Spatial relationship of polar cap patches and field-aligned irregularities observed with an all-sky imager and SuperDARN radar

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Highly sensitive all-sky airglow imager OMTI (Optical Mesosphere Thermosphere Imager) has been operative at Resolute Bay, Canada (geographic latitude 74.7; geomagnetic latitude 82.9) since January 2005. Primary target of this optical measurement is polar cap patches, which are defined as a region of plasma density enhancements drifting anti-sunward across the polar cap. Since plasma density enhancement within the patch approximates to a factor of 2 or more at F-region heights, the highly sensitive optical instrument can figure out spatial structure of patches at 630nm wavelength.

OMTI at Resolute Bay has a common volume with 6 radars of the SuperDARN (Super Dual Auroral Radar Network. Coherent scatter radars such as the SuperDARN can detect field-aligned plasma density irregularities (FAIs) in the vicinity of polar cap patches. If we assume the gradient drift instabilities (GDI) as a generation mechanism of FAIs, FAIs should appear on the trailing edge of the polar cap patches. This theoretical prediction, however, has not been confirmed by substantial observations. In the present analysis, we compare spatial structure of the electron density patches imaged by OMTI with the FAIs observed by the SuperDARN radars. The interval presented is on January 11, 2005, between 2200 and 2400 UT. During this interval, several polar cap patches were observed with OMTI in the duskside polar cap region. 3 SuperDARN radars detected small-scale blobs of FAIs in the vicinity of the large-scale patches. We discuss spatial relationship between plasma density patches (optical patches) and FAIs patches (radar patches) in terms of the plasma instability processes such as GDI.