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VALIDATED LOCAL RISK ACTIONABLE DATA FOR ADAPTATION



D4.1

Initial non-climate data manipulation and visualization tools description

TERRANIS

WP4 - Development of data manipulation tools

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Mission call and number

Grant Agreement No 101112837

Start Date of the Project: 1st June 2023

Duration: 36 months

DELIVERABLE REPORT

Deliverable ID	**D4.1**
Deliverable name	**Initial non-climate data manipulation and visualization tools description**

WP	4	Development of data manipulation tools
Task	T4.1	Implement ingestion, manipulation and integration tools for multi-source non-climate data

Dissemination level[1]	PU
Nature[2]	R

Due delivery date (Annex 1)	30/04/2024
Actual delivery date	06/05/2024

Lead beneficiary	TerraNIS
Contributing beneficiaries	Hereon, HCU, TerraSP, TAKT, ASITIS, CMCC

[1] Dissemination level: **PU** = Public, **PP** = Restricted to other programme participants (including the Commission Services), **RE** = Restricted to a group specified by the consortium (including the Commission Services), **CO** = Confidential, only for members of the consortium (including the Commission Services).

[2] Nature of the deliverable: **R** = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other.

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TABLE OF CONTENT

Mission call and number 1

1. INTRODUCTION 4

1.1 About VALORADA 4

1.2 Objectives of WP4 4

2.3 Objectives of Task 4.1 5

2. TERRANIS' TOOLS 7

2.1 Tool #1 : GreenCity 7

2.2 Tool #2 : Pixagri Territories 11

3. ASITIS' TOOLS 14

3.1 Tool #1 : Adaptation strategy for climate change 14

4. ARISTOTLE UNIVERSITY OF THESSALONIKI'S TOOLS 22

4.1 Tool #1 : Land degradation 22

5. TAKT-IKI'S TOOLS 27

5.1 Tool #1 : Copernicus Risk Relay WebPortal 27

5.2 Tool #2 : EMOWAF Webportal 33

5.3 Tool #3 : SmartAgri (draft version) 38

5.4 Tool #4 : NEODAH 41

6. TERRASPATIUM'S TOOLS 42

6.1 Tool #1 : TerraCoast 42

7. Next steps and future developments 47

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

1. Introduction

1.1 About VALORADA

The EU aims to transform 150 European regions into sustainable and climate resilient regions by 2030. VALORADA contributes to addressing this challenge by co-developing tested FAIR customisable data-manipulation tools to access available climate datasets and to enable the sharing, community validation and use of local socioeconomic, demographic and Earth-Observation data. With a rigorous transdisciplinary approach, the respective risks of climate change are analysed with the local actors in five demonstrators in Europe. Data required for the analysis are compiled from the various already existing repositories (e.g., Copernicus Climate Change Climate Data Store) and locally sourced non-climate data catalogues processed by local communities and regions. The project will co-develop and make available prototype climate data and non-climate data manipulation tools to support and improve existing data portals and platforms and to enable user-oriented multi-data integration.

VALORADA aims to achieve Technology Readiness Levels (TRL) 7 and above. VALORADA's tools will enable the acquisition of different useful climate and non-climate data and make them "interoperable" in terms of metadata, as well as tools able to harmonise the geographical and time references chosen for the data. The "Analyst toolbox" will be composed of software tools able to combine different kinds of data all relevant for assessing climate risks and to calculate resulting indicators. VALORADA will contribute to scaling up to 150 regions through the implementation of dedicated scalability and replicability activities with at least 10 European regions and through strong collaboration with other Horizon projects. Additional activities include capacity-building schemes for end users as well as providers of climate services. VALORADA will explore and assess the options to facilitate the connection of the VALORADA data tools to the Copernicus Atmosphere Data Store.

VALORADA's vision statement: VALORADA wants to empower European regions and cities to steer the upcoming societal transformation towards sustainable and climate-resilient development through their own actions.
VALORADA's mission statement: VALORADA will enable the integration of diverse datasets that enable merging local knowledge with climate and non-climate datasets by means of co-developed data-manipulation tools and climate data.

1.2 Objectives of WP4

• Define and develop multi-source data manipulation tools and make them available and customised to the service providers in charge of the regional demonstrators.
• Define together with WP1, WP2 and with the service providers of WP3, the climate service data which needs specific geographic downscaling, and perform the needed downscaling for the benefit of each service provider of WP3.
• Develop tools for generating a set of indicators combining climate, EO-based and non-climate data for assessing the vulnerability and risks mitigation benefits of the regions
• Assess the maturity level for operationalization with full compliance of the FAIR principles
• Assess the potential integration of the relevant tools into the Climate and Atmosphere Data Store (CADS) and/or other C3S related activities and Climate-ADAPT.

All the tools developed in this WP4 will comply with findability, accessibility, interoperability and reusability as described within the FAIR data principles.

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2.3 Objectives of Task 4.1

Definition of task 4.1: Implement ingestion, manipulation, and integration tools for multi-source non-climate data;

The purpose of this task is to make available a set of services and software tools for manipulating locally-sourced socio-economic, demographic and EO data (previously identified with the demonstrators 'local stakeholders) relevant to locally contextualising climate data. This task includes:

• "Populating" the various local databases into GeoNetwork catalogues, as well as the EO data and Copernicus services available and being of interest for building indicators to inform about climate risks, as identified in the impact climate chains built in WP1. This task involves all the local service providers participating in the demonstrators.

• Making available a set of tools able to handle (in a global approach or in separate steps) the following functions:

- "data ingestion" to get access to the data registered in the metadata catalogues. These tools will allow to ingest the data and images necessary for the relevant areas of interest into a "GeoServer" dedicated to the local area, with a common geographic and time reference, in order to allow easy further manipulation of these different data (optimising data access and data extraction on the time and spatial axis, resampling data).
- "data normalisation," to express the different data (local databases, EO images and land use maps) into common geographical units (hexagonal grids or local administrative units) allowing further merging and alignment of these data with different spatio-temporal resolutions.
- "data analysis and manipulation" in order to generate indicators values, corresponding to the risks identified by the local stakeholders and described in the climate impact chains, and to the indicators definition issued from WP2.

These tools will be made available by TerraNIS (as WP coordinator) or by the different service providers participating to WP4, either as software suite able to be integrated into the local services providers platforms, or as a "Software as a Service" (SaaS) mode running in the TerraNIS cloud environment and made accessible via APIs.

2.4 Positioning and status of the proposed tools

The tools which are described in the following sections have been selected after the first phase of the project. This phase has allowed, through the various workshops and discussions held with the stakeholders from the various demonstration regions, to identify existing tools, among those already developed by some project partners, able to fulfil the three key functions described in the previous section for manipulating the data available in these regions, relevant for the contextualization of the types of climate risks identified locally.

All these tools get the possibility to handle the three key functions: ingestion of data from different sources, normalization of these data in a consistent geo spatial reference, and analysis and manipulation of these data for the different thematic corresponding to each type of risk.

They have generally already achieved an operational level, at least in some application environments where they have been used and they must be able to be adapted to other ones,

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by using the local data available in these different environments. For each tool described hereafter, the input data necessary for their operations are identified, and the Valorada project team is currently assessing for each demonstrator whether and where these data can be made available. In addition, some further developments can be necessary to be done in the next project phases in order to enable the tools adapting to these other environments. This is the purpose of the line “further developments” appearing in each tool description. These developments are still under assessment between the corresponding “tool owner” and the service provider in charge of the local demonstrators.

For the time being, and to handle the first demonstration phase of the project, the following principles have been retained:

- Use of the tools in environments where the data necessary for them to run have been identified and made accessible, and for generating the indicators as defined and discussed with the local stakeholders.
- Populating the tools databases with the local data under the responsibility of the local demonstrator’s service provider, running the tool in its owner’s processing infrastructure and WEB server, and results made available via remote access to the WEB server.
- Generation of a first set of indicators, as co-defined with the local stakeholders.

These principles will be re-assessed by the project team, after the 2nd run of local workshops, to be held between mid-September and mid-October 2024, together with the first feedbacks gathered from the local stakeholders. This re-assessment should allow to extend the capacity of using for the second demonstration phase some tools in more demonstrators’ environments, provided that the necessary input data can be made available.

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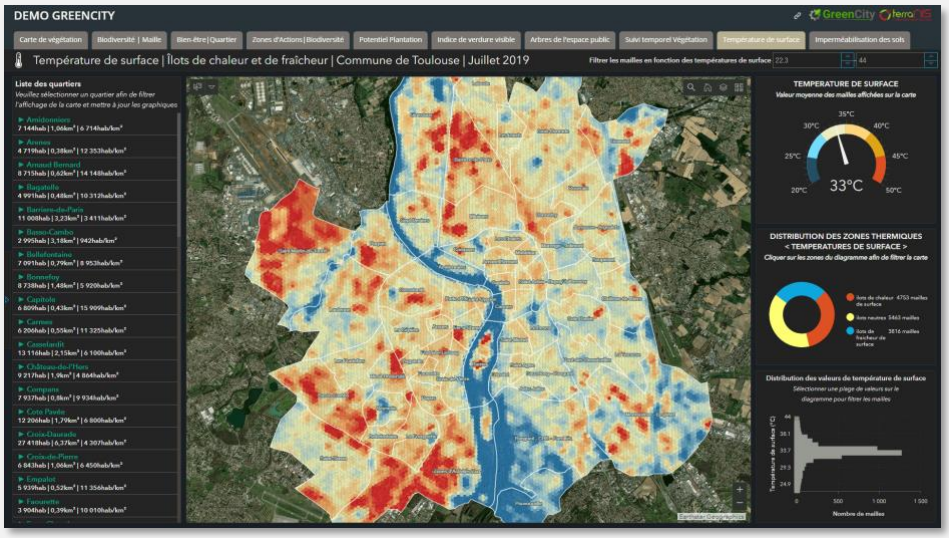
2. TerraNIS' tools

2.1 Tool #1 : GreenCity

TOOL DESCRIPTION

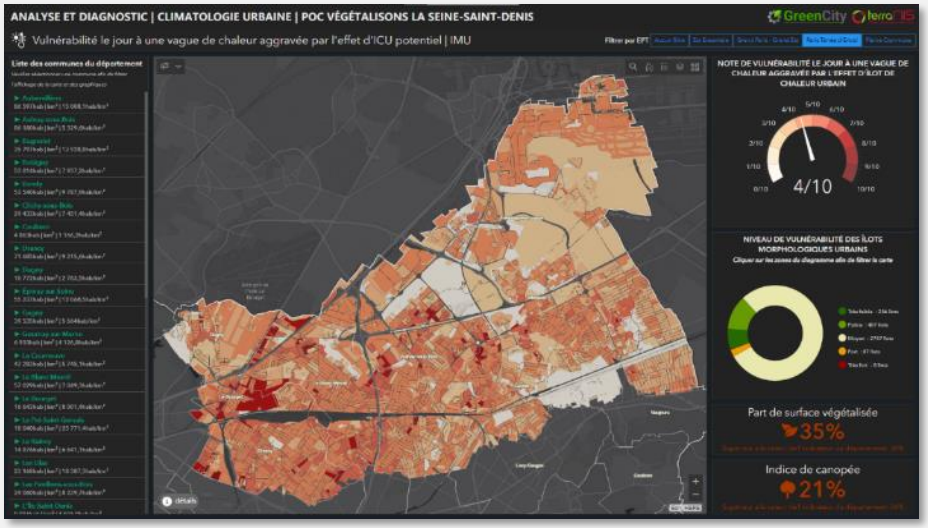
Tool #1	**GreenCity**
Description	Greencity is an urban vegetation observatory for land use planning. The tool makes it possible to visualize the vegetation cover in cities through various indicators, thus allowing urban planners and decision-makers to manage and make informed decisions on their territory.
Type	Web Platform
Technologies	Geoserver / Geospatial database (PostgreSQL / PostGIS) Cloud / Webserver / ArcGIS online / WebMap applications builder
API	~~Yes~~ / No
Output / Indicators	Indicator #1 – Land Surface Temperature (LST) Indicator #2 – Local Climate Zones (LCZ) Indicator #3 – Population vulnerability to heat waves Indicator #4 – Urban vegetation indices
Update	~~Automatic~~ / manual + frequency on demand
Tools used to produce indicators	Python scripts
Developments needed	Ready to use in Occitanie; further indicators to be implemented (resulting from WP2); adaptations to Czech Rep. and Bulgaria environments to be assessed pending on available inputs data.
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes / ~~No~~

