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Are cloud processes key drivers of UTLS chemistry and constituent variability?

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What drives the variability of trace gases and aerosols in the troposphere is not well understood, as is the role of clouds in modulating this variability via radiative, transport, deposition, and lightning effects that are associated with them. Such uncertainties are expected to be of particular importance in the tropical UTLS, a region that receives significant surface emissions and moisture via deep convection and upwelling, and experiences large amounts of lightning production of nitrogen oxides (NO_x). Accurately simulating UTLS composition and its variability is of utmost importance as both could have a significant effect on the region's temperature and circulation, as well as on surface climate and the amount of UV radiation entering the troposphere.

In this presentation, we will present a collection of results focusing on the role of clouds on UTLS composition, based on composition-climate model output from the Chemistry-Climate Model Initiative (CCMI). We will examine the key cloud processes which are expected to have an influence on UTLS composition with a particular focus on their role in modifying solar radiation and photolysis rates of trace gases through the backscattering of shortwave radiation. The role of such processes on seasonal, interannual and multi-decadal time-scales will be examined. Furthermore, we will utilize CCCM, a unique 3-D cloud data product merged from multiple A-Train satellites (CERES, CloudSat, CALIPSO, and MODIS) developed at the NASA Langley Research Center to evaluate the cloud fields and their vertical distribution in a selected CCMI model (HadGEM3), to adjust the cloud fields where appropriate, and to examine the impacts of this adjustment on tropospheric chemistry, with a focus on oxidants in the UTLS.