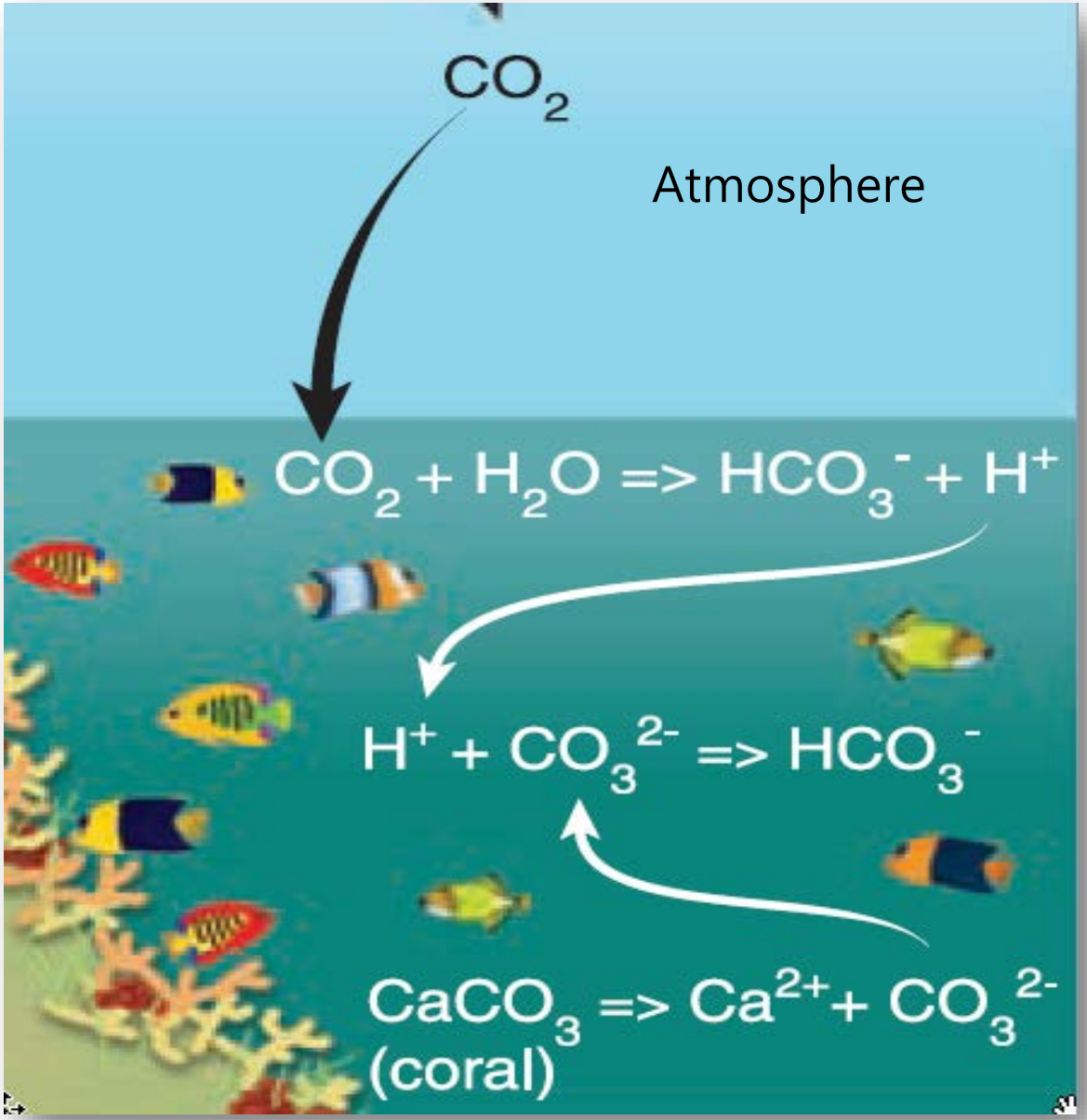
Ocean acidification in the western Arctic Ocean in 2016 summer

Dongseon Kim

KIOST

Ocean acidification



Ocean acidification index

Aragonite saturation state (Ω_{arg})

$\Omega_{arg} = [Ca^{2+}][CO_3^{2-}]/K_{sp}$

K_{sp} = solubility product of aragonite ($10^{-8.22}$)

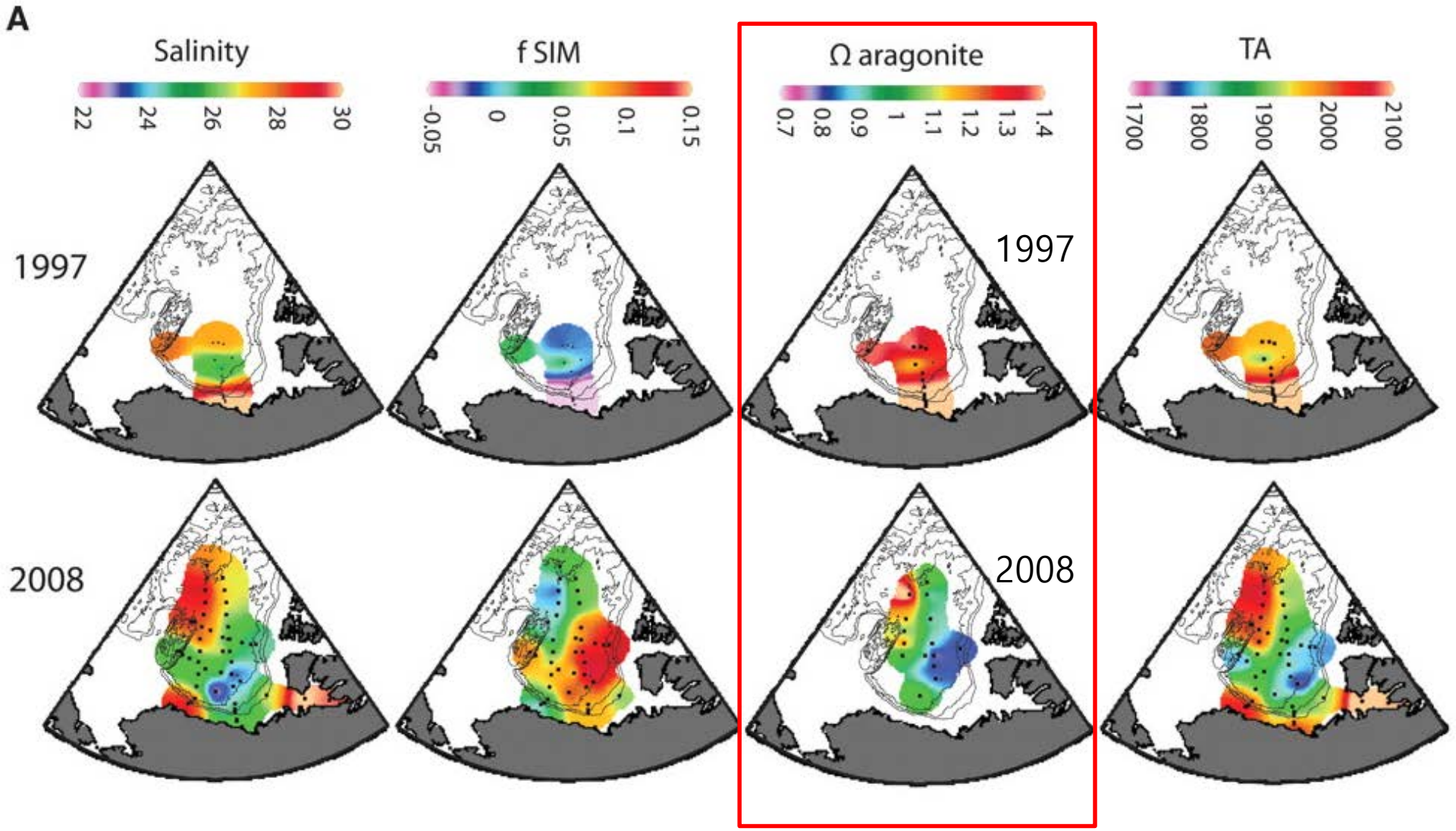
$\Omega_{arg} > 1$ aragonite supersaturation

