IMET Buoy: measured surface heat budget

Model-based surface fluxes are not accurate, for example, NCEP1 suggests a longer, cooler winter and little net heating of the ocean.

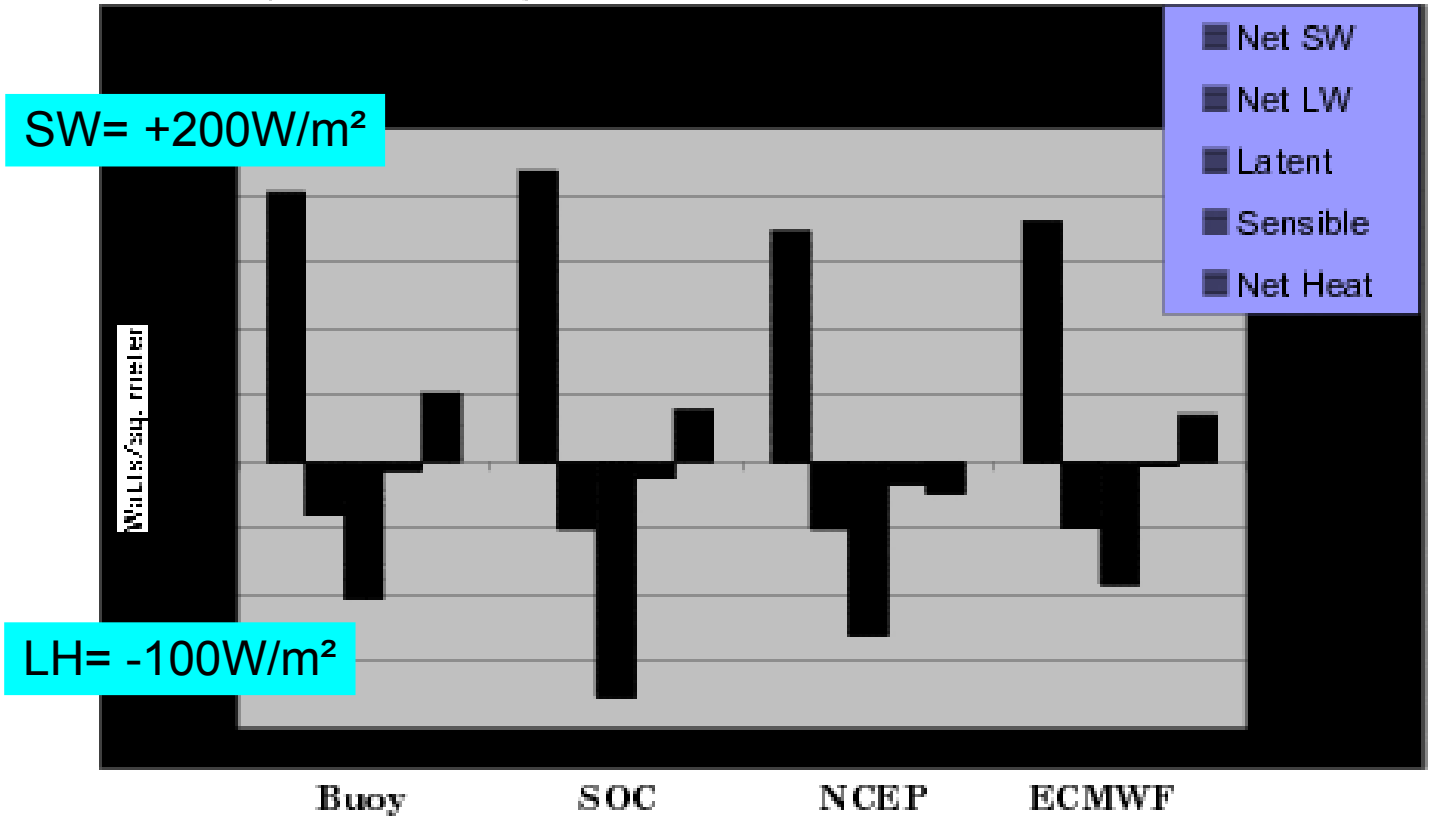
Annual net heat ranges from Buoy - more ocean gain than models, NCEP shows a loss

NCEP stress 30% stronger

Models: rain (.07 to .3 m yr^{-1}) Buoy: no rain to .03 m yr^{-1}

The ocean maintains a positive surface heat budget, contributing to the the maintenance of PBL inversion, SCu decks, & the subtropical anticyclone.

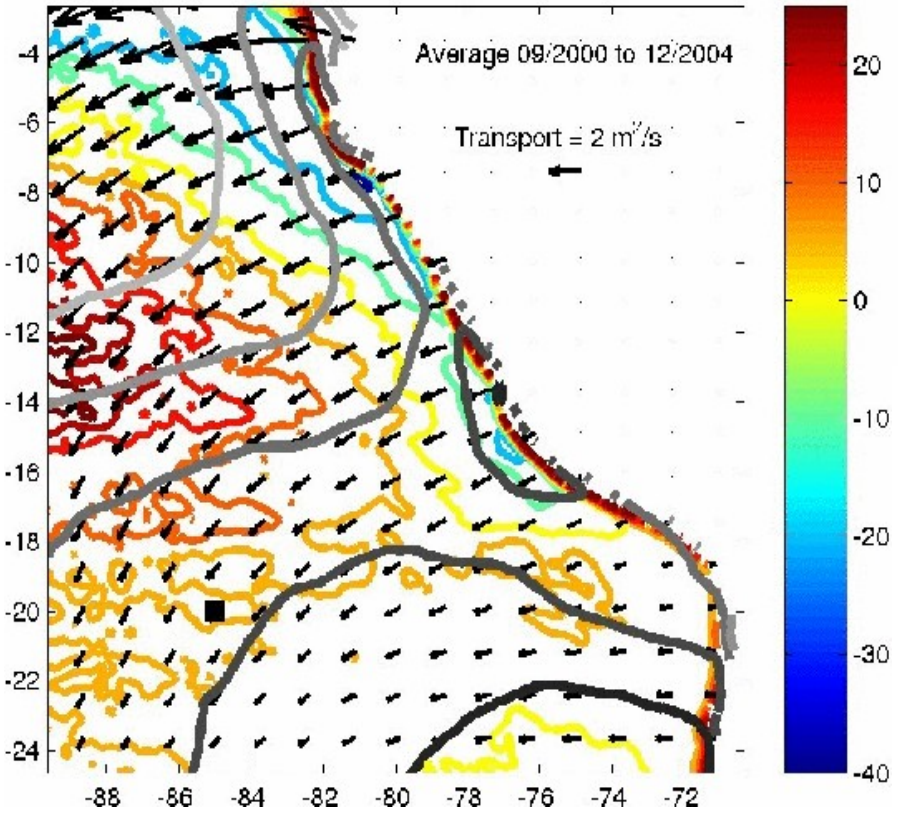
How?

