ISACCO
(Ionospheric Scintillations Arctic Campaign Coordinated Observations) project at Ny-Ålesund

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INTRODUCTION

Inside the auroral oval the ionosphere is particularly interesting as it is directly connected with the outer space by means of the field line reconnection of the geomagnetic field through the magnetopause. The polar ionosphere is sensible to the enhancement of the electromagnetic radiation and energetic particles coming from the Sun especially around a maximum of solar activity as the current 23rd solar cycle condition. Some typical phenomena can occur such as, among the others, geomagnetic storms, sub-storms and ionospheric irregularities. In this frame the high latitude ionosphere may become highly turbulent showing the presence of small-scale (from centimetres to meters) structures or irregularities imbedded in the large-scale (tens of kilometers) ambient ionosphere. These irregularities produce short term phase and amplitude fluctuations in the carrier of the radio waves which pass through them. These effects are commonly called Amplitude and Phase Ionospheric Scintillations. The high latitude encounters significant fading, with the most intense fading depths in the polar cap regions and less intense fading in the auroral regions. The polar scintillation exhibits more phase than amplitude variation. The phase behaviour seems to be related to the magnetic activity. Severe amplitude fading and strong phase scintillation affect the reliability of GPS navigational systems and satellite communications.

DESCRIPTION OF THE ISACCO NYALESUND CAMPAIGN

ISACCO (Ionospheric Scintillations Arctic Campaign Coordinated Observations) is a new project by the Upper Atmosphere Physics Dept. of INGV started at the end of September 2003. The aim of ISACCO is to perform a scintillation measurements campaign by a GISTM (GPS Ionospheric Scintillation and TEC Monitor) at Ny-Ålesun (Svalbard, Norway; geographic coordinates 78.9° N, 11.9° E, fig.1). The GISTM System consists of a NovAtel OEM4 dual-frequency receiver with special firmware, comprises the major component of a GPS signal monitor, specifically configured to measure amplitude and phase scintillation from the L1 frequency GPS signals, and ionospheric TEC (Total Electron Content) from the L1 and L2 frequency GPS signals.
In the frame of Space Weather one of the objective is the forecasting of the severe amplitude fading and strong phase scintillation that affect the reliability of GPS navigational systems and satellite communications. To achieve this goal it's important to constitute a scintillation databank with a good spatial/temporal coverage useful for developing new scintillation models as well as to test the existent ones for further improvements. In this sense, as the scarceness of polar observations, the ISACCO project could offer a good opportunity to the users/scientific community.
ISACCO started at September 26 with the GISTM installation at the "Dirigibile Italia" Arctic Station (fig.1). All scintillation and TEC data are stored locally and transmitted to a data server in quasi-real time (every hour). The 50 Hz raw data are transmitted to the data server and ready to post-processing analysis. The principal features of GISTM are the followings (figs.2,3):

- Tracks and reports scintillation and TEC measurements from up to 11 GPS satellites in view.
- A 25 Hz raw signal intensity noise bandwidth and a 15 Hz phase noise bandwidth insure that all the spectral components of both amplitude and phase scintillations are measured. Phase data and amplitude data are sampled at a 50 Hz rate.
- Single frequency (L1) satellite carrier phase is compared against a stable ovenized crystal oscillator (OCXO) to insure that all phase scintillation effects are recorded, not merely the 1/f refractive component measured by dual-frequency differential systems.
- Software is included in the GISTM to automatically compute and log the amplitude scintillation index, S4, and phase scintillation index,s_j, computed over 1, 3, 10, 30 and 60 seconds. In addition, TEC and TEC phase are each

logged every 15 seconds. Phase and amplitude data, either in raw form or detrended (to remove systematic variations), can also be logged at a 50-Hz.

All scintillation and TEC data are stored locally and transmitted to data server in quasi-real time (every each hour). The campaign will last till April 2004 for achieving a consistent databank. The 50 Hz Raw data are transmitted to the data server and ready to post-processing analysis (figs.2).

