18. INTERNATIONAL CONFERENCE
CRISIS MANAGEMENT DAYS

Advanced Technologies for Forest Fire Risk Assessment and Propagation Modelling

Ante Sanader - Croatian Firefighting Association
Ante Ivanović - University of Split – FESB
Sven Gotovac - University of Split - FESB

1. Introduction and Importance

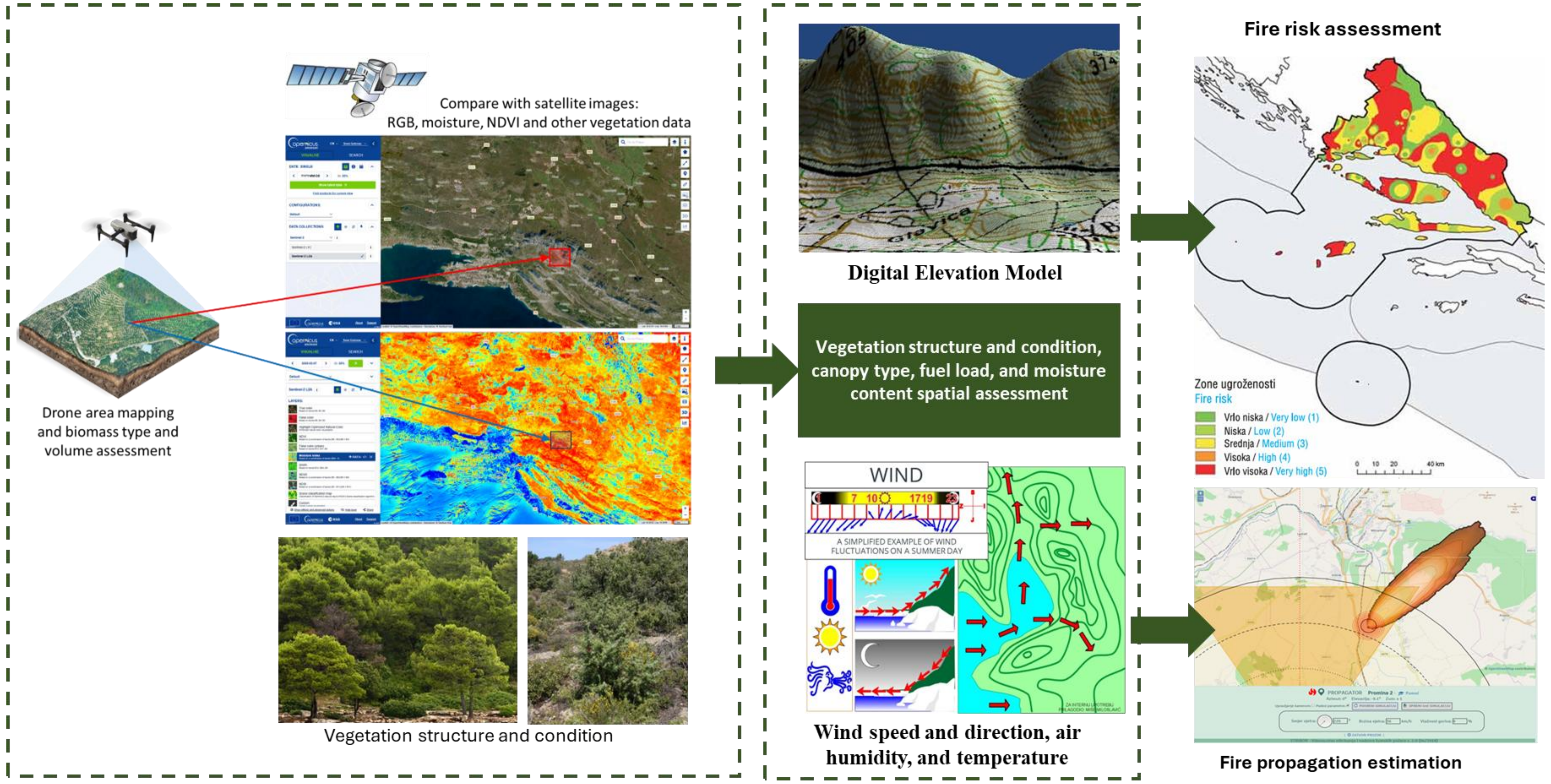
Wildfires have emerged as one of the most pressing natural hazards, particularly in ecologically fragile and climate-sensitive areas such as the Mediterranean. With increasing frequency, scale, and destructiveness of wildfires, advanced technological solutions are becoming essential for effective fire risk assessment and propagation modeling. These technologies not only support early detection and predictive analysis but also enhance preparedness, strategic planning, and real-time decision-making during wildfire events. Their adoption allows firefighting organisations to mitigate threats to lives, infrastructure, and natural ecosystems more efficiently.

2. Methods and System Design

The assessment system integrates a range of geospatial and remote sensing technologies to model fire behavior. Static geospatial inputs—like elevation, slope, and aspect—are extracted from Digital Elevation Models (DEMs), while dynamic weather variables—such as wind, temperature, and humidity—are sourced from meteorological services or numerical weather prediction models like WRF. Vegetation structure and fuel characteristics are captured through multispectral satellite imagery (e.g., Sentinel-2) and UAVs equipped with RGB or LiDAR sensors. These data sources are used to calculate vegetation indices (NDVI), Canopy Height Models (CHMs), and biomass maps in kg/m² or t/ha. These high-resolution datasets feed into fire behavior simulation tools such as BehavePlus, FlamMap, and FARSITE, enabling real-time analysis of fire spread under varying environmental conditions.

3. Results

By synthesizing terrain, meteorological, and fuel data, the system produces detailed spatial maps of fire risk potential and realistic simulations of fire propagation. The use of vegetation indices and LiDAR-derived CHMs enables accurate estimation of fuel loads and canopy characteristics, which are crucial for modeling fire intensity and direction. These outputs allow fire commanders to identify critical risk zones, allocate firefighting resources more efficiently, and make informed decisions during both preparedness and active response phases. Integration of moisture content—either measured in the field or estimated remotely—further refines model reliability, improving the accuracy of fire danger forecasts and tactical planning.



4. Conclusion and Recommendations

The implementation of advanced technologies in wildfire risk assessment and fire behavior modeling offers significant benefits for proactive fire management. To maximize the effectiveness of these tools, it is recommended to establish standardized protocols for data collection, ensure high spatial resolution in weather and fuel data, and integrate real-time sensor feeds where possible. Capacity building and training for fire management personnel in using these systems are also essential. Future work should focus on enhancing the spatial accuracy of dynamic inputs and automating data integration pipelines to support faster, more adaptive wildfire response systems.4

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