IPY PROJECT "HELIOSPHERE IMPACT ON GEOSPACE": SCIENCE AND OUTREACH

K. Kauristie [1)] , A. Weatherwax [2)] , R. Stamper [3)] , J.F. Cooper [4)] , E. Tanskanen [1,5)]
IHY and ICESTAR Teams

1 - Finnish Meteorological Institute, Helsinki, Finland
2 - Siena College, USA
3 - RAL, STFC, UK
4 - GSFC, NASA, USA
5 - University of Bergen, Norway
kirsti.kauristie@fmi.fi

Abstract

The IPY project 63 ("Heliosphere Impact on Geospace") conducts multinational research on solar-generated events which affect the composition and dynamics of the atmosphere in the terrestrial polar areas. This cluster is a collective effort of 29 international consortia which run versatile bi-polar space research instrumentation to support the IPY campaign. The activity is led by two complementary initiatives: the International Heliophysical Year (IHY) programme and ICESTAR project endorsed by SCAR.

This poster presents some examples of recent findings in Cluster 63 scientific work which can be categorized under three main themes:

7.Coupling processes between the different atmospheric layers and their connection with the solar activity
8.Energy and mass exchange between the ionosphere and the magnetosphere
9.Inter-hemispheric similarities and asymmetries in geospace phenomena.

Besides scientific work we describe the consortium's experiences in education and outreach activities.

About publication statistics

Following the publication statistics of IPY Cluster 63 is a challenging task because its sub-projects operate autonomously and represent continuously varying teams of scientists. In order to get a measurable view of the publishing rates and their trends we have selected a sub-group of 16 core scientist from the consortium. The publication activity of these scientist have been followed (SAO/NAS ADS publication data base) during two periods, (i) Jan 2007 – Aug 2007 and (ii) Sep 2007 – June 2008. The survey reveals a clear improvement in the publishing rates during the latter period. The number of peer reviewed articles for the two periods are 34 and 47. On average this means ~5 articles per scientist during the period Jan 2007- June 2008.

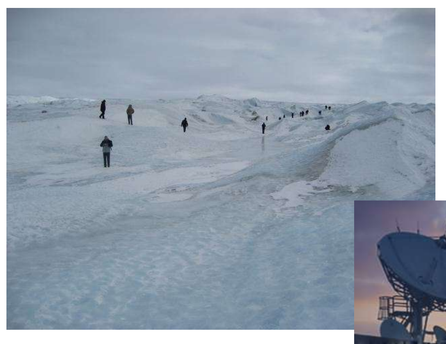
Examples of PR and outreach activities

IPY Cluster 63 has arranged several international scientific meetings with significant PR and outreach components in their programs. Here we present three examples:

Greenland Space Science Symposium (May 2007): The symposium celebrated the rich history of Greenland as a forum for near-Earth space observations. Researchers from 14 countries participated the meeting whose scientific contents will be presented in a JASTP special issue. Local people and political decision makers were invited to the sessions presenting historical reviews and the state-of-art of today's geospace instrumentation. The Nortel LearniT company has created a nice set of education material about the symposium. These material are available in http://nortellearnit.org/nia_nasa/greenland_symposium/.

Polar Gateways Arctic Circle Sunrise (Barrow, Alaska, Jan 2008): The meeting discussed the motivations and legacies of the first three International Polar Years and the main challenges for the on-going Polar Year. The presentations by NASA scientists discussed also the advantages of polar icy regions for testing instrumentation of different planetary missions and of outer solar system exploration. In addition to the sessions in Barrow the meeting included several video conferences with other institutes around the Arctic Circle.

Winter school on auroral substorms in Iceland (Nov 2007): This winter school was organized for university students as collaboration of the University of Bergen and Finnish Meteorological Institute. In addition to daytime lectures and laboratory exercises the students got the opportunity to spot auroras with their own eyes during night time.

