E4WARNING

Eco-Epidemiological Intelligence for early Warning and response to mosquito-borne disease risk in Endemic and Emergence settings – EO in Action

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·E·R·G·O·
Environmental Research Group Oxford

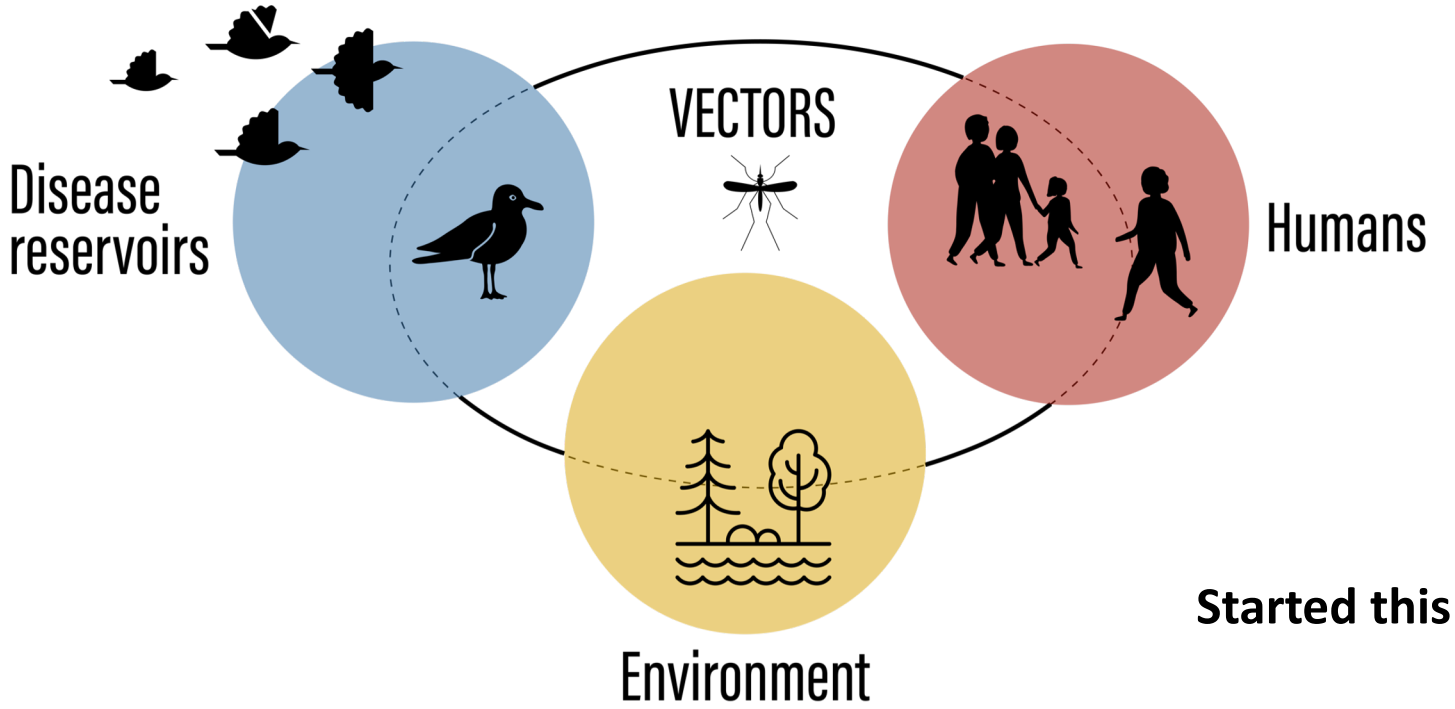
CSIC Consejo Superior de Investigaciones Científicas | CEAB exploring aquatic ecosystems

eurac research

Institute of Atmospheric Pollution Research
National Research Council of Italy

European Commission

Context - ONE HEALTH approach **with EO help**



Started this 2023

INTERDISCIPLINARY
INNOVATIVE | OPEN SCIENCE

- Entomology
- Movement ecology
- Epidemiology
- **Earth Observation science**
- Sensor engineering
- Citizen science expertise
- Sociodemography
- Spatial statistical modelling

Better disease intelligence capable of anticipating and identifying MBDs epidemic risk and outbreaks.

