

PetaApps Project Control Run Results & Discussion of HiRes CCSM Strategy

Frank Bryan

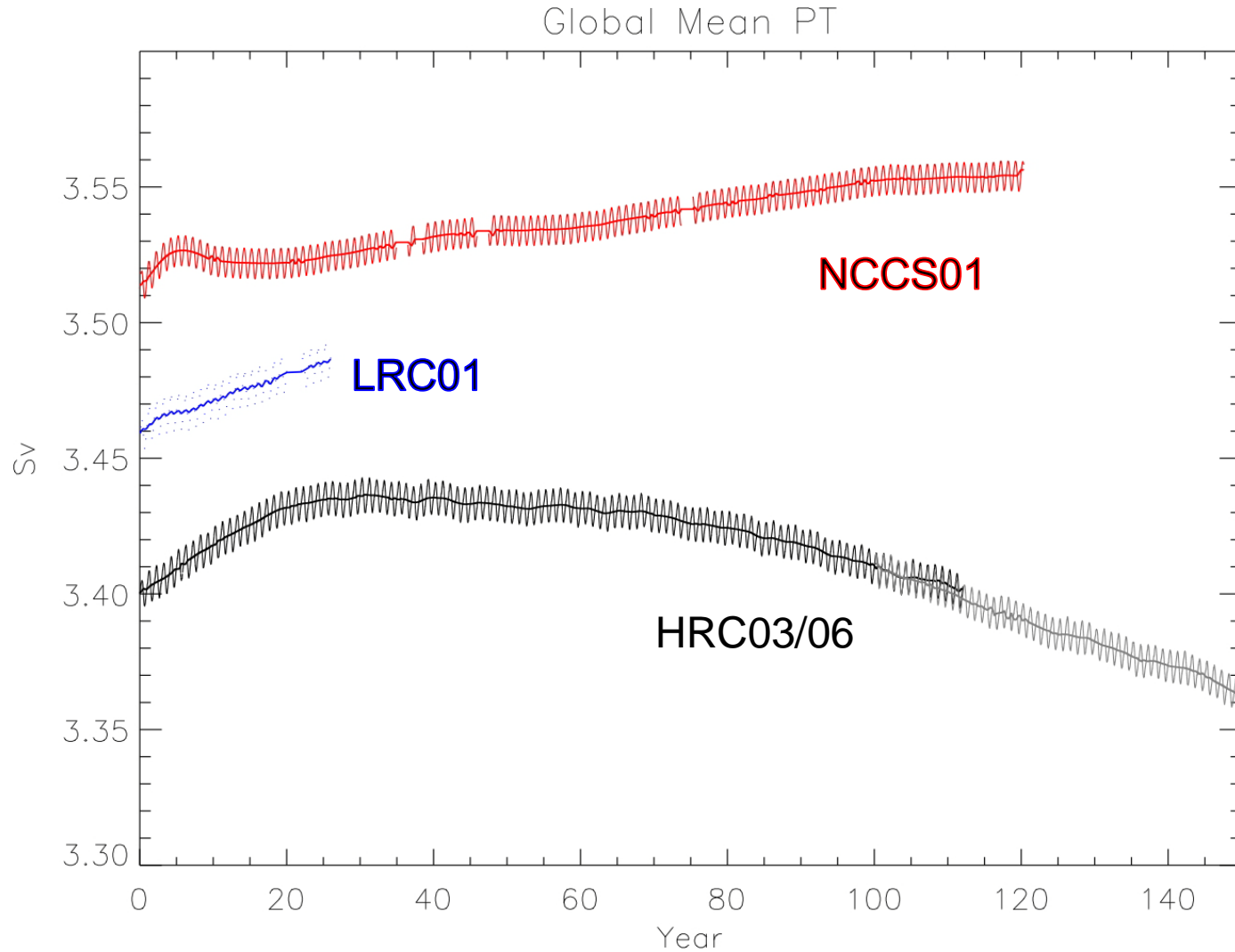
NCAR

What Is PetaApps?

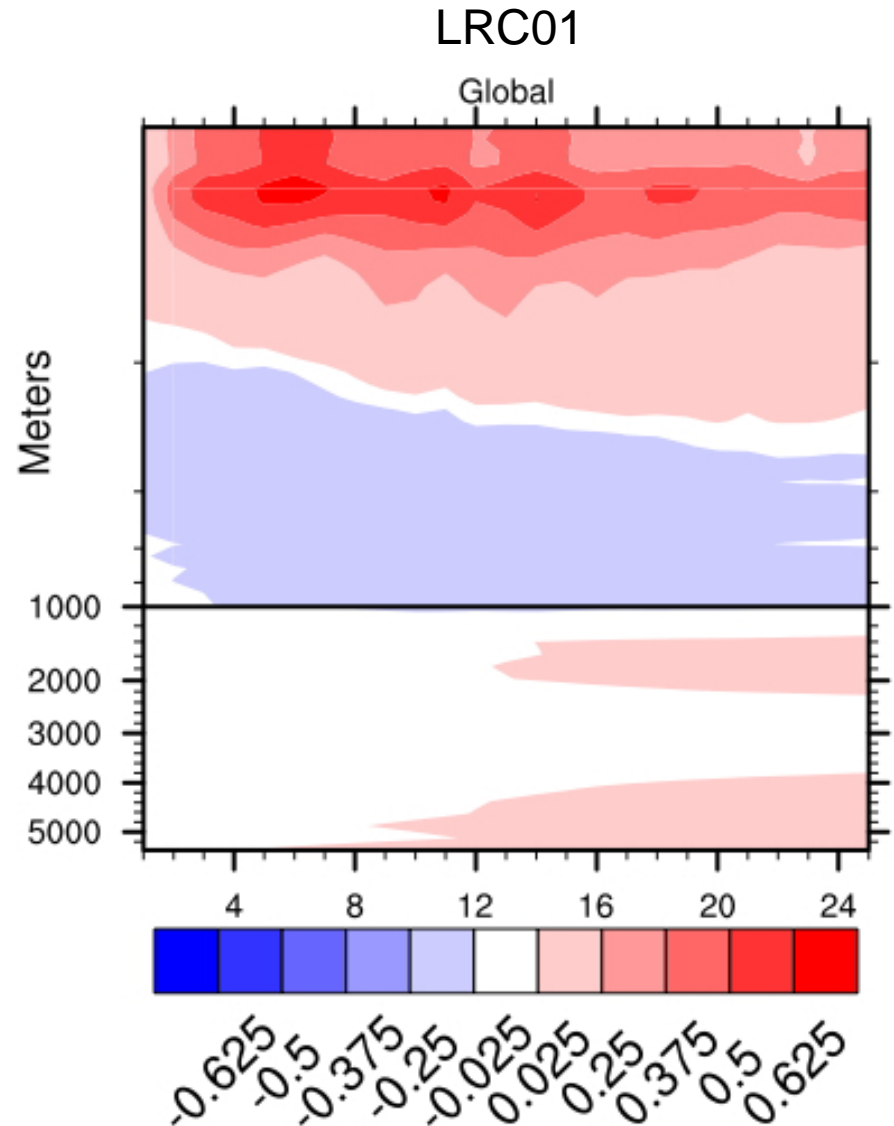
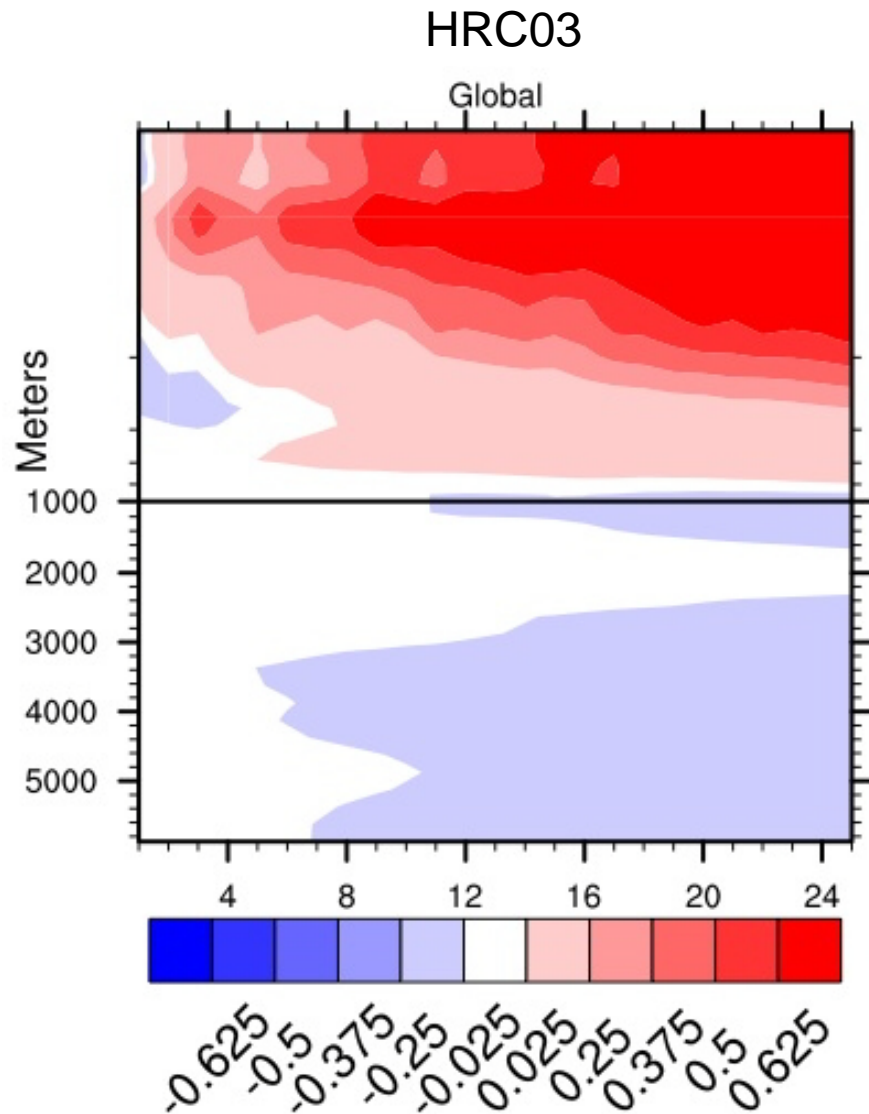
- Project Supported under NSF Office of Cyber Infrastructure
- PIs: Jim Kinter (COLA), Ben Kirtman (U. Miami), Bill Collins and Kathy Yelick (Berkeley), Rich Loft (NCAR), Cecilia Bitz (UW)
- Science Driver: Quantifying Uncertainty
 - Uncertainty due to the internal dynamics (i.e., noise) of the individual climate system components and how that noise impacts the other components of the coupled system.
 - Uncertainty due to the unresolved and “parameterized” physical processes

