The Development of a U.S. Arctic Observing Network (AON) and its Integration with International Observing Systems

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Arctic Observing Network: Supporting Arctic System Science & Enabling Understanding and Response to Arctic Change

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Impact of an Ice-diminishing Arctic on Naval and Maritime Operations
10-12 July 2007, Washington, DC

Significant and Rapid Change Is Occurring in the Arctic

- Area and elevation of melting on the Greenland ice sheet have increased.
- Glacier area, thickness and volume in Alaska have decreased.
- Shrubs and “greenness” have increased on the North Slope of Alaska.
- Boreal forest “greenness” has decreased and fires have increased.
- Permafrost temperatures have risen and thawing is occurring.
- Eurasian rivers’ discharge into the Arctic Ocean has increased.
- Heat flux of Pacific water flowing into Arctic Ocean has increased.
- Salinity of the surface layer of the Beaufort Gyre has decreased.
- **Sea ice extent, thickness and volume have decreased.**

Consensus for an Observing Network for a Changing Arctic

- 2003: Schlosser and others. *Arctic Research Support and Logistics: Strategies and Recommendations for System-Scale Studies in a Changing Environment*.
  - Major Recommendation: Create a blue-ribbon panel with staff and support to develop a plan for creation of an **Arctic Observing Network** to support Arctic System Science.
- 2004: *A U.S. Vision for the International Polar Year (*National Academies, Polar Research Board) recommends that IPY "should be used as an opportunity to design and implement multidisciplinary **polar observing networks** that will provide a long-term perspective."
- 2005: *SEARCH: Plans for Implementation During the International Polar Year* - a point of reference for immediate planning in preparation for IPY and an **Arctic Observing Network**.
- 2006: *Toward an Integrated Arctic Observing Network (*National Academies, Polar Research Board) - the blue ribbon panel recommends that an **Arctic Observing Network** should be initiated immediately to take advantage of IPY.

SEARCH

Study of Environmental Arctic Change

Atmosphere, Oceans & Sea Ice
Hydrology & Cryosphere, Terrestrial Ecosystems
Human Dimensions, Paleo-environment, Data

Observing

↓

Understanding
analysis, synthesis & modelling

↓

Responding

ISAC: International Study of Arctic Change

AON & SEARCH

Changes in the Arctic are large and rapid, and current observing capabilities are not adequate to:

(1) record the full suite of system-wide changes underway;

(2) enable understanding of the causes and consequences of the changes;

(3) enable prediction of the course, magnitude and consequences of future changes; and

(4) develop adaptive responses to future change.

The Arctic is changing and we are not well-prepared.

NSF FY06 IPY Proposal Solicitation
AON was one of three research focus areas

AON Awards
(organized according to the number of projects in each SEARCH Implementation Plan category)

Atmosphere …….	4
Oceans & Sea Ice …….....	9
Hydrology & Cryosphere ……...	2
Terrestrial Ecosystems ……..	2
Human Dimensions ……..…….	2
Data ……..	2
	Σ = 21

