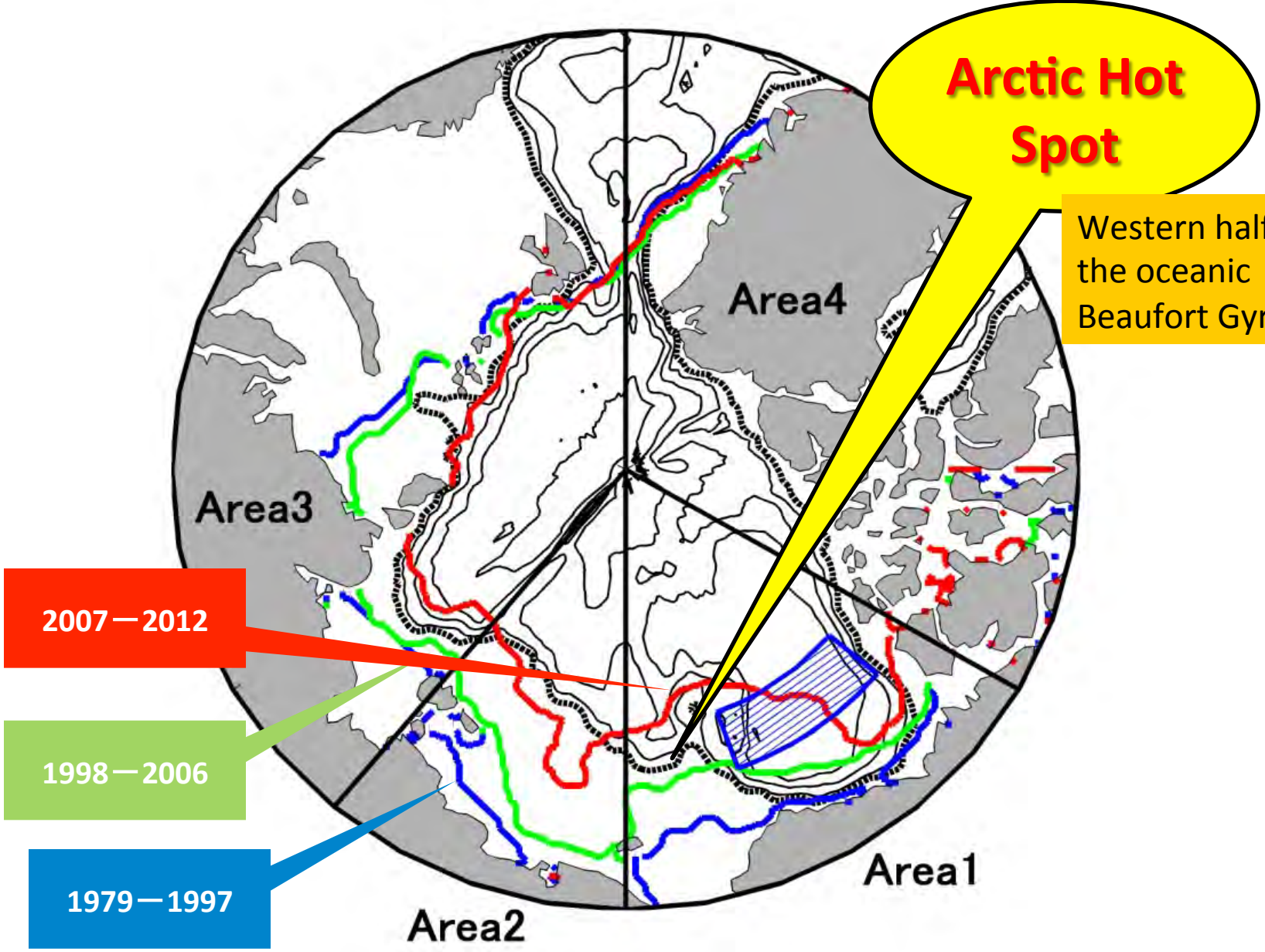
Chukchi Borderland/Arctic Basin joint activities in relation to developing international "Pacific Climate Line" for Canada Basin and shelf-basin lines

PAG meeting, October 28 2014

Koji Shimada (Tokyo Univ. MST, IASC MWG/ Japan)

R/V Mirai in the Barrow Canyon
(one of key gateways)
Photo by Capt. David Snider (2002)

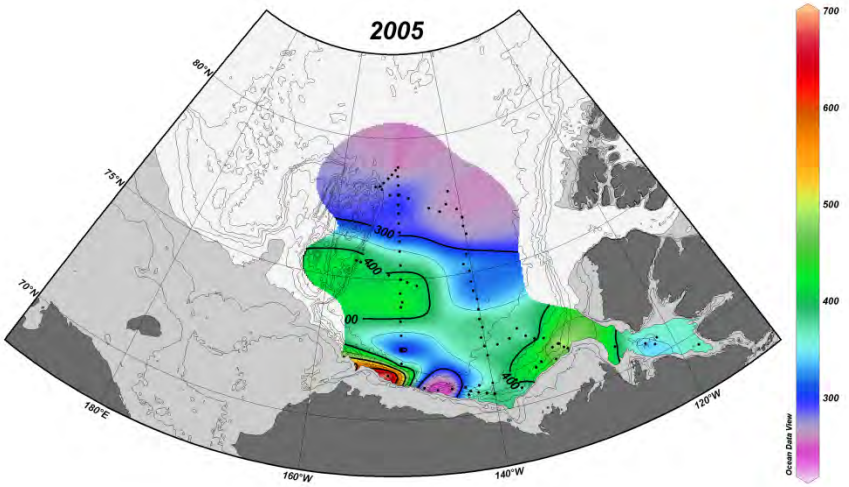

1979-1982
Pacific Waters
We now realize:
Arctic Ocean is not quiet ocean but is vigorous ocean that links to climate changes.
©NASA

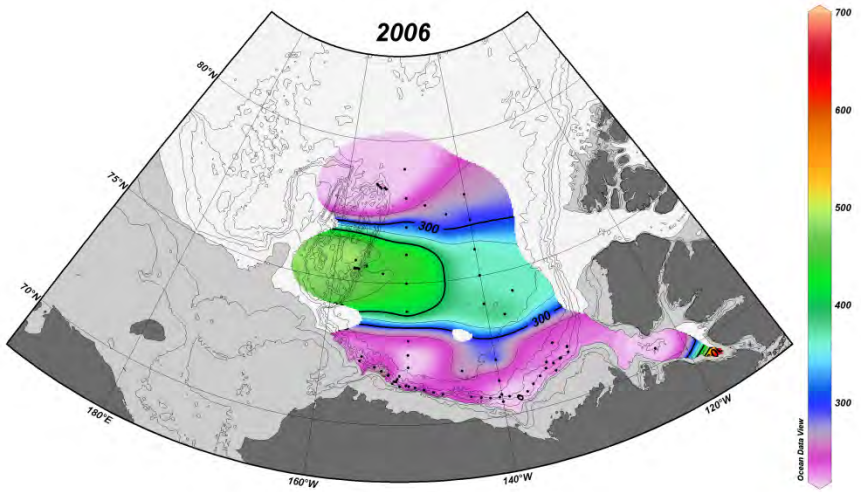


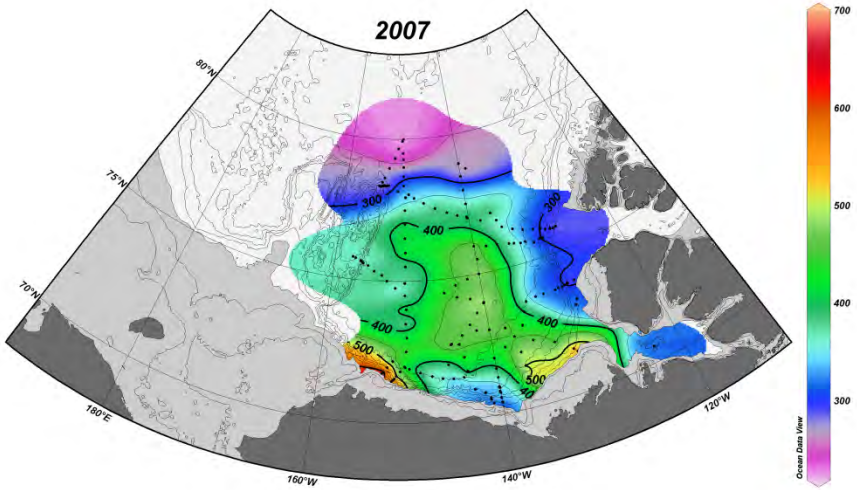
Ice edge in September

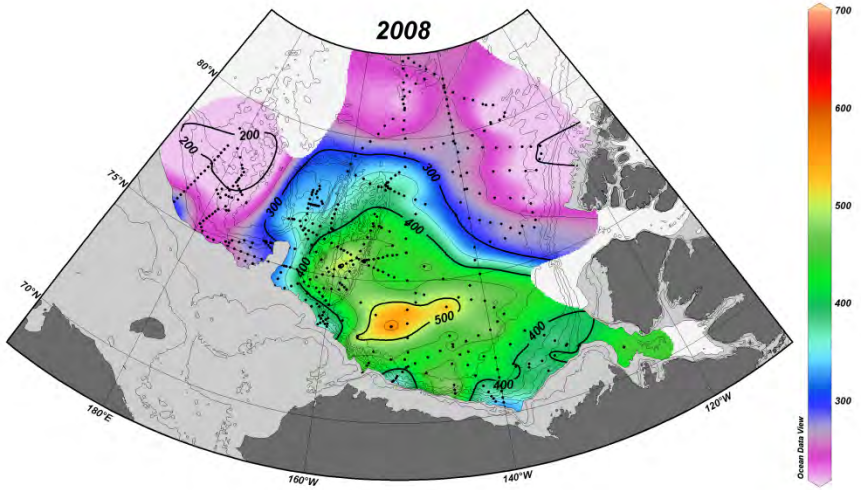
Yoshizawa et al., (2014)

Heat content (20-150m)

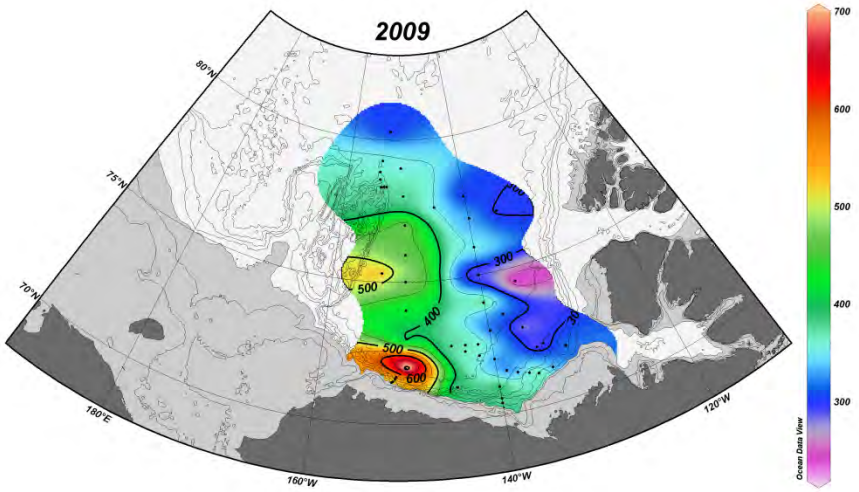


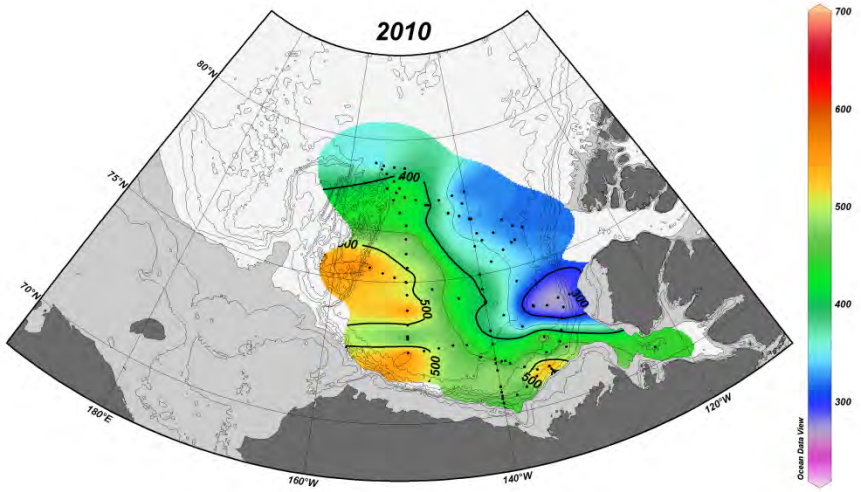


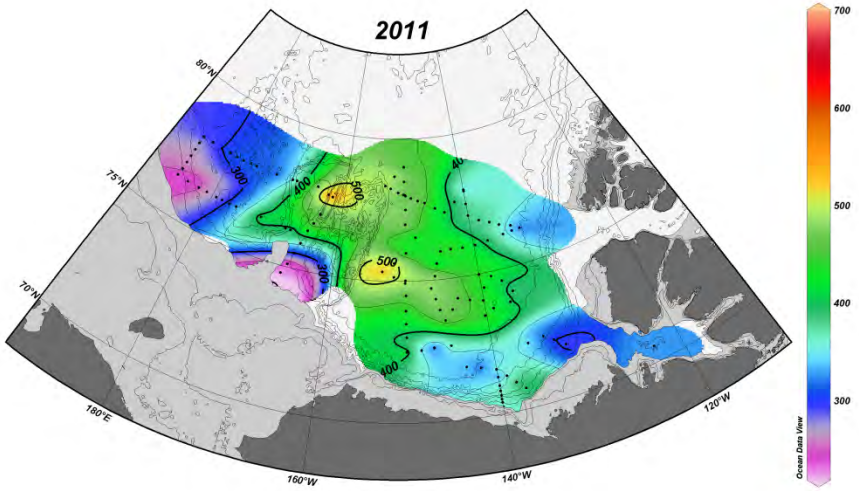


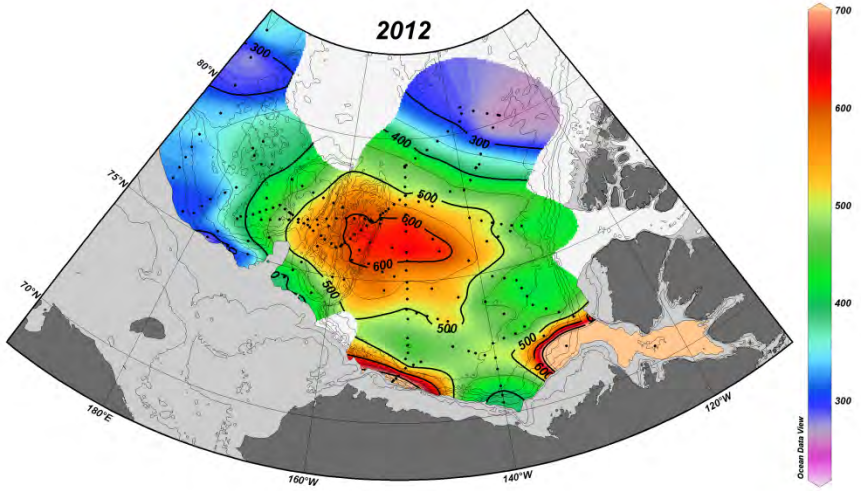


Heat content (20-150m)

