Supplementary Material

- Theoretical relationship between PM and AOD
- The measurement sites
- AOD grid points
- PM data (OPC and reference)
- RH at overpass times
- Correlation coefficients

Theoretical relationship

$$PM_{2.5} \cong \frac{AOD}{BLH} \frac{4\rho_a r_{eff}}{3\langle Q_{ext,aer} \rangle}$$

- AOD is the Aerosol Optical Depth
- BLH is the Boundary Layer Height
- ρ_a is the average aerosol density
- $r_{eff} = \frac{\int_0^\infty r^3\, n(r) dr}{\int_0^\infty n(r) r^2 dr}$ is the Effective Radius of the Particle Size Distribution (PSD) $n(r)$
- $\langle Q_{ext,aer} \rangle$ is the extinction efficiency of the aerosol averaged through the PSD
- All properties are referred to ambient humidity conditions.

Figure 1S. The two measurements sites at DIFA (Department of Physics and Astronomy of the University of Bologna).
Irnerio (I, left; 44° 29’ 56.764419” N, 11° 21’ 14.033632” E) is inside a courtyard within a high vegetated street.
Berti Pichat (BP, right; 44° 30’ 0.8316" N, 11° 21’ 23.4936” E) is near a high traffic highway.
Reference PM and RH measurements are referred to the ground level.
The low-cost OPCs were employed at different heights:

I1: ground level (5 m)
I2: rooftop (22 m)

BP1: ground level (3 m)
BP2: first floor (6 m)
BP3: rooftop (18 m)

Figure 2S. MAIAC grid center points related to measurement sites.
For both sites, we consider the nearest grid centre point to select the corresponding AOD value. Irnerio and Berti Pichat sites are 460 and 440 m apart from their respective grid centers. Irnerio and Berti Pichat sites also are 235 m apart from each other. We chose to take the average AOD from the two cells to have a more representative AOD value.

