Session DD 3.2: Impact of climate change on estuaries round the world (part II)

Chair	Dr. Hans Paerl, University of North Carolina at Chapel Hill, USA
Keynote speaker	Prof. Thomas S. Bianchi, Texas A&M University, USA
Speakers	Prof.dr. Patrick Meire, University of Antwerp, Belgium
	Jyotiraj Patra, Centre for the Environment and Global Sustainability, India
	Jason Rubens, University of Tasmania, Australia
	Marijn van der Velde, IIASA, Austria
	Andreas Schöl, Federal Institute of Hydrology, Germany
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Estuaries provide major sources of sediments for the oceans, but these delta systems are getting more and more vulnerable because of anthropogenic influences. “We’re holding a lot of water with hydraulic engineering; what does this do to our deltas?” Prof. Thomas S. Bianchi answers his own question: It alters the nature of our system. He gives an example. In the Chanjiang river (China), decreases in sediments appear to change the production of CO_2 and fluxes because of phytoplankton in the accumulated mud. This is reflected in the color of the water which varies from brown to green to blue. Hydraulic engineering also causes a lot of wetland loss. Possible solutions are to break the levies of the river at different spots, however this method is quite controversial. A more dynamic model is needed to adapt to this challenges. The Mississippi river seems to be a clear example of what the Chanjiang river will look like if human activities continue to effect the deltas. The question is: will China learn from this case?

Patrick Meire tells the audience about the consequences of global change on the Schelde Estuary, which has changed a lot over time, particularly the last few years as a cause of sea-level rise. Tidal range is increasing not only in this estuary, but in many others in Europe as well. There seems to be a reduction in fresh water discharge to the system because a lot of the water is deviated to other canals in the basin. Climate change causes higher winter discharges and lower summer discharges. Marshes cannot grow when sea-level rise is occurring, except when there is enough sediments available. But fresh water ‘squeeze’ might lead to a reduction in nutrient retention. The loss of marshes which occurs will negatively affect the biogeochemical functioning of a system. This leads to the conclusion that habitat restoration and maintenance is of great importance!

The Bhitarkenika area in India contains many mangroves and has a high genetic diversity. Climate change has impacted this region in the past decade, especially with a systematic rise in cyclones: the Orissa Super Cyclone of 1999 for example killed about 10.000 people. Jyotiraj Patra adds that it is not only cyclones, but also sea-level rise in this region is getting more severe. An ecosystem-based approach presented by this speaker combines Disaster Risk Management, Ecosystem management, Climate Change adaptation and Development planning and takes the ‘livelihood’ of people as an entry point. Opportunities of this Disaster Risk Reduction system include an integrated and boundary approach, community ownership and resilience and comes close to the realization of the Millennium Development Goals 1, 7 and 8.
Also the World Wildlife Fund takes people as an entry point. It is working in Cameroon, Tanzania and Fiji to build local people’s capacity to adapt to climate change, in particular in maintaining mangrove diversities. The aim of the project, says Jason Rubens, is to develop a generalizable method by testing different approaches on the three spots; “from vulnerability to adaptivity”. All spots have similar levels of mangrove biodiversity. Rubens particularly focuses on the Tanzanian site, which has over 20000 inhabitants. There are several impacts of climate change which affect the mangroves: sea-level rise, rise in air temperature and CO_2 and changes in precipitation. Of this effects, sea-level rise will eventually have major impacts. The leading question in this project is, however, the other way round: “what do mangrove species tell us about climate change?” This means that the research focus on these sites is on species diversity.
The main adaptation strategy that proves to be effective is to work with local communities to re-plant the mangroves, while combining this with their biggest source of income: growing rice.

Marijn van der Velde takes the audience to the Netherlands. The management of Dutch water systems by coastal infrastructure measures goes back more than a century, which has had several impacts on transfer and

retention times of river deltas. In this case the transfer and retention times of the Lower Rhine delta are examined, by measuring discharges in Lobith and salinity in the Wadden Sea from 1900 to 2008. The Wadden Sea is a very important area because of its rich biodiversity, but has been under pressure through changing freshwater fluxes and sea-level rise. The Lobith discharges and salinity in the Wadden Sea are measured respectively on a daily and monthly basis, for the periods 1901-1931, 1932-1971 and 1972-2005. Results show that transfer time decreases over time and that there is a change in seasonal salt-fresh dynamics in the Wadden Sea. This method can be used on a wider scale but it has to be further developed; analysis is still incomplete.
The oxygen content of an estuary is a useful descriptor of its water quality. Drivers of the oxygen budget in the estuary are river runoff and the loads of organic matter. Andreas Schöl presents the research on the impacts of climate change on the oxygen budget of the Elbe estuary. By using a hydraulic model and a water quality model it is possible to calculate transport and utilization rates of carbon, oxygen and phytoplankton biomasses. The model uses three scenarios of climate change: a wet scenario, a mean scenario and a dry scenario. Outcomes show that scenario dry leads to an increase of oxygen deficit because of algal growth in the upstream river. Phytoplankton populations seem to be sensitive to discharges.

After these presentations two posters are briefly presented. Tomoya Hashuichi tells about Sanbanze National Park – a project for the Final Tideland Area of Tokyo Bay (From global to local).
Sanbanze National Park is a beautiful area with a lot of shellfish. However, recent developments in Tokyo Bay cause eutrophication and the occurrence of the harmful algae ‘red tide’. How is it possible to regenerate the lovely Sanbanze tideland? Hashiuchi has three solutions: topographic change, pollution control and ecological enhancement.
New measures are needed to protect the Rhine from flooding. De Nijs presents the Rhine estuary ‘Closeable but open’ alternative to dike-building. The research studies results on future flooding levels of dike strengthening versus positioning closeable dams.