

Black Carbon and Brown Carbon absorption by in-situ filter-based photometer and ground-based sun-photometer in an urban atmosphere

**Supplementary Material**

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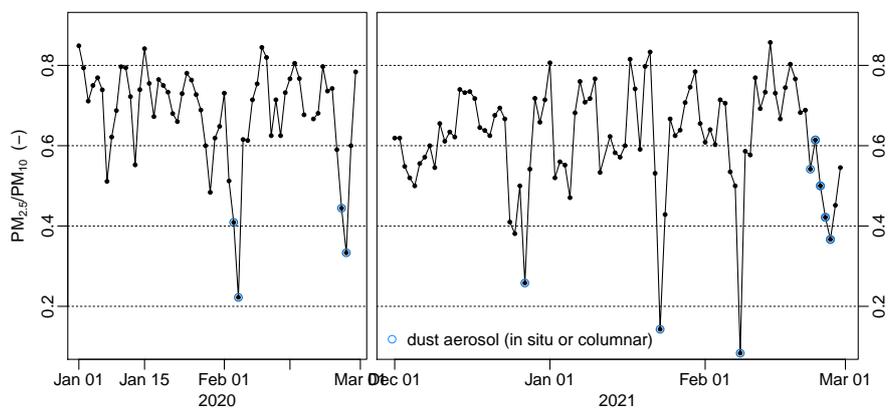


Figure S1: Time series of daily  $PM_{2.5} / PM_{10}$  ratio at the urban background site.

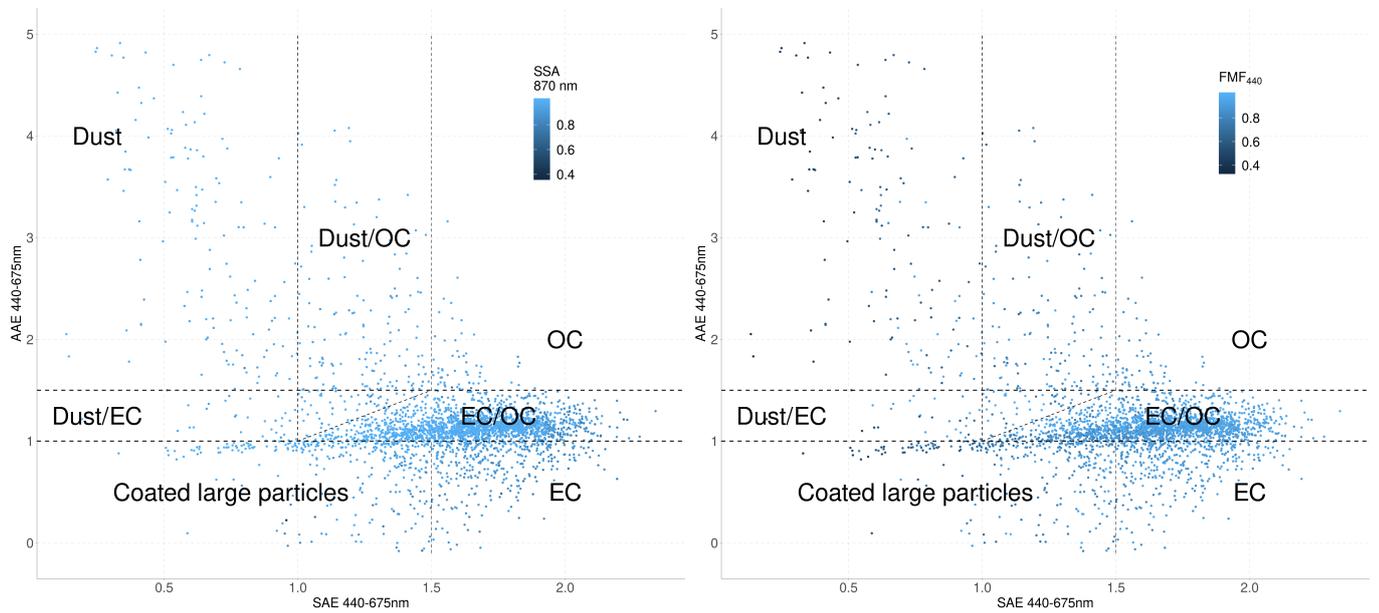


Figure S2: Preliminary classification of AERONET retrievals in Modena (Jan 2016– June 2021) based on Cazorla et al. (2013).

