

Aerosols from wood combustion versus traffic in an Alpine valley

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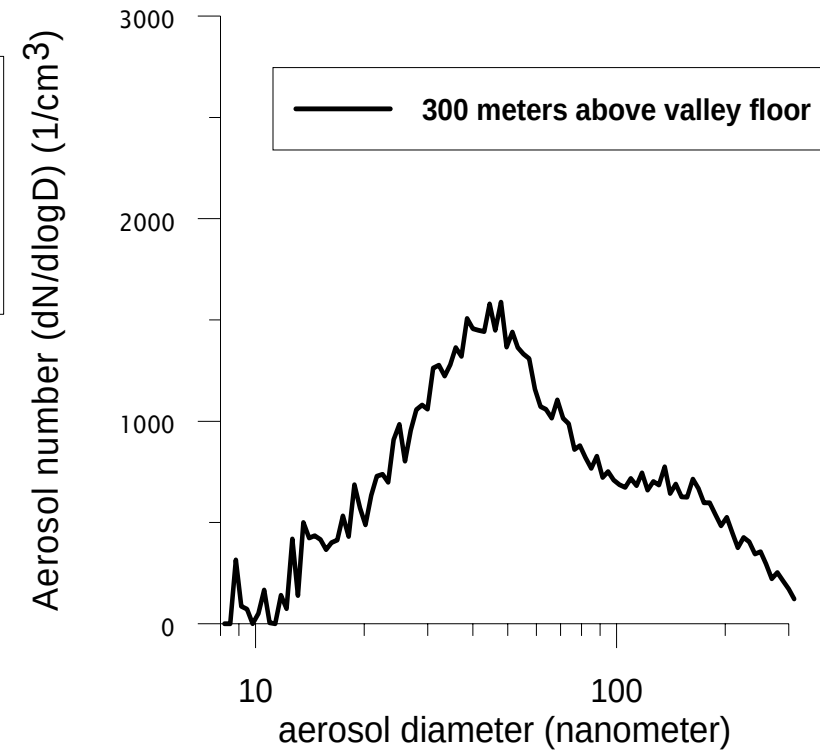
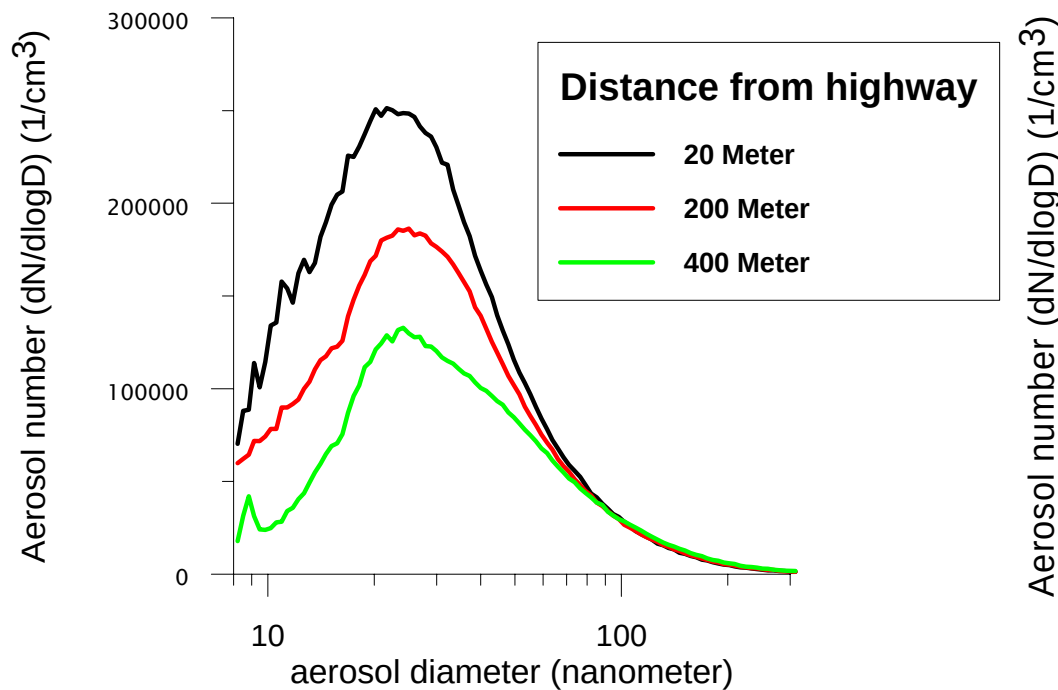
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- CHOICE OF MEASUREMENT LOCATIONS
- RESULTS (*Field measurements*: Aethalometer, Aerodyne Aerosol mass spectrometer, ¹⁴C analysis, Levoglucosan measurements; Aethalometer measurements of freshly emitted wood burning aerosols at EMPA facilities)
- CONCLUSIONS (Contributions of Wood burning versus traffic at two sites; Use of Aethalometer as a tracer for wood burning;)

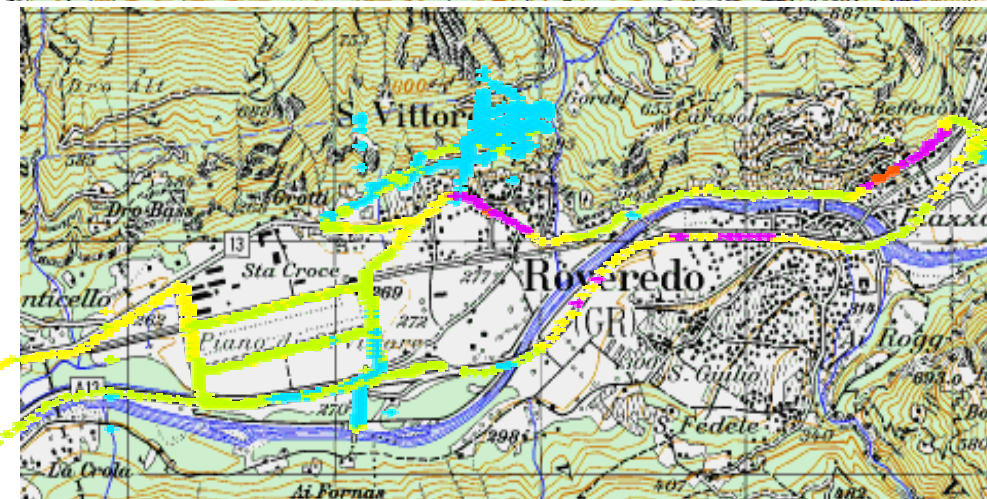
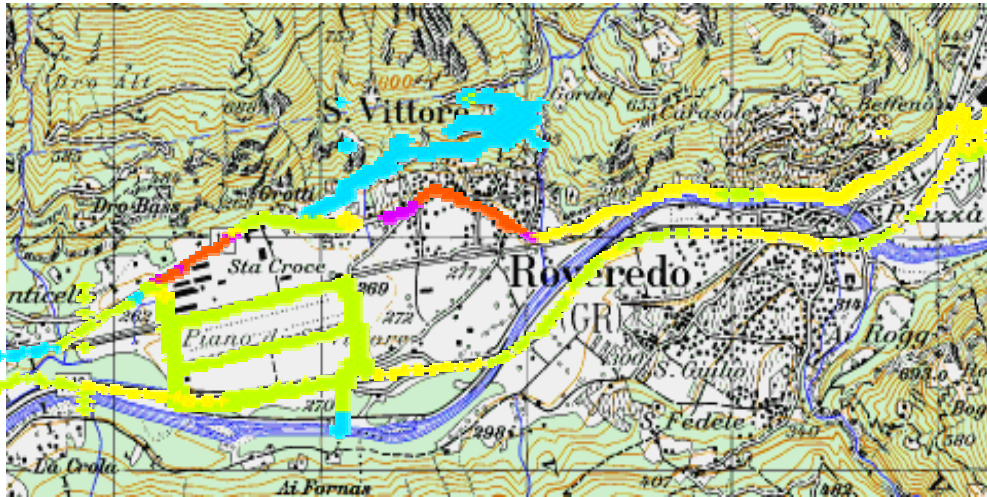
Roveredo, a nice place to study aerosols



