Pacific Arctic Group:
Korean Arctic Ocean Research in 2012/2013

Ho Kyung Ha

Pacific Arctic Group Meeting

Suzhou, China

November 5, 2012

Korea Polar Research Institute

Objectives

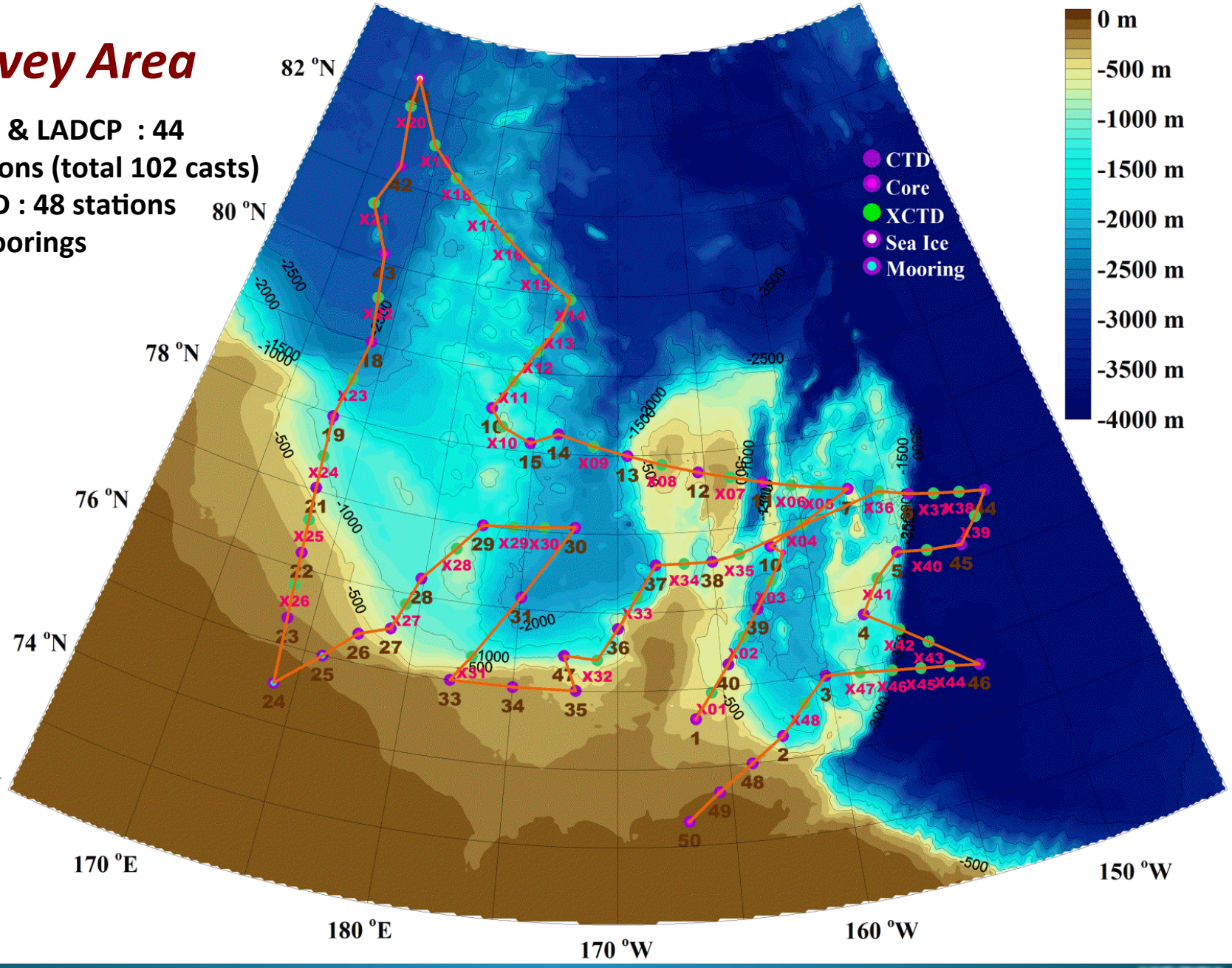
- To monitor marine system responding to ongoing climate changes in the polar oceans
- Chukchi Sea in the Arctic; Ross Sea in the Antarctic

2012 Cruise Summary

- **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 : Sung-Ho Kang (PI)*
  - *The Arctic Paleoceanography (K-POLAR) program: Seung-Il Nam (PI)*
  - *Korea-Polar Ocean Discovery (K-POD) program: Jung-Han Lim (PI)*
- **Period:** 2012. 08.01 ~ 09.10 (Nome to Nome)
- **Chief Scientist:** Dr. Sung-Ho Kang
- **Participating nations:** Korea, China, Japan, US, Canada, Russia, Germany , UK, India, Nepal
- **Research fields:**
  - Hydrographic ocean survey
  - Satellite remote sensing
  - Microbes & plankton ecology
  - Melt pond (ice algae) study
  - Marine geophysics
  - CO_2 systems in water column
  - Atmospheric observation
  - Sea ice study
  - Cryobiology
  - Paleoceanography

