

MODEL-DATA CFC-11 COMPARISON IN THE SOUTHERN HEMISPHERE

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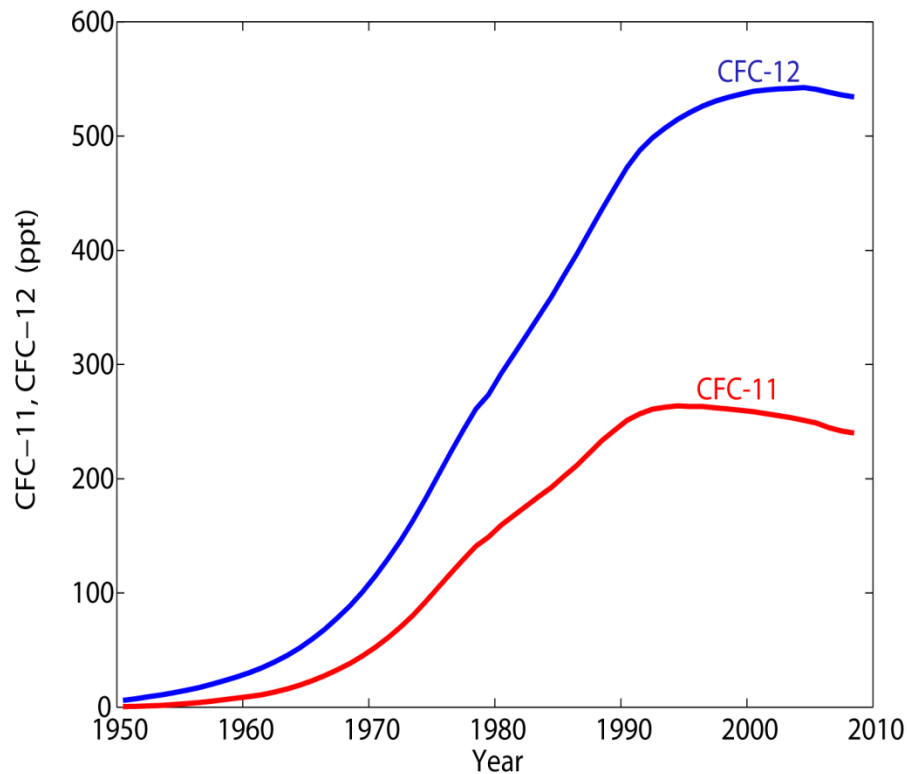
Polar Climate Working Group
2/28/11



Acknowledgements

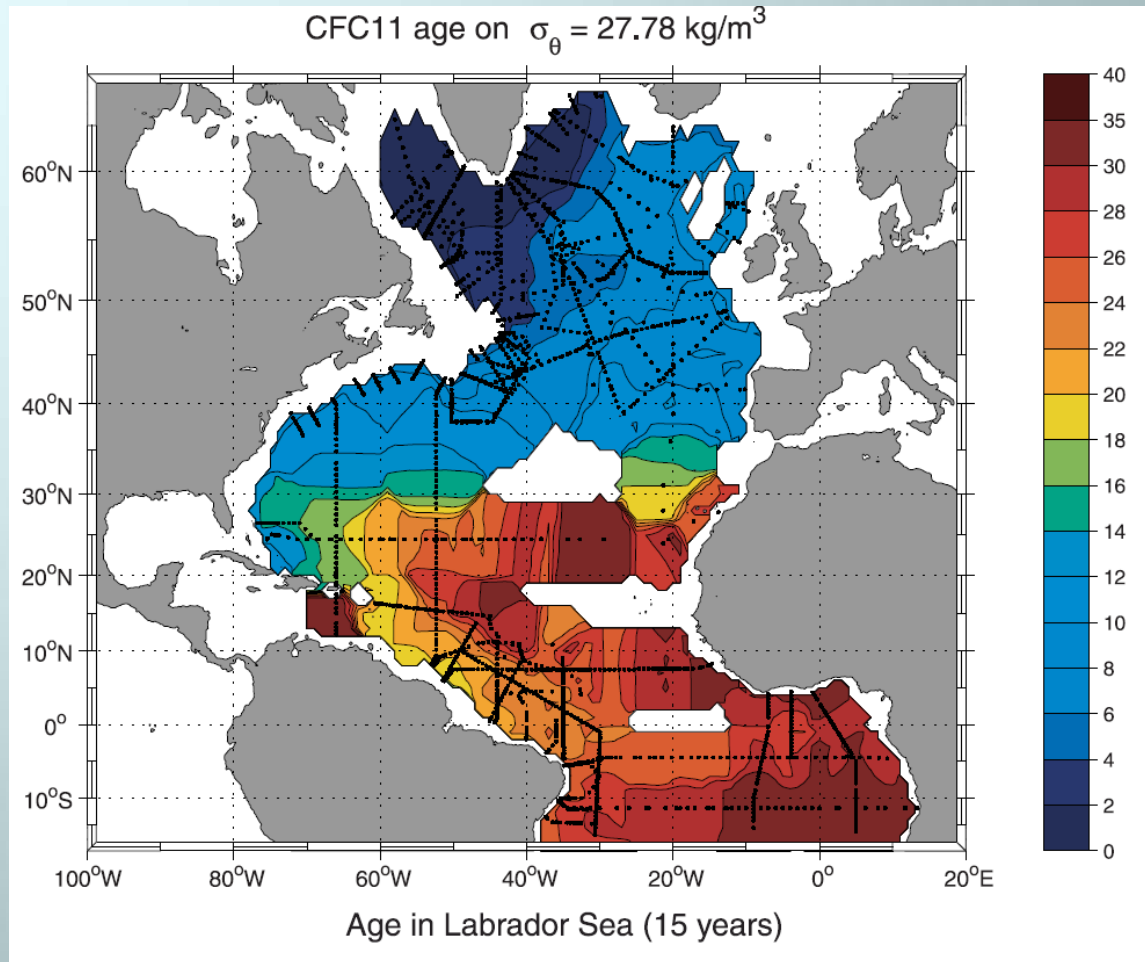
- ▣ Bernadette Sloyan (CSIRO)
- ▣ Wilbert Weijer (LANL)

Chlorofluorocarbons (CFC-11 CFC-12)



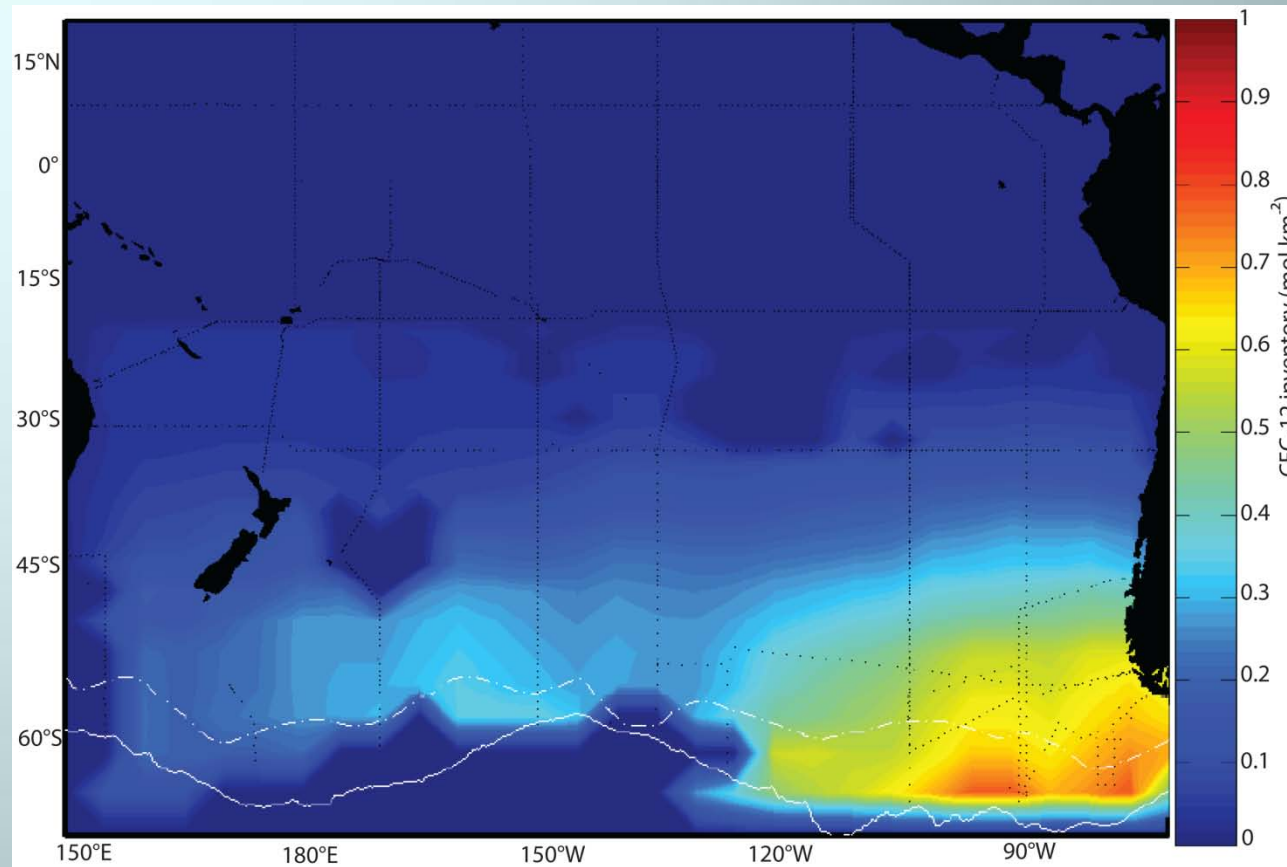
- ▣ Tracers
- ▣ Time Scales: Rate information
 - ▣ Ages
 - ▣ Formation Rates
 - ▣ Biogeochemical rates
 - ▣ AOU rates
 - ▣ Nitrogen fixation rates
 - ▣ CO₂ anthropogenic inventory

