

Pacific Arctic Group: USA Country Report

Jacqueline M. Grebmeier

University of Maryland Center for Environmental Science, Chesapeake
Biological Laboratory, Solomons, Maryland, USA



**PACIFIC ARCTIC GROUP FALL 2014
MEETING**

OCTOBER 28, 2014

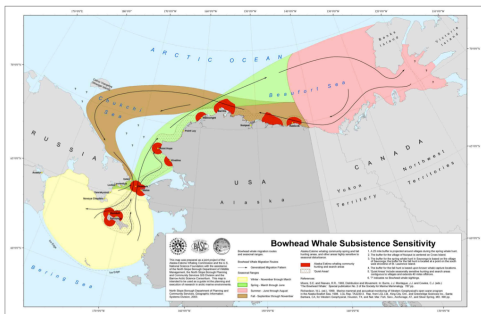
**PACIFIC MARINE ENVIRONMENTAL
LABORATORY/NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION
SEATTLE, WASHINGTON, USA**



Community Primer

A Primer for Marine Scientists Planning Shipboard Work in Alaskan Arctic and Sub-Arctic Waters

A project of the [Arctic Icebreaker Coordinating Committee \(AICC\)](#)



Disclaimer: The contents of this web page are the responsibility of the Arctic Icebreaker Coordinating Committee (AICC) and do not represent the policy or opinions of U.S. government funding agencies or ship operators. The AICC is a volunteer committee facilitated by the University National Oceanographic Laboratory System that provides guidance to the scientific community, the US Coast Guard and U.S. funding agencies that support research by icebreakers in the Arctic. The prime goal of the committee's work is to promote effective use of icebreaker assets in support of arctic scientific research. Editing suggestions and comments for this primer are welcome and can be provided to Lee Cooper, Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, PO Box 38, Solomons MD 20688, USA, or by [email](#).

Introduction

The Arctic polar region differs from the Antarctic significantly in that it has been home to humans for thousands of years. While much has changed since first contact between Inuit in Greenland and European Viking settlers more than one thousand years ago, many circum-Arctic people continue to live in ways that reflect traditional pursuits of food resources from the marine environment while still taking advantage of "Western" technology.

As scientific interest in the Arctic has increased in the past couple decades, particularly to follow apparent recent changes in arctic climate and sea ice cover, some conflicts have arisen between scientific researchers wishing to access Arctic marine research sites and Native subsistence users who often are hunting in the same areas. Concerns such as the impacts of ship operational noise on marine mammal behavior and migration routes have often been the basis for these conflicts. At the same time, many primarily Native communities in Alaska are specifically interested in having scientists help them understand how the Arctic will change physically, and also respond ecologically as climate changes. This creates a paradox combining concern over possible conflicts between scientific research and subsistence hunting, with an interest by local residents in using scientific knowledge to facilitate adaptation to potentially rapid climate change. This means that researchers working in Alaskan marine waters,

Overview

- Healy
- Polar Sea
- Forms
- Policies
- ▾ Foreign Clearances

Advance Notice Requirements

Community Primer

Native Communities

Northern Sea Route

Russian Federation

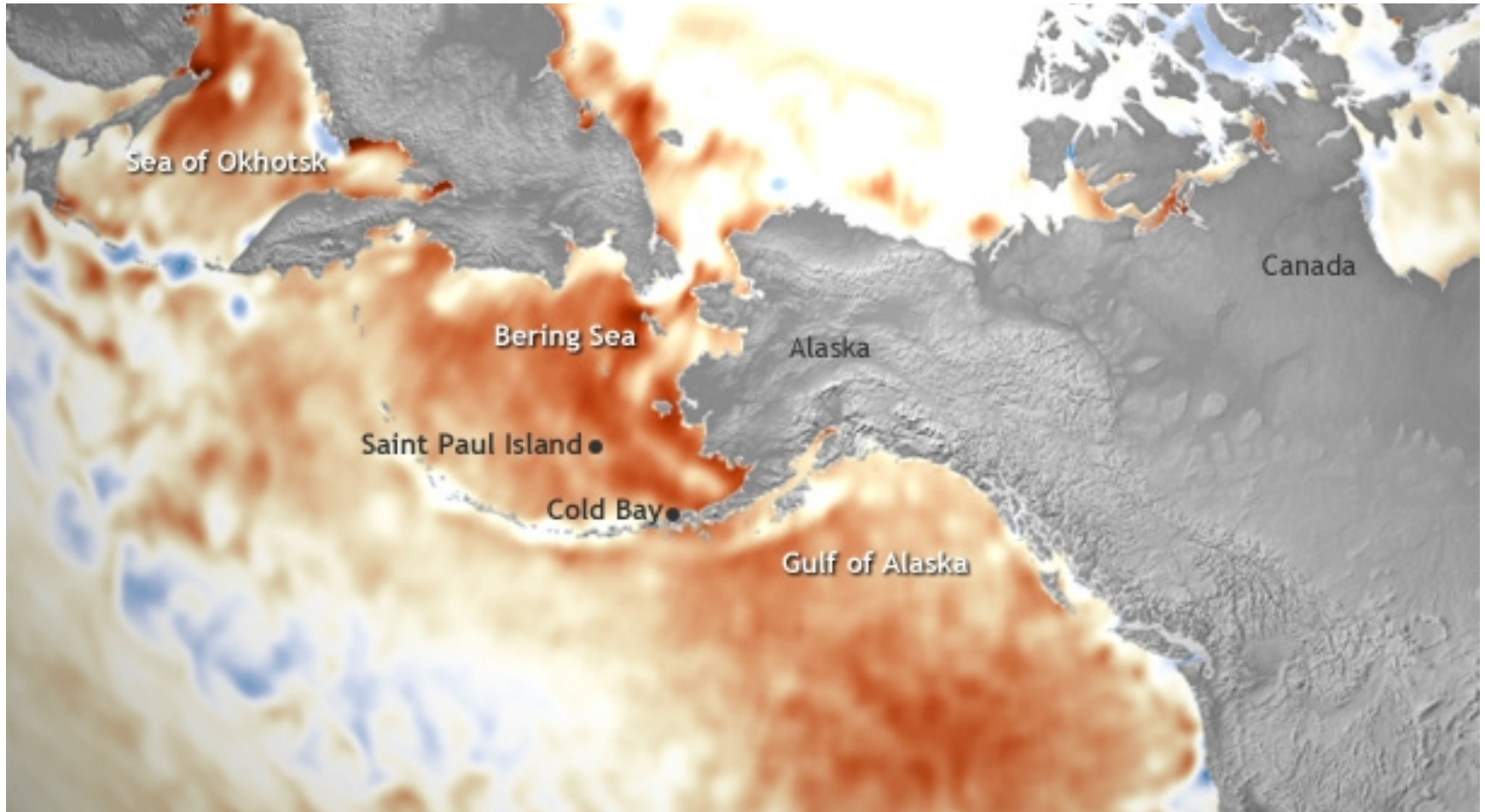
Port Information

Scheduling

www.icefloe.net/
community-
primer

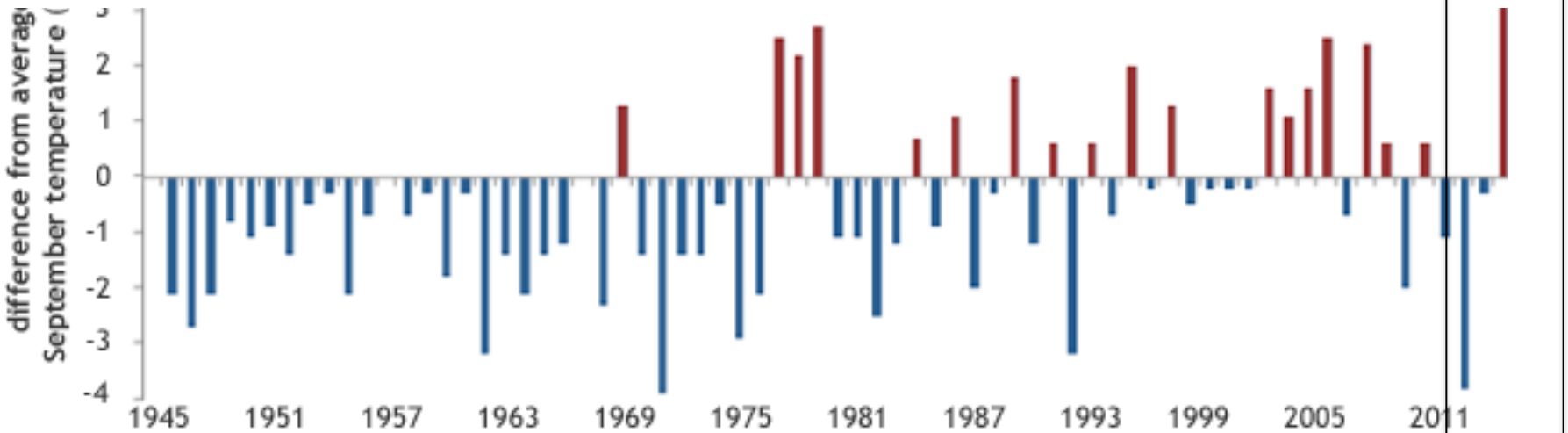
Arctic Icebreaker Coordinating
Committee

Record September warmth for Alaska maritime locations

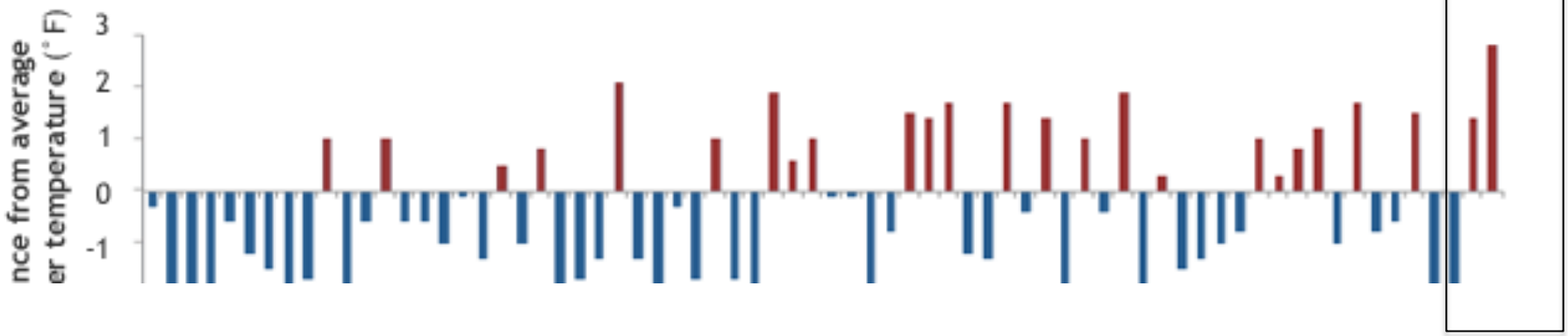


Difference from average (1981-2010) temperature across Northern Hemisphere oceans in September 2014. NOAA map based on satellite data (October 14, 2014; www.climate.gov)

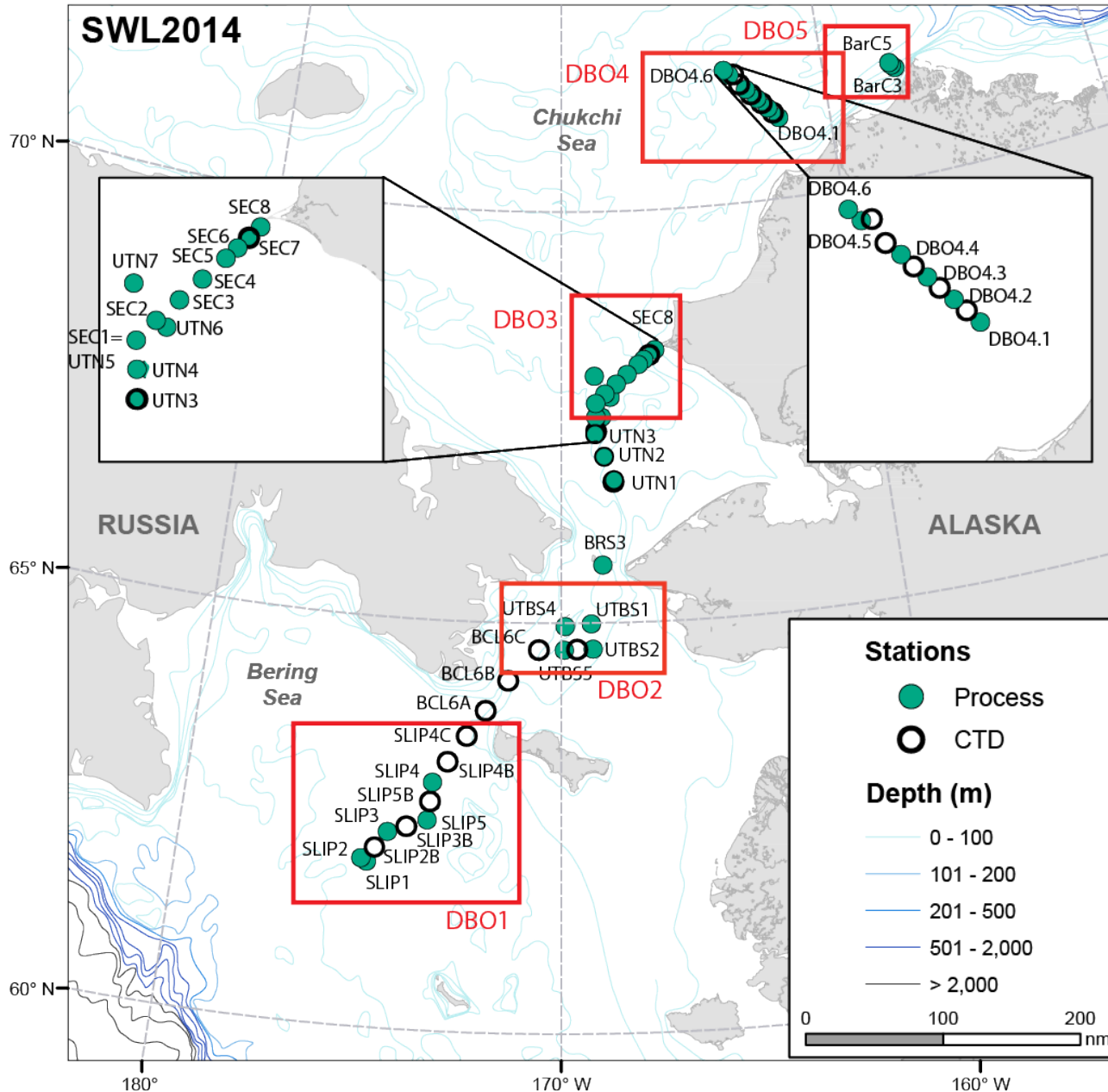
At St. Paul August and Sept the warmest months since records began in the 1920s and at Cold Bay, July-Sept 2014 warmest those months since 1940s



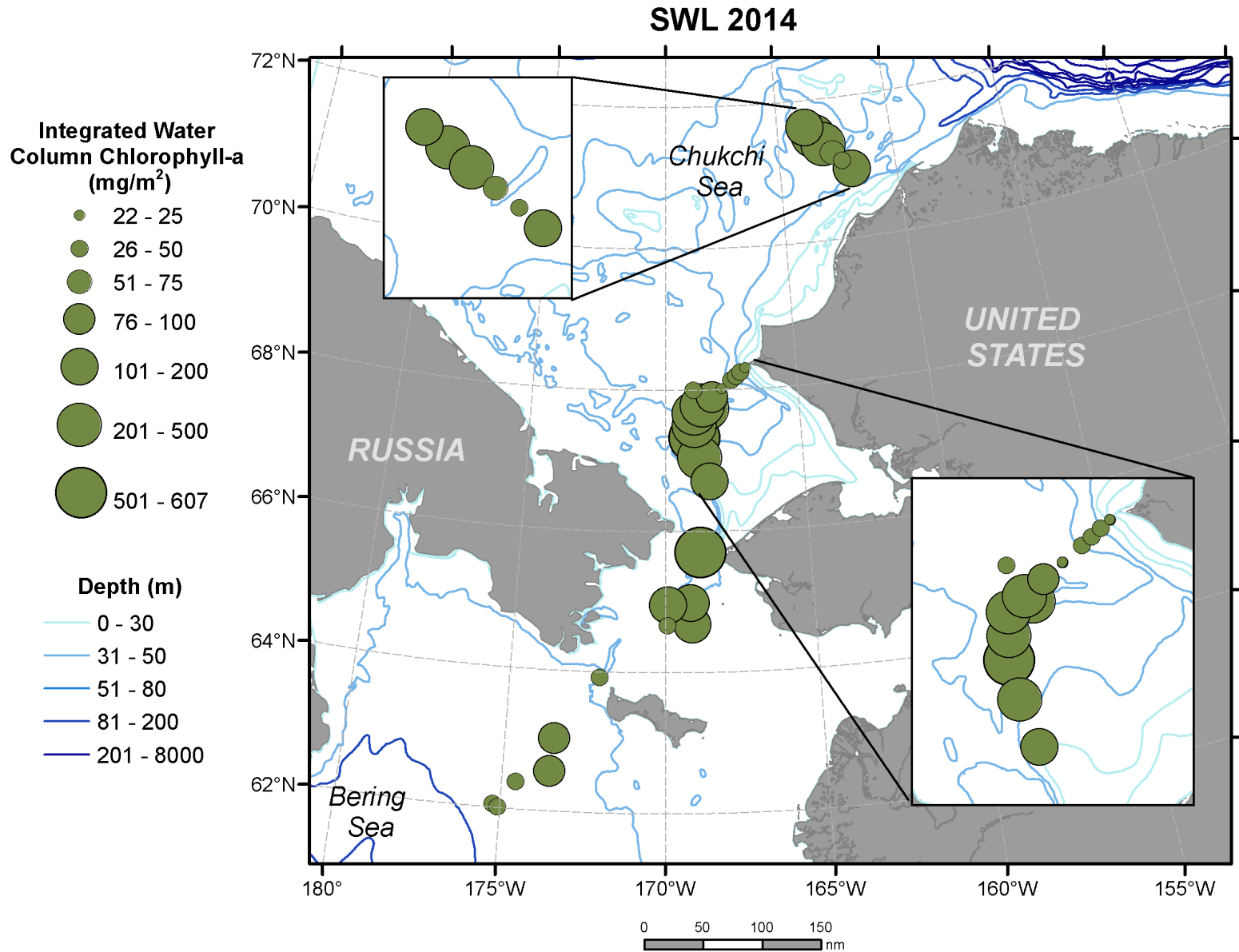
Cold Bay



Canada' Three Oceans (C30) and the Distributed Biological Observatory (DBO)

