Aerosol size distribution and NO_x measurements during and after the Gotthard tunnel shutdown 2001

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Due to the tragic accident in the Gotthard road-tunnel, leading to a complete closing from 24 October - 21 December 2001, the trans-alpine traffic strongly decreased in the adjacent valleys, while traffic increased in the valleys of the alternative San Bernardino route. A strong effect of these traffic changes could be observed for nitrogen oxides (NO_x) concentrations where changes of more than a factor of three were observed. For the aerosol mass, the effects were less pronounced and often not significant. For the active aerosol surface, aerosol volume, as well as carbon monoxide, mobile measurements revealed that other emission sources, probably residential heating with a high fraction of wood burning, are important especially in the Mesolcina valley along the San Bernardino route. Near San Vittore, the concentrations of e.g. the active aerosol surface would increase from the highway toward the small village. The analysis of the PM10 (aerosol mass concentration of all particles of diameter D < 10 μm) monitoring data also suggests that other sources than the traffic explains most of the variance in the PM10 concentrations. However, nanoparticle (<50 nanometers) number concentrations, which hardly contribute to aerosol mass, seemed to be dominated by the emissions of the highway.

Influence of Gotthard tunnel shutdown on aerosol, nitrogen oxide and carbon monoxide concentrations in Alpine valleys

(October 24 to December 21, 2001)

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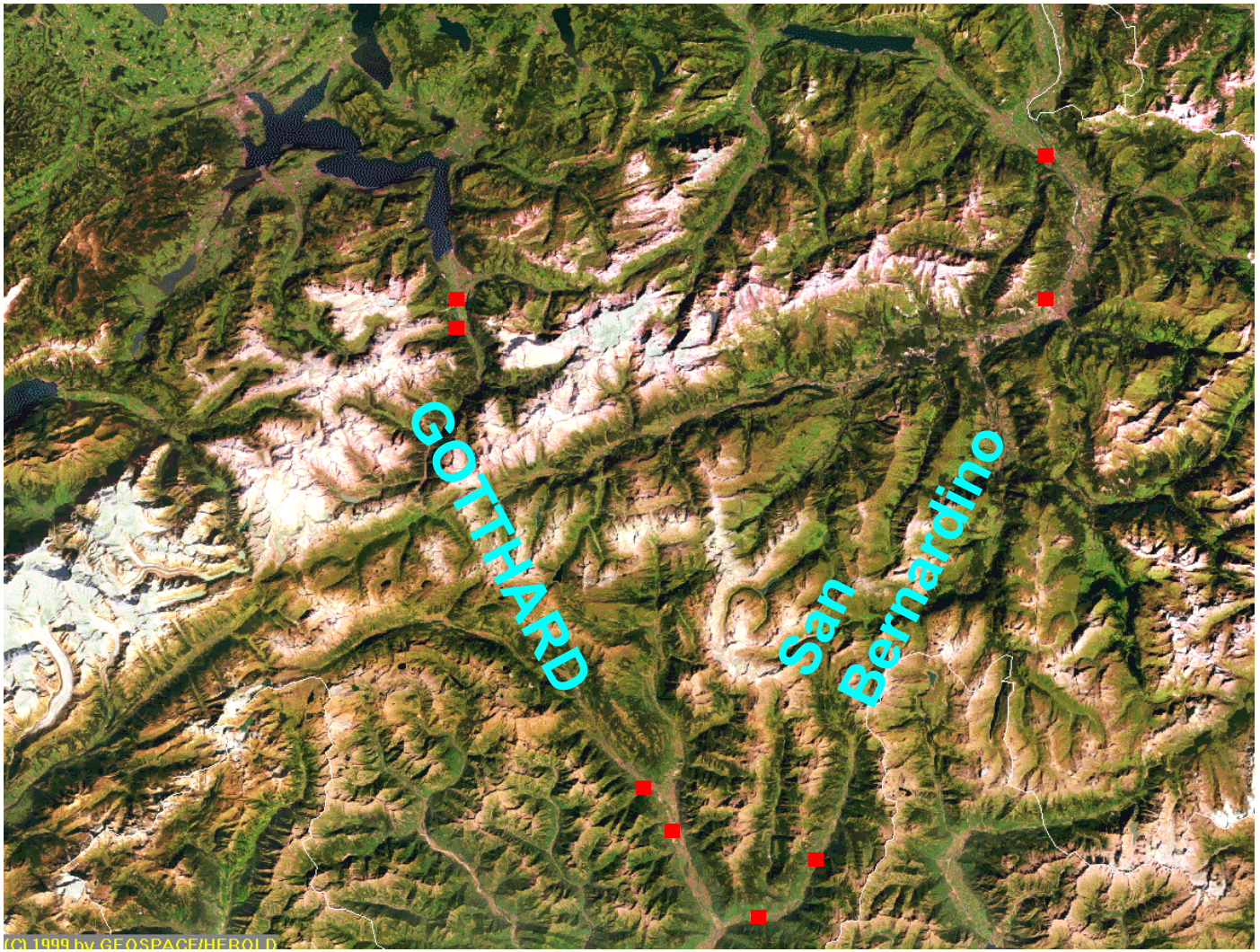
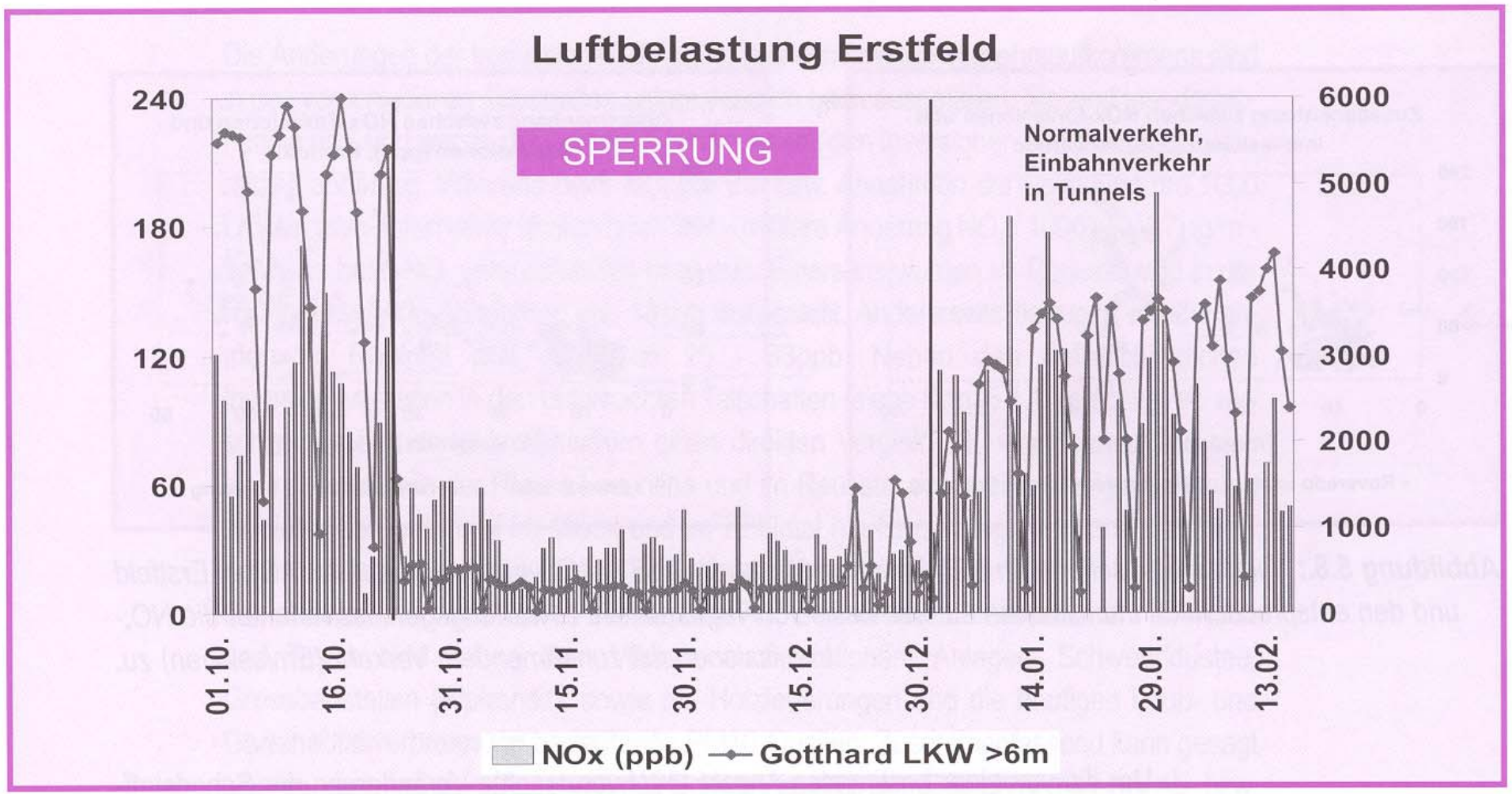
Locations of mobile measurements during the LUTUS project



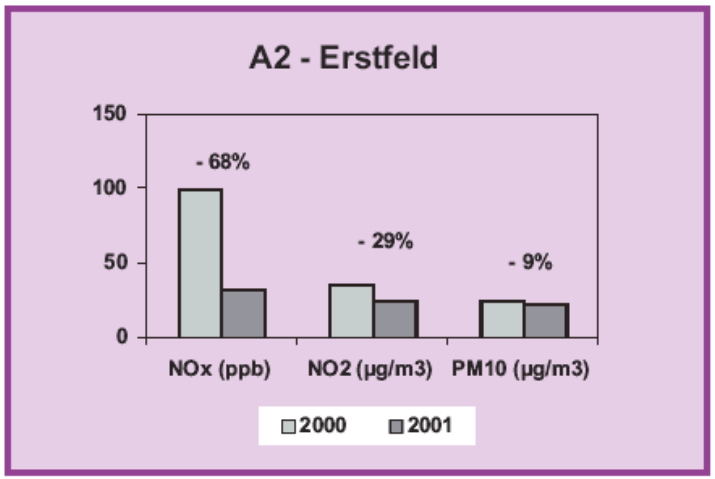
Air quality change after Gotthard Tunnel accident

