CCSM4/CICE4:
When the dust settles.

David Bailey and Marika Holland, NCAR

- 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, first-year ice, aerosols).
- Aerosol cycling and deposition on sea ice / snow.

Aerosol cycling implementation

Four aerosol reservoirs in the vertical

Aerosol cycling due to ice transport, vertical melt/snow-ice formation

Melt water scavenging

Three aerosols – 2 black carbon (hydrophilic/phobic), 1 dust

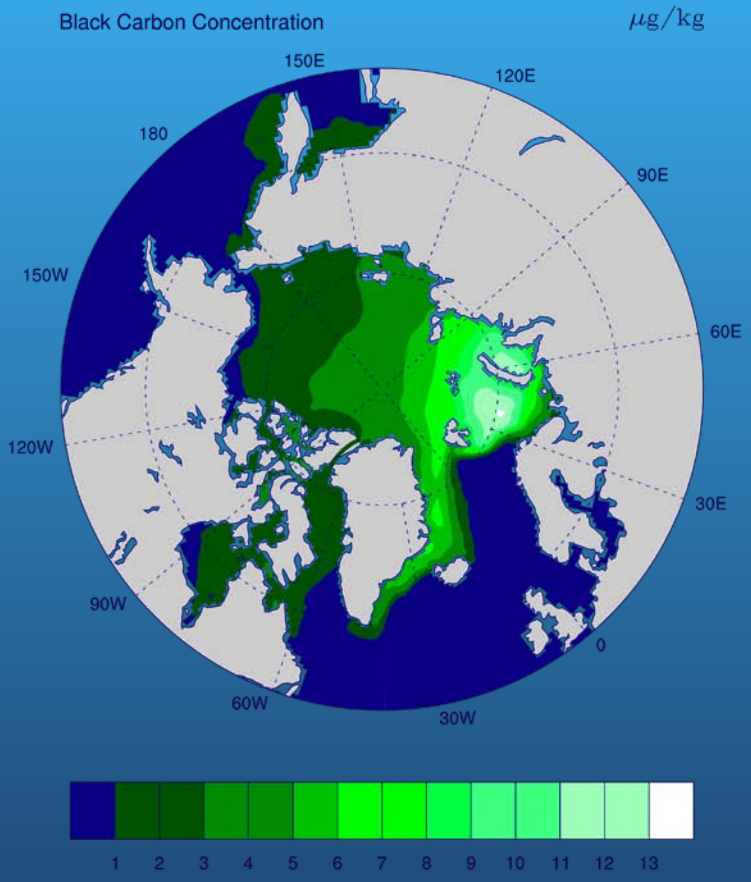
Currently affects radiative transfer

Receiving aerosol deposition from CAM or climatology.

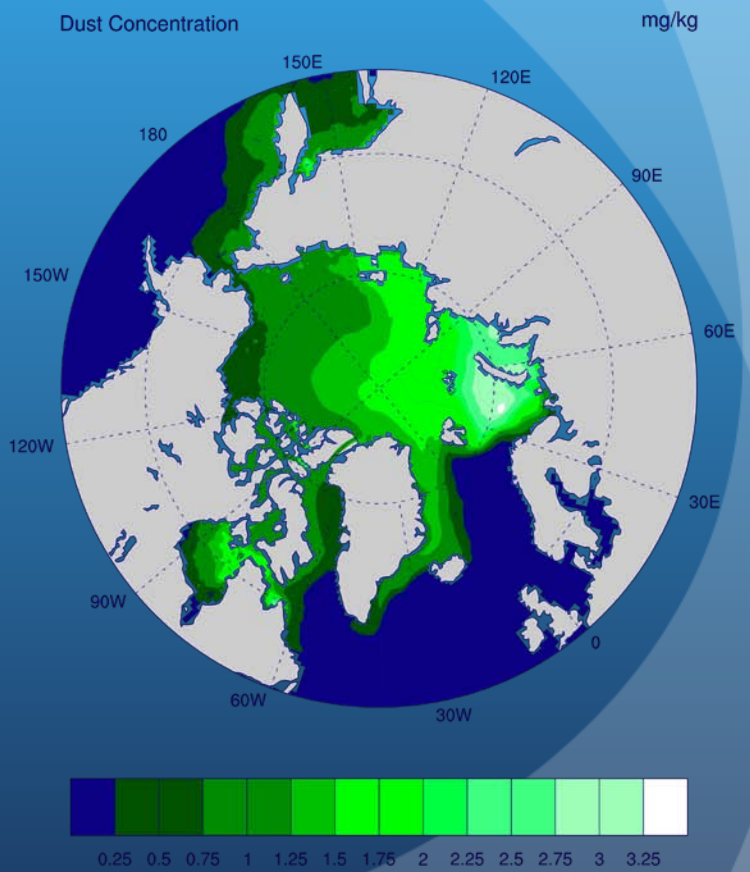
Near-term (months) work will link to ocean iron deposition