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Basic logic

Dengue looks likely to establish and spread in Europe. As it is not yet widely established here, so we have to use what we know about the disease in endemic areas to forecast what will happen in Europe

We are refining dynamic disease models and forecasting tools for a number of endemic areas, and extending these to several identified hotspots from which it is being imported to Europe. Climate by EO

We are using EO data and novel vector sampling methods like automated traps and citizen science monitoring to develop vector and host distribution spatial models at different scales (uban, regional, continental) and to allow environmentally driven disease risk forecasting.

We also need to know how it might spread once it arrives, by looking at 1) spillover from natural areas like wetlands to peri urban and urban areas where the vectors are most widespread; and 2) spread in and between urban areas through for example human movement. EO needed for climate and geography

We are quantifying how it is being imported from endemic areas into Europe, and using our results for spread forecasting to project how it might spread once it arrives. Some spread drivers from EO

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Project structure

Citizen science

IoT Smart traps

High quality real-time **information on vectors** for a scalable and flexible "epidemic intelligence"

WP2, WP3

EO climate Covariate data suite

Water availability models

Estimate and anticipate **mosquito prevalence and disease risk**

WP4

Ecosystem barriers to disease spread

Human mobility

Host and vector **dispersal capacities**

Human **activity** and differential disease **exposure** affecting **spread**

WP5

Endemic Disease models

Dengue import

Dengue forecasting endemic hotspots used together with global traffic patterns to anticipate connectivity and **import risk** to Europe

WP6, WP7

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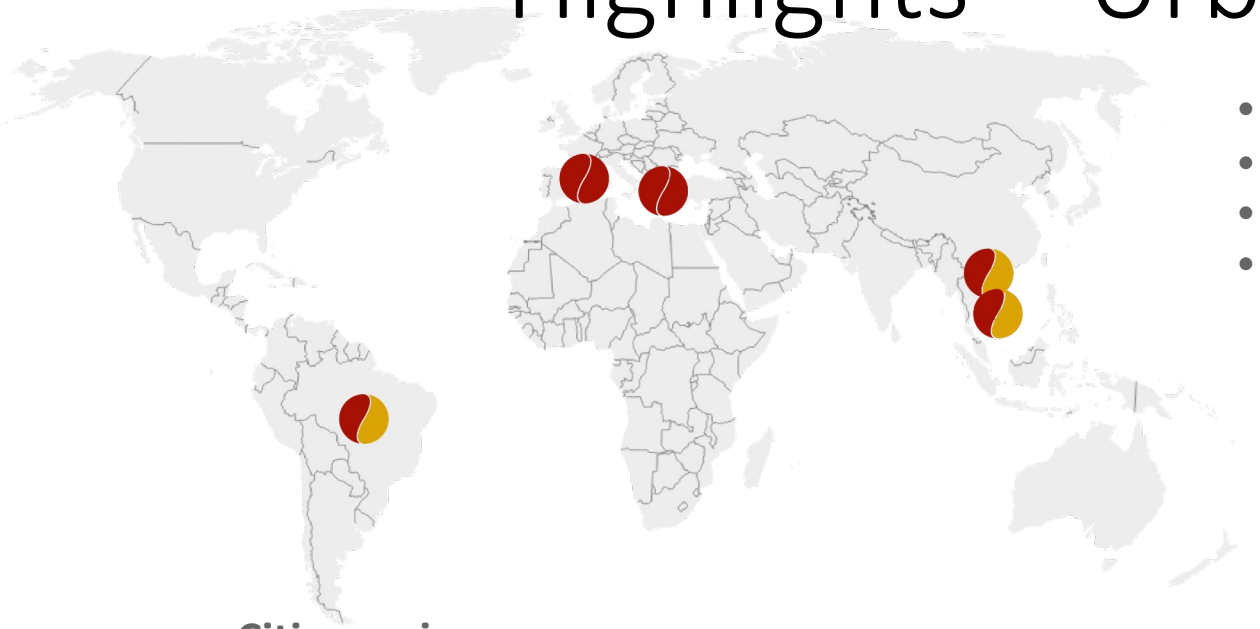
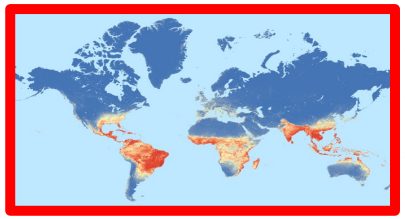
Highlights - Urban environments

