

Scientific Research Programme Report to SCAR

Interhemispheric **C**onjugacy **E**ffects in



ICESTAR



Solar-**T**errestrial and **A**eronomy **R**esearch

Expected Overall Programme duration: 2005 – 2009

Estimated SCAR funding required for the next 2 years: \$30,000 USD

- Co-Chair: Allan Weatherwax, Siena College (U.S.A.), aweatherwax@siena.edu
- Co-Chair: Kirsti Kauristie, Finnish Meteorological Institute (Finland), kirsti.kauristie@fmi.fi

Selected Achievements in 2005 - 2006

- ICESTAR hosts a *Data Portal and Virtual Observatory Workshop* in Toulouse, France, July 2005
- ICESTAR leads *Heliosphere Impact on Geospace*, a core project of the fourth International Polar Year programme
- ICESTAR leads an IPY-ICESTAR proposal effort submitted to the Norwegian Research Council
- ICESTAR scientists will present 38 papers at the Open Science Conference of the 2006 SCAR meeting in Hobart, Australia
- ICESTAR co-sponsored scientific sessions at both the European and American Geophysical Union Meetings in 2006

ICESTAR Progress in 2005 - 2006

The ICESTAR Programme will create an integrated, quantitative description of the upper atmosphere over Antarctica, and its coupling to the global atmosphere and the geospace environment. The reasons to embark on the endeavour now are outlined below.

The Emergence of New Datasets. The volume of experimental data has been increasing significantly in recent years. In addition, many new datasets are expected to come on-line in the near future. At this time, there are new magnetometer chains, new polar orbiting satellites which allow the simultaneous view of the Southern and Northern polar regions, new ionospheric (SuperDARN, AMISR, and EISCAT) radars, new mesospheric/thermospheric wind measurements (meteor radars, FPIs), new digisonde and TEC data. It is the right time to begin to create tools to examine the entire system as a whole.

Emergence of Grid technology. The 'Grid' is just starting to be defined, and has yet to find a real niche. The seamless sharing of data is one possibility, and is one of the main goals of the ICESTAR programme. The creation of visualization tools that can utilize globally distributed data sets will push the limits of the current technologies and will spark the creation of new Grid functions. In addition, enabling the convergence of data and models is another strong goal of the Grid technology, which is synergistic with the programme goals.

Enable Easy Access to Distributed Data. Many research groups are creating data assimilation tools that require the use of as many data sources as possible. The creation of the ICESTAR data portal and use of the Antarctic Data Master Directory will enable these developments to grow.

Uniqueness of Antarctica. The Antarctic continent offers a unique vantage point for examining the near-Earth space environment, spanning from the top of the troposphere, through the stratosphere, mesosphere, thermosphere, and ionosphere, and into the magnetosphere. Here we underscore some of the similarities and differences between the Arctic and Antarctic:

- Very different underlying neutral atmosphere, e.g., planetary waves and gravity waves morphology is very different, and more intense jet stream exists in the Antarctic;
- Much larger displacement of the magnetic dip pole in the South than in the North, which means it is much easier to separate effects that are controlled by solar radiation;
- The geomagnetic field is weakest in the South Atlantic sector, thus the flux of energetic particles is higher than anywhere else allowing to studying the atmospheric consequences of energetic particle precipitation

Focused Science. The ICESTAR programme will enable focused upper atmosphere scientific research from Antarctica. One goal is to determine how this region of space fits within the global system. No other programme exists which is focused specifically on the quantitative understanding of the upper atmosphere above the Antarctic continent.

International Cooperation: Studies of the polar upper atmosphere fundamentally require international collaboration. Consider first the deployment of instruments across Antarctica. These instruments are either located at manned bases or are remotely deployed and serviced from such bases. From a logistical and financial standpoint, it is not feasible to deploy a network of instrumentation in Antarctica without international collaboration. The problem is even more complex in the Arctic as individual countries there have control over portions of the region. With instruments being deployed and operated by different countries, international collaboration is essential so that data can be exchanged and integrated.

