New Experiments with the GISMOS Airborne Radio Occultation System

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Radio occultation has proven to be a resounding success in improving global weather prediction models, particularly at 300 to 50 hPa levels and especially in otherwise poorly sampled regions of the southern hemisphere. As the community looks forward to the next generation in radio occultation constellations, there will be a transition to assimilation of radio occultation data into higher resolution models as the availability of profiles within the desired spatial and temporal windows improves. The desire to improve model performance in specific case studies such as hurricanes or extreme weather will require assessing the utility of radio occultation observations, in general, where strong horizontal gradients are present in the atmosphere, which is where classical one-dimensional retrieval techniques may prove to be inadequate. As a prelude to future missions, airborne radio occultation presents an excellent opportunity to make comparable observations to the spaceborne case, with a denser observation geometry than is currently possible, in order to assess the utility of radio occultation in these situations. The GNSS Instrument System for Multistatic and Occultation Sensing (GISMOS) has been successfully deployed on the NSF HIAPER aircraft and is available for this type of study. We present data from two recent campaigns and show the current status of the achievable data quality. The airborne system presents unique challenges relative to the spaceborne case, in particular due to the uncertainties in the platform velocity, the lower magnitude of the bending signal, and the local receiver clock errors, however the results to date look promising. Many recordings from a campaign over the Gulf Coast made with the conventional phase lock loop receivers descend below 5km, and one recording reached as low as 1km. Using a software receiver that implements an open loop tracking algorithm on data captured by the on-board 10MHz signal recorder, we have tracked signals up to 2 km lower than the conventional receivers. The success of the refractivity retrievals is dependent on accurately removing receiver clock errors, which is complicated by the fact that the system uses different antennas for high elevation versus low elevation satellites. Examples are shown of several occultations where the atmospheric signal is quite clear. The airborne radio occultation technique has exciting potential for providing high resolution vertical profiles in meteorological targets where comprehensive sampling of the environment within 400 km of the aircraft track is desired.