Non-refractory submicron aerosols in the Po Valley: Sources, vertical transport, and chemical composition from measurements at Bologna and Mt. Cimone within AirPoDynamic

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Intro and goal

- **AirPoDynamic** campaign (Aug – Sep 2024) aims at characterizing **aerosol ageing along vertical transport in the Po Valley**, comparing a low-altitude urban site (BO) and a high-altitude remote site (CMN).

BO
CNR Research area, ISAC rooftop

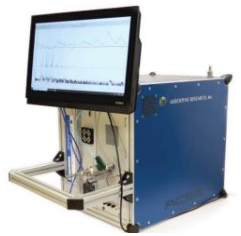
Q-ACSM

Urban site
54 m a.s.l.

Remote site
2167 m a.s.l.

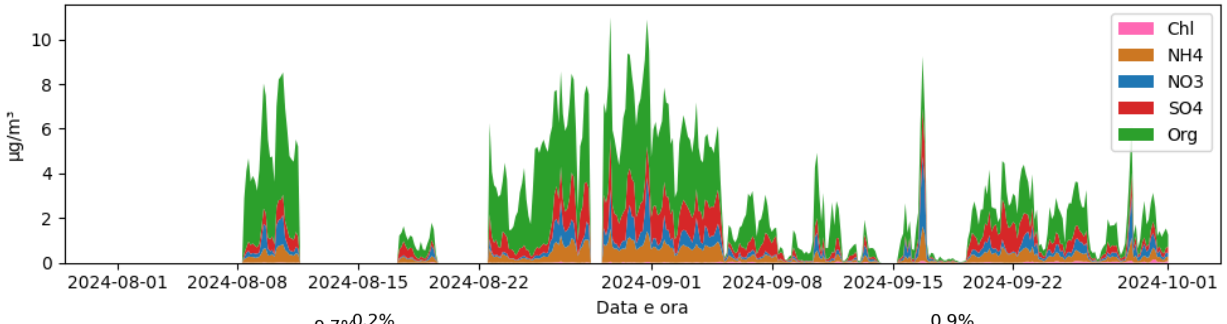
CMN
“O. Vittori” Observatory

ToF-ACSM

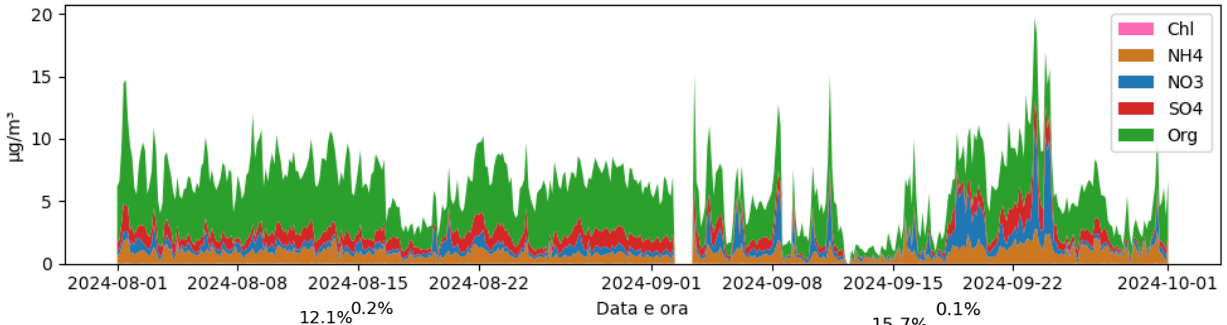


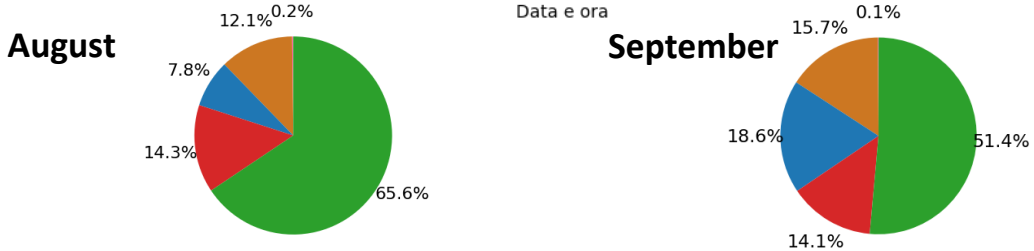
Non Refractory (NR) PM_1

Mt. Cimone



Bologna





How do Planetary Boundary Layer (PBL) and seasonality affect NR-PM_1 during the campaign?

