Nine years of aerosol optical depth measurements over north-central Spain from ground (AERONET-RIMA) and their comparison with satellite (MODIS) observations

Y.S. Bennouna[1], V.E. Cachorro[1], B. Torres[1], R. Rodrigo[1], C. Toledano[1], A. Berjón[2] and A.M. de Frutos[1]
[1]Atmospheric Optics Group (GOA), University of Valladolid (UVA), Valladolid, 47071, Spain
[2]Izaña Atmospheric Research Center, Meteorological State Agency of Spain (AEMET), Santa Cruz de Tenerife, 38071, Spain
Keywords: remote sensing, aerosol, AERONET, MODIS, Aerosol Optical Depth (AOD).
Presenting author email: yasmine@goa.uva.es

The present study establishes the first long-term characterization of aerosol seasonal variability over the northern continental region of the Iberian Peninsula, based on remotely sensed aerosol optical properties, with a focus on the Aerosol Optical Depth (AOD) and Ångström exponent (Alpha) parameters. This work uses direct Sun data from the AERONET-RIMA (Aerosol Robotic NETwork - Iberian Network for Aerosol Measurements) site of Palencia (Spain, 42N, 4.5W). This site can be considered as representative of the background atmospheric conditions of the "Castilla y León" region, and has one of the longest AERONET time series in Europe, starting back in 2003.

In this work, which is similar to that carried out for the AERONET-RIMA site of El Arenosillo (Bennouna et al., 2011), the annual cycle of the two parameters was built for the period 2003-2011, and the interannual variability during the whole period was also examined. The ability of satellite data to reproduce the seasonal patterns and anomalies was investigated using MODIS (Moderate Resolution Imaging Radiometer) aerosol products for Terra and Aqua corresponding to the same period. MODIS instantaneous fields were validated against ground-based sun photometer data, and the differences between monthly values were estimated.

The Palencia site is characterized by a mean daily AOD(440 nm) of 0.15±0.10 and an Alpha(440-870 nm) of 1.25±0.35, thus presenting values typical of a clean continental background. The seasonal pattern correspond to mid-high AOD values during a period starting in mid-spring to the end of the summer (max 0.19), and to a lower AOD during fall and winter months (min 0.09). Although the Alpha parameter is nearly constant throughout de year, the latter shows a slight increase in summer, which is correlated with the high AOD values. This might be explained by the frequent occurrence desert dust intrusions and recirculation processes that have the effect to trap pollutants and aged desert dust aerosols.

When using MODIS data, the overall results for Palencia give a higher AOD(470 nm) with 0.19±0.15 and a much lower Alpha (470-660 nm) of 0.70±0.20. The aforementioned numbers reflect substantial differences, with overestimations of the monthly means that can be almost double those of AERONET in the summer months. However MODIS satisfactorily reproduces the increase-decrease cycle in the AOD. These large differences tend to be more attributed to the aerosol models used in the MODIS algorithm rather than to the sampling difference between ground and satellite in this season. Despite the poor sampling in winter and the small AOD (<0.1) observed over the area, the best agreement between satellite and ground is found during this period. The seasonal pattern of the Ångström exponent derived from MODIS was found to be very different from that of AERONET, the former showing apparently no consistency with the latter. Given the aforementioned results and the fact that the AERONET Alpha value for 470-660 nm is 1.41±0.37 (wavelengths used in the comparison with MODIS), we can conclude that the Alpha derived from MODIS is not representative of the aerosol type characterizing this region of the globe.

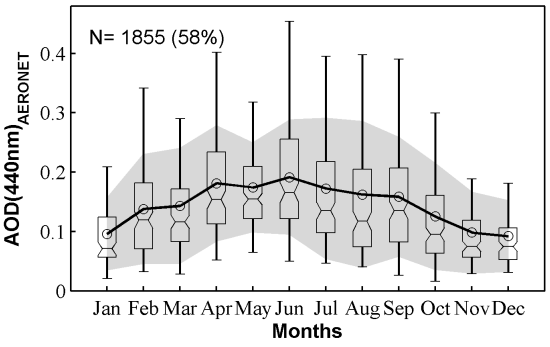

Figure 1: Monthly statistics of the daily AERONET AOD (440 nm) for 2003-2011. N is the total number of days with measurements.

Financial supports from the Spanish MICIIN (projects of ref. CGL2008-05939-CO3-01/CLI, CGL 2009-09740, and "Acción Complementaria" CGL2010-09480-E and CGL2011-13085-E), and from the Environmental Council of the CyL Regional Government (Consejería de Medio Ambiente, Junta de Castilla y León) are gratefully acknowledged.

Bennouna, Y. S., Cachorro, V. E., Toledano, C., Berjón, A., Prats, N., Fuertes, D., Gonzalez, R., Rodrigo, R., Torres, B., de Frutos, A., (2011) Comparison of atmospheric aerosol climatologies over southwestern Spain derived from AERONET and MODIS. *Remote Sensing of Environment* **115**, 1272–1284.