

## Multi-year precipitation characteristics based on in-situ and remote sensing observations at the Arctic research site Ny-Ålesund, Svalbard

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Precipitation is a critical variable in the hydrological cycle. However, precipitation observations are challenging, especially in remote locations such as the Arctic, where climate change is strongly pronounced. In particular, the Svalbard archipelago, located in the warmest region of the Arctic, reveals the highest temperature increase. Climate models indicate a substantial increase in precipitation in the Arctic, with rain becoming the most dominant precipitation type. Still, large uncertainties exist in simulating and observing precipitation. Continuous, detailed observations, which can also be set in context to satellite products and reanalyses data, are thus necessary to better understand precipitation and precipitation-related processes in the Arctic.

In this study, we make use of the complementary precipitation observations performed as part of the Transregional Collaborative Research Centre on Arctic Amplification TR172 (<http://www.ac3-tr.de>) at the Arctic research station AWIPEV at Ny-Ålesund, Svalbard, to analyze precipitation characteristics in detail. The observations include an OTT Pluvio2 weighing gauge, an OTT Parsivel2 distrometer, and a METEK MRR-2 micro rain radar (MRR). While the Pluvio and the Parsivel provide information on surface precipitation amount and type, the MRR provides information on the vertical structure of precipitation up to a height of 1 km. Measurements have been available since the spring/summer of 2017, allowing for more than four years of data analysis.

Using the one-minute resolved data of Parsivel, precipitation frequency is highly variable within the different months, ranging from 0.4 % to 18.8 %, with solid precipitation being the most dominant type typically from September to March and liquid precipitation in the months May to August. However, wind can strongly affect the Parsivel measurements and might result in misclassification of precipitation type. Monthly precipitation sums from August 2017 to December 2021 depict a large variability ranging from 1 mm to 155 mm. We also assessed the role of atmospheric rivers and related weather systems on the precipitation at Ny-Ålesund and their impact on extreme precipitation events. Atmospheric rivers are distinct bands of enhanced water vapor transport and contribute to more than 90% of the poleward moisture transport. For the period analyzed, 42% of the precipitation amount at Ny-Ålesund occurred when atmospheric rivers were present, either separated or collocated with cyclones or fronts. It is thus crucial to understand how air mass transport and weather patterns over Svalbard will change in the future since this will directly impact the water cycle in this region.