

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

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# Motivation

- Simple quantification of the impact of
- $d\ln(C)/d\ln(a_i)$
- C: cloud property, a: aerosol proxy
- Ideally,  $c_i = \text{CCN}$
- 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

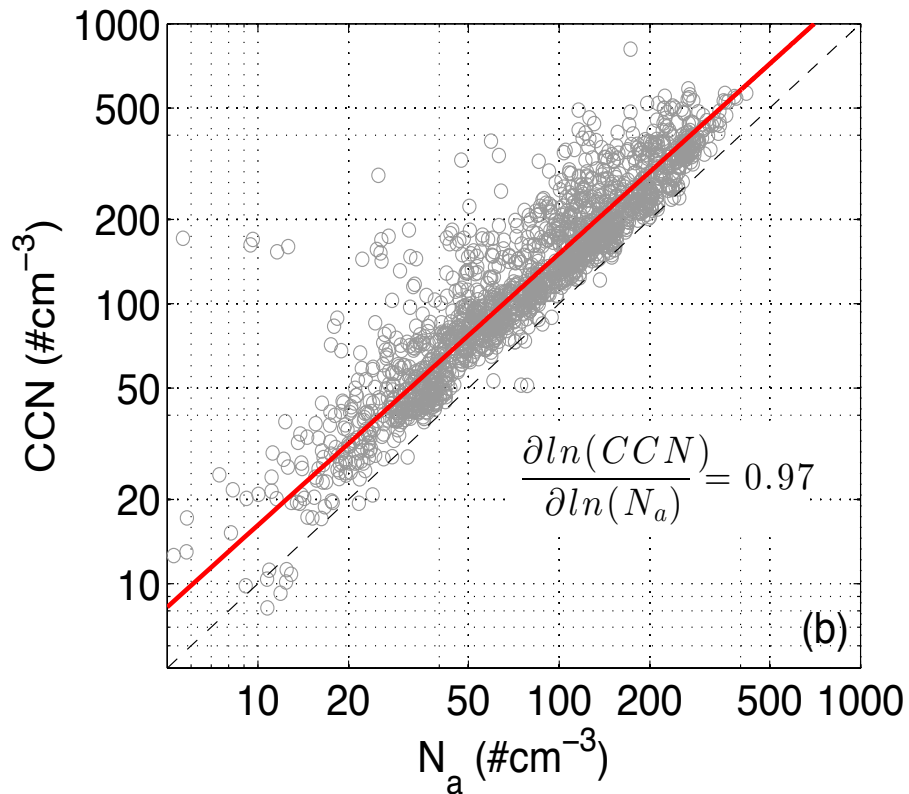
- CCN probe
- Ultra-High sensitivity aerosol spectrometer (UHSAS)
- Nephelometer: aerosol scattering
- Particle soot absorption photometer (PSAP): aerosol absorption
- High spectral resolution lidar
- Probably we analyzed data from every single aerosol probe.

# 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 ( $>1000/\text{cc}!!$ )
- UHSAS shows that peaks are explained by huge concentration peaks of small sizes ( $<40 \mu\text{m}$ )
- Several methods two filter out CCN data:
  - Simplest method: Average data and remove samples with high standard deviation (e.g.  $100/\text{cc}$ )
  - More sophisticated method: use UHSAS data to remove samples with small aerosol effective radius.

