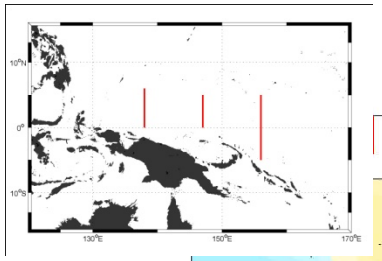
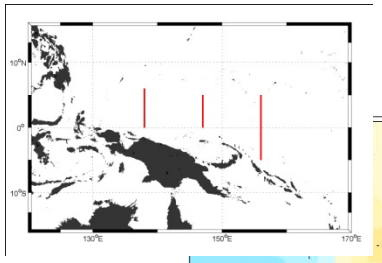
August 2008

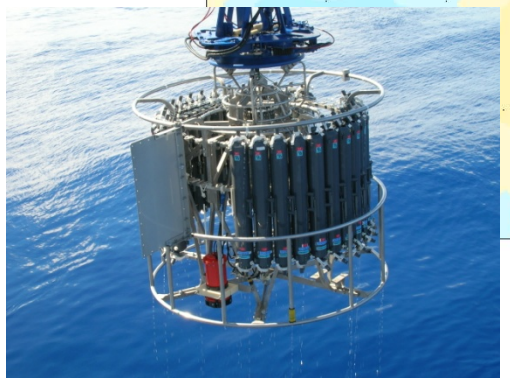


Eq

5N

August 2008





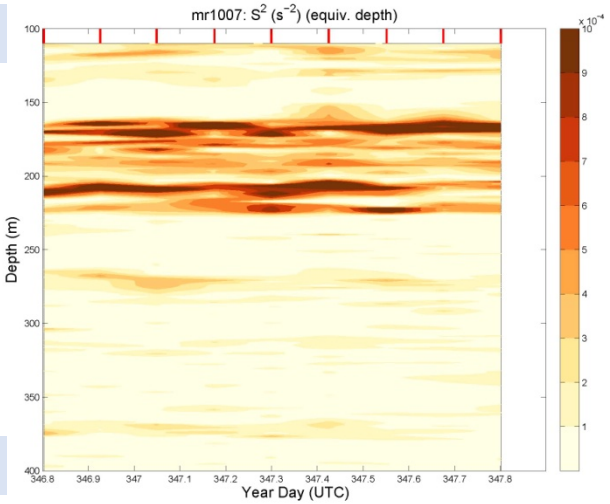
Eq

5N

Eq, 156E

S^2

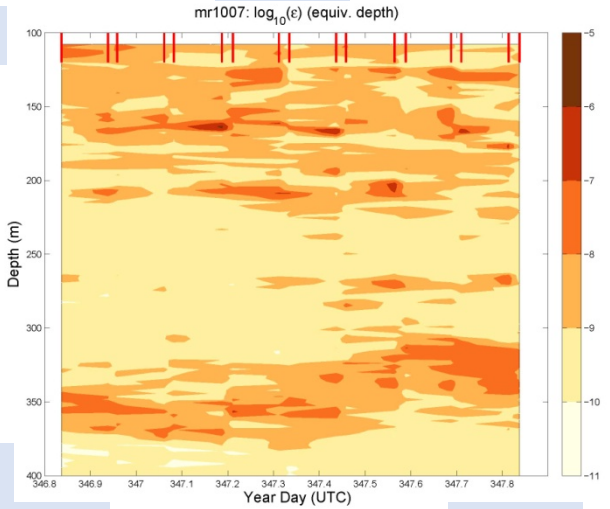
100m



400m

log(ε)

