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Simulation of vertical profiles of stable water isotopes in a snow pit using a new offline isotopic snow-icecore model

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Given that ice cores consist of past snowfall in a chronologic and systematic order, we can utilize stable water isotope (SWI) information in ice cores to reconstruct the past climatic variations of temperature. Several modeling studies have tried to simulate the past SWI in precipitation preserved in ice cores (Werner and Heiman, 2002, Sjolte et al, 2011), but they are limited only on high latitude area. In such region, we do not have to consider post-depositional isotopic processes due to the extremely low temperature all over a year. However, when one wants to simulate the past SWI in ice cores in mid- and low-latitudinal areas, he has to consider the isotopic effects of the post-depositional processes because snow undergoes melt, sublimation and erosion by wind, by which SWI in snow are easily affected. Otherwise the reconstructed information of the past would be distorted and misleading.

In this study, we developed a new off-line isotopic snow-icecore model: it simulates isotopic effects due to the post-depositional processes while precipitated snow is eventually transformed into an ice core. The model is based on the snow layer submodel of Iso-MATSIRO (Yoshimura et al., 2006) with a particular purpose to simulate a vertical profile of SWI at a glacier or ice sheet. Unlimited number of snow layers with a 20mm thickness increment is incorporated, whereas the original Iso-MATSIRO snow submodel has only three layers. The impact of wind erosion process, including blizzard, is also newly incorporated. Using this model forced with the output from IsoRSM (Yoshimura et al., 2010), i.e. an isotope enabled meso-scale climate model forced with historical meteorological reanalysis data, we simulated SWI in snow pits drilled at Belukha, Siberian Altai, which is close to ice core drilling site. The preliminary simulation period is for 2001-2003. Althouth the precipitation SWI simulated by IsoRSM alone does not correlate with the observed snow pit SWI, the SWI vertical profile of the snow layers simulated by the new off-line model shows a good correlation. The simulation result for more than hundred years on the SWI of ice cores in mid- and /or low latitudes is expected to be presented at the conference.

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