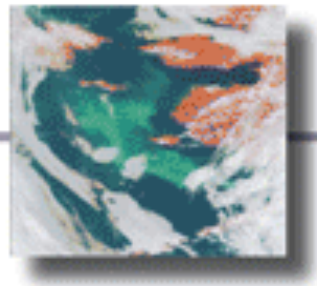
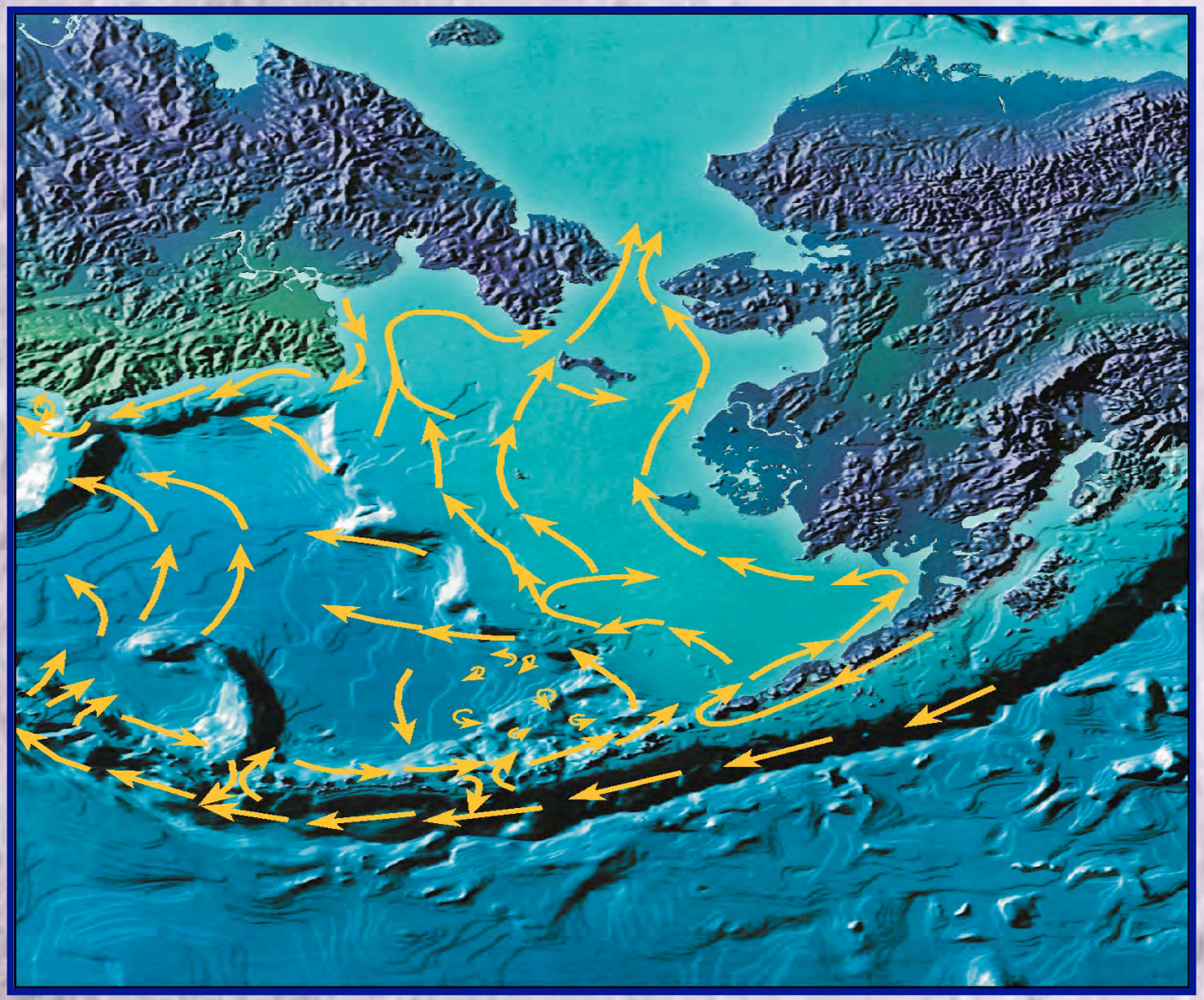
BEST



Bering Ecosystem Study Program

The Bering Sea

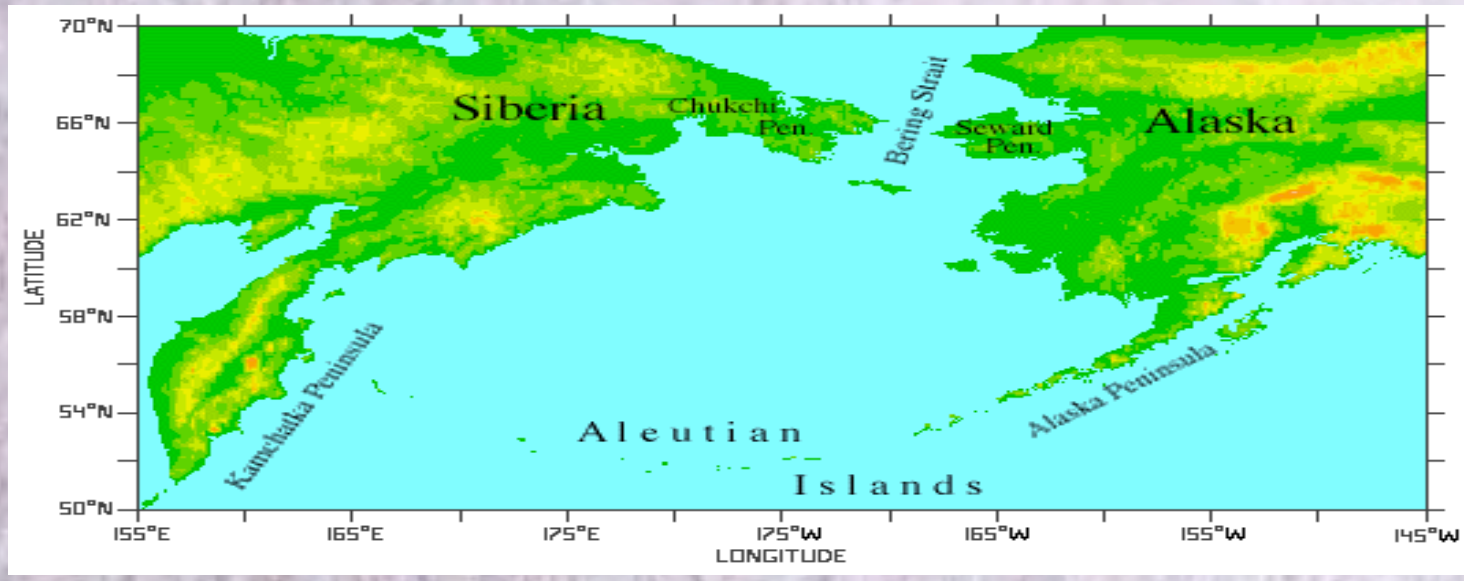


P. Stabeno, PMEL

What is BEST?

