



Sensitivity of Global-mean Steric Sea Level Rise to Interior Ocean Diapycnal Diffusivity

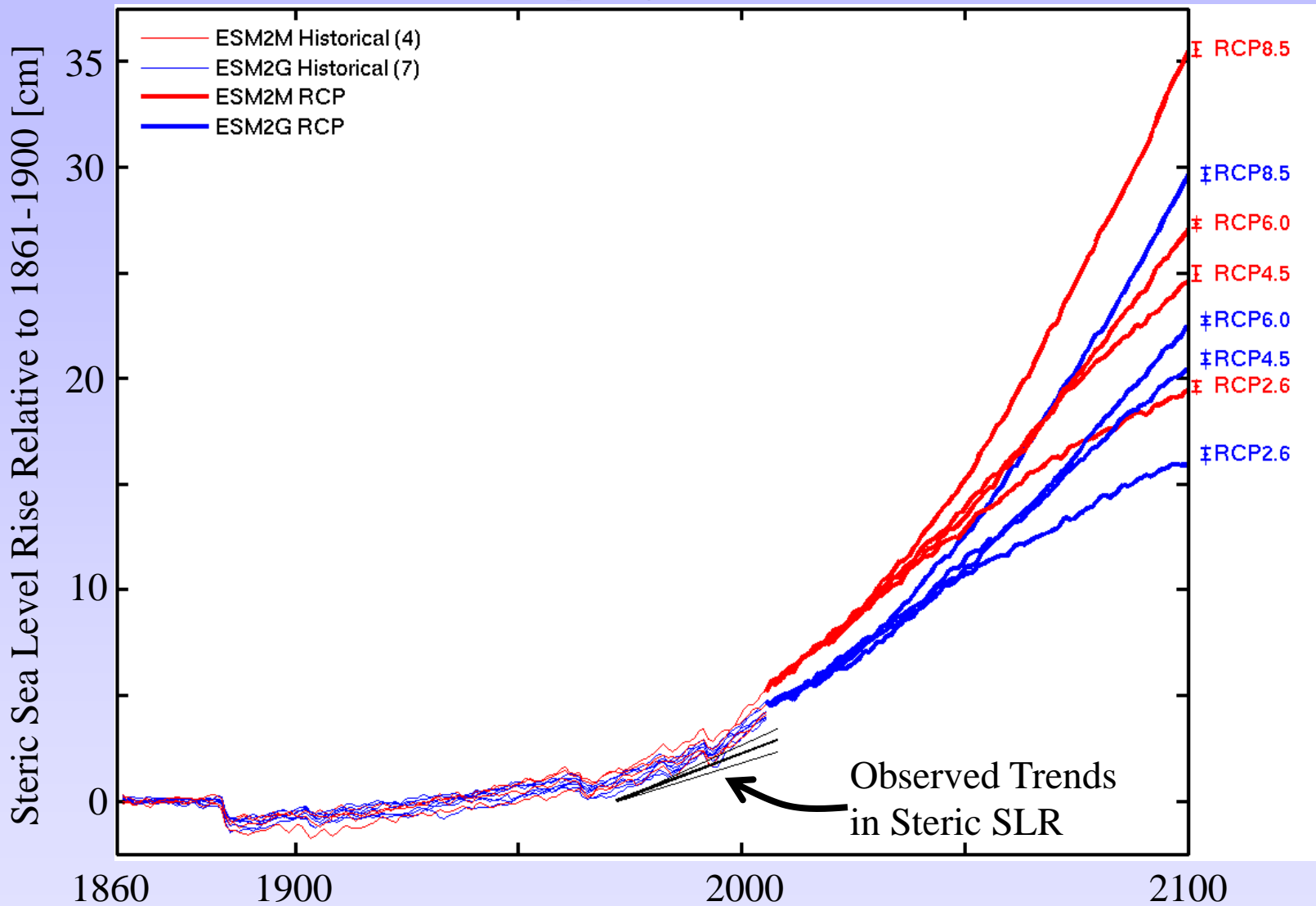
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³*LEGOS, Toulouse, France*