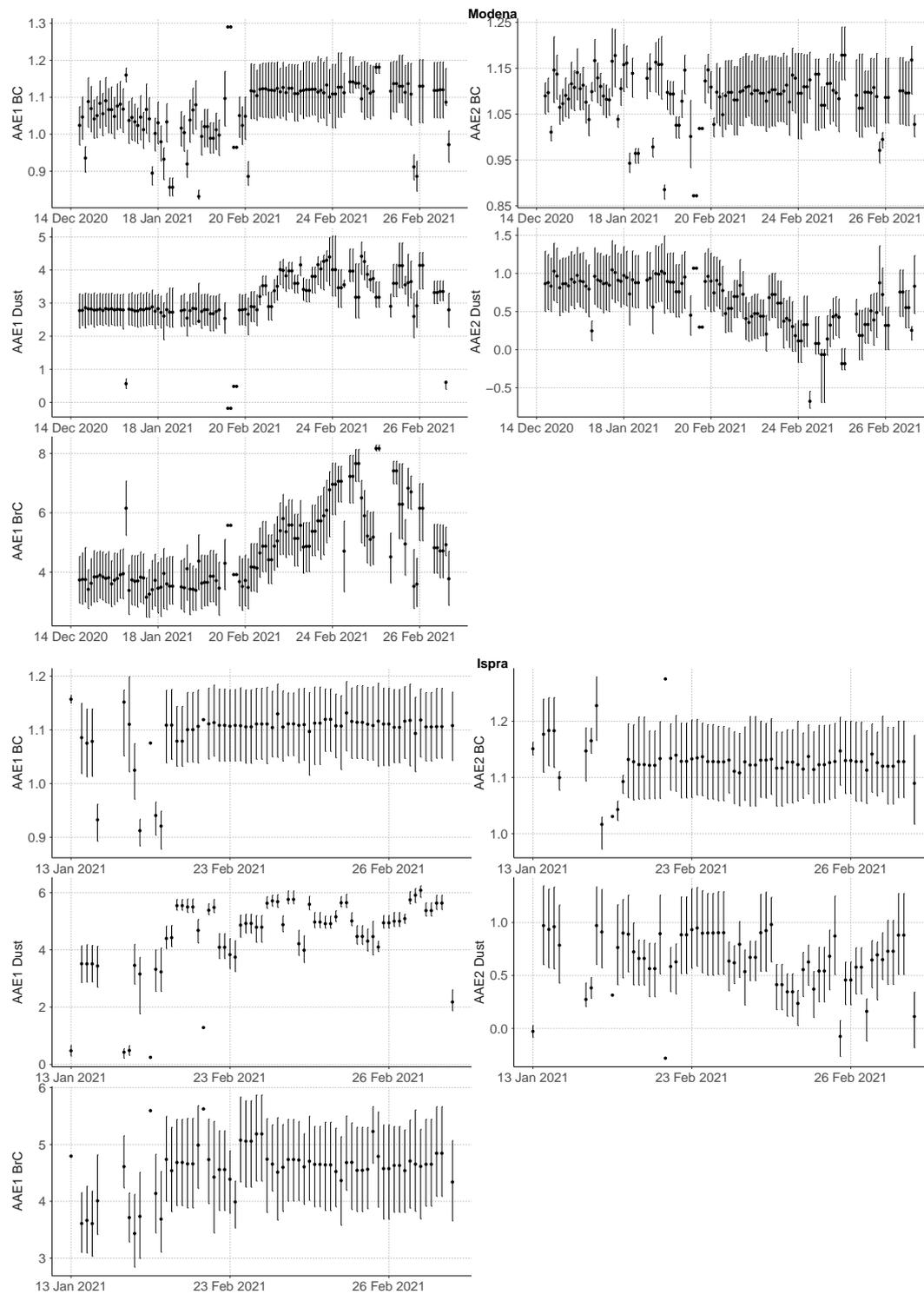


Figure S3: Time series of AAEs resulting from the apportionment of AAOD retrievals in Modena and Ispra. Vertical bars represent the 25th–75th quantile range.

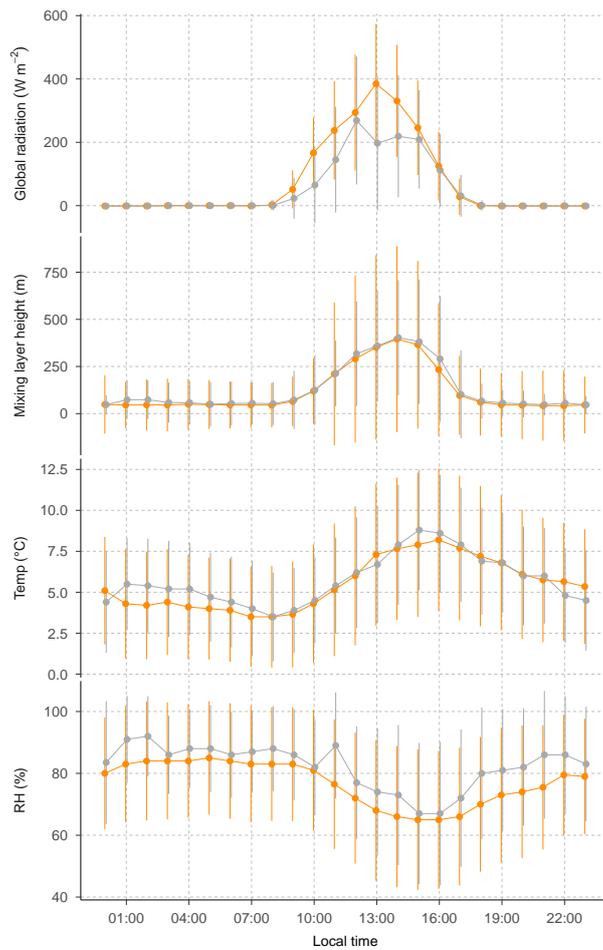


Figure S4: Diurnal pattern for the medians and the interquartile ranges of meteorological variables in winter (DJF) during weekdays and holidays. All variables proceed from an urban meteorological station, besides mixing layer height, provided by ERA5 reanalysis.

