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Long-Term Monitoring of Global Tropopause Parameters Using Radio Occultation

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Changes in the structure of the tropopause have recently received increased attention both as important factors in climate processes and as sensitive indicators of human induced climate change. For example, changes in the height of the tropical tropopause may be associated with variations in the strength of the Brewer-Dobson circulation, and increases in the latitudinal extent of the tropical tropopause suggest a widening of the tropical Hadley cell. Changes in tropopause structure can also affect stratosphere-troposphere exchange and thus stratospheric and tropospheric climate as a whole. Fortunately, along with the increased attention on the tropopause has come an increased capability to measure it.

Several satellite missions make use of radio-occultation (RO), allowing precise, consistent measurement of global tropopause structure in unprecedented detail. The first of these missions was launched in 1995, two missions are in service today, and more are expected in the future. This makes RO a potentially invaluable climate monitoring resource. The stability of RO-derived tropopause height and temperature measurements is critical to their use in studying long-term tropopause trends. RO instruments have the benefit of intrinsic self calibration, so while systematic biases may be present, they should be reasonably consistent with time. However, processing methods vary between data products, producing structural uncertainty. The question is raised, then: can the available RO tropopause datasets be combined to form a consistent long-term climate record?

We address this question by examining error structure first in individual RO products, then between RO and radiosonde data, and finally between RO datasets. We find generally good agreement between more recent RO products and radiosondes, and significant differences in height and temperature between RO datasets. We attribute temperature differences mainly to differences in processing. Between similarly processed datasets we find temperature differences were small; less than roughly 0.4 K and varying by latitude. These differences are small enough that disjoint RO datasets may be useful in measuring tropopause temperature trends, given reasonably similar processing methods. These results provide important details on how to best utilize RO-derived tropopause data for climate change studies.