EGU22-840
https://doi.org/10.5194/egusphere-egu22-840
EGU General Assembly 2022

What determines estuary planform shape, size and channel-bar patterns?

Maarten Kleinhans, Steven Weisscher, Danghan Xie, and Marcio Boechat Albernaz
Universiteit Utrecht, Faculty of Geosciences, Physical Geography, Utrecht, Netherlands (m.g.kleinhans@uu.nl)

Some estuaries gained their planform shape and size by sedimentation of mud flats and establishment of 'coastal floodplains' with saltmarsh or mangrove, while others are laterally confined by valley walls. For rivers, the channel dimensions and bar and bend shapes and sizes are related to upstream discharge, but for estuaries where most of the flow comes from the sea, there is no such fluid flux limit on size. This poses a riddle: what determines estuary planform shape, size and channel-bar patterns? Is there such a thing as an equilibrium or are multiple states possible under the same boundary conditions? A steady state is a convenient concept in assessments of effects of human interference and changing boundary conditions.
We created sandy estuaries with mud and vegetation in numerical biogeomorphological modelling and in the Metronome tidal flume. The partial answers to the riddle include infilling by mud and flow-focussing by vegetation, but also the characteristics of the feeder river and tidal friction. For systems with plenty of sediment input, an `ideal' convergent estuary shape is one endmember equilibrium state. Here, the river, however small, mainly determines estuary size. Another equilibrium state is a system with mid-channel bars, where the collective multiple subtidal channels also develop a convergent shape as floodplains form. Likewise, unfilled estuaries with bay-head and flood deltas also tend to convergent shapes but filling can be arrested by lack of fine sediment, floodplain formation and vegetation settlement. Which of these quasi-steady states is reached depends in part on the system history of filling, wave energy, and (past) rate of sea-level rise.