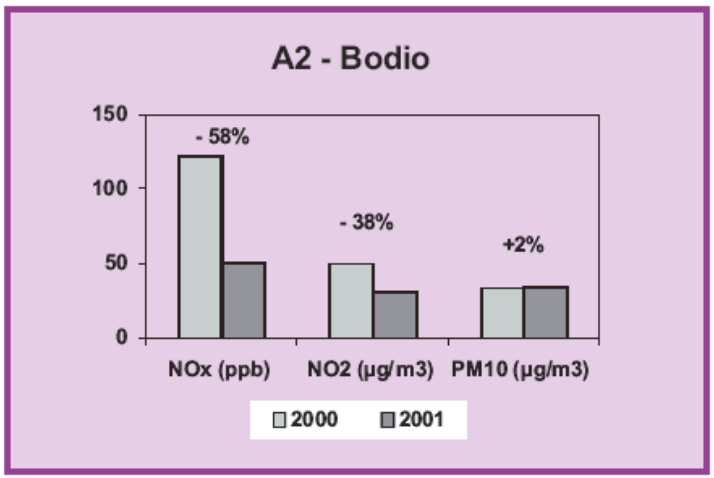


From : Umleitung Gotthard 2001, Cantons Gr, Ti, Ur and BUWAL

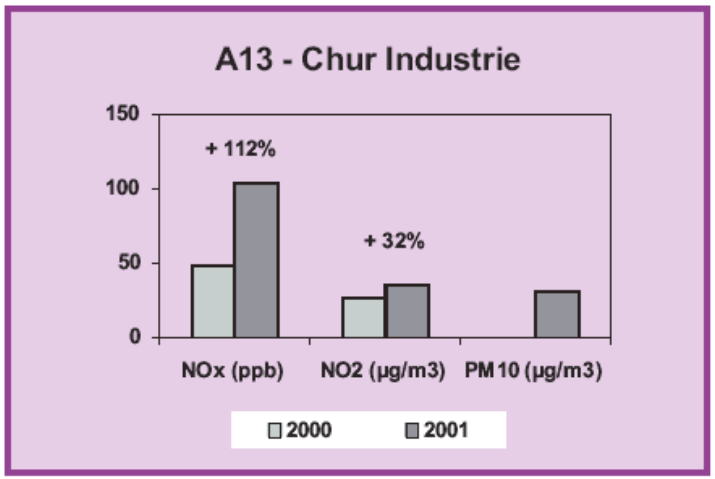
Air quality at the Gotthard and San Bernardino during tunnel shutdown and the year before

