

PMetro: un sistema mobile per la misura delle polveri fini



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the urban environment



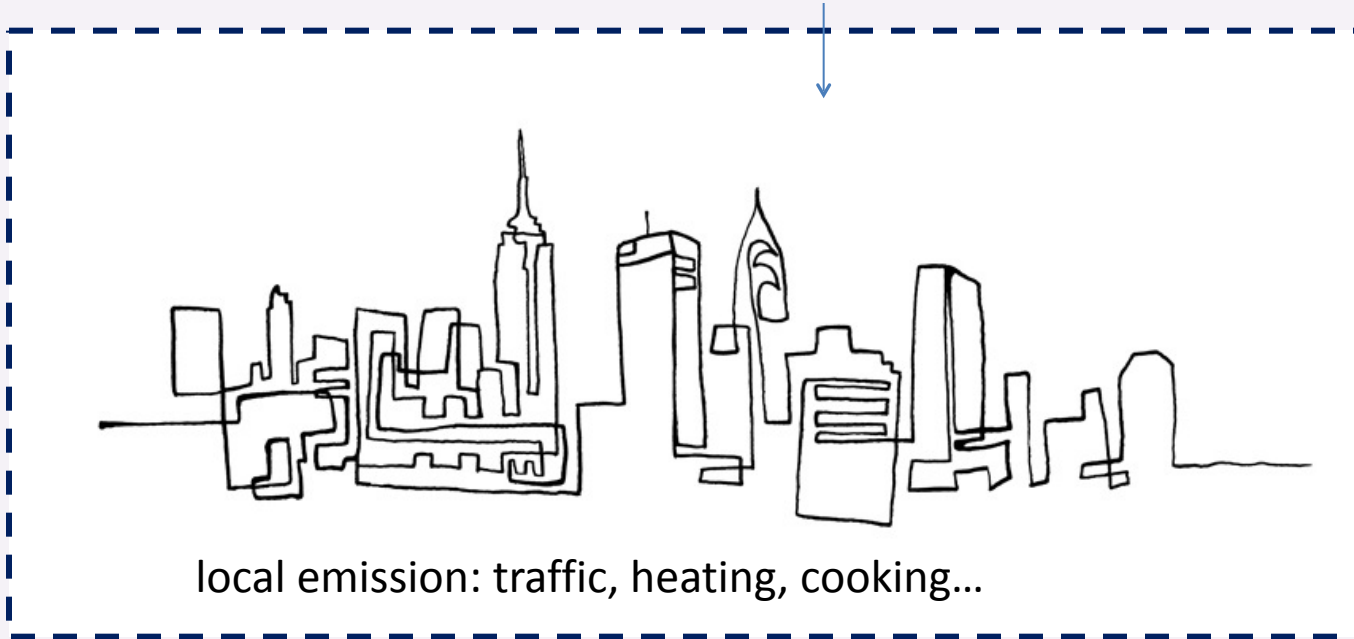
the urban environment



local emission: traffic, heating, cooking...

the urban environment

remote: regional background, long range intrusion..

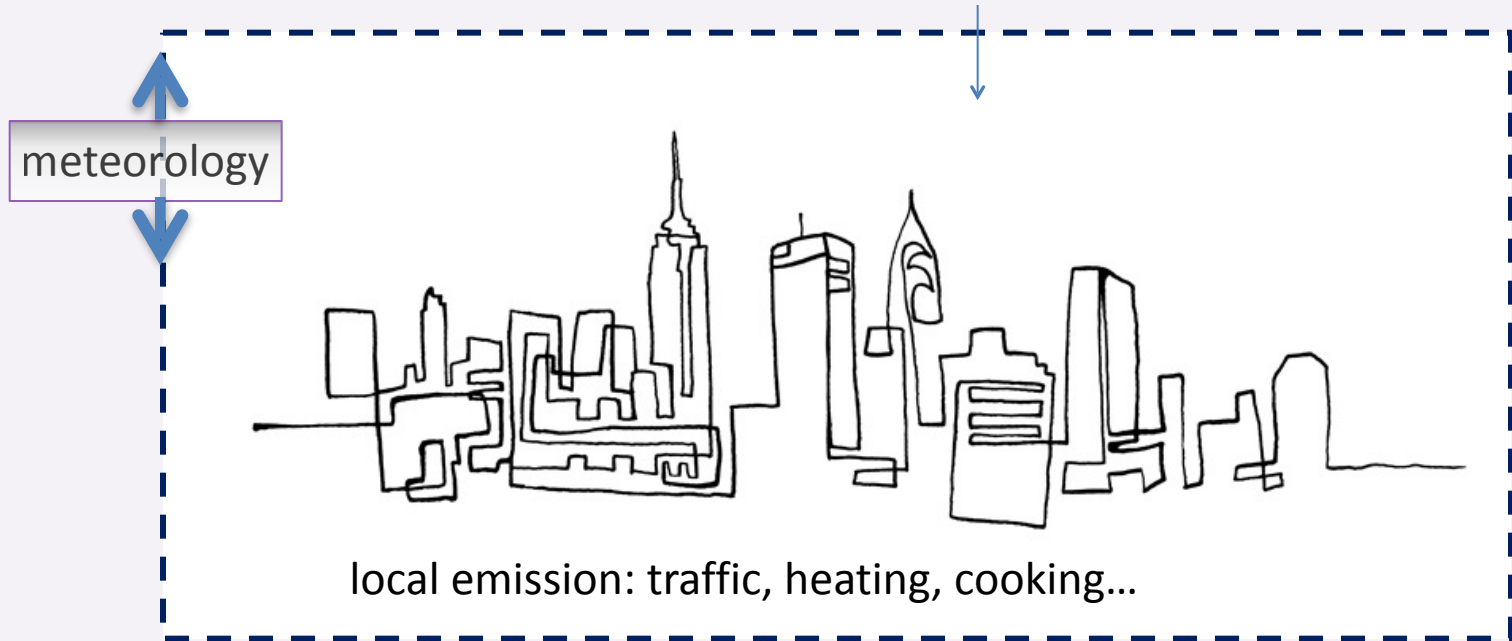


local emission: traffic, heating, cooking...

the urban environment

remote: regional background, long range intrusion..

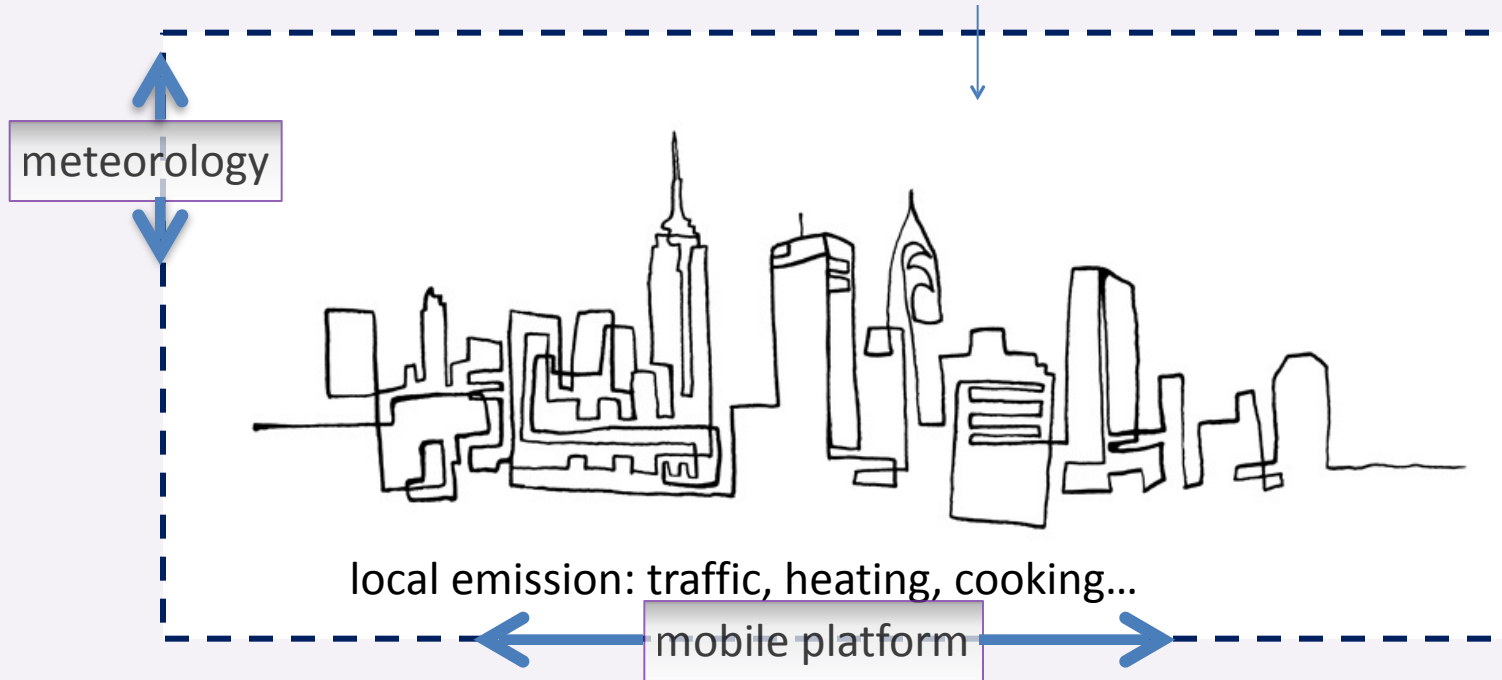
meteorology



local emission: traffic, heating, cooking...

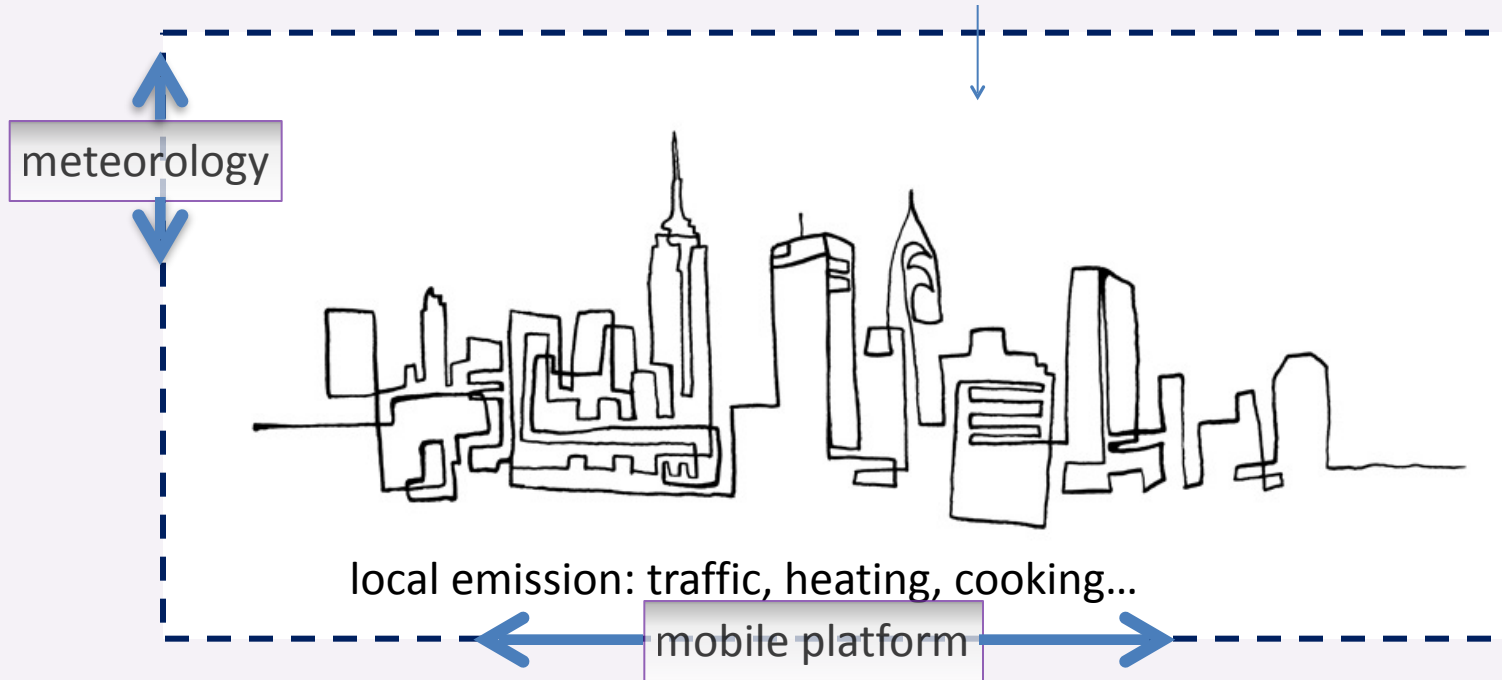
the urban environment

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the urban environment

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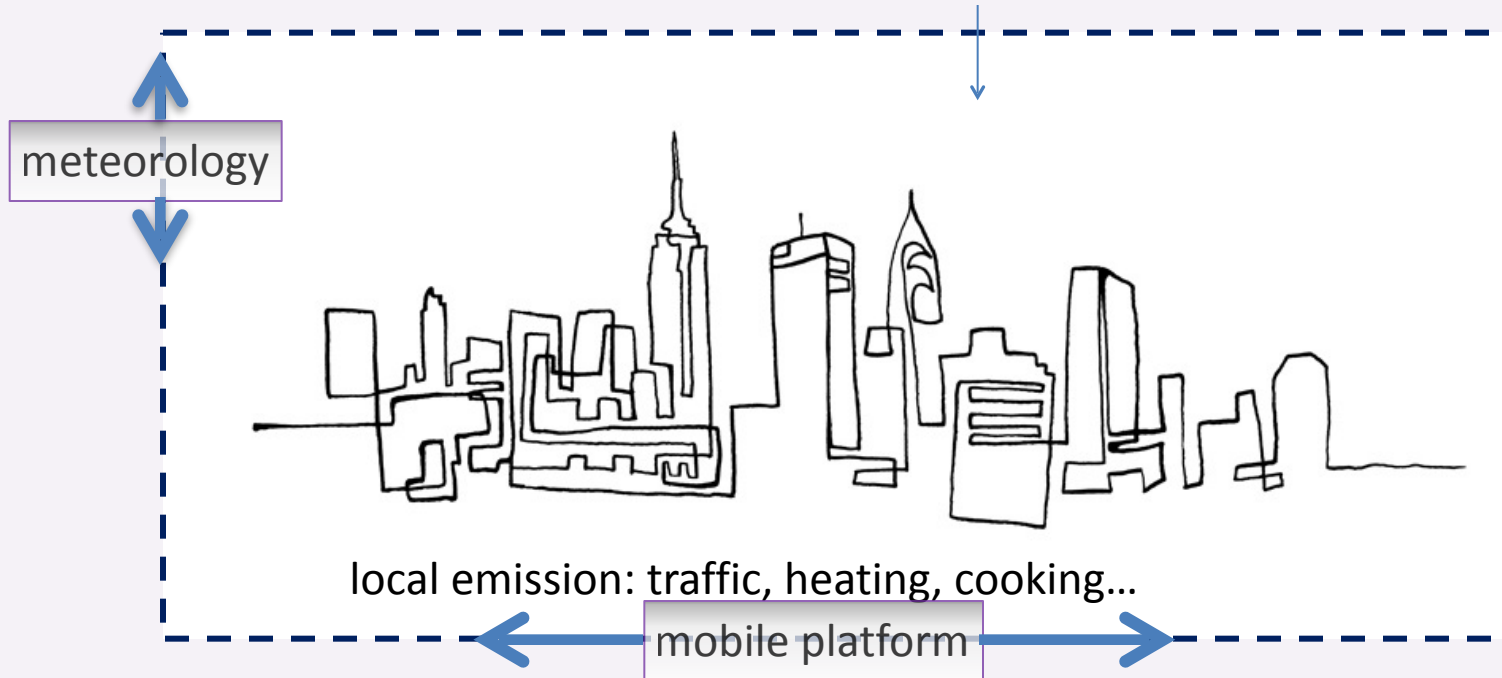


pro

- higher spatial resolution and (necessarily) time resolution
- variability of the particle concentration or size distributions for different locations

the urban environment

remote: regional background, long range intrusion..



