Profiling the Atmosphere with the Airborne Radio Occultation Technique Using GPS Signals Recorded in Open-Loop Mode

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The GNSS Instrument System for Multistatic and Occultation Sensing deployed on the National Science Foundation Gulfstream-V aircraft was designed for dense sampling of meteorological targets using the airborne radio occultation technique. The system includes a GPS RF signal recorder to provide data for post-processing using open-loop tracking in a software receiver, as well as conventional dual frequency geodetic quality receivers for phase lock loop tracking of signals. We present here the first comprehensive results of the performance of the open-loop tracking algorithm from the airborne system, that includes rising and setting occultations. The data was recorded during a 6 hour flight over the Gulf Coast of the United States in February 2008 at a flight level of 14 km. Out of a possible 19 rising and setting occultations that occurred during that time period, we have successfully retrieved the excess phase and amplitude using open-loop tracking for 5 setting and 4 rising occultations with comparable quality. Two occultations were eliminated by aircraft turns during the occultation. By far the most important factor contributing to the missed occultations (five profiles) is the lack of navigation data bits necessary for the open-loop processing. Interference from the aircraft structure did not appear to be a major factor affecting data reliability. Since 2008, the global network providing data bits has improved significantly, so that from a practical point of view the system on a straight flight path would achieve 2.7 occultations per hour of flight time. The open-loop tracking receiver performed much better than the conventional receivers, and consistently tracked as low as 1.7 to 2.7 km in the atmosphere. Current work is focused on the quantifying the accuracy of the refractivity retrievals from these data. Given these preliminary results, the prospects are good for the system to contribute to improved forecasting of storm systems in the sub-tropics and tropics through targeted observations in data poor areas.