**ABSTRACT:**

Aerosol Cloud Interactions (ACI) are the consequence of perturbed aerosols affecting cloud drop and crystal number, with corresponding microphysical and radiative effects. ACI are a significant negative anthropogenic forcing on climate: potential masking greenhouse warming. ACI will be described and their importance assessed in light of current understanding and recent work. ACI are sensitive to both cloud microphysical processes (the ‘C’ in ACI) and aerosol emissions and processes (the ‘A’ in ACI). This talk will highlight the importance of cloud microphysical processes in ACI using idealized and global tests of a cloud microphysics scheme in CESM. Results show that better representations of cloud microphysical processes (the 'C' in ACI) are critical for representing the total forcing from changes in aerosols and cause uncertainties of up to -35% to +50% in ACI. These effects are stronger than uncertainties in natural aerosol emissions (-18 to +31%), but natural emissions are still significant. Uncertain ‘lifetime effects' are manifest in the simulations through changes to LWP with changes in aerosols, and these effects represent 33-50% of the total ACI. Autoconversion parameterizations in particular seem to specify ‘lifetime' effects that are highly uncertain, both in idealized and full tests. Buffering of different processes is important, as is the mixed phase and coupling of the microphysics to the condensation and turbulence schemes in CESM.

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