5.025 Global, In Situ Measurements of New Particle Formation and Growth to CCN Sizes.

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Abstract:

Global models show that new particle formation (NPF) in the free troposphere is the largest source of cloud condensation nuclei (CCN) in the remote marine boundary layer (MBL), where aerosol-cloud-climate interactions are particularly strong (e.g., Merikanto et al., 2009). New global-scale, in situ measurements of aerosol properties have been made using instruments on a continuously profiling DC-8 aircraft over the middle of both the Pacific and Atlantic Oceans between the Arctic and the Antarctic over four seasons as part of NASA's Atmospheric Tomography (ATom) mission. These airborne observations between 0.15 and 12.5 km, along with model results, show that the Earth is girdled by a region of NPF in the upper troposphere between approximately 30 ^{o}N and 30 ^{o}S in all seasons. This globally significant particle source is associated with deep tropical convection, which transports trace quantities of gas-phase aerosol precursors and removes the pre-existing aerosols that compete with NPF for condensing species. Particle sizes increase with decreasing altitude in the tropics and subtropics, likely growing from gas-phase oxidation and condensation in regions of net downward motion. ATom measurements in the MBL consistently show a mode of sub-0.1 micrometer particles that may originate from this free tropospheric particle source. Accurately simulating this globally important CCN source requires that models capture the origins, transport, and removal of precursor species and of aerosol particles that compete for condensing compounds with the newly formed particles that actually alter CCN abundance. The unique ATom dataset provides powerful constraints against global models that simulate these processes.
Merikanto, J., Spracklen, D., Mann, G., Pickering, S. and Carslaw, K.: Impact of nucleation on global CCN, Atmos Chem Phys, 9, 8601–8616, 2009.