

# IZS

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

## **Intelligenza Artificiale e Remote Sensing: metodi innovativi per il monitoraggio dei vettori e delle variabili ecologiche/ambientali ad essi associate**

Progetto di ricerca IZS AM 01/18 RC

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## Progetto

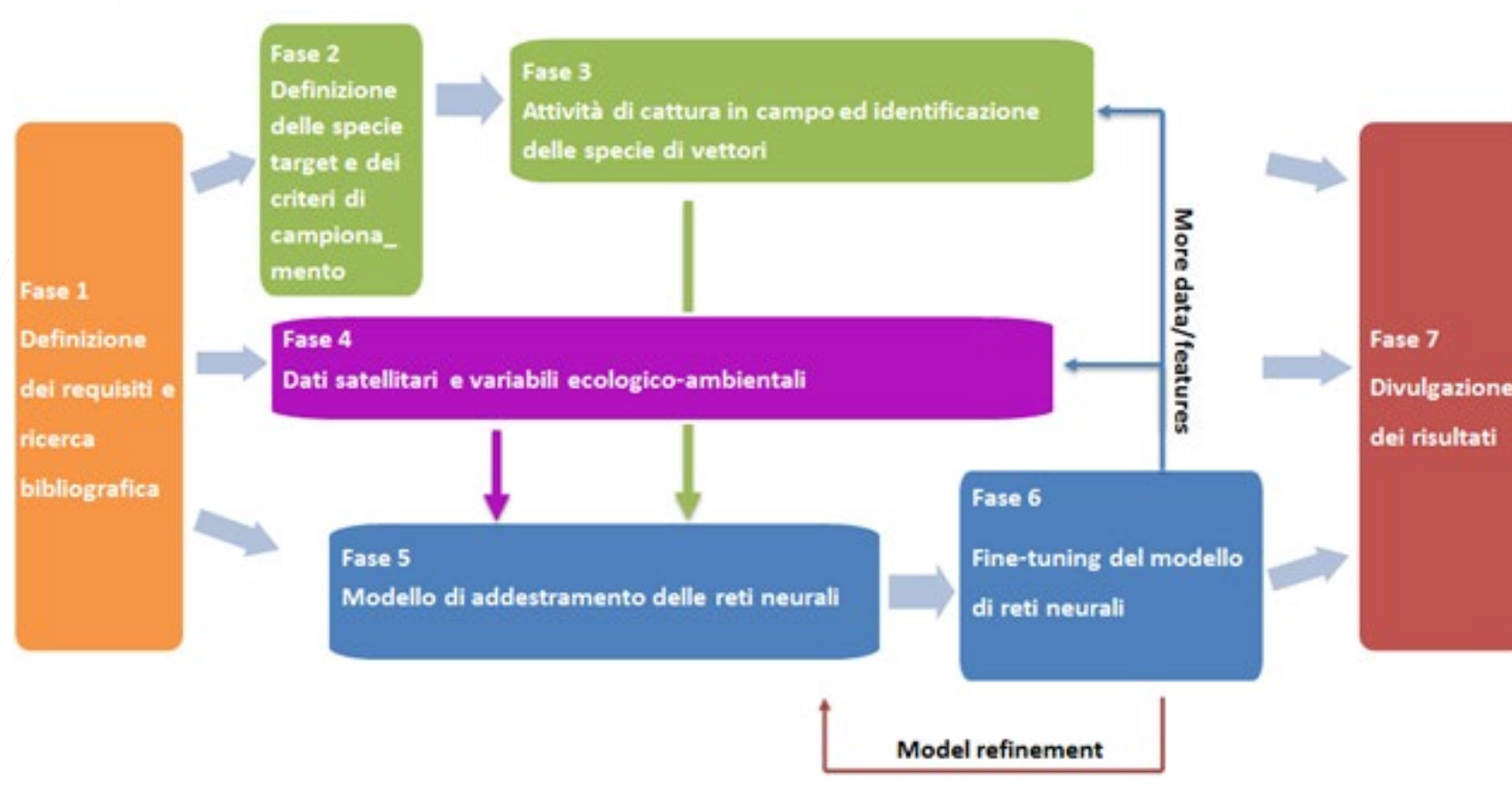
<b>N° Progetto/anno</b>	<b>IZS AM 01/18 RC</b>
<b>Responsabile scientifico IZSAM</b>	<b>Annamaria Conte</b>
<b>Data di inizio</b>	<b>18/12/2018</b>
<b>Data fine</b>	<b>22/05/2022</b>
<b>U.O.1</b>	<b>Carla Ippoliti</b>
<b>U.O.2</b>	<b>Maria Goffredo</b>
<b>U.O.3</b>	<b>Antonio Petrini</b>
<b>U.O.4</b>	<b>Simone Calderara (UNIMORE)</b>