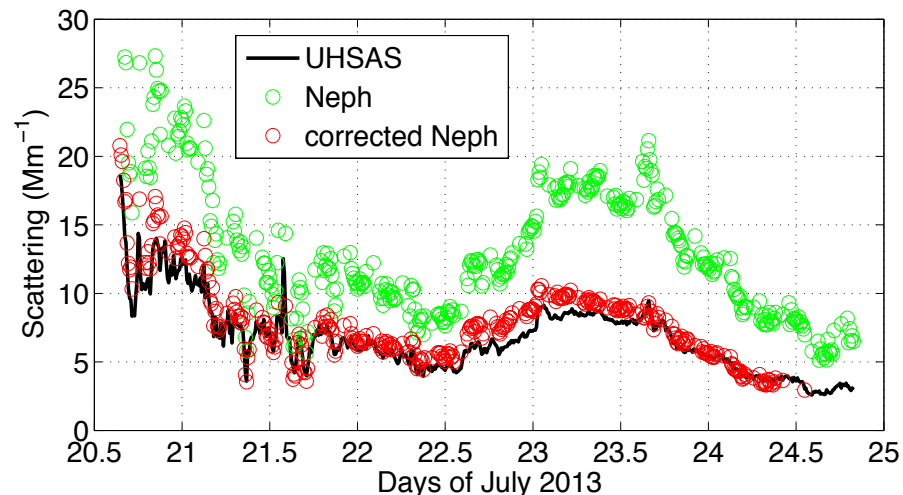
# Accumulation mode vs *CCN*

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



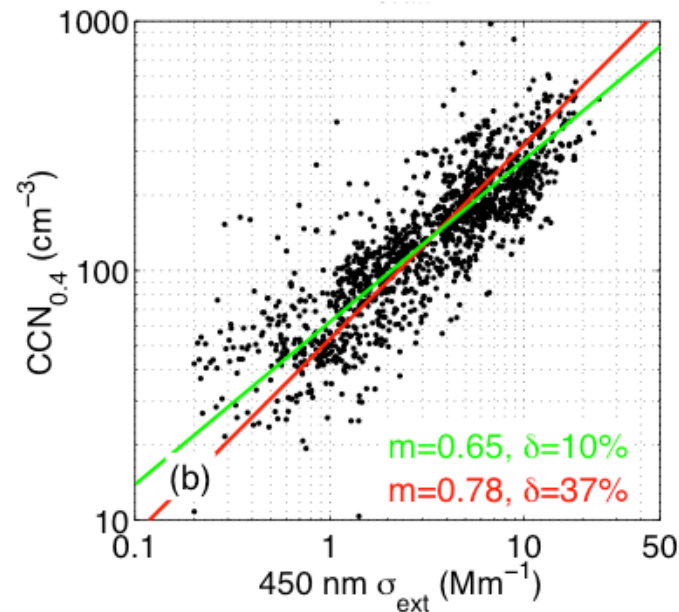
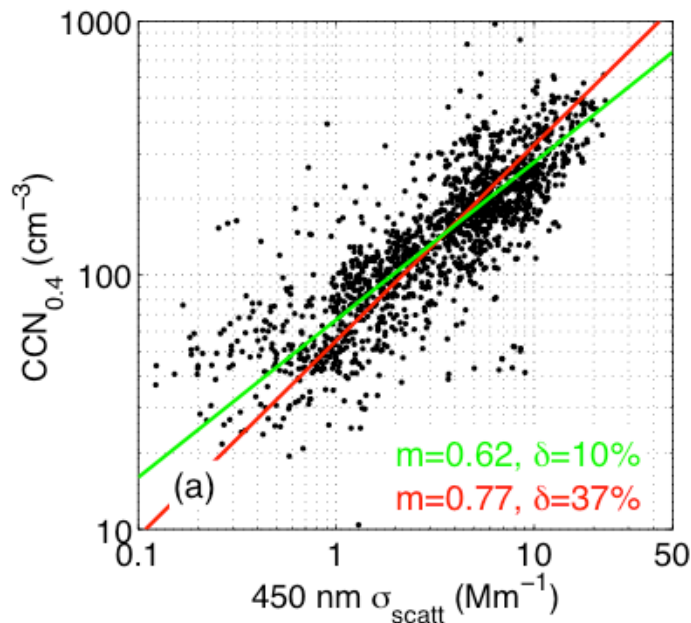
# Aerosol scattering ( $\sigma_{scat}$ ) and extinction ( $\sigma_{ext}$ ) vs *CCN*

- Caution: Dry nephelometer was not dry
- For the same aerosol concentration,  $\sigma_{scat}$  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)



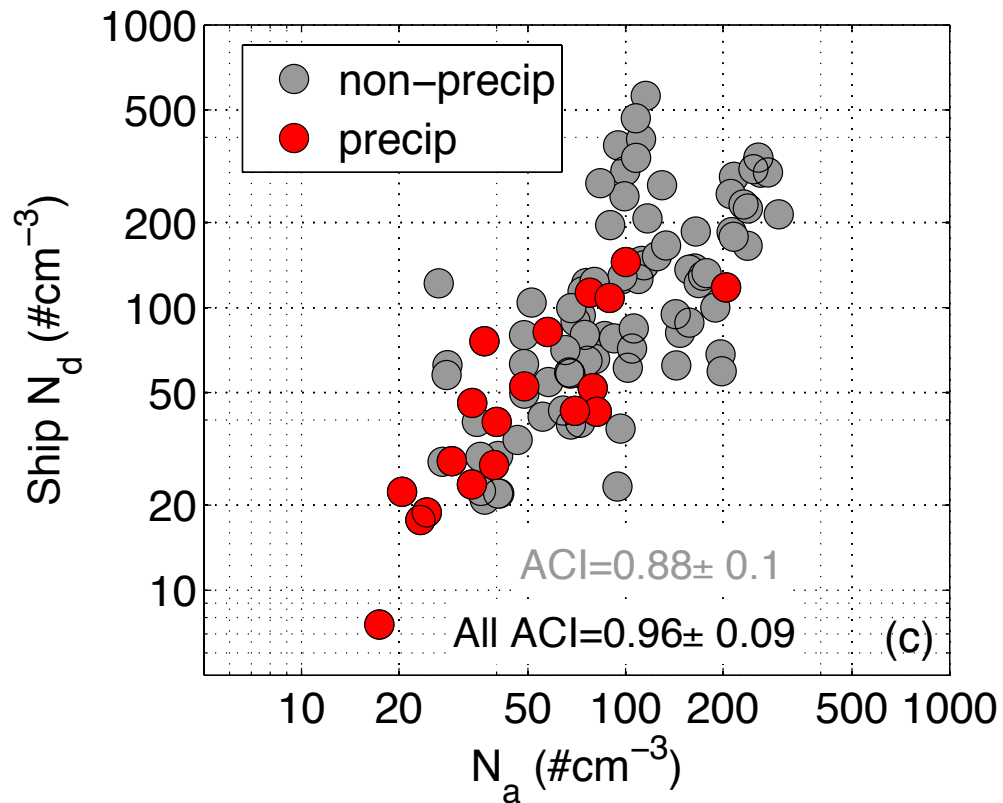
# “Dry” scattering ( $\sigma_{scat}$ ) and extinction ( $\sigma_{ext}$ ) vs *CCN*

- $\sigma$ -*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 physical limit.
- Future work, HSRL data.