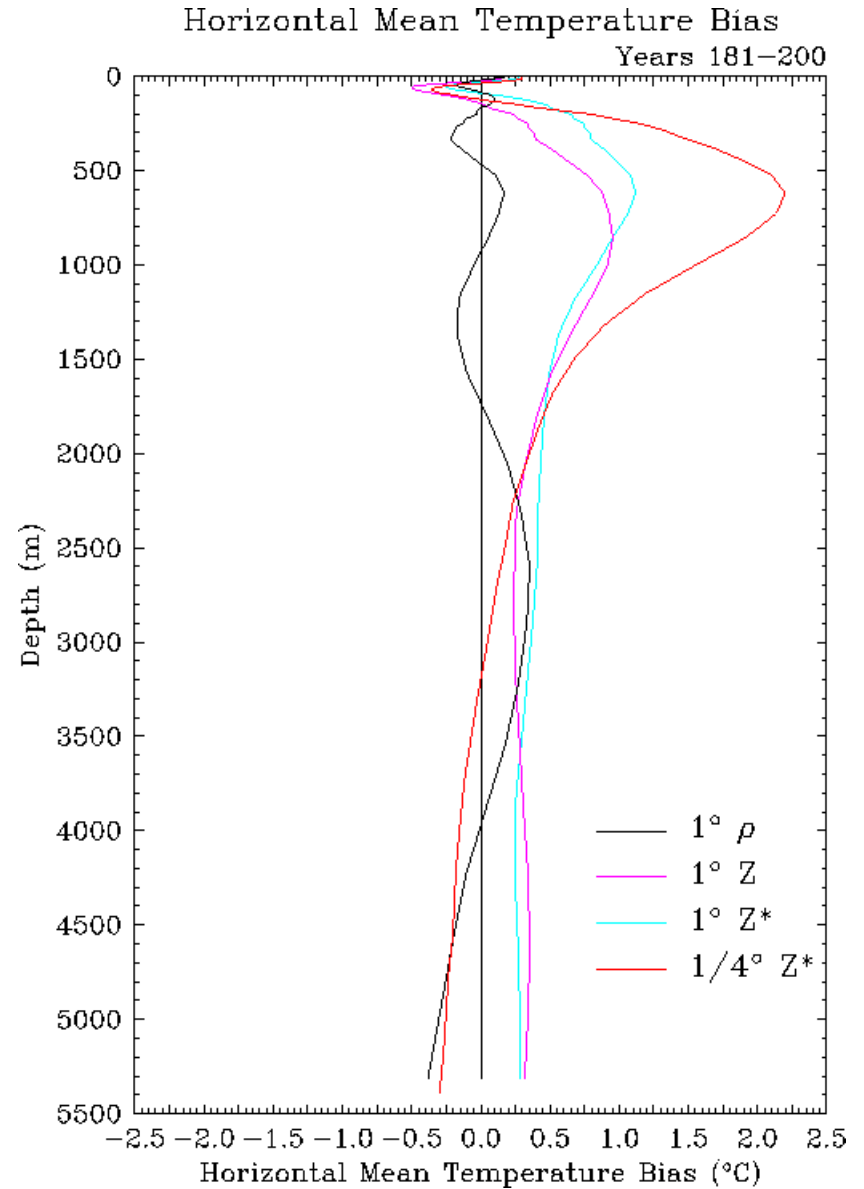
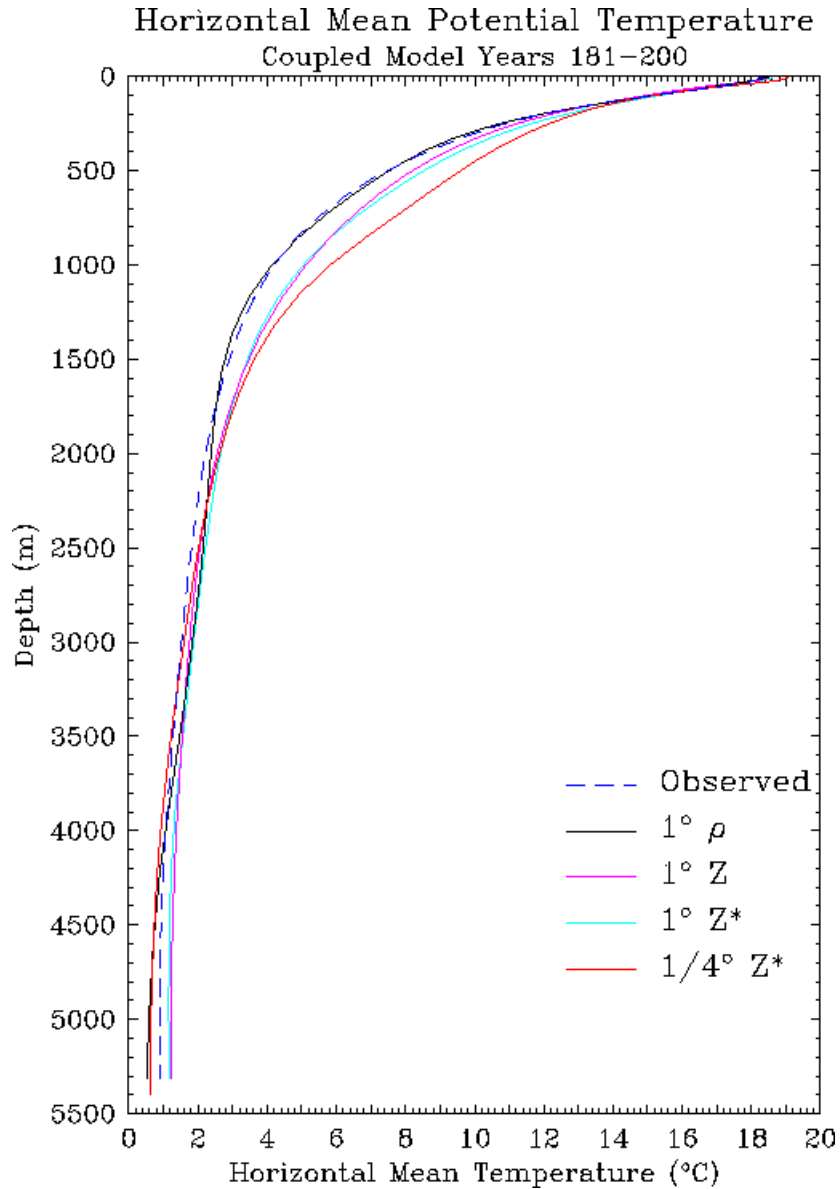


Historical & Scenario-projected Steric Sea Level Rise



- Both models agree with observed steric sea level rise trends.
- ESM2M exhibits 18% more 21st century steric sea level rise than ESM2G.

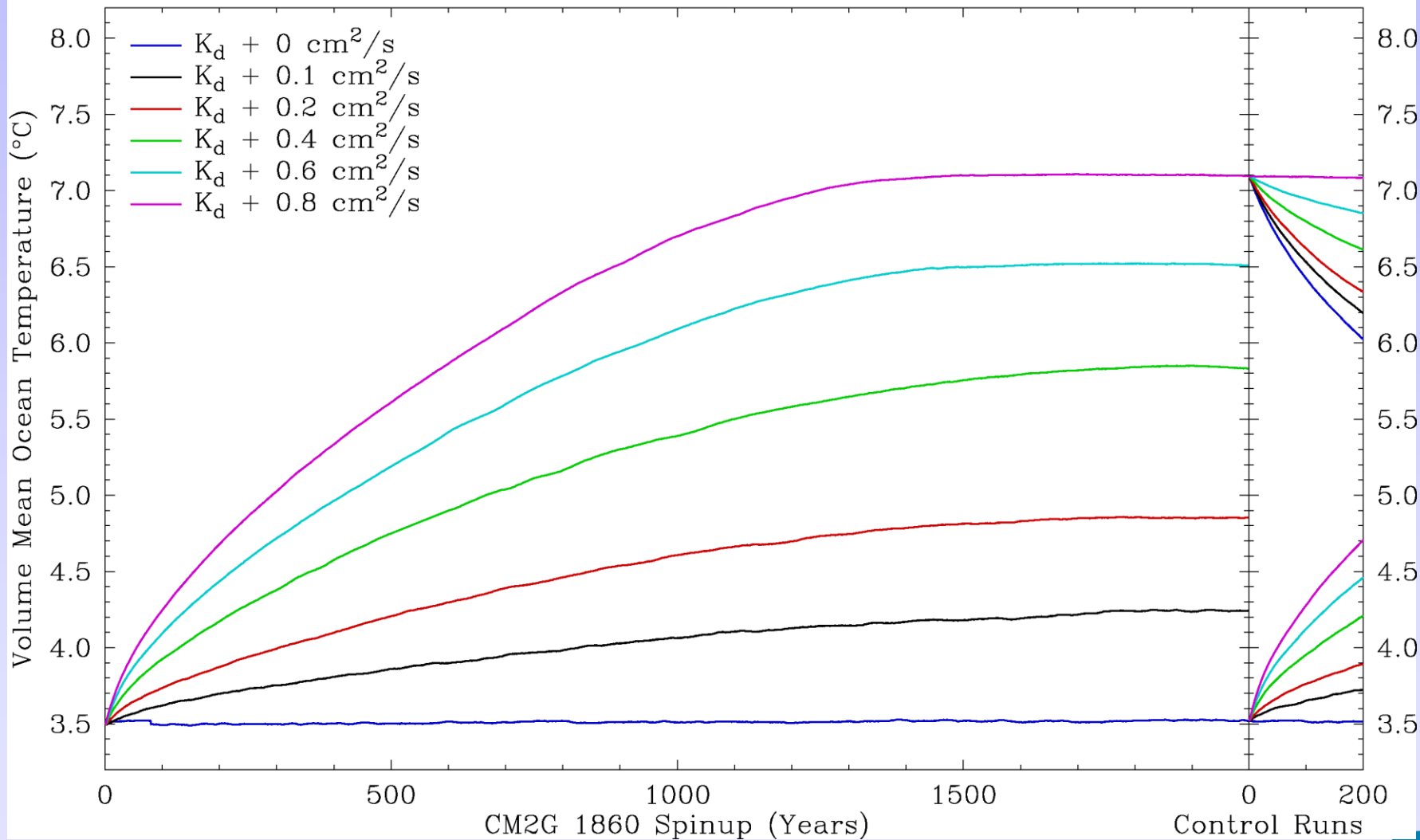
Spurious diapycnal mixing in coupled climate models?





