



State of the Science: A View From AOSB

**Marine Working Group of the International
Arctic Science Committee (IASC)**



Background

In 2009, IASC and AOSB merged to create a single Arctic Science organization covering all fields of research in the Arctic. AOSB, or the Marine Working group of IASC, is one of five Working Groups. The others are:

Atmosphere
Social
Terrestrial
Cryosphere

The IASC mission is to encourage, facilitate and promote leading-edge multi-disciplinary research to foster a greater scientific understanding of the arctic region and its role in the Earth system.





AOSB/IASC Members

 Canada


 China

 Denmark

 Finland

 France


 Germany

 Iceland


 Italy

 Japan

 The Netherlands

 Norway


 Poland


 Republic of Korea


 Russia

 Spain

 Sweden

 Switzerland

 United Kingdom

 United States of America



The IASC member organizations are national science organizations covering all fields of Arctic research. Working Group members are scientists or science managers within members countries.



AOSB a part of the whole

AOSB is just one international organization involved in Arctic Marine Science activities.

ISAC

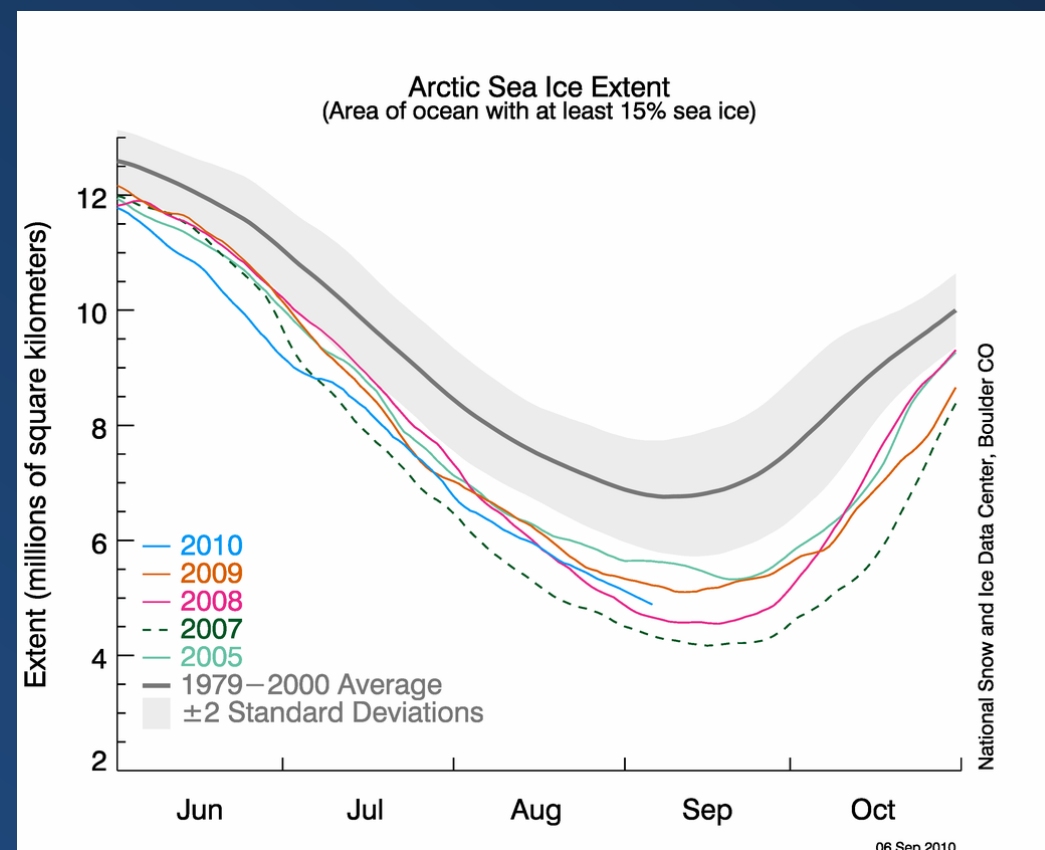
SAON

WCRP-CiC

Plus you have innumerable national, bilateral and regional activities ongoing to better understand the state of the Arctic.

State of the Science

The Arctic Ocean is in a state of transition with tremendous economic, social and environmental consequences. This is best exemplified by the marked reduction in sea-ice cover witnessed in instrumental records over the last 30 years. So what are AOSB's objectives in the coming years?



