



An early warning support system for climate-sensitive vector-borne diseases

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Climate-Sensitive Vector Dynamics Modelling Workshop



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Climate-driven vector-borne disease risk assessment

Wellcome Trust Digital Technology Development Awards
Climate-Sensitive Infectious Disease Modelling

Model and data repository

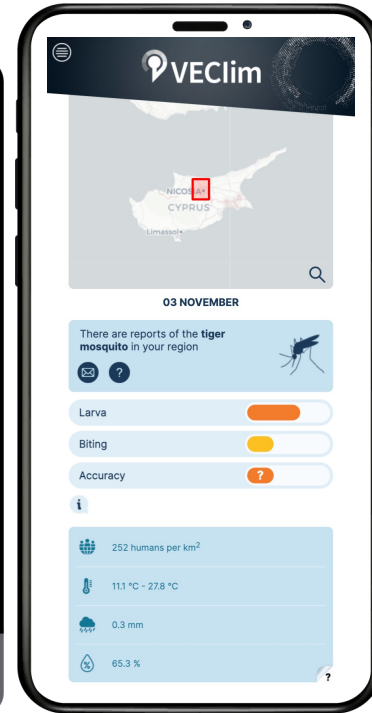
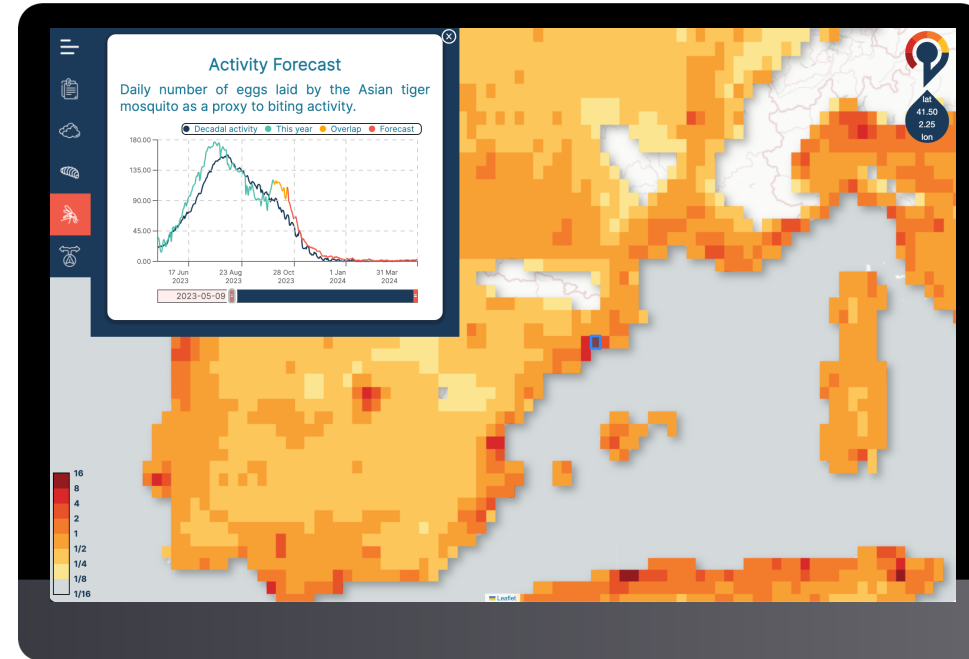
Open-access repository of vector-pathogen models, climate projections, environmental variables, and surveillance data

Short/medium/long-term predictions

Risk maps, seasonal activity, temporal projections of vector activity and disease transmission

Decision support tool

Web-based interactive GIS platform to display risk, run customized scenarios, and inform prevention and control



Aedes albopictus



**Invasive
Aggressive
Competent**
chikungunya
dengue, zika

Phlebotomus papatasi



**Non-invasive
Neglected
Competent**
leishmaniasis
sand fly fever

VECLim's risk indicators



16 SEPTEMBER

There are reports of the **tiger mosquito** in your region

- Larva: High (Red)
- Biting: Medium (Orange)
- Outbreak: Medium (Orange)
- Impact: Low (Yellow)
- Accuracy: ? (Question mark)

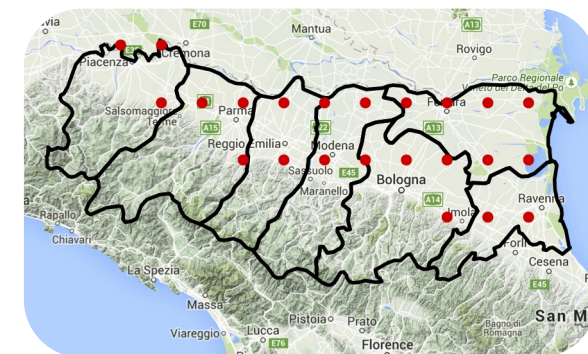
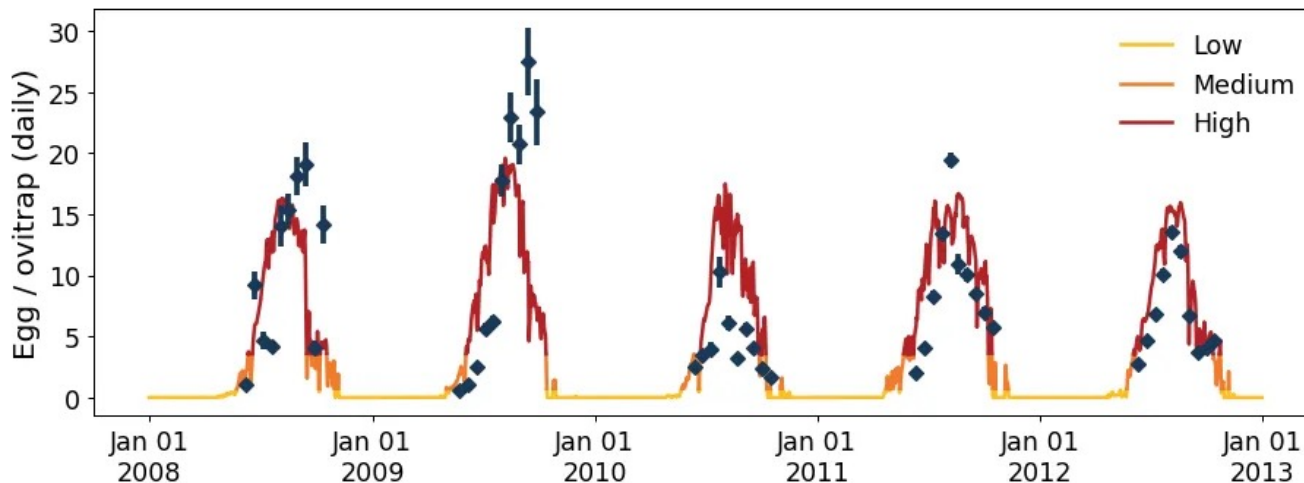
Larva: Larvae in a typical breeding site
Biting: Mosquito activity (bites on people)
Outbreak: Outbreak risk due to an imported case
Impact: Average impact of an imported case

Low (Yellow bar)
 Medium (Orange bar)
 High (Red bar)

Current configuration

VECLim presents a set of indicators of daily vector activity and disease risk at 0.25° resolution based on ERA5 decadal averages and an age-structured population dynamics model of *Aedes albopictus* and CHIKV transmission.

Erguler et al. 2016-2017



January - March

April - June

July - September

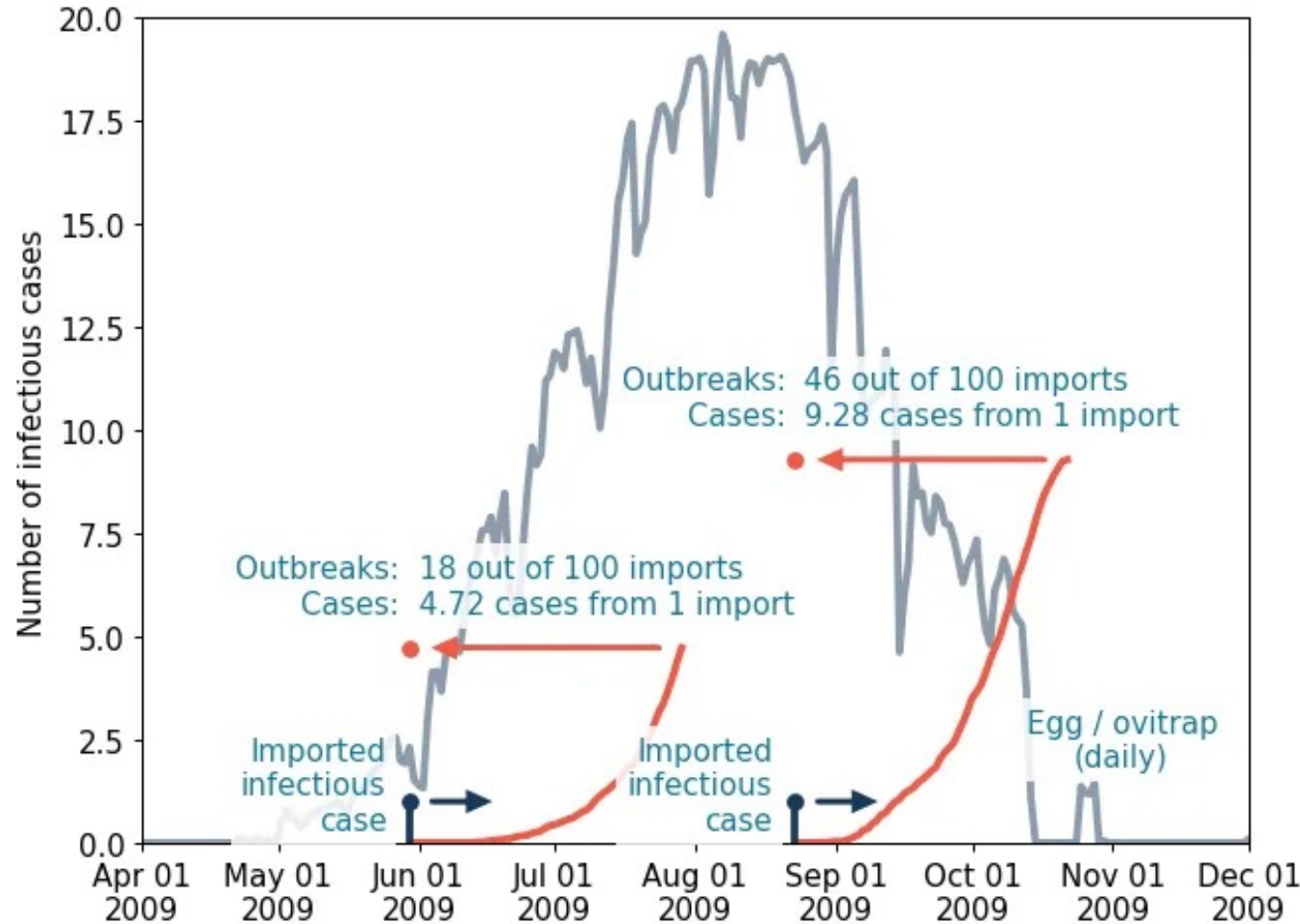
October - December

Expected activity from 2010 to 2020

veclim.com



Relative activity and risk indicators (disease-related)



Lower than 1%
Less than 10 cases



Low	<input type="checkbox"/>
Medium	<input checked="" type="checkbox"/>
High	<input type="checkbox"/>

