THE IMPACT OF LARGE SCALE IONOSPHERIC STRUCTURE ON CLIMATE BENCHMARK ATMOSPHERIC SOUNDINGS USING GNSS RADIO OCCULTATION DATA

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Atmospheric soundings derived from Global Positioning System radio occultations (GPSRO) acquired in low-Earth orbit have the potential to be global climate benchmark observations of significant value to the Global Climate Observing System (GCOS). Geophysical observables such as atmospheric pressure and temperature are derived by measuring propagation delay induced by the atmosphere, a measurement whose fundamental unit, the second, is absolutely determined by calibration against atomic clocks. In this presentation, we analyze the sources of systematic and random error for GPSRO soundings to determine the steps needed to establish GPSRO as a climate benchmark observation. Benchmarks require specific processing strategies and specific forms of documentation so that confidence in the accuracy and precision of the measurements is assured. Establishing calibration traceability to absolute standards (SI-traceability) is an essential strategy. Detailed error analysis suggests that delay of the GPS transmissions due to the Earth's ionosphere can potentially hinder SI-traceability particularly at solar maximum. We present an analysis of ionospheric bending impact on the GPS signal raypath to set an upper limit on residual retrieval errors that affect accuracy over the solar cycle period of 11 years. Three-dimensional ray tracing through realistic radio occultation geometries is combined with estimates of ionospheric structure based on the Global Assimilative Ionosphere Model (GAIM) at JPL. We discuss conditions characteristic of solar maximum, solar minimum and during intense geomagnetic storm conditions that significantly elevate ionospheric densities. Progress in characterizing ionospheric systematic error will be discussed in light of published results studying the effect of the ionosphere on GPS signals.