EXPLORATORY SENSITIVITY EXPERIMENTS

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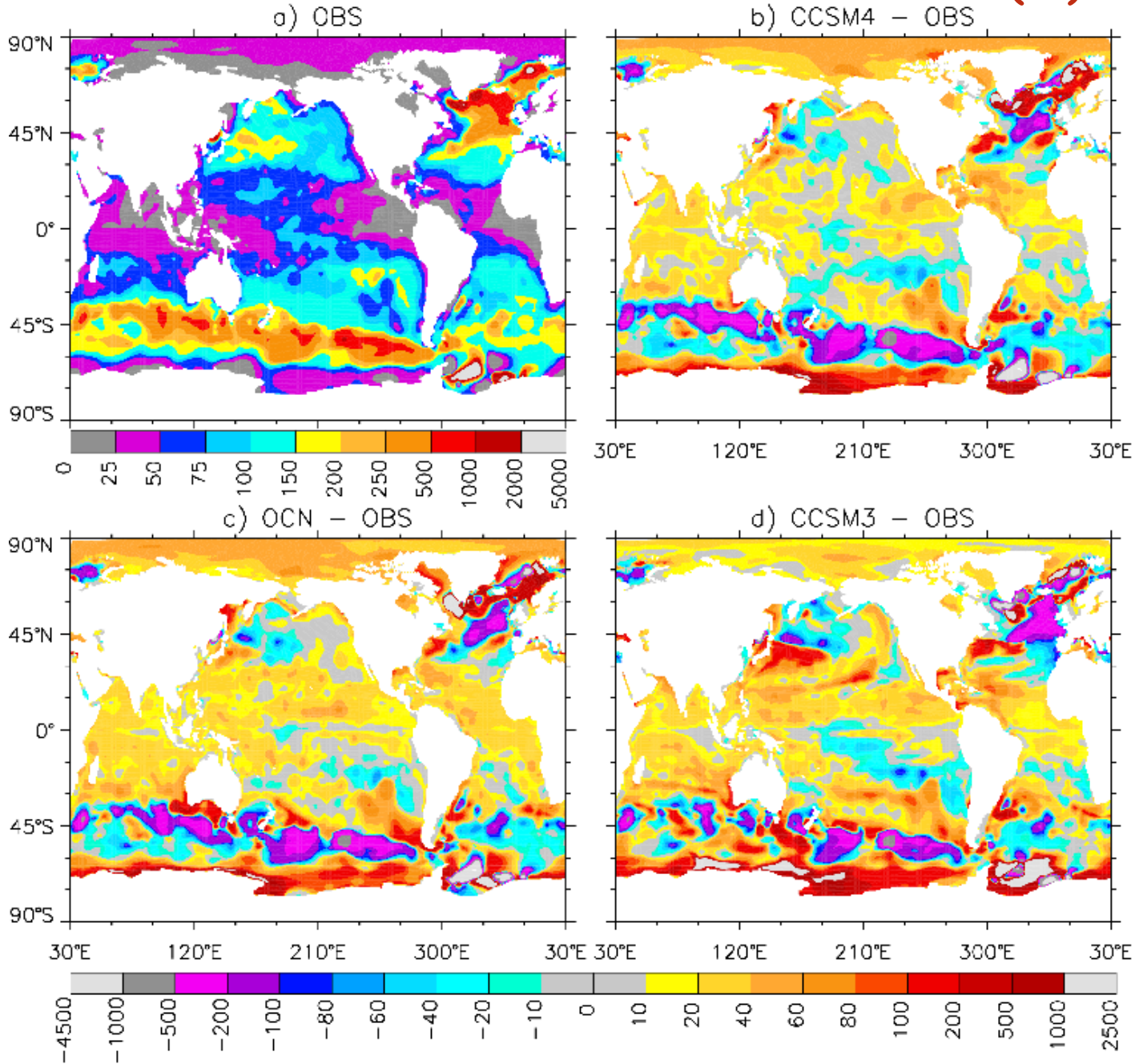
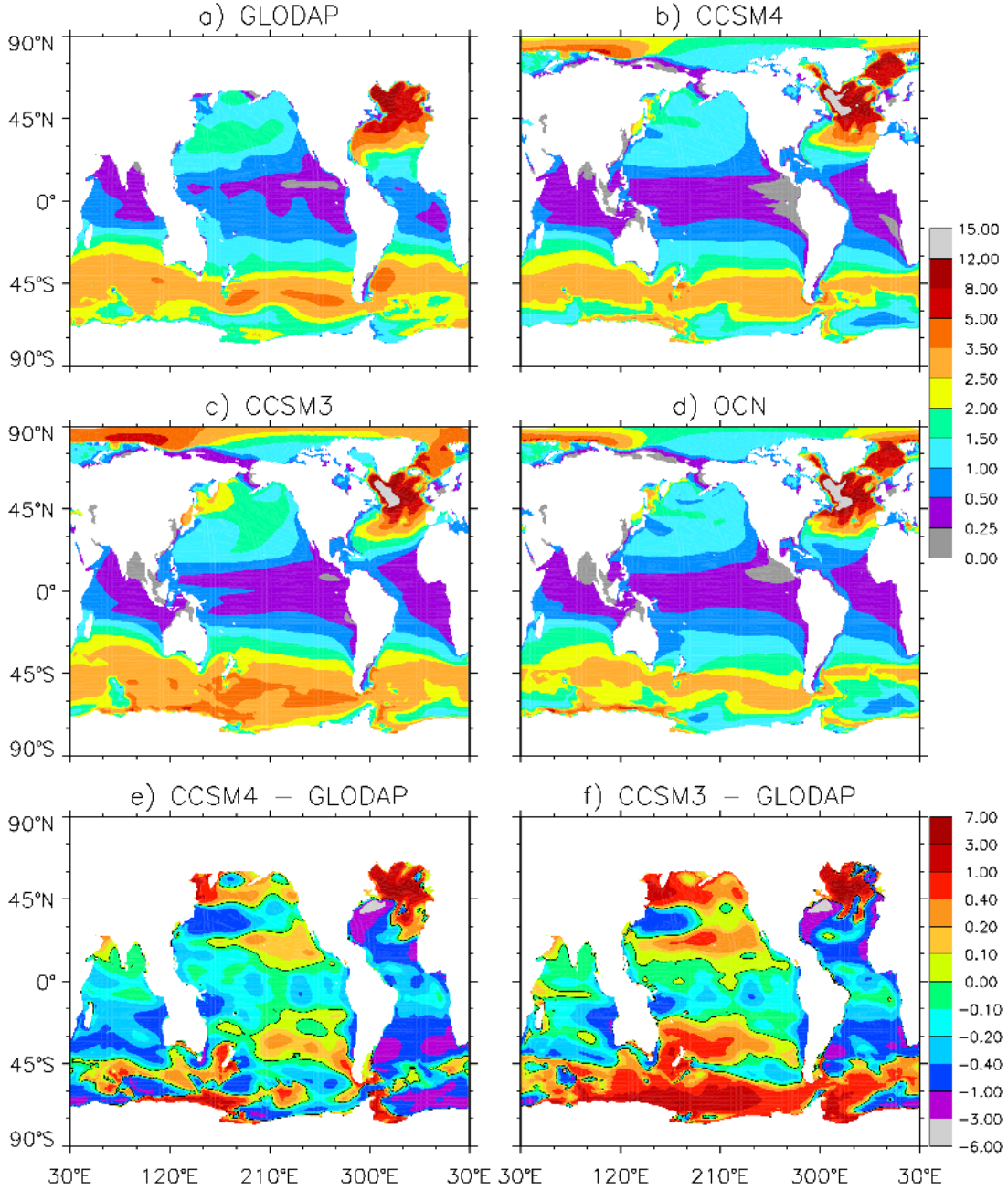
- Preliminary investigation of parameter sensitivities of ventilation and mixing biases.
- Initial focus is the Southern Ocean, considering mixed layer depth and CFC-11 distributions as metrics.

