Project Deliverable D1.3

- Database of large fires behaviour of temperate NW European wildfires and mega fires in Southern Europe-

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This project has received funding from the European Union's Horizon 2020 research and innovation programme MSCA-ITN-2019 – Innovative Training Networks under grant agreement No 860787

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List of Acronyms *(if applicable)*

CA	Consortium Agreement
EB	Executive Board
EC	European Commission
ESR	Early Stage Researcher
GA	Grant Agreement
MoM	Minutes of Meeting
NDA	Non-Disclosure Agreement
PM	Progress Meeting
SB	Supervisory Board
ToC	Table of Contents
WP	Work Package

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Executive Summary

This deliverable, which is an outcome of Work Package 1, describes some of the research outputs from ESR3 and ESR4: fire behaviour data from large fires in north-western and selection of extreme wildfires in southern Europe. The document describes their main features, functionalities and characteristics.

1 Large fires in northwest Europe

The Tecnosylva team developed an algorithm to describe the behaviour of large fires based on information from the Visible Infrared Imaging Radiometer Suite (VIIRS) fire hotspots database. It performs a spatio-temporal clustering of all the hotspots described by the sensor, deriving fire progression isochrones and Rate of Spread (ROS) propagation vectors for each one (Figure 1). It is important to mention that we are talking about large fires, because the size of a VIIRS pixel is 375 metres and for the algorithm to be able to identify fires, more than one is needed. Therefore, this analysis is adjusted to larger scale fires. Related information that can be extracted is fire timing, area burned per time step, fire duration and area growth.

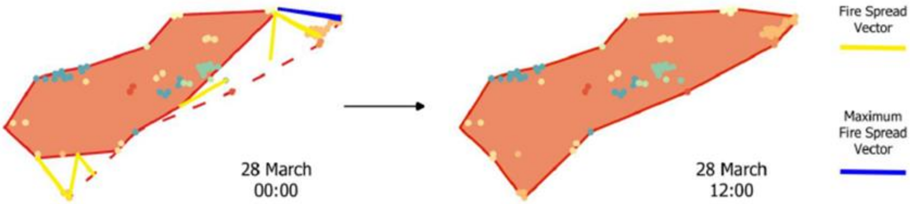

Figure 1. Graphical scheme of the outputs generated by the algorithm. The dots indicate the VIIRS hotspots and the generation of isochrones every 12 hours from these hotspots. Subsequently, fire spread vectors are derived.

This novel methodology was applied to describe the behaviour of large fires in a region of increasing risk, such as north-western Europe. Northwest Europe was delimited as the Atlantic biogeographic region above the 49th parallel (Figure 2). For this, VIIRS data was acquired from 2012 to 2022, covering the beginning of the historical record. 102 large fires could be clusterized, most of them distributed over the British Isles.

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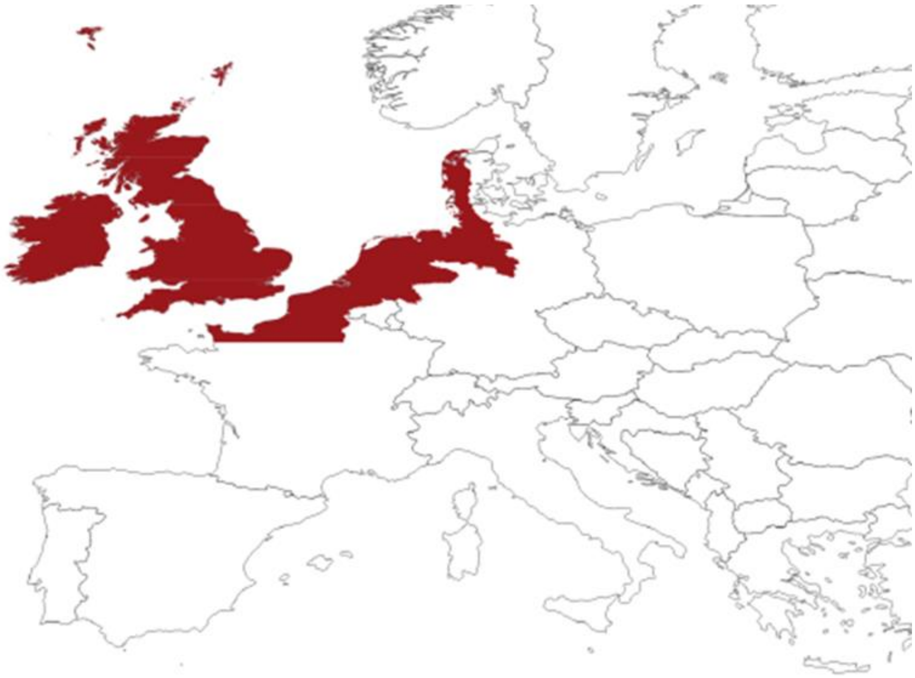