PCFC-11 Age ULSW



Fine et al. (2002)

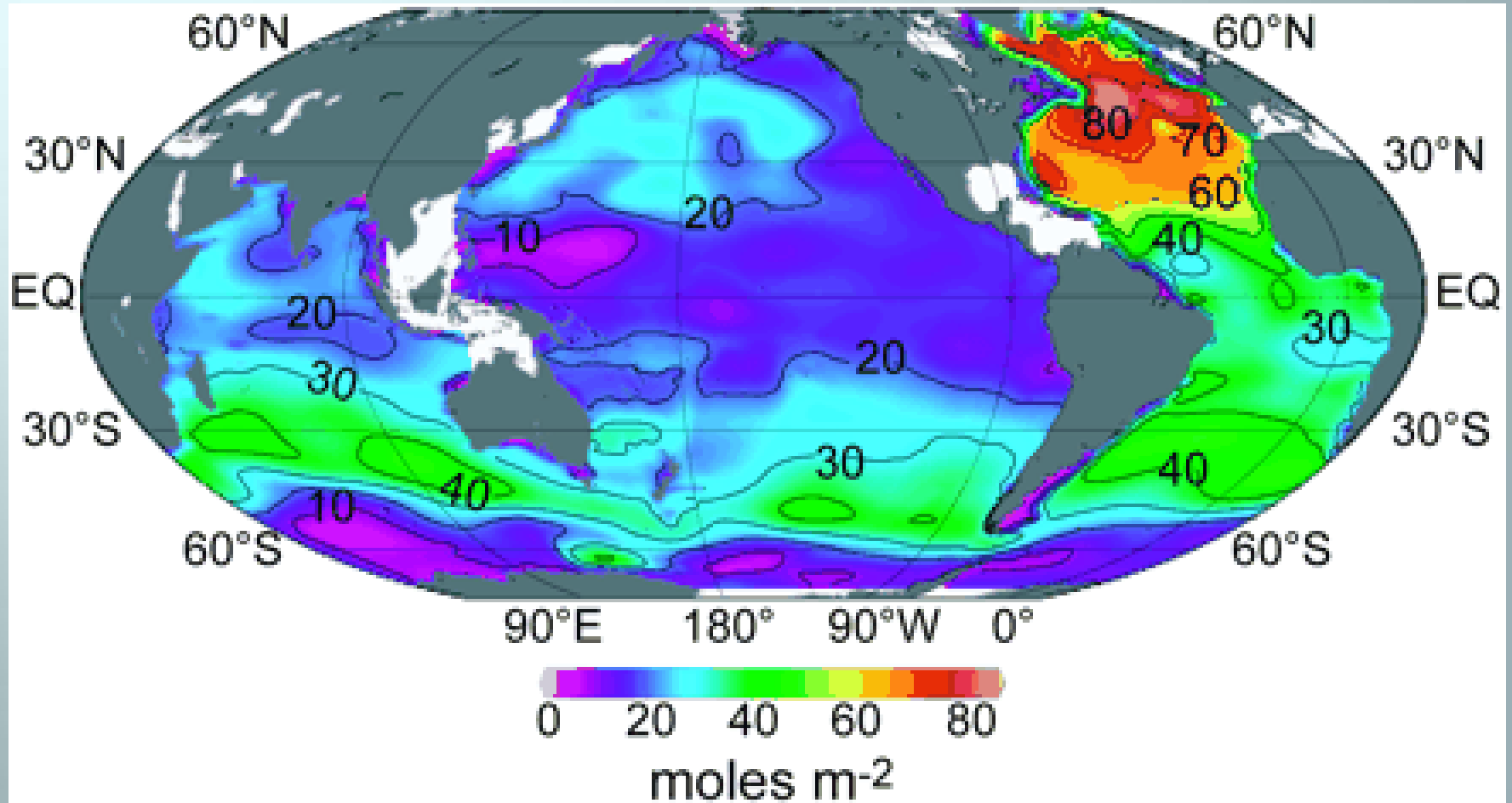
CFC-12 Inventory AAIW



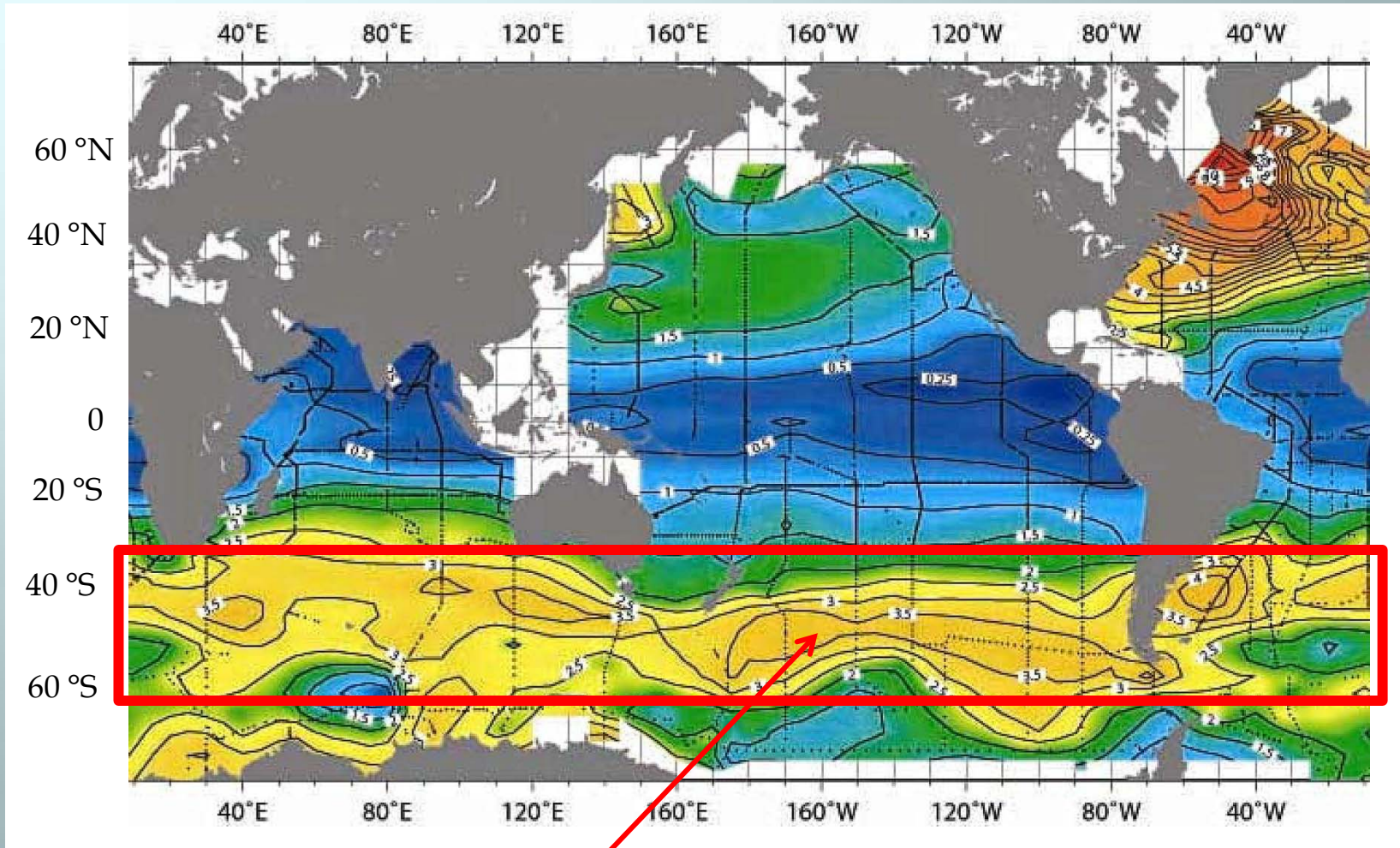
Formation Rate: $5.8 \text{ Sv} \pm 1.7 \text{ Sv}$

Hartin et al. (2011)

Inventory of Anthropogenic CO₂ (1800-1994)



