Plan for 2014 Arctic Field Season: Republic of Korea

♪

Sung-Ho Kang
Division of Polar Ocean & Environment Research
KOPRI

6-7 April 2014
Pacific Arctic Group Meeting

Korea Polar Research Institute


2014 KOPRI Arctic Plan♪
DMC SWL
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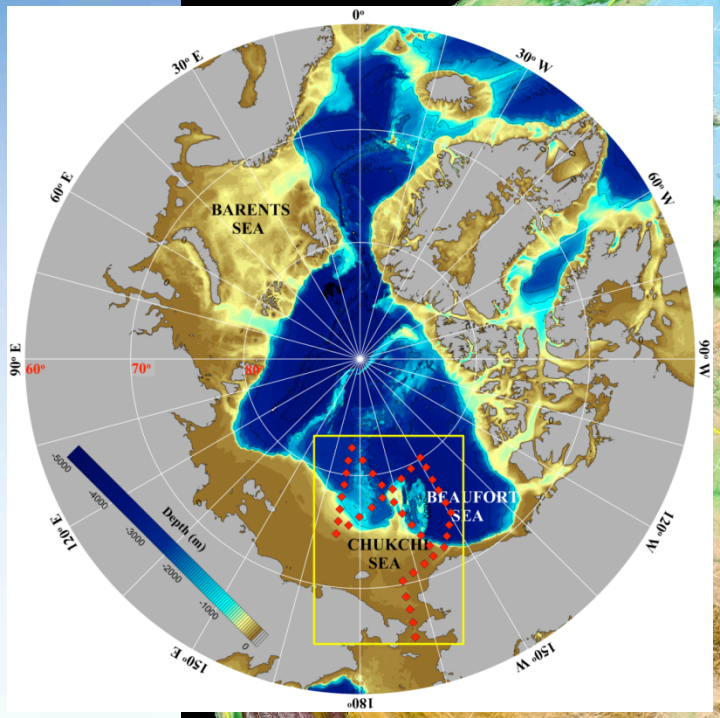
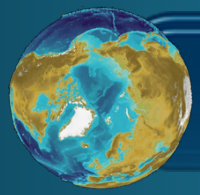
2014 Araon Arctic Ocean Research Plan



2014. 7. 16 ~ 10.03 (Total 79 days) ♪



2014 KOPRI Arctic Cruise♪

- **Aims of the cruise:**

  - To investigate the structure and processes in the water column and subsurface(sediment) around the North Bering Sea, Chukchi Sea, the North site of East Siberian Sea and Beaufort Sea in rapid transition.

  - To understand the sea ice dynamics and sea ice ecosystem

- **Period:** 2014. 7.30 ~ 8.25 -> Water column and Sea ice

  2014. 8.26 ~ 9.19 -> Marine geophysics

- **Chief Scientists:** 1st leg: Dr. Sung-Ho Kang,

  2nd leg: Dr. Young Keun Jin

- **Participating nations:** Korea, US, Canada, Japan, UK

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2014 「ARAON」 Arctic Cruise Plan

- **Projects involved**
  - Leg I: K-PORT (PI: Dr. Sung-Ho Kang, Chief Scientist)
  - Leg II: Geophysical Survey (PI: Dr. Young Keun Jin, Chief Scientist)
- **Period: 2014. 7. 16 ~ 10.03 (Incheon to Busan, Total 79 days)**

Summary

Incheon Departure (7.16) ⇒ Transit (Incheon to Nome) (7.16 ~ 7.29) ⇒ Nome Stay (7.29 ~ 31) ⇒ Transit (Nome to 1st Station of Leg I) (7.31 ~ 8.01) ⇒ Leg I (Bering/Beaufort/Chukchi/East Siberian Seas) (8.01 ~ 8.22) ⇒ Transit (Last Station of Leg I to Barrow) (8.22 ~ 8.24) ⇒ Barrow Stay (8.24 ~ 27) ⇒ Transit (Barrow to 1st Station of Leg II) (8.27 ~ 30) ⇒ Leg II (Beaufort Sea) (8.30 ~ 9.15) ⇒ Transit (Last Station of Leg II to Nome) (9.15 ~ 19) ⇒ Nome Stay (9.19 ~ 21) ⇒ Transit (Nome to Busan) (9.21 ~ 10.03) ⇒ Busan Arrival (10. 03)

