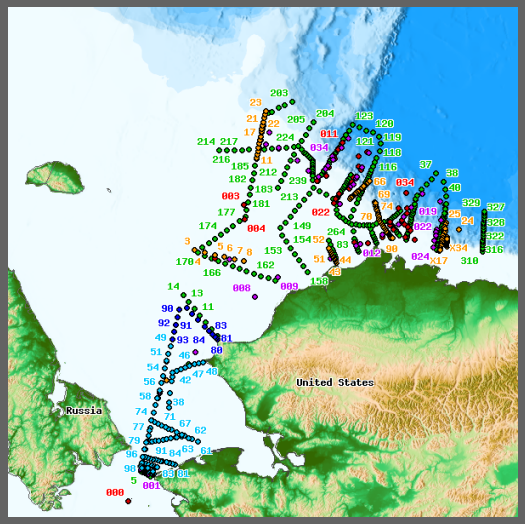
SBI Phase III
eTown Meeting
January 30, 2006: 9 am AST, 1 pm EST

Goal: to provide information to and receive input from the scientific community on developing SBI Phase III synthesis topics within the ARCSS program

Jacqueline Grebmeier
SBI Project Office/ARCUS

SBI arctic change
ONR NSF
SHELF BASIN INTERACTIONS

http://sbi.utk.edu



SBI Phase III planning

- Three planned open discussion sessions for Phase III planning
  - AGU, Dec. 6, 2005 informal oral session
  - ARCUS eTown Hall meeting/open conference call, 30 January 2006, 9 a m AST, 1 pm EST
  - Evening Open Town Hall session, Ocean Sciences Meeting, Wed., Feb. 22, 2006, Level 3, 316A, Hawaii Convention Center, 1830 h (immediately following the plenary session)
  - SBI Advisory Committee meeting Wash. DC, March 6-7; discussion with ARCSS Committee March 29-31, 2006
- NSF AO release planned July 2006, proposal deadline October 2006, funding ~March 2007 at start of the International Polar Year (IPY) 2007-2009

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1. **provide a brief overview of the SBI project to date**

2. discuss draft ongoing and new ideas for SBI Phase III objectives/themes, and

3. outline the upcoming SBI Phase III planning meetings for community input and important dates leading up to a SBI Phase III Announcement of Opportunity

Jackie Grebmeier will lead the discussion, members of the SBI Advisory Committee online acting as moderators.

We will discuss these topics during the informal meeting. Please feel free to provide comments, questions, and ideas to the group throughout the period of time. The meeting agenda will follow a powerpoint presentation that is posted on the SBI website at the following weblink http://sbi.utk.edu/jan30_online_mtg.ppt

SBI Goal and Timeline

The central goal of SBI, funded by the National Science Foundation and Office of Naval Research, is to improve our understanding of the impacts of global change on the physical and biogeochemical connections among the continental shelves, slopes, and deep basins of the western Arctic

Phase I (1998-2001) completed and involved analysis and synthesis of historical data, opportunistic field investigations, and modeling of specific regions and processes (31 PIs, 18 projects)

Phase II (2002-2006) constitutes the field program, which takes place in the Bering Strait region and over the outer shelf, slope in the Chukchi and Beaufort seas into the Canada Basin (40 PIs, 14 projects)

Phase III (2007-2009) will focus on Pan Arctic synthesis and model development suitable for simulating scenarios of the impacts of climate change on shelf-basin interactions

DEEP-SEA RESEARCH PART II

Topical Studies in Oceanography

The Western Arctic Shelf–Basin Interactions (SBI) Project

Volume 52, Numbers 24–26, 2005

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(Continued on inside back cover)

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The Western Arctic Shelf–Basin Interactions (SBI) Project

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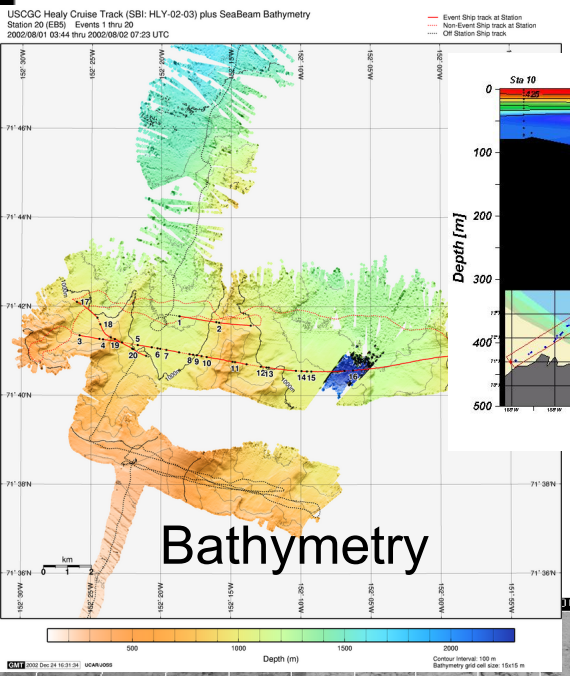
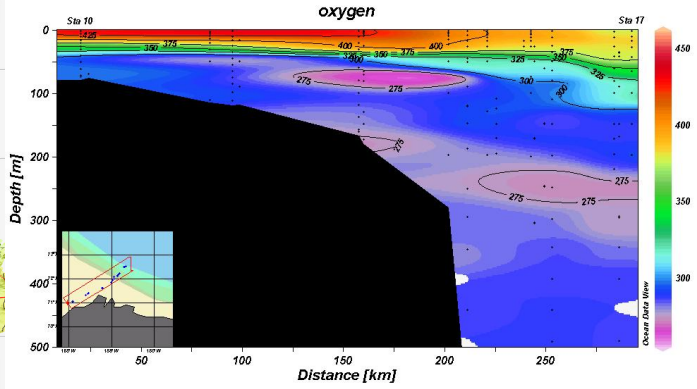
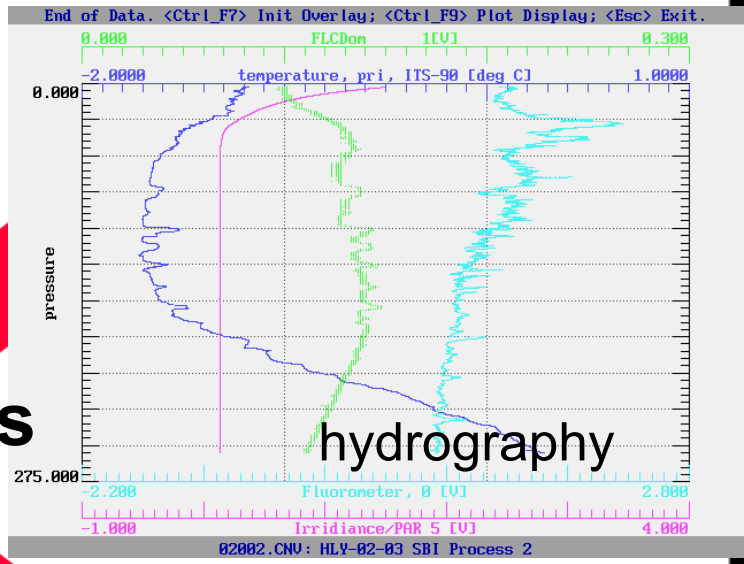
SBI Catalog Products Samples



