Seasonal variation of stable isotopes in Siberian lake simulated by the isotope mass-balance model

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Detailed measurements of temporal variations in the stable isotopic composition of precipitation and lake water in the permafrost region near Yakutsk, eastern Siberia, show that d18O ranged from approximately -30 to -5 permil in precipitation and from -25 to -5 permil in lake water. Temporal changes in d18O of precipitation observed weekly at 12 sites all show the same trend. The temporal variation of d18O in lakes classified into two groups: isotopically steady-state lakes with less than 5 permil variation, and non-steady-state lakes with variation exceeding 10 permil. In non-steady-state lakes, the water originated from snowmelt, and the d18O of lake water gradually enriched as a result of evaporation during the summer. In steady-state lakes, the water originated predominantly from 18O-enriched lake water that had evaporated the previous summer. The temporal volumetric and isotopic variations in alas lakes are accurately depicted by an isotope mass-balance model using Rayleigh fractionation over daily time steps. The inflow of soil water (subsurface flow) was assumed to be constant (200 m3/day) for the entire interval, based on the difference between observed and simulated lake volumes. Taking the isotopic mass-balance into consideration, the inflow component is estimated to be soil-water of the lower part of the active layer which d18O is -23 permil.