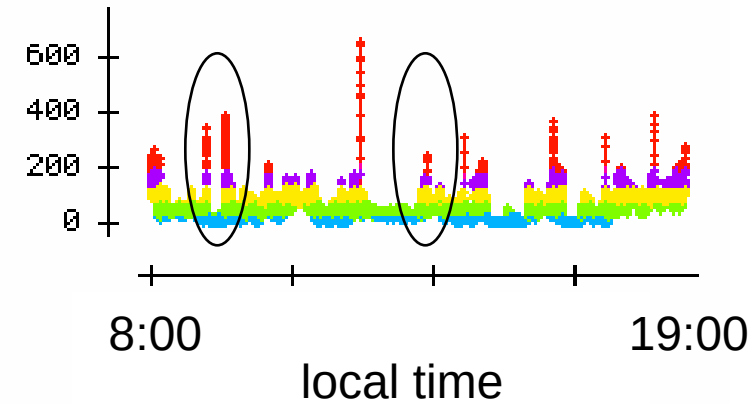
Aersosol number distribution in the Mesolcina valley



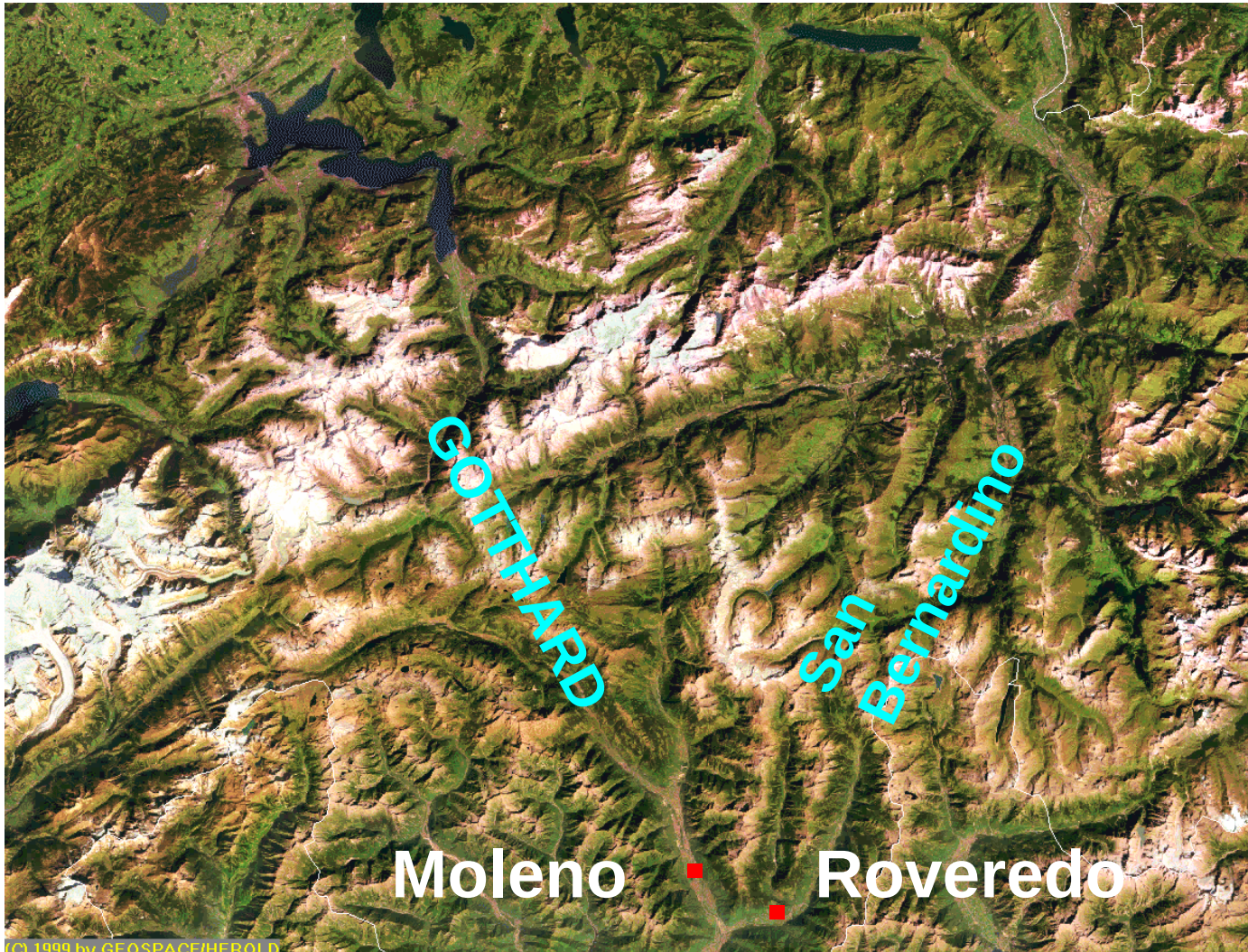
Measurements of aerosol surface (DC) in the Mesolcina valley