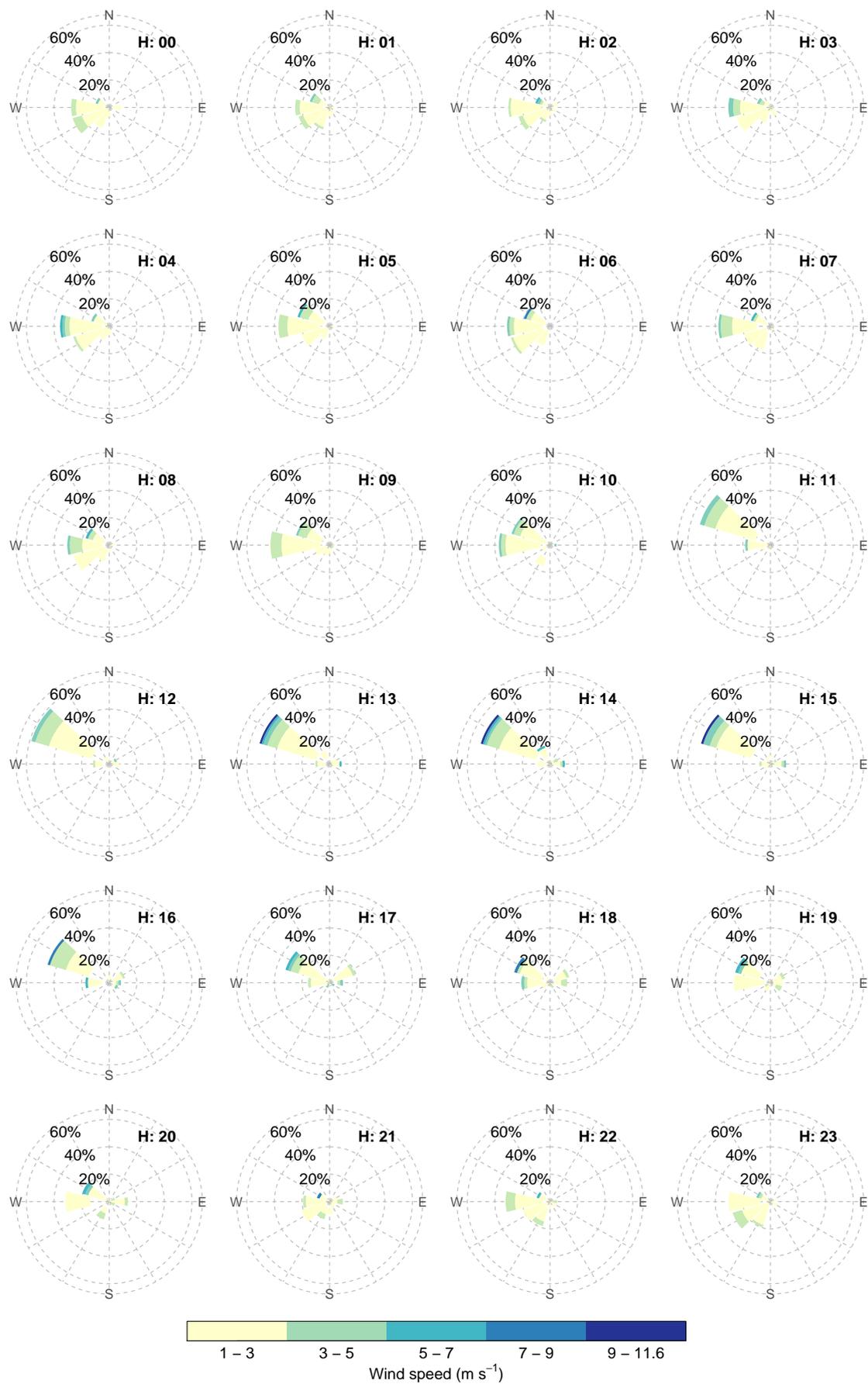


Figure S5: Hourly wind rose (in local time) for Modena during the investigated period

