Wadden Sea Coastlines from Sentinel-1 satellite radar data

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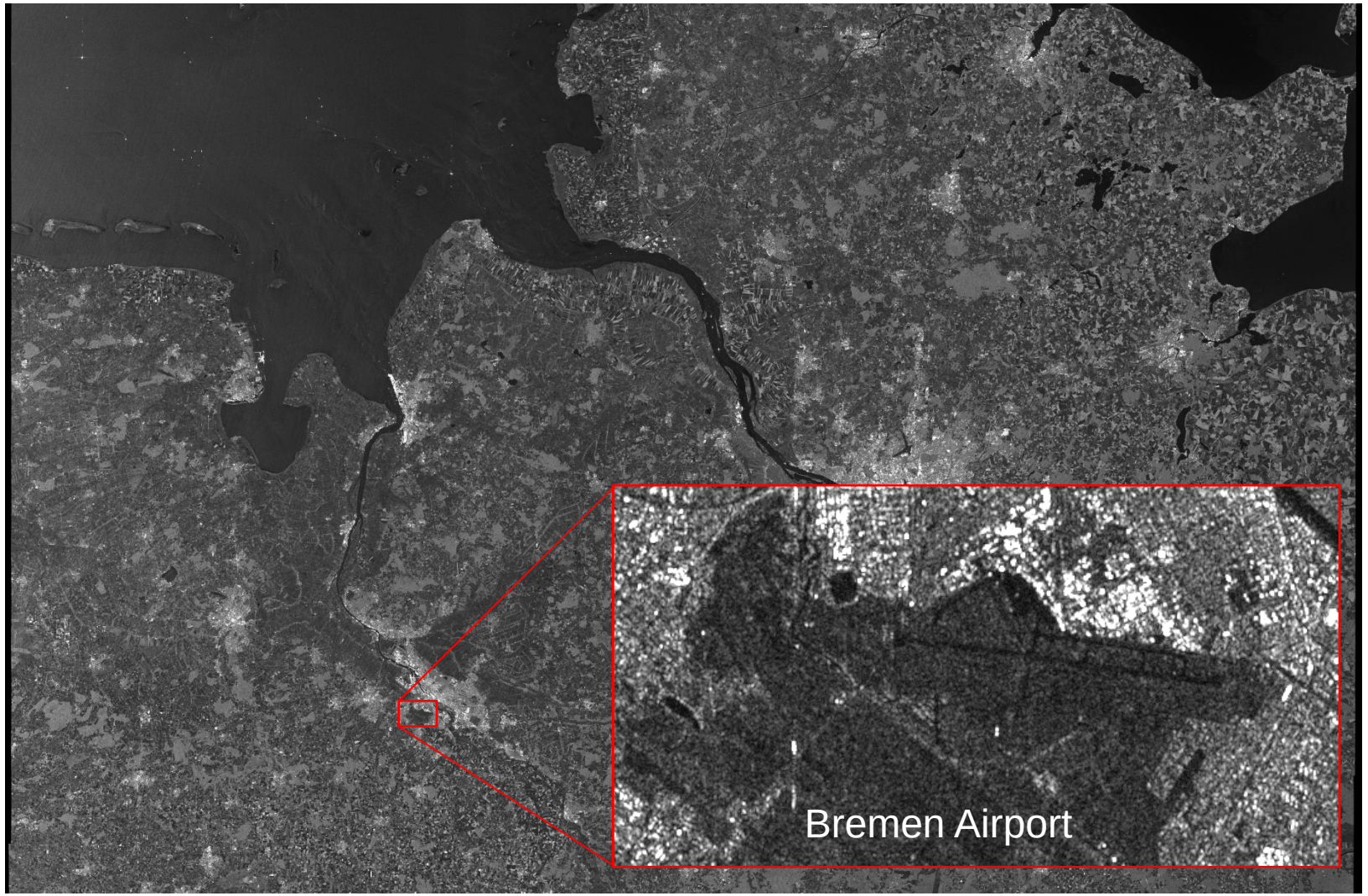
Sentinel-1 IW mode full scene example