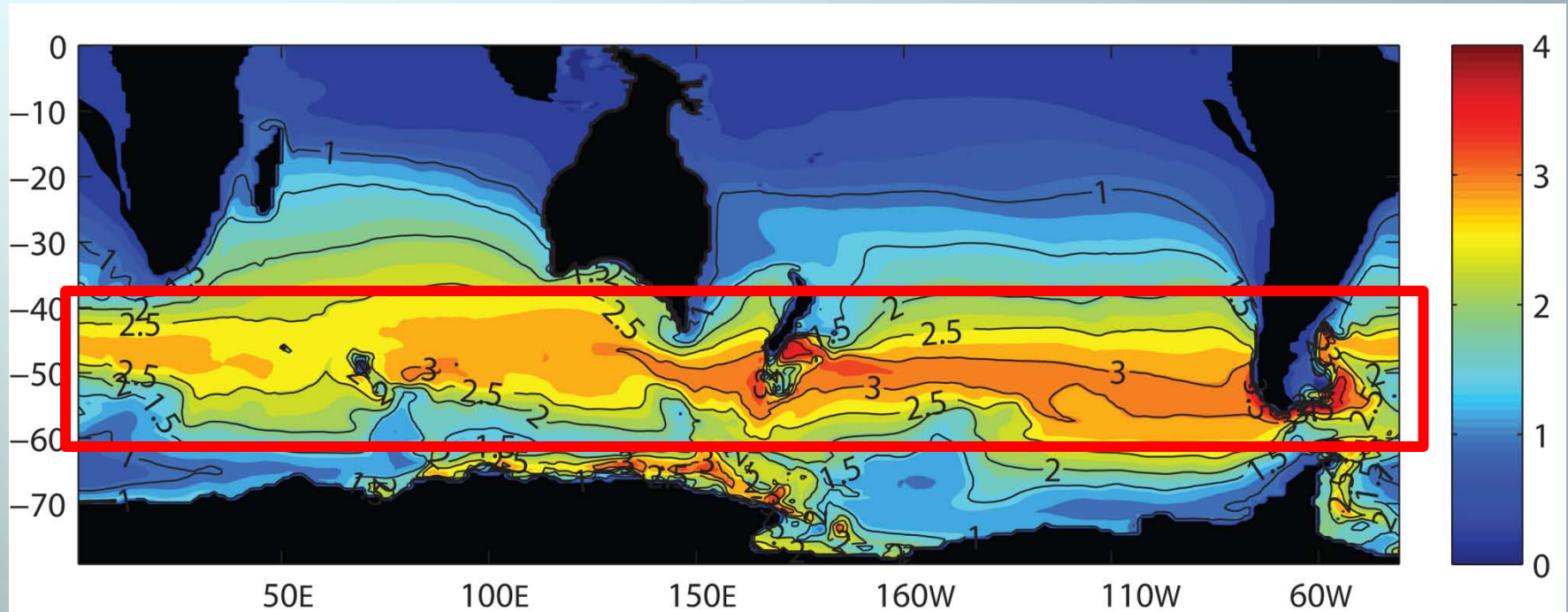
1994 CFC-11 Inventory (mol km^{-2}) Observations



3.5 mol km⁻²

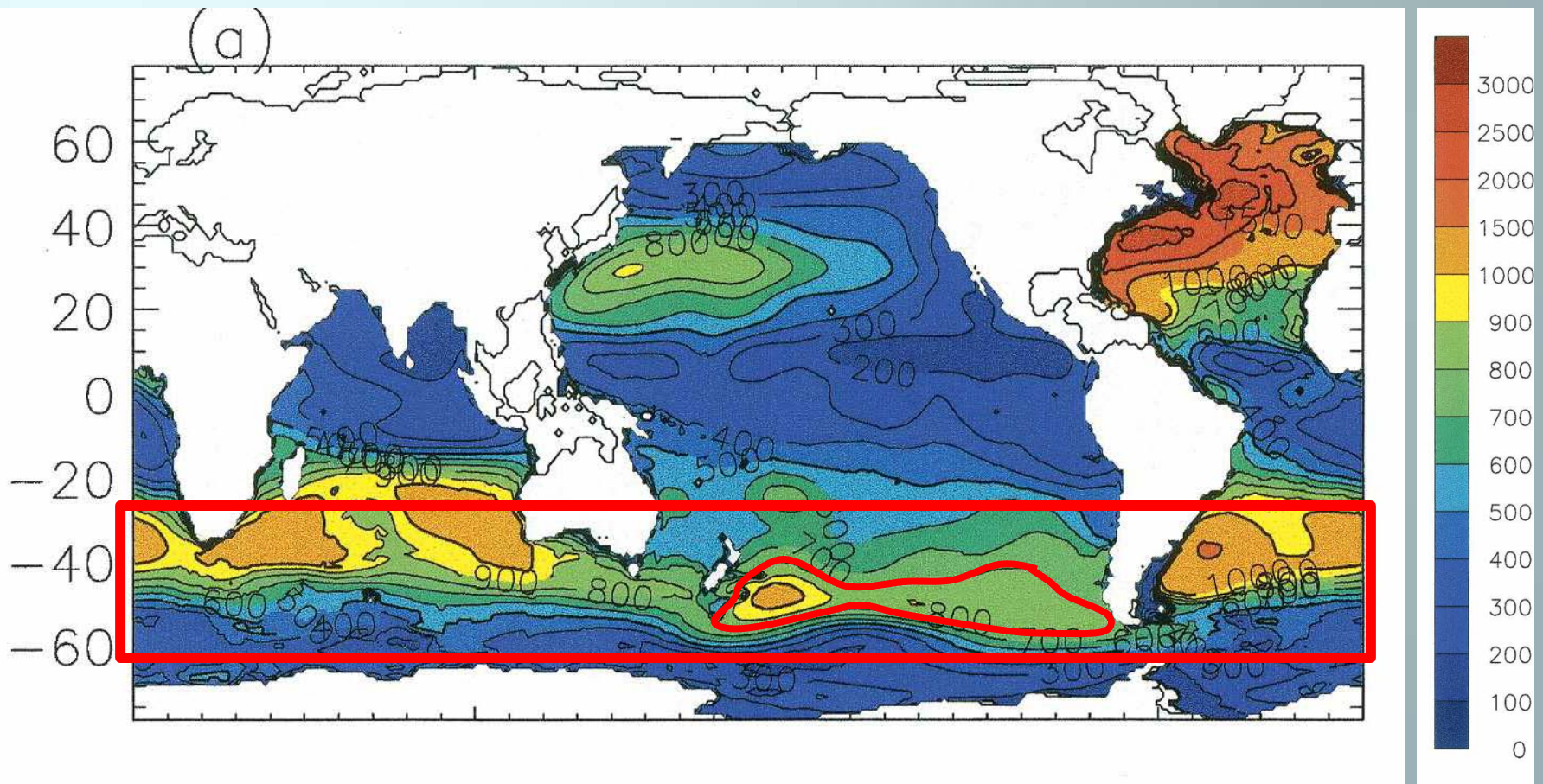
Willey et al. (2004)

