Geophysical Research Abstracts
Vol. 19, EGU2017-13065, 2017
EGU General Assembly 2017

Dehydration, denitrification and ozone loss during the Arctic winter 2015/2016: Simulations with the Chemistry-Climate Model EMAC and comparison to Aura/MLS and GLORIA observations

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The Arctic winter 2015/2016 has been one of the coldest stratospheric winters in recent years. A stable vortex formed already in early December and the early winter has been exceptionally cold. Cold pool temperatures dropped below the Nitric Acid Trihydrate (NAT) existence temperature, thus allowing Polar Stratospheric Clouds (PSCs) to form. The low temperatures in the polar stratosphere persisted until early March allowing chlorine activation and catalytic ozone destruction. Satellite observations indicate that sedimentation of PSC particles have led to denitrification as well as dehydration of stratospheric layers. Nudged model simulations of the Arctic winter 2015/2016 were performed with the atmospheric chemistry-climate model ECHAM5/MESSy Atmospheric Chemistry (EMAC) for the POLSTRACC (Polar Stratosphere in a Changing Climate) campaign. POLSTRACC was a HALO mission (High Altitude and LOng Range Research Aircraft) aiming on the investigation of the structure, composition and evolution of the Arctic Upper Troposphere Lower Stratosphere (UTLS). The chemical and physical processes involved in Arctic stratospheric ozone depletion, transport and mixing processes in the UTLS at high latitudes, polar stratospheric clouds as well as cirrus clouds were investigated. In this presentation, an overview of the chemistry and dynamics of the Arctic winter 2015/2016 as simulated with EMAC will be given. Chemical-dynamical processes such as denitrification, dehydration and ozone loss will be investigated. Comparisons to satellite observations by the Aura Microwave Limb Sounder (Aura/MLS) as well as to airborne measurements with the Gimballed Limb Observer for Radiance Imaging of the Atmosphere (GLORIA) performed onboard of HALO during the POLSTRACC campaign show that the EMAC simulations are in good agreement with observations (differences generally within $\pm 20\%$). However, larger differences between model and simulations are found e.g. in the areas of denitrification. Both, model simulations and observation show that in 2015/2016 ozone loss was quite strong, but not as strong as in 2010/2011 while denitrification and dehydration were so far the strongest in the Arctic stratosphere.