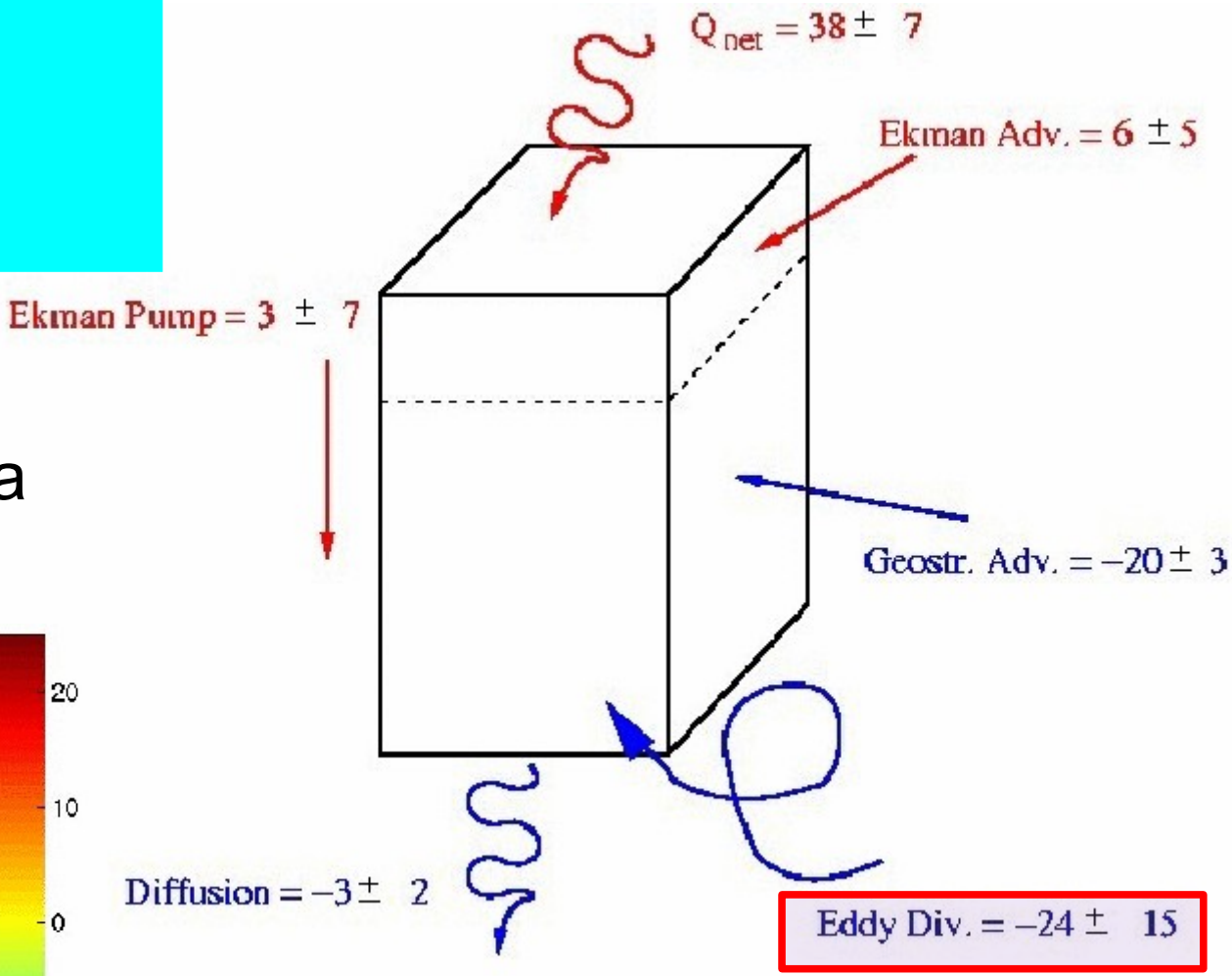


UKMO models:
SW = +210:220 W/m²
LH = -120:130 W/m²

A substantial contribution from oceanic variability

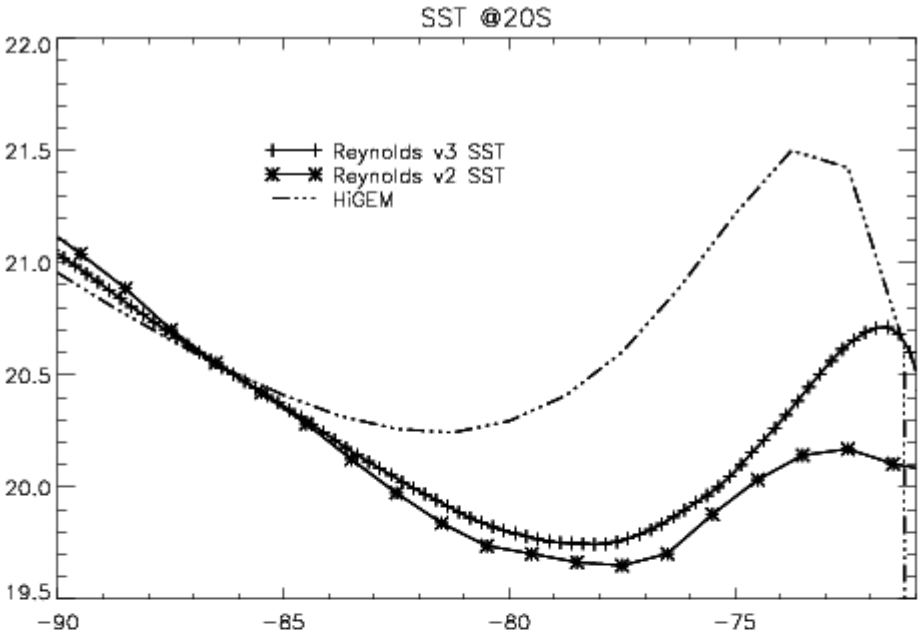
Over more than 3 years, either the heat budget is not maintained, or it is via rectification of variability.





- What variability?
- What time-scales?
- What length-scales?
- What structures?
- What mechanisms?
- What processes?

