EYWA
Early Warning System
for Mosquito Borne Diseases

EO creates
opportunities
for Health &
Epidemics

EYWA: A key tool to the epidemics arsenal

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Earth Observation for Epidemics
of Vector-borne Diseases /
EuroGEO Action Group
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EARLY WARNING
FOR EPIDEMICS
EIC HORIZON
prize

European
Commission

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

e-shape

EYWA
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- **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].

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1. https://www.thelancet.com/action/showPdf?pii=S0140-6736(20)32290-X

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 we are
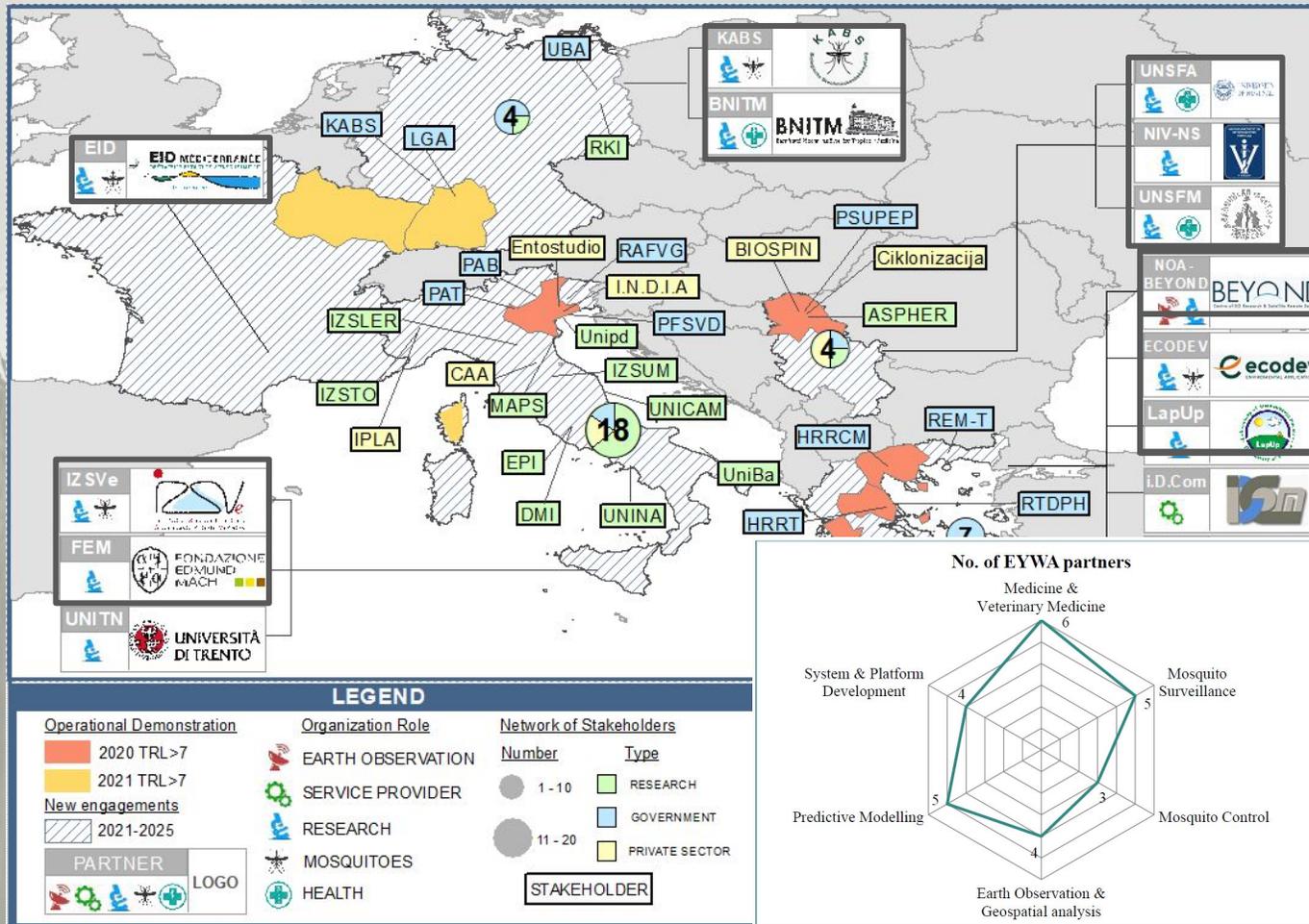
EYWA team

17 partners
7 countries (~30M citizens)

National/International Roles as Reference Entities

Data Handling, Mosquito Surveillance & Control, Medical & Veterinary Medicine from all 7 countries:

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

No. of EYWA partners

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
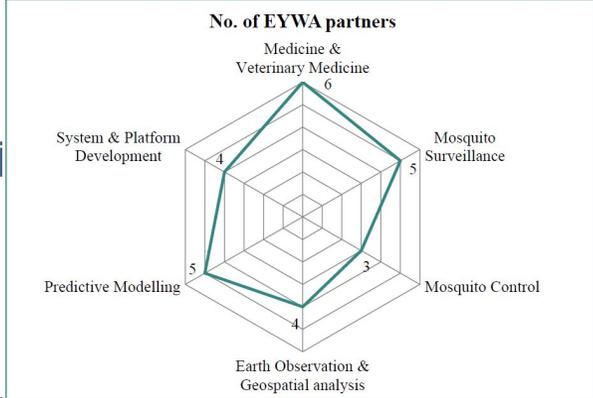
STAKEHOLDER

EYWA 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

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□ **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 frontiers

- ❑ **Onboarded** to **e-shape H2020 project** with the major goal of **expanding** the support of the services to **non-European territories**, specifically **Côte d'Ivoire** and **Thailand**.

- ❑ **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**.

operational
planned

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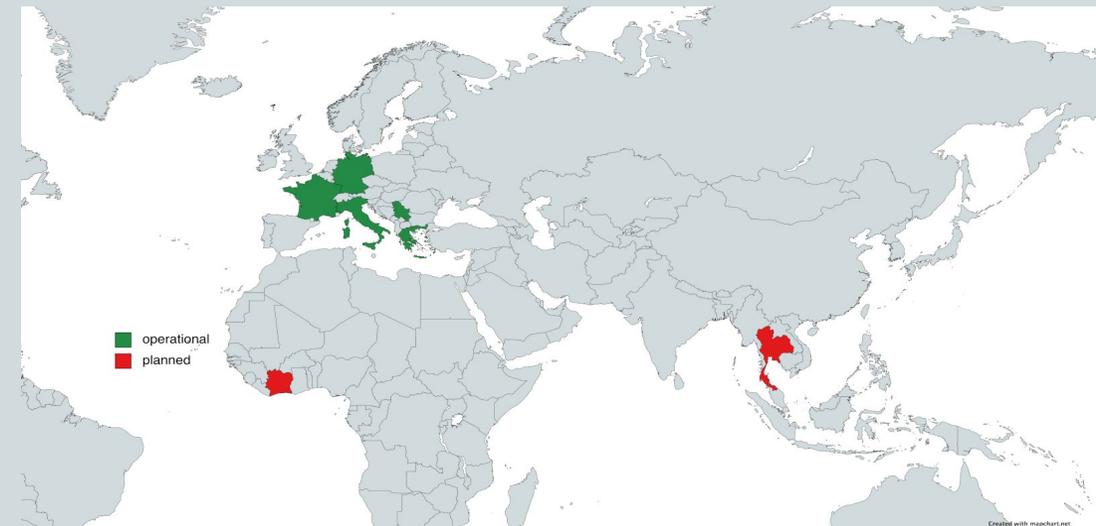
What does EYWA provide?

- **MIMESIS(Univ. 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**
  - **2022:** On track to surpass the above number.
- **BAd(ECODEV) mosquito abundance** model
  - **Settlement** level
  - **4 regions in Greece**
  - **Mosquito Vision**: notifications through app **>2400 villages in Greece**
- **MAMOTH(NOA) mosquito abundance** model
  - **Point** level predictions
  - **Aggregate statistics** for largers areas
  - **4 European countries in 2021**, expanded to 7 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)