$\Omega_{arg} = 1$ aragonite saturation

$\Omega_{arg} < 1$ aragonite undersaturation

KIOST

Surface distribution of aragonite saturation states



Yamamoto-Kawai (2009)

Vertical distribution of aragonite saturation states

1994

1998

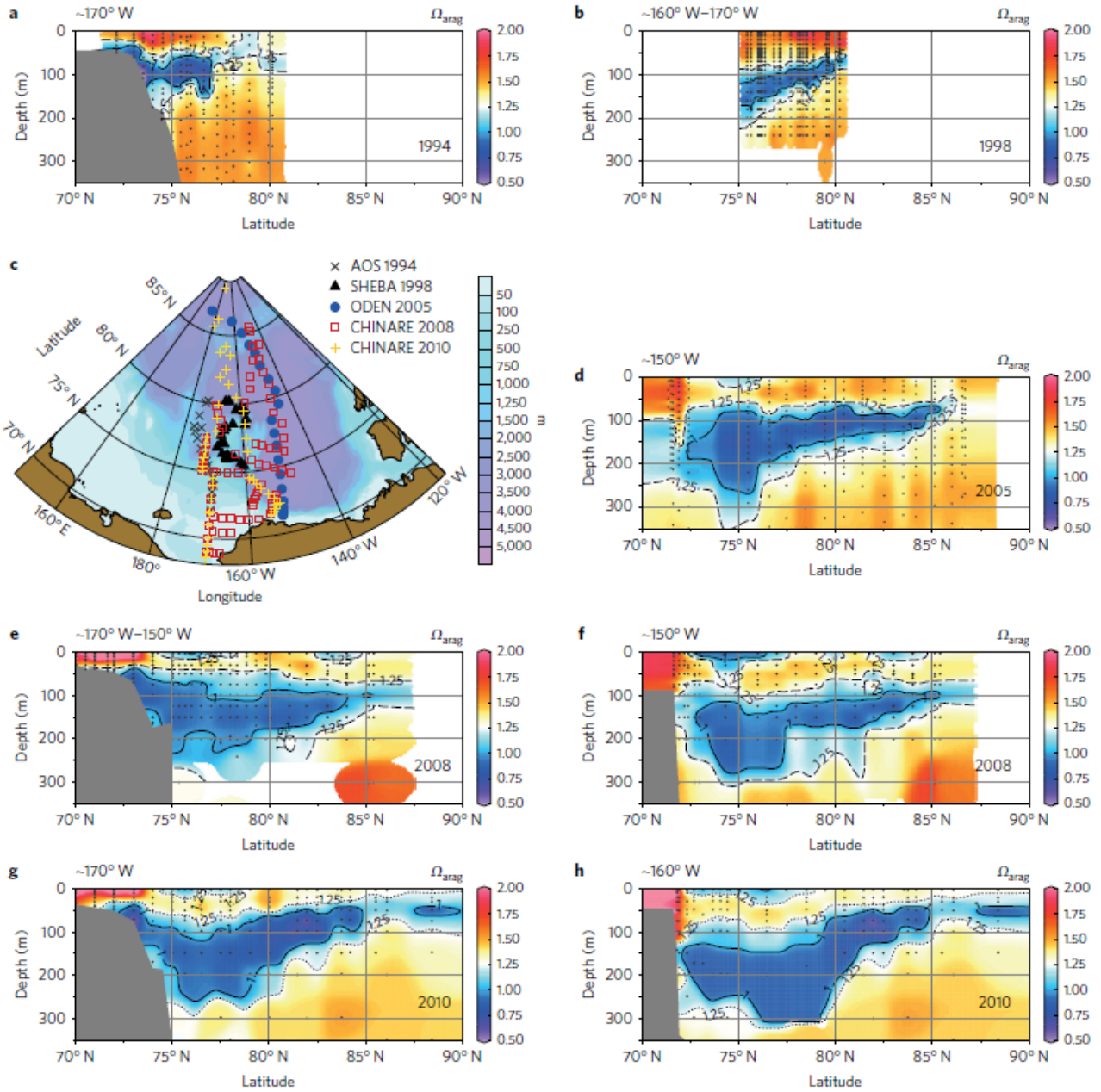
2005

2008

2008

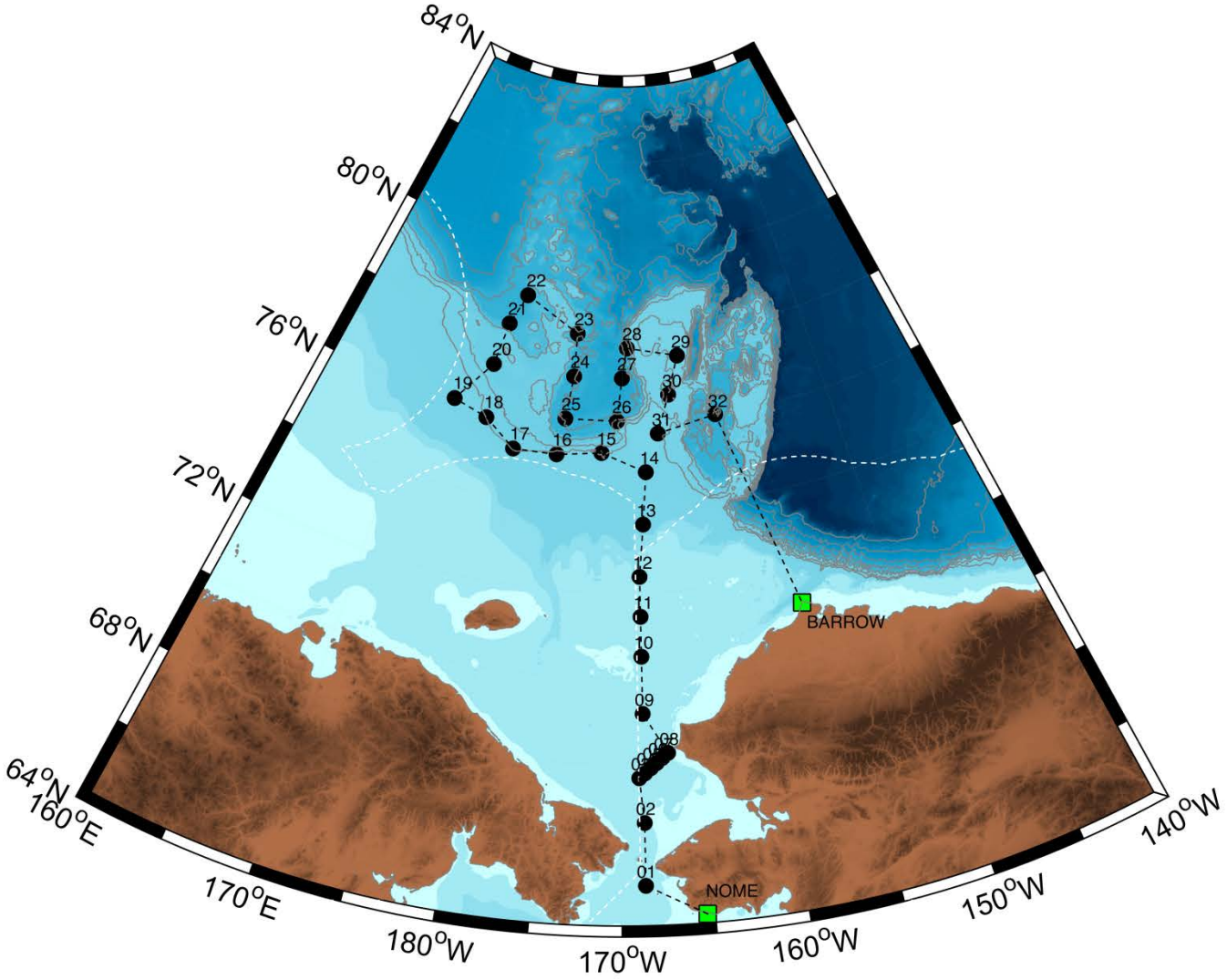
2010

2010



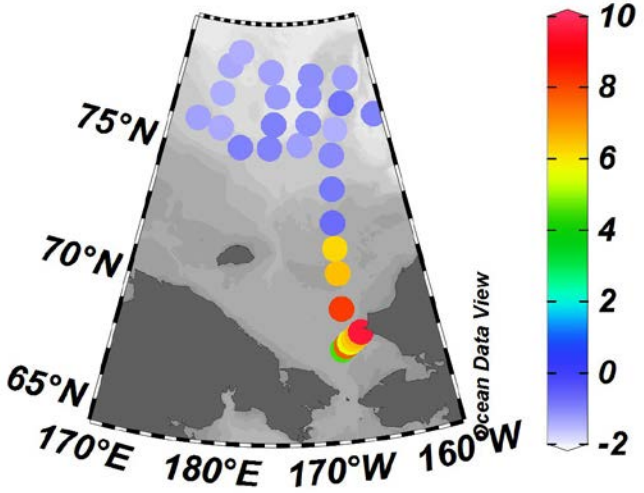
Qi et al. (2017)

