Development of a Distributed Biological Observatory (DBO) to monitor ecosystem change in the Pacific Arctic

Linking Biology to Physics in an Arctic Ocean Observing System

Outline/Authors

The Physics
Sea Ice is in a 'New State' in the Pacific Arctic Region

John Calder, NOAA OAR

Gillian Lichota, NOAA OAR

The Biology
Observed & Anticipated Biological Responses

Sue Moore, NOAA S&T

Jacqueline Grebmeier U MD

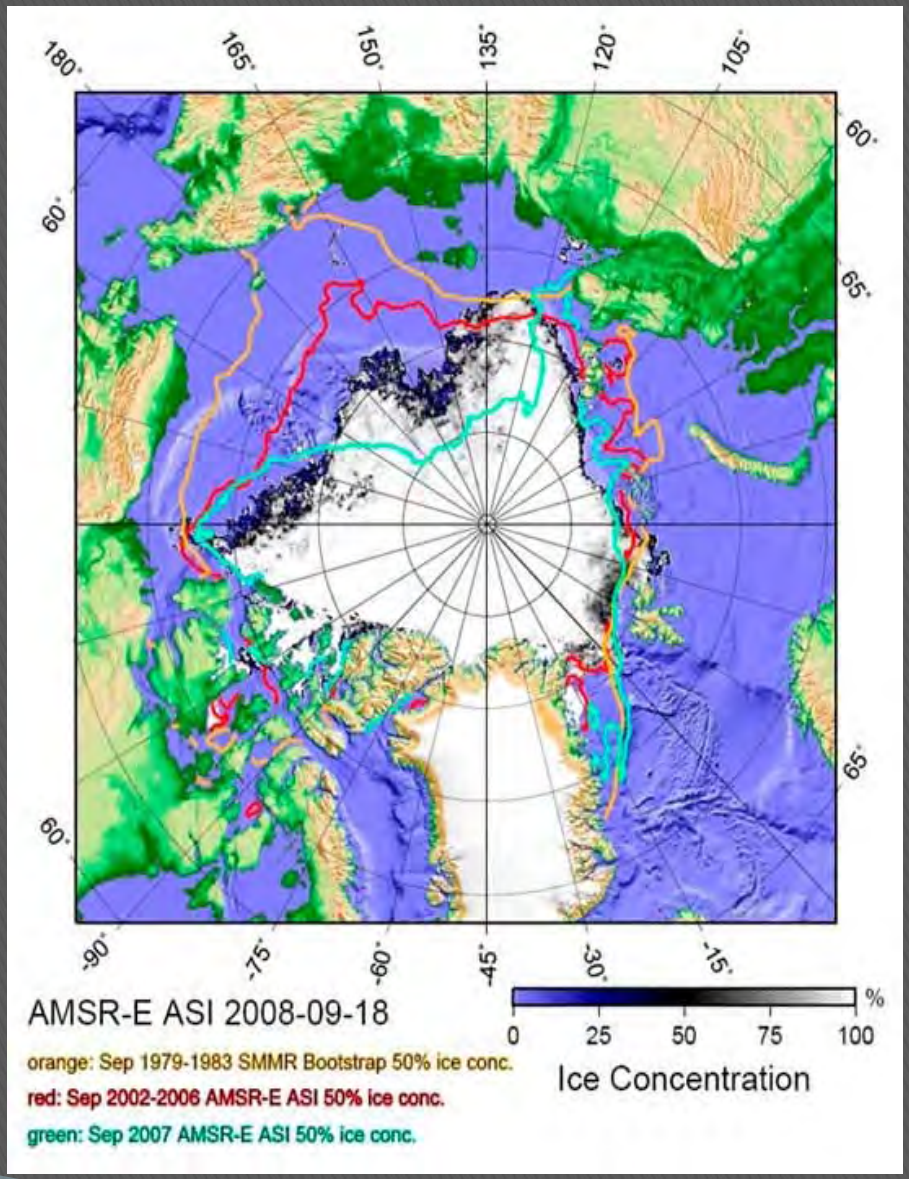
The DBO – a change detection array

James Overland, NOAA PMEL

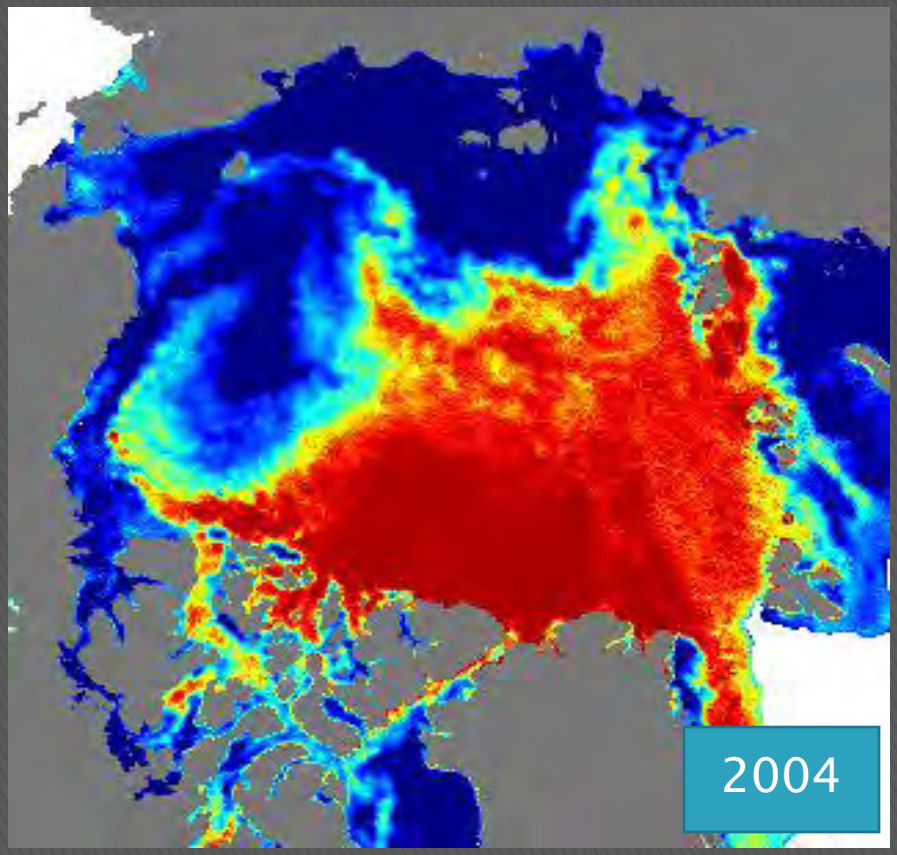
SAON – a process for sustained Pan-Arctic observation & data sharing