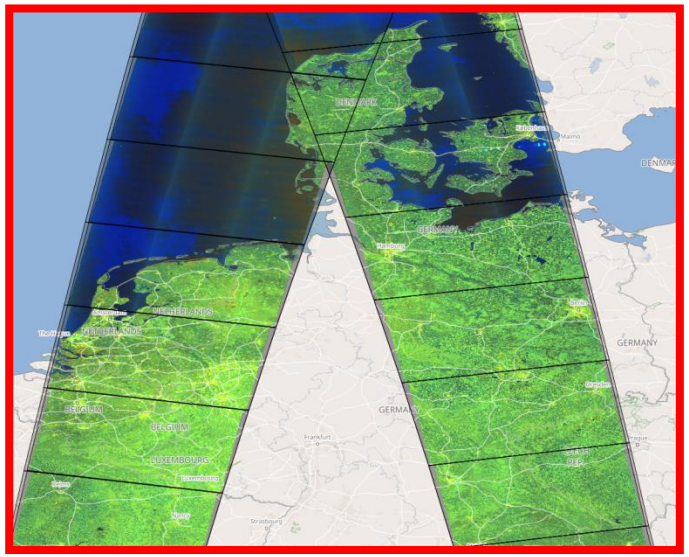


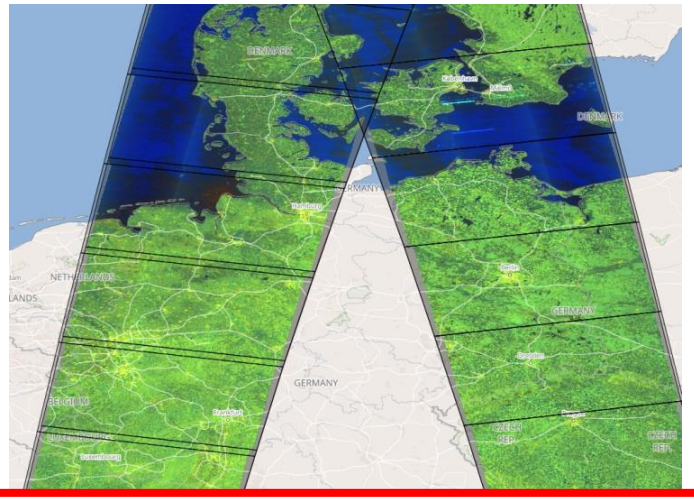
- Radar satellite, not affected by clouds or darkness
- Acquisitions around 06 or 18 o'clock local time (dusk/dawn)

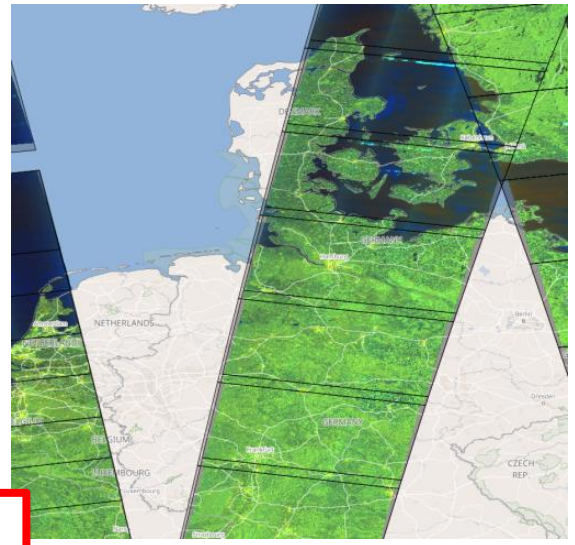
- Sentinel-1 IW mode
  - 10 m pixel size
  - 250 km swath width

- Two satellites (Sentinel-1 A/B)
- 6 days repetition frequency

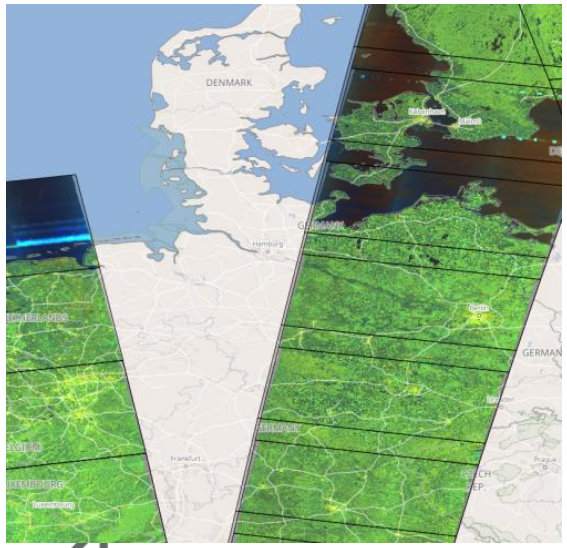
Sentinel-1 daily coverage (Jun 1st to Jun 7th)

