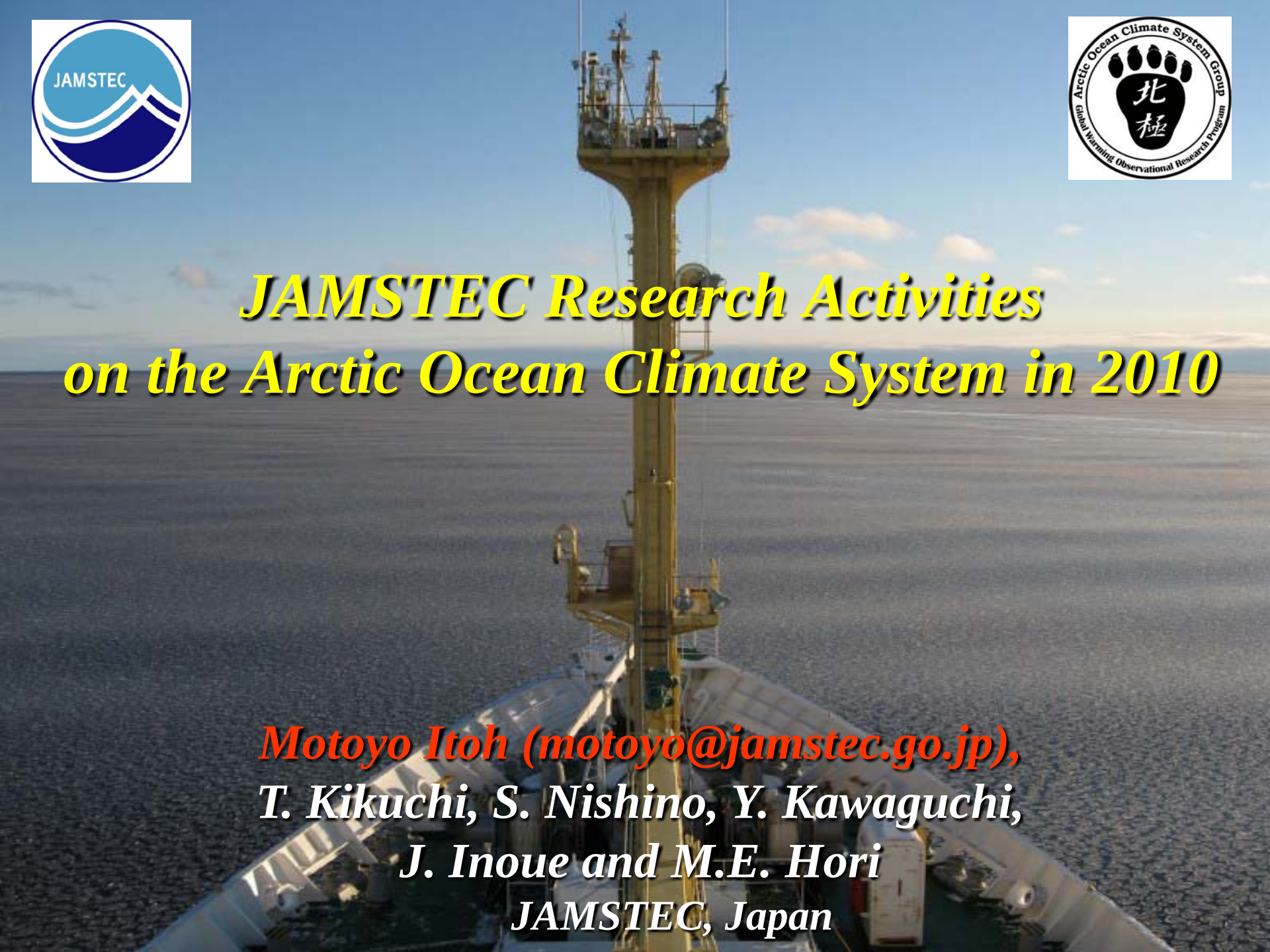


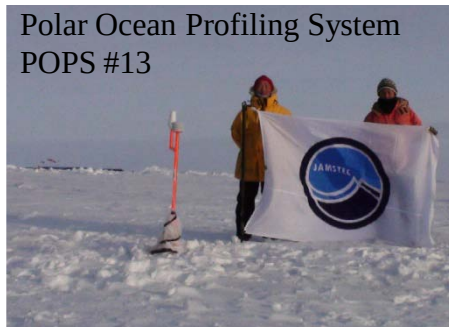
JAMSTEC Research Activities on the Arctic Ocean Climate System in 2010

Motoyo Itoh (motoyo@jamstec.go.jp),
T. Kikuchi, S. Nishino, Y. Kawaguchi,
J. Inoue and M.E. Hori
JAMSTEC, Japan

Map of sea ice concentration (Univ. Bremen) on September 18, 2010
with mean sea level pressure (NCEP reanalysis) in August-September 2010

MR10-05
Sept.2 ~ Oct.16, 2010
Still now on-going . . . . . .
(Cruise track in the map is as of Sept.30)

Polar Ocean Profiling System
POPS #13



POPS #13 deployment:
April 16, 2010,
89.28N, 89.66E
with 4 GPS buoy (IARC)
(Drift track in the map is as of Oct. 6)

R/V Johan Hjort
Barents Sea cruise (part.3)
Sept.15 ~ 25, 2010
(Cruise track in the map)

R/V Johan Hjort (IMR, Norway)

JAMSTEC observational activities in 2010:

1. *Drifting buoy operation at NPEO 2010*
2. *R/V Mirai 2010 cruise in the Pacific Arctic Ocean (MR10-05)*
3. *Participation in R/V Johan Hjort (IMR, Norway) cruise in the Barents Sea*

Arctic Ocean Climate Change

To understand the on-going Arctic climate change and its impact for global climate and ecosystem, we should expand our target into not only physical oceanography but also meteorology and bio-geochemistry in the Arctic Ocean.

Objectives:

1) To quantify on-going changes in ocean, atmosphere, and bio-geochemistry of the Arctic Ocean, which are related to the recent Arctic warming and sea ice reduction.

2) To clarify important processes and interaction among atmosphere, ocean, and bio-geochemistry behind changes of the Arctic Ocean,

3) To collect and distribute data for understanding the effects of the Arctic Ocean changes on global climate.