pro

- higher spatial resolution and (necessarily) time resolution
- variability of the particle concentration or size distributions for different locations

cons

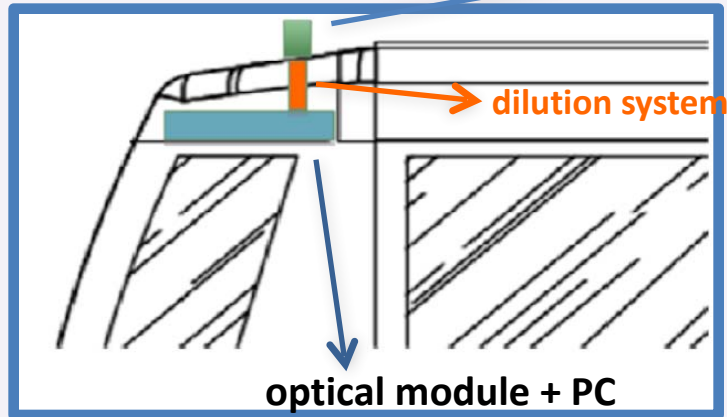
- on board electric supply
- adequate sampling system (particle losses by diffusion, isokinetic conditions,)
- mechanical stability (vibrations..)
- self contamination
- temporal and spatial homogeneity

the Minimetro transport system



- low speed run (4 m/s)
- cabin as a low emission system
- path not traffic related
- variety of urban scenarios
- 3 km radial transect, 200 meters

the integrated OPC



PM₁₀ inlet



Optical unit (CLIMET)
Diode laser: 20 mW @ 639 nm
Wide angle elliptical mirror
22 size channels (0.28-10 μm)
8 calibrated thresholds: 0.28, 0.4, 0.5, 0.7, 1.1, 2.0, 3.0, 5.0
Max. time resolution: 4 Hz
Data integrated for 6 s
Flux: 1 L/min

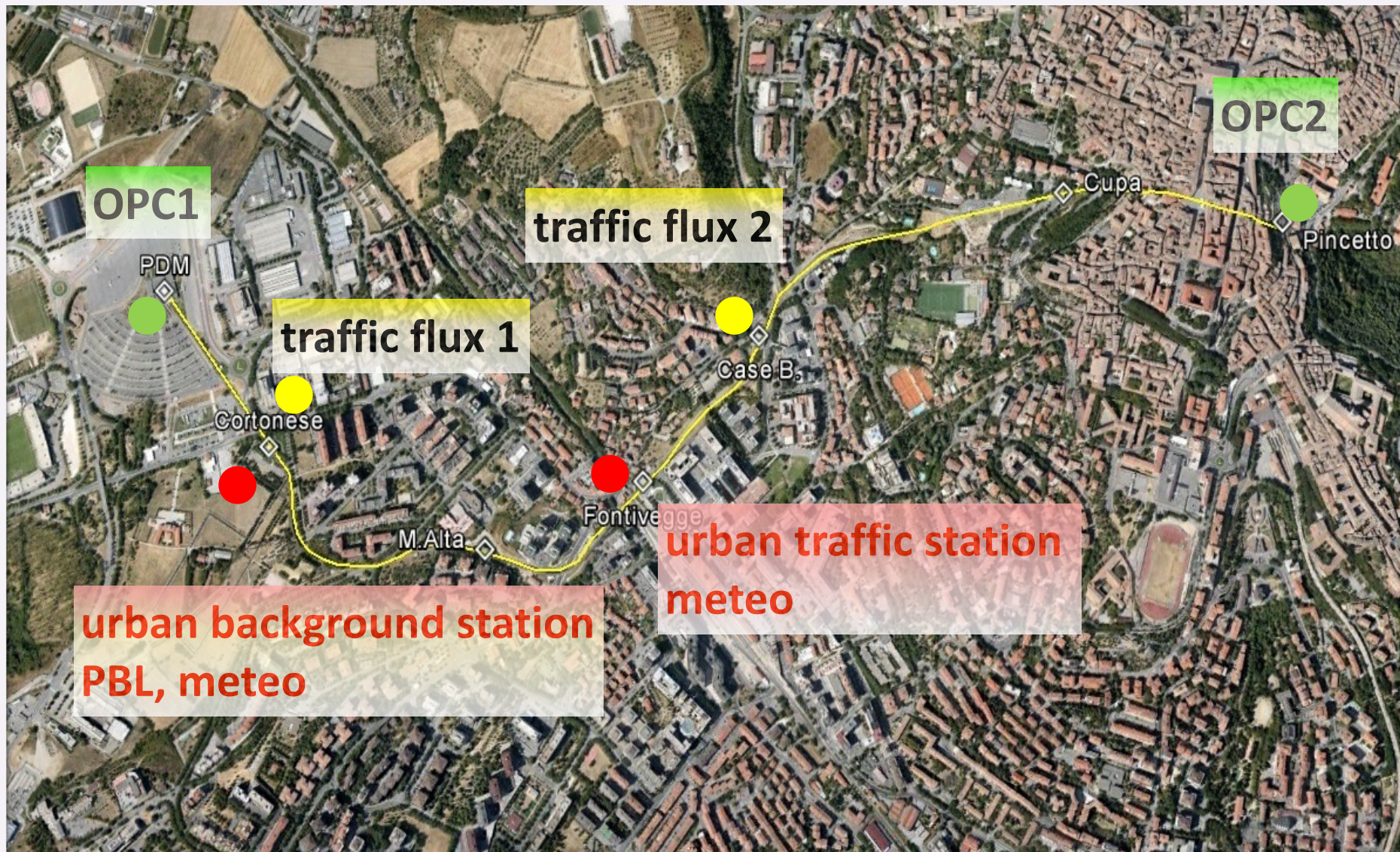
Daily: zero test (15 min at 00:00) of dilution line



Integration with the cabin:

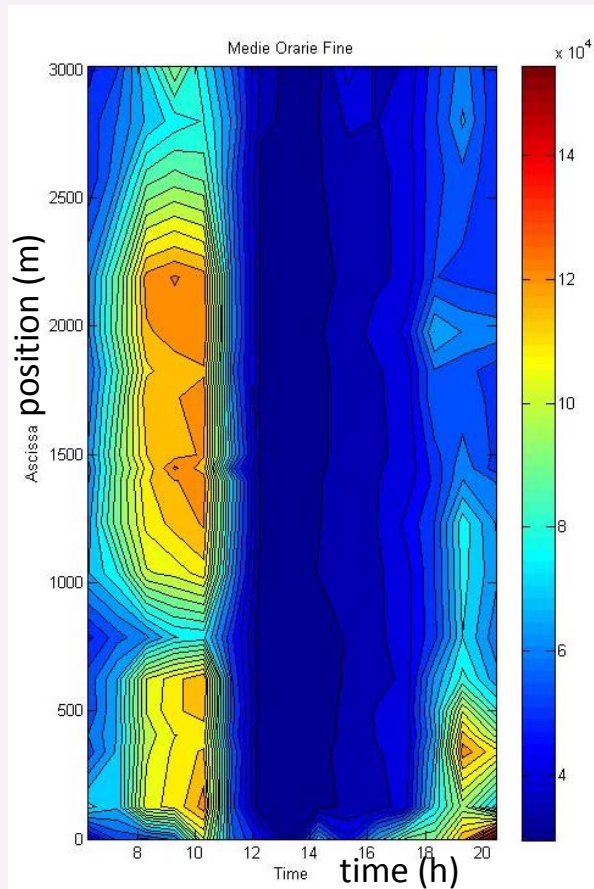
- central SW provides accurate position and speed
- DC (~80 W at 24 V) through a battery pack.

Minimetrò path & instrumentation

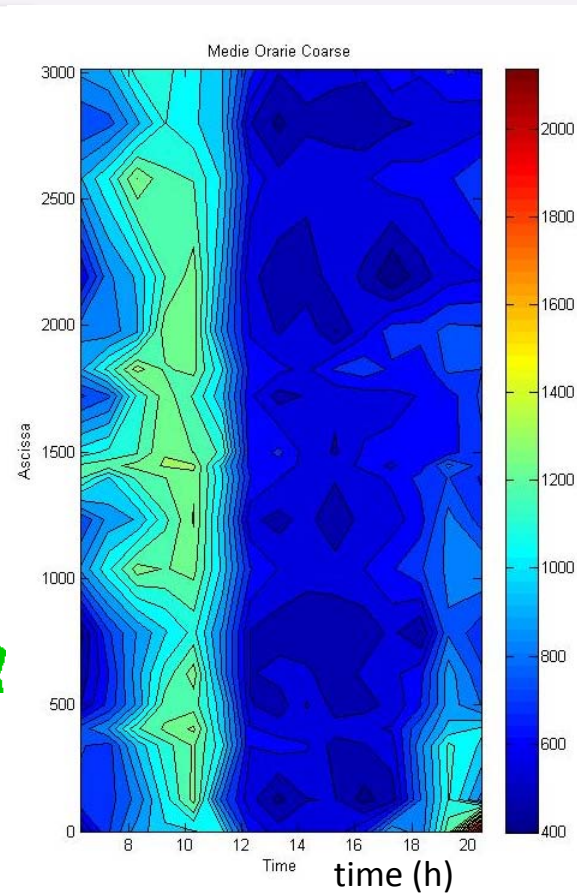


mobile cabin: daily data

fine ($D_p < 1.1 \mu\text{m}$)



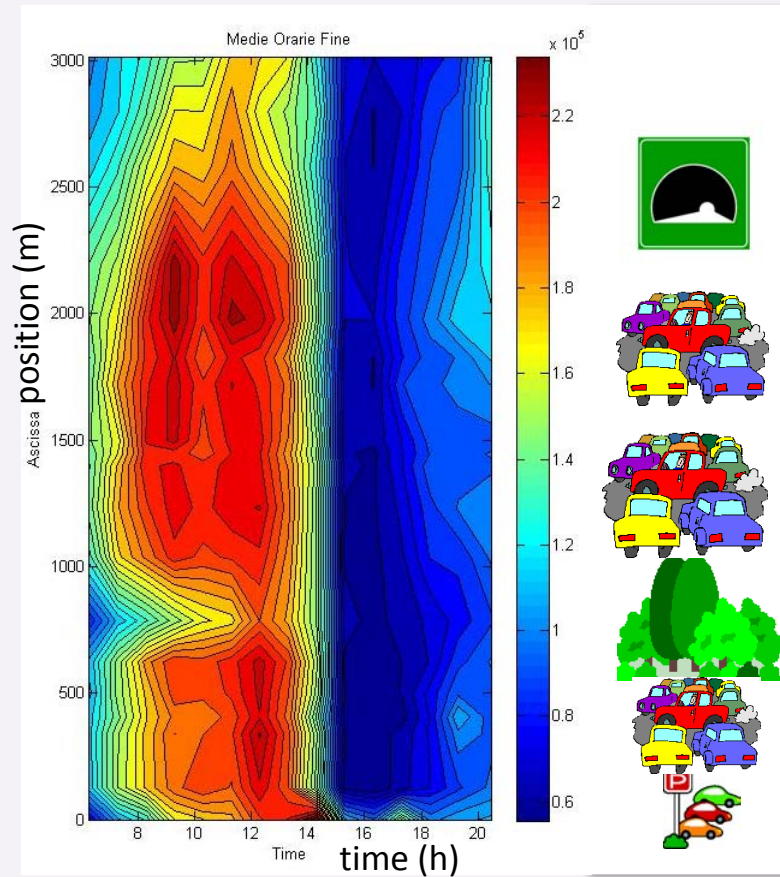
coarse ($D_p > 1.1 \mu\text{m}$)



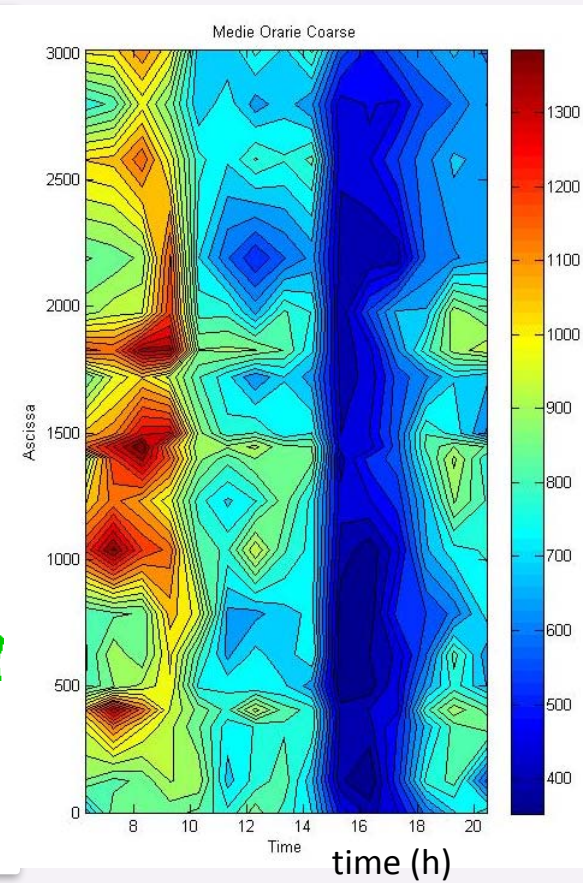
03 Oct 2012

daily data

fine ($D_p < 1.1 \mu\text{m}$)

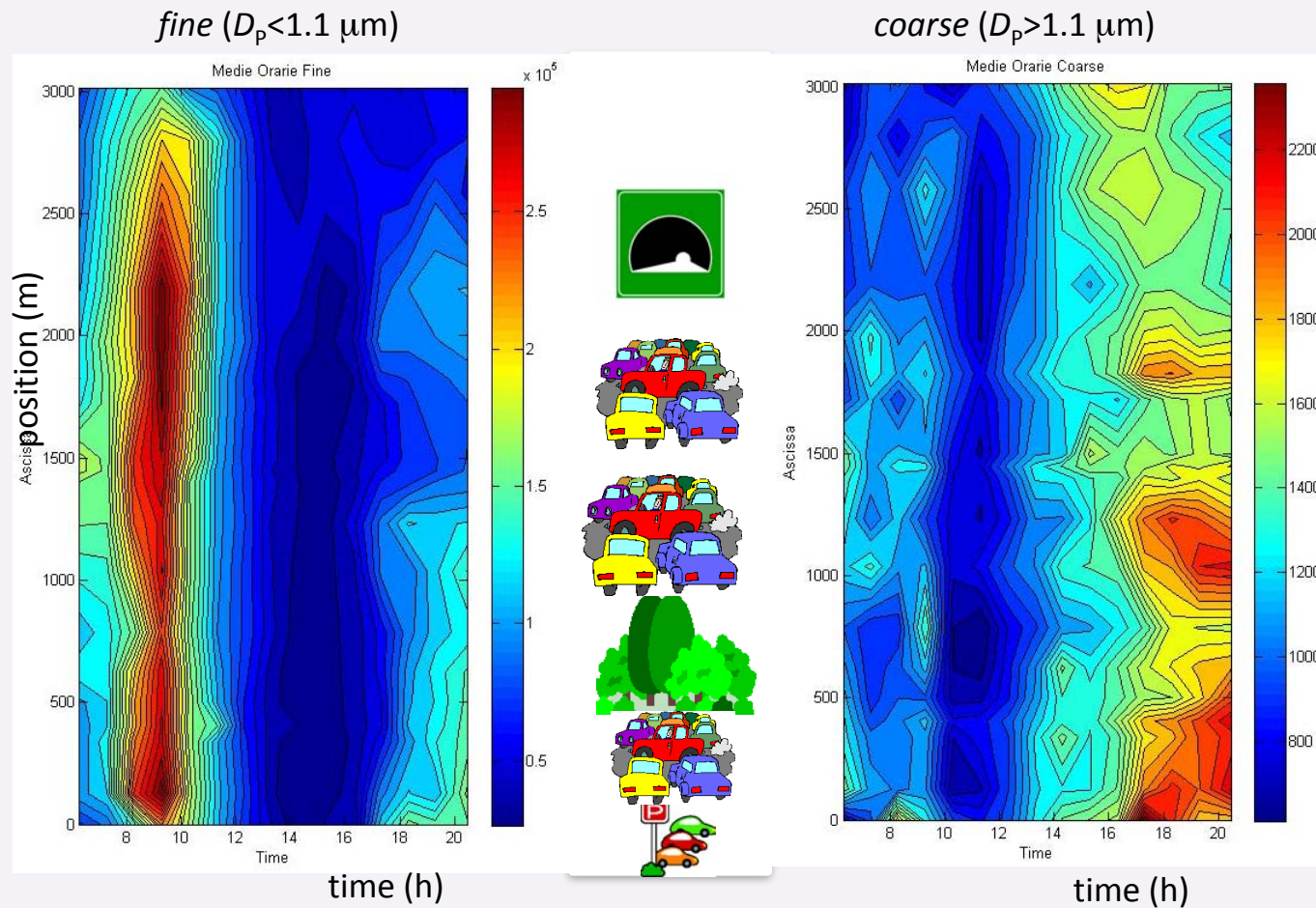


coarse ($D_p > 1.1 \mu\text{m}$)



