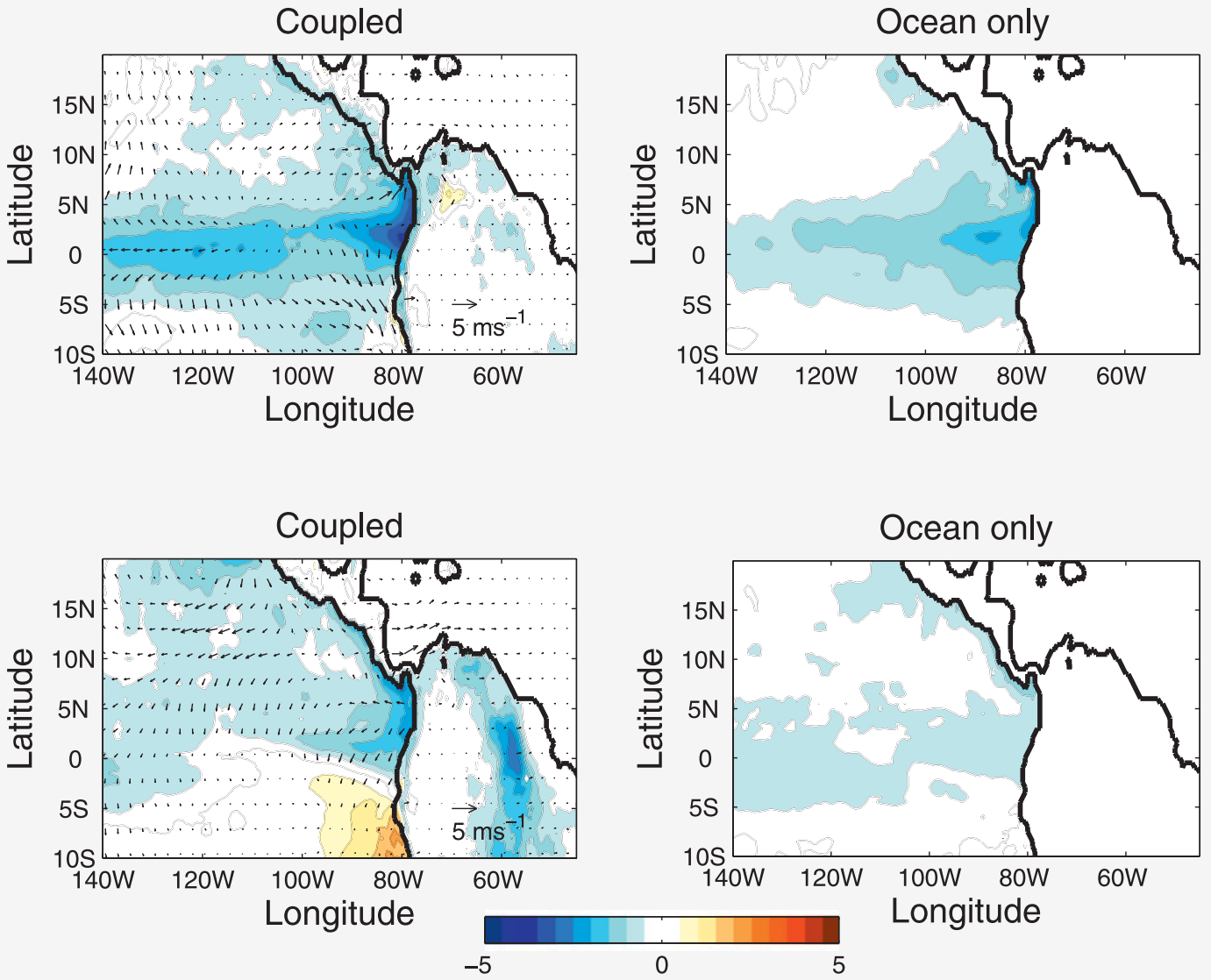
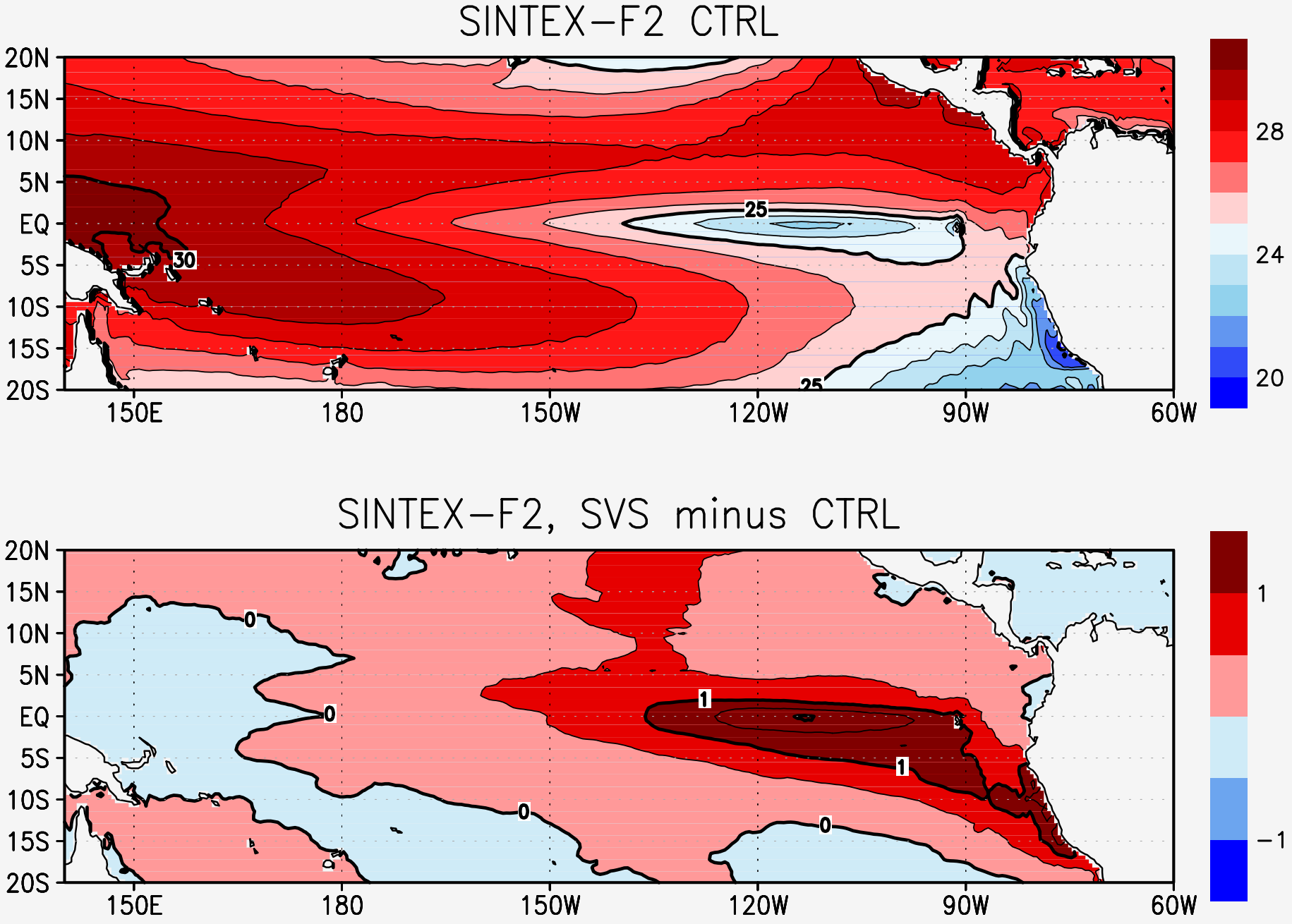
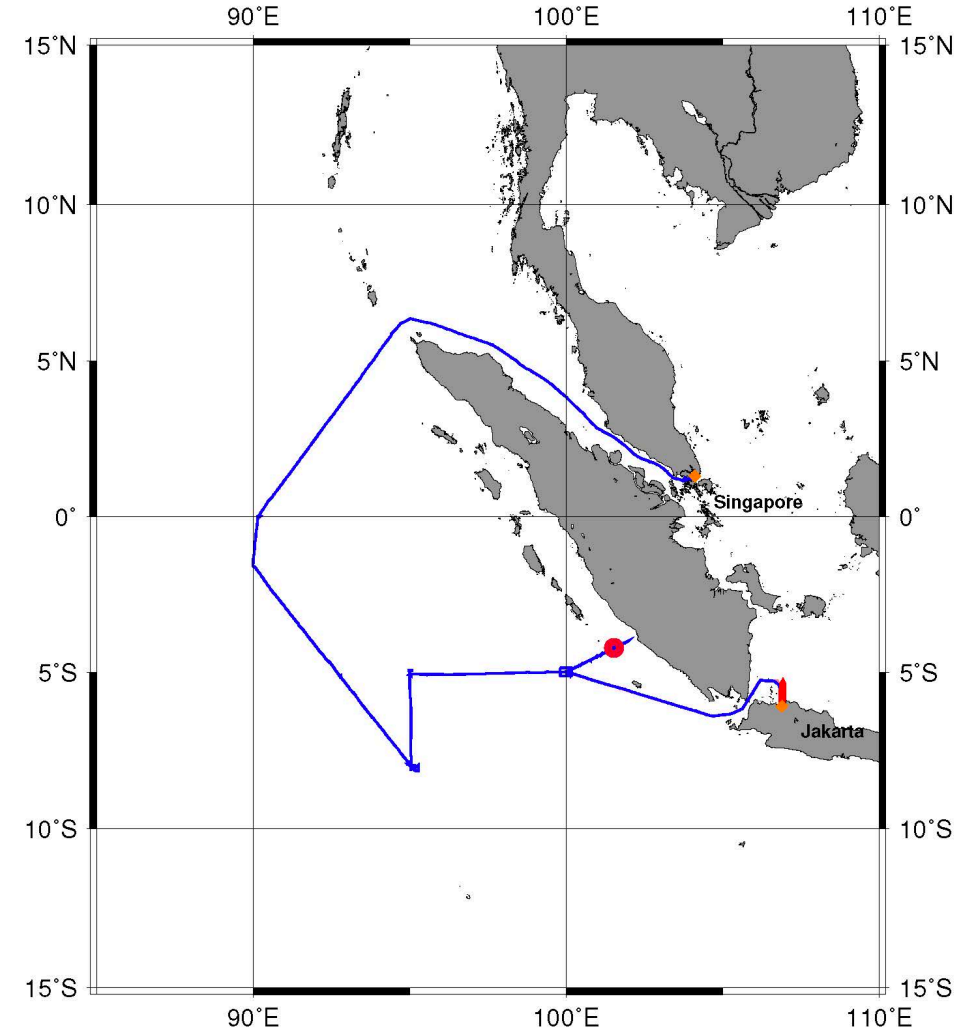
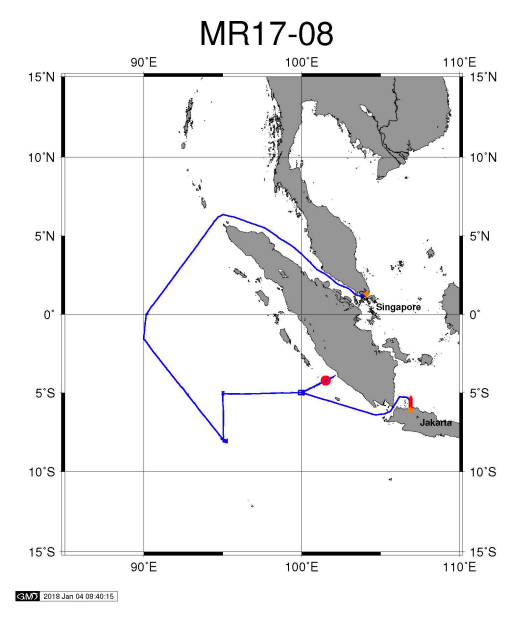


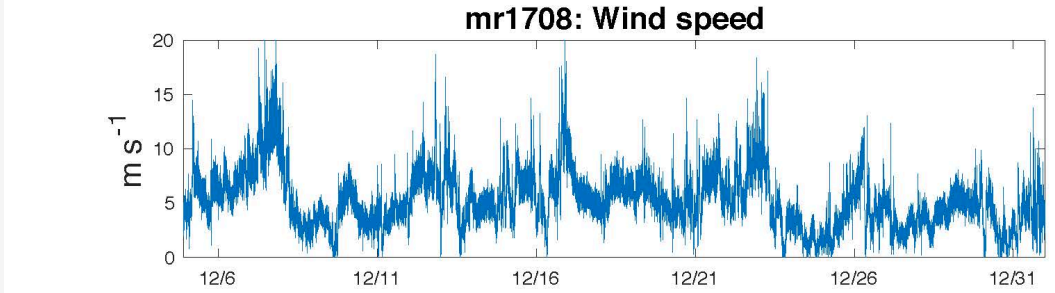
FIG. 6. Differences in surface properties between the HIGH and LOW runs: surface temperature (color; contour interval of 0.5°C) and near-surface winds (vectors) for (top) March and (bottom) October climatologies in the (left) fully coupled and the (right) ocean-only experiments.

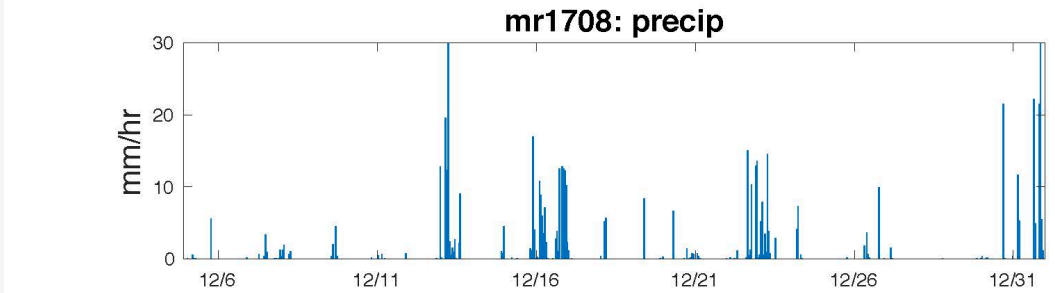

SINTEX–F2 CTRL
20N
15N
10N
5N
EQ
5S
10S
15S
20S
150E
180
150W
120W
90W
60W
30
25
25
28
24
20
SINTEX–F2, SVS minus CTRL
0
0
0
0
1
1
1
−1

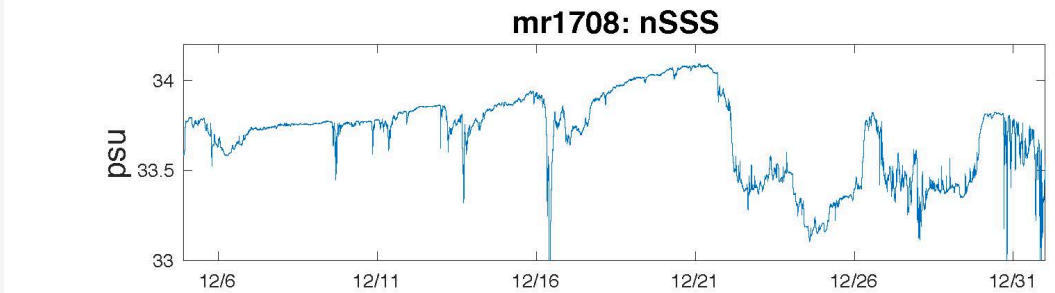
MR17-08

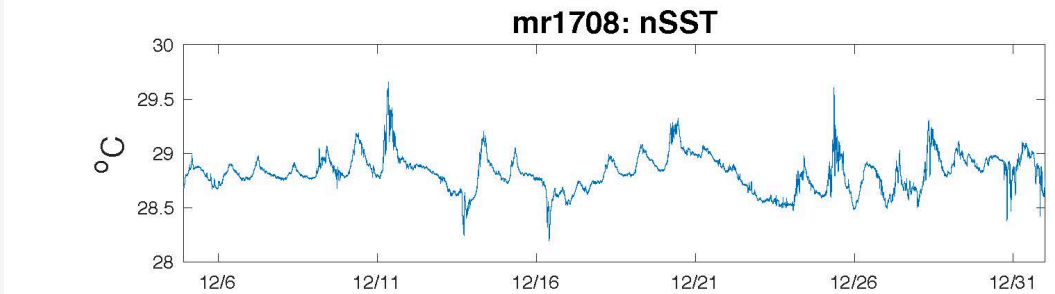

90˚E
100˚E
110˚E
15˚N
10˚N
5˚N
0˚
5˚S
10˚S
15˚S
Singapore
Jakarta
2018 Jan 04 08:40:15

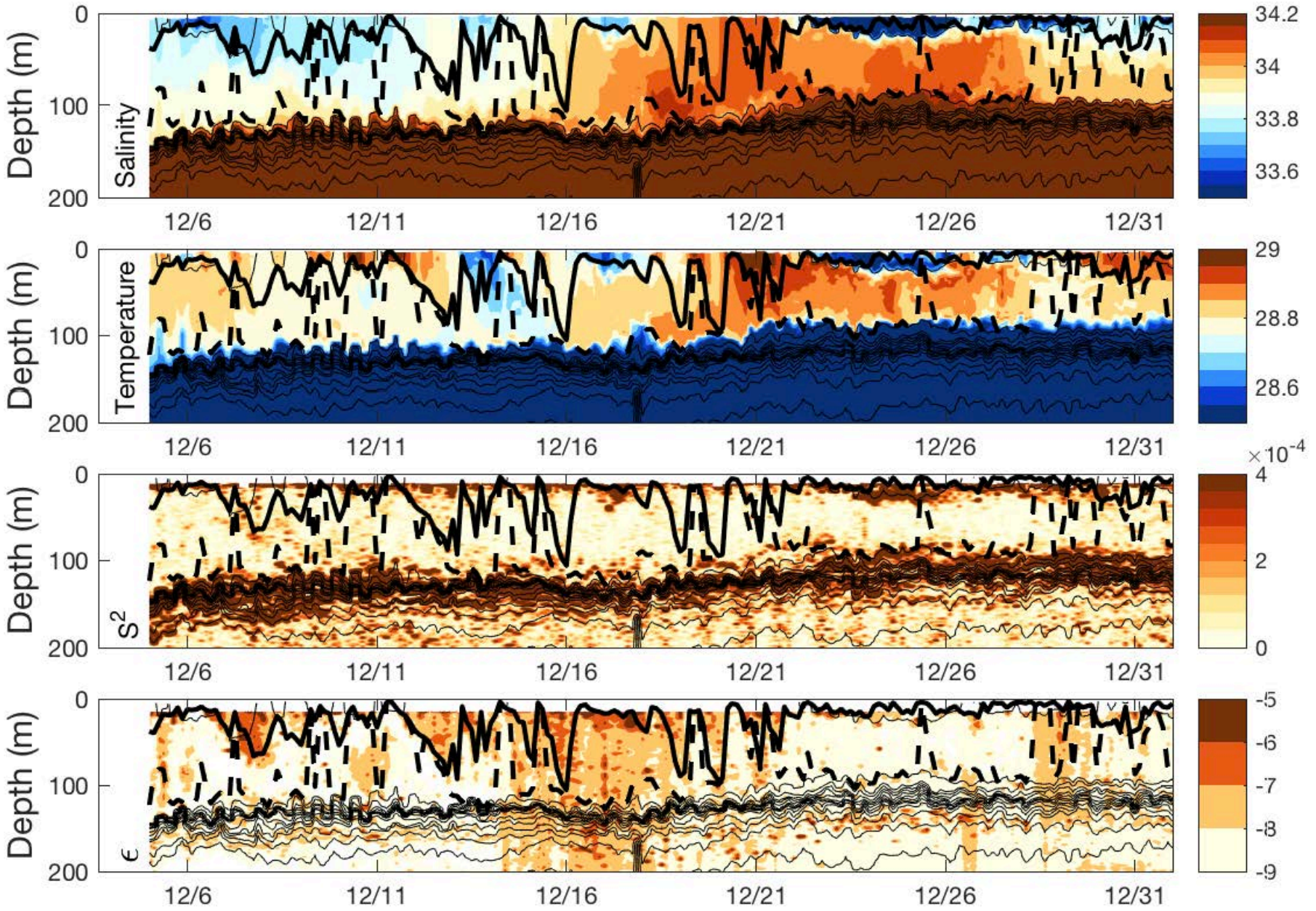

MR17-08
90°E
100°E
110°E
15°N
10°N
5°N
0°
5°S
10°S
15°S
Singapore
Jakarta
2018 Jan 04 08:40:15

