BEeS

The LifeWatch ERIC Biodiversity & Ecosystem eScience Conference

Seville
22-24/05/23

Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective

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[FIDESOL]

Remote nevadensis: a system for monitoring changes in essential biodiversity variables

BEeS Seville, 22-24 May 2023

Threats and challenges to biodiversity and ecosystem conservation from an eScience perspective

LifeWatch ERIC

Remote nevadensis: a system for monitoring changes in essential biodiversity variables

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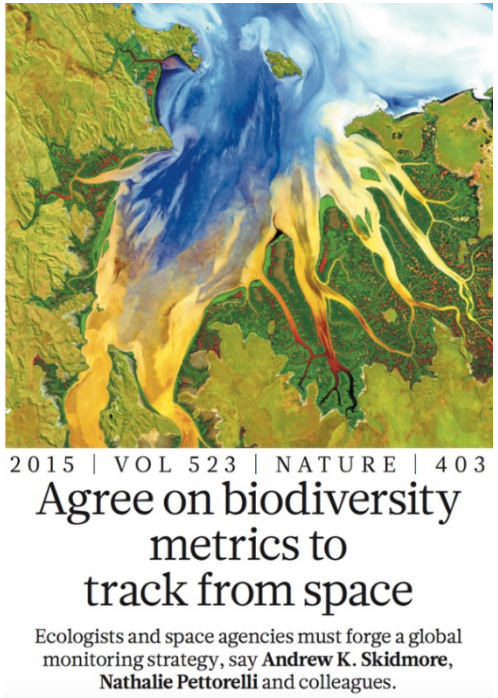
[FIDESOL] 15 AÑOS

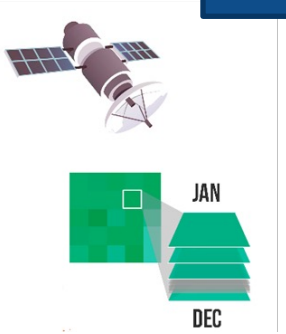
Monitoring system of protected areas

- **Real time**
- **Comparable** between locations
- **Management-relevant**
- **Understandable** by the citizens
- Based on **essential biodiversity variables**

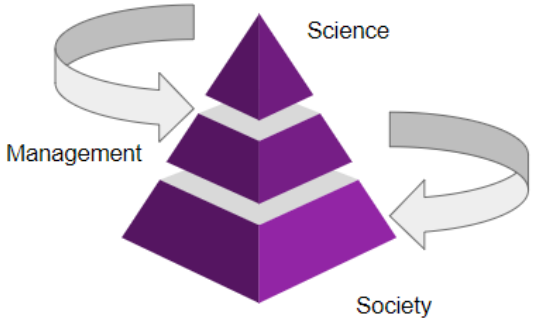


Introduction

Remote sensing monitoring of protected areas

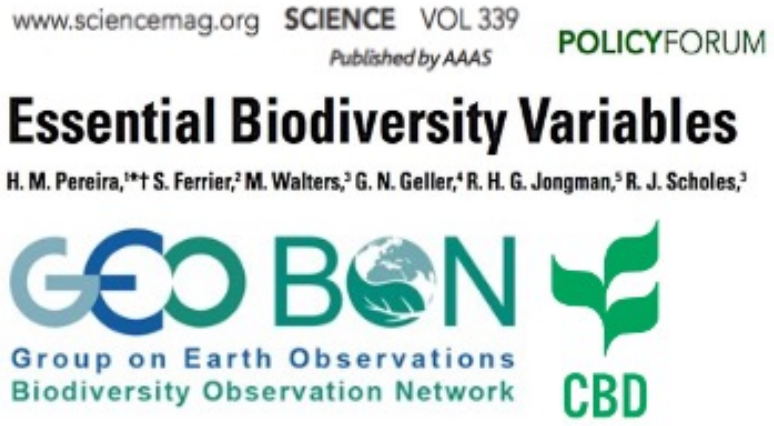


- **Multi-temporal scale**
- Identification of **spatial and temporal patterns** in ecosystem functioning
- **Multiple** spatial and temporal **resolutions** (from meters to kilometers)
- **Standardized protocols** for different environments
- **Lower cost and effort** than field campaigns
- **Users cascade**



Essential Biodiversity Variables (EBVs)

- **Minimum set of essential measures** that capture the main dimensions of biodiversity: composition, structure and function (Noss 1990).
- Informs on the **status of biodiversity**
- **Sensitive to changes** in biodiversity
- **Effective, ecosystem-independent and global**



Ecosystem dimensions

Satellite-derived metrics that can be used as a set of highly informative core variables characterizing different dimensions of ecosystem functioning

Ecosystem services

Nutrient cycling

- Aerosols

Energy balance

- Surface temperature
- Albedo
- Evapotranspiration

Organic carbon

- Vegetation indices NDVI-EVI
- Chlorophyll in water bodies Chlorophyll-a
- Available metabolic energy
- Passera model

Water balance

- Evapotranspiration
- Latent heat
- Snow cover dynamics: NDSI, % snow days…
- Water content in vegetation-soil: NDWI, LSWI

General objective

REMOTE Nevadensis will **alert** us to **changes in essential biodiversity variables related to ecosystem functioning**, such as primary production, soil moisture content or snow cover, among others.

