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GPS Total Electron Content Variations Associated with Poleward Moving Sun Aligned Arcs

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Global Positioning System (GPS) Total Electron Content (TEC) has showed quasi-periodic oscillations of varying amplitude associated with Poleward Moving Sun-Aligned Arcs (PMSAAs). Amplitude of TEC variations showed a maximum of $\sim$3 TECu, and seemed to decrease as the arcs moved poleward from the source/generation region. Simultaneous DMSP data showed that fluctuations in TEC and optical intensification were caused by precipitation of high-energy (>500 eV) particles. Concurrent ionosonde observations also exhibited quasi-periodic variations (within limit of the resolution of the data) in peak ionospheric electron density of the ionosphere. Bottom height of the ionopsheric layers produced by precipitating particles varied between 130 km (upper E region) and 300 km (F region) indicating variable particle precipitation energy. Frequency analysis of high resolution TEC data showed a broad range of discrete frequency components from 1.60 mHz to 22.80 mHz present in the TEC oscillations, which may provide insight into the energisation/modulation of precipitating particles by these oscillations. A broad distribution of equivalent vertical thickness of arcs was calculated using GPS TEC and ionosonde measurements of peak electron density. This distribution showed a minimum thickness of 21 km, a maximum of 84 km and an average of 49 km. The equivalent vertical thickness also showed a linear relationship with bottom-side height of the ionospheric layer (auroral arc). The relationship showed an increase in the vertical thickness with an increase in bottom-side height of the layer. This relationship is a consequence of variations in the energy of the precipitating particles causing different ionospheric production profiles.