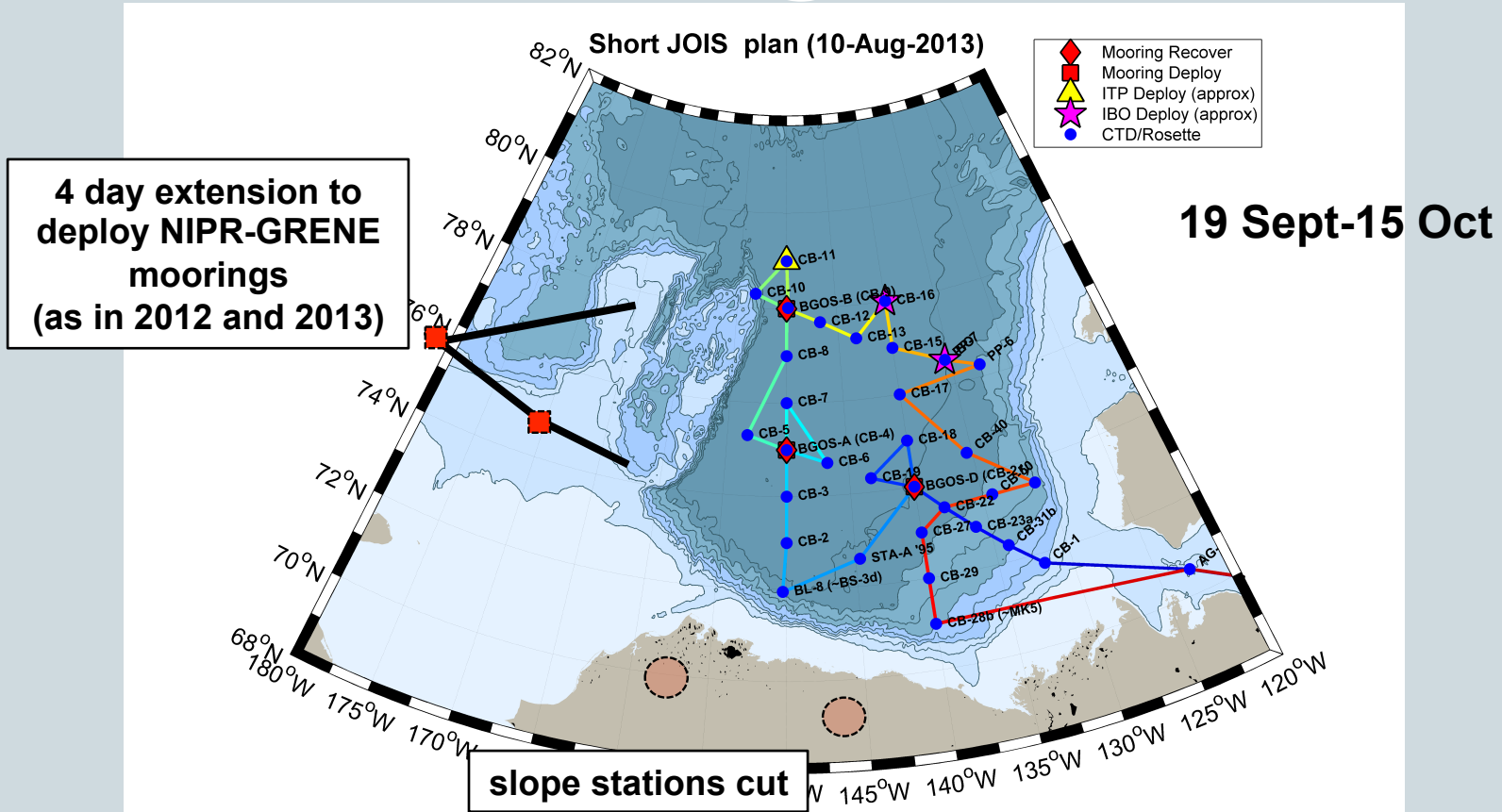


DBO Integrated Chlorophyll a (mg/m²) during July 2014



SCIENCE-Basin

JOIS/AON BGOS (Canada-USA-Japan)

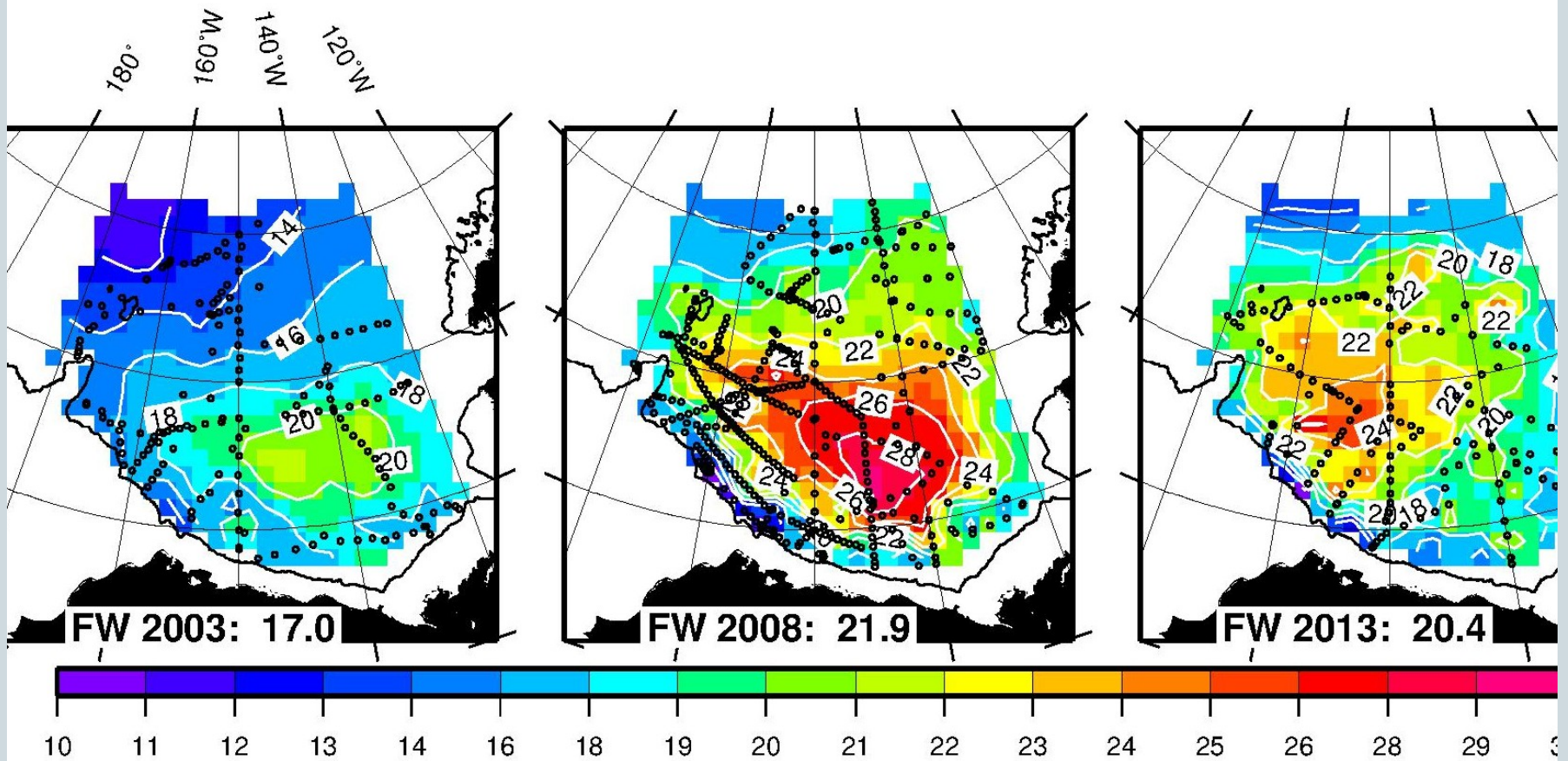


JOIS=Joint Ocean-Ice Study; AON=Arctic Observing Network;
 BGOS=Beaufort Gyre Observing System

(courtesy Bill Williams, IOS)

SCIENCE-Basin: JOIS/AON-BGOS

Time series of freshwater content



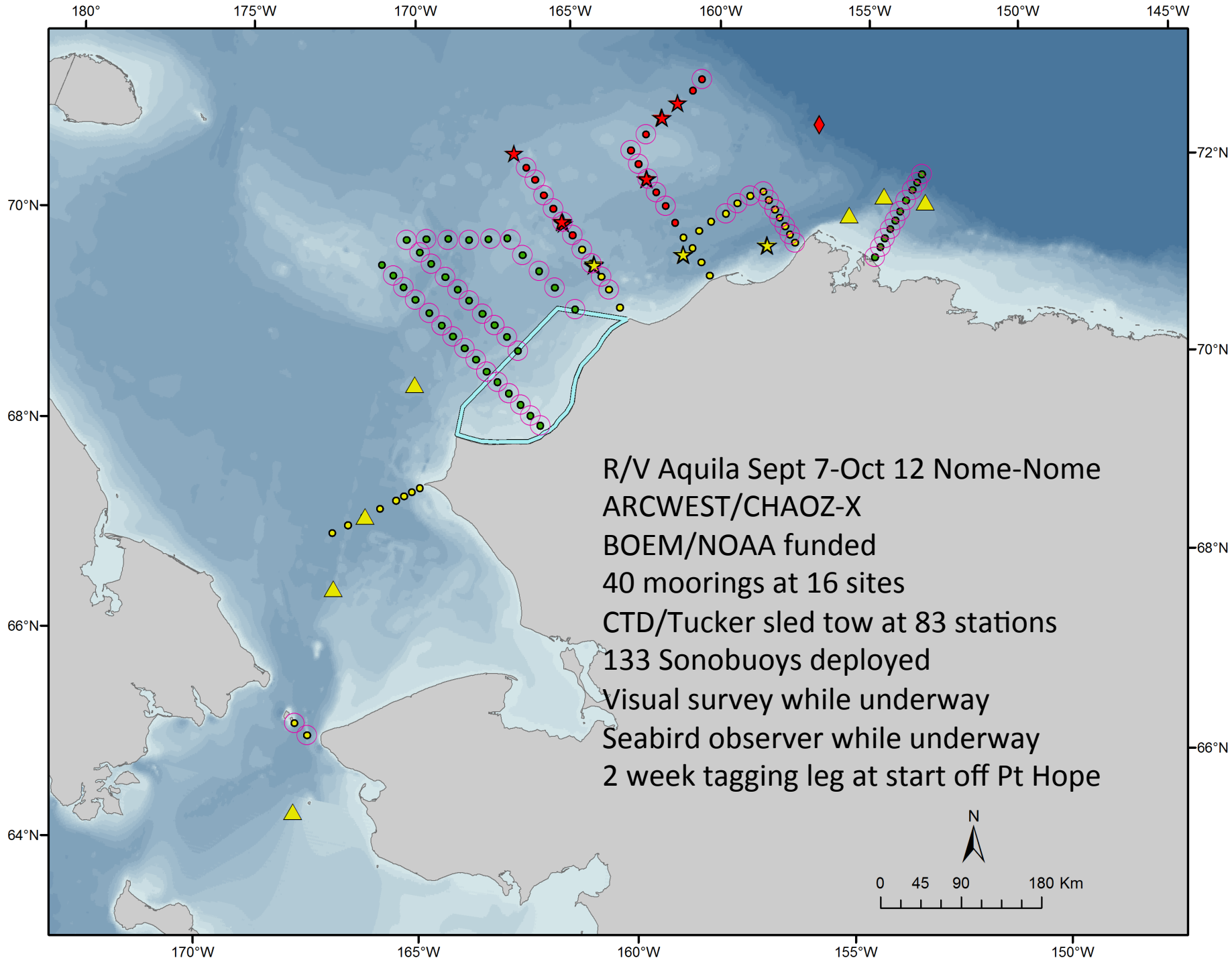
(courtesy Rick Krishfield, WHOI)

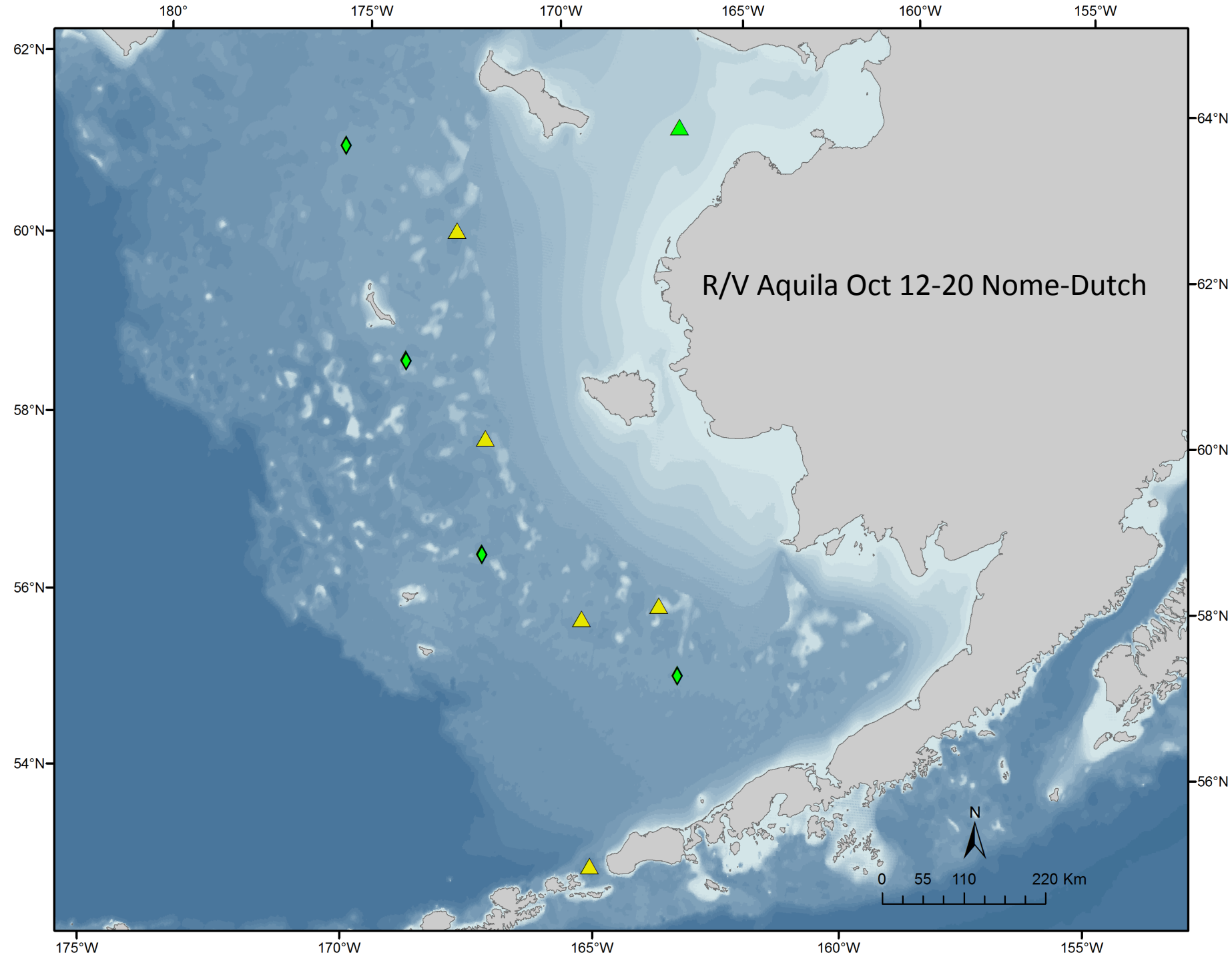
CCGS AMUNDSEN

Canadian Research Icebreaker

Leg 2b (16d)







Healy cruise 1401: Under-Ice Phytoplankton Blooms May – June 2014

Chief Scientist: Kevin Arrigo, Stanford University

Chukchi Sea May 2014
Photo by Amanda Kowalski



Water Column

Hydrographic Measurements and Shipboard Velocity

Phytoplankton Physiology and Biogeochemistry

Ra Isotopes and Trace Metals

Biomarkers

Herbivory and Bacterivory Rate Measurements

Zooplankton Analysis (LOKI)

Mesozooplankton Abundance and Composition

Particulate absorption

Marine Optics (AOP and IOP profiles)

Microbial Community Composition and Viral Production

Prokaryotic Abundance and Production

Nutrient Assimilation and Regeneration



Ice

Sea Ice Physical and Optical Properties

Phytoplankton Physiology and Biogeochemistry

Biomarkers

CDOM absorption

Marine Optics (AOP and IOP profiles)