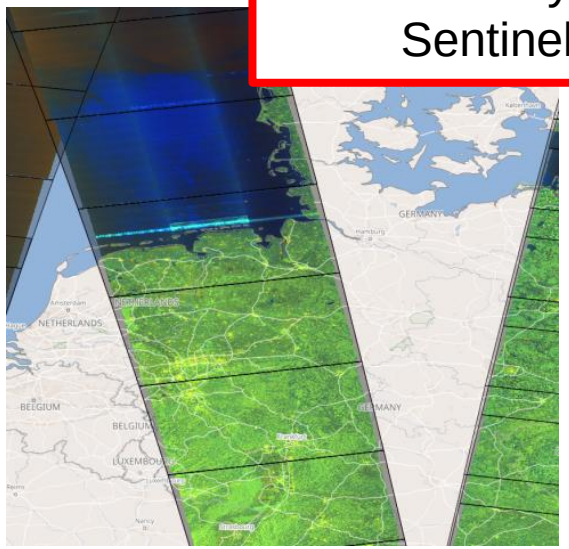


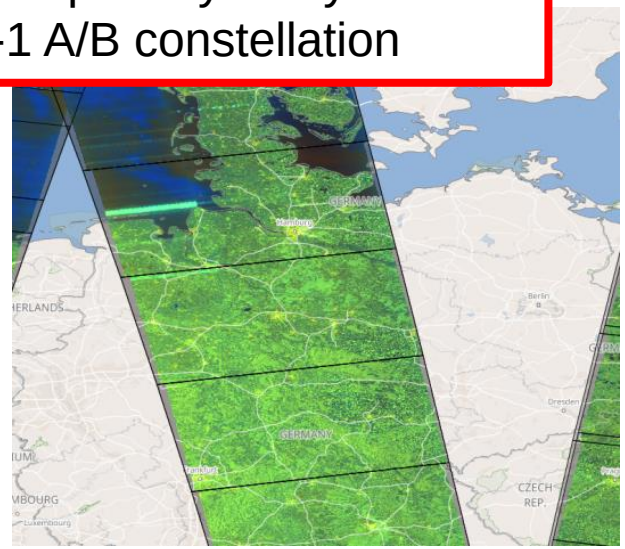


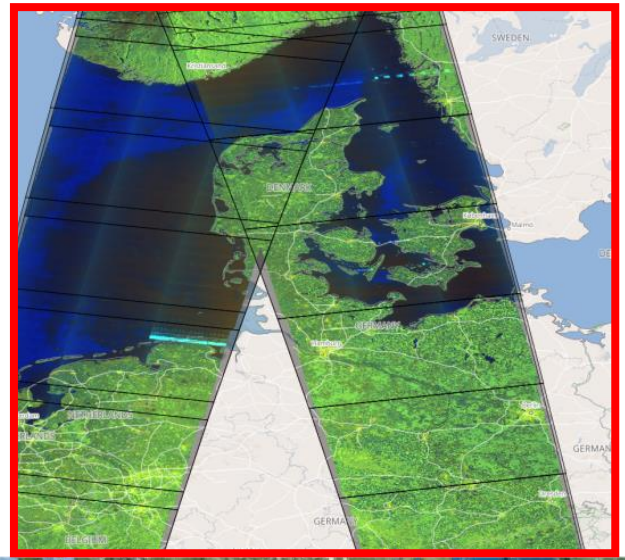


6 days repeat cycle by
Sentinel-1 A/B constellation





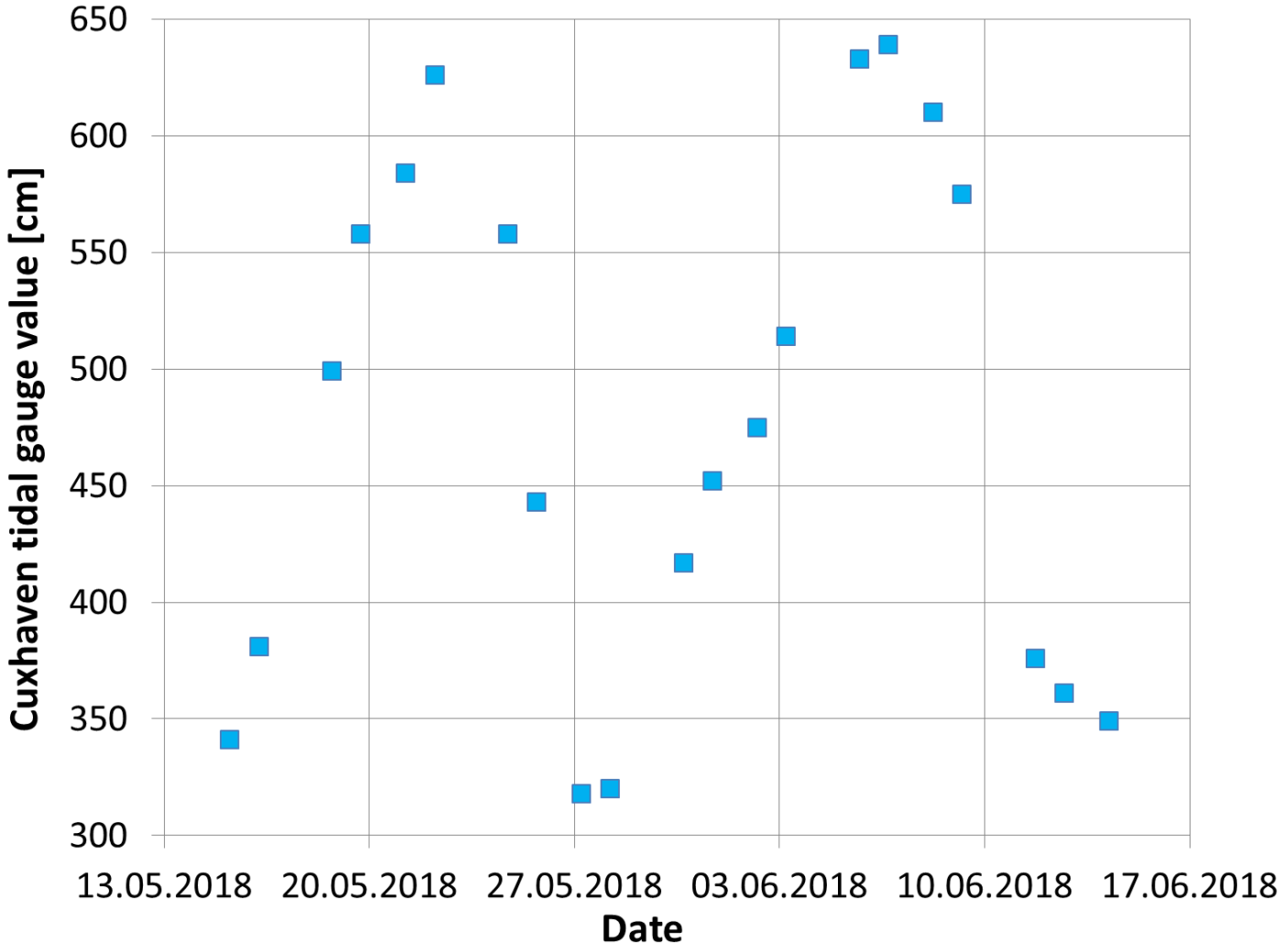




Screenshots: CODE-DE

Sentinel-1 and tides

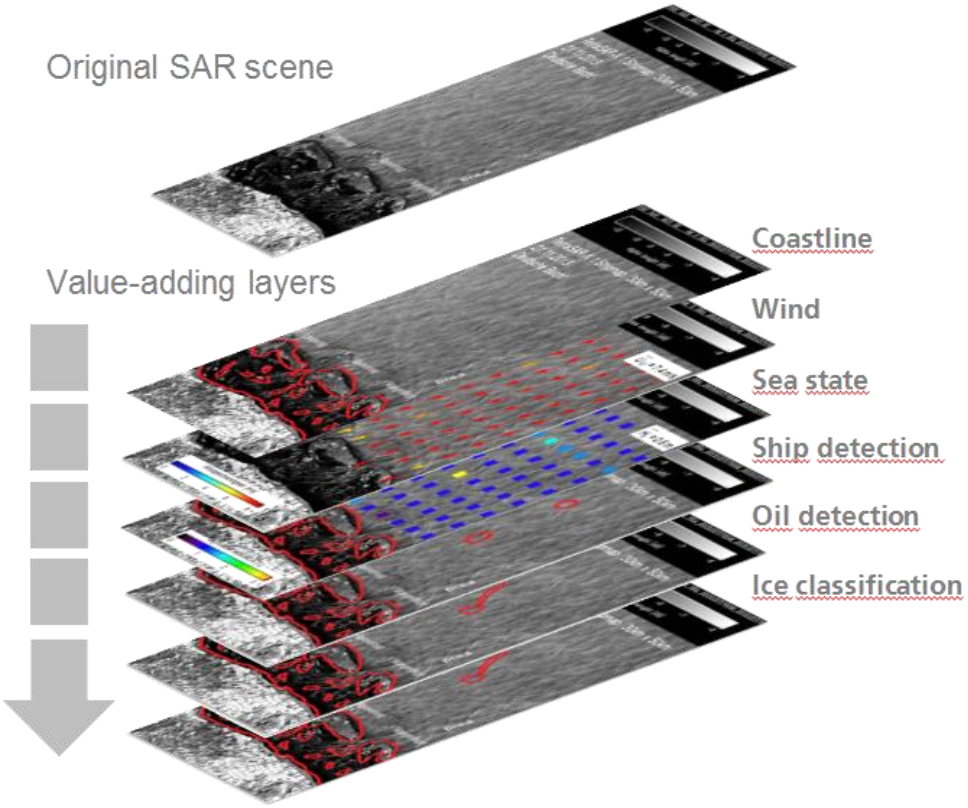
- Elbe estuary covered almost daily
- About 2 weeks for coverage of one tidal cycle



Waterline retrieval algorithm

- Intended purpose
  - Run as part of DLRs SAINT processing chain for more accurate land masking
  - Scene-based
  - All satellites and acquisition modes
  - Wadden Sea application as hard test case

