The Livingston Island Geomagnetic and Ionospheric Observatory

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Introduction

The Ebre Observatory Institute manages a partly manned geophysical observatory at the Spanish Antarctic Station (SAS) Juan Carlos I, in the South Shetland Islands. It was set up in 1995 and it has been updated yearly by our team throughout several projects. Nowadays, it hosts a geomagnetic station with the IAGA code LIV, providing data during the entire year, and an ionospheric station providing vertical and oblique data during austral summer. Also, ionospheric oblique soundings furnished by La Salle team, transmitting from the SAS to Spain, have been carried out since 2003. Data provided by the geophysical observatory along with other instruments operated in the SAS (GNSS receiver) and in its neighborhood have been used by the Ebre, La Salle and GAGE teams to study the geomagnetic field and the ionosphere under the framework of a coordinated project.

Ebre Observatory, geomagnetism

Instrumentation

The instruments in use at LIV magnetic observatory can be classified into two types:
1) Variometers (automatic instruments aimed at accurately recording field magnetic variations). Two different variometers are in continuous service:
   1a) The three-axis fluxgate (left), based on a set of three orthogonal fluxgate bars. The effective accuracy is about 0.2 nT, and samples the magnetic field vector once per second.
   1b) The proton vector magnetometer (left), based on two pairs of Helmholtz coils and a proton magnetometer. Its accuracy and sampling rate are much more reduced.
2) The absolute instrument, a D/I-fluxgate theodolite (right), aimed at recording magnetic field variations (time delay spread, Doppler spread and Doppler shift). Also, correlations of observations by OSIS and VIS have been performed for modeling purposes. Below are depicted examples, of the average Doppler shift (left) indicating the apparent movement of the reflecting layer and the relative movement of the MUF interface at the receiving site by VIS and the availability of the channel and the SNR recorded by OSIS.

Ebre Observatory, ionosphere

Instrumentation

The ionospheric instrumentation at the SAS, operating since 2005, consists of an ionospheric sounder of vertical incidence, VIS (left), providing ionograms during the surveys at a regular sampling of 10 minutes (bottom).

The daily pattern of ionospheric characteristics, their typical variability and the study of the effects of ionospheric characteristics caused by weather space are clearly recorded by each survey (right). Vertical incidence data from different stations is studied also to correlate with trans equatorial soundings from SAS to Spain.

Data is analyzed for ionospheric research and to feed and validate climatologic ionospheric models.

Research

We developed an analytical model to predict the electron density peak height during quiet and disturbed periods. OE hmF2. Also, the AMPERE-driven TIE-GCM has recently been improved by introducing ionospheric conductivities consistent with FACs.

Future plans

Our future proposal for the geophysical observatory aims at installing an automatic instrument (AUTODIF) to carry out absolute geomagnetic measurements when the observatory is unattended, thus fulfilling INTERMAGNET standards. Increasing the sampling rate would also be required. Moreover, studies aiming at upgrading automatic scaling of the VIS are envisaged as well as further research and modeling studies on this region to better knowledge of the main effects of the interaction between the Solar Wind and the Earth’s ionosphere.

MODIP=-56.2). From these AATR values we can analyze the ionospheric activity in this region is quite moderate, except during some epochs which are related with geomagnetic storms. This relationship between perturbed values of AATR (at these latitudes) and geomagnetic storms can be seen in the next plot where we compare the AATR of OH2 with the DST during some days on 2011, we have also included the AATR for the receiver KERG (Kerguelen Islands, MODIP=−62).

Research

Ionospheric Activity in the Antarctic Peninsula from GNSS measurements

The Along Arc TEC Rate (AATR) is an ionospheric activity indicator based on GNSS measurements. We have study the ionospheric activity over the Antarctic peninsula during a whole Solar Cycle by computing the AATR values of the data collected by the GNSS receiver OH2 (MODIP=-64.4). With this study we are able to see the main dependencies on time of the ionospheric activity.

In the previous figure we can see that some temporal dependencies of the AATR are related to Solar Flux periodicities (solar cycle and Solar rotation) as other regions in the Planet. But, unlike other regions, the AATR presents a clear annual anomaly: the AATR in this region is larger around the December solstice than around the June Solstice.


From these AATR values we can also conclude that the ionospheric activity in this region is quite moderate, except during some epochs which are related with geomagnetic storms. This relationship between perturbed values of AATR (at these latitudes) and geomagnetic storms can be seen in the next plot where we compare the AATR of OH2 with the DST during some days on 2011, we have also included the AATR for the receiver KERG (Kerguelen Islands, MODIP=−62).