e-shape solutions: Earth Observation for biodiversity and water management

14 - 15 February 2023
9.30 – 17.00 CET
The Hague - NSO Headquarter
Centre Court

mySPACE - Drivers of change and ecosystem responses in European Protected Areas (PA)

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Deltares
Ghada.elserafy@deltares.nl, anna.spinosa@deltares.nl

e-shape

An event co-organised by

eurisy
ACTING COLLECTIVELY TO BRIDGE SPACE AND SOCIETY

Netherlands Space Office

mySPACE: Drivers of change and ecosystem responses in European Protected Areas (PA)

Pilot partners: CNR (lead), CREAF, DELTARES, UBT, CERTH, BGU (associate partner)

User community: Protected Area Management

SC-1 agriculture | SC-2 health | SC-3 energy | SC-4 ecosystem | SC-5 water | SC-6 disasters | SC-7 climate

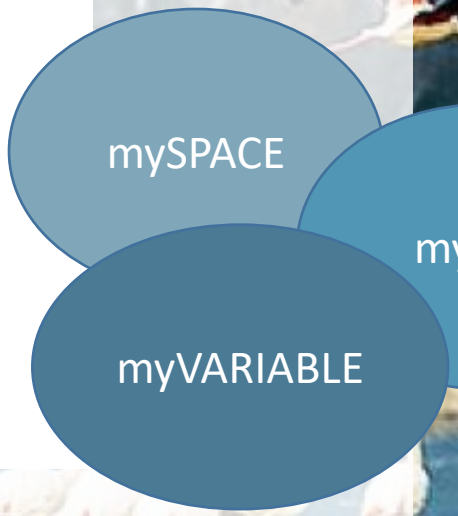
The myEcosystem showcase

The showcase myECOSYSTEM will serve focal user groups such as research, environmental assessment, reporting and management by offering seamless access to consistently scaled environmental information from various sources at benchmark sites.

Showcase Leader:
UFZ, Ulf Mallast

Pilots →

ecosystem



mySPACE: Drivers of change and ecosystem responses in European Protected Areas (PA)

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User community: Protected Area Management

Objectives

- Secure **ecosystem benefits** under increasingly anthropogenic pressures
- Encompass **effective monitoring** (combined Remote sensing RS and insitu) and modelling of the trends and states of the ecosystem and its services
- Provide **Remote Sensing based information** for the management of selected **Protected Areas** and environmental assessment in benchmark ecosystems
- **Integrate the remote sensing maps and in-situ data** of mySITE to produce consistent spatial and temporal variables, e.g. relevant to the extractions of EBV in pilot myVARIABLE
- Provide access to **spatially continuous and value-added EO products** relevant to users

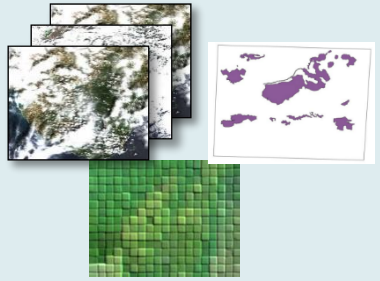
mySPACE: Drivers of change and ecosystem responses in European Protected Areas (PA)

Integrate the remote sensing maps and in-situ data of mySITE to produce consistent spatial and temporal variables, e.g. relevant to the extractions of EBV in pilot myVARIABLE

mySITE

Data collection

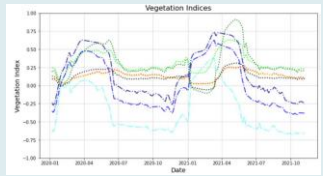
Data Processing



Vegetation Index

NDVI, LAI, MNDVI

Proxies



Data Integration and modeling for enhanced ecosystems and biodiversity monitoring

In situ

Statistical models

ML/AI models

Processed-based

Spatially continuous and value-added EO products

Target Indicators

Quality metrics

EBVs (GPP, NPP, phenology, etc.)

Visualization

Sharing, storage & management

Science

Policy Makers

Industry

myVARIABLE

EcoSense

B2SHARE

EUDAT

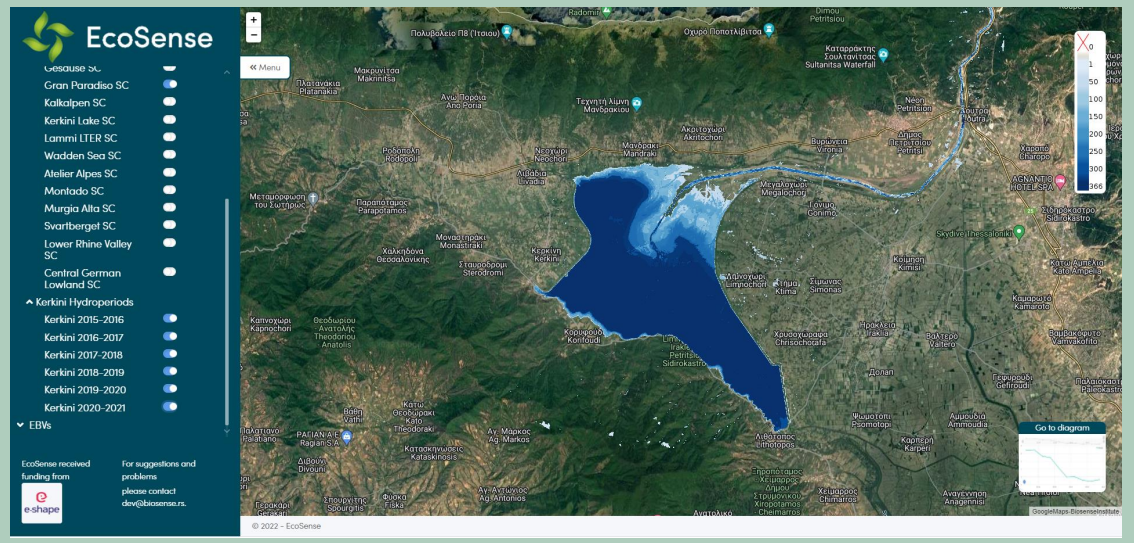
ecosystem

mySPACE

Provide access to spatially continuous and value-added EO products relevant to users.

By sharing workflows and ready-to-use algorithms by means of Vlab

By sharing EO-based products within the Ecosense portal



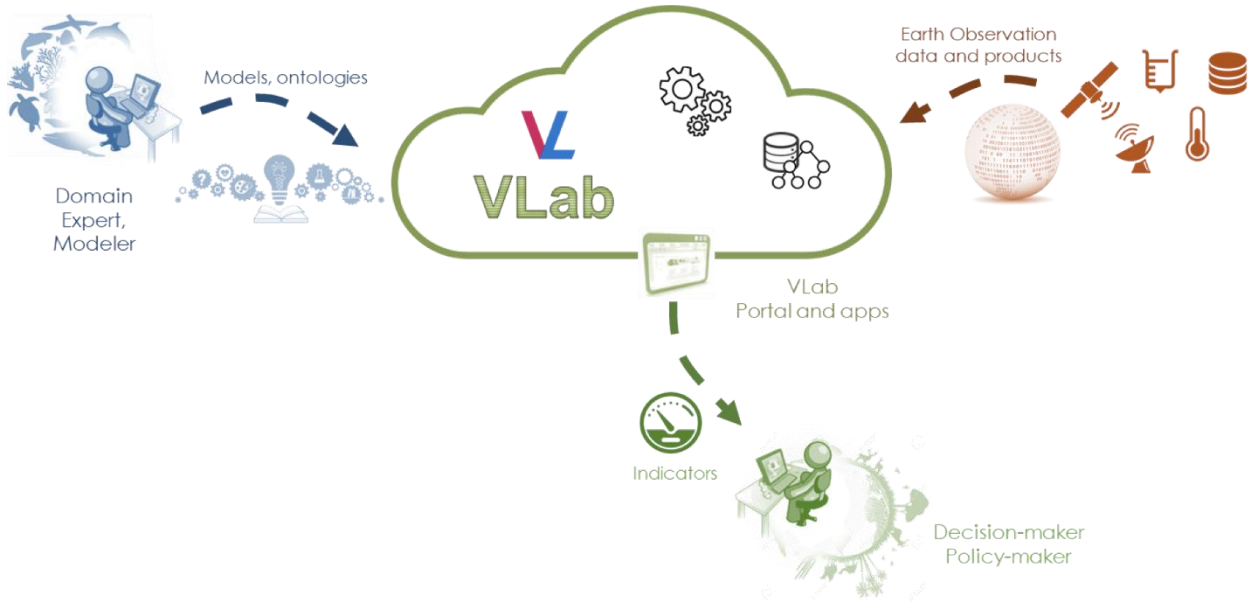
mySPACE - Virtual Earth Laboratory (VLab)

