



EYWA: A key tool to the epidemics arsenal

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

EuroGEO



Winner of the first "EIC Horizon Prize
on Early Warning for Epidemics"



Introduction | A global problem

- ❑ **Climate Change, globalisation** and other drivers are altering ecological conditions for **mosquitoes**.
- ❑ [Mosquito-Borne Diseases \(MBDs\)](#) are present in **over 100 countries**.
- ❑ [700,000 deaths](#) per year.
- ❑ **Malaria**, most lethal for kids aged under five in the sub-Saharan regions.
- ❑ **Europe** a “hot spot” of **West Nile Virus**.
- ❑ **Chikungunya** and **dengue fever** increased [40% over 1950](#)¹.

Working towards a solution

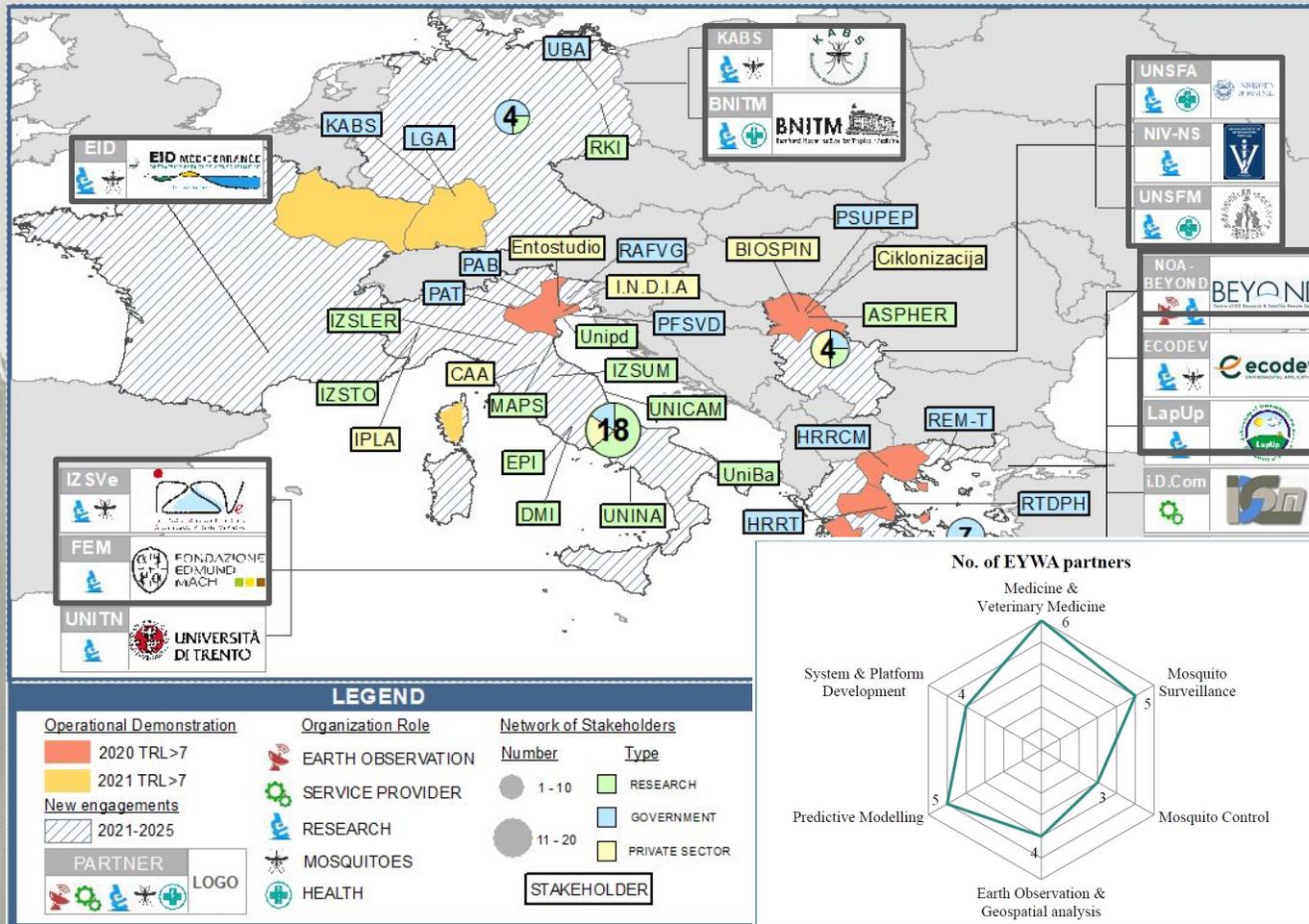
- ❑ **Need to control** this **threat** gave birth to the **EYWA early warning system**.
- ❑ **EYWA**: outcome of a 3-year voluntary action.
- ❑ **Vision**: EYWA as a **key tool** to the epidemics arsenal.
- ❑ **State of the art tool guiding**:
 - Vector preventive/control actions.
 - targeted door-to-door awareness.
- ❑ **Diverse domains of expertise**:
 - **Earth Observation**,
 - Advanced **epidemiological** and **entomological** modeling,
 - **Artificial Intelligence/Machine Learning, Big data** analytics.
- ❑ Operational since **2020**.
- ❑ **2021**: **10 regions** in **5 European countries** (**France, Germany, Greece, Italy, Serbia**).
- ❑ **2021**: joining e-shape project, expanding to **Cote d'Ivoire** and **Thailand**.
- ❑ **EYWA**: **1st European Innovation Council Horizon Prize on Early Warning for Epidemics!**



