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Channel-shoal morphodynamics in response to distinct hydrodynamic drivers at the outer Weser estuary

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The interaction of tidal, wave and wind forces primarily governs the morphodynamics of intertidal channel-shoal systems. Typical morphological changes comprise tidal channel meandering and/or migration with related shoal erosion or accretion. These intertidal flat systems are likely to response to accelerated sea level rise and to potential changes in storm frequency and direction. The aim of the ongoing research project is an evaluation of outer estuarine channel-shoal dynamics by combining the analysis of morphological monitoring data with high-resolution morphodynamic modelling. A focus is set on their evolution in reaction to different hydrodynamic forcings like tides, wind driven currents, waves under fair-weather and high energy conditions, and variable upstream discharges. As an example the Outer Weser region was chosen, and a tidal channel system serves as a reference site: Availability of almost annual bathymetrical observations of an approx. 10 km long tidal channel (Fedderwarder Priel) and its morphological development largely independent from maintenance dredging of the main Weser navigational channel make this tributary an ideal study area. The numerical modelling system Delft3D (Deltares) is applied to run real-time annual scenario simulations aiming to evaluate and to differentiate the morphological responses to distinct hydrodynamic drivers. A comprehensive morphological analysis of available observations at the FWP showed that the channel migration trends and directions are persistent at particular channel bends and meanders for the considered period of 14 years. Migration trends and directions are well reproduced by one-year model simulations. Morphodynamic modelling is applied to interpolate between observations and relate sediment dynamics to different forcing scenarios in the outer Weser estuary as a whole and at the scale of local tributary channels and flats.