Pacific Arctic Group:
Korean Arctic Ocean Research Plan in 2017

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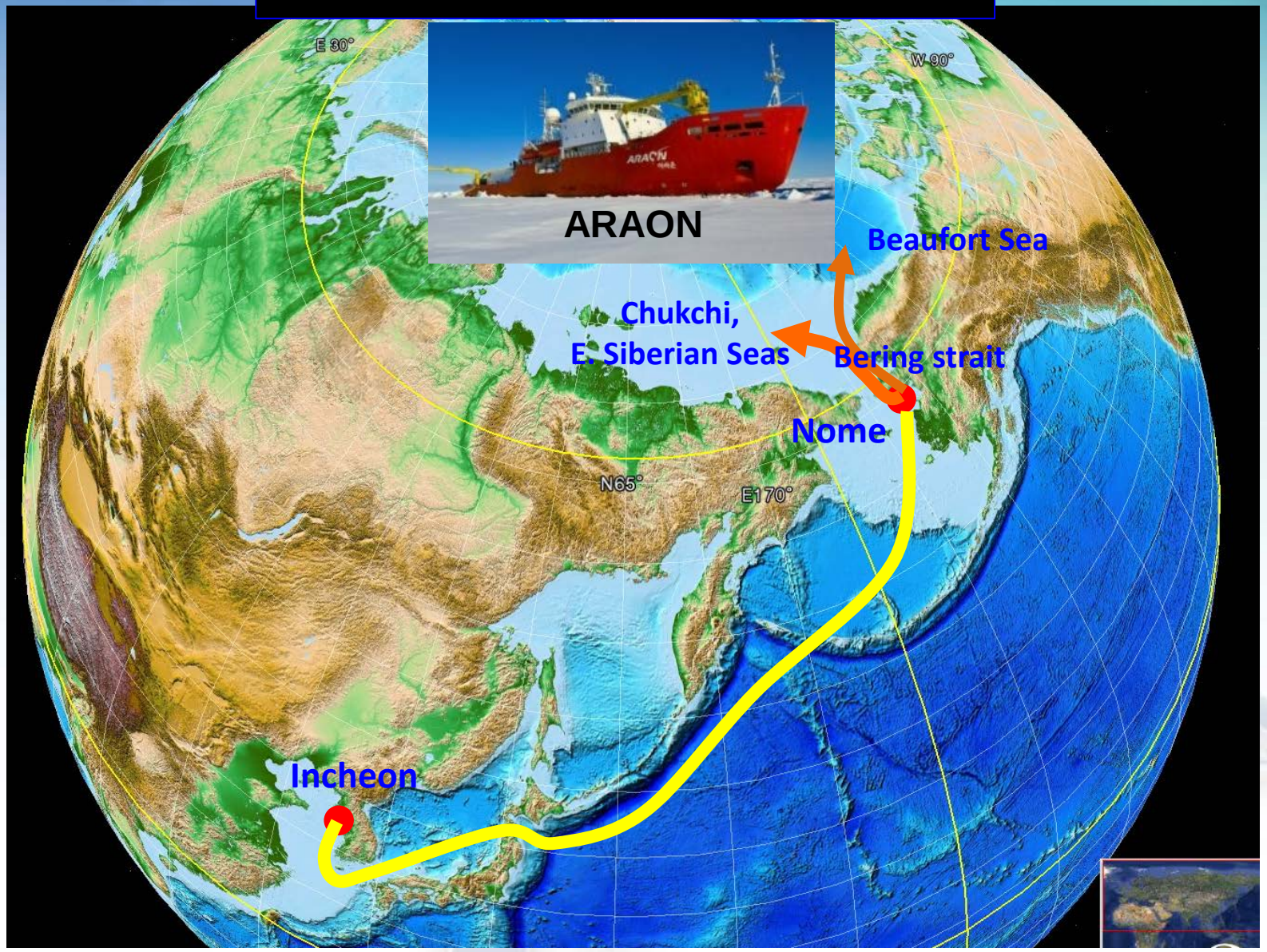
Division of Polar Ocean Science
KOPRI

