Korea's Arctic research activity and plan; 2014-2015

International cooperation department
Korea Polar Research Institute

KOPRI 극지연구소

prepared for FARO, 25 April 2015, Toyama, Japan

Outline

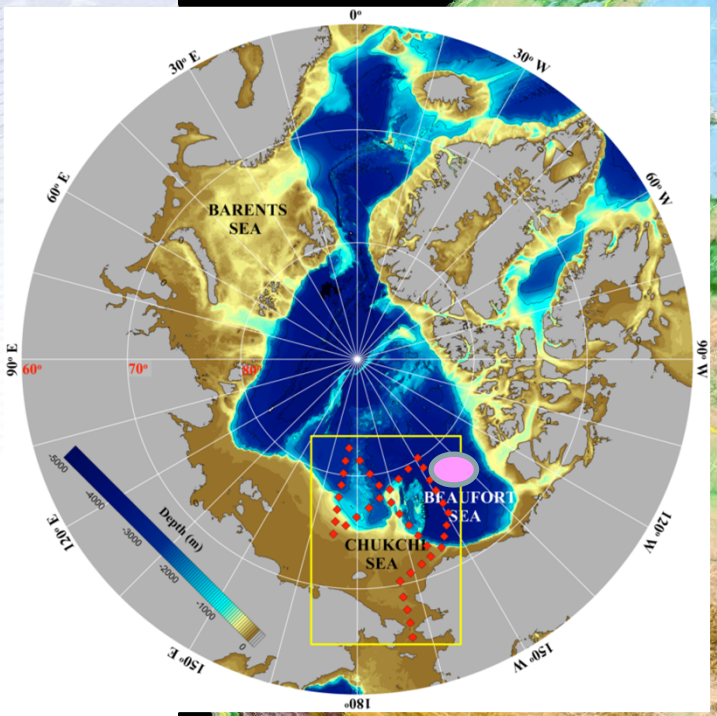
Ocean going expedition

Land-based efforts

Expanding partnership

Korean Arctic Consortium & Arctic Council WG participation

2014 RV ARAON cruise track, study area, period



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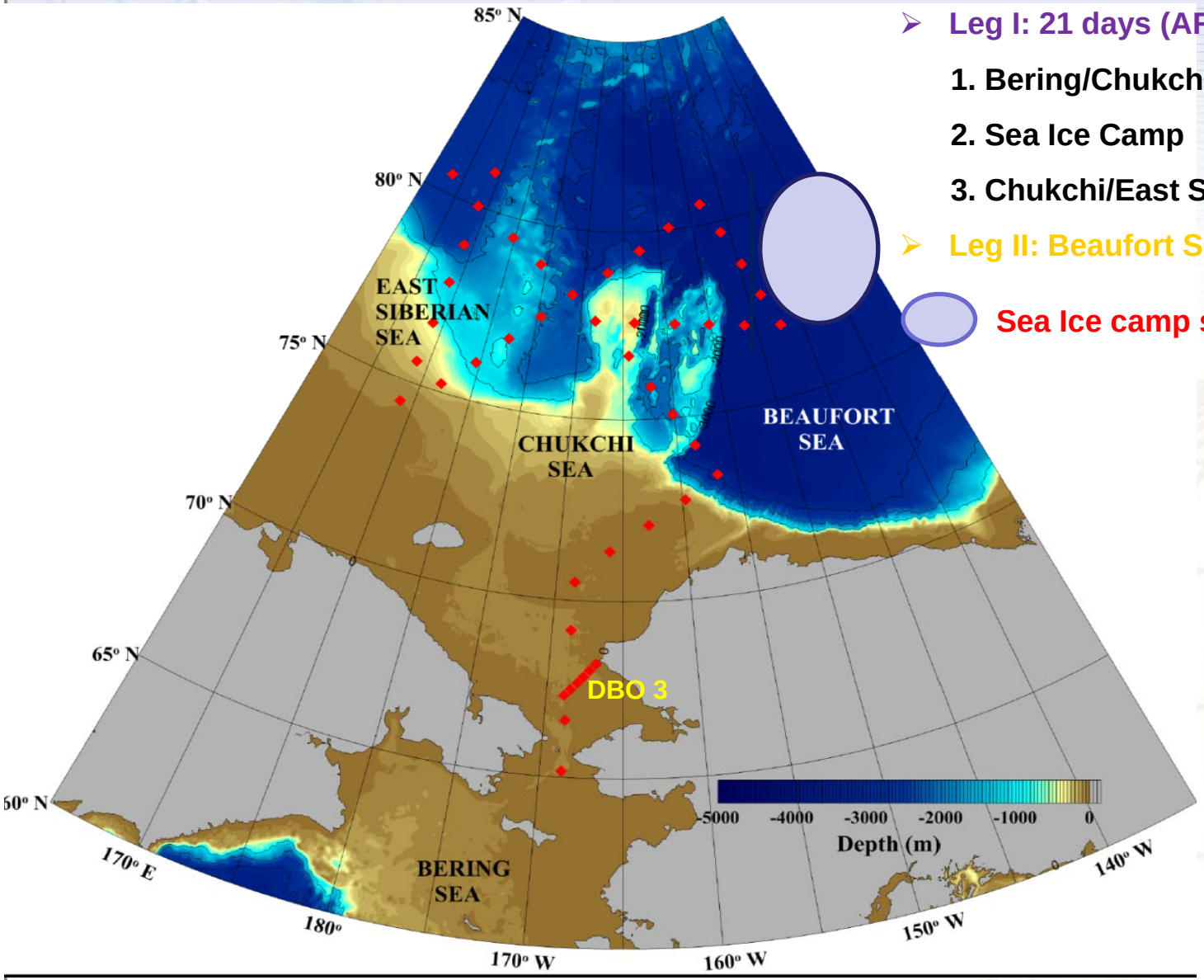
2014. 7. 16 ~ 10.03 (Total 79 days)

KOPRI

2014 Arctic Survey



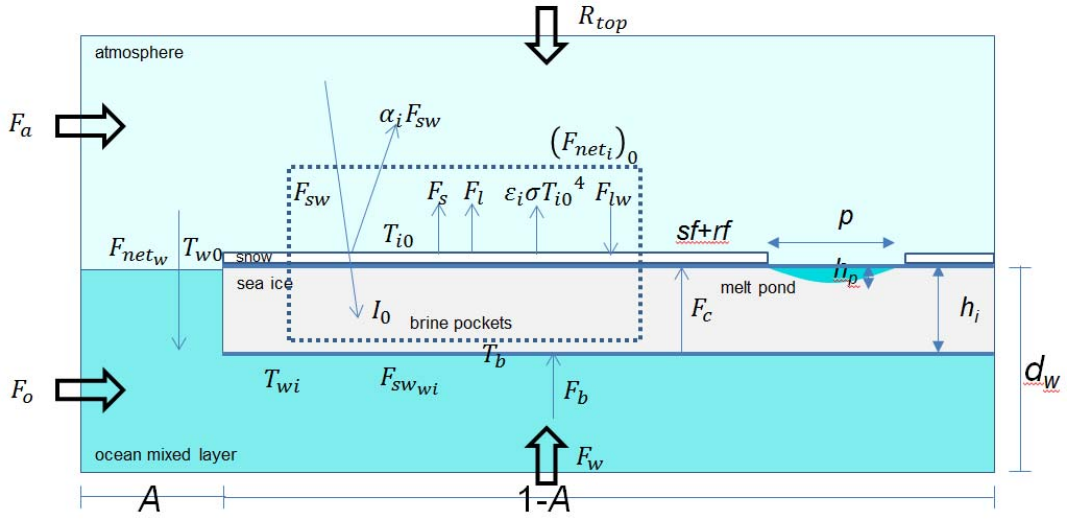
- **Leg I: 21 days (ARA05A)**
  1. **Bering/Chukchi Seas : 3 days**
  2. **Sea Ice Camp : 7 days (KOPRI+ONR)**
  3. **Chukchi/East Siberian Seas : 11 days**
- **Leg II: Beaufort Sea : 16 days (ARA05B)**

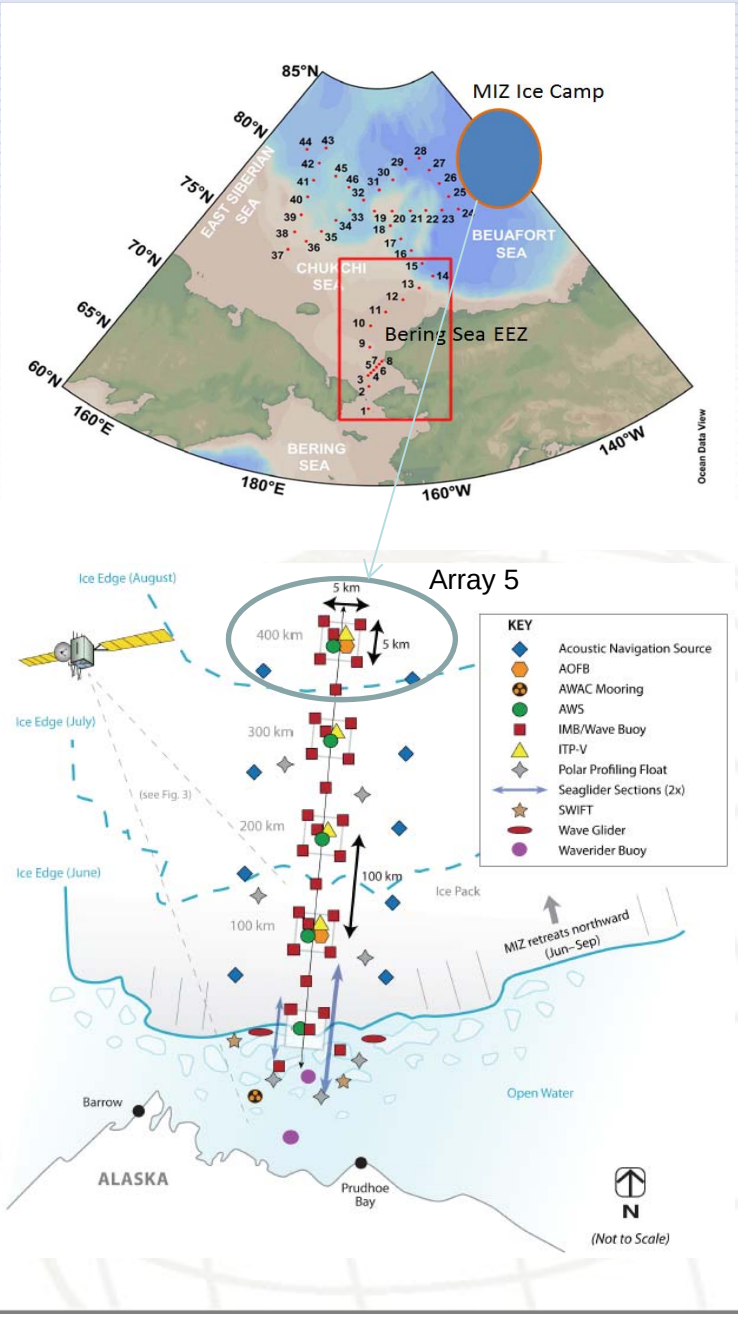
Sea Ice camp station (with ONR-MIZ)

