Geophysical Research Abstracts
Vol. 19, EGU2017-3531-1, 2017
EGU General Assembly 2017

Stratospheric evolution of temperature and different atmospheric trace gases during winters at the NDACC Alpine mid-latitude station at Bern

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The Earth's climate is sensitive to changes in temperature and trace gas concentrations in the stratosphere region. There is a wealth of possible sources of natural variability of these atmospheric properties in the stratosphere. The concentration of species as ozone and water vapour can vary as a result of different factors, some interacting among themselves through their effects on chemistry and transport. For example, phenomena originally tropical such as the quasi-biennial oscillation (QBO) and El Niño-Southern Oscillation (ENSO) can lead to wave structures and wave propagation in mid-latitudes. This can affect the zonal mean meridional transport of trace gases from the tropics to mid-latitudes and polar latitudes in the stratosphere and also produce variations in the strength of the polar winter vortices and stratospheric warming events. Wintertime is specially an interesting period in which the variability in atmospheric parameters and composition is large. Strong changes in temperature and in the concentration of trace gases as ozone or water vapour can be observed in a very short time interval, and therefore measurements with a high temporal resolution are needed.

The present study shows the capability of ground-based microwave technique to monitor with a relatively good spatial and temporal resolution the stratospheric composition and temperature during complex phenomena occurring in winter. In this way, the evolution of stratospheric temperature, ozone and water vapour profiles during the last winters over Bern (Switzerland) are analyzed. The measurements were performed by three microwave radiometers (TEMPERA for temperature, GROMOS for ozone and MIAWARA for water vapour) which have been designed and built at the University of Bern. The measurement at a fixed location allows to observe local atmospheric dynamics over a long-time period, which is crucial for climate research. The detection of some singular sudden stratospheric warming (SSW) during the analyzed period shows the necessity of such a continuous monitoring in order to detect and understand some important processes which could happen on a short time scale. In this study we have also compared the microwave measurements with the ones from satellite (MLS instrument on board of Aura satellite) and with the output from SD-WACCM (Whole Atmosphere Community Climate Model with Specified Dynamics).