Update of 2015 field activities & preliminary 2016 plans : Republic of Korea

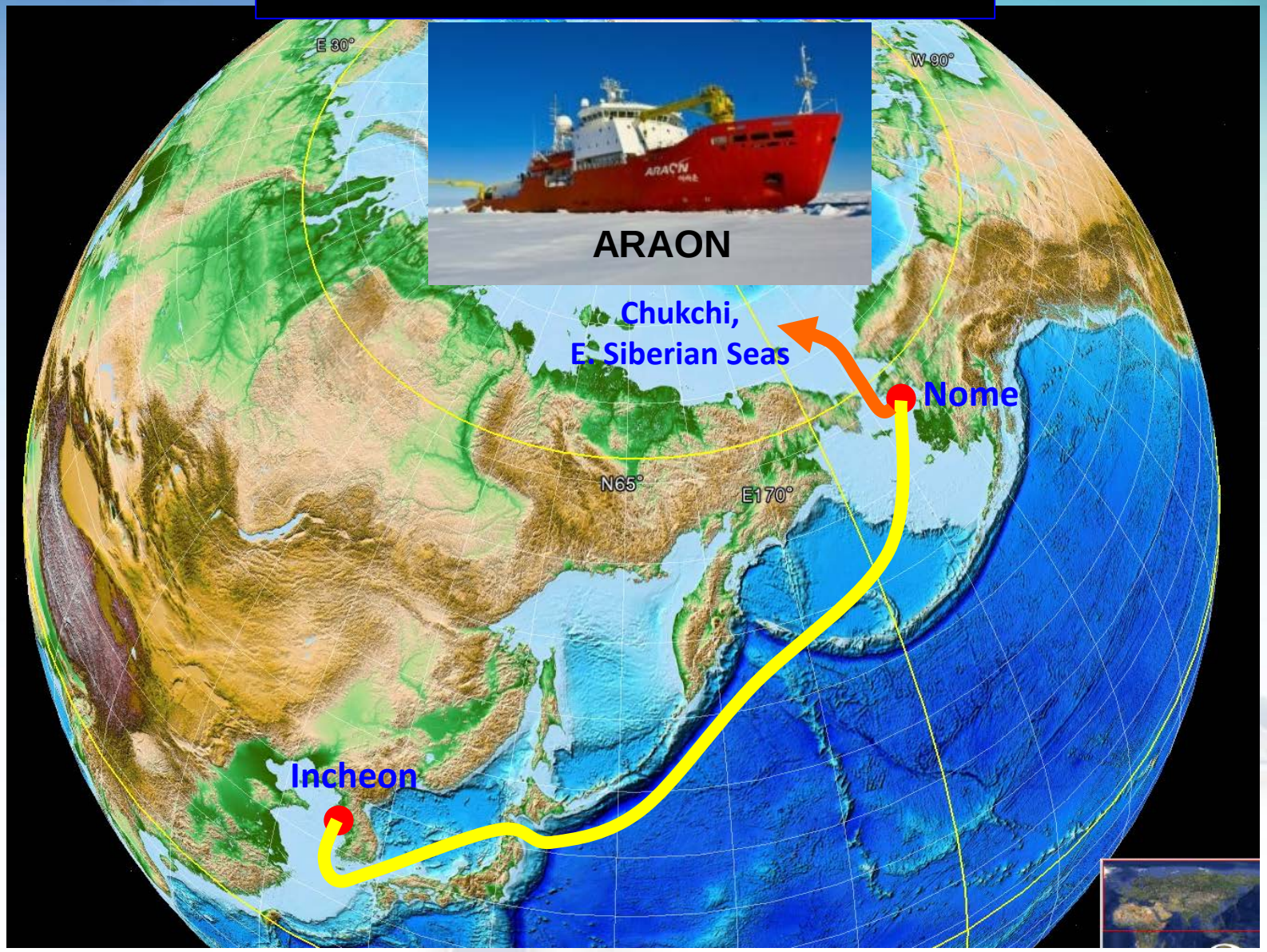
Eun Jin Yang and Sung-Ho Kang
Division of Polar Ocean & Environment Research
KOPRI

28-29 October 2015

Pacific Arctic Group Fall Meeting, KOPRI

Korea Polar Research Institute

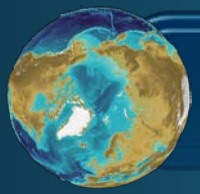
Korean Arctic Ocean Cruise track



Typical expedition periods: from the end of July to the end of September

2015 KOPRI Arctic Research Activity

2015. 8. 1 ~ 9. 10



2015 KOPRI Arctic Cruise (1st leg)

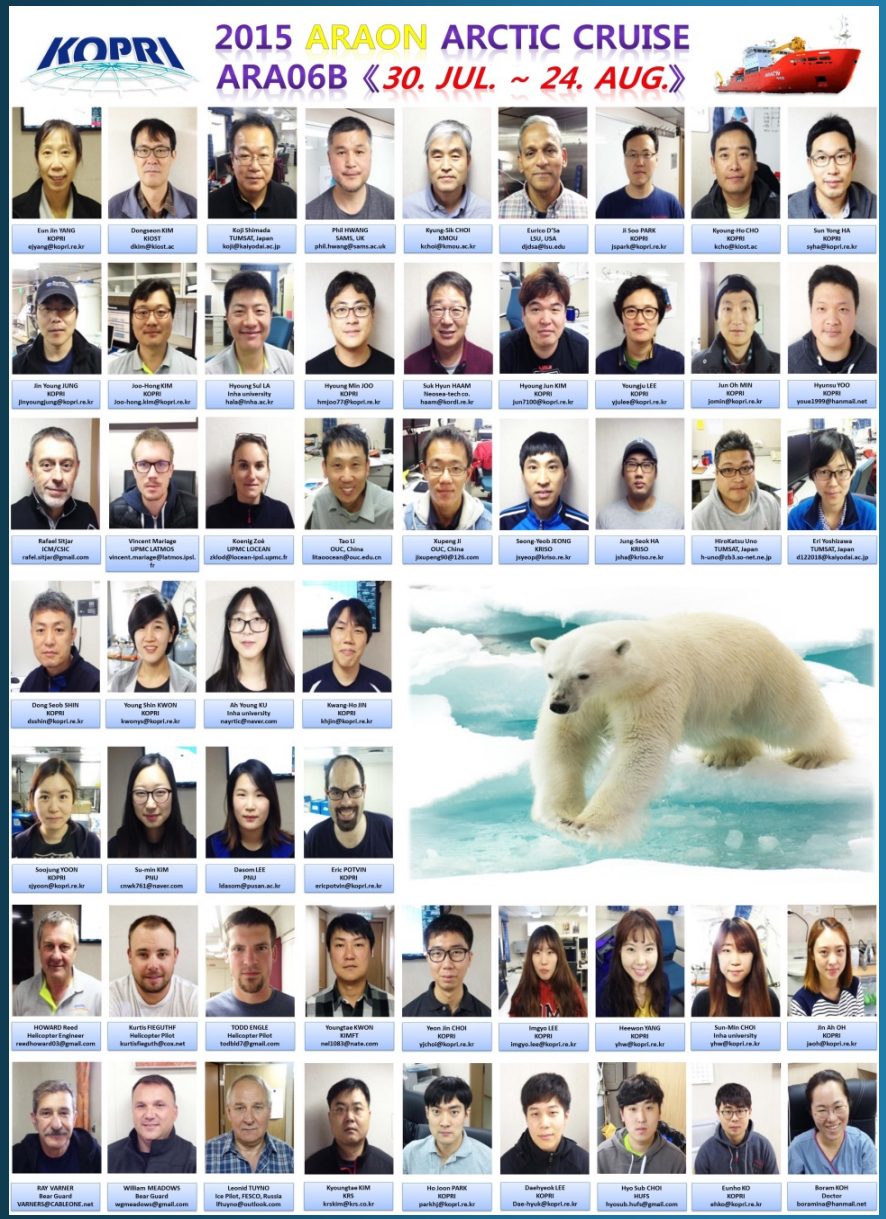
- **Ocean and geophysics study**
- **Aims of the cruise:**

  - To investigate the structure and processes in the water column and sub-bottom layers around the North Bering Sea, Chukchi Sea, and the North site of the East Siberian Sea in rapid transition .