Experimental Design – Volume Mean Ocean Temperatures in Spinup & Some Control Runs

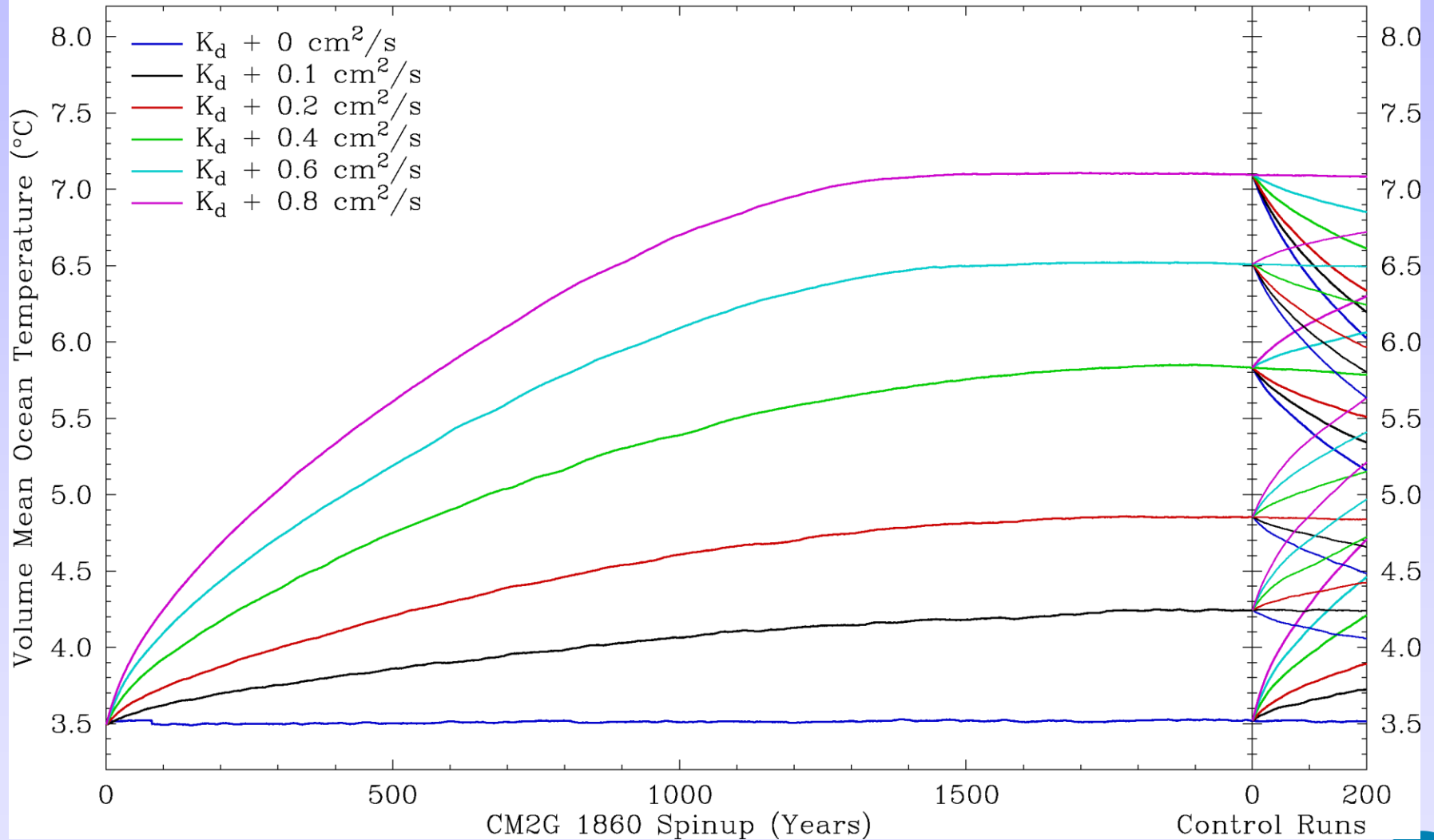
CM2G Coupled Model Control Run Temperatures





Experimental Design – Volume Mean Ocean Temperatures in Spinup & All 36 Control Runs

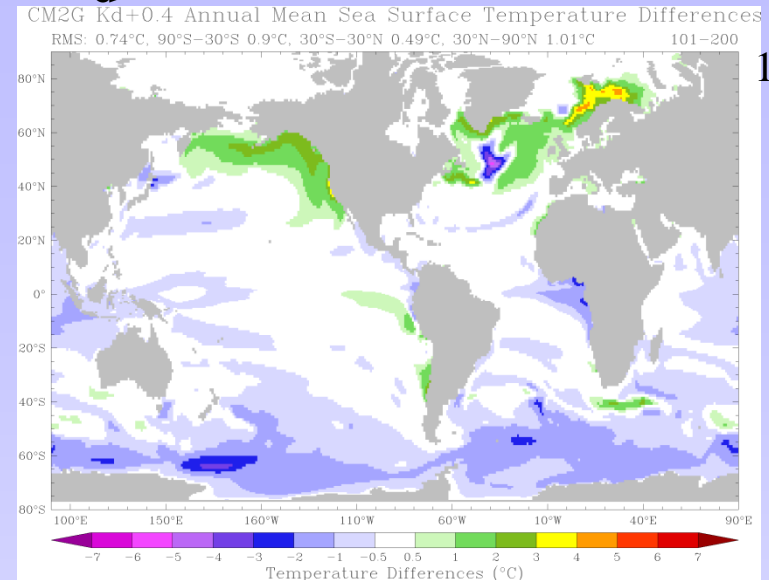
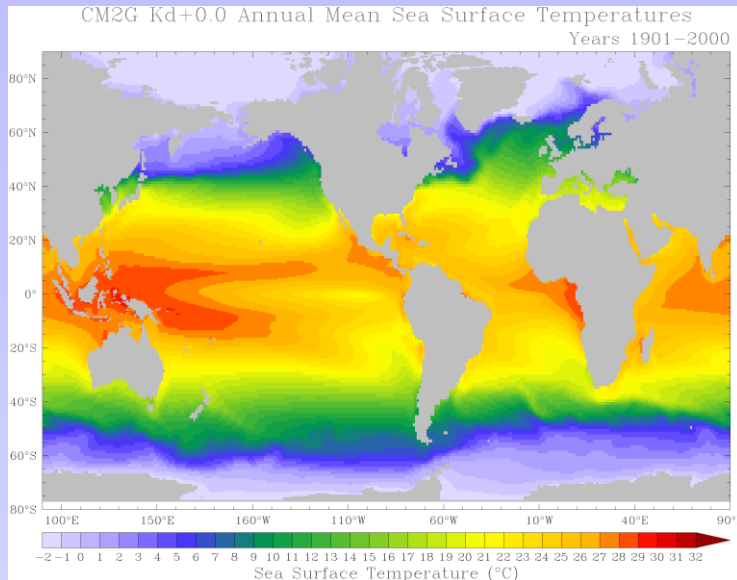
CM2G Coupled Model Control Run Temperatures