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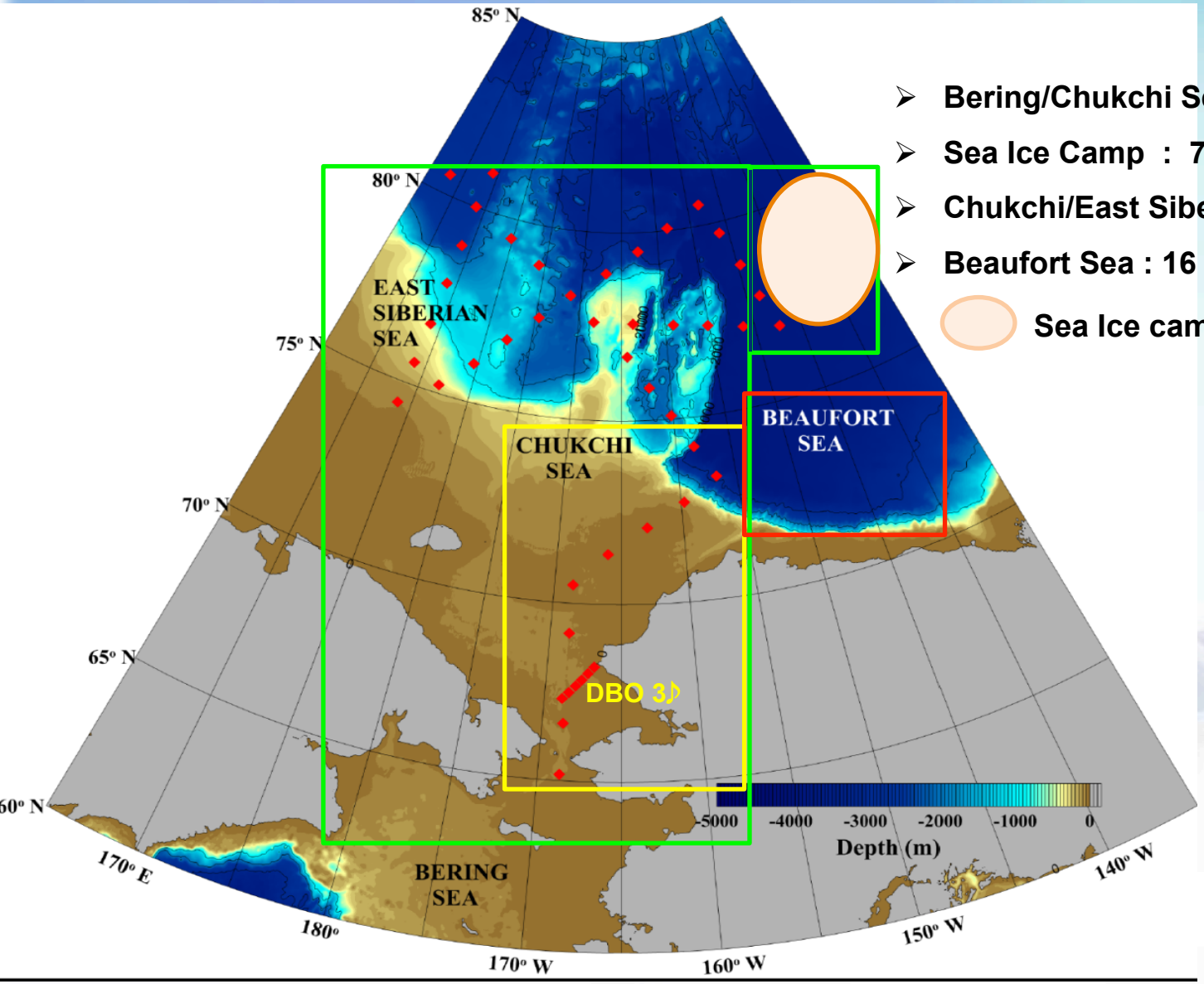
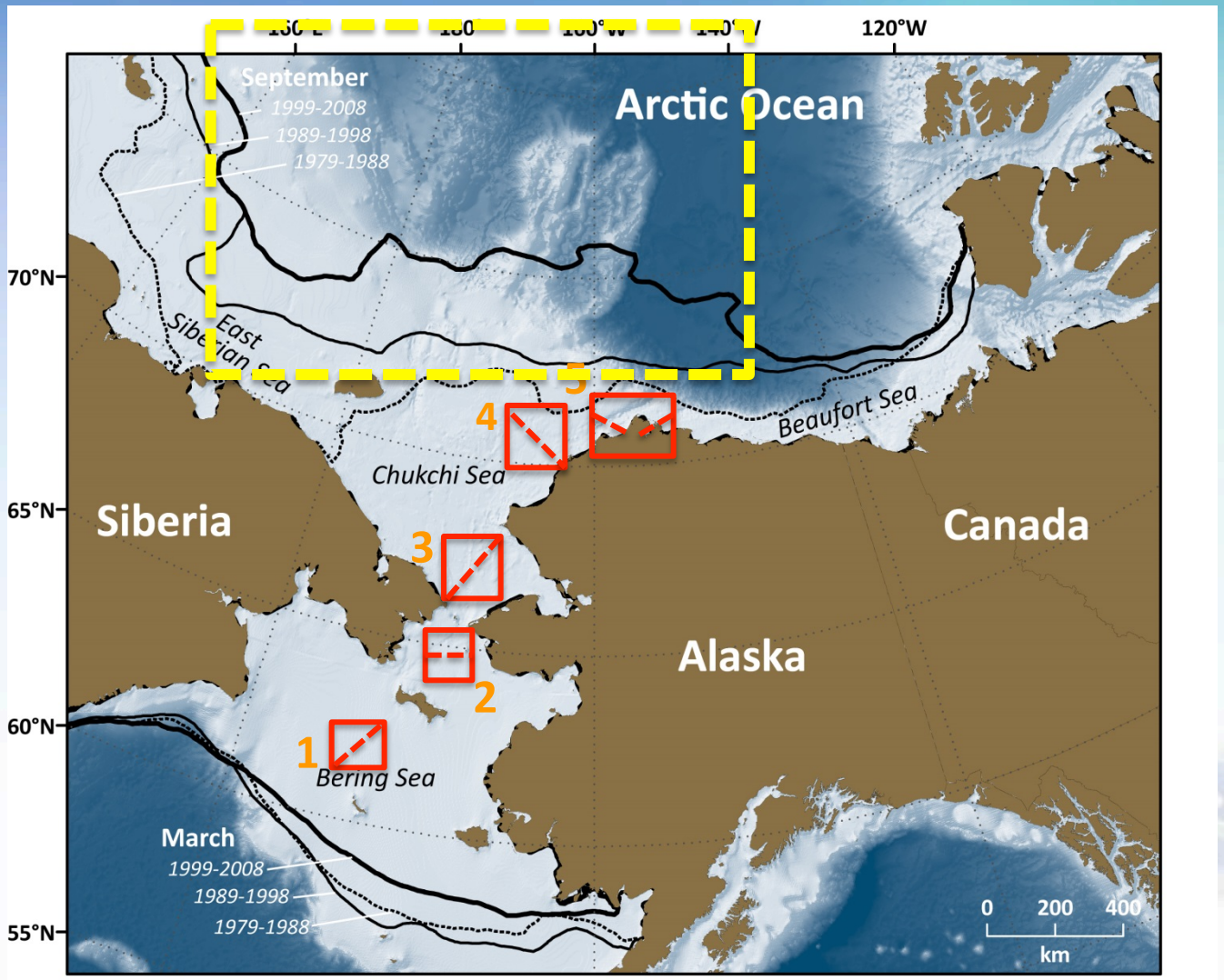
2014 Arctic Survey



- Bering/Chukchi Seas : 3 day
- Sea Ice Camp : 7 days (KOPRI+ONR)
- Chukchi/East Siberian Seas : 11 days
- Beaufort Sea : 16 days

Sea Ice camp station (with ONR-MIZ)