A parameterization for Small Vertical Scales (SVS, Kelvin Richards et al. 2011)

WINTER-TIME MIXED LAYER DEPTH (m)

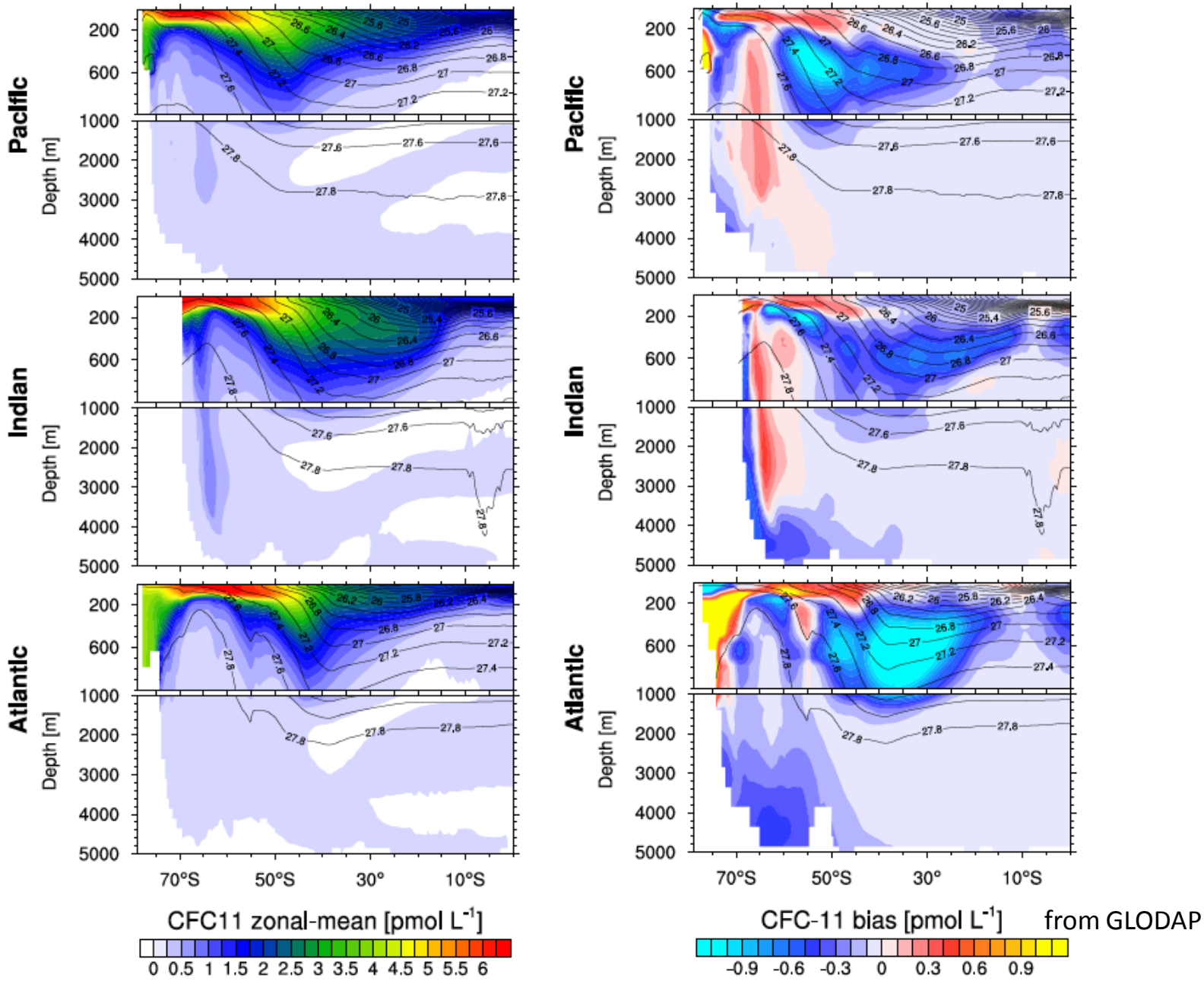


CFC-11 COLUMN INVENTORY (moles km^{-2})



for 1994

ZONAL-MEAN CFC-11 from CONTROL



from GLODAP

EXPERIMENTAL SETUP

Ocean – sea-ice coupled simulations (G cases) forced with the CORE inter-annually varying data sets for the 1947-2007 period.

CONTROL: 300-yr simulation,
SENSITIVITY EXPERIMENTS: 60-yr integrations starting from year 240 of the control case.

Experiments:

Ricrx2: Set Ri_{cr} = 0.6 (up from 0.3)

Pistonx2: Double the CFC piston velocity

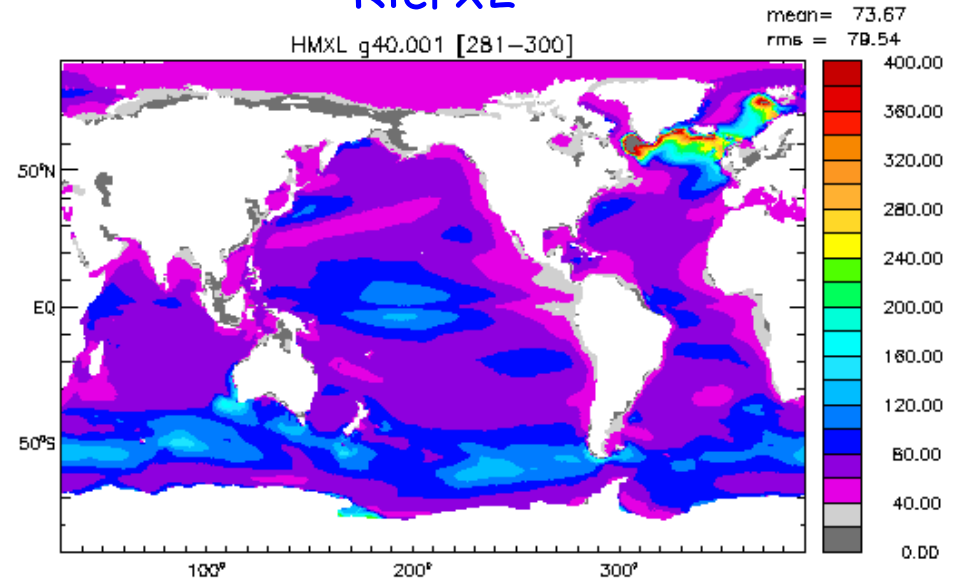
K(600): increase minimum Redi diffusivity coefficient to 600 $m^2\ s^{-1}$ (from 300 $m^2\ s^{-1}$)