With climatological Aerosol deposition

Black Carbon Concentration June Mean b40.1850.track1.008



Dust Concentration June Mean b40.1850.track1.008



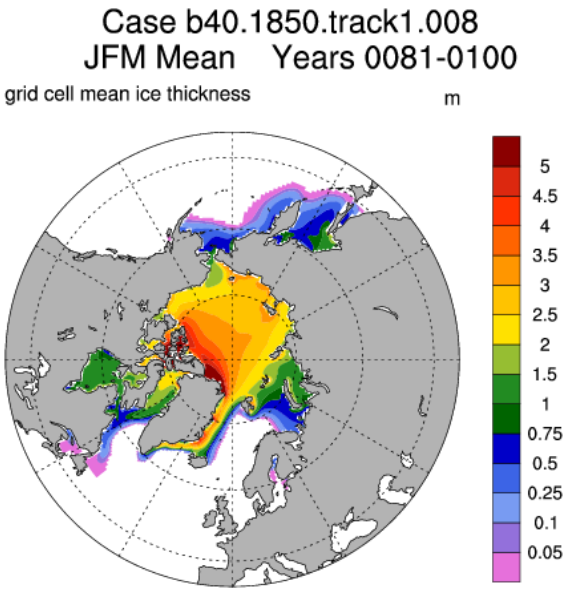
New Albedo (delta-Eddington) Formulation

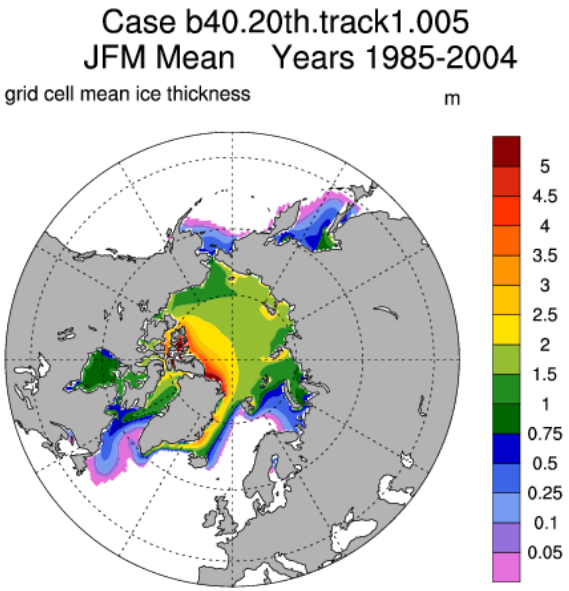
- Snow and ice albedos now a function of zenith angle and optical properties of snow, sea ice, and melt ponds.
- Tunable non-melting and melting snow grain radius -> target albedos. (Not easy!)
- Accounts for the effect of impurities (aerosols, algae, dust, etc) in the snow and ice.
- Very simple snow-aging (linear radius growth) at this stage.

