MIRI – Master International Research Internship ; SSC Sustainability – Una Europa; ERASMUS +

1. Internship title

"Causalities in forest disturbance regimes: a case study from continental Spain"

2. Host institution and context

Host institution and supervisor : Enrique Andivia – Facultad de Ciencias Biologicas – Departamento de Biodiversidad, Ecologia y Evolucion –Universidad Complutense Madrid (eandivia@ucm.es)

Home institution : Romain Courault - UFR de Géographie – Université Paris 1 Panthéon-Sorbonne - Master Risques et Environnement – UMR CNRS 7533 LADYSS (romain.courault@univ-paris1.fr)

Required level: Master 1 / Master 2 in Environmental Sciences

Internship duration: 4 to 6 months

Preferred period: January to June 2027

Stipend / Erasmus grant: Erasmus grant

Working language: Spanish, English

3. Thematic description

Spanish forests are subject to increasingly pronounced disturbance regimes, dominated by wildfires whose intensity is amplified by climate change and changing land-use patterns[1].

Understanding the causal links between vegetation productivity conditions, forest structure, fire-triggering factors, and post-fire regeneration dynamics is essential to anticipate risks and guide prevention strategies.

This internship addresses this issue by combining satellite time series of forest productivity (MODIS), field data from National Forest Inventory (NFI), LIDAR series and fire occurrence data (VIIRS, Copernicus EFFIS), in order to better characterize the interactions between vegetation, climate, and disturbances, and to assess to what extent these environmental datasets meet the operational needs of fire prevention and firefighting services in Spain.

4. Materials and methods

4.1 Data used

- Forest productivity: MODIS MOD13A1/MYD13A1 product (NDVI/EVI, 500 m resolution, bi-monthly composites), 2000–2025 period
- Active fire detection: MODIS and VIIRS products (NASA FIRMS – daily thermal detections).
- Burned areas and validated perimeters: Copernicus EFFIS (European Forest Fire Information System).
- Field data / alerts (if available): information from Spanish firefighting services (civil protection, regional prevention plans).
- Field data about forest structure and composition from National Forest Inventories
- LIDAR series

4.2 Methodological steps

a. Pre-processing of MODIS time series and other databases
b. Downloading and cleaning of 13A1 products (cloud/quality masking, reprojection, clipping to the study area)

[1] https://eu-space.europa.eu/components/earth-observation-copernicus/image-of-the-day/severe-fires-affected-europe-and-north-africa-july-and-august-2026

c. Construction of NDVI/EVI time series per pixel or landscape unit over 2000–2025
d. Time series smoothing (e.g. Savitzky-Golay filter, BFAST method or equivalent) to identify productivity trends and anomalies
e. Construction of the fire event database
f. Extraction and harmonization of VIIRS/MODIS detections and EFFIS perimeters over the study period
g. Characterization of events (date, area, approximate intensity, spatial recurrence)
h. Cross-analysis of productivity and wildfires
i. Spatio-temporal overlay of NDVI/EVI series and fire events
j. Analysis of post-fire regeneration trajectories (time to return to a reference productivity level, cross-site comparison)
k. Statistical approach: time-series break-point detection models, linear mixed models, or survival models to estimate regeneration speed as a function of environmental covariates (climate, topography, dominant species, fire severity)
l. Analysis of operational needs
m. Comparison of results with the alert and prevention systems used by Spanish firefighting services
n. Identification of triggering factors and leading factors relevant to operational forecasting
o. Discussion of the potential contribution of satellite environmental data to existing alert systems

4.3 Tools

- Data processing: Python (xarray, rasterio, geopandas, scikit-learn) and/or R (raster/terra, bfast, lme4)
- Large-scale processing: Google Earth Engine (direct access to MODIS/VIIRS collections)
- GIS: QGIS for mapping and spatial analysis
- Statistics: time-series break-point models, mixed models, survival analysis

5. Expected outcomes

A consolidated dataset cross-referencing forest productivity (MODIS 13A1) and fire events (VIIRS/EFFIS) over 2000–2025.

A statistical model characterizing post-fire forest regeneration dynamics as a function of environmental factors.

A critical synthesis of environmental data needs for fire prevention systems in Spain.

Drafting of a scientific article (or a solid basis for publication) presenting the results obtained.

6. Required skills

Degree in ecology, physical geography, environmental sciences, or remote sensing, at M1/M2 level.

Basic proficiency in remote sensing and satellite data (understanding of vegetation indices such as NDVI/EVI).

Programming skills: Python and/or R (experience with Google Earth Engine is a plus).

Good knowledge of GIS (QGIS or equivalent).

Notions of applied statistics (time series, linear/mixed models).

Interest in natural hazards and forest management.

Ability to work independently and to write in English (reading scientific articles, writing up results).

Scientific curiosity and rigor; interest in interdisciplinary work (climate, ecology, risk management).

7. Application

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Documents to send: CV, cover letter, academic transcripts

Application deadline: December 2026