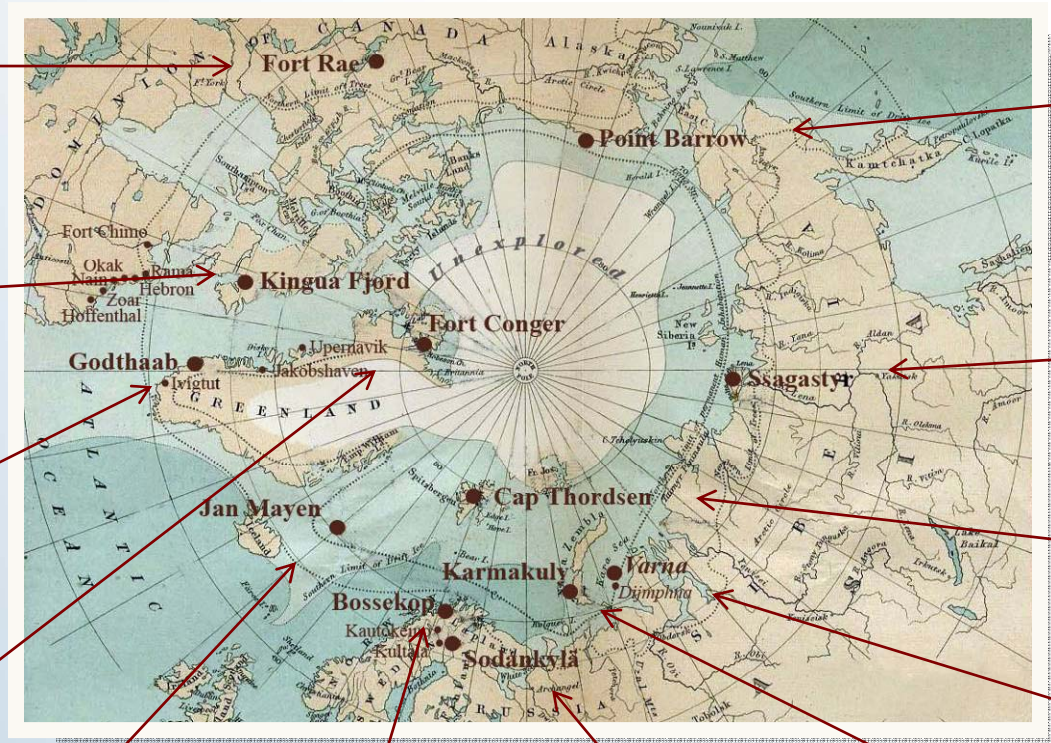
21 IPY projects
~$37M during FY06 – FY09

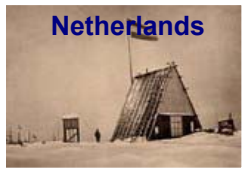
Long-term Observing in the Arctic Prior to IPY

NSF has been funding long-term observing (LTO) projects in the Arctic since 2003. Examples include: North Pole Environmental Observatory; Beaufort Gyre Observatory; Circumpolar Environmental Observatories Network. The twelve LTO projects are now an integral part of AON, which has a total of 34 projects distributed among the SEARCH categories as follows:

SEARCH Category	IPY	LTO	**AON**
Atmosphere …….	4	3	**7**
Oceans & Sea Ice ……....	9	7	**16**
Hydrology & Cryosphere ……...	2	2	**4**
Terrestrial Ecosystems ……...	2	1	**3**
Human Dimensions ……..…….	2	0	**2**
Data …….	2	0	**2**
	Σ = 21	13	**34**

The First AON - IPY, 1882-83





12 primary stations
12+ auxiliary

The contents of this slide courtesy of Kevin Wood, University of Washington, and Jim Overland, NOAA-PMEL, Seattle.

NSF IPY Observing: Oceans & Sea Ice

BSSN
(Aleut Int'l Assoc., UAA)

