

PAG Climate Line Workshop, Tokyo, April 21-22, 2015

KOPRI Activities for PAG Climate Line in the Arctic Ocean: Physical Oceanography and Sea Ice Works



Presenter: Kyoung-Ho Cho

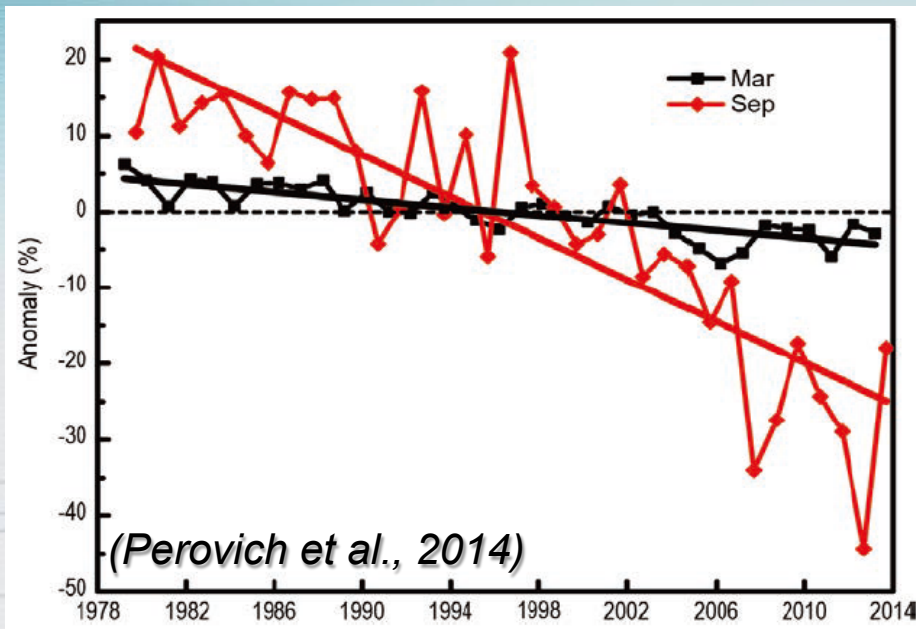
**Division of Polar Ocean Environment
Korea Polar Research Institute, Korea**

KOPRI

Korea Polar Research Institute, KIOST

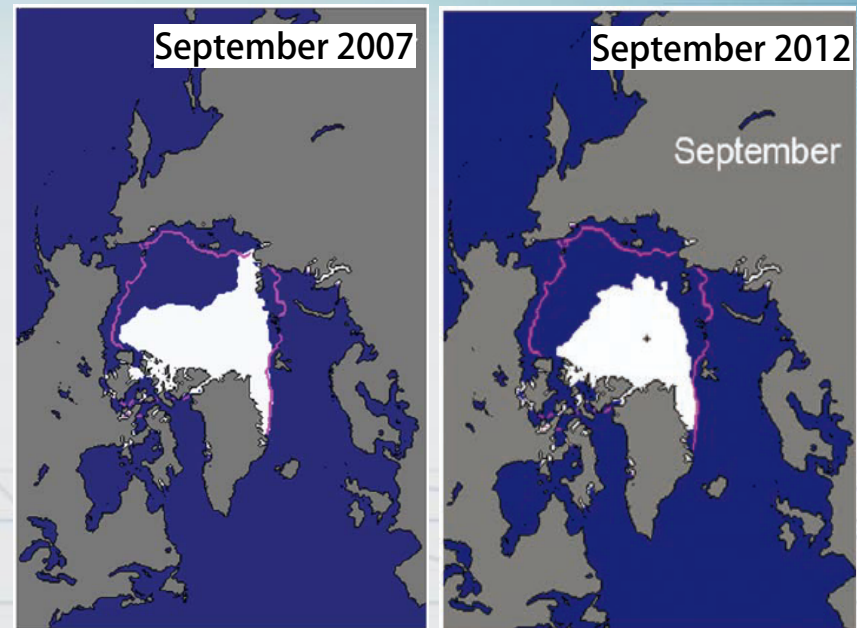
Sea Ice Extent

- ◆ Sea ice extent anomalies (in %) relative to the average values (1981-2010)



September monthly average trend is -13.7% decade⁻¹ relative to the 1981-2010 average.

- ◆ Sea ice extent in Sep 2007 and Sep 2012 (*Richter-Menge et al., 2008; Perovich et al., 2013*).

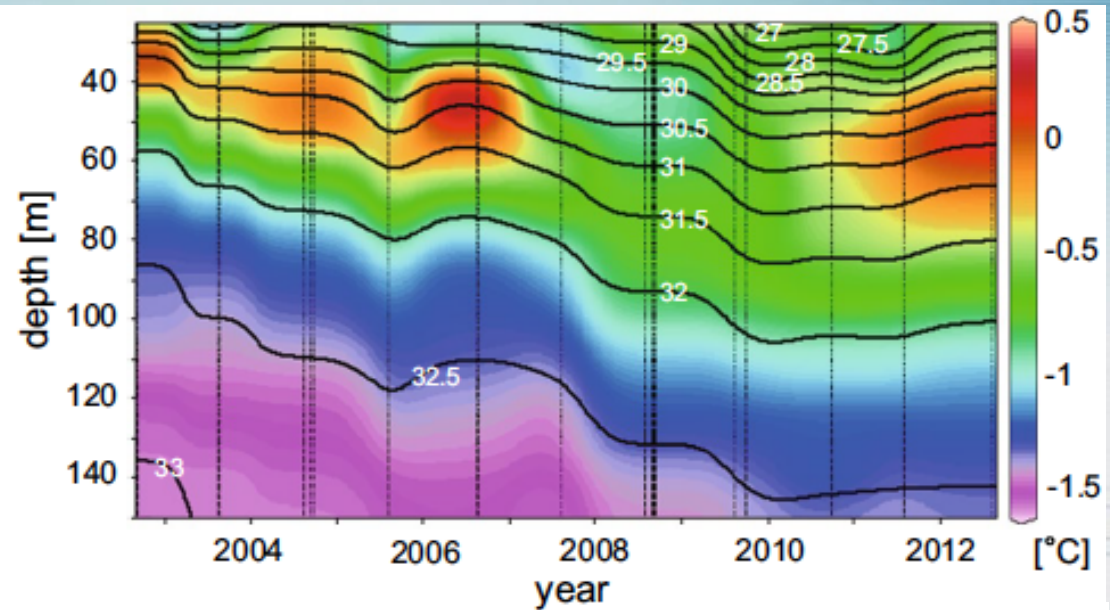
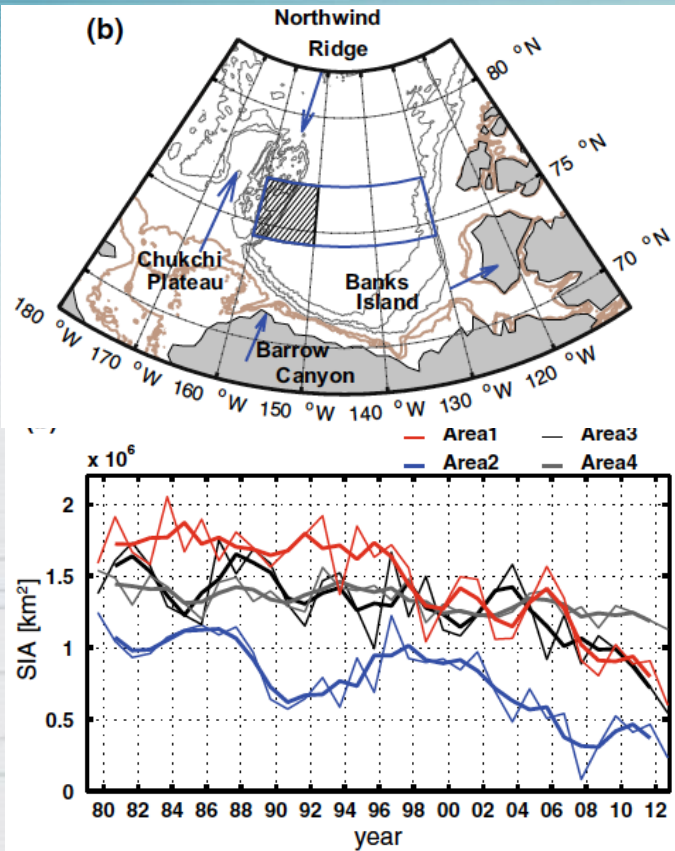


Summer min ice extent reached 4.3M km^2 in Sep 2007 and 3.41M km^2 in Sep 2012.

