Aerosol proxies and their co-variability with cloud microphysics during MAGIC

David Painemal

Pat Minnis

Motivation

- Simple quantification of the impact of
- $d\ln(C)/d\ln(a_i)$
- C: cloud property, a: aerosol proxy
- Ideally, c_i=CCN
- Other aerosol measurements can also provide qualitative information about CCN but…
- They are not necessarily the same, i.e.:

- **$d\ln(C)/d\ln(a_1) \neq d\ln(C)/d\ln(a_2) \neq d\ln(C)/d\ln(a_n)$**

Dataset

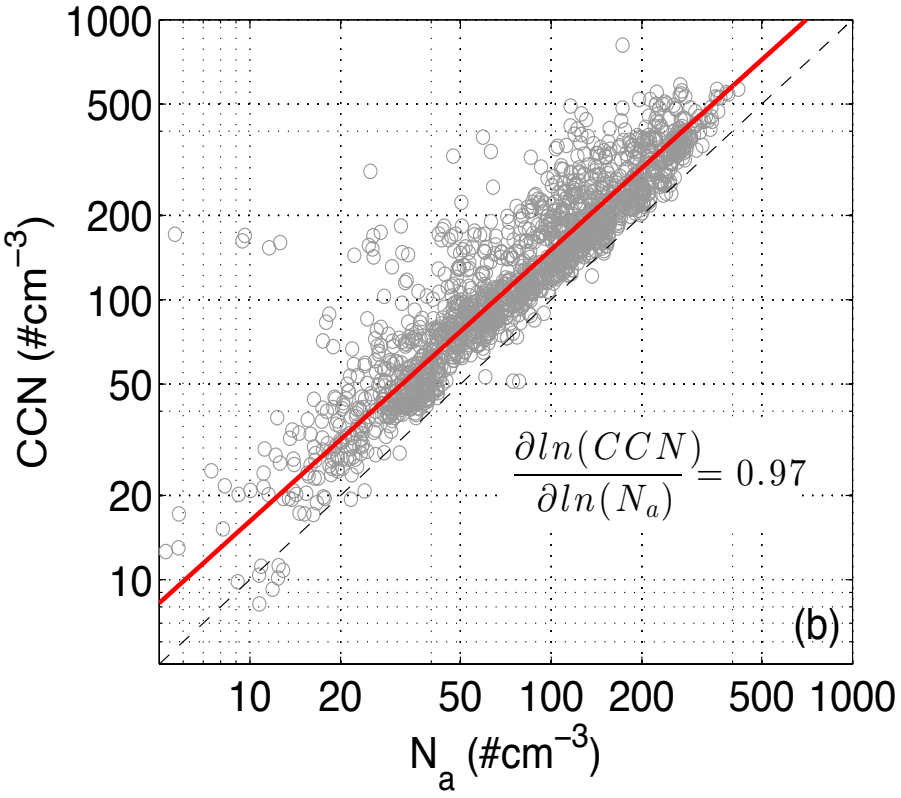
- CCN probe
- Ultra-High sensitivity aerosol spectrometer (UHSAS)
- Nephelometer: aerosol scattering
- Particle soot absorption photometer (PSAP): aerosol absorption
- High spectral resolution lidar
- Probably we analyzed data from every single aerosol probe.

Aerosol measurements during MAGIC

- Good news: CCN, CN probes, and aerosol concentration from the UHSAS are qualitative consistent.
- So-so news: Frequent peaks of very high aerosol concentration (>1000/cc!!)
- UHSAS shows that peaks are explained by huge concentration peaks of small sizes (<40 μm)
- Several methods two filter out CCN data:
  - Simplest method: Average data and remove samples with high standard deviation (e.g. 100/ cc)
  - More sophisticated method: use UHSAS data to remove samples with small aerosol effective radius.