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

□ 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

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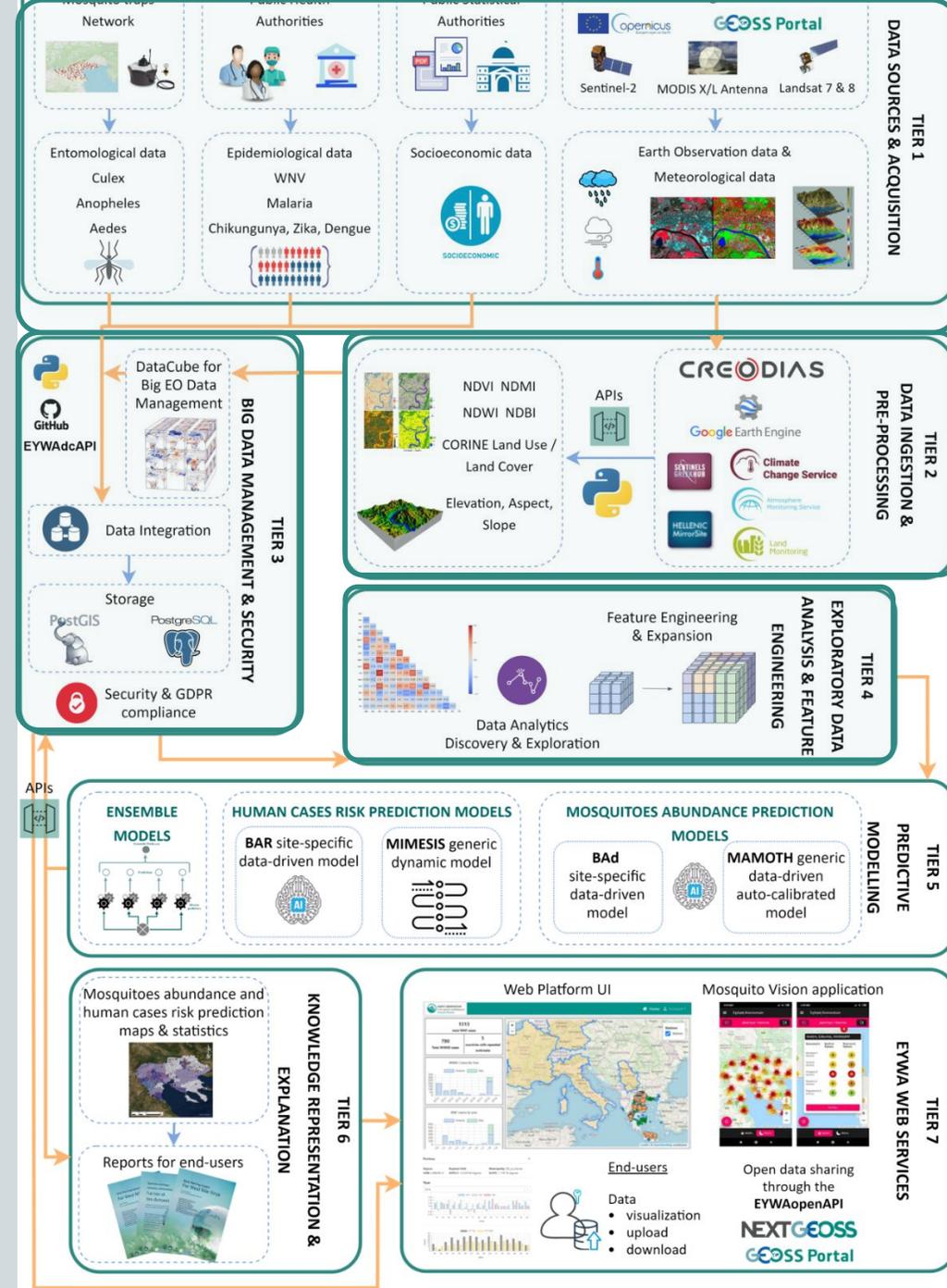
Working with Ivory Coast

❑ **Major Threats in Ivory Coast:**

- Aedes Aegypti

- Anopheles

❑ **Aedes Aegypti can spread:**

- Dengue Fever

- Chikungunya

- Yellow fever

- Zika fever

- and more disease agents

❑ **Anopheles can spread:**

- Malaria

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Working with Ivory Coast

❑ **Health risks:**

    ❑ **Malaria**

        ■ **leading cause of mortality among children[1]**

    ❑ **Dengue fever**

        ■ **Previous outbreaks 2010[2], 2017[3], 2022[4]**

❑ **Challenges:**

    ❑ **Different climatic conditions**

    ❑ **Different socioeconomic conditions**

    ❑ **Non-uniformity in data collection methods**

    ❑ **In contrast to the European regions mosquitos in Ivory Coast are active all year round**

1. https://www.cdc.gov/globalhealth/countries/cote-d-ivoire/default.htm#malaria
2. https://www.sciencedirect.com/science/article/pii/S0399077X14002054
3. https://www.who.int/emergencies/disease-outbreak-news/item/04-august-2017-dengue-cote-d-ivoire-en
4. https://www.africanews.com/2022/05/04/dengue-fever-outbreak-one-dead-11-cases-recorded-in-ivory-coast//

❑ **BEYOND Center | NOA with:**

   ❑ **Bernhard Nocht Institute for Tropical Medicine**

   ❑ **Centre Suisse de Recherches Scientifiques in Côte d'Ivoire**

❑ **Goals:**

   ❑ **MAMOTH model**

      ■ **predict mosquito abundance**

      ■ **early warning for mosquito outbreaks**

      ■ **already operational**

   ❑ **Develop epidemiological models**

      ■ **Malaria, Dengue fever, Yellow fever and more**

      ■ **Planned**

❑ **Roadmap**

   ❑ **Incorporate data from additional regions and species of Ivory Coast in the MAMOTH mosquito abundance model.**

   ❑ **Increase the supported area of Ivory Coast**

   ❑ **Develop epidemiological models**

   ❑ **Expand to more countries in Africa**

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Prize Winner
Project EYWA

European Commission

Thank you!

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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)

http://beyond-eocenter.eu

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