Investigation of local meteorology on PM_{10} and BC atmospheric concentrations in the alpine Arve Valley, France

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The Arve Valley in the French Alps is one of the most polluted areas in France in winter. Local meteorology has a large impact on concentration of many gases and particles, especially related to temperature inversions (Chemel *et al*, 2016). It is necessary to investigate this link at the fine scale to improve both the forecast of pollution events, and planning and evaluation of air quality abatement plans.

Continuous meteorological and chemical composition measurements on a 15-min time scale have been conducted since November 2013 in the Arve Valley, with the sites (Chamonix, Passy, Marnaz) differing in topography and urbanization. Temperature and humidity are measured along the slopes (10 sensors per site) every 100 m or less in altitude from the air quality station where PM_{10} and black carbon (BC) concentrations have been measured with TEOM-FDMS and Aethalometer AE33, respectively. A Wind cube Lidar was also deployed in one site. To define meteorological system capacity to characterize vertical atmospheric structure, a large comparison was also conducted during an intensive field campaign (Paci *et al*, 2015) at one site between measurements of radio-sounding with the measurements from sensors located along the slopes.

In anticyclonic conditions, strong temperature inversions very close to the surface were observed, leading to high concentration of PM and BC. It indicates a large impact of processes within the first 100-200m above ground on the pollutant concentration. Average winter temperature gradient in the first 100 m above ground at the 3 sites indicate temperature inversion during night-time, with breakup during the day, a mechanism already described in deep valleys elsewhere (Whiteman, 1982).

By categorizing winter days according to the intensity of temperature gradient in the first 100 m, a quasi linear relationship is found between the intensity of the maximal temperature gradient at night and the amplitude of the morning decrease of PM_{10} concentrations due to breakup (figure 1). This relation is found at the 3 sites but this does not apply for day of moderate inversion. It is shown that others local meteorological parameters (wind speed, wind direction, and humidity) play a role in determining the concentration variations, and can explain a part of large standard variation observed in the relation between intensity of temperature gradient and PM_{10} concentration.

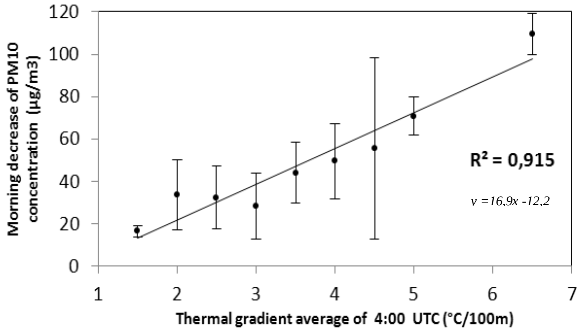

Figure 1. Relationship between early morning intensity temperature gradient and morning decrease of PM10 concentration for day with strong inversion (Passy).

We further investigate the processes and the parameters influencing the concentrations, including higher altitude inversion and temperature profiles. The comparison will be made between the evolution of PM_{10}, the contribution from fossil fuel combustion BC_{ff} and wood-burning BC_{wb}, the last two ones being given by the AE33 measurements (Sandradewi *et al*, 2008) Ultimately, the goal is to provide a tool for a better forecasting of days above the PM_{10} EU threshold.

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Chemel, C *et al.* (2016) *Atmos. Environ.* **128**, 208-215.

Paci A. *et al*. (2015) *Proc. of the 33rd International Conference on Alpine Meteorology*, Innsbruck, Austria.

Sandradewi J. *et al.* (2008) Environ. Sci. Techno. **42**, 3316-3323

Whiteman C.D. (1982) *Journal of Appl. Meteoro.* **21**, 270-289.