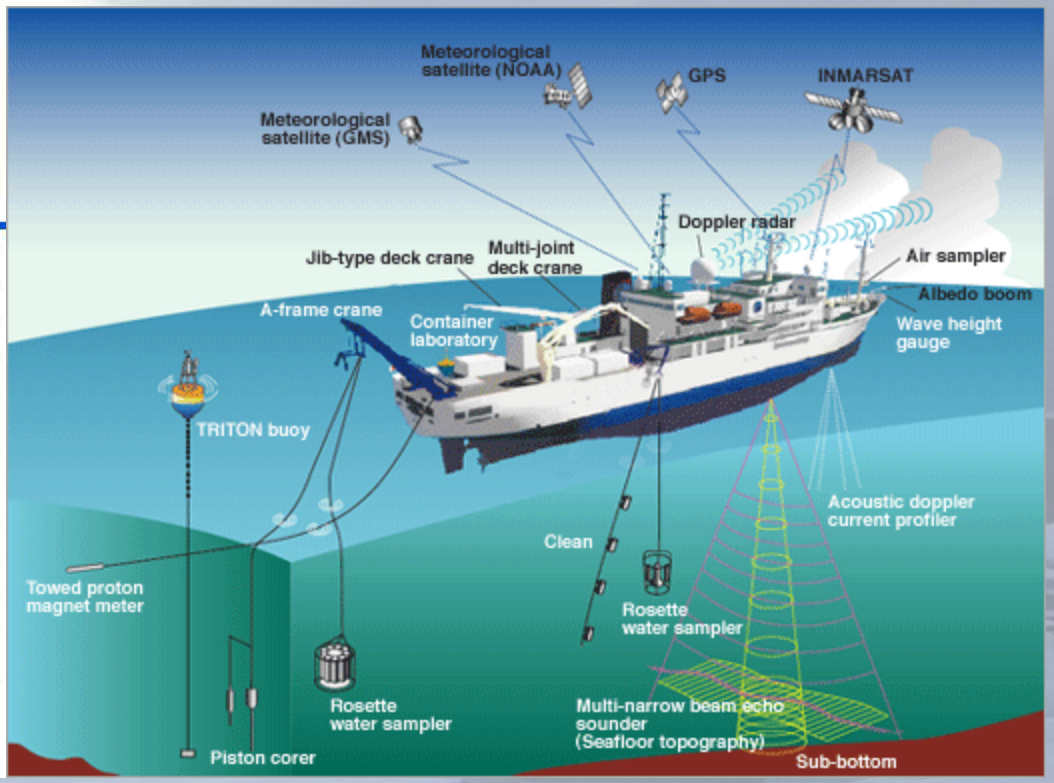
Sea ice condition on September 16 2007
From NASA Earth Observatory web site http://earthobservatory.nasa.gov/

R/V Mirai (JAMSTEC)

Ice-strengthen ship (not ice-breaker)

Principal specifications

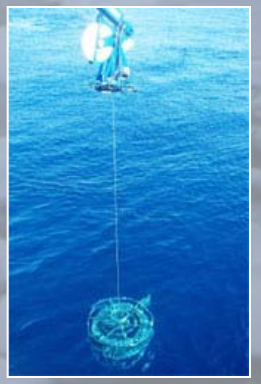
Length	128 m
Beam	19 m
Depth	10.5 m
Draft	6.9 m
Gross tonnage	8,687 tons
Cruising speed	Approx. 16 knots
Range	Approx. 12,000 nautical miles
Accommodation	80 (34 crew, 46 research personnel)
Main propulsion system	Diesel engines: 1,838kW × 4
	Electric propulsion systems: 700kW × 2
Main propulsion method	Controllable pitch propeller × 2



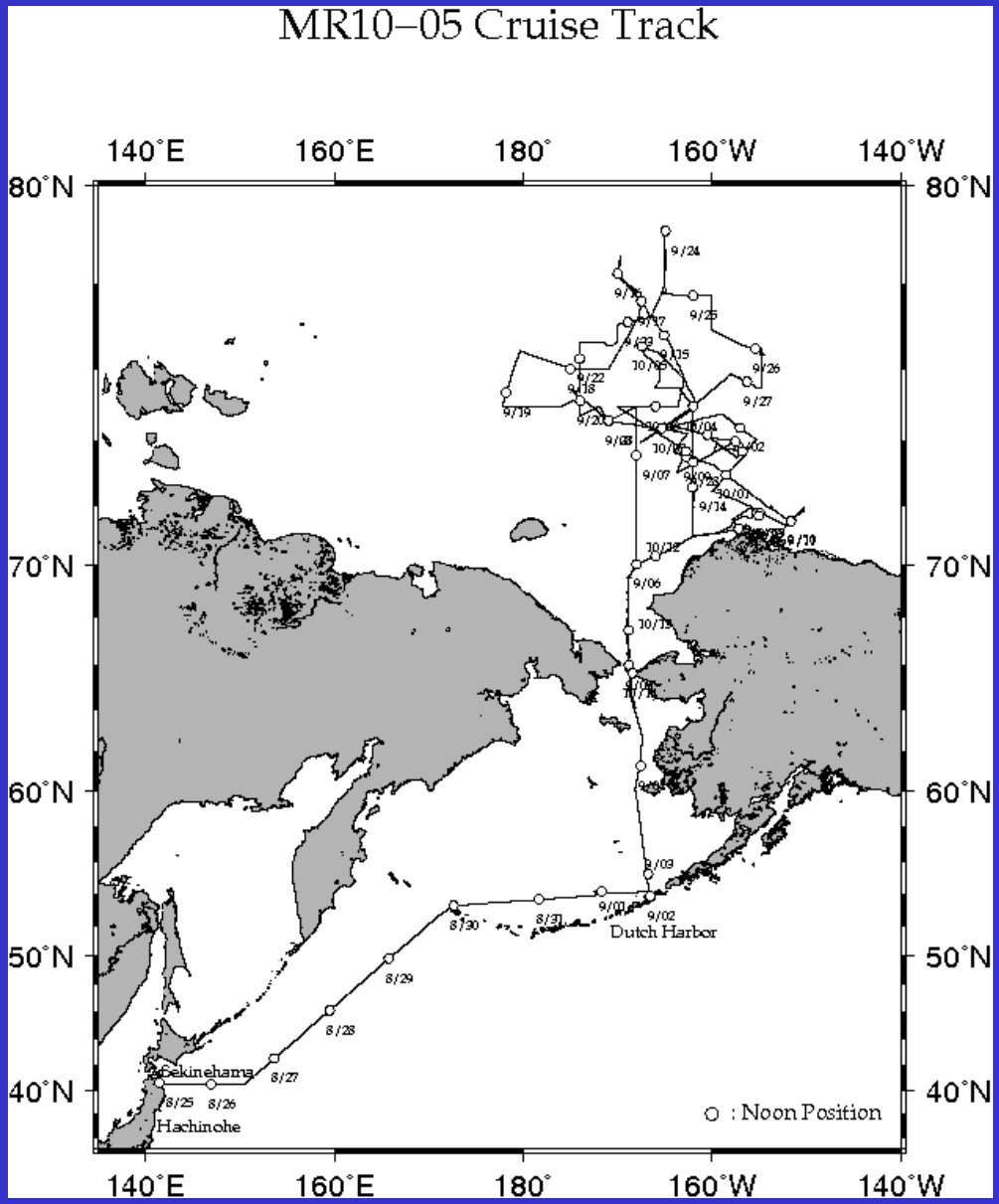
A large vessel able to perform observational studies over wide areas under rough weather conditions, MIRAI is one of the largest class of research vessels in the world.

Equipped with large observation instruments

Equipped with Doppler radar, *MIRAI* is able to carry large observation instruments, including 14 large-scale buoys (TRITON buoys), as well as large water samplers and piston corers.



MR10-05 Mirai Arctic Cruise in 2010



24 Aug, Sekinehama, Japan
Pacific Ocean (9 days)

1-2 Sept, Dutch Harbor

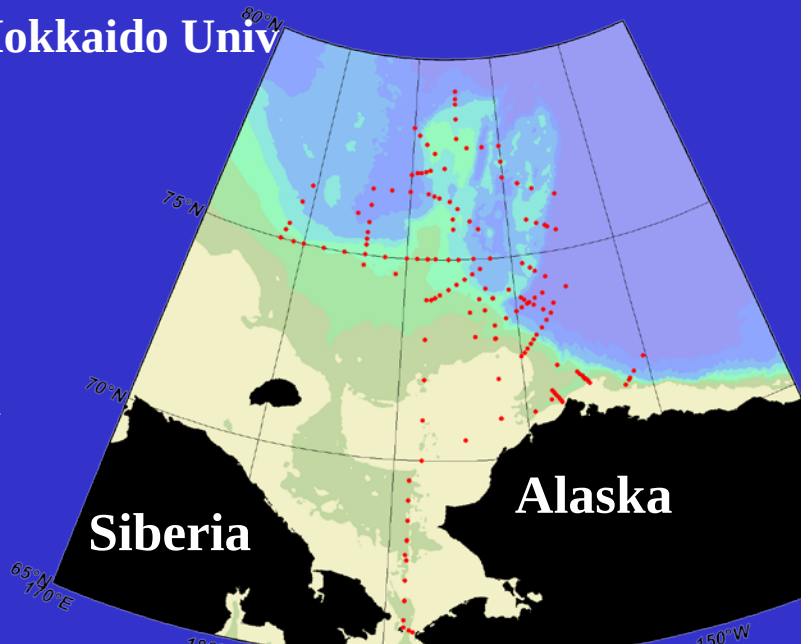
Arctic Ocean (45days)