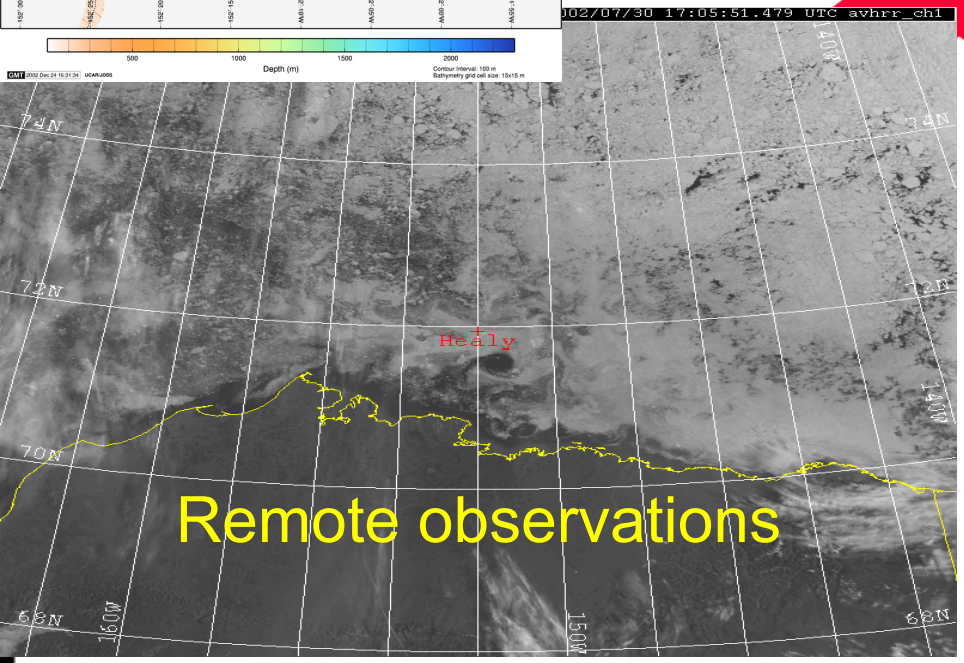
Bathymetry

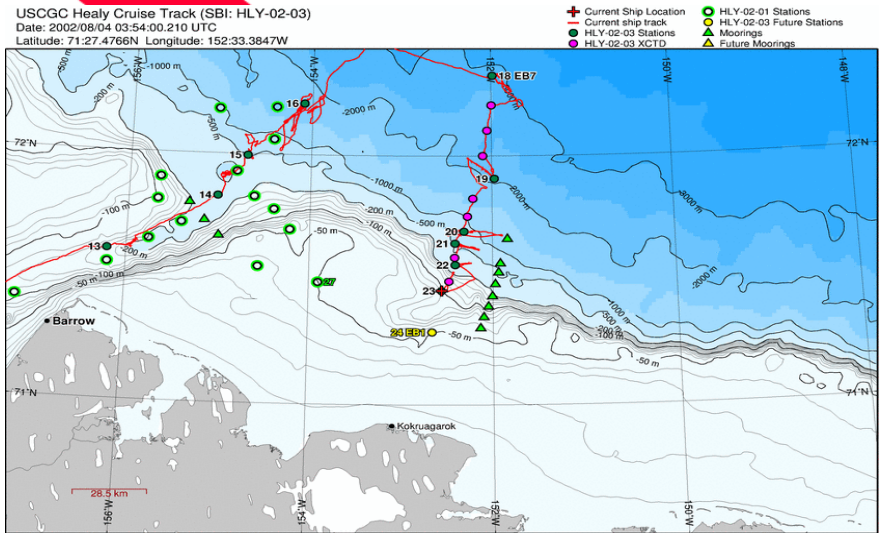


Multiple Data Sets



hydrography





SBI Phase II Results-Ice

- Western Arctic sea ice cover is undergoing substantial transformation, however, the nature of the changes is much more complex than suggested by the widely reported finding of reduced summer minimum ice extent. Important aspects include:

(1) Thinning of both level first- and multiyear ice appears to be forced in significant part by enhanced ocean heat fluxes (with warm layers extant at base of halocline), origin of heat (solar, advected Pacific or Atlantic waters not fully resolved);

(2) Bottom melt events common throughout winter, with substantial implications for ice algal communities and ice associated production;

(3) Deformation and ice growth in coastal polynyas appear to contribute substantially to volume of ice along inner shelf (also, ULS data from Melling, 2005, indicate that between 1991 and 2004 no statistically significant ice thinning has been observed over Mackenzie shelf);

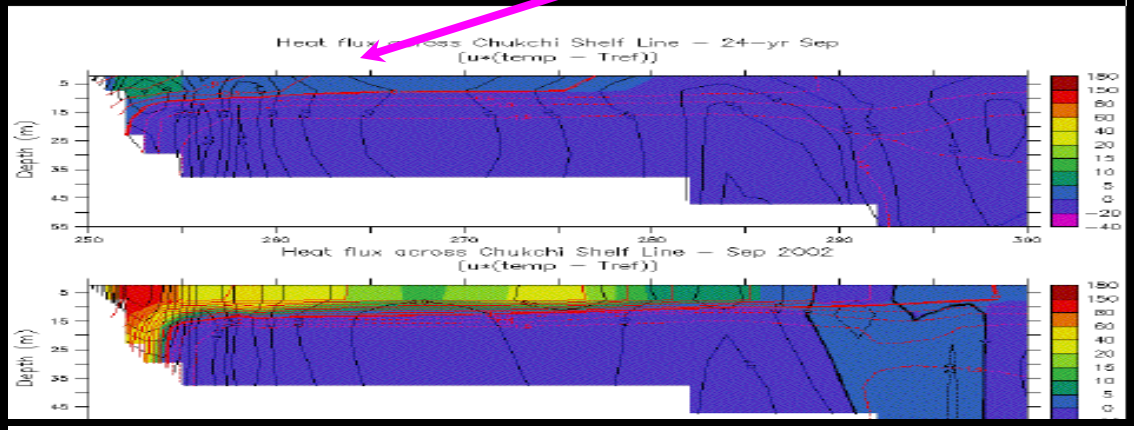
(4) Dynamic ice regime of recent decade favors entrainment of sediments into sea ice, contributing significantly to cross- and along-shelf sediment and carbon transport (with potential for enhancing land-ocean transfer).

Eicken

Modeling accomplishments of SBI II

- simulation of the accelerated reduction of sea ice extent/concentration in the western Arctic Ocean during the 2000s in agreement with satellite observations
- modeling of increased fluxes from the Chukchi shelf into the Beaufort Sea and their overall significance on melting of the perennial ice
- quantification of mean Bering-Chukchi volume transports, property fluxes, main pathways and rates of Chukchi-Beaufort shelf-basin exchange
- development, integration and validation of the coupled biophysical model of the Chukchi-southern Beaufort seas

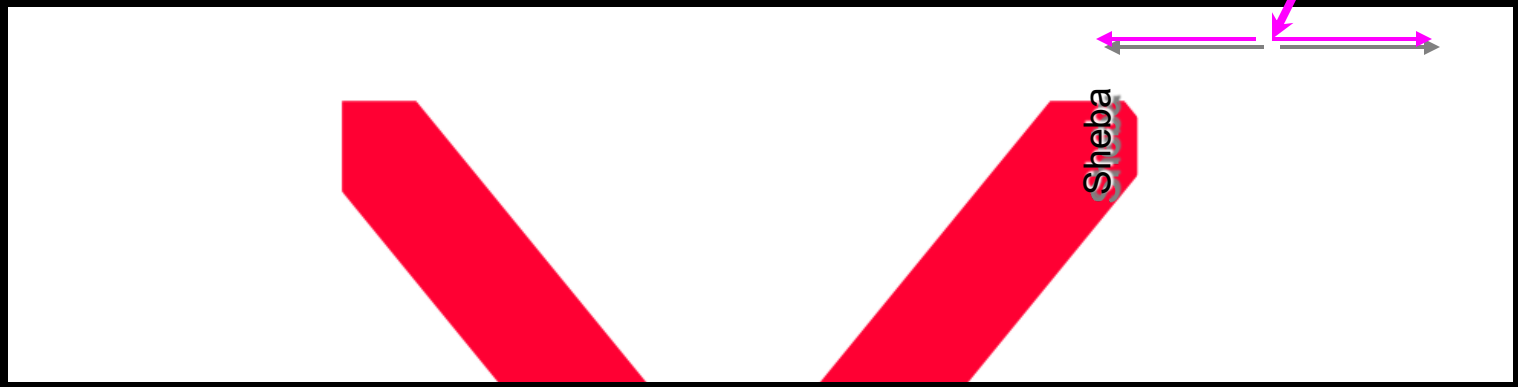
Pacific water heat fluxes into the Arctic Ocean