Atmosphere

Weather Balloons and Cloud Height Measurements

Benthic

van Veen grabs and IP₂₅ sampling



Outreach

Writing

Photography

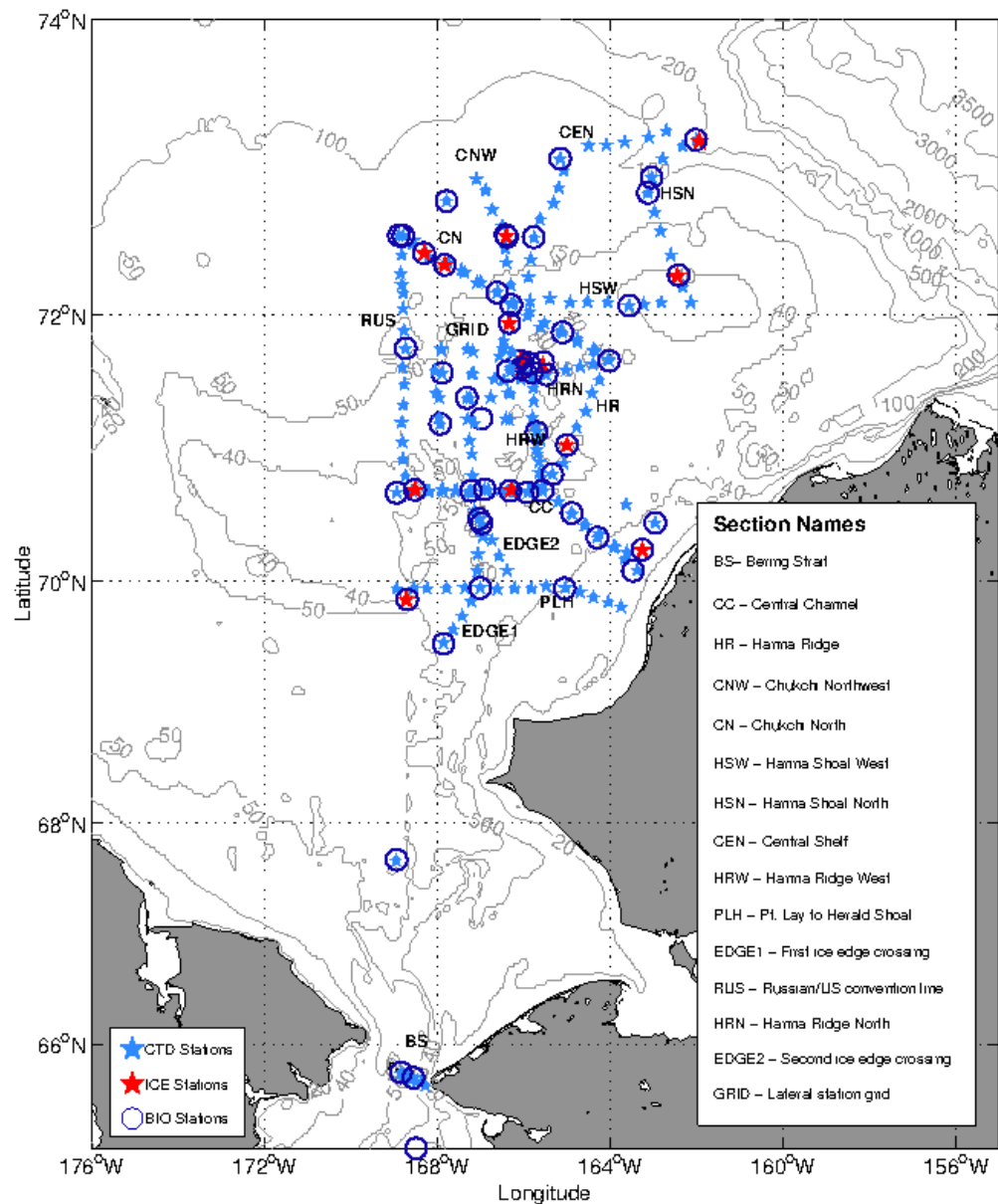
Video

Art

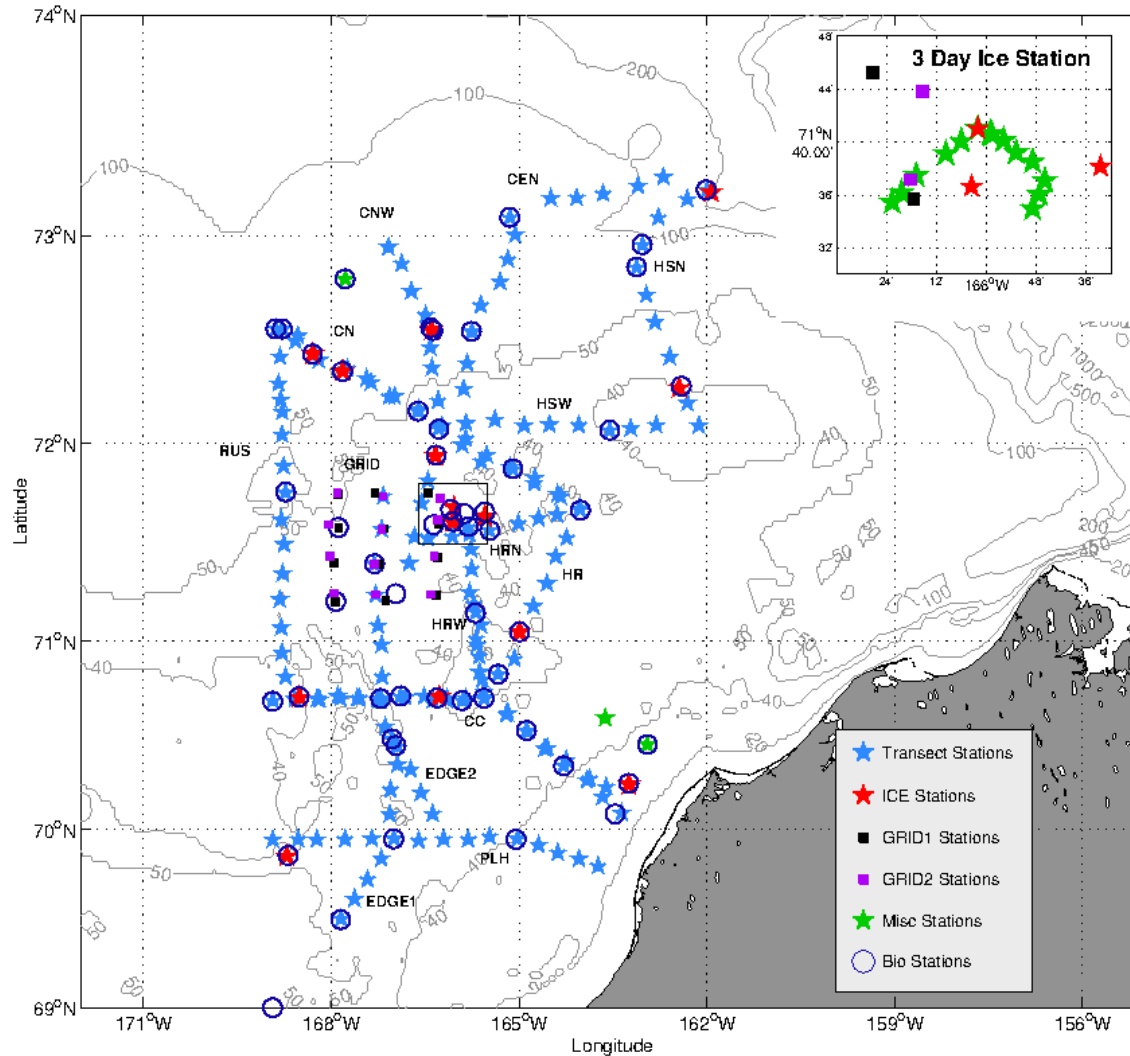
Dance

Cruise track

14 transects
12 ice stations

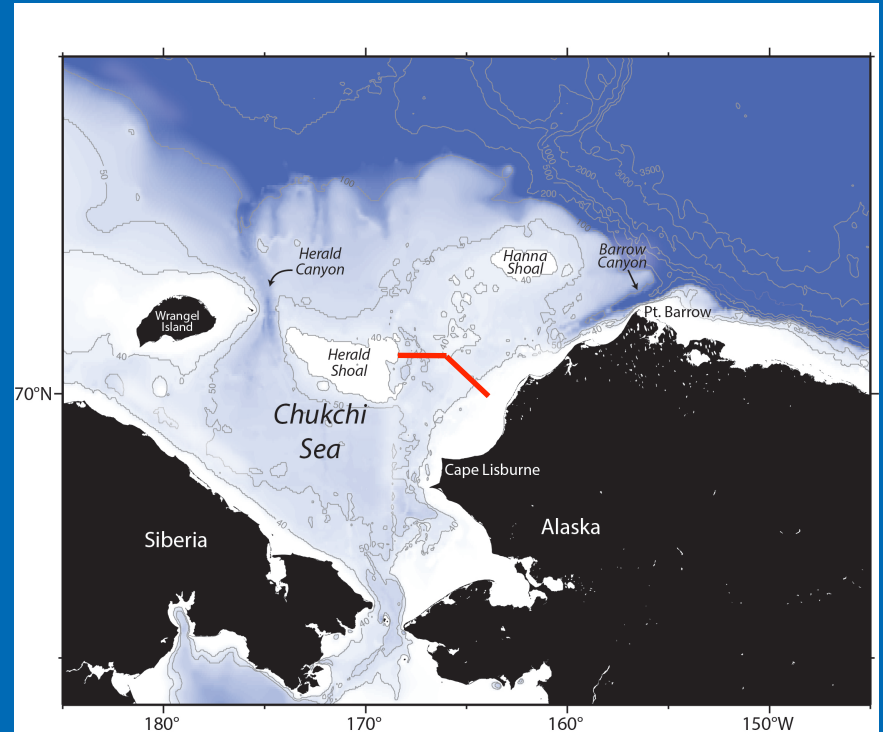
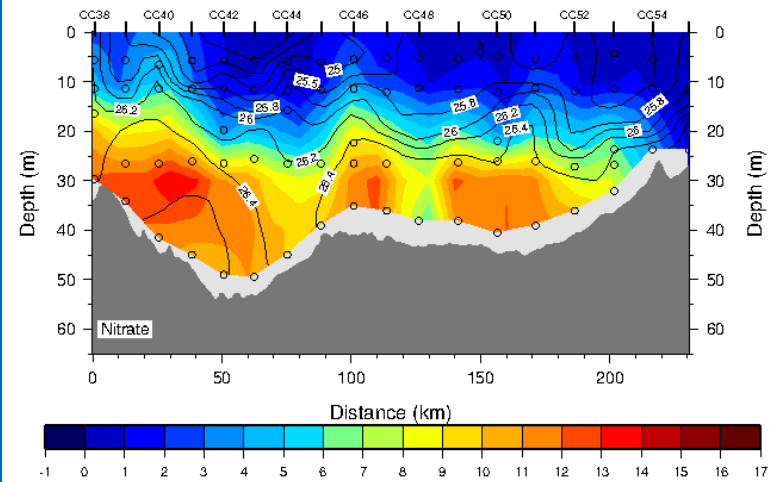
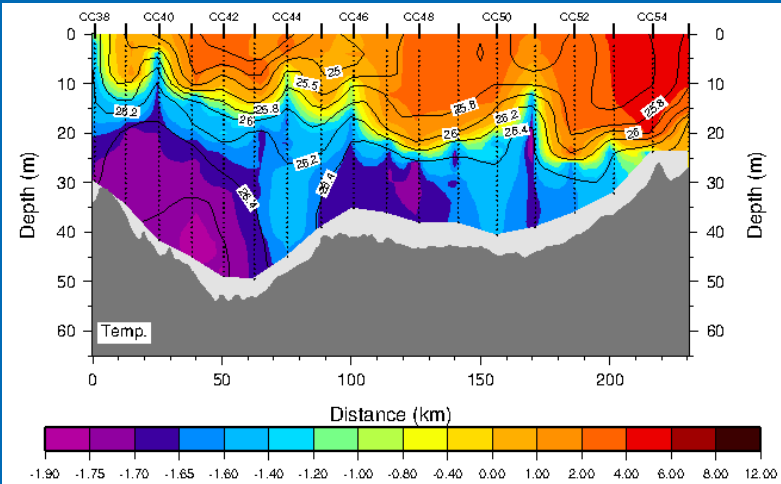


Cruise track (zoomed in)



Central Channel Section

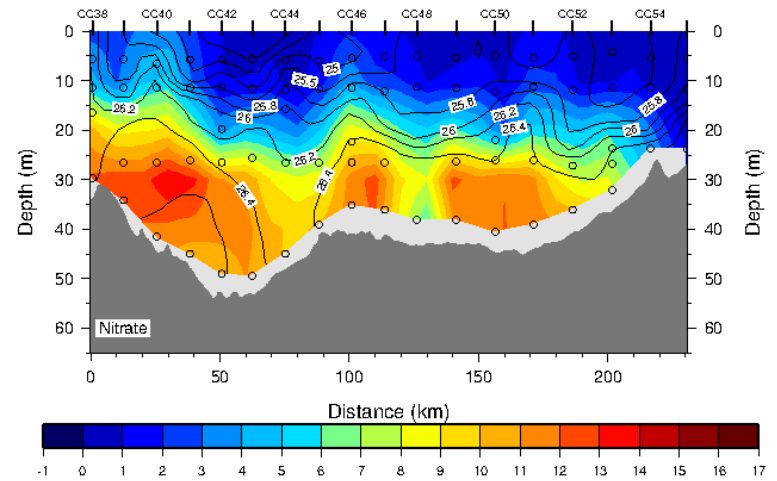
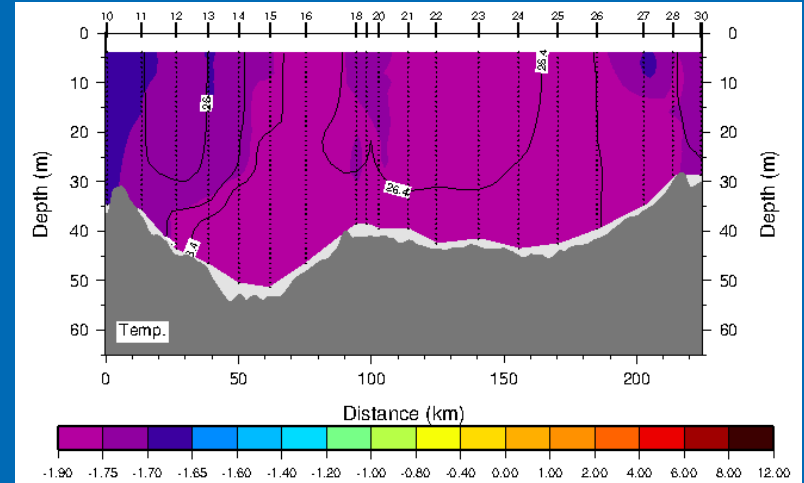
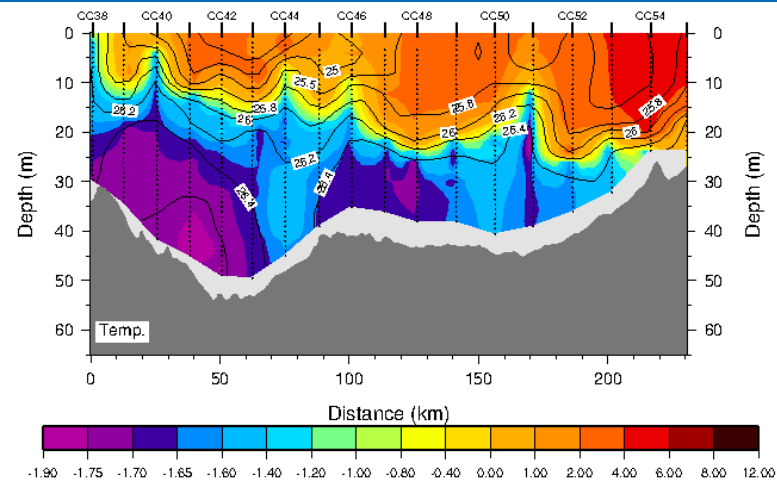
1 July 2010



Central Channel Section

1 July 2010

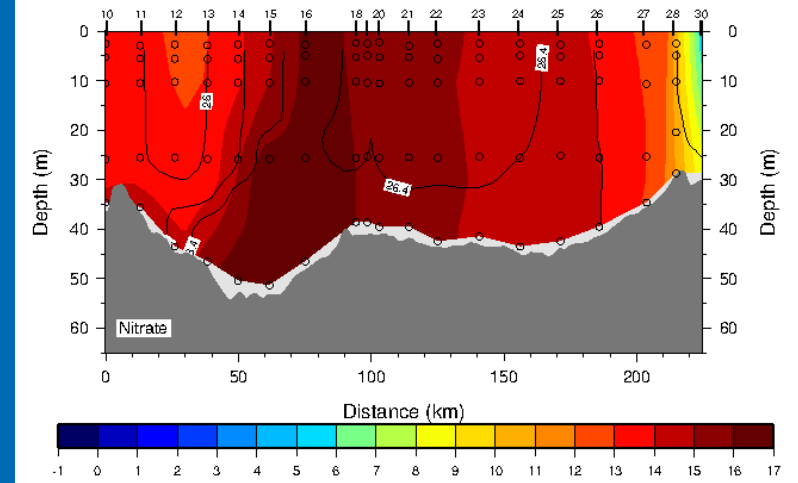
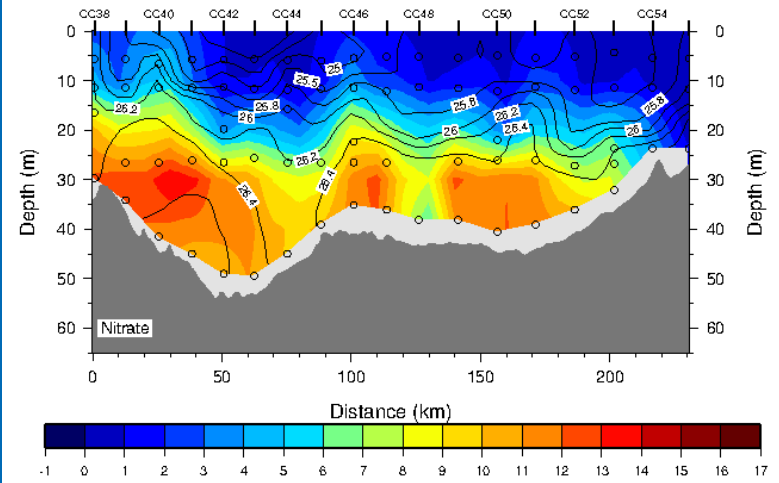
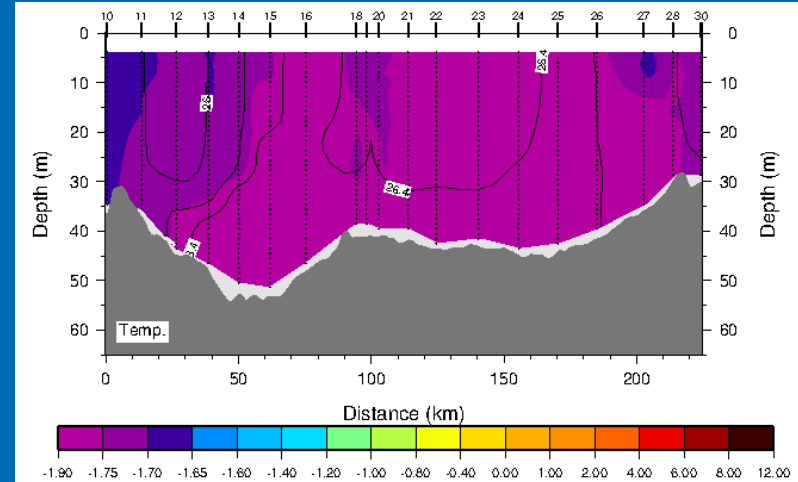
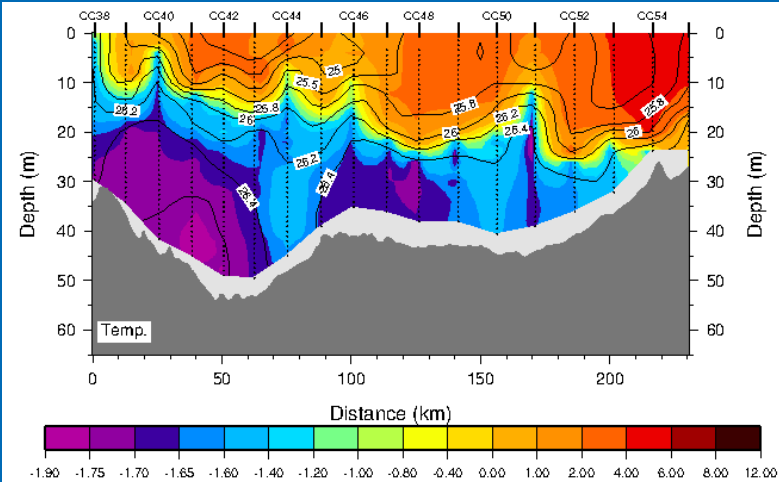
18 May 2014



Central Channel Section

1 July 2010

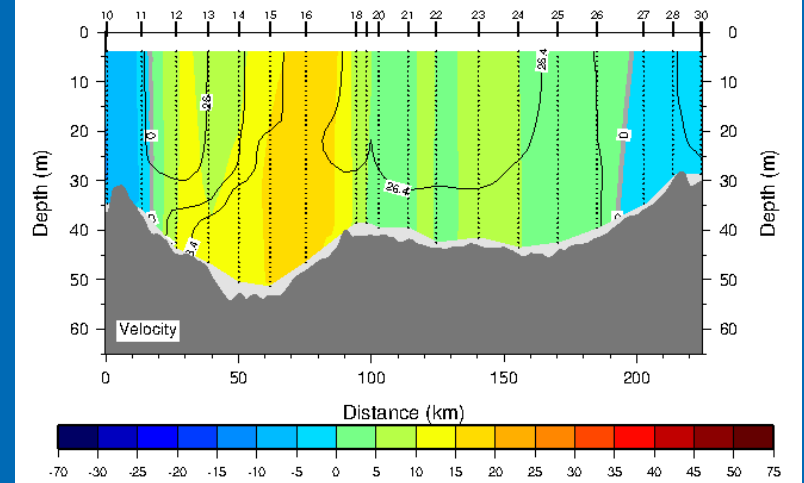
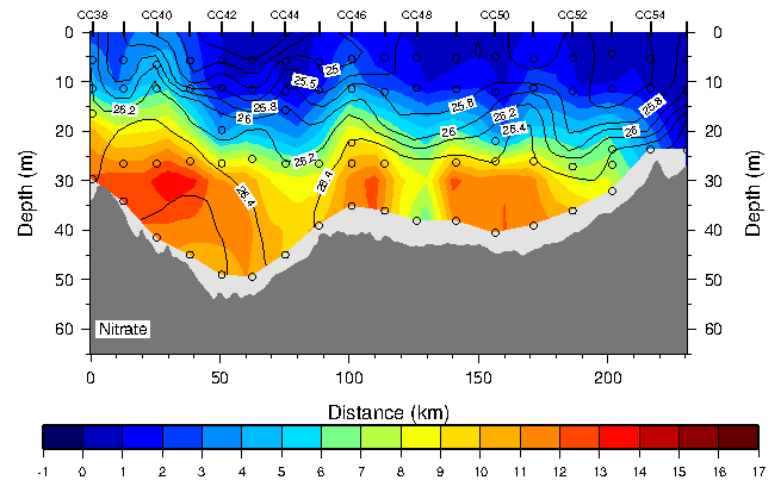
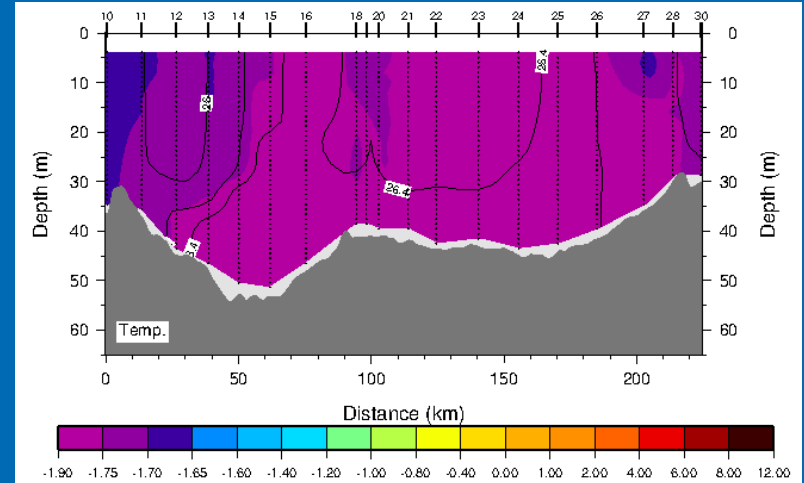
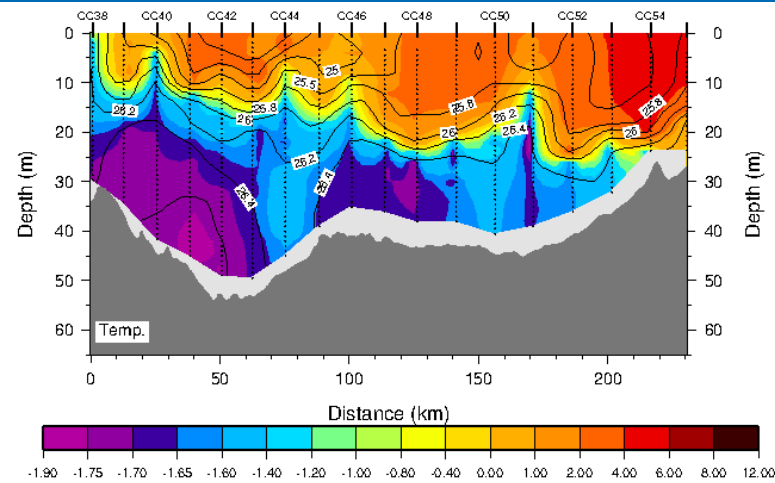
18 May 2014