The Virtual Earth Laboratory addresses the needs of scientists and modelers facilitating the generation of knowledge for evidence-based decision-making. It provides functionalities for:

- Harmonized discovery of and access to heterogeneous resources from multiple systems
- Publication of scientific workflows developed on heterogenous programming environments
- Run of scientific workflows developed on heterogenous programming environments
- Publication of workflow results

The VLab version used in e-shape is the one developed under a legacy of joint projects

https://vlab.geodab.org/

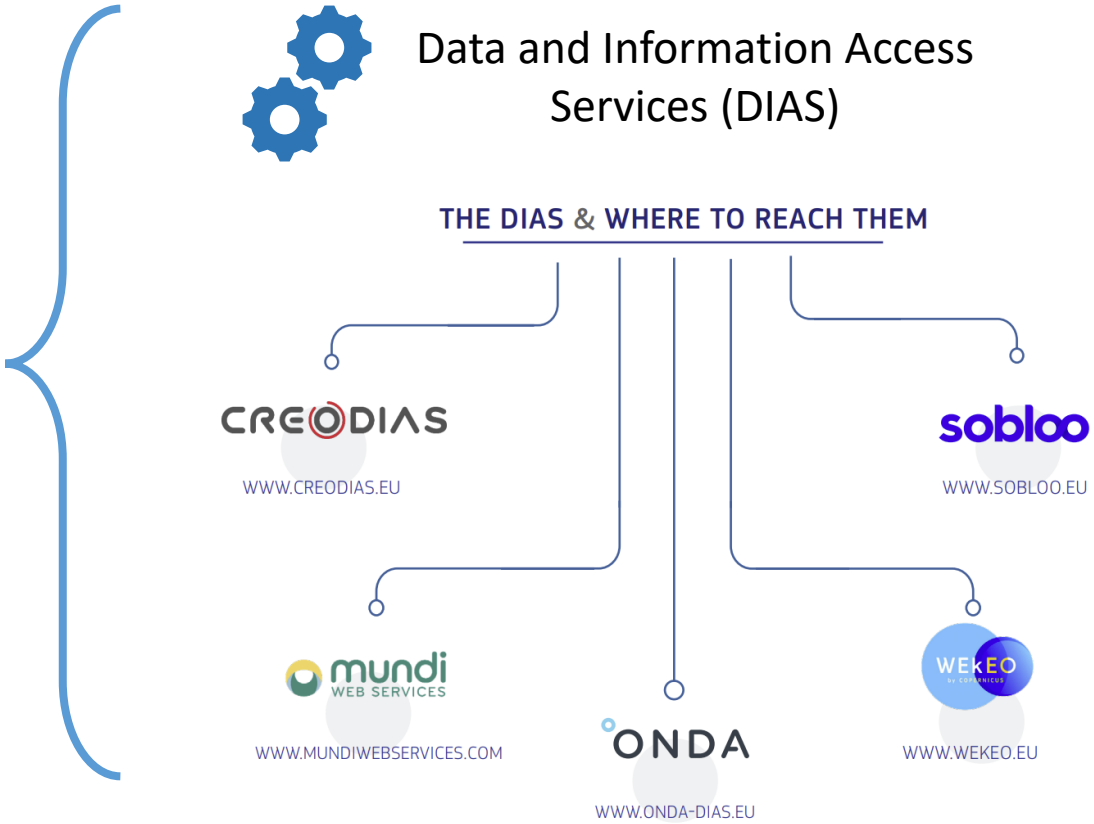


mySPACE - Virtual Earth Laboratory (VLab)

Vlab is an **open source** cloud based platform that makes **data and models interoperable** through data brokering and software **containerization** technologies

Vlab has also been successfully tested to run on **DIAS platforms**, such as Sobloo, ONDA and Creodias, facilitating the access to Copernicus data.

https://vlab.geodab.org/



babbea74

Home

Control

Workflows

My Experiments

Refresh

1 - 6 of 44 « ‹ 1 of 8 › »

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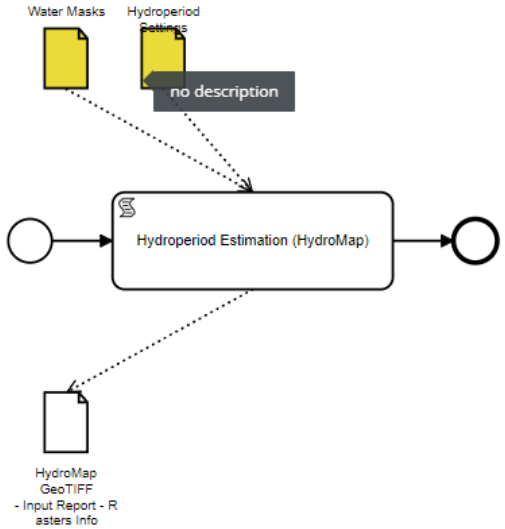
Create New Experiment

New Experiment Wizard

Select Workflow (1) — Inputs (2) — Review (3)

* Experiment Name

* Experiment Description



* Water Masks

* Hydroperiod Settings

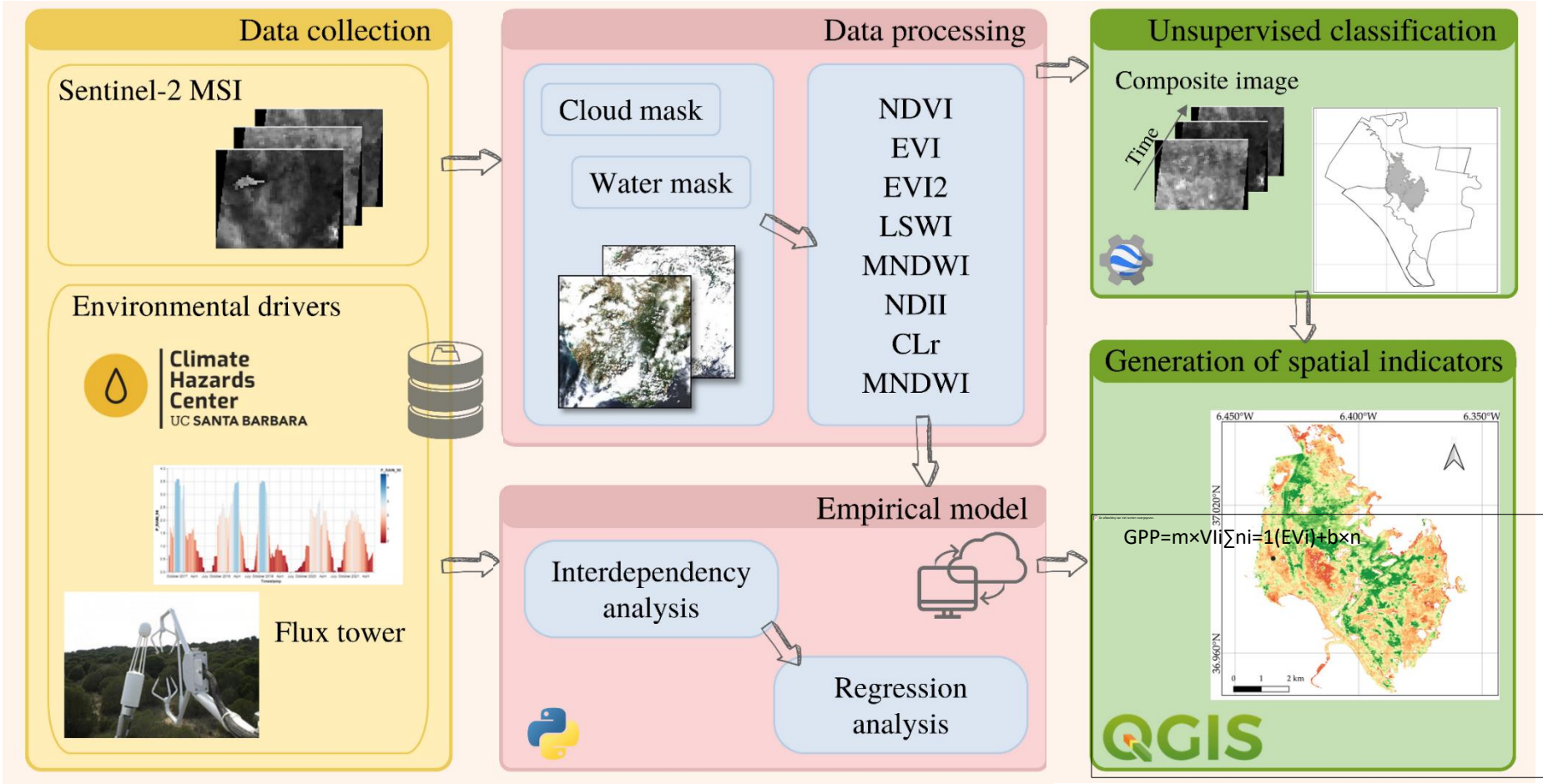
Cancel | < Back | Next >

e-shape ecosystem

https://vlab.geodab.org/

mySPACE – Gross Primary Productivity

GPP is the total amount of carbon or energy captured by plants. PP is a process that underpins most of the **ecosystem functions** essential for the understanding of the global carbon cycle → **GPP is an EBV** useful to understand whether the areas are fulfilling their ecosystem role

