# The mesoscale eddy activity in the Alaskan Stream area and its impact on biological productivity

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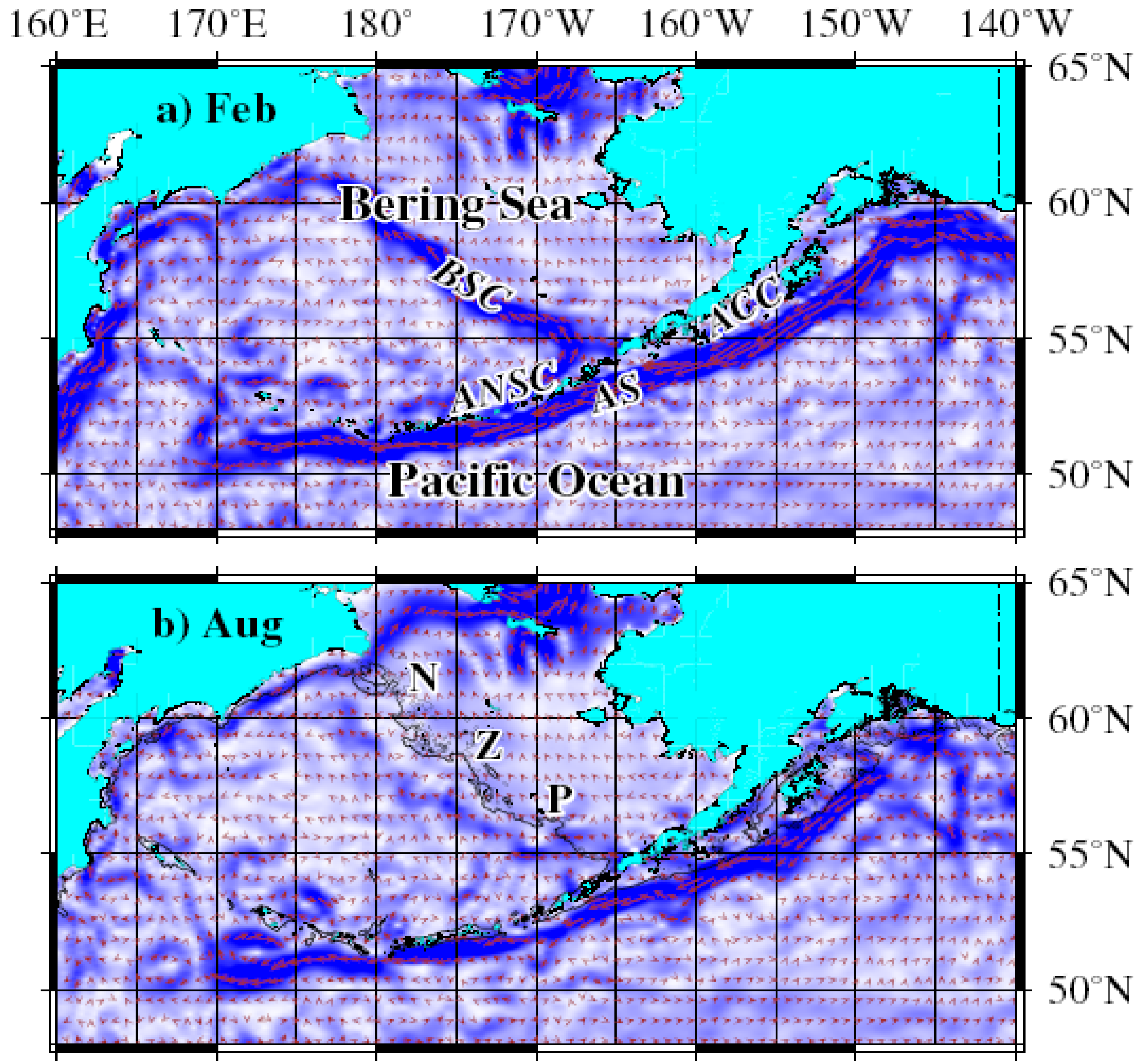
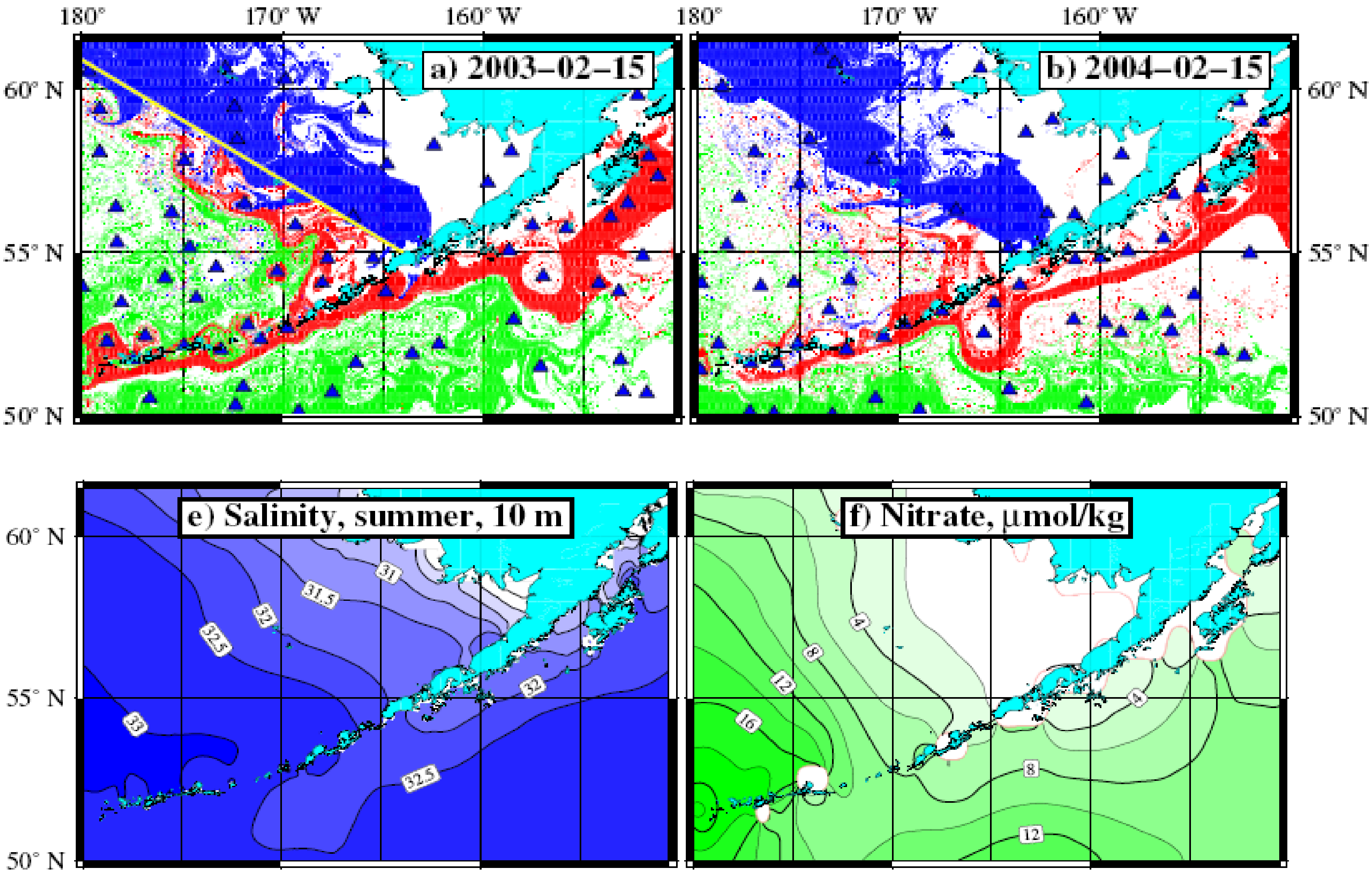
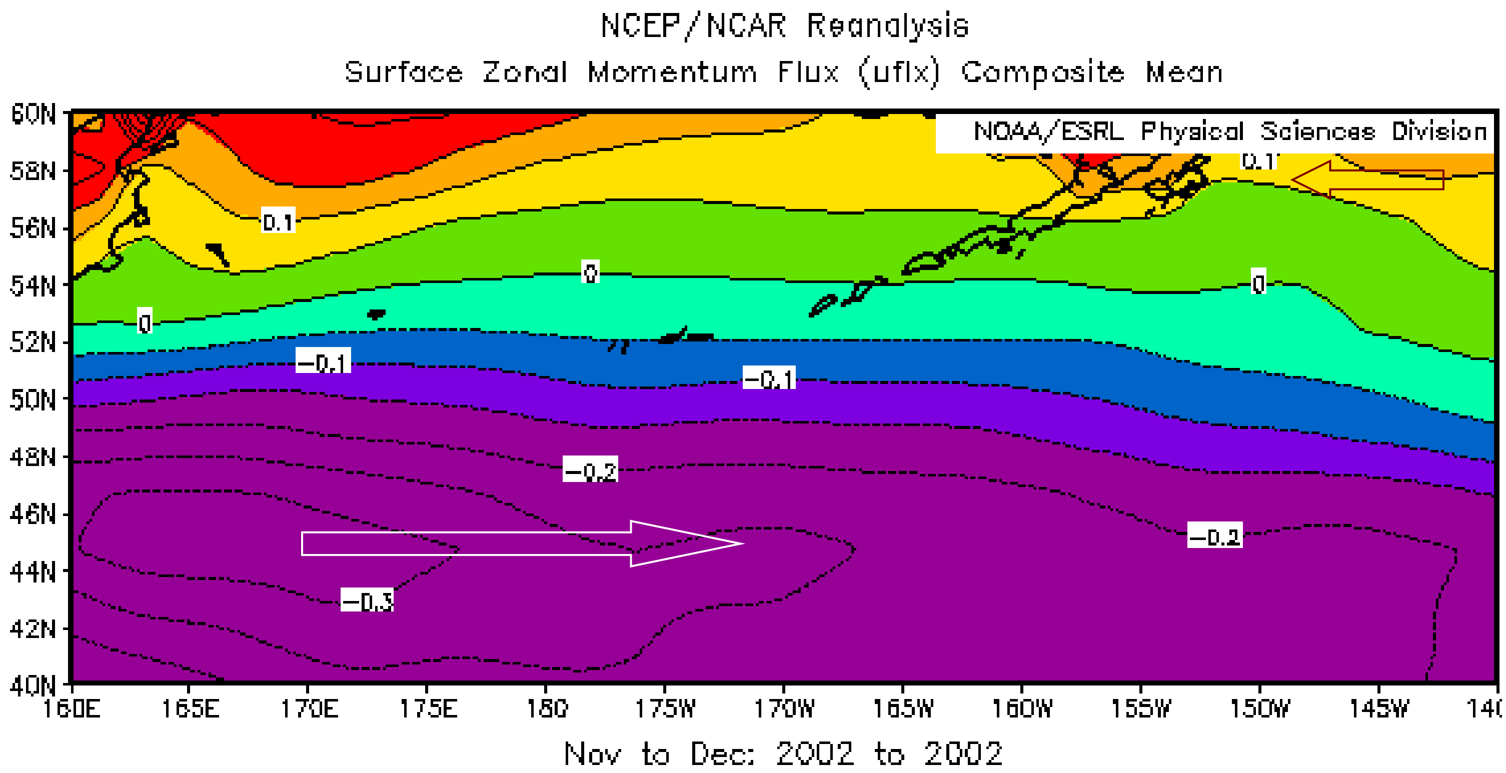