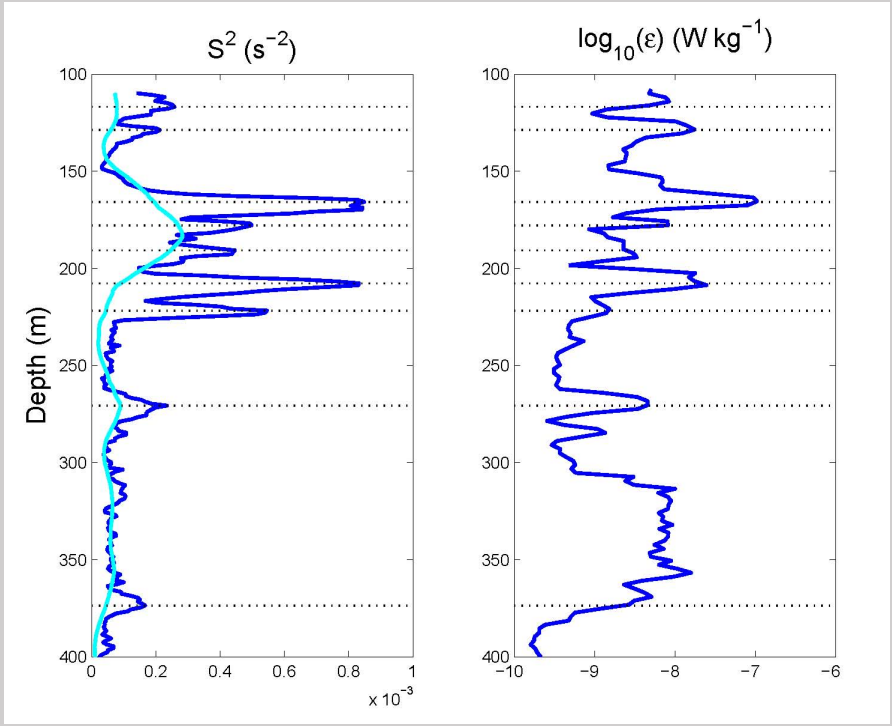
100m



400m

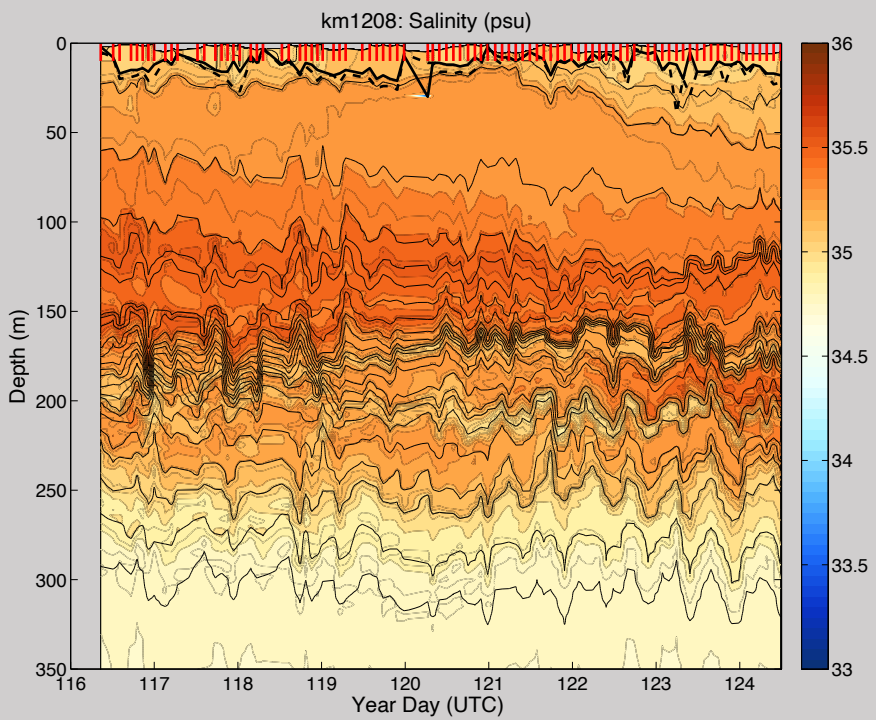
6am

6am

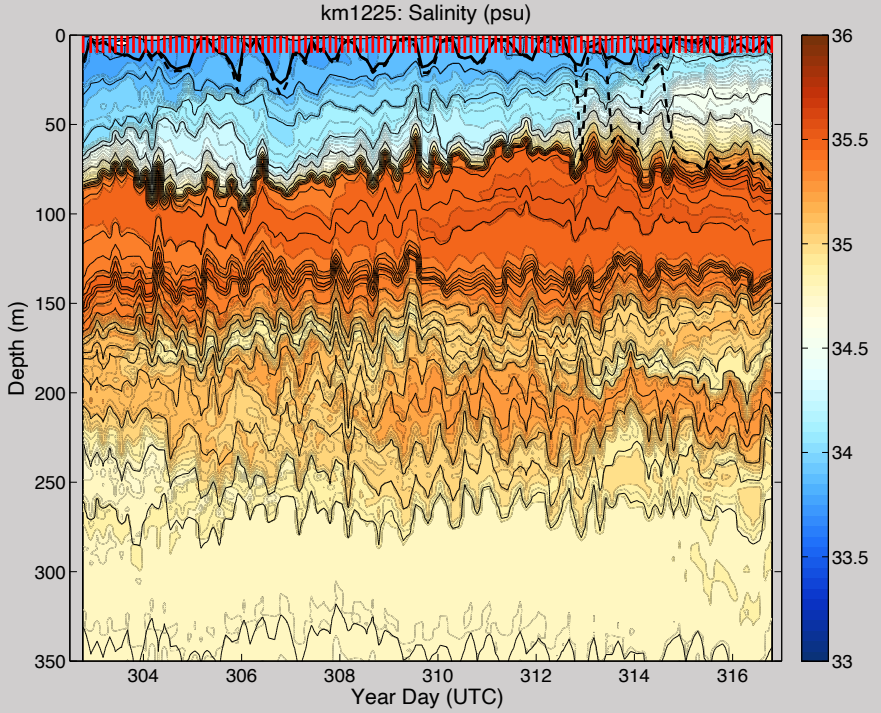


24hr time average

