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BATHYMETRY AND TIDAL FLAT TOPOGRAPHY FROM SENTINEL-1 ACQUISITIONS

Abstract

The automatic processing of bathymetry in shelf oceans as well as the creation of topography for tidal flat areas from Sentinel-1 Synthetic Aperture Radar (SAR) satellite data was developed.

SAR bathymetry processing is applicable in oceans with water depths of about 10m to 100m. This is a crucial depth range for many offshore construction areas like wind parks. The high costs of bathymetry generation with conventional ship surveys are a major reason for the lack of accurate bathymetry data worldwide. Using radar satellites like Sentinel-1 and automated algorithms, the effort of generating bathymetry data on suitable coasts worldwide is strongly reduced. The algorithm tracks changes of the lengths of long swell waves interacting with the seafloor, shortening the wave length due to the shoaling effect when waves reach shallower waters.

In tidal flat areas like the Wadden Sea at the Danish, German and Dutch North Sea coast, the morphodynamics of seabed structures are significant; the soft seabed can change within days during severe storms. Data from past measurement campaigns, which are very expensive using ship soundings and airborne LIDAR scanning, deprecates quickly as the positions of islands, sandbanks or tidal inlets change. We have developed automated algorithms to retrieve the waterline from SAR images. In the tidal flat areas of the Wadden Sea, analyzing time series of acquisitions at similar tidal states allows estimating rates of change and sediment transport; a combination of several images acquired within a short time frame at different tidal states allows estimating the topography.

Acquisitions from the Sentinel-1 (S1) Synthetic Aperture Radar (SAR) satellites cover most coasts worldwide. With two satellites currently in orbit, the acquisition interval is at most 6 days at the equator and almost daily in our latitudes. The Interferometric Wide Swath (IW) mode covers lands and coastal oceans with a swath width of 250km and an image resolution of 10m. In contrast to optical satellites, SAR acquisitions are independent of illumination and cloud cover; hence, they deliver new images very reliably. The DLR satellite ground station in Neustrelitz receives these data and processes and delivers the value-added products in Near Real Time (NRT), usually within 20 minutes after acquisition.