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Assessment of the impact of HF radar current measurements on hydrodynamical model forecasts in the German Bight

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The impact of high frequency (HF) radar measurements in the German Bight is investigated using a statistical assessment approach as well as an assimilation method. Within the project COSYNA (Coastal Observation SYstem for Northern and Arctic seas) three HF radar stations located in Wangerooge, Büsum, and Sylt will provide continuous surface current measurements. The presented study is about first steps towards the use of these data in an assimilation system to improve forecasts with a three dimensional hydrodynamical model.

To get a first idea about the impact of radar measurements, an optimal linear estimator is used to re-construct the complete surface current field from HF radar observations taking into account both the prior current distribution and radar measurement errors. The prior current distribution is estimated using a three dimensional hydrodynamical primitive equation model with 1 km resolution. The performance of the HF radar observations is quantified in terms of the re-construction quality. Different combinations of radar stations are investigated using synthetic observations. In particular the impact of the additional two-dimensional information obtained with two stations instead of one station is illustrated. The direct use of radial current components for the re-construction is compared to the use of surface current vectors derived from the combination of two or three radar stations. Apart from the capability of the HF radar observations to provide estimates of the current field at the time of the observations, the potential of the measurements to provide forecasts is investigated with the linear re-construction approach as well. Furthermore the linear approach is used to re-construct the surface elevation rate of change making use of the continuity equation.

An assimilation method based on the ensemble Kalman filter is used for a first impact assessment of HF radar measurements within a forecast system. Synthetic measurements with different characteristics, e.g., different combinations of radar stations, different measurement errors, are investigated. Twin runs are performed to compare forecasts with different configurations of the assimilation system, e.g., different assimilation intervals or different numbers of ensemble members.

First available measurements of the radial surface current component obtained by the Wangerooge station are analyzed. Both the horizontal current field structure and the temporal evolution of the current field are compared to the numerical model with a focus on the M_2 tidal signal. The analysis will also provide a statistics on the frequency of missing values, which is important for the assimilation of the data.