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Effect of snow depth on interannual seesaw oscillation of active layer depth between the Arctic river basins

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A coupled hydrological and biogeochemical land surface model (CHANGE) is used to explore the spatial and temporal variations of active layer depth and its associated factors for the Arctic terrestrial regions over the period of 1948-2006. Modeling results show that the linear trend of the active layer depth during the period increased significantly in eastern Siberia, western Alaska, and regions around Hudson Bay. Snow depth during the same period indicated decreasing trends in the major drainages of North America while increasing in ones of Siberia. A seesaw pattern in the active layer depth between the Lena and Mackenzie basins also occurred in the 59-year time series, with sub-decadal timescales of about 8-11 years. The interannual seesaw oscillation of active layer depth between the two basins was influenced by the interannual variations of snow depth as much as by the forcings of the summer air temperature/thawing index. This suggests that the variability of active layer depth does not simply reflect the warming of air temperature, because the temporal evolution of snow depth shows significant variability that is not necessarily correlated with temperature variability. Therefore, this result will contribute to improve model algorithm and scenarios for the simulation of future climate change.