09 Oct 2012

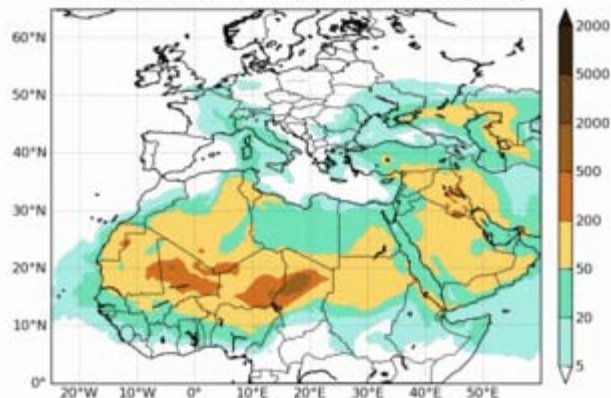
daily data



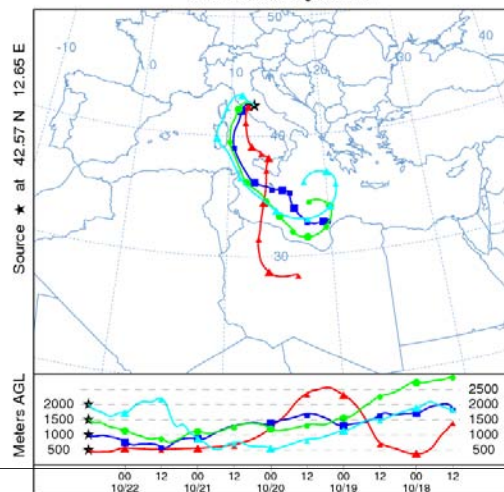
20 Oct 2012 (sat)

Sahariana 22 Oct 2012 (MM+models)

WMO SDS-WAS N.Africa-Middle East-Europe RC
 MEDIAN Dust Surface Concentration ($\mu\text{g}/\text{m}^3$)
 Run: --h 22 OCT 2012 Valid: 12h 22 OCT 2012 (H+00)

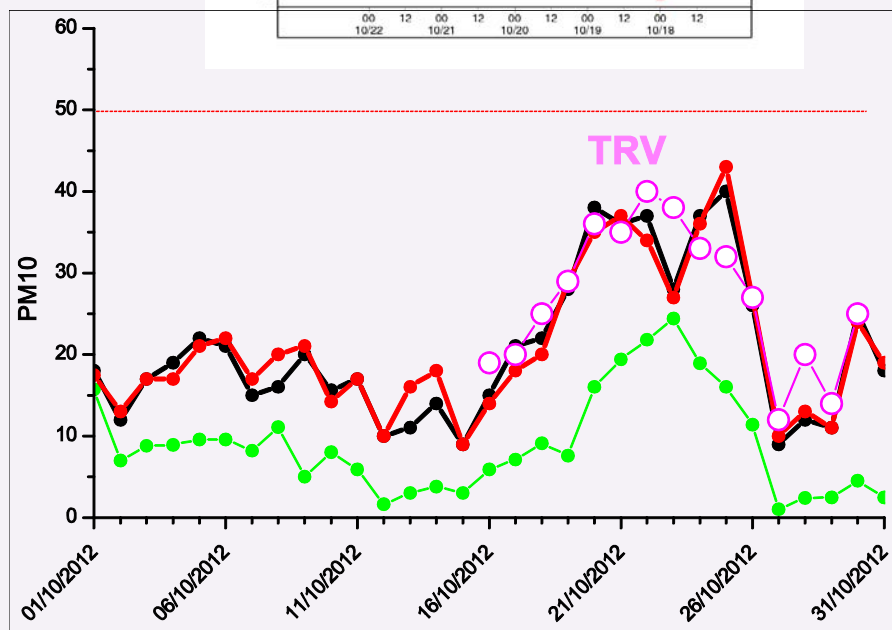
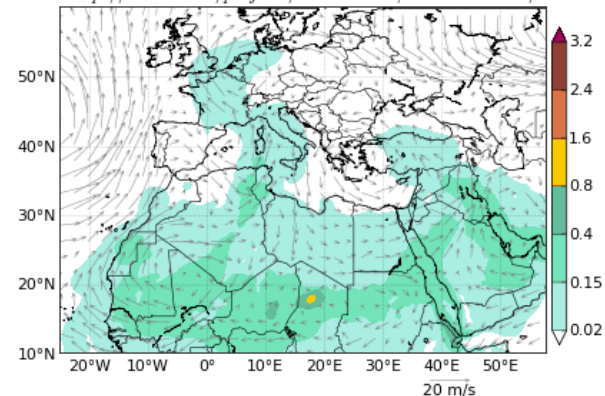


NOAA HYSPLIT MODEL
 Backward trajectories ending at 1200 UTC 22 Oct 12
 GDAS Meteorological Data



BSC-DREAM8b v2.0 Dust Opt. Depth 550nm and 3000m Wind
 00h forecast for 12UTC 22 Oct 2012

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>

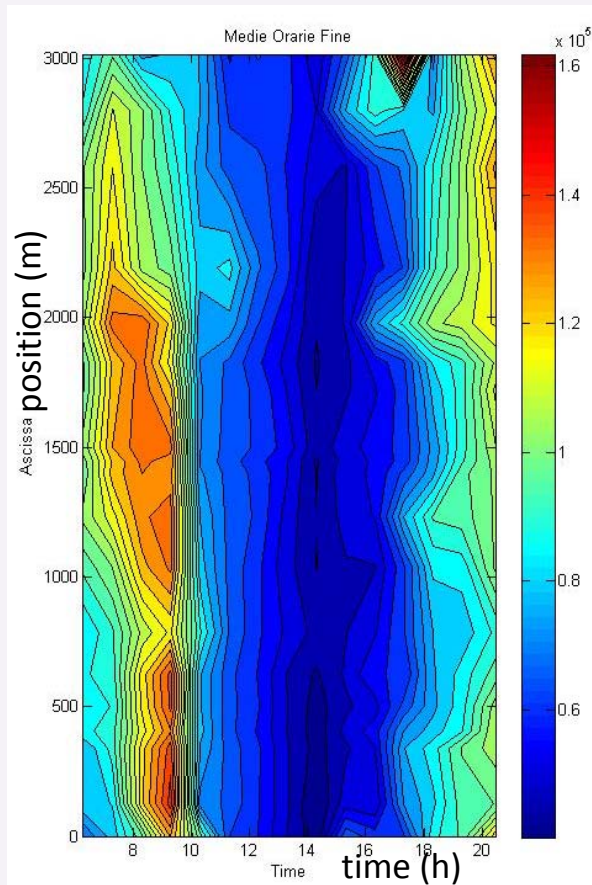


PERUGIA

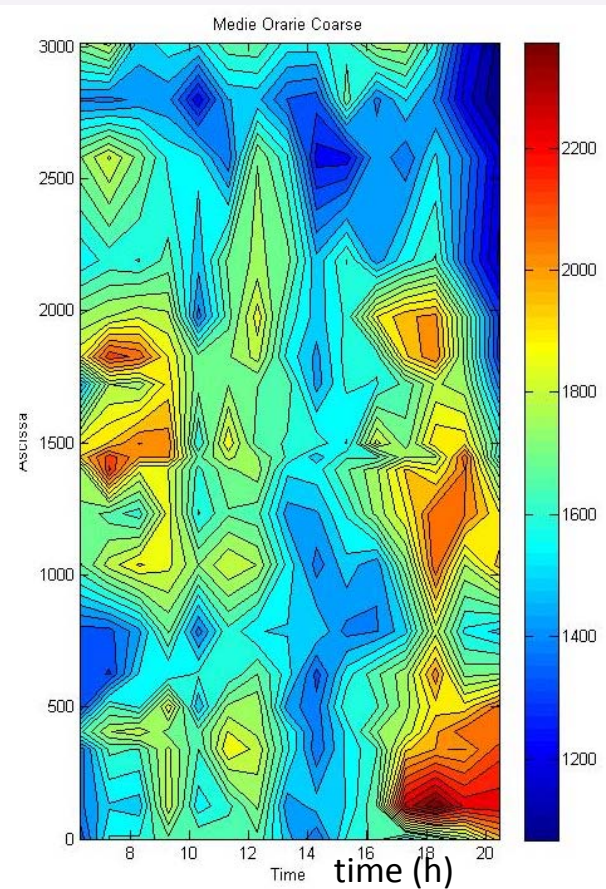
MARTANI

1. particle resuspension

fine ($D_p < 1.1 \mu\text{m}$)



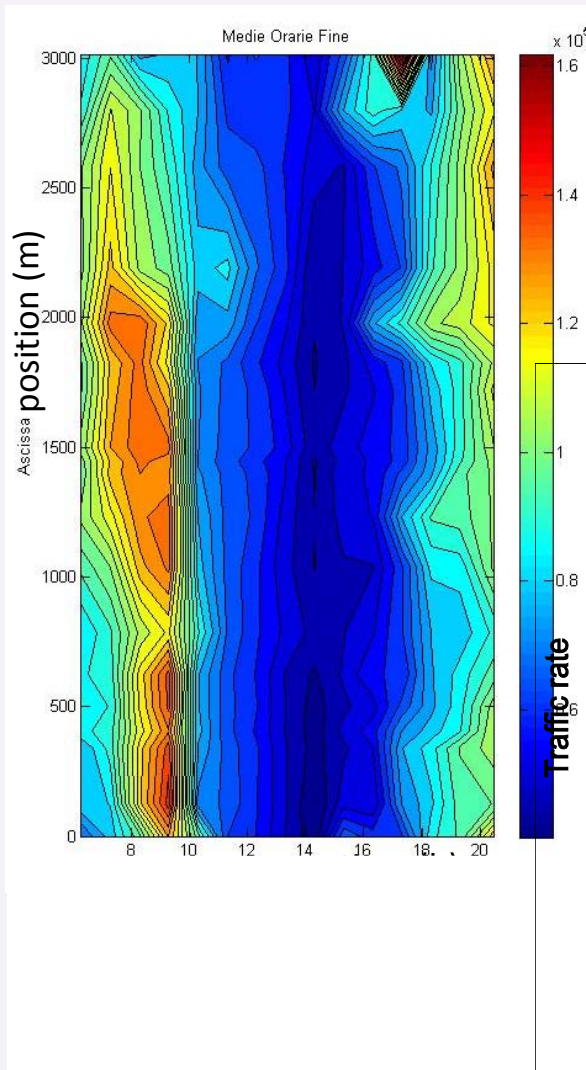
coarse ($D_p > 1.1 \mu\text{m}$)



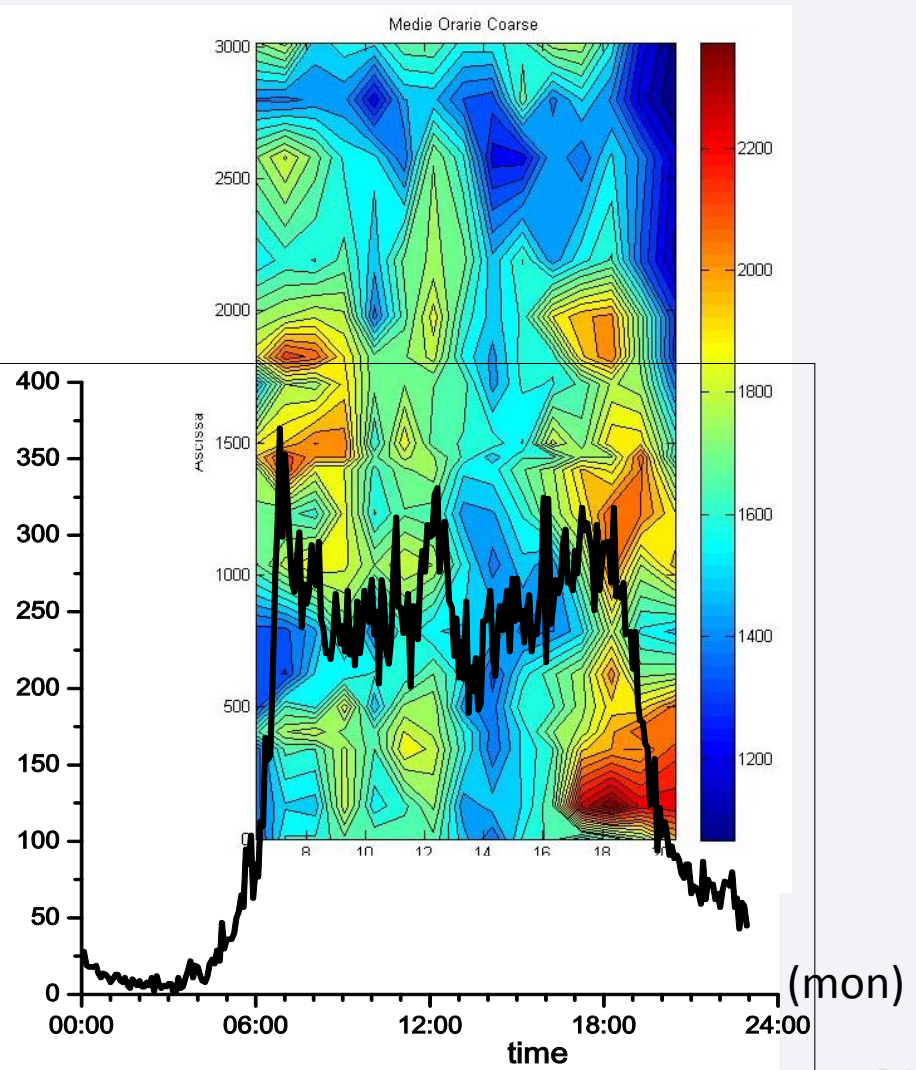
22 Oct 2012 (mon)