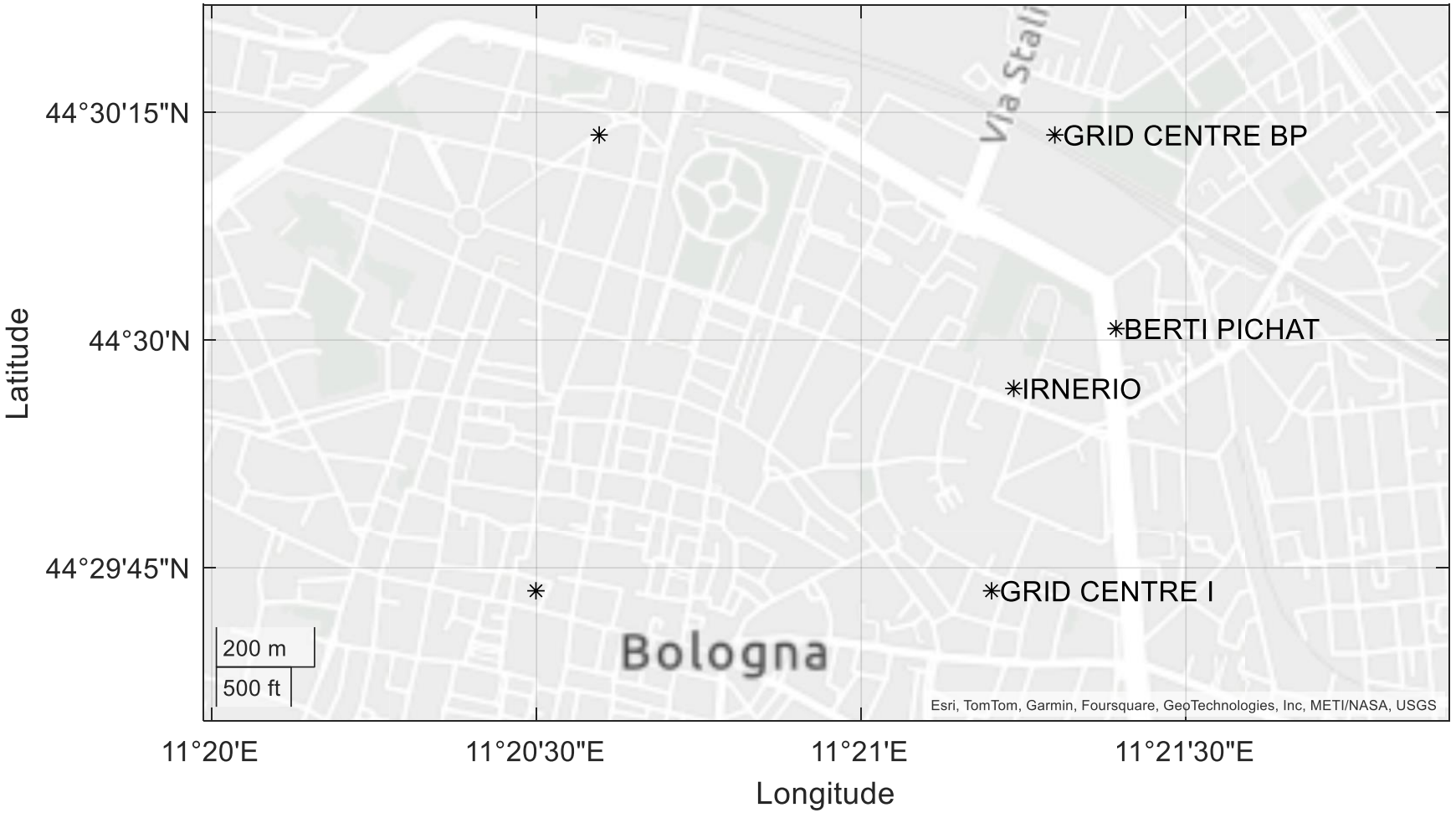


Figure 3aS. Hourly PM2.5 from low-cost OPCs compared to reference daily PM2.5. Hourly RH from reference instruments is also shown in red. Highligthed areas refer to precipitation events.

OPC data is highly affected by ambient humidity. In the case of low-cost sensors, precipitation events and local factors can affect the measurements.

