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Impact of revised sea surface roughness length over shallow waters in the global forecast model simulations

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Sea surface roughness length is one of the important factors in heat and momentum exchanges between the atmosphere and sea. In the numerical weather forecasting and climate models, sea surface roughness length is often assumed to be a function of friction velocity based on the study by Charnock (1955), and this explains well the relation between wind speed and the roughness length over the open ocean. Over the shallow sea, however, observational studies have shown that the surface roughness length for a given wind speed is larger than over the open ocean. Recently, Jimenez and Dudhia (2018) have suggested the formula of the sea surface roughness length applicable for the shallow waters. In their formula, the roughness length is dependent on the water depth as well as the wind speed. In this study, surface roughness length over the shallow sea is modified following their formula and its impact on the simulation of the global forecast model is examined. Model used for simulations is the Korean Integrated Model. New formula was used over the shallow sea with depth less than 100 m, and over the open ocean, the original formula (modified version of Charnock relation) was used. Effect of modified roughness length is notable near the coast as expected. While the global distribution of atmospheric variables is not much changed, wind speed near the surface is changed over the shallow water region. In particular, wind speed at 10 m over the sea in west and south of the Korean peninsula, which is overestimated in the winter season in the original simulations, is reduced in the simulations with new formula of the sea surface roughness length. This results in reduction of overestimated surface sensible and latent heat fluxes over this region.