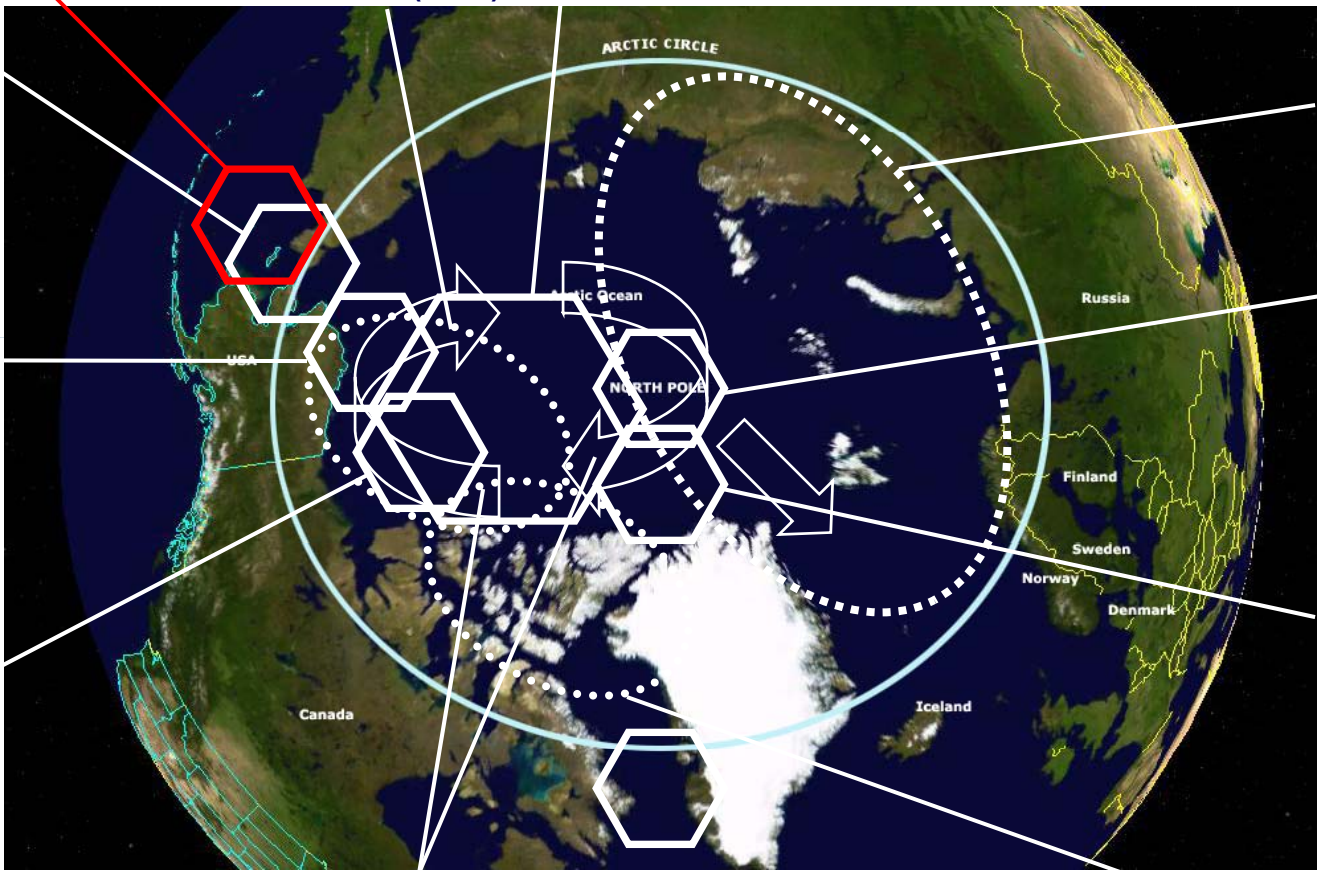
C3O: Canada's Three Oceans (CDN)

Aerial Hydrographic Surveys *(UW, WHOI ...)*

Bering Strait
(UW, UAF, NOAA, Russia)

Seasonal Ice Zone
(UAF, CRREL, DAMOCLES)

Beaufort Gyre Observatory & Deepest Waters
(WHOI)



DAMOCLES
(EU)

North Pole Environ-mental Observatory
(UW ...)

Switchyard *(Columbia ...)* ***& Seasonal Ice Zone***
(UAF, CRREL, DAMOCLES)