Accomplishments in 2005 - 2006

- **ICESTAR Website:** Established to facilitate international communication.
- **CEDAR/GEM Meeting 2005:** ICESTAR team member Allan Weatherwax helped organize the Coupled Geospace Workshop at the 2005 Santa Fe CEDAR/GEM Meeting .
- **Polar Research Working Group II-G:** ICESTAR coordinated activities with the IAGA Polar Research Working Group. Future collaborative endeavours are underway with this IAGA working group.
- **ICESTAR Data Portal Workshop:** The ICESTAR Data Portal and Virtual Observatory Workshop was held on 23 July 2005 in conjunction with the IAGA 2005 Scientific Assembly, Toulouse, France. There were more than 35 in attendance. A full report is given at: <http://www.siena.edu/physics/icestar>.
- **Prototype Virtual Observatories and Data Portals:**
 - A prototype of the VO for optical data (browser for quicklook data) was released: see <http://gaia-vxo.org>.
 - A prototype of the VO for magnetometer data, VGMO.NET, was released: see <http://mist.engin.umich.edu/mist/vgmo/vgmo.html>.
 - A prototype of the VO for the multi-instrument data sets at South Pole Station was released: see <http://siena.isti.com/>.
- **ICESTAR and IPY:** ICESTAR, under the direction of [Kirsti Kauristie](#) of the Finnish Meteorological Institute, submitted on 10 Jan 2005 an Expression of Interest to the Joint Committee of IPY. IPY JC selected the programme to the second round of core project candidates and encouraged collaboration with the IHY EoI in order to establish an umbrella organization for 24 geospace oriented projects. The ICESTAR/IHY programme was endorsed on Dec 1 2005 as one of the IPY core projects. After that five more EoIs has joined the initiative. IPY will publish the final list of the core projects in March 2006. *See IPY contributions section below.*
- **Meeting on Atmospheric Studies by Optical Methods:** Prof. Scott Palo presented an invited talk about the ICESTAR program at the 32nd Annual European Meeting on Atmospheric Studies by Optical Methods, 01 September 2005, London, Ontario
- **EGU General Assembly Special Session Announced:** TAG Team leader Nikolai Ostgaard announces the session, Interhemispheric similarities and asymmetries in geospace phenomena. He will chair this session together with Janet Kozyra who is a work package leader in the CAWSES programme.
- **Presentation:** TAG Team Leader [Nikolai Østgaard](#) gave a talk on conjugate imaging of cusp aurora at the IHY meeting in Paris.
- **Fall 2005 AGU - ICESTAR Related Talks and Presentations**
 - Deploying a Low Cost Virtual Observatory and Data Portal at a Small Liberal Arts College by H. Schechner and A. T. Weatherwax
 - Geospace Climatology: A Window to the Heliosphere Through Polar Regions by V. O. Papitashvili
 - The Future of Systems Aeronomy in Addressing New Science Frontiers by J. U. Kozyra, L. J. Paxton and A. Ridley.
 - GAIA - A Virtual Auroral Observatory by E. Donovan.
 - Polar Gateways to Exploration of Icy Worlds in the Solar System by J. Cooper.