## Obiettivi

- Il progetto mira a sviluppare algoritmi di Intelligenza Artificiale addestrati su dati di osservazione della terra da satellite, applicati ad una distribuzione spazio-temporale dettagliata di vettori responsabili di VBD.

Obiettivi specifici sono:

- **mappatura di specie di zanzare** su tutta l'area di studio: abbondanza e stagionalità
- **sviluppo di un modello di Intelligenza Artificiale** di classificazione (presenza/assenza) temporale delle principali specie ritrovate



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THE EUROPEAN SPACE AGENCY



living planet | BONN  
symposium | 23-27 May  
2022

TAKING THE PULSE  
OF OUR PLANET FROM SPACE

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

Ippoliti C.1, Vincenzi S.2, Bonicelli L.2, D'Alessio S.G. 1, Di Lorenzo A. 1, Tora S. 1, Porrello A. 2, Calderara S. 2, De Ascentis M. 1, Quaglia M. 1, Goffredo M. 1, Conte A. 1

1 Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise, Teramo, Italy

2 AImageLab, University of Modena and Reggio Emilia, Modena, Italy



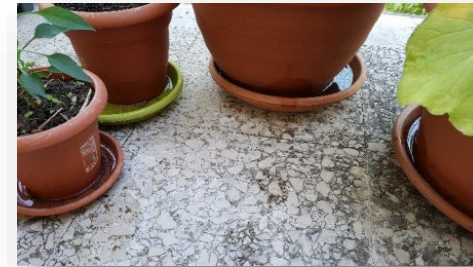
## *Culex pipiens*

Able to adapt to a wide variety of environments

Vector of many diseases



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



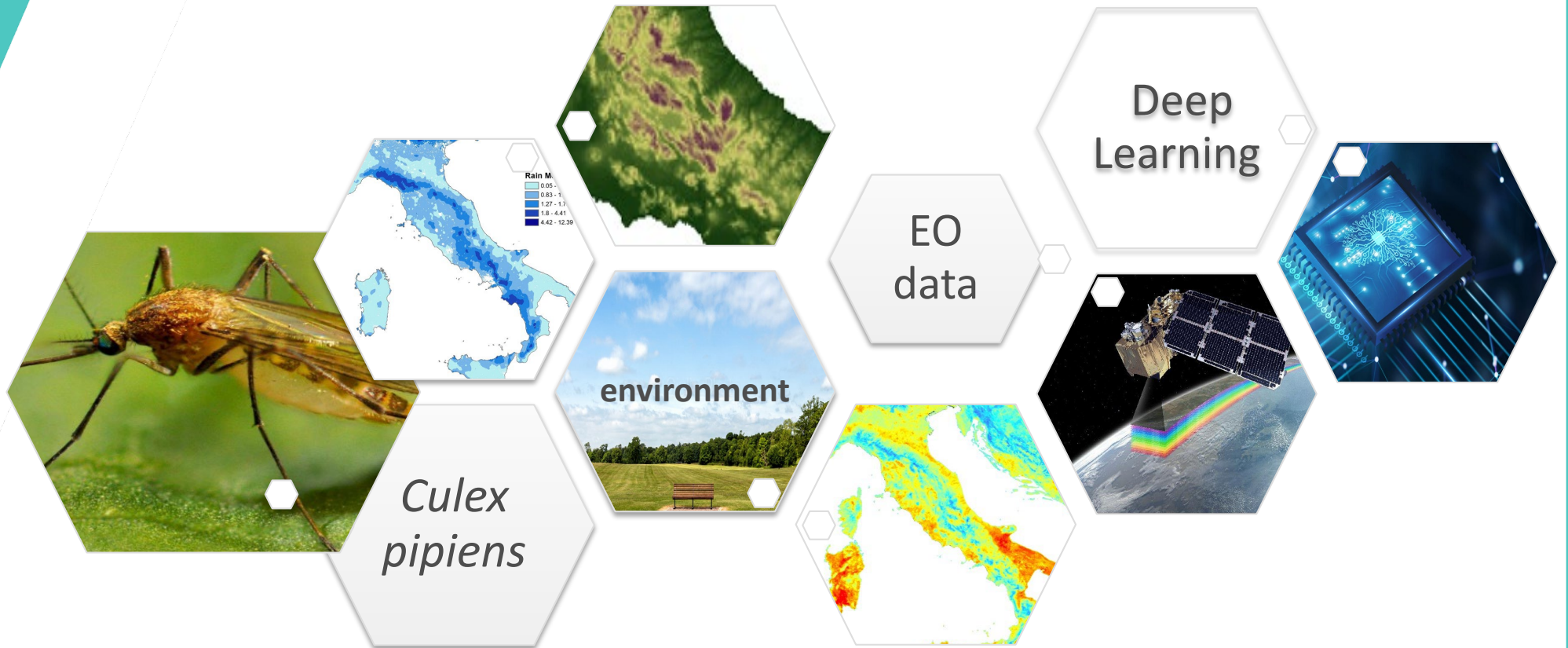
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## Research aim