1994 CFC-11 Inventory (mol km^{-2}) CCSM4

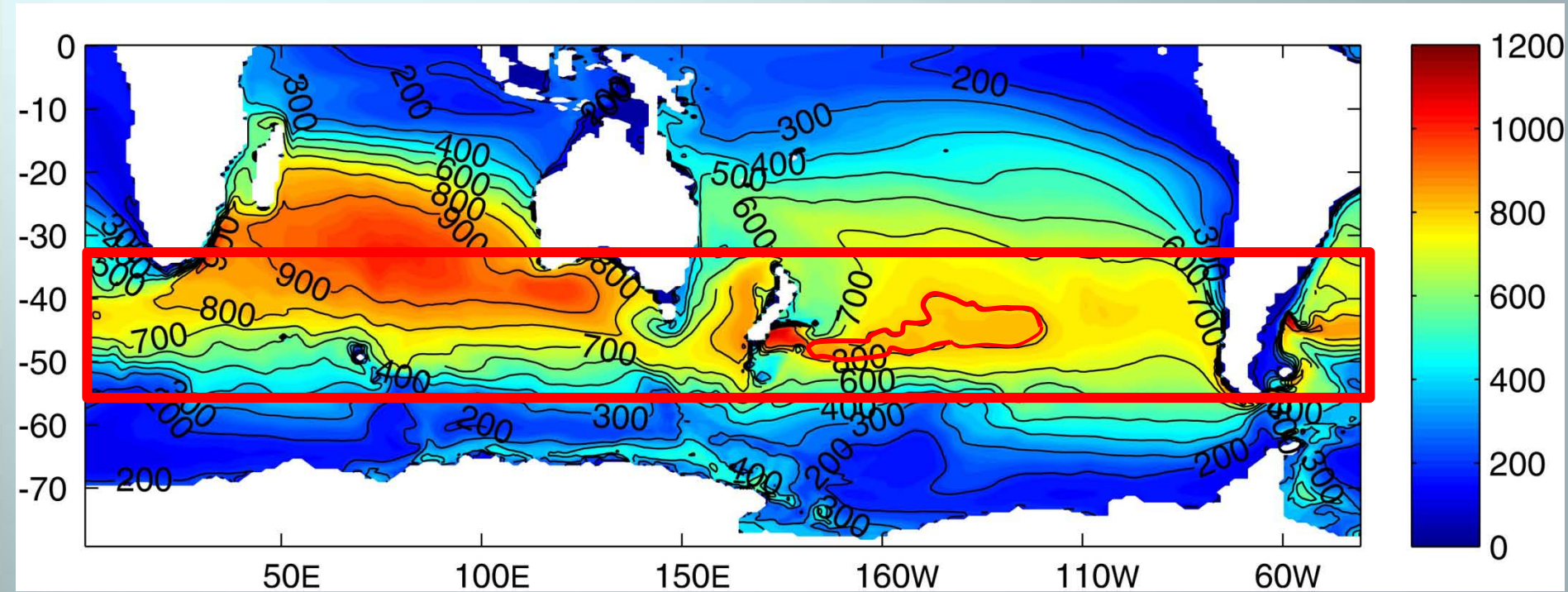


Under-estimates the inventory $0.5 - 1.0 \text{ mol km}^{-2}$

Penetration Depth (m) Observations

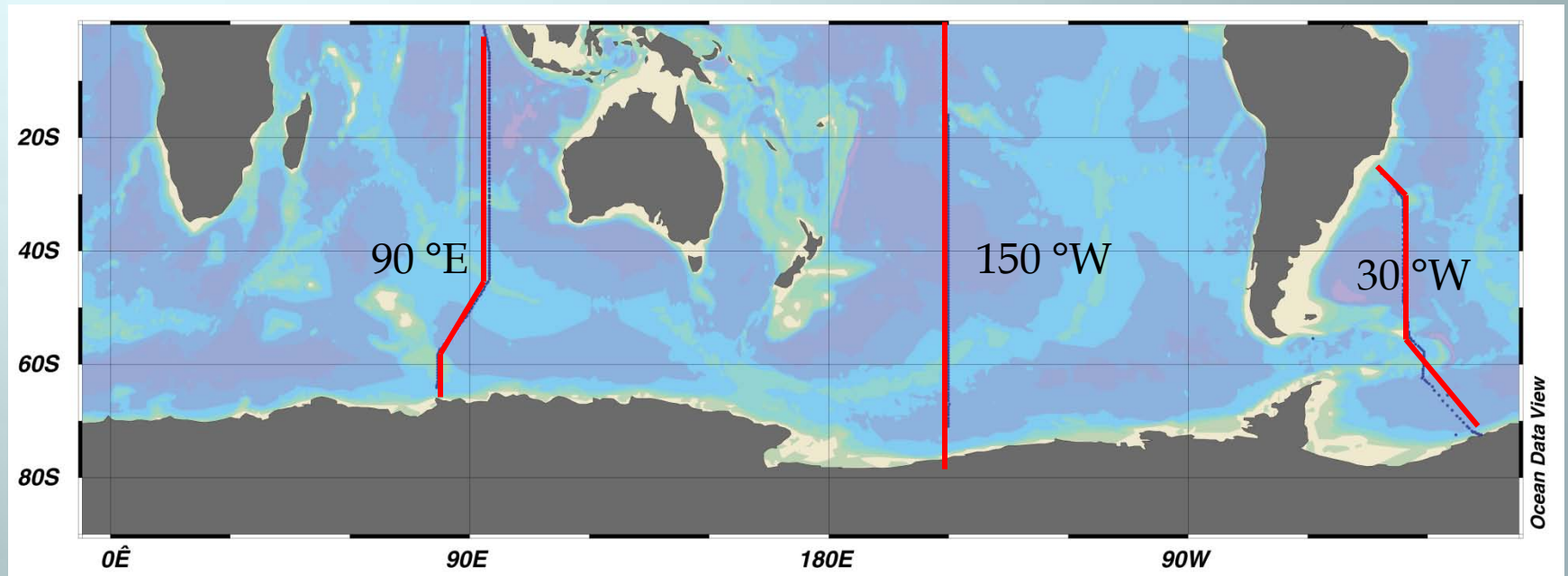


Penetration Depth (m) CCSM4



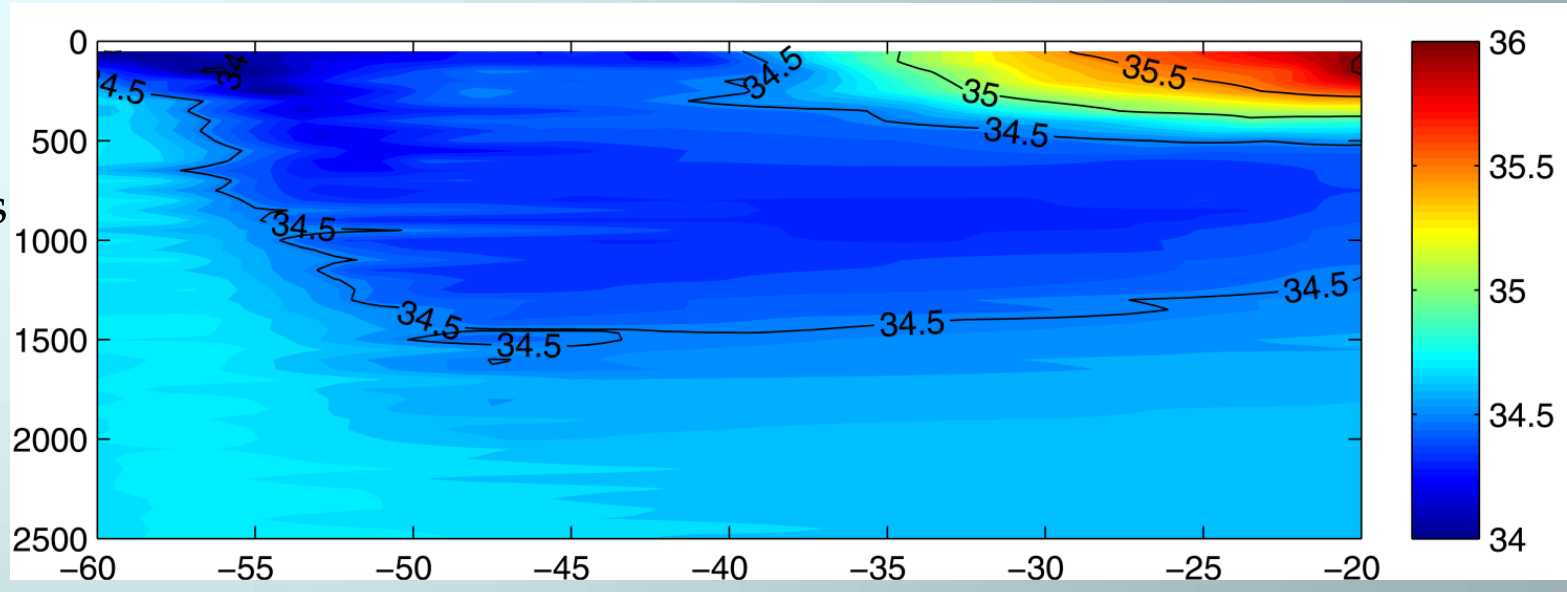
Southeast Pacific main region of SAMW and AAIW formation

