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The International Polar Year 2007/08: Opportunities and Challenges

By Hajo Eicken, Geophysical Institute

March 2007 rang in the start of the Fourth International Polar Year (IPY-4). IPY-4 will last through March of 2009 and constitutes a broad, intensive international effort of coordinated observations and exploration of the Earth's polar regions. While the IPY-4 is formally organized through the International Council for Science and the World Meteorological Organization (for details on IPY see the International Coordination Office's web site at www.ipy.org, or the U.S. Committee's web site at www.us-ipy.org), it is very much a bottom-up affair that is largely driven by the interests and activities of individual researchers, educators, students and members of the public in over 60 nations.

Alaska, specifically, has a long and strong history of involvement with the IPY, ever since the U.S. Army Signal Corps' Observation Hut was put in place near the present village of Barrow in 1882/83 for the first IPY. Out of the two hundred IPY-4 projects that have been formally endorsed at the international level, roughly a quarter have direct ties to Alaska or involvement by UA. The Geophysical Institute, in particular, played a pivotal role in the past IPY, which due to its broader geographic focus was referred to as the International Geophysical Year (IGY). It is instructive to contrast the IGY, which involved tens of thousands of scientists across the globe, with IPY-4, in the context of satellite remote sensing and specifically the Alaska Satellite Facility's (ASF) potential role.

The IGY initiated the space age and satellite era with the first successful rocket launch of the Soviet Union's Sputnik into orbit on October, 4 1957; amateur radio enthusiasts were able to pick up the signal from Sputnik's transmitter. Today, at ASF and UA alone, more than a dozen satellites transmit data to ground receiving stations and many of these data streams are available to anyone with a reasonably fast internet connection hours after acquisition. Geospatial data products derived from satellites are distributed through various data centers and have reached all the way from university research into K-12 science projects. IPY-4 may well mark the threshold between the largely passive registration of science as a complex, somewhat impenetrable, enterprise that figured prominently in the context of the Cold War during the IGY years, and a much more participatory era with an active, two-way dialog between scientists and the public.

An example of the vast potential of new technology coupled with a genuine interest of the public and local experts is offered by Figure 1, showing an amalgamation of different types of geospatial and historical information that relies on Google™ Earth as a relatively simple geospatial data portal visualization tool. It is likely that the trajectory from the IGY to IPY-4 and progress in Earth remote sensing was in significant part due to the motivation the IGY provided to bright and capable scientists and engineers to get involved in the study of the Earth using advanced methods. The hope is that IPY-4 will inspire future generations in similar ways. A big difference between the IGY and IPY-4 is that

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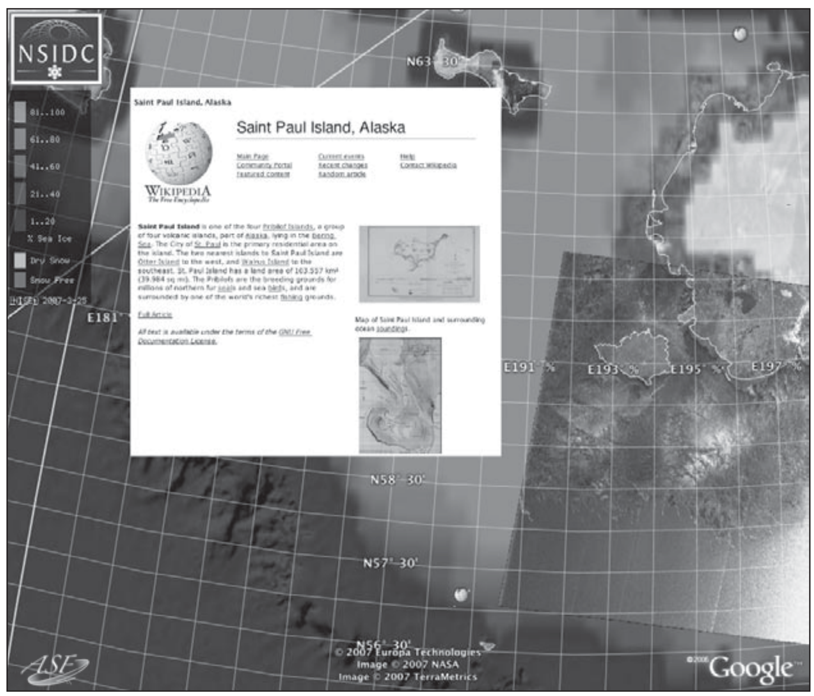

