A nest experiment of the Indonesian Seas

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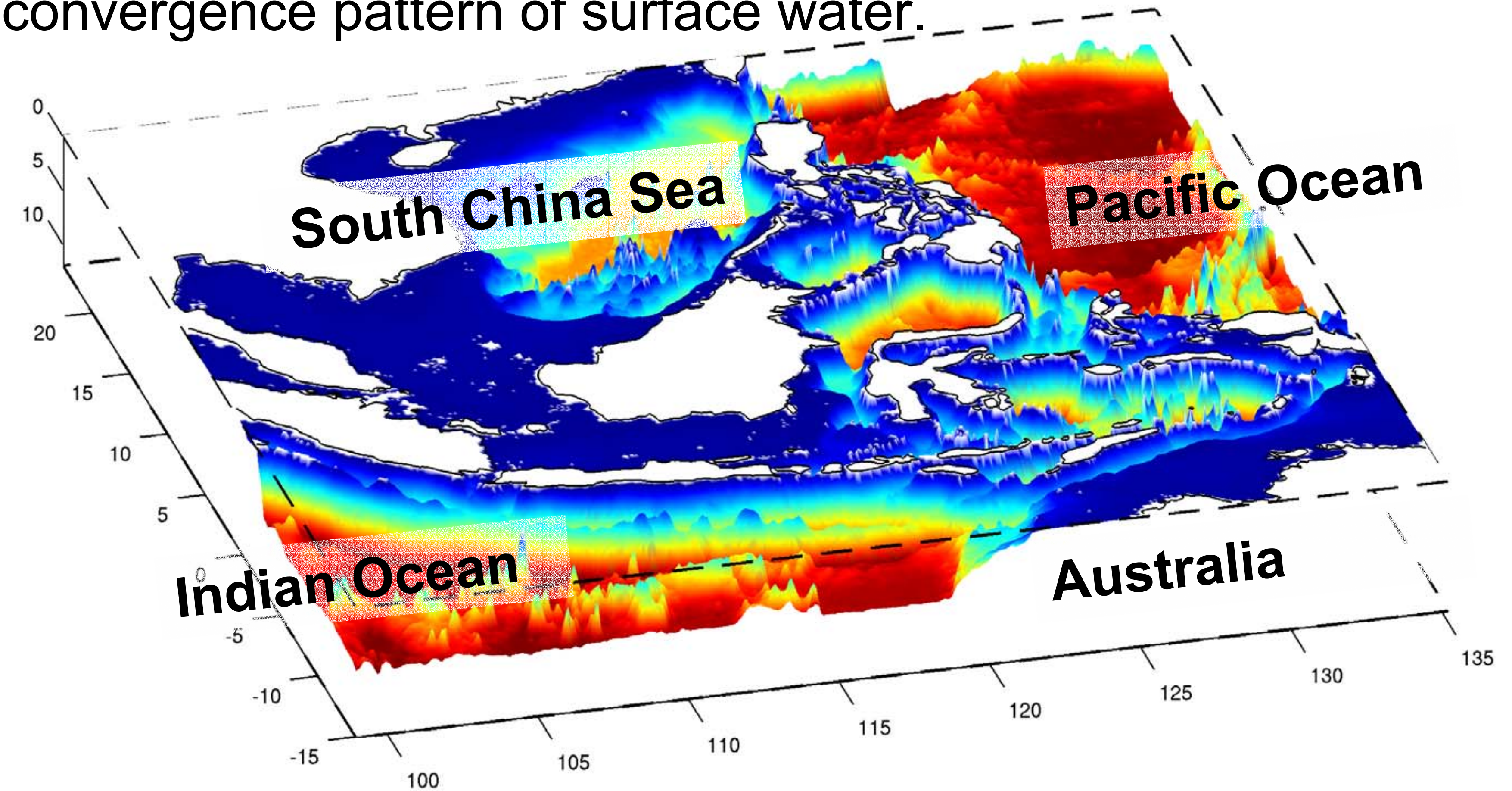
ITF in global climate

