Wildfires in North Spain: Smoke aerosol and its radiative effects

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Keywords: aerosols, radiative forcing, size distribution, wildfires
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Wildfires constitute a major source of concern since they are responsible for important economic, human and environmental losses. They are a relevant source of aerosol particles and trace gases, with important impacts on several aspects: human health, visibility, biogeochemical cycles, atmospheric chemistry and global and regional climate. Wildfires change significantly chemical, optical and radiative characteristics of aerosol particles. Linked to these emissions, solar irradiance at the top and at the bottom of the atmosphere results affected, causing important effects on regional conditions of the climate system (Chubarova et al., 2012). At present, radiative direct forcing of wildfires continues to be at a medium to low level of scientific understanding (IPCC, 2007).

Several authors have pointed out that changes in climate will propitiate a considerable increase in fire intensity, frequency and area burned. Hence, a complete characterisation of forest fire emissions and their effects is of great interest. Furthermore, it is important to keep in mind that transport processes play a crucial role, as these events not only have a local impact, but they also have consequences at thousands of kilometres from the source.

On 19th August 2012 a forest fire occurred in the district of Castrocontrigo (León, Spain) (42° 10′ 58″ N, 6° 11′ 18″ W) in the southwest of the province of León and lasted for 10 days. A vast area was affected, including several districts. The land that was burnt (117.24 km^2) included shrub (11.69 km^2) and wooded land (105.55 km^2). Furthermore, another forest fire occurred in Cubo de Benavente (Zamora, Spain) (42° 07′ 25″ N, 6° 09′ 47″ W) affecting a total of 8.24 km^2 between 18th and 20th August 2012. The effects of these wildfires were rapidly noticeable in the city of León (42° 35′ 59″ N, 5° 34′ 18″ W, 840 m asl), located at around 60 km and 100 km, respectively, from the points where the wildfires started. Thus, mainly on 19-21 August, a thick haze from these fire events covered the city, limiting visibility. The presence in the air of large amount of ash and cinder and a significant particle deposition onto cars, land, buildings, etc., was observed. There was also a large red/pink halo around the sun, which caused a partial darkness in the city, uncommon during daylight hours.

A sampling campaign was carried out in the city of León during August 2012. A laser spectrometer PCASP-X was used for measuring particles from 0.1 µm to 10 µm. This optical counter was calibrated with latex particles with a refractive index of 1.58 –0.0i. To retrieve the exact number concentration versus exact size, the raw size bins were corrected using a program based on Mie Theory implemented with a computer code developed by Bohren and Huffman (1983). Additional measurements that were carried out *in situ* included temperature at surface level, and direction and speed of surface wind. The short-wave radiative forcing (SW) was studied using the Radiative Transference Model (RTM) GAME (Global Atmospheric Model) (Dubuisson et al 2004).

Using the data collected in the city of León, this study aims to analyse the aerosol properties and their radiative effects during the wildfires occurring in Castrocontrigo and Cubo de Benavente to compare the smoke aerosol with the characteristics of the atmosphere before and after the fire events.

An appropriate understanding of the emissions from wildfires and their radiative effects is needed in order to quantify the atmospheric impacts of these events (they likely affect regional atmospheric stability, heating rates, surface temperatures, cloud formation, and precipitation) and to provide input data for local/regional climate modelling.

This study was supported by the Spanish Ministry of Science and Innovation (Grant TEC2010-19241-C02-01). Elisabeth Alonso and Ana I. Calvo acknowledge the pre-doctoral (CGL2010-1777 from the Spanish Ministry Science and Innovation) and posdoc (SFRH/BPD/64810/ 2009 from FCT) grants, respectively.

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