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Altitude dependent stratospheric temperature trends and radio occultation soundings

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Long-term temperature trends in the lower and mid stratosphere are in the order of 1 K/decade, exhibiting altitude and latitude dependent variations thought to be a distinct aspect of climate change (Ramaswamy et al., 2001; 2002). Comparisons with model-simulated trends indicate discrepancies, though: around 5 hPa, models give consistently stronger cooling trends than satellite observations, while modelled trends between 20 and 70 hPa are smaller than radiosonde and satellite derived trends (Shine et al., 2003). These differences are currently not well understood; Shine et al. conclude with stating that "a full assessment of the causes of stratospheric temperature trends is seriously hampered by uncertainties in the analysis of observations both of the temperature and of the radiatively reactively gases that are important for determining the temperature".

GPS based radio occultation (RO) soundings, being inherently calibration free and not suffering from instrumental drifts or biases, exhibit highest accuracies in the lower to mid stratosphere. They therefore seem very well placed to provide additional high quality temperature soundings in the stratosphere, and might provide insight in the altitude dependence of temperature trends in the future.

But as with every remote sensing measurement, the retrieval of temperatures from raw RO signals depends on a priori data and/or assumptions. In particular, the information content of RO data decreases rapidly in the mid stratosphere with increasing altitude, and the retrieved temperatures are increasingly dominated by a priori. Thus, can RO data indeed provide reliable information on the vertical structure of trends in stratospheric temperatures? In this presentation, the information content of RO data and its implications for the detection of altitude dependent trends in the stratosphere using RO temperature retrievals will be addressed. We discuss advantages and shortcomings

of several retrieval options.

References:

Ramaswamy et al., 2001: Rev. Geophys, 39, 71-122.

Ramaswamy et al., 2002: SPARC Newsletter No. 18, 7-8.

Shine et al., 2003: Quart. J. Royal Met. Soc. 129, 1565-1588.