Experiment	HRC03/HRC06	LRC01	GC008/Bhr21	T4031qtB	NCCS01
Atmos. Res.	0.5° /26L	0.5° / 26L	0.5° /26L	0.25° / 26L	CORE data
Ocean Res.	0.1° / 42L	~1.0° / 60L	0.1° / 42L	0.1° / 42L	0.1° / 42L
Initial Condition	Coarse res. CCSM3.0 present day control @ 500	Coarse res. CCSM3.0 present day control @ 500	WOCE SAC Hydrography (Gouretski)	Exp. GC008 @ Year 2	WOCE SAC Hydrography (Gouretski)
Integration Length	>150 yr	>25 yr	13 yr	20 yr	120 yr
Coupling Frequency	6 hour	6 hour	6 hour	6 hour	daily

Global Temperature Drift

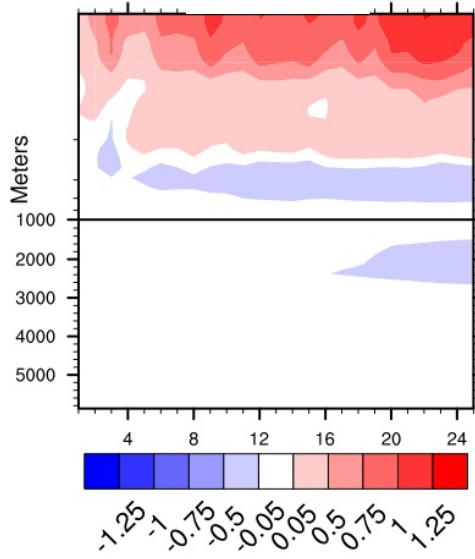


Global Temperature Drift (wrt IC)

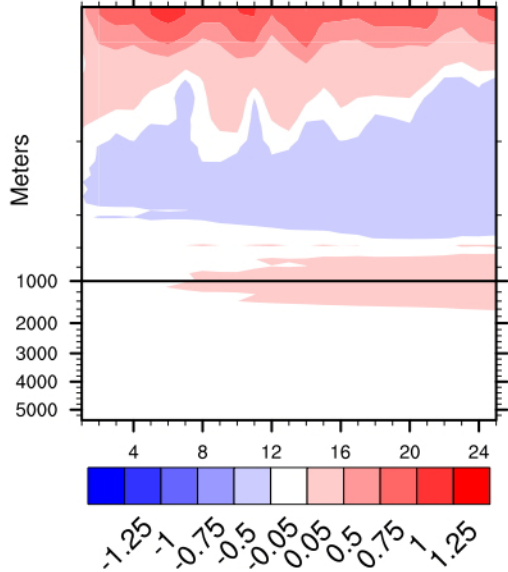


Basin Temperature Drifts

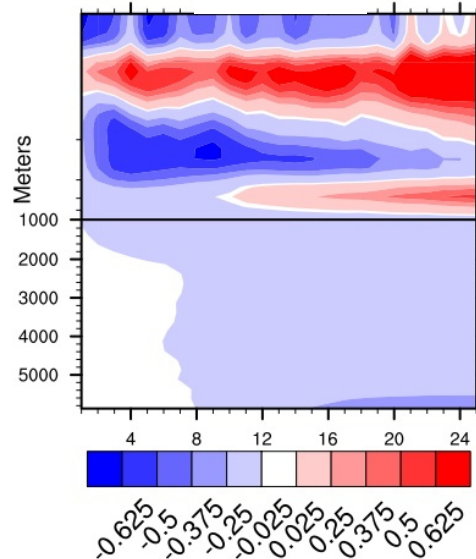
Pacific



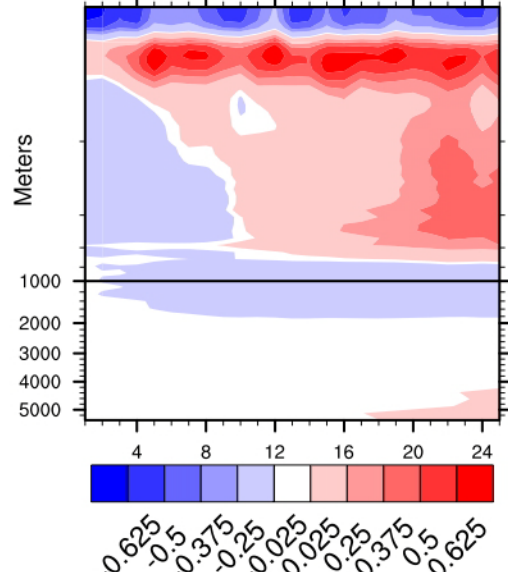
Pacific Ocean



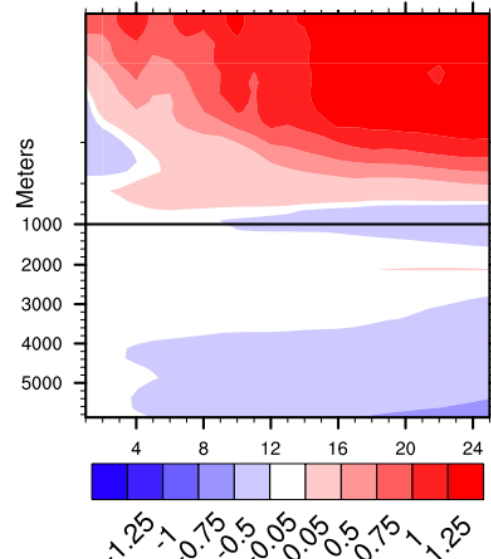
Indian



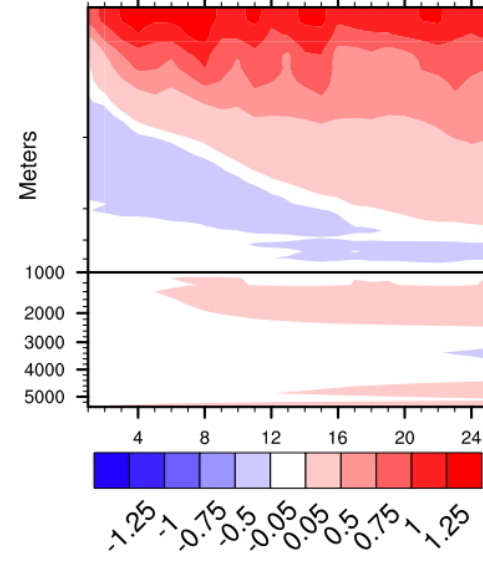
Indian Ocean



Atlantic



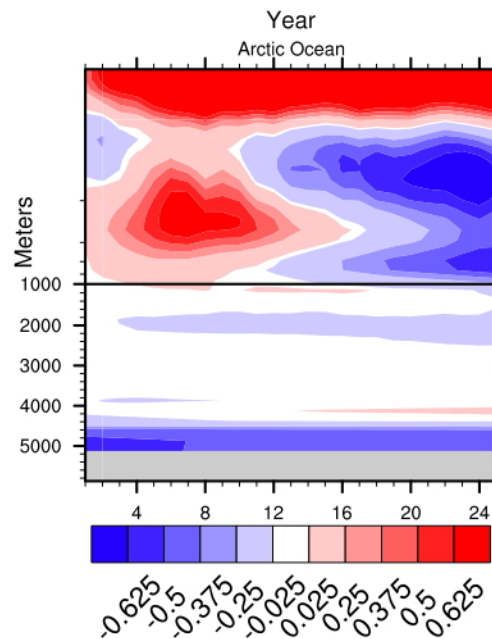
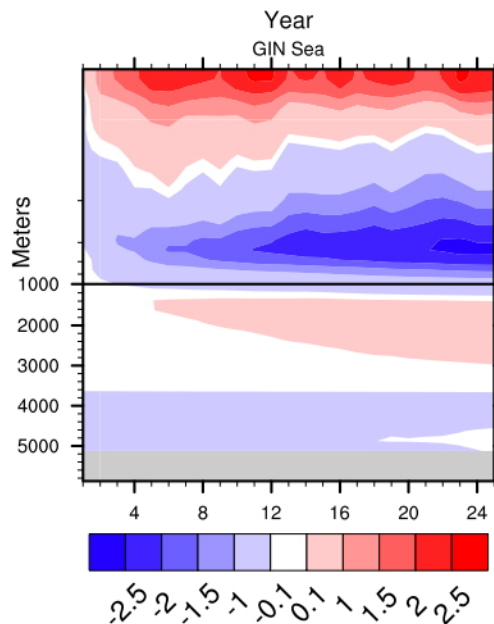
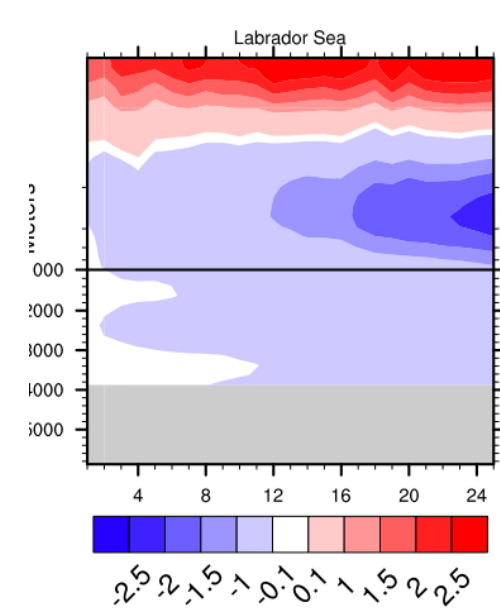
Atlantic Ocean