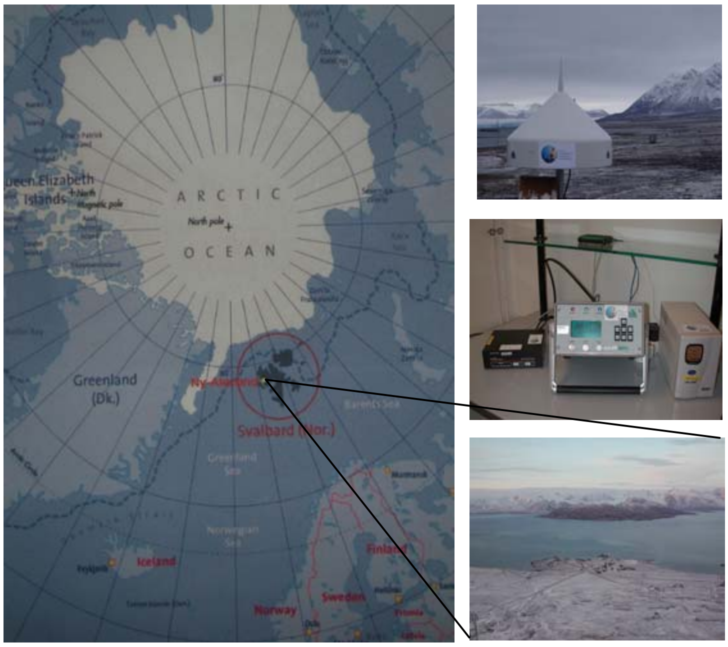


Figure 1. Geographic location of NyAlesund Arctic Station, GISTM antenna and unit.

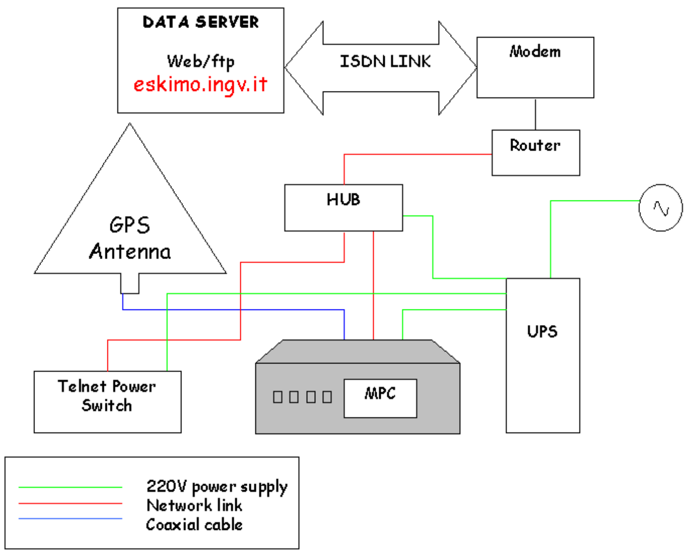


Figure 2. ISACCO system.