Marginal Ice Zone (MIZ) Field Activities

2014 “ARAON” Arctic Cruise (Leg I)

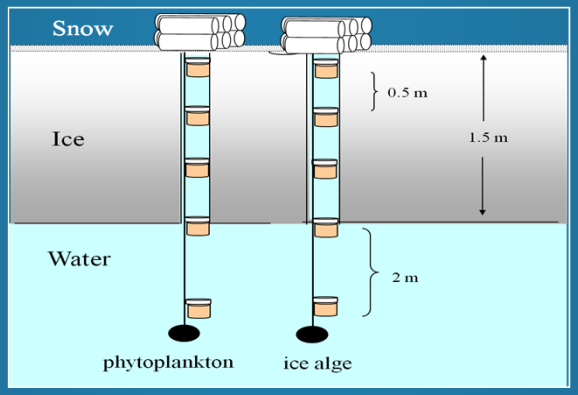
- “ARAON”: MIZ Ice Camp 2014
  - Observations
    - Ocean-to-ice heat fluxes
    - Meteorological variables
    - Radiative heat fluxes
    - Snow and ice thickness, ice temperature
  - Research subjects
    - Ice energy budget and thickness evolution
      - Sea ice energy budget
      - Sea ice model to simulate ice



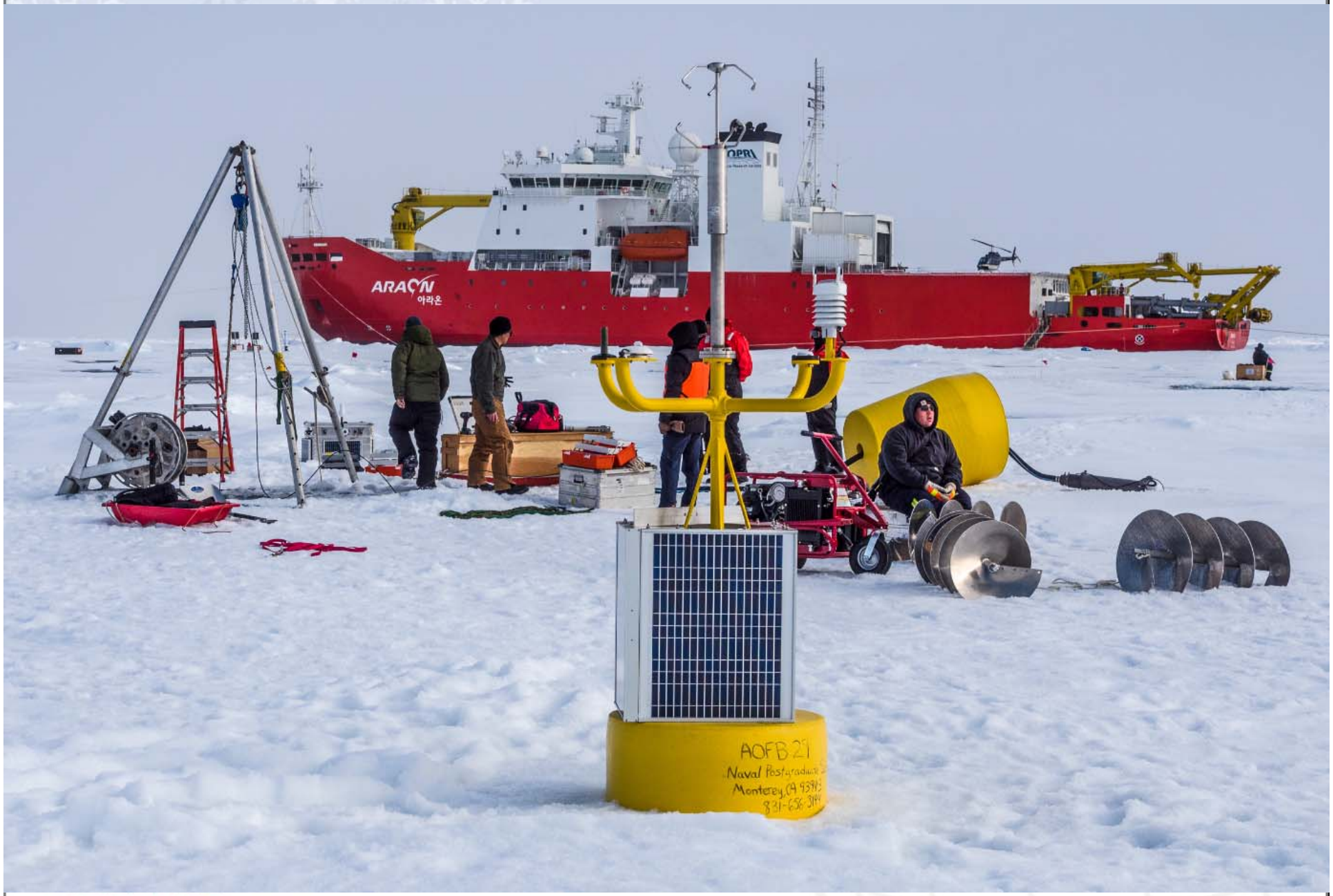


Sea Ice Biogeochemical Study

- The effect of changing sea-ice on Arctic marine ecosystem
- Species composition, abundance, and diversity relative to 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

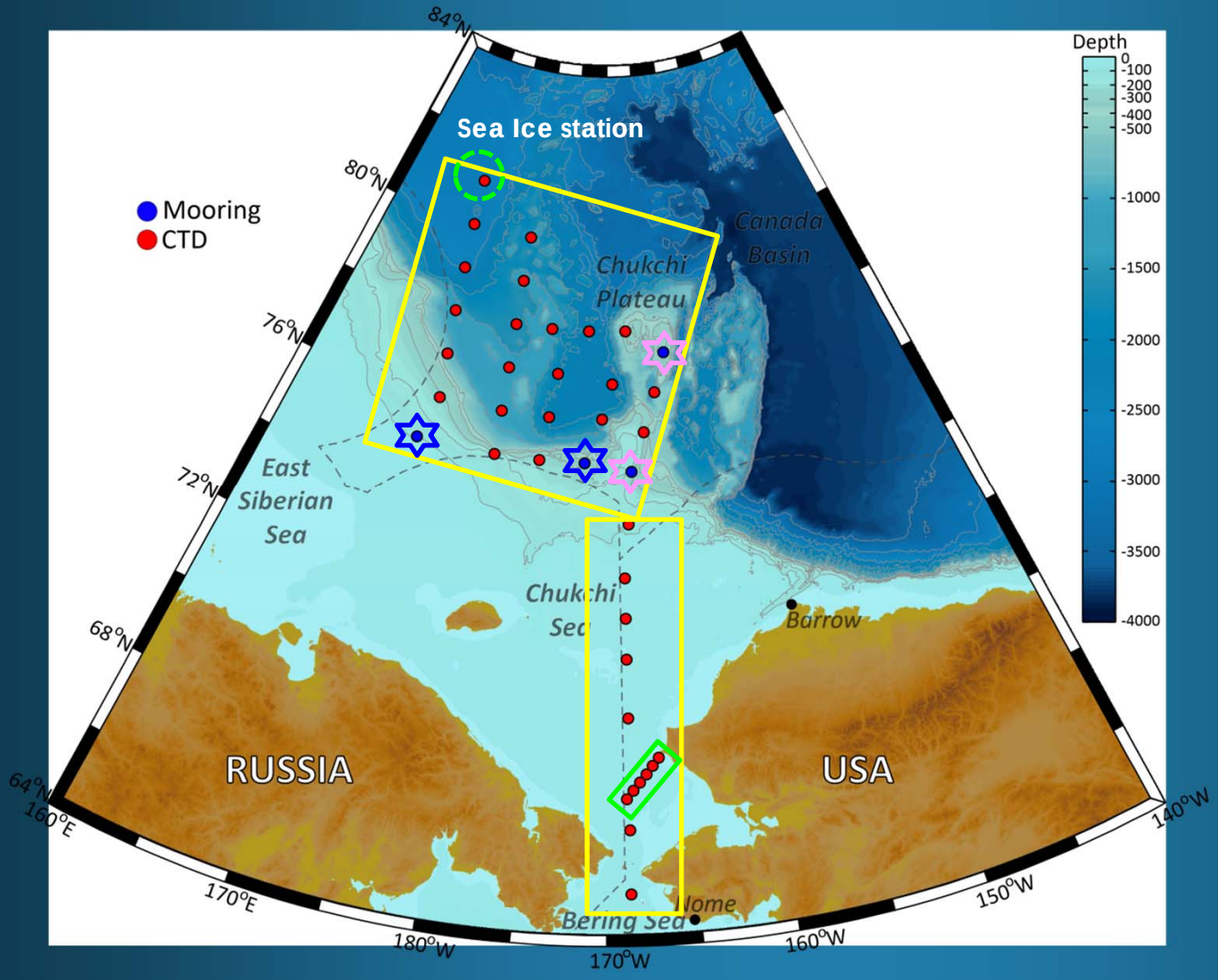



ARAÓN


ARAON
아라온
AOFB 21
Naval Postgraduate
Monterey, CA 9394
831-656-3144

2015 Arctic Survey plan

1st Leg (ocean and geophysics study)

