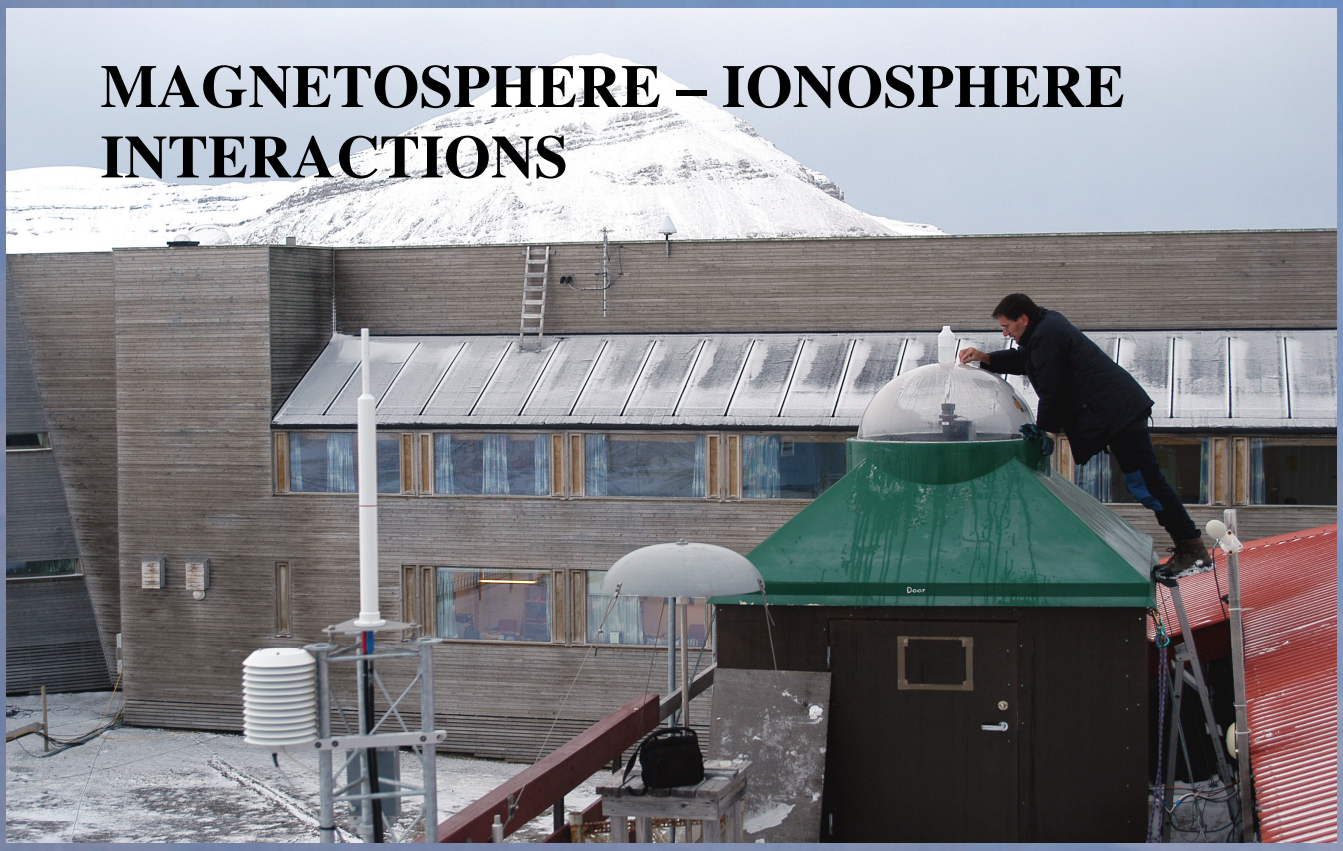
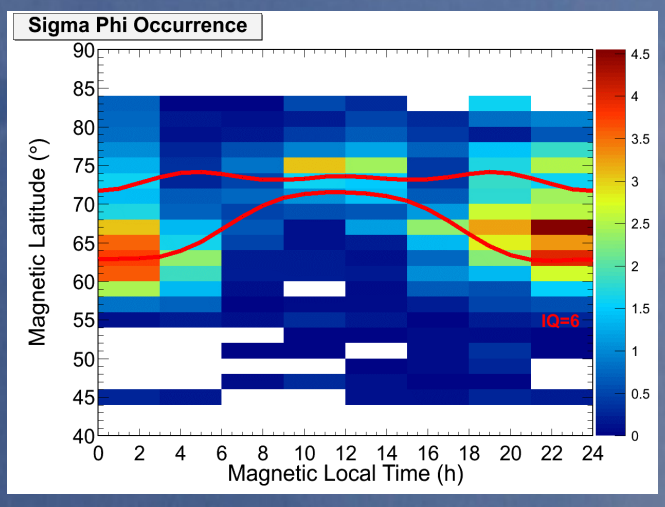
MAGNETOSPHERE – IONOSPHERE INTERACTIONS



