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Black carbon and aerosol optical property measurement at a midsize city in Po valley, Italy

Background
Particles in atmosphere effect human health and climate change, and black carbon (BC) is recognized to responsible for global warming (IPCC, 2013). Piacenza is one of those midsize cities exposure in the European air pollution hot-spot Po Valley with density particle pollution sources.
Methods
During the UPUPA measurement campaign in Piacenza in September 2011, black carbon was measured by A Multi Angle Absorption Photometer (MAAP 5012), an Aethalometer AE31 and a Micro Aethalometer AE51 and the inter-comparisons were conducted. Optical columnar properties of aerosols were also measured by Ocean Optics S2000 radiometer. Aerosol Optical Depth (AOD), Angstrom extinction parameter (alpha) and size distributions were analyzed to investigate particles optical and microphysical properties and their origin, supported by back trajectories calculation.
Results and conclusions
The BC levels and trends measured by three instruments are correlated with each other. During the measurement period BC records pronounce morning and evening peaks at rush hours. The average concentrations are 3686 ± 136 ng/m^3 by Maap, 4404 ± 166 ng/m^3 by AE31 and 4185 ± 144 ng/m^3 by AE51 during the simultaneous measurement period. For the entire analysis period (6 days) a mean value of AOD(780) nm of 0.21±0.17 has been recorded with a maximum value of 0.53±0.04 on 28 September and a minimum of 0.06±0.02 on 20 September. Alfa recorded between a minimum of 0.70±0.12 on 21 September and a maximum of 1.77±0.48 on 20 September with a mean value of 1.24±0.38. The mean AOD and alpha values are comparable to other studies (Calvello et al., 2010).

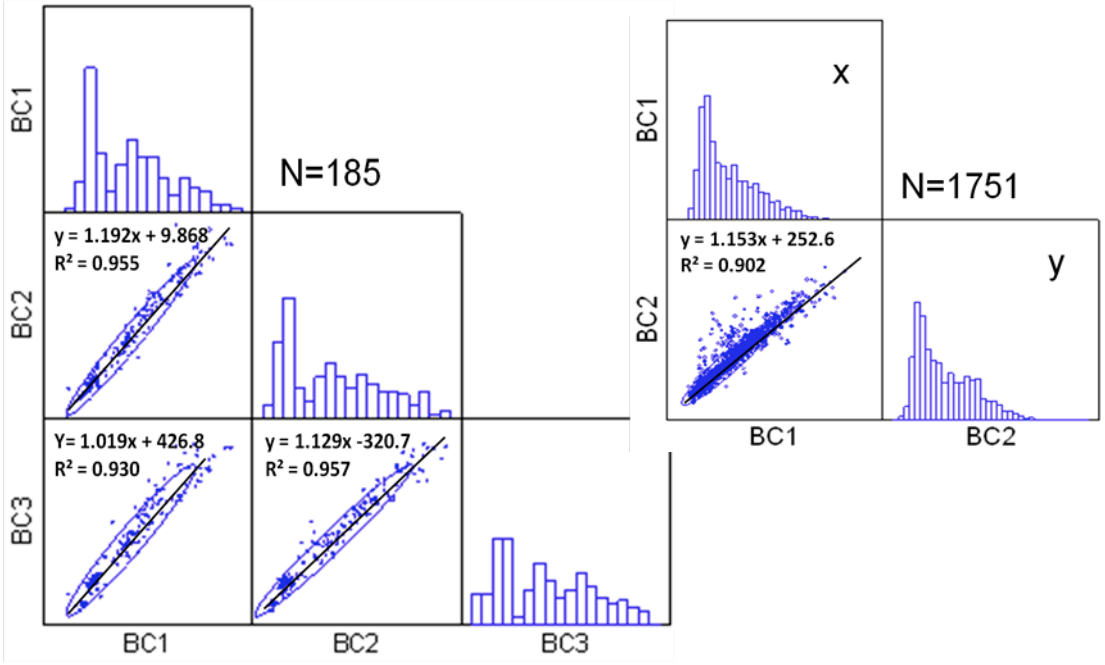

Figure 1 Relationship of BC levels by Maap (BC1), AE31(BC2), AE51(BC3)

Figure 1 presents the BC concentration distribution and a line regression for the two simutanious dataset respectively. The results show coefficence of black carbon concentrations obtaind by three instruments are higher than 0.9. The regeration indicates that AE31 over estimated BC concentration about 10-15% compared to Maap and AE51. When the BC

concentration is lower than 1st quartile or higher than 3st quartile more difference are recorded by Maap and AE31.

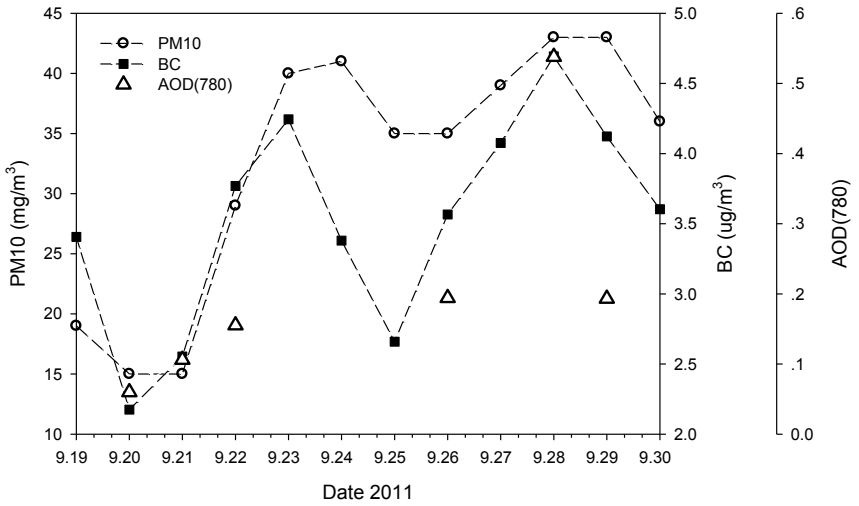

Figure 2 Temporal variations of PM10 (daily averaged surface mass concentration) columnar fine fraction particle of BC (daily averaged surface black carbon by AE31, 880nm), AOD(daily averaged columnar data) for measurements days.

In Figure 2, PM10 and BC averages are calculated over 24h, whereas for radiometer only measurements from 8:00 to 15:00 are available. During September 20, 21, lower levels of PM10, BC and AOD are observed, when the air mass was from North-West sea with high loading of water soluble ions. Maximum values correspond to air mass from East Europe with more particle loading of aged urban emissioins on September 28. This distinguish of aerosol origins has also been reflected by the relationship between AOD and alfa. Apart from local emissions, air mass origins also have detectable effect on the black carbon and particle optical properties in Piacenza.

References

IPCC: Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, 2013.

Calvello et al., Atmos. Chem. Phys., 10, 2195–2208, 2010.