EYWA
Early Warning System
for Mosquito Borne Diseases

Earth Observation for Epidemics
of Vector-borne Diseases /
EuroGEO Action Group

EuroGEO

EO creates opportunities for Health & Epidemics

EO based Early Warning System for Mosquito-Borne Diseases

An operational application in EU

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National Observatory of Athens

On behalf of the EYWA
EuroGEO Consortium

eo4geo

Copernicus Academy

BEYOND
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LapUp
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MSc Applied Meteorology
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University of Patras

EYWA
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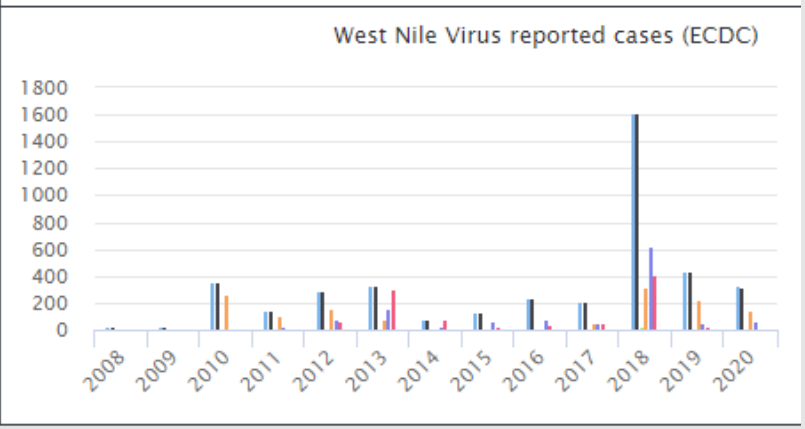
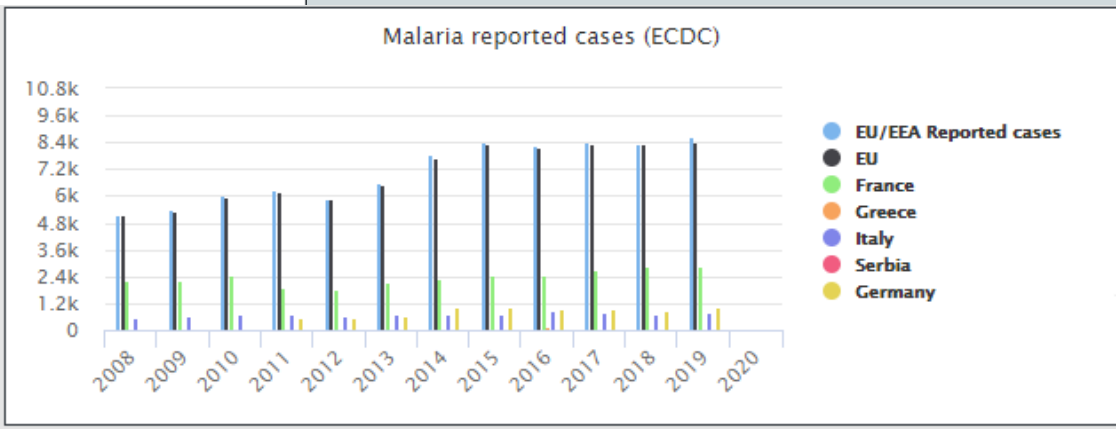
Mosquito-Borne Diseases in Europe
An emerging threat

West Nile Virus:**4226**
Malaria:**85246**
Dengue, Zika and Chikungunya:**30249**
Source: ECDC, EU/EEA Reported cases 2008-2020