160°E
170°E
180°
170°W
160°W
150°W
140°W
65°N
60°N
55°N
50°N
a) Feb
Bering Sea
BSC
ACC
ANSC
AS
Pacific Ocean
b) Aug
N
Z
P

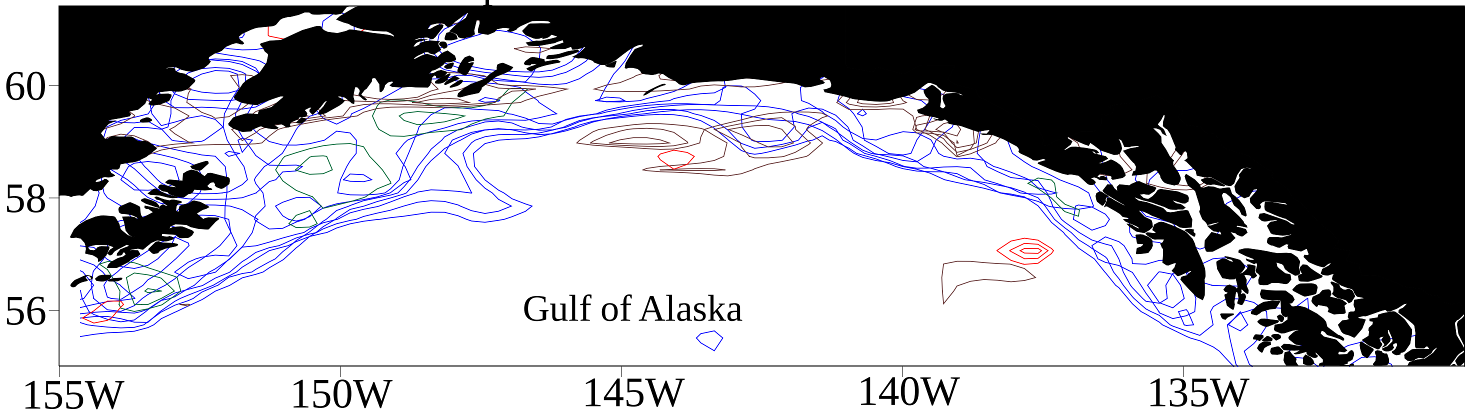


180°
170° W
160° W
60° N
55° N
50° N
a) 2003–02–15
b) 2004–02–15
e) Salinity, summer, 10 m
31
31.5
32
32.5
33
32
32.5
f) Nitrate, μmol/kg
4
8
12
16
4
8
12



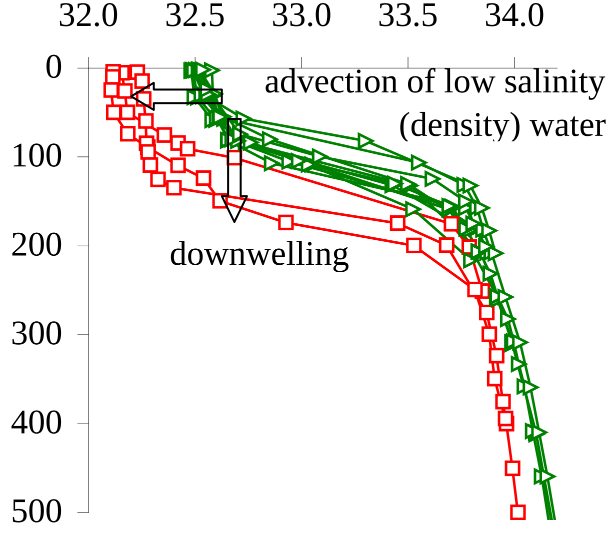
NCEP/NCAR Reanalysis
Surface Zonal Momentum Flux (uflx) Composite Mean
NOAA/ESRL Physical Sciences Division
60N
58N
56N
54N
52N
50N
48N
46N
44N
42N
40N
160E
165E
170E
175E
180
175W
170W
165W
160W
155W
150W
145W
0.1
0
-0.1
-0.2
-0.3
Nov to Dec: 2002 to 2002

Coef. Cor. (0.60-0.85, int.= 0.05) SSH vs along shore wind stress
Nov&Dec-brown lines, Jan&Feb-blue lines, Mar-green lines, Apr-red lines
westward wind stress is positive

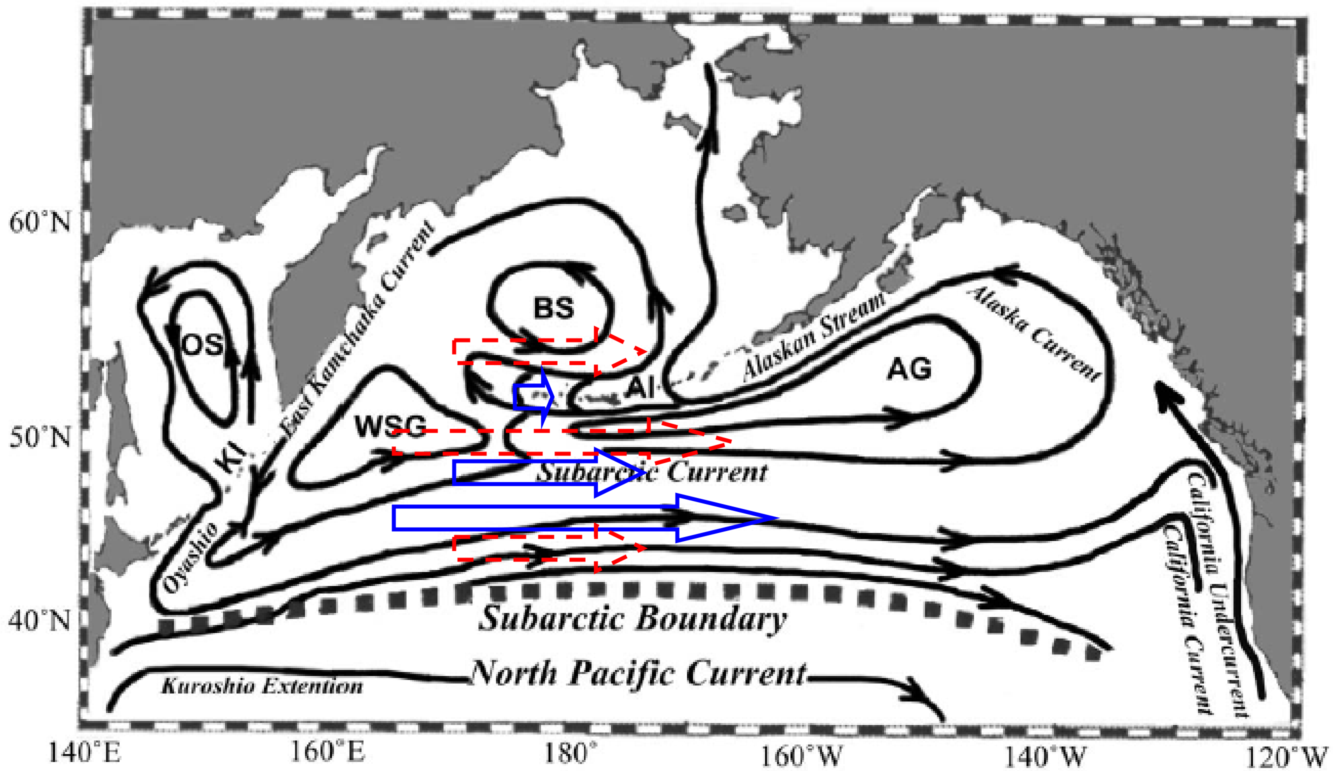



In the **Alaska Current** region, the stronger offshore transport of passive tracers coincides with periods of stronger downwelling which trigger the development of stronger eddies (Combes et al., 2009).

The offshore transport of passive tracers in the **Alaskan Stream** does not correlate neither with a large-scale atmospheric forcing, nor with local winds (Combes et al., 2009).