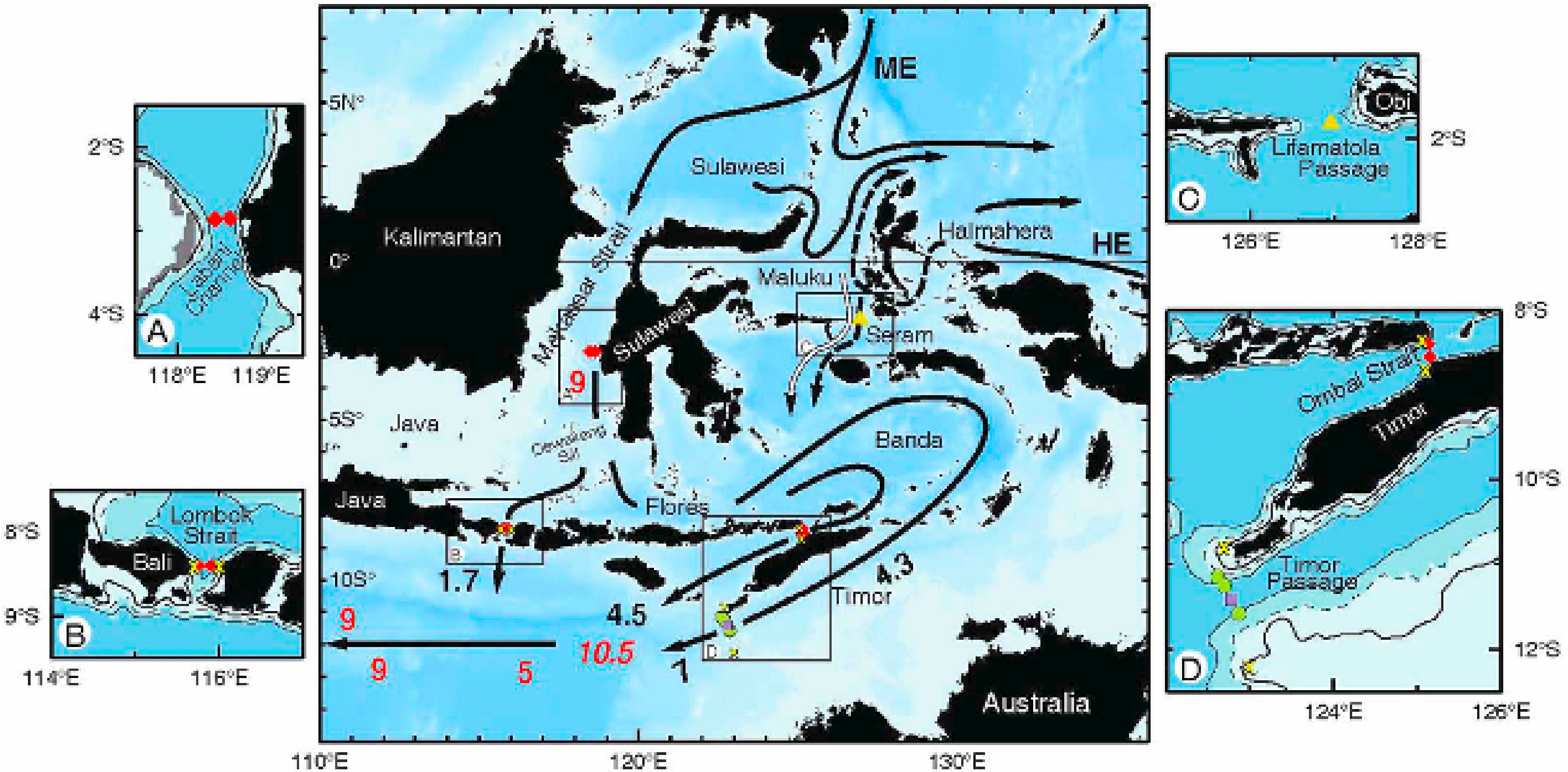
- Large scale observations (by direct measurements and inverse solutions) reveal a significant export of mass, heat, and freshwater from the Pacific to the Indian Ocean through the Indonesian Seas (Indonesian Throughflow, ITF).
- Oceanic heat and freshwater fluxes (by ITF) affect atmosphere-ocean coupling with potential impacts on the ENSO and monsoon phenomena (Webster 1998).
- The uncertainty of the size of ITF is the dominant source of error in the heat and freshwater budget analyses for the Pacific (Wijffels et al., 2001) and Indian Oceans. (Robbins and Toole, 1997)

The Indonesian seas

• The Indonesian Seas provide more than a complex array of seas through which the ITF flow. The ITF water (Pacific water) is altered by air-sea flux of heat and freshwater, by (tidal) mixing, by upwelling/downwelling due to seasonal divergence/ convergence pattern of surface water.

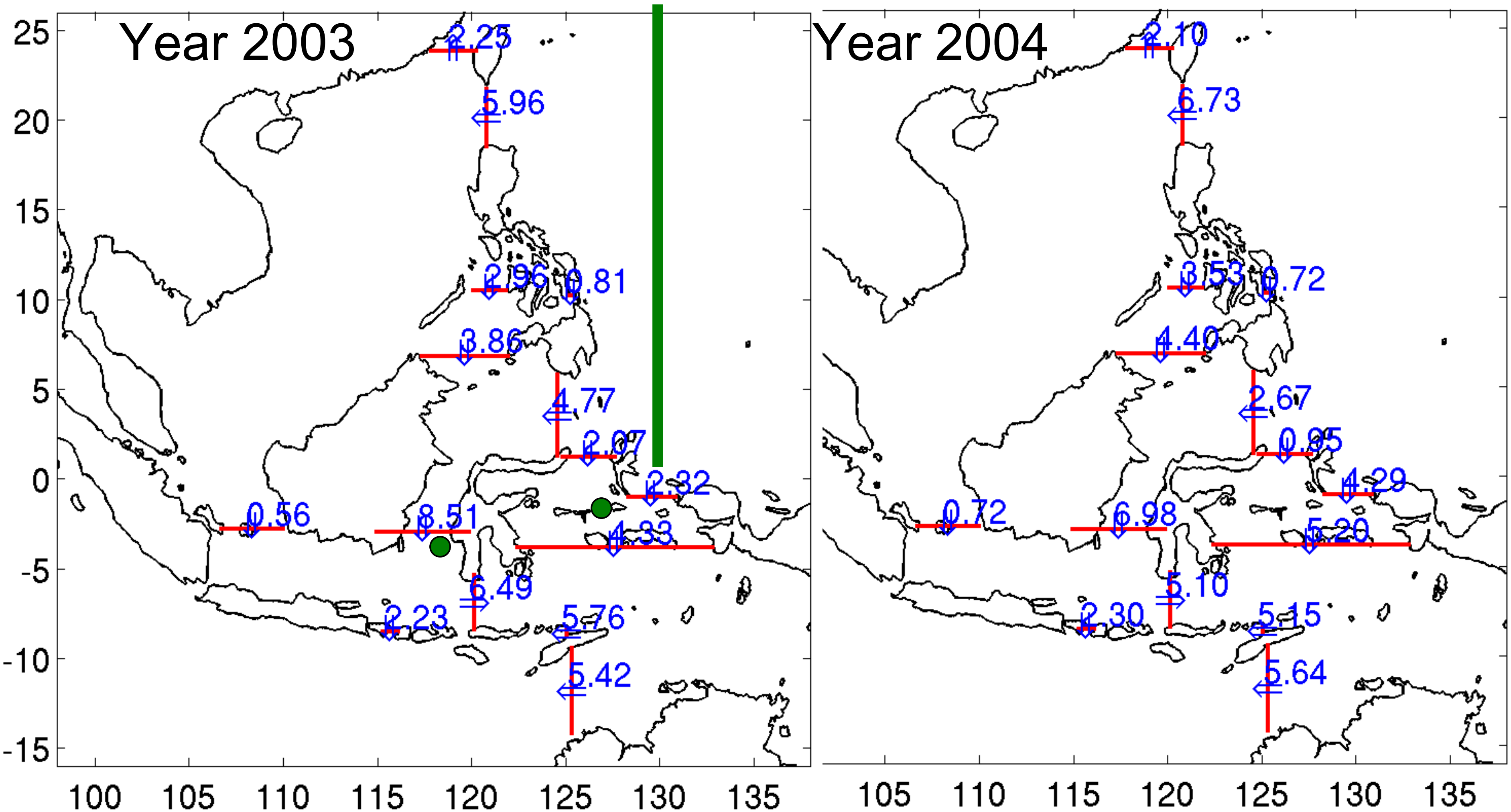


The observed ITF



Schematic of the Indonesian through pathway, Sprintall et al., 2004. EOS.