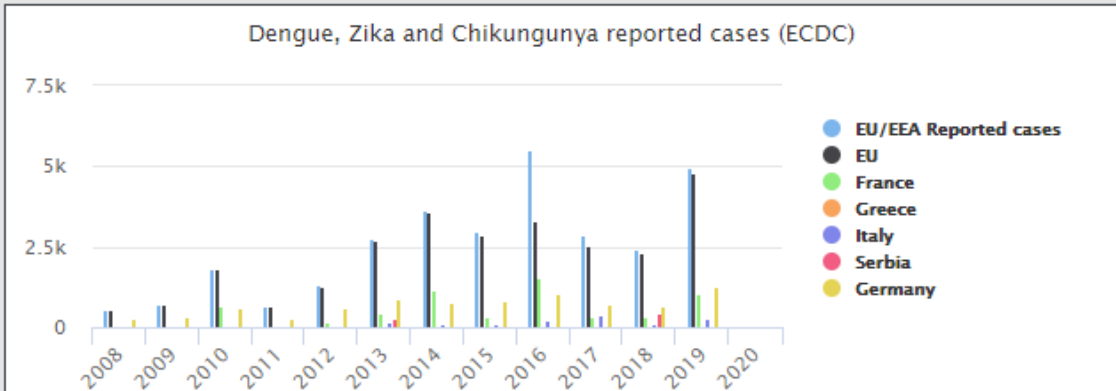


Mosquitoes and Diseases

Culex - West Nile Virus

Anopheles - Malaria

Aedes albopictus - Dengue, Zika, Chikungunya



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Mosquito-Borne Diseases in Europe
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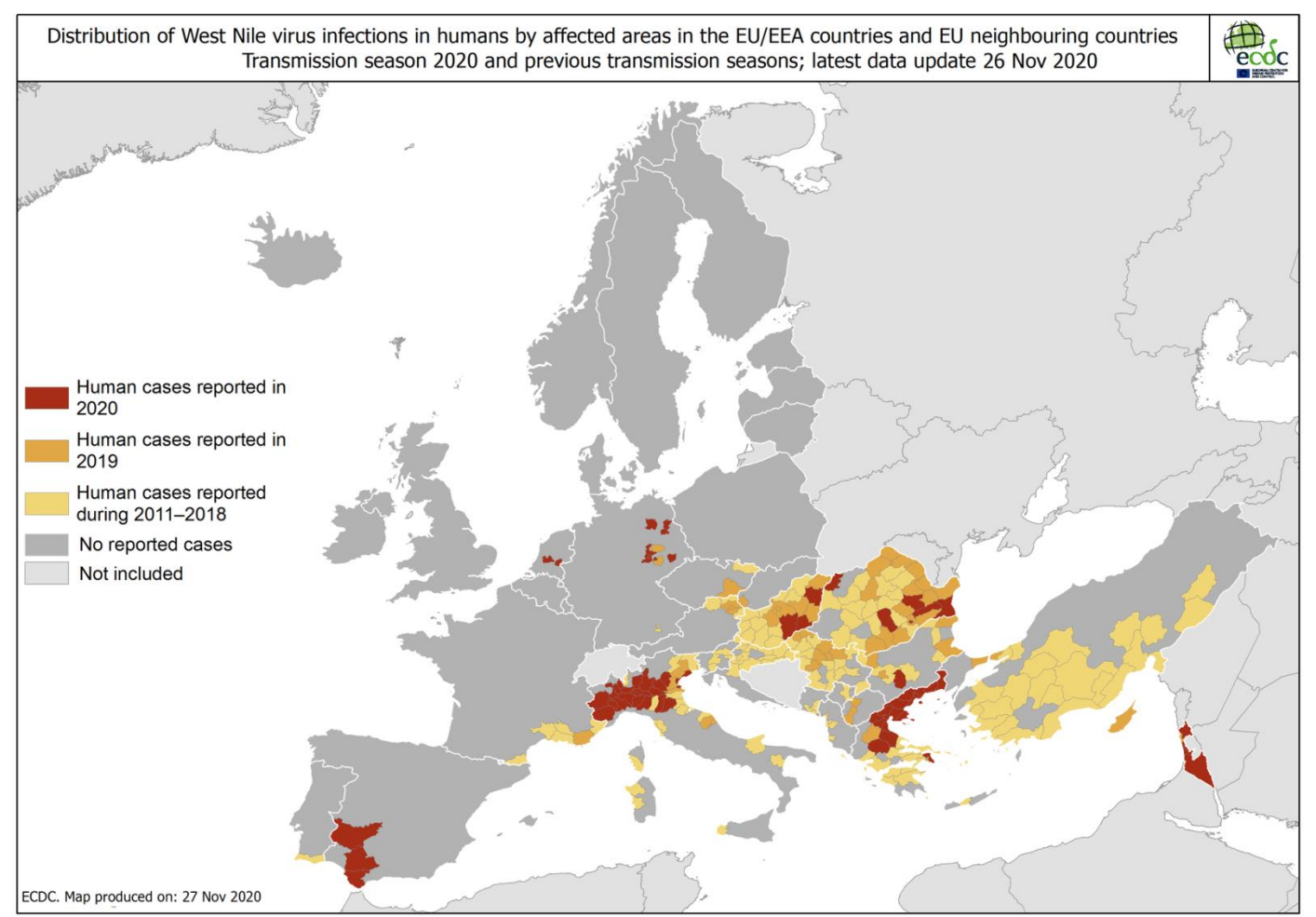

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EuroGEO

Action Group EO4EViDence

(Earth Observation for Epidemics of Vector-Borne Diseases)

EYWA is a vision, a network, a European and even global standard.

EYWA offers a scalable, reliable and sustainable early warning system, relying on Earth observation big data combined with entomological, epidemiological and socioeconomic data, to forecast and monitor Mosquito-Borne Diseases.

SUSTAINABLE DEVELOPMENT GOALS

3 GOOD HEALTH AND WELL-BEING

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

EYWA
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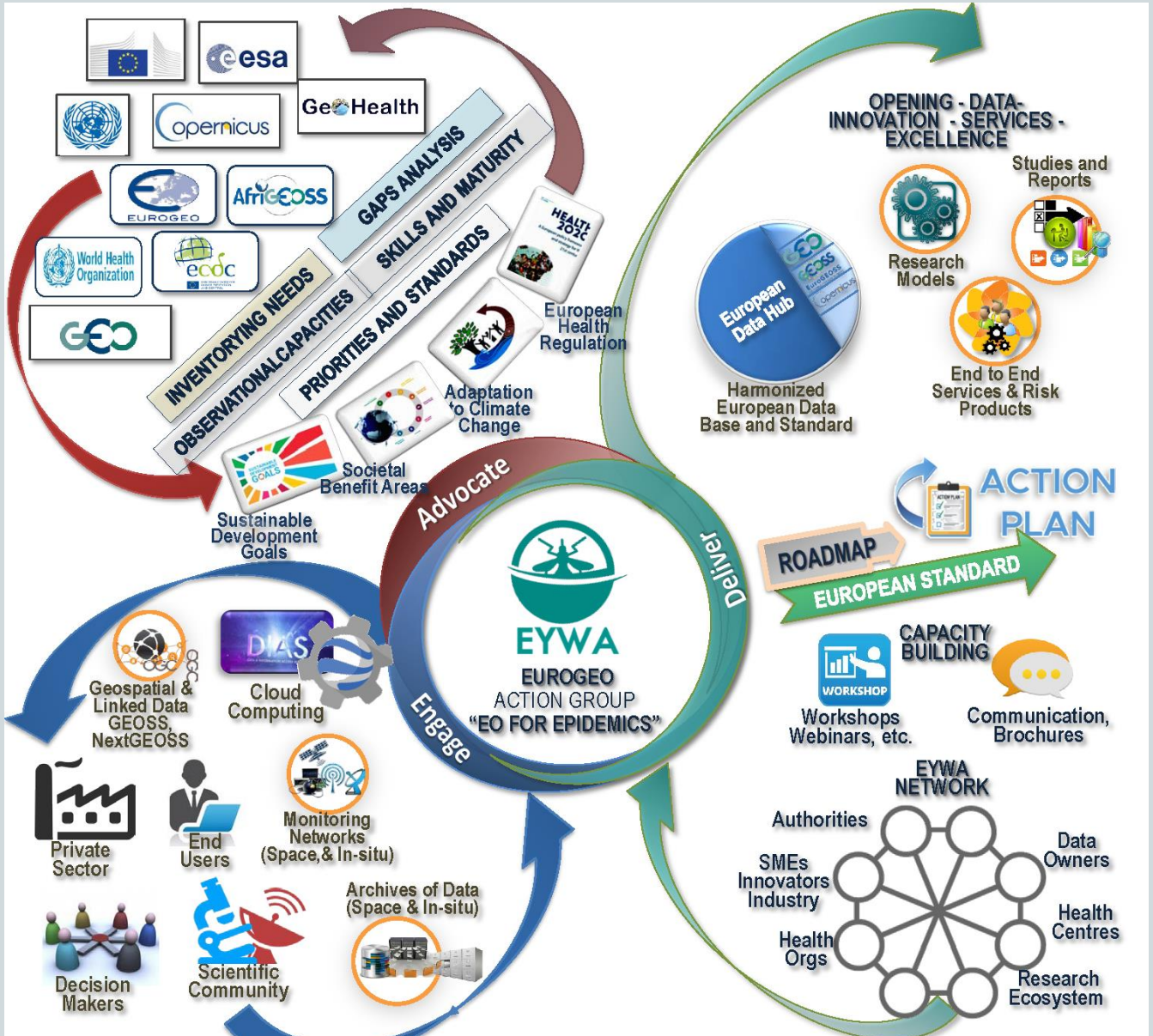
EYWA is built on the GEO triptych:

ADVOCATE
ENGAGE
DELIVER



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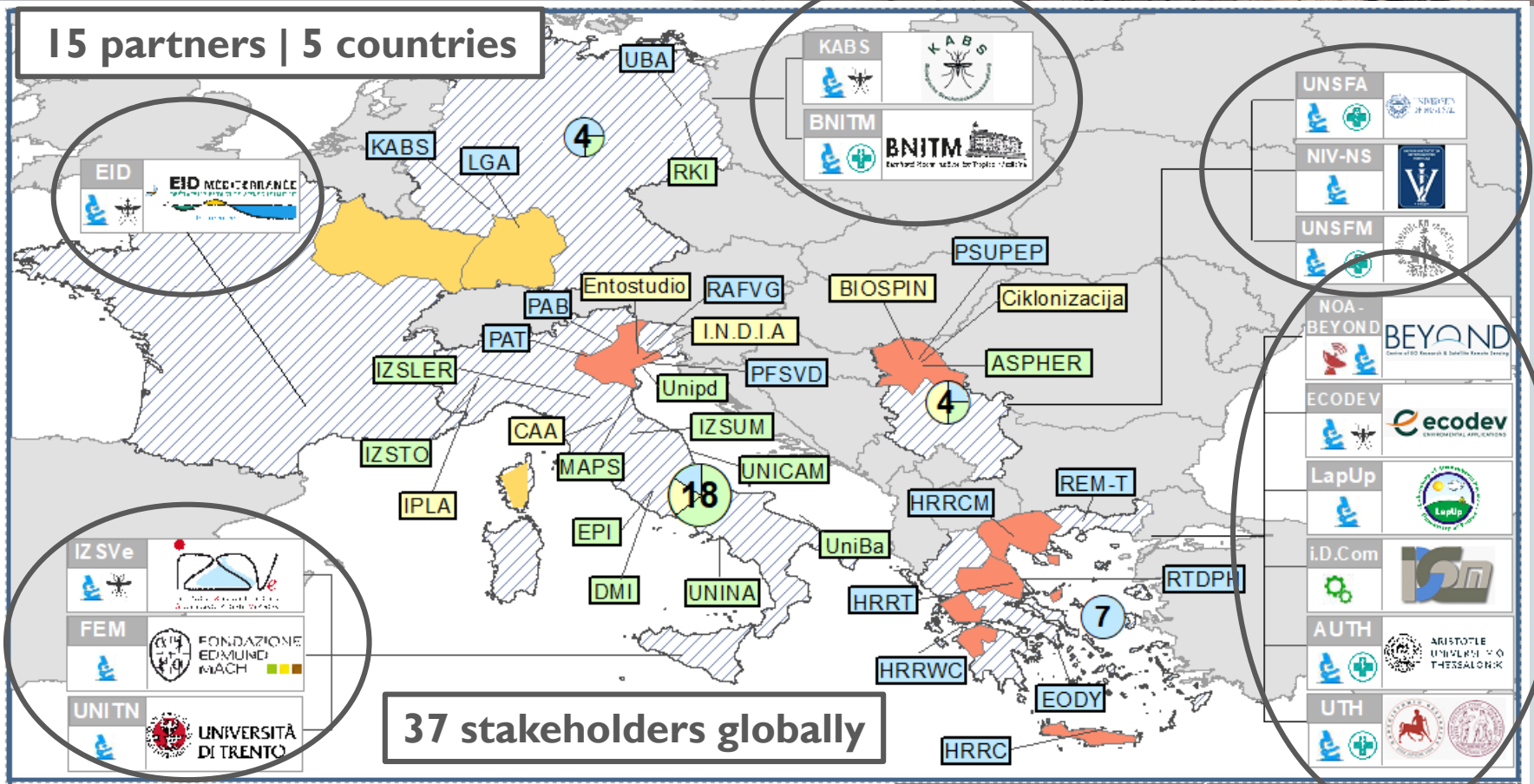


