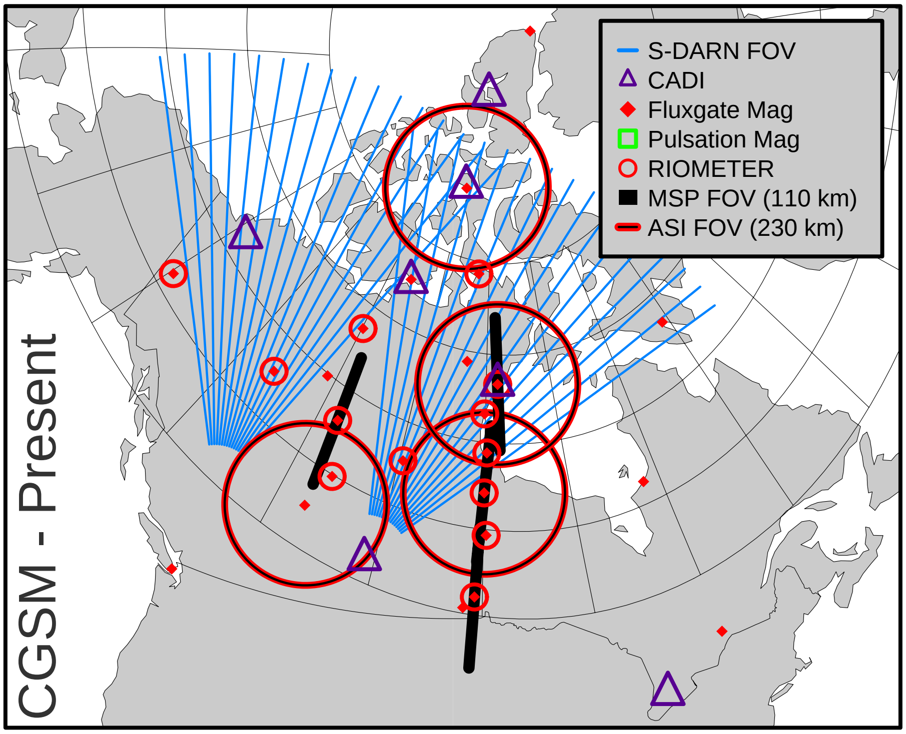

Figure 1: Present status of ground-based instruments operated by programs that fall under the CGSM umbrella.