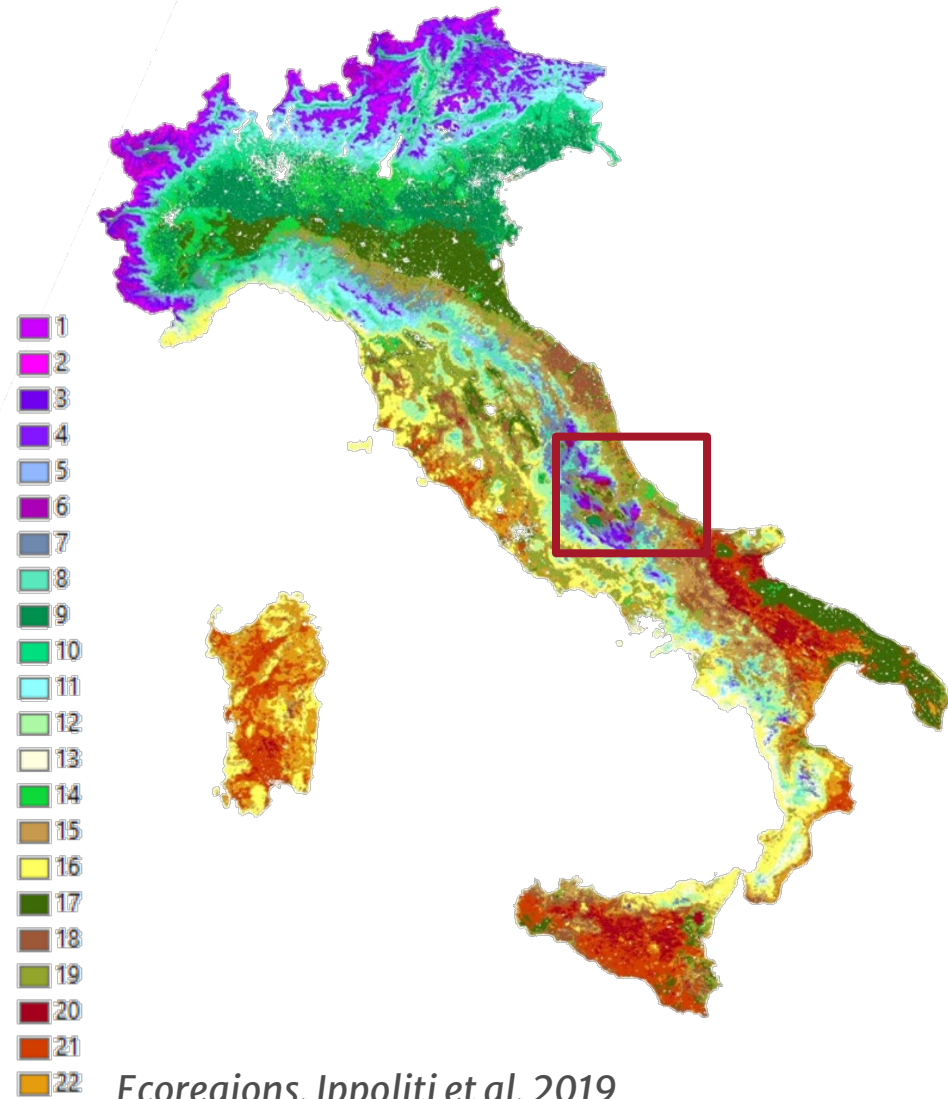


to predict the spatio-temporal environments in central Italy suitable for the presence of *Culex pipiens*, exploiting EO data cubes and DL modeling