Figure 1: Screenshot showing a combination of satellite-derived data from the National Snow and Ice Data Center (NSIDC, www.nsidc.org) indicating the extent of the sea-ice cover in the southern Bering Sea (light gray shades) in late March 2007, along with a RADARSAT Synthetic Aperture Radar [© Canadian Space Agency (CSA)] scene provided by ASF (courtesy of D. Atwood, www.asf.alaska.edu). Google™ Earth also integrates high-resolution, visible range satellite imagery showing the land surface. Also, thanks to an effort led by M. Nolan at UA (www.earthslot.org/ipy), a large number of data layers showing additional information of relevance for the IPY are included. Shown as well, is a window inset that appears when clicking on St. Paul Island, explaining more about the island and showing historical maps. The information for this inset has been derived from Wikipedia (en.wikipedia.org), a collaborative, on-line encyclopedia project that is reflective of the vast potential for multilateral exchange and collaboration in the digital age.

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the research agenda has become broader and more interdisciplinary with the increasing recognition of how important, for example, human activities are for the Earth's climate and vice versa.

Another important factor to consider, in particular for the satellite remote-sensing community, is the fact that the linkages and the degree of exchange between scientists, engineers, and various stakeholder groups, who are relying on scientific data and model output for short- and long-term planning purposes is becoming ever more sophisticated. Arguably, it is at this interface that some of the most exciting and far-reaching IPY activities over the course of the next 2 years will take place. To be truly successful, a deeper and more substantive dialog is required between data providers, researchers, and key stakeholder groups on how to derive the maximum synergistic benefits out of existing programs, and the flurry of activities that are part of the IPY-4. In regards to the latter, the plans for a broad-based Arctic Observing System that builds on the suite of dramatic changes witnessed in the Arctic over the past two decades (see www.arcus.org/search for more details) carry both great promise and the responsibility to engage stakeholders and local communities at an early stage. Here, satellite remote sensing can play a major role to bring together different perspectives and integrate across a range of different scales.

Looking back to the IGY and previous Polar Years, one may well ask: So what's so special about this IPY? While there are still plenty of unexplored problems and challenges that will be addressed through scientific discovery and innovation during the IPY, grand challenges and opportunities loom. Thus, the Arctic appears to be subject to a complex of change in the physical, chemical, and biological environment that is in many ways unprecedented in the recent past. At the same time, with the end of the Cold War, geopolitical change, and receding snow and ice, many of the circum-Arctic nations are reexamining their territorial claims and geopolitical stance in the North. At the local and regional level, indigenous populations have gained significant degrees of autonomy over the past decade or two. With industrial activities such as mining, and oil and gas development moving north, socio-economic impacts are substantial. Finally, owing to these changes (and aided in important ways by satellite remote sensing), the linkages between the Arctic and lower latitudes have become more apparent and explain why so many non-Arctic nations are planning significant research efforts in the North during IPY-4. Each one of these changes is important and significant in its own right. However, it is the combination and interaction between all of these that make research – and life – in the North so exciting.

Global Interagency International Polar Year Polar Snapshot Year (GIIPSY)

By Kenneth Jezek, Byrd Polar Research Center, The Ohio State University and Mark Drinkwater, European Space Agency, ESTEC

The Global Interagency International Polar Year Polar Snapshot Year (GIIPSY) project aims to obtain high-resolution, broad spectral snapshots of the polar regions during 2007/08. Our primary purpose is to use these snapshots as gauges for comparing past and future environmental changes in the polar ice, ocean, and land. In the spirit of IGY, we also seek to secure these data sets as our legacy to the next generations of polar scientists.