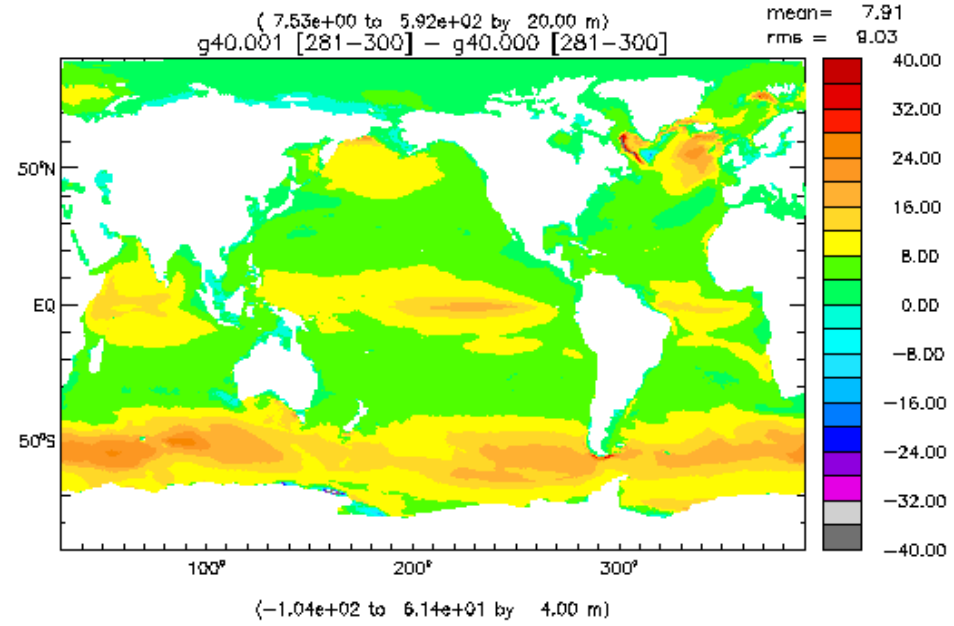
K(1000): increase minimum Redi diffusivity to 1000 $m^2\ s^{-1}$

k_v: increase the background vertical diffusivity to 0.3×10^{-4} $m^2\ s^{-1}$ (from 0.17×10^{-4} $m^2\ s^{-1}$)

