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Water vapour in the Upper Troposphere and Lower Stratosphere (UTLS): A new vertically resolved dataset from limb and nadir satellite observations

Hao Ye¹, Michaela Hegglin¹, Martina Krämer², Christian Rolf², Alexandra Laeng³, Dale Hurst^{4,5}, and Holger Vömel^{6,7}

¹University of Reading, Reading, UK

²Forschungszentrum Juelich, Juelich, Germany

³Karlsruhe Institute of Technology, IMK-ASF, Karlsruhe, Germany

⁴Cooperative Institute for Research in Environmental Sciences, Boulder, CO, United States

⁵NOAA Earth System Research Laboratory, Global Monitoring Division, Boulder, CO, United States

⁶National Center for Atmospheric Research, Boulder, CO, United States

⁷DWD, Tauche, Germany

Water vapour in the upper troposphere and lower stratosphere (UTLS) has a significant impact both on the radiative and chemical properties of the atmosphere. Reliable water vapour observations are essential for the evaluation of the accuracy of UTLS water vapour from model simulations, and thereafter of the contribution to the global radiative forcing and climate change. Limb-viewing and nadir satellites provide high quality water vapour observations above the lower stratosphere and below the upper troposphere, respectively, but show large uncertainties in the tropopause region. Within the ESA Water Vapour Climate Change Initiative, we have developed a new scheme to optimally estimate water vapour profiles in the UTLS and in particular across the tropopause, by merging observations from a set of limb and nadir satellites from 2010 to 2014. The new data record of vertically resolved water vapour is validated against the aircraft in-situ water vapour observations from the JULIA database and frostpoint hydrometer records from WAVAS. Furthermore, the new data record is used to evaluate the UTLS water vapour distribution and interannual variations from chemistry-climate model (CCM) simulations and the ERA-5 reanalysis.