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Integrating wave modelling and observations in a complex coastal area

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The eastern Wadden Sea in the Netherlands is a highly complex area where many physical processes play a role in the evolution of wind waves. The area consists of barrier islands, tidal inlets, sand banks and deep channels often with steep slopes. In addition, astronomical and wind forcing generate spatial and temporal varying current and water levels. These complexities pose a challenge for the accurate determination of wave conditions along the water defenses protecting the low-lying parts of the Netherlands.
Identifying weak points in the numerical modelling is an important step towards improving these models. With this in mind, a 12-year measurement campaign was initiated in the Eems-Dollard estuary using X-band remote-sensing techniques and buoy measurements to determine the characteristics of the nearshore wave field, and laser techniques to accurately determine the wave run-up and overtopping against the water defenses.

Of special interest is the evolution of wind-generated waves as they propagate through the tidal channels towards the coast, especially in areas with steep slopes. Presently, this evolution can conveniently be assessed using spectral wave models like SWAN, but this requires properly designed (unstructured) grids. There are, however, indications that the linear approach has some fundamental limitations and suggestions have been made that additional processes like diffraction, tunneling, three-wave interactions or non-linear effects should be included.

The measurement campaign will assist in identifying the weak points in the presently used model setup. As point measurements are of limited value remote sensing techniques are deployed to provide a two-dimensional picture of the wave field as it propagates through this complex channel system. An analysis method is now being developed to integrate the measurements with the results of numerical wave models with the aim to identify and remedy the causes of mispredictions.

The general setup of the measurement campaign will be presented in combination with the numerical tools presently used to determine the wave evolution in this channel system. Hereafter, the method will be outlined to integrate the results of the remote-sensing techniques with those obtained from the numerical modelling.