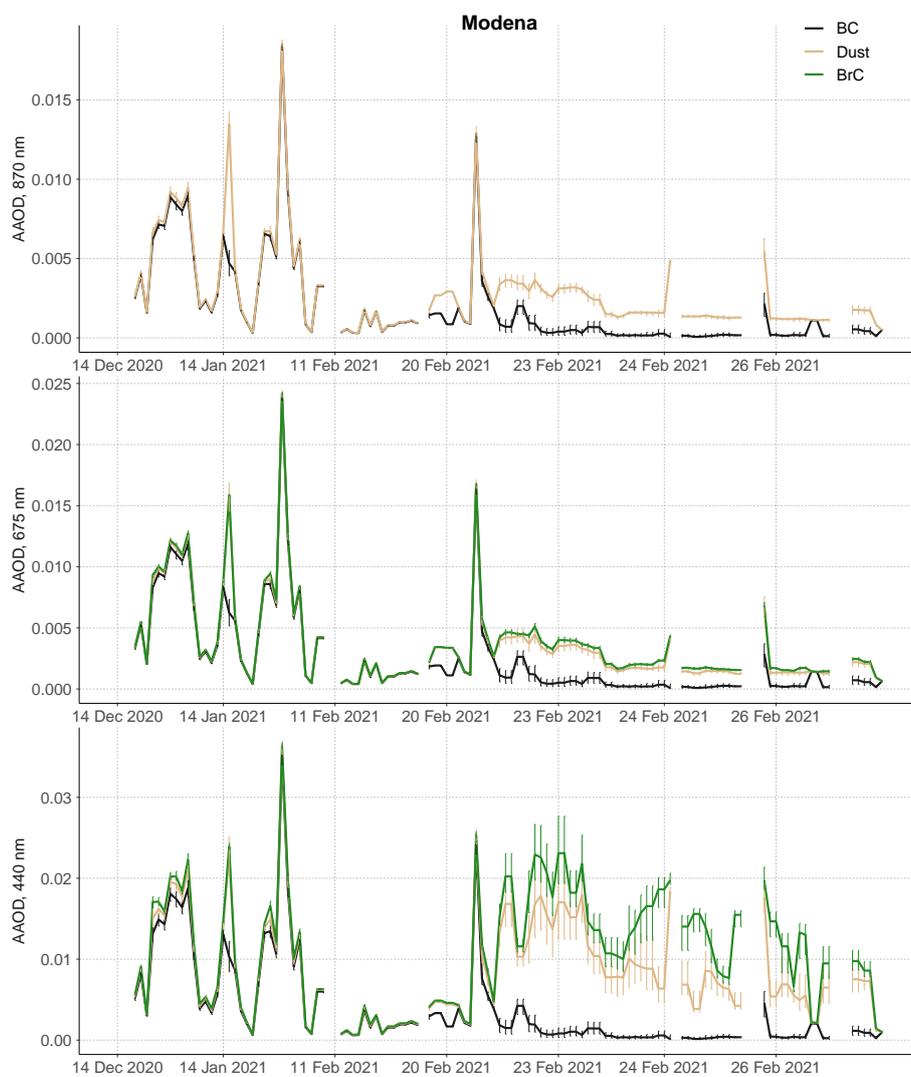


Figure S6: Total AAOD in Modena apportioned to BC, Dust and BrC, represented as stacked lines, based on Bahadur et al. (2012) and tailored AAE estimates: the black line represents the AAOD by BC, the brown line represents the sum of the AAOD by BC and dust, the green line represents the total AAOD with the contribution of BrC summed to the AAOD by BC and dust. For a better readability the scale of the x-axis is fixed and not proportional to time.

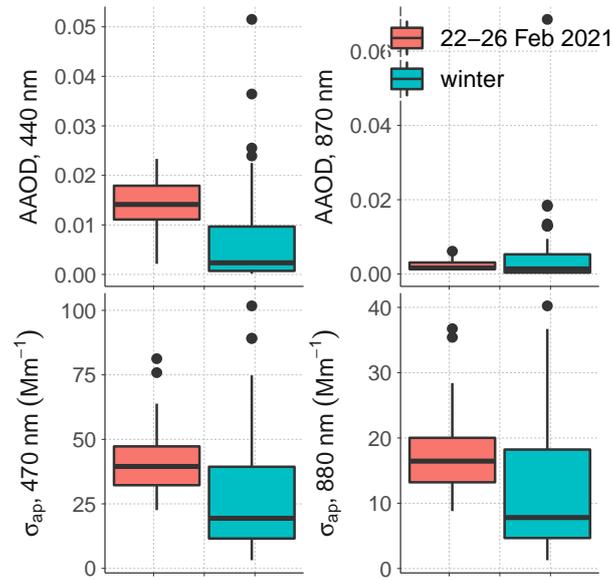


Figure S7: Boxplot of AAOD and  $\sigma_{ap}$  in Blue and IR for the whole winter dataset and for 22–26 Feb 2021 in Modena.