1. particle resuspension

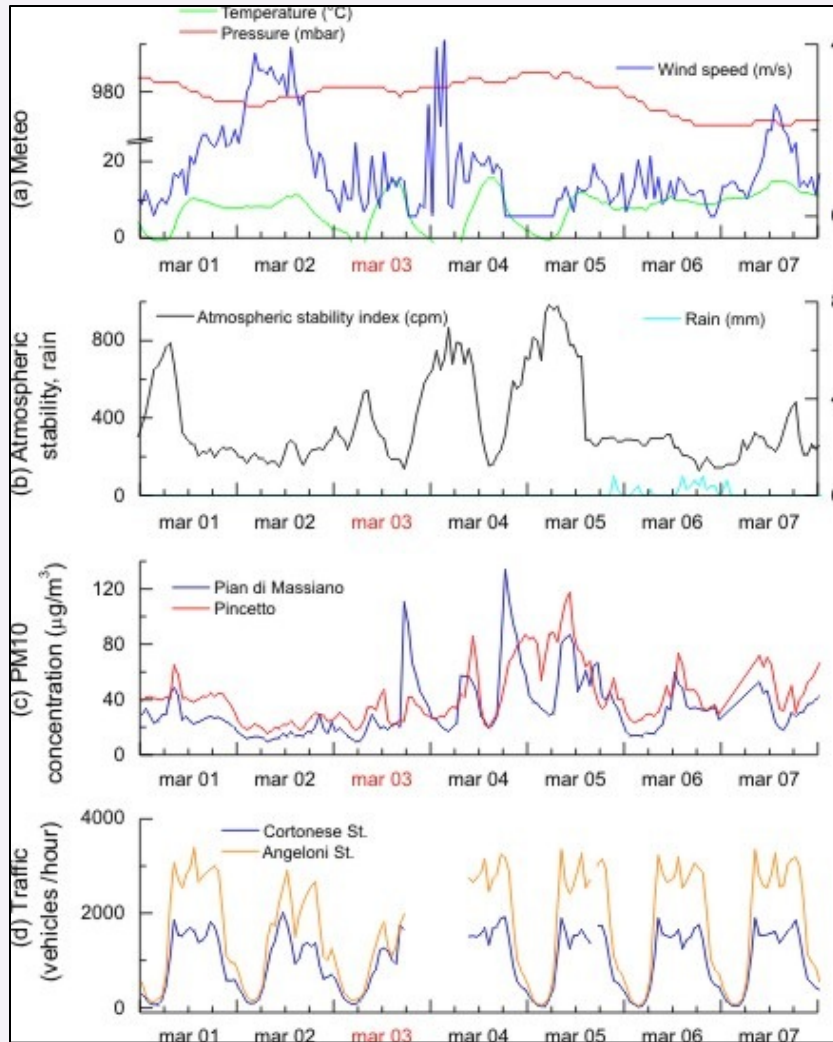
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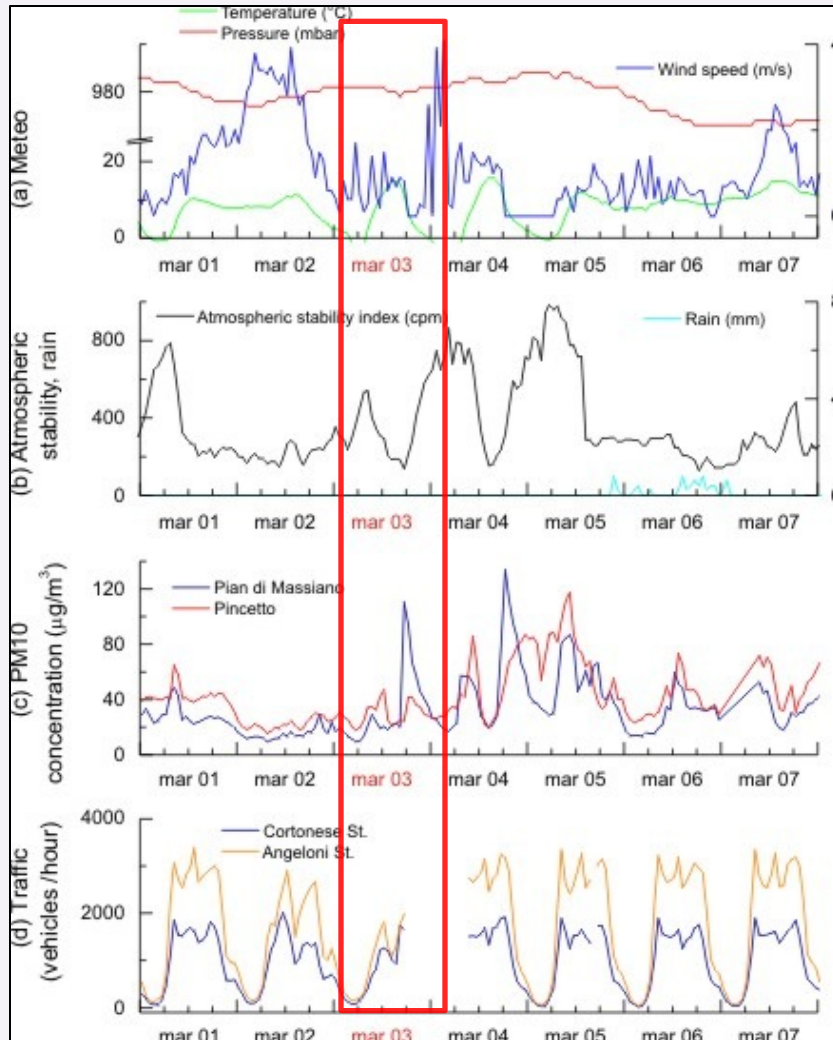
coarse ($D_p > 1.1 \mu\text{m}$)



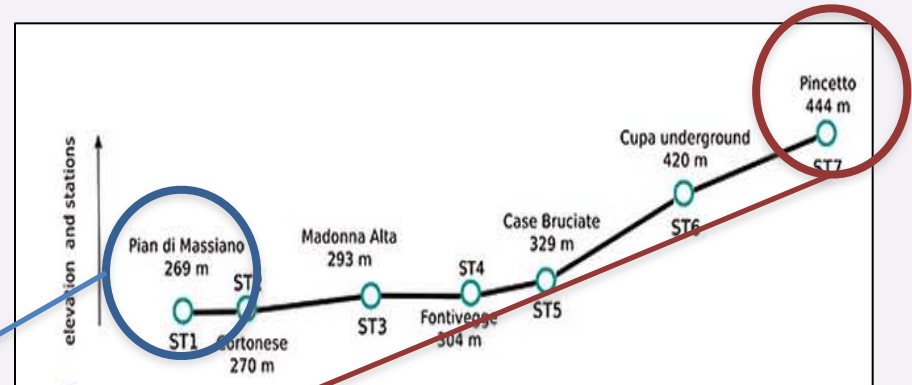
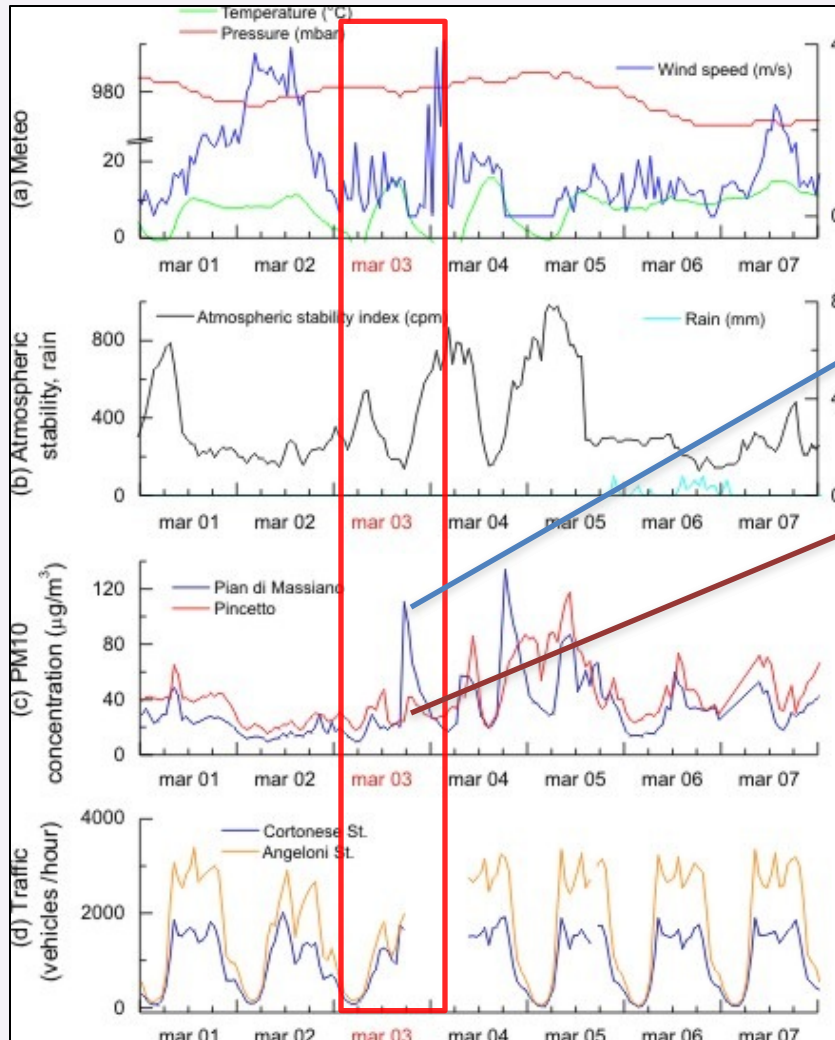
2. atmospheric stability



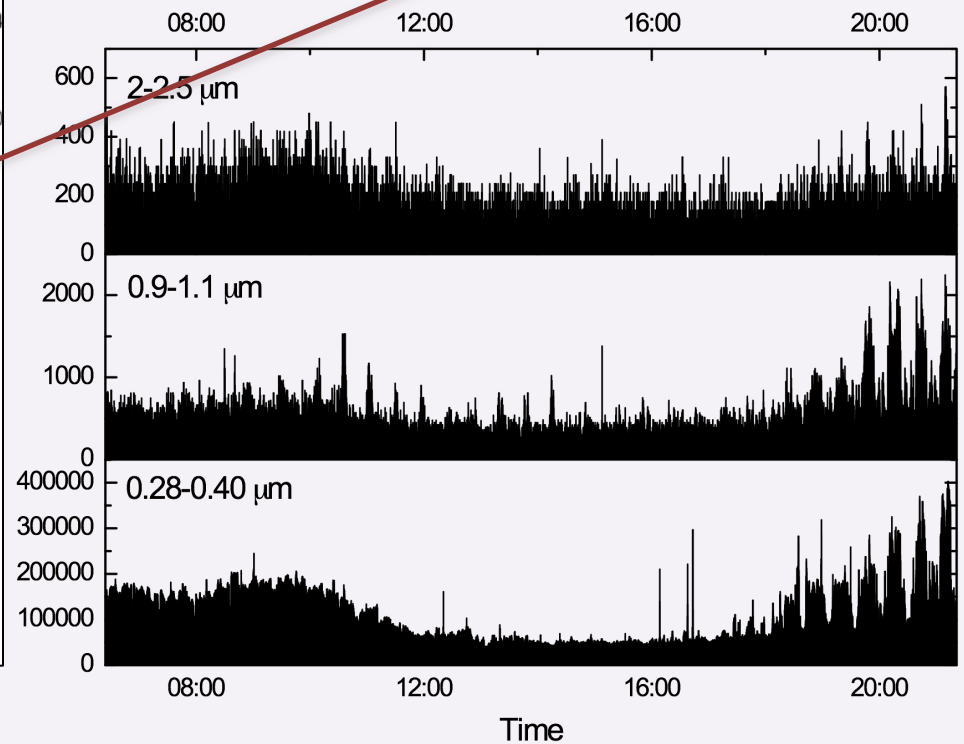
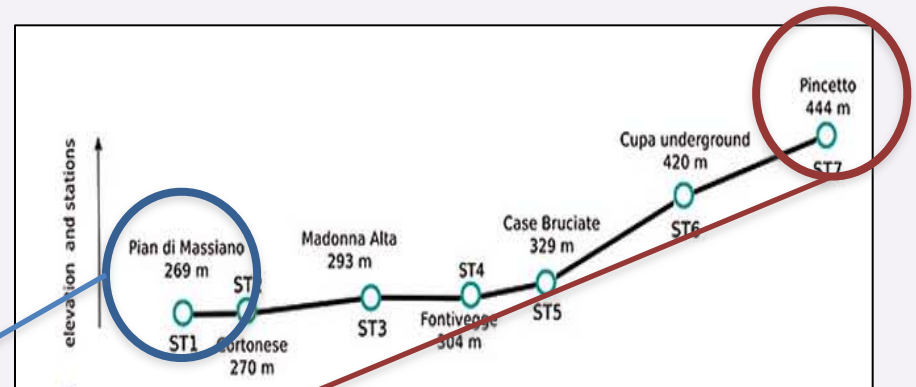
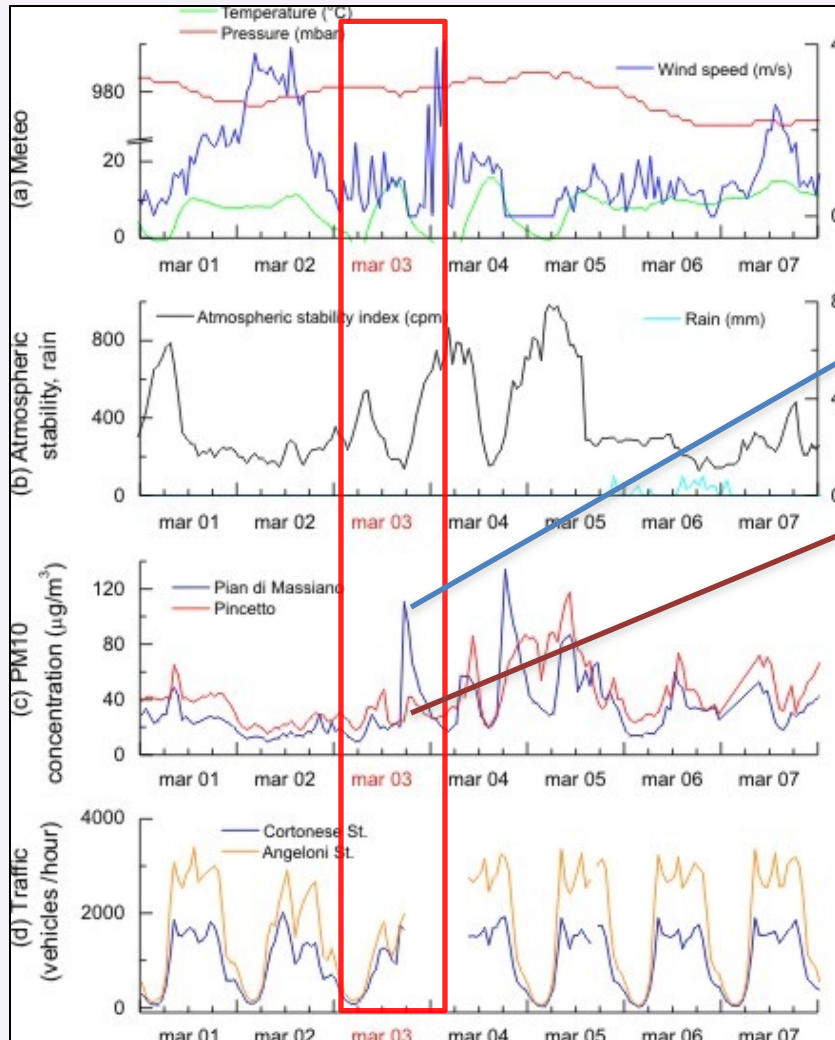
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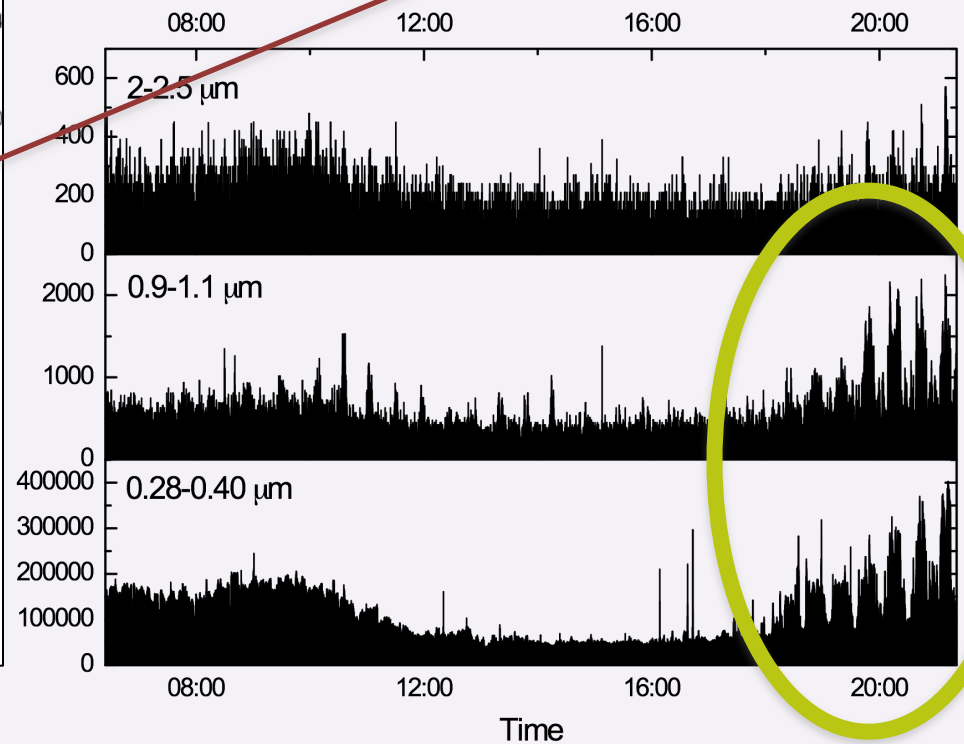
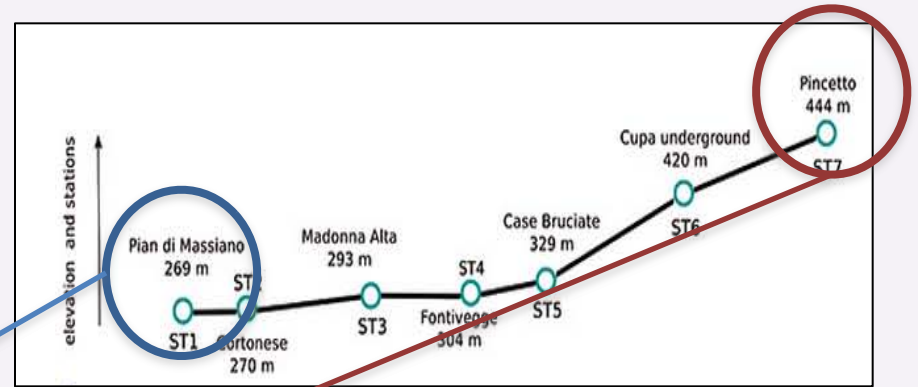
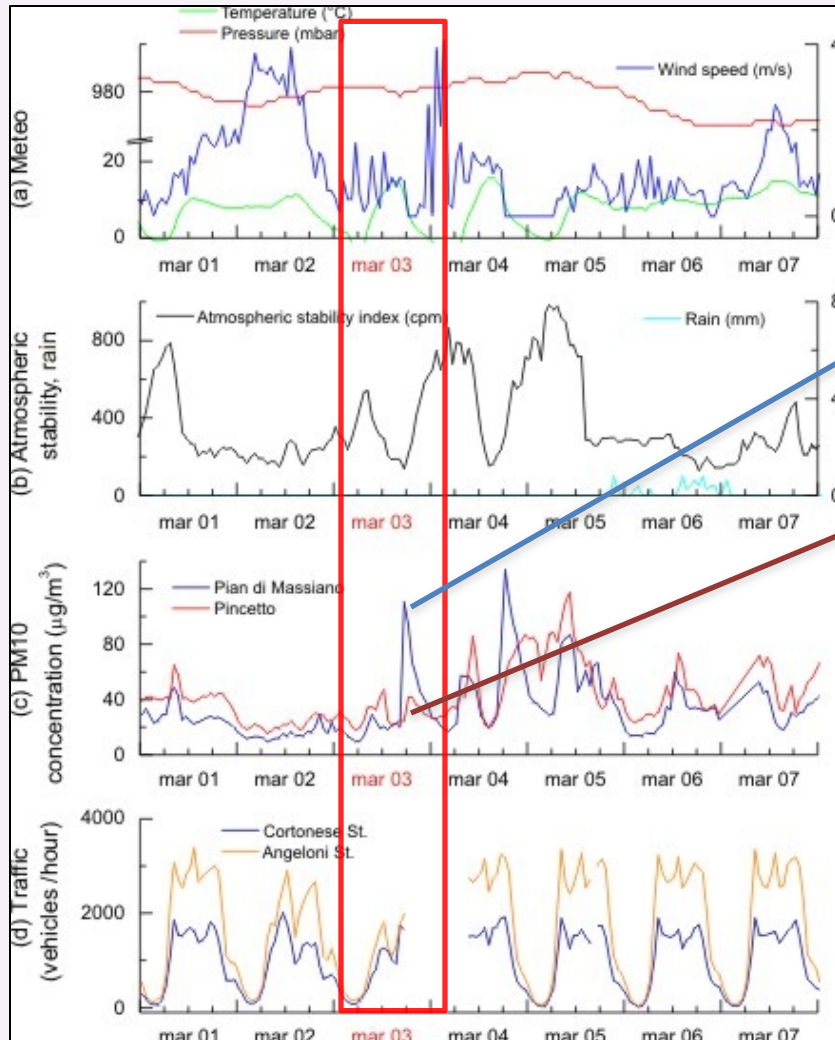
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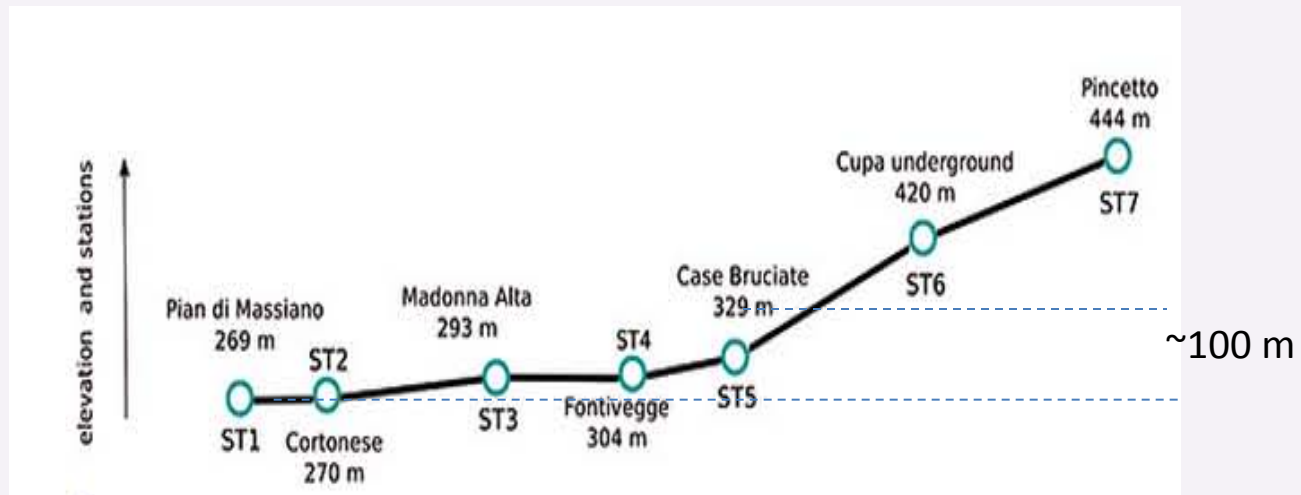
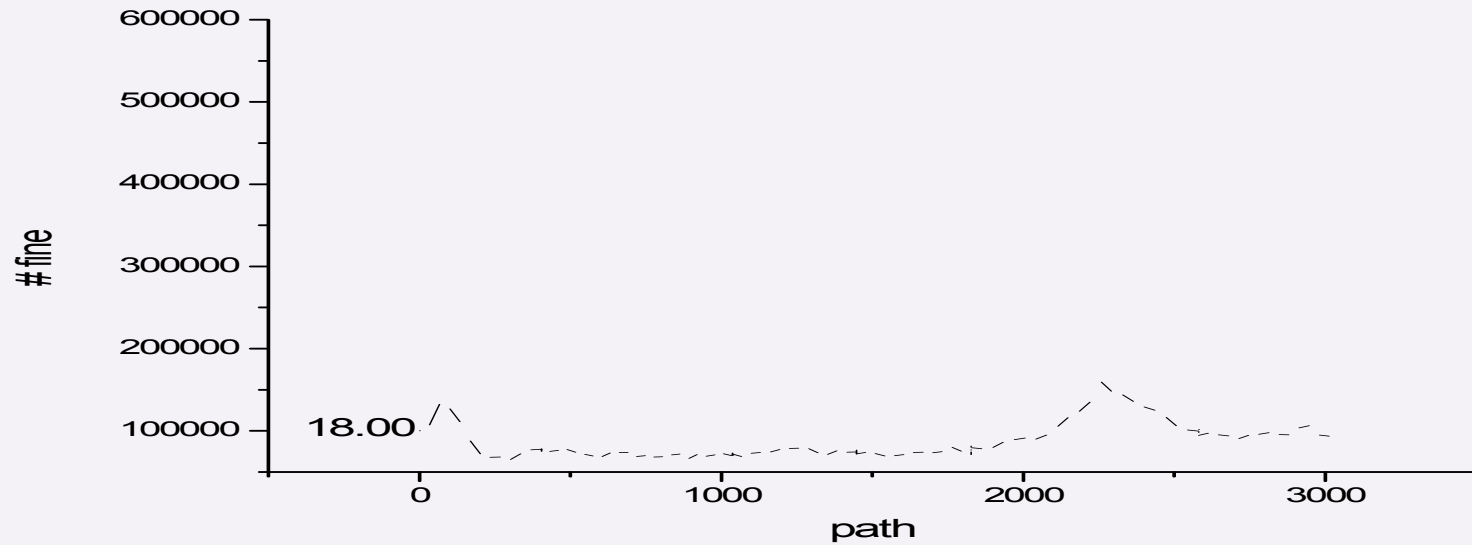