Survey Area

- CTD & LADCP : 44 stations (total 102 casts)
- XCTD : 48 stations
- 2 moorings

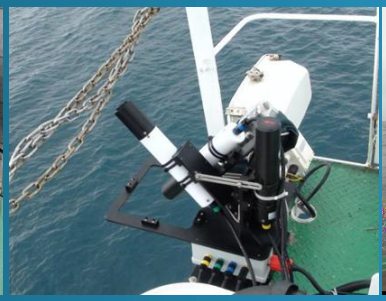


Research Activities

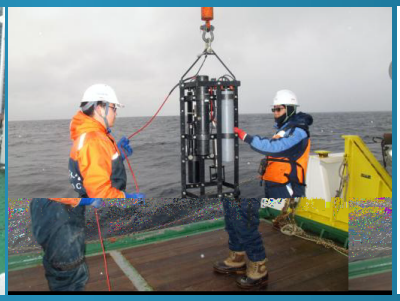
Satellite Remote Sensing

- Ocean Color Remote Sensing (Ocean Optics Measurement)

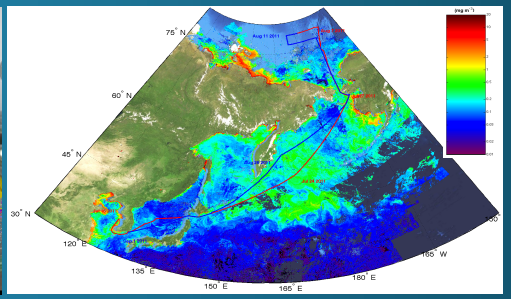
Hyper-spectroradiometer



Above water spectroradiometer



APC deployment

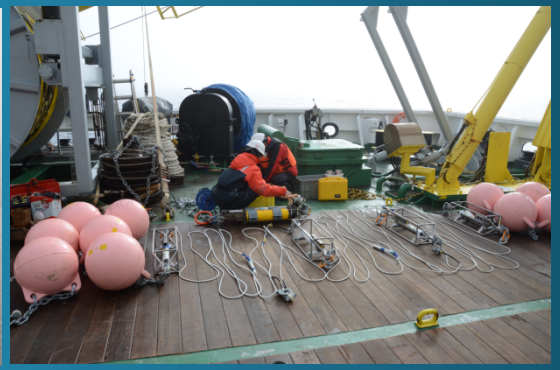


Hydrographic Survey

- Water mass distribution (T/S) & current field in Chukchi Borderland/Mendeleev Ridge

CTD & ADCP

XCTD



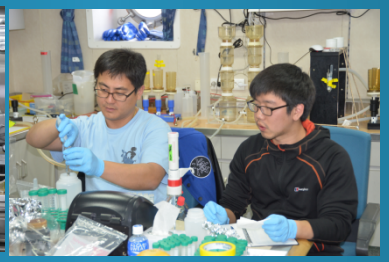
Ocean Mooring

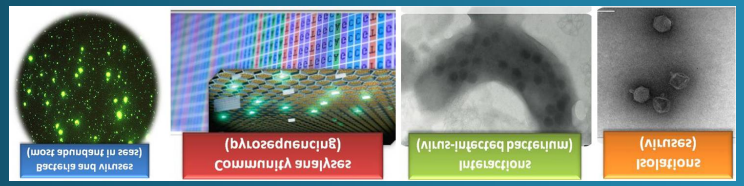
Microbes/Plankton Ecology

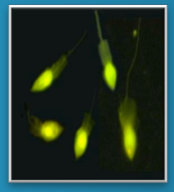
- Distribution of bacteria, virus and community structure
- Species compositions of phytoplankton , chlorophyll *a* concentration and primary production
- Abundance and community structure of heterotrophic protists
- Mesozooplankton community and grazing impacts on phytoplankton biomass