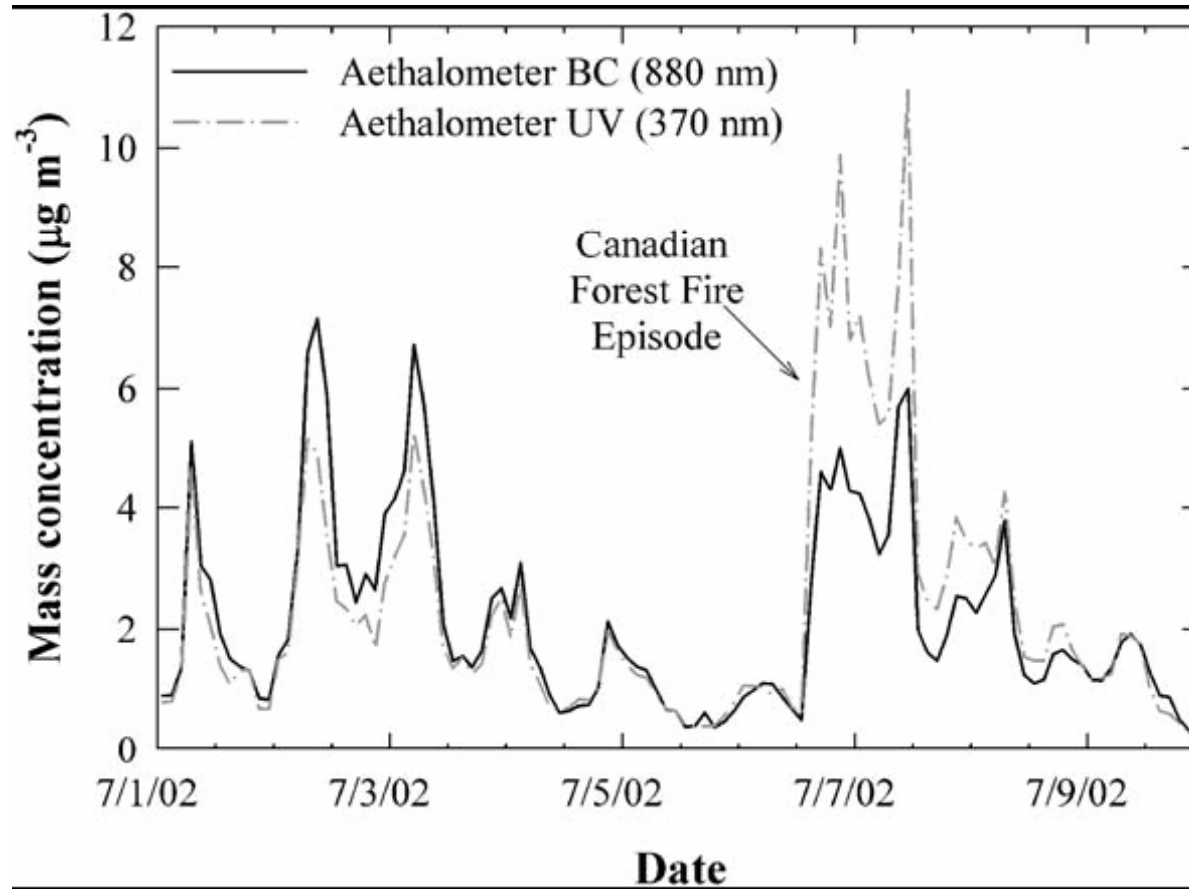
Aerosol surface
($\mu\text{m}^2/\text{cm}^3$)



Sites during the AEROWOOD study

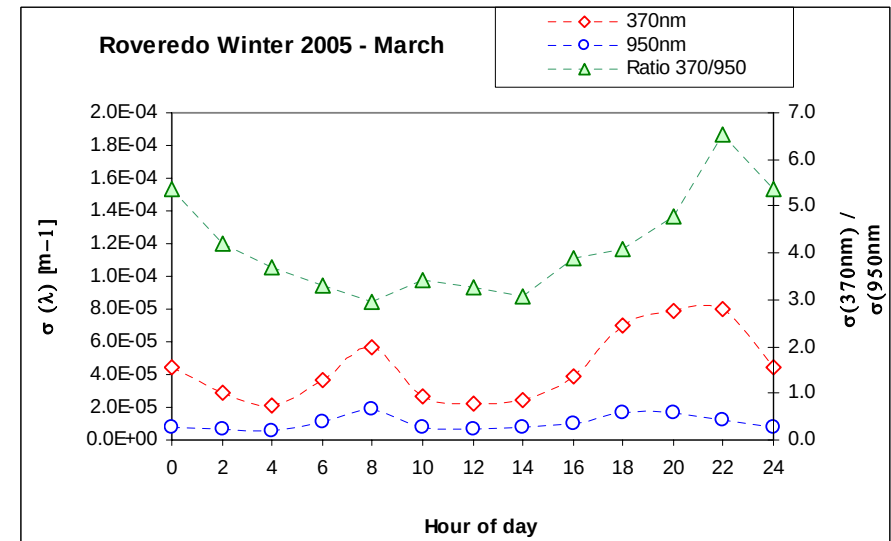
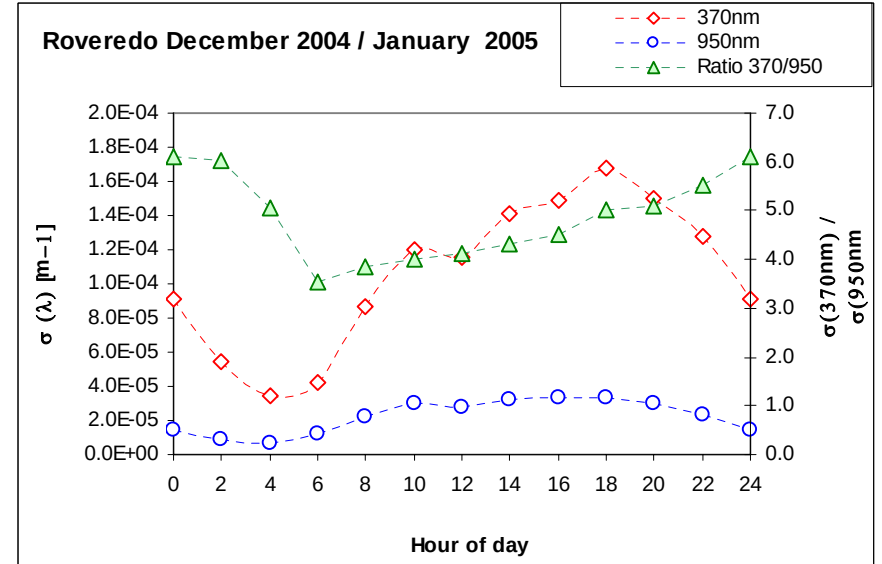
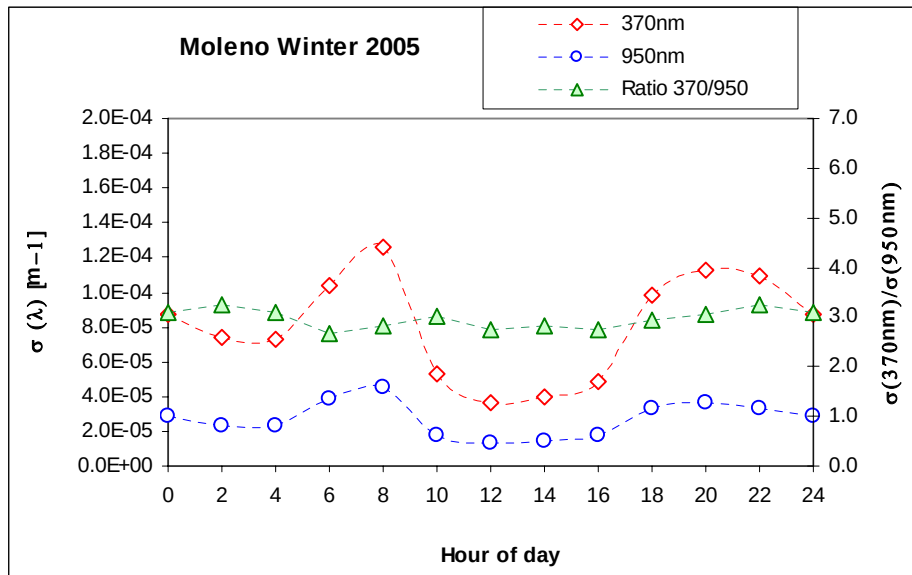


