

e-geos

AN ASI / TELESPAZIO COMPANY

UN-SPACE 19TH OPEN SESSION

**EARTH OBSERVATION AND INTEGRATED APPLICATIONS FOR DISASTER
RISK MANAGEMENT AND SUSTAINABLE DEVELOPMENT**

**SESSION: EARTH OBSERVATION AND SPACE INTEGRATED APPLICATION
FOR SUSTAINABLE DEVELOPMENT**

CASE STUDIES

United Nations Global Service Center – UNDISC

19th October 2023 - Brindisi, Italy





Geoinformation.

TELESPAZIO + **e-geos** + **GAFAG**
a LEONARDO and THALES company AN ASI / TELESPAZIO COMPANY an e-GEOS (ASI / Telespazio) Company

600+ 50% in Italy, 50% ROW **120M €** Revenues

Partners e-GEOS

- IBF Servizi**
- Precision Farming Jolanda di Savoia Consorzio Tern**
- Local Services Basilicata EarthLAB**
- Digital Systems & downstream - Luxembourg**

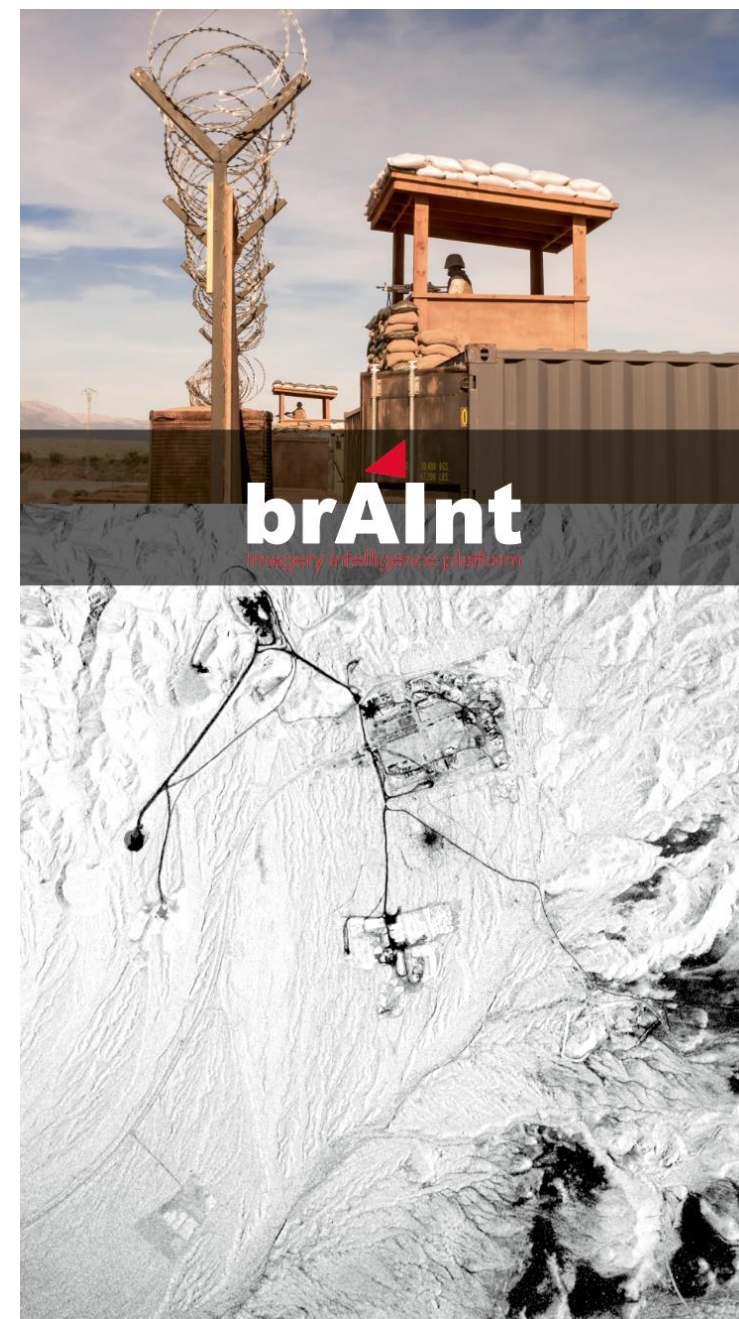
Digital Solutions for Vertical Services



The online marketplace to access geo information Analytics & Geoinformation Digital Service, driving the e-GEOS digital transformation process of its portfolio



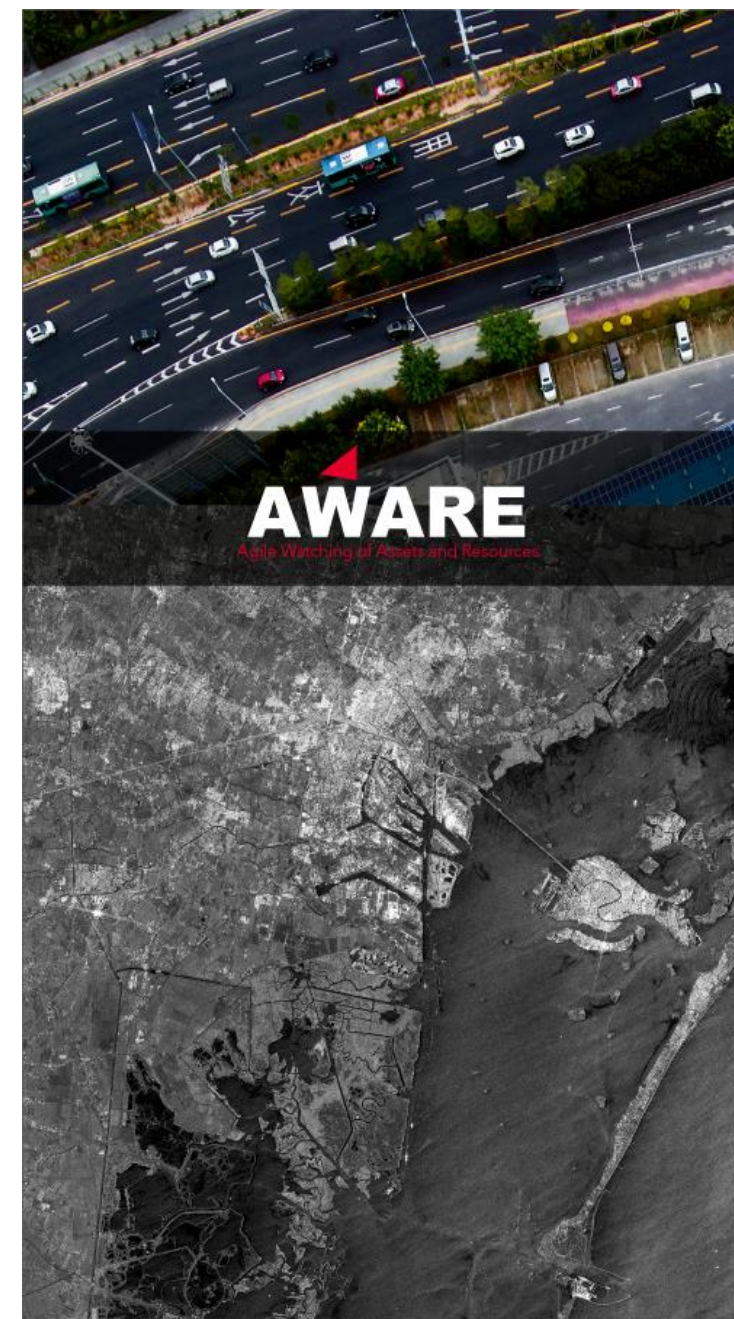
MARITIME SURVEILLANCE



DEFENCE AND INTELLIGENCE



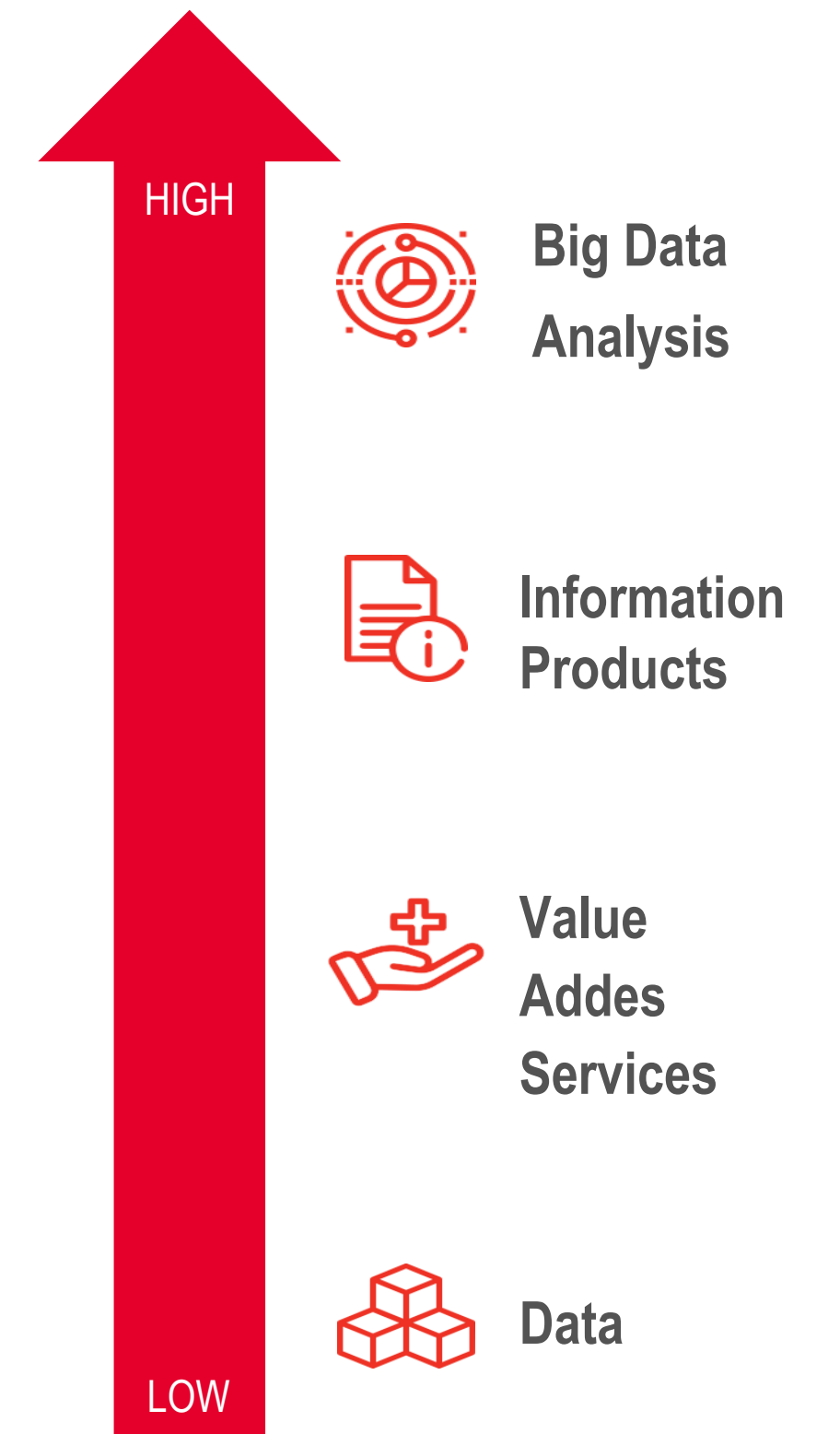
AGRICULTURE MANAGEMENT



ASSET MANAGEMENT



EMERGENCY MANAGEMENT



COSMO-SkyMed

e-GEOS is the exclusive commercial worldwide distributor of COSMO-SkyMed

We are **COSMO-SkyMed** constellation exclusive commercial worldwide distributor **COSMO SECOND GENERATION & AI**

3 COSMO-SkyMed + 2 COSMO Second Generation

+ 2 under construction

The COSMO-SkyMed First and Second Generation is a long-term constellation of 5 radar EO satellites, plus 2 already financed and in construction (next satellite launch beginning 2025)

Synthetic Aperture Satellites Radar

1500+

Stripmap per day

300+

Spotlight per day

1800

Scenes per day



Large area coverage
at global scale



Left/Right
Looking



Fastest
Revisit Time



All weather
Day/Night



Outline

1. Overview: EO-based services for sustainability
2. Use cases
 - 2.1 ESA – Global Development Assistance – Fragility, Conflict and Security
 - 2.2 Copernicus EMS Risk and Recovery – Ishkashim (Afghanistan)
 - 2.3 Copernicus Evolution H2021 – CENTAUR
3. Conclusions

1. Overview: EO-based services for sustainability



e-GEOS services in agriculture are based on the **continuous extraction of information and analytics over each agricultural plot**, allowing to manage the production, guarantee food security, maintain fair price levels, a more sustainable usage of the land resources, support the reduction of water and chemicals usage, maintaining or improving land and soil quality, supporting sustainability and environment preservation.

e-GEOS provides, through its AWARE platform, a wide range of solutions for developing resilient sustainable infrastructures.