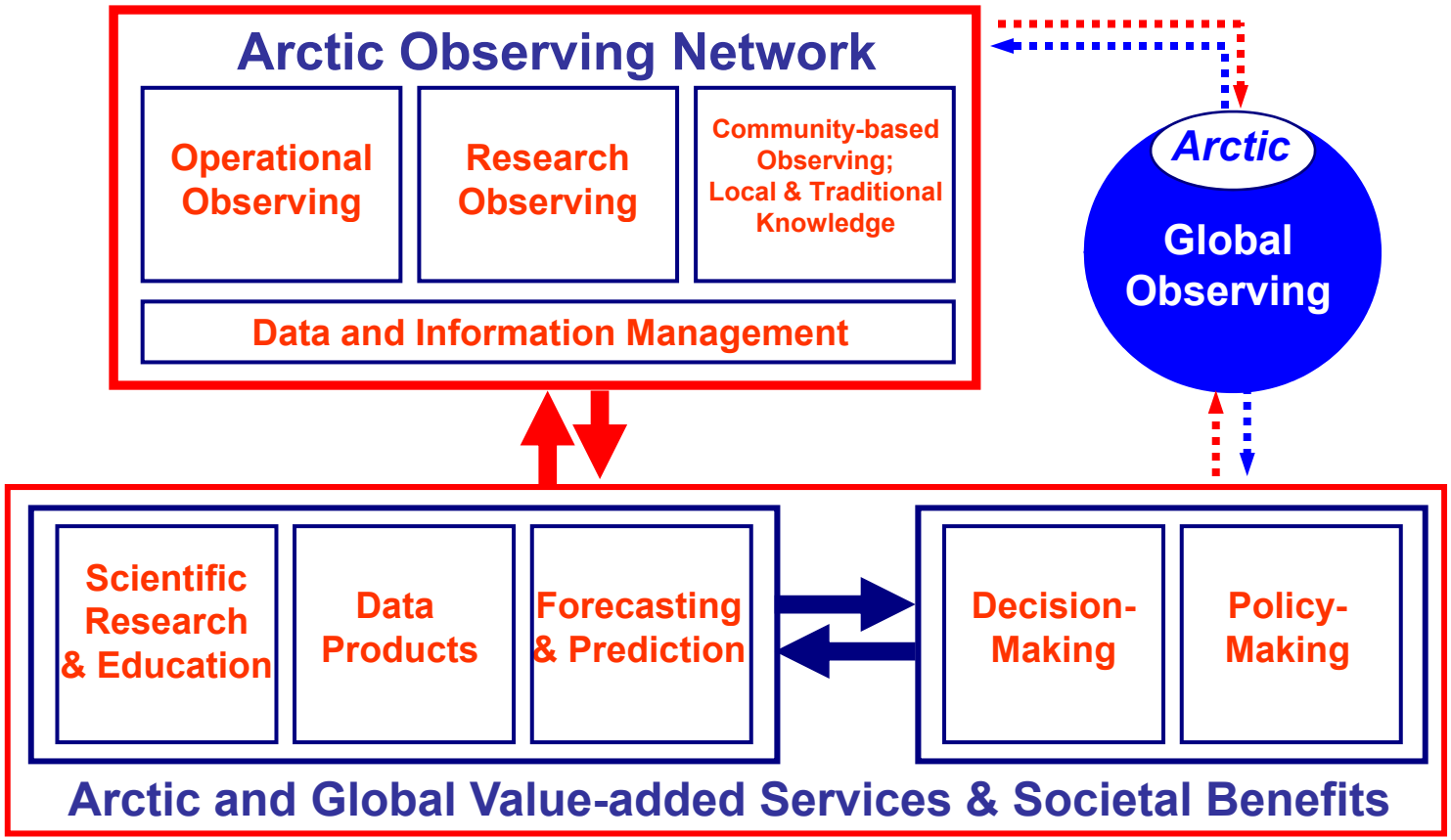
Ice-Tethered Profilers *(WHOI, NPS)* ***& Ice Dynamics, Mass Balance and Weather Buoys***
(CRREL, IABP, DAMOCLES ...)

Davis Strait
(UW, BIO-CDN, DAMOCLES)

OCAC: Ocean Currents of Arctic Canada (CDN)

DAMOCLES: Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies

AON: A Framework



Through exchanges and flows of data and information, Arctic observing will yield value-added services and societal benefits of regional and global importance, and contribute to comprehensive observation of the Earth system.