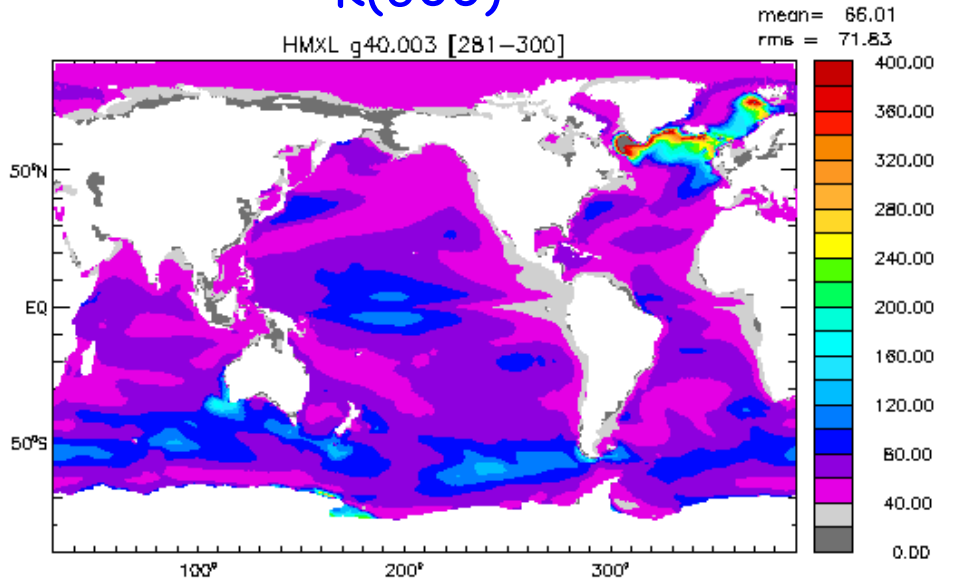
TIME-MEAN MIXED LAYER DEPTH

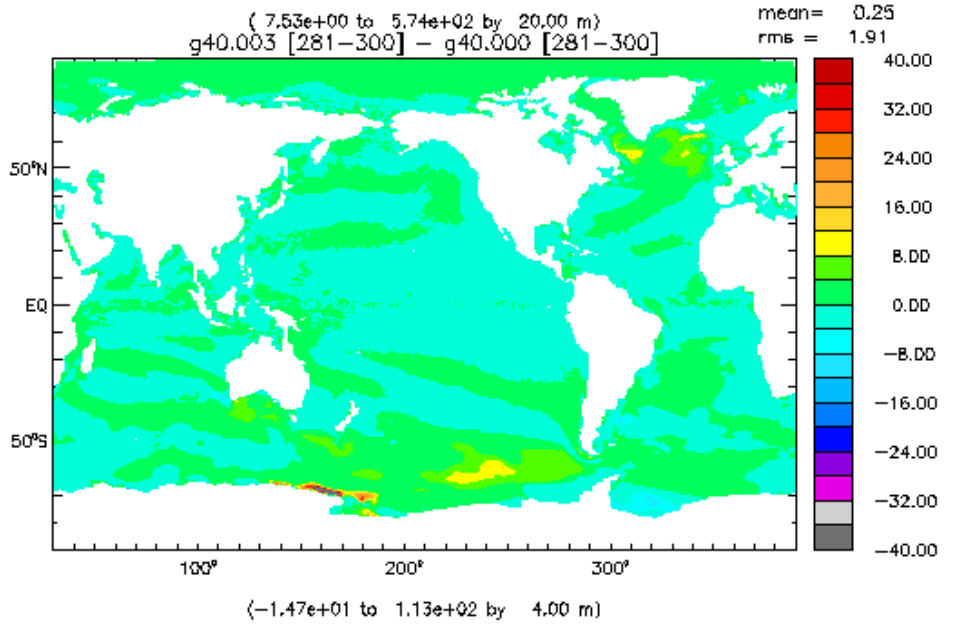
Ricrx2



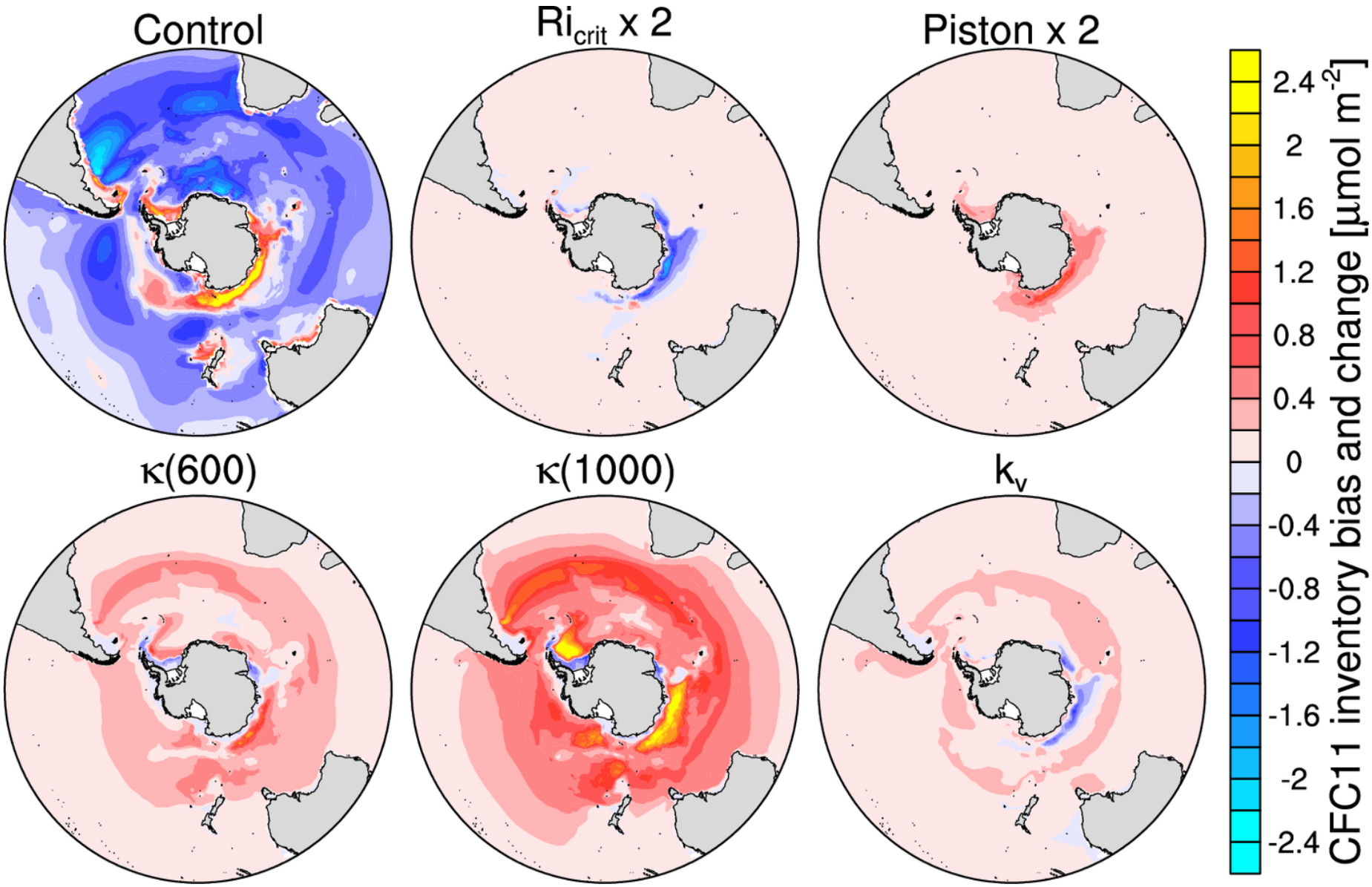


K(600)

