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Water vapour in the Arctic lower stratosphere

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The water vapour in the lower stratosphere is radiatively important however, the observational data is relatively sparse. The main sources of stratospheric water vapour are intrusion through the tropical tropopause and production from oxidation of methane. Methane and water also affect the ozone chemistry. There is a strong gradient in the water vapour profile over the tropopause and the stratosphere is very dry, which makes accurate observations difficult to obtain. It is also challenging to model the stratospheric water vapour content correctly,
e.g. due to sensitivity to temperature dependent processes in the tropical tropopause. Accurate measurements are needed for model validation. Water vapour can also be used as a tracer for studies of e.g. sudden stratospheric warmings.

Both transport and chemistry contribute to the extratropical lower stratospheric water vapour content. Accurate soundings of stratospheric water vapour have been made above Sodankylä, in northern Finland, since early 2000. In this study we focus on the winter/spring period. In early 2010 the Arctic polar vortex was unusually cold and persistent dehydration was observed for the first time. In this study we will compare measured (in-situ and satellite) with modelled stratospheric water vapour profiles for the Arctic region. Effects on ozone chemistry will also be studied.

Global middle atmospheric simulations have been performed with the FinROSE chemistry-transport model (FinROSE-ctm) using ERA-Interim winds and temperatures. The FinROSE-ctm is a global middle atmosphere model that produces the distribution of 30 long-lived species and tracers and 14 short-lived species. The chemistry describes around 110 gas phase reactions, 37 photodissociation processes and the main heterogeneous reactions related to aerosols and polar stratospheric clouds.