IPY, eGY, IHY: perspectives for solar-terrestrial physics?

Maurizio Candidi, IFSI-CNR/INAF Italy

International Geophysical Year
2007
Celebrating 50 years of global geospace studies

Register: Click here to register your interest in IGY2007.

Interesting IGY2007 links:
• National Academy’s historical description
• Photos of IGY1957
• IGY memorabilia
• International Heliophysical Year 2007 (NASA/GSFC)

What is this all about?

Following a suggestion by NAS member Lloyd Berkner, ICSU in 1952 proposed a comprehensive series of global geophysical activities to span the period July 1957-December 1958. The International Geophysical Year (IGY), as it was called, was modeled on the International Polar Years of 1882-1883 and 1932-1933 and was intended to....

ICSU recommended that artificial satellites be launched for the occasion....

International organization and funding of the IGY were overseen by the International Council of Scientific Unions (ICSU), an independent federation of international scientific unions. A Special Committee for the IGY (CSAGI, an acronym derived from the French....

American participation in the IGY was charged to a US National Committee (USNC) appointed in March 1953 by the NAS. Joseph Kaplan, Professor of Physics at UCLA, was appointed Chairman of the USNC. Physicist Alan H. Shapley of the National Bureau of Standards (NBS) was appointed Vice-Chairman. The Thirteen Technical Panels..., were formed to pursue work in the following areas: aurora and airglow, cosmic rays, geomagnetism, glaciology, gravity, ionospheric physics, longitude and latitude determination, meteorology, oceanography, rocketry, seismology, and solar activity. In addition, a technical panel was set up to attempt to launch an artificial satellite into orbit around the earth.

Sputnik and The Dawn of the Space Age

History changed on October 4, 1957, when the Soviet Union successfully launched Sputnik I. The world’s first artificial satellite was about the size of a basketball, weighed only 183 pounds, and took about 98 minutes to orbit the Earth on its elliptical path. While the Sputnik launch was a simple event, it marked the start of the space age...

The story begins in 1952, when the International Council of Scientific Unions decided to establish July 1, 1957, to December 31, 1958, as the International Geophysical Year (IGY) because the scientists knew that the cycles of solar activity would be at a high point then. In October 1954, the council adopted a resolution calling for artificial satellites to be launched during the IGY to map the Earth’s surface...

In July 1955, the White House announced plans to launch an Earth-orbiting satellite for the IGY... In September 1955, the Naval Research Laboratory’s Vanguard proposal was chosen to represent the U.S. during the IGY...

The Sputnik launch changed everything... Its size was more impressive than Vanguard’s intended 3.5-pound payload...

Immediately after the Sputnik launch in October, a simultaneous alternative was Vanguard... Wernher von Braun and the Army Redstone Arsenal team began work on the Explorer project...

On January 31, 1958 the United States successfully launched Explorer I. This satellite contained a small scientific payload that eventually discovered the magnetic radiation belts around the Earth, named after principal investigator James Van Allen.

http://www.hq.nasa.gov/specialhistory/sputnik/
The objective of the IGY is to discover the physical mechanisms at work which couple the Earth to events from the Sun and heliosphere. This systematic global study of this connection is to be the central theme of the IHY. This special session will focus on research and campaign efforts which lay the groundwork for the IHY.

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What is IPY

The Polar Regions are remote areas of the Earth that have profound significance for the Earth’s climate and ultimately environments, ecosystems and human society. However we still remain remarkably ignorant of many aspects of how polar climate operates and its interaction with polar environments, ecosystems and societies. To understand the current global climate and what might happen in future the science community needs a better picture of conditions at the poles and how they interact with and influence the oceans, atmosphere and land masses. Existing climate models do not work well in the polar regions and have for example failed to predict the dramatic break-up of Antarctic ice shelves observed in recent years. The three fastest warming regions on the planet in the last two decades have been Alaska, Siberia and parts of the Antarctic Peninsula.

The IGY produced unprecedented exploration and discoveries in many fields of research and fundamentally changed how science was conducted in the polar regions. Fifty years on, technological developments such as earth observation satellites, autonomous vehicles and molecular biology techniques offer enormous opportunities for a further quantum step upwards in our understanding of polar systems. An IPY in 2007-2008 also affords an opportunity to engage the upcoming generation of young Earth System scientists and to get the public to realize just how much the cold ends of the sphere we all live on really do influence us.