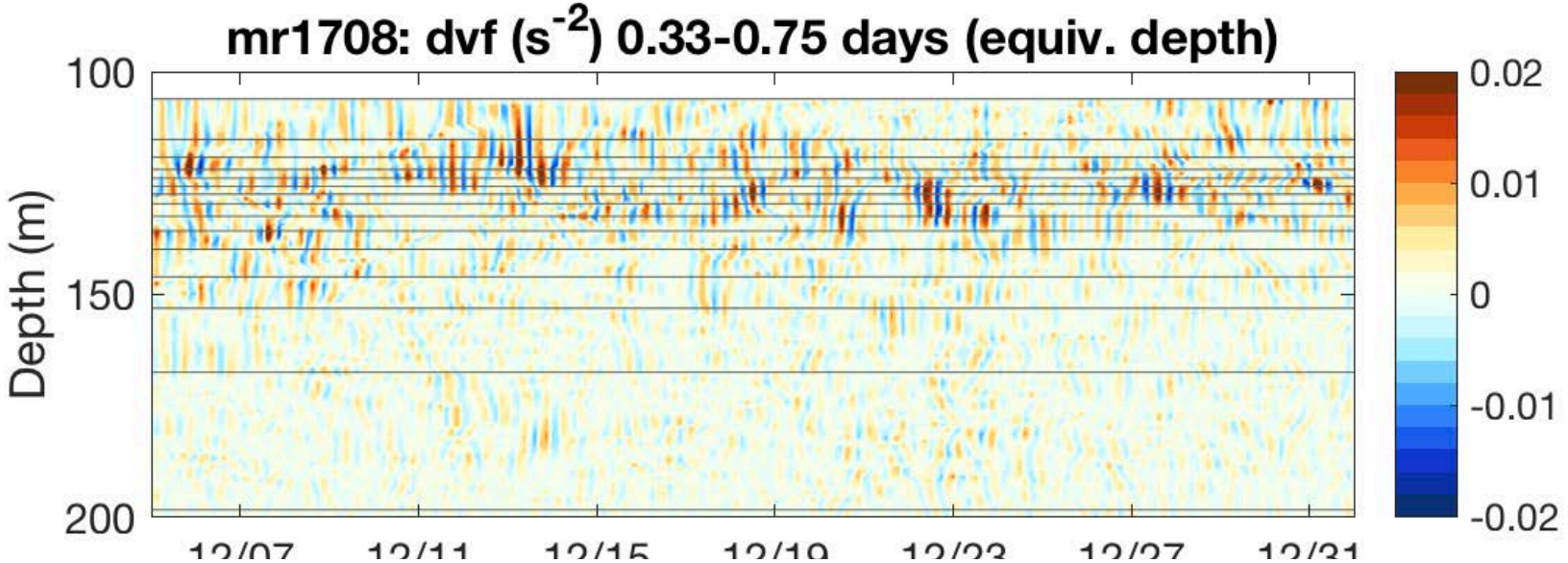

mr1708: Wind speed
m s-1
20
15
10
5
0
12/6
12/11
12/16
12/21
12/26
12/31


mr1708: precip
mm/hr
30
20
10
0
12/6
12/11
12/16
12/21
12/26
12/31


mr1708: nSSS
psu
34
33.5
33
12/6
12/11
12/16
12/21
12/26
12/31

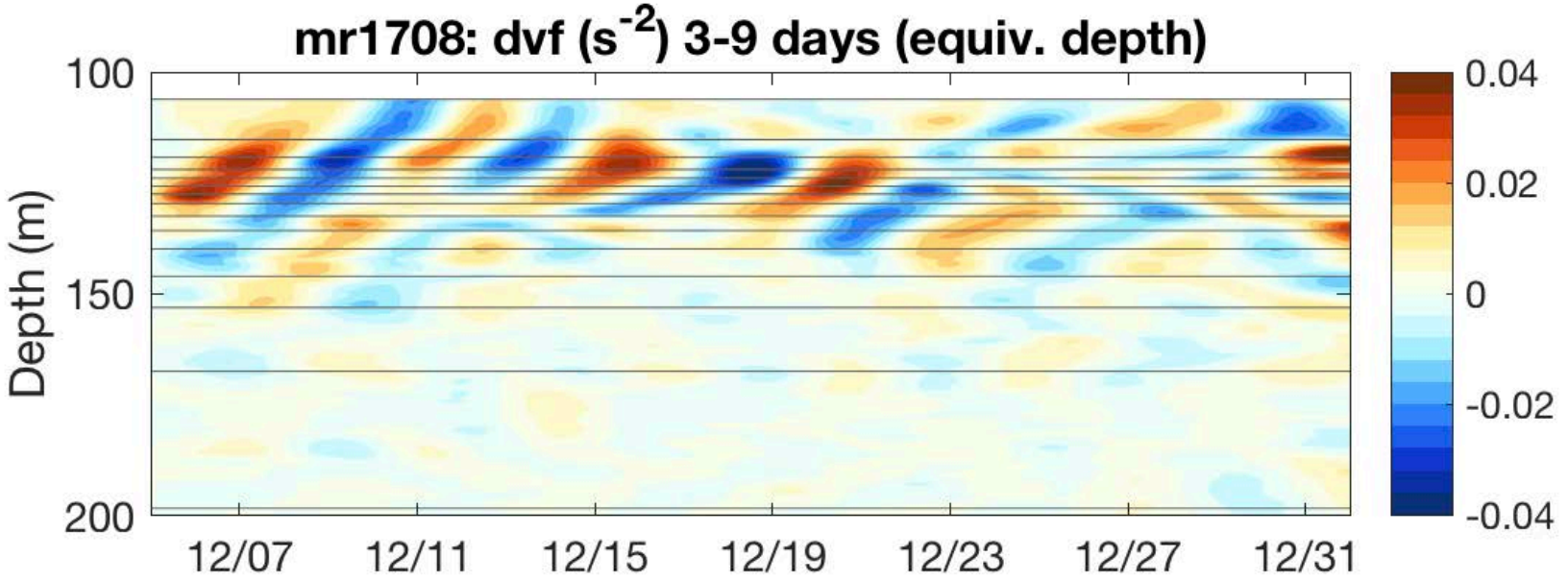

mr1708: nSST
°C
30
29.5
29
28.5
28
12/6
12/11
12/16
12/21
12/26
12/31


Depth (m)
0
100
200
Salinity
34.2
34
33.8
33.6
12/6
12/11
12/16
12/21
12/26
12/31
Temperature
29
28.8
28.6
S^2
$\times 10^{-4}$
4
2
0
ϵ
-5
-6
-7
-8
-9



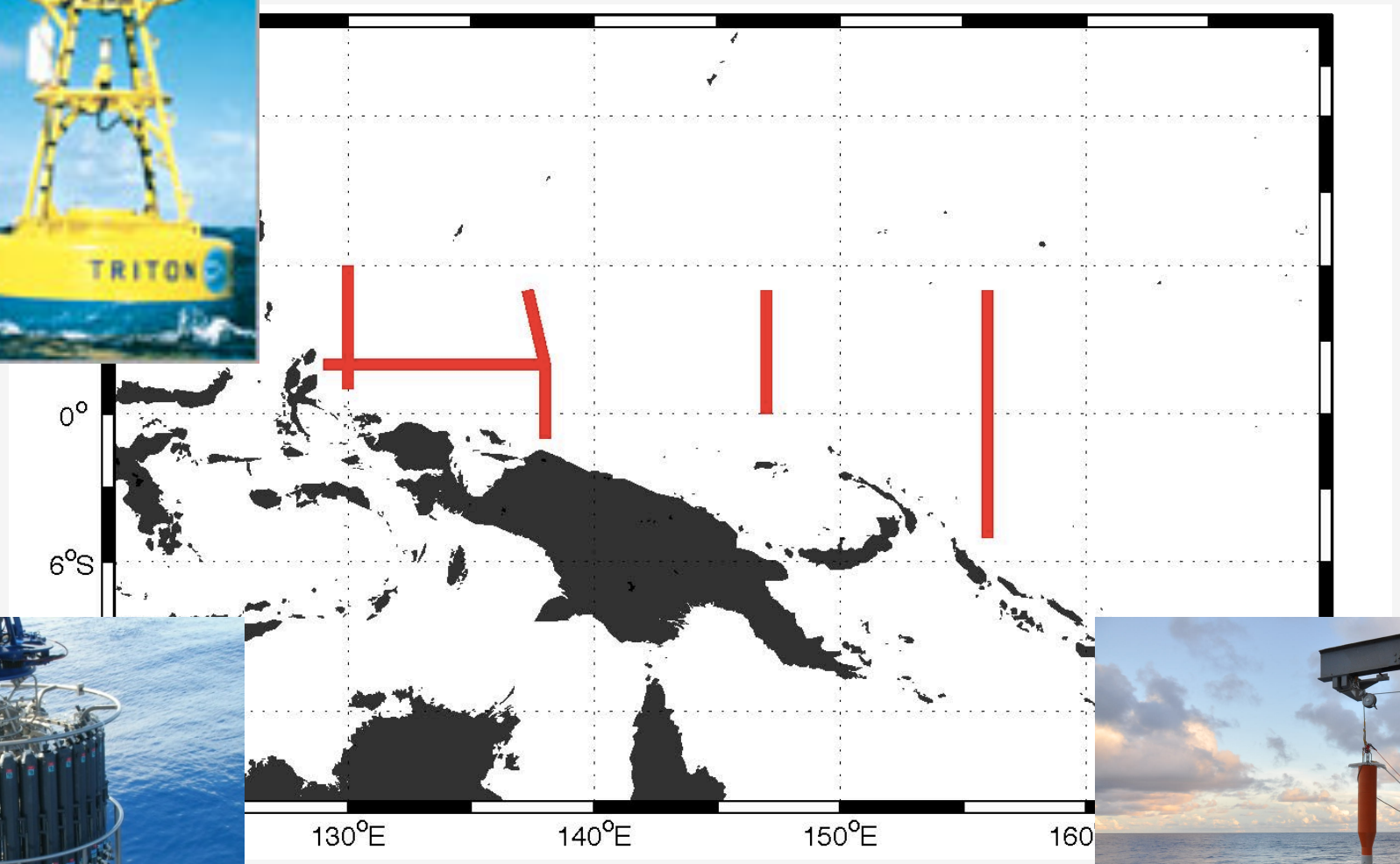
∂v/∂z

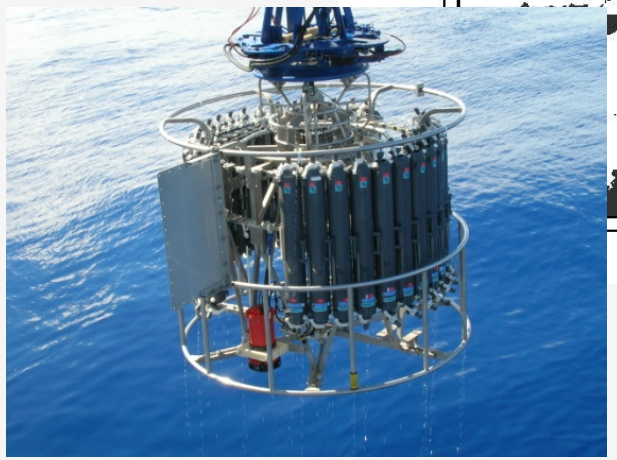
Tide

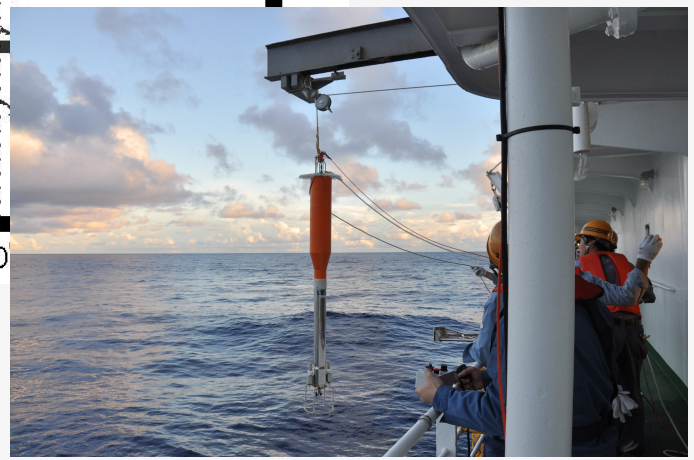


Inertia gravity wave

TRITON


0°
6°S
130°E
140°E
150°E
160

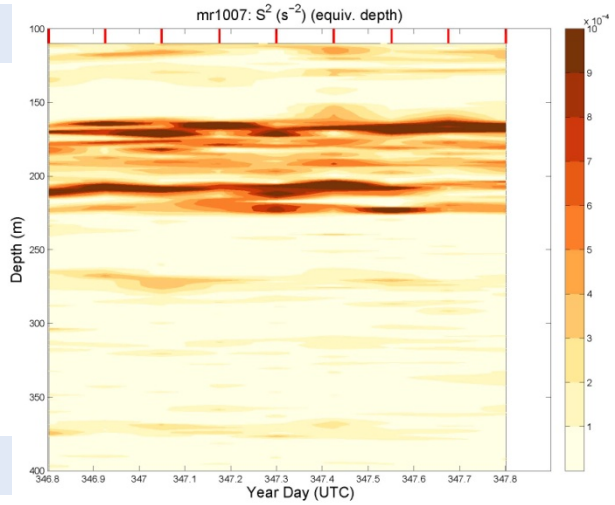




Eq, 156E

S^2

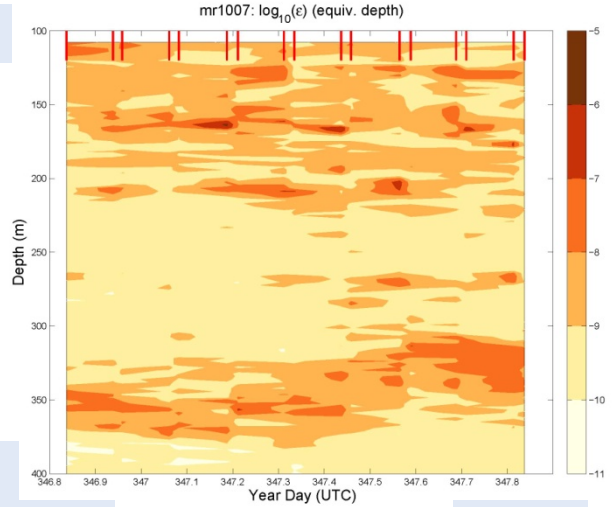
100m



400m

log(ε)