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

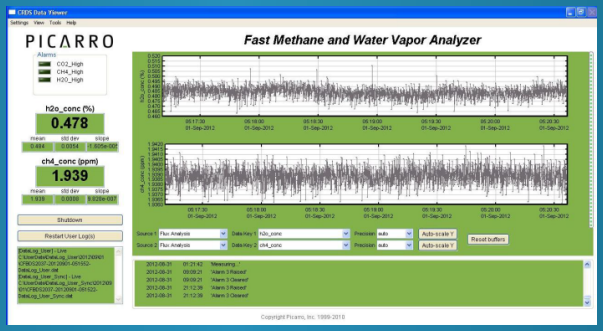


[modified by Karen Frey from Grebmeier et al. 2010, EOS 91]

Atmospheric Observation

- Direct measurements of Air-Sea Greenhouse Gas Fluxes (CO_2 and CH_4)

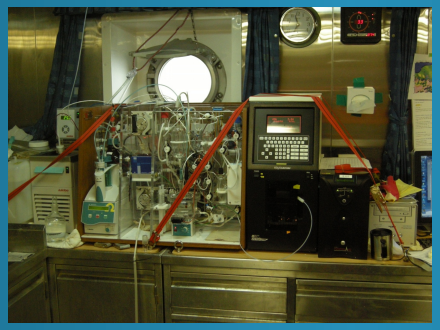
Open-path eddy covariance at the foremast of ARAON



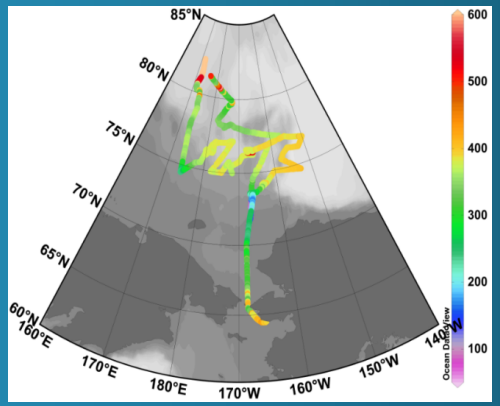
Real time variation of CH_4 and H_2O in flux mode

CO_2 system in water column

- Pursuing spatial and temporal variation of CO_2 system in the Arctic Ocean



Analytical system for DIC and TA

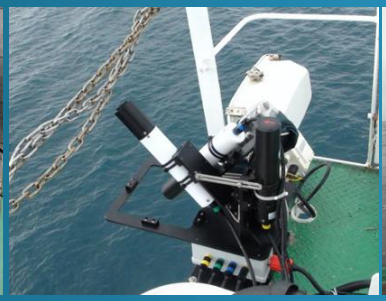


Dissolved pCO_2 along the track

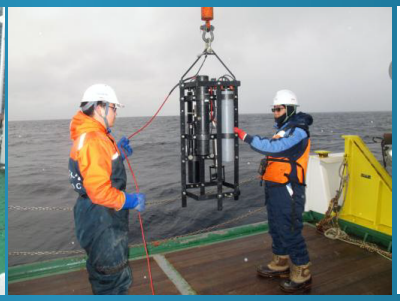
Satellite Remote Sensing

- Ocean Color Remote Sensing (Ocean Optics Measurement)

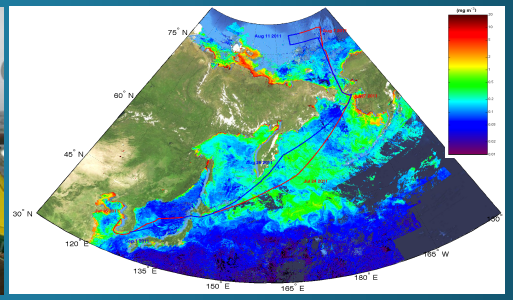
Hyper-spectroradiometer



Above water spectroradiometer



APC deployment

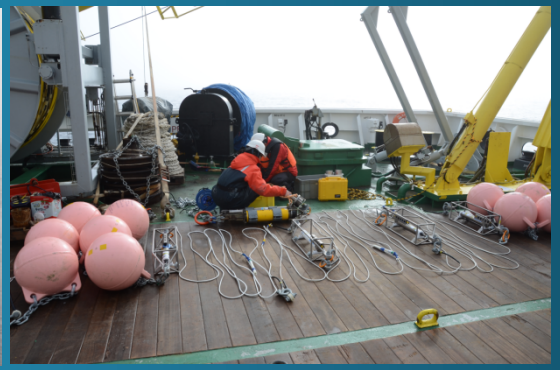


Hydrographic Survey

- Water mass distribution & characteristics

CTD & ADCP

XCTD



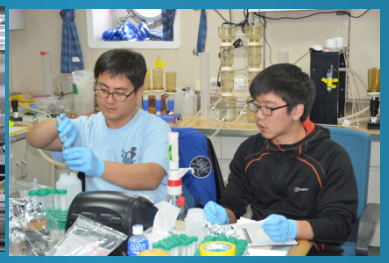
Ocean Mooring

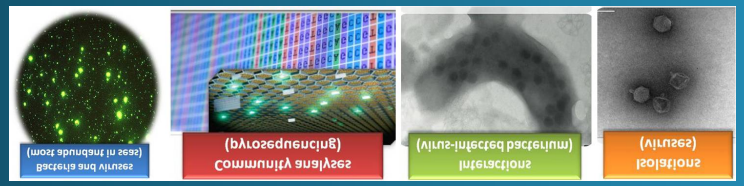
Micobes/Plankton Ecology

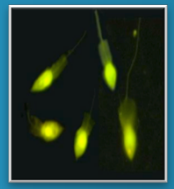
- Distribution of bacteria and virus and community structure
- Species compositions of phytoplankton , chlorophyll *a* concentration and primary production
- Abundance and community structure of heterotrophic protists
- Mesozooplankton community and grazing impacts on phytoplankton biomas