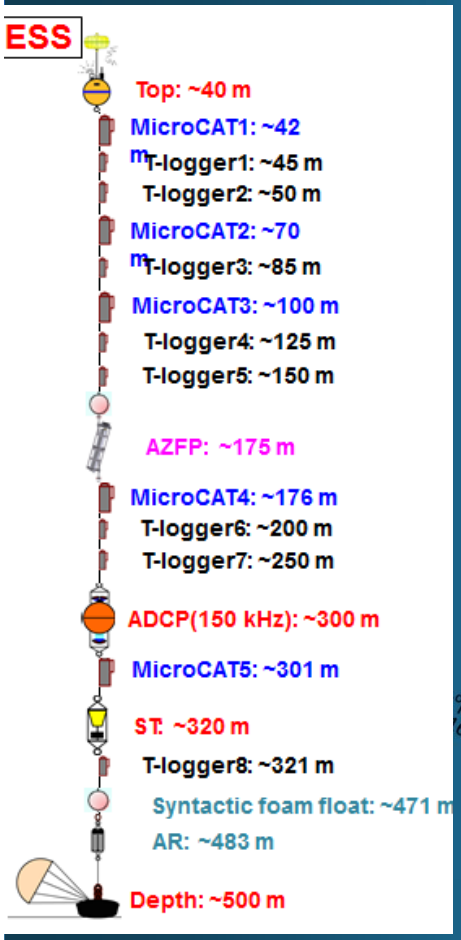


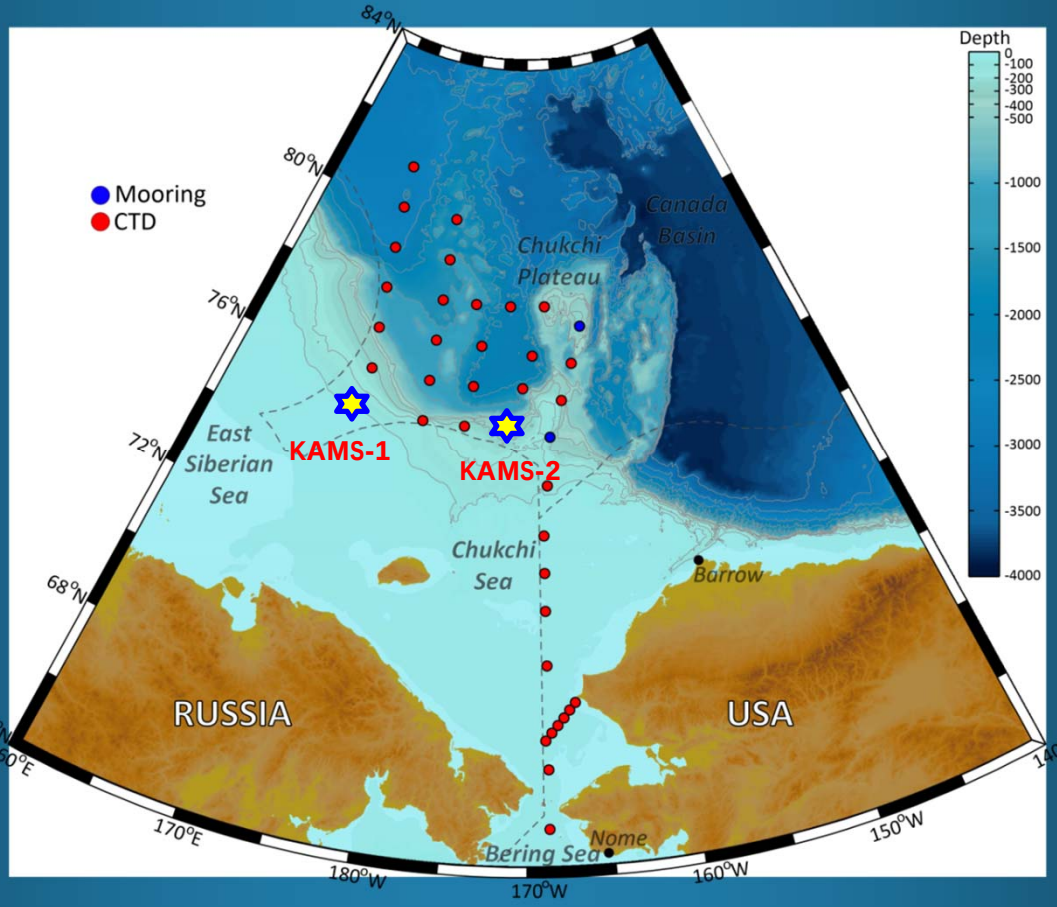
- North Bering Sea (DBO 3)
- Chukchi Sea
- East Siberian Sea & Mendeleev Ridge
- Sea Ice station
- Ocean mooring station
  - KOPRI
  - TUMSAT

KOPRI ocean mooring system

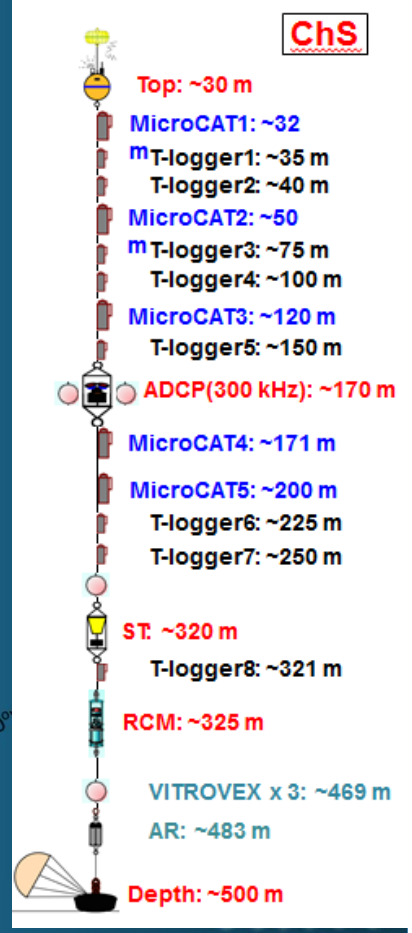
- Chukchi Sea and East Siberian Sea
- ADCP, Microcat, Sediment trap, RCM, AZFP

