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Impact of forest fires on the Mediterranean aerosol burden in summer 2003

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It is well documented that summer 2003 was the hottest in the last centuries in Europe. The meteorological conditions characterized by the persistent presence of a high pressure over Western Europe determined the occurrence of spread and persistent fires in Southern Europe.

Spectral aerosol optical depth (AOD) in the visible and near infrared and Ångström exponent were measured by means of a Multi-Filter Rotating Shadowband Radiometer (MFRSR) at the remote island of Lampedusa (35.5˚ N, 12.6˚ E). Through the application of a radiative transfer model reproducing the ratio of the diffuse to direct irradiance, the spectral single scattering albedo were derived at 60˚ solar zenith angle (SZA).

An unusual aerosol plume was observed at Lampedusa for 22 days, from August 2 to 23. The average AOD at 415.6 nm and 868.7 nm for the period are 0.45 and 0.12, respectively, and the average Ångström exponent is 1.8 at 60˚ SZA. The average column-integrated single scattering albedo is 0.83 at 415.6 nm and 0.79 at 868.7 nm.

The comparative analysis of the aerosol optical parameters, fire locations and the airmass paths indicated that such an extend plume was principally due to the fires developed in France, Italy and the Balkans and to the peculiar synoptic situation, which favoured the accumulation of aerosols and trace gases.

The AOD at 550 nm and the Ångström exponent measured at Lampedusa were compared with the observations of the Moderate Resolution Imaging Spectroradiometer (MODIS), showing a good agreement. MODIS observations in selected remote locations of the Mediterranean basin evidence that the plume observed at Lampedusa

extended over a large part of the Mediterranean with different time extension (from 11 to 20 days) and AOD at 550 nm (from 0.21 to 0.30), depending on the geographic location.

MODIS data for the period July-August from 2000 to 2004 confirm the unusual temporal and spatial extension of the fire plume of 2003: in fact, although similar episodes were observed in summer, mostly in the Western and Central Mediterranean basin, they were characterized by a shorter duration (4-7 days), lower spatial extension and AOD.

The aerosols from the fire plume may have increased the heating of the atmosphere with respect to the background conditions. Radiative model simulations showed that the heating rates in the spectral range 300-800 nm may increase by up to 2.2 K/day at 30° SZA or 1.7 K/day at 60° SZA within the plume layer, depending on the aerosol vertical distribution. This further heating may likely increase the atmospheric stability, weakening the convective processes and the cloud formation, thus contributing to maintain the anomalous atmospheric conditions met in summer 2003.