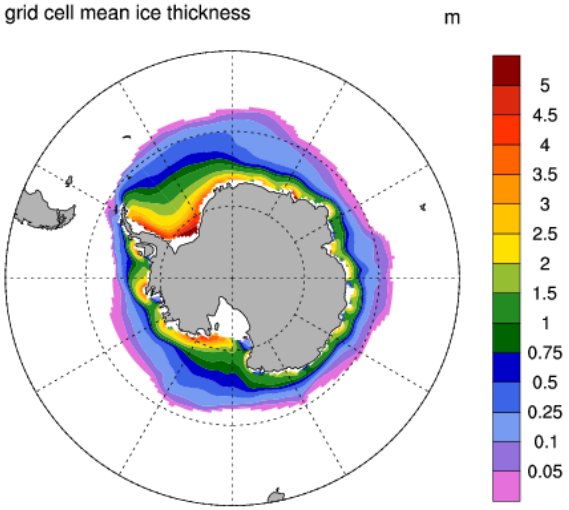
Current Simulations

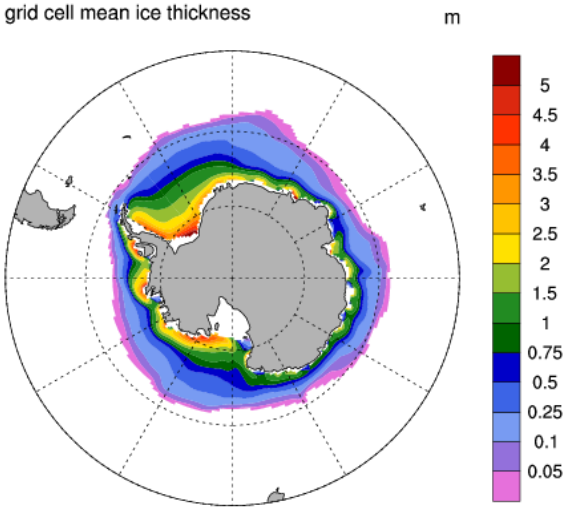
- Focus on track I two-degree results.
- Several attempts at optimal snow grain radius.
- Generally want Arctic snow to melt away in summer. What about 1850?
- Delicate balance between losing snow in summer and ice thickness.
- Different parameter settings for each track or resolution.

1850 control and 20th Century Runs (Track I)

