EMS Annual Meeting Abstracts
Vol. 13, EMS2016-28, 2016
16th EMS / 11th ECAC

Roughness length for coastal waters from wave boundary layer model

Jianting Du (1), Xiaoli Larsén (1), and Rodolfo Bolaños (2)

(1) Department of Wind Energy, Technical University of Denmark, 4000 Roskilde, Denmark, (2) DHI, DK-2907 Hørsholm, Denmark

The impact of ocean surface waves on the estimation of aerodynamic roughness length has been investigated by implementing a wave boundary layer (WBL) model in the third-generation ocean wave model-SWAN. The wave boundary layer model explicitly calculates the wave-induced stress and turbulent stress based on the conservation of momentum in the air-sea interface. At the same time, the air-sea momentum flux which is represented by the roughness length or drag coefficient is determined by the growth of the wind-waves. Therefore this method could be used to estimate the roughness length and drag coefficient under a wide range of wind and wave conditions. Numerical experiments are designed, for a coastal area west coast of Denmark, to investigate the wind and wave features and their impact on the estimation of roughness length under various wind and wave conditions including deep and shallow water conditions, young and old waves, onshore and offshore wind and waves, waves with turning winds, etc. It is found that the estimate of roughness length not only depends on the wind speed and wave age, but also depends on the significant wave height. The wind and wave characteristics, the roughness length and the drag coefficient calculated from the WBL model are validated with measurements from a coast site Horns Rev. Results suggest that the WBL model provides detailed wave characteristics giving more reliable roughness length estimation for coastal zones than the common used parameterization that is most suitable for open sea conditions. It is expected that the improved water surface descriptions will improve the coastal wind modeling, which is essential for near coastal wind farm planning, operation and maintenance.