# PCWG Update

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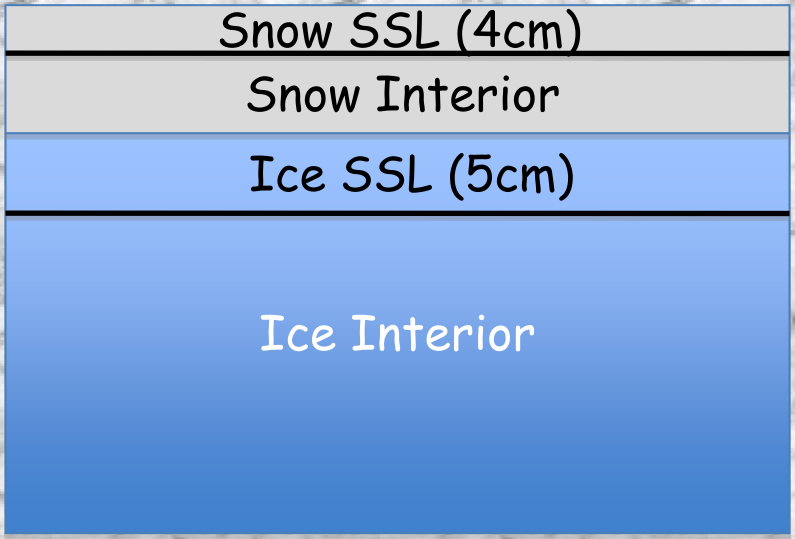
- Community Ice CodE (CICE) 4.0 Base Code
- Delta-Eddington Radiative Transfer in sea ice and snow. (Briegleb and Light)
- Melt Pond Parameterization. (Bailey and Holland)
- Arbitrary Number of Tracers (for example – age, melt ponds, FY area, aerosols).
- Aerosol cycling and deposition on sea ice / snow.