Salinity: 156E, Eq

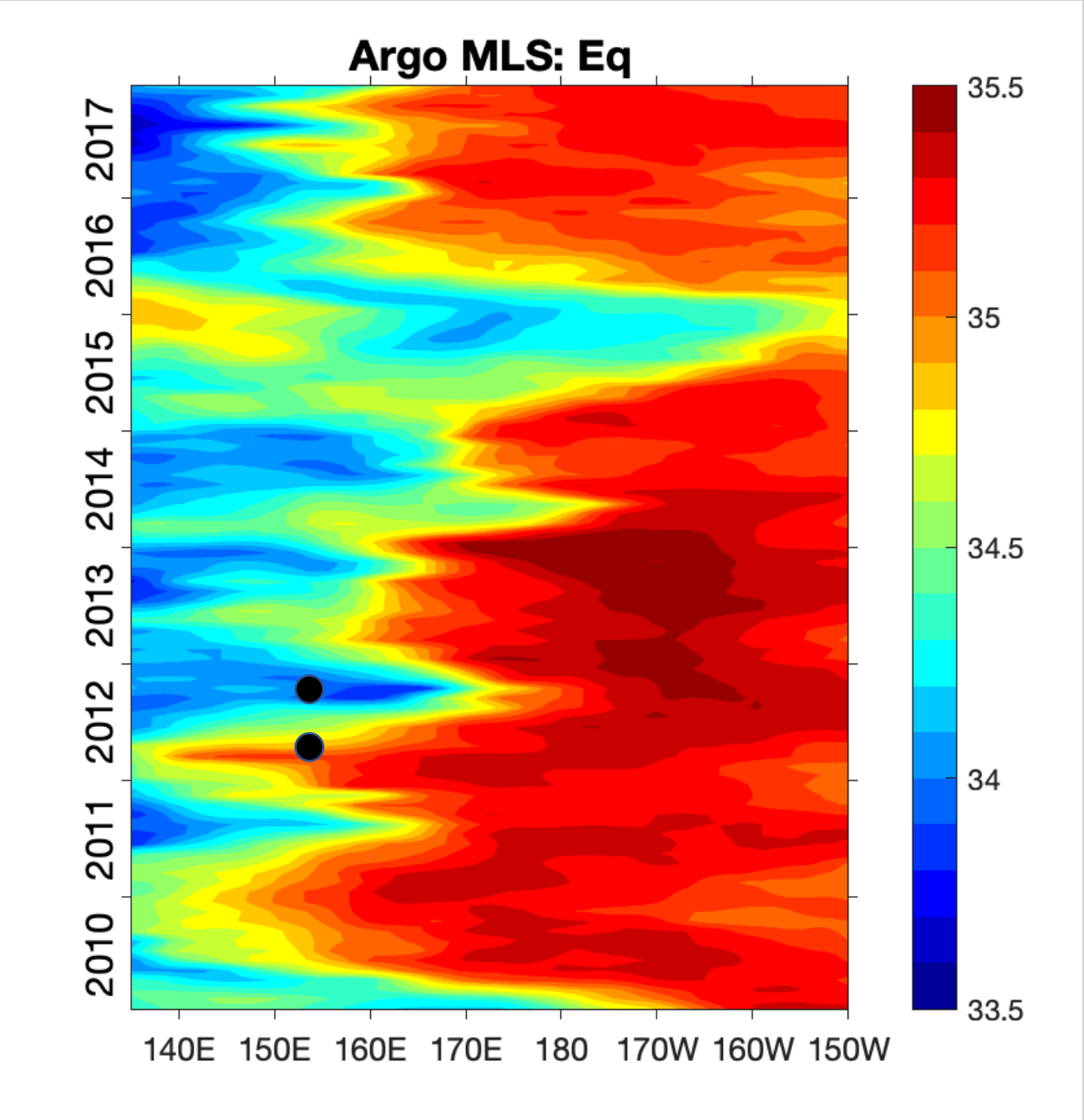


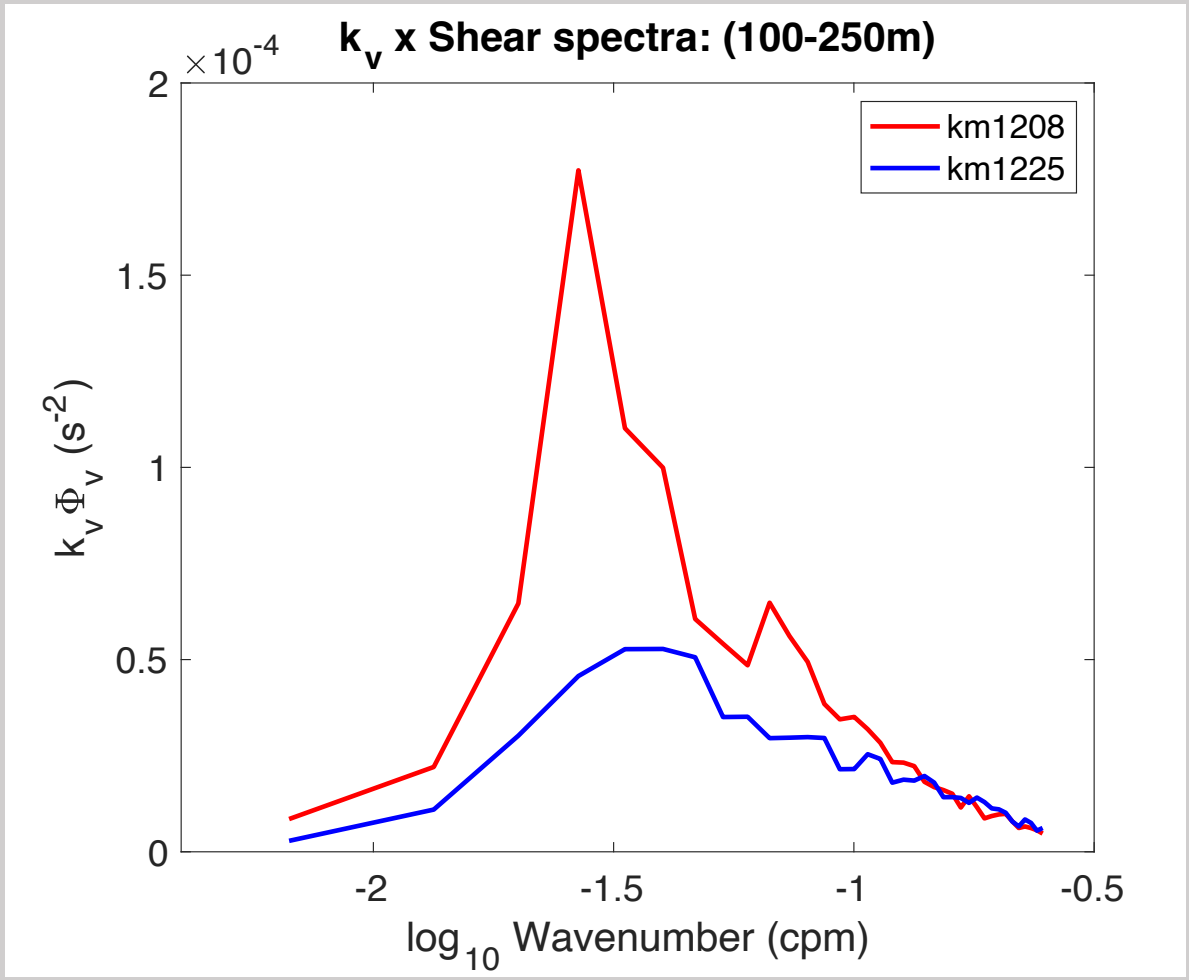
May 2012

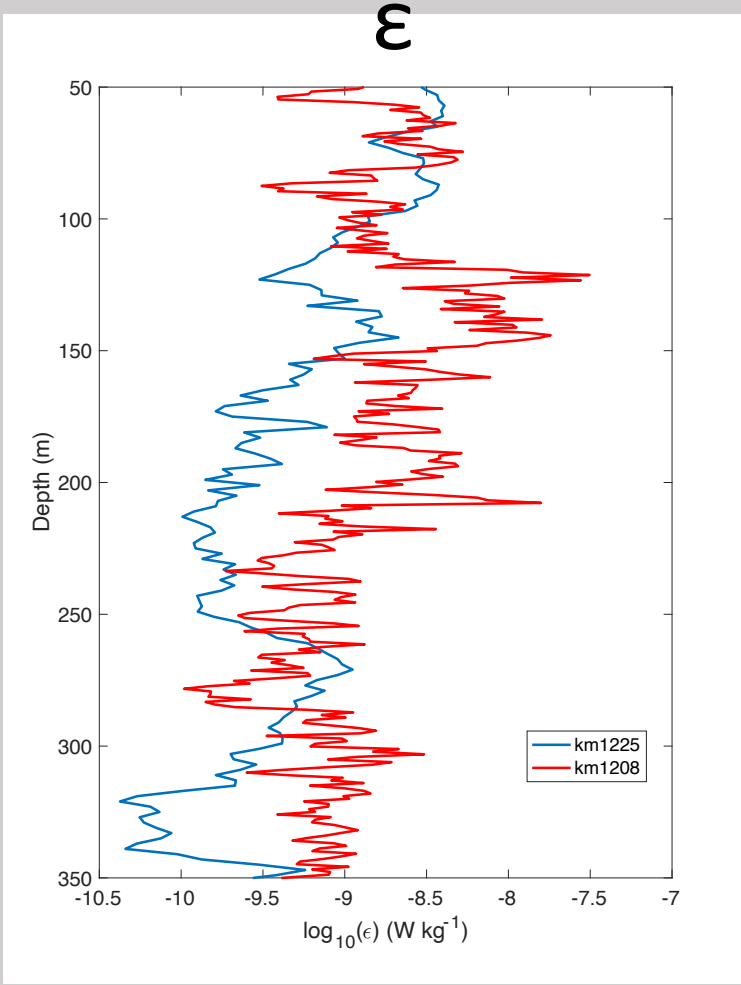


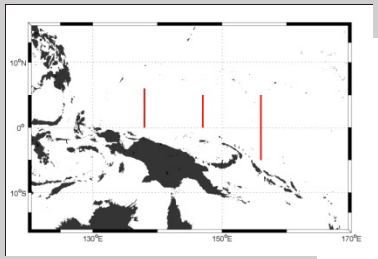