LEGEND

Operational Demonstration
- 2020 TRL>7
- 2021 TRL>7

New engagements
- 2021-2025

PARTNER LOGO

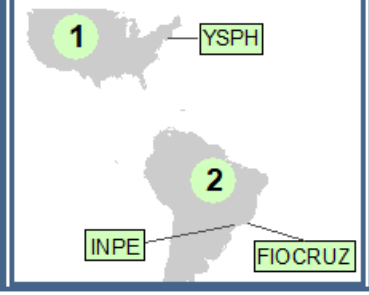
Organization Role
- EARTH OBSERVATION
- SERVICE PROVIDER
- RESEARCH
- MOSQUITOES
- HEALTH

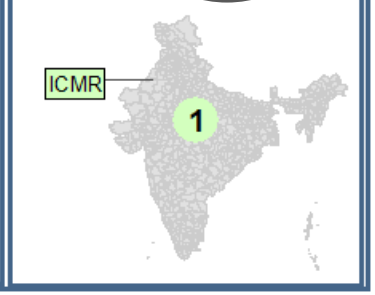
Network of Stakeholders

Number: 1 - 10; 11 - 20

Type: RESEARCH; GOVERNMENT; PRIVATE SECTOR

STAKEHOLDER





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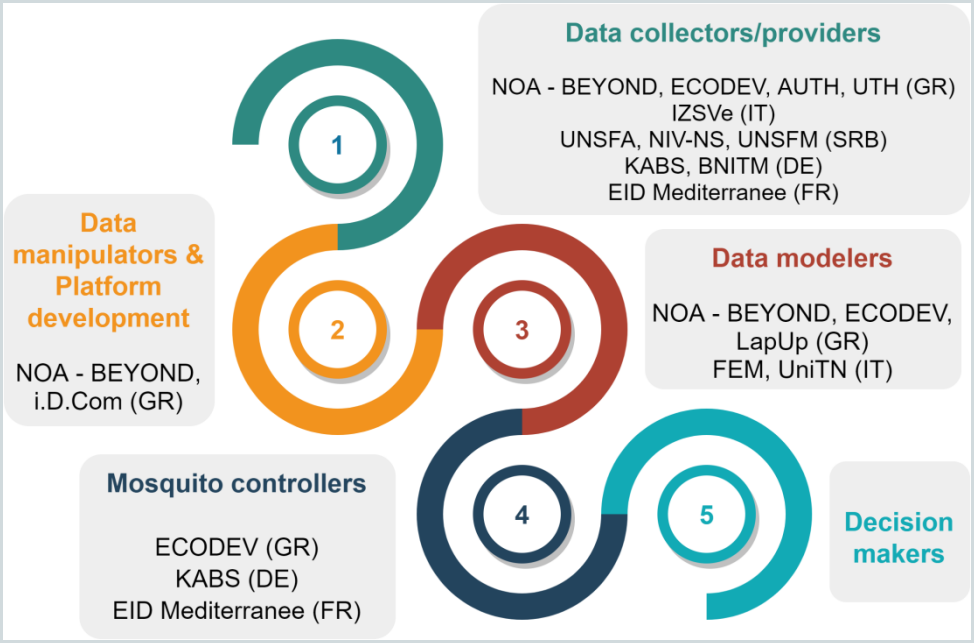
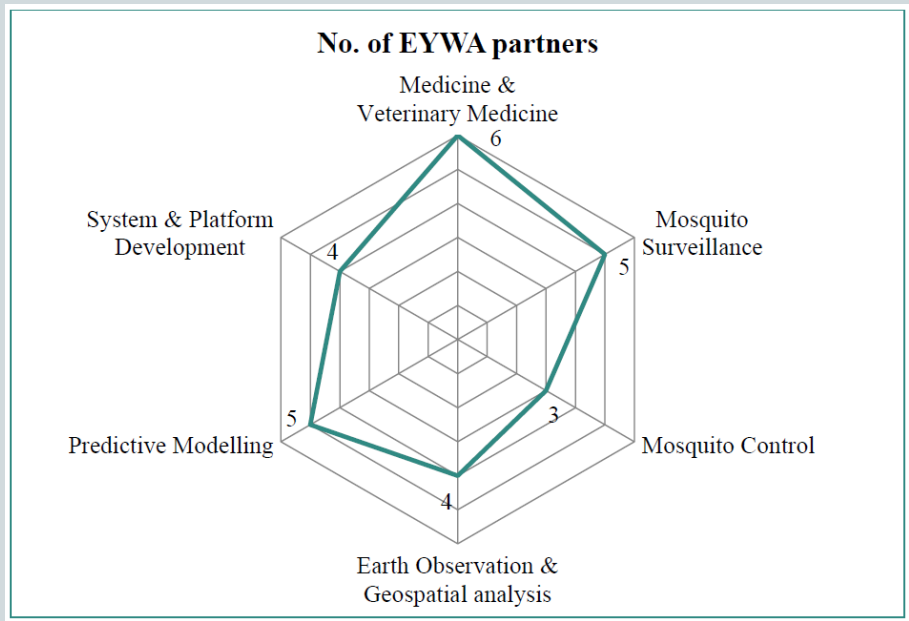
EYWA TEAM
"Together Everyone Achieves More"





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How EYWA competes

Free and open satellite Earth Observation and meteorological data

Open data

European technology

Copernicus Sentinels, CAMS, CLMS, CCS, CreoDIAS, GEOSS, Sentinels Greek Hub, Hellenic Mirror site

Streamlined and automated pipeline for EO, entomological, epidemiological and auxiliary data ingestion

Automation

Scalable

EYWA's generic models are designed to scale-up easily and were in pre-operational phase in 5 European regions

EYWA's generic and site-specific models can be transferred in multiple geographic regions

Transferable

Fully operational

EYWA is in successful operational use since April 2020 in Greece & Italy. From 2021 and onward, will be operational in more countries.