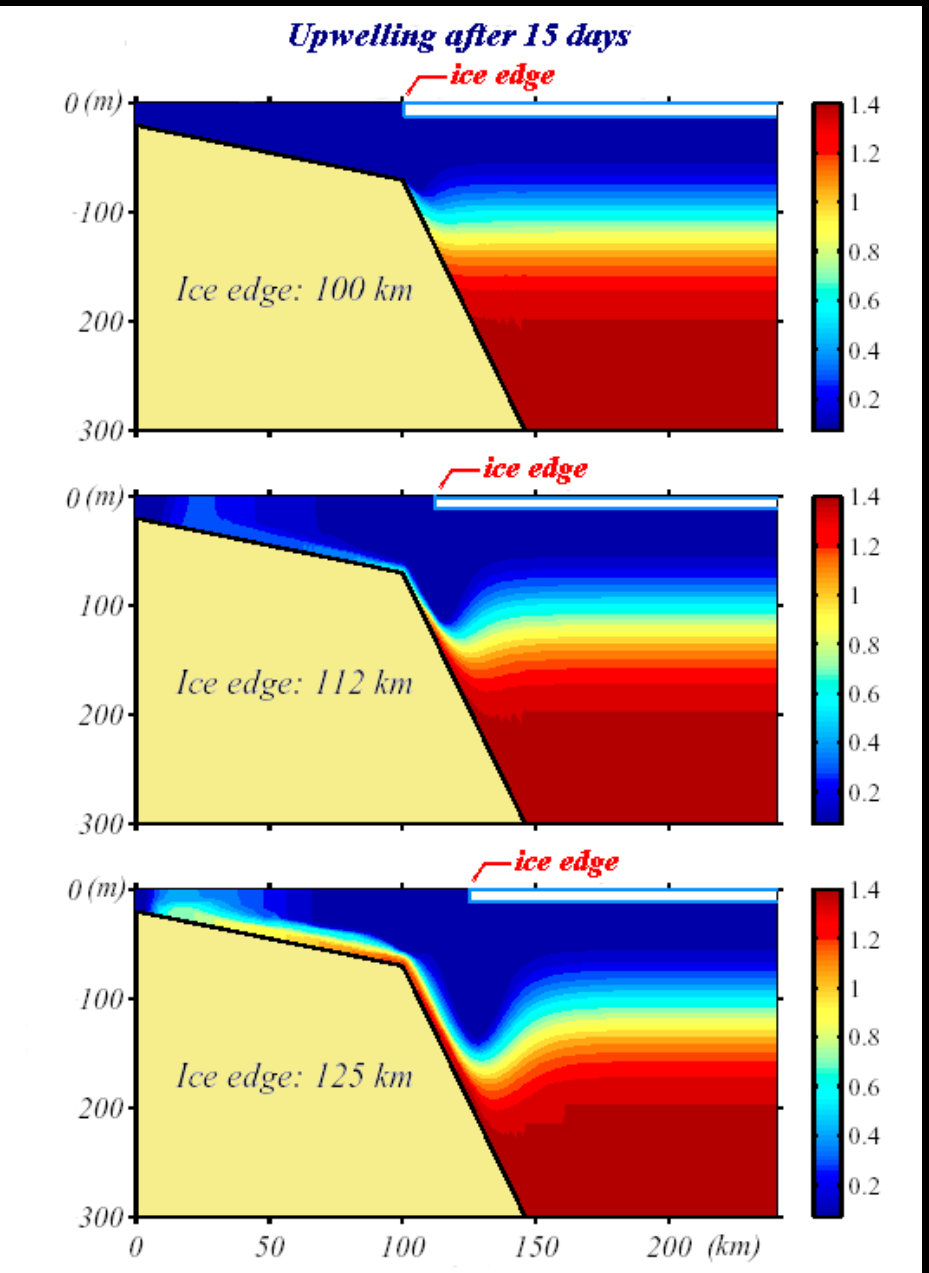
-Increased northward heat flux off the Chukchi Shelf coincides with the sea ice retreat in the 2000s.

- Studies (both field and modeling) are needed to understand effects of Pacific Water advection from Bering Strait into the Arctic Ocean and its effect on the environment

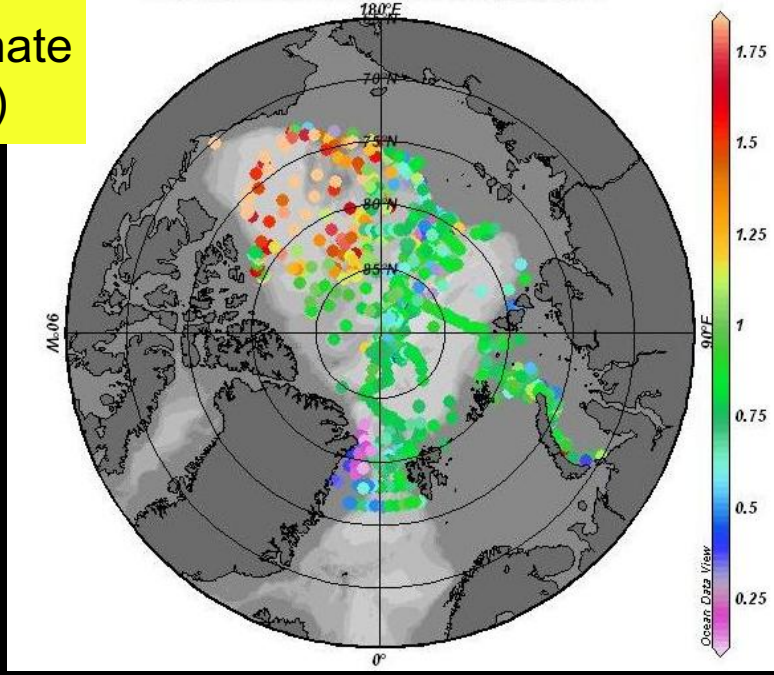
(Courtesy of W. Maslowski)



MODEL RESULTS



Phosphate (μM)



Nutrient–rich waters lie off the shelf break

The continued retreat of the summer ice cover exposes more and more of the shelf-break for longer and longer periods of time to upwelling favorable winds …

[From: Carmack & Chapman, GRL, 2003]

SBI Phase II Results

The data Dennis Hansell et al. published in Science with some follow-up contributions by our Cooper et al. PARTNERS/SBI JGR paper have shown that DOC in the Arctic Ocean is probably not as refractory as previously thought, is being lost while circulating in the Arctic Ocean, and/or fluxes of DOC from river sources are possibly being underestimated.