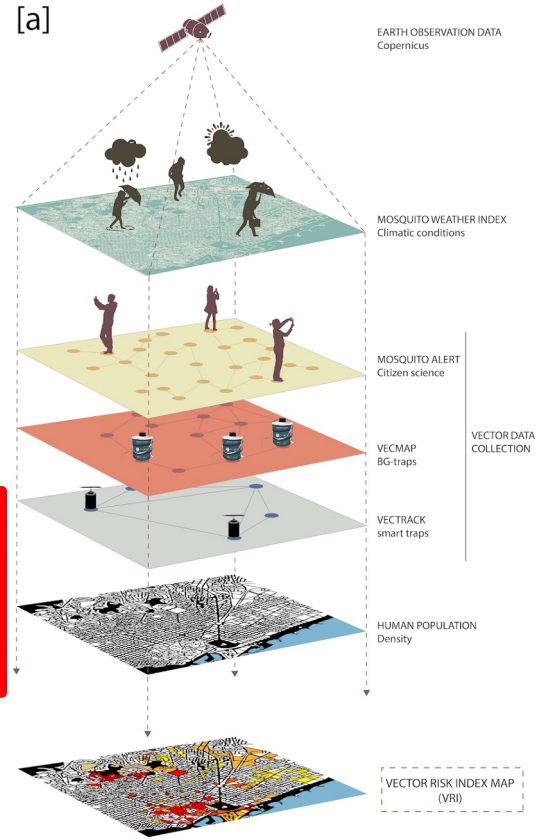


- Athens
- Barcelona
- Brasilia
- Hanoi / Ho Chi Minh City

Aedes albopictus

Aedes aegypti





- Citizen science
- Traditional surveillance
- IoT Smart traps
- Earth Observation data
- Climatological data
- Human activity-spaces
- Human mobility

→

- Vector presence
- Vector phenology
- Vector abundance
- Vector activity
- Human-vector interaction
- Vector passive dispersal

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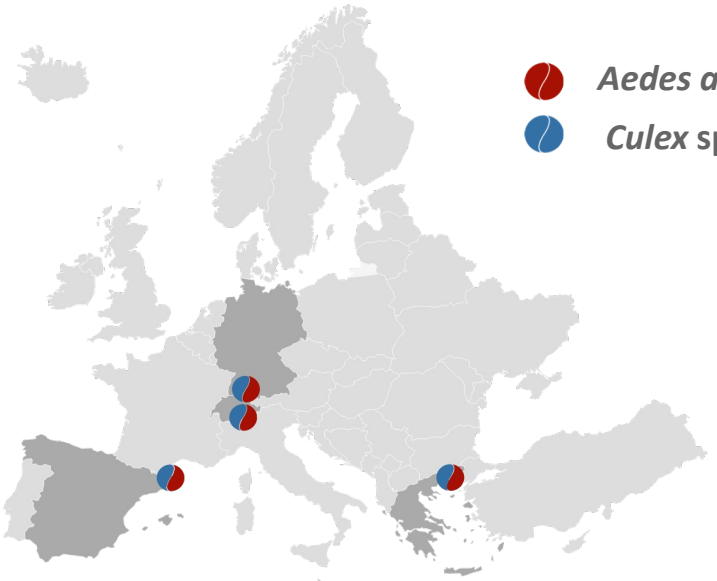
Highlights – spillover from wetlands to peri urban



- *Aedes albopictus* introduced + DENV imported
- *Culex* sp. WNV suspected

MARK-RELEASE-RECAPTURE (MRR) &

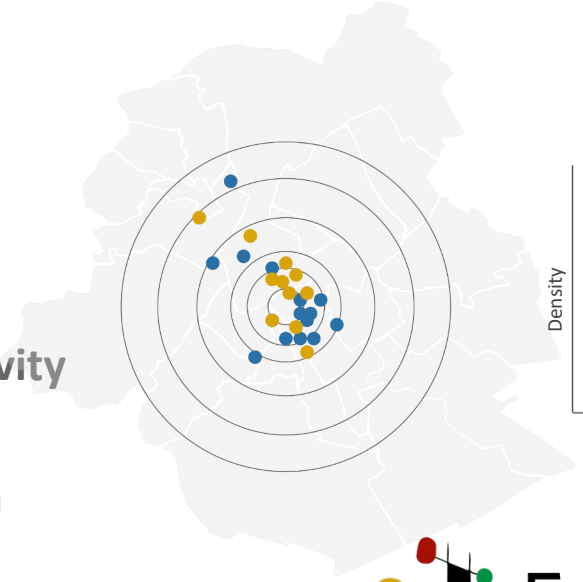
self-MARK AND CAPTURE (sMC):