16 Oct, Dutch Harbor

Summary of measurements of R/V Mirai 2010

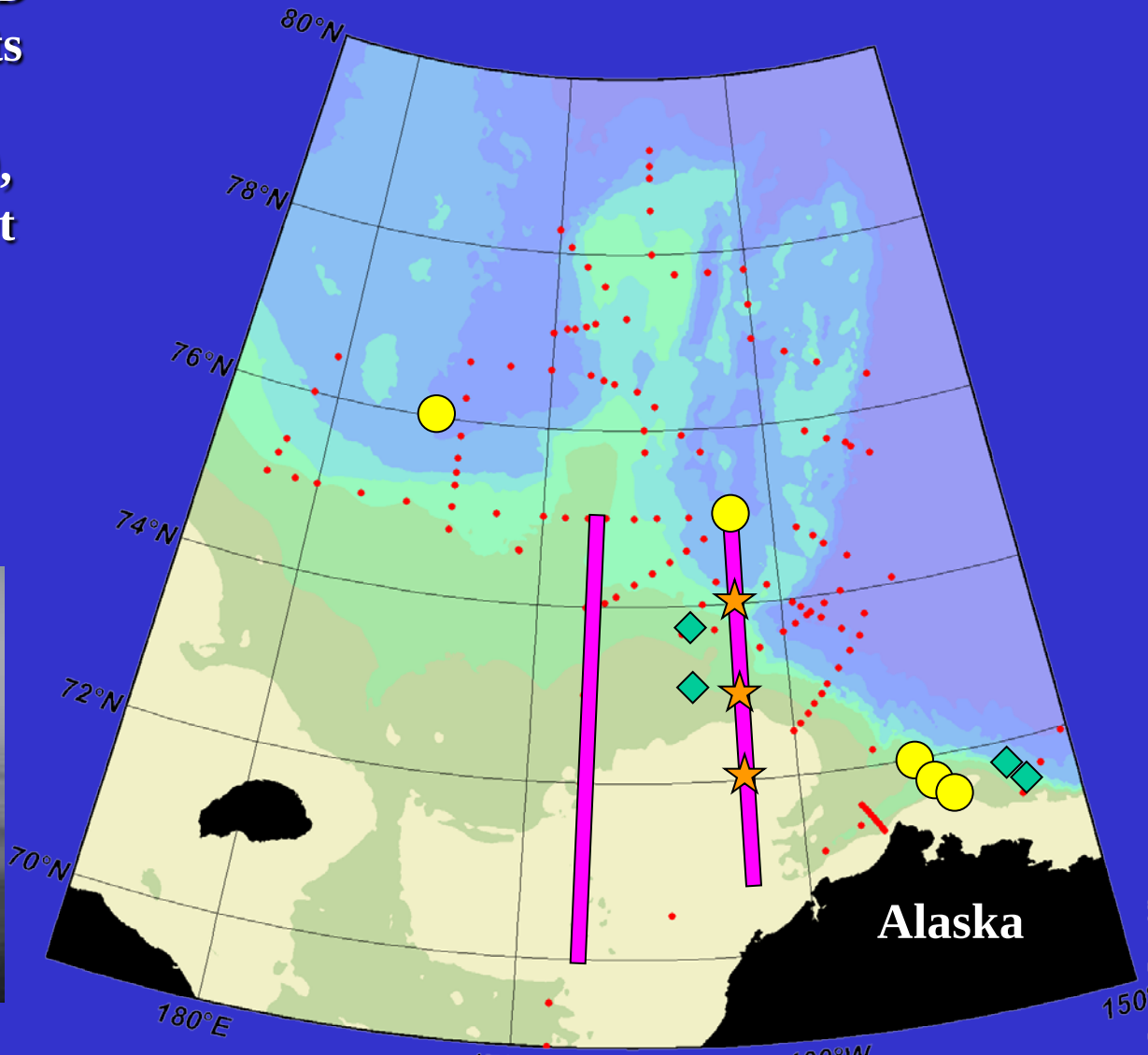
- Radiosonde, Doppler radar, could radar, other meteorological observations
- CTD with LADCP, XCTD
- Turbulence measurements by TurboMAP
- Mooring operations
- Surface buoy operations (Collaboration with Dr. I. Rigor)
- Water sampling for Sal, Oxy, Nut, Chl-a, alkalinity, TOC, POC, del-O18
- Carbon uptake experiments
- Underway measurement by ship-mounted ADCP, surface water monitoring system (T,S,DO etc), surface meteorology monitoring

- Bio-optical observation PI: Dr. Hirawake @Hokkiado Univ
- Zoo plankton net tows PI: Dr. Yamaguchi @Hokkaido Univ
- Sediment trap mooring operation
  PI: Dr. Harada @JAMSTEC
- Microbial communities observation
  PI: Dr. Utsumi @ Tsukuba Univ
- Piston coring PI: Dr. Uchida @ NIES
- Aerosol sampling PI: Dr. Kondoh @ Tokyo Univ



Summary of measurements of R/V Mirai 2010

215 Radiosonde
6hourly & 162W section: 9/13,9/27,10/11, 168W section: 9/8
177 CTD/LADCP, 168 XCTD
30 TurboMAP measurements
6 mooring deployment
BCC-10, BCE-10, BCW-10,
CAP-10, CAP-10t, NAP-10t
3 SVP deployments
4 Piston core stations

