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Determination of emissions from Mediterranean shrubland fires.

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Forest fires have been increasing during the last decades in the Mediterranean Basin, significantly contributing to greenhouse gases (GHG) and aerosol emissions to the atmosphere. More than 50% of these fires affect shrublands accumulating high fuel load. The quantity and composition of emissions depend on burning conditions and on the composition of fuels. In order to characterize the specific emissions from widely representative Mediterranean shrublands, we conducted experimental burnings during April 2009 in the Ayora valley (Valencia, Spain). In this paper we present an overview of the experimental setup and main results obtained. Three 1000 m^2 plots located on the same slope and with the same type of vegetation were selected as representative fire-prone Mediterranean shrublands for fire occurrence and as emission source. Vegetation-fuel was characterized before burning. A meteorological tower was installed to provide temperature, wind speed and humidity measurements during the experimental burns.

The instrumentation used during the experiments was designed to obtain continuous measurements, and to collect simultaneously samples in cartridges and high-volume filters at ground level. Determination and quantification of the chemical compounds emitted, both in gaseous and particulate phase, was carried out using GC-MS and LC-MS. We explored the identification of biotracers from the two phases and compared with previous studies.

The emission composition research was focused on acids, alcohols, aldehydes, ketones, volatile organic compounds (VOC's) and poliaromatic hydroacarbons (PAH's). The main compounds found were palmitic acid, glutaric acid, phthalic acid, levoglucosan, cresol, glyoxal, methylglyoxal, butanone, pentanone, limonene, a-pinene, pirene and fluorantene. The results were calculated in mass C/m^3 to estimate a total mass of carbon sampled during burning emissions. The range of concentration measured was in the order of microg/m^3 for each group of compounds.

The relationship between Mass Combustion Efficiency (MCE), fuel, moisture, temperature and Emission Factors (EF) of CO_2, CO and CH_4 were established and the results compared with similar studies. The identification of the two phases of the fire (flaming and smoldering) was done comparing the ratio of the concentration CO_2:CH_4 and the temperature profile of the fire. With this procedure, it was possible to separate the emissions during each phase.

The maximum ground surface temperature reached was 700ºC and the total fire MCE was lower than 90%.The MCE values for the flaming phase were comparable to wildfires data from the literature, but lower for the smoldering phase.

The EF (CO_2) in the flaming phase was around 1700 gCO_2/kg dry matter and 1045 gCO_2/kg dry matter for the smoldering phase. Total emission in the three replicates was 3.8 Kg CO_2/m^2 in flaming and 2.3 Kg CO_2/m^2 in smoldering.

This work provides new experimental data that would contribute to improve the emission factors currently used in GHG inventories for Mediterranean countries, and to identify characteristic trace compounds from shrubland fires.