Korea -
Updates of 2012 Araon field results & Plan for 2013 field season♪

14 April 2013
PAG, ASSW, Krakow Poland

Sung-Ho Kang
Director, Division of Polar Climate Research

Korea Polar Research Institute

2012 Araon Arctic Cruise♪

- **Aim of the cruise:** To investigate the structure and processes in the water column and subsurface(sediment) around the Chukchi Borderland and Mendeleyev Ridge in rapid transition

  - *Korea-Polar Ocean in Rapid Transition (K-PORT) program : PI Sung-Ho Kang*
  - *The Arctic Paleoceanography (K-POLAR) program: PI* Seung Il Nam
  - *Korea-Polar Ocean Discovery (K-POD) program: PI* Jung Han Yim

- **Period:** 2012. 08.01 ~ 09.10 (Nome to Nome)
- **Chief Scientist:** Sung-Ho Kang
- **Participating nations:** Korea, China, Japan, US, Canada, Russia, Germany UK, India, Nepal♪

Survey component

Cruise Report:
RV *Araon* ARA03B, August 1-Septmeber 10, 2012
Chukchi Borderland and Mendeleyev Ridge

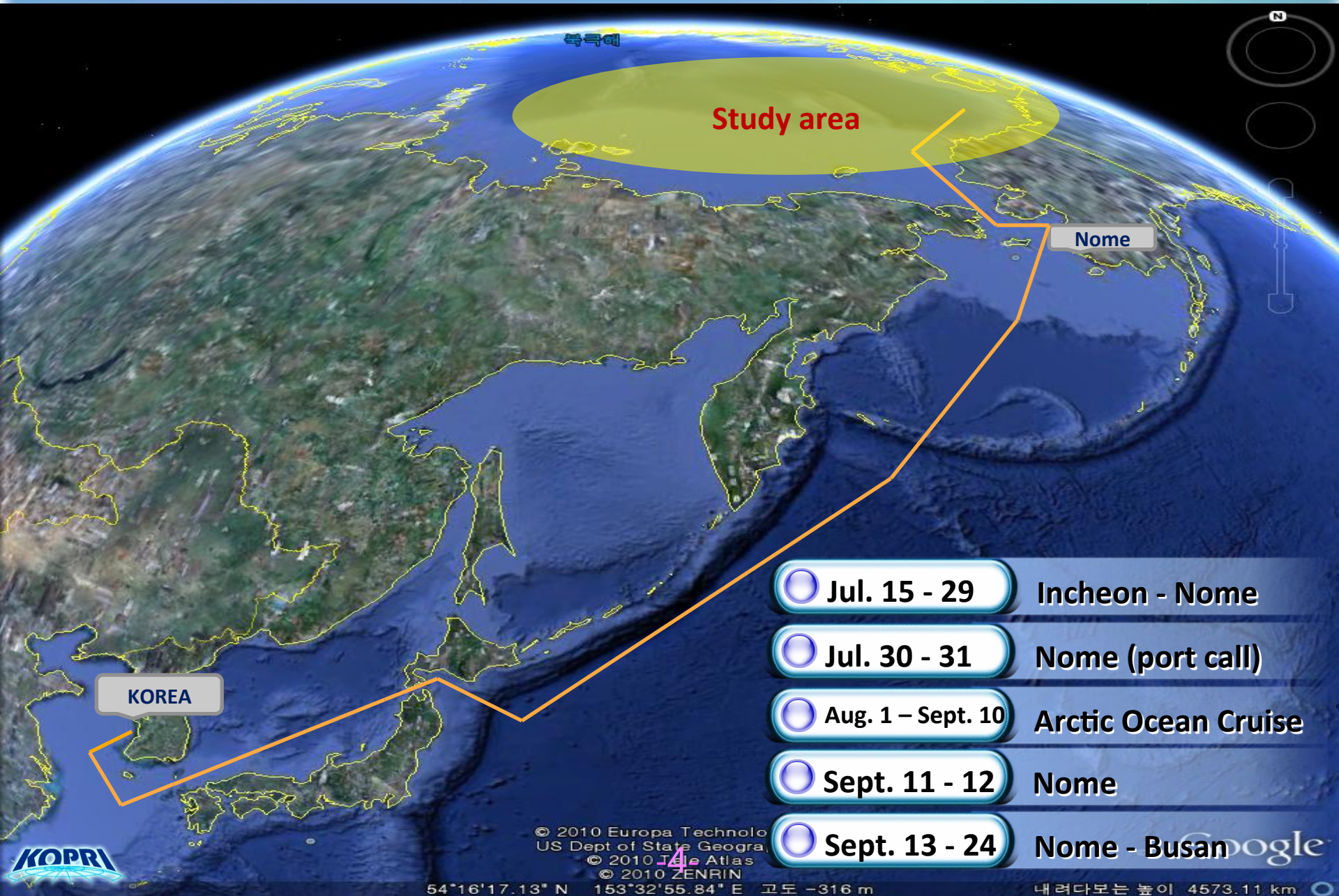
Sung-Ho Kang, Chief Scientist
Korea Polar Research Institute (KOPRI)

KOPRI
Korea Polar Research Institute

- **Water Column (WC) components**
  - Water column observations of biota
  - Pelagic ecosystems observations
  - Plankton ecosystems
  - Nutrients and productivity
  - Bio-geochemical measurements
- **Underway collection of meteorological and near-surface seawater**
- **Meteorological data from ship sensors**
- **XCTD (expendable temperature, salinity and depth profiler) casts**
- **CTD/rosette casts for hydrograph and geochemistry (ecosystem, nutrients, salinity, and barium)**
- **Deploy oceanographic moorings**
- **Sea-ice (ICE) observations through regular visual observations from bridge and automated fixed-camera photos.**
  - Ice observations
  - Ice biology
- **Geophysical and Paleoceaongraphical components**
  - Multiple corer sampling
  - Seabed Mapping: Seafloor mapping and paleoceanography

KOPRI

Arctic Cruise (2012)



2012 *ARAON* ARCTIC CRUISE

ARA03B (1ST AUG. – 10TH SEPT.)