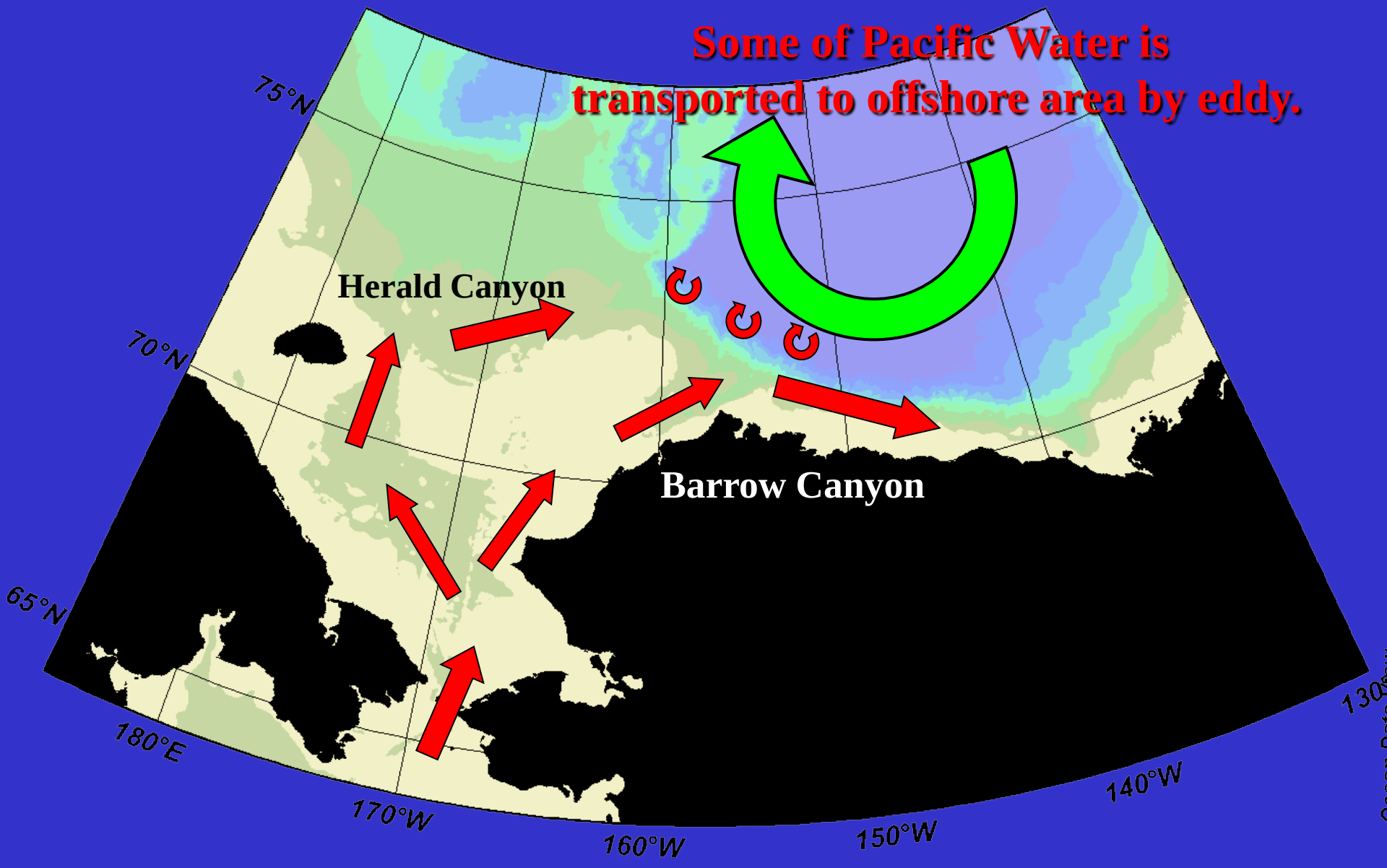


2008

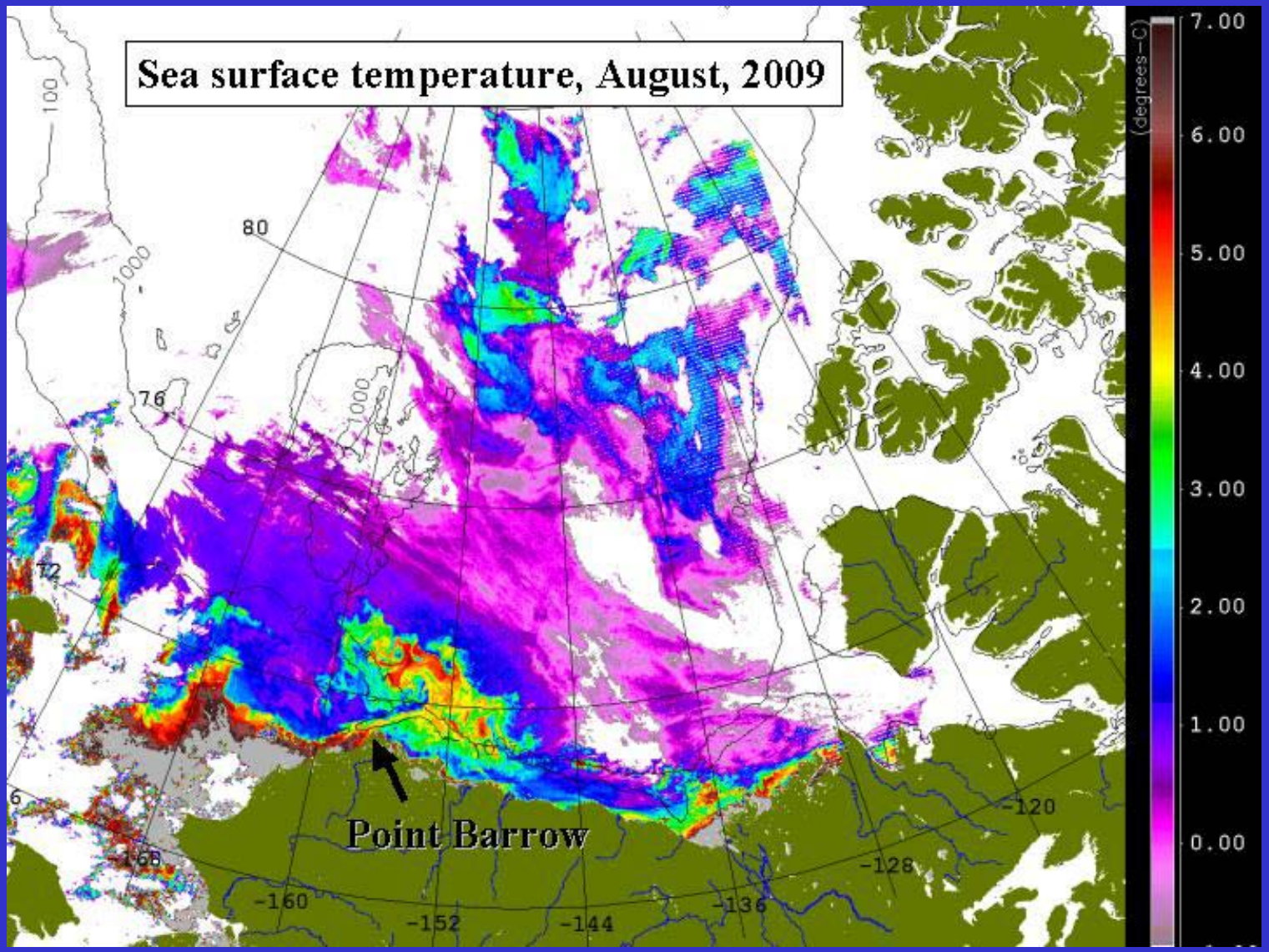
2009

2010

Pacific Water pathways into the Arctic Basins

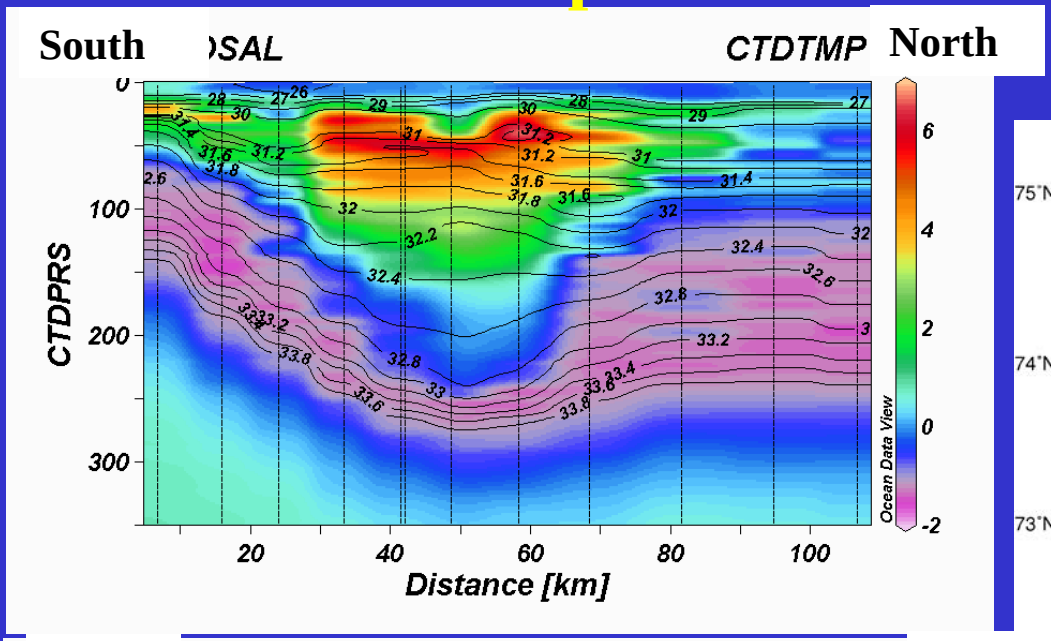


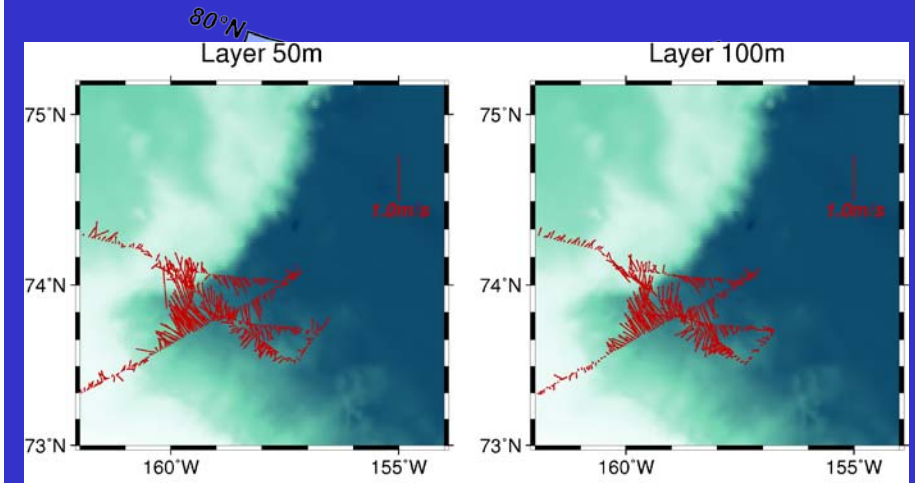
