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Evaluation of isotope enabled Global Circulation Models against observations of water vapor isotopic composition above the Greenland Ice Sheet

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We have for the last four summer seasons since 2009 measured the isotopic composition of the water vapor in continuous mode on top of the Greenland Ice Sheet as part of the NEEM deep ice core-drilling project (77.45 N 51.06 W, 2484 m a.s.l). The purpose of this campaign has been to improve our understanding of the climatic factors controlling the ice core isotope signal, which can then be used to reconstruct past climate.

To achieve such an understanding general circulation models provide a valuable tool. It is therefore crucial to test the ability of the models to simulate the present day hydrological cycle and its isotopic counterparts. We therefore compare the observed water vapor isotopic composition with model outputs from two isotope-enabled general circulation models (LMDZiso and isoGCM). We are thereby able to both validate, but also point to weaknesses in the modeled isotopic values. This gives us information about which parameterizations in the atmospheric hydrological cycle may need improvement.

Together with the atmospheric water vapor observations on the Greenland Ice Sheet we also collected snow surface samples from the top one cm of the snow pack. The isotope values of these snow surface samples constitute the climate signal, which are stored in the ice core. We find that between precipitation events large variations are observed in the snow surface isotopic composition – potentially lagging the atmospheric water vapor isotopic composition. This finding has great importance for understanding the ice core isotope signal.