Central Channel Section

1 July 2010

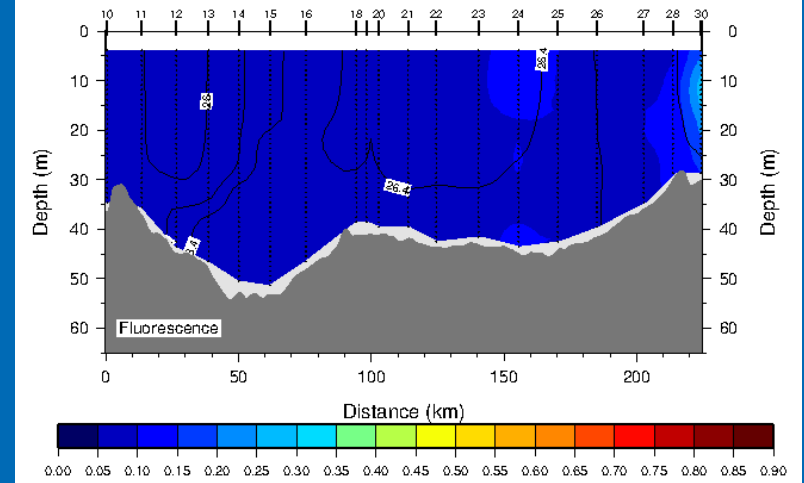
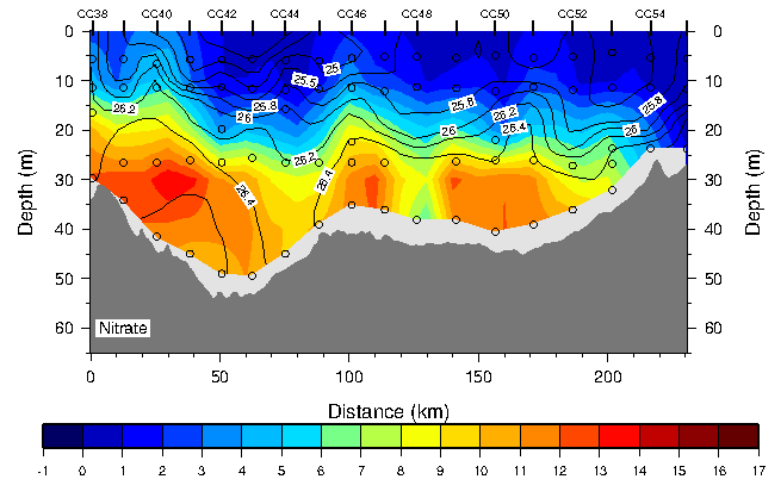
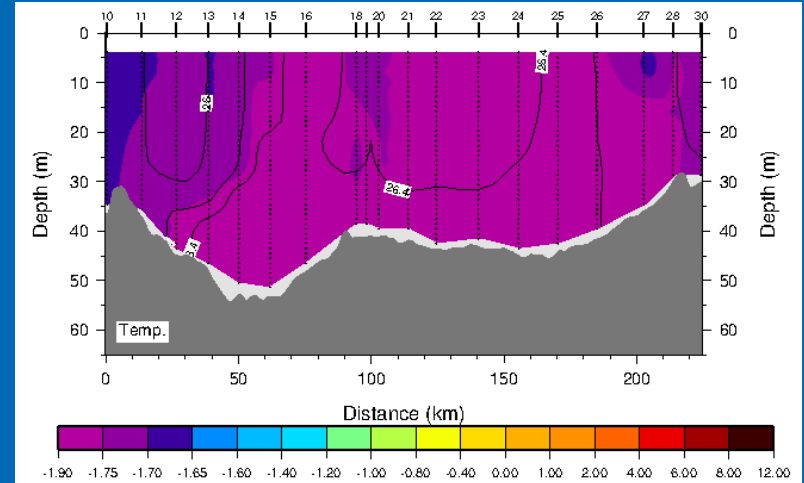
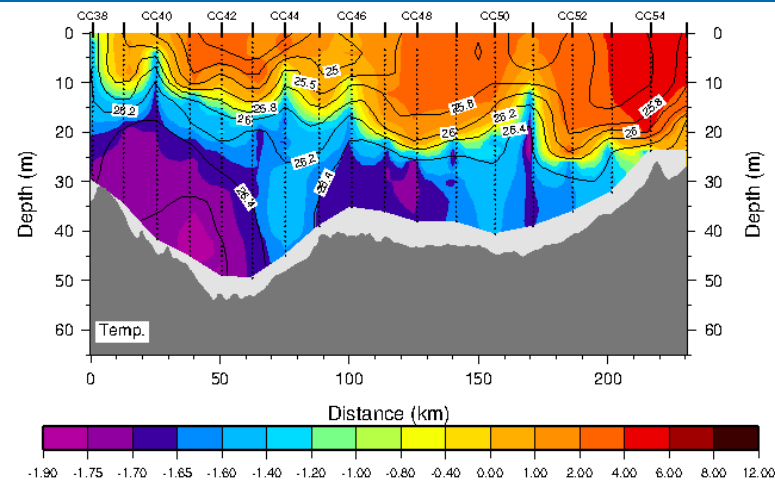
18 May 2014



Central Channel Section

1 July 2010

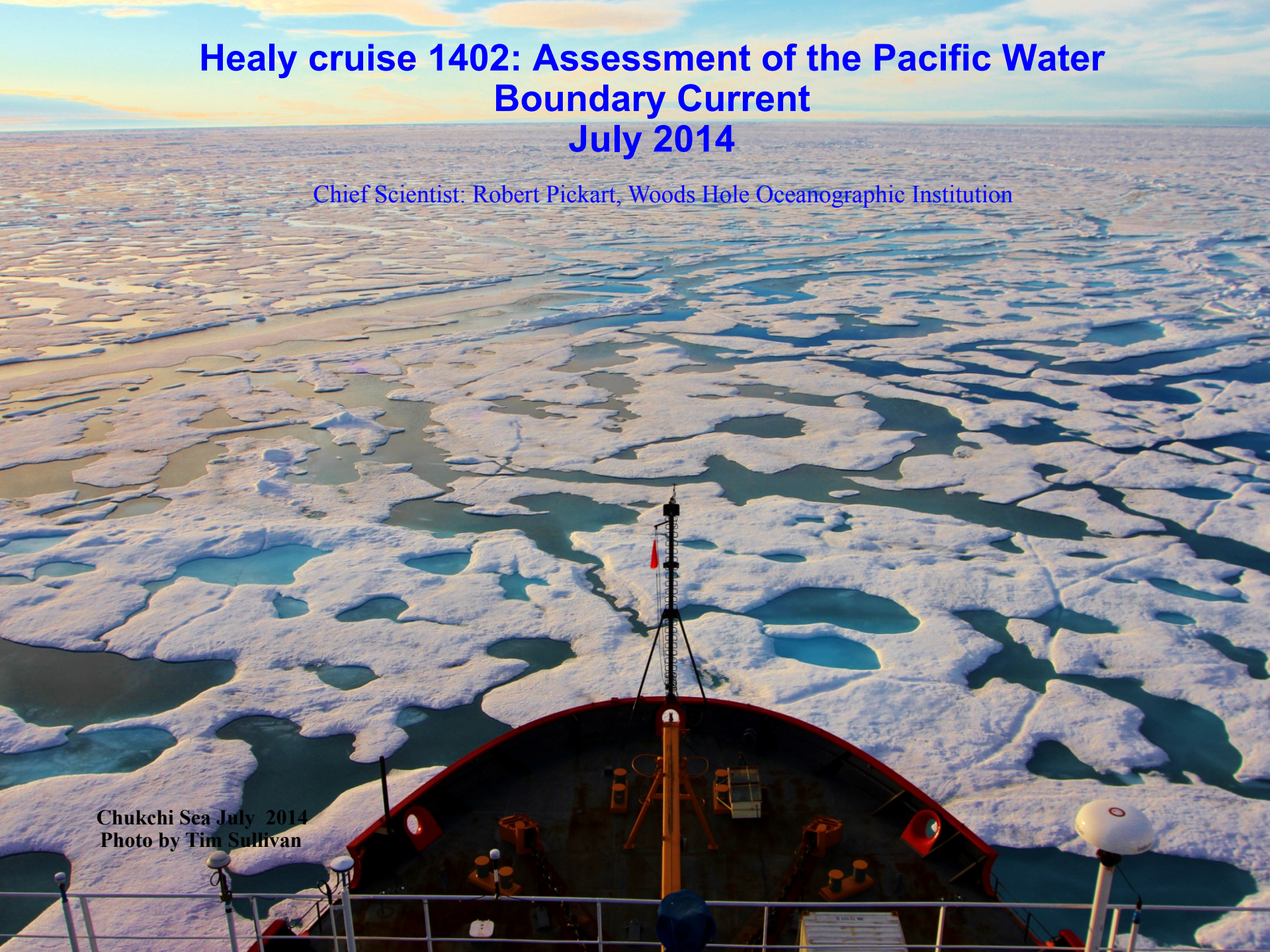
18 May 2014



Healy cruise 1402: Assessment of the Pacific Water Boundary Current July 2014

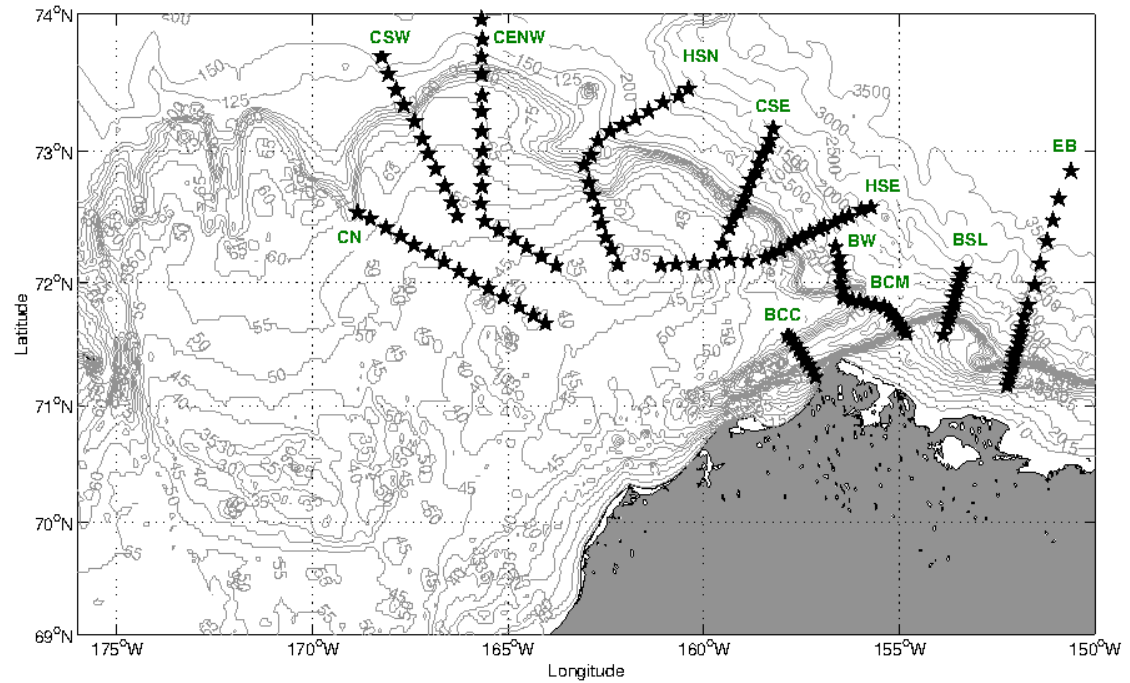
Chief Scientist: Robert Pickart, Woods Hole Oceanographic Institution

Chukchi Sea July 2014
Photo by Tim Sullivan



Cruise track

10 transects
5 moorings



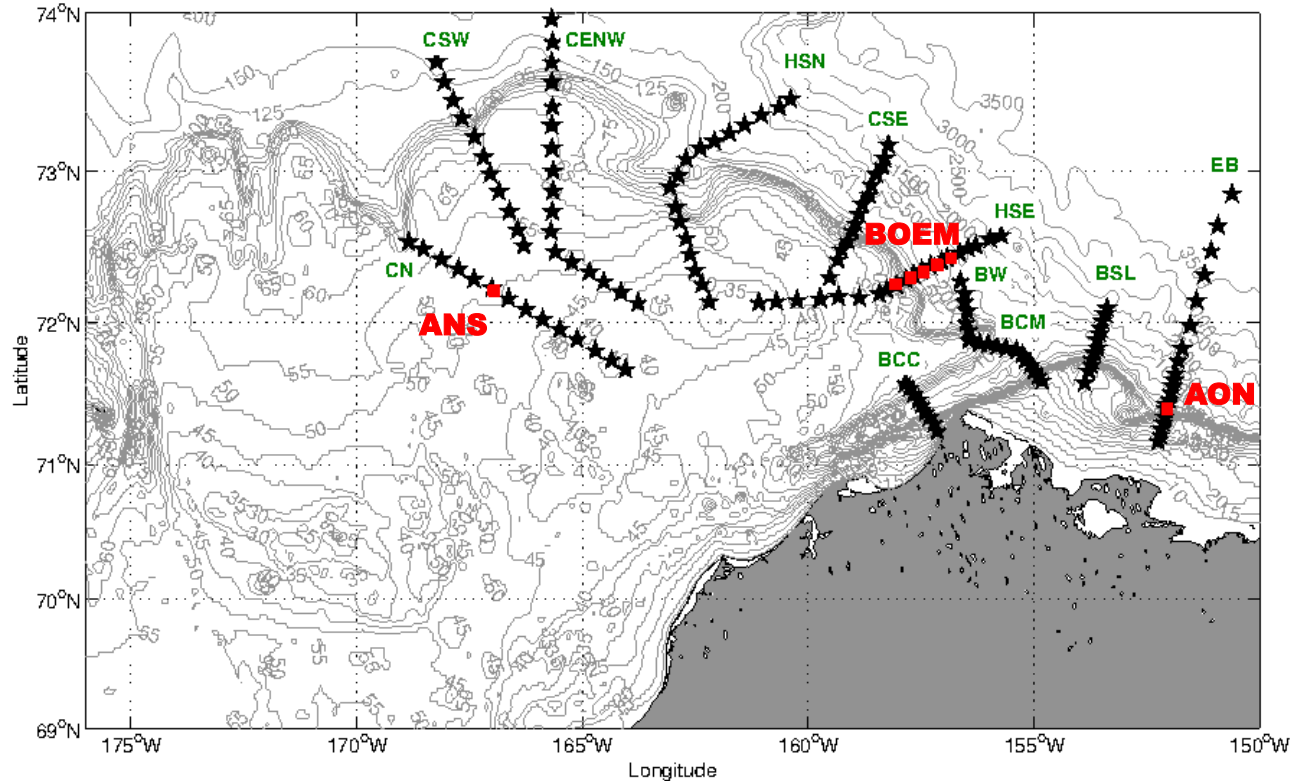
CN - Chukchi North
CSW - Chukchi Slope West
CENW - Central Shelf West
HSN - Hannal Shoal North

CSE - Chukchi Slope East
HSE - Hanna Shoal East
BCC - Barrow Canyon Central
BCM - Barrow Canyon Mouth

BW - Barrow West
BSL - Barrow Slope
EB - East Barrow

HLY1402 + Norseman II (Sep)

■ **WHOI moorings**



CN - Chukchi North

CSW - Chukchi Slope West

CENW - Central Shelf West

HSN - Hannal Shoal North

CSE - Chukchi Slope East

HSE - Hanna Shoal East

BCC - Barrow Canyon Central

BCM - Barrow Canyon Mouth

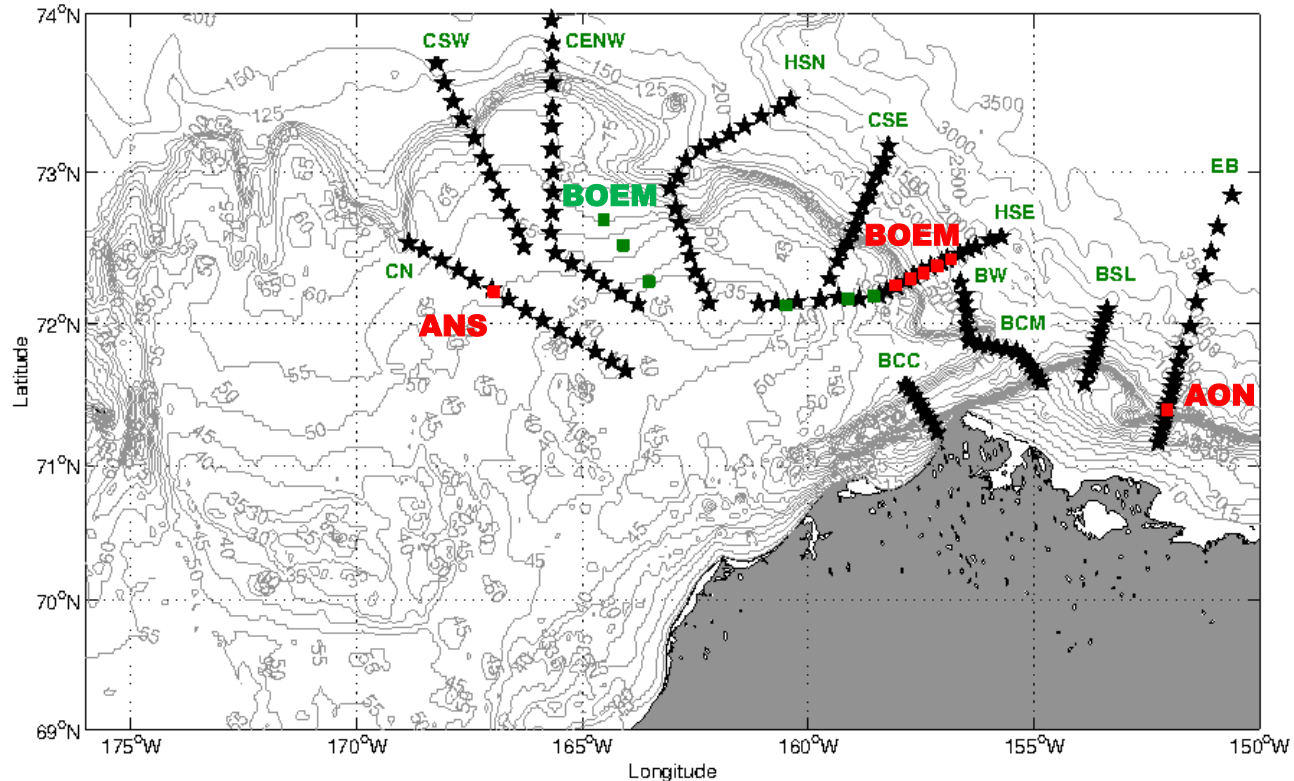
BW - Barrow West

BSL - Barrow Slope

EB - East Barrow

HLY1402 + Norseman II (Sep)