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Who are we

EO creates opportunities for Health & Epidemics



EYWA team

15 partners
5 countries (~30M citizens)

National/International Roles as Reference Entities

Data Handling, Mosquito Surveillance & Control, Medical & Veterinary Medicine from all 5 countries:

BEYOND/NOA, ECODEV, LapUp, AUTH, UTH (GR)
 IZSVe, FEM (IT)
 UNSFA, UNSFM, NIV-NS (SRB)
 KABS, BNITM (GER)
 EID-Mediterranee (FR)

BEYOND/NOA: Crosscutting role for Big Data manipulation, standardisation, harmonization & storage.

Predictive modelling: BEYOND/NOA, ECODEV, LapUp

System, Web Platform and mobile applications development: BEYOND/NOA, i.D.Com, ECODEV, LapUp

EYWA engages 40 stakeholders globally up to now & has received Letters of Support from: Germany, Italy, Serbia, Greece, USA, Brazil & India

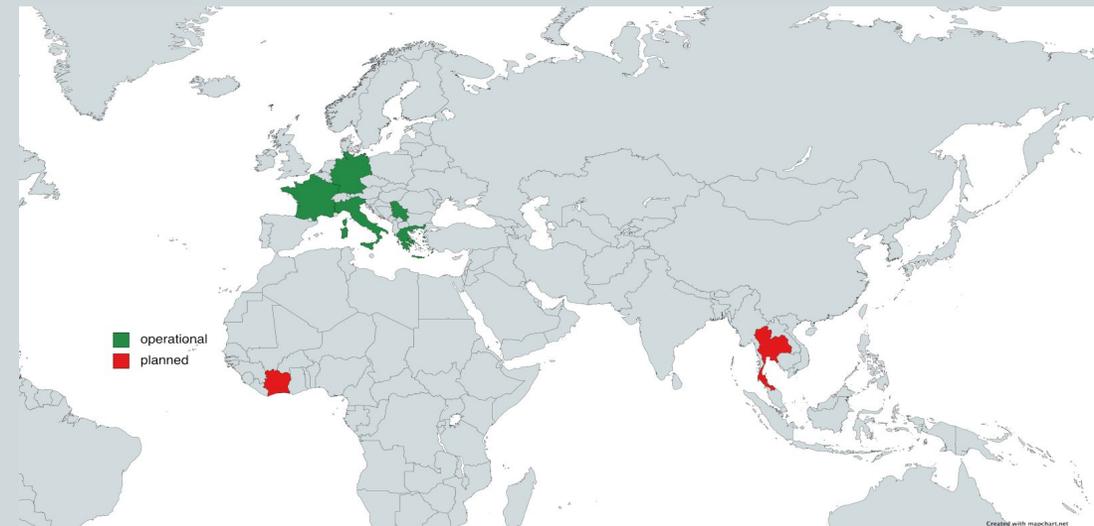
211 publications & more than 44,450 citations

Reaching out globally

- ❑ **EYWA** engages **>40 stakeholders** at a **European** and **global** level.
- ❑ **EYWA** signed an **MoU** with **EC's Joint Research Center (JRC)** to **expand** and **exploit the innovation**.
- ❑ EYWA to provide support to **European Health Emergency and Response Authority (HERA)**.
- ❑ **Participation** in: **GEO Health Community of Practice, GEO & EuroGEO Symposiums, GEO-CRADLE Initiative, EO4GEO community.**

Expanding the service to non-European territories

- ❑ **Onboarded to e-shape H2020 project** with the major goal of **expanding** the support of the services to **non-European territories**, specifically **Thailand** and **Côte d'Ivoire**.
- ❑ **Expand the database of entomological & epidemiological data**
- ❑ **Train and adapt** the models to new regions with different **climatic** and **socioeconomic** conditions.
- ❑ **Strengthen the models.**
- ❑ **Supporting awareness campaigns.**



What does EYWA provide?

