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Auroral Scintillation Monitoring for GNSS

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Auroral precipitation and associated electric currents affect accuracy of practical systems and services: e.g. global navigation satellite systems (GNSS), communication systems, and power systems. Such space weather hazards are important for Canadians due to increasing civilian and military activity in the Arctic, and increasing reliance on GNSS in the decade ahead. Ionospheric scintillation associated with the diffuse and discrete aurora can be particularly problematic for safety-critical operations. In order to better study, model and mitigate such effects, the University of Calgary leads the Transition Region Explorer (TREx) - the world's foremost auroral imaging facility for remote sensing the near-earth space environment.

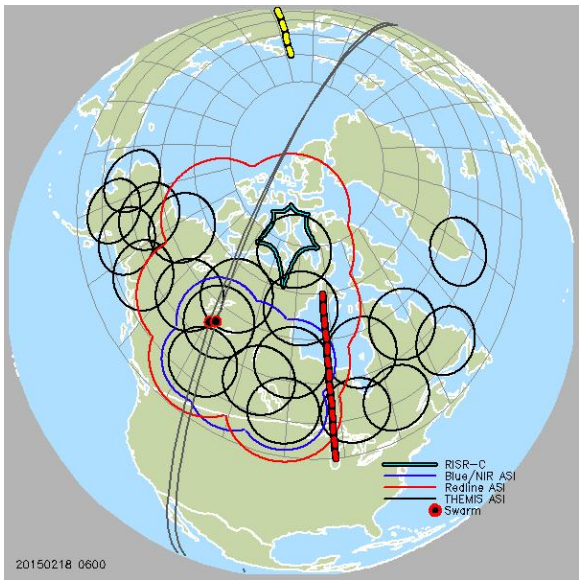

Figure 1. Current and upcoming University of Calgary ground-based ionospheric observing systems

TREx ground-based observing systems include All-Sky Imagers (Blue/NIR, Redline, and THEMIS), Global Navigation Satellite System (GNSS) receivers including RF front-end data collection, and our Incoherent Scatter Radar (ISR) at Resolute Bay (RISR-C). This amounts to more than 60 instruments and a hardware investment of more than $40M. Our observing systems provide a unique opportunity to classify types of auroral phenomena and to study the physical drivers of ionospheric scintillation, with some of the most comprehensive multi-scale observations of the aurora and other high latitude phenomena ever obtained.

In this paper we present initial TREx multi-instrument studies characterizing auroral ionospheric scintillations and drivers (both for discrete arcs and patchy pulsating aurora). We propose a network monitoring approach for GNSS users that exploits ground-based observations combined with our impact models. Space weather products for specific user applications, such as marine navigation, are presented.