  - To understand sea ice dynamics and sea ice ecosystem

- **Period:** 2015. 8.1 - 8.22 (from Nome to Barrow)
- **Chief Scientists:** Dr. Eun Jin Yang
- **Participating nations:** Korea, US, China, Japan, UK, France, Spain, and India

2015 Arctic survey (1st Leg)

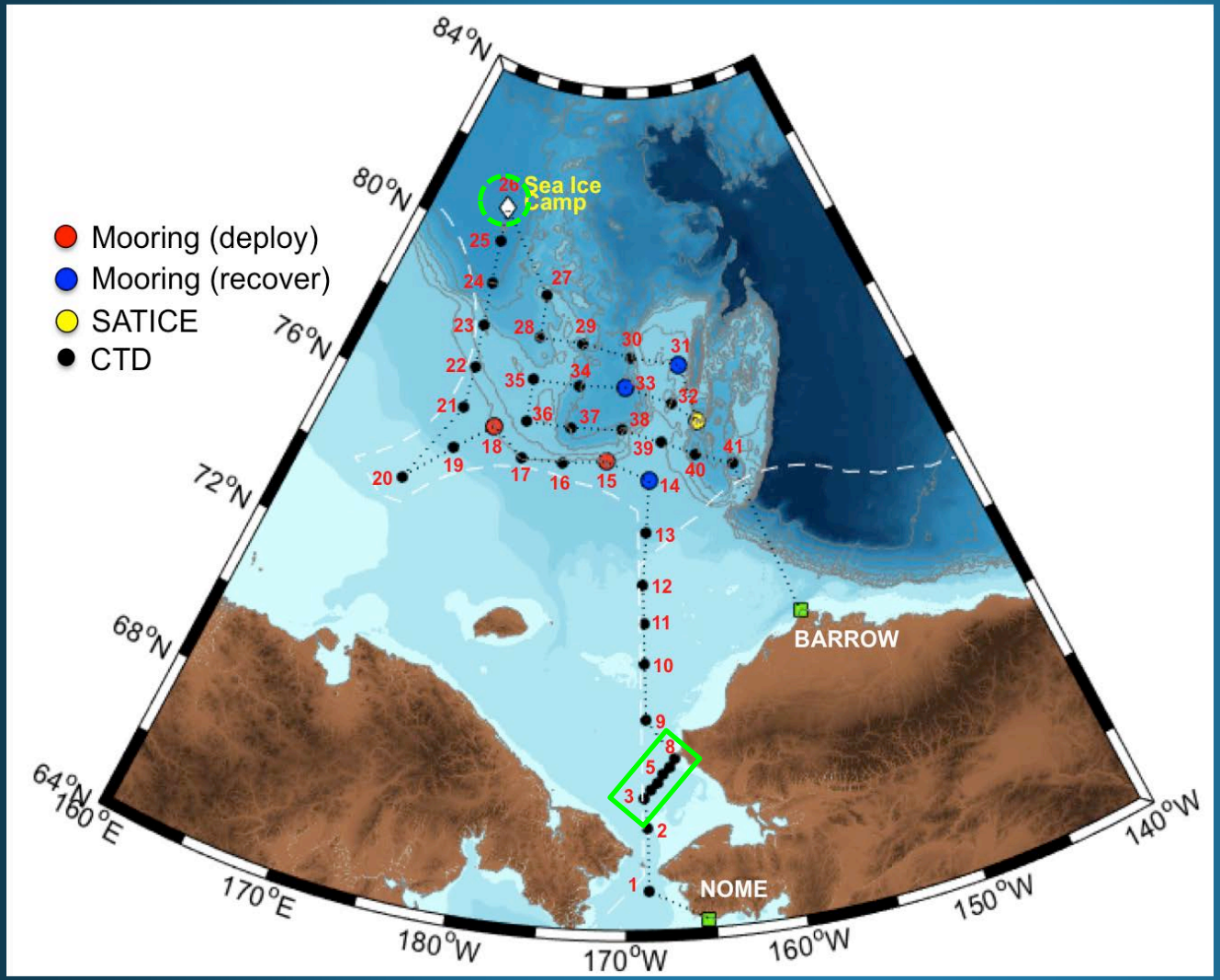


2015 Araon Arctic Cruise (ARA06B)
1 August ~ 22 August

Total 8 counties, 83 participants

2015 Arctic survey

1st Leg (ocean and geophysics study)

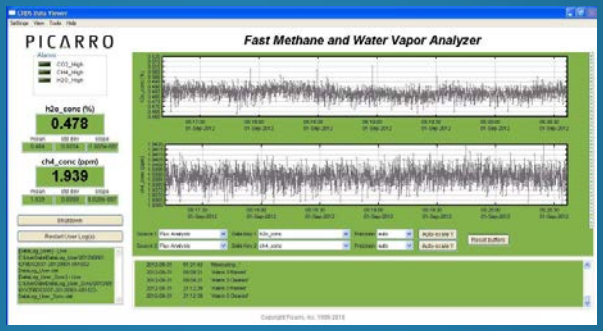


- North Bering Sea (DBO 3)
- Chukchi Sea
- East Siberian Sea & Mendeleev Ridge
- Sea Ice station
- Ocean mooring station
  - KOPRI (deploy)
  - TUMSAT (recover)

Atmospheric Observation

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

Open-path eddy covariance at the foremast of ARAON

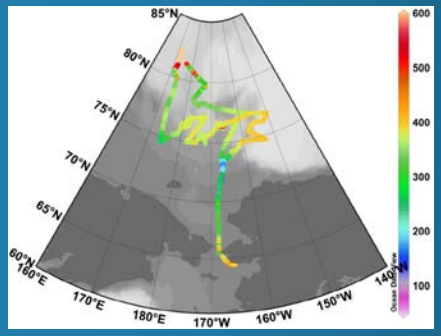


Real time variation of CH_4 and H_2O in flux mode

Chemistry in water column

- Pursuing spatial and temporal variation of CO_2 system in the Arctic Ocean
- Behavior of nutrients (NH_4, NO_2+NO_3, PO_4 and SiO_2)
- Characteristics of dissolved and particulate organic mattter (DOM and POM)

Analytical system for DIC and TA

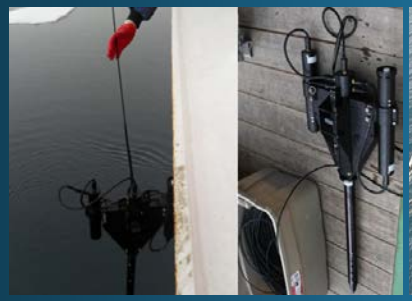


Dissolved pCO_2 along the track

TOC-TN analyzer

Satellite Remote Sensing

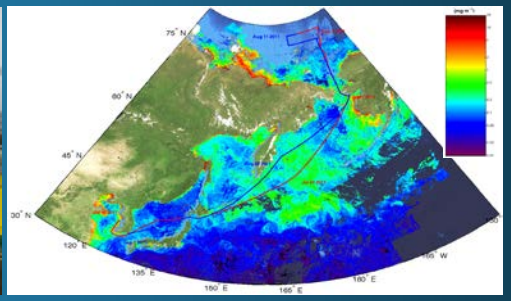
- Ocean Color Remote Sensing (Ocean Optics Measurement)