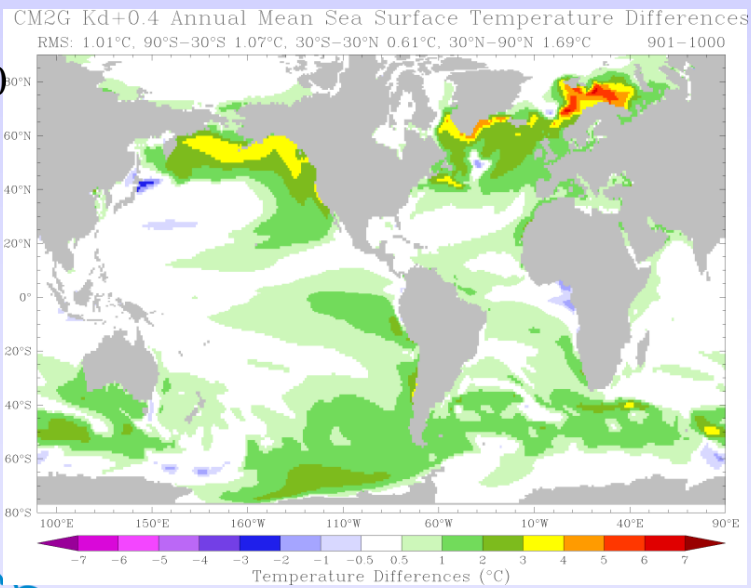


Sea Surface Temperatures & SST Anomalies with $K_d + 0.4 \text{ cm}^2 \text{ s}^{-1}$

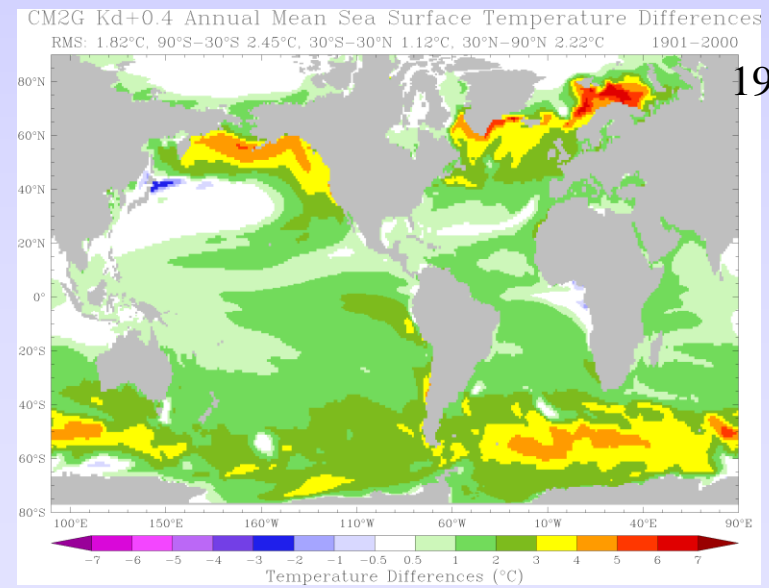
Years
101-200



Years
901-1000

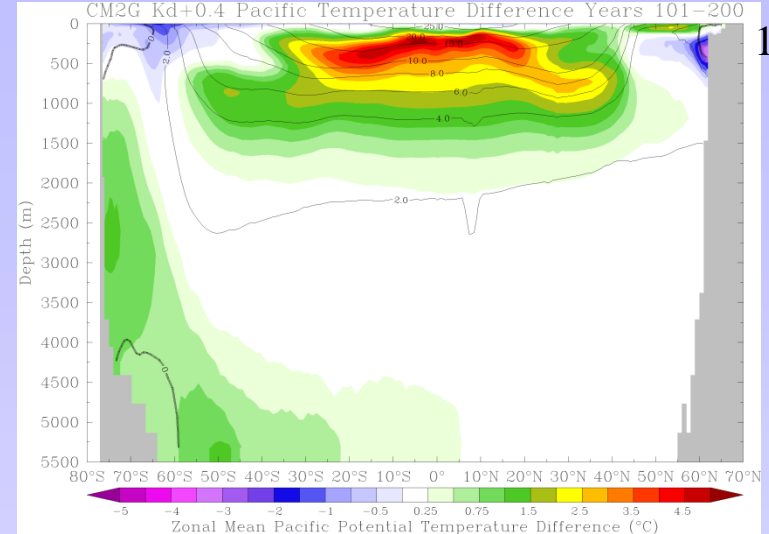
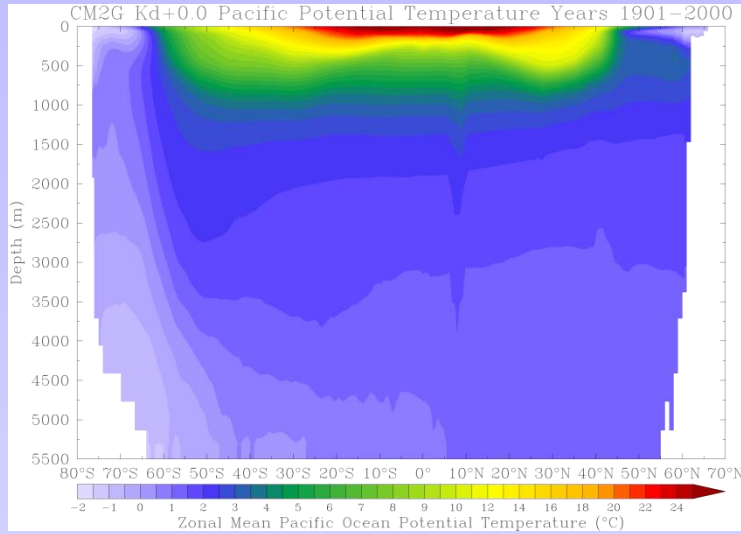


