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Geospace environment monitoring at the Princess Elisabeth Antarctic (PEA) station: instrumentation and first results

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1. Extended Abstract

The scientific community and the general public that use electromagnetic wave signals reflecting on or passing through the ionosphere and the plasmasphere, require an increasingly better modelling and understanding of the behavior of these layers. This is the case of Global Navigation Satellite Systems (GNSS, i.e. GPS, GLONASS, Galileo) users, as well as spacecraft designers and operators, who require a precise knowledge of the vertical profile of electron density distribution for different solar activity levels and during space weather events. While the ionosphere and plasmasphere are now well monitored and characterized at low- and mid-latitudes, there is a lack of our knowledge in Polar Regions especially over Antarctica due to the lack of ground observations. Consequently, one of the present challenges of the Space Weather community is to better characterize (1) the climatological behavior of the polar ionosphere and plasmasphere in response to variations in the solar activity at high latitudes, and (2) the different responses of the ionosphere and plasmasphere during extreme solar events and strong geomagnetic storms.

To answer these questions, we installed, in the frame of different projects, instruments dedicated to monitoring the geospace at and around the Belgian Princess Elisabeth Antarctic (PEA) polar base (North-East Antarctica, Queen Maud Land, Utsteinen, geomagnetic coordinates: 70.5°S-67.8°E). Since 2009 we installed five GNSS stations around the PEA station mainly for Geodesy and Glaciology. In this study we analyzed data in addition to those from other GNSS stations (e.g. the IGS global network, POLENET) to estimate the Total Electron Content (TEC) over Antarctica using the ROB-IONO software. The estimated TEC data set is then used to constrain an empirical model based on a least-squares adjustment that predicts the TEC every 15-min from the F10.7P solar index as input. From the output of this model we discuss the different climatological behaviors identified in the ionosphere-plasmasphere TEC at these high latitudes. Finally, we show some examples of typical TEC disturbances observed during extreme solar events.

Additionally, we present the first results from the VLF (Very Low Frequency, 3-30 kHz) magnetic antenna installed at PEA station in 2016. This antenna is part of a global network called AWDAnet (Automatic Whistler Detector and Analyzer network) providing information about the state of the plasmasphere. Finally, data from the geomagnetic observatory installed at the PEA station in 2015 will be also presented.