At CMN:

- **NR-PM_1 concentration decrease** (lower concentration in Free Troposphere (FT))
- **SO_4 relative increase** (higher relative abundance in FT)

At BO:

- **NO_3 relative increase** (thermally-driven partitioning into particle phase)

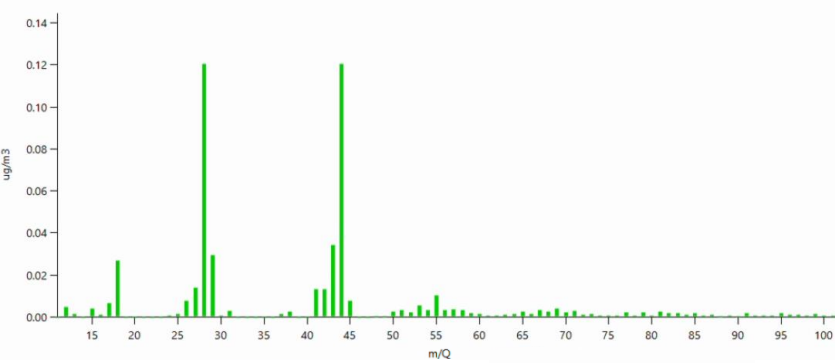
At both sites:

- **Org consistently decrease**
- **NH_4 is more stable**
- **Chl is negligible**