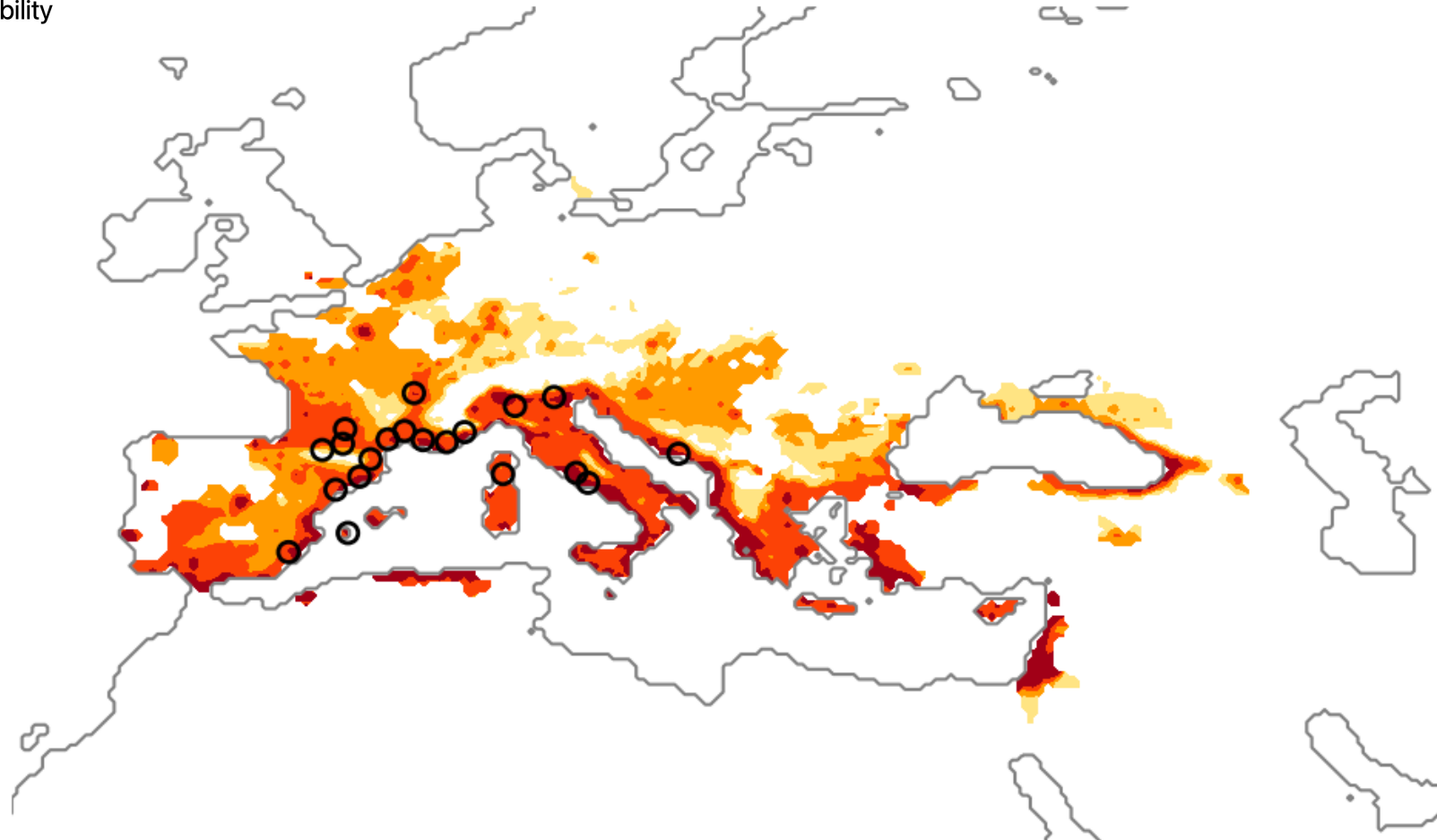
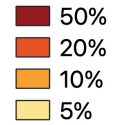


Larger than 50%
More than 500 cases



Outbreak probability vs. Dengue outbreaks

Outbreak probability



The likelihood of an imported case resulting in an outbreak in Europe from 2010 to 2020.
Circles: regions of the observed dengue outbreaks between 2010 and 2023.

Decadal averages Medium-range forecasts Long-range projections

→ Decadal averages

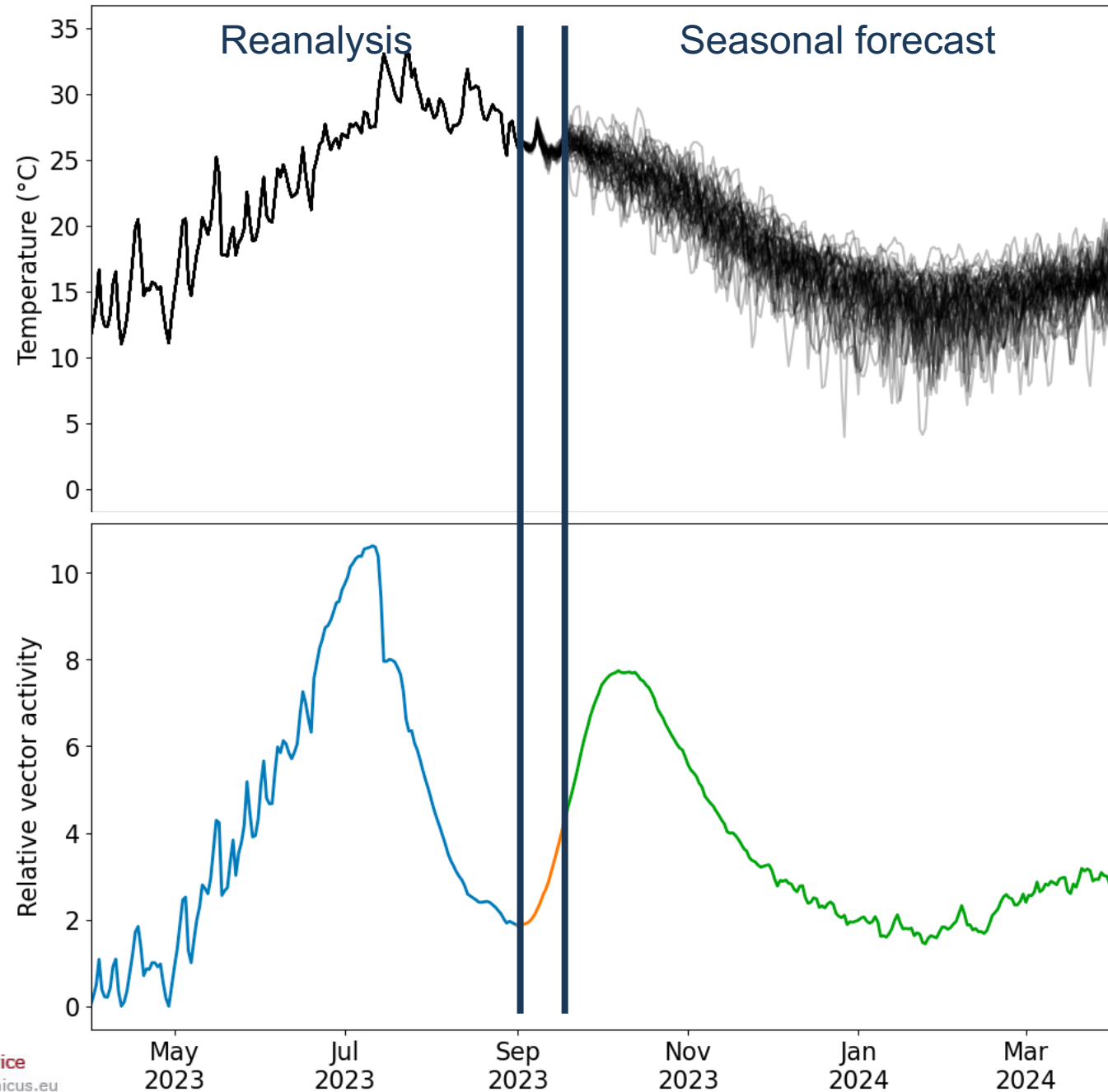
- Reanalysis dataset (2010-2020)
- Daily at 25 km resolution

→ Seasonal forecast

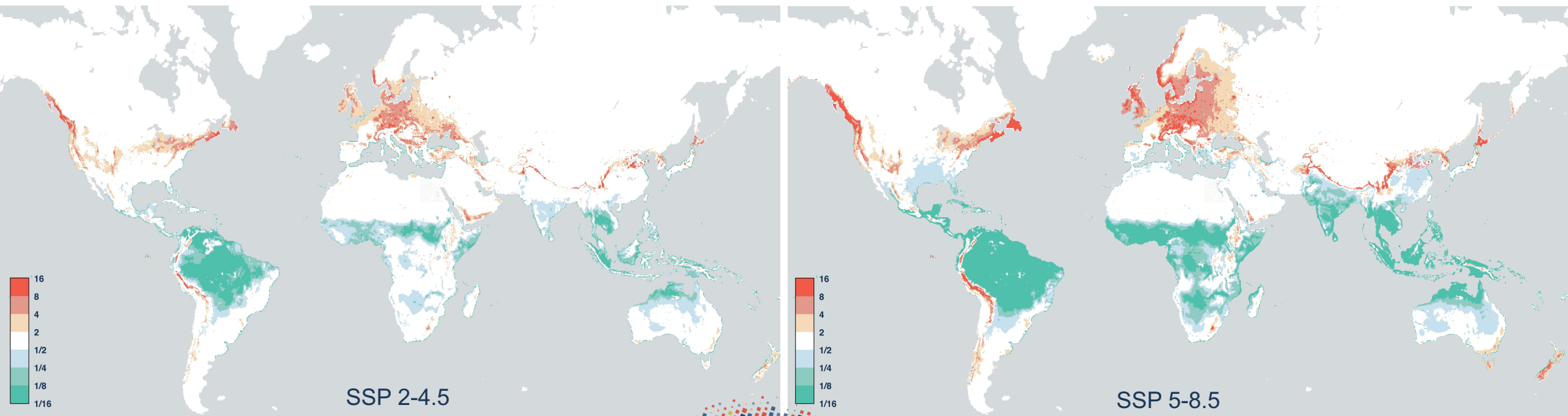
- Present & future (3-6 months)
- Daily at 25-100 km resolution

→ Climate projections

- NEX-GDDP-CMIP6 (2090-2100)
- SSP2-4.5 & SSP5-8.5
- Daily downscaled at 25 km resolution



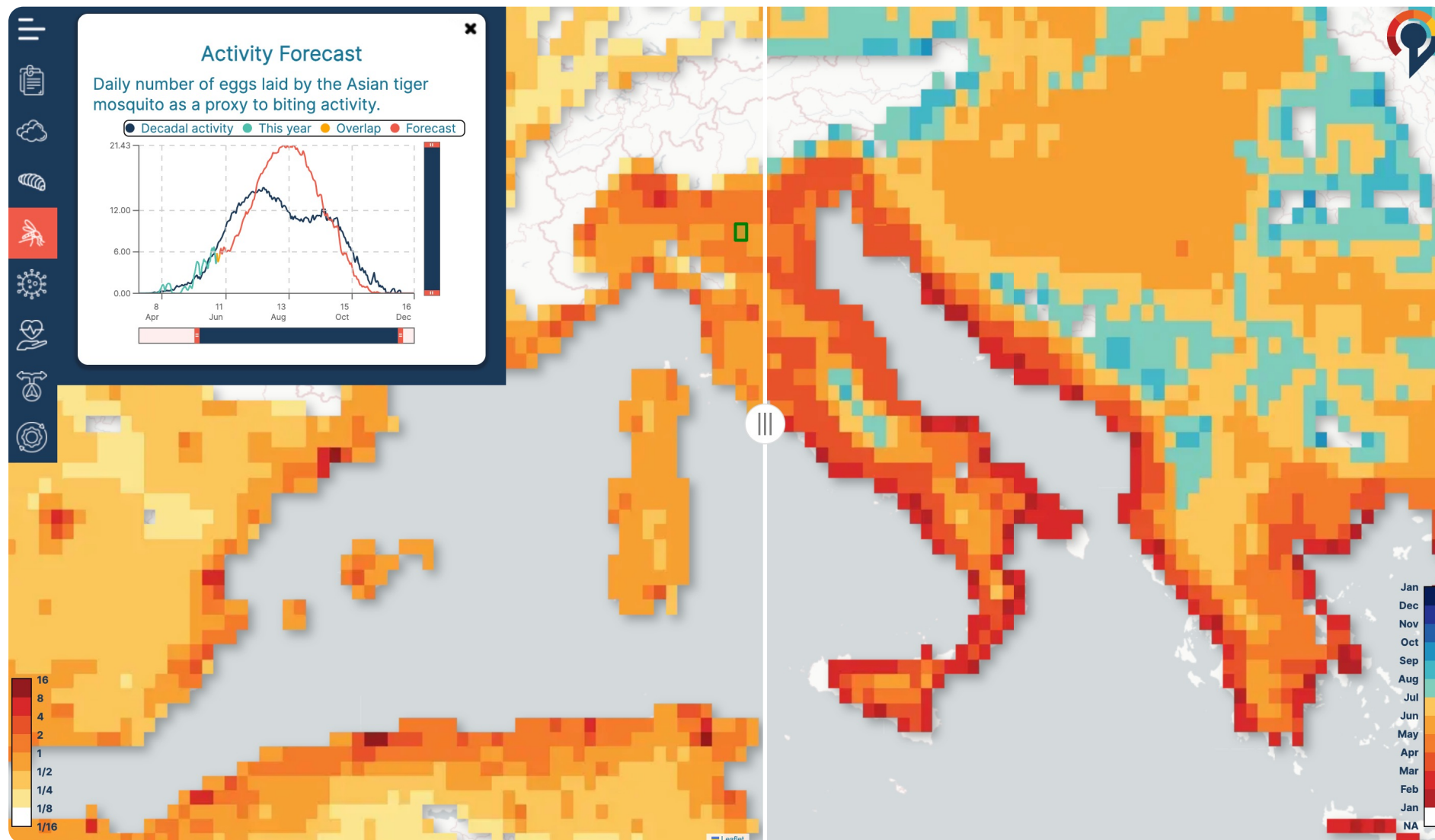
Expected activity in 2090-2100 compared to 2010-2020



