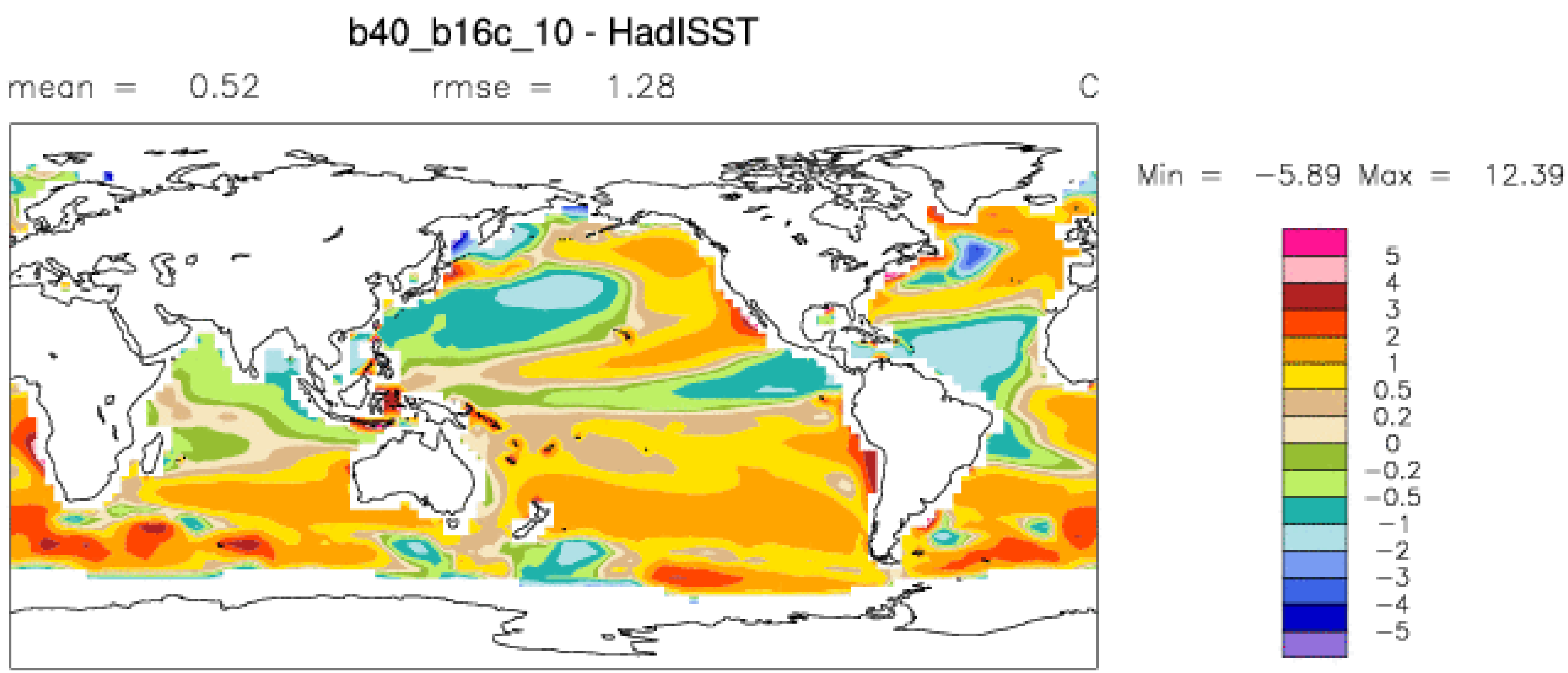
Update on CAM development
Phil Rasch



What has the Development team been doing?