- **ICESTAR-IHY Collaboration:** Kirsti Kauristie attended the first European General Assembly of IHY (Jan 10-13 2006), gave there an invited presentation about ICESTAR and discusses with the European IHY coordinators (Prof. R. A. Harrison, R. Stamper, and C. Briand) about the future ICESTAR-IHY activities.
- **Activities in the EGU-Meeting:** TAG Team Leader Nikolai Østgaard will gave an invited talk about the ICESTAR science and coordination activities in an EGU Union Symposium hosted by Dr J. C. Ellis-Evans.
- **EGU General Assembly Special Session:** 'ST5.5 Inter-hemispheric similarities and asymmetries in geospace phenomena', will be convened by TAG-C Team leader Nikolai Østgaard. He will chair this session together with Janet Kozyra who is a work package leader in the CAWSES programme. We will have an invited talk by Aaron Ridley (given by Gombosi) and an ICESTAR/IHY paper by L. Alofsi.
- **ICS-8:** TAG Team Leader [Nikolai Østgaard](#) will give an invited talk at the International Conference on Substorms-8 on conjugate imaging of substorms.
- **ICS-8:** [Krsti Kauristi](#), Nikolai Østgaard, and Allan Weatherwax present ICESTAR related papers at the Eighth International Conference on Substorms, March 27-31, 2006
- Co-director Allan Weatherwax presented an ICESTAR related seminar at South Pole Station during a visit to Antarctica to conduct fieldwork.

Proposed Work Plan for the Next 2 Years

- Build the User Interface and other necessary elements.
- Test the prototype system with the design reference models.
- Test results presented e.g. in a CAWSES-ICESTAR workshop.
- Adjust the system according to the feedback from the first test runs.
- IHY Discipline Planners will categorize the submitted CIPs according to Universal Processes and present the implementation plans for coordinated campaigns during the IPY years (Reconnection and wave-particle interactions are examples of Universal Processes with common ICESTAR and IHY interests).
- Foster the first measurements of the NASA THEMIS mission (especially TAG-B and C)
- Second meeting of the Scientific and Technical Board: Mid-term review.
- Introduce the VO to the IPY community and expanding the system with new data archives and software.
- Establish reliable monitoring routines for user statistics (both for VO and for the individual data archives)
- Publish the results of the design reference models.

Deliverables

The ICESTAR programme will deliver a wide variety of products ranging from a better scientific understanding of the polar atmosphere to a data portal that will enable scientists to create a systems-view of the polar region. Specifically, the ICESTAR programme will focus on delivering:

- A data portal linking together a large number of polar sites with diverse datasets. This data portal will have visualization and data translation modules that will allow users to examine the data and download it in formats that they can easily

understand. The following data types will be provided to the portal by the associated groups: magnetometers, HF and MST radars, lidars, passive optical instrumentation, digisondes, riometers, VLF/ULF receivers, TEC measurements, and atmospheric electric field observations.

- Quantification of the role of seasonal differences in polar ionospheric conductance and the effects on magnetospheric, ionospheric, and thermospheric dynamics.
- Constraints on models based on conjugate remote sensing of inner magnetospheric dynamics.
- Characterization of the spatial and temporal properties of mesoscale convection in the ionosphere.
- Characterization of the basic state of the polar middle atmosphere.
- Quantification of the AC and DC global atmospheric circuit and its effects on the ionospheric state.

IPY Contributions

The ICESTAR community submitted an Expression of Intent to the call of IPY Core projects in January 2005. As response the IPY Joint Committee suggested ICESTAR to join with the IHY community (IHY= International Heliophysical Year) and to form an umbrella for 22 other projects which will address geospace and polar area aeronomy research topics. ICESTAR and IHY submitted the second round proposal with the title “ICESTAR/IHY – Interhemispheric Conjugacy in Geospace Phenomena and their Heliospheric Drivers” in June 2005 for IPY JC reconsideration. At the beginning of December the proposal received IPY’s final endorsement after which the programme has still been expanded with seven additional sub-projects according to the suggestions of IPY JC. Consequently, today the programme includes 29 multinational consortia and appears as the project number 63 (“Heliosphere Impact on Geospace”) in the official IPY Planning Chart.

