Geophysical Research Abstracts
Vol. 18, EGU2016-13022, 2016
EGU General Assembly 2016

Modelling the impacts of sea level rise on tidal basin ecomorphodynamics and mangrove habitat evolution

Barend van Maanen (1), Giovanni Coco (2), and Karin Bryan (3)

(1) Faculty of Geosciences, Utrecht University, The Netherlands, (2) School of Environment, University of Auckland, New Zealand, (3) Faculty of Science and Engineering, University of Waikato, New Zealand

The evolution of tidal basins and estuaries in tropical and subtropical regions is often influenced by the presence of mangrove forests. These forests are amongst the most productive environments in the world and provide important ecosystem services. However, these intertidal habitats are also extremely vulnerable and are threatened by climate change impacts such as sea level rise. It is therefore of key importance to improve our understanding of how tidal systems occupied by mangrove vegetation respond to rising water levels.
An ecomorphodynamic model was developed that simulates morphological change and mangrove forest evolution as a result of mutual feedbacks between physical and biological processes. The model accounts for the effects of mangrove trees on tidal flow patterns and sediment dynamics. Mangrove growth is in turn controlled by hydrodynamic conditions. Under stable water levels, model results indicate that mangrove trees enhance the initiation and branching of tidal channels, partly because the extra flow resistance in mangrove forests favours flow concentration, and thus sediment erosion in between vegetated areas. The landward expansion of the channels, on the other hand, is reduced.
Model simulations including sea level rise suggest that mangroves can potentially enhance the ability of the soil surface to maintain an elevation within the upper portion of the intertidal zone. While the sea level is rising, mangroves are migrating landward and the channel network tends to expand landward too. The presence of mangrove trees, however, was found to hinder both the branching and headward erosion of the landward expanding channels. Simulations are performed according to different sea level rise scenarios and with different tidal range conditions to assess which tidal environments are most vulnerable. Changes in the properties of the tidal channel networks are being examined as well. Overall, model results highlight the role of mangroves in driving the morphological evolution of tidal systems and emphasize the need to account for ecomorphodynamic feedback mechanisms when assessing sea level rise impacts.