# New Albedo (delta-Eddington) Formulation

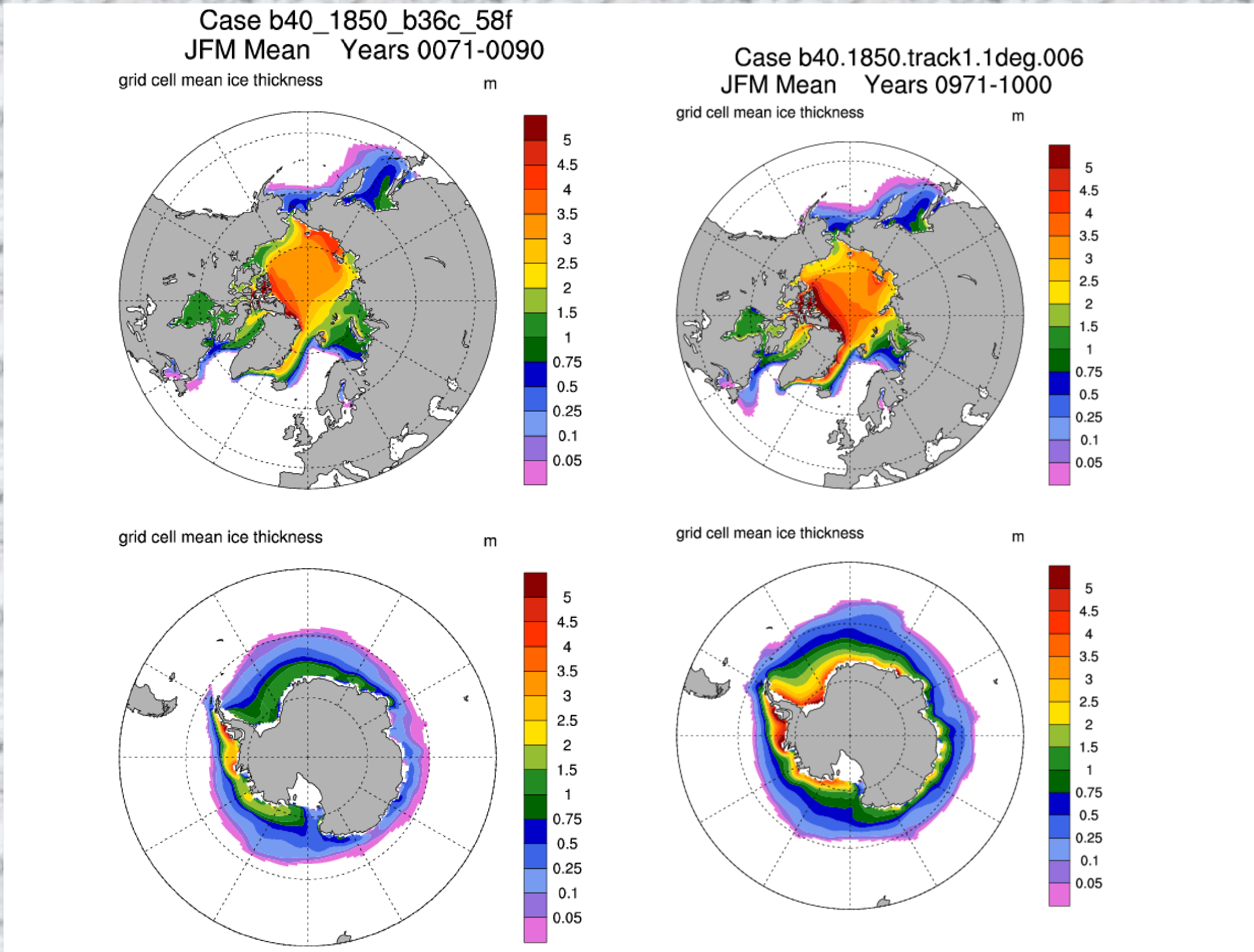
- Snow and ice albedos now a function of zenith angle and optical properties of snow, sea ice, and melt ponds.
- Tunable non-melting and melting snow grain radius -> target albedos.
- Accounts for the effect of impurities (aerosols, algae, etc) in the snow and ice.
- Simple linear snow-aging at this stage.