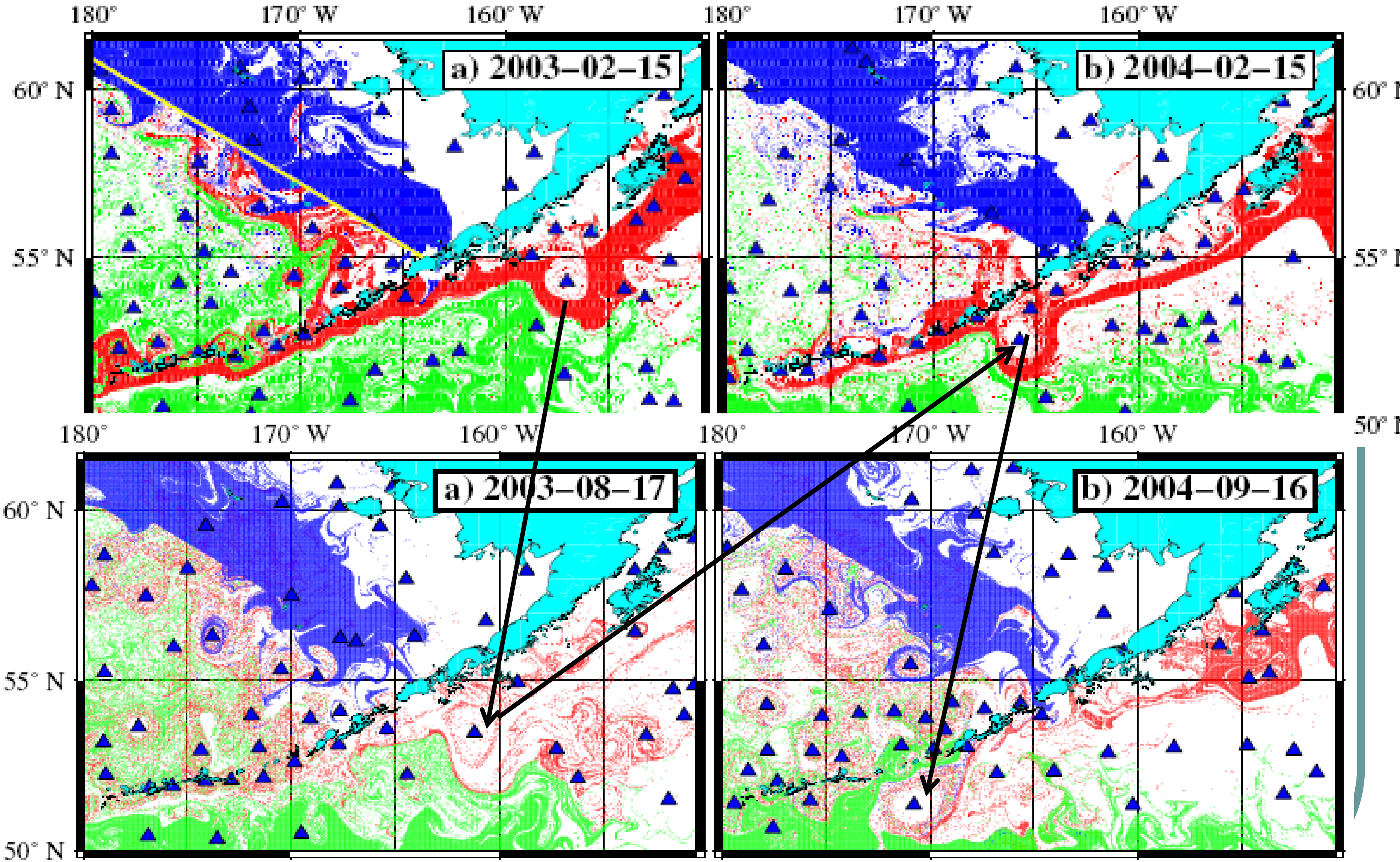


Our results demonstrate that reinforcement of the AS anticyclonic eddies southward of the Alaskan panhandle Peninsula (53 -55°N, 156°W-158°W) occurs during the periods of the increased wind stress curl in the northern North Pacific (46-48°N, 165°E-170°W) in November- March.

