Sediment dynamics in a mangrove creek catchment

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1 The importance of mangrove development and aim of this study

Mangroves consist of trees and shrubs adapted to grow on water-logged soils in the intertidal area of tropical and sub-tropical coasts. Mangroves provide a thriving habitat for many animals and they provide mankind with an abundance of ecosystem services (e.g. wood and food). Next to that the presence of mangrove vegetation in the intertidal zone impacts on coastal dynamics. Hydrodynamic energy is being attenuated (Mazda et al. 1997) and sediments are being trapped (Furukawa et al. 1997).

Sedimentation in mangroves is a very important feature from the perspectives of stabilization of coasts and climate change impacts. Alongi (2008) found that field studies in mangroves generally show average sedimentation rates that are slightly higher than the local rates of mean sea level rise. However, field data on the flow paths of water and sediments through mangroves is limited yet. Sediment dynamics in mangrove creeks have been studied in several field sites, as well as sediment deposition in a mangrove catchment. However, the linkage between sediment transport and deposition in mangroves and the input and output of sediment through creeks and over the mangrove fringe (bordering the sea/river) is relatively unknown.

Currently we are performing a field campaign with the aim to determine how deposition in mangroves occurs, in order to understand the importance of mangroves for coastal stabilization. To that end we perform measurements to determine sediment deposition patterns, to monitor sediment fluxes through the forest and to determine how the sediments enter the mangroves, i.e. either over the mangrove fringe or through the creeks.

2 Field measurements

Our study site is a mangrove creek catchment in Trang province, Thailand (figure 1).

Figure 1: The field site is located at the Andaman coast in Thailand. From left to right: the Thai Andaman coast; the coast of Trang province; the mangrove area around Kantang Tai village; and an impression of the creek catchment under study (about 150x150 m^2).

Within the creek catchment several processes are being monitored on a 24-points grid (see figure 1). At these grid points we measure: 3D flow velocities (Acoustic Doppler Velocimeters), water levels (pressure sensors), suspended sediment concentrations (water sampling) and

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sediment deposition rates (sediment trapping). The topography of the entire creek catchment has been mapped with laser altimetry (Total Station combined with GPS reference points) and the vegetation within the area will be characterized by counting heights, densities and diameters of all types of vegetation. These measurements will be executed continuously over a period of four months, which is longer than most previous studies in mangroves, so to cover a range of spring-neap tidal cycles and hopefully a storm event.

3 Expected results

Our first data indicate that inundation of mangroves during a tidal cycle shows two mechanisms: creek flow and sheet flow. The creeks are being filled during flood tide until the creek banks overflow and the forest starts to inundate. At overbank flow, flow velocities in the creek accelerate, resulting in a large influx of water (and sediments) into the mangroves (figure 2). Sheet flow is initiated over the mangrove fringe and is the second mechanism for water influx into mangroves (figure 2). The relative importance of both mechanisms is of interest, because of their impact on sediment fluxes (e.g. origin and direction). For salt marshes, the equivalent of mangroves in temperate climates, Temmerman et al. (2005) found comparable results.

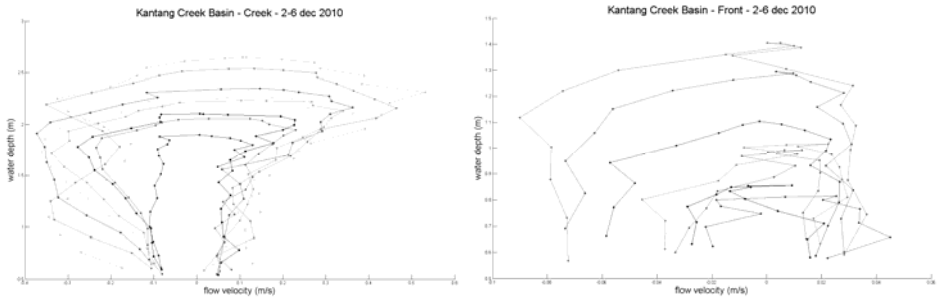

Figure 2: Horizontal flow velocities measured in a mangrove creek (left) and right in the mangrove fringe (right) of our study site. Velocity measurements are executed with an Acoustic Doppler Velocimeter and positive values indicate the landward direction.

Simultaneously with current velocities, suspended sediment concentrations are being sampled. Together, these data will be used to compute sediment fluxes into and out of the creek catchment; both through the creek (creek flow) and through the mangrove front (sheet flow). Our final aim is to link sediment deposition patterns to these sediment fluxes through the forest and to the sediment source being either the mangrove fringe or the creek.

4 Acknowledgement

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5 References

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