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Assessments of North Hemisphere snow cover response to 1.5 °C and 2.0°C warming

Aihui Wang, Lianlian Xu, and Xianghui Kong
(wangaihui@mail.iap.ac.cn), Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

The 2015 Paris Agreement set a goal to pursue a global mean temperature below 1.5 °C and well below 2 °C above pre-industrial levels. Although it is an important surface hydrology variable, the response of snow under different warming levels has not been well investigated. This study provides a comprehensive assessment of the snow cover fraction (SCF) and snow area extent (SAE), as well as the associated Land Surface Air Temperature (LSAT) over the Northern Hemisphere (NH) based on the Community Earth System Model Large Ensemble project (CESM-LE), CESM 1.5 °C and 2 °C projects, as well as the CMIP5 historical RCP2.6 and RCP4.5 products. The results show that the spatiotemporal variations of those modeled products are grossly consistent with observations. The projected SAE magnitude change in RCP2.6 is comparable to that in 1.5 °C, but lower than that in 2 °C. The snow cover differences between 1.5 °C and 2 °C are prominent during the second half of the 21st century. The Signal-Noise-Ratios (SNRs) of both SAE and LSAT over the majority of land areas are greater than one, and for the long-term period, the dependences of SAE on LSAT changes are comparable for different ensemble products. The contribution of an increase in LSAT on the reduction of snow cover differs across seasons, with the greatest occurring in boreal autumn (49-55%) and the lowest occurring in boreal summer (10-16%). The snow cover uncertainties induced by the ensemble variability are invariant over time across CESM members but show an increase in the warming signal between the CMIP5 models. This feature reveals that the physical parameterization of the model plays the predominant role in long-term snow simulations, while they are less affected by internal climate variability. Reference: Wang, A., L. Xu, and X. Kong, 2018: Assessments of the Northern Hemisphere snow cover response to 1.5ºC and 2.0ºC warming. Earth Syst. Dyn., 9, 1–13. https://doi.org/10.5194/esd-9-1-2018.