INDICATORS DESCRIPTION

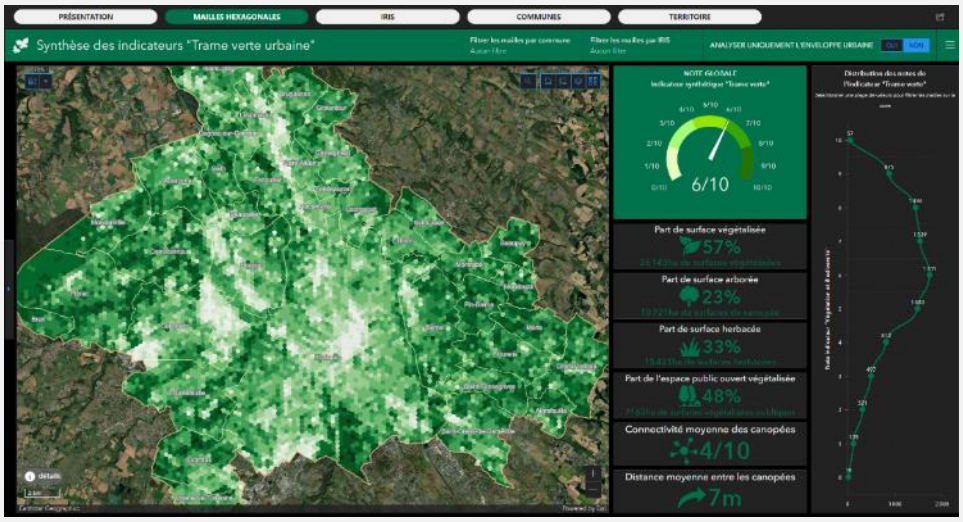
Indicator #1	**Land Surface Temperature (LST)**
Description	Estimation of the temperature levels of surface materials using an energy balance influenced by the orientation of the surfaces, the albedo, the emissivity of the different materials, the proportion of vegetation cover, the surface roughness or even the humidity of the ground.
Input data	Data #1.1 - Landsat-8 satellite data
Spatial resolution	30m
Frequency	One image every 16 days
Output / unit	°C
Example of representation	

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Indicator #2	**Local Climate Zones (LCZ)**
Description	Classification of urban areas into different microclimatic zones. The method is based on the morphological characteristics of the urban fabric (building height, compactness, roughness, rate of waterproofing, vegetation, etc.). Its aim is to group together areas which have comparable behavior from a climatic point of view (Stewart and Oke).
Input data	Data #2.1 – Land use classification Data #2.2 – 3D building Data #2.3 – Urban morphological units
Spatial resolution	Urban morphological units / Hexagonal grid
Frequency	On demand
Output / unit	LCZ categories
Example of representation	

Indicator #3	**Population vulnerability to heat waves**
Description	Mapping the level of vulnerability of populations to a heat wave aggravated by the potential ICU (urban heat island) effect.
Input data	Data #3.1 – Local Climate Zones (LCZ) Data #3.2 – Vegetation mask Data #3.3 – Population census and socio-economic data Data #3.4 – Level of accessibility to cooling zones Data #3.5 – Location of sensitive infrastructure
Spatial resolution	Urban morphological units / Hexagonal grid
Frequency	On demand
Output / unit	Vulnerability level (0 to 10)
Example of representation	

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Indicator #4	**Urban vegetation index**
Description	Percentage of vegetated areas
Input data	Data #3.2 – Vegetation mask
Spatial resolution	Urban morphological units / Hexagonal grid
Frequency	On demand (usually every 3 or 5 years)
Output / unit	%
Example of representation	

DATA DESCRIPTION

Data #1.1	**Landsat-8 satellite data**
Description	Earth observation data from satellites developed under a joint program between the USGS and NASA. Landsat-8 captures images of the Earth's surface with an optical resolution of 30 meters, every 16 days, using multispectral and thermal instruments.
Spatial coverage	World
Spatial resolution	30m
Format	Raster, GeoTiff
Time period	Since 2013
Temporal resolution	16 days
Source	NASA
Open Data	Yes / ~~No~~

Data #2.1	**Land use classification**
Description	Classification of land cover from very high resolution imagery (Pleiades) into 6 classes: 1 = frame 2 = roads and mineral surfaces 3 = permeable bare soil 4 = water surfaces 5 = tree vegetation (woody vegetation, tall vegetation) 6 = herbaceous vegetation (non-woody vegetation, low vegetation)
Spatial coverage	On demand
Spatial resolution	50cm
Format	Raster, GeoTiff
Time period	-
Temporal resolution	-
Source	TerraNIS
Open Data	~~Yes~~ / No

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Data #2.2	3D building
Description	3D vector description (structured in objects) of the elements of the territory and its infrastructures. It allows visualization, positioning, simulation in the service of analysis and operational management of the territory. The description of geographic objects in 3D makes it possible to realistically represent spatial analyzes useful for decision-making processes.
Spatial coverage	National territory (France)
Spatial resolution	Scales ranging from 1:2,000 to 1:50,000
Format	Shapefile, Geopackage, SQL
Time period	-
Temporal resolution	Trimester
Source	BD TOPO (IGN)
Open Data	Yes / ~~No~~

Data #2.3	Urban morphological units (= morphological segmentation of the territory)
Description	Division of the territory into urban morphological units: digital geographic reference of the typo-morphology of blocks, both urban blocks (or “house blocks”) and blocks of open spaces without buildings. Typo-morphologically homogeneous polygons (afforestation, large watercourse, large lake, similar agricultural plots, residential area, urban sector with the same type of building, etc).
Spatial coverage	Cities with more than 50 000 inhabitants
Spatial resolution	Urban morphological units
Format	Shapefile
Time period	2006, 2012, 2018, (2024)
Temporal resolution	Every 6 years
Source	Urban Atlas (Copernicus Land service)
Open Data	Yes / ~~No~~

Data #3.1	Local Climate Zones (LCZ)
Description	Classification of urban islands into different microclimatic zones which have comparable behavior from a climatic point of view.
Spatial coverage	On demand
Spatial resolution	Urban morphological units / Hexagonal grid
Format	Shapefile
Time period	-
Temporal resolution	On demand
Source	Tool #1 – GreenCity (TerraNIS)
Open Data	~~Yes~~ / No

Data #3.2	Vegetation mask
Description	Vegetation mask based on the analysis of satellite imagery
Spatial coverage	On demand
Spatial resolution	50cm
Format	Shapefile
Time period	-
Temporal resolution	On demand
Source	TerraNIS
Open Data	~~Yes~~ / No

Data #3.3	Population census and socio-economic data
Description	Database providing information on population census (number of inhabitants) and socio-economic data. For example, it provides age groups of households (share of vulnerable population; - 5 years and + 65 years), or income levels (poverty rate)
Spatial coverage	National (France), but probably other existing sources in other European countries
Spatial resolution	IRIS
Format	Table csv
Time period	-

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Temporal resolution	Annual
Source	INSEE.fr
Open Data	Yes / ~~No~~

Data #3.4	**Level of accessibility to cooling zones**
Description	Average time in minutes on foot to reach a refreshment area (example: access to a public green space, a body of water or a fountain/fogger)
Spatial coverage	On demand
Spatial resolution	Urban morphological units
Format	Shapefile
Time period	-
Temporal resolution	On demand
Source	TerraNIS
Open Data	~~Yes~~ / No

Data #3.5	**Location of sensitive infrastructure**
Description	Data which provides the location of various sensitive infrastructures such as children's nurseries, hospitals, retirement homes etc.
Spatial coverage	On demand
Spatial resolution	Urban morphological units
Format	Shapefile
Time period	-
Temporal resolution	On demand
Source	OSM
Open Data	Yes / ~~No~~

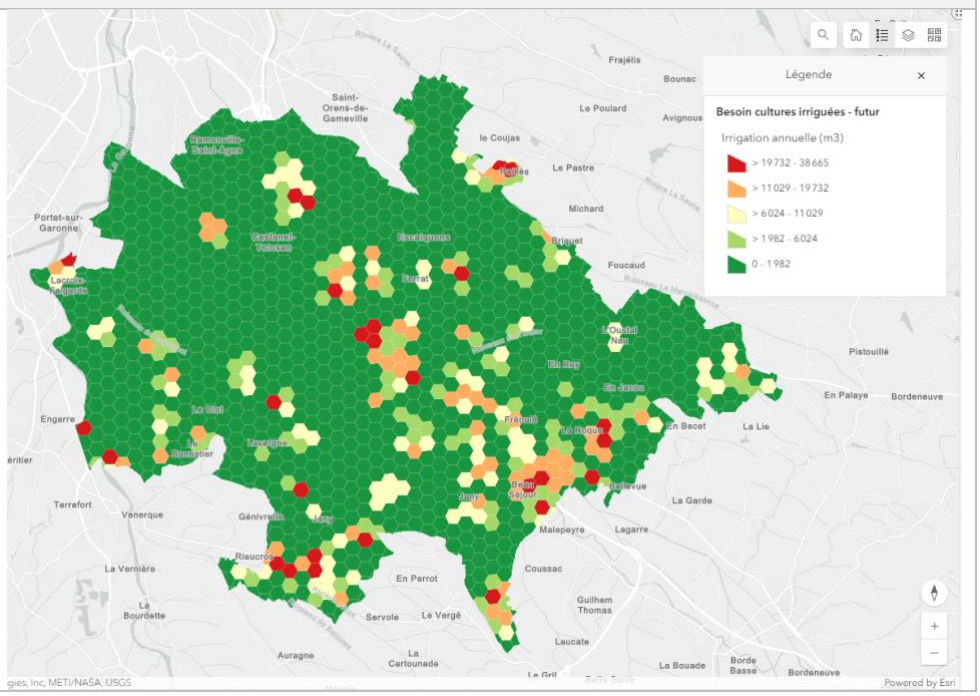
2.2 Tool #2 : Pixagri Territories

TOOL DESCRIPTION

Tool #1	**Pixagri Territories**
Description	Pixagri territories is a tool for visualizing indicators on the management of water resources in agricultural areas
Type	ESRI dashboard
Technologies	ArcGIS online
API	~~Yes~~ / No
Output / Indicators	Indicator #1 – Agriculture Water Demand
Update	~~Automatic~~ / manual + frequency on demand
Tools used to produce indicators	Python scripts
Developments needed	First prototype under development for Occitanie (Sicoval environment); further indicators to be implemented (resulting from WP2); adaptations to Greece and to Molisa environments to be assessed pending on available inputs data.
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes / ~~No~~

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INDICATORS DESCRIPTION

Indicator #1	**Agriculture Water Demand**
Description	Agriculture water demand corresponds to the estimation of water quantity applied by farmers to the crops located to grow properly, i.e. to match yielding objectives in current situation.
Type	Shapefile (vector)
Input data	Data #1.1 - Land Use Land Cover (LULC) Data #1.2 – Irrigated fields Data #1.3 - Rainfall & Temperature Database Data #1.4 - Crop coefficient (Kc)
Spatial resolution	LandUse level / Hexagon / Hydrological basin
Time resolution	Monthly
Unit	Mm3
Example of representation	

DATA DESCRIPTION

Data #1.1	**Land Use Land Cover (LULC)**
Description	Detailed land classification over the area of interest. The classification of agricultural areas must be sufficiently precise to categorize each type of crop (corn, sorghum, wheat, barley, sunflower, rapeseed, etc.)
Spatial coverage	Area of interest
Spatial resolution	Polygons
Format	Shapefile (vector)
Time period	-
Temporal resolution	Yearly
Source	In France: RPG files (declarations made by farmers for the Common Agriculture Policy)
Open Data	Yes / ~~No~~

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Data #1.2	**Irrigated plots**
Description	Detailed land register indicating which plots are irrigated
Spatial coverage	Area of interest
Spatial resolution	Polygons
Format	Shapefile (vector)
Time period	-
Temporal resolution	Yearly
Source	Water Agencies; Local institutions, but not always available.
Open Data	~~Yes~~ / No

Data #1.3	**Rainfall & Temperature Database**
Description	Monthly cumulated rainfall and temperature dataset over period of interest
Spatial coverage	Area of interest
Spatial resolution	1km (downscaling needed)
Format	Raster format
Time period	-
Temporal resolution	Monthly
Source	ECMWF
Open Data	~~Yes~~ / No

Data #1.4	**Crop coefficient (Kc)**
Description	Table providing monthly crop coefficient (Kc), properties of plants used in predicting evapotranspiration (ET). Kc is simply the ratio of ET observed for the crop studied over that observed for the well calibrated reference crop under the same conditions. This Kc is defined according crop calendar, literature references and experts knowledge.
Spatial coverage	-
Spatial resolution	-
Format	Table (csv)
Time period	-
Temporal resolution	Monthly
Source	Literature and experts knowledge (in France: National Research Center for Agriculture)
Open Data	Yes / ~~No~~

