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

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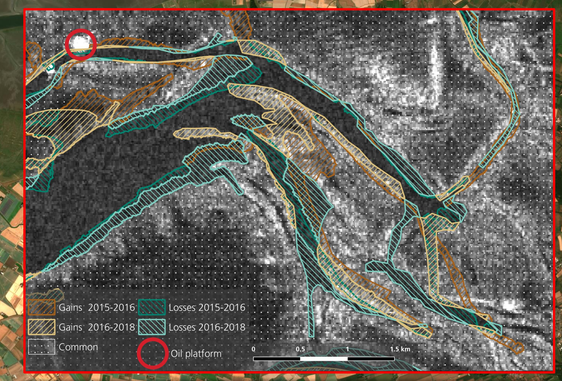
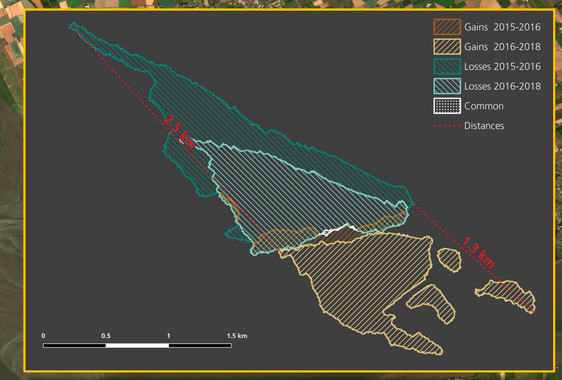
Current Situation

- Elbe river connects North Sea to port of Hamburg, Germany's largest port
- Elbe estuary in Wadden Sea, world heritage site with high biodiversity
- Erosion and sedimentation of tidal flats threaten shipping, nature and tourism
- Official survey campaigns conducted only every 6 years
- Further deepening of Elbe river in progress, stronger sedimentation processes in estuary expected

Map of the German Bight, southeastern North Sea. The Wadden Sea (green) extends up to 20km from the main land. The Elbe estuary is marked in red.



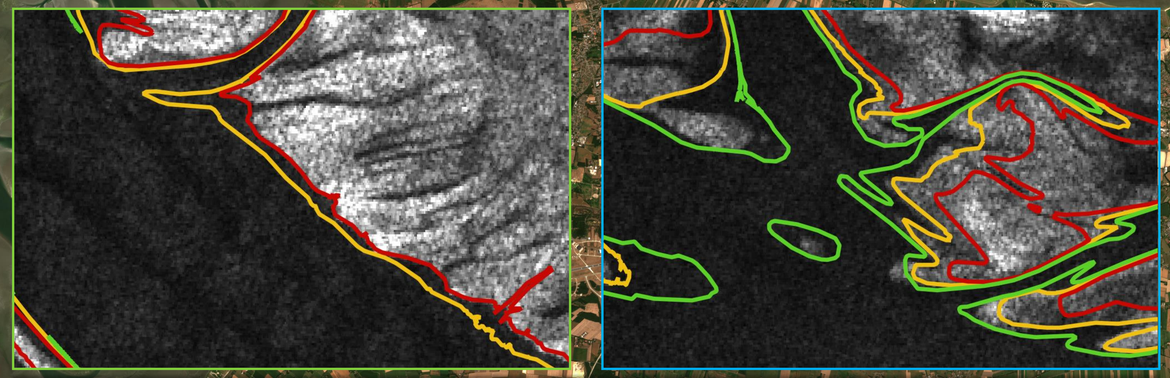
Changes of tidal flats near Mittelplate, Germany's only offshore oil platform. Built on a sand bank, monitoring the surrounding tidal channels is crucial for its safety.



Kratzsand, a tidal sand bank situated in the central Elbe estuary close to the fairway, moved by more than 1m per day during the 3-year investigation period.

Monitoring Data

- Sentinel-1 Synthetic Aperture Radar (SAR) data from early 2015 to late 2018, availabe free of charge
- Interferometric Wide Swath (IW) mode with 10m pixel spacing and 250km swath width
- Aquisitions covering Elbe estuary almost daily, coverage of full tidal cycle within two weeks
- Waterline extracted by automatic, contrast-based algorithm



Sentinel-1 SAR data (04.05.2016) and contour lines from official topography (created Spring 2016) at 310cm, 350cm, 400cm; gauge level at Cuxhaven: 348cm at rising tide. A higher tide is already present at the western location (left) where visible tidal flats align well with the red line; the water level at the eastern location (right) is lower, closer to the green line.

Results and Outlook

- Sand bank movements of more than 1m per day during 3 years observed
- SAR waterline retrieval results match official surveys
- Resolution and coverage frequency of Sentinel-1 IW mode sufficient for change monitoring of tidal flats
- Results can also be used by modellers for further model tuning and validation
- Local authorities highly interested in continuous monitoring

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