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Effects of relative humidity on aerosol light scattering: Results from different European sites

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Atmospheric aerosol particles change in size due to water uptake which is determined by their chemical composition and the ambient relative humidity (RH). As a result also their optical properties - especially the aerosol light scattering - strongly depend on RH. Therefore, long-term measurements of aerosol physical and optical properties are generally recommended at dry conditions in order to keep measurements comparable (e.g. RH < 30 - 40%). However, for the comparison of such ground-based measurements with other optical aerosol measurements, for the purpose of aerosol correction of satellite retrievals, or for the use in climate models, accurate knowledge of the RH effect is very important.

The key parameter to describe the influence of RH on the aerosol light scattering is the scattering enhancement factor $f(\lambda,\mathrm{RH})$, which is defined as the scattering coefficient $\sigma_{\mathrm{sp}}(\lambda,\mathrm{RH})$ at a certain RH divided by the dry scattering coefficient $\sigma_{\mathrm{sp}}(\lambda,\mathrm{RH}_{\mathrm{dry}})$:

$$f(\mathrm{RH},\lambda) = \frac{\sigma_{\mathrm{sp}}(\mathrm{RH},\lambda)}{\sigma_{\mathrm{sp}}(\mathrm{RH}_{\mathrm{dry}},\lambda)}, \tag{1}$$

where λ denotes the wavelength.

Here, we will present measurement and modeling results of the aerosol scattering enhancement, which are based on our field experiments throughout Europe in the years 2008-2010. During these campaigns different aerosol optical and micro-physical properties were measured in-situ and by various remote sensing techniques (e.g., LIDAR, MAX-DOAS and satellite retrieval), which allowed comprehensive closure studies for the specific sites.

Results will be shown for aerosol found at the high alpine site Jungfraujoch, Switzerland (Fierz-Schmidhauser et al., 2010a), for Arctic aerosol measured at Ny-Ålesund, Spitsbergen (Zieger et al., 2010), for maritime aerosol measured at Mace Head, Ireland (Fierz-Schmidhauser et al., 2010b), and for aerosol typically found at Cabauw, The Netherlands (Zieger et al., 2011) and Melpitz, Germany.

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