Relationship between ground-based remote sensing and in situ aerosols measurements: a 13-month study

EAC 2021 European Aerosol Conference
30 August - 3 September 2021

J. Blanco, C. Blanco-Alegre, A.I. Calvo, F. Oduber, A. Castro and R. Fraile
Department of Physics, IMARENAB University of León, 24071 León, Spain

Keywords: AERONET, AOT, asymmetry parameter, SSA.

Presenting author email: *cblaa@unileon.es*

INTRODUCTION

Atmospheric aerosols influence the radiative budget of the Earth-Atmosphere system, playing an important role in climate. Furthermore, they cause and/or exacerbate health problems. Several methods have been developed for monitoring atmospheric aerosols in order to estimate and reduce their impacts. Ground-based remote sensing and in situ aerosols measurements are complementary tools in the search for a link between aerosol properties and climate change. Aerosol optical properties depend on their chemical composition and mixing state as well as their size and shape (Luoma et al., 2019). The main aim of this study is to analyze the evolution of the aerosol optical properties retrieved from two AERONET sites and explore its relationship with ground-based in situ measurements of aerosol size distribution.

STUDY AREA

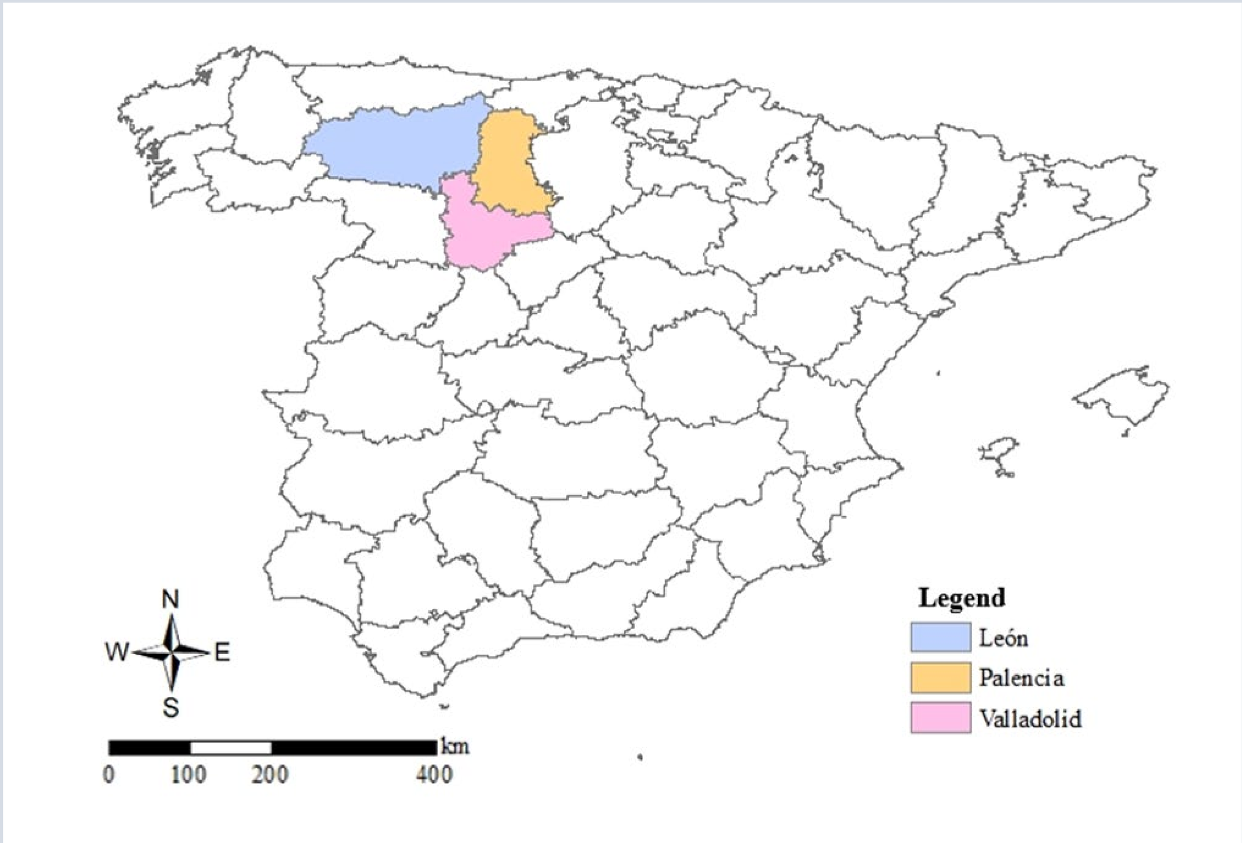


Figure 1. Research locations in Spain.

