Tropopause altitude identification using GPS radio occultation bending angle data

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Accurate and continuous observations of the tropopause on a global scale are crucial for monitoring climate change and understanding stratosphere-troposphere exchange. Reanalyses and radiosonde observations show an increase of the global mean tropopause altitude of the order of 100 m per decade during the last 25 years. Determining tropopause altitude using radiosonde temperature data benefits from their high vertical resolution but their use for monitoring on a global scale is limited by their poorly distributed coverage. Identification of the tropopause in reanalyses is limited by their coarser vertical resolution and model biases.

This paper describes a new method to determine the tropopause altitude directly from GPS Radio Occultation (RO) measurements of bending angle. This is of particular value since they are directly derived from climate benchmark data. RO data have uniformly distributed global coverage and high vertical resolution. Long-term stability enables data from different sensors and missions to be combined without the need for inter-calibration. An objective covariance transform method is applied to identify transitions in a bending angle profile. This method avoids the need for additional RO data processing and assumptions to derive parameters such as dry temperature, and the use of subjective tropopause identification criteria.

The RO tropopause altitude shows good agreement with lapse rate and cold point criteria using dry temperatures and radiosonde temperature profiles. A longer-term tropopause altitude analysis from summer 2008 to summer 2009 using the RO bending angle method is presented to analyse the spatial distribution and annual variability of global tropopause altitude. The application of the method for monitoring global multiple tropopause characteristics is discussed.