



### Recent News and Updates

- Prof. Eric Donovan joins the ICESTAR team as a Thematic Action Group (TAG) leader. Eric is an Associate Professor in the Department of Physics and Astronomy at the U. of Calgary. He will lead data portal and virtual observatory initiative.
- ICESTAR co-sponsors the polar Gateways Arctic Circle Sunrise 2008, Barrow, AK, Jan. 23-29, 2008
  - The Mystic Twins: Aurora Borealis and Australis, Nikolai Ostgaard, U. of Bergen, Norway
  - Heliosphere Impact on Geospace: Solar-Terrestrial and Aeronomy Research During the Fourth Polar Year Campaign, Kirsti Kauristie, Juha-Pekka Luntama, A. Weatherwax, and R. Harrison

### Greenland Space Science Symposium and Special Issue in the JASTP

The Greenland Space Science Symposium was arranged in May 2007 to celebrate Greenland's rich history in using arrays of scientific instruments for monitoring geospace phenomena. The program of the symposium included both historical reviews and presentations describing the latest advancements in observations and modeling of solar-terrestrial and aeronomy phenomena in polar areas. ICESTAR project had a dedicated session in the symposium with the title "Solar Influence on Geospace as Determined by Hemispherically Conjugate Observations".

The participants of the Symposium were invited to do submissions to a special issue of Journal of Atmospheric and Solar-Terrestrial Physics. After the symposium the invitation was widened to cover also that part of ICESTAR community which was not able to participate the meeting. The title of the issue will be "Transport in the Coupled Solar Wind - Geospace System seen from a High-Latitude Vantage Point". Dr. Jurgen Watermann (LPCE/CNRS, France) who was the chair of the scientific organizing committee of the Symposium serves also the main guest editor of the special issue. Roughly ten to fifteen manuscripts are anticipated to be submitted to the issue which will according to current plans be published in 2008.

### EISCAT workshop in Finnish Archipelago

The community using the system of EISCAT incoherent scatter radars arranged a workshop in Åland (Finnish archipelago). Roughly 100 abstracts were submitted to this workshop which was accompanied by a two-week summer school to teach students to use the radar facilities. A special issue presenting papers of the workshop will appear during the year 2008 in *Annales Geophysicae*. Roughly twenty papers are currently under there the reviewing process which is conducted by the guest editors Anita Aikio (University of Oulu), Björn Gustavsson (University of Tromsø), and Ian McCrea (RAL) and *Annales* special issue editor Kirsti Kauristie (Finnish Meteorological Institute).

### Heliosphere Impact on Geospace

"Heliosphere Impact on Geospace" is one of the core projects of the fourth International Polar Year programme which will take place during March 2007 - March 2009. The project (IPY ID# 63) will be run by a federation of 29 international research groups from which the ICESTAR and IHY communities will carry the management responsibilities and will serve as the contact point towards the IPY Project Office. Dr. Kirsti Kauristie of the ICESTAR team is a primary leader of this IPY initiative.

### Upcoming ICESTAR Sponsored/and/or Supported Events and Meetings

- **IPY Cluster63 Meeting, Bergen Norway**
  - March/April 2008
- **International Riometer Workshop III**
  - Riometers are emerging as an important tool in both space science and space weather. Global networks of imaging and single beam riometers support studies of high energy CPS and radiation belt electron precipitation, dynamic magnetospheric processes such as dispersionless injections, the effect of geospace processes on high latitude atmospheric composition and dynamics, and the effects of polar cap high energy proton precipitation on communications. The growing capabilities of the global network of riometers is facilitating studies of processes involving the production, transport, and loss of high-energy magnetospheric particles at spatial scales ranging from local to essentially global. There is the potential for the deployment of large numbers of these inexpensive instruments in dense continent-wide networks. Agreements between data providers, under the auspices of the IPY ICESTAR and Gloria initiatives, and facilitated by the GAIA Virtual Observatory, are on the verge of enabling ready access to these data. The Third International Workshop on Riometry is being held from 9:00 AM to 5:00 PM on Sunday, June 22, 2008 at the Zermatt Resort in Midway Utah. See the ICESTAR website for complete details.
- **Polar research - Arctic and Antarctic Perspectives in the International Polar Year**
  - In the Open Science conference of SCAR and IASC especially the themes "Polar/Global Linkages" (2.0) and "The Poles as a vantage point for Observations" (4.0) will include contributions from the communities of solar-terrestrial physics, aeronomy, astronomy and astrophysics. Dr. Eigil Friis-Christensen from the Danish National Space Center will give one of the Keynote Lectures under the title "Space Weather fascinating science and auroral displays". The session dedicated for the Sun's interactions with the Earth's atmosphere and electromagnetic environment (2.3) will be chaired by Akira Kadokura (NIPR, Japan) and Kirsti Kauristie (FMI, Finland). According to current plans this session will have invited talks describing highlights from the STEREO and THEMIS missions, ICESTAR science and latest advancements in European space weather services. Just before the Open Science Conference (i.e. July 6, 2008) ICESTAR will arrange a business meeting in the conference facilities where the future activities of the project will be discussed.