KAMS-1



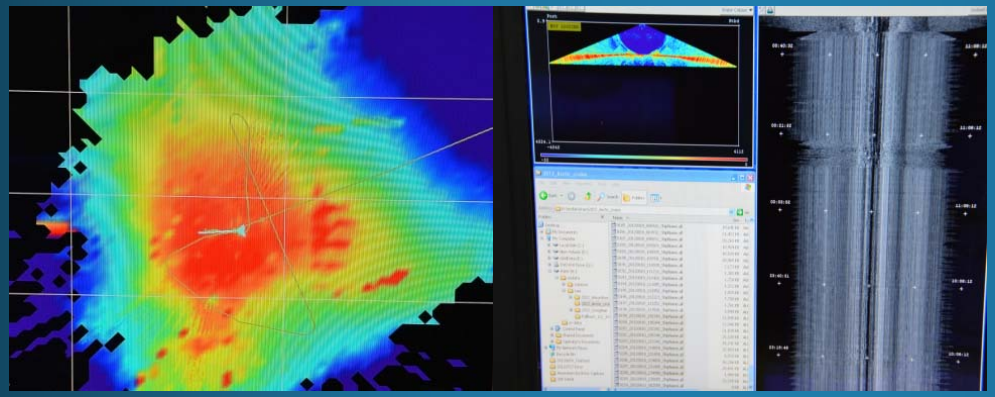


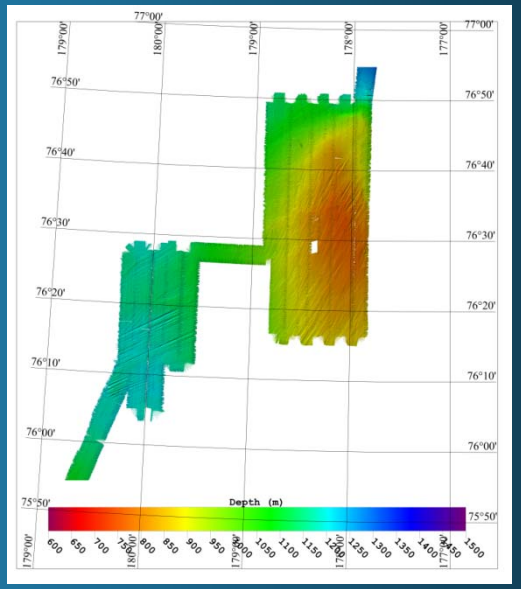
KAMS-2



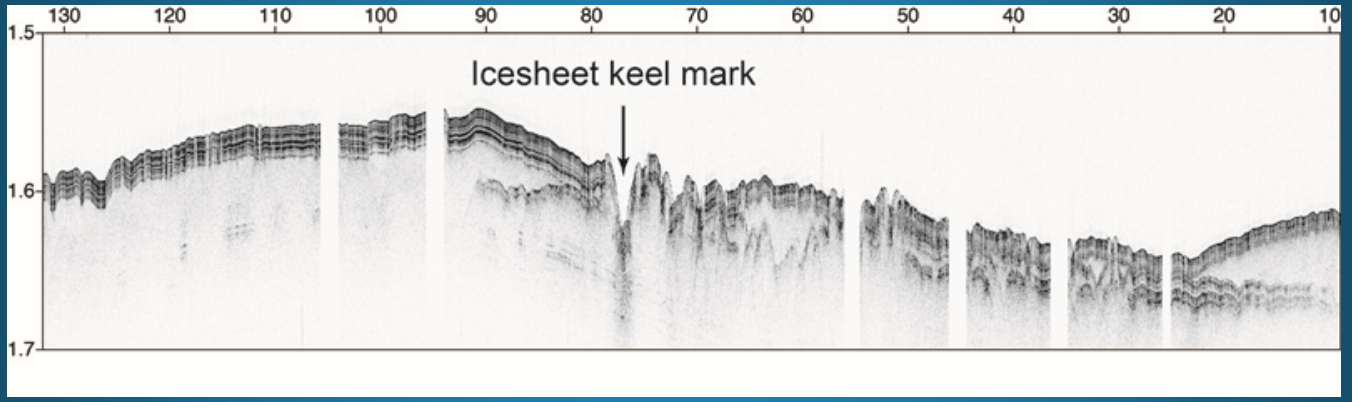
Marine Geophysics

- **Swath bathymetry**



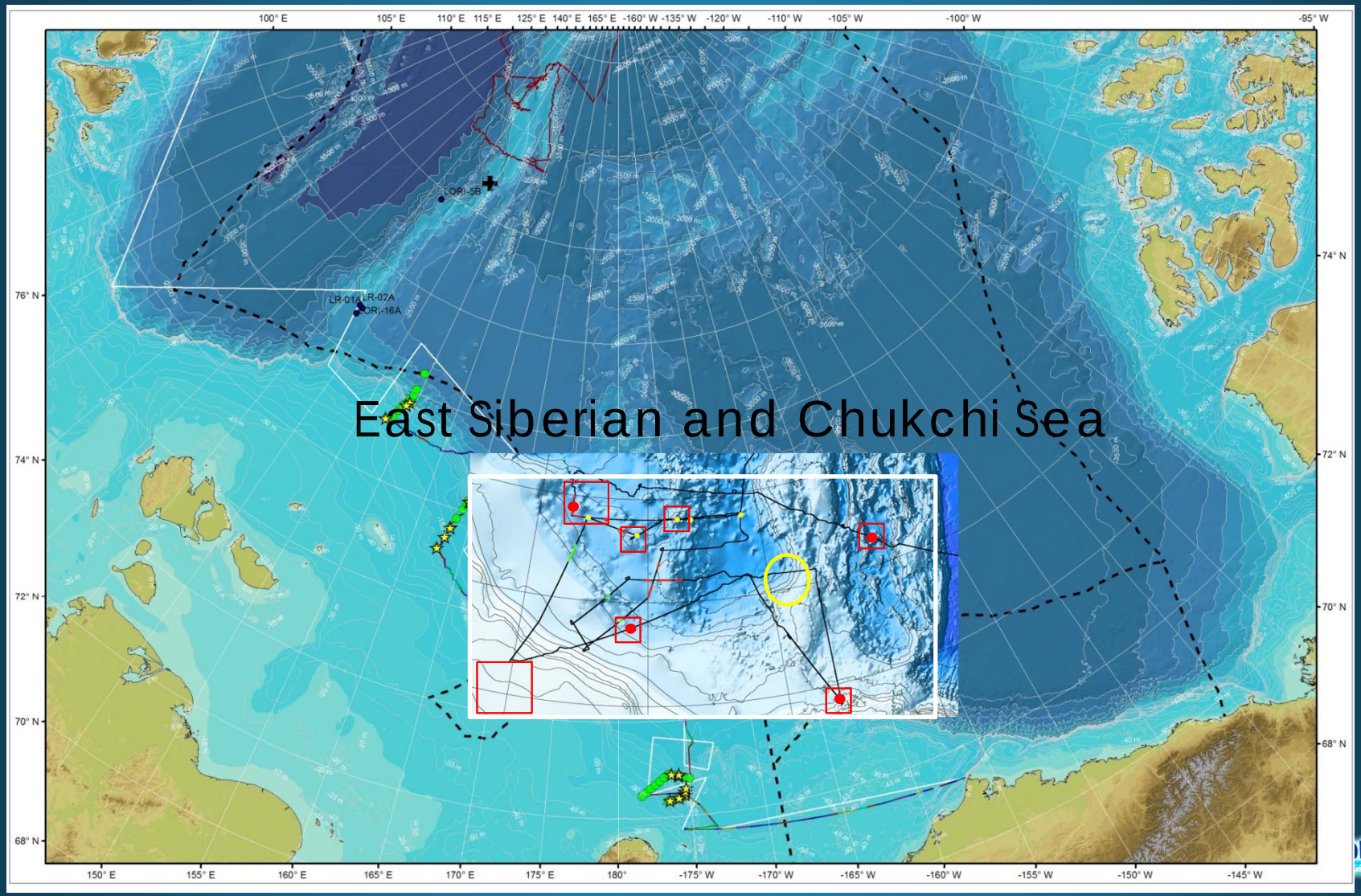


- **High-resolution subsurface features (Subbottom Profiling)**



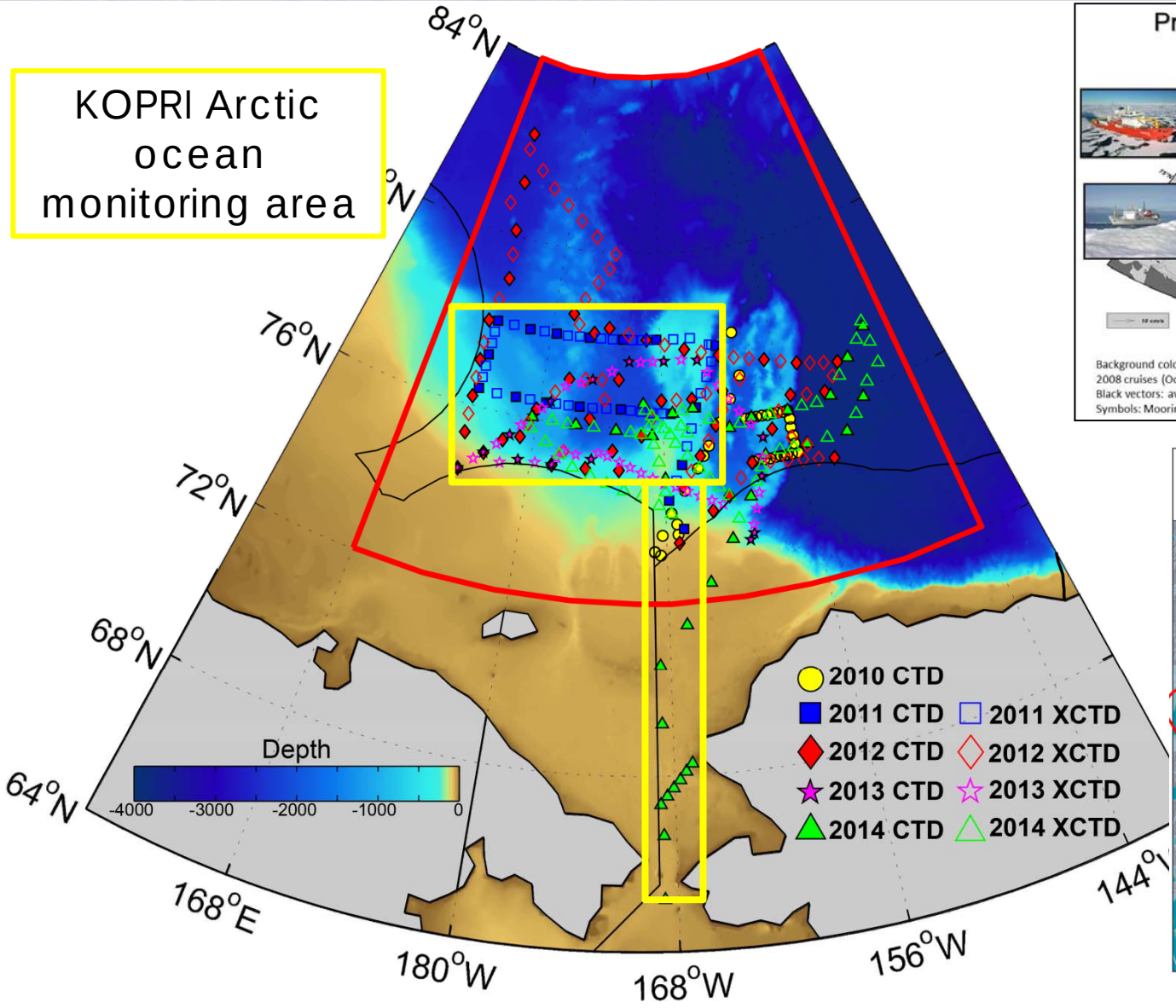
- **Gravity Survey**
  => Data shared with Arctic Gravity Project

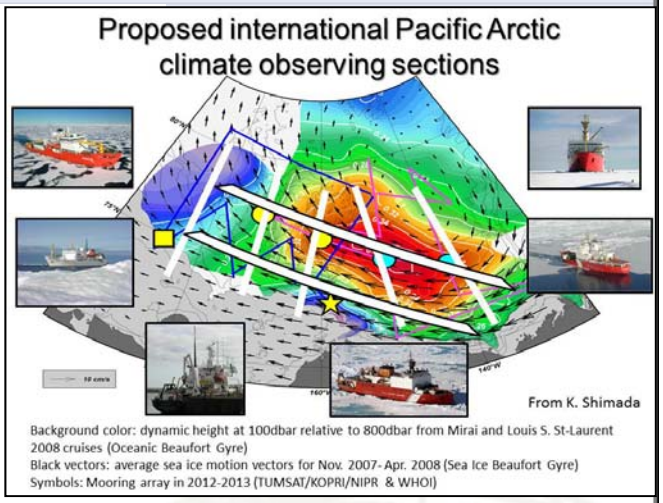
2nd Leg (Paleocenography)

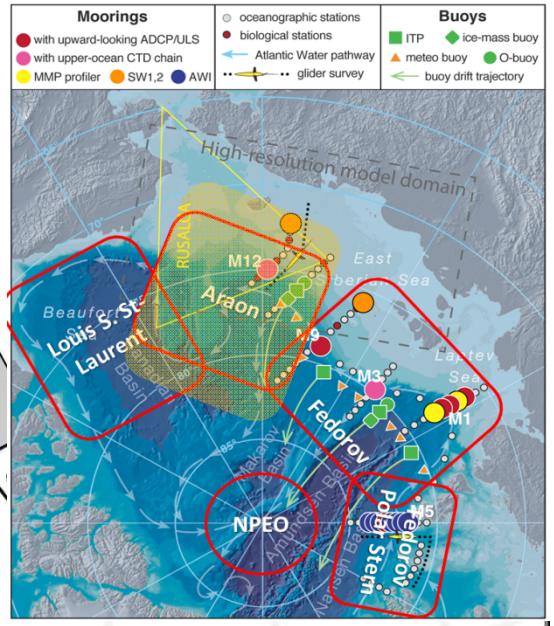


Future KOPRI Arctic survey (2015 -)

KOPRI Arctic ocean monitoring area







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

CAPEC (Circum Arctic Permafrost Environmental Changes): Korean Permafrost Research Project

Yoo Kyung Lee & Bang Yong Lee
Arctic Research Center
Korea Polar Research Institute

CAPEC

MISP sponsored research grant

PI: Dr. Bang Yong Lee (bylee@kopri.re.kr)

Period : 2011. 6 ~ 2016. 6 (Second: 2016. 6 ~ 2020. 6 ?)

