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The influence of atmospheric rivers on winter melt and accumulation in the northeast of Greenland.

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The Greenland Ice Sheet (GrIS) has been losing mass at an accelerated rate in the last few decades, of which, approximately 50% is related to surface melting and runoff (Imbie Team, 2020). Since the mid 2010's, the highest melt anomalies were found in the northeast of Greenland, where the North East Greenland Ice Stream drains 8 - 12 % of the GrIS. Unsurprisingly, the vast majority of melting occurs in the summer months, however the increasing trend in air temperatures is larger in winter. Similarly, very warm winter periods have been observed recently in the north of Greenland and Arctic Ocean. Due to our previous focus on summer melting, our understanding of glacial hydrology and surface mass balance in winter is still poor.

Here, we present the frequency and amount of surface melting and precipitation, as simulated by the Modèle Atmosphérique Régional (MAR) at 15 km spatial resolution (from 1980 to 2018) and the COupled Snowpack and Ice surface energy and mass balance model in PYthon (COSIPY) at 1 km spatial resolution (from 2014 to 2018). Observations from two automatic weather stations are also used to analyse the meteorological setting. We find that both periods of winter melt and extreme precipitation are related to the presence of atmospheric rivers along the east coast of Greenland and in the Atlantic Ocean (specifically in the Greenland Sea and Fram Strait). On average, the detection of atmospheric rivers in the vicinity of the northeast of Greenland leads to a daily warming of +8°C and can raise temperatures to the melting point for a short period of time. We also present the changes in precipitation type (rainfall vs snowfall), from 1980 to 2018 from both MAR and the ERA5 reanalysis product, which are related to atmospheric rivers and passing storms.