Coordinated Multiple-ISR Studies of Polar Cap Structure

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The addition of new advanced modular incoherent scatter radars (AMISRs) in Resolute Bay, Canada creates new opportunities for studies of polar cap dynamics using multiple incoherent scatter radars. The Resolute Bay Incoherent Scatter Radar – North (RISR-N) became operational in 2009 and the Resolute Bay Incoherent Scatter Radar – Canada (RISR-C) became operational in 2015. The Resolute Bay site is only 1760 km away from the Sondrestrom Incoherent Scatter Radar site in Greenland. While Sondrestrom does not quite have a common volume with RISR-N or RISR-C, their proximity nonetheless creates opportunities to use these three radars together as a regional observatory. Beginning in 2016, these three radars have been running coordinated science campaigns. In addition to the existing world day coordinated experiments, the operators of these three radars in particular have been coordinating their normal operations as closely as possible.

All three radars observed a compelling event during the October 12-14, 2016 coronal mass ejection geomagnetic storm. The three radars rotated through the dayside during a period of sustained strongly southward interplanetary magnetic field and observed very large storm enhanced densities (SED) convecting northward into the polar cap. The SED were observed first in the eastern edge of the Sondrestrom field of view and progressed from east to west. This observation is consistent with the SED being persistent in magnetic local time, and the radars rotating with the Earth underneath. The electronic beam steering capabilities of RISR-N and RISR-C clearly show that the SED is segmented into a series of polar cap patches.

Maximizing the scientific return from these multi-radar experiments requires the development of new analysis techniques and data visualization methods. Data from scanning dish radars and electronically steerable phased arrays have different advantages and drawbacks that complicate the interpretation. Extensive effort has been devoted to optimal analysis techniques for combining data from multiple beams of an AMISR into derived data products such as vector electric fields. These techniques can be expanded to combine data from multiple radars simultaneously.