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Title:
Water vapour in the central Arctic: How well do remote sensing observations and models perform?

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Abstract (max. 300 words):
Water vapour estimates are uncertain over sea ice in the Arctic due to the missing ground stations and difficulties in satellite remote sensing. Commonly used reanalyses assimilate raw satellite observations and therefore depend on their signal quality. Previous studies have shown that different satellite water vapour observations and reanalyses strongly disagree on the integrated water vapour in summer (IWV). As the Arctic is rapidly warming, some regions also show a moistening trend, especially around Svalbard in early winter. In other regions and seasons, the moistening trend and even the sign of the trend varies between reanalyses, which is likely related to the uncertain water vapour observations over sea ice.

This study assesses the quality of IWV and specific humidity profiles of four state-of-the-art models (reanalyses and weather forecast) and two satellite products (infrared and microwave observations) in the data-sparse central Arctic for a whole year. The year-long Multidisciplinacy drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition provides excellent reference observations. The quality of IWV is analysed with respect to the ship-based microwave radiometer (MWR) observations. In the cold seasons, three of the four models underestimated IWV while both satellite products showed a strong

negative bias in moist conditions. Specific humidity profiles of models also show negative biases in the cold seasons in the lower troposphere with respect to the reference given by the radiosonde observations. As many specific humidity biases throughout the year seem to be related to humidity inversions (height layers where specific humidity increases with height), we further analysed how they are represented in the different data sets using the radiosondes as reference. The occurrence of near-surface humidity inversions is well caught by the models throughout the year and by the ground-based MWRs in winter. However, inversion strength and depth often differ from the radiosonde observations.