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Synergy between satellite observations and model simulations during extreme events

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In this study the quality of the wind and wave data provided by the new satellite Sentinel-3A is evaluated. The focus is brought to the coastal areas, where altimeter data tend to get worse than in the open ocean. Satellite data of Semtinel-3A, Jason-2 and CryoSat-2 performance is assessed, with respect to in-situ measurements and the spectral wave model (WAM) simulations. Wave model sensitivity on wind forcing is evaluated, using data with different time and space resolution, as ERA-Interim and ERA5 reanalyses, ECMWF operational analysis and German Weather Service (DWD) forecast. The analyses showed that the wave model forced with the ERA-5 reanalyses demonstrates the best skill over the whole study period, as well as during extreme events. In order to further estimate the variance of the significant wave height of the ensemble members with different wind forcing, especially during extreme event, an Empirical Orthogonal Function (EOF) analysis are performed. Compared to in-situ measurements, the general performance of all satellites is good and fairly similar for the North Sea and Baltic Sea within the whole study period, although the significant wave height from the satellites tends to slightly overestimate the one of in-situ measurements with 7 cm to 30 cm. The quality of all satellite data near the coastal area worsens, however, within 10 km of the coast, Senitinel-3A performs better than the other two satellites. Analyses have been carried out, in which data from the satellite tracks are separated between onshore and offshore flights, with onshore flights passing from the ocean to the shore and offshore flights passing from the shore to the ocean. When comparing the statistical values for the onshore and offshore flights, no substantial difference is found. Therefore, the transition from land to water does not much influence the quality of the satellite measurements for the German Bight region. No substantial differences have been also found between the satellite tracks under varying metocean conditions. It can be concluded that the quality of the data in coastal areas has improved for the new satellite Sentinel-3A compared to older satellites. Furthermore, the prediction limits and applications for the combination of newly available satellite observations, in-situ data and model simulations is addressed.