



Remote Sensing for Assessing Vegetation Fuels in Wildfire Risk and Propagation Modelling

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Problem - The Escalating Threat of Wildfires

- **Wildfires are intensifying** globally, especially in Mediterranean ecosystems, driven by climate extremes, prolonged drought, and fuel buildup.
- **Traditional detection and risk assessment** (watchtowers, manual mapping) lack spatial coverage and real-time capability.
- **Remote sensing technologies**, particularly UAVs and satellites, now enable scalable, non-invasive, and real-time wildfire monitoring.
- Accurate input data—**fuel load, vegetation type, and moisture content**—is essential for **fire modeling and early warning systems**.

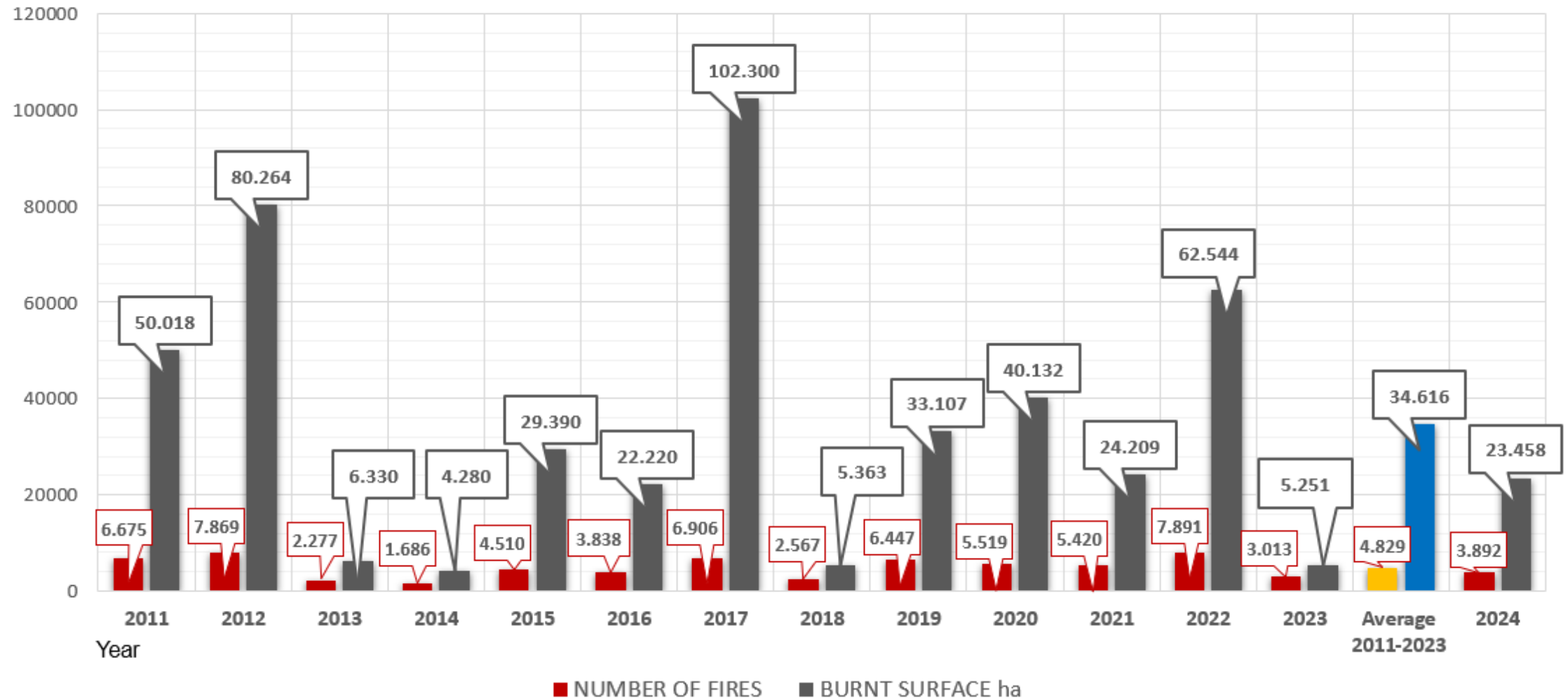


Overview of fire data from 2011. to 2024.



Wildfires - Republic of Croatia

Period: From 01.01. to 31.12. – 2011. to 2024.



Overview of fire data in 2024/2023.