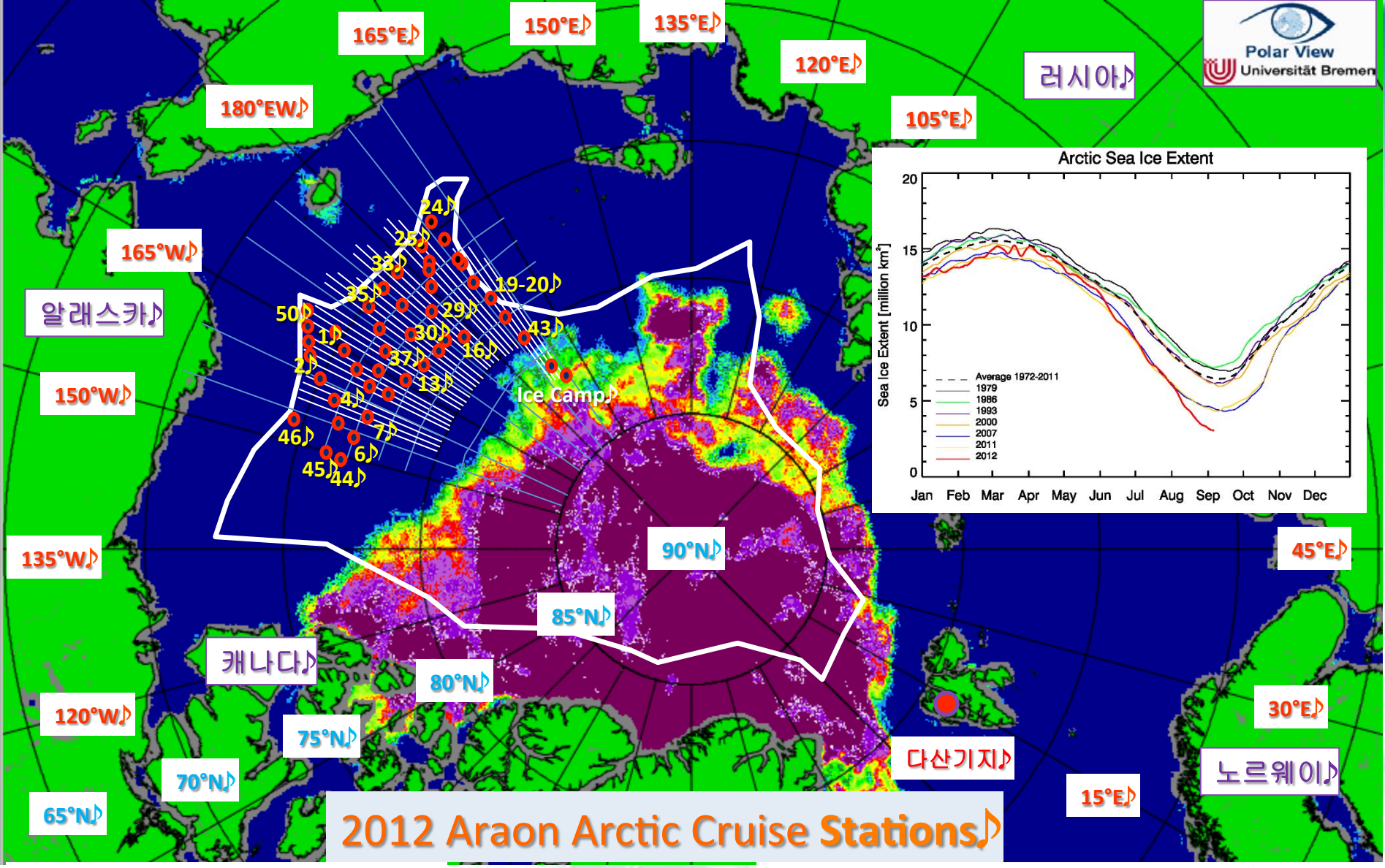
KOPRI

K-PORT (Korea-Polar Ocean in Rapid Transition) Project (PI, Dr. Sung-Ho Kang)
K-POLAR (Arctic Paleoceanography) Project (PI, Dr. Seung Il Nam)
K-POD (Korea-Polar Ocean Discovery) Project (PI, Dr. Jung Han Yim)

- Korea Polar Research Institute (KOPRI) ♪
- Korea Maritime University (KMU) ♪
- Pusan National University (PNU) ♪
- Hanyang University (HANYANG) ♪
- Chungnam National University (CNU) ♪
- Jeju National University (JNU)
- Gwangju Institute of Science and Technology (GIST) ♪
- Tokyo University of Marine Science and Technology (TUMSAT), Japan ♪
- Hokkaido University (HU), Japan ♪
- The Scottish Association for Marine Science (SAMS), Scottish Marine Institute, UK ♪
- Ocean University of China (OUC), China ♪
- Louisiana State University (LSU), USA ♪
- Alfred Wegener Institute for Polar and Marine Research (AWI) ♪
- Russia (Ice Navigator)
- US Helicopter pilots
- Scientists from Canada, India, Nepal Nationality

Total 10 Nations, 81 particiapants♪

KOPRI



2012 Araon Arctic Cruise Stations♪

양극해 환경변화 이해 및 활용 연구

K-PORT KOREA-POLAR OCEAN IN RAPID TRANSITION

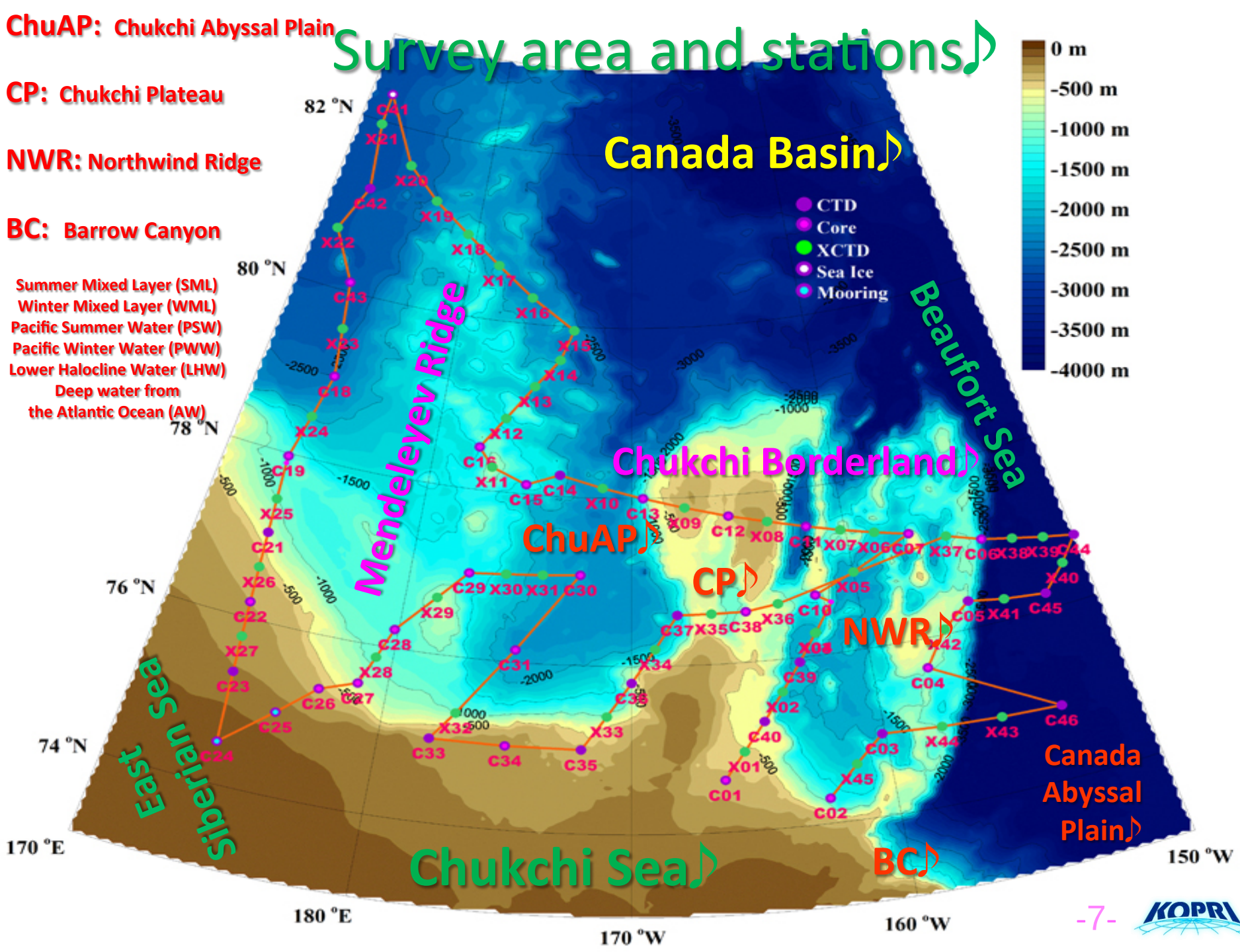
KOPRI 국토해양부 R/V Araon

2012
6th Sept.