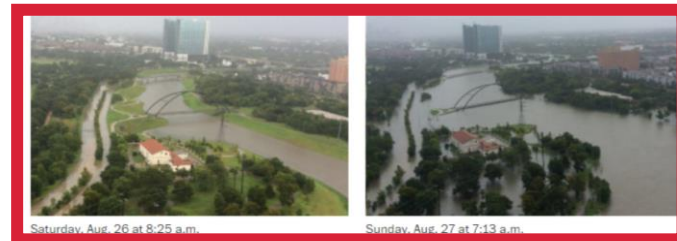
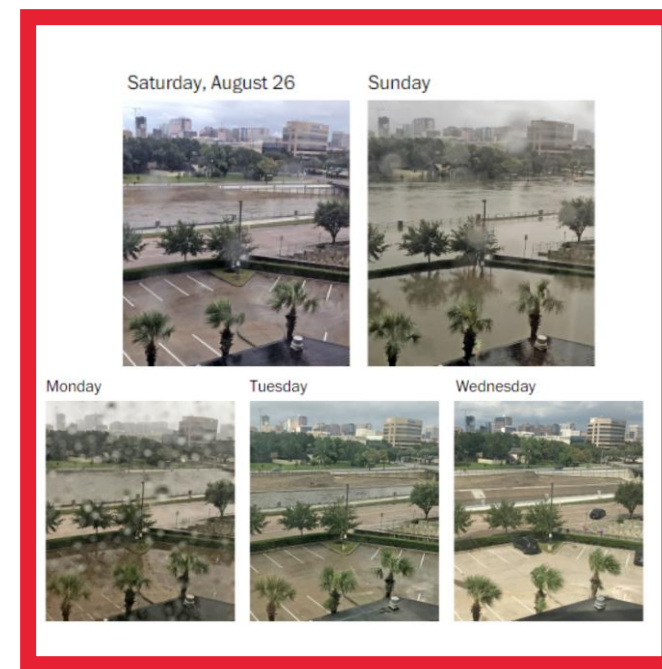
Services support the whole lifecycle of infrastructures:

- **Planning: three dimensional descriptions** of the territory and displacement analysis for sites selection.
- **Construction: monitoring activities** and their impact on the surrounding environment.
- **Management: monitor infrastructure resilience.**

1. Overview: EO-based services for sustainability



Goal 11: make cities inclusive, safe, resilient and sustainable

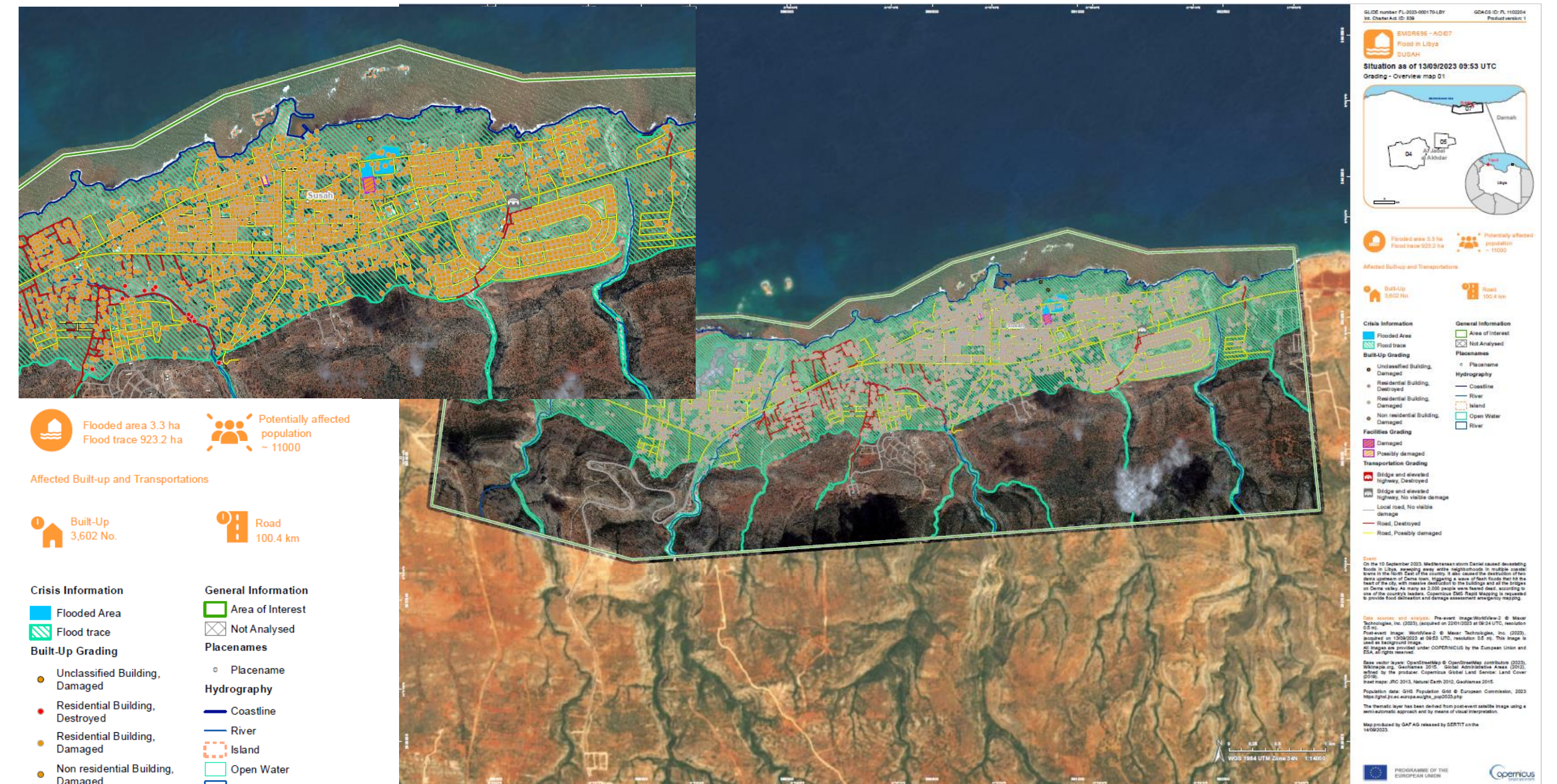


e-GEOS contributes to make cities and human settlements safer, resilient and sustainable, with solutions for monitoring and managing urban environments:

- **3 dimensional detailed mapping** basis for analysis and monitoring.
- **Infrastructure displacement monitoring**, for resilience support.
- **Simulation modules** for a better assessment and risks management.
- **Emergency Mapping Service** in support to recovery and rehabilitation phases following a disaster event.



Goal 13: Take urgent action to combat climate change and its impacts

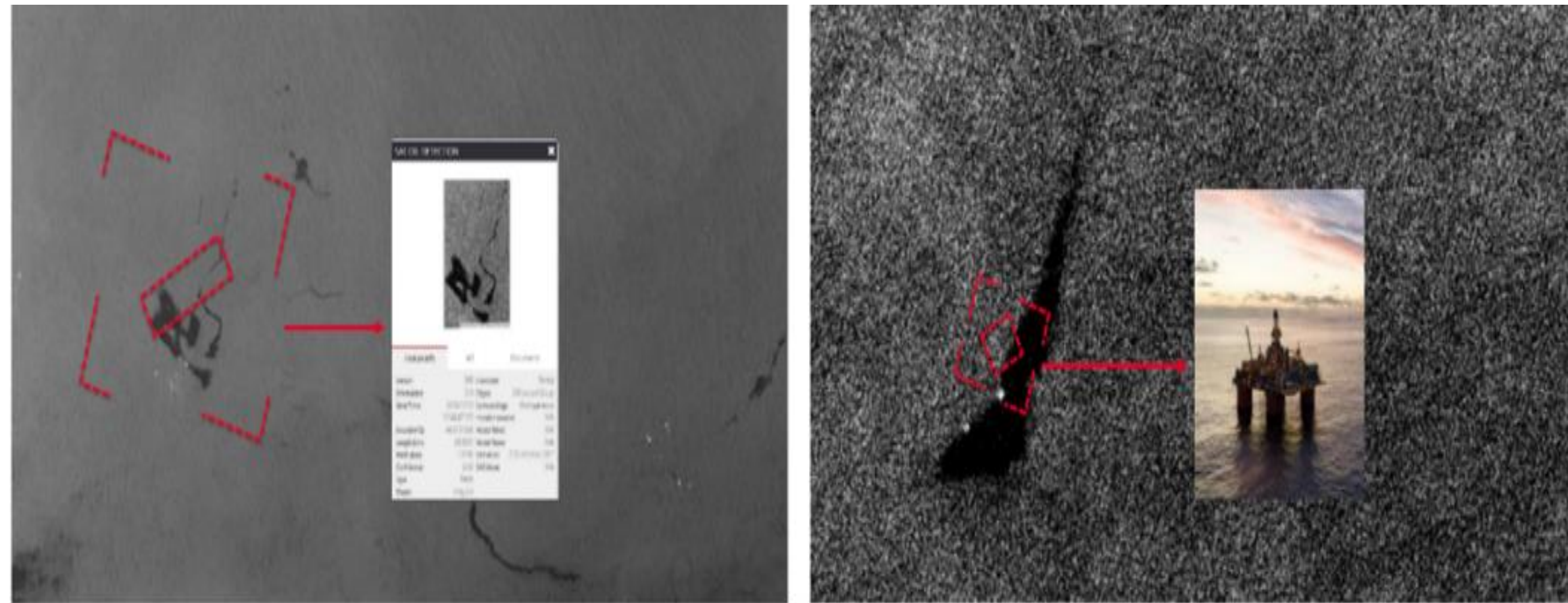


- **Emergency Mapping Services** of e-GEOS provides timely assessment, through delineation and impact maps of extreme events such as floods and typhoons mostly driven by climate change, thus supporting an early management of immediate recovery actions, and supporting longer term actions to be adopted for damages impact mitigation.
- **Other services strengthening resilience and adaptive capacity to climate-related hazards** and natural disasters in all countries are available through Mapcy and Aware platforms.

1. Overview: EO-based services for sustainability



Goal 14: Conserve and sustainably use the oceans, seas and marine resources

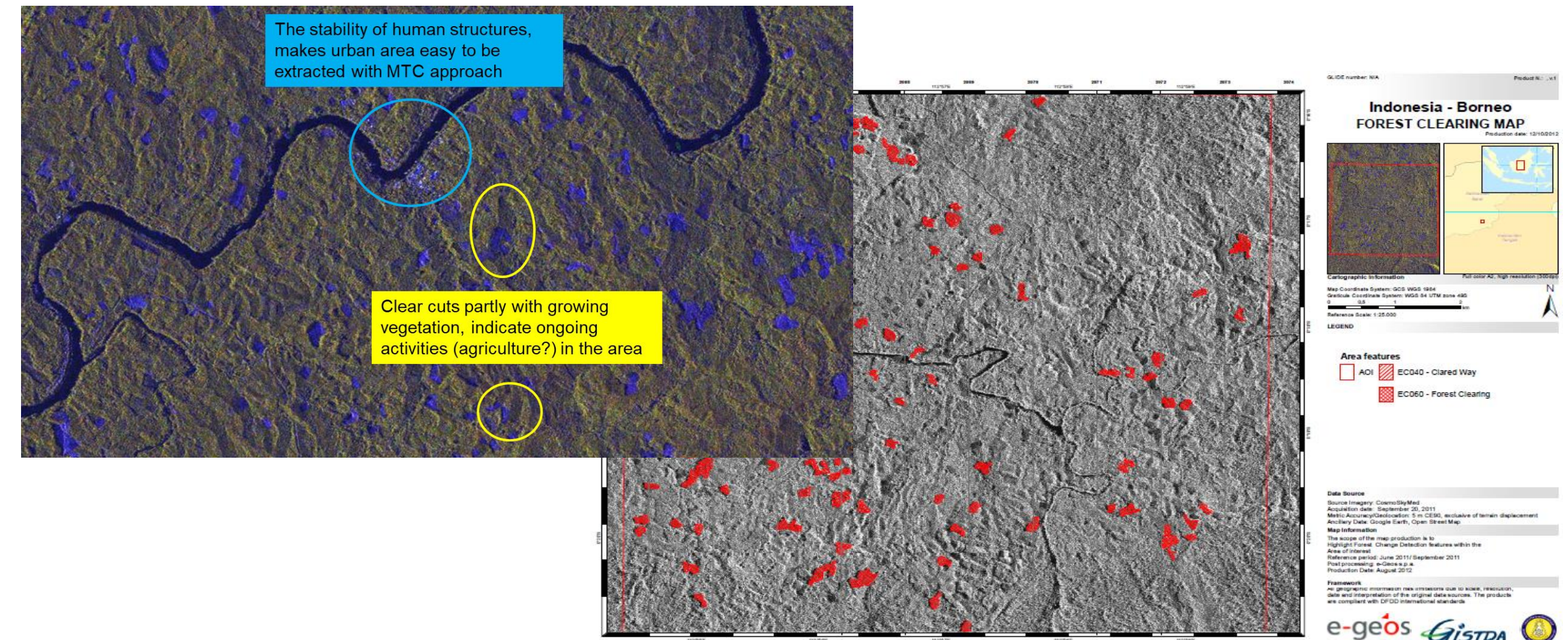


e-GEOS solutions available through the SeonSe application platform dedicated to the marine environment:

- **The oil spill monitoring service**, allowing the activation of recovery actions for a quick recovery of the polluted area.
- **The identification of illegal and overfishing situations**, supported by merging the capabilities of all weather monitoring of radar images with complementary information provided by vessels AIS.
- **Monitoring the access to marine protected area**, therefore identifying possible threads for the marine environment preservation.



Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss



e-GEOS services to support in several ways SDG 15 targets:

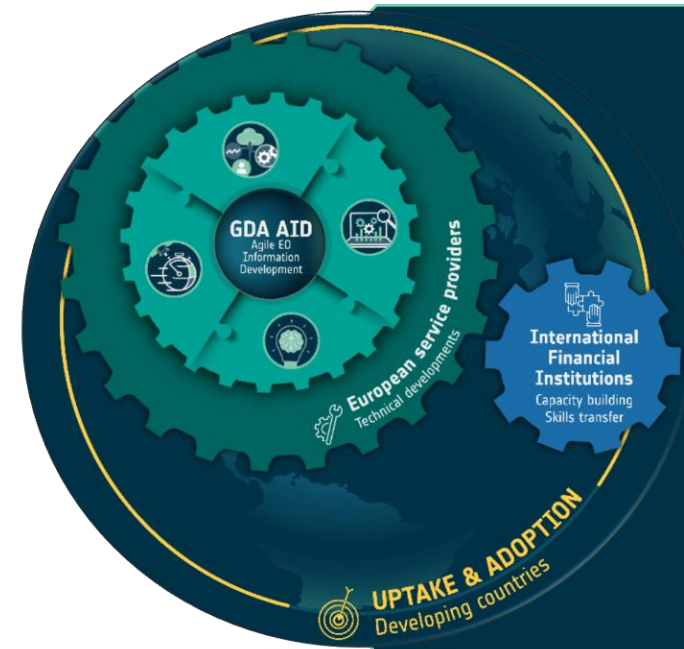
- **Land cover maps** generated at different level of detail and temporal frequency, to monitor the status and the extension of forests, wetlands, mountains and drylands.
- **Forest monitoring services** support a sustainable management of the forests, halting deforestation and restoring degraded forest.
- **Time series of spectral indices and biophysical parameters** with land cover support restoring of degraded land and natural habitats, providing insights on the situation and monitoring its evolution.