MATERIAL AND METHODS

Scanning Mobility Particle Sizer spectrometer (TSI-SMPS Model 3938) (14 nm - 1 µm) (Fig. 2a).

Passive Cavity Aerosol Spectrometer Probe (PCASP-X) (0.1 - 10 µm) (Fig. 2b).

a) b)

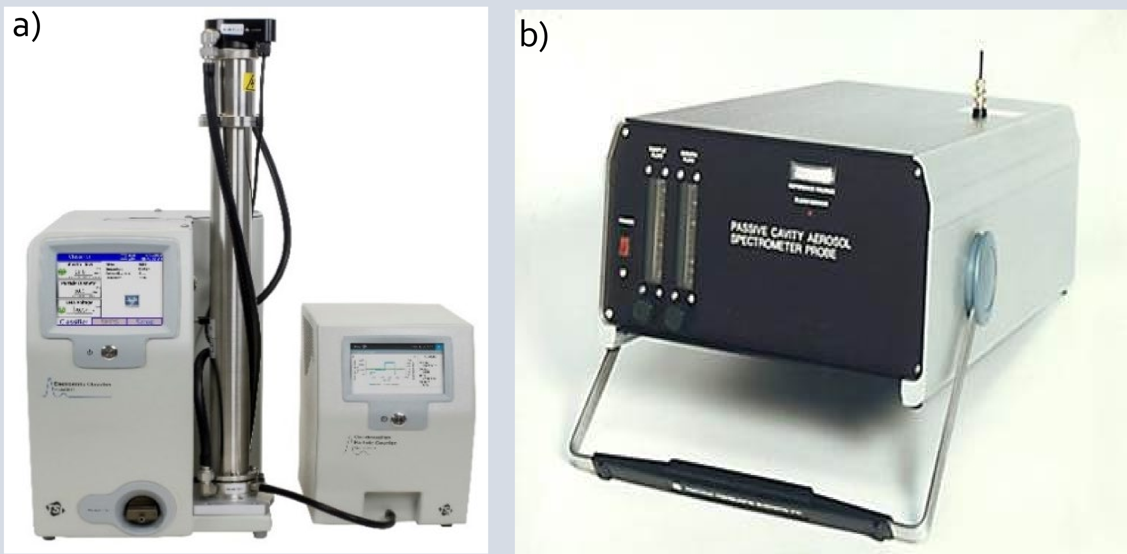


Figure 2. Measuring instruments in León.

AERONET AEROSOL ROBOTIC NETWORK

SSA and *g* do not register important variations throughout the seasons. However, *AOT*, that depends on aerosols concentration, shows a greater seasonal variation (Table 1).

Table 1. Seasonal optical parameters registered in Valladolid and Palencia.

	Valladolid			Palencia		
	g	AOT	SSA	g	AOT	SSA
Winter16	0.65	0.066	0.89	0.63	0.045	0.81
Spring	0.63	0.040	0.93	0.63	0.041	0.84
Summer	0.63	0.062	0.96	0.63	0.070	0.87
Autumn	0.63	0.034	0.90	0.65	0.029	0.85
Winter17	0.63	0.086	0.91	0.64	0.078	0.83
Mean	0.63	0.057	0.92	0.64	0.056	0.84

All optical parameters showed significant correlations with the number of particles by modes: *SSA* with the coarse mode (positive correlation), *AOT* with the accumulation mode (positive) and *g* with the nucleation mode (negative).