■ **WHOI moorings** ■ **UAF moorings**



CN - Chukchi North

CSW - Chukchi Slope West

CENW - Central Shelf West

HSN - Hannal Shoal North

CSE - Chukchi Slope East

HSE - Hanna Shoal East

BCC - Barrow Canyon Central

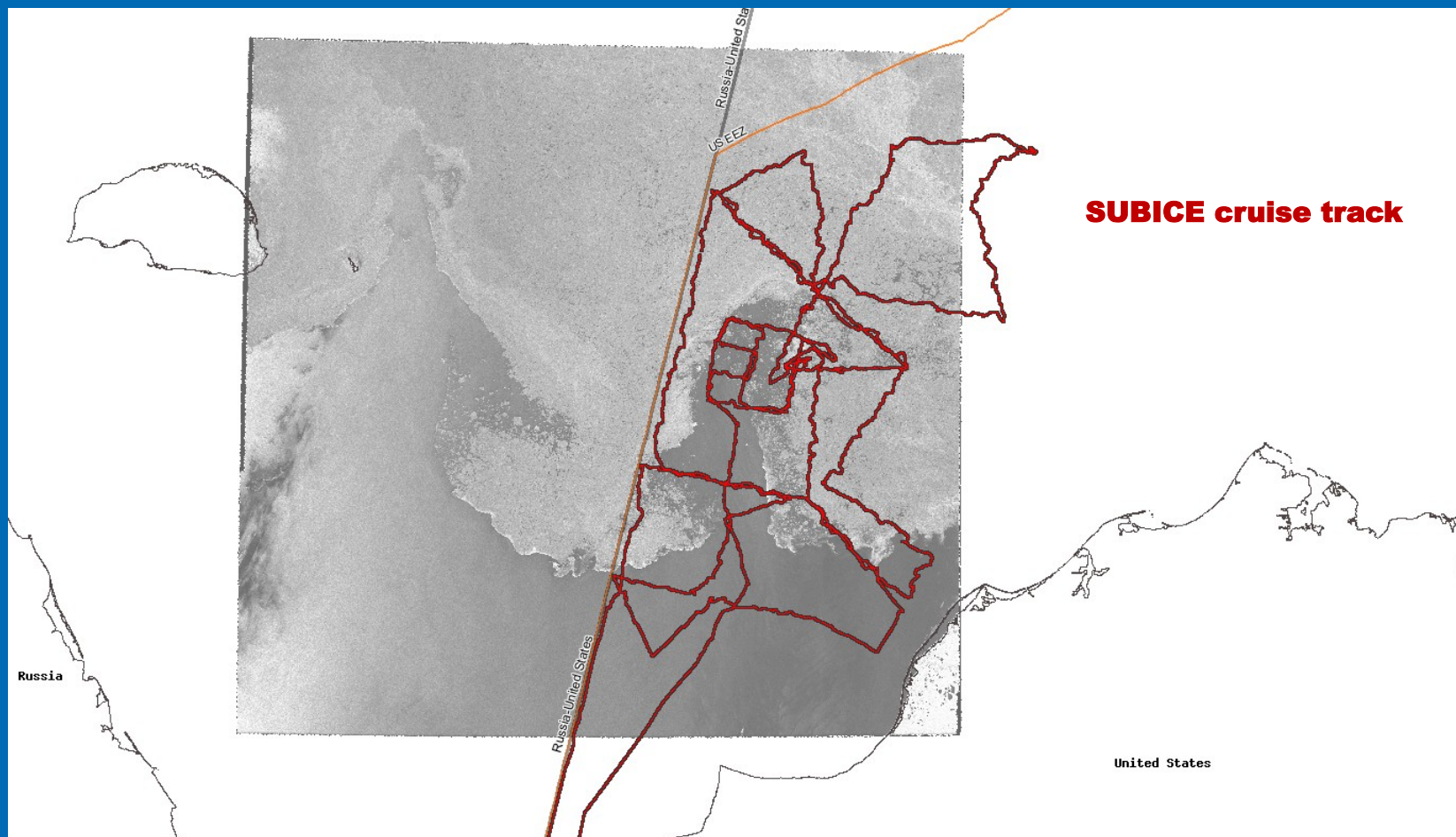
BCM - Barrow Canyon Mouth

BW - Barrow West

BSL - Barrow Slope

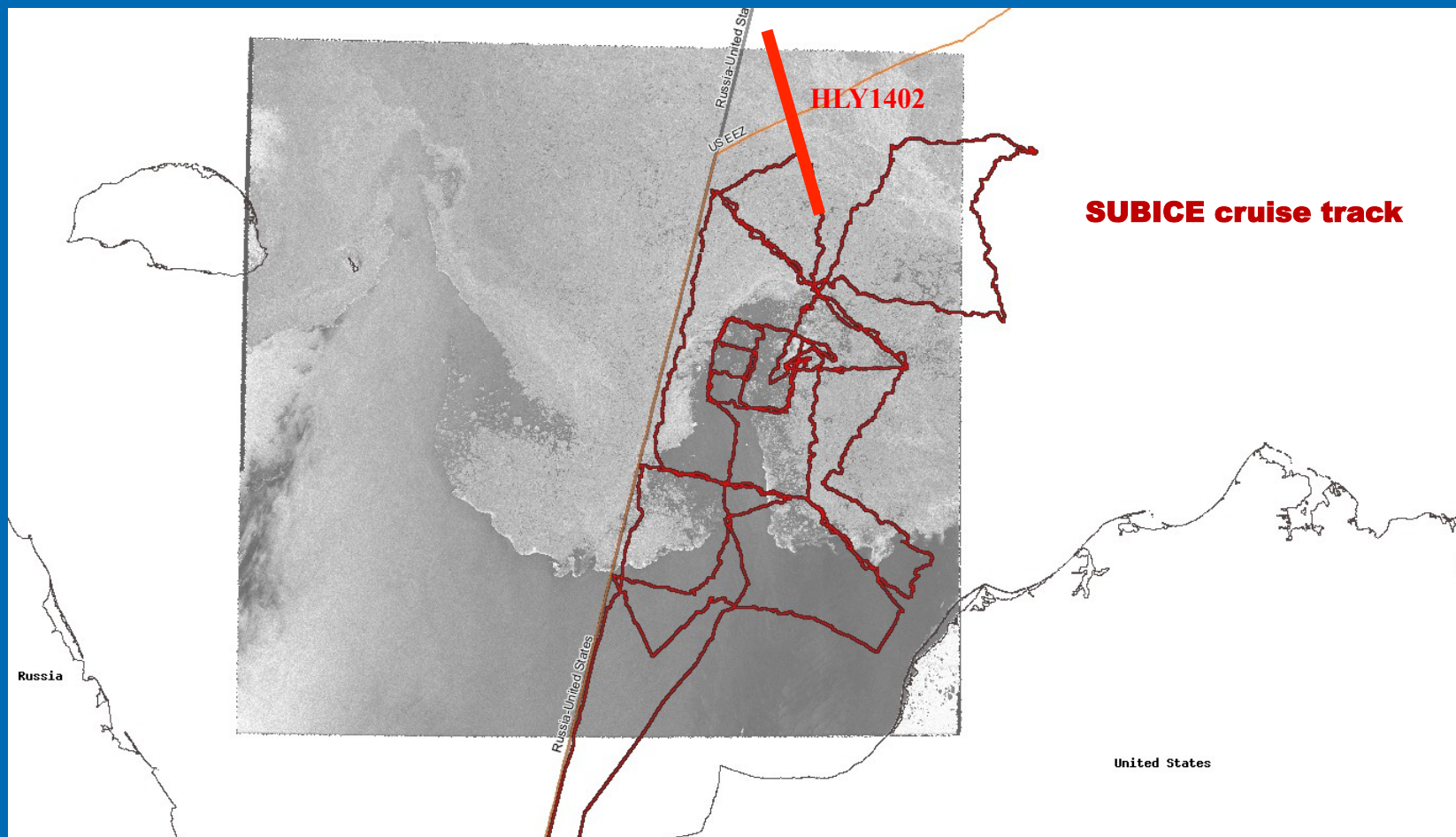
EB - East Barrow

Continuing under-ice bloom study



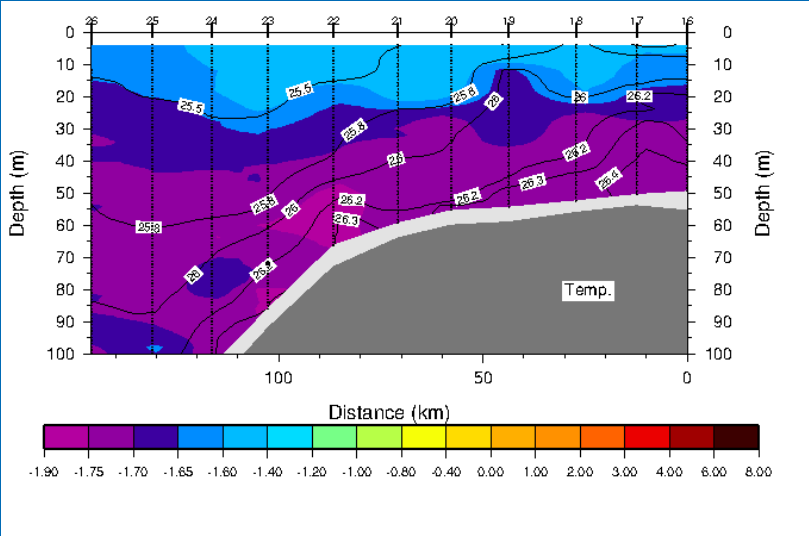
RADARSAT ice image on 2 July 2104

Continuing under-ice bloom study

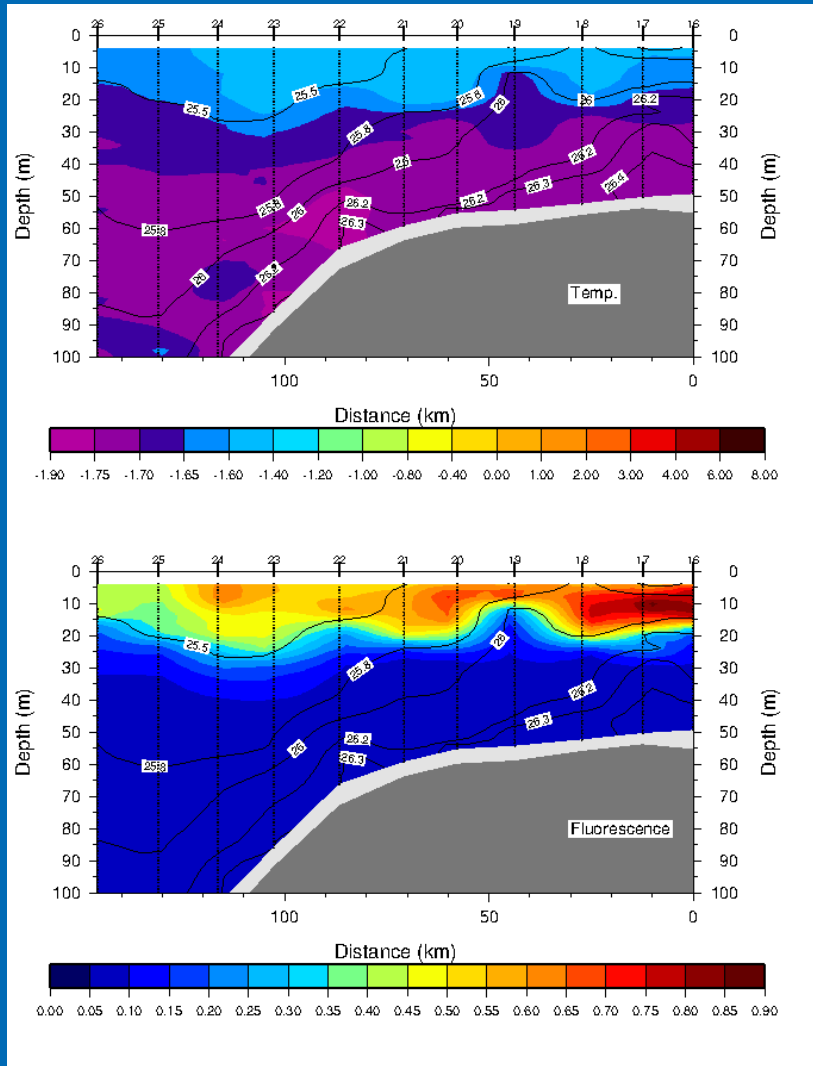


RADARSAT ice image on 2 July 2104

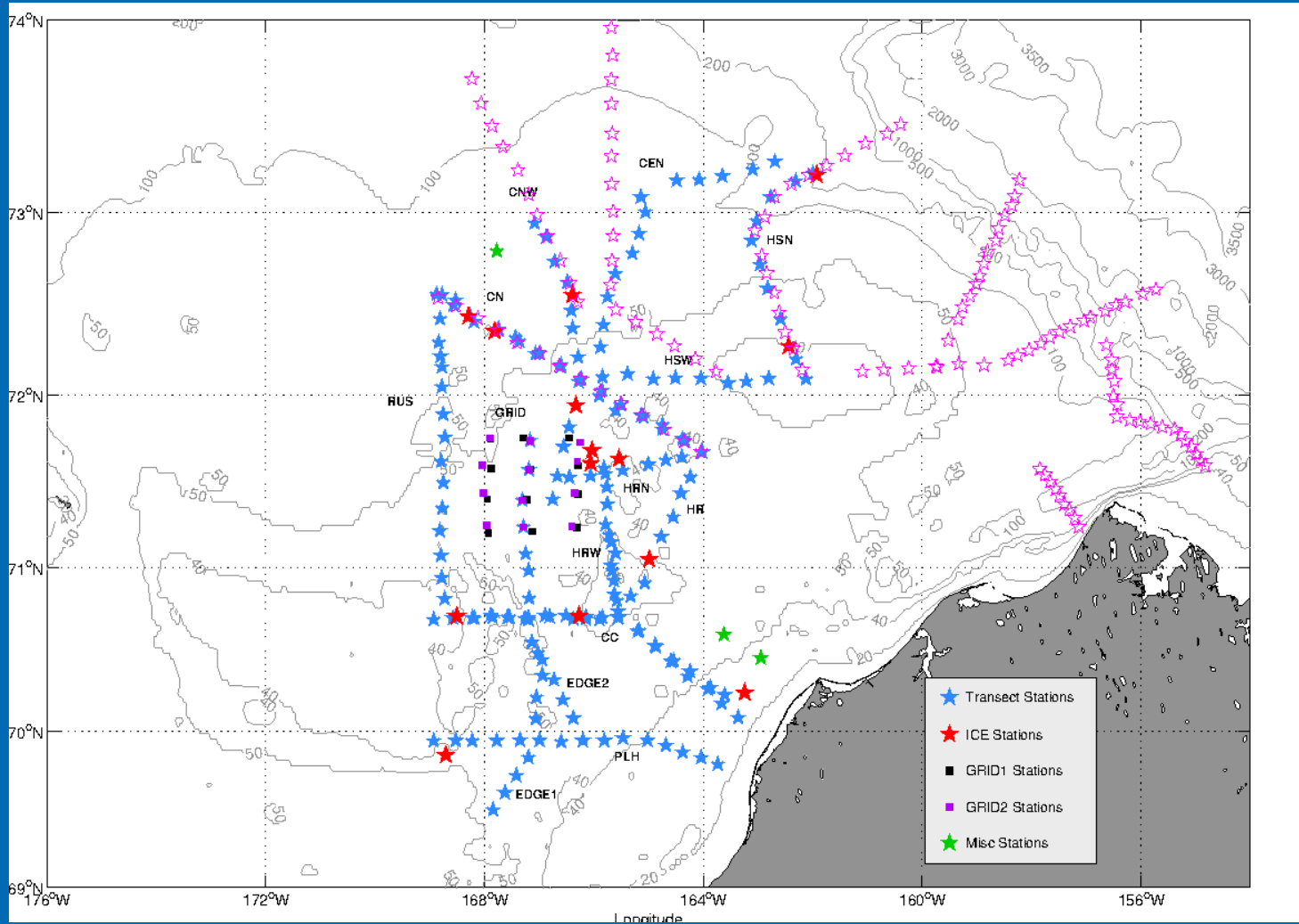
Northern shelf section



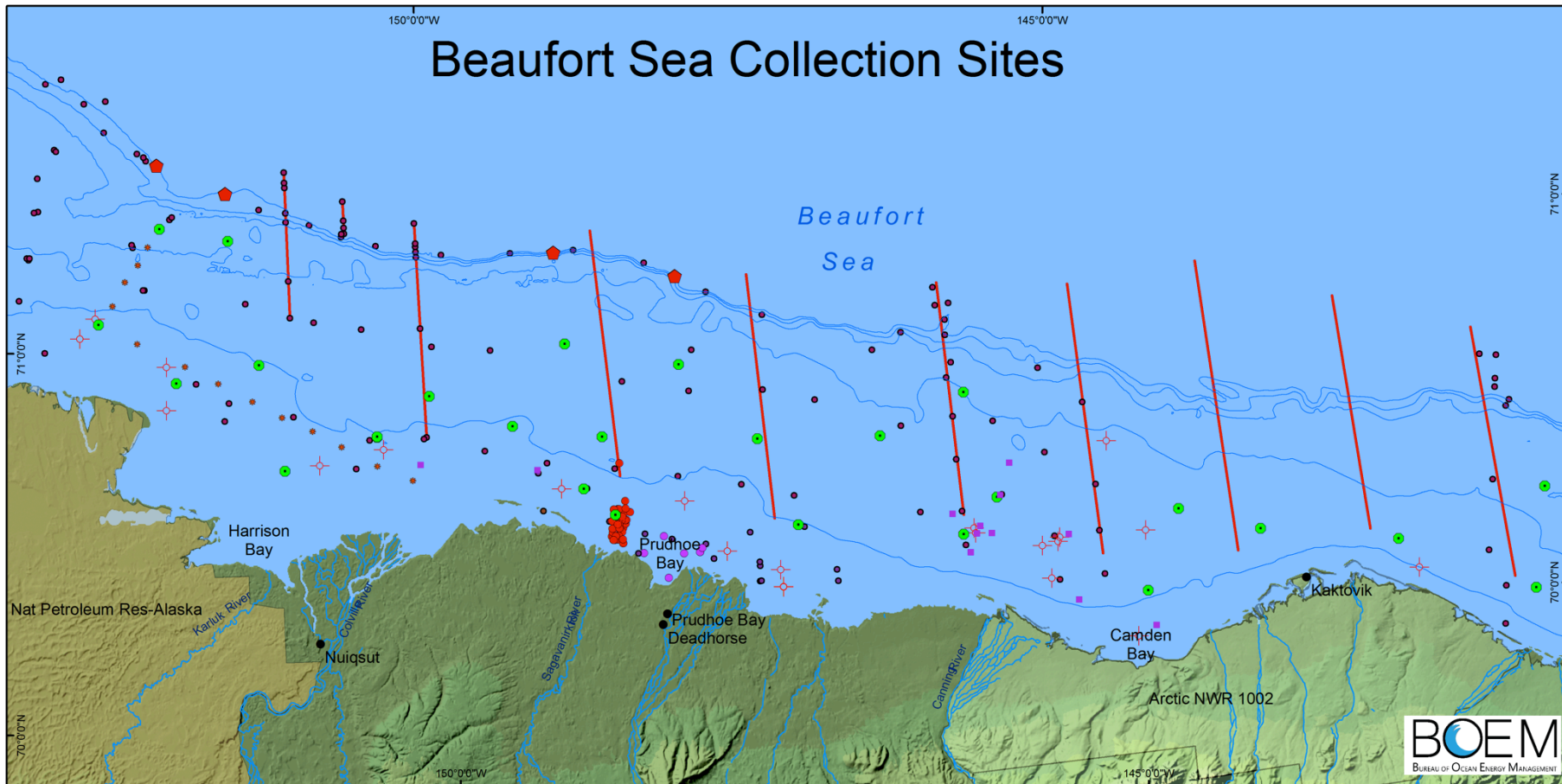
Northern shelf section



HLY1401 + HLY1402



Beaufort Sea Collection Sites



Legend

2014 ANIMIDA Stations

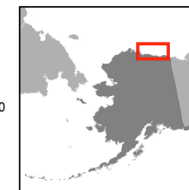
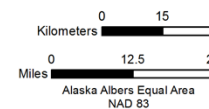
- Biology/Chemistry
- Chemistry
- ◆ Core Samples
- CTD Casts