Hyper-spectroradiometer

Above water spectroradiometer

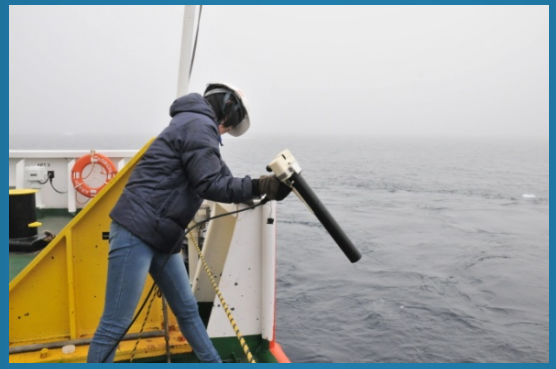
APC deployment



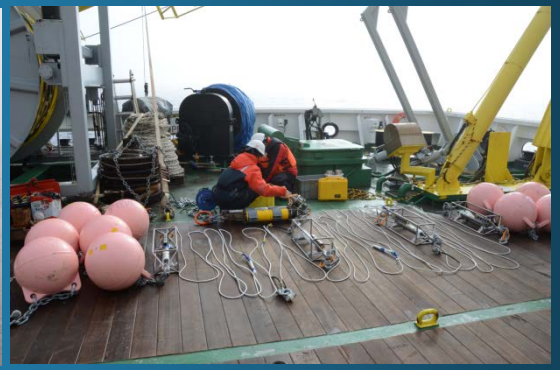
Hydrographic Survey

- Water mass distribution & characteristics

CTD & LADCP



XCTD



Ocean Mooring

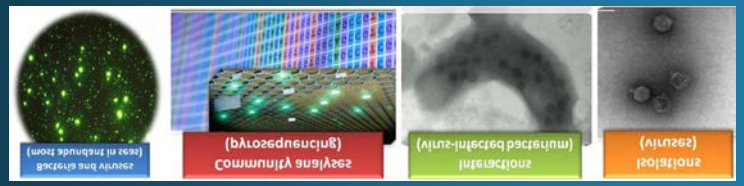
Microbes/Plankton Ecology

- 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 biomass









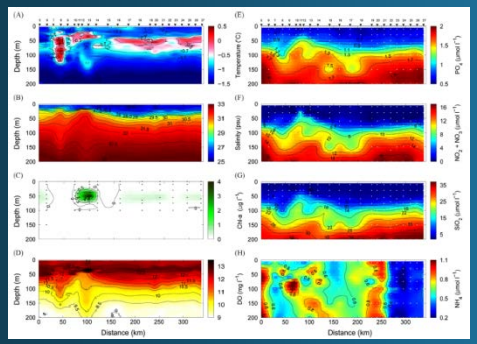
Phytoplankton physiology

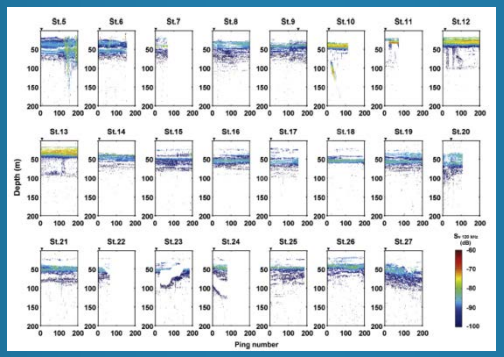
- To understand the photosynthetic characteristics of phytoplankton

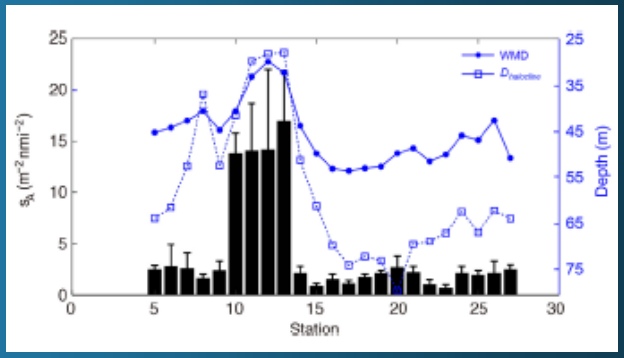
-> Phytoplankton physiology (photochemisty) parameters using a Fluorescence Induction and Relaxation (FIRe II) system

Bioacoustic surveys

- Variations in the sound-scattering layer that were reflected from the mesozooplankton
- Spatial and vertical distribution of dominant mesozooplankton using EK 60





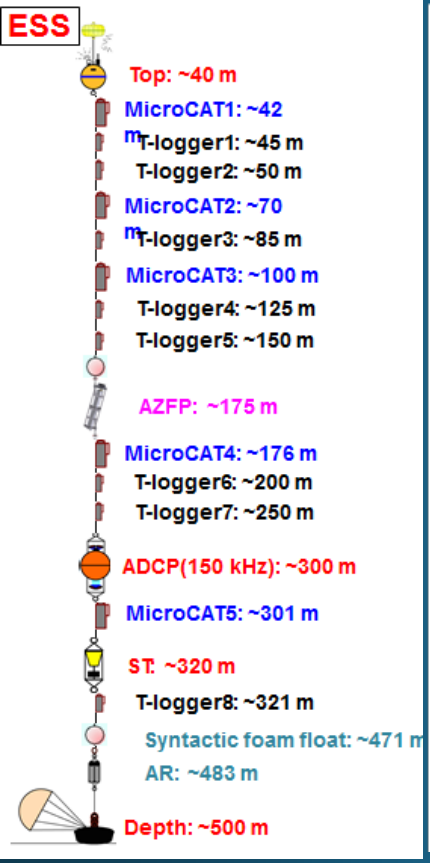


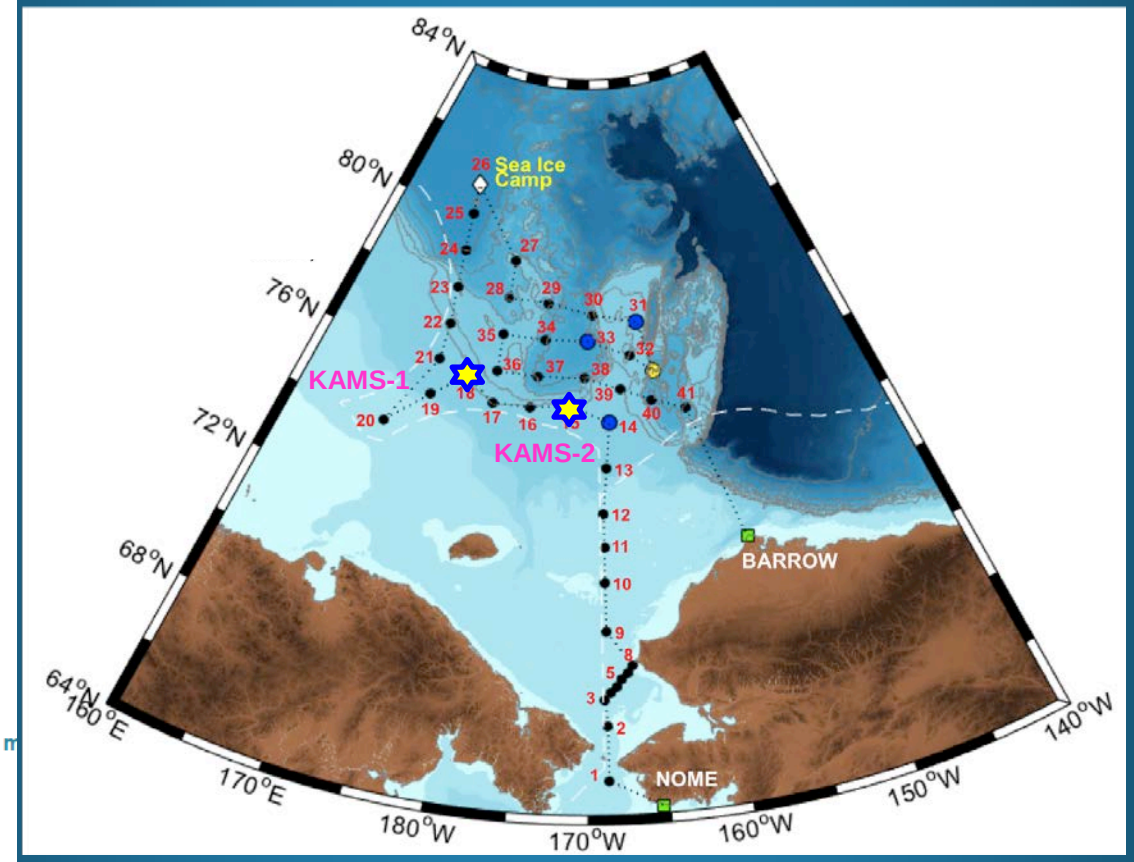
[Spatial variation of Arctic copepods over Northwind Ridge]

