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Effect of river discharge and geometry on tides and net water transport in an estuarine network, an idealised model applied to the Yangtze Estuary

Huib E. de Swart and Niels C. Alebregtse
Utrecht University, Inst. of Marine and Atmospheric Research, Utrecht, Netherlands (h.e.deswart@uu.nl)

Many estuaries in the world show a complex pattern of interconnected branches. The water motion in these estuarine networks is dominated by tides and by net water transport, the latter being primarily forced by river discharge and by nonlinear tidal rectification processes. The behaviour of tides (sea surface height and currents) and the distribution of net water transport over the branches is an important topic of research, e.g. for flushing of pollutants, salinity intrusion and sediment transport.
Field observations, e.g. in the Yangtze Estuary, show that tides and distribution of net water transport over the branches are highly sensitive to river discharge (wet and dry season) and to changes in geometry, e.g. due to navigational works. To understand such sensivities, this contribution presents a semi-analytical model that yields explicit solutions for tides and net water transport for arbitrary tidal network configurations. The model accounts for tide-river interactions, which in particular affect friction, and for tidal rectification processes. The model is subsequently applied to the Yangtze Estuary.
It will be shown that tide-river interactions are crucial to understand the observed differences in tidal propagation between the wet and dry season. Furthermore, the relative increase of the net water transport driven by tidal rectification with respect to that driven by river discharge explains the observed differences in distribution of water transport over the branches between wet and dry season in this estuary. Finally, it will be shown that the construction of navigational works resulted in an increase of tidal currents, a decrease of net water transport and an increase in ebb-dominance in the North Passage of the Yangtze Estuary, consistent with observations.