Solar-Terrestrial Physics is not main objective!

But….

Chris Rapley - Chair ICSU Planning Group

IPY Concept

An international programme of coordinated, interdisciplinary, scientific research and observations in the Earth’s Polar regions to explore new scientific frontiers, to deepen our understanding of polar processes and their global linkages, to attract and develop new generations of polar scientists, engineers and logistics experts, to capture the interest of the public and decision-makers.

Timeframe

1st March, 2007 to 1st March, 2009

Content

60° F to 90° N and S

Involvement

- Scientists from 25 countries, 25 ICSU and non ICSU bodies, 7 national points of contact (National Committees in formation, more than 30 “ideas”)

And….

IPY Themes

1. To determine the present environmental status of the polar regions by quantifying their spatial and temporal variability
2. To quantify and understand past and present environmental and human change in the polar regions in order to improve predictions
3. To advance our understanding of polar-global teleconnections on all scales, and of the processes controlling these interactions
4. To investigate the unknowns at the frontiers of science in the polar regions
5. To use the unique vantage point of the polar regions to develop and enhance observatories studying the Earth’s inner core, the Earth’s magnetic field, geospace, the Sun and beyond

The 5th theme includes solar-terrestrial physics!

ICESTAR: is one of five major programs for SCAR, may be Core Program for IPY

How to fit the pieces together

Project Steering Committees

Task

Develop science and implementation plans

Lead and manage project

Membership

National PI’s

Representatives from bodies key to success

Self-funding

What Exactly by Whom?

Projects carried out by researchers and support staff from:

National university research groups

National research institutes and operational bodies

International bodies

Funded by national mechanisms (plus some international)

Coordinated by:

ICYS/SCAR

IPY organisational structure internationally

The International Polar Year (IPY)

www.ipy.org

Latest News

- The ICSU/WMO IPY EXPRESSION OF INTENT ONLINE SUBMISSION AVAILABLE
- 09 Nov 2004

- The IPY Programme Office has now established an online submission form for Expressions of Intent which participants are encouraged to use, rather than the Word document version which is for those without reliable Web access. The forms are designed to ensure a standardised response by participants in addressing the IPY project criteria. The deadline for submission will be January 14th, 2005. All submissions will be examined by the IPY Joint Committee and comments on the match to IPY criteria provided to each Expression by February/March 2005.
The electronic Geophysical Year

The eGY website currently contains descriptions of eGY - objectives, themes, operational models, activities, attractions, news articles, and downloadable copies of presentation material. The site will be developed as a portal for use by eGY participants. Please send content suitable for the website to: marissa.rusinek@lasp.colorado.edu

eGY website  www.egy.org

The electronic Geophysical Year

The International Heliophysical Year
http://ihy.gsfc.nasa.gov/

The International Polar Year (IPY)
www.ipcy.org

The International Year of the Planet Earth
http://www.esfs.org/

Background
A key achievement of the 1957-1958 International Geophysical Year (IGY) was the establishment of a worldwide system of physical observatories and data centres. The access to data that this observational data framework provided triggered a leap forward in our understanding of the Earth and its space environment.

Two developments have brought us to the threshold of another revolution in the advancing of our understanding of the Earth and geospace. First, our ability to collect data has increased dramatically, with pervasive networks of observational stations on the ground, in the oceans, in the atmosphere, and in space. Second, modern digital communications and methodologies for information management (largely internet-based) provide us with an unprecedented ability to access and share information.

These developments coincide with a heightened awareness by governments of the need for sustainable management of the finite natural resources of our planet, the importance of understanding the Earth as a complex system, and the central role that ready access to comprehensive information plays. This translates into a growing readiness to support so-called e-Science and grid infrastructures of computing resources.

An international resolve and coordinated effort by all nations spanning all geoscience disciplines will help us maximize the value to society of these developments and to share the benefits equally between all nations.
The International Heliophysical Year (IHY)  
http://ihy.gsfc.nasa.gov/

The International Polar Year (IPY)  
www.ipy.org

The International Year of the Planet Earth  
http://www.esfs.org/

The electronic Geophysical Year  
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SCIENTIFIC PROGRAMS FOR 2007

The International Polar Year (IPY)  
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How IHY is Organized

The IHY organization is developed in response to the goals and objectives of IHY.  
An International Steering Committee coordinates all of the IHY activities, through its  
Science Working Groups.