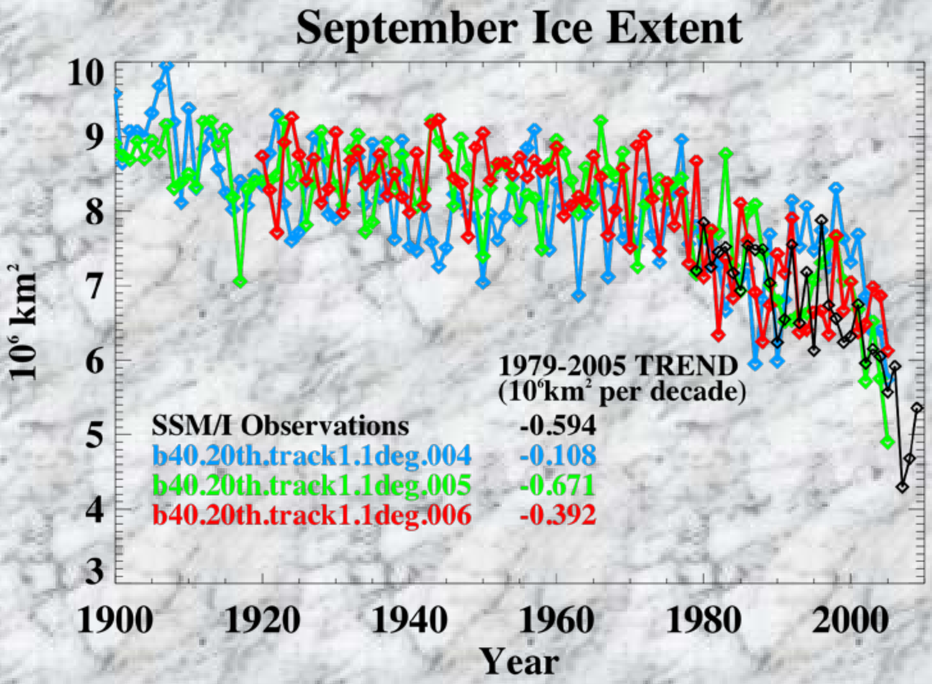
# Aerosol cycling implementation

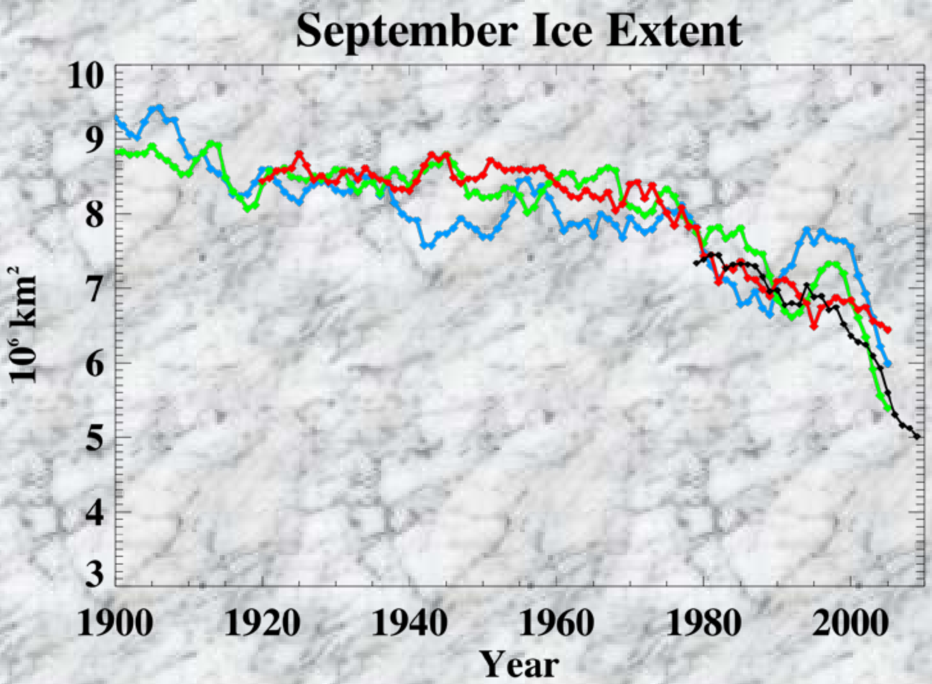



- Four aerosol reservoirs in the vertical
- Aerosol cycling due to ice transport, vertical melt/snow-ice formation
- Melt water scavenging
- Six aerosols – 2 black carbon (hydrophilic/phobic), 4 dust
- Currently affects radiative transfer
- Receiving aerosol deposition from CAM V
- Future work will link to ocean iron deposition