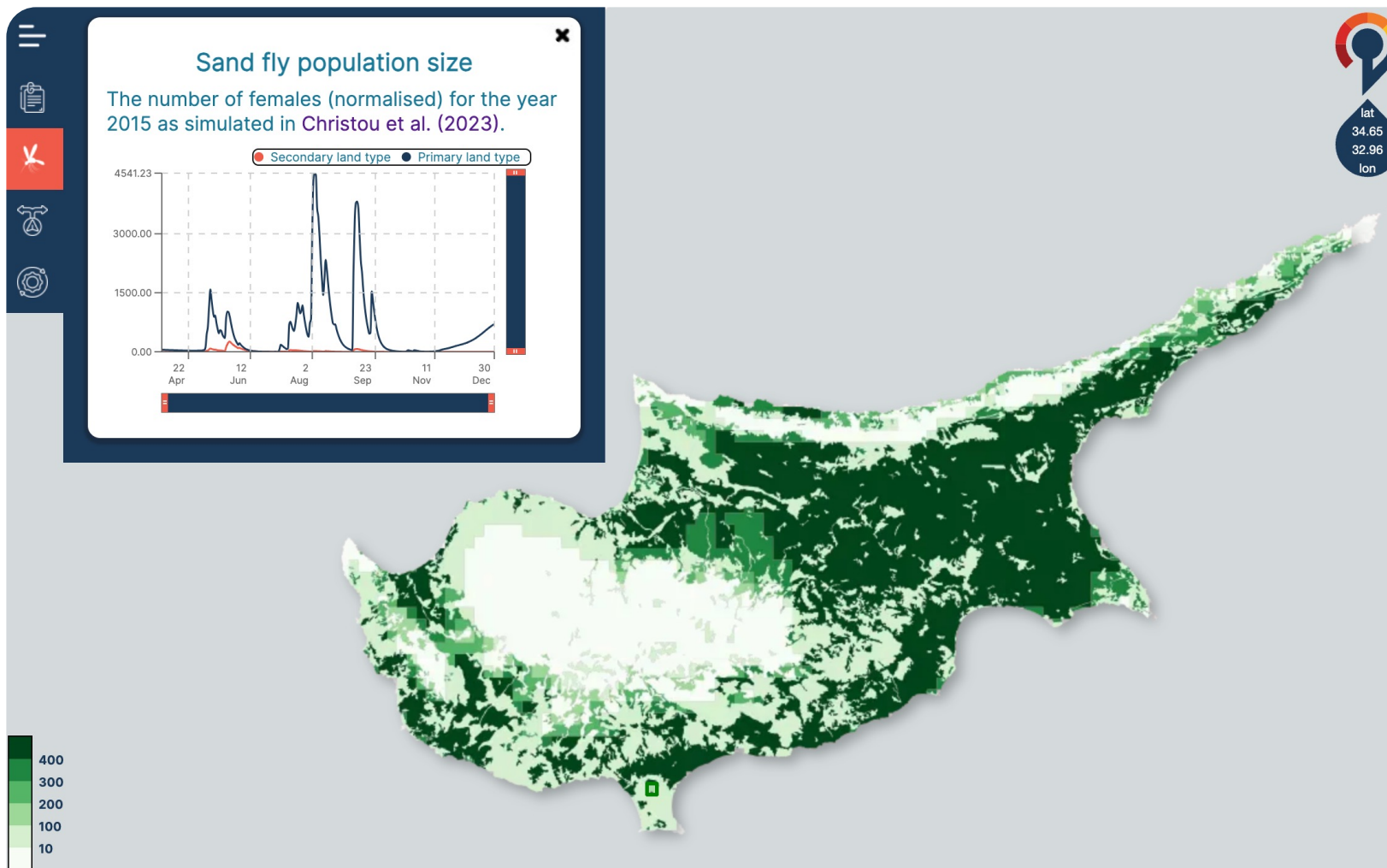
Coming soon!

VECLim's GIS & tile server

Current configuration
 VECLim's versatile GIS tools enable browsing simulation results and risk indicators spatially and temporally, overlaying and analyzing different outputs at the same time.



VECLim's GIS & tile server



Current configuration

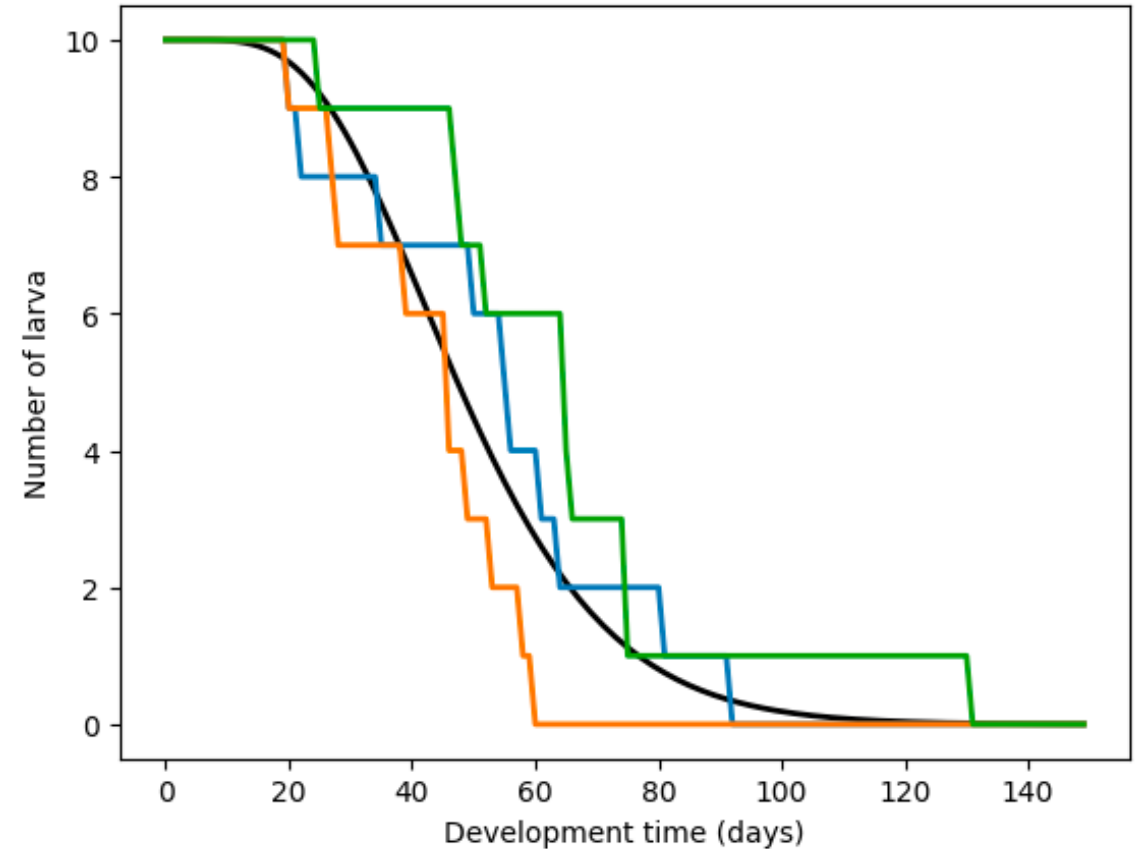
The platform enables studying different models and predictions, operating at any spatial and temporal resolution and over custom geospatial ranges.