Science Working Groups coordinate analysis and modeling efforts, and are  
responsible for planning IHY meetings, symposia and workshops through the three  
major thrusts:

The team reviews proposals for IHY campaigns, coordinates the input from the  
observatory representatives, and maintains the IHY observing and campaign  
schedule.

2. Scientific Meetings and Publications: arranges for communication of  
scientific results to the broader science community.

3. Public Outreach: responsible for increasing public awareness of IHY activities.  
This committee produces newsletters, maintains the websites, writes articles,  
coordinates media affairs, and develops outreach products.

These IHY activities link directly to the success of IHY and require a long-term commitment  
for the planning and execution phases. We're seeking the participation of both individuals  
and organizations in these efforts.

Science Working Groups

Atmosphere-Climate Working Group
Solar Drivers Working Group
Heliosphere & Solar Wind Working Group
Magnetospheres & Ionospheres Working Group

The oversight of the Scientific Campaigns is coordinated through the  
Science Working Groups.

Public Outreach

The Public Outreach initiative communicates the goals and activities of IHY by  
coordinating affairs with the media and making a variety of materials available,  
such as newsletters, websites, newspaper articles and other outreach products.

Of course, IHY benefits from everyone's participation in the public outreach program.

Schedule of Activities

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International Science Organizing Committee

U.S. Science Organizing Committee

Science Campaigns Formation

IHY Science Campaigns

International Living With a Star

Int'l Living With a Star Meeting

Int'l Living With a Star Conference

Integrated Activities of IHY program

IHY International Steering Committee

- Help to stimulate, find support for, and coordinate with National IHY Initiatives in other countries
- Help to plan international workshops and meetings
- Work on “integration and synthesizing” in 2005-2006


IHY has Six International Regions: Latin America, Asia/Pacific, FSU, Europe, Africa, US/Canada

Leadership teams have been or are being established for each region.

Note: All members are not confirmed

The International Heliophysical Year (IHY) http://ihy.gsfc.nasa.gov/

The International Planning Coordinators

- Heinzl: Czech Republic
- Michalek: Poland
- Arnold Benz: Switzerland
- Rob Wimmer-Schweinbruger: Germany
- Dalmiro Maia: Portugal
- JavierRodriguez-Pacheco: Spain
- PatriceAmorosa: France
- AndyBrown: UK
- PeterGalagher: Ireland
- PatricKearney: Brazil
- BillLuo: Canada
- GuangliHuang: China
- Rajmal Jain, Narain Rao: India
- LuLee: Taiwan
- KohtaroKamada: Fug, Tottowa, Japan
- StefanPeters: Belgium
- IsmailSafar: Kuwait
- RoAndonsson: Norway

The International Year of the Planet Earth http://www.esfs.org/

What has been the variability in climate over the last 1000 years?

Climate varies in temperature, precipitation and the frequency of extremes such as drought, storms and floods. The emerging view from the long-term climate record is important to modern societies because it provides a basis for understanding recent trends and their causes. By about 5,000 years ago agricultural systems were widespread. By 3000 years ago extensive areas were under cultivation. Geologically, record tells us that all these changes were accompanied by forest clearing, increased burning patterns, and increased erosion rates. This graph shows records of climate changes from the past four glacial cycles. High resolution records of the 6000 years ago agricultural systems widespread. By 3000 years ago extensive areas were under cultivation. The data sets are few, the best being reconstructions of marine temperature for the last 1000 years for the mid to high latitudes of the Northern Hemisphere. The International Year of the Planet Earth is the International Year of the Planet Earth. It was endorsed by UNESCO’s Earth Science Division, and the UNDESA-EOS International Geoscience Program (IGCP). The main aim of the IYPE is to demonstrate the great potential of Earth Sciences to lay the foundations of a safer, healthier and wealthier society. The IYPE team aims to have the IYPE proclaimed through the UN system, targeting 2006 as the Year itself. However, we expect the Year’s activities to begin in 2005 and culminate in 2007.
What is the role of human activities in climate forcing?

