EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates opportunities for Health & Epidemics

EYWA: A key tool to the epidemics arsenal

Mirka Rossi
Konstantinos Tsaprailis
Haris Kontoes

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

EuroGEO

EARLY WARNING FOR EPIDEMICS EIC HORIZON prize

European Commission

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

e-shape

BEYOND · ecodev · FONDAZIONE EDMUND MACH · UNIVERSITÀ DI TRENTO · KABS · BNITM Bernhard Nocht Institute for Tropical Medicine · EID MÉDITERRANÉE

EYWA
Early Warning System
for Mosquito Borne Diseases

Introduction | A global problem

EO creates opportunities for Health & Epidemics

- **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].

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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

Working towards a solution

EO creates opportunities for Health & Epidemics

- **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!**

EARLY WARNING FOR EPIDEMICS EIC HORIZON prize

European Commission

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

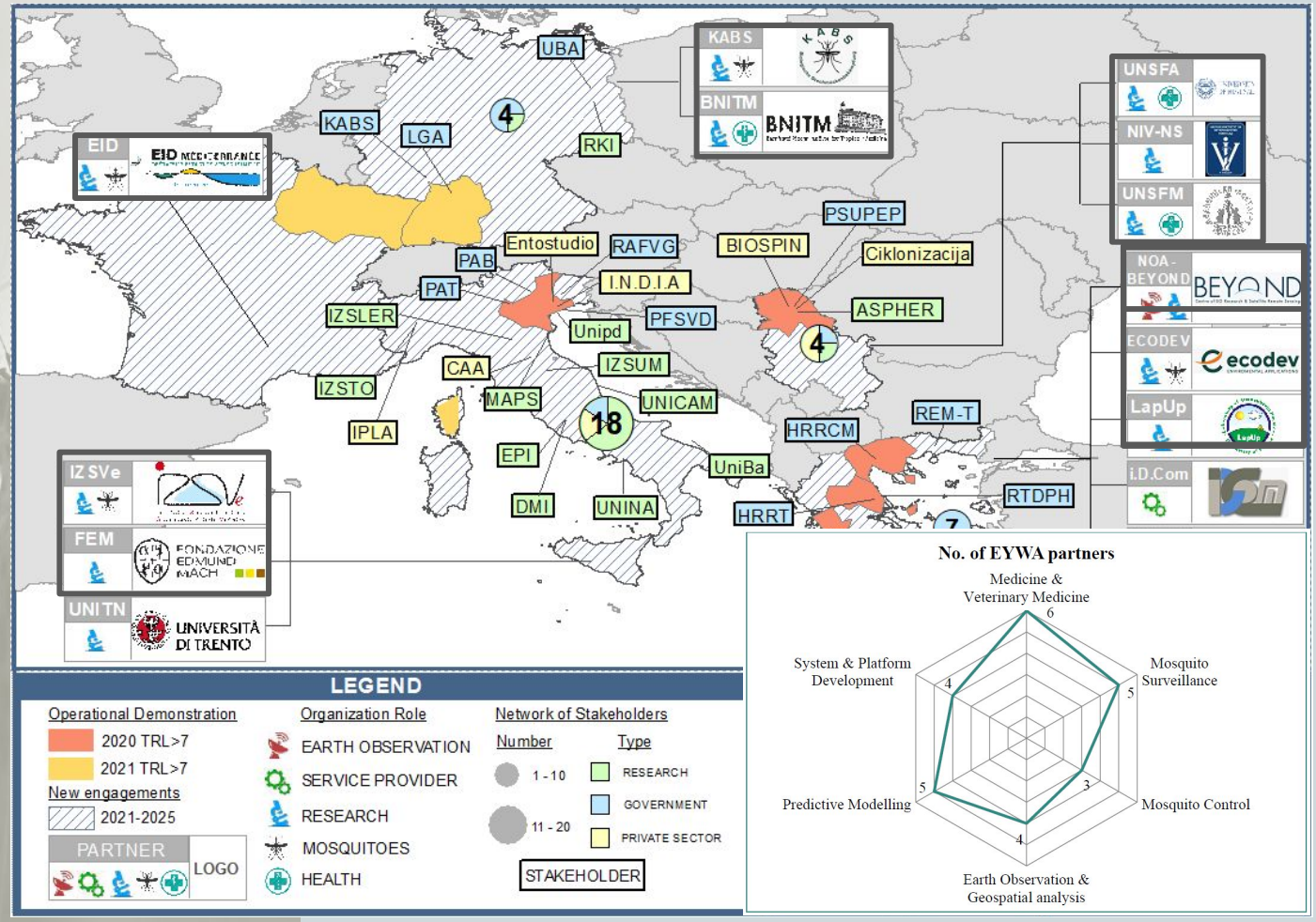
Earth Observation for Epidemics of Vector-borne Diseases / EuroGEO Action Group