- Output
  - Land polygon shapefile

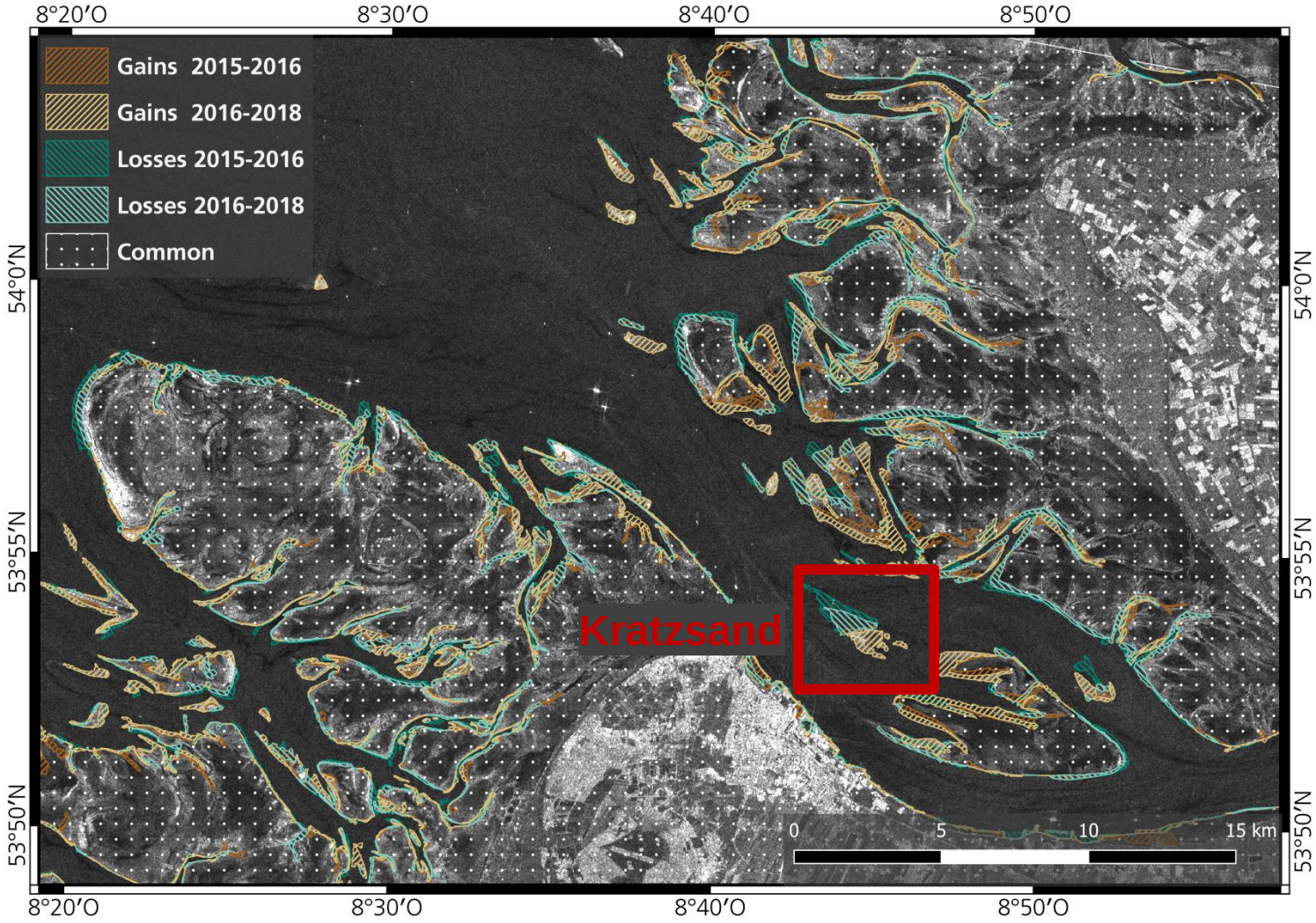


Workflow of DLRs SAINT processing toolbox

Changes in the Elbe estuary during Sentinel-1 time

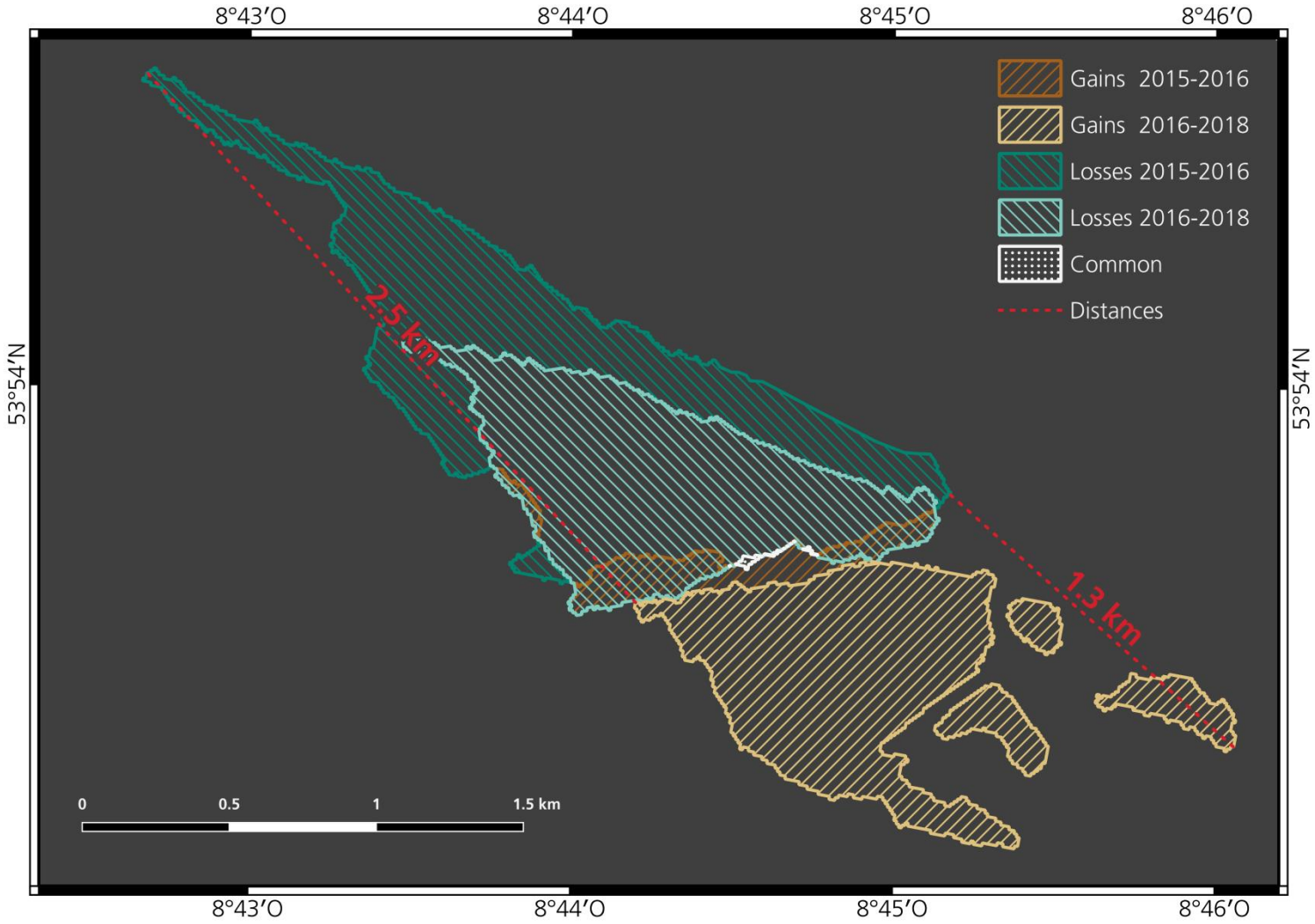
- Used lowest tide scene during 3 time spans
  - Winter 2014/2015 (earliest Sentinel-1 data)
  - Spring 2016 (measurement campaign)
  - Summer 2018 (most recent)

- Acquisition time and gauge level (Cux)
  - 2015-01-19, 06:41, 343 cm
  - 2016-05-04, 18:17, 348 cm
  - 2018-07-26, 06:41, 350 cm