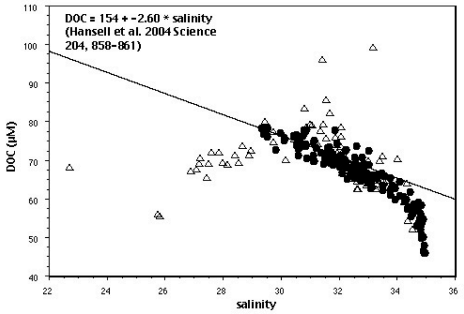
- Rapid and deep transport of a high proportion of particles from the sea ice surface, as indicated by Beryllium-7 assays
- High recent deposition on the continental slopes (Pb-210 and Cs-137assays)
- Brief presence of melted sea ice in surface waters (<1 year) and predominance of runoff as a freshwater component based up oxygen-18 measurements
- Potential importance of sediments as a source of DOC to the Arctic Ocean
- Key role of Barrow Canyon as an area of high productivity, deposition, and sedimentation

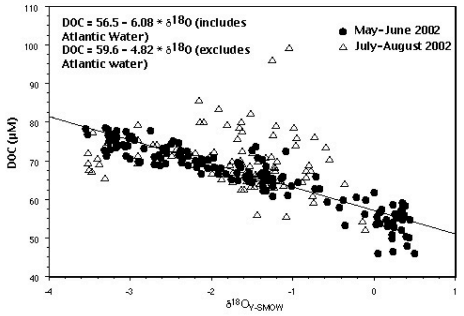
***"Biogeochemical Tracers in Arctic Rivers: Linking the Pan-Arctic Watershed to the Arctic Ocean"* (the "PARTNERS" project)**
Lead contact: Bruce Peterson, Woods Hole, (peterson@mbl.edu)

Linking ARCSS programs

Western Arctic Shelf-Basin Interactions (SBI)"
Lead contact SBI/PARTNERS: Lee Cooper, University of Tennessee Knoxville

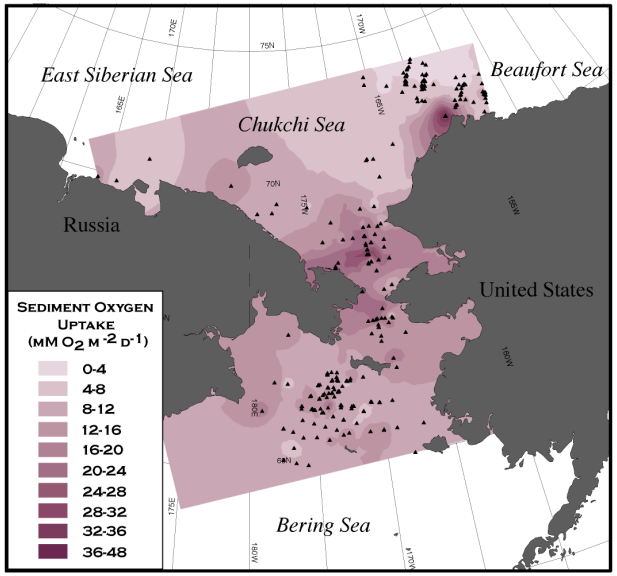
(lcooper1@utk.edu)





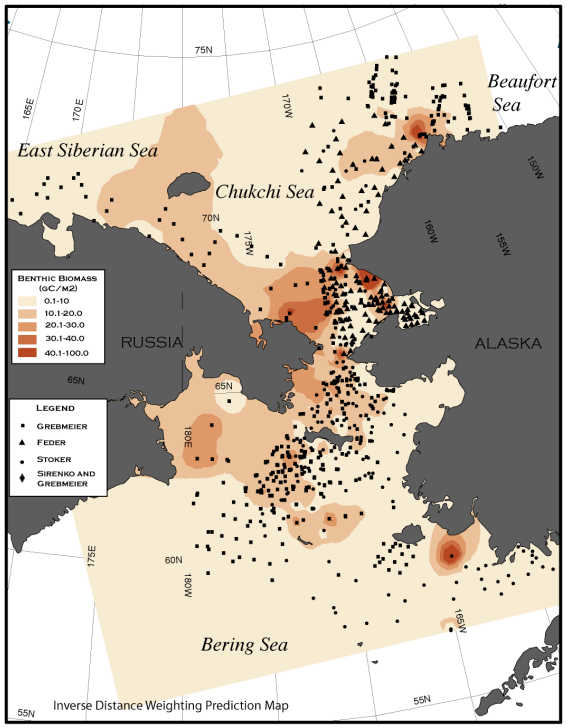
[Cooper et al. 2005, JGRBiogeochemistry]

SBI I and II results



Sediment community oxygen uptake ($mM\ O_2\ m^{-2}\ d^{-1}$) from 1984-2004

- an indicator of carbon supply to the underlying benthos, persistent patterns of carbon flux to sediments
- yet time series stations in "hot spots" indicate decline carbon supply and benthic standing stock