2th April, 2017

Pacific Arctic Group Meeting, Prague

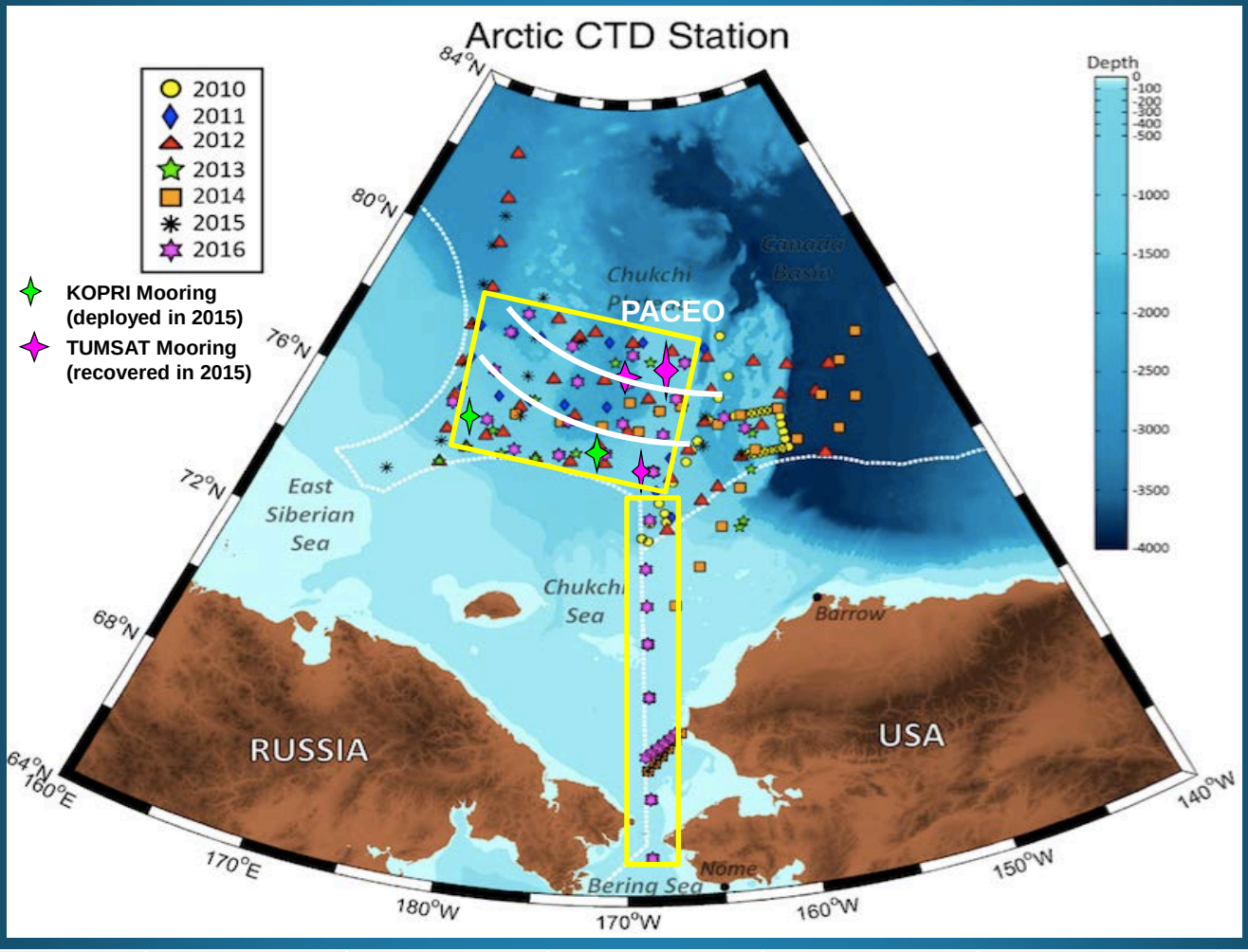
KOPRI
Korea Polar Research Institute

Korean Arctic Ocean Cruise track



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

IB R/V ARAON Arctic Cruises (2010~2016)



	2010	2011	2012	2013	2014	2015	2016
CTD	38	18	44	16	32	42	34
XCTD	*	33	48	36	51	61	38
Period	07/20~08/10	08/02~08/16	08/04~09/06	08/24~09/01	08/01~08/23	08/01-08/21	08/05-08/21

2017 KOPRI Arctic Research Plan

2017. 8. 5 ~ 9. 15

2017 KOPRI Arctic Cruise (1st leg)

- **Ocean and Sea ice study**
- **Aims of the cruise:**

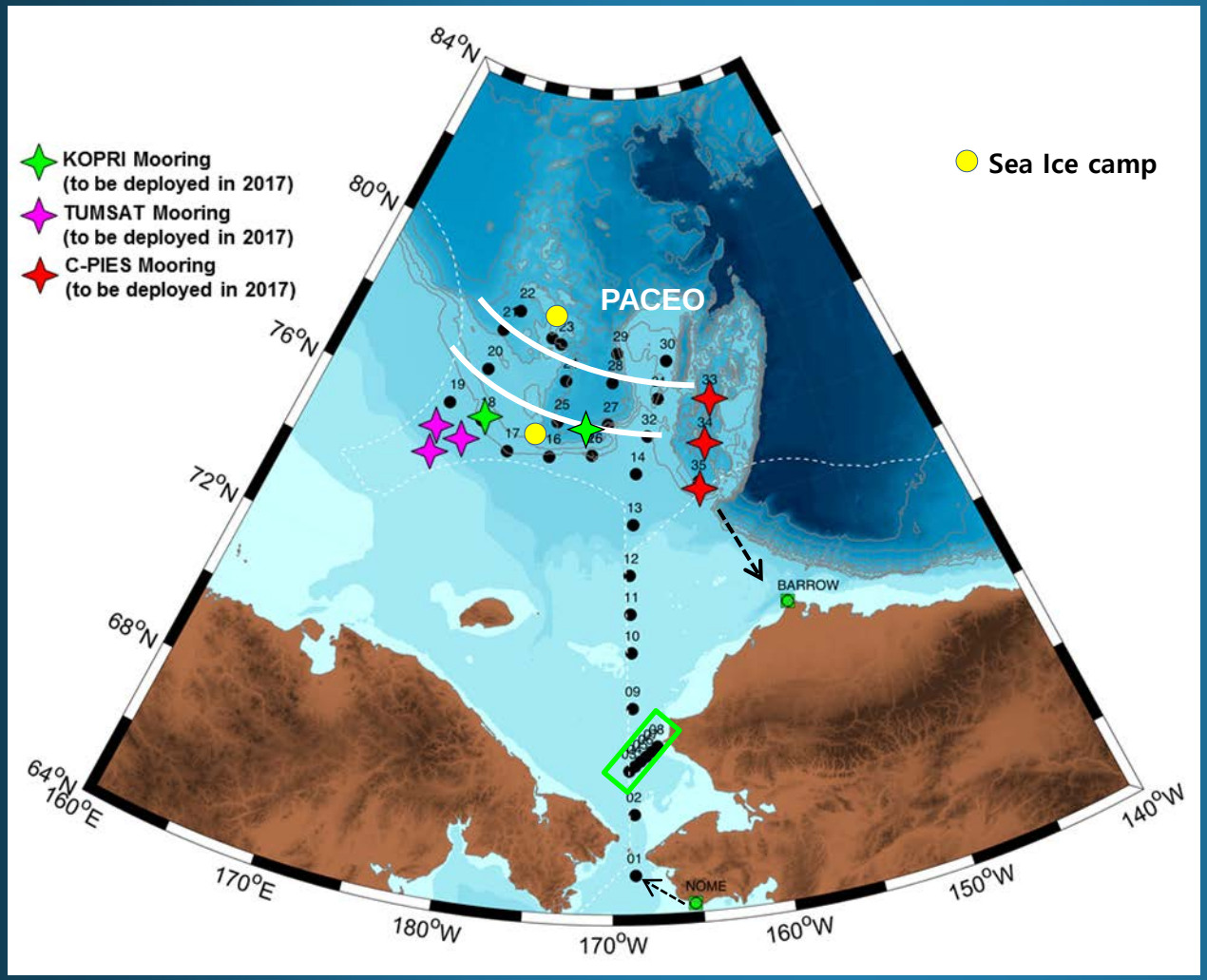
  - To investigate the structure and processes in the water column around the North Bering Sea, Chukchi Sea, and the East Siberian Sea in rapid transition .

