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Automatic Waterline Detection and Change Monitoring in the Wadden Sea

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An algorithm for automatic detection of the land-water-line in TerraSAR-X images was developed with focus of application to tidal flat areas. The Wadden Sea is a very unique and dynamic coastal region located in the North Sea in the Netherlands, Germany and Denmark. During low tide, tidal flats extend several kilometres away from the coast, creating features like tidal inlets and sand banks. These features change over time under the influence of tidal currents transporting large amounts of eroded material. During heavy storms, the topography can even change severely within a few hours. The Wadden Sea is also a region with high ship traffic to the ports of Hamburg, Bremerhaven, Wilhelmshaven and others. Hence, observing obstacles like sand banks and decreasing water depth is a crucial task for maritime security. In-situ monitoring campaigns with ships or airplanes are not frequently done in most areas as they are economically expensive and provide only limited coverage. Using TerraSAR-X acquisitions, the developed algorithm aims to extract the waterline at the time of recording. As the algorithm is designed for automatic operation under Near-Real-Time constraints, it allows for a fast and large scale determination of changes in island and coastal outlines. By combining multiple acquisitions of the same area acquired at different tidal levels, the topography can be reconstructed. Mainland areas covered by grass, agriculture or buildings generally provide a high radar backscatter while smaller water areas like rivers or lakes have a very low radar backscatter. Tidal flat areas, however, are very challenging, as their intensities are very heterogeneous and range from very low to very high backscatter values depending on surface structure, composition or water content. On the sea, on the other hand, wind causes an increase in intensities. Hence, since intensity levels alone are not enough, the algorithm uses contrast-based methods and several processing steps for artefact removal.