ANIMIDA 1999-2008

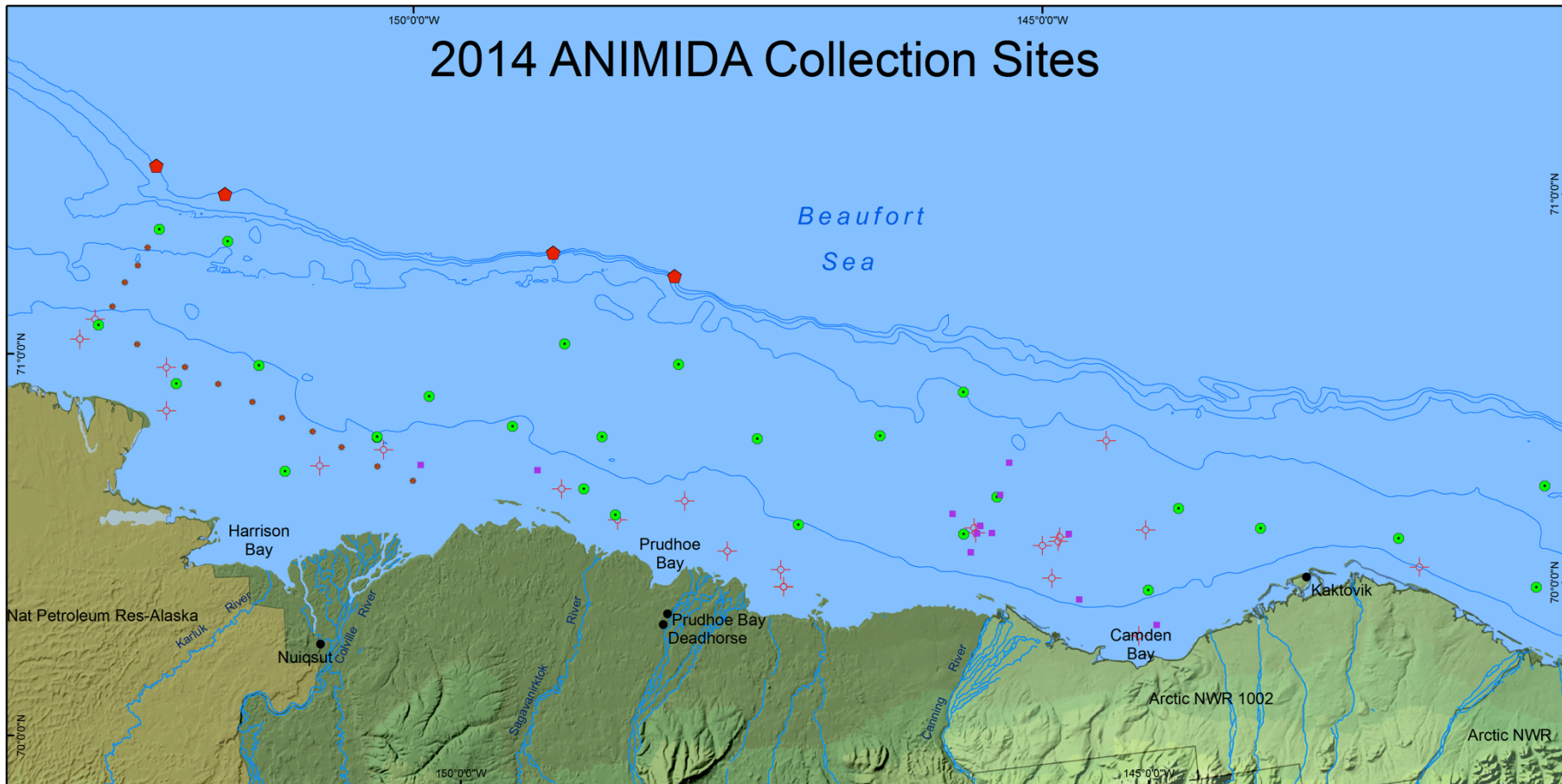
- BSMP
- Harrison Bay
- Northstar
- Prudhoe Bay

— Transboundary Transects

✦ Historic Wells



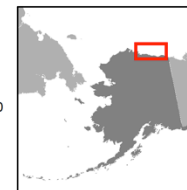
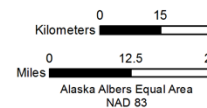
2014 ANIMIDA Collection Sites



Legend

- Biology/Chemistry
- ◆ Core Samples
- ⊠ Historic Wells
- Chemistry
- CTD Casts

BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT



Kathy Kuletz-USFWS 2013-2014
Seabird sampling

Seabird Prey includes copepods to inverts, to forage fish

What birds eat & where they can access it, drives distribution

But little known about seabird diet in NBS/Arctic

especially post-breeding period (critical to survival ?)

age- 0 & 1 walleye pollock



Euphausiids



age-0 & 1 Pacific cod & arctic cod



forage fishes (capelin, sand lance, myctophids, juv herring...)

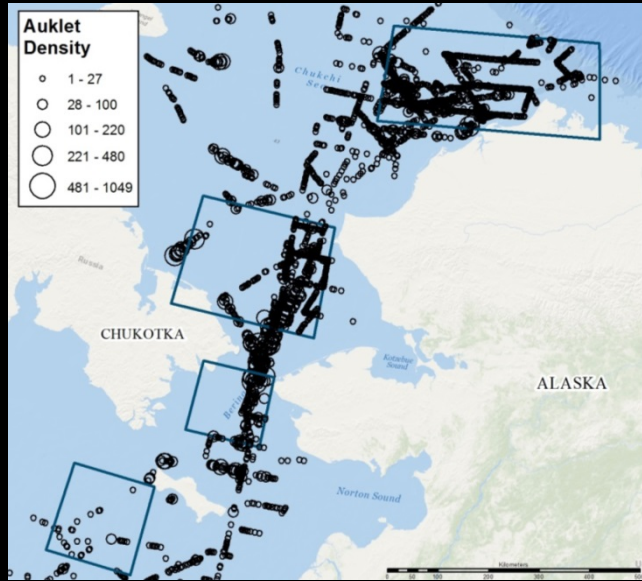
Also – squid (important, but little known about them)

larval & juvenile crab, shrimp, clams, amphipods, worms,
etc

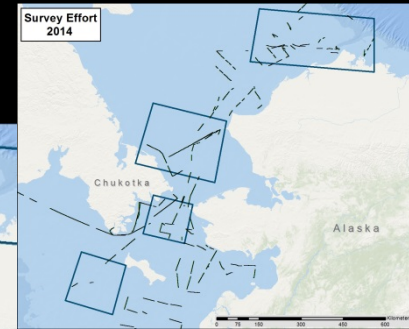
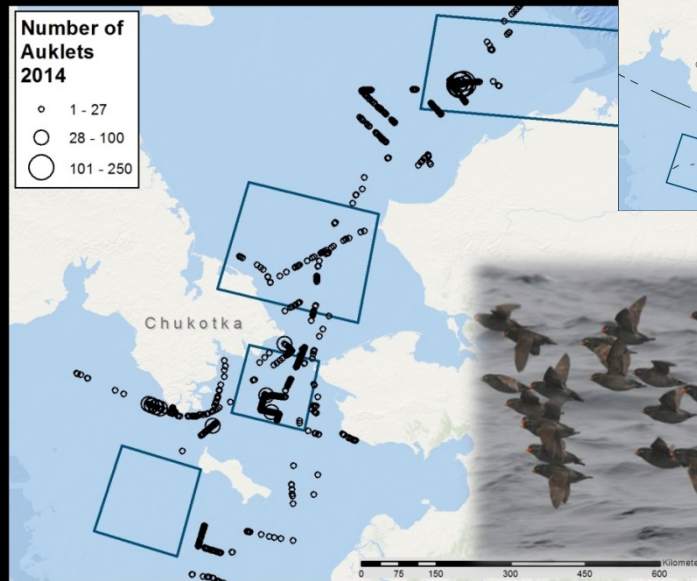
Seabird surveys on 4 cruises in 2014 in Arctic

AUKLETS

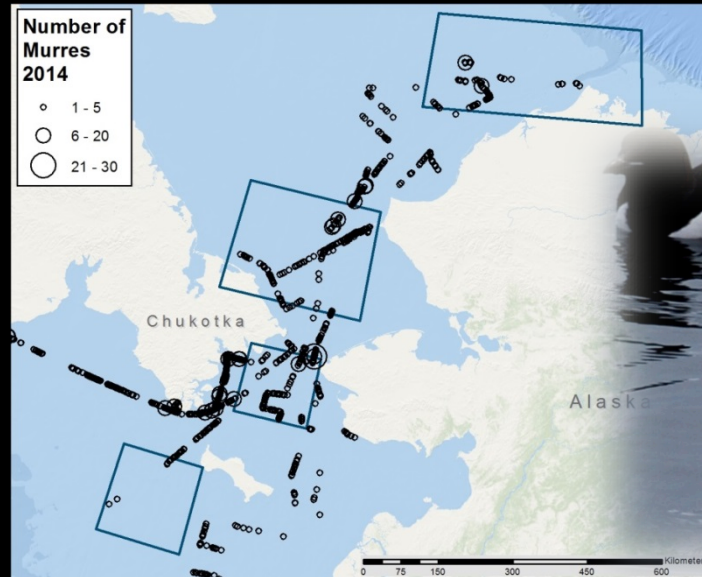
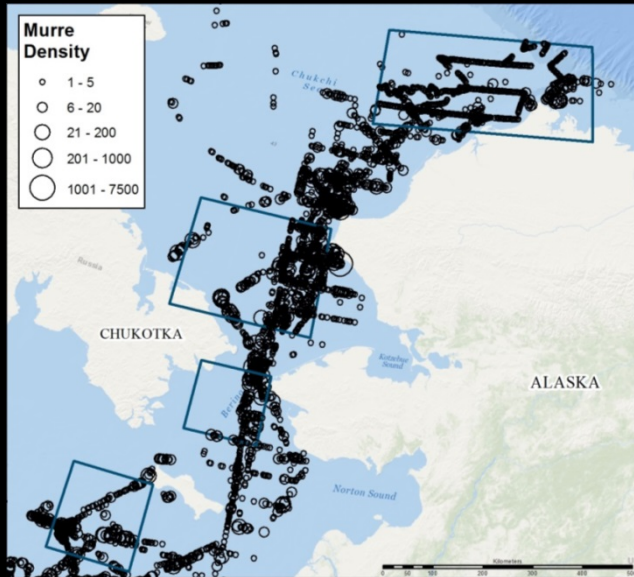
2010-2013



2014

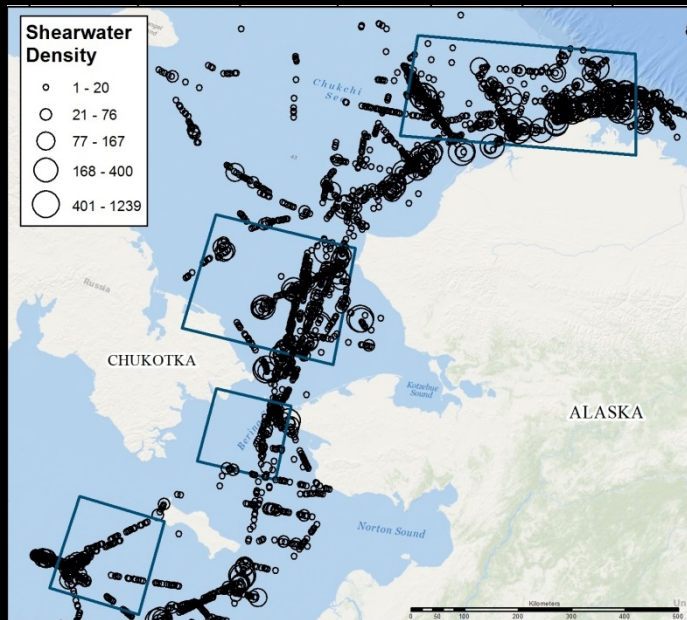


MURRES

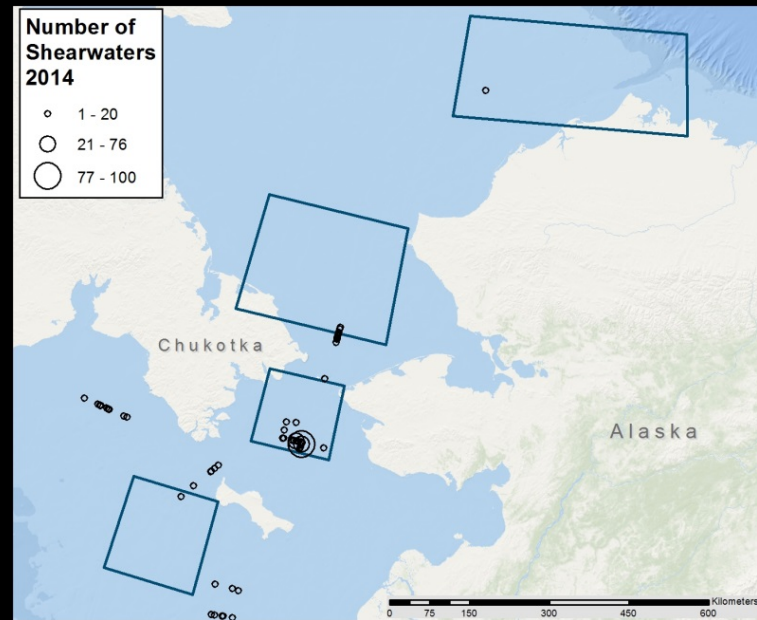


SHORT-TAILED SHEARWATER

2010 – 2013



2014



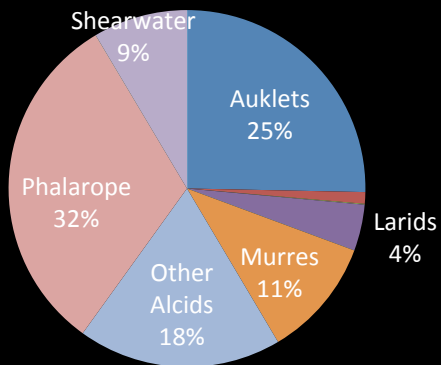
Short-tailed shearwater distribution and abundance in 2014 was very different from 2010-2013.

Shearwaters had been at least half of all birds, throughout N.Bering & Chukchi, but were **absent in 2014.**

Seabird species composition by DBO - 2013 & 2014

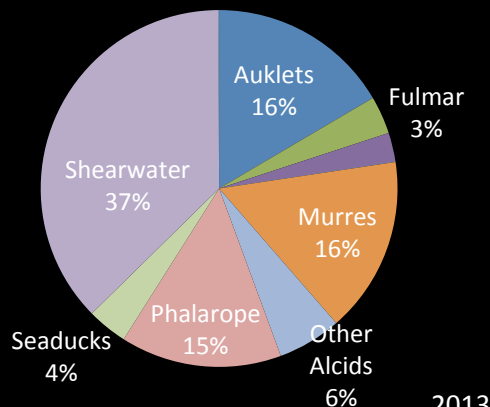
(2013 was similar to previous 3 years; 2014 had different species & abundance)

Chirikov Basin



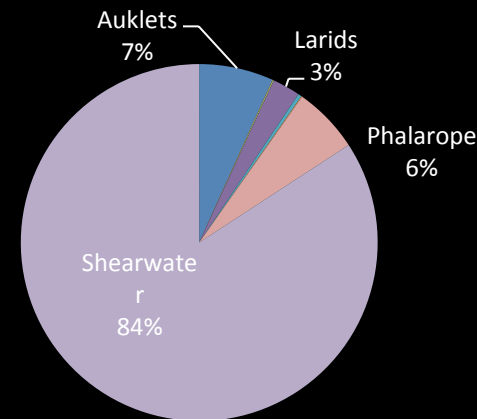
2013

Hope Basin

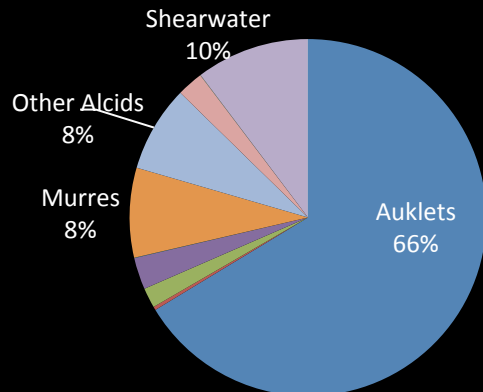


2013

NE Chukchi

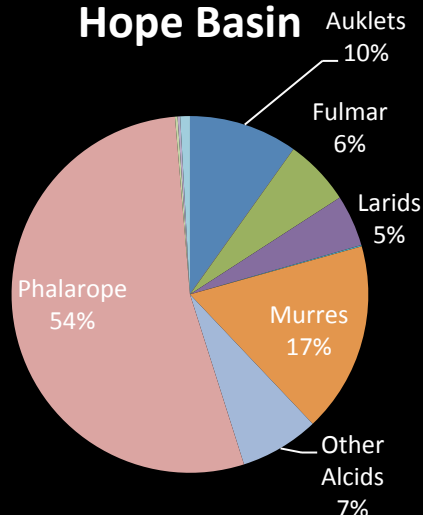


Chirikov Basin



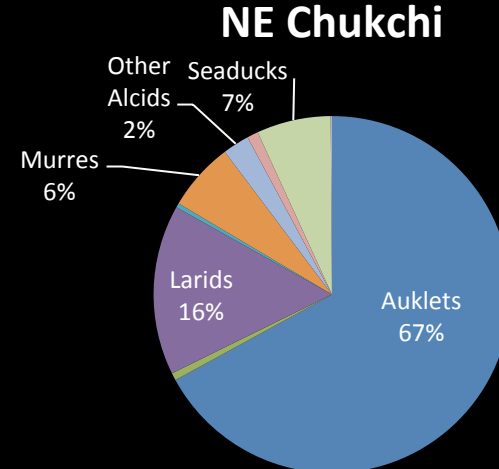
2014

Hope Basin



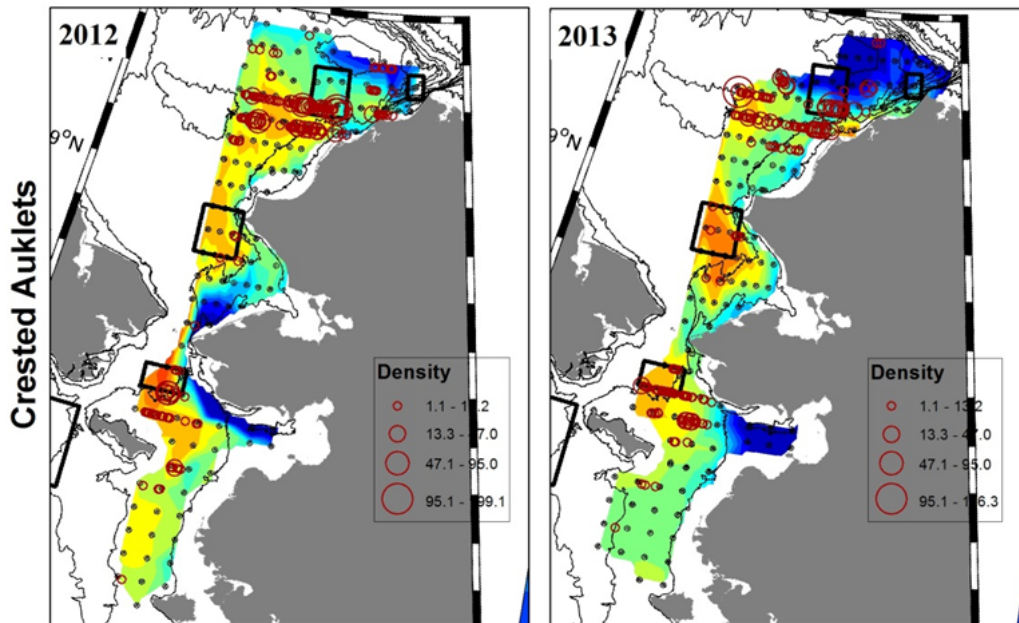
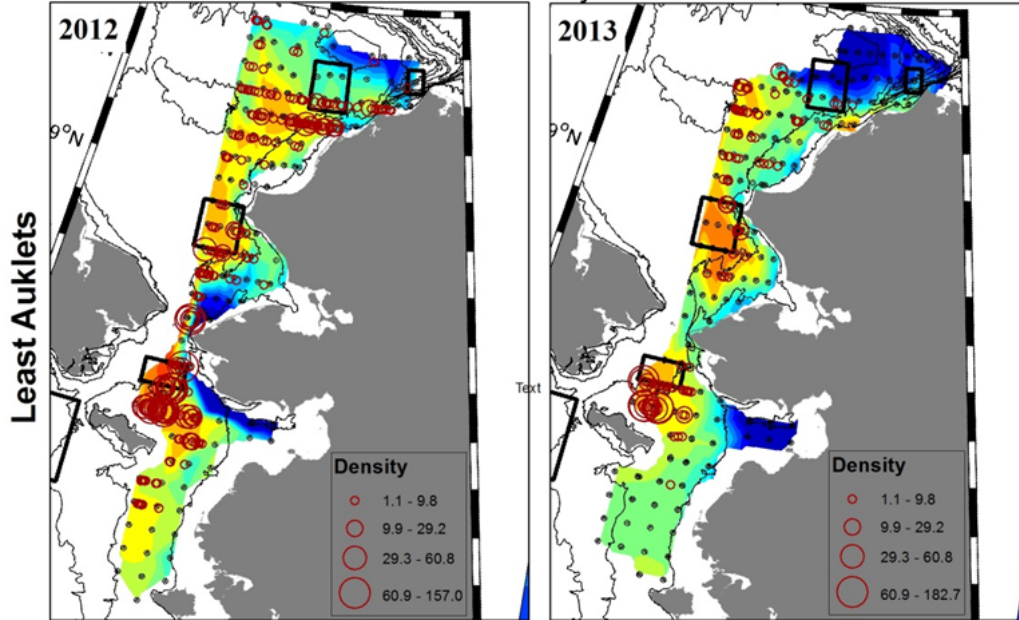
2014

NE Chukchi



2014

Salinity



Seabird Distribution varies among years

Example:

Total Seabird density higher in 2012 than in 2013, especially in N. Chukchi Sea.