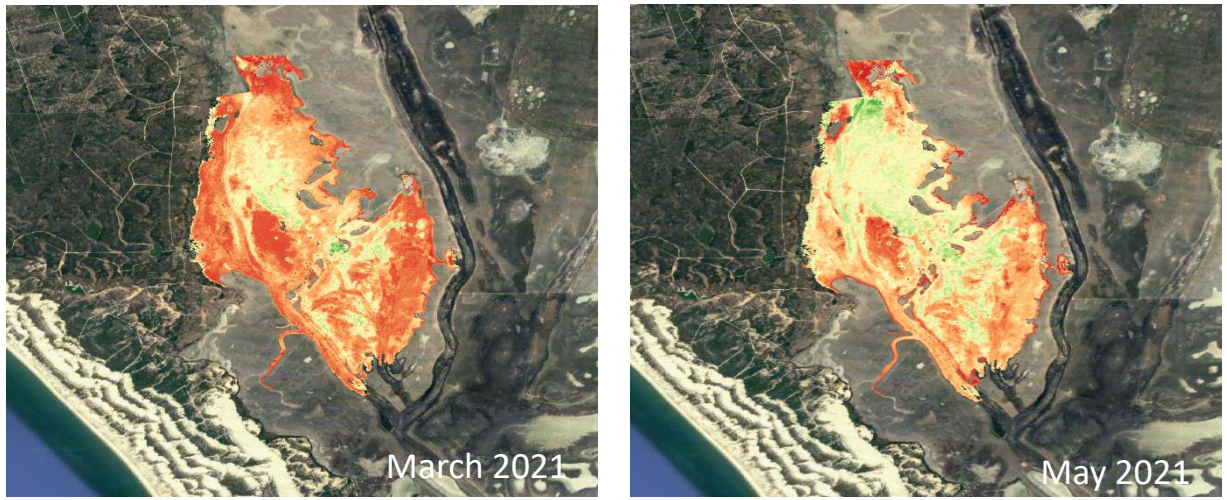


mySPACE – Gross Primary Productivity

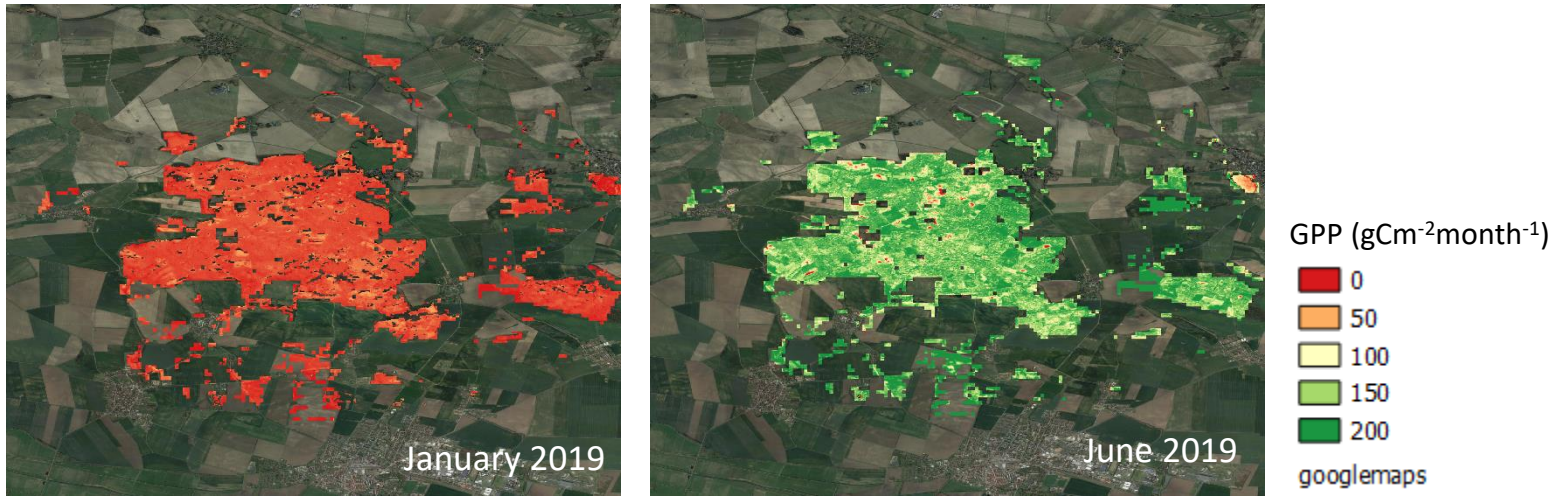
GPP maps generated for all the available Sentinel-2 cloud-free data for the pilot sites:

- Torgnon (Italy), grassland
- Montado (Portugal), woodland
- Doñana (Spain), wetland
- Svartberget (Sweden), evergreen forest
- Hyytiala (Finland), forest
- Wustebach (Germany), forest and grassland
- Harz Central Lowland (Germany), deciduous forest

Doñana National Park



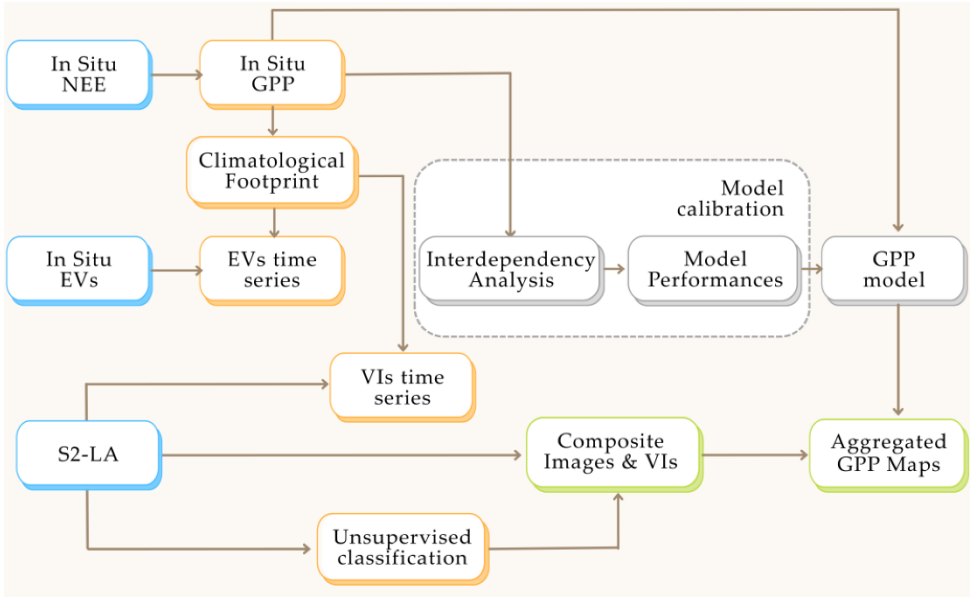
Harz Central Lowland



Spinosa, Anna, Mario Alberto Fuentes-Monjaraz, and Ghada El Serafy. "Assessing the Use of Sentinel-2 Data for Spatio-Temporal Upscaling of Flux Tower Gross Primary Productivity Measurements." Remote Sensing 15, no. 3 (2023): 562.

mySPACE – Gross Primary Productivity

The workflow is available in VLab and GitHub



Spinosa, Anna, Mario Alberto Fuentes-Monjaraz, and Ghada El Serafy. "Assessing the Use of Sentinel-2 Data for Spatio-Temporal Upscaling of Flux Tower Gross Primary Productivity Measurements." Remote Sensing 15, no. 3 (2023): 562.