"EYWA is a robust and scalable Early Warning & Decision Support System that welcomes new partners from around the world to share data and transform scientific knowledge into decision-making & mosquito control actions"

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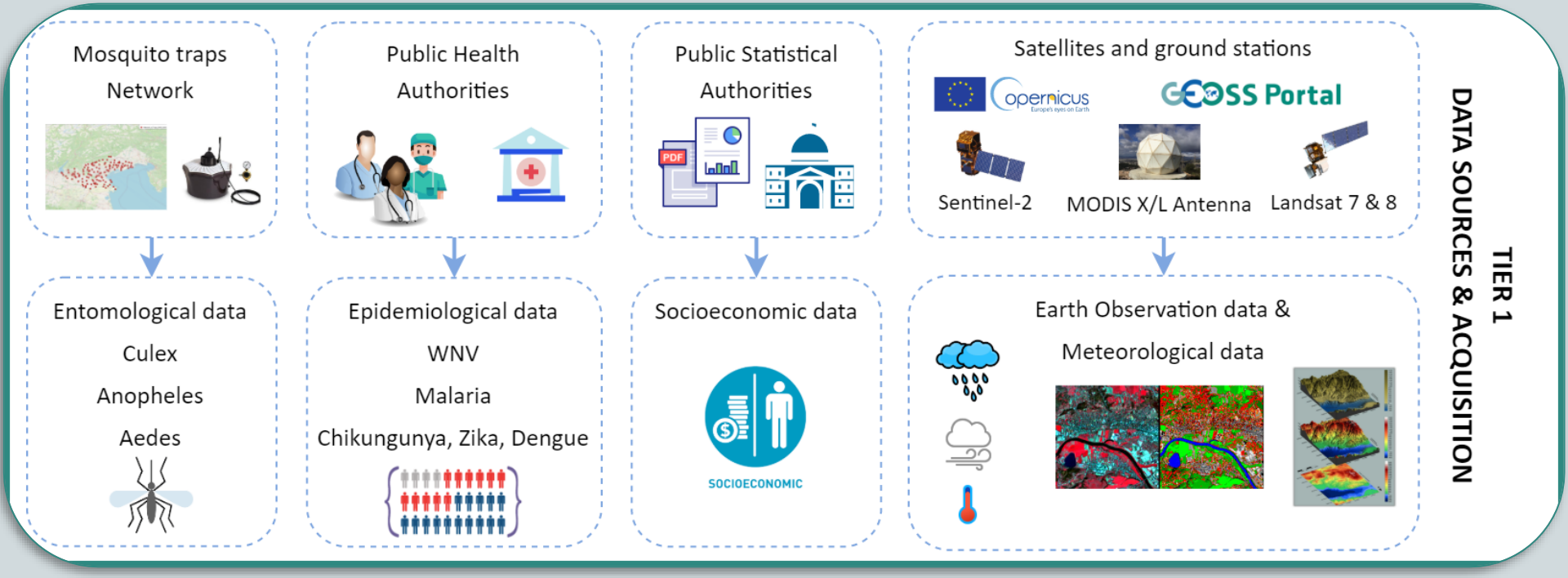
EYWA System Architecture



EYWA incorporates 10-years time-series of Copernicus (Sentinel-2) and other space-based data (Landsat-7 & -8, MODIS and ERA-5) in addition to in-situ entomological, epidemiological, socioeconomic and crowdsourcing data.

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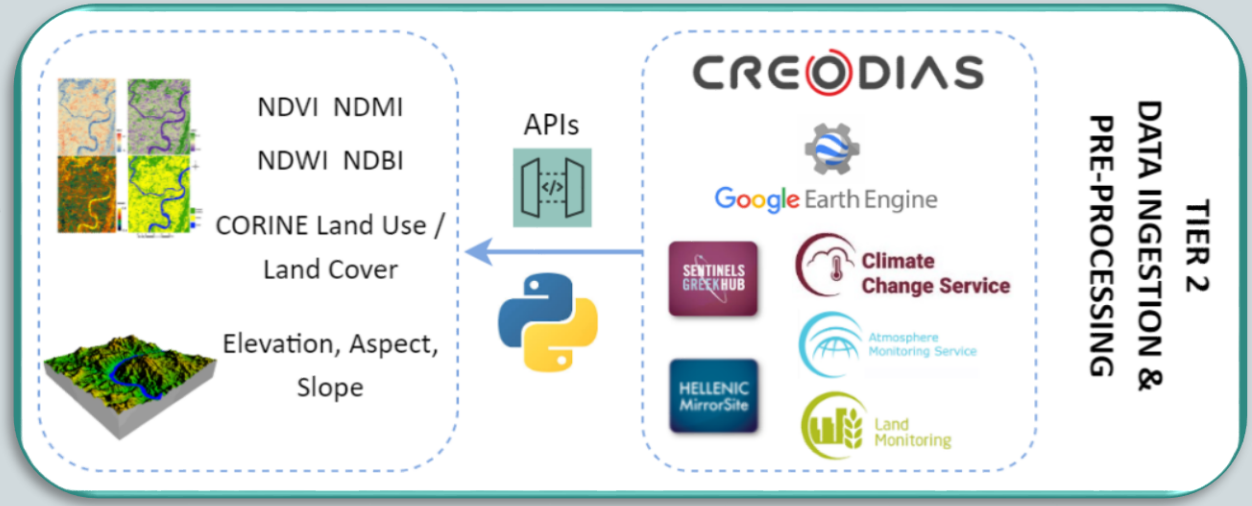
EYWA System Architecture

A suite of APIs is developed and publicly available through BEYOND-NOA's GitHub profile for automatic:

- **Data Harvesting**
- **Data Pre-processing**
- **EO-based indices derivation**



Satellite data harvesting and processing, exploiting European and non-European services:

- Umbrella Sentinel Access Point of the Hellenic Mirror Site (an API that constitutes 100% EU innovation and has been developed by BEYOND-NOA in the framework of the NextGEOSS and EOPEN EU projects)
- CreoDIAS and Google Earth Engine

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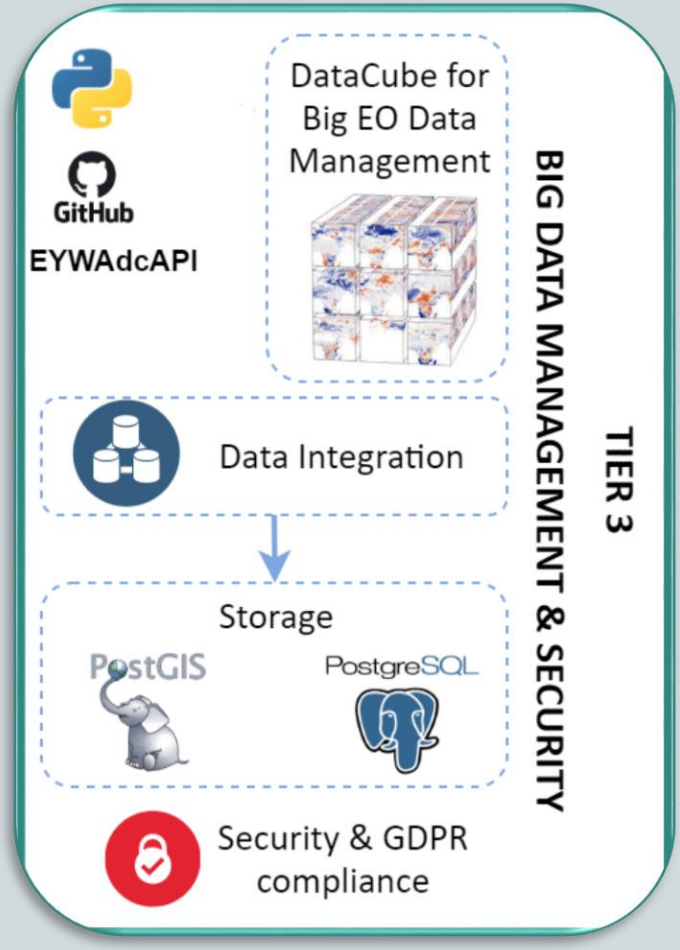
EYWA System Architecture

- Big Data management (**278 TB and counting**)
- Open Data Cube (ODC) technology, state-of-the-art tool for Earth Observation and other data fusion, feature engineering and data analytics
- All these processing steps are available through the dedicated Python API "**EYWAdcAPI**" at BEYOND-NOA's GitHub profile in the epidemics repository



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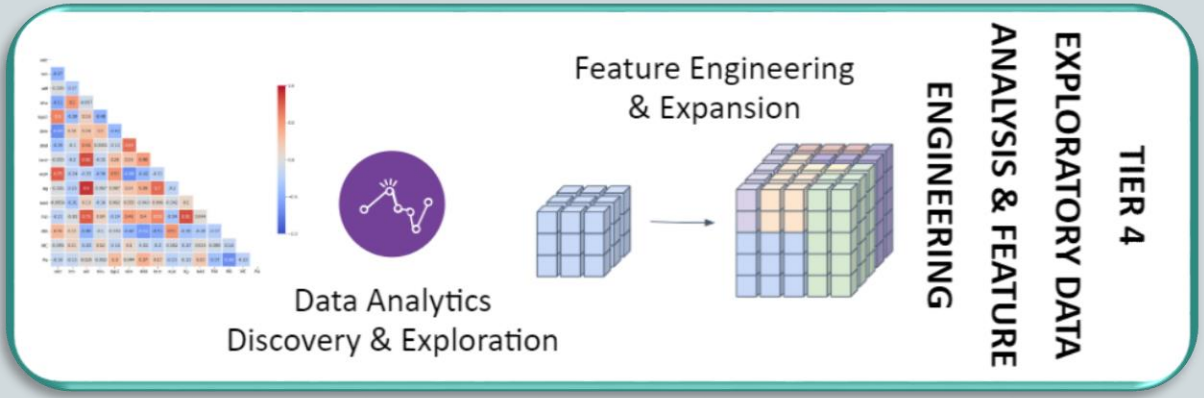
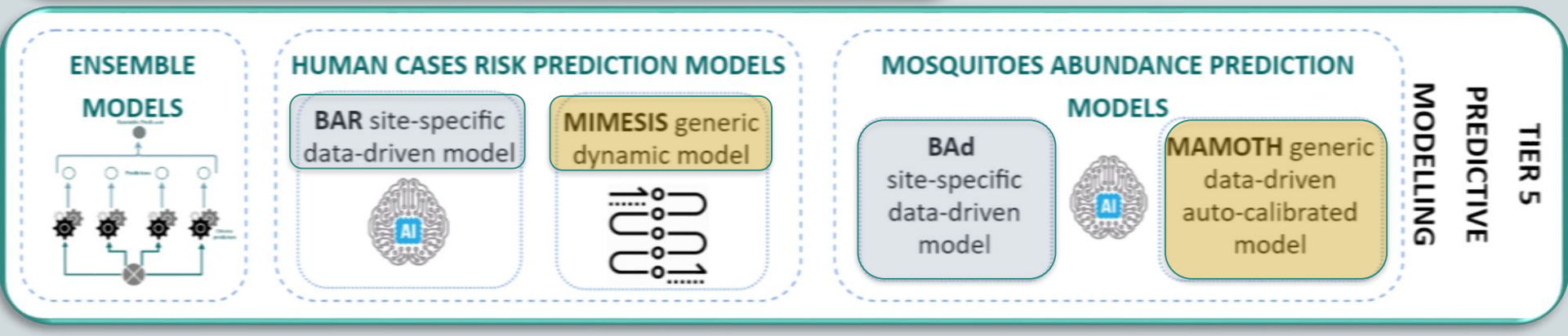


A "mammoth" feature space of at least 10-years time-series of data for every mosquito-traps network in nine regions in Europe.