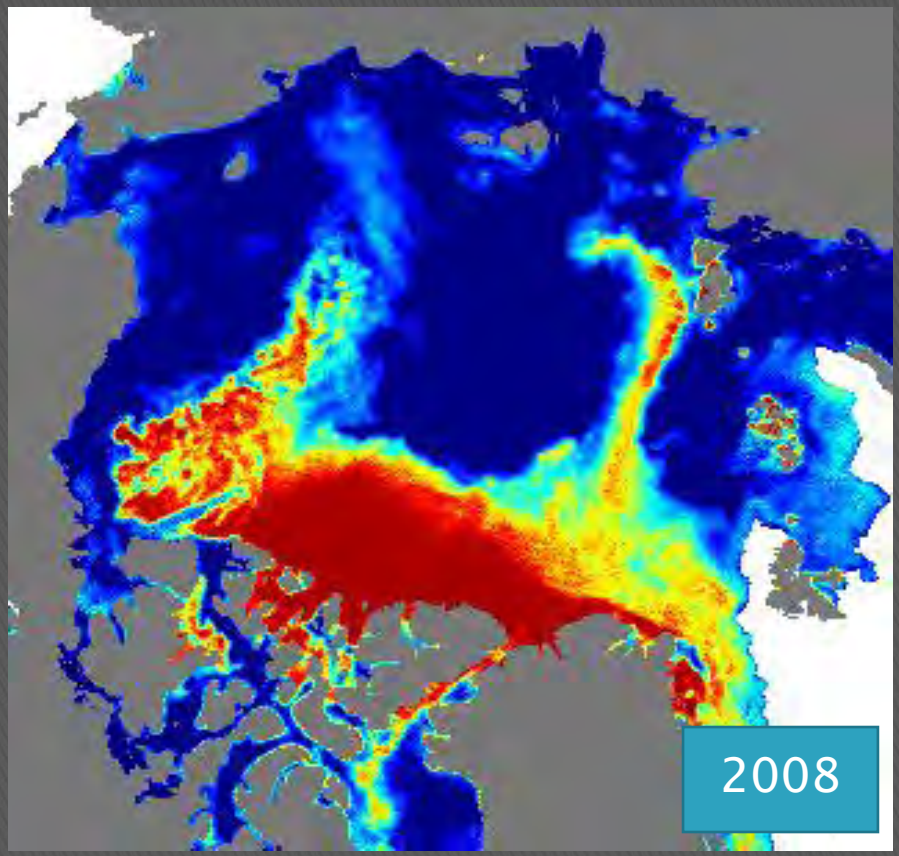
Arctic Sea Ice = 'New State'

- 2007 sea ice retreat called 'catastrophic' (Shimada 2007)
- Nearly ice-free September now predicted for 2037 (Wang & Overland 2009)
- Biggest change is loss of multi-year ice + delay in fall freeze-up



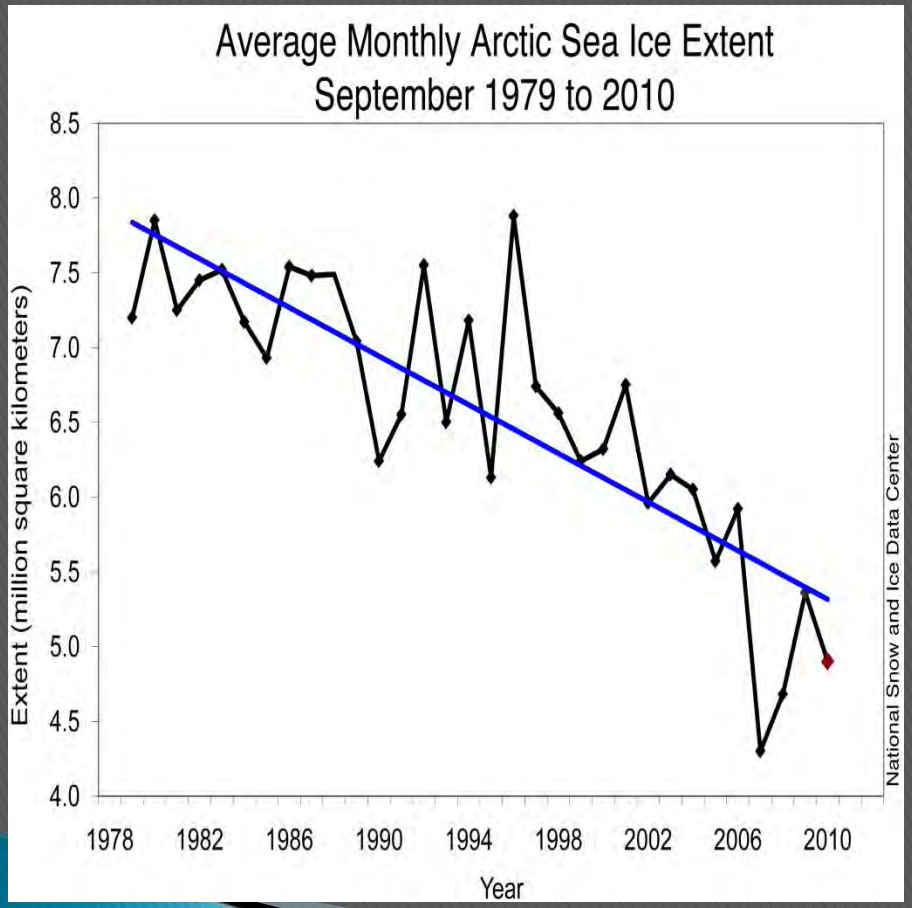
42 % Loss of Multi-year (thick) Sea Ice between 2004 and 2008