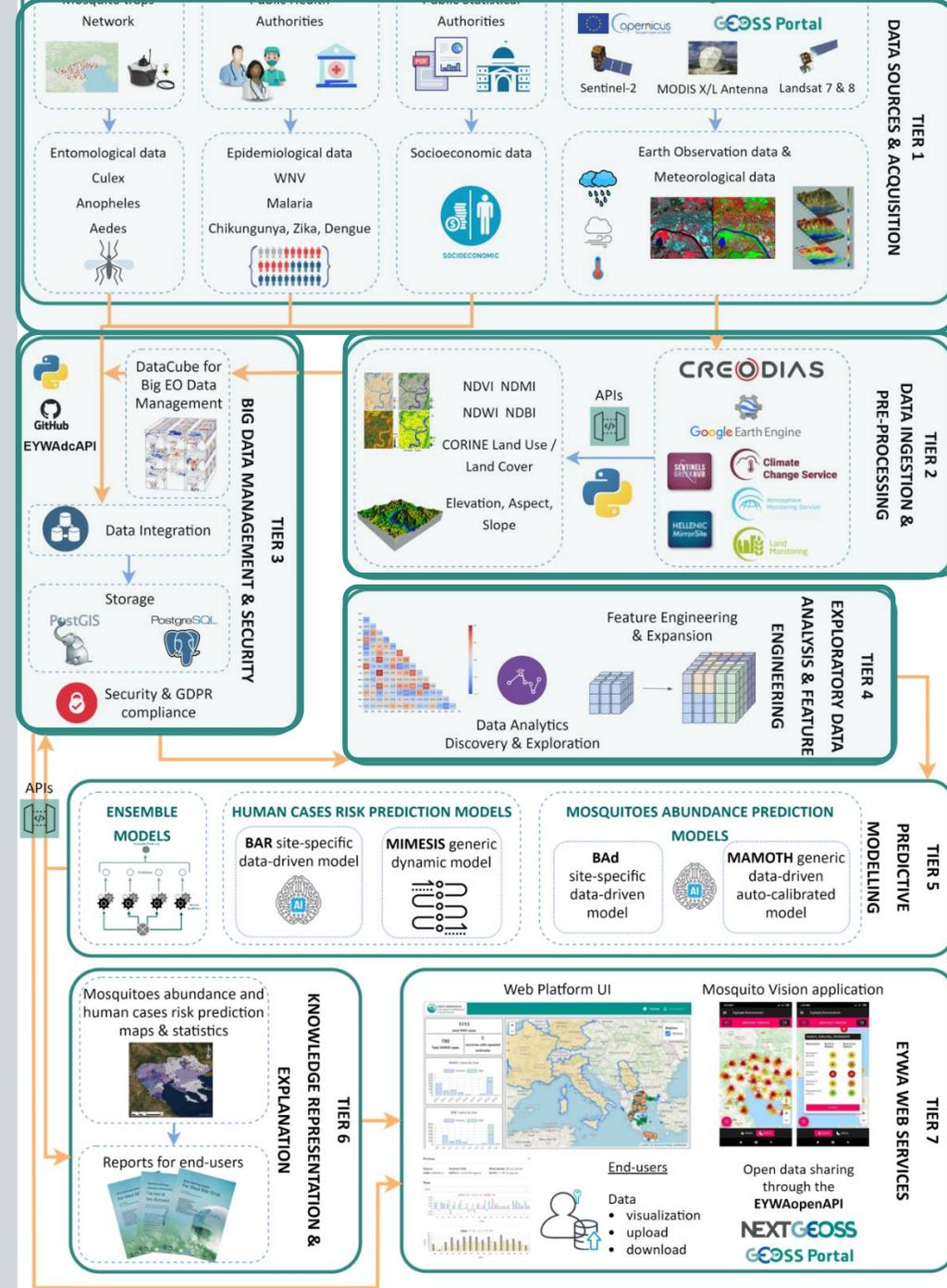
- **MIMESIS(Uni of Patras), BAr(ECODEV) WNV risk models.**
 - **Municipality/Settlement level**
 - **4 regions in Greece and 1 region in Italy**
 - Support preventive actions
 - **Door to door awareness**
 - **2021: > 31,000 households in Central Macedonia, Greece.**
- **BAd(ECODEV) mosquito abundance model.**
 - **Settlement level.**
 - **4 regions in Greece**
 - **Mosquito Vision: notifications through app >2400 villages in Greece**
- **MAMOTH(NOAA) mosquito abundance model.**
 - **Trap level.**
 - **4 European countries in 2021, more in 2022.**
 - **Culex, Aedes albopictus and Anopheles.**

