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Linking Lagrangian model simulations with stable water isotope measurements in Arctic weather systems.

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Transport of water from an evaporation source towards a precipitation sink is the essence of the atmospheric water cycle. However, there are significant challenges with the representation of the atmospheric water cycle in models. For example, incomplete representation of sub-grid scale processes like evaporation, mixing or precipitation can lead to substantial model errors. Here we investigate the combined use of Lagrangian and Eulerian models and in-situ observations of stable water isotopes to reduce such sources of model error. The atmospheric water cycle in the Nordic Seas during cold air outbreaks (CAOs) is confined to a limited area, and thus may be used as a natural laboratory for hydrometeorological studies. We apply Lagrangian and Eulerian models together with observations taken during the ISLAS2020 field campaign in the Arctic in spring 2020 for characterising source-sink relationships in the water cycle. During the field campaign, we observed an alternating sequence of cold air outbreaks (CAO) and warm air intrusions (WAI) over the key measurement sites of Svalbard and northern Norway. Thereby, meteorological and stable water isotope measurements have been performed at multiple sites both upstream and downstream of the CAOs and WAIs. The Lagrangian model FLEXPART has been run with the input data from the regional convection-permitting numerical weather prediction model AROME Arctic at 2.5 km resolution to investigate transport patterns. The combination of observations and model simulations allows us to quantify the connection between source and sink for different weather systems, as well as the link between large-scale transport and stable water isotopes. Findings will lead to a better understanding of processes in the water cycle and the degree of conservation of isotopic signals during transport. This study may also serve as a guideline on how to evaluate the performance of Lagrangian transport models using stable water isotope measurements, and on how to detect constraints for quantifying the transport route and evaporation source from stable water isotope measurements for future work, including an aircraft campaign planned in 2021.