PARTICLES

León

- Nucleation mode <30 nm
- Aitken mode 30 – 100 nm
- Accumulation mode 100 – 1000 nm
- Coarse mode >1000 nm

OPTICAL PARAMETERS

Valladolid and Palencia

- Aerosol Optical Thickness - AOT
- Single Scattering Albedo - SSA
- Asymmetry parameter- g

February 2016 → March 2017

RESULTS

a)

b)

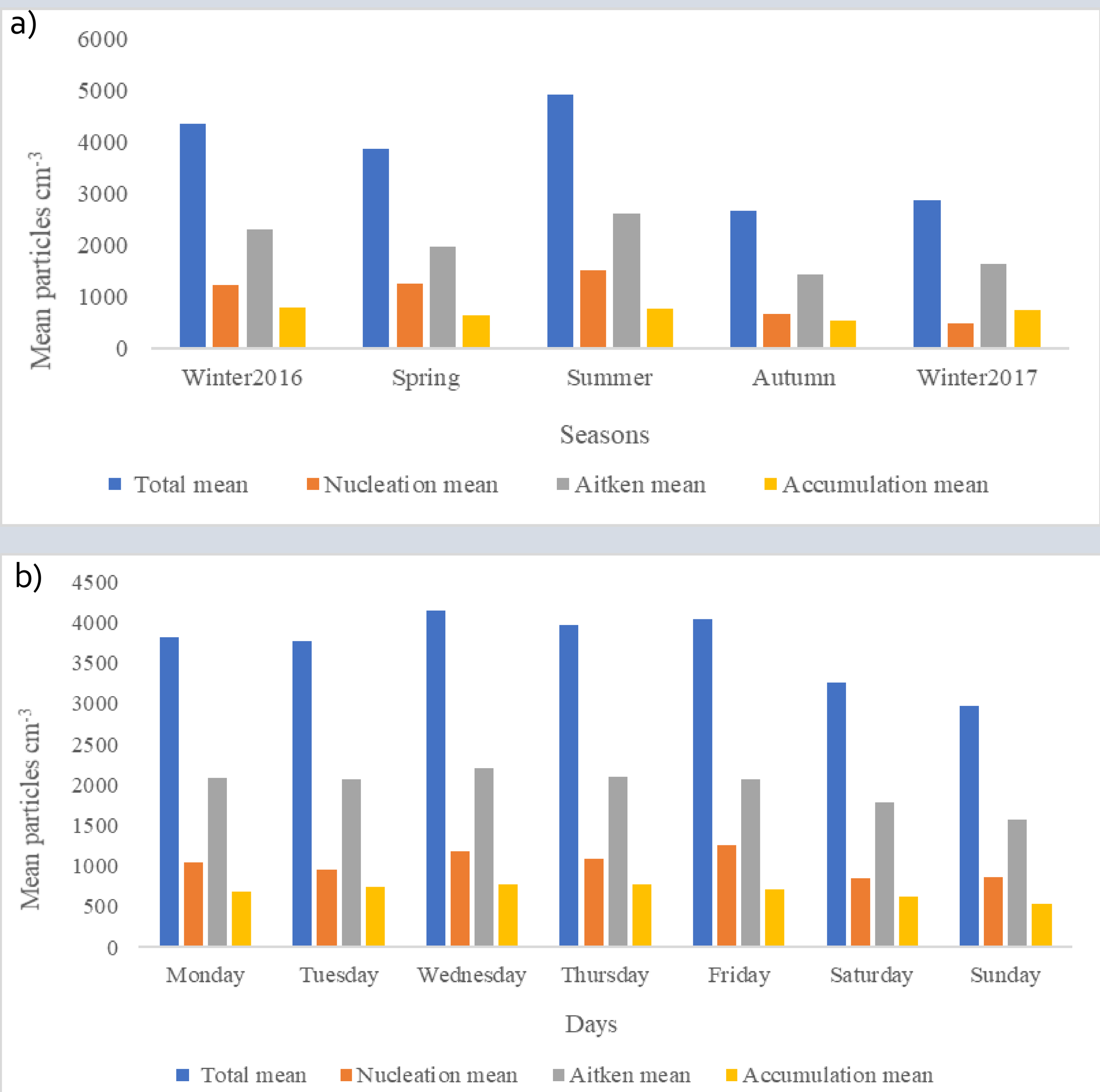
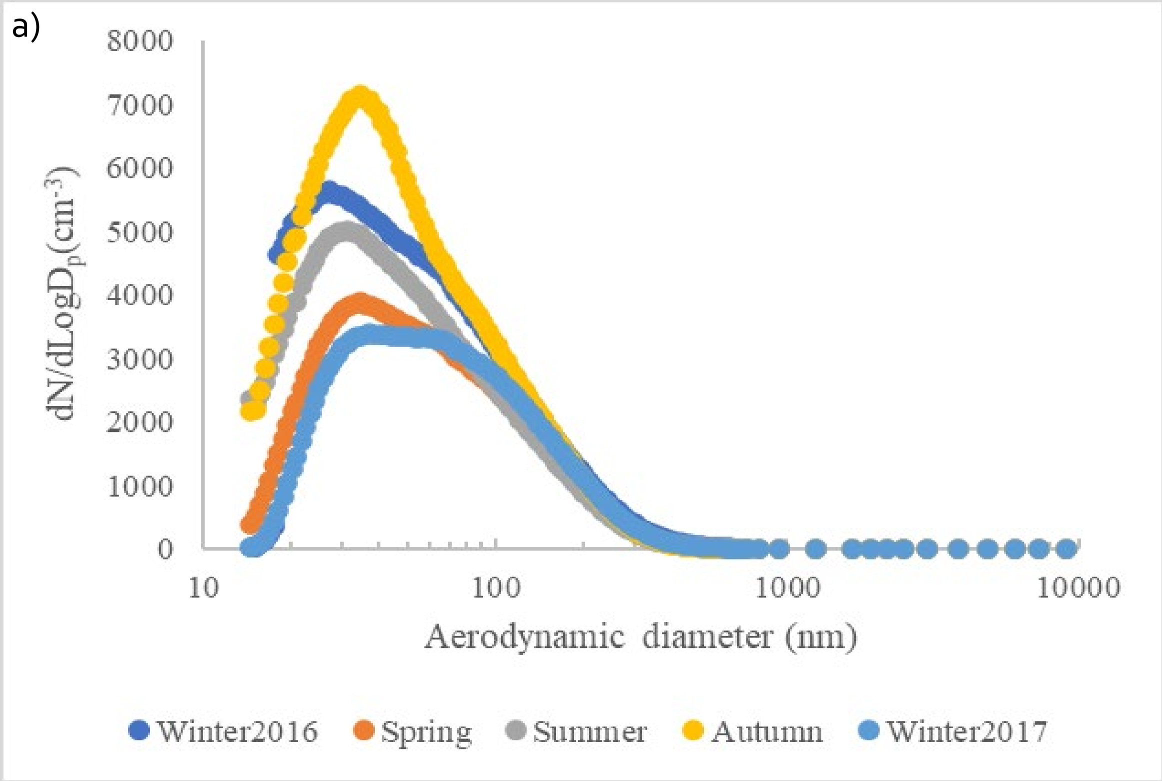


