

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Space Communications and Navigation Global Technical Session (8-GTS.3)

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ANOMALOUSLY HIGH AMPLITUDE SCINTILLATION OBSERVED FROM GLONASS SATELLITES
DURING LOW SOLAR ACTIVITY

Abstract

The presence of ionospheric irregularities in the signal path of global navigation satellite system (GNSS) induce amplitude and phase fluctuations. The fluctuations in the signal intensity are referred to as amplitude scintillation. These fluctuations severely limit the performance of GNSS and may cause loss of receiver lock. The occurrence of ionospheric scintillation depends on various spatial and temporal factors including time of day, season, geographical location, and solar activity. In general, geographical regions close to equatorial ionization anomaly and high latitude regions are prone to scintillation more than mid latitudes regions, specifically, in high solar activity times. In this work, we have presented some anomalous amplitude scintillation observations (S4 index) from GLONASS (GLObal NAVigation Satellite System) GNSS satellites during low solar activity time of Winter 2021. The observations were recorded using a multi-constellation GNSS scintillation monitor manufactured by Septentrio (PolarRx5s) installed at the Arabian Peninsula (Sharjah: 25.3N, 55.5E). PolarRx5S uses a choke ring antenna (PolarNt Choke Ring) which includes a radio-frequency absorbing material underneath the antenna that shields the antenna from any multi-path effects from below. Scintillation observations recorded with L1 signal (at 1575.42 MHz) are considered in this work for both the GPS (Global Positioning System) and GLONASS constellations. A comparative analysis between GPS and GLONASS amplitude scintillation observations are presented which clearly reveals that specific GLONASS satellites (e.g., R17 and R08) consistently showed high scintillation (S4 index ≥ 0.3) even at very high elevation of close to 90 degrees. All other satellites of the GLONASS constellation also displayed elevated levels of S4 (S4 ≥ 0.1) during the Winter 2021. During the same time, there were no such observations recorded using GPS satellites. The GLONASS satellites

that showed anomalously high scintillation were declared healthy and in normal operation at the time of observations. Such observations, if consistently observed may adversely affect the reliability and integrity of the GLONASS positioning service, especially during periods of heightened geomagnetic activity.