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# Meteo-Marine Parameters from High-Resolution Satellite-Based Radar Measurements and Impact of Wind Gusts on local Sea State Variability

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To investigate local geophysical processes, sea surface wind speed and the sea state field simultaneously estimated from X-band satellite-borne Synthetic Aperture Radar (SAR) images acquired over North Sea were compared and analysed. The data were retrieved from TerraSAR-X (TS-X) satellite scenes with overflight covering $\sim$300km$\times$30km with resolution of 3m. The inhomogeneity of wind fields and the impact of wind gust systems on the local sea state are studied based on space-covered remote sensing data and in-situ buoy measurements in the German Bight of the North Sea.

The sea state parameters and wind speed were estimated using newly developed Sea State Processor (SSP)for meteo-marine parameter estimation. The SSP is designed for supporting forecast services and providing validation in coastal areas with robust automatic space-covering processing in near real time (NRT). SSP includes a pre-filtering procedure for removing artefacts like ships, seamarks, buoys, offshore constructions and slicks from analysed images, the empirical XWAVE_C (C=Coastal) algorithm developed for coastal seas for estimation significant wave height, XMOD-2 wind algorithm and an additional procedure performing a control of results based on the statistics of the whole scene.

The collected, processed and analysed data base for the German Bight consists of more than 60 TS-X StripMap scenes/overflights with more than 200 images acquired since 2013. The acquired conditions vary in range 0-7m for significant wave height and in range 0-25m/s of the surface wind speed. The spatial comparison of sea state and wind field estimated form remote sensing data to the results of the wave prediction models show local variations due to distinctions in bathymetry and in wind front propagation. At the first time it was observed and registered: the local wave height increase of 1-2m is connected to wind gusts in kilometre-scale clusters. The statistical analysis allows to connect the typical weather conditions with instabilities in wind field and the sea state inhomogeneity on local scale. This local inhomogeneity is mostly not present in prediction models due to the smooth wind input. The results gained can be adopted in forecast modelling as an additional term for inhomogeneity of the wind field and sea state.