

CHARACTERISATION OF THE WET AND DRY ATMOSPHERIC DEPOSITION OVER LEÓN - NW SPAIN

C. Gonçalves¹, E.D. Vicente², C. Alonso-Rodríguez¹, P. Rodríguez-Rodríguez¹, C. Blanco-Alegre¹, L.B. Osa-Akara¹, A.I. Calvo¹, A. Rodríguez-Fernández³, A. Sánchez de la Campa⁴, M. Cerqueira² and R. Fraile¹

¹Department of Physics, Universidad de León, Campus de Vegazana, 24071, León, Spain;

²Department of Environment and Planning, Centre for Environmental and Marine Studies, University of Aveiro, 3810-193, Aveiro, Portugal;

³Department of Biodiversity and Environmental Management, Universidad de León, León, Spain;

⁴Centre for Research in Sustainable Chemistry, University of Huelva, Huelva, E21071, Spain.



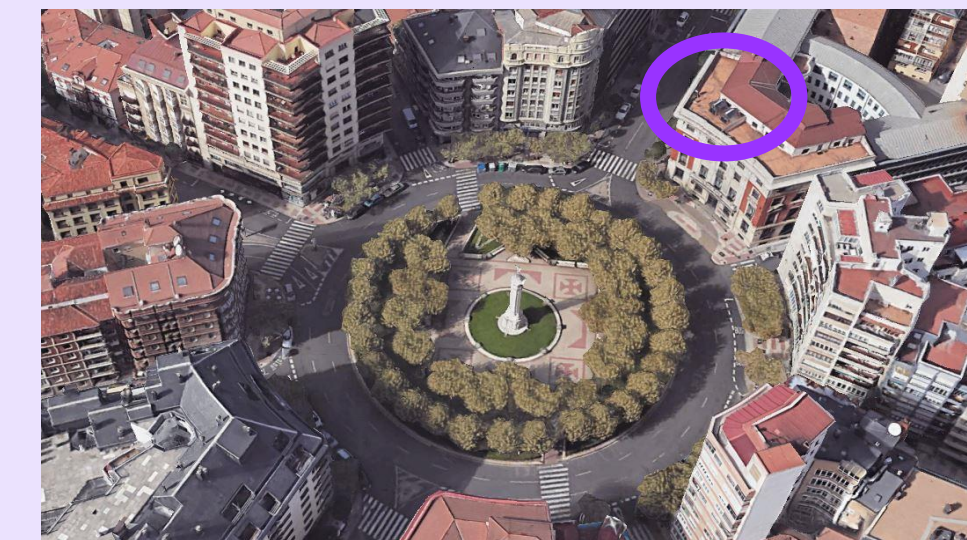
INTRODUCTION

Aerosol atmospheric deposition is the ultimate path by which particles and trace gases are removed from the atmosphere. This process can occur through precipitation scavenging (wet deposition), or by direct sedimentation during periods without rain (dry deposition). The chemical composition of the wet and dry deposition can offer insights into local pollutant emission sources, and also the effects of emissions transported over long distances (like those from Saharan dust intrusions or forest fires events). Based on a long monitoring campaign, the goal of this research is to characterise atmospheric particulate matter deposition in León city.

MATERIAL AND METHODS

Sampling campaign

Sampling was carried out in León city. Two sampling sites with different characteristics were selected. The sampling took place simultaneously at the two places (for most of the campaign time). Daily rainwater samples were collected between January 2022 and May 2023. The dry deposition samples were collected during the same period, on a weekly basis.