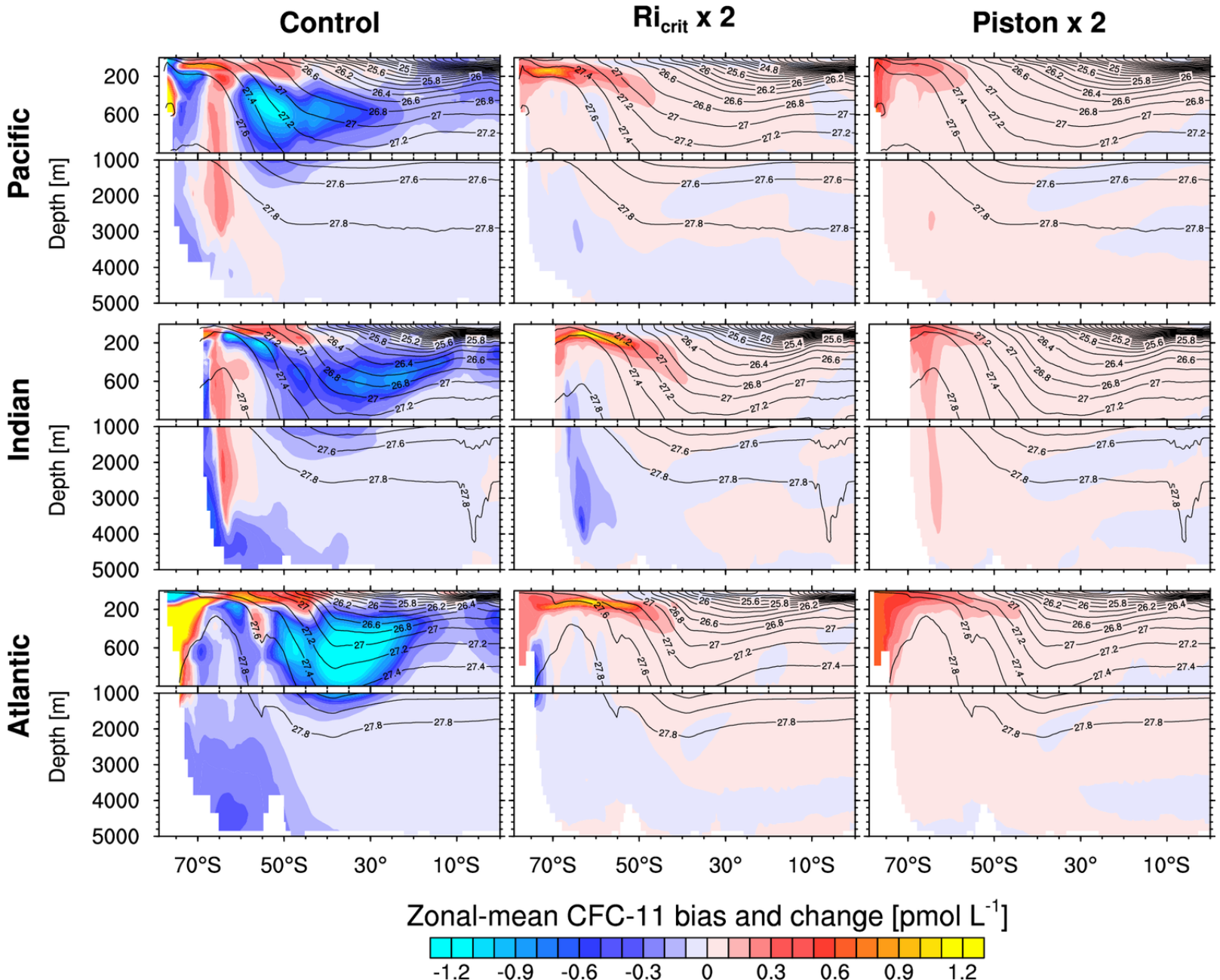




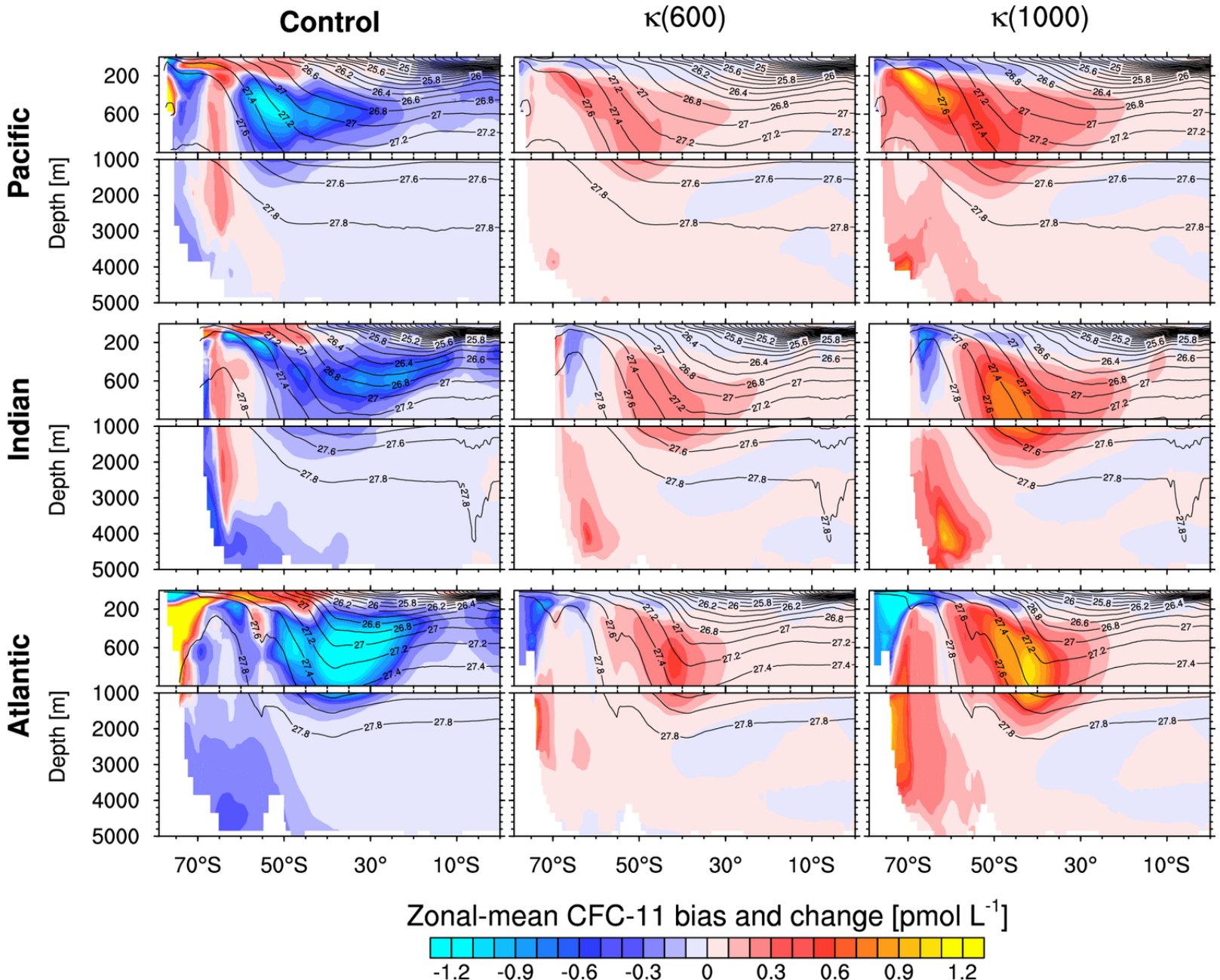
CFC-11 COLUMN INVENTORY



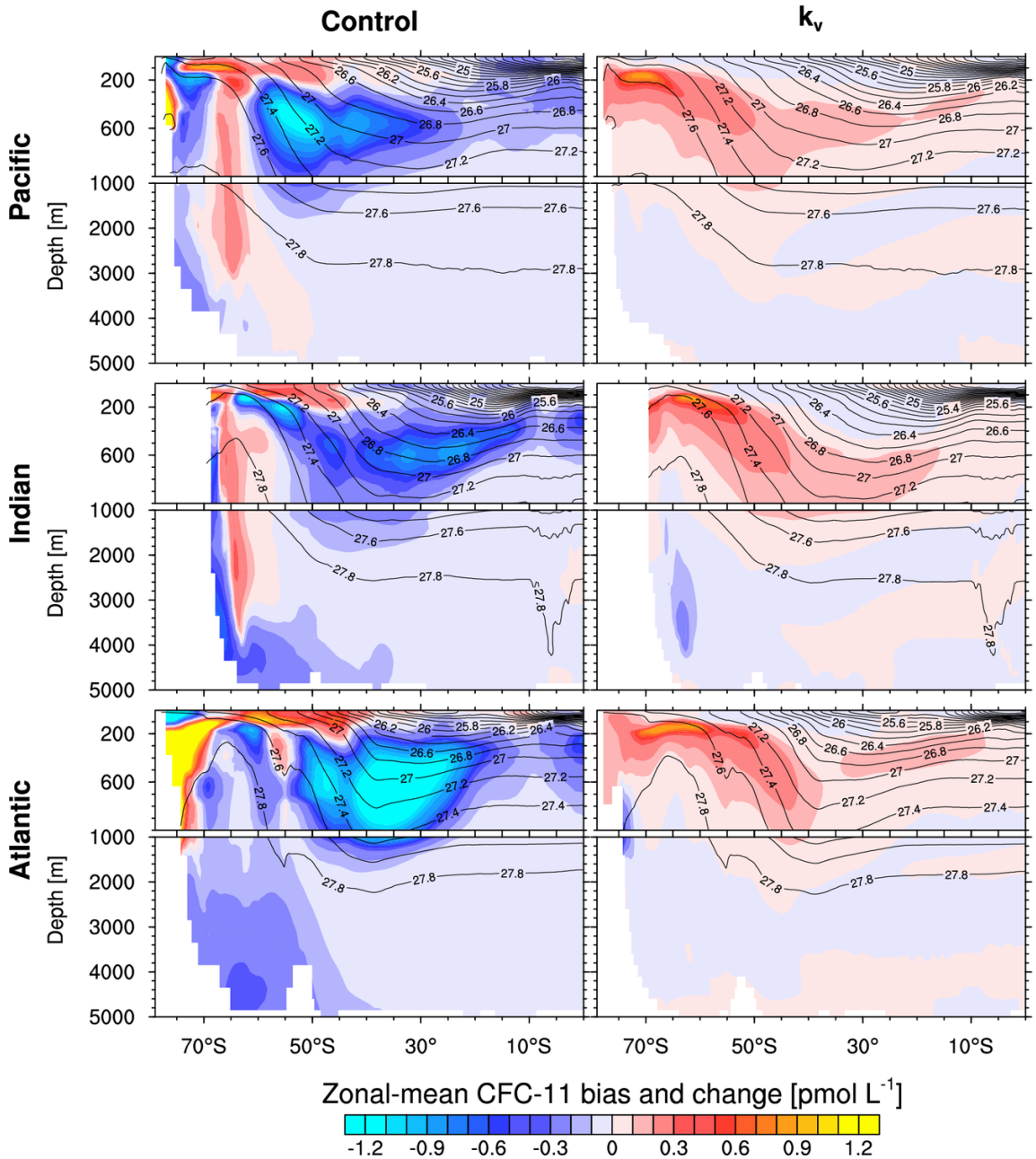
ZONAL-MEAN CFC-11 DIFFERENCES



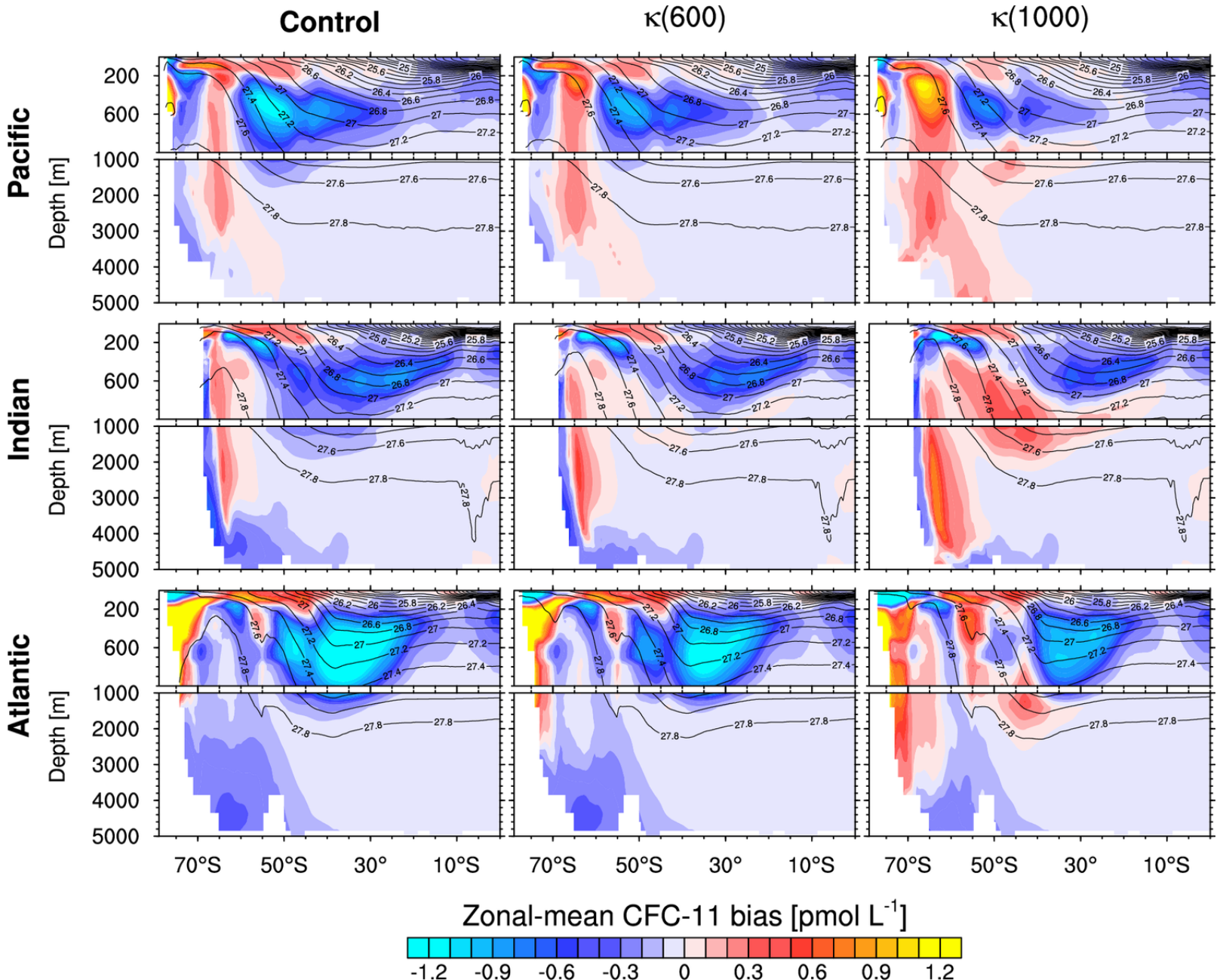
ZONAL-MEAN CFC-11 DIFFERENCES



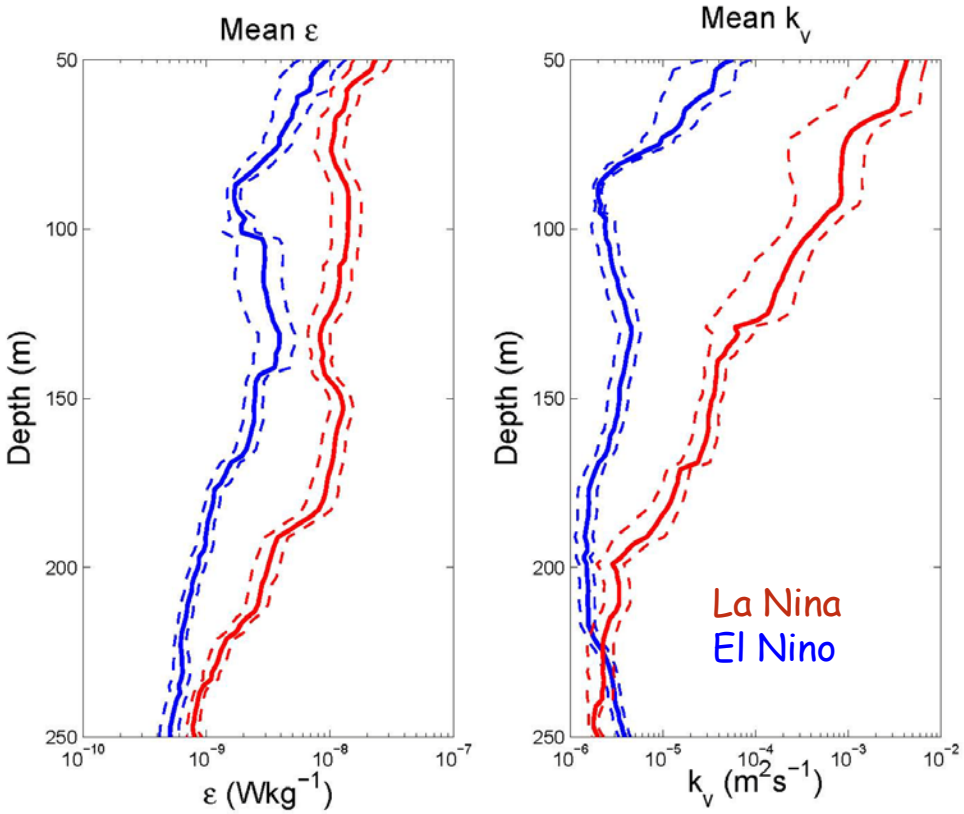