Specific objectives

Development of a Virtual Research Environment (VRE) with three types of end-users:

- **Researchers and managers programmers**

Code and functionalities (import via GEE or use of specific code editor)

- **Non-programmer managers and researchers**

Selection of variables and calculations via user interface

- **Citizens**

Pre-calculated set of variables and storytelling

Methods

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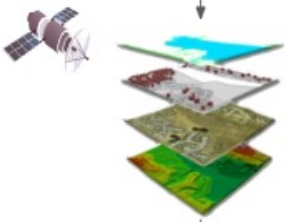
Ecosystem dimensions

Variables
NDVI, EVI, NDSI, TS, LSWI...



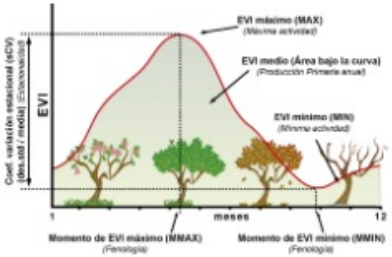
Sensors
MODIS, LANDSAT y Sentinel-2

Fusion between sensors → Quality filtering → Gap filling

Analysis

Reference conditions
(mean, median, min, max, sum or percentile)

Functional Attributes
(mean, SD, CV, min, max, moment of min y max...)



Anomalies

Trends

Spatial variabilty
Ecosystem Functional Types (EFTs), richness and rarity of EFTs

Finals users

Researcher and managers programmers
Code and functionalities

Non-programmer managers and researchers
Filtering and computations through a user interface

Citizens
Pre-calculated set of variables and detailed explanations

CSV

Export of data, maps and reports

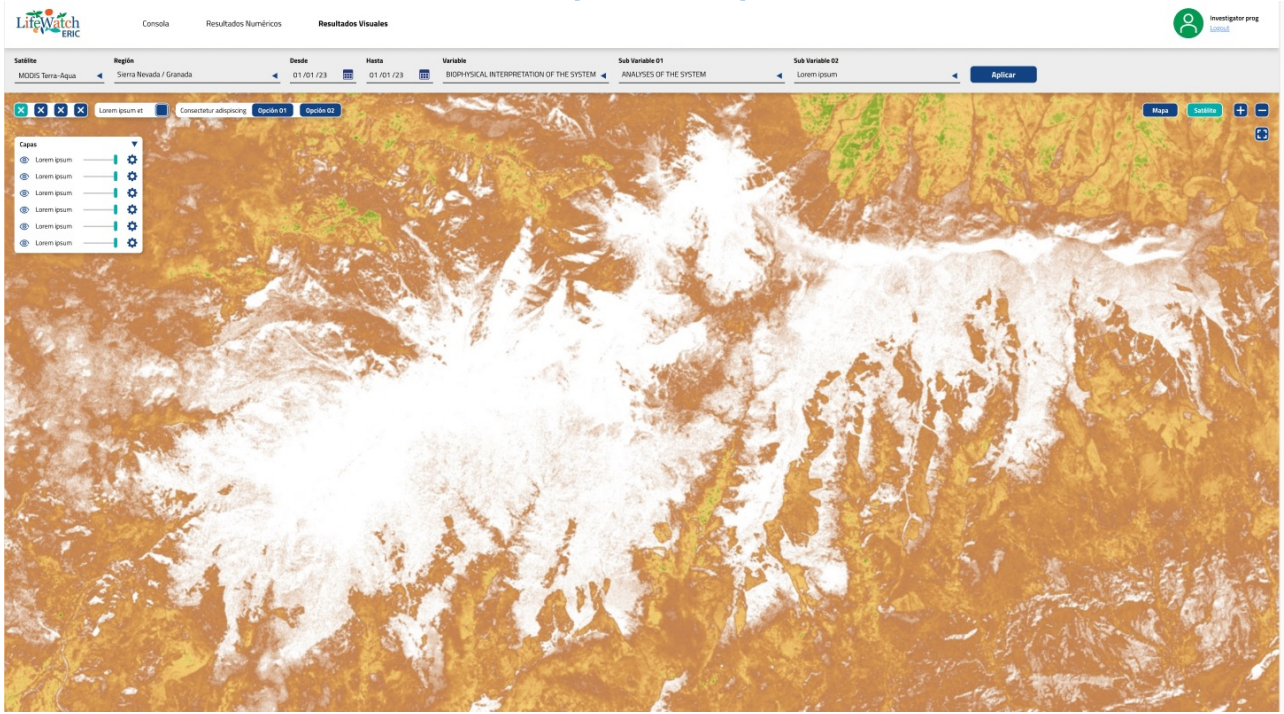
Virtual Research Environment (VRE)

Results

A. Researcher/manager programmer

Display with selection of:

- Variables
- Sensor
- Dates
- Analysis to be carried out and
- Downloadingc



Virtual Research Environment (VRE)