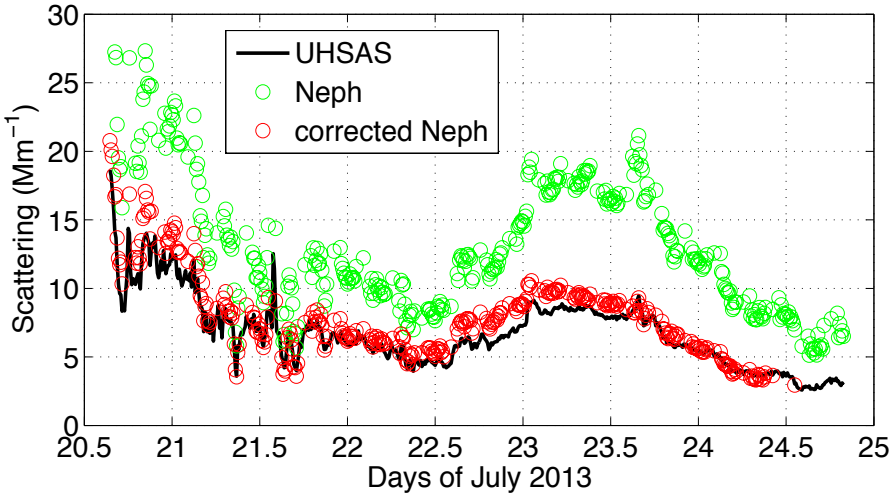
Accumulation mode vs *CCN*

- Correlations near 1, slopes=0.97.
- Accumulation mode is a good CCN proxy.



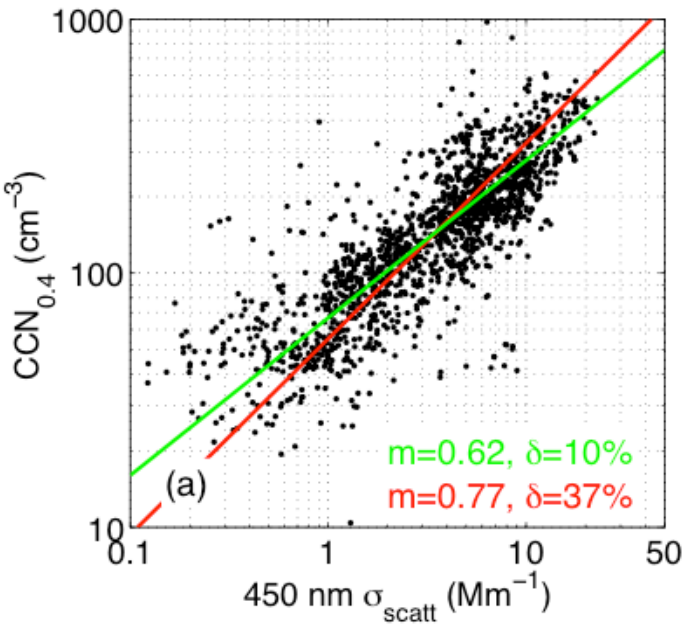
Aerosol scattering (σ_{scat}) and extinction (σ_{ext}) vs *CCN*

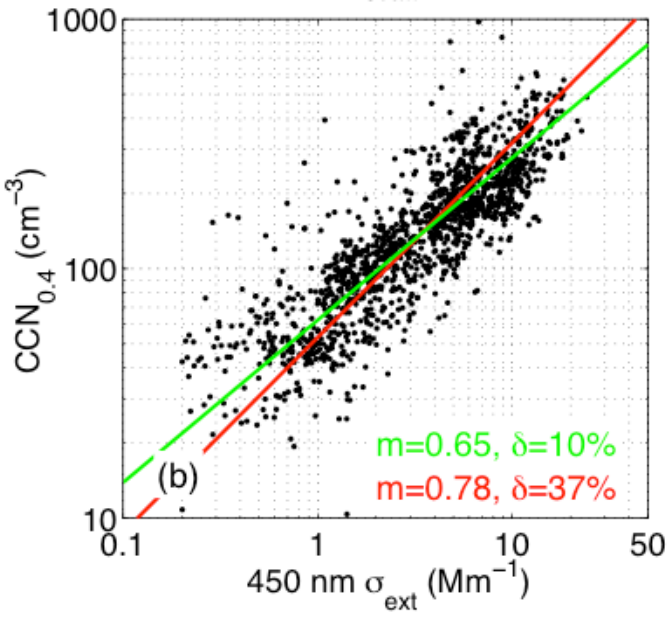
- Caution: Dry nephelometer was not dry
- For the same aerosol concentration, σ_{scat} can change by a lot for different values of relative humidity (RH).
- Commonly used approximation: $\sigma_{wet}=\sigma_{dry}*F$
- *F*: humidification factor, Gassó et al. (2000): $F=0.76*(1-RH/100)^{-0.69}$ (for a pristine marine environment)



