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Dynamical processes and transport influencing the water vapour budget in the upper troposphere / lower stratosphere (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) have significant effects on the atmospheric radiation balance. Improved projections 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).

We analyze important underlying processes based on multi-annual simulations by the Chemical Lagrangian Model of the Stratosphere (CLaMS), in combination with satellite observations. Our results indicate that the Asian monsoon plays a crucial role for transporting moist air from the tropical troposphere into the extra-tropical lowermost stratosphere during boreal summer. In the tropics, transport of water vapour into the deep stratosphere is significantly influenced by the Quasi Biennial Oscillation and by Major Stratospheric Warming events during boreal winter.