Source: National Snow and Ice Data Center, <http://nsidc.org/arcticseaicenews>



Physical Oceanography

The Integrated Arctic Ocean Observing System (iAOOS)

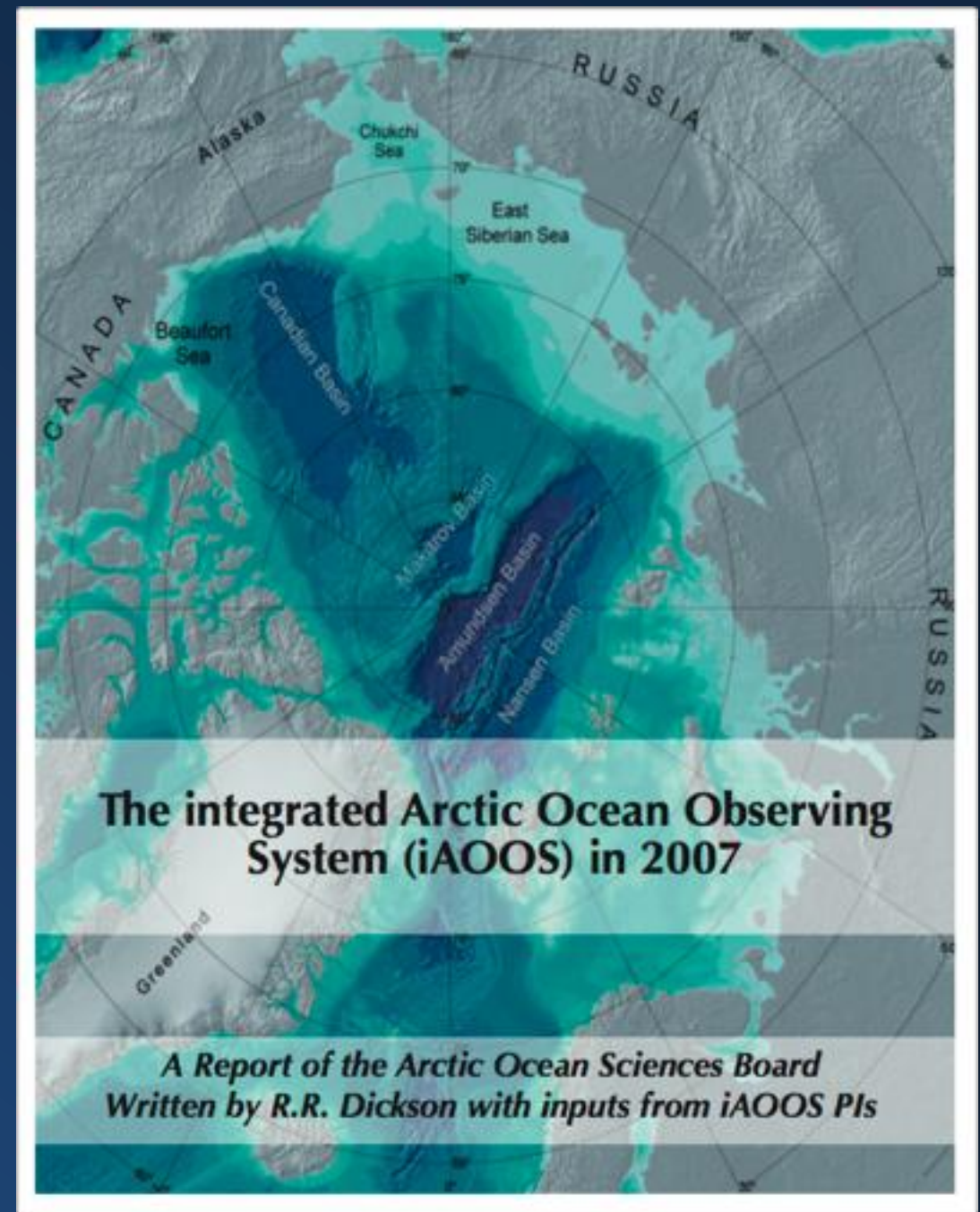
AOSB's Flagship IPY program.

Observing our Northern Seas during the International Polar Year.

Based on 1500 IPY Expression of Interests focused on the present state and future fate of the Arctic Ocean perennial sea ice.

Largely physical oceanography. Three reports publishing results.

Not a funded program but a pan-arctic framework for study.





Physical Oceanography

WHAT IS THE PLAN FOR THE FUTURE

- 1) *Following the IPY, how would we now define the role of the Northern Seas in Climate?*
- 2) *What questions should we be testing to help us understand that role?*
- 3) *How should we design an ocean observing system to test these questions?*

<http://aosb.arcticportal.org/pdf/AOSB-JC.pdf>

Based on conversations with many colleagues, Dr. Robert Dickson, on behalf of the AOSB, suggests 3 *issues* led as follows.