C[%]
0 25 50 75 100
Ice Concentration

ASI (from SSMIS/F18) ver. 5.2, Grid 6.25 km

Survey area and stations♪

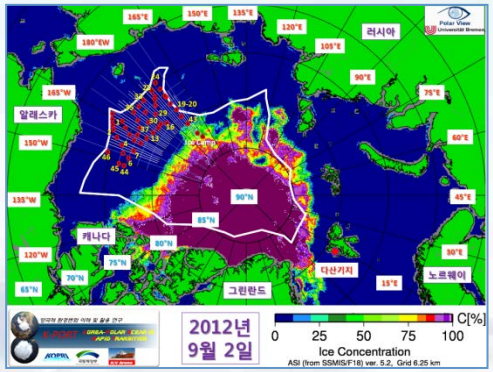


Summary

-Period: '12 08.01 ~ 09.10

-Surveys :

- **CTD : 44**
- **XCTD :** 48
- CTD Moorings : 2
- **Ice Station : 1**
- **Biology Stas.: 15**
- **Cores : 3**
- **SBP, MB:** whole area



Sealce

Sea-ice camp 82.20N
SATICE♪

Sea Mt.
Correction♪

Pacific Summer
Water

Gas-related
Pockmark

High Chlorophyll♪

Glacier marks♪

High Methane conc.
on air

Glacier marks♪

Manganese
nodules♪

Mooring♪

Cold fresh core

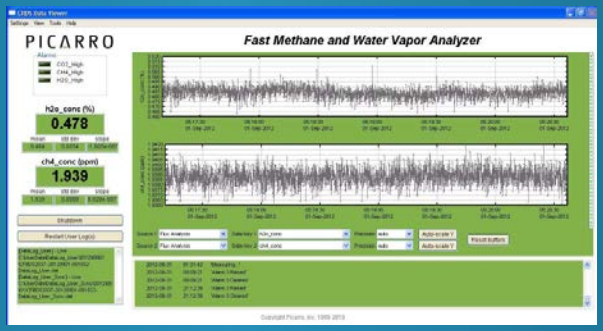
Low oxygen environment♪

Pacific Winter Water

Atmospheric Observation

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

Open-path eddy covariance at the foremast of ARAON

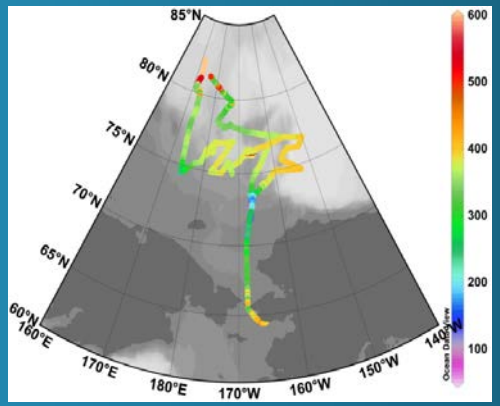


Real time variation of CH_4 and H_2O in flux mode

CO_2 system in water column

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

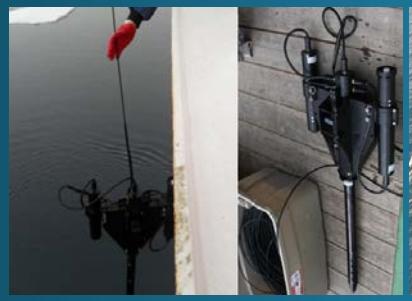
Analytical system for DIC and TA



Dissolved pCO_2 along the track

Satellite Remote Sensing

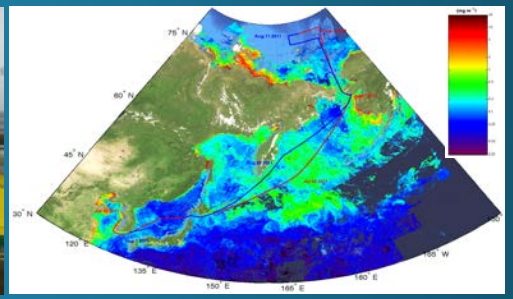
- Ocean Color Remote Sensing (Ocean Optics Measurement)



Hyper-spectroradiometer

Above water spectroradiometer

APC deployment

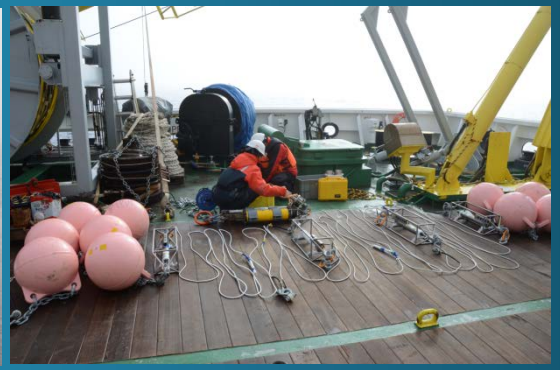


Hydrographic Survey

- Water mass distribution & characteristics in Chukchi Borderland/Mendeleev Ridge