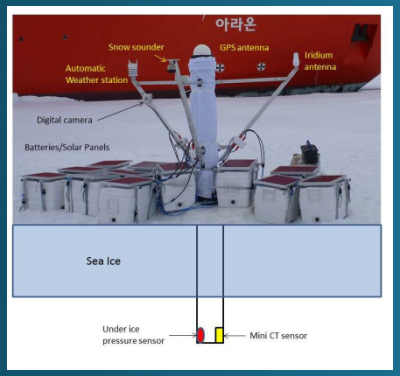





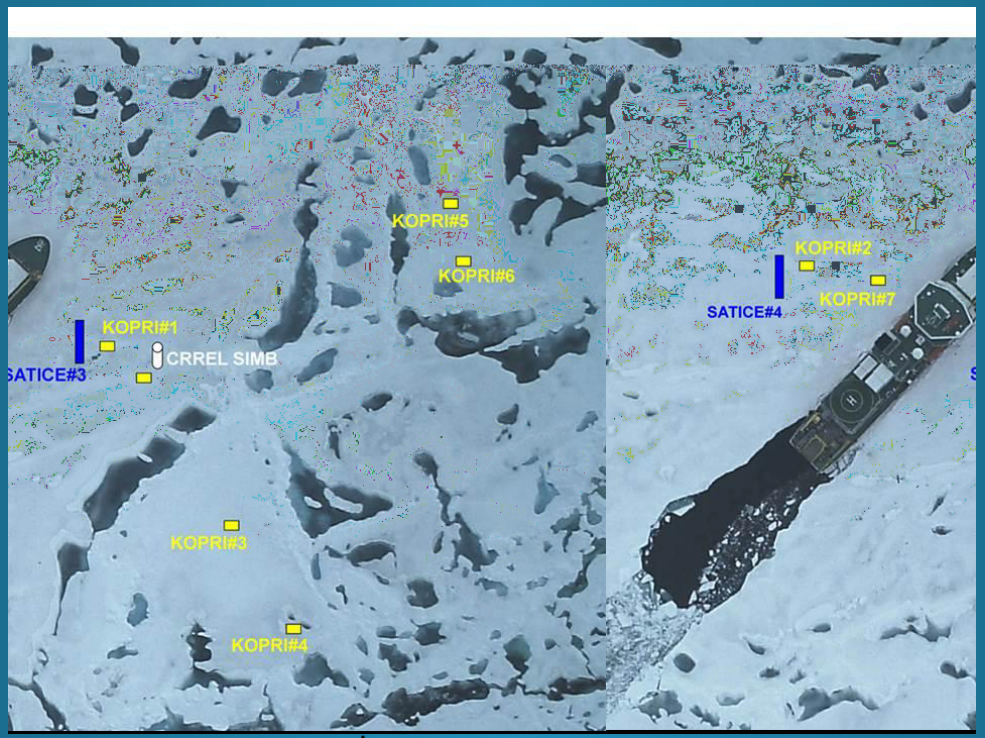



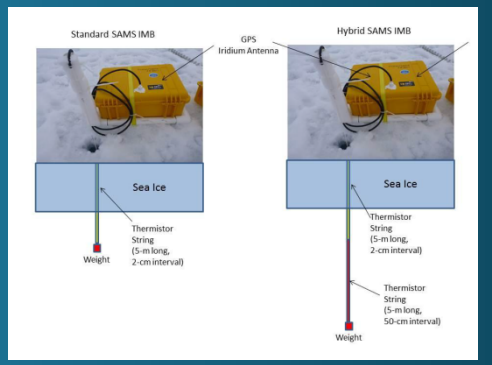

Sea ice study

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



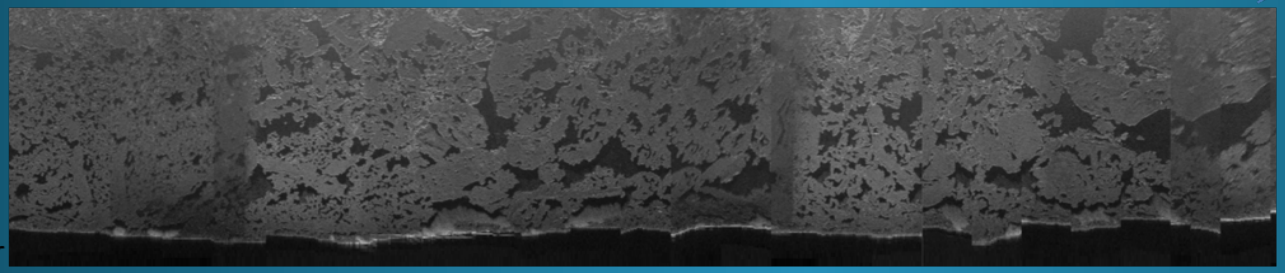
SATICE buoy



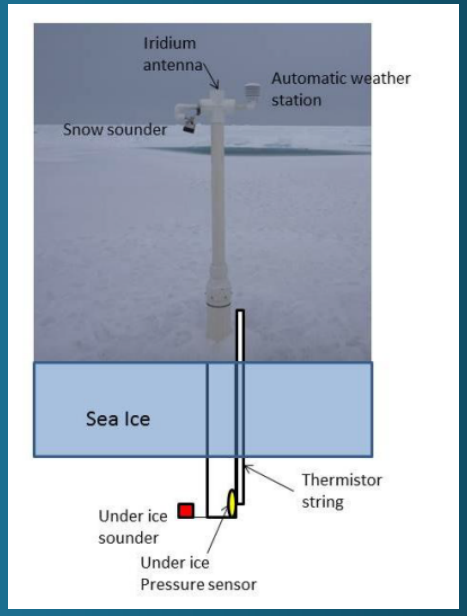


SAMS/KOPRI IMB buoy

far 05:02 UTC time



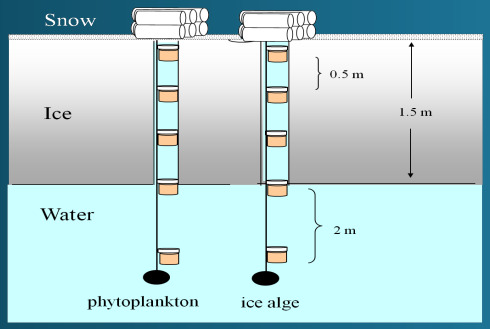