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

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

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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates opportunities for Health & Epidemics

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.**

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

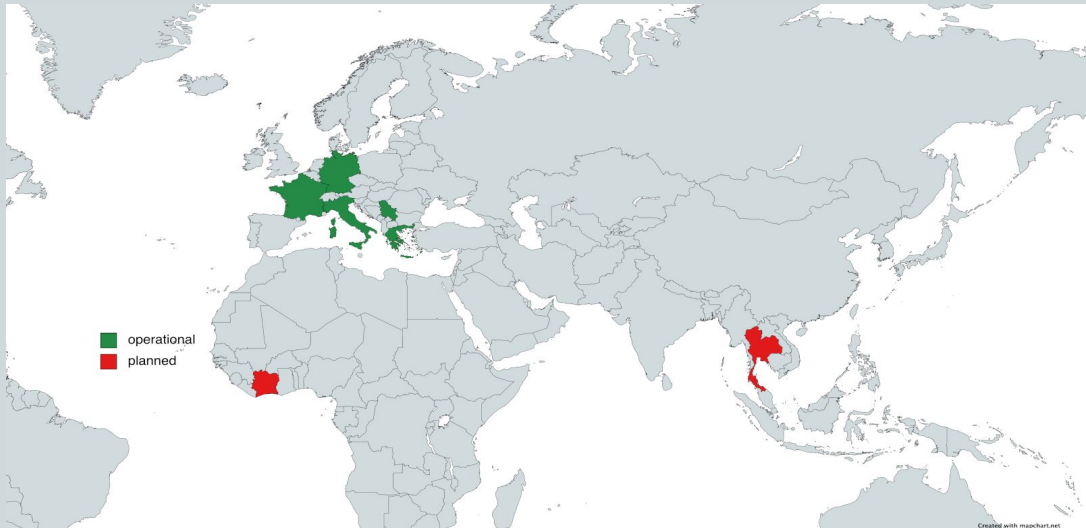
EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates opportunities for Health & Epidemics

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**.



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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates opportunities for Health & Epidemics

What does EYWA provide?

- **MIMESIS, BAr 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 mosquito abundance** model.
  - **Settlement** level.
  - **4 regions in Greece**
  - **Mosquito Vision**: notifications through app **>2400 villages in Greece**
- **MAMOTH mosquito abundance** model.
  - **Trap** level.
  - **4 European countries in 2021**, more in 2022.
  - **Culex, Aedes albopictus** and **Anopheles**.