Hydrographic Sections

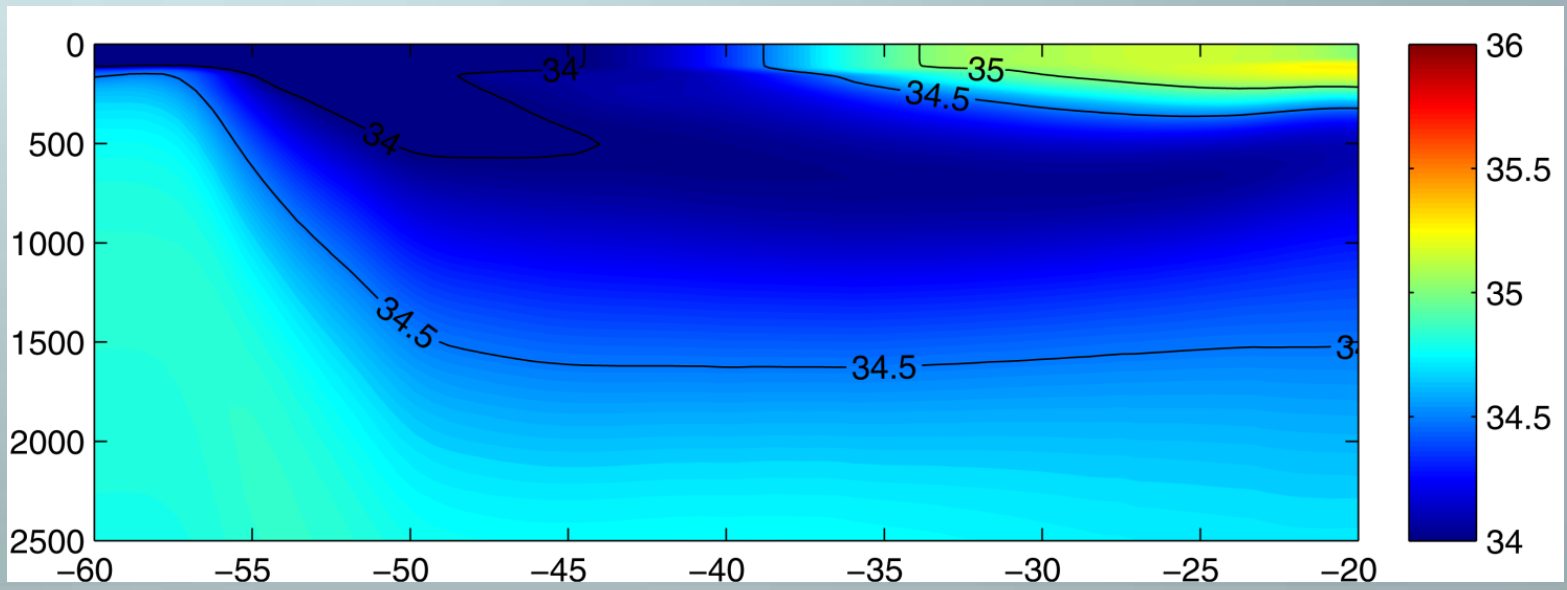


South Pacific (150°W 2005) Salinity

Observations

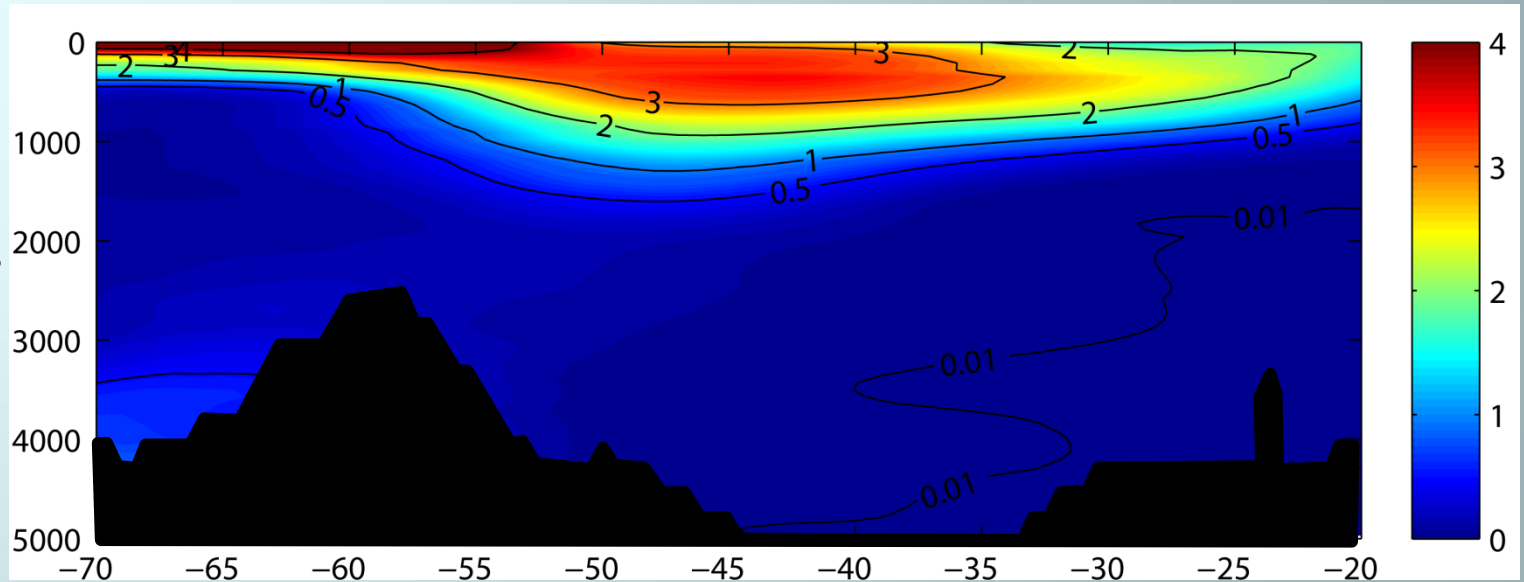


CCSM4

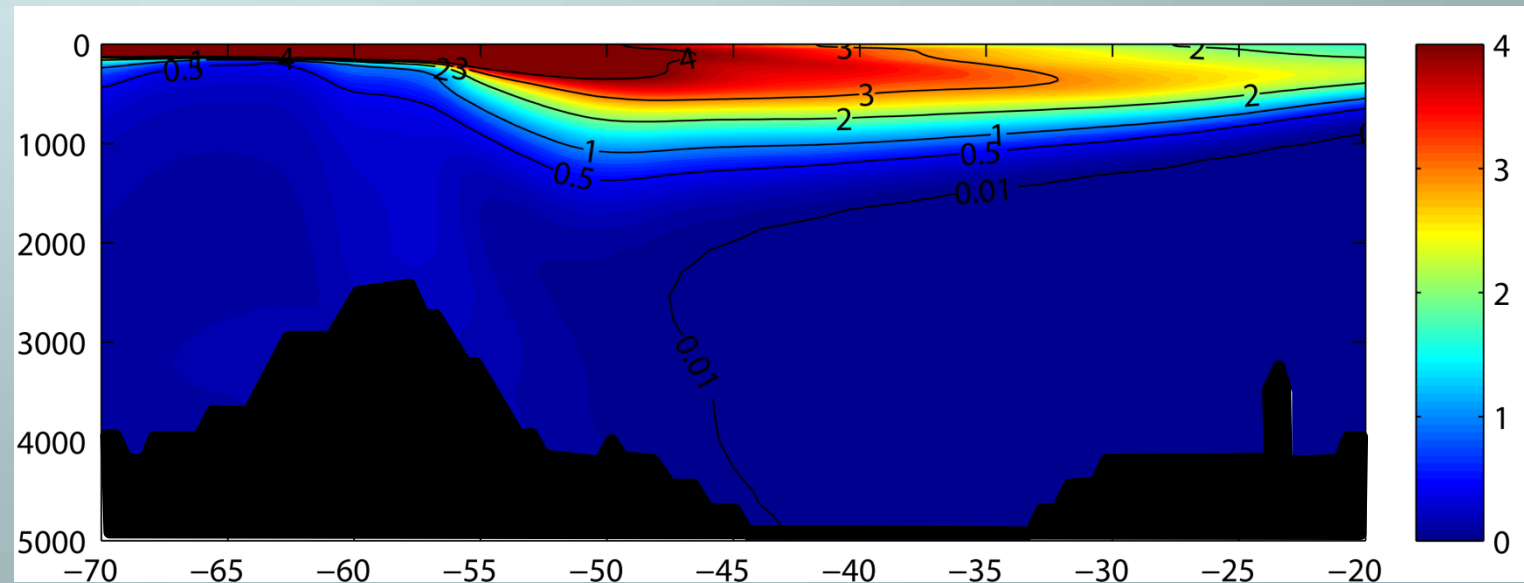


South Pacific (150°W 2005) CFC-11

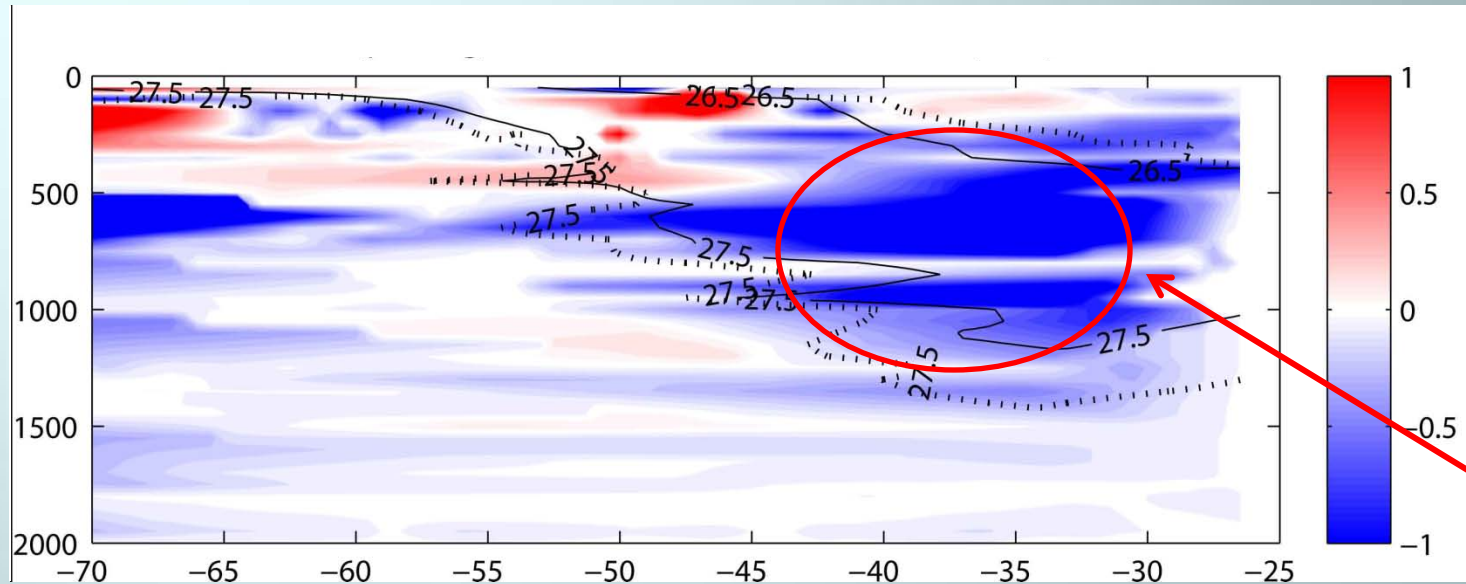