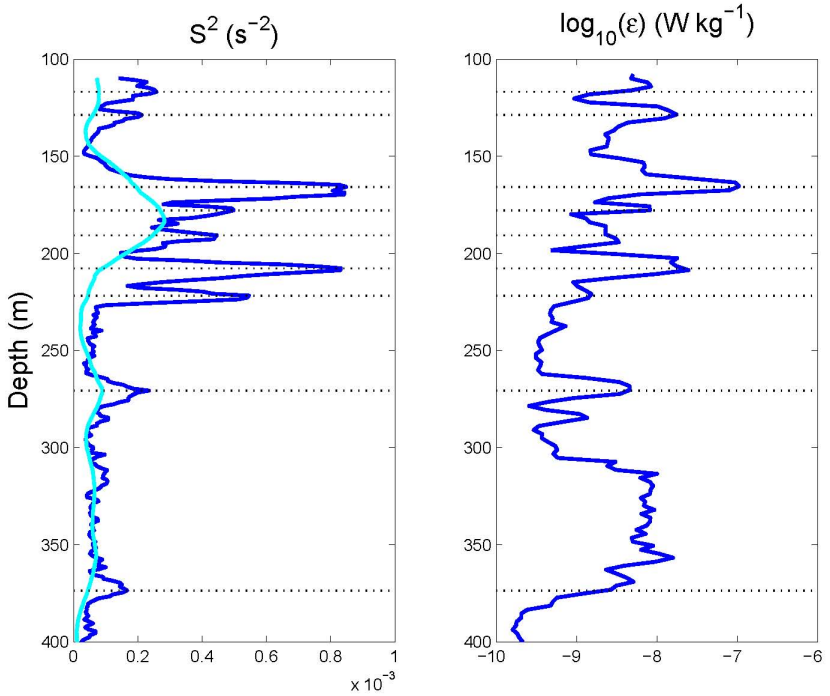
100m



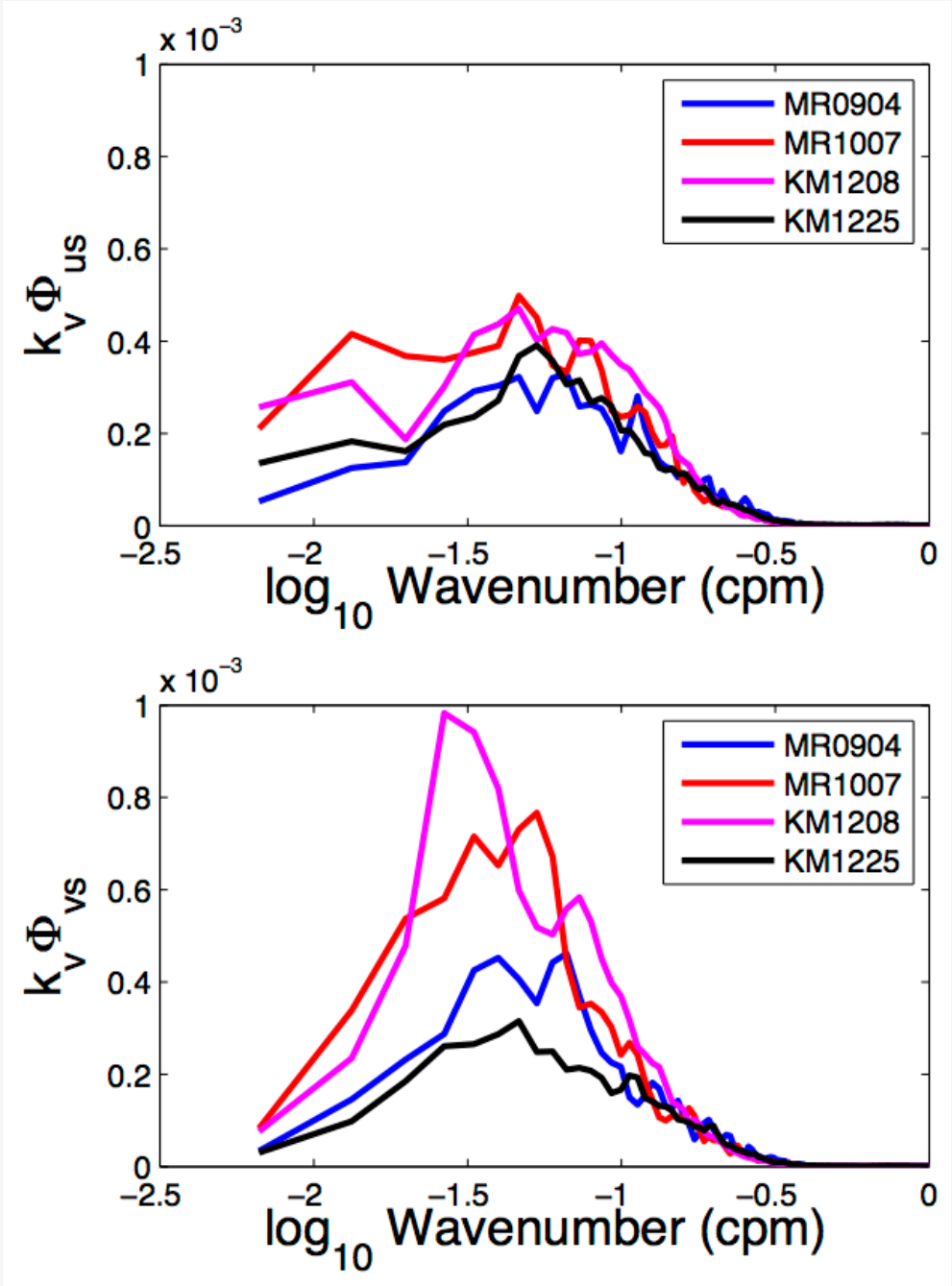
400m

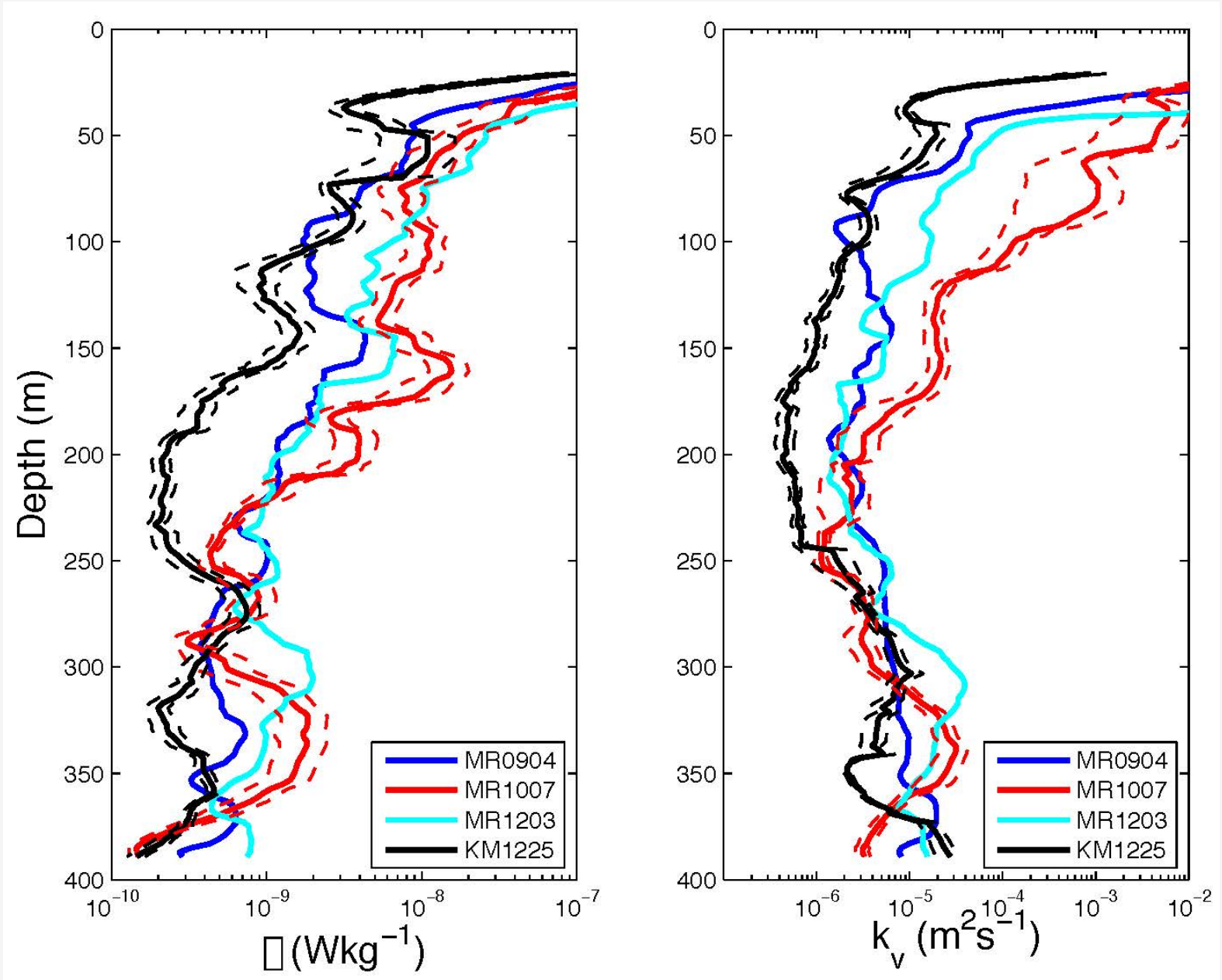
6am

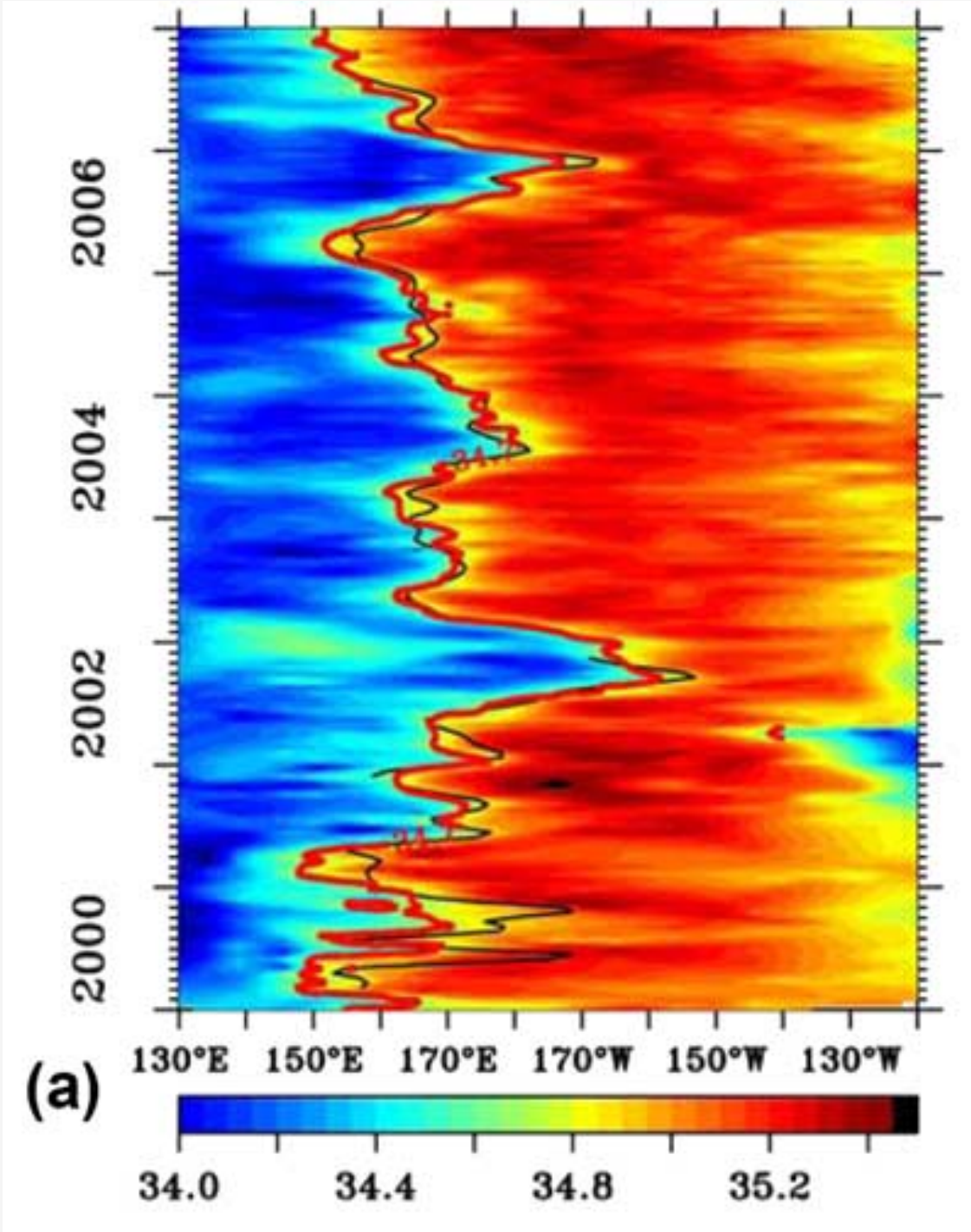
6am

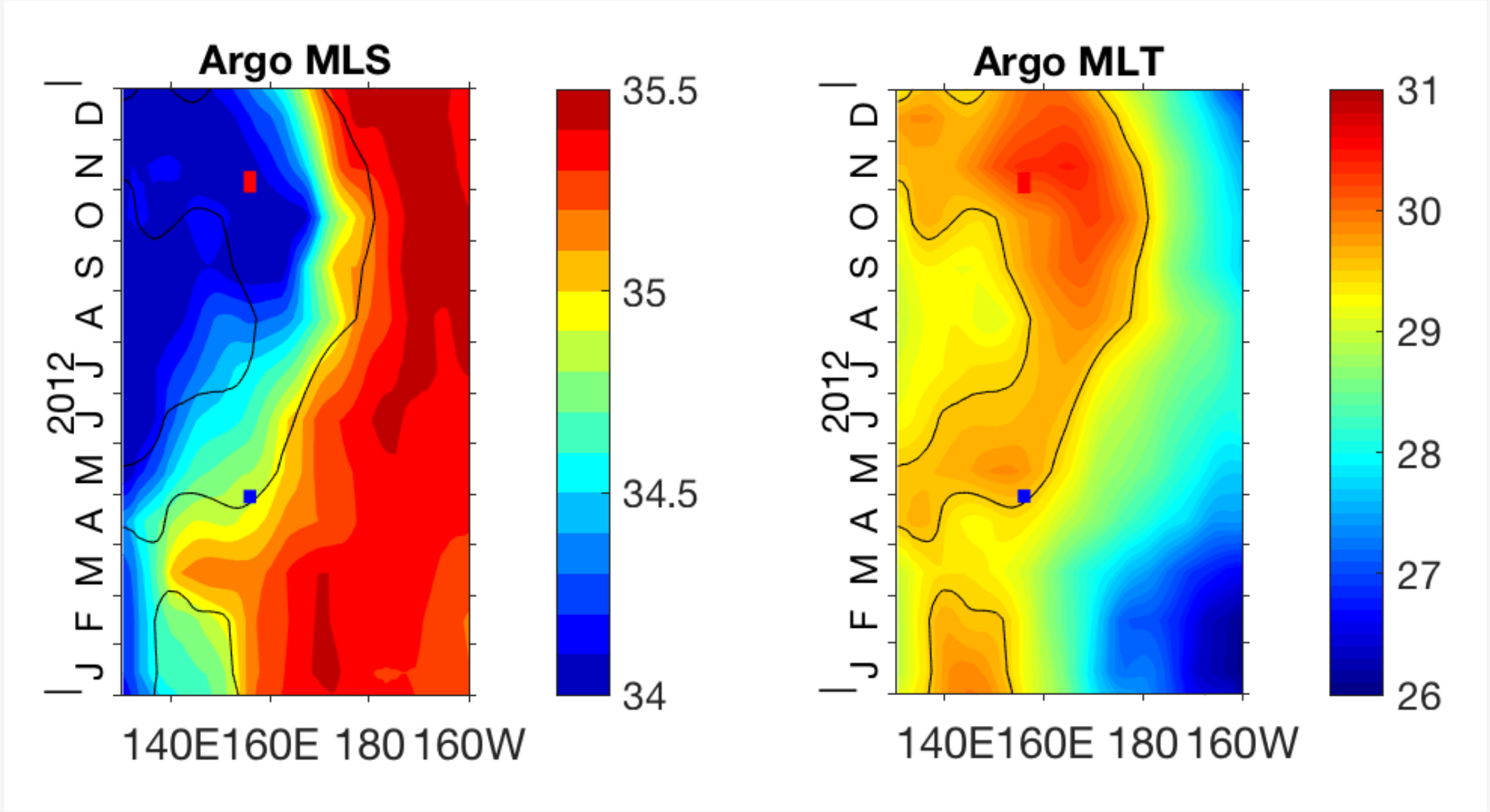


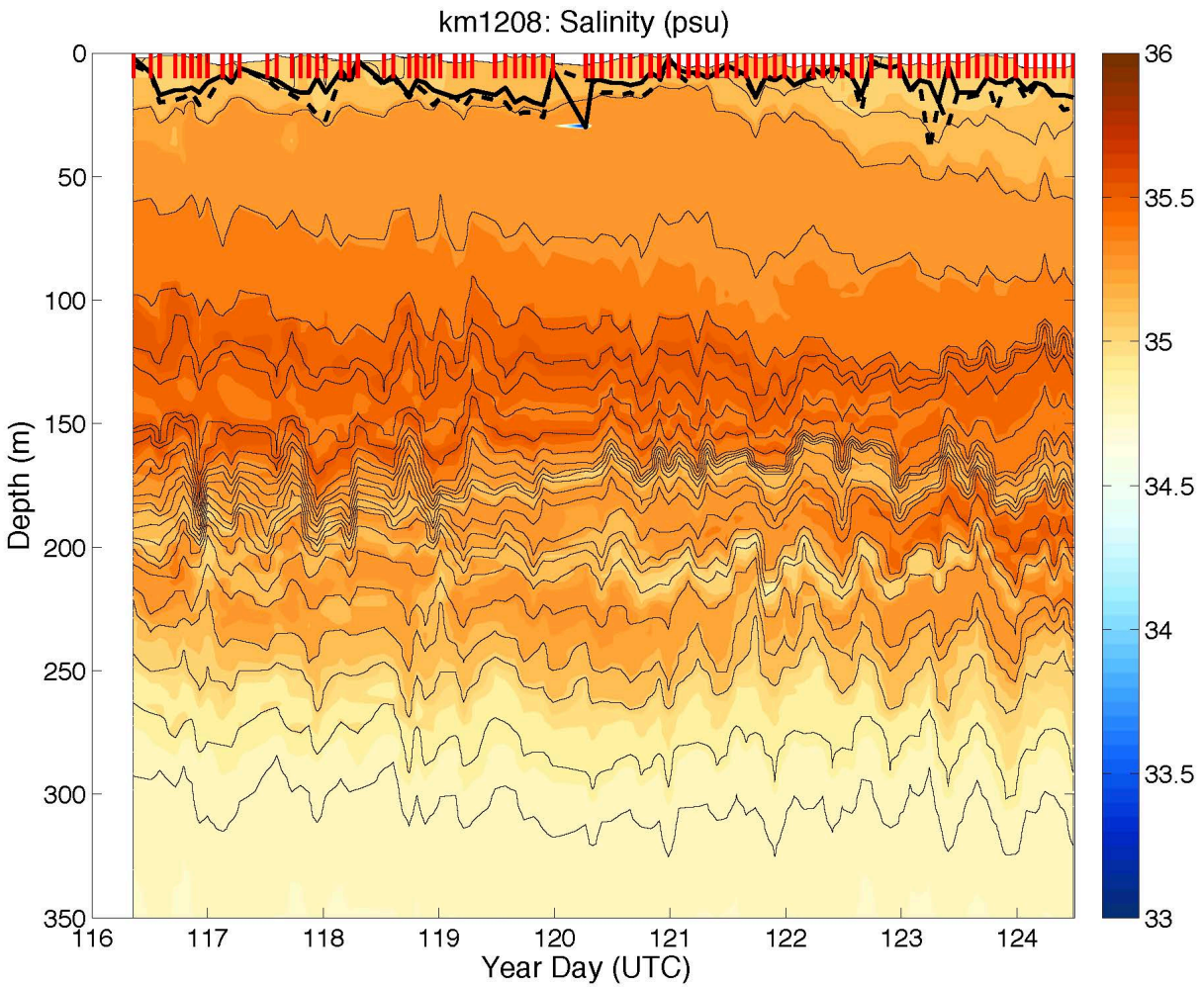
24hr time average

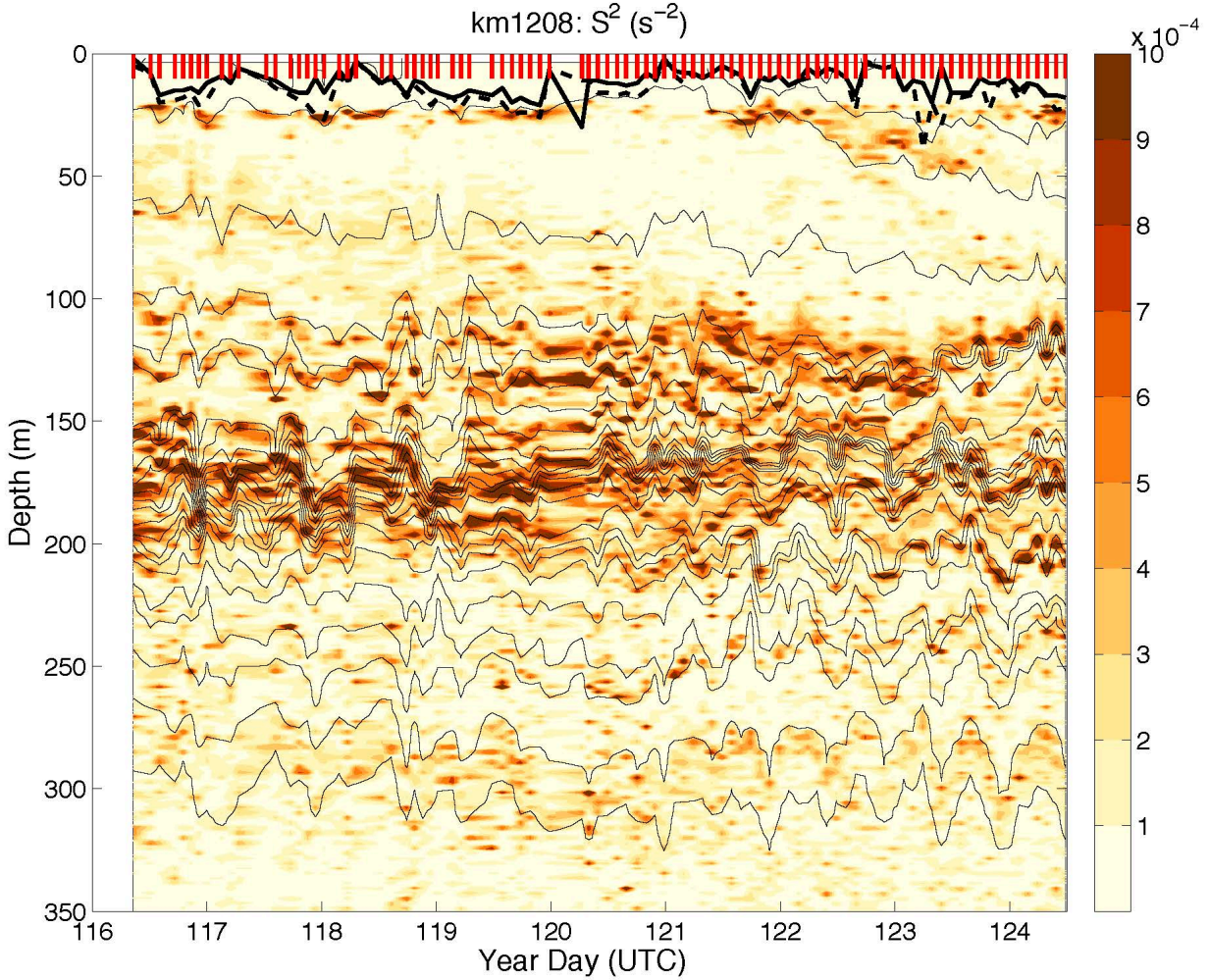

x 10^-3
1
0.8
0.6
0.4
0.2
0
k Φ vus
MR0904
MR1007
KM1208
KM1225
−2.5
−2
−1.5
−1
−0.5
0
log10 Wavenumber (cpm)
x 10^-3
1
0.8
0.6
0.4
0.2
0
k Φ vvs
MR0904
MR1007
KM1208
KM1225
−2.5
−2
−1.5
−1
−0.5
0
log10 Wavenumber (cpm)


Depth (m)
0
50
100
150
200
250
300
350
400
10^{-10}
10^{-9}
10^{-8}
10^{-7}
□ (Wkg^{-1})
MR0904
MR1007
MR1203
KM1225
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
k_v (m^{2}s^{-1})

