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Ionospheric Sounding Opportunities Using Signal Data From Pre-existing Amateur Radio And Operational Networks

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Amateur radio and other signals used for dedicated purposes, such as the Automatic Position Reporting System (APRS) and Automatic Dependent Surveillance Broadcast (ADS-B), are signals that exist for another reason, but can be used for ionospheric sounding. Whether mandated and government funded or voluntarily constructed and operated, these networks provide data that can be used for scientific and other operational purposes which rely on space weather data. Given the current state of the global economic environment and fiscal consequences to scientific research funding in Canada, these types of networks offer an innovative solution with pre-existing hardware for more real-time and archival space-weather data to supplement current methods, particularly for data assimilation, modelling and forecasting. Furthermore, the mobile ground-based transmitters offer more flexibility for deployment than stationary receivers.

Numerical modeling has demonstrated that APRS and ADS-B signals are subject to Faraday rotation as they pass through the ionosphere. Ray tracing techniques were used to determine the characteristics of individual waves, including the wave path and the state of polarization at the satellite receiver. The modeled Faraday rotation was computed and converted to total electron content (TEC) along the ray paths. TEC data can be used as input for computerized ionospheric tomography (CIT) in order to reconstruct electron density maps of the ionosphere. The primary scientific interest of this study was to show that these signals can be used as a new source of data for CIT to image the ionosphere, possibly other data assimilation models, and to obtain a better understanding of magneto-ionic wave propagation.

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