NoR sponsorship, Project achievements report for project “Connecting sea level heights from radar altimetry with shoreline changes from optical remote sensing”

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Project Objectives

The goal of this (PhD) project is to combine changes in sea surface heights from satellite altimetry with changes in shoreline positions extracted from optical remote sensing imagery to study the interplay of sea level, vertical land motion, shoreline changes and morphodynamics over a period of 30 years (1992 - 2022). The first study area is the northern beach of barrier island of Terschelling at the Dutch coast, between North Sea and Wadden Sea. This are was chosen because of the availability of auxiliary datasets as tide gauge and GNSS records for validation of the satellite observations and determination of vertical land motion.

How using tools and data within cloud environments helped you to achieve your goals

At the beginning of the project one of the research goals was also to study the performance of different algorithms to retrack radar altimeter waveforms, as well as finding the best set of corrections. For this we started to use the P-PRO Earth Console ALES cloud retracking service to derive sea surface heights from 20 Hz Sentinel-3A/B waveforms close to the coast of Terschelling.

In the meantime we came to the conclusion that starting out with Level-1 data is too ambitious for a 4-year project where data processing is only the first step to gaining new scientific insights. We therefore decided to use readily available datasets that already include coast-specific processing, corrections, outlier detection and inter-mission cross calibration.

Preliminary results with the Sentinel-3 ALES-retracked data from the Earth Console were presented at two conferences, the ESA Living Planet Symposium 2022 in Bonn and the Coastal Altimetry Workshop 2023 in Cadiz (see poster cutout below).

Apart from these first experiments we currently plan no further use of the ESA Earth Console.

Sentinel-3B retracked with ALES (20 Hz)

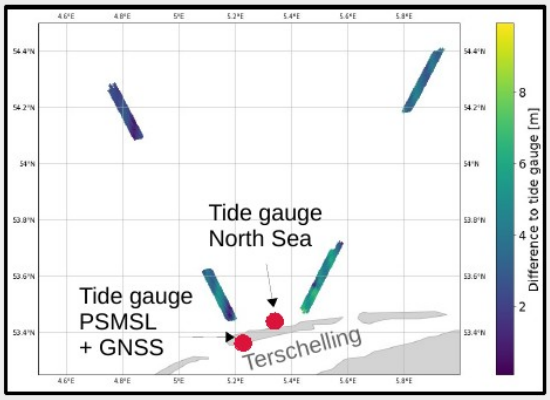

Figure 2: Sentinel-3B observations at the Dutch coast retracked with ALES in the ESA Earth Console. All sea surface heights observed during one month were averaged over each of the four areas with a distance to the coast of 5-25 km and 80 - 100 km for left and right track.

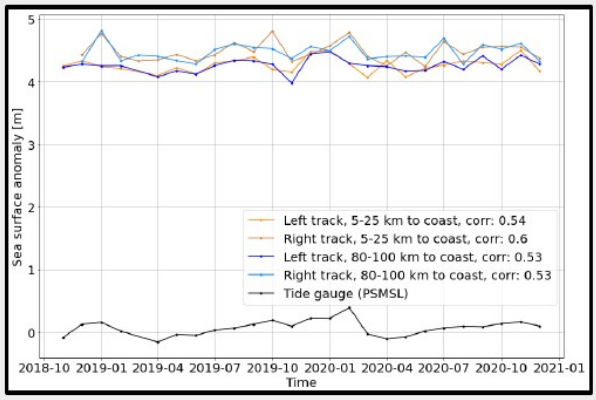

Figure 3: Timeseries of corrected sea surface anomalies with their correlations to the tide gauge show differences between the tracks but no significant increase in correlation closer to the coast. Each timestep is a monthly average over the respective area (figure 2).

Benefits to society derived from your project

By identifying coastal areas that are vulnerable to sea level rise this work has the potential to aid climate change adaptation and will help coastal zone management and policy. As this work bridges the disciplines morphology, geodesy and earth observation it will be of interest for a broad scientific audience and may serve as an important input for follow up studies.