(The magenta lines indicate the median ice extents during the period 1979-2007)

Ocean Response

- ◆ Time series of potential temperature and salinity in the region near the Northwind Ridge, the black hashed box (*Yoshizawa et al., 2015*)

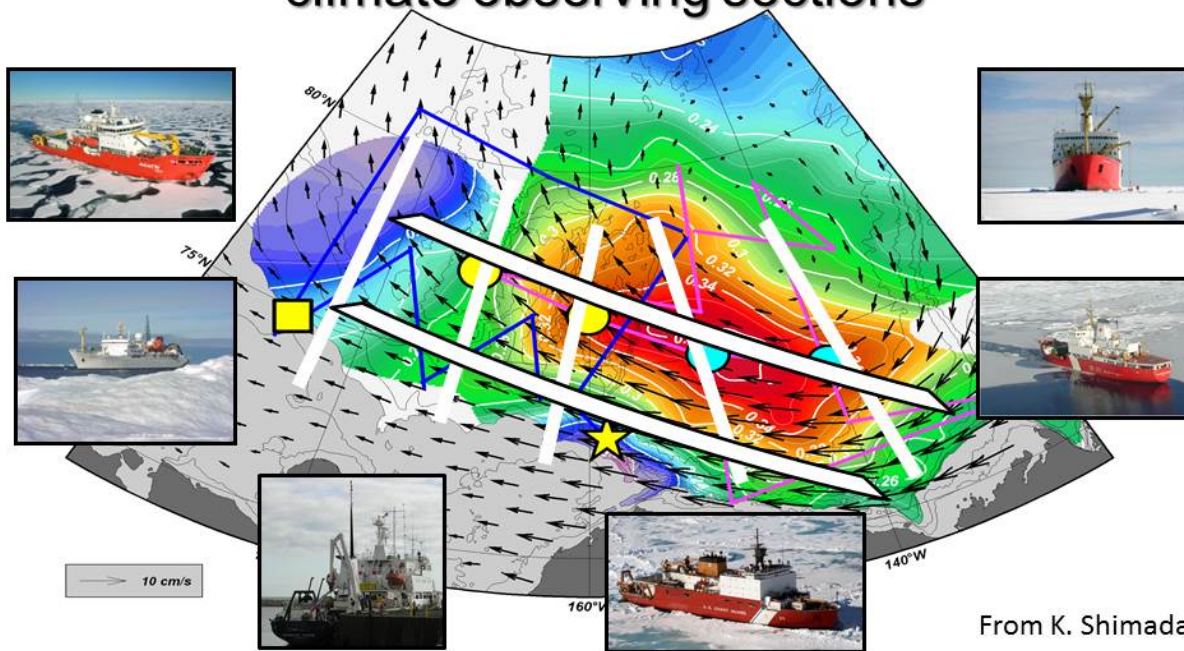


A Hovmöller diagram of depth-averaged potential temperature and salinity

Thickness of the PSW layer, associated with the oceanic thermal condition affecting the overlying sea ice cover, increased from 2007 to 2009.

Climate Line Section

Proposed international Pacific Arctic climate observing sections

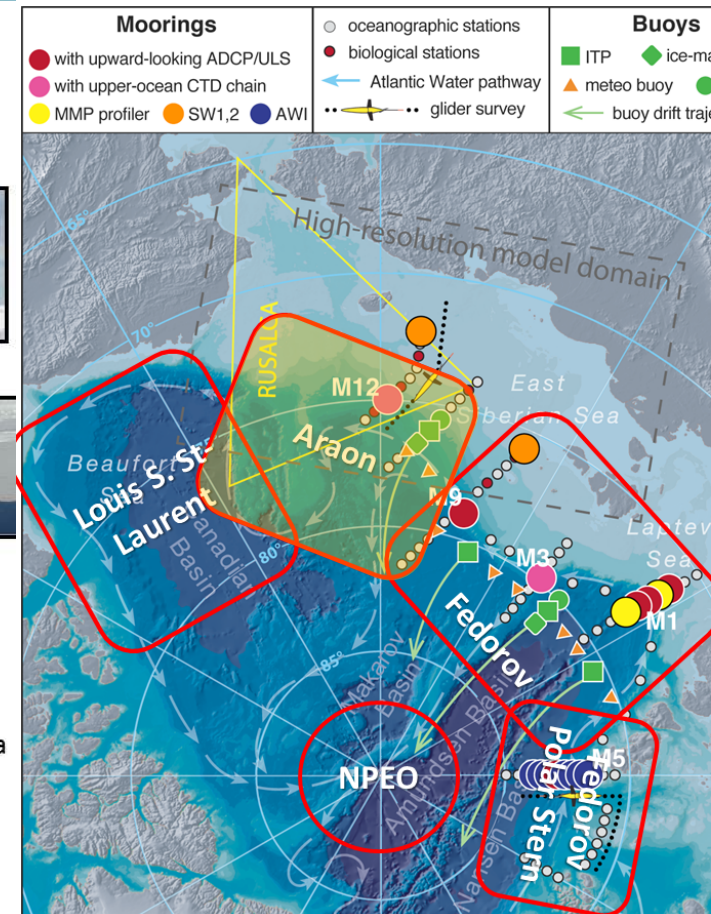


From K. Shimada

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)

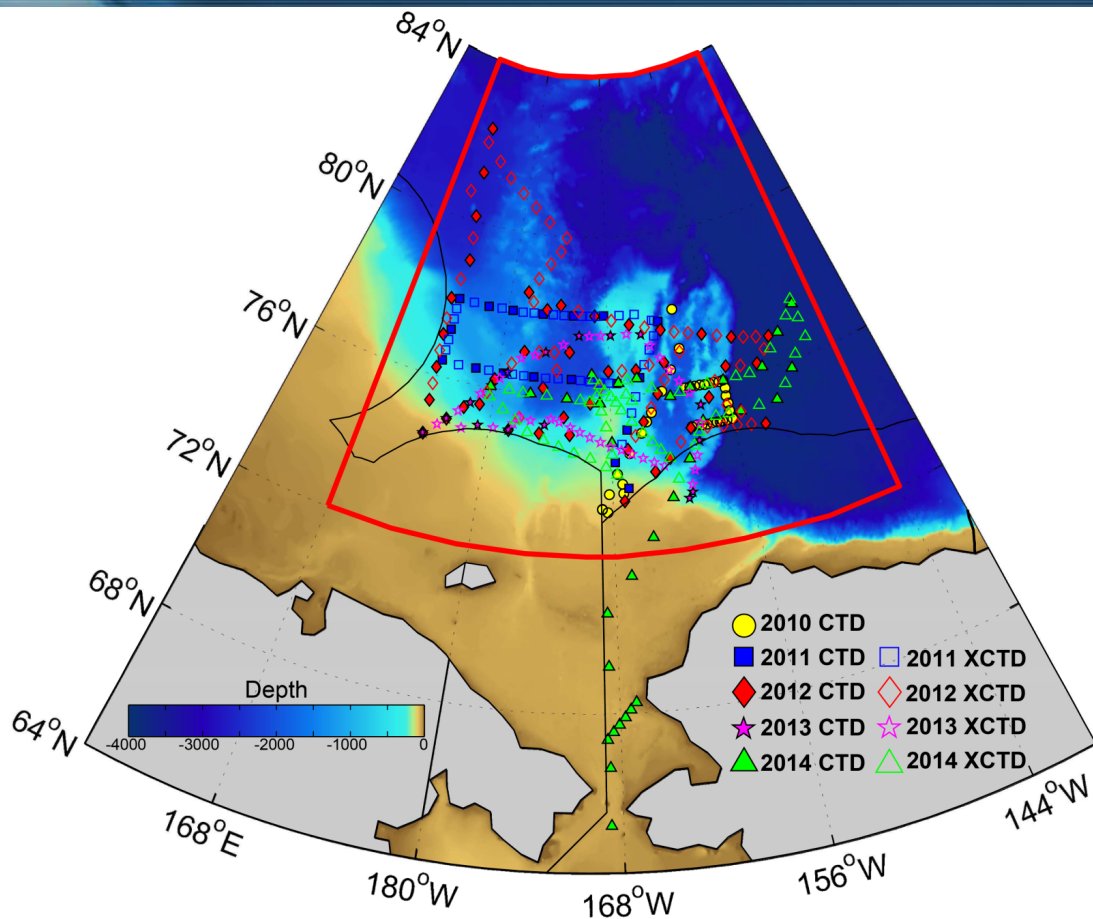
Symbols: Mooring array in 2012-2013 (TUMSAT/KOPRI/NIPR & WHOI)



(NABOS-II map from <http://research.iarc.uaf.edu/NABOS2/>)

◆ ARAON will cover the region from the Chukchi Borderland to the Mendeleev Ridge.