PopJSON: a JavaScript Object Notation representation

```

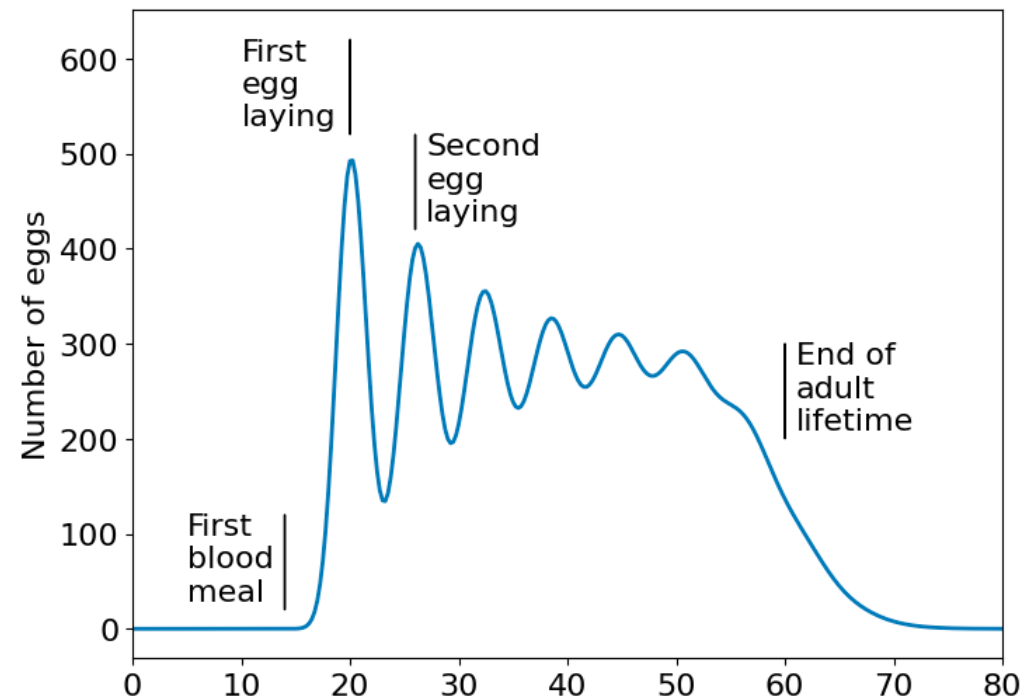
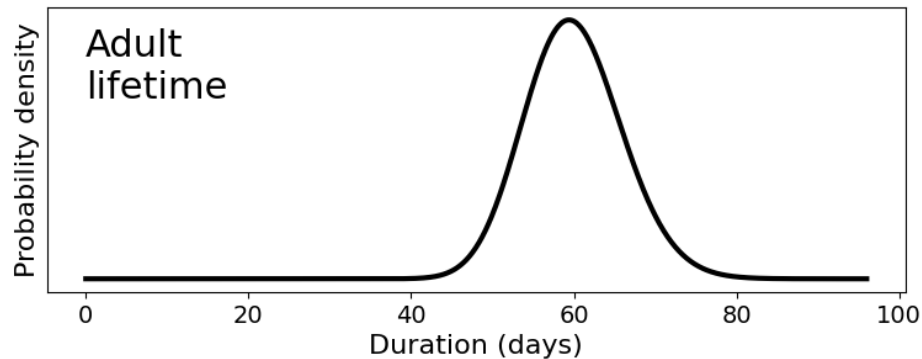
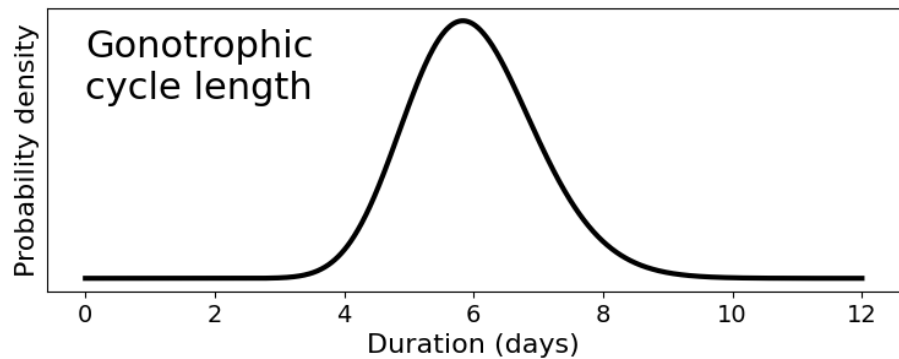
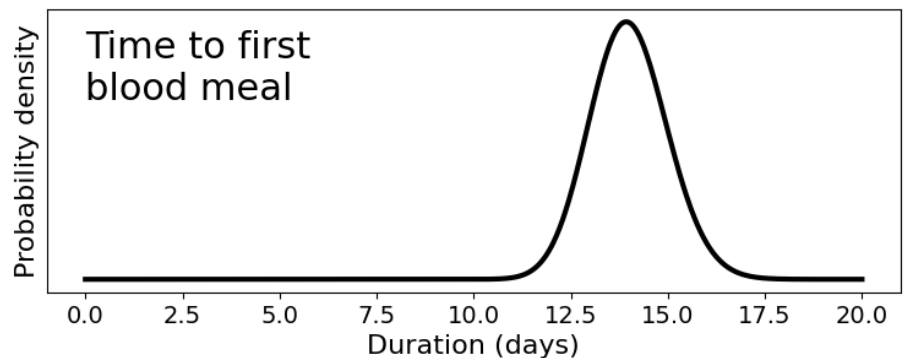
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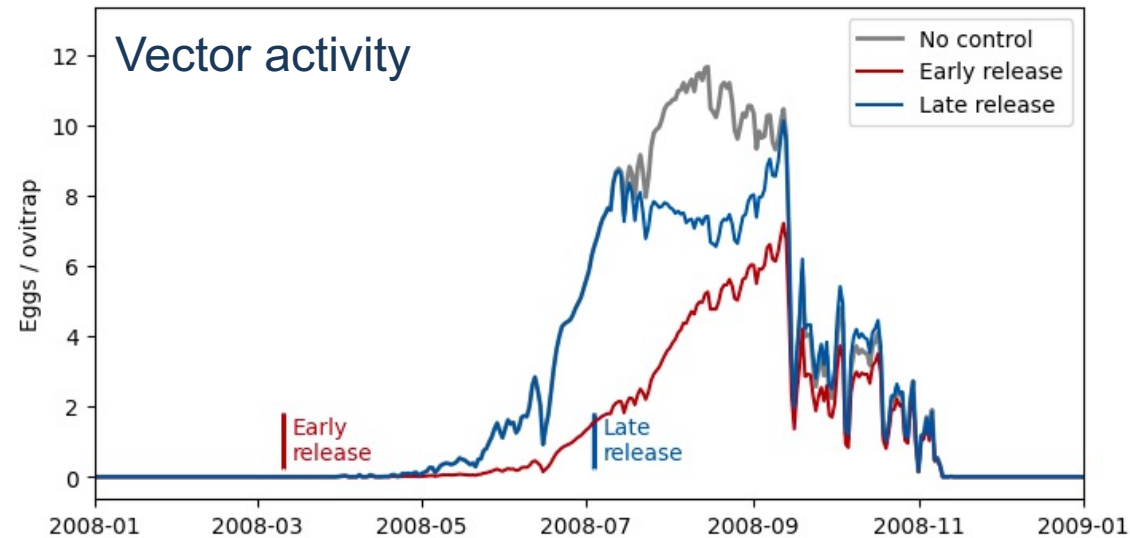
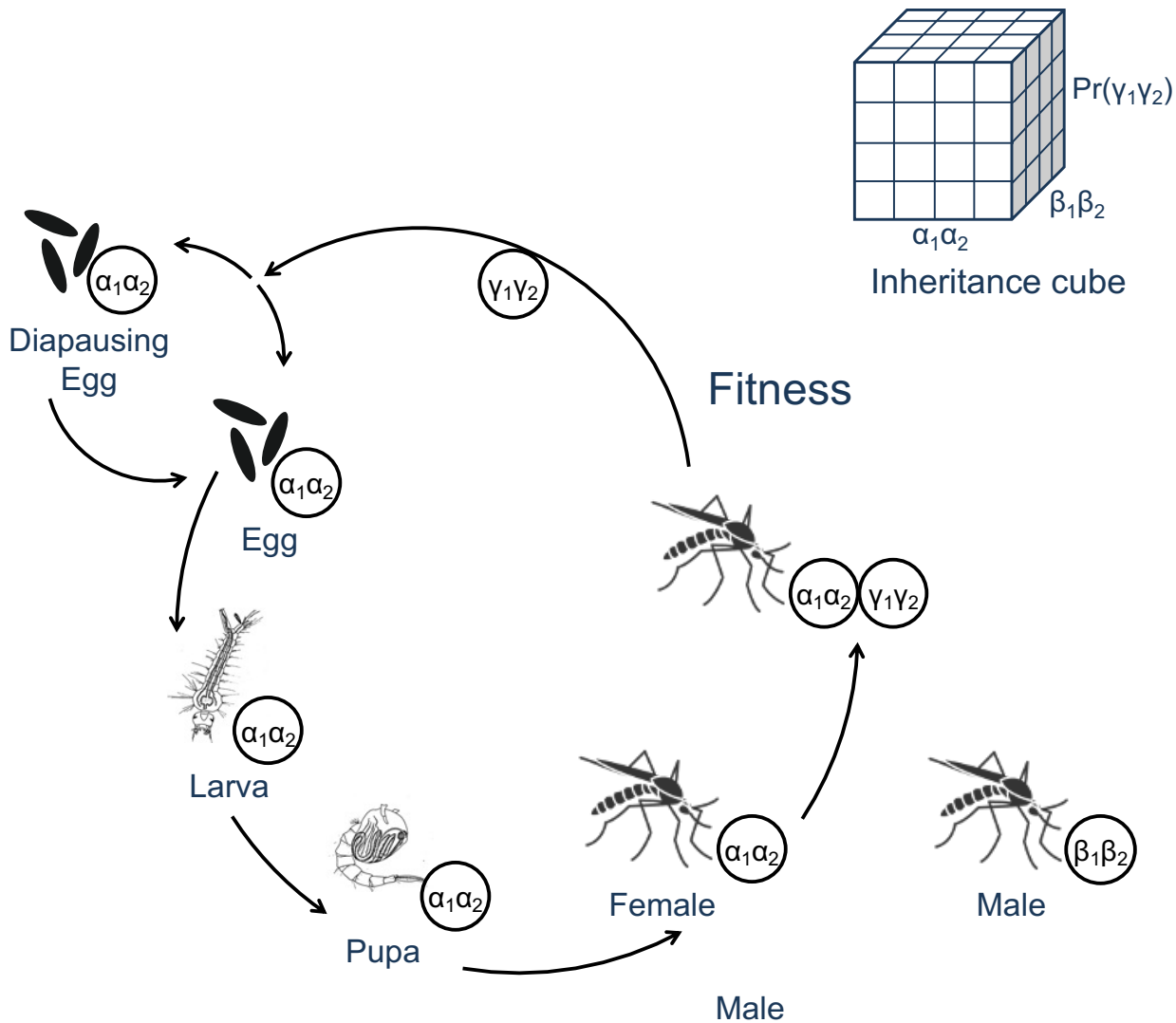
clarity - reproducibility - transferability

Dynamic multi-process modelling with PopJSON and the Population package

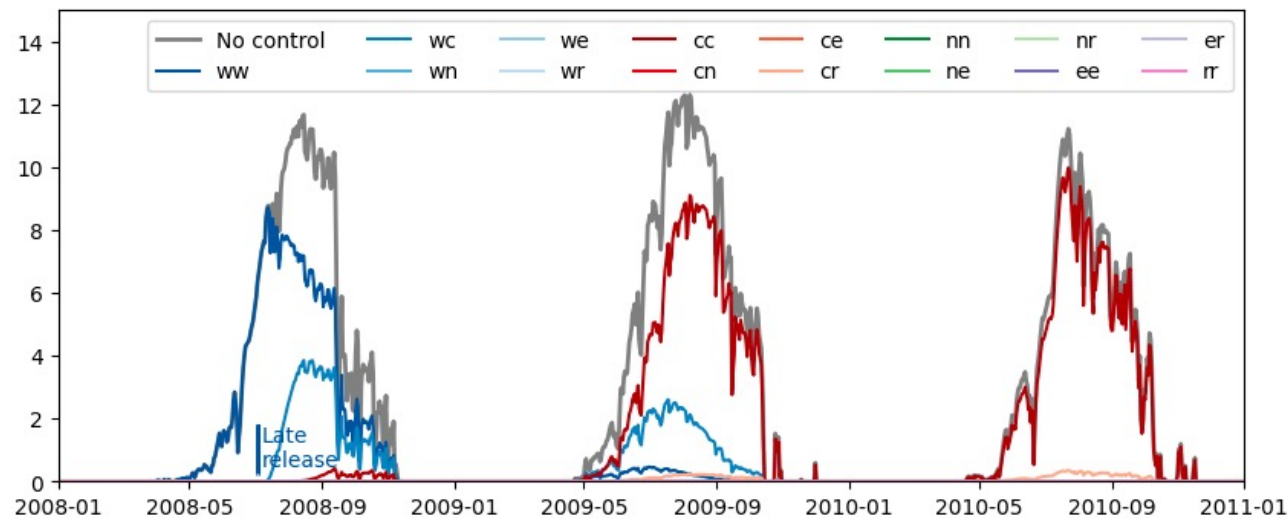


Dynamics of genetic control

Sterile insect technique

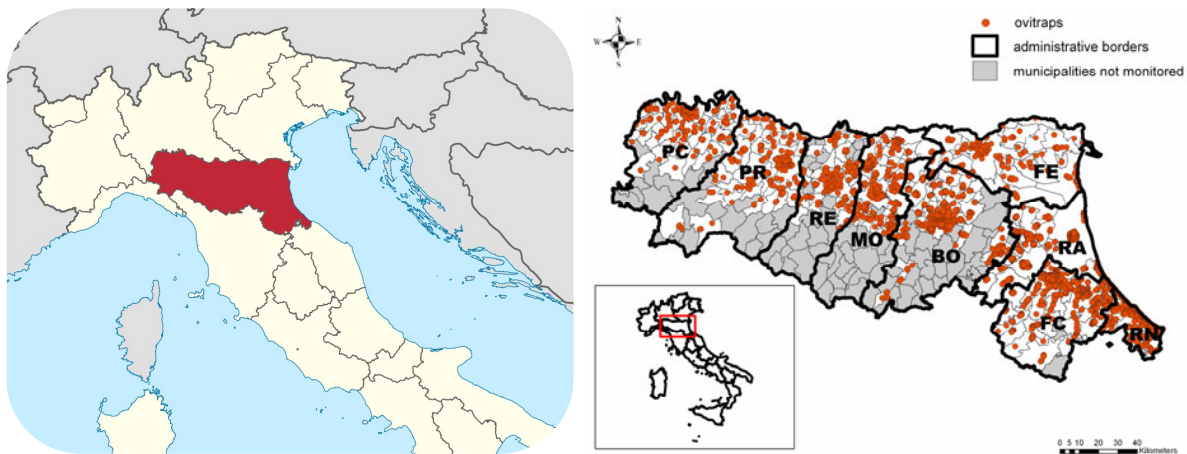


Classical replacement gene drive

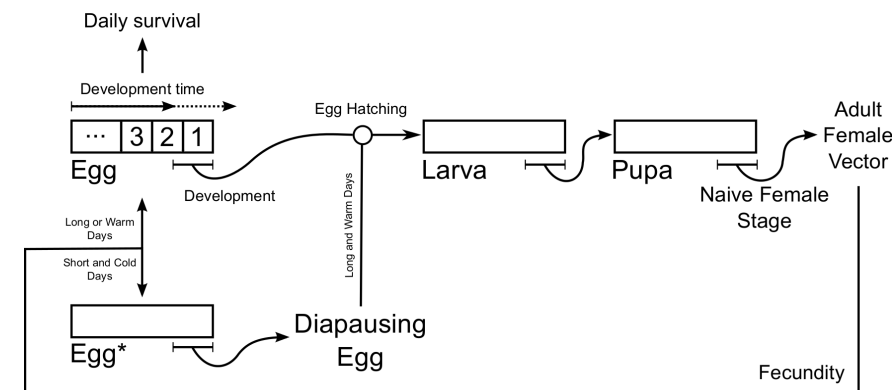
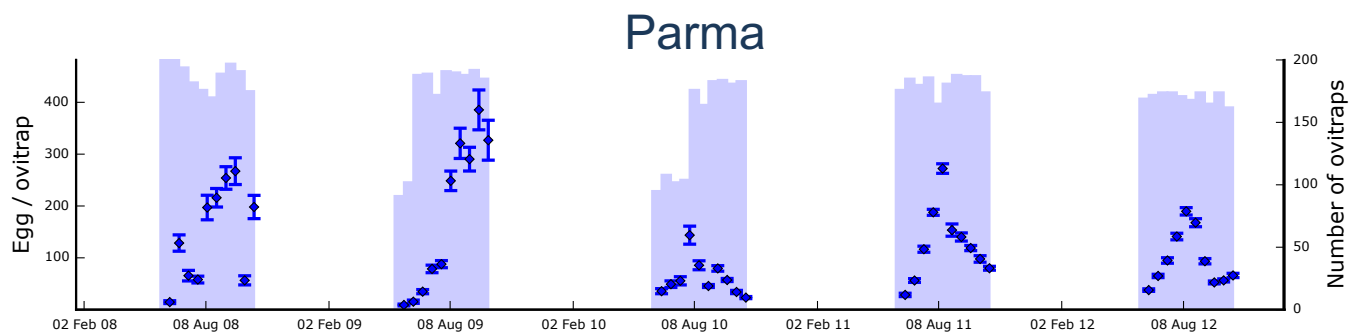
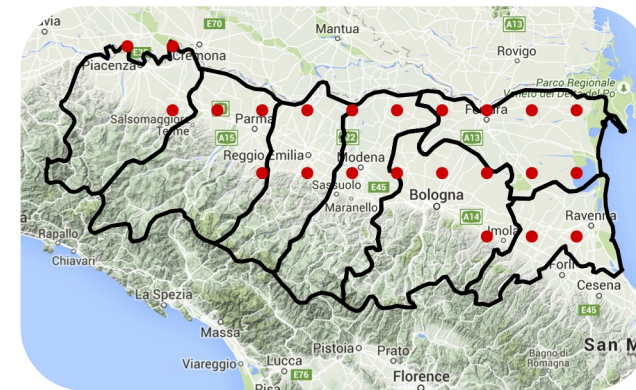