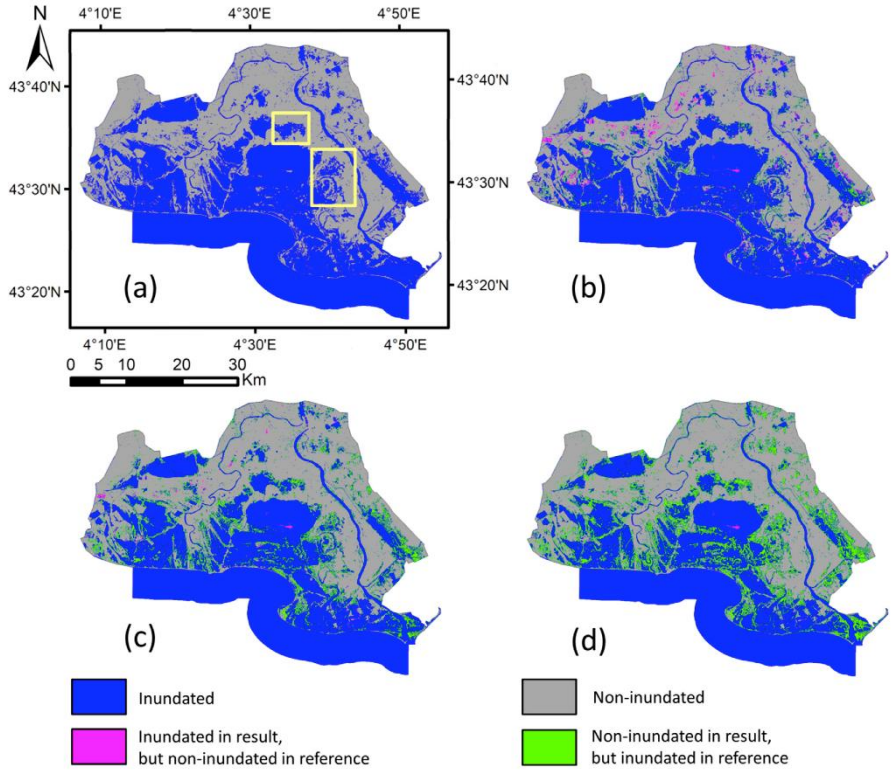
mySPACE - Hydroperiod

Hydroperiods is defined as the number of days per year that an area of land is wet or the length of time and portion of year a location holds water.

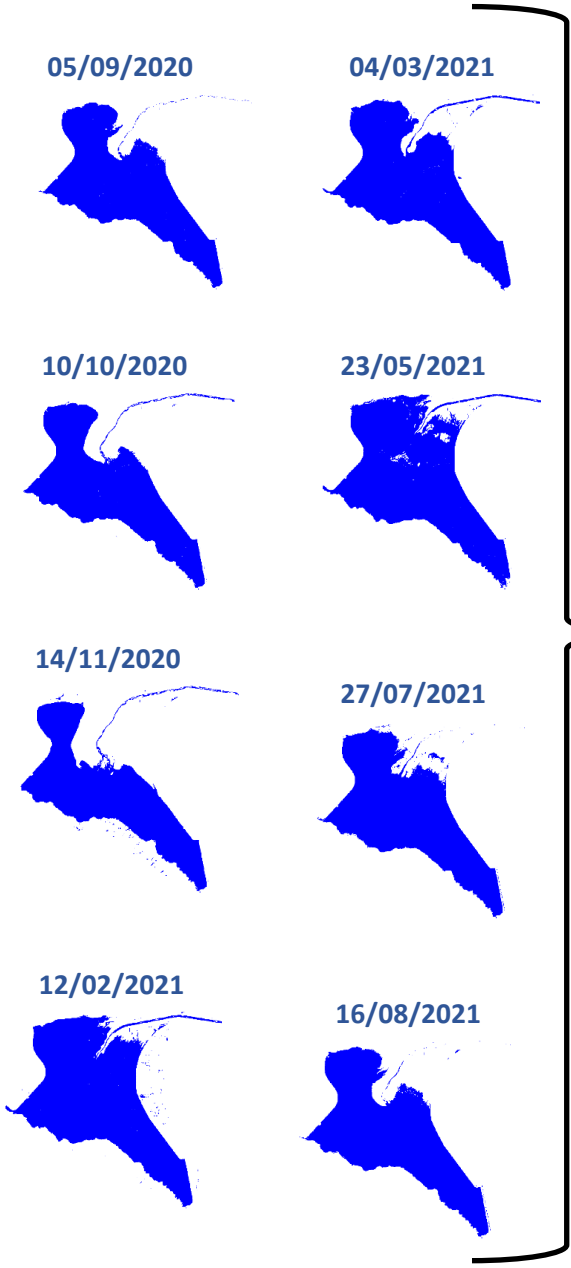
Hydroperiod (disturbance) is a primary source of **variation in community structure**, since it determines, e.g., the creation of niches for different plant species in wetlands, or the length of time that amphibian larvae have for developing to the point where they can leave the water for land, but also the number and types of predators to which they are exposed.

mySPACE - Hydroperiod

Watermasks



G. Kordelas, I. Manakos, G. Lefebvre, B. Poulin, Automatic Inundation Mapping Using Sentinel-2 Data Applicable to Both Camargue and Doñana Biosphere Reserves, 2019, Remote Sensing Journal, 11(19), 2251, DOI: https://doi.org/10.3390/rs11192251.



Kerkini example

Annual Hydroperipod 2020-2021

For more information: Ioannis Manakos (CERTH) imanakos@iti.gr

mySPACE - Hydroperiod

Hydroperiod maps generated for all the available sentinel-2 cloud-free data for the pilot sites:

- Braila (Romania)
- Montado (Portugal)
- Donana (Spain)
- Murgia Alta (Italy)
- Kekrini (Greece)
- Tereno Harz (Germany)
- Wadden Sea (Netherlands)

05/09/2020

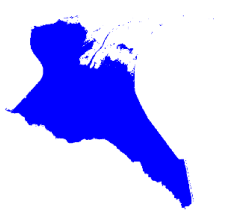
04/03/2021

10/10/2020

23/05/2021

14/11/2020

27/07/2021

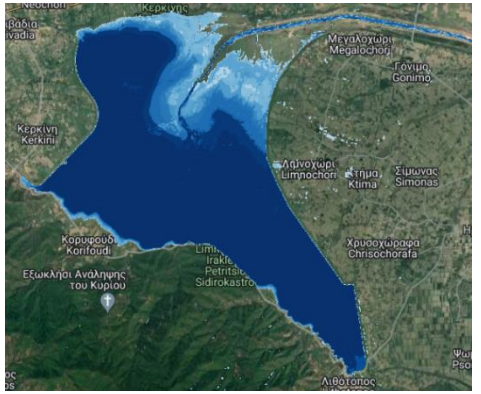


12/02/2021

16/08/2021

Kerkini example

Annual Hydroperipod 2020-2021

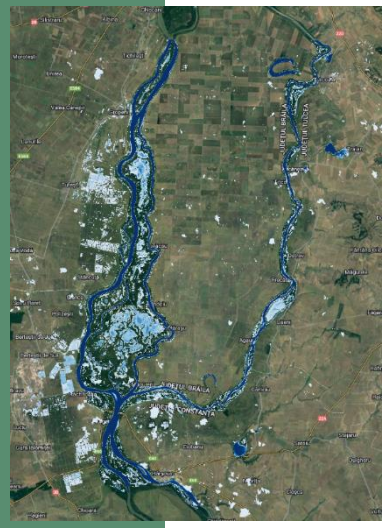


Find Hydroperiod products (please look at):
https://ecosense.biosense.rs/#/home or
https://b2share.eudat.eu/records/?q=hydroperiod&sort=-&page=1&size=10