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3. ASITIS' tools

3.1 Tool #1 : Adaptation strategy for climate change

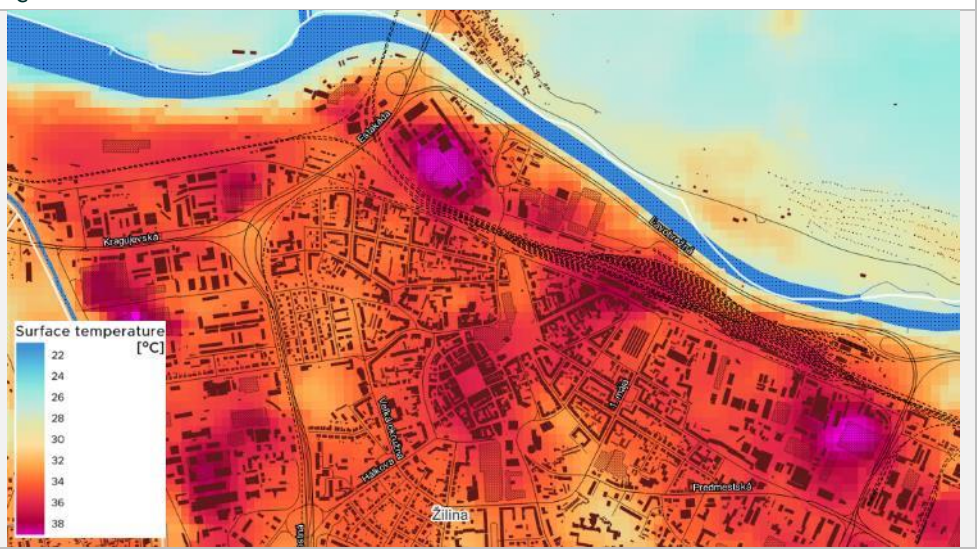
TOOL DESCRIPTION

Tool #1	**Adaptation strategy for climate change**
Description	Strategical document for city (or region) administration assessing threads and vulnerability connected with climate change. It is high level report assessing data and outlines directions for adaptation. It is not dealing with individual localities and specific adaptation measures.
Type	Report, maps and datasets.
Technologies	Cloud (AWS)
API	Yes / No
Output / Indicators	Indicator #1 - Longterm Surface Temperature (LST) Indicator #2 - Land Surface Temperature (LST) Indicator #3 - Functional vegetation cover Indicator #4 - Surface permeability Indicator #5 - Drought resilience Indicator #6 - Vegetation distribution Indicator #7 - Greenery around buildings Indicator #8 - Distribution of vulnerable populations Indicator #9 - Distribution of infrastructures and build-up area Indicator #10 - Vulnerability to flash floods Indicator #11 - Vulnerability to drought Indicator #12 - Vulnerability to heat waves
Update	manual + frequency on demand
Tools used to produce indicators	Python scripts running in cloud, SentinelHUB service, standard GIS tools
Developments needed	Transfer of the generation of the report into a WEB portal by using ArcGIS and Terranis infrastructure under assessment; possibility to ensure an interactive interface via this web server to be assessed as well.
Metadata available	No
GeoNetwork compatibility	No

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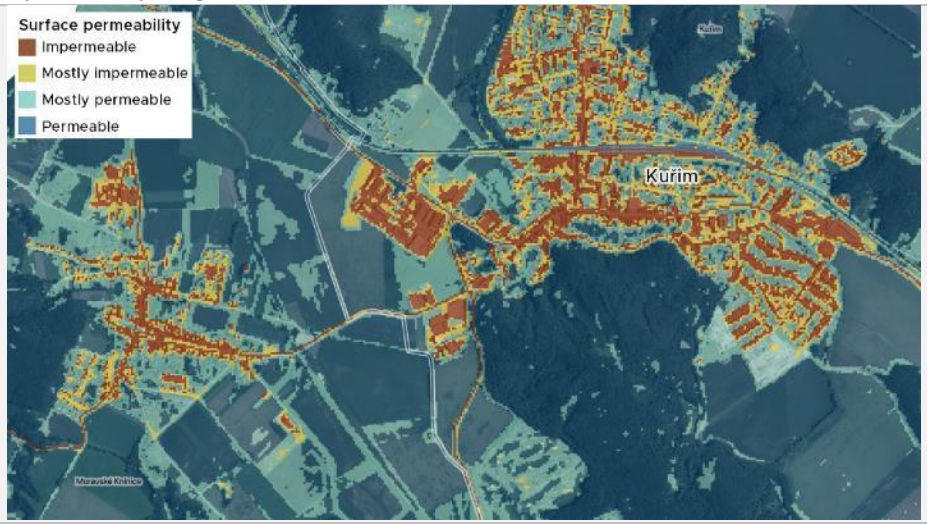
INDICATORS DESCRIPTION

Indicator #1	**Longterm Surface Temperature (LST)**
Description	Longterm surface temperature and surface temperature during the hottest days
Input data	Landsat – 7, 8 satellites data
Spatial resolution	Resampled to 30 m
Frequency	actual state (update every 3 years)
Output / unit	°C
Example of representation	

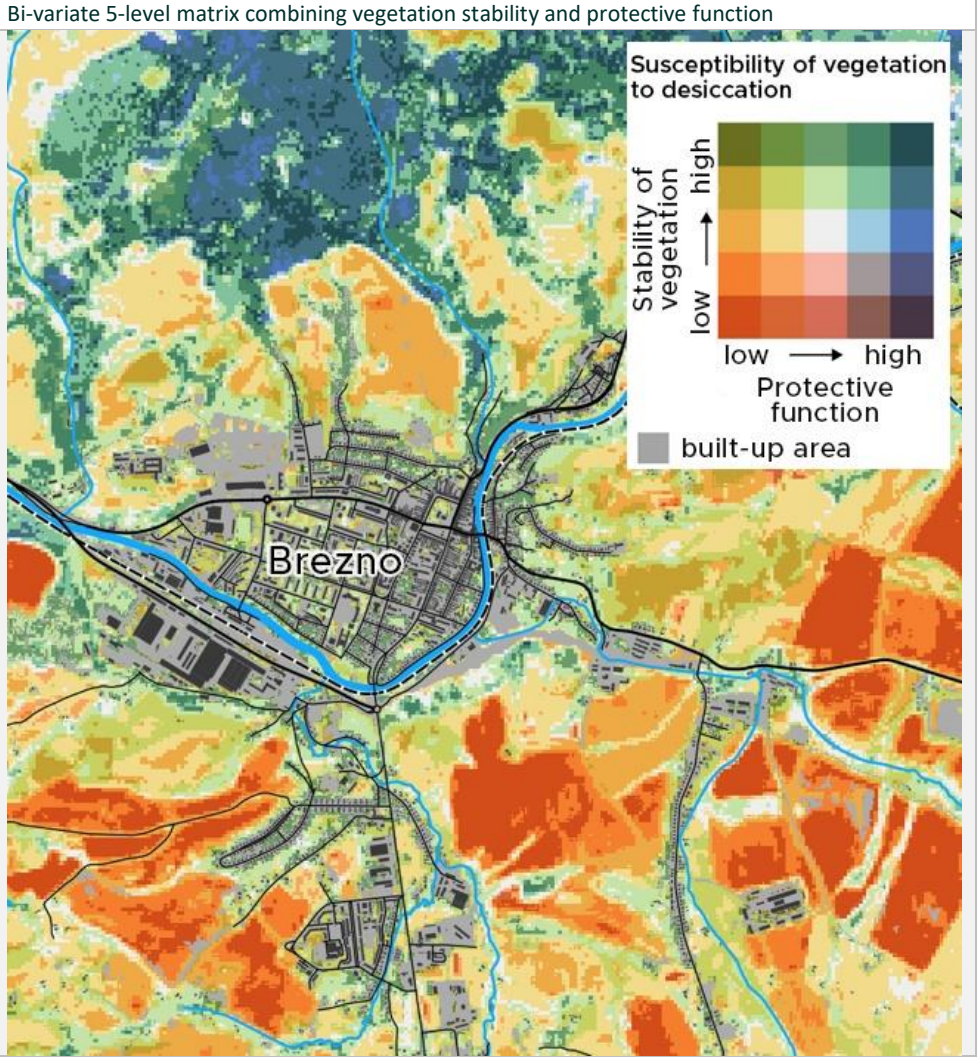
Indicator #2	**Land Surface Temperature (LST)**
Description	Surface temperature during the hottest days
Input data	Landsat – 7, 8 satellites data
Spatial resolution	Resampled to 30 m
Frequency	actual state (update every 3 years)
Output / unit	°C
Example of representation	

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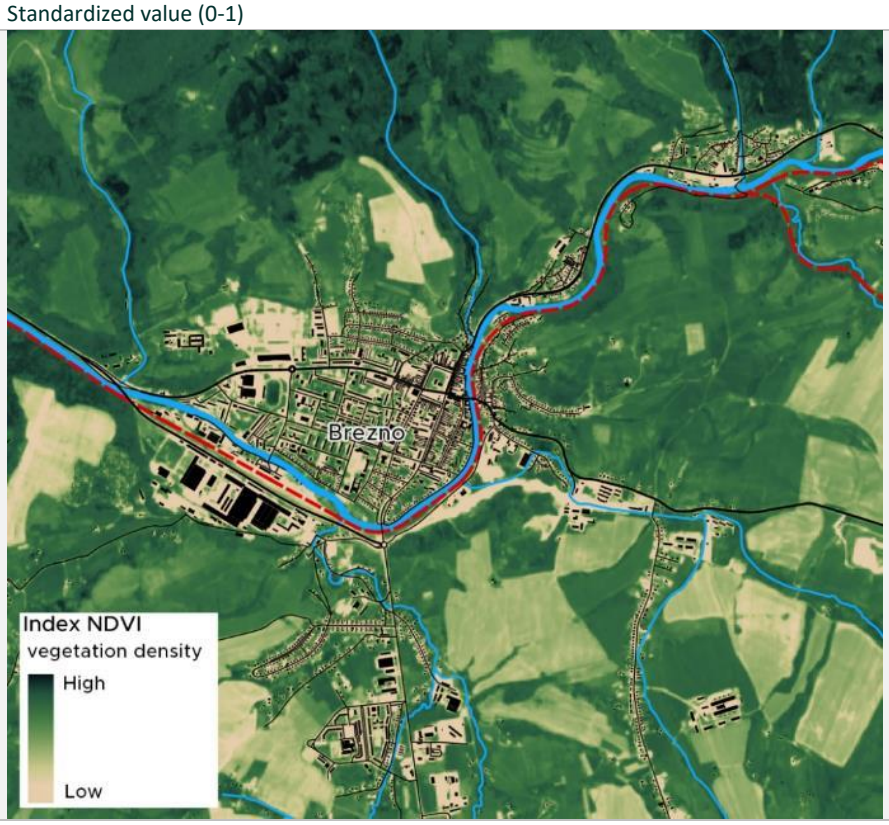
Indicator #3	**Functional vegetation cover**
Description	Landcover classification of the surface with focus on vegetation its function related to adaptation capacity within city.
Input data	Sentinel 2 A/B
Spatial resolution	10 m
Frequency	actual state (update every 2 years)
Output / unit	11 surface classes
Example of representation	

Indicator #4	**Surface permeability**
Description	Ability of the surface to capture precipitation.
Input data	Sentinel 2 A/B
Spatial resolution	10 m
Frequency	actual state (update every 2 years)
Output / unit	4 permeability categories
Example of representation	

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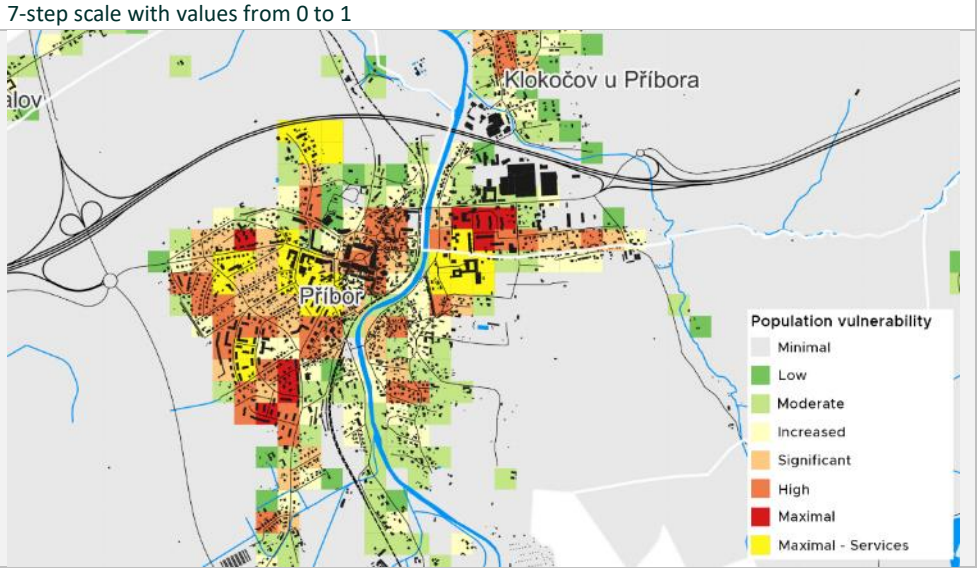
Indicator #5	**Drought resilience**
Description	Vulnerability of surface to drought based on protective function and stability of vegetation.
Input data	Sentinel 2 A/B
Spatial resolution	20 m
Frequency	actual state (update every 2 years)
Output / unit	Bi-variate 5-level matrix combining vegetation stability and protective function
Example of representation	

