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Understanding simulated aerosol vertical profile shortcoming

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Aerosol vertical distribution causes a significant uncertainty in radiative forcing projection. Climate models poorly reproduce the aerosol vertical distribution with too much aerosol aloft in the upper troposphere. In previous studies show that it may be due to the ambient convective mass flux, lack of removal process, and deficient simulation of the atmospheric circulation. In this study, we evaluate aerosol vertical profile from several Coupled model intercomparison project 5 (CMIP5) models and Community Atmosphere Model 5 (CAM5) relative to Cloud-Aerosol Lidar Infrared Pathfinder Satellite Observation (CALIPSO). Moreover, we investigate the role that convection and wet deposition have in contributing to the deficient simulation of the vertical aerosol profile by performing sensitivity experiments. The results show that all models significantly underestimate extinction coefficient in the lower troposphere and overestimate in the upper troposphere. In addition, majority of models indicate land ocean contrast in the relationship between aerosol extinction coefficient and convective mass flux in upper troposphere. More convective mass flux is related to more aerosol aloft over the continents, and more convective mass flux associated with less aerosol lofting in upper troposphere over the ocean.