Study area in the 2016 summer

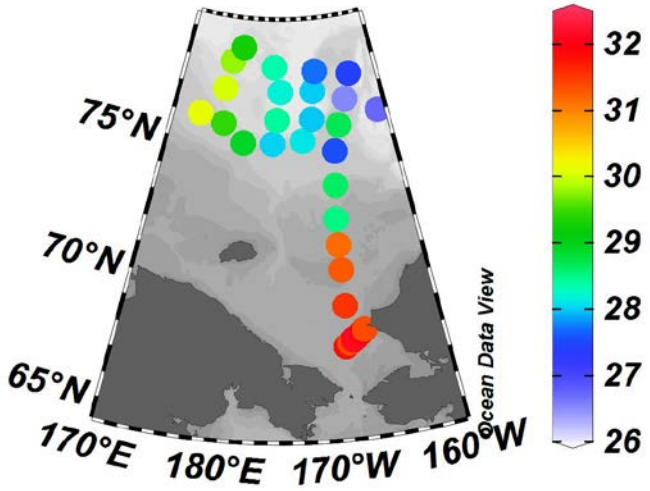


Surface distribution of aragonite saturation states

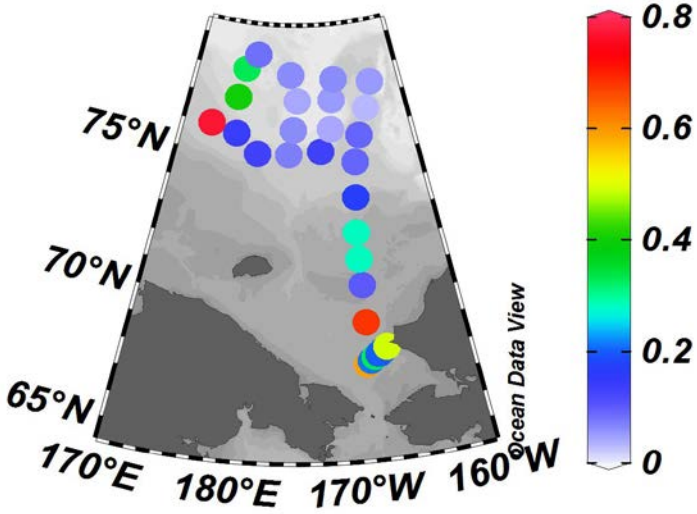
Temperature



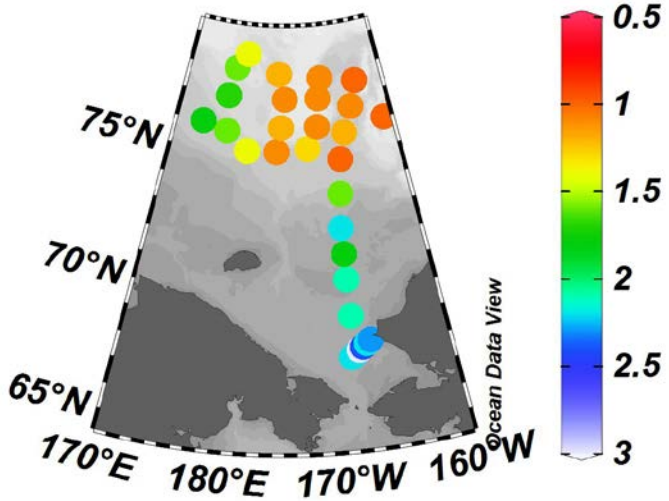
Salinity