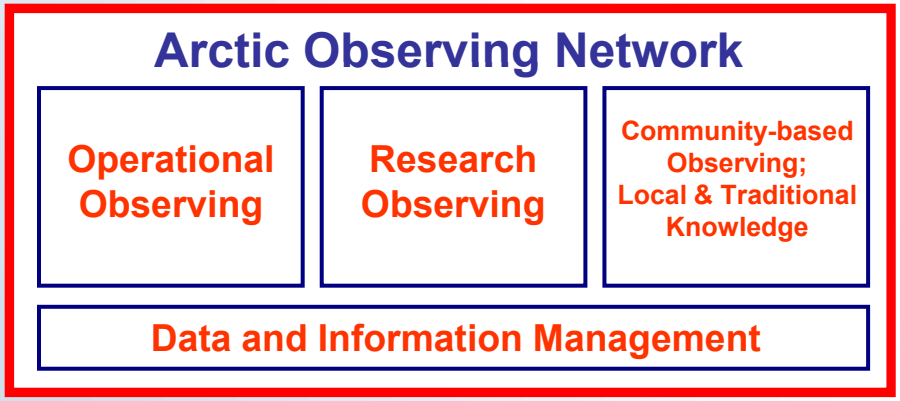
AON & SEARCH: A US Federal Inter-agency Program

SEARCH is a US federal inter-agency program, and numerous agencies have Arctic observing assets and capabilities to contribute to the Arctic Observing Network.

Those agencies include NOAA (e.g., weather stations and satellites, incl. DMSP [DoD]), NASA (e.g., earth observation satellites), USGS (e.g., river gauges, glacier monitoring), NPS (e.g., Inventory and Monitoring Program-Arctic Network).

As the lead agency for SEARCH and the Inter-agency Arctic Research Policy Committee, NSF is working with NOAA to develop an AON Implementation Plan that will identify current observing assets, assess future needs, and improve coordination among research and operational agencies as a lasting legacy of IPY.

- NSF - NASA
- Commerce (NOAA)
- Interior - Defense
- Agriculture - HHS
- Homeland Security
- Transportation - EPA
- Smithsonian - NEH



- State of Alaska
- Alaska Ocean Observing System
- North Slope Science Initiative

AON & SEARCH: International Connections

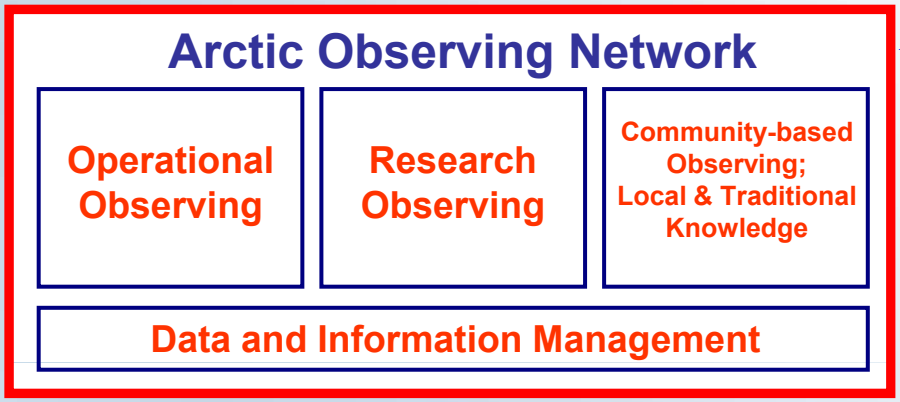
Identifying current observing assets, assessing future needs, and improving coordination is also an international challenge that must include all the Arctic nations, and the many nations outside the Arctic that have a strong Arctic research tradition and a vital role to play in Arctic observing.