Nov 2012

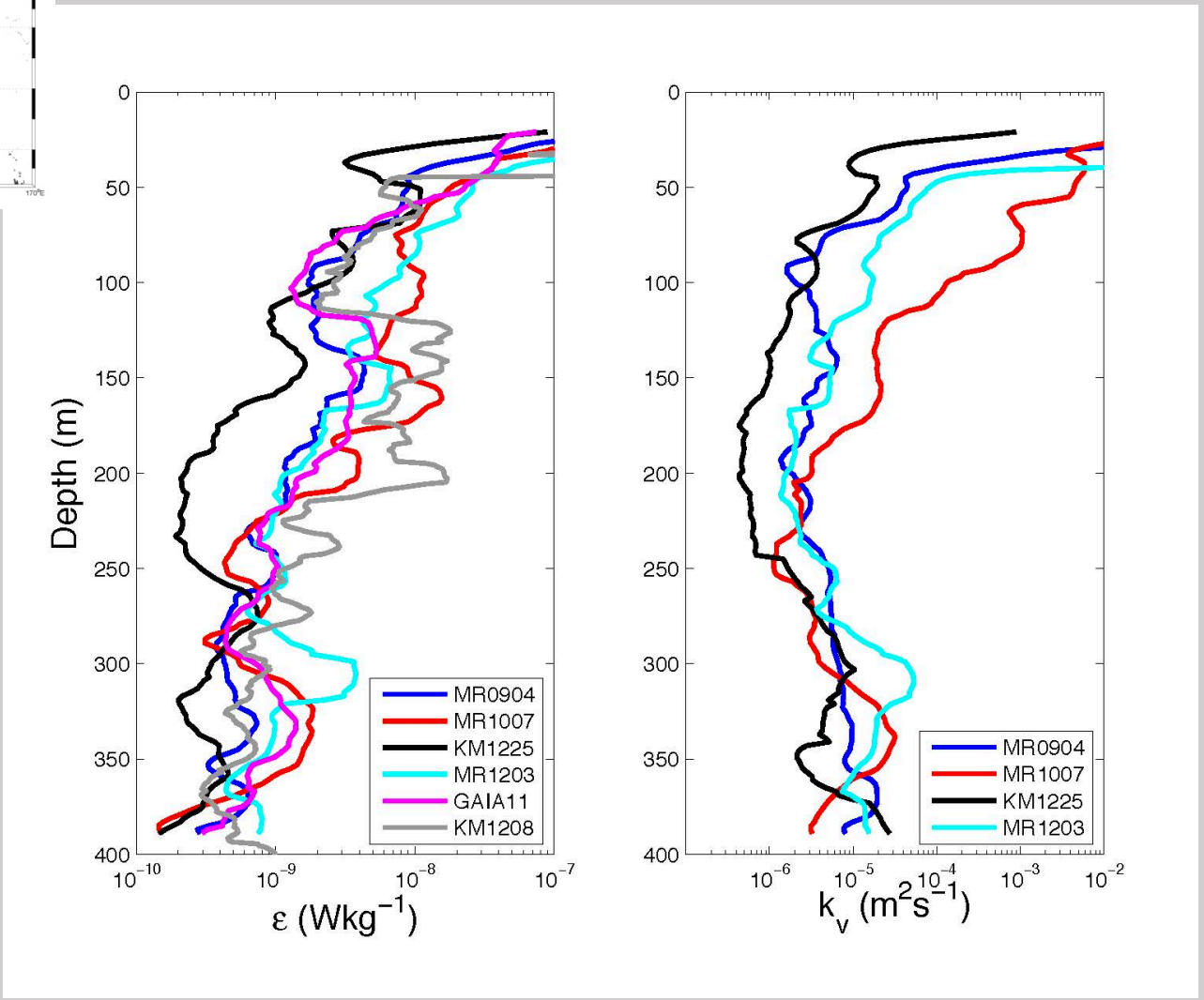
Surface salinity along equator



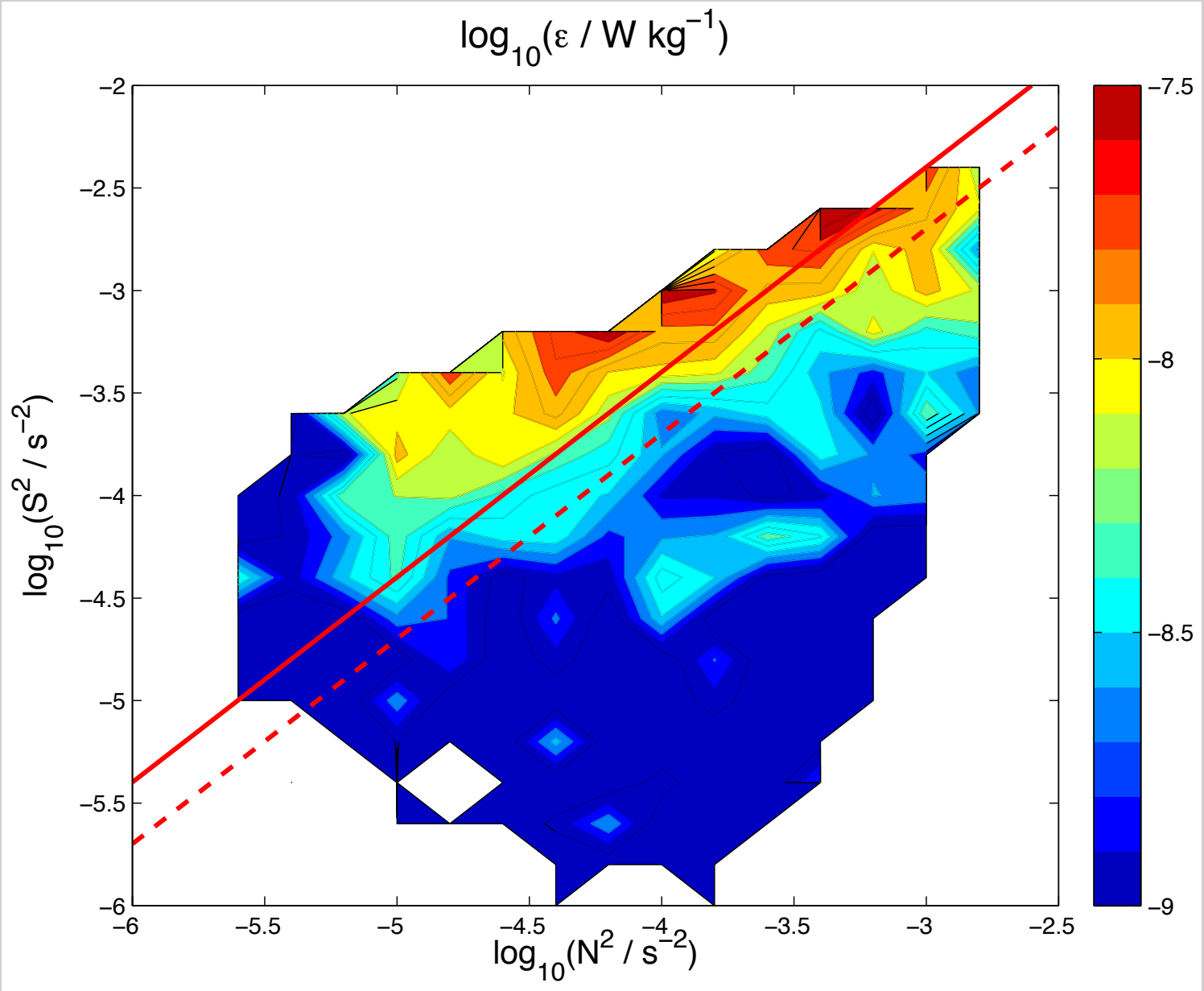

k_v x Shear spectra: (100-250m)
$\times 10^{-4}$
2
1.5
1
0.5
0
$k_v \Phi_v$ (s^{-2})
km1208
km1225
-2
-1.5
-1
-0.5
$\log_{10}$ Wavenumber (cpm)


ε
50
100
150
200
250
300
350
Depth (m)
-10.5
-10
-9.5
-9
-8.5
-8
-7.5
-7
$\log_{10}(\epsilon)$ (W kg^{-1})
km1225
km1208





Enhanced mixing within and above equatorial thermocline induced by small vertical scale features


