# Ecosystem Time Series

Phyllis J. Stabeno
Pacific Marine Environmental Laboratory

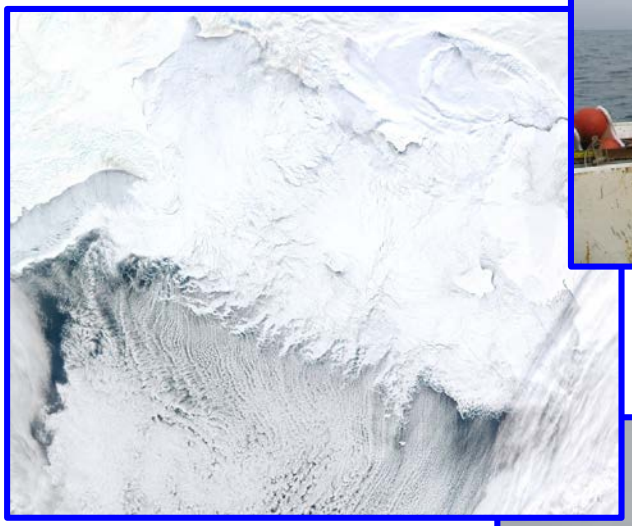
Alaska
Fisheries
Science
Center

Ecosystem Science Review
Juneau, Alaska
May 2-6, 2016

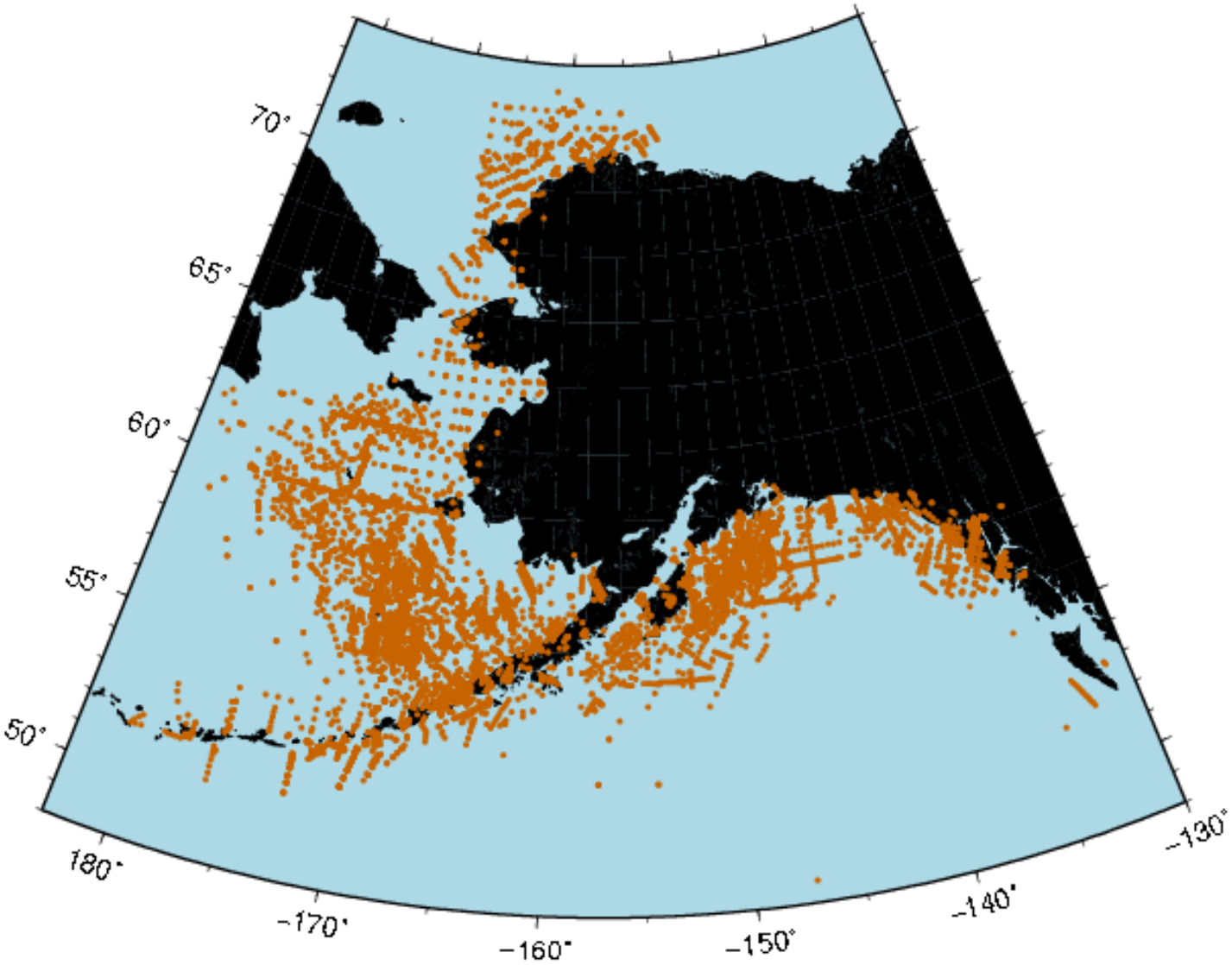
# Ecosystem Time Series

## Physics - Chlorophyll

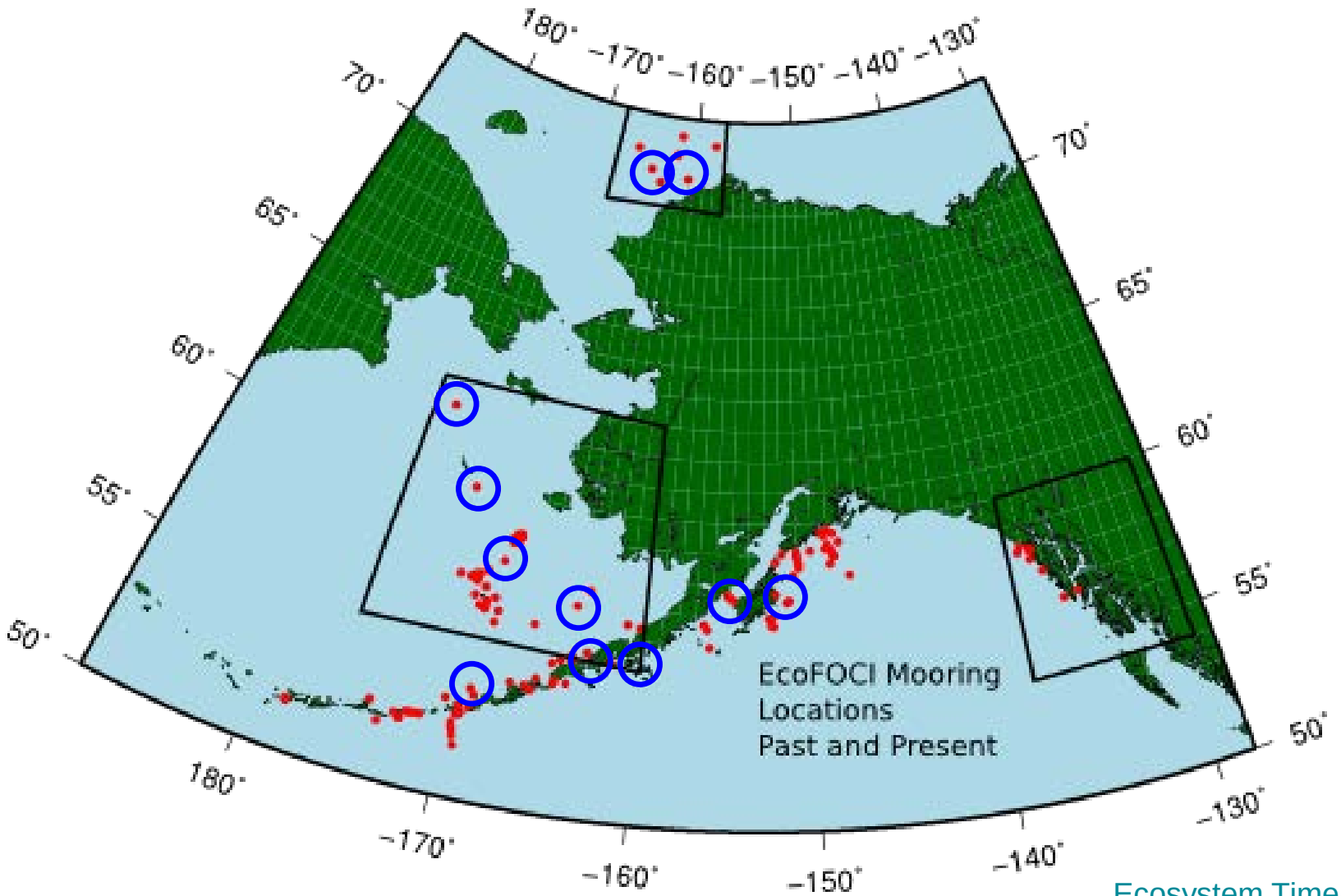
- BioPhysical Moorings
- Hydrography
- Satellite
- Meteorology
- Sea Ice