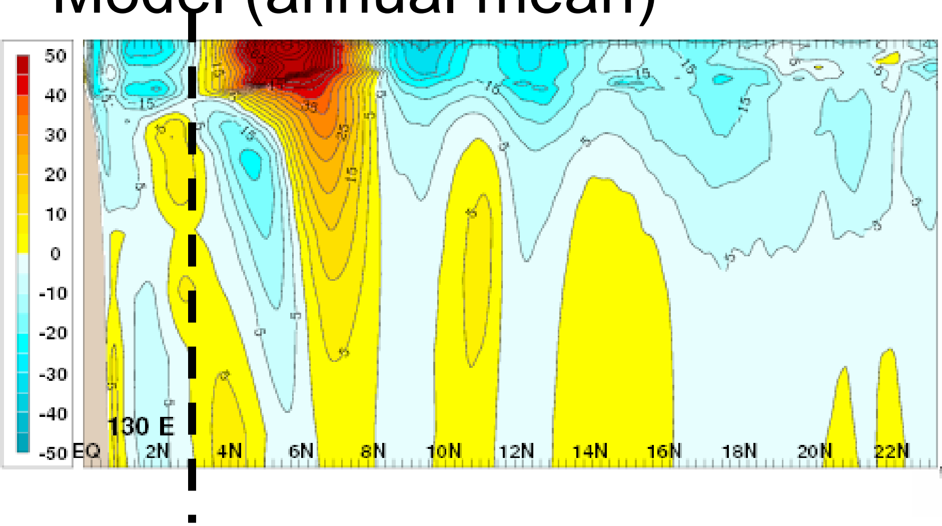
Mean ITF transport in GLBa0.08



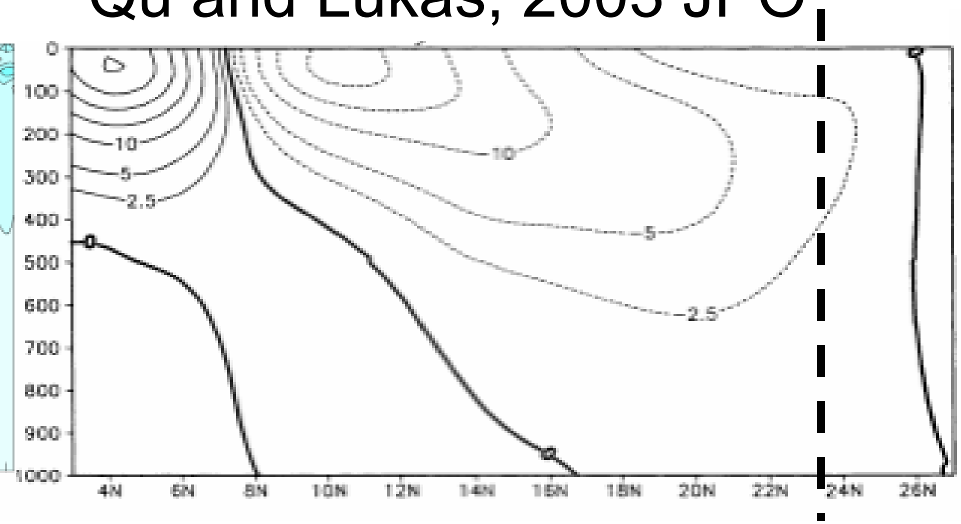
Simulated ITF volume transport (one-year mean) through various passages

At 130°E in Pacific Ocean

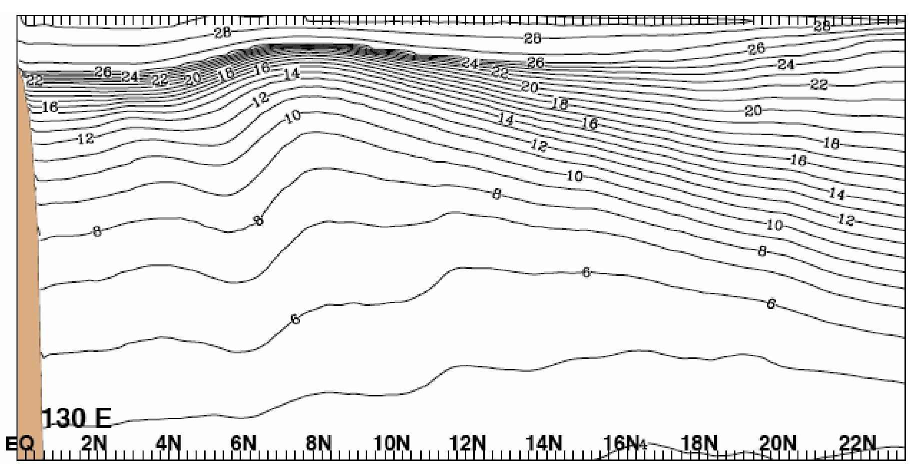
Model (annual mean)



