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Multimodal Size Distributions in Fog: Cloud Microphysics or Measurement Artifact?

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In recent years there have been a number of observations during fog events whereby the measured size distributions show more than a single mode, sometimes even three or four. These multiple modes have been explained using various physical models including entrainment and mixing, coalescence, sedimentation, and new particle activation. Whereas all of these mechanisms are physically possible, a simpler explanation may explain how these multiple modes are formed, at least in those cases where optical particle counters (OPC) are used to measure the droplet sizes.

The most frequently used OPC is the Droplet Measurement Technology (DMT) FM-100 that measures droplets from 2 – 50 μm. The technique is single particle light scattering whereby droplets pass through a focused laser beam and the light scattered in a forward, solid angle of 4-12° is collected and converted to a current in a photodetector. The relationship between scattered light and droplet size is determined from Mie theory and for the laser wavelength and collection geometry of the FM-100, this relationship is non-linear and non-monochronic, i.e. the same scattering intensity can be produced by droplets of different sizes in a number of size ranges.

This presentation will show how the ambiguities in the scatter versus size relationship in the FM-100 introduces bimodality in the measured size distributions and that the false modes tend to fall where published data has shown modes measured during fog events. These artificial peaks can be removed and size distributions can be extracted that are more representative of the ambient spectra using an inversion algorithm that accounts for the Mie scattering relationship.