Temporal and spatial variation of GPS phase scintillation during substorms and auroral breakups

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The ionospheric structure caused by precipitation of high energy particles can adversely affect the GPS causing phase scintillation and cycle slip (loss of lock). GPS phase scintillation correlates with the intensity of the aurora, especially the rapid change in the auroral brightness [1,2,3]. Enhancement of the total electron content (TEC) observed during the substorm expansion phase in the night side downward region 1 current seems to be related to intense precipitation particle flux [4]. Such TEC enhancements cause phase scintillation that is most intense just after substorm onsets and auroral breakups. Phase scintillation index is computed for sampling rate of 50 Hz by specialized GPS scintillation receivers from the Canadian High Arctic Ionospheric Network (CHAIN). A proxy scintillation index is obtained from dual frequency measurements of geodetic-quality GPS receivers sampling at 1 Hz, which include globally distributed receivers of RT-IGS network that are monitored by the Canadian Geodetic Survey in near-real-time. Temporal and spatial changes of TEC and phase scintillation are investigated in the context of equivalent ionospheric currents derived from ground magnetometer network using the spherical elementary current method [5,6]. The relation of phase scintillation with auroral emission is also examined. In general, GPS phase scintillation maps to regions of strong westward electrojet and to the poleward edge of the eastward electrojet. Following substorm onsets and auroral breakups, strong phase scintillation associated with TEC enhancements are mapped mainly to the upward region 2 current or the equatorward edge of the downward region 1 current at or near the Harang discontinuity region [7].

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