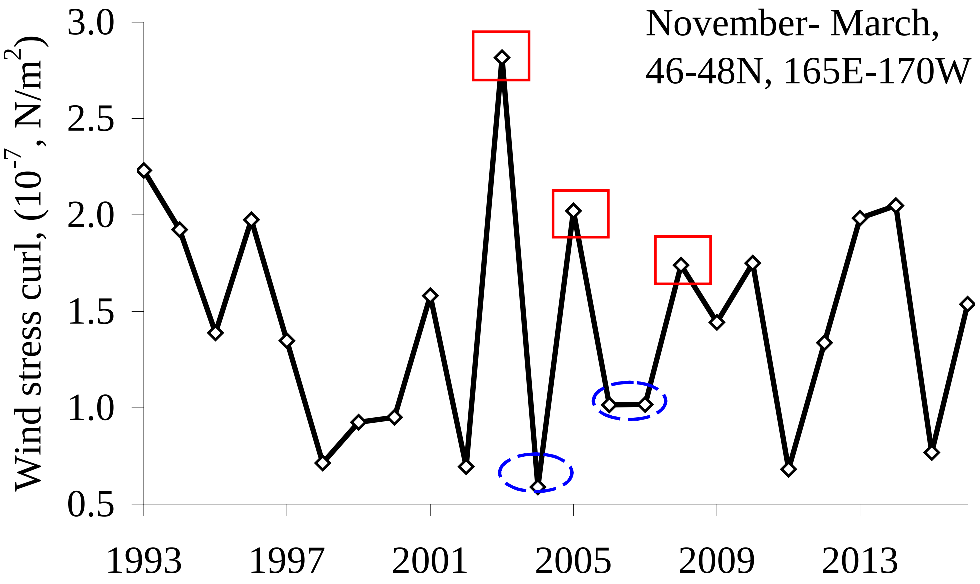



Zonal wind Stress, Nov. 2002 –Mar. 2003

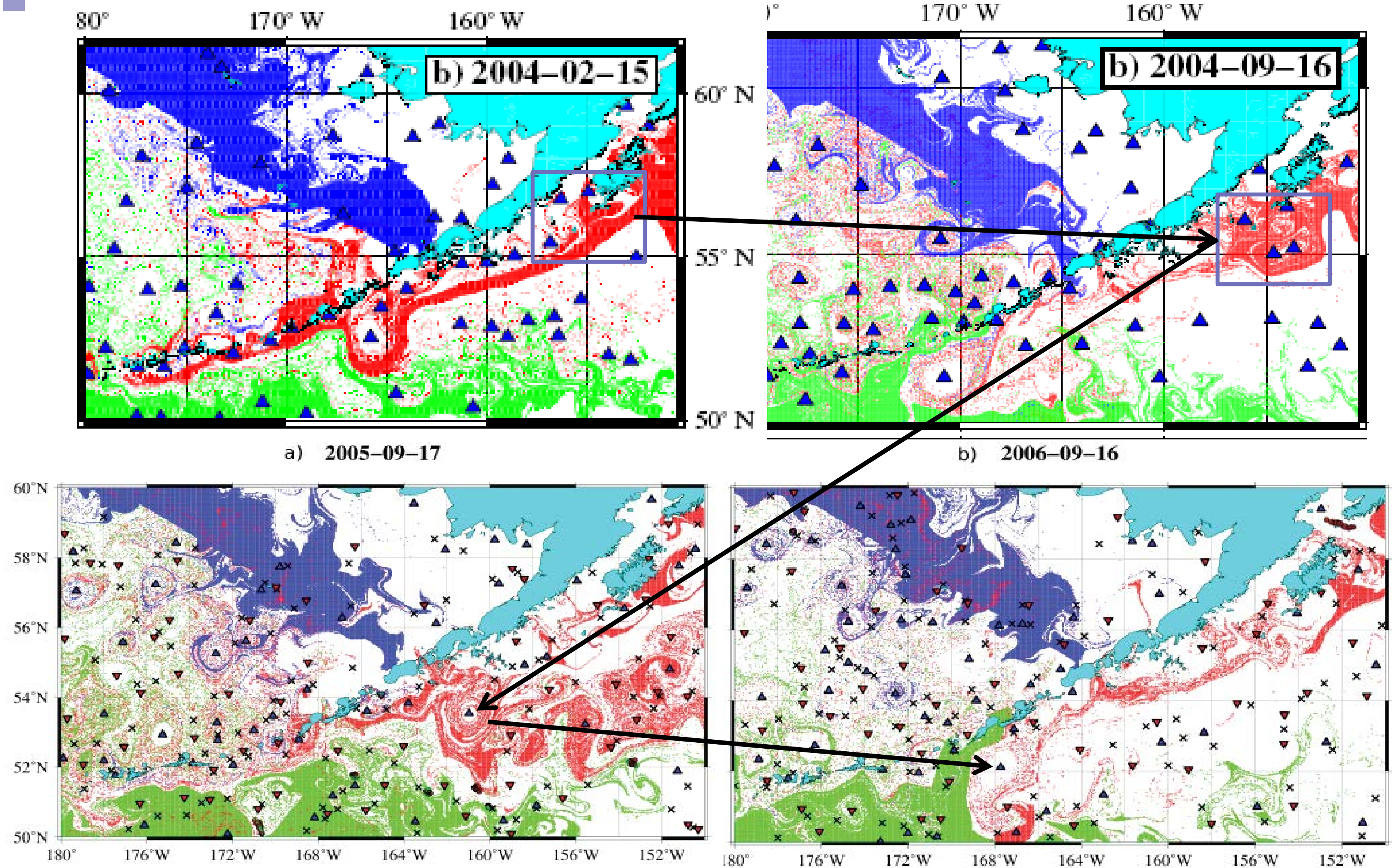
Zonal Wind Stress, Nov. 2003 –Mar. 2004



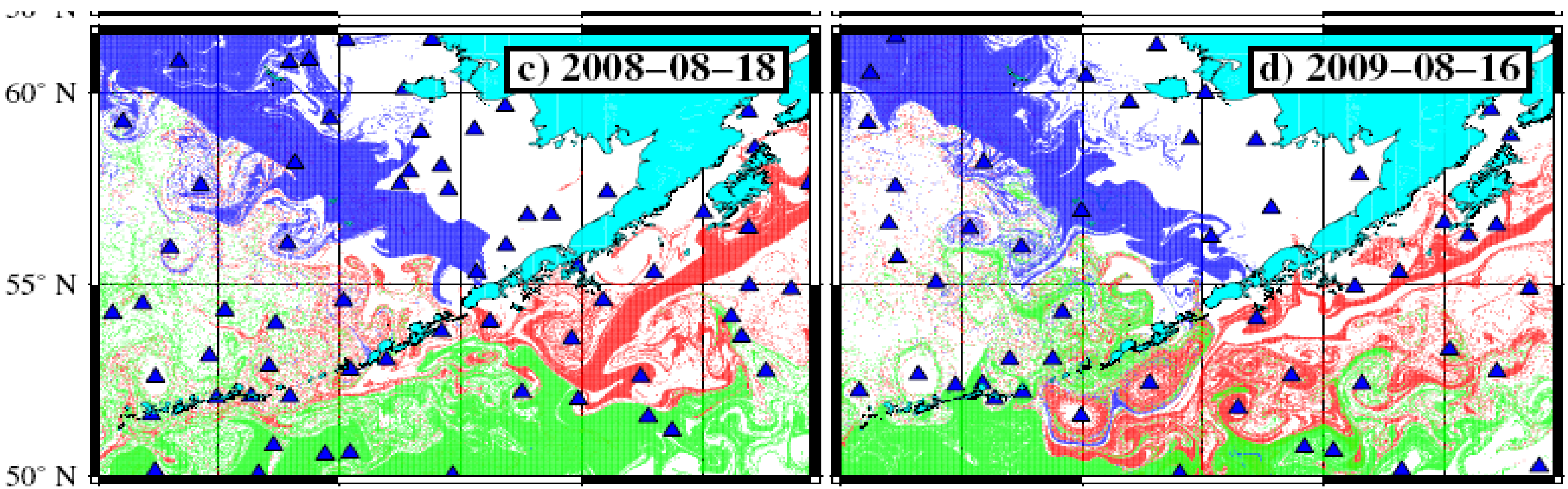
a) 2003–02–15
b) 2004–02–15
a) 2003–08–17
b) 2004–09–16
180°
170° W
160° W
60° N
55° N
50° N

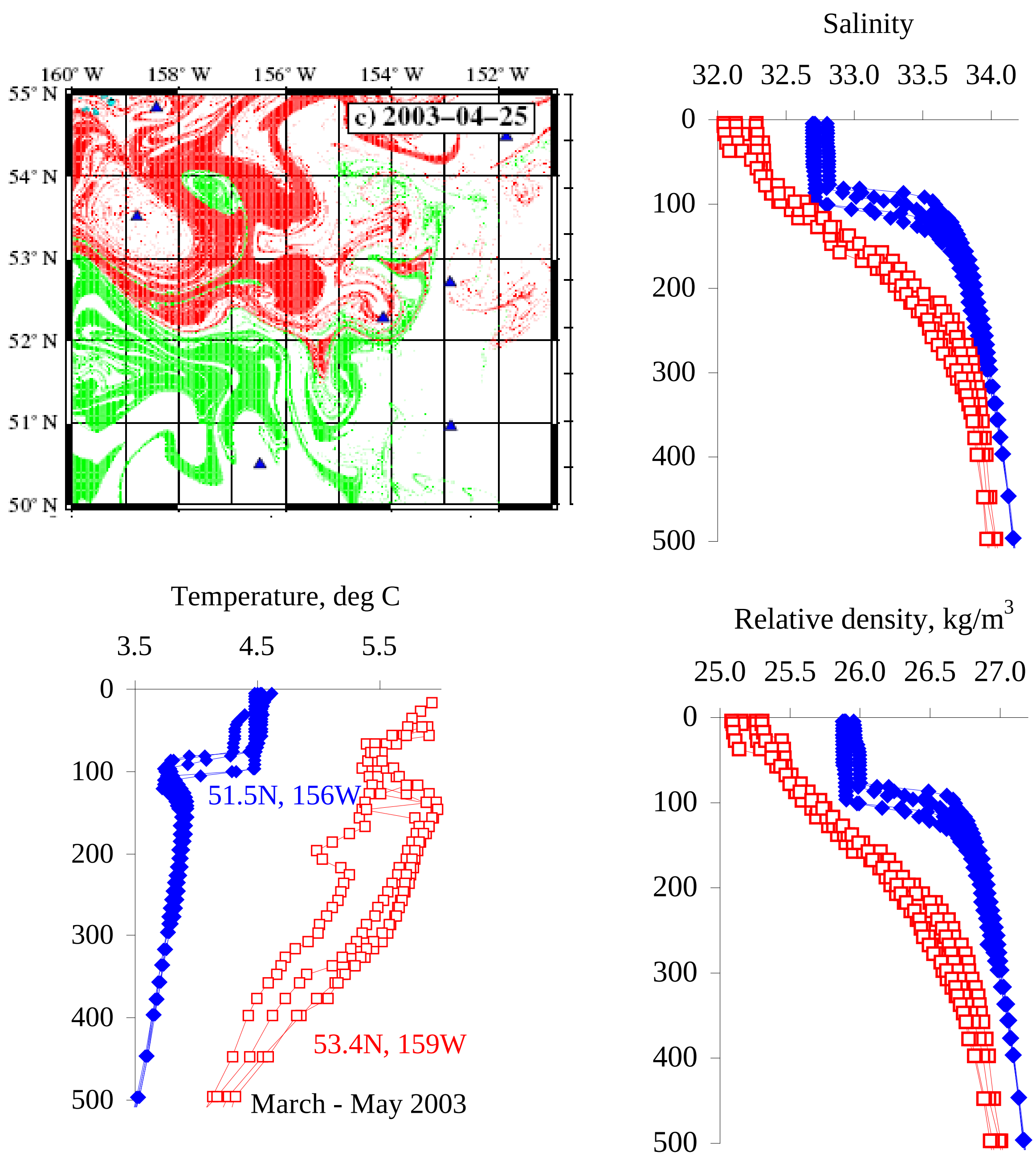


Wind stress curl, ($10^{-7}$, N/$m^2$)
3.0
2.5
2.0
1.5
1.0
0.5
1993
1997
2001
2005
2009
2013
November- March,
46-48N, 165E-170W

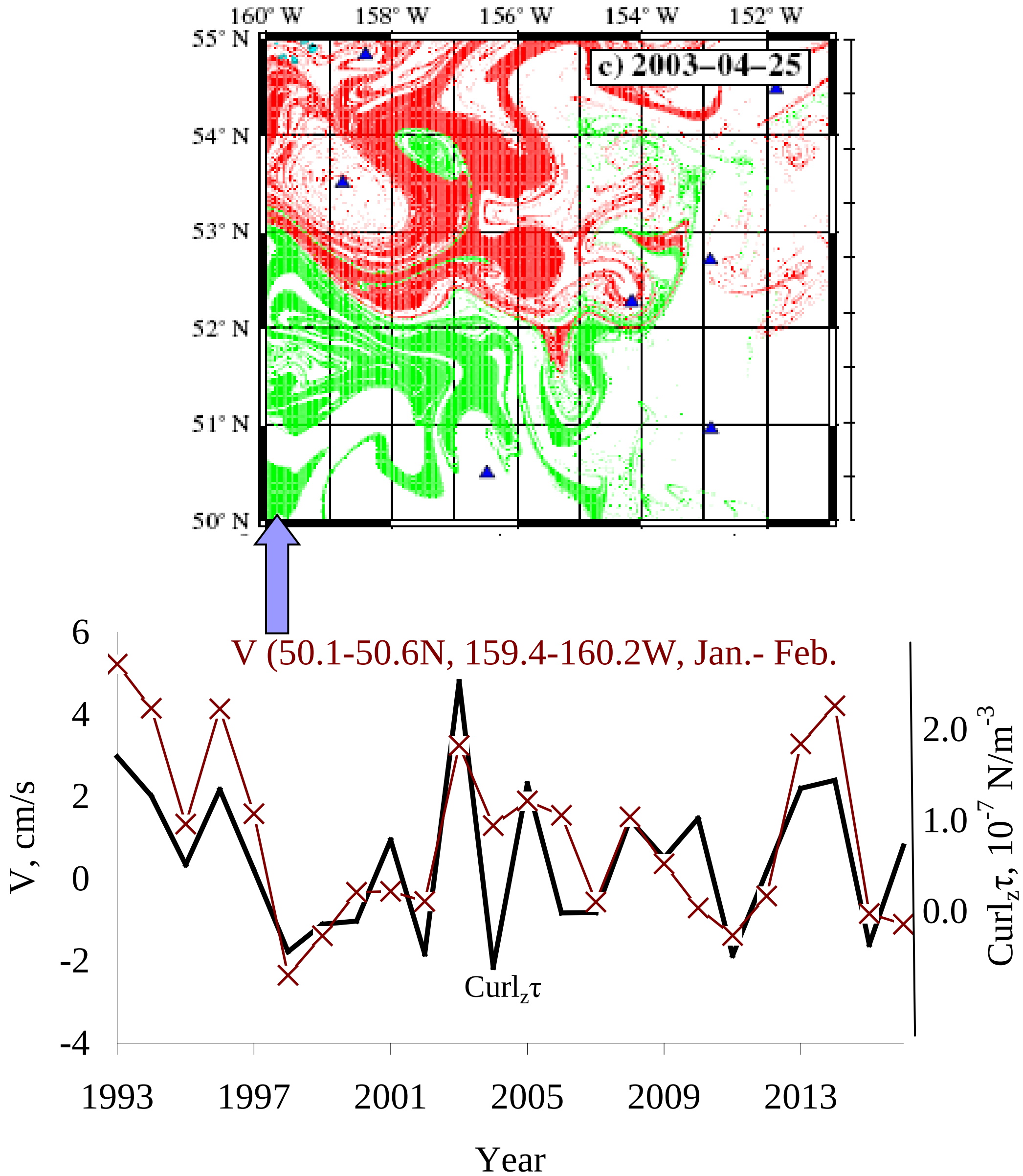


80°
170° W
160° W
b) 2004–02–15
60° N
55° N
50° N
a) 2005–09–17
170° W
160° W
b) 2004–09–16
b) 2006–09–16
60°N
58°N
56°N
54°N
52°N
50°N
180°
176°W
172°W
168°W
164°W
160°W
156°W
152°W