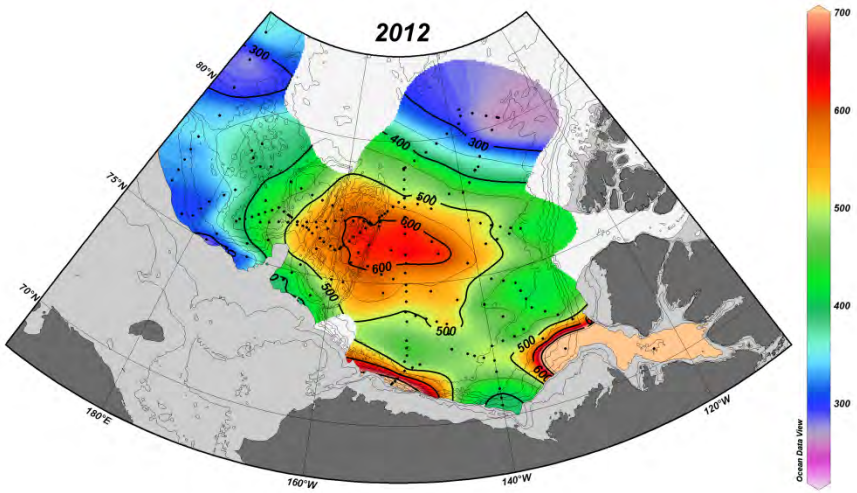


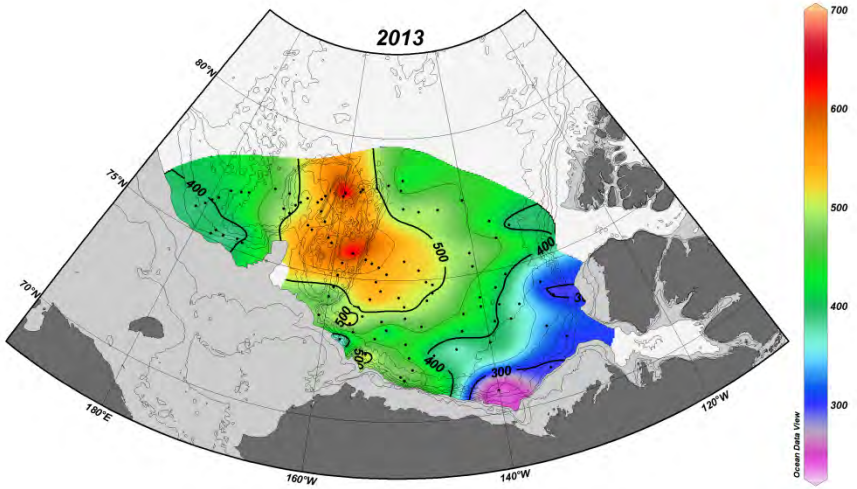


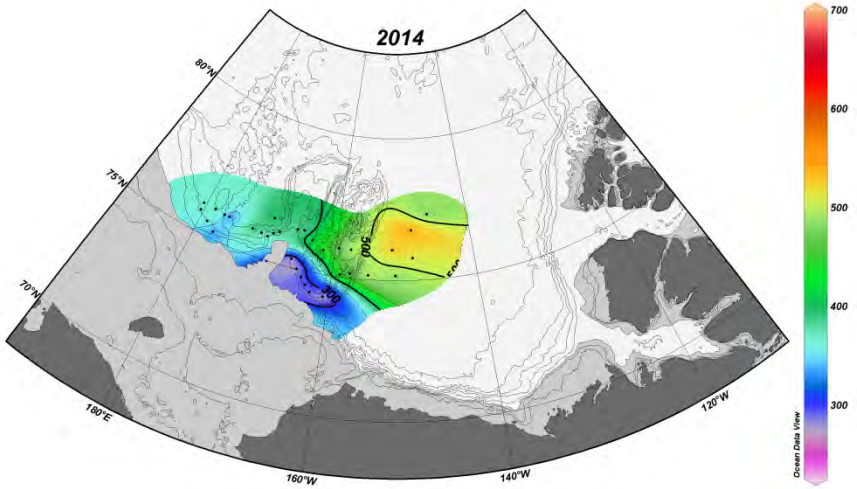


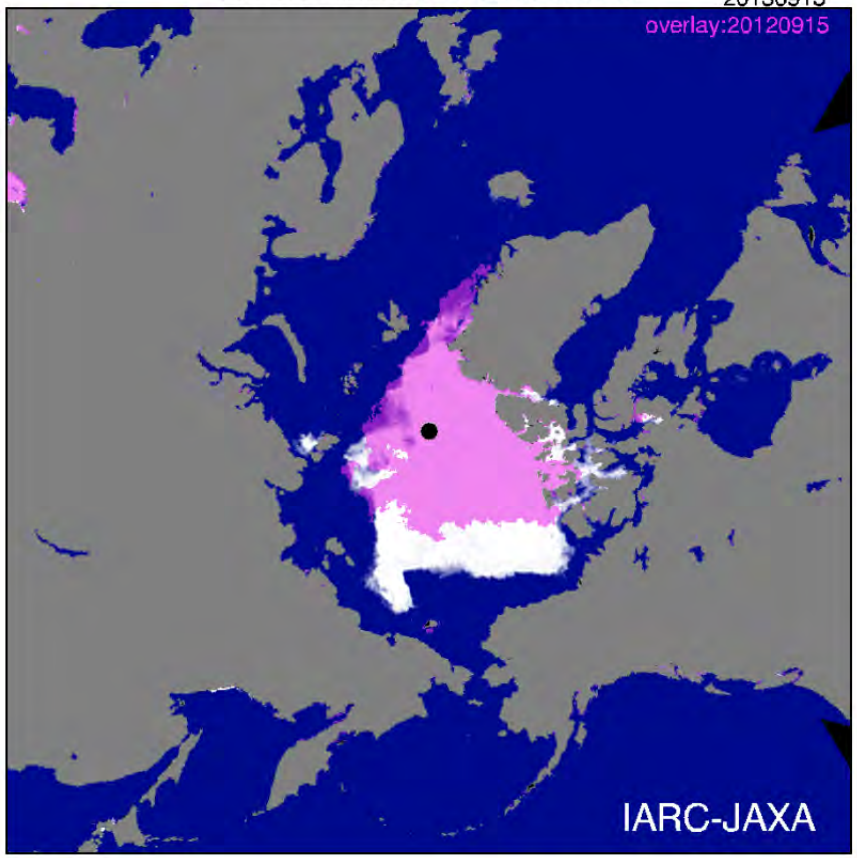


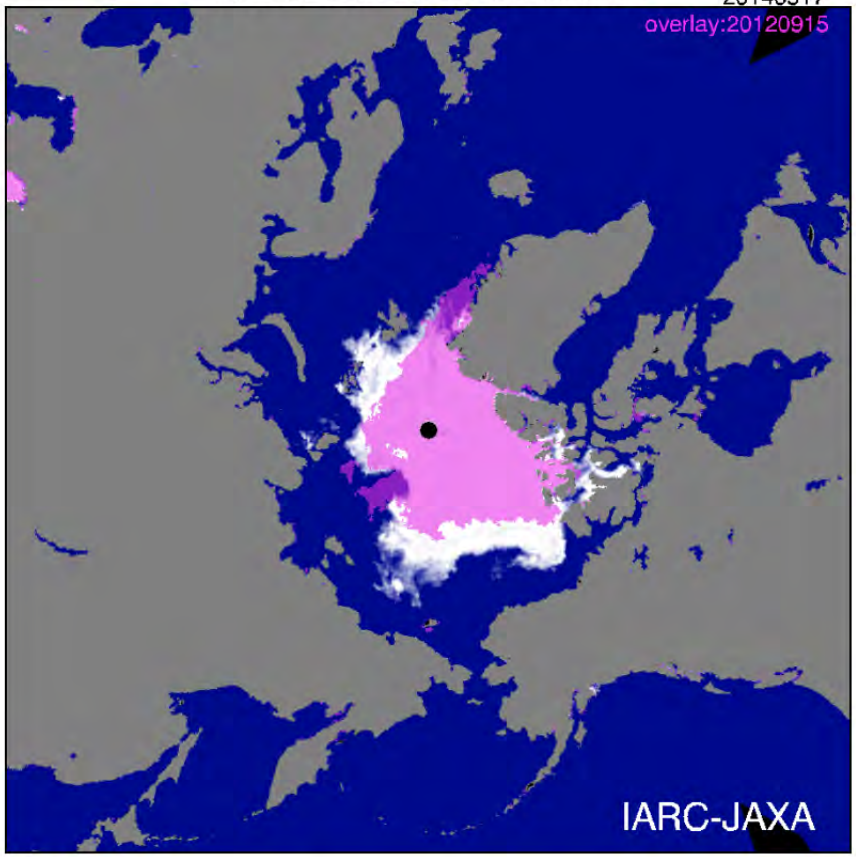
Heat content (20-150m)

