R: Spatial distributions and radiative forcing of aerosols in ACME v1-beta (AV1C-04P)

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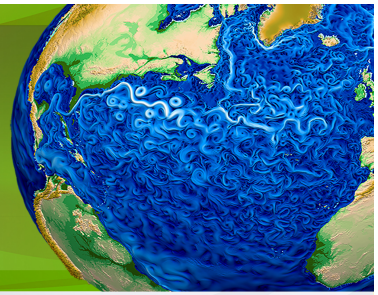


Objective and Summary

Objective:

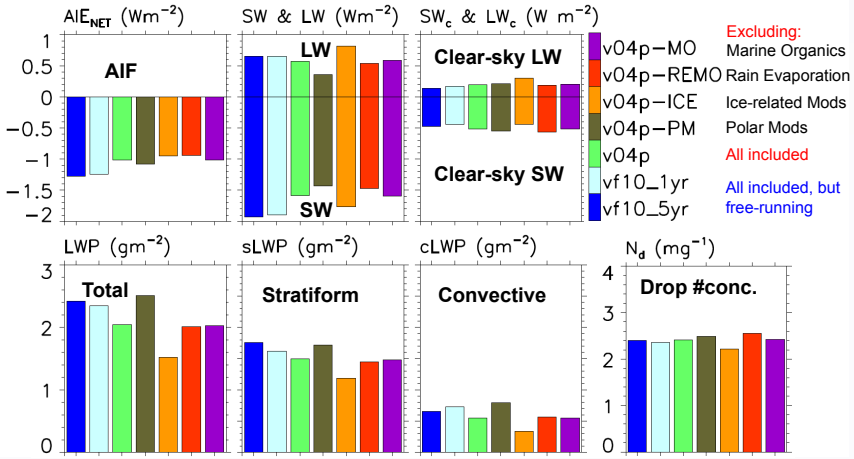
Several new treatments of aerosol, cloud, and cloud-aerosol interaction have been implemented in the ACME v1-beta. Here we show overall and individual effects of the new treatments on aerosols and cloud properties, using nudged low-resolution (ne30) simulations.

Summary:

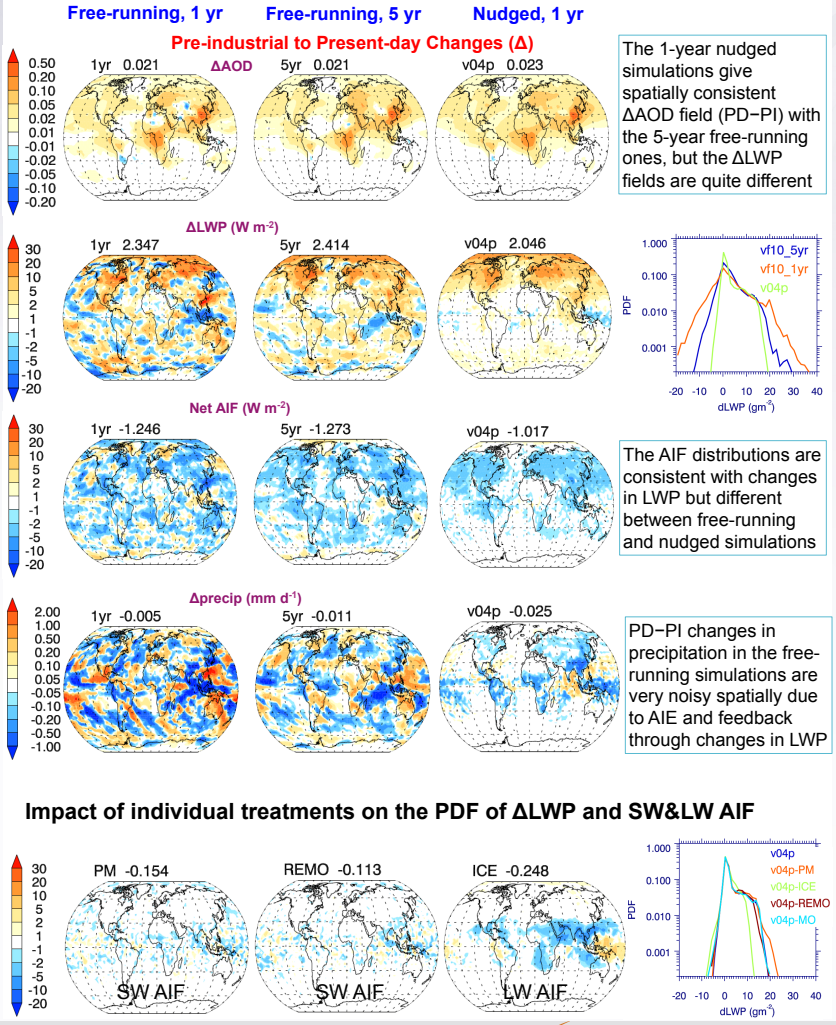
- Compared to earlier model configurations, the atmospheric AV1C-04P version has some code and input changes and parameter tunings that reduce biases in aerosol spatial distributions, aerosol indirect effects (AIE), low clouds, and precipitation.
- The net aerosol indirect forcings (AIF) of −1.3 and −1.0 W m^{-2} (from the 5-year free-running and 1-year nudged atmosphere simulations, respectively) are reasonably low. New treatments have individual impacts of less than 0.1 W m^{-2} on net AIF but have more significant impacts on SW AIF (−0.15 to 0.18 Wm^{-2}) and LW AIF (0.04 to −0.25 Wm^{-2})
- The differences in AIF are mostly due to effects on the liquid water path (LWP), as opposed to cloud drop number (N_d)
- The short nudged simulations can be a very useful tool for model evolution and tuning

Aerosol Direct and Indirect Effects

- The SW and LW AIFs are more sensitive to ice-related new treatments (e.g., nucleation, DCS) and the Polar Mods (e.g., convective transport and wet removal processes)
- The sensitivity is dominated by changes in LWP in both stratiform and convective clouds



Spatial distributions of AIE



The 1-year nudged simulations give spatially consistent ΔAOD field (PD−PI) with the 5-year free-running ones, but the ΔLWP fields are quite different

The AIF distributions are consistent with changes in LWP but different between free-running and nudged simulations

PD−PI changes in precipitation in the free-running simulations are very noisy spatially due to AIE and feedback through changes in LWP

Impact of individual treatments on the PDF of ΔLWP and SW&LW AIF

ACME Accelerated Climate Modeling for Energy

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