Deltas in Depth scientific sessions Deltas in Depth Theme 4. Coastal systems and wetlands		
DD 4.7 Wetlands as natural flood protection		
Chair	Prof. Hans Paerl, University of North Carolina, Morehead City, North Carolina, USA, on behalf of Prof. John Day, Louisiana State University, Baton Rouge, Louisiana, USA	
Presentations	•	Prof. dr. Stijn Temmerman, University of Antwerp, Belgium
	•	Prof. dr. Stijn Temmerman, on behalf of Chen Wang, University of Antwerp, Belgium
	•	Prof. dr. Peter Herman, Netherlands Institute of Ecology/Royal Academy of Sciences, the Netherlands - cancelled

Prof.dr. Stijn Temmerman – on the flood protection value of estuarine and deltaic wetlands
The first presentation focuses on the potential of ecosystem-based approaches to reduce flood risks. The researchers implemented both a field work and modelling approach to study the effect of marsh vegetation on flood attenuation in coastal estuaries. The field data show that flood attenuation by marshes occurs under normal flooding conditions, but not under storm conditions. This is attributed to the lack of friction from the vegetation. Floods that overtop marsh vegetation are thereby less attenuated due to this lack of friction. The model results indicate that marshes are important for reducing inland flooding. The potentials for this approach are applicable to large deltas and estuaries where there is a lot of space between the coast and the urban areas for the development of these marshlands. In the discussion, the effects of flood reduction in estuaries vs. deltas are discussed (the larger the system, the higher the flood attenuation). Additionally, it is likely that flood attenuation effects are large in micro deltas (with small channels) compared to macro deltas, because of the increase in friction. Furthermore, deepening of the river may lead to a decrease in flood attenuation, although these effects are difficult to study.

Chen Wang (presented by prof.dr. Stijn Temmerman) – biogeomorphic shifts and stable states in intertidal flats and marshes
The second presentation focuses on two alternative stable states in estuaries; an elevated vegetated state and a low and bare mud flat state. Although several models indicate the existence of tipping points, switching the system in either of the two states but not in a transient state, there is no empirical data available. Analyses on aerial photographs and digital elevation models suggest the existence of two stable states and an unstable transient state. The switch from a bare mud flat to a vegetated state seems to depend on the elevation of the bare mud flat. The elevation of the mud flat is then used to predict the shift to a vegetation state and to search for a threshold that triggers this shift. Ultimately, the model results show a reasonably good match with historical field data.
The discussion starts off with a question about the slope of the elevation and if that influences vegetation establishment. Although this was not part of the study, the slopes are probably gentle in the transient state but increase when vegetation develops. Next, the human interference on the system and the concomitant effects on the estuary are discussed, which indeed affects factors such as the sedimentation and erosion processes. This calls for a follow-up research in a pristine environment. Nevertheless, also in this human influenced system there are two distinct stable states. The audience asks for a clarification of the threshold elevation at which vegetation establishes, which is around 0.5 to 1 meter below the mean high water level. The geomorphology of the system plays a crucial role in creating a suitable environment where the plants can establish. Vice versa, when

vegetation establishes it influences the geomorphology of the system. The discussion also focused on the time span of the shift from one state to the other, which occurs in a couple of decades in this system, although this might take longer in other systems where there is lower sedimentation rate.

The last presentation by prof.dr. Peter Herman was cancelled.