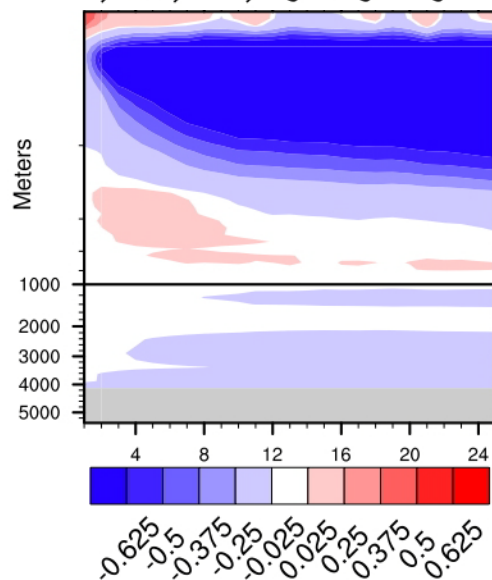
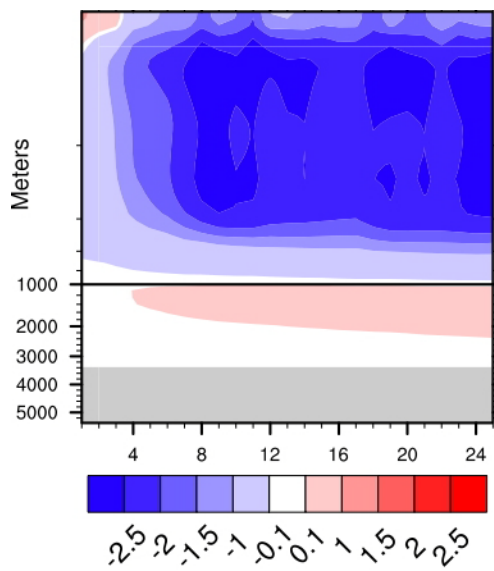
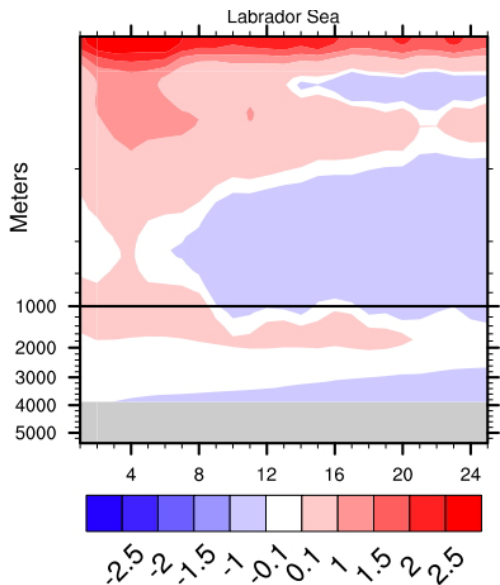
HRC03

LRC01

Polar Basin Drifts



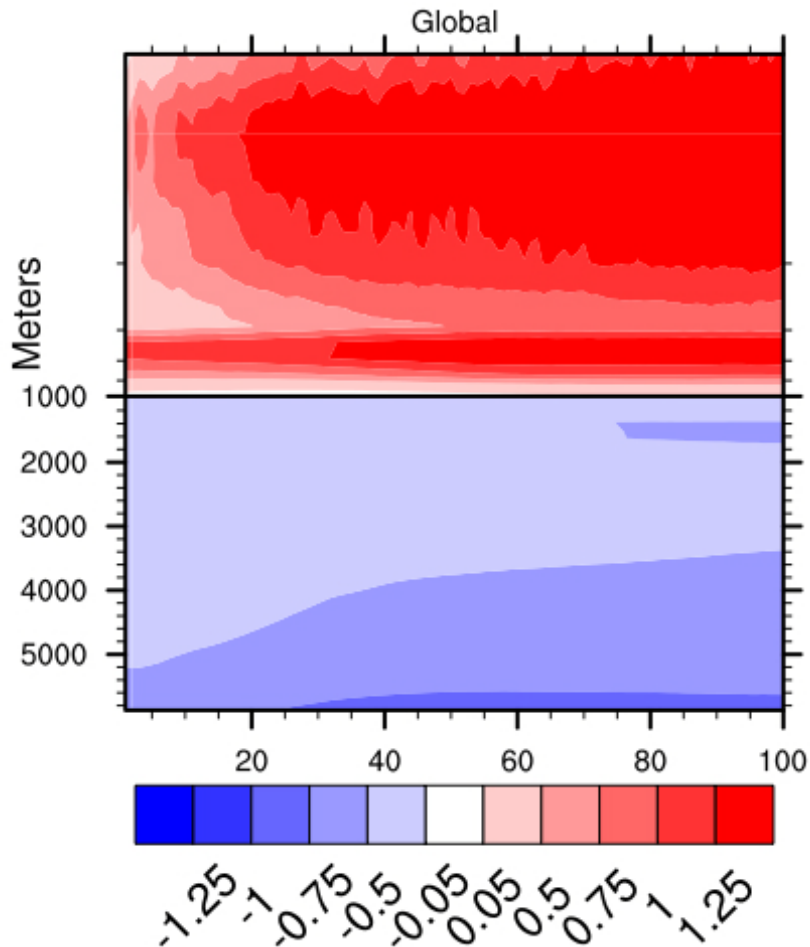
HRC03



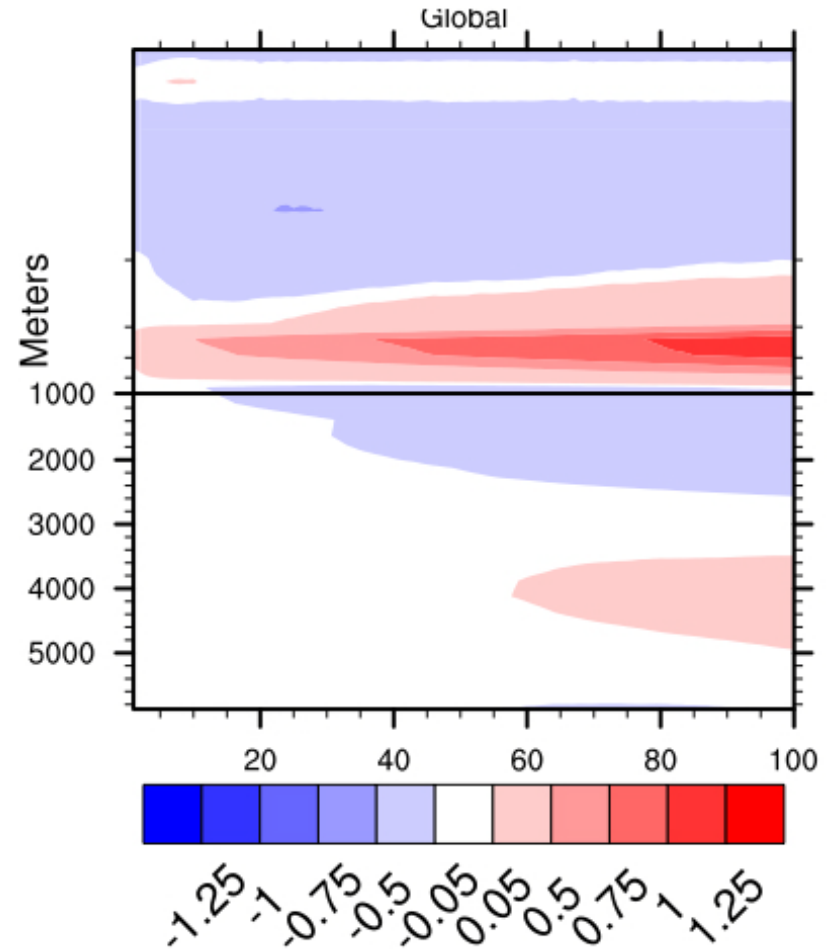
LRC01

Global Temperature Drift (wrt WOA05)

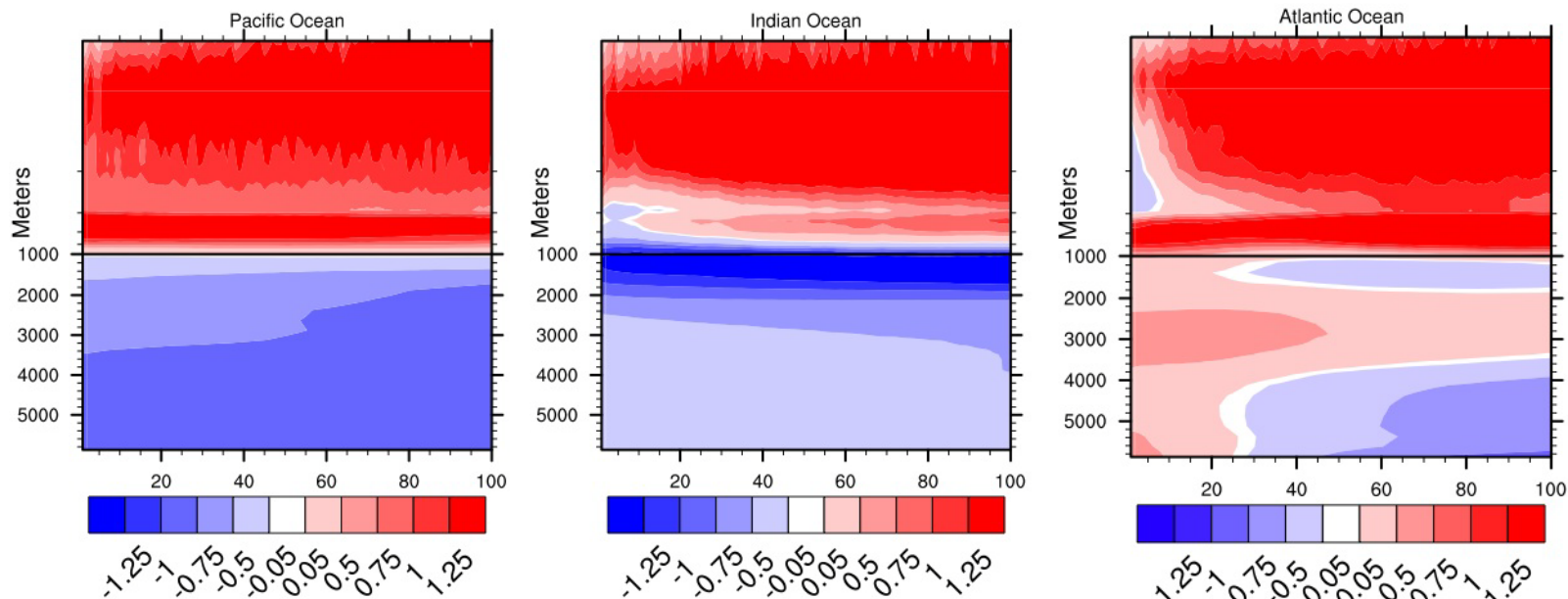
Coupled (HRC03)