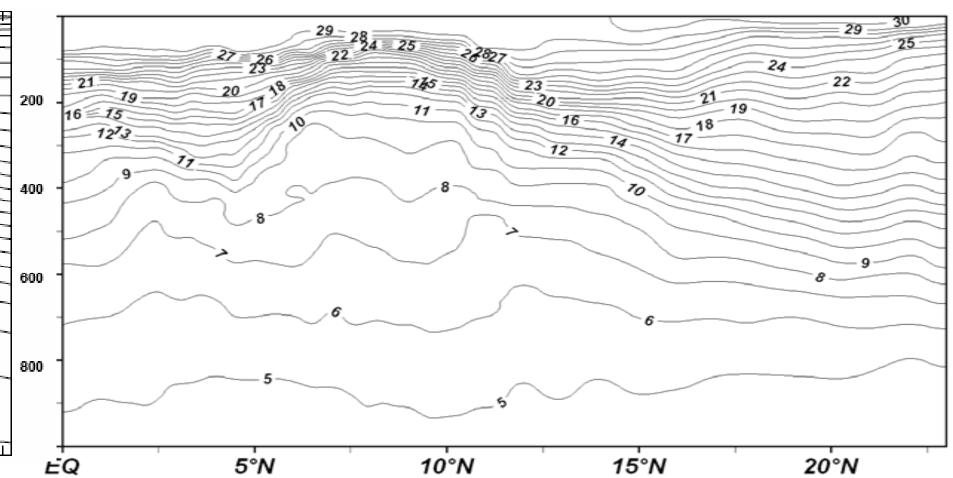
Qu and Lukas, 2003 JPO



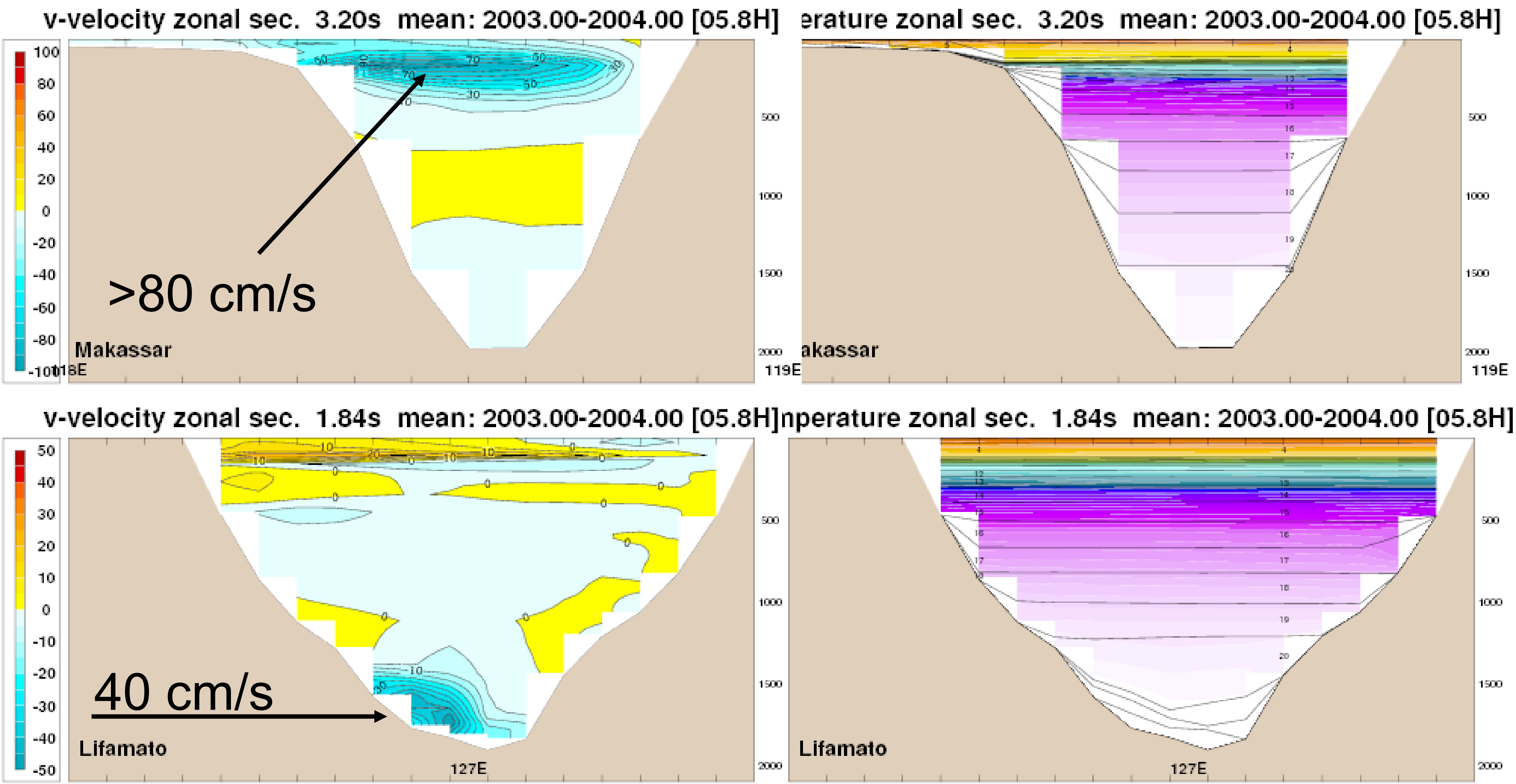
Model (annual mean)



CTD WOCE (P8 Jun/1996)