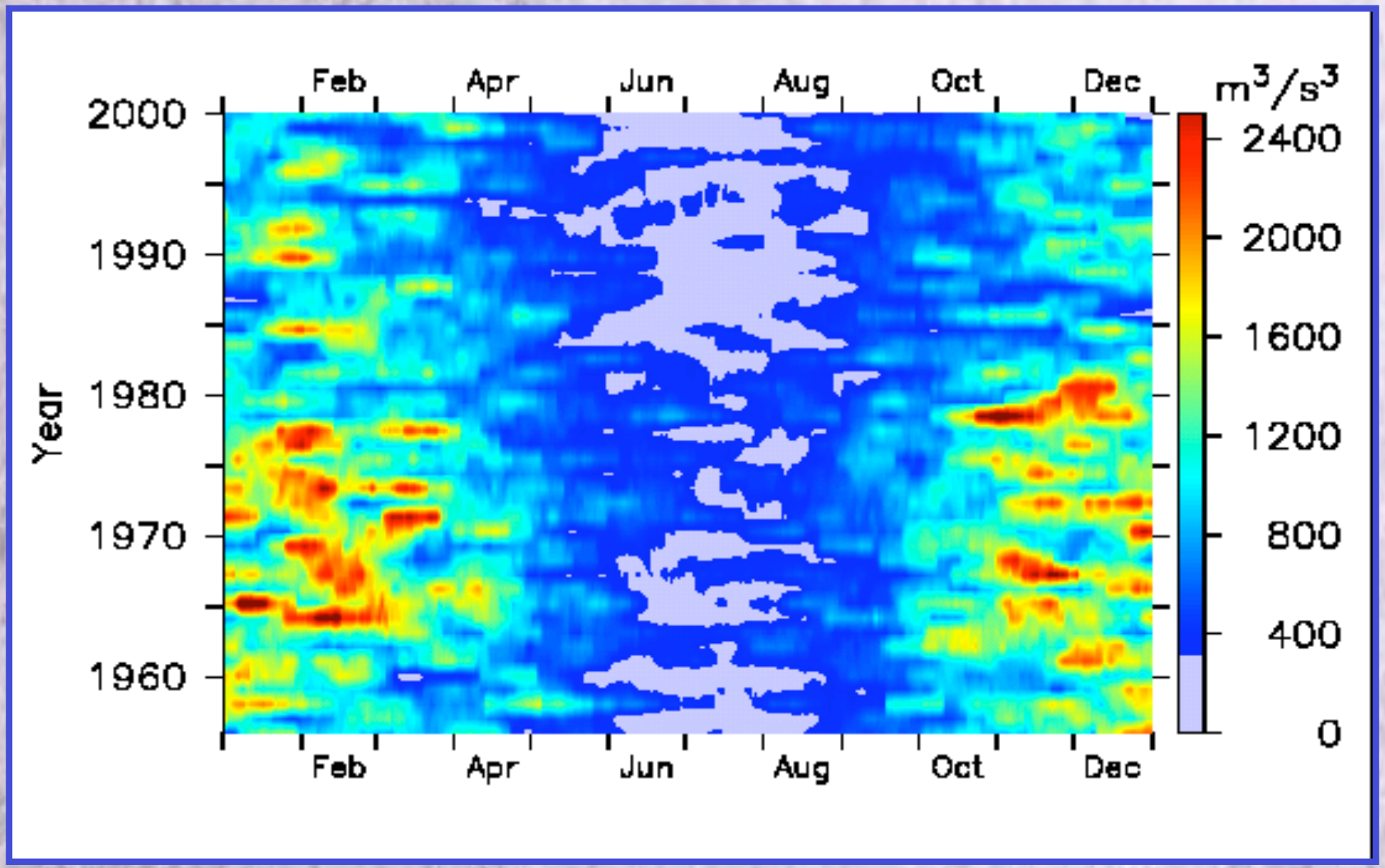
- A program designed to understand and predict the consequences of climate change for Bering Sea marine ecosystems
- End to End: Climate, physics, primary production, zooplankton, fish, seabirds, marine mammals and people
- Strong social sciences component coming on line

Why Study the Bering Sea?



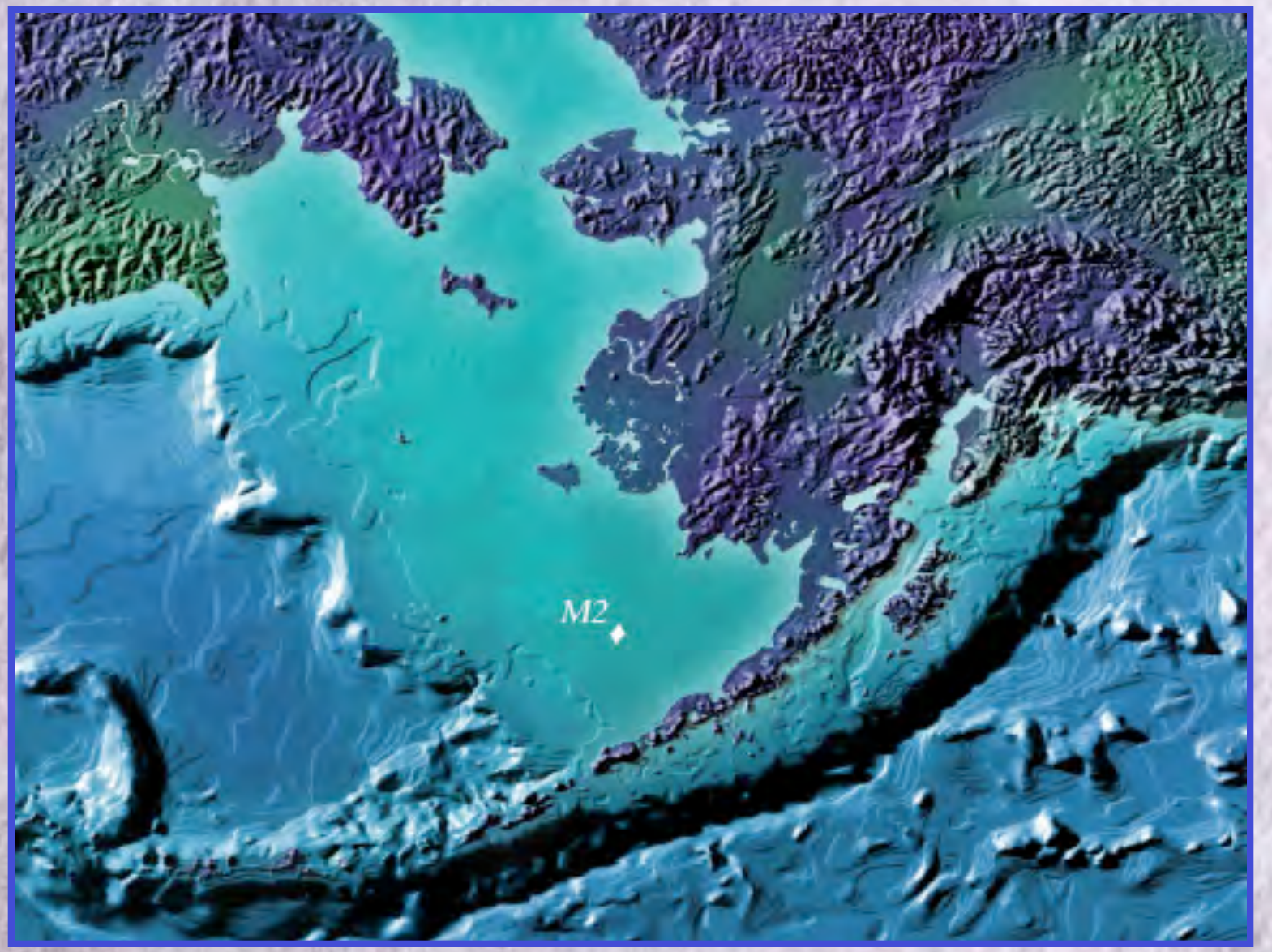
- One of world's most productive regions
- Very rich assemblage of seabirds, marine mammals, fish, shellfish
- Commercial and subsistence economy
- Dutch Harbor: # 1 - 2 U.S. port $ landings
- 50 % all fish / shellfish landings in U.S.

