Recent CCSM development simulations: Towards CCSM4

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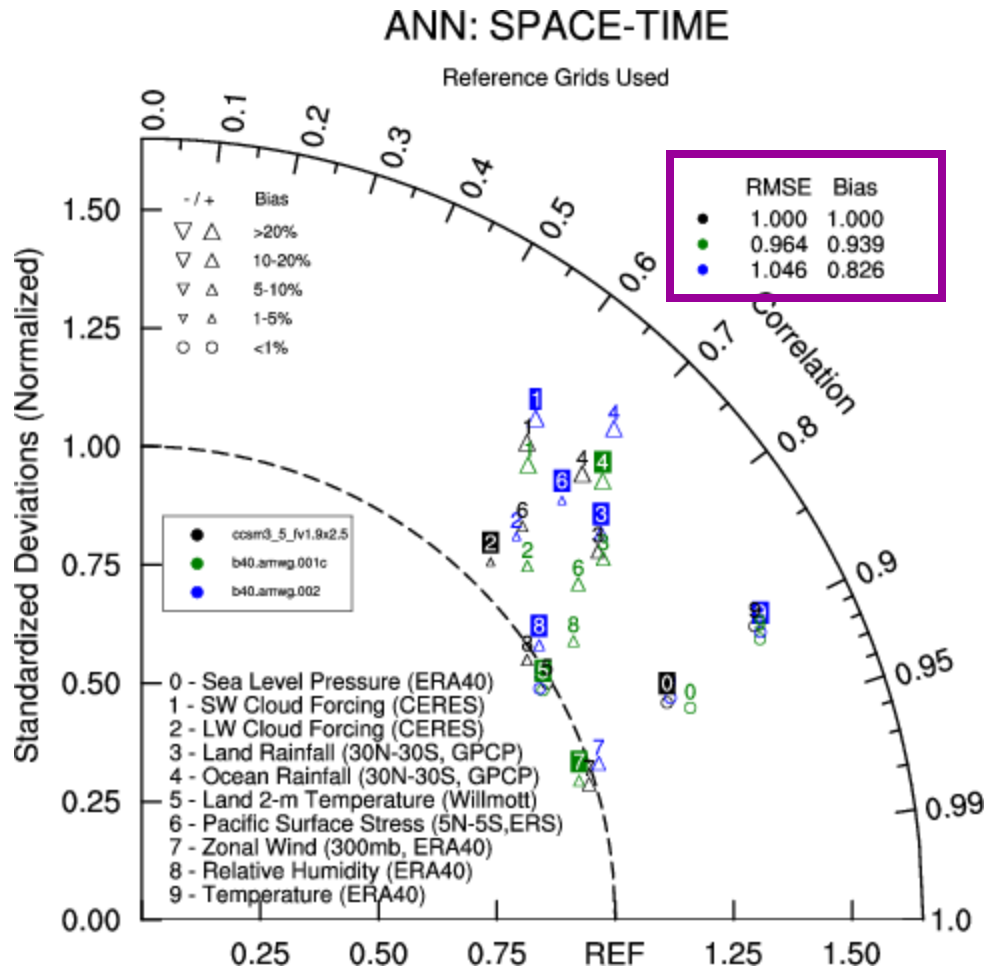CGD, NCAR

Coupled Simulations

- CCSM3.5 control (sequential CCSM)
- MG microphysics
- CCSM3.5 with 31/27 levels (20-m level)
  - Improved representation of surface fluxes
  - Control simulation
  - Modified deep convection triggering

- UW PBL + shallow convection
- CCSM3.5 high resolution atmosphere (0.5 deg)

CCSM4-alpha coupled integrations

- Run with cpl7 CCSM4 alpha code
- Control reproduces CCSM3.5 climate
- MG 2-moment microphysics replaces existing RK scheme
  - Morrison and Gettleman (2008)
  - Predicts number concentration and mixing ratios for ice and liquid
  - Diagnoses number concentrations and mixing ratios for rain and snow
  - Allows inclusion of cloud indirect effects with interface to aerosols
- Stable for a 100-year integration