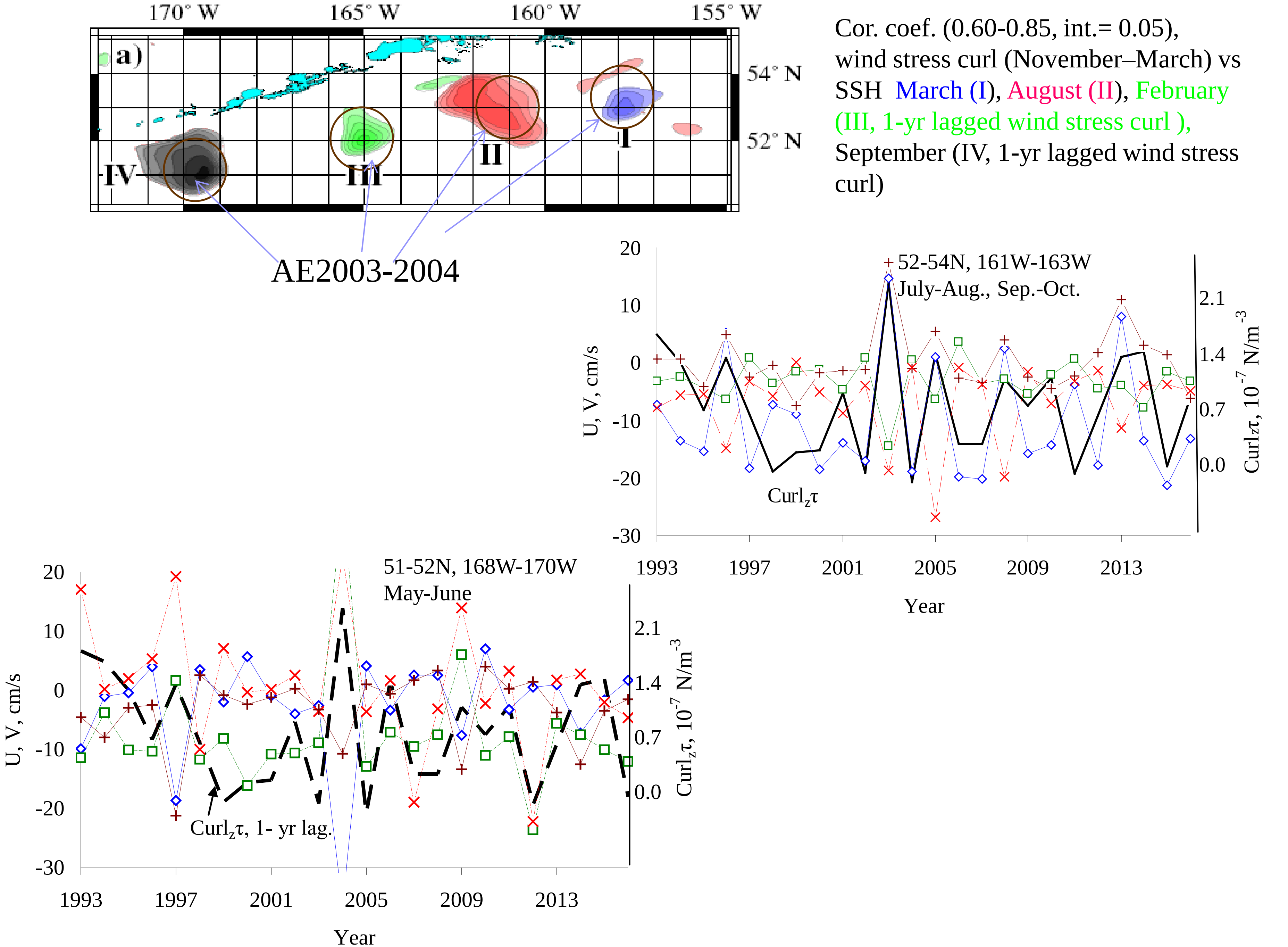

c) 2008–08–18
d) 2009–08–16
60° N
55° N
50° N



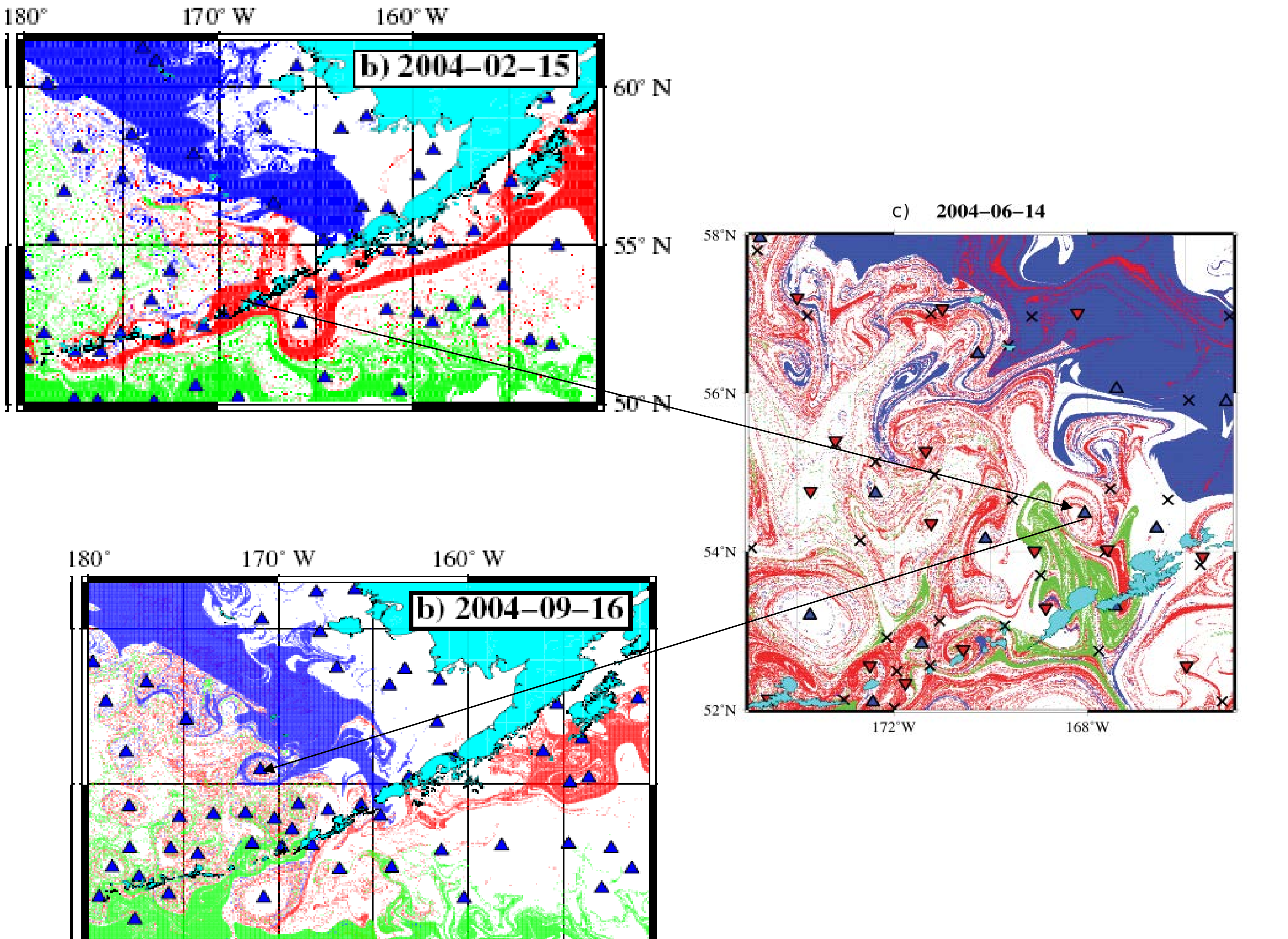
160° W
158° W
156° W
154° W
152° W
55° N
54° N
53° N
52° N
51° N
50° N
c) 2003–04–25
Salinity
32.0
32.5
33.0
33.5
34.0
0
100
200
300
400
500
Temperature, deg C
3.5
4.5
5.5
51.5N, 156W
53.4N, 159W
March - May 2003
Relative density, kg/m3
25.0
25.5
26.0
26.5
27.0