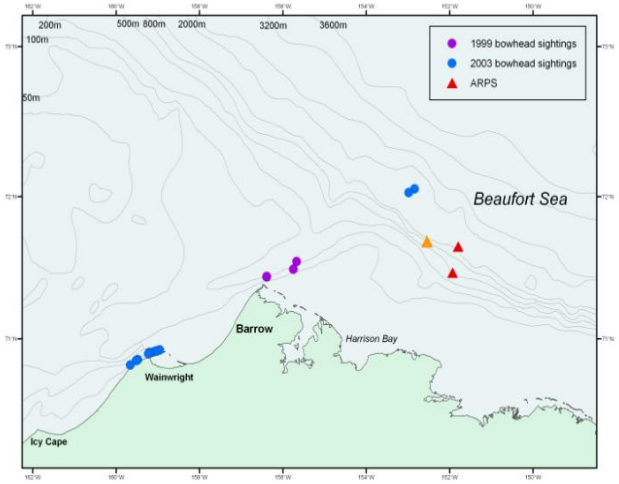


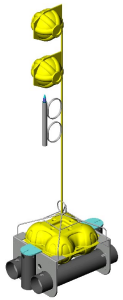
Macrofaunal biomass (g C m^{-2}) from 1977-2004

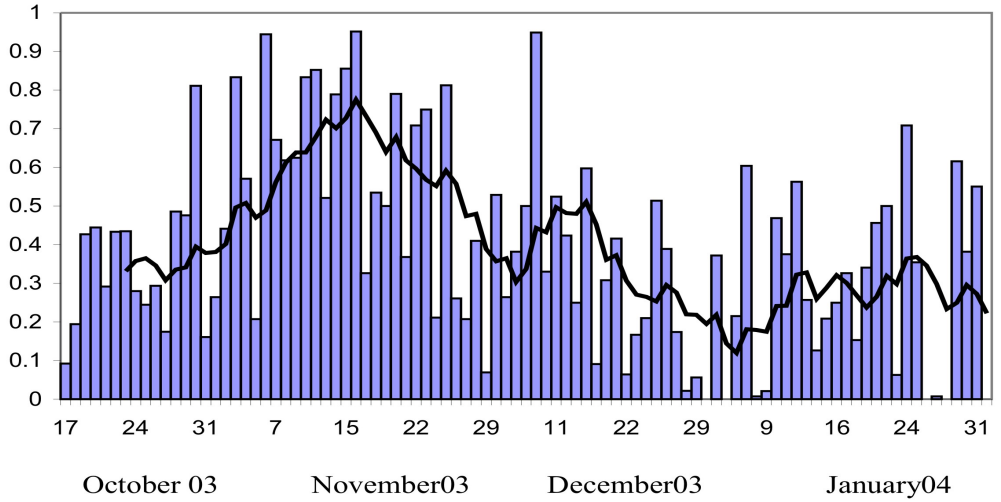
- identify "foot prints" of high carbon deposition and
- benthic biomass on the shallow continental shelves for time series investigations embedded in periodic process studies

[Grebmeier et al. in revision, Prog. Oceanogr.]

Recorders Near Barrow Detect Gray Whale Calls throughout winter `04 [until May]







Gray whale pulses at site B (deep ARP) from 17 October 2003 to 31 January 2004. Black line is 7 day moving average. Bars represent the proportion of daily 10 minute files with gray whale pulses.

- ARPs deployed OCT03-SEP04,via NSF-SBI cruises
- Part of broader AK array; *BioScience*, January 2006

With thanks to:
L. Munger (SIO)
R. Pickart (WHOI)

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ARCSS Synthesis

ARCSS-supported research seeks to:

- Identify the most sensitive and critical components and interactions driving arctic system behavior
- Integrate and synthesize modeling results, observations, process understanding, paleo-environmental data, and human dimensions knowledge
- Strengthen interactions between arctic research communities and the broader Earth system science community in order to ensure that the Arctic is accurately represented in earth system models
- Enhance two-way communication with stakeholders, decision-makers, and the public to increase the impact of ARCSS research.

Currently ARCSS program is advancing toward an integrated understanding of the system by focusing explicitly on questions that link multiple system components and processes across a range of temporal and spatial scales through:

- Focus on interdisciplinary, cross-cutting questions that will lead to a better understanding of how the system components function and interact
- Demonstrate relevance to the entire arctic system, and if possible, relevance of the arctic system within the broader Earth system.
- Incorporate existing arctic data, information, and models

[http://www.arcus.org/ARCSS/index.html and current ARCSS AO]