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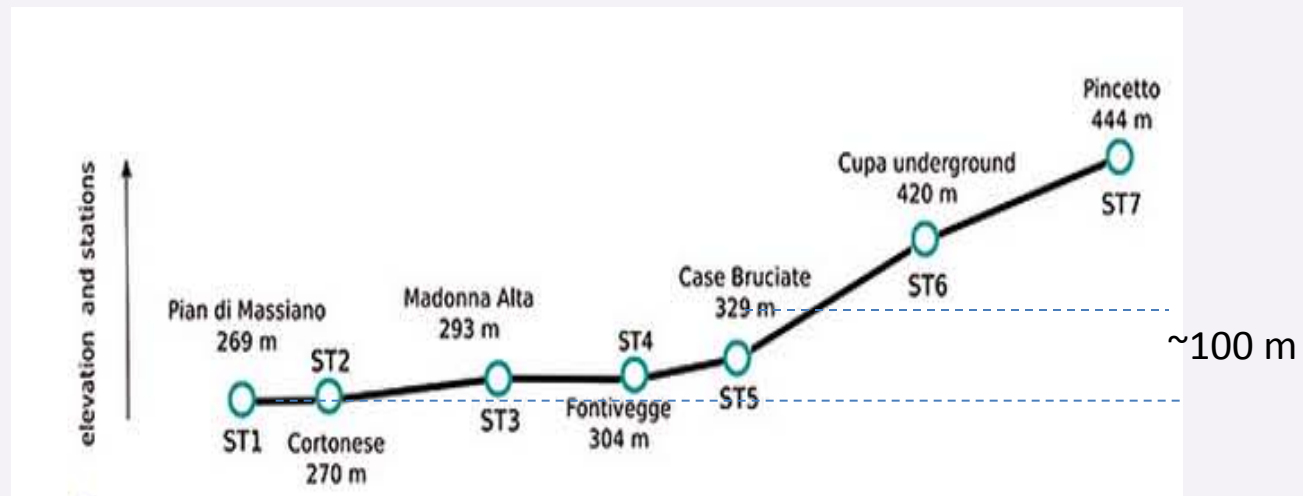
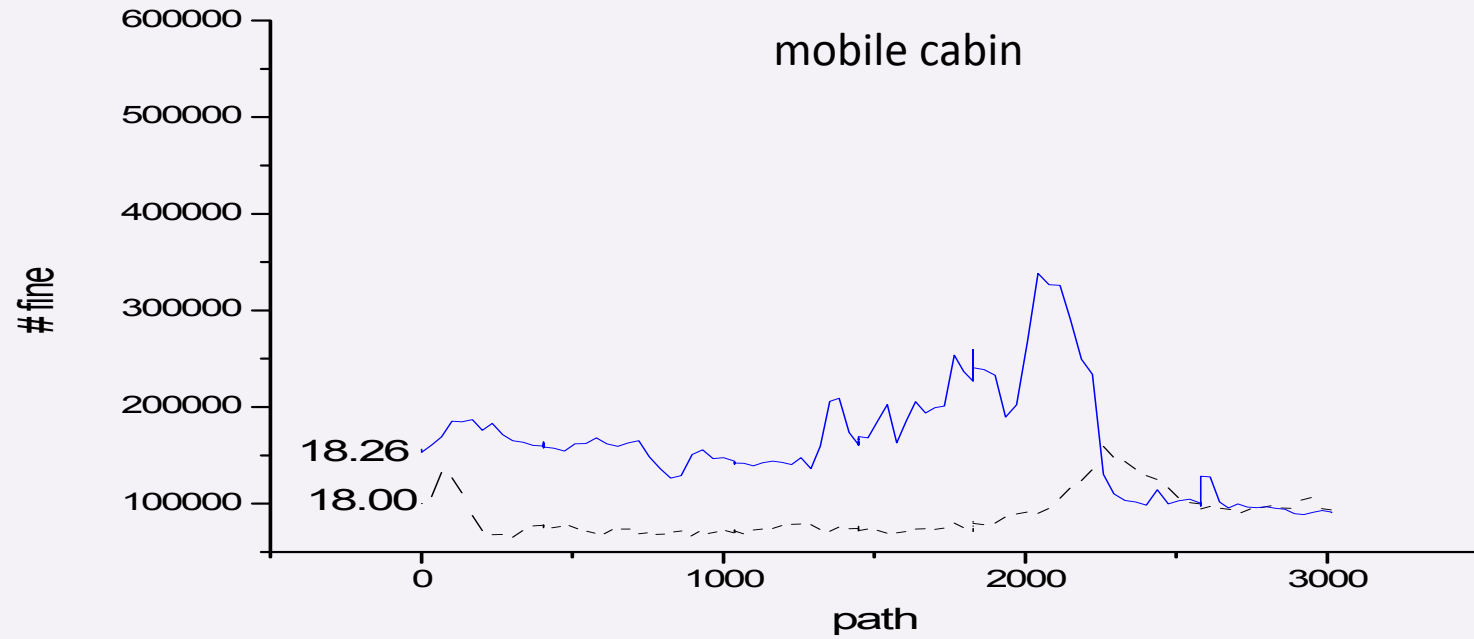


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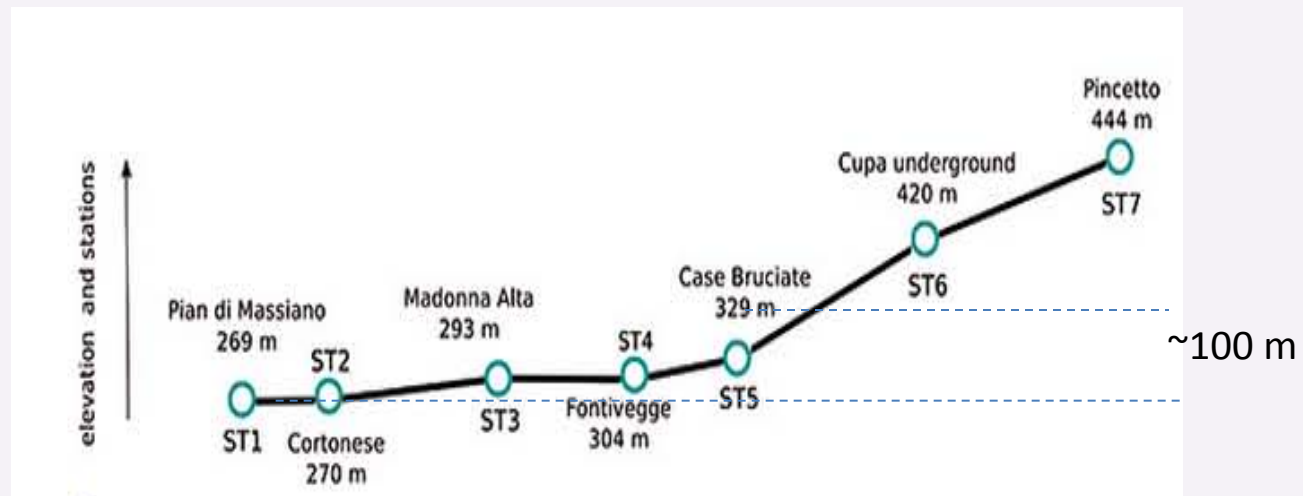
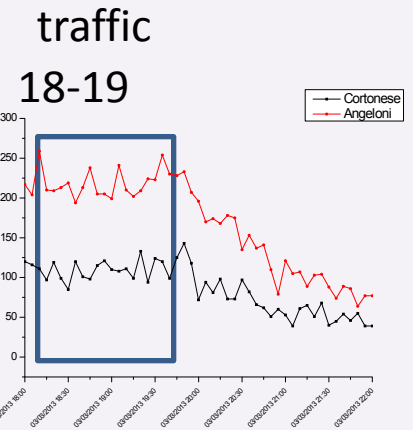
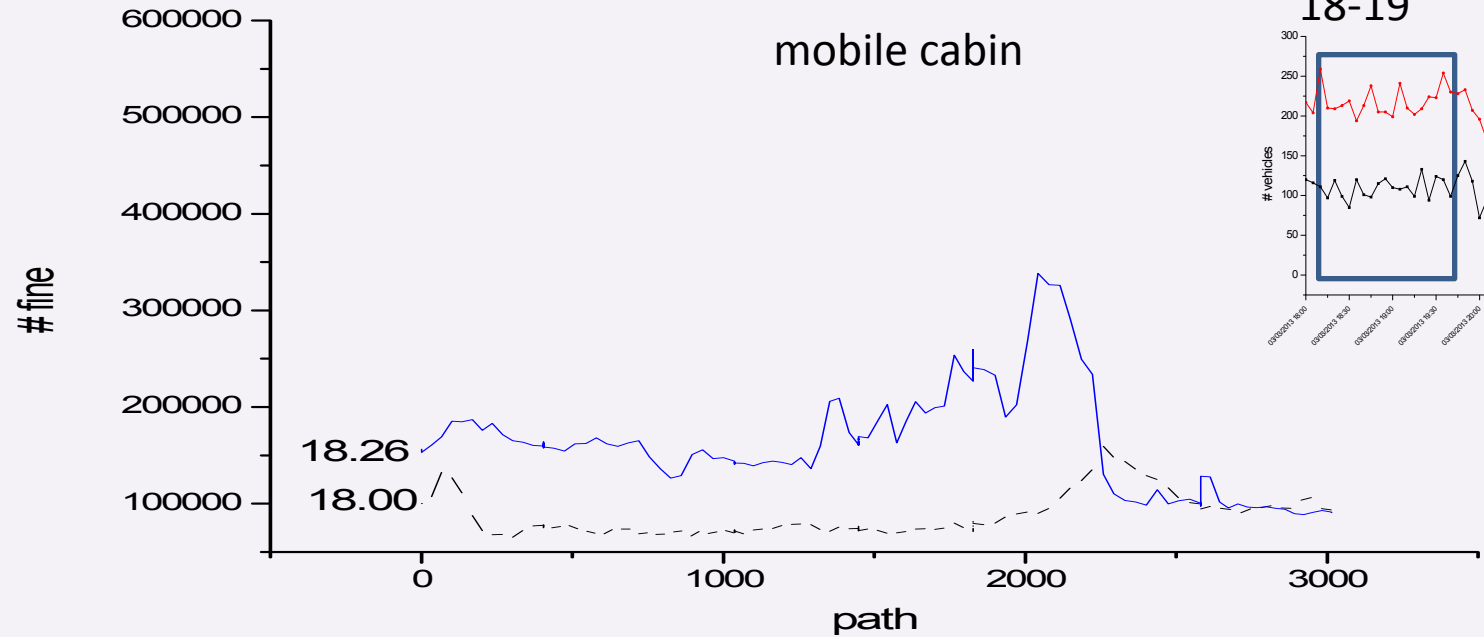
mobile cabin