Using Satellite Earth Observation

- ❑ **Environmental variables** (geographical, climatological, and hydrological) that influence MBDs can be monitored from satellites[1].
- ❑ **West Nile Virus specific:**
 - **Temperature** (positive correlation)
 - **Rainfall** (positive correlation)
 - **Elevation** (negative correlation)
 - **Normalized Difference Vegetation Index** (positive correlation)
 - **Land use, specifically irrigated crops and populated forests** (positive correlation)

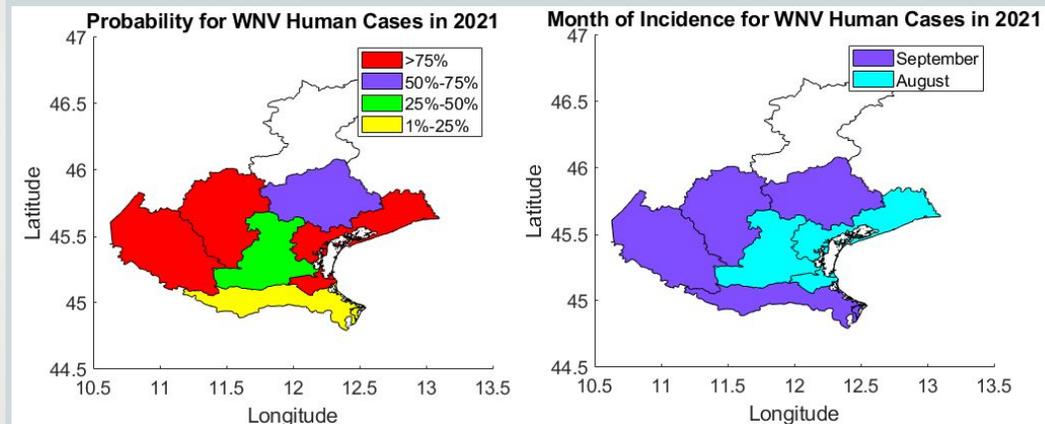
Making it work

- ❑ Time-series **entomological, epidemiological, socio-economic, satellite Earth Observation, meteorological and geomorphological** data
- ❑ 36 features for each of the 39.000 mosquito collections in our database.
- ❑ A “MAMOTH” feature space **10-years time series of data** for mosquito-traps network in **10 regions** in Europe.
- ❑ Data opened & disseminated through NextGEOSS
- ❑ **Environment proxies** (Sentinel 2, Landsat 7/8):
 - Normalized Difference Vegetation Index (**NDVI**)
 - Normalized Difference Moisture Index (**NDMI**)
 - Normalized Difference Water Index (**NDWI**)
 - Normalized Difference Build-Up Index (**NDBI**)
- ❑ **Meteorological Data (Copernicus ERA-5, MODIS, IMERG):**
 - Wind, Land Surface Temperature (**LST**), Rainfall
- ❑ **Geomorphological Data (Alos Palsar, Copernicus Water & Wetness):**
 - Elevation, Aspect, Slope
 - Composite features

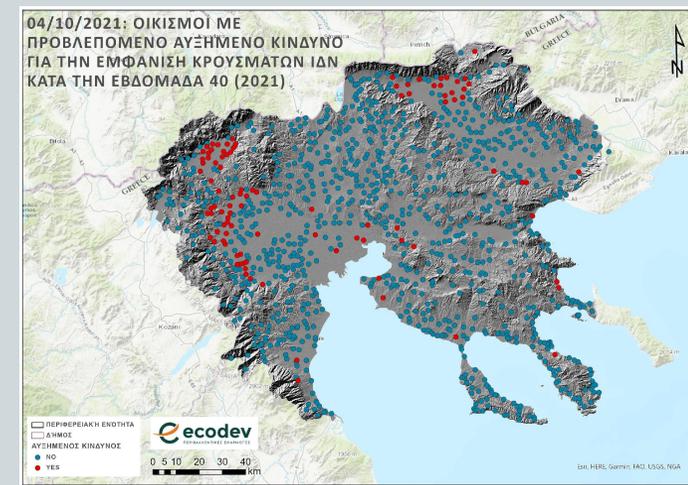


What is disseminated?