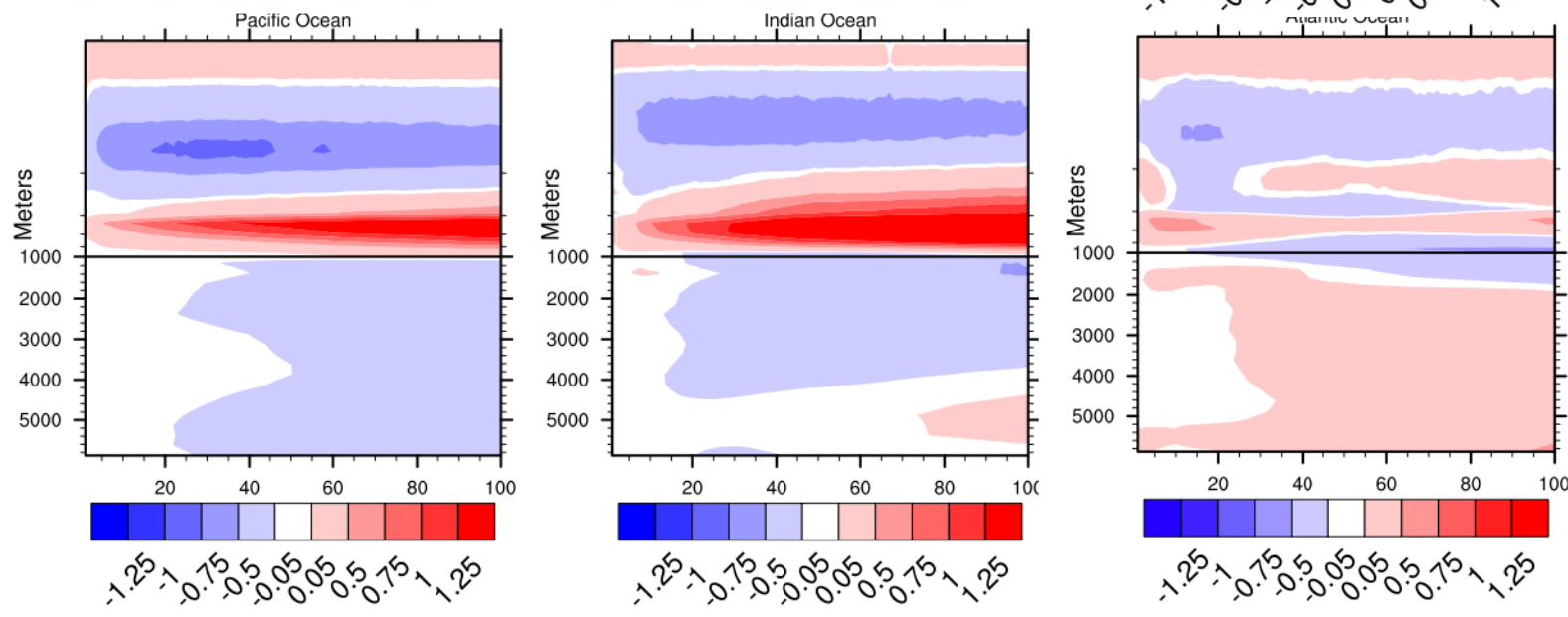
Forced Ocean (NCCS01)



