First insight into thermodynamic profiles, IWV and LWP from ground-based microwave radiometers during MOSAiC

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The Arctic is currently experiencing a more rapid warming compared to the rest of the world. This phenomenon, known as Arctic Amplification, is the result of several processes. Within the Collaborative Research Centre on Arctic Amplification: Climate Relevant Atmospheric and Surface Processes and Feedback Mechanisms (AC)3, our research focuses on the influence of water vapour, the strongest greenhouse gas. The collection of data about water vapour is essential to understand its impact on Arctic Amplification. Over the past decades, a positive trend in integrated water vapour in the Arctic has been identified using radiosondes and reanalyses for certain regions and seasons. However, inconsistent magnitudes of the moistening trend in the reanalyses cause the need of a more thorough investigation. While radiosondes offer precise measurements of thermodynamic (temperature and humidity) profiles, they fail to capture the variability of water vapour because of the low sampling rate (two to four sondes per day) and spatial coverage. To obtain a more complete picture of water vapour variability, remote sensing instruments (satellite- and ground-based) are used. Microwave radiometers (MWRs) onboard polar orbiting satellites allow the coverage of the entire Arctic but suffer from uncertainties related to surface emission. Observations at the surface gathered during the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) campaign can serve as reference measurements in the central Arctic for the assessment of water vapour products from reanalyses, models and satellite retrievals.

In this study, we give a first insight into the variability of integrated water vapour (IWV), liquid water path (LWP) and thermodynamic profiles retrieved from two ground-based MWRs onboard the research vessel Polarstern throughout the MOSAiC campaign. The first radiometer is a standard low frequency HATPRO system and the other one is the high-frequency MiRAC-P, which is particularly suited for low water vapour contents. The retrieved quantities are compared with radiosonde measurements. A first analysis reveals that the IWV is very well captured by the MWR measurements. Over the observation period (October 2019 - October 2020), a large variety of meteorological conditions occurred. Besides the considerable seasonal cycle, which is especially interesting because of the contrast between polar night and polar day, several synoptic events contribute to the variety of conditions, which will be highlighted as well.

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