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Lagrangian detection of moisture sources for an arid region in Northeast Greenland: relations to the North-Atlantic Oscillation and temporal trends from 1979 to 2017

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Northeast Greenland is predicted to be one of the most sensitive terrestrial areas of the Arctic to anthropogenic climate change, resulting in an increase in temperature that is much greater than the global average. Associated with this temperature rise, precipitation is also expected to increase as a result of increased evaporation from an ice-free Arctic Ocean. In recent years, numerous palaeoclimate projects have begun working in the region with the aim of improving our understanding of how this highly-sensitive region responds to a warmer world. However, a lack of meteorological stations within the area makes it difficult to place the palaeoclimate records in the context of modern climate.

This study aims to improve our understanding of precipitation and moisture source dynamics over a small arid region located at 80 °N in Northeast Greenland. This region hosts many speleothem-containing caves that are being studied in the framework of the Greenland Caves Project (greenlandcavesproject.org). The origin of water vapour for precipitation over the study site is detected by a Lagrangian moisture source diagnostic, which is applied to reanalysis data from the European Centre for Medium-Range Weather Forecasts (ERA-Interim) from 1979 to 2017.

While precipitation amounts are relatively constant during the year, the regional moisture sources display a strong seasonality. The most dominant winter moisture sources are the ice-free North Atlantic ocean above 45 °N, while in summer the patterns shift towards more local and North Eurasian continental sources. During positive North-Atlantic Oscillation (NAO) phases evaporation and moisture transport from the Norwegian Sea is stronger, resulting in larger and more variable precipitation amounts. Although the annual mean temperature in the study region has increased by 0.7 °C dec $^{-1}$ (95% confidence interval [0.4, 1.0] °C dec $^{-1}$) according to ERA-Interim data, we do not detect any change in the amount of precipitation with the exception of autumn where precipitation increases by 8.2 [0.8, 15.5] mm dec $^{-1}$ over the period. This increase is consistent with future predicted Arctic precipitation change.