SBI Phase III-Draft Objectives

- Investigate global change consequences for the ecosystems of the Arctic margins
- Develop Pan-Arctic models (including embedded regional submodels) suitable for exploring "what-if scenario" studies related to global change
- SBI Science/Implementation Plans identified that Phase III synthesis identified two potential themes:
  (1) global change effects on the biological, chemical and physical processes in the Arctic, and
  (2) determine global change on the overall carbon/nitrogen cycles and the combined effects on the yield and structure of the higher trophic levels, including human populations in the Arctic
- Opportunity for intercomparison of carbon currency types within production-transport-fate synthesis topics from marine, freshwater and sea ice projects (SBI, Freshwater Integration,SNACS, SASS; international, regional coincident projects with datasets:CASES, CHINARC, JWACS, RUSALCA)
- SBI results have added step-function data availability for oceanographic and sea ice evaluations in the western Arctic Ocean
- Need for coupled biochemical/physical modeling of the Arctic Ocean ecosystem at seasonal to interdecadal scales; potential for prediction of scenarios of Arctic climate change and its effects on the Arctic Ocean ecosystem
- SBI Phase III coincident with planning for shelf-basin exchange (SBE) studies via international AOSB/CLIC IPY efforts, SEARCH, ISAC and International Polar Year (2007-2009), SBI synthesis efforts will be both timely in productivity and scope
- Updated discussions are that SBI Phase III would produce syntheses from the regional to the entire Arctic and, in some cases, the entire global ecosystem in the context of SBI objectives. Results from the SBI Phase I and II data sets are anticipated to form the basis of western Arctic synthesis studies and may also include results from coincident field programs that occurred during the SBI program to date. Projects would examine broad scale implications of these results in order to develop a better systems understanding of shelf-basin interactions in the Arctic and its connection to global processes

Updated SBI Phase III-Draft Topics

- What are the broad scale impacts of a warming of the influx waters passing through Bering Strait and the implications for the Arctic sea ice regime and ecosystems, including regional, central Arctic and downstream areas? How can Bering Strait inflow and downstream impacts influence global overturning circulation? (climate, ecosystem, ocean-human interactions)

- Results from SBI have revealed that the shelf-edge boundary current in the Canada basin is highly turbulent and subject to intense offshore flux of mass, nutrients, and other properties. Are these processes generic to the entire Arctic boundary current, and what are the large-scale ramifications for the ecosystem of the Arctic Ocean interior?

- How can observations in the western Amerasian Arctic collected during SBI and coincident studies be used for regional assessments and modeling of key forcing functions and system responses ? Is it possible to expand this to a pan-Arctic perspective?

- Bioavailable dissolved organic matter (DOM) and POC are rapidly produced in shelf waters during spring and summer and some of this DOM/DOM is transport to the basin. Through SBI studies we know that rates of utilization of DOM are relatively low in shelf waters compared to POC. Terrigenous DOM discharged to the Arctic Ocean by rivers has a modern radiocarbon age and is abundant in shelf and polar surface waters. We need to understand the role of increased seawater temperature on carbon cycling in river and marine waters and the impact this will have on the Arctic Ocean carbon cycle.

- There are temporal differences in the contribution of photic zone metabolism to carbon fluxes in the SBI study area. How would perturbations that alter the frequency or duration of these contrasting modes of metabolic balance impact carbon sinks and sources in this region of the Arctic Ocean? What are the implications of such a modal shift on the Arctic carbon cycle?

- Increase seawater temperature could enhance both primary (plant) and secondary (zooplankton, bacterial) production, thus enhanced water column cycling and limiting benthos, movement towards pelagic vs benthic-dominated region in Ameriasian Arctic with implications to higher trophic populations and human utilization.

Carbon Cycling in the Arctic System

- Carbon Sources in the system:
  autochthonous **marine** production >300 Mt/yr POC
  allochthonous **terrestrial** carbon ~12.6 Mt/yr POC

- Sediments often show enhanced terrestrial carbon - where and why?

- Impact of differing transport mechanisms (rivers, ice) and geographic differences (narrow vs broad shelves) on distribution?

- Comparisons to other shelf/marine environments in the Arctic and elsewhere. Consequences for climate?

Synthesis Topics within SBI and ARCSS

e.g., Arctic change will influence cycles: water, carbon and heat which impact the Arctic system. What questions can we put forward and answer with SBI and other available data sets related to the carbon cycle that will improve our understanding of the Arctic system, whether regionally, circum-arctic, or globally?

e.g., Will our enhanced understanding of ice and physical margin dynamics through SBI data synthesis enable us to evaluate the impact of future process changes on shelf-basin interactions that would feedback to the Arctic system?

Do the eTown Meeting participants have other suggestions for topics of focus for SBI Phase III within the overall framework of an Arctic system synthesis?

