

Effect of snow-albedo feedback on future strong warming in boreal forest region of northern Eurasia in MIROC-ESM

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We investigated future change in snow amount and effect of snow albedo feedback (SAF) on strong warming in boreal forests region of the northern Eurasia in the simulation by Earth System Model, MIROC-ESM. Under the future scenario, RCP 8.5, snow amount during fall-spring over the northern Eurasia decreases due to global warming. The significant reduction of snow amount is found in western Eurasia during fall-spring. On the other hand, although reduction of snow amount over Siberia in fall and spring occurs, winter snow amount over Siberia increases due to increasing snow fall, which is attributable to more water vapor with higher air temperature. Relating to such snow changes, then, surface air temperature (SAT) changes are enhanced through SAF. During spring, particularly, future SAT increases dominantly over Siberia, boreal forest region (Fig. 1), although snow cover decreases less than that in western Eurasia (Fig. 2).

We further analyzed decomposed components of SAF with the simplified equation including the snow albedo, the land albedo, and snow cover fraction. The result from this analysis that the dominant increase in SAT over Siberia is attributed to strong SAF which is caused by both reduced snow albedo and reduced snow cover fraction. This result emphasize the snow albedo change, in addition to the reduced snow cover, is crucial for SAF in boreal forest region under future climate change. This snow albedo change includes a vegetation masking effect on snow albedo in snow-covered canopy. Future increase in leaf area index (LAI) which is exchanged between climate and land process in MIROC-ESM may perform an important role in the vegetation masking effect. On the other hand, in southern regions with snow cover during the recent past, land surface albedo change affects slightly the SAF. The land surface albedo may be modified by LAI calculated in ecological model. Therefore, future increase in LAI is likely to play an important role in surface albedo change in the northern Eurasia.

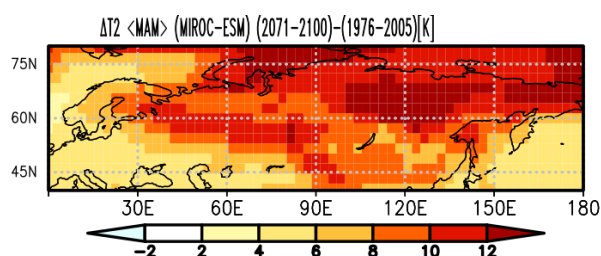


Figure 1. Future change in spring surface air temperature (SAT). Unit is K. Future scenario used is RCP8.5.

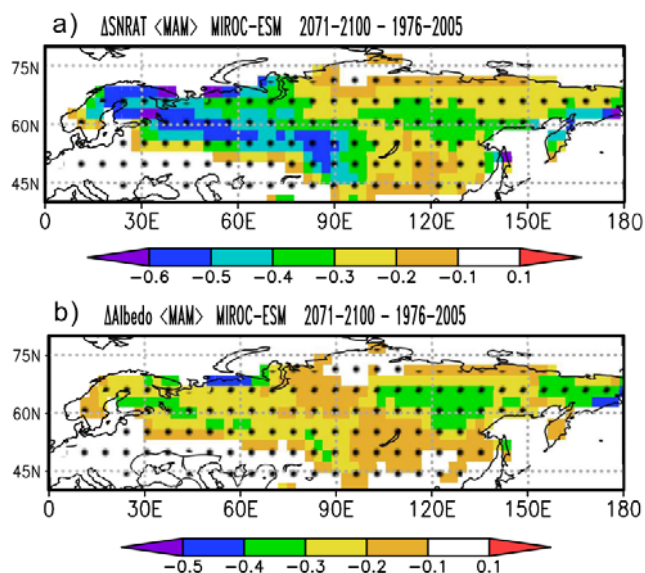


Figure 2. Future change in a) spring snow cover fraction and b) spring surface albedo. No unit in both. Future scenario used is RCP8.5.

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