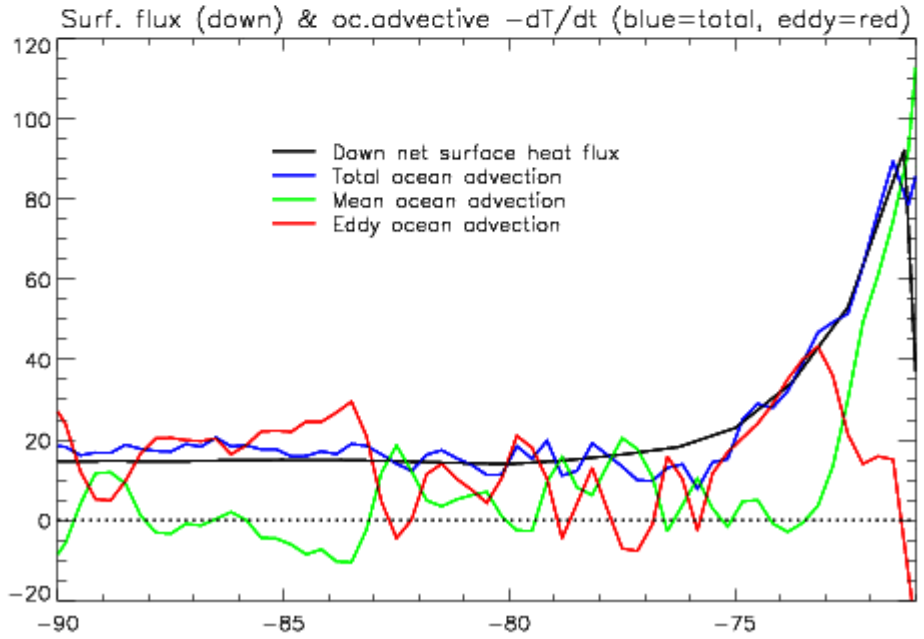
Ocean SEP heat advection in the HiGEM model

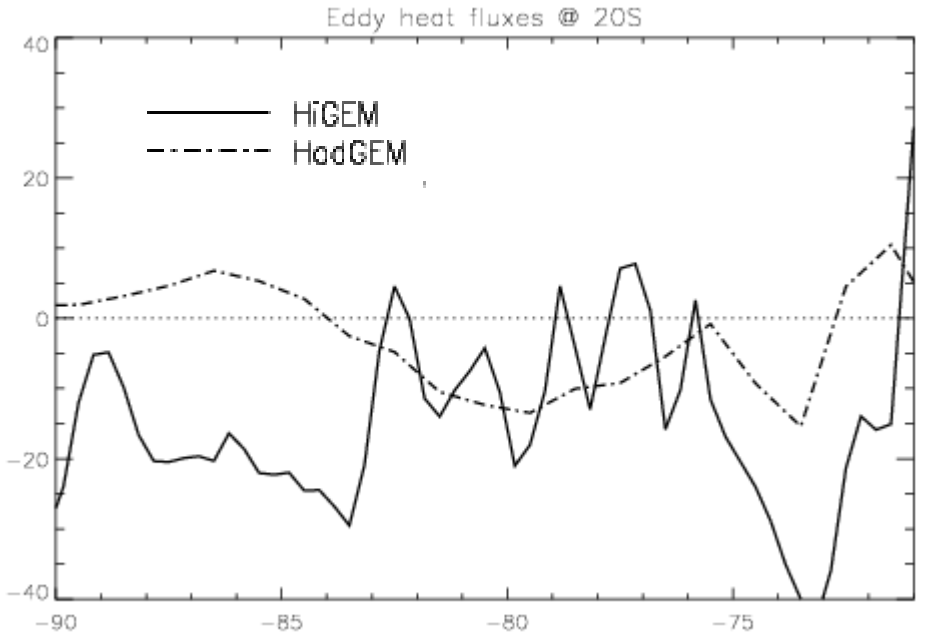


The vertically integrated oceanic heat budget as represented in HiGEM is consistent with Bob Weller's observational estimate.

This is accompanied by surface SST climatology very close to observed.

HadGEM has much weaker variability.