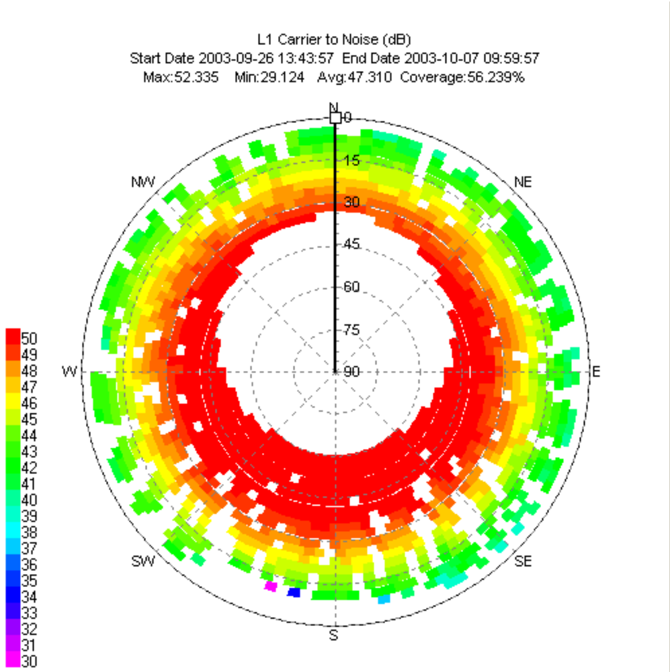
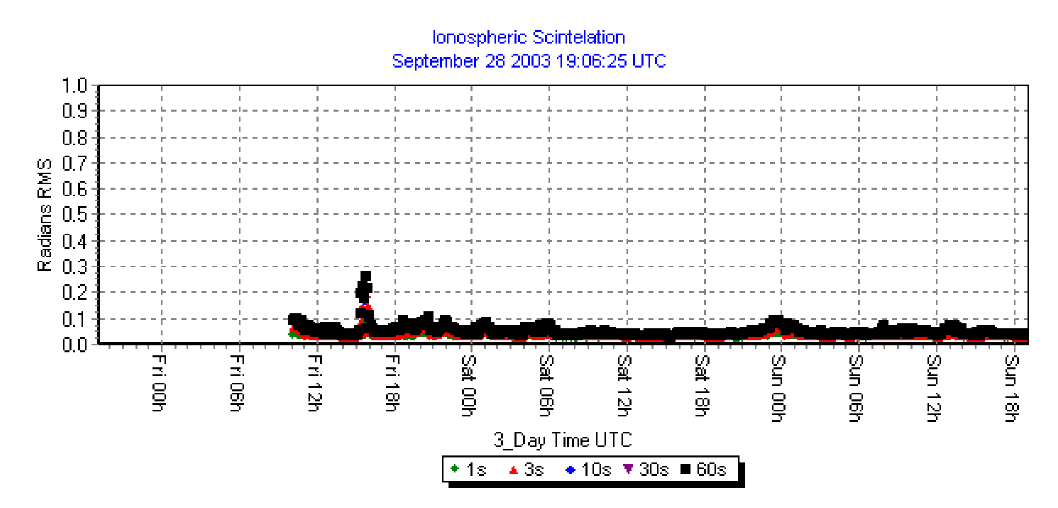


Figure 3. ISACCO GPS signal coverage.

FIRST IONOSPHERIC SCINTILLATION OBSERVATIONS AT POLAR LATITUDE

A scintillation event occurred on September 26 2003 (figs 4 and 5) at 15:45 UT. Around the same time the geomagnetic field shows unsettled conditions (figs 6 and 7). The scintillation could be due to a electron flux enhancement recorded by GOES satellites at the same time (fig 8).
Scintillation events will be investigated to contribute to the understanding of the physical mechanisms responsible of the ionospheric scintillations and their adverse effects on communication and navigation systems.



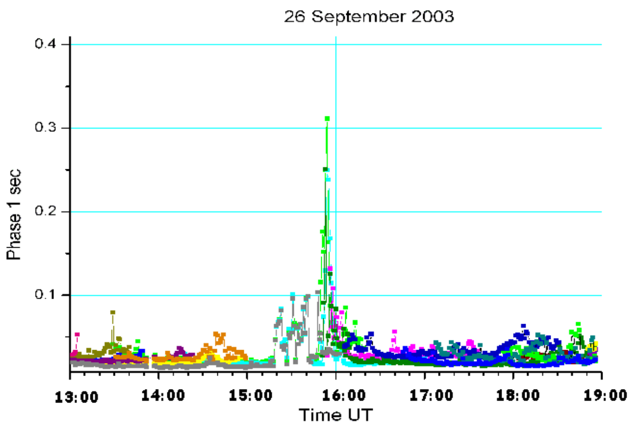


Figure 5. Elaborated Phase Scintillation data computed over 1 second. Different colors represented the locked satellites. Only measurements from satellite elevation greater than 25° are reported.

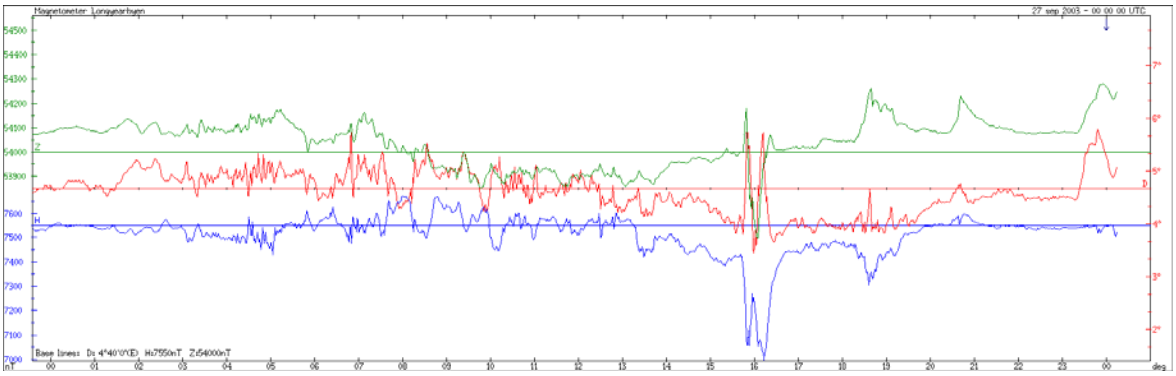


Figure 6. Geomagnetic field components (H,Z,D) recorded at Longyearbyen on September 26.