Basin Temperature Drifts



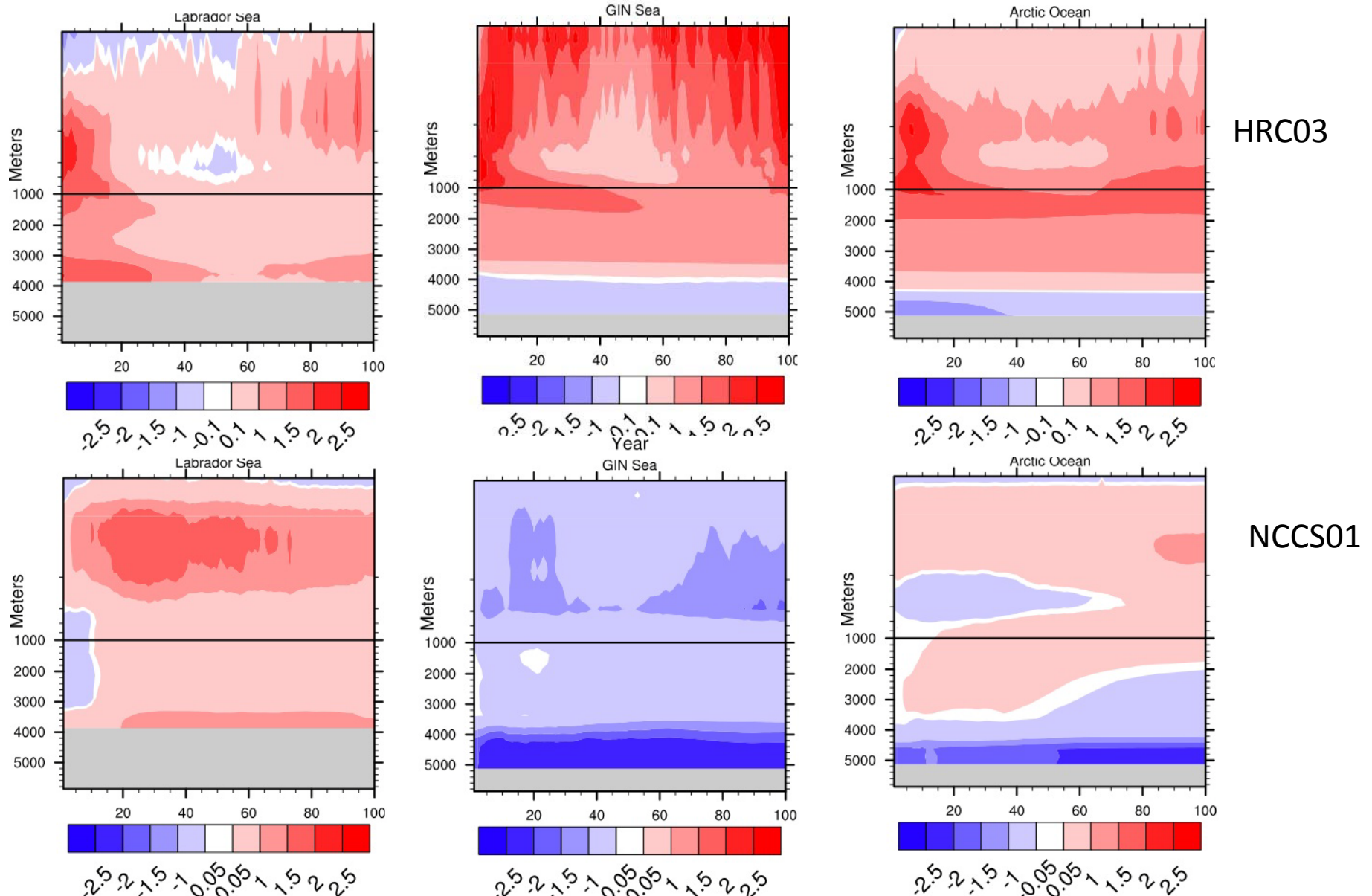
HRC03



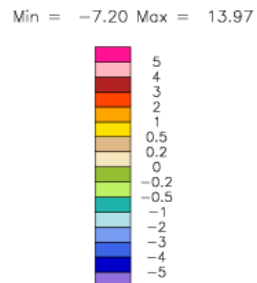
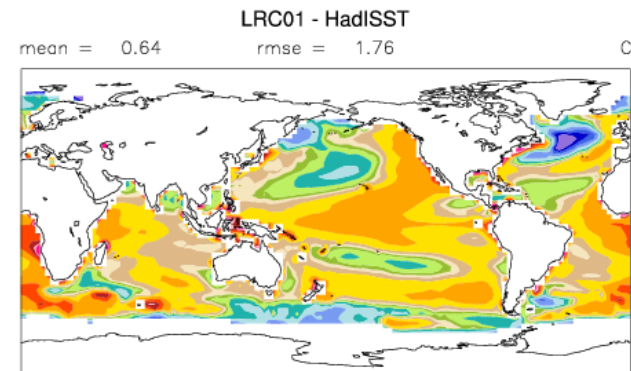
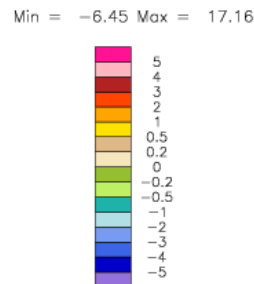
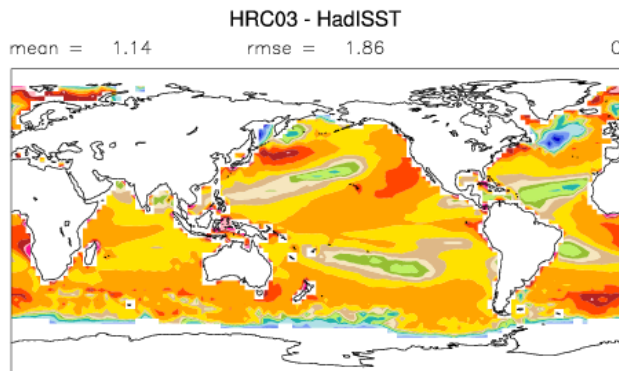
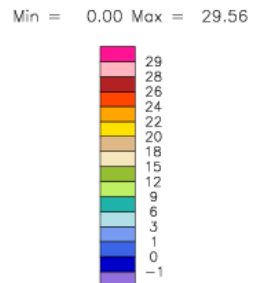
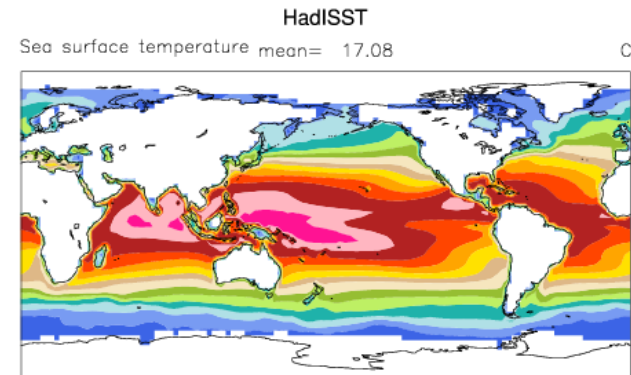
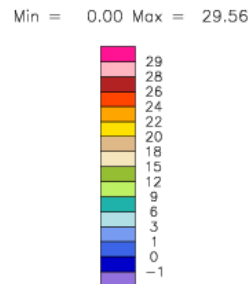
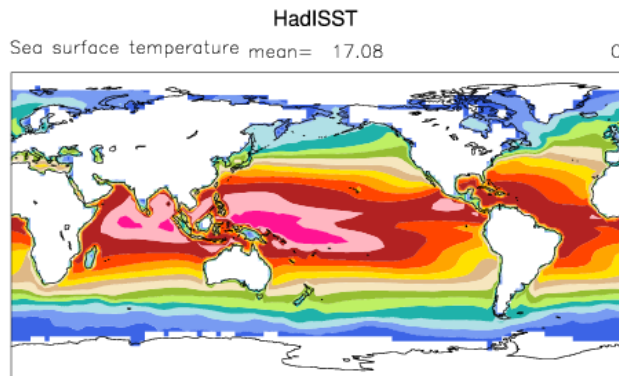
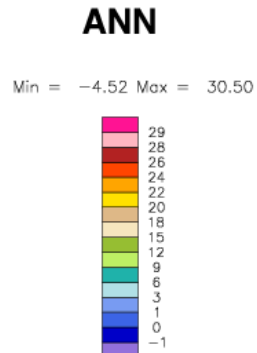
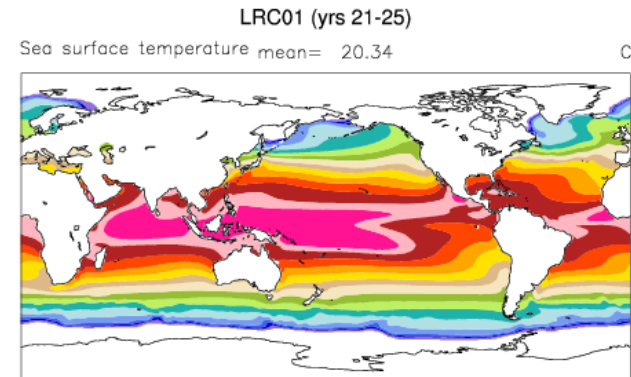
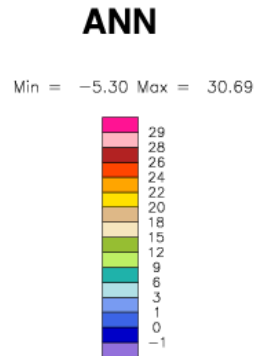
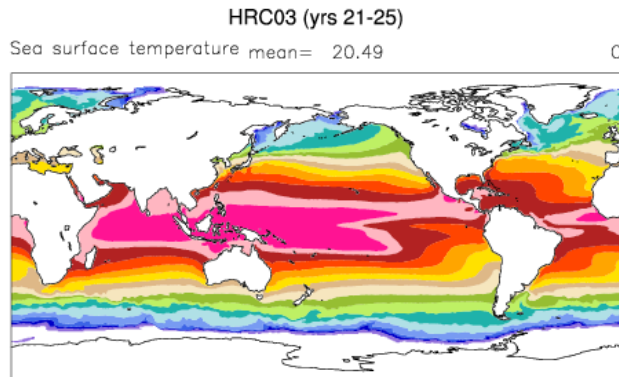
NCCS01

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Polar Seas Temperature Drift