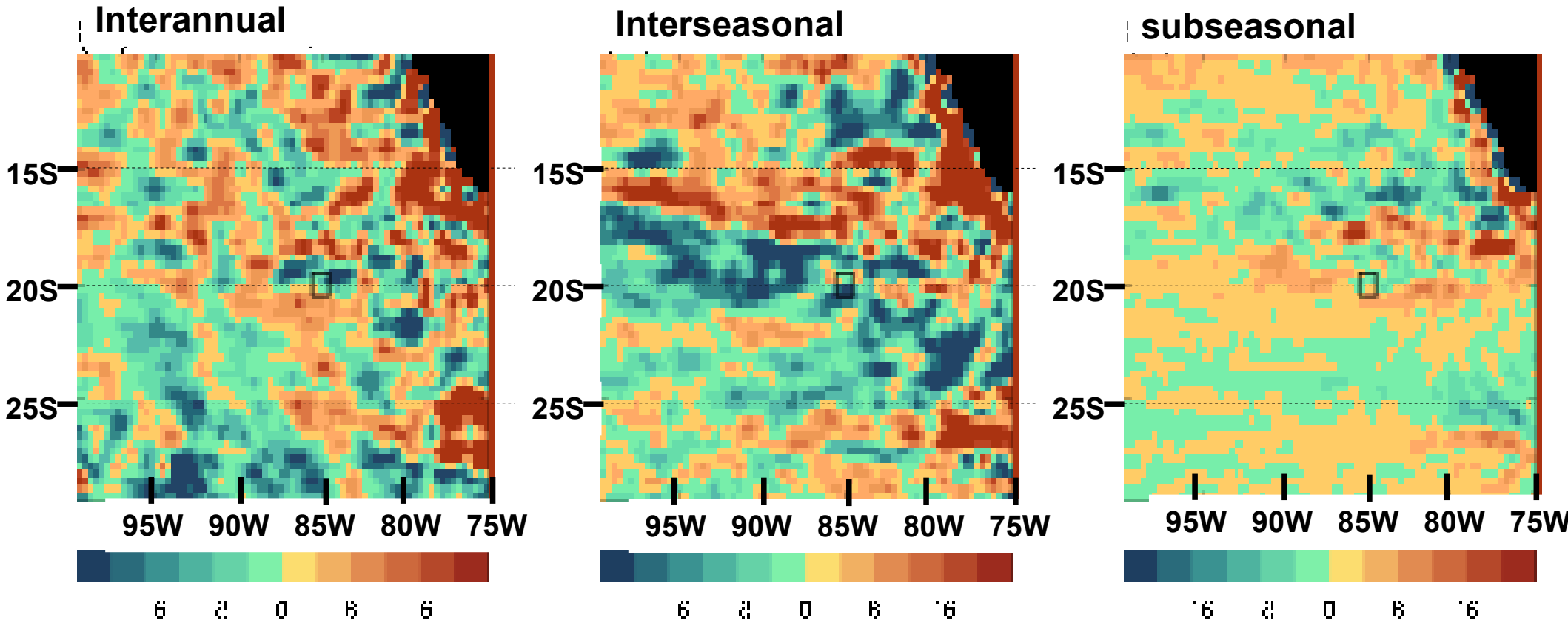


Contributions from different time-scales

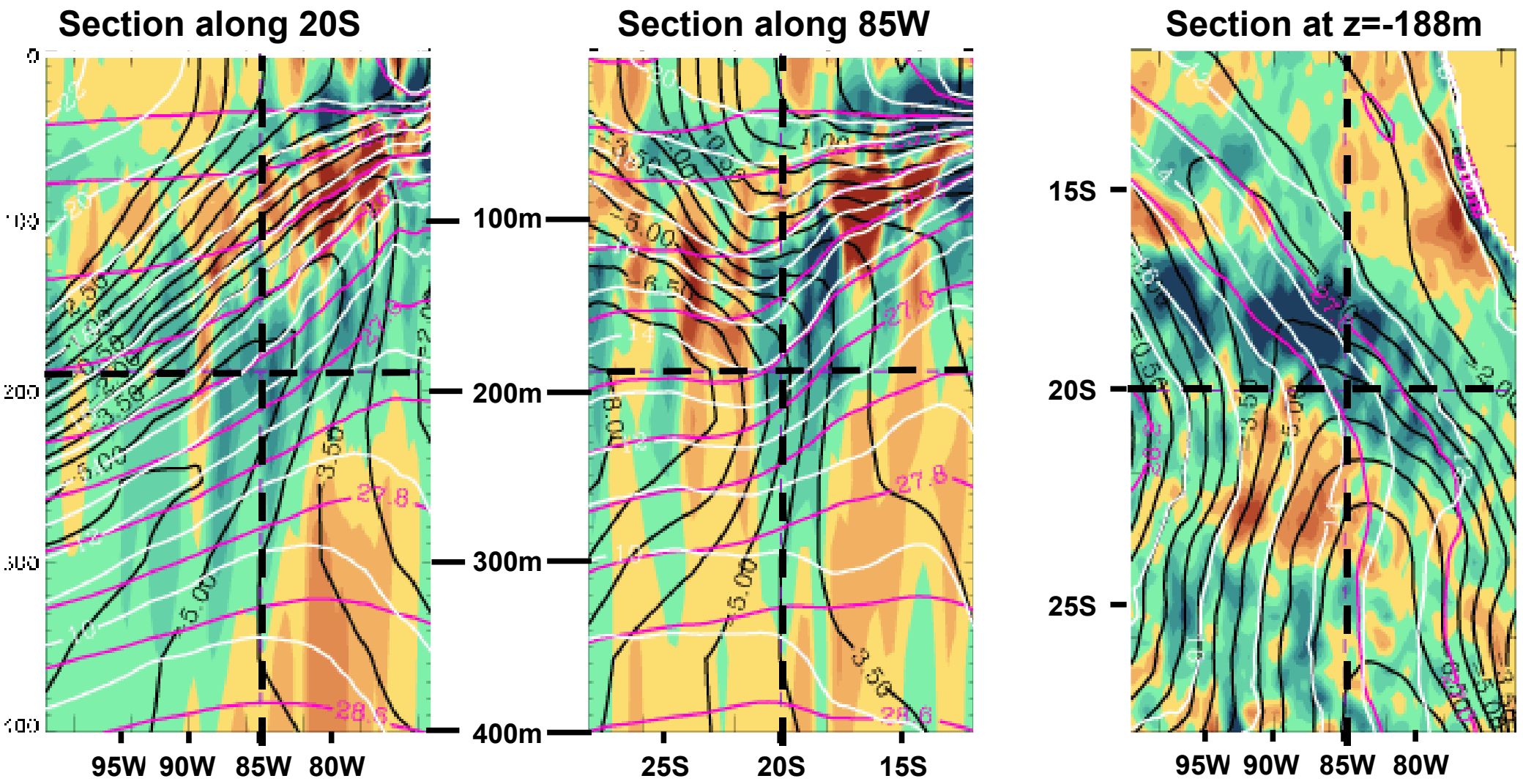
$$u\cdot\nabla T = \underbrace{\bar{u}\cdot\nabla\bar{T} + u'\cdot\nabla T'}_{\text{rectifying}} + \underbrace{u'\cdot\nabla\bar{T} + \bar{u}\cdot\nabla T'}_{\text{non-rectifying}}$$

$u' = u'_1 + u'_2$ etc.; spatially or temporally filtered components

Geostrophic transients with 4 month < P < 1 yr are dominant
Organised in large-scale pattern