IB R/V ARAON Arctic Cruises (2010~2014)



	2010	2011	2012	2013	2014
CTD	38	18	44	16	32
XCTD	*	33	48	36	51
Duration	07/20~08/10	08/02~08/16	08/04~09/06	08/24~09/01	08/01~08/23

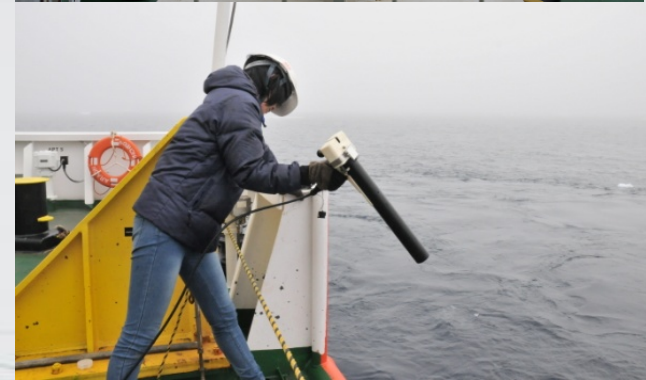
What we observed

Equipment

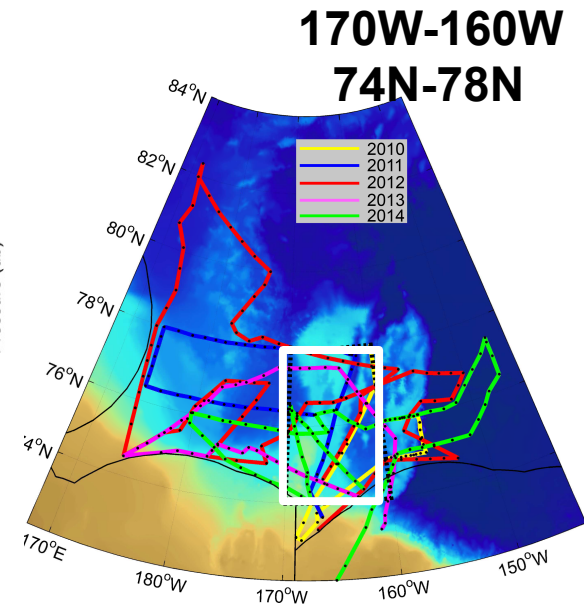
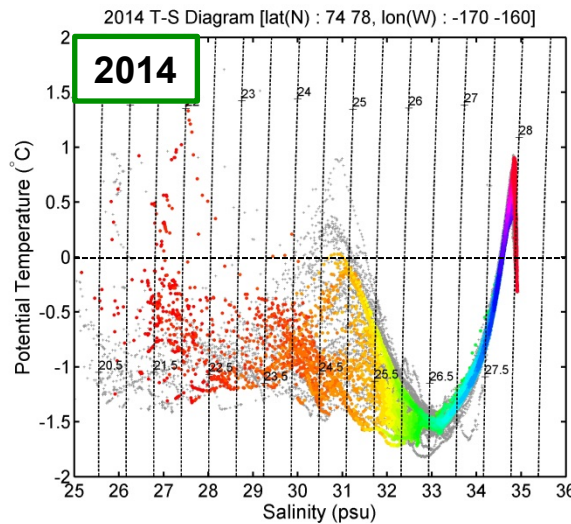
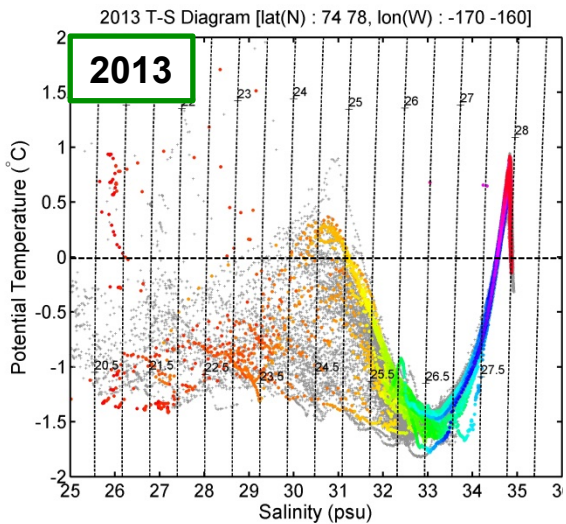
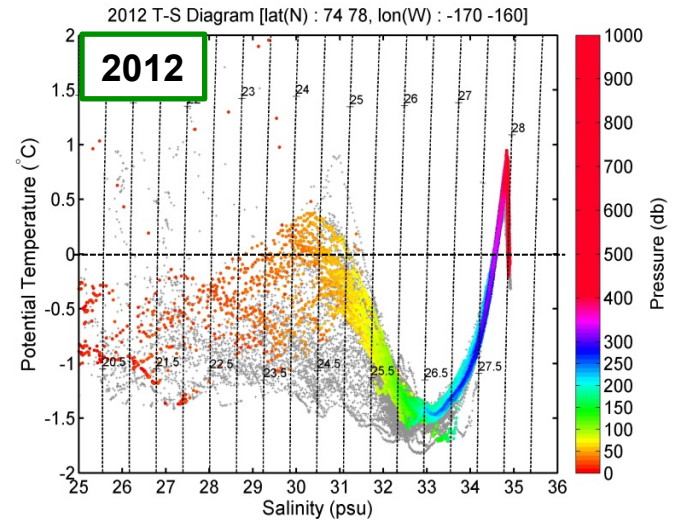
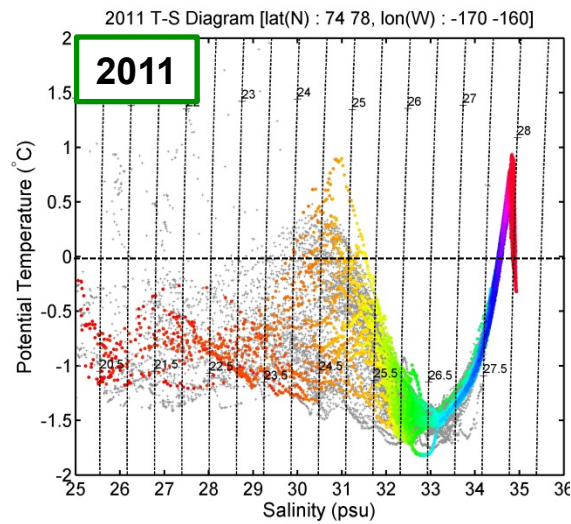
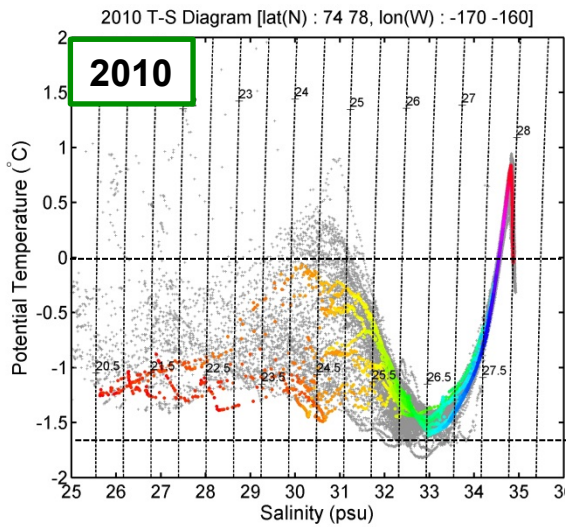
- CTD, Lowered ADCP, XCTD
- Ocean Mooring System
- Bio/Geo/Chemical equipment

Items

- **Temperature, salinity**, DO, fluorescence, PAR, transmission, backscatter, **water velocity**
- Primary production and new production,
- Phytoplankton composition,
- Chlorophyll-a and HPLC,
- Zooplankton composition and abundance
- Bacterial and virus biomass
- Micro-zooplankton biomass, composition, and grazing
- Nutrients, POC, PON, DOC, DON, DOP
- N₂O gas, pCO₂, DIC, pH, SS, TA
- Atmospheric components



CTD/XCTD: θ -S Diagram (local area)



CTD/XCTD: Anomaly of θ , S (local area)

