Ofire+: A Pioneer Solution on Wildfire Incident Planning and Response for Enhancing the Resilience of Individual Infrastructures

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Abstract

Ofire+ is a commercial human-centralized early warning system which aims in supporting managers on making informed decisions about proper management of human and material resources and the available response time towards threats from sub-urban wildland fires. The system consists of an administrator application as well as a user mobile application providing a direct communication channel between the two. The impact of the system is that it bridges the gap between informed decisions and coordinated actions by incorporating scientific and timely operational data which are transformed into critical information. *Ofire+* aligns with current EU priorities and can help in reducing societies' vulnerability and strengthening resilience, mitigating negative effects on economic activities, rationalizing insurance risk-based premiums and compensations, invigorating individual action, lessening governmental financial exposures and even in shaping concrete EU wildland fire safety policies. Furthermore, the implemented methodology is based on open satellite data which makes the system versatile and scalable. *Ofire+* is currently in operational implementation in the Municipality of Dimos Thermis (administrator appl.) and is scheduled to be completed by the end of summer 2019.

Keywords: incident planning; wildfire prevention; risk response; infrastructure resilience

1. Introduction

Rural and sub-urban wildland fires are an extremely serious threat to society and the national economies as they cause significant losses such as infrastructure destruction, business disruption and horizontal degradation of the natural environment, and have significant secondary effects (eg. flooding after a fire). The problem of wildland fires is particularly acute in the Mediterranean region, but also in other parts of the world with similar climatic conditions. According to the European Forest Fires Information System (EFFIS) data in Europe, in 2017, 79.863 recorded fires were reported, which burned 2.520.159 hectares of forest or rural land. Only in Greece in 2017 1.083 fires were recorded with respectively 13.393 hectares of burned area. Despite the environmental, economic and human losses that arise as a consequence of such crises, there is to date no appropriate training from the official authorities or the necessary initiatives to reduce the risk in future cases. This is due to the fact that historically the main shift was at prevention but this policy model has begun to change in recent years (IUFRO 2018, GFMC 2019). Since the probability of most types of extreme weather events is expected to grow significantly the Green Paper on the insurance of natural and man-made disasters (COM(2013)213 final) clearly states that "in hazard prone areas, property owners will have to invest even more in property-risk reduction measures". To avoid tragic incidents and to reduce the risk of fire and its potential impact, a region-specific approach based on the understanding of the characteristics and behavior of the fire, vigilance and population awareness, tracking of fire events and their timely announcement and fuel management is required (IUFRO 2018). *Ofire+* is a commercial human-centralized early warning system addressed to cultural or tourism infrastructure managers and / or civil protection officers and supports them in making informed decisions about the proper management of human and material resources and the available response time towards threat from wildland fires in order to increase levels of direct and indirect infrastructure protection and to reduce overall security and protection costs from natural disasters.

2. Method

Ofire+ utilizes specialized scientific methods and new technology tools in order to provide its services to the target groups. More specifically, the system consists of 2 main applications, the administrator application and the user application. The administrator application uses and presents: 1) analytical fuel mapping within the area of implementation of the system, 2) daily meteorological data, namely temperature, relative humidity, precipitation, intensity and direction of wind which are used for the calculation of FWI (Fire Weather Index). The FWI was developed by the Canadian Forest Service (Van Wagner, 1987) and is proven to be well adapted to the Mediterranean region (Dimitrakopoulos et al, 2011; Ertugrul and Varol, 2016) 3) Simulation of

the behavior of the fire based on the FARSITE model. 4) Information on the commencement of fire based on hotspots provided by the MODIS satellite for the last 24 hours. All the aforementioned services are currently fully-functional. The application of the user is a hybrid cellular mobile application, currently under development, in which basic information such as the FWI or daily weather conditions and customised information depending on the profile of the final recipient (staff, visitor) will be shown. The admininstrator-user communication will be bi-directional and will provide on the one hand the administrator with crowdsourced information based on user observations (smoke, fire, fallen logs etc) and on the other hand the user with direct messages when a fire event occurs nearby.

3. Results

For the verification of the methodology and the extraction of its first results, a pilot operational implementation of Ofire+ took place on the Municipality of Thermi in Thessaloniki Prefecture covering approx. 53.200 ha, including the settlements of Thermi, Triadiou, Raidestos, Peristeras, Livadi, Risiou, Tagarades, Kardias and A. Scholari with final recipients of services approx. 30.000 citizens (based on ELSTAT 2011 census). Fuel mapping was implemented using an object based Sentinel-2 image analysis methodology. The images were retrieved at different seasons (January, April, June and August) in order to better detect and analyze the phenological parameters of the vegetation. The updated CORINE2018 dataset was retrieved from the Copernicus Land Service and used for determining the vegetation classes. The results of the mapping process were verified with the use of very large-scale images (google earth) and information concerning land cover derived from LUCAS points and the confusion matrices and accuracy metrics produced very good results (>75%). The classified vegetation was associated with the Standard Fire Behaviour Fuel Models (Scott 2005). For the creation of the FWI, data from the meteorological forecasting model GFS of NOAA was used which provides hourly weather forecasts with a 6-hour time step. For the simulation operation, the Copernicus Land Service EU-DEM altitude model was used, from which the layers of slope and aspect were generated. The simulation incorporates weather information, relief information (height, slope, aspect) and the fire characteristics of vegetation (rate of spread, flame length) in order to create isochronous curves which show the spatial extent of fire with a time-step of 30 minutes. The administrator application will be used by the municipal authorities throughout the summer period of 2019 and data will be collected for the improvement of the administrator application.

4. Milestones And Future Steps

The development of the user mobile application is expected to be completed by the end of summer of 2019 at which point the system will be fully functional. The next steps for advancing Ofire + is to incorporate timely announcement functions by a) integrating EUMETSAT SEVIRI sensor products which are provided for free and have a time step of 15 minutes b) collecting relevant data feeds from social networks such as the twitter account of the Fire department with the use of NLP and geocoding algorithms for the region of implementation.

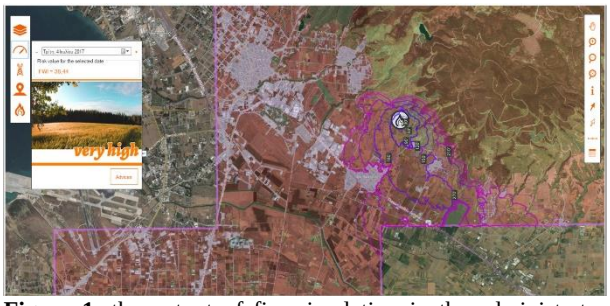

Figure 1: the output of fire simulation in the administrator application depicting areas of Municipality of Dimos Thermis.

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