Science of the ICESTAR-IHY-IPY programme

The scientific goals of the ICESTAR-IHY-IPY programme can be categorised under the following three main themes:

- (i) *Coupling processes between the different atmospheric layers and their connection with the solar activity:* E.g. effects of mid-atmospheric circulation and extreme solar activity on the content of stratospheric ozone and minor constituents, variations of the cosmic ray fluxes above the polar areas and South Atlantic Anomaly, energy transfer from powerful weather fronts to geospace heights and using novel technology for stratospheric magnetic field measurements.
- (ii) *Energy and mass exchange between the ionosphere and the magnetosphere:* E.g. multiscale and tomographic studies of ionospheric phenomena (auroral precipitation, convection, turbulence and electron content) as driven by magnetospheric and solar activity, remote-sensing of the radiation belts, and balloon-borne radio soundings of the ionosphere in conjunction with ground stations and satellites as pilot studies for future NASA missions.
- (iii) *Inter-hemispheric similarities and asymmetries in geospace phenomena:* Science goals as above but under this theme special emphasis will be put on using both Arctic and Antarctic observations. In addition to several magnetometer and optical instrument networks bipolar data will be available also from HF-radars, riometers,

digital ionosondes, dynasondes, dual-frequency GPS receivers and LEO satellite beacon receivers.

Each project in the combined proposal has a set of project-specific scientific objectives, but the interrelationships between the studied processes mean there is significant synergy between the projects. The result is that the overall proposal will be able to address topics with far-reaching scientific impact and of importance to society at large. For example, a practical benefit will be improved prediction of space weather phenomena which adversely affect spacecraft operations, humans in space, and satellite-based positioning systems; on the scientific side, global scale coordination of observing networks will allow us to study conjugate and multi-scale geospace phenomena in fundamentally new ways.

Instrumentation and measurement campaigns

The groups of the programme already run a large body of instrumentation in both the Arctic and the Antarctic polar regions to support their research projects. Several consortia are also proposing to install new instruments to significantly improve the spatial coverage and resolution and to provide pairs of geomagnetically conjugate observations from both the hemispheres. A wide range of instrumentation with anticipated lifetimes beyond 2007 is proposed for installation in both polar regions including: HF radars, magnetometers, riometers, auroral imagers, GPS scintillation and dual frequency receivers, a VLF beacon transmitter, MST radars, radiometers, autonomous meteo-magnetic stations and balloon-borne radio sounders. Below we list some examples of institutes and/or research groups who have expressed their intentions to arrange measurement campaigns or to build permanent instrumentation in the polar regions:

Institute	Instrument/Campaign	Comments
British Antarctic Survey, UK	Radiometers, mesospheric imagers, Lidars	Collaboration with ALOMAR and EISCAT facilities
IFSI/INAF, Italy	Antarctic SuperDARN radar	
University of Calgary, Canada	THEMIS optical instrumentation	Data sharing will take place via the GAIA Virtual Observatory
University of La Sapienza, Italy	Balloon campaigns measuring the cosmic microwave background and magnetic field in the Arctic stratosphere	Collaboration with the Andoya Rocket range.
The EISCAT Association, Sweden	Continuous measurements with the EISCAT Svalbard radar	
NASA, USA	Balloon campaigns to test instrumentation for the NASA mission "Jupiter Icy Moons Orbiter"	
National Institute of Polar Research, Japan	Antarctic MST/IS radar (PANSY)	The radar will start operation during the IPY years
National Institute of Geophysics and Volcanology, Italy	GPS scintillation and dual frequency receivers both permanent stations and campaigns (Antarctic research	

	vessel)	
GLORIA-team, several countries	New Arctic and Antarctic Imaging riometers	
Stanford University, USA	VLF transmitter and receivers in Antarctica	
University of Saskatchewan, Canada	Artic SuperDARN radars	The PolarDARN extension of SuperDARN
National Academy of Science, Ukraine	Antarctic automatic meteorological stations	
Polar Research Institute of China	Magnetometers, Antarctic SuperDARN radar	

The IHY community will coordinate an overarching synoptic observation programme and will provide systems and assessment processes for coordinating and facilitating dedicated campaigns in order to reap the advantages of interdisciplinary observations. The sub-projects within the ICESTAR-IHY-IPY programme projects have been encouraged to register their activities formally with the IHY either as Coordinated Investigation Programmes (CIPs) or as Synoptic Programmes. Seven of the sub-projects have made their CIP proposal already. The proposals will be reviewed by IHY Science Working Groups (SWGs), organised by discipline and consisting of experts in the field. For the projects coming together for IPY there is typically already a commitment of resources. The role of the SWGs will therefore, in this case, largely be confined to identifying synergies between proposals; in general, they will also liaise with observatory representatives and IHY national coordinators to assess the feasibility of proposals and negotiate the use of observatory facilities.