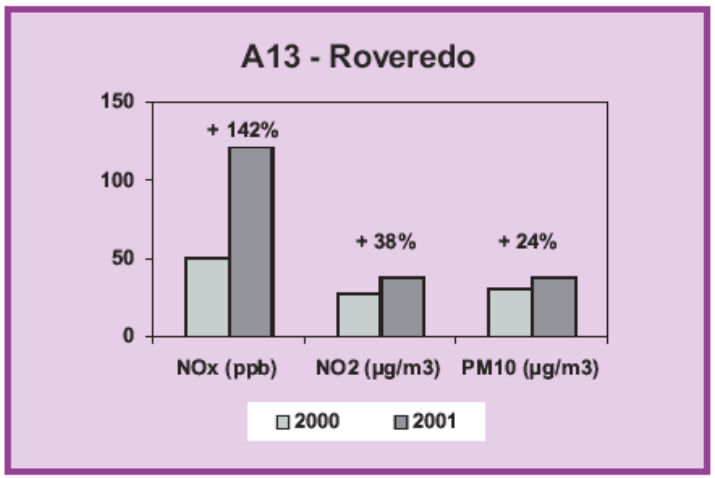
Gotthard



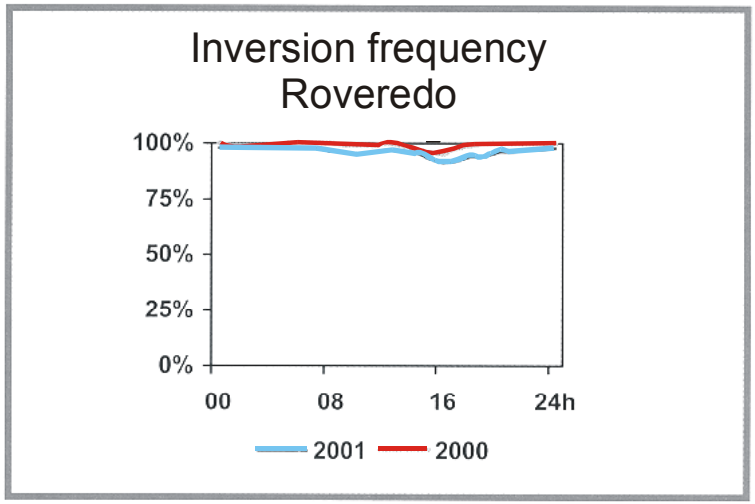


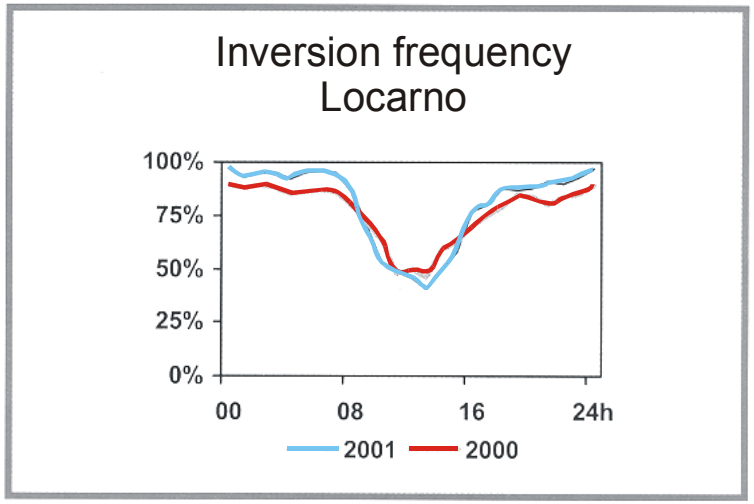
San Bernardino

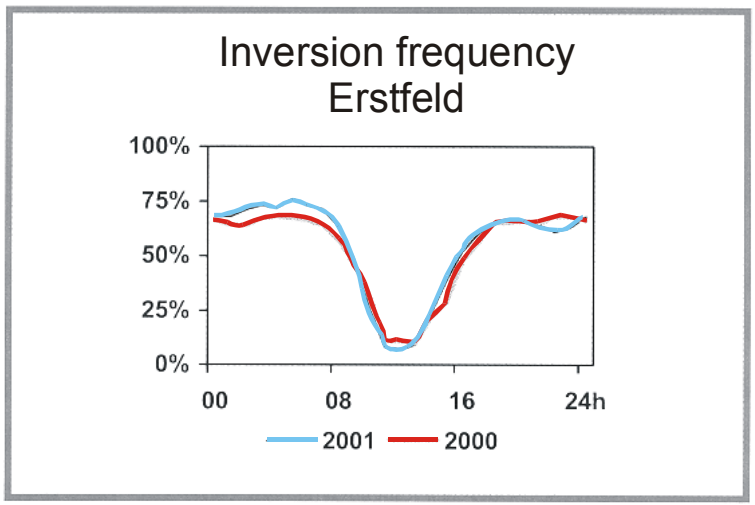


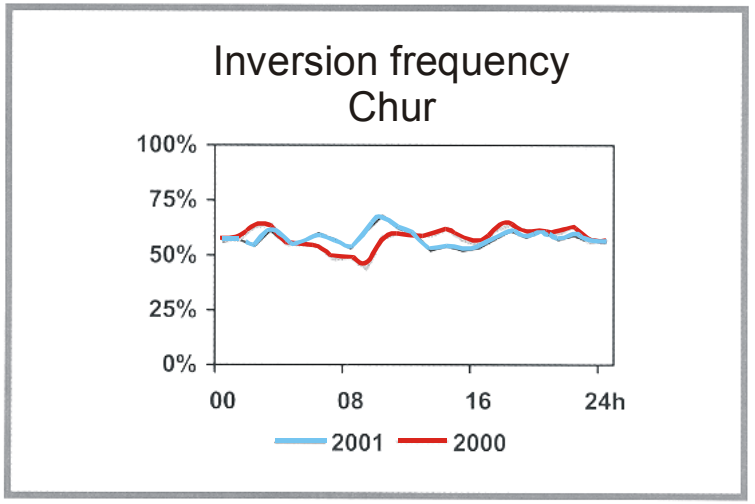


Inversion frequency in the lowest 300 meters in 2000 and 2001

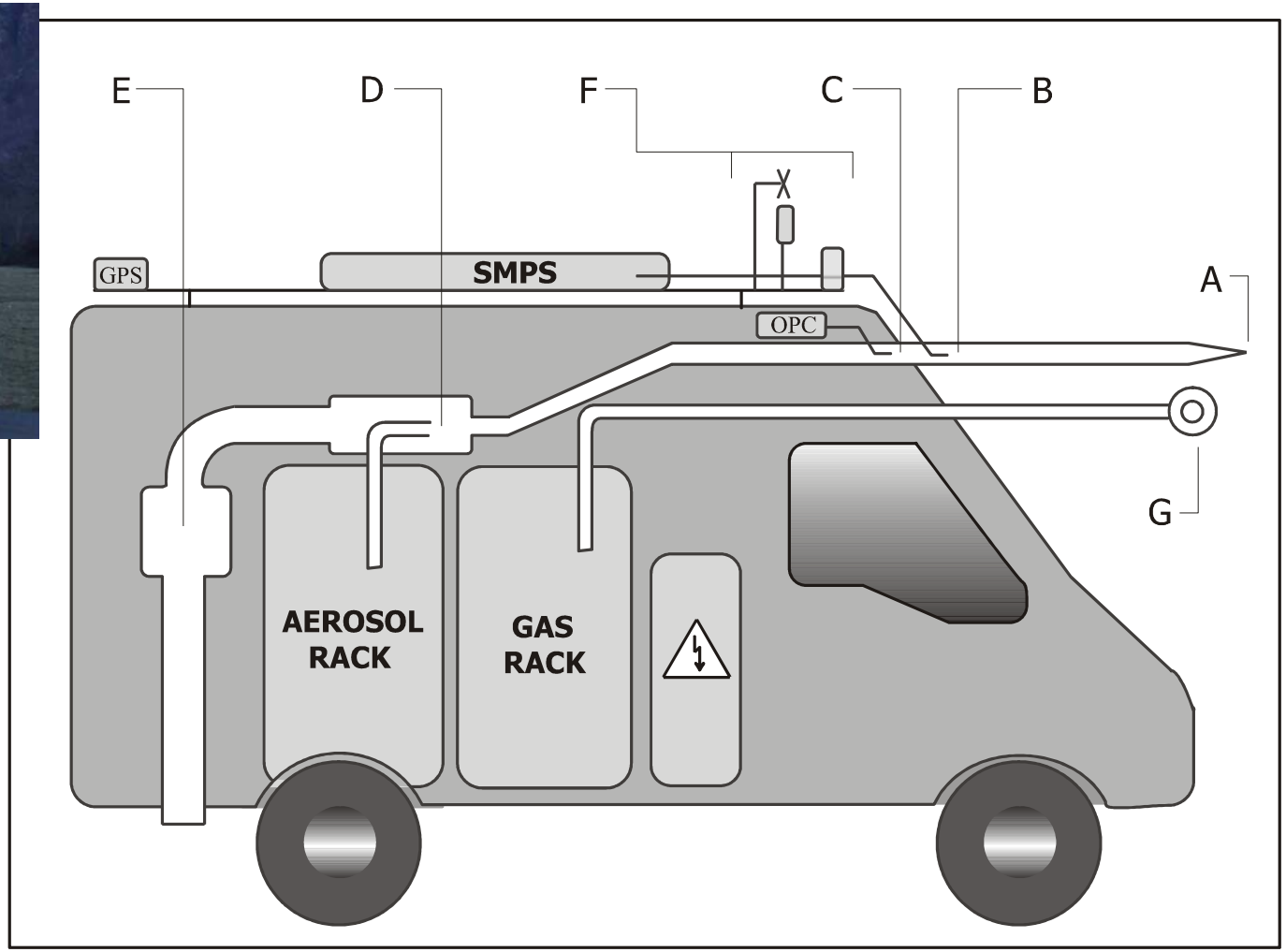








Setup of the PSI Mobile Pollutant Measurement Laboratory

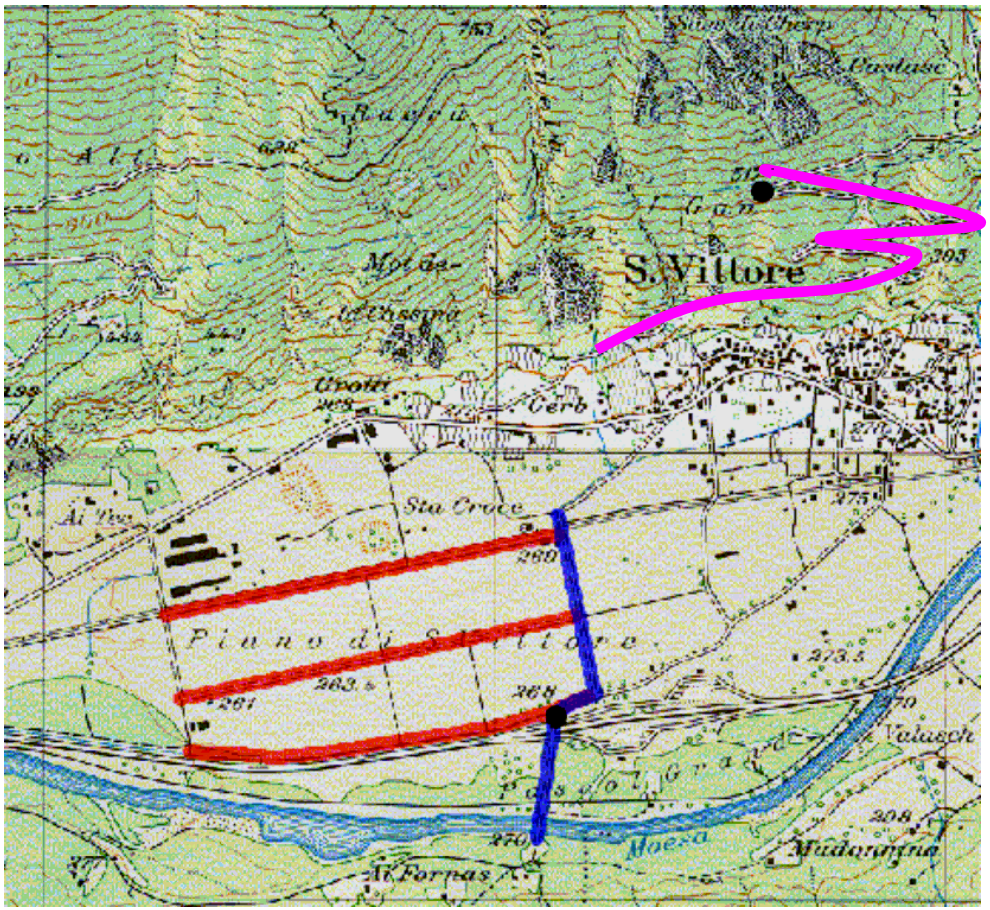


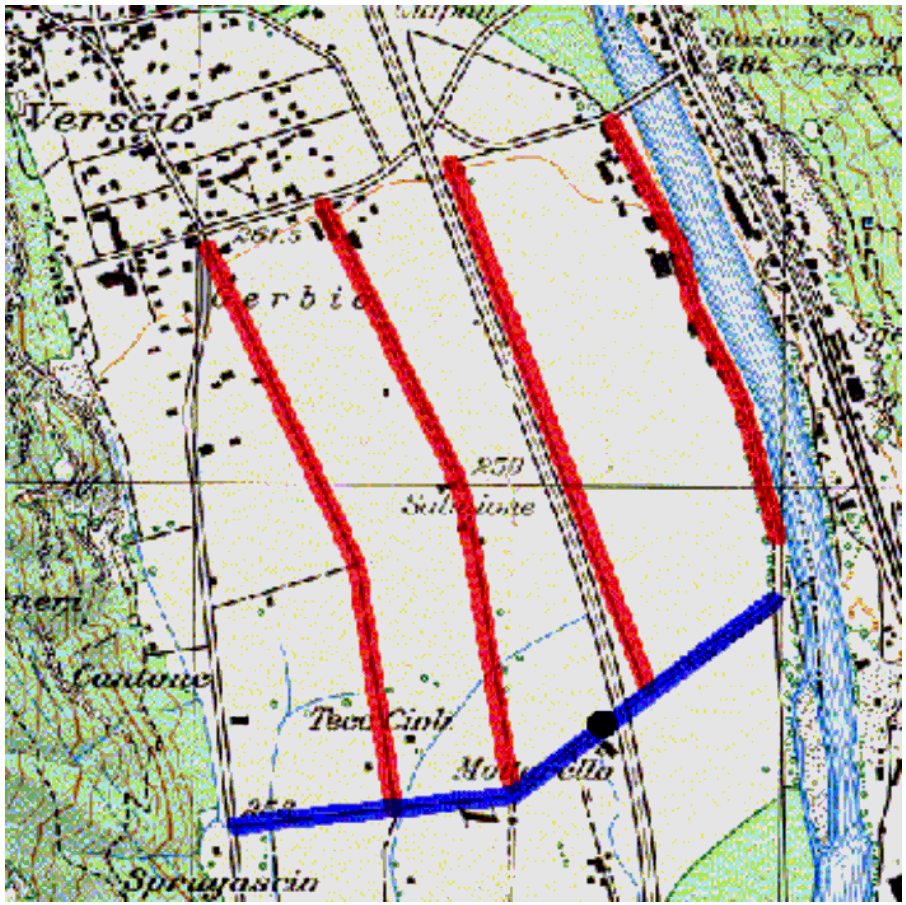
A: Inlet tip
B: SMPS sampling line branching
C: OPC sampling line branching
D: Flow distribution cylinder
E: Blower
F: Wind direction, relative humidity, global radiation
G: Gas inlet

Main instrumentation of the mobile PSI Atmospheric Laboratory

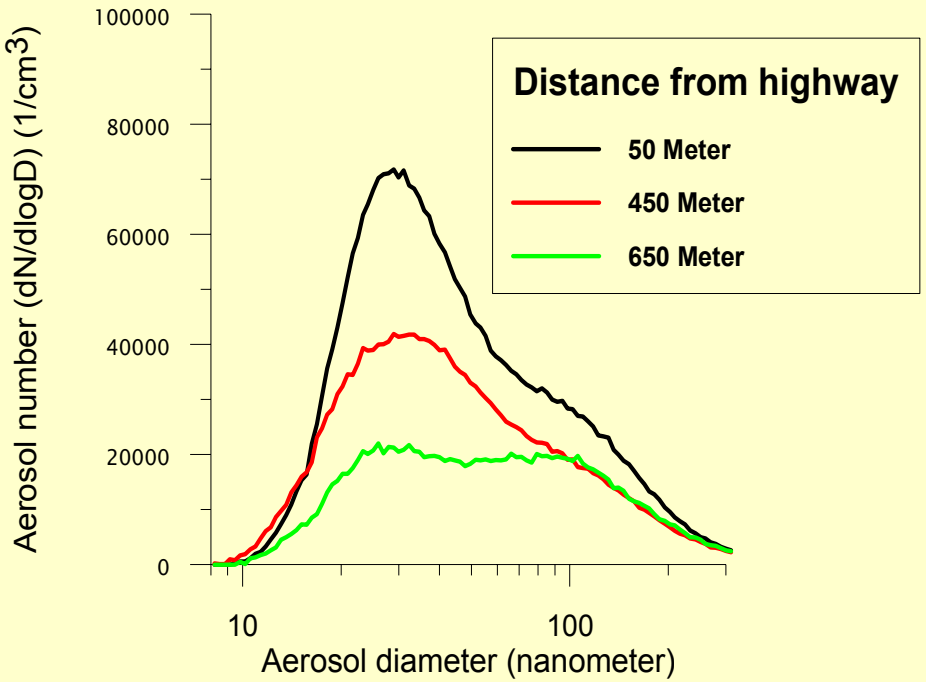
AEROSOL				GAS PHASE			
Parameter	**Instrument**			**Parameter**	**Instrument Method / Type**		
Size Distribution D = 7-310 nm	SMPS			**Ozone**	(UV absorption)		
Number Concentration D > 3 nm	CPC			**CO**	Vacuum UV resonance fluorescence		
Size Distribution D = 0.3-20 mm	OPC			**CO_2**	IR absorption		
Active Surface Area	DC			**NO_x, NO_y, HNO_3, PAN**	Luminol Chemi-luminescence		
Black Carbon	Aethalometer			**H_2O_2, total peroxide**	Peroxidase FluorescencePeroxide		
PM2.5	Betameter			**HCHO**	Hantzsch Fluorescence		

