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Improved parameterization of albedo in WRF + Noah in snow events simulation in the Tibetan Plateau

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Snowfall and the subsequent evolution of the snowpack have a large effect on surface energy balance and water cycle, among which albedo is a major driver. However, the current widely used Noah land surface model does not describe snow albedo correctly, although it keeps snow-related variables i.e. snow cover and age into account. In our study, the impact of an improved albedo parameterization scheme in WRF coupled with Noah was investigated. In the improved albedo scheme, albedo was parameterized as functions of snow depth and age which was developed using remote sensing retrievals of albedo.

Numerical experiments were conducted to model a severe snow event in March 2017. The performance of WRF coupled with Noah applying the improved albedo scheme was compared with that of applying the default albedo scheme and with that of WRF coupled with CLM applying CLM's complex albedo scheme. First, the improved albedo scheme largely reduces the WRF coupled with Noah default albedo overestimation in the southeastern Tibetan Plateau, remarkably reducing the large cold bias estimates by 0.7 □ air temperature RMSE. Second, the improved albedo scheme gives the highest correlationship between the satellite-derived and the model estimated albedo, contributing to achieve the SWE spatial pattern, heavy snow belt and maximum SWE estimates in eastern Tibetan Plateau. Third, the fine resolution simulation, such as 5 km (1 km), significantly reduces the eastern SWE overestimation by 29% (49%).

In order to investigate the applicability of the improved albedo scheme in snow events simulation in the Tibetan Plateau, 16 numerical experiments were conducted to simulate 8 snow events by using WRF coupling with Noah default and improved albedo schemes. The assessment demonstrates that the improved albedo scheme significantly reduces the air temperature underestimation, and reduces the air temperature RMSE by 0.5 - 1 □ for both 5 km and 1 km resolution simulations. It is expected that the improved albedo parameterization scheme will have a good prospect in high resolution simulation of snow events in the Tibetan Plateau.