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Climatology of GPS ionospheric TEC, scintillation and HF radar backscatter at high latitudes under solar minimum conditions

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The GPS data from the first two years of operation of the Canadian High-Arctic Ionospheric Network (CHAIN) are analyzed to develop climatology of ionospheric total electron content (TEC) and phase scintillation in the auroral and polar ionospheres. CHAIN consists of ten dual-frequency receivers, configured to measure amplitude and phase scintillation from the L1 frequency GPS signals and ionospheric TEC from the L1 and L2 frequency GPS signals. During the past solar minimum, the S4 index remained very low but events of strong phase scintillation were observed and associated with perturbed cusp ionosphere, auroral arc brightenings and auroral substorms. The enhanced phase scintillation occurrence and mean TEC as a function of magnetic local time and geomagnetic latitude are collocated with ionospheric regions defined by the process of solar wind coupling to the magnetosphere, namely, the ionospheric footprint of the cusp, polar cap patches and auroral oval. Depletions in the mean TEC are identified with the statistical high-latitude and mid-latitude troughs. The statistical cusp and auroral oval are observed in the occurrence of the HF radar ionospheric backscatter from field-aligned irregularities and the mean ground magnetic perturbations due to ionospheric currents. As part of the climatology study seasonal and diurnal variations are also considered.