**Improving the prognostic treatment of cloud-borne aerosols in E3SM**

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**Abstract**

Aerosol particles can stay in the cloud-borne state (i.e., as part of cloud droplets) through cloud nucleation and other microphysical processes. Fully prognostic representation of cloud-borne aerosols in a global model is crucial but challenging for global modeling of the aerosol lifecycle and aerosol-cloud interactions. In E3SMv1, the horizontal advection of cloud-borne aerosols is neglected, although cloud droplets are transported. The grid-scale advection may play a minor role in coarse-resolution models, but it is expected to be important for simulations at convection-permitting resolutions. In this work, we implement the advective transport cloud-borne aerosols and investigate its impact on aerosol budgets, clouds, and aerosol radiative effects. The simulations with 1-degree horizontal grid spacing show that the introduction of cloud-borne-aerosol advection increases the global burden of interstitial aerosols by 5% but decreases cloud-borne aerosols by 20%. Regional changes in clouds are also discernible. For example, the change in cloud droplet number can be more than 20% over East Asia and Europe. Results from 0.25-degree simulations will be also presented.