GIIPSY comprises polar scientists from around the world who together have assembled a list of observing objectives that call upon the collective resources of the international space agencies. Our programmatic goal is to identify ways in which the resources of space-faring countries can be used in such a way as to achieve our science objectives without putting undo burden on any single organization. To that end, we seek cooperation in terms of spaceborne instruments, data relay systems, ground segments, processing, and archiving capabilities.

A general description of the GIIPSY program can be found at http://www-bprc.mps.ohio-state.edu/rsl/GIIPSY/. Details on observational objectives can be found at: http://www-bprc.mps.ohio-state.edu/rsl/GIIPSY/index_files/GIIPSYScienceRequirements.htm. Together, we have taken our detailed science requirements and distilled them into a table of thematic objectives, which are listed in Table 1. Topics range from permafrost to sea ice and include several acquisition objectives that would be the first of their kind.

Interaction between GIIPSY and the international flight agencies is coordinated through the IPY Space Task Group (STG), which is convened by the World Meteorological Organization (WMO). The first STG meeting occurred in Geneva, Switzerland, during January 2007. Participating agencies and organizations included: CMA, CNES. CSA, DLR, ESA, EUMETSAT, NASA, ROSHYDROMET, WCRP/IGOS, WMO. We will be joined in the future by INPE, JAXA, USGS and NOAA and have approached ISRO and ASI about their participation.

We presented GIIPSY goals and objectives at the STG meeting.

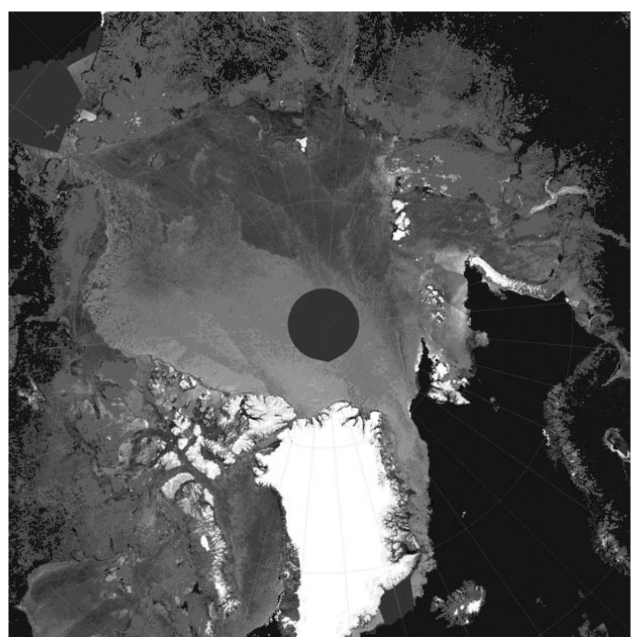


Figure 1. A primary GIIPSY goal is to obtain broad spectral coverage of both polar regions as illustrated by this Envisat ASAR and MERIS composite Arctic Mosaic, January 14, 2006, courtesy Microsoft Vexcel UK (PolarView Consortium).

Table 1. GIIPSY Thematic Objectives Derived From GIIPSY Science Requirements

A. Sea level rise, and hemispheric climate (glaciers, ice caps, ice sheets):

1) *For the first time*, one summer, one winter, SAR snapshot of the polar ice sheets, glaciers and ice caps. Near simultaneous imagery at L, C, and X band, polarimetric, quad pole for documenting ice surface physical parameters.
2) *For the first time*, pole-to-coast multifrequency InSAR measurements of ice surface velocity.
3) *For the first time*, repeated X-band InSAR topography for detecting local changes in ice-sheet elevation associated with motion of subglacial water.
4) *For the first time*, one summer, one winter, high-resolution visible/near IR/ TIR snapshot of the entirety of the polar ice sheets, glaciers, and small ice caps followed with bimonthly coverage of select glaciers for snow-zone mapping.
5) Continued measurements of ice surface elevation from radar and laser altimeters (spaceborne and airborne) for volume change.
6) Continued daily visible and infrared, medium-resolution imaging of the entirety of the polar ice sheets, glaciers, and ice caps and to be compiled into monthly maps.
7) Continued, daily, medium-to-coarse resolution active and passive microwave images of the polar ice sheets, ice fields, and ice caps for melt extent.
8) Continued measurements of the gravity field for mass balance.