KOPRI ocean mooring system

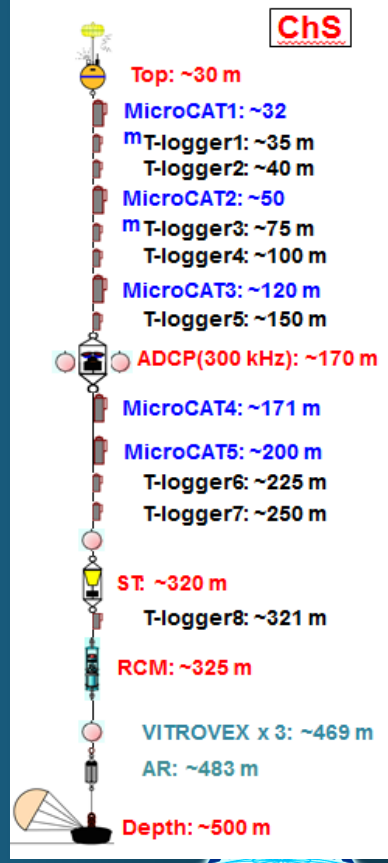
- Chukchi Sea and East Siberian Sea
- ADCP, Microcat, Sediment trap, RCM, AZFP

KAMS-1



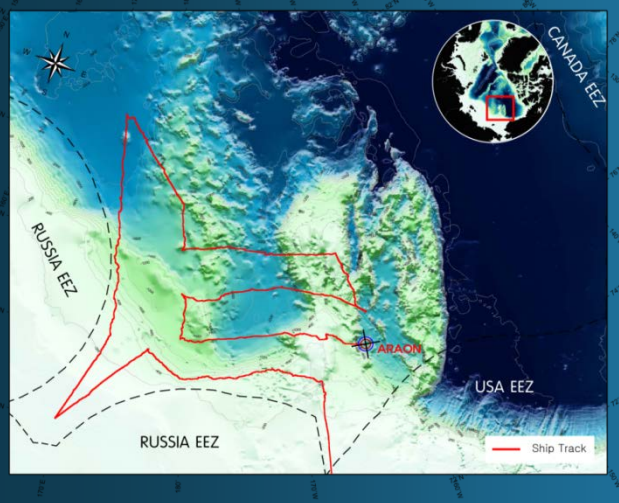


KAMS-2

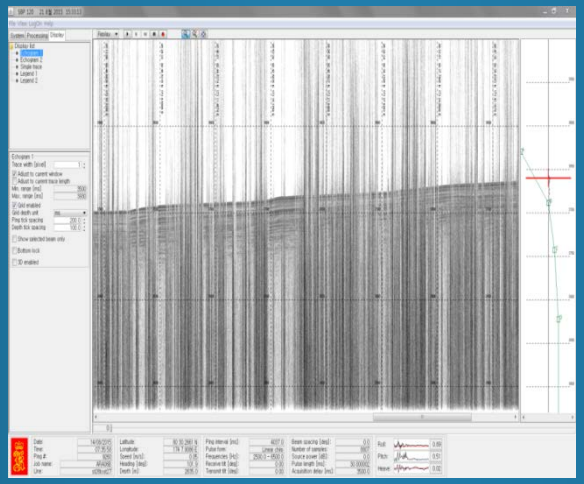


Marine Geophysics

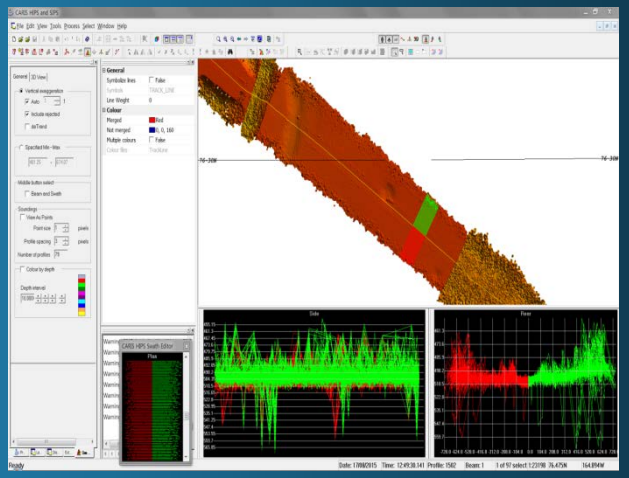
- Swath bathymetry (multibeam siesmic and multibeam echosounder)
- High-resolution subsurface features (Subbottom Profiling)



Red line is a multibeam and SBP survey track



A screen image of SBP recorder



Multibeam data process

- Gravity Survey
  => Data shared with Arctic Gravity Project

Sea ice dynamics

- International collaboration : KOPRI-SAMS- BAS-ONR-China-France-Spain
- Buoy deployments for physical observation
  - To measure in-situ physical parameters of atmosphere, ice and ocean autonomously
  - To study the energy balance at the atmosphere-ice-ocean interface

SAMS-type Ice Mass Balance Array (SIMBA)

KOPRI/SAMS(UK)

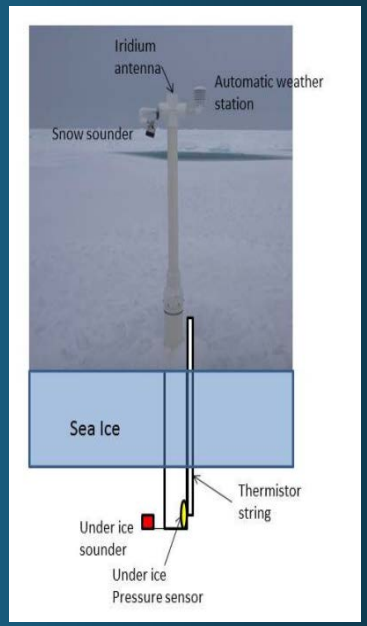
BAS-type IMB with radiation sensors

BAS(UK)/SAMS/KOPRI

Wave buoy

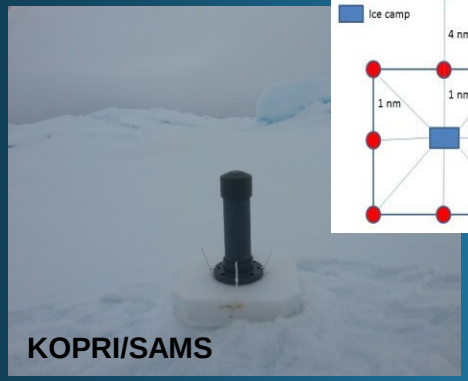
ONR(US)/BAS/SAMS

CRREL-type Seasonal IMB (SIMB)