CTD & ADCP

XCTD



Ocean Mooring

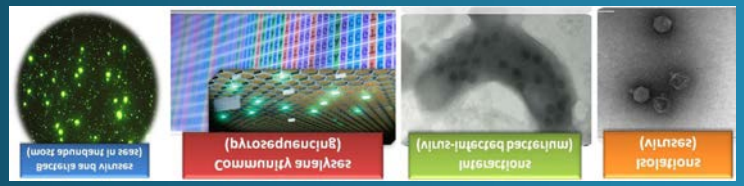
Micobes/Plankton Ecology

- 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





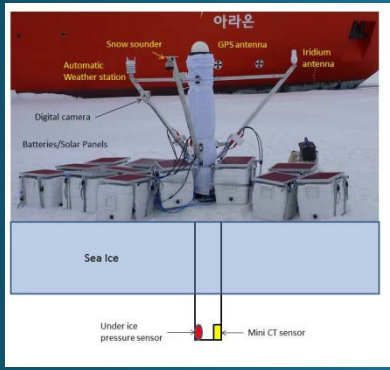


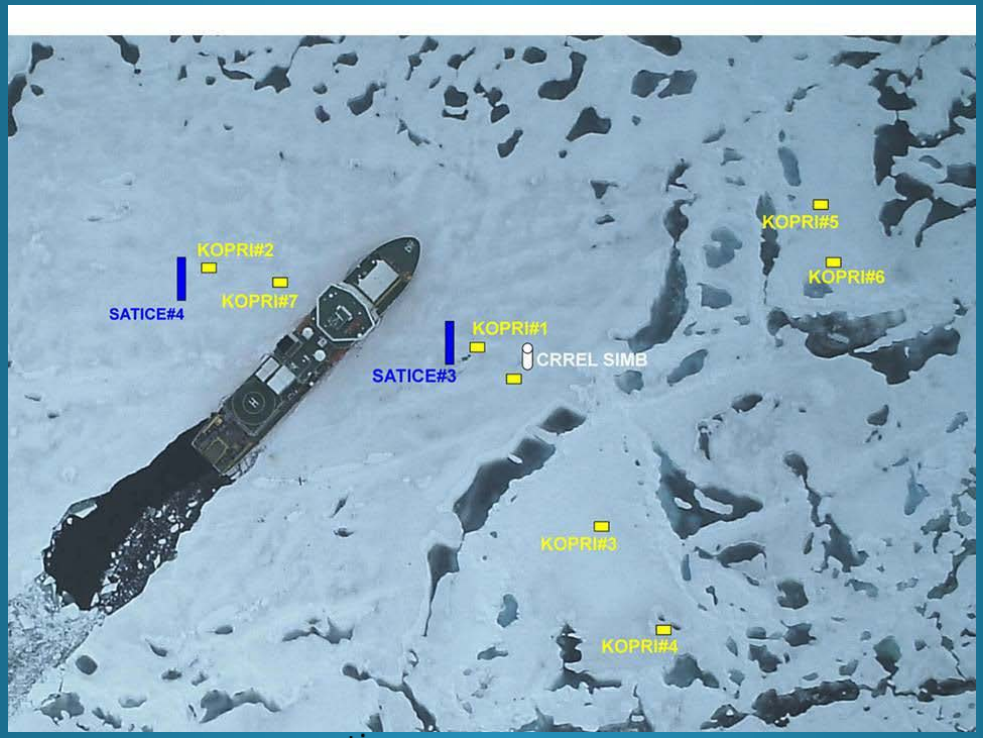


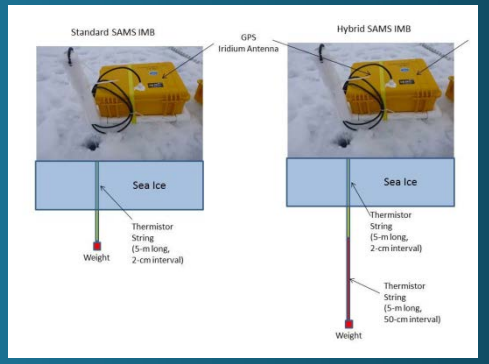
Sea ice study

- **Buoy deployment and helicopter survey (KOPRI-SAMS)**

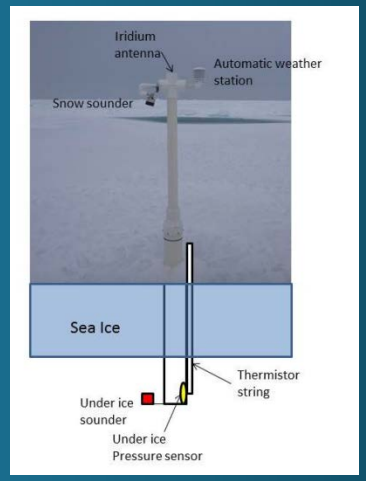


SATICE buoy

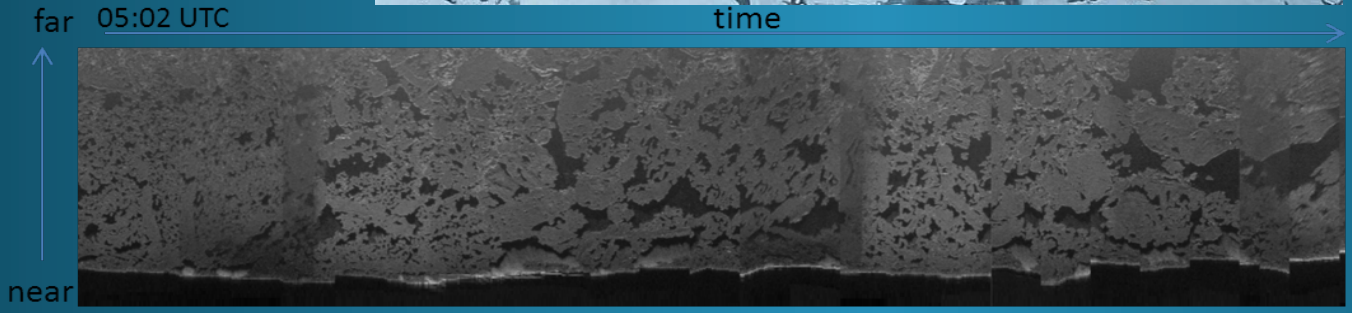




SAMS/KOPRI IMB buoy

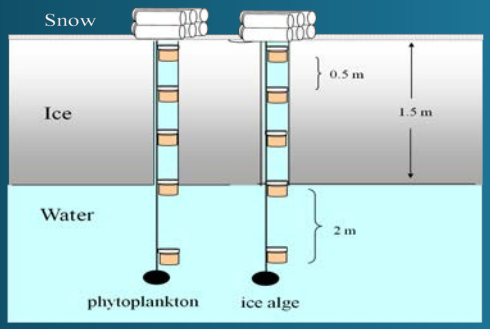


CRREL buoy



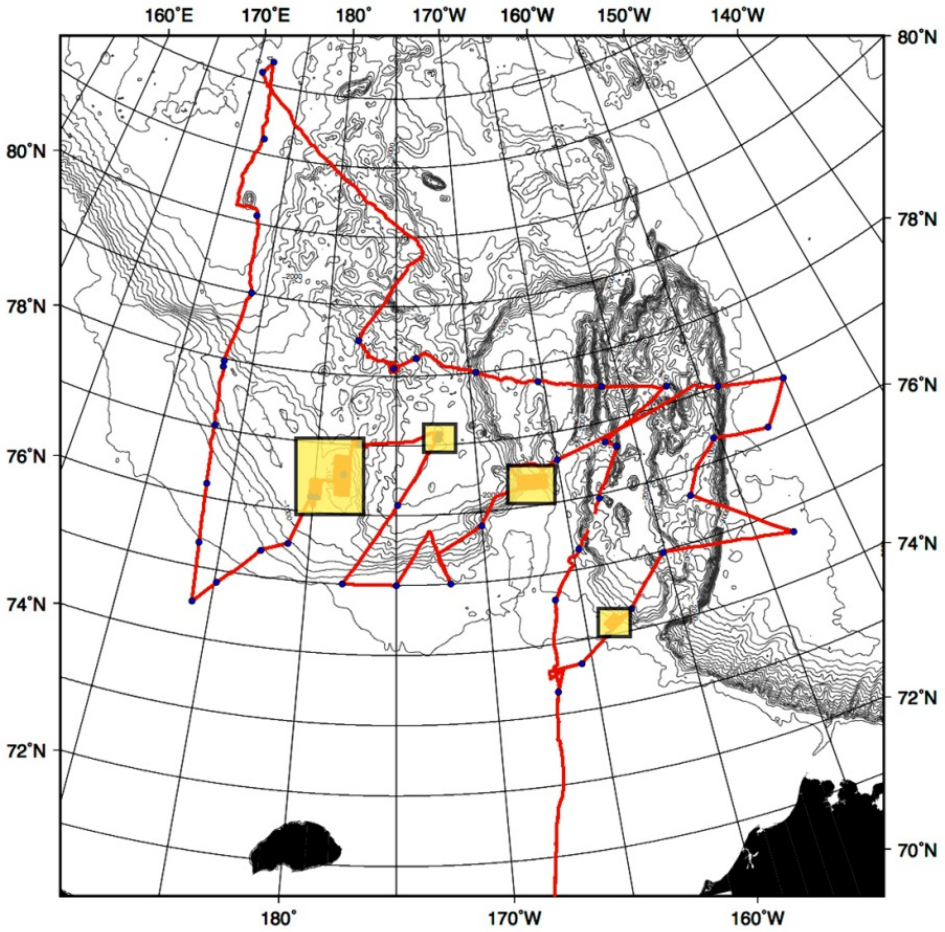
Melt pond study: Ice algae

- Species composition and abundance of algae
- Productions and macromolecular compositions of algae



Marine Geophysics

A New understanding of Arctic bathymetry and paleogeography



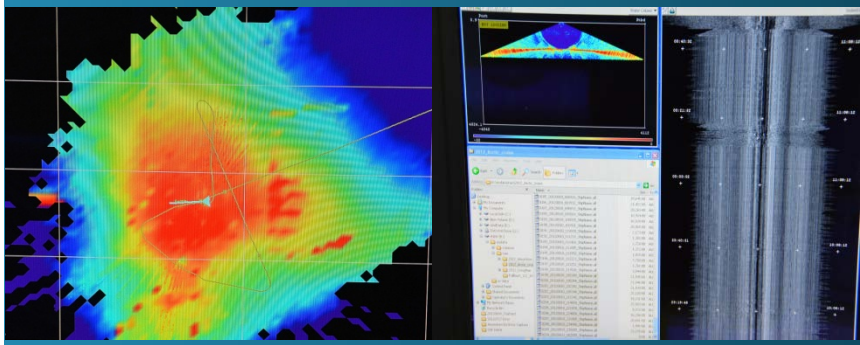
In the Chukchi sea, many subsurface features are unknown.