FireTech

Report: National firefighting command and coordination centre 193 about fires from 01.01. to 31.12.2023.									
Types of fires	Outdoor Fires	Wildfires	Burnt surface ha	Fire in/on the building	Vehicle fire	Total number of fires	Number of fatalities reported	Number of injuries recorded	Operation of air force on wild fires
Total:	5.475	3.013	5.251	3.931	1.008	10.414	21	166	33
							Firefighter 0	Firefighter 27	

Report: National firefighting command and coordination centre 193 about fires from 01.01. to 31.12.2024.									
Types of fires	Outdoor Fires	Wildfires	Burnt surface ha	Fire in/on the building	Vehicle fire	Total number of fires	Number of fatalities reported	Number of injuries recorded	Operation of air force on wild fires
Total:	6.669	3.892	23.458	3.887	1.075	11.631	26	178	91
							Firefighter 0	Firefighter 26	

Data comparison 2024. / 2023.	21,81%	29,17%	346,73%	-1,12%	6,65%	11,69%	23,81%	7,23%	175,76%
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Fire season
2024/2023 only



Year	Number of fires	Burnt area (ha)
2023 (June - September)	1.300	2.520
2024 (June - September)	1.981	15.154
COMPARISON:	52.38 %	501.35%

CONSEQUENCES

Major
material
damage

Landscape
destruction,
soil erosion

Habitat loss

Negative
impact on
tourism



Objectives and Research Focus

Research Goals and Hypothesis:

- Develop a **multi-platform remote sensing framework** combining UAV and Sentinel-2 data.
- Accurately estimate:
 - **Fuel mass** (via UAV-LiDAR and photogrammetry)
 - **Vegetation type** (via RGB/multispectral imagery + ML classifiers)
 - **Live Fuel Moisture Content (LFMC)** (via spectral indices: NDVI, NDWI)
- Integrate these parameters into **fire propagation models**: FARSITE, FlamMap, etc.
- Evaluate methodology across Mediterranean landscapes for **scalability, reliability, and operational readiness**.

Methodological Framework



Satellite Imagery (Sentinel-2, MODIS, Landsat):

- Used to assess vegetation health and dryness (NDVI, NDWI, NDMI, EVI).
- 13-band multispectral data enables regional-scale classification and moisture trend analysis.
- Ideal for **large-area risk mapping** and monitoring over time.

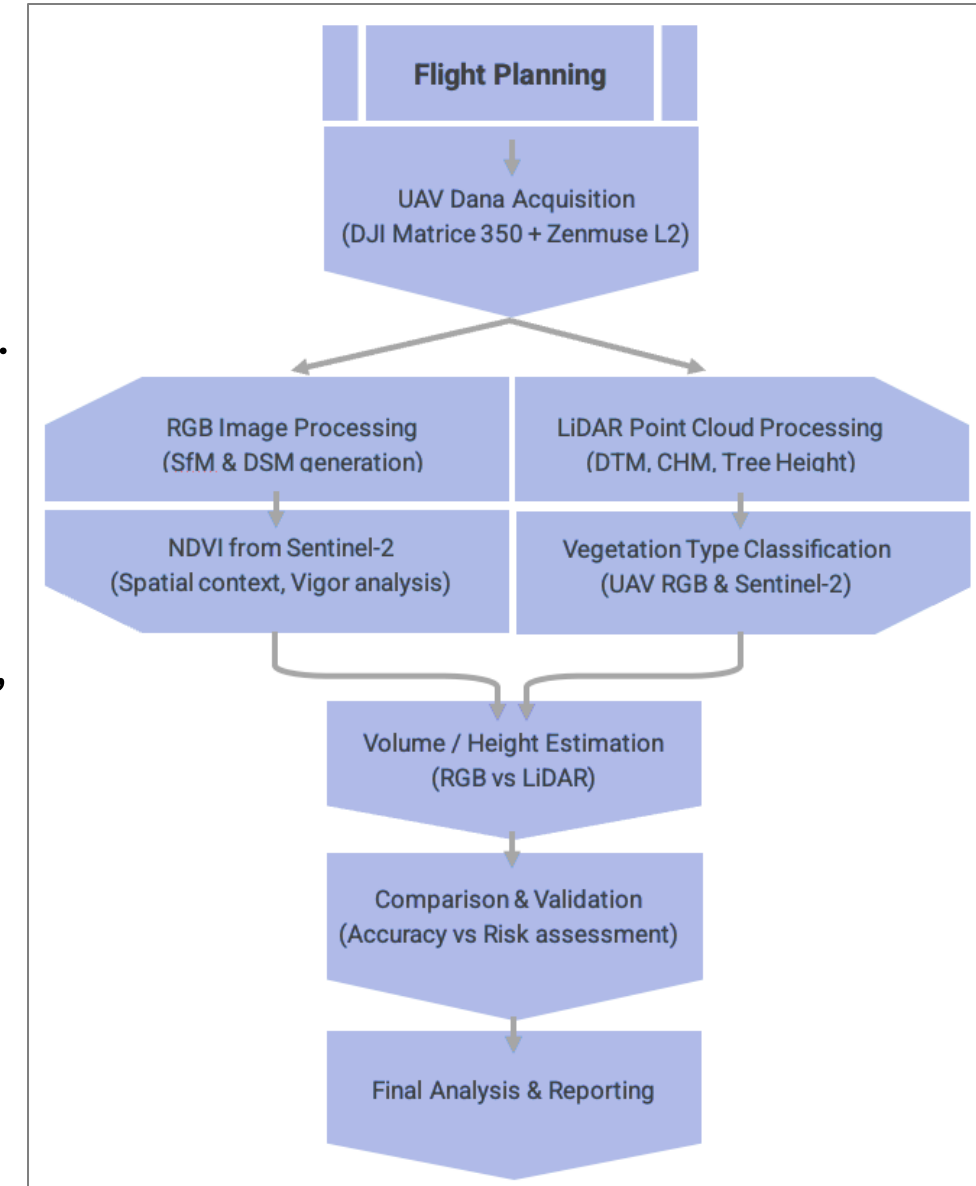
UAV-Based Sensing (RGB + LiDAR):