Wind Speed Cubed at St. Paul Is.



P. Stabeno,

The Middle Shelf: M2 Mooring



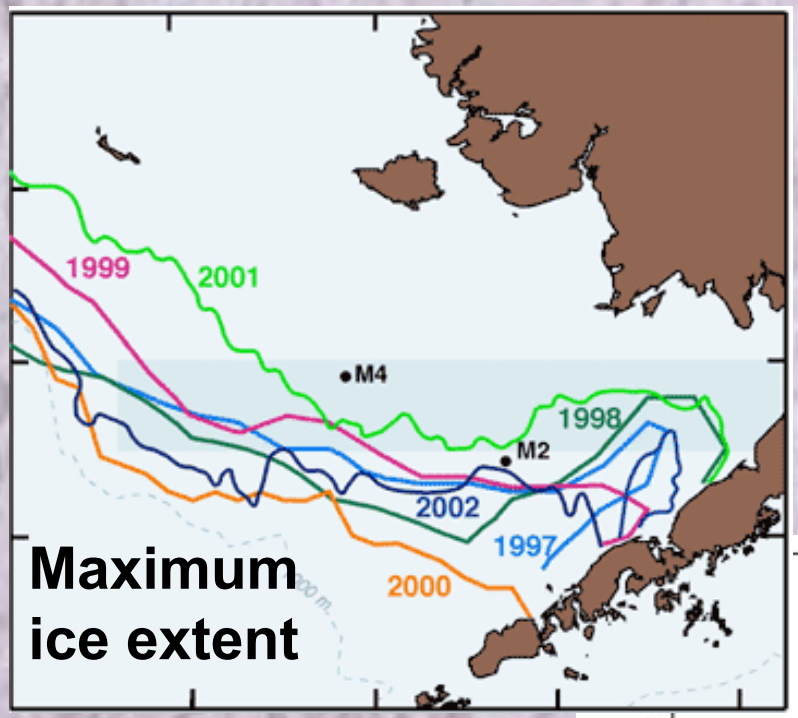
P. Stabeno, PMEL

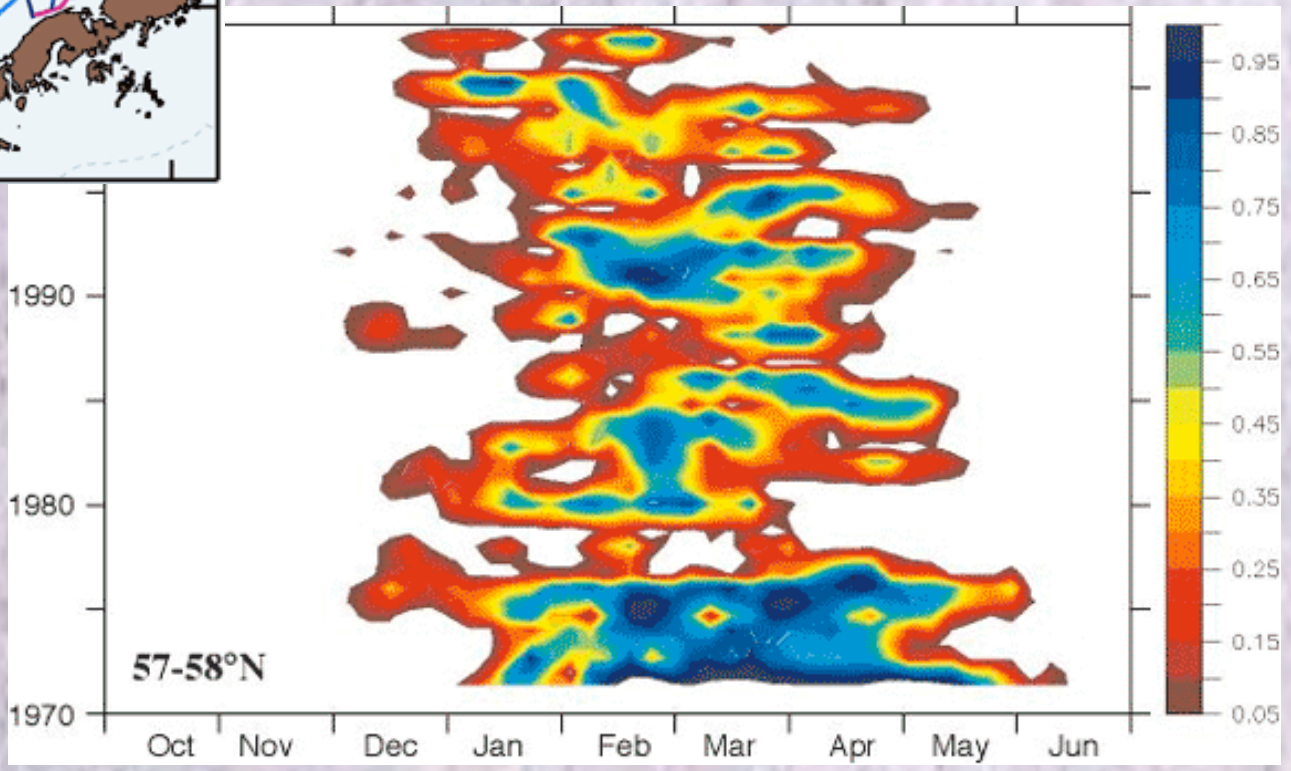
Sea Ice

P. Stabeno, PMEL

Changing Climate

Bering Sea ice has retreated over last two decades (1970 - 2002)

