Aircraft observations: Vertical profiles of aerosol optical and physical properties above NE Spain

M. Ealo[1 2], M. Pandolfi[1], G. Mocnik[3], N. Pérez[1], A. Ripoll[1], X. Querol[1] A. Comerón[4], M. Sicard[4], J. A. Morguí[5] and A. Alastuey[1]

[1]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain.
[2] Department of Astronomy and Meteorology, Faculty of Physics, University of Barcelona, Spain.
[3] Aerosol d.o.o. and Jozef Stefan Institute, Ljubljana, Slovenia.
[4] Dept. of Signal Theory and Communications, Polytechnic University of Catalonia, Barcelona, Spain.
[5] Catalan Institute of Climate Sciences (IC3), Barcelona, Spain.
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Presenting author email: marina.ealo@idaea.csic.es

The abrupt orography surrounding the Western Mediterranean Basin (WMB), which remains under weak pressure gradient conditions during warm season, induces a regional meteorology that favours the recirculation and layering of pollutants affecting air quality and climate. (Rodríguez et al., 2002; Pérez et al 2004).

This study focuses on the characterization of the spatial distribution and vertical stratification of atmospheric aerosols with the aim of reducing uncertainties on aerosol radiative forcing, by mean of providing physical and optical aerosol column observations.

16 vertical profiles were performed by mean of flight airborne measurements during summer period in 2014 and 2015 over northeast of Spain. Aircraft was equipped with nephelometer, aethalometer, condensation counter, optical counter and meteorological instruments. Helicoidal profiles, with a diameter of approximately 750 m, were performed from 600 up to 4000 m.a.s.l. Aircraft observations were supported with columnar measurements (LIDAR at Barcelona site, and ceilometer and sun photometer measurements at Montsec site) and aerosol in situ observations at Barcelona, Montseny and Montsec stations.

Here we present a case study which took place on 16 July 2015. Atmospheric scenario was leaded by anticyclonic conditions over the Iberian Peninsula. The weak pressure gradient gave rise to local and regional atmospheric circulation process resulting in the presence of stratified polluted layers above the Planetary Boundary Layer (PBL).

Aerosol layers were found above the PBL up to approximately 4 km (Fig. 1a). Larger levels of PM_X, scattering and absorption were detected within the three stratified layers (identified by grey background colour). Large scattering angstrom exponent (SAE~1.7-2) and low absorption angstrom exponent (AAE~1) indicated the presence of fine particles of anthropogenic origin. Interestingly, the SSA increased with altitude, leaded by increasing scattering and more constant absorption with altitude, revealing a darker atmosphere at lower levels.

LIDAR vertical profiles (Fig. 1b) confirmed the presence of polluted layers until approximately 4.5 Km. Mean backscatter Ångström exponent (BAE=1.48) and lidar ratio (S_{aer}=66.9 sr) indicated dominance of fine particles.

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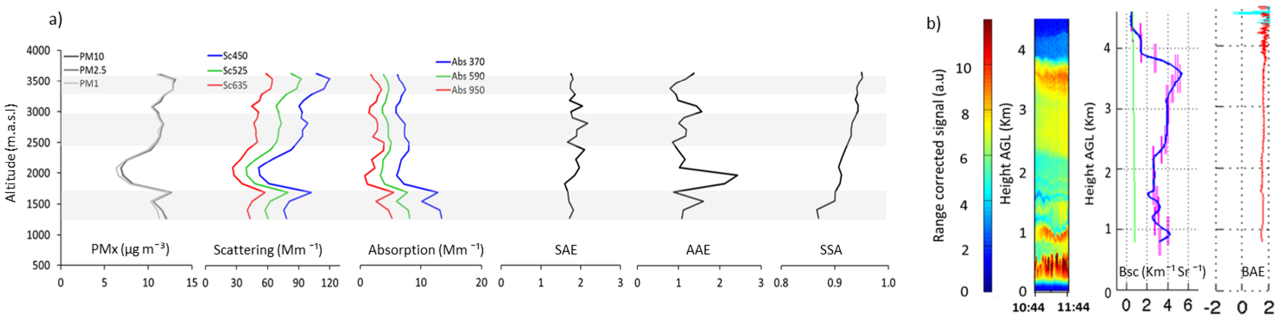

Figure 1. a) Vertical profiles from aircraft measurements of PM_X, Scattering, Absorption, Scattering Ångström Exponent (SAE), Absorption Ångström Exponent (AAE) and Single Scattering Albedo (SSA) on 16/07/2015 during 09:45-10:06 UTC. b) Vertical profiles from LIDAR measurements of range corrected signal, backscatter (Bsc) at 1064 nm and Backscattering angstrom exponent (BAE) at 1064-532 nm during 10:44-11:44 UTC on 16/07/2015.