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Numerical simulation of isotopic ratio in snow using an offline 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 climate. 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. It also newly includes the impact of wind erosion process, including blizzard. 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, and Gregoriev, Tien Shan, which are close to ice core drilling sites. The preliminary simulation period is for 1997-2007. With the new off-line model, the simulated SWI vertical profile of the snow layers shows a better correlation with the observed snow pit SWI than the simulation without the model. This study aim to simulate SWI of ice cores in mid- and /or low latitudes for more than hundred years, and it is expected to present the latest updates at the conference.