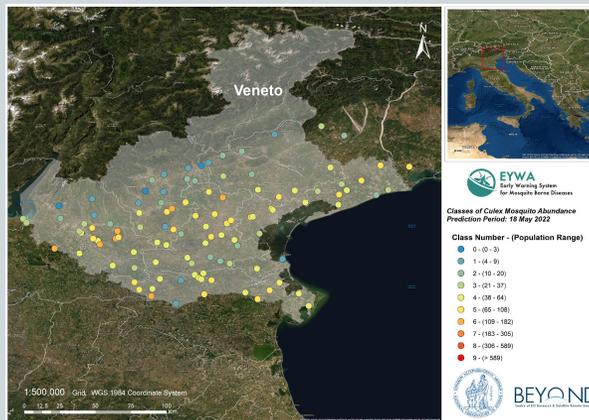
MIMESIS: West Nile Virus human risk



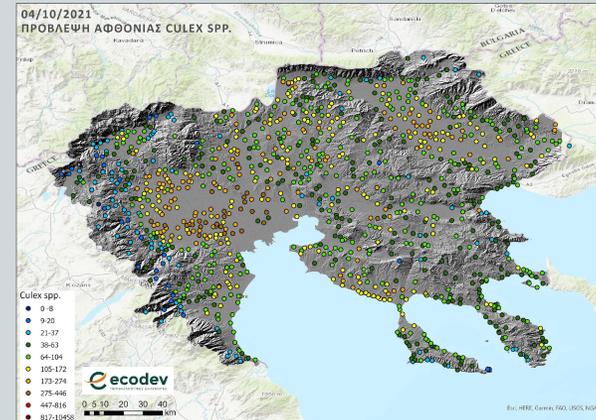
BAR: West Nile Virus human risk



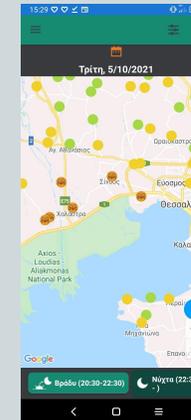
MAMOTH: Mosquito Abundance



BAd: Mosquito Abundance



Mosquito Vision



What is disseminated?

EO creates
opportunities
for Health &
Epidemics



Entomological Data

Epidemiological Data ▾

Mosquitoes' Abundance Predictions ▾

Human Cases Risk Predictions ▾

EYWAopenAPI

Reports

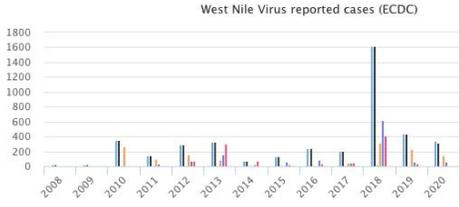


Entomological Data

West Nile Virus:4226
Malaria:85246
Dengue, Zika and Chikungunya:30249

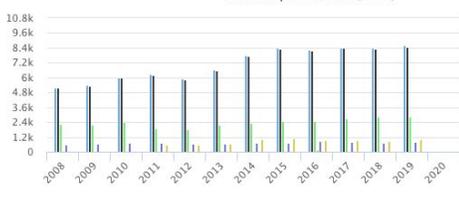
Source: ECDC, EU/EEA Reported cases 2008-2020

West Nile Virus reported cases (ECDC)



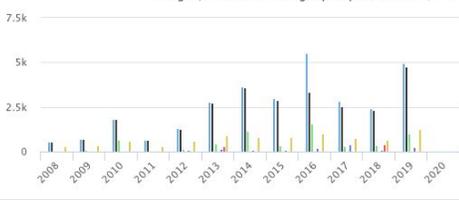
- EU/EEA Reported cases
- EU
- France
- Greece
- Italy
- Serbia
- Germany

Malaria reported cases (ECDC)