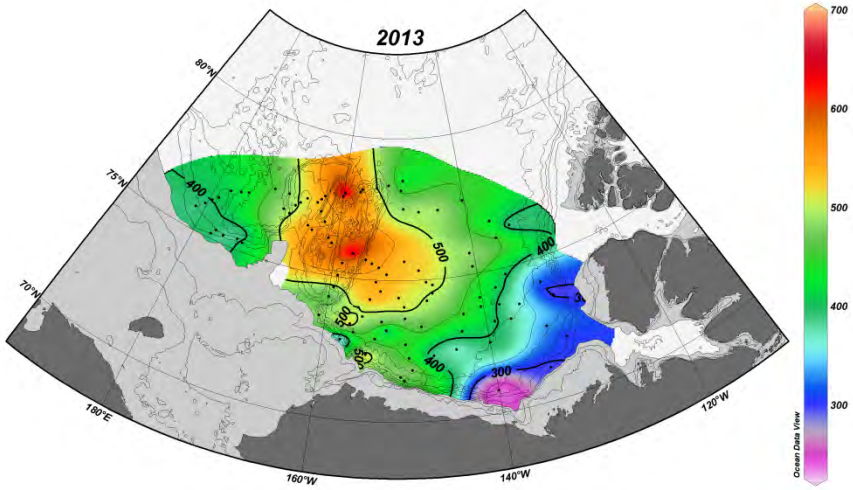


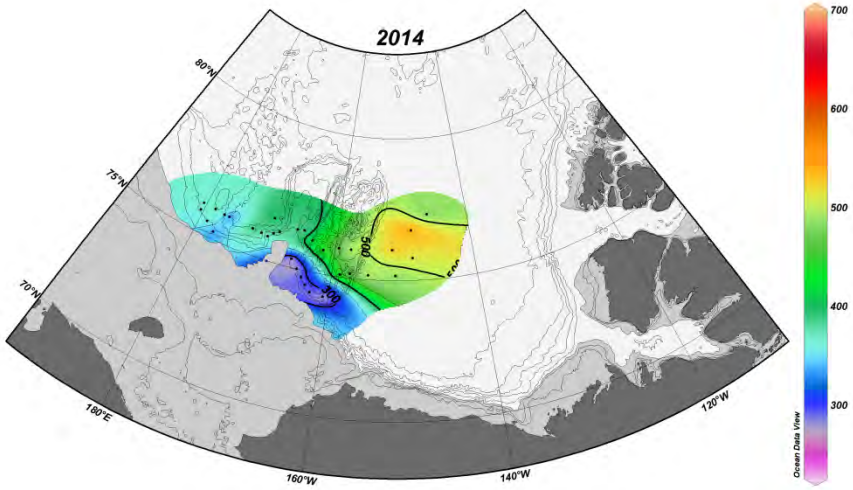




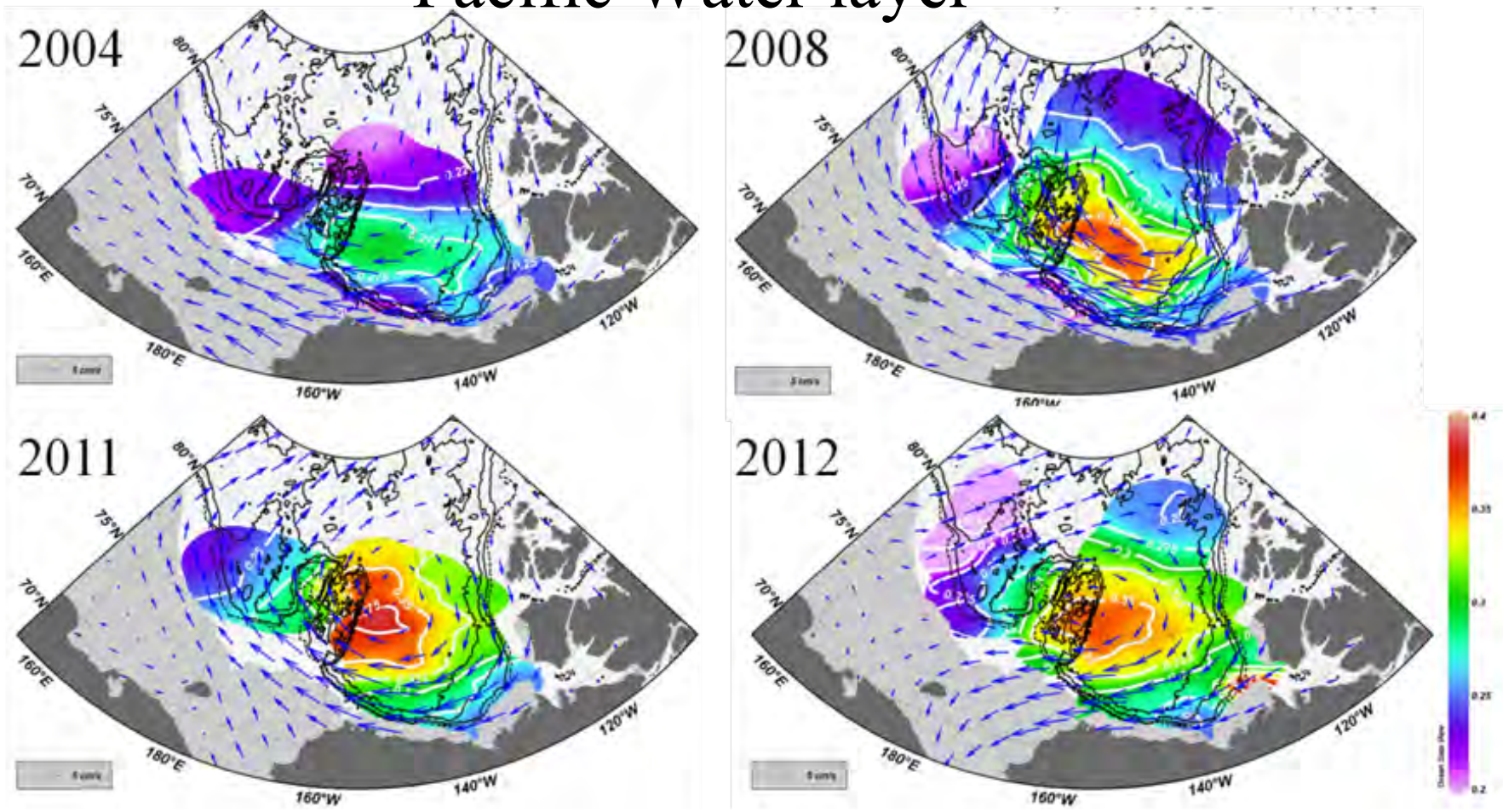

AMSR2 Sea Ice Concentration
20130915
overlay:20120915
IARC-JAXA


AMSR2 Sea Ice Concentration
20140917
overlay:20120915
IARC-JAXA


2013
80°N
75°N
70°N
180°E
160°W
140°W
120°W
400
500
600
300
700
Ocean Data View

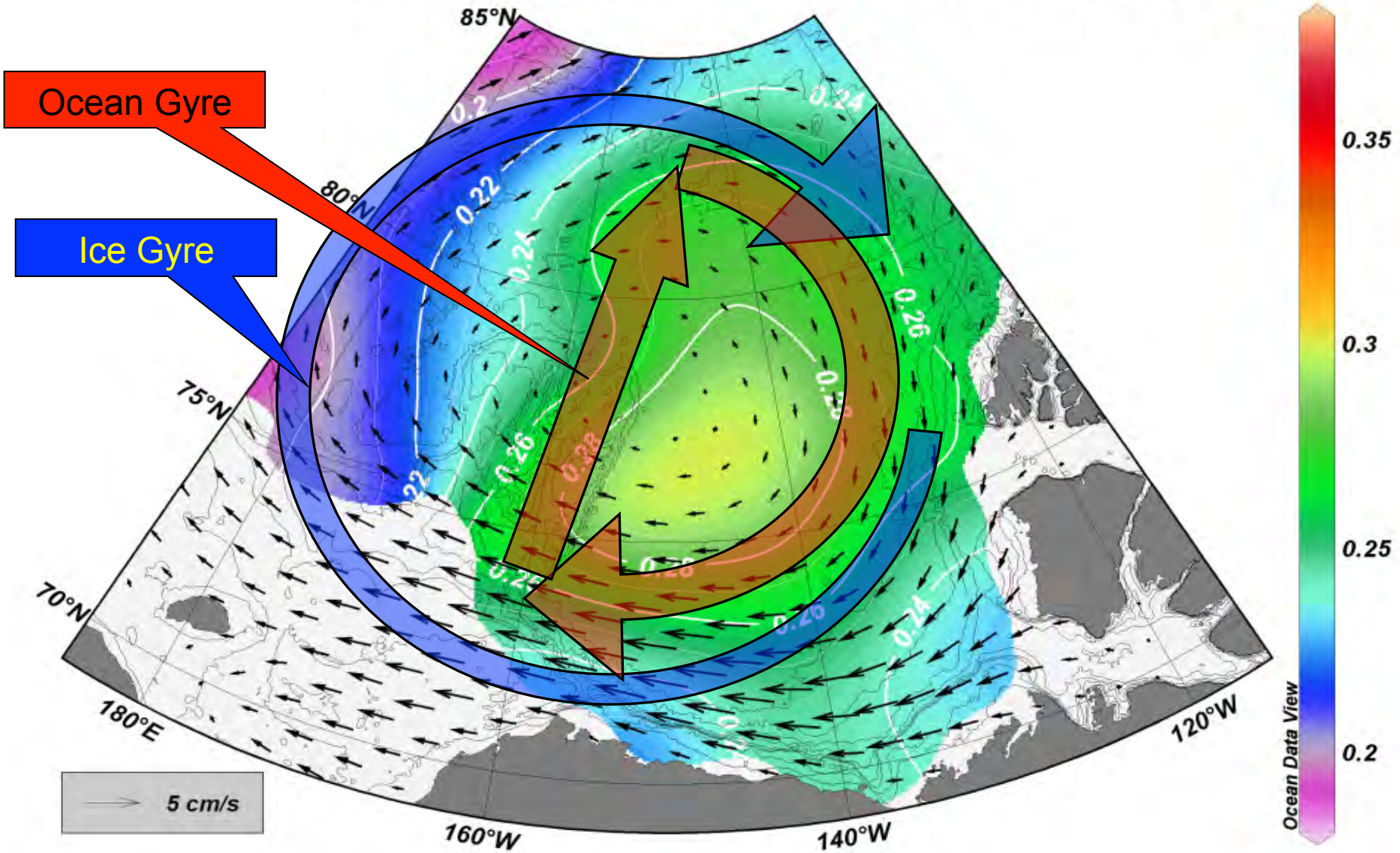

2014
80°N
75°N
70°N
180°E
160°W
140°W
120°W
500
300
700
600
400
Ocean Data View

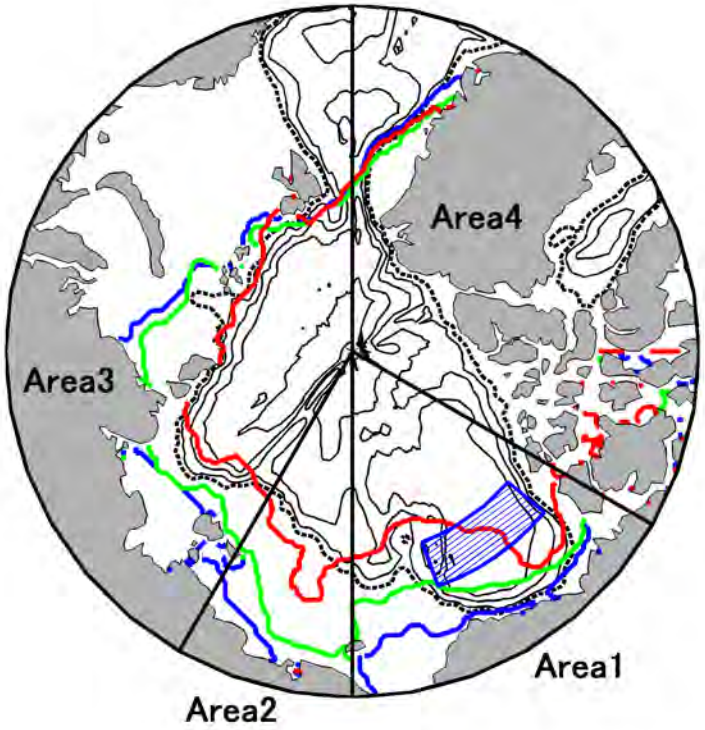
Sea ice motion and ocean circulation of Pacific Water layer

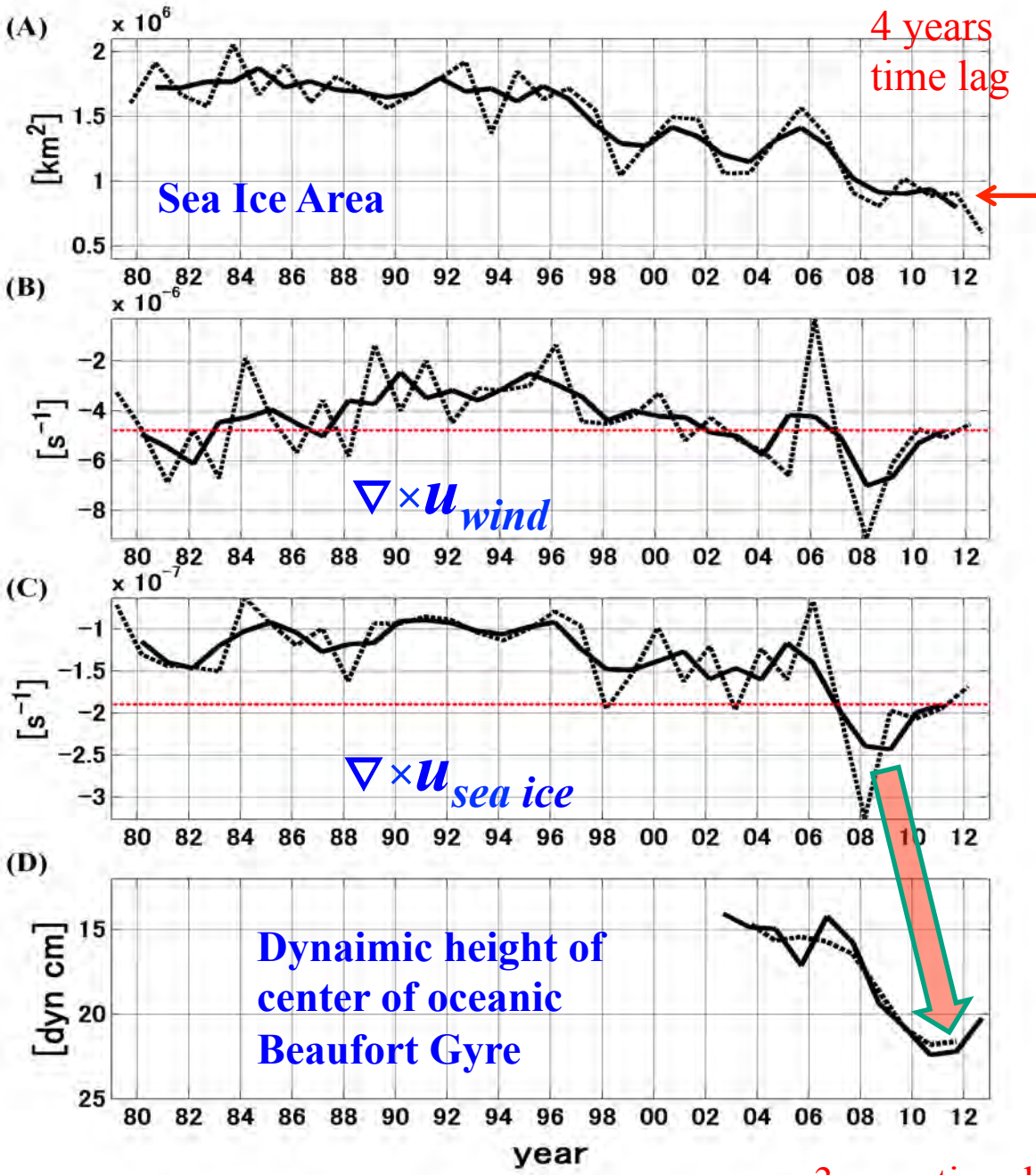


Background color: dynamic height at 100dar relative to 800bdar (Oceanic Beaufort Gyre)
Black vectors: average sea ice motion vectors for November – April.

Yoshizawa et al., (2014)
in revision


Dyn.Ht.-800 [dyn m] @ Pressure(Depth) [db]=100
Ocean Gyre
Ice Gyre
85°N
80°N
75°N
70°N
180°E
160°W
140°W
120°W
5 cm/s
0.35
0.3
0.25
0.2
Ocean Data View

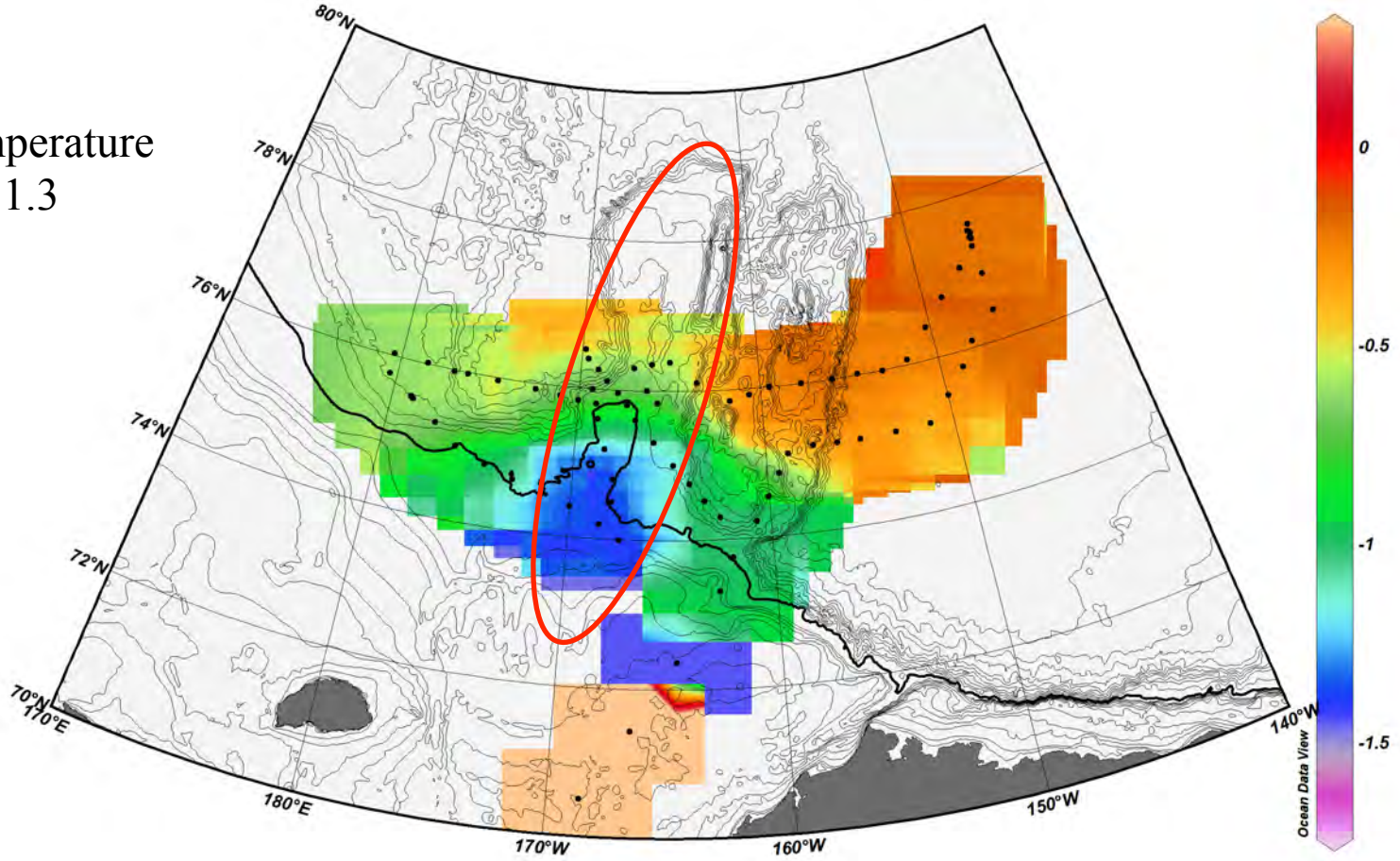




Upper ocean response delayed about 3 years relative to the surface forcings (wind or sea ice motion).