Figure 2. Atlantic biogeographaical region above the 49th parallel, area of interests for the fire behavior analysis.

This applied methodology and subsequent analyses associated with seasonal, spatial and land use variation of behaviour in this region were published in the Natural Hazards and Earth System Sciences journal [1] (see attachment Cardil et al. 2023.pdf). In addition, the generated perimeters and propagation vectors are available as an open database in zenodo (https://zenodo.org/record/7019770#.ZCQW23ZByHu:~:text=10.5281/zenodo.6330200).

2 Extreme Wildfires in southern Europe

It is a fact that extreme wildfires represent only a small fraction of the total number of wildfires occurring, but they account for the majority of the total burned area. However, there is no single and adequate definition that can be applied to define all cases of extreme wildfire events, as they depend entirely on the socio-ecological context in which they occur. Consequently, this deliverable should be seen as an interim approach for establishing a database of extreme wildfires for southern Europe.

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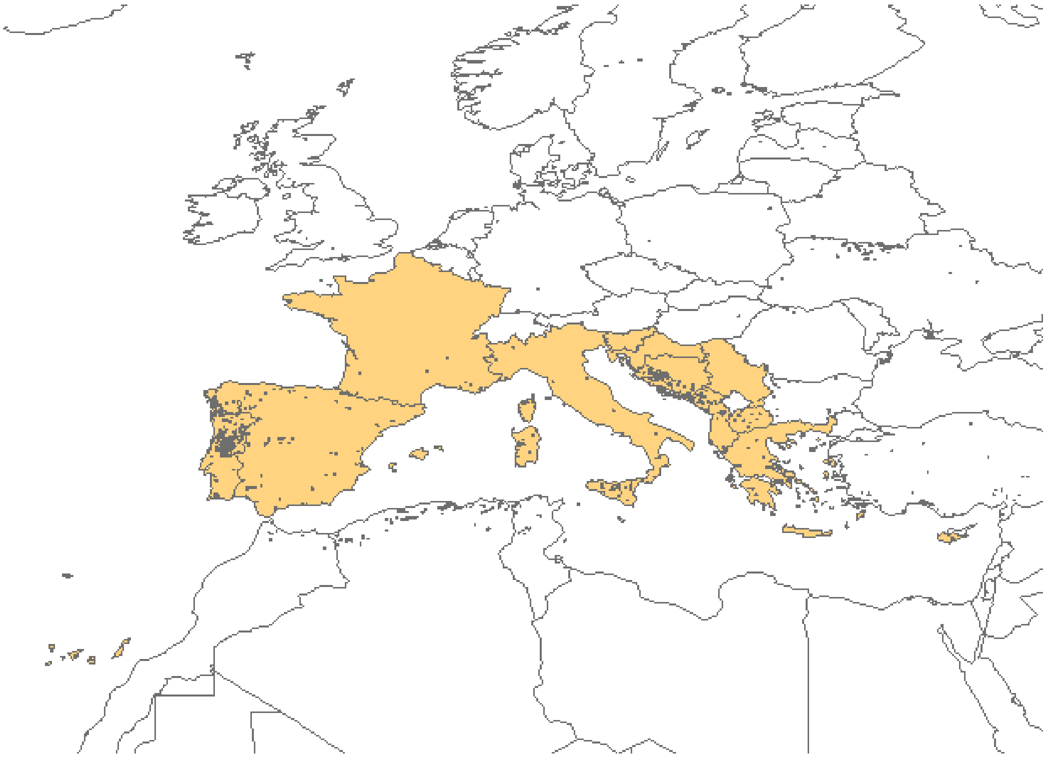