ZONAL-MEAN CFC-11 DIFFERENCES



ZONAL-MEAN CFC-11 DIFFERENCES FROM OBSERVED



Mixing due to Small Vertical Scales (SVS) in the tropical Pacific (Kelvin Richards et al.)



Suggested parameterization:

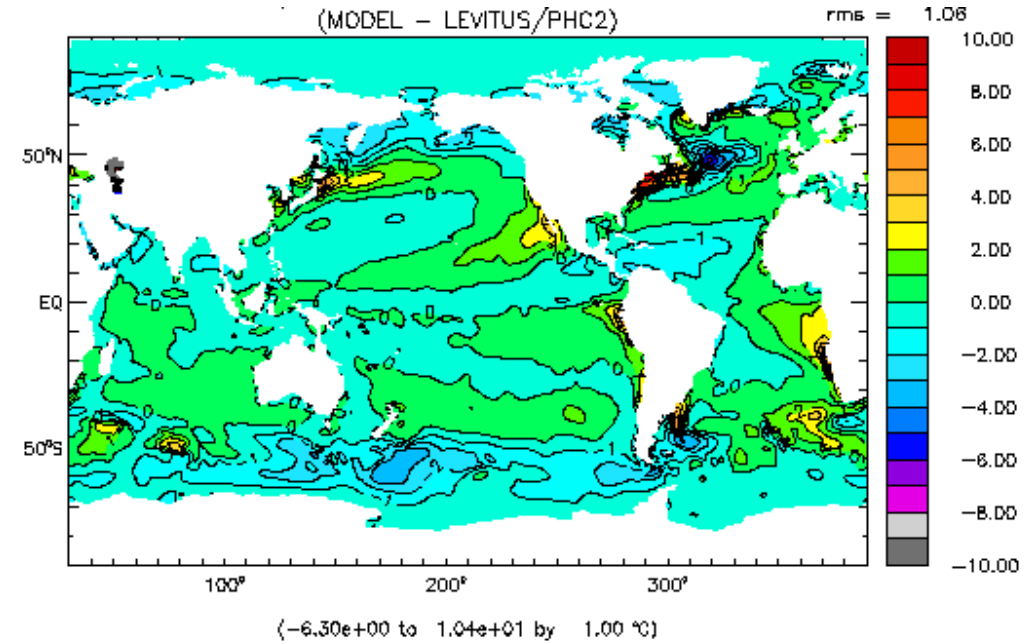
$k_o = 5 \times 10^{-5}$ m^2 s^{-1} above 20°C isotherm