Yoshizawa et al., (2014) in revision

PSW temperature
T on S=31.3

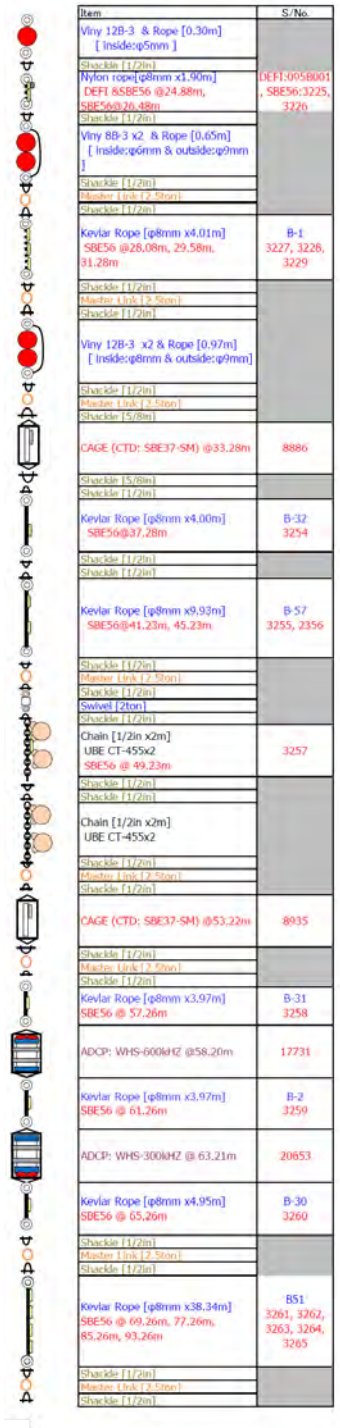


Heat release is huge over the Chukchi Plateau (every year) around critical latitude with shallow bottom topography

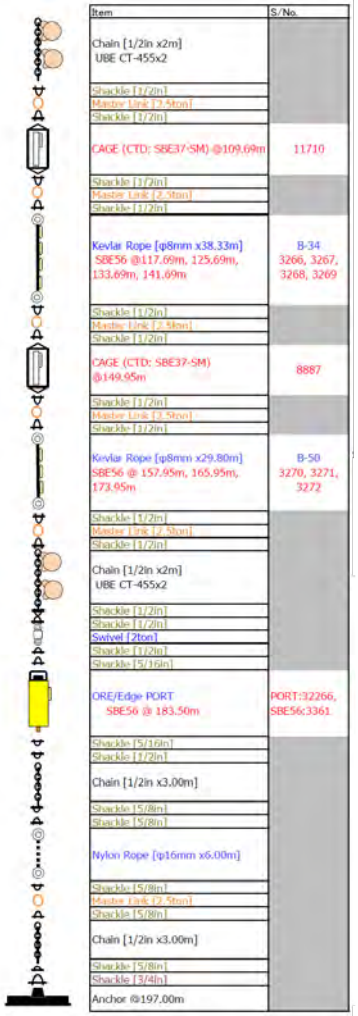
Center of action on sea ice reduction!

18m

58m



Item	S/No.
Viny 12B-3 & Rope [0.30m] [Inside:φ5mm]	
Shackle [1/2in]	
Nylon rope[φ8mm x1.90m] DEFI &SBE56 @24.88m, SBE56@26.48m	DEFI:005B001, SBE56:3225, 3226
Shackle [1/2in]	
Viny 8B-3 x2 & Rope [0.65m] [Inside:φ6mm & outside:φ9mm]	
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x4.01m] SBE56 @28.08m, 29.58m, 31.28m	B-1 3227, 3228, 3229
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Viny 12B-3 x2 & Rope [0.97m] [Inside:φ8mm & outside:φ9mm]	
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [5/8in]	
CAGE (CTD: SBE37-SM) @33.28m	8886
Shackle [5/8in]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x4.00m] SBE56@37.28m	B-32 3254
Shackle [1/2in]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x9.93m] SBE56@41.23m, 45.23m	B-57 3255, 2356
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Swivel [2ton]	
Shackle [1/2in]	
Chain [1/2in x2m] UBE CT-455x2 SBE56 @ 49.23m	3257
Shackle [1/2in]	
Shackle [1/2in]	
Chain [1/2in x2m] UBE CT-455x2	
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
CAGE (CTD: SBE37-SM) @53.22m	8935
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x3.97m] SBE56 @ 57.26m	B-31 3258
ADCP: WHS-600kHZ @58.20m	17731
Kevlar Rope [φ8mm x3.97m] SBE56 @ 61.26m	B-2 3259
ADCP: WHS-300kHZ @ 63.21m	20653
Kevlar Rope [φ8mm x4.95m] SBE56 @ 65.26m	B-30 3260
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x38.34m] SBE56 @ 69.26m, 77.26m, 85.26m, 93.26m	B51 3261, 3262, 3263, 3264, 3265
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	



Item	S/No.
Chain [1/2in x2m] UBE CT-455x2	
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
CAGE (CTD: SBE37-SM) @109.69m	11710
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x38.33m] SBE56 @117.69m, 125.69m, 133.69m, 141.69m	B-34 3266, 3267, 3268, 3269
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
CAGE (CTD: SBE37-SM) @149.95m	8887
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Kevlar Rope [φ8mm x29.80m] SBE56 @ 157.95m, 165.95m, 173.95m	B-50 3270, 3271, 3272
Shackle [1/2in]	
Master Link [2.5ton]	
Shackle [1/2in]	
Chain [1/2in x2m] UBE CT-455x2	
Shackle [1/2in]	
Shackle [1/2in]	
Swivel [2ton]	
Shackle [1/2in]	
Shackle [5/16in]	
ORE/Edge PORT SBE56 @ 183.50m	PORT:32266, SBE56:3361
Shackle [5/16in]	
Shackle [1/2in]	
Chain [1/2in x3.00m]	
Shackle [5/8in]	
Shackle [5/8in]	
Nylon Rope [φ16mm x6.00m]	
Shackle [5/8in]	
Master Link [2.5ton]	
Shackle [5/8in]	
Chain [1/2in x3.00m]	
Shackle [5/8in]	
Shackle [3/4in]	
Anchor @197.00m	

193m

Mooring CPS14

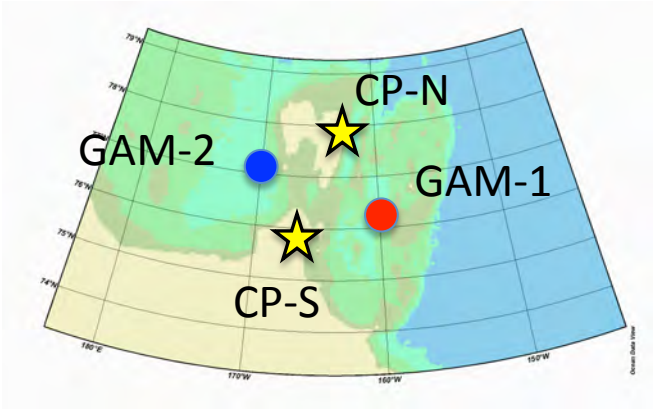
Deployment:
August 21, 2014, 4:25:22AM (UTC)

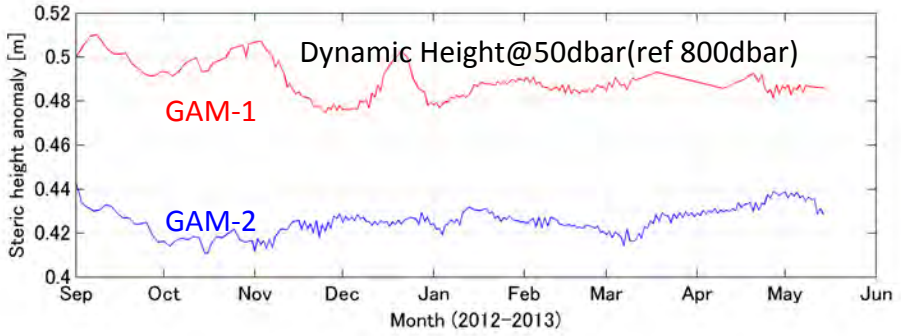
Anchor Drop Position:
74°48.014'N, 167°53.878'W

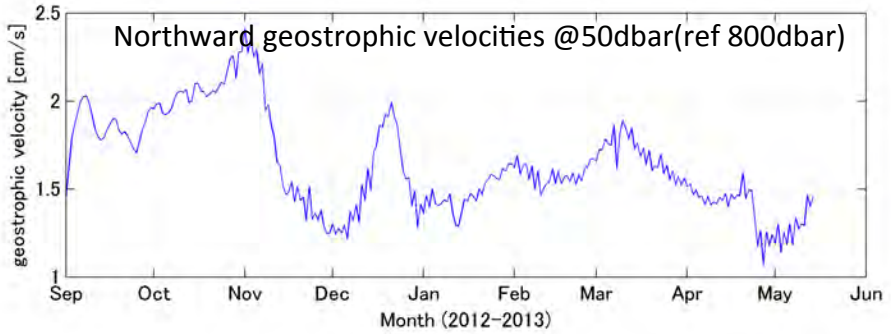
Trianglation Position:
74°48.0369'N, 167°53.8962'W
(74.800614552°N, 167.898270959°W)

Bottom Depth:
197m (CTD)
190m(MultiBeam)+3.5m=193.5m

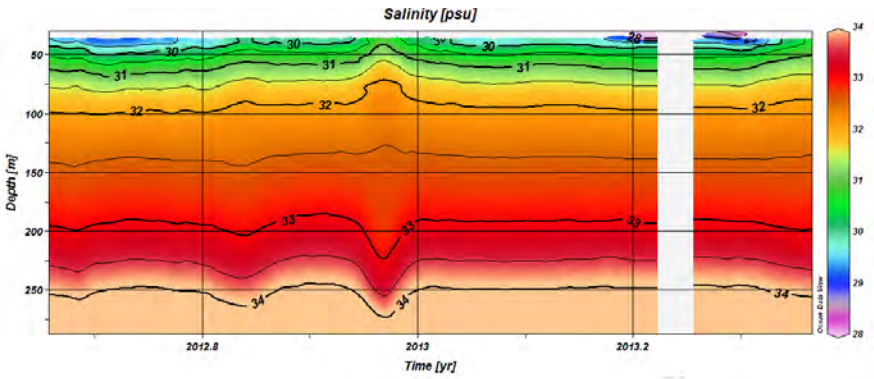
Circulation and heat release associated with vertical mixing around Chukchi Borderland





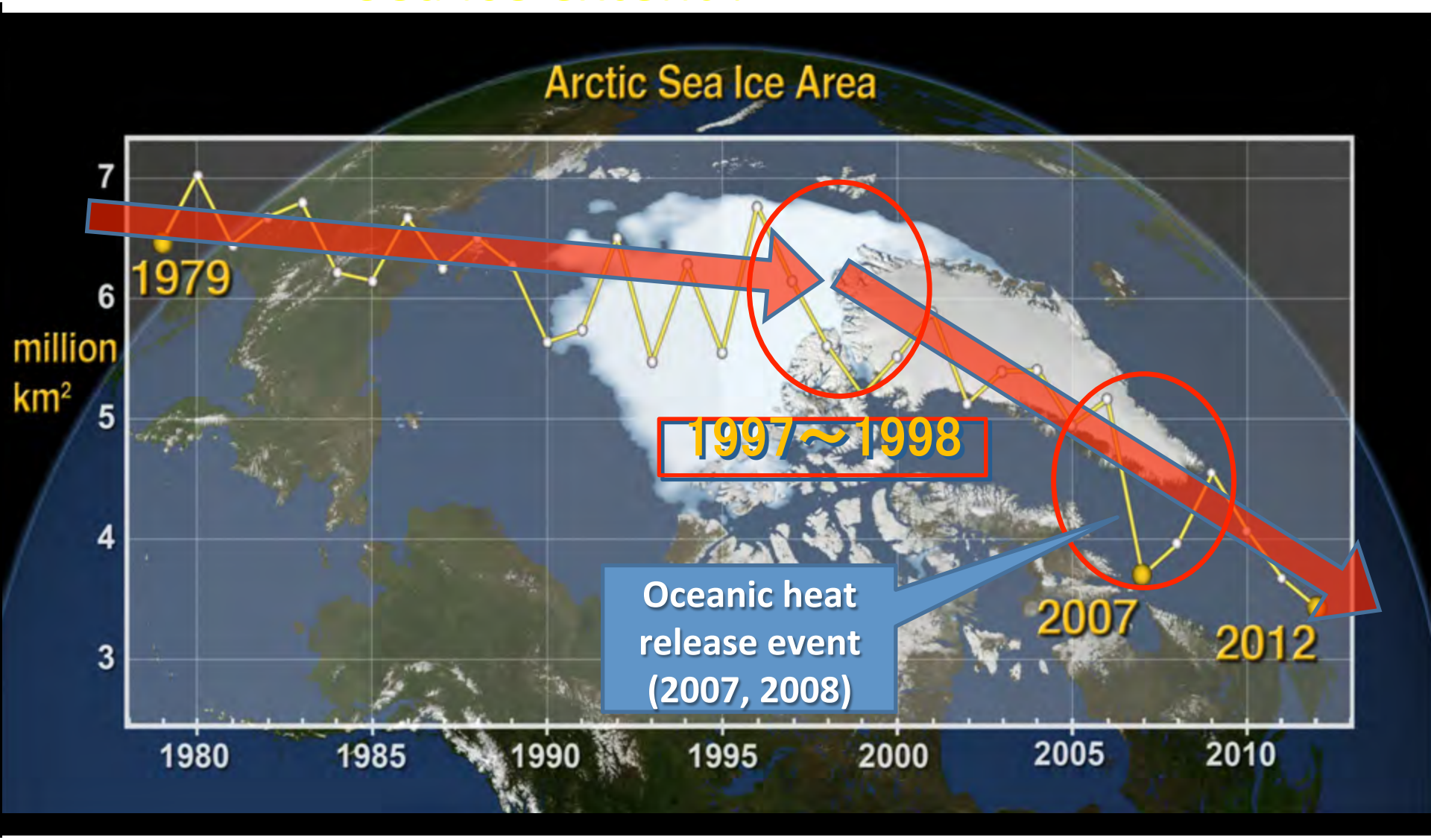


GAM-1, timeseries of salinity

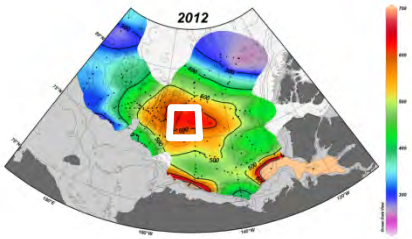


Mean northward speed of PSW along Chukchi Plateau was 1.64cm/s.
Seasonal variation was small.
Eddies was found in GAM-1, but almost no eddies in west of Chukchi Plateau.