Why use an Aethalometer to detect wood burning particles



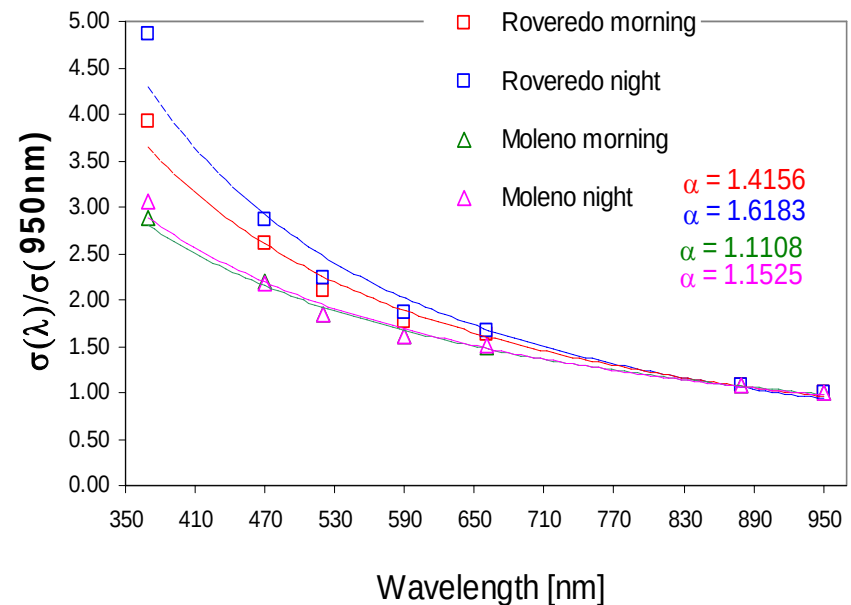
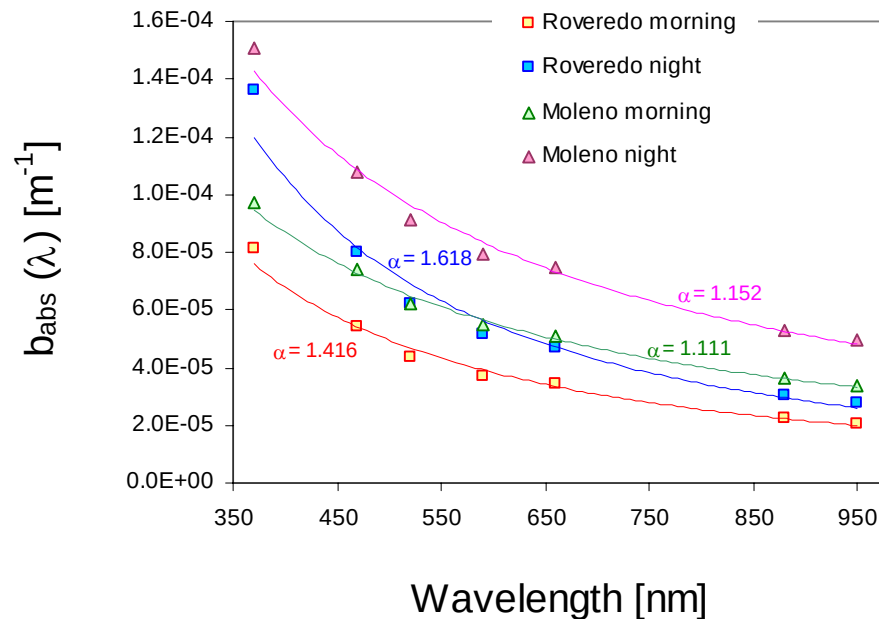
Jeong et al., Atmos. Environ., 2004

Aerosol light absorption coefficient (950nm and 370 nm) at Moleno and Roveredo



Wavelength dependence of the aerosol light absorption coefficient in Roveredo and Moleno

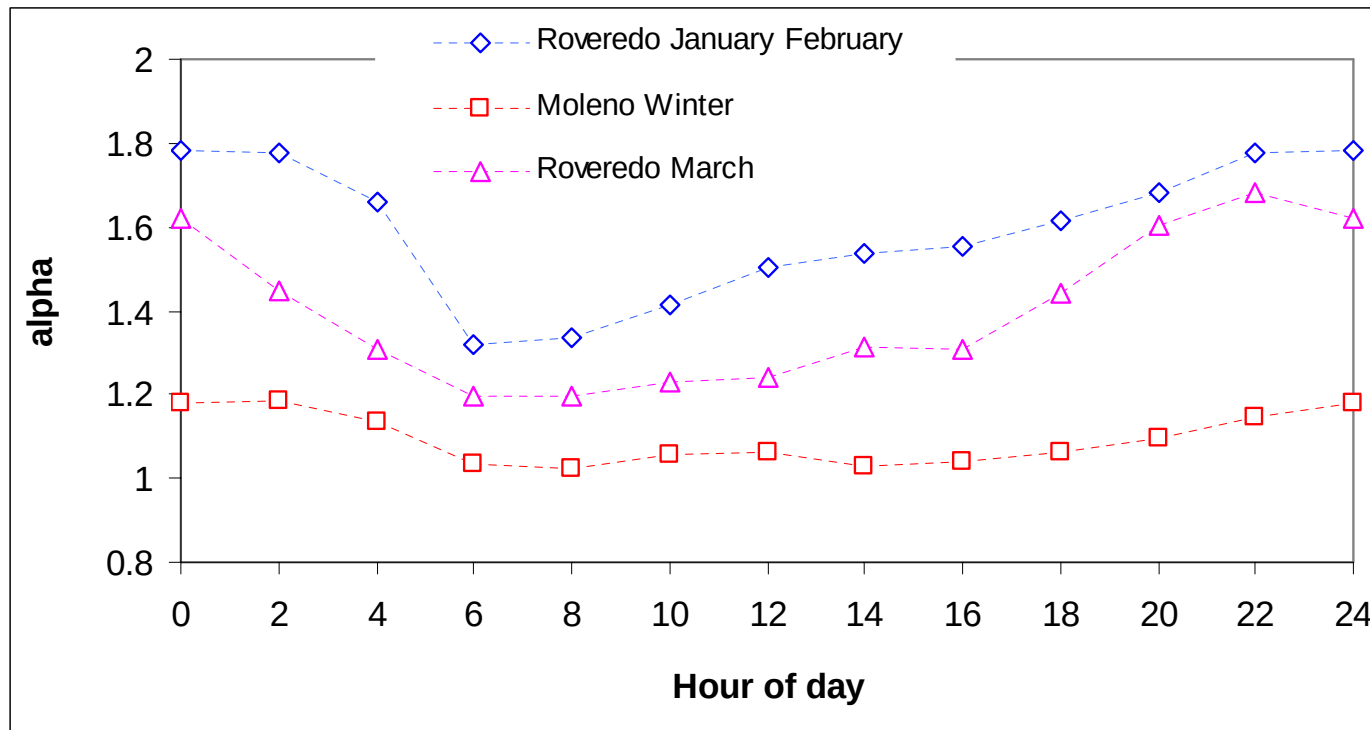
α : aerosol absorption power law exponent



