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The impact of rain on wave evolution and its feedback to the atmosphere

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Rain can alter the exchange of properties across the ocean surface in several ways. In particular, rainfall can cause an increase in the surface roughness by enhancing both vertical and horizontal stresses on the water surface when raindrops strike the moving water surface. In the context of this study, the impact of rain on wave evolution and its feedback to atmosphere is examined using a two-way fully coupled atmosphere-ocean wave system. The system consists of the Weather Research Forecasting model coupled with Chemistry (WRF-Chem) as the atmospheric component and the Wave model (WAM) as the ocean wave component. Due to their advanced capabilities and features, the two models have been dynamically coupled using the OASIS Model Coupling Toolkit (OASIS3-MCT) and the resulting name of the coupled system is CHAOS (CHemical Atmospheric Ocean wave System). In order to analyze the rain-ocean wave interactions, a new parameterization scheme was added in the surface layer scheme of CHAOS. The new scheme incorporates indirect rain-ocean wave effects adding a rain-induced roughness length to the roughness length produced by wind blowing over sea-surface as initially proposed by Kitaigorodskii (1973) and afterwards by Kumar et al (2009). CHAOS has been assessed for its consistency and performance in the high-impact atmospheric and sea-state case study of hurricane Sandy occurred in late October 2012. Its efficiency was statistically evaluated against buoys records and satellite retrievals. Preliminary results indicate that the coupled system was mainly able to resolve the rain-ocean wave interaction mechanisms, improve the simulation of wave formation and decrease of the simulation errors. The feedbacks have systematic effects on the momentum fluxes and the sea surface roughness by modifying the characteristics of the atmospheric boundary layer and offering further improvements in the simulation of near surface wind.