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

Prikryl, Paul; Gillies, Robert G.; Themens, David R.; Kunduri, Bharat S.~R.; Varney, Roger; Weygand, James M.

DOI:
10.5194/egusphere-egu21-6775

EGU21-6775
https://doi.org/10.5194/egusphere-egu21-6775
EGU General Assembly 2021

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

Paul Prikryl[1,2], Robert G. Gillies[3], David R. Themens[1,4], Bharat S. R. Kunduri[5], Roger Varney[6], and James M. Weygand[7]

[1]University of New Brunswick, Physics Department, Ottawa, ON, Canada
[2]Geomagnetic Laboratory, Natural Resources Canada, Ottawa, ON, Canada
[3]Department of Physics and Astronomy, University of Calgary, AB, Canada
[4]School of Engineering, University of Birmingham, Birmingham, UK
[5]Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA, USA
[6]Center for Geospace Studies, SRI International, Menlo Park, California, USA
[7]Earth Planetary and Space Sciences, University of California, Los Angeles, CA, USA

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. 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. The neutral atmosphere is affected by ionospheric currents resulting in Joule heating. The pulses of ionospheric currents in the cusp launch atmospheric gravity waves (AGWs) causing traveling ionospheric disturbances, as they propagate equatorward and upward. On the other hand, the downward propagating AGW packets can impact the lower atmosphere, including the troposphere. Despite significantly reduced wave amplitudes, but subject to amplification upon over-reflection in the upper troposphere, these AGWs can trigger/release existing moist instabilities, initiating convection and latent heat release, the energy leading to intensification of storms.