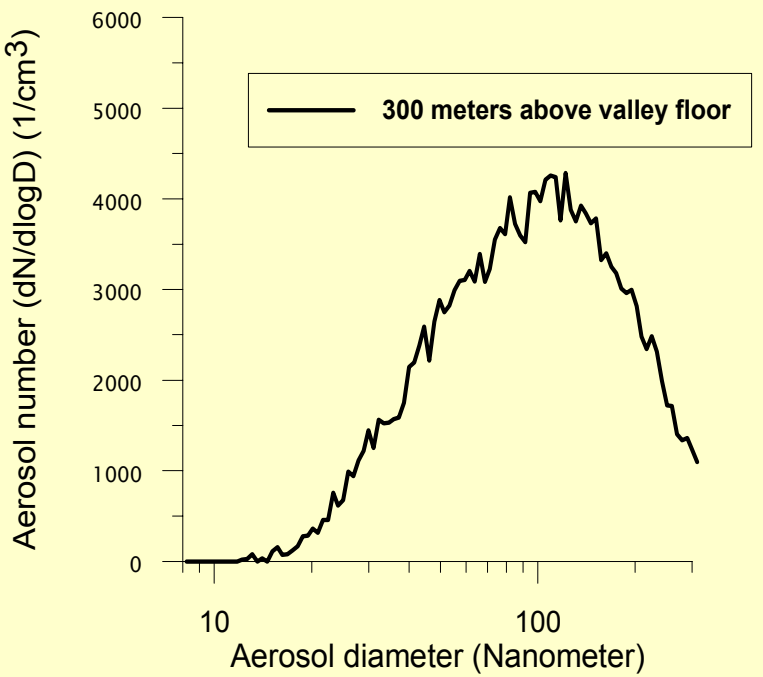
Examples of mobile van driving routes during the LUTUS project



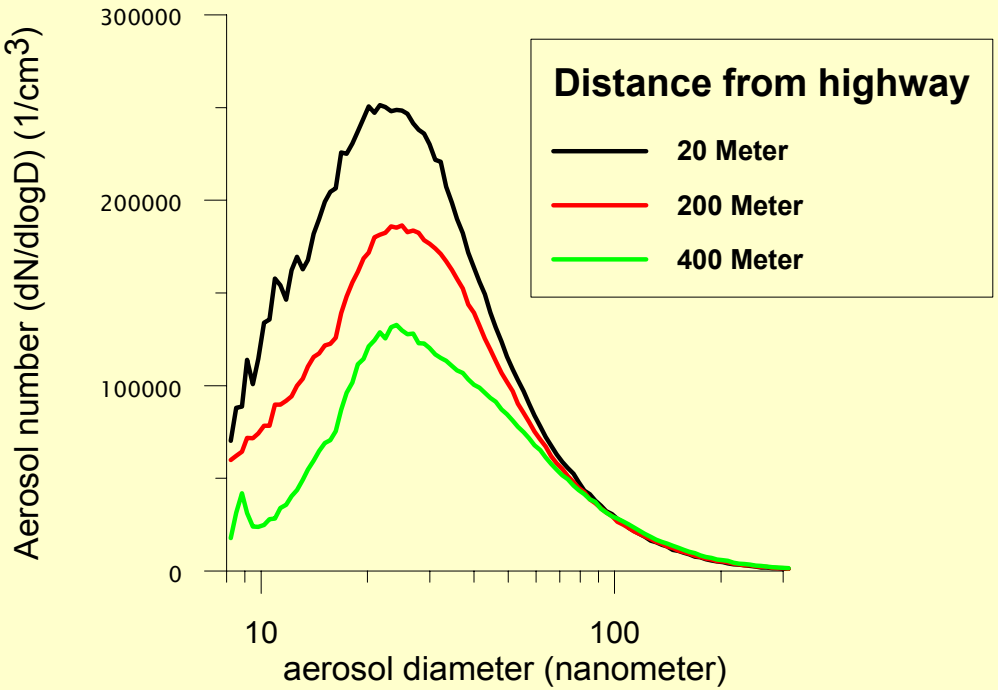


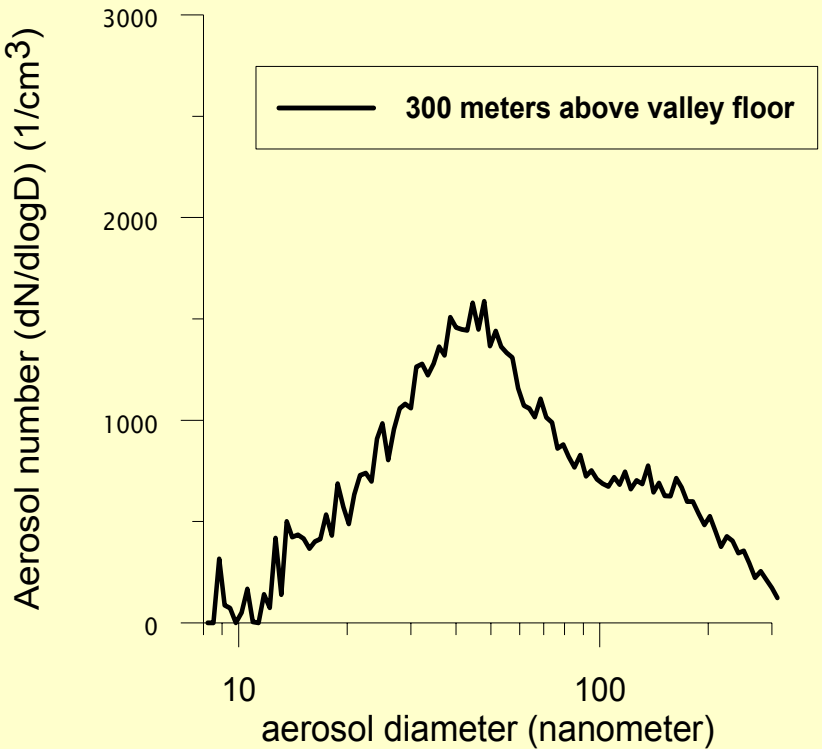
Aerosols along the Gotthard – Route near Personico



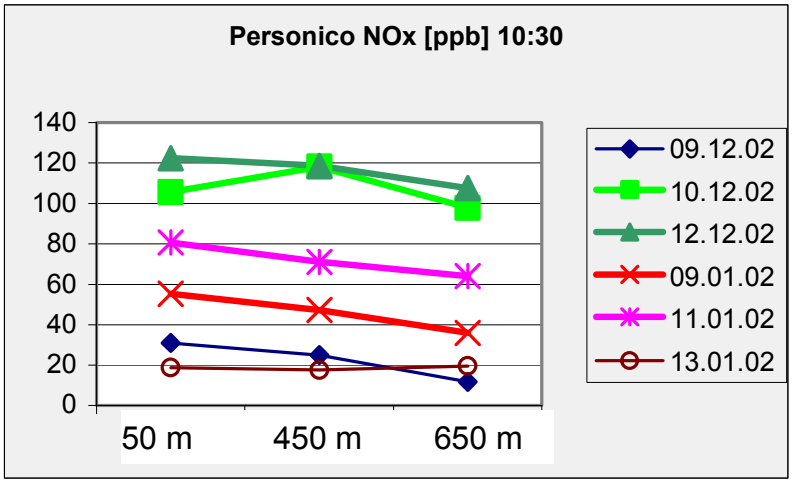


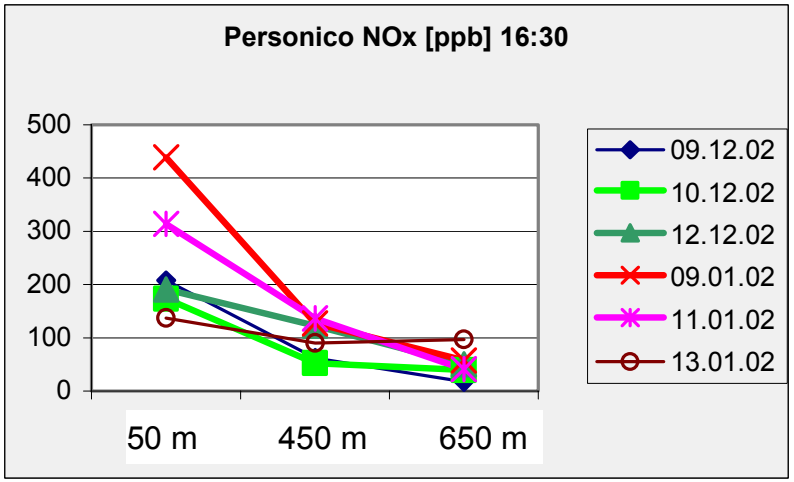
Aerosols along the San Bernardino – Route near San Vittore