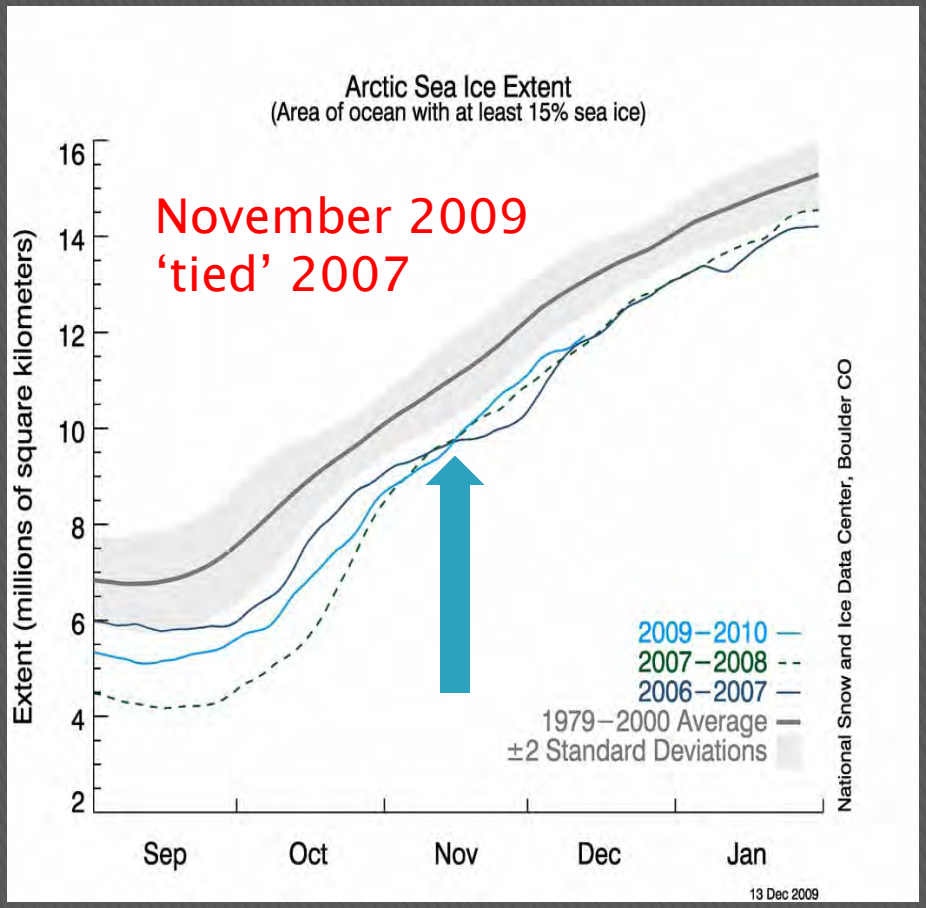




JANUARY Satellite Data (QuickScat) Ron Kwok (JPL; *JGR* 2009)

2010 = 3rd SEP 'minima' on record
2009 = note delay in ice formation





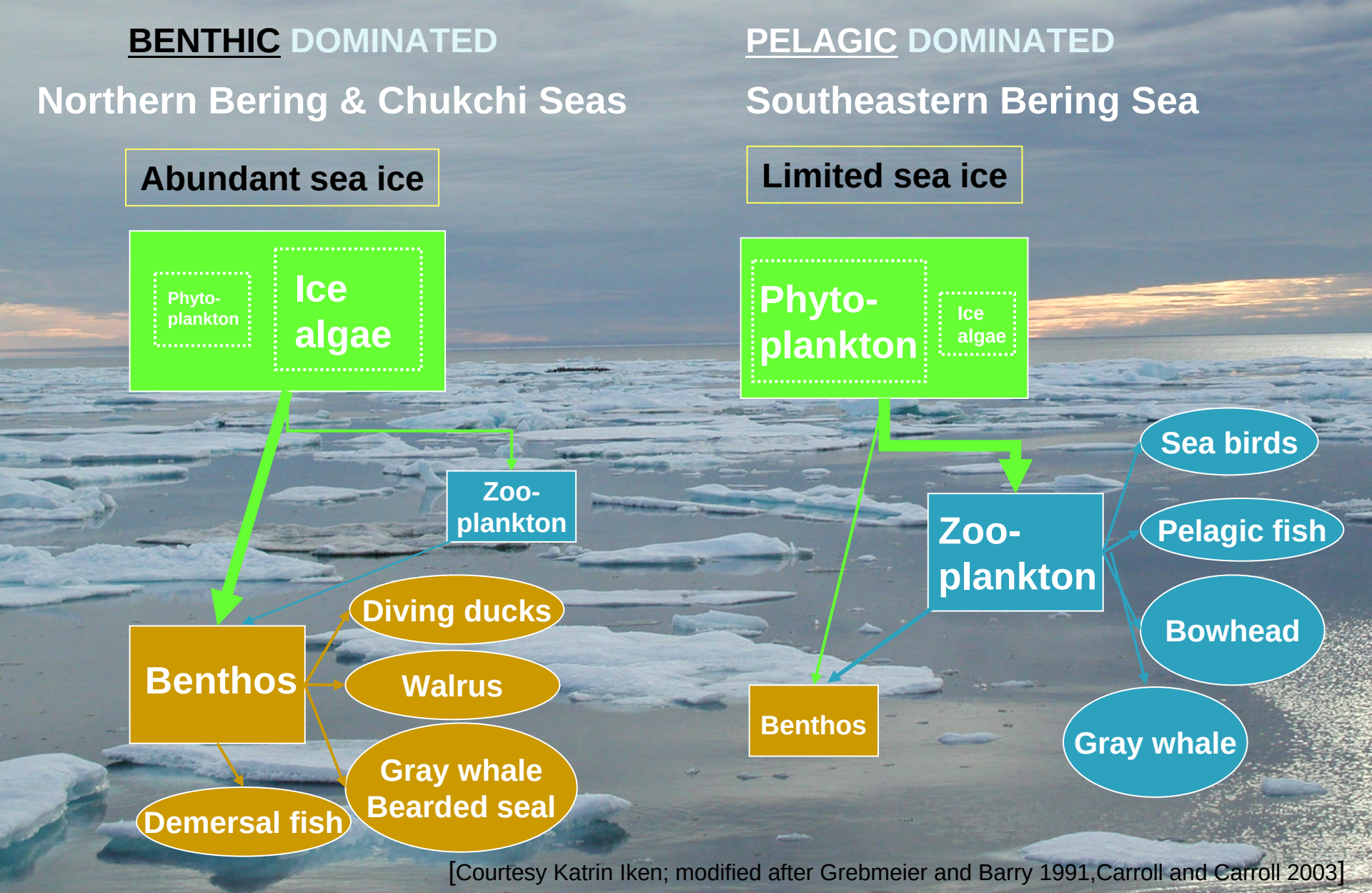
But, what effect does this have on biological processes?..