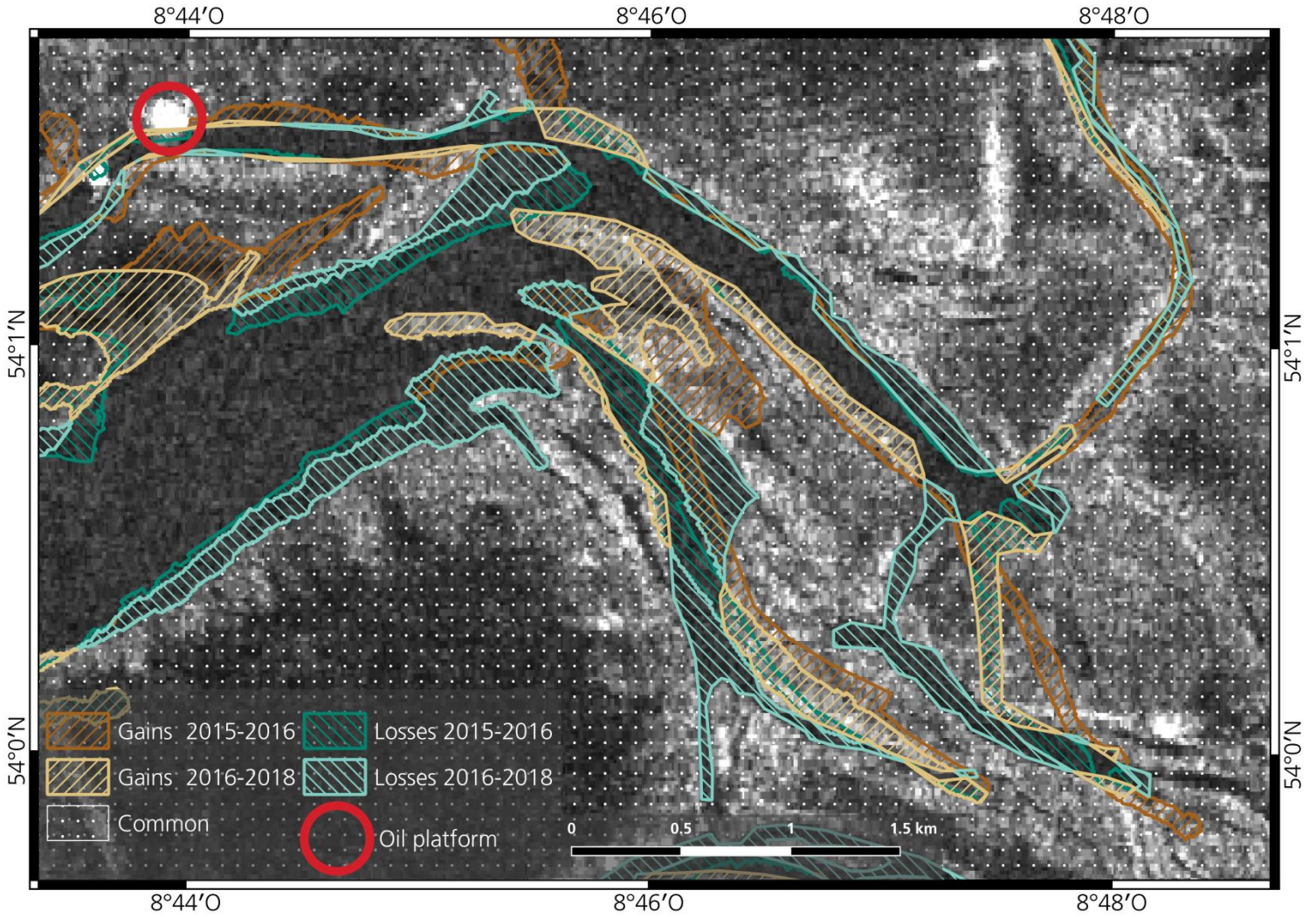
Changes of Kratzsand

- Sandbank moved south
  - 1.3 km (southern part)
  - 2.5 km (northern part)
  - Average: > 1 m per day