We know that human activity has resulted in changes to atmospheric chemistry and land cover, and caused serious declines in biodiversity. In addition thousands of new synthetic chemical substances have been produced whose role in the biosphere is not fully understood. Many lake systems, for example, have become acidic as a direct consequence of industrial gas emissions over the past 150 years. Modifying biogeochemical cycles leads to complex feedbacks into key elements of climate systems and hence into economic activity and water and food security. One of the ways we can monitor climate modulation by humans is to estimate the greenhouse gas emissions resulting from human activities. We can estimate the amounts but we cannot identify where they all end up. Are they trapped in the soil, incorporated into forest cover? Are they absorbed much of them, or are all these - factors involved. Figure 7 attempts to separate human and natural factors driving recently observed climate change. The relative climatic contributions of land-cover change and changes to the chemistry of the atmosphere still remain to be worked out. Research priorities in this area require process-studies in biology, soil science (pedology) and oceanography, involving automatic monitoring, remote sensing and “ground-truthing” – in other words, the necessary reality check of actual field studies. In addition, studies of sediment chemistry in high deposition rate settings will also add detail.

CAWSES
Climate and Weather of the Sun-Earth System
A new SCOSTEP Program for 2004-2008

EUROCORES Programme
European Solar Terrestrial and Atmospheric Research (E-STAR)
The quantification of physical coupling processes which causally link interplanetary space to the Earth’s atmosphere and thereby influence the global climate system.

EOSTRAT
Atmospheric Coupling Processes

Climatology of the Sun-Earth System

Four Themes under CAWSES

Solar Influence on Climate

Space Weather: Science and Applications

Atmospheric Coupling Processes

The International Living With a Star program http://ilws.gsfc.nasa.gov/
Theme 1: Solar Influence on Climate
Co-Chairs: Michael Lockwood (UK) and Lesley Gray (UK)

WG 1.1: Assessment of Evidence for Solar Influence on Climate, 
Jeremy Beggs (Switzerland), William Russell (USA), Ilya Usoskin (Russia), Judith Lean (USA), Gerard Thuillier (France), Gerry North (USA), Peter Stott (UK), Warren White (USA), Lon Hood (USA), Karl Labitzke (Germany), Augusto Mangini (Germany)

WG 1.2: Investigation of Mechanisms for Solar Influence on Climate, Ulrich Cubasch (Germany), Gerry Meehl (USA), Kuni Kodera (Japan), R. Garcia (USA), David Rind (USA), Mark Baldwin (USA), Charles Jackman (USA), Jon Kristjansson (Norway) and Giles Harrison (UK)

Theme 2: Space Weather Science & Applications
Co-Chairs: Janet Kozyra (USA) and Kazunari Shibata (Japan)
Santimay Basu (USA), Walter Gonzalez (Brazil), Nat Gopalswamy (USA), A. T. Kobea (Ivory Coast), Anatoly Petrukovich (Russia), Rainer Schwenn (Germany), Wei Feng Si (China) and R. Sridharan (India)

Theme 3: Atmospheric Coupling Processes
Co-Chairs: Franz-Josef Luebken (Germany) and Joan Alexander (USA)

WG 3.1: Dynamical Coupling and its Role in the Energy and Momentum Budget of the Middle Atmosphere, Martin Mlynczak (USA), William Ward (Canada), David Fritts (USA), David Hathaway (USA), S. Gurbatsev (Russia), S. Garbarun (India), M. Hagan (USA), J. Y. Liu (Taiwan), Dan Musson (Canada), Dave Pancheva (UK), Kauto Sato (Japan), Kazuo Shiokawa (Japan), Shane Takahashi (Brazil), Robert Vincent (Australia) and Yi Pan (China)

WG 3.2: Coupling via Photochemical Effects on Particles and Minor Constituents in the Upper Atmosphere, Charles Jackman (USA), Ulf Hoppe (Norway), Manuel Lopez-Parra (Spain), Daniel Marsh (USA), David Siskind (USA)

WG 3.3: Coupling by Electrodynamics including Ionospheric Magnetospheric Processes, Steve Cummer (USA), Peter E. Dym (Australia), Jon S. Buitin (Brazil), Aruncha Nutthuks (India), Jorge Chau (Peru), Martin Fullekrug (Germany), Gang Lu (China), Undu Tsubota (USA), and M. Yamamoto (Japan)

WG 3.4: Long-Term Trends in Coupling Processes (interconnected with 4.4)

Theme 4: Space Climatology
Co-Chairs: Claus Froehlich (Switzerland) and Jan Sojka (USA)

WG 4.1: Solar Irradiance Variability, Judit Pap (USA) and Gerard Thuillier (France)

WG 4.2: Heliosphere Near Earth, Leif Svalgaard (USA)

WG 4.3: Radiative Belt Climatology, Takahiro Obara (Japan)

