Geomagnetic Phenomena near the AUTUMNX Magnetic Array in Québec, Canada

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The AUTUMNX Magnetic Array's main chain has a closely-spaced set of UCLA THEMIS-class magnetometers along the east coast of Hudson Bay. Stations at Sept-Îles and Scheffervill, Québec, along with the THEMIS station at Kuujuaq and the NRCan Iqaluit observatory on Baffin Island make a looser second chain. This chain may be extended by a proposed new partner site in Fredericton, New Brunswick, and there are several other subauroral stations near the Hydro-Québec power grid. AUTUMNX magnetic data is freely available with one minute and 2 Hz cadence at http://autumn.athabascau.ca/autumnxquery.php?year=2017&mon=02&day=02 and pages easily accessed from there. It is also distributed widely, and in near-real time, to the THEMIS project, and quickly accessible through CDAWeb. More than one year of baselined one-minute cadence data (to the end of 2015) is now available through SuperMAG at http://supermag.jhuapl.edu/mag/. Since its establishment in late 2014, AUTUMNX has had a high rate of reliability and gathered nearly continuous data. For dates through mid-2016, however, potential users are urged to contact the PI about initial data quality issues at some sites. AUTUMNX is complemented by other arrays in eastern North America to now give good coverage in this region, which before 2014 had few magnetometers. AUTUMNX also improves magnetic data coverage near the footpoint of GOES East. It has magnetic conjugate points on land/ice in Antarctica, where the PRIMO project hopes to put new magnetometers.

The dense coverage of the Eastern Hudson Bay part of AUTUMNX allows magnetic inversion studies to be done well. Here we use techniques based on forward modelling to analyze cross meridian and regional currents. In addition to substorms, some of small total current, we find that steady convection is common. The currents in the March 17, 2015 storm attained 3 MA. A new finding relevant to space weather is that impulsive events are common. The Hydro-Québec utility measures harmonic distortion in the grid, and we find a close correlation with impulsive events. Our first detection of a pulse subsequently found to cause GIC in the Hydro-Québec network was on February 2, 2017 (link given above). In approximately 50 other cases, we have verified that GIC pulses initially detected in the grid had associated magnetic impulses. These are sometimes associated with substorms, but those which are not often show direct correlation with solar wind changes.

The AUTUMNX array has distinct advantages for ground magnetic studies in which high data rate, coverage of a large region, at least one closely spaced meridian chain, and conjugacy to geosyncronous satellites are important. We have also compared magnetic data with that from nearby GPS stations to show colocation of the auroral electrojets with scintillation during a storm. To these we currently add proximity to the major Hydro-Québec power grid servicing eastern North America for studies on space weather effects. There is further the potential for interhemispheric studies both on the conjugate magnetic footpoints in Antarctica at latitudes interesting for substorm studies, and along the meridian overlapping with Asia for day/night studies.

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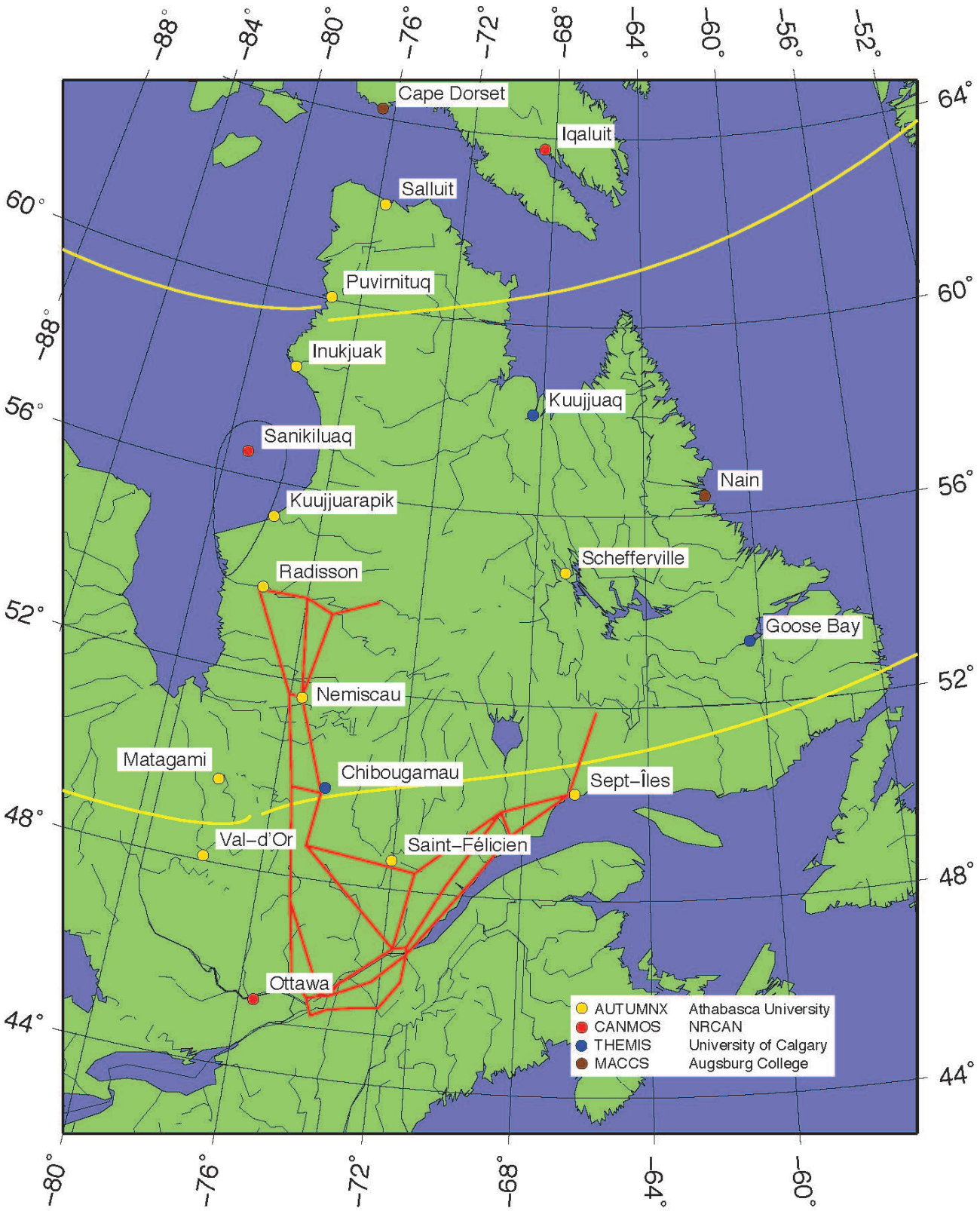

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