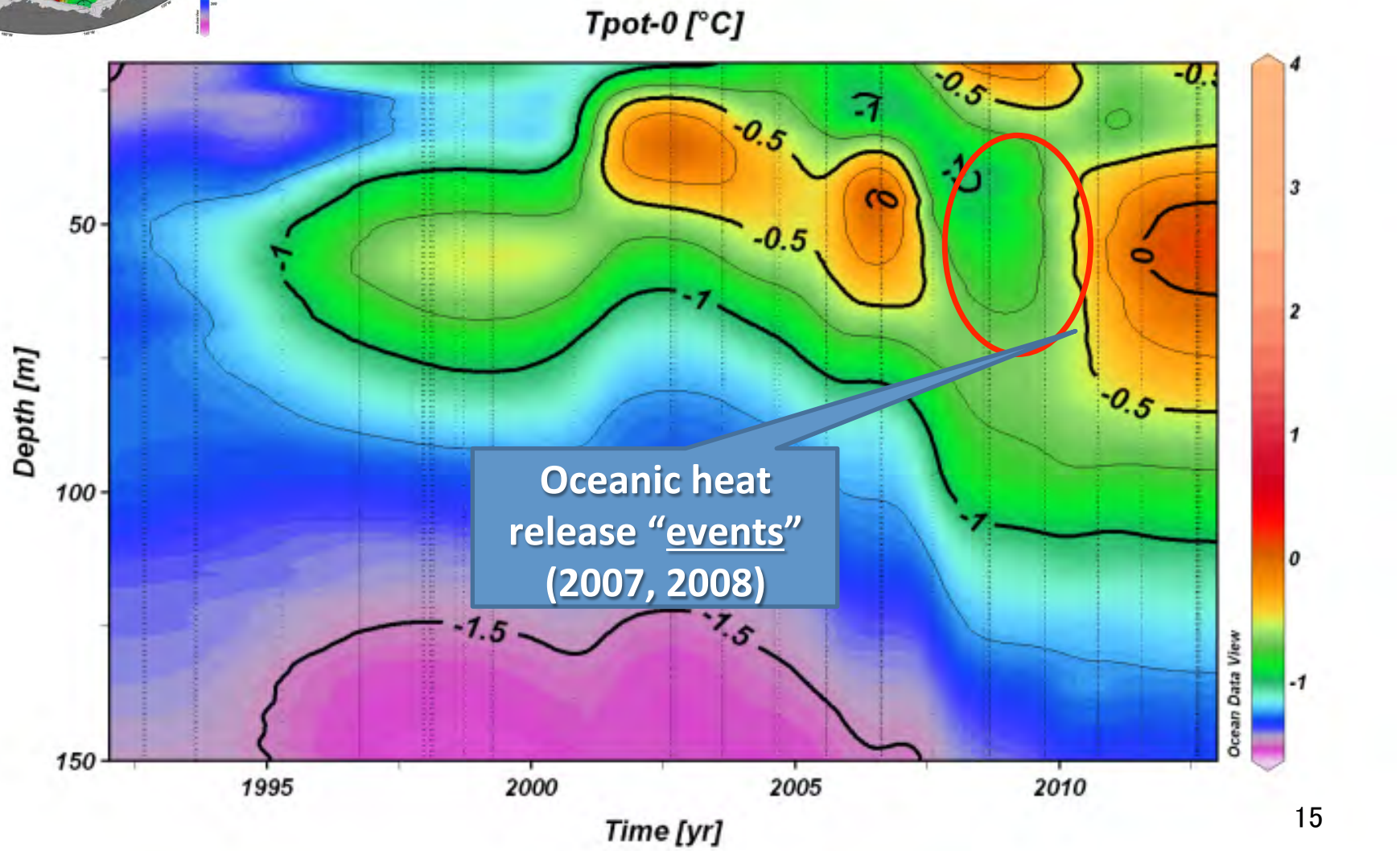
Sea ice extent : 1979～2012



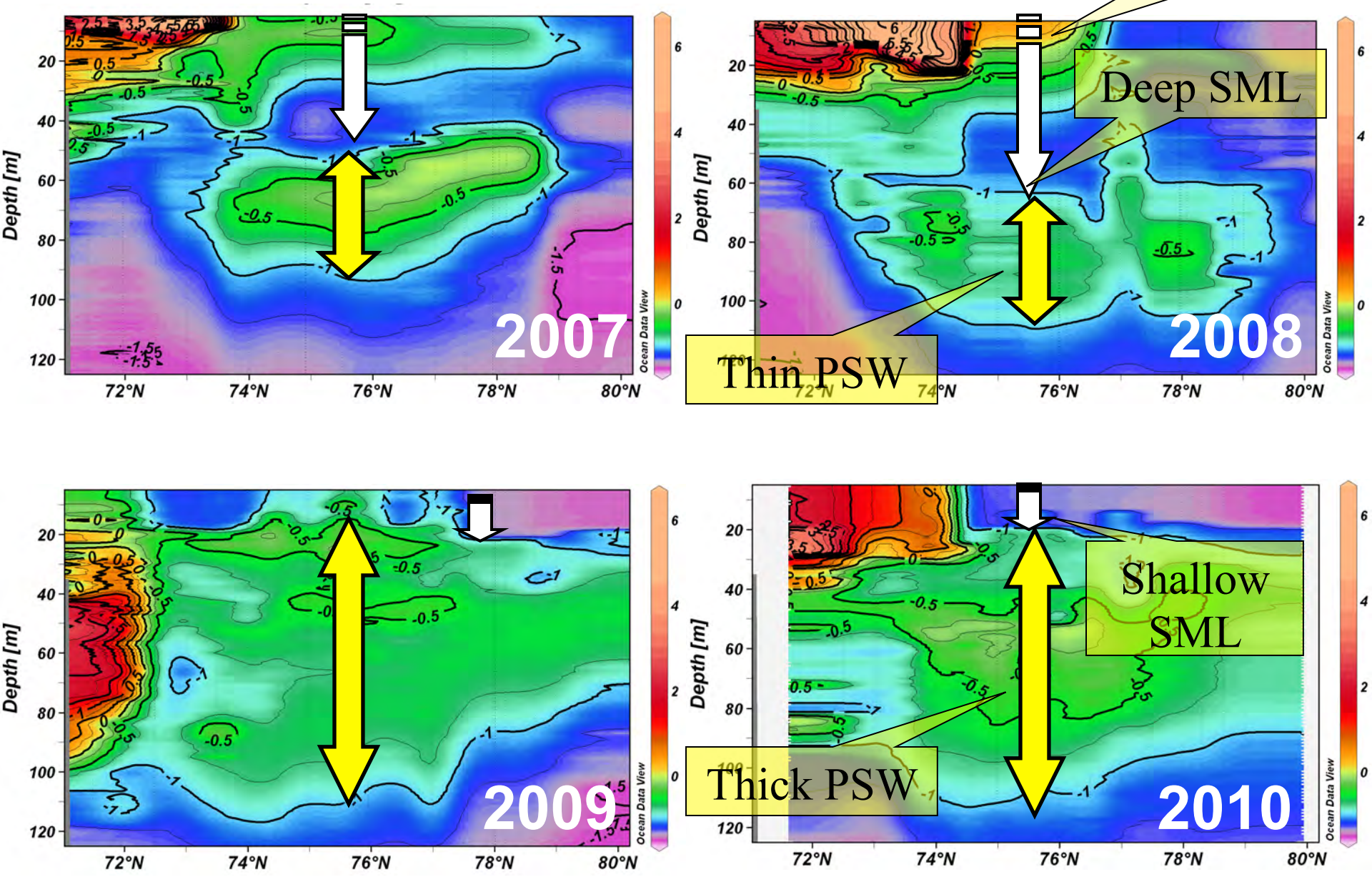
Time series of temperature on the Northwindridge

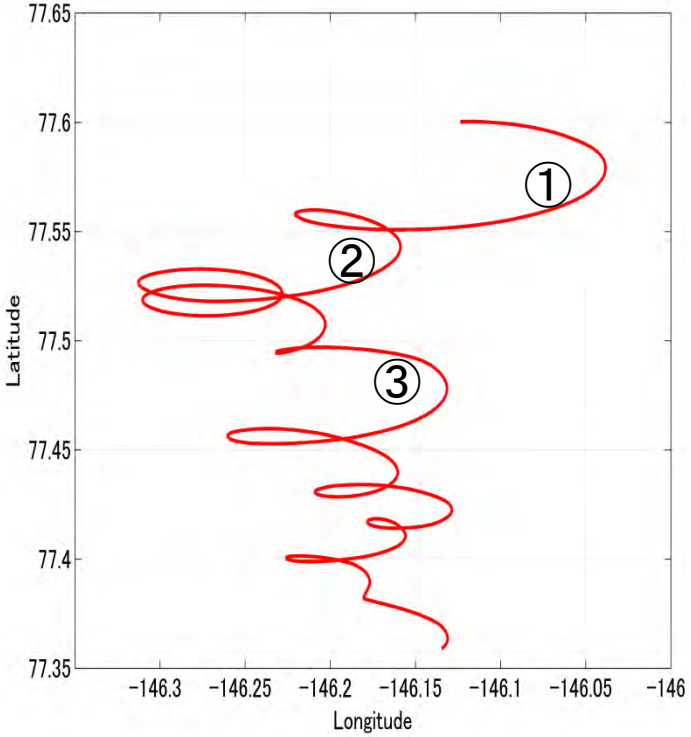


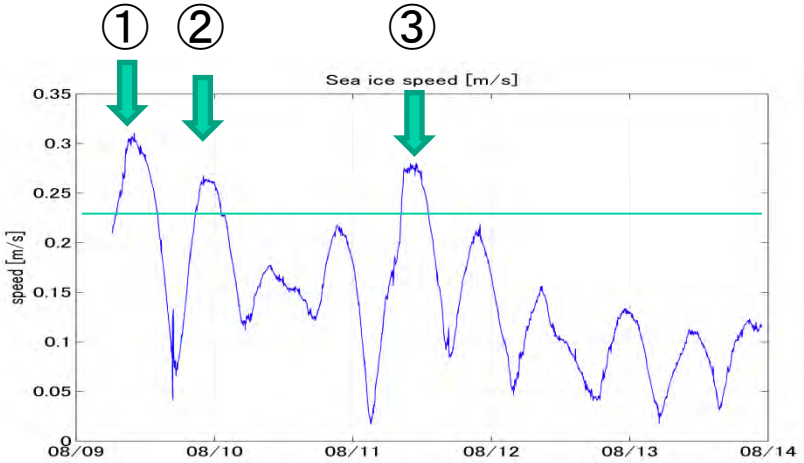
Heat release “event”.