- DJI Matrice 350 RTK with Zenmuse L2 sensor used for 3D canopy structure.
- **Structure-from-Motion (SfM)** and **LiDAR** for canopy height, tree volume, biomass proxies.
- **Machine Learning (Random Forest, SVM)** applied to classify vegetation types from high-res images.

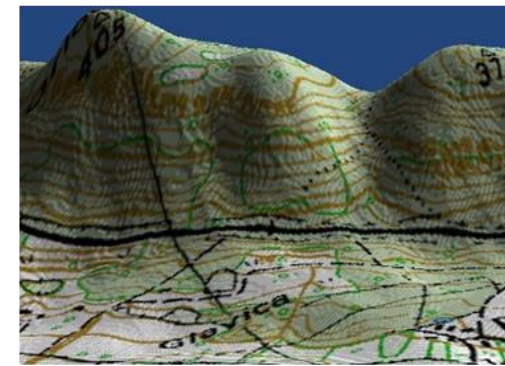
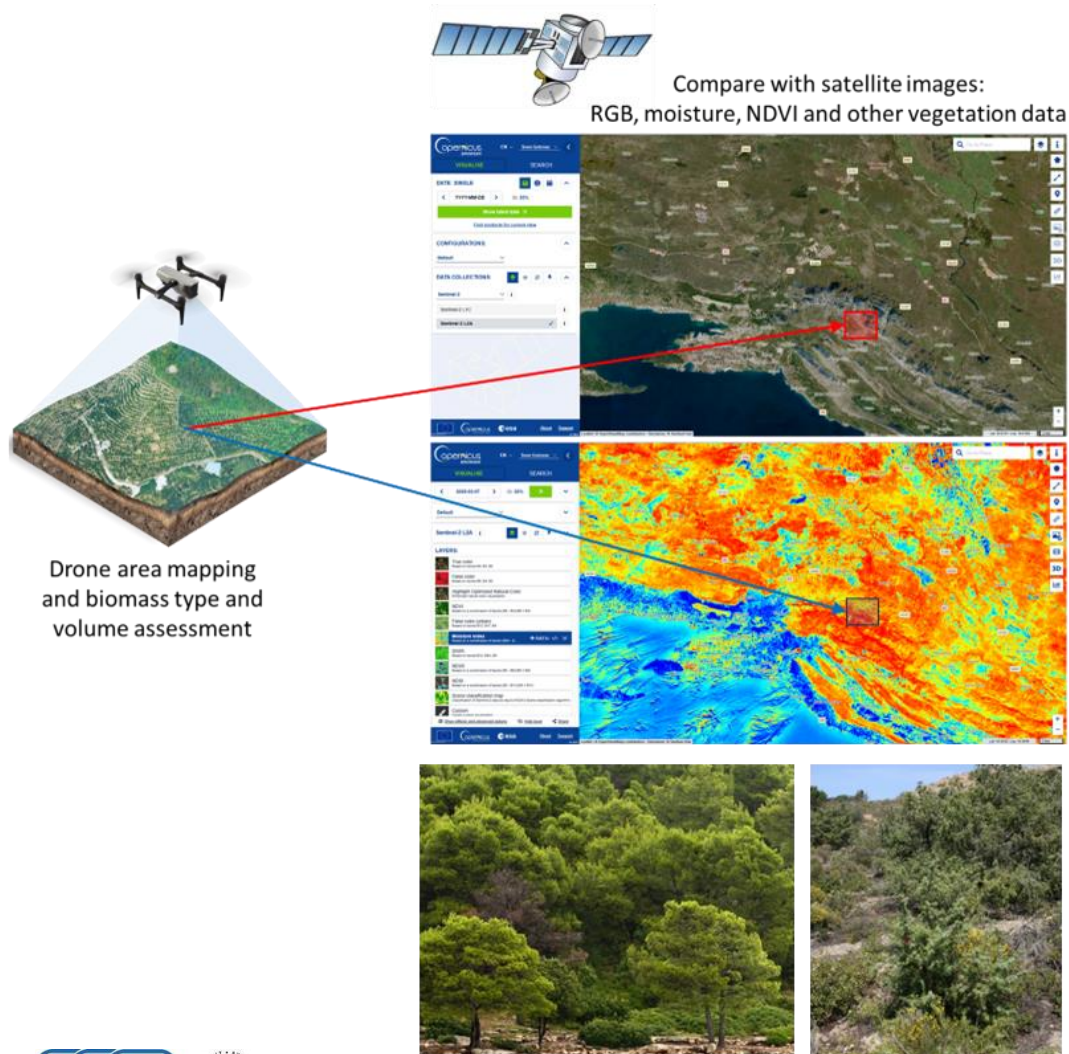