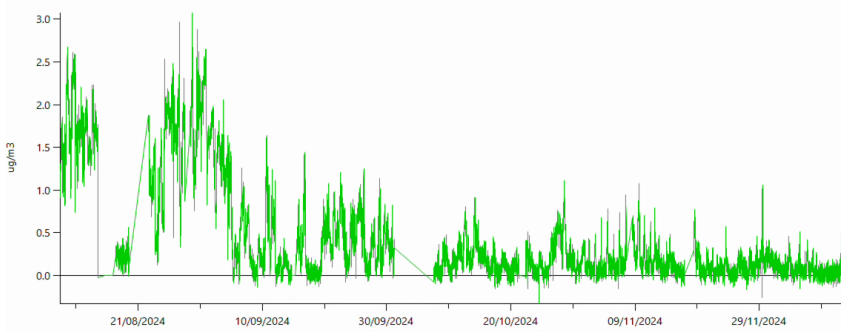
Positive Matrix Factorization

Data input

Org Mass Spectra

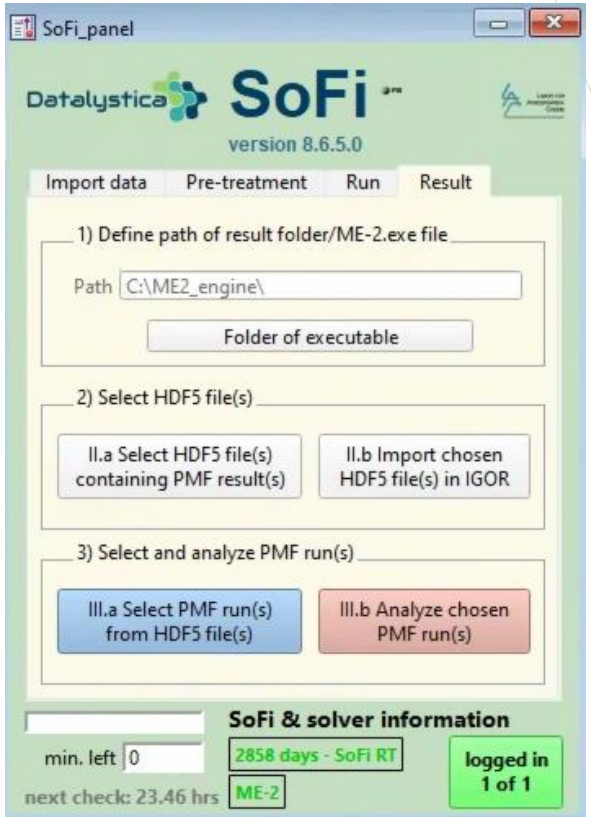


Org Time Series



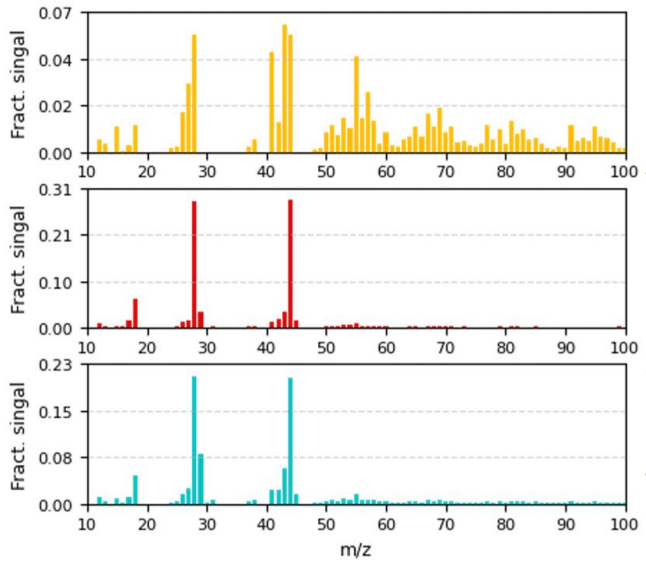
Canonaco, F. et al., *Atm. Meas. Tech.* **6, 3649–3661** (2013).

PMF algorithm



Results

Factors



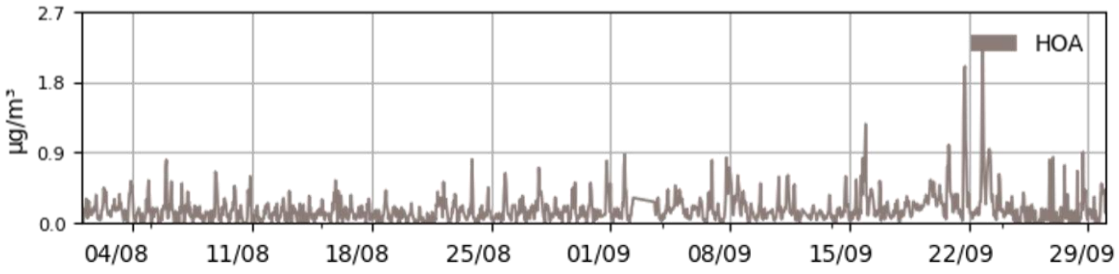
Factors: recurring chemical classes from specific Organic Aerosol (OA) sources/formation processes.

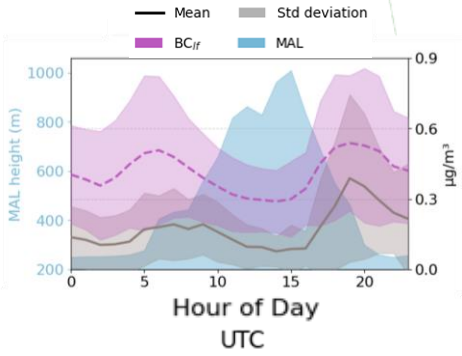
Source Apportionment

Bologna

ITINERIS

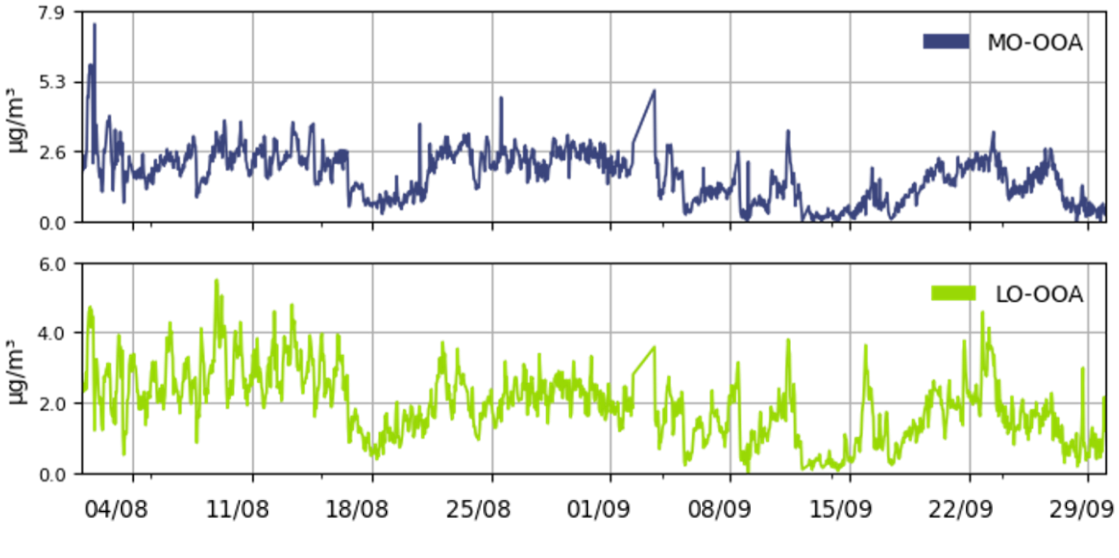
- **Primary emitted aerosol** (HOA and BC) is **influenced Mixed Aerosol Layer (MAL) heigh.**