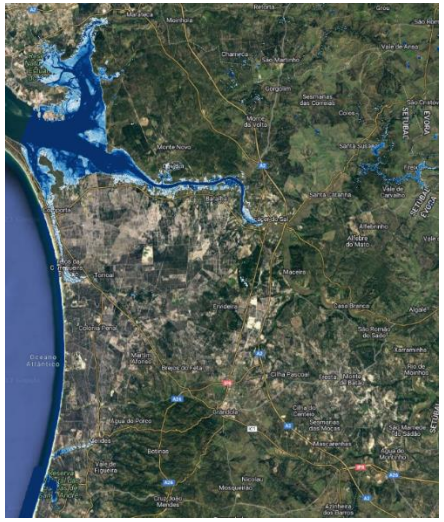
For more information: Ioannis Manakos (CERTH) imanakos@iti.gr

mySPACE - Hydroperiod

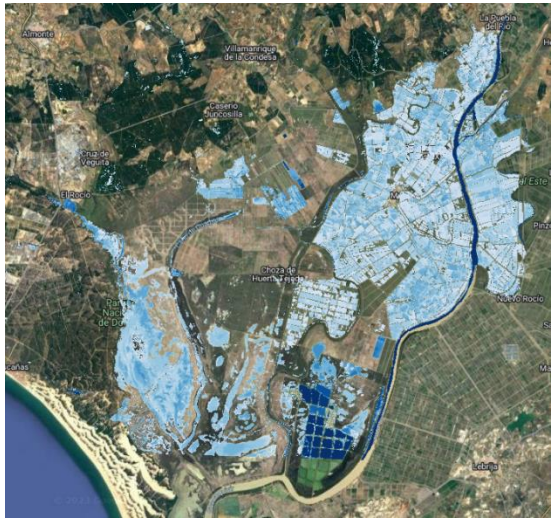
Braila 2020-2021



Montado 2019-2020



Donana 2020-2021



Murgia Alta 2017-2018

Kerkini 2015-2016

Tereno Harz 2018-2019

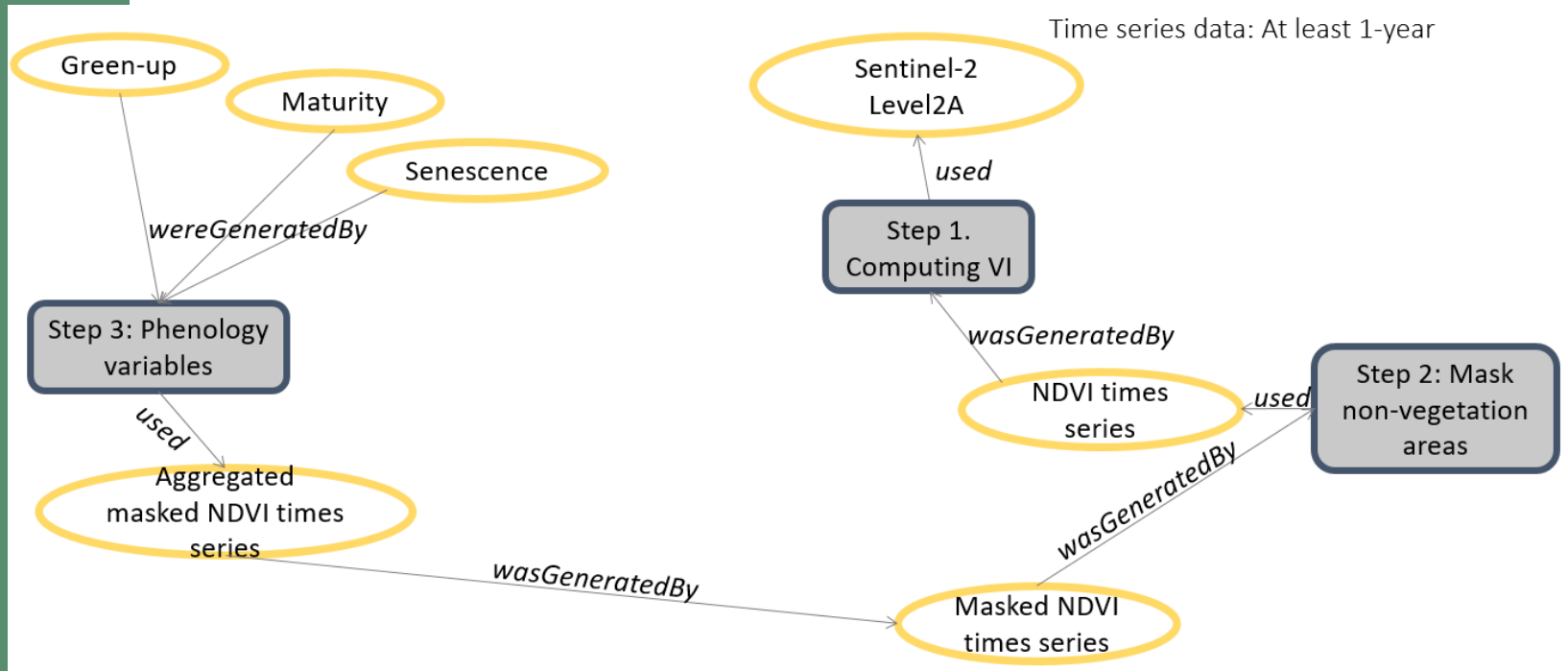
Wadden Sea 2018-2019

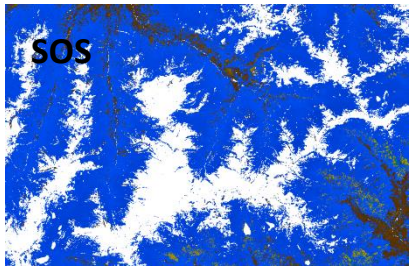
For more information: Ioannis Manakos (CERTH) imanakos@iti.gr

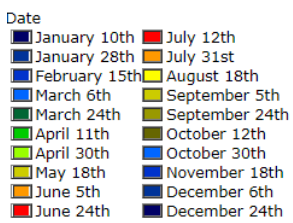
mySPACE - Phenology

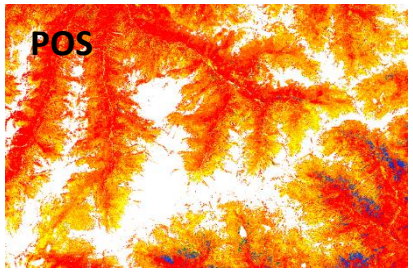
Phenology is the **observation of seasonal changes in plants and animals**, such as flowering, the appearance of insects and bird migration. **Changes in the rhythms of nature** give scientists a lot of information about the **effects that variations in climate produce on natural ecosystems → EBV**

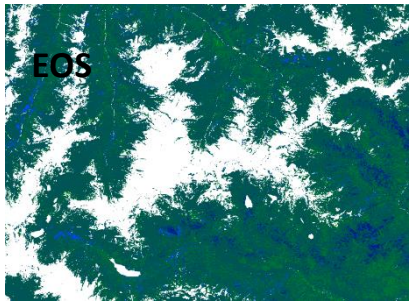
CREAF produces specific vegetation phenology metrics to describe specific stages on the seasonal trajectory, represented by phenological dates such green-up, maturity, senescence, the length of the season. Phenology from Sentinel-2.