Predicting tiger mosquito abundance

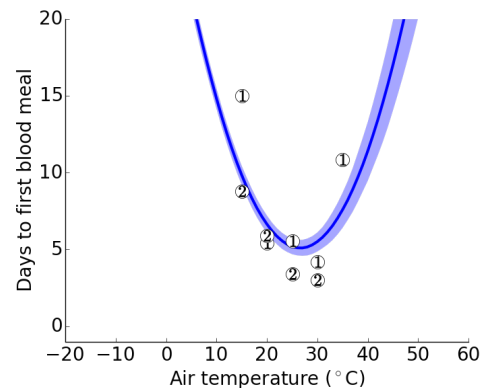
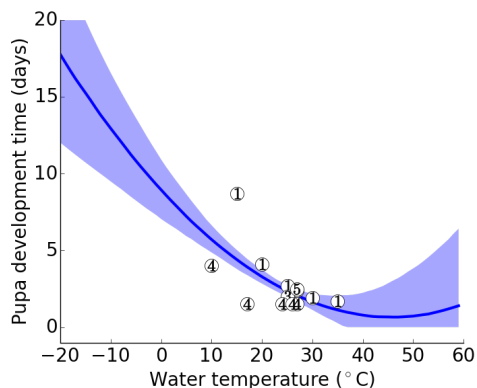
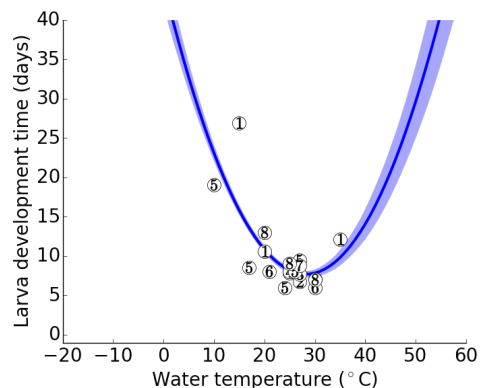
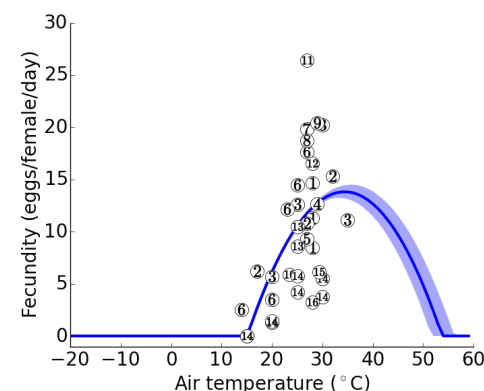
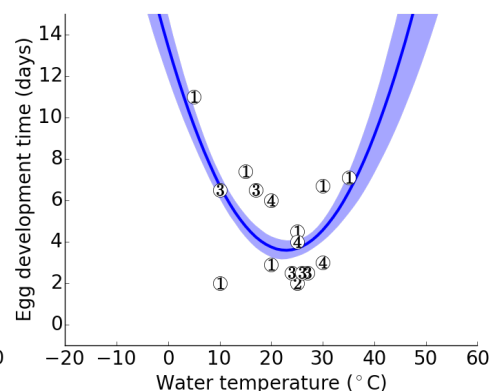
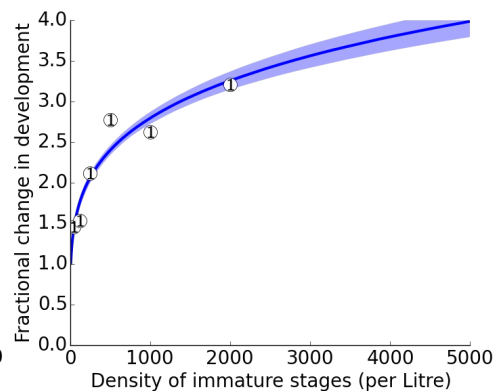
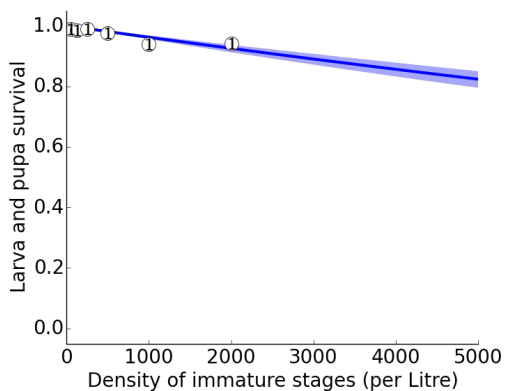
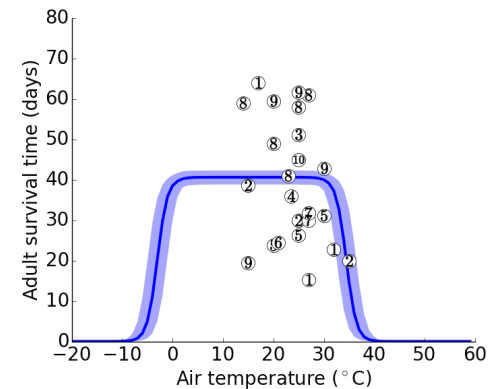
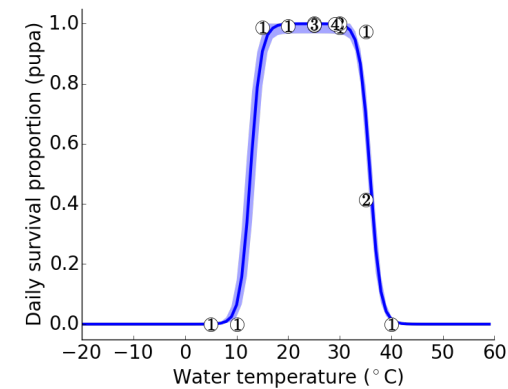
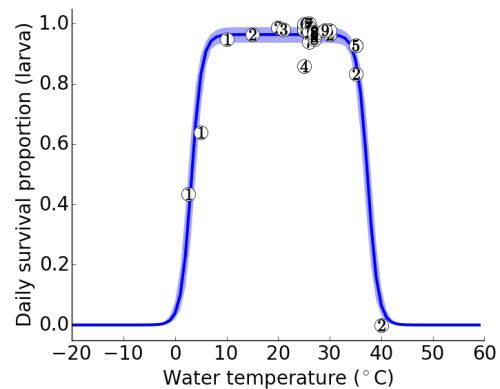
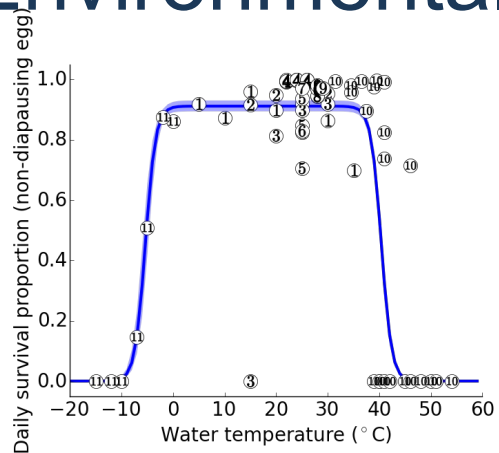
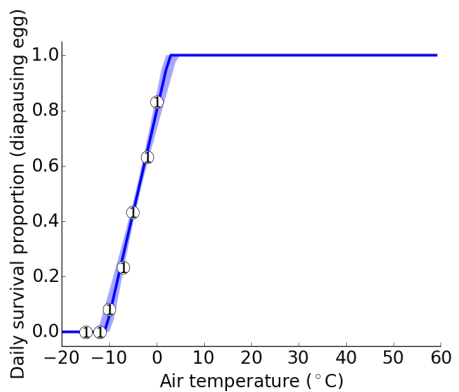


Albieri et al. Bull. Insectology 63(2) (2010)

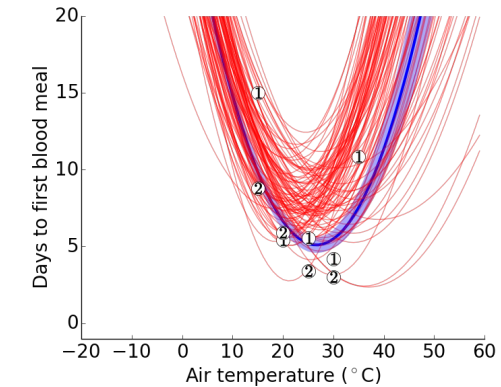
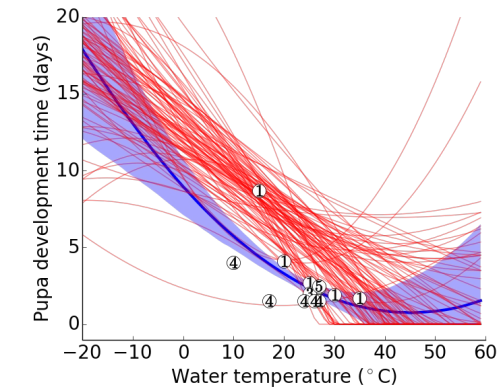
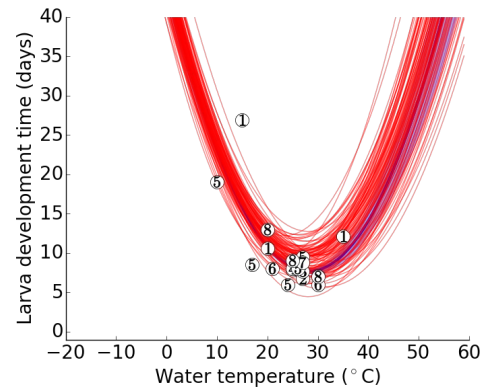
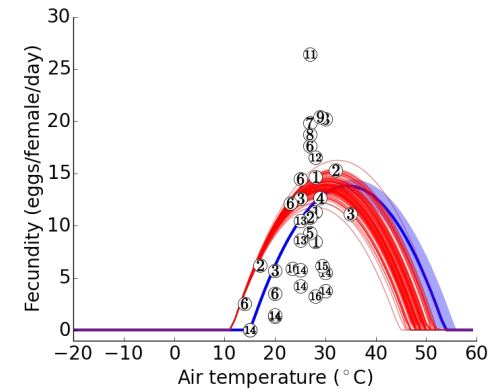
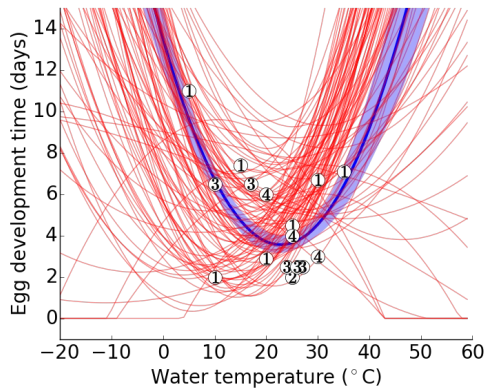