Data Portals

In the first ICESTAR workshop in July 2005 Toulouse the data sharing issues were discussed for the first time among a wider community including representatives of some of the most widely used existing geospace data servers (e.g. SPIDR and CDAWeb, for more details see the notes of this meeting in http://www.siena.edu/physics/ICESTAR/portal_workshop.htm). It was decided in the workshop that special attention in the first phase will be paid to three data servers: VGMO (magnetometer data), GAIA (auroral precipitation data), and Madrigal (Incoherent scatter radar data). The aim is to build or upgrade these systems so that they have easily adoptable interfaces both to the direction of the users and the data providers. A more ambitious goal will be to make the systems to communicate with each other electronically.

The VGMO system has been designed in the University of Michigan (<http://mist.engin.umich.edu>). The user interface can appear either as a web-based portal (for a passive user) or as set Java-scripts to be installed to a computer which aims to be a standalone data node. VGMO has been built to adapt fluently new data sets and data analysis tools and it can easily be upgraded for automatic communication with other VOs. However, before this system or any other data broker interface can be used efficiently the wide community of magnetometer data providers should agree on the standard data query and metadata elements and acknowledgement practices. The ICESTAR community (more specifically research groups in the University of Michigan, University of Alberta and British Antarctic Survey) has taken the responsibility to arrange splinter meetings in the context of scientific conferences to maintain such discussion until a consensus about the standards has been reached at least among the most important data providers. The goal is to find a practice which enables the data providers to contribute to multiple portals with minimum effort. The first splinter meeting was arranged in Banff (Canada) in March

2006 where the coordinators started to collect the principal contacts and their agreements to participate the discussions.

The first version of the GAIA-portal is available in <http://gaia-vxo.org>. It has been built by the Institute of Space Research at the University of Calgary in collaboration with the University of Lancaster. The service is a browsing and indexing tool for optical and riometer quicklook data. The system fetches the data quality charts (e.g. keograms for allsky camera data) from distributed data sources and combines them “in fly” to a composite chart showing the global data availability. Although the current version of the portal does not provide full resolution data it will facilitate the usage of optical and riometer instruments significantly: the data providers are requested to provide only the periods of optimum performance of their instruments. GAIA has received some positive attention in the NASA Virtual Observatory (VO) Programme. This programme will expand the existing NASA VO system with six new VO’s and has invited GAIA to serve as a “working VO” in their outreach and education material. This collaboration will give GAIA the opportunity to participate to the decision making of future practices allowing interoperability of VOs from different disciplines.

The Madrigal data portal is a well-established and widely appreciated tool for professional incoherent scatter (IS) radar users. IS radars can provide interesting observations for a multitude of geospace and aeronomy research areas. Thus the IPY years will provide the IS radars a valuable opportunity to increase their user community. However, the current version of Madrigal may be a too heavy tool for beginners to use for the browsing of raw data or to extract any data products. This may appear as a harmful obstacle for starting a deeper collaboration with the IS radar community. To avoid such complication the EISCAT community has started to investigate the possibilities to use the functionalities developed in the UK AstroGrid programme in order to build a beginner-interface for Madrigal and to upgrade it with inter-VO communication capabilities.