Evidence of eddy formation from Satellite data

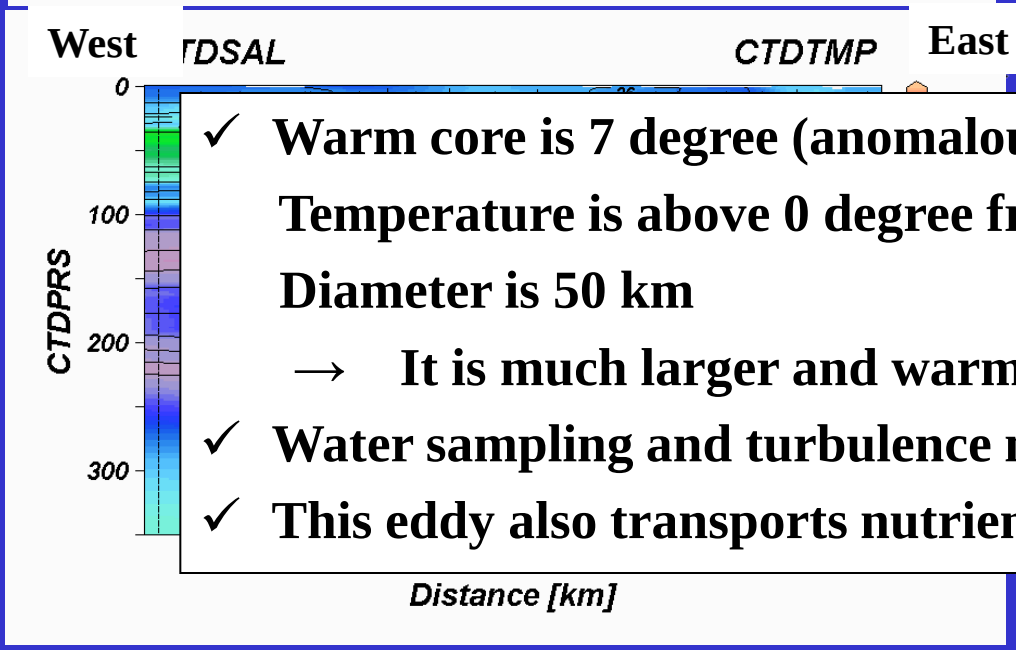


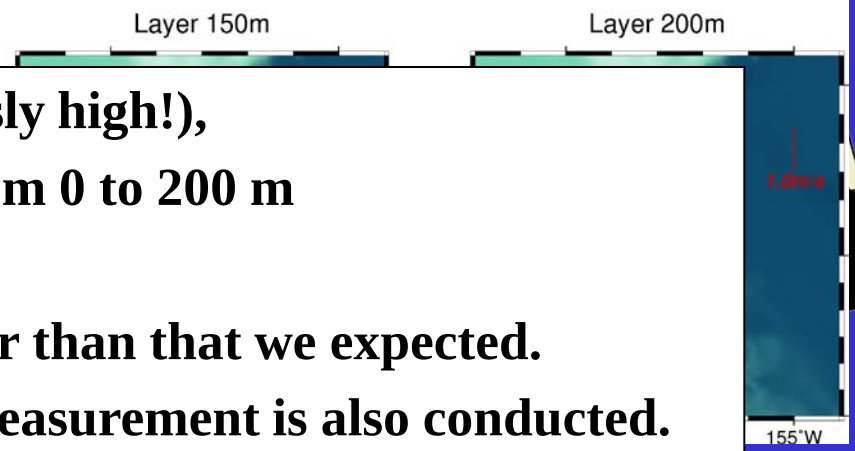
Courtesy of Dr. R. Pickart

Anticyclonic eddy trapped warm Pacific Summer Water and transported it into the basin