In Aug. 2012, KOPRI acquired bathymetric data and SBP data during the whole period of the survey.

Because of ice-free sea condition, high-quality bathymetry data have been acquired.

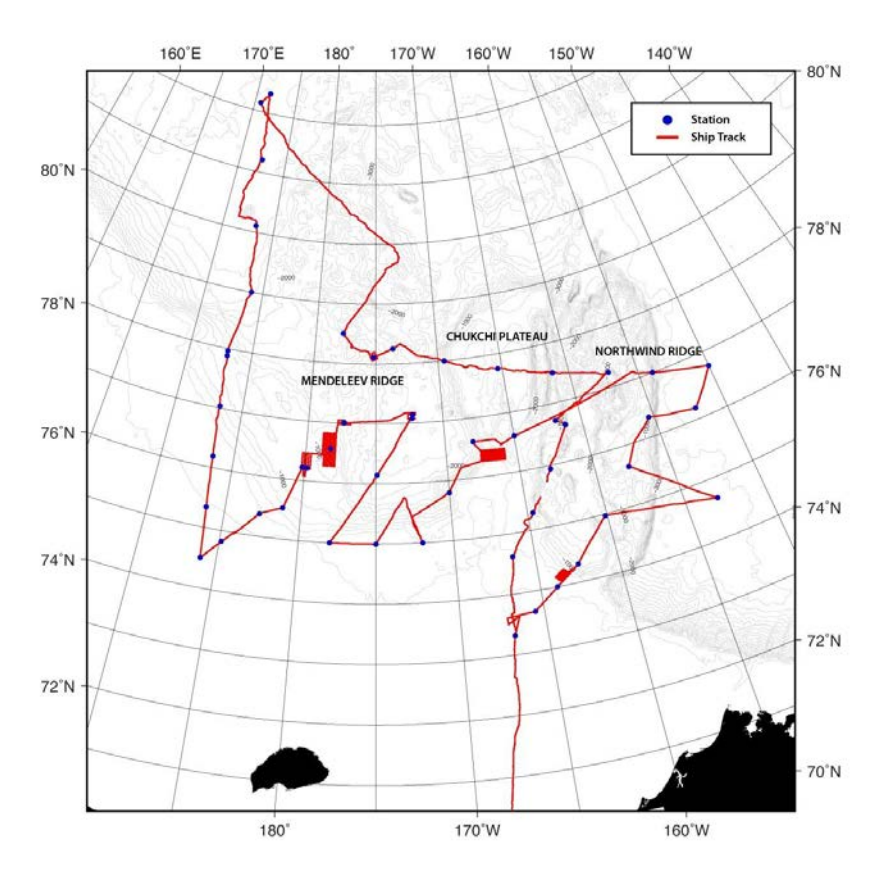
We select 4 areas for intensive seafloor mapping.

There area are characterized by ice lineation and pockmarks.

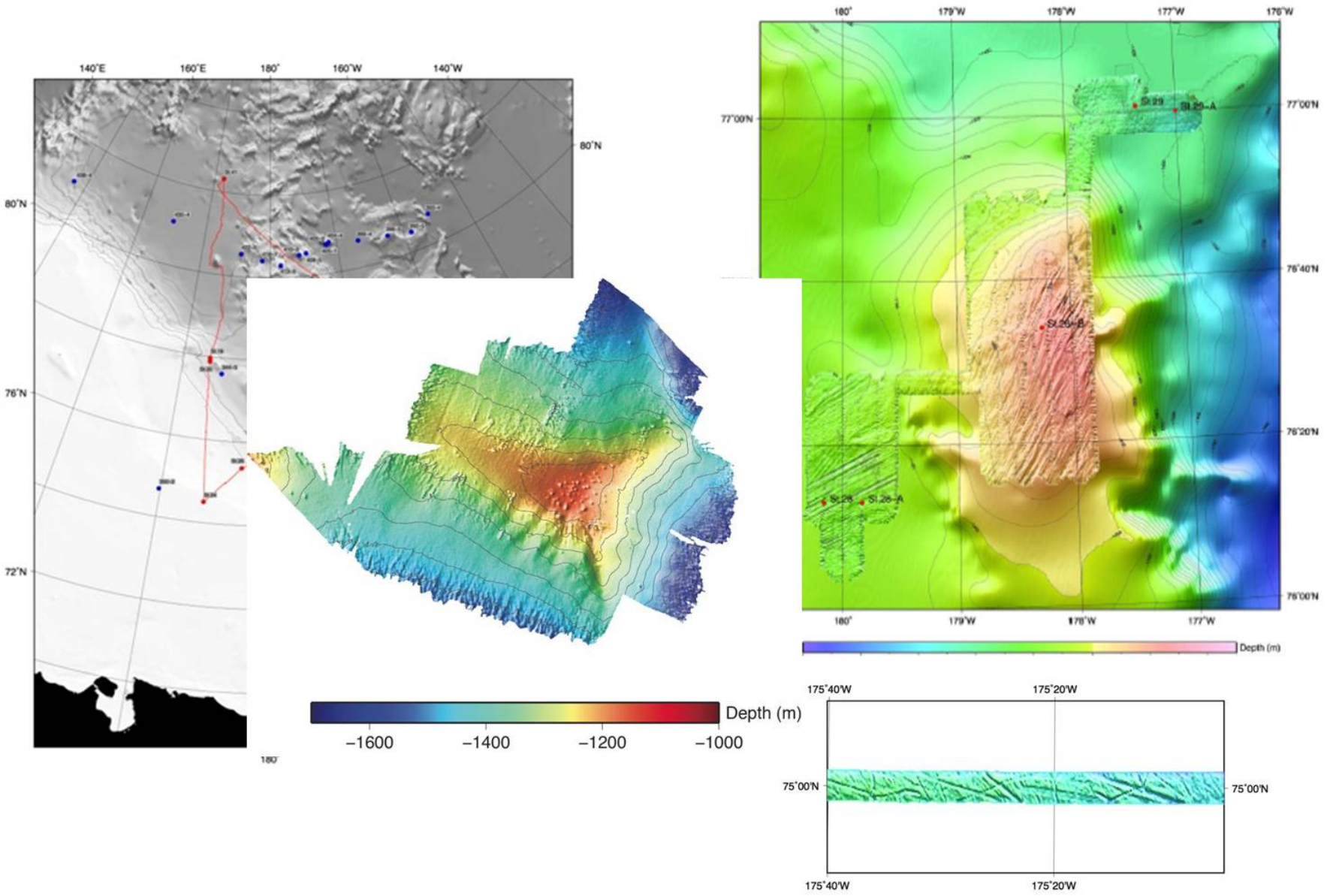


Paleoceanography

- **Reconstruction of glacial history & paleoceanography in the western Arctic**
  - Acquisition of ca. 10,000 km SBP & Multi-beam data
  - 24 Geo-stations: ca. 130 m sediment cores
  - MSCL logging & XRF core scanning♪