Auklets (planktivores) [red circles] accounted for most of the change



Most auklets occurred in fairly saline waters (associated with higher zooplankton abundance?)

THE CSESP DBO LINE, 2013



Robert H. Day, Arny L. Blanchard and the CSESP team

Presenter: Arny L. Blanchard

Pacific Arctic Group Workshop

Seattle WA, October 28-29

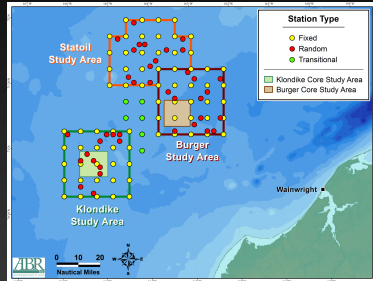
Introduction

- Chukchi Sea Environmental Studies Program— industry-funded science to describe and understand ecosystem of NE Chukchi Sea in vicinity of oil and gas prospects
- Study design incorporates:
 - Ecosystem approach (multidisciplinary)
 - Seasonal variability (2–3 cruises/year)
 - Interannual variability (2008–present; annually)
 - Spatial variability (broad-scale grid in 2011-2012)

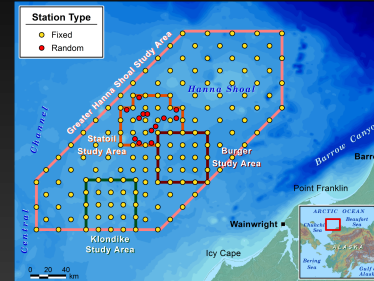
Disciplines

- Physical oceanography (CTD, ADCP, moorings)
- Nutrients
- Acidification (2011–12)
- Zooplankton (microplankton added 2012)
- Benthic macrofauna
- Benthic megafauna (trawling 2009–10, camera [spotty] 2011–12)
- Fishes (trawling 2009–10, acoustics 2011–12)
- Seabirds
- Marine mammals
- MM acoustics (moorings nearby)
- NOT ALL DISCIPLINES AT EVERY STATION!

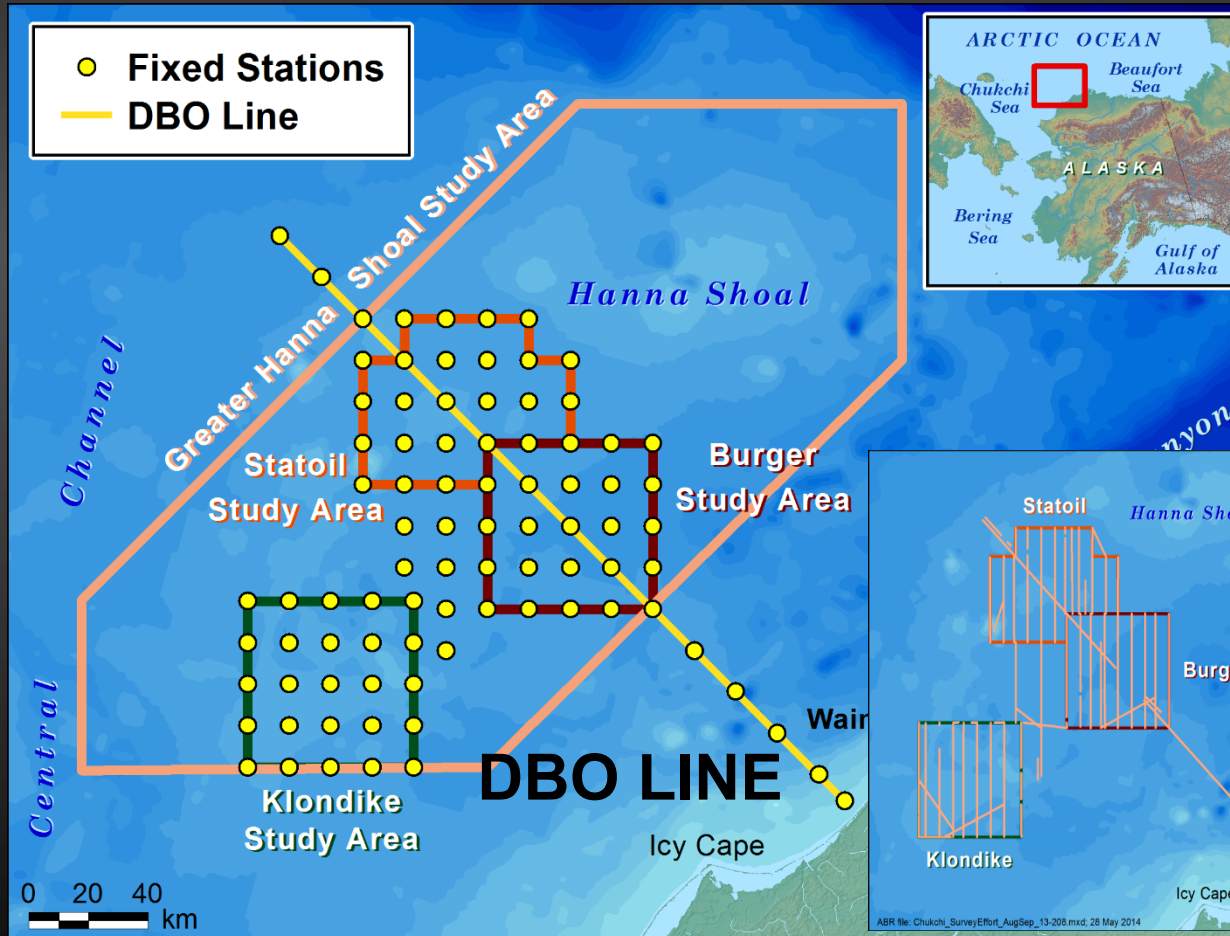
Sampling Design



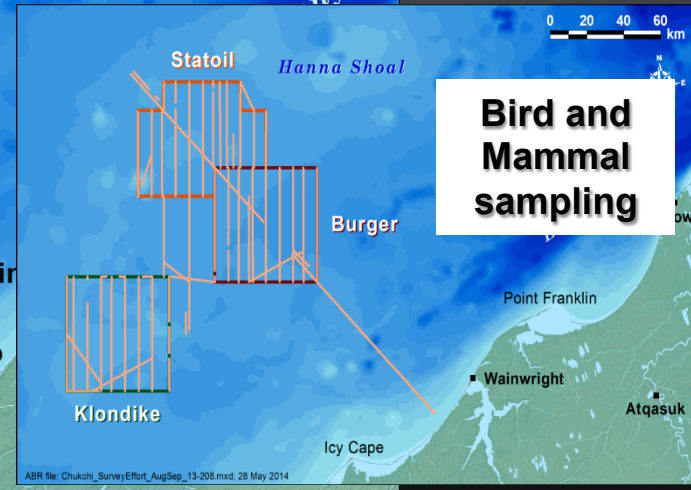
2008-2010



2011-2012



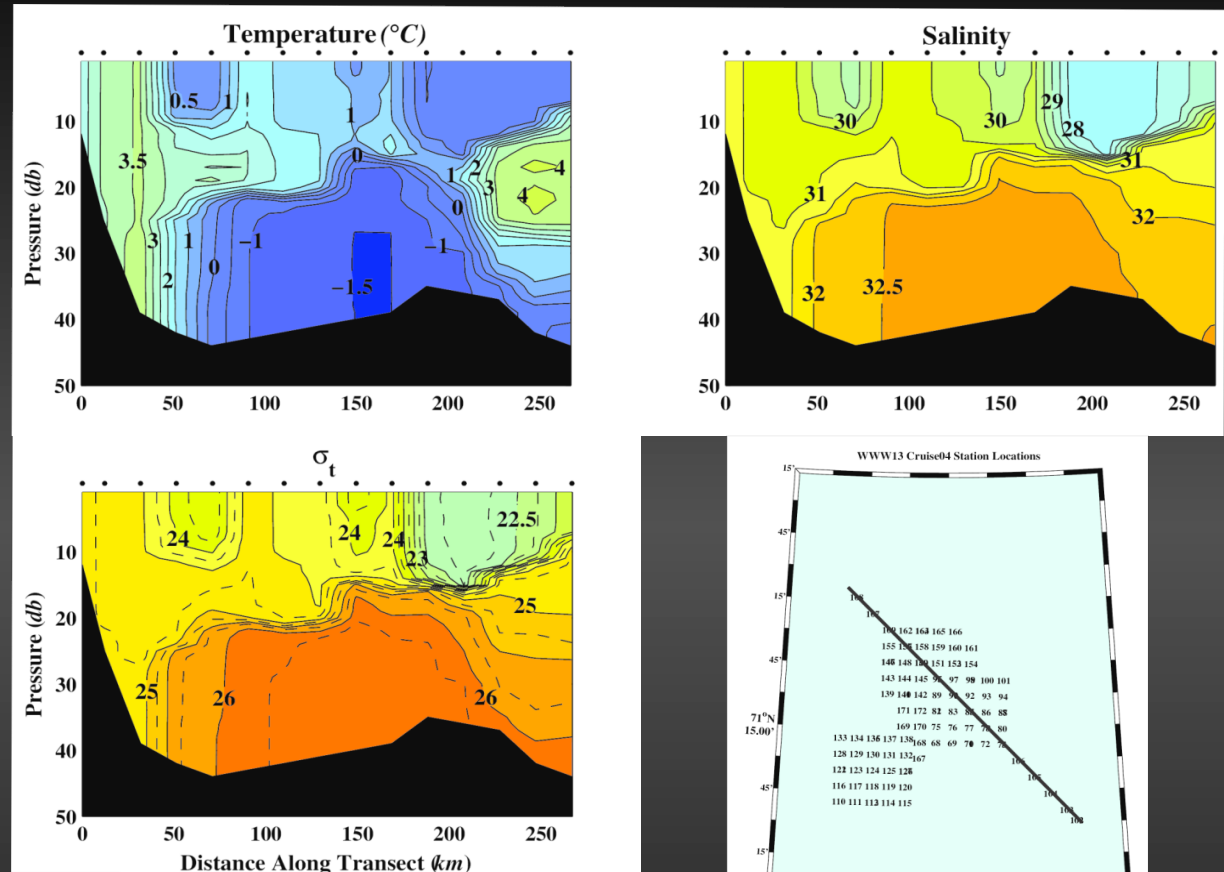
2013



Bird and Mammal sampling

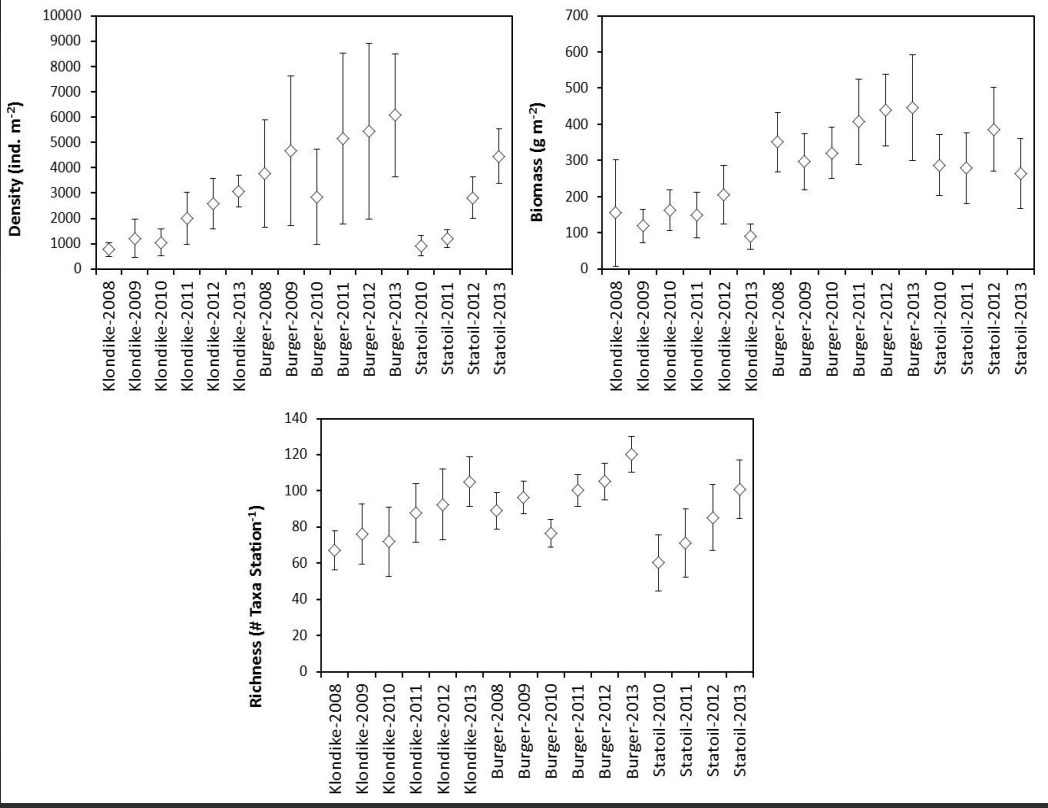
Physical Oceanography 2013

- Warm water nearshore.
- Cold meltwater on surface offshore.
- Cold, saline water on bottom offshore.



INSHORE
 BURGER
 STATOIL
 CENTRAL
 CHANNEL

Benthic Macrofauna 2008-2013



- Significant annual variability with values generally increasing over time.
- Spatial variability appears related to water circulation and cold pool @ Burger.

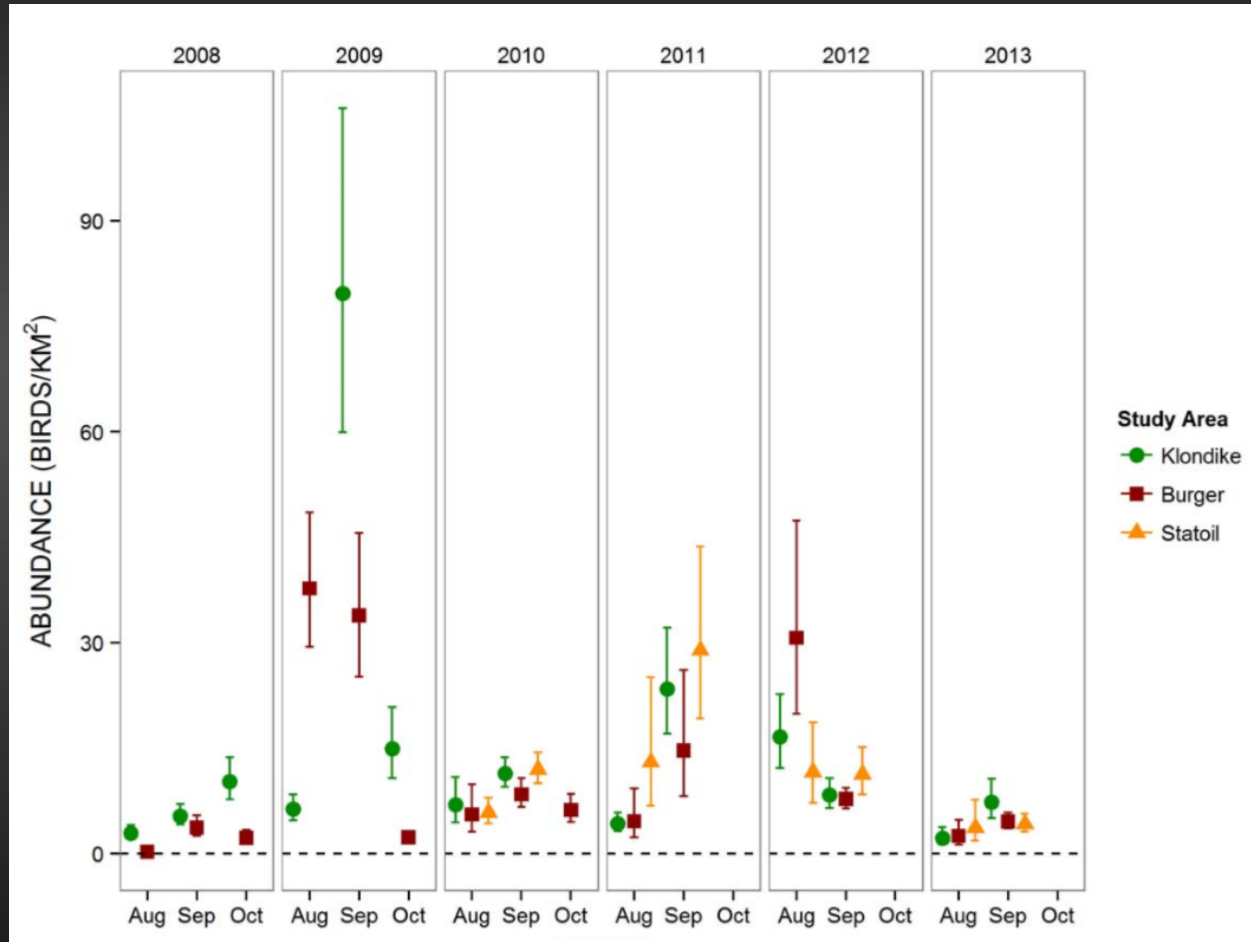
Seabirds 2013

Seabirds more abundant towards fall.

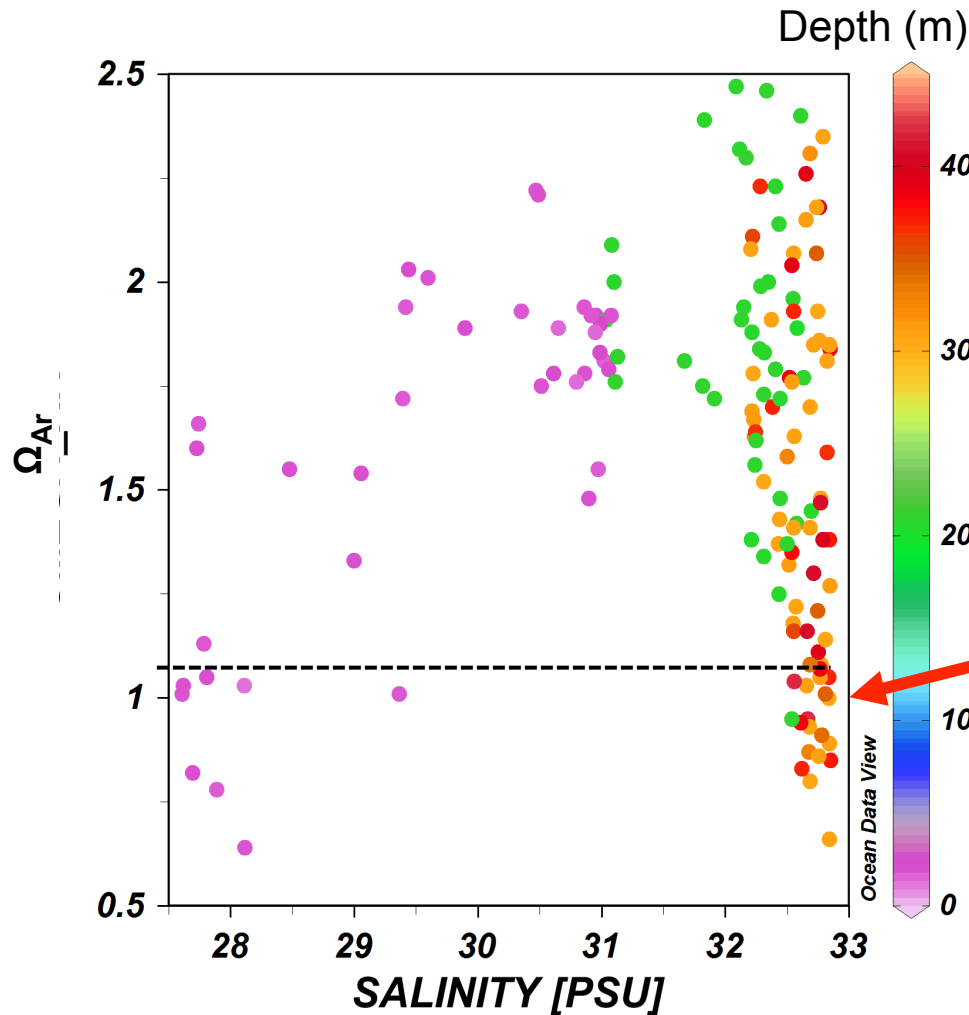
High geographic variability.