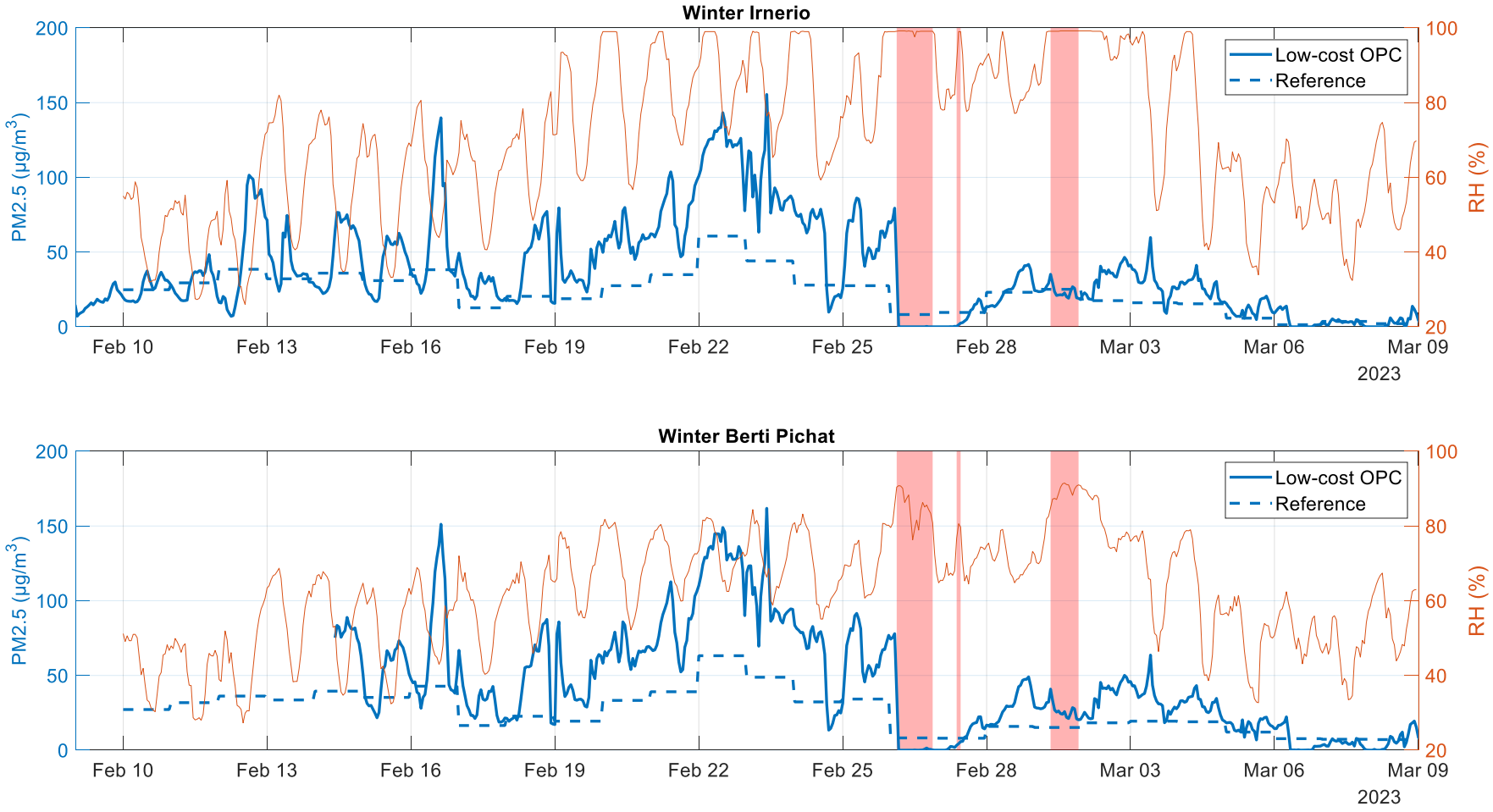
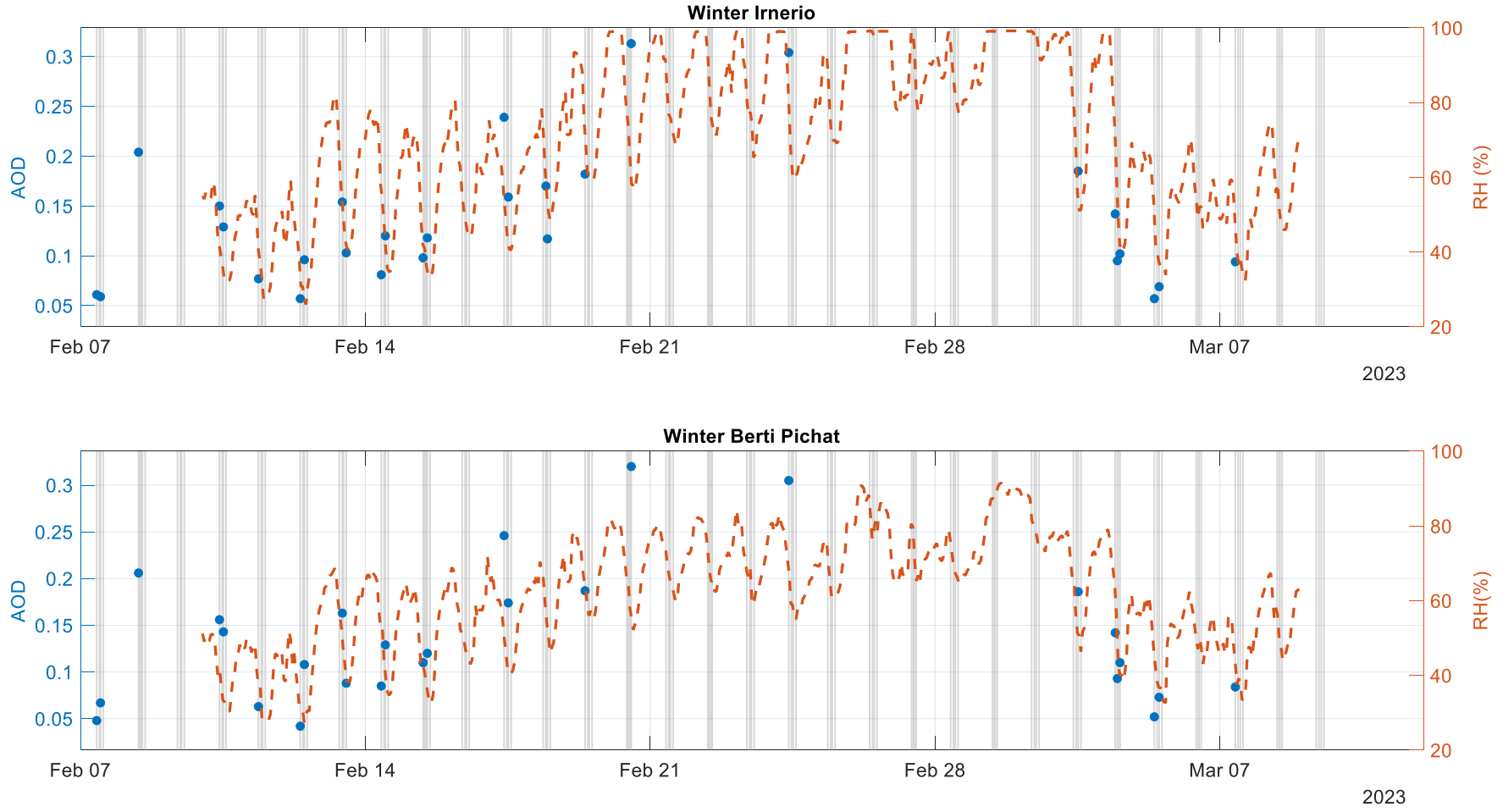


