



Morphological processes of tidal flats in the Elbe estuary monitored with Sentinel-1 data

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Morphological processes in the Elbe estuary in the German Bight, part of the southeastern North Sea, during the last three years were studied using Sentinel-1 Synthetic Aperture Radar (SAR) data. The Elbe River connects the port of Hamburg, Germany's biggest port, to the North Sea. The Elbe estuary is part of the Wadden Sea, a unique and environmentally protected ecosystem with tidal flats extending up to 20 km off the mainland. Carrying out measurement campaigns in the tidal flat areas requires the combined effort of shallow water survey ships and airborne LIDAR measurements; such a survey is currently conducted once every six years. With Sentinel-1 A and B, the full tidal range including low-tide scenes is currently acquired within 2-4 weeks, allowing much more frequent information updates.

The land-water-line is determined from Sentinel-1 acquisitions by an automatic algorithm with manual corrections applied in a second step. Three times were selected for processing: early 2015 as beginning of Sentinel-1 data availability, spring 2016 in parallel to a survey campaign, and summer 2018 as a recent point in time. About seven scenes per time were selected for covering the full tidal range with respect to ebb or flood. From low tide scenes, information about the position and extension of individual sand banks and tidal channels is obtained. In this study, a sandbank moving more than one meter per day on average was found. Combining the waterlines from all tidal states, the tidal flat topography at each time can be retrieved.

These data sets help local authorities to detect ongoing changes and identify possible threats to shipping and marine infrastructures. Offering additional data in between measurement campaigns, they can also help modelers to get validation points for modelling results.