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Overall Performance Improvements

- CCSM4-alpha: Comparable climate to CCSM3.5

- Improvements to the radiative cloud forcing (LW+SW) metrics
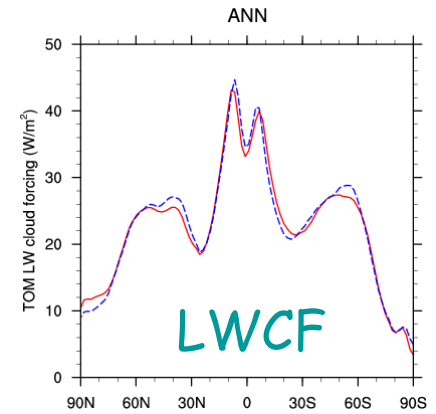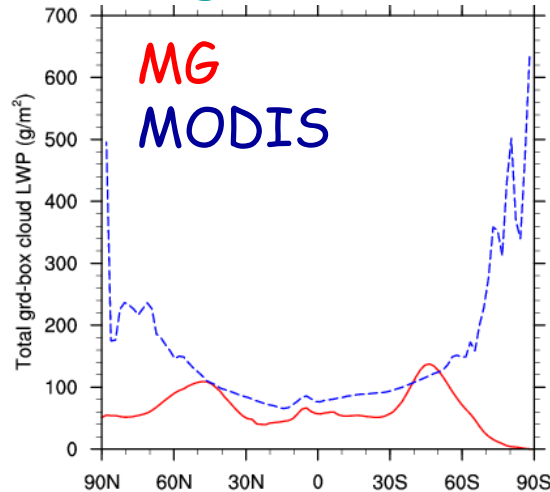
- Maintains CCSM3.5 El Nino characteristics
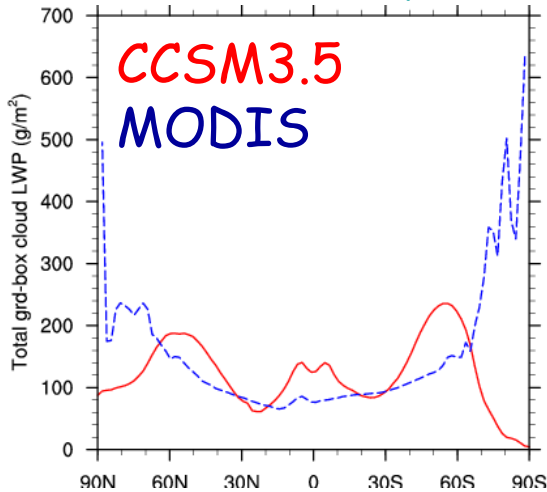
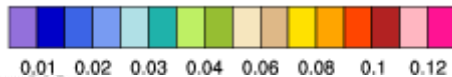- Some polar cloud problems remain

CCSM3.5 (cpl6)

CCSM3.5 (cpl7)

CCSM3.5+MG (cpl7)

