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Microwave temperature profiles from ground to the stratopause

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The thermal structure of the atmosphere is one of the most important atmospheric characteristics for determining chemical, dynamical and radiative processes in the atmosphere. In the lowest part of the atmosphere, temperature profiles are a key input for the weather forecast models. In the stratosphere, temperature can influence chemical processes, and its vertical distribution is fundamental for investigating other atmospheric species as for example ozone or water. In addition, stratospheric temperature is also a very important indicator of climate change.

Despite the importance of the knowledge of the temperature from the ground to the tropopause there are few measurement techniques that are able to cover the whole range. A relatively new temperature radiometer (TEMPERA) has been designed and built by the microwave group at the Institute of Applied Physics (IAP), University of Bern, Switzerland. This is the first ground-based radiometer that measures temperature profiles in the troposphere and in the stratosphere simultaneously. The main advantage of microwave radiometers is the capacity of providing atmospheric profiles with a high temporal resolution and a reasonable vertical resolution under most weather conditions. In particular, TEMPERA provides continuous temperature measurements (day- and night-time observations) with a temporal resolution of 15 minutes in the troposphere and 2 hours in the stratosphere.

In this study, the validation of the tropospheric and stratospheric temperature profiles from TEMPERA radiometer will be presented. In the troposphere, the performance of TEMPERA was evaluated by comparing with radiosondes and the results show very good agreement between both techniques with a bias and standard deviation lower than 1 K and 2 K, respectively. In the stratosphere, the measurements from TEMPERA were compared with the ones from different techniques as radiosondes, satellite, lidar and also with WACCM model. The results showed absolute biases and standard deviations lower than 2 K for most of the altitudes and comparisons proved the good performance of TEMPERA to measure the temperature in the stratosphere. TEMPERA has also shown very good results under cloudy conditions when an improved algorithm that include cloud information is used to retrieve temperature profiles.