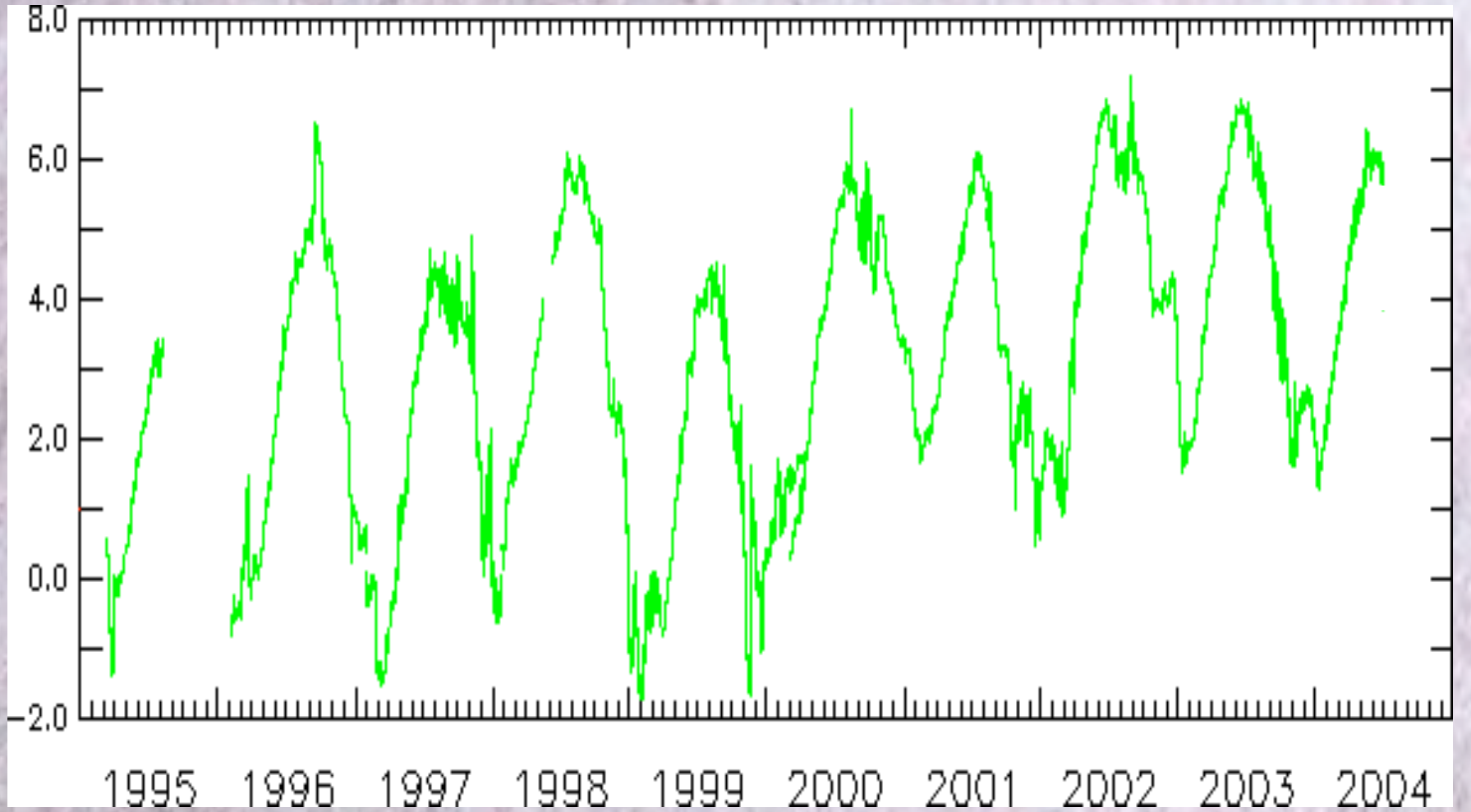




Percent ice cover within gray box on map above

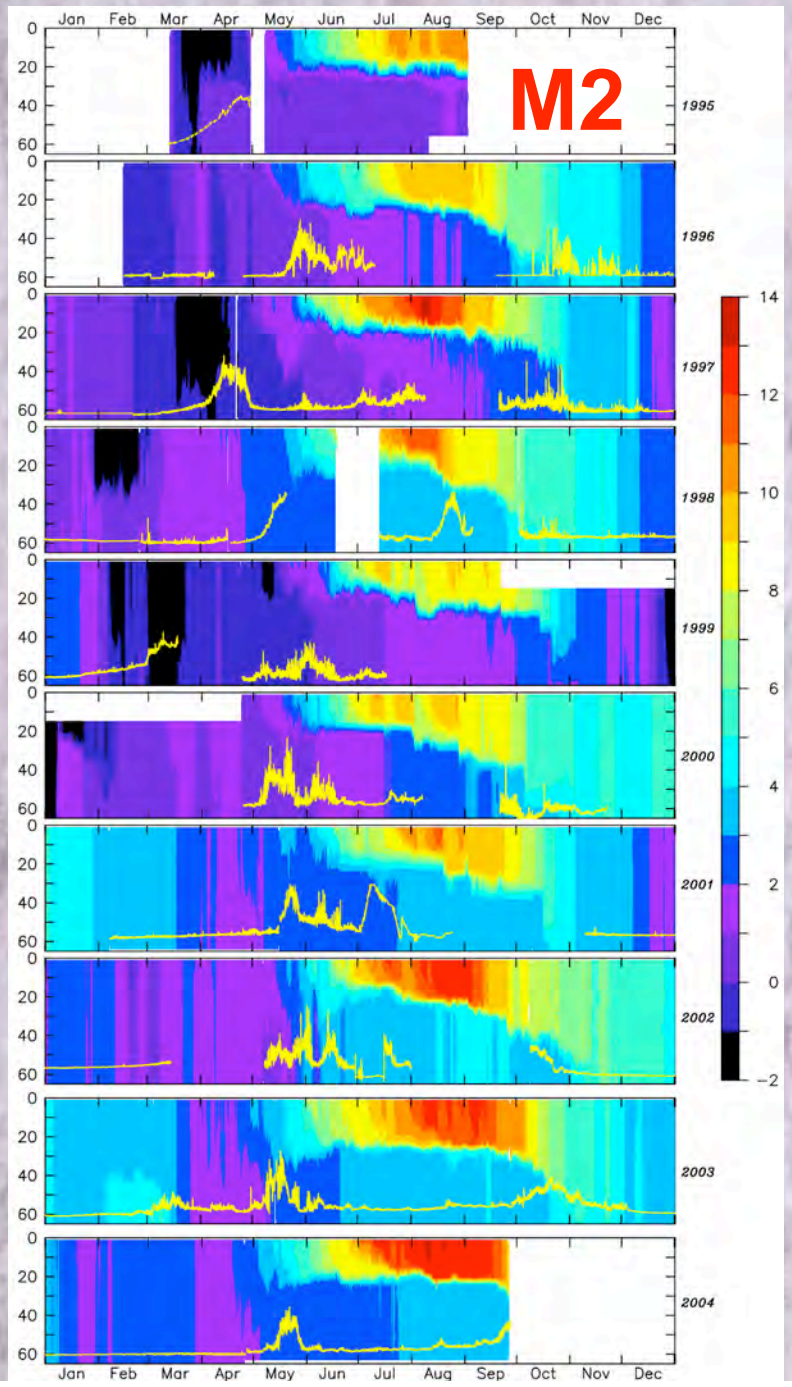
P. Stabeno, PMEL