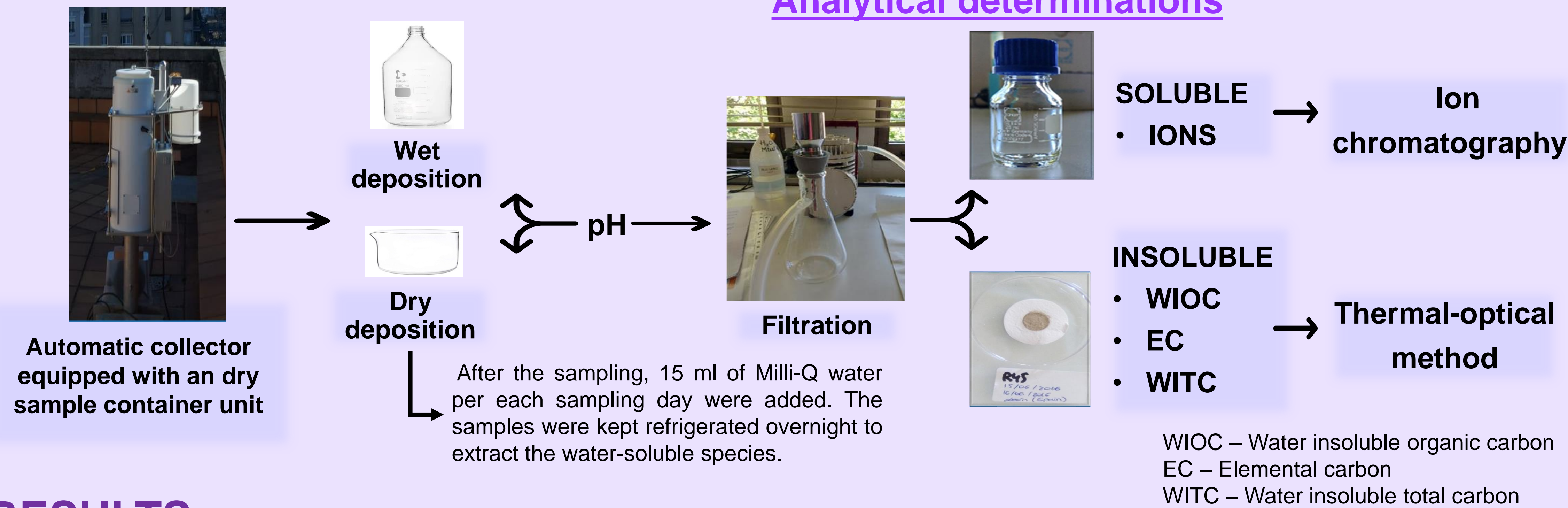


Roadside
The top of a public building located in downtown León (20 m above street level).

Urban background
The top of the Faculty Veterinary Medicine building at the University of León (12 m above street level).

Site	Sampling period	Days with precipitation	Days without precipitation	Total amount of precipitation (mm)	Mean daily precipitation (mm/day)	Range (mm)
Roadside	01/2022 – 05/2023	126	390	617	4.9	0.25 - 32.25
Urban background		175	341	796	4.6	0.25 - 42.21

Analytical determinations



Volume-weighted mean precipitation concentrations (VWM)

