Review of manuscript egusphere-2025-1868

Summary

The authors present an evaluation of the effective radiative forcing due to anthropogenic aerosol changes in the SCREAM model. The aerosols are prescribed with a simplified scheme and are coupled to the radiation and cloud microphysics. They perform high-resolution simulations with the SCREAM model and compare those with coarse-resolution simulations with the E3SM model. They find a more negative radiative forcing due to aerosol-cloud interactions in the high-resolution simulations. They show that this difference is linked to the limiter of the cloud droplet number concentration in E3SM and the activation of aerosols to cloud droplets in SCREAM. They conclude that high-resolution simulations with prescribed aerosols allow us to perform rigorous process-level studies under controlled conditions. The paper is well written, well structured, and insightful. There are two general comments and some specific comments.

General comments

- The authors should describe in more detail how the cloud droplet number is handled in their simulations. Please list all processes, i.e., sources and sinks, that act on the prognostic cloud droplet number. And please explain whether the liquid cloud fraction is binary or continuous and whether it is subject to a threshold.

- The authors should describe in more detail how the aerosols are prescribed in their simplified scheme. Please add information about the aerosol optical depth at 550 nm for the present-day and pre-industrial scenario. That would also make it easier to compare their scheme with the MACv2-SP scheme of Stevens et al. (2017).

Specific comments

- Line 2: If possible, please shorten or split that long term, i.e., Energy Exascale Earth System Model (E3SM) Simple Cloud-Resolving E3SM Atmosphere Model (SCREAM) v1 configuration.

- Line 75: Is there a similar condition for the liquid cloud fraction? Is the liquid cloud fraction binary as well, i.e., either 0 or 1?

- Line 96: Please provide information about the aerosol optical depth to allow a comparison with the MACv2-SP scheme of Stevens et al. (2017).

- Line 110: Please list all processes, i.e., sources and sinks, that act on the prognostic cloud droplet number.

- Line 133 - 137: Please clarify what chemical processes are prescribed.

- Line 141: Please provide information about the aerosol optical depth of the present-day and pre-industrial simulation.

- Line 182: Does that estimate take into account the potential impact of aerosols on large-scale dynamics?

- Table 1: What is the minimum cloud droplet number concentration in the other simulations, i.e., 1 to 3 and 4 to 7?

- Figure 3: It looks like 10^{-5} should be replaced with 10^{5}.

- Line 253: Please explain the filtering method in more detail.