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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates opportunities for Health & Epidemics

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)

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

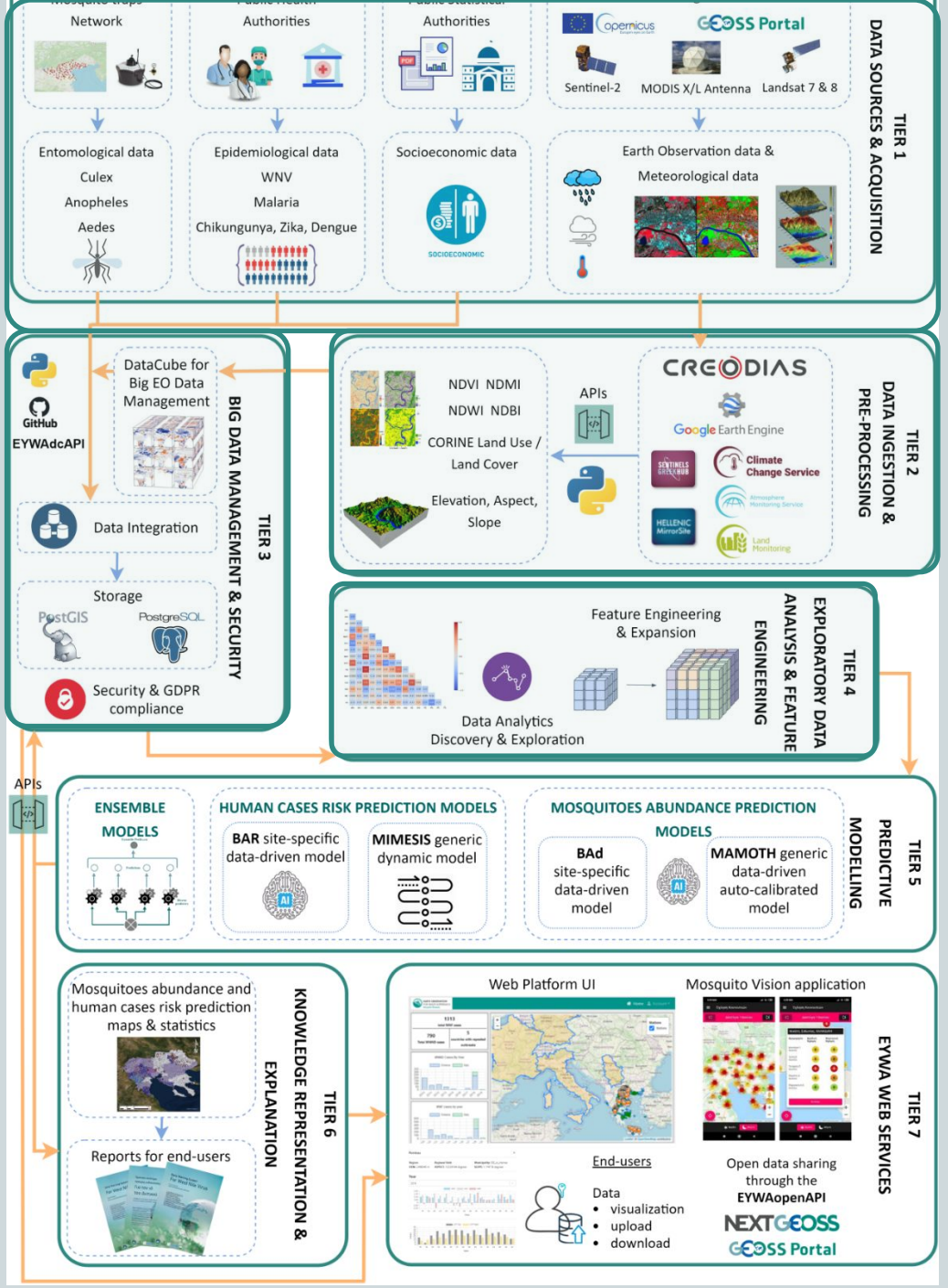
EuroGEO

1. Parselia, E.; Kontoes, C.; Tsouni, A.; Hadjichristodoulou, C.; Kioutsioukis, I.; Magiorkinis, G.; Stilianakis, N.I. Satellite Earth Observation Data in Epidemiological Modeling of Malaria, Dengue and West Nile Virus: A Scoping Review. *Remote Sens.* **2019**, *11*, 1862. https://doi.org/10.3390/rs11161862