# CAM V vs CAM IV Mean State

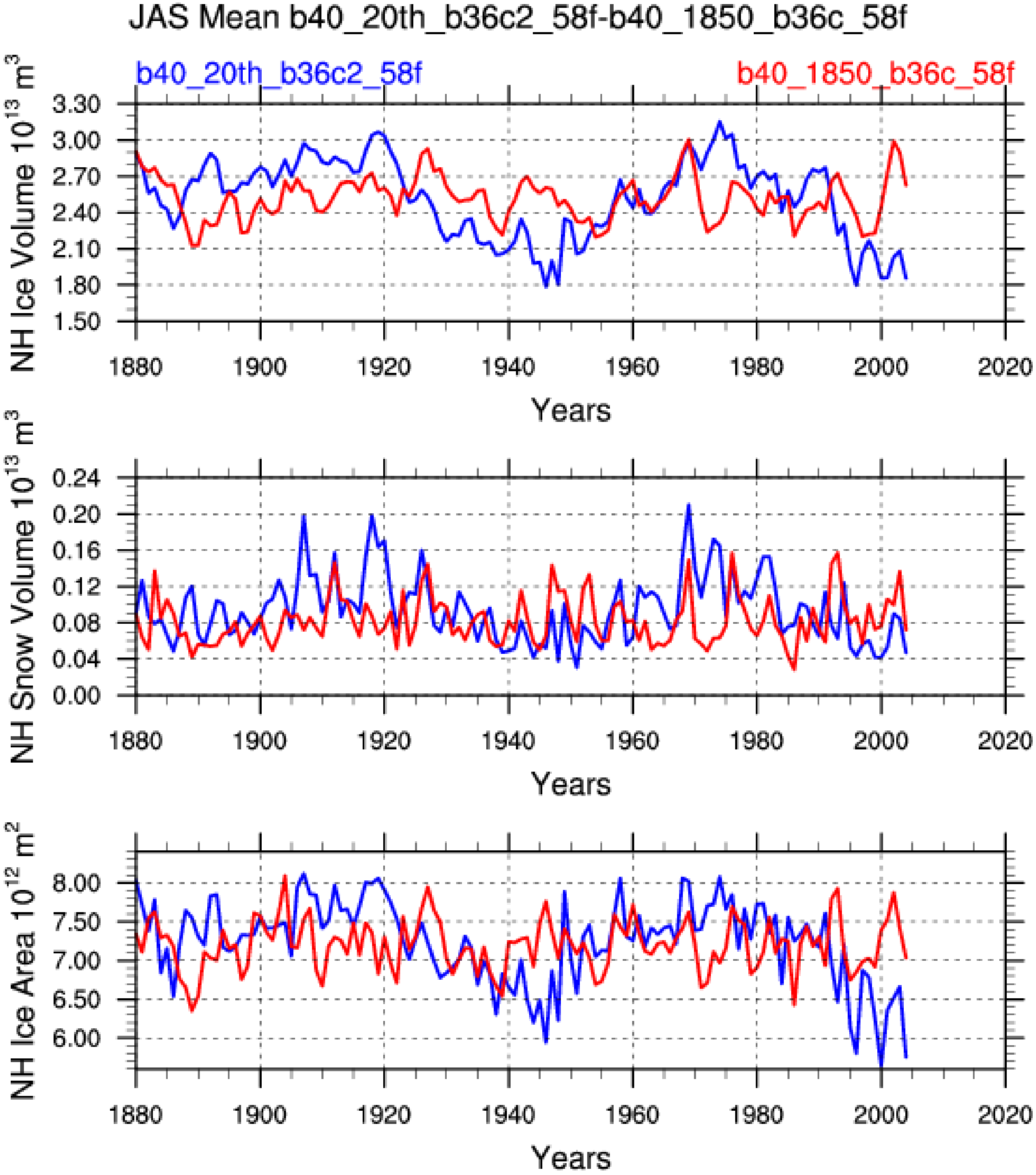




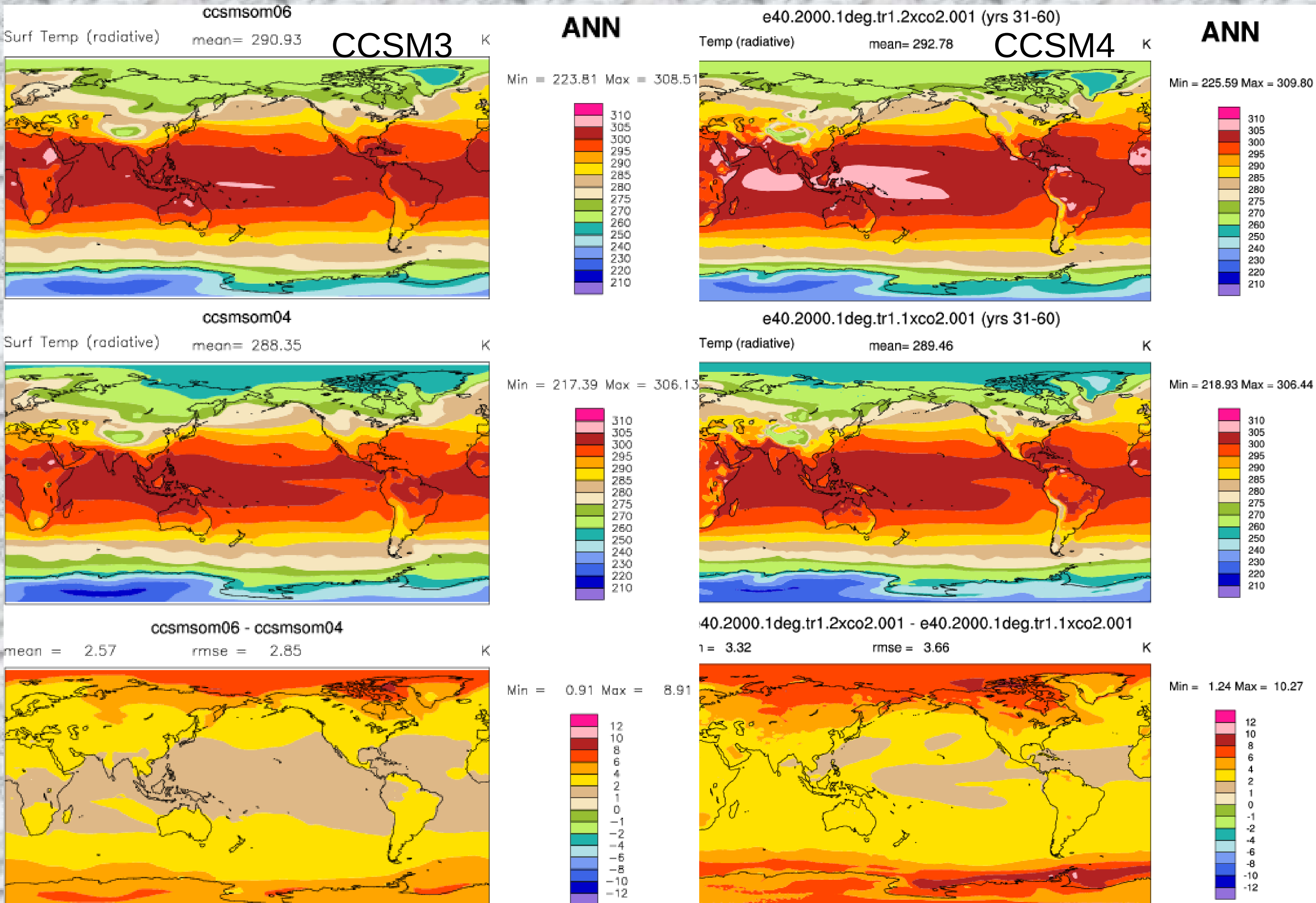