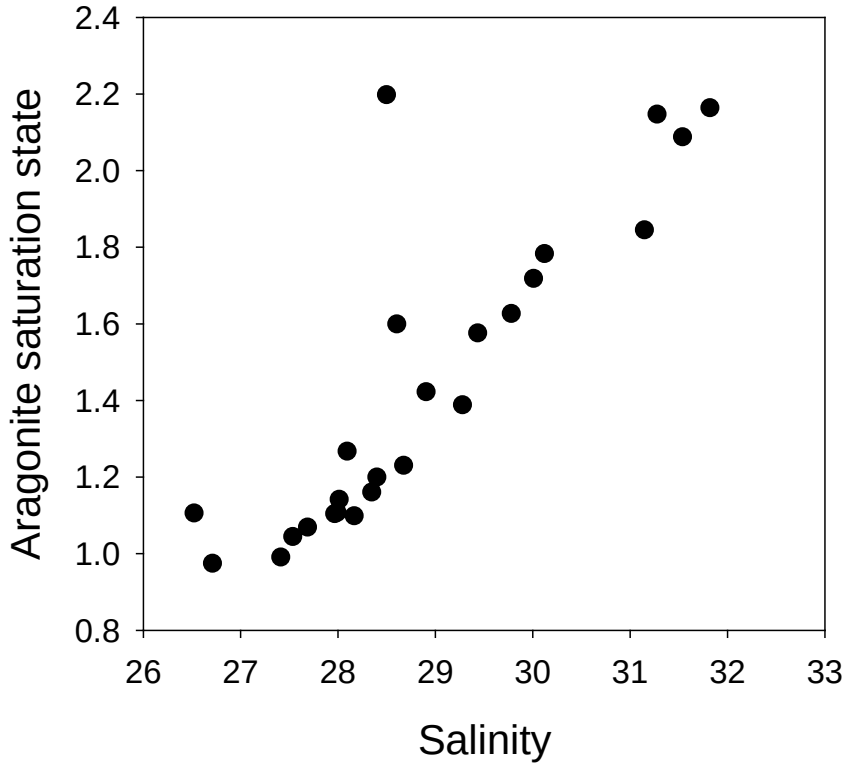
Chlorophyll-a

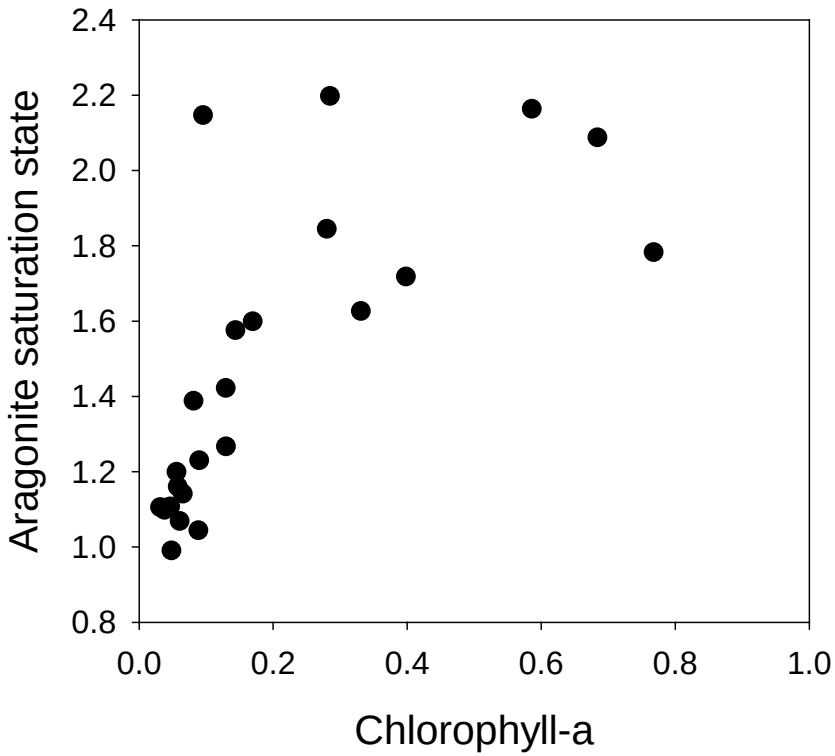


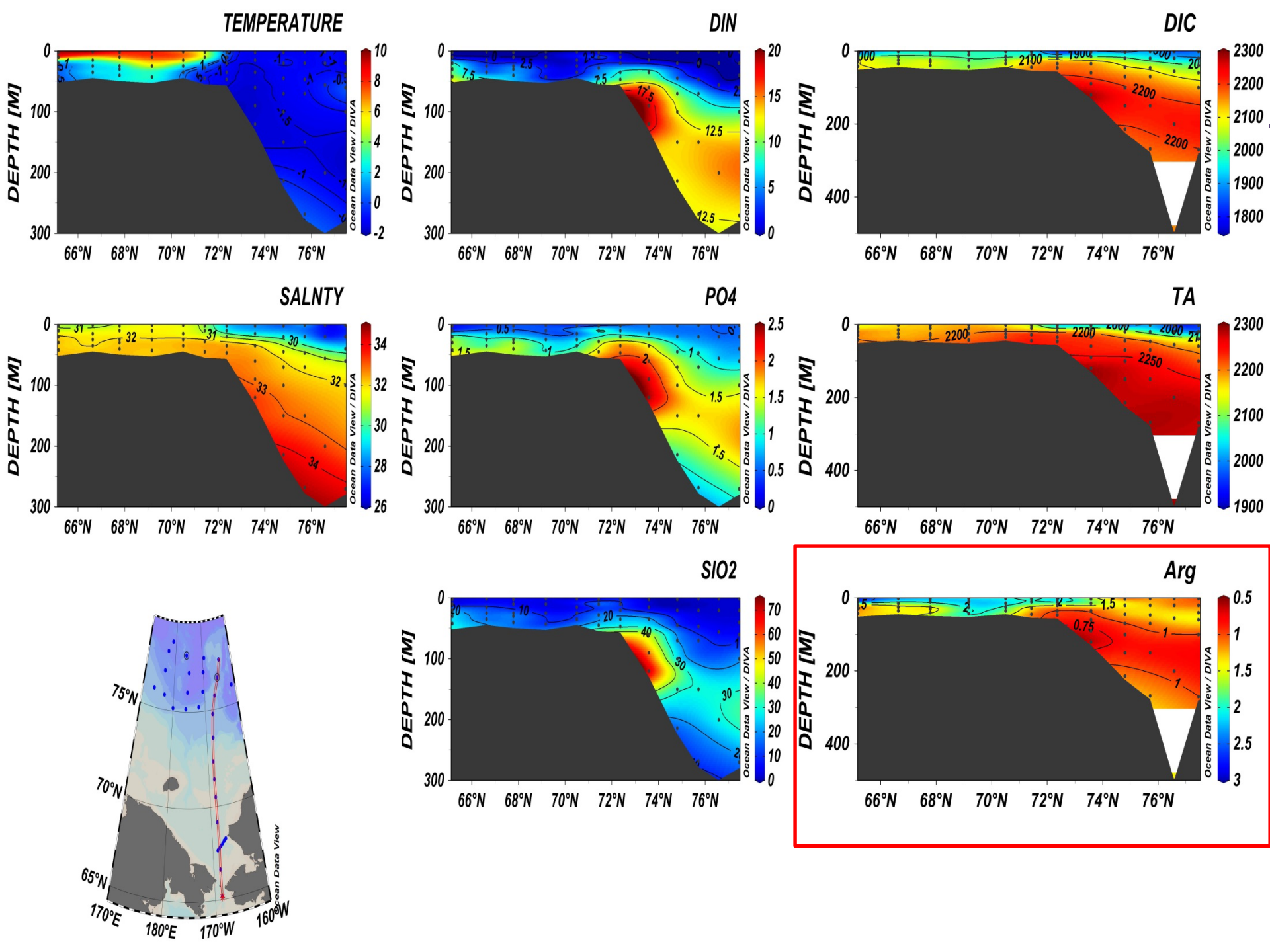
Aragonite saturation state



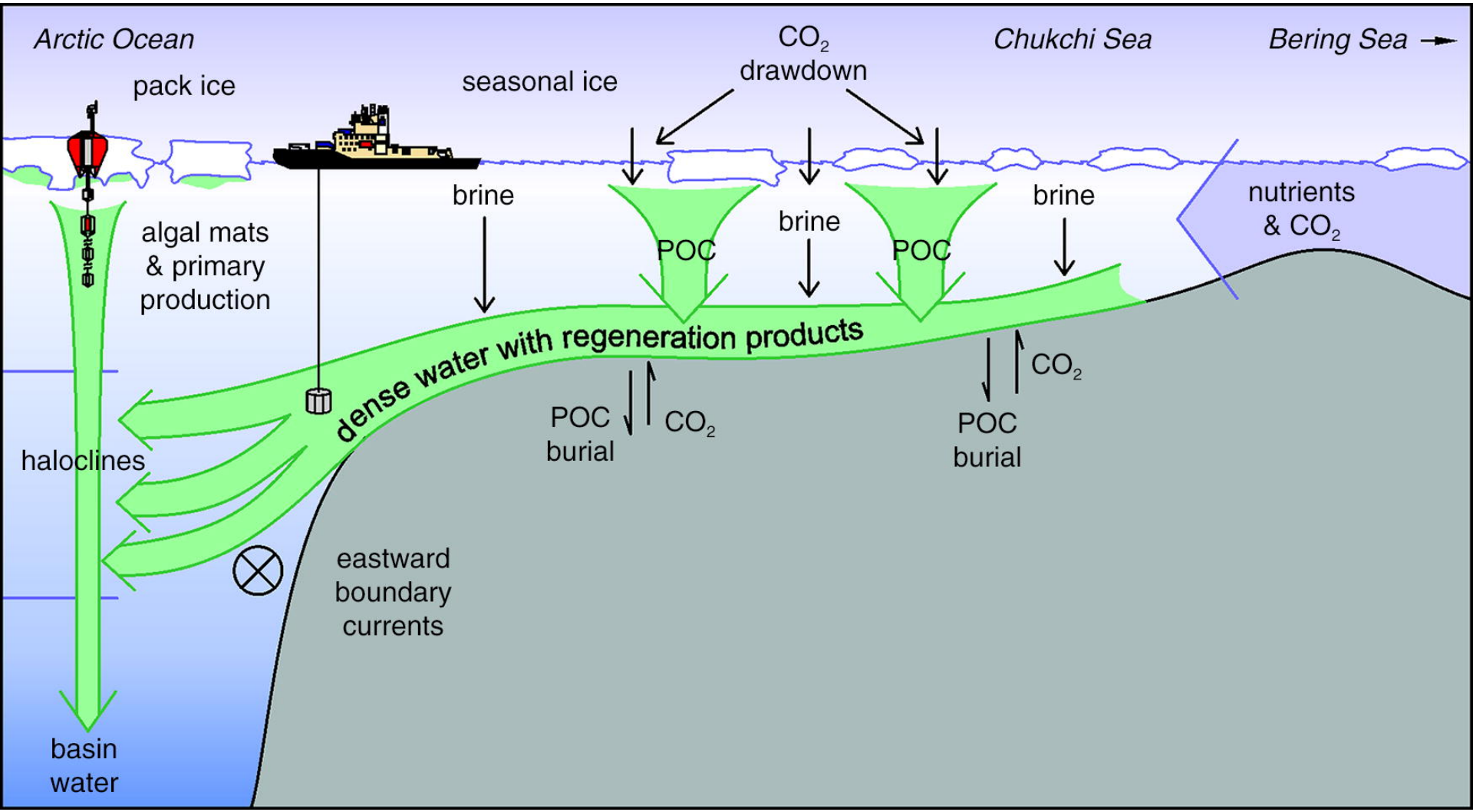
Aragonite saturation states vs. salinity & chl-a