1. Sorting out the inflows. **Bert Rudels**, Precision ship-based oceanography. Theta-S! Precisely-placed arrays

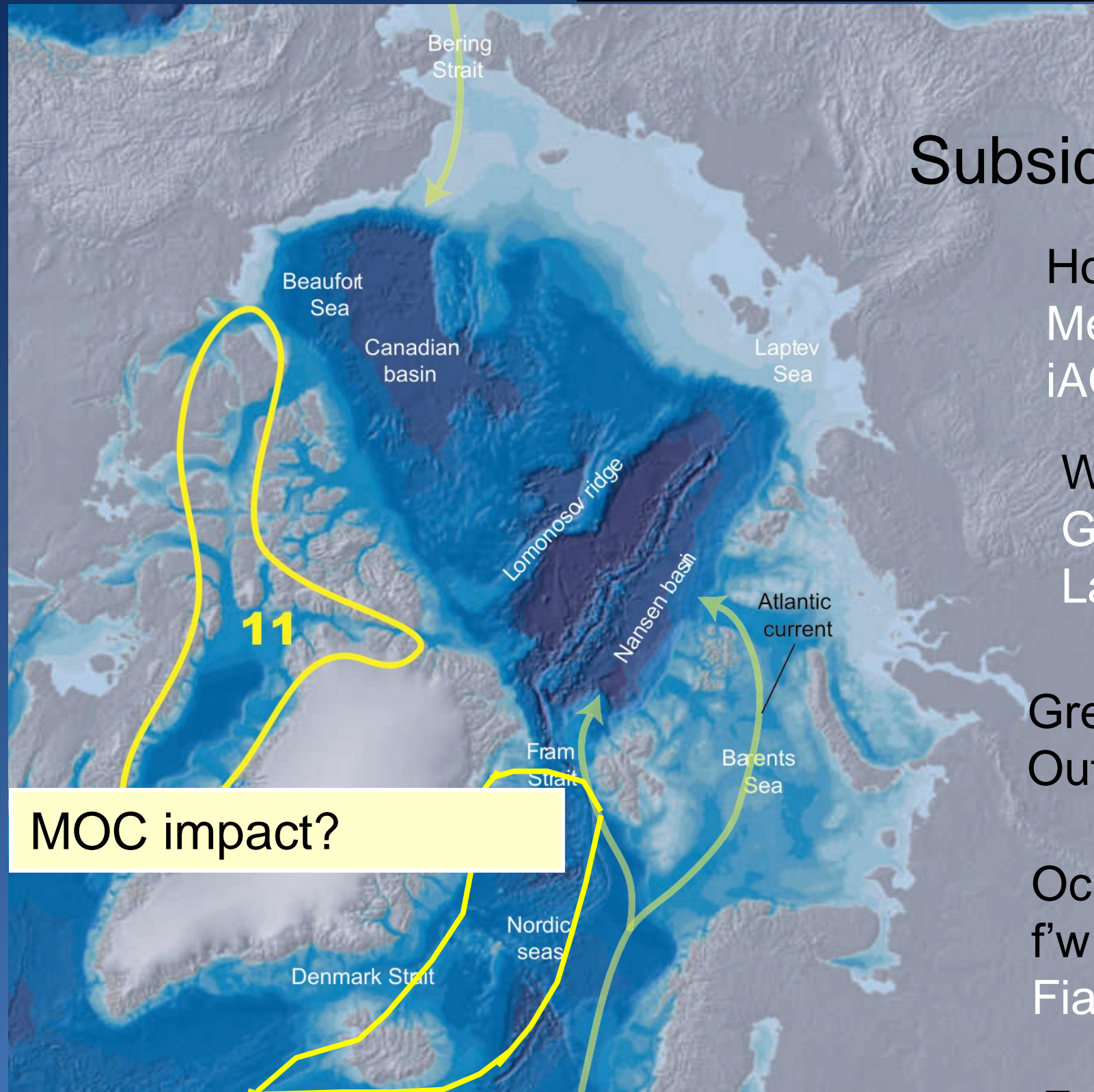
2. Coping with change in the Arctic watercolumn, **Craig Lee**, Clever, adaptive observing systems



3. Revitalising our ideas about Greenland, freshwater and the MOC'. **Tom Haine and ASOF-2**, Novel observing techniques, theory, modelling



Issue 3. Revitalising our ideas about Greenland, freshwater and the MOC



Subsidiary questions are:

How much? Craig Lee, Humfrey Melling, Simon Prinsenberg, iAOOS for Norway Q11

Which side? Ruediger Gerdes, Alexandra Jahn, Laura de Steur Q10

Greenland f'w impact on CAA Outflow? Bert Rudels Q11

Ocean Impact on Greenland f'w production? Kelly Falkner Fiamma Straneo Q16

Future impact on MOC? Tom Haine & ASOF-2

State of the Science

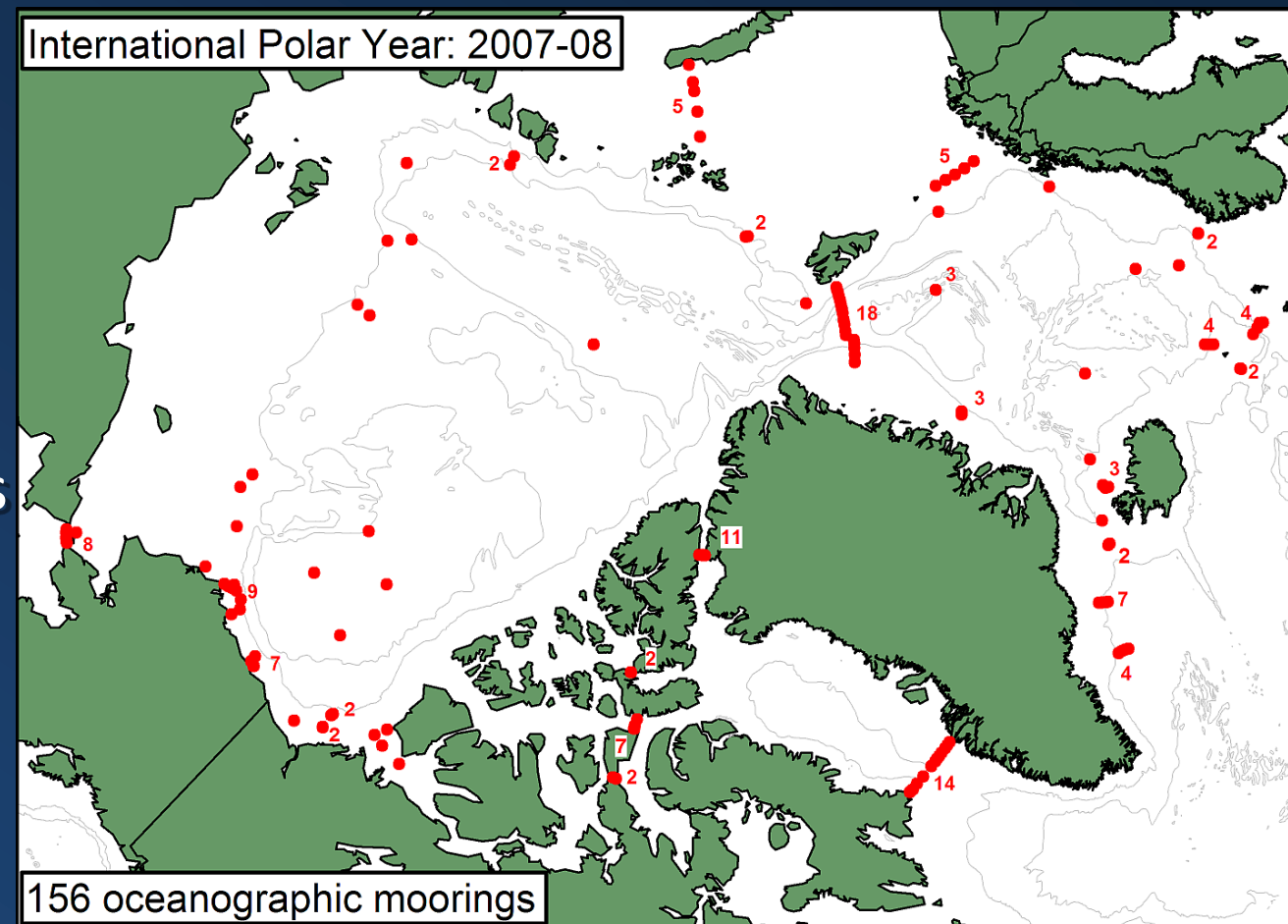
An IPY Synthesis

Recognizing the truly unprecedented number of observations of the Arctic Ocean during the IPY

- 173 moorings
- Many ship-based CTD sections and stations
- Ice-based water column profiles

AOSB is initiating an international synthesis and possible modeling project

- Create integrated data set
- Create 4-D depiction of state of Arctic Ocean during IPY
- Improve Arctic Ocean models, perform reanalysis, and develop forecast models