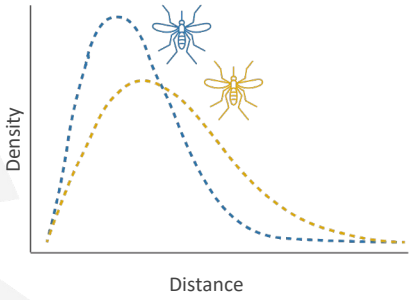
To estimate dispersal capacity and dispersal-mediated connectivity between wetlands, peri-urban and urban areas of *Aedes albopictus* & *Culex pipiens*

- self-Mark and Capture (*Culex*)
- Mark-Release-Recapture (*Aedes*)
- Biologging of birds in field
- Human-vector interaction
- **Habitat identification**
- Human mobility

→

- Vector dispersal capacity
- Reservoirs home ranges
- Reservoirs behaviour activity
- Vector activity
- Human-vector interaction
- Vector passive dispersal





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Endemic Disease to inform EU models

EARTH OBSERVATION DATA
Previous 20 years

MODIS/VIIRS
LST, EVI, NDVI

DAILY, DEKADAL, MONTHLY
SYNOPTIC
FOURIER PROCESSED

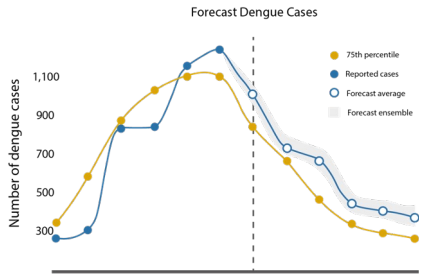
COVARIATE DATA SUITE
Previous 20 years

REPORTED CASES OF DENGUE
Previous 20 years

PROBABILISTIC WEATHER FORECAST FOR THE NEXT 6 MONTHS

MODEL TO FORECAST PARAMETERS RELATED TO WATER AVAILABILITY

MODEL TO FORECAST THE NUMBER OF DENGUE CASES



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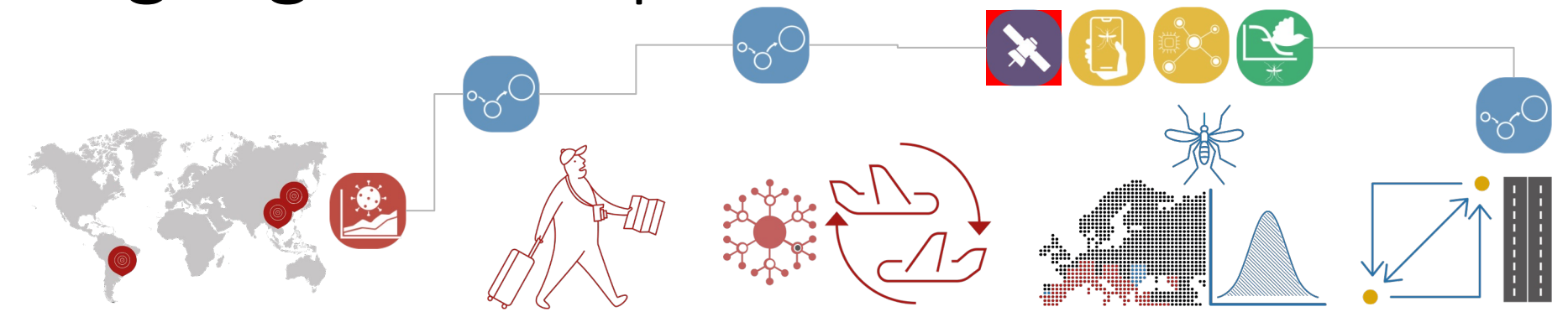
Highlights – Import to EU



Identify disease hotspots in Latin America & Southeast Asia

International touristic hotspots

International transportation hubs

Vector suitability, seasonality & activity

Human mobility within Europe

Risk of disease introduction from the hotspots to Europe under different scenarios

Disease introduction risk from introduction sites towards the rest of Europe

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THANKS FOR LISTENING

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irideon innovation partners

Benaki Phytopathological Institute

·E·R·G·O· Environmental Research Group Oxford

MAX PLANCK GESELLSCHAFT

BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

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hr wallingford

CSB Consorci Sanitari de Barcelona
ASPB Agència de Salut Pública

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