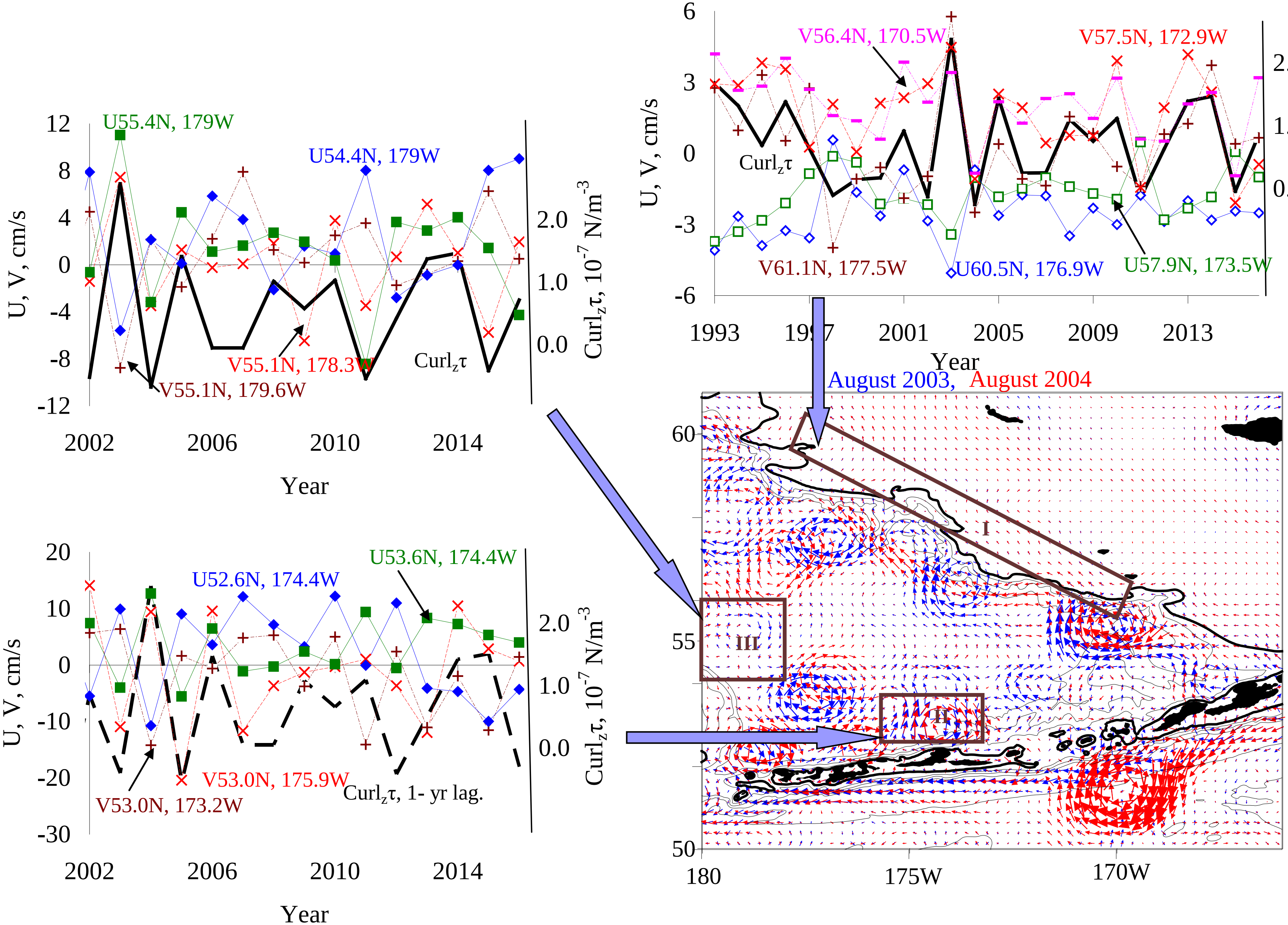


160° W
158° W
156° W
154° W
152° W
55° N
54° N
53° N
52° N
51° N
50° N
c) 2003–04–25
V (50.1-50.6N, 159.4-160.2W, Jan.- Feb.
V, cm/s
6
4
2
0
-2
-4
2.0
1.0
0.0
Curl$_z\tau$, 10$^{-7}$ N/m$^{-3}$
Curl$_z\tau$
1993
1997
2001
2005
2009
2013
Year

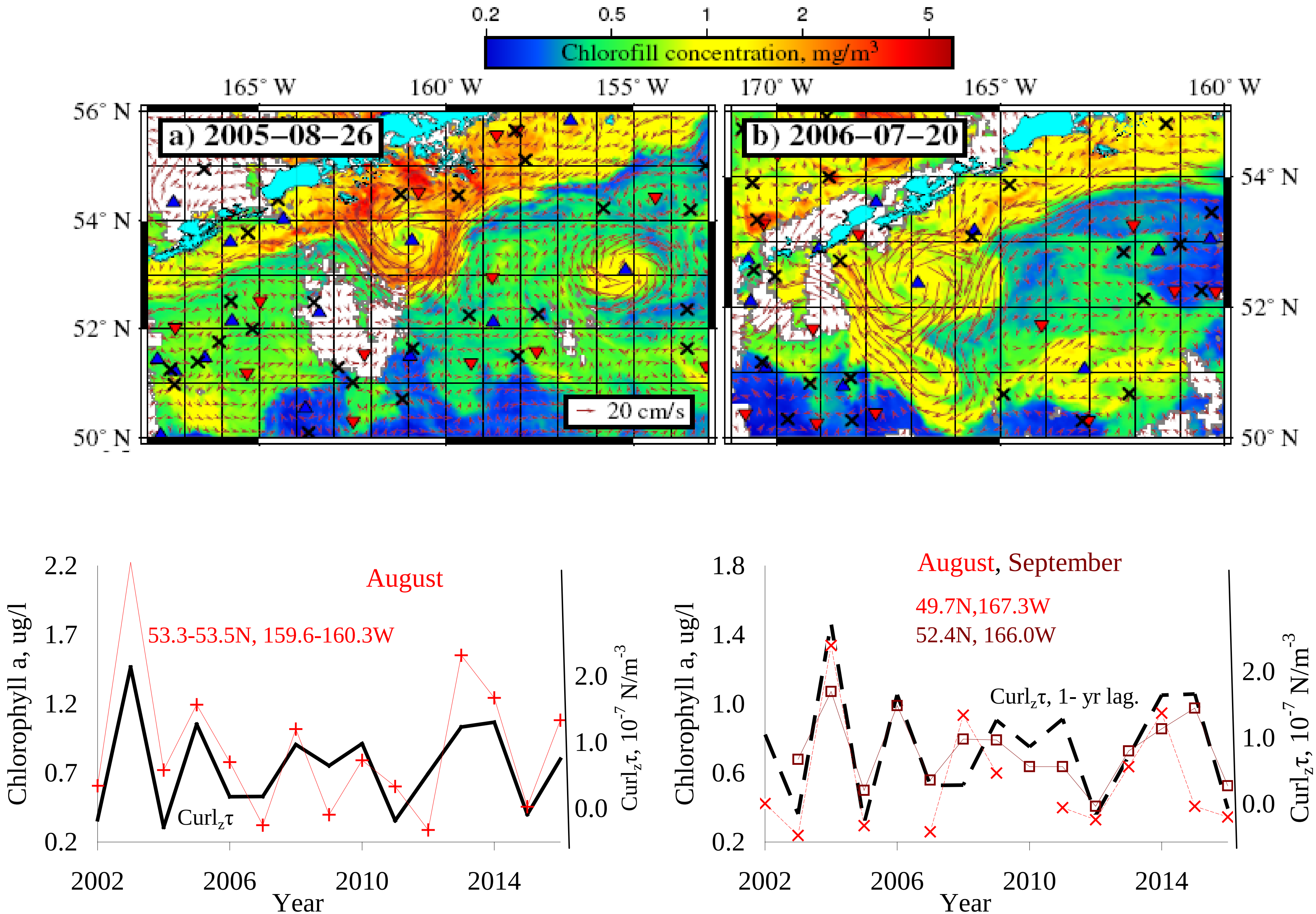


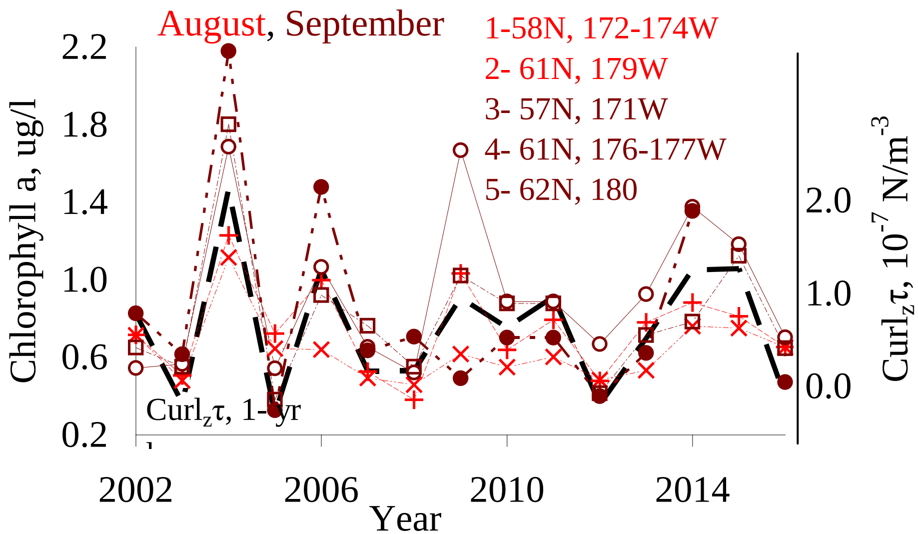
170° W
165° W
160° W
155° W
54° N
52° N
a)
I
II
III
IV
AE2003-2004
Cor. coef. (0.60-0.85, int.= 0.05), wind stress curl (November–March) vs SSH March (I), August (II), February (III, 1-yr lagged wind stress curl ), September (IV, 1-yr lagged wind stress curl)
52-54N, 161W-163W
July-Aug., Sep.-Oct.
Curl$_z\tau$
U, V, cm/s
Curl$_z\tau$, $10^{-7}$ N/m$^{-3}$
Year
51-52N, 168W-170W
May-June
Curl$_z\tau$, 1- yr lag.
U, V, cm/s
Curl$_z\tau$, $10^{-7}$ N/m$^{-3}$
Year