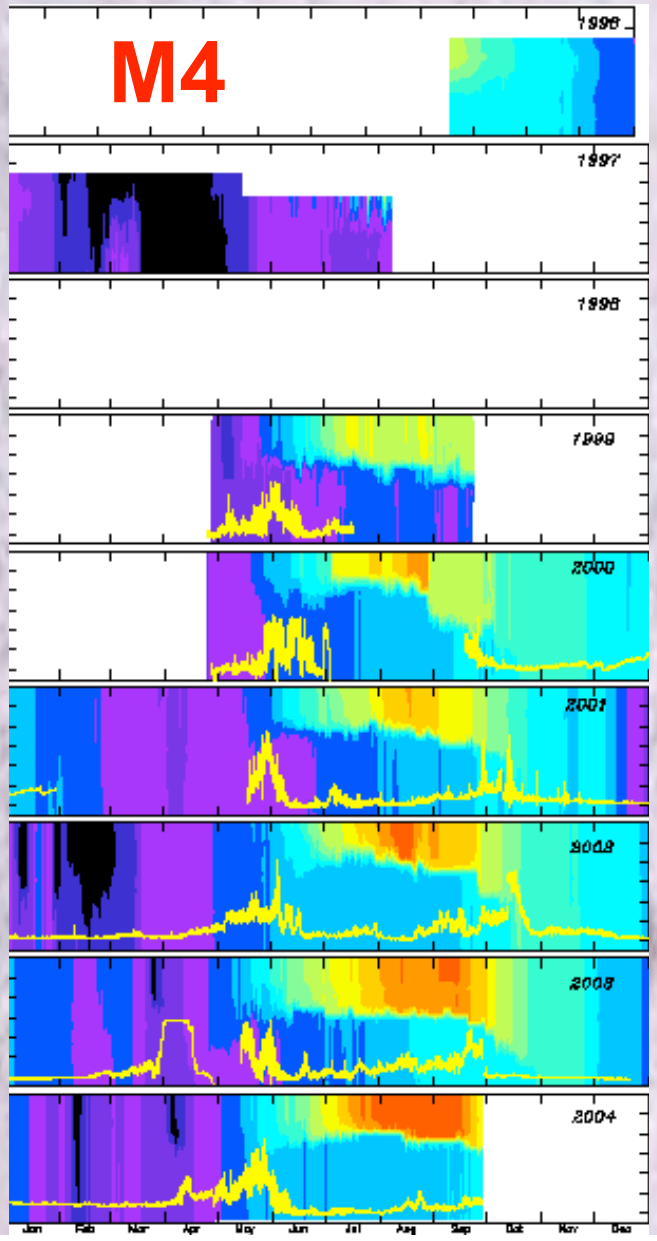
Vertically Averaged Temperature (°C) at Site M2



P. Stabeno, PMEL

Temperature and fluorescence at Sites M2 (left) and M4 (right)



