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Influence of sea ice cover on evaporation and water vapour isotopic composition in the Arctic

Jean-Louis Bonne (1), Martin Werner (1), Hanno Meyer (1), Sepp Kipfstuhl (1), Benjamin Rabe (1), Melanie Behrens (1), Lutz Schönicke (1), and Hans Christian Steen-Larsen (2)

(1) Alfred Wegener Institute for Polar and Marine Research, Paleoclimate Dynamics, Bremerhaven, Germany (martin.werner@awi.de), (2) Center for Ice and Climate, University of Copenhagen, Copenhagen, Denmark

Since July 2015, water stable isotopes (HDO and H218O) have been measured at two Arctic facilities: during the summer on board of the research vessel Polarstern, and year-round at the Siberian coastal site of Samoylov, situated in the Lena delta (N 72°22', E 126°29'), close to the Laptev Sea. In both places, the isotopic composition of water vapour is analysed continuously in surface air. Additional isotopic measurements are performed on a daily basis in ocean surface water samples taken on Polarstern and on an event basis from precipitation sampled in Samoylov. The two Polarstern summer campaigns cover a large region of the western Artic Ocean, including a one-month campaign in the central and eastern Arctic crossing the North Pole in September 2015, with very cold conditions (up to -20°C).

Combining ocean and atmospheric observations from Polarstern allows an evaluation of local surface water evaporation and its isotopic fingerprint relative to the oceanic and meteorological conditions as well as the partial sea ice cover. In the central and eastern Arctic, a large area of complete sea ice cover also revealed a strong impact on the advected moisture above the ice cap under very cold conditions.

A first year of Siberian observations at Samoylov depicted a large seasonal variability, with extremely dry and isotopically depleted winter values. Contrasted seasonal isotopic regimes might be utilized for identifying moisture sources changes in the region, such as ocean surface closure by sea ice, or freezing of the Lena River.

Besides documenting the present meteorology and changes in the Arctic, our measurements will contribute to a better interpretation of regional paleoclimate records based on water isotopes and to the evaluation of climate models in the Arctic. A first model-data comparison of our measurements with simulation results by the isotope-enabled atmospheric general circulation model ECHAM5-wiso have revealed relevant model biases in the Arctic realm.