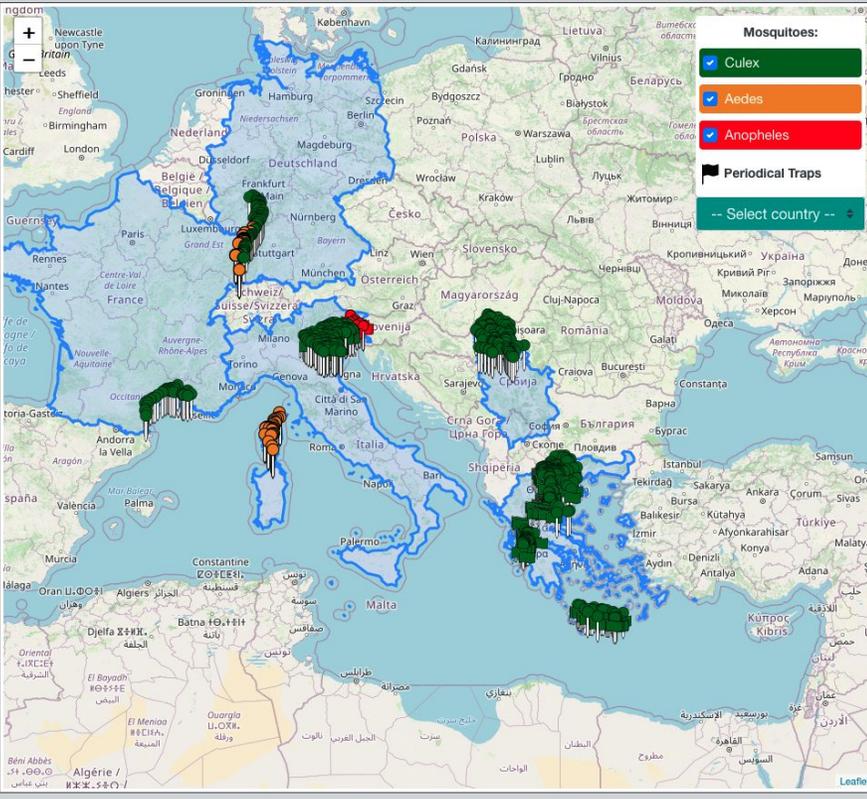
- EU/EEA Reported cases
- EU
- France
- Greece
- Italy
- Serbia
- Germany

Dengue, Zika and Chikungunya reported cases (ECDC)



- EU/EEA Reported cases
- EU
- France
- Greece
- Italy
- Serbia
- Germany

demo ▾



Mosquitoes:

- Culex
- Aedes
- Anopheles

Periodical Traps

-- Select country -- ▾

EYWA outreach after our distinction Prize European Commission

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opportunities
for Health &
Epidemics



EARLY WARNING
FOR EPIDEMICS

EIC HORIZON
prize

“ My sincere congratulations to EYWA – the winner of the EIC Horizon Prize on Early Warning for Epidemics. The solution, based on Earth observation and other data, improves Europe’s preparedness to fight vector-borne diseases, also addressing the effects of climate change on human health, at home and abroad. A special mention goes to the other two finalists of this important prize, D-MOSS and FARSEER, for their outstanding work. I am both proud and grateful that European excellence has demonstrated once again to be capable of providing solutions to global challenges. ”

Mariya Gabriel
Commissioner for Innovation, Research, Culture, Education and Youth

[#eicHorizonPrize](#)




European Commission

EARLY WARNING FOR EPIDEMICS

EIC HORIZON **prize**

PRIZE WINNER

Project EYWA





EYWA system wins the 1st EIC Horizon Prize on Early Warning for Epidemics

In April 2018, the European Commission launched a €5 million prize for an early warning system for epidemics.

The prize rewards the development of a scalable, reliable and cost-effective early warning prototype system based on Earth Observation data to forecast and monitor outbreaks of vector-borne diseases.

EYWA | The Winner of the EIC Horizon Prize on Early Warning for Epidemics

Developed in the context of EuroGEO Action Group "Earth Observation for Epidemics of Vector-borne Diseases - EO4EVIDence", Early Warning System for Mosquito-borne Diseases (EYWA) is a game changer in the domain of epidemics. It transforms scientific knowledge into decision-making and contributes significantly to combating and controlling the threat of mosquito-borne diseases.

The solution enhances mosquito surveillance and control at various spatio-temporal scales and in different climatic zones, and guides day to day prevention and mitigation actions. It significantly reduces the entomological risk and results in the aversion of human cases in thousands of villages where EYWA is employed.

The technological novelty of EYWA lies in the efficient handling of multiple data sources such as entomological, epidemiological, Earth Observation, crowd and ancillary geospatial data, along with dynamic and data driven models to generate knowledge on the mosquitoes' abundance and pathogens' transmission. Thanks to data provided by Copernicus satellites and Copernicus Core Services, EYWA reliably depicts the dynamics of mosquito habitats and breeding sites. The system capitalizes on European investments in Earth observation and cloud-based data repositories and capacities (i.e. DIAS, GEOSS, NextGEOSS).