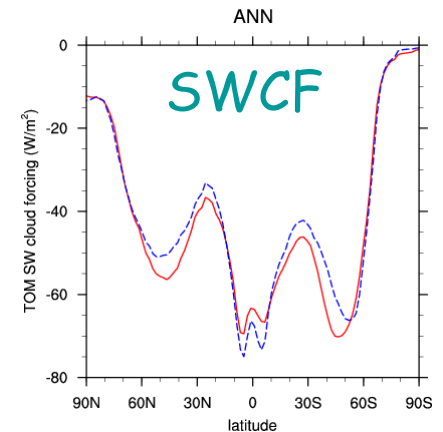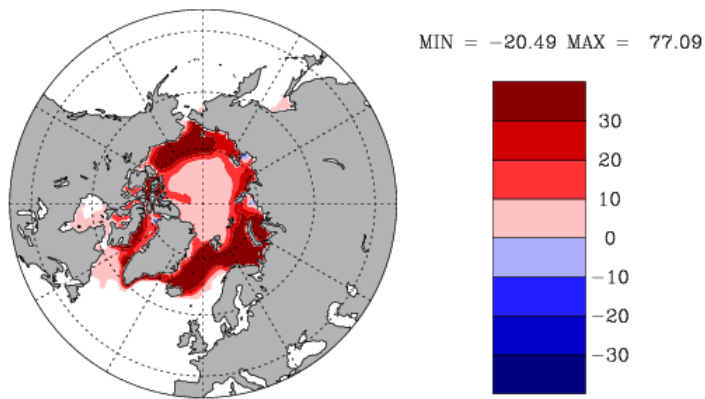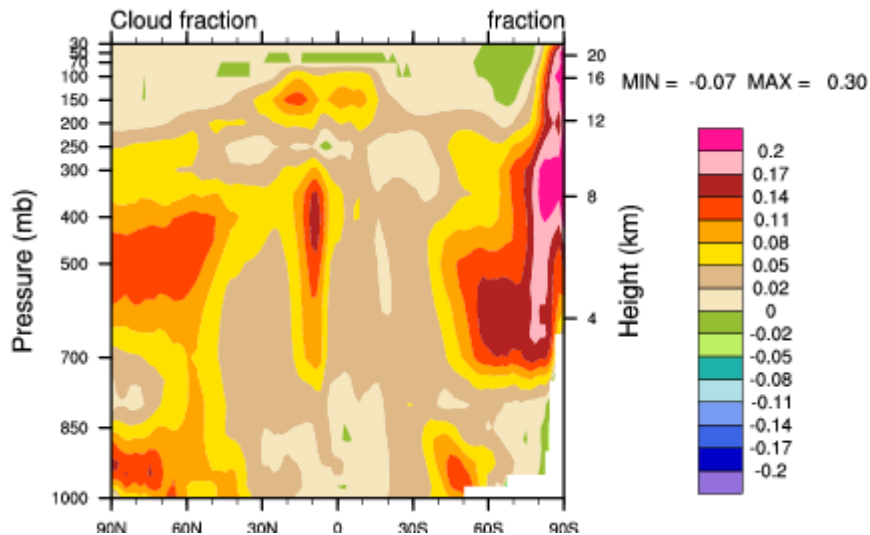# Improved Liquid Water Path
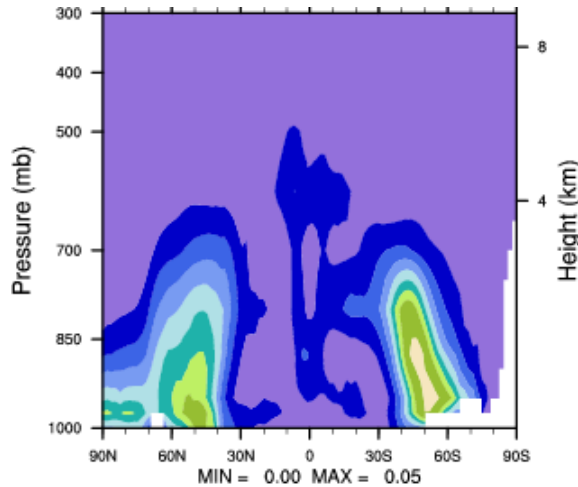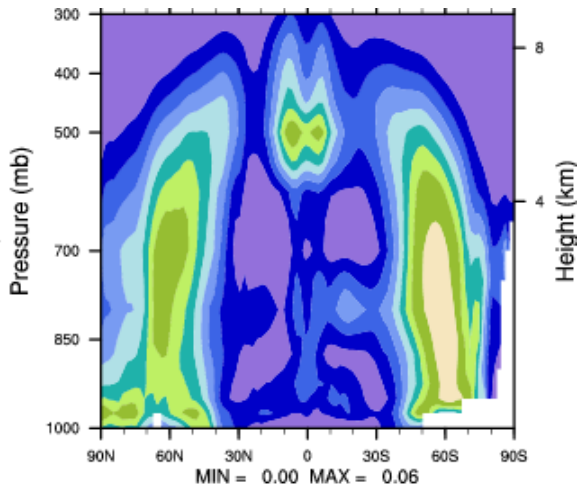
Polar Cloud Problems

JAS Ice Area Diff.

