MOS water level forecasts – especially for open tidal harbours

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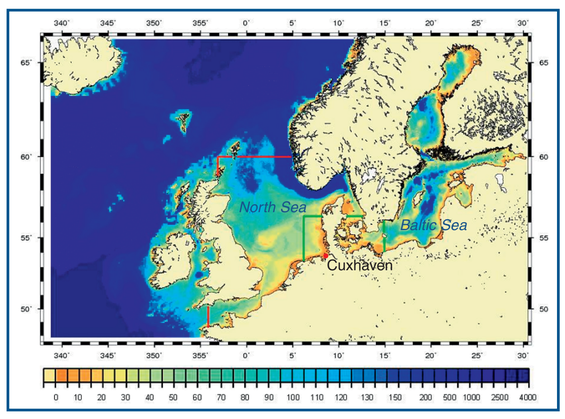
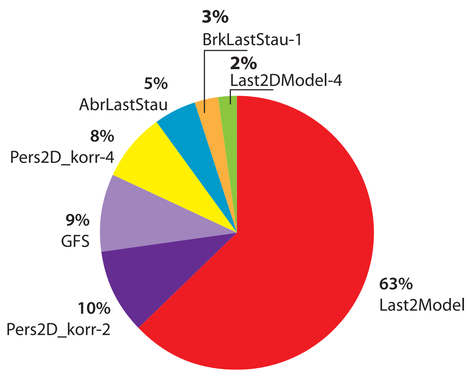
Cuxhaven tide gauge building

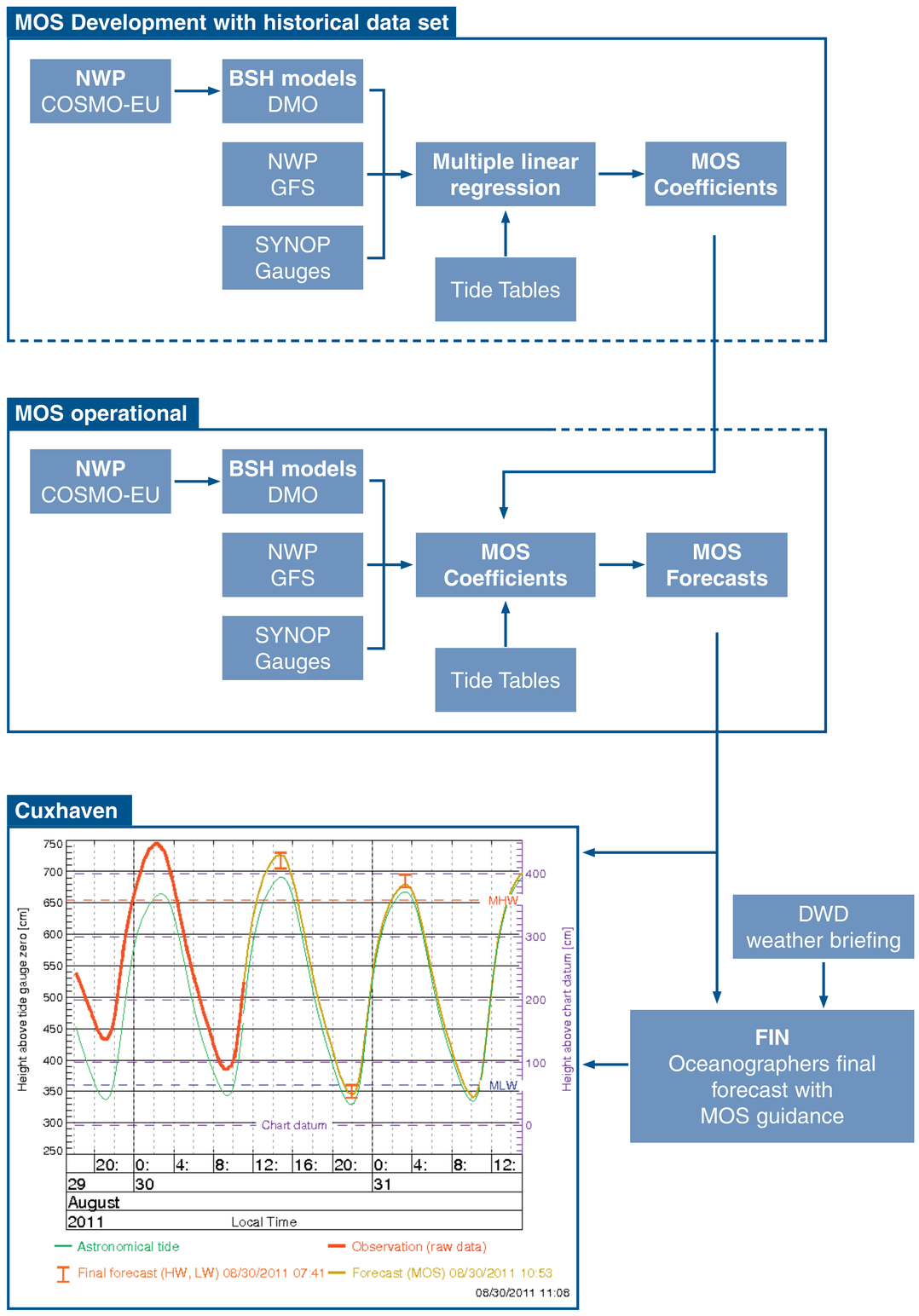
The water depth available to a vessel is computed by adding the current local water level referred to local chart datum to the water depth shown in the navigational chart, allowing for some under-keel clearance. The physical factor most relevant in this regard is the water level, which fluctuates periodically about a mean value due to tidal influence, and aperiodically mainly due to meteorological factors (wind surge). On the example of the German tidal harbour of Cuxhaven, located on the mouth of the river Elbe downstream of Hamburg, it is demonstrated how the quality of wind surge and water level forecasts can be improved by applying the Model Output Statistics (MOS) method.