- Since the last Breckinridge meeting
  - Helping with “track 1”
  - Getting all the new “track 5” components to work together
    - Revisions to: ice clouds, ice microphysics, macrophysics, aerosols, scavenging, emissions, deposition,
  - Connecting with other surface models + SOM (integration+ gaining experience with them)
  - Understanding particular features of the model
    - Clear sky OLR
    - Water vapor burdens
    - Indirect effect
- Since Spring AMWG meeting
  - Working in coupled model framework
    - High latitude model response
    - Indirect effect
    - Preindustrial vs present day simulations

Two Tracks for CAM

- Track 1
  - Essentially CAM3.5 (‘Modifications to convection (Neale et. Al., Richter et. Al.)
  - Substantial code revisions (Eaton et. Al.)
  - The rest of the parameterizations are as in CAM3, but…
    - FV dynamical core becomes default
    - Polar filters + GW Froude#
    - All aerosols can be interactive (for CAM3, only Sulfur and Soot were calculated) Hess, Vitt, Mahowald, Rasch, Lamarque)
    - New aerosol emissions (Lamarque) or prescribed aerosol datasets
    - Revised aerosol optics (Ghan)
    - New solar constant, GHG conc, and O3
    - Probably a few small bugs found
  - Coupled to new surface models in CCSM
- Track 5
  - CAM3.5+
  - New cloud microphysics (Morrison, Gettelman)
  - Revised ice clouds (Gettelman, Liu, Park, Mitchell)
  - PDF based warm cloud fraction (Park)
  - New Radiative Transfer (Iacono, Collins, Conley, Mitchell, Ghan)
  - New PBL and Shallow convection (Bretherton and Park)
  - New “macrophysics” (Park, Bretherton, Rasch with contributions from Morrison and Gettelman)
  - New aerosol formulation (Ghan, Liu, Easter with contributions from Hess, Mahowald, Lamarque and Rasch)
  - Tweaks to GWD and Mountain form drag (Sassi and Richter)
  - Volcanic Aerosols (Ammann, Conley et. Al.)
  - Radiatively active + consistent convective clouds (Neale, Rasch, Park)

Differences in model properties

- Track 1
  - The “tried and true” model
  - Quite “long in the tooth” in terms of “physical” parameterizations
    - Radiative transfer
    - Phase characterization of condensate
    - Lack of supersaturation in upper troposphere, “mixed” saturation vapor pressure treatment
    - Hack convection
    - Inconsistencies in assumptions about cloud particles in microphysics and radiative transfer
    - “single moment = bulk” treatments for aerosols and clouds
    - External mixtures for aerosol composition
  - No capability for indirect effect