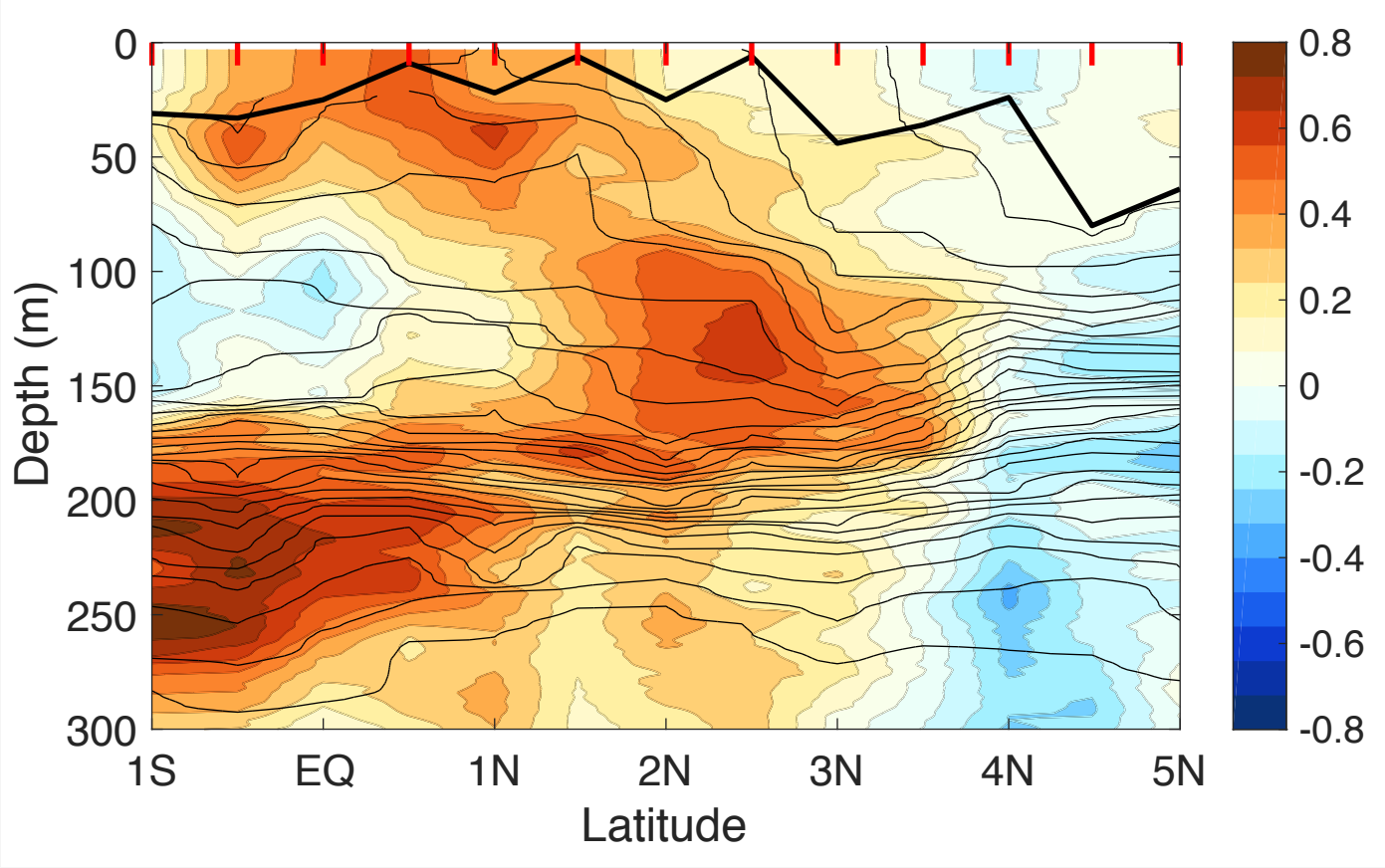

2006
2004
2002
2000
(a)
130°E
150°E
170°E
170°W
150°W
130°W
34.0
34.4
34.8
35.2

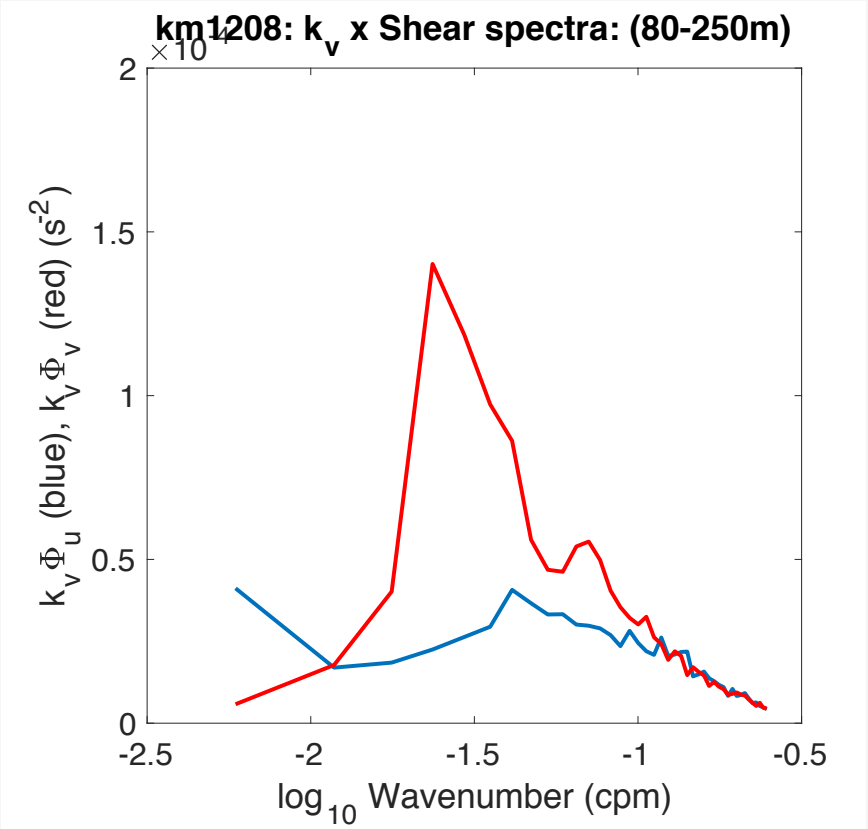

Argo MLS
J F M A M J J A S O N D
2012
140E 160E 180 160W
35.5
35
34.5
34
Argo MLT
J F M A M J J A S O N D
2012
140E 160E 180 160W
31
30
29
28
27
26

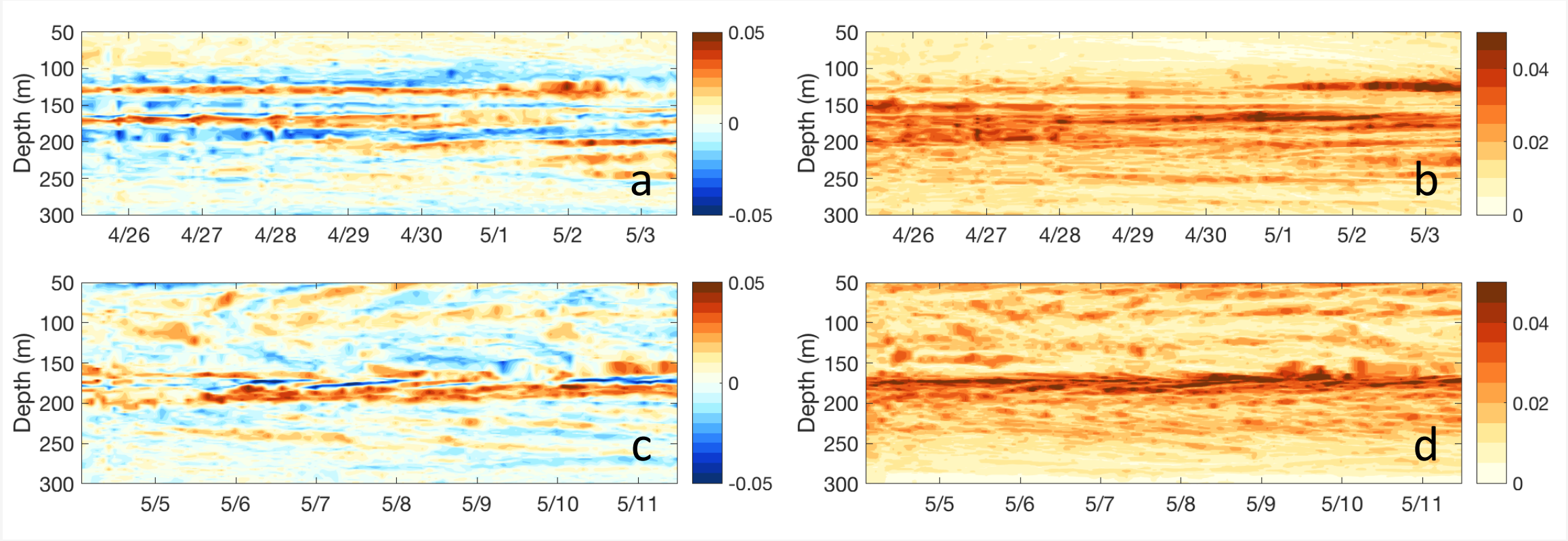

km1208: Salinity (psu)
Depth (m)
Year Day (UTC)
0
50
100
150
200
250
300
350
116
117
118
119
120
121
122
123
124
36
35.5
35
34.5
34
33.5
33

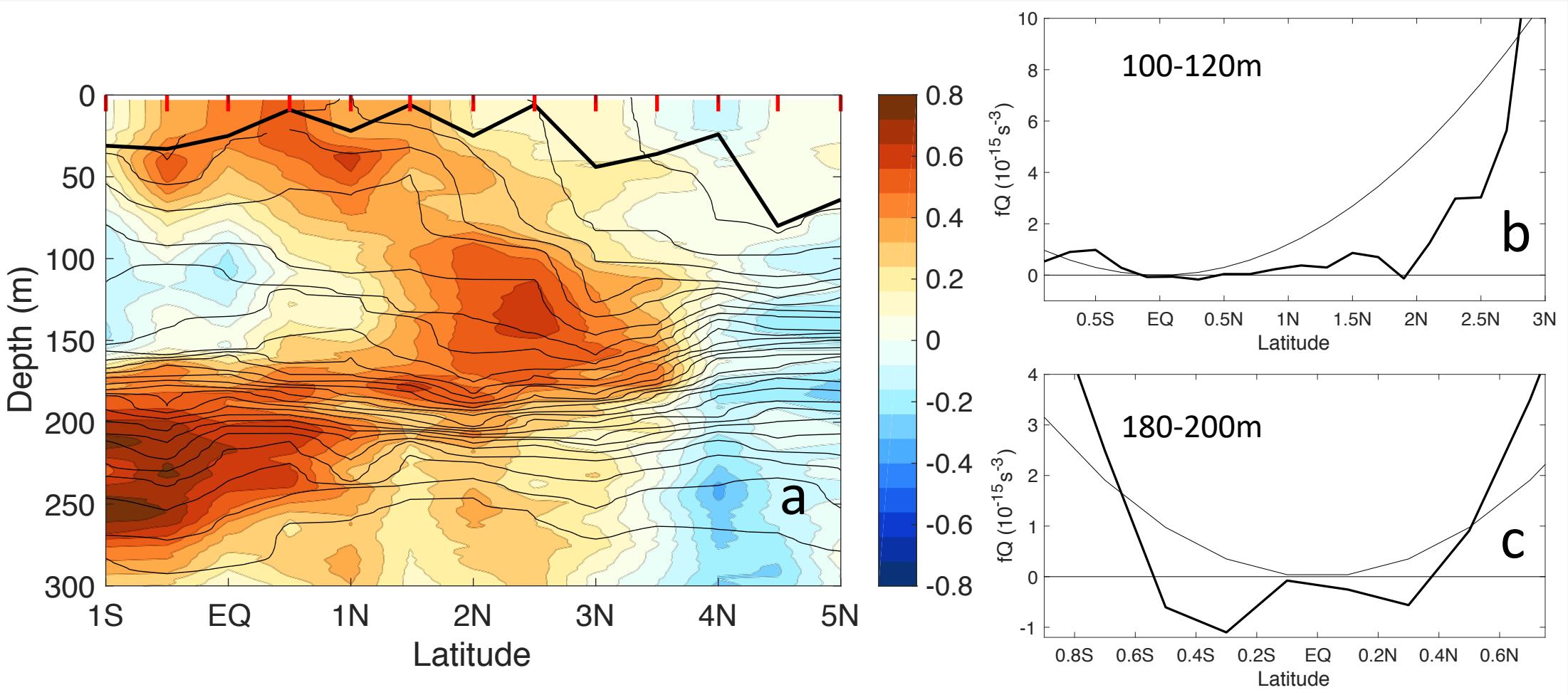

km1208: S^2 (s^{-2})
x 10^{-4}
Depth (m)
Year Day (UTC)
0
50
100
150
200
250
300
350
116
117
118
119
120
121
122
123
124
10
9
8
7
6
5
4
3
2
1

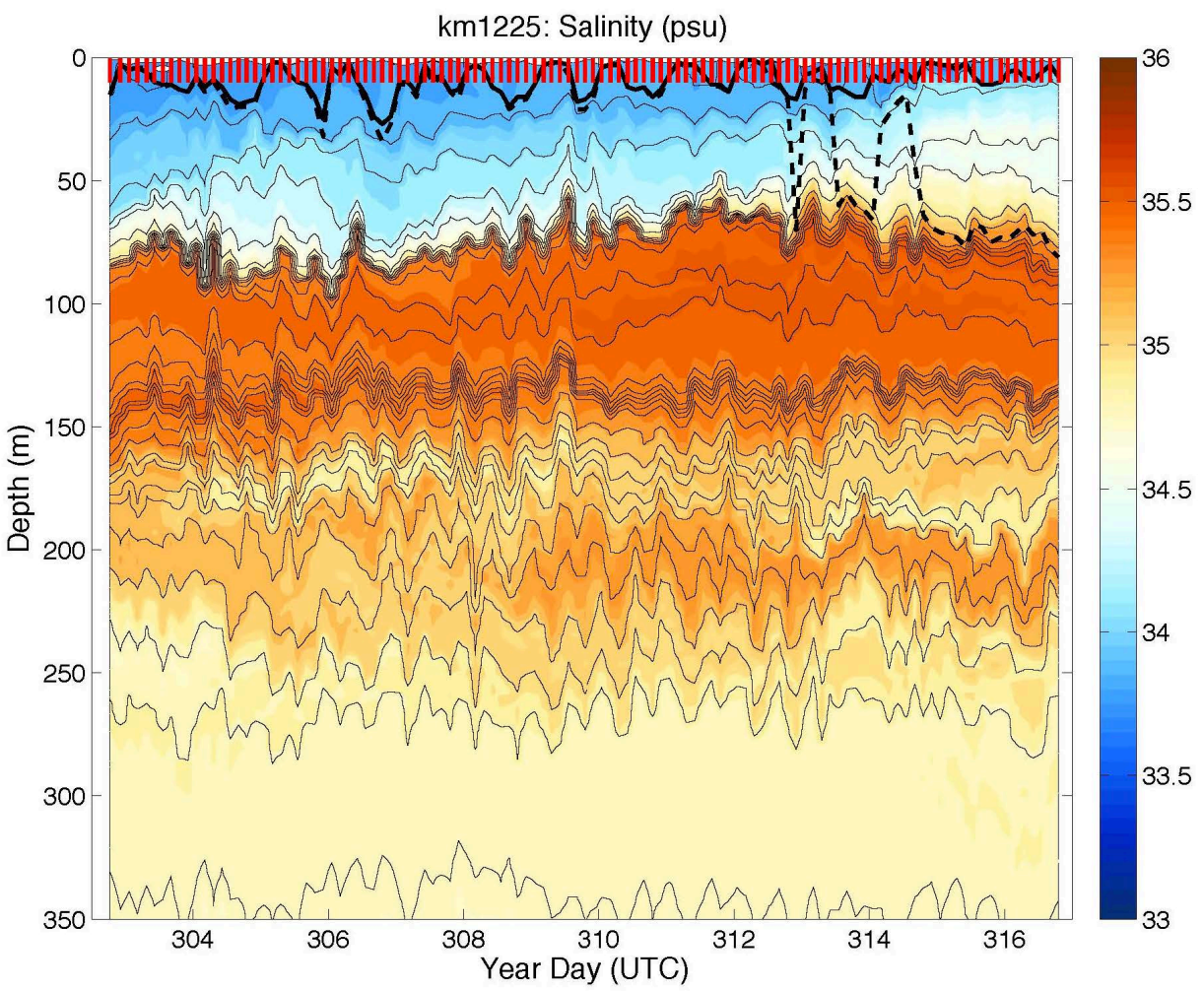
east

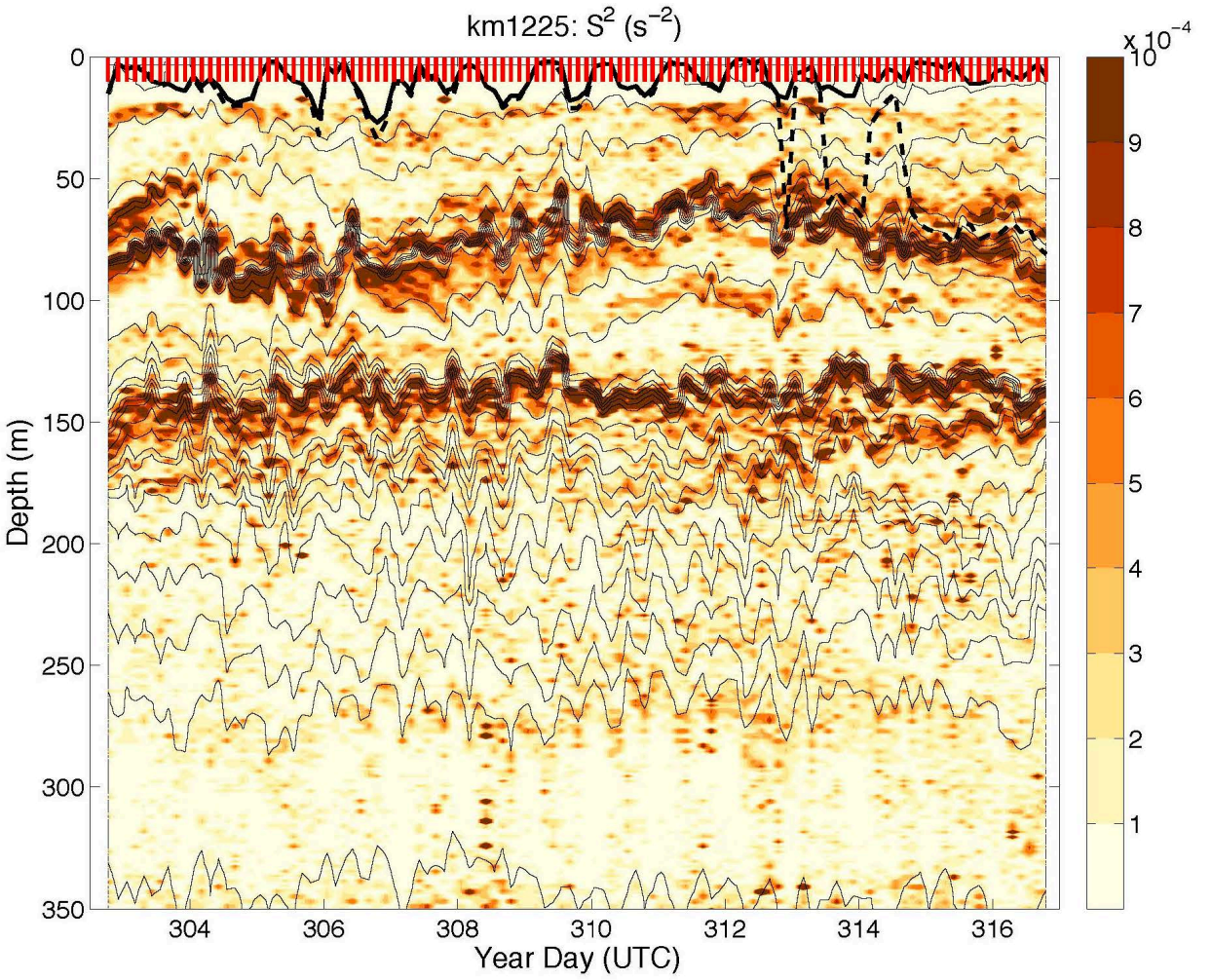

0
50
100
150
200
250
300
Depth (m)
1S
EQ
1N
2N
3N
4N
5N
Latitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8


km1208: k_v x Shear spectra: (80-250m)
×10^14
2
1.5
1
0.5
0
k_v Φ_u (blue), k_v Φ_v (red) (s^-2)
-2.5
-2
-1.5
-1
-0.5
log_10 Wavenumber (cpm)

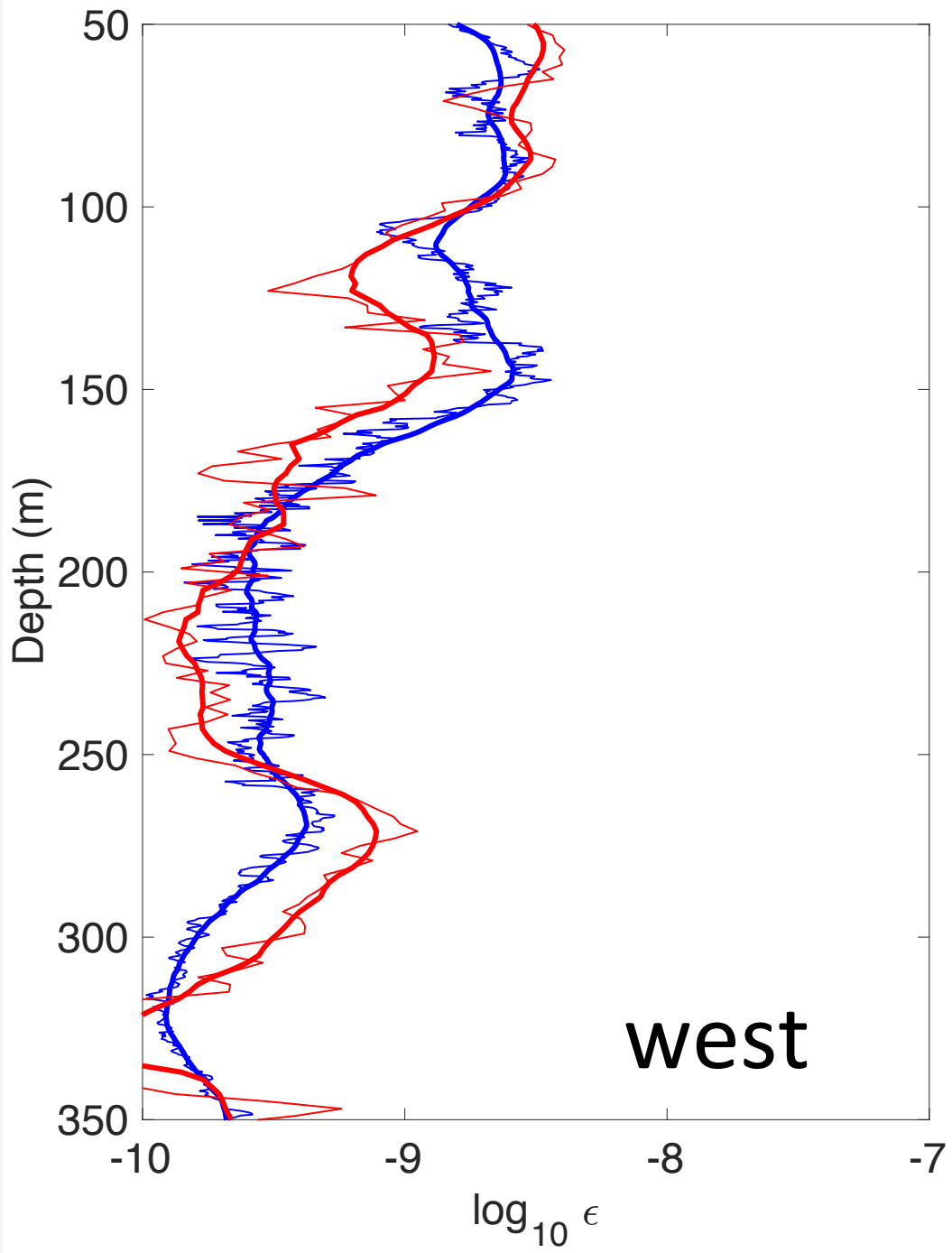

Depth (m)
50
100
150
200
250
300
4/26
4/27
4/28
4/29
4/30
5/1
5/2
5/3
0.05
0
-0.05
a
b
0.04
0.02
0
5/5
5/6
5/7
5/8
5/9
5/10
5/11
c
d