  - To understand sea ice dynamics and sea ice ecosystem

- **Period:** 2017. 8.5 - 8.23 (from Nome to Barrow)
- **Chief Scientists:** Dr. Sung-Ho Kang
- **Participating nations:** Korea, China, France, Japan, Spain, US and UK

2017 Arctic Survey plan

1st Leg (ocean and sea ice study)

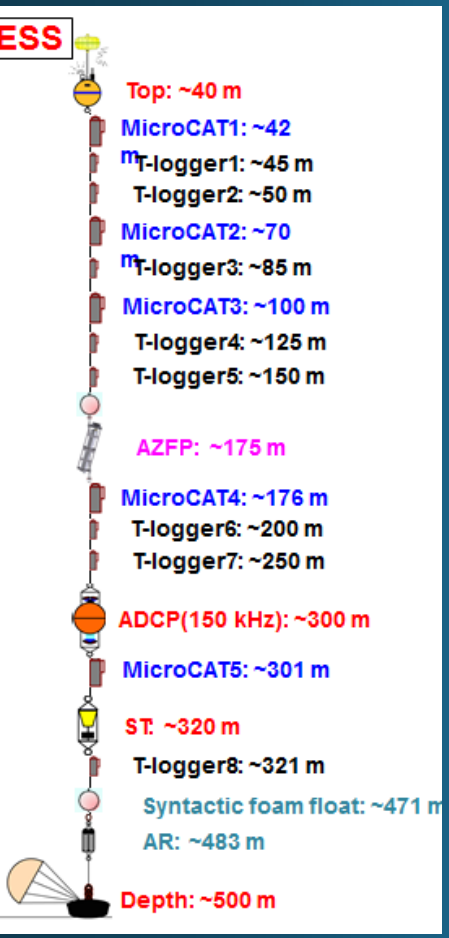


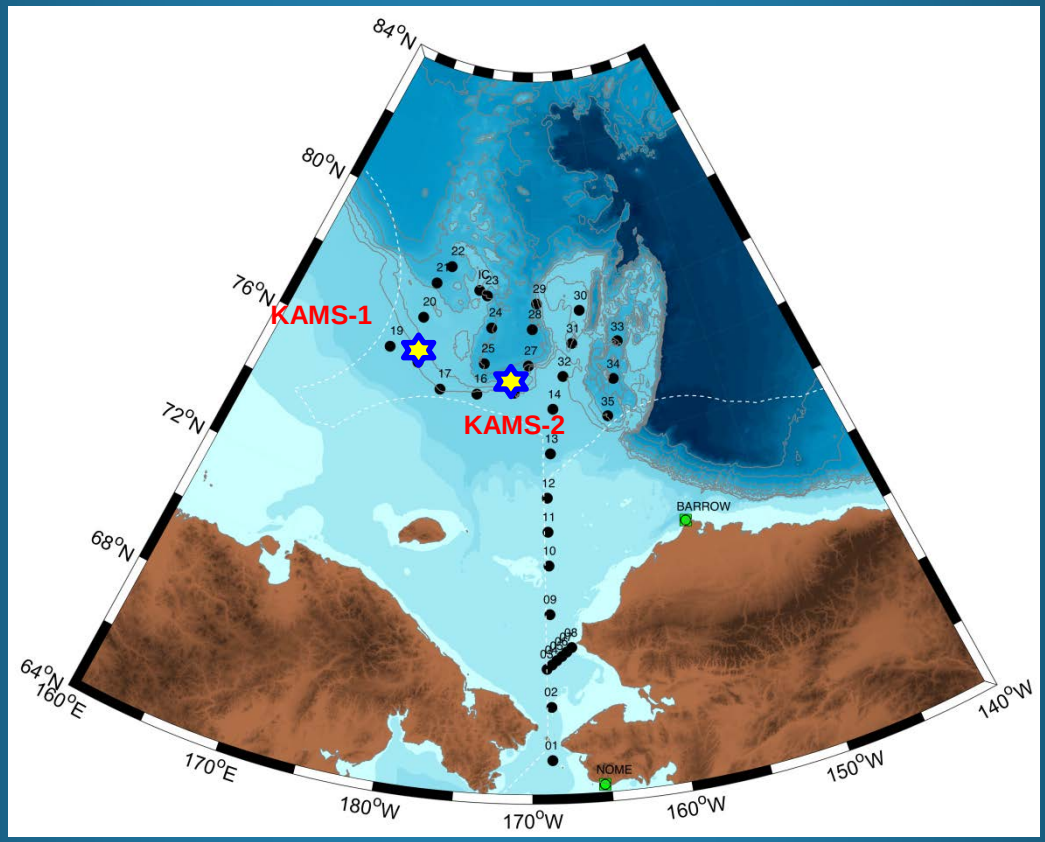
- North Bering Sea (DBO 3)
- Chukchi Sea
- East Siberian Sea & Mendeleev Ridge
- Sea Ice station (2 site)
- Ocean mooring station (8 stations)