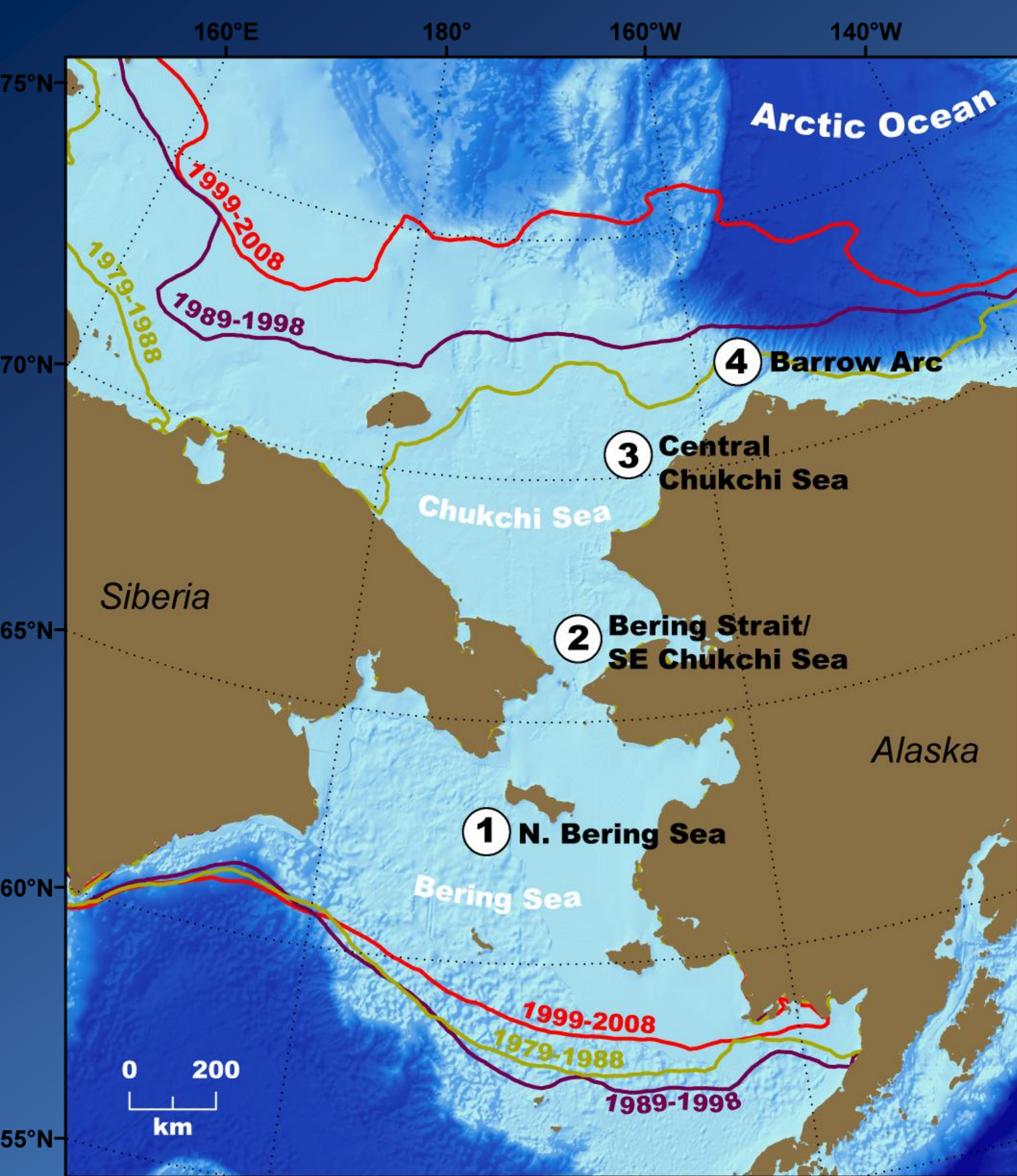
The 156 moorings in place in the IPY is an improvement on the iAOOS plan, covering all gateways and now including some sites that have been needed for some time ---Svinoy, NE Barents Sea, EGC etc



Biological Oceanography

Distributed Biological Observatory (DBO)

The DBO is designed as a change detection array for the identification and consistent monitoring of biophysical responses in pivotal geographic areas that exhibit high productivity, biodiversity and rates of change. A pilot program of this array is being undertaken in 2010 in the Pacific Sector of the Arctic.



Linking Physics & Biology: the Distributed Biological Observatory (DBOs) Concept

- The DBO will focus on four regional “hotspot” locations along a latitudinal gradient
- DBO regions exhibit high productivity, biodiversity, and overall rates of change
- The DBO will serve as a *change detection array* for the identification and consistent monitoring of biophysical responses

[map courtesy Karen Frey; further details see Grebmeier et al. 2010, EOS 91(18):161-162]

[courtesy Karen Frey]

“Vision” for Distributed Biological Observatory

Core standardized ship-based sampling:

- CTD
- Chlorophyll
- Nutrients
- Ice algae/Phytoplankton (size, biomass and composition)
- Zooplankton (size, biomass and composition)
- Benthos (size, biomass and composition)
- Seabird (standard transects, no additional shiptime)
- Marine mammal observations (no additional ship time)