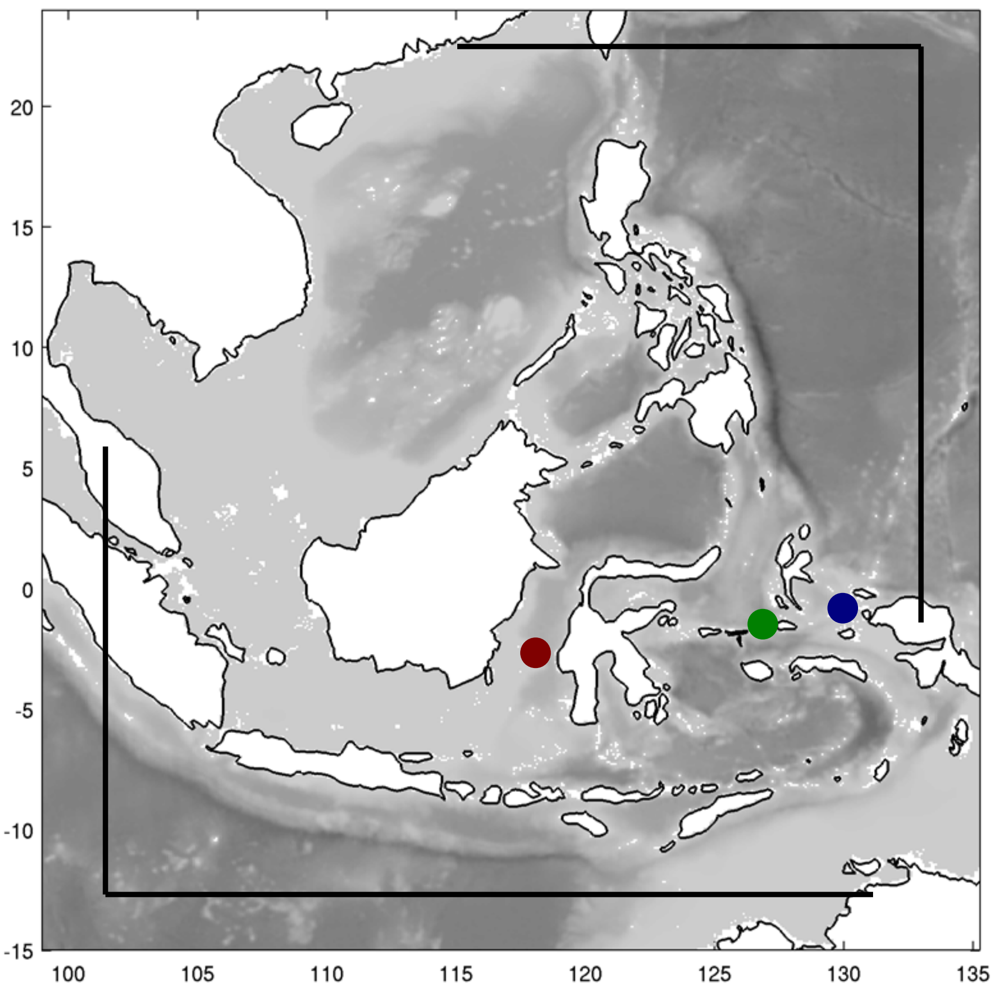
Makassar St. and Lifamatola Pa.



~25 cm/s overflow (with strong Fortnightly tide) measured at 300m above the Lifamatola Sill by V. Aken in INSTANT

Nest experiment

- A subset of the GLBa0.08 experiment with interannual air-sea forcing (year 2003).



- 10-grid buffer zone near all 4 boundaries, with e- folding time of:

  ITF1: 0.2 -2 day

  ITF2: 0.1 -1 day

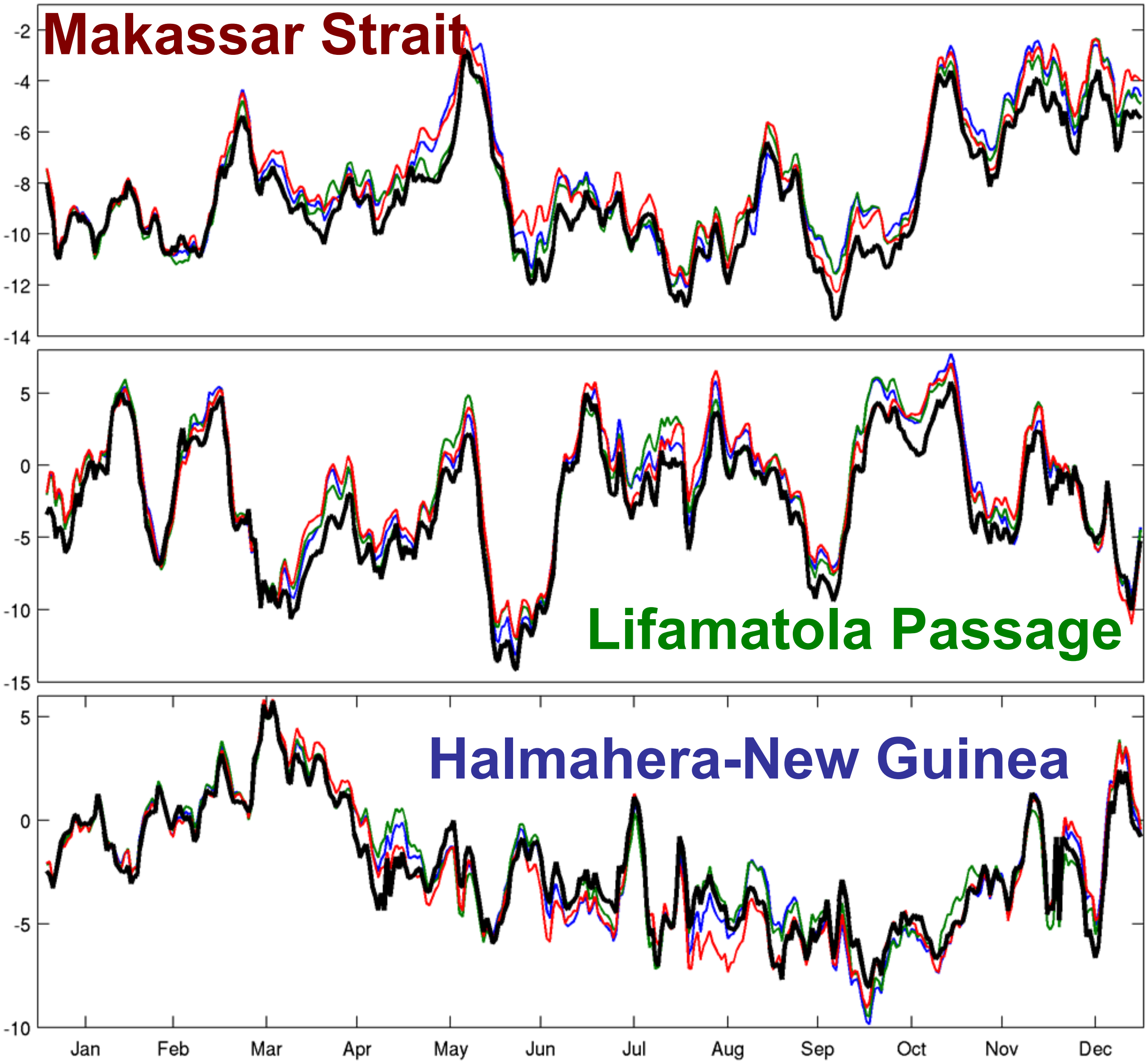
  ITF3: 0.05-0.5 day

● Makassar Strait

● Lifamatola Passage

● Halmahera-New Guinea

Transport as function of time

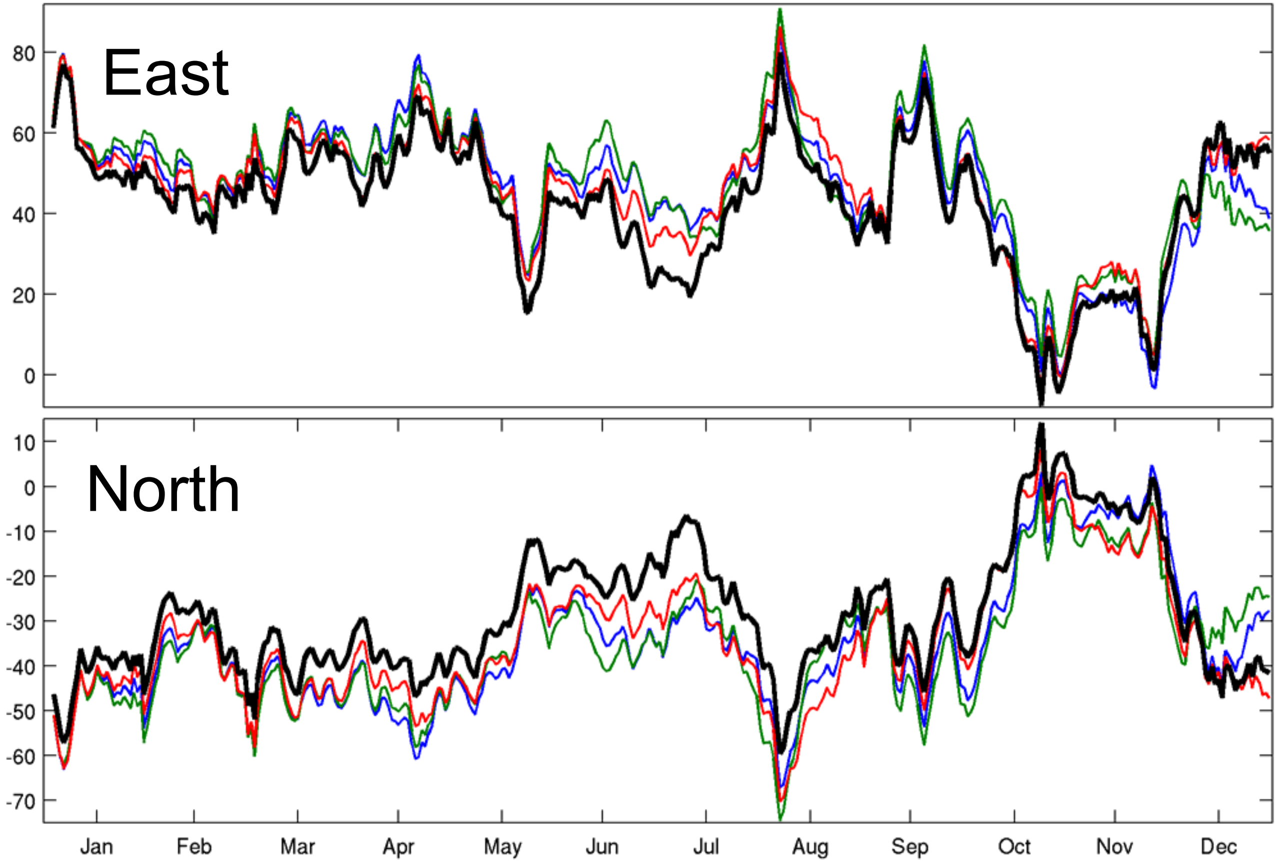


ITF1: -7.33 Sv
ITF2: -7.85 Sv
ITF3: -7.99 Sv
GLB: -8.51 Sv

ITF1: -1.40 Sv
ITF2: -1.57 Sv
ITF3: -1.54 Sv
GLB: -2.69 Sv

ITF1: -2.46 Sv
ITF2: -2.30 Sv
ITF3: -2.14 Sv
GLB: -2.32 Sv

