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Air-sea interactions during tropical cyclone in the Indian Ocean

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Estimation of air–sea momentum flux during tropical cyclone is one of the most important fields of study in wind - wave modeling and prediction. A number of studies suggested that the Charnock coefficient depends on the sea state. The Charnock coefficient (α) is firstly considered as a constant 0.0144 (Charnock, 1955). Toba et al. (1990) suggested that α increases with the wave age (β) based on the observations of mostly young waves in a wave flume, while Donelan (1990), Johnson et al. (1998), Lange et al. (2004), showed that α decreases with the wave age β. Moon et al. (2004) studied the effect of surface waves on Charnock coefficient under tropical cyclones and pointed out that the Charnock coefficient is mainly determined by two parameters: the wave age and the wind speed. Also there is a strong correlation between drag coefficient (Cd) and wave age (β) for each wind speed. When the wind speed is higher than 30 m/s, Cd will increase with β, otherwise Cd will decrease with increasing β. Amorocho et al. (1980) showed that three regions exist in the development of the wind stress: (i) a lower region in which the wind waves have not begun to break, for which drag coefficient (Cd) is approximately constant; (ii) a transitional region after the onset of breakers, for which Cd varies non-linearly with U10; (iii) a limiting region for which Cd tends again toward a constant value, and corresponds to a condition of breaker saturation. The three regions described above can be classified as 'low roughness', 'transitional', and 'high roughness', respectively. Wavewatch III model was used to study the air sea interaction during tropical cyclone in the Indian Ocean. ECMWF winds (2.5° x 2.5°) have been used for forcing the wave model. Air–sea momentum data was obtained by simulating wave fields of tropical cyclones during 1996 in the Indian Ocean. The wave parameters from the model results have been compared with measured buoy data and with merged altimeter data. The model results show good agreement with the buoy and altimeter data. As the cyclone reaches the peak, the significant wave heights are reducing due to the near shore bottom effect. During cyclone, most of the waves are young waves and few mature waves. It is found that the charnock coefficient decreases with wave age and increases with wind speed. Drag coefficient decreases with wind speed. Drag coefficient varies nonlinearly with wind speed (i.e. transitional region) before the cyclone reaches to its peak and later it becomes almost constant.

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