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Indicator #6	**Vegetation distribution**
Description	Vegetation density based on standard vegetation index.
Input data	Sentinel 2 A/B
Spatial resolution	10 m
Frequency	actual state (update every 2 years)
Output / unit	Standardized value (0-1)
Example of representation	

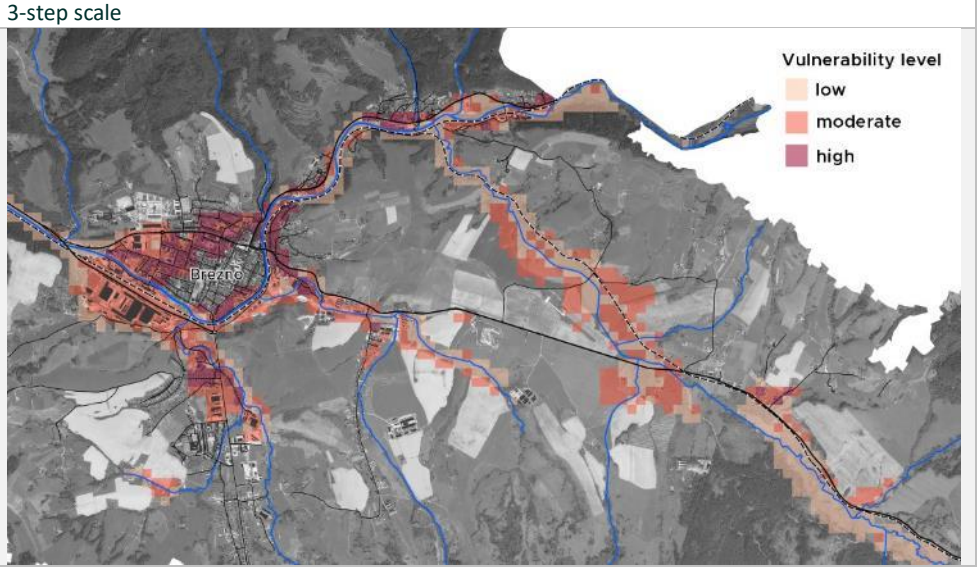
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Indicator #7	**Greenery around buildings**
Description	Accessibility of the greenery in the individual building proximity.
Input data	Sentinel 2 A/B
Spatial resolution	individual building
Frequency	actual state (update every 2 years)
Output / unit	Amount of vegetation cover (%) around the building
Example of representation	

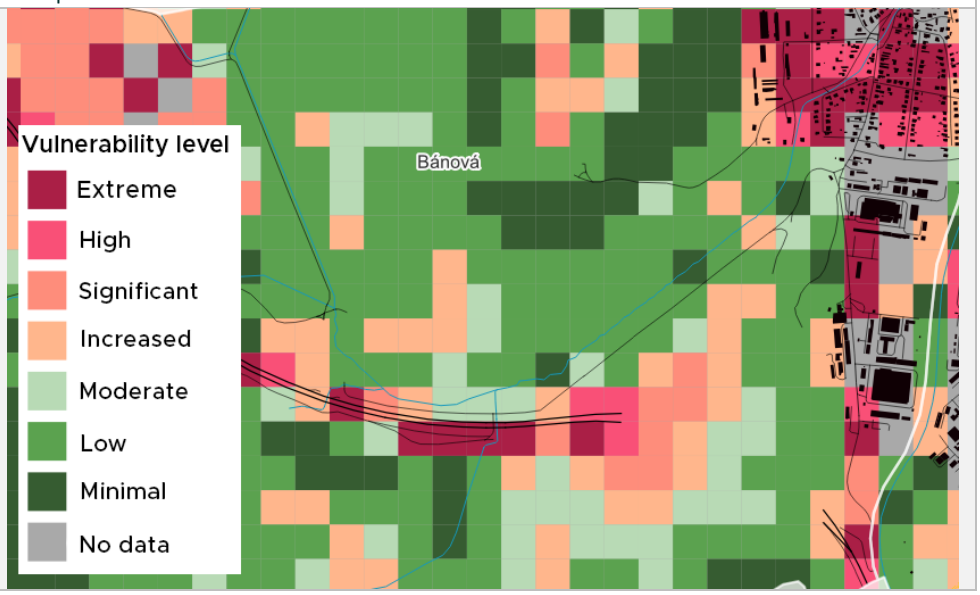
Indicator #8	**Distribution of vulnerable populations**
Description	The map shows the distribution of the sensitive population (age groups 0-15 years and 65+) in a 100x100m grid. The amount of sensitive population is reclassified into values 0 to 1, where 1 indicates the highest sensitivity. Services such as schools, hospitals and retirement homes are automatically set to 1 as this is a vulnerable location with a higher number of vulnerable groups.
Input data	address points, population by street, list of schools and hospitals in city
Spatial resolution	Vector grid 100x100m
Frequency	actual state
Output / unit	7-step scale with values from 0 to 1
Example of representation	

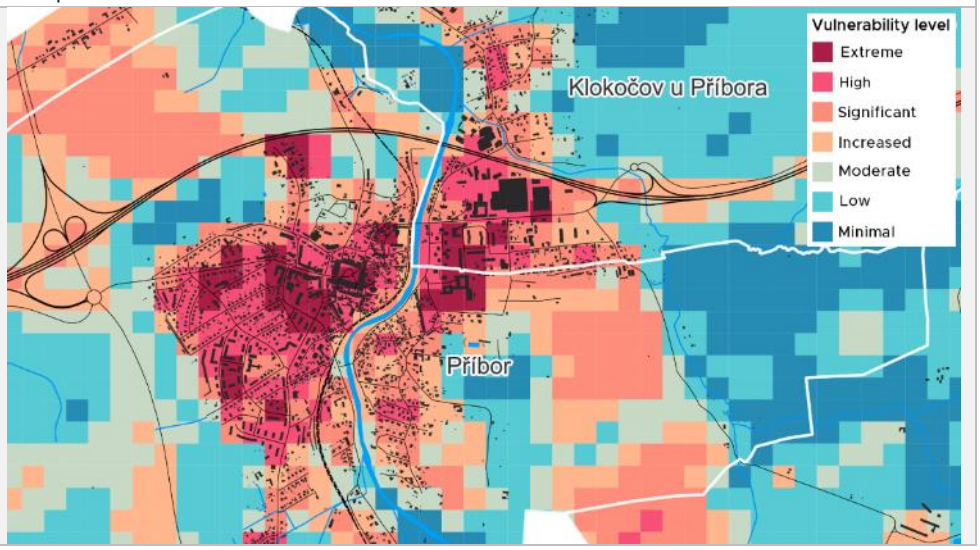
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Indicator #9	**Distribution of infrastructures and build-up area**
Description	proportion of built-up area and infrastructure per 100x100m grid area.
Input data	Vector data from OSM – roads, rails, buildings
Spatial resolution	Vector grid 100x100m
Frequency	actual state
Output / unit	3-step scale
Example of representation	

Indicator #10	**Vulnerability to flash floods**
Description	Combination of (vulnerable) population, infrastructure distribution and flood occurrence analysis analysed with respect to surface.
Input data	Sentinel 2 A/B and other
Spatial resolution	Vector grid 100x100m
Frequency	actual state (update every 2 years)
Output / unit	3-step scale
Example of representation	

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Indicator #11	**Vulnerability to drought**
Description	Combination of vulnerability of the vegetation to drought and surface permeability
Input data	Sentinel 2 A/B and other
Spatial resolution	Vector grid 100x100m
Frequency	actual state (update every 2 years)
Output / unit	7-step scale
Example of representation	

Indicator #12	**Vulnerability to heat waves**
Description	Combination of surface temperature during the hottest days, distribution of vulnerable population, surface analysis and vegetation index.
Input data	Sentinel 2 A/B and Landsat 8
Spatial resolution	Vector grid 100x100m
Frequency	2015-2022
Output / unit	7-step scale
Example of representation	

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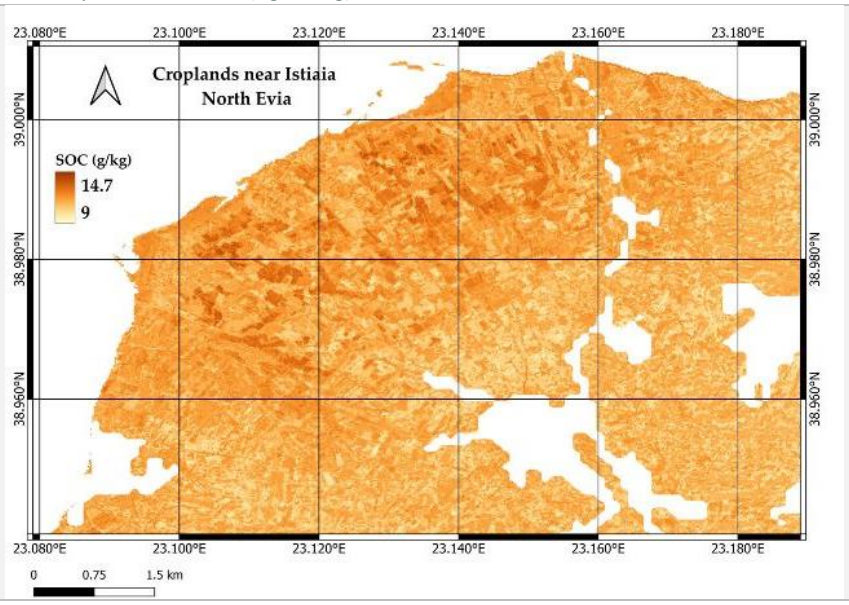
4. Aristotle University of Thessaloniki's tools

4.1 Tool #1 : Land degradation

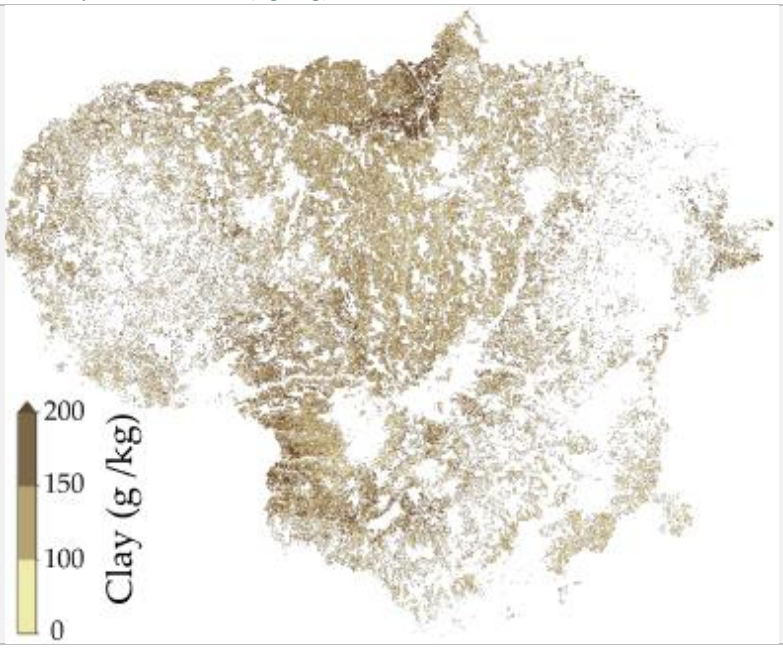
TOOL DESCRIPTION

Tool #1	**Land degradation**
Description	Land degradation is a monitoring system for specific (climate risk indicators) soil spatial explicit indicators. The tool could offer various geospatial outputs of soil erosion, SOC and soil texture, thus providing valuable information for decision-making and planning supporting the actual actors involved.
Type	GeoTiff, shp.
Technologies	Open Data Cube, ArcGIS.
API	Yes / No
Output / Indicators	Indicator #1 – Soil organic Carbon (SOC) Indicator #2 – Soil texture (sand, silt, clay %) Indicator #3 – Soil erosion
Update	Automatic / manual + frequency on demand
Tools used to produce indicators	Python and Google Earth Engine scripts
Developments needed	Ready to use in local Greek environment by using soil samples gathered locally; needs in situ measures for being calibrated in other environments; possibility to be applicable to other environment and results made available in a Terranis ArcGis server to be assessed.
Metadata available	Yes
GeoNetwork compatibility	No