A general spatial pattern not clear every year.

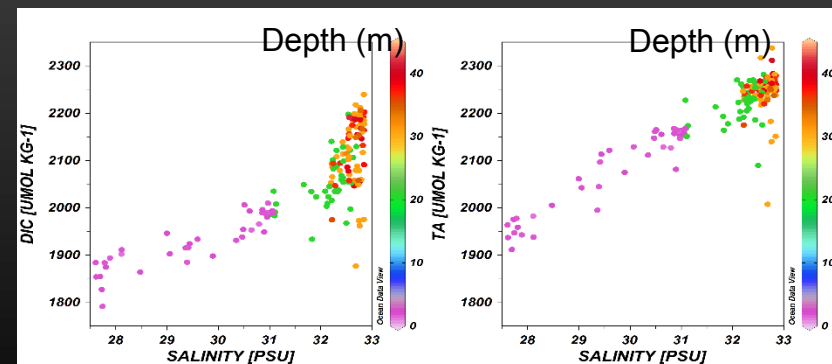
Total Seabird Abundance & Temporal Variability



Ocean Acidification



2013 was consistent with 2010-2012, showing that aragonite becomes undersaturated in bottom waters.

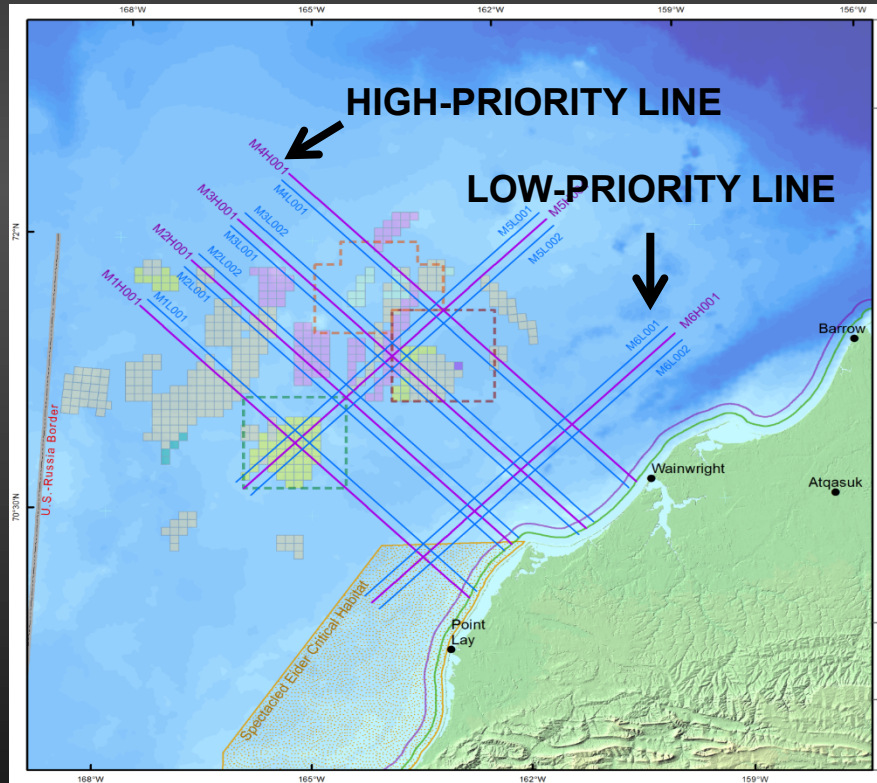
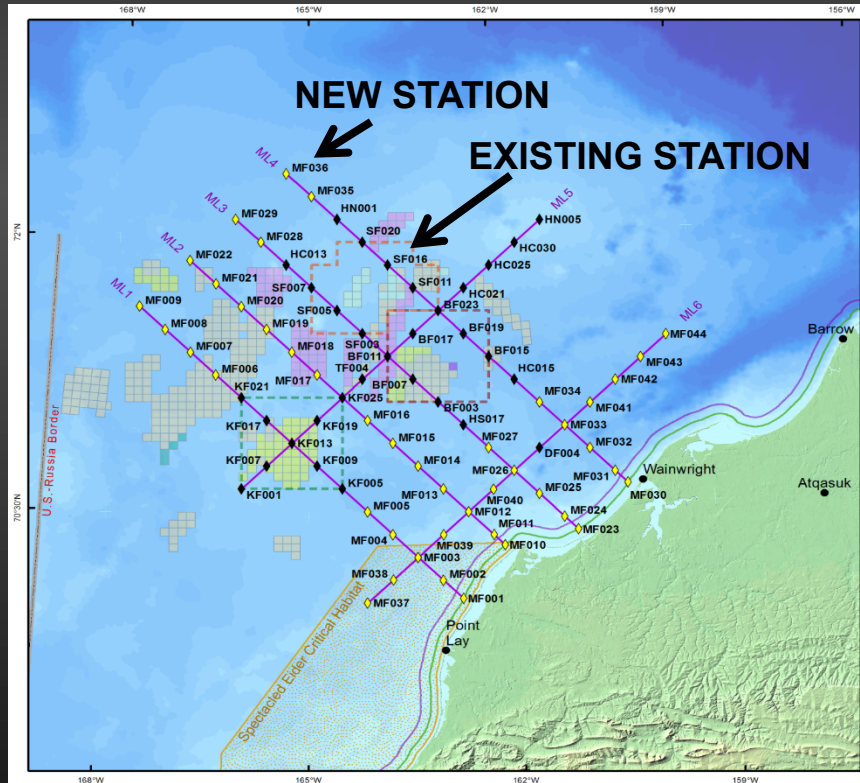


Conclusions

- Multidisciplinary study demonstrates high variability in each component.
- Ecosystem more complex than first thought!
 - Strong spatial variations in biological components, largely aligning with physical oceanographic characteristics.
 - Strong temporal variability as well.

Sampling 2014

- New emphasis on monitoring lines—4 orthogonal to coastline, 2 parallel to coastline



Find out more about the
Chukchi Sea Environmental
Studies Program (CSESP) at:

www.chukchiscience.com

Bio-physical mooring NE Chukchi Sea 2015-2020 (Science and Industry)

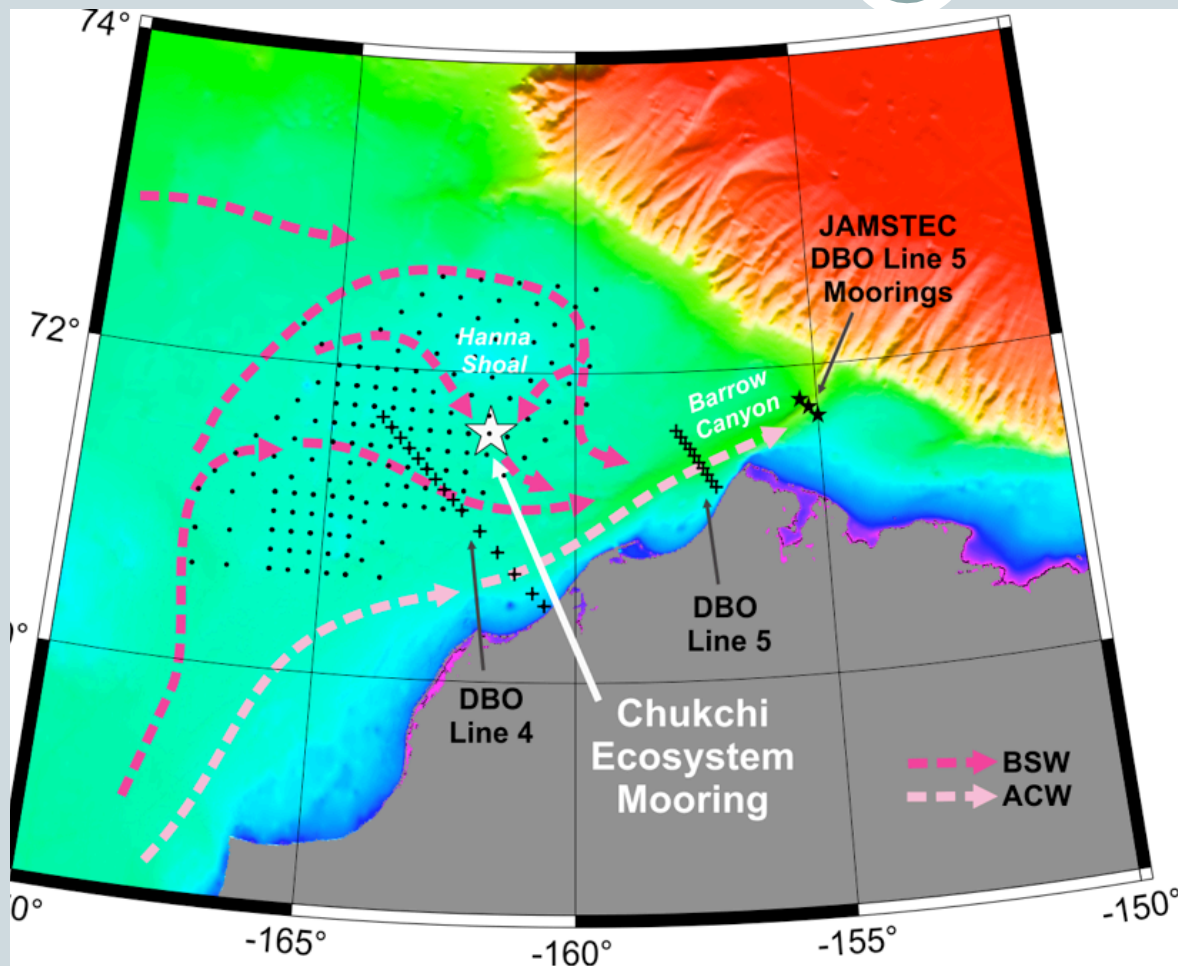


Figure 1. Map of the NE Chukchi Sea, with color-shaded bathymetry, place names, idealized depictions of the flow field (arrows) and sampling locations of the Distributed Biological Observatory (DBO; pluses); the Chukchi Sea Environmental Studies Program (CESP; dots and pluses on DBO Line 4), and DBO Line 5 moorings maintained by the Japanese Agency for Marine-Earth Science and Technology (JAMSTEC, black stars). BSW = Bering Shelf Water; ACW = Alaska Coastal Water.

[courtesy S. Danielson]

NE Chukchi Sea Circulation Studies

Velocity observations

- High-frequency (HF) Radars (2009-2014)
- Oceanographic Moorings (2008-2014)
- Satellite-tracked Drifters (2011-2014)
- Vessel-mount ADCPs (2009-2014)

Supporting data and models

- Meteorological Buoys (2008-2014)
- Shipborne CTDs (2008-2014)
- Towed CTDs (2012-2014)
- AUV Gliders (2010-2014)
- 2D & 3D Numerical Modeling

Partners

Academic

UAF

UW

WHOI

Public

AOOS/IOOS

BOEM

CIAP

NOAA

NSB

NSF

Non-Governmental

Conoco-Phillips

Cully Corp.

NPRB

Ogloolik Corp.

Ogloolik-Fairweather

Shell

Statoil

Ukpeagvik Inupiat Corp.

dm.sfos.uaf.edu/chukchi-beaufort/

UAF UAg Google Wikipedia c2o2 News scholar UAonline LANCE worldview AP

Chukchi & Western Beaufort Circulation Study

BOEM UAF UNIVERSITY OF ALASKA FAIRBANKS

Real-Time Map | **Synopsis of Conditions** | **Objectives & Background** | **Field Schedule** | **Partners**

Welcome to the project home page. See the tabs above for links to other aspects of this project. Below is the Real-Time Data Map.

Map Satellite

Barrow

Wainwright

Atkasuk

Point Lay

10 kt Wind

10-22-2014

0.5 1.541 1.5

Knots

Google

Imagery ©2014 TerraMetrics | Terms of Use

Use the checkboxes to choose the data to display.

Active Drifters:
See the [Drifters Page](#) for all drifter deployments.

- NSBW, 7/23
- NSBW, 7/26
- NSBW, 7/29
- NSBW, 8/06
- ARCTREX, 9/09
- ARCTREX, 9/15
- Final Positions of 2014 Drifters

UAF HFR Surface Currents:

- Hourly UAF Surface Current Vectors ([HFR](#))
- Daily UAF Surface Current Vectors ([HFR](#))

Sea Ice:

MODIS Truecolor Image, courtesy of [NASA's Earth Observing System](#)

- MODIS Day of Year 295

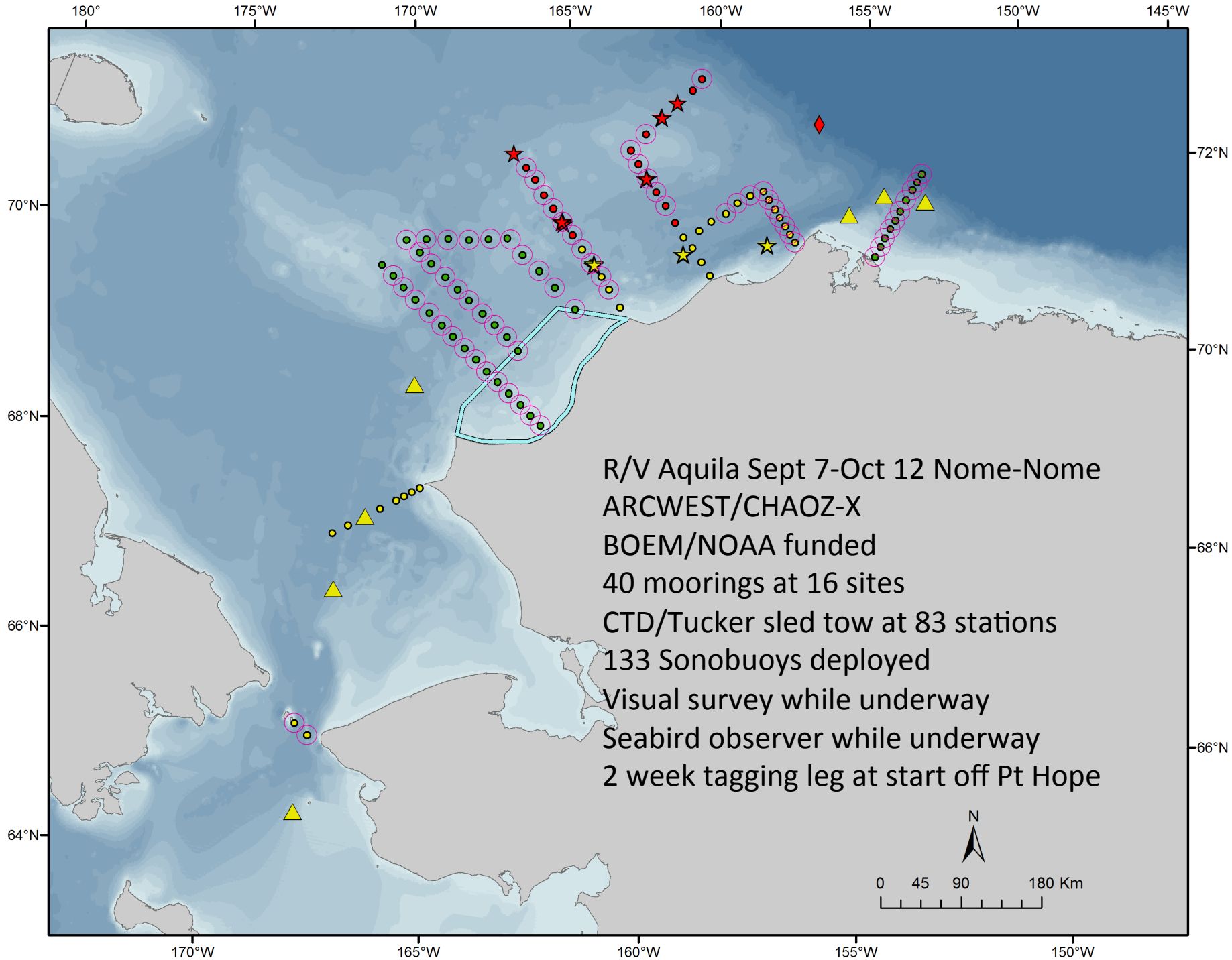
Ice categories, courtesy of [NOAA's NWS](#). Click on each shape to view category definition.

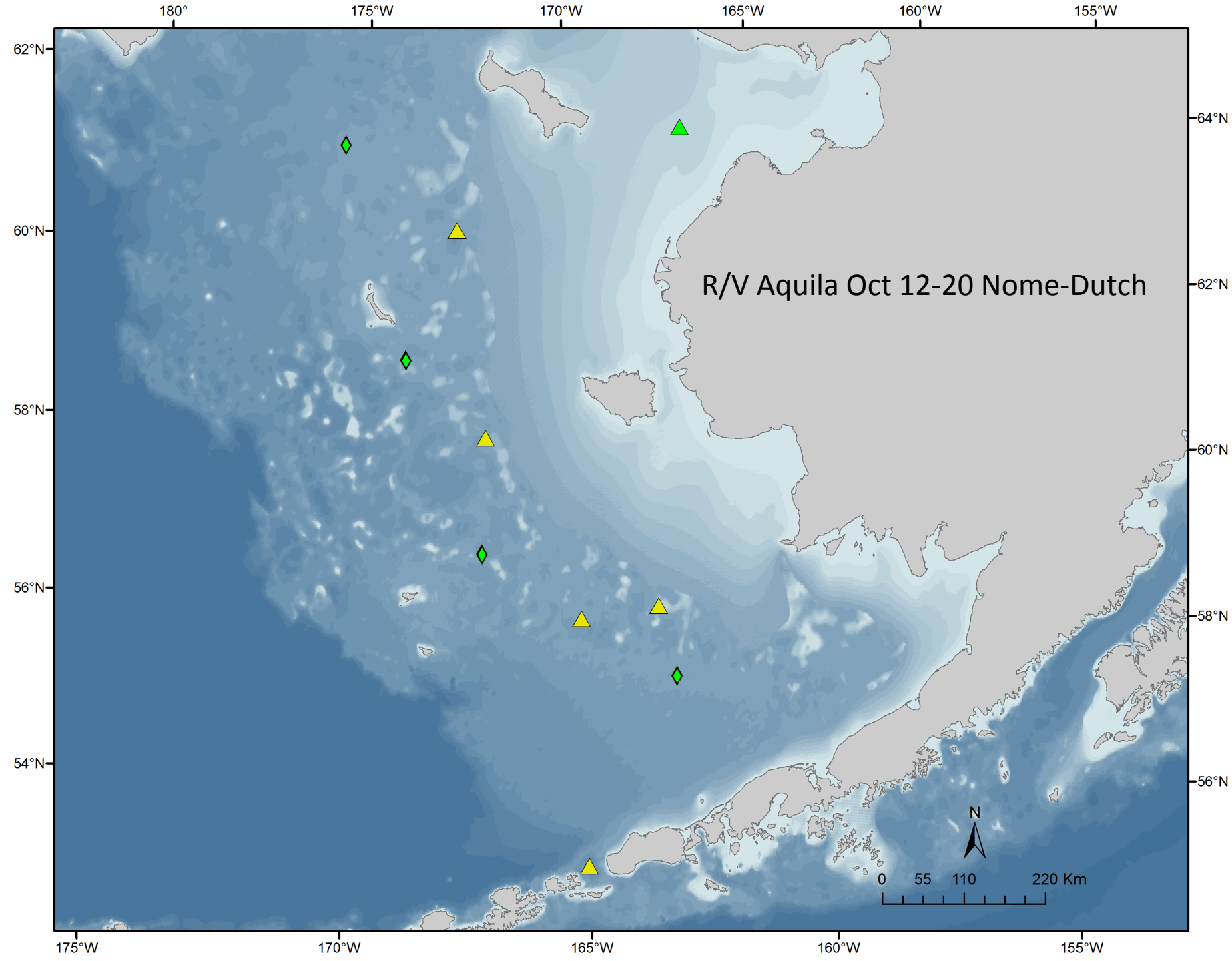
- Oct. 19, 2014

Online:

- HF Radar Daily Averages
- Blog
- Links to Animations

<http://dm.sfos.uaf.edu/chukchi-beaufort/>







END