

New Space Weather Measurements from MACAWS: Monitors for Alaskan and Canadian Auroral Weather in Space (MACAWS)

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The MRI Collaborative: Development of Monitors for Alaskan and Canadian Auroral Weather in Space (MACAWS) is a sensor web network that provides both real-time and historical GNSS TEC and scintillation data products. These data are needed for geospace science and space weather monitoring in the auroral regions of northern Alaska and northwestern Canada that are currently not sampled or under-sampled. These regions are significant as they are the locations of origin for the majority of space weather events that affect the United States. At the end of the project, it is planned that 35 PolaRx5S Septentrio GNSS receivers in Canada and northern Alaska will be installed. Currently, 15 receivers have been shipped and a subset of these have been installed. Each receiver tracks both the GPS and GLONASS constellations. The data are collected to compute TEC and scintillation statistics for each satellite in track at every new station. All data are freely available. A subset of the data are available in near real-time. Processed TEC and scintillation indices are input into the Madrigal database. We report here on the TEC and scintillation data collected from the currently installed MACAWS sites. These include the line of sight TEC data from each GNSS satellite-receiver pair at one minute intervals plus scintillation parameters from each of the MACAWS receivers. We will demonstrate how these data products can be freely downloaded and show the new TEC maps, with the overlay of the measured scintillation.

We will also focus on analysis of recent space weather events, including a case analysis of a substorm observed on 1 March 2017. On this day at approximately 10 UT, magnetometers at Ft Yukon and Poker Flat in Alaska measured the classic signature of an auroral substorm: a rapid decrease in the northward component of the magnetic field. Nearby, a camera at Venetie Alaska captured intensive visual brightening of multiple auroral arcs at approximately the same time. Our data and model analysis focuses on this time period. We are taking advantage of the extensive instrumentation that was in place in Northern Alaska on this date due to the ISINGLASS rocket campaign. Although no rockets were flown on 1 March 2017, this substorm was monitored at Poker by the three-filter survey all-sky and at Venetie by three all-sky cameras running simultaneously, with each filtered for a different wavelength. Our analysis includes the MACAWS co-incidental high precision GNSS receiver data providing total electron content (TEC) measurements of the overhead auroral arcs. The receiver at Venetie also monitored L-band scintillation. In addition, the Poker Flat Incoherent Scatter radar captured the rapid ionization enhancement in the 100-200 km region across multiple beams looking to the north of Poker. The timing of these events between the multiple sites is closely monitored, and inferences of the propagation of this event are described. The available SuperDARN data from this time period indicates this substorm happened at about the same time within the Harang discontinuity. This event presented an unprecedented opportunity to observe occurrence and development of a substorm with a combination of ground-based remote sensing instruments. To support our interpretation of the data, we present first simulations of the magnetosphere-ionosphere coupled system during a substorm with the self-consistently coupled SAMI/RCM code.