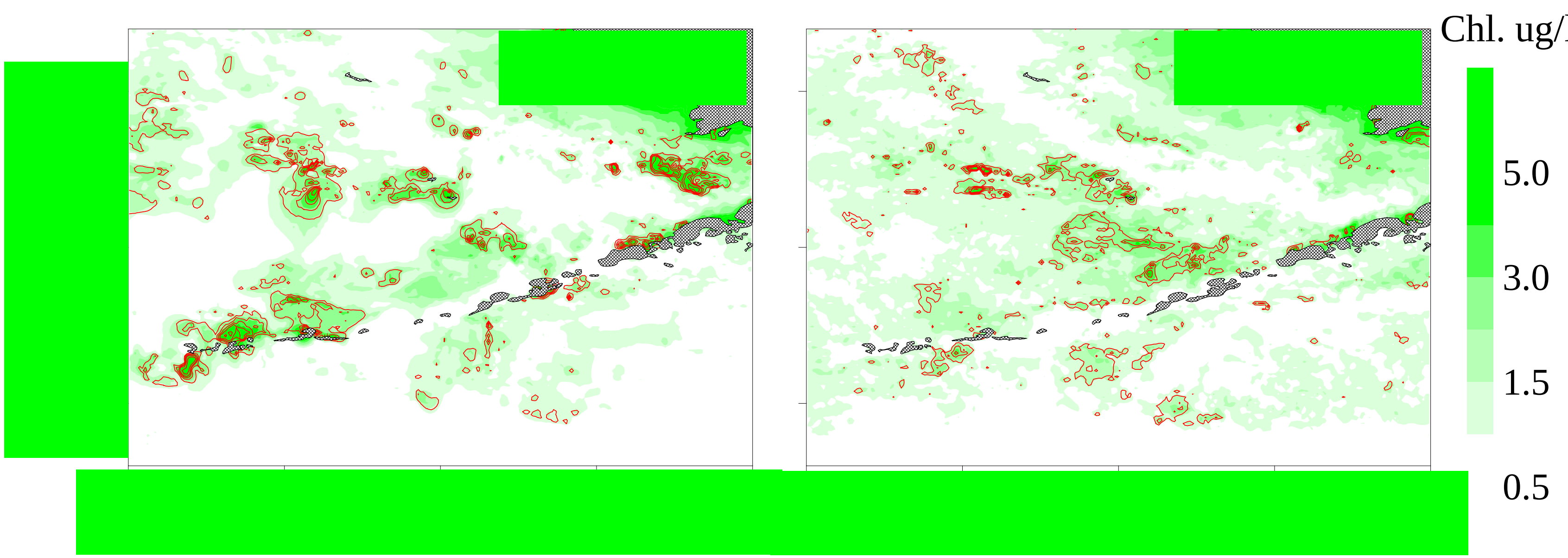

180°
170° W
160° W
b) 2004–02–15
60° N
55° N
50° N
c) 2004–06–14
58°N
56°N
54°N
52°N
172°W
168°W
180°
170° W
160° W
b) 2004–09–16



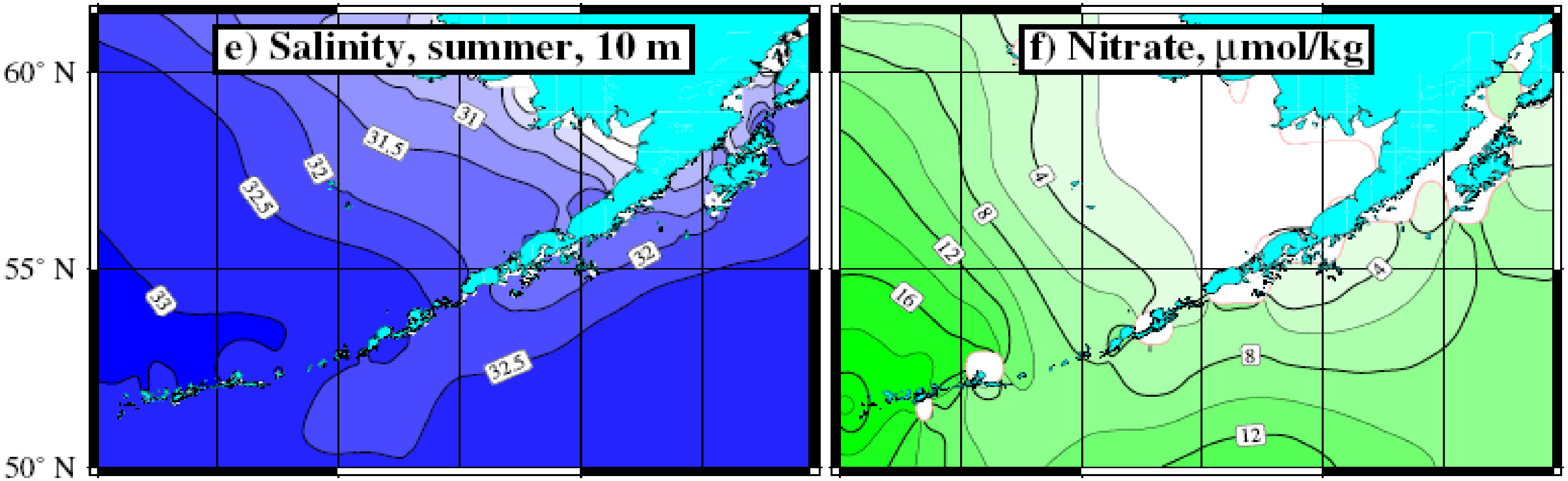
U55.4N, 179W
U54.4N, 179W
V55.1N, 178.3W
V55.1N, 179.6W
Curl$_z\tau$
U, V, cm/s
Curl$_z\tau$, $10^{-7}$ N/m$^{-3}$
Year
U53.6N, 174.4W
U52.6N, 174.4W
V53.0N, 175.9W
V53.0N, 173.2W
Curl$_z\tau$, 1- yr lag.
V56.4N, 170.5W
V57.5N, 172.9W
V61.1N, 177.5W
U60.5N, 176.9W
U57.9N, 173.5W
August 2003, August 2004
I
II
III
180
175W
170W


0.2
0.5
1
2
5
Chlorofill concentration, mg/m3
165° W
160° W
155° W
170° W
165° W
160° W
56° N
54° N
52° N
50° N
a) 2005–08–26
b) 2006–07–20
20 cm/s
Chlorophyll a, ug/l
August
53.3-53.5N, 159.6-160.3W
Curlzτ
Curlzτ, 10-7 N/m-3
Year
2002
2006
2010
2014
August, September
49.7N,167.3W
52.4N, 166.0W
Curlzτ, 1- yr lag.