Years
1901-2000



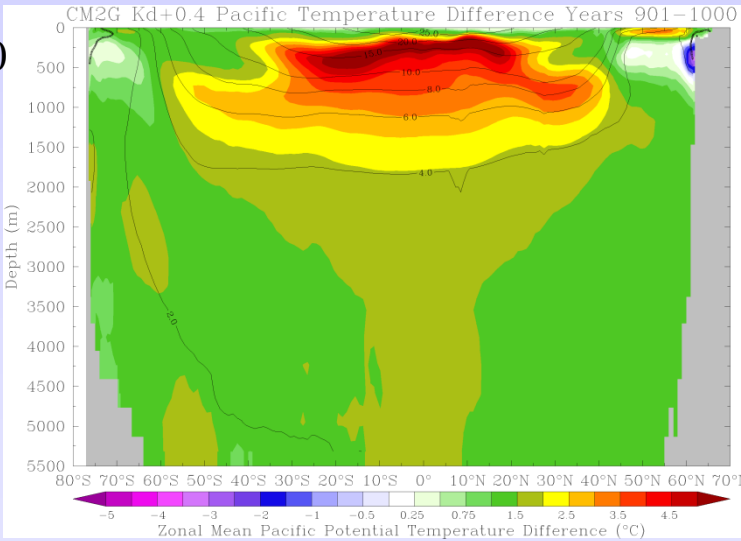


Zonal Mean Pacific Potential Temperatures & Anomalies with $K_d + 0.4 \text{ cm}^2 \text{ s}^{-1}$

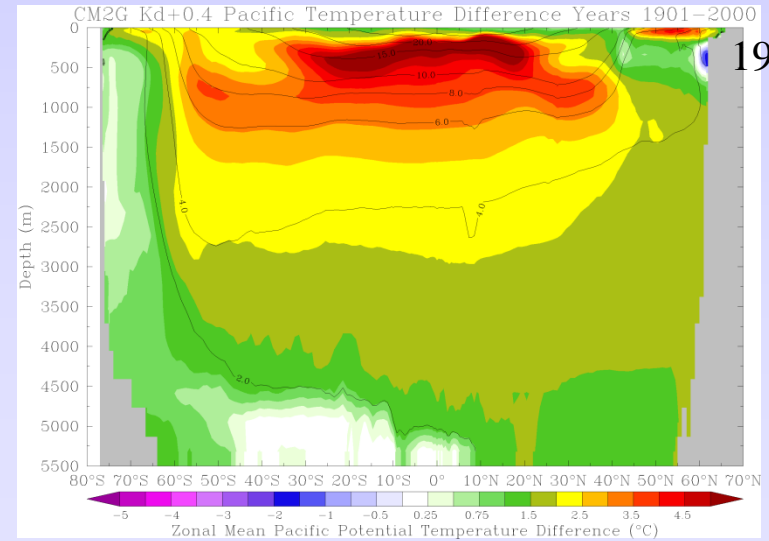


Years
101-2000

Years
901-1000



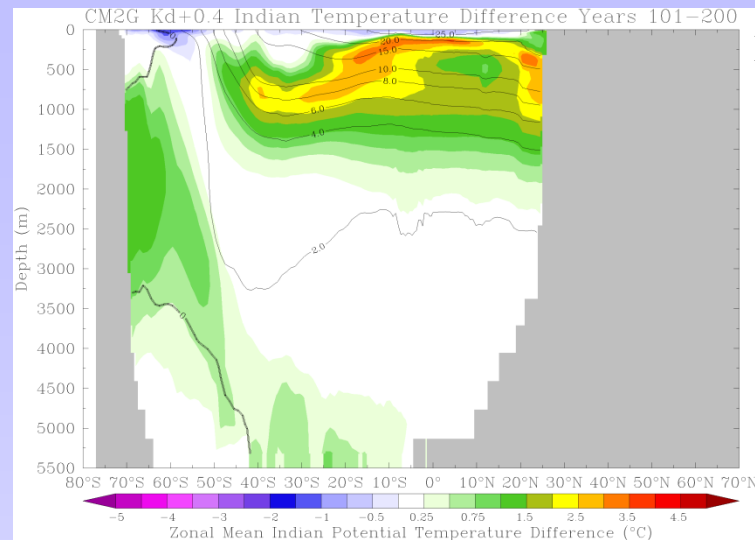
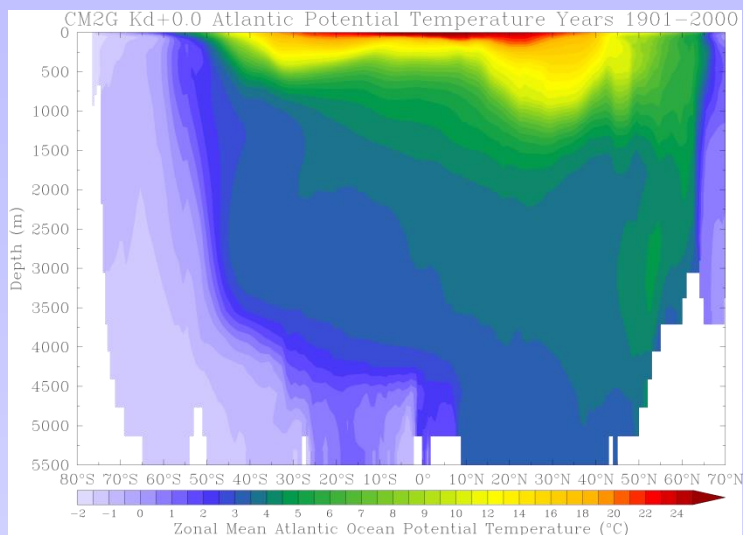
Years
1901-2000



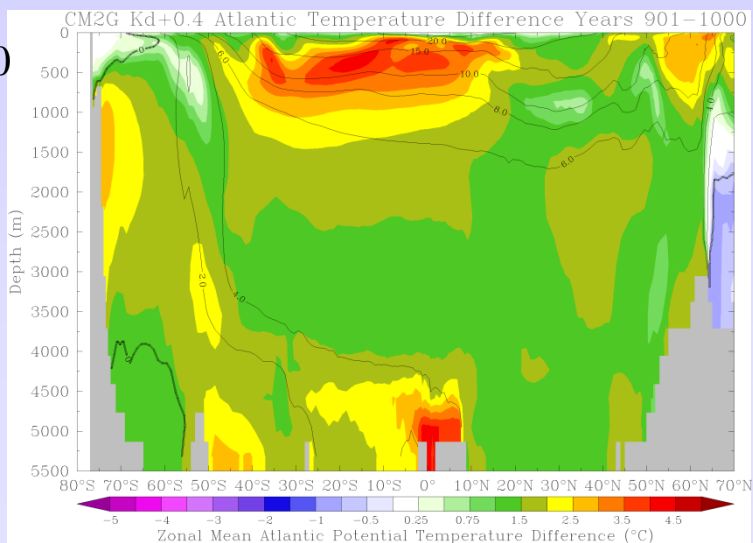


Zonal Mean Atlantic Potential Temperatures & Anomalies with $K_d + 0.4 \text{ cm}^2 \text{ s}^{-1}$