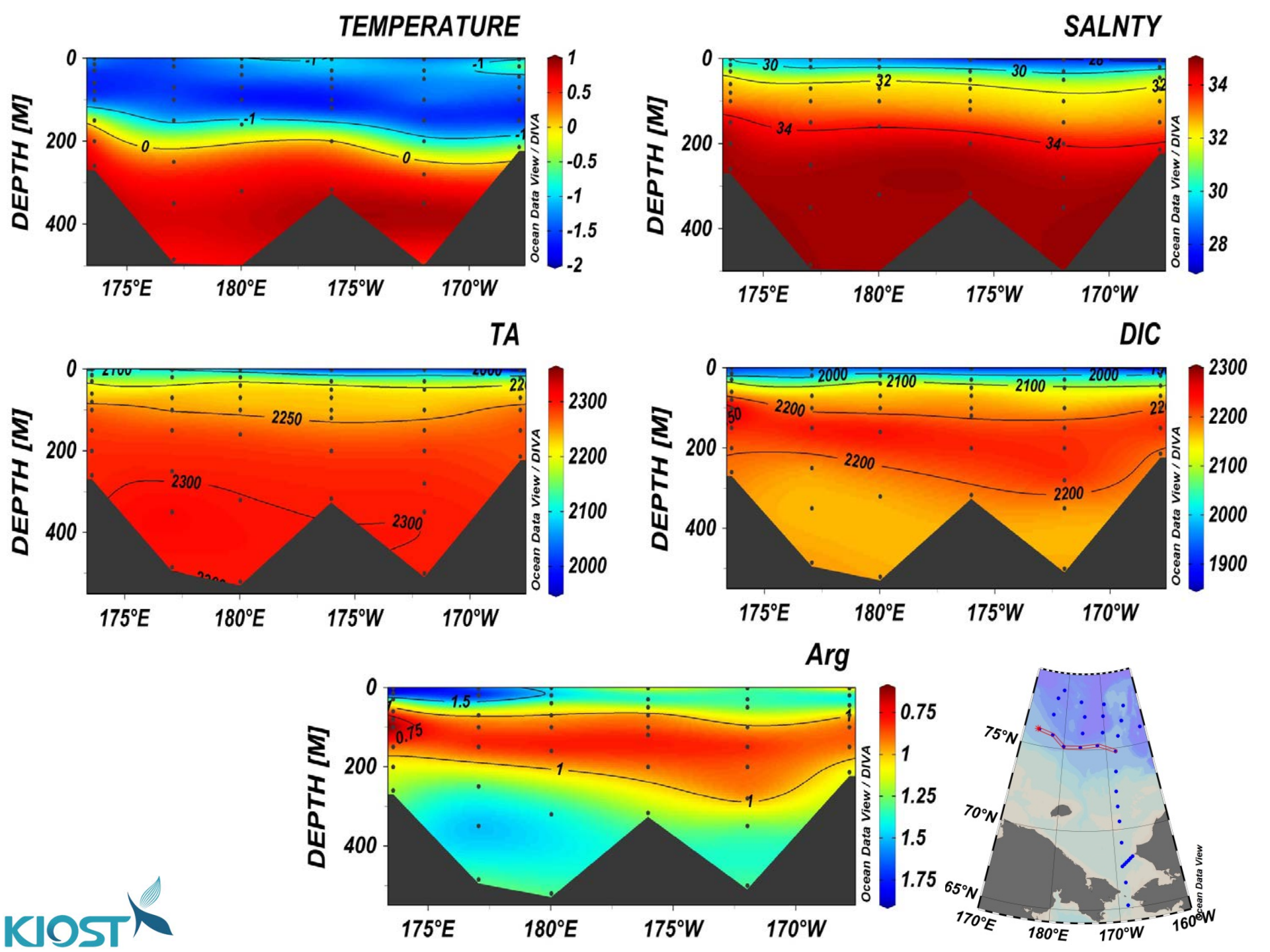


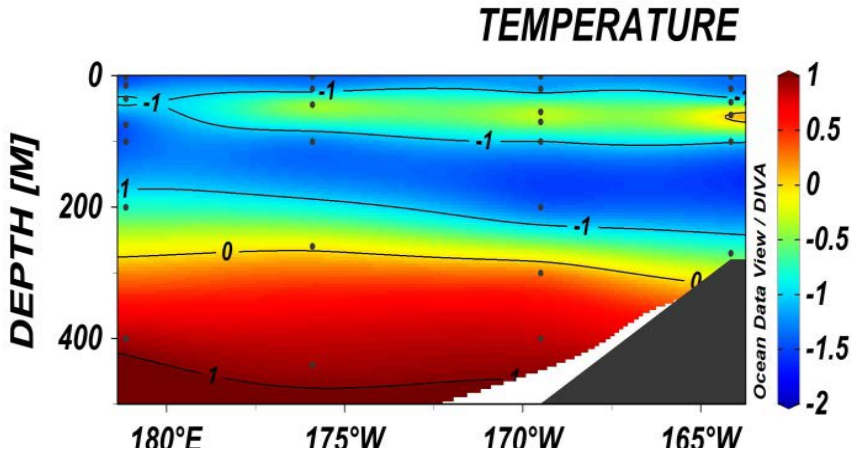

TEMPERATURE
DIN
DIC
SALNTY
PO4
TA
SIO2
Arg
DEPTH [M]
Ocean Data View / DIVA
66°N
68°N
70°N
72°N
74°N
76°N
75°N
70°N
65°N
170°E
180°E
170°W
160°W