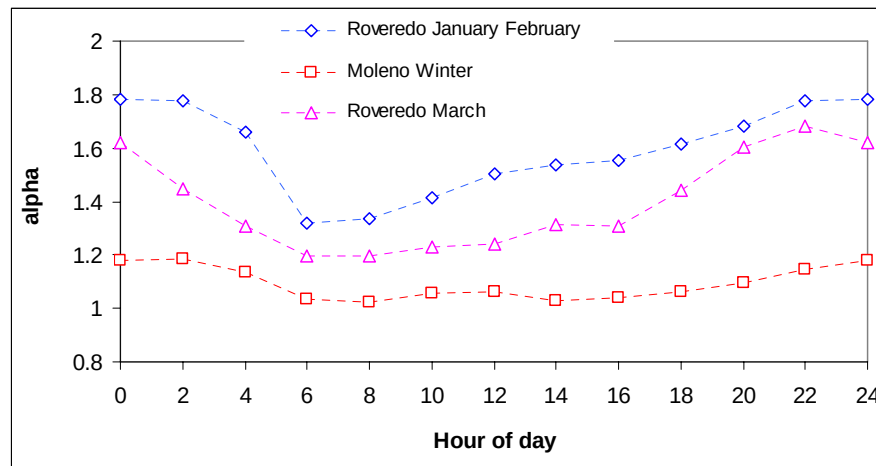
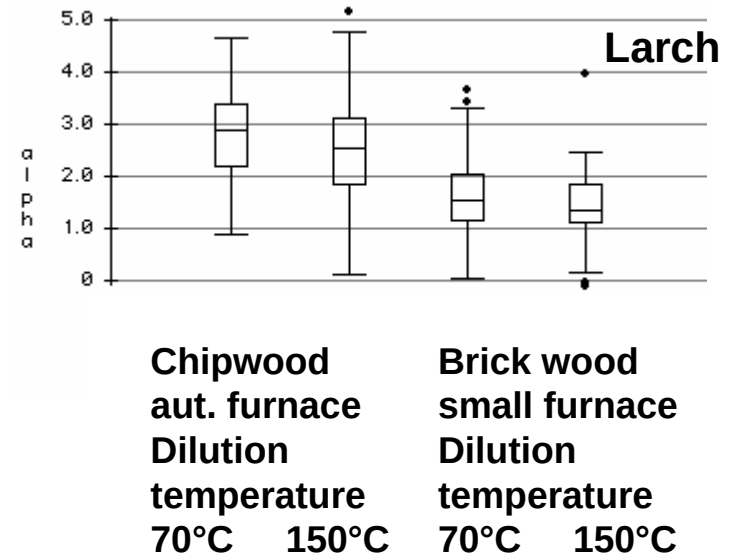
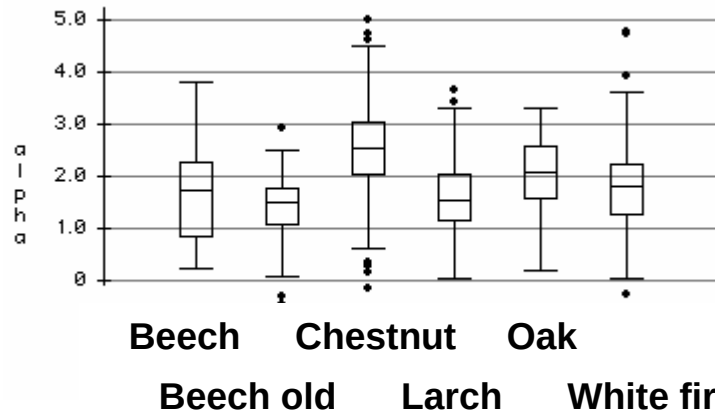
α (diesel traffic) typically around 1.1

See also poster by Schmidhauser et al.

Diurnal pattern of aerosol absorption power law exponent α in Roveredo and Moleno



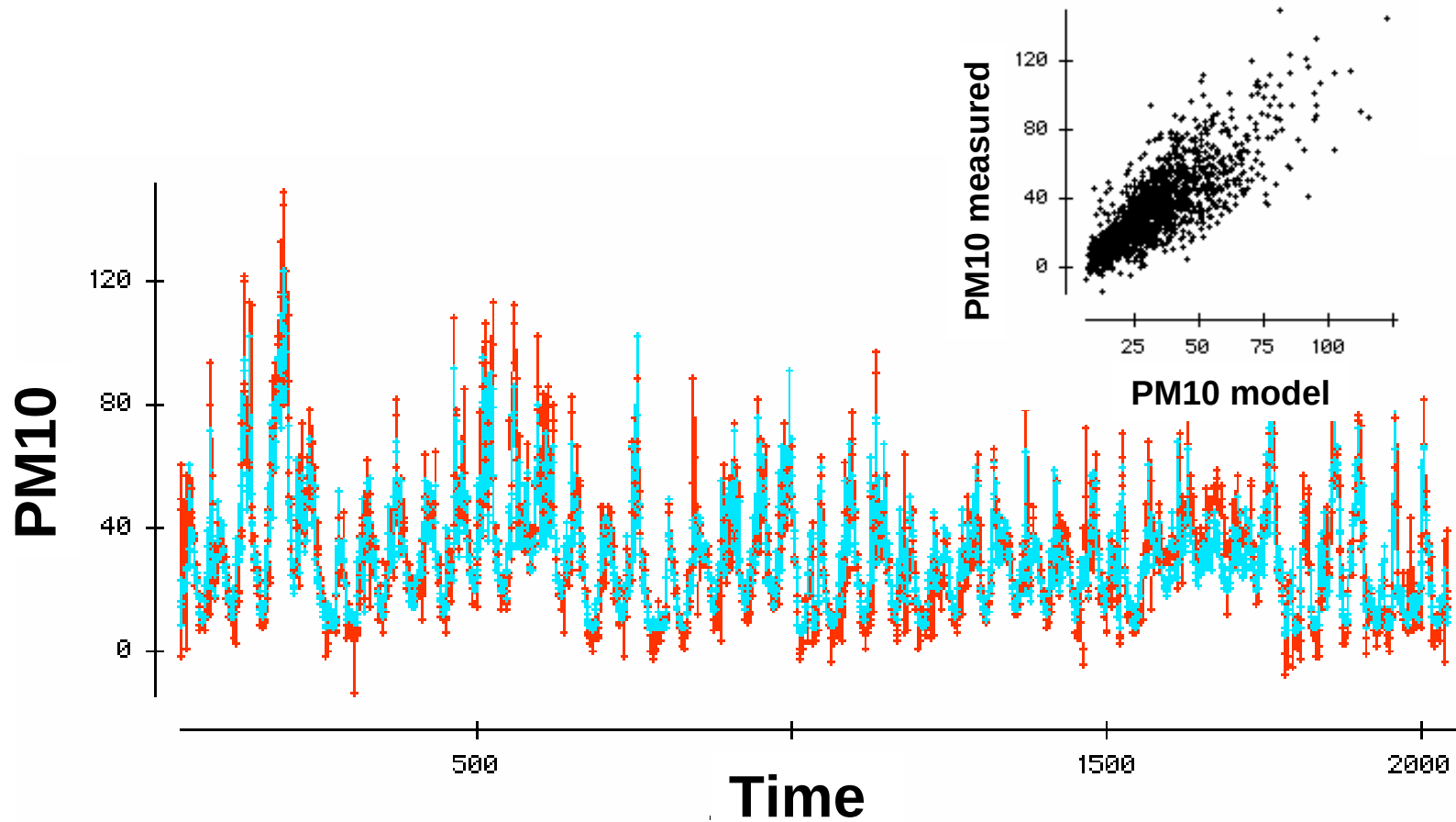
Aerosol absorption power law exponent in Roveredo and Moleno compared to direct wood burning aerosols (Experiments performed at EMPA)