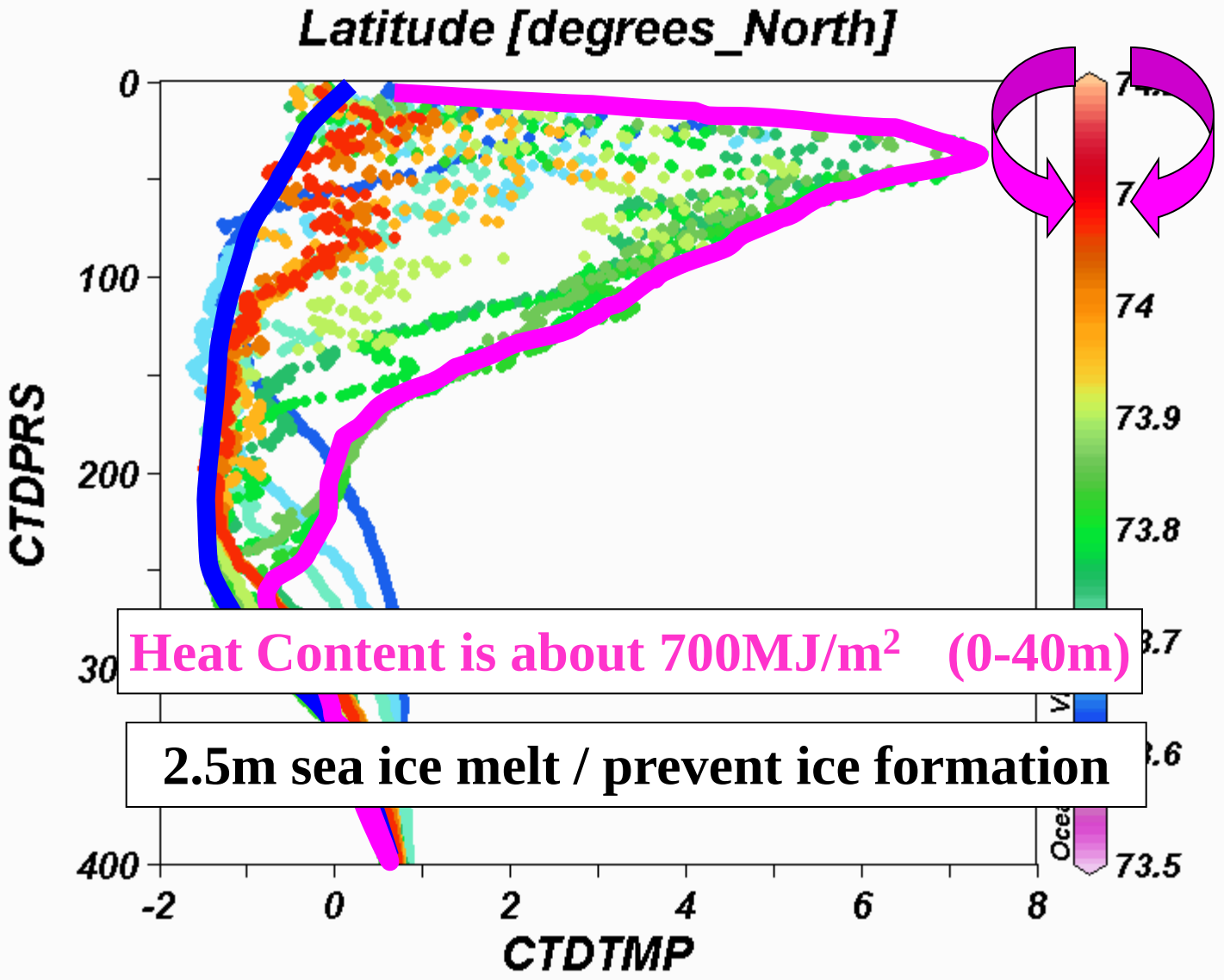






- ✓ **Warm core is 7 degree (anomalously high!),**
  Temperature is above 0 degree from 0 to 200 m
  Diameter is 50 km
  → **It is much larger and warmer than that we expected.**
- ✓ **Water sampling and turbulence measurement is also conducted.**
- ✓ **This eddy also transports nutrient from the shelf into the basin.**

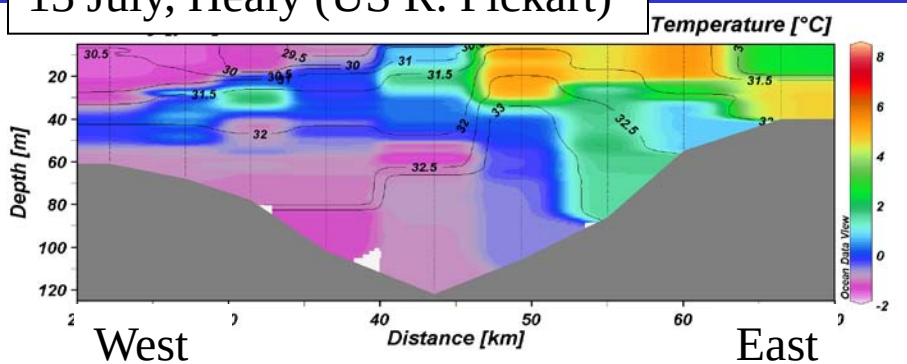
Heat will be released, once winter convection starts



When did such warm water pass the Barrow Canyon ?

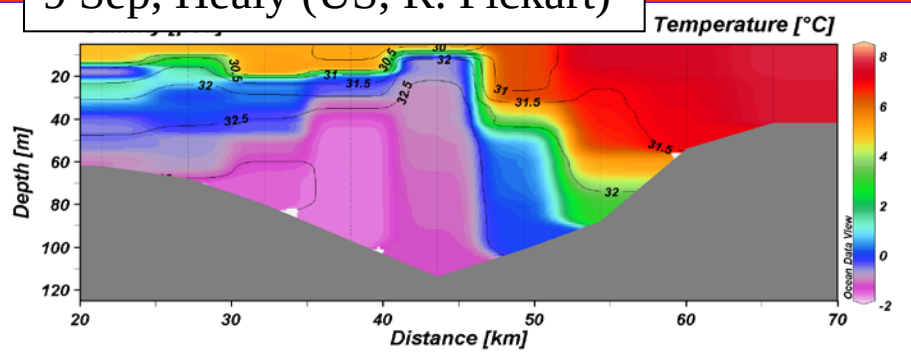
Based on DBO transect

13 July, Healy (US R. Pickart)

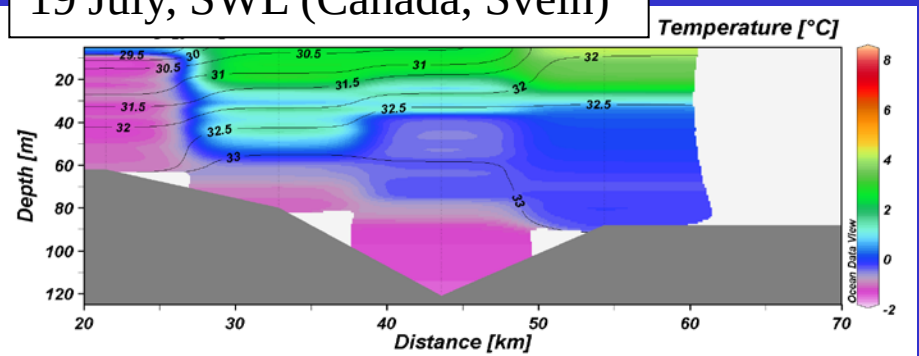


West East

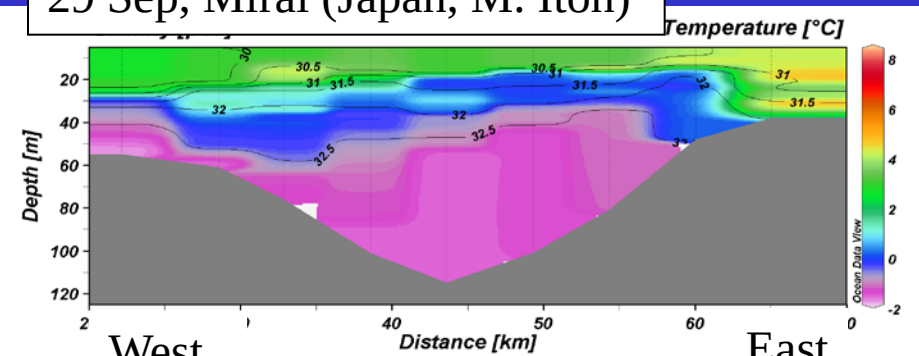
9 Sep, Healy (US, R. Pickart)