Results

A. Researcher/manager programmer

- Code editor
- Can load libraries, functions and assets

evi-modis.js — Get Link | Save | Run | Reset | Apps

```
var remote = require('users/mantequera/remote:/remote.js');

remote.date.year.setFrom(2000).setTo(2020);
remote.date.month.setFrom(1).setTo(12);

remote.region.useProtectedArea('ESP', 'Sierra Nevada');

remote.source.reset();

/*
remote.source.setVariable('EVI');
remote.source.setSensor('Modis');
remote.source.setAggregation('mean');
remote.source.setCollection('MODIS/061/MOD13Q1');
remote.source.setBands(['EVI']).setCalc('b("EVI")*0.0001');
*/

remote.source.setEcosystem('CPP').setVariable('EVI').setSensor('MODIS').setAggregation('mean');

var temporalDynamics = remote.workflow.getTemporalDynamics();

var efa = remote.workflow.getEfa('Mean', temporalDynamics);

remote.map.addLayers(efa, {min: 0, max: 1, palette: ['eaddd4', '0b1e05']});

remote.report.addSerie(efa, 250);

remote.report.showChart();
```

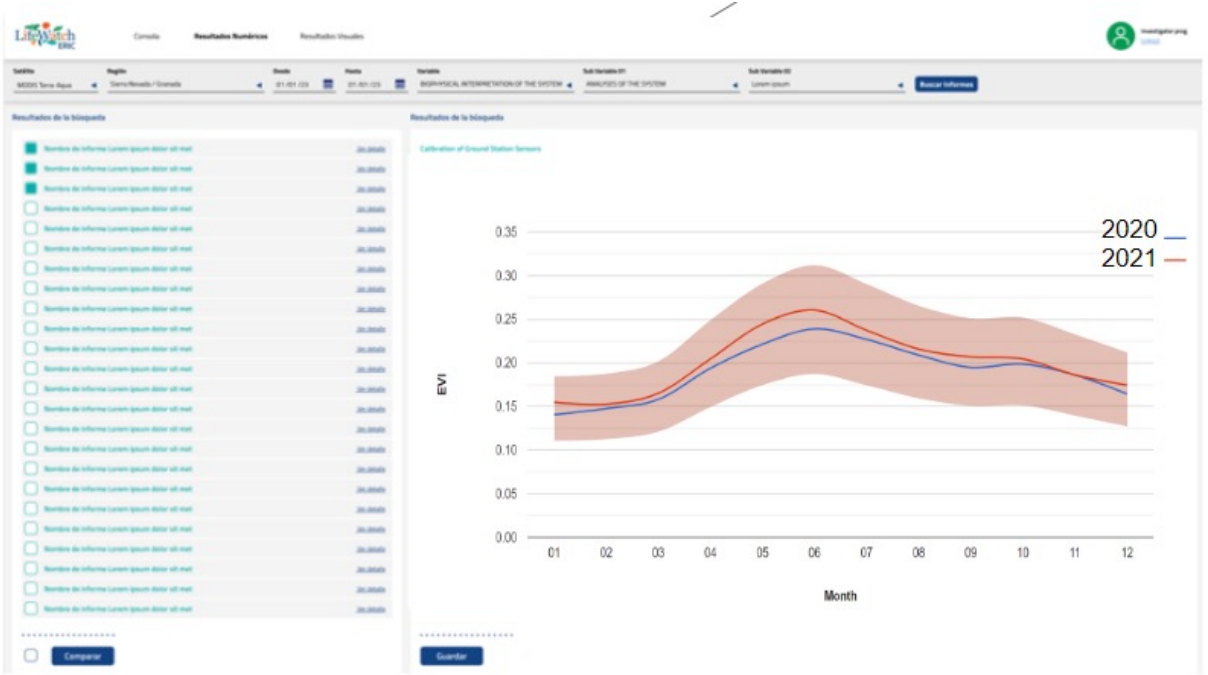
Virtual Research Environment (VRE)

Results

A. Researcher/manager programmer

Graphs for reports with option to select:

- Variables
- Sensor
- Dates,
- Analysis to be performed and
- Downloaded



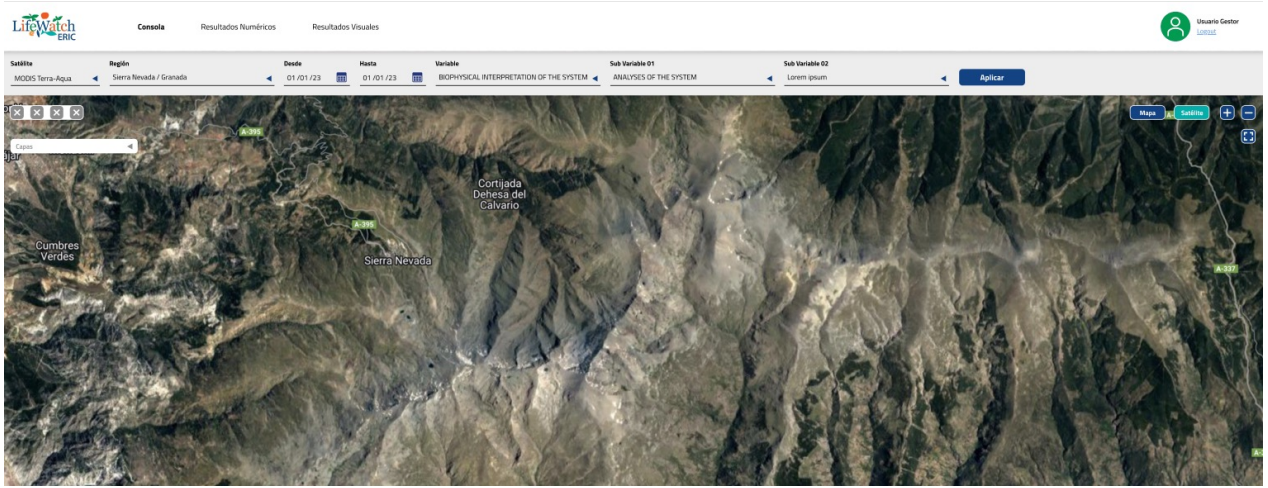
Virtual Research Environment (VRE)