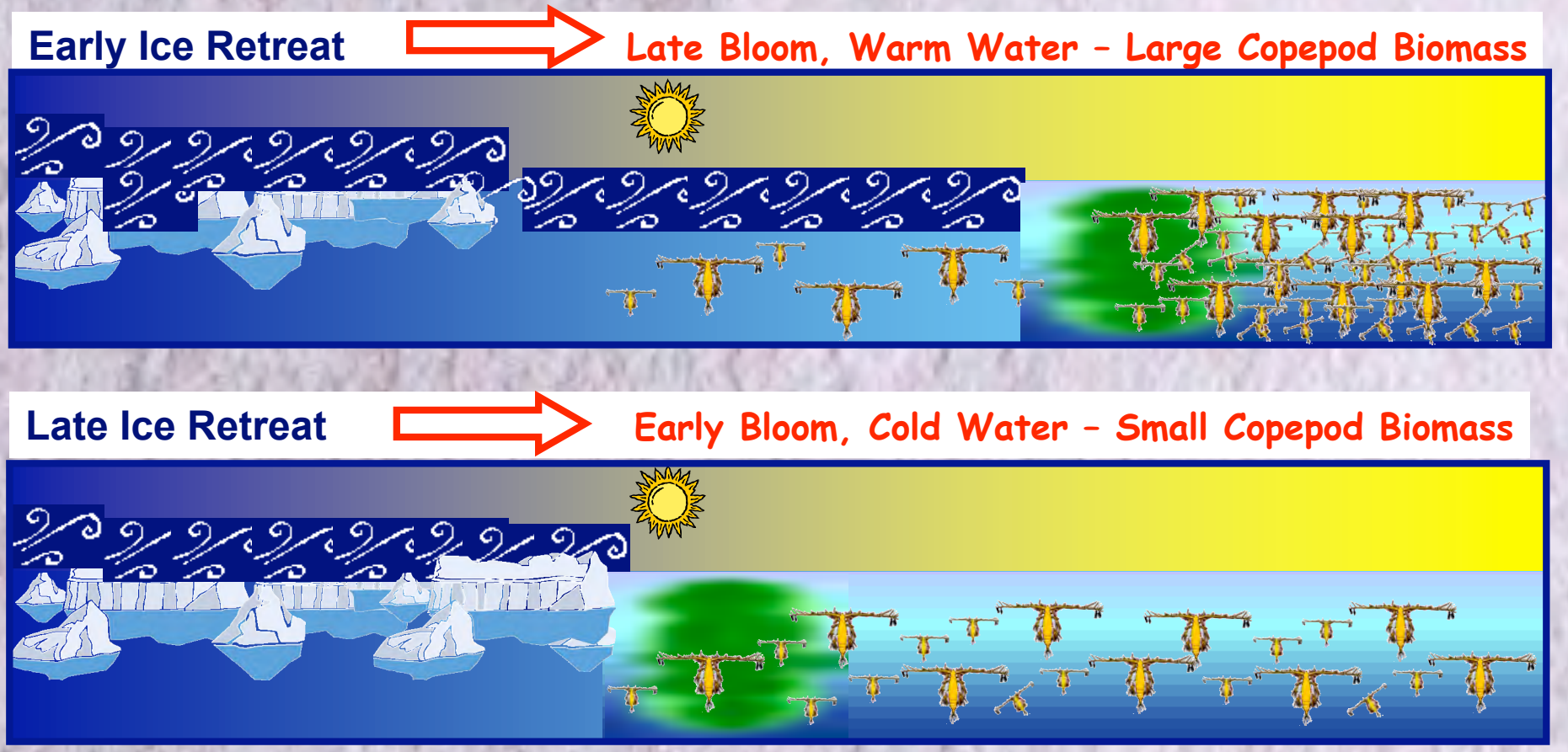


1996

P. Stabeno, PMEL

2004

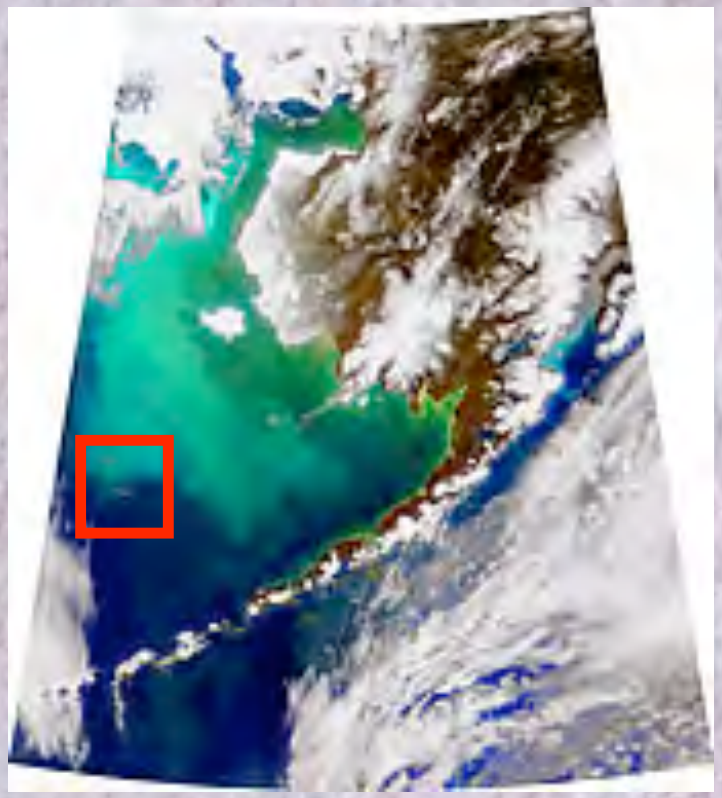
Ice, Wind, Bloom, Copepods



G. Hunt, U. Calif. Irvine

Emiliania huxleyi cell

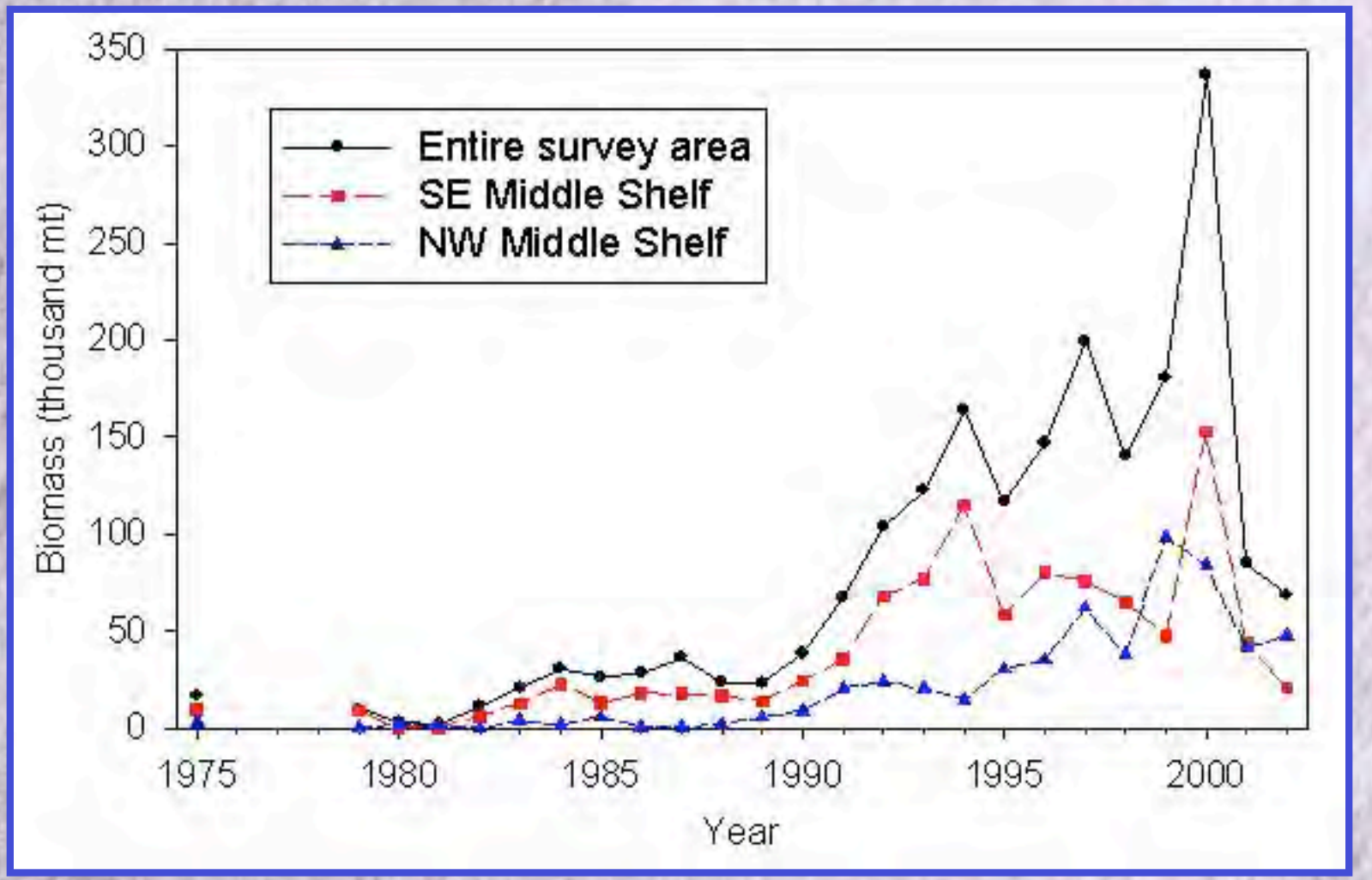
Bering Sea Coccolithophore Bloom



April 25, 1998

SeaWiFS program

Biomass of Medusae in the S.E. Bering Sea



Oscillating Control Hypothesis

Cold Regime

(Bottom-Up Regulation)

Beginning of Warm Regime

(Bottom-Up Regulation)

