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Ocean waves by typhoons and a perspective of their role in interaction

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Extremely strong winds by typhoons generate very high waves in ocean, which is quite dangerous to voyaging vessels and gives much damage to beach structures. Since wave information is crucial for disaster prevention both in seas and coasts, Japan Meteorological Agency (JMA) operates wave models and issues information on ocean waves.

JMA now operates two wave models: one is the Global Wave Model (GWM) for the whole sea area and the other is the Coastal Wave Model (CWM) which covers the seas around Japan. The wave model is the third generation wave model MRI-III, which was originally developed in Meteorological Research Institute (MRI) of JMA. The third generation wave model explicitly calculates the non-linear energy transfer (Snl) values, which is one of three source functions like energy input and dissipation. Operational wave models usually calculate the change of wave spectra, energy of many components divided in many frequency and direction. It is important to calculate accurate Snl values are crucial for quick development of waves or windsea-swell interaction. Multi directional waves usually exist in seas under typhoons, and thus accurate estimation of Snl is necessary.

An Example of high waves by typhoons and wave model prediction, we show a high waves by Typhoon Roke (1115) in 2011. Ty Roke moved eastward in the sea south of Japan main land, with strong intensity and high waves over than 8m height were generated in the central part of the typhoon. Irozaki coastal wave recorder, located in the tip of Izu Peninsula in Shizuoka Prefecture, observed the maximum wave height of 10.6m (wave period was 12.8 sec.) at 06UTC on 21 Sep. The Irozaki wave recorder also observed 2 dimensional wave spectra at that time. The CWM of 12UTC on 20 initial predicted the maximum wave height of 10.5m and wave period of 14.5 seconds at 09UTC. The predicted time of peak wave was 3hours later than the observation but the wave height was fairly compared. The predicted wave spectra were similar to the observed spectra too. The wave model may satisfactory predict wave conditions by typhoons.

It is well known that momentum and heat fluxes from seas are very important for typhoon intensity changes. These values are transferred through sea, whose surface under typhoon is quite rough by high waves and covered by drifting sea sprays. Flux values might be supposed to be influenced by wave condition, or more generally ”sea state”. There are many works which investigate the impact of the effect on tropical cyclone intensity by using integrated numerical models, namely a weather-ocean-wave coupled model.

However, wave influence itself has not been sufficiently cleared yet; rather even principle mechanism is still unknown. It would be necessary to couple a wave model with a weather model and to investigate the effect intensively. We show some results of impact of typhoon intensity by a weather-wave coupled model. The influence change by the different drag coefficients is also shown.

Keywords: ocean waves, typhoons, air-sea interaction