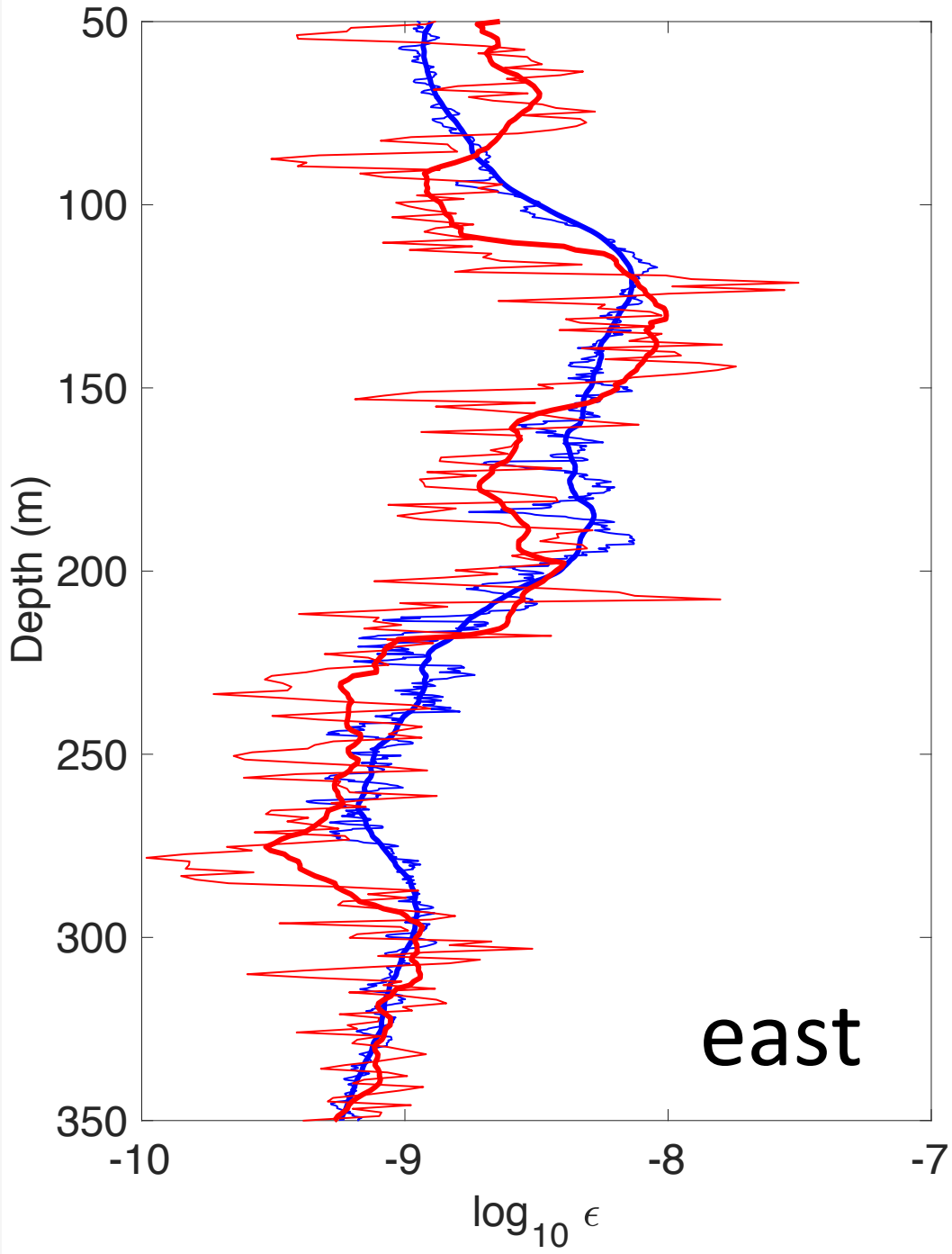

Depth (m)
0
50
100
150
200
250
300
1S
EQ
1N
2N
3N
4N
5N
Latitude
a
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
100-120m
fQ (10^-15 s^-3)
10
8
6
4
2
0
0.5S
EQ
0.5N
1N
1.5N
2N
2.5N
3N
Latitude
b
180-200m
fQ (10^-15 s^-3)
4
3
2
1
0
-1
0.8S
0.6S
0.4S
0.2S
EQ
0.2N
0.4N
0.6N
Latitude
c

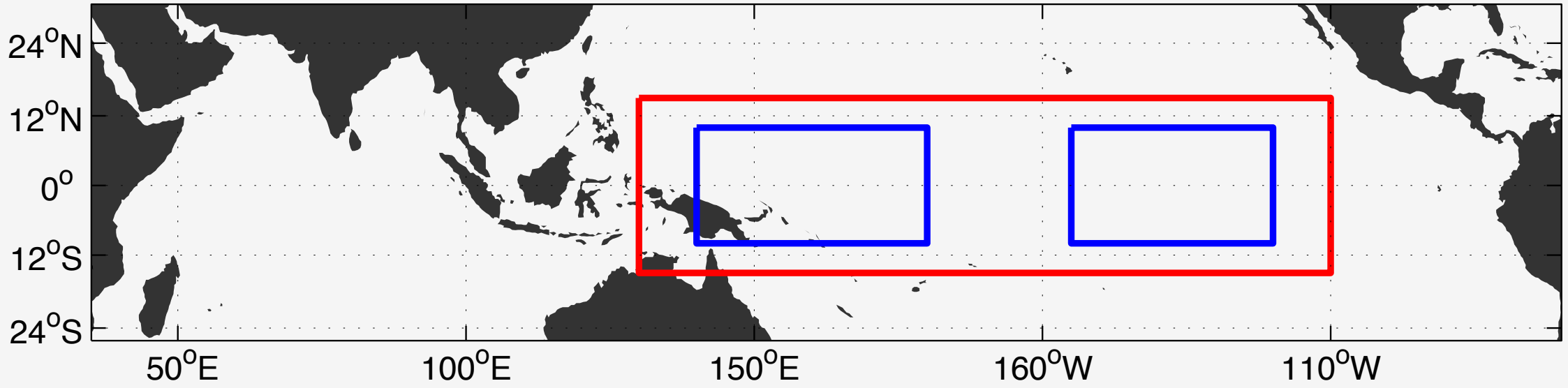

km1225: Salinity (psu)
Depth (m)
Year Day (UTC)
0
50
100
150
200
250
300
350
304
306
308
310
312
314
316
36
35.5
35
34.5
34
33.5
33

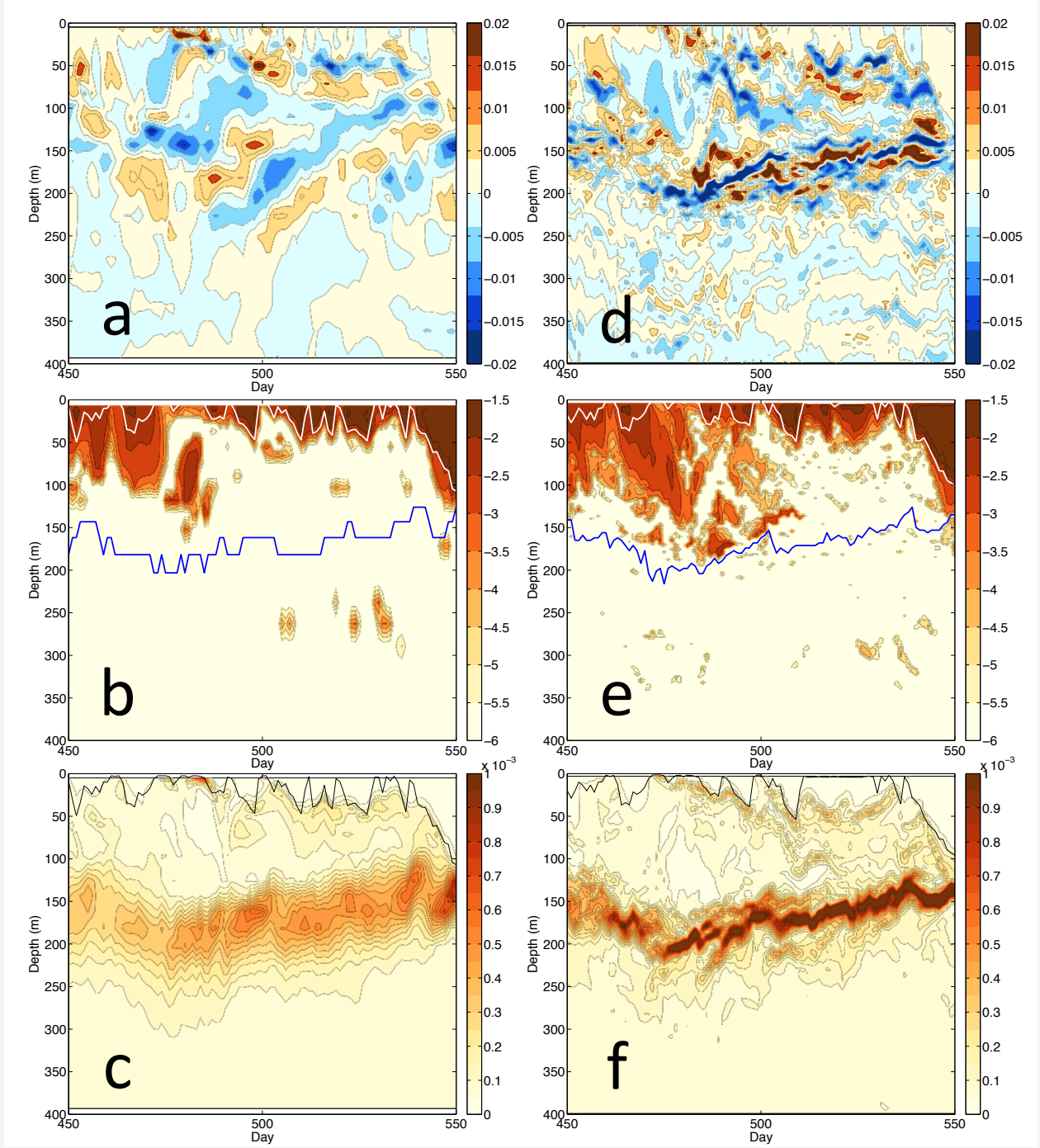

km1225: S^2 (s^{-2})
x 10^{-4}
Depth (m)
Year Day (UTC)
0
50
100
150
200
250
300
350
304
306
308
310
312
314
316
10
9
8
7
6
5
4
3
2
1