Warm Regime

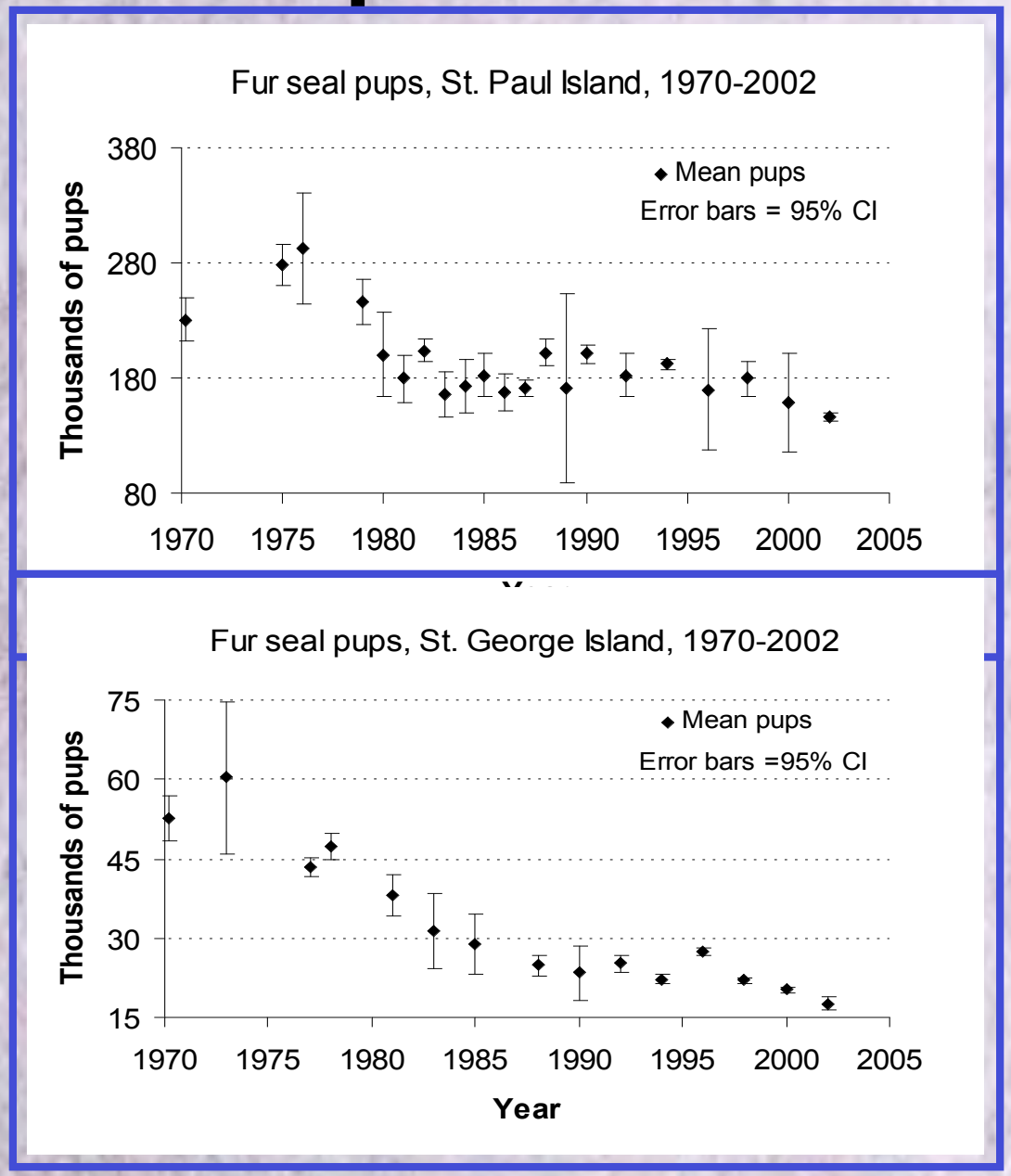
(Top-Down Regulation)

Beginning of Cold Regime

(Both Top-Down and Bottom-Up Regulation)

Zooplankton | Larval Survival | Abundance of Piscivorous Adult Fish | Juvenile Recruits

Fur Seal Pups at the Pribilof Is.



NMML, NOAA

History of BEST

- Sept. 2002: Laguna Beach, Initial Planning
- Mar. 2003: Seattle, Science Plan Workshop
- Oct. 2004: Science Plan Published
- May 2005: Open Implementation Workshop
- June 2005: Draft Implementation Plan needed by NSF

Laguna Beach Workshop, Sept. 2002

Who	Result
R. Beamish K. Drinkwater M. Flint J. Grebmeier R. Harris G. Hunt N. Karnovsky H. Loeng J. Morrison J. Napp B. Norcross G. Ottersen C. Pautzke N. Shiga P. Stabeno N. Swanberg	**Agreed to the development of :** **1) Bering Sea Ecosystem study- BEST** **a) Envisaged as 5 to 10 year project** **b) Funding at $ 6-7 million/yr** **c) Year-round field program with 2 ships and an icebreaker for 3-4 months** **2) Ecosystem Studies of Sub-Arctic Seas- ESSAS**

Seattle Workshop, Mar. 2003

Who		Result
K. Arrigo	W. Maslowski	**Developed Science Plan for BEST:** **1) Focus: Predicting effects of climate change on sustainability of eastern Bering marine ecosystems** **2) Area to cover: Peninsula to southern Chukchi Sea** **3) All Seasons** **4) End to End: Including people**
R. Brodeur	L. McNutt	
D. Caron	J. Napp	
K. Coyle	J. Overland	
J. Grebmeier	G. Owletuck	
E. Hofmann	M. Pete	
G. Hunt	S-I. Saitoh	
G. Kruse	R. Sambrotto	
E. Lessard	P. Stabeno	
P. Livingston	L. Tupas	
L. Madden		

SSC Implementation Teleconferences, Mar. - May 2005

Who	Result
Ben Fitzhugh Rolf Gradinger Eileen Hofmann George Hunt Anthony Merculief Arthur J. Miller Jeff Napp Jim Overland Kenneth Rose R. Sambrotto Sharon L. Smith Peter Winsor	**Draft Implementation Plan:** 1) **NSF Guidance:** 3-5 years- **aim for: 4 field seasons, then 2nd phase** 2) **NSF Guidance:** $1-3 million/yr- **aim for: $3-4 million from NSF** 3) **NSF Guidance-** Ship Time-2 months icebreaker plus an ice-strengthened ship- **aim for: 3 months of icebreaker time, 4 months of ice-strengthened ship** 4) **Focus on one area of study and do well**

BEST Research Priorities

- **Primary Focus:**

  How is the Disappearance of Sea Ice Affecting the eastern Bering Sea Ecosystem and the people dependent on it?

- **Secondary:**

  a) What Controls the abundance of nutrients on the shelf and what is the influence of climate variability?

  b) What will be the ecosystem effects of a warmer and more stratified Bering Sea?

  c) Regional studies: Northern Bering; Pribilofs; Aleutian Passes

BEST Research Priorities

- Focus on the Spring- 1 March to 30 June
- How does climate drive ice conditions?
- How does sea ice affect the type, amount and fate of primary production?
- What controls the biomass of zooplankton in spring and what role do they play?
- How do these bottom-up factors interact with top-down mechanisms?
- What are the expected impacts on upper trophic-level organisms including people?

