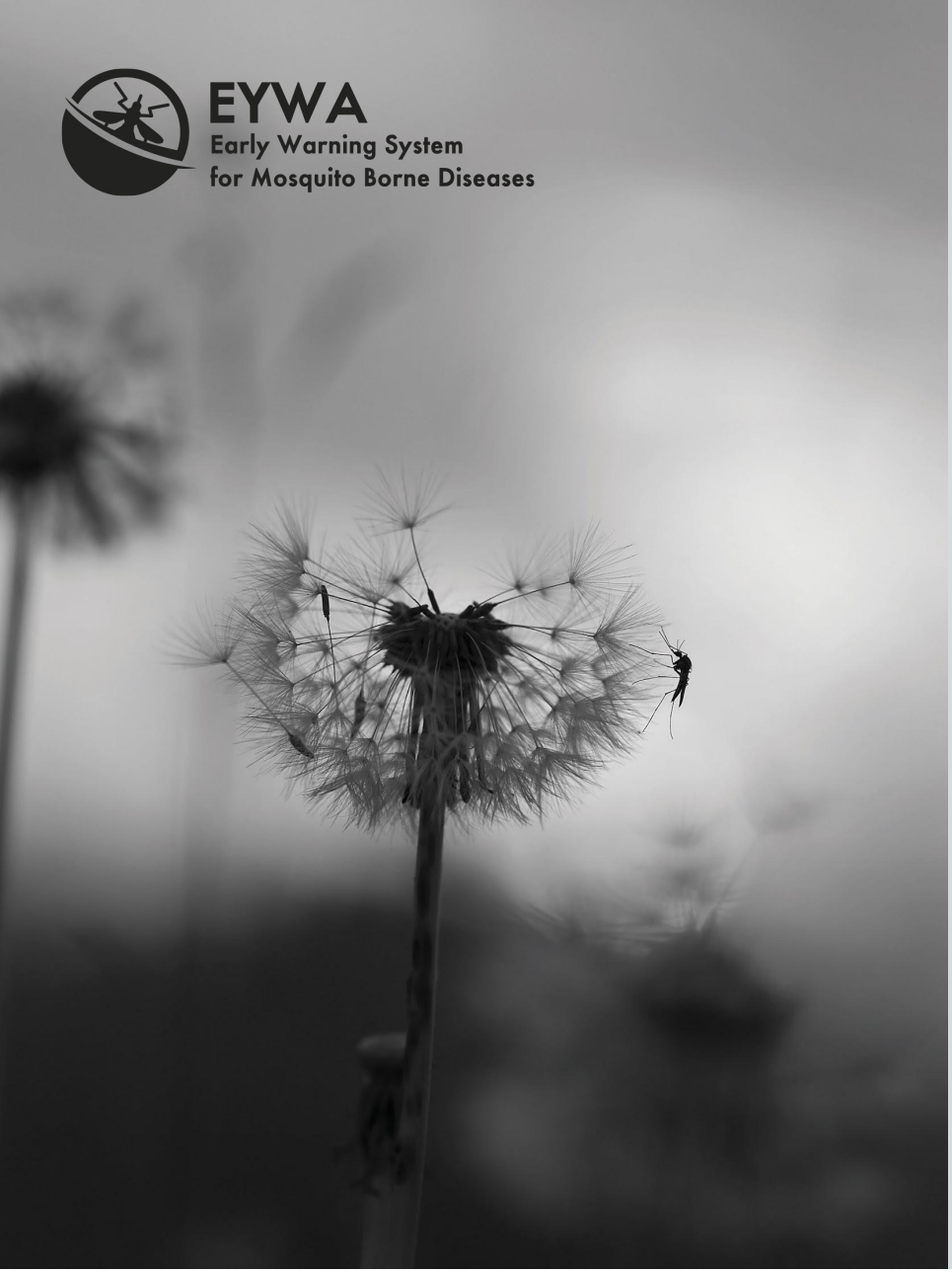
EYWA
Early Warning System
for Mosquito Borne Diseases

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

EuroGEO

EO creates
opportunities
for Health &
Epidemics



EYWA: A key tool to the epidemics arsenal

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e-shape

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

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Introduction - A global problem

- **Climate Change**, **globalisation** and other drivers are altering ecological conditions for **mosquitoes**.
- Globally, Mosquito-Borne Diseases (MBDs) as **malaria**, **dengue** and **yellow fever**, and **Zika** are present in over 100 countries over the world.
- Each year they account for some 700,000 deaths globally. **Malaria**, which represents more than half of these, is tragically most lethal for kids aged under five in the sub-Saharan regions.
- But **Europe** is also considered as a "hot spot" especially because of the **West Nile Virus epidemic** due to elevated temperature. Also local expansion of **chikungunya** and **dengue fever** in continental Europe has increased by over 40% compared to the 1950 baseline[1].