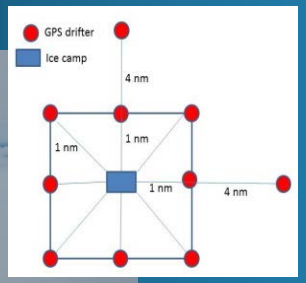


CRREL(US)/SAMS/KOPRI

GPS drifter



KOPRI/SAMS

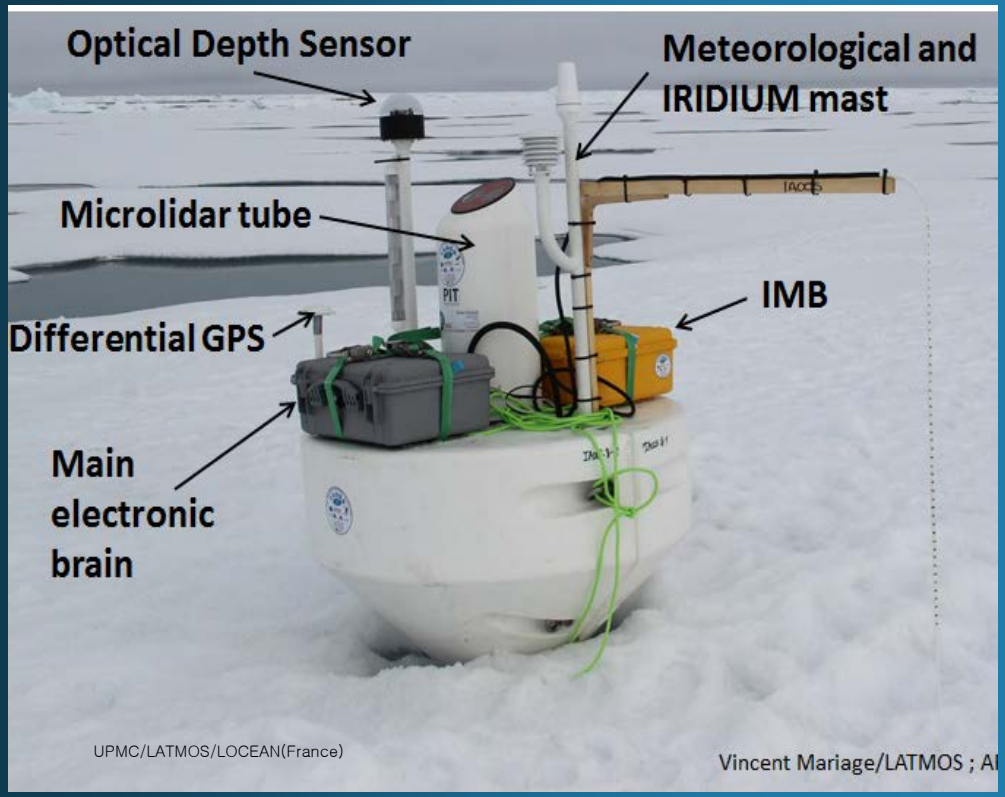


SATICE buoy

CSIC(Spain)/SAMS

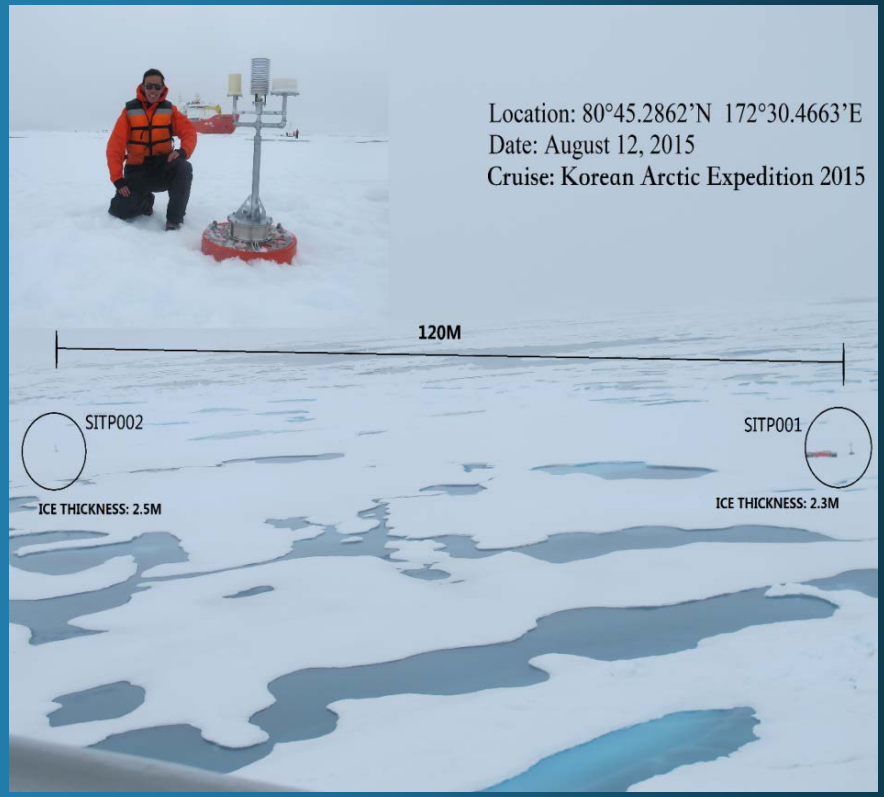
Sea ice dynamics

Ice-Atmosphere-Ocean Observing System(IAOOS)



France/UPMC-LOCEAN-LATMOS

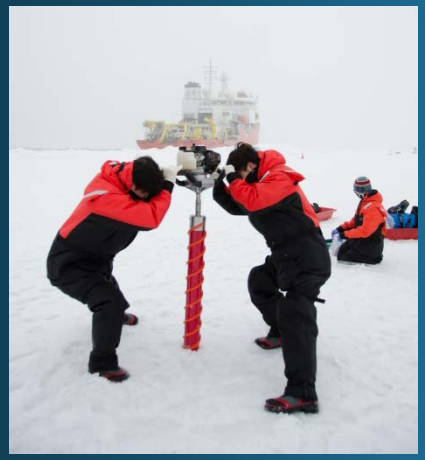
Smart Ice-Tethered Profilers (SITPs)



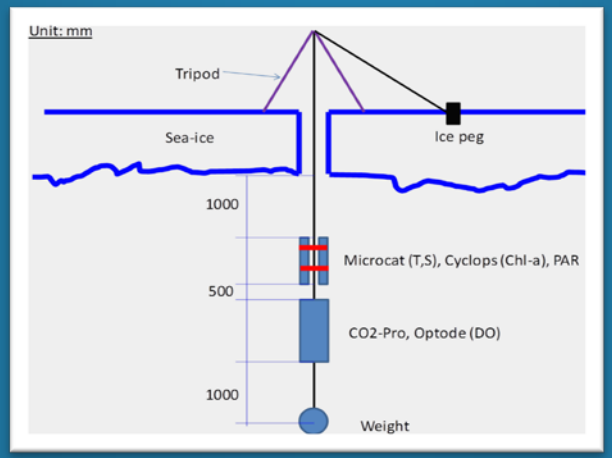
China (OCU)

Sea Ice_Biogeochemical Study

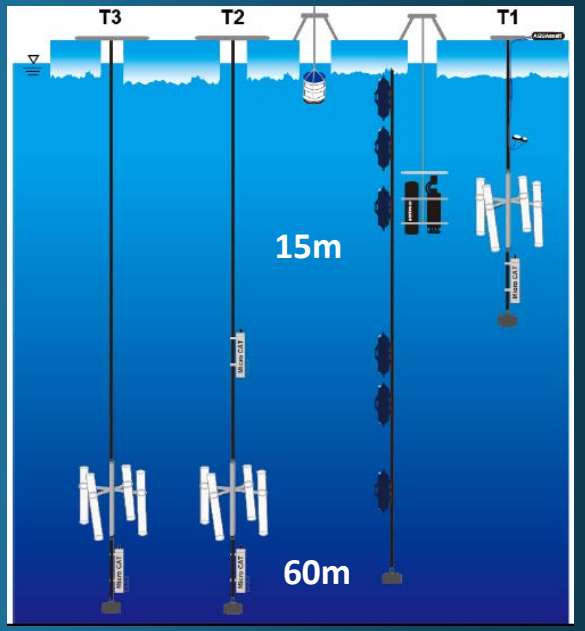
- The effect of changing sea-ice on Arctic marine ecosystem
- Species composition, abundance, and diversity associated with sea ice condition
- Carbon interaction between Sea Ice and water column
- Particle flux and vertical distribution under the sea ice



