A New Land Surface Scheme for the JMA Global NWP Model: Validation Study using the CEOP In Situ Observation Data

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Land surface processes are very important for the simulation of global energy budget and continental-scale atmospheric circulation by numerical models. The JMA global NWP model uses a Simple Biosphere (SiB) model to represent the land surface processes. However, some shortcomings are revealed in the current SiB model, and we have been developing a revised SiB model (New-SiB) to improve the current one (Op-SiB). The New-SiB can treat soil and snow processes more elaborately than the Op-SiB. In this study, snow coverage and near surface meteorology expressed by the JMA global NWP model are evaluated using the CEOP in situ observations, focusing on the differences between the Op-SiB and the New-SiB.

A long-range time integration experiment with each SiB model is executed to evaluate the simulations of snow cover. The JMA model can properly reproduce the snow processes with each SiB model. However, the experiment shows an overestimation of thaw in the Op-SiB. Sensitivity experiments demonstrate that thaw remarkably progresses in the daytime and wet snow albedo has strong impacts on the expression of snow cover. Thus, the Op-SiB evidently underestimates a snow albedo in the melting season. The refinements of snow processes in the New-SiB bring an improvement of snow melting.

In order to validate a diurnal variation of near surface meteorology in the model, an assessment of the short-range time integrations with each SiB model are done using the CEOP reference site data for the EOP-3. In winter season, the accuracy of near surface air temperature is improved over snow covered area by using the New-SiB. In the Op-SiB, snowmass is simply treated as iced water on bare ground to calculate the heat budget of the surface skin layer. Since the New-SiB introduces a snow submodel, the accuracy of surface air temperature over snow covered area is fairly improved. However, the New-SiB still underestimates the magnitude of diurnal variation in near surface temperature compared with the observations.

The CEOP project provides useful datasets for an evaluation of land surface modeling, and reference site data are highly valuable for validation of the NWP models. They would also be effective to validate the other physical processes of the numerical model, such as atmospheric boundary layer and radiation processes.