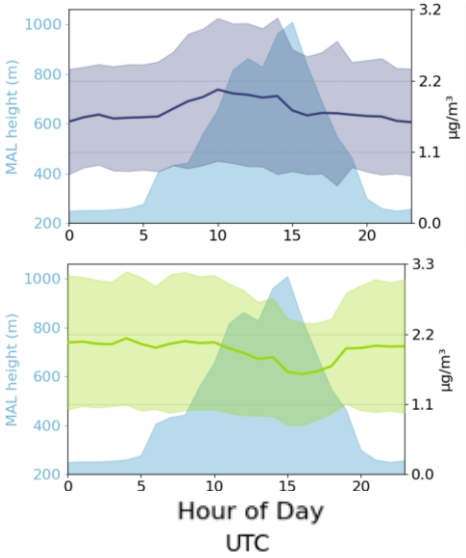




Hydrocarbon-like OA (HOA):
From traffic, strongly correlated (R >0.85) with Black Carbon from liquid fuel combustion (**BC_{lf}**)

- **Secondary OA** (MO/LO-OOA) is **less affected by the MAL diurnal variation**





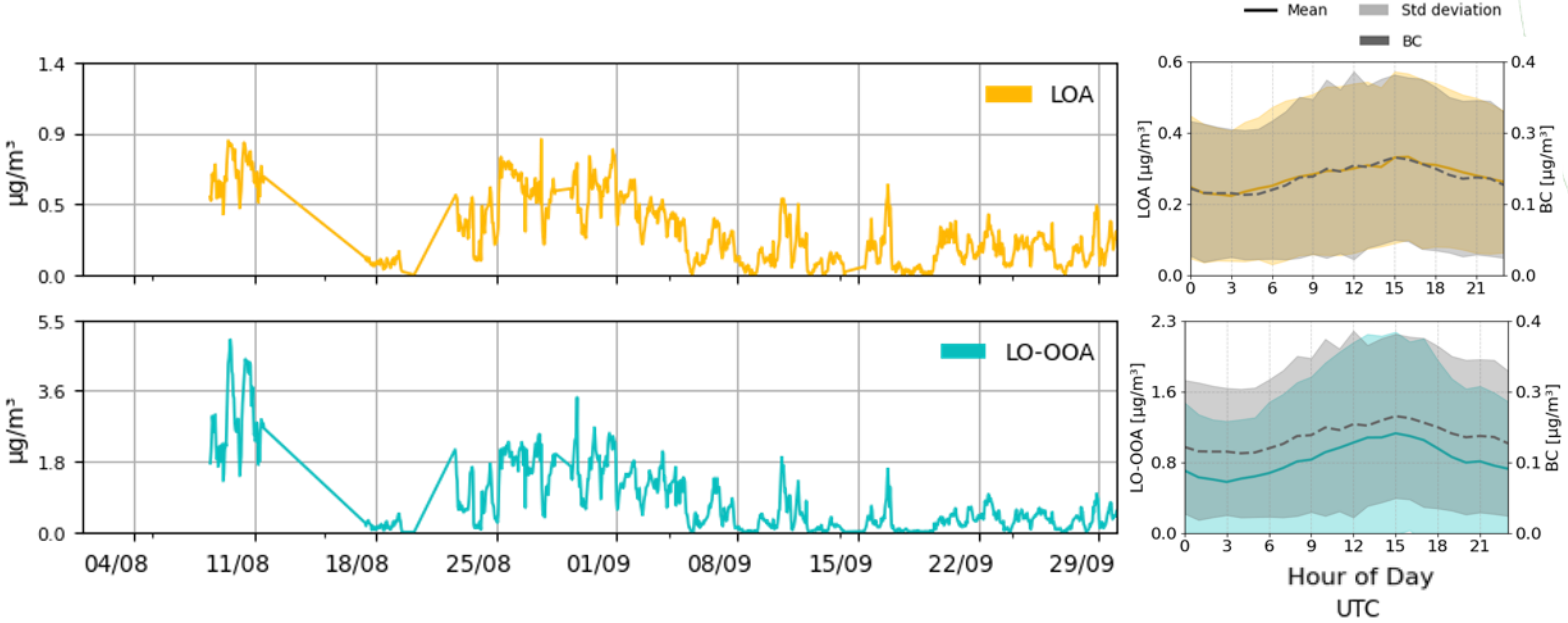
More-Oxidized Oxygenated OA (MO-OOA):
Highly aged/oxidized OA from photo-oxidation.