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Ecoregions, Ippoliti et al, 2019

## In-field sampling campaigns

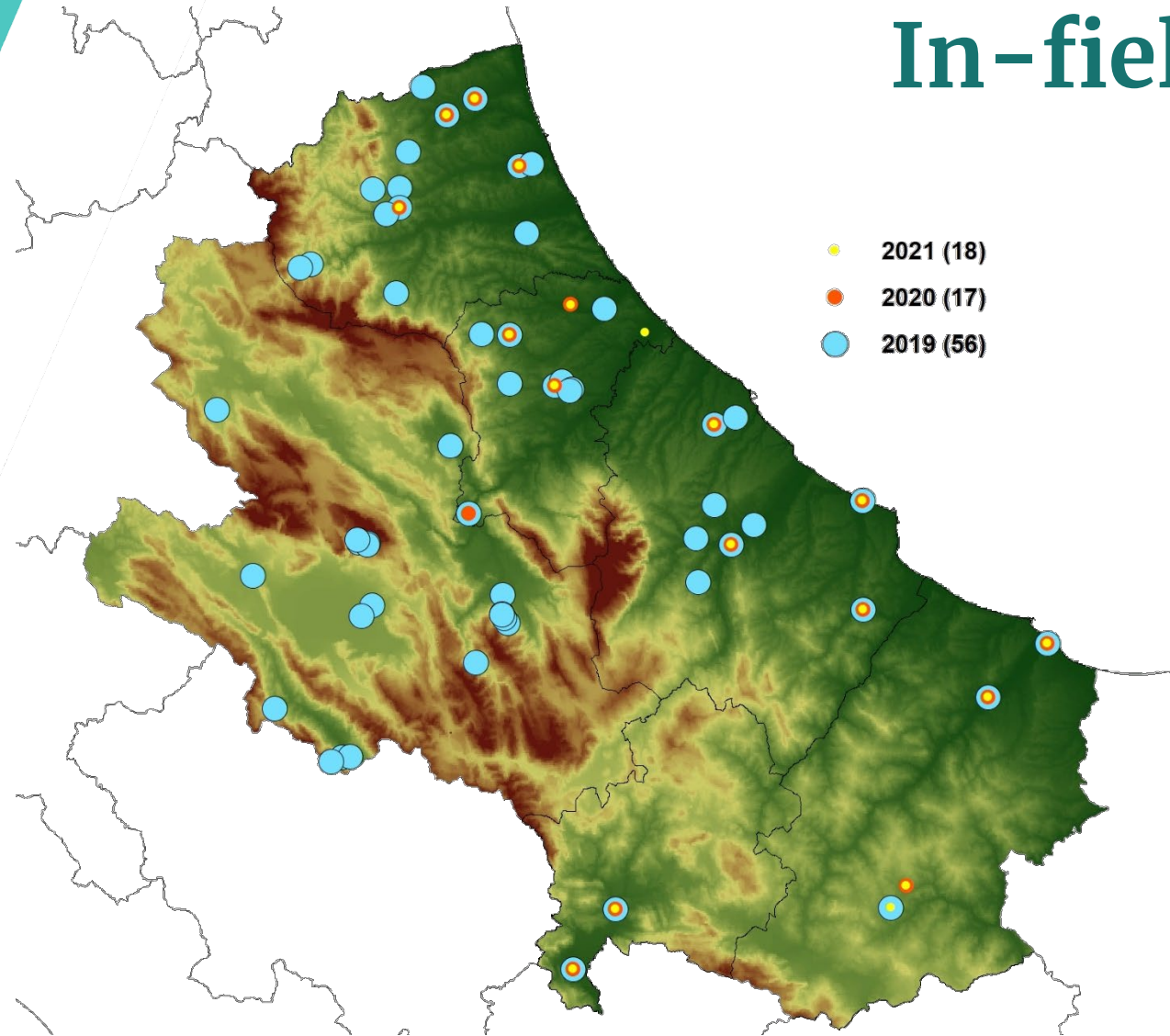