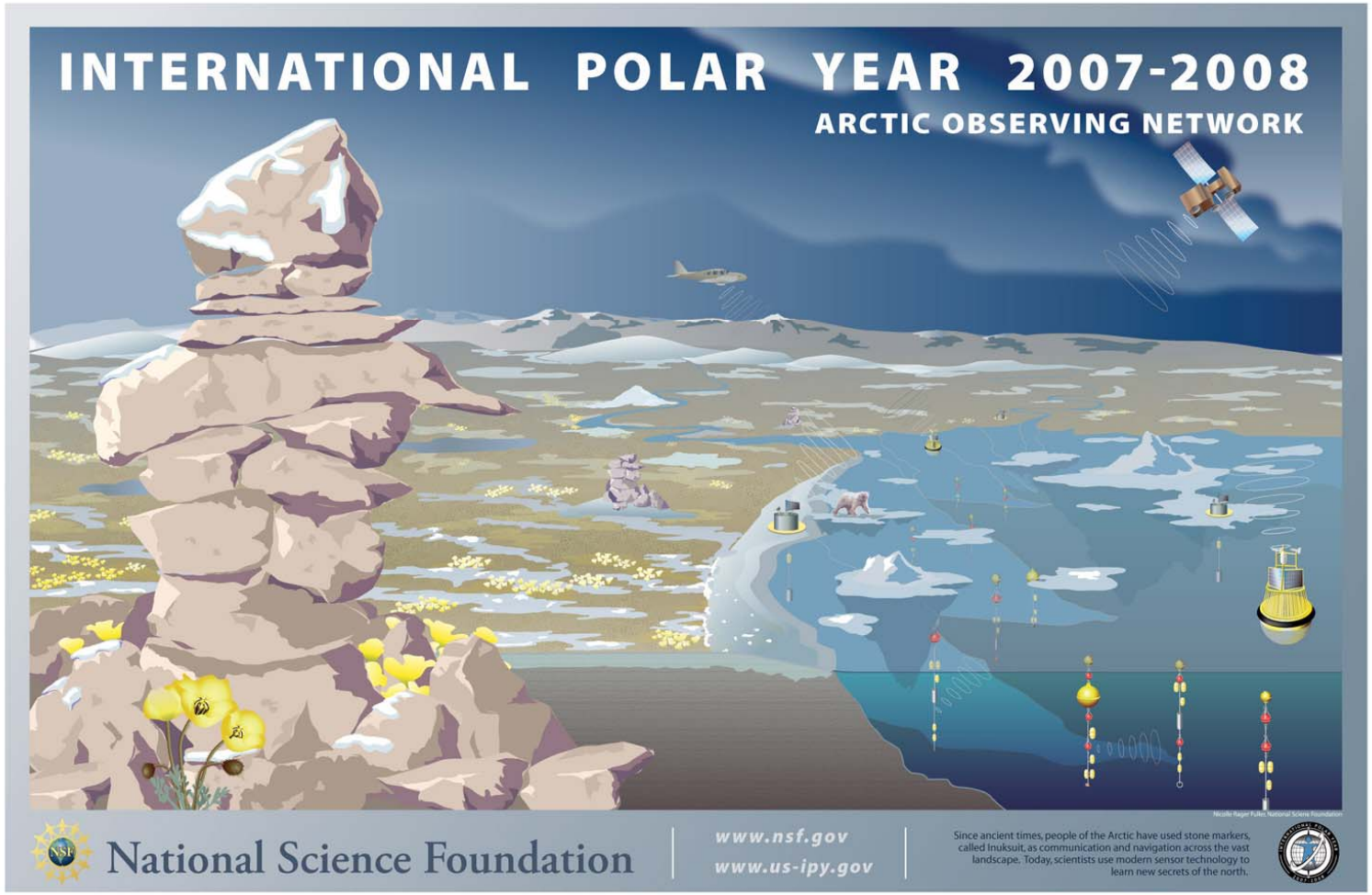
NSF is helping to meet this challenge through

promotion of international cooperation in science-driven observing that will enable better understanding and response to Arctic Change (ISAC: International Study of Arctic Change); and

participation in the Sustained Arctic Observing Network-Initiating Group (SAON-IG).

