Geophysical Research Abstracts
Vol. 13, EGU2011-11767, 2011
EGU General Assembly 2011

Aggravation of air quality conditions due to multi-layer aerosol load in the Paris area during the heatwave of August 2003

Juan Cuesta (1,2,3), Pierre H. Flamant (2), and Cyrille Flamant (3)

(1) IPSL / LISA, Créteil, France (juan.cuesta@lisa.u-pec.fr), (2) IPSL / LMD, Palaiseau, France, (3) IPSL / LATMOS, Paris, France

The heatwave over Europe in August 2003 led to catastrophic health conditions that produced a large number of excess deaths (>15,000 in France). Extremely difficult living conditions were linked to very hot ground level temperatures (anomalies from climatology reaching +10°C in France during 5-12 August) and respiratory difficulties due to high production and accumulation of pollutants in urban agglomerations, as induced by strong stagnant conditions over France. During the first two weeks of August, local and remote sensing observations have shown anomalously high aerosol concentrations over Europe, both from urban pollution in the atmospheric boundary layer (ABL) and from forest fires (particularly originating in Portugal) in the free troposphere (FT). Such situation remained during day and night time without release during several weeks.
In the present paper, we investigate the link between the multi-layer aerosol load over the Paris area, the local radiative budget and the ABL dynamics during the August heatwave. For characterizing aerosols vertical distribution, their radiative impact and atmospheric stability, we use a synergetic technique of observations from aerosol lidars, sun photometers and meteorological in situ sensors, so-called LIBOD and the radiative transfer code STREAMER. Our findings show a strong day-to-day correlation between a delay and lengthening of 2 hours in the morning development of the convective ABL and the occurrence from 5 to 10 August of forest fire aerosols in the FT and the accumulation of pollution aerosols in the residual ABL. We estimate that the radiative impact of such complex multi-layer aerosol distribution consist of deepening the atmospheric stratification, by significantly cooling down the air layers from the surface up to 400 m above ground level (agl) and by heating them up from 400 m agl up to 2200 m agl. Radiosoundings from Trappes (15 km from Paris downtown) indeed showed a concomitant anomalously strong stratification (a potential temperature gradient from -10 to -20 K/km) during the night (measured at mid-night) at approximately the same period and vertical location. Noon radiosounding showed as well a similar potential temperature day-to-day decrease from the surface and up to 500 m agl (during 7-9 August). Strong stagnant conditions produced by a high pressure system centred over France and the Paris region suggest very limited exchanges with other regions and thus local conditions appear to be the main driving factor the ABL dynamics. The pronounced nocturnal stratification is much likely responsible of the delay of morning development of the convective ABL, which inhibited pollutant vertical mixing during the morning and aggravate the breathing conditions within the heatwave period (5-10 August).