B. Ocean circulation and polar air-sea interactions (sea ice):

1) *For the first time*, L-band SAR mapping of the Arctic ocean and marginal seas, sea-ice cover for leads and ridges.
2) *For the first time*, repeat, fine-resolution SAR mapping of the entire Southern ocean sea-ice cover for ice motion.
3) *For the first time*, SAR and optical fine-resolution mappings of the entire Arctic ocean.
4) Continued, 3-day, medium-resolution SAR mapping of sea-ice covered waters for motion and melt pond coverage.
5) Continued passive microwave observations of sea-ice concentration and extent.
6) Continued, laser and radar altimeter measurements of ice thickness and sea surface topography.
7) Measurements of IPY Polar Geoid.

C. Regional climate, precipitation and hydrology (terrestrial snow cover):

1) Daily medium resolution visible/near IR/TIR observations of all snow covered terrain.
2) Daily passive microwave observations of snow covered terrain for determination of snow water equivalent.

D. Changing permafrost and Arctic climate (permafrost):

1) *For the first time*, one complete high-resolution snapshot of polar permafrost terrain at L, C, and X band.
2) *For the first time*, one complete, high-resolution, visible and thermal IR snapshot of polar permafrost terrain.
3) Continued medium and coarse active and passive, microwave observations of polar permafrost.

E. Aquatic ecosystems, transportation, and hazards (lake and river ice):

1) *For the first time*, pan-arctic, high- and medium-resolution microwave snapshots of freshwater break/freeze-up.
2) *For the first time*, pan-arctic, high- and medium-resolution visible, near IR and TIR snapshots of freshwater break/freeze-up.
3) Seasonal, low-frequency (6-10 GHz), passive microwave observations of lake ice thickness.

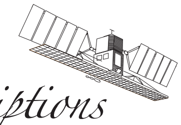
The agency representatives were enthusiastic about the objectives and adopted them as the guiding directives for STG activities. To that end, they have now begun the process of developing data set portfolios. The portfolios will ultimately constitute the IPY legacy data sets acquired by spaceborne instruments. Furthermore, and to better coordinate data acquisitions, the agencies agreed to form two acquisition subgroups – one concentrating on SAR/InSAR observations and one concentrating on high-resolution optical observations.

We believe that GIIPSY is significant for several reasons. First, the spaceborne data are a very important complement to other IPY observations if we are to understand changes in the polar regions and to predict the societal impact and consequences of future changes. Indeed satellite remote-sensing data represent one of the greatest technical measurement leaps beyond those which were available to IGY era scientists. Second, we think this activity provides a unique and very interesting venue for collaboration between the world's space agencies. If successful, we think it can be a prototype for other and grander plans envisioned as part of the Global Earth Observation System of Systems.

The confluence of international science programs, technical capabilities, and IPY present a once-in-a-lifetime opportunity for gathering data essential for understanding changing polar climate and its global impact. We encourage interested scientists to become involved with GIIPSY. This can easily be done by contacting either one of the authors.

ALOS PALSAR Data now Available Through ASF

NASA has created a U.S. Government-sponsored science data Consortium for the purpose of accessing ALOS PALSAR data for research, environmental monitoring, and educational purposes. The initial Consortium members include NASA, NSF and USGS. If you are interested in using ALOS PALSAR data, please submit a proposal to one of the participating agencies through the User—Proposal Application Submission System (U-PASS) system at https://ursa.asfdaac.alaska.edu/upass/cgi-bin/welcome/guest/<https://ursa.asfdaac.alaska.edu/upass/cgi-bin/welcome/guest/>. If you already have an account on the ASF DAAC User Remote Sensing Access (URSA), system then you will be able to login into U-PASS using your user id and password. If you do not already have a user id and password, you may establish one through the U-PASS system by selecting register on the front page. If you have questions, please contact ASF User Services at uso@asf.alaska.edu or (907) 474-6166.



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