JJA Cloud Diff.

JAS Ice Thickness Diff.

JJA Net Surface SW

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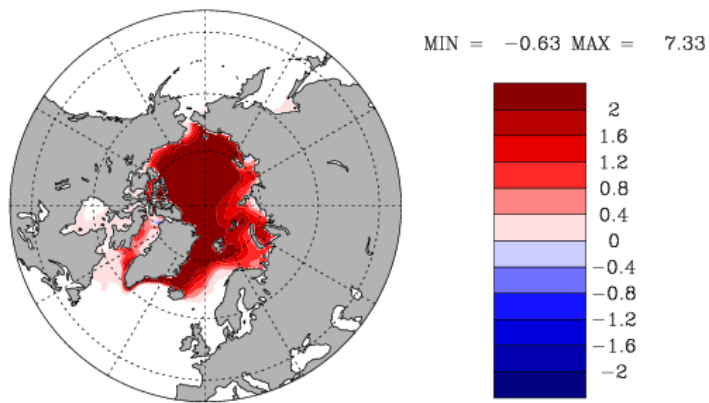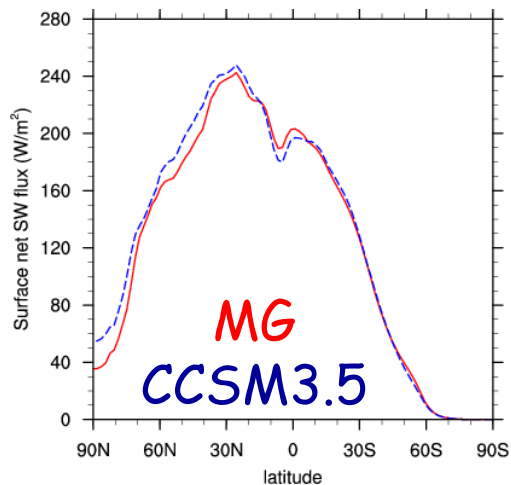
CCSM3.5 El Nino Retained