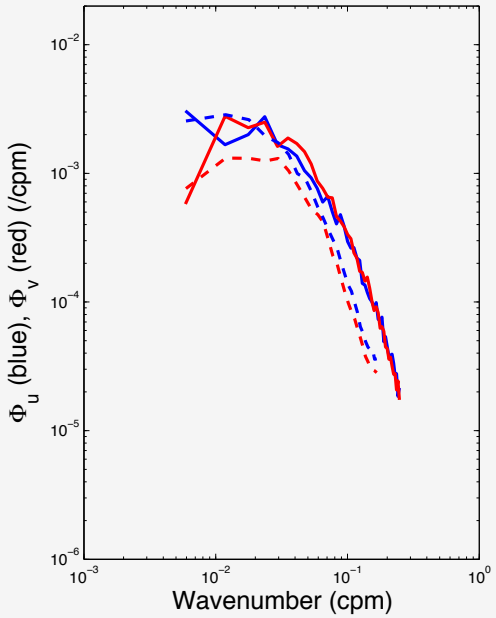
west

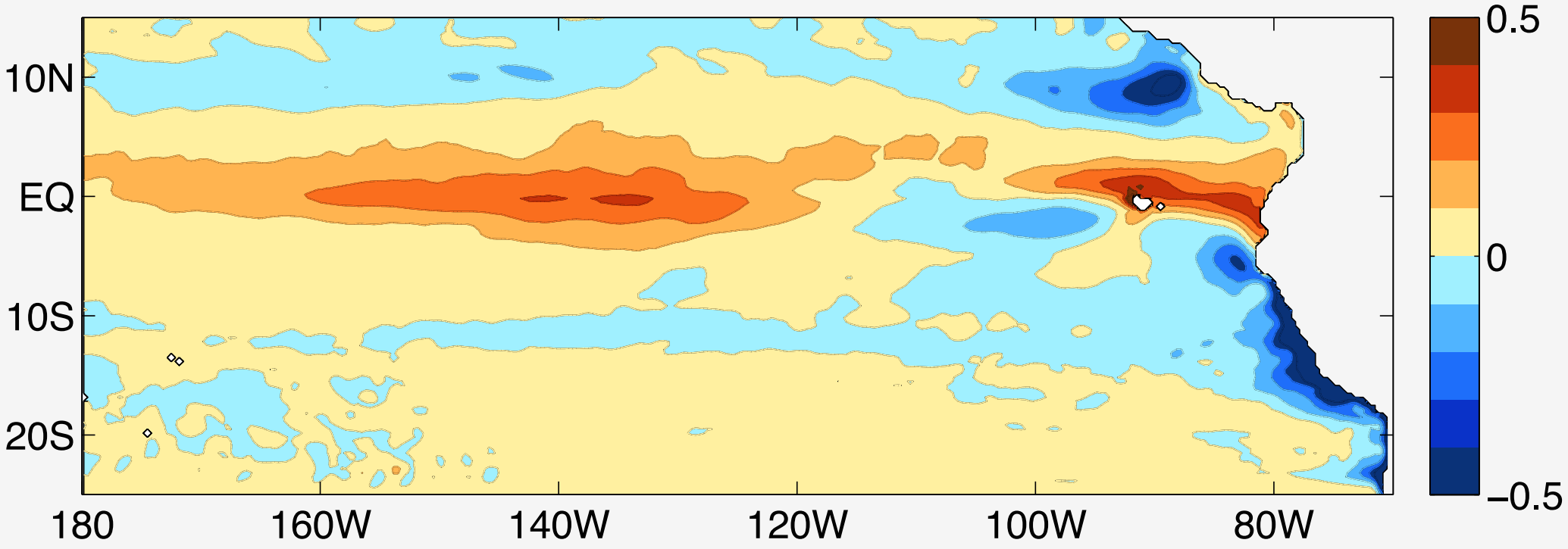

50
100
150
200
250
300
350
Depth (m)
-10
-9
-8
-7
log10 ϵ
west

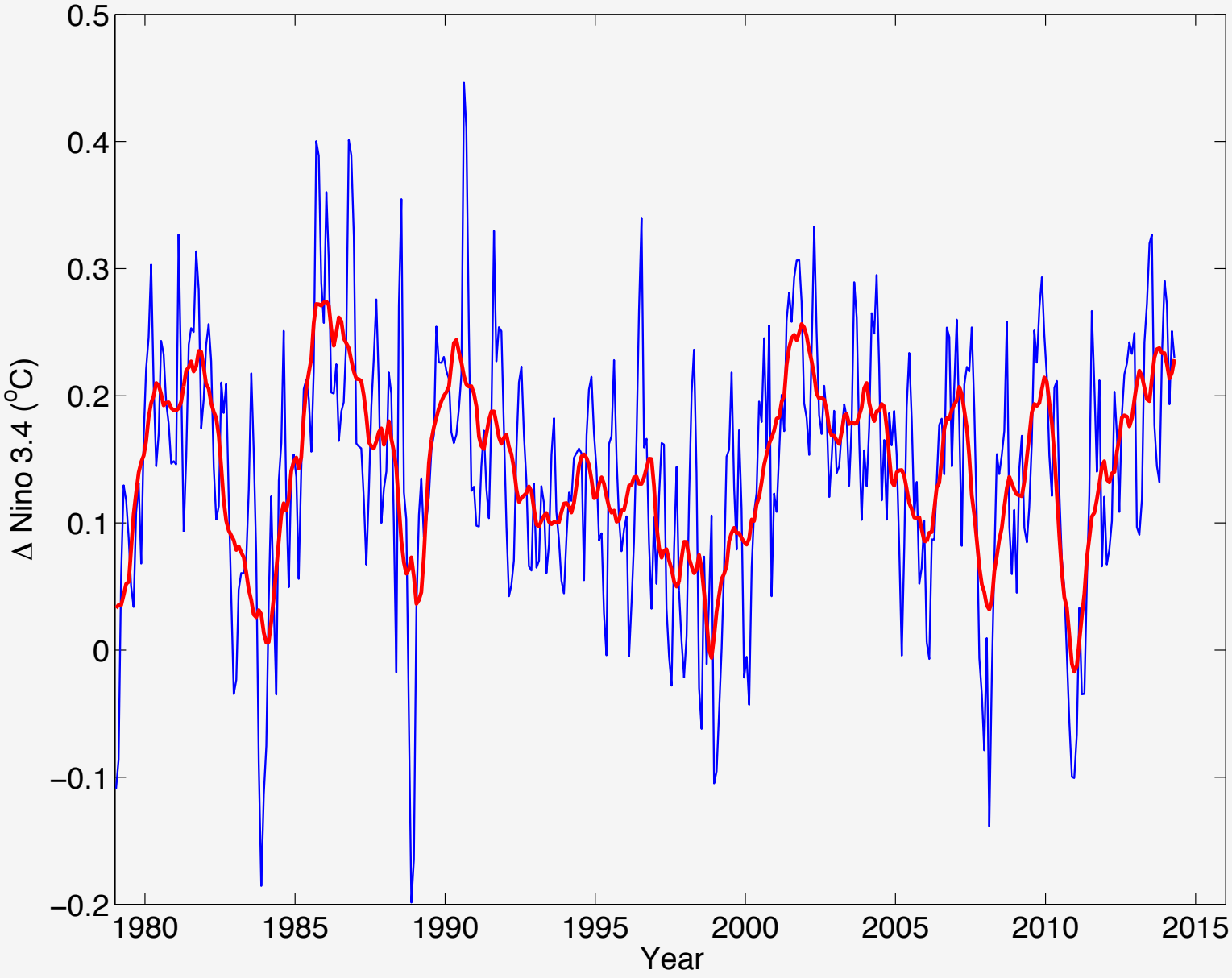

50
100
150
200
250
300
350
Depth (m)
-10
-9
-8
-7
log10 ϵ
east

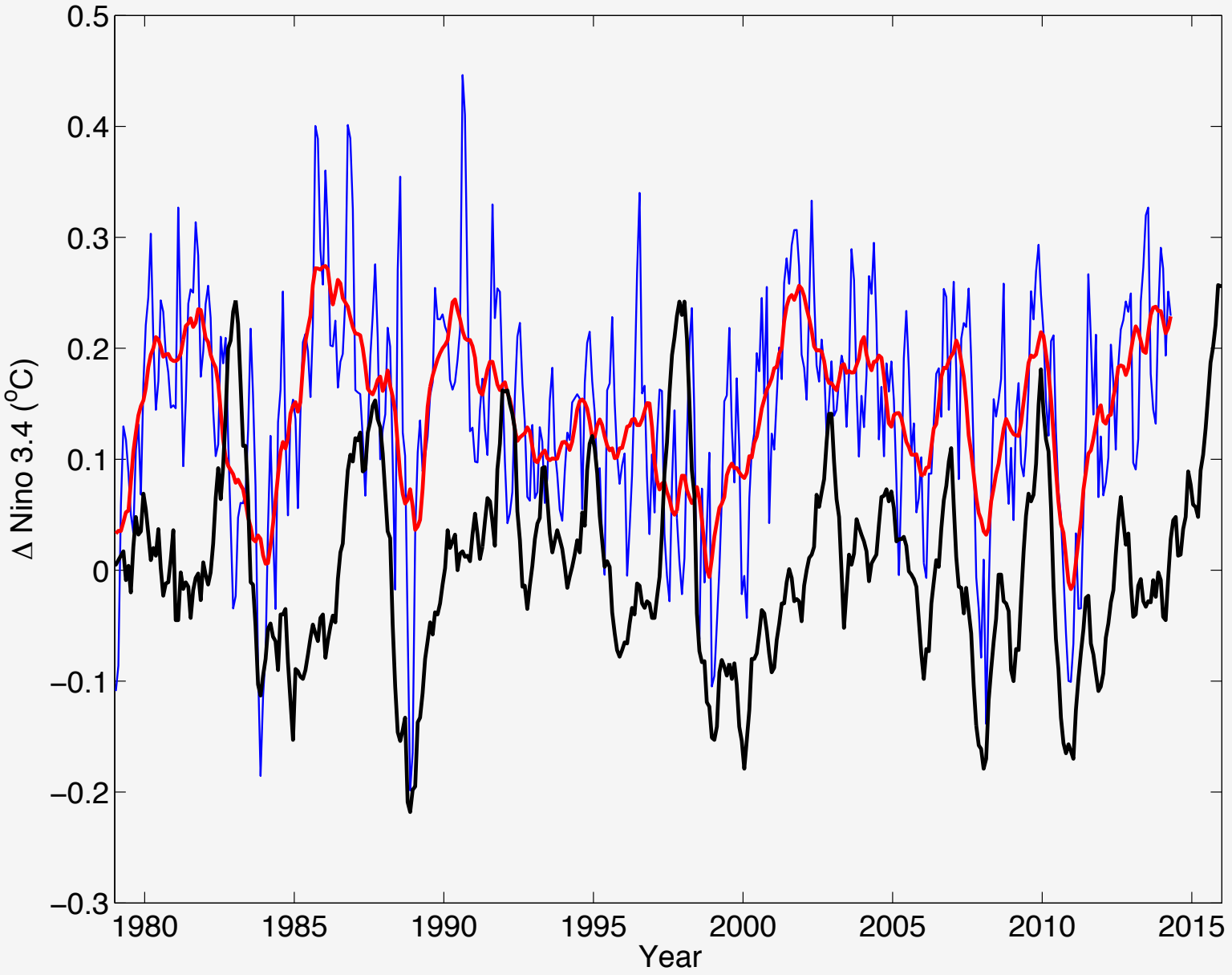

24°N
12°N
0°
12°S
24°S
50°E
100°E
150°E
160°W
110°W

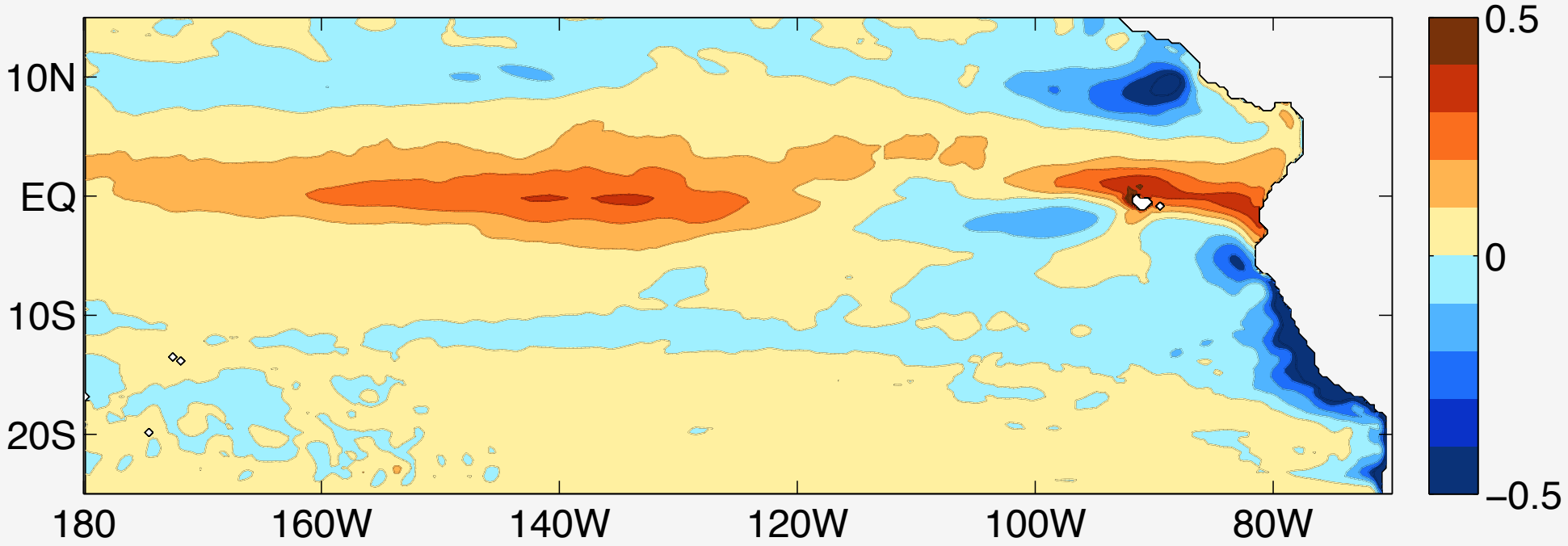

a
b
c
d
e
f
Depth (m)
Day
x 10^-3


Φu (blue), Φv (red) (/cpm)
Wavenumber (cpm)

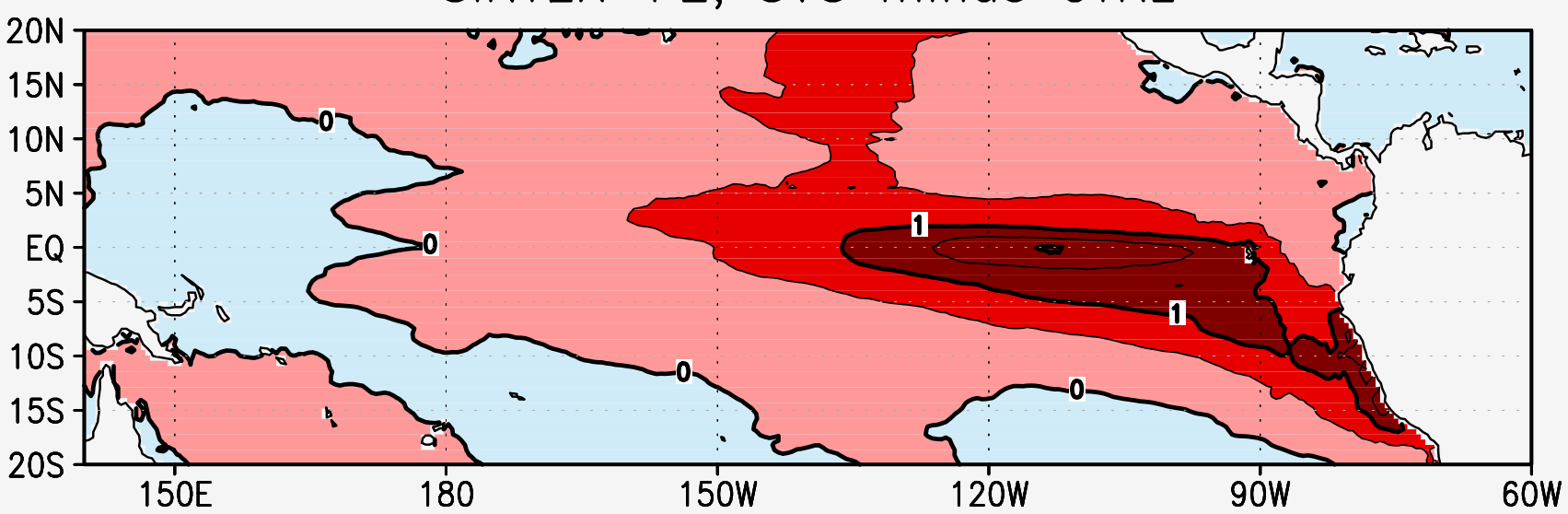

10N
EQ
10S
20S
180
160W
140W
120W
100W
80W
0.5
0
−0.5

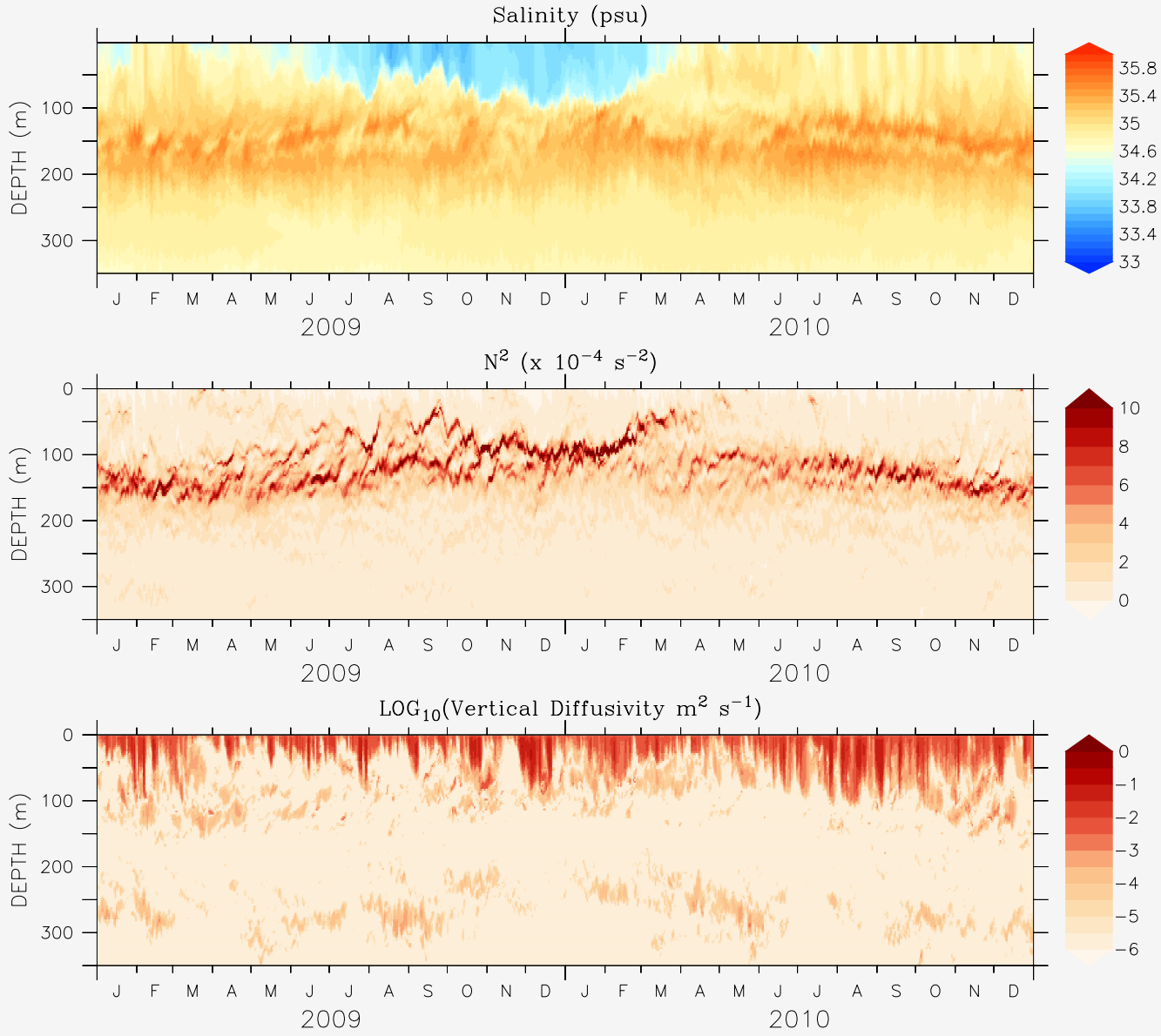

0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
Δ Nino 3.4 (°C)
1980
1985
1990
1995
2000
2005
2010
2015
Year

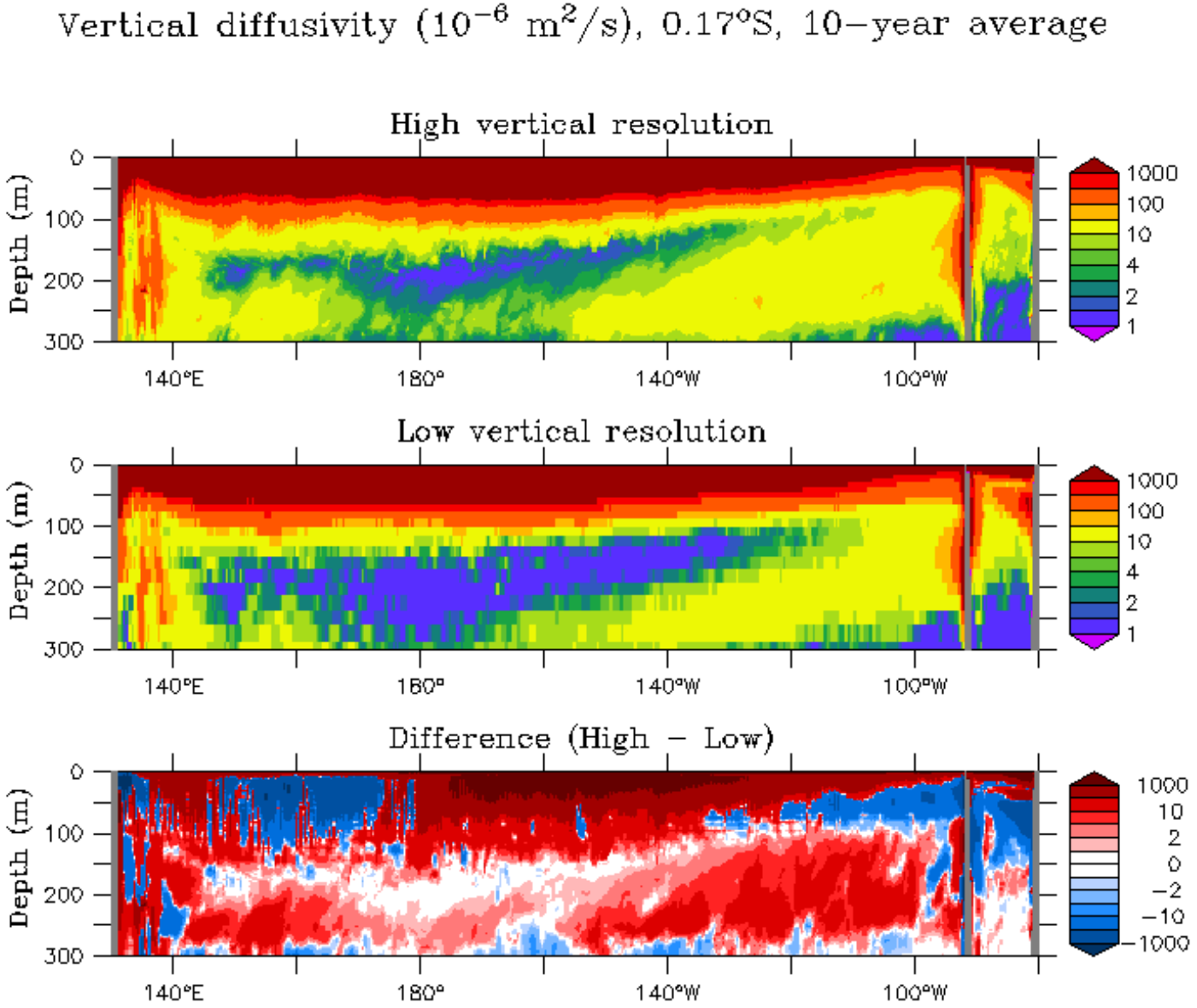

0.5
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
Δ Nino 3.4 (°C)
1980
1985
1990
1995
2000
2005
2010
2015
Year