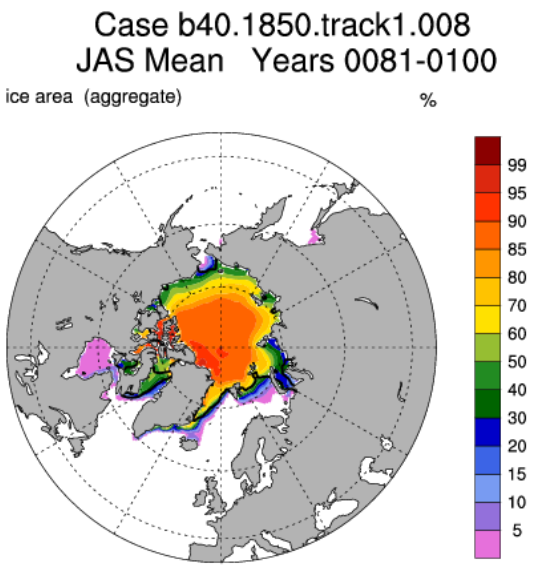


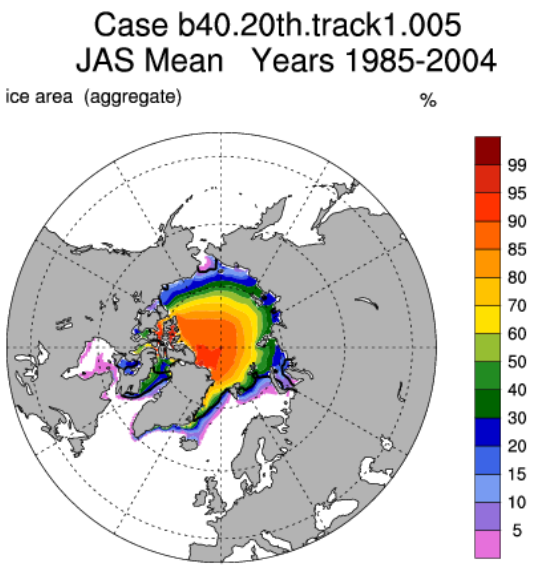


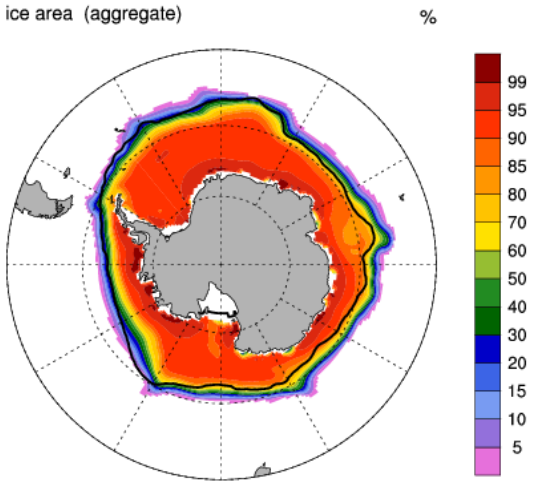


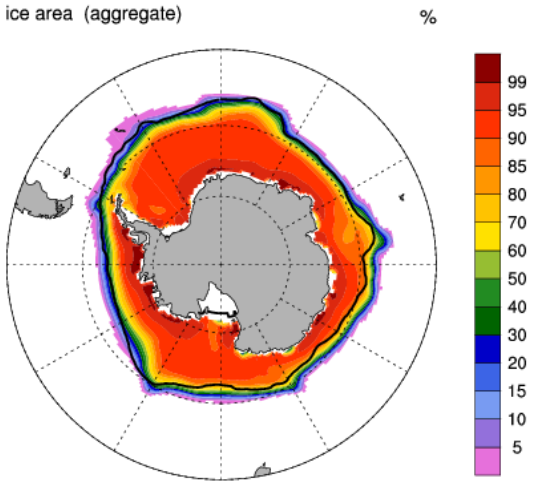


1850 control and 20th Century Runs (2)



