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High-resolution smoke emissions from the 2017 extreme wildfires in Portugal

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Abstract

In Portugal, wildland fires are one of the most serious natural disasters, due to their recurrent occurrence, their extension and their destructive effects. The year 2017 will be forever remembered with several lives lost during wildland fire events. In October, in particular, seven extreme wildfire events(EWE) were registered (Leiria, Lousã, Quiaios, Sertã, Oliveira do Hospital, Seia and Vouzela), which burned more than 200,000 hectares in less than 24 hours and caused a high number of victims among the civilian population, the destruction of hundreds of homes and businesses, and several environmental damages, including the degradation of air quality. The main objective of this work was to calculate and characterise the atmospheric emissions of these October EWE based on a high spatial-temporal bottom-up approach. Particulate matter (PM10 and PM2.5), nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), carbon dioxide (CO_2) and methane (CH_4) emission factors, burning efficiency, fuel load and burnt area data were used considering the available information per EWE and by forest type. Local characteristics of the consumed forest type and shrubs were obtained from the Portuguese Nature and Forest Conservation Institute. Furthermore, fire data, such as the starting location and ignition time, propagation information and burnt area per EWE were obtained from national technical reports. The highest total emissions were estimated for the Leiria EWE, which were on average 37% higher than the sum of emissions from all other EWE. During the EWE between 15th and 16th October 2017 (≈ 48 hours) fire PM10, PM2.5 and CO_2 emissions were 117%, 158% and 259%, respectively, higher than the total anthropogenic emissions in Portugal for the entire 2017 year. Moreover, estimated values were compared with data from Moderate Resolution Imaging Spectroradiometer (MODIS) and Spinning Enhanced Visible and InfraRed Imager (SEVIRI) sensors. For PM10, this study's values were on average 3 times higher than SEVIRI ones and 2 times lower than MODIS ones. In conclusion, the high detailed spatial-temporal information allowed obtaining an improved characterization of the EWE emissions. It is important to implement this emissions estimation approach in smoke forecasting systems to timely inform stakeholders about the possible occurrence of

smoke wildfire air pollution episodes and therefore to better manage human health effects.

Keywords: Extreme wildfire events; Smoke Emissions; Emission factors; fireline propagation; Mediterranean conditions

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