Budget: 1.3 M Euro (2,000 MW) / year

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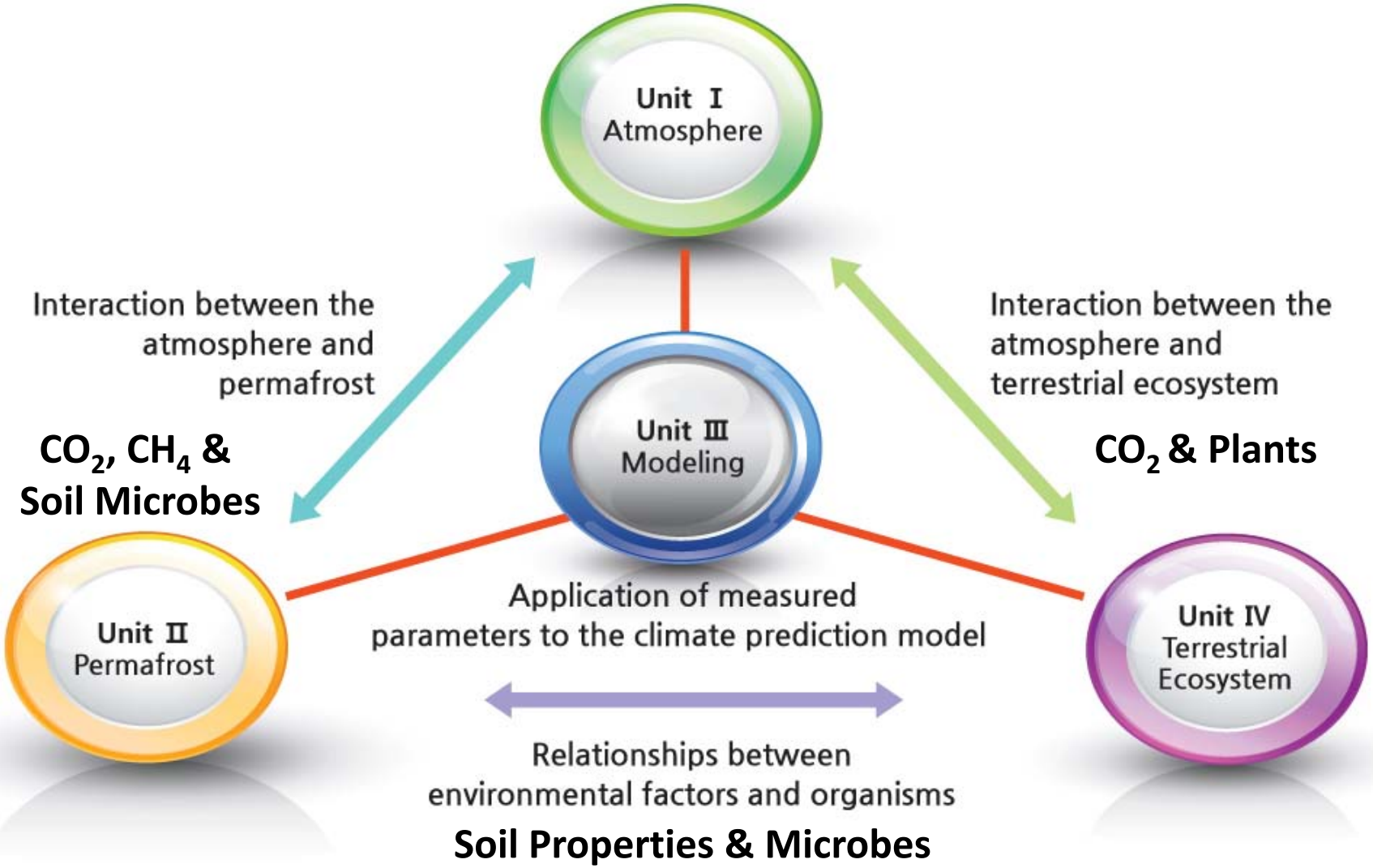
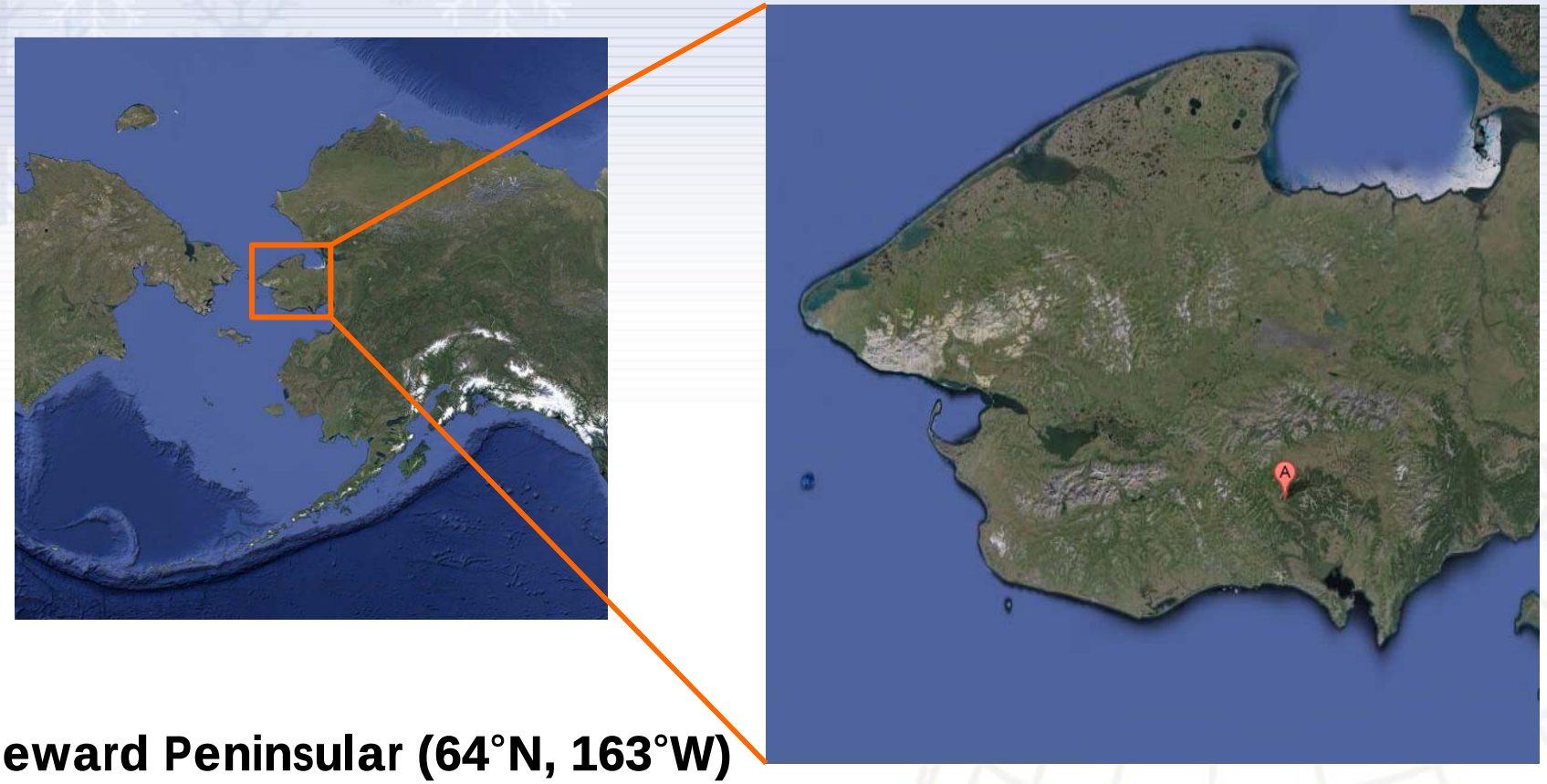
CAPEC


Unit Ⅰ
Atmosphere
Interaction between the atmosphere and permafrost
CO_2, CH_4 & Soil Microbes
Interaction between the atmosphere and terrestrial ecosystem
CO_2 & Plants
Unit Ⅲ
Modeling
Unit Ⅱ
Permafrost
Application of measured parameters to the climate prediction model
Unit Ⅳ
Terrestrial Ecosystem
Relationships between environmental factors and organisms
Soil Properties & Microbes


Council, Alaska

Council, Alaska (65˚N)



- Seward Peninsular (64˚N, 163˚W)
- Discontinuous permafrost
- Temp.: air -30 ~ 20˚C; soil -15 ~ 10˚C
- Average active layer thickness: 50 ~ 70 cm

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Council, Alaska (65°N)

Eddy-covariance

- Fluxes (mtm, SHF, LHF, CO_2)
- Radiation (Up/Down SW/LW)
- Photos, NDVI

Automatic chamber (CO_2)

- Vascular plant (10)
- Tussock (4)
- Lichen (1)

USN (Hanyang Univ.)

- 9x9 grid
- Tsfc, Tsoil, Qsoil, photo

Power

- solar panel (140 W x 6)
- battery (100 Ah x 10)

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Atmospheric Observation

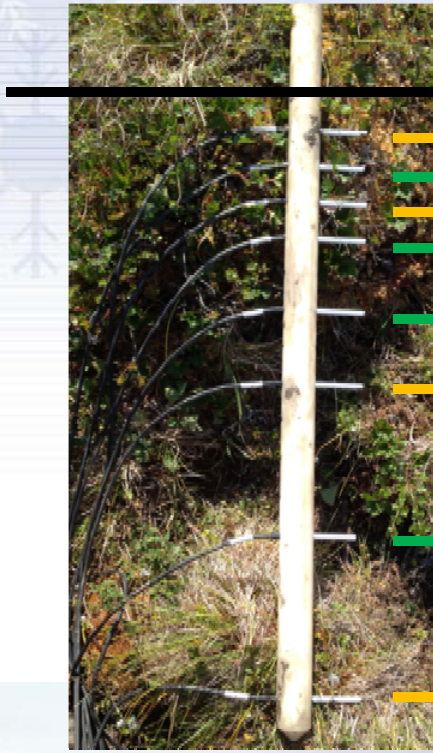
Greenhouse Gas Flux (CO_2, H_2O, CH_4) by Eddy-covariance