2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security



ESA-GDA – THE CONTEXT

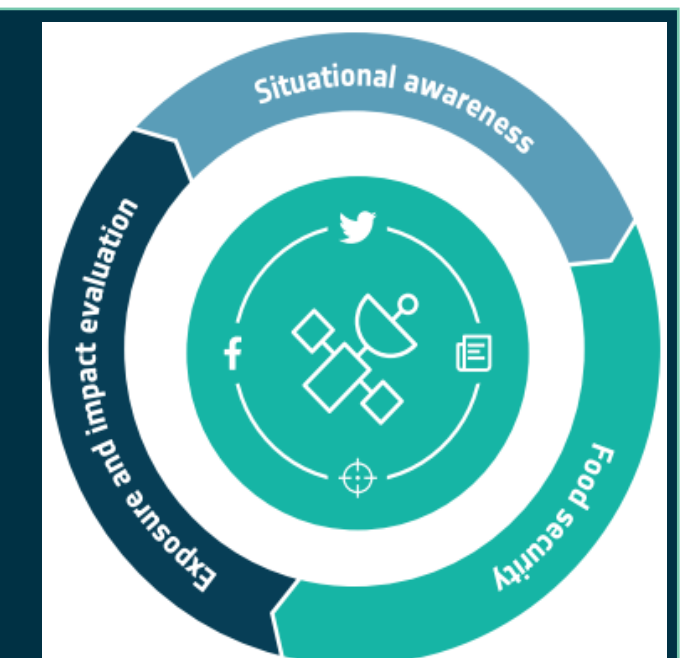


ESA-GDA Mission is to accelerate impact through the power of satellite Earth Observation (EO) in international development assistance, focusing on Agile EO Information Development (GDA AID) applied to **11 thematic priority sectors**. GDA was brought to life by ESA Member States at the Space19+ Ministerial Council in November 2019 and **implemented in partnership with International Financial Institutions (IFIs)**.

FRAGILITY, CONFLICT AND SECURITY – THE TOPIC



The ESA-GDA-FCS programme engages with IFIs to co-design tools supporting ongoing initiatives, fostering **situational awareness, exposure and impact evaluation, food security in countries affected by conflicts**. Preventing and mitigating FCS challenges is key to making progress towards the Sustainable Development Goals (SDGs) and to the international community's broader efforts to promote prosperity. Products are developed in a multidisciplinary approach: EO data are integrated with heterogeneous sources (OSINT), to improve decision making processes.



2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security

THE TEAM AND THE APPROACH

Project launch: January 2022

Activities performed by a consortium of **six European companies led by e-GEOS (CGI, DLR, HENSOLDT Analytics, JANES, VITO)** leading in the fields of Earth Observation (EO), Remote Sensing, Open Source Intelligence (OSINT), Socio-Spatial Intelligence (SOSINT), and the integration of technology into international development contexts.




2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security




2 further use cases under design for new stakeholder IFAD

UC1 - Security/ Assessment Briefings




End User: B. Murguet / F. OvandaMbele – World Bank
WB Project: P150999-Cameroon Transport Sector Development Project
Main Objective: EO/OSINT integrated analysis promptly warning on security risks (military movements, attacks, conflict zones) over streets under construction/maintenance in **Northern Cameroon**, preventing impacts on civilians.

UC2 - EO to Support Impact Evaluation




End User: B. Murguet / T. Bougna – World Bank
WB Project: P144852 - Impact Evaluation – Rural Access and Mobility P095003 - NG-Rural Access & Mobility Project-Phase 2
Main Objective: indicators of impacts produced by roads rehabilitation in **Nigeria** through EO-based analysis, detecting anomalies affecting rehabilitated infrastructures.

UC3 - Smallscale infrastructures Monitoring



End User: M. Malik, B.N. Khan – World Bank
WB Project: P151075 - Pakistan Community Support Project - PCSP
Main Objective: monitoring ongoing activities of construction/rehabilitation of small scale-infrastructures in **Pakistan** through EO data, prioritizing activities and needs.

UC4 - Land and Conflict




End User: Paul Prettitore - World Bank
WB Project: P128950 - Assessing the Nexus of Land Administration and Resilience to Disaster and Climate Risk
Main Objective: integrating EO/OSINT data to identify land grabbing indicators due to the ongoing conflict in **Ukraine**, as it is producing expropriation, transactions, forced land abandonment phenomena.

UC5 - Effects of Displaced Population on local Economy




End User: Jeffrey Tanner - World Bank
WB Project: P172830 - The Cox's Bazar Analytical Program
Main Objective: integrating EO/OSINT/AI data model to monitor the impact on local economy/welfare growth from refugee camps in **Ukhia/Teknaf** districts (**Bangladesh**), to better addressing budget.

UC6 - IGAD through the Emergency Response Program




End User: Kenneth Mwangi - World Bank
WB Project: P174546 - Emergency Locust Response Project
Main Objective: Employing EO data to monitor desert locust flow through eastern African regions, enhancing IGAD's inter-regional platform, as locusts affect agriculture, producing food insecurity.

UC7 - Population Movement



End User: Valeria Fabbroni, E. De Benedetti – ADB
ADB Project: TA 9986 Regional: Enhancing Differentiated Approaches in Context-Sensitive Situations
Main Objective: monitoring migration flow from **North-Afghanistan/South-Tajikistan**, monthly basis, to consistently allocate Tajikistan financial resources, as migration flow over these areas is relevant and confirm evidence from AKDN.

UC8 - Enhanced Country Performance Assessment



End User: Valeria Fabbroni, E. De Benedetti – ADB
ADB Project: TA 9986 Regional: Enhancing Differentiated Approaches in Context-Sensitive Situations
Main Objective: estimating an enhanced CPA indicator of **12 FCAS/non-FCAS** countries (**Timor Leste, Pakistan, Tajikistan, Afghanistan, Kyrgyz Republic, Uzbekistan, Lao PDR, Papua New Guinea, Cambodia, Suthan, Nepal**) through EO/OSINT-based country level indicators in AI model, to allocate adequate financial resources.

2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security

USE CASE 8 – COUNTRY PERFORMANCE ASSESSMENT



IFI & project supported

Asian Development Bank - TA 9986 Regional: Enhancing Differentiated Approaches in Context-Sensitive Situations

Objective

ADB estimates a annual Country Performance Assessment (CPA) index at country level, for all the Asian Development Fund (ADF) eligible countries, assessing policy and institutional frameworks, coherence of structural policies, policies and institutions equity and inclusion, quality of governance, etc. CPA scores are from 0 to 6: countries with an avg. CPA of 3.2 or below are classified as Fragile Conflict-Affected Countries.

Areas of interest

First iteration: 9 countries (Timor-Leste, Afghanistan, Pakistan, Tajikistan, Uzbekistan, Kyrgyz Republic, Myanmar, PNG, Lao PDR)
 Second iteration: first 9 above and adding further 3 countries (Cambodia, Buthan, Nepal)

Time window

From 2020 – up today

Partners involved

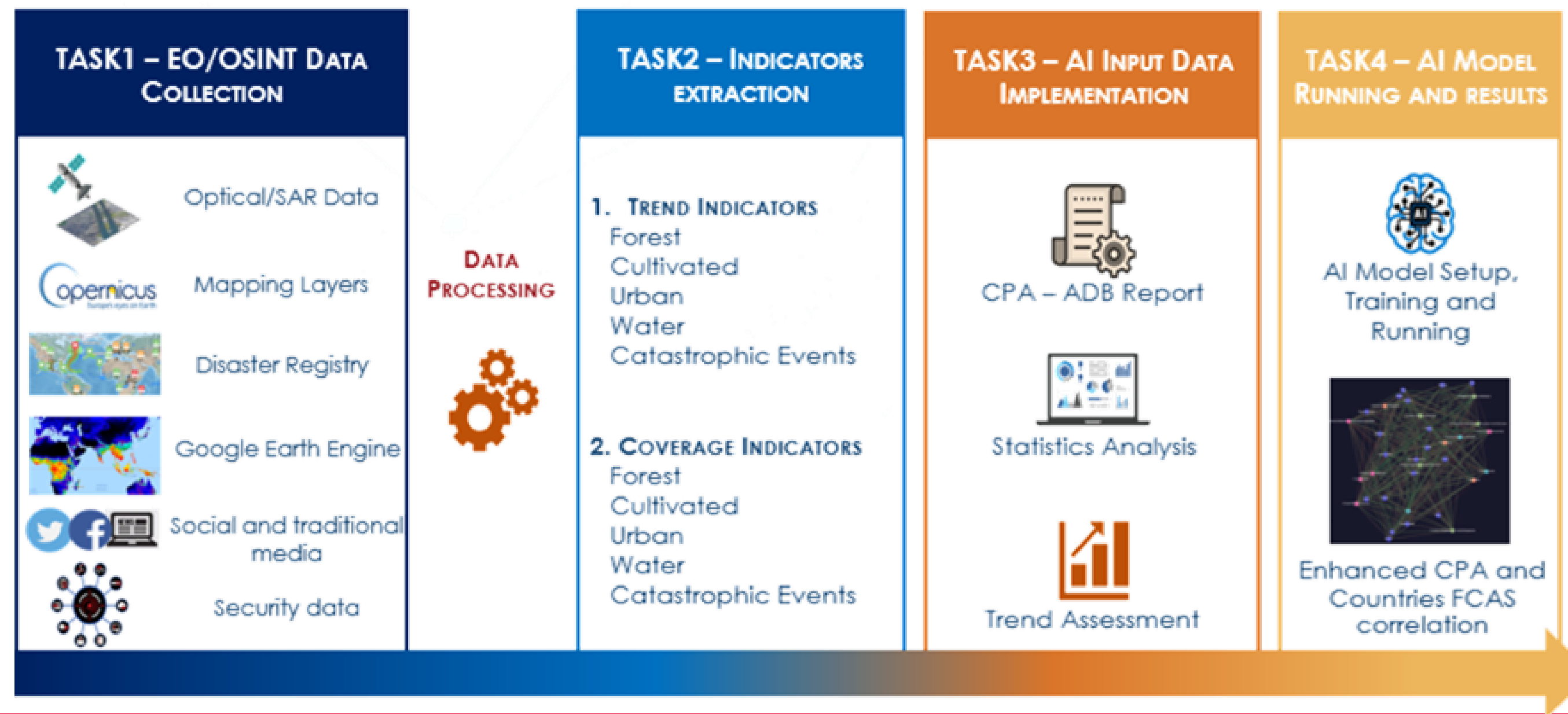


2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security

METHODOLOGY

As the **main constraint** refers to the **subjectivity of the CPA presently estimated**, on which the analysis of the expert economists are based, **UC8 aims at enhancing the CPA through EO/OSINT based indicators** (both in the security domain as well as social/traditional media covering non-subjective aspects and **developing an unsupervised Machine Learning (ML) model** that takes in input trends and statistics of new indicators, grouping countries that according to ML model are similar from in terms of CPA and new indicators.



2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security



INDICATORS

Completed data collection and pre-processing (two iterations) for:

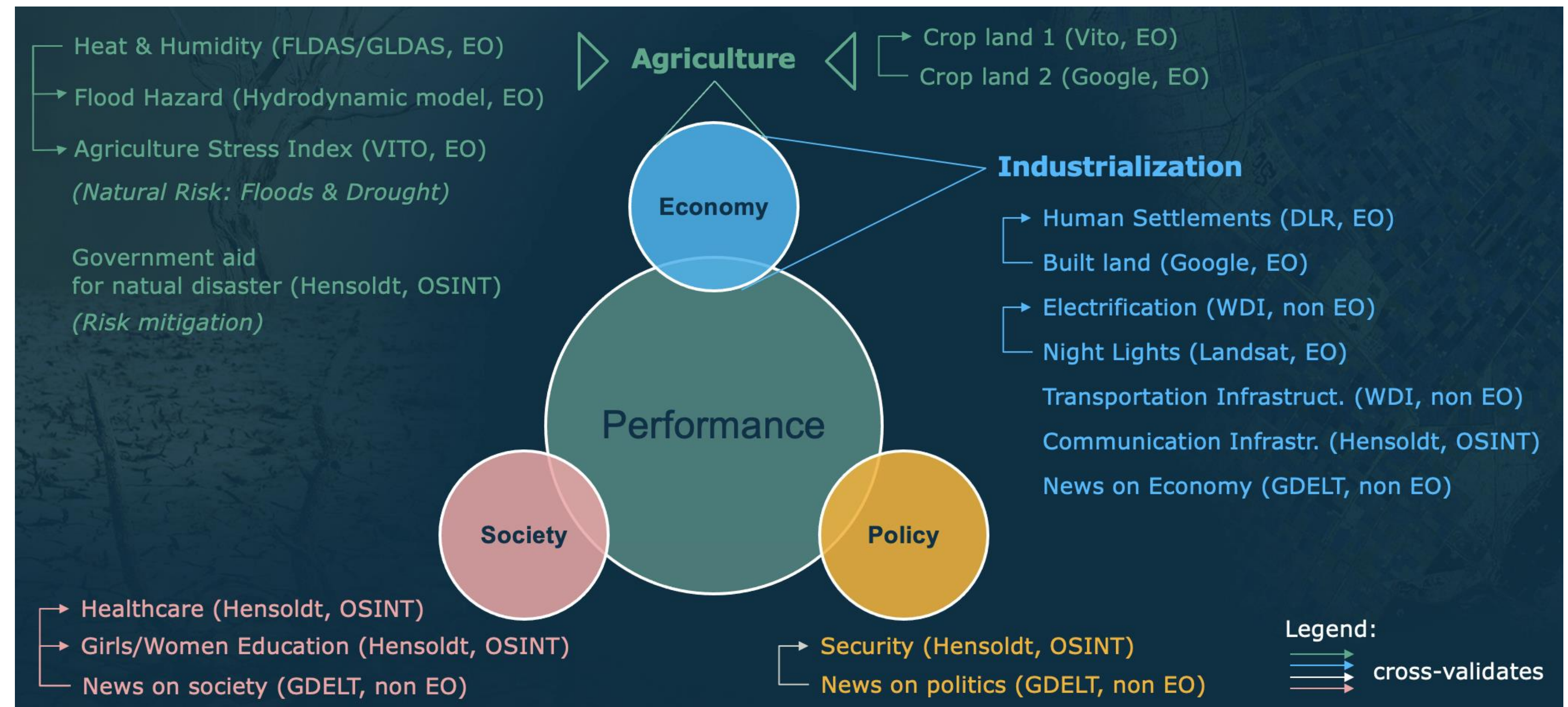
- a total of 107 indicators, EO and non EO, divided in 3 classes called economy, society and policy
- 12 countries
- 6 years (2017-2022)

Completed data normalization.

