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Investigation of coastal wave field variations with TerraSAR-X

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Spaceborne Synthetic Aperture Radar (SAR) is a uniquely powerful sensor providing two-dimensional information of the ocean surface like a broad spectrum of meteo-marine parameters such as windfields, significant wave height, peak wavelength and other seastate characteristics. SAR is particularly suitable for many oceanographic observations due to its high resolution in combination with global coverage and the independence of daylight and cloud conditions. The data has been amongst others used to investigate geophysical processes and for numerical model validation. It has also so been found to be a valuable contribution regarding data assimilation into meteorological, marine and coupled models.

The X-band radar of the TerraSAR-X (TS-X) satellite acquires images of the sea surface with a high resolution up to 1m. Due to a lower platform altitude and a higher signal frequency, nonlinear imaging effects of the moving ocean surface are reduced when compared to previous C-band sensors and thus individual ocean waves with wavelengths below 30m are detectable.

Minor importance of nonlinear effects in the wave imaging process also gives rise to new empirical model functions to derive sea state parameters directly from the SAR image spectrum properties and thus minimizing data processing time. This is of special interest with regard to the development of near-real-time (NRT) data products often favorable for maritime safety and security applications particularly .

The latest generation of the empirical algorithm for TS-X seastate analysis XWAVE has been tuned with hundreds of collocated buoy measurements over the open ocean and subsequent validation exhibits a very good agreement with in–situ data. However, in contrast to the open ocean where seastate parameters do not change significantly on the scale of kilometers, coastal waters exhibit a large spacial variablility owing to ,inter alia, subsurface topography influence. The lateral variation complicates the extraction of spectral parameters and thus needs to be accounted for.

We present an updated XWAVE algorithm which was improved for coastal applications. The study was carried out for the German Bight and we compare our results with collocated buoy data as well as with the coastal wave model CWAM of the German Weatherservice (DWD).