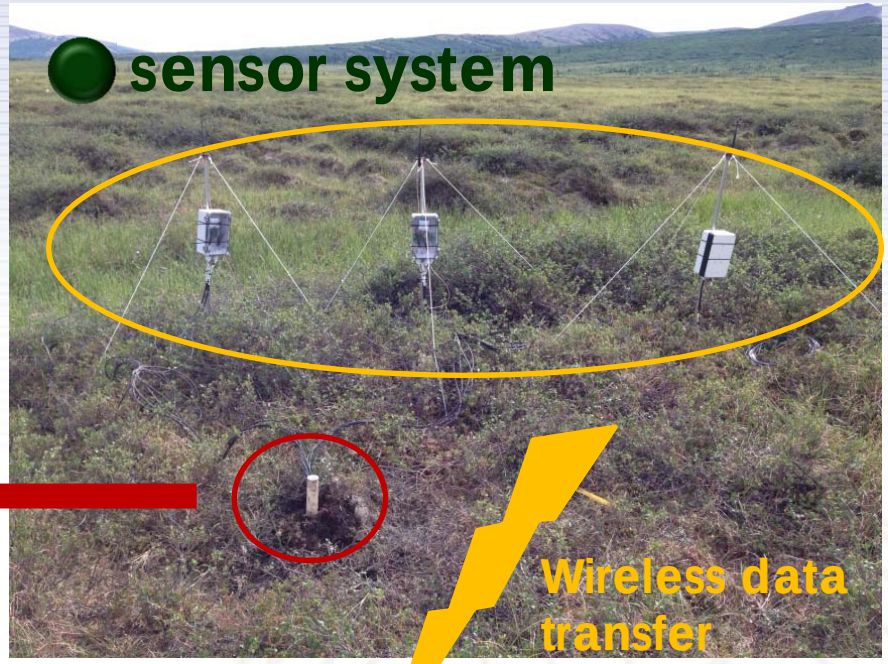
Tethersonde

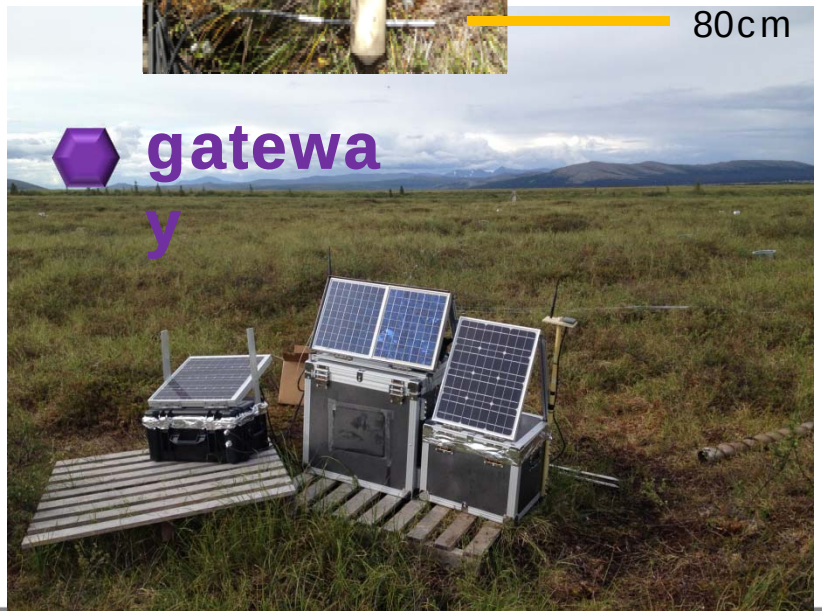
Net CO_2 Exchange Measurements

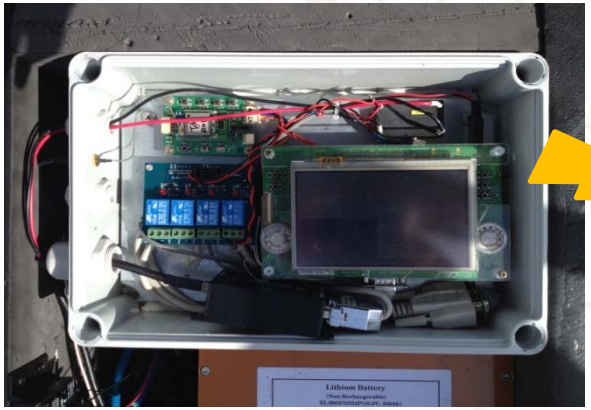
Photosynthesis & Soil Respiration Measurements

USN (Ubiquitous Sensor Network)





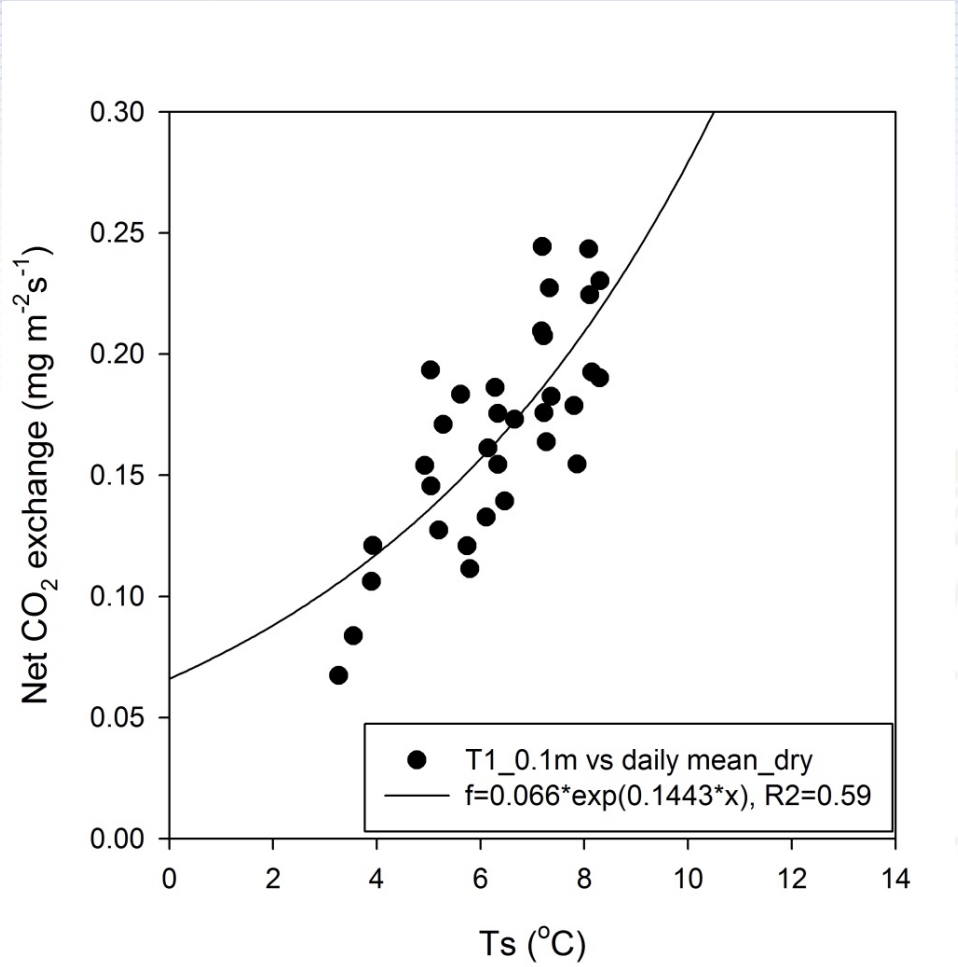




Gateway in Alaska

KOPRI in Korea

Net ecosystem CO_2 exchange



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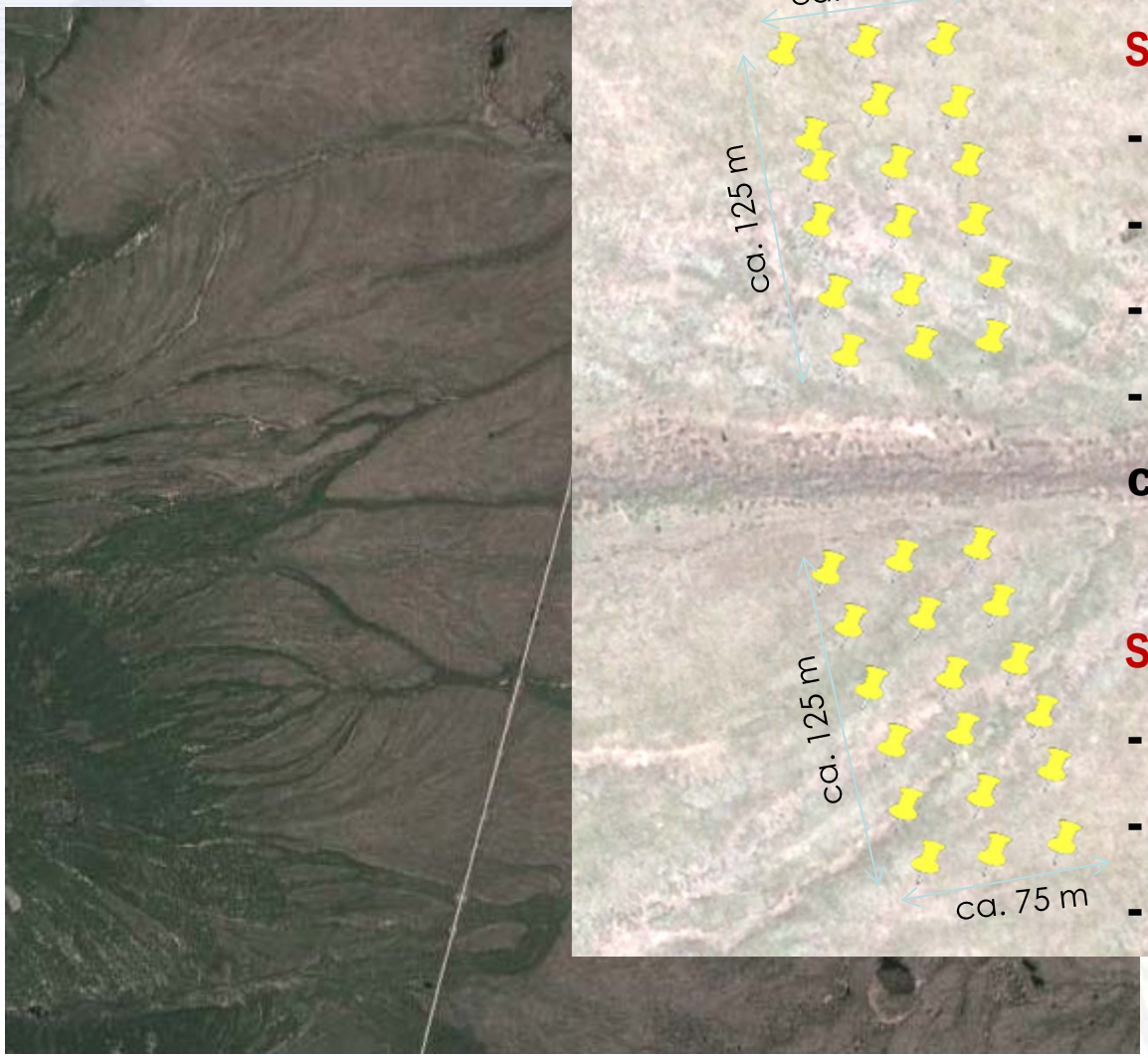
Horizontal Distribution of Bacteria



Sampling site characteristics

- Elevation: 30 m
- Average air temp.: -3°C
- Precipitation: 400 mm
- Depth of active layer: 50~70 cm

Soil sampling in 2011

- Total 36 sites
- 25 m apart between each site
- 0 ~10 & 10~20 cm depths

Soil Properties

	pH	SOC (%)	TN (%)	C:N
Upper layer (0-10 cm)	4.35±0.29	39.9±6.8	1.50±0.5	28.5±9.1
Lower layer (10-20 cm)	4.53±0.28	35.9±12.4	1.54±0.6	24.2±6.6

* SOC, soil organic carbon; TN, total nitrogen

- The soil was acidic.
- The lower layer soil had less amount of SOC.
- The C/N ratio was higher in the upper layer.