near



CRREL buoy

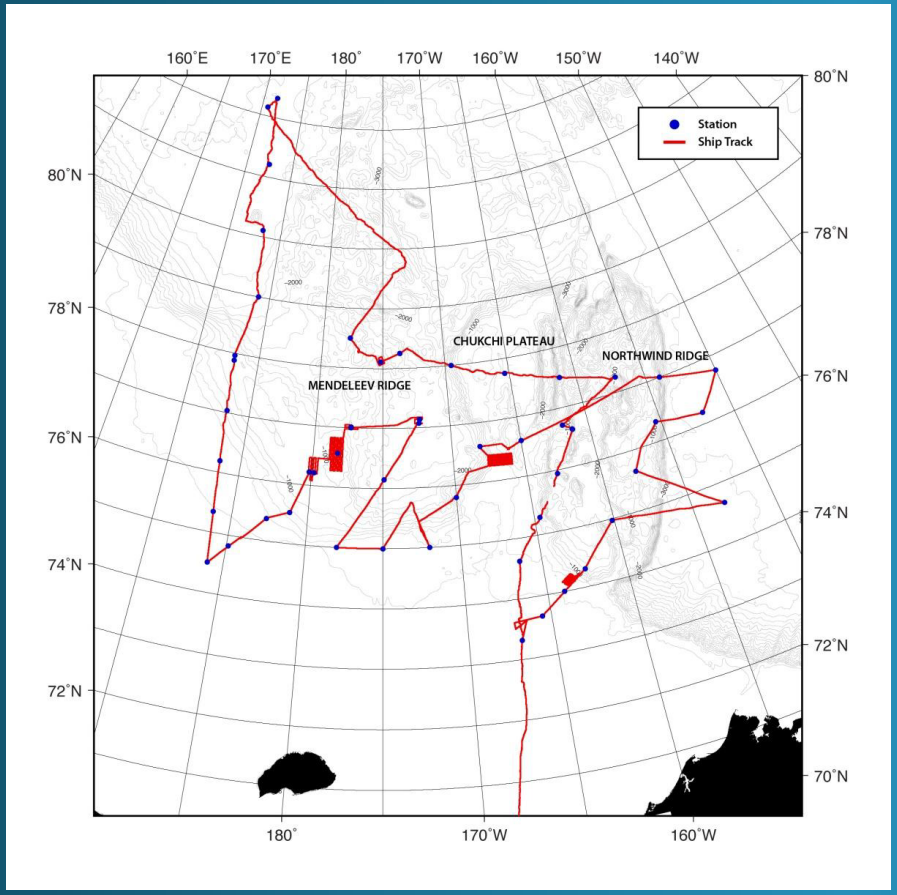
Melt pond study

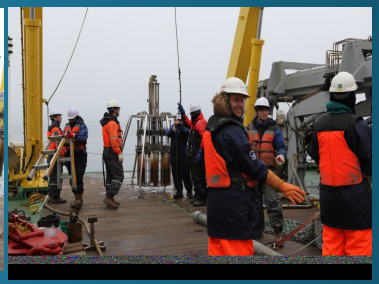
- Species composition and abundance of ice algae
- Productions and macromolecular compositions of algae
- Particle flux under the sea ice



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
  - XRF core scanning





2013 Plan (tentative)

2 cruise legs in 2013 :

