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Multi-instrument observations of polar cap patches and traveling ionospheric disturbances during geomagnetic storms

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Solar wind Alfvén waves [1] coupling to the magnetosphere-ionosphere-thermosphere (MIT) have been associated with high-intensity long-duration continuous auroral electrojet activity [2] and shown to modulate ionospheric convection in the cusp generating polar cap patches and atmospheric gravity waves [3,4]. The Resolute Bay Incoherent Scatter Radars (RISR-C and RISR-N) [5] are well suited for observing the ionospheric signatures of flux transfer events and subsequent polar patch formation in the cusp. During minor to moderate geomagnetic storms caused by corotating interaction regions at the leading edge of solar wind high speed streams polar patches were observed as they convected over the RISR, and the Canadian High-Arctic Ionospheric Network (CHAIN) ionosondes and GPS receivers [6]. The patches were generated by the MIT coupling of Alfvén waves in the upstream solar wind. The coupling process modulated the ionospheric convection and the intensity of ionospheric currents, including auroral electrojets. The horizontal equivalent ionospheric currents and vertical current amplitudes are estimated from the ground-based magnetometer data using an inversion technique [7]. Pulses of ionospheric currents that are a source of Joule heating in the lower thermosphere launched atmospheric gravity waves causing traveling ionospheric disturbances (TIDs) propagating equatorward. TIDs were observed in the SuperDARN HF radar ground scatter [8], in the detrended GPS TEC maps, and in one case, in the altitude profiles of ionospheric electron densities observed by the Poker Flat ISR [9].

[1] Belcher, JW, Davis, L, Jr. 1971. J. Geophys. Res. 76, 3534–3563.

[2] Tsurutani, BT, Gonzalez, WD. 1987. Planet. Space Sci. 35(4), 405–412.

[3] Prikryl, P, et al., 1999. Ann. Geophys. 17, 463–489.

[4] Prikryl, P, et al., 2005. Ann. Geophys. 23, 401–417.

[5] Gillies RG, et al., 2016. Radio Sci., 51(10):1645-1659.

[6] Jayachandran, PT, et al., 2009. Radio Sci., 44, RS0A03.

[7] Weygand, JM, et al., 2011. J. Geophys. Res. 116, A03305.

[8] Chisham, G., et al., 2007. Surv. Geophys. 28, 33–109.

[9] Heinselman, CJ, Nicolls, MJ, 2008. Radio Sci., 43, RS5013.