KOPRI ocean mooring system

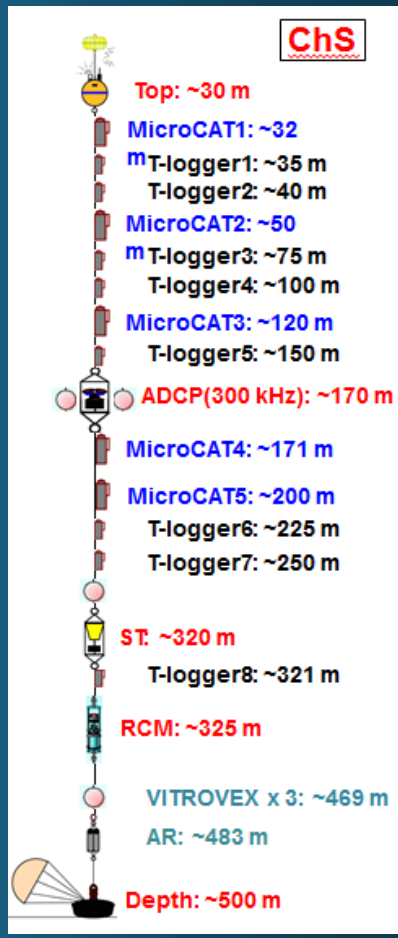
- Chukchi Sea and East Siberian Sea
- ADCP, Microcat, Sediment trap, RCM, AZFP, Chla, PAR

KAMS-1



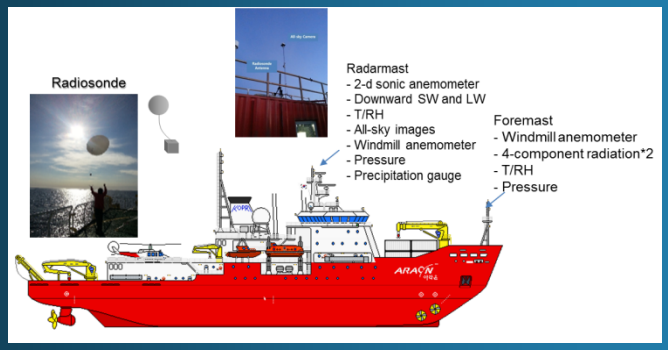


KAMS-2



Atmospheric Observation

- Surface basic meteorological variable : physical understanding of weather events and prediction
- Claud radiative flux on surface , physical understanding of weather events
- Radiosonde balloon launch : temperature, humidity and wind



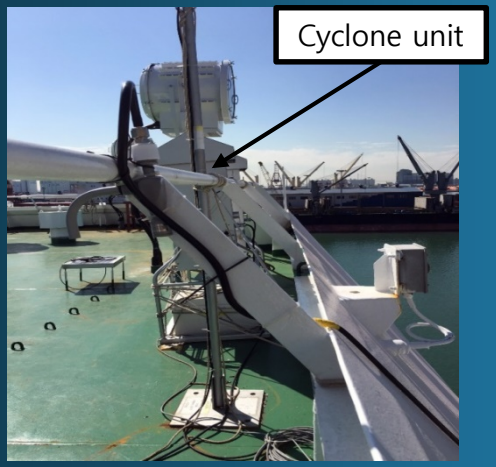
Radiosonde balloon

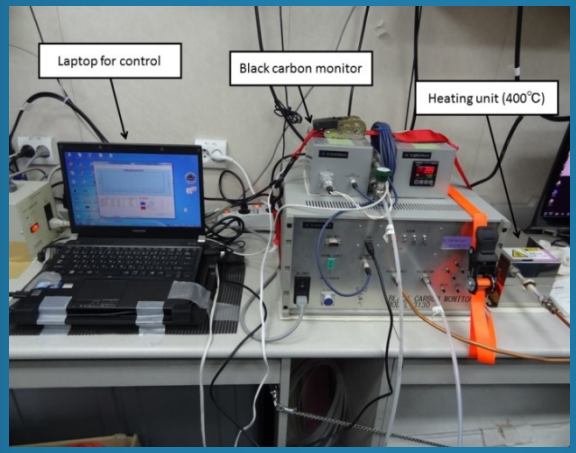
INMARSAT satellite

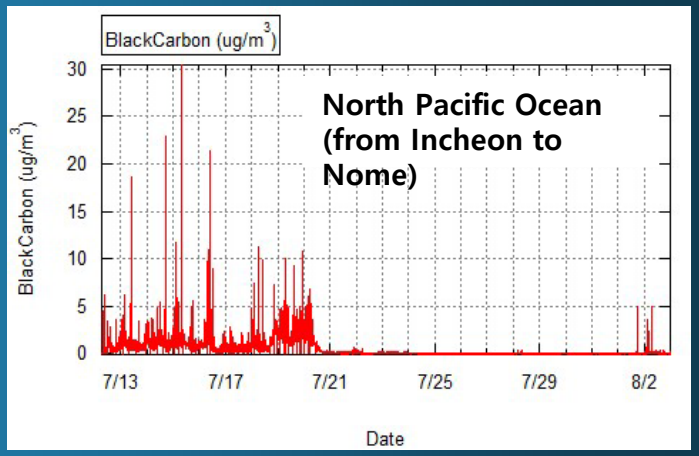
World Meteorological Organization

Global Telecommunication System (GTS)

- Direct measurement of Black carbon (BC)



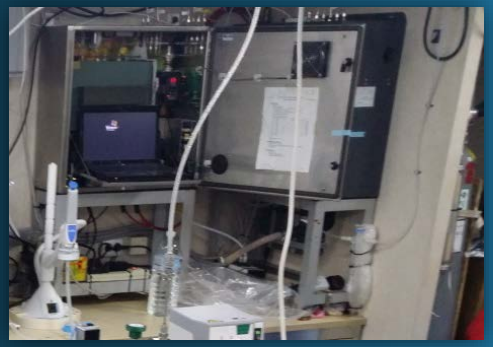




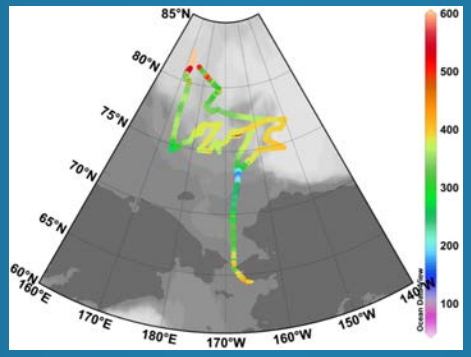
Preliminary result

Chemistry in water column

- Pursuing spatial and temporal variation of pCO_2 system in the Arctic Ocean
- Net community production(NCP) using EIMS(Equilibrator-inlet Mass Spectrometry)