Fire Simulation Software Integration:

- Fuel data transformed into spatial fuel models used by:
 - **BehavePlus** – estimates fireline intensity, spread rate
 - **FlamMap / FARSITE** – landscape-scale fire simulation

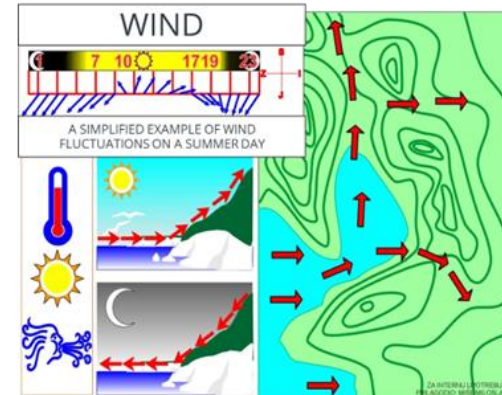


Methodological Framework



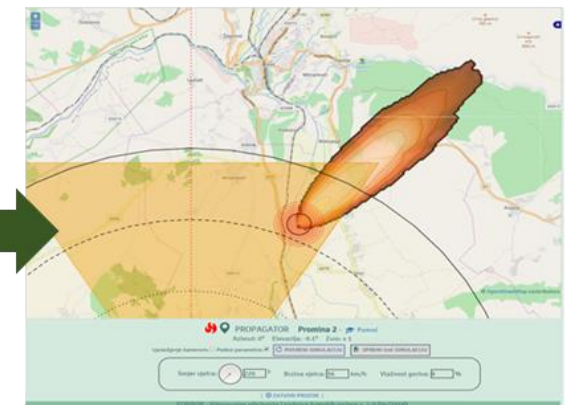
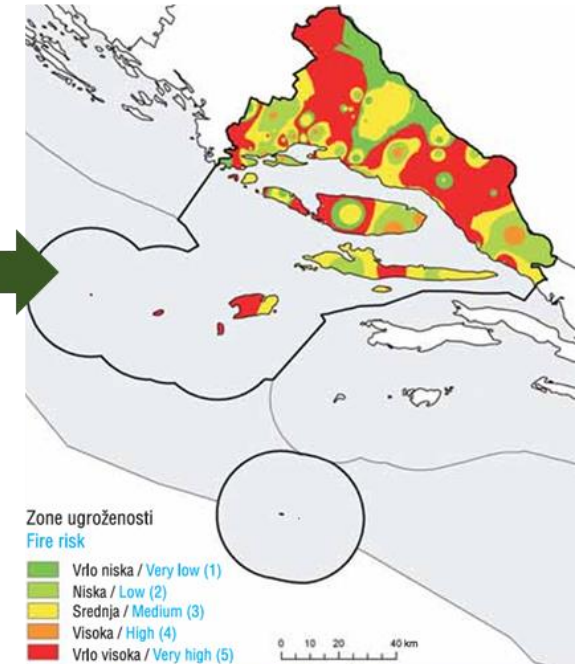
Digital Elevation Model

Vegetation structure and condition,
canopy type, fuel load, and moisture
content spatial assessment



Wind speed and direction, air
humidity, and temperature

Fire risk assessment



Fire propagation estimation

Conclusion and Strategic Outlook



From Research to Real-Time Decision Support



Integrated remote sensing approaches provide a scalable, high-resolution foundation for next-gen wildfire intelligence systems.



Supports **science-based planning**: from prevention (fuel maps), to active fire suppression (propagation prediction), to post-fire analysis.



Future direction:

Real-time UAV monitoring + satellite data fusion

Cloud-based AI for continuous learning and fire risk forecasting

Integration into operational platforms used by firefighting authorities

Any
Questions?



***Thank you for
your
attention!***