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

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

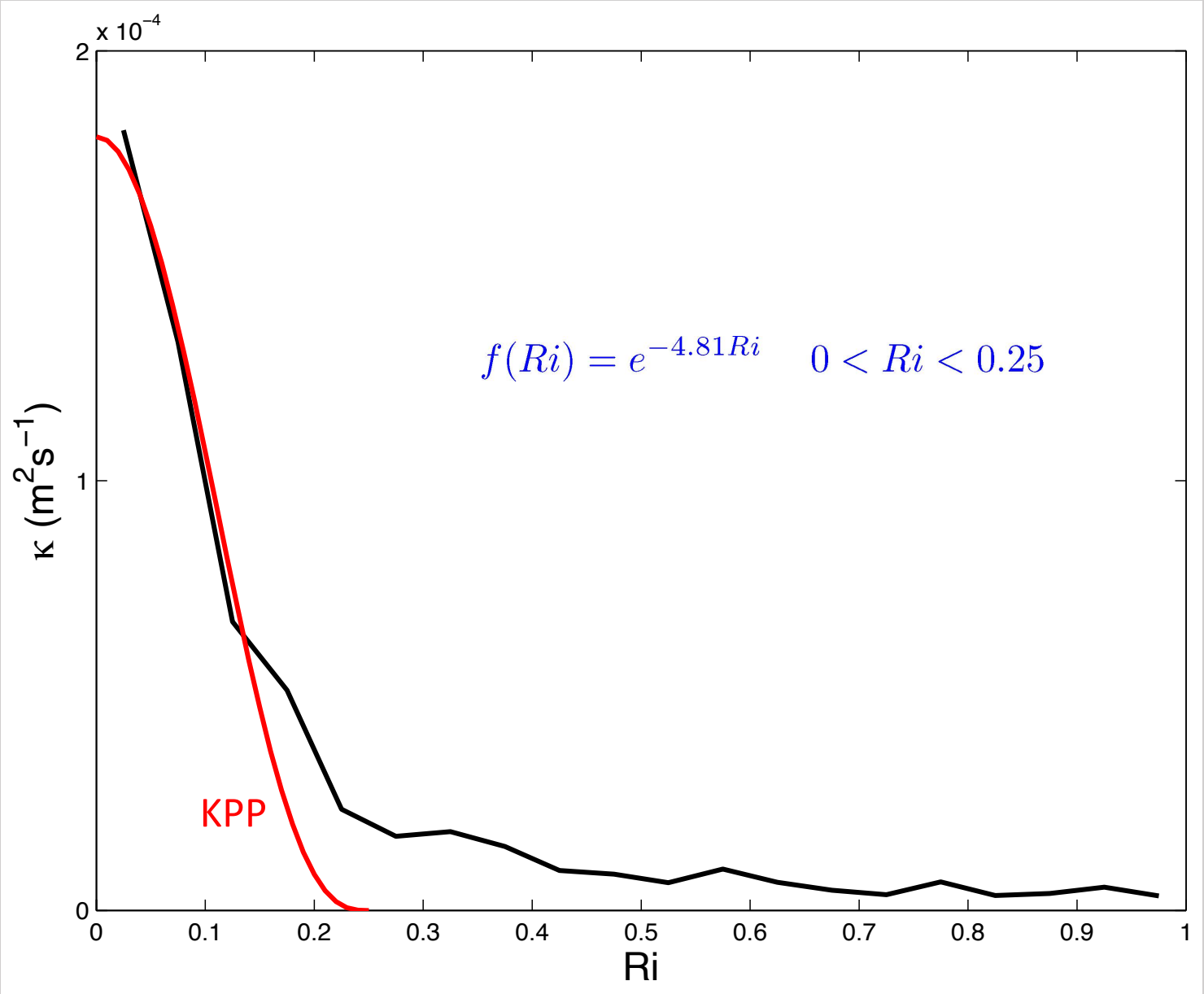
$$\epsilon = \ell_v^2 N^3 f(Ri)$$

then

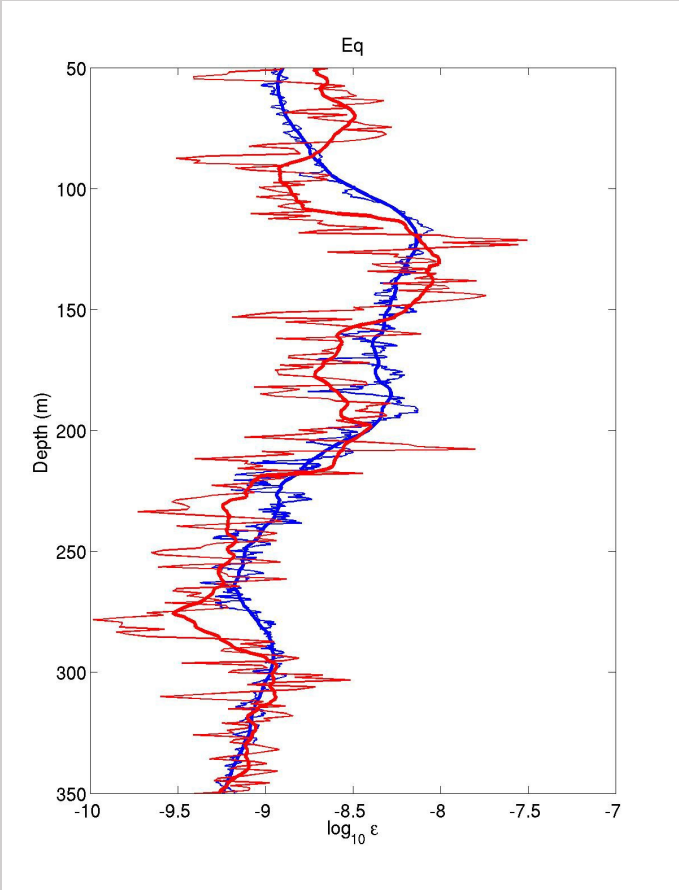
$$\ell_v = c\frac{u_t}{N}$$

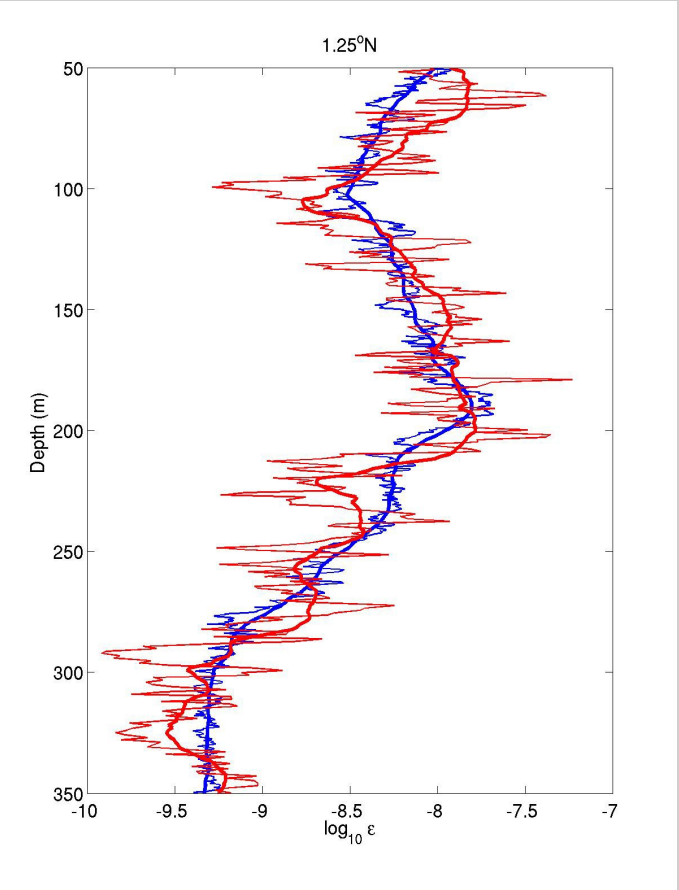
$$u_t \simeq 0.1\tilde{u}$$

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


x 10^-4
2
1
0
κ (m^2 s^-1)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Ri
$f(Ri) = e^{-4.81Ri} \quad 0 < Ri < 0.25$
KPP

Eq, 156E





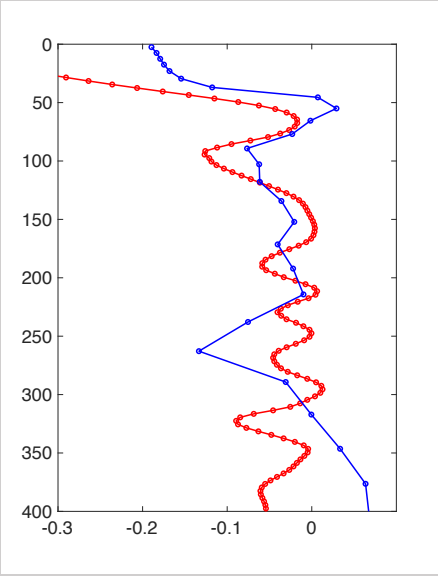
1N, 156E