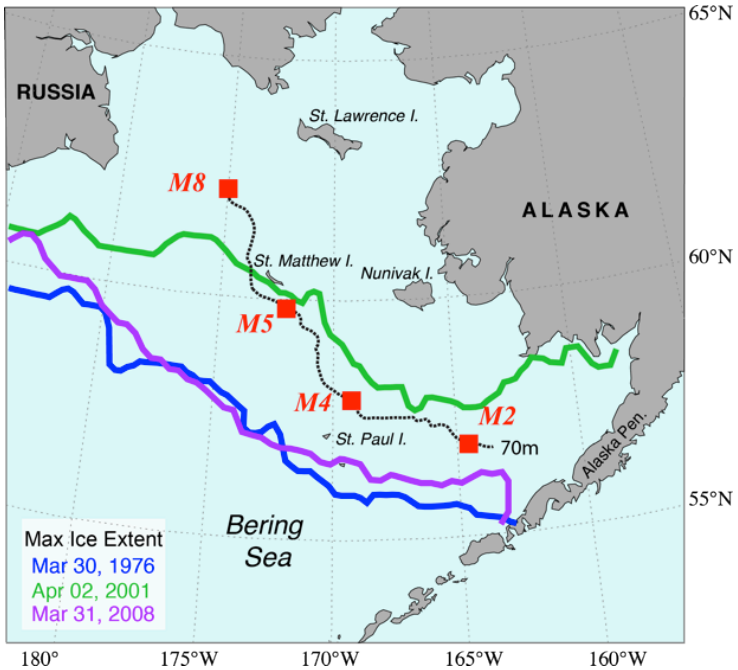
# Hydrography:
## Gulf of Alaska, Bering Sea and Arctic



# Moorings:
# Gulf of Alaska, Bering Sea and Arctic



# BioPhysical Moorings: Bering Sea



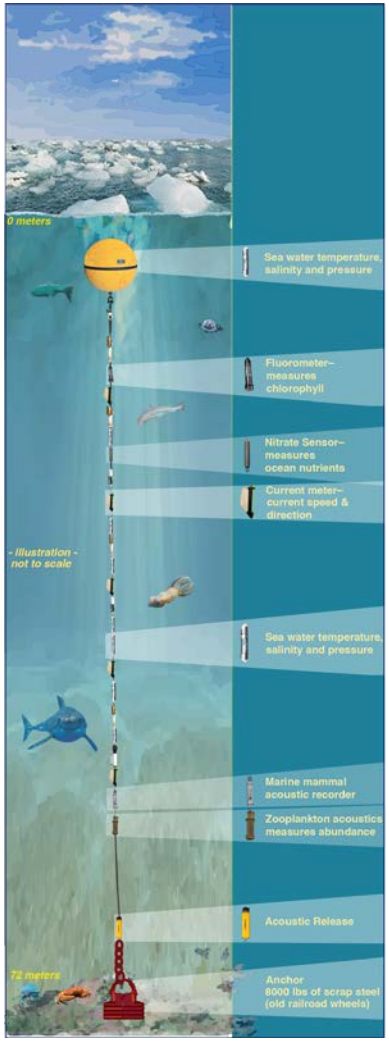

**First Deployed**

**M8 - 2004**

**M5 - 2004**

**M4 - 1998**

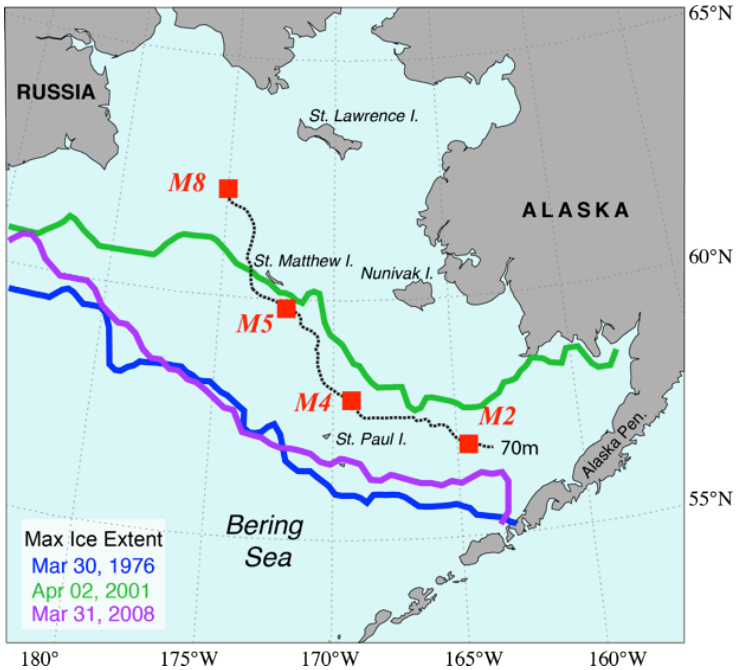
**M2 - 1995**




**Measurements:**

**Temperature, salinity, currents, chlorophyll fluorescence, nitrate, PAR, $O_2$, ice keel depth, $CO_2$, meteorological variables, sound (passive acoustics), active acoustics**

# BioPhysical Moorings: Bering Sea




- **First Deployed**
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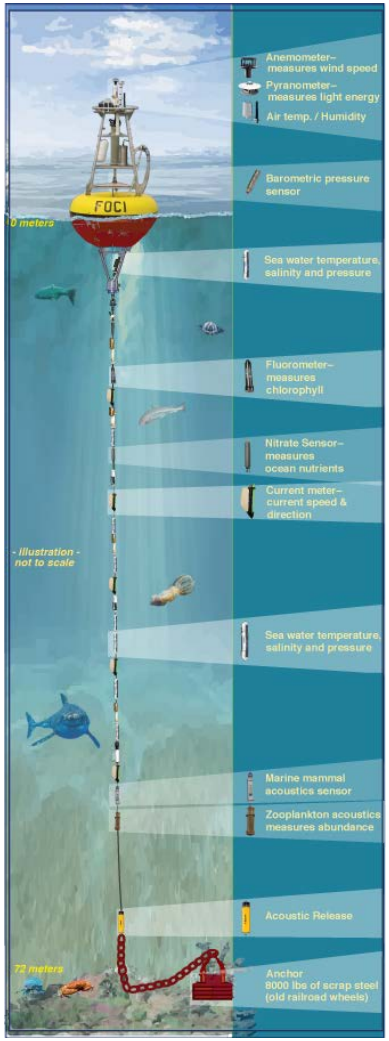