(1) Ocean + Paleoceanography

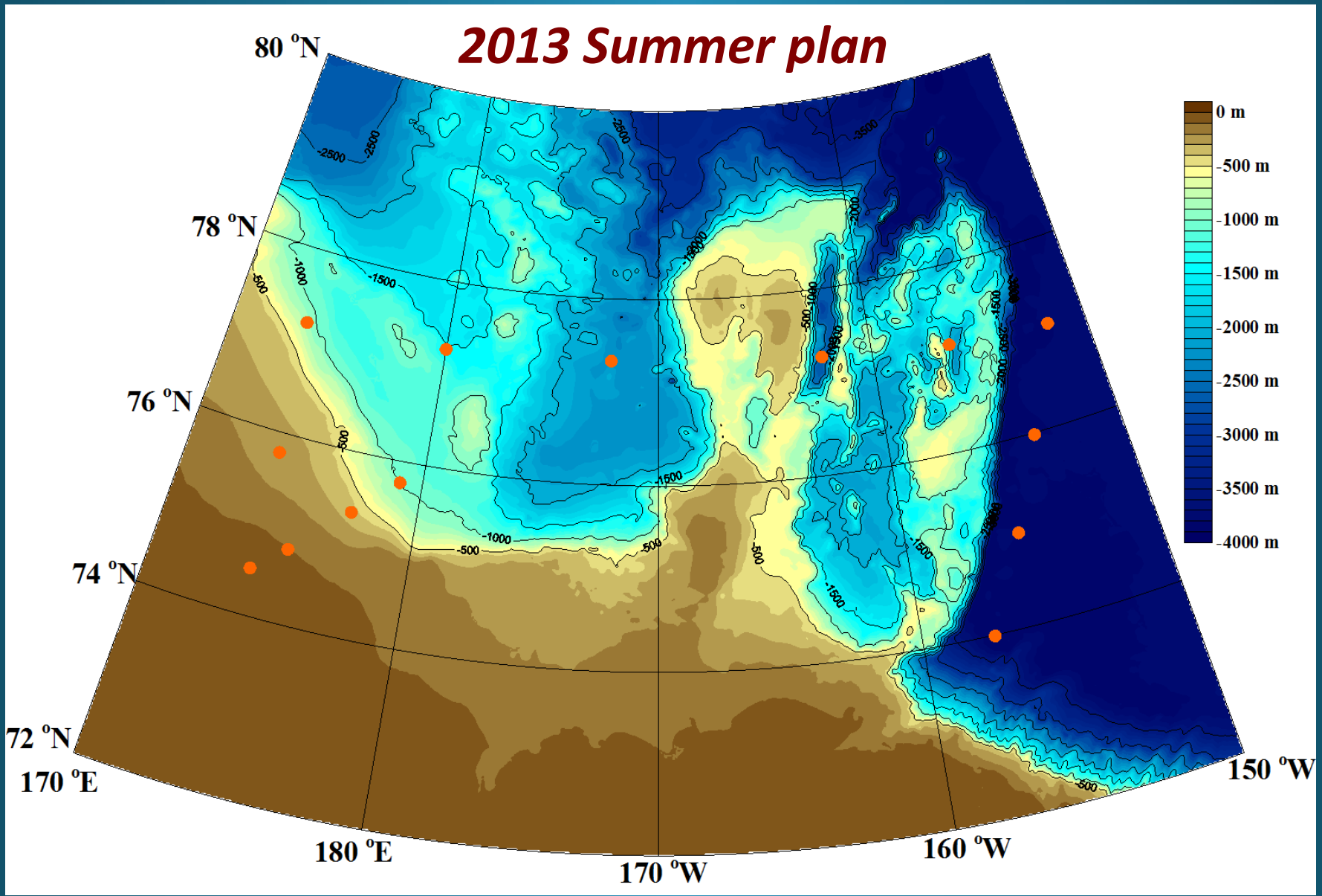
(2) Geophysics + Gas hydrate

1-a. Chukchi Sea Cruise: Ocean Study

- **Aim:** **Same with 2012 cruise, but narrow study focus** due to limited time
  - ***Korea-Polar Ocean in Rapid Transition (K-PORT) program***
- **Period:** **Early September, 2013 (1st leg)**
- **Chief Scientist:** **Kyung Ho Chung**
- **Participating nations:** **Korea, Japan, US, Canada, Germany, UK**
- **Research fields:**

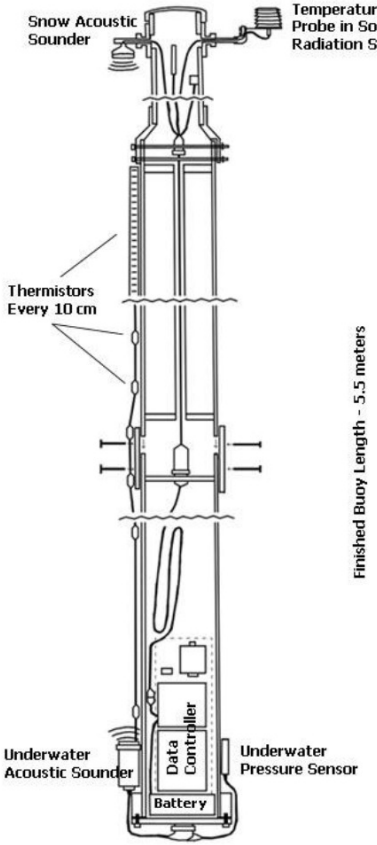
- Atmospheric observation
- Satellite remote sensing
- Microbes & plankton ecology
- Sea ice works
- CO_2 systems in water column
- Hydrographic survey
- Marine geophysics

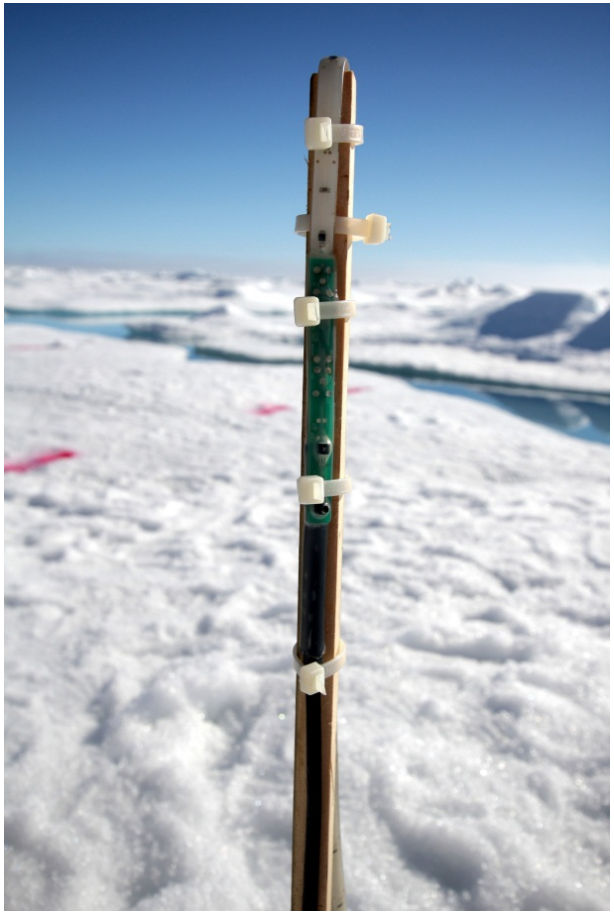
2013 Summer plan



- Mooring recovery and service
- 77 N will be maximum.