Completed data rescaling.

Currently developing AI model for:

- country ranking
- country clustering
- visual assessment and comparison



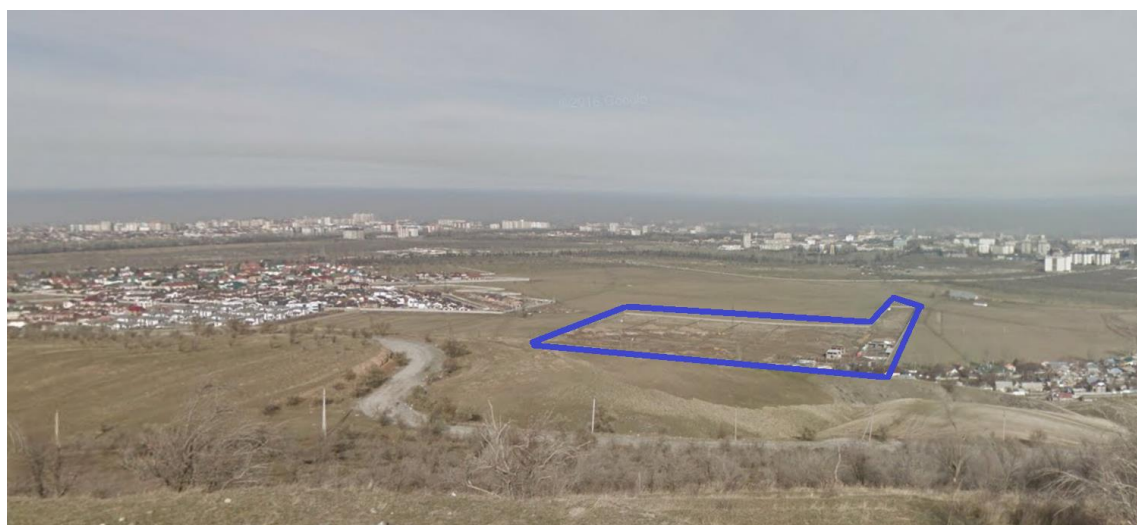
2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security

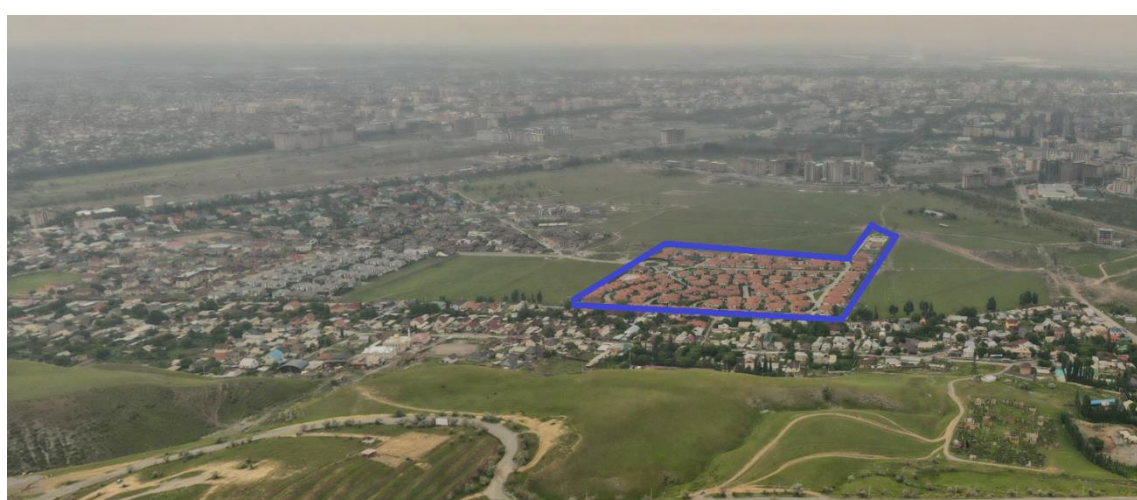
INDICATORS EXAMPLE, POPULATION DENSITY



2017

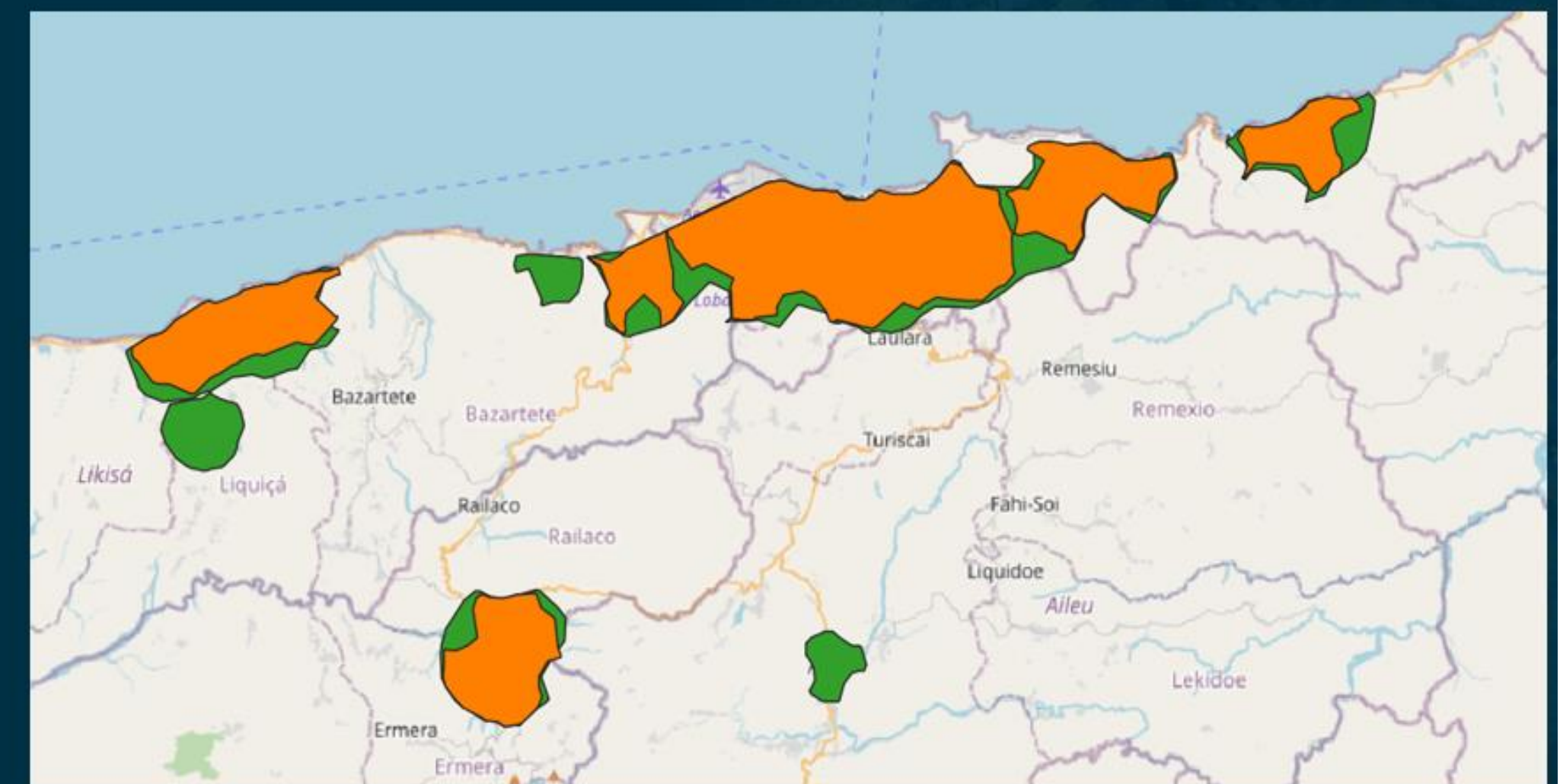


2022



- Density clustering
- 2017-2022 comparison
- orange and green areas represent clustered pixels in 2017 and 2022, respectively
- grey pixels represent isolated (e.g. rural) built areas
- table below shows increasing concentration of population in larger built areas

Timor Leste, zone around the capital – Dili



2017 2022

	Total number of built pixels	Total number of clustered pixels	population
2017	241.767	31.926	1.243.000
2022	253.998	37.798	1.321.000
	% variation	% variation	% variation
	5,06%	18,39%	6,28%

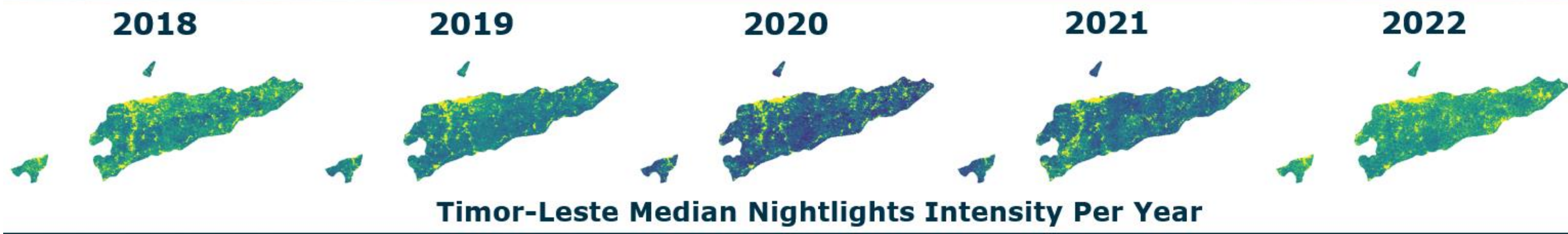
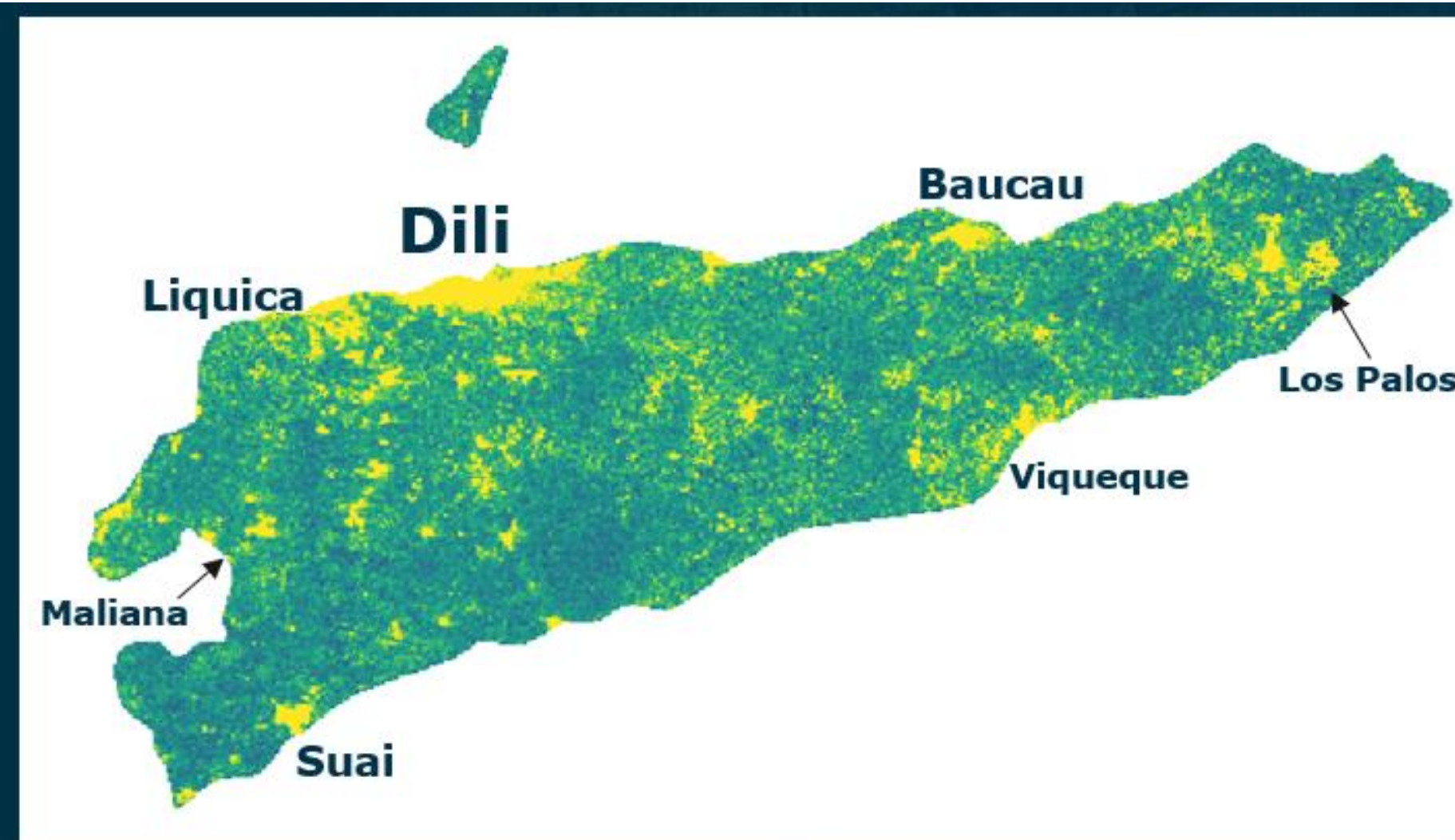
2. Use Cases