Ice core sampling



PCO_2 monitoring system

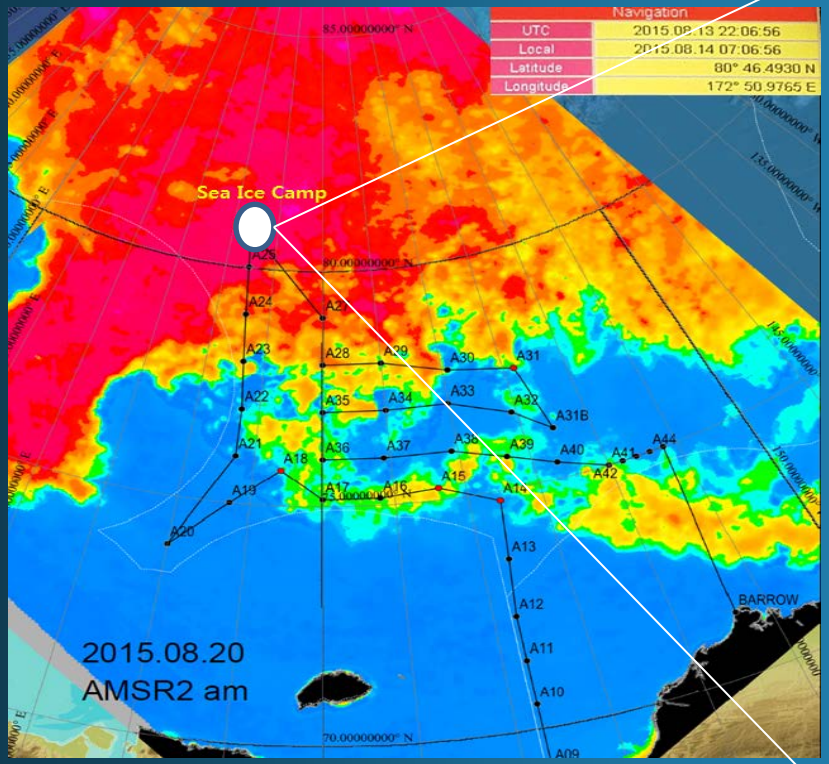


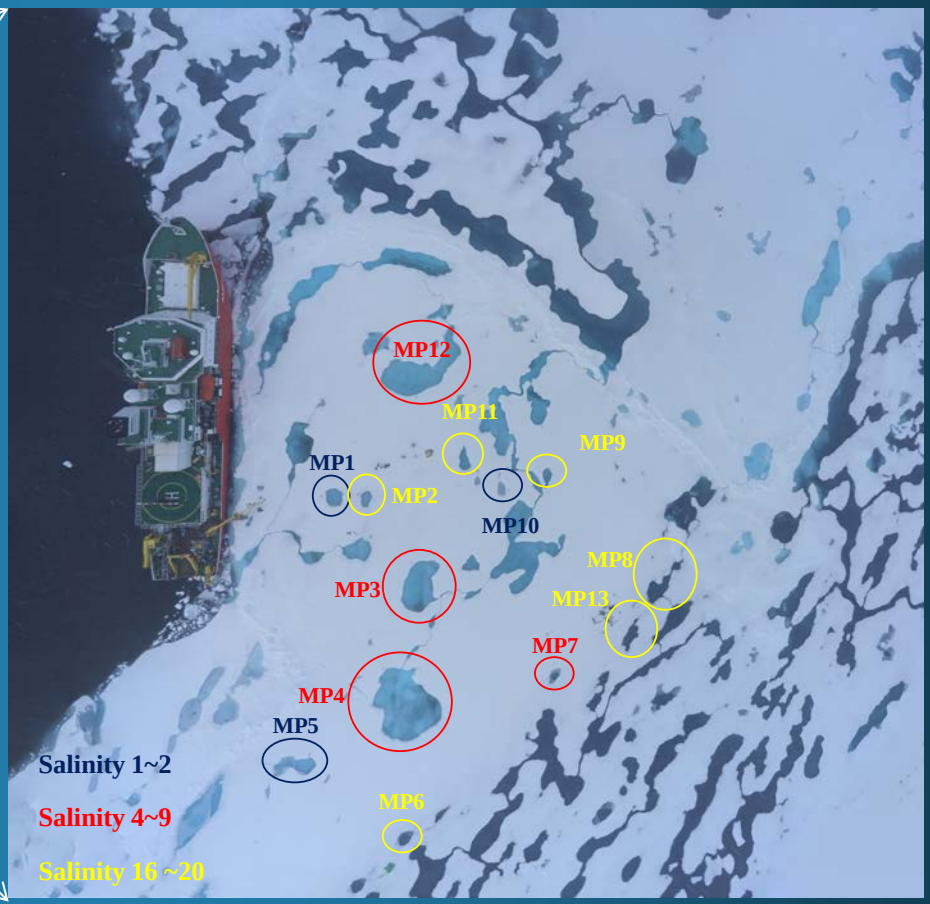
Sediment trap, Microcat, CTD,

- **Research components;**
  - **Plankton composition and diversity**
  - **Production and macromolecular of ice algae**
  - **PCO_2 monitoring under sea ice**
  - **Small sediment trap**

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.

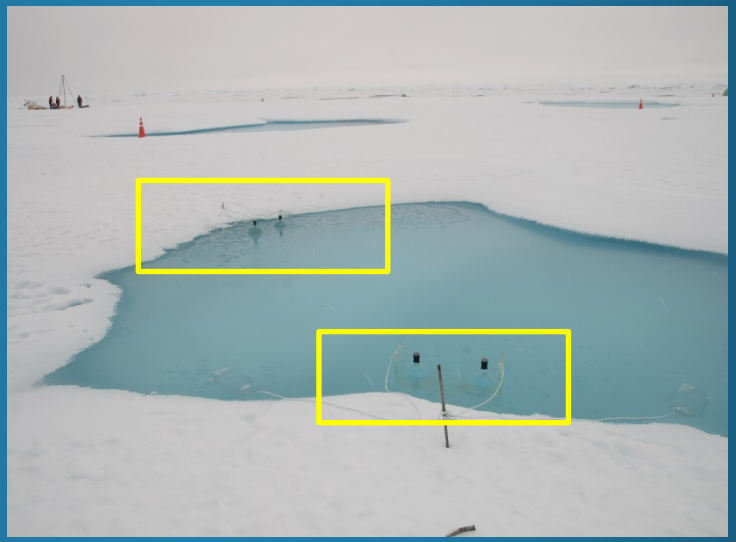




Melt Pond study

- **Research components;**
  - Plankton composition, diversity and physiology
  - Production and respiration of plankton
  - Gas interaction between air and surface of ponds
  - Biogeochemical parameters (Carbon and Nitrogen …)

Melt pond sampling



Incubation experiment

Plankton netting

2015 KOPRI Arctic Cruise (2nd Leg)

- **Paleoceanography program (East Siberian Sea and Chukchi Sea)**

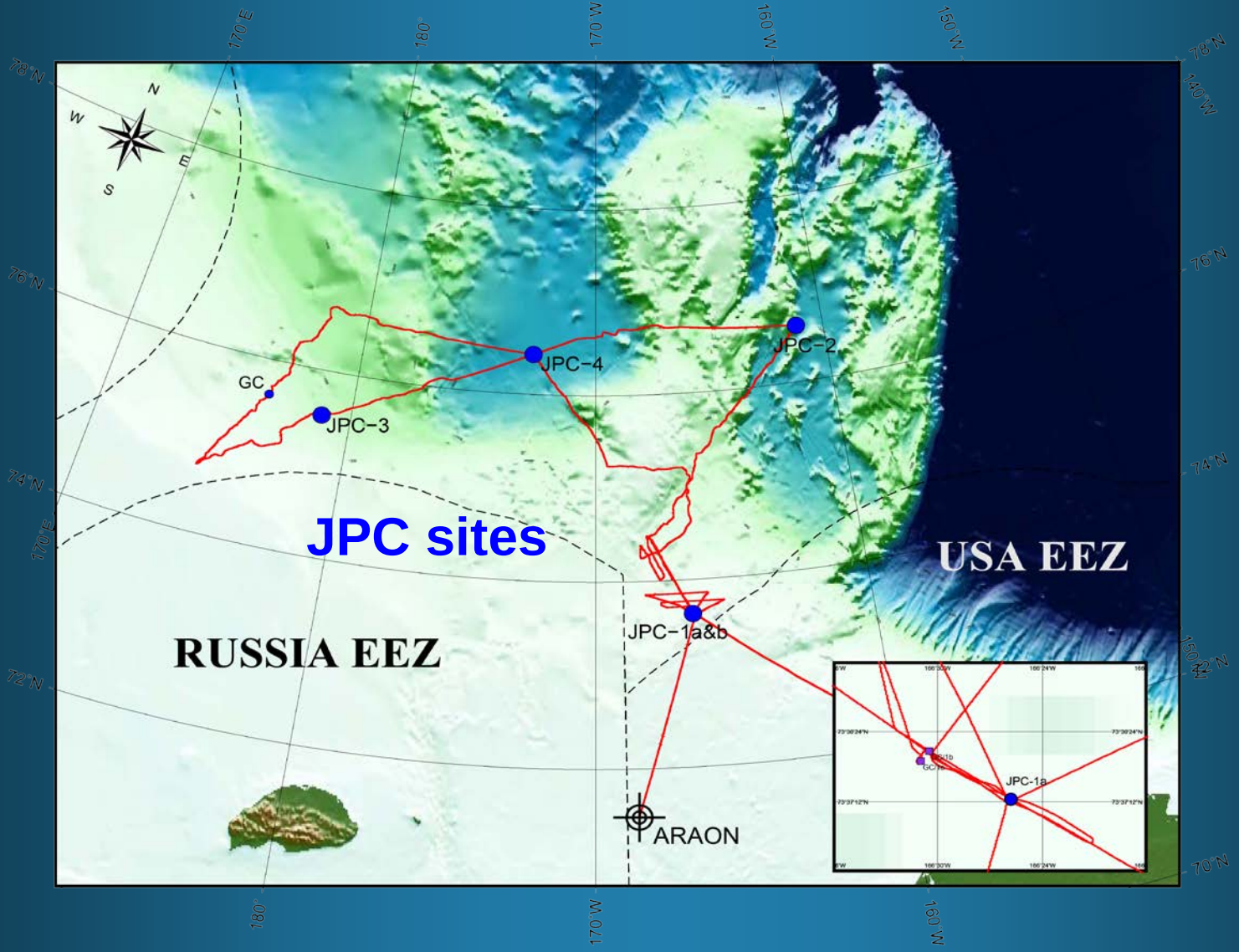
- **Aims of the cruise:**
  - to take long sediment cores with high-resolution paleoceanographic records using JPC system
    - to reconstruct Quaternary glacial history in the western Arctic
    - to establish further precise stratigraphic records in the western Arctic during the Quaternary
  - to acquire Multi-beam together with SBP and Sparker data from the shallow E. Siberian-Chukchi sea continental margin
    - Bathymetric mapping for seafloor morphology combined with sub-bottom reflection profiling (SBP) for geometry of sedimentary sequences and seismo-stratigraphic correlations