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Working towards a solution

- The need to confront, control, and foresee this continuous threat gave birth to the **EYWA early warning system**.
- It is a niche **state-of-the-art tool** to sustain **targeted door-to-door awareness** and **aversion** of **human cases** in **thousands of villages** in the European territories.
- The **EYWA** system is the outcome of a 3-year voluntary action with the ultimate vision to introduce EYWA as a **key tool** to the epidemics arsenal and contribute significantly to **combat and control MBD**.
- It operates and distills information to monitor human health, supported by diverse domains of expertise including **EO**, advanced **epidemiological** and **entomological modeling**, and innovative **AI** and **ML** big data analytics.
- The Early Warning System has been operational since **2020** and in **2021** supported **10 regions** in **5 European countries (France, Germany, Greece, Italy, Serbia)**. In late 2021 EYWA was also successfully onboarded as a pilot to the e-shape project with a goal to bring the operational services in non-European countries, specifically in **Cote d'Ivoire** in Africa and **Thailand** in Asia.
- This endeavor was a significant accomplishment and EYWA was awarded with the **1st European Innovation Council Horizon Prize on Early Warning for Epidemics**.

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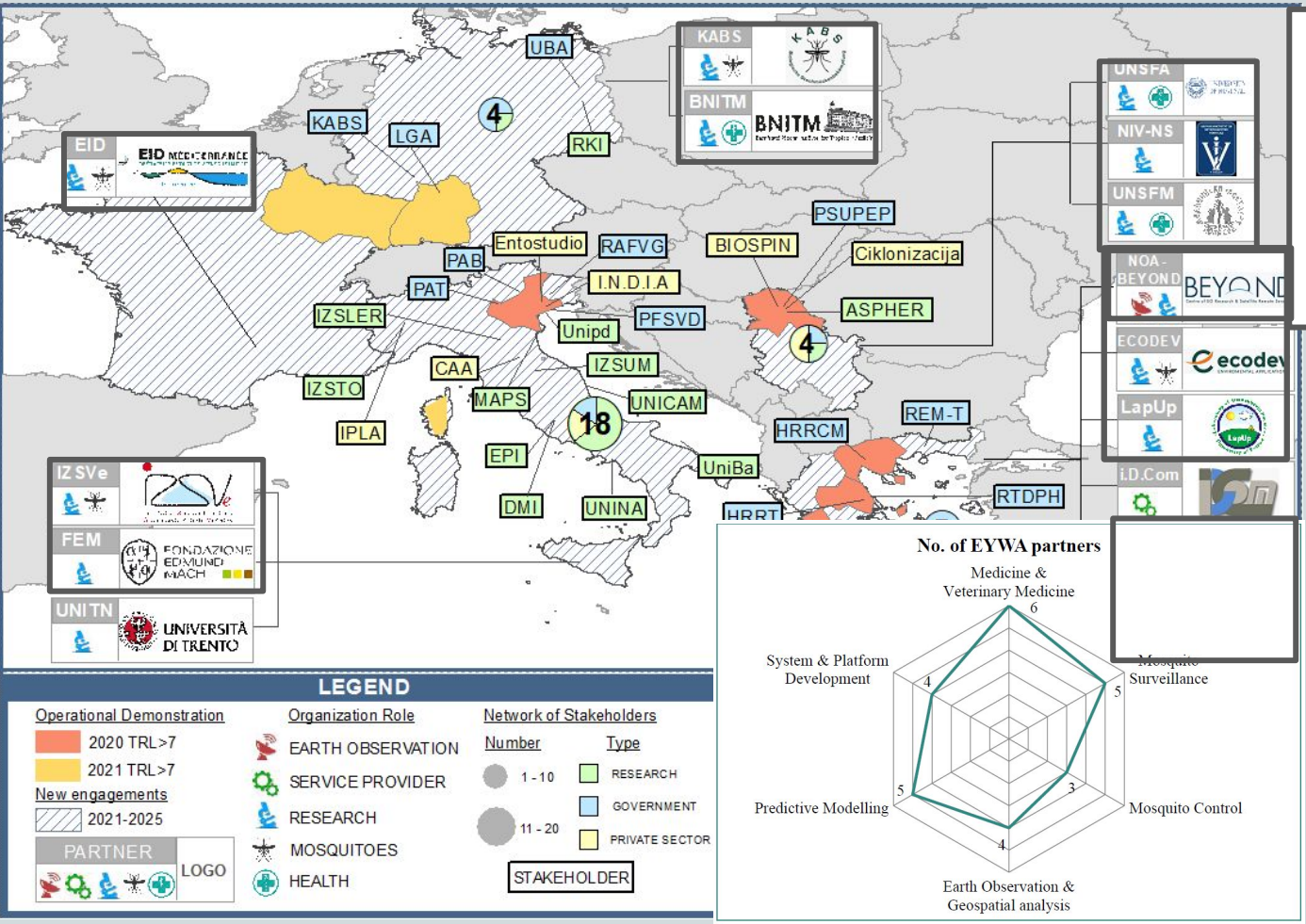
ΕΜΠΡΟΣ (EMPROS)