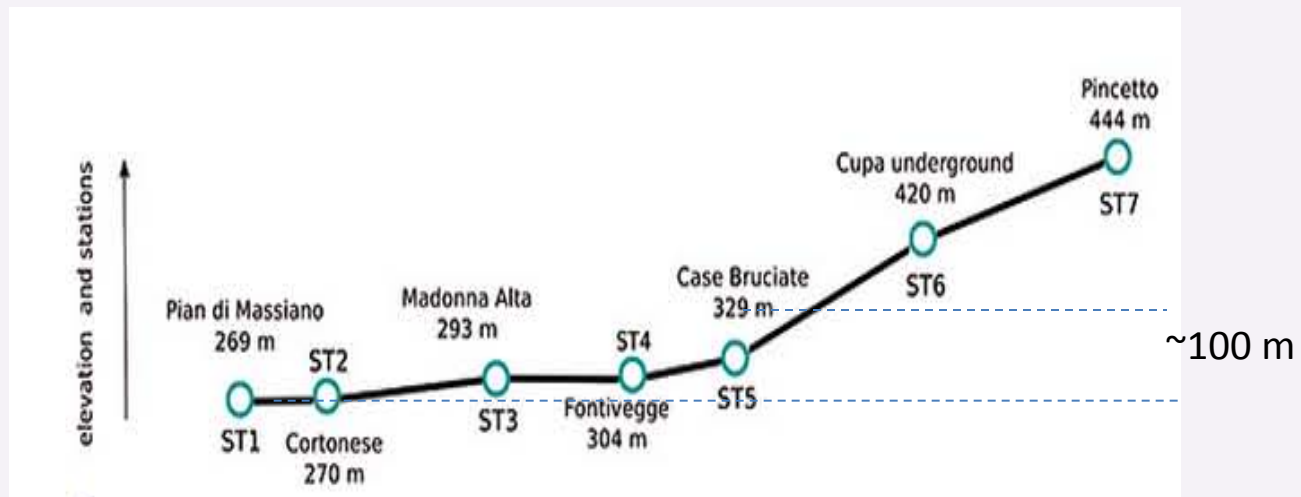
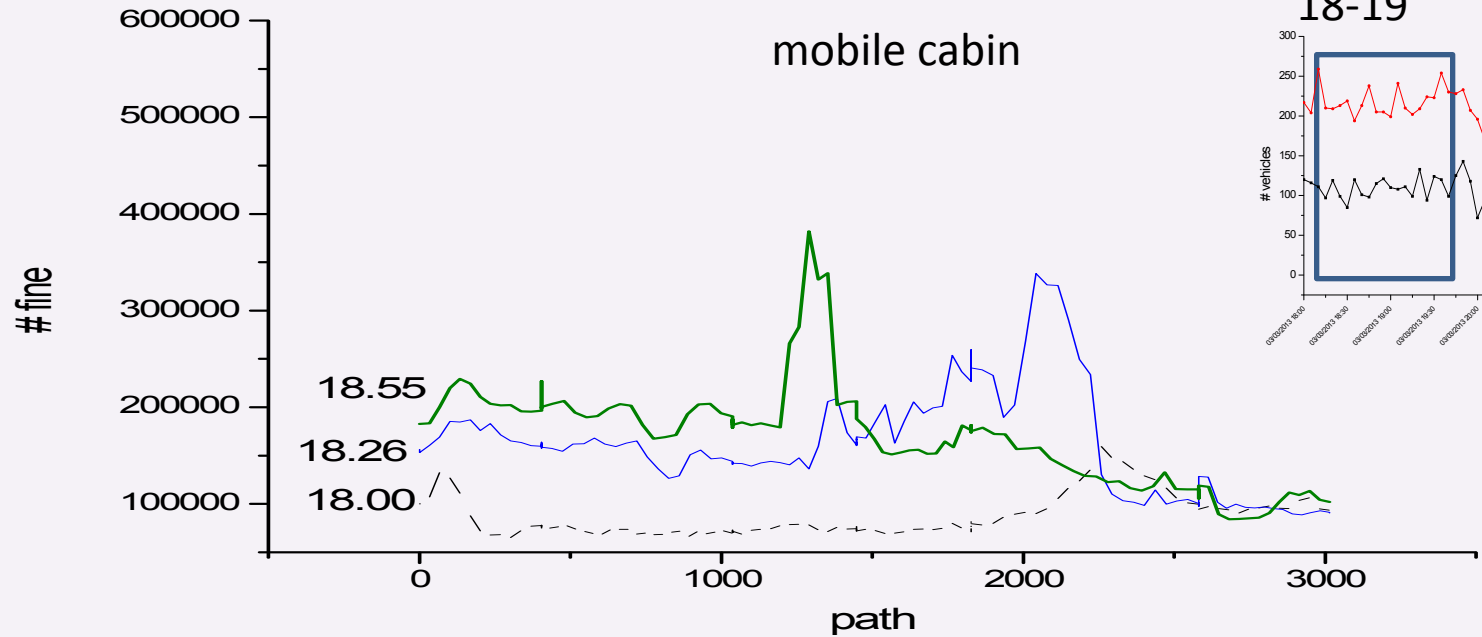
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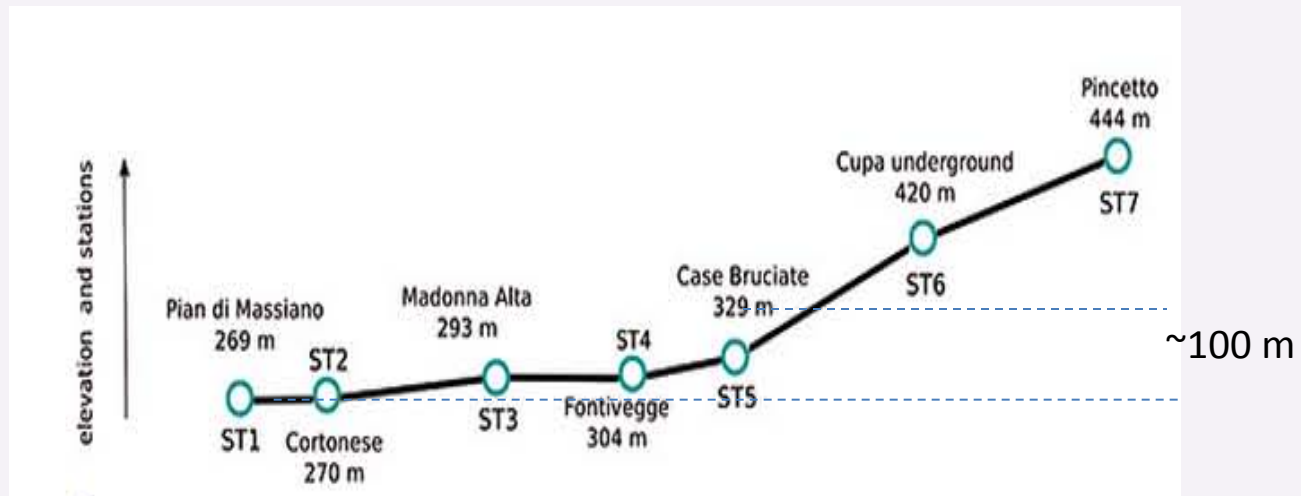
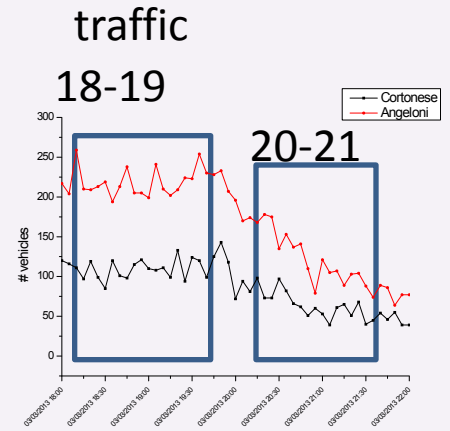
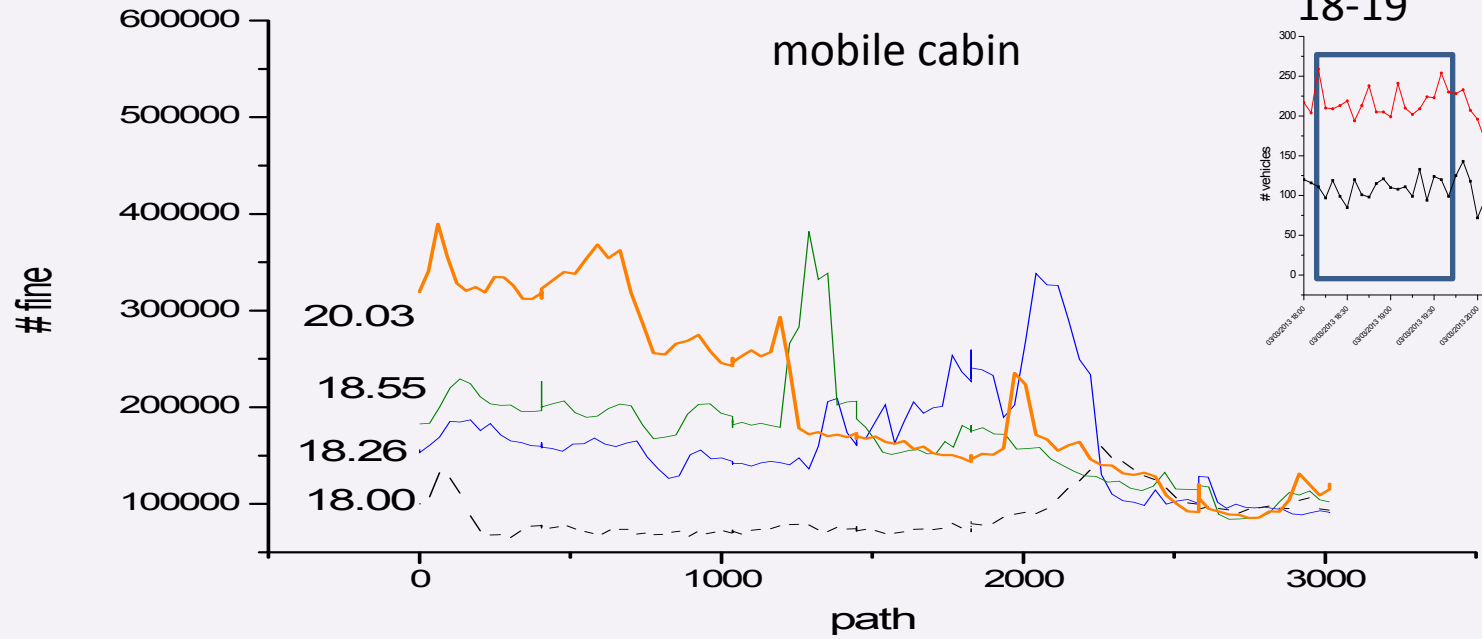
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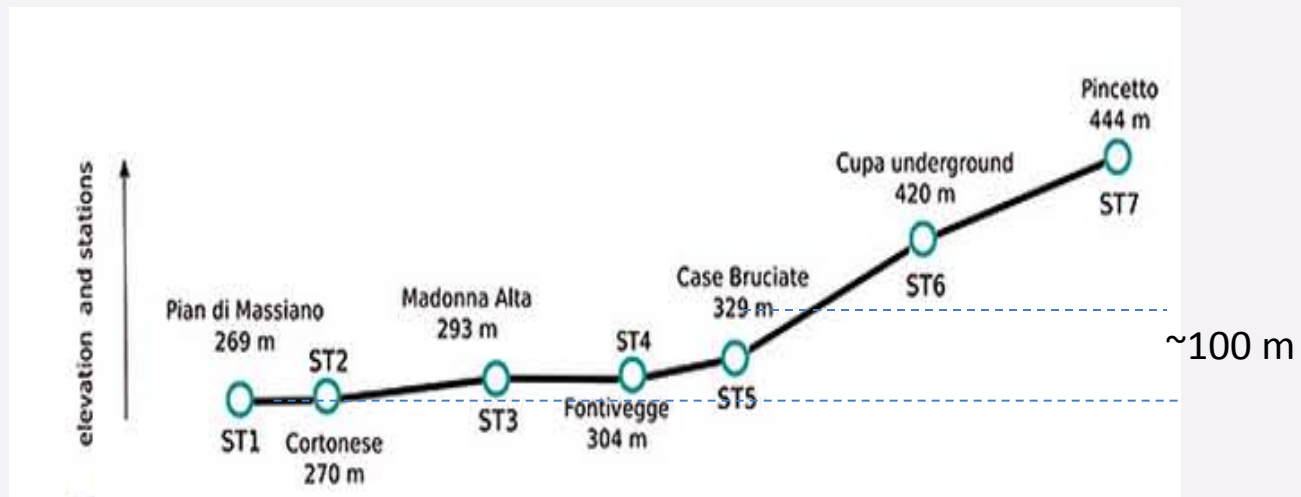
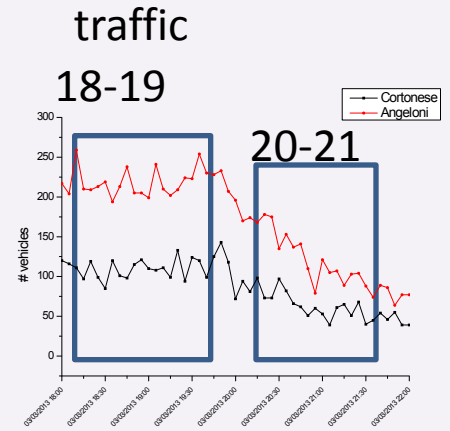
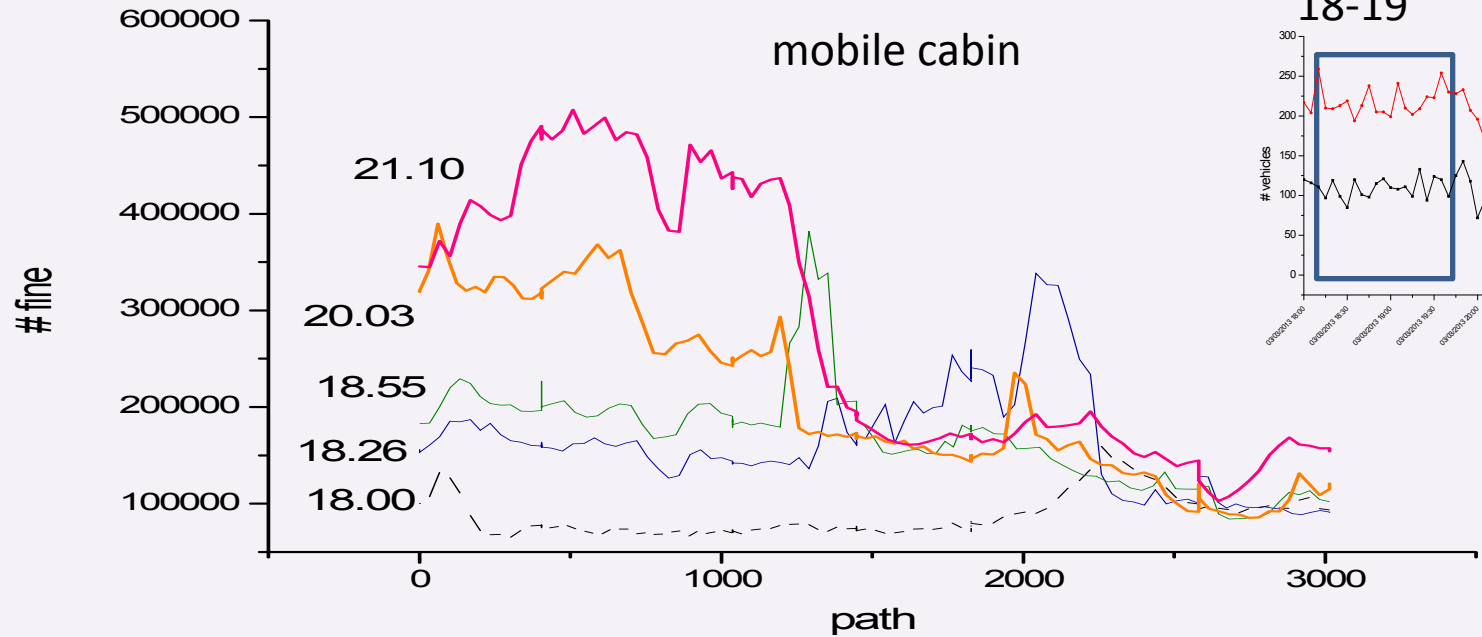
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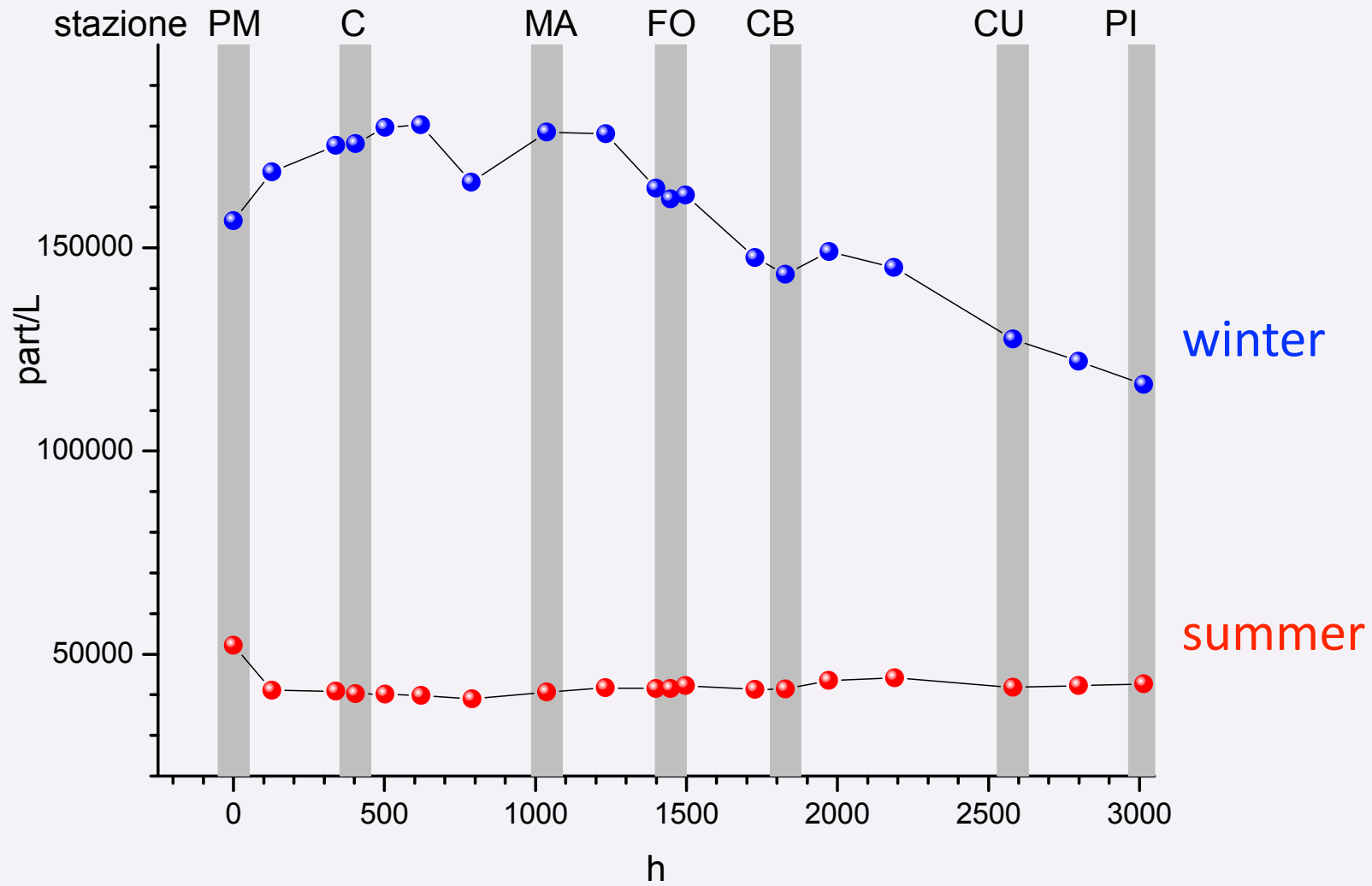
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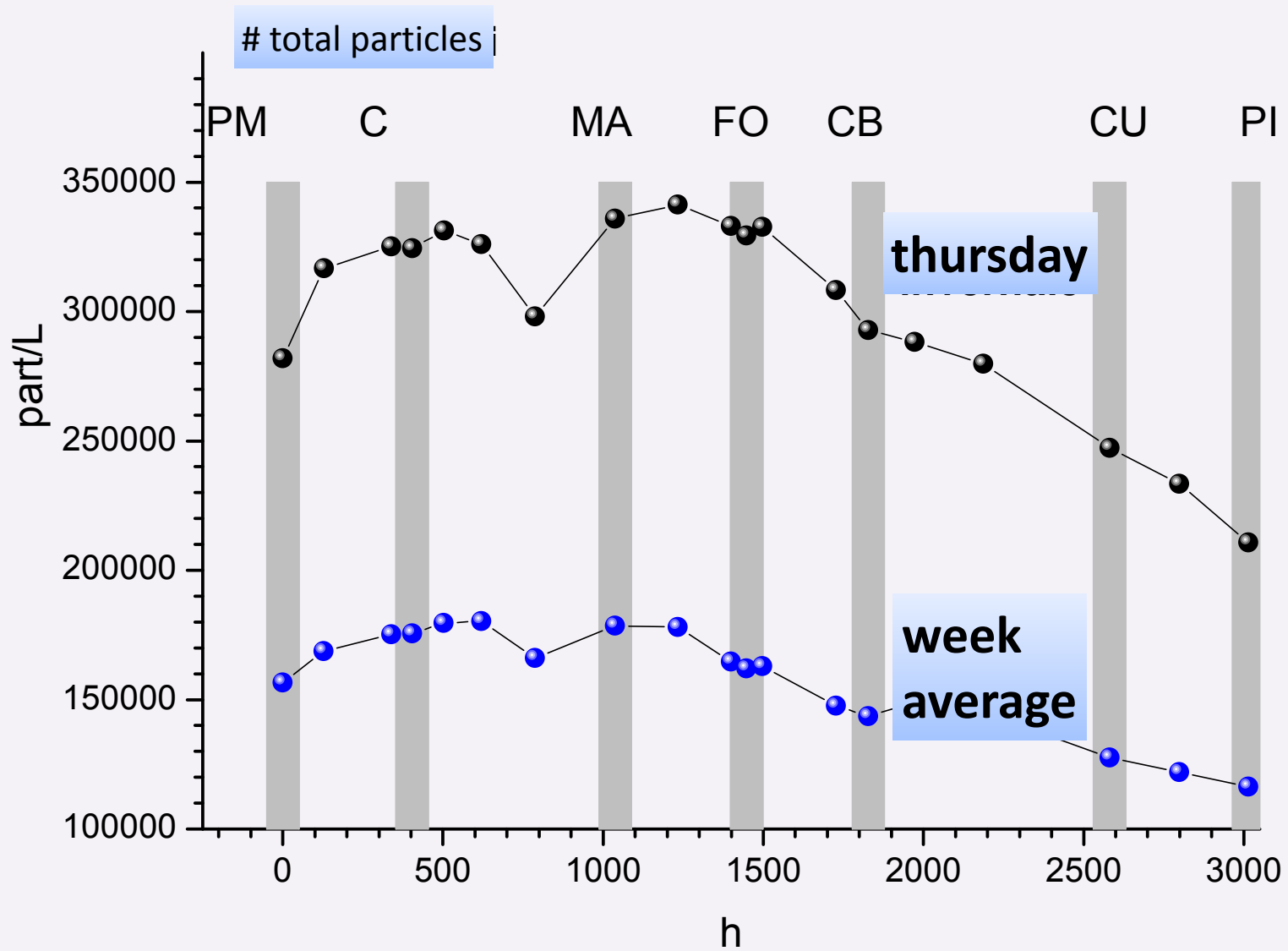
2. atmospheric stability