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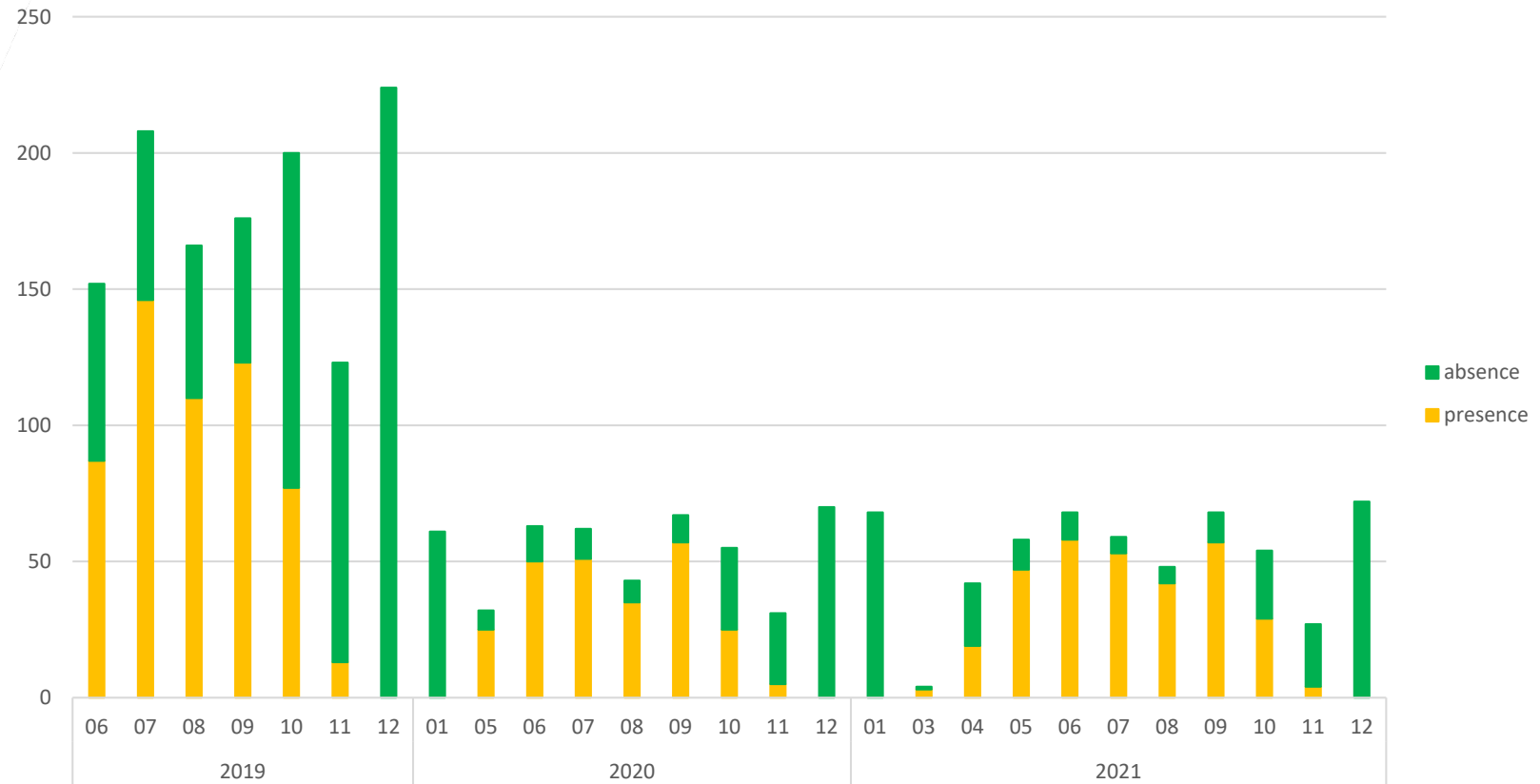


## In-field sampling campaigns

● 2021 (18)  
● 2020 (17)  
● 2019 (56)