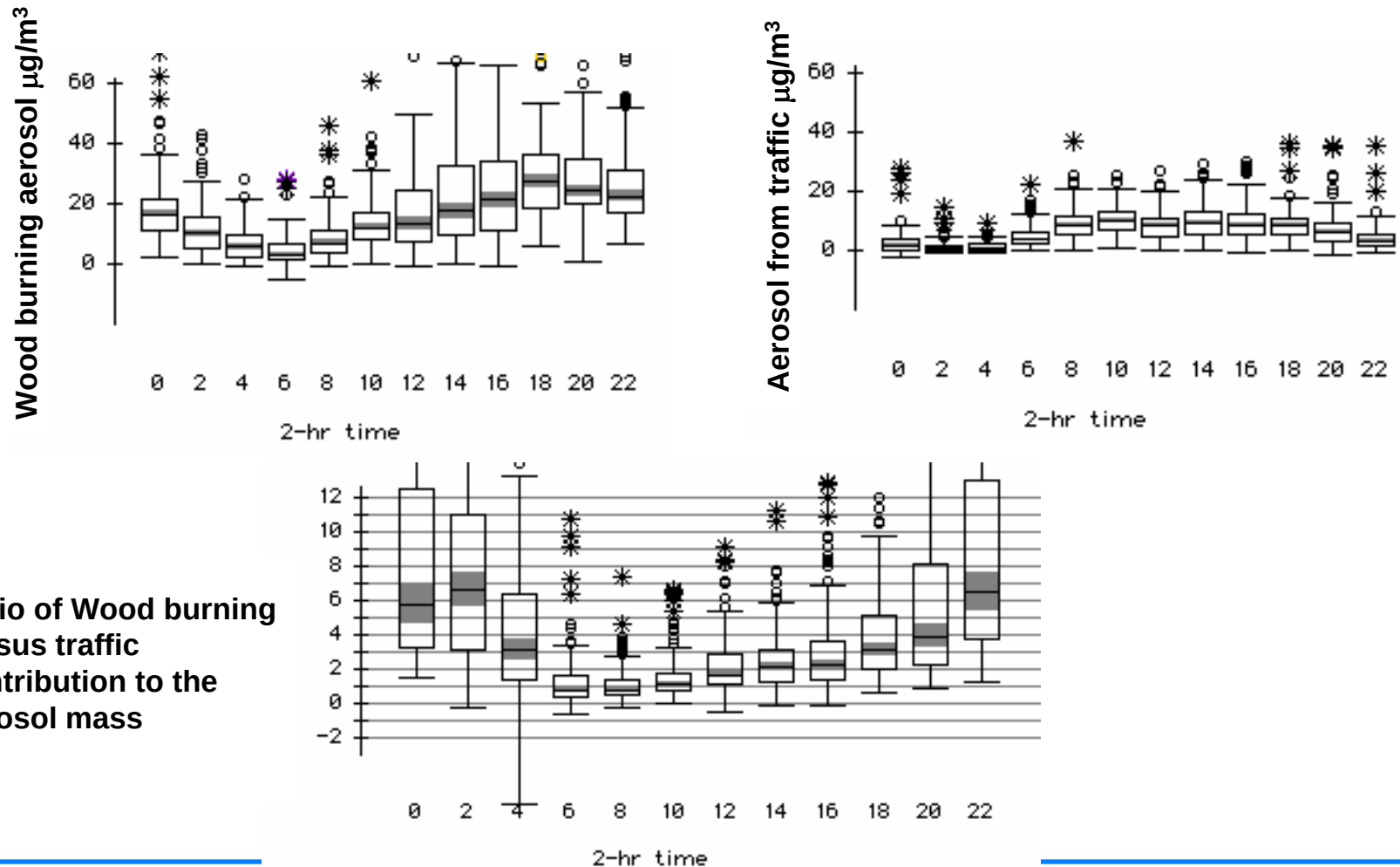
A possible estimation of wood burning and traffic fraction with the Aethalometer

- Derivation/Estimation of aerosol absorption powerlaw exponent for traffic ($\alpha(\text{traffic})=1.1$) and wood burning aerosol ($\alpha(\text{wood})=2.1$)
- Calculate contribution of traffic and wood burning to the absorption at 950 and 370 nanometers
- 1st Assumption : Emission of traffic particulate mass proportional to the traffic contribution to $\sigma(950)$
- 2nd Assumption : Emission of wood burning particulate mass proportional to the wood burning contribution $\sigma(370)$
- Multi-linear regression : $\text{PM}_{10} \sim \alpha * \sigma(950) + \beta * \sigma(370) * \gamma$

