Title of the project:
Modelling tree growth of expanding mangroves in the Firth of Thames estuary, New Zealand.

Assignment no.: 19.22	**Internal/external:** Internal
Head graduation committee: K.M. Wijnberg	**Daily advisor:** R. Gijsman E.M. Horstman
Name(s) of participating companies or institutes:	**Start of the project:** ASAP

Required courses:
Building with Nature, Short Waves and Coastal Dynamics, Long Waves and Tidal Morphodynamics, Data Analysis in Water Engineering and Management, Mathematical Physics of Water Systems

Short description of the project

This project considers the growth of mangrove trees in the Firth of Thames estuary in New Zealand. Over the past 70 years, these mangroves have been expanding in the seaward direction with an average rate of 12 ha/year. This expansion is facilitated by an increasing surface elevation, due to the continued accumulation of sediments. When the surface elevation reaches a certain level, mangrove trees can cope with the reduced hydrodynamic stress and continue to grow at these locations. Once mangrove trees have established, they reduce hydrodynamic energy and support further sediment accumulation, thereby stabilising the intertidal area and facilitating the growth of other trees. Yet, mangrove trees also compete for resources and they cannot all survive. Hence, mangrove tree growth depends on morphological processes (e.g. surface elevation changes), hydrodynamic processes (e.g. periods of tidal inundation) and biological processes (e.g. competition for resources).

The wave attenuation capacity of mangrove ecosystems makes them sustainable and cost-effective alternatives to traditional hard engineering solutions. However, to guarantee their continued ability to attenuate storm waves, tools to study their temporal dynamics need to be developed. At present, the processes describing the long-term growth of mangrove trees and the expansion of mangrove forests have not been quantified yet. In this project, you will contribute to the development of a numerical model to simulate the expanding dynamics of the mangroves in the Firth of Thames. Firstly, you will be working with a dynamic mangrove growth model (setup in Python) to study the effects of hydrodynamic-, morphodynamic- and biological processes on the growth of the mangrove trees (one-way feedback). Secondly, the mangrove growth model will be coupled to a state-of-the-art hydro-morphodynamic model (Delft3D Flexible Mesh--DFM) to study the effects of the trees on the hydrodynamic- and morphological processes (two-way feedback).

Within this project, you will be working with an existing python-based mangrove growth model. Based on the tree growth as observed in the Firth of Thames, you will study the most important processes and parameters in the model. You will be a pioneer in coupling a mangrove growth model describing growth of individual trees to DFM, using recently developed methods. In coupling the model to DFM, you will explore alternative ways to simulate the mangrove vegetation dynamics. The outcomes of these methods will be compared to wave attenuation as observed in the Firth of Thames estuary mangroves.

This assignment requires dedication and motivation to work on data processing and programming in Python.