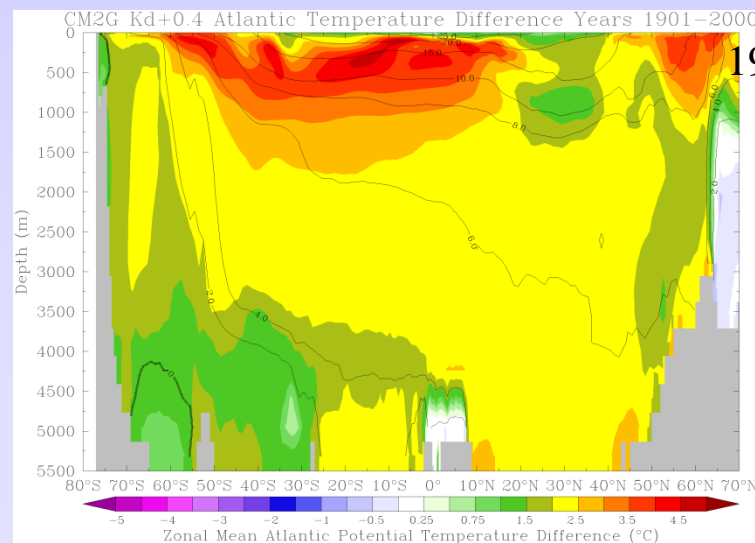
Years
101-200



Years
901-1000



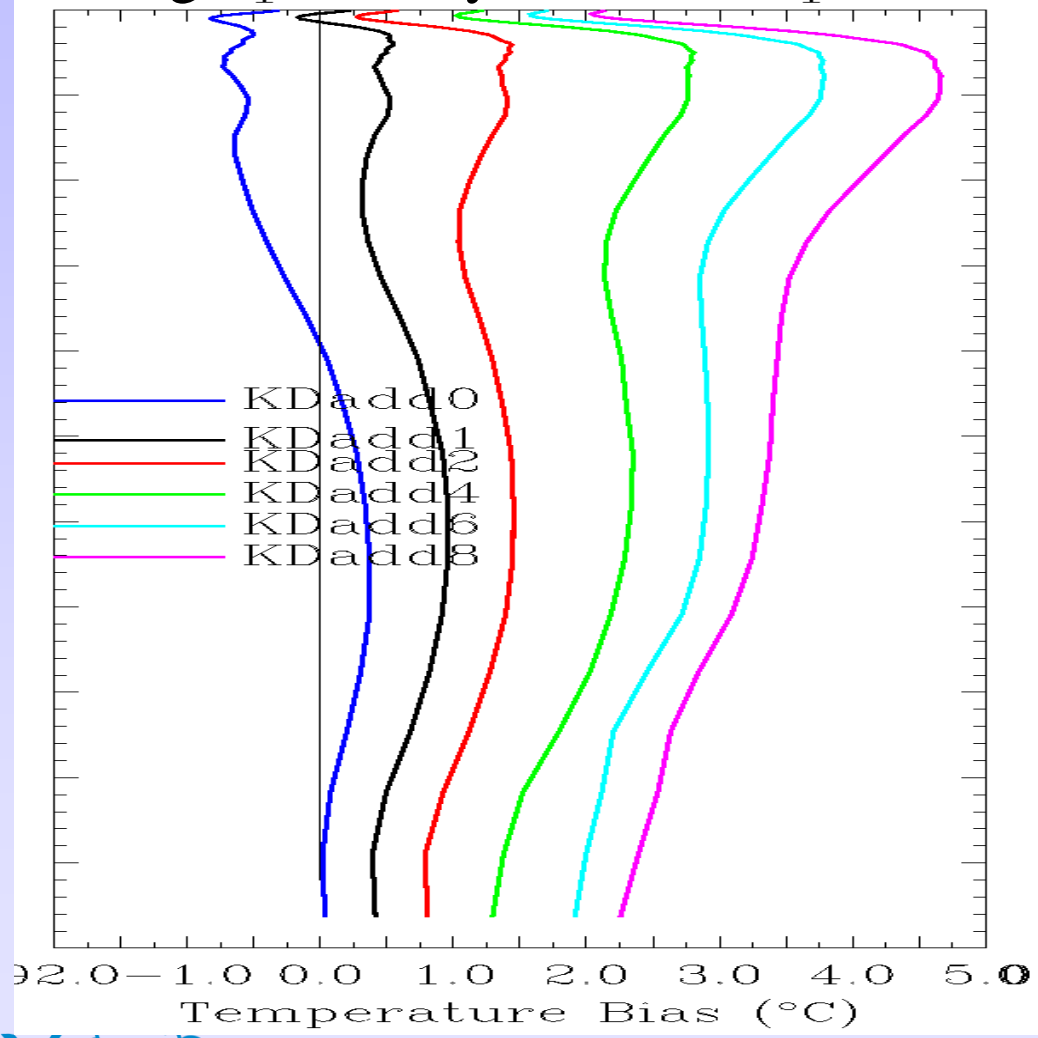
Years
1901-2000



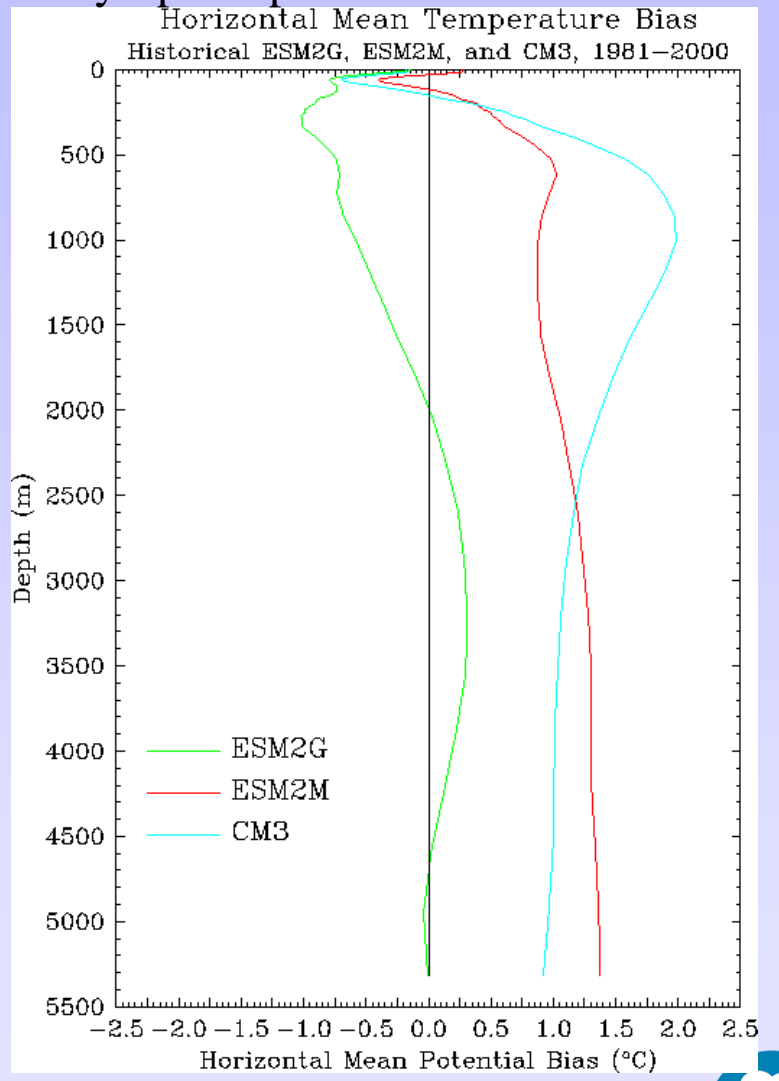


Equivalence of adding diapycnal diffusivities to spurious diapycnal mixing in coupled climate models?