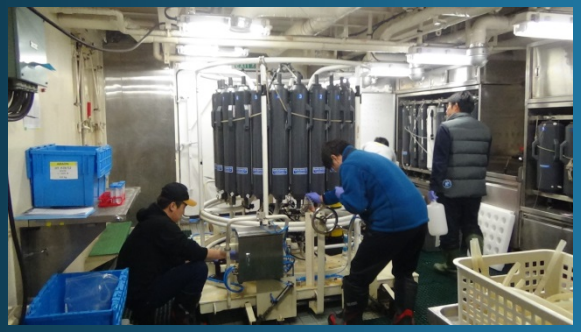
Continuous observation system of pCO_2



Dissolved pCO_2 along the track

Continuous observation system of NCP

- Behavior of nutrients (NH_4, NO_2+NO_3, PO_4 and SiO_2)
- Characteristics of dissolved and particulate organic matters (DOM and POM)
- UV-absorbing compounds (Mycosporine-like amino acids)

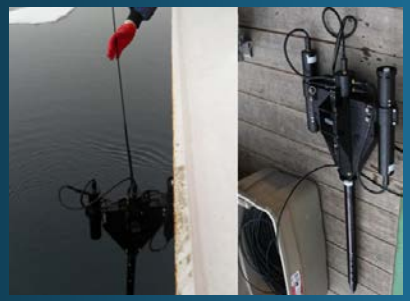


Analytical system for DIC and TA

TOC-TN analyzer

Satellite Remote Sensing

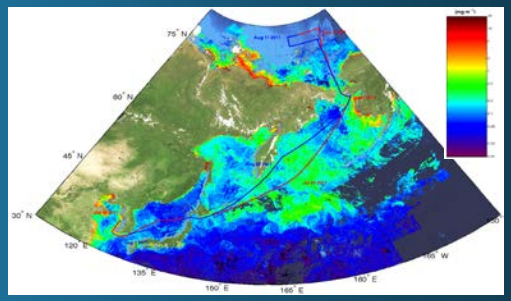
- Ocean Color Remote Sensing (Ocean Optics Measurement)



Hyper-spectroradiometer

Above water spectroradiometer

APC deployment



Hydrographic Survey

- Water mass distribution & characteristics

CTD & LADCP

XCTD

Ocean buoy (from OCU)

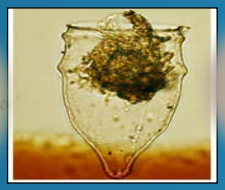
Plankton Ecology/Production

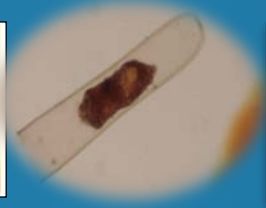
- Distribution of bacteria and virus and community structure
- Species compositions of phytoplankton and chlorophyll *a* concentration
- Abundance and community structure of heterotrophic protists
- Mesozooplankton community and grazing impacts on phytoplankton biomass
- Primary production and new production
- Food web interaction between phytoplankton and zooplankton

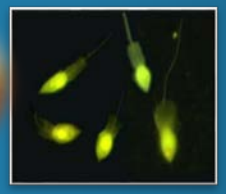
Phytoplankton Net

Zooplankton Net

Deck Incubation



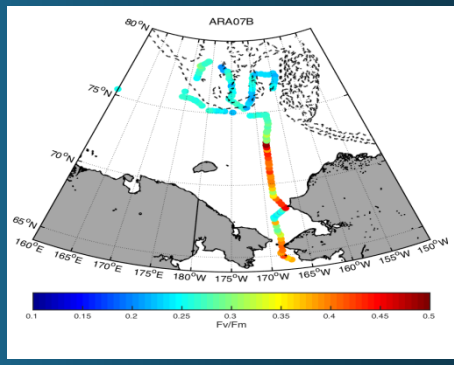




Phytoplankton physiology

- To understand the photosynthetic characteristics of phytoplankton
  -> Phytoplankton physiology (photochemisty) parameters using a Fluorescence Induction and Relaxation (FIRe II) system

