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

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Highly sensitive all-sky imager of OMTIs (Optical Mesosphere Thermosphere Imagers) 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 enhancement 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 630 nm wavelength.

The all-sky imager 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 have compared spatial structure of electron density patches imaged by the all-sky imager with FAIs observed by the SuperDARN radars. As a result, we found that FAIs are distributed on the entire region of electron density patches, which suggests that some nonlinear cascading process is working in producing deca-metre scale FAIs in the vicinity of patches.