Observed versus Estimated ε

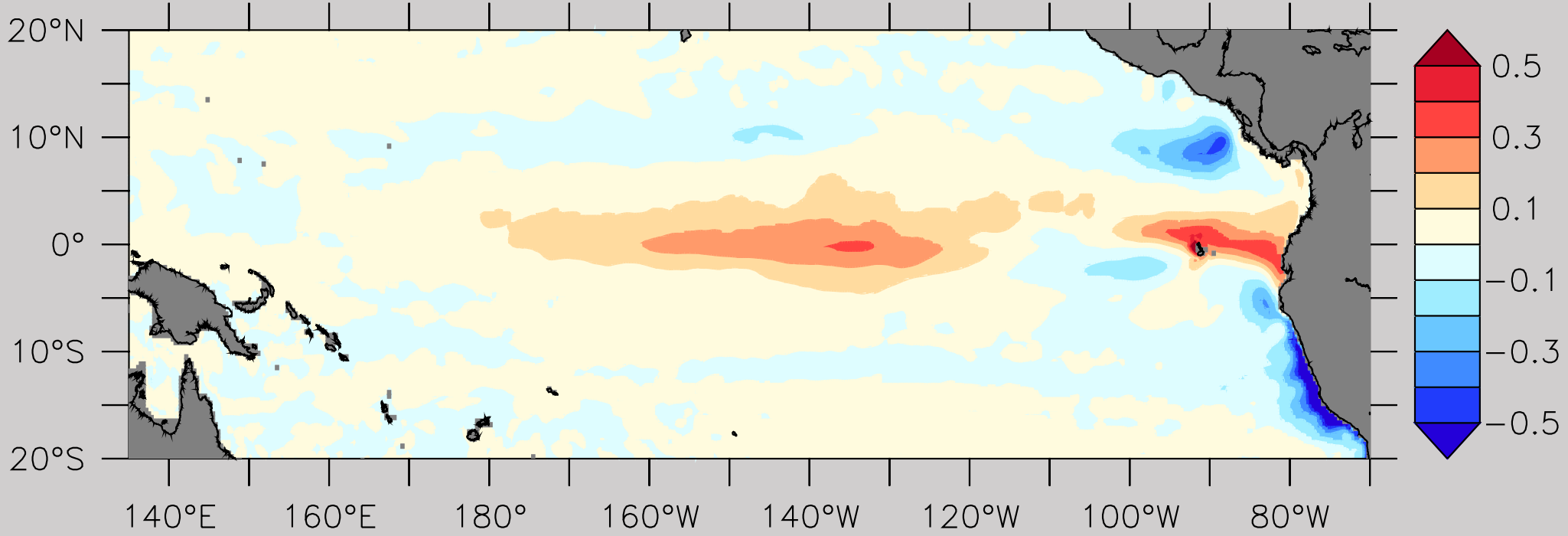
Richards et al, JGR, 2021

But do the fine scales and associated mixing matter?

Capturing fine scales in models by increasing vertical resolution



ΔSST



Model high – Model low

Jia et al, Ocean Modelling, 2021

- Small vertical scales matter – and need to be resolved, or accounted for, in both observations and models

- They provide a link between wind variability and the larger scale ocean state and ENSO

- Think seriously about increasing vertical resolution …
  (or implementing a parameterization for the impact of SVSs)