19 July, SWL (Canada, Svein)

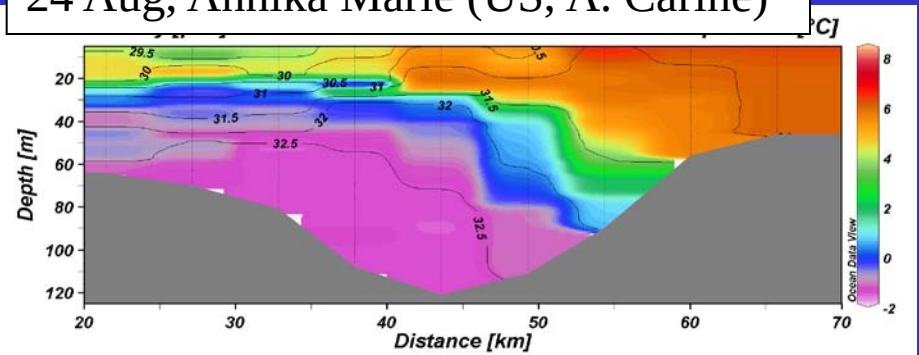


29 Sep, Mirai (Japan, M. Itoh)



West East

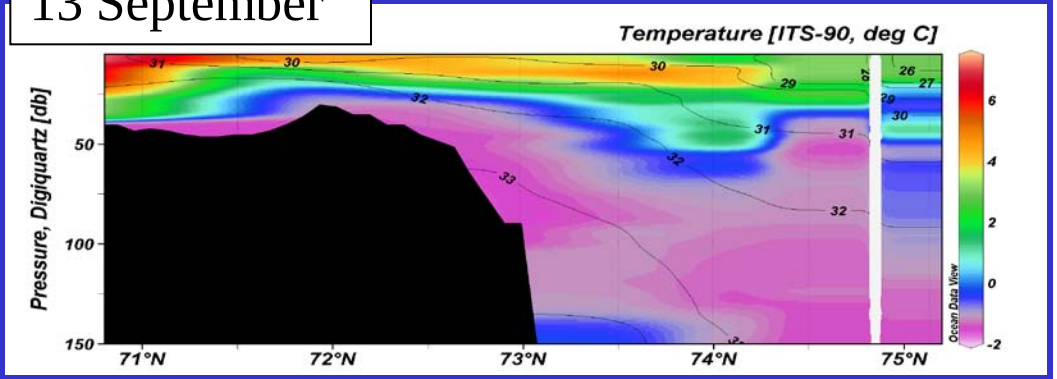
24 Aug, Annika Marie (US, A. Carine)



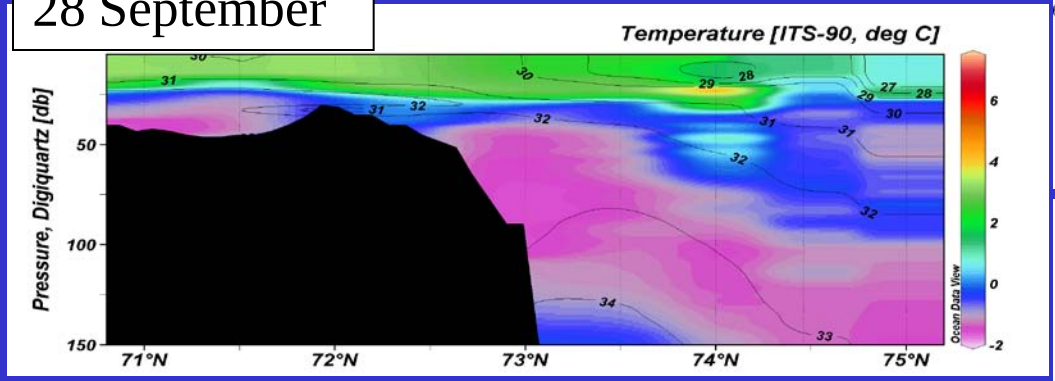
Warm Pacific Summer Water (> 7degree) is observed in early September by Healy.