Observed Changes in the PAR

a few examples from `09 Workshop Participants

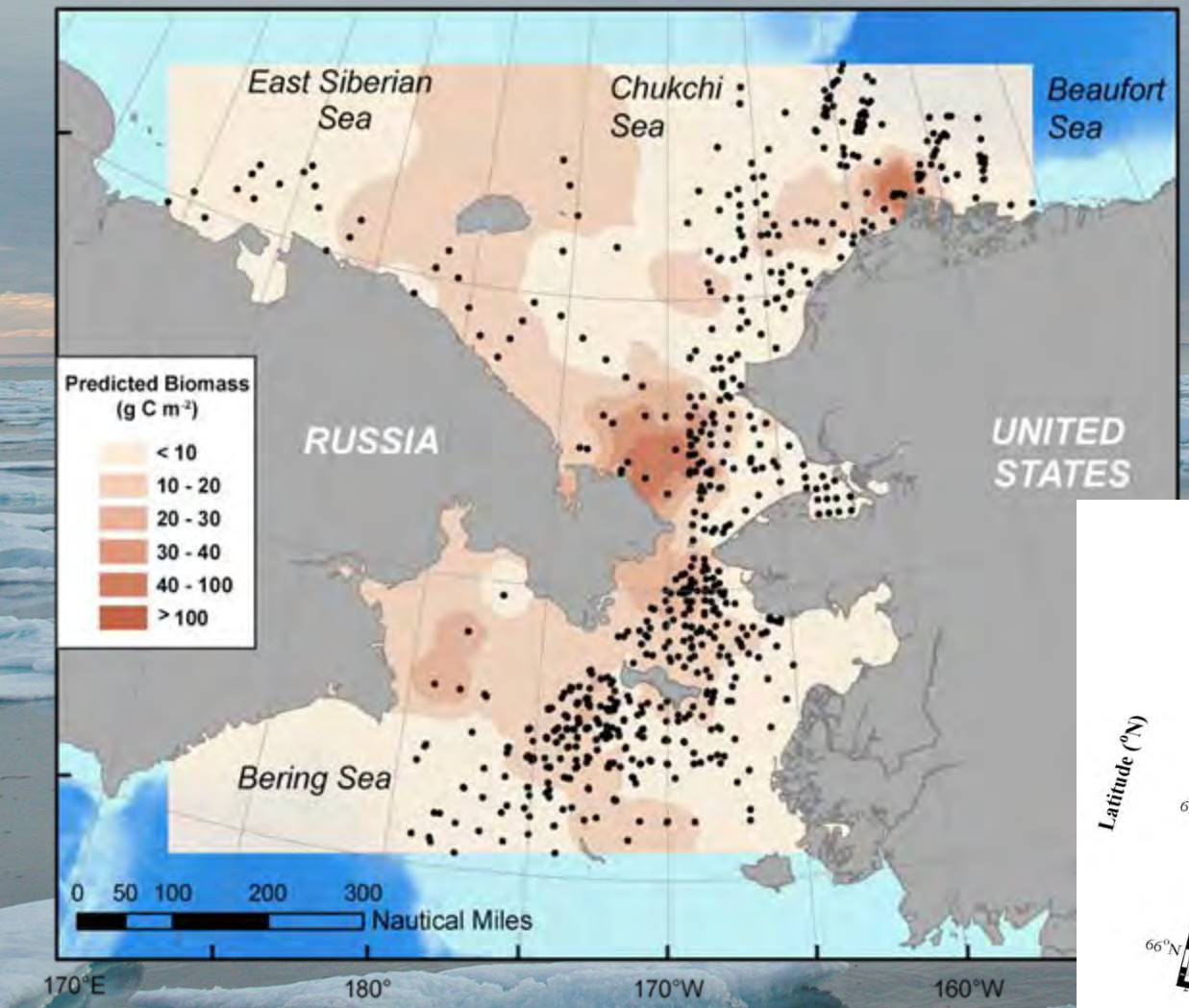
- Pacific zooplankton in Beaufort Sea
- Pollock & snow crab in the western Beaufort Sea
- Seabird declines with drop in clam biomass [eiders] & access to ice-associated cod [guillemots]
- Gray whale feeding–focus shift from N. Bering to Chukchi
- Walrus hauling out on land in unprecedented numbers
- Polar bears reported drowned at sea, scavenging & denning on land

Linking Ice Cover to Ecosystem Structure the 'Conceptual Model'



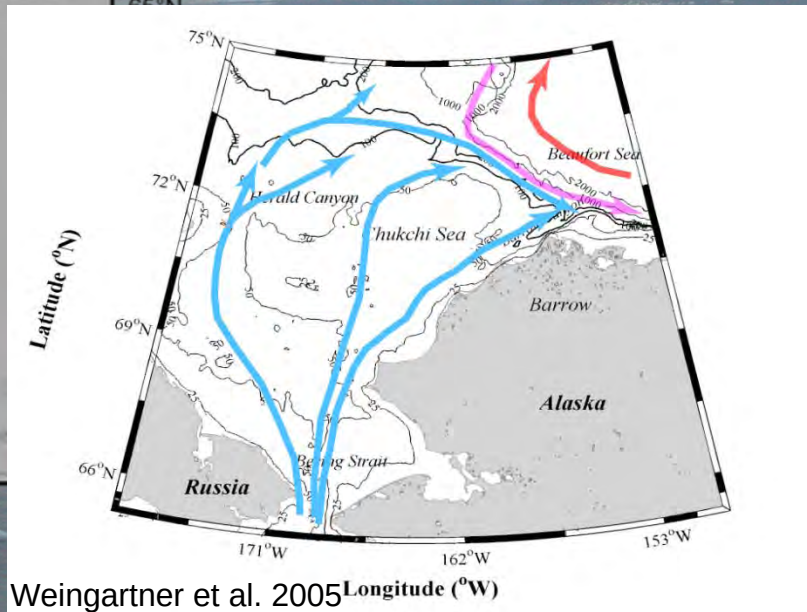
[Courtesy Katrin Iken; modified after Grebmeier and Barry 1991,Carroll and Carroll 2003]