2.1 ESA-Global Development Assistance-Fragility, Conflict and Security

INDICATORS – EXAMPLE, ELECTRIFICATION



- The median nightlights intensity is calculated for each pixel for each year
- Largest urban areas can be clearly identified on the resulting map
- A drop in nightlights intensity can be seen during the COVID years (2020-2021), followed by a return to pre-COVID values in 2022 (see figure on the right)



2. Use Cases

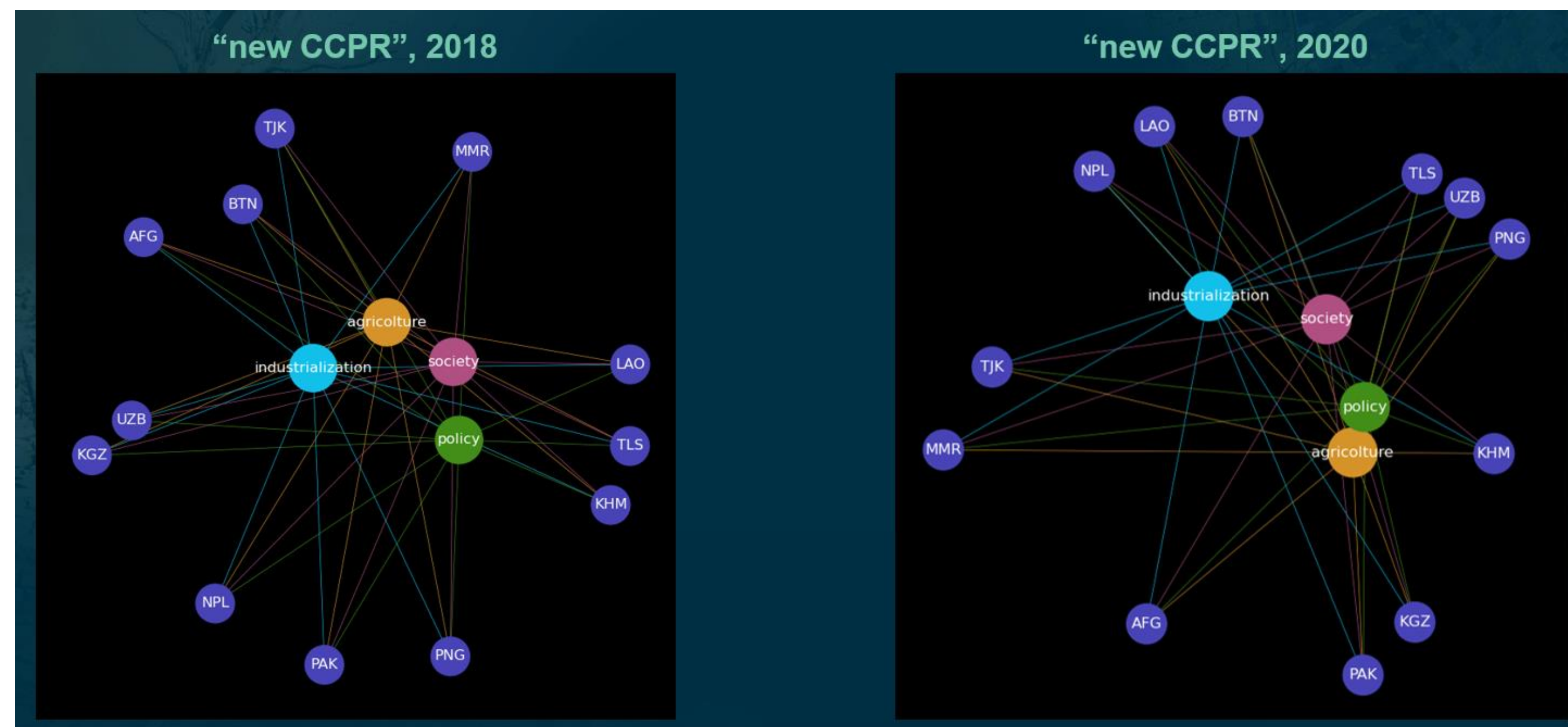
2.1 ESA-Global Development Assistance-Fragility, Conflict and Security



RESULTS

Visual representation of the new CCPR generated in the context of ESA-GDA-Fragility, in 2018 and 2020: the closeness of a country to a dimension of performance generally indicates greater performance. Predictive analytics, to test whether the new aggregate country performance indicator can be used to predict the value of the old CCPR. This test has been successful, with low error levels (again, below 10%) suggesting that the new indicators can be exploited to obtain early signals of change that can support important decision making within IFI processes and, particularly, in the selection of the key initiatives to be monitored as part of the activities for the assessment of the traditional CCPR.

A fundamental benefit of the new EO/OSINT indicators is their ability to assess many aspects of country performance in an automated way and with greater frequency/detail. This enables a change in perspective, from a periodical aggregate judgment to a continuous analysis that support IFI processes in all their phases.



2. Use Cases

2.2 Copernicus EMS Risk and Recovery – Ishkashim (Afghanistan)



USE CASE DESCRIPTION

Activation description and objectives

EMSN120 - Preparedness studies for resilience in the Ishkashim area at the border of Afghanistan and Tajikistan
Supporting the German Federal Office of Civil Protection and Disaster Assistance (BBK) as well as Deutsche Welthungerhilfe e. V. within the context of hazard identification and management activities by providing detailed information on infrastructure (buildings and road network) and agricultural activity (field delineation, crop mapping, and productivity), to better identify potential risks that may endanger food security, and mitigation measures to increase resilience in this fragile environment.

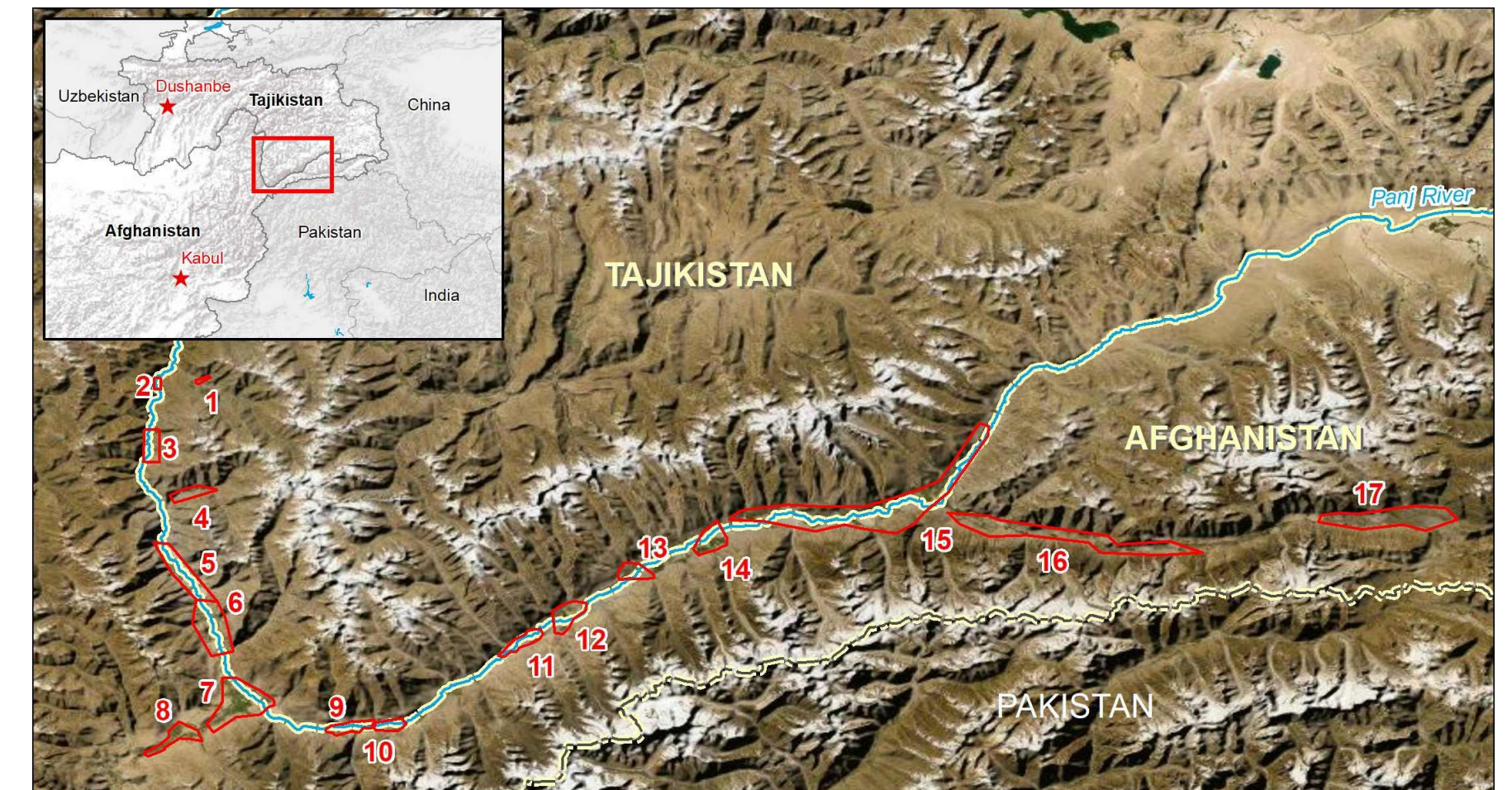
Areas of interest

17 areas of interest on the border Afghanistan/Tajikistan
Tot: 506.30 Km²

Time window

Retrospective analysis (2021)

Partners involved



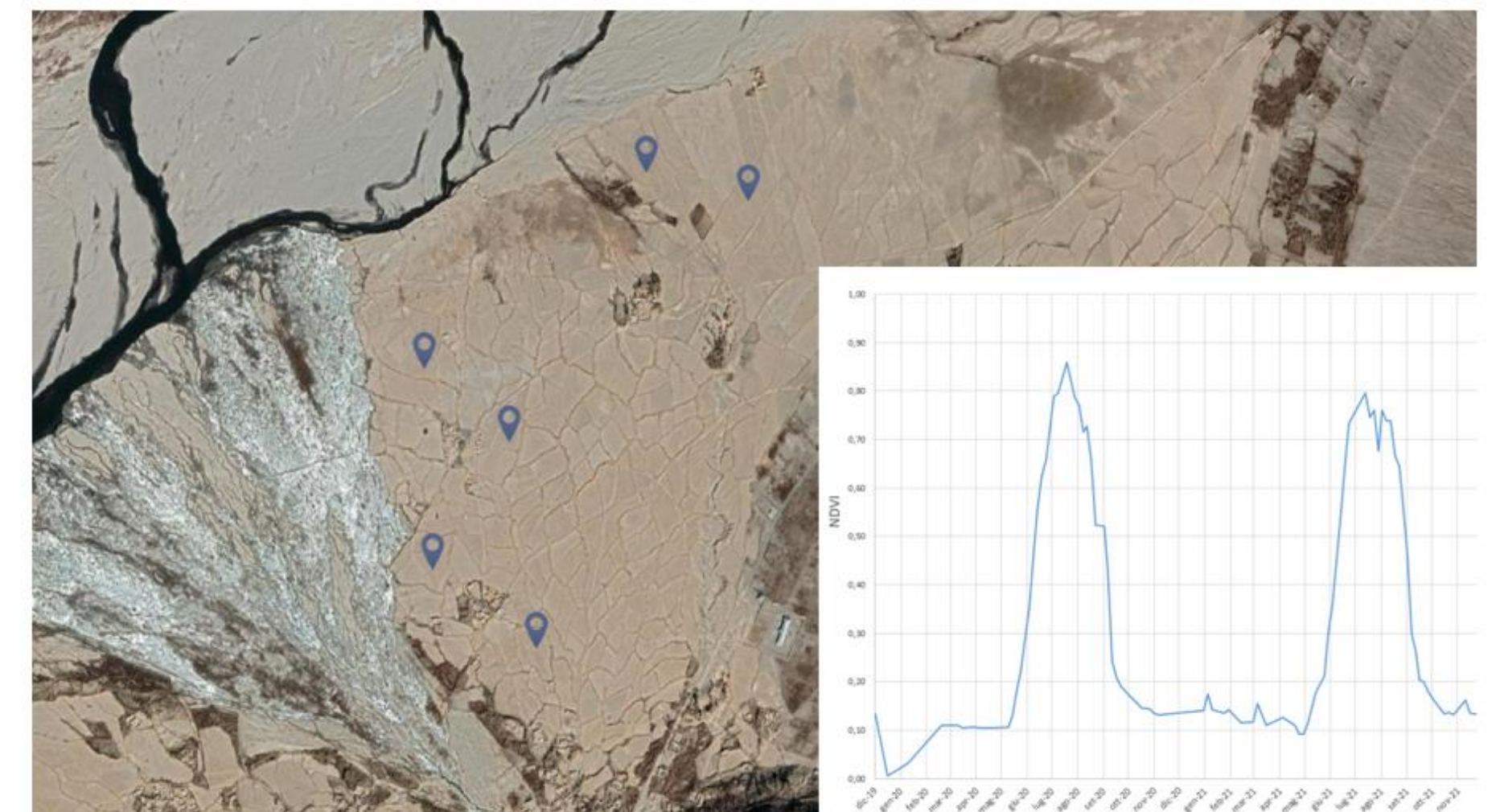
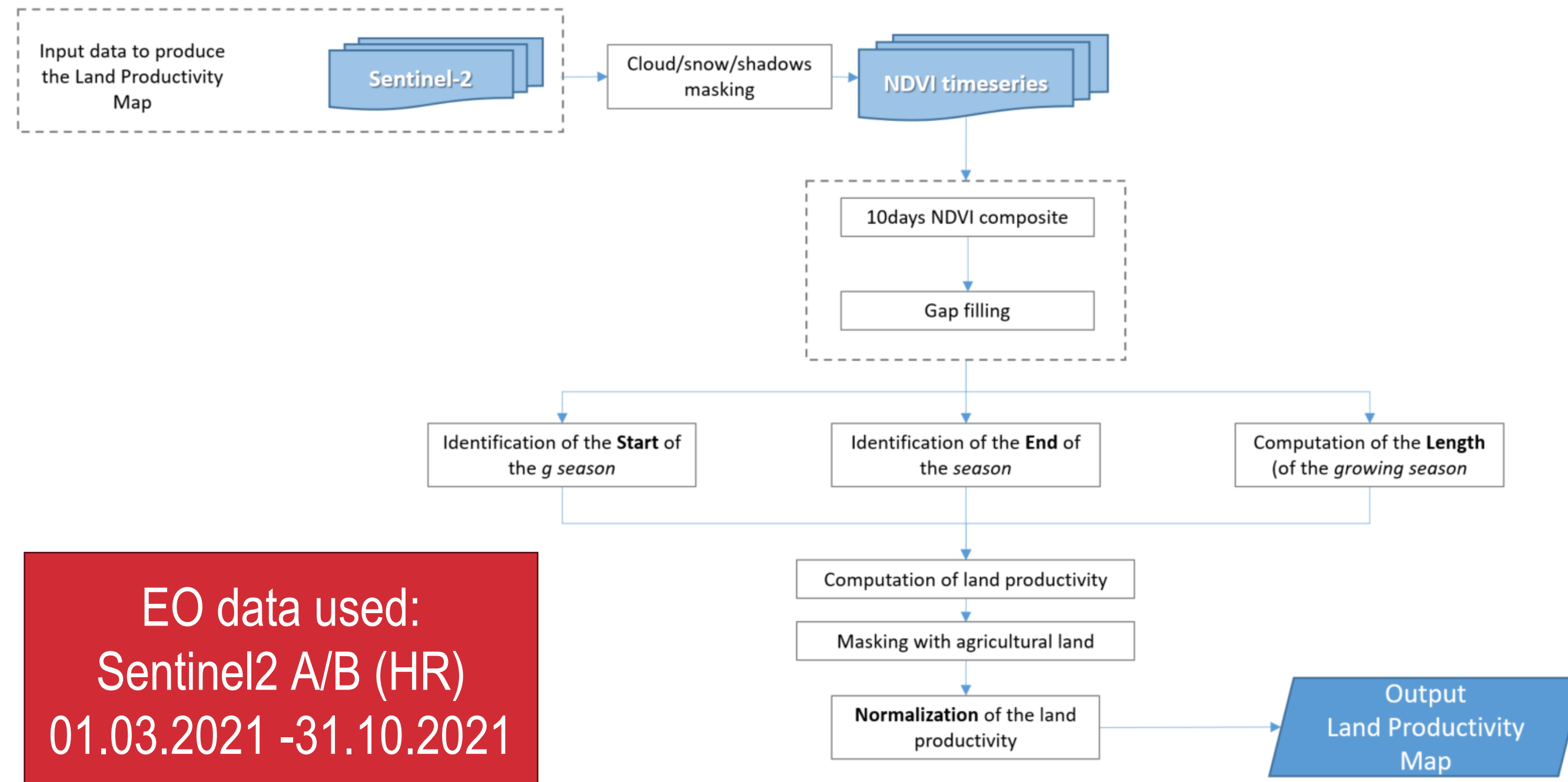
2. Use Cases