Observations



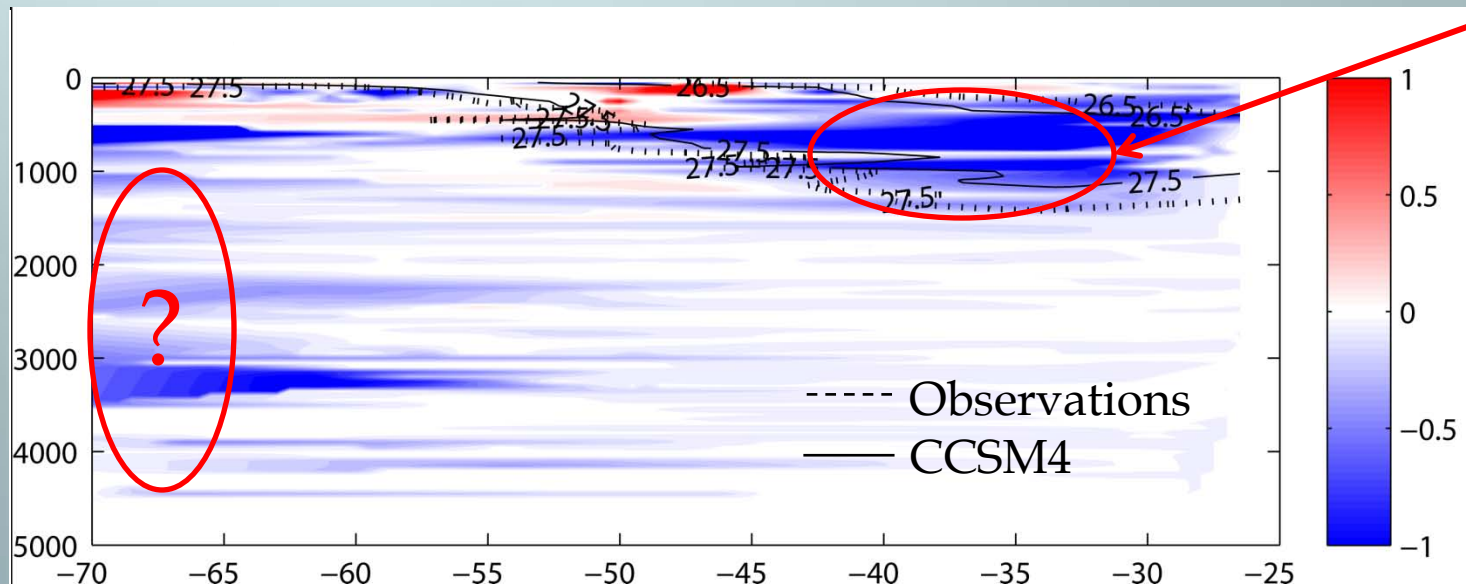
CCSM4



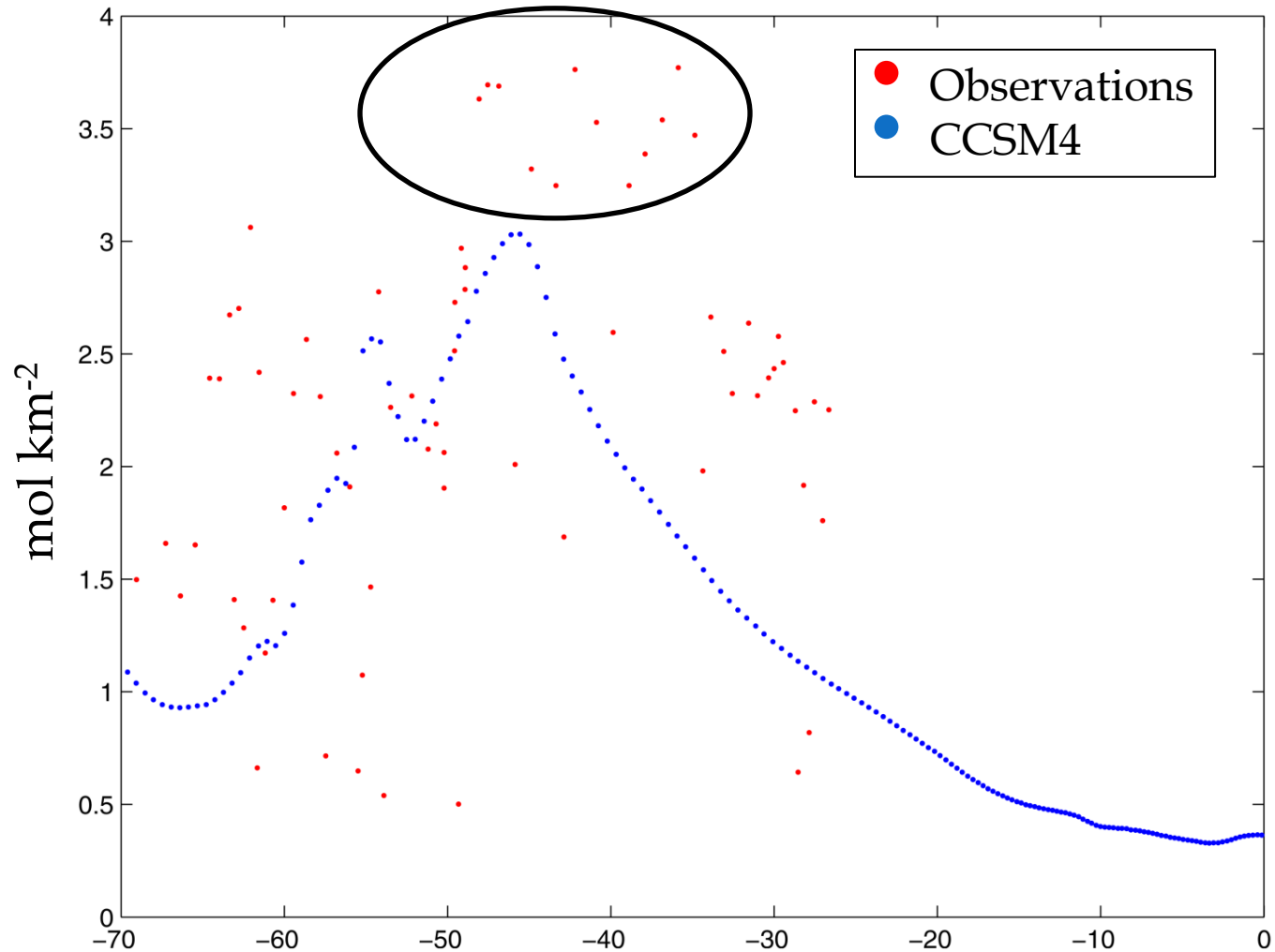
South Atlantic (30°W 1995) CFC-11



Subtropical
gyre
(SAMW
AAIW)

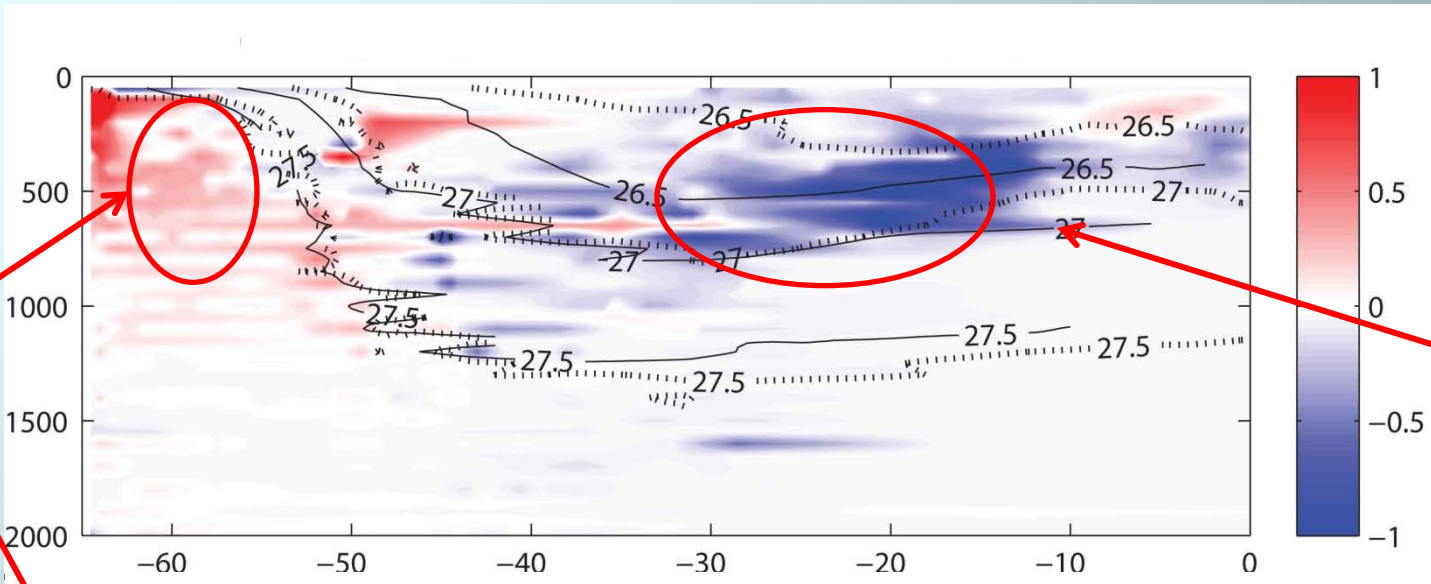


South Atlantic (30°W 1995) CFC-11 Inventory (moles km⁻²)