Rich benthic communities on the western side of the Bering/Chukchi Sea system



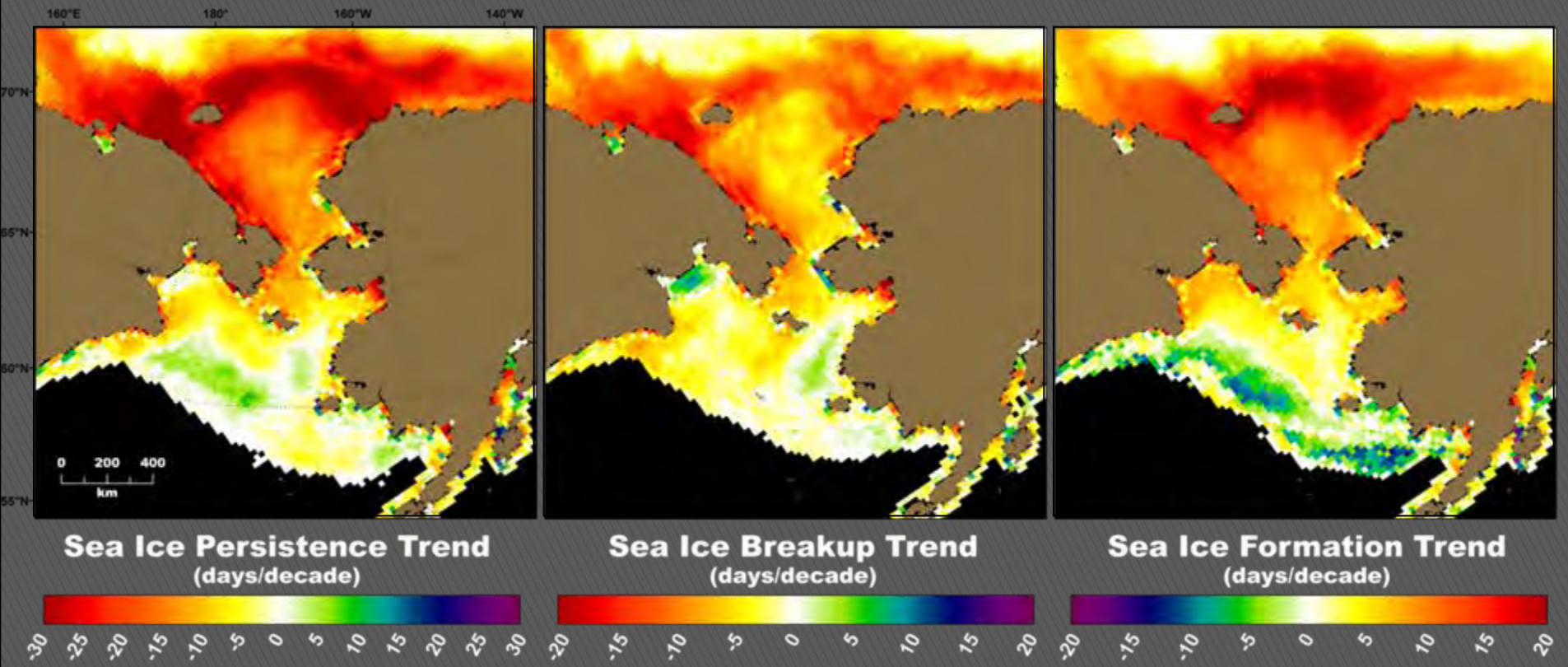
updated from Grebmeier et al. 2006a

- **"foot prints"** of high benthic biomass reflect pelagic-benthic coupling and export of carbon to sediments
- advection of carbon also influences biomass patterns



Weingartner et al. 2005

Trends in Sea Ice Cover
(1979-2008)

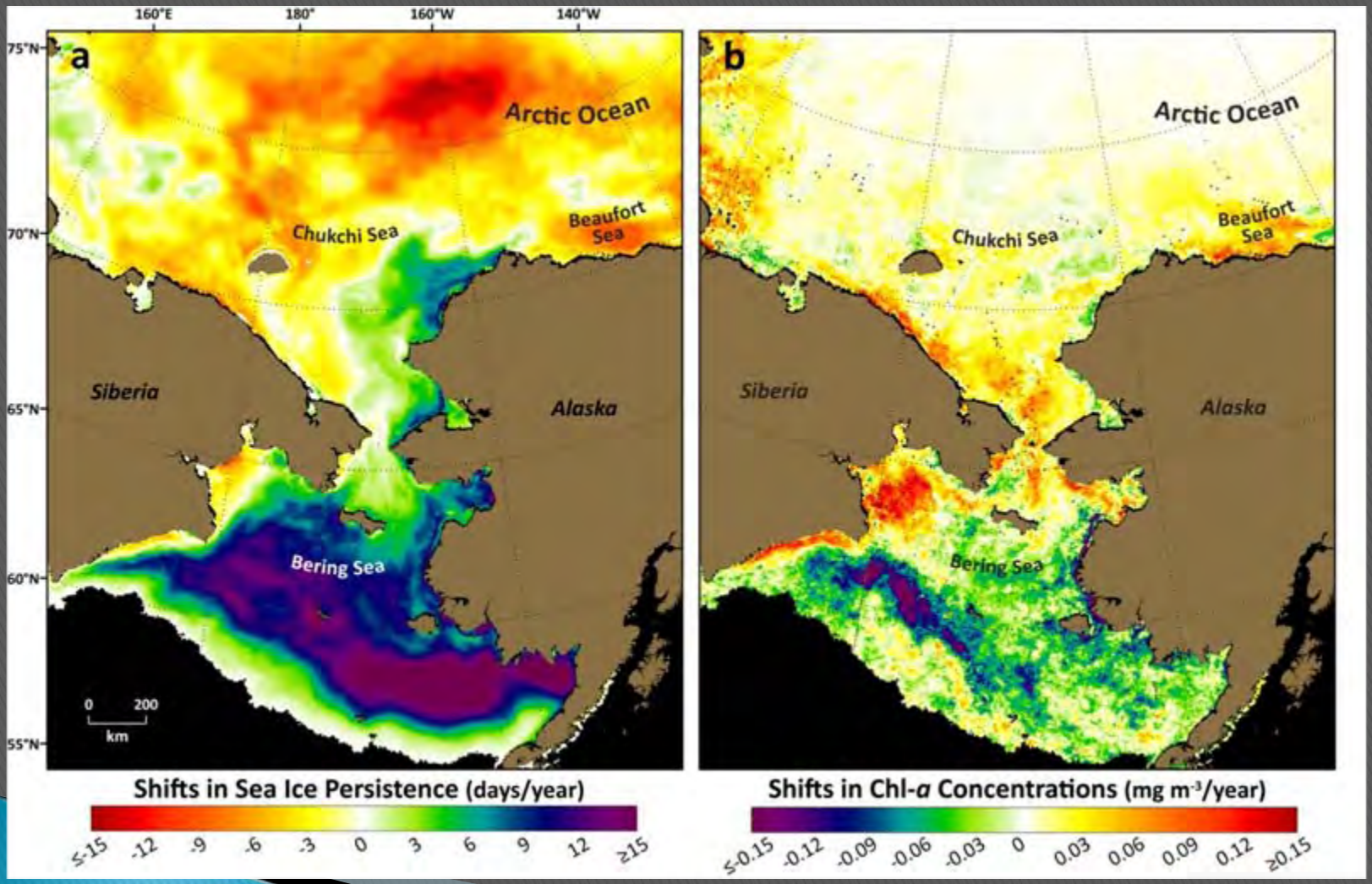


[courtesy Karen Frey]