Comparison measured PM10 versus model PM10

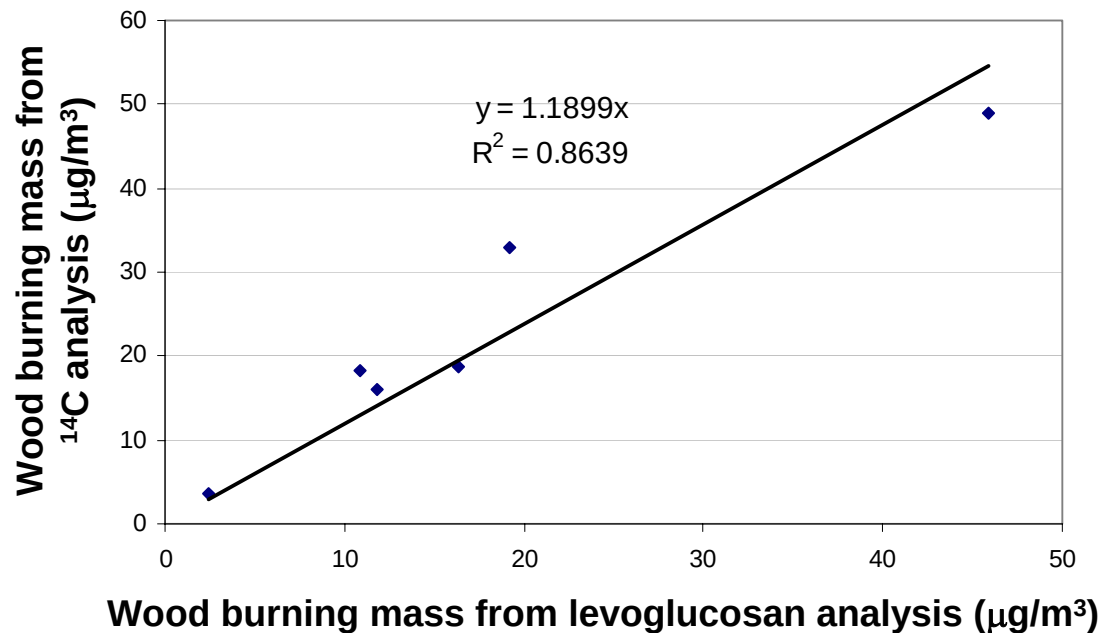


Average diurnal pattern Wood burning versus traffic aerosol mass in Roveredo



Preliminary ^{14}C and levoglucosan analysis

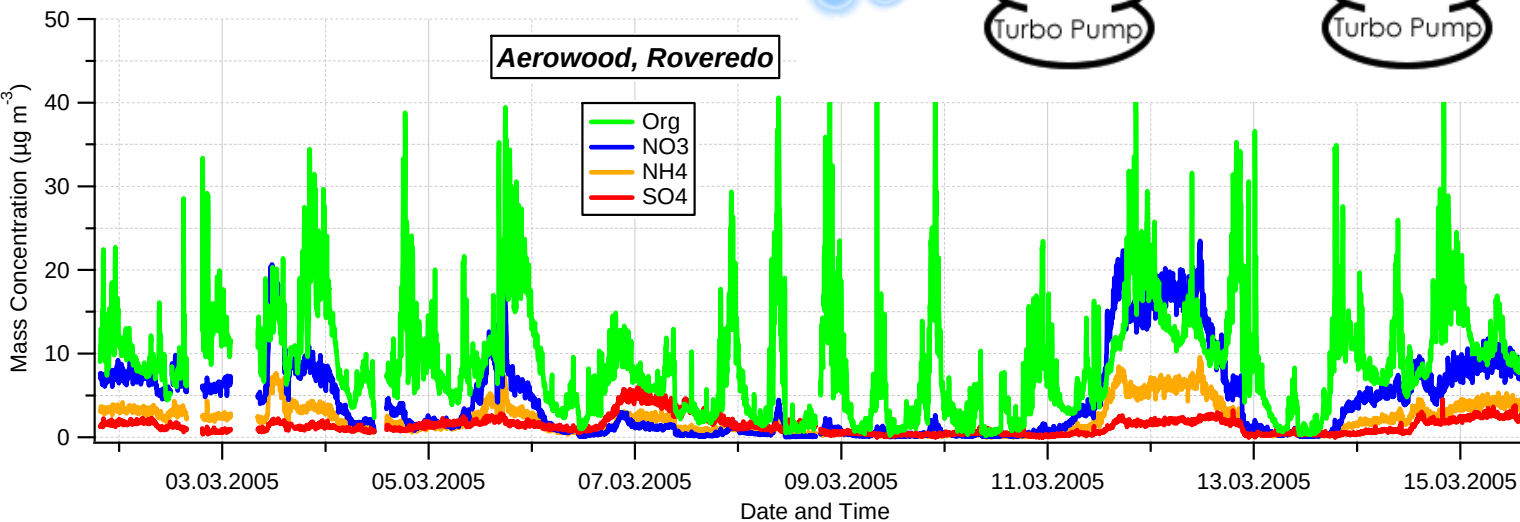
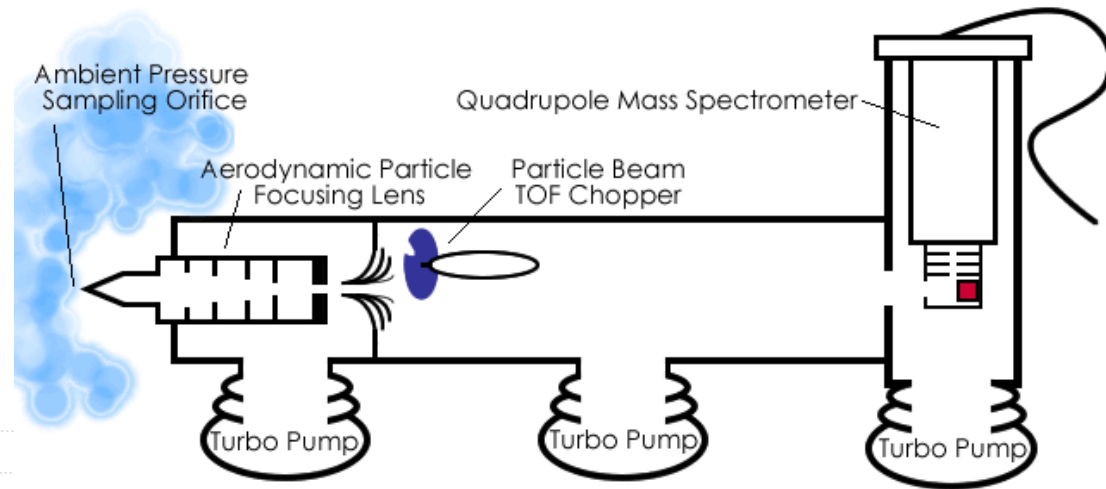
- ^{14}C analysis of HiVol-Quartz filters yields modern and fossil carbon fraction of EC and OC (Szidat et al., 2004)
- Assumptions OM/OC (traffic) = 1.4 ; OM/OC (wood burning) = 2.4
- Wood burning aerosol mass = 10 * Levoglucosan mass