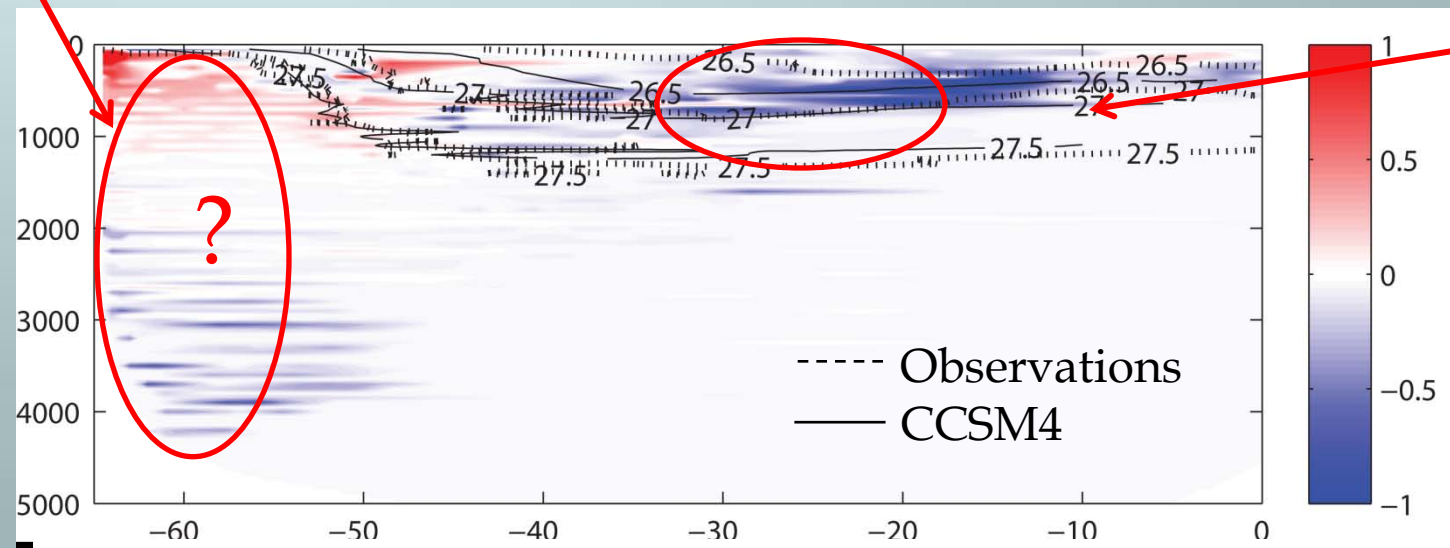
Indian (90°E 1995) CFC-11

CPDW
AABW

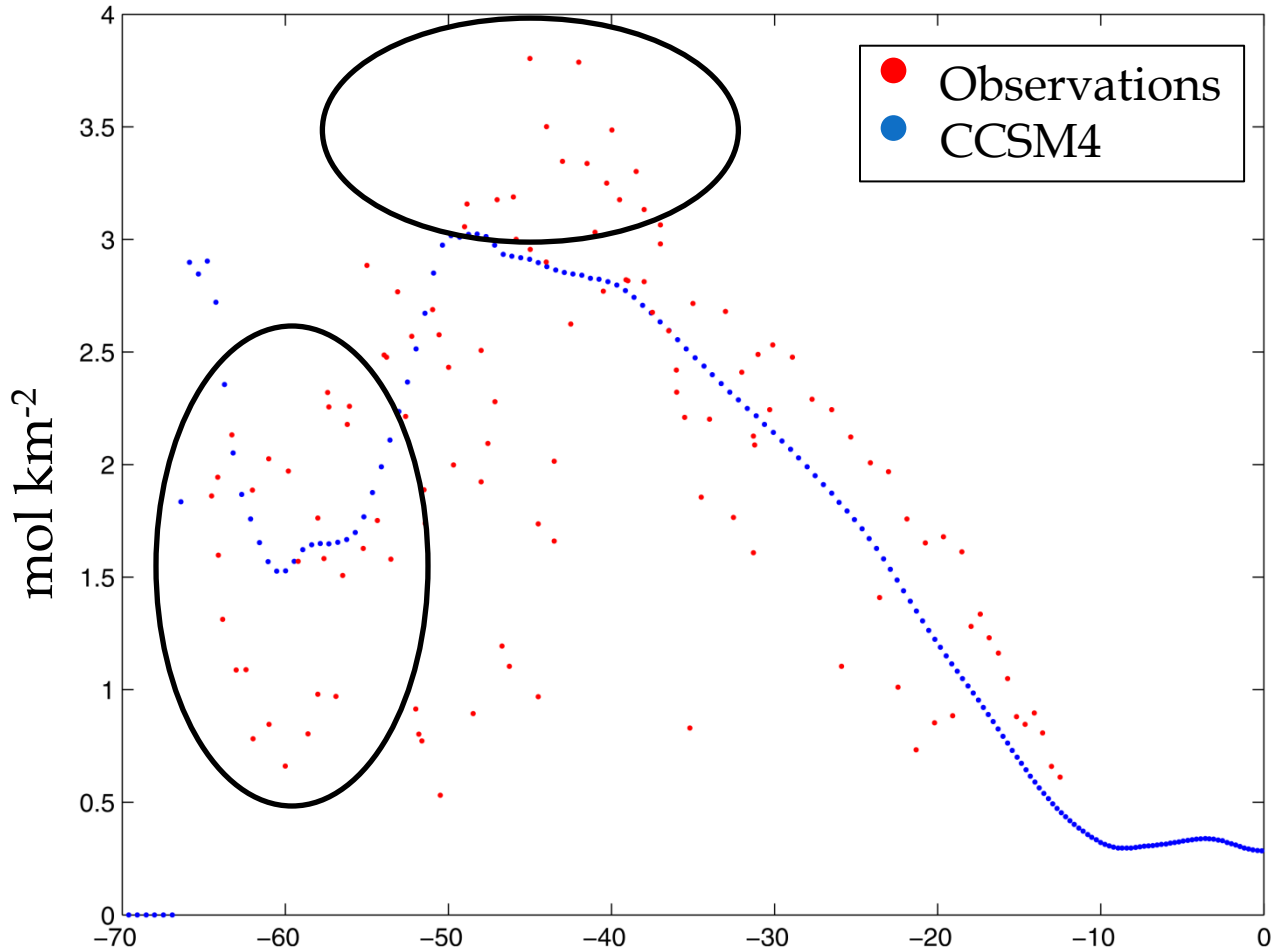


Subtropical
gyre
SAMW
AAIW

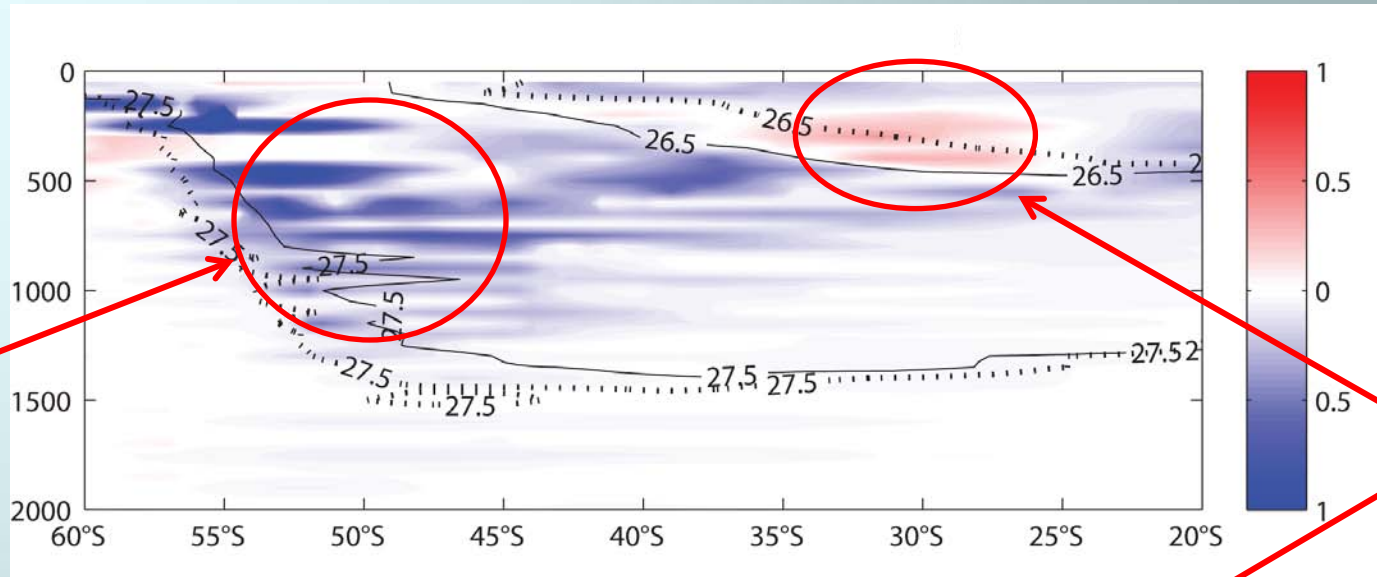
?



Indian (90°E 1995) CFC-11 Inventory (moles km⁻²)