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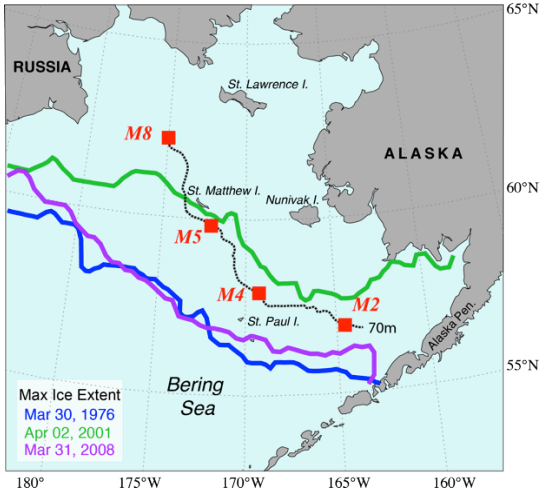
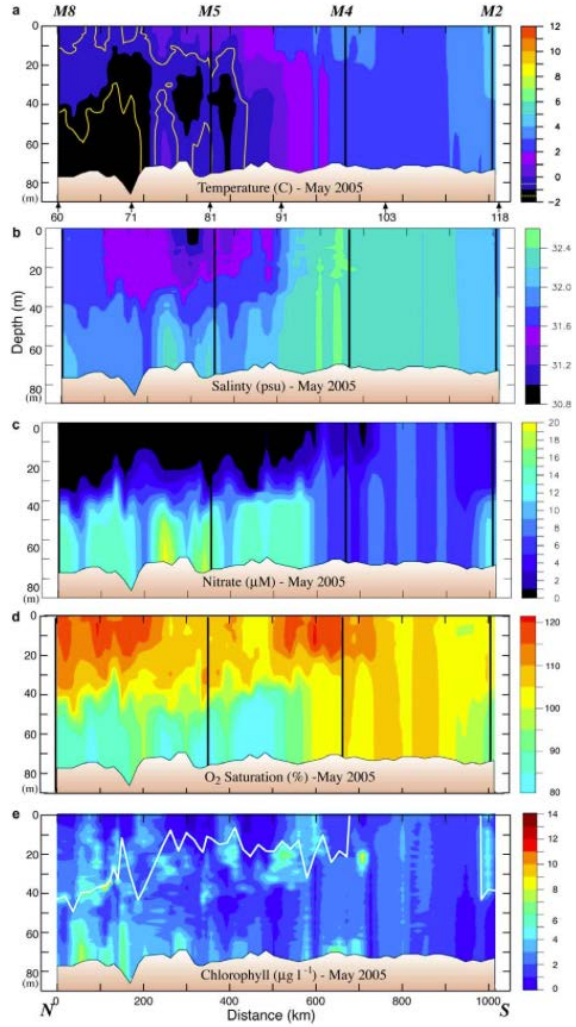
# BioPhysical Hydrography: Bering Sea