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	Type
1 - 10	RESEARCH
11 - 20	GOVERNMENT
	PRIVATE SECTOR

STAKEHOLDER

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 more than **40 stakeholders** at a **European and global** scale providing essential data and feedback.
- The **EYWA consortium** signed an MoU with the **European Commission's Joint Research Center (JRC)** to further advance the collaboration towards the common goal of **expanding and exploiting the innovations** in the early warning forecasting services.
- Furthermore it is being considered for EYWA to provide support to the **European Health Emergency and Response Authority (HERA)** of the **European Commission.**
- **Participation** in: **GEO Health Community of Practice, GEO & EuroGEO Symposiums, GEO-CRADLE Initiative, EO4GEO community.**

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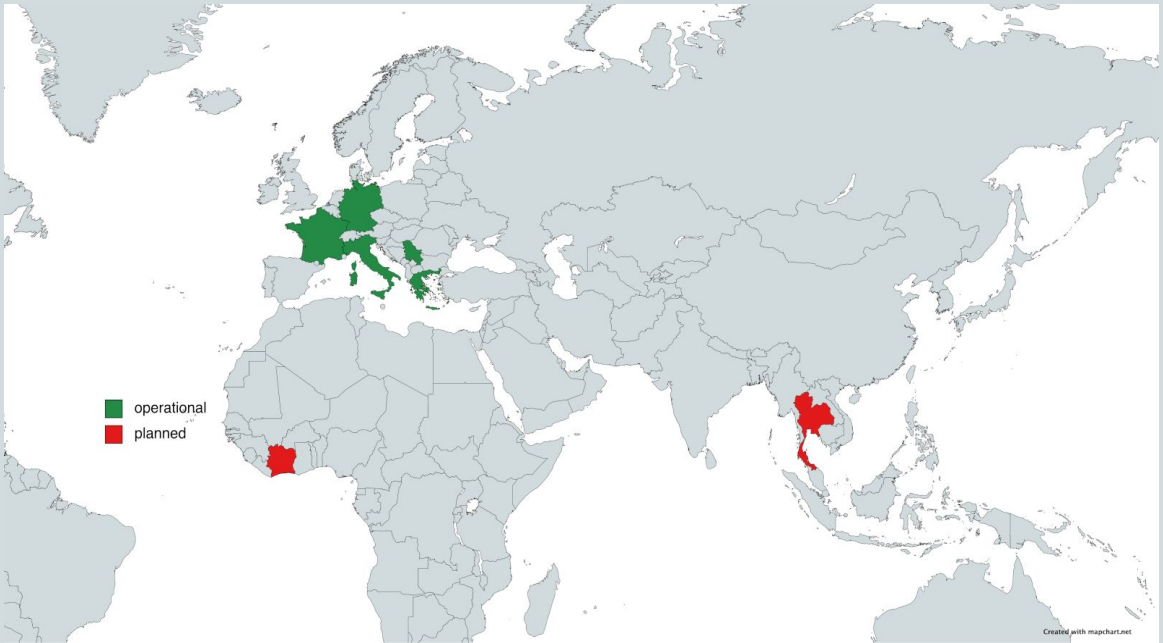
Expanding the service to non-European territories

- **EYWA** was **on-boarded** as a pilot to the **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** data, **train and adapt** the models to new regions **climatic** and **socioeconomic** conditions.
- **Strengthen** the **models** and help **make an impact to the people** in these regions by **supporting** the on the ground **awareness campaigns**.



e-shape

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What does EYWA provide?

