Assessment of parameterizations of optical properties and hygroscopic growth of aerosols

A.R. Esteve[1,2], E.J. Highwood[2], W.T. Morgan[3], H. Coe[3], R.G. Grainger[4], P. Brown[5], C.L. Ryder[2], K. Szpek[5] and J.A. Martínez-Lozano[1]

[1]Department of Earth Physics and Thermodynamics, University of Valencia, Burjassot, 46100, Spain
[2]Department of Meteorology, University of Reading, Reading, RG6 6BB, UK
[3]Centre for Atmospheric Science, University of Manchester, Manchester, M13 9PL, UK
[4]Atmospheric, Oceanic and Planetary Physics, University of Oxford, Oxford, OX1 3PU, UK
[5]Observation Based Research, Met Office, Exeter, EX1 3PB, UK
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Presenting author email: Anna.Esteve@uv.es

Atmospheric aerosols affect the Earth's climate both directly, through the scattering and absorption of radiation, and indirectly, via changes to cloud microphysics and properties. In order to estimate the "direct effect", climate models generally require aerosol optical properties such as the extinction coefficient, the single scattering albedo and the asymmetry parameter. And for these, they need to quantify first the spectral refractive index, the size distribution, the influence of relative humidity and the mixing state of atmospheric aerosols. This complexity of the atmospheric aerosols requires synergistic use of models and measurements in order to provide the information needed in climate models.

The Facility for Airborne Atmospheric Measurements (FAAM) BAe-146 aircraft has recently provided a new body of measurements of the chemical composition, microphysical, optical and hygroscopic properties of the atmospheric aerosols (Johnson *et al.*, 2000; Osborne *et al.*, 2007), which allow us to explore the agreement between models and measurements of the aerosol optical properties.

In this work we have used a flexible framework for assessing parameterizations of optical properties and hygroscopic growth of aerosols. We have used this framework to calculate aerosol optical properties at a given relative humidity based on composition, and then we have compared with measured values of the same. For this, we have used data collected by the FAAM BAe-146 aircraft over Western Europe during the EUCAARI-ADIENT project (Kulmala *et al.*, 2009) and over the South East Pacific region during the VOCALS-UK project (Wood *et al.*, 2011).

The methodology used in this work consists in using the measurements of the aerosol composition made by a Time-of-Flight Aerosol Mass Spectrometer (ToF-AMS) and a Single Particle Soot Photometer (SP2) and the measurements of the size distribution made by a Passive Cavity Aerosol Spectrometer probe (PCASP-100x) together with volume weighted mixing rules, best estimates of refractive indices and assumptions about the growth factors of the aerosol components to determine the ambient size distribution and the refractive indices of an internally mixed aerosol at a given relative humidity. The scattering and absorption by the internally mixed aerosol can be then calculated using a Mie scattering code (Wiscombe, 1979). Finally, the resulting scattering and absorption are compared against coincident scattering and absorption measurements from a TSI 3563 integrating nephelometer and a Particle Soot Absorption Photometer (PSAP) (Figure 1).

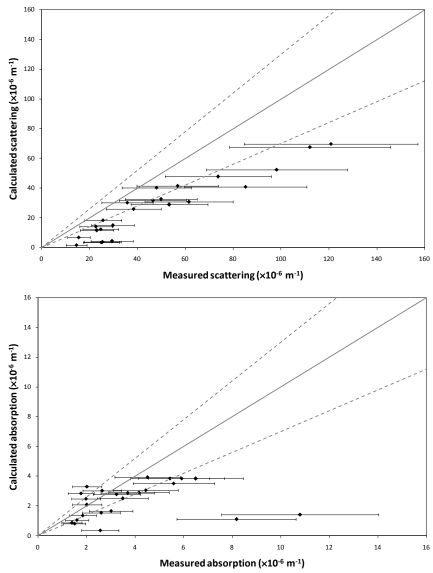

Figure 1. Comparison of modelled and measured scattering and absorption during the EUCAARI-ADIENT project.

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