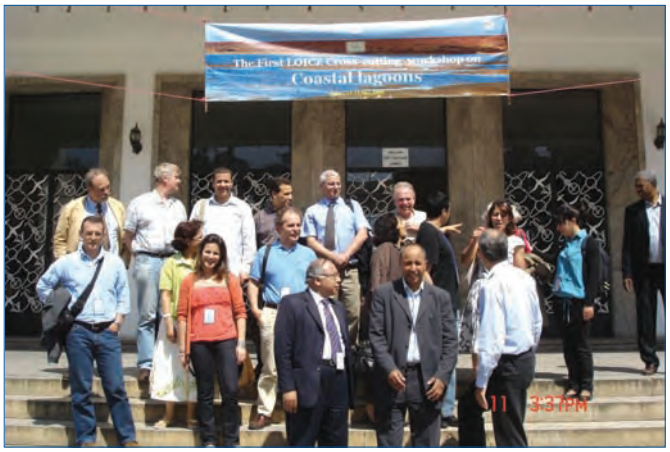
Wisner, B.; Blaikie, P.; Cannon, T. & Davis, I. (2004): At risk: natural hazards, people's vulnerability and disasters, 2nd ed. Routledge, London.

Contact: Center for International Climate and Environmental Research (CICERO), Oslo

http://www.ilankelman.org/contact.html

1st cross-cutting workshop on Coastal Lagoons at the Université Mohamed V in Rabat, Morocco, May 11–15, 2009

Following up on the IGBP-MENA (Middle East and North Africa) workshop held in Cairo in November 2008, LOICZ held its 1st cross-cutting workshop on Coastal Lagoons at the Université Mohamed V in Rabat, Morocco. The workshop was hosted by Prof. Maria Snoussi. It concentrated on a particular issue each day: residence time (Stephen Mudge), biogeochemical budgets (Gianmarco Giordani), sea-level rise (Georg Umgiesser and Saida Niazi), conceptual diagrams (Sonia Cristina), DPSIR (Alice Newton), assessment of trophic status (John Icely). The workshop also included a field trip to the lagoon of Moulay BouSelhan. 22 researchers, mostly from MENA countries, Morocco, Algeria, Tunisia and Egypt attended the workshop, as well as researchers from Portugal, Spain, France, Italy and the UK.



(Photo: Alice Newton)