CSA – Canada; ESA – Europe
RKA –Russia; JAXA – Japan
ISRO – India; CNSA – India
NASA, NOAA, DoD (NPOESS)





The End

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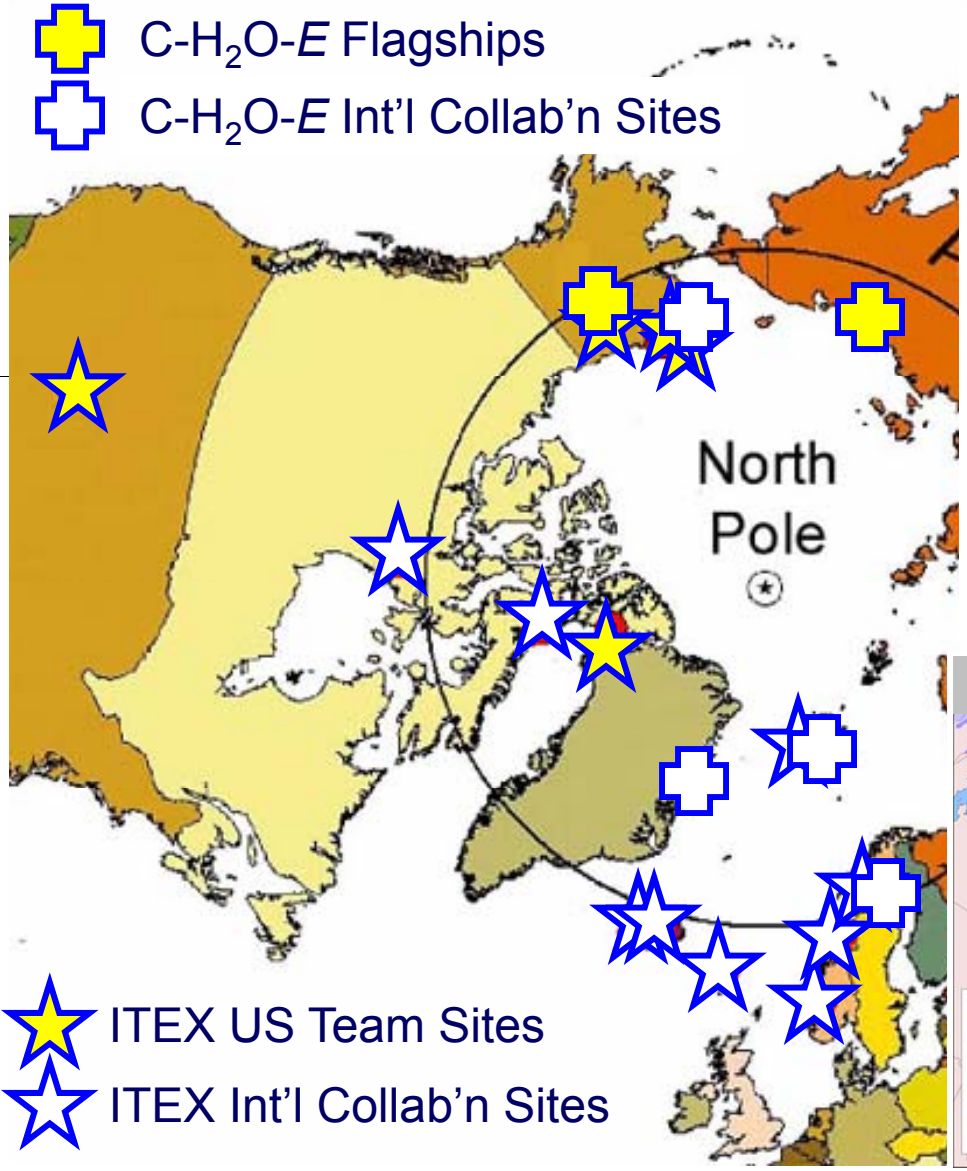
NSF IPY Observing: Terrestrial Ecosystems & Permafrost