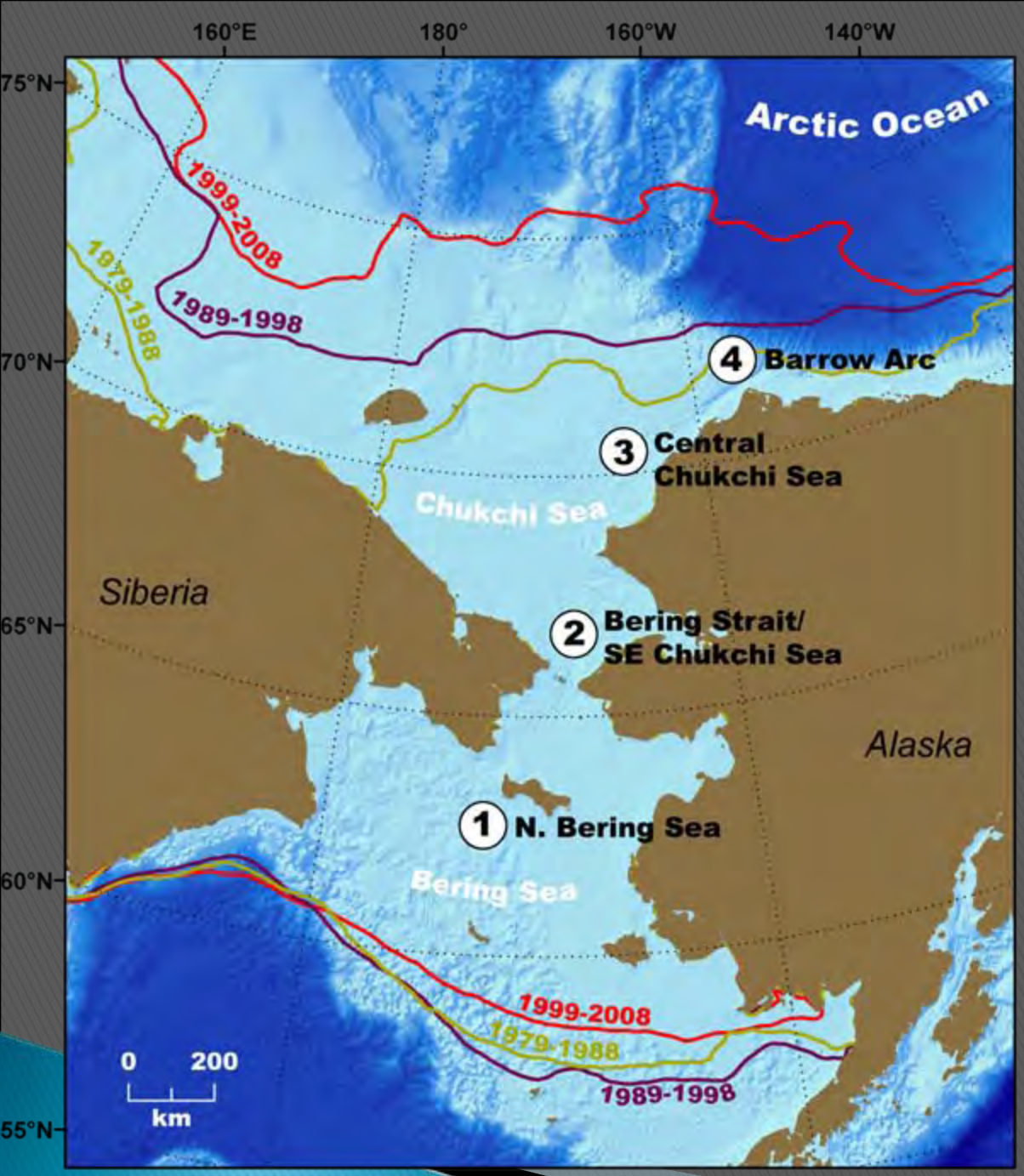
Based on SMMR and SSM/I Satellite-Derived Sea Ice Concentrations (1979-2008)

Chl-a signal does not 'track' sea ice loss

EOS paper – Grebmeier et al. 2010



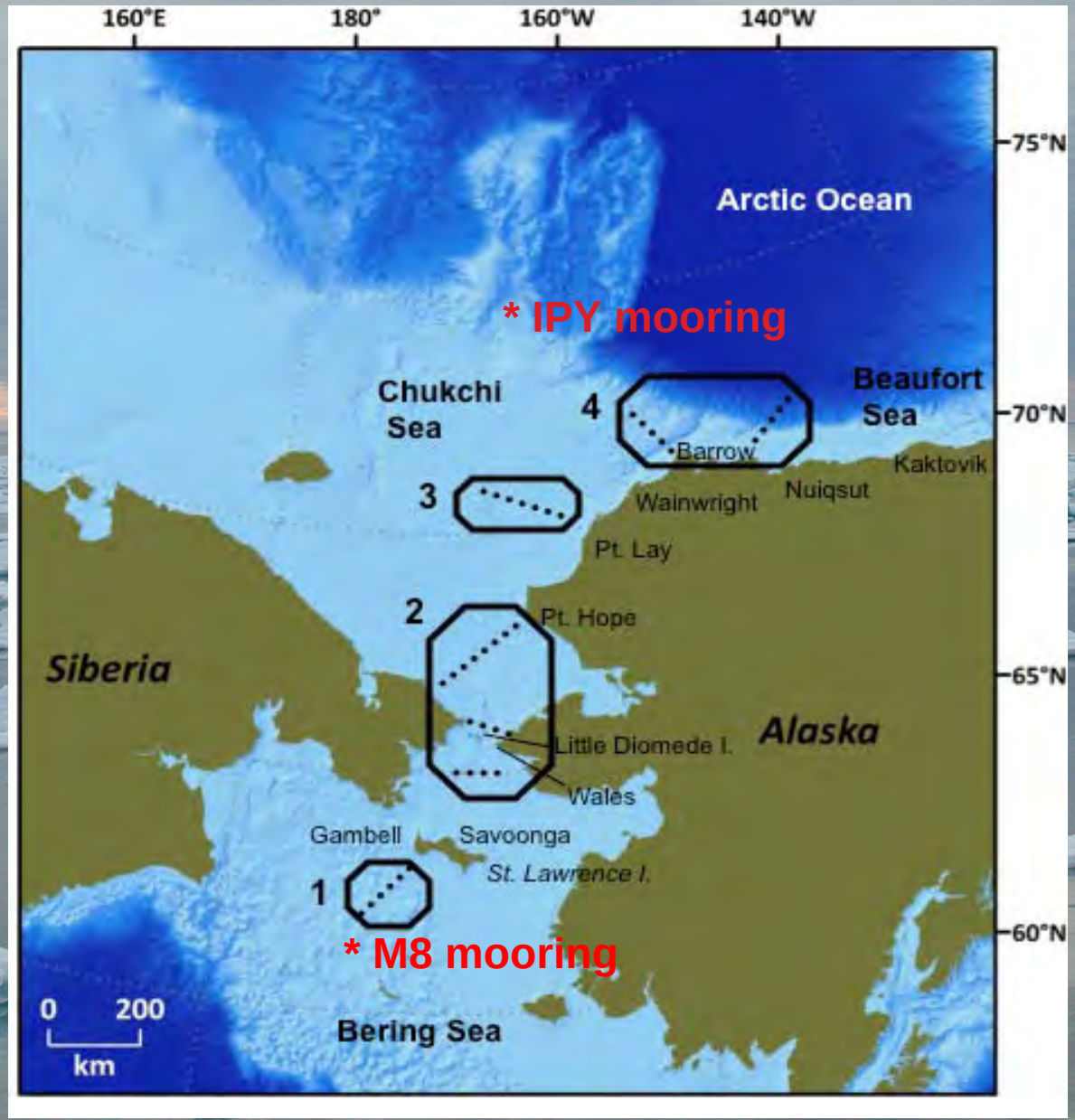
courtesy Karen Frey



Linking Physics-Biology: the Distributed Biological Observatory (DBO)