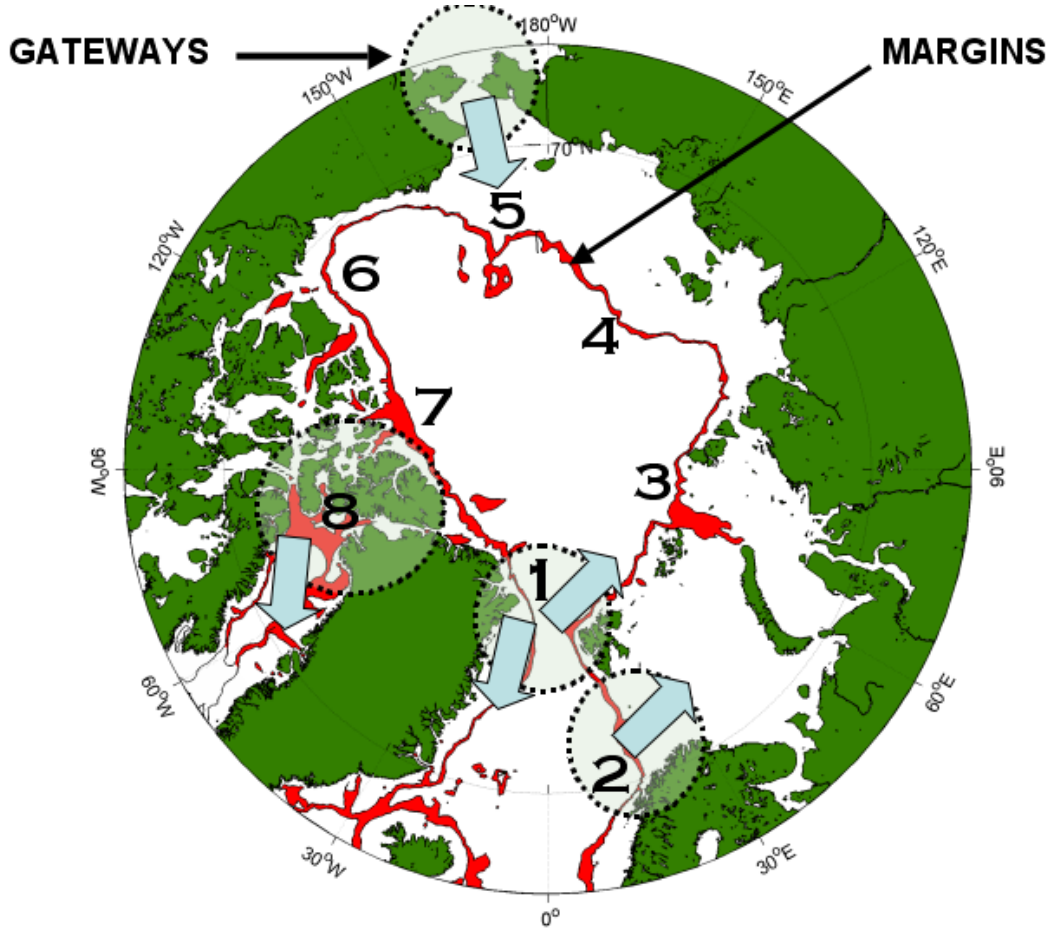
Data Products SBI I, II and into III

- JOSS prepare special composite and/or integrated datasets that will assist with Phase 3 activities as well as provide the broader community useful products from SBI. These might include the composite bottle data, multi-cruise composites of parameters of interest, other useful GIS mapped or gridded integrated datasets for model and display applications, etc.

- Proactive coordination with IPY, SEARCH and ARCSS synthesis activities

- Continued population of the SBI Phase 2 dataset and augmentation through Phase 3. This is generally continuing support to the project as we have done up until now and making sure the community can access the data from all SBI

Arctic Margins and Gateways



[map courtesy Eddy Carmack, 2005]

1. Fram Strait Complex (gateway)
2. Barents Sea inflow (gateway)
3. Santa Anna Trough margin
4. Kara/Laptev Sea margin
5. Bering Strait Complex (gateway)
6. Beaufort Sea margin
7. Northern Canada margin
8. Canadian Arctic Archipelago (gateway)

The AOSB/CLIC science bodies are proposing an “Arctic Snapshot” of key shelf-basin exchange (SBE) parameters at the shelf break and gateway complexes in the Arctic for the International Polar Year (IPY) in 2007-2009 through development of a synoptic network of collaborative international studies over a pan-Arctic scale (website (http://asof.npolar.no/IPY.html).

Grebmeier

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2006 Oceans meeting, SS112. Pan-Arctic Margin Dynamics: Physical forcing, biogeochemical cycling and ecosystem response (Feb. 22-23, 2006)

- Conveners: Jackie Grebmeier, Mike Steele, Eddy Carmack, Leif Anderson and Bob Pickart
- one of top 6 largest sessions for the meeting, 2 days, Town Hall meeting Feb.22, 76 papers
- 36 oral and 40 poster presentations organized around 6 themes
    - O1. Pan-Arctic Margin Dynamics: Physical forcing, Atlantic-influenced system
    - O2. Pan-Arctic Margin Dynamics: Physical forcing, Pacific-influenced systems
    - O3. Pan-Arctic Margin Dynamics: Circum-arctic slope processes
    - O4. Pan-Arctic Margin Dynamics: Biogeochemical cycling and carbon production
    - O5. Pan-Arctic Margin Dynamics: Carbon transformation and export
    - O6 Pan-Arctic Margin Dynamics: Pelagic-benthic coupling and ecosystem response
    - Two coincident poster sessions in afternoon, Feb. 22, same themes

February 2006 Ocean Sciences Meeting, Honolulu, Hawaii (sponsored by AGU/ASLO/TOS/ERF)

Town Hall Title: Western Artic Shelf-Basin Interactions (SBI): Implementation Planning for Phase III Modeling and Synthesis
Date: 02/22/06
Start Time: 1830h
Location: Level 3, 316A, Hawaii Convention Center
Abstract (150 words)

The goal of the ongoing Western Arctic Shelf-Basin Interactions (SBI) project is to improve our understanding of the impacts of global change on the physical and biogeochemical connections among the continental shelves, slopes, and deep basins of the western Arctic. SBI was developed to include three phases: Phase I (1999-2001) included retrospective synthesis, opportunistic sampling and modeling, Phase II (2002-2006) is the on-going multi-year field program and modeling effort in the Amerasian Arctic, and the planned Phase III will be the pan-Arctic synthesis and modeling component. The purpose of this evening Town Hall session is to have an open-forum to discuss implementation objectives and planning for SBI Phase III and to solicit community input for a systems approach to understanding Arctic shelf-basin dynamics.

Synthesis Topics within SBI and ARCSS

1. Do the eTown Meeting participants have further suggestions for topics of focus for SBI Phase III within the overall framework of an Arctic system synthesis?

2. Ideas about best way to obtain input through the open community sessions that will assist with Phase III planning?

3. Final comments?

Thank you to Laura Slater and ARCUS for organizing this online meeting and to everyone who participated in it.