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Role of organic aerosol species in the hygroscopic scattering enhancement

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Atmospheric aerosol particles have a profound impact on Earth's energy balance and consequently on the global climate. Aerosol particles interactions with ambient water vapour largely determine their influence on climate. On one hand, aerosol particles can take up water from the environment which modifies their optical properties directly affecting the global radiative balance. On the other hand, the water affinity of aerosol constituents, together with their dry size, determine the ability of these particles to activate as cloud condensation nuclei (CCN). Therefore, it is necessary to understand how the different aerosol constituents interact with water vapour in the atmosphere to better quantify their effect on climate.

Compared to the inorganic component, usually limited to a few species, the organic component of ambient aerosols may consist of hundreds of species, which contribute substantially to the fine aerosol mass. Unlike inorganic species that exhibit a well characterized hygroscopic behaviour, knowledge on the influence of the water uptake of the organic aerosols remains limited (e.g., Rastak et al., 2017). Furthermore, the hygroscopicity of organic material varies with its oxidation state and ageing (Jimenez et al., 2009). The uncertainty in the hygroscopicity of organic aerosols leads to uncertainties in aerosol indirect and direct forcing that can be of the same order of magnitude of the estimated radiative forcing (e.g., Rastak et al., 2017).

This study investigates the link between the hygroscopic scattering enhancement factor and the aerosol chemical composition with special emphasis on the organic components. A closure exercise using Mie theory is performed in order to confirm the consistency between in-situ measurements and investigate the specific role of the different organic aerosols (i.e. primary, secondary) in the scattering enhancement factor.

References

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