- **Period:** 2015. 8.25 - 9.9 (from Barrow to Nome)

- **Chief Scientists:** Dr. Seung-il Nam

- **Participating nations:** Korea, Japan, USA, France and Germany

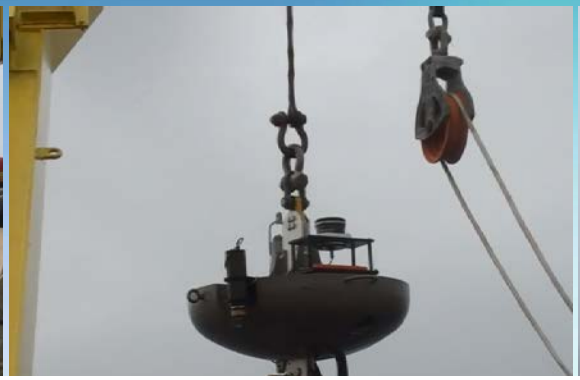
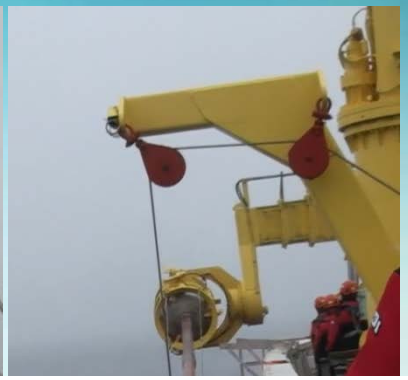
Survey lines and JPC sites



Paleocenography

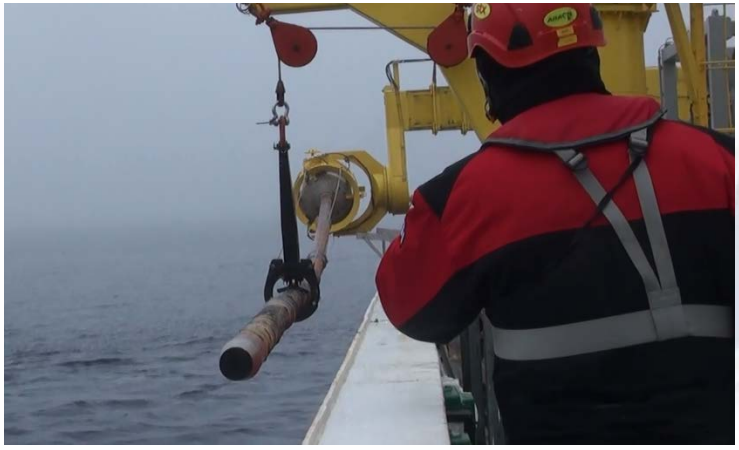
- Survey line : a total of 2,467 nm (3,947 km)
- Multi-beam & SBP
- 13 XCTD (TUMST, Japan)
- Sparker survey : ca. 500 km
- 4 JPC long sediment core : ca. 42.96 m
  - ca. 14 m long core sediment : 800 ka paleoclimate records
- 3 GC sediments at Chukchi Shelf : ca. 16.37 m
- 7 BOX & 6 MUC

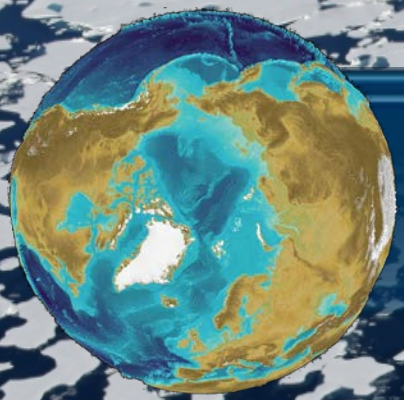
Sediment recovered with JPC corer

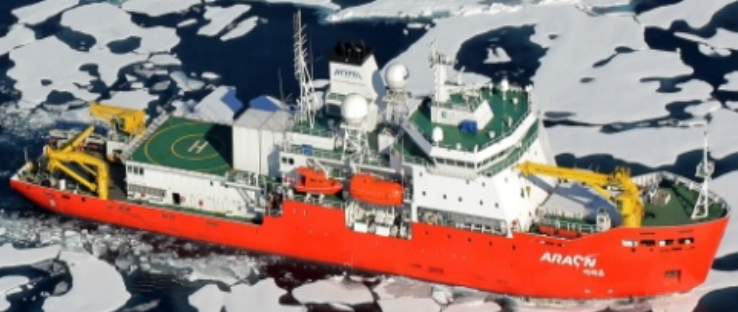
Recovery of sediments retrieved with JPC corer

Core	Water depth (cm)	Sediment recovery (cm)	Number of core sections
01A-JPC	100	1040	7
02-JPCg	2077	737.5	5
03-JPC	673.4	1132.5	8
04-JPC	2200	1386	10