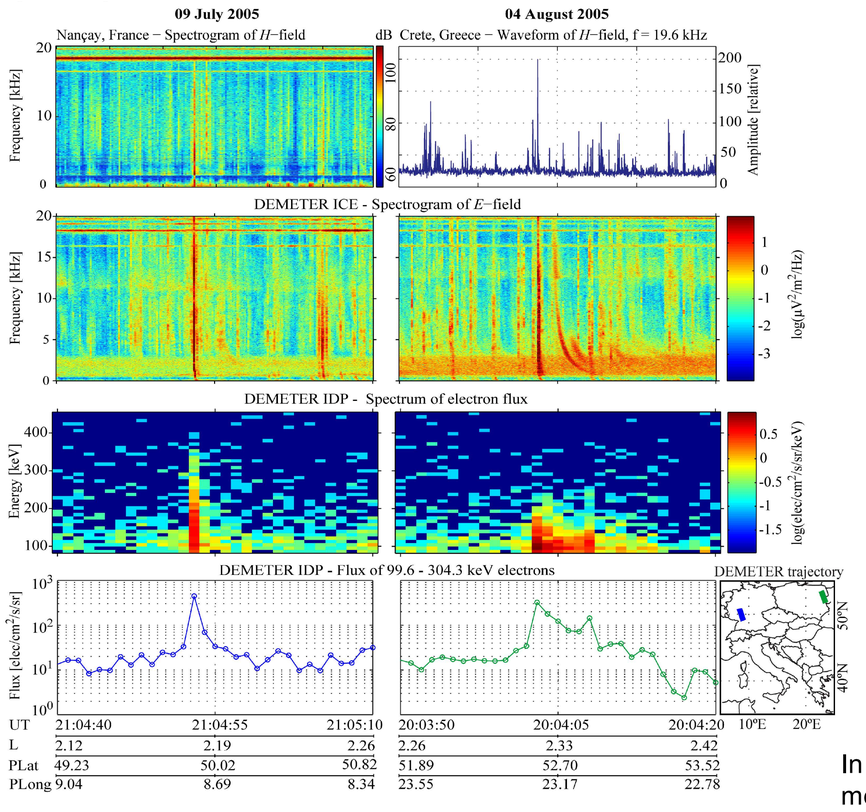


(Left) Space scientists inspecting boundary layer physics of the Greenland ice cap. (Below) The ionospheric radar in Sondrestromsfjord is one example of the historical instrumentation celebrated in the Greenland symposium. Photos by Noora Partamies and Nortel LearniT.

Participants of the Polar Gateways meeting were awarded with a nice certificate designed by Jay Friedlander (NASA).

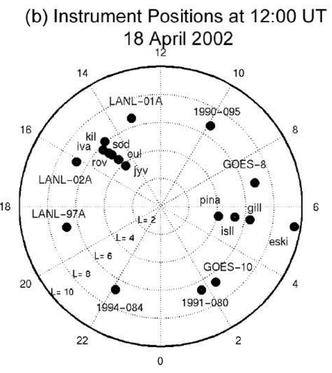
Students of the Iceland substorm school are learning team work.
Photo by Noora Partamies.

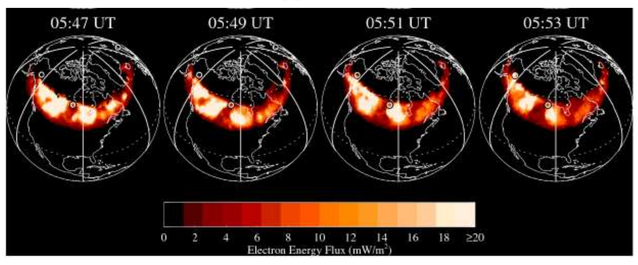
Example study, Theme 1: Detecting lightning induced electron precipitation



Lightning activity during strong thunderstorms is known to launch electromagnetic waves which propagate both in the wave guide between the earth surface and ionosphere (spherics) and along geomagnetic field lines (whistlers). The waves propagating along the field-aligned ducts can interact with radiation belt electrons and under certain conditions cause their precipitation into the atmosphere. The study of Inan et al. (2007) gives for the first time clear observational support for this scenario. The study uses combined observations from VLF-antennas, from a lightning detection system, and from the DEMETER satellite.

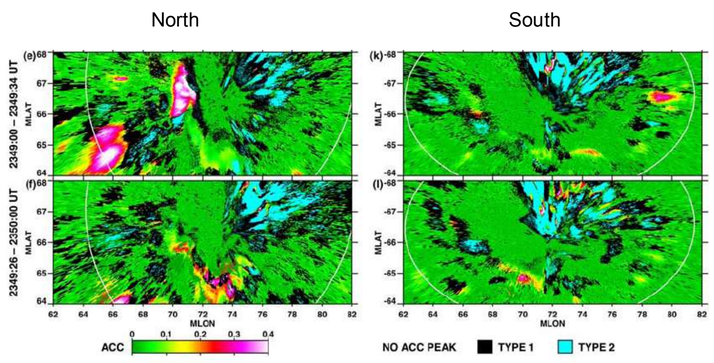
Example study under Theme 2: Auroral precipitation during sawtooth events





In some cases ground-based and space-based instruments can measure the onset of certain magnetospheric processes with remarkably good mutual consistency. Riometers and particle flux instruments onboard geostationary satellites form such a pair for monitoring near-Earth particle injections at substorm onsets. The study of Kavanagh et al. (2007) uses efficiently unified riometer and geostationary particle observations to investigate the azimuthal expansion of injection fronts during so called sawtooth events. Their conclusions about the energization of injected particles due to azimuthal drift motion and about the differences and similarities between sawtooth events and standard subtorm injections rely heavily the improved longitudinal coverage which the ground-based and space-based observations provide together.

Example under Theme 3: Absence of magnetic conjugacy in pulsating auroras



Traditionally pulsating auroras have been assumed to appear similarly in both hemispheres at magnetically conjugate locations. Auroral images from paired aircraft flights conducted during years 1967-1971 show that also small scale pulsating structures can have coherent behaviour. The study of Watanabe et al. (2007) reveals that such coherence does not always exist. Ground-based TV camera observations from Iceland and Antractica show that in some conditions relatively large patches (10-200 km, pink regions in the plot above) of pulsating aurora can appear only in one hemisphere and in some cases the northern and southern pulsation periods can be different.

References:

Inan, U.S., et al.:DEMETER satellite observations of lightning-induced electron precipitation, Geophys. Res. Lett., doi:10.1029/2006GL029238, 2007.
Kavanagh, A.J., et al.: Energetic electron precipitation during sawtooth injections, Ann. Geophys., 25, 1199-1214, 2007.
Watanabe, M., et al: Absence of geomagnetic conjugacy in pulsating auroras, Geophys. Res. Lett., doi:10.1029/2007GL030469