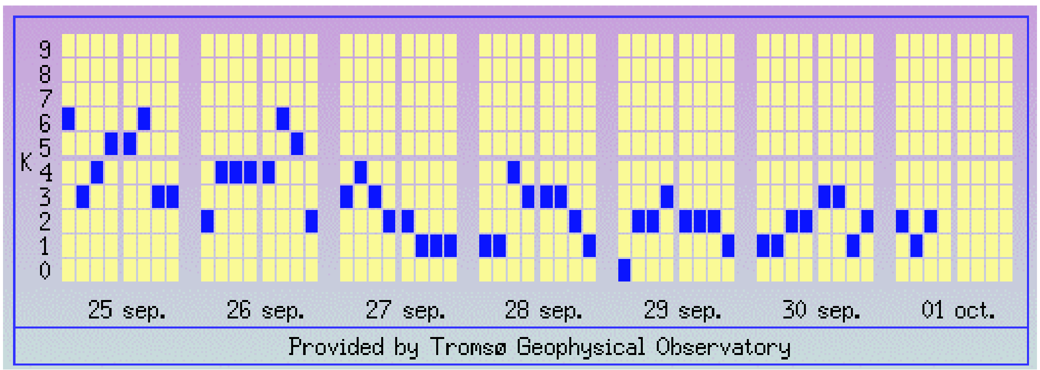


Figure 7. K index from September 25 to October 1 provided by Geophysical Observatory of Tromso

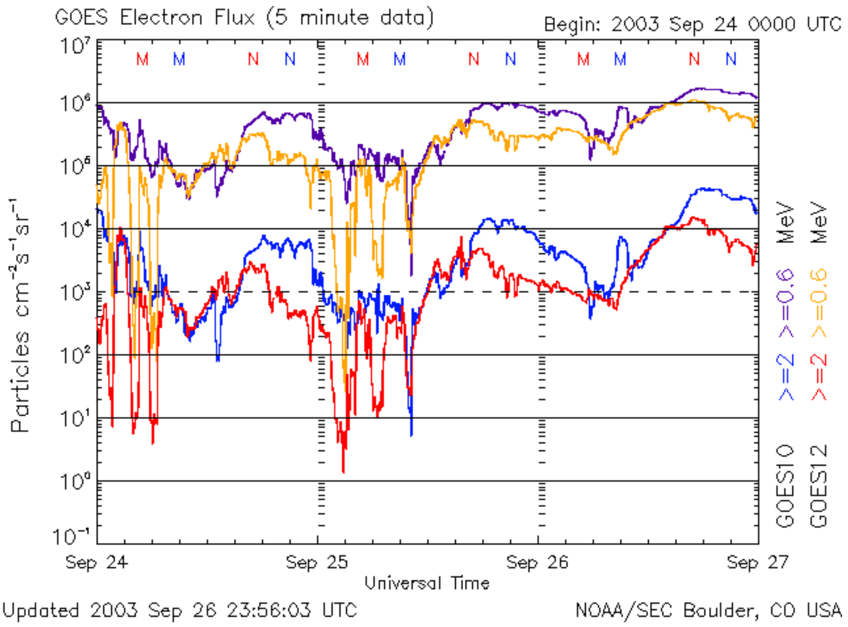


Figure 8. 5-min Electron flux by GOES 10 and 12 from September 24 to 27. "A coronal hole, which has induced a high-speed solar wind stream for the last few days, is in its final stages, but continues to impact the Earth's magnetic field. The greater than 2 MeV electron flux at geosynchronous orbit reached high levels on 26 September" (www.sec.noaa.gov/majordomo_archive.cgi)

ACKNOWLEDGEMENTS

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