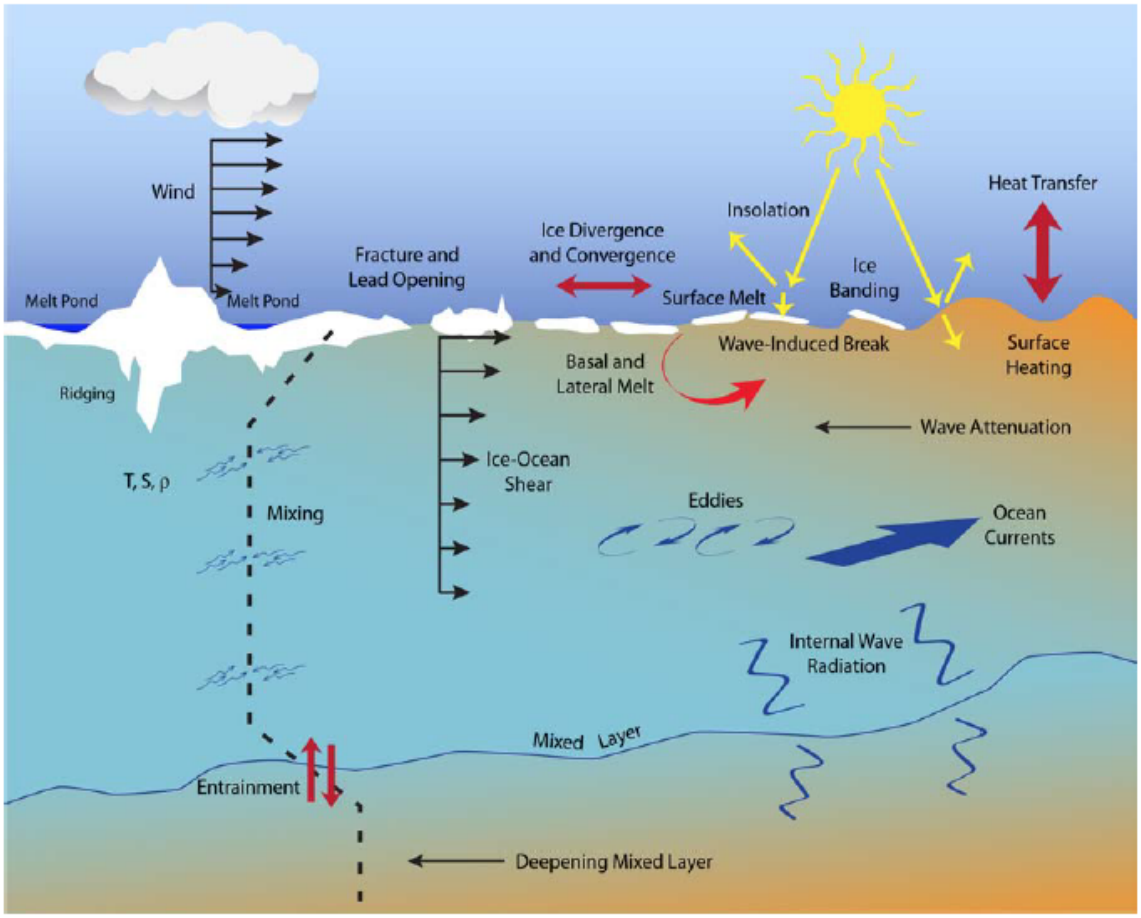





MIZ program: Processes governing atmosphere-ice-ocean interaction



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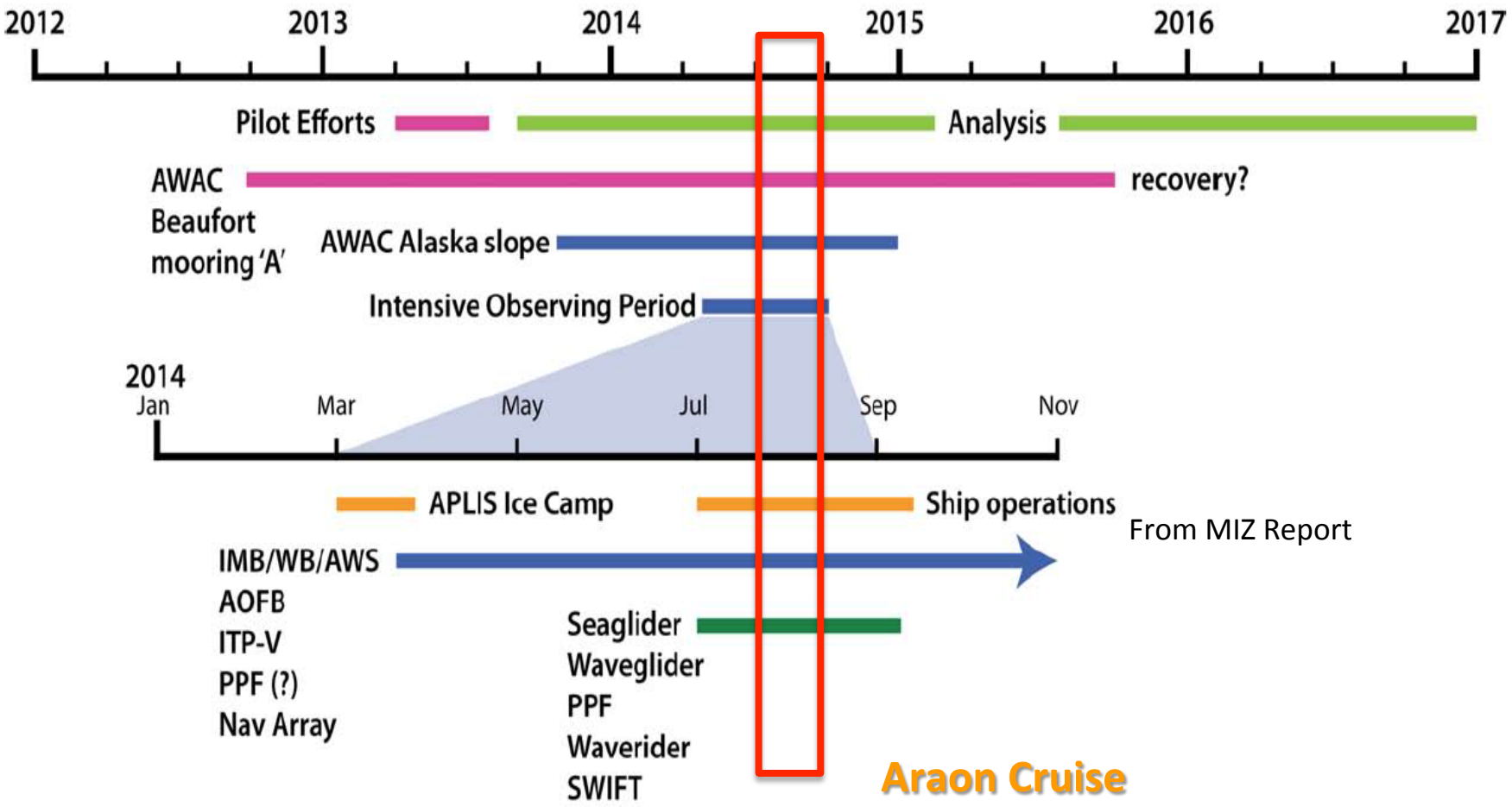
MIZ Program Timeline