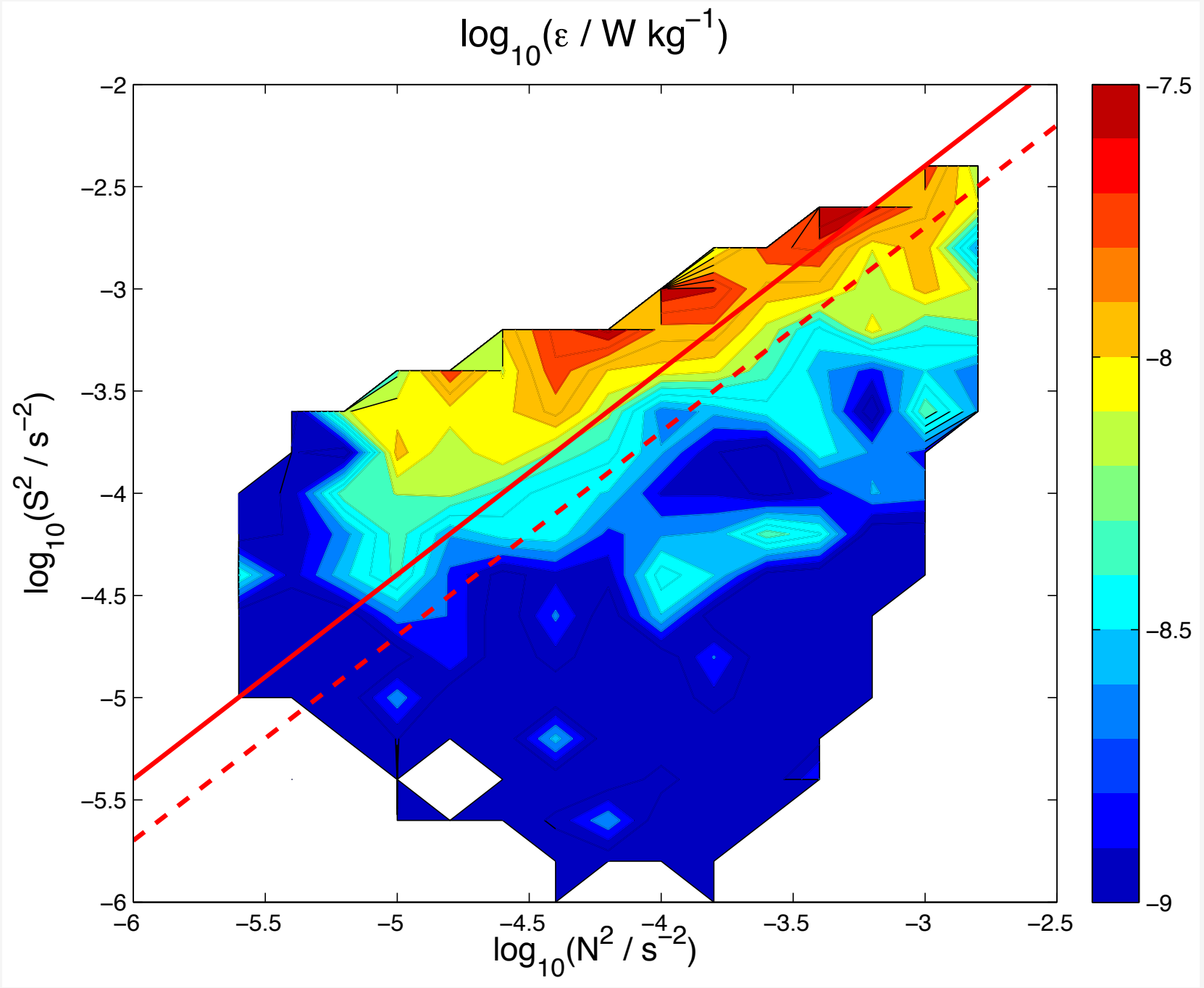


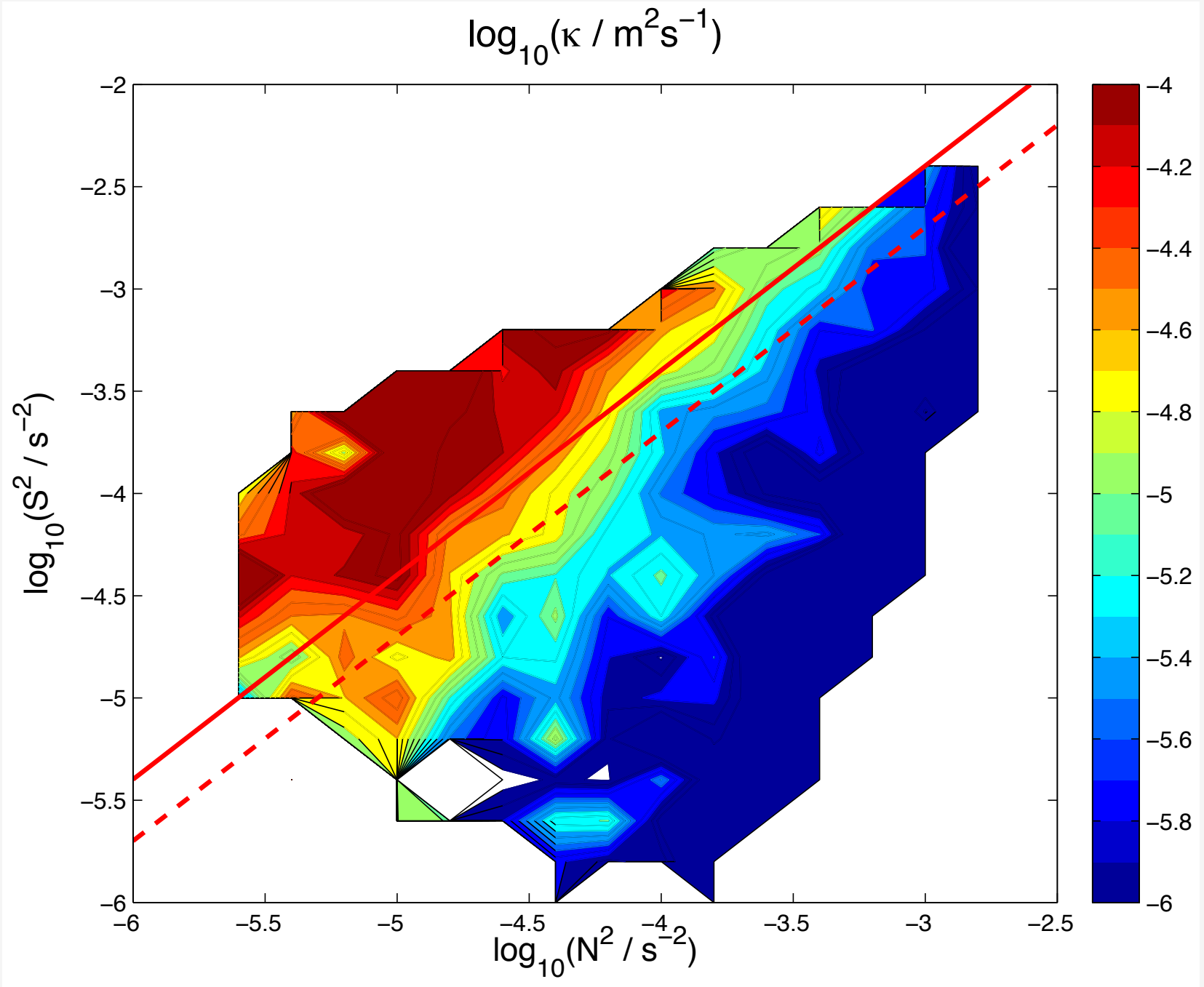
SINTEX−F2, SVS minus CTRL




Salinity (psu)
DEPTH (m)
100
200
300
35.8
35.4
35
34.6
34.2
33.8
33.4
33
J F M A M J J A S O N D J F M A M J J A S O N D
2009
2010
N² (x 10⁻⁴ s⁻²)
0
100
200
300
10
8
6
4
2
0
LOG₁₀(Vertical Diffusivity m² s⁻¹)
0
−1
−2
−3
−4
−5
−6


Vertical diffusivity (10^{-6} m^2/s), 0.17°S, 10−year average
High vertical resolution
Low vertical resolution
Difference (High − Low)
Depth (m)
0
100
200
300
140°E
180°
140°W
100°W
1000
100
10
4
2
1
1000
10
2
0
−2
−10
−1000

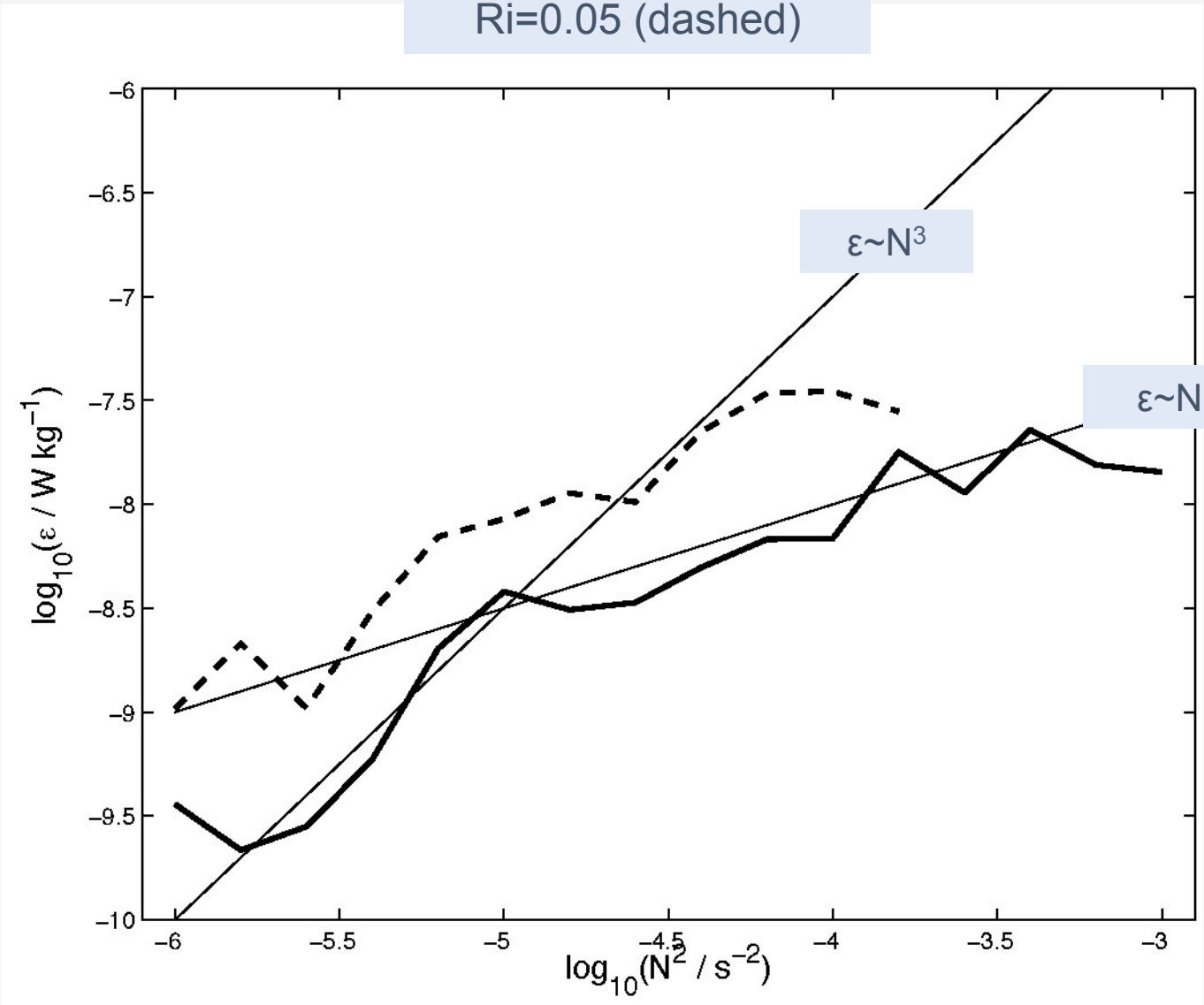

log10(ε / W kg−1)
log10(S2 / s−2)
log10(N2 / s−2)
−2
−2.5
−3
−3.5
−4
−4.5
−5
−5.5
−6
−6
−5.5
−5
−4.5
−4
−3.5
−3
−2.5
−7.5
−8
−8.5
−9



$$\kappa = \gamma \frac{\epsilon}{N^2}$$

Ri=0.25 (solid)

Ri=0.05 (dashed)



The variation of ε ~N for constant Ri has implications for the scaling of the turbulence

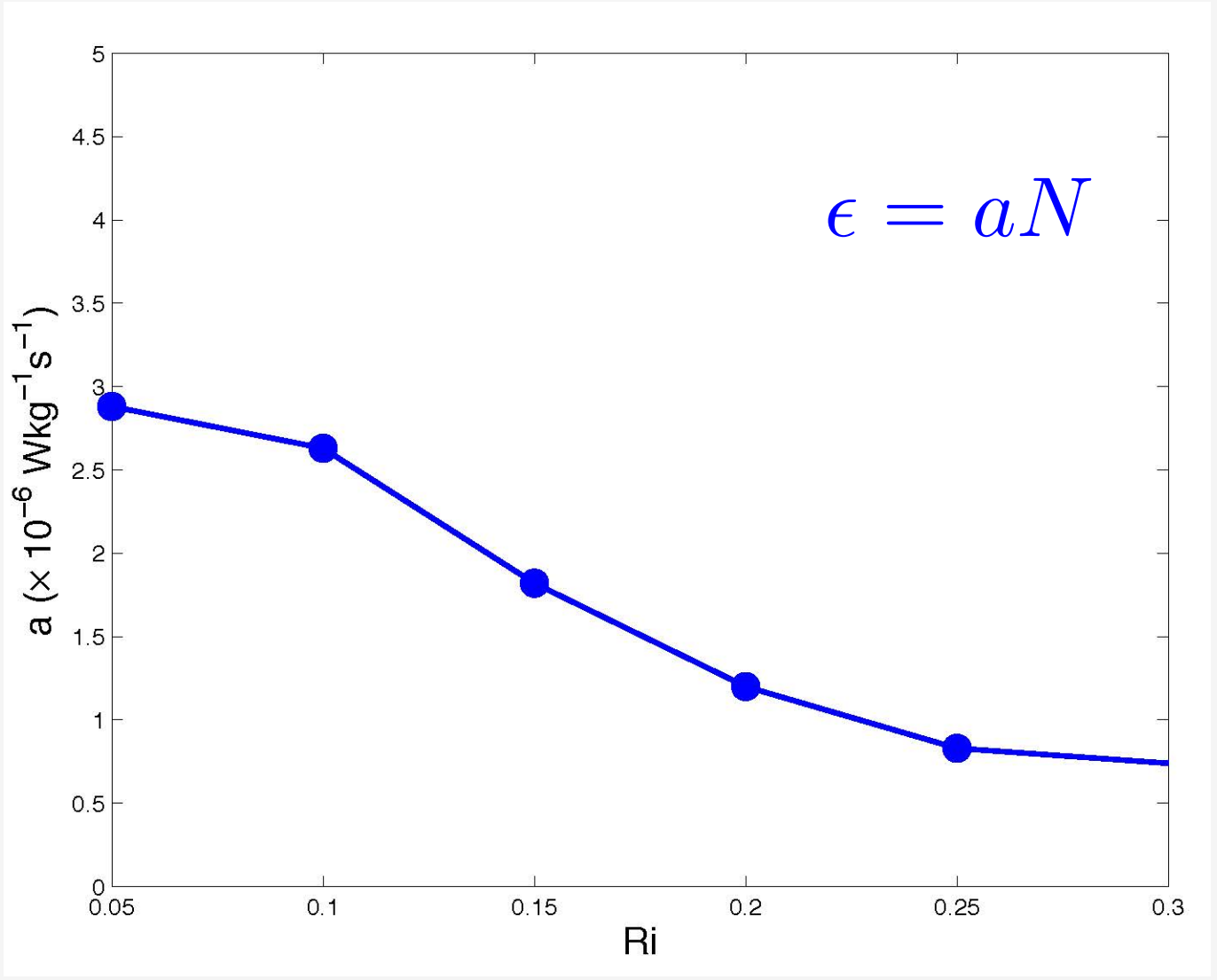
$$\epsilon = \ell_v^2 N^3 f(Ri)$$

then

$$\ell_v = \frac{u_t}{N}$$

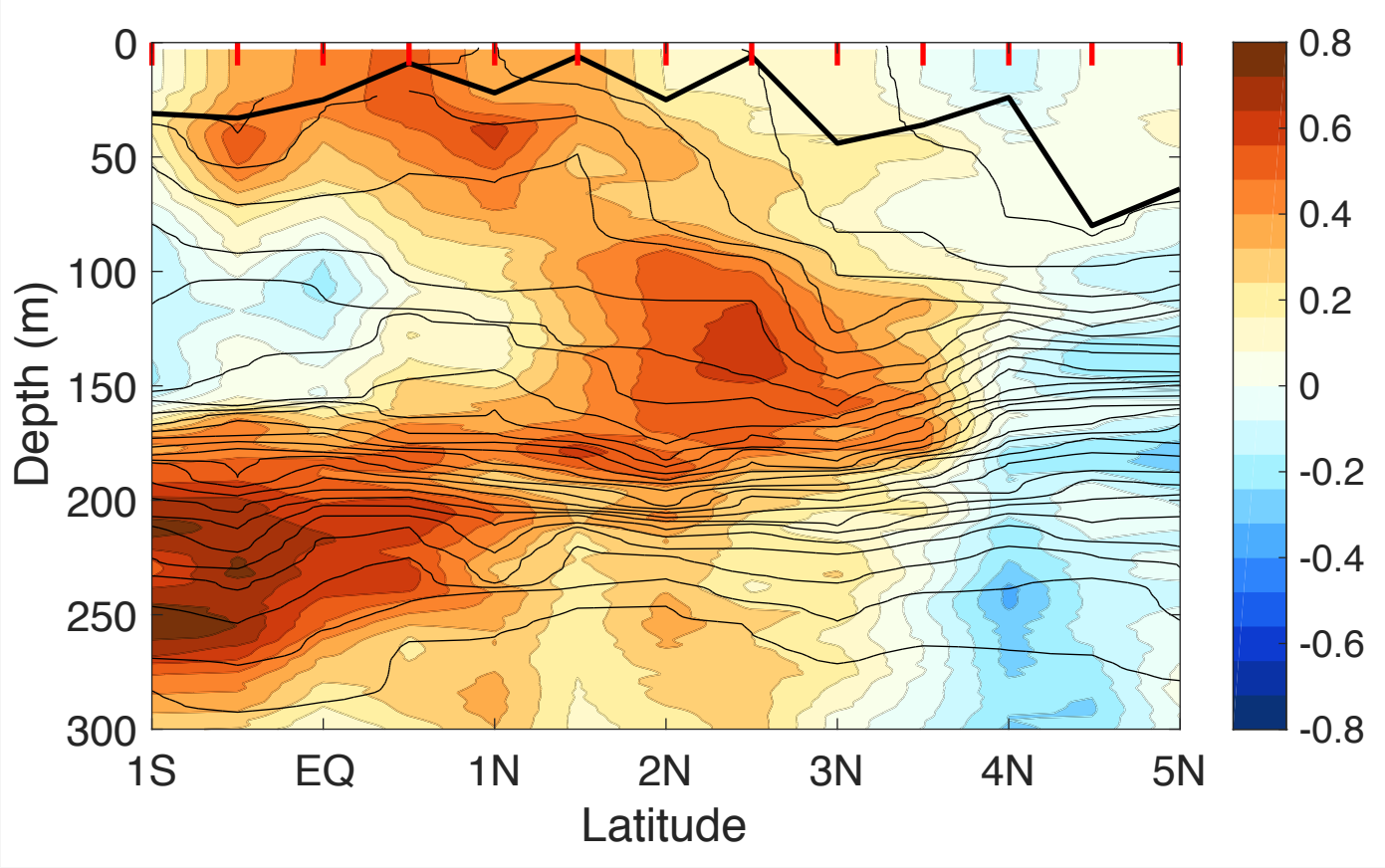
$$f(Ri) = 1, \quad \ell_v = L_O = \sqrt{\epsilon/N^3}$$

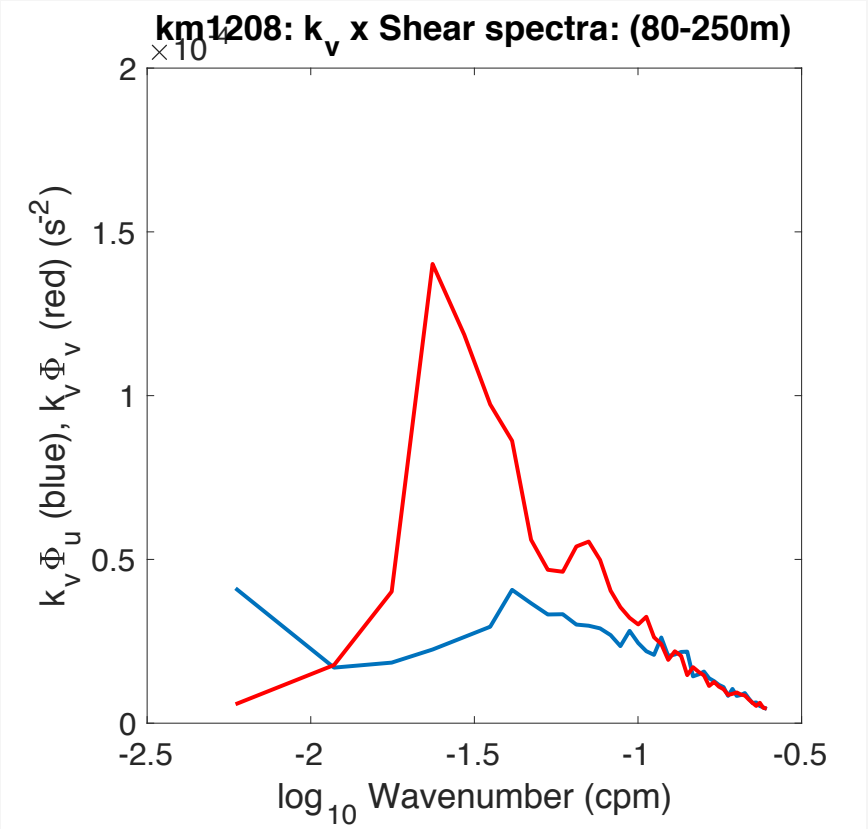
$$f(Ri) = Ri^{-3/2}, \quad \ell_v = L_C = \sqrt{\epsilon/S^3}$$

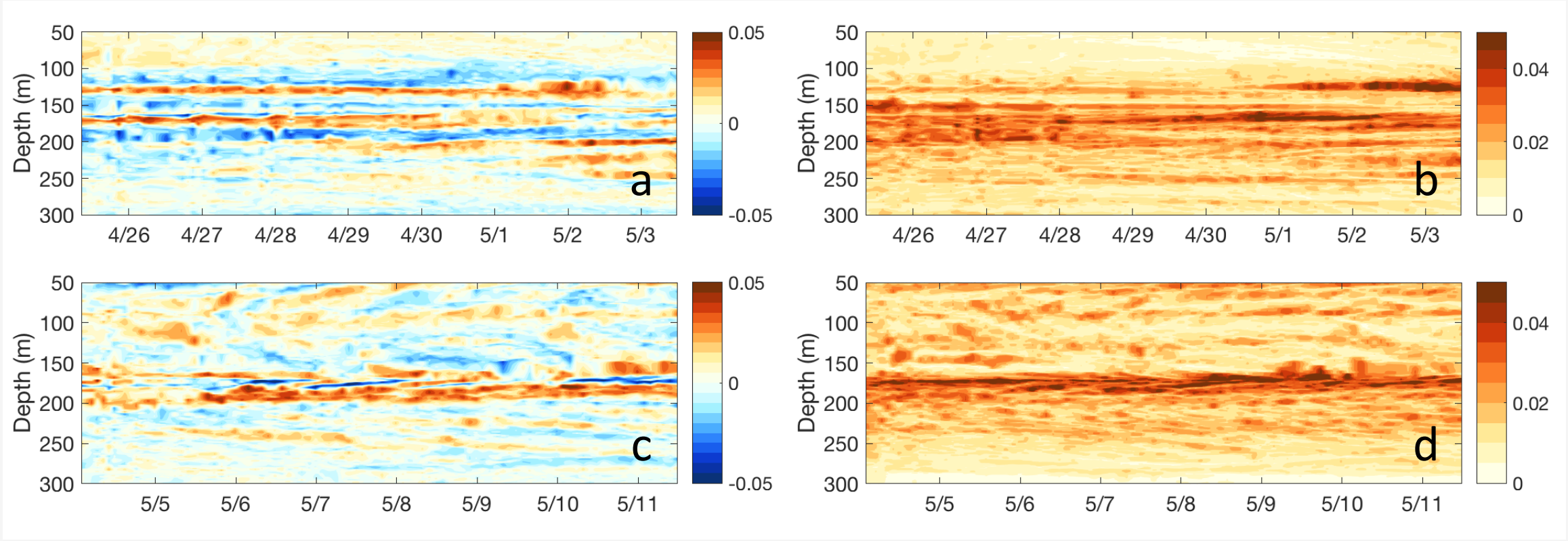

$\epsilon = aN$
a ($\times 10^{-6}$ Wkg^{-1}s^{-1})
Ri
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0.05
0.1
0.15
0.2
0.25
0.3

