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ISTITUTO ZOOPROFILATTICO SPERIMENTALE DELL'ABRUZZO E DEL MOLISE "G. CAPORALE"

Sentinel 2 and Deep Learning methods to map *Culex pipiens* distribution in central Italy

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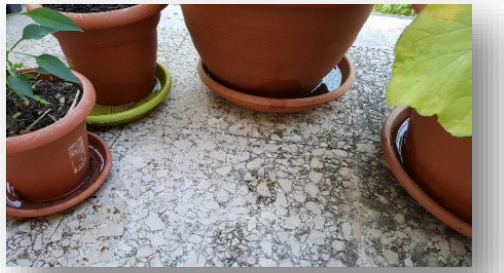
Culex pipiens

Vector of many diseases

- **West Nile fever**
- Usutu
- Eastern Equine encephalitis
- Japanese encephalitis
- Rift Valley fever
- St. Louis encephalitis
- And others …

Able to adapt to a wide variety of environments



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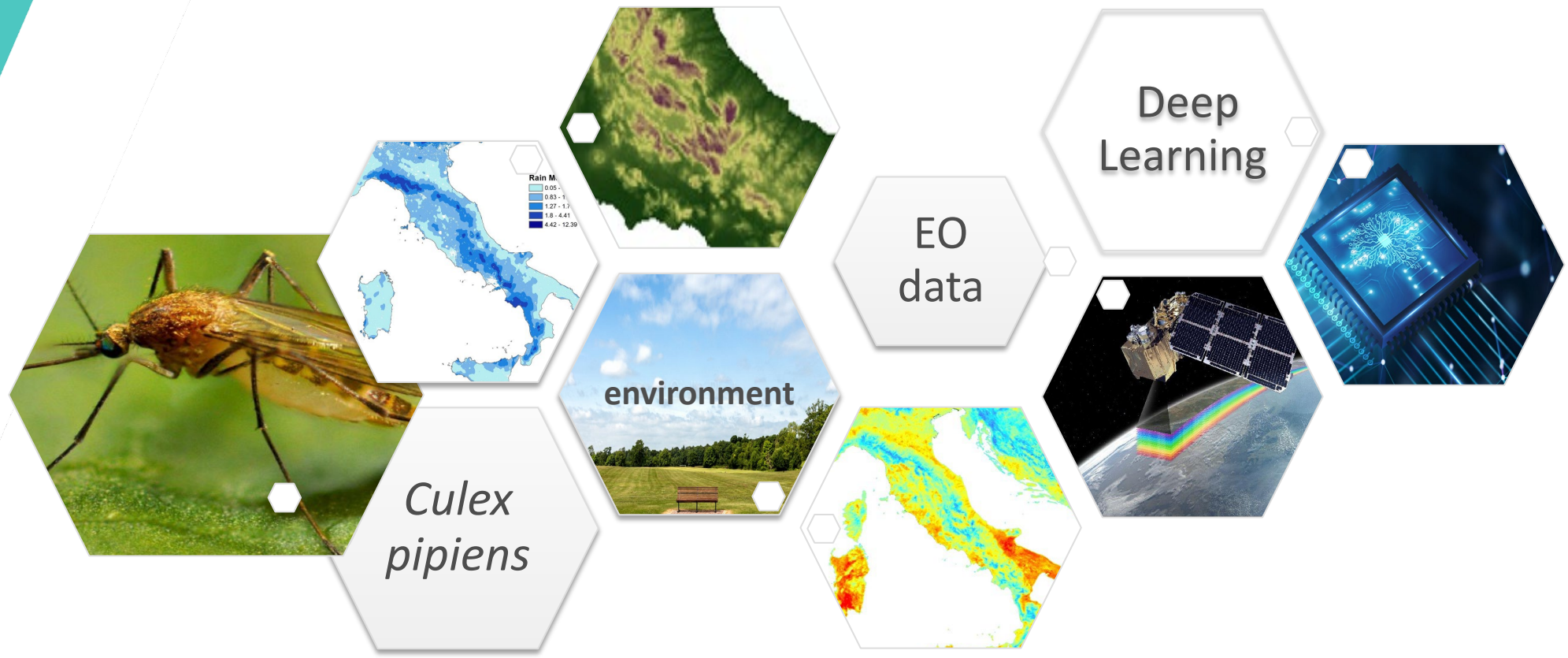
Research aim



to predict the spatio-temporal environments in central Italy suitable for the presence of *Culex pipiens*, exploiting EO data cubes and DL modeling

