Aerosol hygroscopicity

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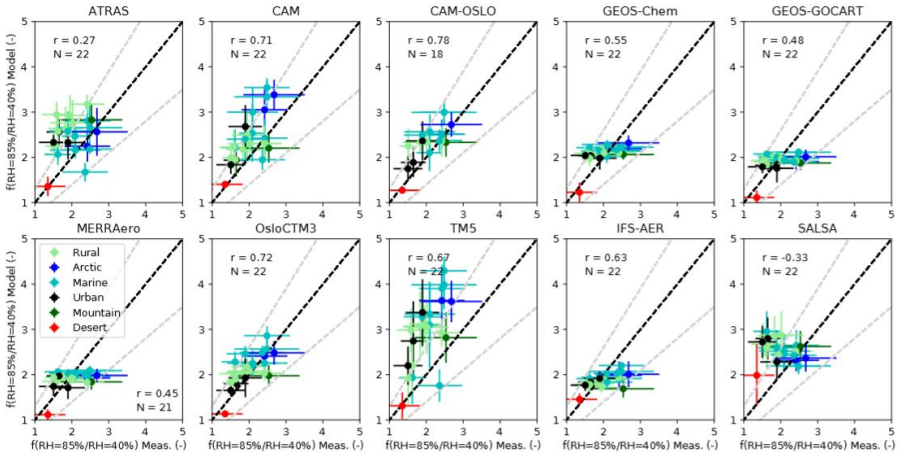
Scattering enhancement factor *f*(RH):

$$f(\mathrm{RH},\lambda) = \frac{\sigma_{sp}(\mathrm{RH},\lambda)}{\sigma_{sp}(\mathrm{RH_{dry}},\lambda)}$$

wet/ambient scattering coefficient

dry scattering coefficient

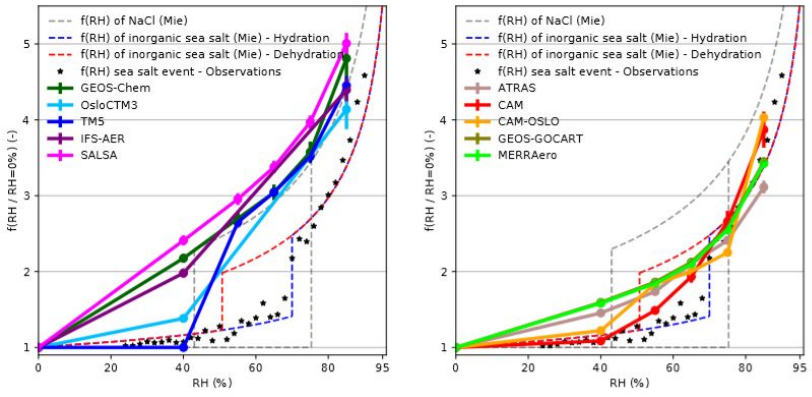


- Model-measurement evaluation **performed**
- Differences in the **model parameterizations of hygroscopicity** and model **chemistry** are driving some of the observed diversity in simulated *f*(RH)
- See **talk by Maria Burgos** this afternoon & recent paper in ACP

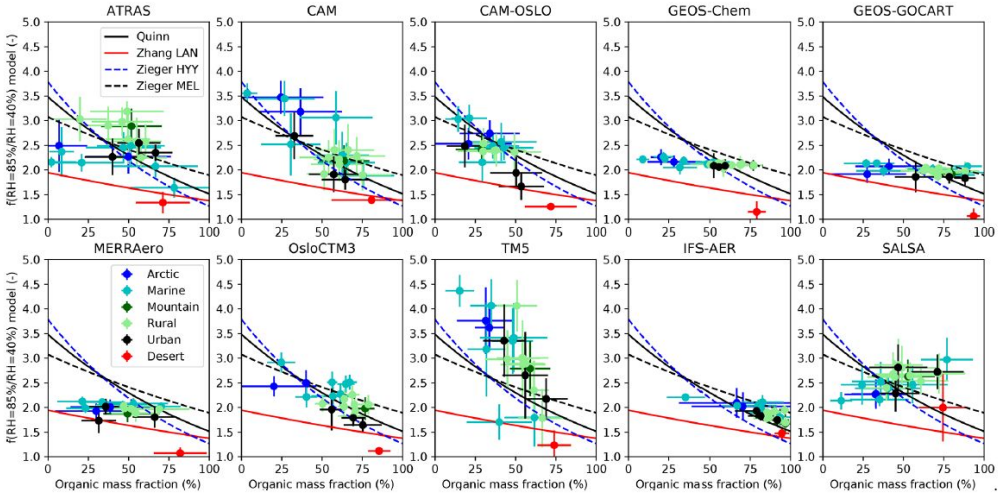
Burgos, M. A., Andrews, E., Titos, G., Benedetti, A., Bian, H., Buchard, V., Curci, G., Kipling, Z., Kirkevåg, A., Kokkola, H., Laakso, A., Letertre-Danczak, J., Lund, M. T., Matsui, H., Myhre, G., Randles, C., Schulz, M., van Noije, T., Zhang, K., Alados-Arboledas, L., Baltensperger, U., Jefferson, A., Sherman, J., Sun, J., Weingartner, E., and Zieger, P.: A global model–measurement evaluation of particle light scattering coefficients at elevated relative humidity, Atmos. Chem. Phys., 20, 10231–10258, https://doi.org/10.5194/acp-20-10231-2020, 2020