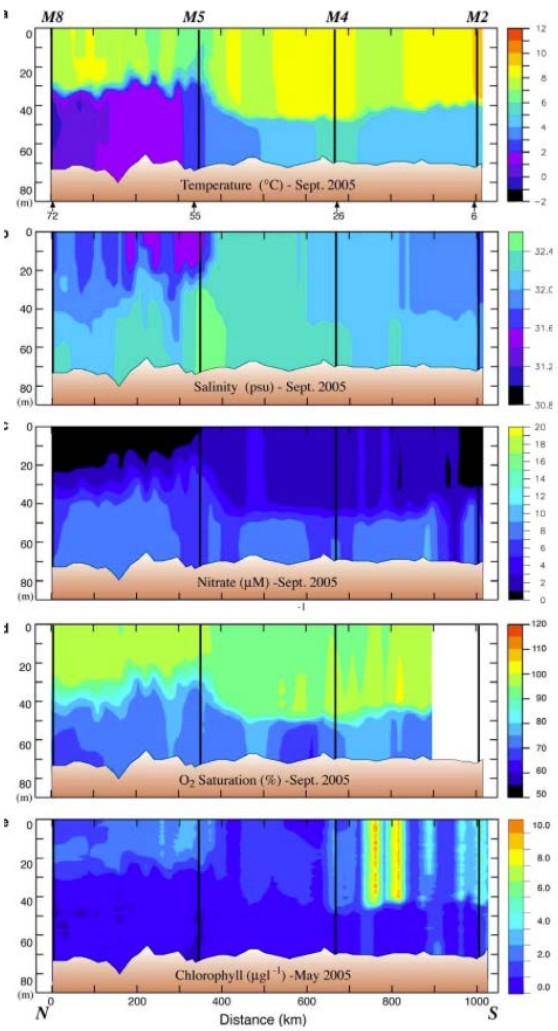
## 70-m Isobath



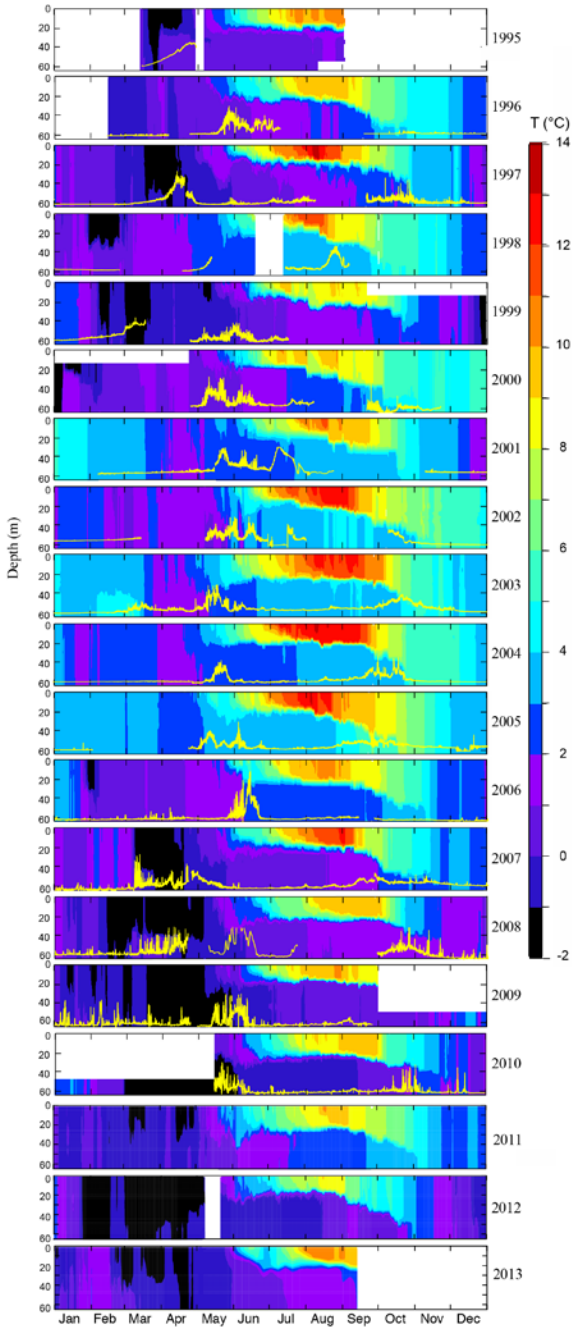

## Spring

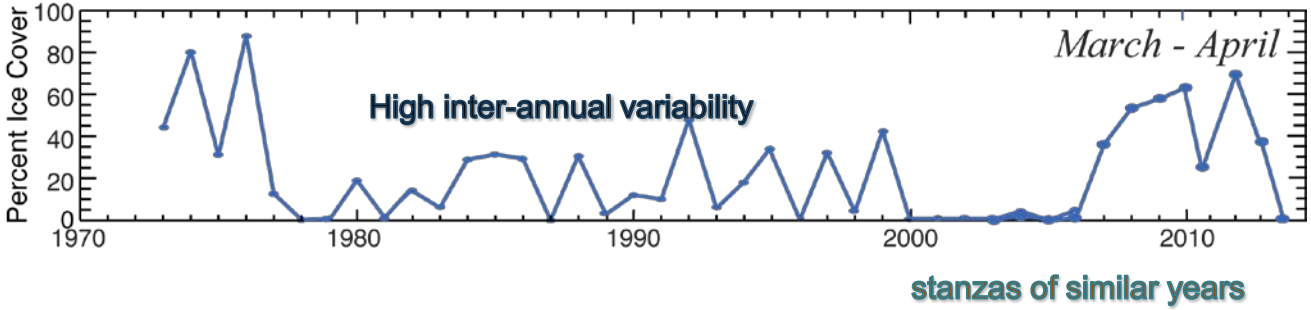



## Autumn

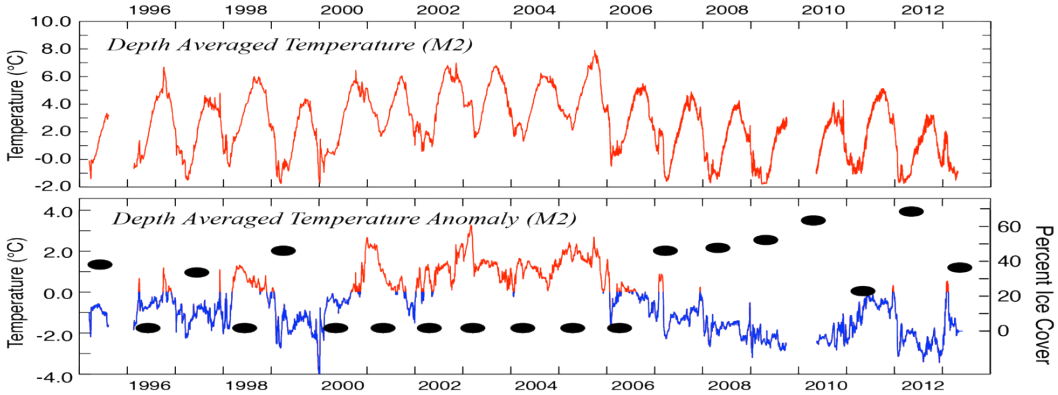


# BioPhysical Moorings



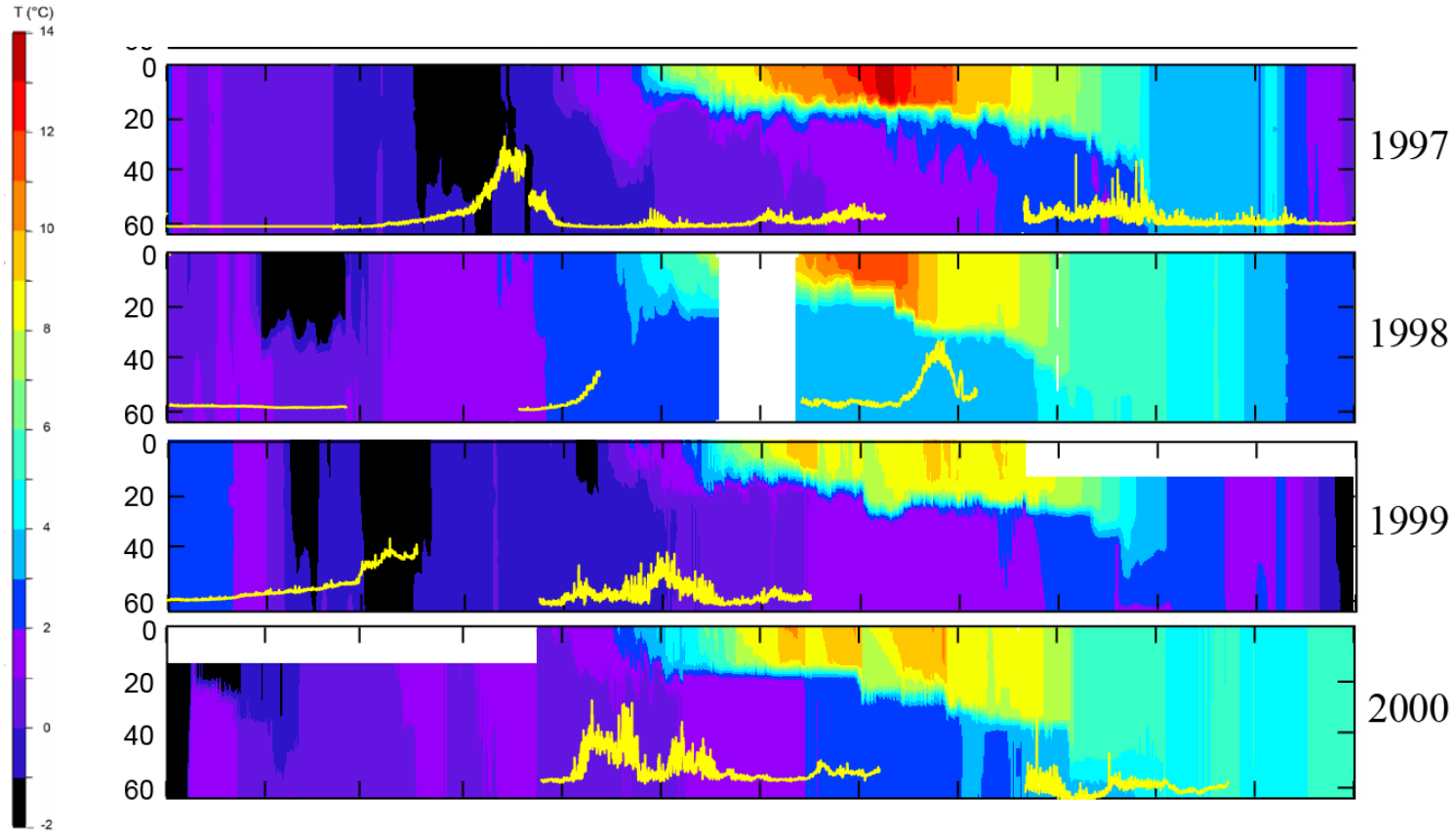



stanzas of similar years




**Percent Ice Cover (March – April)**

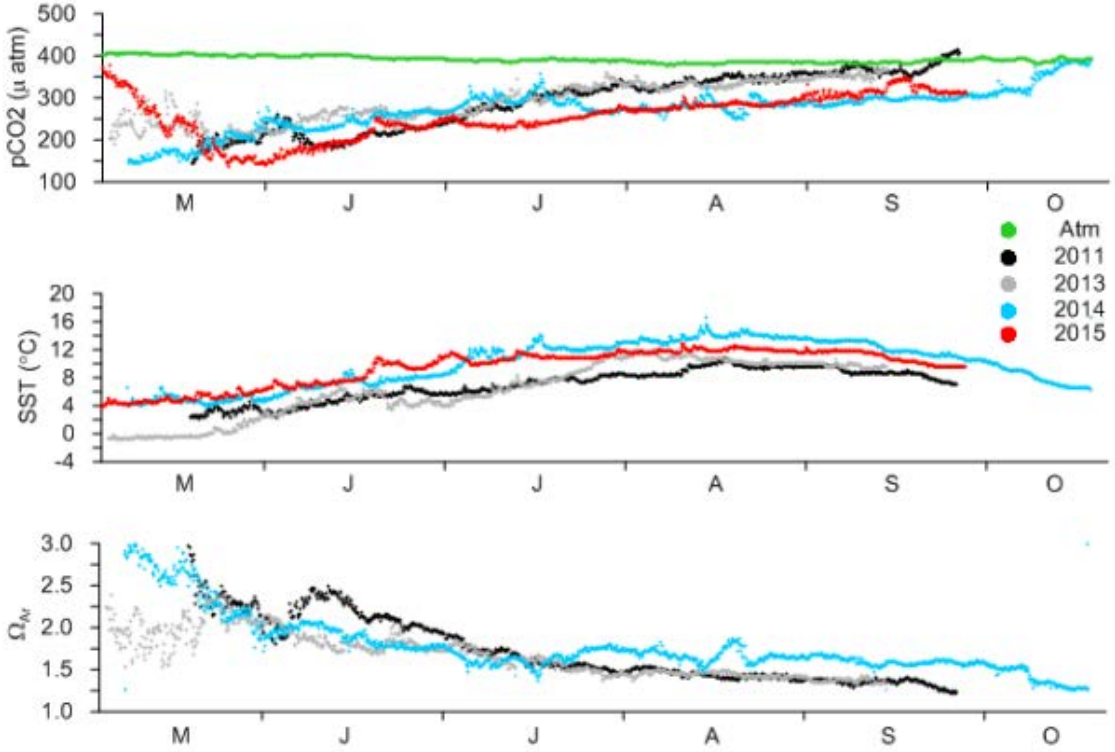
# Nutrients and Chlorophyll



# Carbon Biogeochemistry

**M2 Carbon: 2011-2016**

*Surface $CO_2$ flux measurements help constrain the biological pump and ocean acidification signals.*

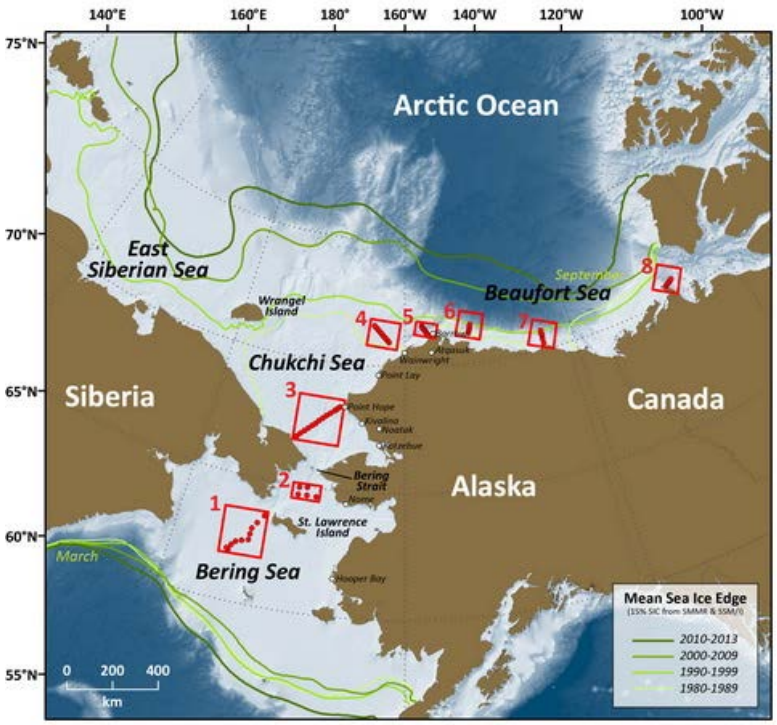


# Observations: US Arctic

BOEM
Bureau of Ocean Energy Management

RUSALCA
Russian-American Long-term Census of the Arctic