Results

B. Manager / Researcher NON-programmer

Display with selection of:

- Variables
- Sensor
- Dates
- Analysis to be carried out and
- Downloading



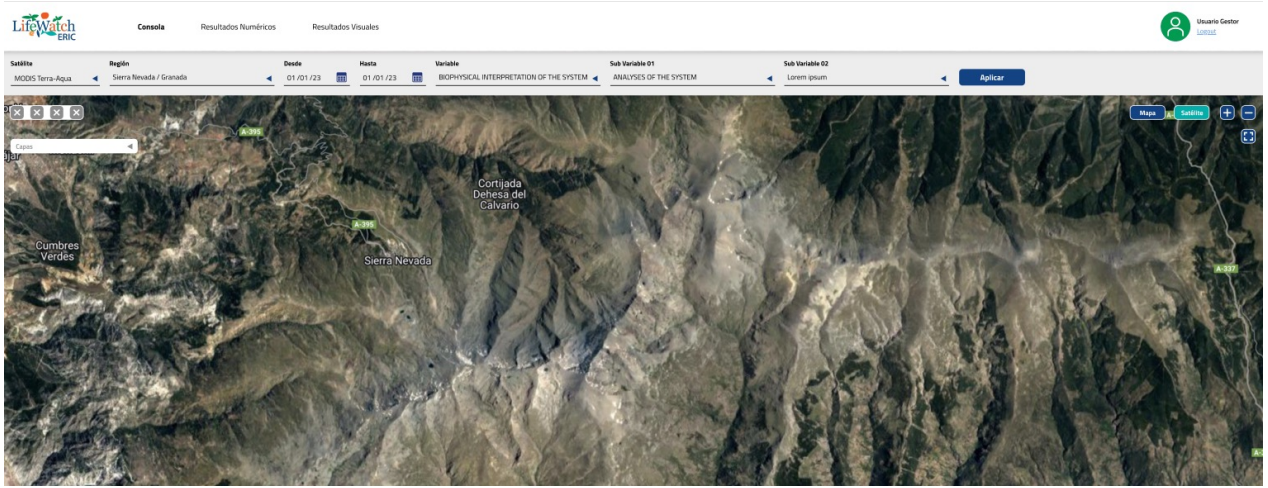
No code console for programming !!

Virtual Research Environment (VRE)

Results

C. Citizen (Outreach)

Analysis to be carried out with **default** dates, without choice



No code console for programming !!

Virtual Research Environment (VRE)

Results

C. Citizen (Outreach)

Vegetation Index monitoring

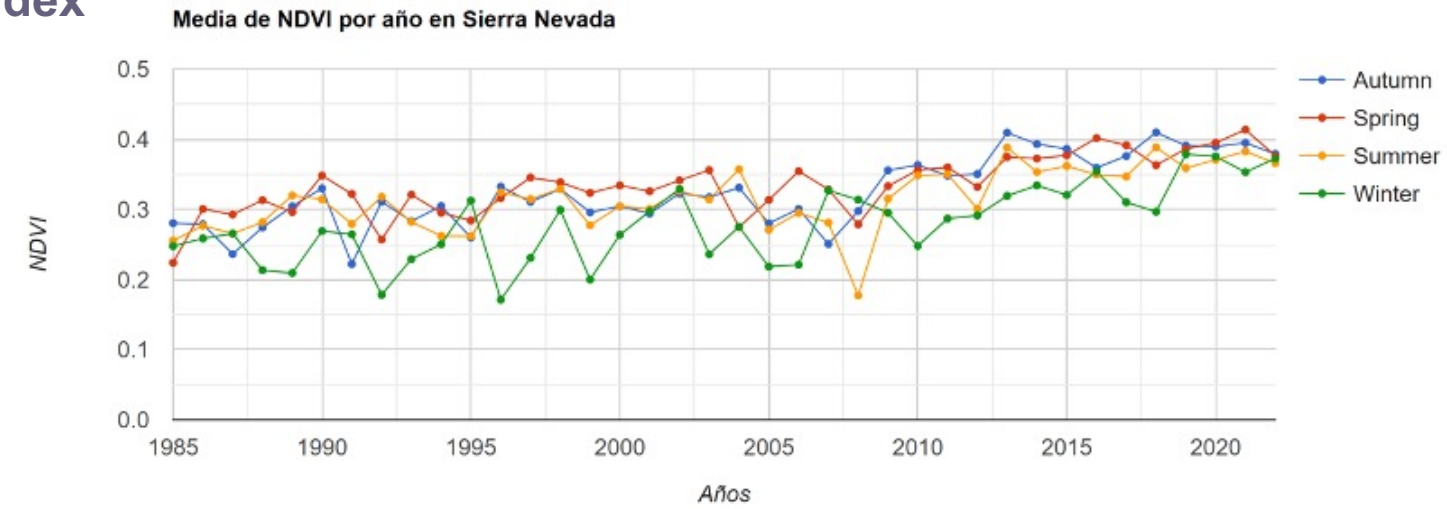
Virtual Research Environment (VRE)