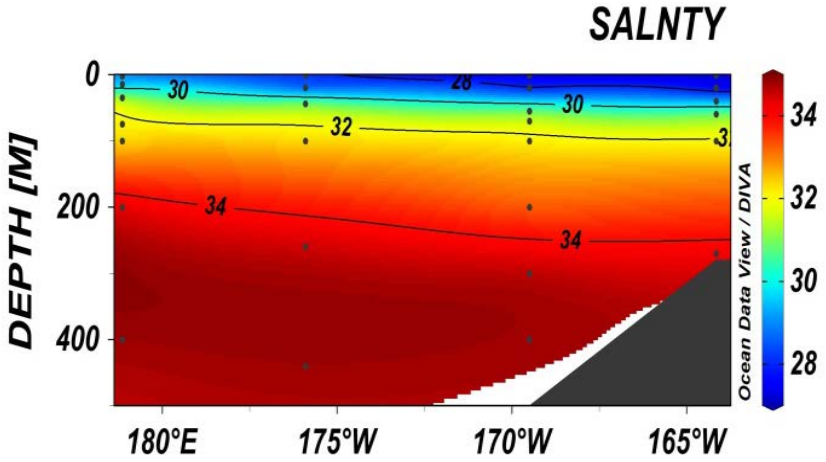
Continental shelf pump

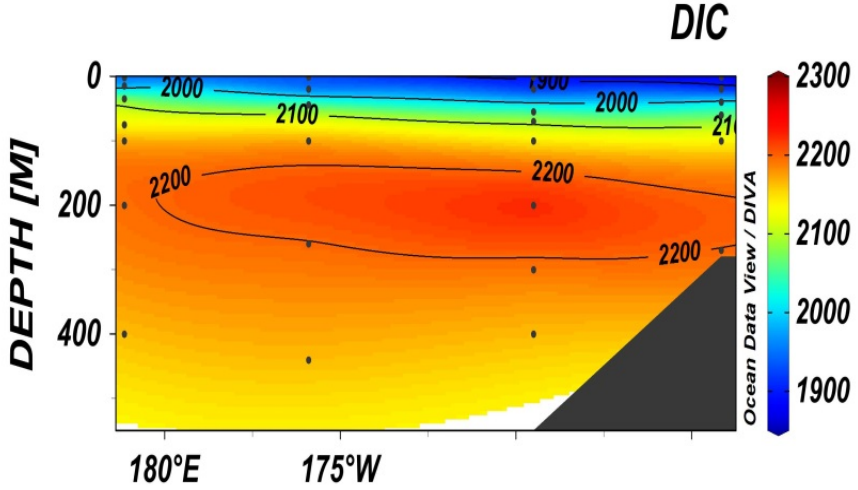


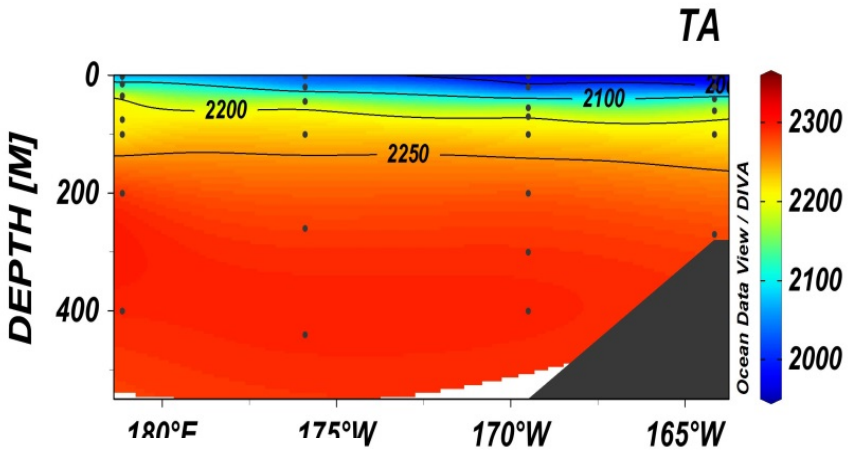
Anderson et al. (2010)

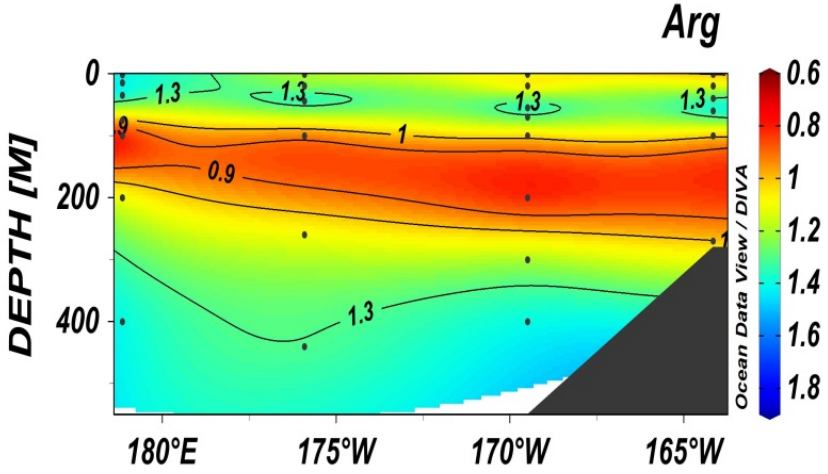

TEMPERATURE
DEPTH [M]
0
200
400
175°E
180°E
175°W
170°W
1
0.5
0
-0.5
-1
-1.5
-2
Ocean Data View / DIVA
SALNTY
34
32
30
28
TA
2300
2250
2200
2100
2000
DIC
2300
2200
2100
2000
1900
Arg
1.5
1
0.75
1.25
1.75
75°N
70°N
65°N
170°E
180°E
170°W
160°W
Ocean Data View

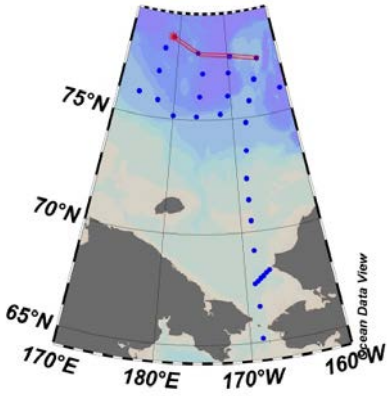

TEMPERATURE
DEPTH [M]
0
200
400
180°E
175°W
170°W
165°W
Ocean Data View / DIVA
1
0.5
0
-0.5
-1
-1.5
-2