**DBO sites: 1-8**



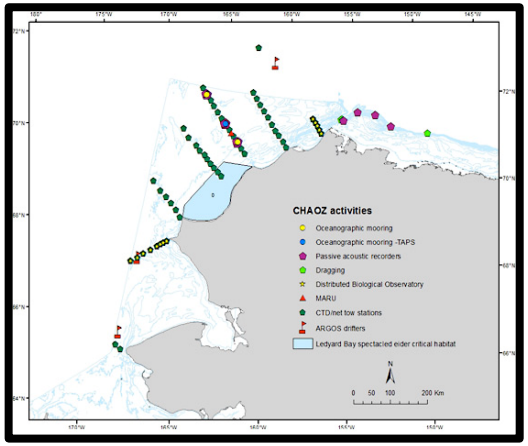

## Distributed Biological Observatory

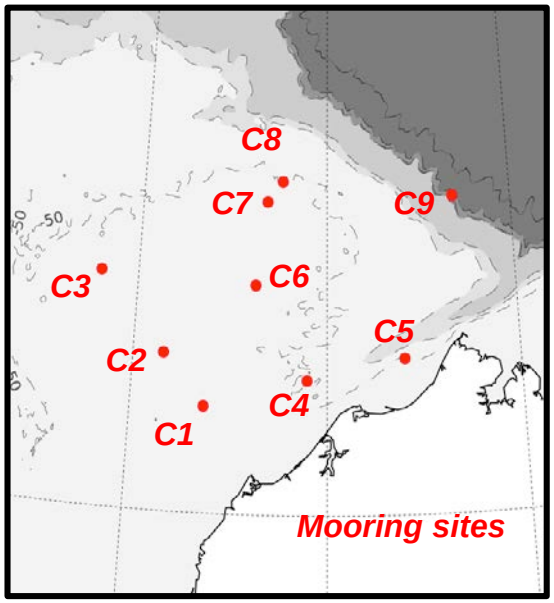
*Linking Physics and Biology*

# BioPhysical Moorings: US Arctic

BOEM
Bureau of Ocean Energy Management

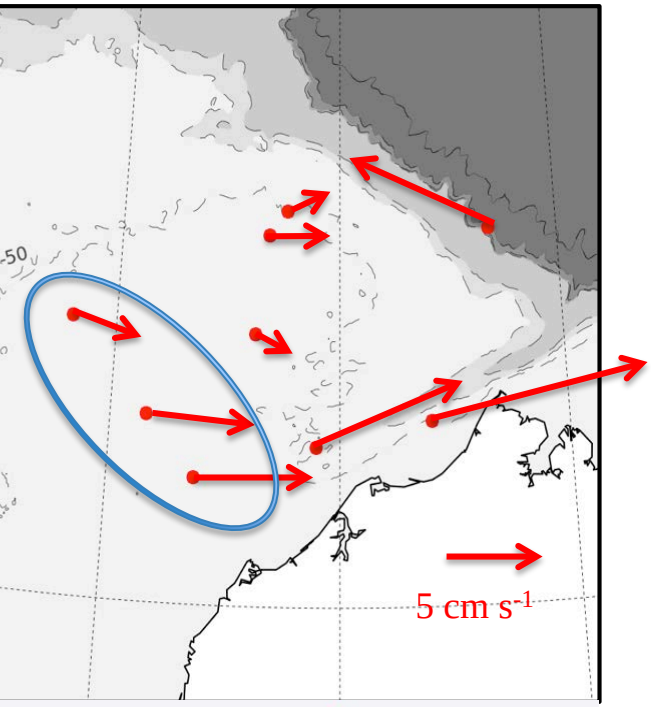
- CHAOZ – Chukchi Acoustics, Oceanography, and Zooplankton (Field years 2010, 2011)
  - Investigates distribution and abundance of whales in relation to changes in oceanography, prey density, and anthropogenic activities
- ArcWEST – Arctic Whale Ecology Study (Field years 2013, 2014)
  - Investigates the transport of krill and nutrients from the northern Bering Sea to Barrow Canyon
- CHAOZ-Extension ((Field years 2013, 2014)
  - Extension of CHAOZ to Hanna Shoal

