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Validation of stratospheric temperature profiles from a ground-based microwave radiometer with other techniques

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Vertical profiles of atmospheric temperature trends has become recognized as an important indicator of climate change, because different climate forcing mechanisms exhibit distinct vertical warming and cooling patterns. For example, the cooling of the stratosphere is an indicator for climate change as it provides evidence of natural and anthropogenic climate forcing just like surface warming. Despite its importance, our understanding of the observed stratospheric temperature trend and our ability to test simulations of the stratospheric response to emissions of greenhouse gases and ozone depleting substances remains limited. One of the main reason is because stratospheric long-term datasets are sparse and obtained trends differ from one another.

Different techniques allow to measure stratospheric temperature profiles as radiosonde, lidar or satellite. The main advantage of microwave radiometers against these other instruments is a high temporal resolution with a reasonable good spatial resolution. Moreover, the measurement at a fixed location allows to observe local atmospheric dynamics over a long time period, which is crucial for climate research.

This study presents an evaluation of the stratospheric temperature profiles from a newly ground-based microwave temperature radiometer (TEMPERA) which has been built and designed at the University of Bern. The measurements from TEMPERA are compared with the ones from other different techniques such as in-situ (radiosondes), active remote sensing (lidar) and passive remote sensing on board of Aura satellite (MLS) measurements. In addition a statistical analysis of the stratospheric temperature obtained from TEMPERA measurements during four years of data has been performed. This analysis evidenced the capability of TEMPERA radiometer to monitor the temperature in the stratosphere for a long-term. The detection of some singular sudden stratospheric warming (SSW) during the analyzed period shows the necessity of these continuous monitoring in order to measure and understand some important processes which could happen on a short time scale.