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INTRODUCTION

The Saharan dust system, considered the largest in the world, transports billions of tons of dust annually, most of which settles over the Atlantic ocean. However, the Mediterranean basin is also frequently affected.

In terms of frequency, the winter months experience the least activity (Merjdi *et al.*, 2023). Nevertheless, from March 14 to 16, 2022 a significant increase in PM₁₀ concentration was reported across the Iberian Peninsula due to the combination of two atmospheric phenomena: a high-impact storm in the Gulf of Cádiz region and a cut-off low south of the Peninsula. This led to an unprecedented and extreme outbreak of Saharan dust that affected the Iberian Peninsula.

Based on the lack of studies on winter intrusions in the northwest of Spain and the wide variability of impacts they have on the climate, air quality, ecosystems and human health (Oduber *et al.*, 2019; Pérez-Pastor *et al.*, 2023), an analysis of the synoptic situation and air mass trajectories is essential to determine these impacts and establish future mitigation measures.

AIM OF STUDY

The aim of this study is to assess the influence of the dust intrusion on air quality within the autonomous community of Castilla y León (Spain). For this purpose, an analysis was conducted on the hourly PM₁₀ concentrations recorded in March at the background monitoring stations situated in the nine provincial capitals.

MAIN RESULTS

The study of PM₁₀ evolution during March from 2017 to 2022 reveals an increasing trend in the average monthly concentration of PM₁₀ particles (µg/m³) across the provinces of Castilla y León. In 2022, values ranged from 27% higher in Soria to 82% in Segovia compared to 2017 (shown in the left graphs).

The notable peak observed on March 14, 15, and 16 of 2022 aligns with the intrusion of sub-Saharan dust into the Iberian Peninsula. On March 15, the daily averages soared to 943, 841, 757, and 702 µg/m³ for the provinces of Segovia, Ávila, Valladolid, and Salamanca respectively (depicted in the right graphs). These values were 15 to 20 times higher than the threshold established in Real Decreto 102/2011, which sets a daily limit of 50 µg/m³ for protection.

