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Sensitivity of the wind stress and storm surges to surface drag changes

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At the Royal Netherlands Meteorological Institute (KNMI), the current operational suite for storm surge forecasts consists of the atmospheric model HIRLAM and the storm surge model WAQUA/DCSM98. The storm surge model is driven by the 10-meter wind speed from HIRLAM, using a formulation for the drag coefficient. The implementation, which is based on the Charnock relation, is different in WAQUA than in HIRLAM, since the values for the Charnock parameter are different. That brings the inconsistency into the system.

In the present study a consistent formulation for the sea drag is established, aiming at improving the quality of storm surge forecasts in case of extreme weather. To that end, the storm surge model is driven with the surface stress calculated by HIRLAM, so that the storm surge model does not require the sea drag formulation anymore. The quality of the storm surge forecasts, resulting from removing this inconsistency, is assessed.

It is investigated, how the uncertainty in the magnitude of the drag coefficient translates into an uncertainty in the storm surge forecast - in case of extreme weather - through changes in the wind stress. Given the wind speed, the stress is linear in the drag coefficient. However, the effect of changes in the drag coefficient is smaller, since increasing the sea drag leads to reduced wind speeds. Several storms from the last few years are considered and the correlation between the increase in the drag coefficient and the increase in the storm surge is determined.