Adding Diffusivity, Years 1901-2000

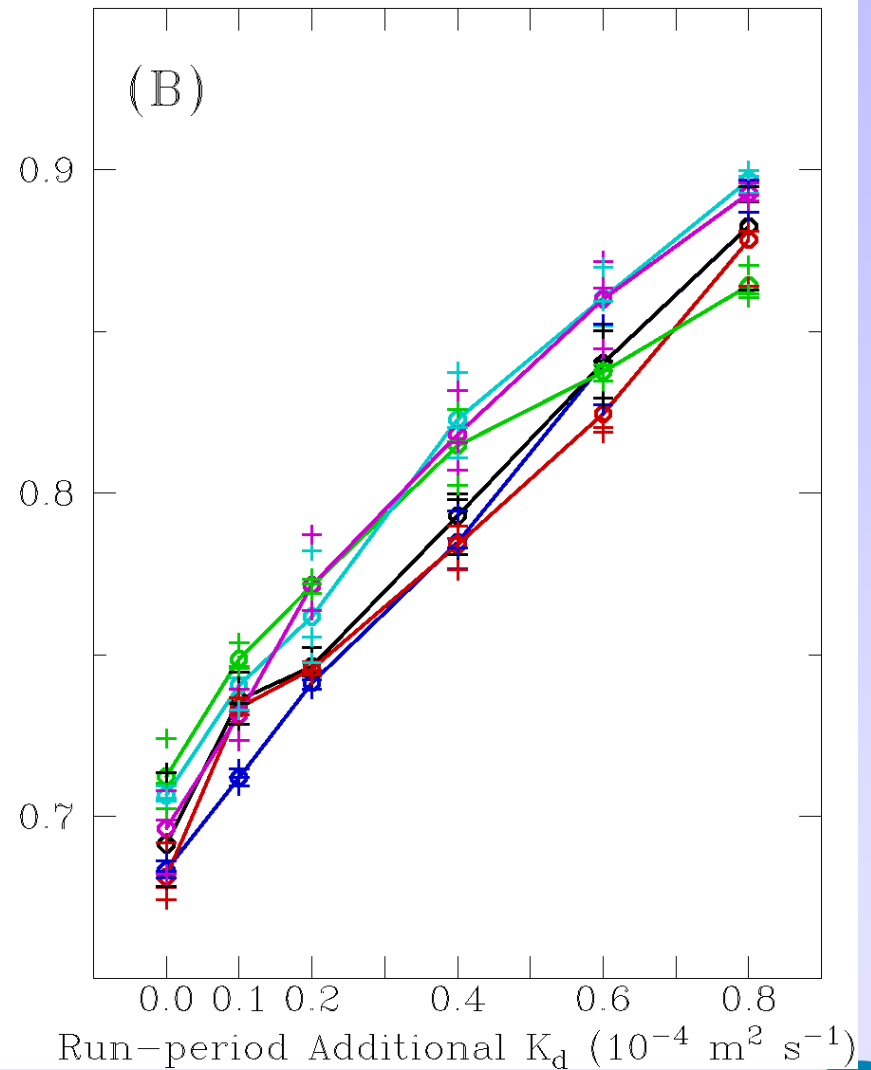
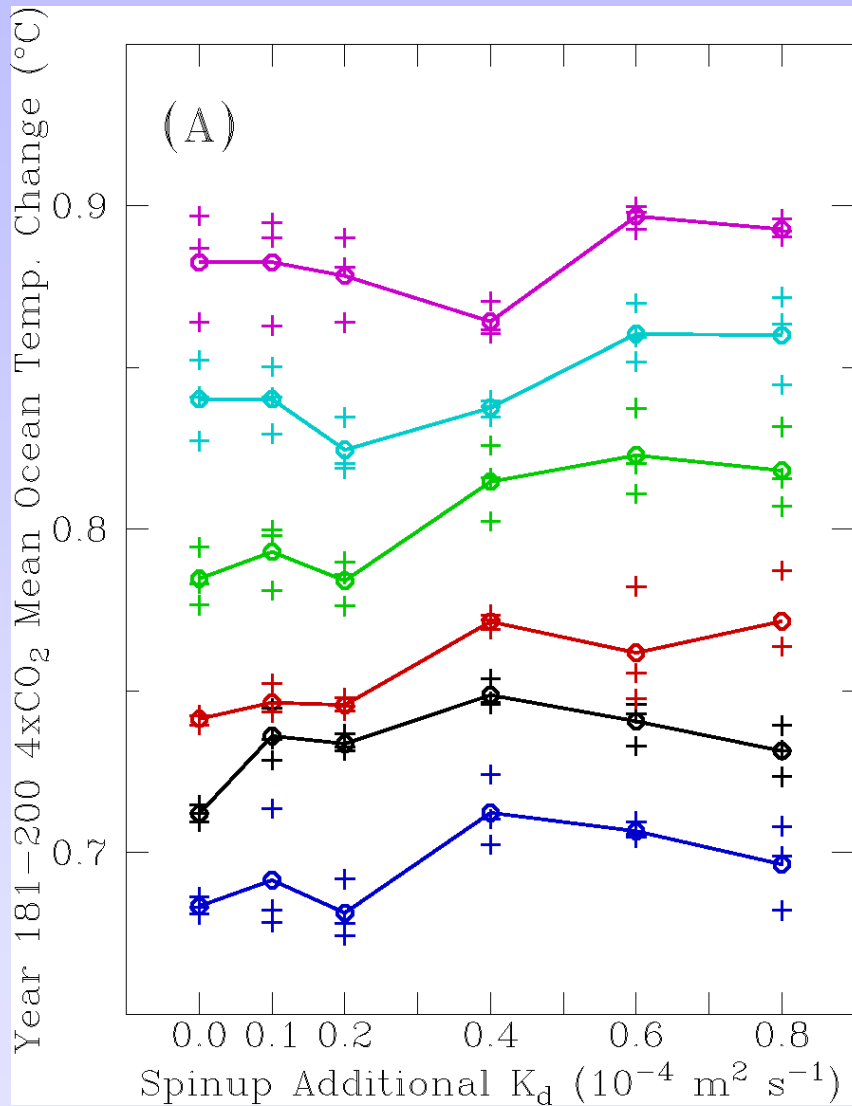