# $20^{th}$ Century Sept Ice Extent (CCSM4)

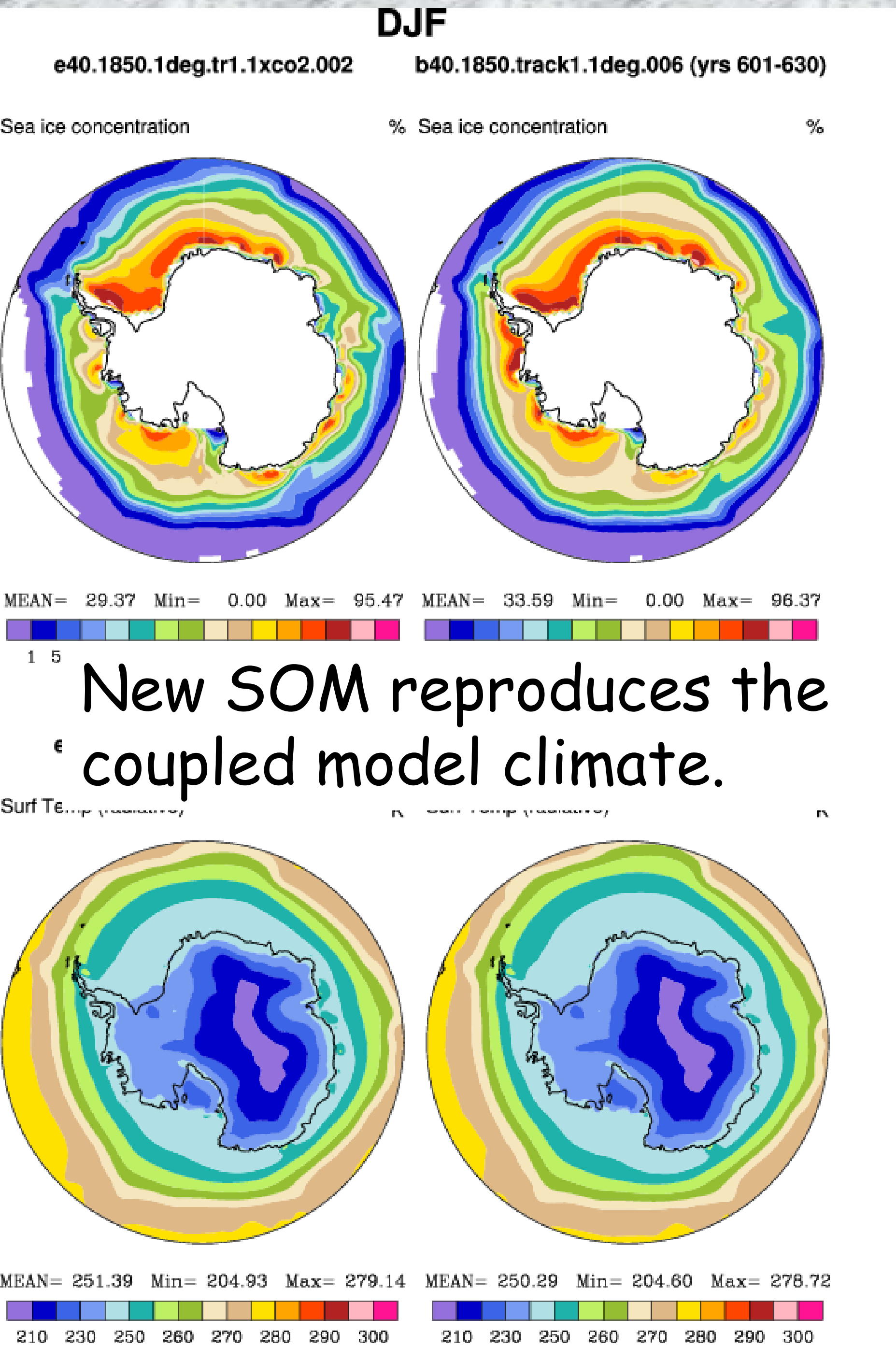
Trends in late $20^{th}$ century Sept ice extent loss from the ensemble members bracket the observed trend