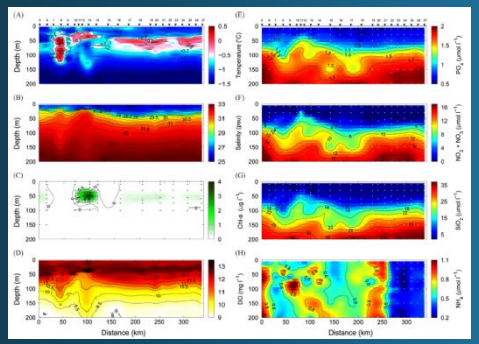
FIRe II system

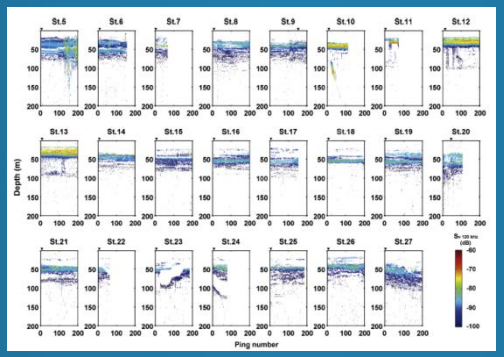


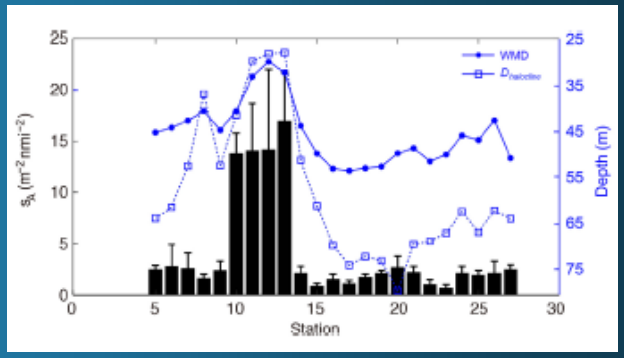
Fv/Fm value along the track

Bioacoustic surveys

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





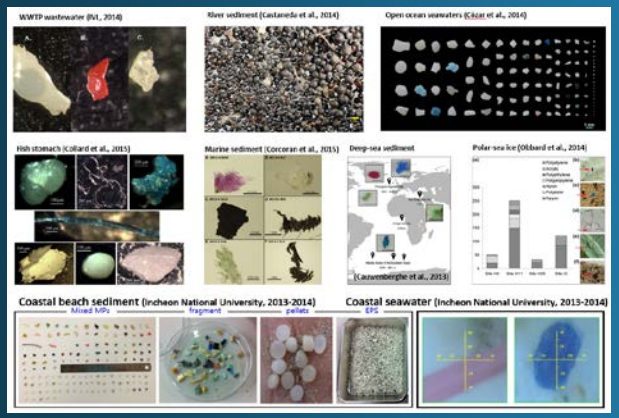


[Spatial variation of Arctic copepods over Northwind Ridge]

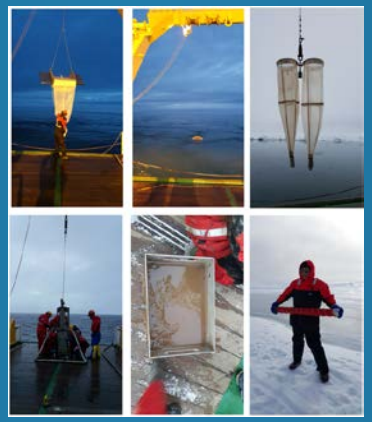
Microplastics (MPs) Study

- **To investigate the abundance and distribution of MPs in Arctic region**
- **To identify possible transport pathway and source of MPs**
- To survey how MPs redistribute among various Arctic media/habitat
- To predict the effect of MPs on Arctic ecosystem and sea-ice melting/formation

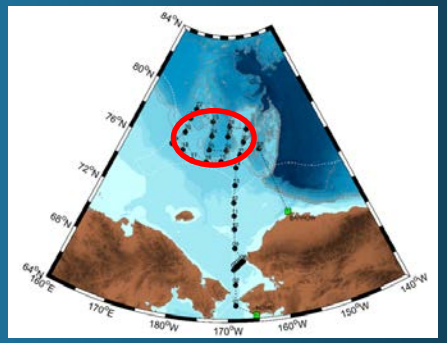
MPs in environments



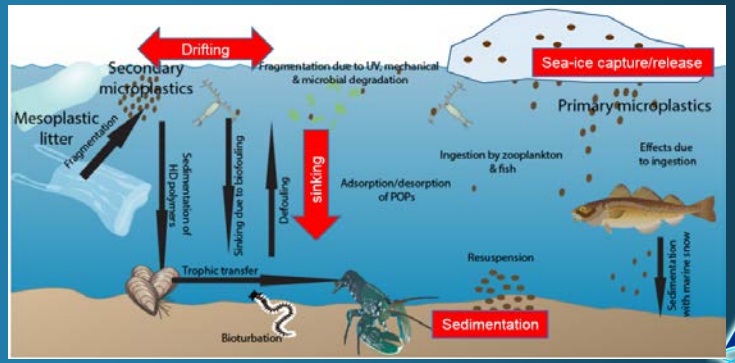
MPs monitoring



MPs pollution mapping



Effect of MPs on ecosystem/see-ice melting



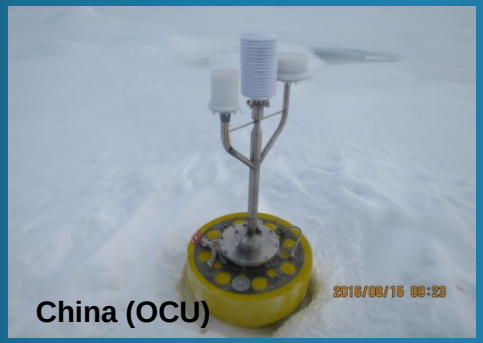
- **Research issues;**
  - drifting MPs in surface/sub-surface waters
  - sinking & sedimentation of MPs
  - intake of MPs by Arctic organisms
  - sea-ice capturing mechanisms of MPs
  - effect on melting/formation of sea-ice
  - effect of MPs-associated pollutants

Sea ice dynamics

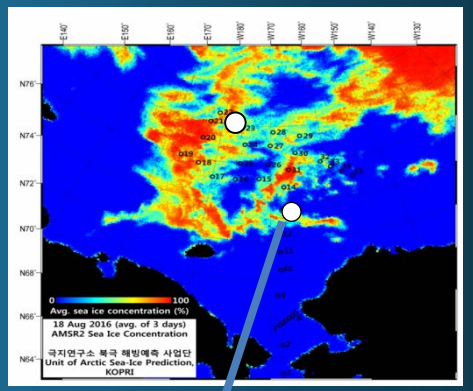
- International collaboration : KOPRI, UK(BAS), China(OCU), Spain, France
- Buoy deployments for physical observation
  - To measure in-situ physical parameters of atmosphere, ice and ocean autonomously
  - To study the energy balance at the atmosphere-ice-ocean interface

Melt pond Ice Mass Balance (IMB) with radiation sensors

Smart Ice-Tethered Profilers (SITPs)