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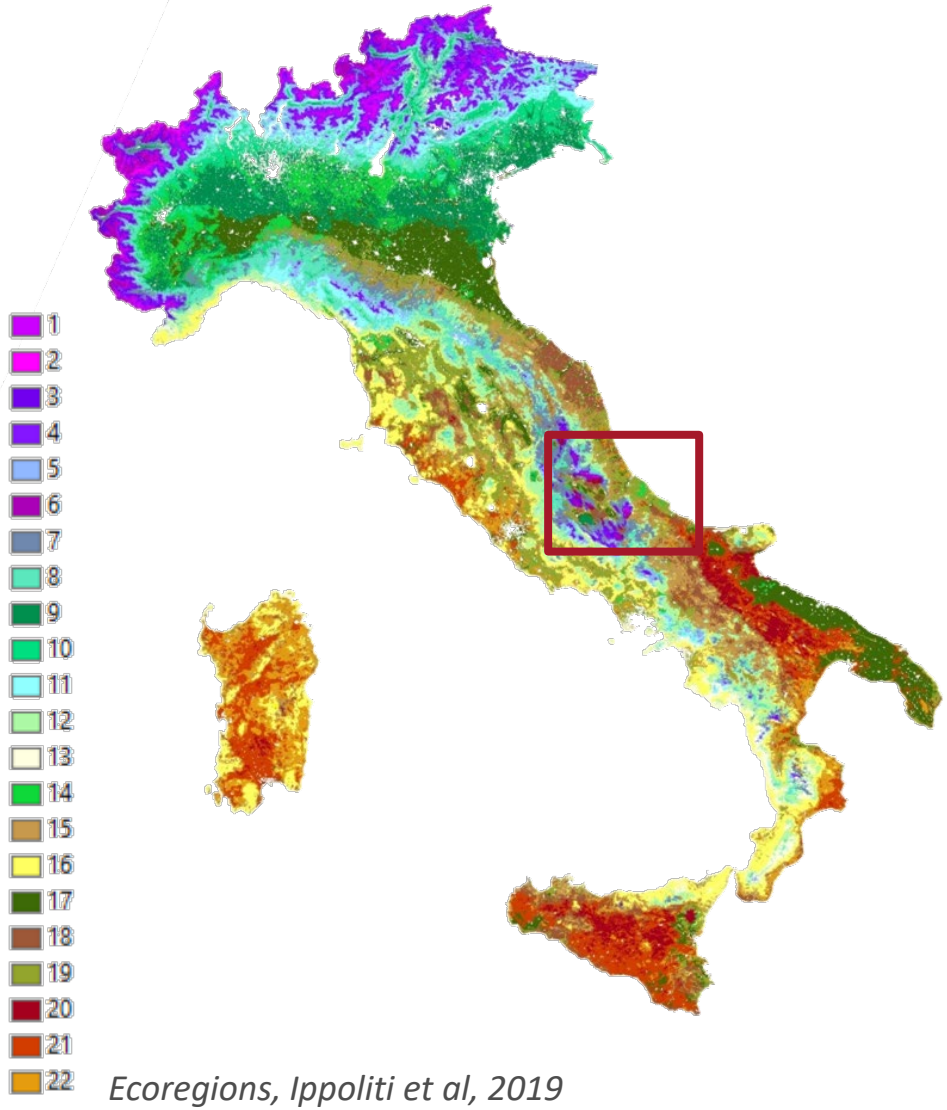
In-field sampling campaigns