Collaboration – buoy & sea ice work





CRREL
Seasonal Ice Mass Balance Buoy (SIMBB)

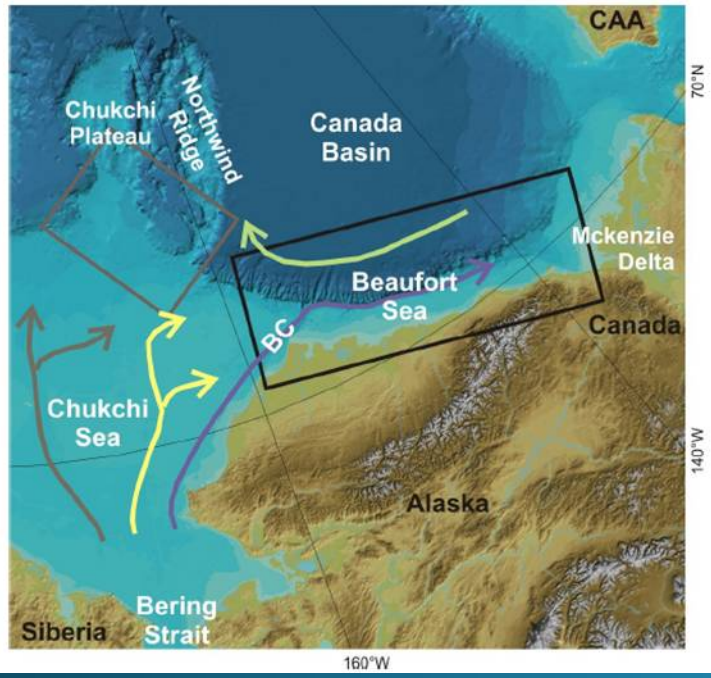
SAMS
Thermistor array

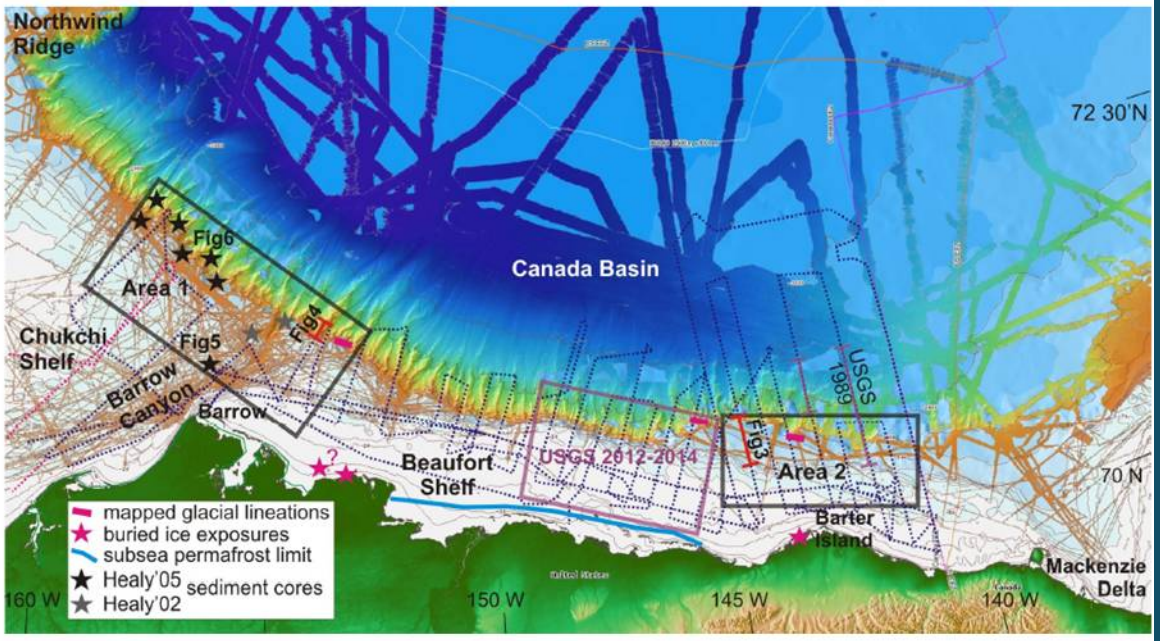
Other buoys: WHOI, UW (UpTempO) …

PI: Dr. Seung-Il Nam (sinam@kopri.re.kr)

