EVALUATION OF EMPIRICAL RELATIONS FOR THE SEA SURFACE ROUGHNESS OF FETCH-LIMITED WIND WAVES

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The sea surface roughness plays a key role in the momentum exchange process between wind and waves and thus in air-sea interaction in general. It depends on the wave field present. For open sea conditions the Charnock relation has been applied successfully. In near coastal areas it has been found that parameters other than the wind speed also play an important role. The reason is that the sea state is not only determined by the wind speed, but also by upstream fetch.

Numerous attempts have been made to find an empirical relation for the sea surface roughness with an improved description of the wave field. The aim is to find a power law between non-dimensional scaling groups describing the sea surface roughness and the wave field. For sea surface roughness z_0 usually either the Charnock parameter $z_0 g/u_*^2$ (with friction velocity u_* and gravitational acceleration g) or the ratio of z_0 and significant wave height H_s are used. The wave field is most commonly parameterised by the ratio of peak wave velocity c_p and friction velocity u_* (or alternatively the 10m wind speed u_{10}), the so called wave age c_p/u_* or c_p/u_{10}. Another possibility is the ratio of significant wave height and peak wave length, the wave steepness H_s/L_p.

Recent data from the Danish offshore measurement at Rødsand include simultaneous wind and wave data from a 50 m meteorological mast and an acoustic sea bed mounted wave gauge. The site experiences fetches between 10 km and 100 km. More than 2000 half-hourly records have been analysed and used to test and compare all combinations of the above mentioned scaling groups. It was found that the parameterisation of the Charnock parameter with the wave age based on friction velocity yields the highest correlation between measurement and model. The parameters of the different relations have been found by a fit to the Rødsand data set. The different relations have then been tested for their capability of predicting the 10 m wind speed from the measured quantities. Again the parameterisation of the Charnock parameter with the wave age based on friction velocity yields the best results. A comparison with predictions based on parameter values from literature shows that the different parameter values result in smaller deviations than the variations between the different relations.