Repeat sections of CTD and radiosonde along 162W

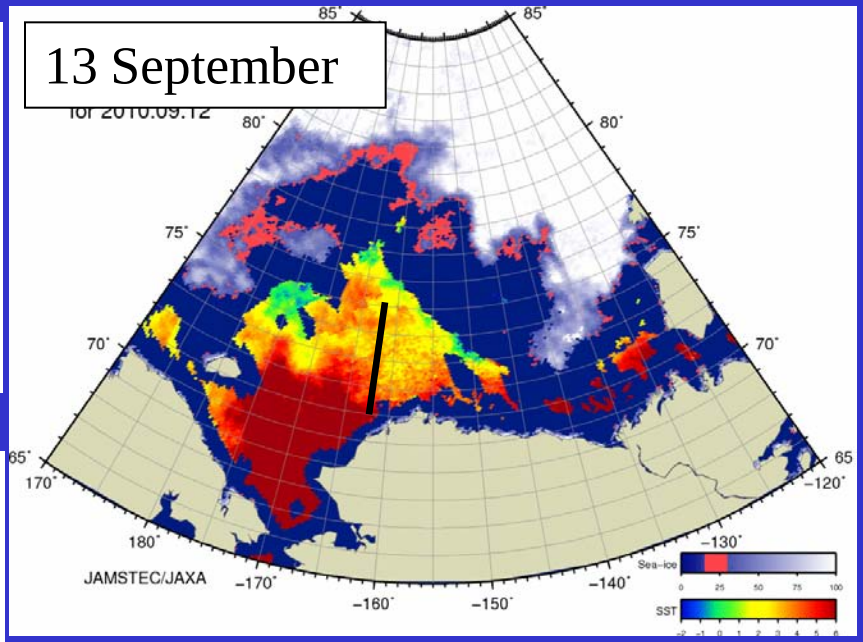
13 September



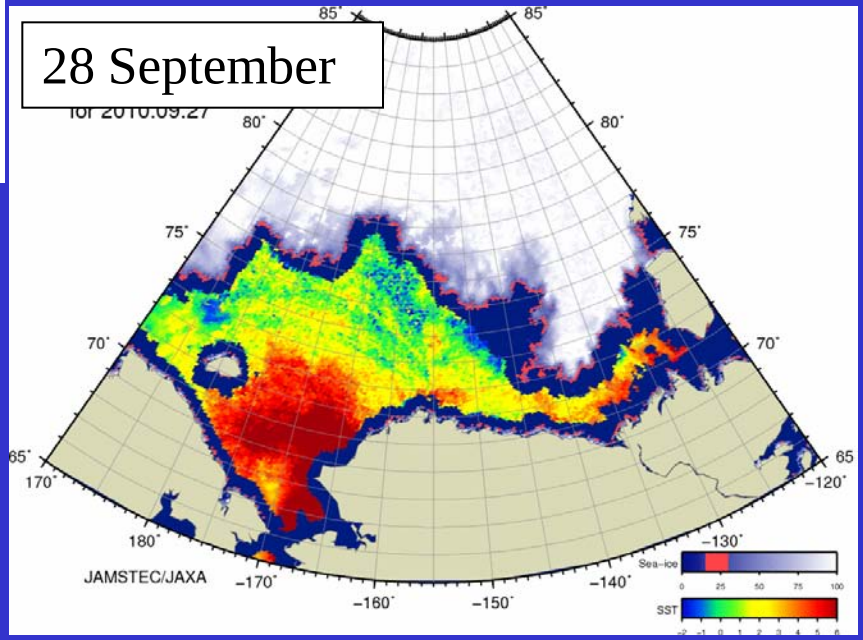
28 September



13 September



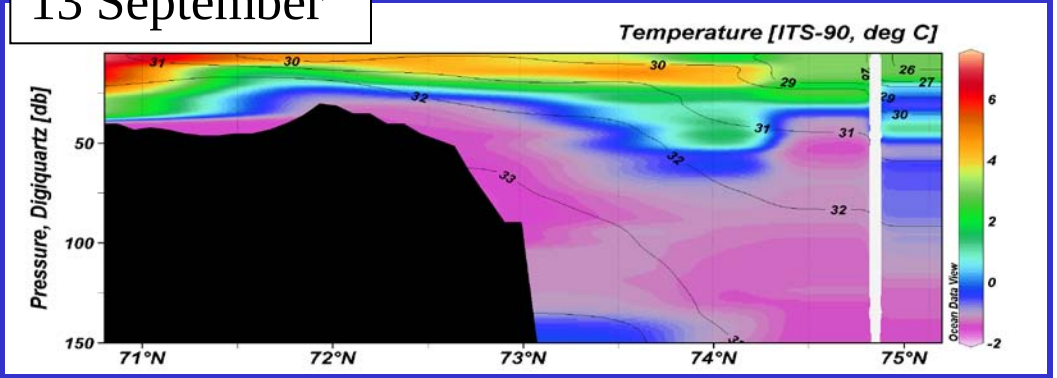
28 September



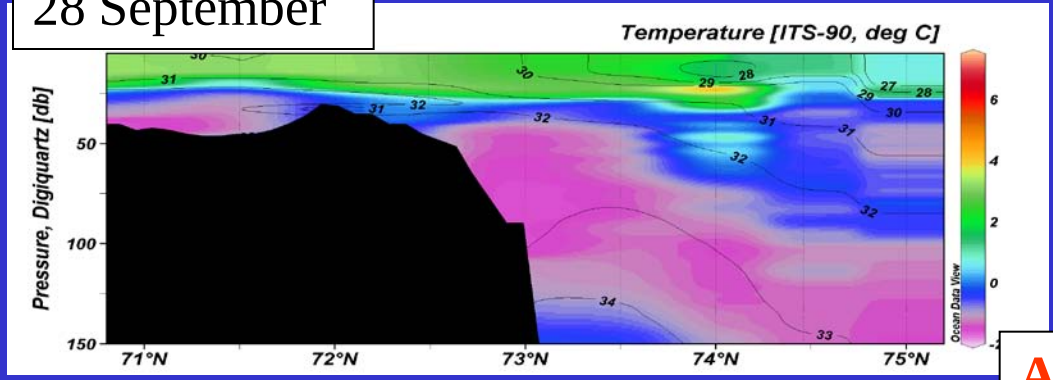
Surface water is cooled about 2 degree between 13 Sept to 28 Sept.
130W/m^2 is released to the atmosphere.

Repeat sections of CTD and radiosonde along 162W

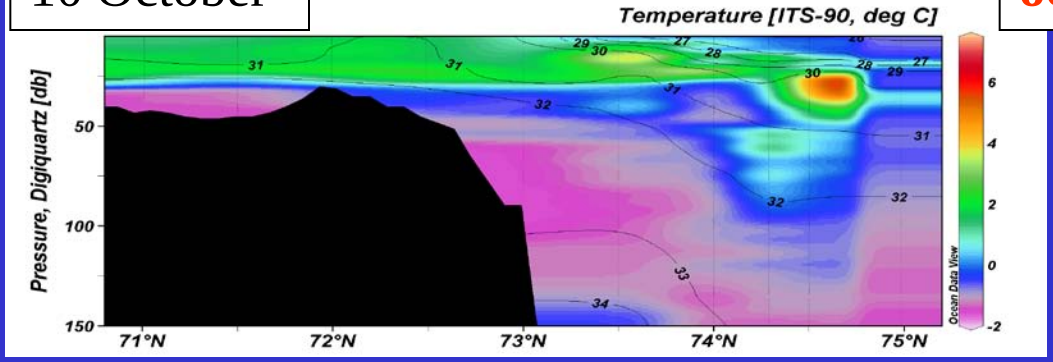
13 September



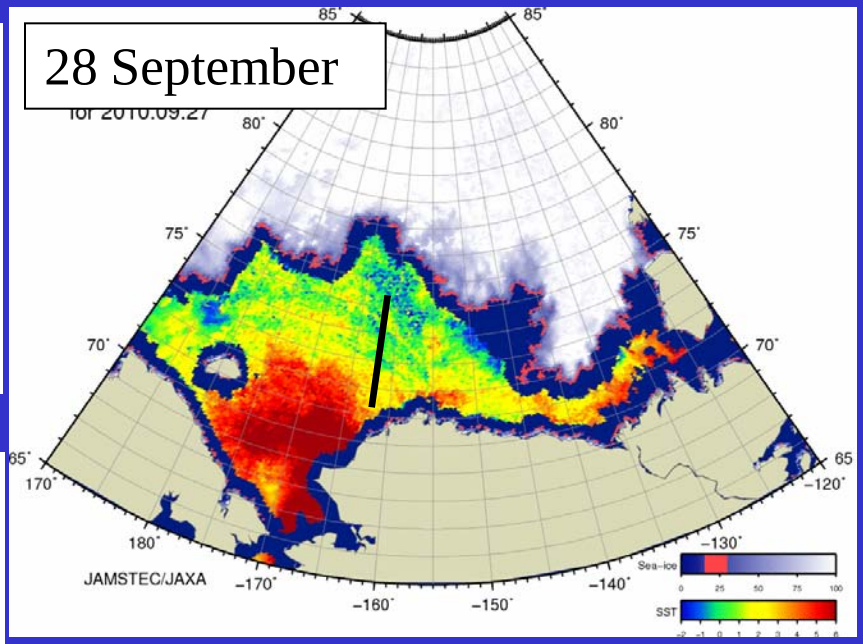
28 September



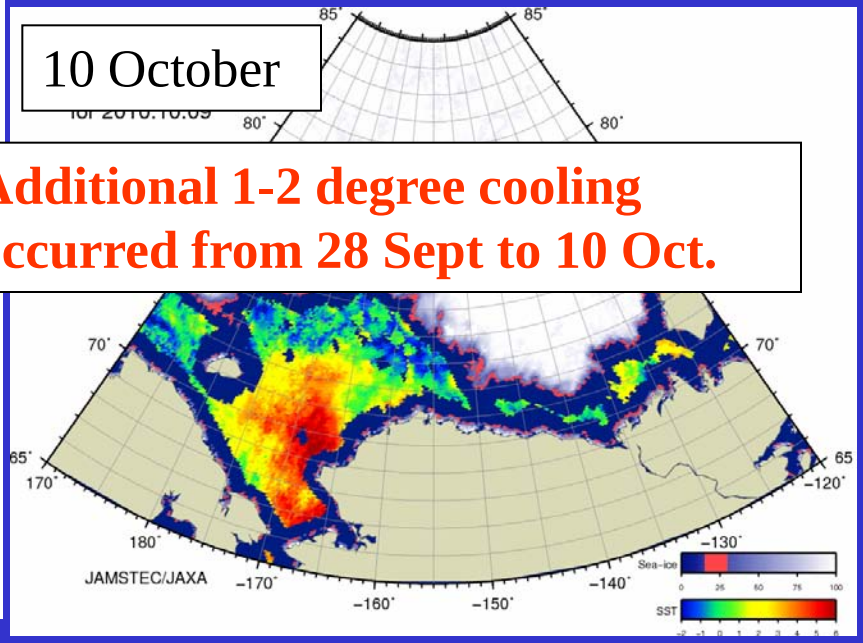
10 October



28 September



10 October



Additional 1-2 degree cooling occurred from 28 Sept to 10 Oct.

JAMSTEC Future Plan in the Pacific Arctic

- ✓ Next Mirai Arctic Cruise is planned in 2013

- ✓ XCTD observation in the Canada Basin in 2011

  collaboration with Drs. A. Proshutinsky and R. Krishfield @ WHOI and Drs. E. Carmack and W. Williams @ IOS

- ✓ Mooring operations in the Barrow Canyon and Chuck and Northwind Abyssal Plains in 2011

  collaboration with Dr. R. Pickart @ WHOI and Dr. H. Melling @ IOS

Thank you for your attention!