- Average of 20 samplings per year
- Plus pseudo-absence in winter months (December and January)

## Ground truth database



The database was made up of 2301 records

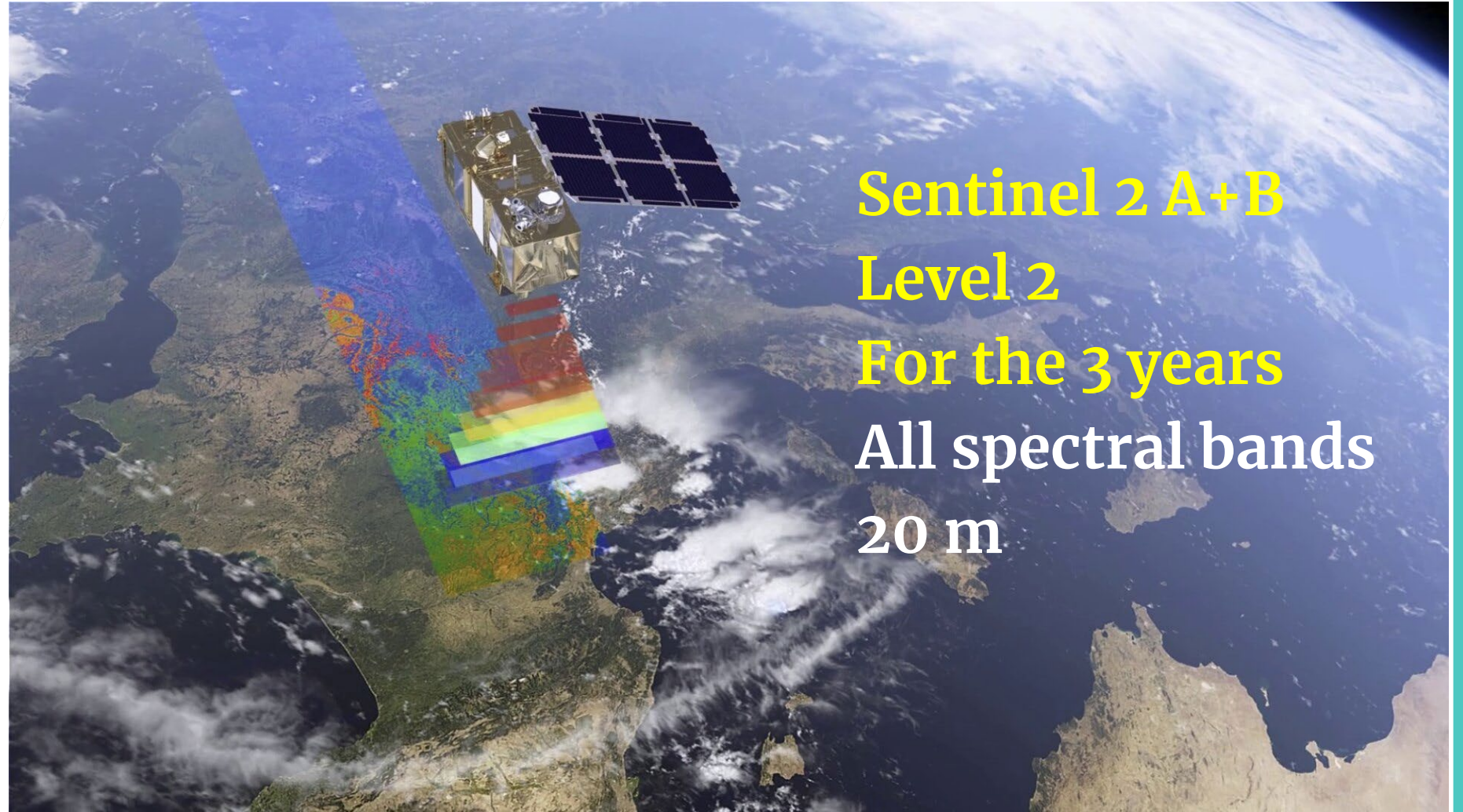
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## E0 dataset