$k_o = 1 \times 10^{-6}$ m^2 s^{-1} below

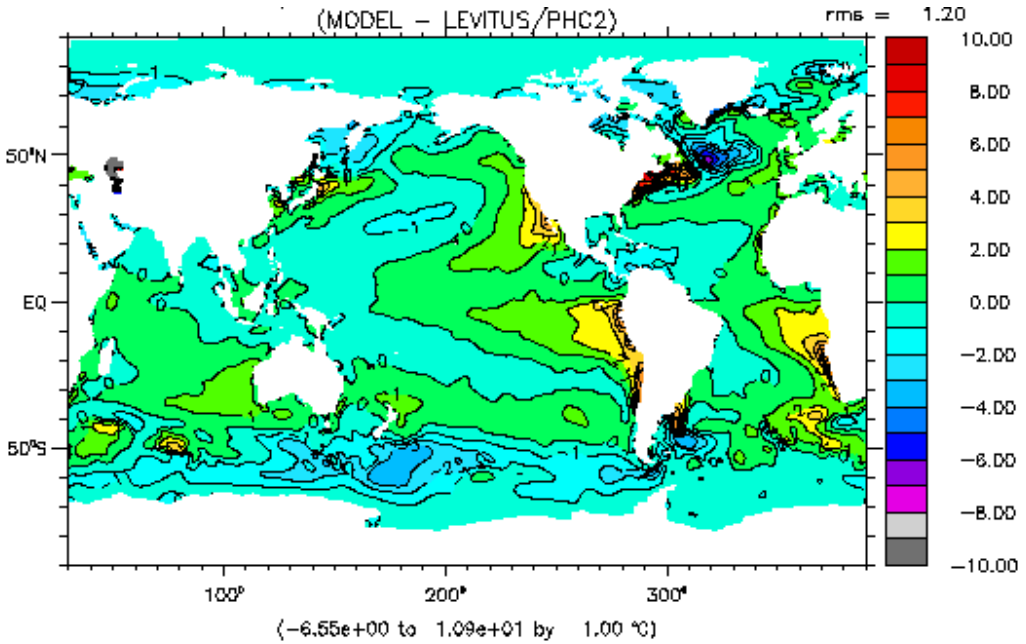
k_o: background vertical diffusivity

CONTROL: 1850 pre-industrial control
SVS: 50-year coupled simulation, starting from year 863 of control