EYWA was recently onboarded as a pilot to the [e-shape](#) community with the main objective to further augment the database of entomological data from non-European territories and evolve the suite of predictive models to include non-European areas where the climate conditions are very different to those found in Europe.

This accomplishment is a significant milestone and an exceptional example of the unlimited Earth Observation power and the societal benefits that can derive from harnessing space technology.

EYWA partners

Partner	Country
National Observatory of Athens (NOA) – BEYOND Centre of Earth Observation Research and Satellite Remote Sensing	Greece
Ecodevelopment S.A. (ECODEV)	Greece

University of Patras, Physics Department, Laboratory of Atmospheric Physics (LapUp)	Greece
Dimitris Vallianatos (i.D.Com)	Greece
Aristotle University of Thessaloniki (AUTH)	Greece
University of Thessaly (UTH), Medical School, Laboratory of Hygiene and Epidemiology	Greece
Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe)	Italy
Edmund Mach Foundation (FEM)	Italy
University of Trento (UNITN), Department of Mathematics	Italy
University of Novi Sad, Faculty of Agriculture, Laboratory for Medical and Veterinary Entomology (UNSFa)	Serbia
Scientific Veterinary Institute "Novi Sad" (NIV-NS)	Serbia
Kommunale Aktionsgemeinschaft zur Bekämpfung der Schnakenplage (KABS) e.V.	Germany
Bernhard Nocht Institute for Tropical Medicine (BNITM)	Germany
EID Méditerranée	France
University of Novi Sad, Faculty of Medicine (UNSFm)	Serbia

Useful links:

- <https://www.youtube.com/watch?v=RNZFRNDSBVY>
- https://ec.europa.eu/info/news/eic-horizon-prize-early-warning-epidemics-commission-awards-eu5-million-winning-project-2022-jan-17_en
- <http://beyond-eocenter.eu/index.php/web-services/eywa>

Contact us:

Haris Kontoes

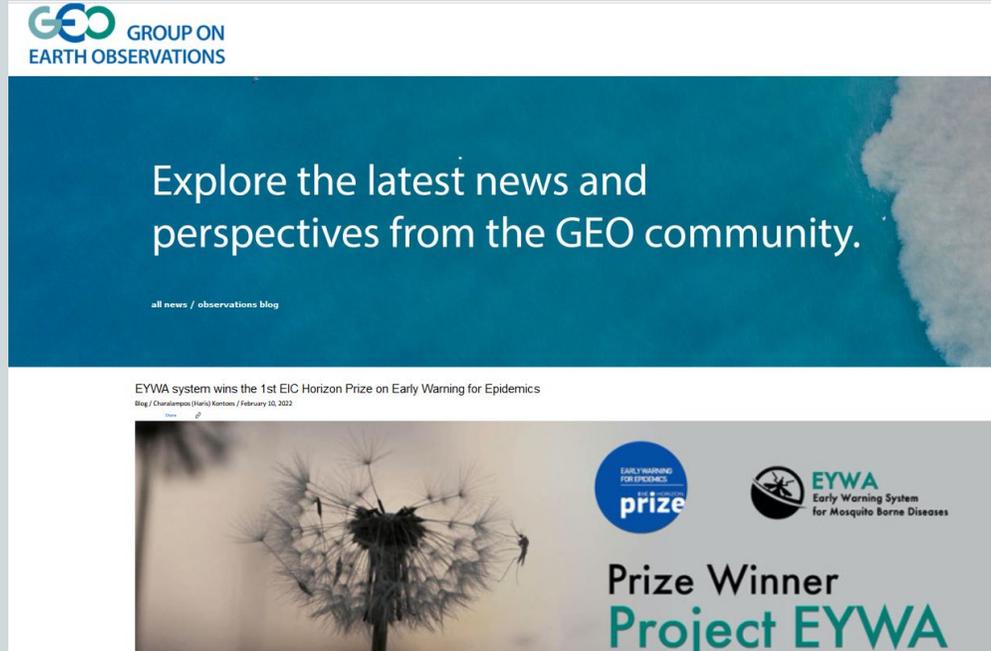
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EYWA outreach after our distinction Prize International publicity

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GEO GROUP ON EARTH OBSERVATIONS

Explore the latest news and perspectives from the GEO community.