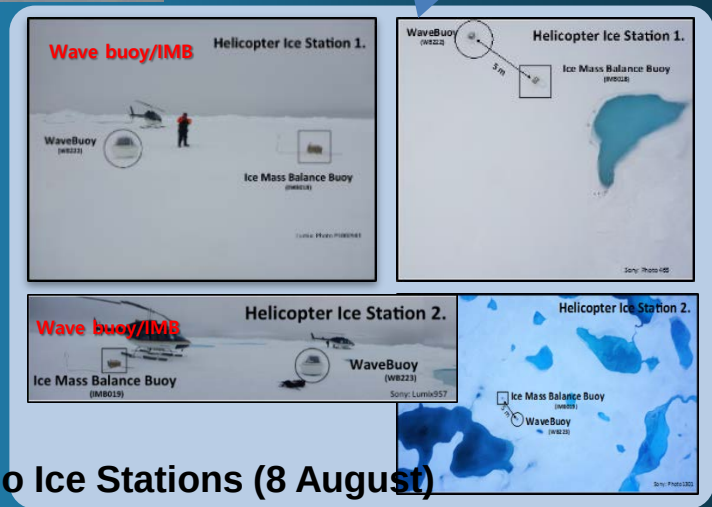


AWS



Wave buoy

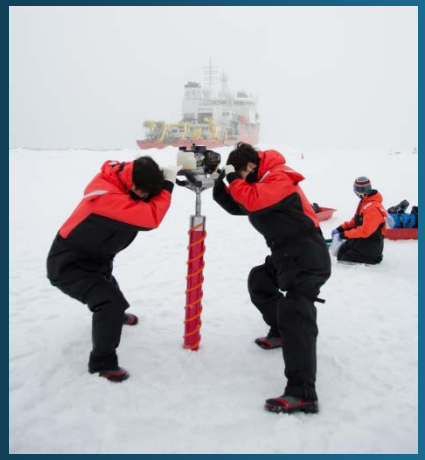
IAOOS buoy



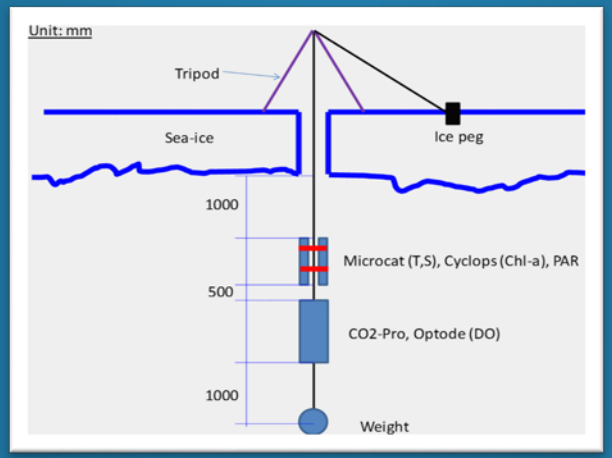
Helo Ice Stations (8 August)

Sea Ice_Biochemical Study

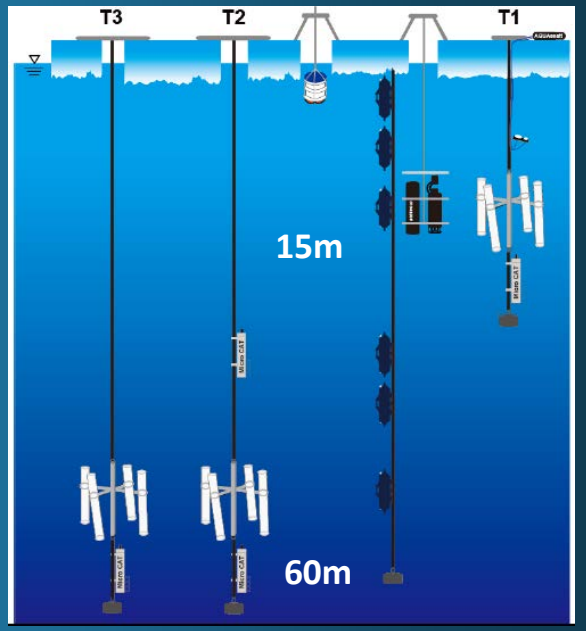
- The effect of changing sea-ice on Arctic marine ecosystem
- Species composition, abundance, and diversity associated with sea ice condition
- Carbon interaction between Sea Ice and water column
- Shor-term mooring under sea-ice (carbon flux and vertical distribution)



Ice core sampling



PCO_2 monitoring system



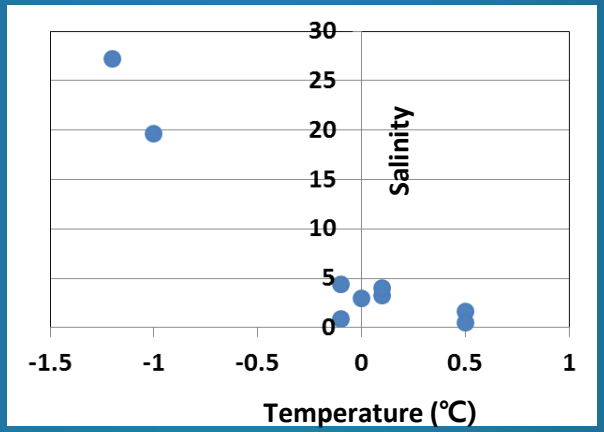
Small sediment trap,
Microcat, CTD,

- **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 melt pond condition
- To estimate the carbon contribution of entire sea ice floes in the western Arctic Ocean.