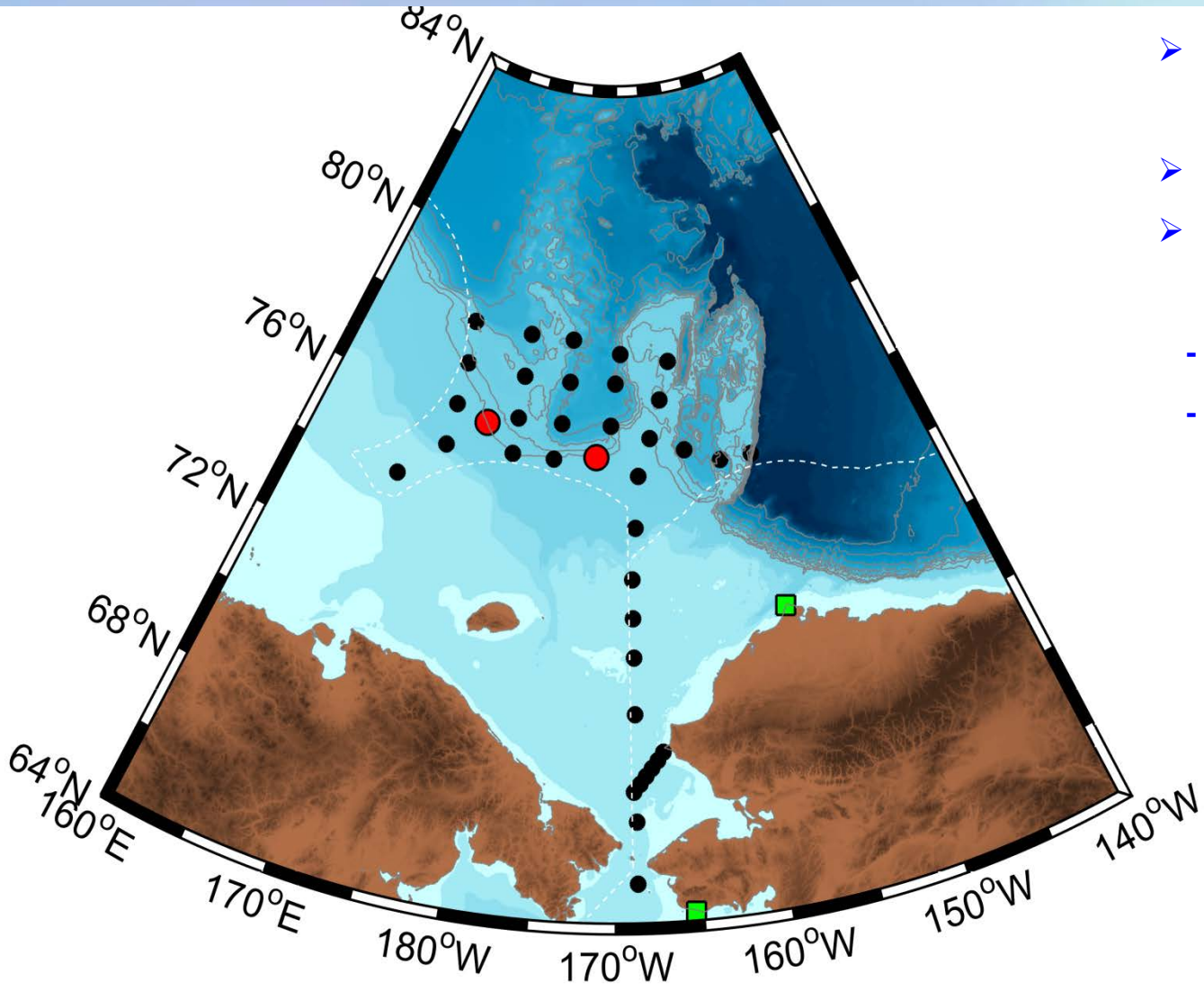




2016 KOPRI Arctic research plans



Preliminary KOPRI Arctic plan (2016. 8-9)



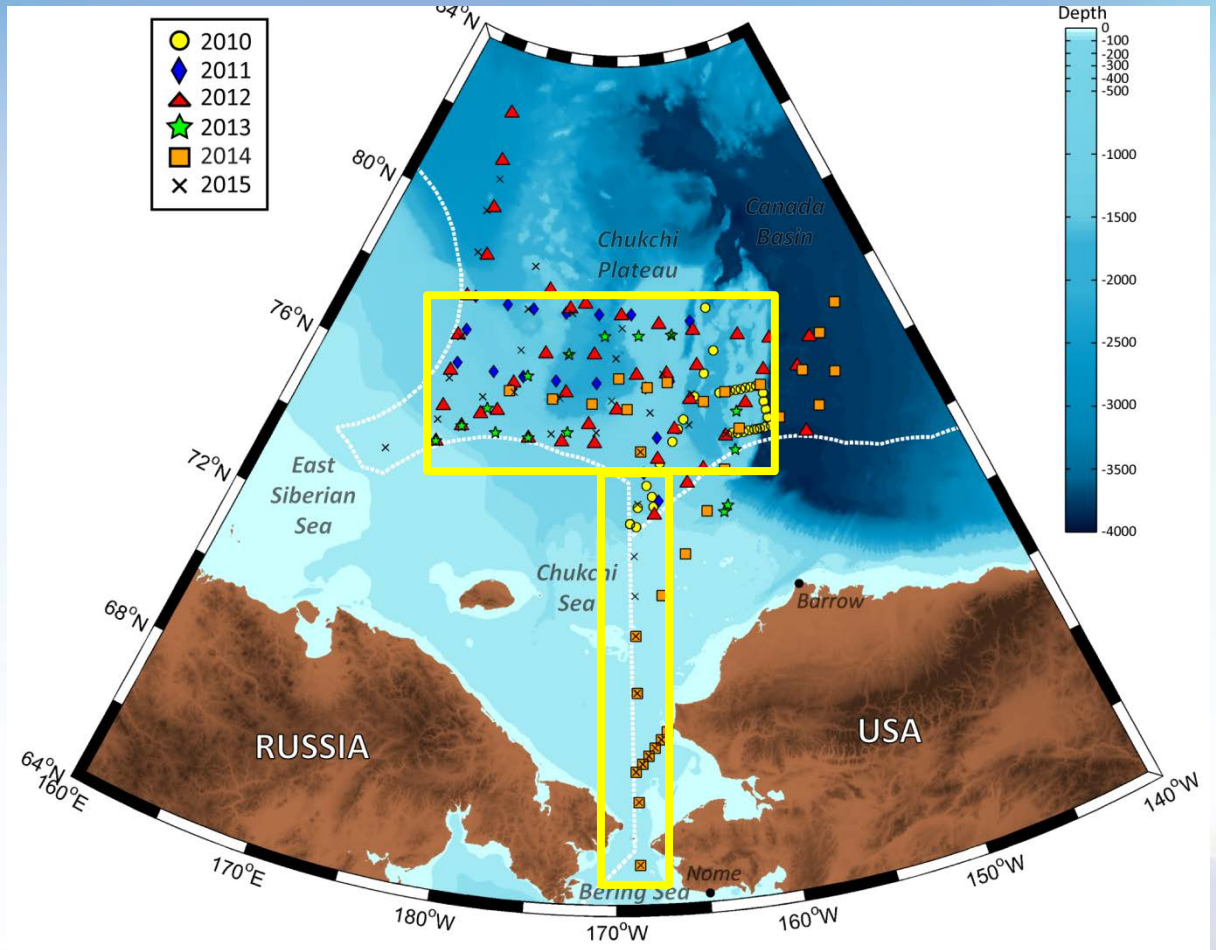
- North Bering Sea (DBO 3)
- Chukchi Sea
- East Siberian Sea

- Sea Ice station
- Ocean mooring station

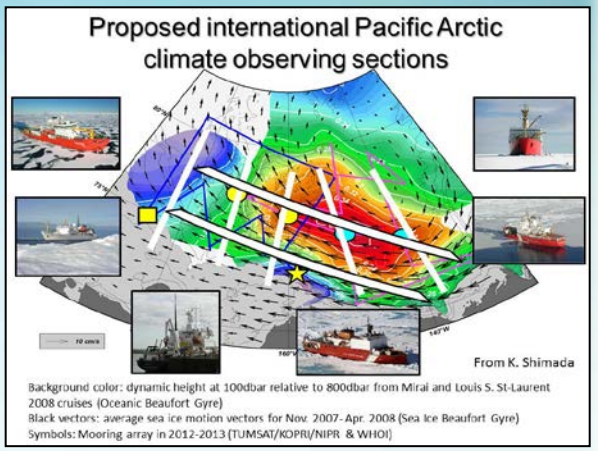
2 KOPRI station

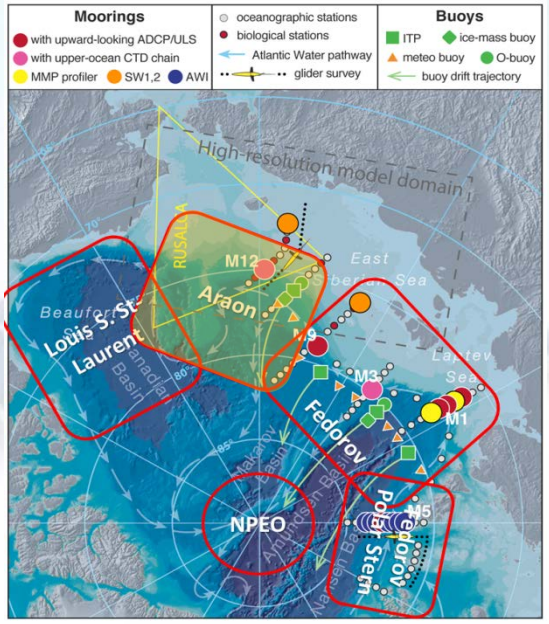
- ✓ Ocean
- ✓ Geophysics
- ✓ Gas hydrate

Future KOPRI Arctic survey



KOPRI Arctic ocean monitoring area





- ARAON will cover the region from the Chukchi Borderland to the East Siberian Sea and Mendeleev Ridge

Thank you