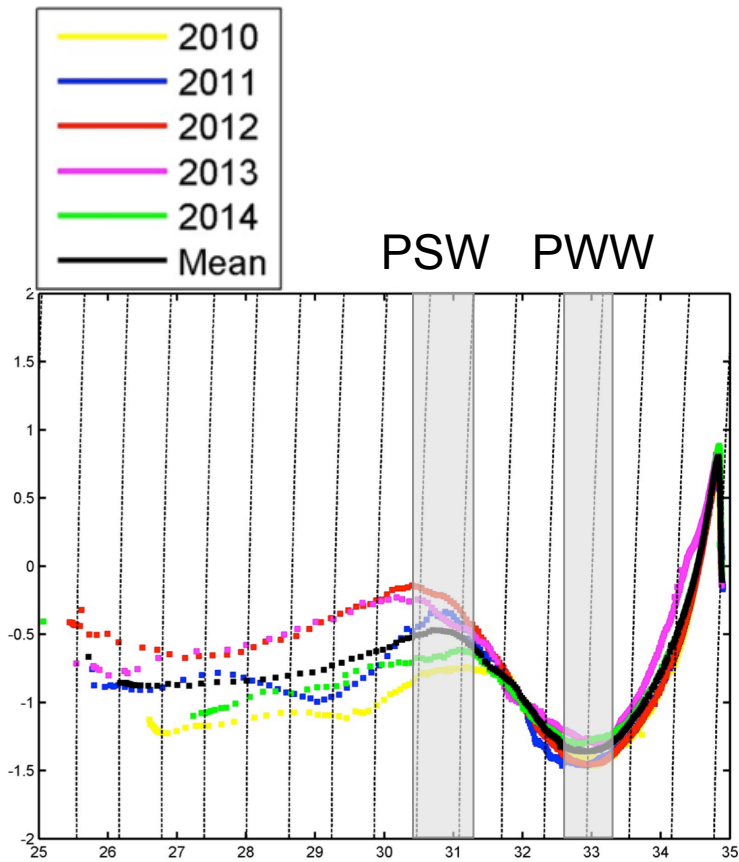
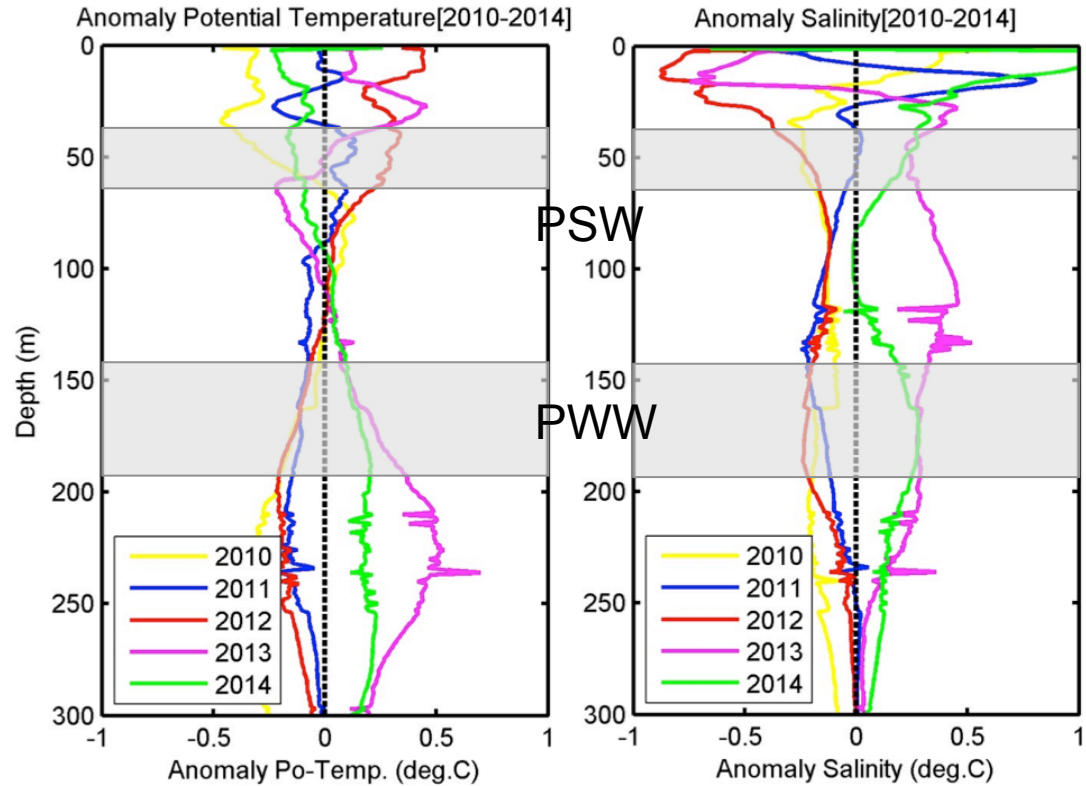


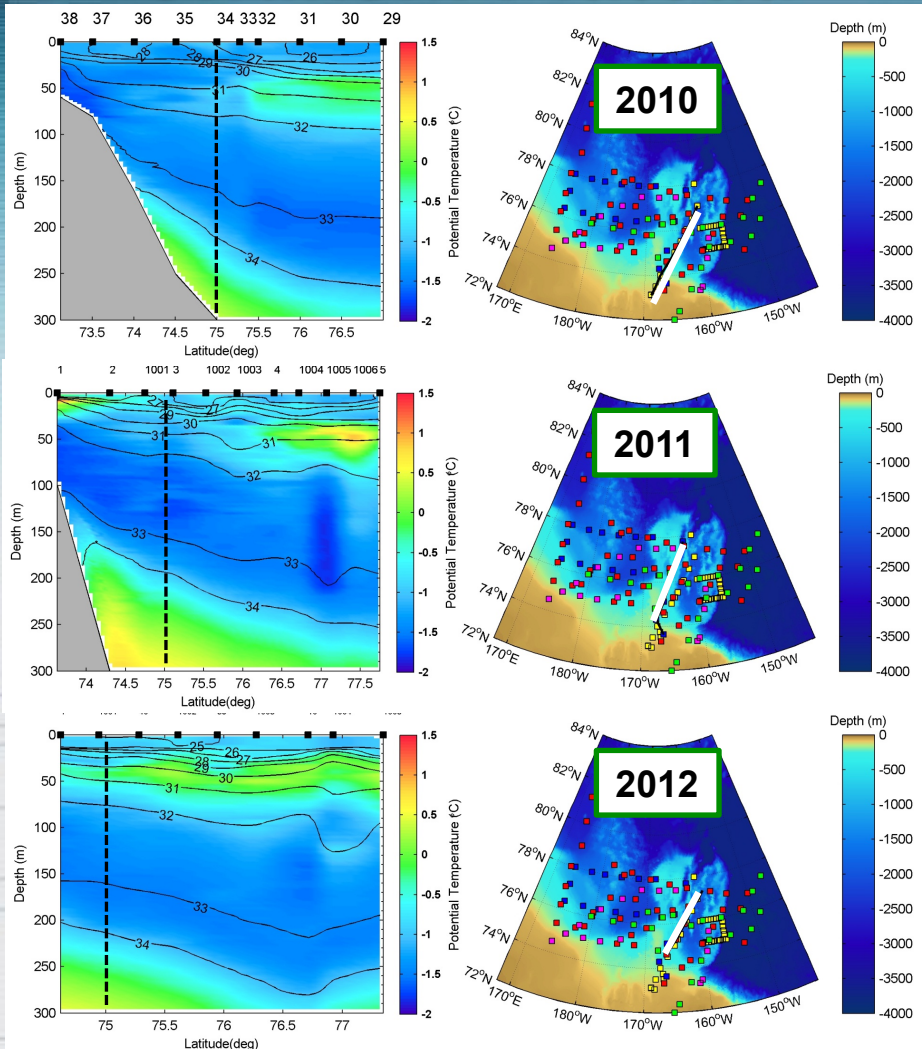
Diagram of θ -S averaged on the area ($170^{\circ}\text{W}\sim 160^{\circ}\text{W}$, $74^{\circ}\text{N}\sim 78^{\circ}\text{N}$) each year



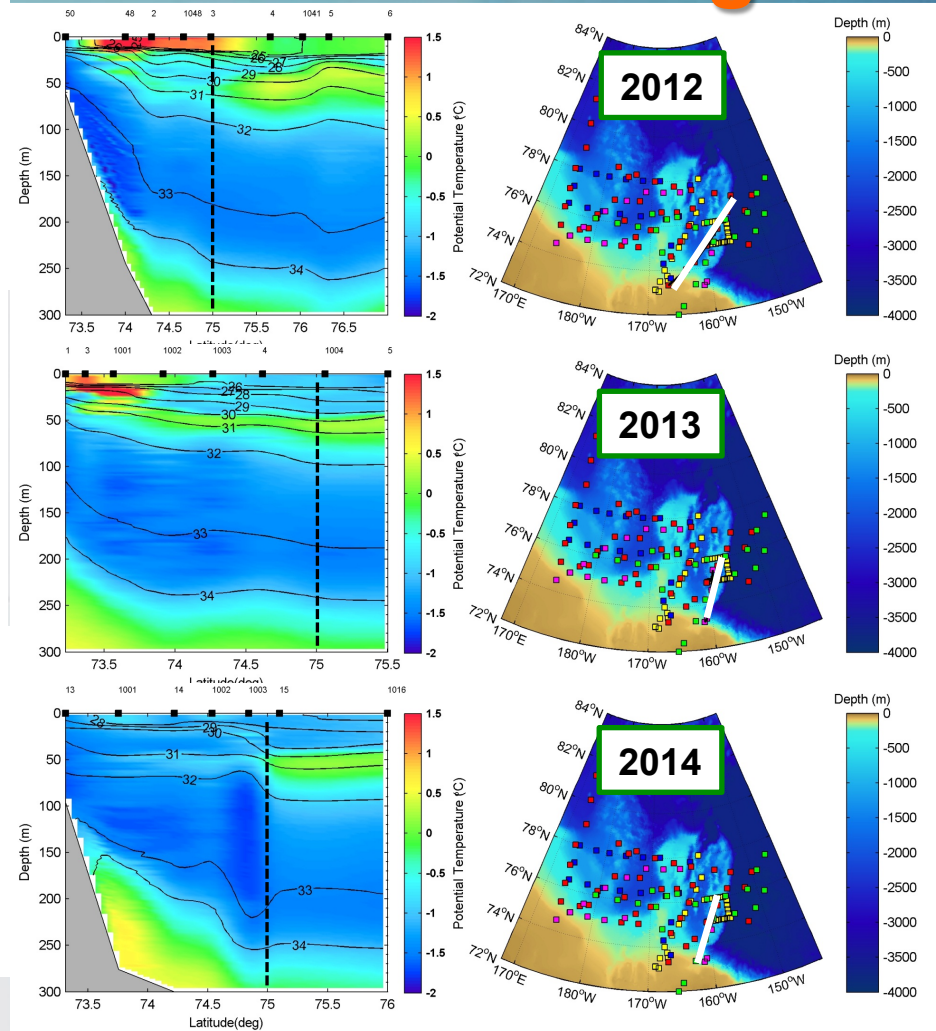
Potential temperature anomaly
PSW: negative in 2010, 2014
PWW: positive in 2013, 2014