Ecoregions, Ippoliti et al, 2019

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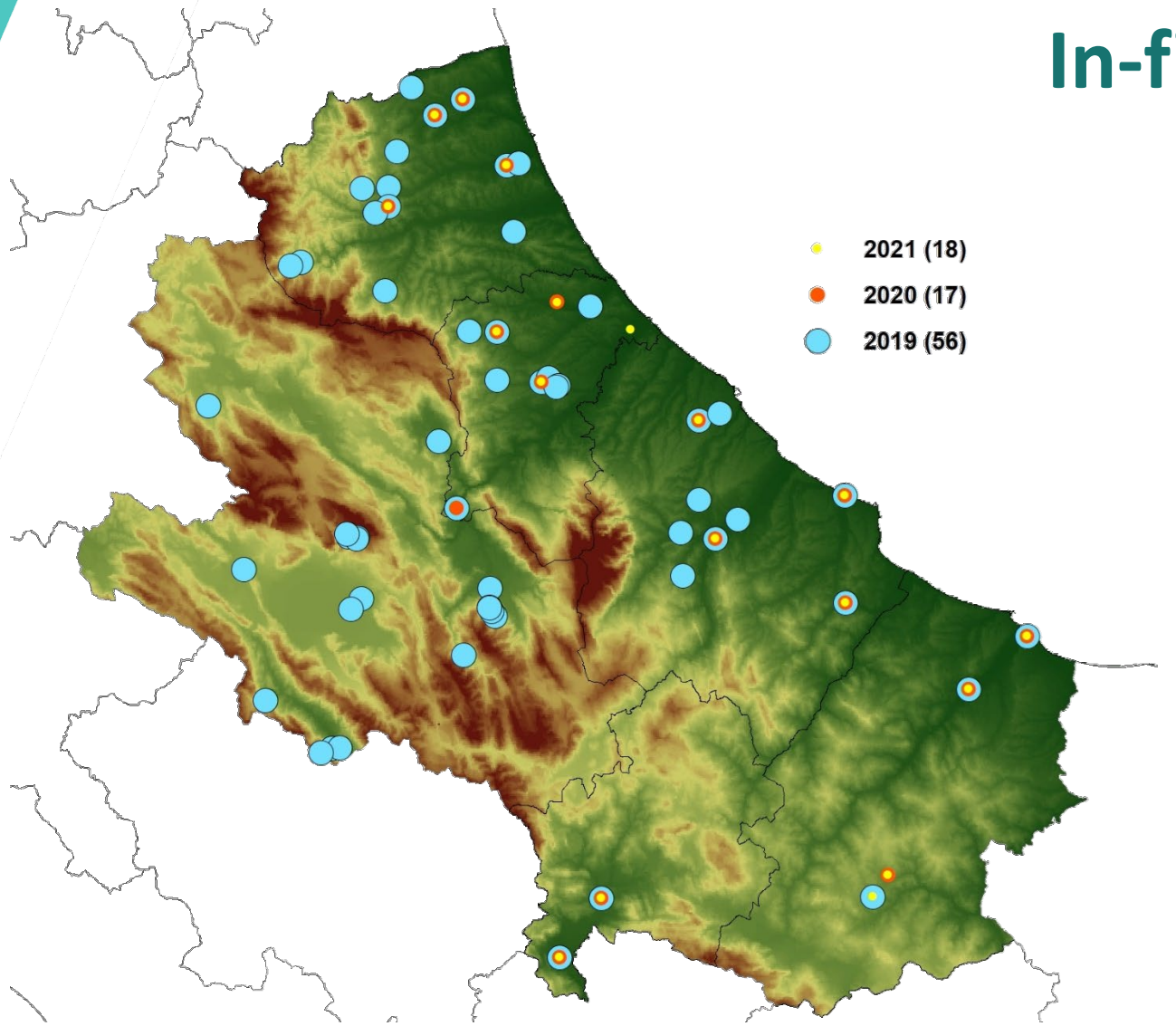
In-field sampling campaigns



- Average of 20 samplings per year
- During vector season (May to November)
- Plus pseudo-absence in winter months (December and January)

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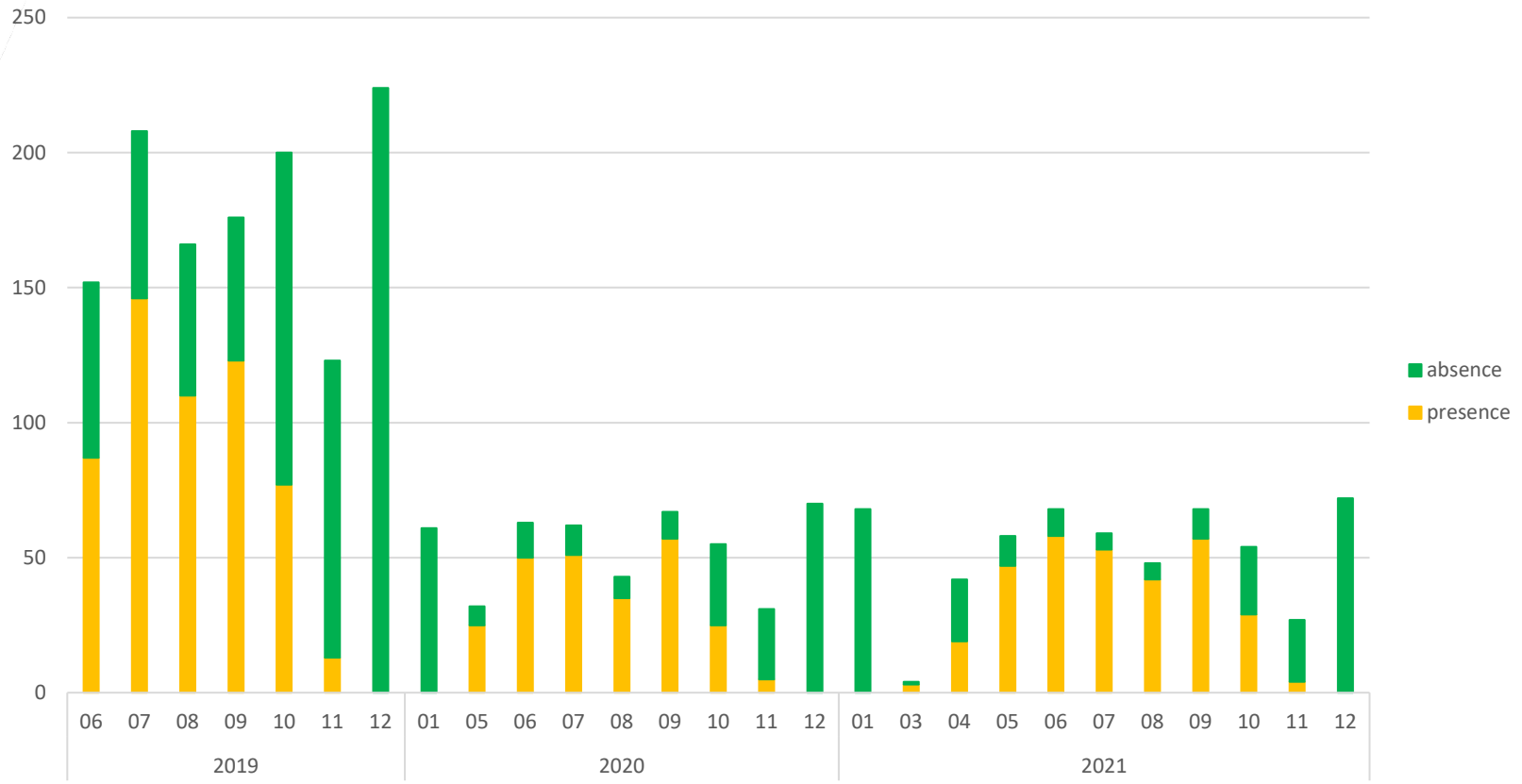
Ground truth database



