How do Atmospheric Rivers contribute to Arctic precipitation?

Lessons learned from field campaigns

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The Arctic has been experiencing significant warming and moistening with several potential factors at play. In general, the warming amplifies the Arctic hydrological cycle. There are two processes which could affect the water vapour content in the Arctic. These are the enhanced local evaporation due to the missing insulation effect of sea ice and the poleward moisture transport from lower latitudes. This poleward moisture transport is often associated with Atmospheric Rivers (ARs). The role of ARs in the Arctic precipitation is yet to be explored. As ARs are typically associated with not only moisture but also significant heat advection, they can bring precipitation as rain and/or snow. Moreover, additional feedbacks can occur: the warming effect of the ARs on the surface, coupled with rain lowering surface albedo, can cause thinning and melting of Arctic sea ice and snow. This, in turn, could increase the relative role of the local evaporation compared to the moisture transported from lower latitudes.

In this study, we investigate the relationship between the poleward moisture transport by ARs and the precipitation in the Arctic. For this purpose, we develop a multi-parameter, multi-data set for different case studies (ACLOUD May/June 2017, AFLUX March/April 2018 close to Svalbard, eventually for core winter season of the MOSAiC expedition) within the Collaborative Research Center "Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms $(AC)^3$".

Existing AR catalogues from global and polar-specific algorithms with the input of ERA5 reanalyses data are used. The detected AR events are analysed in terms of the change of precipitation, including frequency, intensity, and type of precipitation (rain or snow). For this purpose, we use reanalyses data for the water vapour transport, total precipitation, rain and snow profiles. Reanalysis products are evaluated using a set of observational data (satellite data, in-situ, ground-based remote sensing measurements).