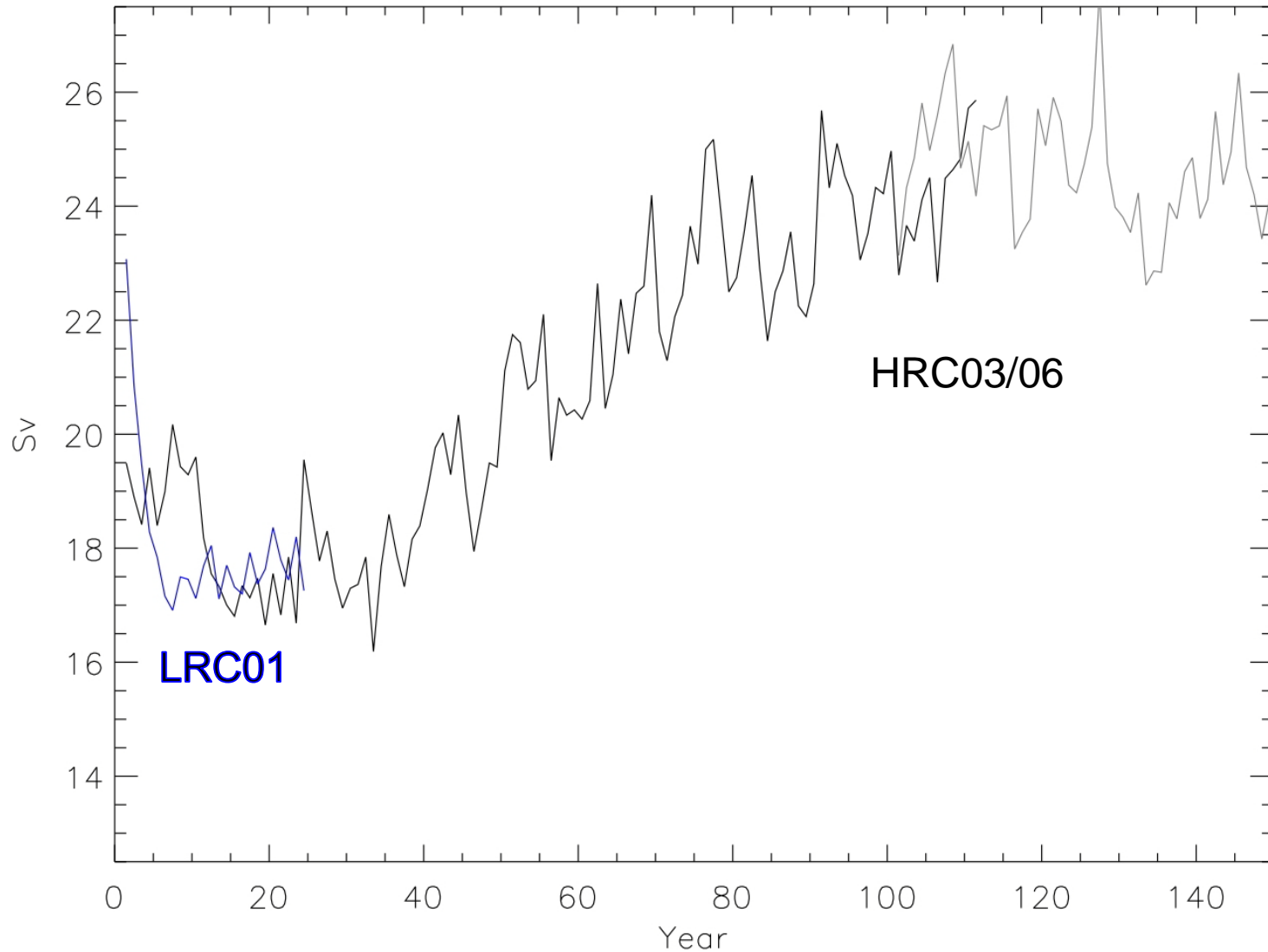


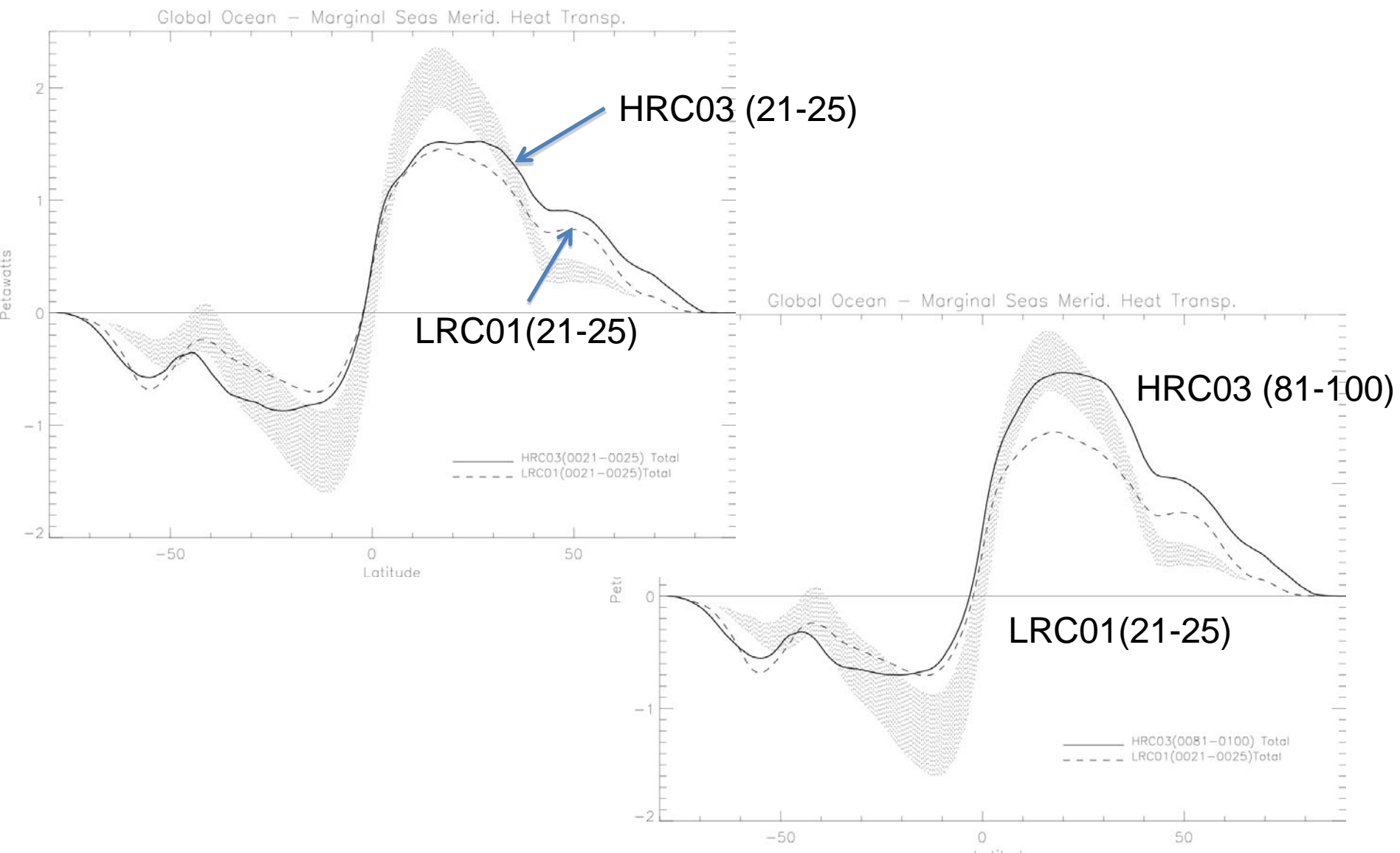
Annual Mean SST



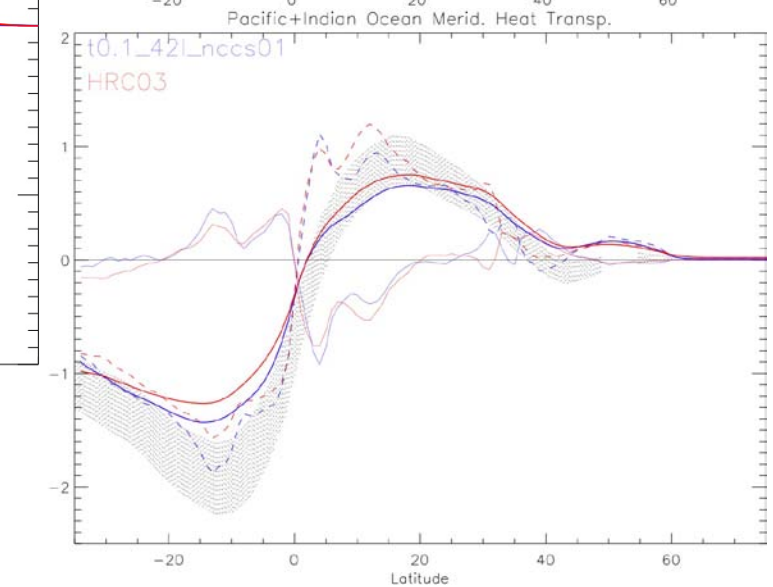
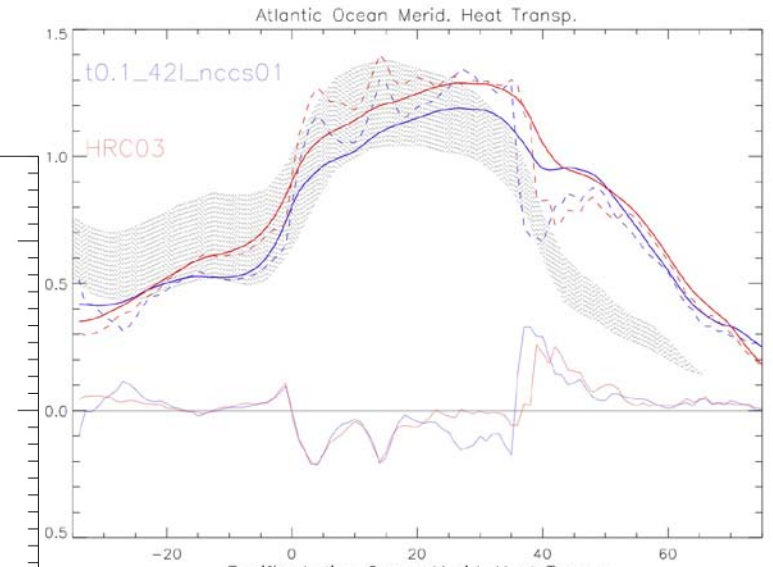
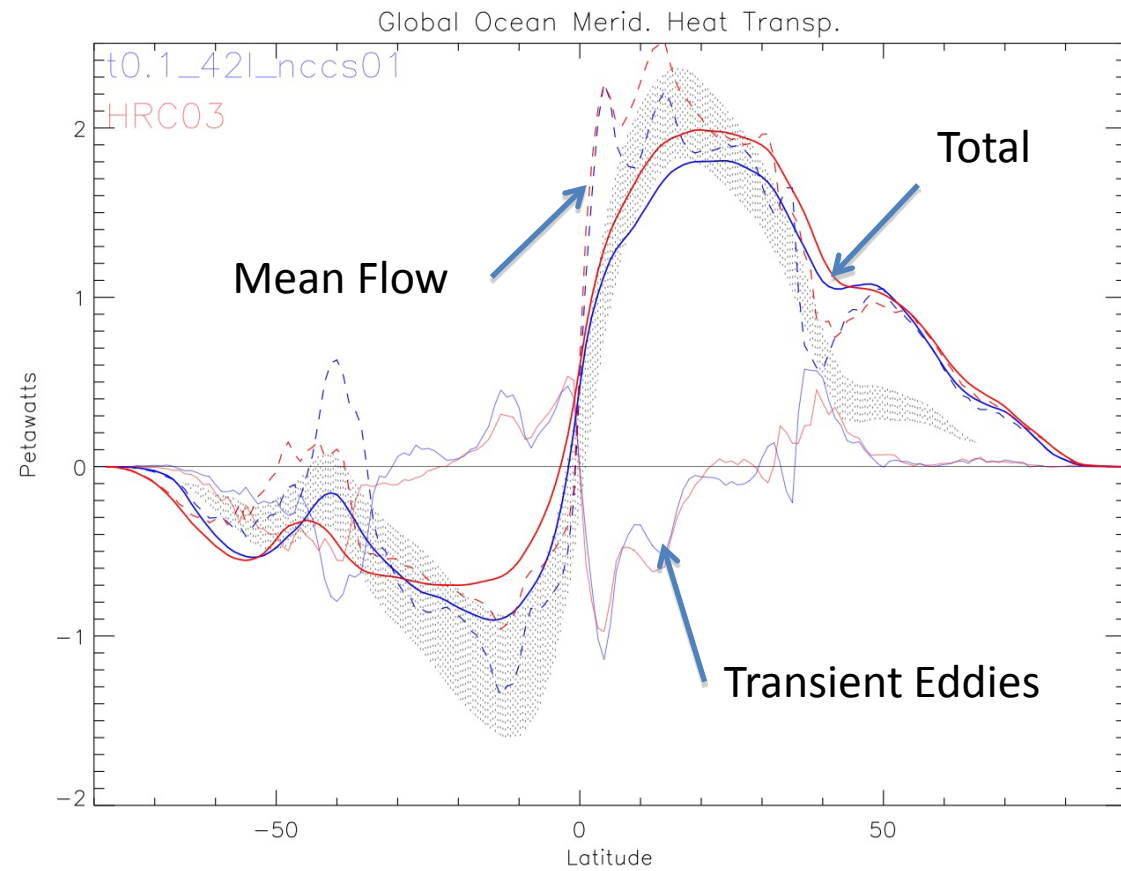
AMOC Variability