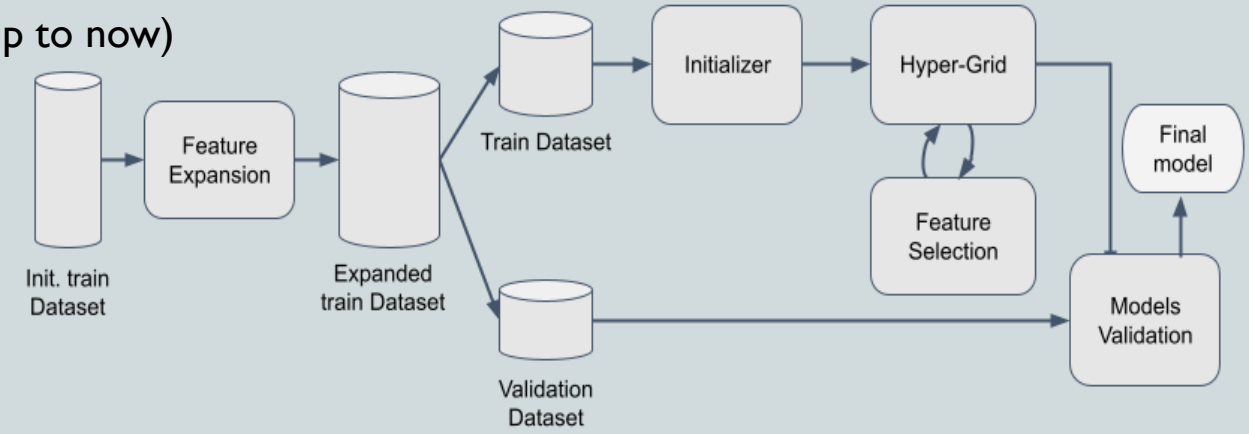
How is this plethora of independent data transformed into meaningful scientific knowledge?

EYWA has a factory of dynamic and data-driven models, learning about the dynamics of mosquitoes' abundance and mosquito-borne diseases transmission, and providing monthly, weekly, daily predictions.

EYWA System Architecture

The MAMOTH model

- **MAMOTH (M**osquitoes **A**bundance prediction **M**odel aut**O**-calibrated from features ple**TH**ora)
- **Generic data-driven** approach relying on open **EO data**
- Automated Feature Selection:
  - **No human bias** on feature selection is injected in the model
  - **Transferable** and **replicable**
- **Knowledge expansion:** Operating under the **same architecture** and the **same mathematical principles** to different cases, offers extensive capability of comparative studies, responding to: "which characteristics seem important in one case and which on the other?"
- MAMOTH is **composed** of 32 (up to now) in-housed developed Python functions that are organized in **5 operational Modules**



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EYWA System Architecture

Predictions results dissemination to the relevant Public Health Authorities through monthly reports and the EYWA Web Platform

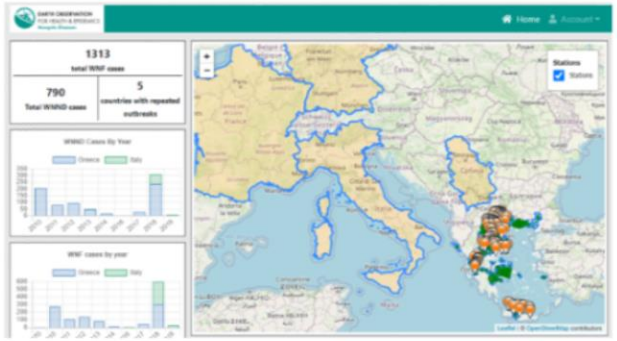
TIER 6 – KNOWLEDGE REPRESENTATION & EXPLANATION

Mosquitoes abundance and human cases risk prediction maps & statistics

Reports for end-users

TIER 7 – EYWA WEB SERVICES

Web Platform UI



Mosquito Vision application

End-users

Data
- visualization
- upload
- download

Open data sharing through the **EYWAopenAPI**

NEXTGEOSS

GEOSS Portal

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EO creates opportunities for Health & Epidemics

EYWA & open data sharing

NEXTGEOSS DataHub & EYWAopenAPI

EYWA is an autonomous European Initiative, building upon the Open Innovation, Open Science and Open to the World vision for Europe.

Analysis ready 10-years' time-series of environmental, meteorological and geomorphological data for every mosquito-traps network in 10 European regions. Accessible through:

- The "EYWAopenAPI" (http://epidemics.space.noa.gr/api_v2/)
- NextGEOSS DataHub

Who is it for?

Public Health Professionals

Scientists

Public

EYWA in Action

EYWA's **operational implementation in 2020** (TRL>7) with a demonstrated impact in:

- Greece (Regions of Central Macedonia, Thessaly, Western Greece and Crete)
- Italy (Veneto region)

forecasting *Culex* mosquito populations and West Nile Virus outbreaks in 2020.

