NWS14-2014-000107

Abstract for an Invited Paper
for the NWS14 Meeting of
the American Physical Society

Measuring and Mitigating Ionospheric Effects on Global Navigation Satellite Systems

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Global Navigation Satellite Systems (GNSS) such as GPS are employed by many users worldwide for purposes of recreation, vehicle navigation, and safety-critical aviation marine and applications (to name a few). The GNSS signals experience propagation delays and attenuation in the Earth's ionosphere - resulting in degradation of signal quality and positioning accuracy. Such effects must be mitigated, particularly for safety-critical systems, to ensure continuous service and integrity to meet system specifications. This presentation describes some of the major limitations and solutions for mitigating challenging ionospheric effects on GNSS. Ground-based and space-borne GNSS receivers may allow direct calibration of ionospheric parameters and therefore exploitation of GNSS as an ionospheric remote sensing tool. Applications include space weather, ionospheric profiling using radio occultation measurements and detection of natural hazards such as earthquakes and tsunamis using GNSS estimates of ionospheric total electron content. In recent years the GPS has been modernized with new signals and system capabilities. Additional GNSS include Galileo, GLONASS, QZSS and Beidou. The new generation GNSS receivers have multi-constellation and multi-frequency capabilities. This presentation explores the tremendous opportunity for increased observability and estimation of ionospheric properties using GNSS.