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# Static Stability in the Global Upper Troposphere and Lower Stratosphere: Observations of Long-term Mean Structure and Variability using GPS Radio Occultation Data

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Static stability is a fundamental dynamical quantity that measures the vertical temperature stratification of the atmosphere. The long-term mean static stability field is characterized by the well-known transition from low values in the troposphere to high values in the stratosphere. However, the magnitude and structure of fine-scale static stability features near the tropopause are difficult to discern in temperature data with low vertical resolution. In this study, the authors apply over six years of high vertical resolution Global Positioning System radio occultation temperature profiles to document the long-term mean structure and variability of static stability in the global upper troposphere and lower stratosphere (UTLS).

The results of this study demonstrate that a shallow but pronounced maximum in static stability exists just above the tropopause at all latitudes (i.e., the "tropopause inversion layer," or TIL). This study also uncovers two novel aspects of static stability in the global UTLS. In the tropical lower stratosphere, the results reveal a unique vertically and horizontally varying static stability structure, with maxima located at $\sim$17 km and $\sim$19 km. The upper feature peaks during the NH cold season and has its largest magnitude between 10 and 15 degrees latitude in both hemispheres; the lower feature exhibits a weaker seasonal cycle and is centered at the Equator. The results also demonstrate that the strength of the TIL is closely tied to stratospheric dynamic variability. The magnitude of the TIL is enhanced following sudden stratospheric warmings in the polar regions and the easterly phase of the quasi-biennial oscillation in the tropics.