The database was made up of 2301 records

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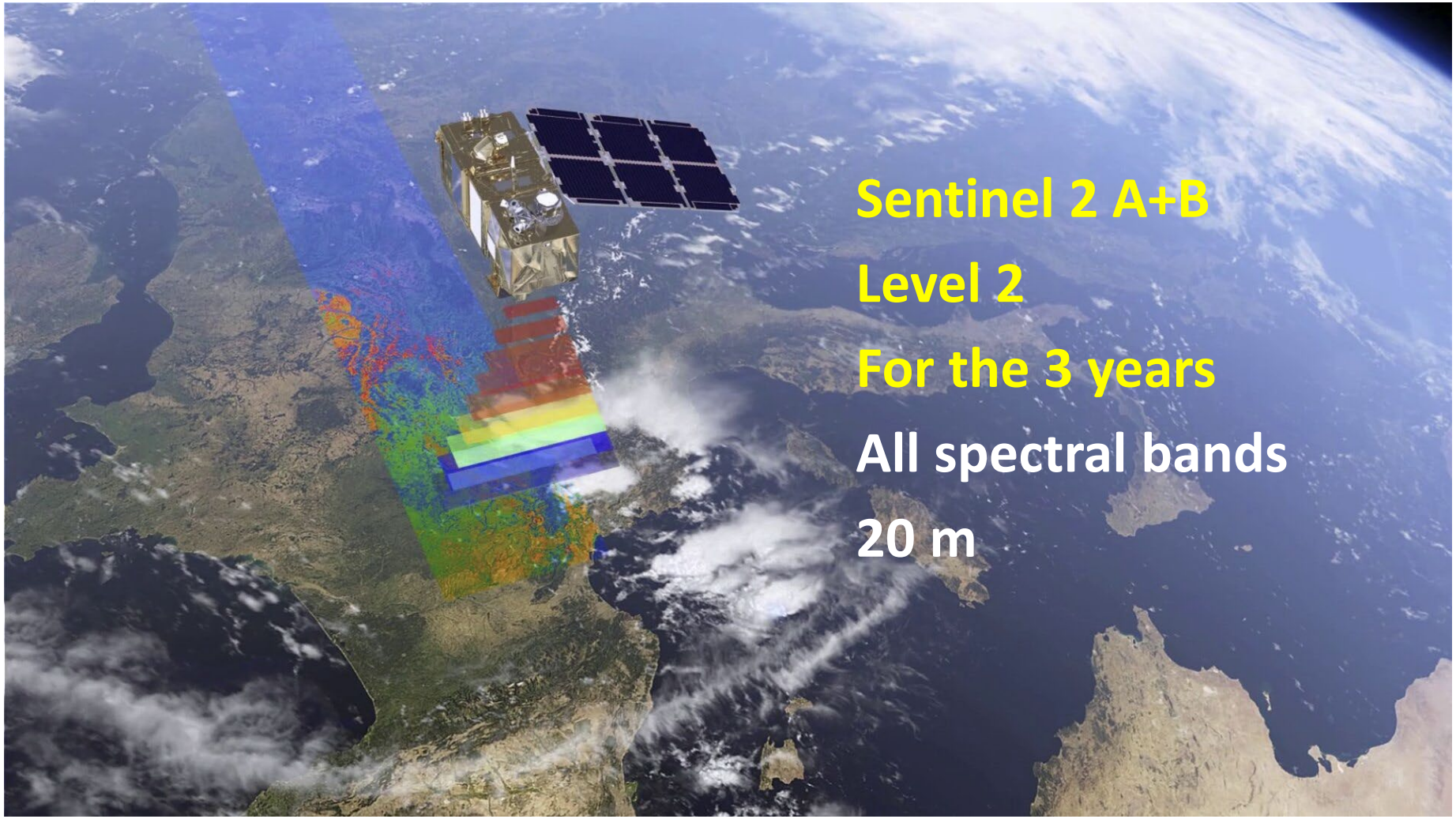
EO dataset