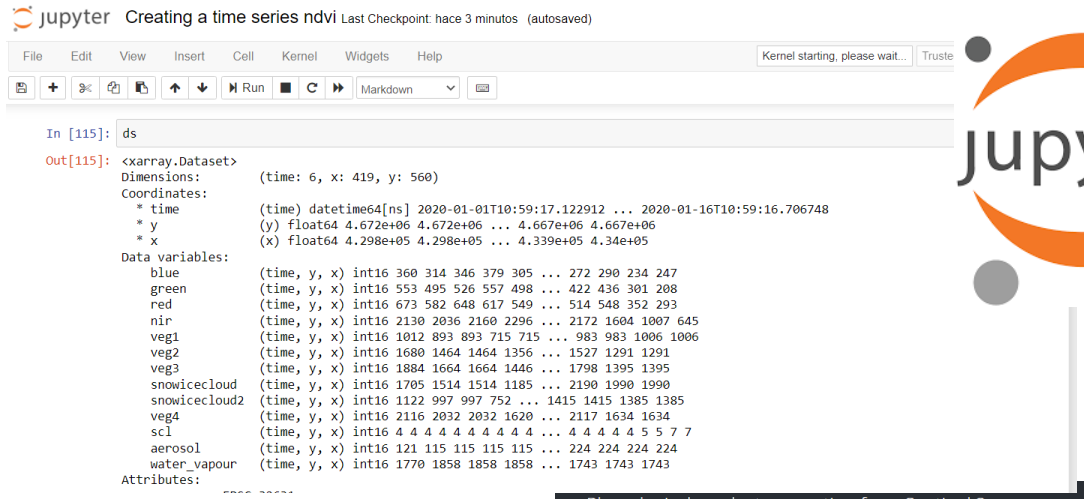


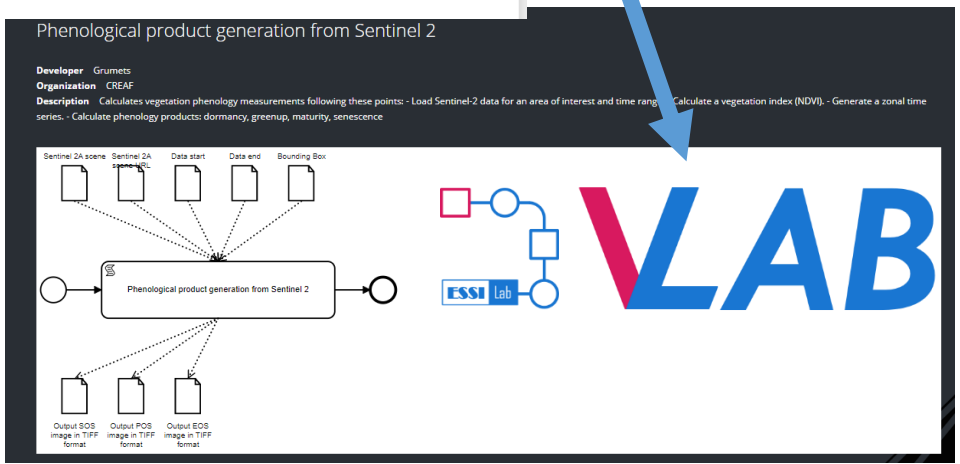




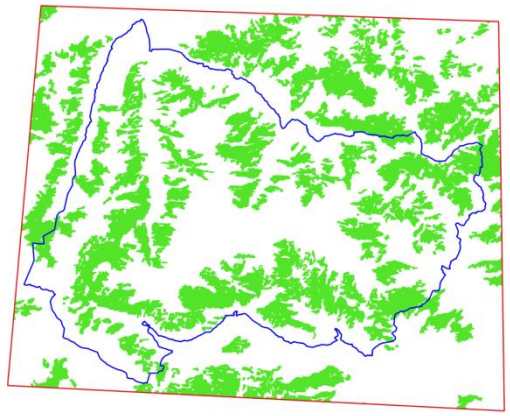
mySPACE - Phenology

A guide for using a common datacube approach to calculate phenology in Python by implementing several data access connectors in Python, for the Data and Information Access Services (DIAS), Virtual Laboratory Platform (VLab) and Open Data Cube is produced. It can be found in the GitHub repository https://github.com/grumets/phenology-e-shape



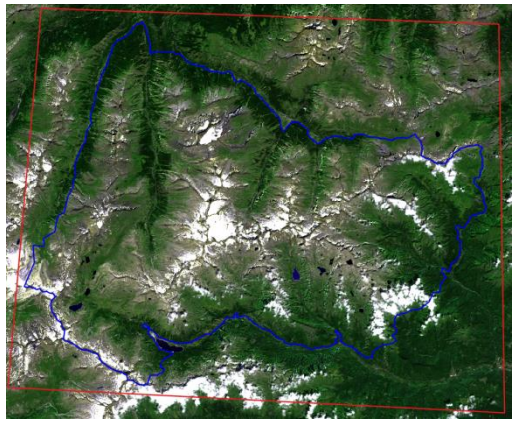


mySPACE - Land Cover Changes

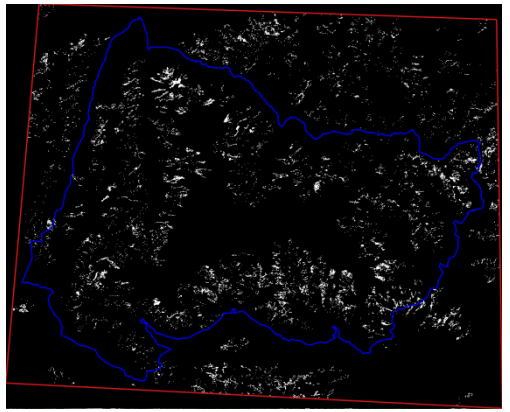


Grassland Layer at time t1

Cross Correlation Analysis
CCA



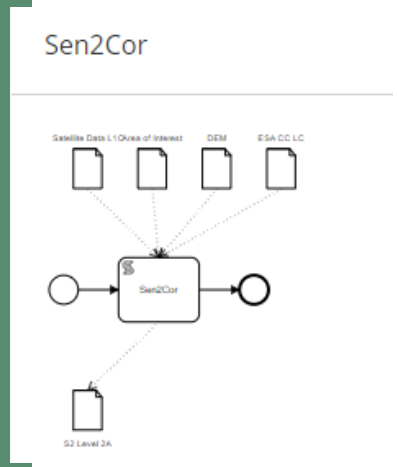
Sentinel-2 image at time t2

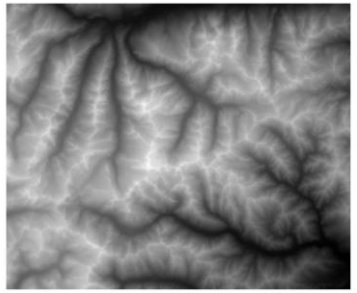


Changes in grassland layer

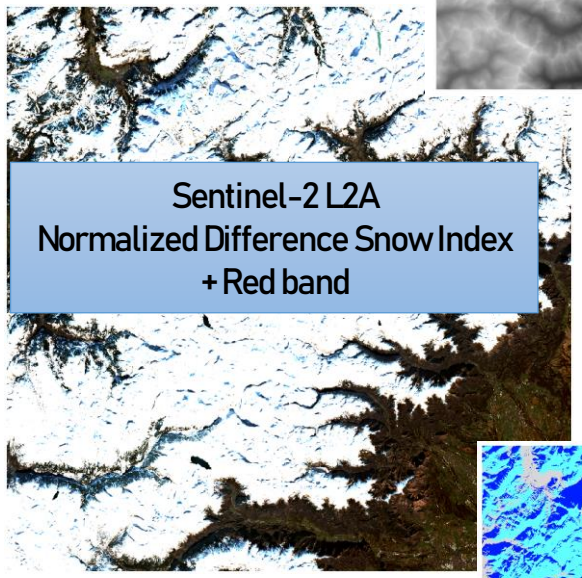
Tarantino, C.; Adamo, M.; Lucas, R.; Blonda P. Detection of changes in semi-natural grasslands by cross correlation analysis with WorldView-2 images and new Landsat 8 data. *Remote Sens. Environ.* 2016, 175, 65–72.

mySPACE- Snow Cover Extent



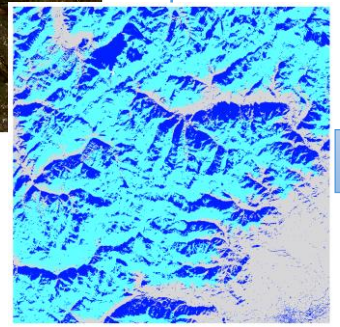


Digital Elevation Model

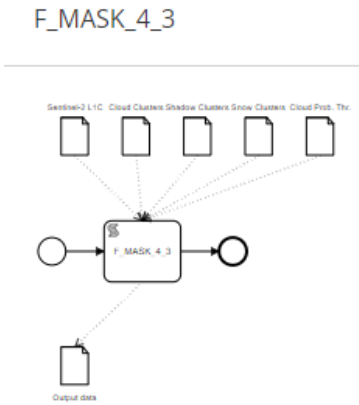


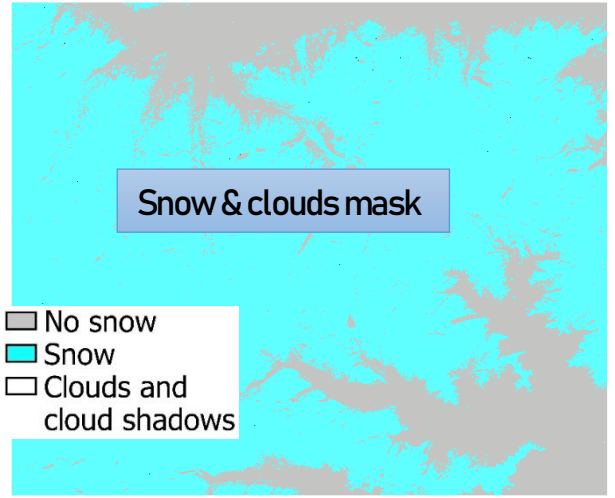
Sentinel-2 L2A
Normalized Difference Snow Index
+ Red band

