Influence of high-latitude atmospheric circulation changes on wintertime Arctic sea ice and climate

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Our analysis is focused on the remarkable climate anomalies observed in the Arctic fall-winter 2016, marked by record loss of Arctic sea ice cover and record warm surface air temperatures [1]. Understanding such climate anomalies requires to unveil the respective roles of atmospheric circulation from local (e.g. albedo/sea-ice) feedbacks [2]. Here, we investigate the influence of atmospheric circulation on regional climate anomalies using water vapour isotopic composition to trace moisture origin, combined with information from atmospheric reanalyses, backtrajectory calculations, and atmospheric modelling.

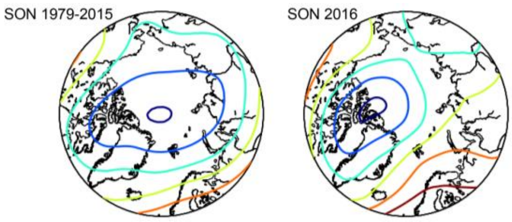

Figure 1: Geopotential height at 500 hPa

Using Greenland summer data, Steen-Larsen et al [3] related high d-excess levels in surface vapour to the advection of moisture from the Arctic sea ice margin, where strong kinetic fractionation occurs at evaporation. Here, we extend these results using datasets from several Arctic sites (Svalbard, North West Greenland, Polastern ship) and identify joint anomalies of d-excess and $\delta^{18}O$ to characterize atmospheric transport pathways. We further use the warm Arctic climate anomalies of fall and winter 2016 to explore intra-seasonal isotope-temperature relationships for climate warmer than in the present days during e.g. the last interglacial period or future climate change. We use these data to benchmark an isotopically-enabled atmospheric model.

[1] National Snow and Ice Data Center [2] Ding et al, 2017, Nat. Clim. Change [3] Steen-Larsen et al, 2013, ACP