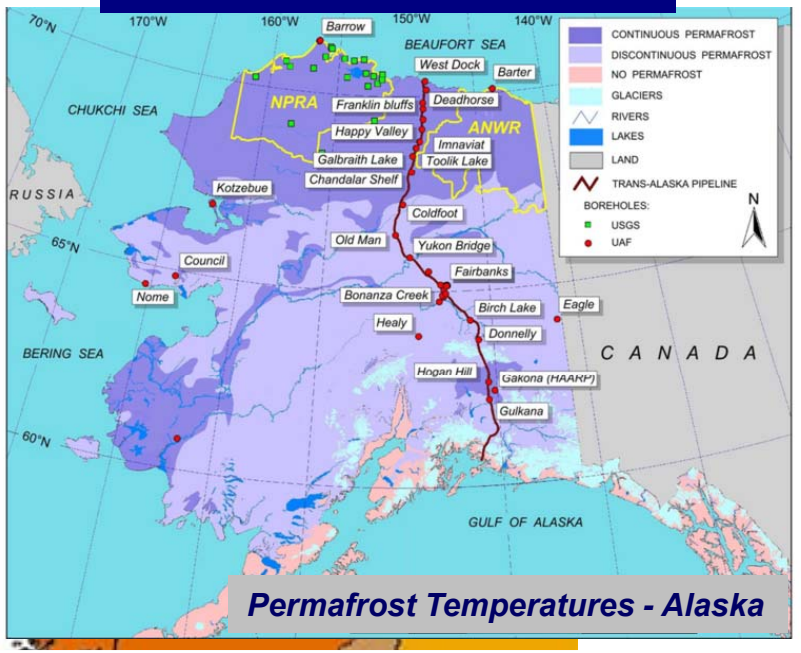
C-H_2O-*E* Flagships

C-H_2O-*E* Int'l Collab'n Sites



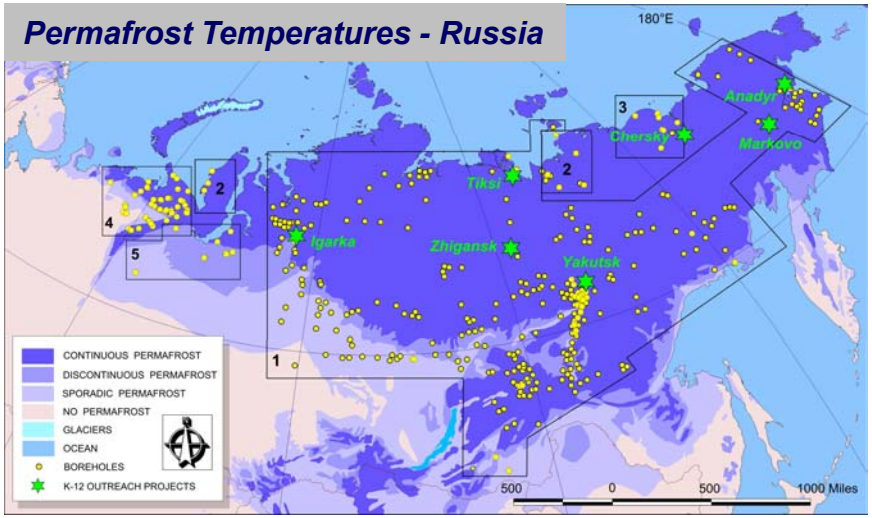
ITEX US Team Sites

ITEX Int'l Collab'n Sites



Permafrost Temperatures - Alaska

Permafrost Temperatures - Russia



NSF IPY Observing: Atmosphere

IASOA: International Arctic Systems for Observing the Atmosphere

Coupled Tropospheric, Stratospheric and Mesospheric Circulation

Cloud properties from surface and satellite measurements

Core measurements at Summit

O-Buoys for Atmospheric Chemistry