- **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**

DBO- Repeated Oceanographic Sampling with Links to Community-based "research partnerships"



- Stations from prior & existing research programs: SBI, RUSALCA, SNACS, BOWFEST

Framework for integration of IPY * and many other research programs

Links to prior & existing Community-based Research: SLI/Diomede Pt. Lay, Barrow

Vessel	Country	PI
Moana Wave	USA	Grebmeier
NMML/CHAOZ	USA	Berchok, Stabeno Napp
Aaron	Korea	Lee
Xue Long	China	Zhao
Mirai	Japan	Itoh
Laurier	Canada	Fudge
ST Laurent	Canada	Carmack
Healy	USA	Arrigo
Healy	USA	Pickart
Annika Marie	USA	Ashjian
Khromov	USA	Crane

Example: *Laurier* Cruise

Grebmeier/Fudge: 6-21 July 2010

DBO 2010 'Pilot'Season:

Cruises to DBO regions, 2010

http://pag.arcticportal.org

"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:

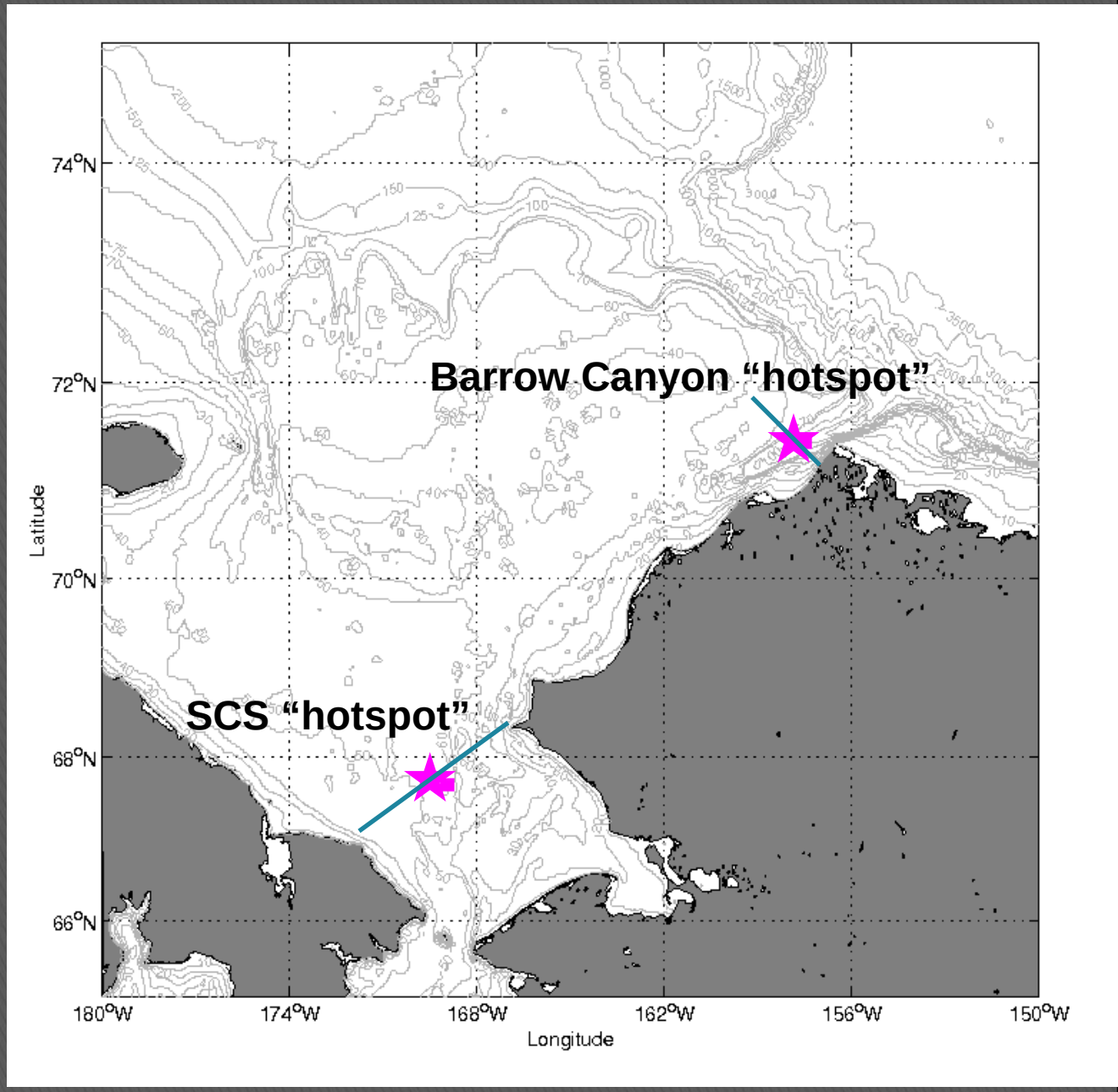
- Fishery acoustics (less effort than standardized bottom trawling)
- Bottom trawling (every 3-5 years)

Additional leveraged programs both domestic and international

Grebmeier: PAG & ASSW 2010 DBO 'Pilot Focus'

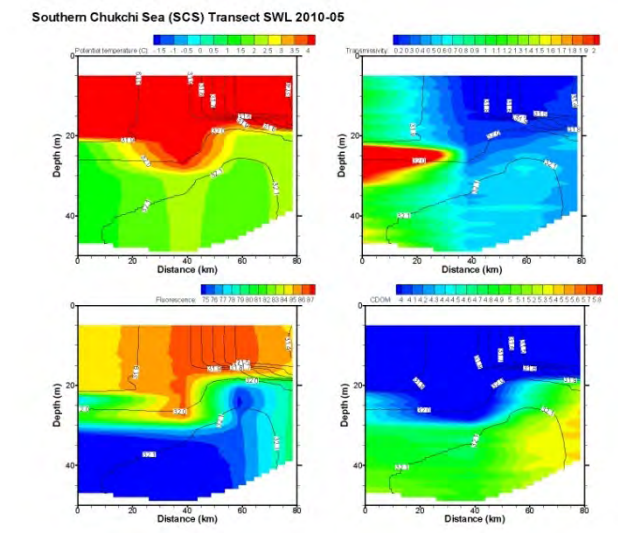
University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
CHESAPEAKE BIOLOGICAL LABORATORY