From MIZ Report

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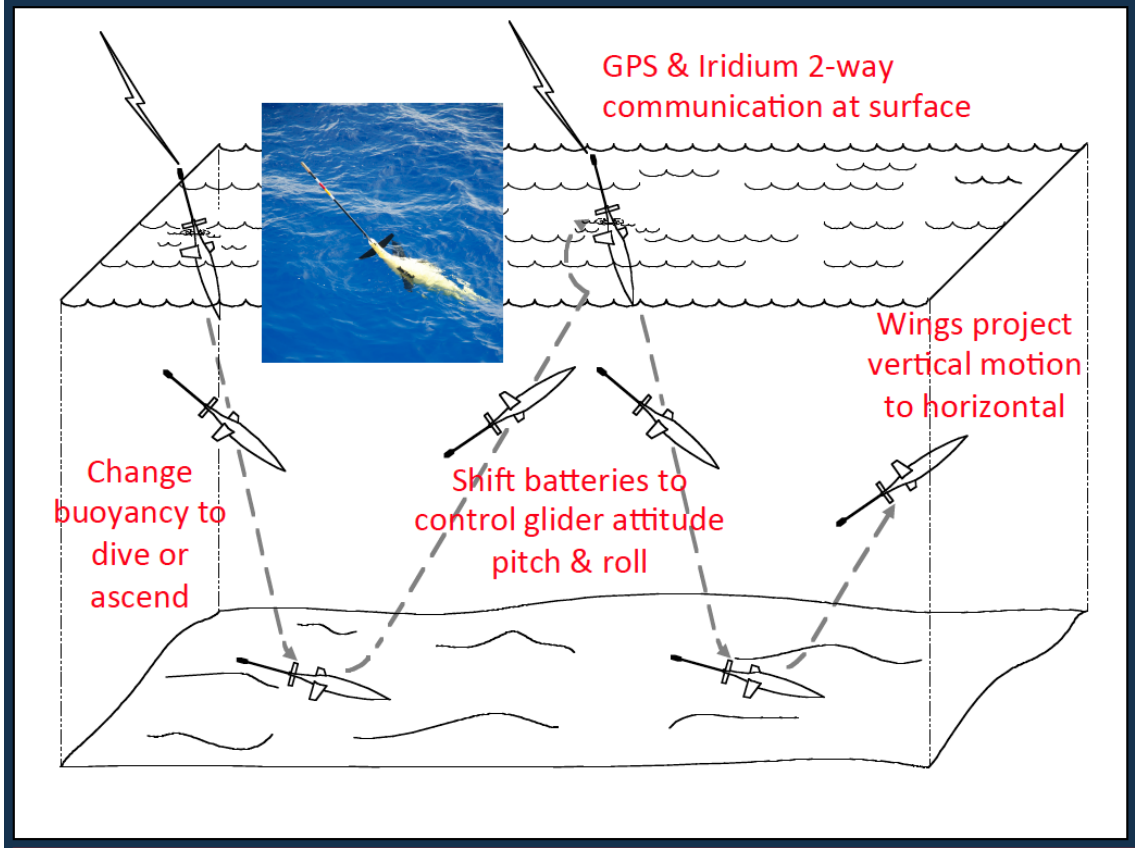
ONR - Marginal Ice Zone Project: Observation approach with Araon

- 'Lagrangian' array drifts with ice pack- follow evolution of target region through entire season.
- Maintains focus on MIZ by following northward retreat of ice edge.
- Intensive ice-based array.
- Drifting platforms in open water.
- Mobile platforms span ice-free, MIZ and ice-covered regions.

Long-endurance autonomous Gliders

Craig Lee (APL-UW)



- 50 kg, 2-m length.
- Flexible logistics- RHIBs, charters, R/V, helicopters.
- Cycle 0-1000 m, ~6 km ~6 hours.
- Horizontal velocity ~0.25 m/s (20 km/day).
- Vertical velocity ~0.1 m/s.
- Typical deployment 4-6 months, longest to-date ~10 months.
- Endurance depends on ambient stratification, dive depth and desired speed.
- 2-way Iridium comms, data upload, slow remote control.
- Telemetry via acoustic modem.

Temperature, salinity, pressure, current, fluorescence (Chl, CDOM), optical backscatter, dissolved oxygen, turbulence, marine mammal acoustics, depth-average velocity (inferred). Quantitative biogeochemistry and ecology.

Development: nitrate, zooplankton (acoustic), ADCP

Melt Pond Mass Ice Algae

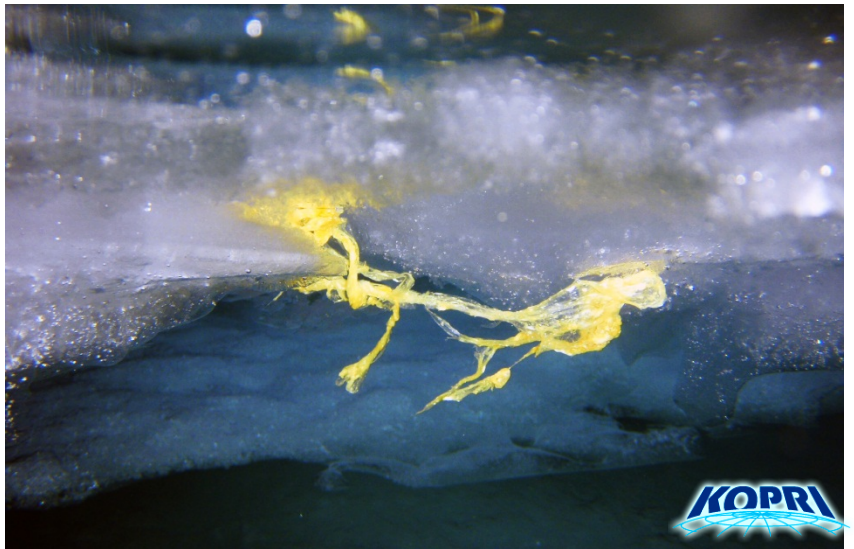
Holes in Progressively Thinning Arctic Sea Ice Lead to New Ice Algae Habitat