Recommendations for modelling

1. **Update hygroscopic parameterization** for some components, such as sea salt (see current diversity Table 3 in Burgos et al., 2020) and parameterizations based on OPAC
2. **Reproducing observational-based parameterizations of *f*(RH)** using chemical mass fractions (e.g. by Quinn et al. (2005), Zhang et al. (2015) and Zieger et al. (2016)).



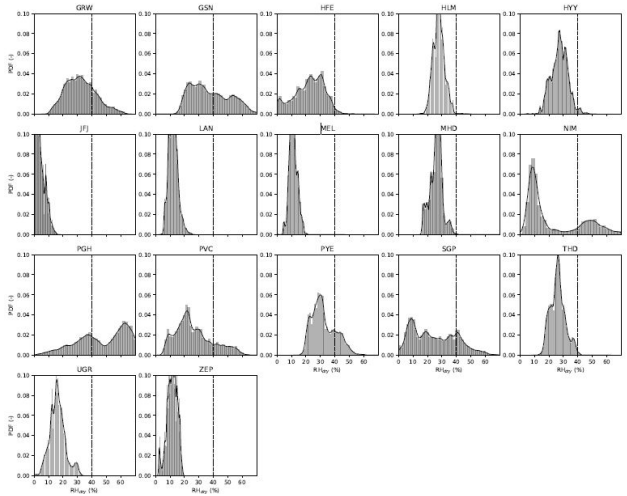
f(RH) of sea salt dominated aerosol at Graciosa



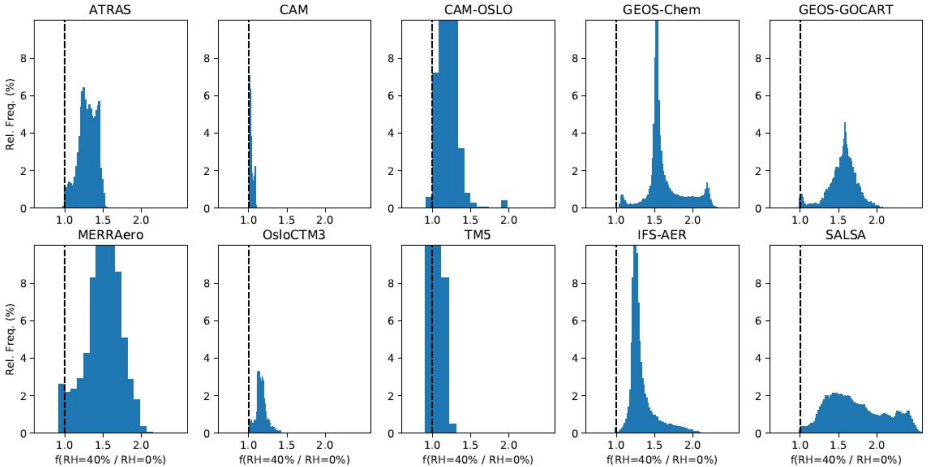
f(RH) vs. organic mass fraction

Evaluation Issues

1. **Problem with dry RH**: (a) RH of dry state in model and measurements was different (b) effects of hysteresis (salts) handled differently within models
2. **Particle size information** from models was not available



Differences in RH during **measurement of dry reference scattering coefficient** varied between sites



Relative frequency of occurrence (%) of the **modeled** scattering enhancement **between 0 and 40% RH** for all sites

Proposed AeroCom activities

- We suggest that **models and measurements are compared at similar conditions**:
  a. Models could calculate scattering at the same variable RH conditions as the measurements
  b. Measurements in the future could better control their reference RH, keeping it below 40% and maintaining a narrower distribution of RH_{ref}
- Carry out a similar assessment but taking into account other variables such as **aerosol chemistry** and **size distribution**. Constrained to sites with sufficient measurements. ***f*(RH) for individual aerosol components** from models (see sea spray comparison).

Proposed experiments:

1. **New experiment with common/improved hygroscopicity scheme for all ESMs**
2. Study the influence on aerosol (e.g. AOD, radiative forcing, lifetime) and cloud properties **with improved hygroscopicity scheme**
3. Is it possible to model backscattering? Is it available already? (We could calculate forcing efficiency at dry and wet conditions)

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