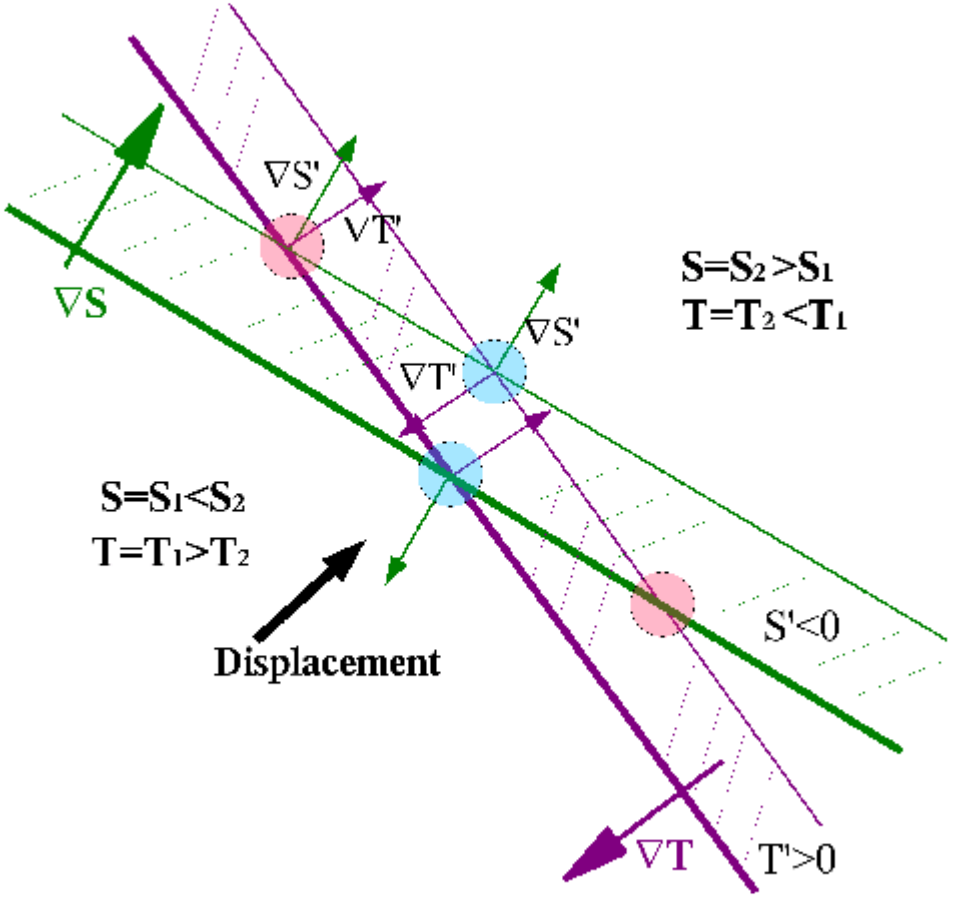


The distribution of rectifying transient advection in relation with the T,S climatology



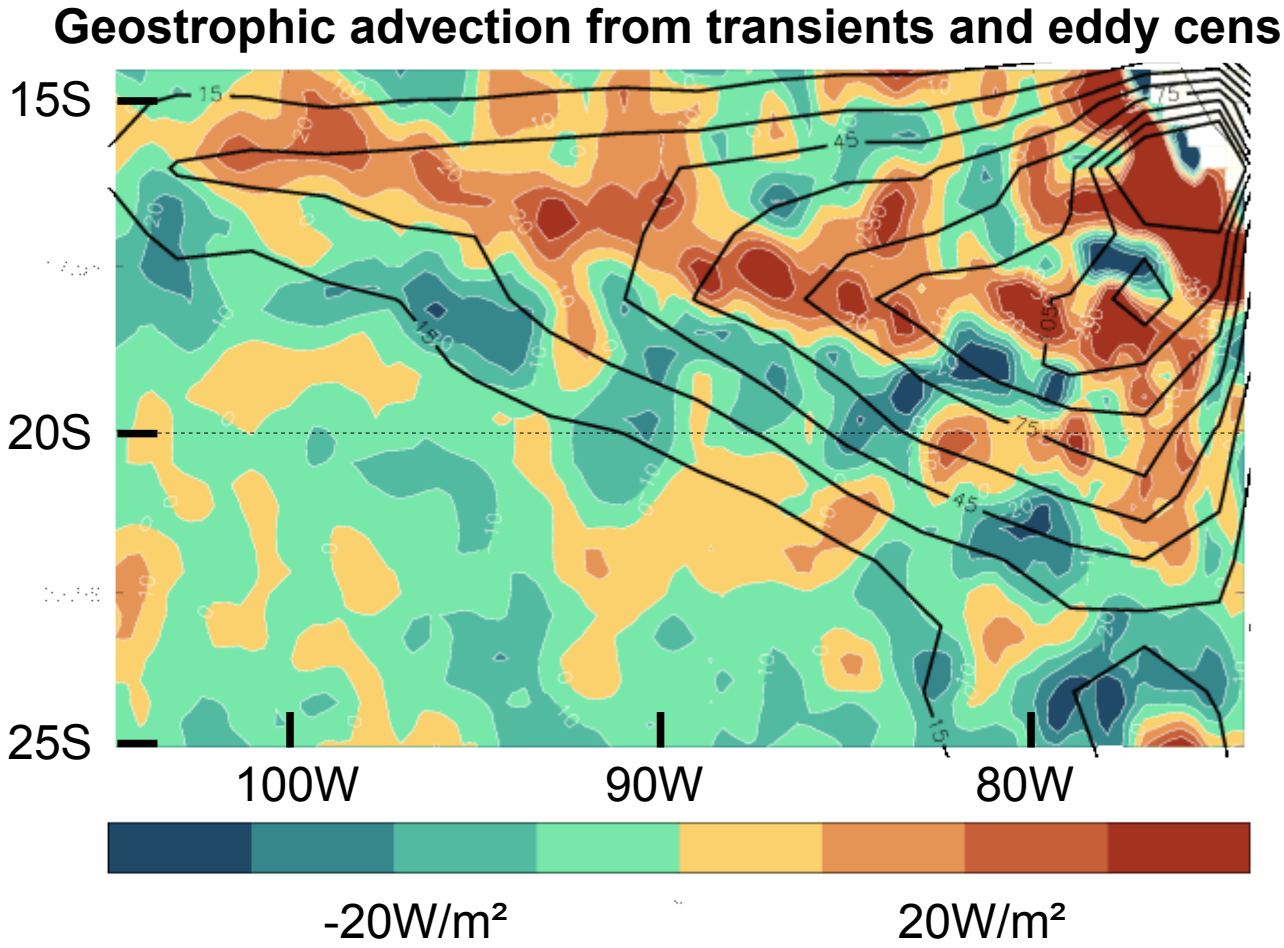
A conceptual model: transient displacements of a sharp salinity ("spiciness") front

Geostrophic temperature advection anomalies:
$u' \cdot \nabla T' \sim \nabla S' \times \nabla T'$