seasonal dependence



week dependence



in depth **statistical analysis**

in collab. G. Ranalli (Dpt. Scienze Statistiche- UNIPG)

1. Functional Data Analysis (& cluster analysis)

2. Generalized Additive mixed model (GAM)

- Size classes quite correlated
- Good predictors: rain, relative humidity, solar radiation, wind speed, PBL
- If other things are equal → traffic significant predictor

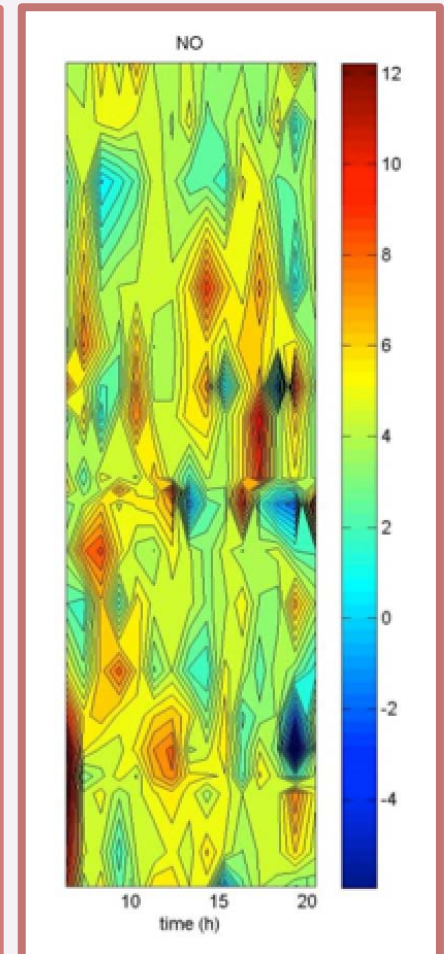
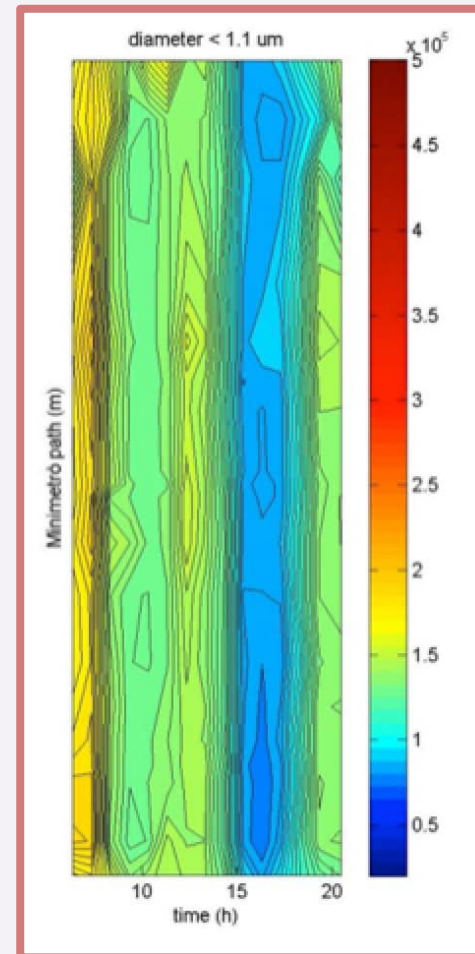
nitric oxide

fine ($D_p < 1.1 \mu\text{m}$)

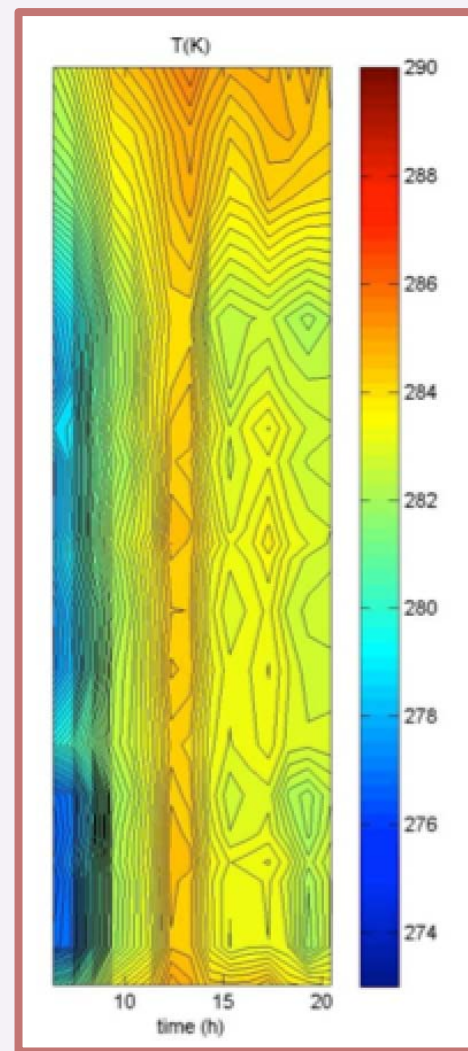
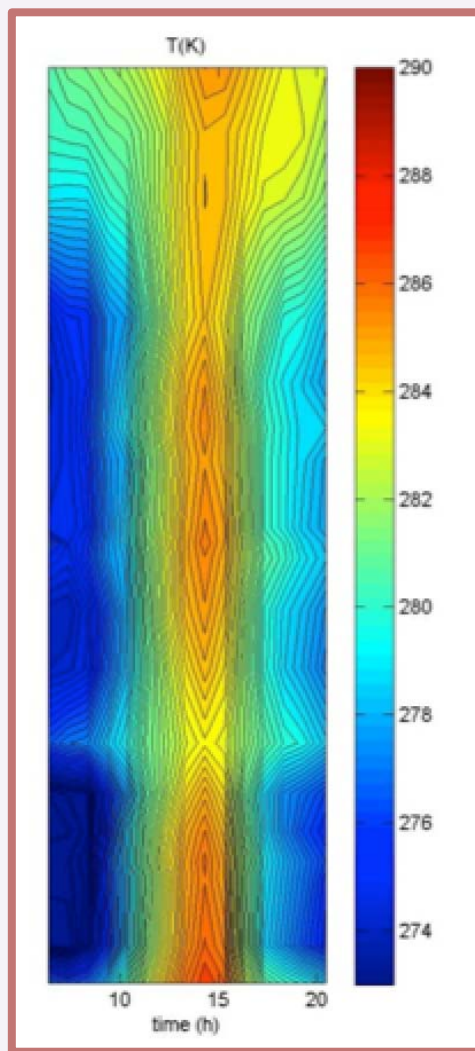
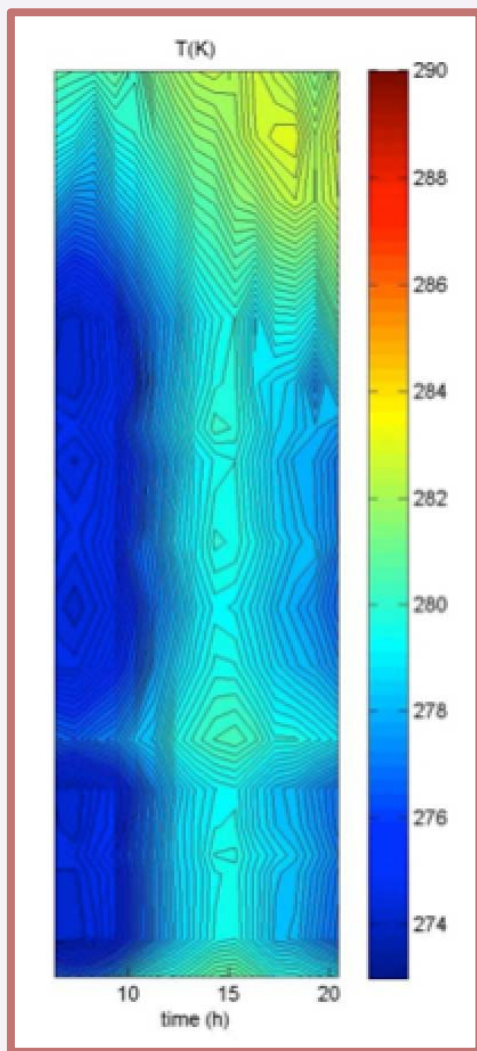
NO



NO - 2Btech (10 sec. res.)
in collab. IIA-CNR
(Iannello/Salvadori/Esposito/Spataro)



urban micro-meteorology



Intensive campaigns

- Black Carbon (micro-Aethalometer)
- nanoparticles (miniDisk*)

*in collab. Ferrero/Bolzacchini- UNIMIB)

- CO₂, O₃

communication

www.pmetro.it

communication

www.pmetro.it

PMetro • THE FUTURE IS IN THE AIR.



search



PMetro is a novel approach to characterize urban particulate matter, which exploits a mobile platform integrated on a Minimetro cabin and combines real time measurements with the data from the local Environmental Protection Agency (ARPA).