Mobile measurements of NOx during Gotthard tunnel shutdown

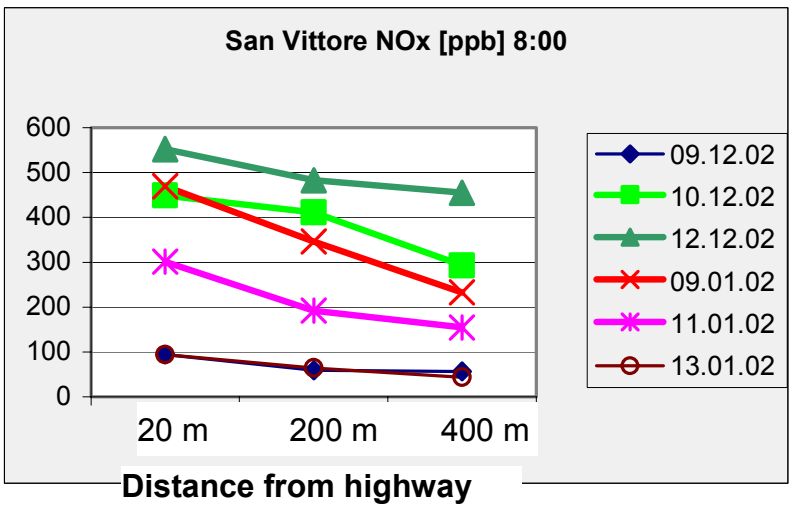


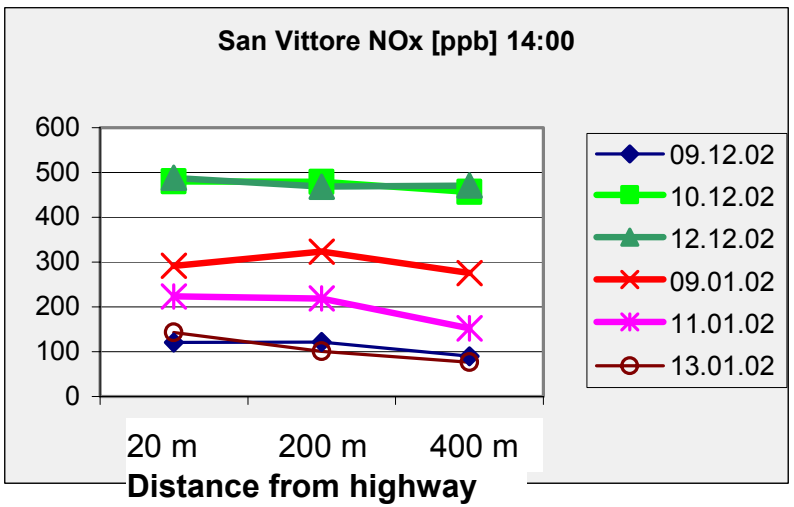


Gotthard

sunday

sunday



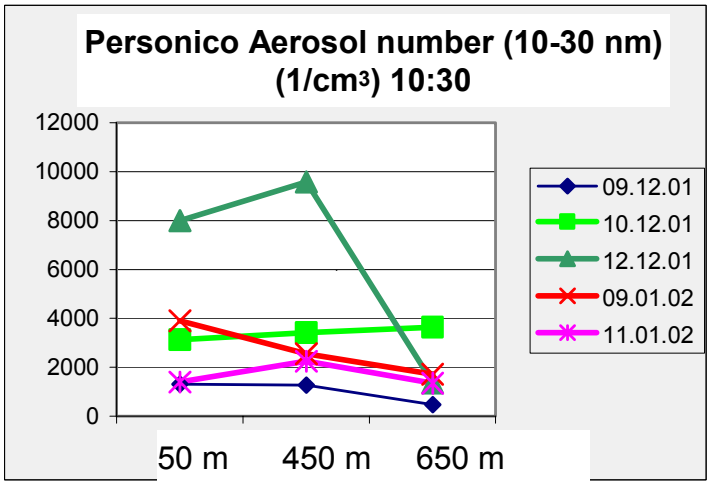


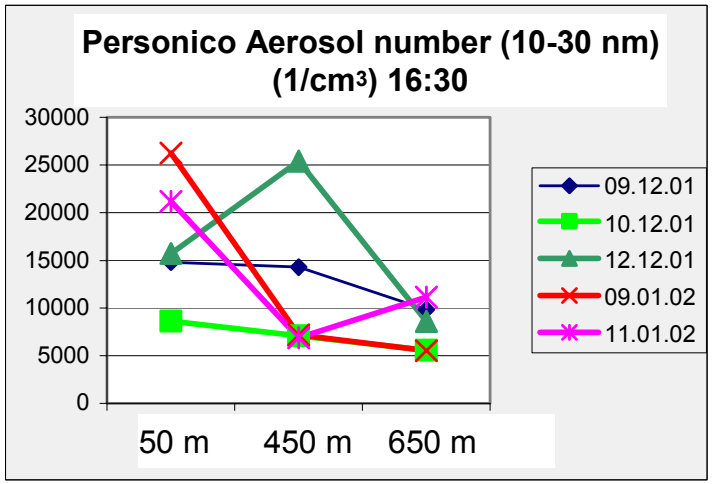
San Bernardino

sunday

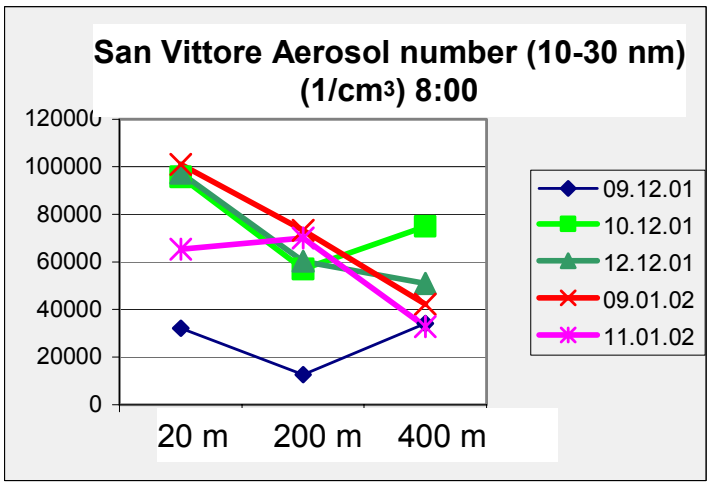
sunday

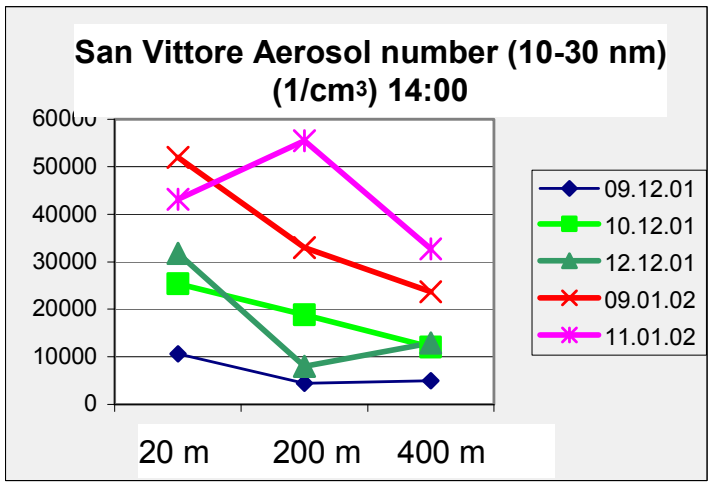
Mobile measurements of nanoparticles (10-30 nm)





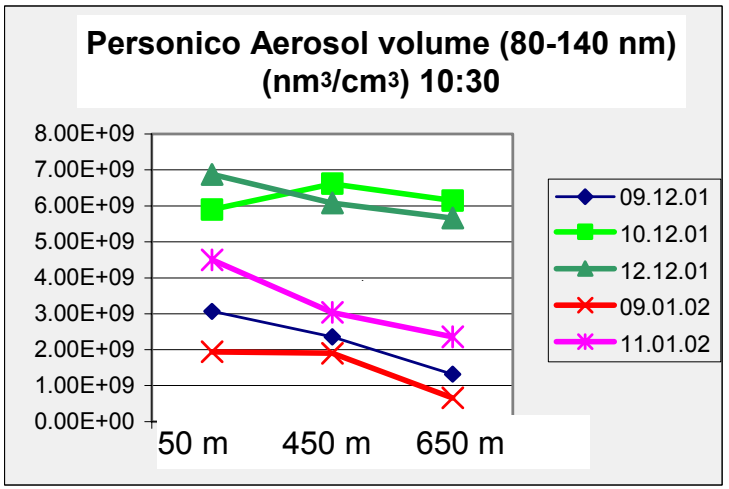
Gotthard

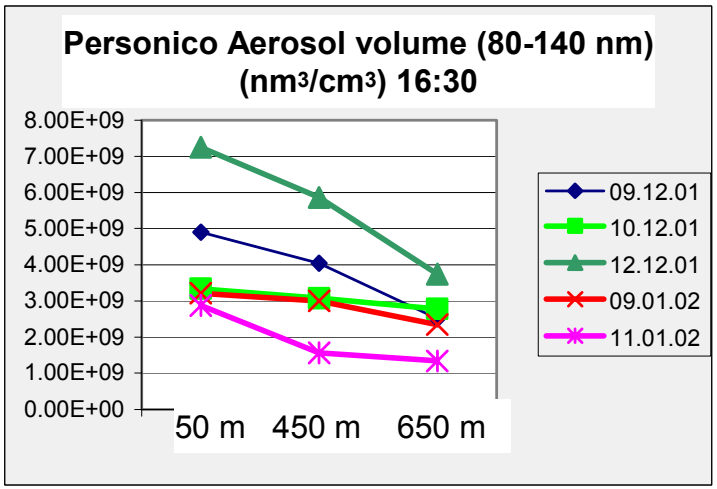




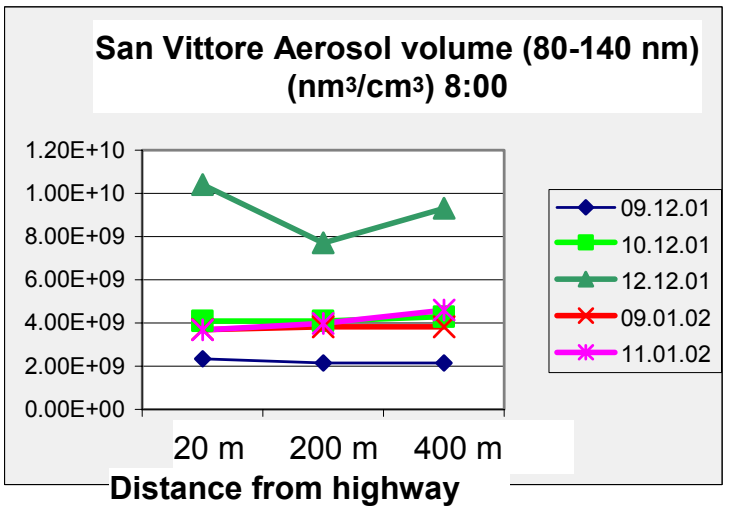
San Bernardino

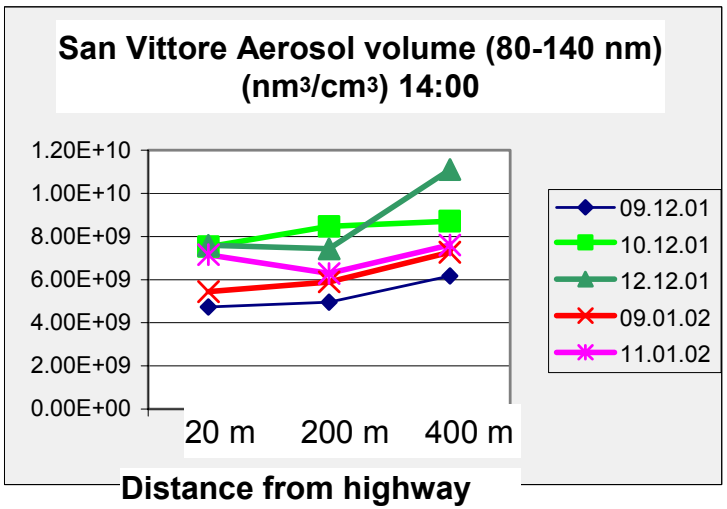
Aerosol volume (80-140 nm, typical size range of emitted soot particles)





