GPS Radio Occultation on a CubeSat Platform

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Radio occultation with global position satellites has been used for decades to do remote atmospheric sounding. The signal from a GPS or GNSS satellite is tracked as the positioning satellite "sets" with respect to a receiver on a satellite in Low Earth Orbit. As the electromagnetic signals interact with the atmosphere, they will bend and the path length will change incrementally. The relationship between how much the signal refracts and the density of the air the signal passed through gives information on the temperature and pressure of that volume of atmosphere. GPS receivers are commonly flown on satellites for position and tracking information, and with minor modifications these can yield useful scientific information.

There has been progress in the development, space qualification, and flight of miniaturized dual-frequency GPS RO sensors for use on CubeSats and other nanosatellites. The CubeSat standard is widely adopted by both academia and industry, and tens of these satellites are manifest each year as secondary payloads on commercial or government launches to Low Earth Orbit. CubeSat capabilities continue to improve, and there is considerable momentum to transition from scientific and academic proof-of-concept missions into dedicated observation missions that generate valuable science products.

In this paper we show the expected atmospheric depth and precision for temperature profiles measured using GPS radio occultation with commercially-available CubeSat-scale GPS and GNSS receivers. We also provide an analysis of the repeatability and global coverage of atmospheric measurements for varying numbers and orbits of satellites.