Comparison ^{14}C method with Aethalometer method

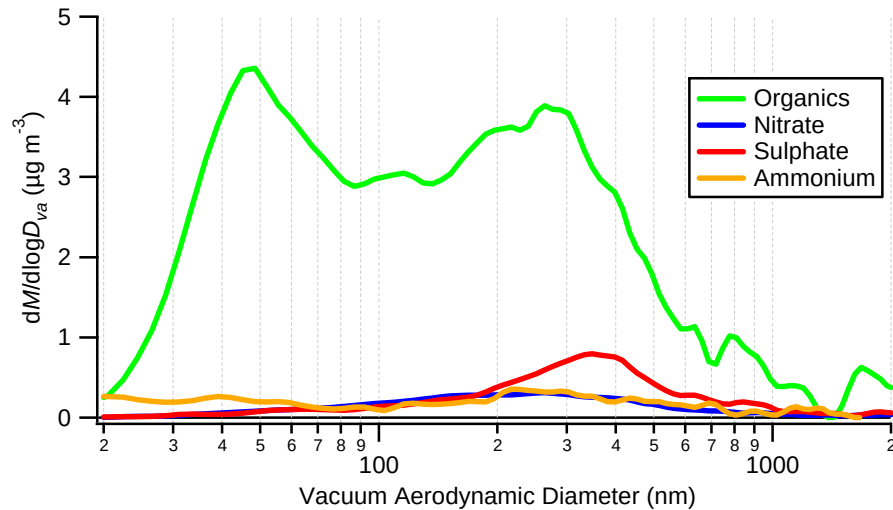
RATIO wood burning to traffic aerosols	^{14}C method	Aethalometer method
Roveredo (6-14 h) January	3.6	2.1
Roveredo (18-02 h) January	9.7	5.2
Roveredo (6-14 h) March	0.6	0.1
Roveredo (6-14 h) March	7.6	5.9
Moleno (6-14 h) February	1.2	0
Moleno (18-02 h) February	2.4	0.2

Aerodyne Aerosol mass spectrometer measurements in Roveredo

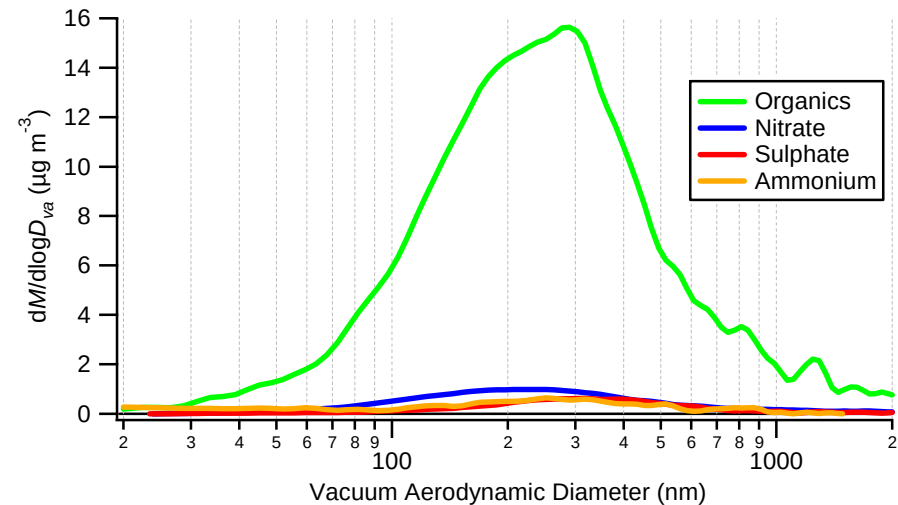


Data shown : 2 minute time resolution. Instrument very sensitive.

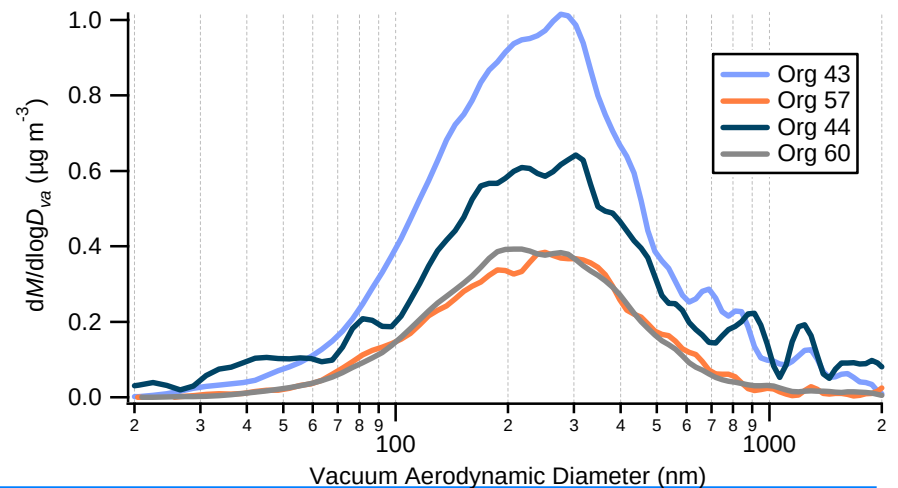
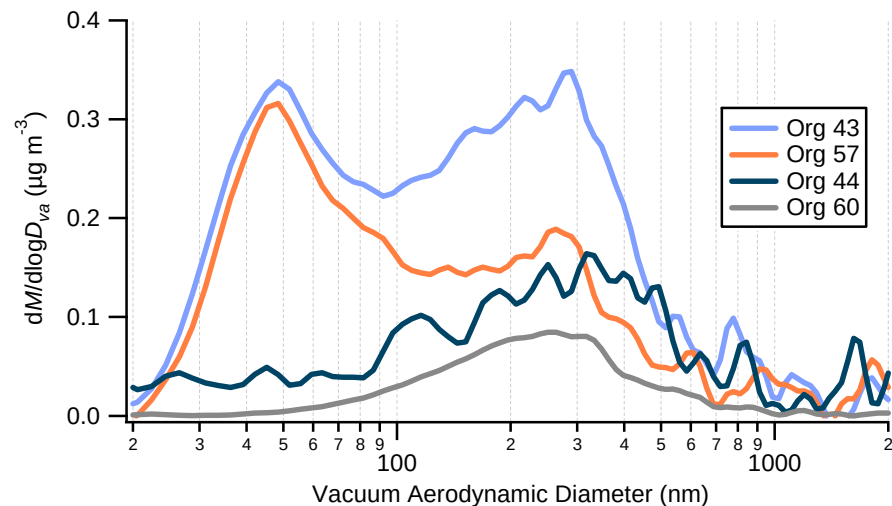
Average mass size distributions for March filters



March morning filter, traffic important



March evening filter, mostly wood burning



CONCLUSIONS

- In Roveredo, wood burning particles contribute most to the aerosol loading in winter
- Even in Moleno next to the Gotthard highway, wood burning is a very important contributor to the aerosol mass in winter
- Generally, wood burning emissions might be underestimated in Europe
- More ultrafine particles (number) are found from traffic compared to wood burning
- The wavelength dependence of absorption may be used for source apportionment close to the wood burning and traffic sources. However, aging might change the wavelength dependence.
- The use of fragment patterns of the aerosol mass spectrometer (AMS) measurements to distinguish traffic from wood burning looks very promising.
- ^{14}C and/or levoglucosan measurements are very valuable but not very cheap and only possible for HiVol-filters and thus low time resolution.