INDICATORS DESCRIPTION

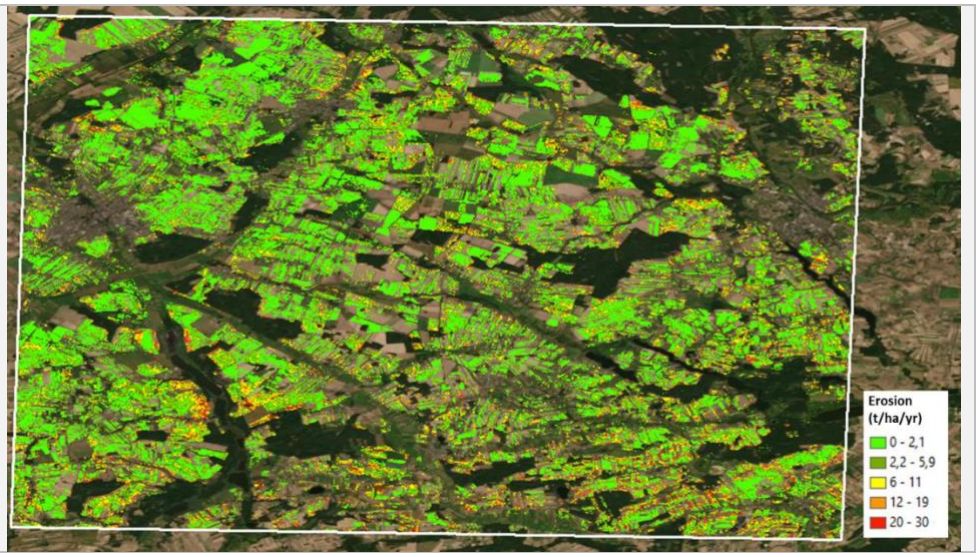
Indicator #1	**Soil Organic Carbon (SOC)**
Description	Map of topsoil SOC content in croplands generated from multi-annual Copernicus multi-spectral data via digital soil mapping approaches.
Input data	Data #1.1 – Sentinel-2 multi-temporal data (3 years) Data #1.2 – Reference in situ SOC values in the area
Spatial resolution	10 m
Frequency	Annual product
Output / unit	Cloud-optimized GeoTiff (dg C / kg)
Example of representation	

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Indicator #2	**Soil texture**
Description	Maps of topsoil soil texture (sand, silt, clay %) developed from multi-annual Copernicus multi-spectral data via digital soil mapping approaches.
Input data	Data #1.1 – Sentinel-2 multi-temporal data (3 years) Data #1.2 – Reference in situ Clay values in the area
Spatial resolution	10 m
Frequency	Annual product
Output / unit	Cloud-optimized GeoTiff (dg / kg)
Example of representation	

Indicator #3	**Soil Erosion**
Description	Soil erosion map for cropland and woodland areas generated with the RUSLE equation.
Input data	Data #1.1 - Sentinel-2 multi-temporal data Data #3.1 - MODIS multi-temporal data Data #3.2 - EU-DEM v1.1 Data #3.3 - OpenLandMap Percipitation Monthly Data #3.4 - ESA WorldCover Data #3.5 - European Support Practices factor (P-factor)
Spatial resolution	10 m for croplands, 250 m for woodlands
Frequency	Annual product
Output / unit	Cloud-optimized GeoTiff / (ton/ha/yr)

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Example of representation	

DATA DESCRIPTION

Data #1.1	**Sentinel-2 multi-temporal data**
Description	Earth observation data from satellite constellation of Copernicus
Spatial coverage	World
Spatial resolution	10 m / 20 m / 60 m
Format	Raster JPEG2000
Time period	Since late 2017
Temporal resolution	3 to 5 days
Source	ESA / Copernicus
Open Data	Yes

Data #1.2	**Reference in situ soil data**
Description	Point data with reference SOC and soil texture (sand, silt, clay) values. The soil properties area measured analytically in a chemical laboratory from the soil samples collected from the area. For VALORADA, a total number of 120 samples successfully collected (40 from croplands and 80 from woodlands).
Spatial coverage	Extent of area to be mapped, spanning part of Northern Evia, Greece
Spatial resolution	N/A
Format	CSV file, .shp file, GeoJSON, etc.
Time period	2023
Temporal resolution	On demand
Source	AUTh
Open Data	No

Data #1.2	**Land Use and Coverage Area frame Survey (LUCAS)**
Description	Topsoil point
Spatial coverage	European
Spatial resolution	Point
Format	CSV file, .shp file.
Time period	2009, 2015, 2018
Temporal resolution	Every 3 years
Source	EUROSTAT
Open Data	Yes, under request

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Data #3.1	MODIS multi-temporal data
Description	Earth Observation data from NASA's MODIS satellite
Spatial coverage	World
Spatial resolution	250 m / 500m / 1000m
Format	Raster GeoTiff
Time period	Since 1999
Temporal resolution	16 days
Source	NASA
Open Data	Yes

Data #3.2	EU-DEM v1.1
Description	Digital Elevation Model
Spatial coverage	Pan-European
Spatial resolution	25 m
Format	Raster
Time period	Since 2016
Temporal resolution	3 years
Source	ESA / Copernicus
Open Data	Yes

Data #3.3	OpenLandMap Percipitation Monthly
Description	Monthly precipitation based on SM2RAIN-ASCAT 2007-2018, IMERG, CHELSA Climate, and WorldClim.
Spatial coverage	World
Spatial resolution	1 km
Format	Raster
Time period	Since 1980
Temporal resolution	Annual
Source	OpenGeoHUB
Open Data	Yes

Data #3.4	ESA WorldCover
Description	Land use and land cover maps
Spatial coverage	World
Spatial resolution	10 m
Format	Raster Geotiff
Time period	Since 2020
Temporal resolution	Annual
Source	ESA
Open Data	Yes

Data #3.5	European Support Practices factor (P-factor)
Description	European map for support practice factor (P-factor)
Spatial coverage	European

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Spatial resolution	100 m
Format	Raster Geotiff
Time period	Since 2015
Temporal resolution	Only for 2015
Source	ESDAC
Open Data	Yes under request

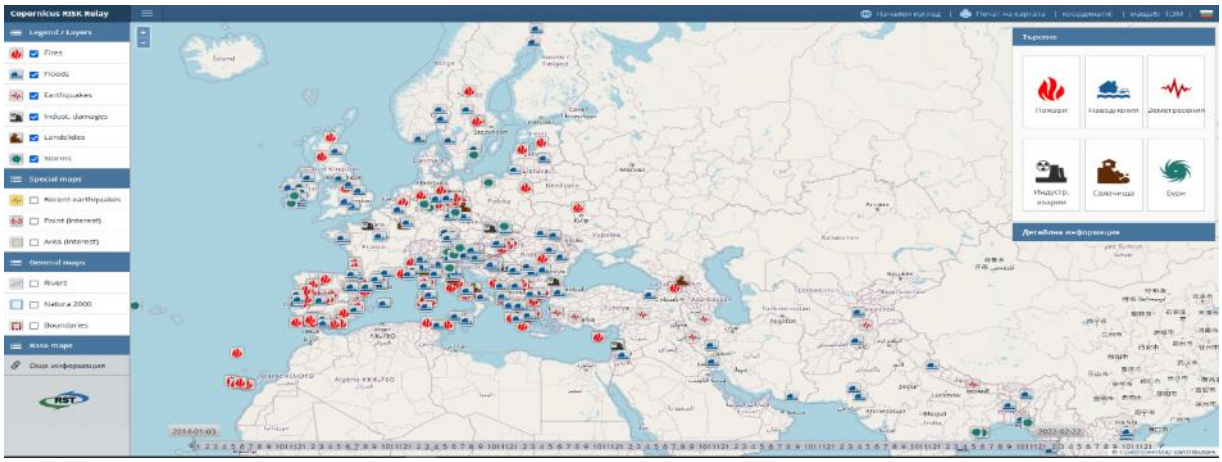
The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

5. TAKT-IKI's tools

5.1 Tool #1 : Copernicus Risk Relay WebPortal

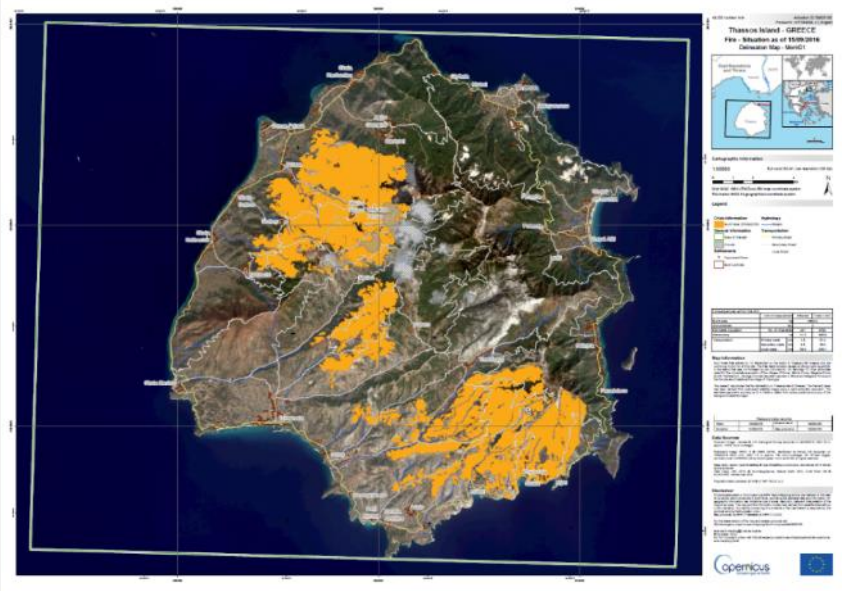
TOOL DESCRIPTION

Tool #1	COPERNICUS RISK RELAY WEBPORTAL
Description	The Web Portal provides different types of access (depending on the users) to view, reference and print geospatial and attribute information on events related to crises, disasters and accidents. The Copernicus Risk Relay is a web portal developed, in order to make it easy for the users to browse and view data from the Copernicus EMS, especially the Rapid Mapping service. It updates the list every day to check for new events and adds them to the database. Information from other sources of data, can be integrated and visualised it in the form of WFS/WMS layers or mapped disasters from other sources.
Type	Web Platform
Technologies	Geoserver / Geospatial database (PostgreSQL / PostGIS) / Webserver
API	Yes / ~~No~~
Output / Indicators	Indicator #1 – Fires Indicator #2 – Floods Indicator #3 – Earthquakes Indicator #4 – Industrial damages Indicator #5 – Landslides Indicator #6 – Storms
Update	Automatic / manual + frequency on demand
Tools used to produce indicators	Python scripts
Developments needed	Ready to use in Bulgaria, by using local data sets; further indicators to be implemented (Fire risks and others as resulting from WP2); possibility to be transferred in another WEB portal provided by Terranis under assessment
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes / ~~No~~



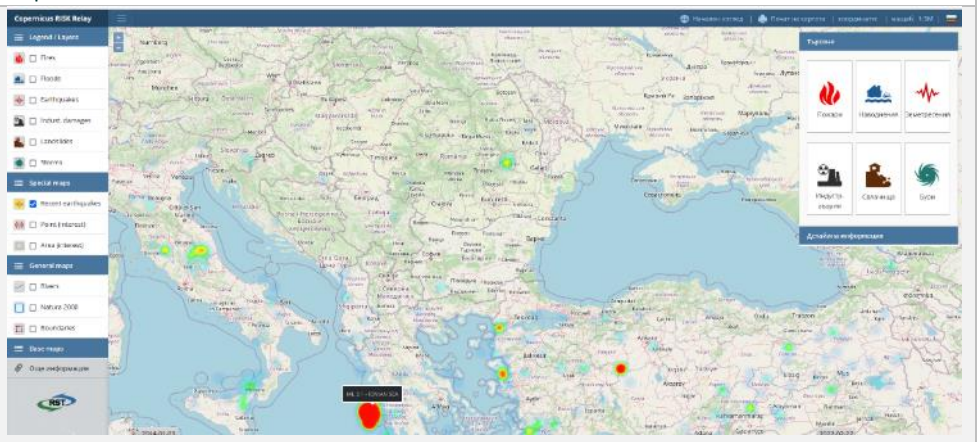
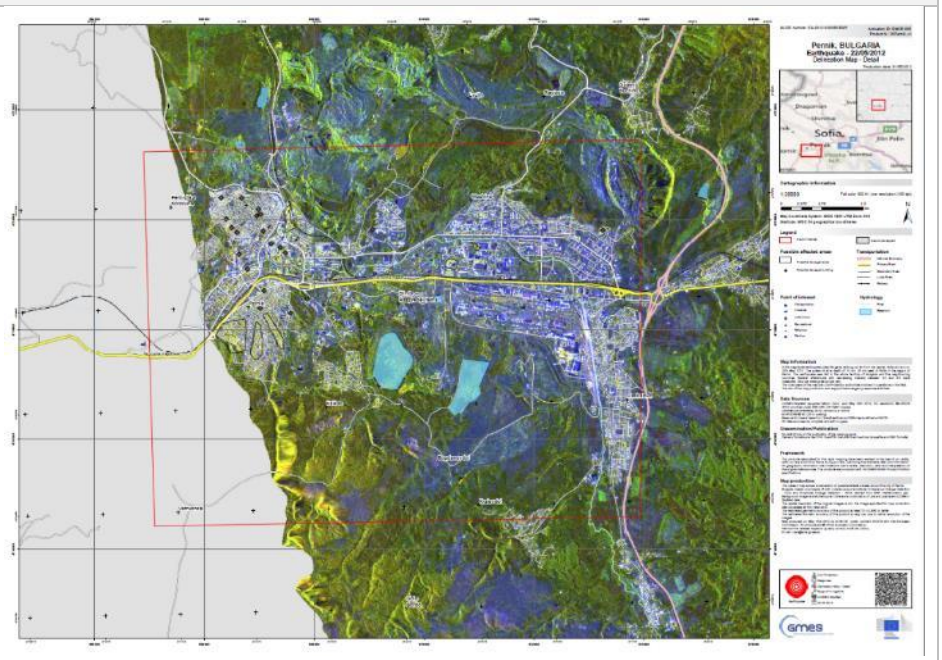
The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