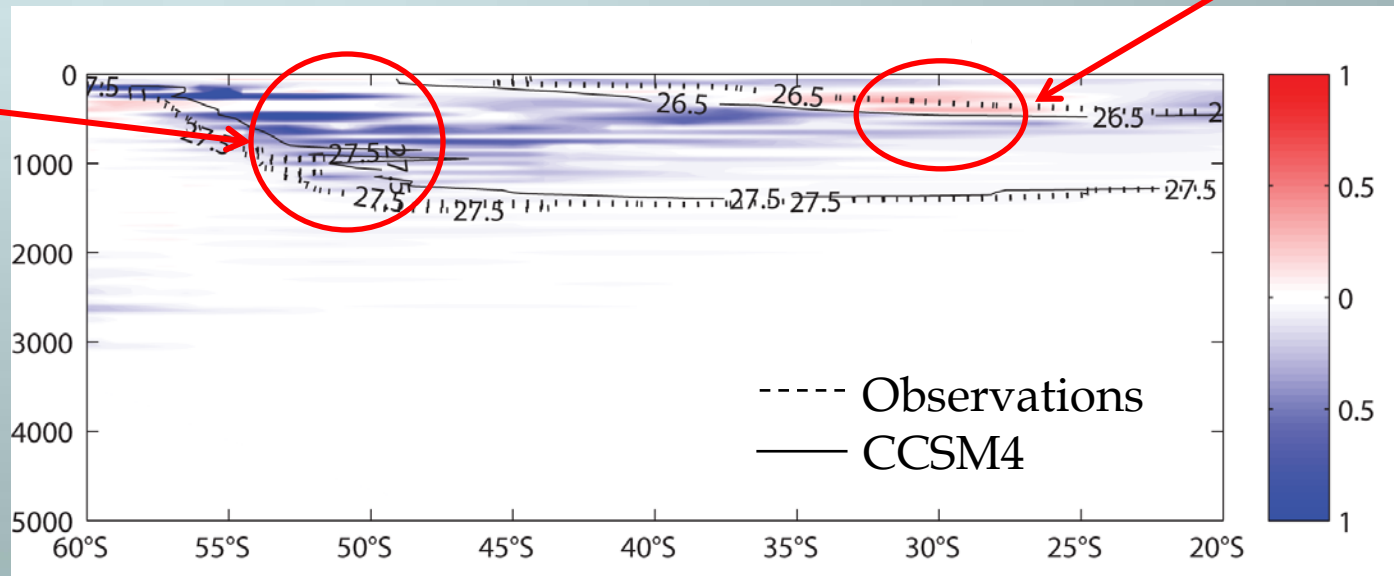


South Pacific (150°W 1991) CFC-11



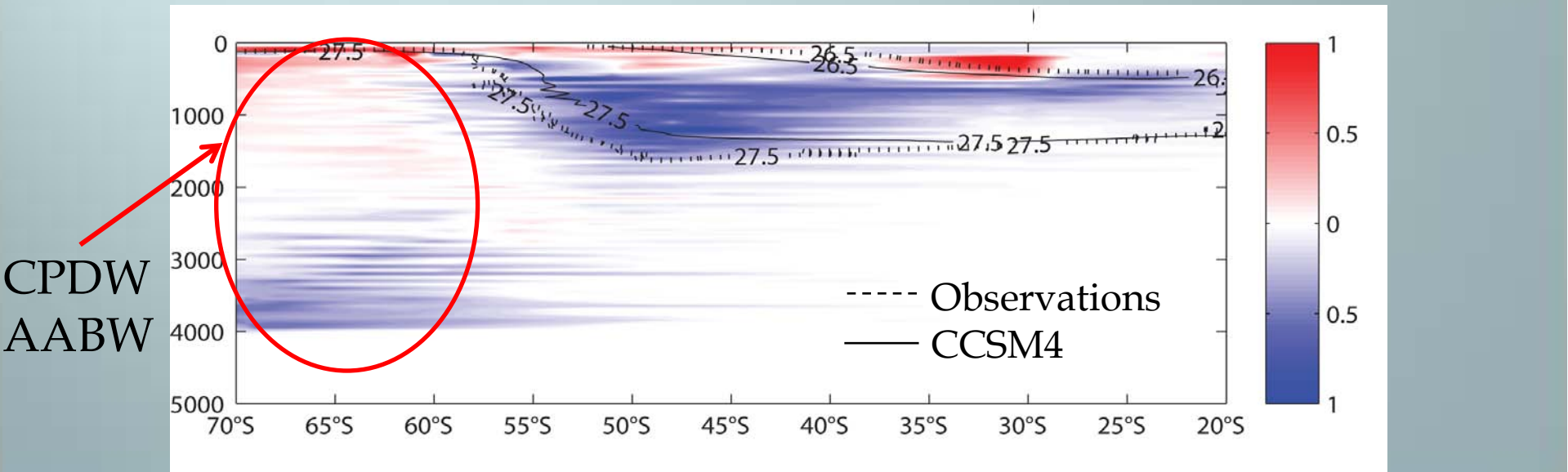
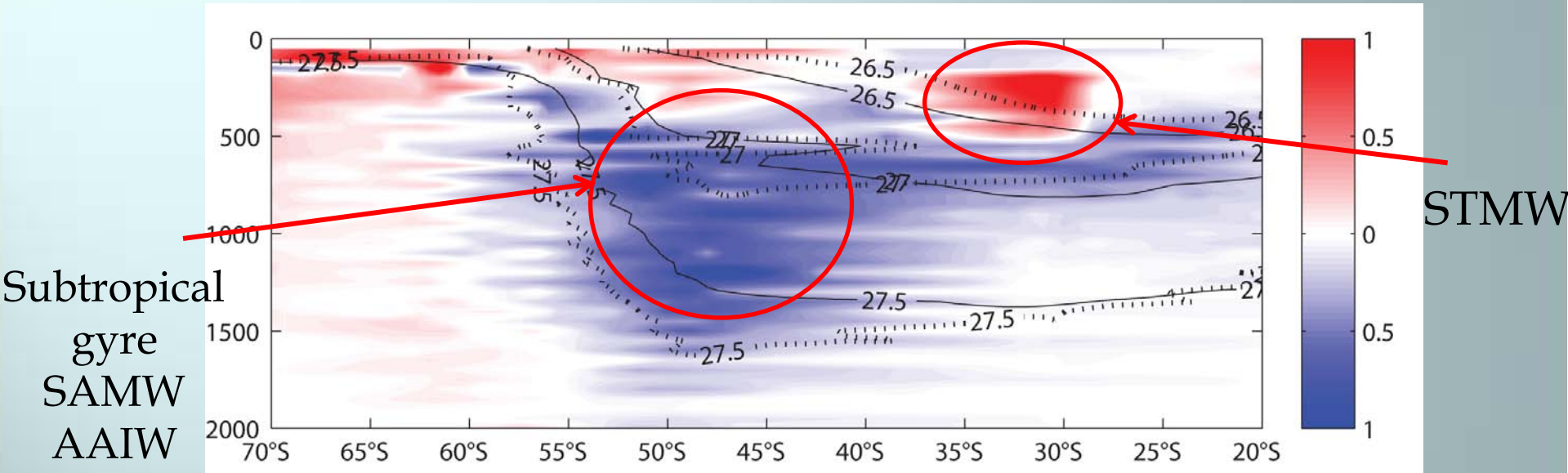
Subtropical
gyre
(SAMW
AAIW)

STMW

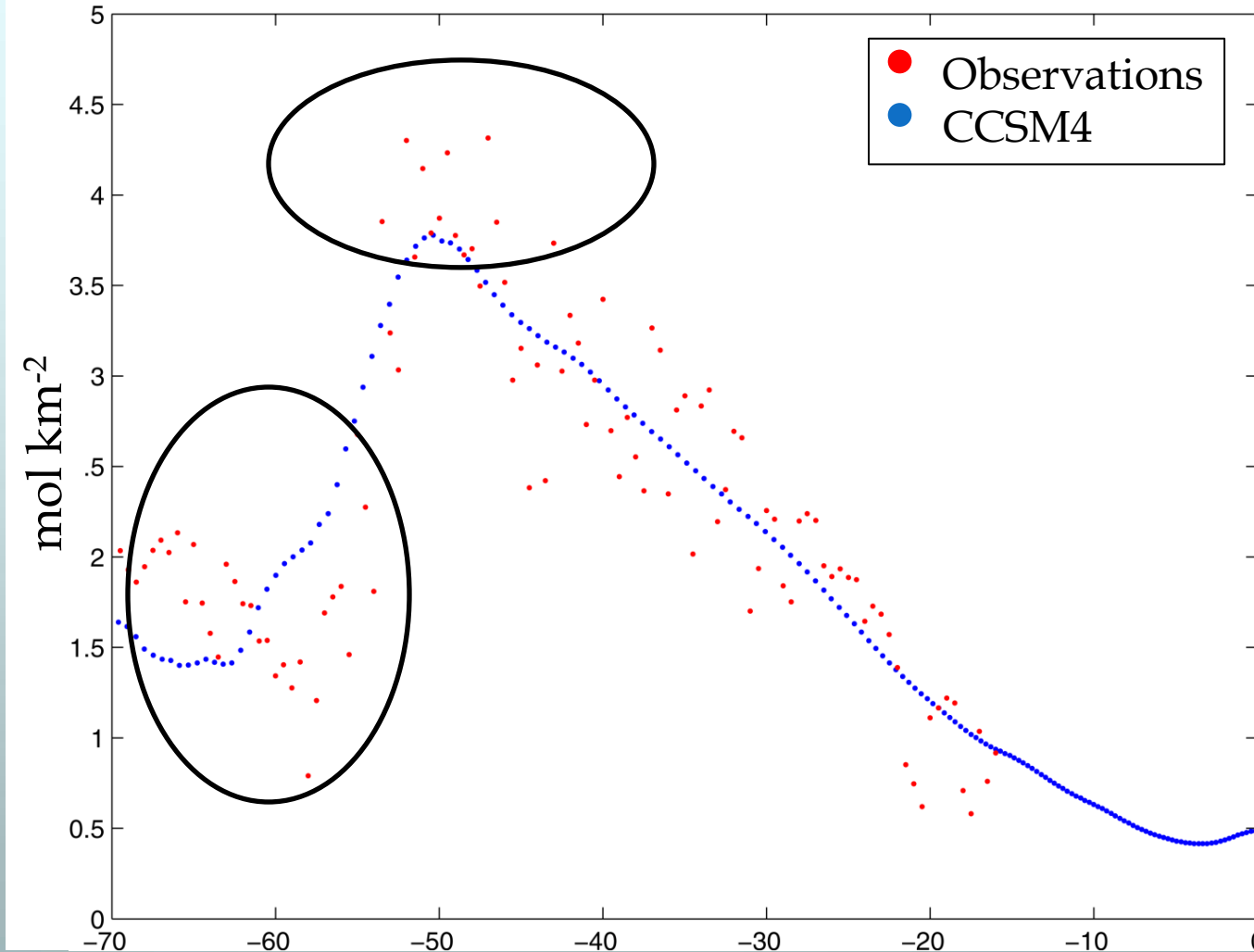


----- Observations
—— CCSM4

South Pacific (150°W 2005) CFC-11



South Pacific (150°W 2005) CFC-11 Inventory (moles km⁻²)



Conclusions

- ▣ Under-ventilation of subtropical gyre (SAMW / AAIW) in Atlantic, Indian and Pacific
- ▣ Under-ventilation of AABW
- ▣ Over-ventilation of STMW in South Pacific
- ▣ Over-ventilation CPDW → ?

Future Work

- ▣ Investigate the southeast Pacific
 - Physical properties
 - Mixed layer depth
- ▣ SAMW and AAIW
 - CFC Inventories
 - Formation rates using CFCs

Reasons? Ideas?