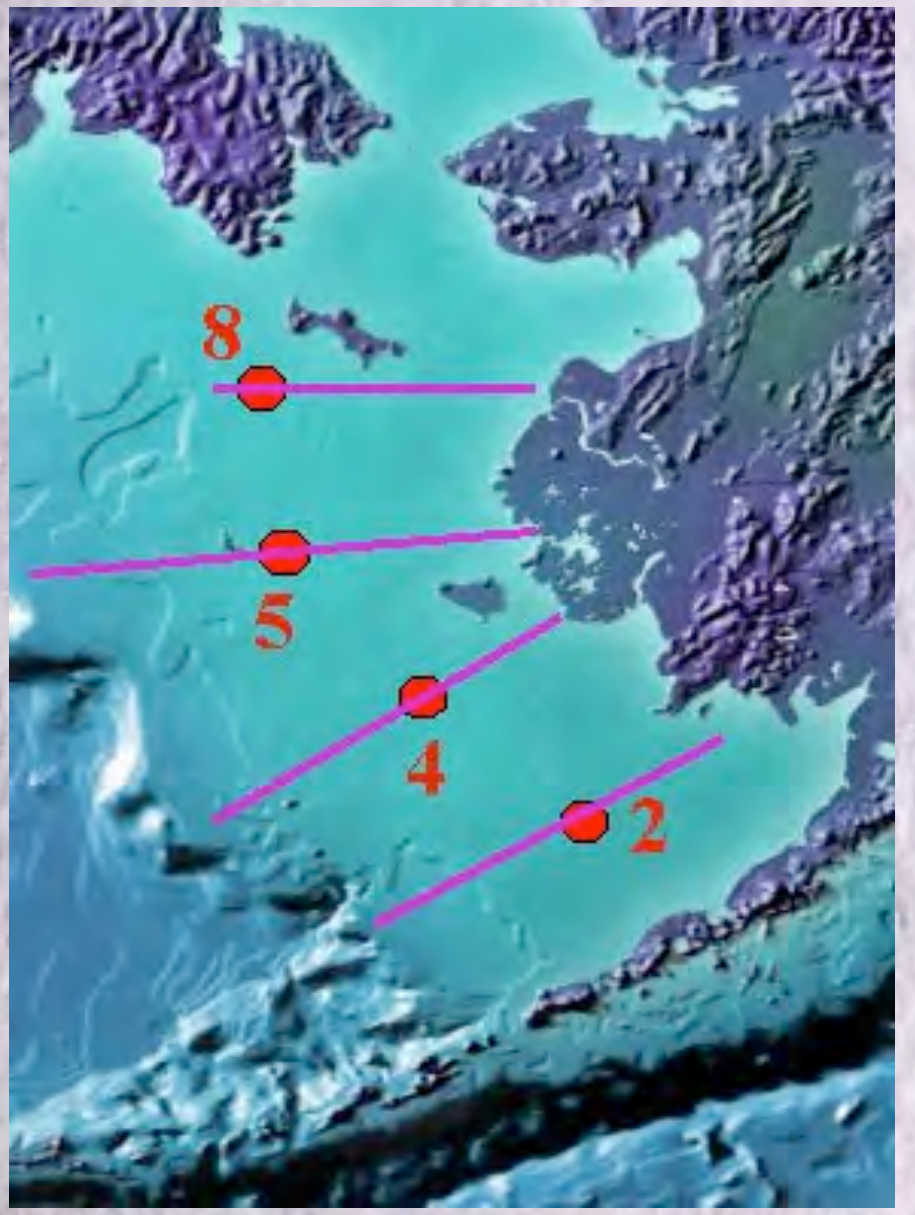
Implementation Plan- Management

- **Interagency Oversight Committee**
- **Science Steering Committee**
- **Project Office (once project funded)**
  Chief Scientist
  Executive Committee (3-4 people)
- **Working Groups as Needed**
  (data management, modeling, integration & outreach, etc)

BEST Bering Sea Partners

- **NSF**
  - a) **SEARCH** NSF-sponsored program on Arctic Change)
    - i) Bering Ecosystem Study (**BEST**)
- **NOAA**
  - a) National Marine Fisheries Service (**NMFS**)
  - b) National Marine Mammal Laboratory (**NMML**)
  - c) Pacific Marine Environmental Laboratory (**PMEL**)
  - d) North Pacific Climate Regimes and Ecosystem Productivity Program (**NPCREP**)
  - e) Loss of sea Ice (**LOSC**) (proposed for IPY)
- North Pacific Research Board (**NPRB**)
- Alaska Ocean Observing System (**AOOS**)
- US Fish and Wildlife Service (**USFWS**)
- US Geological Survey (**USGS**)

Planned NPCREP Moorings and Lines



BEST Bering Sea Partners

International Partners

- North Pacific Anadromous Fish Commission (**NPAFC**)
    a) Bering Aleutian Salmon International Survey (**BASIS**)
- Census of Marine Life **(CoML)**
- International Pacific Halibut Commission **(IPHC)**
- Ecosystem Studies of Sub-Arctic Seas (**ESSAS**) - **GLOBEC**
    a) International Polar Year (**IPY**) programs

BEST Time Line

- 2002 Sept. Planning Workshop, Laguna Beach
- 2003 Mar. Planning Workshop, Seattle
- 2004 Oct. Science Plan Published
- 2005 Mar. SSC Formed
- 2005 May. Open Implementation Workshop
- 2005 June. Implementation Plan Ready
- 2005 ? Late Fall. NSF Announcement of Opportunity
- 2006 Proposals Due 90 days later
- 2007 Mar. Begin Field Program

BEST Information Sources

- **Web Site: http://www.arcus.org/Bering/index.html**
- **Science Plan: Available in Hard Copy at:**

  Arctic Research Consortium of the U.S. (ARCUS)
  3535 College Road, Suite 101
  Fairbanks, AK 99709
  Phone: 907-474-1600; Fax: 907-474-1604

- **Planning Group: c/o George L. Hunt, Jr.**

  School of Aquatic & Fishery Sciences
  University of Washington
  Email: geohunt2@u.washington.edu


BERING SEA
BEST
ECOSYSTEM STUDY


Ecosystem Studies
ESSAS
of Sub-Arctic Seas

Goal of ESSAS

- ***The goal of the ESSAS Program is to compare, quantify and predict the impact of climate variability on the productivity and sustainability of Sub-Arctic marine ecosystems.***

Major Research Questions

- **How will the External Forcing Functions be Affected by Climate Change?**
- **How will Changes in the External Forcing Mechanisms Affect BioPhysical Coupling?**
- **How will Changes in BioPhysical Coupling Influence Biological Interactions?**