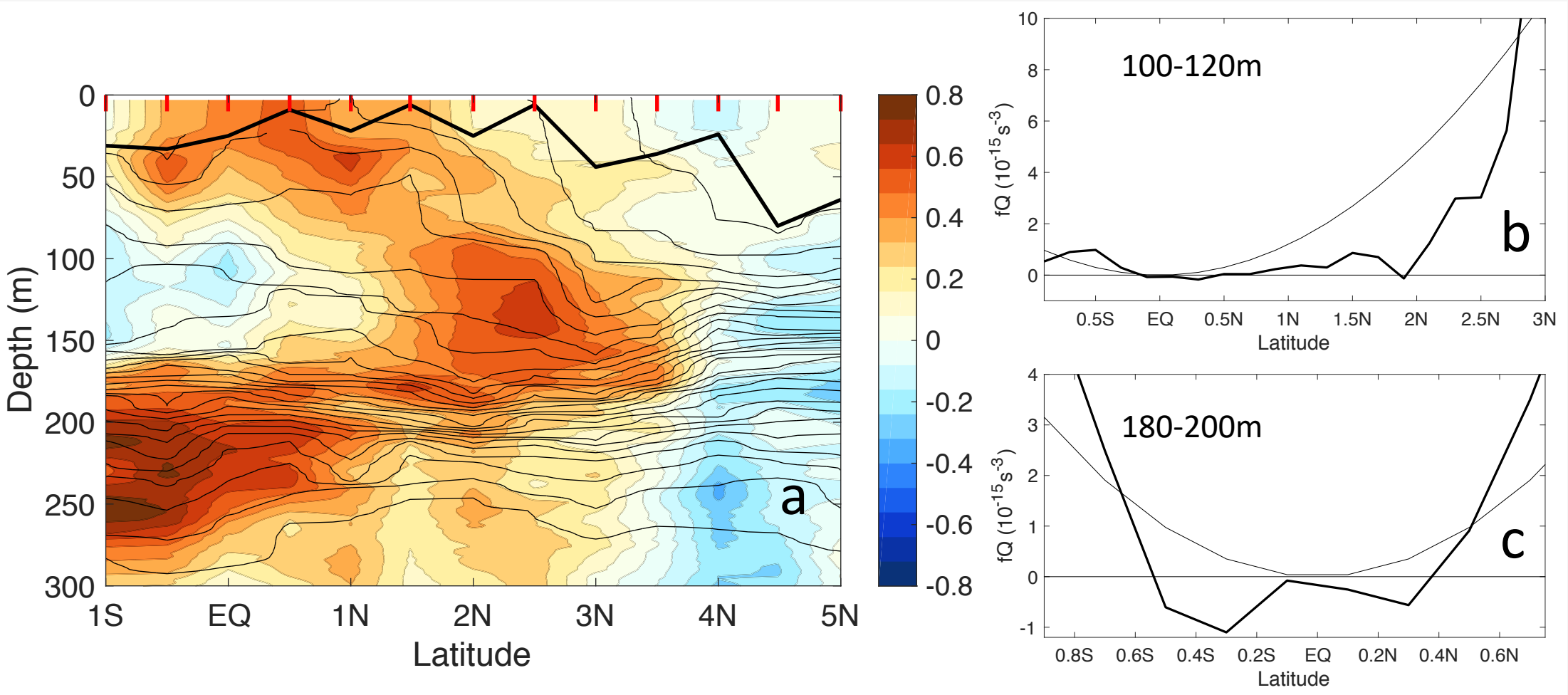
$$\kappa_v = \frac{\gamma u_t^2 f(Ri)}{N}$$

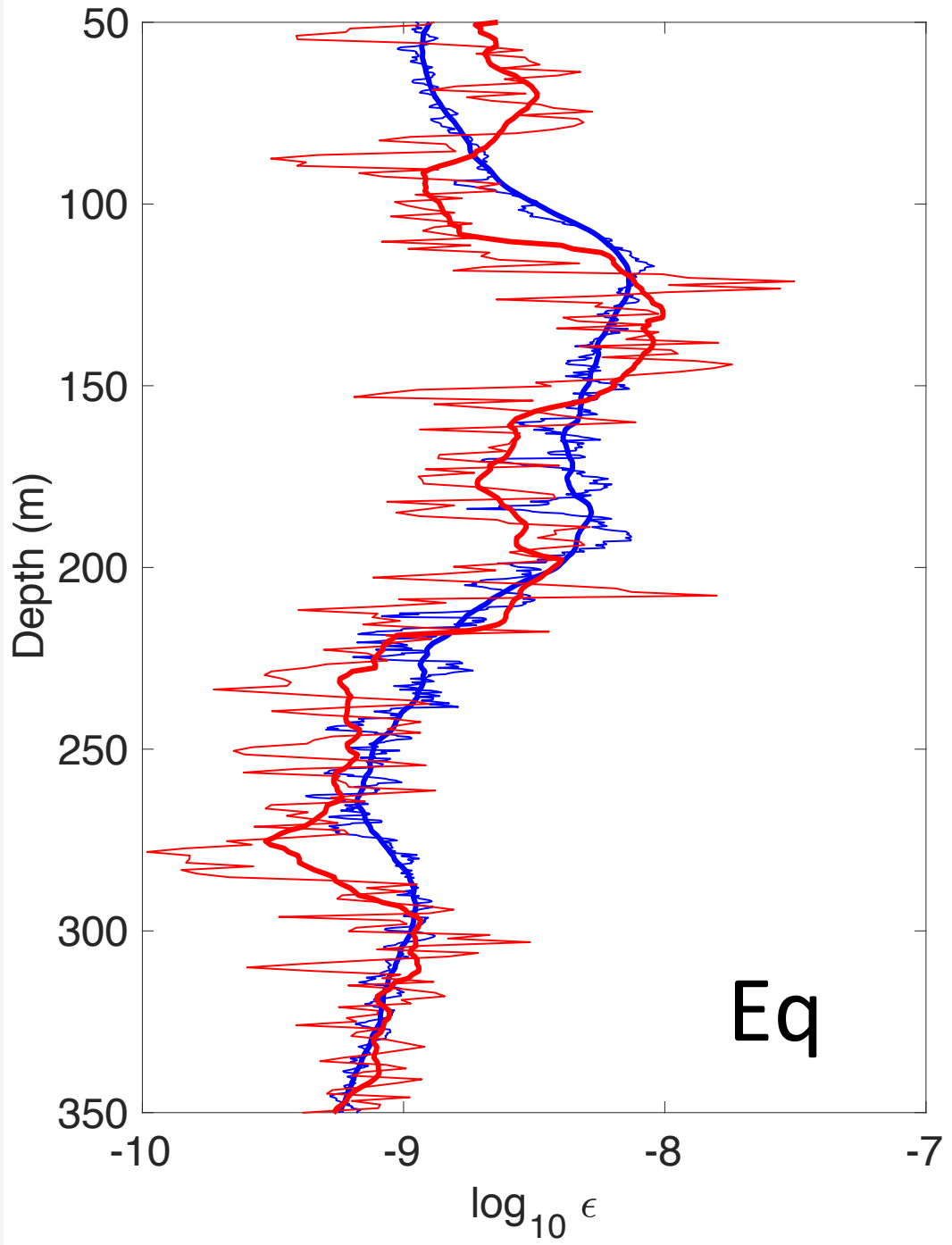
$$u_t \simeq 0.1\,\tilde{u}$$

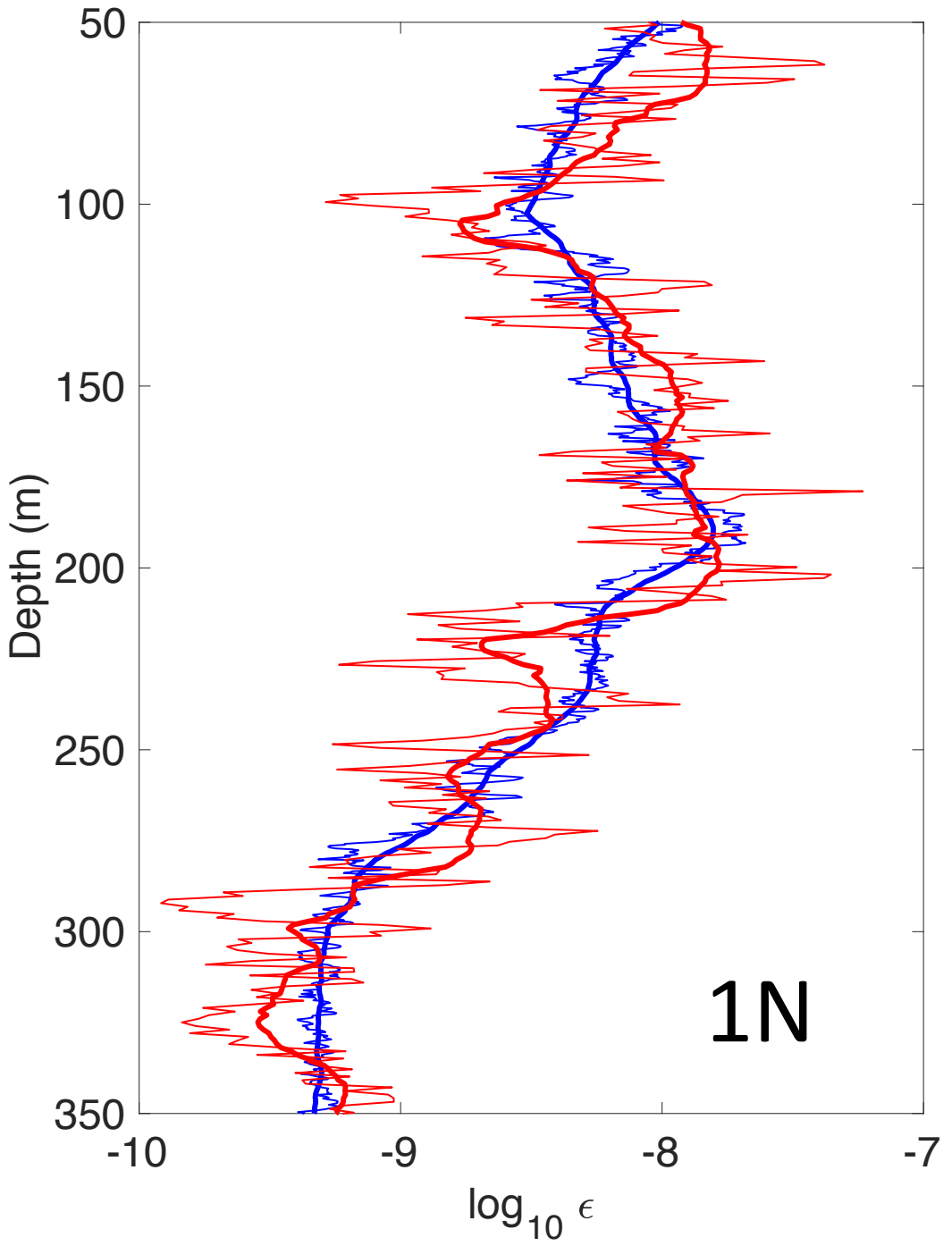

0
50
100
150
200
250
300
Depth (m)
1S
EQ
1N
2N
3N
4N
5N
Latitude
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8

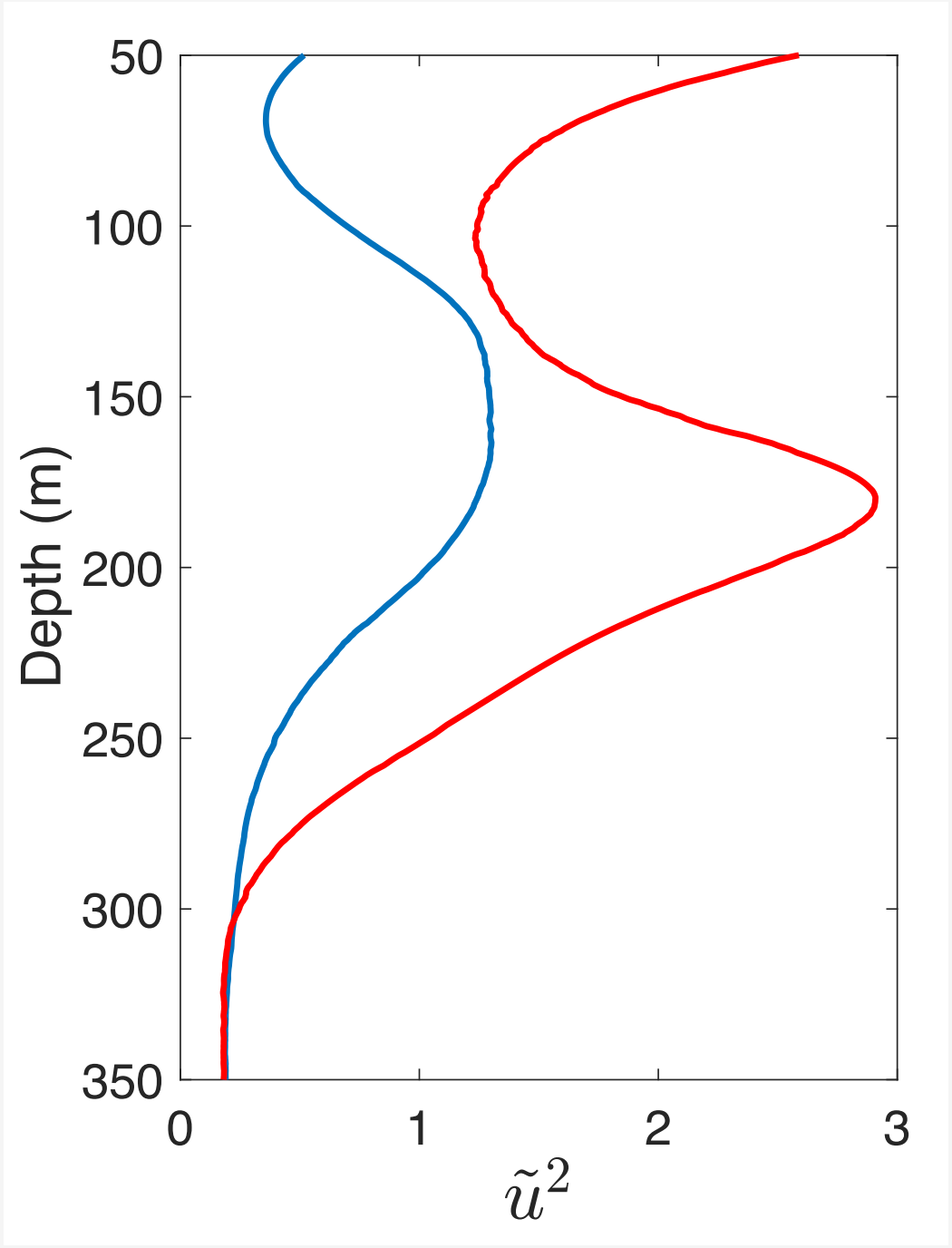

km1208: k_v x Shear spectra: (80-250m)
×10^14
2
1.5
1
0.5
0
k_v Φ_u (blue), k_v Φ_v (red) (s^-2)
-2.5
-2
-1.5
-1
-0.5
log_10 Wavenumber (cpm)

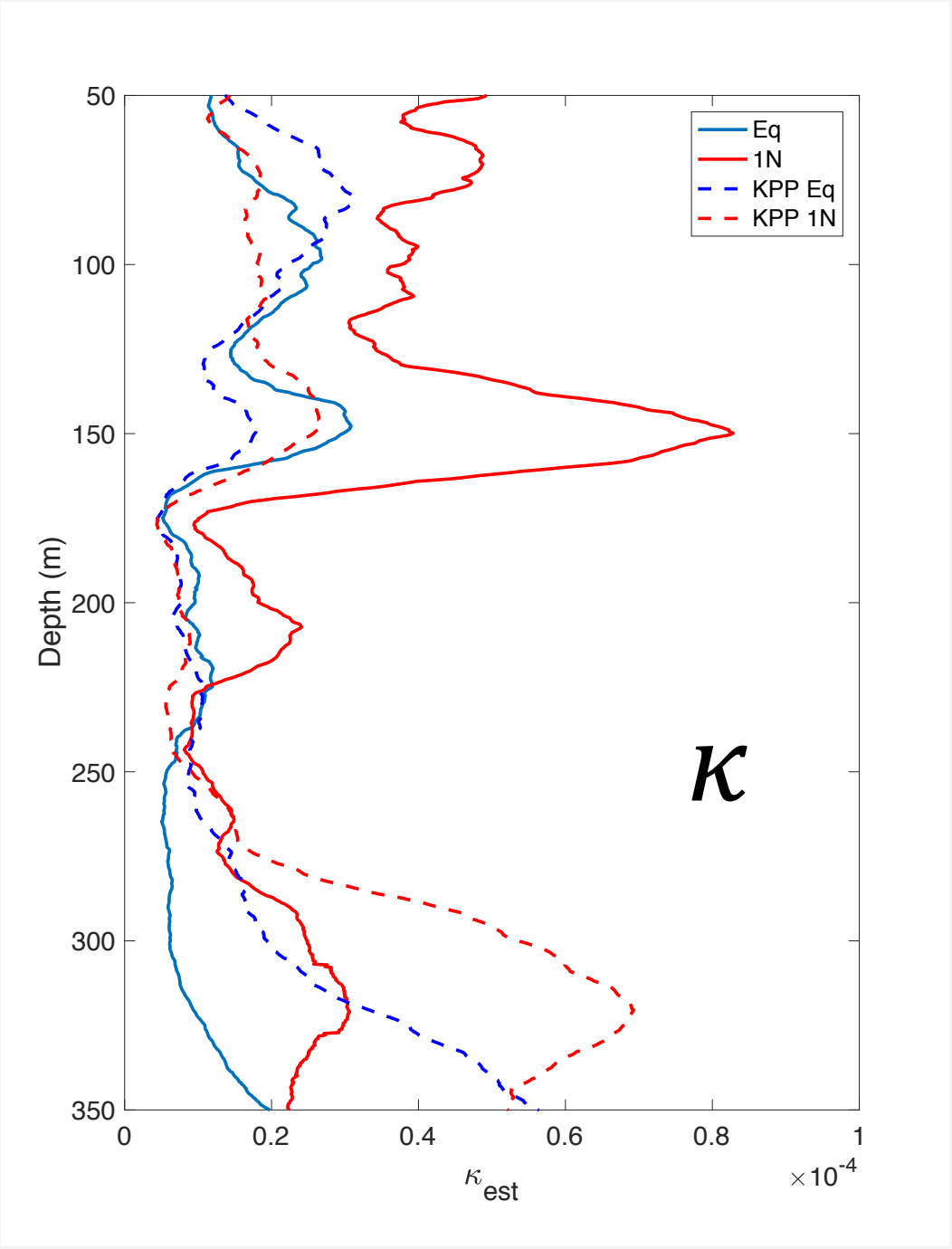

Depth (m)
50
100
150
200
250
300
4/26
4/27
4/28
4/29
4/30
5/1
5/2
5/3
0.05
0
-0.05
a
b
0.04
0.02
0
5/5
5/6
5/7
5/8
5/9
5/10
5/11
c
d


Depth (m)
0
50
100
150
200
250
300
1S
EQ
1N
2N
3N
4N
5N
Latitude
a
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
100-120m
fQ (10^-15 s^-3)
10
8
6
4
2
0
0.5S
EQ
0.5N
1N
1.5N
2N
2.5N
3N
Latitude
b
180-200m
fQ (10^-15 s^-3)
4
3
2
1
0
-1
0.8S
0.6S
0.4S
0.2S
EQ
0.2N
0.4N
0.6N
Latitude
c


50
100
150
200
250
300
350
Depth (m)
-10
-9
-8
-7
log10 ϵ
Eq


50
100
150
200
250
300
350
Depth (m)
-10
-9
-8
-7
log10 ϵ
1N


50
100
150
200
250
300
350
Depth (m)
0
1
2
3
$\tilde{u}^2$


Eq
1N
KPP Eq
KPP 1N
Depth (m)
50
100
150
200
250
300
350
0
0.2
0.4
0.6
0.8
1
κ_{est}
$\times 10^{-4}$
κ

Parameterization if S^2, N^2 **NOT** resolved

$$\kappa(\mathbf{x}, t) = \frac{\gamma}{N^2}\,\epsilon(S^2, N^2)$$

$$(S^2, N^2) \sim (\langle U \rangle, \langle N \rangle^2, F(x - x', t - t'), F_T \downarrow)$$