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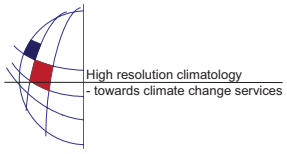


# Enhancing the prediction of turbulent kinetic energy in the marine atmospheric boundary layer

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A recent study by Shaikh and Siddiqui (2010) has shown definitively that the turbulent structure of boundary layer flows over water is fundamentally different compared with that over a smooth surface and with that over a solid wavy surface whose wave amplitude is similar to that of dynamically wind-generated waves. In light of this new information, the constants of the Mellor-Yamada boundary layer model, which are based on laboratory data over solid walls, are re-evaluated to suit the turbulent dynamics of a dynamic, wavy surface. The constants are based on the principal that the enhanced turbulent production in the vicinity of waves is redistributed among the normal stress components by virtue of the enhanced pressure-velocity covariances also found in the vicinity of waves. There is then a feedback mechanism whereby enhanced normal stresses modify the dynamic surface. The net effect of this is that in the marine boundary layer, one can expect an enhancement of turbulent kinetic energy due to the enhancement of normal stresses at the expense of shear stresses. The constants in the Mellor-Yamada-Janjic planetary boundary layer scheme within the Weather Research and Forecasting (WRF) model are changed to fit this principal. Simulations are then performed and compared with data (wind speed and turbulent kinetic energy) from the FINO1 platform in the North Sea. It is found that while predictions of the wind speed are barely changed, the magnitude of the tke error (RMS) is reduced by up to 50%. This is expected to be practically relevant for the estimation of blade fatigue of wind energy converters, where the tke is an important parameter in this assessment. It could also be relevant for pollution dispersion in marine boundary layers.