INDICATORS DESCRIPTION

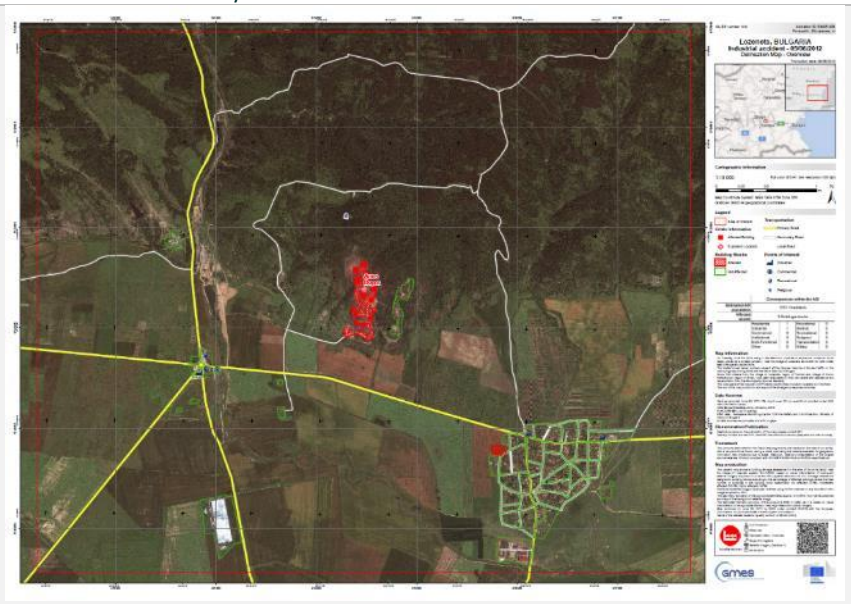
Indicator #1	**Fires**
Description	Provides information for emergency response in relation to fires.
Input data	EMS
Spatial resolution	Depends on the satellite data used
Frequency	Depends on the activation in the EMS
Output / unit	Consequence and damage assessment maps provide relevant and up-to-date thematic information immediately after the crisis event.
Example of representation	

Indicator #2	**Floods**
Description	Provides information for emergency response in relation to floods.
Input data	EMS/ On demand mapping
Spatial resolution	Depends on the satellite data used form EMS/ HR, VRH images
Frequency	Depends on the activation in the EMS
Output / unit	Consequence and damage assessment maps provide relevant and up-to-date thematic information immediately after the crisis event.
Example of representation	

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Indicator #3	**Earthquakes**
Description	Provides information for emergency response in relation to earthquakes.
Input data	EMS for activation, Live information for recent earthquakes
Spatial resolution	Depends on the satellite data used
Frequency	Depends on the activation in the EMS
Output / unit	Depends on the activation in the EMS
Example of representation	
	

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Indicator #4	**Industrial damages**
Description	Provides information for emergency response in relation to industrial damages.
Input data	EMS
Spatial resolution	Depends on the satellite data used
Frequency	Depends on the activation in the EMS
Output / unit	Consequence and damage assessment maps provide relevant and up-to-date thematic information immediately after the crisis event.
Example of representation	

Indicator #5	**Landslides**
Description	Provides information for emergency response in relation to landslides.
Input data	EMS
Spatial resolution	Depends on the satellite data used
Frequency	Depends on the activation in the EMS
Output / unit	Consequence and damage assessment maps provide relevant and up-to-date thematic information immediately after the crisis event.
Example of representation	

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Indicator #6	**Storms**
Description	Provides information for emergency response in relation to storms.
Input data	EMS
Spatial resolution	Depends on the satellite data used
Frequency	Depends on the activation in the EMS
Output / unit	Consequence and damage assessment maps provide relevant and up-to-date thematic information immediately after the crisis event.
Example of representation	

Indicator #7	**Fire risk – *to be developed for VALORADA project***
Description	Provides information for drought and fire risk
Input data	EMS, European Forest Fire Information System
Spatial resolution	Depends on the satellite data used
Frequency	Depends on the activation in the EMS
Output / unit	Fire danger assessment, maps of fire danger, fire danger index
Example of representation	-

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DATA DESCRIPTION

Data #1.1	**Maps of the crisis events**
Description	Consequence and damage assessment maps provide relevant and up-to-date thematic information immediately after the crisis event.
Spatial coverage	Depends on the satellite data used
Spatial resolution	Depends on the satellite data used
Format	PDF
Time period	Depends on the activation in the EMS
Temporal resolution	Depends on the satellite data used
Source	EMS
Open Data	Yes /~~No~~

Data #1.2	**Geospatial data for the crisis events**
Description	Vector layers and a tabular files (with metadata) for the crisis event.
Spatial coverage	Depends on the satellite data used
Spatial resolution	Depends on the satellite data used
Format	Shapefiles, tabular
Time period	Depends on the activation in the EMS
Temporal resolution	-
Source	EMS
Open Data	Yes / ~~No~~

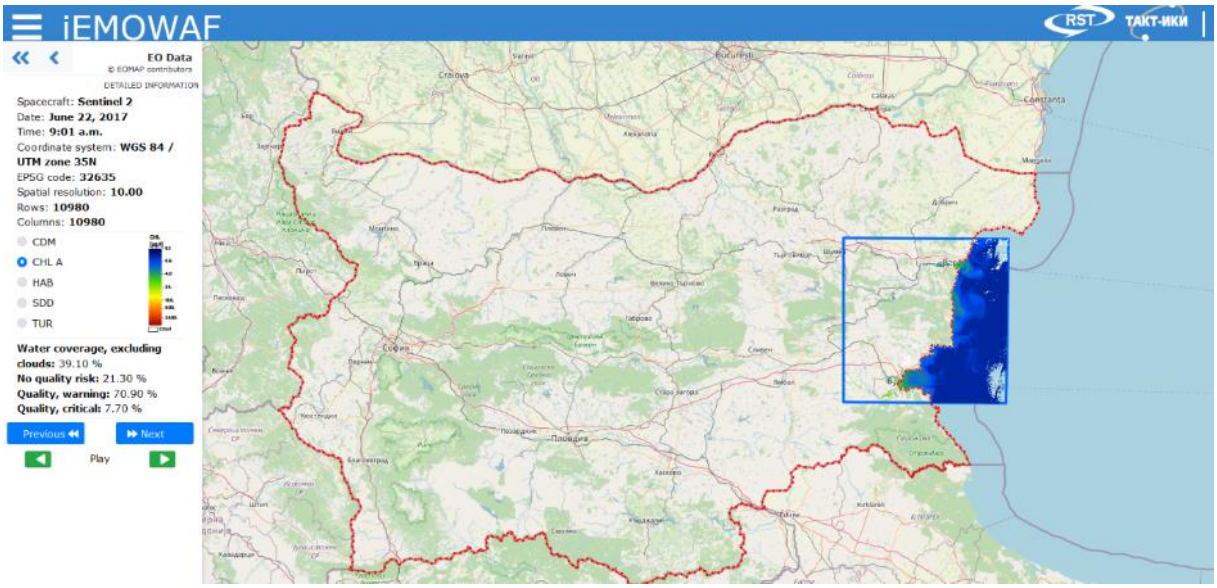
Data #1.2	**Geospatial data for the crisis events**
Description	Vector layers and a tabular files (with metadata) for the crisis event.
Spatial coverage	Depends on the satellite data used
Spatial resolution	Depends on the satellite data used
Format	WMS,
Time period	Depends on the activation in the EMS
Temporal resolution	-
Source	EMS
Open Data	Yes / ~~No~~

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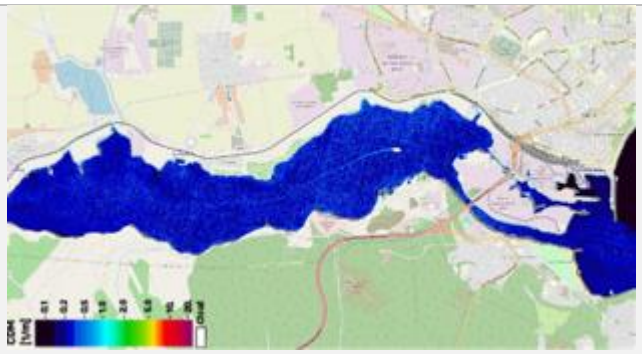
5.2 Tool #2 : EMOWAF Webportal

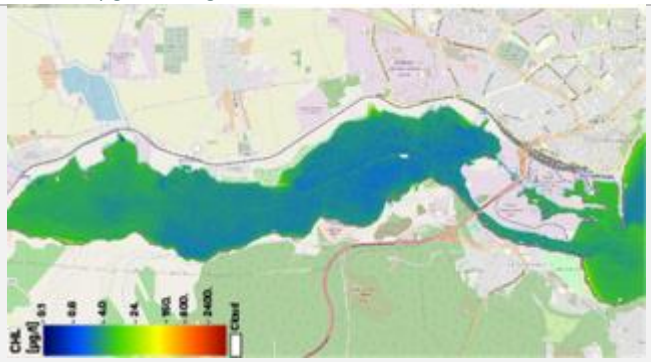
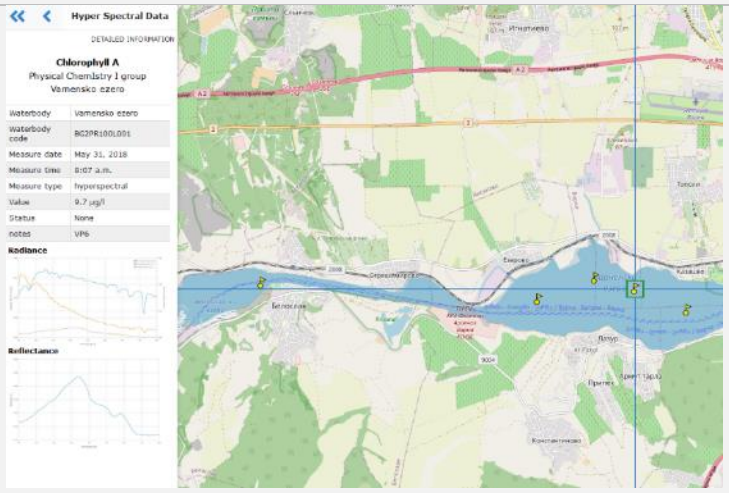
TOOL DESCRIPTION

Tool #2	EMOWAF Webportal
Description	EMOWAF is a service provider platform (PasS) supporting water quality monitoring, environmental monitoring and coastal protection. It is the first operational platform in Bulgaria which offer EO data and services on the market and the first service usage of Sentinel data in Bulgaria for water quality monitoring. It integrates and visualise EO, in situ and hyperspectral in situ data for the water quality of the Bulgarian water bodies.
Type	Web Platform
Technologies	Geoserver / Geospatial database (PostgreSQL / PostGIS) / Webserver , Django Framework
API	Yes / ~~No~~
Output / Indicators	Indicator #1 – CDM Indicator #2 – CHL A Indicator #3 – HAB Indicator #4 – SSD Indicator #5 – TUR Indicator #6 – Waterbody status
Update	Automatic / manual + frequency on demand
Tools used to produce indicators	Python scripts
Developments needed	Ready to use in Bulgaria cases; application to other environments to be assessed (in particular Molisa)
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes /~~No~~