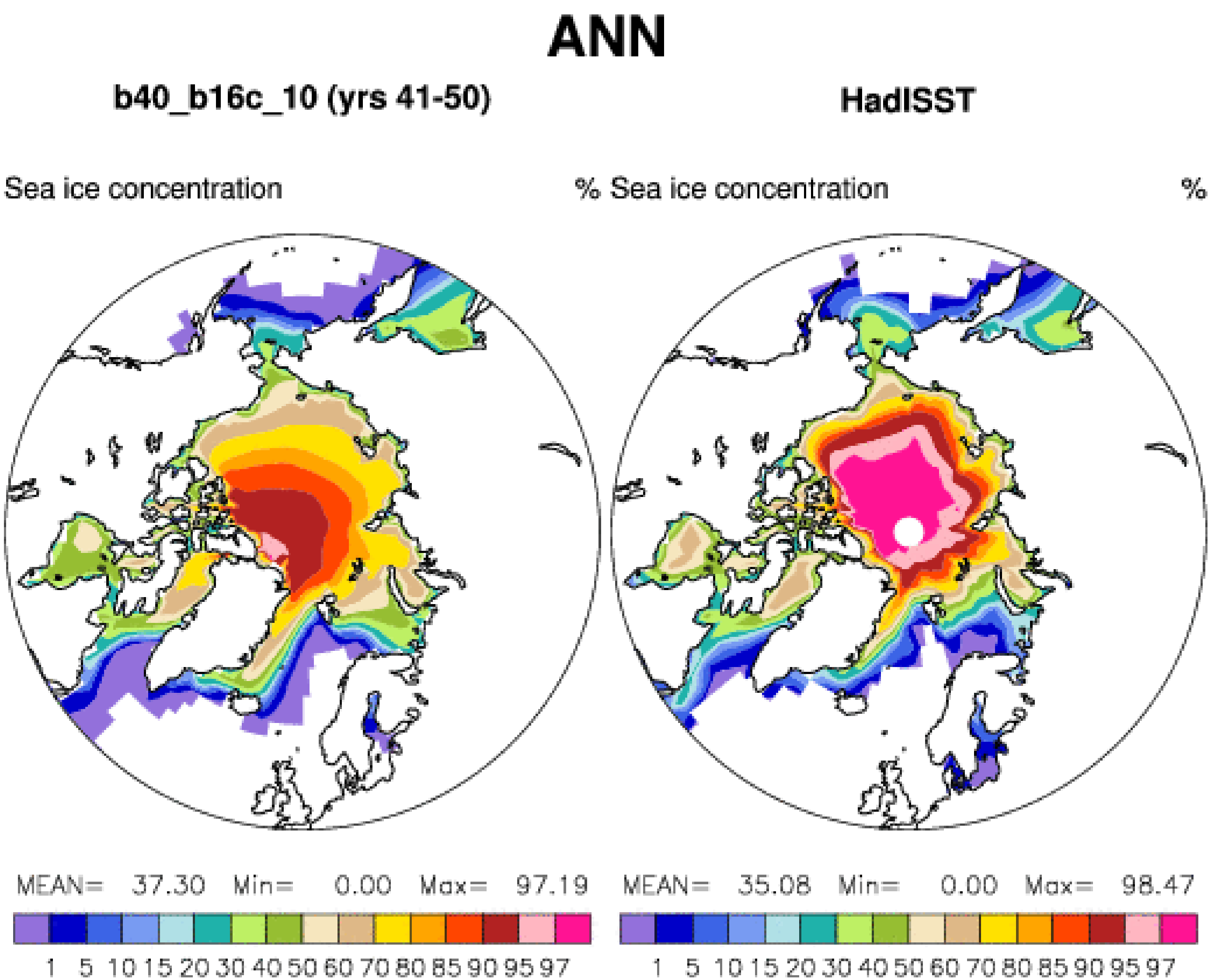
“Connections” are a blessing and curse

- Track 5
  - The “bleeding edge” model
  - Explicit connections between boundary layer processes, shallow clouds, and cloud fraction
  - Much more flexibility, power, accuracy in radiative transfer calculation
  - “two moment” (mass + number) treatments for clouds and aerosols
  - Modal aerosols, internal mixtures
  - Explicit connections between aerosols, clouds, & drop and crystal activation, allowing treatment of Aerosol Indirect Effect (Total AIE 1.2-1.5W/m2)
  - Much more consistent treatment of “condensed species” for radiation, microphysics, sedimentation, scavenging, etc
  - Much more consistent treatment of condensation & cloud fraction evolution
  - Stronger connections between clouds, the PBL, and the surface

Differences in Simulation characteristics

- Track 1
- Much more experience with this model
- Cheaper
- Better Standalone simulation than CAM3
- Better Coupled simulations than CCSM3
- Good simulations for the "wrong" reasons?
- Multiple, century+ simulations with PD, PI, and transient

- Track 5
- More flexibility, power
- More expensive
- More realistic simulation of subtropical clouds, arctic cloud
- Condensed water paths lower than track 1, more like retrievals
- Higher burdens of water vapor
- Lower Clearsky OLR
- Lower Longwave Cloud Forcing
- Excessive precipitation over tropical land
- Better Standalone Simulations than Track 1 (both RMS and Bias errors)
- First really encouraging coupled simulations last week. No transient runs yet.
- Currently worse coupled simulations than Track 1 (better RMS, worse Bias)
  - Thinner sea ice
  - Too high precip over tropical land


ANN
b40_b16c_10 (yrs 41-50)
HadISST
Sea ice concentration
%
Sea ice concentration
%
MEAN= 37.30 Min= 0.00 Max= 97.19
1 5 10 15 20 30 40 50 60 70 80 85 90 95 97
MEAN= 35.08 Min= 0.00 Max= 98.47
1 5 10 15 20 30 40 50 60 70 80 85 90 95 97

What remains to be done in the very short term?

- Small tunings to
  - Retune convective cloud properties to deal with tropical precipitation over land (standalone, present day)
  - Balance TOA fluxes for coupled Preindustrial
  - Then long Preindustrial run
- Explore in transient run
  - Sea ice thickness (perhaps more changes to clouds)
  - Climate sensitivity, T_S response
- 1 degree and ½ degree runs