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Patch formation in the high-latitude nightside ionosphere

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Coupling between the geomagnetic field lines and the Interplanetary Magnetic Field (IMF) has a significant influence upon the plasma distribution in the polar ionosphere on a wide range of spatial scale sizes. Of particular interest to this study are polar cap patches which have a horizontal dimension of at least 100 km and occur in the F-region. These patches are formed of ionospheric plasma that is believed to be drawn poleward from auroral or subauroral latitudes on the dayside as a Tongue-of-Ionisation (TOI) before being broken into a series of discrete patches. Numerous mechanisms have been proposed to break up a TOI including variation in the high-latitude convection pattern in response to changes in the IMF, modification of the convection pattern by transient bursts of magnetospheric reconnection, modulation of plasma densities by particle precipitation and modification of plasma recombination rates by either fast plasma jets or variation in the thermospheric composition. These mechanisms have been extensively studied in the dayside ionosphere.

The process of the breakup of a TOI due to variation in the high-latitude convection pattern in response to changes in the IMF forms patches close to the solar terminator. Around equinox the terminator is located deep within the polar cap and so this mechanism has the potential to operate in this region. Results are presented from an EISCAT special programme experiment which showed the first observations of this patch formation mechanism in this sector. The EISCAT Svalbard Radar (ESR) and the EISCAT UHF radar (UHF) were both used in scanning modes, sampling the ionosphere across some 13o latitude at F-region altitudes in the high-latitude nightside ionosphere. The terminator was close to the poleward edge of the ESR field-of-view. On 26 March 2008 a TOI was observed being broken into a series of discrete polar cap patches due to variation in the convection pattern driven by changes in the IMF. In the absence of photoionisation the plasma decayed by chemical recombination with the thermosphere. Aberystwyth University's PLASLIFE simulation is used to estimate the lifetime of these patches.