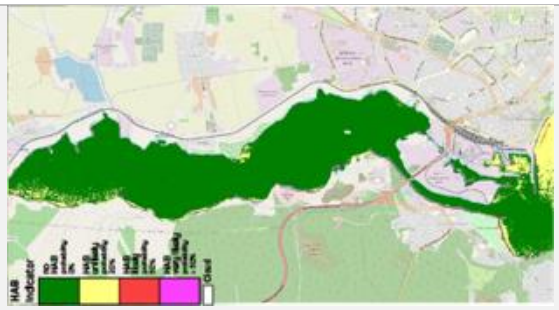


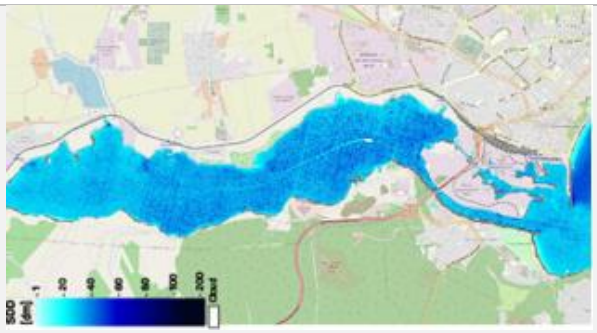
INDICATORS DESCRIPTION

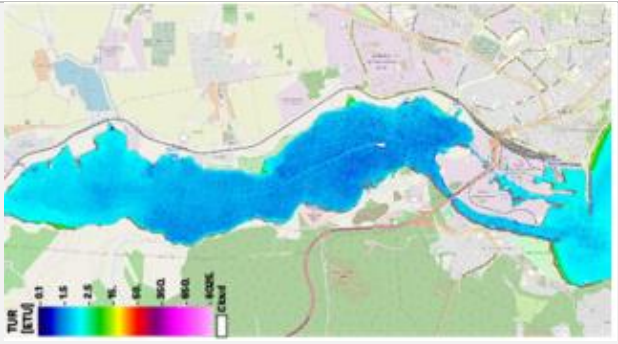
Indicator #1	**CDM**
Description	Colored dissolved organic absorption comprise all dissolved organic matter which influence the water colour.
Input data	Sentinel2/Landsat8
Spatial resolution	10m/30m
Frequency	2 days
Output / unit	Geotiff, [1/m]
Example of representation	

Indicator #2	**CHL A**
Description	Chlorophyll a is one essential pigment included in phytoplankton cells and therefore a measure of phytoplankton.
Input data	Sentinel2/Landsat8 / hyperspectral in situ measurements
Spatial resolution	10m/30m
Frequency	2 days
Output / unit	Geotiff , [µg/IJ or [mg/m3]
Example of representation	
	

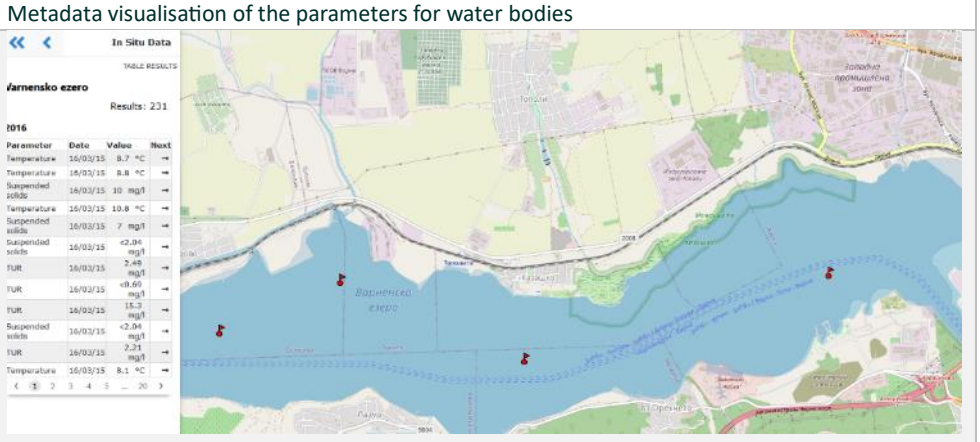
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Indicator #3	**HAB**
Description	Harmful Algae Blooms detects areas likely affected by harmful algae blooms formed by cyanobacteria containing phycocyanin as pigment
Input data	Sentinel2/Landsat8
Spatial resolution	10m/30m
Frequency	2 days
Output / unit	Geotiff, No unit.
Example of representation	

Indicator #4	**SDD**
Description	Secchi Depth or transparency indicates the clarity in the water column.
Input data	Sentinel2/Landsat8 / hyperspectral in situ measurements
Spatial resolution	10m/30m
Frequency	2 days
Output / unit	Geotiff, [m]
Example of representation	

Indicator #5	**TUR**
Description	Turbidity is derived from the scattering caused by suspended particles in water
Input data	Sentinel2/Landsat8
Spatial resolution	10m/30m
Frequency	2 days
Output / unit	Geotiff, NTU
Example of representation	

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Indicator #6	Waterbody status
Description	Data from in situ measurements of the physical and chemical parameters in the points of the network of Bulgarian Basin directorates
Input data	National Executive Environmental Agency, Bulgarian Ministry of Ecology and Environmental Protection
Spatial resolution	-
Frequency	1-4 times a year
Output / unit	Metadata visualisation of the parameters for water bodies
Example of representation	

DATA DESCRIPTION

Data #1.1	Landsat-8 satellite data
Description	Earth observation data from satellites developed under a joint program between the USGS and NASA. Landsat-8 captures images of the Earth's surface with an optical resolution of 30 meters, every 16 days, using multispectral and thermal instruments.
Spatial coverage	World
Spatial resolution	30m
Format	Raster, GeoTiff
Time period	Since 2013
Temporal resolution	16 days
Source	NASA
Open Data	Yes / No

Data #1.2	Sentinel-2 satellite data
Description	The Copernicus SENTINEL-2 mission comprises a constellation of two polar-orbiting satellites placed in the same sun-synchronous orbit, phased at 180° to each other. It aims at monitoring variability in land surface conditions, and its wide swath width (290 km) and high revisit time (10 days at the equator with one satellite, and 5 days with 2 satellites under cloud-free conditions which results in 2-3 days at mid-latitudes) will support monitoring of Earth's surface changes.
Spatial coverage	World
Spatial resolution	10m
Format	Raster, GeoTiff
Time period	2015
Temporal resolution	2-3 days
Source	ESA
Open Data	Yes / No

The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

Data #1.3	**In situ data from Bulgarian Basin Directorate**
Description	Data from in situ measurements in the points of the network of Bulgarian Basin directorates
Spatial coverage	Lakes in Bulgaria, in accordance with the Ordinance for water quality monitoring
Spatial resolution	-
Format	metadata
Time period	2016-2018
Temporal resolution	1-4 times a year
Source	National Executive Environmental Agency, Bulgarian Ministry of Ecology and Environmental Protection
Open Data	Yes / ~~No~~

Data #1.4	**Hyperspectral reflectance data**
Description	Hyperspectral data collected with handheld field hyperspectral instrument, providing information for the water quality parameters for water bodies in Bulgaria.
Spatial coverage	Selected lakes in Bulgaria
Spatial resolution	-
Format	metadata
Time period	2018
Temporal resolution	-
Source	**TAKT-IKI**
Open Data	~~Yes /~~ No

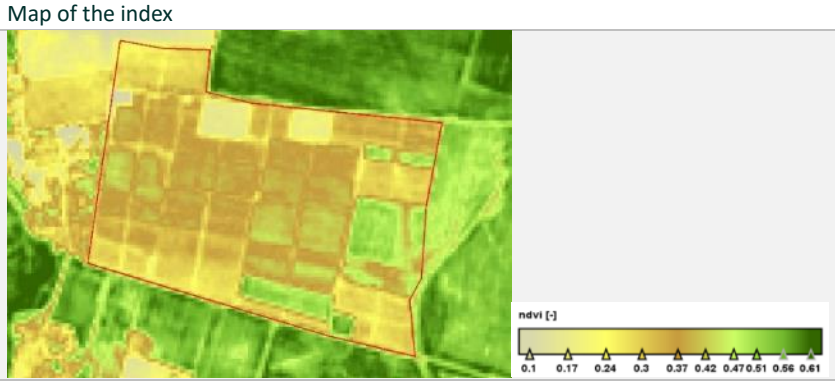
The project has received funding from the Horizon Europe Framework Programme under grant agreement No 101112837

5.3 Tool #3 : SmartAgri (draft version)

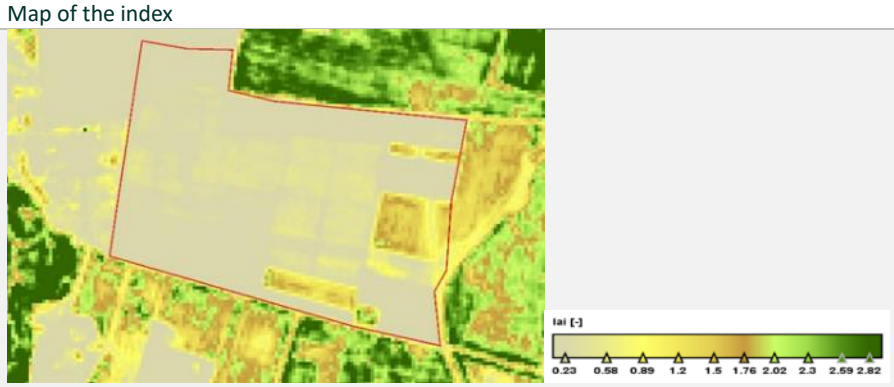
TOOL DESCRIPTION

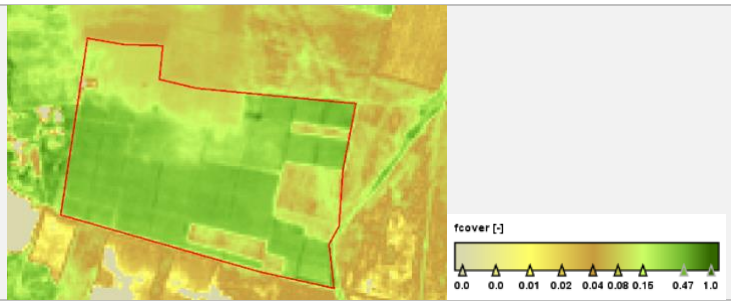
Tool #3	**SmartAgri**
Description	Wep platform integrating data from satellite and UAV to provide land use and land change information to the users. Vegetation indices are used to assess the status of the crops.
Type	Web Platform
Technologies	Geoserver / Geospatial database (PostgreSQL / PostGIS) / Webserver
API	Yes / ~~No~~
Output / Indicators	Outputs are under developments: Indicator #1 – NDVI Indicator #2 – LAI Indicator #3 – fcover Indicator #4 – FAPAR
Update	Automatic / manual + frequency on demand
Tools used to produce indicators	Python scripts
Developments needed	Under development in the frame of the National Research Programme “Smart Crop Production”, funded by the Bulgarian Ministry of Education and Science. Possibility to be interconnected with the Pixagri Territories tool of Terranis under assessment.
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes /~~ No~~

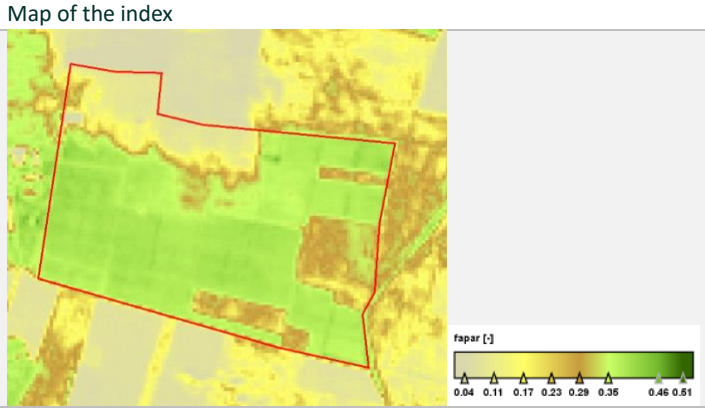
INDICATORS DESCRIPTION

Indicator #1	NDVI
Description	Normalized Difference Vegetation Index
Input data	Sentinel2
Spatial resolution	10m
Frequency	2-3 days
Output / unit	Map of the index
Example of representation	

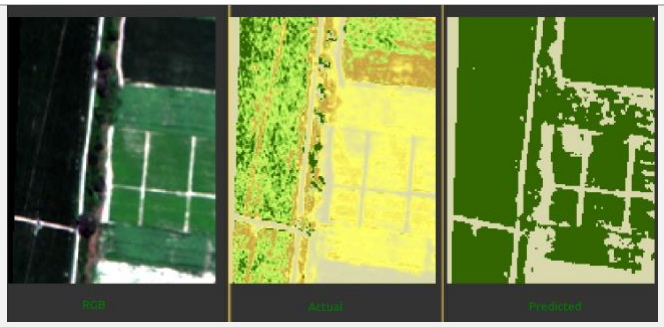
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Indicator #2	LAI
Description	Leaf Area Index
Input data	Sentinel2
Spatial resolution	10m
Frequency	2-3 days
Output / unit	Map of the index
Example of representation	