Results

B. Manager / Researcher NON-programmer

Download CSV | Download SVG | Download PNG

Vegetation Index monitoring

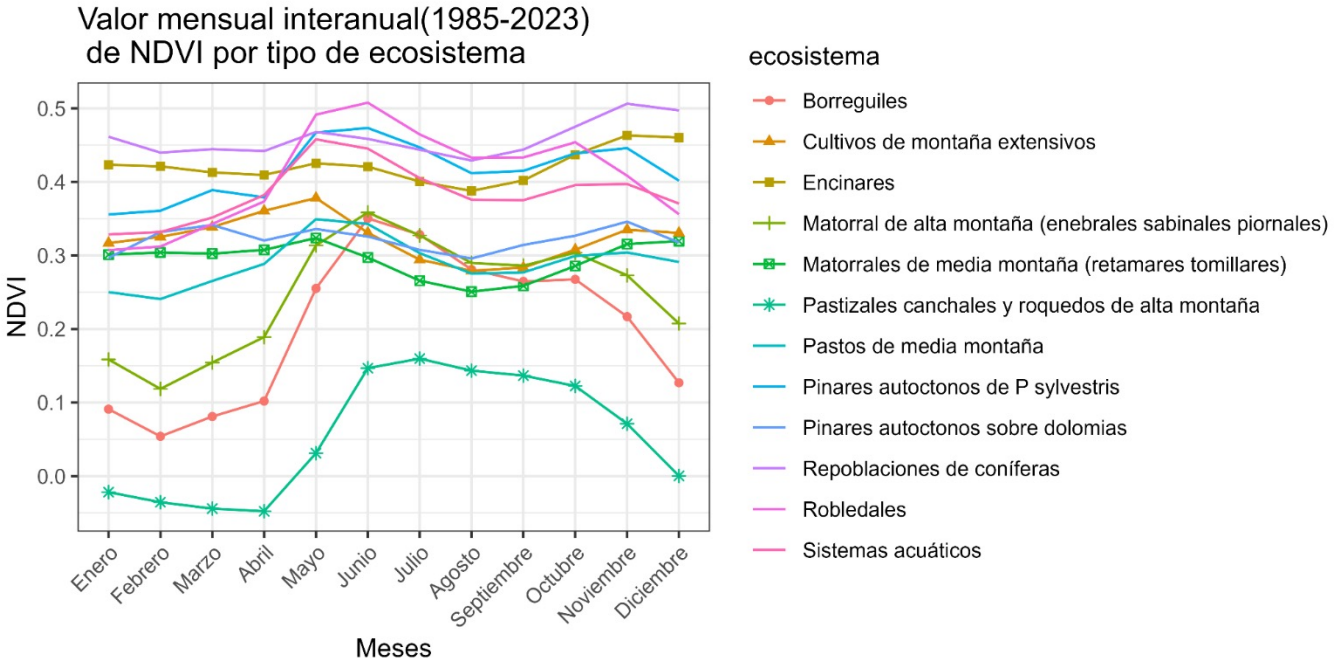


Virtual Research Environment (VRE)

Results

A. Researcher / manager programmer

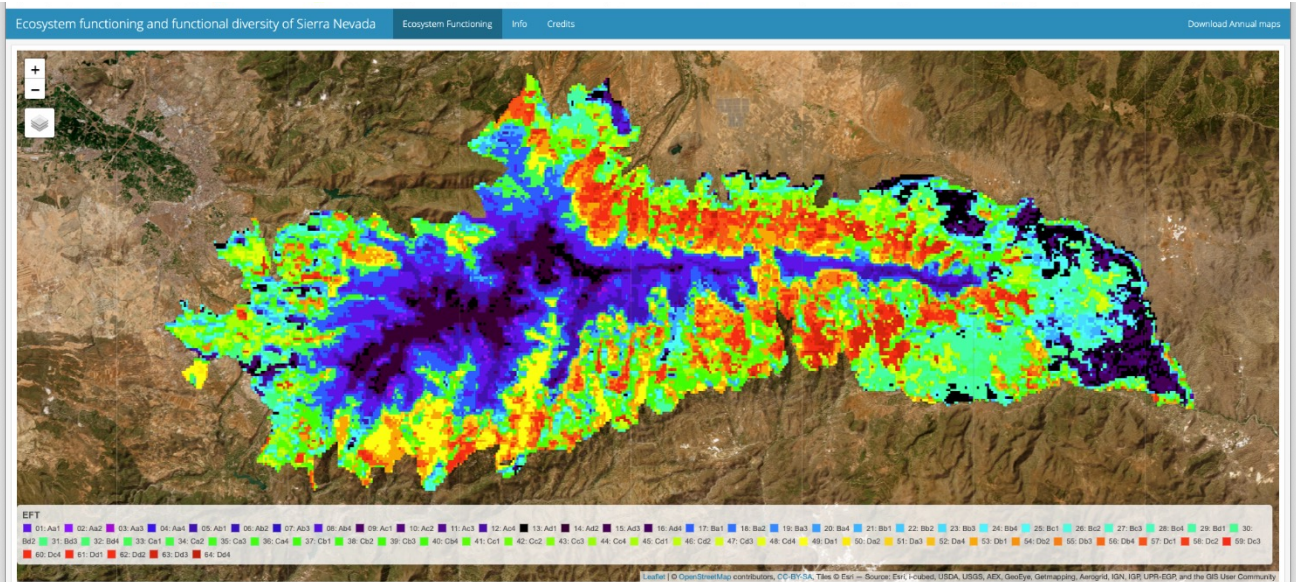
Vegetation Index monitoring



Virtual Research Environment (VRE)