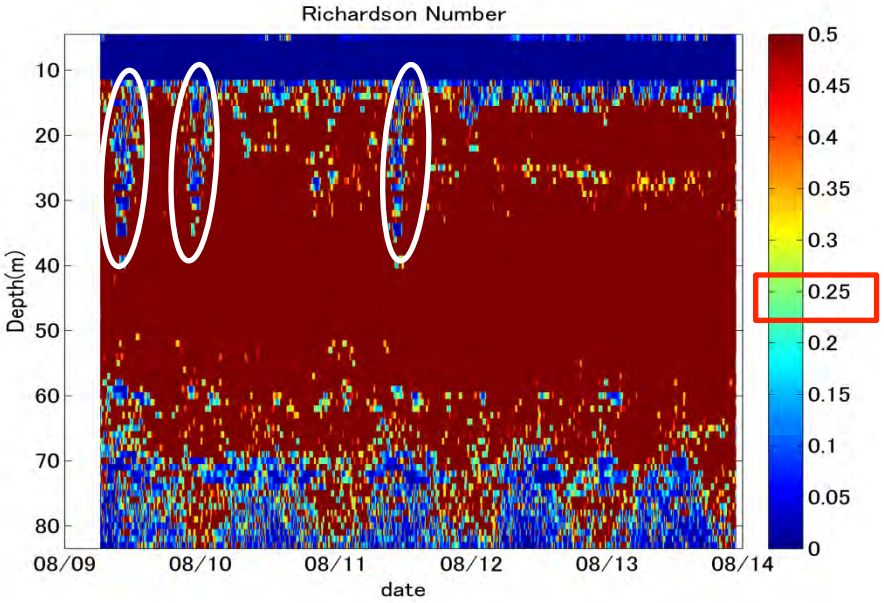


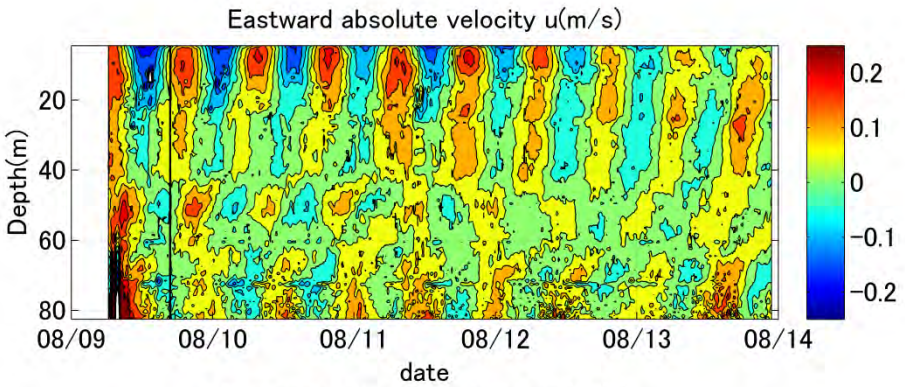
Changes in temperature along 150W

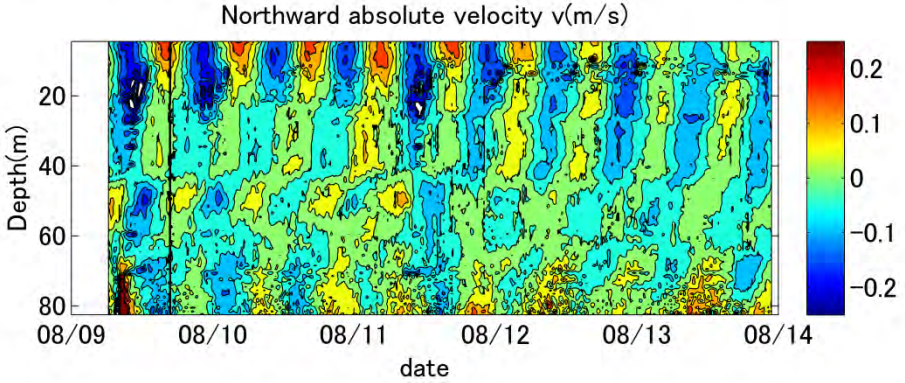


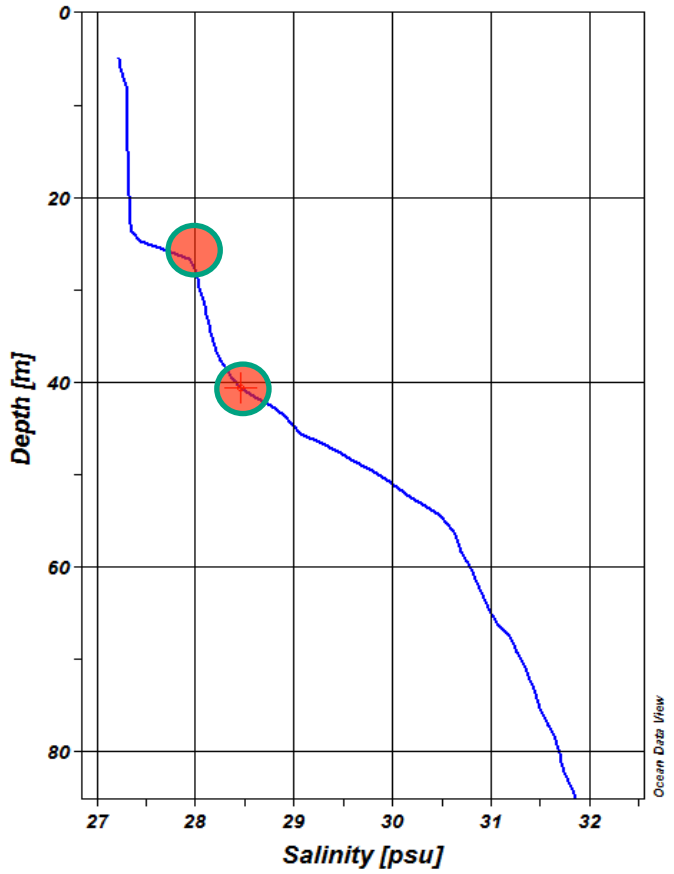

77.65
77.6
77.55
77.5
77.45
77.4
77.35
Latitude
-146.3
-146.25
-146.2
-146.15
-146.1
-146.05
-146
Longitude
①
②
③

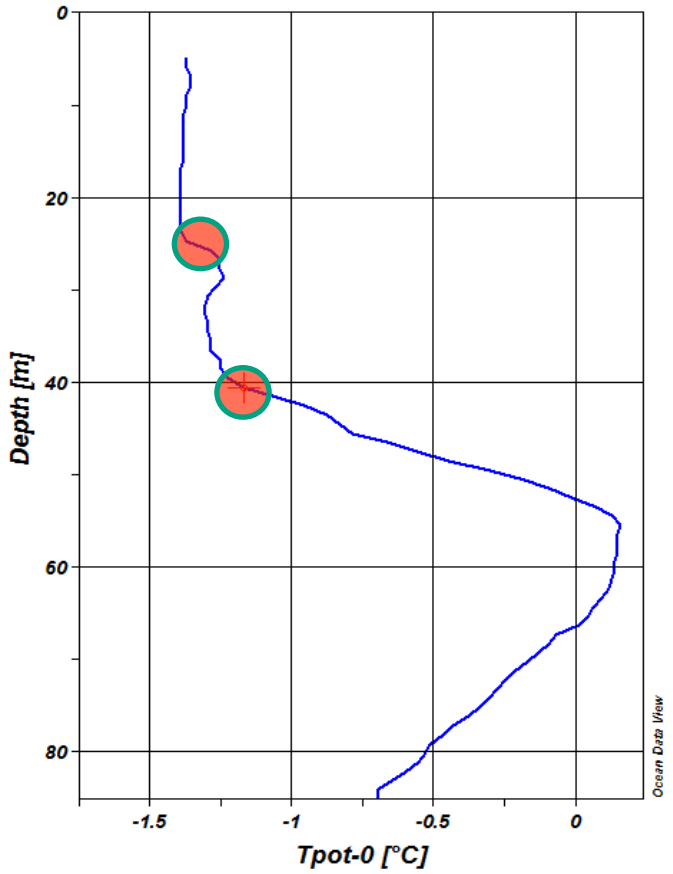

①
②
③
Sea ice speed [m/s]
speed [m/s]
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
08/09
08/10
08/11
08/12
08/13
08/14

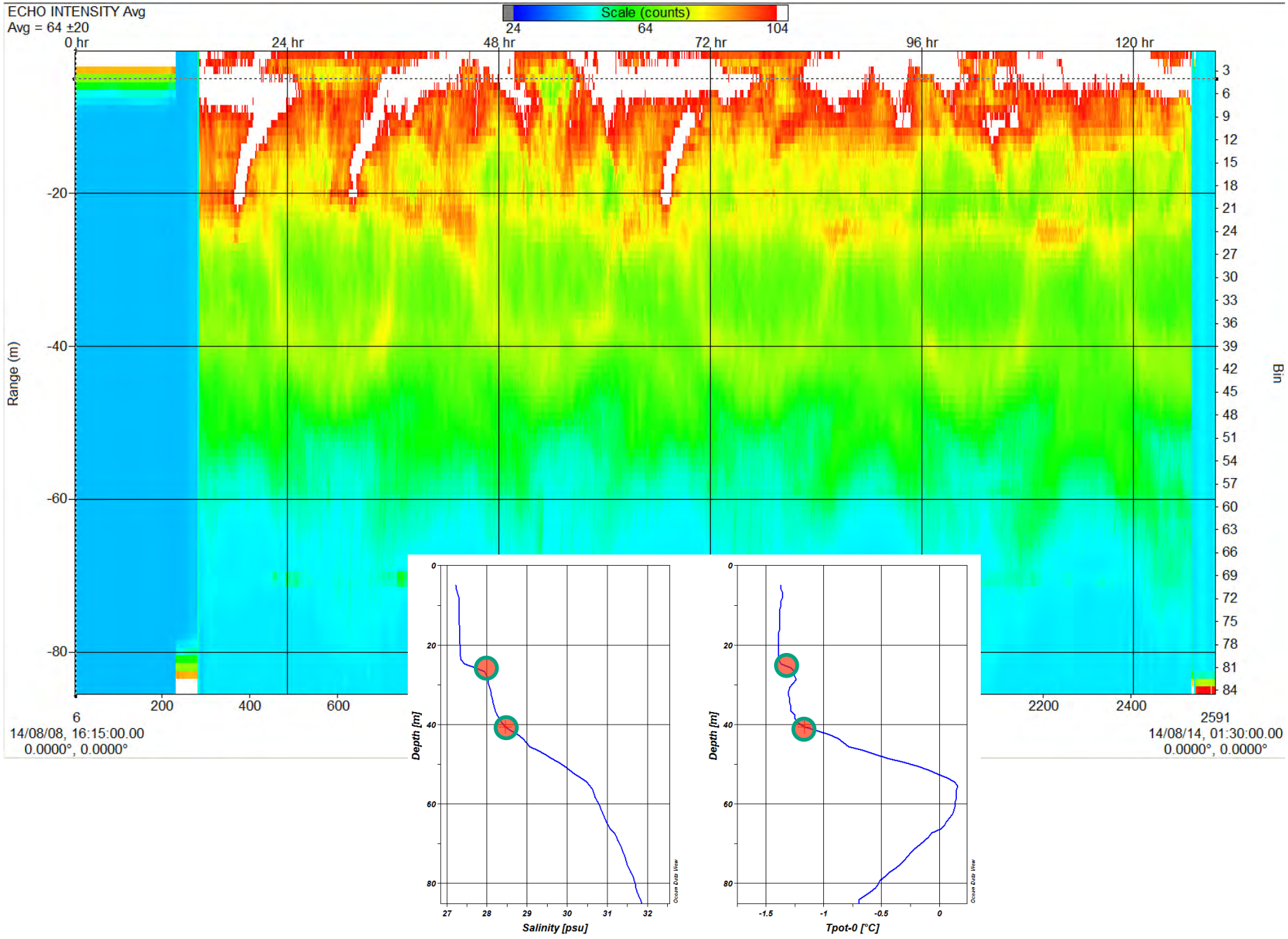

Richardson Number
Depth(m)
10
20
30
40
50
60
70
80
08/09
08/10
08/11
08/12
08/13
08/14
date
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0


Eastward absolute velocity u(m/s)
Depth(m)
20
40
60
80
08/09
08/10
08/11
08/12
08/13
08/14
date
0.2
0.1
0
−0.1
−0.2


Northward absolute velocity v(m/s)
Depth(m)
20
40
60
80
08/09
08/10
08/11
08/12
08/13
08/14
date
0.2
0.1
0
−0.1
−0.2


0
20
40
60
80
Depth [m]
27
28
29
30
31
32
Salinity [psu]
Ocean Data View

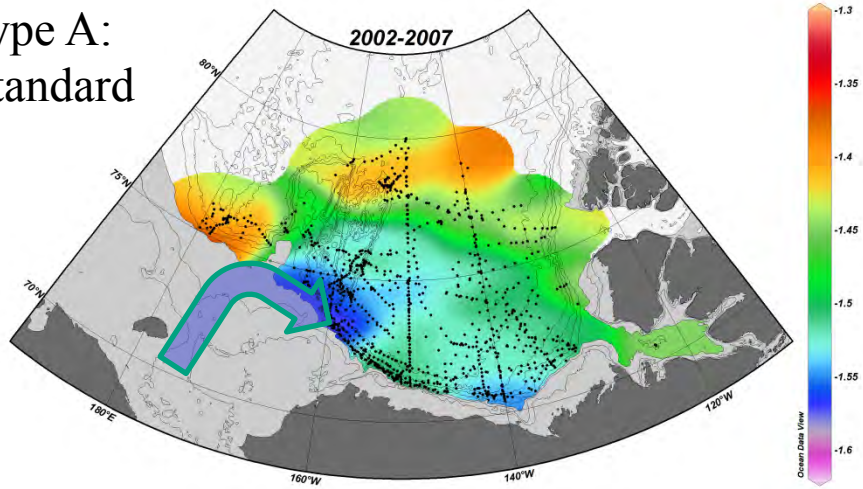

0
20
40
60
80
Depth [m]
-1.5
-1
-0.5
0
Tpot-0 [°C]
Ocean Data View


ECHO INTENSITY Avg
Avg = 64 ±20
Scale (counts)
24
64
104
0 hr
24 hr
48 hr
72 hr
96 hr
120 hr
Range (m)
-20
-40
-60
-80
Bin
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60
63
66
69
72
75
78
81
84
6
200
400
600
2200
2400
2591
14/08/08, 16:15:00.00
0.0000°, 0.0000°
14/08/14, 01:30:00.00
0.0000°, 0.0000°
Depth [m]
Salinity [psu]
27
28
29
30
31
32
Tpot-0 [°C]
-1.5
-1
-0.5
0
Ocean Data View

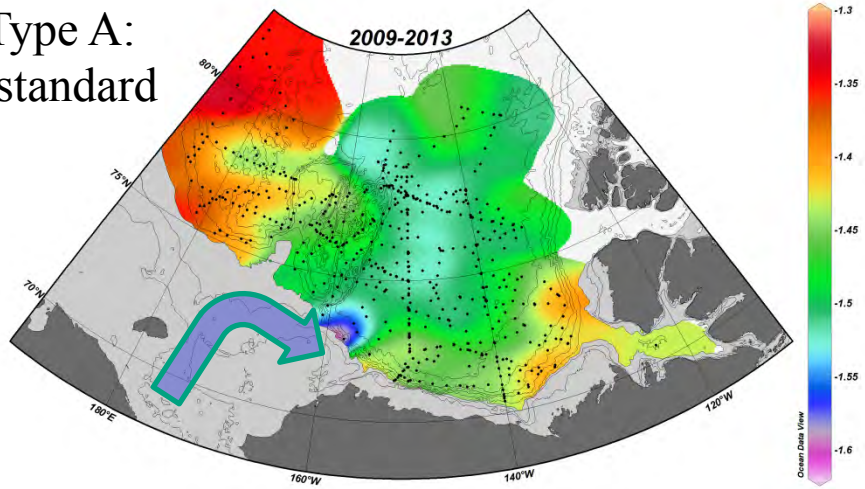
Two spreading pathways of Pacific Winter Water into the Basin