EYWA's **pre-operational test in 2020** for:

- *Culex* (WNV) abundance prediction in Serbia (Vojvodina region) and Germany (Baden-Württemberg region)
- *Anopheles* (Malaria) in Italy (Veneto region)
- *Aedes albopictus* (Chikungunya, Dengue, Zika) in France (Grand Est and Corsica regions)

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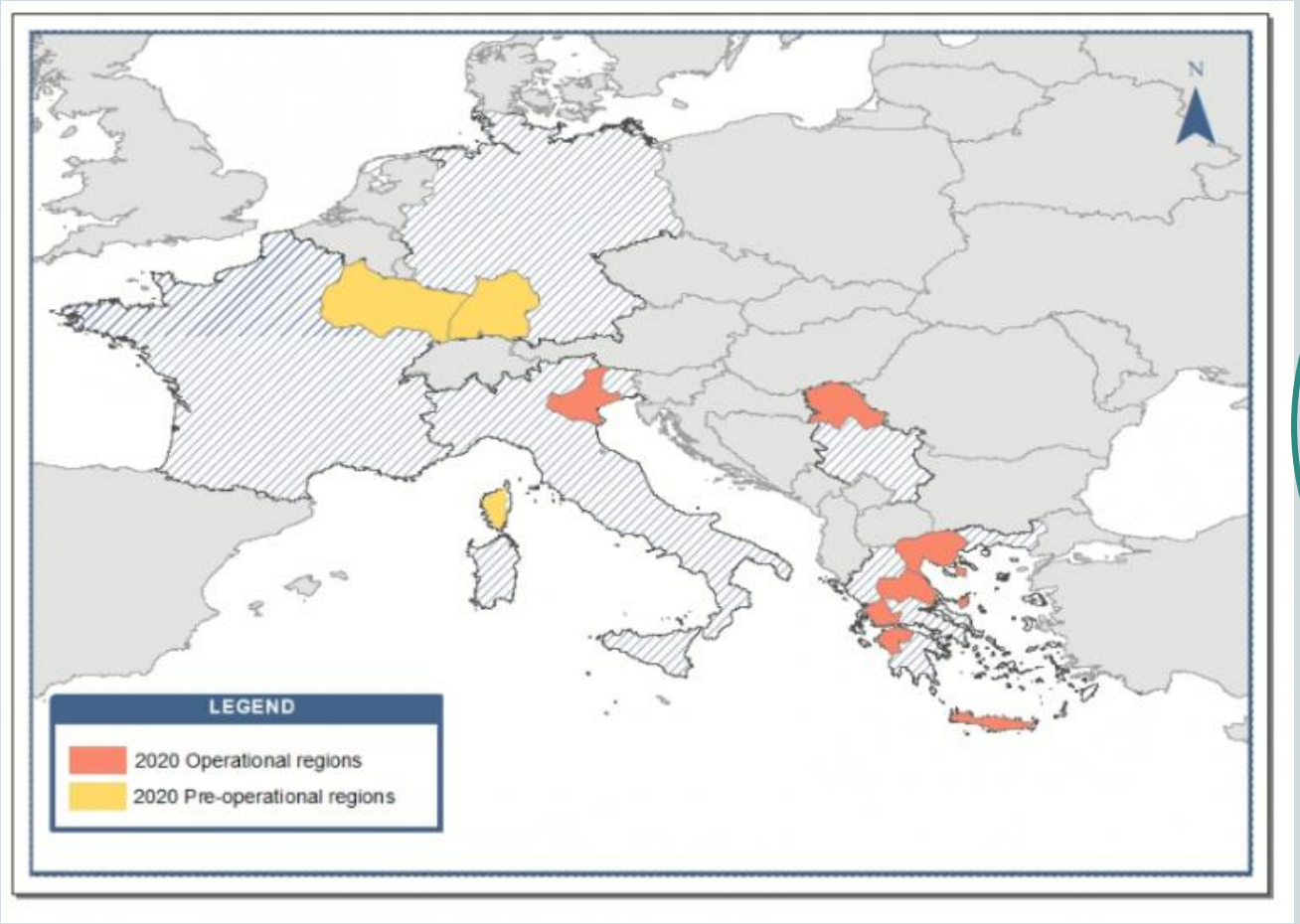
EYWA in Action



EYWA is now fully operational in all these areas and started delivering results again for the 2021 mosquito season in the end of April.

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EYWA in Action

Reports with operational results

EYWA produces knowledge in the form of reports, statistics, validated assessments and web GIS information layers, all available to the end-users through the EYWA Web Platform.

The EYWA Reports are delivered operationally from April to October every year to the relevant Public Health Authorities and decision makers.

The monthly reports assist the authorities in organizing their mosquito control strategy and actions. Measurable performance indicators are used to evaluate the level of EYWA's effectiveness toward the protection of the engaged communities against the disease outbreak.

The reports indicate

- Up-to-date epidemiological status of the Region
- The state-of-the-art models used
- The mosquito abundance predictions for the month
- The estimated human risk

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EYWA in a nutshell

- Plethora of satellite Earth Observation data
- Entomological, epidemiological, crowdsourced, socioeconomic and auxiliary data
- State-of-the-art technological tools

Leveraging scientific knowledge and ultimately proving that EO can upend our understanding in the field of epidemics

The pivotal role of EYWA is to become a key lever for Public Health authorities and decision makers, support preparedness and timely strategic design of the health system response actions, and raise citizens awareness on the expected risk, with a view to fight Mosquito-Borne Diseases.

Thank you!

Partners

Greece

National Observatory of Athens (NOA) – BEYOND Centre of EO Research & Satellite Remote Sensing

Ecodevelopment S.A

University of Patras – Physics Department - Laboratory of Atmospheric Physics (LapUP)

Dimitrios Vallianatos (IDCOM)

Aristotle University of Thessaloniki

University of Thessaly, Medical School. Laboratory of Hygiene and Epidemiology

Italy

Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe)

Edmund Mach Foundation

University of Trento

Serbia

University of "Novi Sad", Faculty of Agriculture, Laboratory for Medical and Veterinary Entomology

Scientific Veterinary Institute "Novi Sad"

University of Novi Sad, Faculty of Medicine

Germany

German Mosquito Control Association (KABS)

Bernhard Nocht Institute for Tropical Medicine

France

EID Méditerranée

Contact us

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(Lead Partner of EYWA)

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