“Change detection array” – same measurements every year, process information in near real time <6 mos; detect regime shifts in rapid changes

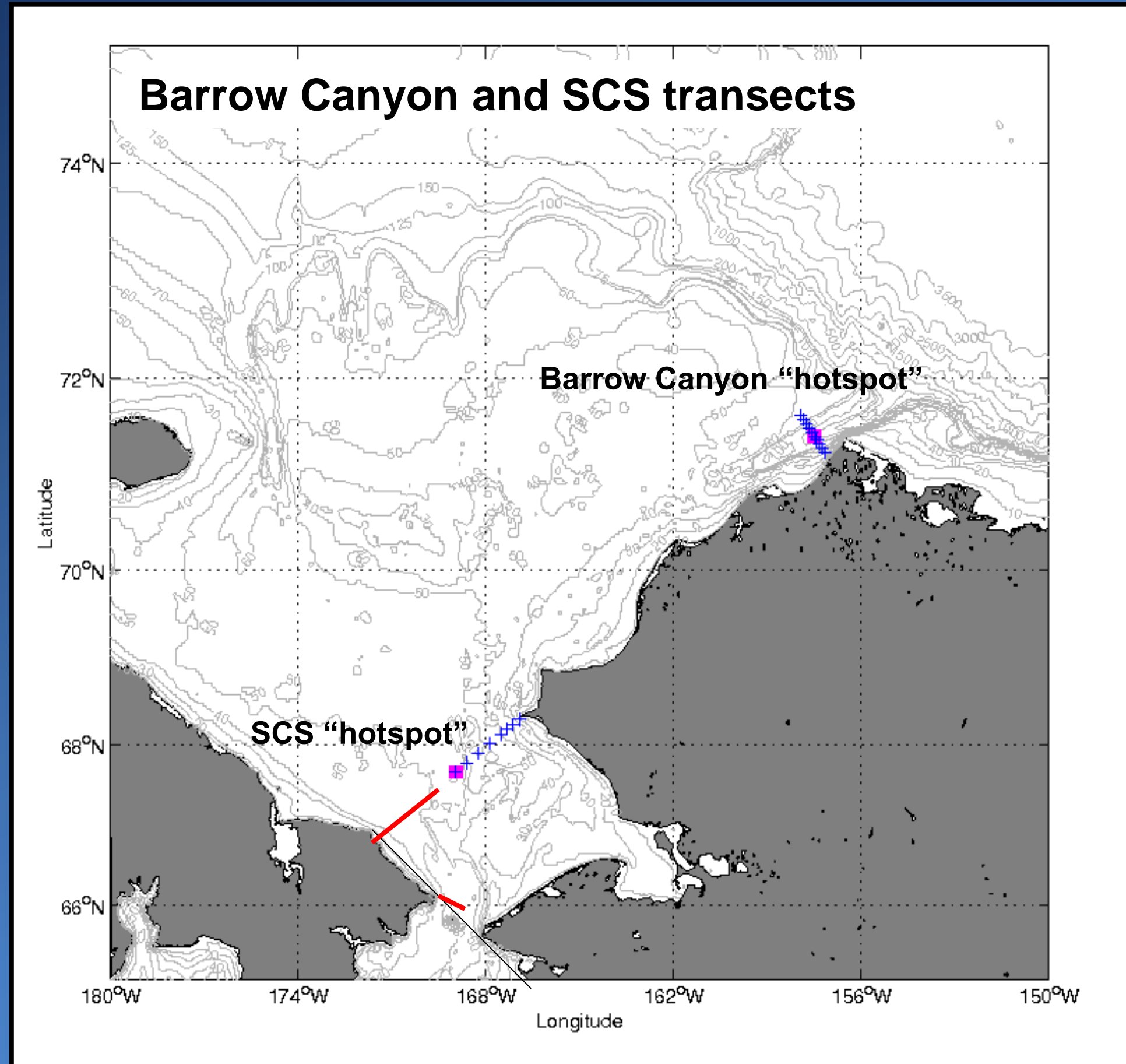
Second tier ship-based sampling:

- Fishery acoustics (less effort than standardized bottom trawling)
- Bottom trawling (every 3-5 years)

Additional leveraged programs both domestic and international

- 2010 PAG pilot program for DBO
- international ship programs will occupy two DBO hotspot and transect lines
- 9 cruises in area 2010
- GPS locations standard for sequential cruise sampling
- CTD data plots passed real-time to subsequent cruise for “time slice” for select measurements