CTD/XCTD: N-S transect

Chukchi Plateau

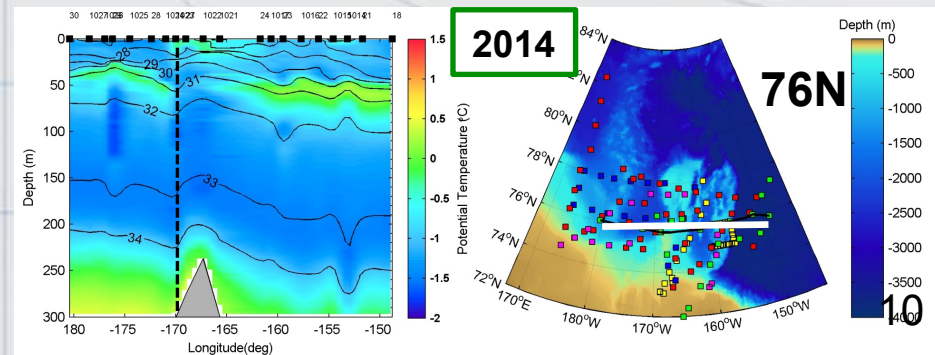
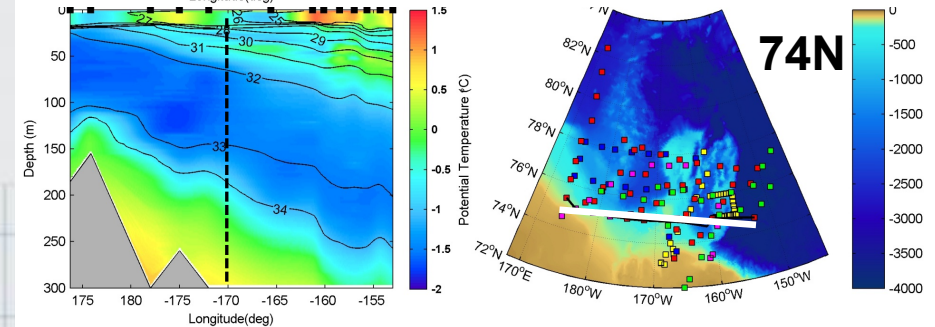
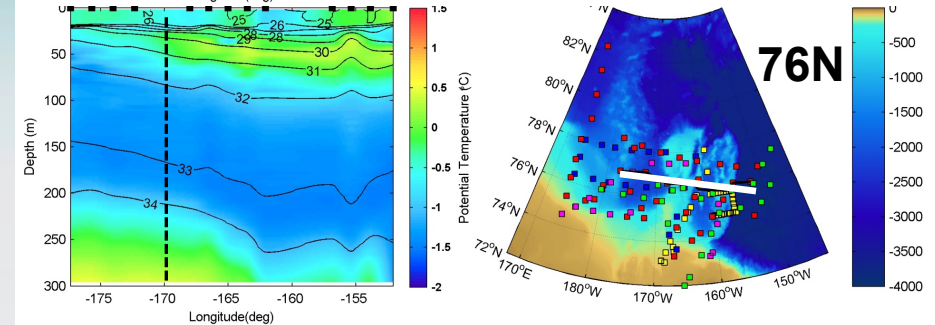
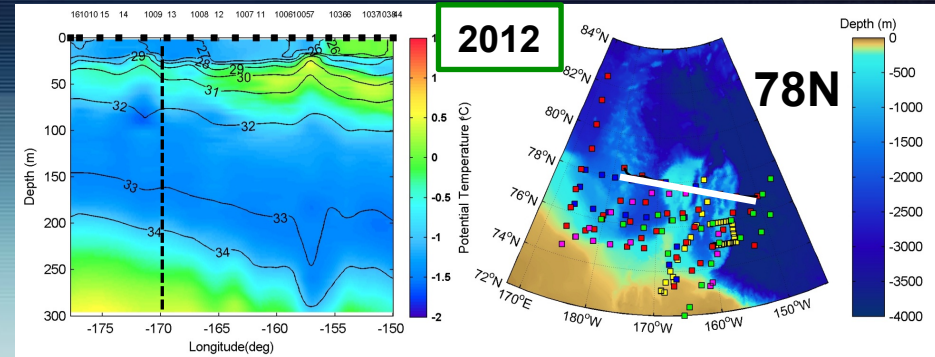
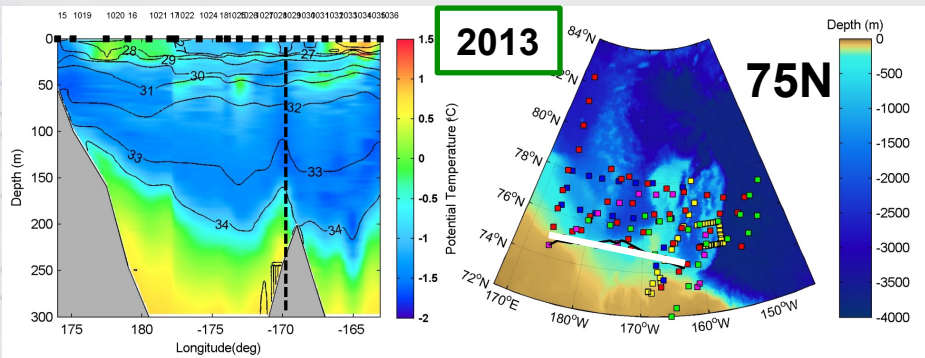
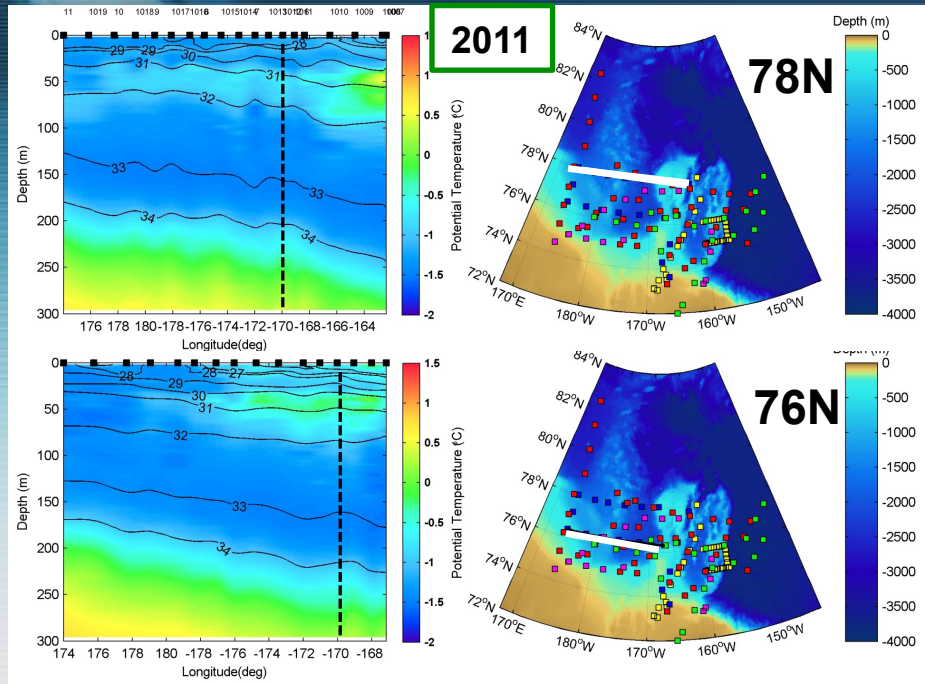


Northwind Ridge

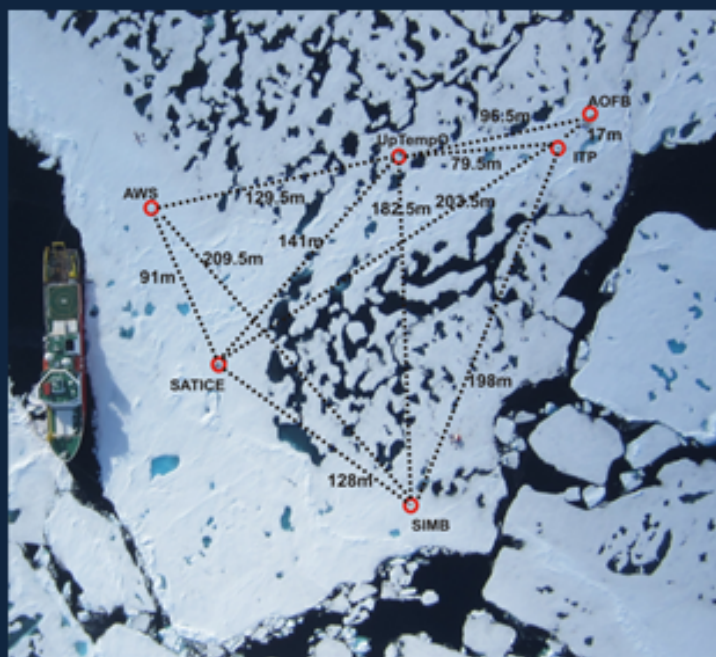


Background color: potential T
Black contours: isohalines

E-W transect



Background color: potential T
Black contours: isohalines



SIMBr: Seasonal Ice Mass Balance Buoy (CRREL)

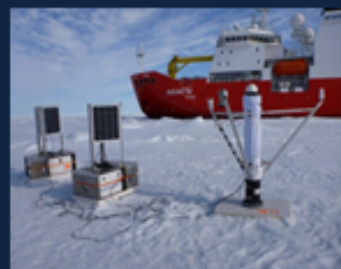


ITP: Ice-Tethered Profiler (WHOI)
AOFB: Autonomous Ocean Flux Buoy (NPS)