Max. NH Atlantic Overturning



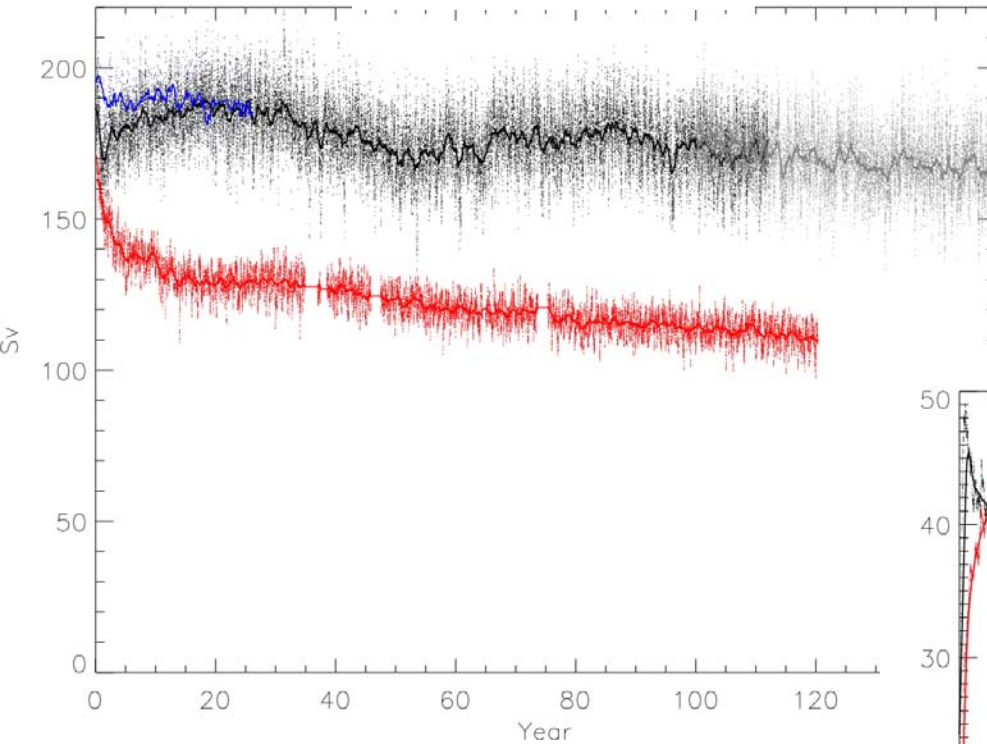


Heat Transport

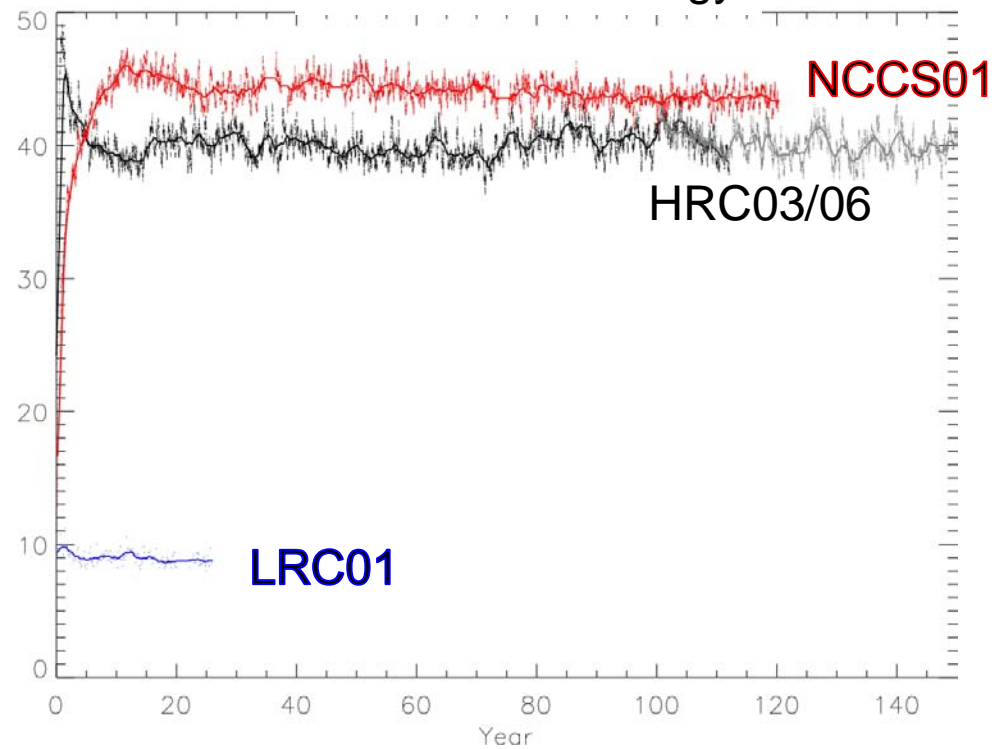


Currents Spinup

ACC Transport



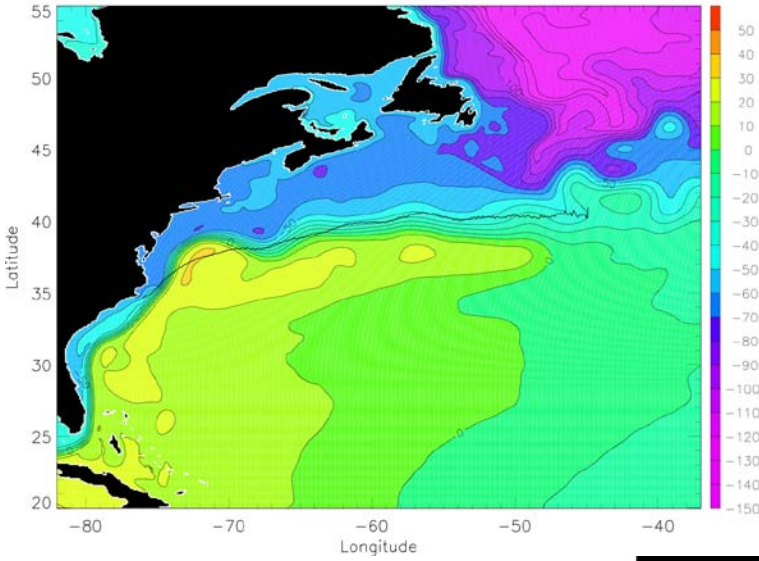
Total Kinetic Energy



Gulf Stream

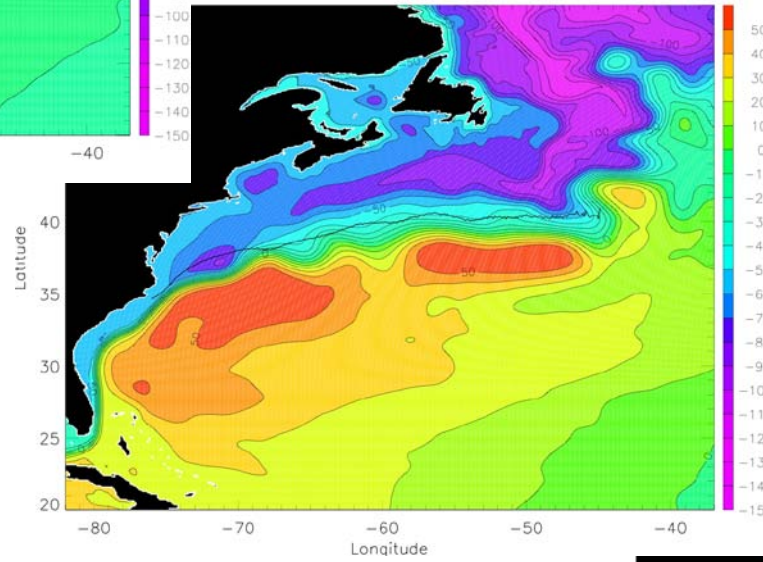
HRC03

SSH HRC03 0081-0100



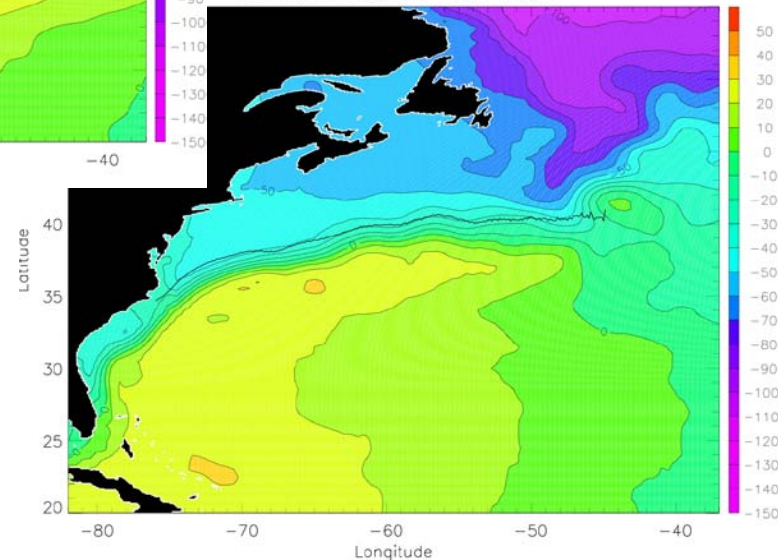
NCCS01

SSH t0.1_42l_nccs01 0100-0119



OBS

SSH MD01060401 1992-2002

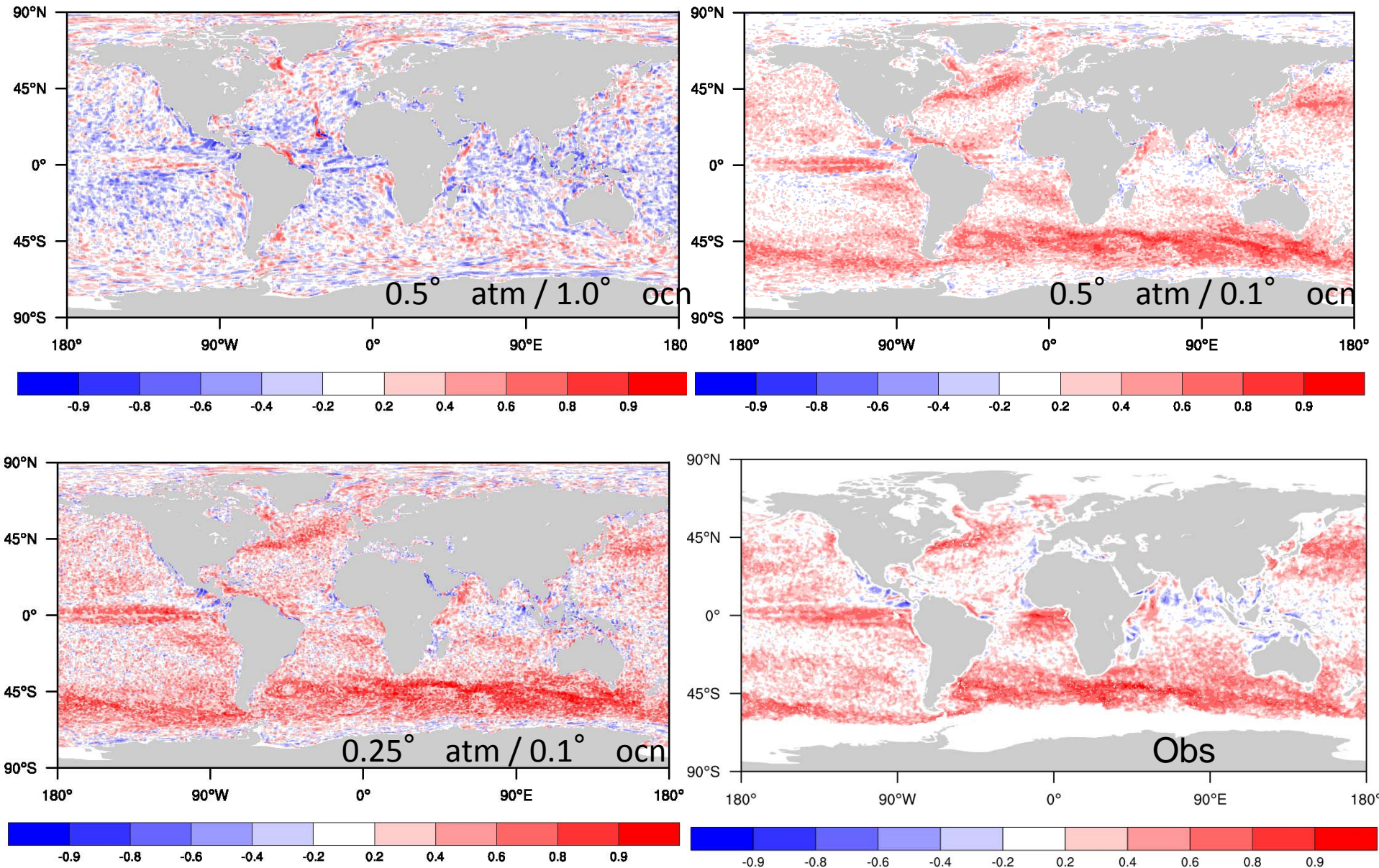


What Science Can We Do With the Runs We Have in Hand?