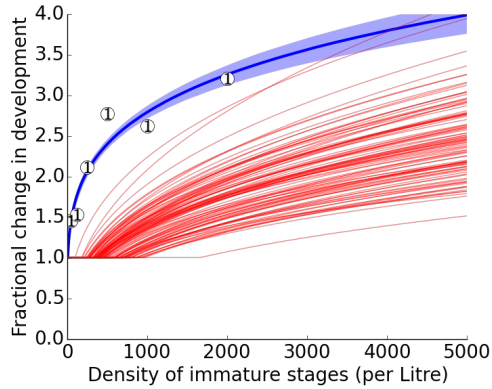
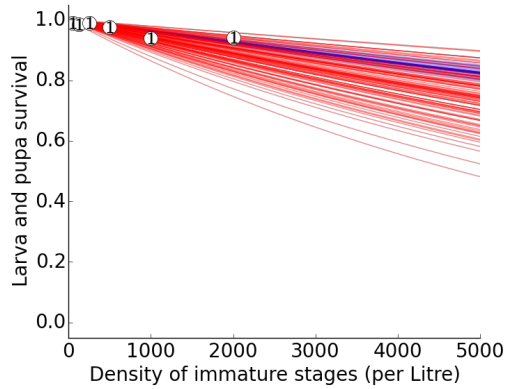
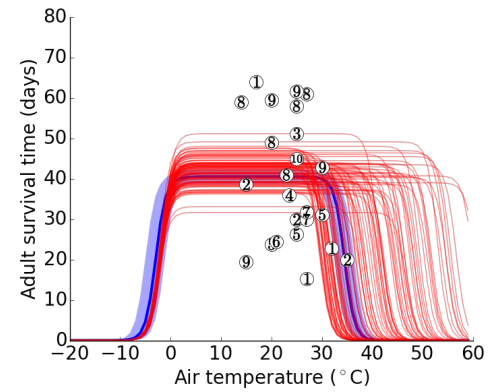
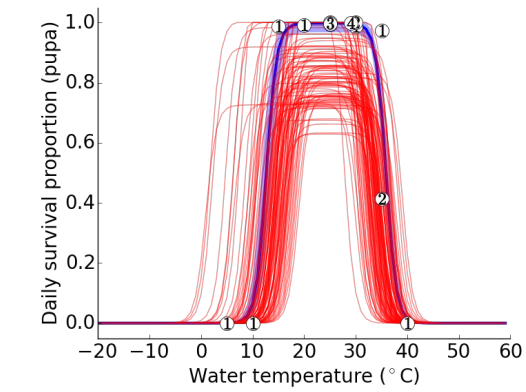
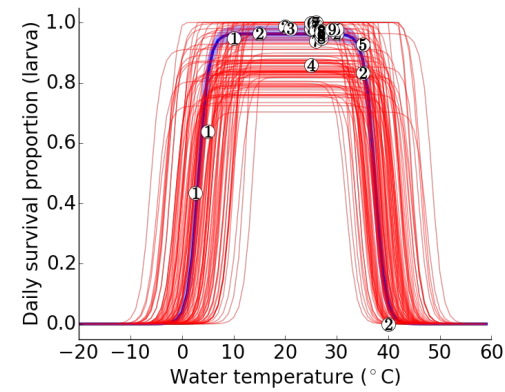
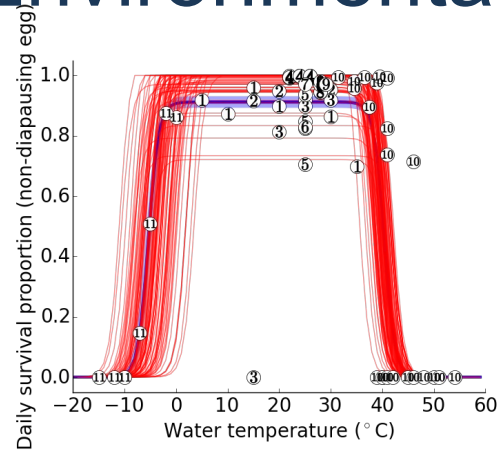
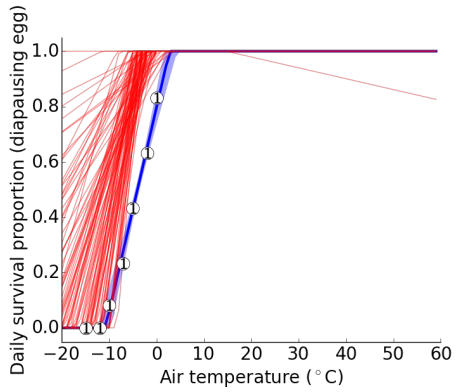


- Temperature and precipitation (E-OBS)
- Human population density (SEDAC)
- Photoperiod

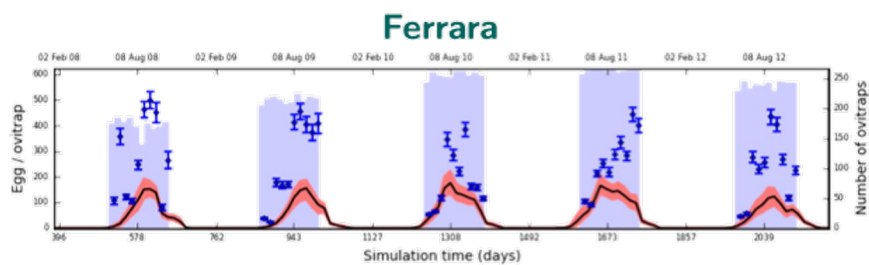
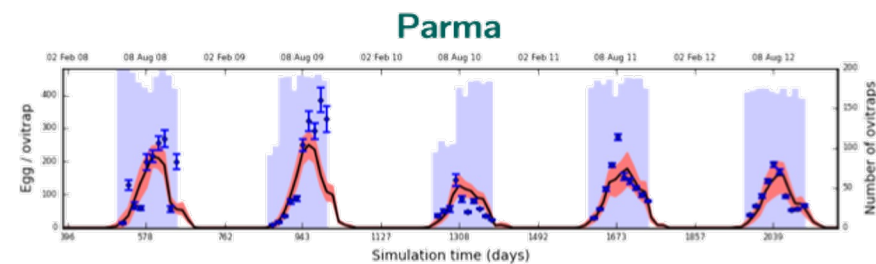
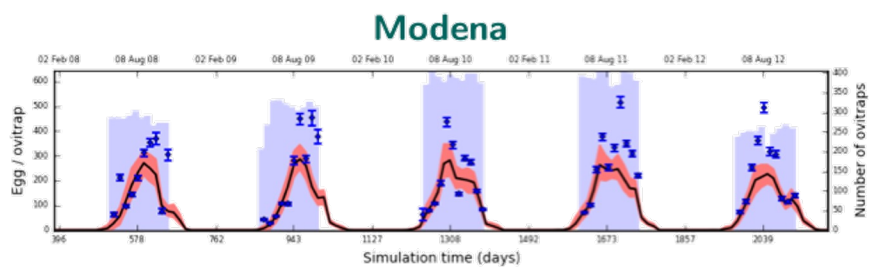
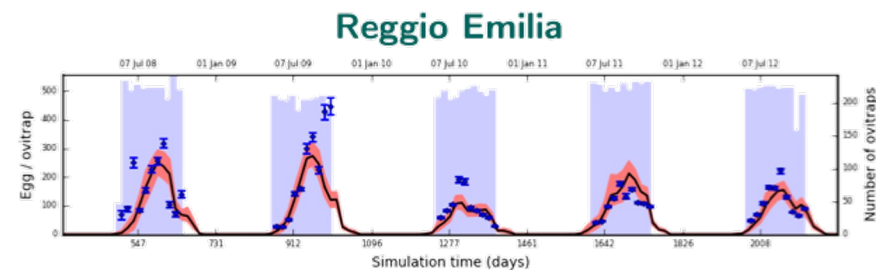
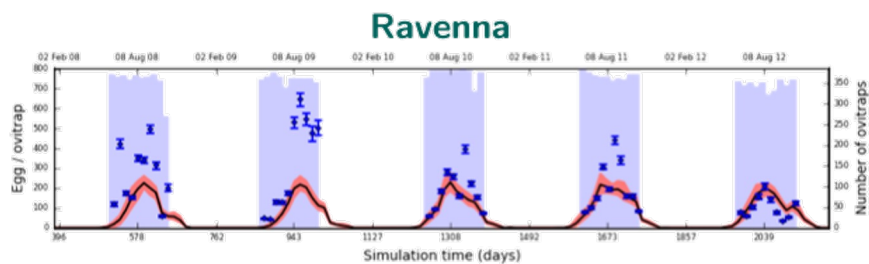
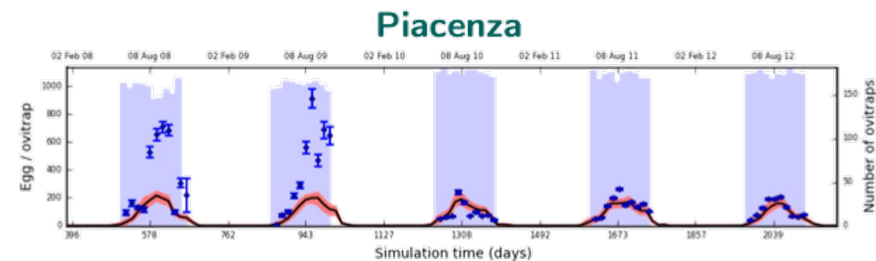
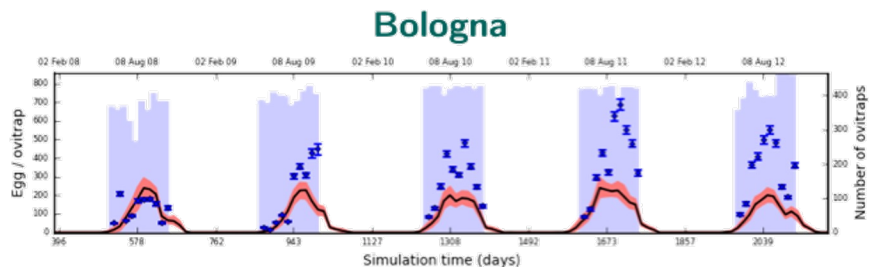
Environmental dependency of life processes



Environmental dependency of life processes



Goodness-of-fit over Emilia-Romagna