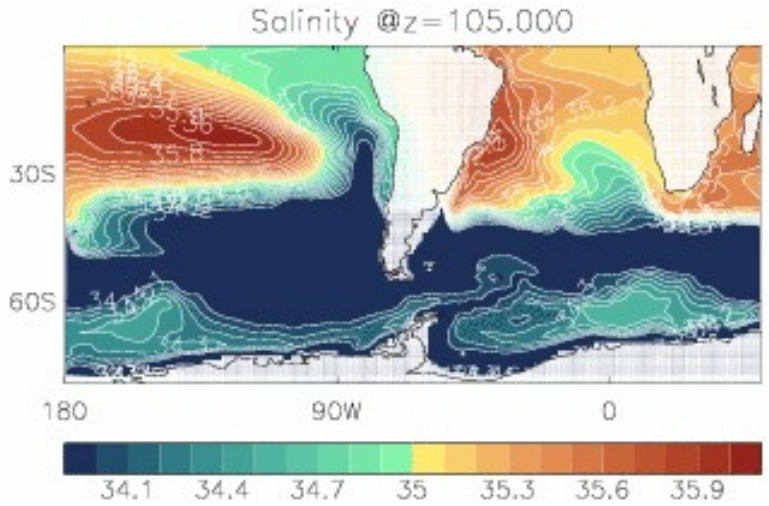


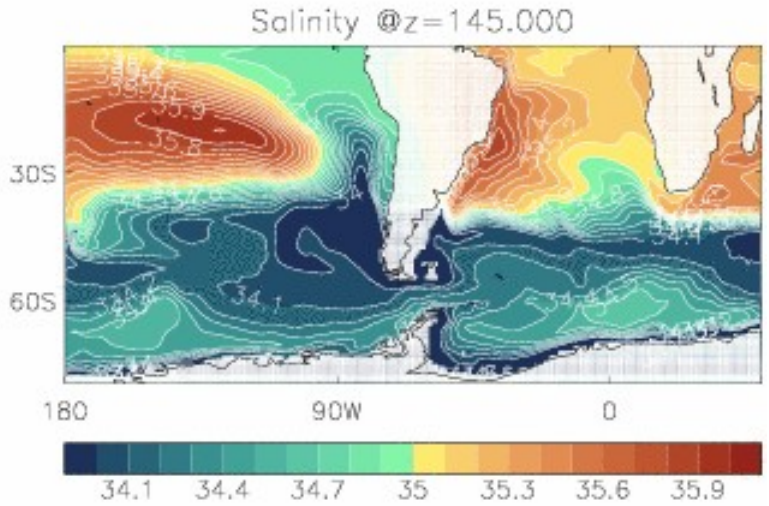
As long as the displacement is larger than the width of the fronts, the associated advection tendencies generate a rectifying dipolar pattern

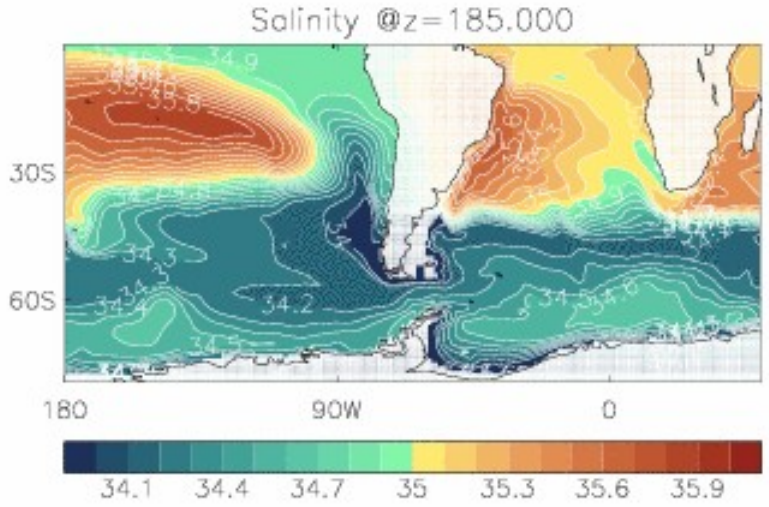
HiGEM represent O-W features with the qualitative characteristics of observed mesoscale ocean eddies

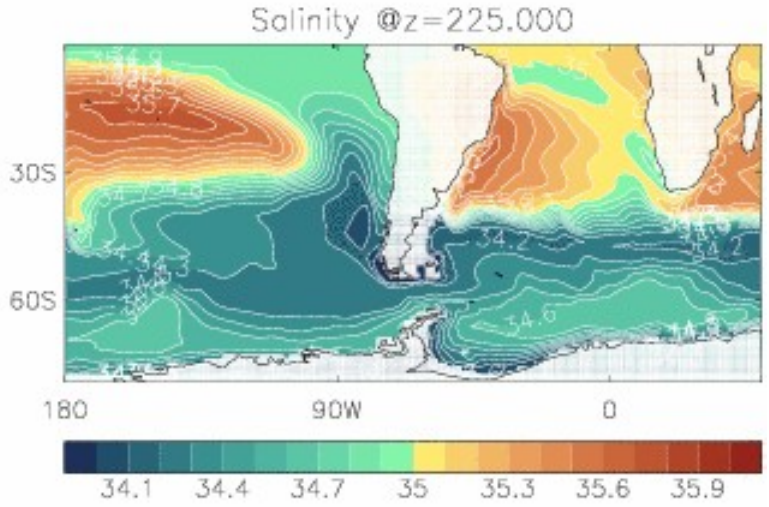


The freshwater intrusion in the eastern south Pacific (& South Atlantic)