WB: Wave Buoy (BAS/UPMC)

AWS: Autonomous weather station (BAS/SAMS)



SATICE: High-precision GPS buoy (CSIC/MIT)

UpTempO: Upper layer Temperature of the Polar Oceans (APL/UW)

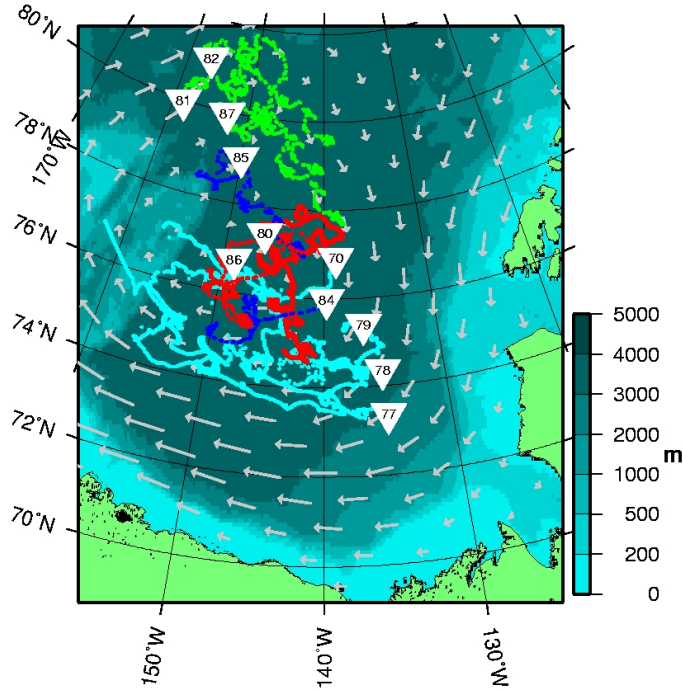


ONR-MIZ team: WHOI: Woods Hole Oceanographic Institution (Rick Krishfield), NPS: Naval Postgraduate School (Tim Stanton), British BAS: Antarctic Survey (Jeremy Wilkinson), UPMC: Villefranche-sur-mer oceanological observatory (Martin Doble), SAMS: Scottish Association for Marine Science (Phil Hwang)

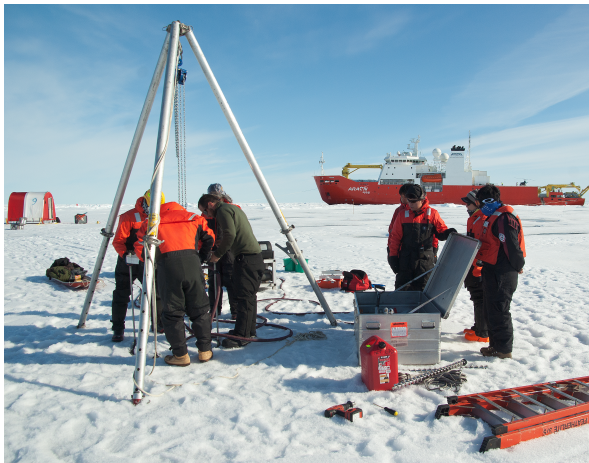
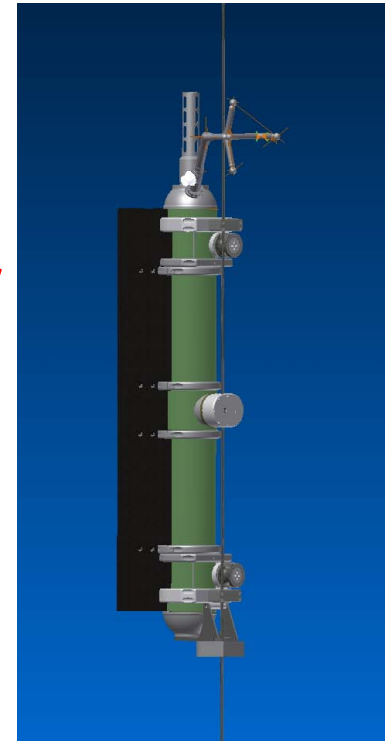
Others: ICM-CSIC/MIT: Spanish Institute of Marine Sciences/Massachusetts Institute of Technology (Pedro Elosegui), CRREL: Cold Regions Research and Engineering Lab (Jackie Richer-Menge), APL: Applied Physics Lab/UW (Mike Steele).



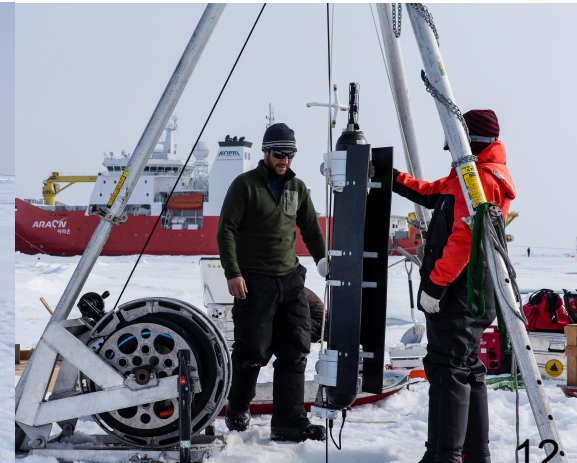
2014 ITP Deployments



- 70 MIZ ITP-V (2013)
- 77-79 MIZ ITP-Vs
- 80 MIZ KOPRI ice camp ITP-V
- 81, 82, 87 OUC Xuelong ITPs
- 84, 85 NSF Louis ITPs
- 86 NSF Araon ITP



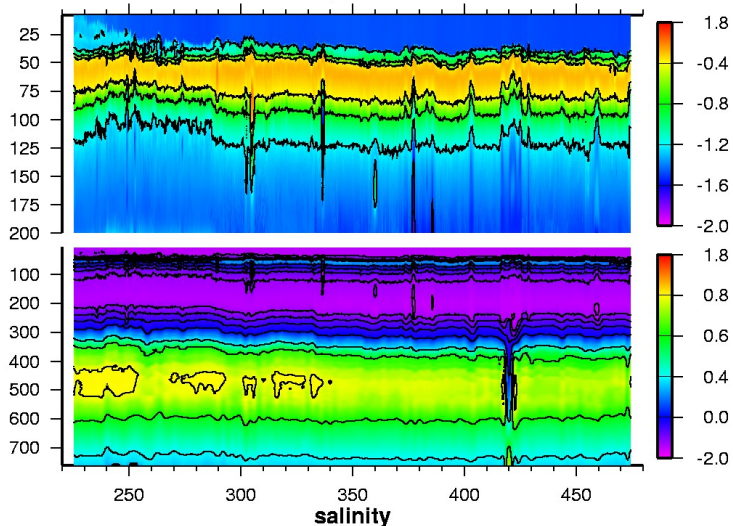
Photos by Craig Lee



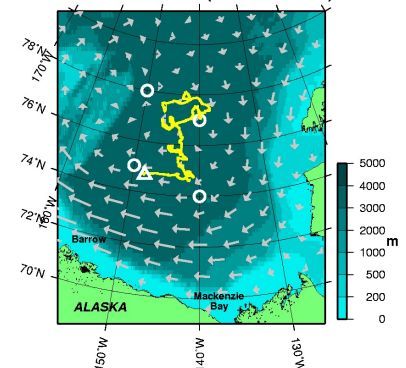
ITPs Deployed on MIZ Sea Ice Camp 2014

ITP80 Up Profile Contours (to profile 2857)

temperature



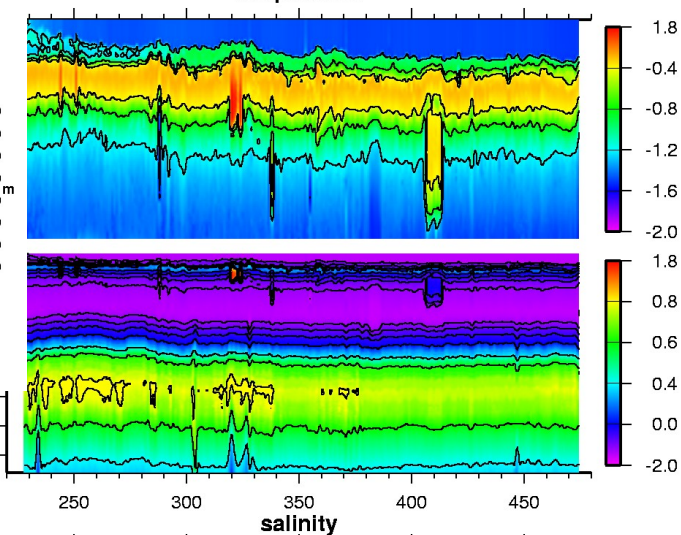
ITP80 Drift Track (as of 2015/04/19)



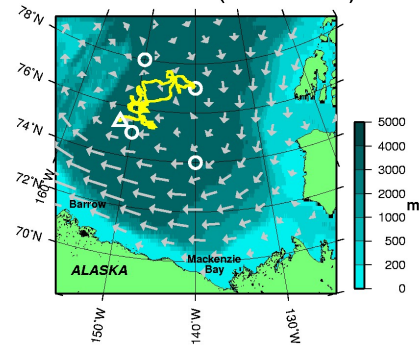
ITP drift (yellow line) and latest location (triangle),
BGOS moorings (white circles) and annual ice drift from
IABP (grey vectors) on IBCAO bathymetry (shading).

