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## Substantial Convection and Precipitation Enhancements by Ultrafine Aerosol Particles

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Aerosol-cloud interactions remain the largest uncertainty in climate projections. Ultrafine aerosol particles smaller than 50 nanometers ( $UAP_{<50}$ ) can be abundant in the troposphere, but are conventionally considered too small to affect cloud formation. Observational evidence and numerical simulations of deep convective clouds (DCCs) over the Amazon show that DCCs forming in a low aerosol environment can develop very large vapor supersaturation because fast droplet coalescence reduces integrated droplet surface area and subsequent condensation.  $UAP_{<50}$  from pollution plumes that are ingested into such clouds can be activated to form additional cloud droplets on which excess supersaturation condenses and forms additional cloud water and latent heating, thus intensifying convective strength and precipitation. This mechanism suggests a strong anthropogenic invigoration of DCCs in previously pristine regions of the world.

**Publication:**

American Geophysical Union, Fall Meeting 2018, abstract #A21E-07

**Pub Date:**

December 2018

**Bibcode:**

2018AGUFM.A21E..07F

**Keywords:**

0305 Aerosols and particles;  
ATMOSPHERIC COMPOSITION AND STRUCTUREDE: 0345  
Pollution: urban and regional;  
ATMOSPHERIC COMPOSITION AND STRUCTUREDE: 3305 Climate  
change and variability;  
ATMOSPHERIC PROCESSESDE: 3311 Clouds and aerosols;  
ATMOSPHERIC PROCESSES

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