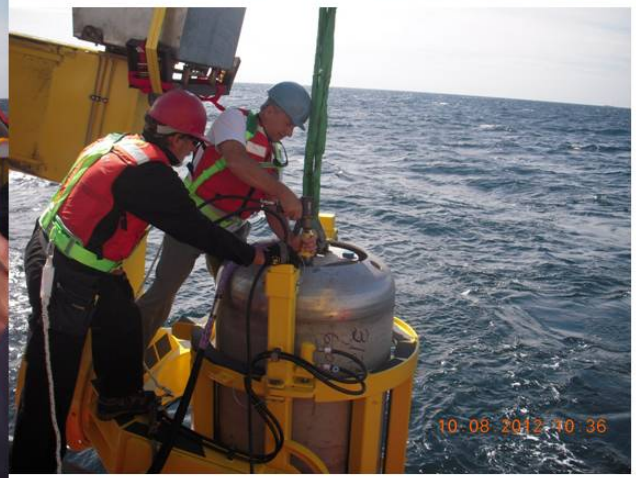
1-b. Chukchi Sea & northern Alaska Margin: Paleoceanography

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





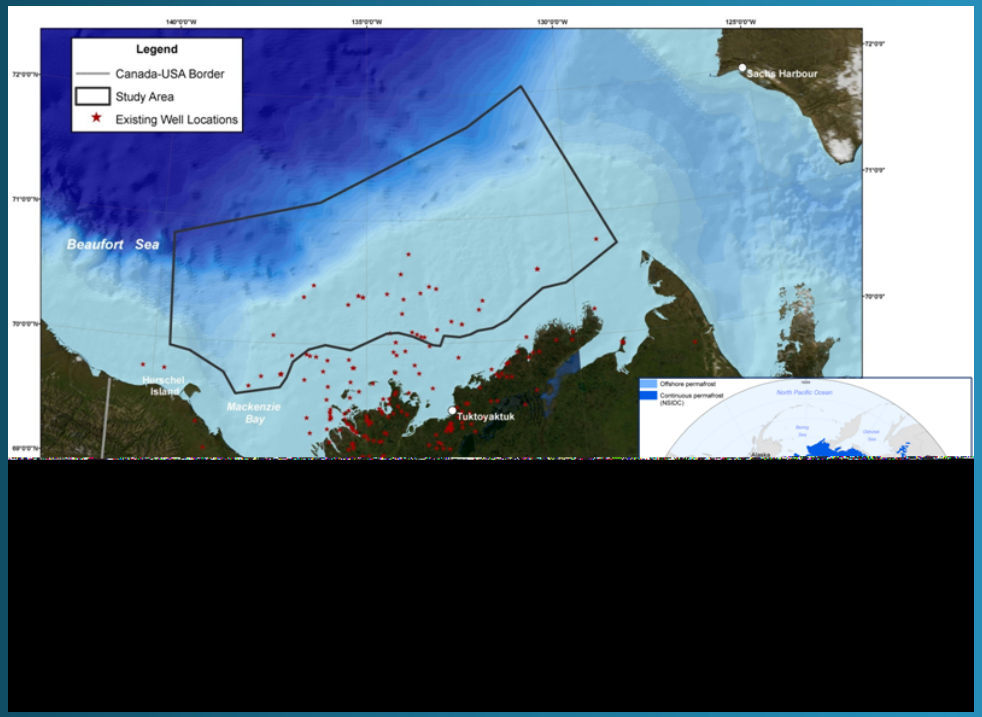
40 m Jumbo Piston Core System



Coming soon in IBRV *Araon*!

2. Beaufort Sea Cruise : Gas hydrate study

- Korea/Canada/US Joint Program
- Geophysical survey on the Beaufort Sea using multichannel seismic, multi-beam echosounder and SBP



Purpose of the Study

- To reveal geological structures of the permafrost and gas bearing layers.
- To understand geohazard by gas hydrates
- To study the effect of gas from the sediment on ocean and atmosphere

- **Period:** Late September, 2013 (2nd leg)
- **Chief Scientist:** Dr. Young Keun Jin

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

Thank You

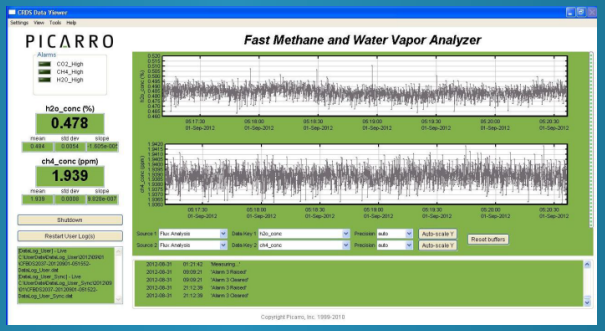
Survey component

- **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**
- **On-shore calibration of instrument compasses**
- **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
- **Cryobiological components**

Atmospheric Observation

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

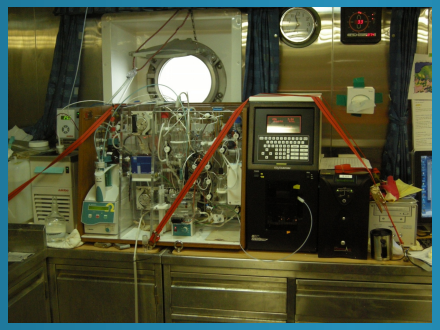
Open-path eddy covariance at the foremast of ARAON



