6.027 A First Look at the Global Distribution of Newly Formed Particles from the NASA Atmospheric Tomography Mission (Atom).

Early Career Scientist

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Abstract:

Aerosols affect climate by directly scattering sunlight and affecting cloud properties. Over half of global cloud condensation nuclei (CCN) come from particles formed in-situ from the gas phase rather than directly emitted particles. Particle formation mechanisms are poorly understood, and different mechanisms lead to different spatial distributions of particles. The probability of newly formed particles becoming CCN varies spatially e.g. with pre-existing condensation, so knowing the spatial distribution of nucleated particles is important in assessing their contribution to radiative forcing.

Measuring the global distribution of aerosols would allow evaluation of different particle formation mechanisms in global models. Remote areas are under-sampled but could provide the most direct evidence to distinguish between these mechanisms. Furthermore, newly formed particles may contribute more to CCN concentrations and direct effects in environments with low direct anthropogenic emissions. Current satellite sensors cannot directly measure particles $<0.05\mu m$. Previous airborne studies evaluating aerosol size distributions have tended to amalgamate data from separate campaigns, which often use differing methodologies, be regional in scale, or focus on specific phenomena.

A contiguous global dataset of nanoparticle size distributions, with coverage of remote areas, is needed to better constrain climate models and improve our understanding of new particle formation and its effects on climate. Here we present aerosol size distributions from the first of four around-the-world flights of the NASA Atmospheric

Tomography mission (ATom). The flights scanned the atmosphere in continuous ascents and descents (0.2-12km) over the Pacific and Atlantic with near-pole-to-pole coverage in July and August 2016. We report the first ultrafine aerosol size distributions (5-60nm) from ATom, measured with a suite of fast-response instruments, identifying large-scale spatial features from the lower to the upper troposphere, spanning remote polar, temperate, and tropical regions across both ocean basins.