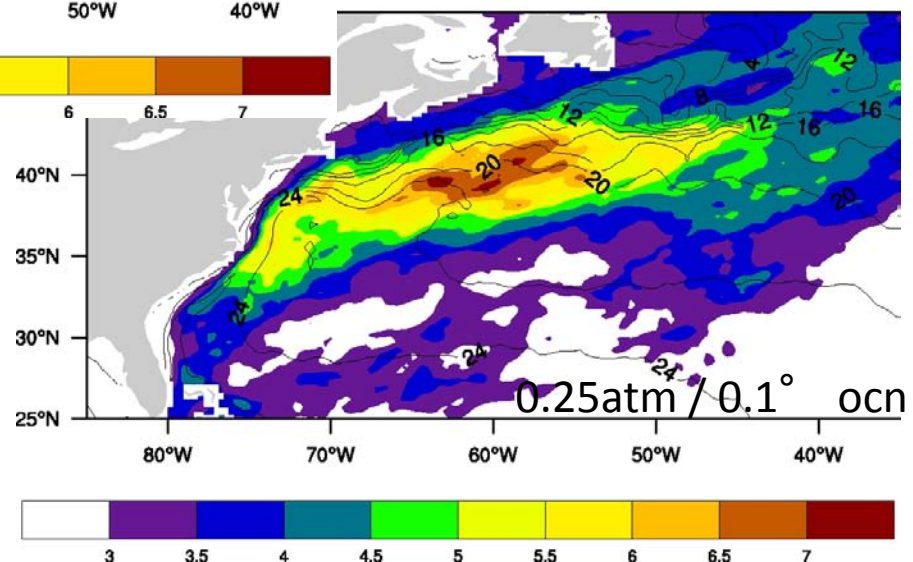
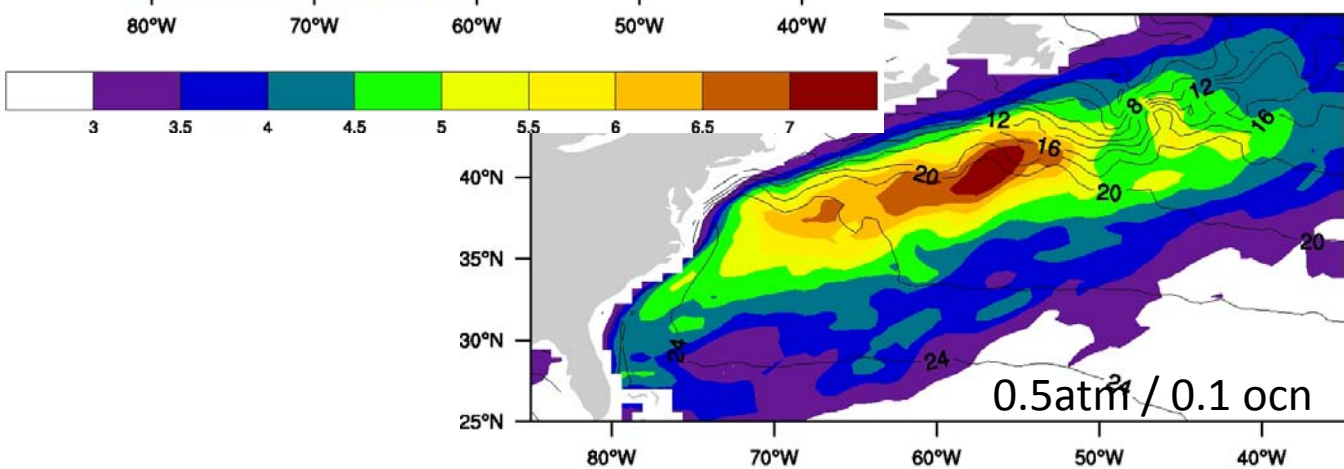
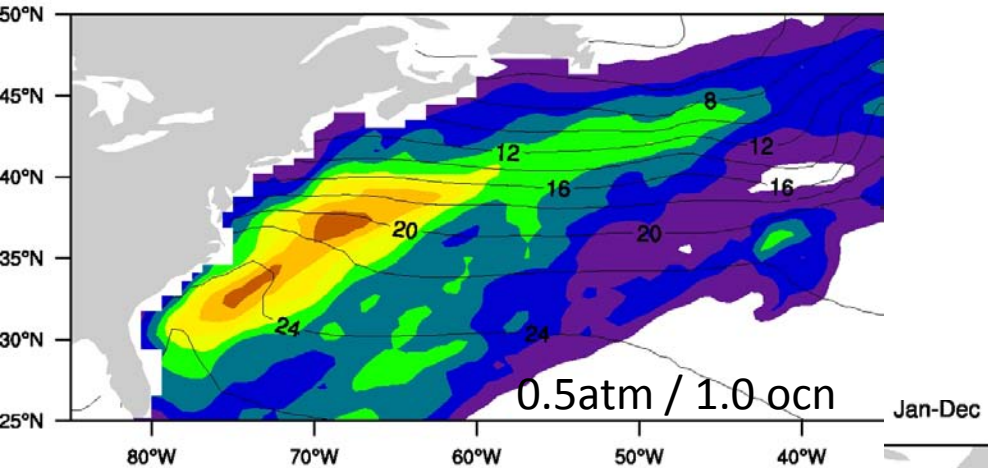
Frontal Scale Air-Sea Interaction

- High-resolution satellite observations show that SST variations on the scale of ocean fronts and eddies drive variations in low level winds
 - High SST → High winds
- This is opposite the response expected at large scales
 - High winds → Low SST

Correlation Spatial High-Pass SST vs. $|\mathbf{u}_{\text{srf}}|$

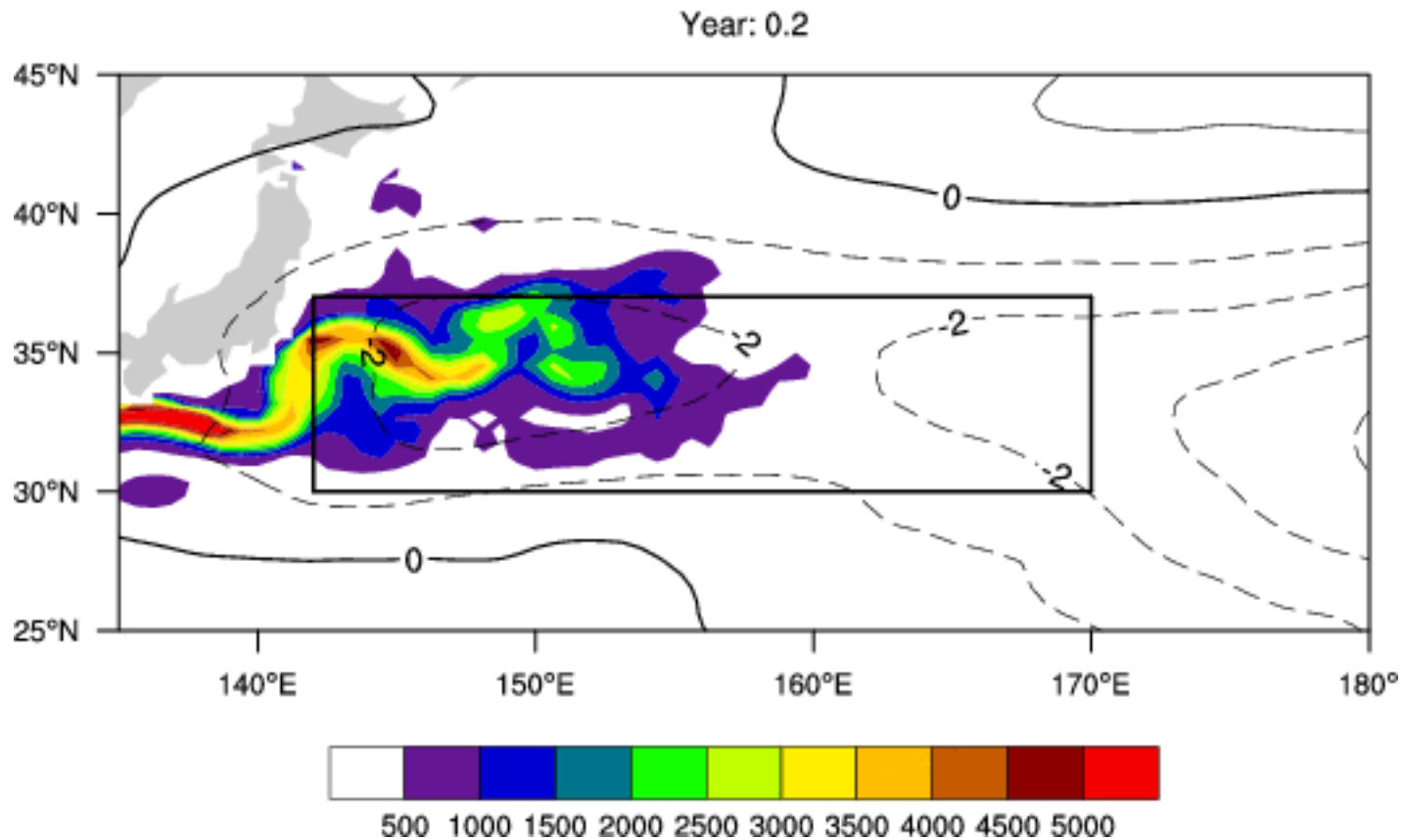


Winter Mean Precip vs. SST



Storm Track Variability

KE (vert avg to: 46591 cm) (CI: 500 cm²s⁻²) HRC03
U(200hPa) (CI: 1 ms⁻¹)



What Are the Next Steps?

- Incorporate 0.1° ocean in to CCSM ✓
 - tx0.1v2 available “out-of-the-box” in CCSM4
 - Data models with optimized data structures, I/O now available
- Bring parameterizations up to CCSM “state-of-the-art (tidal mixing, sub-mesoscale, ...)
- Work toward improved mean climate
 - Focus on subpolar NA circulation & transports
- Plow ahead with new science using current configuration (transient CO₂, predictability, ...)