

Session DD 3.1: Climate change and estuarine ecosystems

Chair	Prof.dr. Peter Herman, Netherlands Institute of Ecology, NIOO, the Netherlands
Keynote speaker	Prof.dr. Hans Paerl, University of North Carolina at Chapel Hill, USA
Speakers	Manfred Meine, Hamburg Port Authority, Germany Dr. Shadananan Nair, Nansen Environmental Research Centre India, India Eva-Maria Bauer, Federal Institute of Hydrology, Germany Mick van der Wegen, UNESCO-IHE, the Netherlands Dr. Maminul Sarker, CEGIS, Bangladesh Prof.dr. Karl Flessa, University of Arizona, USA Henriette Stoop, CSO adviesbureau, the Netherlands Dr. Verónica Zagare, Delft University of Technology, Argentina
Report	Karel van Hussen, Climate changes Spatial Planning, the Netherlands

In the Pamlico Sound system an extensive monitoring programme does vertical and horizontal monitoring of the Neuse River's for water quality data. The system drains half of North Carolina's land. The coastline is shaped by the many storms it faces. Prof.dr. Hans Paerl explains that it is a challenge to interact climate perturbations and their impacts on human interests. Climate change, which leads to increased storm frequency, will have an effect on water quality. As well as human activities, the storms supply the river with many nutrients. The resulting algae bloom means decreased water quality. To stop the nutrient flow from reaching the river, natural buffer areas have proved to be very successful.

The human needs in the estuary of the Elbe river in Germany show a different focus. Manfred Meine described the problems the Hamburg Port Authority experiences with climate change. The estuary is changing naturally, but also man made changes have an effect. A part of the tidal area is lost due to diking, which means more tidal energy reaches the harbor. The upstream flows are stronger, which means sediment is transported upstream. If you add that up to intensified periods of drought due to climate change, a bigger dredging effort in the port of Hamburg is required. Potential solutions are to give the estuary more space, as to dampen the sediment load coming so far upstream. Another alternative is to catch the sediment on so called sediment traps before it reaches the harbor.

India is a vulnerable country for the effects of climate change. It has a 7500 kilometer long densely populated coastline, the population is large, growing fast, with a majority living below the poverty line. The main issue is that the economy and rural life is closely tied to the climate sensitive natural resource base. The environmental problems the country is facing are numerous. The presentation of dr. Shadananan Nair shows that the implementation and regulation of environmental policy is where part of the problem lies. The effects and potential solutions for the basic environmental problems are summarized by dr. Nair. Climate change will only intensify the resulting environmental problems, boding a challenge for policy makers to act.

In Germany, Eva-Maria Bauer is researching vegetation shifts in estuaries due to climate change. The research is underway, expected to be finished in 2013. The focus lies on key species, and the effect natural and anthropogenic disturbance might have on them. Further research will show whether mowing can be used as a tool to strengthen reed vitality, and thus control erosion.

Mick van der Wegen is modelling the morphodynamic evolution of estuarine rivers. Starting with a basic, very close to linear river, he modeled the evolution of the river. He showed the results using a film of how this river evolved into a stable system. He added sea level rise to the model, resulting into a change in the basin. After

500 years it became an importing system, with sandbanks moving upstream and a deepening of the basin. More research may give us more insight in how rivers evolve and behave in general terms.

The aspect of climate change researched by Van der Wegen, sea level rise, is also object of study in Bangladesh. With a low slope gradient one would conclude Bangladesh is very vulnerable to sea level rise. Dr. Manimal Sarker explains that in the past there have also been sea level rises. Historical sea level rise caused the river to respond. With a higher sea level, the base line of the river shifts, causing it to place sediment on the land. It actually compensated for the rise in sea level, by rising the 'land level'. Two difficulties may occur. There has to be enough sediment available and the river has a response time which is not instantaneous. Currently, one third of the available sediment is transported into sea, so that will not be an issue. The delay caused by the response time may however cause problems in extreme weather events.

The problems occurring in the Colorado river estuary are of a different nature. The river water does not reach the estuary. Prof.dr. Karl Flessa researches whether the habitat recovery is possible. The river has been dry since 1960, caused by dams and the use of water by mainly agriculture. He placed the scope on historical situations, using Carbon and Oxygen isotope measurements on skeletal remains of fish. The difference between available water supplies was visible in the success of the Totoaba population, a fished specie. Calculations have been made for the amount of water needed to restore the riparian zone and for the entire habitat. Five percent of the total river discharge is needed for full restoration., an amount of water which is not (yet) available.

In Bangladesh, the problems of a rising sea level could be tackled by the natural response of the river by sedimentation. In The Netherlands, that is much more difficult. The river and sea do not get the chance to reach the subsiding soil. Henriette Stoop therefore researches an ambitious idea; whether it is possible to change land functions over time to give the low lying areas the chance to sedimentate. The research is currently underway, results will follow later. The idea is that low lying areas are opened up, changing their function into nature or marine agriculture. There sedimentation occurs, after which the area can get the old agricultural function. If this process is gradually done around the entire coast, a great reduction of salinization can be accomplished. Beside the technical research questions, research must show whether it is possible to combine marine agriculture with sedimentation and if it politically possible to implement this.

Where sediment is a (potential) solution to the problem of sea level rise in the Netherlands and in Bangladesh, it bodes a problem in Buenos Aires. The sediment flow from the Parana river nearly reaches the harbor of Buenos Aires. Other problems intensified by climate change are relevant. Every year there are floods, caused by river discharge, or by El Nino's. That added up to relevant socio-economic issues makes adapting to climate change in the estuary a complex problem.

The chair, prof.dr. Peter Herman, concludes the session very strikingly. In all the different presentations of the estuaries we have seen many different kind of problems. Not one estuary was the same, there is not one delta. Furthermore, not only the hydrological / physical aspects play a role. The relevance of these aspects differs in different delta's, but in every case it is clear that the social aspects play a major role.