### Selected Science Results

**Geospace-atmosphere coupling:** 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 coupling between lightnings, spherics, whistlers and energetic electron precipitation at middle latitudes has been known for a while but clear observational evidence has been missing so far. The study of Umran et al. (2007) shows with combined observations from VLF-antennas, lightning detection system, and DEMETER satellite that there really exists a causal relationship between lightnings and electron precipitation events. DEMETER carries instrumentation both for detecting electromagnetic waves and electron fluxes which together with the ground-based observations enables testing theoretical models connecting the intensity of electromagnetic waves with precipitation fluxes. The first tests of Umran et al., show qualitative consistency between the model and observations but on the other hand demonstrates the need of better knowledge about the magnetospheric electron populations. Reference: Inan, U.S., Piddiyachiy, D., Peter, W.B., Sauvaud, J.A., and M. Parrot: DEMETER satellite observations of lightning-induced electron precipitation, *Geophys. Res. Lett.*, doi:10.1029/2006GL029238, 2007.

**Solar-Terrestrial physics:** Kavanagh et al., (2007) study the correspondence between energetic particle injections at the geostationary orbit and energetic electron precipitation into the ionosphere during storm time substorms. During strong solar wind forcing substorms tend to appear as quasi-periodic activations called sawtooth events. The analysis of Kavanagh et al. reveals that first activations during sawtooth sequences can resemble very much isolated substorms from ionospheric viewpoint but later on the picture

becomes more complicated. Comparison of ionospheric precipitation observations from mid night and morning sectors suggests the magnetospheric electrons to experience significant energization due to dawnward drift at geostationary distances. Kavanagh et al. demonstrate nicely how virtual observatories, for this case GAIA, and other web-based data servers can nowadays be used fluently as a combined asset to address the coupling processes of different scale sizes in geospace phenomena. Reference: Kavanagh, A.J., Lu, G., Donovan, E.F., Reeves, G.D., Honary, F., Manninen, J., and T.J. Immel: Energetic electron precipitation during sawtooth injections, *Ann. Geophys.*, 25, 1199-1214, 2007.

**Interhemispheric comparison studies:** First tests about the appearance of interhemispheric conjugacy in small scale auroral structures were conducted with 18 paired aircraft flight in late 1960's (Davis, 1992). These tests showed that in some cases northern and southern auroras resemble each other surprisingly well and even pulsating structures can evolve in concert at both hemispheres. These observations suggest some wave-particle interaction occurring at the magnetospheric equator to cause the synchronous precipitation variations. More recent observations with ground-based all-sky TV-cameras suggest, however, that independent modulation sources for each hemisphere located far from the equatorial plane can also exist. Profound evidence to support this scenario is presented in the study of Watanabe et al. (2007). Detailed analysis of all-sky images shows simultaneously non-pulsating structures which are similar in south and north and thus prove the ambient conjugacy and pulsation structures with obviously missing conjugacy. The authors report about two types of non-conjugacy: (i) pulsating auroras can appear in both hemisphere but their spatial appearance and period are different and (ii) pulsating auroras appear only in one hemisphere. References: N. Davis: *The Aurora Watcher's Handbook*, University of Alaska Press, 1992. Watanabe, M., Kadokura, A., Sato, N., and T. Saemundsson, Absence of geomagnetic conjugacy in pulsating auroras, *Geophys. Res. Lett.*, doi:10.1029/2006GL030469, 2007.