Near east/north boundary

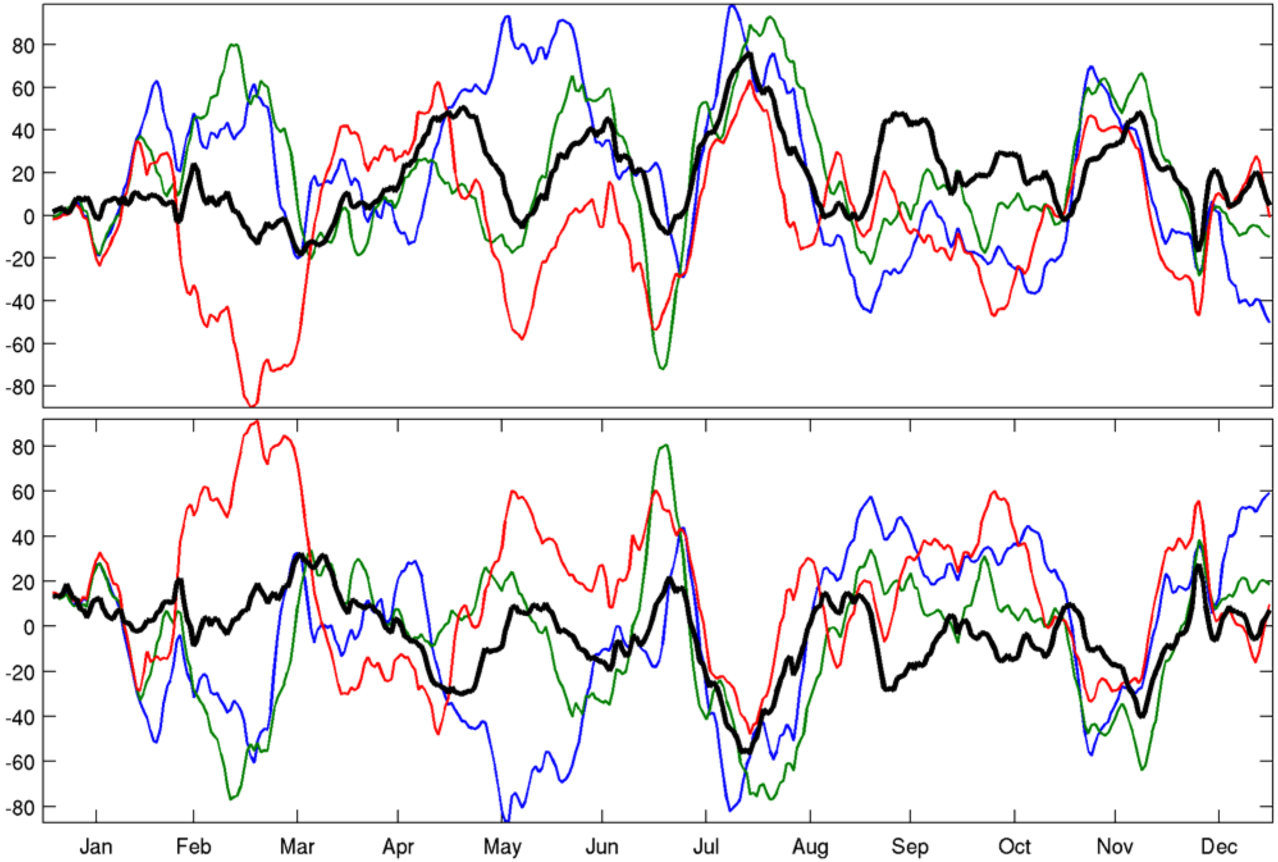


ITF1: 46.20 Sv
ITF2: 47.00 Sv
ITF3: 48.16 Sv
GLB: 42.28 Sv

ITF1: -34.60 Sv
ITF2: -35.26 Sv
ITF3: -36.39 Sv
GLB: -28.35 Sv

Q: What causes this difference? Is it “natural”?

Near west/south boundary

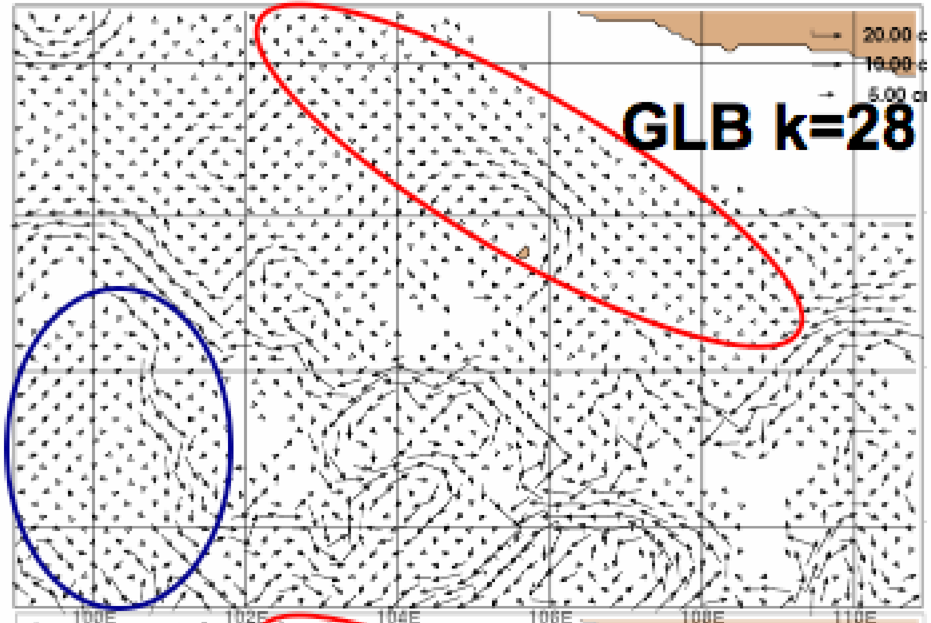


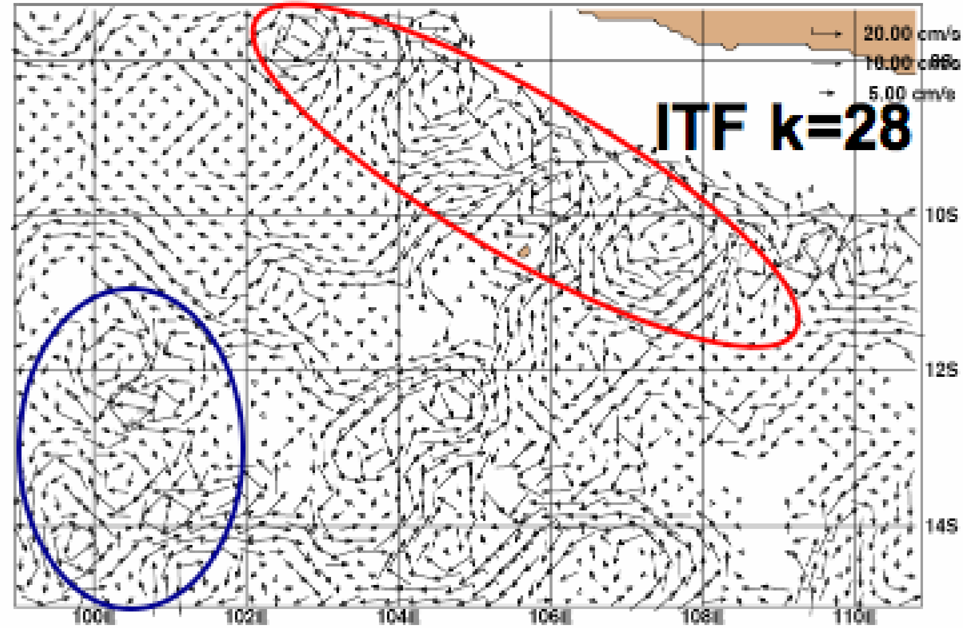
ITF1: -2.84 Sv
ITF2: 18.15 Sv
ITF3: 19.09 Sv
GLB: 18.36 Sv