Surveillance period:
2008 - 2012

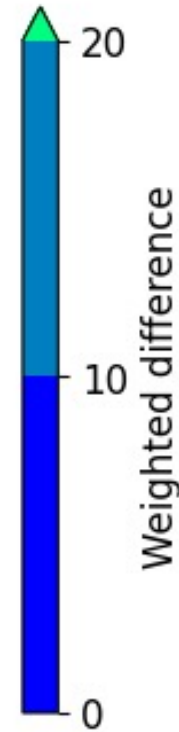
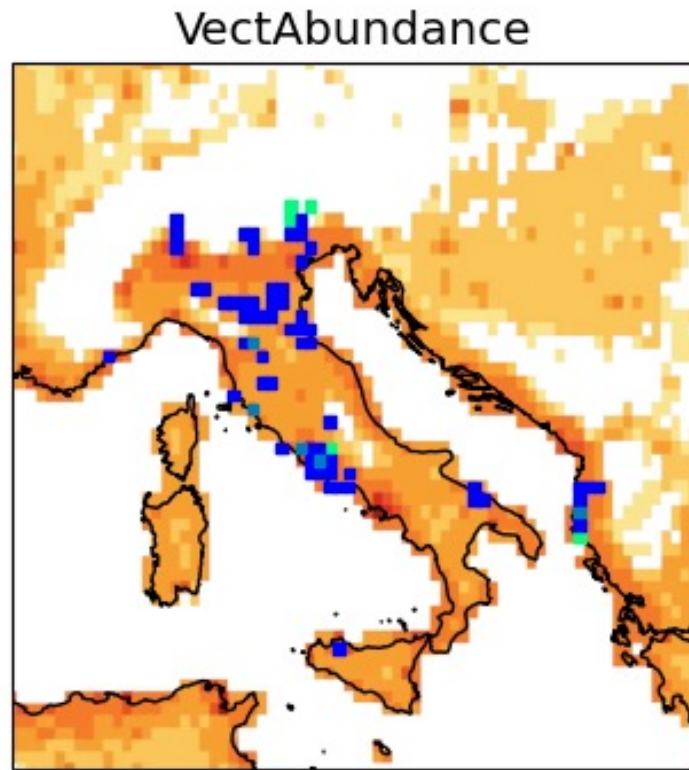
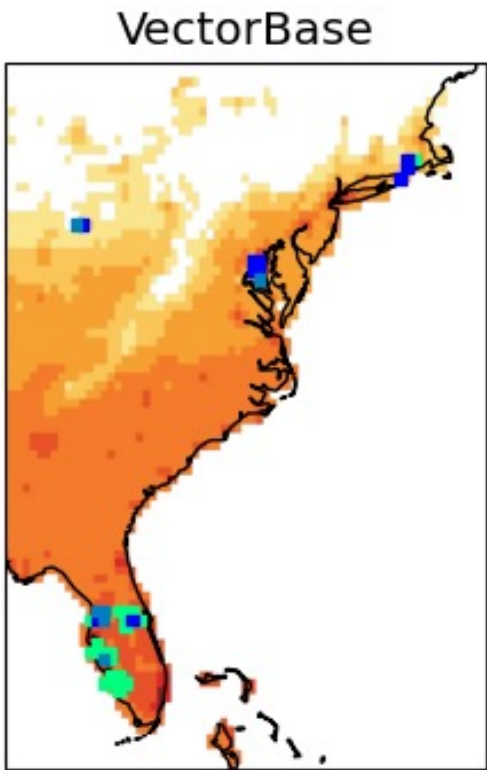
Global applicability assessment

Methods

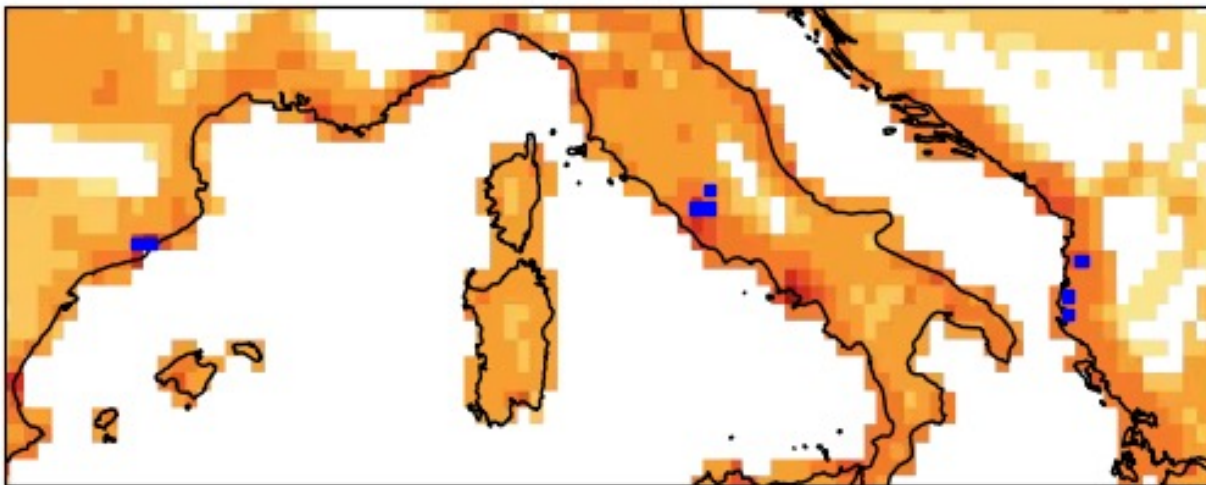
- Gridded
 - 25 km
- Filtered
 - At least 50 data points
 - Sampling: 1-day adult, 7-day egg

Results

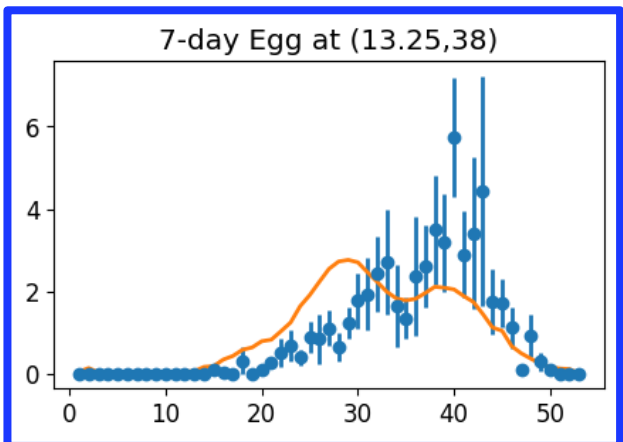
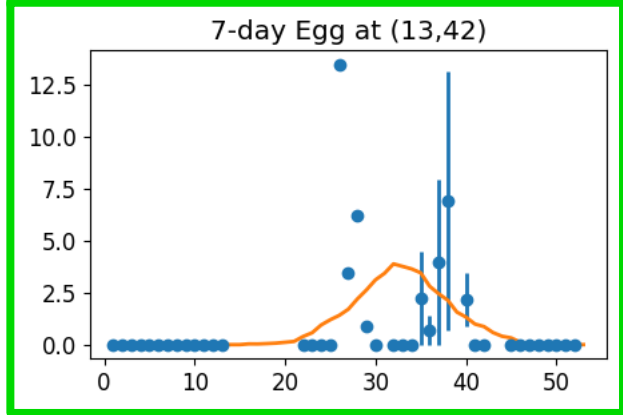
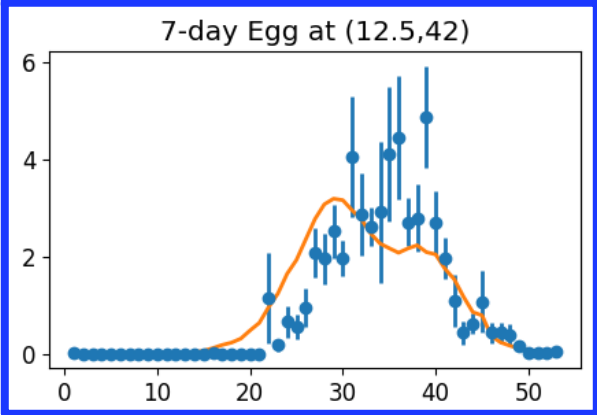
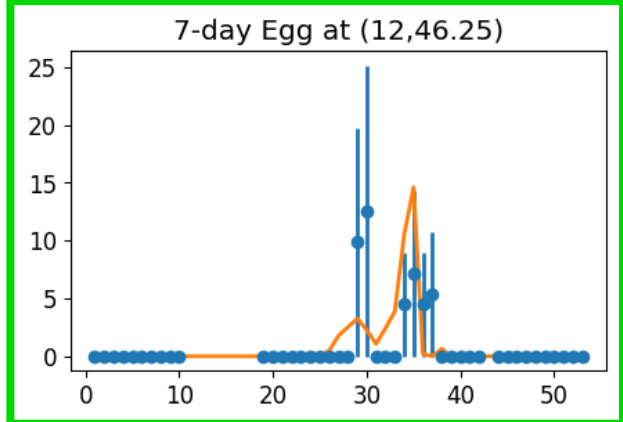
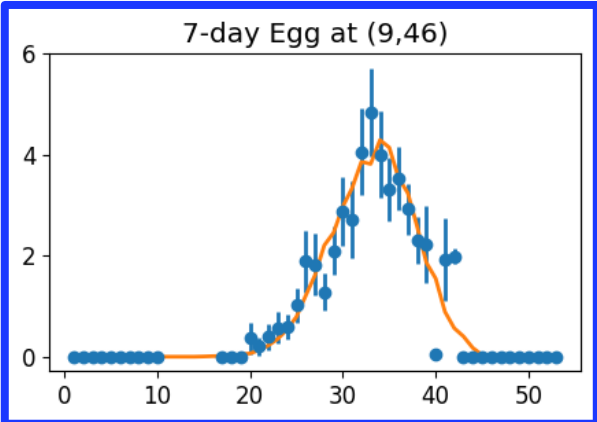
- Predictive in
 - Italy
 - Temperate and similar climates
- Needs improvement in
 - High altitudes
 - Tropical regions



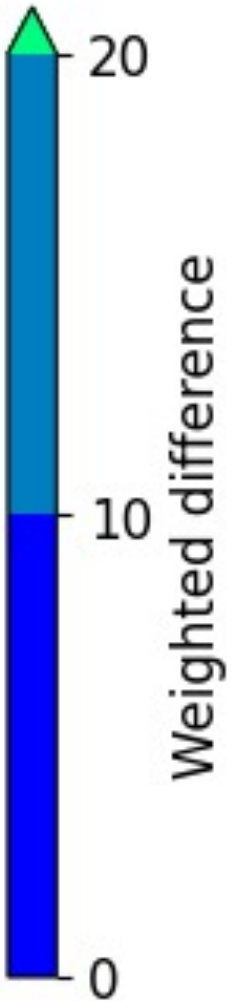
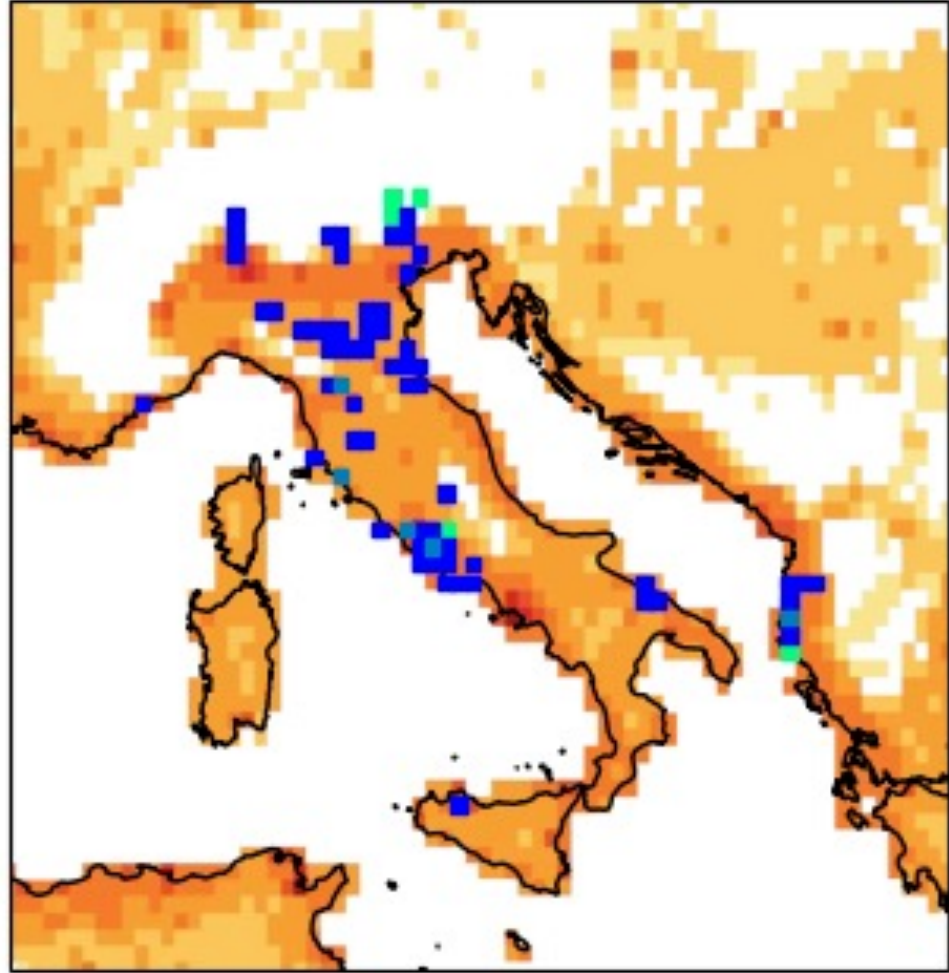
AIMSurv



