Geophysical Research Abstracts
Vol. 20, EGU2018-4194, 2018
EGU General Assembly 2018

The role of sampling biases for the discrepancies in lower stratospheric water vapour trend estimates derived from the FPH observations at Boulder and a merged zonal mean satellite data set

Stefan Lossow (1), Dale F. Hurst (2), Karen H. Rosenlof (2), Gabriele P. Stiller (1), Thomas von Clarmann (1), Sabine Brinkop (3), Martin Dameris (3), Patrick Jöckel (3), Doug E. Kinnison (4), Johannes Plieninger (1), David A. Plummer (5), Felix Ploeger (6), William G. Read (7), Ellis E. Remsberg (8), James M. Russell (9), and Mengchu Tao (6)

(1) Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Hermann-von-Helmholtz-Platz 1, 76344 Leopoldshafen, Germany, (2) NOAA Earth System Research Laboratory, Global Monitoring Division, 325 Broadway, Boulder, CO 80305, USA, (3) Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, 82234 Oberpfaffenhofen-Wessling, Germany, (4) University of Colorado, Atmospheric Chemistry Observations & Modeling Laboratory, P.O. Box 3000, Boulder, CO 80305-3000, USA, (5) Environment and Climate Change Canada, Climate Research Branch, 550 Sherbrooke ouest, Montréal, Quebec H3A 1B9, Canada, (6) Forschungszentrum Jülich, Institute for Energy and Climate Research: Stratosphere (IEK–7), Leo-Brandt-Straße, 52425 Jülich, Germany, (7) Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109, USA, (8) NASA Langley Research Center, 21 Langley Boulevard, Hampton, VA 23681, USA, (9) Hampton University, Center for Atmospheric Sciences, 23 Tyler Street Hampton, VA 23668, USA

Trend estimates with different signs are reported in the literature for lower stratospheric water vapour considering the time period between the late 1980s and 2010. The NOAA (National Oceanic and Atmospheric Administration) frost point hygrometer (FPH) observations at Boulder (Colorado, 40.0°N, 105.2°W) indicate positive trends (about 0.12 ppmv/decade to 0.45 ppmv/decade). Contrary, negative trends (approximately -0.15ppmv/decade to -0.05ppmv/decade) are derived from a merged zonal mean satellite data set for a latitude band around the Boulder latitude. Overall, the trend differences between the two data sets range from about 0.25 ppmv/decade to 0.45 ppmv/decade, depending on altitude. A possible explanation for these discrepancies is a different temporal behaviour at Boulder and the zonal mean, which simply indicates a sampling bias. In this work we investigate trend differences between Boulder and the zonal mean using primarily simulations from ECHAM/MESSy (European Centre for Medium-Range Weather Forecasts Hamburg/Modular Earth Submodel System) Atmospheric Chemistry (EMAC), WACCM (Whole Atmosphere Community Climate Model), CMAM (Canadian Middle Atmosphere Model) and CLaMS (Chemical Lagrangian Model of the Stratosphere). On shorter time scales we address this aspect also based on satellite observations from UARS/HALOE (Upper Atmosphere Research Satellite/Halogen Occultation Experiment), Envisat/MIPAS (Environmental Satellite/Michelson Interferometer for Passive Atmospheric Sounding) and Aura/MLS (Microwave Limb Sounder). Overall, both the simulations and observations exhibit trend differences between Boulder and the zonal mean. The differences are dependent on altitude and the time period considered. The model simulations indicate only small trend differences between Boulder and the zonal mean for the time period between the late 1980s and 2010. These are clearly not sufficient to explain the discrepancies between the trend estimates derived from the FPH observations and the merged zonal mean satellite data set. Unless the simulations underrepresent variability or the trend differences originate from smaller spatial and temporal scales than resolved by the model simulations, trends at Boulder for this time period should be quite representative also for the zonal mean and even other latitude bands. Trend differences for a decade of data are larger and need to be kept in mind when comparing results for Boulder and the zonal mean on this time scale. Beyond that, we find that the trend estimates for the time period between the late 1980s and 2010 also significantly differ among the simulations. They are larger than those derived from the merged satellite data set and smaller than the trend estimates derived from the FPH observations.