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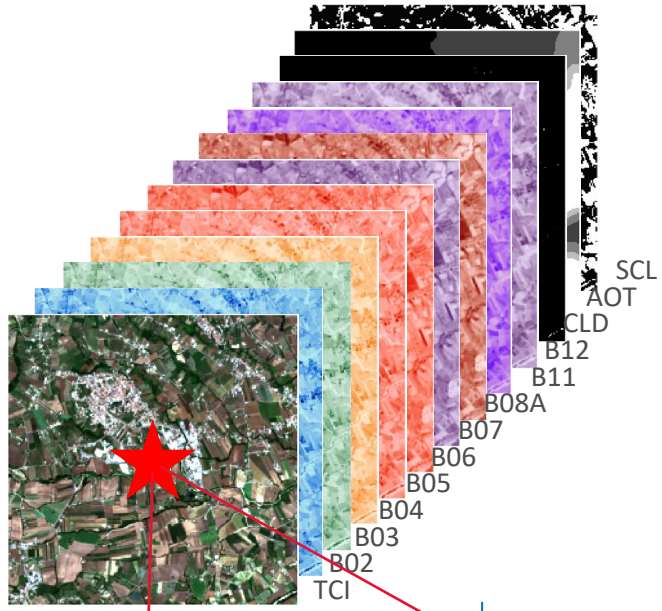
EO dataset

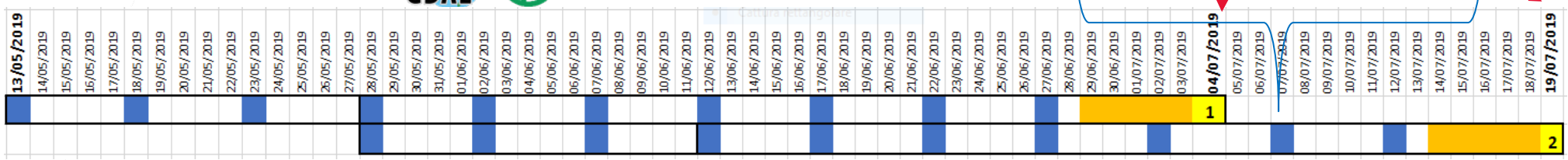
- Cropped around trap locations
- Squares of 224x224 pixels
- For each revisit time



Python Libraries
For GIS and Mapping

GDAL

GeoPandas



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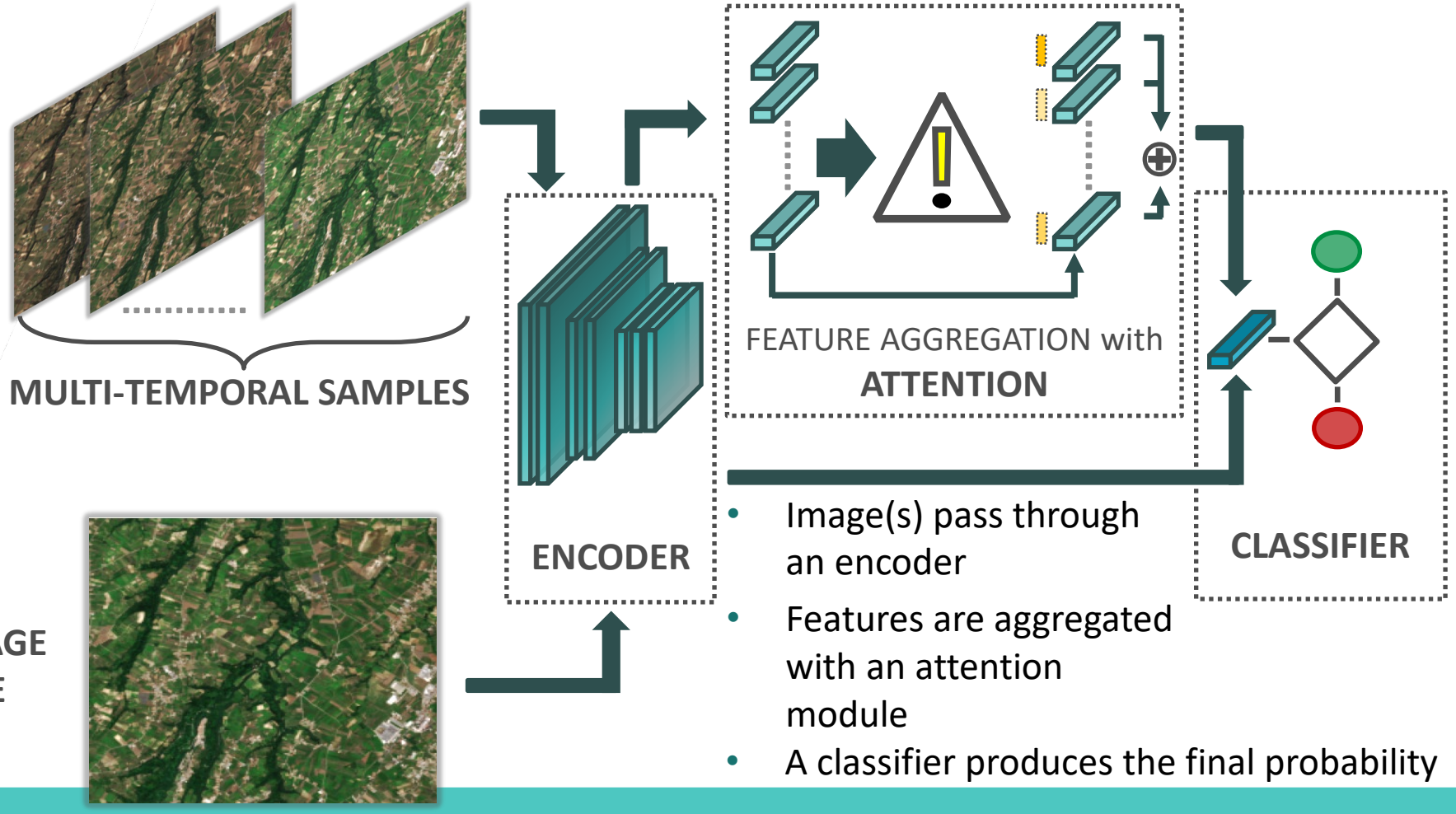
Deep models