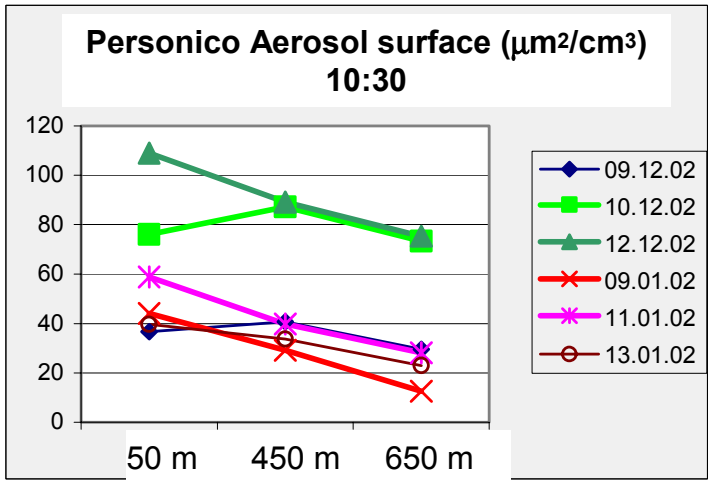
Gotthard

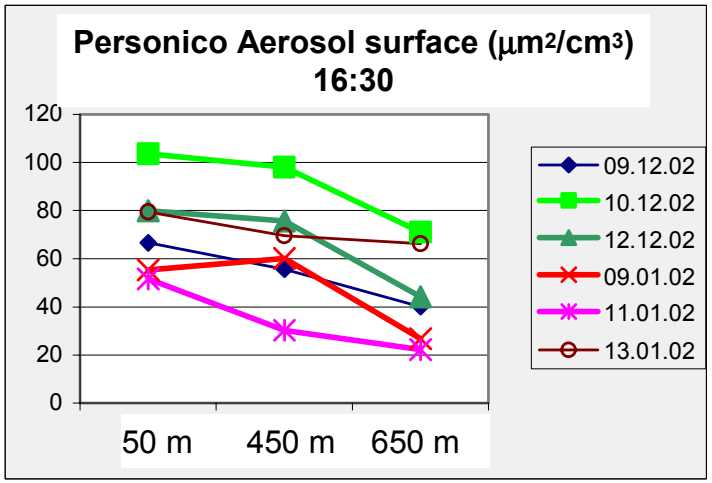




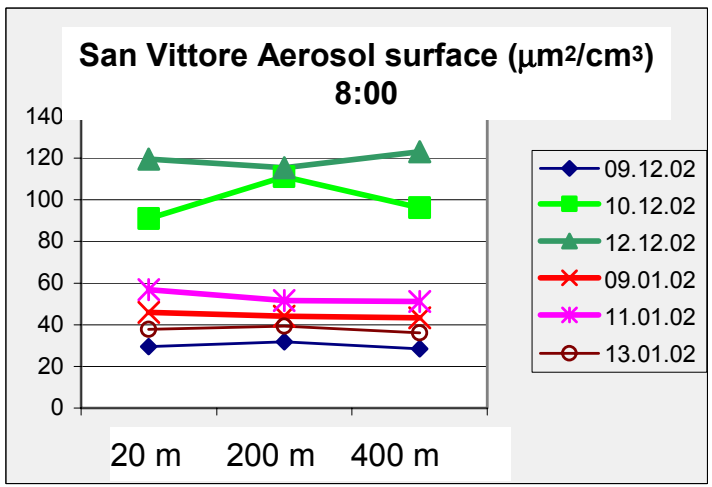
San Bernardino

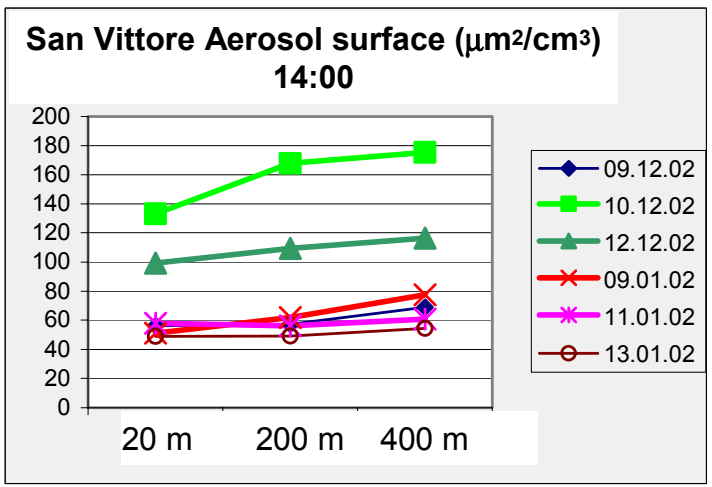
Mobile measurements of Aerosol surface (Diffusion charger)