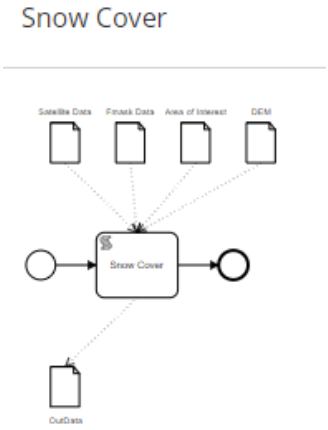
Snow cover algorithm



Fmask (clouds mask)

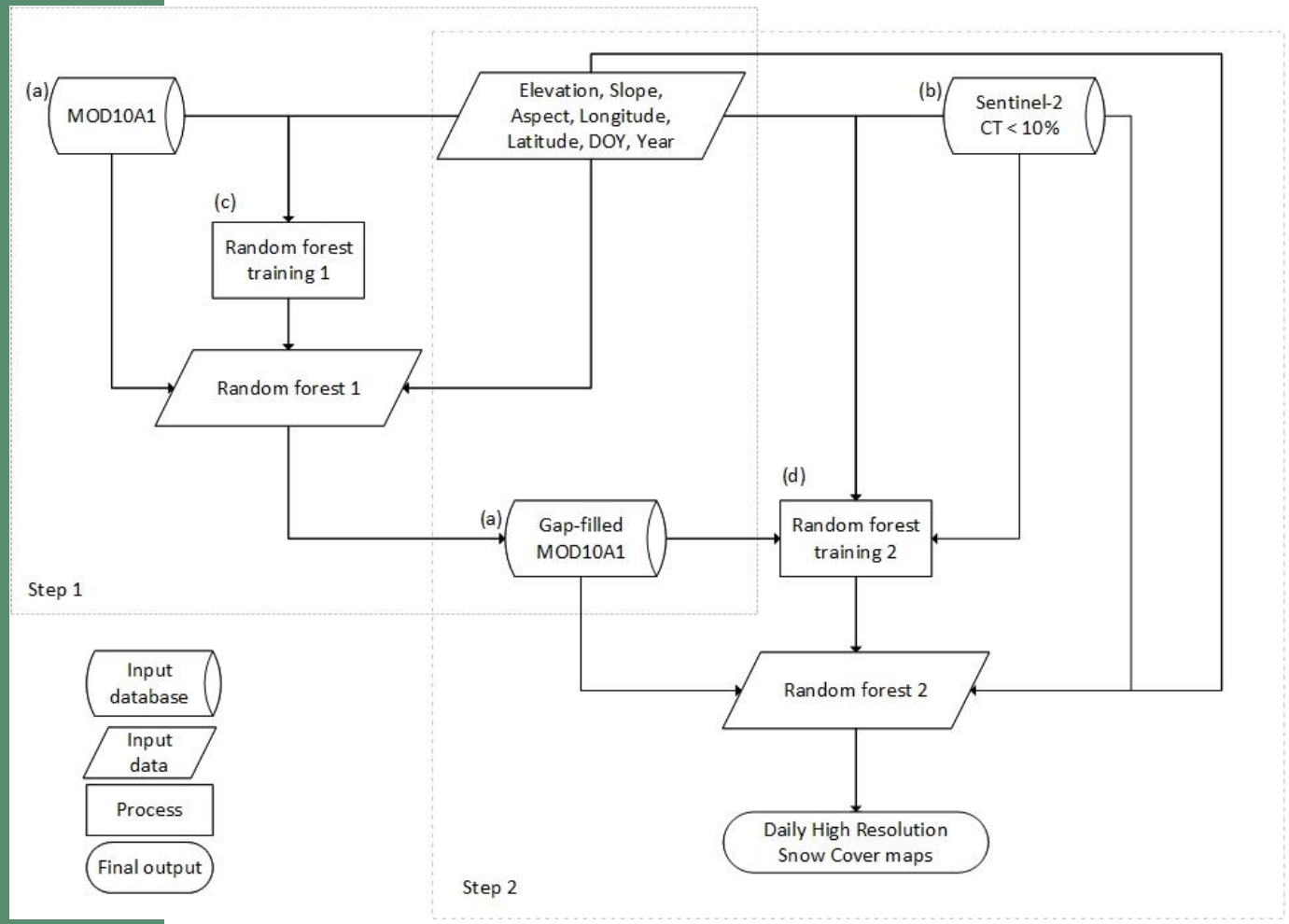


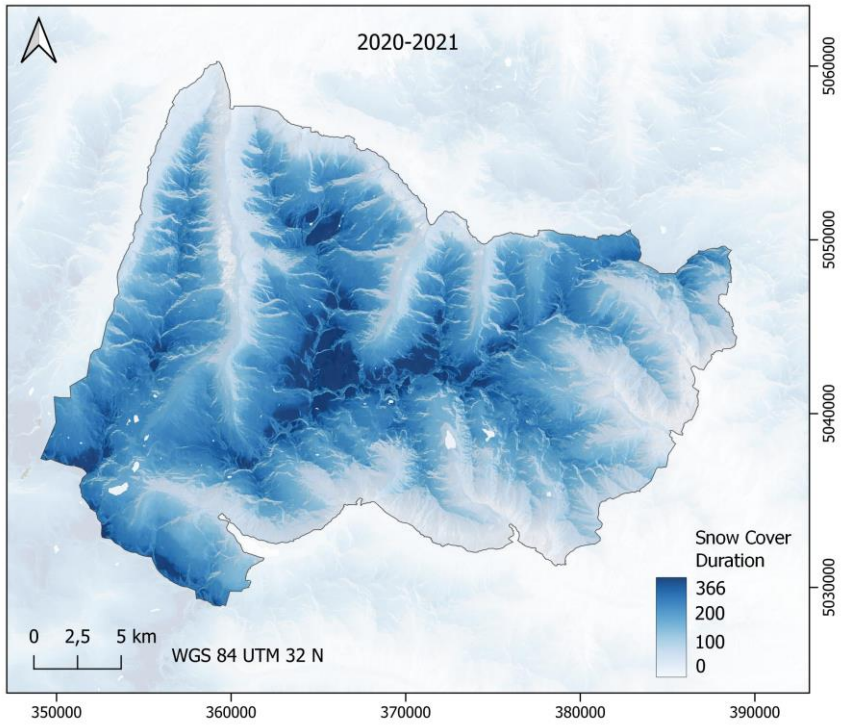




Richiardi, C.; Blonda, P.; Rana, F.M.; Santoro, M.; Tarantino, C.; Vicario, S.; Adamo, M. A Revised Snow Cover Algorithm to Improve Discrimination between Snow and Clouds: A Case Study in Gran Paradiso National Park. *Remote Sens.* 2021, 13, 1957. https://doi.org/10.3390/rs13101957

mySPACE- Snow Cover Duration





the map represents how many days there was snow in every point

- Generated from series of snowcover masks
- Each snow cover duration starts from 01 September of each year and ends on 31 August of the next year
- Random forest used to fill gaps in Sentinel-2 time series
- Additional inputs: DTM, MOD10

Richiardi, C.; Siniscalco, C.; Adamo, M. Comparison of Three Different Random Forest Approaches to Retrieve Daily High-Resolution Snow Cover Maps from MODIS and Sentinel-2 in a Mountain Area, Gran Paradiso National Park (NW Alps). *Remote Sens.* 2023, 15, 343. https://doi.org/10.3390/rs15020343

mySPACE - crocoTile

powered by eLTER

Issue: Some of the DEIMS pilot sites do not provide a specific polygon or the polygon is too large to be analyzed

Purpose: To define the most appropriate polygon for image analysis of a requested area

Workflow:

Case A

Pilot sites' location is declared only by the centroid coordinates

Steps:

1. Retrieve the polygon(s) of the closest Natura 2000 site to the centroid point.
2. Create the minimum circle that includes the polygon(s) of the selected Natura 2000 site.
3. Calculate the ratio: R = circle diameter / polygon perimeter.
4. Employ R as the percentage to expand the surface of the selected polygon(s) for processing (generate the buffer accordingly), so that co-registration errors and neighboring influences may be taken into account.
5. Use the new buffered polyline of the polygon to draw around the minimum parallelogram. The parallelogram will then encapsulate exactly the buffered area to be processed.
6. Examine whether the finally delineated parallelogram fits within a Sentinel-2 100x100km2 tile, and if this not the case, then select reducing the size of the parallelogram towards the tile, which holds the bigger extent of the site within.