BY SANG HEON LEE, C. PETER MCROY, HYOUNG MIN JOO, ROLF GRADINGER, XUE HUA CUI, MI SUN YUN, KYUNG HO CHUNG, SUNG-HO KANG, CHANG-KEUN KANG, EUN JUNG CHOY, SEUNGHYUN SON, EDDY CARMACK, AND TERRY E. WHITLEDGE

ABSTRACT. The retreat and thinning of Arctic sea ice associated with climate warming is resulting in ever-changing ecological processes and patterns. One example is our discovery of myriad new "marine aquaria" formed by melt holes in the perennial sea ice. In previous years, these features were closed, freshwater melt ponds on the surface of sea ice. Decreased ice thickness now allows these ponds to melt through to the underlying ocean, thus creating a new marine habitat and concentrating a food source for the ecosystem through accumulation of algae attached to refreezing ice in late summer. This article describes the formation of these late-season algal masses and comments on their overall contribution to Arctic ecosystems and the consequences of a continued decline in sea ice.

INTRODUCTION

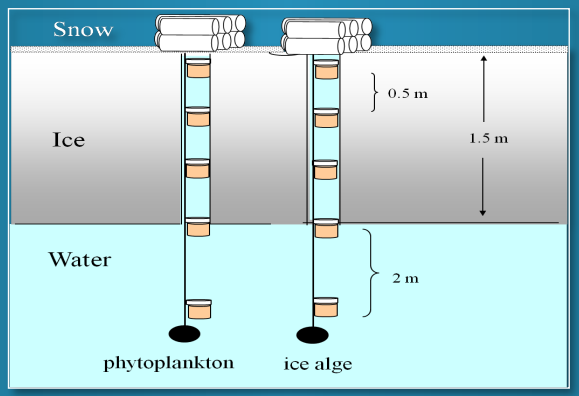
As a result of climate warming, the surface of the perennial Arctic sea ice pack in summer in now being transformed from a network of closed, surface melt pools into one of holes that completely penetrate the ice. It has long been known that sea ice algae growth in early spring provides a crucial food source for microfauna (Apollonio, 1965; Alexander, 1980; Legendre et al., 1981; Horner and Schrader, 1982; Michel et al., 1996; Gosselin et al., 1997; Lizotte, 2001; Lee et al., 2008). In previous years, with a colder Arctic and thicker perennial sea ice, summer surface melting formed only shallow, freshwater ponds on the sea ice surface without connection to the seawater below. However, higher temperatures over the past several decades have decreased sea ice extent and thickness and reduced the area of perennial sea ice (Vinnikov et al., 1999; Rothrock et al., 2003; Perovich and Richter-Menge, 2009; Perovich, 2011, in this issue), so that now the largely freshwater melt ponds are being transformed into holes. While melt ponds have recognized impacts on the physical environment, such as



Lee et al. 2011. Oceanography

Sea Ice Biogeochemical Study

- The effect of changing sea-ice on Arctic marine ecosystem
- Species composition, abundance, and diversity associated with sea ice condition
- Carbon interaction between Sea Ice and water column
- Particle flux under the sea ice
- Ice core, underwater sea ice and melting pond



Melt Pond study

- To define environmental characteristics of various melt ponds on sea ice floes in the Arctic Ocean
- To understand food web interaction associated with environmental variation
- To estimate the carbon contribution of entire sea ice floes in the Arctic Ocean.

- Research components;
  - Plankton composition and diversity
  - Production and macromolecular of ice algae
  - Gas interaction between air and surface of ponds
  - Biogeochemical parameters (Carbon, Nitrogen and DMS…)
  - Albedo of ponds

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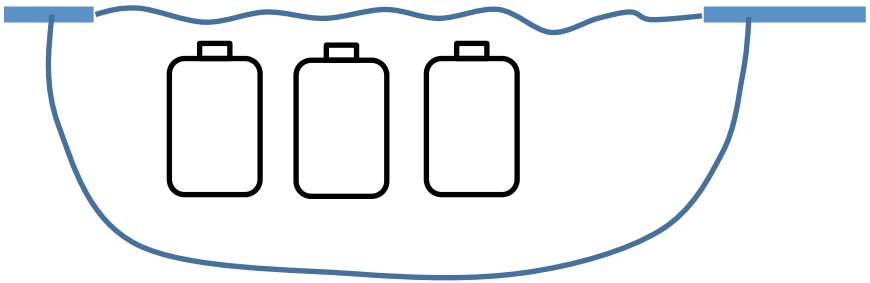
Melting pond study

Microcosm Exp. (Shor-term temperal variation) in melting ponds

Natural condition : Light and Temperature



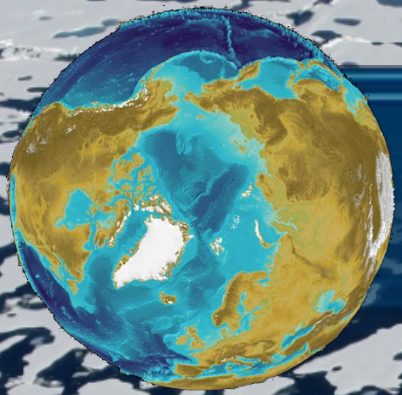
- Small ecosystem change
- Characteristic by difference of physical factors (Pond size, Salinity, light…)
- Carbon cycle (or nutrient cycle)
- Need biological and chemical paprameters