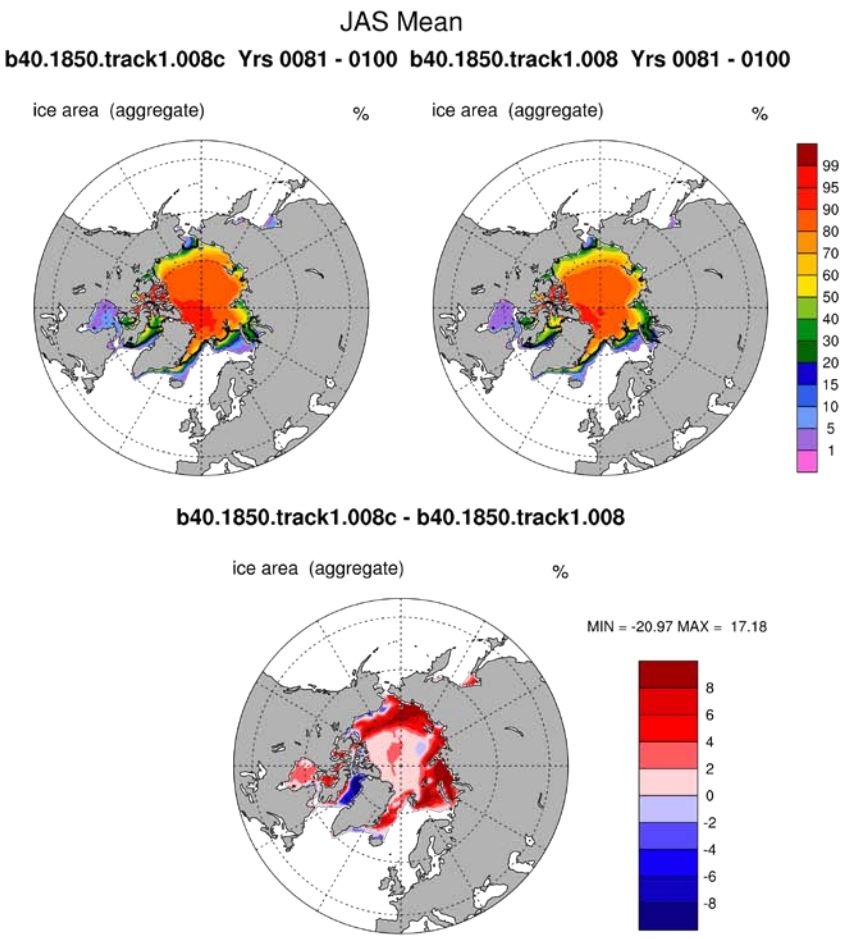




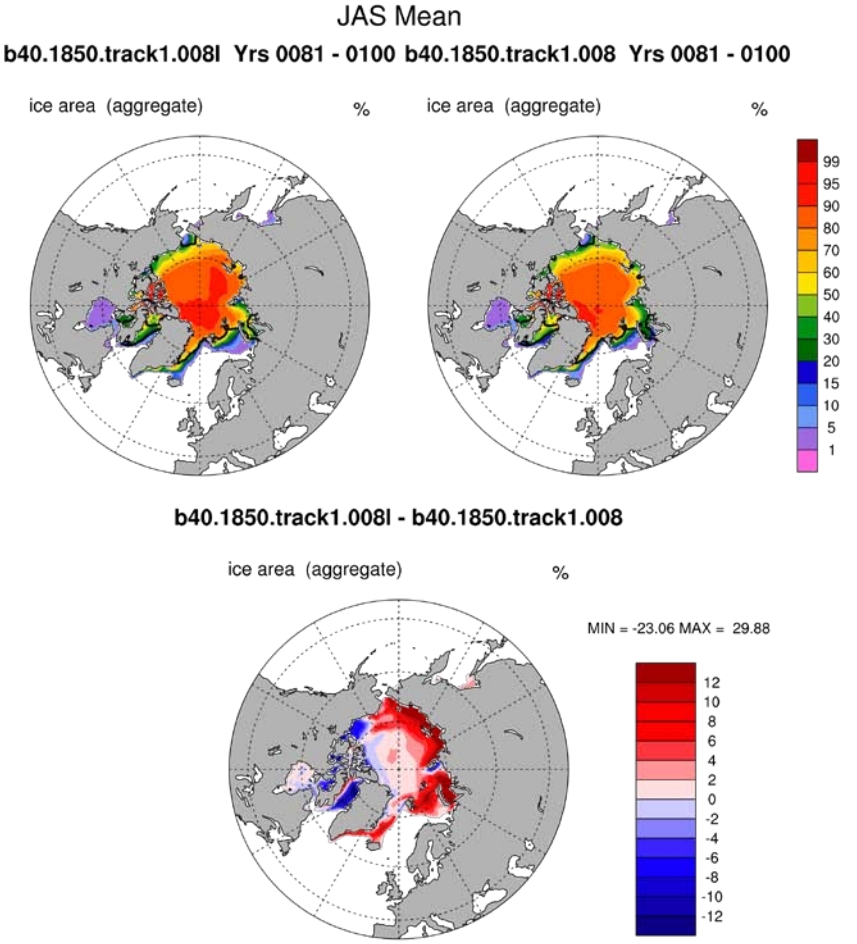


Sensitivity Runs: Low ice concentrations.

CCSM3 Shortwave



No lateral melt



Summary

- New CICE physics.
- Aerosols have a limited impact in the central Arctic, but more important near the margins.
- Tuning delta-Eddington snow grain radius is more challenging than CCSM3 radiation.
- Reasonable two-degree results for both hemispheres (better in SH). Low ice concentrations?
- One-degree atmosphere produces similar results in NH, but more extensive ice in SH.
- Track V issues.