Polar cap patches, GPS TEC variations, and atmospheric gravity waves

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The southward pointing field of view of the Canadian component of the Resolute Bay Incoherent Scatter Radar (RISR-C) is well suited for observing the ionospheric signatures of flux transfer events and subsequent polar patch formation in the cusp [1]. The fast azimuthally oriented flows and associated density depletions often show an enhanced ion temperature from Joule heating caused by the sudden change in plasma flow direction. The newly formed polar patches are then observed as they propagate through the field-of-views of both RISR-C and RISR-N. In the ionosphere, the electron density gradients imposed in the cusp, and small-scale irregularities resulting from gradient-drift instability, particularly in the trailing edges of patches, cause GPS TEC and phase variations, and sometimes amplitude scintillation. A byproduct of the coupling process forming polar cap patches are traveling ionospheric irregularities (TIDs) [2]. Pulses of ionospheric currents in the cusp are a source of Joule heating launch atmospheric gravity waves (AGWs) causing medium- and large-scale TIDs propagating equatorward and upward, where they are observed by mid-latitude SuperDARN radars, as well as in the detrended GPS TEC maps. However, the AGWs propagate globally, both upward and downward from the lower thermosphere [3]. The downward propagating AGW packets can impact the lower atmosphere, including the troposphere. Despite significantly reduced wave amplitudes, these AGWs, subject to amplification upon over-reflection in the upper troposphere, can trigger/release existing moist instabilities, initiating convection and latent heat release, the energy leading to intensification of storms [4].

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