Under water Sea ice study

Carbon flux study

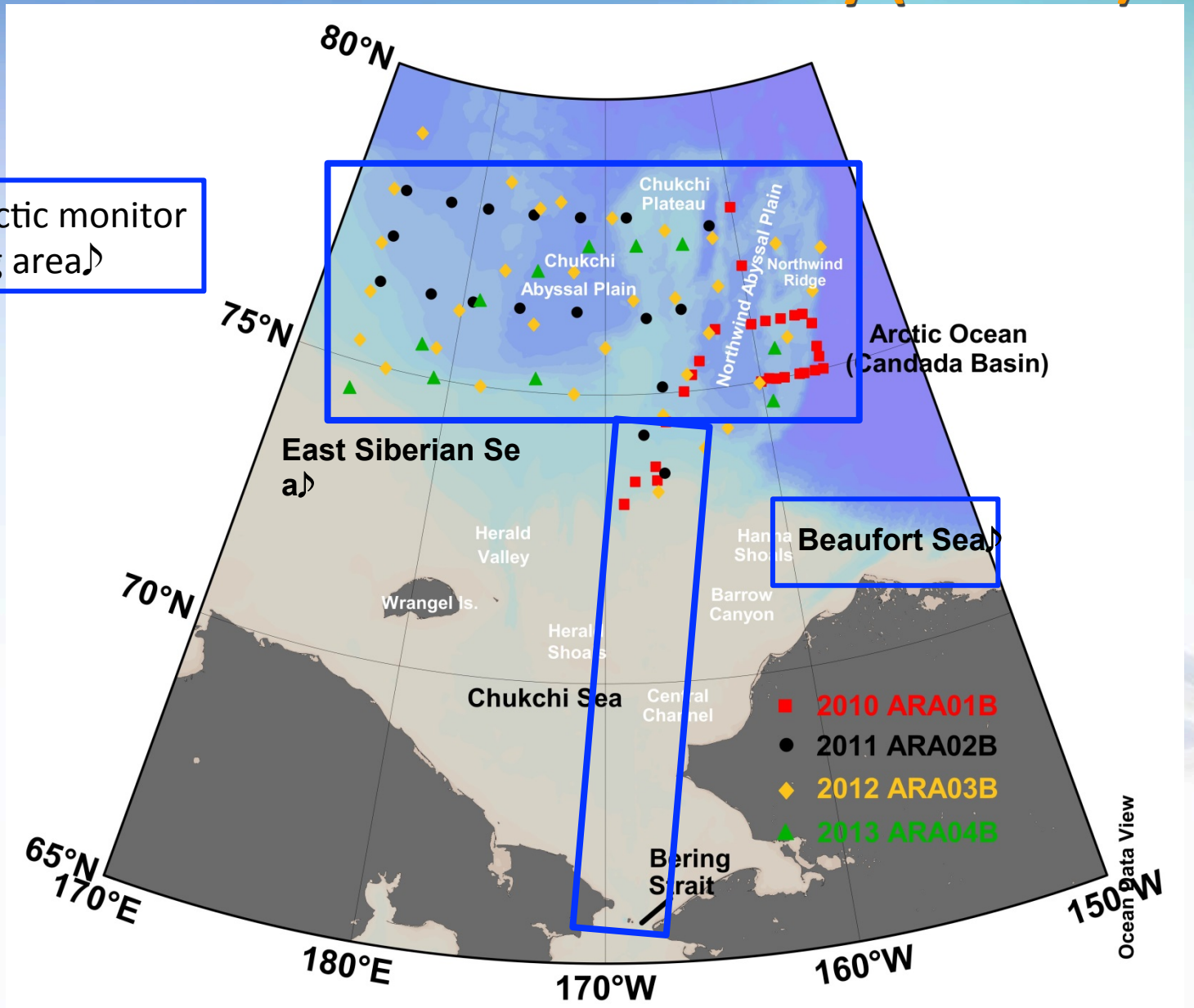
- Small sediment trap (several days)
- Parameters : pp, phytoplankton, grazers, POC..

