

Impact of setbacks on the estuarine morphology

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ABSTRACT: Setting back of defences is considered as a measure in the development of flood defence strategies and to support the creation of new intertidal habitat both in the Humber estuary and the Schelde estuary. The impact of setbacks on the large-scale estuarine morphology was analyzed using the ESTMORF model. Generally, setbacks induce long-term morphological changes landward and seaward of the setback that differ from the initial response. Seaward of the setback the estuary erodes. Landward of the setback sediments are deposited that erode again at larger timescales. At the scale of the entire estuary set backs always cause a loss of sediments. For seaward situated set backs this erosion is smaller and the long-term gain of intertidal area is larger than for landward located set backs. These results can be used in the site selection and design of sustainable setbacks.

1 INTRODUCTION

Safety against flooding and a sustainable development of ecological values are prime management objectives in many European coastal plain estuaries. Both sea level rise (*slr*) and human interferences may threaten the safety levels and ecological values of estuaries. In particular, sea level rise may affect the ecological values of estuaries where the 'room for water' is limited. In these estuaries a future decrease of intertidal area is likely because of the so-called coastal squeeze effect related to sea level rise: the available water surface area at high water can only increase a little with increasing mean sea level (limited space), whereas the water surface area at low water can increase much more, thus reducing the intertidal area. This effect of limited storage at high water may overrule the effect of changes in intertidal range and sedimentation in the estuary related to sea level rise. In addition, man interferes in the morphologic and hydrodynamic evolution of estuaries. These interferences often include dredging and dumping of sediments to maintain shipping lanes and harbours as well as land reclamation and sand excavation projects (e.g. harbour development). These activities often affect the safety level and intertidal area in an indirect way and over longer timescales.

Setting back of defences, i.e. creating room for water, is considered as a measure in the development

of new flood defence strategies and to support the sustainable creation of new intertidal habitat, both in the Humber estuary (United Kingdom) and the Schelde estuary (Netherlands and Belgium). Setbacks provide a direct initial gain in intertidal area, thereby potentially increasing the ecological value of the estuary. Depending on the design (size and averaged height) and the exact location, the set backs dissipate the tidal energy resulting in (initially) reduced water levels, thereby increasing the safety against flooding. However, the increase in intertidal basin storage, related to the setback itself, the overall changes in tidal range and the associated changes in tidal volume may affect the large-scale morphology at longer timescales (decades) as well. This paper aims to identify and explain these short-term and long-term impacts by analyzing typical setback scenario's for the Humber estuary, using the hybrid (semi-empirical) ESTMORF model. The general effects and the use of these results in the site selection and design of sustainable set backs will be discussed in section 5. Herein the experiences for the Schelde estuary will also be briefly addressed.

2 STUDY AREA

The Humber estuary is a tide-dominated estuary that is situated along the east coast of England (Figure 1).