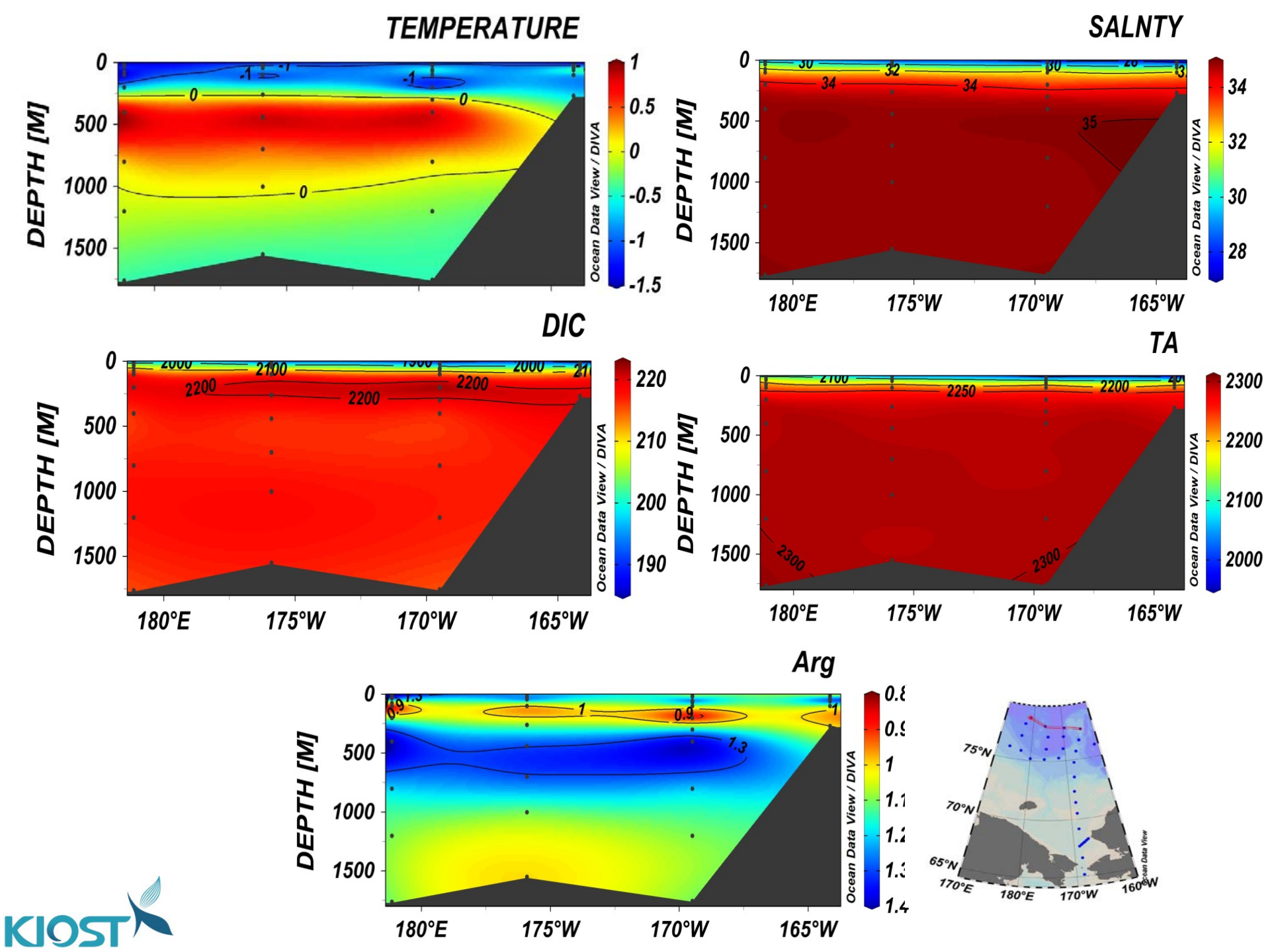

SALNTY
DEPTH [M]
0
200
400
180°E
175°W
170°W
165°W
Ocean Data View / DIVA
34
32
30
28


DIC
DEPTH [M]
0
200
400
180°E
175°W
Ocean Data View / DIVA
2300
2200
2100
2000
1900

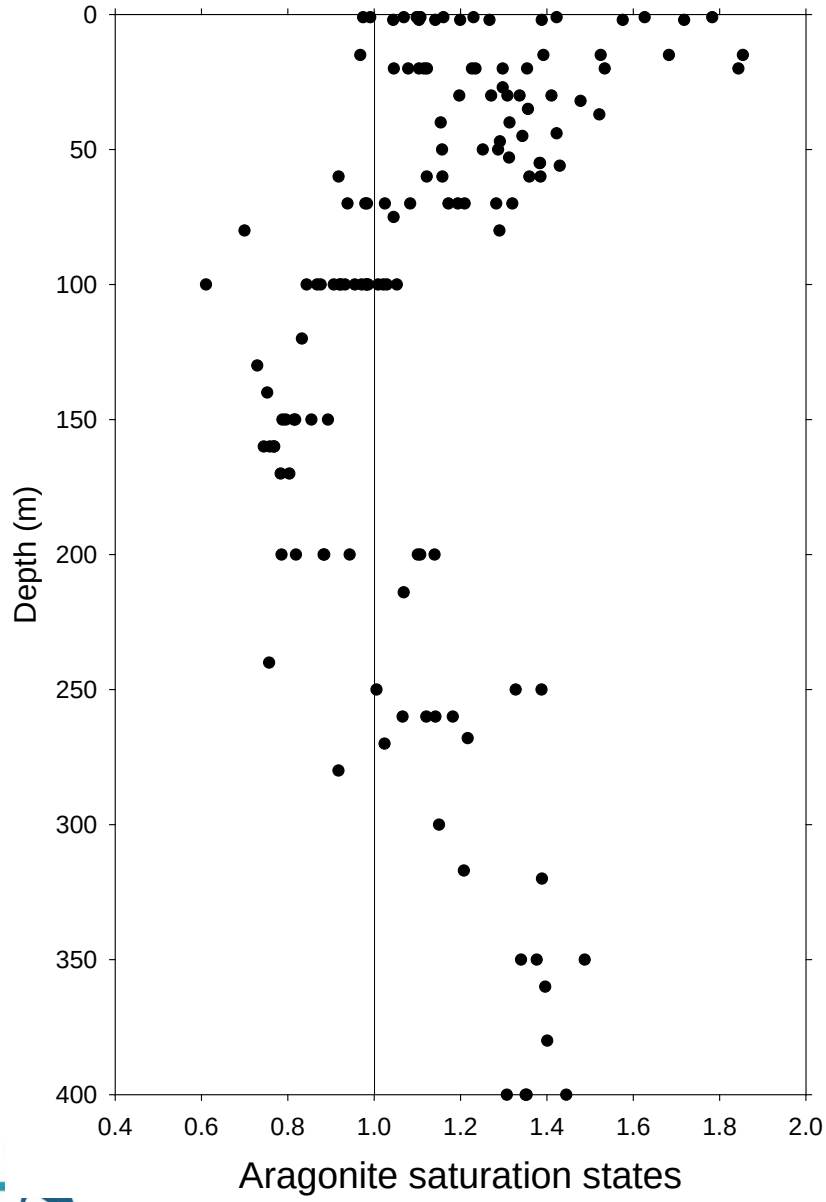

TA
DEPTH [M]
0
200
400
180°E
175°W
170°W
165°W
Ocean Data View / DIVA
2300
2200
2100
2000


Arg
DEPTH [M]
0
200
400
180°E
175°W
170°W
165°W
Ocean Data View / DIVA
0.6
0.8
1
1.2
1.4
1.6
1.8