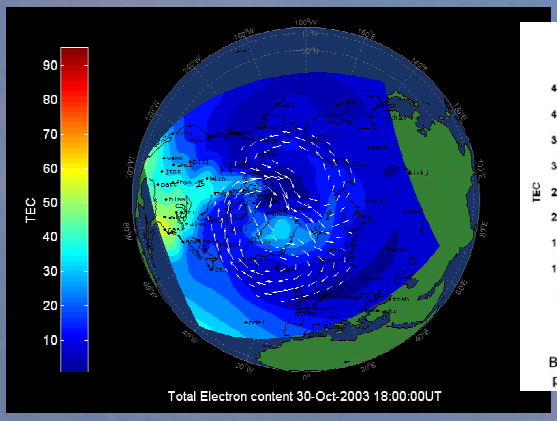
The field of Sun-Earth relations has received increasing interest in the last years: firstly the scientific community continues to pursue the goal of achieving a better understanding of all the physical processes pertaining to Sun-Earth relations, in the second place such understanding is being applied to the emerging discipline of “Space Weather”. The term “Space Weather” indicates the changes occurring in the space environment that can affect the near Earth environment. Space Weather processes can include changes in the interplanetary magnetic field, coronal mass ejections from the Sun, and disturbances in Earth's magnetic field. The effects of Space Weather can range from damage to satellites to disruption of power grids on the Earth, so that their knowledge is vital for our modern society. The investigation of the Space Weather processes is strongly multidisciplinary and necessarily based on a multi-instruments approach able to give experimental observations of the state of the geospace, fundamental for developing empirical and physical models of the complex mechanisms pertaining the outer space. The ability to monitor the Space Weather in near-real time is also required as our society becomes increasingly dependent on technological systems, such as the GNSS (Global Navigation Satellite System). Critical applications as railway control, highway traffic management, emergency response, commercial aviation, marine navigation require high precision positioning. As a consequence, these applications require real-time knowledge of Space Weather effects.
In this frame the Italian community can contribute with expertise on multi-instrument observations over both the polar regions, addressed to the investigation of the solar-terrestrial environment. The research groups and institutions participating to the activities in Ny-Alesund are involved in several international projects.

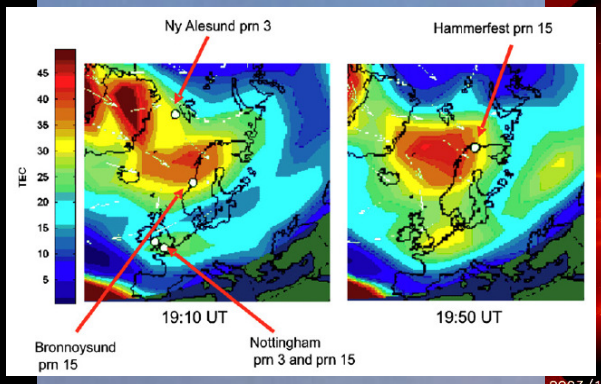


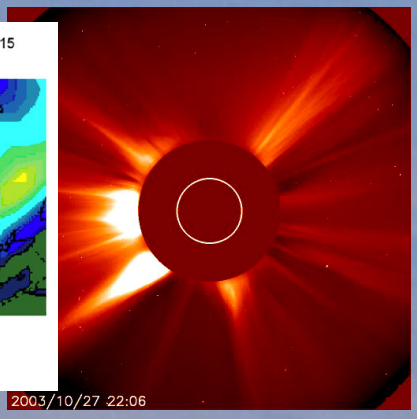
An example showing a map of phase scintillation index percentage of occurrence merging data from a network of ionospheric scintillations stations (including Ny-Ålesund). Red curves describe the auroral oval position under disturbed conditions (IQ=6).