Results

- **Diversity of Ecosystem Functional Types** (primary production, phenology, seasonality)
- **Rarity, richness, dissimilarity of EFTs,** etc. (Online Demo)

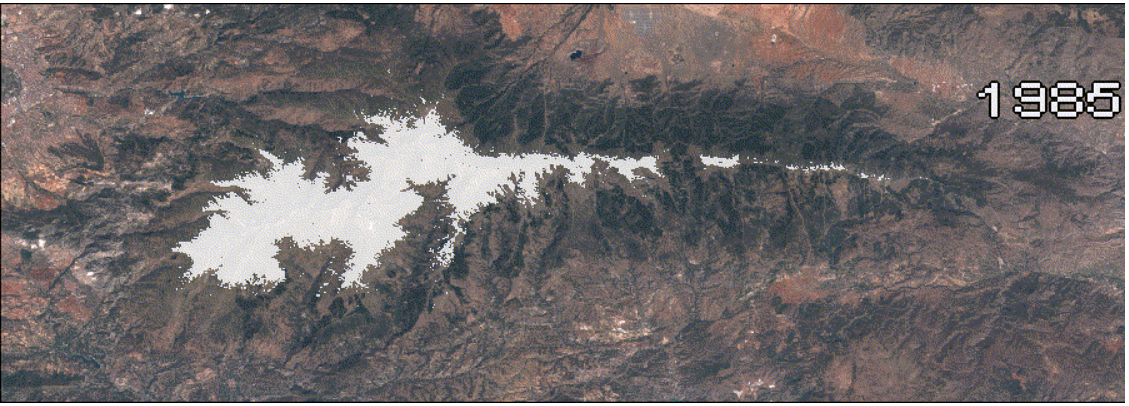


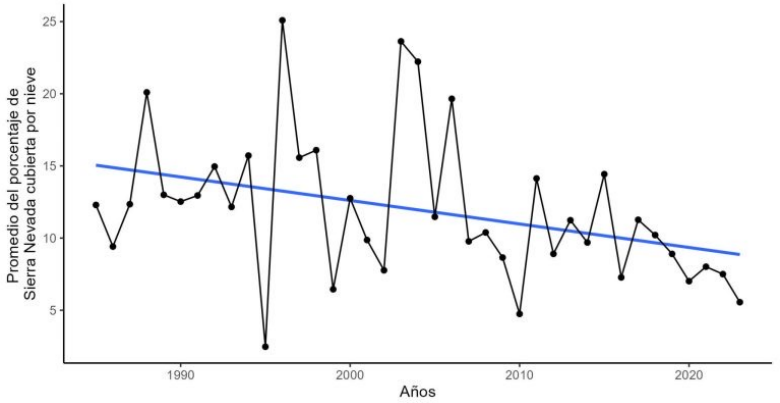
Cazorla *et al.* 2023

Virtual Research Environment (VRE)

Results

Snow cover monitoring

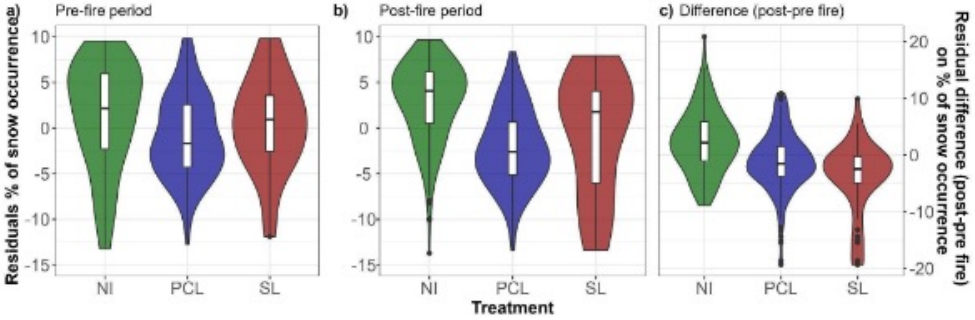


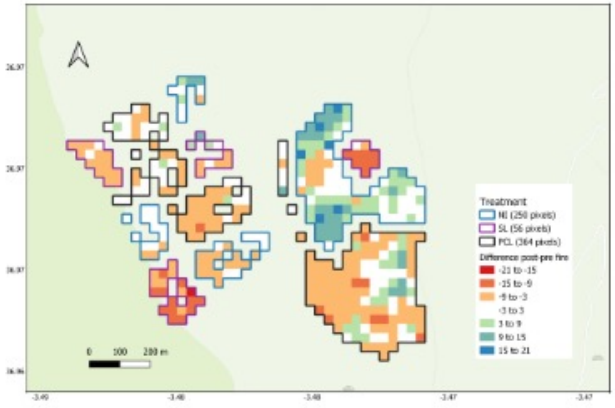


Virtual Research Environment (VRE)