Melt pond study site from 2016



Temperature & Salinity

Melting pond study

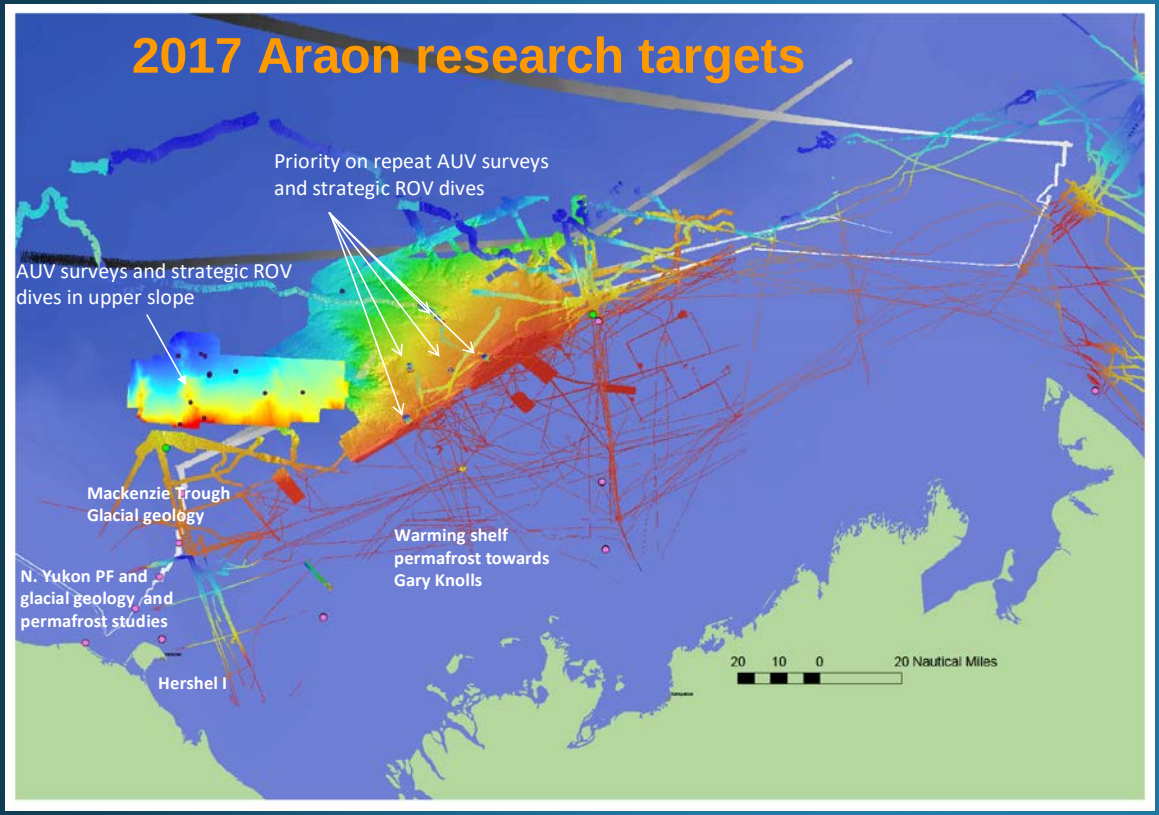
- Research components;
  - Plankton composition, diversity and physiology
  - Gas interaction between air and surface of ponds
  - Biochemical parameters (Carbon and Nitrogen …)

2017 KOPRI Arctic Cruise (2nd Leg)

- Marine geology/geophysics (Beaufort Sea)
- Aims of the cruise:
  - To establish the slope and shelf basin geology, permafrost and/gas hydrate structure
  - To understand geological processes related to melting subsea permafrost and gas hydrate in the Arctic and potential marine geohazards
  - To investigate CH^4 release and CH^4 cycle from the Arctic shelf
  - To assess the glacial history of the area and the distribution of offshore permafrost
- Period: 2017. 8.28 - 9.15 (from Barrow to Nome)
- Chief Scientists: Dr. Young-Keun Jin
- Participating nations: Korea, Canada and US

2nd Leg

Marine Geological/Geophysical Survey @ the Beaufort Sea



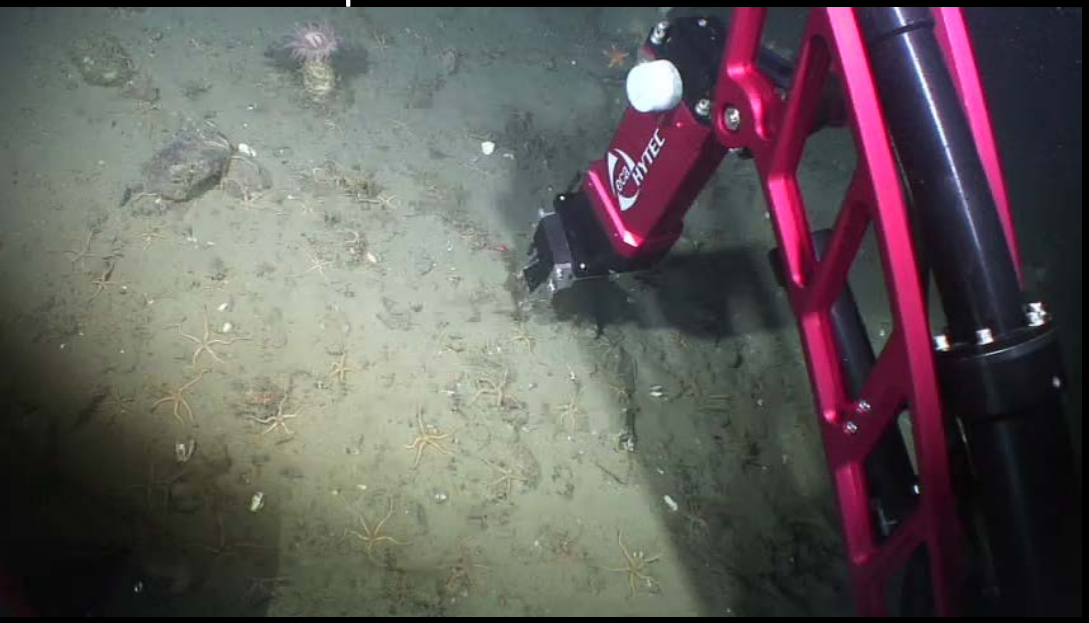
- **Research items;**
  - Multi-chananel Seismic survey
  - ROV/AUV investigations
  - Sub-bottom profiling
  - bathymetric mapping
  - Sediment coring
  - Heat flow measurements
  - Underway gravity survey
  - Water column study
  - Methane flux study
  - Microbiological study

ROV Dives

- 2010 - 12 shallow
- Phantom dives

- 2011 – initiated
- Mini-ROV project

- 2012 & 2013
  - 29 Mini-ROV dive
  - Up to 1004 m depths
  - 1st Deep dives in Western Arctic



Mapping AUV

- 2013 - First deep-water AUV operations in western Arctic

- 8 dives - 5 surveys

Thank you