SST DIFFERENCES



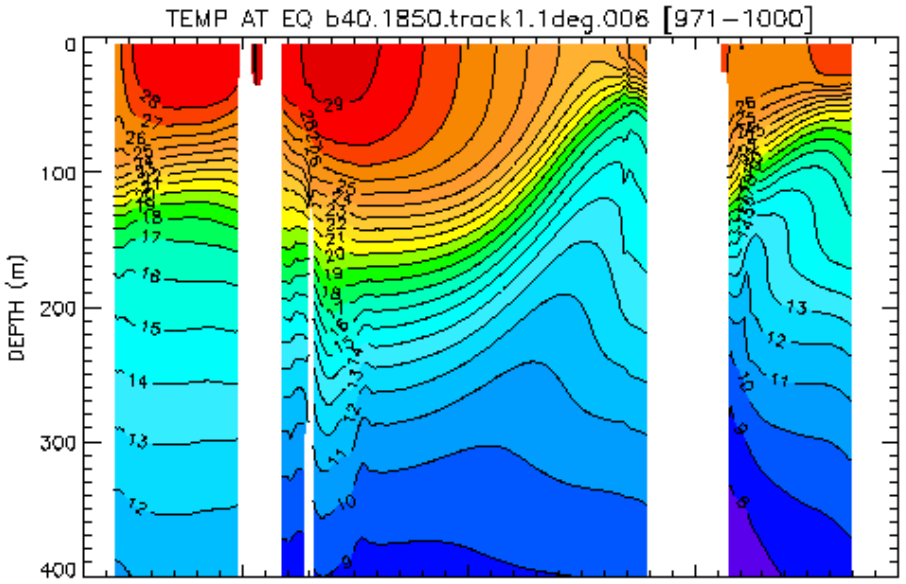
CONTROL - OBS

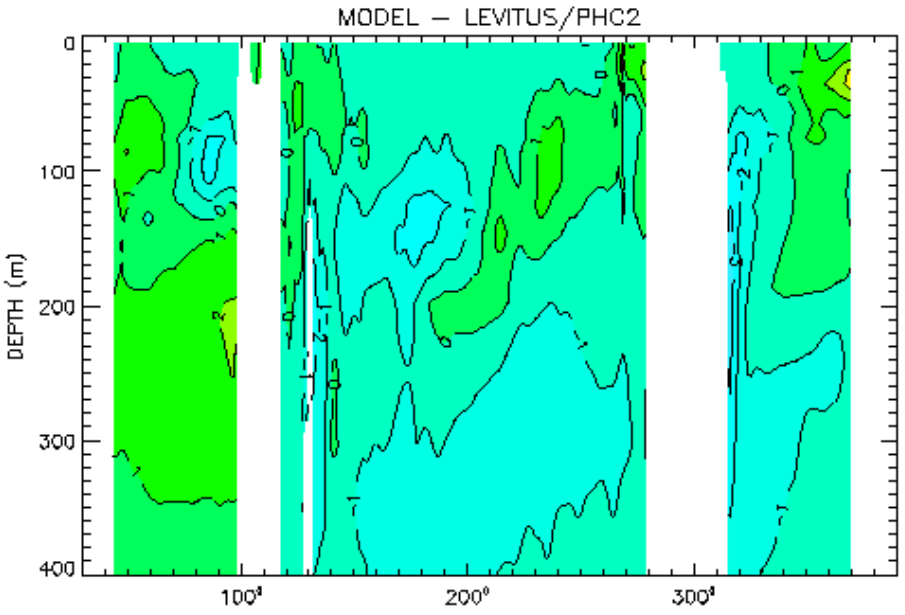


SVS - OBS

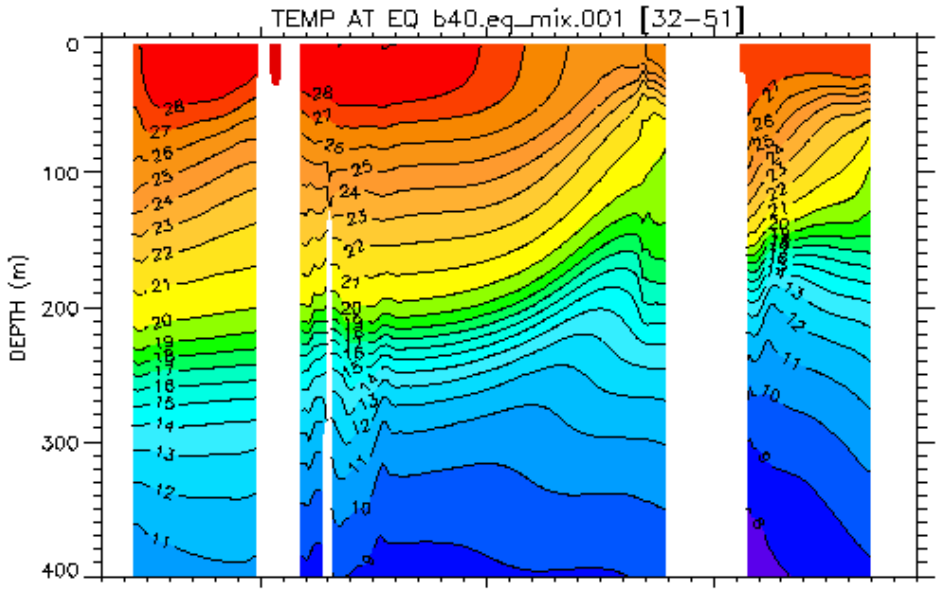
EQUATORIAL TEMPERATURES

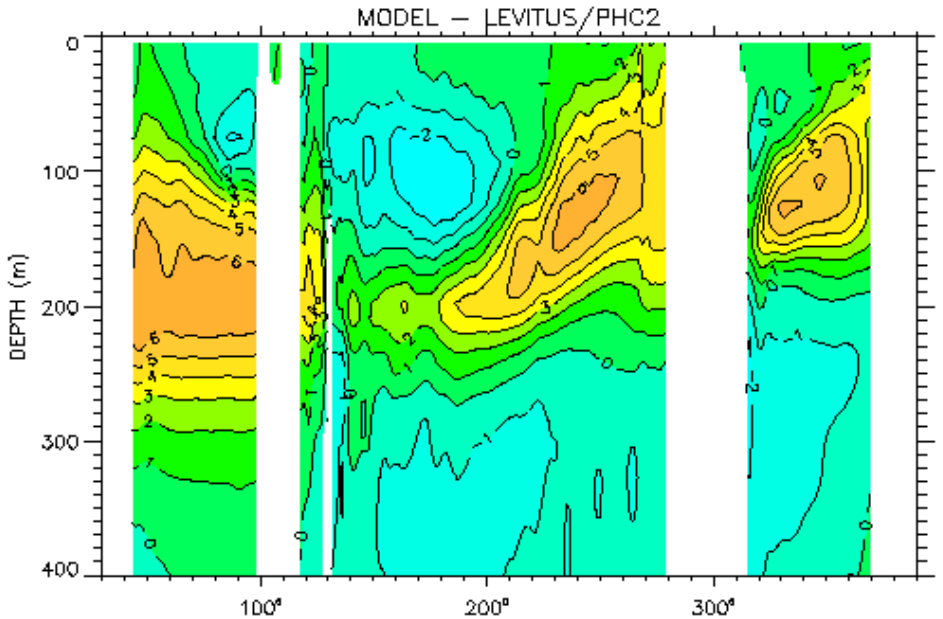
CONTROL



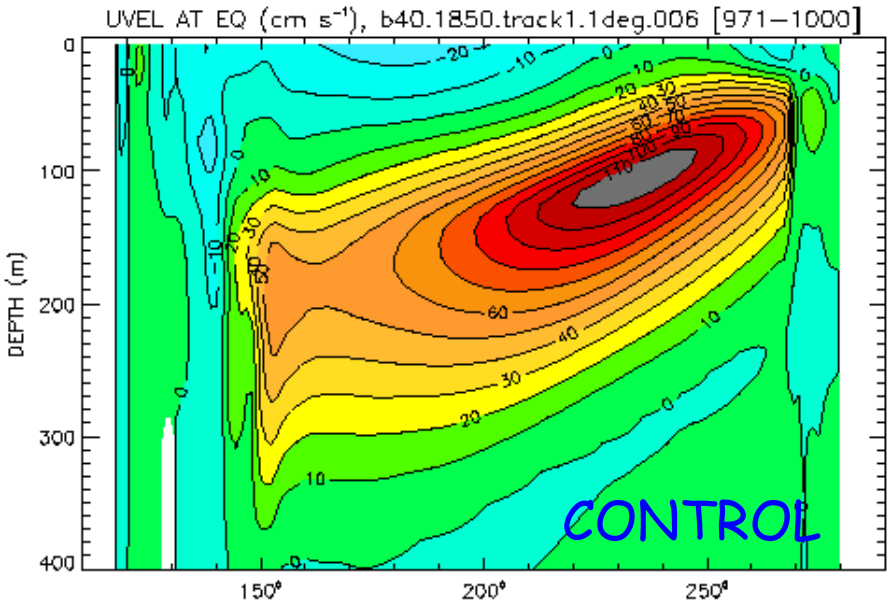


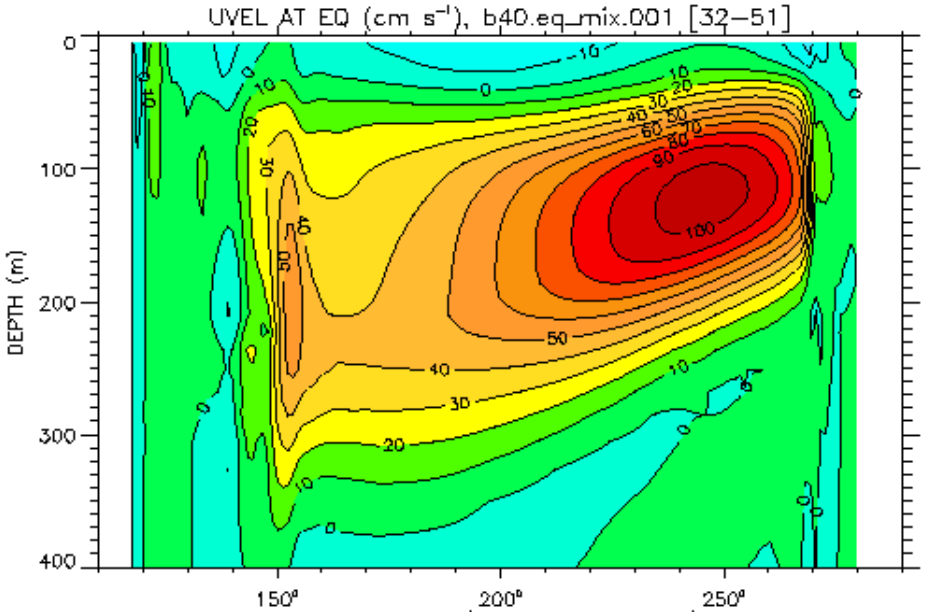
SVS



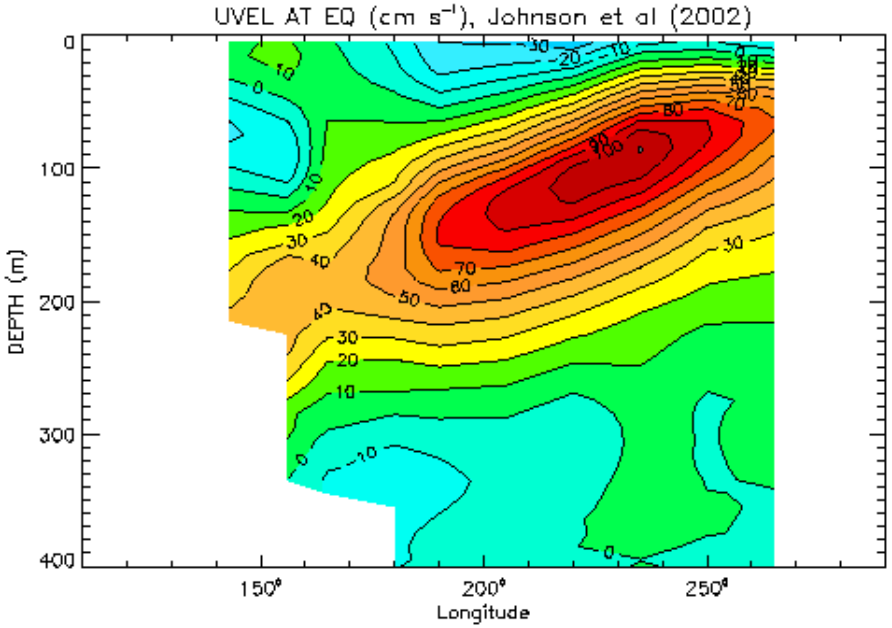


PACIFIC EQUATORIAL UNDERCURRENT





SVS



OBS

SUMMARY

- Work in progress,
- Clear improvements in CFC-11 distributions, particularly with increased Redi diffusivity,
- K(600) seems optimal in these measures.

- NIW and frequent coupling impacts will be considered next,
- Come up with a set of "optimal" parameters, also considering impacts on other metrics,
- Assess long term behavior, including other BGC fields.

Any other suggestions?