Iceberg scouring and pockmark on the shelf and in the deep sea



2013 Plan♪

Long-term Plan of Araon Arctic cruise♪

Broader Areas of the Arctic

Bering, Chukchi, Beaufort Seas

Chukchi and East Siberian Seas

Chukchi and Beaufort Seas

Chukchi Borderland & Mendeleyev Ridge

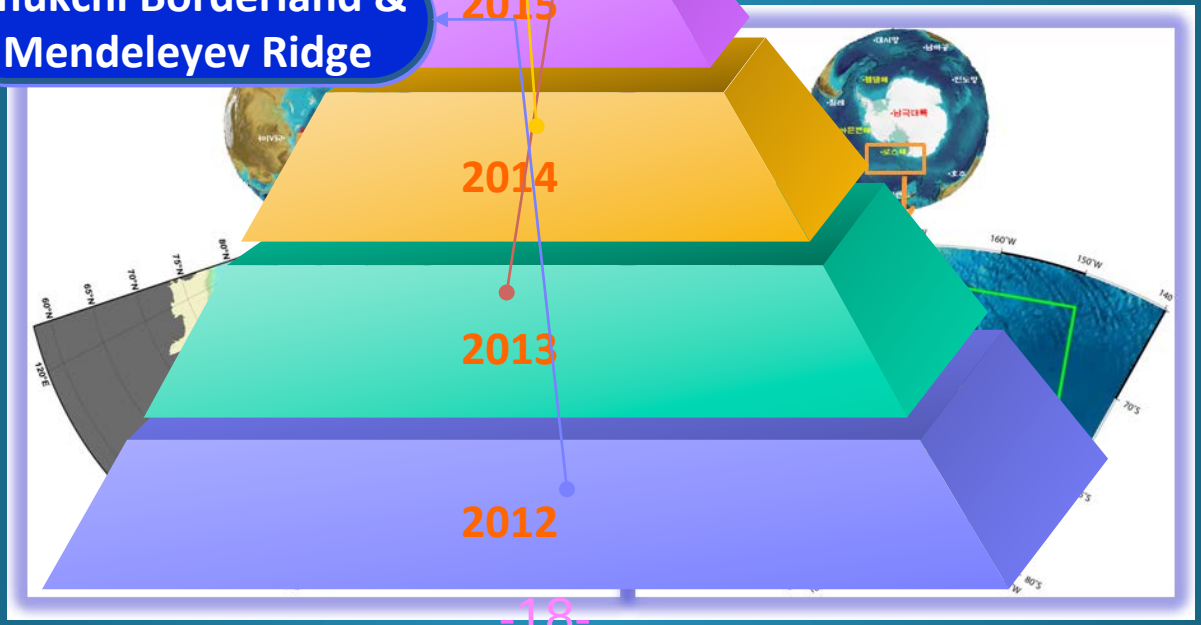
2016~

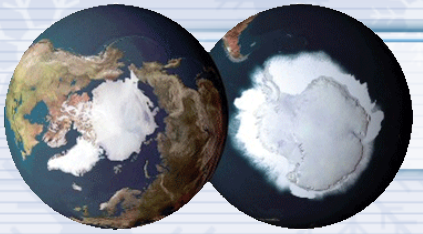
2015

2014

2013

2012





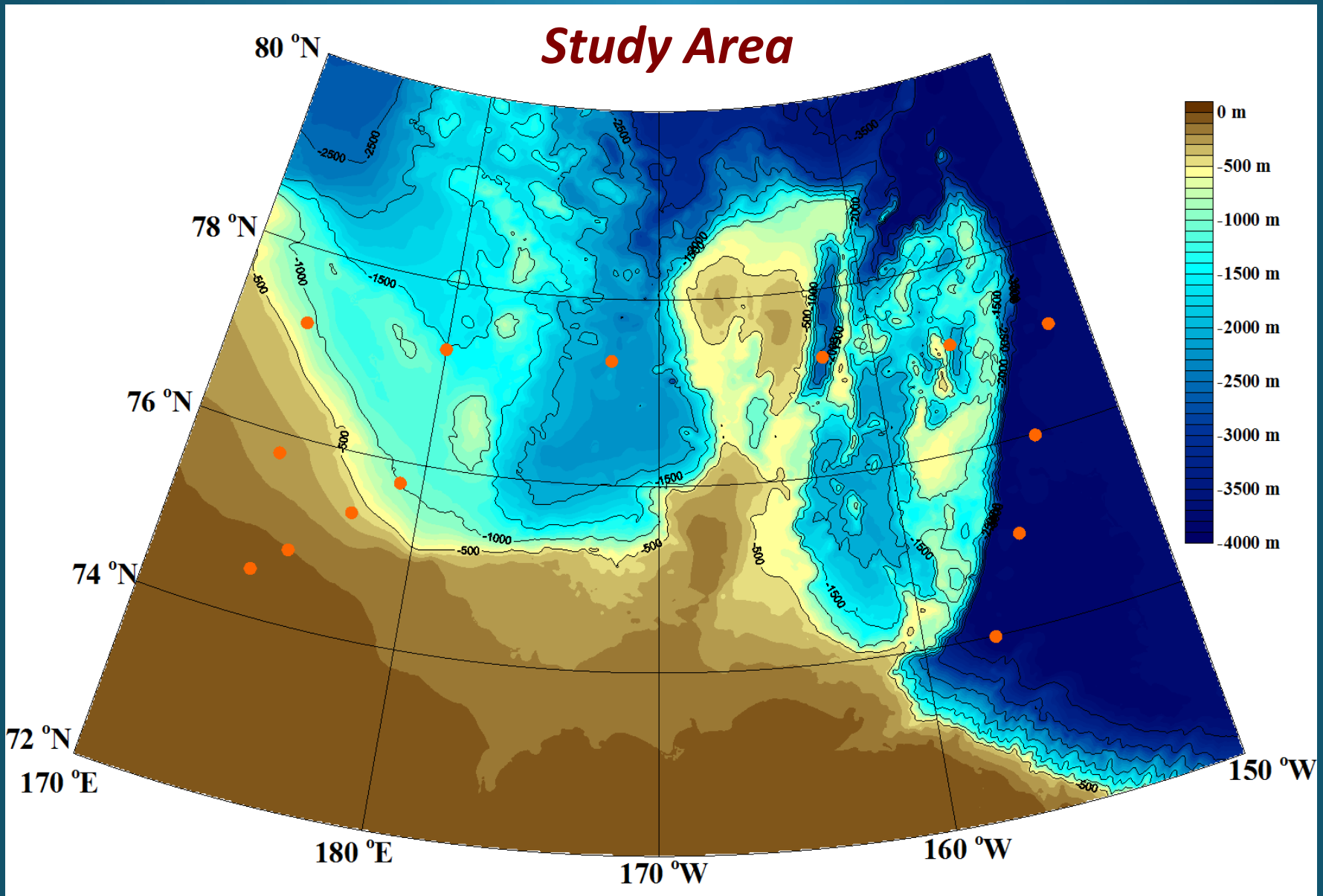
Future plan♪

- 2013 August; Leg 1: ocean and paleoceanography in Chukchi Sea, Leg 2: geohazard research (gas hydrate) in Canadian Beaufort Sea as major effort

- 2014 August; sea-ice camp, oceanography and marine ecosystem studies, paleoceanography in Bering, Chukchi, Beaufort Seas (2 months)