2.2 Copernicus EMS Risk and Recovery – Ishkashim (Afghanistan)



ANALYSIS OF NDVI FOR LAND PRODUCTIVITY ASSESSMENT

The computation of land productivity is based on the integral of NDVI in all the 10-days windows between crop emersion and crop harvesting. Output values are normalized within a proper range from zero to a maximum value (theoretical maximum value is 36, real maximum value is much lower). In this case, since it has been considered a period from April to October, 21 decades were analysed for the computation. **A thematic raster map has been generated over the agricultural land defined, and computation of the land productivity was carried out also over single agricultural plots.**



NDVI time series of agricultural parcels over two years. Growing season starts in April/May and ends at the beginning of October/ end of September.

2. Use Cases

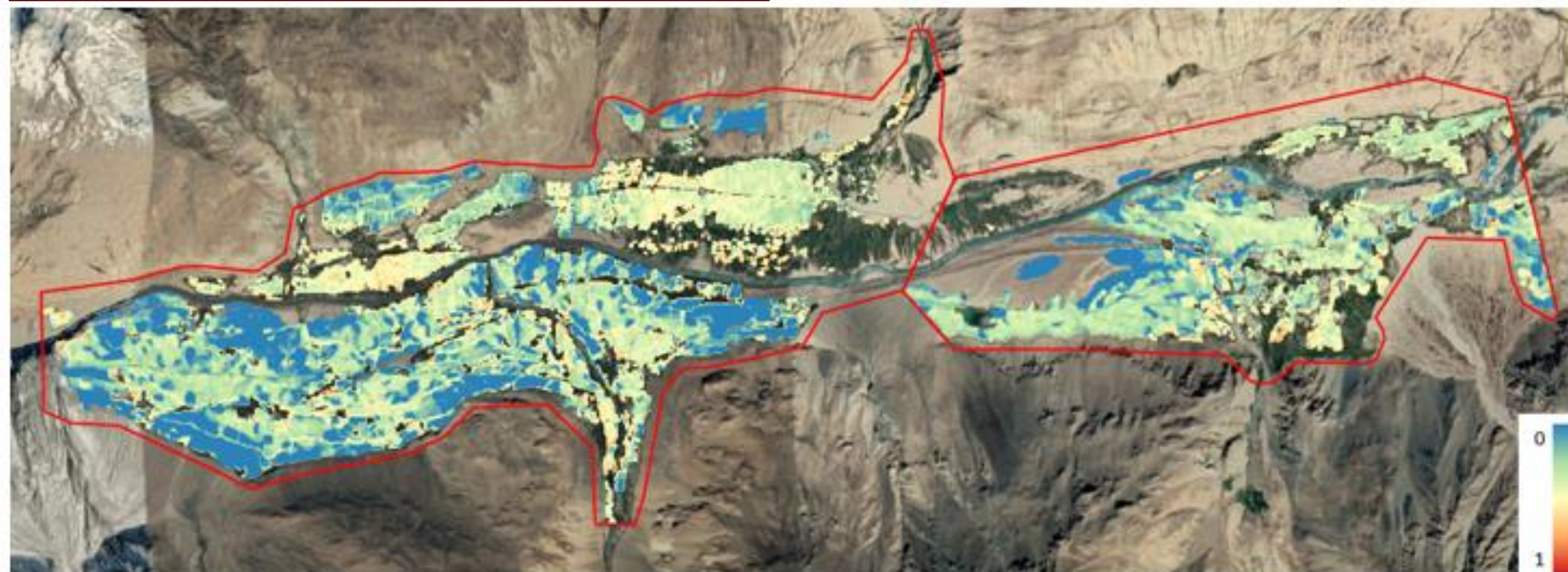
2.2 Copernicus EMS Risk and Recovery – Ishkashim (Afghanistan)



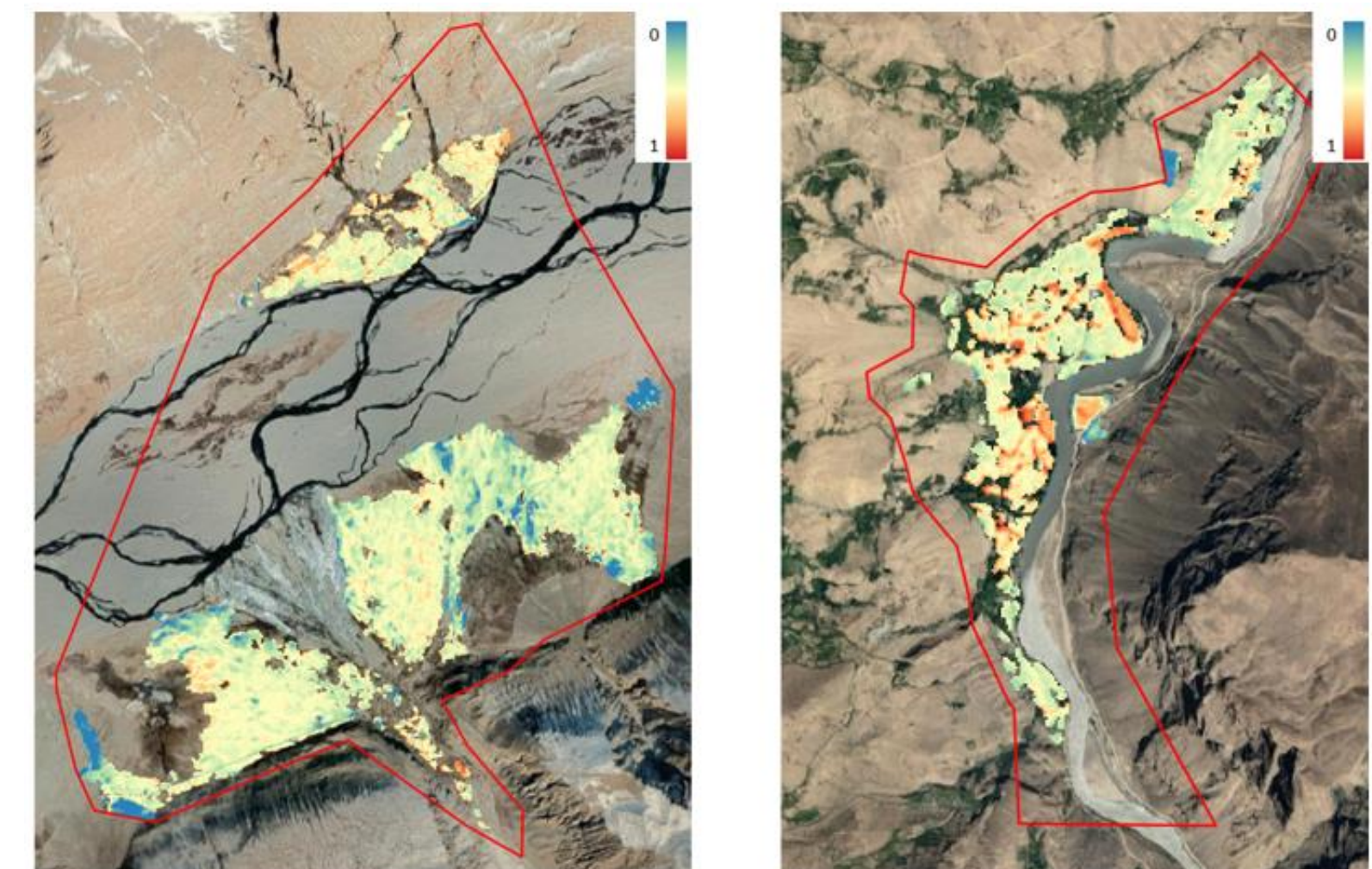
ANALYSIS

These values indicate the productivity of the agricultural land inside each AOI. Plots with high values of productivity show a high intensity of photosynthetic activity along the entire growing season. Some examples of land productivity after normalization over agricultural land.

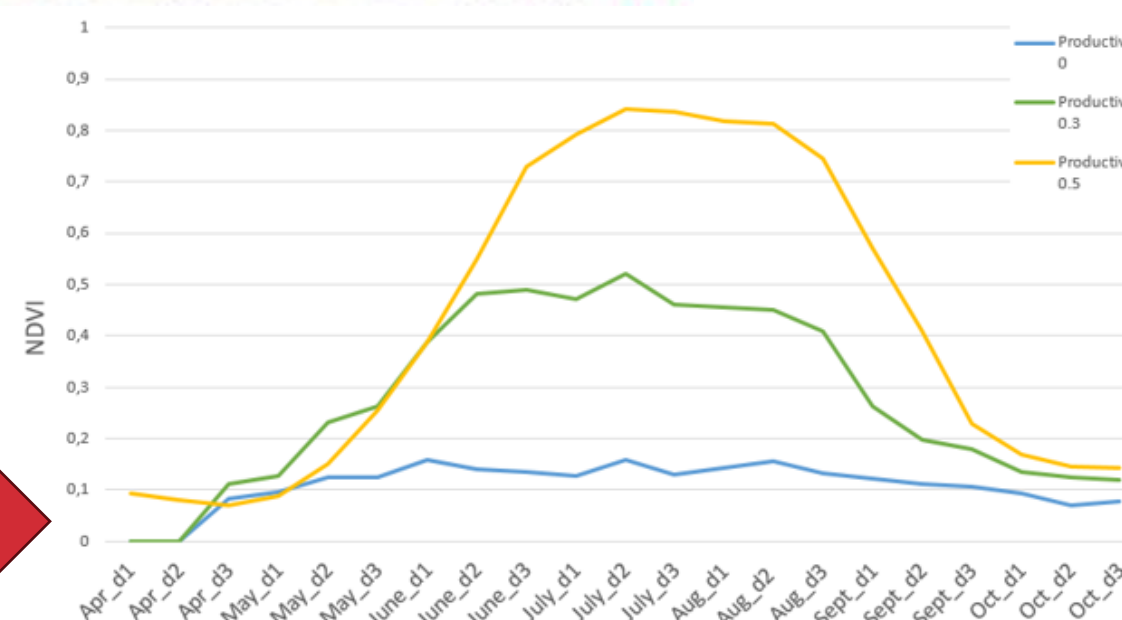
PRODUCTIVITY MAP OVER NAMAGUTI BOLO AND WARK



PRODUCTIVITY MAP OVER VOCHVOD AND SHAYKHBEK



NDVI PATTERN ALONG THE GROWING SEASON FOR PARCELS OF THE SAME CROP TYPE AT DIFFERENT VALUES OF PRODUCTIVITY



2. Use Cases

2.3 Copernicus Evolution Horizon2021 – CENTAUR



Project & Objectives

CENTAUR - Copernicus ENhanced Tools for Anticipative Response to Climate Change in the Emergency and SecURity Domain

CENTAUR responds to societal challenges from Climate Change threats developing/demonstrating new components for Copernicus EMS and Copernicus SEA:

- Improve situational awareness and preparedness around climate change and impact on complex emergencies and (security) crises.
- Anticipate occurrence and knock-on effects of crisis events triggered by climatic extremes, thus contributing to resilience and effective adaptation.