- **MIMESIS, BAr WNV risk** models.
  - Provide risk maps of pathogen circulation on **Municipality & Settlement/Village** level
  - So far available in **4 regions in Greece** and **1 region in Italy**, expanding to more regions.
  - Support supplementary preventive actions (more intense larviciding).
  - Provide complementary door-to-door awareness campaigns.
  - In **2021** more than **31,000** households in reached in the **Central Macedonia region of Greece**.
- **BAd mosquito abundance** model.
  - Works on a **Settlement** level.
  - Available in **Greece** soon in more regions
  - Powers the "**Mosquito Vision**" mobile application, used in more than **2400 villages in Greece** sending out notifications on high nuisance and getting crowdsourced feedback.
- **MAMOTH mosquito abundance** model.
  - Works on a trap level.
  - Available operationally in **4 European countries in 2021**, expanding to more in 2022.
  - Supports different mosquito species including **Culex, Aedes albopictus and Anopheles**.

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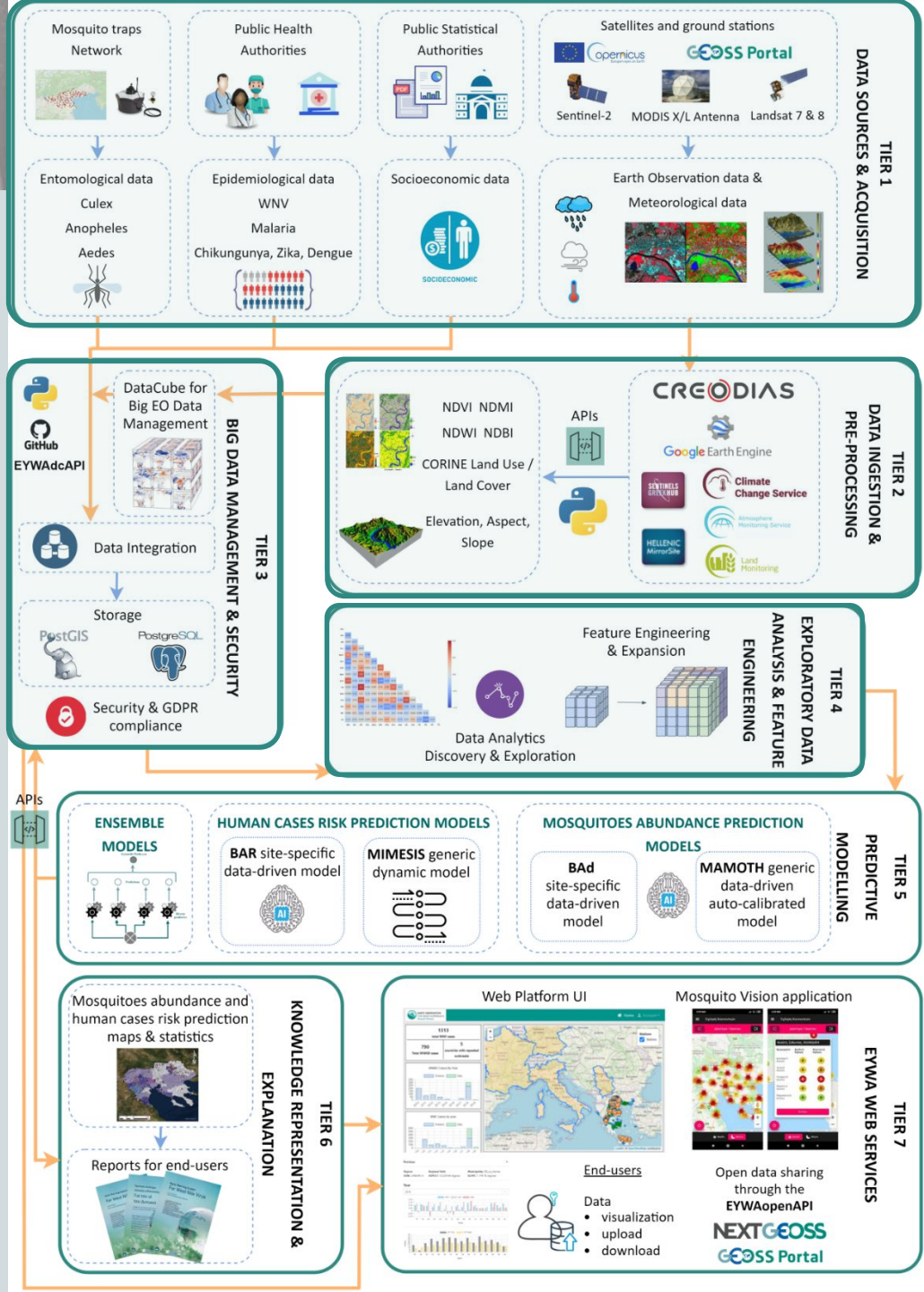
Making it work

- Time-series of **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 of at least **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
  - Other composite features related to the proximity of trapping sites to mosquito breeding sites, waste treatment facilities, water bodies and more.