WG 4.4: Long-Term Trends in Ionospheric and Upper-Atmospheric Variability (interconnected with 3.4), M. Jarvis (UK) and John Emmert (USA)

Capacity Building & Education
Co-Chairs: Marv Geller, S. T. Wu and Joe Allen

• CAWSES will hold meetings and provide specialized training courses for scientists from developing nations and help with computational and data resources
• Establish partnerships between developing & industrialized nations
• CAWSES - AOPR Center will facilitate such activities

SCIENTIFIC PROGRAMS FOR 2007-2009

The International Polar Year (IPY)
www.ipy.org

The International Year of the Planet Earth
http://www.esfs.org/

The International Heliophysical Year
http://ihy.gsfc.nasa.gov/

The electronic Geophysical Year
www.egy.org
Advances During Previous International Years

- **IPY 1**
  - Auroral oval structure and dynamics
  - Currents in the upper atmosphere produce magnetic perturbations on the ground
  - Currents flow between upper atmosphere and space

- **IPY 2**
  - International polar observing network
  - New instrumentation (radiosondes and ionosondes)
  - Rapid run magnetometers
  - Simultaneous measurements at multiple stations
  - Global current pattern for specific magnetic disturbance (magnetic bays)

- **IGY**
  - Interhemispheric network of polar stations
  - New instrumentation (all-sky cameras, satellites)
  - Major discovery (radiation belts)
  - New concepts (the magnetosphere, substorms)
  - Exploration of space
  - Global 3D synoptic data
  - Evidence of time-dependent global dynamics

The logical next step is to extend global studies into the Heliosphere to incorporate the drivers of Geophysical change into the global system-The IHY.

**IPY, eGY, IHY: perspectives for solar-terrestrial physics?**

Maurizio Candidi
IFI-CNR/INAF Italy

In 2007 to 2009 the 50th anniversary of the IGY will be celebrated, and many research initiatives by ICSU and its disciplinary bodies are underway: solar terrestrial physics is present in the draft plans and will certainly have a large role, as a core discipline in this framework. Several scientific programs in STP are being implemented by SCAR, IAGA, SCOSTEP, and other unions. SCAR has recently approved the Interhemispheric Conjugacy Effect in Solar Terrestrial Physics (ICESTAR) program, for bipolar research. SCOSTEP is conducting its CAWSES program; COST724 is active in Europe, these programs present ample scope for coordination and synergy in international research.

**What is the Opportunity?**

Cross-cutting solar system science

- Similar physical processes are evident in vastly different environments

Maurizio Candidi
IFI-CNR/INAF Italy

Context

- Existing polar science coordination bodies: SCAR, IASC, COMNAP, FARO, AOSB
- National and International Space Agencies (NASA, ESA, JAXA, CSA, etc.)
- International Oceanographic Commission (IOC)
- International Geosphere-Biosphere Programme (IGBP)
- International Human Dimensions Programme (IHDP)
- DIVERSITAS
- Global X-Observing System (GXOS)
- Diversi
- More Context

- European Polar Board (EPB)
- International Union of Radio Sciences (URSI)
- International Society of Photogrammetry and Remote Sensing (ISPRS)
- Census of Marine Life (CoML)

Additional “Stakeholders”:

- National Funding Agencies and Polar Logistics operators
- Other national bodies (Academy committees, interdepartmental/interagency coordinating bodies, etc.)
- The various meteorological and ocean-operational agencies (NOAA, EUMETSAT, etc.)
Specific Issues (1)
- What is the status of the high latitude ocean circulation and composition?
- How do polar ecosystem structure and function change?
- How are climate, environment, and ecosystems in the polar regions changing?
- How has polar diversity responded to long-term changes in climate?
- What are the inter-hemispheric connections in these changes? (Including magnetic conjugacy of geospace phenomena; see SCAR; see ICESTAR program)
- How has the planet responded to multiple glacial cycles?

Specific Issues (2)

Specific Issues (3)
- What is the pattern and structure of polar marine and terrestrial biodiversity?
- What effect does the solid earth have on ice sheet dynamics?
- What are the nature, composition and morphology of the sea floor and earth crust?
- How does phylogenetic and functional diversity change?
- How does the neutral atmosphere interact with geospace at the polar regions and what are the consequences?
- What is the influence of solar processes at the polar regions on earth’s climate?
- What is the state of the Earth’s magnetic dipole?
- Is the inner core rotating differentially?