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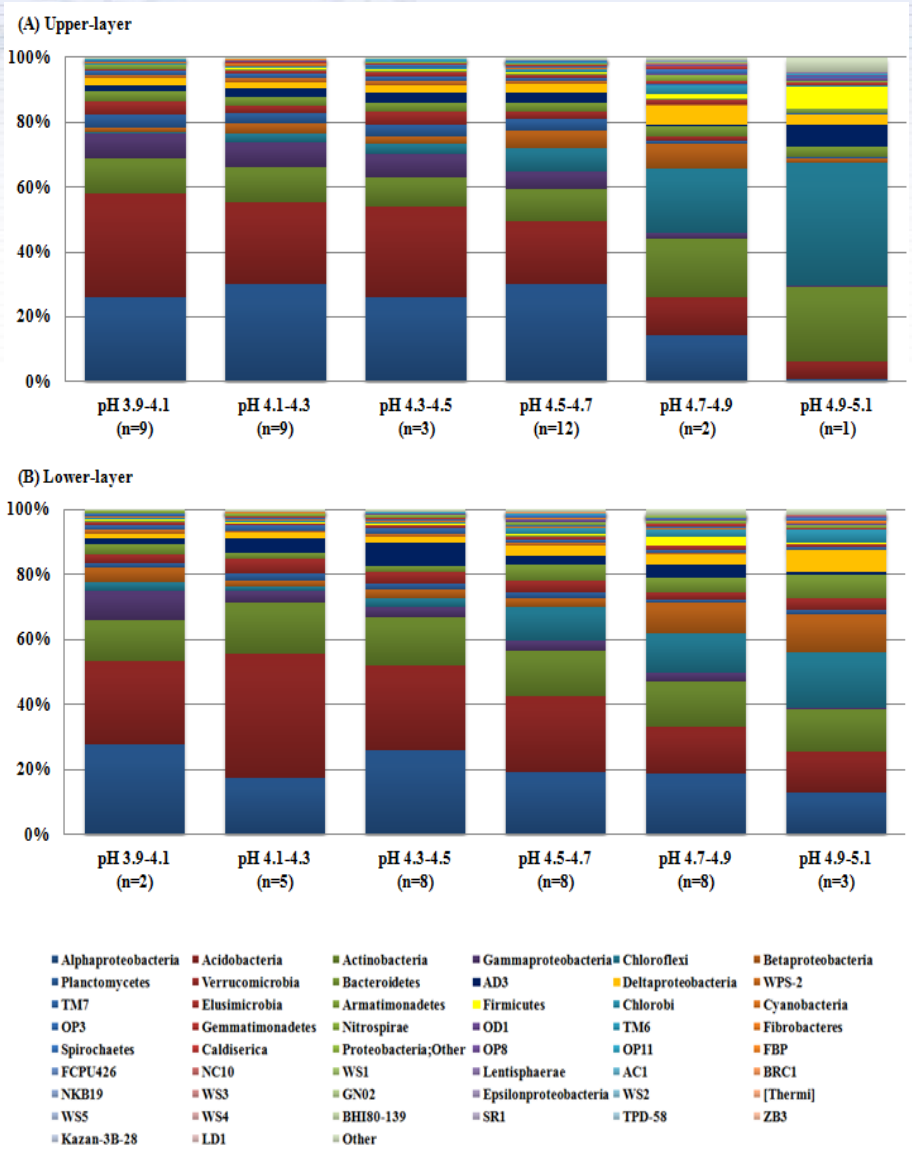
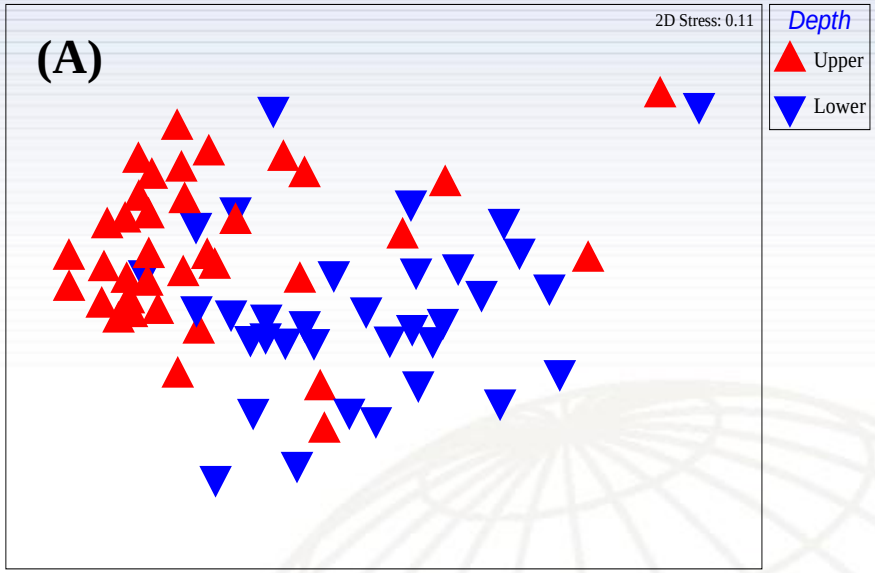
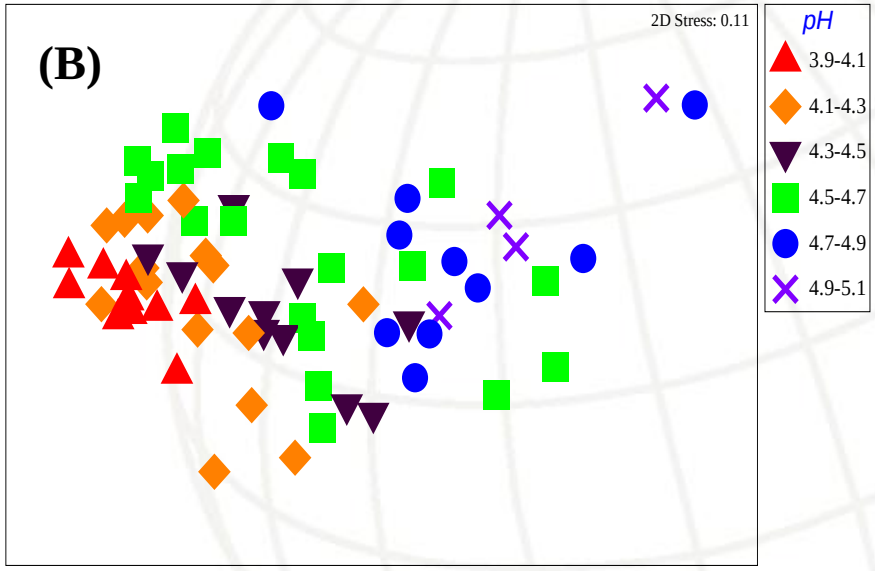
Bacterial Community Structure







Cambridge Bay, Canada

Research Topics in Cam Bay

- Monitoring of carbon dioxide and black carbon in the atmosphere
- Study on the effects increasing temperature and precipitation on abiotic and biotic factors

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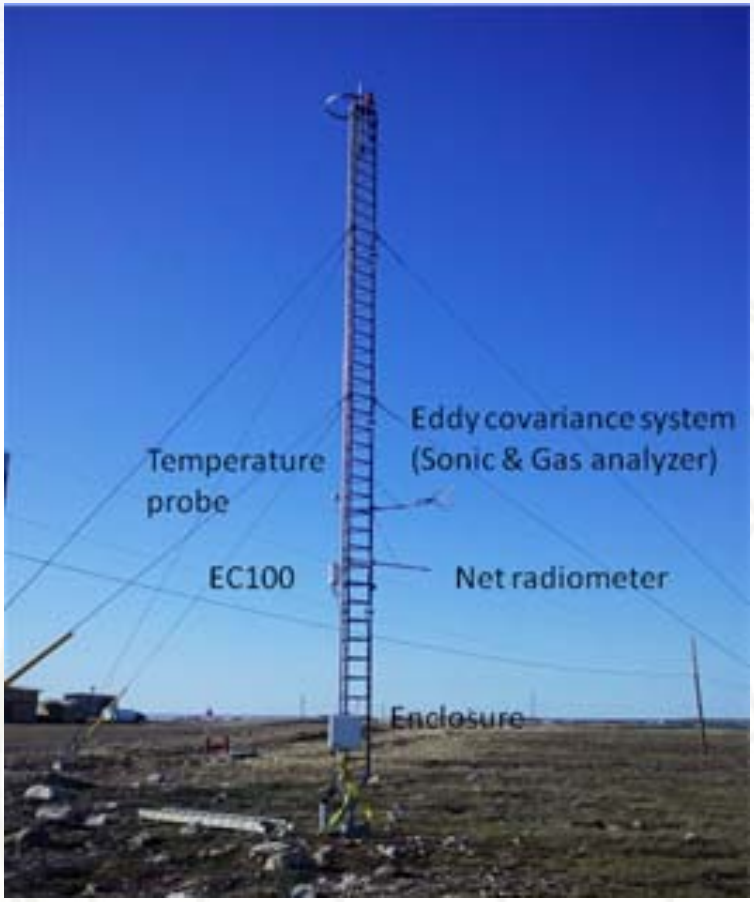
Monitoring of carbon dioxide and black carbon in the atmosphere

- Long-term monitoring of CO_2 and energy flow between the atmosphere and the ecosystem: eddy covariance flux system together with a net radiometer



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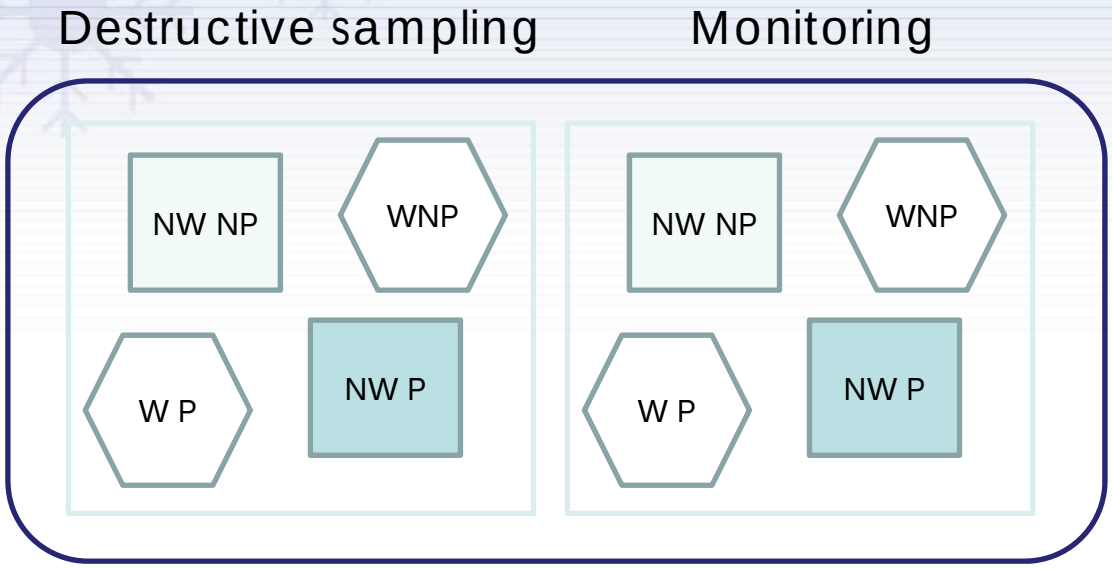
Climate Manipulation Experiment



Composition for one block

W: warming
NW: non-warming (ambient)
P: increased precipitation
NP: no increase in precipitatio

- Since 2012
- Warming by Open top chambers (2 m basal diameter)
- Precipitation: 2 L/plot/week
- OTCs and precipitation operation: Early July ~ early October