Management

The ICESTAR-IHY-IPY programme will be organised as a federation of subsidiary projects, each with a large degree of autonomy but with coordinating oversight from a steering committee. The constituent projects will have their own management bodies typically consisting of the instrument PIs and representatives from the funding parties, so that the best available expertise is close to the everyday activities. The umbrella steering committee will consist of representatives from the subprojects, with the lead being taken by IHY and ICESTAR, and including experts for the scientific issues, for the data-sharing procedures and for public and educational outreach. This committee will identify where the constituent projects have the potential to collaborate on observations or logistics. In this context it is important to note that some of the projects are already consortia with well-established procedures for coordination (e.g. the EISCAT and SuperDARN communities). The detailed networking and collaboration plan will be finalized in the ICESTAR-IHY-IPY kick-off meeting which will be arranged in Helsinki (Finland) at the beginning of year 2007.

Education and public outreach

For direct communication with the general public ICESTAR-IHY-IPY will establish an outreach programme which aims to coordinate parallel semi-annual media events in all participant countries during the IPY years. These events will be realized as press releases and popular lectures summarizing the recent scientific findings of the project. For the audience keen on observing the environment several research groups will put up web-interfaces to show real-time

data from their instrumentation. The public understanding of geospace science will be expanded also in collaboration with national research councils. The IPY 2007 Space Science Symposium and the “Life on Icy Worlds” conference, respectively, planned to be arranged in Greenland and in Alaska will be important forums for educating national science administrators and teachers about historical and forthcoming research activities with the perspectives from Arctic natives, Antarctic scientists, and solar system explorers.

To educate next generation of geospace scientists ICESTAR-IHY-IPY will together with space science centers provide plenty of material for interesting and challenging exercises and thesis works. Students will participate in the measurement campaigns and in the development of the modern data-sharing systems. The easily accessible data-archives will provide important reference material for observational and theoretical investigations.

Supporting Information

Implementing the multi-national ICESTAR programme requires careful management. The Steering Committee, led by two Co-Chairs and guided by the SSG/PS leadership *ex officio*, will provide the overall management and guidance of the programme.

- **Co-Chair:** [Allan Weatherwax](#), Siena College (U.S.A.)
- **Co-Chair:** [Kirsti Kauristie](#), Finnish Meteorological Institute (Finland)
- Brian Fraser, University of Newcastle (Australia)
- Martin Fullekrug, University of Bath (U.K.)
- Ruiyuan Liu, Polar Research Institute (China)
- Nikolai Østgaard, University of Bergen (Norway)
- Scott Palo, University of Colorado (U.S.A.)
- Aaron Ridley, University of Michigan (U.S.A.)
- Natsuo Sato, National Institute of Polar Research (Japan)
- Eftyhia Zesta, University of California - Los Angeles (U.S.A.)
- Maurizio Candidi, SCAR SSG/PS (Italy), *ex officio*

The Steering Committee will meet every year to determine the programme progress and outline the venues for international collaboration. ICESTAR will hold scientific workshops either separately or in conjunction with the biennial SCAR Science Meetings. Specifically, ICESTAR will have four working groups that will focus on the following broad science objectives:

- Quantifying the atmospheric consequences of the global electric circuit and further understanding the electric circuit in the middle atmosphere as guided by the electric fields generated at the solar wind--magnetosphere interface;
- Quantifying the effects on the polar ionosphere and atmosphere of the magnetospheric electromagnetic fields and plasma populations, from the radiation belts to the tail plasma;
- Quantifying and understanding the similarities and differences between the Northern and Southern polar upper atmospheres, under the varying influence of the solar electromagnetic radiation and of the solar wind;
- Creating a data portal that will integrate all of the polar data sets and modeling results. This data portal will enable the research to be conducted by the other working groups.

The above-listed objectives will be the focus of four Thematic Action Groups (TAGs) established to coordinate research activities:

TAG-A: Quantification of the coupling between the polar ionosphere and neutral atmosphere from the bottom-to-top and the global electric circuit.

Leader: Martin Fullekrug, University of Bath (U.K.)

TAG-B: Quantification of the inner magnetospheric dynamics using remote sensing techniques.