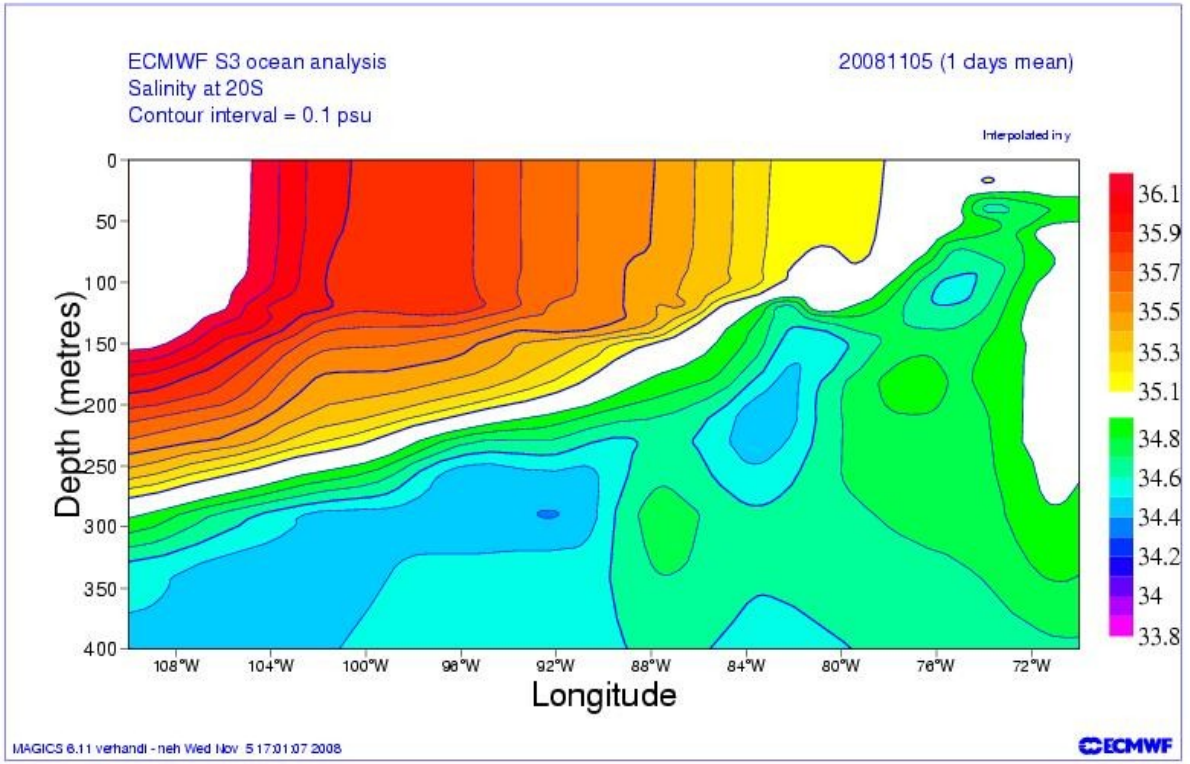


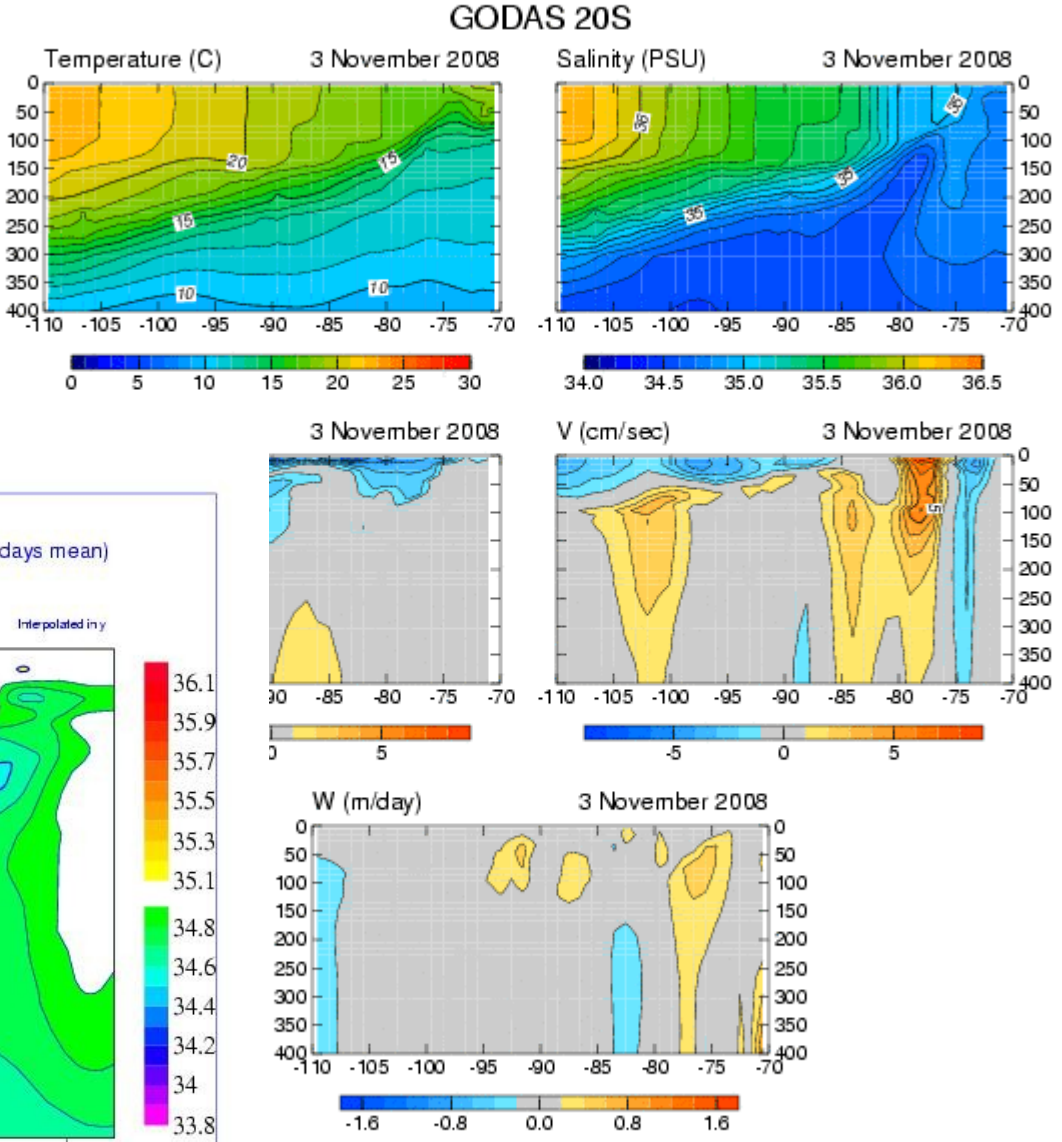




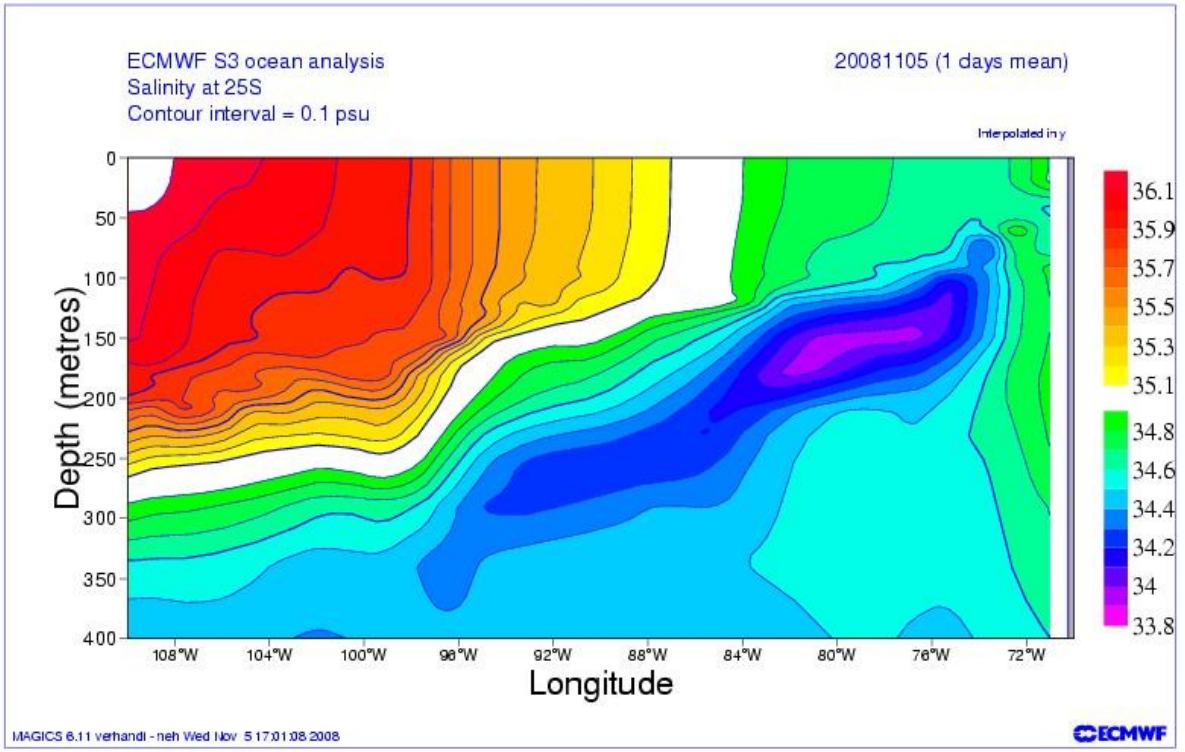
Reanalysis data for present position of S-front and currents

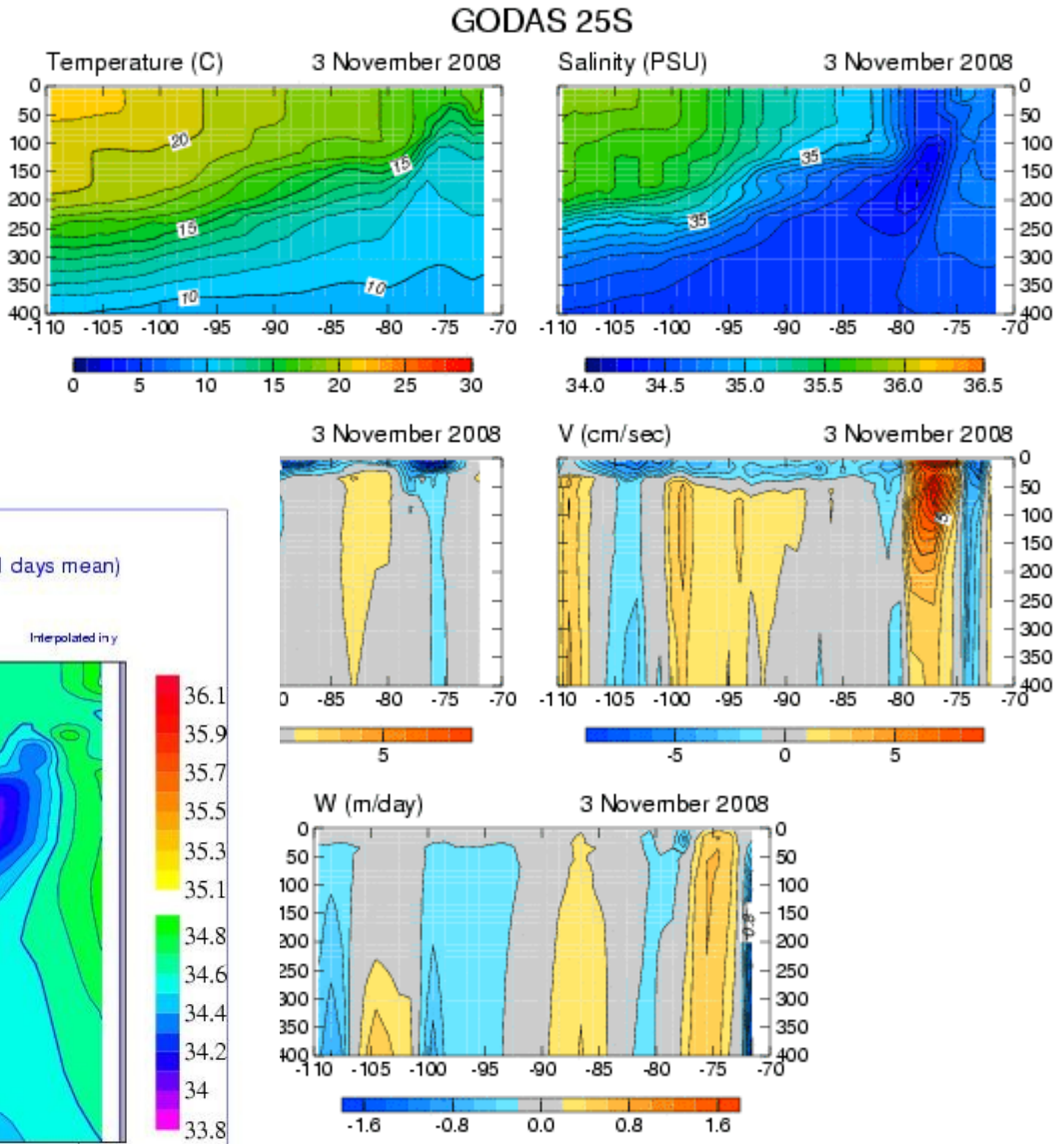
20 South





25 South


ECMWF S3 ocean analysis
Salinity at 25S
Contour interval = 0.1 psu
20081105 (1 days mean)
Interpolated in y
Depth (metres)
Longitude
108°W
104°W
100°W
96°W
92°W
88°W
84°W
80°W
76°W
72°W
36.1
35.9
35.7
35.5
35.3
35.1
34.8
34.6
34.4
34.2
34
33.8
MAGICS 6.11 verhandl - neh Wed Nov 5 17:01:08 2008
ECMWF


GODAS 25S
Temperature (C)
3 November 2008
Salinity (PSU)
3 November 2008
V (cm/sec)
W (m/day)