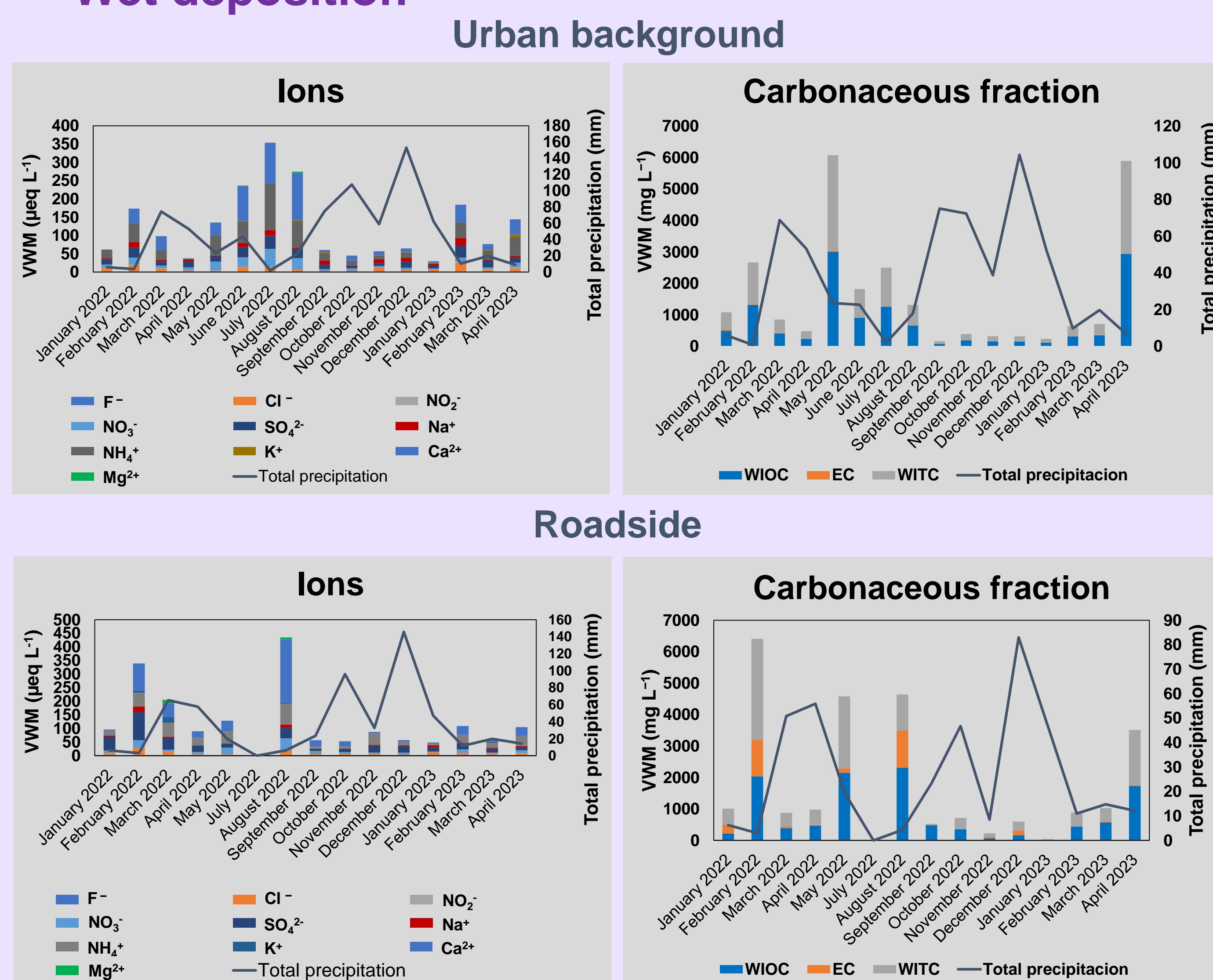
Monthly VWM concentration was calculated following equation:

$$VWM = \frac{\sum_{i=1}^N C_i P_i}{\sum_{i=1}^N P_i}$$

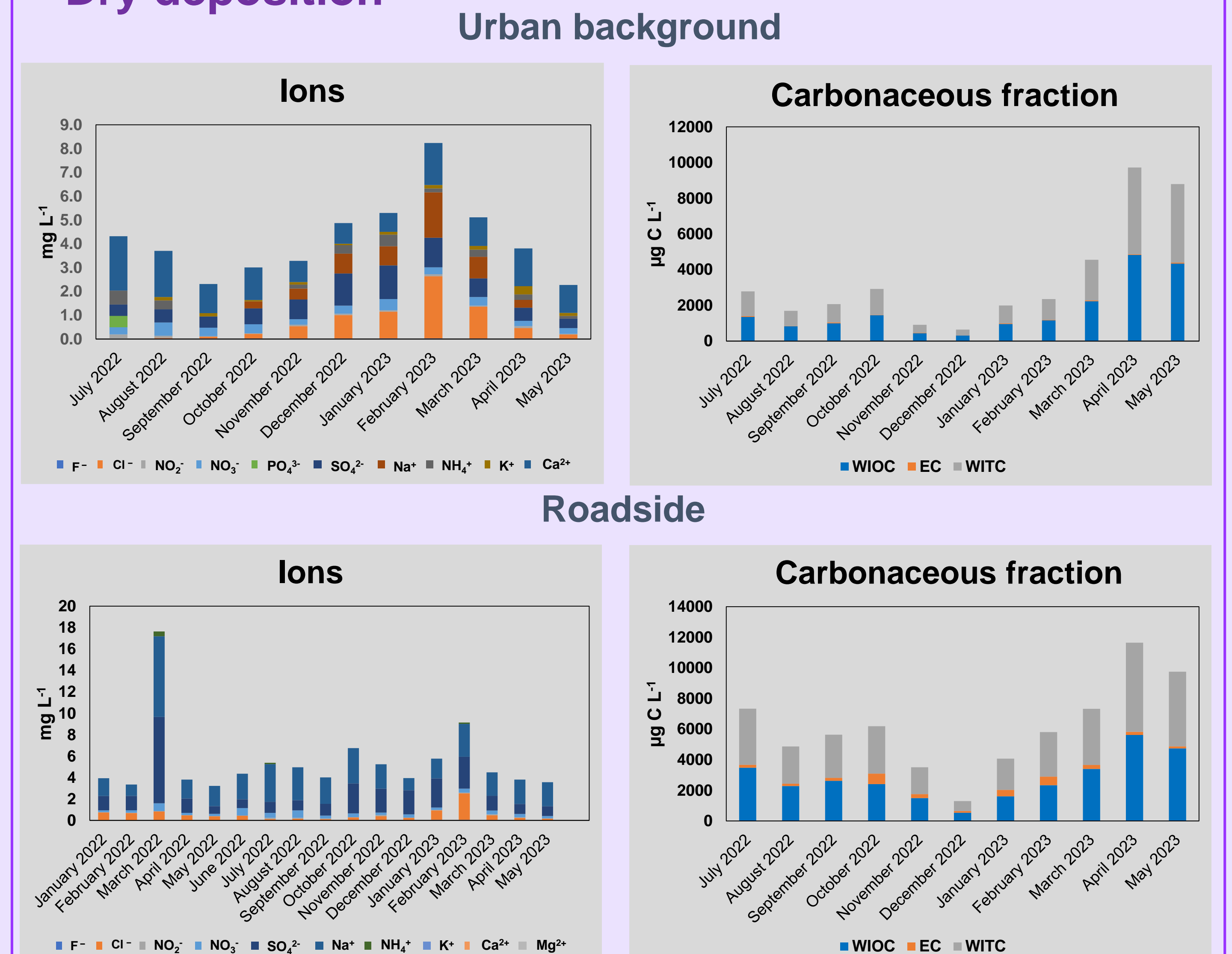
where, C_i is the concentration of each species in $\mu\text{eq L}^{-1}$ (ions) and in mg L^{-1} (for carbonaceous fraction), P_i the precipitation amount for each precipitation event in mm, and N the total number of precipitation events in each study period.

RESULTS

Wet deposition



Dry deposition



CONCLUSIONS

- No acid rain problems have been detected, since the pH varies between 5.2 and 7.9 (the average value was 6.5 ± 0.5 and 6.4 ± 0.6 for Urban background and Roadside, respectively). The pH in dry deposition shows average values of 6.5 ± 0.4 and 6.7 ± 0.3 for Urban background and Roadside, respectively.
- NH_4^+ , Ca^{2+} , SO_4^{2-} and NO_3^- were the dominant ions in precipitation samples at both sampling sites, in two different periods (summer months and February of 2022/2023). The abundance of these species to the mass composition of precipitation can be related with the contribution of dust outbreaks and/or anthropogenic sources. This trend is connected to the low levels of precipitation observed during these periods.
- Regarding the carbonaceous fraction concentrations in precipitation, the EC was found to be a minor contributor to total particulate carbon in both wet and dry deposition. A temporal variation was observed for the particulate carbon fractions: the WIOC concentrations were lower in the autumn and winter months (from September to February), which was related to the dilution effect of autumn/winter precipitations. The EC concentrations were higher in winter and spring, in the Roadside, especially with regard to dry deposition, which reflects the incomplete burning of fossil fuels and the use of heating devices.

ACKNOWLEDGEMENTS: This work was partially supported by the Junta de Castilla y León co-financed with European FEDER funds (Grant LE025P20). Furthermore, it is part of the project TED2021-132292B-I00, funded by MCIN/AEI/10.13039/501100011033 and by the European Union "NextGenerationEU"/PRTR.