Less-Oxidized Oxygenated OA (LO-OOA):
Less oxidized OA, linked to primary sources and secondary formation.

Source Apportionment

Mt. Cimone

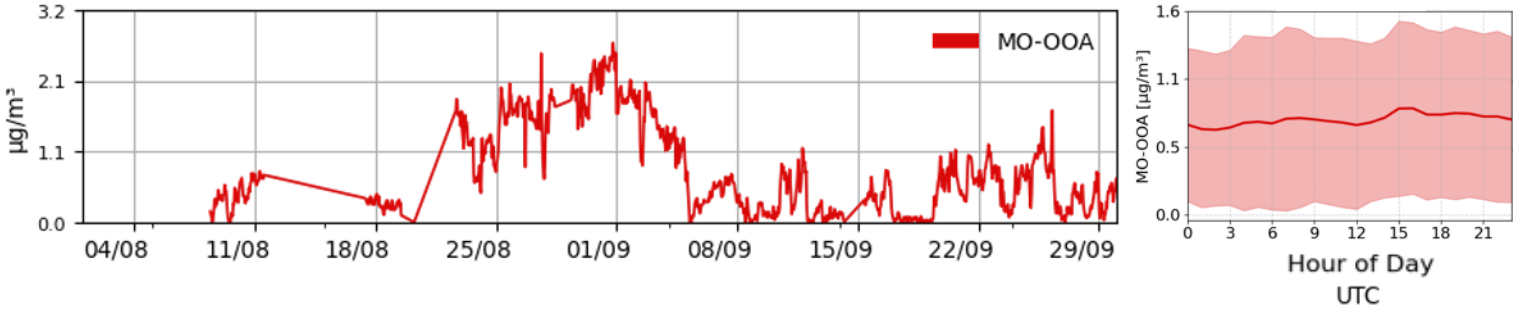
BC and POA-linked factors show a high correlation (R>0.9), confirming the transport from lower altitudes.



Local OA (LOA):
A POA-like factor, likely influenced by anthropogenic activities near to Mt. Cimone.

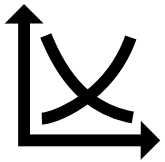
LO-OOA – Less-Oxidized Oxygenated OA:
Less aged POA-linked factor, more pronounced variation when vertical mixing is enhanced.

Highly aged OA are less affected by PBL-dynamics

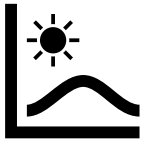


MO-OOA – More-Oxidized Oxygenated OA:
It constitutes the regional background factor.

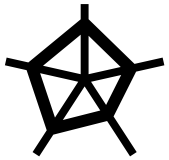
Conclusions



At low-altitude: measurements display a **pronounced dilution of primary anthropogenic species, induced by vertical mixing.**



At high-altitude: aerosol measurements show **higher concentrations in warm periods, when PBL-driven transport is enhanced.**



At both sites: more oxidized SOA are less affected by PBL dynamics.

THANKS!

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