Tropical Atlantic Biases: A Biased Global Coupled Model Perspective
Biased Perspective of Biases

• Attribution

• Parameterization Development and Improvement:
  – Processes
  – Seamless Approach
  – Uncertainty Quantification (Stochastic-Dynamic)

• Resolution:
  – AGCMs
  – OGCMs (eddy resolving vs. eddy permitting)
CMIP3 Errors: Rainfall and SST

(a) Rainfall

(b) SST

Legend:
- Rainfall: 0-300 cm
- SST: -4 to 4 °C
Have Models Improved?
Maybe, Not in the Atlantic
Biased Perspective of Biases

• **Attribution**
• **Parameterization Development and Improvement:**
  – Processes
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  – Uncertainty Quantification (Stochastic-Dynamic)
• **Resolution:**
  – AGCMs
  – OGCMs (eddy resolving vs. eddy permitting)
Schneider (2002):
“... atmospheric models ... are primarily responsible for differences ...”
“... no dominant process ... that explains the differences...”
Biased Perspective of Biases

- Attribution
- **Parameterization Development and Improvement:**
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  - Seamless Approach
  - Uncertainty Quantification (Stochastic-Dynamic)
- **Resolution:**
  - AGCMs
  - OGCMs (eddy resolving vs. eddy permitting)
Affect of Improved Parameterized Physics

- CCSM3.0 vs CCSM3.5
  - Atmosphere: T85; Ocean 1x1
Martin et al. (2010): Reduction of Systematic Errors through a Seamless Approach to Modeling Weather and Climate
Parameterization of Model Uncertainty:

Stochastic-Dynamic Approaches (Palmer 2001)

Stochastic Physics (Buizza et al. 1999)

Stochastic Backscatter (Berner et al. 2008)
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Increasing AGCM Resolution:
2x2 vs 0.5x0.5

Gent et al. 2010
Biased Perspective of Biases

- Attribution
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Affect of Resolved Ocean Eddies

- **CCSM4**
  - Atmosphere: 0.5x0.5
  - Two Versions: 1x1 [LRC] and 0.1x0.1 [HRC]
Sea Surface Height Standard Deviation

LRC SSH

HRC SSH
Local SSTA Co-Variability with ENSO

LRC Correlation

HRC Correlation
Local SSTA Co-Variability with ENSO

Obs Correlation

HRC Correlation
Local SSTA-Latent Heat Flux Correlation

LRC Correlation

HRC Correlation
Biased Perspective of Biases

• Attribution
• Parameterization Development and Improvement (Progress):
  – Processes
  – Seamless Approach
  – Uncertainty Quantification (Observational Basis)
• Resolution (Not Simple/Not Solved):
  – AGCMs
  – OGCMs (Stratification and Co-Variability)