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NEWS

Weekly focus

Mildly cloudy to covered sky with weak rains and storms.

...

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NEWS
Weekly focus
Mildly cloudy to covered sky
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...
[All news »](#)

aknowledgments

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Roberto Ferrera, Enrico Bompadre (FAI Instruments)

Giovanna Ranalli (Università di Perugia, Dip. Statistica)

Monica Angelucci, Marco Pompei, Mara Galletti (ARPA Umbria)

Max, Peter, Manuel (Leitner srl)

Luca Patiti (Minimetro spA)

Stefania Papa (Comune di Perugia)

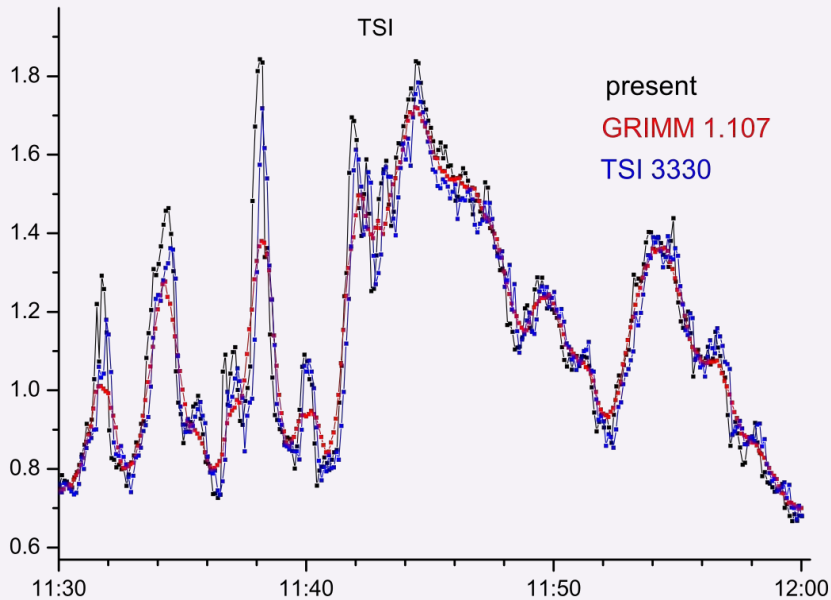
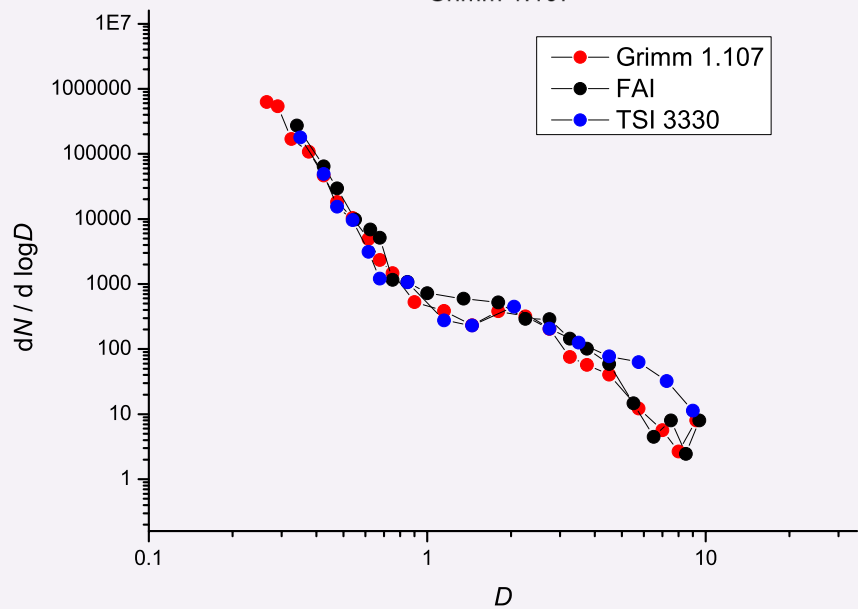
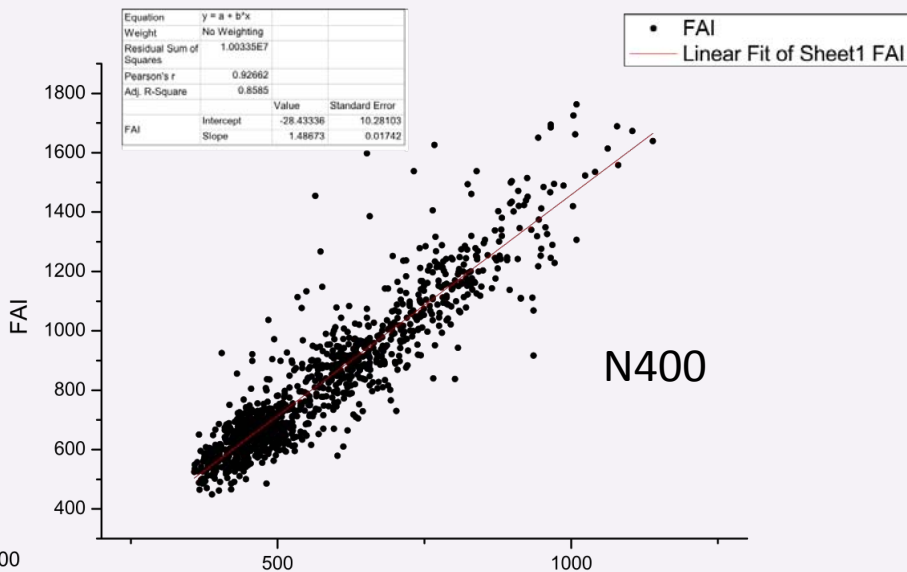
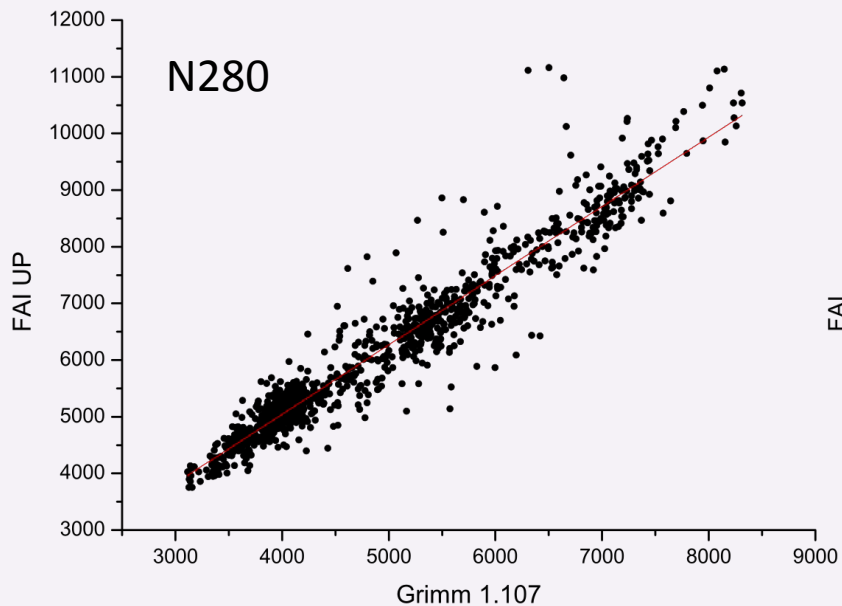
Francesca Spataro, Antonietta Ianniello, Rosamaria Salvatori, Giulio Esposito (IIA- CNR)

Luca Ferrero, Ezio Bolzacchini (UNIMIB)

Financial support: ARPA Umbria

Technical support: FAI Instruments, Leitner srl

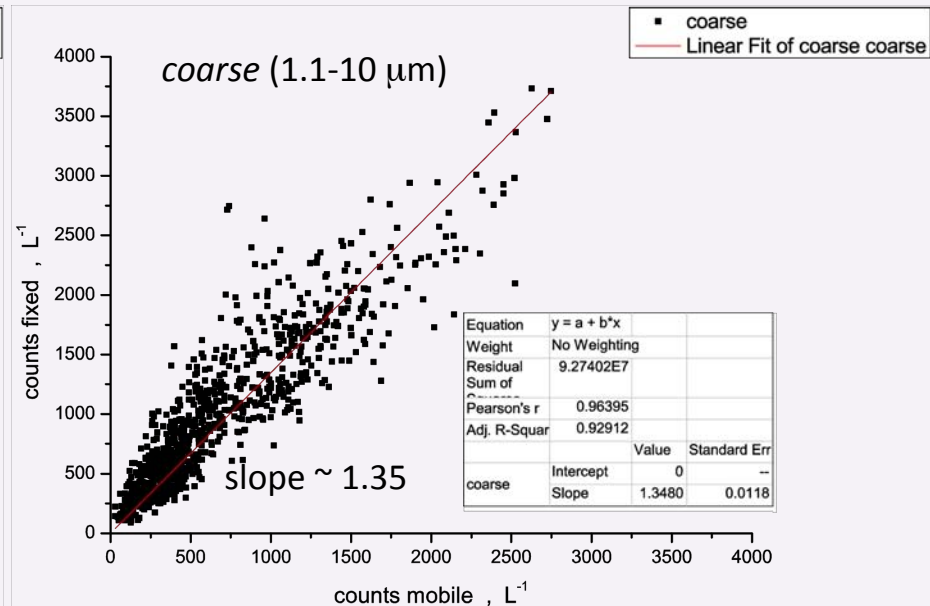
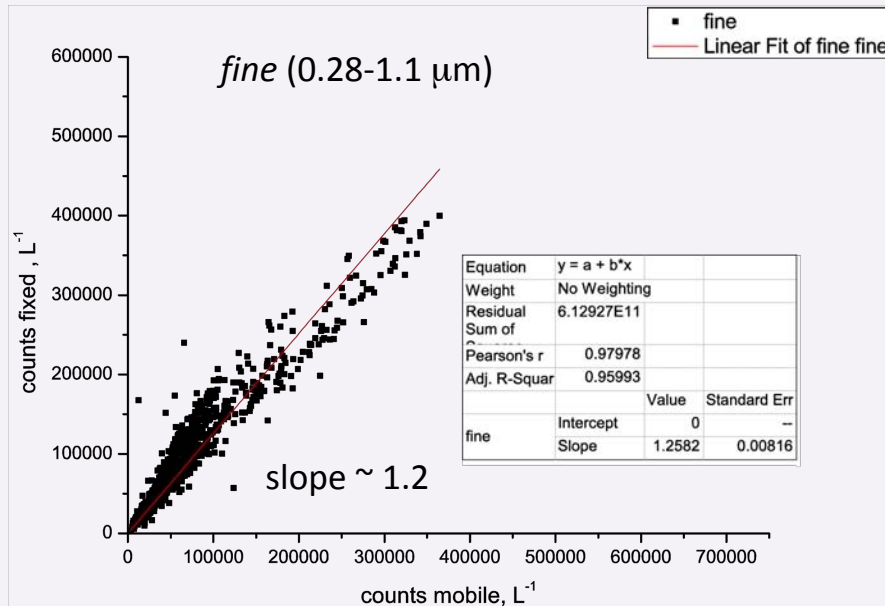
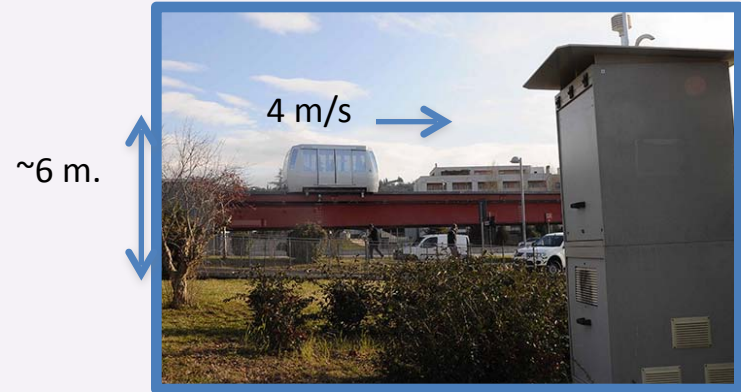
intercomparison (FAI-TSI-GRIMM)



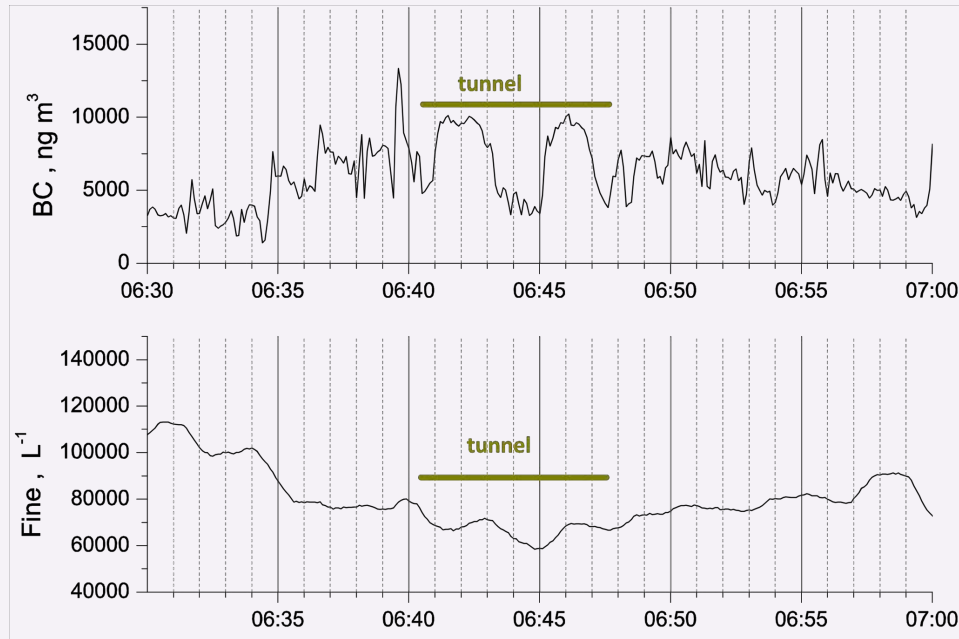
mobile vs fixed

Cabin speed 4 – 7 m/s (dep. timeframe)
 Flux 1 L min⁻¹
 Calculated particle losses 1-10% for $D_p < 1\mu\text{m}$
 20-60% (for $D_p > 5\mu\text{m}$)

(PLC, von der Weiden et al., 2009)



3. tunnel



- Seasonal (week long) campaigns (indoor vs outdoor) with HVS multistage impactors (metals, OC/EC, PAH, alkanes, BC, SEM)

$D_p < 0.4 \mu\text{m}$: OC/EC 2.1 ± 0.2 (tunnel) 5.5 ± 2.0 outdoor

in depth statistical analysis

in collab. G. Ranalli (Dpt. Scienze Statistiche- UNIPG)