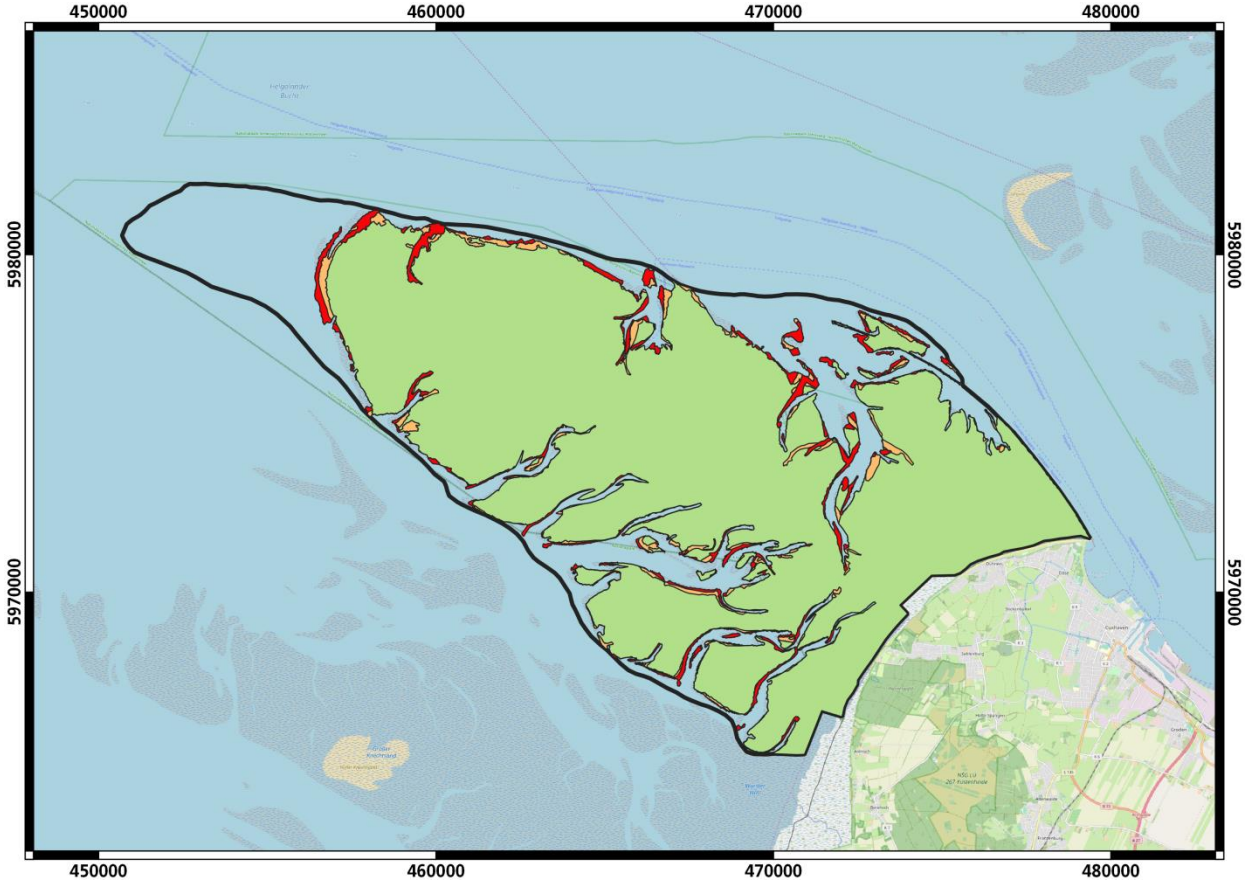


Changes near oil platform Mittelplate

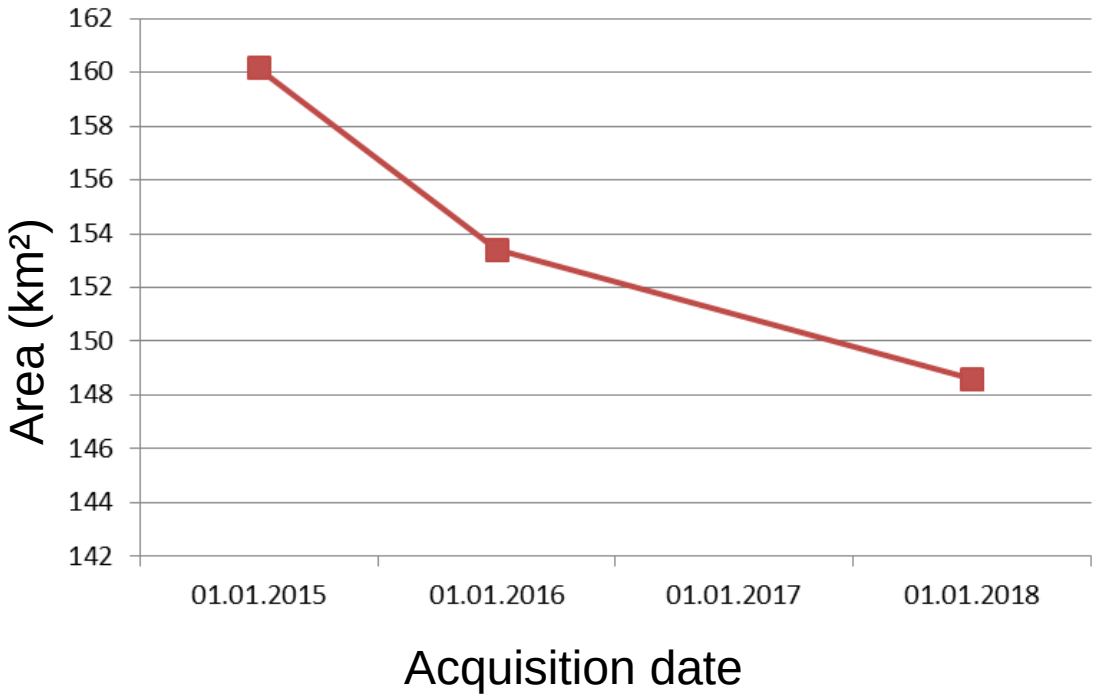
- Mittelplate
  - Germany's only offshore oil platform
  - Built on a sandbank
  - Monitoring of surrounding tidal flats necessary for safety of platform