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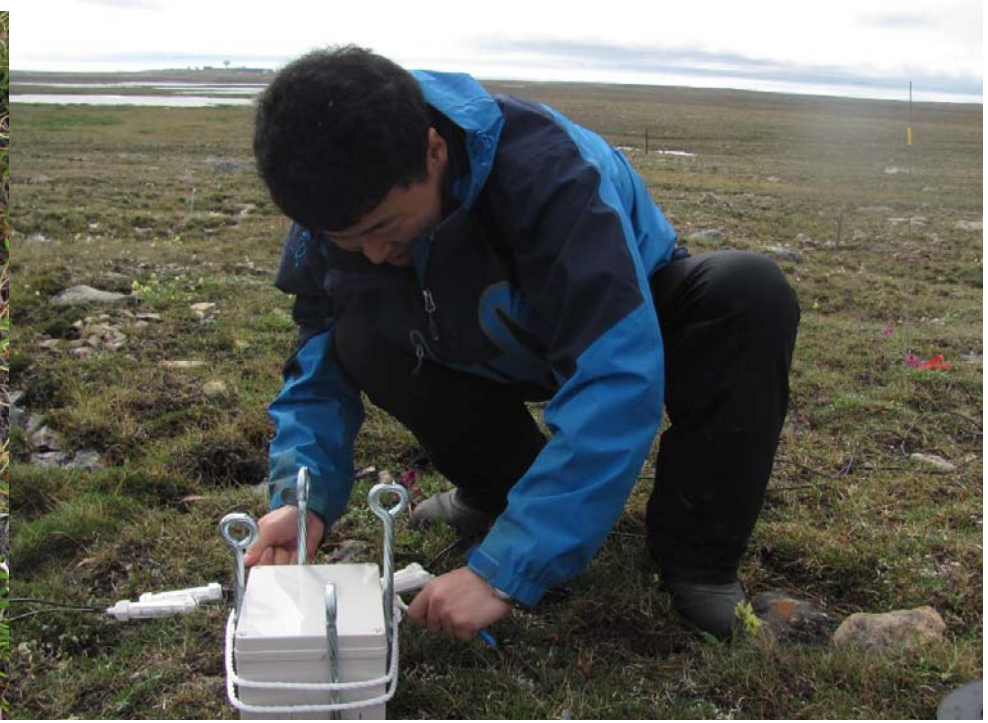
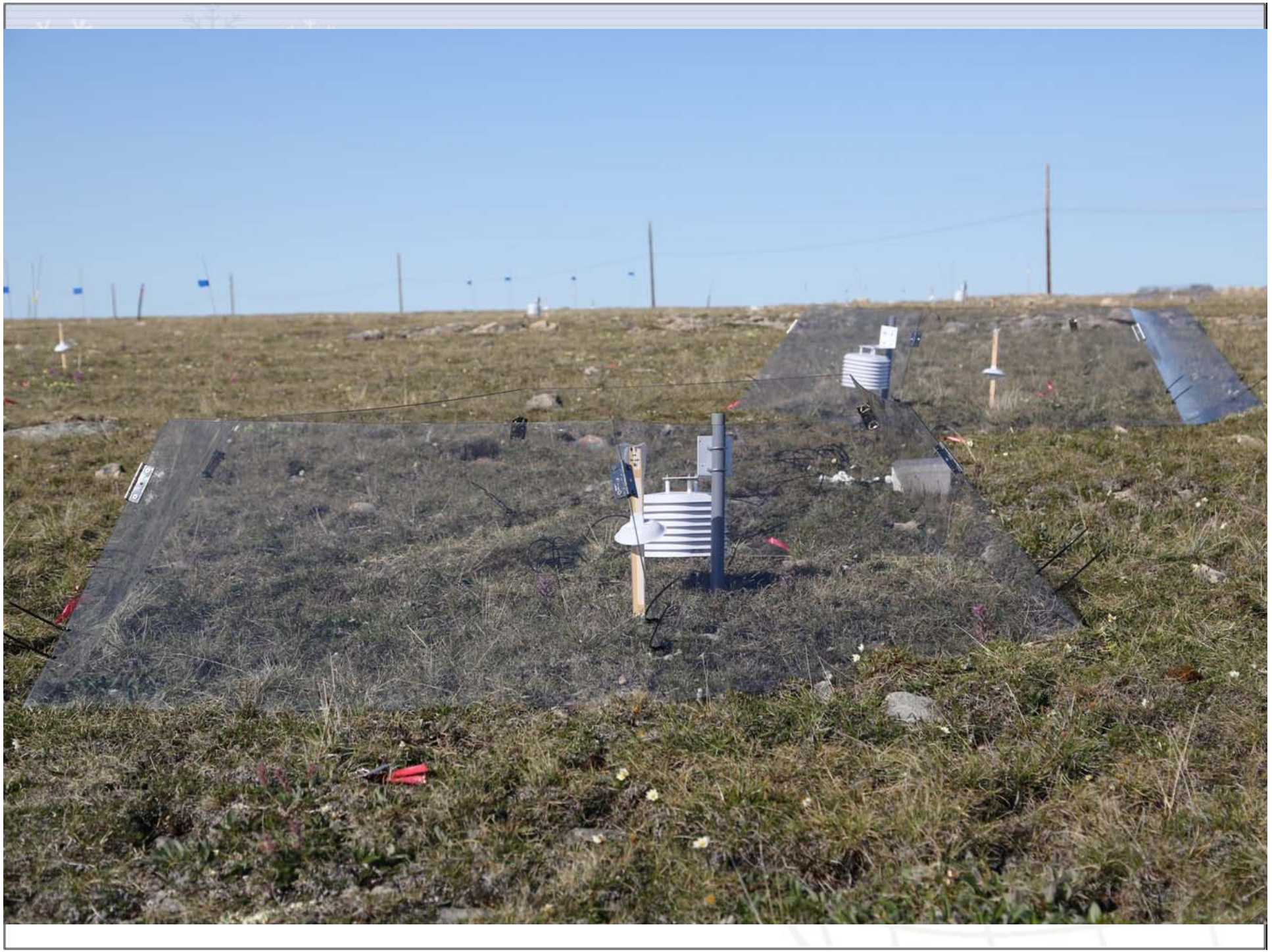
Non-warming & Precipitation

Warming & Precipitation





Sampling plan

- 2012: Soil sampling for acquisition of baseline data (T_0)
- 2013: after 1 year of treatments
- 2015: after 3 years of treatments

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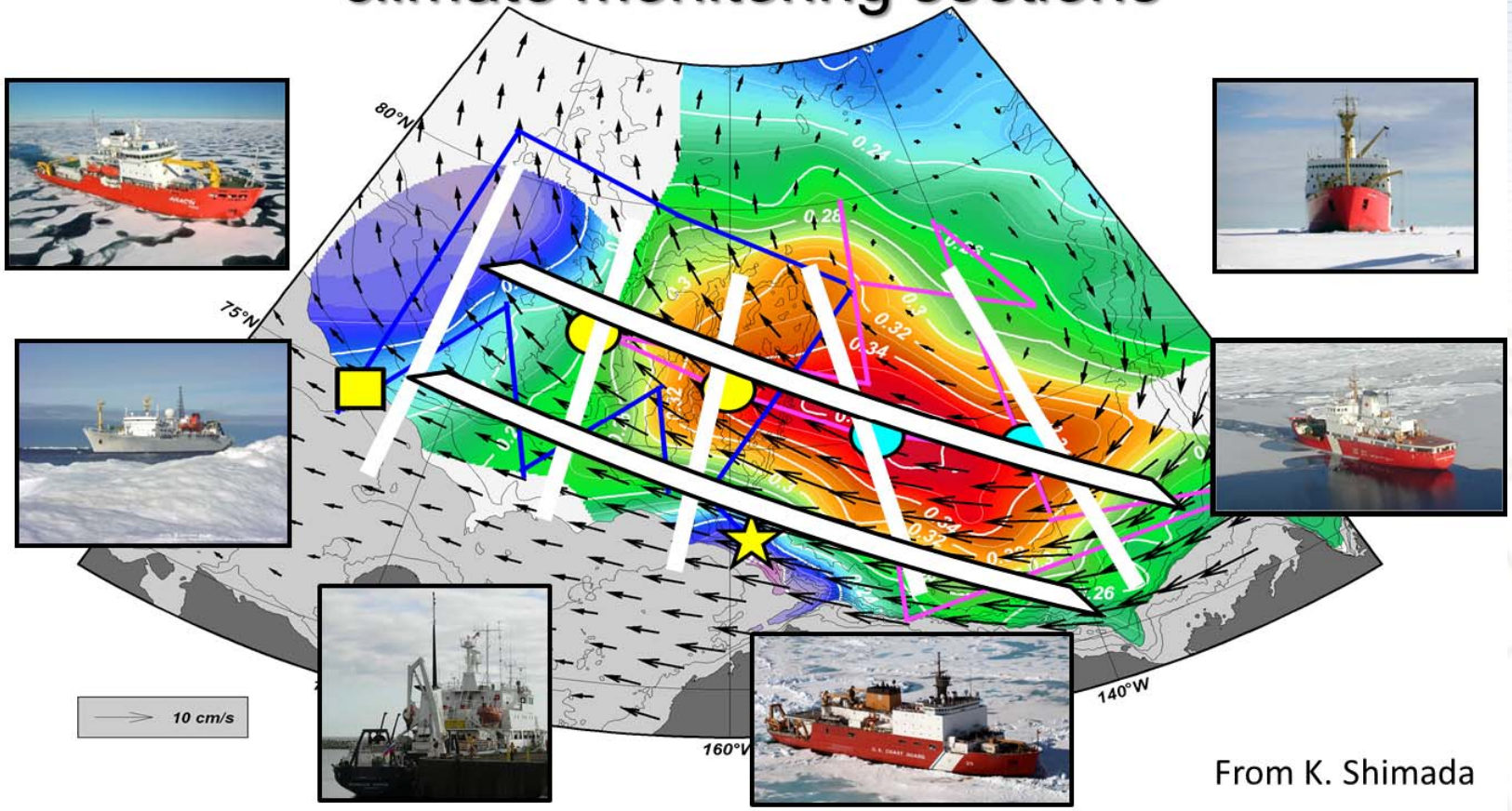
Expanding partnership

NPI lead N-ICE (Norwegian Young sea ICE cruise) participation, linked to KOPRI's climate research

Pacific Arctic Group (PAG) endeavors

Developing new ties and old ties; CHARS, NRCan, AFoPS

Proposed international Pacific Arctic climate monitoring sections



From K. Shimada

Background color: dynamic height at 100dbar relative to 800dbar from Mirai and Louis S. St-Laurent 2008 cruises (Oceanic Beaufort Gyre)

Black vectors: average sea ice motion vectors for Nov. 2007- Apr. 2008 (Sea Ice Beaufort Gyre)

Symbols: Mooring array in 2012-2013 (TUMSAT/KOPRI/NIPR & WHOI)

Korean Arctic Consortium

Expected to start later this year

Assessing research needs and priority

Planning study being undertaken

3 sectors; research, technology and industry, policy

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Arctic Council WG participation

Korean Arctic Expert Network forming

Observing WG activities with focus on AMAP, CAFF, PAME (and EPPR)

Possible contribution (based on current research) explored


Thank you
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