ITP86 Up Profile Contours (to profile 494)

temperature



ITP86 Drift Track (as of 2015/04/18)



ITP drift (yellow line) and latest location (triangle),
BGOS moorings (white circles) and annual ice drift from
IABP (grey vectors) on IBCAO bathymetry (shading).

day 2014

day 2014

Autonomous Ocean Flux Buoy (AOFB)

AOFB program is being conducted to monitor and better understand the delicate balance between the upper ocean, sea ice cover, and incoming solar radiation.

Buoy 29 Summary Info

Deployment Site: Araon Ice Camp

Status: realtime

Initial Position (Lat, Lon): 77.431, -146.188

Initial Time: 12-Aug-2014 00:42:04 UTC

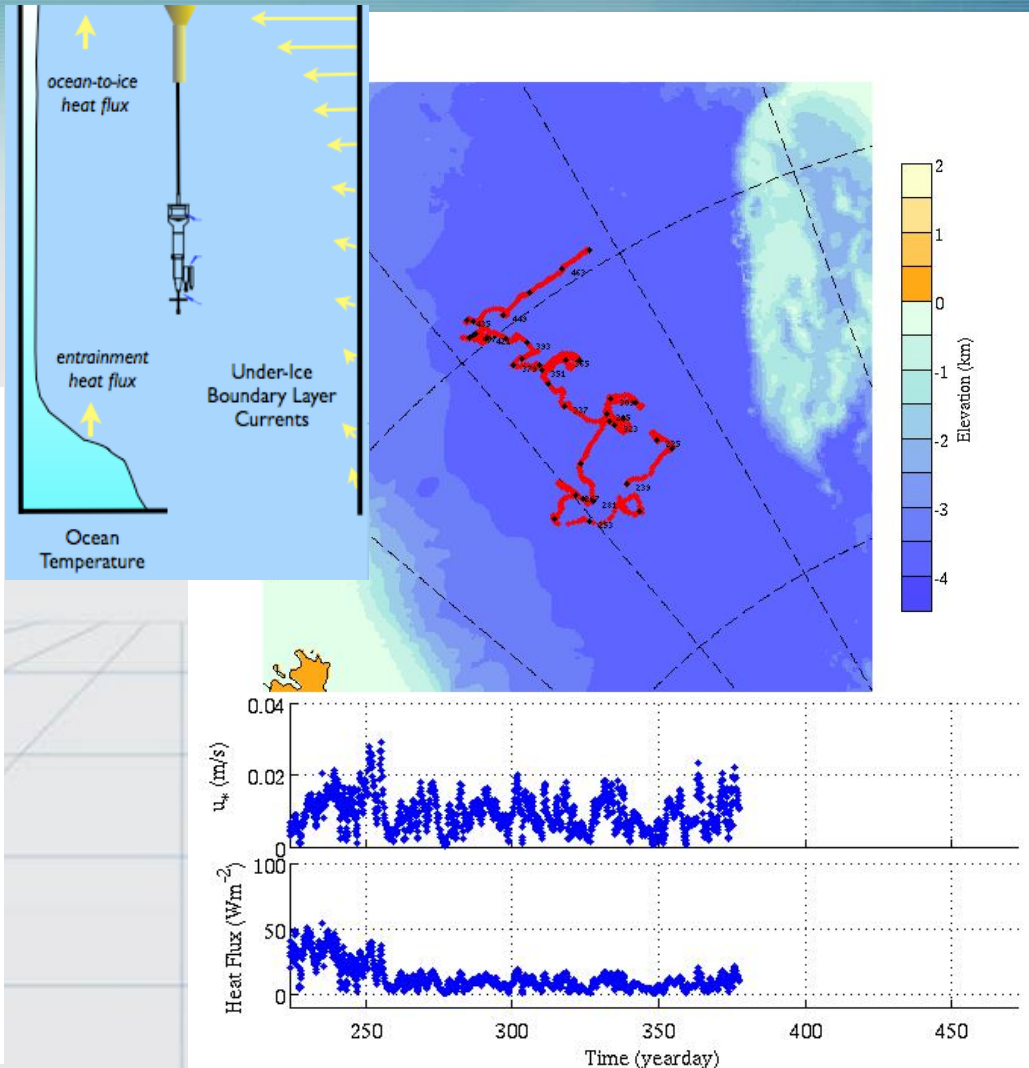
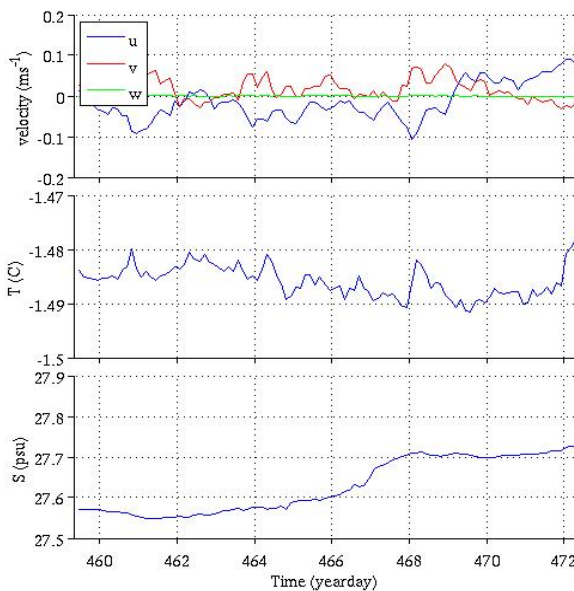
Latest Position (Lat, Lon): 74.738, -148.584