Case B:

Pilot sites' location is delineated by numerous small polygons spread across a wider area

Steps:

1. Create the minimum circle that includes all polygons.
2. Calculate the ratio: R = circle diameter / accumulative polygons perimeter.
3. If R ≥ 1, then a parallelogram shall be drawn around each polygon following Case A steps 3. – 5. Where parallelograms overlap, a bigger one encapsulating overlapping ones shall be created. If R < 1, then Case A steps 3. – 5. are applicable.
4. Examine whether the finally delineated parallelogram fits within a Sentinel-2 100x100km2 tile, and if this not the case, then select reducing the size of the parallelogram towards the tile, which holds the bigger extent of the site within.

Case C:

Pilot sites' location is delineated by an all-inclusive very large polygon

Steps:

1. Retrieve all the Natura 2000 sites polygons, which belong to the deims polygon.
2. Calculate the median area of the downloaded Natura 2000 sites polygons and maintain only those with a surface equal or higher than the median.
3. Sort step's (2) selected Natura 2000 sites according to their land cover diversity using the Corine Land Cover of 2018.
4. Select the sites based on their ranking in relation with their land cover diversity (highest first) until the total selected surface area exceeds the 10% of all the designated polygons in the deims suggested large area. Aim is to work demonstratively on the 10% surface of the Natura 2000 sites included in the suggested by the deims all-inclusive large polygon area.
5. Select the Sentinel -2 tile that contains the most of the selected sites of step 4.
6. Select all the Natura 2000 sites that belong to the selected tile and follow Case B steps 2., 3a or 3b, 4.

Case D:

For any other pilot site

Steps:

If the pilot site's polygon belongs to one tile, keep the whole polygon and draw around the minimum parallelogram. The parallelogram will then encapsulate exactly the area to be processed. Else, select the tile that includes the bigger extent of the site, and reduce the site's polygon to fit in this tile.

Find crocoTile application (please look at) :
https://elter-crocotile.datalabs.ceh.ac.uk/

For more information: Ioannis Manakos (CERTH) imanakos@iti.gr

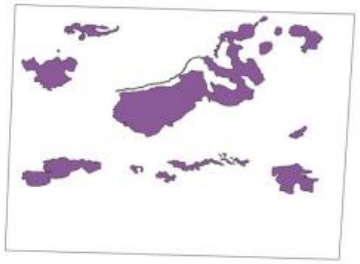
mySPACE - crocoTile

Example (case C)
Area: LTSER Zone Atelier Alpes – France

1. Download all the Natura 2000 sites polygons, which belong to the deims polygon.

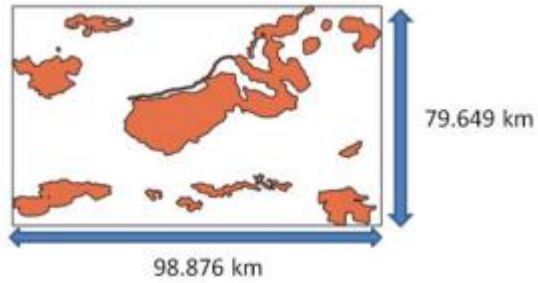
2. Select the sites based on their **land cover diversity (highest first)** until the total selected surface area exceeds the 10% of all the designated polygons in the deims suggested large area.

3. Find the Sentinel-2 tile that includes the most of the seleted Natura 2000 sites and select only the sites which belongs to this tile



4. Create the minimum circle around the Natura polygons and calculate the buffer by the formula:
Buffer=diameter/perimeter

5. Add 11% buffer to the polygons' surface and create the minimum parallelogram around the buffered area.



Find crocoTile application (please look at) :
https://elter-crocotile.datalabs.ceh.ac.uk/

For more information: Ioannis Manakos (CERTH) imanakos@iti.gr

mySPACE - Products validation

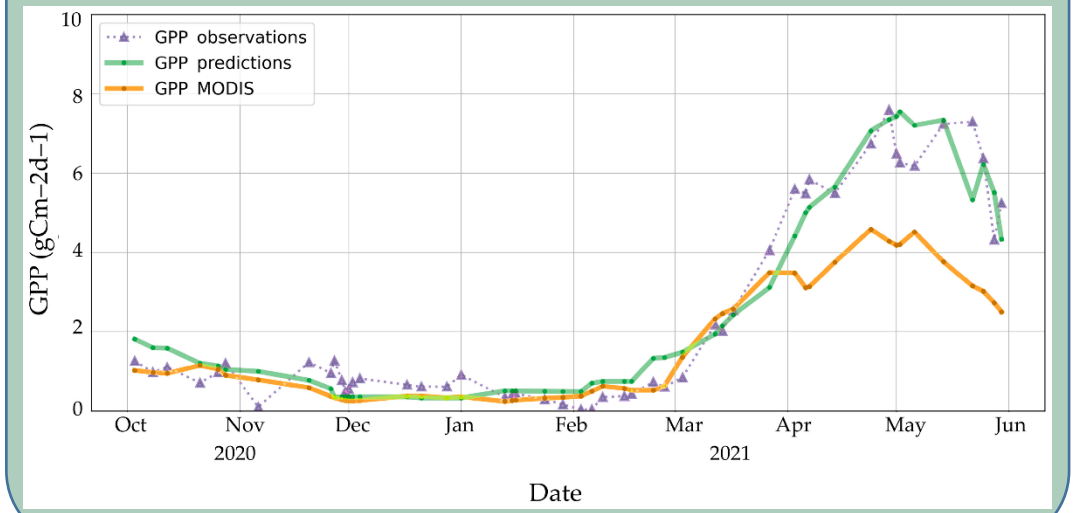
Validation performed by comparison with in situ data collected at weather station for the snow cover, and by eddy covariance tower for GPP.

The SCD maps were validated against in situ data collected by weather stations equipped with snow gauges.
The following metrics were computed: Root Mean Squared Error (RMSE), Mean Absolute Error (MAE) and Mean Bias Error (MBE).

Snow Cover Extent	
OA	0,93
Macro F1-score	0,91
Snow F1-score	0,87
No Snow F1-score	0,95

Snow Cover Duration (Days)	
RMSE	16,5
MAE	14
MBE	6,5

GPP products [$gCm^{-2}day-1$]	
RMSE	0,63
MAE	0,52



mySPACE - EO-based products – data access

RZoneAtelierAlpes - Snow Cover Extent - 2019/2020

by Richiardi, Chiara (CNR IIA); Adamo, Maria (CNR IIA);

Nov 11, 2022

Abstract: Sentinel-2 Snow Cover Extent (SCE) for LTSERZoneAtelierAlpes e-shape site of years 2019 and 2020.

Methods: Details on methodology used can be found in this reference: https://doi.org/10.3390/rs13101957.

TechnicalInfo: The final output consists of 20 m resolution raster masks in GeoTIFF format with: 0, No snow; 100, Snow; 205, Cloud; 254, No Data.

Disciplines: 3.3.2 → Earth sciences → Environmental science

Keywords: EO data product ; e-shape ; mySpace ; Snow Cover Extent ; eLTER;

DOI: 10.23728/b2share.09454896da99494f931be25e279658ef

PID: 11304/74bc7f1f-549f-4e91-b091-ee23b6c0dd0c

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Files

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LTSERZoneAtelierAlpes_SnowCoverExtent_2019_2020.zip	40.94 MB

Basic metadata

Open Access	True ✔
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Contributors	**Name** Maria Adamo (adamo@iia.cnr.it) **Type** ContactPerson
Resource Type	**Category** Dataset
Publisher	Consiglio Nazionale delle Ricerche - Istituto sull'Inquinamento Atmosferico

LTER Metadata

Metadata URL	https://deims.org/79d6c1df-570f-455f-a929-6cfe5c4ca1e9

https://b2share.eudat.eu/

EO-based products – data visualization

https://ecosense.biosense.rs/#/home

e-shape

Thank you!

www.e-shape.eu