The impact of giant aerosols on drizzle formation

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Question:

Are giant sea-salt aerosols (GNI) important for the precipitation formation?

This is relevant, as most models (and observations) focus on the total drop concentration (determined largely by smaller aerosol particles) when describing a clouds ability to precipitate by warm processes.
Giant Aerosol Slide exposures
Microscope image of GNI slide

Dark lines separated by 37 micron, slide in humidified air (92% RH).

Contact-angle from side-looking camera.

Kohler theory to calculate dry salt size (assume NaCl).
Giant aerosol measurements

POC

noPOC
Comparison of cumulative spectra with Woodcock (1953).

VOCALS has smaller salt particles!
Why?
Drizzle removal?

RF06 had surface wind speeds of 8 – 14 m/s.
Sea-Salt loading (RF06)
**Gillespie (1973) Stochastic Coalescence Model**

Monte-Carlo model for coalescence (no numerical broadening)

Condensation from near sea-surface (50 m) through cloud base (380 m) to cloud top (1450 m)

Initiated with particles from
  - Uwyo CCN
  - NCAR C-130 PCASP
  - NCAR Giant Nuclei Impactor (GNI)

Use Cloud Base conditions from first RF06 POC flight

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**4 cases:**

POC CCN with Giant Aerosols  noPOC CCN with Giant Aerosols
POC CCN without Giant Aerosols  noPOC without Giant Aerosols
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POC CCN without Giant Aerosols   noPOC without Giant Aerosols
Evolution of rain rates

383s = cloud base (386 m)
850s = cloud top (1450 m, 
LWC=1.8 g/m3
1500 s = stop model

2 m/s from cloud base to top, 
then 0 m/s thereafter

POC has about 60 CCN/cc 
noPOC has about 190 CCN/cc
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Results:
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Outside POC, giant aerosols contribute to rain rate by a factor 3 (mean radius is 16 micron)

Likely an underestimate (more time)
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Implications:

It is possible for large scale models to generate drizzle, and maybe even the correct amount of drizzle – without considering giant aerosols.

In that case, model-calculated drizzle rates may be a result of numerical diffusion in coalescence scheme or initialization scheme or other causes.

However, what happens when the GNI concentrations are different in other circumstances? - This may be a problem for GCM and other models.
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The End