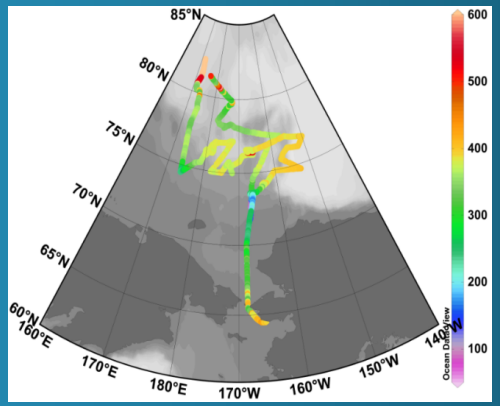
Real time variation of CH_4 and H_2O in flux mode

CO_2 system in water column

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



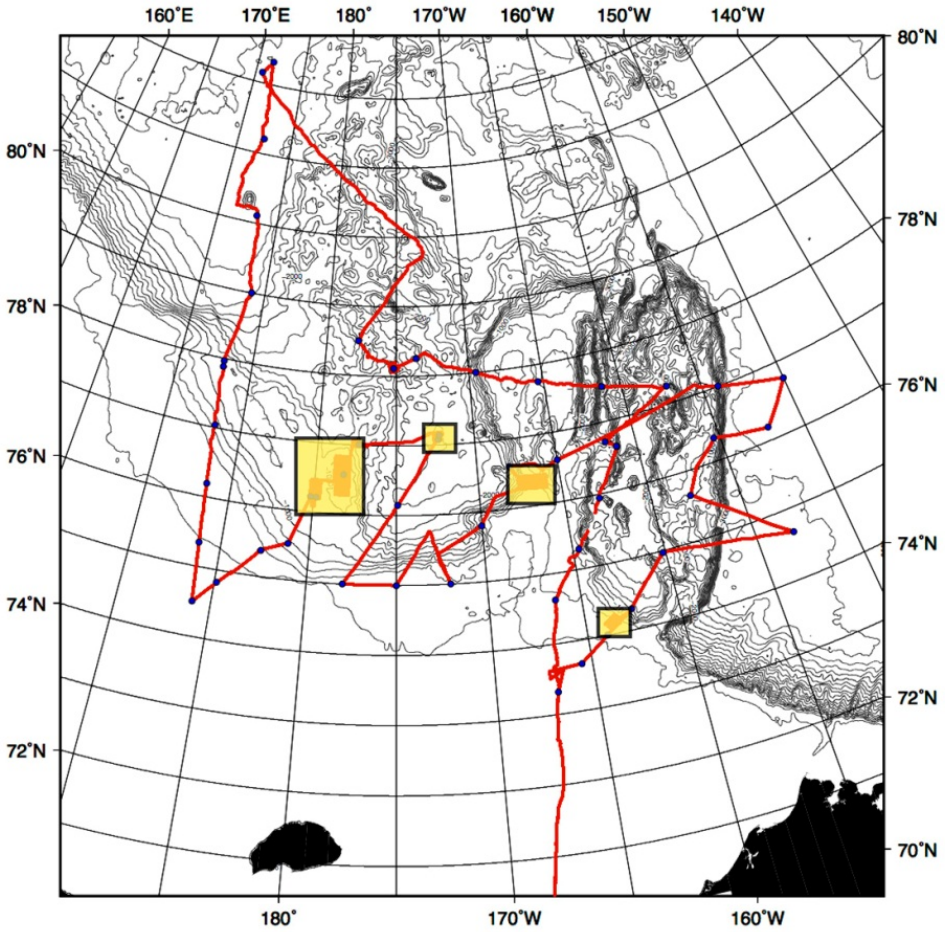
Analytical system for DIC and TA



Dissolved pCO_2 along the track

Marine Geophysics

A New understanding of Arctic bathymetry and paleogeography



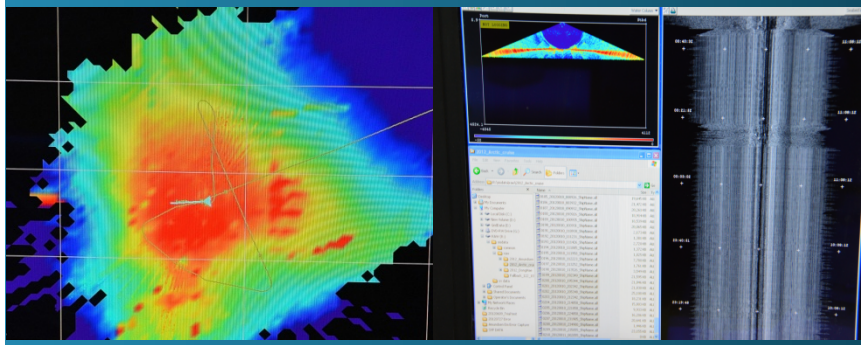
In the Chukchi sea, many subsurface features are unknown.

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.



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