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On the observation of climate-relevant processes in the UTLS

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Changes and variability of UTLS composition are major drivers of surface climate change (e.g. Solomon et al., 2010). Even small changes of spatially highly variable concentrations of greenhouse gases such as water vapor (H2O) and ozone (O_3), aerosols and cirrus clouds have significant effects on the atmospheric radiation balance. Improved prediction capabilities of chemistry-climate models (CCM) therefore rely on a realistic representation of physical and chemical processes affecting UTLS composition. This is problematic, because UTLS composition is governed by the complex interactions of various physical and chemical processes that operate at a wide range of temporal and spatial scales (local to global). Water vapor and ozone are particularly sensitive to atmospheric transport due to their steep spatial mixing ratio gradients in this region. Small-scale trace gas filaments in the UTLS represent an important example of structures that are not yet adequately characterized. The same applies to small-scale gravity-waves that are important for the dynamical coupling between different atmospheric layers.

In the past, most progress in our understanding of the UTLS and small-scale processes in this region was made on the basis of detailed airborne in-situ observations. Satellite limb observations, e. g. by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) onboard Envisat, provided the global view, however, at limited spatial resolution. For this reason, there is a gap of observations concerning small-scale trace gas structures and temperature fluctuations, with a vertical extent of less than 500 m and a horizontal extent of less than 100 km.

The talk will give an overview on climate-relevant processes in the UTLS and important associated scientific questions. Limitations of current observation system are discussed as well as need for three-dimensional observation of trace gases, clouds and temperature structures with adequate spatial resolution.