Area comparison of Cuxhaven mudflats

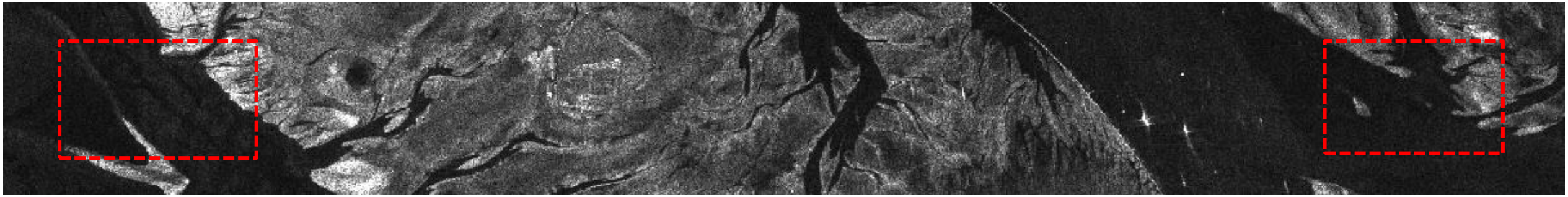


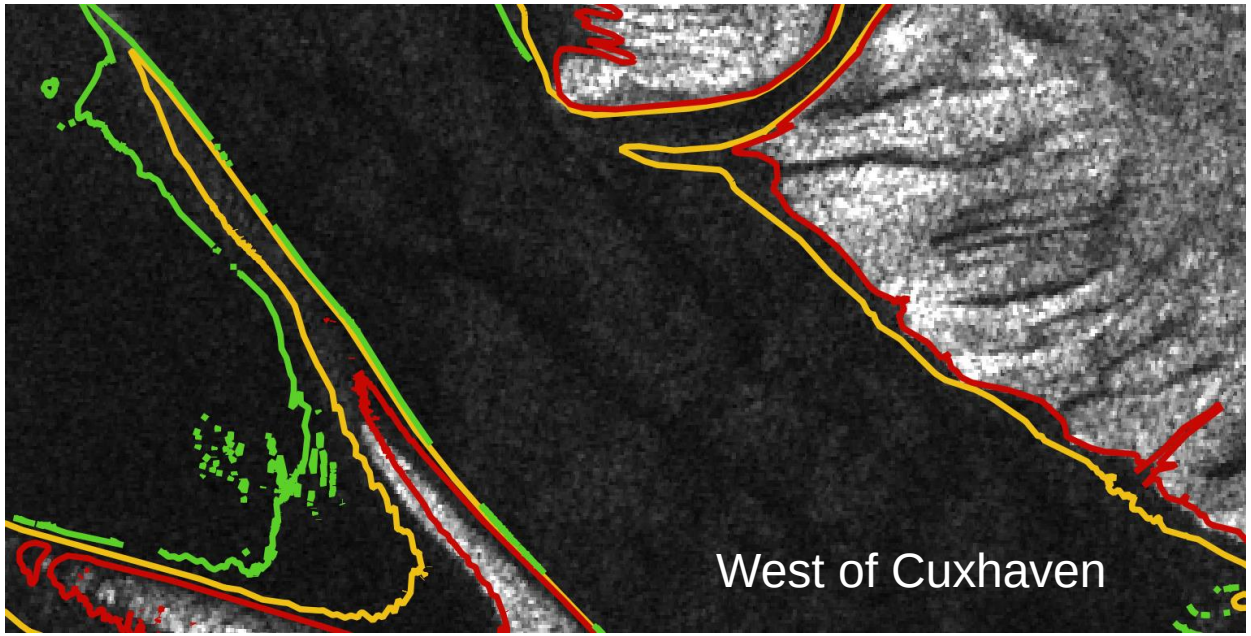
2015-01-19 - 2016-05-04 - 2018-07-26

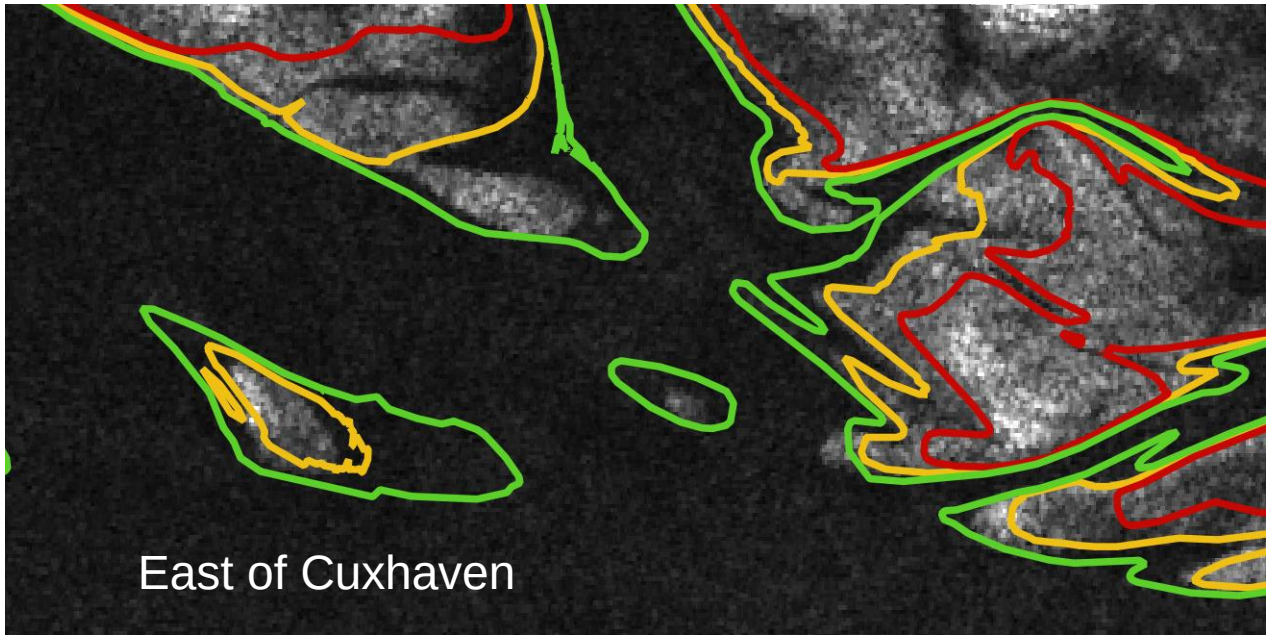


- -6.9% (160 km² to 149 km²) in 30 months
- But: different tides (343/348/350 cm); more data points possible

Comparison to measured DEM







DGMW2016 contour lines: **310 cm** - **350 cm** - **400 cm**

Scene: Sentinel-1A 04.05.2016 17:17 UTC, Cuxhaven water level: **348 cm**, during flood

Thank you for your attention!

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