- Image(s) pass through an encoder
- Features are aggregated with an attention module
- A classifier produces the final probability

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Deep models

- Data is split in 5 **folds.**
- Proportion of *positive-to-negative* samples for each fold is kept:

	# Positive	# Negative
Train (avg)	894	948
Test (avg)	223	237

- Results are averaged across folds

	F1-score	Sensitivity	Specificity
Baseline	78.63%	87.15%	68.61%
Multi-Temporal	81.62%	85.32%	79.27%

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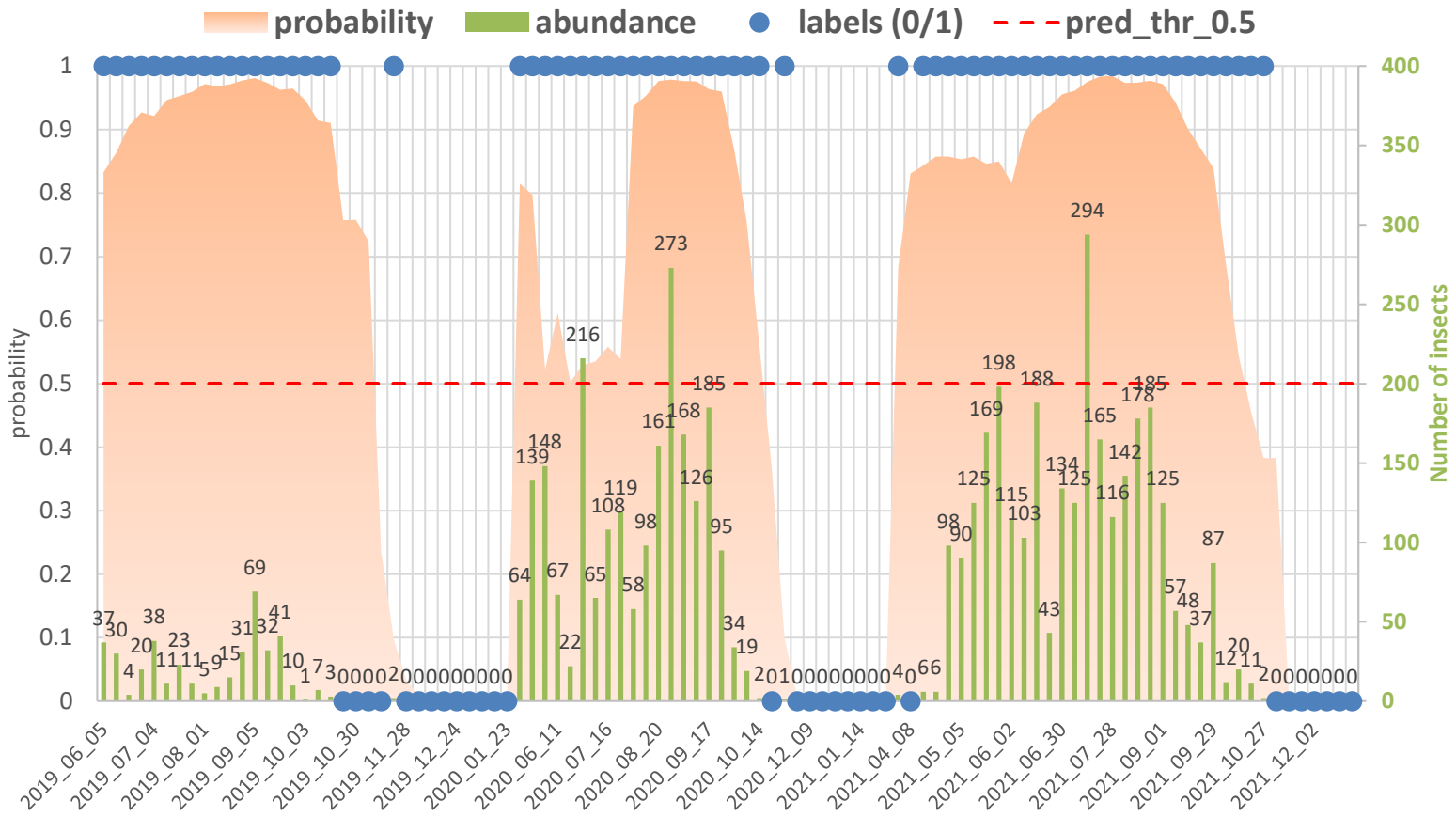