Nino3.4 SSTAs
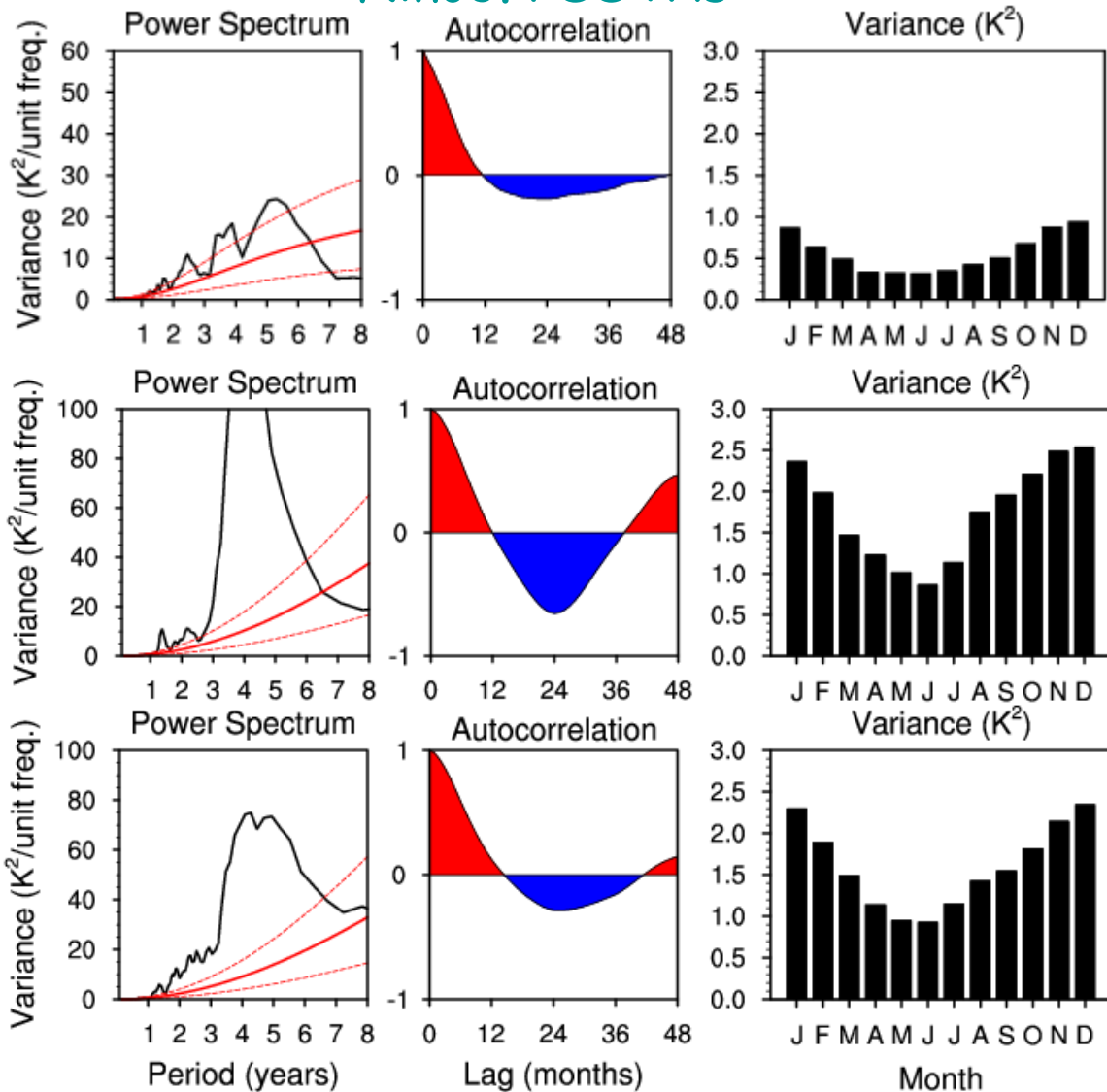
Observations (HadISST)

RK (CCSM3.5) Microphysics

MG Microphysics

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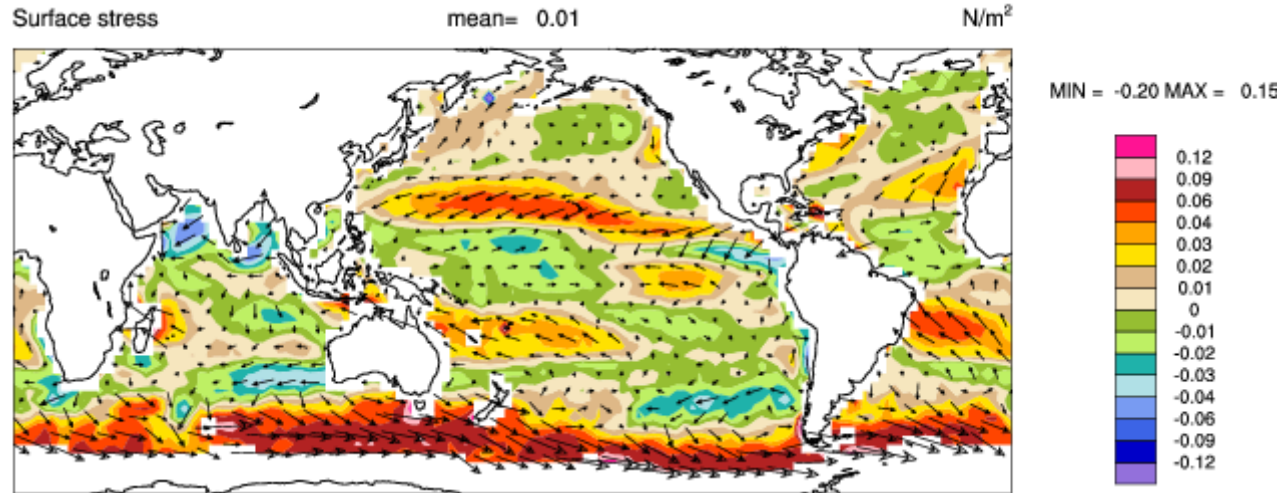# EL Nino with 20-m surface layer