**Fall 2007 AGU Presentation: Planetary Waves, Ozone Distribution And Tropopause Height Asymmetries In Connection To Antarctic Peninsula Warming:** Decadal variations of the quasi-stationary wave amplitude and zonal structure are analyzed using the TOMS data [Milinevsky, G et al., 2007]. Seasonal dependence of total ozone content (TOC) is considered. The amplitudes of quasi-stationary planetary waves in TOC zonal distribution at high latitudes of Southern Hemisphere are calculated for 1979-2005. The highest values of the quasi-stationary wave amplitude at latitude 65S in October are observed. The asymmetry of total ozone distribution over Antarctic region during Austral spring is discussed. The amplitude and longitudinal position of zonal anomalies are calculated for total ozone content distribution along seven individual latitude bands at 5-degree intervals between 50S and 80S. The mid-latitude ozone-rich collar has a mid-latitude maximum with mean position between 90E-180E longitudes and with up to 390 DU. The significant planetary wave TOC minimum eastward shift about 40 degrees in longitude is observed over Weddell Sea during 1979-2005, whereas the zonal maximum is relatively stable in position. This displacement is discussed in connections to latest findings of the strengthening circumpolar westerlies and regional climate warming in Antarctic Peninsula. Tropopause height anomalies over Antarctic region show seasonal change associated with total ozone losses during spring months. The tropopause height anomaly in West Antarctica coupled with its increasing decadal trend could be involved in climate change in this region. The research was made in the framework of the SCAR ICESTAR Program, and ORACLE-O3 IPY Project, and partly supported by project 06BF051-12, Grant Greece-Ukraine M/86-2006, and Australian

**Fall 2007 AGU Presentation:** Antarctic Ground-based Observations During Selected THEMIS Satellite Event Studies by Weatherwax et al., *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract SM11A-0330.

**Fall 2007 AGU Presentation:** PENGUIn Observations of the THEMIS March 23, 2007 Substorm Event by Lessard et al., *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract SM21C-07.

**ICESTAR and IPY (ID#63) Related Publications in 2007**

1. Bhardwaj, Anil; Randall Gladstone, G.; Elsner, Ronald F.; Østgaard, Nikolai; Hunter Waite, J.; Cravens, Thomas E.; Chang, Shen-Wu; Majeed, Tariq; Metzger, Albert E.: First terrestrial soft X-ray auroral observation by the Chandra X-ray Observatory, *Journal of Atmospheric and Solar-Terrestrial Physics*, Volume 69, Issue 1-2, p. 179-187, 10.1016/j.jastp.2006.07.011, 2007.
2. Bhardwaj, Anil, Ronald F. Elsner, G. Randall Gladstone, Thomas E. Cravens, Carey M. Lisse, Konrad Dennerl, Graziella Branduardi-Raymont, Brad Wargelin, J. Hunter Waite Jr., Ina Robertson, Nikolai Ostgaard, Peter Beiersdorfer, Steven L. Snowden, Vasili Kharchenko. X-rays from Solar System Bodies, Review paper in *Planet Space Science*, Vol 55/9, pp 1135-1189, doi: 10.1016/j.pss.2006.11.009, 2007.
3. Borg, A. L.; Østgaard, N.; Pedersen, A.; Øieroset, M.; Phan, T. D.; Germany, G.; Aasnes, A.; Lewis, W.; Stadsnes, J.; Lucek, E. A.; Rème, H.; Mouikis, C.: Simultaneous observations of magnetotail reconnection and bright X-ray aurora on 2 October 2002, *Journal of Geophysical Research*, Volume 112, Issue A6, CiteID A06215, 10.1029/2006JA011913, 2007.
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5. Dejong, A. D.; Cai, X.; Clauer, R. C.; Spann, J. F.: Aurora and open magnetic flux during isolated substorms, sawteeth, and SMC events, *Annales Geophysicae*, Volume 25, Issue 8, 2007, pp.1865-1876, 2007.
6. Dhillon, R. S.; Robinson, T. R.; Yeoman, T. K.: EISCAT Svalbard radar observations of SPEAR-induced E- and F-region spectral enhancements in the polar cap ionosphere, *Annales Geophysicae*, Volume 25, Issue 8, 2007, pp.1801-1814
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8. Engebretson, M. J., et al. (2008), Pc1–Pc2 waves and energetic particle precipitation during and after magnetic storms: Superposed epoch analysis and case studies, *J. Geophys. Res.*, 113, A01211, doi:10.1029/2007JA012362.
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10. Grocott, A.; Yeoman, T. K.; Milan, S. E.; Amm, O.; Frey, H. U.; Juusola, L.; Nakamura, R.; Owen, C. J.; Rème, H.; Takada, T.: Multi-scale observations of magnetotail flux transport during IMF-northward non-substorm intervals, *Annales Geophysicae*, Volume 25, Issue 7, 2007, pp.1709, 2007.
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