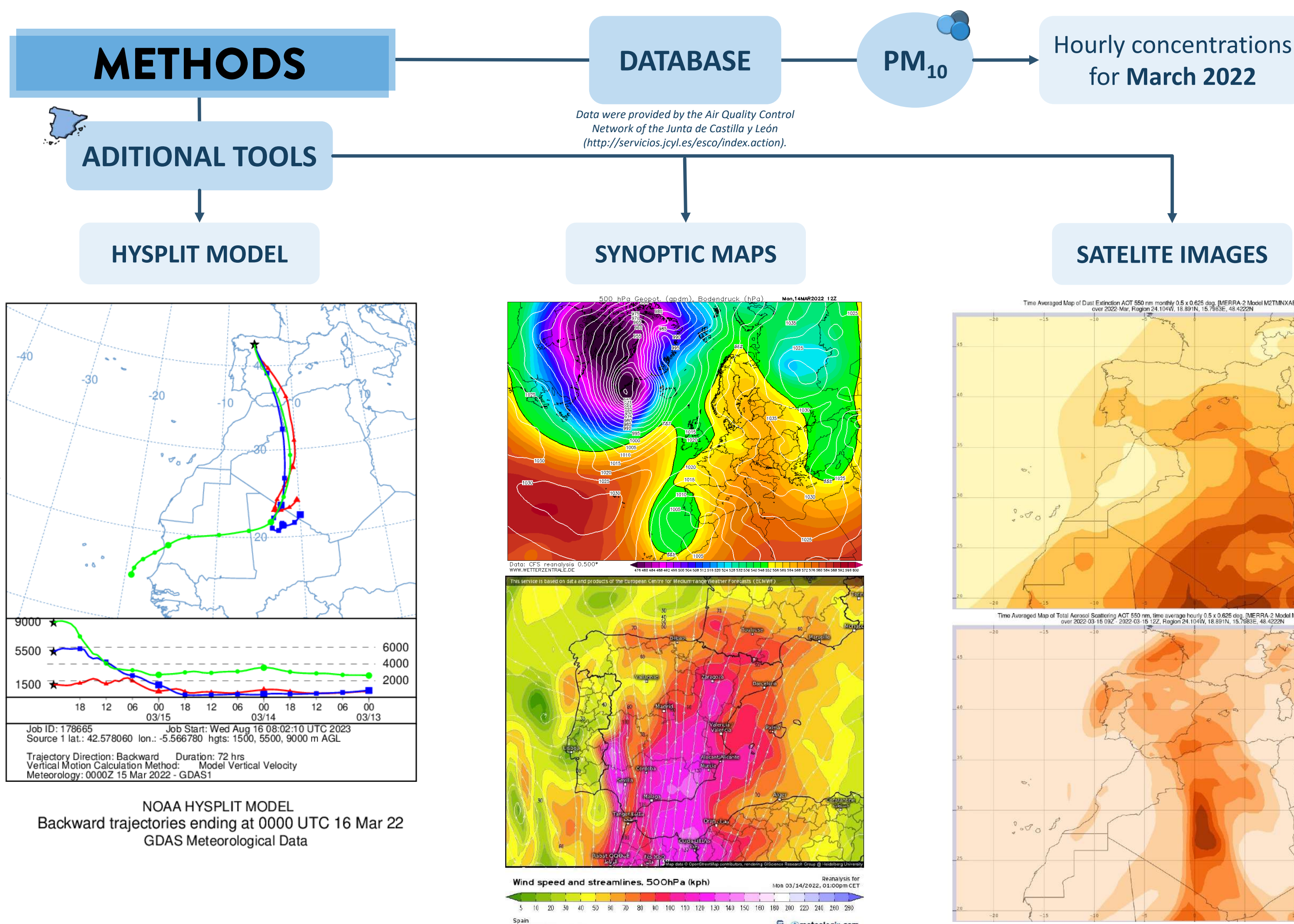
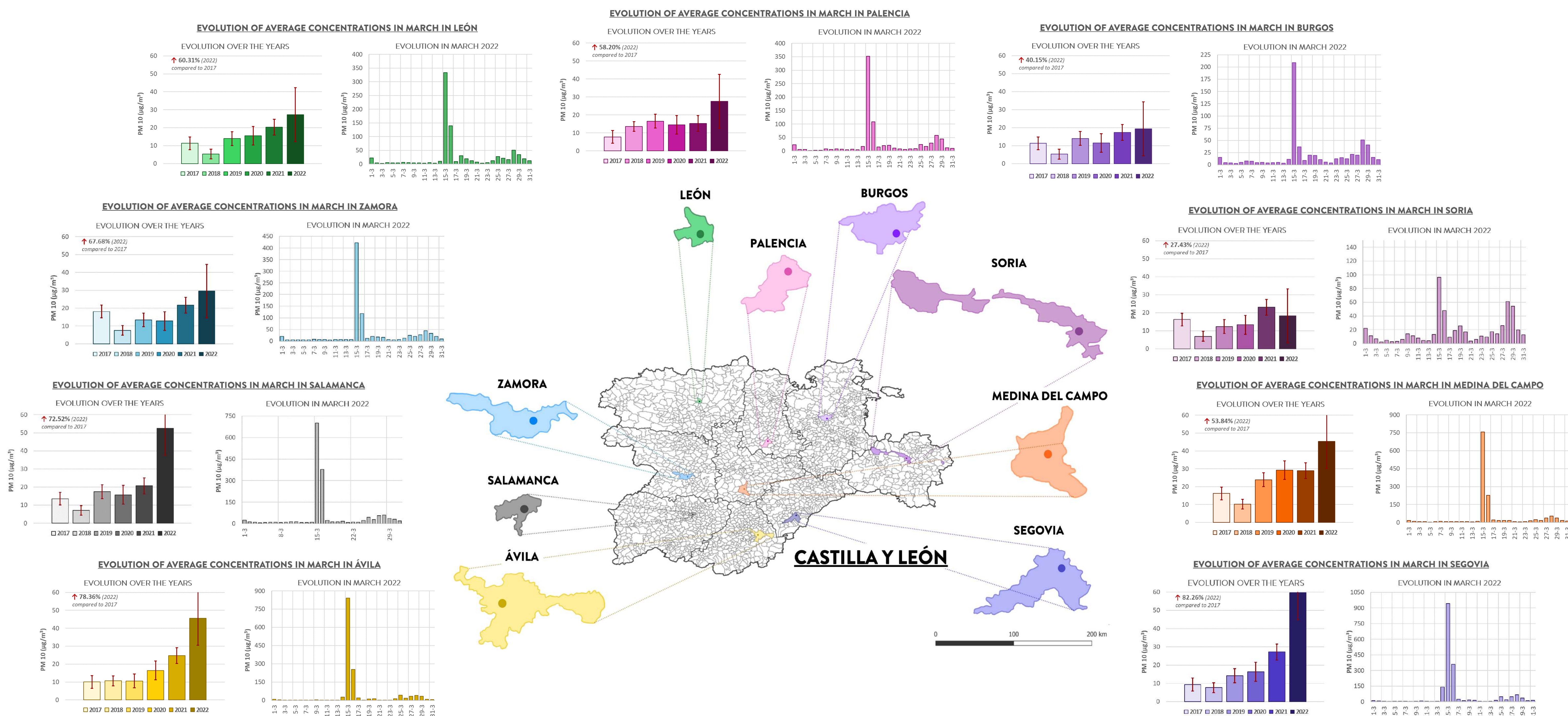


Fig. 1. Back-trajectories obtained at 0000 UTC on March 16, 2022. Calculations for 300, 500 and 850 hPa (9000, 5500 and 1500 m) at León with trajectory of 72 h. Source: HYSPLIT Model, ready.noaa.gov.

Fig. 2. Geopotential maps at 500 hPa obtained at 1200 UTC. Europe (up) and Iberian Peninsula (down). Sources: wetterzentrale.de and meteologix.com based on the European Center for Medium-Range Weather Forecasts (ECMWF).

Fig. 3. Satellite images of the Iberian Peninsula (AOT 550 nm). Dust extinction map for the whole month of March 2022 (up). Map of total aerosol dispersion from 0900 to 1200 UTC on March 15, 2022 (down). Source: MERRA-2, giovanni.gsfc.nasa.gov.



ACKNOWLEDGMENT & REFERENCES

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CONCLUSIONS

- 1) Over the span of five years, PM₁₀ data registered during the months of March in Castilla y León exhibit a significant increase, being 82% higher compared to 2017 in cities such as Segovia.
- 2) The concentration peaks detected in March 2022 are consequence of the intrusion of Saharan desert dust on the 14th.
- 3) The additional tools used have facilitated the confirmation of the origin and behaviour of this intrusion, resulting from a synergy between a high-impact storm in the Gulf of Cádiz region and a cut-off low south of the Peninsula.
- 4) On March 14, 15 and 16, 2022, the PM₁₀ concentrations were nearly 20 times higher than those established by law. The provinces most severely affected include Segovia, Ávila, Valladolid, and Salamanca.