Circulation in the basin controls the shelf water spreading

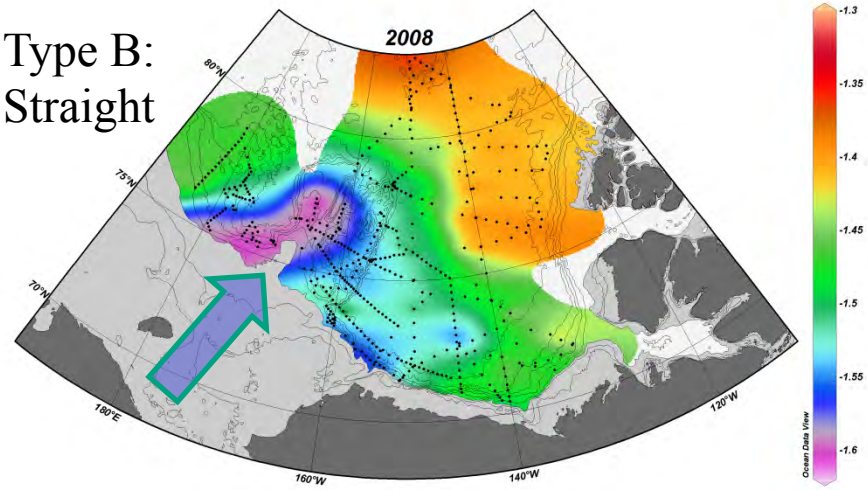
Type A:
standard



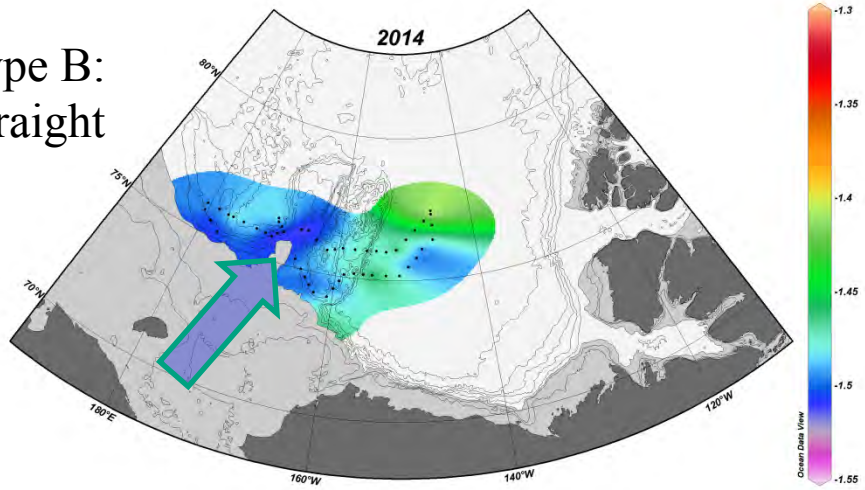
Type A:
standard

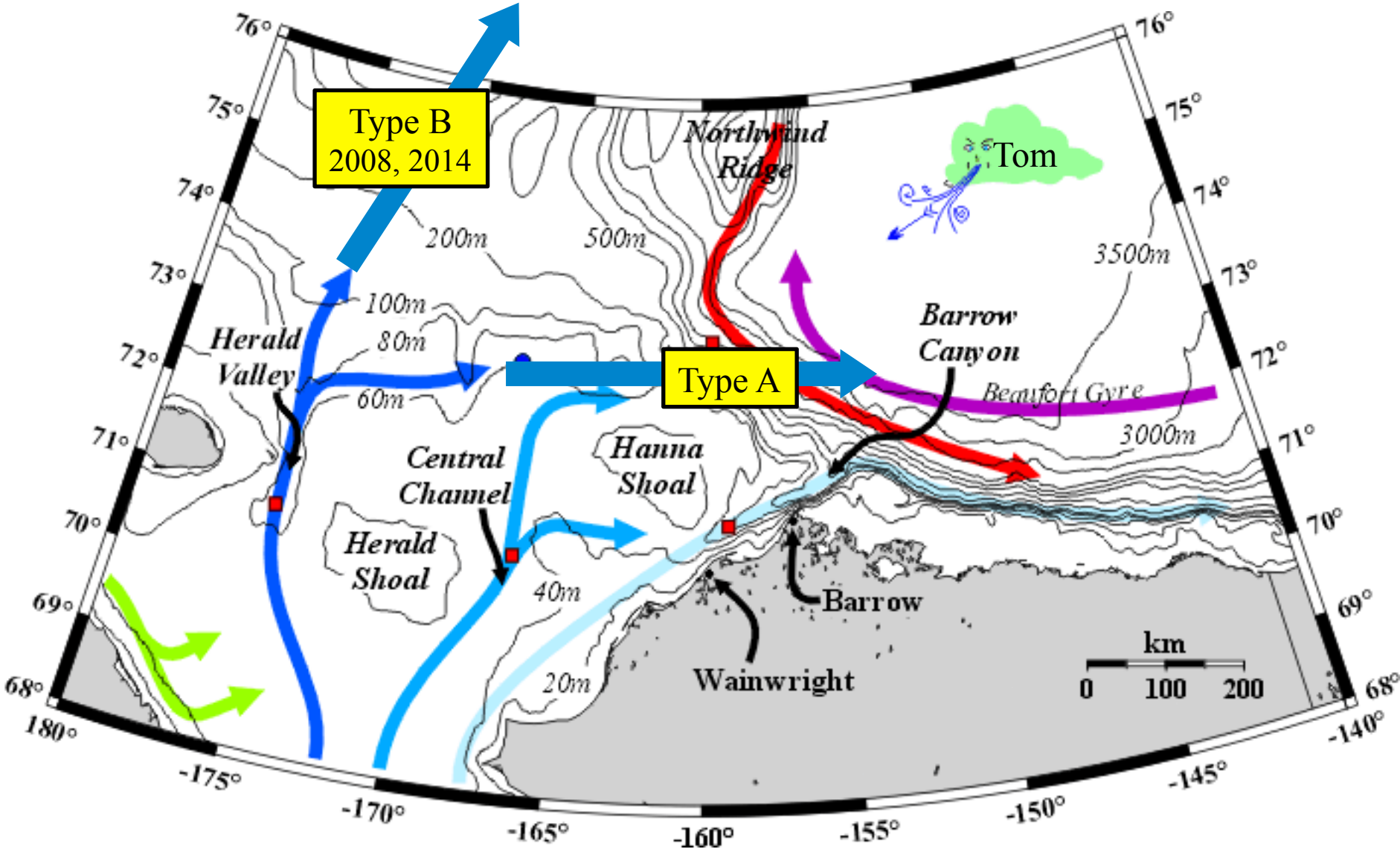


Type B:
Straight



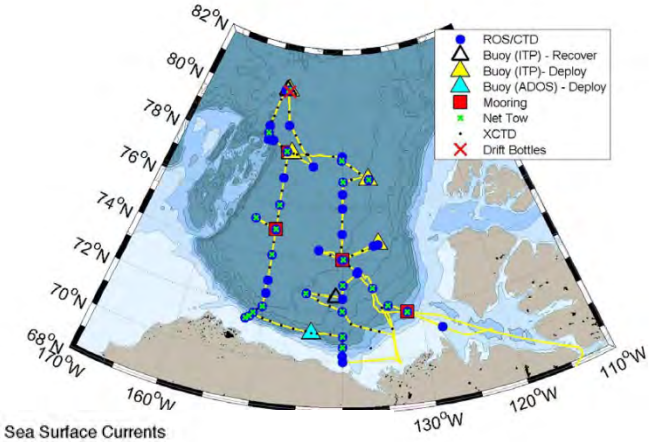
Type B:
Straight

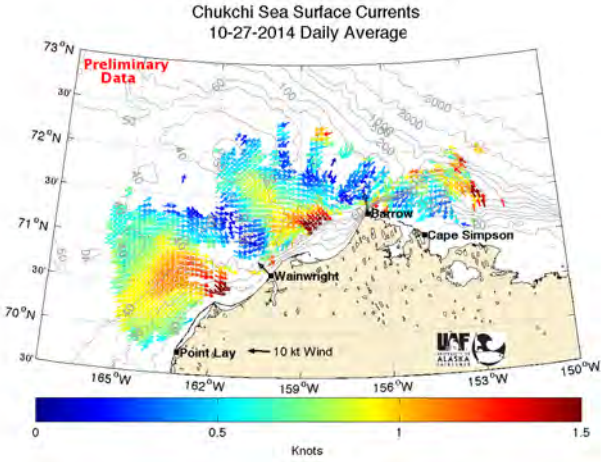


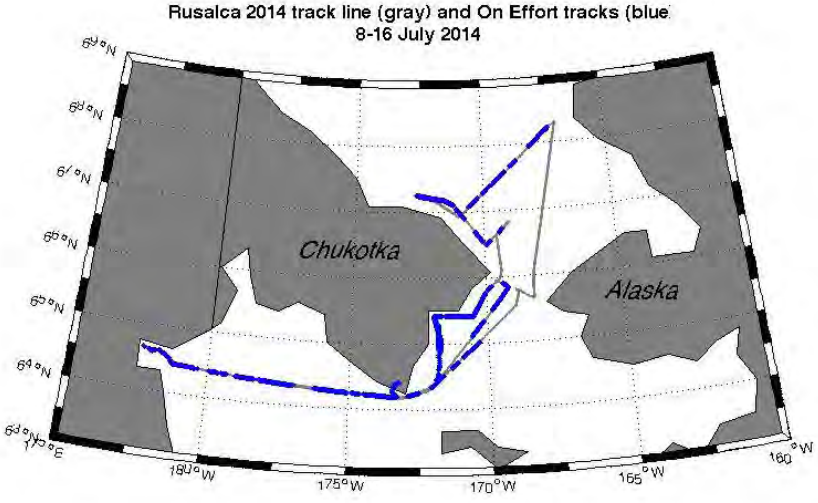


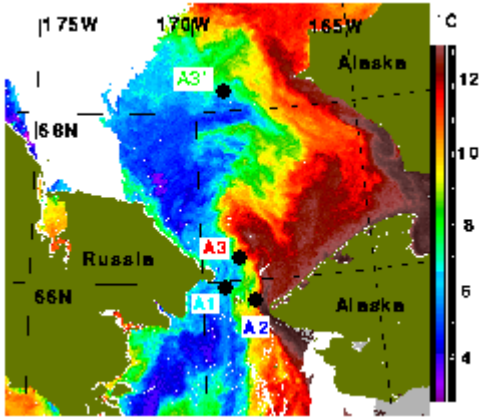
Background: Figure of Tom Weingartner

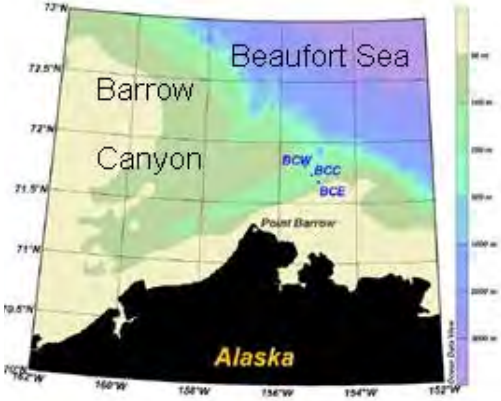

September
1999-2008
1989-1998
1979-1988
Arctic Ocean
East Siberian Sea
Beaufort Sea
Barrow
Wainwright
Nuiqsut
Kaktovik
Chukchi Sea
Pt. Lay
Pt. Hope
Siberia
Canada
Alaska
Little Diomede I
Wales
Gambell
Savoonga
St. Lawrence I
Bering Sea
1
2
3
4
5
March
1999-2008
1989-1998
1979-1988
0 200 400
km


ROS/CTD
Buoy (ITP) - Recover
Buoy (ITP)- Deploy
Buoy (ADOS) - Deploy
Mooring
Net Tow
XCTD
Drift Bottles
82°N
80°N
78°N
76°N
74°N
72°N
70°N
68°N
170°W
160°W
130°W
120°W
110°W


Chukchi Sea Surface Currents
10-27-2014 Daily Average
Preliminary Data
Barrow
Cape Simpson
Wainwright
Point Lay
10 kt Wind
UAF
ALASKA
165°W
162°W
159°W
156°W
153°W
150°W
73°N
72°N
71°N
70°N
0
0.5
1
1.5
Knots

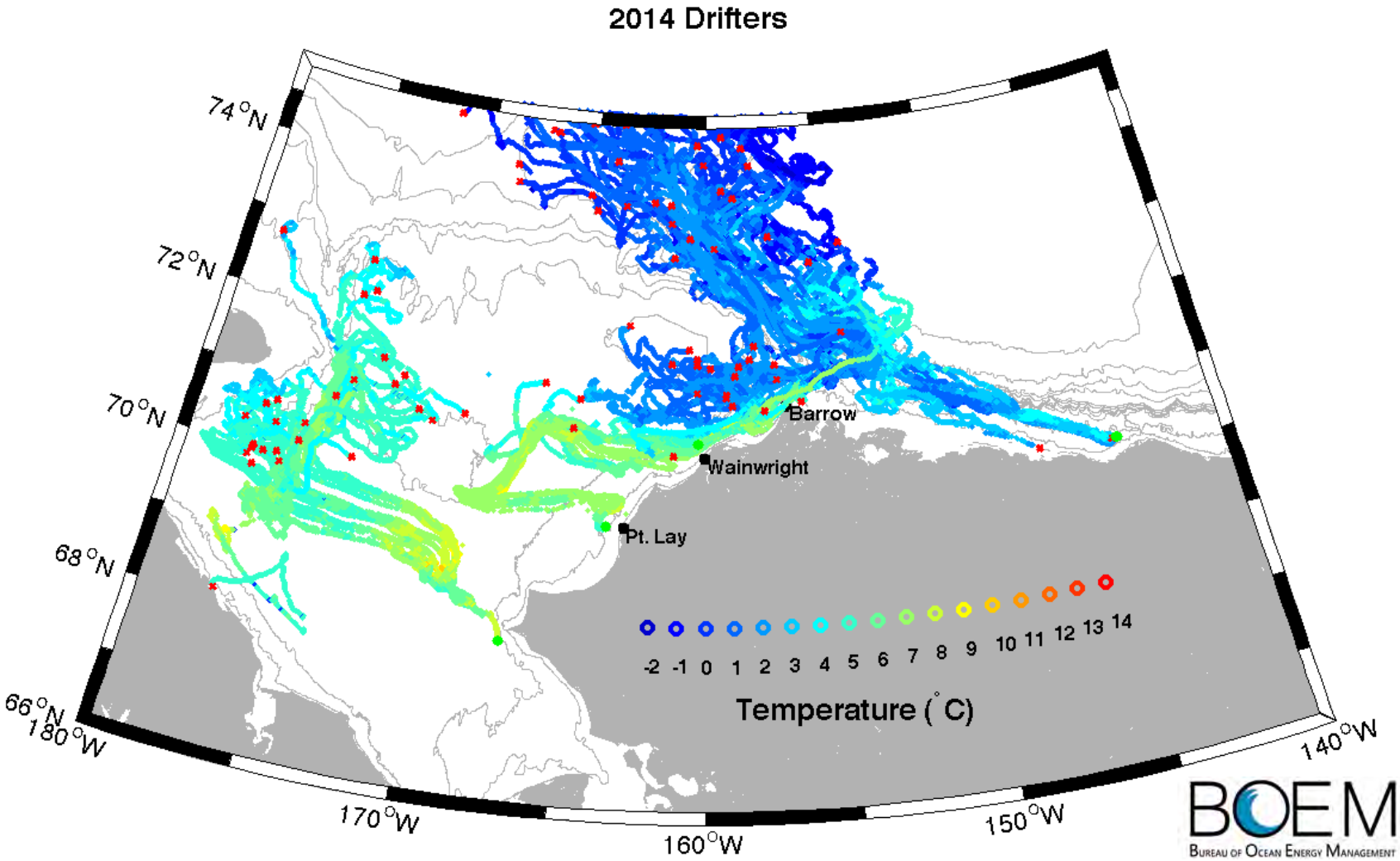

Rusalca 2014 track line (gray) and On Effort tracks (blue
8-16 July 2014
Chukotka
Alaska
69°N
68°N
67°N
66°N
65°N
64°N
63°N
180°W
175°W
170°W
165°W
160°W