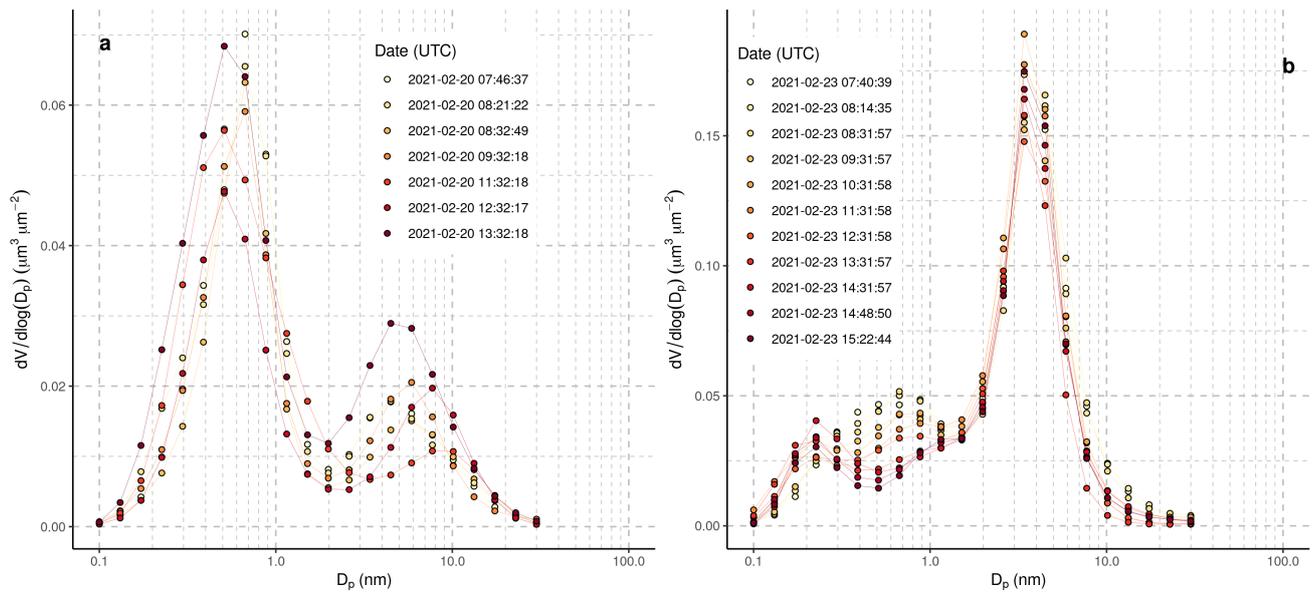


Figure S8: Volume size distribution by AERONET inversion in Modena for Feb 20th 2021 (left) and Feb 23rd 2021 (right).