Results

Monitoring of post-fire snow cover (forest management)



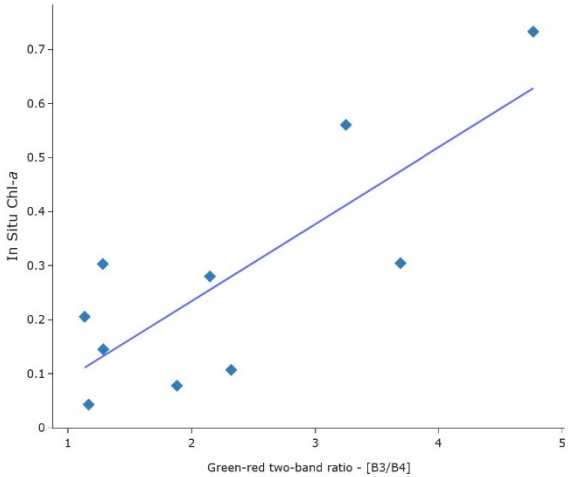


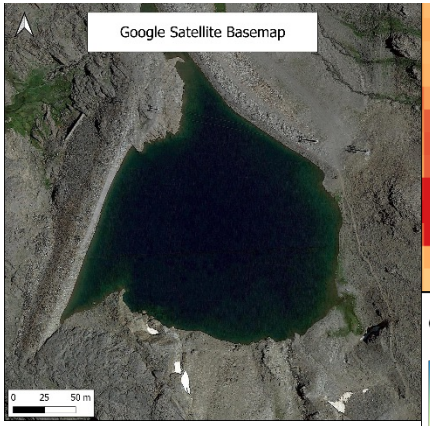
Virtual Research Environment (VRE)

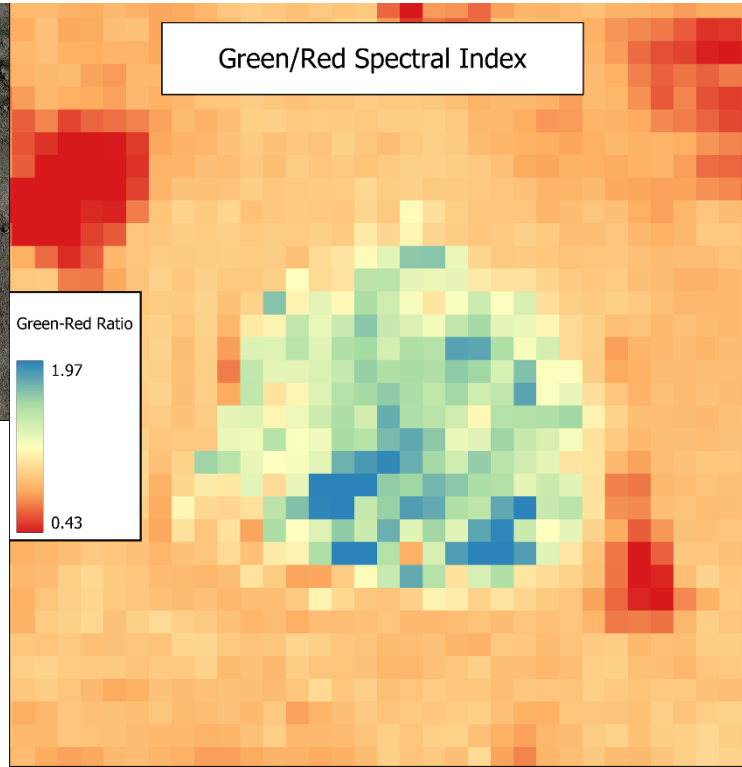
Results

Chlorophyll-a monitoring in high mountain lakes (Sentinel-2)