"Dry" scattering (σ_{scat}) and extinction (σ_{ext}) vs *CCN*

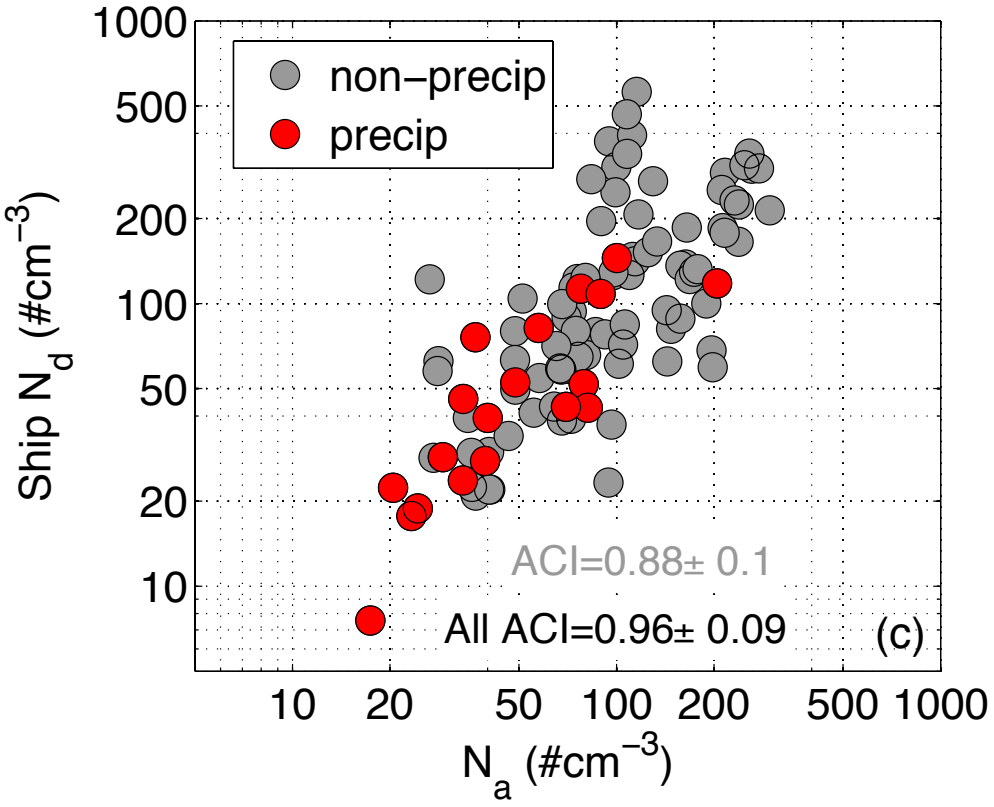
- σ-*CCN* slope 0.62-0.78 (York fit), depending on the error assumed in the measurements
- Contribution of absorption is modest. Mostly particle scattering.
- Result consistent with Shinozuka et al (2015, ACP)





Aerosol cloud co-variability

- Na vd Nd



Summary

- Close agreement among different aerosol measurements.
- Aerosol-cloud interactions are near the upper phyisical limit.
- Future work, HSRL data.