

The Tidal Elbe - Natural Development, Sediment Management (Physical Basics), and Climate Change

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Sediments can be of different relevance in Coastal Management. If estuaries are functioning for coastal waterways growing in depth and width from decade to decade in the past and also in the near future, the tidally induced net sediment transport plays an important role.

What do we really know about the different processes governing the net-transport of sediments in complex estuary systems and what are handy tools to study and analyze the transport processes?

Our observations at different estuaries brought a general insight: a deep fairway enhances the net-transport of sediments in the upstream direction. Because of ongoing deepening of the tidal river Elbe, today nearly any man living behind the dikes knows the concept named tidal-pumping.

What are the main reasons for the tidal-pumping? To answer this question we can learn a lot from the behaviour of the Ems Estuary and we can undertake comparisons with respect to other estuaries. The first thing we have to accept is that a strict separation between natural and anthropogenic factors is not possible because the shape of an estuary is today not exclusively influenced by human activities but also by the natural long-term morphology.

The Federal Waterways Engineering and Research Institute (Bundesanstalt für Wasserbau) developed 3D-simulation models for all Estuaries at the German coasts. The comprehensive results are processed with self developed software tools generating characteristic values for all physical system parameters. The amount of disagreement between characteristic values of different stages of the development of the Elbe Estuary will increase our knowledge in combination with the analysis of nautical charts and all data from the field.

The models and software tools are also used for environmental assessment studies for the current planned deepening of the Elbe fairway. This study demonstrated how the increase of the tidal range due to the deepening can be minimized by a sand bar in a channel branch within the estuary mouth.

The recently started climate impact research for the coastal waterways in Germany (KLIWAS and KLIMZUG NORD) is likewise based at BAW on this software technology. First results for a sea level rise of 0.6 m gave us insights into increased net-sediment transports within the Elbe river mouth.

The BAW is convinced that it is absolutely necessary in the near future to further enhance mathematical modelling of estuary dynamics on the basis of improvements of numerical procedures, mathematical description of the physics of sediment transport, assimilation methods for field data and multi model approach on the basis of integrated modelling (open standard interface definitions). It will give us a useful key for problem solutions.