Nino3.4 SSTAs
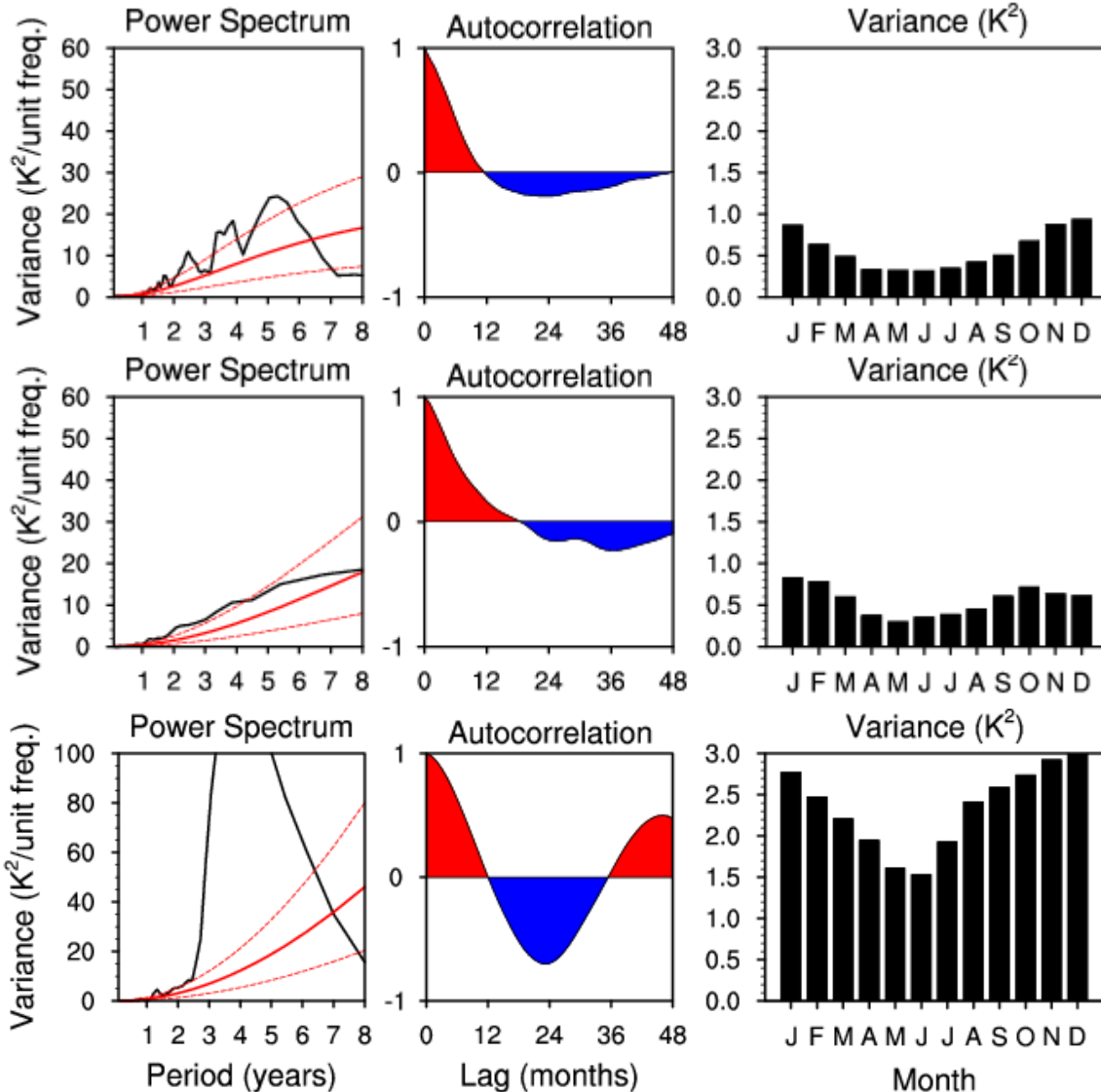
Observations (HadISST)