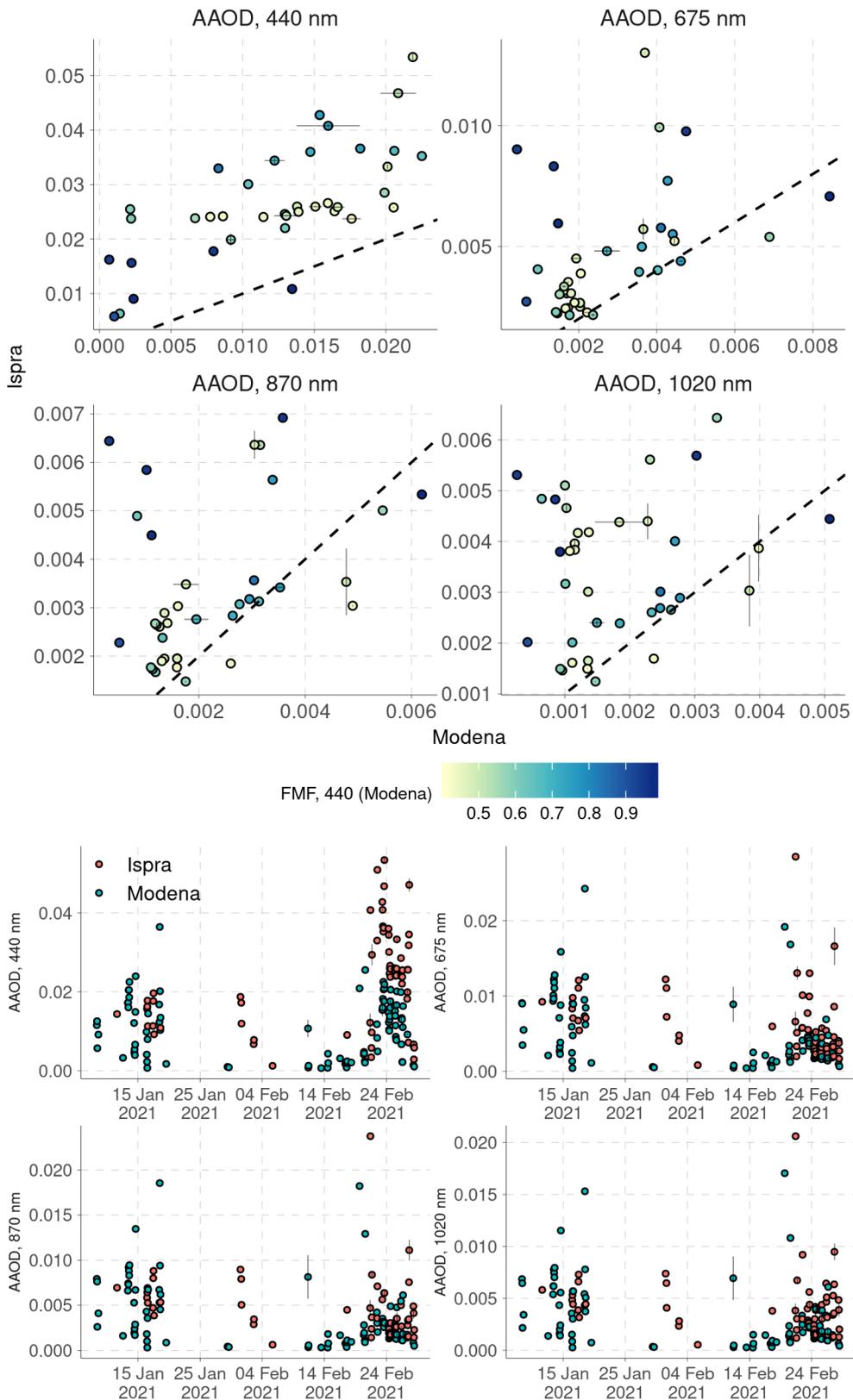


Figure S9: Top panel: comparison of hourly median AAOD retrieved in Modena and Ispra at 4 wavelength during the investigated period, color-coded according to the Fine Mode Fraction (FMF) at 440 nm. Bottom panel: the dashed line indicates the 1:1 line. Lower panel: Timeseries in Modena and Ispra of AAOD during the investigated period. The bars indicate the hourly interquartile range.

## References

- Bahadur, R., Praveen, P. S., Xu, Y., and Ramanathan, V.: Solar absorption by elemental and brown carbon determined from spectral observations, *Proceedings of the National Academy of Sciences*, 109, 17 366–17 371, <https://doi.org/10.1073/pnas.1205910109>, 2012.
- Cazorla, A., Bahadur, R., Suski, K. J., Cahill, J. F., Chand, D., Schmid, B., Ramanathan, V., and Prather, K. A.: Relating aerosol absorption due to soot, organic carbon, and dust to emission sources determined from in-situ chemical measurements, *Atmospheric Chemistry and Physics*, 13, 9337–9350, <https://doi.org/10.5194/acp-13-9337-2013>, 2013.