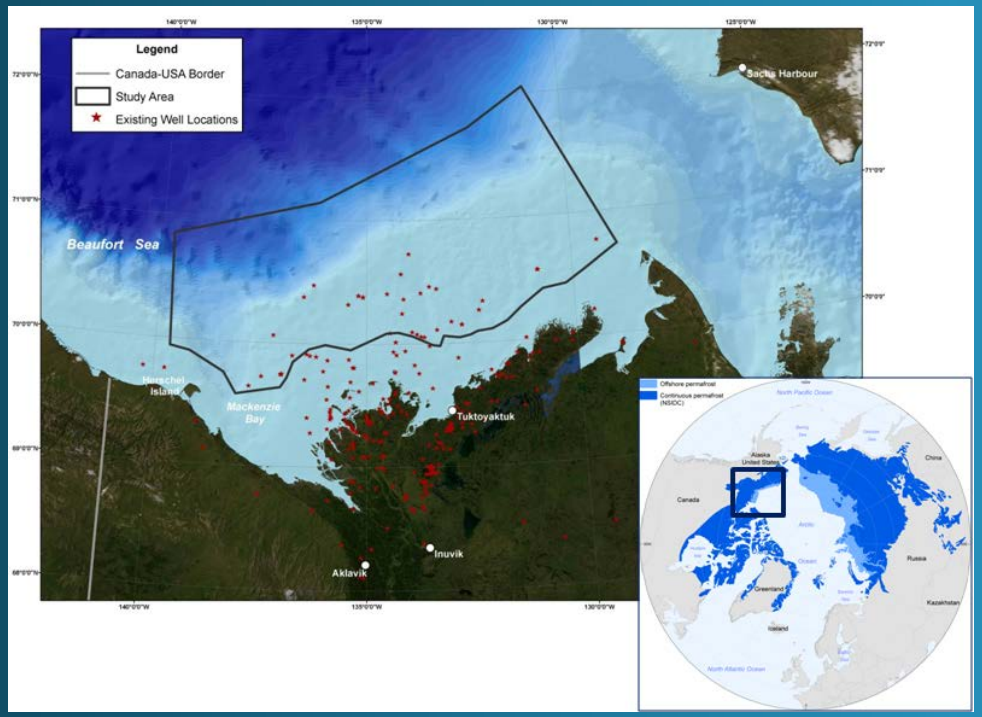
- 2015; discussion underway, possibly late summer/autumn sea ice, air-sea interaction campaign in East Siberian Sea (Ice camp)♪

Study Area


80 °N
78 °N
76 °N
74 °N
72 °N
170 °E
180 °E
170 °W
160 °W
150 °W
0 m
-500 m
-1000 m
-1500 m
-2000 m
-2500 m
-3000 m
-3500 m
-4000 m

Beaufort Sea Cruise : Gashydrate study

Geophysical survey on the Beaufort Sea using multichannel seismics, multibeam echosounder and SBP
Korea/Canada/US Joint Program



Purpose of the Study

To reveal geological structures of th e permafrost and gas bearing layers

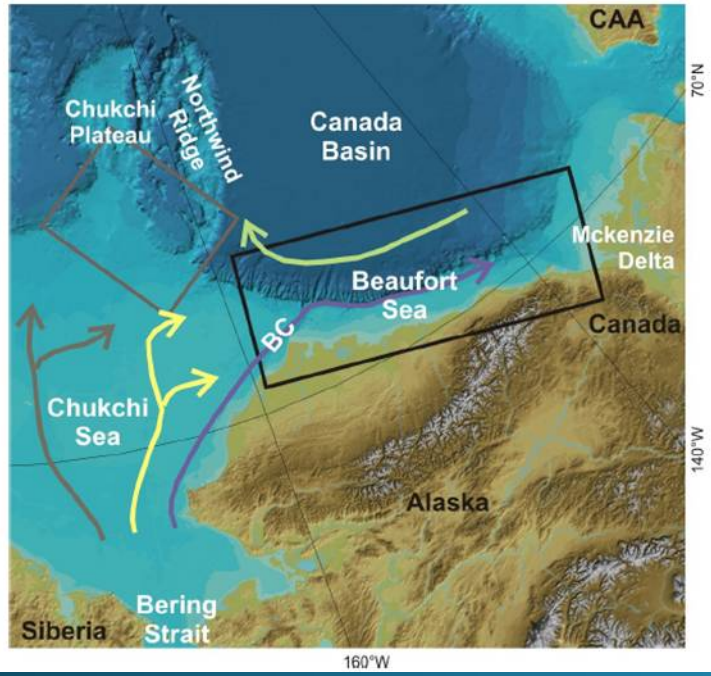
To understand geohazard by gas hy drates

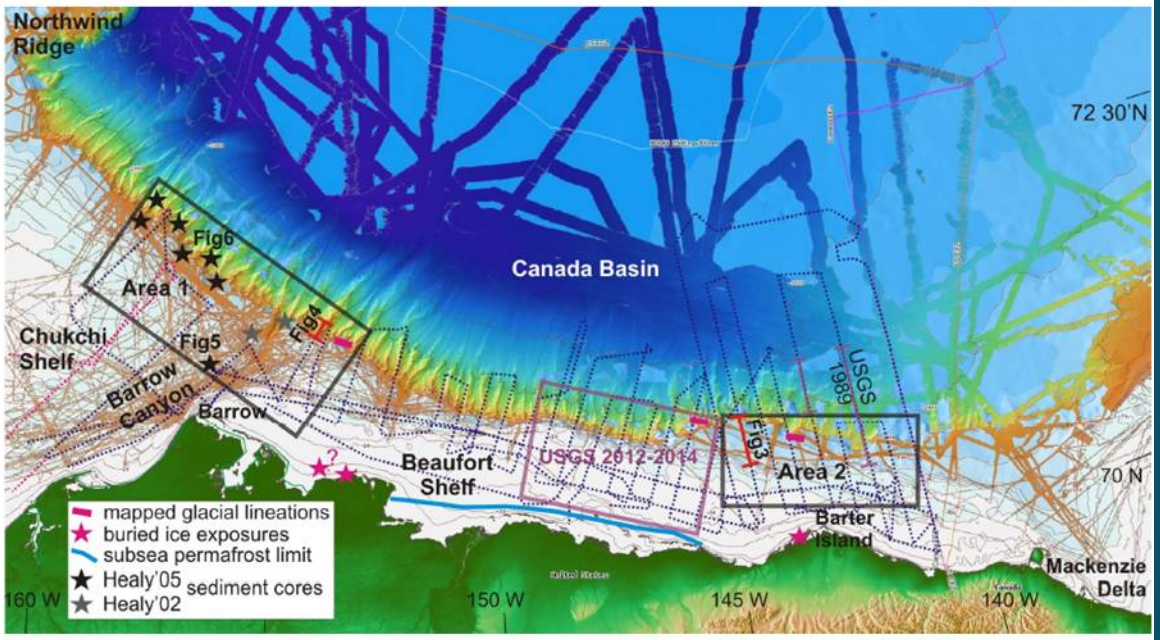
To study the effect of gas from the s ediment on ocean and atmosphere

- *Korea-Polar Ocean in Rapid Transition (K-PORT) program*

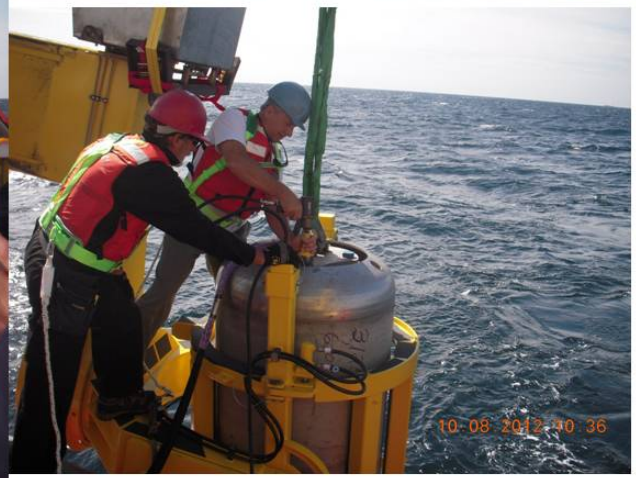
Chukchi Sea & northern Alaska Margin: Geophysics & paleoceanograhy

- 4 countries joint survey (Korea, Germany, USA, Japan)
- Acquisition of SBP & multibeam from survey area
- Recovery of long sediment cores using JPC long core
- Submission of IODP proposal on Chukchi-Alaskan Marine Paleooceanography♪





40 m Jumbo Piston Core System



Possible opportunities for upcoming season ♪

Leg 1; 25 Aug 2013 – 3 Sep 2013 (Nome to Barrow)♪

Leg 2; 12 Sep 2013 – 28 Sep 2013 (in Canadian Beaufort, f rom Barrow back to Barrow)♪

