# Observing Pole to Pole – A virtual observing system

The Gobal Inter-agency IPY Polar Snapshot Year (GIIPSY) and the IPY Space Task Group

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NASA ICEsat







### Climate Change and the IPY 2007-2008

- The IPY provided an international framework for understanding polar processes and high-latitude climate.
- Spaceborne technology offered unique capabilities for obtaining essential data for predictive models.
- *IPY era spaceborne instrumentation represented a technological leap beyond the capabilities of the IGY*

2000 Modified Antarctic Mapping Mission ice velocity model. A precursor activity to GIIPSY and the STG (K. Jezek) http://bprc.osu.edu/rsl/





### **Cryosphere Satellite Missions**



Solid Colour = R & D mission; Hatched = operational mission

Courtesy: M. Drinkwater

#### Global Interagency IPY Polar Snapshot Year (GIIPSY)





The 1957 IGY began the rigorous scientific investigation of the Polar Regions.

The 2007-08 IPY goes beyond the IGY through the numbers and capabilities of earth observing satellites. These systems can routinely observe the poles and cast polar processes within the context of the global environment.

In November 2005, the Global Interagency Polar Snapshot Year (GIIPSY) project was established to develop consensus requirements on polar science objectives that could best and perhaps only be met with Earth observing satellites



## GIIPSY Strategy



- Work with the science community to compile IPY science data requirements
- Identify those requirements which will be satisfied through routine operations (eg MODIS, MERIS, SSMI/I, AMSR-E, AVHRR)
- For routine observations, work with flight agencies to assure that data are available/archived in some standardized fashion
- Identify those requirements that can only be satisfied by non-routine tasking, processing and distribution. Work with the flight agencies to acquire these data in a fashion that distributes the operational load.
- Following selection of projects through the national A.O.'s, identify whether any legacy data sets are absent from the acquisition plans. Make necessary requests.
- GIIPSY science requirements and related documentation are posted at www.bprc.osu.edu/rsl/GIIPSY



### **IPY Space Task Group (STG)**

The STG is the body tasked with addressing how to meet IPY space observation requirements developed by GIIPSY.

The STG was established by the WMO/ICSU IPY Joint Committee to coordinate agency planning, processing and archiving of IPY Earth observation legacy data sets.

It is comprised of nominated representatives from Brazil, Canada, China, France, Germany, Italy, Japan, Russian Federation, United Kingdom, United States, and both the European Space Agency and The European Organization for the Exploitation of Meteorological Satellites, the later two of which alone represent 26 nations.

STG coordinates across CEOS and CGMS Agencies.



World Meteorological Organization



## STG Strategy

•Satisfy GIIPSY science requirements in a fashion that distributes the acquisition and processing loads across agencies

•Select projects that are compatible with the operational mandates of individual agencies and commercial partners

Encourage participation of other nations as additional polar observation capabilities are developed
Identify a limited number of the most important scientific objectives achievable within the STG framework and within the IPY time period.

Participating International Space Agencies: ASI, CSA, CMA, CNES, DLR, ESA, EUMETSAT, INPE, JAXA, NASA, NOAA, ROSHYDROMET, WMO, WCRP-CLiC



Daily sea ice concentration for Dec. 09, 2009. Courtesy of National Snow and Ice Data Center/NASA Earth Observatory



## STG Goals

The STG initially accepted 4, primary objectives based on the GIIPSY requirements. Polar meteorology and atmospheric chemistry goals were later added.

- Pole to coast multi-frequency InSAR measurements of ice-sheet surface velocity.
- Repeat fine-resolution SAR mapping of the entire Southern Ocean sea ice cover for sea ice motion.
- One complete high resolution visible and thermal IR (Vis/IR) snapshot of circumpolar permafrost.
- Pan-Arctic high and moderate resolution Vis/IR snapshots of freshwater (lake and river) freeze-up and break-up.

TerraSAR-X image of Leverett Glacier and the South Pole Traverse Route



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## Multisensor data provide new views of the polar ice sheets



COSMOS-SKYMED observation of the Wilkins Ice Shelf Break up



SPOT stereo digital elevation model from CNES SPIRIT project. Hoffsjökull Ice Cap, Iceland









Agency

Canadian Space Agence spatiale canadienne

archived and distributed through ASF, and processed by the University of Washington under contract to NASA

1.0 m/d DLR Canadian Space Agence spatiale Agency canadienne



Recovery Glacier and Continental Scale Observations of Antarctica

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#### 2008 Arctic sea ice extent



2007: lowest minimum 2008: second lowest minimum

Lein Part



mosaics

ENVISAT

#### **ASAR**

Global Monitoring Mode (GMM) – 1km resolution Antarctica monthly sea ice extent

Repeat fine-resolution SAR mapping of the entire Southern Ocean sea ice cover for sea ice motion.





### **Visible/IR Image Mosaics of the Poles**



courtesy Brockmann Consult

SPOT VGT 1km daily mosaics (courtesy CNES)

http://igeo.de/ImageOfTheDay/SAE\_05-06/index.htm

http://www.vgt.vito.be/VEGETATION%20samples/album/poles/index.html



One complete high resolution visible and thermal IR (Vis/IR) snapshot of circumpolar permafrost.





### ALOS: AVNIR-2 (10m) & PRISM (2.5m)

Acquired

Acquired



New circumpolar and Antarctic data sets from ALOS sensors at 10 and 2.5m





## Arctic Optical Coverage



Envisat - MERIS - 300m optical image of Arctic tundra



## Circumpolar Cloud Free Mosaics



Corrected for BRDF & cloud effects (courtesy, Government of Canada, Natural Resources Canada, Earth Sciences Sector and Canadian Space Agency)



Canadian Space Agence spatiale Agency canadienne

http://ess.nrcan.gc.ca/ercc-rrcc/proj3/theme6/index\_e.php



### River Ice & Ice Jam Monitoring

Pan-Arctic high and moderate resolution Vis/IR snapshots of freshwater (lake and river) freezeup and break-up.



Alternating polarisation mode ASAR data



January 11, 2008

Courtesy PolarView



http://www.polarview.org/services/rim.htm

#### Direct Broadcast (Readout) MODIS and AVHRR Winds





- Aqua, Terra, AVHRR winds are generated separately
- Data source is direct readout (broadcast)
- 1 km MODIS and AVHRR remapped to 2 km.
- Cloud-track and water vapor (MODIS) winds
- NCEP's GFS is used as the background.
- Pros: Low latency; high resolution.
- Cons: Incomplete polar coverage.





# Continued atmospheric composition measurements, e.g., ozone (O3) and bromium monoxide (BrO)



http://www.iup.uni-bremen.de/doas/polarcat.htm











## Summary



- The STG has contributed fundamentally to IPY by ensuring inter-Agency coordination needed to acquire a critical 21<sup>st</sup> century climate benchmark dataset necessary to meet IPY Science goals
- IPY satellite Legacy dataset is multi-dimensional and spans data from 14 space agencies.
- The Space Task Group mechanism is itself an IPY legacy and a model for future coordination of polar and cryospheric Earth observations



#### What Next?



Establish a path for securing future collections of spaceborne snapshots of the poles through development of a Polar virtual constellation

The WMO Global Cryosphere Watch could be a vehicle for achieving that objective.

How would a reconstituted STG operate in a new framework? Would there be expanded scientific objectives? What would be the extent of the planning window?

What would be the new functional link to the science community.

An open forum for discussing the STG and future directions will be held immediately following the last T5-5 session. Please plan to attend!