Laguna-embalse de las Yeguas







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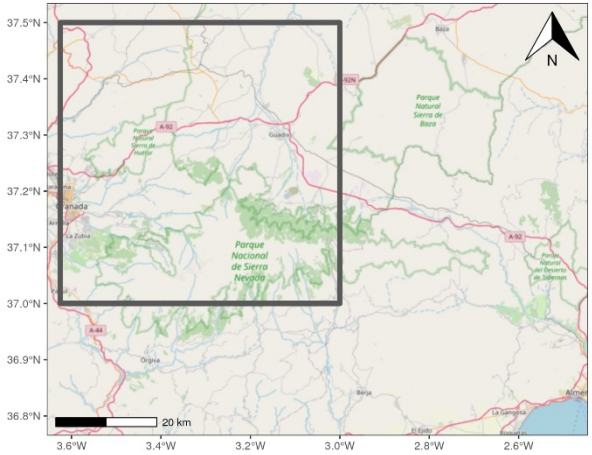
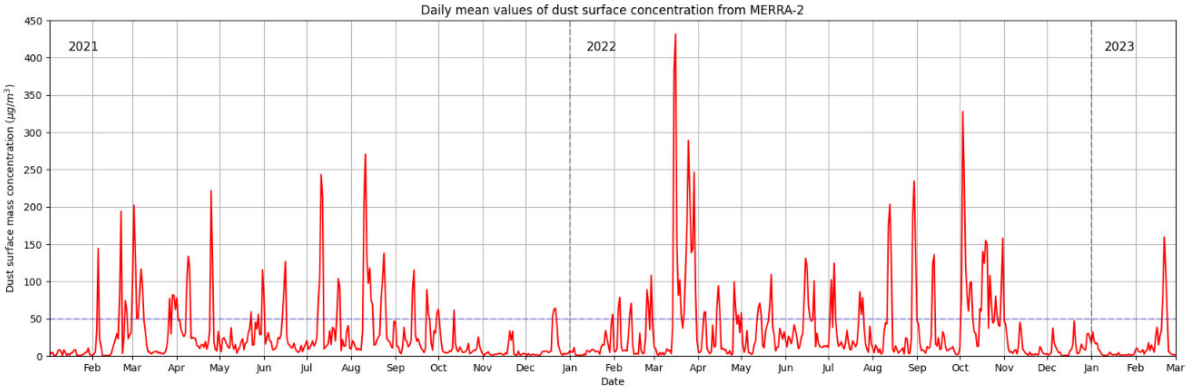
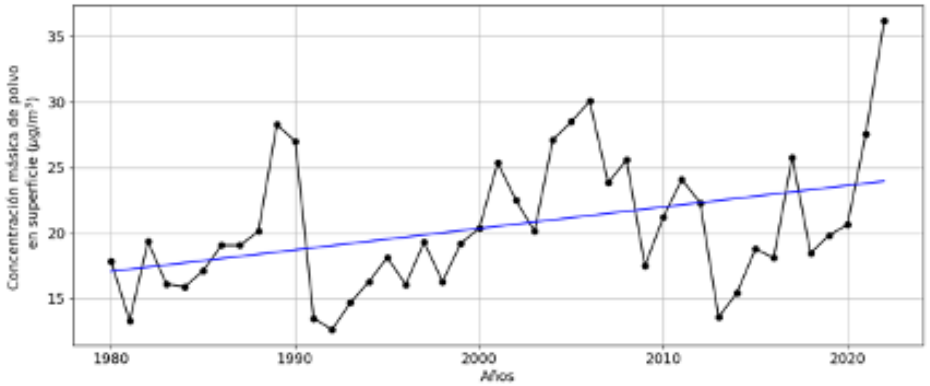
Virtual Research Environment (VRE)

Results

Atmospheric coarse particles (Saharan dust): Merra-2







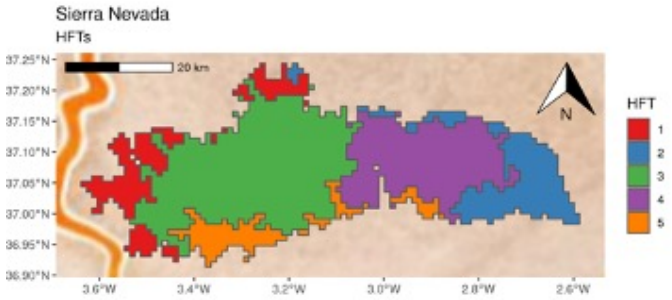
Virtual Research Environment (VRE)

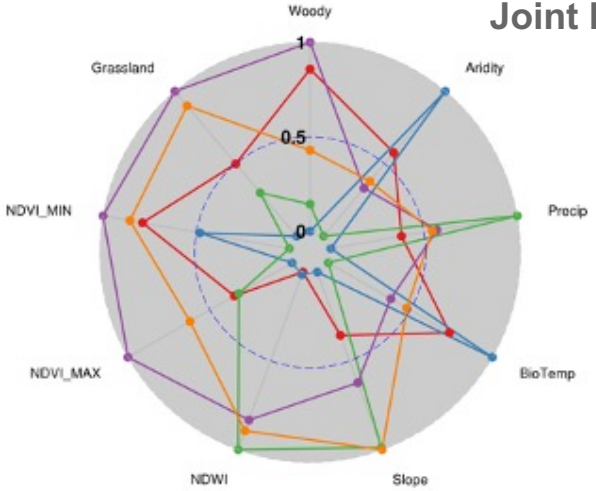
Results

- **Diversity of Functional Habitat Types**
- **Climatic, structural and functional variables** (mean precip. and temp., seasonality, herbaceous/woody cover, slope, soil moisture/vegetation).
- **Potentially similar areas within the ecoregion**
- **Connectivity between AAPPs**

Digital Observatory for Protected Areas (DOPA)
Joint Research Centre

European Commission





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Conclusions

- A **monitoring system** for key biodiversity **variables** related to **ecosystem structure, functioning and services**: e.g. carbon cycling, water, nutrients, etc.
- **Reference** conditions, **trends**, **rapid changes** and **anomalies** in a fast, reliable way and in all areas
- **LifeWatch Virtual Research Environment (VRE)** has **three types of users**: programmer **researcher**, **manager** and non-programmer researcher, and **citizen**. Overcoming the barrier of non-programmer researcher/manager access to satellite information
- Monitoring systems have proven to be **useful and necessary** for researchers, managers and the society (Global Forest Watch, Global Surface Water Bodies, Digital Observatory for Protected Areas, ...)

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