Berth for observation and simple underway instrument d eployment♪

Long term engagement and involvement in sub-Arctic mo nitoring/observation♪

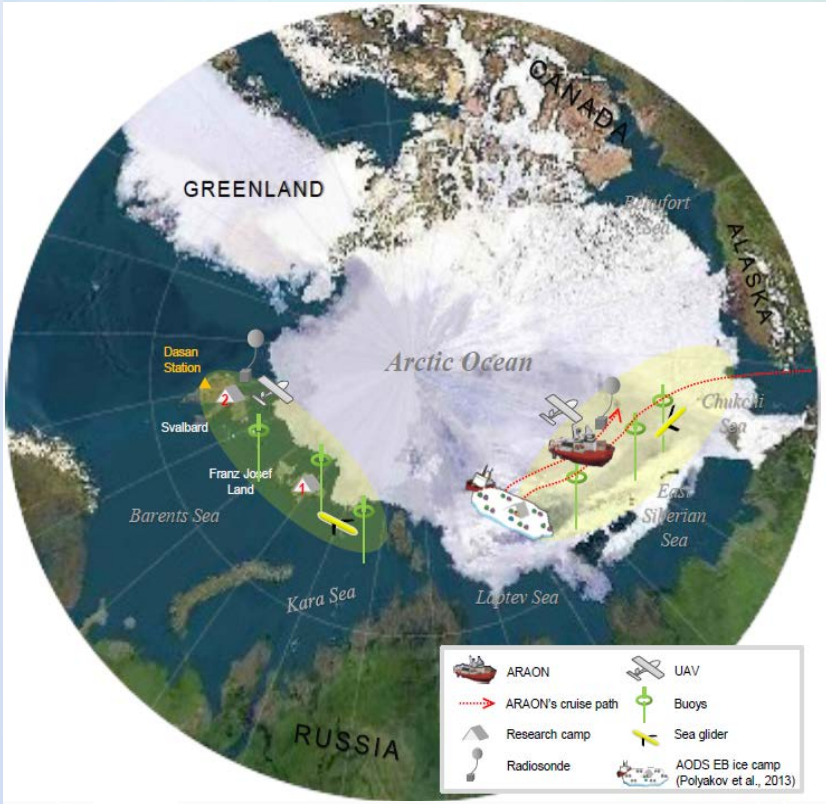
Contact
Sung Ho Kang (shkang@kopri.re.kr)

- Rapid decline of the Arctic sea-ice is conside red as a cause of extreme weather events o ver many mid-latitude regions including Kor ean peninsular

- It is important to understand the intense he at exchange events during a cold air outbre ak in the west Arctic Ocean to improve our seasonal and decadal predictability of the i mpacts of future Arctic climate changes.

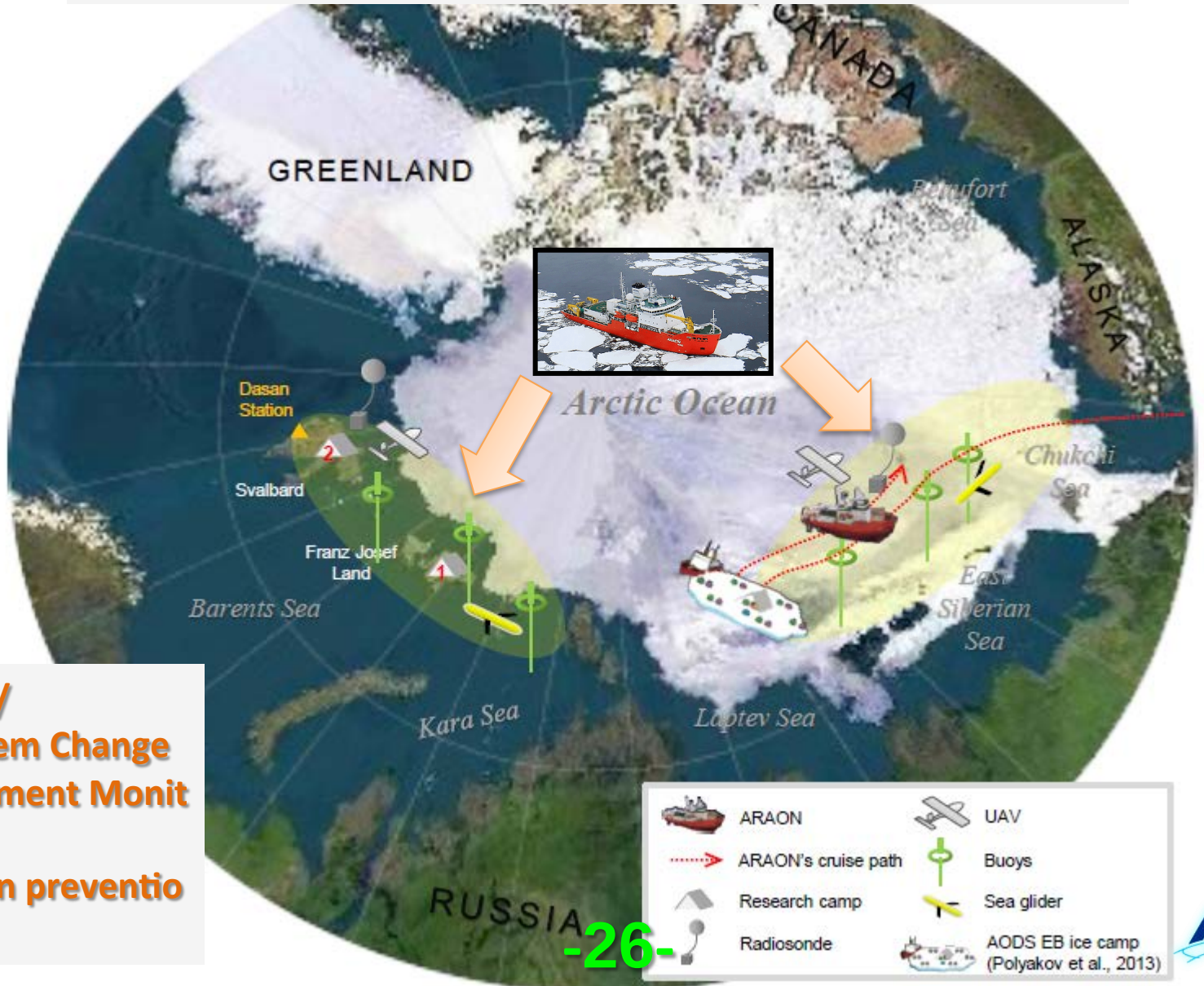
- KOPRI is going to conduct a comprehensive observational study in ice-based camps at t he northern Barents/Kara Seas and on boar d Korean icebreaker ARAON in the Chukchi and East Siberian Seas.

- We expect the proposed observations can l ead to the improvement of numerical mode ls' capability of prediction of future climate change in the Arctic.♪



Possible Joint Research with *ARAON*

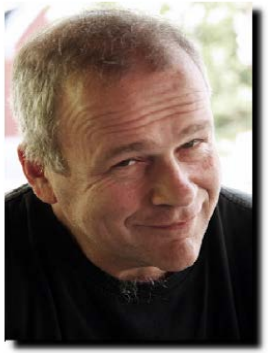
Comprehensive Observational Study in the Seasonal Ice Zone: Role of Air-Sea Interaction for Arctic Amplification♪



Climate/ Ecosystem Change Environment Monitoring/ Pollution prevention

Thank you

In Loving Memory



Martin (Marty) Bergmann
February 19, 1956 - August 20, 2011

In Loving Memory

KyungHo Chung
November 02, 1959 - December 25, 2012