On Going Projects

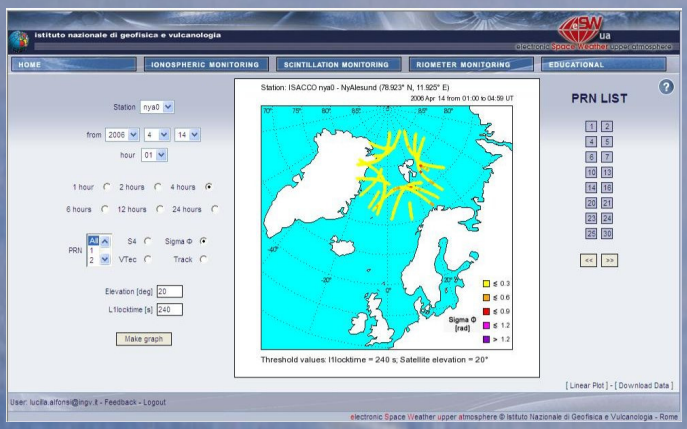
2.1 Sun-Earth Interaction: Auroral Observations from Svalbard Islands with "ITACA²", ITalian All-sky-Camera for Auroral observations
(Stefano Massetti, INAF, Rome, stefano.massetti@ifsi-roma.inaf.it)
2.2 ISACCO Ionospheric Scintillations Arctic Campaign Coordinated Observations
(Giorgiana De Franceschi, INGV, Rome, defranceschi@ingv.it)
2.3 Polar patches influence on HF radio communications
(Lucilla Alfonsi, INGV, Rome, lucilla.alfonsi@ingv.it)



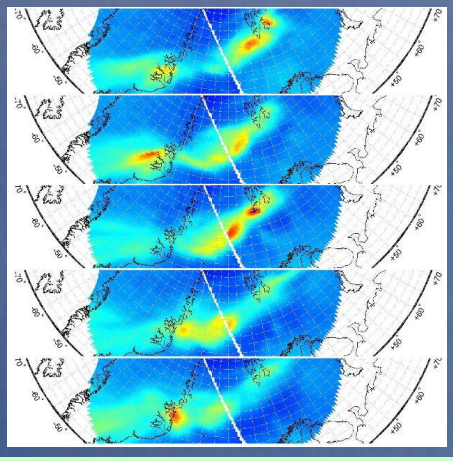




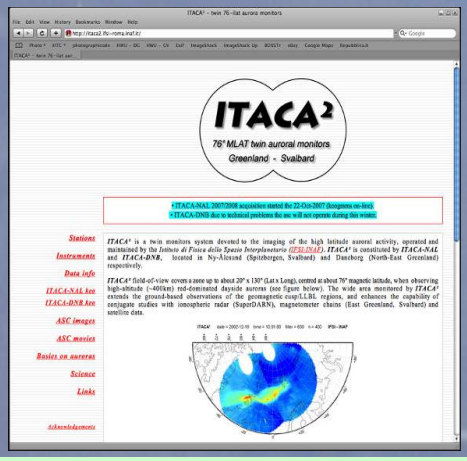
Experimental observations from the GISTM (GPS Ionospheric Scintillation TEC Monitor) station at Ny Alesund (part of ISACCO project) are available in near-real time at the web site: www.eswua.ingv.it. In the figure is reported a polar map of the phase scintillation observed by all satellites in view from Ny Alesund on April, 14 2006 from 01:00 to 04:59 UT. At that time some satellites experienced scintillations (in red on the tracks) due to ionospheric irregularities causing tracking errors on GPS receivers.



Real time monitoring of the ionospheric scintillations is at the base of mitigation of errors induced by the ionosphere on GNSS systems. Such mitigation is crucial to protect the infrastructures relying on satellite technology that are negatively affected by the ionospheric scintillations. As the solar activity is currently increasing in view of the imminent maximum, ionospheric scintillations are expected to be amplified during the forthcoming years.



An example showing the dynamics of the dayside auroral activity as observed by the ground based ITACA² observatories, located at Ny-Ålesund (Svalbard) and Daneborg (North-East Greenland). The dayside auroras are directly connected with the solar wind interaction with the Earth's magnetosphere and



controlled by the Interplanetary Magnetic Field (IMF) direction, via the magnetic merging processes in the cusp region(s). The mosaic of 5 images (10 minutes) shows the 630.0nm red emission peaking at about 500km of altitude, induced by soft-electron (100-200 eV) precipitation, over the Greenland-Svalbard sector. Near-real time auroral data quicklooks (*keograms*) can be browsed at the ITACA² web site (*http://itaca2.ifsi-roma.inaf.it*). The original data are available to the international scientific community upon request, for coordinated ground-space studies.