L31 CCSM3.5 w/ 20-m layer

(poor CAM climate)

L27 CCSM3.5 w/ 20-m layer + no deep conv. from layer
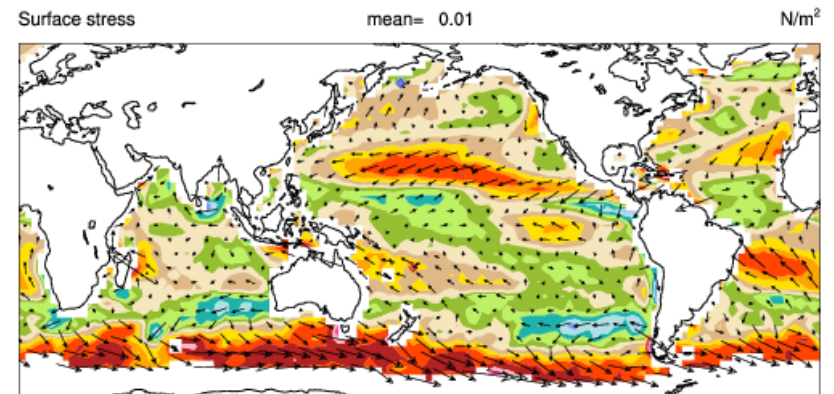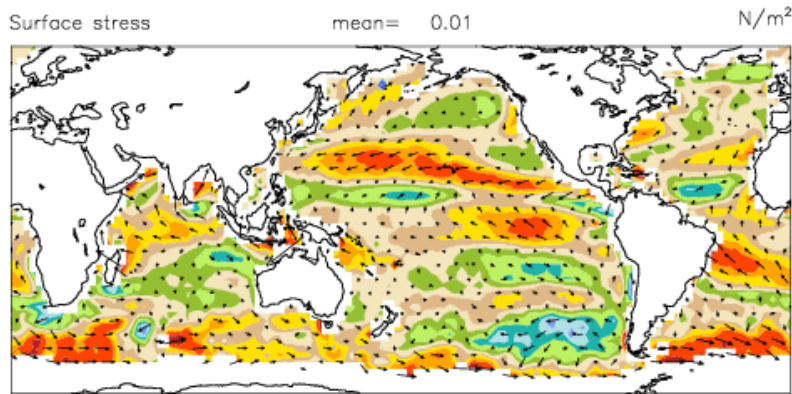
(improved CAM climate)

Surface stress with a 20-m layer

CCSM3.5 Zonal Stress Error

20-m layer

20-m layer + convection mod.

Summary

- Running coupled integrations with credible climate using sequential CCSM (cpl7)
- Adding MG microphysics retains liquid water path improvements seen in CAM-standalone experiments
- El Nino properties remain from the CCSM3.5; some improvements also seen
- Polar cloud problems need to be addressed
- Interaction with UW-PBL may help to offset the polar biases
- Role of 20-m layer complex; appears to be strongly linked to deep convection

Other runs

- UW PBL + shallow convection
  - Improved stratocumulus; excessive El Nino amplitude
- CCSM3.5 high resolution atmosphere (0.5 deg)
  - Improved US mean climate; reduced coastal SST warm errors

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