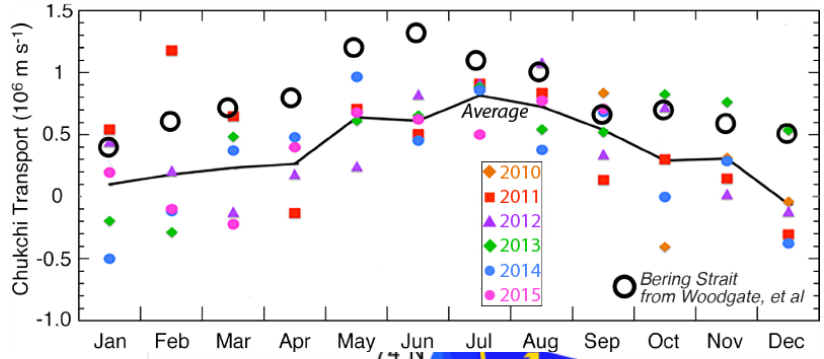



Shipboard measurements Biophysical moorings Satellite-tracked drifters

# Observations: US Arctic

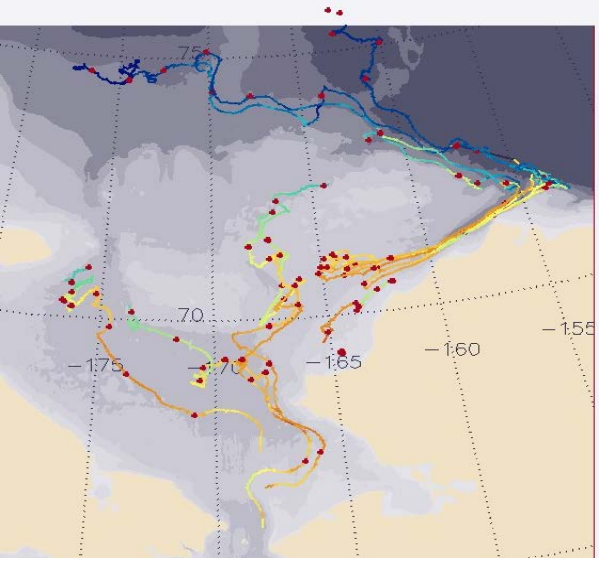


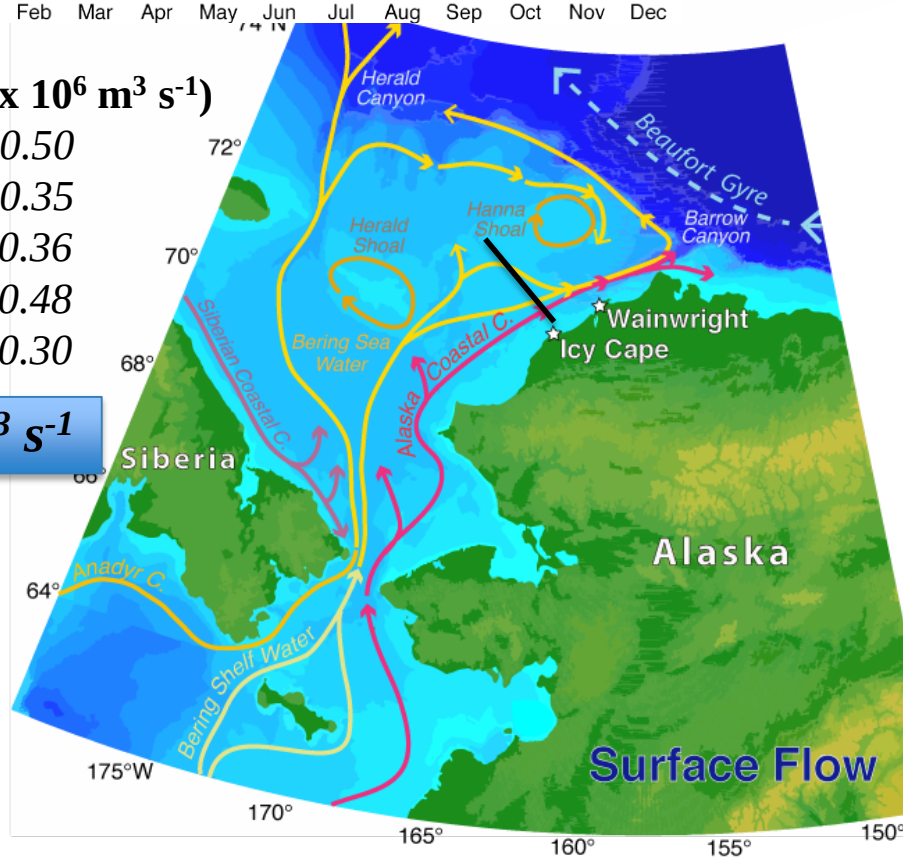




**Annual Transport (x $10^6$ $m^3$ $s^{-1}$)**

*2010-2011 - 0.50*
*2011-2012 - 0.35*
*2012-2013 0.36*
*2013-2014 0.48*
*2014-2015 0.30*

***0.40 x $10^6$ $m^3$ $s^{-1}$***



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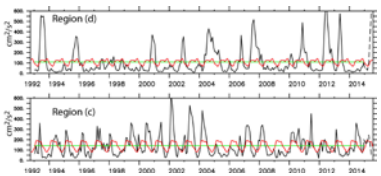
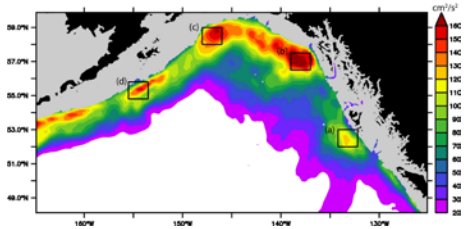
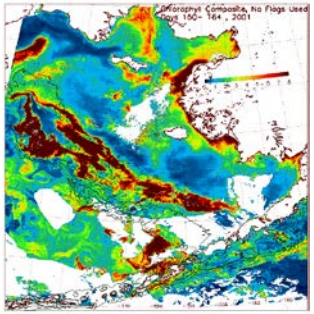
# Satellite and other products