Model areas of BSH's numerical water level forecast system

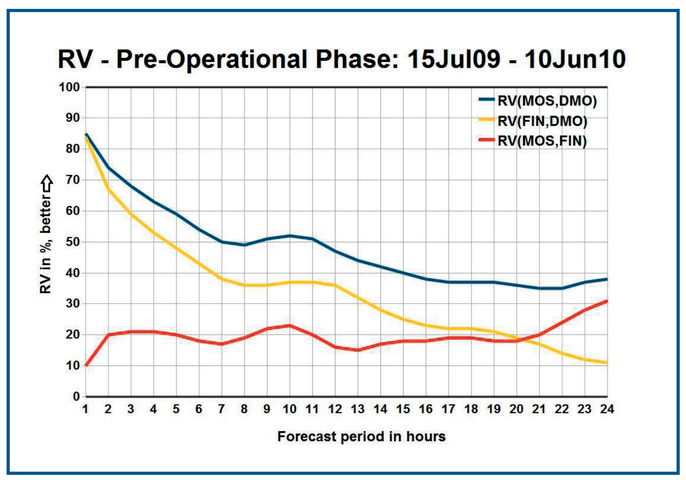


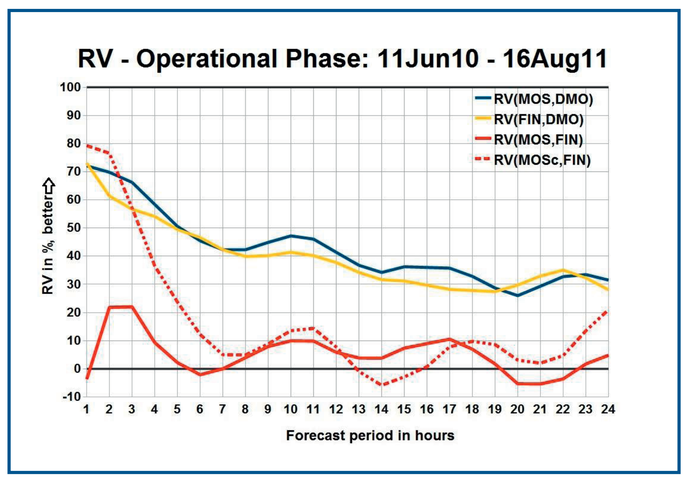
Predictor weights for lead time T+3 h. Predictors of 2D hydrodynamic model (input from DWD/COSMO-EU), tide gauge measurements from other locations (Borkum, Aberdeen) and independent weather prediction model GFS. Pie chart: S. Drefenstedt



Verification

MOS reduces 50% of the error variance of the high quality numerical model, i.e. the sum of squared errors of MOS is about half that of DMO (direct 2D model output).

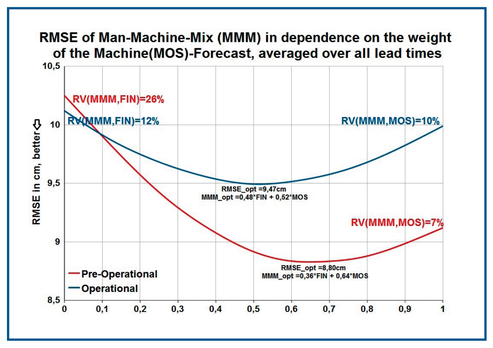




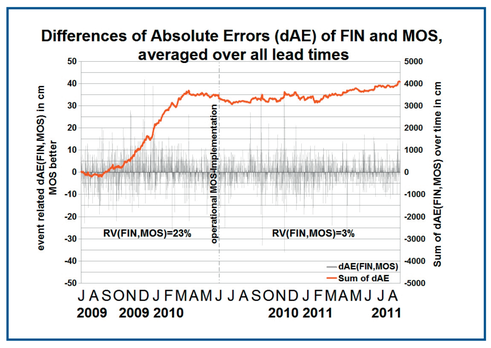
Abbreviations

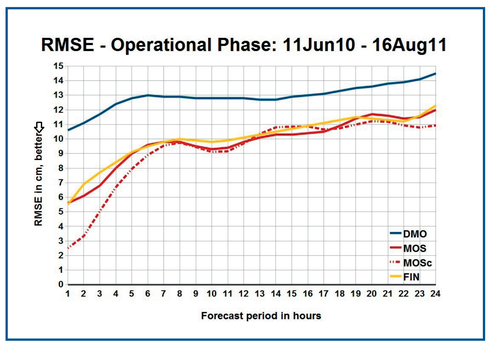
RV(M,R): Reduction of error variance RV of M with respect to R
RV(M,R) = [1 - MSE(R)/MSE(M)] * 100%
MOS: MOS forecast of high and low water wind surge
MOSc: MOS forecast of high and low water wind surge derived from full curve
DMO: Direct Model Output (2D-hydrodynamic North Sea model)
FIN: Final Forecast (oceanographers' forecast)
NWP: Numerical Weather Prediction
DWD: German Meteorological Service
GFS: Global Forecast System

Oceanographers forecasts (FIN) without MOS guidance



Oceanographers forecasts (FIN) with MOS guidance





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