Figure 3. Evolution of: a) particle number concentration by modes and seasons; b) particle number concentration by modes and days in León.

- The number of particles is higher in summer, mainly due to new particle formation (NPF) events (Figure 3).
- In winter time vehicles and heating devices are the main aerosol sources (Oduber et al., 2021b).
- Regarding the days of the week, the concentration of particles is higher during working days, probably due to work activity.

a)



b)

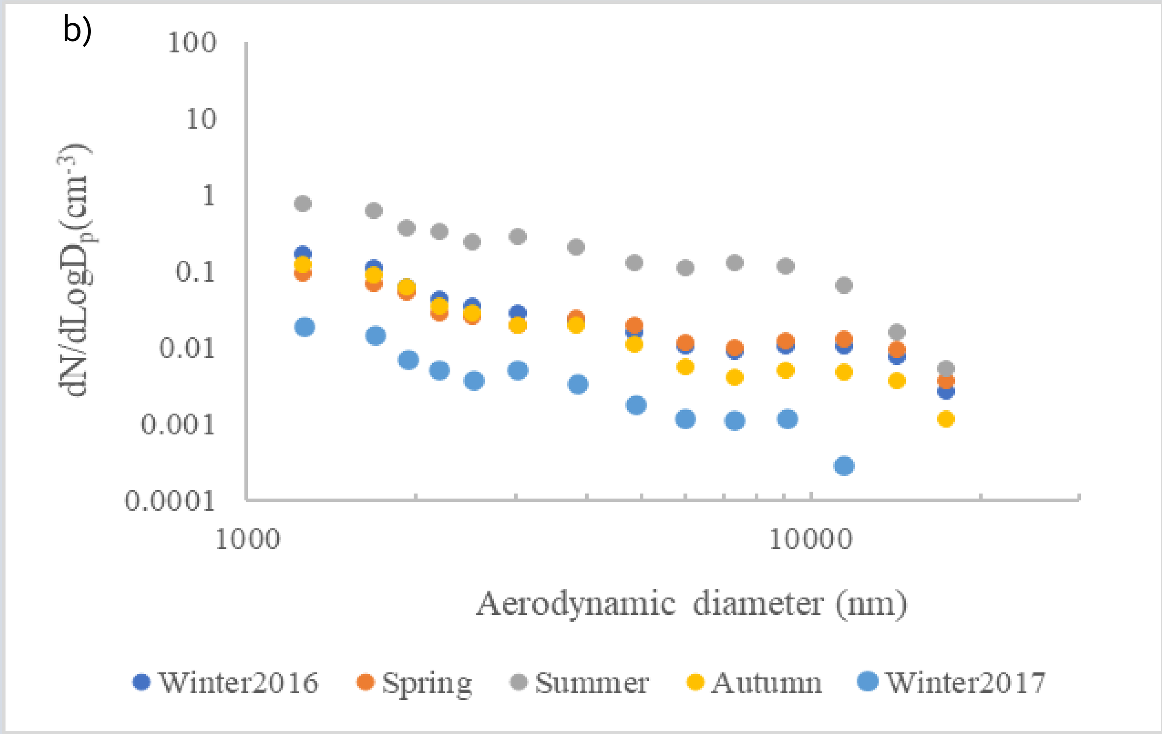


Figure 4. Aerosol particle size distribution during seasons between; a) 14-1000 nm b) higher than 1000 nm.

- The highest values were registered between 20 and 60 nm, mainly during summer, with an important contribution of NPF events (Fig. 4a).
- For particles larger than 1000 nm, the highest values were registered in summer and spring, probably due to the occurrence of Saharan intrusions (Fig. 4b).

CONCLUSION

The highest particle concentrations occurred during summer were due to the greater photochemical activity; during working days, to working activity and traffic associated. The optical parameters *g* and *SSA* , mainly dependent on the type of aerosol present, showed stable values throughout all seasons. However, *AOT*, more dependent on the concentration of particles, showed seasonal variations due to both work activity and the use of fuels.

References

- Luoma, K., Virkkula, A., Aalto, P., Petäjä, T., Kulmala, M. Over a 10-year record of aerosol optical properties at SMEAR II. Atmos. Chem. Phys. 19 (2019) 11363–11382. doi:10.5194/acp-19-11363-2019
- Oduber, F., Calvo, A. I., Castro, A., Blanco-Alegre, C., Alves, C., Calzolai, G., Nava, S., Lucarelli, F., Nunes, T., Barata, J. and Fraile, R. (2021b) "Characterization of aerosol sources in León (Spain) using Positive Matrix Factorization and weather types", Science of the Total Environment, 754. doi:10.1016/j.scitotenv.2020.142045.

Acknowledgements

The sampling campaign was partially supported by the Spanish Ministry of Science, Innovation and Universities (Grant RTI2018-098189-B-I00), the University of León (Programa Propio 2015/00054/001 and 2018/00203/001), the AEROHEALTH project (Ministry of Science and Innovation, Grant PID2019-106164RB-I00, co-financed with European FEDER funds) and the Junta de Castilla y León co-financed with European FEDER funds (Grant LE025P20). C. del Blanco Alegre acknowledge the grant FPU16/05764 from the Spanish Ministry of Education. Authors thank to Ministry of Science, Innovation and Universities of Spain for the support through the research project with reference DPI2017-89840-R. We thank AERONET network and specially Victoria E. Cachorro Revilla and Carlos Toledano for establishing and maintaining the Valladolid and Palencia AERONET site used in this investigation.