Mangroves, Low-lying Land and Sea-level Rise

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Sea level rise predictions for New Zealand are becoming increasingly certain, and now more than ever, coastal managers need to make robust plans for coastal communities to adapt to the coming changes. One potential adaptation pathway for low-lying rural land is that we change the land-use and restore the land to its native habitat of coastal wetland. Low lying agricultural land can require intensive and costly drainage, while contributing disproportionately to atmospheric carbon emmisions. Conversely, coastal wetland is known for its ability to sequester and bury carbon. Mangroves are particularly known for their capacity to trap carbon, largely due to their dense and deeply rooted systems.

In a global effort to protect existing mangrove areas and re-establish former mangrove areas, the ability of mangroves to protect coastal land against rising sealevels and coastal storms is often highlighted as an added benefit. The evidence for protection against wind waves is compelling, but recent evidence has shown that the protective capacity is strongly dependent on wave period. Short period waves respond quickly to the dissipative effect of roots and tree stems, whereas the evidence against protection against the much longer period waves like surges and king tides is less clear. Longer period waves tend to react more the large-scale geometry of the system, such as the accomodation space, the overall water depth and the existance of chanelisation. Moreover, it is not clear how these geometrical considerations might change as the coastline morphology responds to the changing sea level.

This presentation will explore how different aspects of the coastal morphology contribute to changes in hydrodynamics across mangrove-dominated areas. Current and potential changes to the distribution of sediment transport pathways will be demonstrated by manipulations in idealised Delft3D modelling scenarios. Results show that the existence of channels and the overall extend of the mangrove forest play a much greater role in shaping pathways than the density of trees in the intertidal. Scenarios are constrained by emulating the characteristics of a site (Pahoia) in Tauranga Harbour. Additional scenarios, using even simpler set ups designed to reflect conditions at the Firth of Thames and including morphological change, show that predictions of changes into the future depend subtly on the balance between sediment supply and accumulation, which can ultimately determine the impact on accomodation space and channel development. In these second set of scenarios, the sediment properties are changed during exposure so that both the erosion rate and the critical erosion threshold are made to be dependant on exposure temperature. In these cases, the shape of the intertidal profile and the generation of channels is shown to be susceptable to changes in erosion characteristics. The profile is likely to become steeper on the lower intertidal, and flatter in the intertidal.

These experiments highlight the role of morphodynamic complexity in determining how the coastline might respond to storms and change conditions. Nevertheless, there are still clear messages which can be used to inform coastal adaption strategies.

Figure 1 Storm surge at the seaward fringe of the mangroves (*Avicennia marina subsp. australasica*) in the Firth of Thames. Photo: Erik Horstman.

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