Study of aerosol spatial variability by means of a mobile observing system

I. Popovici[1], P. Goloub[1], T. Podvin[1], L. Blarel[1], R. Loisil[1], A. Mortier[3], F. Ducos[1], C. Deroo[1], M. Choel[4], S. Crumeyrolle[1], S. Victori[2], N. Sohne[5]

[1]Laboratoire d'Optique Atmosphérique - UMR 8518, Université Lille 1/CNRS, Villeneuve d'Ascq, 59655, France
[2]CIMEL Advanced Monitoring, Paris, 75011, France
[3]Norwegian Meteorological Institute, Oslo, 0313, Norway
[4]Laboratoire de Spectrochimie Infrarouge et Raman - UMR 8516, Université Lille 1, Villeneuve d'Ascq, 59655, France
[5]ATMO Nord-Pas-de-Calais, Lille, 59000, France

Keywords: aerosols, mobile system, spatial variability, remote sensing, in situ.
Presenting author ie.popovici@ed.univ-lille1.fr

Aerosols are a quite variable component of the atmosphere, impacting air quality, human health and climate. The spatial and temporal variability of aerosol properties makes their characterization difficult and is one of the uncertainties in climate forcing.

A mobile system that combines passive and active remote sensing observations with in situ optical measurements comes as a multi-observation tool for the characterization of aerosol vertical and near-surface properties. This innovative tool complements the existing atmospheric study capabilities, such as fixed ground-based and satellite-based observation techniques. Applications of such system are various, from the observation of aerosol inter-regional gradients in case of pollution events to the validation of satellite measurements and model outputs.

The mobile system used in this study is composed of a CIMEL micro-LIDAR (Pelon *et al*, 2008), a mobile sun photometer - PLASMA (Karol *et al*, 2013), a nephelometer, an optical particle counter and a meteorological station. The measurements are performed during the vehicle motion and data are transferred via 3G-telecommunication network for processing and display in near real time.

As this observation system performs measurements during motion, it allows the fast spatial exploration to measure the aerosol variability at surface level (nephelometer, particle counter) and within the atmospheric column (Lidar, sun photometer). The mobile system was used up to now for the study of inter-city variability (Lille-Paris, Lille-Dunkerque) and inter-regional studies (Nord-Pas-de-Calais-Belgium). Surrounding countryside will be explored, especially during pollution events.

The use of all the above-mentioned instruments provides informations on vertical profiles of lidar-derived extinction coefficients, lidar ratio, aerosol optical depth, Angström exponent, number and volume size distribution and aerosol mass concentration.

First measurements

The investigation of Nord-Pas-de-Calais and Île-de-France regions revealed a strong inter-regional variability in case of a pollution event that occurred in April 2015 (Popovici, 2015). The vertical distribution and spatial variability of aerosols is illustrated in Figure 1. Mass concentrations of 72 µg/m^3 were recorded in Lille and decreased to 25 µg/m^3 when arriving in Paris. A comparison of lidar-derived aerosol mass concentrations with air quality model outputs was made. The results showed that the predicted values of PM_{10} were higher than the values derived from mobile measurements. This example illustrates the variability in aerosol distribution and concentration within 200 km and 3 hours time interval in case of pollution events and highlights the interest of such studies.

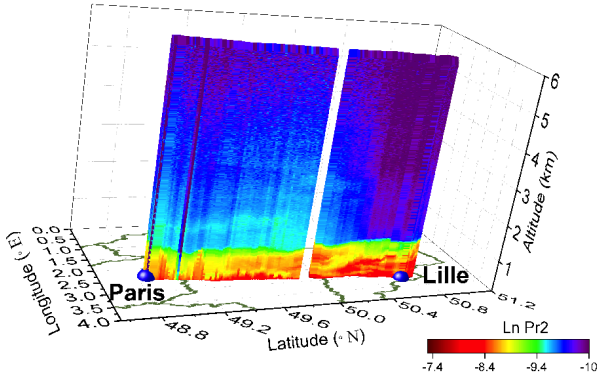

Figure 1. Lidar range corrected signal recorded during Lille-Paris mobile measurements

This work was performed within the framework of a CIFRE grant (ANRT contract #0161) for the doctoral work of I. Popovici at LOA and CIMEL Advanced Monitoring. The authors acknowledge the support from CaPPA project and SNO PHOTONS/AERONET.

Pelon, J., Mallet, M., Mariscal, A., Goloub, P., Tanré, D., Bou Karam, D., Flamant, C., Haywood, J., Pospichal, B. and Victori, S. (2008) *J. Geophys. Res.*, **113**, D00C18

Karol, Y., Tanré, D., Goloub, P., Vervaerde, C., Balois, J. Y., Blarel, L., Mortier, A. and Chaikovsky, A. (2013), *Atmos. Meas. Tech.*, **6**, 2383-2389

Popovici, I. (2015) *Aerosol spatial distribution as seen from a mobile observing system*, Master thesis report available at Laboratoire d'Optique Atmospherique