Future KOPRI Arctic research plans♪



Future KOPRI Arctic survey (2015 ~) ♪

KOPRI Arctic monitoring area♪

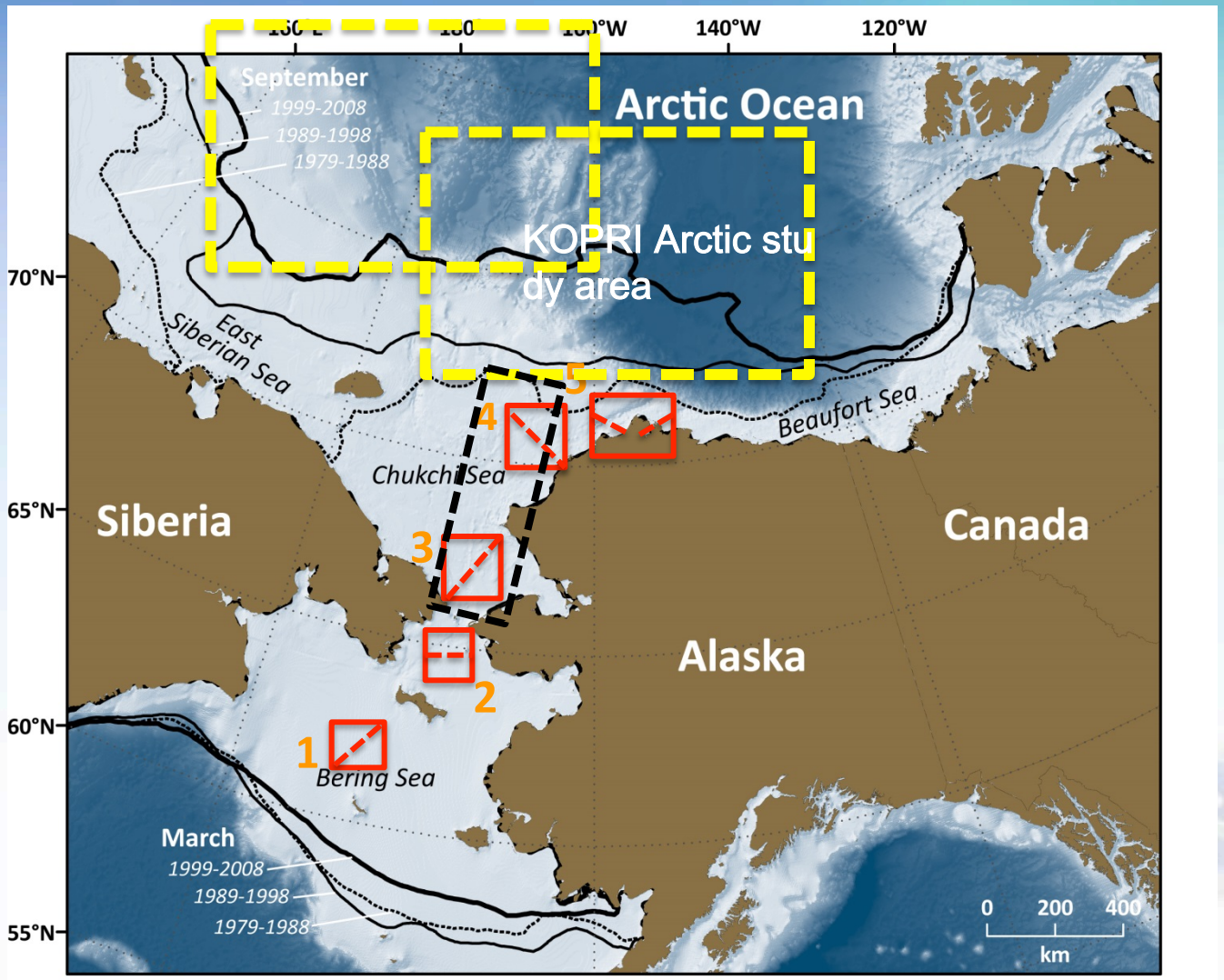


Collaboration

- **Icebreaker-based measurement**
  - **Annual-based revisit**
  - **Robust icebreaker (Araon)**
  - **Long-term moorings**

- **On/under sea-ice measurement**
  - **Mass balance buoy**
  - **Ice-tethered profiler**
  - **Gliders**

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



[modified by Karen Frey from Grebmeier et al. 2010, EOS 91]

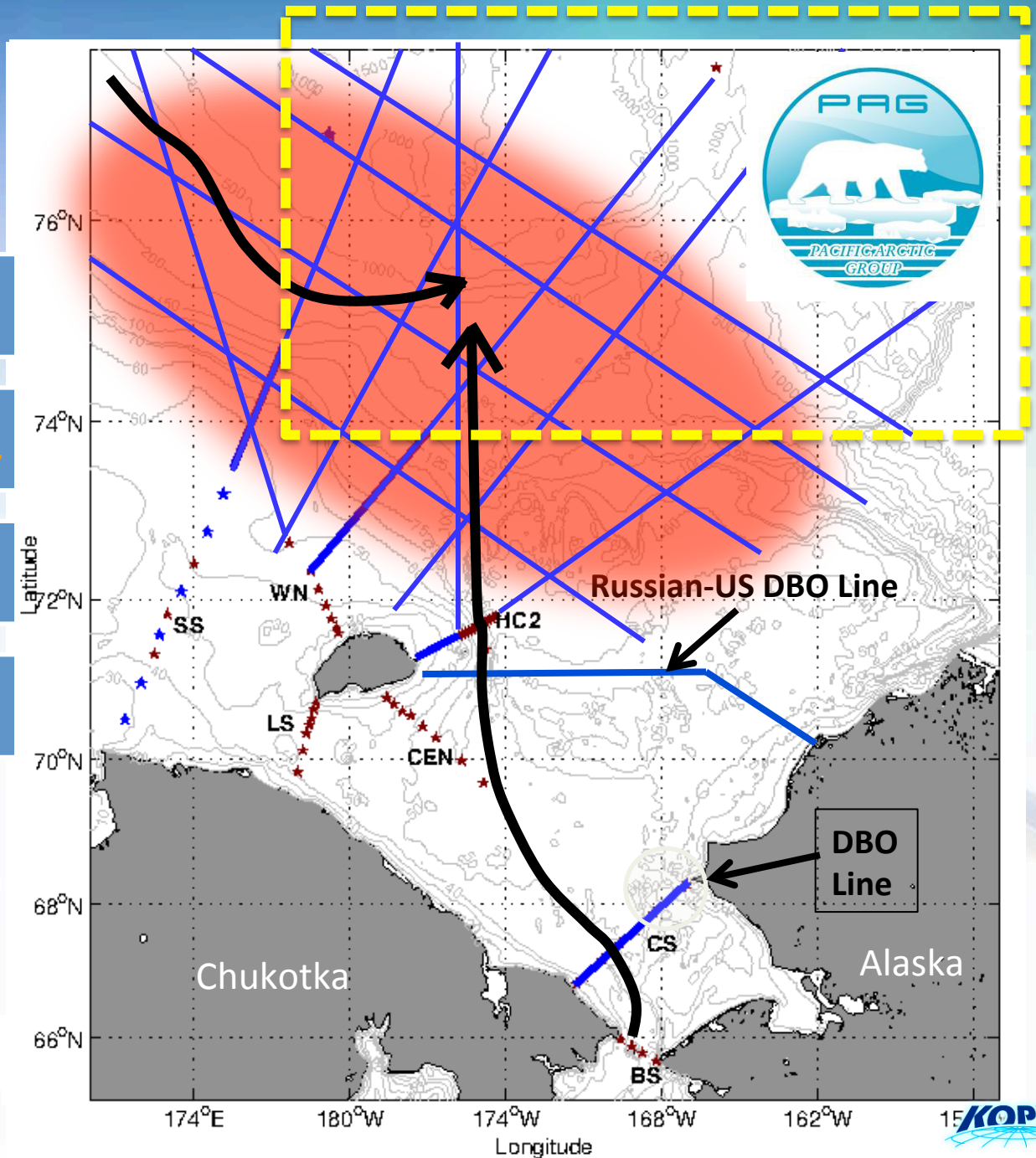
Considerations for 2015-2020 sampling

2 U.S.-Russian Distributed Biological Observatory Lines

10 Hydrographic transects, Pacific, Atlantic Water's lateral and vertical heat flux, air, ice sea fluxes

Census of Marine Life and Census of Benthic Methane Fluxes

RUSALCA + Pacific Arctic Group + EU (3 – 5 vessels and aircraft)



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Thank you
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