Fully Spun-up Historical Climate Runs



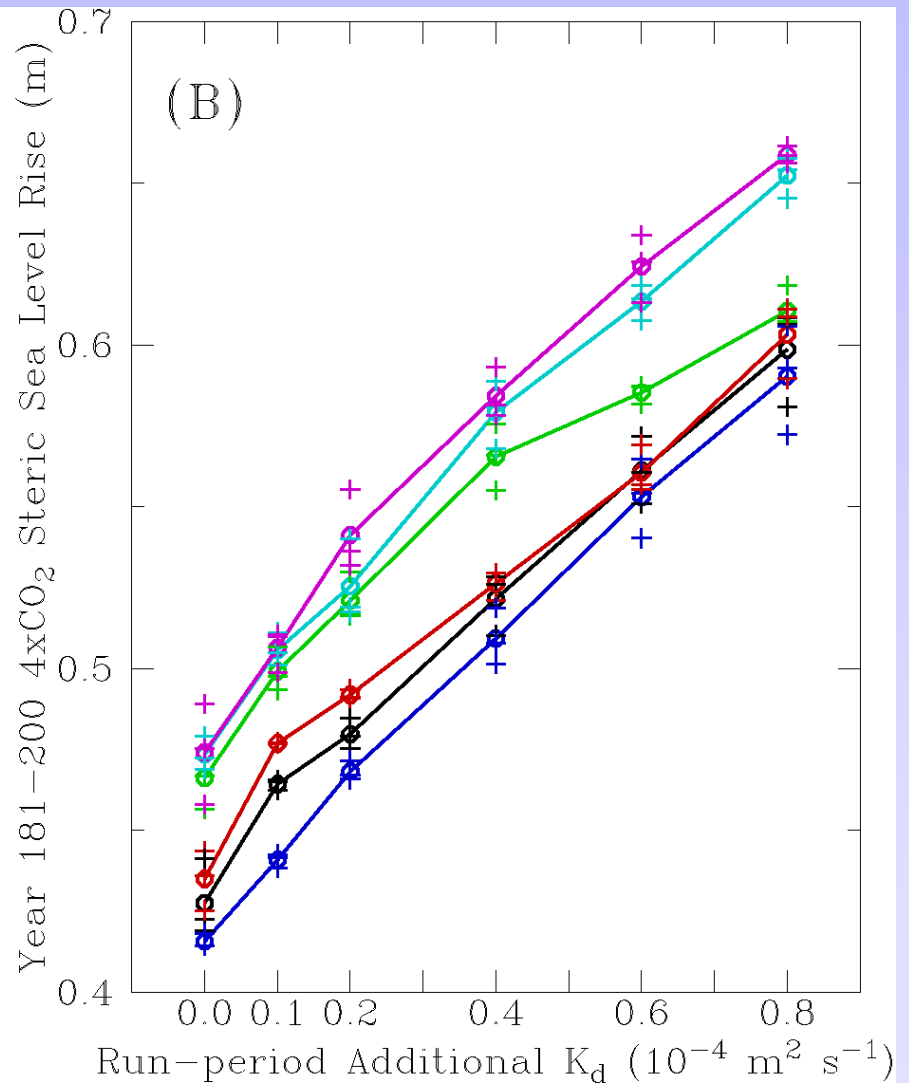
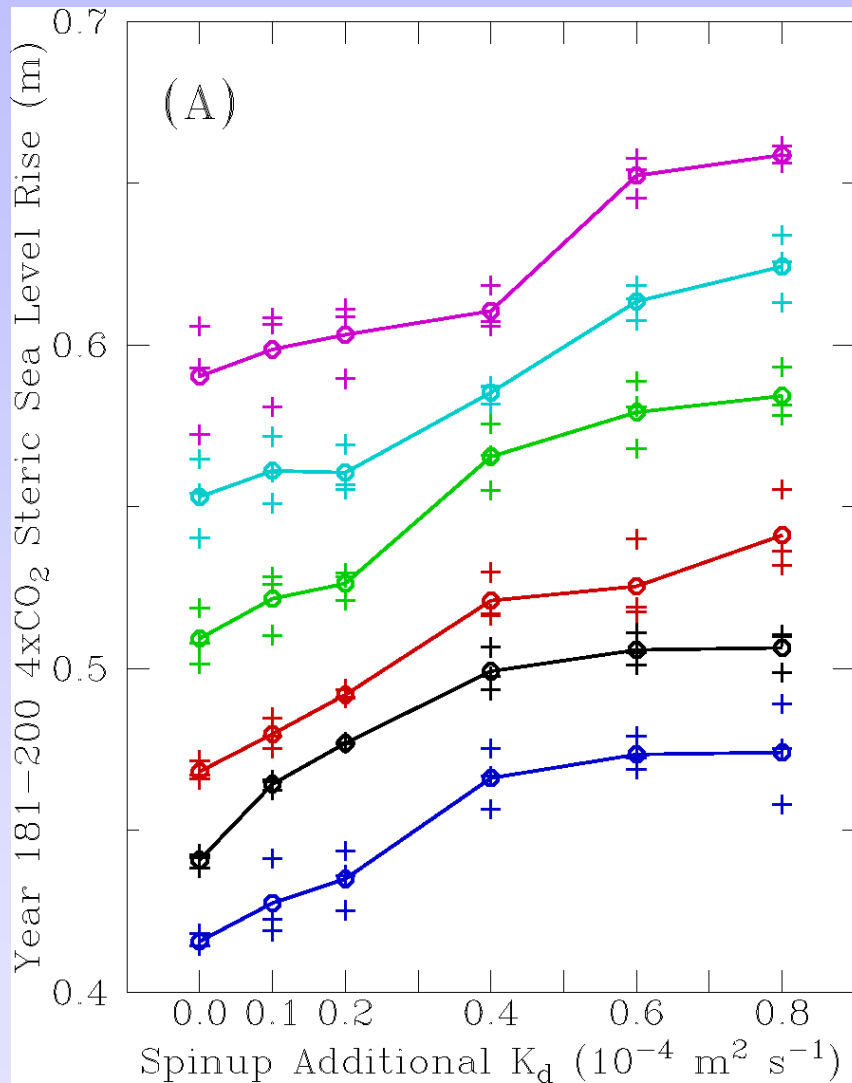


Change in Mean Ocean Temperature in 1%/year to 4xCO₂ Runs, Years 181-200





Mean Steric Sea Level Change in 1%/year to 4xCO₂ Runs, Years 181-200





Summary

- Projected steric sea level rise increases with increased diapycnal diffusion
 - Diffusion during climate change runs and in the main thermocline is more important, but diffusion during the model's spin-up matters too.
- Two sources of steric SLR sensitivity to diffusivity:
 1. Increasing diffusion warms the ocean & warmer water expands more.
 2. Increasing diffusion increases the ocean heat uptake.
- Many coupled climate models use similar (Z-coordinate) ocean models with common warm and diffuse main thermocline biases
 - Multi-model projections likely overestimate steric SLR.
 - Shorter spinup does not help much.
- Mean state ocean biases may be a good indicator of coupled model utility in predicting steric sea level rise.