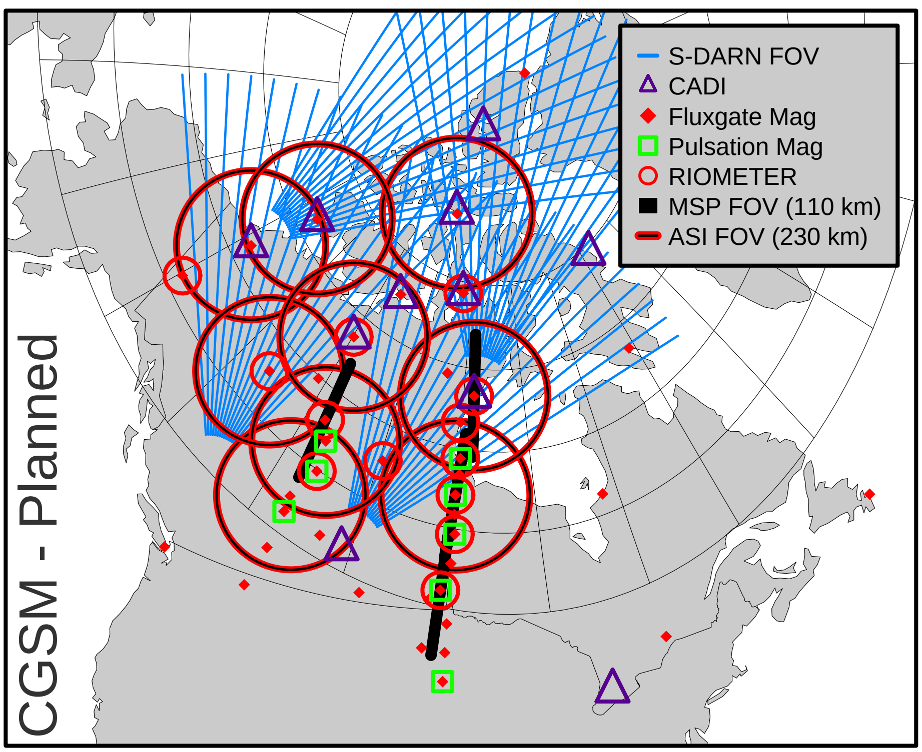

Figure 2: CGSM ground-based instrument array including planned enhancements.

CADI – Canadian Advanced Digital Ionosonde

Prior to CGSM, the CADI array operated as an array of five digital ionosondes. Of these, three are operating in polar regions: the CADIs at Resolute Bay and Eureka provide unique monitoring of open field line regions, whilst the third at Cambridge Bay often lies under the ionospheric projection of the boundary between open and closed magnetic field lines (i.e., the polar cap boundary). The existing CADI array will continue operations under CGSM, and will be enhanced with the addition of six new CADI instruments (see Figure 2). These instruments will be deployed both east and west of the existing three polar stations, at geomagnetic latitudes that are typical of the polar cap boundary between open and closed magnetic field lines.

Each CADI instrument provides two basic types of ionospheric measurements: i) ionograms which give information about ionospheric electron densities and vertical ionospheric structuring; and ii) fixed frequency measurements which measure the Doppler shifts of the reflections and from which ionospheric flows can be calculated. CADI convection measurements have been truthed against both SuperDARN convection measurements, and velocities inferred from optical measurements of drifting auroral polar cap patches [*Grant et al.*, 1995]. An example of measurements of CADI convection speed is given in Figure 3. A significant advantage of the digital ionosonde is that it gives virtually continuous high time resolution measurements, even during dynamic times. The CGSM coverage provided by the CADI array thus facilitates the monitoring of reconnection events, including FTEs, as well as the continuous monitoring of convection local to the CADI location which will provide crucial input to science theme I. The CADI array will also permit the study of transient ionospheric and magnetospheric phenomena such as substorms, as well as remote-sensing the characteristics of drifting ionospheric patches.

Transport of magnetic flux and plasma across the open-closed field line boundary is also one of the most important processes in the magnetospheric system, and plays a central role in both the supply of plasma to the central plasma sheet, and the supply of energy to the overall convection process. The new CADI instrumentation deployed in the expanded CADI array will provide an internationally unique capability for continuously monitoring convection and ionospheric characterization in the important polar cap boundary region across ~7 hours of magnetic local time. This monitoring will be particularly crucial for addressing science theme I.

In summary, the temporally continuous CADI data set will provide an excellent complement to the SuperDARN dataset. CADI ionospheric density and flow measurements, particularly at the polar cap boundary, will providing important monitors of the global solar-terrestrial coupling related to science themes I and II. CADI data will also provide monitoring of the dynamics of the mass density profiles in the coupled ionosphere-magnetosphere system which will be important for studies related to science theme V. An additional benefit of operating the CADI program within CGSM will be its capability for mesoscale characterization of the ionosphere and convection in the region surrounding the FOV of the NSF funded incoherent scatter facility at Resolute Bay.

The CADI program is led by Dr. John MacDougall (jmacdoug@uwo.ca) of the University of Western Ontario.