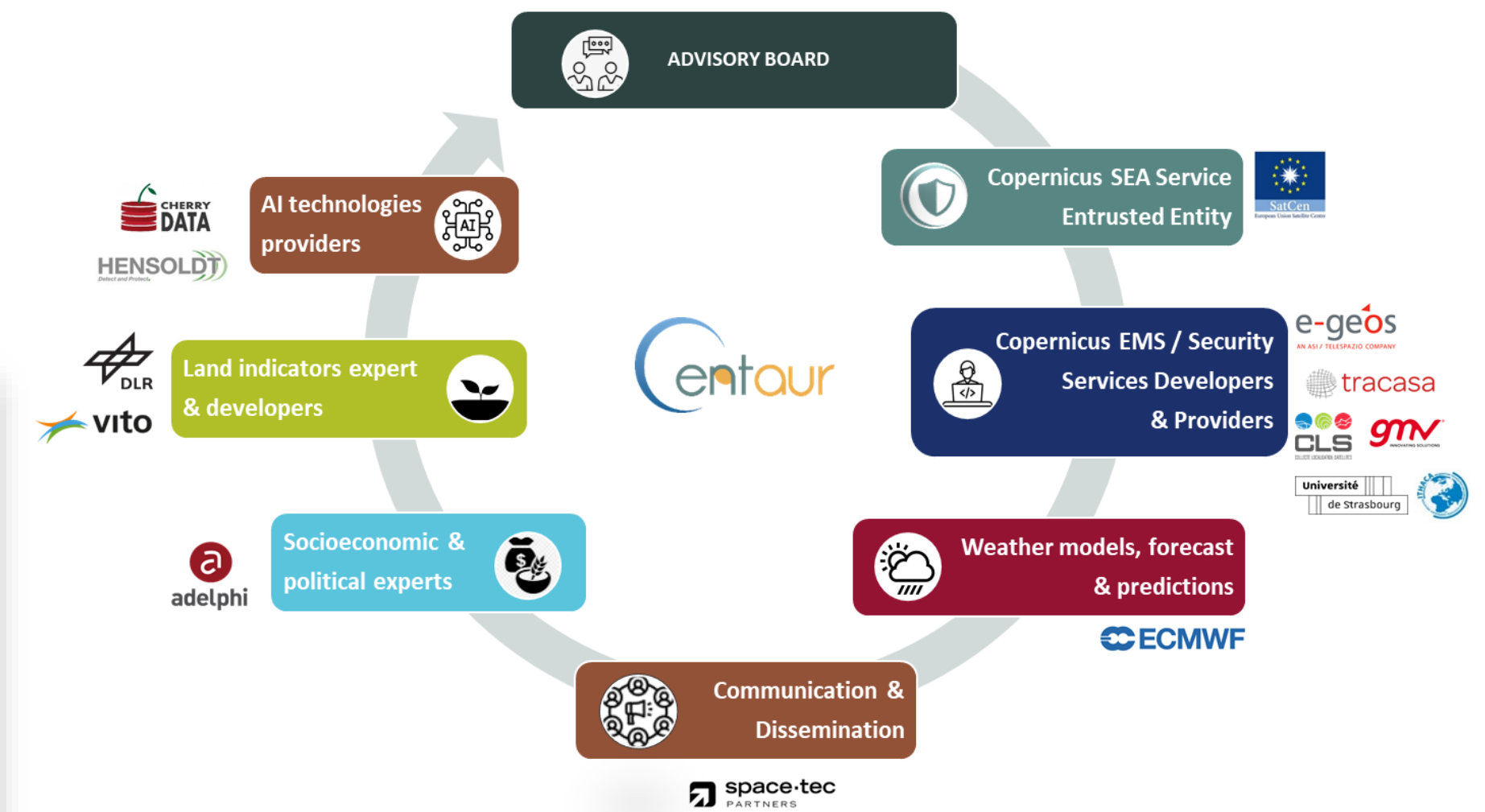
CENTAUR thematic areas



Flood-related threats to population, assets in urban areas.



Water/food insecurity and model subsequent risks political instability, conflicts and displacements risks in developing and fragile countries.



2. Use Cases

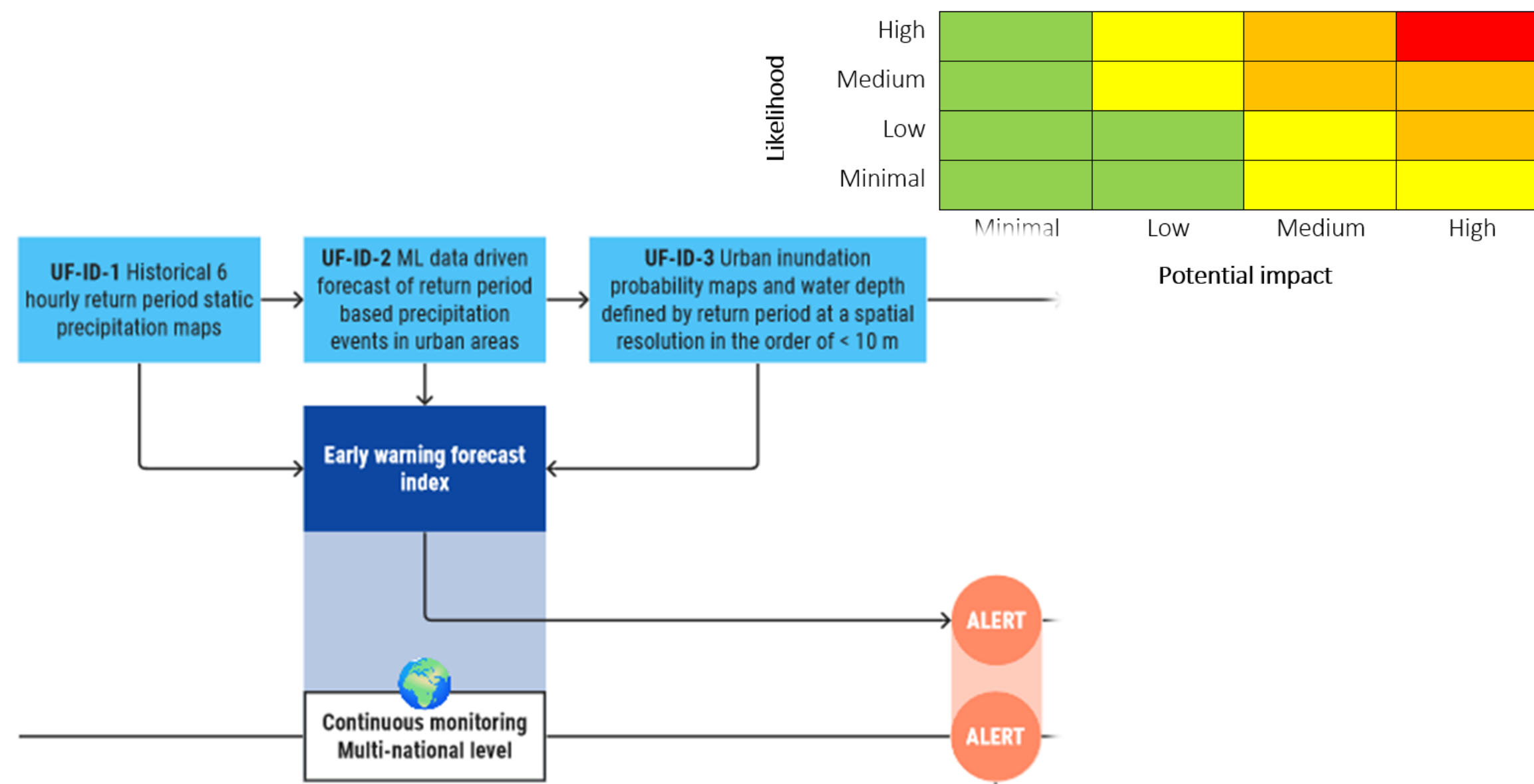
2.3 Copernicus Evolution Horizon2021 – CENTAUR



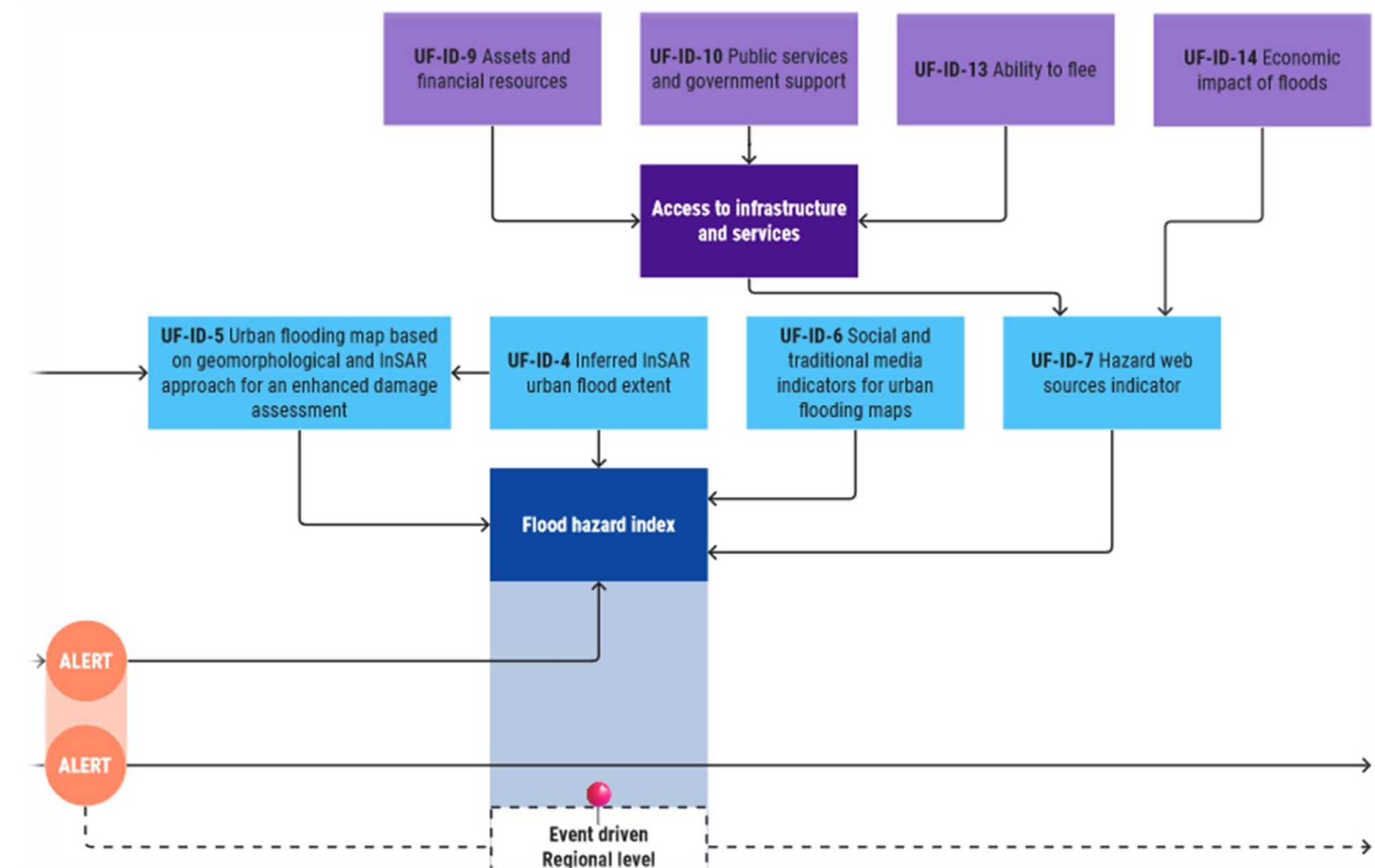
CONCEPTUAL MODEL

Conceptual model for the urban floods (UF) track

- **Continuous monitoring** at a **global scale**.
- System based on 3 **indicators**: 2 **precipitation-based** indicators: UF-ID-1 and -2; 1 **integrated** indicator: UF-ID-3.
- **Early warning forecast index** to assess **likelihood** of crisis event.
- Basis to **trigger an alert** and activate the second analysis scale.



- **Event-driven monitoring** at a **regional scale**.
- Focus on an **AOI**, akin to CEMS RM activations.
- Analysis based on 4 **event-based** indicators: UF-ID-4 to -7 and 4 **context-based** indicators: UF-ID-9, -10, -13 and -14.
- **Flood hazard and impact index** to assess urban floods extent/damage.
- Integration of **heterogeneous data**.



