ASSESSMENT OF FOREST FIRES AND EROSION PREDICTION USING SENTINEL-1 AND SENTINEL-2: ANALYSIS OF ADVANCED INDICES

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INTRODUCTION:

Forest fires are a major disturbance in **Mediterranean ecosystems**, leading to:

- Severe **vegetation loss**
- **Soil** structure **degradation**
- Increased erosion and runoff risk

This study focuses on a pine forest affected by wildfire near **Júzcar (Málaga, Spain)**.
We used Sentinel-1 (SAR) and Sentinel-2 (optical) satellite data to:

- Monitor **post-fire vegetation recovery**
- Detect **changes in surface characteristics**
- Extract key **temporal features** through time series analysis

Results aim to support better post-fire management and **ecological restoration strategies.**

MATERIALS:

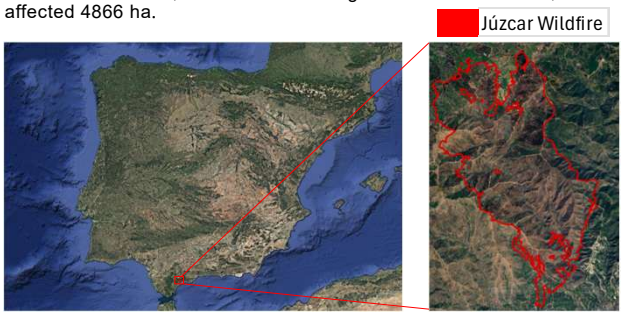
Multi-temporal data from **Sentinel-1** (SAR) and **Sentinel-2** (optical) satellites were used:

- Sentinel-2 provided multispectral imagery (10–20 m resolution) for calculating vegetation and burn indices: **MIRBI, dNBR, RdNBR, RBR, NDVI, LAI, fAPAR,** and **fCOVER**.
- Sentinel-1 SAR data (VV and VH polarizations) enabled the detection of changes in surface moisture and structure. **InSAR** techniques were applied to assess terrain stability and erosion risk.

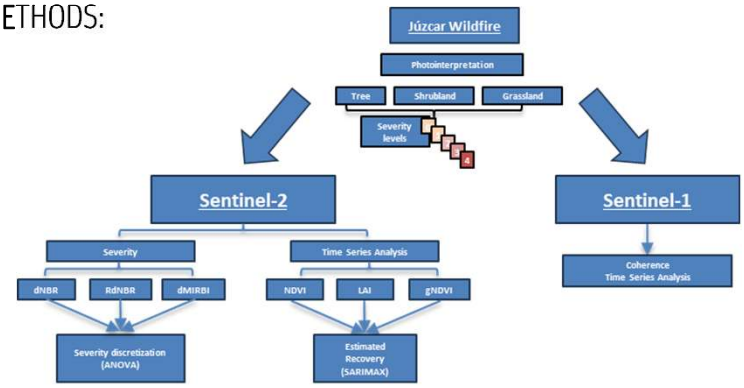
Time series supported the evaluation of **vegetation recovery** after the fire.

STUDY AREA:

The Júzcar wildfire, conducted in Malaga on June 8th of 2022, affected 4866 ha.



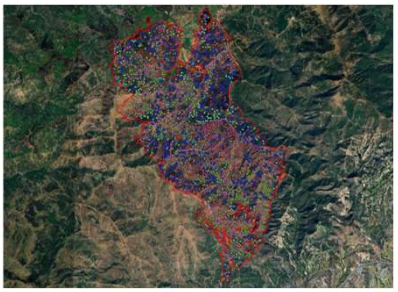
METHODS:

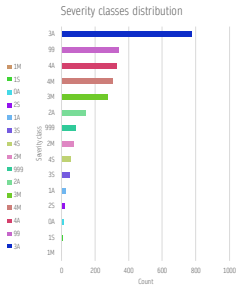


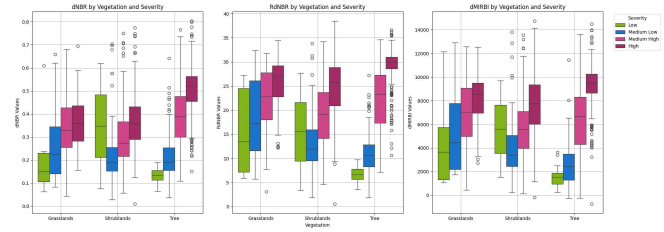
RESULTS:

SEVERITY ANALYSIS

Initially, a photointerpretation of the terrain was conducted, encompassing the classification of the extent of the burned surface and the categorization of the vegetation type.
The severity of the issue was subsequently quantified using severity indexes, and the differences between the severity and vegetation type were observed.

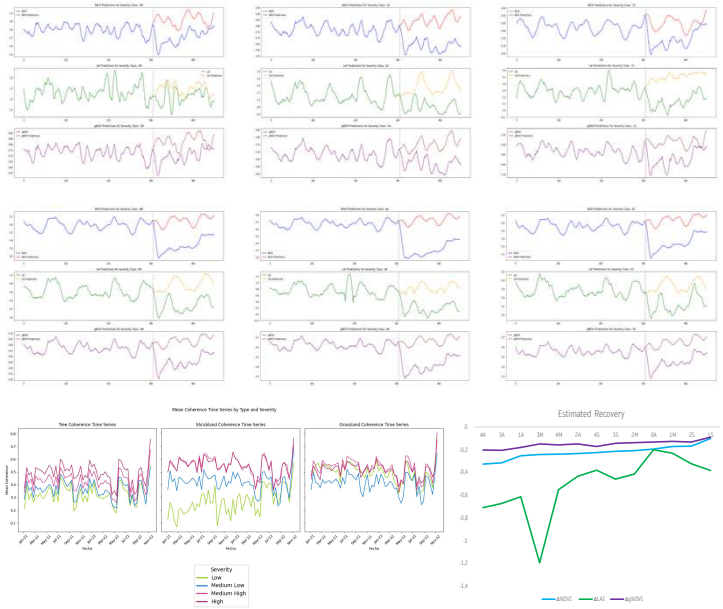






TIME SERIES ANALYSIS

For each severity class, an estimated recovery analysis has been conducted, predicting the 'unburned future' with ARIMA models. This approach enables the identification of discrepancies in the dynamics between the real series and the estimated series.
Further analysis with time series of coherence (radar) indicates a magnification of the values in the most severe classes following the wildfire.



CONCLUSIONS:

- Lower severity degrees depicts higher recovery values.
- In general, tree cover (A) is characterized by lower recovery values.
- Higher deforestation degree shown higher coherence values after wildfire.
- Further necessary analysis in order to evaluate the recovery dynamics, identifying different species.

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