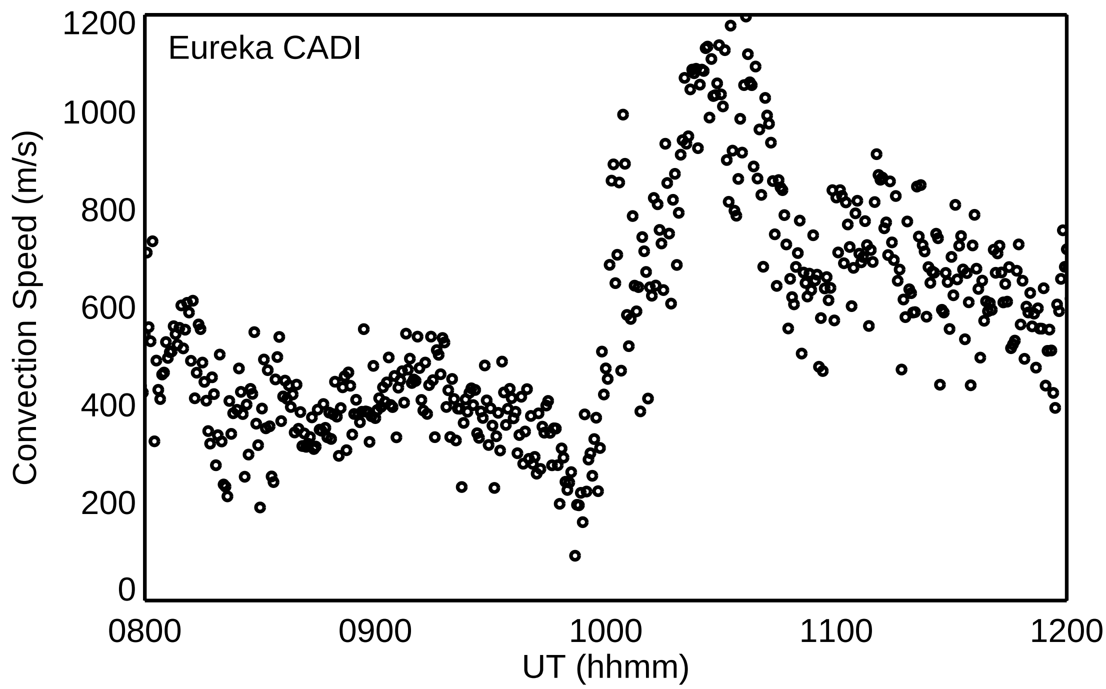

Figure 3: Example of CADI convection speed measurements from the Eureka instrument. There is a substorm onset at 0950 UT (seen separately in Dawson magnetometer measurements), which is preceded by a rapid decrease in convection speed, and followed by a significant increase.

Representative CADI Publications

Abdu, M., P. Jayachandran, J. MacDougall, J. Cecile, and J. Sobral, Equatorial F region zonal plasma irregularity drifts under magnetospheric disturbances, *Geophys. Res. Lett.*, 25(22), 4137–4140, 1998.

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Jayachandran, J., and J. MacDougall, Seasonal and IMF By effect on polar cap convection orientation, *Geophys. Res. Lett., 26, 7,* 975, 1999.

Jayachandran, P., J. MacDougall, J.-P. St. Maurice, D. Moorcroft, P. Prikryl, P. Newell, Coincidence of the ion precipitation boundary with the HF E-region backscatter boundary in the dusk-midnight sector, *Geophys. Res. Lett.*, DOI 10.1029/2001GL014184, 2002.

Jayachandran, P. T., J. W. MacDougall, E. F. Donovan, J. M. Ruohoniemi, K. Liou, D. R. Moorcroft, and J.-P. St-Maurice (2003), Substorm associated changes in the high-latitude ionospheric convection, *Geophys. Res. Lett.*, 30(20), 2064, doi:10.1029/2003GL017497.

MacDougall, J., G. Hall, and K. Hayashi, F region gravity waves in the central polar cap, *J. Geophys. Res.*, 102(A7), 14,513–14,530, 1997.

MacDougall, J., M. Abdu, P. Jayachandran, J. Cecile, and I. Batista, Presunrise spread F at Fortaleza, *J. Geophys. Res.*, 103(A10), 23,415–23,426, 1998.