Tropical cyclone-ocean interactions on Typhoon Haiyan (2013) simulated by a coupled atmosphere-wave-ocean model

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Typhoon Haiyan, the deadliest tropical cyclone (TC) ever recorded in the Philippines, made landfall in the central Philippines on 8 November 2013. To understand roles of TC-ocean interactions on Haiyan, numerical simulations of Haiyan and analogous Typhoon Mike (1990) were performed using a 2-km-mesh nonhydrostatic atmosphere model (NHM) and its atmosphere-wave-ocean coupled model (CPL). Comparison between Haiyan and Mike revealed that relatively rapid translation and small sea surface cooling (SSC) were the factors critical for simulating the extraordinary intensity of Haiyan. Without SSC, Mike might have become stronger than Haiyan. To evaluate uncertainties of TC intensity predictions under different oceanic initial conditions, ensemble simulations for thirty-three oceanic conditions were performed with a 7-km mesh NHM and its CPL for the two TCs. Uncertainties of preexisting oceanic conditions directly affected the central pressures simulated by the NHM. In addition, uncertainties of simulated central pressures were reduced via modification of the secondary circulation due to reduction in the uncertainties of sea surface temperature, irrespective of geographical location, even though wave coupling resulted in some uncertainties of drag coefficients, surface winds, and latent heat fluxes near the TC centers. The ensemble simulations also indicate the importance of TC moving speed and thereby sea surface cooling on TC predictions.

Keywords: Tropical cyclone-ocean interaction , Atmosphere-wave-ocean coupled model, sea surface cooling, Oceanic environment

