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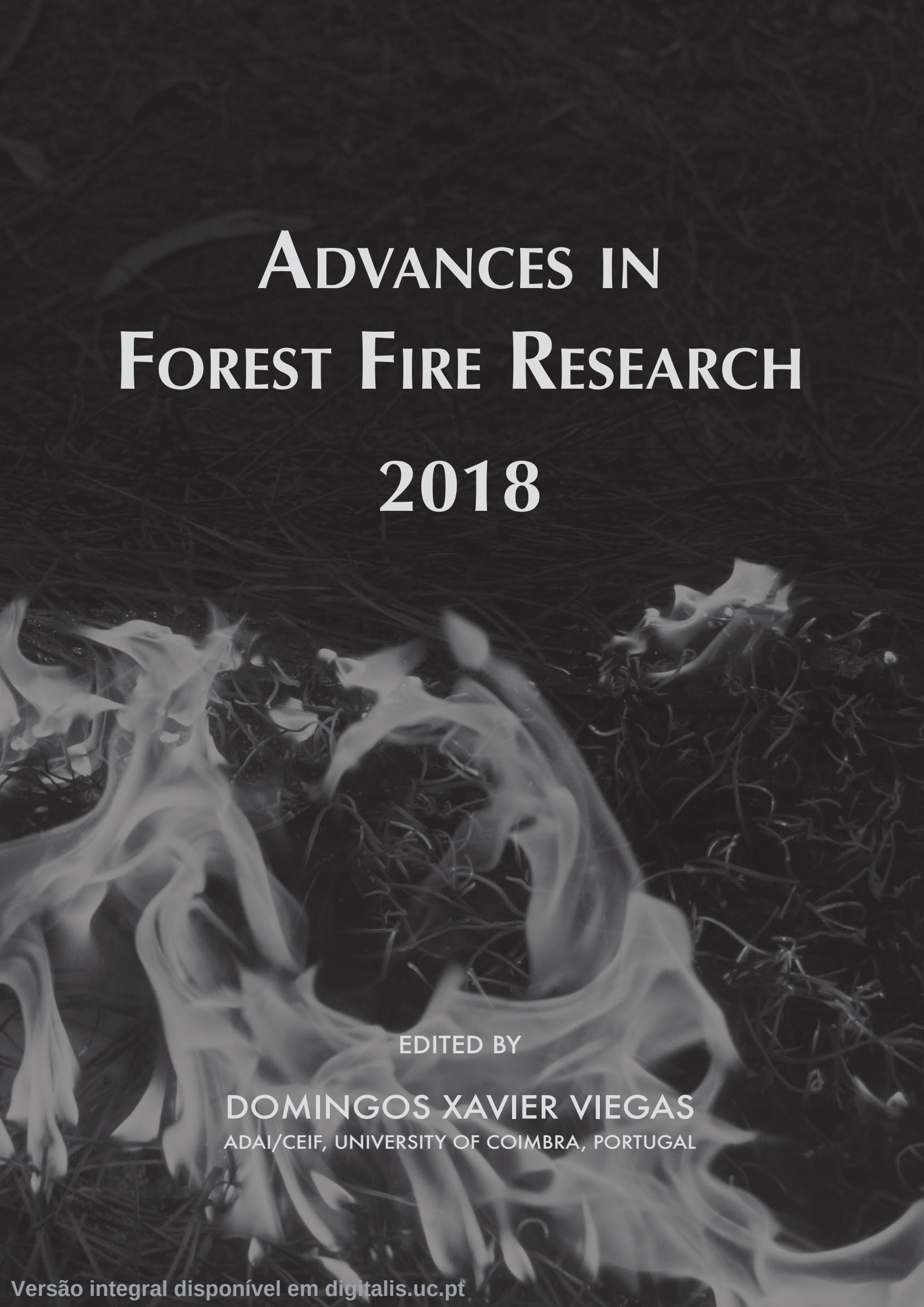

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Atmospheric flow and a Large fire interaction: the unusual case of Pedrogão Grande, Portugal (17 June 2017)

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Abstract

On the afternoon of 17th June 2017 the fire was progressing in a hilly region of central mainland Portugal. A hot and dry atmosphere, characterized by a classic inverted V profile, typical from dry downburst environments (Weisman and Klemp, 1986), was in place, thus favoring high level based convection. In fact, an MCS that was observed both on satellite imagery and weather radar, has developed southeast of the fire area and, during the afternoon of this day, produced several downbursts that were recorded in several automatic weather stations (AWS). It was found that several shear lines, identified on Doppler radar, were considered to be consistent with convective outflow gust front surges that emanated from a downburst, or downbursts, generated by the MCS, and propagated over the fire area. It was verified that as this happened, the fire suffered an outstanding intensification, having produced a very violent and widespread firestorm that materialized an Extreme Fire Behavior (EFB), confirmed by ground survey (Viegas et al, 2017). As an outcome of this first interaction between the atmosphere and the fire, it was observed that a vertically developed dry pyroconvective column formed and made its way through the MCS anvil, placed overhead the fire by that time. Soon after, this smoke column top altitude decreased more than 5000 m in just 10 minutes. This remarkable behavior, resembling a downburst top collapse, was accompanied by a rapid low level plume displacement, interpreted as a result of the downburst induced circulation close to the ground. Just 10 minutes later, another fire blowup occurred, as the plume started to grow vertically. This second outstanding pyroconvective column growth was seen as a direct result of the stated downburst induced circulation at low levels that, as it was manifesting, induced another EFB episode.

Keywords: mesoscale convective system; outflows; shear lines; fire blowup; downburst; weather radar

1. Introduction

As recognized in specialized literature (Werth, P, et al, 2016), prolonged periods of drought are positively correlated with the occurrence of intense hot fires, although several studies (e.g. Viegas and Simeoni, 2011) have also clearly linked extreme fire behavior (EFB) with fuel properties and topography. The Pedrogão Grande (PG) large fire occurred in central mainland Portugal, after several months of under average rainfall records (April was the driest since 1931) and above average temperatures. By late May, more than two thirds of the country were in a severe drought level, according to Palmer Drought Severity Index (IPMA, 2017, in portuguese).

The PG large fire started during the early afternoon of the 17th June 2017. Less than one hour later, a second ignition originated a separate fire, a few kilometers far from the first location. By the same time, a multicell convective convective system (MCS) formed and started to propagate to the east-southeast of the fire area, in a very hot and dry low troposphere environment. It was observed, both on radar and ground stations, that several convective outflows were produced by the MCS. As the meteorological system was propagating closer the fire, some gust front surges started to interact with it and, on a certain occasion, a first outstanding fire intensification was observed. It materialized an EFB, as confirmed by ground survey. As it happened, the fire went out of control and more than 50 people were killed.