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Comparison of stratospheric temperature profiles from a ground-based microwave radiometer with lidar, radiosonde and satellite data

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The importance of the knowledge of the temperature structure in the atmosphere has been widely recognized. Temperature is a key parameter for dynamical, chemical and radiative processes in the atmosphere. 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 ([1] and references therein). However, 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. Stratospheric long-term datasets are sparse and obtained trends differ from one another [1]. Therefore it is important that in the future such datasets are generated.

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.

TEMPERA (TEMPERature RAdiometer) is a newly developed ground-based microwave radiometer designed, built and operated at the University of Bern. The instrument and the retrieval of temperature profiles has been described in detail in [2]. TEMPERA is measuring a pressure broadened oxygen line at 53.1 GHz in order to determine stratospheric temperature profiles. The retrieved profiles of TEMPERA cover an altitude range of approximately 20 to 45 km with a vertical resolution in the order of 15 km. The lower limit is given by the instrumental baseline and the bandwidth of the measured spectrum. The upper limit is given by the fact that above 50 km the oxygen lines are splitted by the Zeeman effect in the terrestrial magnetic field.

In this study we present a comparison of stratospheric temperature profiles retrieved from TEMPERA radiometer with the ones obtained from different techniques such as in-situ (radiosondes), active remote sensing (lidar) and passive remote sensing on board of Aura satellite (MLS) measurements. Moreover, a statistical analysis of the stratospheric temperature from TEMPERA measurements for three years of data have been performed.The results evidence 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.

References

[1] D. W. Thompson, D. J. Seidel, W. J. Randel, C.-Z. Zou, A. H. Butler, C. Mears, A. Osso, C. Long, and R. Lin, “The mystery of recent stratospheric temperature trends,” Nature, vol. 491, no. 7426, pp. 692–697, 2012.
[2] O. Stähli, A. Murk, N. Kämpfer, C. Mätzler, and P. Eriksson, “Microwave radiometer to retrieve temperature profiles from the surface to the stratopause,” Atmospheric Measurement Techniques Discussions, vol. 6, no. 2, pp. 2857–2905, 2013.