Figure 3: South European region, area of interests for the extreme wildfires database with selected wildfires

Prior to building this database, we spent some time studying the different definitions of extreme wildfires, a term we prefer to use rather than the often used but potentially more subjective "megafires", which may lead to the misconception that the definition of these fires is based solely on the size of the burned area. An issue that we have discussed at length in a manuscript (Stoof et al. under review submitted as a response to Linley et al. (2022)).

Despite the ambiguity of the term, the creation of a database requires the definition of selection threshold(s). Therefore, among the possible definitions of extreme wildfires, we have relied on two different metrics to select extreme fires in southern Europe: size and Fire Radiative Power (FRP). Hence, two selections were made from the reliable available data obtained from the European Forest Fire Information System (EFFIS) between 2003 and 2021.

- One based on wildfire size and setting its minimum threshold on 5000 ha, as an approximation to the 95th percentile of the size of large (>500 ha, as per the EFFIS definition) wildfires for the entire studied area;

- A second selection that includes all wildfires greater than or equal to 1000 ha whose 95th percentile of the FRP exceeds the overall 95th percentile of the FRP for southern Europe.

Work to improve the thresholds for different ecosystem types is currently ongoing, while waiting to receive updated and corrected satellite data that will allow us to include in the database the particularly extreme wildfire season that have occurred during 2022.

A second component of the database is explicit fire behaviour characteristics observed during the wildfire or reconstructed after the fact. For this purpose, we have considered ground observations or their combination with remotely-sensed data, from monitoring aircraft to satellites. The database includes wildfires dating from 1983 to 2022 and the information was collected from various sources, both from the scientific literature and from fire management agencies and other governmental

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initiatives. To this end the BONFIRE worldwide fire behaviour database (Fernandes et al. 2020) was updated, including additional records and improvement of pre-existing records.

3 Data availability

Attached to this document are different files related to both NW and Southern Europe fires.

For **NW Europe**, the file "NW Fires Table.xlsx" is attached, which is a general summary of the behaviour of the 102 fires that could be clustered, as well as the zipped file "NW Fires Spatial data.zip" which includes the advance isochrones of all the fires, together with their spread vectors in KML format.

For the **South European Extreme Wildfire database**, it is attached the file 'ExtremeWildfires_SouthEurope_deliverable1_3.xlsx' with all information above mentioned and a shapefile to locate the fire polygons from EFFIS, included in the zipped file 'ExtremeWildfiresEFFISdata_2003_2021_SEurope.zip'.

4 References

[1] Cardíl, A., Tapia, V. M., Monedero, S., **Quiñones, T**., Little, K., Stoof, C. R., Ramirez, J., and de-Miguel, S.: Characterizing the rate of spread of large wildfires in emerging fire environments of northwestern Europe using Visible Infrared Imaging Radiometer Suite active fire data, Nat. Hazards Earth Syst. Sci., 23, 361–373, https://doi.org/10.5194/nhess-23-361-2023, 2023.

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[3] Linley, G. D., Jolly, C. J., Doherty, T. S., Geary, W. L., Armenteras, D., Belcher, C. M., Bird, R., Duane, A., Fletcher, M., Giorgis, M., Haslem, A., Jones, G., Kelly, L., Lee, C., Nolan, R., Parr, C., Pausas, J.G., Price, J., Regos, A., Ritchie, E., Ruffault, J., Williamson, G., Wu, Q., and Nimmo, D. G. (2022). What do you mean,'megafire'?. Global Ecology and Biogeography 31(10): 1906-1922.

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