Global applicability assessment

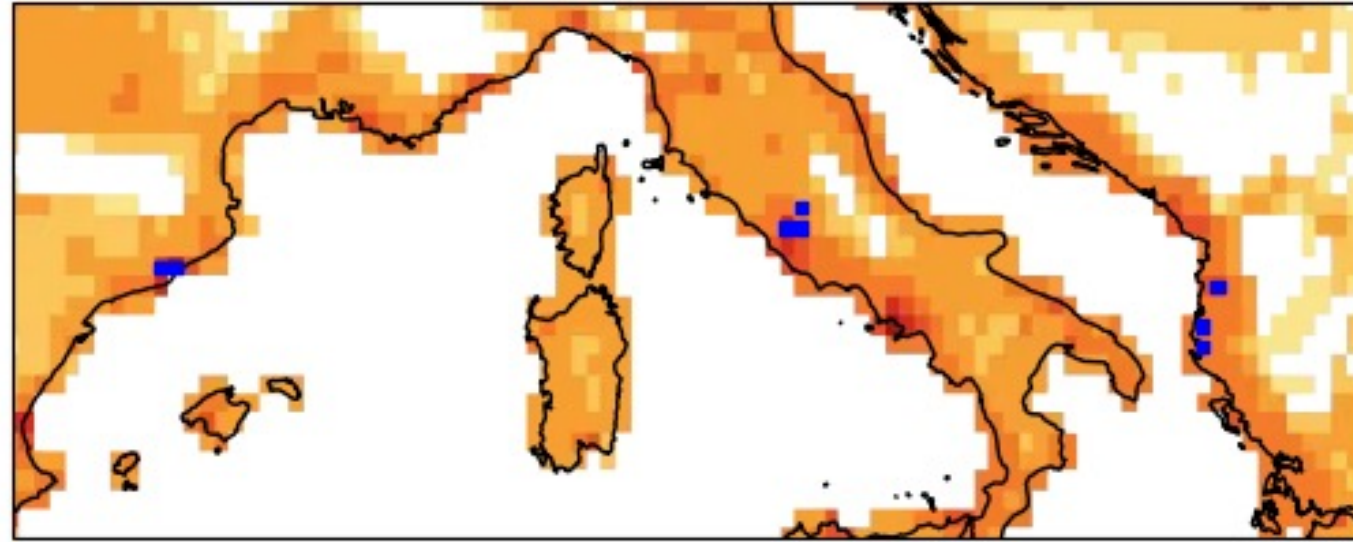


VectAbundance

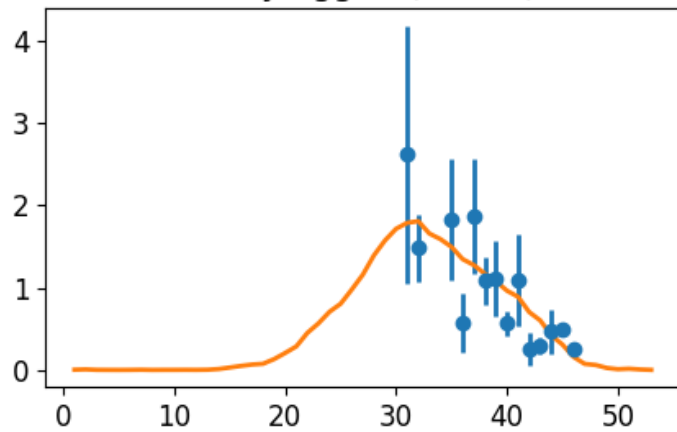


Global applicability assessment

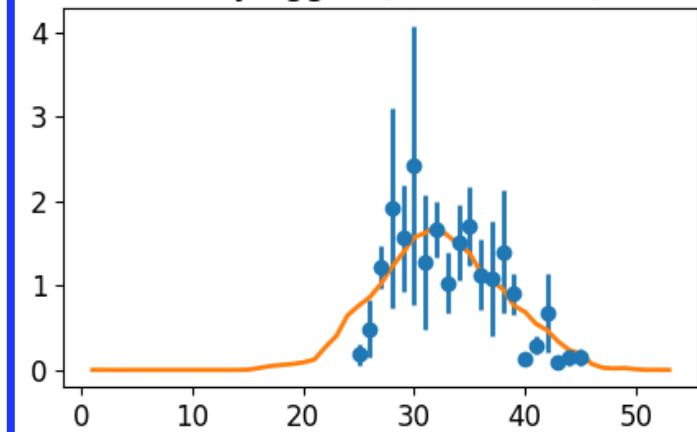
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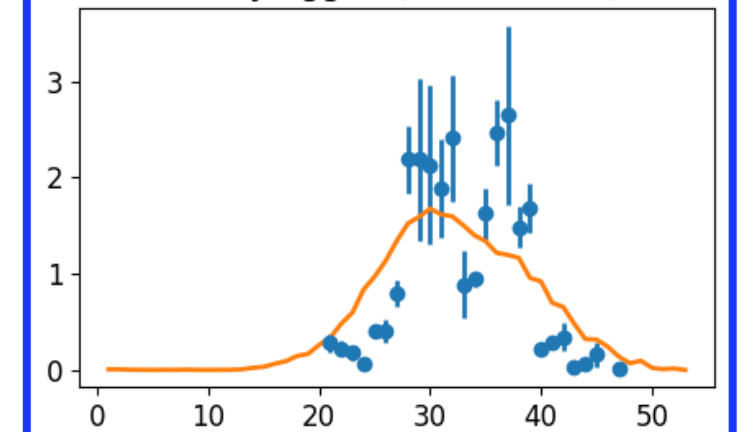
7-day Egg at (2,41.5)



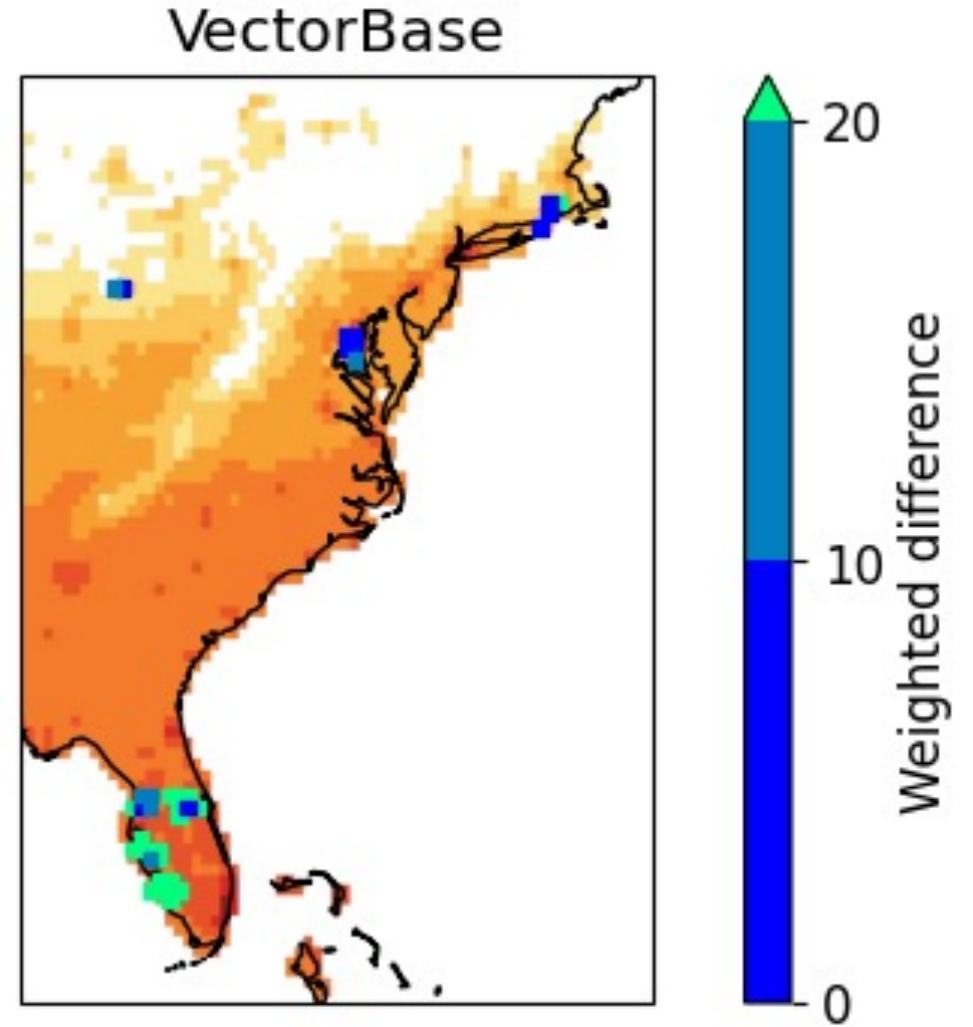
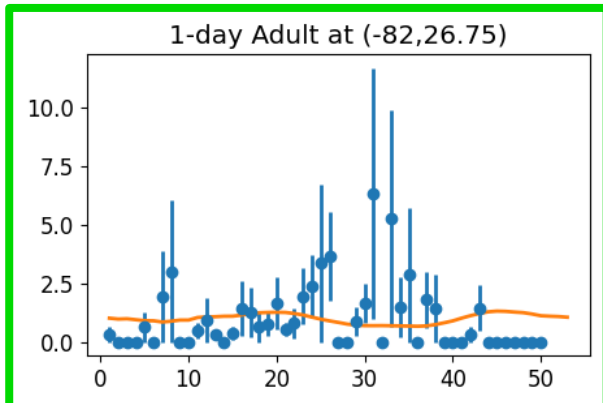
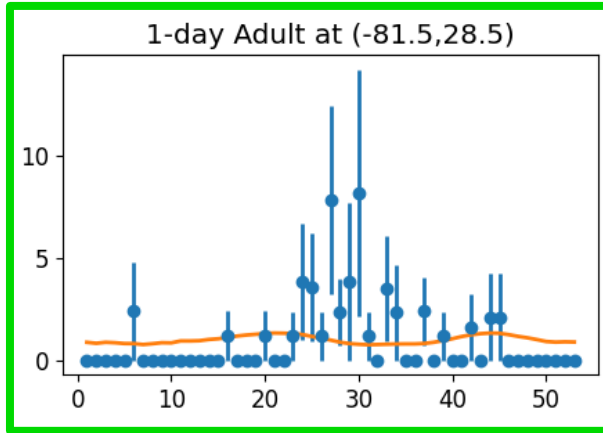
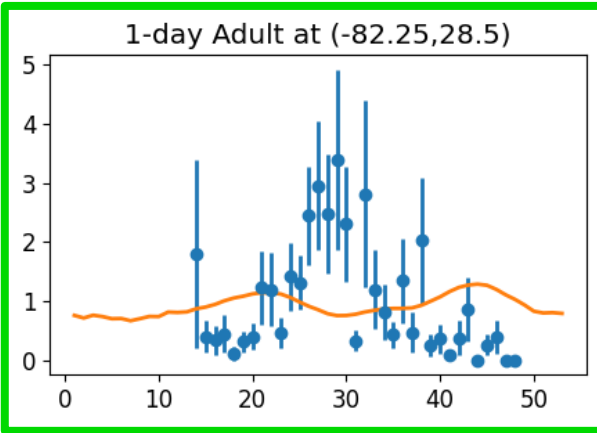
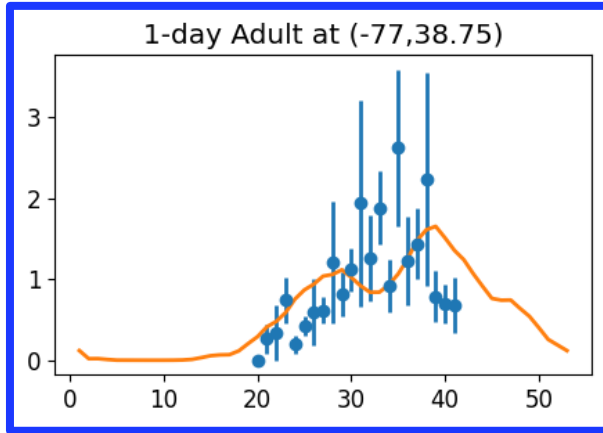
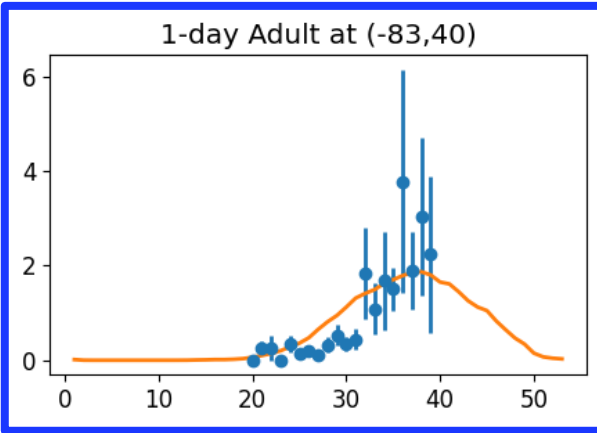
7-day Egg at (12.75,42.25)



7-day Egg at (19.75,41.25)

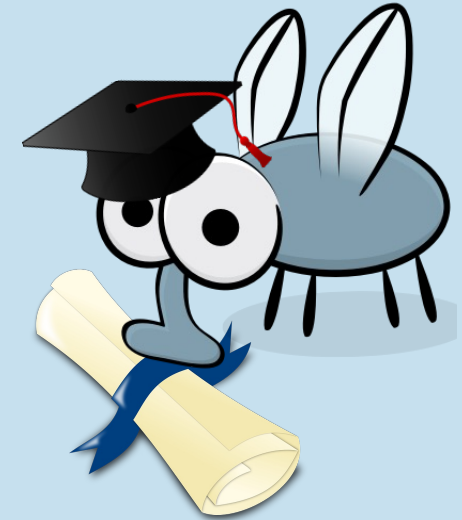


Global applicability assessment





THANK YOU



LOOKING
FOR
TEAMMATES!



Ahmet



Hande



George