EYWA
Early Warning System
for Mosquito Borne Diseases

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.
- **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



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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EYWA outreach after our distinction Prize European Commission

EO creates opportunities for Health & Epidemics

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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EYWA Press Release

EO creates opportunities for Health & Epidemics

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

EuroGEO

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).

e-shape

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:

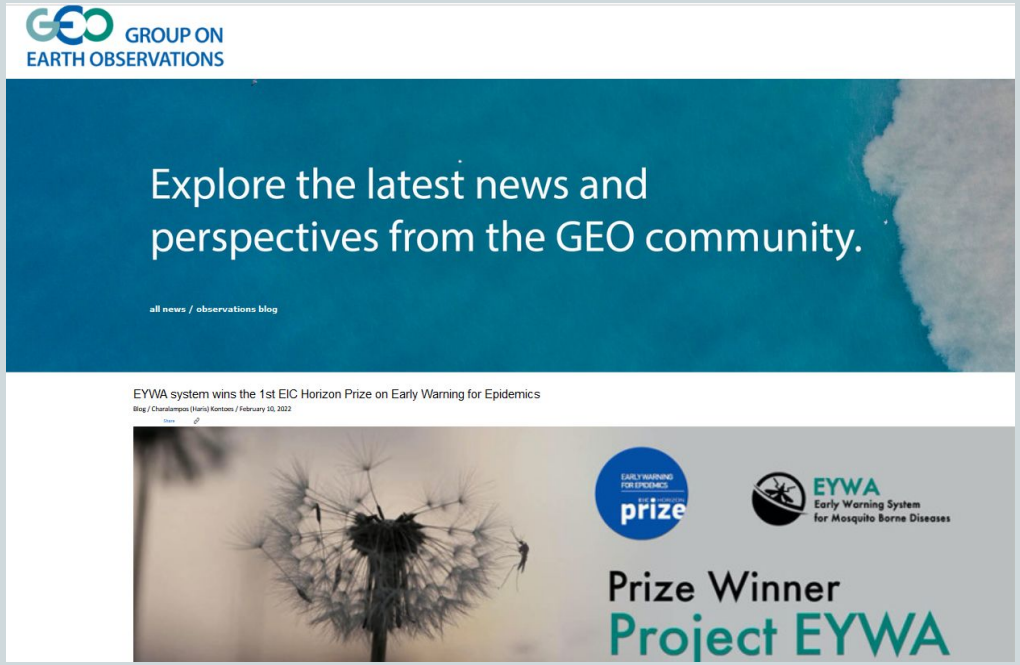
Haris Kontoes
Coordinator of EuroGEO Action Group for Epidemics & Lead Partner of EYWA
kontoes@noa.gr
+302103490012 | +306932208817

Mirka Rossi
Communications Coordinator of EYWA
mrossi@noa.gr
+302103490125 | +306937138133

EYWA
Early Warning System
for Mosquito Borne Diseases

EYWA outreach after our distinction
Prize International publicity

EO creates opportunities for Health & Epidemics



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

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

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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

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

EO creates opportunities for Health & Epidemics

Pilot 2.4 | EYWA - EarlY WArning System for Mosquito-Borne Diseases

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

Search ...

Stay In The Loop !

Subscribe to our newsletter to get the

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?

EYWA
Early Warning System
for Mosquito Borne Diseases

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:

kontoes@noa.gr
(Coordinator of EuroGEO Action Group for Epidemics | Lead Partner of EYWA)

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

EuroGEO

EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates opportunities for Health & Epidemics

EARLY WARNING FOR EPIDEMICS EIC HORIZON prize

EYWA
Early Warning System
for Mosquito Borne Diseases

Prize Winner
Project EYWA

European Commission

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

EuroGEO

Thank you!

15 Partners | 5 Countries

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