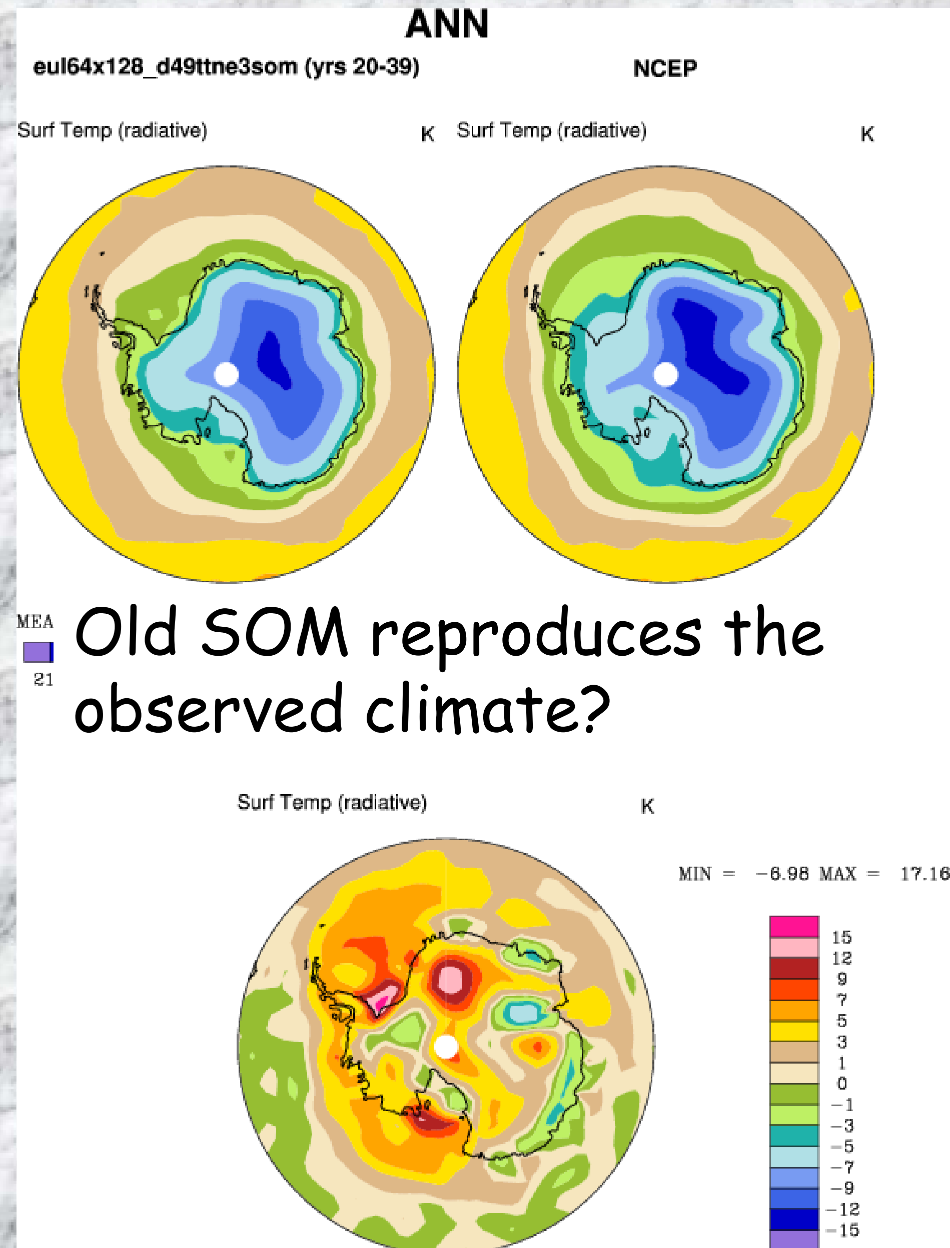

# 20th Century JAS mean (CAM V).

# Climate Sensitivity: What's SOM got to do with it?






New SOM reproduces the coupled model climate.




Old SOM reproduces the observed climate?

# Summary

- New CICE physics and SOM.
- Aerosols have a limited impact in the central Arctic, but more important near the margins.
- CAM V sea ice: room for improvement.
- 20$^{th}$ century sea ice simulations bracket obs.
- Climate sensitivity in CCSM4 about 0.5-0.7 higher than CCSM3 (SOM formulation, model component physics changes).
- New SOM reproduces coupled model climate.

# And Beyond CCSM4?

- Ice model to-do list (Feb, 2006):
  - improved radiation scheme (DONE)
  - dynamic stability improvements (DONE)
  - inclusion of biogeochemistry (In Progress)
  - sea ice "hydrology" including melt ponds, brine pockets and drainage, percolation and snow-ice formation (Some progress)
  - snow metamorphosis; snow aging (June, 2007; ??)
  - blowing snow parameterization (??)
- New applications that we are/may contribute to
  - regional modeling (POP-ROMS/CAM-WRF)
  - weather-climate (WRF) scale interactions
  - high-resolution coupled integrations
  - Do these new areas have specific model development needs?
  - How do we entrain the necessary communities?
- More generally - What is needed to accelerate model developments? What is needed to identify new areas?