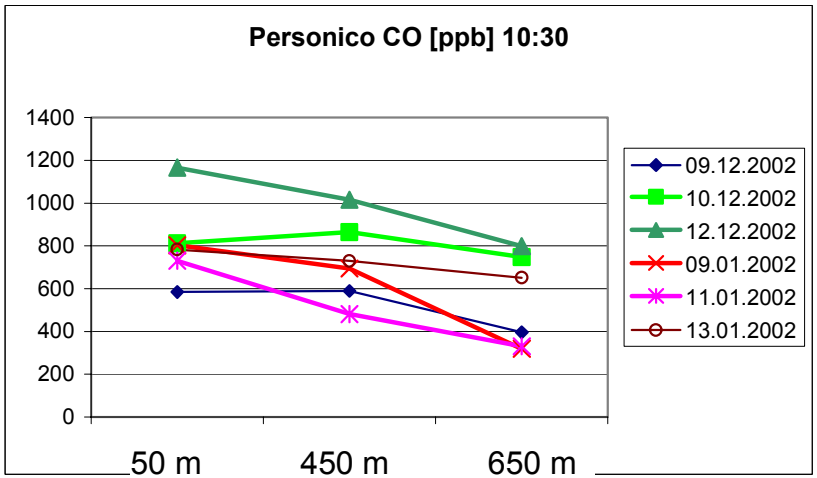
Gotthard

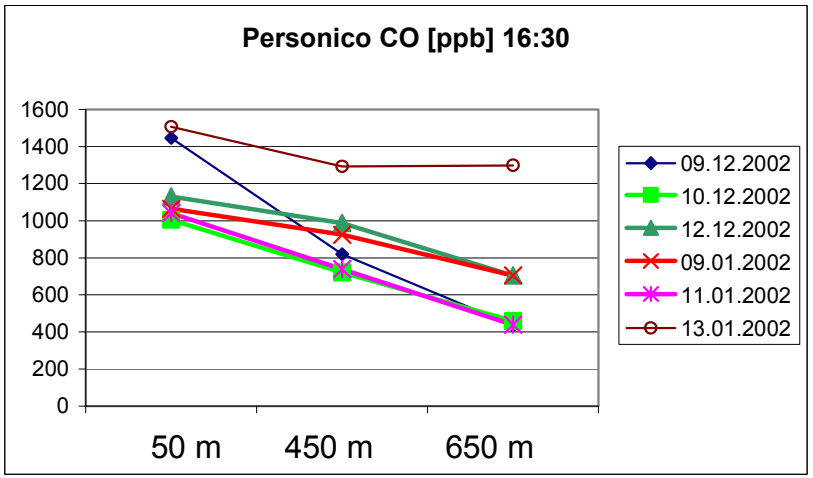




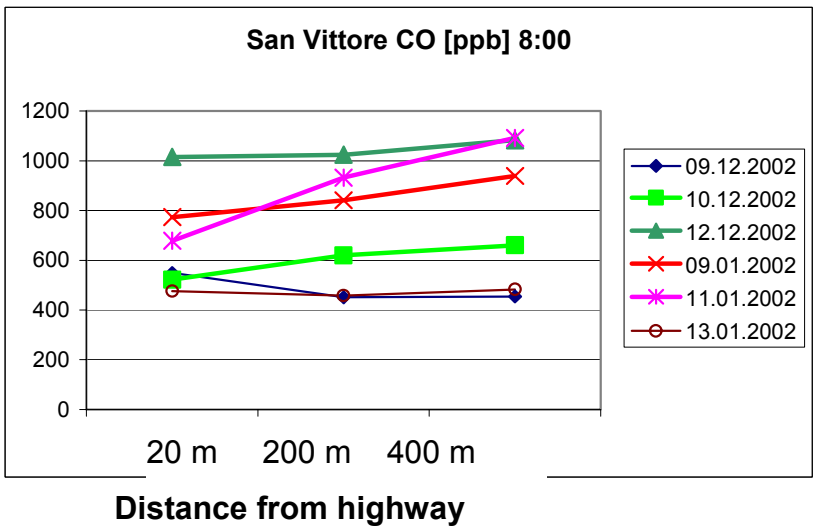
San Bernardino

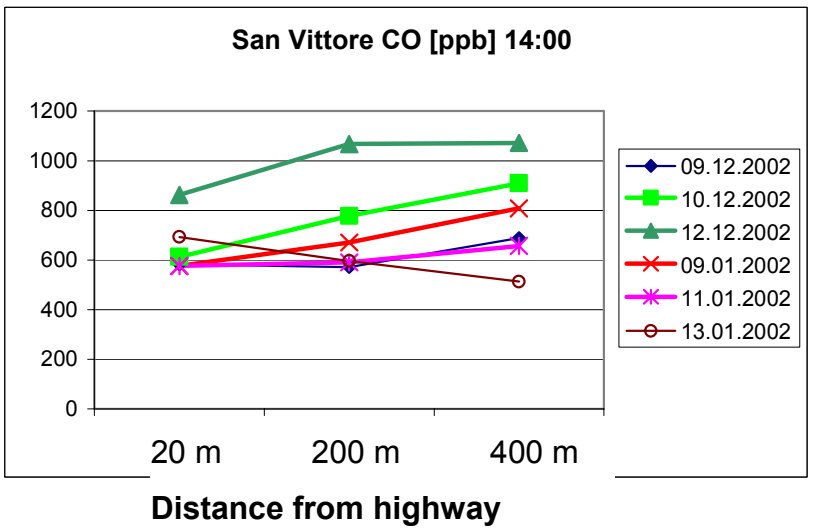
Mobile measurements of carbon monoxide





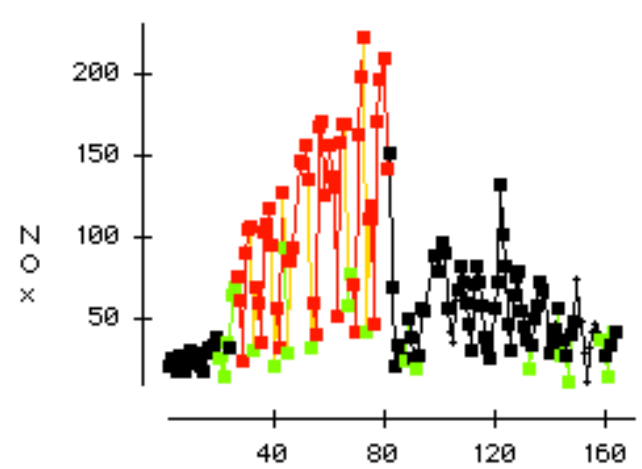
Gotthard

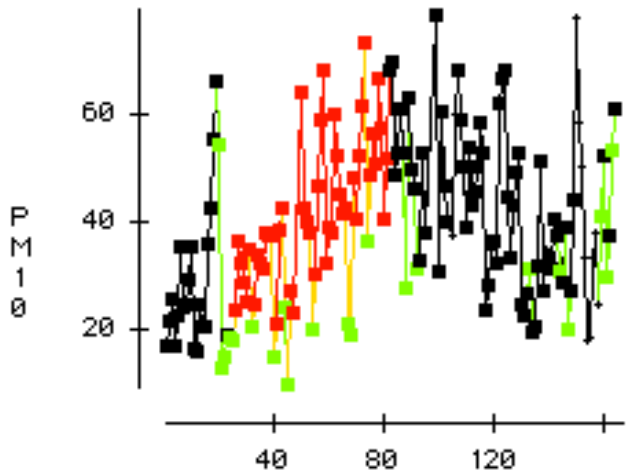


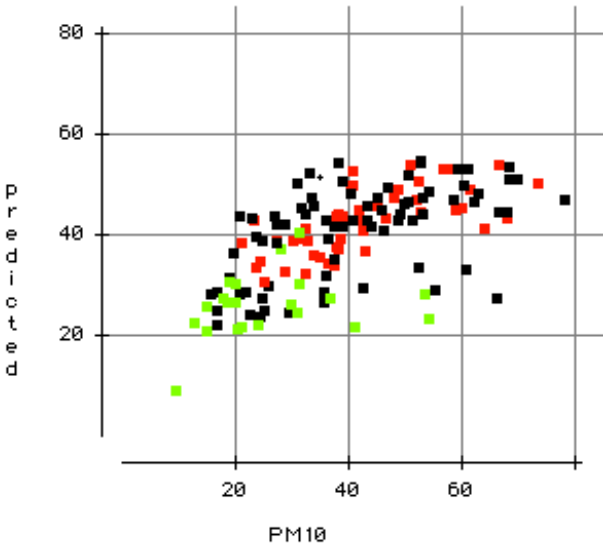


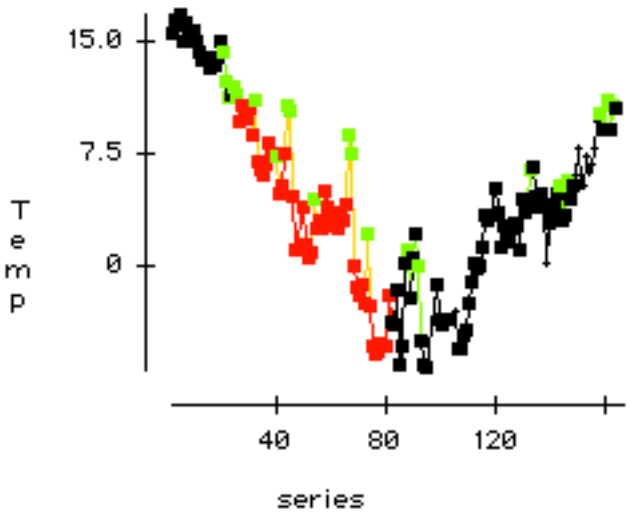
San Bernardino

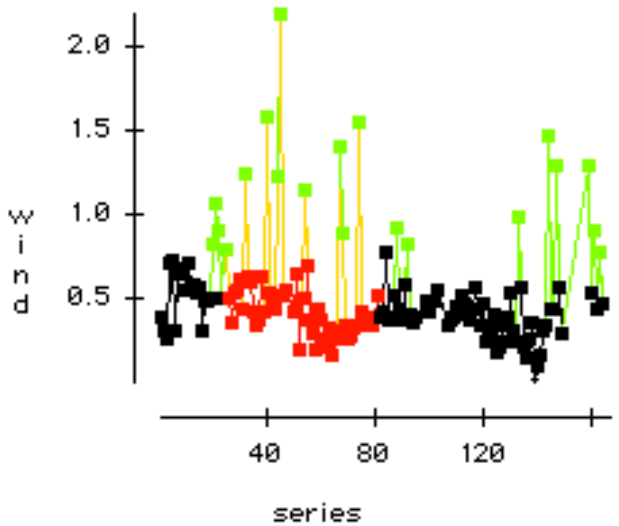
NOx, PM10, Temp and wind at Roveredo (San Bernardino)



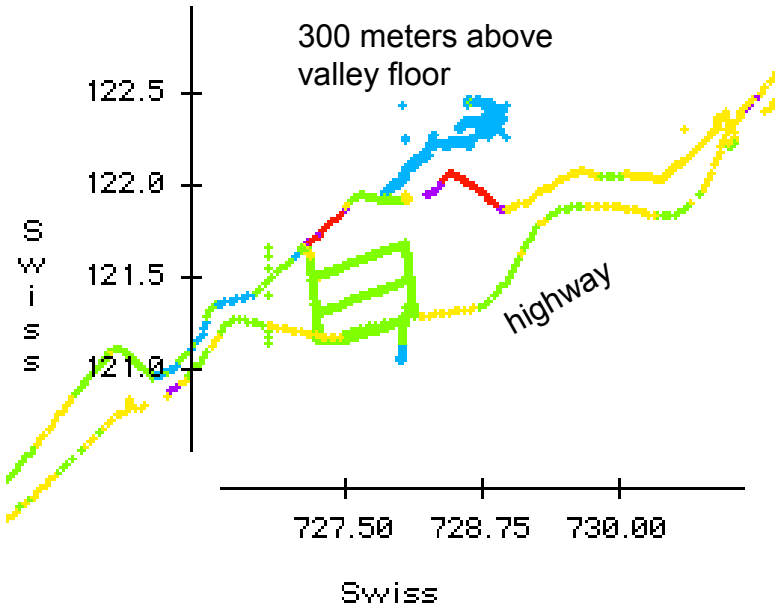


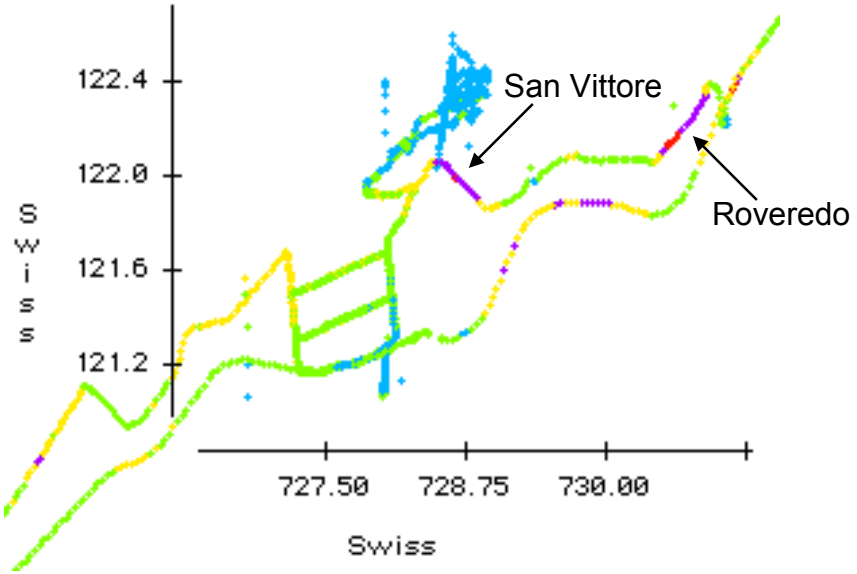


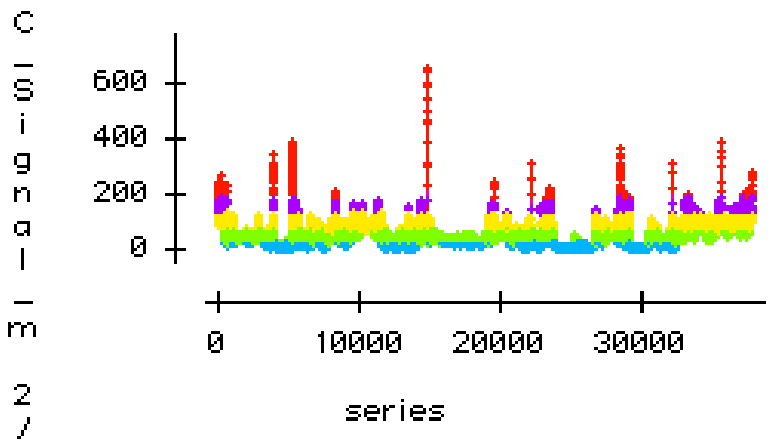




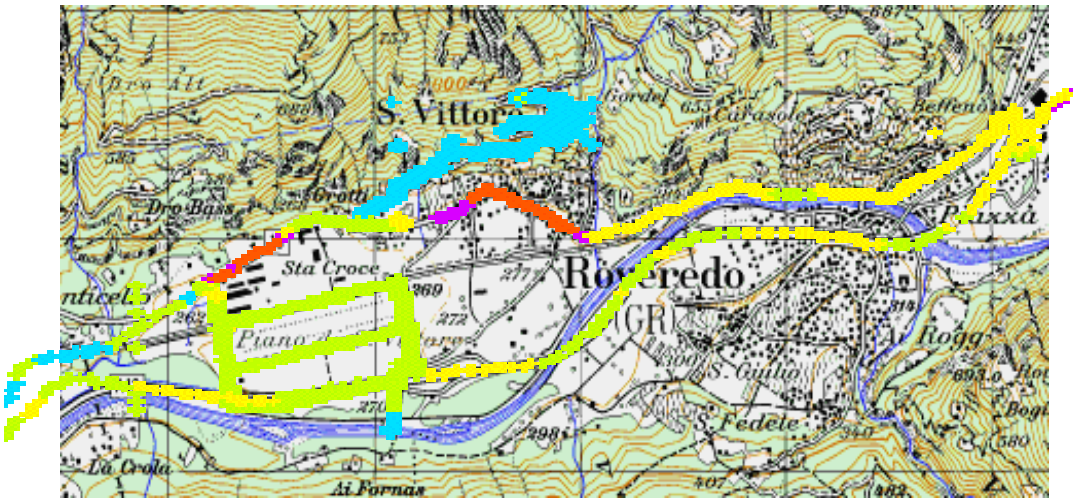
Active aerosol surface area around San Vittore on January 9, 2002