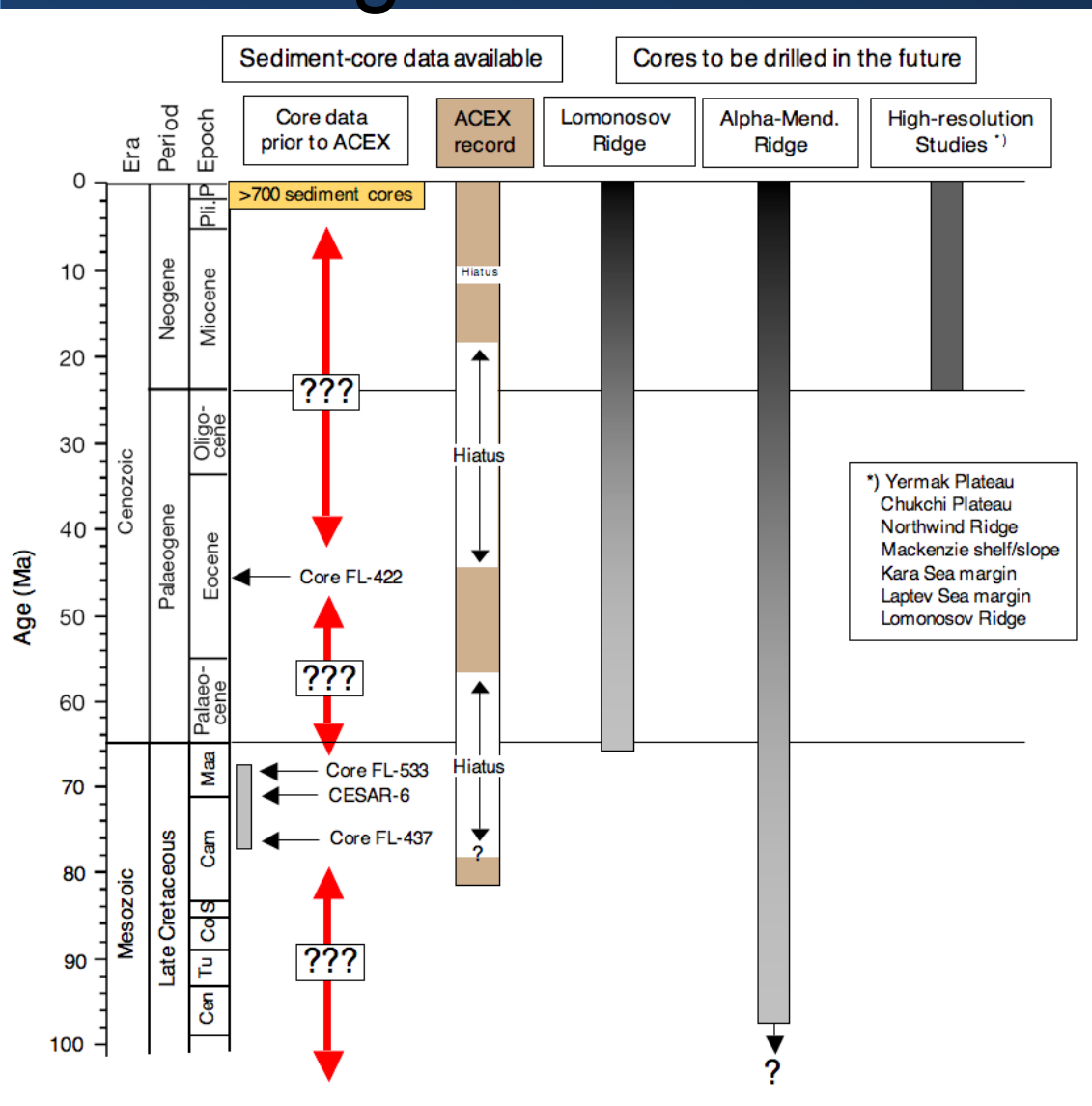
RUSACA-variable





State of the Science Deep Basin Drilling

Existing Core Records



AOSB is exploring ways to promote drilling based on proposal already submitted to the IODP. The vast number of IODP proposals and institutional bias against drilling in the Arctic, make it necessary to explore ways on how best to get seismic surveys in the increasingly ice-free waters in the Arctic which will lead to a better understanding of the best locations for future drilling expeditions there.



State of the Science A Systems Approach



The ART Initiative is an integrative, international, multi-disciplinary, long-term pan-Arctic program to study changes and feedbacks among the physical and biogeochemical components of the Arctic Ocean and their ultimate impacts on biological productivity.



