Multi-Scale Observational Views of Subauroral Magnetosphere-Ionosphere Coupling

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Processes in the ionosphere, plasmasphere, and inner magnetosphere are inherently coupled due to strong electrodynamic forces and the presence of dynamic changes in the cold plasma environment around Earth. The complexity, time variation, and non-local nature of these coupling processes require coordinated, multi-scale observations to advance knowledge on the dominant energy and momentum pathways that cause intense structuring and mass transfer. Understanding of the inner magnetosphere is particularly important for such fundamental processes as heavy, cold O+ ion outflow into the plasma sheet and ring current, and feedback mechanisms that regulate the amount of energy input to the magnetosphere from the solar wind through cold plasma mass loading of the magnetopause.

The recent launch of the Arase satellite provides an excellent opportunity to conduct conjunctive measurements of the inner magnetosphere and subauroral ionosphere. In particular, the Millstone Hill incoherent scatter radar provides wide field views of the E region, F region and topside ionosphere over more than 3 hours in MLT and 25 degrees in magnetic latitude in the American longitude sector. Combining this diagnostic with inner magnetospheric transits of Arase and NASA's Van Allen Probes satellites provides a powerful way to examine dynamic electric field coupling and mass flows in regions affected by the sub auroral polarization stream (SAPS) and storm enhanced density (SED) plumes. We will present early results from dusk sector conjunction measurements that are planned using Millstone Hill, Arase, and Van Allen Probes in late summer and early fall 2017. The in-situ satellite data and ground-based ionospheric radar measurements are complemented by global GPS based total electron content maps, calculated by MIT Haystack Observatory on a routine cadence from more than 5,000 worldwide receivers. GPS TEC measurements provide mesoscale context and interpretation to the localized, precise conjunctive observations, along with large scale imaging of the plasmapause and enhanced density structuring in the dusk MLT sector.