Latest Time: 17-Apr-2015 07:42:02 UTC

Latest Temperature (C): -1.45

Latest Salinity (psu): 27.70

Latest Ice Speed (m/s): NaN



Detailed information available at: <http://www.oc.nps.edu/~stanton/fluxbuoy/>

2015 ARAON Cruise Plan: Station Map

◆ Period

Leg 1: August 1 - 22, 2015

Nome to Barrow

◆ Chief Scientist

Dr. EunJin Yang

◆ Nations

Korea, Japan, China, UK, France,
Spain, and US

◆ Research fields

Hydrographic survey

Sea ice physics

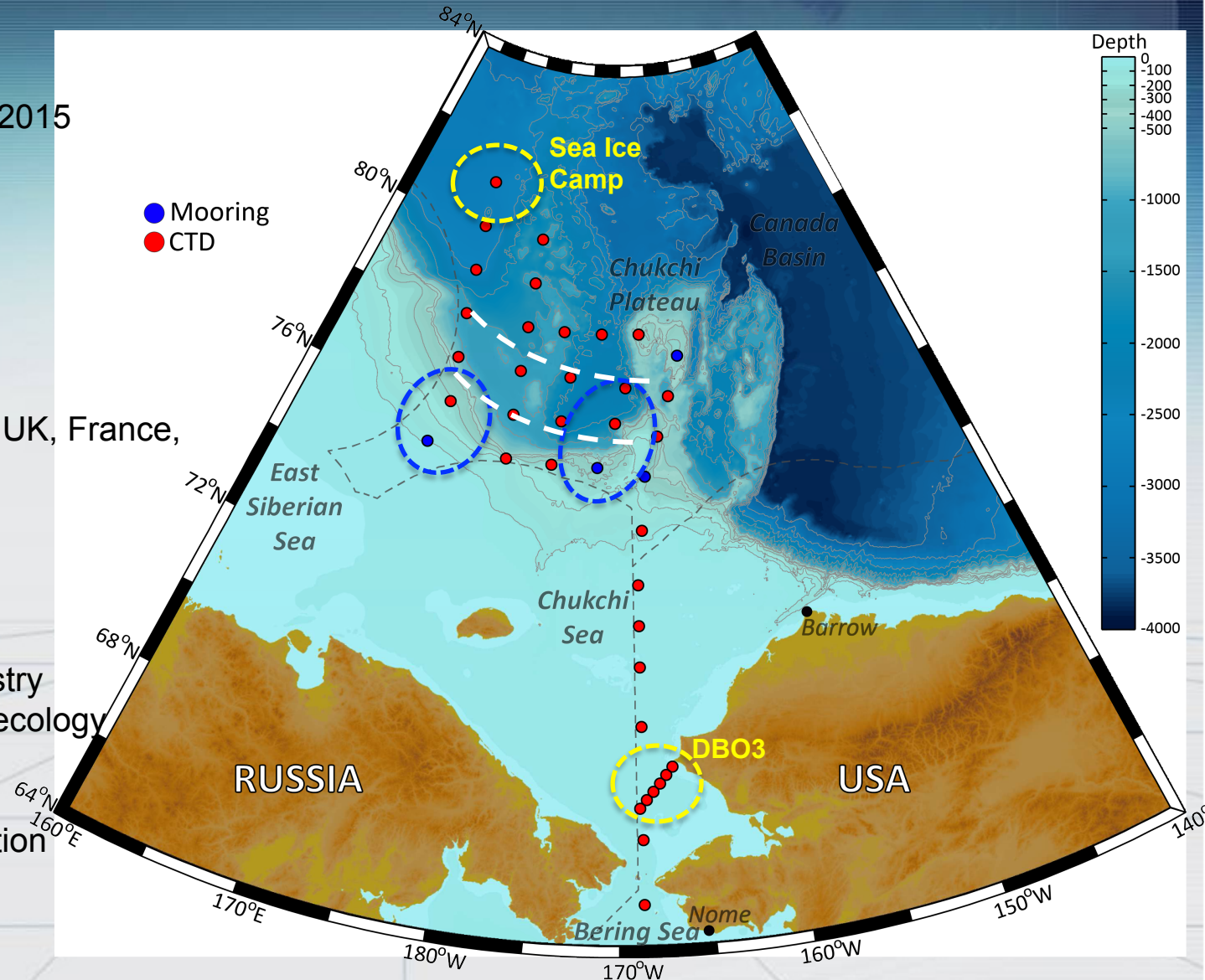
Sea ice biogeochemistry

Microbes & plankton ecology

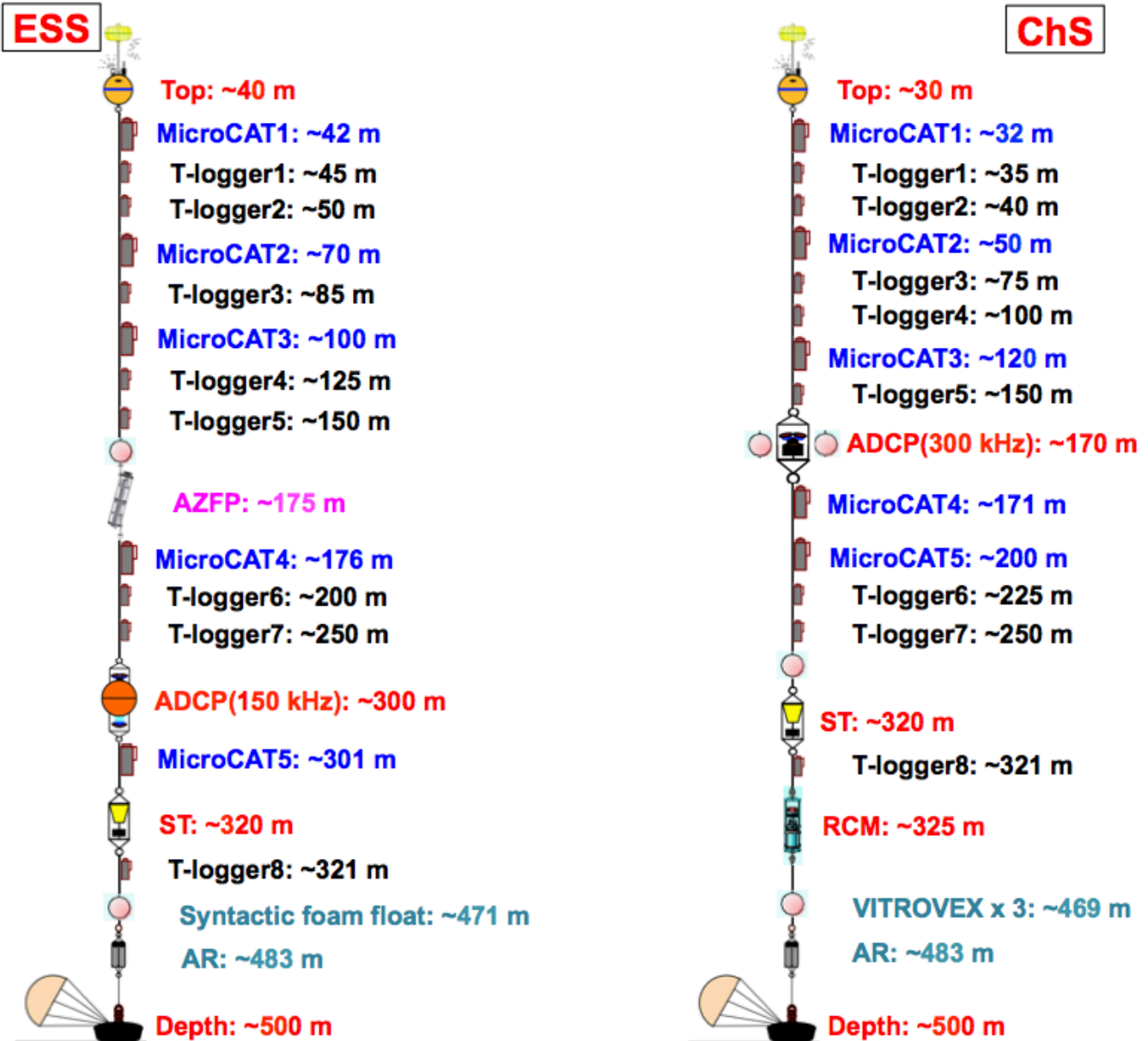
Marine chemistry

Remote sensing

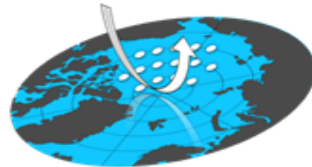
Atmospheric observation



2015 ARAON Cruise Plan: Ocean Mooring



Sea Ice Works



Scientific area: Monitoring Arctic climate change.

European context: IAOOS, ACCESS are 2 concrete elements to launch the French Observatory of the Arctic.

Scientific environment: Observing, understanding and quantifying climate changes in the Arctic. IAOOS is specifically concerned with the potential for a significantly reduced sea ice cover, and the impacts this might have on the environment and on human activities, both regionally and globally.

Coordinating partner UPMC (LOCEAN-LATMOS)

Organization of the partners INSU, IPEV, ICARE, NKE, CIMEL.

Main objective of IAOOS

Provide and maintain an integrated observing system over the Arctic Ocean.

Goal of IAOOS

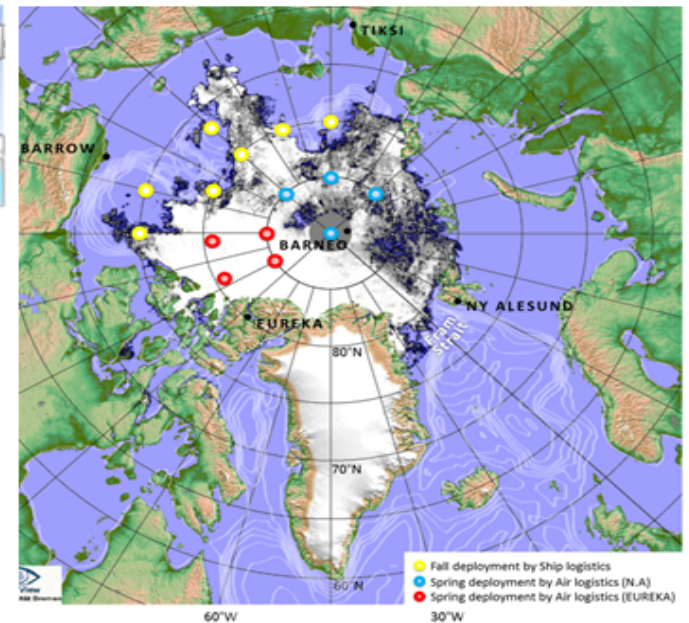
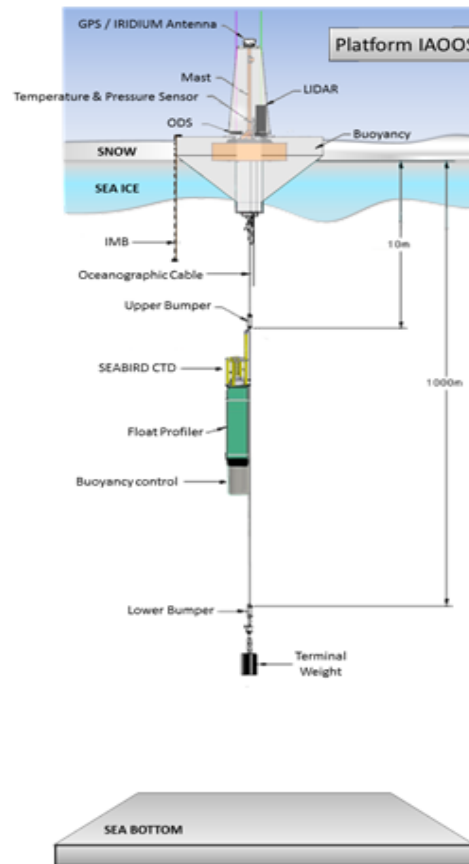
Real time data related to the State of Arctic (Ocean, Atmosphere, Sea-Ice).

Equipment: IAOOS Platforms

- CTD vertical profilers from 0 to 1000m depth (conductivity, temperature, depth).
- Ice Mass Balance (IMB).
- Temperature and pressure sensors.
- Microlidars.
- Optical depth sensors (ODS).

Logistics

- 15 autonomous platforms operating at any given time in the Arctic Ocean for a period of 7 years.
- 6 platforms to be deployed every year following the first deployment of 15 platforms, amounting to a total of 40.



Distribution of buoys: These platforms deployed on sea-ice and in open water, would be drifting according to sea-ice motions and currents mainly imposed by the Arctic transpolar drift and the Beaufort Gyre.

Questions or Comments?