[all news / observations blog](#)

EYWA system wins the 1st EIC Horizon Prize on Early Warning for Epidemics
Blog / Chandanops (Harris) Kambon / February 20, 2022



Prize Winner
Project EYWA

https://earthobservations.org/geo_blog_obs.php?id=545



European Commission

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HEALTH SPACE ENVIRONMENT

Observations from space help scientists get one step ahead of the tiny but deadly mosquito

21 February 2022
by Andrew Dunne



Diseases carried and transmitted by bloodsucking mosquitoes account for some 700,000 deaths globally. © KPicMining, Shutterstock

Each year, nearly three-quarters of a million people die from mosquito-borne diseases, and with climate change the problem is getting worse. EU researchers are giving public health officials the tools they need to take targeted action fast.

<https://ec.europa.eu/research-and-innovation/en/horizon-magazine/observations-sce-help-scientists-get-one-step-ahead-tiny-deadly-mosquito>

EYWA outreach after our distinction Prize e-shape publicity | onboarded pilot

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opportunities
for Health &
Epidemics

Pilot 2.4 | EYWA - Early Warning System for Mosquito-Borne Diseases



16 January 2022

EYWA our new onboarded pilot wins the 1st EIC Horizon Prize on Early Warning for Epidemics

Congratulations to our new onboarded pilot EYWA for winning the first "EIC Horizon Prize on Early Warning for Epidemics". This accomplishment is a significant milestone and an exceptional example of the unlimited Earth Observation power and the societal benefits that can derive from harnessing space technology.



GEO blog article | EYWA system wins the 1st EIC Horizon Prize on Early Warning for Epidemics

Read the dedicated article in GEO blog regarding our new onboarded pilot EYWA for winning the first "EIC Horizon Prize on Early Warning for Epidemics".

20 February 2022

Read the dedicated article about the EYWA system in the Horizon magazine!

How observations from space help scientists get one step ahead of the tiny but deadly mosquito?



home / showcases / pilot 2.4 | eywa - early warning system for mosquito-borne diseases

More than 80% of the global population lives in areas at risk of at least one major Vector-Borne Disease (VBD), with more than 700,000 deaths at a global scale (WHO, 2020). Mosquitoes are the protagonists of these vectors, transmitting pathogens to living beings with the most important being the Mosquito-Borne Diseases (MBDs) in Europe, namely West Nile Fever linked to Culex mosquitoes, Malaria linked to Anopheles mosquitoes and Chikungunya, Dengue and Zika linked to Aedes mosquitoes.

There is a constantly increasing need to innovate on how the continuous threat of MBDs are confronted, treated but most of all foreseen. This gave birth to the idea of EYWA, an integrated and contemporary Early Warning System (EWS) for MBD, which utilizes state-of-the-art AI/ML technologies and furthermore assimilates big EO data and geo-spatial information, embodying a complete, adaptable (scalable, and replicable) and operational European EWS. EYWA offers operational and pre-operational services for MBD outbreak (TRL >7 up to 9) in five countries (France, Germany, Greece, Italy, Serbia).

Under the e-shape pilot EYWA will seek to further augment the database of entomological data from non-European territories and evolve the suite of predictive models to include non-European areas where the climate conditions are very different to those found in Europe. This will help make the model predictions even more robust in the face of different inputs. Furthermore, there will be an assessment of the combined accuracy gain of the mosquito abundance model MAMOTH with the dynamic epidemiological model MIMESIS for the West Nile virus (WNV) risk.

Showcase 2 - Pilots

Pilot 2.1 | EO-based surveillance of mercury pollution

Pilot 2.2 | EO-based surveillance of POPs pollution

Pilot 2.3 | EO-based pollution-health risks profiling in the urban environment

Pilot 2.4 | EYWA - Early Warning System for Mosquito-Borne Diseases

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EYWA outreach after our distinction Prize

Useful links:

- ❑ <http://beyond-eocenter.eu/index.php/web-services/eywa>
- ❑ <https://www.youtube.com/watch?v=RNZFRNDSBVY>
- ❑ https://ec.europa.eu/info/news/eic-horizon-prize-early-warning-epidemics-commission-awards-eu5-million-winning-project-2022-jan-17_en
- ❑ <https://e-shape.eu/index.php/showcases/pilot-2-4-eywa-early-warning-system-for-mosquito-borne-diseases>
- ❑ <https://e-shape.eu/index.php/news-events/eywa-our-new-onboarded-pilot-wins-the-1st-eic-horizon-prize-on-early-warning-for-epidemics>

Contact us:

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Greece

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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