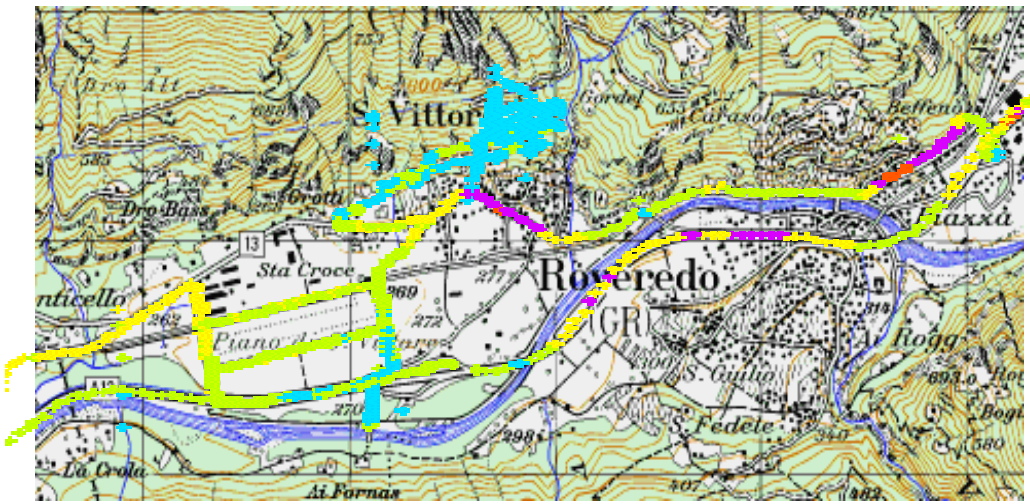




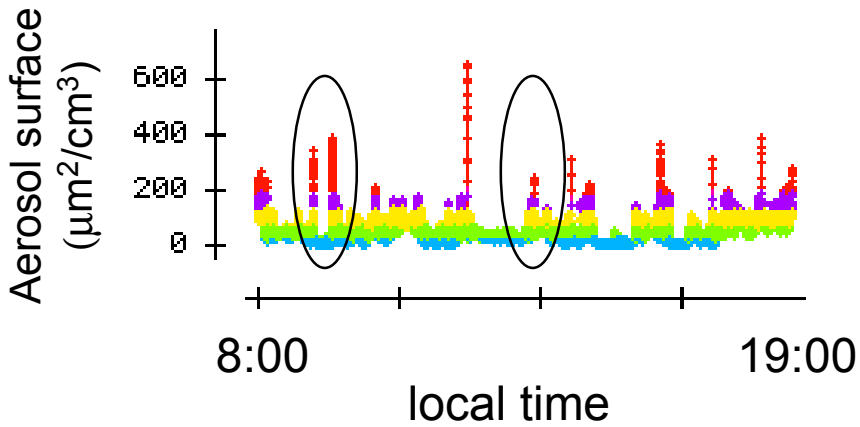
Active aerosol surface area around San Vittore on January 9, 2002



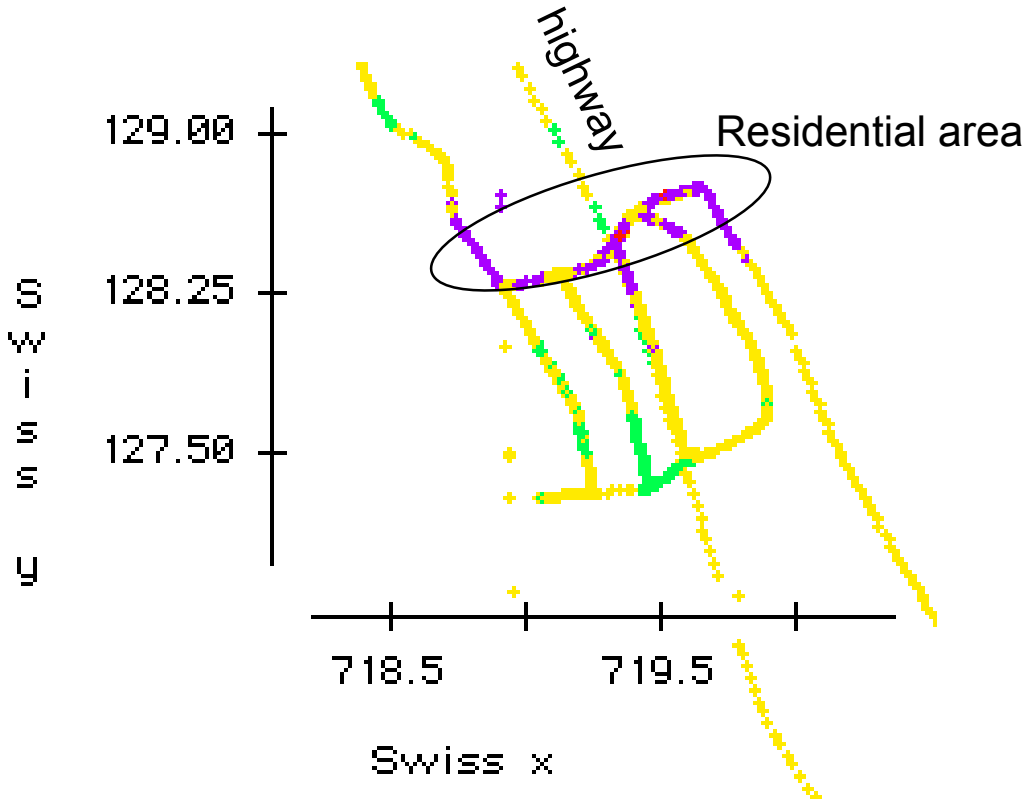
morning

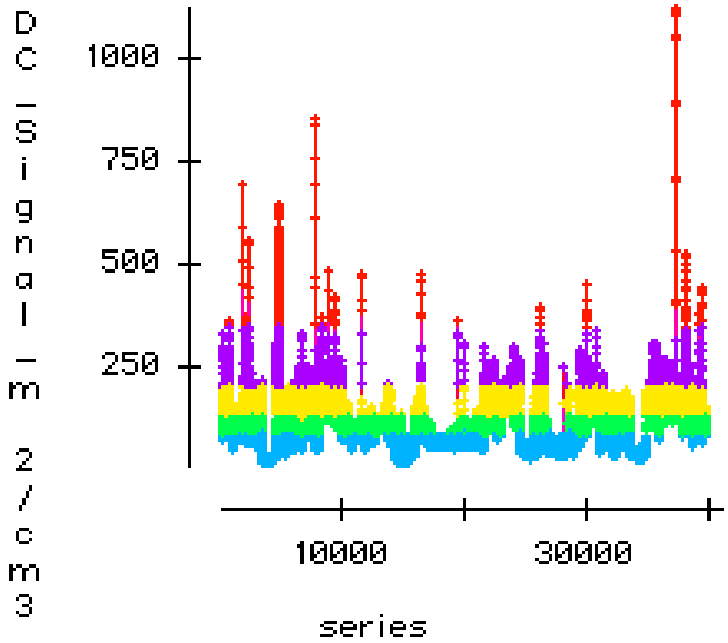


Early afternoon

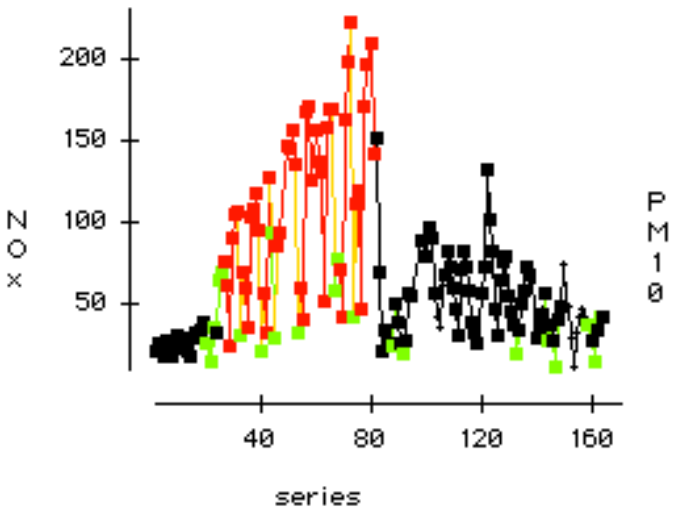


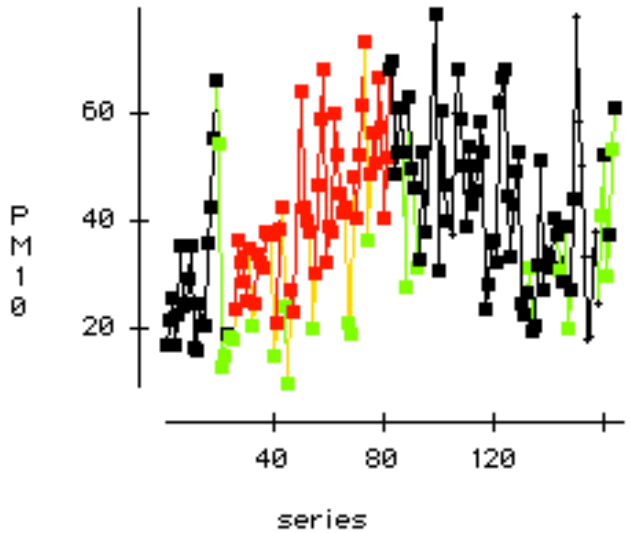
Aerosol surface area around Lodrino, 10 December 2001

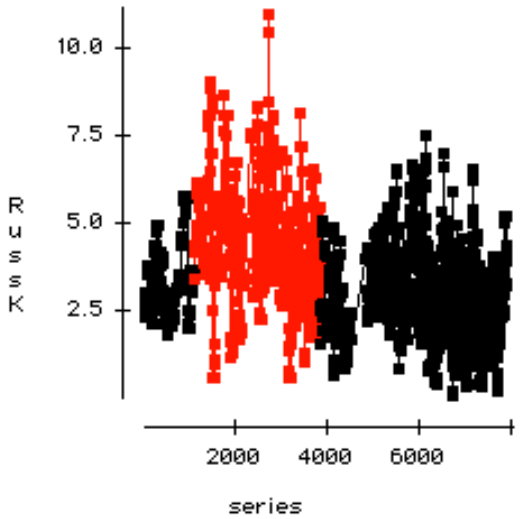




NOx, PM10, ‚Soot number‘







Summary

- The Gotthard tunnel shutdown had a very strong influence on the ambient levels of nitrogen oxides in the valleys atmosphere
- The tunnel shutdown influenced the soot concentration in the valleys but the impact on PM10 concentrations is not large due to high background concentrations and other PM10 sources.
- Better quantification of traffic and wood burning contributions to the aerosol mass needed in this area.

  Suggested further work: Measurements of aerosol properties and markers for traffic and wood burning:

  - Levoglucosan
  - C14
  - Multi-wavelength-Aethalometer
  - Acetonitrile
  - Potassium
  - VOCs, OVOCs
  - .....