Distribution of Common-volume LEO-based and Ground-based GNSS Ionosphere Observations

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The advent of low-cost high-quality Global Navigation Satellite Systems (GNSS) receivers has brought with it a proliferation of their use for observing Earth's atmosphere. The geometric circumstance of GNSS orbits leads to two principle perspectives–from the ground and from LEO (low Earth-orbiting) satellites–for their use in making atmospheric observations. The prior is manifest through various ground-based GNSS networks, while the latter has become relevant in the past decade with radio occultation missions CHAMP and COSMIC. For the purposes of investigating electron density in the ionosphere, the two geometries provide complementary information that is especially useful when and where we find observations of a common-volume. Here we present a fundamental understanding of the LEO and ground-based observation volumes and qualitative results on the availability of their common-volume observations of the Earth atmosphere.