Indicator #3	**fCover**
Description	Sentinel2
Input data	10m
Spatial resolution	2-3 days
Frequency	Map of the index
Output / unit	Sentinel2
Example of representation	

Indicator #4	**FAPAR**
Description	Fraction of Absorbed Photosynthetically Active Radiation
Input data	Sentinel2
Spatial resolution	10m
Frequency	2-3 days
Output / unit	Map of the index
Example of representation	

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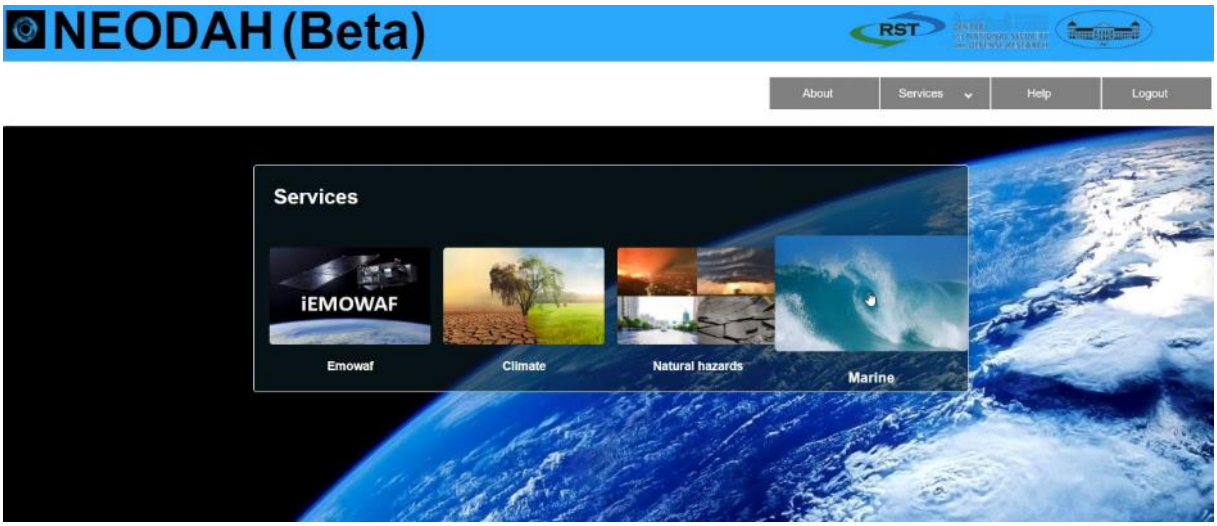
Indicator #5	**LAI - VHR**
Description	Downscaling biophysical products from CLMS – LAI, using ML techniques and VHR satellite data to enhance the spatial resolution of the index and predict the values.
Input data	Sentinel2, CLMS, VHR satellite data
Spatial resolution	VHR
Frequency	2-3 days
Output / unit	Map of the index
Example of representation	

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5.4 Tool #4 : NEODAH

TOOL DESCRIPTION

Tool #3	NEODAH (National EO Data Application Hub)
Description	Aims to develop an EO hub which will be able to showcase several thematic use cases. These shall be achieved by developing and delivering a customised set of EO-based information services that utilise cloud computing-based processing resources and high-through put computing capabilities and fusion of large volumes of EO data from the Sentinel missions and other European EO missions with HR and VHR. Integration with non-EO data is also foreseen as an essential component, including the opportunity to exploit the potentiation for innovative service delivery (or new data access, processing and management solutions).
Type	Web Platform
Technologies	Geoserver / Geospatial database (PostgreSQL / PostGIS) / Webserver/ Django/Angular
API	Yes / ~~No~~
Output / Indicators	Outputs are under developments: Indicator #1 – Climate Indicator #2 – Marine Indicator #3 – Water Quality Monitoring Indicator #4 – Natural Hazards Indicator #5 – Land
Update	Automatic / manual + frequency on demand
Tools used to produce indicators	Python scripts
Developments needed	Under development for the national Bulgarian authorities
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes / ~~No~~



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6. TerraSpatium's tools

6.1 Tool #1 : TerraCoast

TOOL DESCRIPTION

Tool #1	**TerraCoast**
Description	TerraCoast is a tool dedicated on microtidal coastline monitoring that combines different indicators, aiming at providing a multitemporal retrospective - can cover past 25 years- operational picture for coastal managers. Tool is addressing Regions, Municipalities, Natura2000 managers, Coastal Observatories, and Insurance companies.
Type	Thematic Layers (in vector and raster formats)
Technologies	Erdas Imagine, ArcGIS online
API	~~Yes~~ / No
Output / Indicators	Indicator #1 – Waterline (WL) Indicator #2 – Coastal vegetation boundary (CVB) Indicator #3 – Beach width (BW) Indicator #4 – Waterline Changes (WLC) Indicator #5 – Coastal Erosion Hazard (CEH) Indicator #6 – Sea Level Rise Impact (SLRI)
Update	Automatic / manual + frequency on demand
Tools used to produce indicators	Erdas Imagine Model Builder
Developments needed	Ready to use in Greece; adaptations to Occitanie and to Molisa environments to be assessed pending on available inputs data. Transfer to Arcgis pro server under assessment for indicators generation.
Metadata available	Yes / ~~No~~
GeoNetwork compatibility	Yes / ~~No~~

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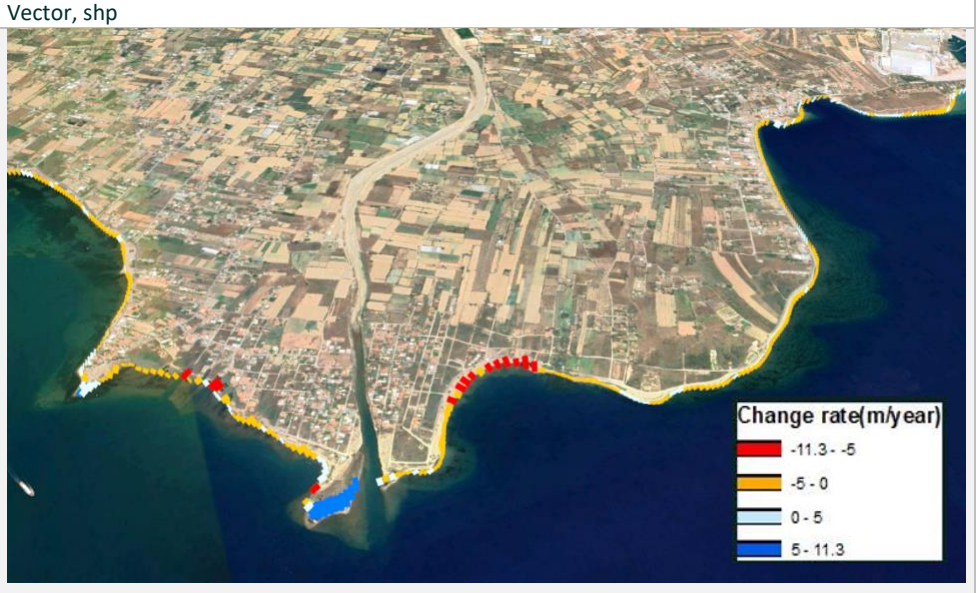
INDICATORS DESCRIPTION

Indicator #1	**Waterline (WL)**
Description	Waterline is the line between sea and land, or else the sea/land interface.
Input data	Data #1.1 - Landsat-5 satellite data Data #1.2 - Landsat-8 satellite data Data #1.3 - Sentinel-2 satellite data
Spatial resolution	30m, 15m and 10m
Frequency	Yearly
Output / unit	Vector, shp
Example of representation	

Indicator #2	**Coastal vegetation boundary (CVB)**
Description	Costal vegetation boundary is the limit between land and coastal vegetation. This indicator plays a critical role in the deterioration (or not) of coastal habitats.
Input data	Data #1.1 - Landsat-5 satellite data Data #1.2 - Landsat-8 satellite data Data #1.3 - Sentinel-2 satellite data
Spatial resolution	30m, 15m and 10m
Frequency	Every 3-5 years
Output / unit	Vector, shp
Example of representation	

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Indicator #3	**Beach width (BW)**
Description	Beach width indicator is the indicator that depicts a zone between the waterline and the upper beach limit (upper boundary) which is most of the times fixed between different periods.
Input data	Data #1.1 - Landsat-5 satellite data Data #1.2 - Landsat-8 satellite data Data #1.3 - Sentinel-2 satellite data Data #1.4 - Upper boundary of the beach
Spatial resolution	30m, 15m and 10m
Frequency	Every 3-5 years
Output / unit	Vector, shp / meters
Example of representation	

Indicator #4	**Waterline Changes (WLC)**
Description	It is the indicator that reflects the change of the waterline position between different periods, and thus characterize the change on the coastline as erosion or accretion.
Input data	Indicator #1 for a full set of time-series
Spatial resolution	30m, 15m and 10m
Frequency	It depends on the time-step of input data/indicator #1
Output / unit	Vector, shp
Example of representation	

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Indicator #5	**Coastal Erosion Hazard (CEH)**
Description	It is the indicator that assess coastal vulnerability to sea level rise, due to erosion and/or inundation. It uses as variables: Geomorphology, coastal slope, shoreline changes (indicator#4 Waterline changes), beach width (indicator#3 Beach width), relative sea level rate, mean significant wave height, mean tidal range, vegetation boundary (indicator#2 Coastal vegetation boundary).
Input data	Geomorphology, coastal slope, shoreline changes (indicator#4 Waterline changes), beach width (indicator#3 Beach width), relative sea level rate, mean significant wave height, mean tidal range, vegetation boundary (indicator#2 Coastal vegetation boundary). For producing coastal slope, a Digital Elevation Model over the area of interest is needed.
Spatial resolution	10m
Frequency	It depends on the time-step of input data
Output / unit	Vector, shp

Indicator #6	**Sea Level Rise Impact (SLRI)**
Description	It is the indicator that reflects the loss of land due to the sea level rise future projections. It uses different scenarios for sea level rise.
Input data	Indicator #1 Waterline for the most recent year, future projections of the sea level rise. A Digital Elevation Model over the area of interest is needed.
Spatial resolution	10m
Frequency	It depends on the time-step of input data
Output / unit	Vector, shp

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DATA DESCRIPTION

Data #1.1	**Landsat-5 satellite data**
Description	Earth observation data from satellites developed under a joint program between the USGS and NASA.
Spatial coverage	World-wide
Spatial resolution	30m
Format	Raster, GeoTiff
Time period	1995-2013
Temporal resolution	16 days
Source	NASA
Open Data	Yes / ~~No~~

Data #1.2	**Landsat-8 satellite data**
Description	Earth observation data from satellites developed under a joint program between the USGS and NASA.
Spatial coverage	World-wide
Spatial resolution	15m
Format	Raster, GeoTiff
Time period	Since 2013-today
Temporal resolution	16 days
Source	NASA
Open Data	Yes / ~~No~~

Data #1.3	**Sentinel-2 satellite data**
Description	Earth observation data from satellites developed under the Copernicus EU Program
Spatial coverage	World-wide
Spatial resolution	10m
Format	Raster, GeoTiff
Time period	Since 2015-today
Temporal resolution	7 days
Source	EU – Copernicus Program
Open Data	Yes / ~~No~~

Data #1.4	**Upper boundary of the beach**
Description	It is the fixed (usually) upper boundary of a microtidal sandy beach. It is derived by line extraction from existing large scale ortho-imagery open for the Greek territory.
Spatial coverage	Over Greece
Spatial resolution	5m
Format	Vector, shp
Time period	For 1998, 2009 and 2015
Temporal resolution	For 1998, 2009 and 2015
Source	Open Greek data
Open Data	~~Yes~~ / No

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7. Next steps and future developments

As said in the previous sections, the tools described hereabove will be used for the first demonstration phase with the objective of getting first feedbacks from the local institutional stakeholders.

The following steps will be undertaken in the next phases:

- Assessment of the set of indicators definition, as resulting from WP2 Tasks, and of the possibility to implement it in the current tools,
- Setting up of a consistent project catalogue description, gathering all the data sets used by the different tools in the demonstration cases. The software implementation of these catalogues will however be kept at local GeoNetwork levels to facilitate its updating and the integration with the tools,
- Assessment of the possibility of using some tools in more demonstration cases in the second phase of demonstration, and implementation of these collaboration schemes between the various service providers involved in the project. This assessment will take into account the availability of all inputs data necessary for the tools to be run.
- Development of adaptations for some tools as made necessary to achieve the steps identified above.
- Preparation of the second demonstration phase, to be started in June 2025 to test all these modifications.

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