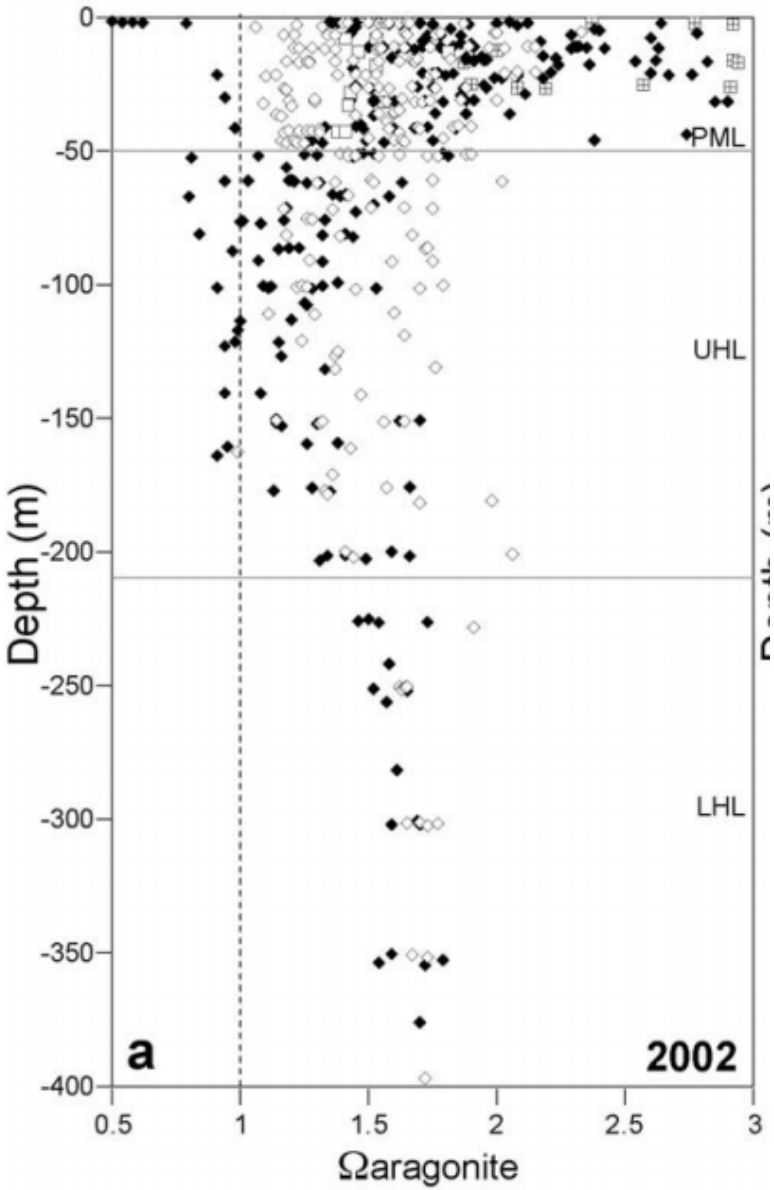

75°N
70°N
65°N
170°E
180°E
170°W
160°W
Ocean Data View


TEMPERATURE
SALNTY
DIC
TA
Arg
DEPTH [M]
0
500
1000
1500
180°E
175°W
170°W
165°W
Ocean Data View / DIVA
1
0.5
0
-0.5
-1
-1.5
34
32
30
28
220
210
200
190
2300
2200
2100
2000
0.8
0.9
1
1.1
1.2
1.3
1.4
75°N
70°N
65°N
170°E
180°E
170°W
160°W
Ocean Data View

2016 summer

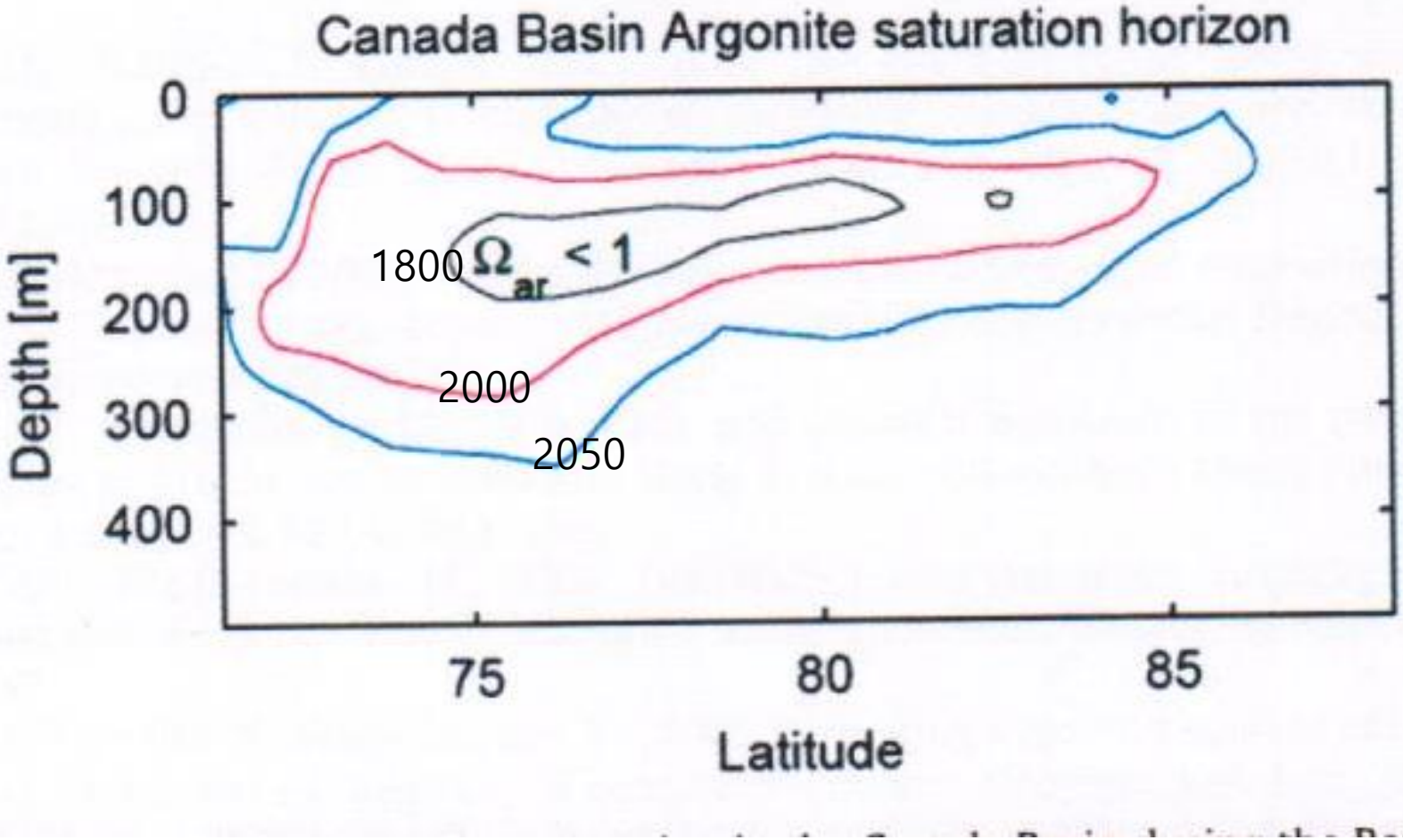


2002 summer



Bates et al. (2009)

Projection of aragonite saturation horizon



Anderson et al. (2010)

Summary

- Most of the surface waters are supersaturated with respect to aragonite in the western Arctic ocean during 2016 summer
- Sea ice melt waters and biological activities are main factors controlling the surface distribution of aragonite saturation states
- Most of the subsurface waters (50~250 m) are undersaturated with respect to aragonite.
- The undersaturated subsurface waters result from the contribution of CO_2 remineralized from organic matter produced on the continental shelf
- Aragonite undersaturation in the subsurface waters had considerably progressed from 2002 to 2016

KIOST


Thanks for your
attention