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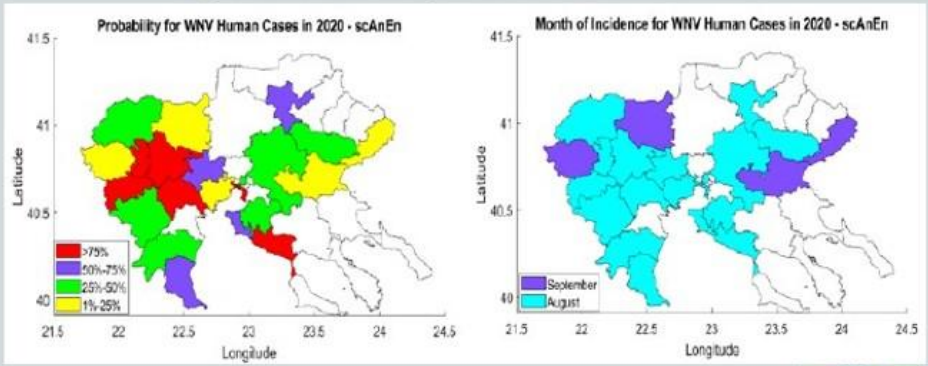
ΕΜΠΡΟΣ (EMPROS)

Indicative EYWA operational results during the period | April – October 2020

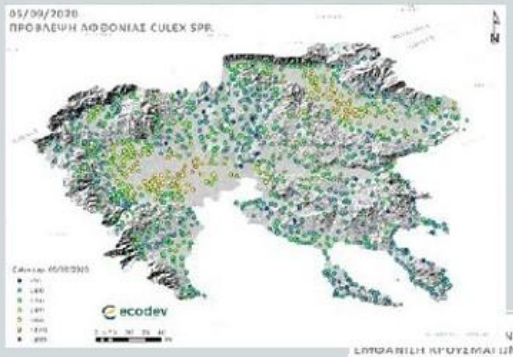
Human case risk forecast – Region of Central Macedonia - Dynamic modelling – Issued on 25/07/2020



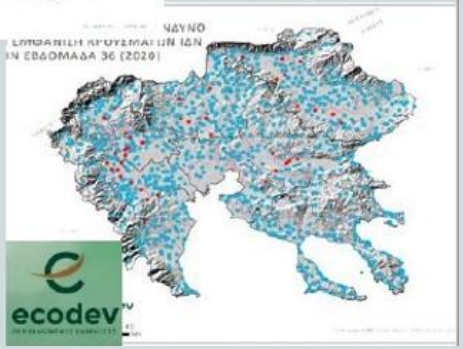
Human case probability map (left) and probable month of human cases incidence (right)

Mosquitoes population risk map - Data Driven Model - Region of Veneto (Italy) Period 25/08/2020-25/09/2020

Mosquito Vision: Smartphone application for 5-day predictions of evening and night nuisance from mosquitoes



Mosquito abundance forecasts in the 1040 municipalities of Central Macedonia for the week 02/09 έως 06/09/2020



Human case risk forecasts for WNV incidence calculated over the 1040 municipalities in Central Macedonia for the week 31/08-06/09/2020

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In a nutshell

- **EYWA** was borne out of a need to create a state-of-the-art early warning system for the rising threat of Mosquito borne Diseases.
- Fusion of big **Earth Observation** data with **in-situ** collected, to feed advanced **deterministic** & **machine learning** based modelling.
- **West Nile Virus risk** models provide **early warning** for pathogen circulation to help support the preventive actions, and guide targeted door-to-door awareness campaigns.
- **Mosquito population abundance** models provide early warning for multiple mosquito genuses and different spatial and temporal resolutions.
- The project has **developed standards** to support the **decision making** on:
  - local (via **Public Health Authorities, Vector Control Companies**)
  - European (through an established collaboration with the **EC JRC**)
- Established a large **database** of **entomological & epidemiological** data to support research.
- Is continuously expanding the **network of stakeholders** to new regions on a global scale.

Thank you!

Contact us:
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(Coordinator of
EuroGEO Action Group
for Epidemics)
(Lead Partner of EYWA)

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

EuroGEO

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