Site TE05_NER

The model well catches the seasonality in a positive site, with abundance of *Cx. pipiens* (green bars)

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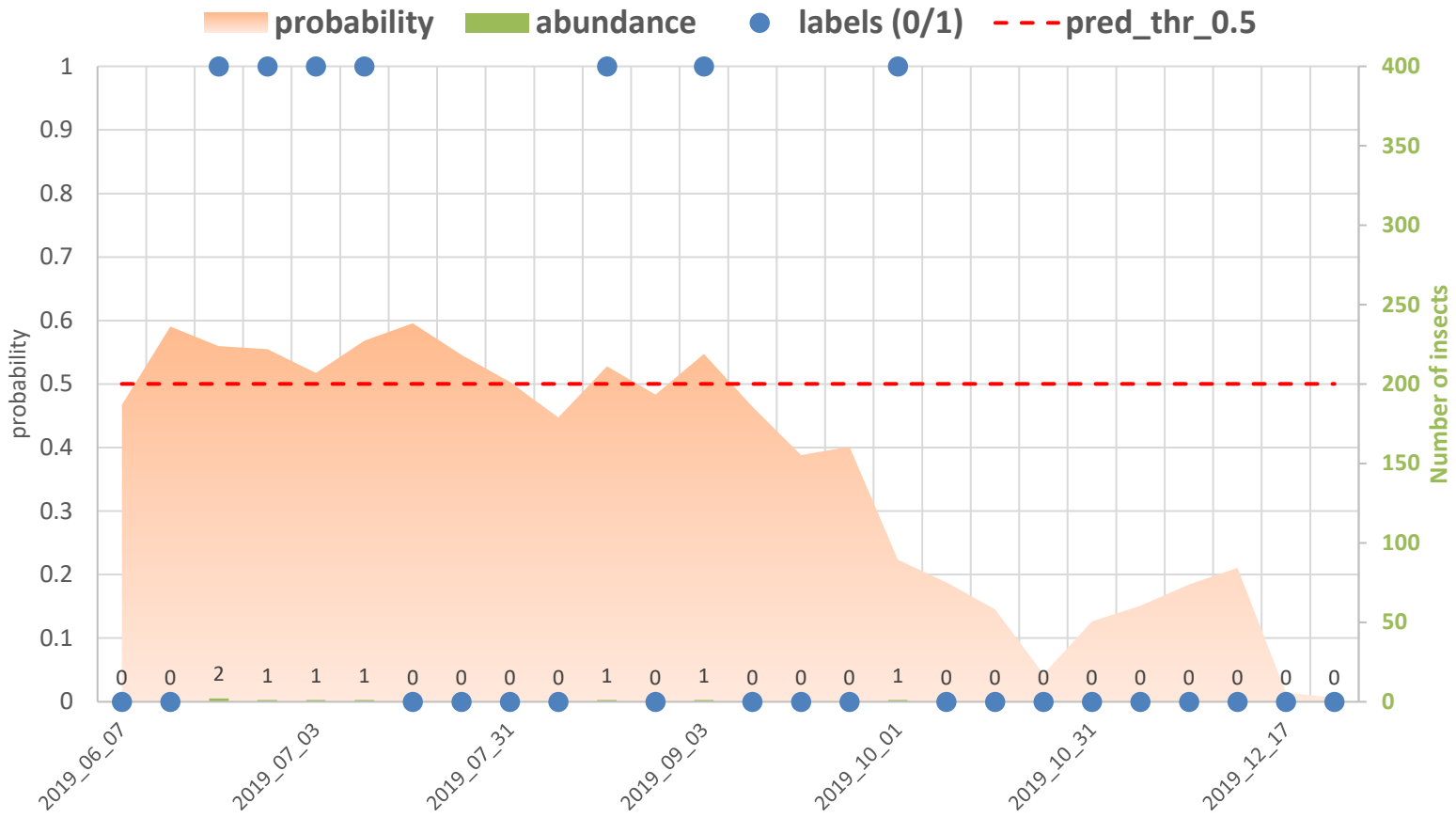
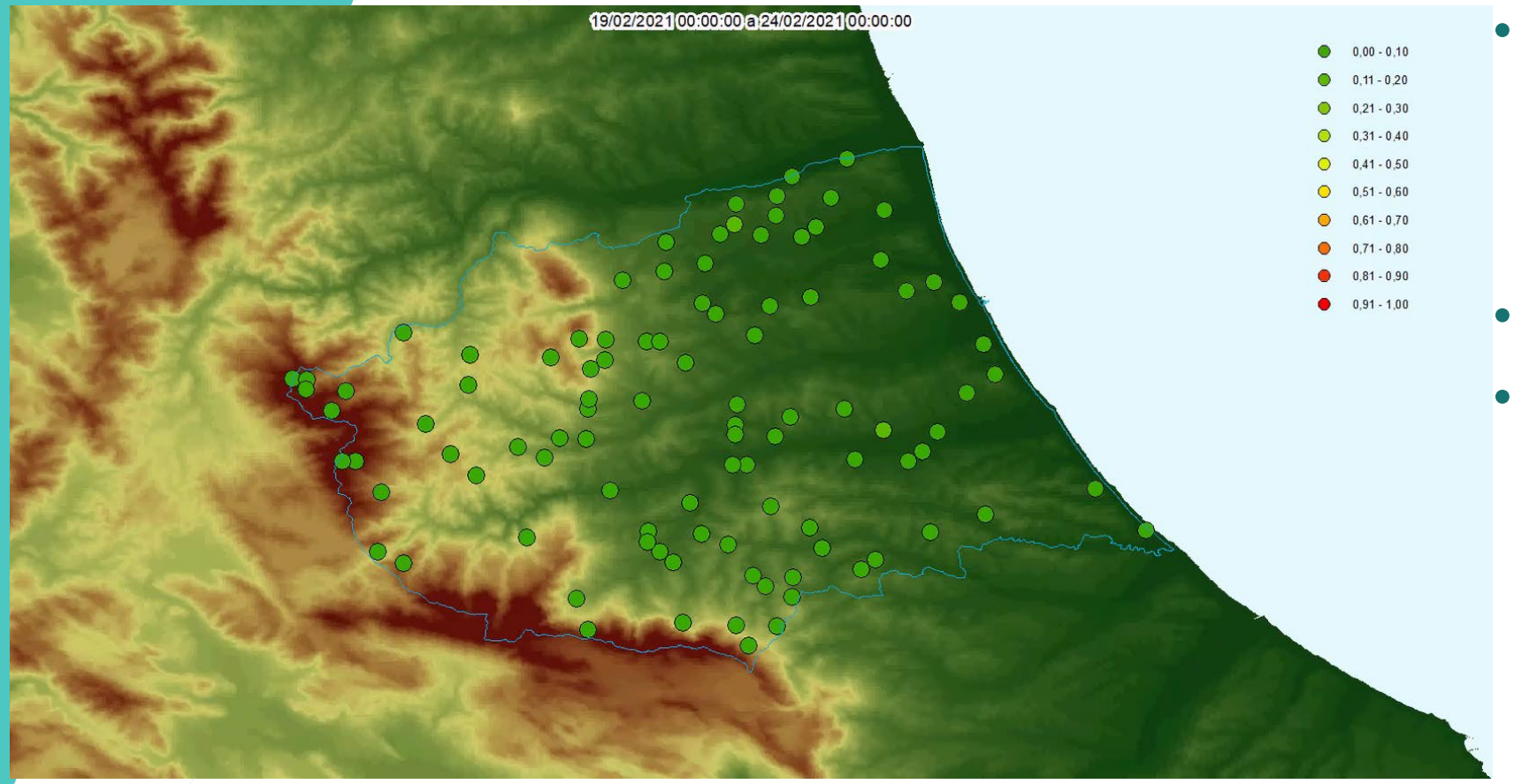


Site TE10_RIP

The model well catches the characteristics in a pretty negative site (considering the threshold of 0.5)

Prediction



- In terms of spatio-temporal simulation of the occurrence of the species
- in Teramo province
- in unseen locations

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Conclusions

- *Culex pipiens* is widespread, as expected
- the temporal patterns is catched by the model
- giving useful information for targeting surveillance activities in the following seasons
- the methodology adopted can be extended to the national territory and to other vectors

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