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Reply on RC1

Lian Liu et al.

Author comment on "Improved parameterization of snow albedo in Noah coupled with Weather Research and Forecasting: applicability to snow estimates for the Tibetan Plateau" by Lian Liu et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-305-AC1, 2021

Response to Anonymous Referee #1

Thank you for your recognition of our work. I will respond to your comments item by item.

1. This study select eight different intensity of snow events to evaluate the universal applicability. It is enough, but why you choose these snow events?

Response

Heavy snowfall processes have a large impact on stock farming on the Tibetan Plateau. And the rate of snowmelt varies widely depending on the heterogeneous underlying surfaces. Albedo is strongly determined by snowfall and snowmelt. This makes it necessary to carry out numerical experiments on heavy snow events i.e., moderate-to-heavy snowfall and snowstorm over the heterogeneous Tibetan Plateau to assess how reliably the improved albedo scheme to characterize different snowfall intensities and snowmelt processes. That's why eight different intensities of snow events on the heterogeneous eastern and southern Tibetan Plateau were selected in our study.

2. The snow albedo parameterization scheme is referred to Oerlemans and Knap (1998). What changes have been made in this albedo scheme used in snow events over the Tibetan Plateau.

Response

Oerlemans and Knap (1998) used ground observations on a glacier to calculate parameters in the albedo scheme, while satellite-retrieval of reflectance and albedo products as well as modelled snow depth over the whole Tibetan Plateau were used to calculate parameters in the scheme in our study. And, Oerlemans and Knap (1998) only focused on a glacier and snow-free albedo is albedo of ice. In our work, we combined all the MODIS land use types over the Tibetan Plateau to average the bare ground albedo as snow-free albedo when calculating parameters in the scheme.

Oerlemans, J. and Knap, W. H.: A 1 year record of global radiation and albedo in the ablation zone of Morteratschgletscher, Switzerland, J. Glaciol., 44, 231-238, 1998.

3. The improved snow albedo scheme shows much better performance in land-atmospheric interaction simulations at fine resolution such as 1 km. This study configures five snow events with 1 km resolution simulations, and three snow events with 5 km resolution simulations. Why not configure all the snow events to 1 km resolution?

Response

Conducting numerical experiments at high resolution i.e., 1 km is beneficial to the complex topographic Tibetan Plateau. We attempted to two nested modeling of 5 km and 1 km resolution for all eight selected snow events. However, the extremely steep terrain on the central and southern Tibetan Plateau led to model instability and failure for 3 snowfall events when a relatively fine horizontal resolution of 1 km was used, while the calculations remained stable when the resolution was increased to 5 km. We therefore used two nested modeling of 5 km and 1 km resolution for 5 snowfall events, and a single modeling of 5 km resolution for 3 snowfall events.