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High-resolution wave forecasting system for the seasonally ice-covered Baltic Sea

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When forecasting surface waves in seasonally ice-covered seas, the inclusion of ice conditions in the modelling is important. The ice cover affects the propagation and also changes the fetch over which the waves grow. In wave models the ice conditions are often still given as a boundary condition and handled by excluding areas where the ice concentration exceeds a certain threshold value. The ice data used are typically based on satellite analysis or expert analysis of local Ice Services who combine data from different sources. This type of data is sufficiently accurate to evaluate the near-real time ice concentrations, but when making forecasts it is also important to account for the possible changes in ice conditions. For example in a case of a high wind situation, there can be rapid changes in the ice field, when the wind and waves may push the ice towards shores and cause fragmentation of ice field.

To enhance handling of ice conditions in the Baltic Sea wave forecasts, utilisation of ice model data was studied. Ice concentration, thickness produced by FMI's operational ice model HELMI were used to provide ice data to wave model as follows: Wave model grid points where the ice concentration was more than or equal to 70% and the ice thickness more than1 cm, were excluded from calculations. Ice concentrations smaller than that were taken into account as additional grid obstructions by decreasing the wave energy passed from one grid cell to another.

A challenge in evaluating wave forecast accuracy in partly ice covered areas it that there's typically no wave buoy data available, since the buoys have to be recovered well before the sea area freezes. To evaluate the accuracy of wave forecast in partially ice covered areas, significant wave heights from altimeter's ERS2, Envisat, Jason-1 and Jason-2 were extracted from Ifremer database. Results showed that the more frequent update of the ice data was found to improve the wave forecast especially during high wind situations. However, there were some situations in which the accuracy of the ice forecast was not as good as that of the expert analysed ice product, which naturally affected the accuracy of the wave forecasts.