Leader: Eftyhia Zesta, UCLA (U.S.A.)

TAG-C: Quantification of the state of the upper atmosphere, ionosphere, and magnetosphere over the Antarctic continent and how it differs from the Northern hemisphere during a wide range of geophysical conditions.

Co-Leader, Nikolai Østgaard, University of Bergen (Norway)

Co-Leader, Scott Palo, University of Colorado (U.S.A.)

TAG-D: Creation and management of the data portal.

Leader: Aaron Ridley, University of Michigan (U.S.A.)

Each TAG will establish and maintain liaison with the National Antarctic Programs through SCAR and its relevant scientific groups and committees: ADD (Antarctic Digital Database), MAGMAP (Magnetic Anomaly Map), and READER (Reference Antarctic Data for Environmental Research). The programme goals and objectives will be detailed together with the SSG/PS Expert Group on Solar-Terrestrial Processes and Space weather (STEPS) and the relevant Action Groups APTIC (Antarctic Peninsula Troposphere - Ionosphere Coupling) and MADREP (Middle Atmospheric Dynamics and Relativistic Electron Precipitation). Similar collaboration will be established with relevant projects of the International Arctic Science Committee (IASC; <http://www.iasc.no>). The ICESTAR activities will also be coordinated with the Working Group on Polar Research of the International Association of Geomagnetism and Aeronomy (IAGA) and with the new international programmes Climate and Weather in the Sun-Earth System (CAWSES) sponsored by SCOSTEP and International Heliospheric Year (IHY) endorsed by COSPAR, IAU, and by UN Office for Outer Space Affairs. Finally, the proposed period for ICESTAR (2005-2009) overlaps the planned research activities in the framework of fourth International Polar Year (IPY, 2007-2008), during which ICESTAR and IHY together will coordinate the research of 29 multinational consortia to form a geospace focused core programme in the IPY network.

The following key solar-terrestrial physics and polar aeronomy questions provide a sound scientific background for the ICESTAR TAG team leaders to help address:

- How is Earth's magnetosphere different qualitatively and quantitatively under extreme, moderate, and quiet solar wind conditions?
- What is common and what is different in the solar-terrestrial and aeronautical phenomena observed over both the Arctic and Antarctic?
- Does auroral activity during substorms arise from instabilities in the ionosphere or does this aurora simply mirror plasma motions in the outer magnetosphere?
- How much do dark and sunlit ionospheres control polar substorm dynamics?
- To what extent are the ionized and neutral high-latitude upper atmospheric regions affected by mechanical and electrodynamic inputs from the lower atmosphere?
- How does the global electric circuit affect the ionosphere state?
- How is the global electric circuit closed between the low and high latitudes?

It is important and timely to act now to study the polar-regions in their interhemispheric context from observations in space and over the Arctic and Antarctic. The ICESTAR TAG team leaders will provide international guidance in addressing these, and other, important problems.

Budget Request for the Next Biennium

Estimated SCAR funding required for the next two years is approximately \$30,000 USD, as budgeted in the original proposal. The SCAR funds will enable ICESTAR to run the following three meeting:

Dates	ICESTAR Sponsored Meeting	Amount
Summer 2006	ICESTAR participation at the SCAR meeting in Hobart.	\$8,000
Winter 2007	ICESTAR-IHY-IPY coordination meeting in Helsinki, Finland.	\$10,000
Summer 2008	ICESTAR Data Portal Meeting II	\$7,000

ICESTAR will further continue to provide travel to support for researchers worldwide to participate and present ICESTAR related papers at scientific meeting and workshops. Approximately \$5,000 is budgeted for such expenses.

Members List

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Outputs/Deliverables

- **ICESTAR Website:** Established to facilitate international communication.
 - <http://www.siena.edu/physics/ICESTAR/default.htm>
- **ICESTAR-IHY-IPY Website:** *Heliosphere Impact on Geospace*
 - <http://www.space.fmi.fi/ipyid63/>