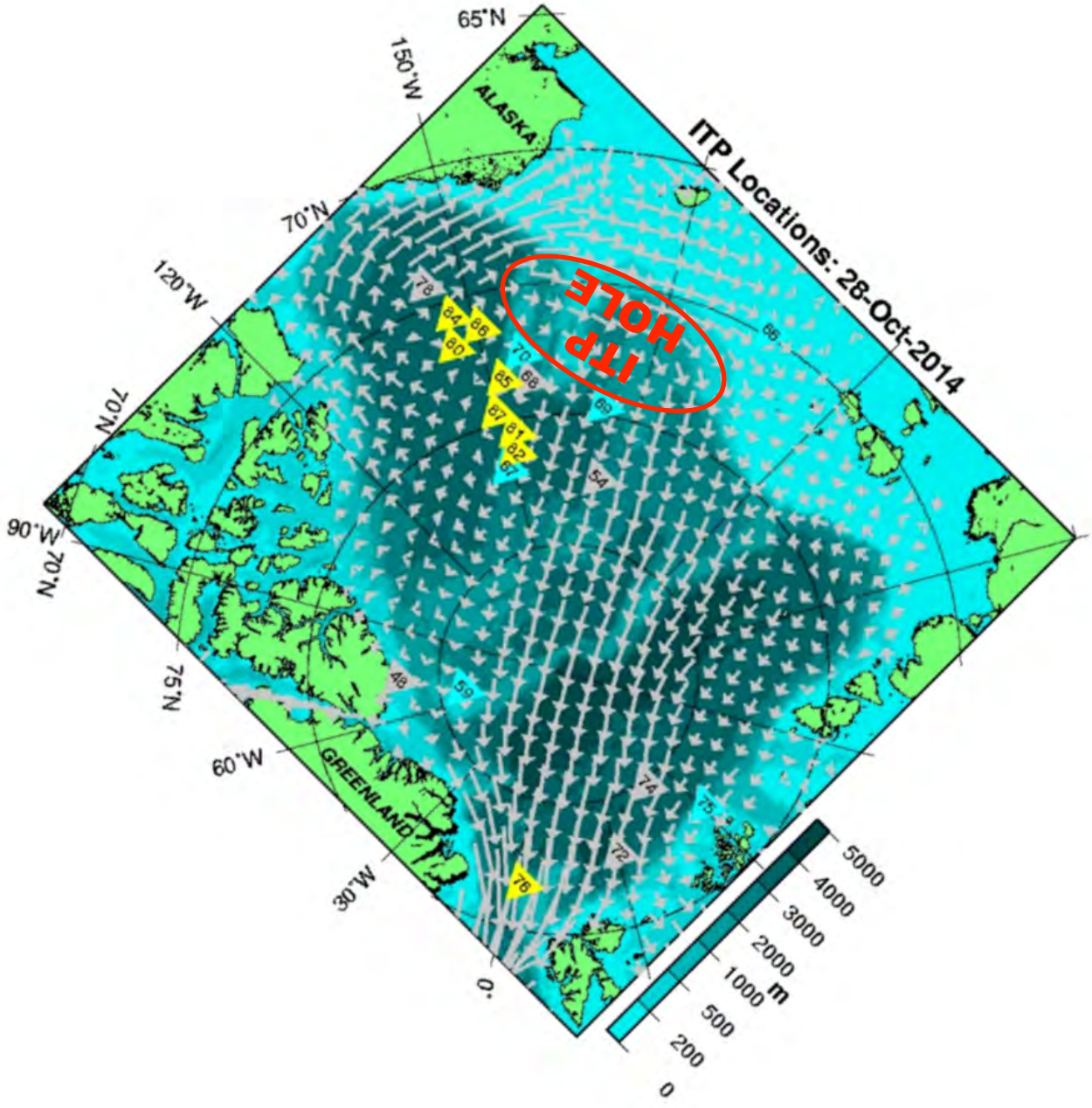

175W
170W
165W
°C
Alaska
A3'
68N
Russia
66N
A3
A1
A2
Alaska
12
10
8
6
4


Beaufort Sea
Barrow
Canyon
BCW
BCC
BCE
Point Barrow
Alaska

Chukchi Sea Surface Currents

Tom Weingartner, Peter Winsor, Rachel Potter, Hank Statscewich
University of Alaska Fairbanks
School of Fisheries and Ocean Sciences

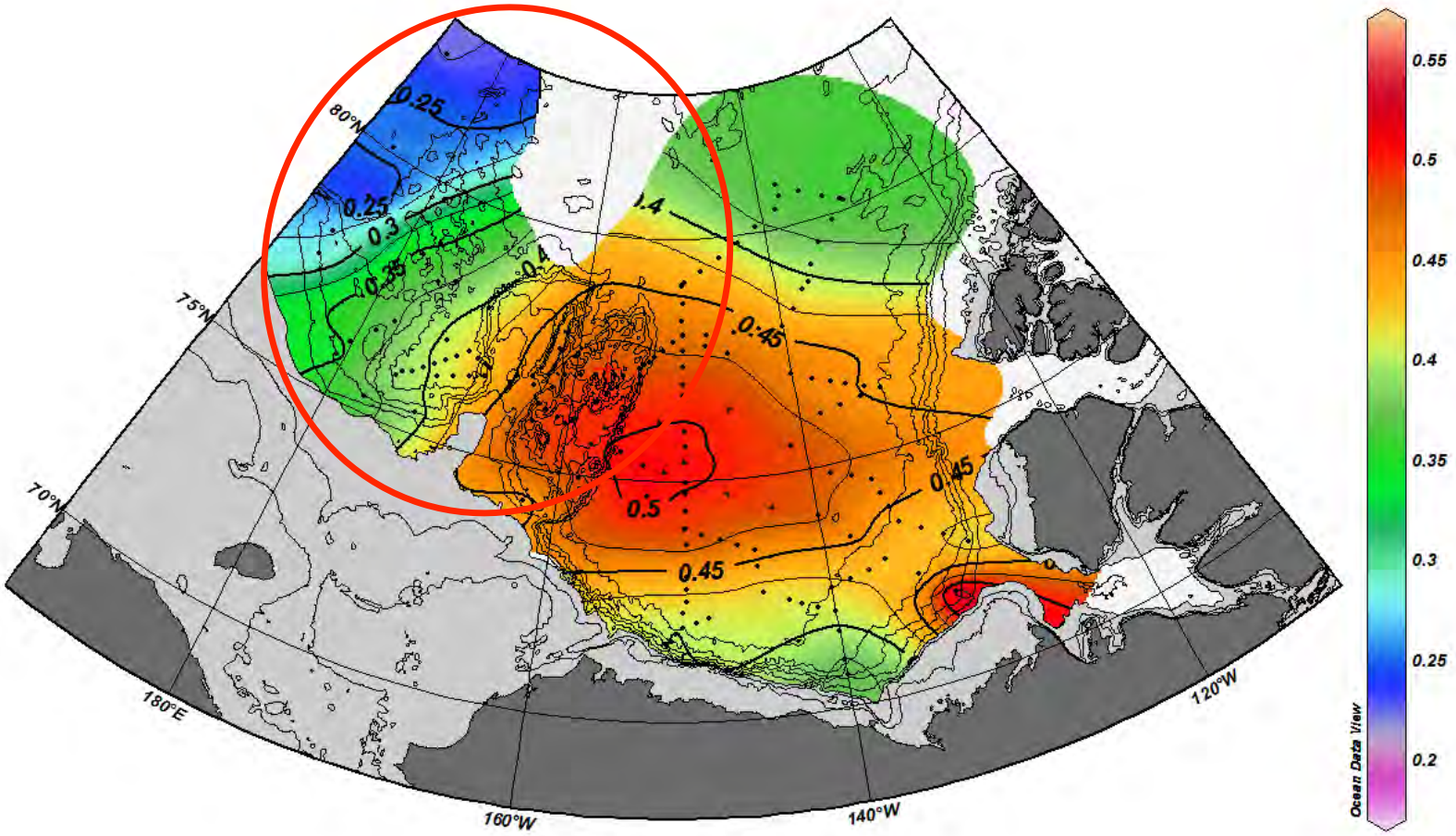



ITP Locations: 28-Oct-2014
ITP HOLE
ALASKA
GREENLAND
65°N
150°W
70°N
120°W
70°N
90°W
70°N
75°N
60°W
30°W
0°
5000
4000
3000
2000
1000
m
500
200
0

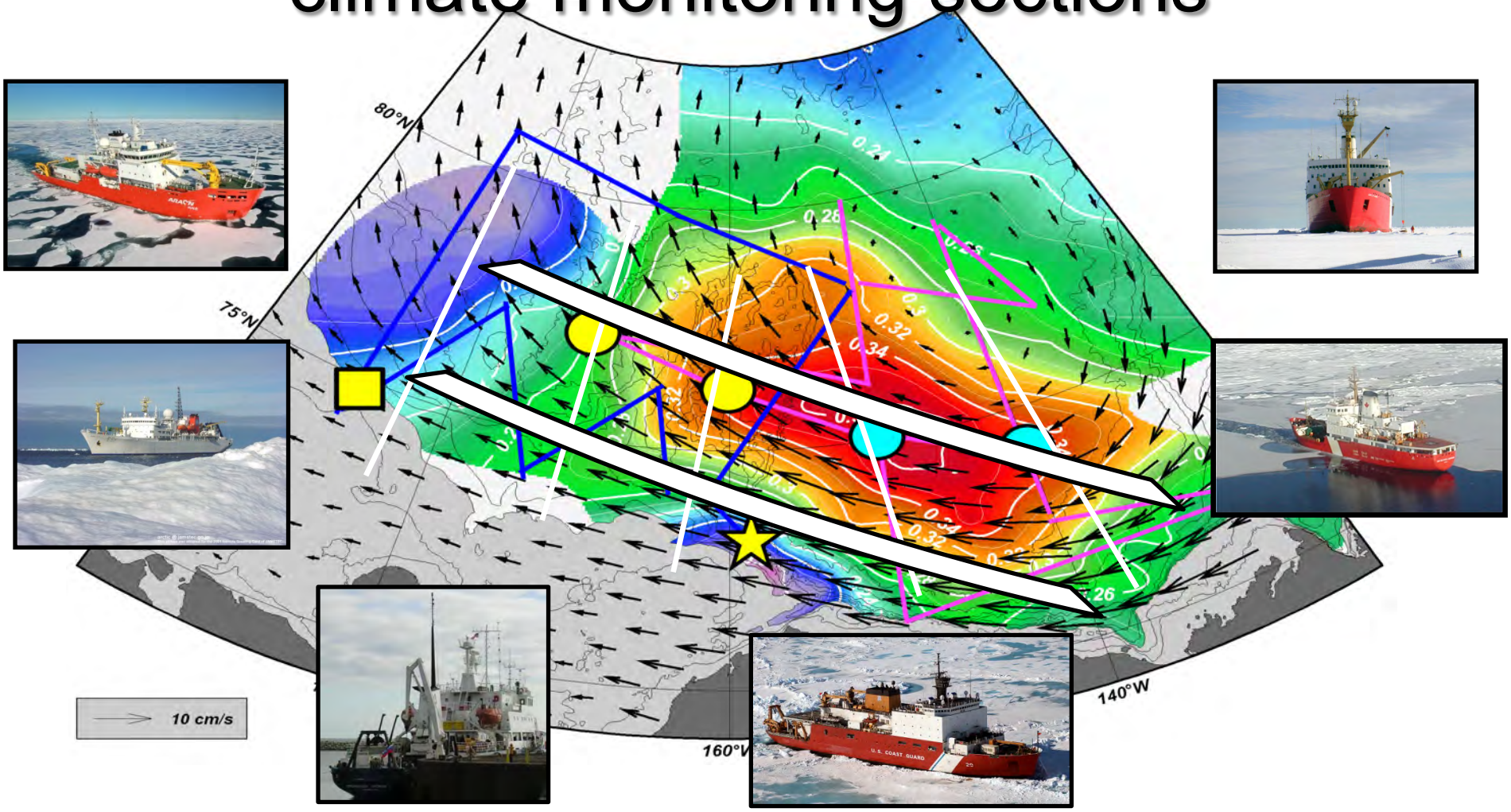
Northward currents from shelf region into basin in the region west of Northwind Ridge

Changes in sea ice cover, nutrient delivery

Dynamic height @ 50dbar (ref. 800 dbar)



Proposed international Pacific Arctic climate monitoring sections



Background color: dynamic height at 100dar relative to 800bdar 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)
Simbols: Mooring array in 2012-2013 (TUMSAT/KOPRI/NIPR & WHOI)