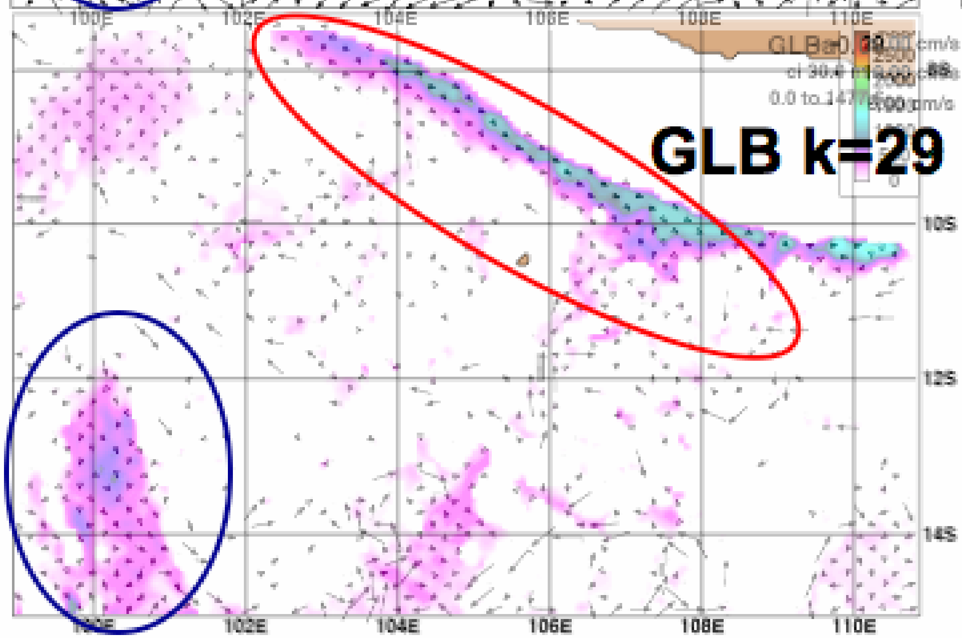
ITF1: 15.04 Sv
ITF2: -5.83 Sv
ITF3: -6.72 Sv
GLB: -3.73 Sv

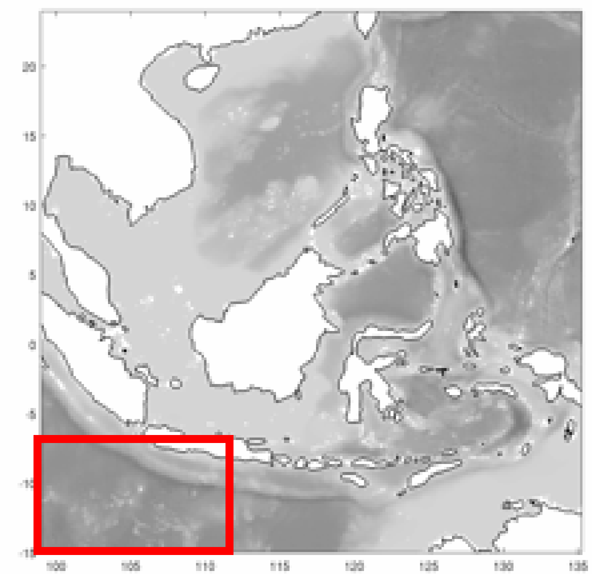
Q: why the west/south boundary are so different from the east/north boundary?

Bottom layers

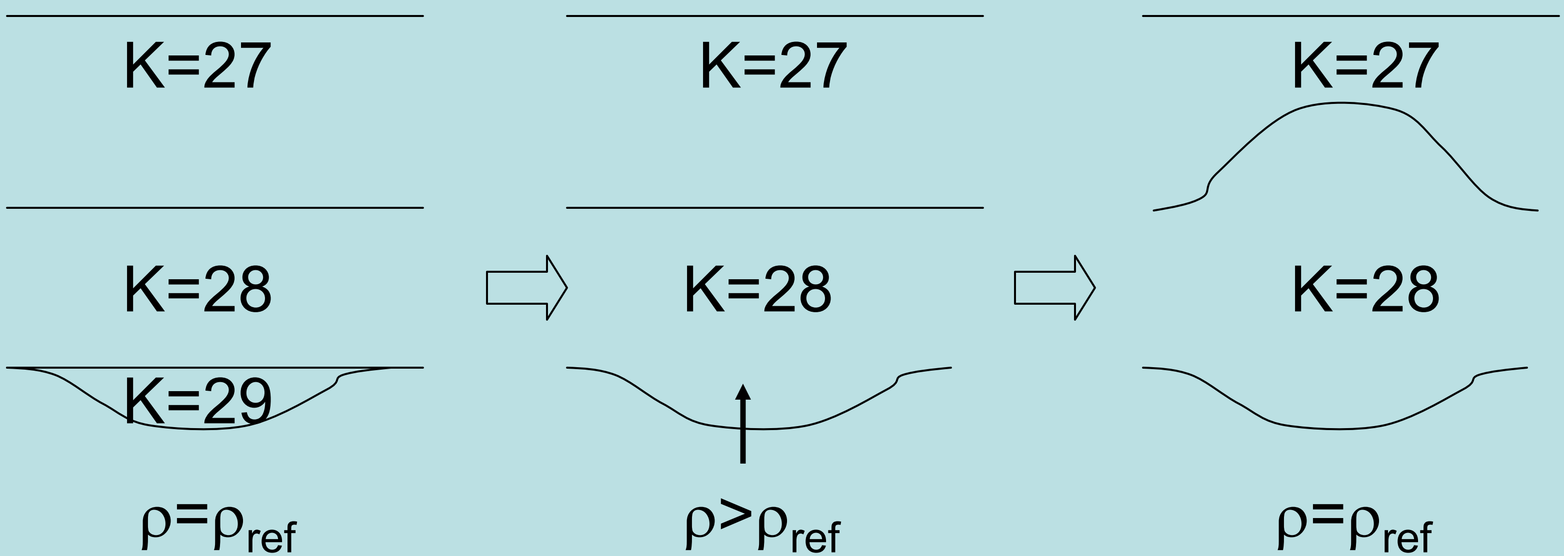








Does this happen when excluding layer 29?



Seasonal development of a suite of eddies identified by satellite altimeters on TOPEX/Poseidon (CSIRO Marine Research group)

Current southern boundary

Future experiments

- With constant (annual mean) boundary forcing and different air-sea forcing (i.e., annual mean, monthly mean, real-time high frequency)
- With seasonal cycle of boundary forcing and different air-sea forcing.