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Assessing the precision of Global Positioning System (GPS) radio occultation

There have been previous theoretical, experimental, and comparison studies to determine the precision of Global Positioning System (GPS) radio occultation (RO), but the current stage of the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) satellites presents a unique opportunity to determine the precision using collocated soundings. The collocated soundings from the COSMIC Data Analysis and Archive Center (CCDAC) were constrained on latitude bands as well as local time and scintillation index and the standard deviations of the soundings were calculated for a specific height grid. This study showed the consistency of the tropopause in different regions and established that the occultations were not affected by the tropopause. This was concluded by viewing the high precision of a parameter, PPMT, which stands for "precision parameter for middle troposphere" by region. Larger PPMT values (implying lower precision) were observed for the southern hemisphere for GPS RO soundings that were separated by 200 and 300 km and related to significant refractivity variations due to active weather systems on both the mesoscale and synoptic scale. The precision of the refractivity determined in this study of collocated GPS RO less than 1 km apart is 0.02%, which for temperature is approximately 0.05°C. The precision of a typical radiosonde system is on the order of 0.5°C or higher, therefore, the GPS RO is one order of magnitude more precise than the radiosonde. With such a precision and spatial coverage, GPS RO is currently the best technique for climate analysis as well as weather prediction.