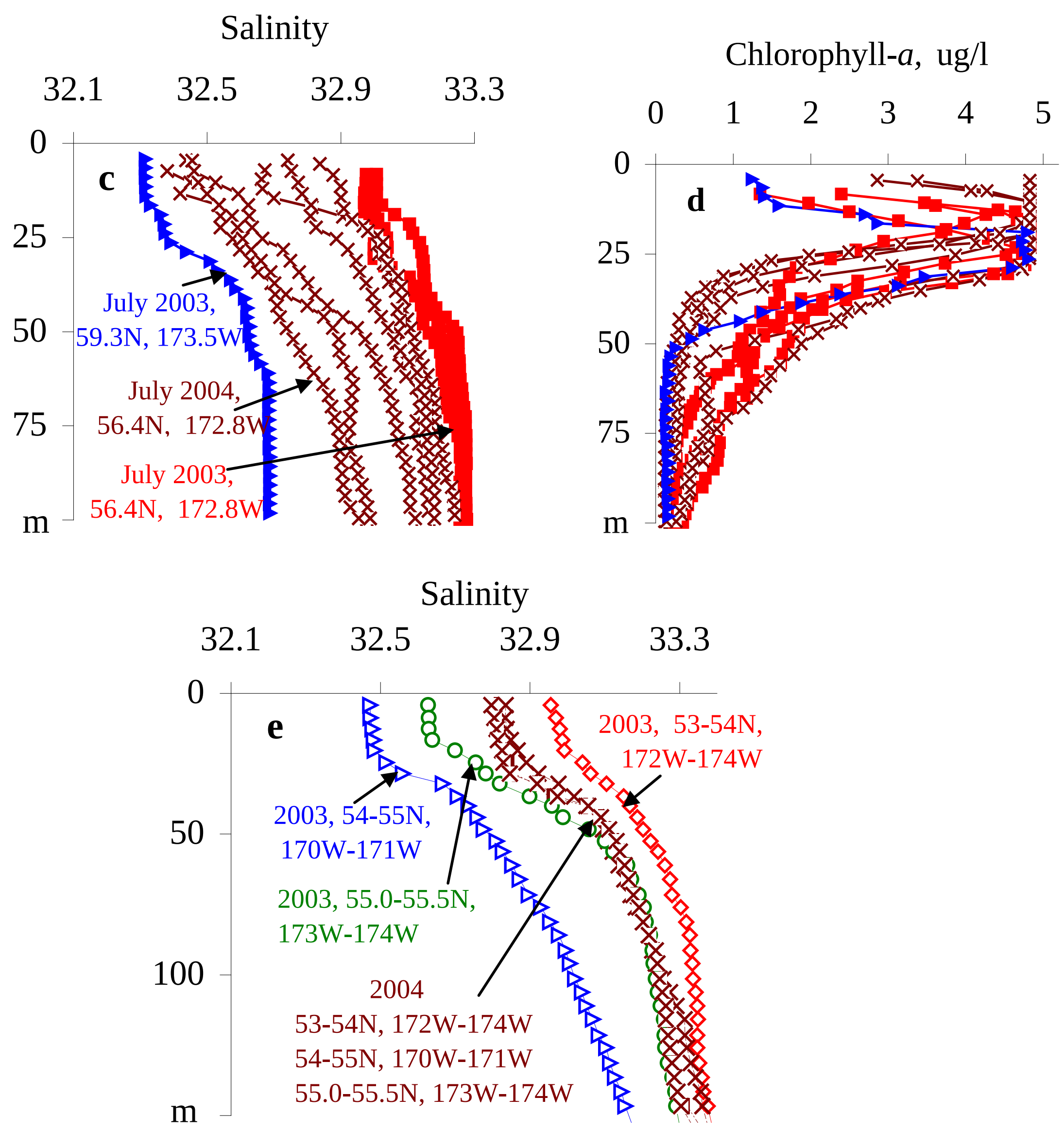


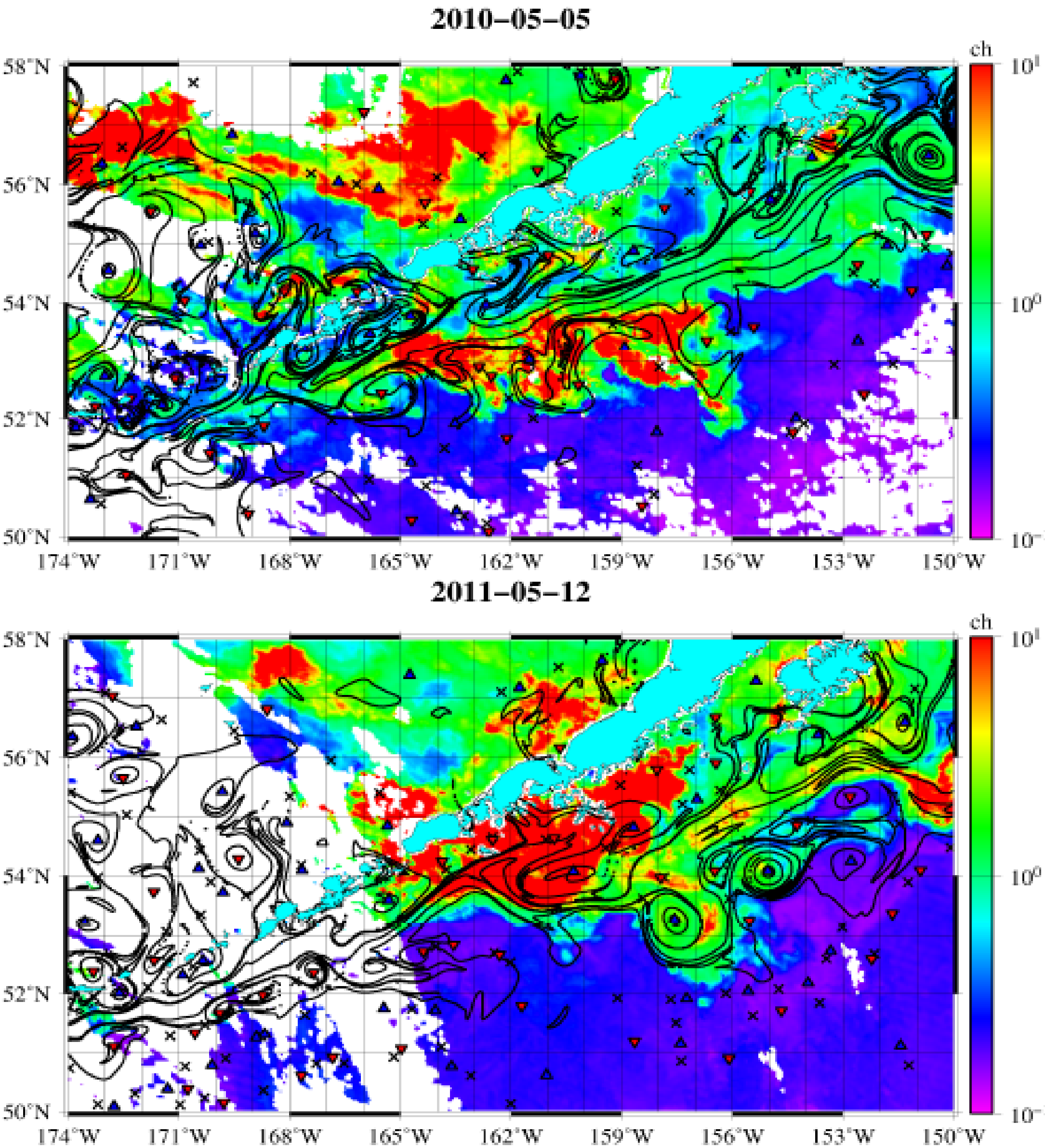



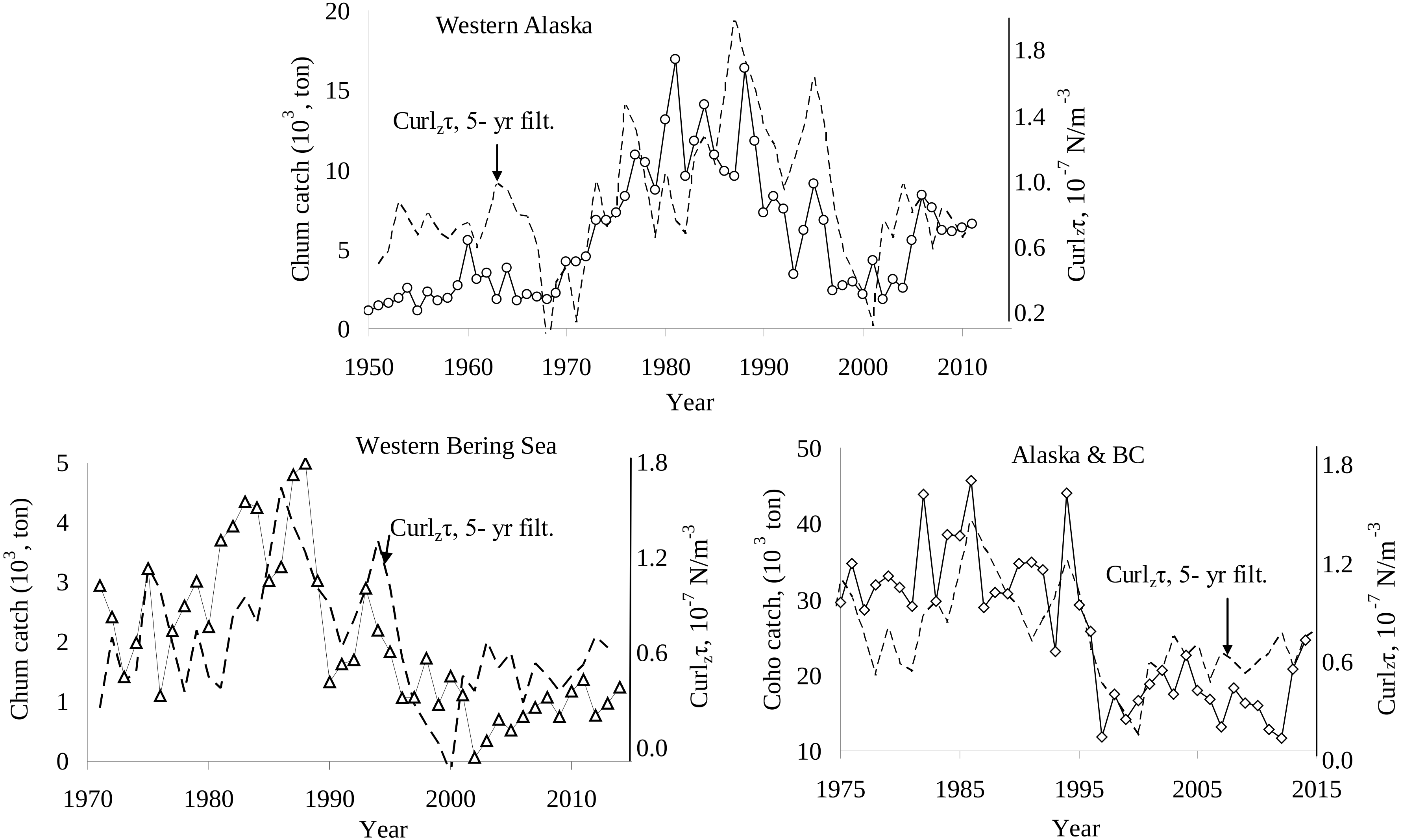

Red lines show the difference between 2004 and 2003, 1-5 ug/l



e) Salinity, summer, 10 m
f) Nitrate, µmol/kg
60° N
55° N
50° N
31
31.5
32
32.5
33
32
32.5
4
8
12
16
4
8
12


Salinity
32.1
32.5
32.9
33.3
0
25
50
75
m
c
July 2003,
59.3N, 173.5W
July 2004,
56.4N, 172.8W
July 2003,
56.4N, 172.8W
Chlorophyll-a, ug/l
0
1
2
3
4
5
0
25
50
75
m
d
Salinity
32.1
32.5
32.9
33.3
0
50
100
m
e
2003, 53-54N,
172W-174W
2003, 54-55N,
170W-171W
2003, 55.0-55.5N,
173W-174W
2004
53-54N, 172W-174W
54-55N, 170W-171W
55.0-55.5N, 173W-174W


2010−05−05
58°N
56°N
54°N
52°N
50°N
174°W
171°W
168°W
165°W
162°W
159°W
156°W
153°W
150°W
ch
$10^{1}$
$10^{0}$
$10^{-1}$
2011−05−12
58°N
56°N
54°N
52°N
50°N
174°W
171°W
168°W
165°W
162°W
159°W
156°W
153°W
150°W
ch
$10^{1}$
$10^{0}$
$10^{-1}$



Western Alaska
Chum catch (10^3, ton)
Curl_zτ, 5- yr filt.
Curlzτ, 10^-7 N/m^-3
Year
Western Bering Sea
Chum catch (10^3, ton)
Curl_zτ, 5- yr filt.
Curl_zτ, 10^-7 N/m^-3
Year
Alaska & BC
Coho catch, (10^3 ton)
Curl_zτ, 5- yr filt.
Curlzτ, 10^-7 N/m^-3
Year

# Summary

A mesoscale eddy activity along the shelf–deep basin boundaries in the Alaskan Stream region and the eastern Bering Sea is shown to be related with the wind stress curl in the northern North Pacific in winter. A significant correlation is found between the concentration of chlorophyll a in the Alaskan Stream area and eastern Bering Sea in August–September and the wind stress curl in the northern North Pacific in November–March. The mesoscale dynamics, forced by wind stress curl in winter, may determine not only lower-trophic-level organism biomass but also salmon abundance/catch in the study area.