Sampling included CTD transects across Southern Chukchi *and* Barrow Canyon

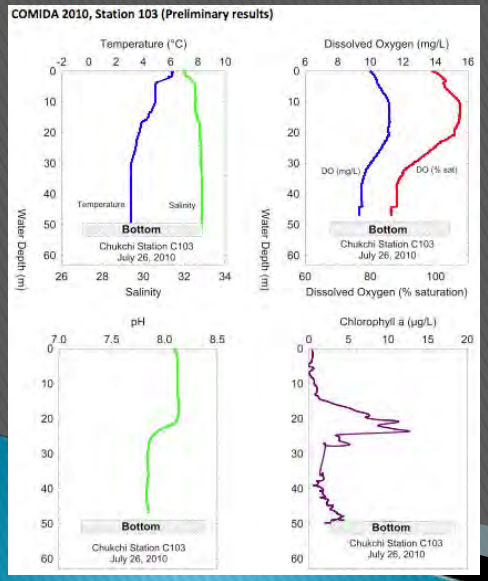


Examples of DBO Hydrographic Data 2010

SE Chukchi Sea

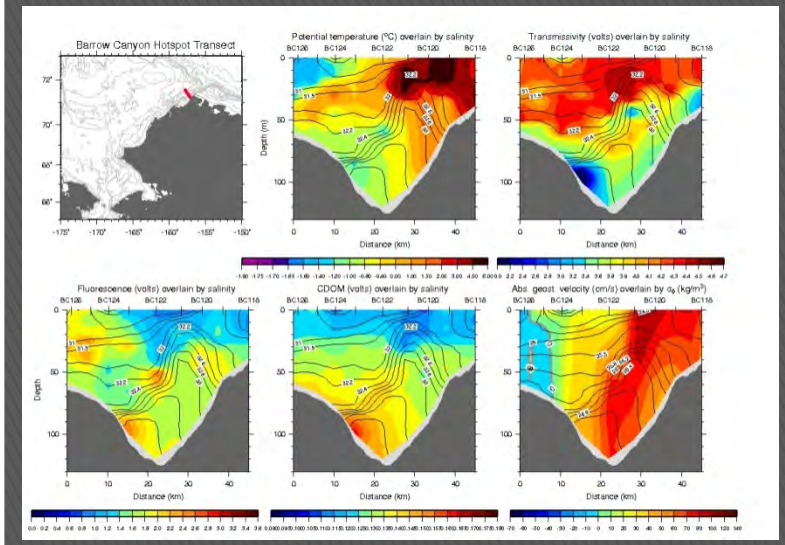


Svein Vogle-CGCS Sir Wilfrid Laurier-July 2010

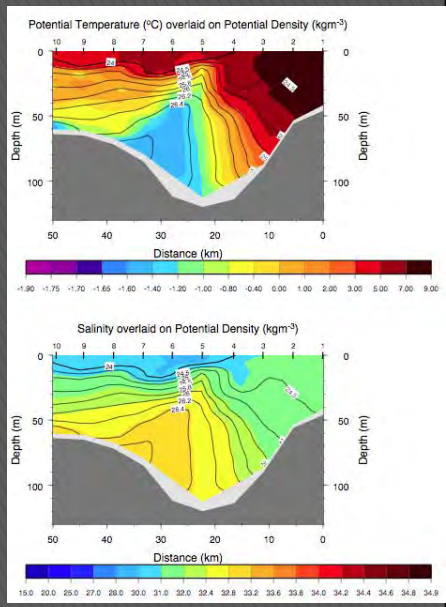


John Trefry/Ken Dunton-Moana Wave July 2010

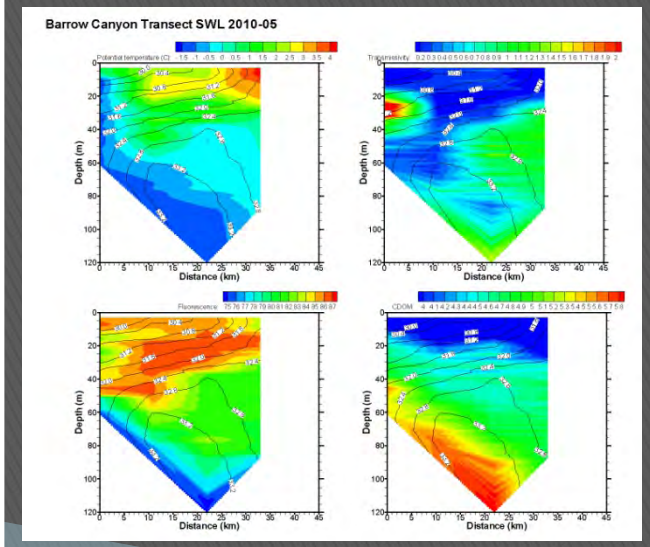
Barrow Canyon



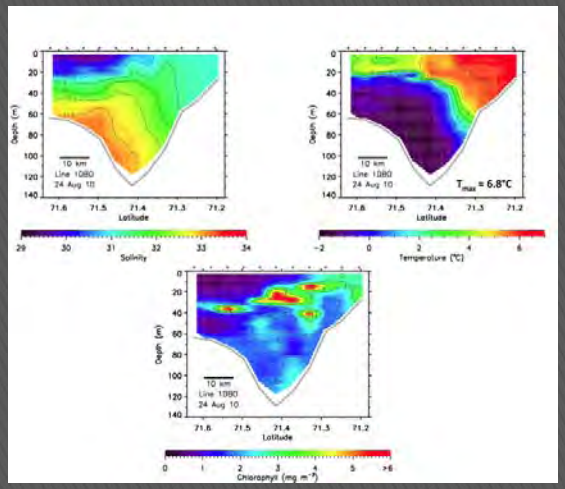
Robert Pickart-USCGC Healy July 2010



R. Pickart-USCGC Healy Sept 2010



Vogle-CGCS Sir Wilfrid Laurier-July 2010



Carin Ashjian-Annika Marie, August 2010

Status Report on SAON

Meeting of Senior Arctic Officials (SAO)
October 19-20, 2010
Torshavn, Faroe Islands, Denmark

The DBO will depend on international cooperation to provide sustained and coordinated sampling

It is envisioned that data will be made available through the Sustaining Arctic Observing Network (SAON)

Last week, the SAON Steering Group** proposed that SAON undergo a transition from a planning process to an operational program. The Status Report outlines the proposal for creating the operational phase of SAON.

**John Calder (AMAP) and David Hik (IASC), SAON SG Co-Chairs

www.arcticobserving.org

Purpose of SAON

- Support and strengthen the development of multinational engagement for sustained and coordinated pan-Arctic observing and data sharing systems that serve societal needs

- Work to be performed by self-directed teams based on mutual interests

FOCUS OF IMMEDIATE-FUTURE SAON Work

(based on Task proposals submitted to date)

1. metadata standards
2. data integration, access and visualization
3. decision-support tools
4. workshops aimed at improving the state of Arctic observing and data management

The DBO as a *Showcase* for SAON

1. SAON emphasizes integration of data sets – across disciplines, media & borders
2. DBO requires integration of data to achieve its objectives
3. DBO has been proposed to the Pacific Arctic Group as a key activity with pilot work completed in summer 2010
4. A team of experts already exists to do what DBO requires and SAON desires

NEXT on DBO: workshop to review 2010 'pilot season'; updates @ AMSS & ASSW