Figure 4aS. Hourly RH from reference instrument compared with overpass times of Aqua and Terra satellites (grey highlighted areas) and available MAIAC AOD. Satellite overpass times correspond to the descending branch of RH daily evolution.
Successful AOD retrievals are 20% of total overpasses, due to clouds.
RH at overpass times ranges in average from max value of 52% to min value of 45%.
Aerosol properties are mostly affected by hygroscopicity for RH > 70 %.



Correlation coefficients

BP1	Rho (hourly)	Rho (Ref. Daily)	Rho (150 min)	p-value (hourly)	p-value (Ref. Daily)	p-value (150 min)
AOD	0.4993	0.0449	0.6602	0.0413	0.8310	0.0054
AOD/BLH	0.5482	0.2118	0.6873	0.0227	0.3095	0.0033
AOD*Reff	0.5950	0.4648	0.7148	0.0117	0.0601	0.0019
AOD*Reff/BLH	**0.5886**	0.4561	**0.7014**	0.0129	0.0658	0.0025

BP2	Rho (hourly)	Rho (Ref. Daily)	Rho (150 min)	p-value (hourly)	p-value (Ref. Daily)	p-value (150 min)
AOD	0.4665	0.0449	0.5430	0.0187	0.8310	0.0050
AOD/BLH	0.5669	0.2118	0.5999	0.0031	0.3095	0.0015
AOD*Reff	0.5448	0.1238	0.6145	0.0049	0.5555	0.0010
AOD*Reff/BLH	**0.5924**	0.2392	**0.6187**	0.0018	0.2494	0.0009

BP3	Rho (hourly)	Rho (Ref. Daily)	Rho (150 min)	p-value (hourly)	p-value (Ref. Daily)	p-value (150 min)
AOD	0.0744	0.0449	0.0491	0.8183	0.8310	0.8797
AOD/BLH	0.7679	0.2118	0.6939	0.0035	0.3095	0.0123
AOD*Reff	0.3123	-0.5869	0.2825	0.3229	0.0448	0.3737
AOD*Reff/BLH	**0.8117**	0.0916	**0.7401**	0.0013	0.7770	0.0059

I1	Rho (hourly)	Rho (Ref. Daily)	Rho (150 min)	p-value (hourly)	p-value (Ref. Daily)	p-value (150 min)
AOD	0.4376	-0.0035	0.5416	0.0253	0.9866	0.0063
AOD/BLH	0.6056	0.1939	0.6442	0.0010	0.3528	0.0007
AOD*Reff	0.6006	0.1170	0.6545	0.0015	0.5774	0.0005
AOD*Reff/BLH	**0.6689**	0.2317	**0.6781**	0.0003	0.2651	0.0003

I2	Rho (hourly)	Rho (Ref. Daily)	Rho (150 min)	p-value (hourly)	p-value (Ref. Daily)	p-value (150 min)
AOD	0.3214	-0.0035	0.3972	0.1173	0.9866	0.0546
AOD/BLH	0.5319	0.1939	0.5428	0.0062	0.3528	0.0061
AOD*Reff	0.4751	0.0627	0.5358	0.0164	0.7711	0.0069
AOD*Reff/BLH	**0.5996**	0.2269	**0.5968**	0.0015	0.2861	0.0021

- Rho: Pearson's linear correlation coefficient; closer to 1 means better linear correlation
- p-value: statistical parameter that helps quantifying the likelihood of thelinear hypothesis; values smaller than a threshold (eg. 0.004) indicate a better correlation.

Both are computed from the respective data using the matlab function corr.

Brackets refer to PM data used together with AOD, Reff and BLH:

- Hourly: OPC PM2.5 averaged hourly (points closest to satellite overpass times are considered)
- Ref. Daily: daily PM2.5 reference
- 150 min: OPC PM2.5 averaged 150 minutes around nominal satellite overpass (75 minutes before and after)

References

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