Overarching Scientific Questions

Sea Ice and Past Transition

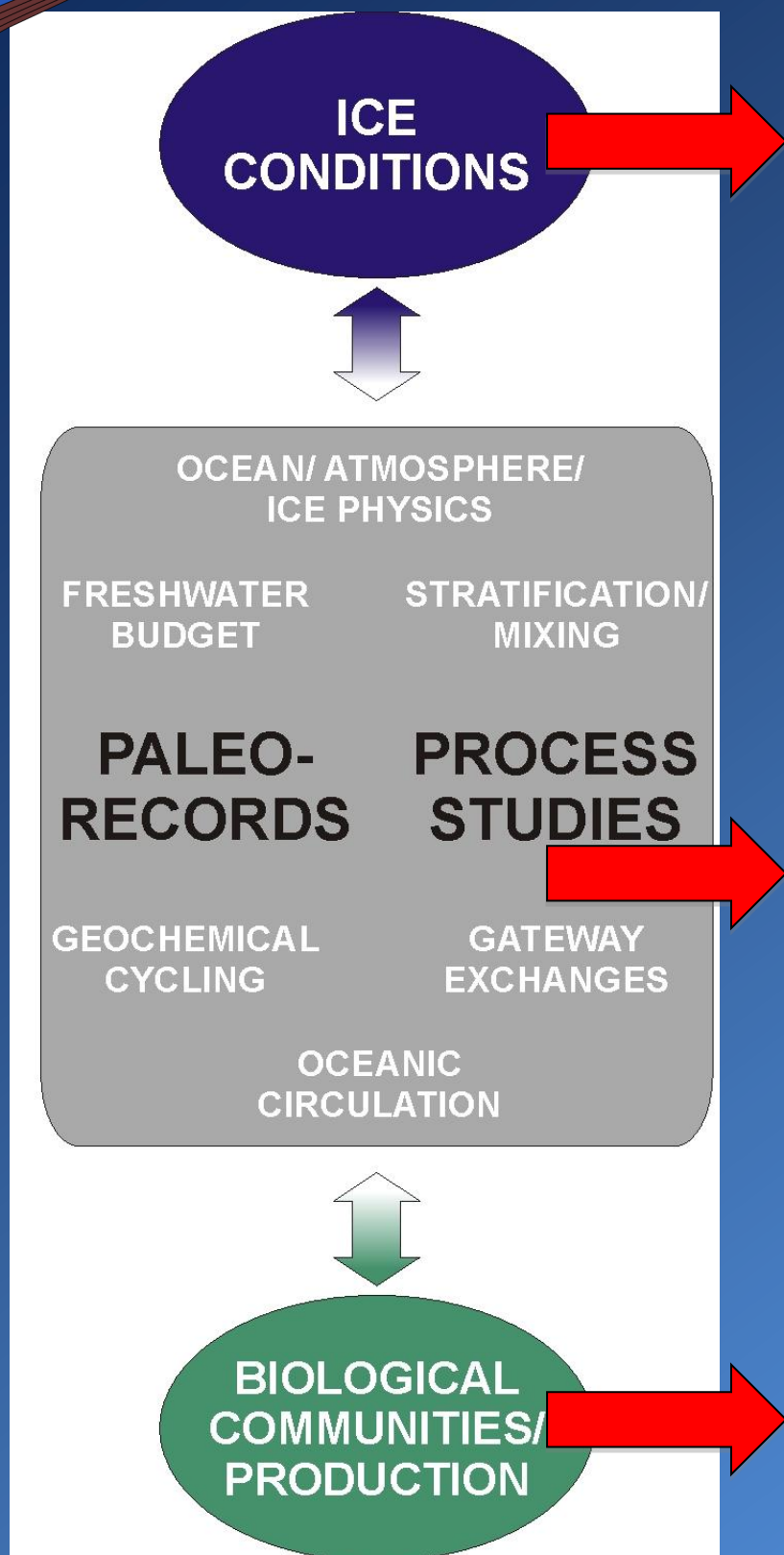
- How were past transitions in sea ice connected to energy flows, elemental cycling, biological diversity and productivity, and how do these compare to present and projected shifts?

Land-Ocean-Gateway Interactions

- How will biogeochemical cycling respond to transitions in terrestrial, gateway and shelf-to-basin fluxes?

Ecosystem and Organisms

- How do Arctic organisms and ecosystems respond to environmental transitions including temperature, stratification, ice conditions, and pH?





State of the Science A Systems Approach

The ART Science Plan is available on the AOSB web site at <http://aosb.arcticportal.org/art.html>.

A workshop to develop the ART implementation plan will be held in Winnipeg, Canada on October 18-20. About 10 early career scientists and 10 senior scientists will come together to develop an international implementation plan which will be presented to the AOSB in March. The workshop serves two purposes, to train early career scientists in the science planning process and to develop an implementation plan that will facilitate funding from multiple funding agencies in various countries.