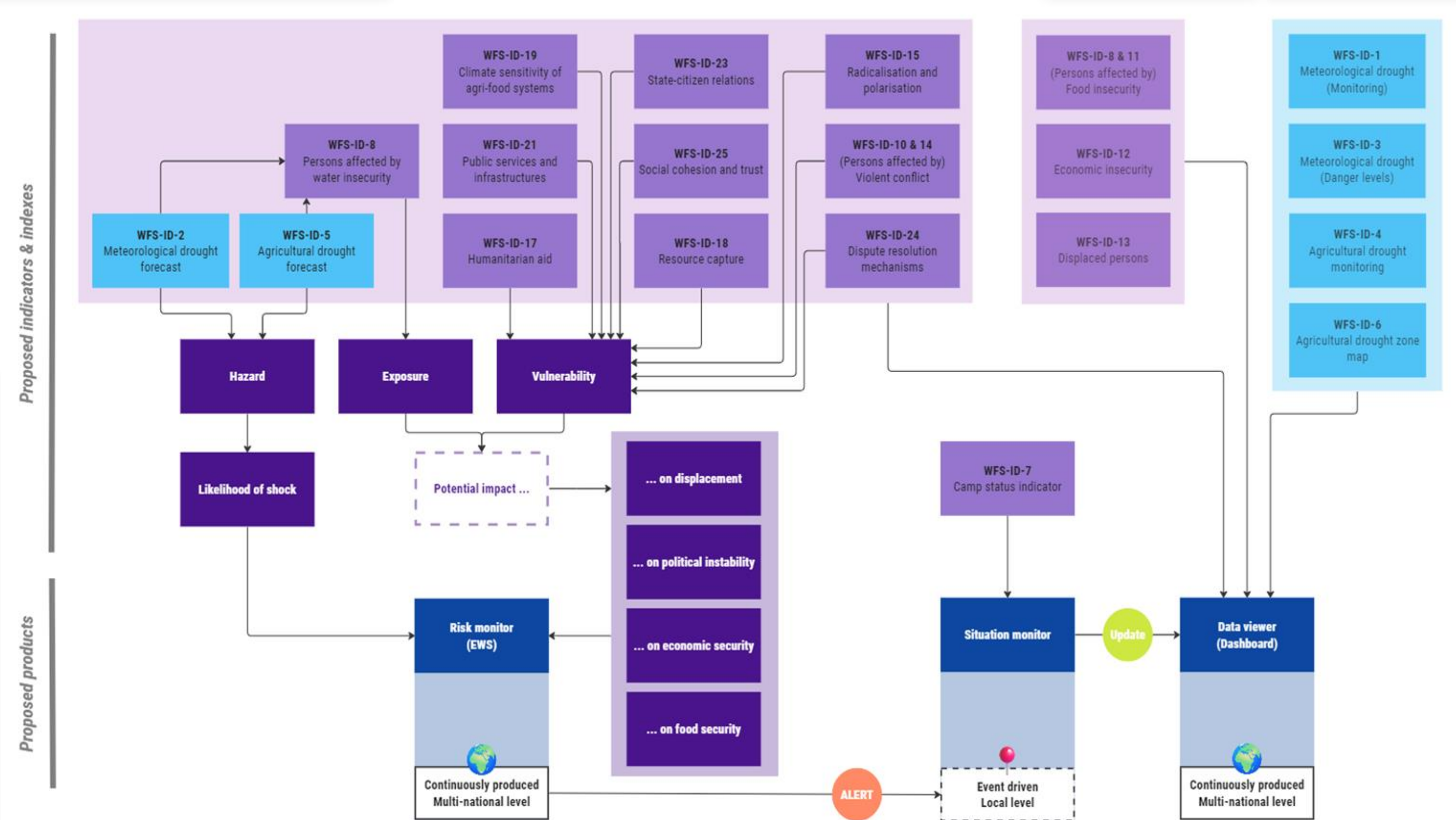
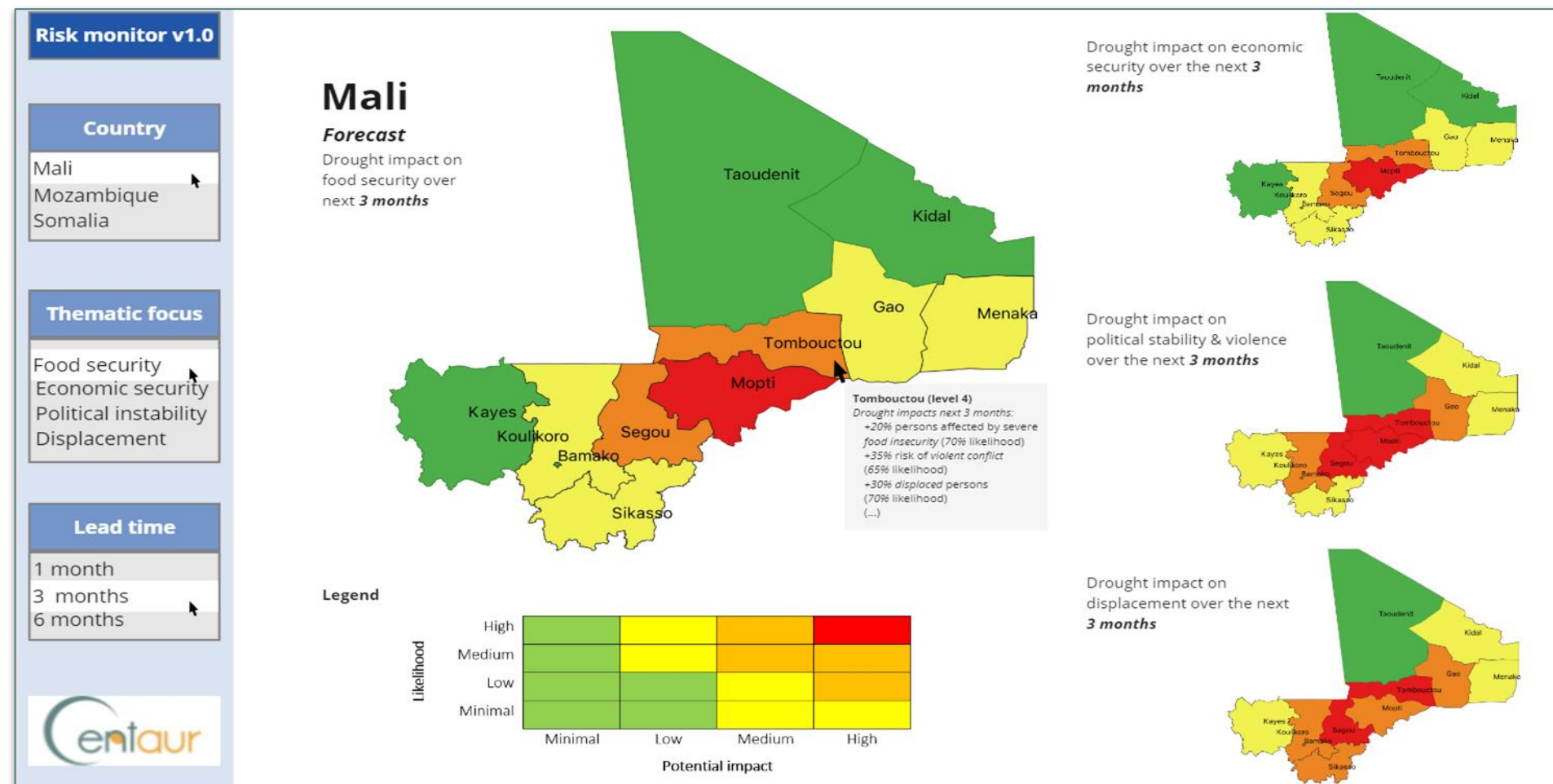
2. Use Cases

2.3 Copernicus Evolution Horizon2021 – CENTAUR

CONCEPTUAL MODEL

Conceptual model for the Water&Food Security (WFS) track

- Data catalogue (repository)
- Monitoring & Early warning system
- Geo/data portal (dashboard)
- Forecasting & scenario tool



2. Use Cases

2.3 Copernicus Evolution Horizon2021 – CENTAUR

USE CASES SELECTION

- **8 use cases** selected across Europe and Africa, in consultation with **CEMS and CS-SEA end users**, at city (CEMS) or country (CS-SEA) level.
- Focus on **major past or ongoing events**, with a **potential for new crisis** occurring during the project's lifetime.
- **Cross-cutting demonstrator** in Mozambique, to assess the **interplay** between urban floods, water & food security, and the different indicators and indexes computed for each use case.

OBJECTIVES

- **Initial assessment** and **calibration** with cold cases (past events) where **validation data** is readily available, with a focus on free or open source data sets.
- **Pre-operational testing** of the system with hot cases, and gradual improvements.
- **Demonstrate added value** to current CEMS and CS-SEA operations.

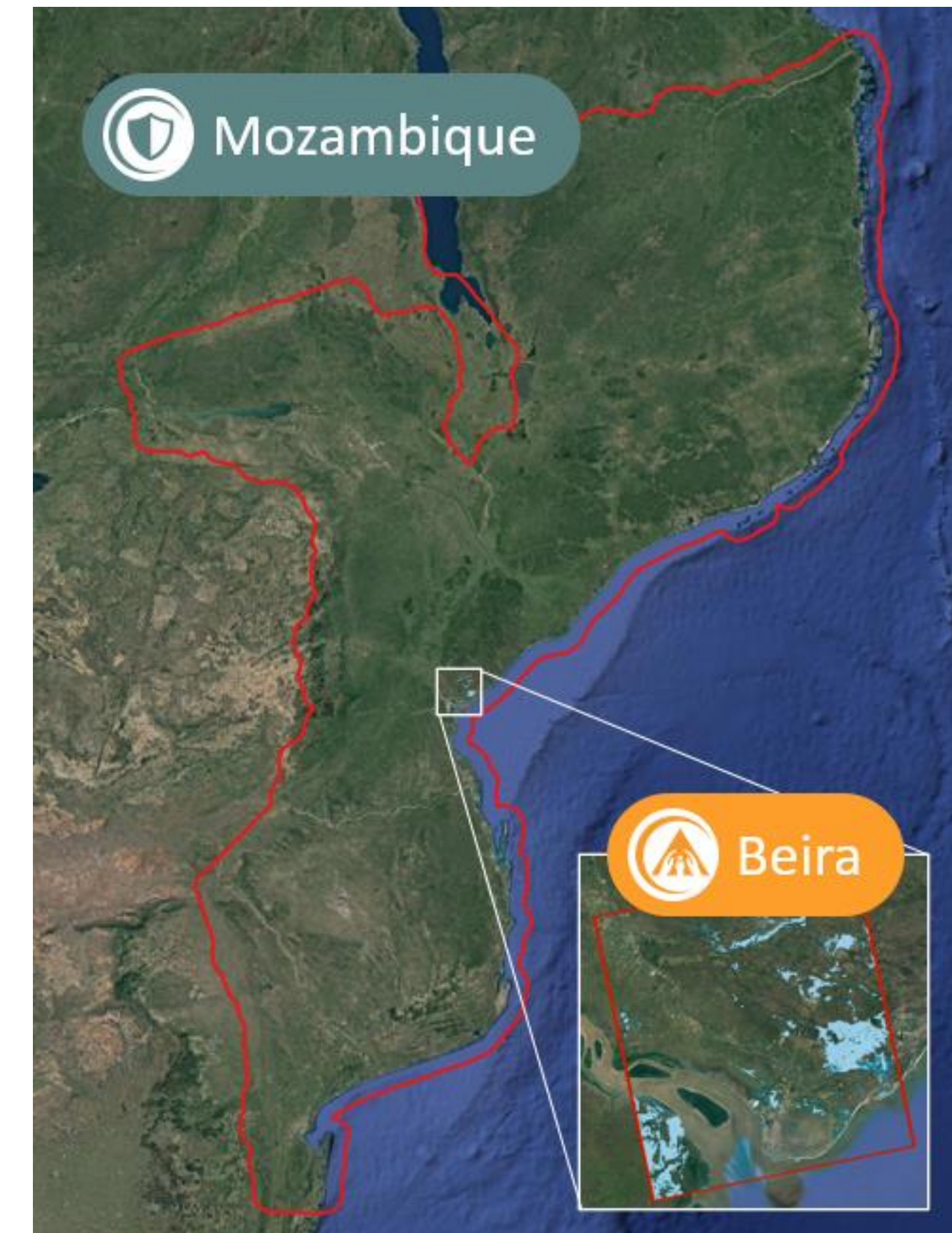
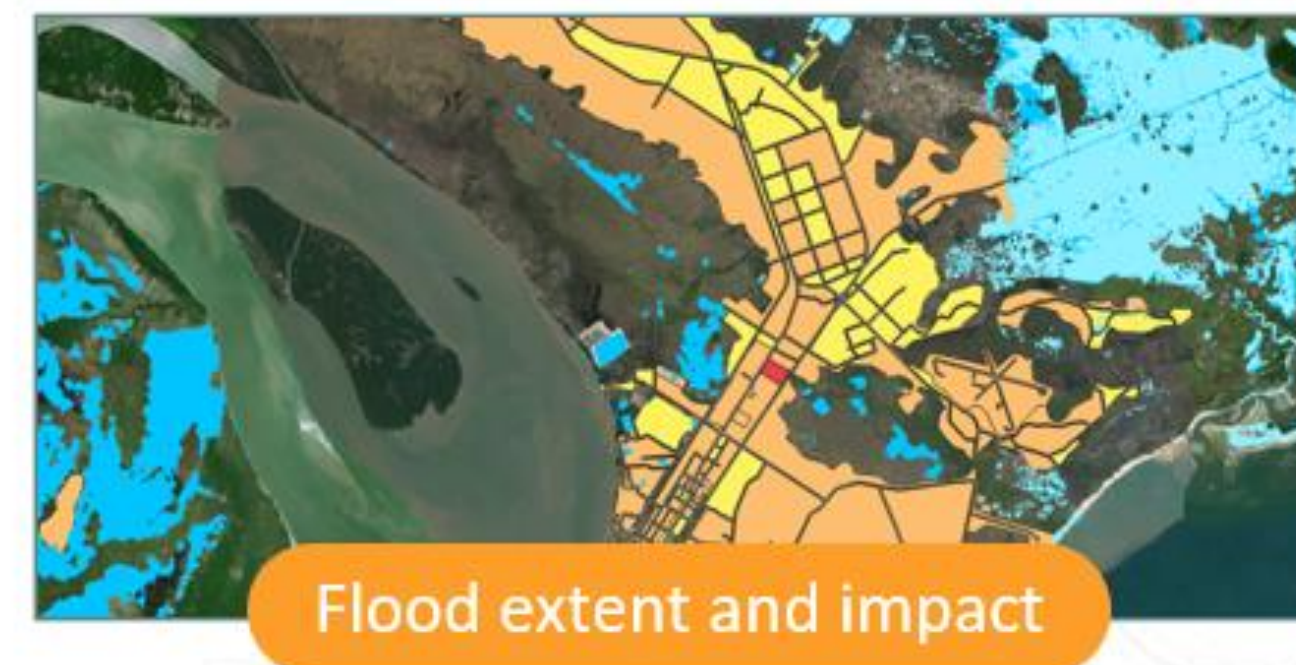


2. Use Cases

2.3 Copernicus Evolution Horizon2021 – CENTAUR

CROSS-CUTTING USE CASE - MOZAMBIQUE

- Conflicts in Mozambique (e.g. Cabo Delgado, 2017) resulting in insecurity, food shortages, disruption in agriculture, population displacement...
- Tropical storms, coastal surges and severe floods resulting in destroyed infrastructures and settlements, homelessness and population displacement, disruption in agriculture, disease outbreaks...
- Common concerns between urban floods (UF) and water & food security (WFS).
- UF – Focus on Beira, a coastal city that has been flooded several times.
- WFS – Focus on the entire country, exposed to extreme weather and instability.



3. Conclusions

- Earth Observation is a very powerful instrument for the provision of information for supporting and monitoring the progress towards SDGs achievements, mostly for the environmental dimension.
- e-GEOS is turning through its operational workflows huge amount of Earth Observation image data into actionable information, providing to its institutional and private customers insights for monitoring and managing their progress towards improved sustainability.

e-geos

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