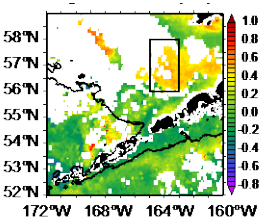
**Sea-surface height**

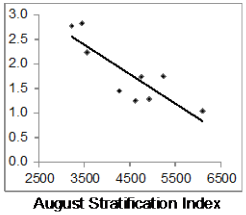


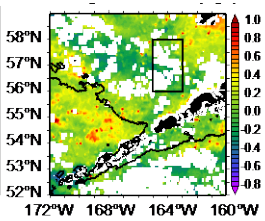



**Chlorophyll**

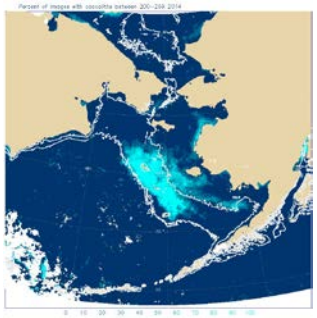




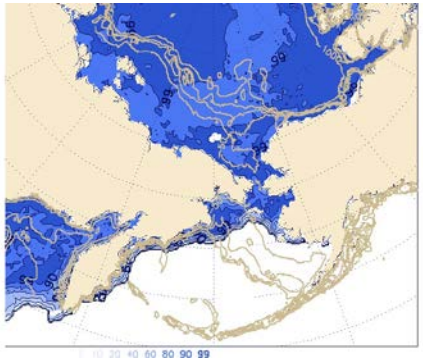



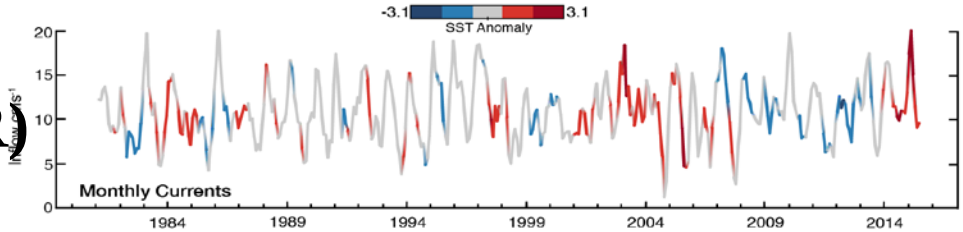

**True color**



**Sea ice**

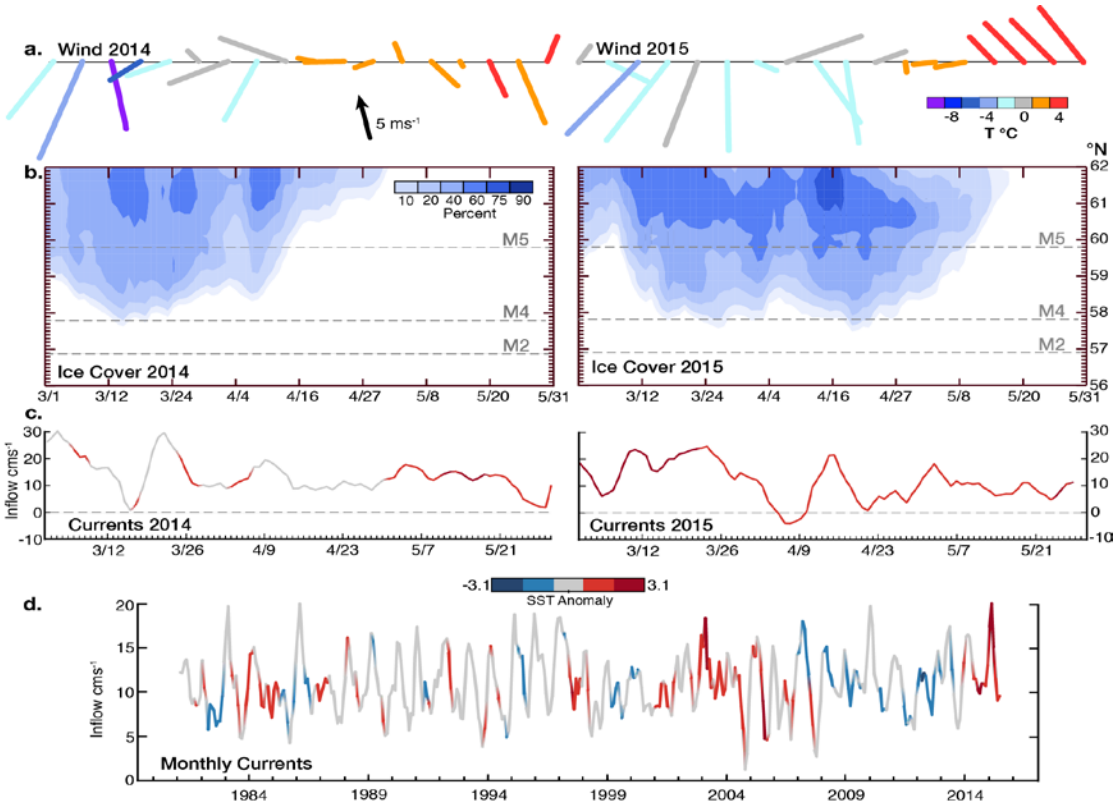


**Model products (NCEP, NARR)**



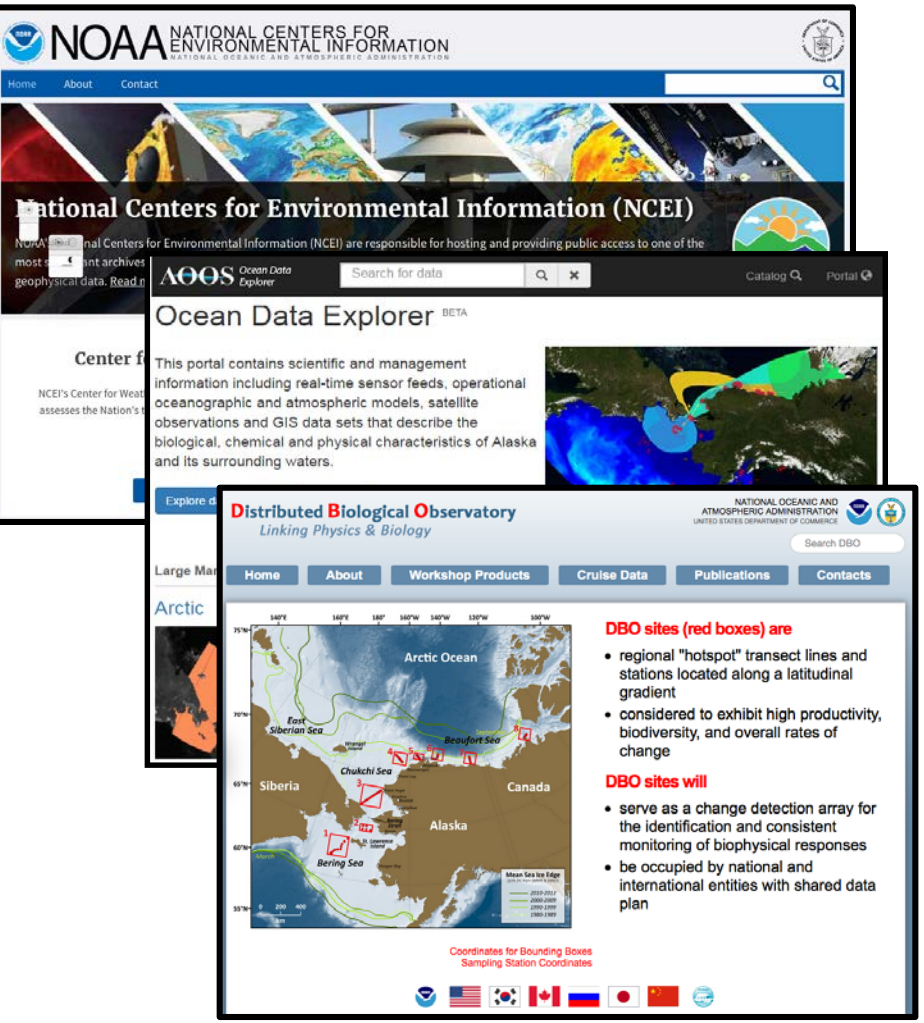
# An integrated story

High resolution model, assimilated dataset, sea ice and observations.

