

Meteo-marine parameters from Sentinel-1 SAR imagery: towards near real-time services for the Baltic Sea

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Abstract

Method

for estimating meteo-marine parameters from satellite Synthetic Aperture Radar (SAR) data, with a purpose of near-real-time (NRT) service over the Baltic Sea, is presented and validated. The empirical function CWAVE_S1-IW which is based on the spectral analysis of radar image subscenes is used for retrieving total significant wave height from Interferometric Wide swath (IW) Sentinel-1A/B imagery. CMOD algorithm was used for wind speed estimation from SAR images. In total, 15 Sentinel-1A/B scenes (116 acquisitions) over the Baltic Sea were processed for comparison with off-shore sea state measurements (52 collocations) and coastal wind measurements (357 collocations). Sentinel-1 wave height was spatially compared with WAM wave model results (Copernicus Marine Environment Monitoring Service-CMEMS). The comparison of SAR-derived wave heights shows good agreement with measured wave heights ($r = 0.88$) and with WAM model ($r = 0.85$). The wind speed, estimated from SAR images yields to agreement with in-situ data ($r = 0.91$). The study demonstrates that the wave retrievals from Sentinel-1 IW data provide valuable information for operational and statistical monitoring of wave conditions in the Baltic Sea. The Sentinel-1A/B wave data in general agrees with the results retrieved from altimetry, however SAR provides additional value when monitoring coastal region where altimetry data is missing. Sentinel-1A/B data is valuable for model data validation and interpretation in the regions where and during periods when in situ measurements are lacking. The Sentinel-1 A/B wave retrievals provide more detailed information about spatial variability of the wave field in the coastal zone compared to in situ measurements, altimetry wave products and model forecast. Thus, SAR data enables estimation of storm locations and areal coverage. Methods shown in the study are implemented in NRT service in German Aerospace Center's (DLR) ground station Neustrelitz.