multi-Risk sciEnce for resilienT commUnities undeR a changiNgclimate

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1. Technical references

Project Acronym	RETURN
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* PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

1.1. Document history

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2. ABSTRACT

Wildfires have an impact on human lives, infrastructures, ecosystems, soil properties, and can trigger cascading effects such as increasing runoffs and landslides. Cutting edge technology and applied research are two important allies in tackling this complex phenomenon. In this Report, the result of Task 3.4 are outlined. Novel technologies such as artificial intelligence (AI), Earth Observation (EO) techniques, sensor networks, and drones, embedded and integrated into a Decision Support System (DSS) to support all the management phases: before, during and after the wildfires. Considering prevention, cutting edge modeling, remote sensing and proximal sensor techniques will be used to improve both long term landscape planning and early detection. During the event, fire spread scenarios will provide timely info on potential fire behavior. Drone assisted operations are also explored in this phase. After the event, the quantification of the burned area extent and the severity of the fire will be used to support recovery and restoration planning considering more resilient nature-based solutions adapted to climate change scenarios.

The Report has a structure which highlights the different Participants activities.

The first one (see paragraph 4.1) is about CIMA activity on integrated wildfire management adopting IA, unmanned aerial vehicles (UAV) and wildfire spread models. Different fuel maps are used as input to PROPAGATOR, a Cellular Automata based fire spread simulator. The fuel maps are derived from the application of ML techniques on past burned areas combining susceptibility maps with Plant Functional Type. This approach can be used both at regional-supranational scale using open data or at local scale at very high-resolution using UAV data (up to 5 m resolution). The use of the different fuel maps as input to PROPAGATOR has been tested in the case study of Albenga (Savona, Italy). The use of PROPAGATOR has been tested both for supporting decisions during emergencies (single fire scenario) and in the prevention phase, for the optimization of prescribed burning locations (Montecarlo approach with multiple scenarios). In both research activities, different fuel maps (default ones and AI – UAV based ones) have been tested.

As per UNIPD (see paragraph 4.2), the topic of the presented research is the interaction between natural disturbances (such as windstorms and bark beetle proliferation) and wildland fire behavior, starting from LiDAR and UAV-based detection of spatial inputs at the catchment scale. The proposed use of remote sensing and GIS-based modeling is intended to overcome the current limits of wildfire behavior modelling under forest disturbances. The considered study areas are two forested catchments in northern Italy (Veneto region), close to the Rocca Pietore municipality, where VAIA storm and bark beetles damage caused profound forest disturbances. An AI approach applied to LiDAR data (validated by on field samples) automatically extracts forest metrics distribution at high-resolution detail for the entire study areas. Such data is conveyed into specific fuel models and landscapes, used as inputs for a fire spread simulator (FlamMap). Statistical analysis of data and FlamMap results detected correlations between natural disturbances and wildfire behavior factors (Rate of Spread -RoS-, flame length, etc.).

UNICA work (see paragraph 4.3) revolves around the establishment of a comprehensive sensor network dedicated to air quality surveillance for fire risk monitoring in the Wildland Urban Interface. The proposed network, instead of using only thermal anomalies, will also detect Particulate Matter and volatile organic compounds. A preliminary case study is outlined, from the sensor infrastructure implementation to the Data Integration, Connectivity and Analytics, culminating in an EWS establishment and community engagement/preparedness.

Concerning UNIGE contribution (see paragraph 4.4) the objective has been to integrate an automated robotic drone management platform into the activities of firefighting teams. The platform enables the continuity of UAV use by automatically changing the payload of drones and replacing exhaust batteries. The integration between drone operations and firefighting activities are studied, adopting wildfire spread models (Level Set Method and Rate of Spread modeling) and designing automatic strategies to direct firefighting (with special emphasis on the use of drones in such operations). Research on how to estimate the rate of spread of a fire front from punctual observed data was conducted.

UNINA activities are not present in this Report, however fruitful discussion about wildfire spread models and the comparison between UNINA and CIMA modelling assets have been undertaken and will be integrated in next reports.

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