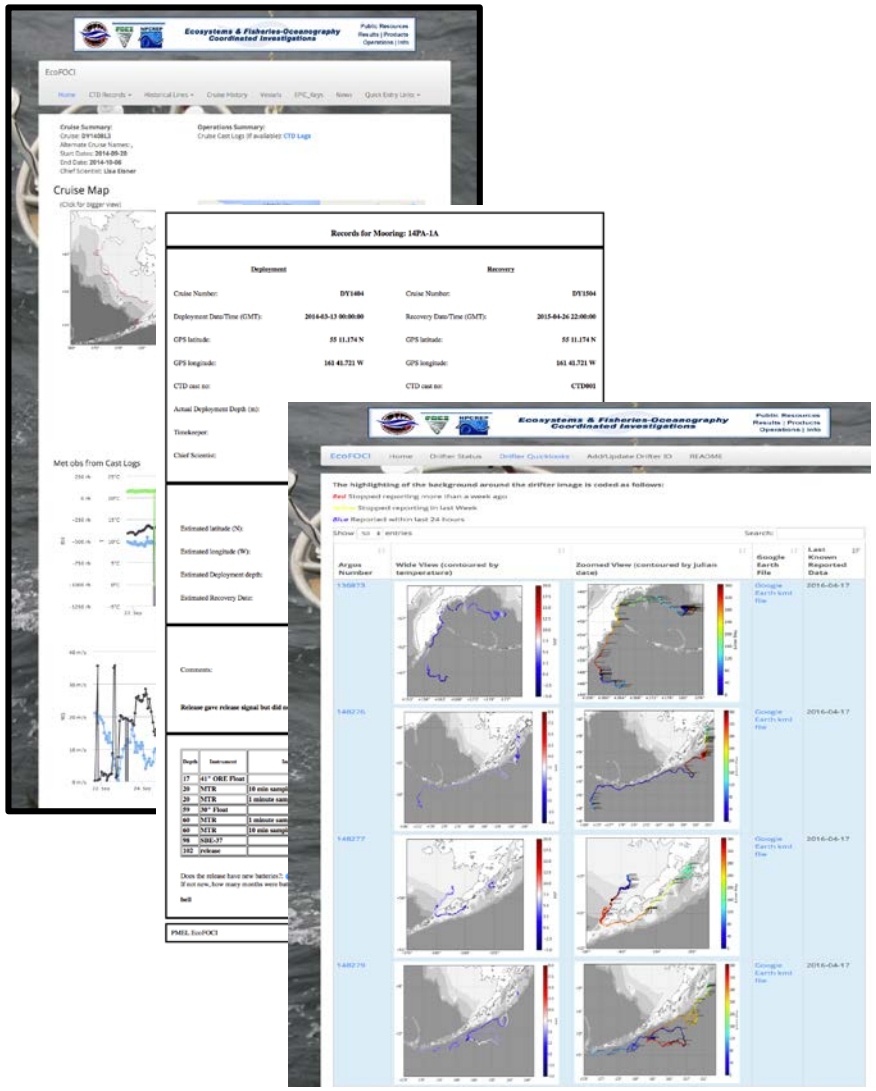


# Data Management and Web access

National




Local




Ecosystem Time Series

# Communication to managers, partners, stakeholders and the public

THE CONVERSATION US PILOT

Academic rigor, journalistic flair

Arts + Culture Economy + Business Education Environment + Energy Health + Medicine Politics + Society Science

**What is the 'warm blob' in the Pacific and what can it tell us about our future climate?**

May 15, 2015 6.18am EDT

California has been inundated with stranded, hungry sea lion pups, a result of warm waters causing fish to move. Michael Fiala

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People living across the US have lived through some odd weat
past year. It's been unusually warm and dry in the western US,
East had a very cold and snowy winter. Meanwhile, scientists h
seeing Pacific marine species in places they're not normally fo
huge spike in hungry, stranded sea lion pups on California sho

All these phenomena are linked to a giant patch of remarkably

Alaska Dispatch News

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Science

## Scientists probe effects of unusual warming pattern in fish-rich Bering Sea

Yereth Rosen | Alaska Dispatch News | September 22, 2015

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A device is lowered into the Bering Sea to measure conductivity, temperature and depth of a coccolithophore bloom in the Bering Sea, in this Sept. 13 photo. The bloom, caused by phytoplankton, is what makes the Bering Sea waters appear turquoise.
*Alex Andrews / NOAA*

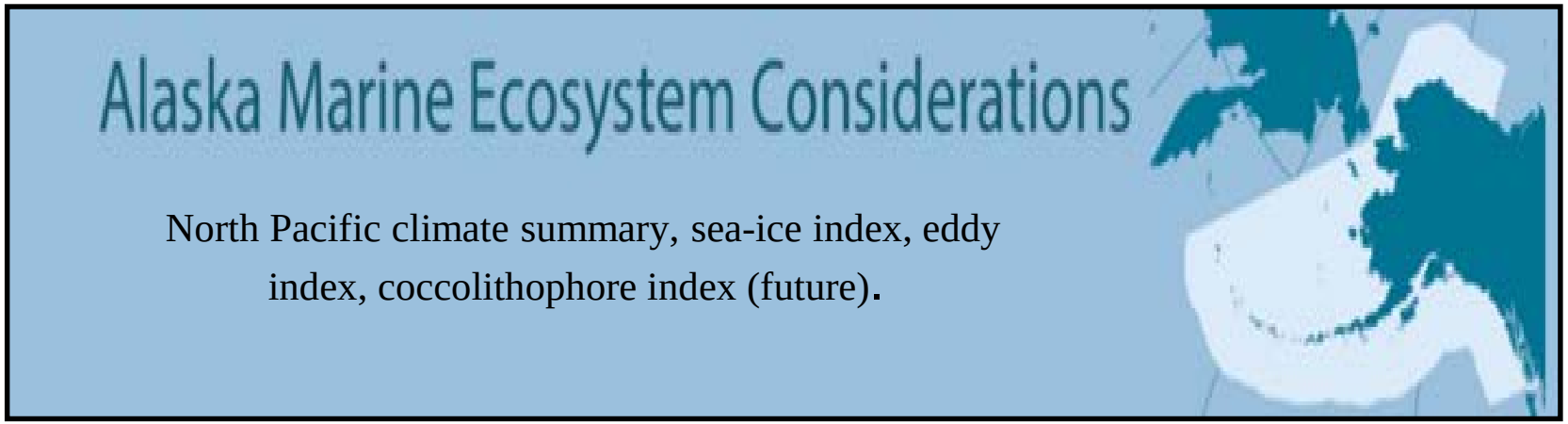
ALASKA PUBLIC MEDIA NEWS PROGRAMS SCHEDULES STREAMING

## Warming ocean temps may bode poorly for pollock

month-long cruise through the unusually warm waters
how the second year of a warming pattern is
nation's largest fishery, pollock.

chers hold walleye pollock over brown jellyfish.

# Inclusion of ecosystem data into living marine resource management advise



Ecosystem Time Series

# Peer-review of ecosystem related science programs, products and presentations

ASLO Association for the Sciences of Limnology and Oceanography

North Pacific Marine Science Organization

AGU American Geophysical Union

# Questions?