**Sentinel 2 A+B**

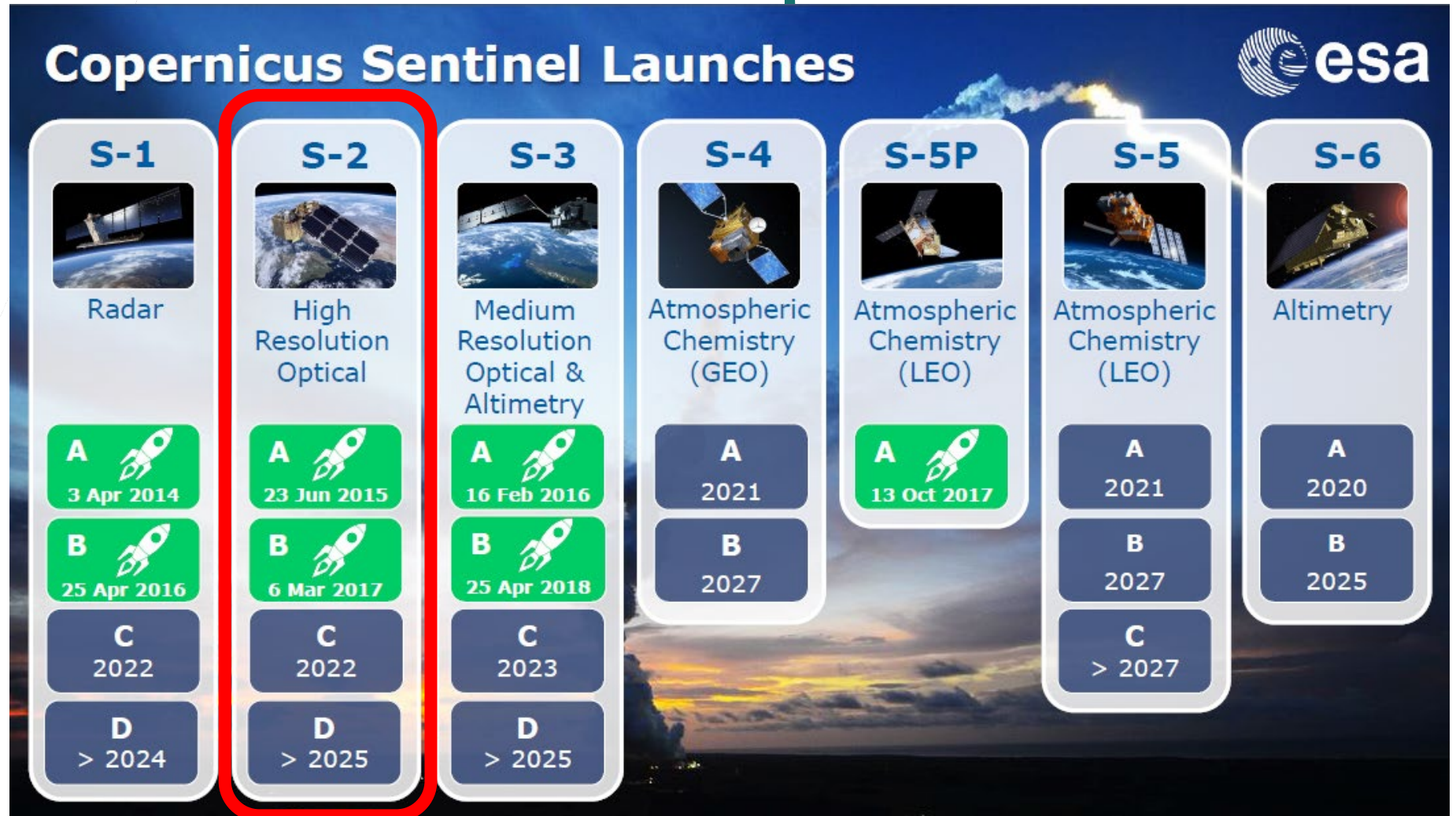
**Level 2**

**For the 3 years**

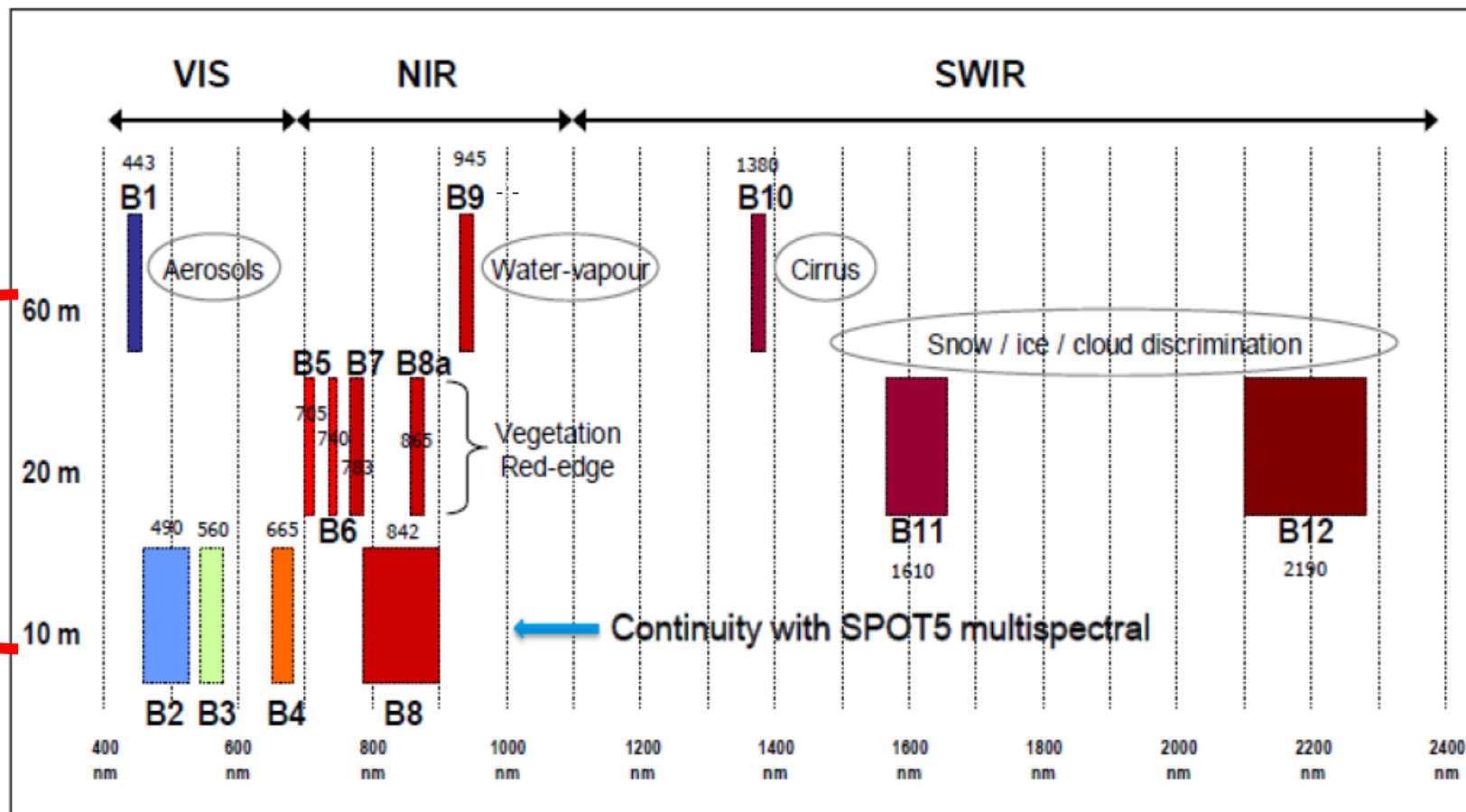
**All spectral bands**

**20 m**

## Copernicus schedule



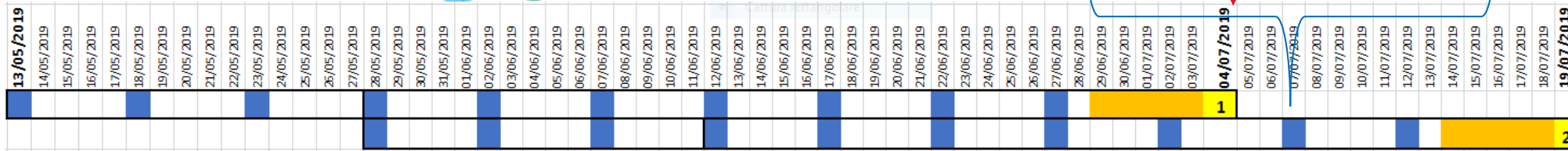
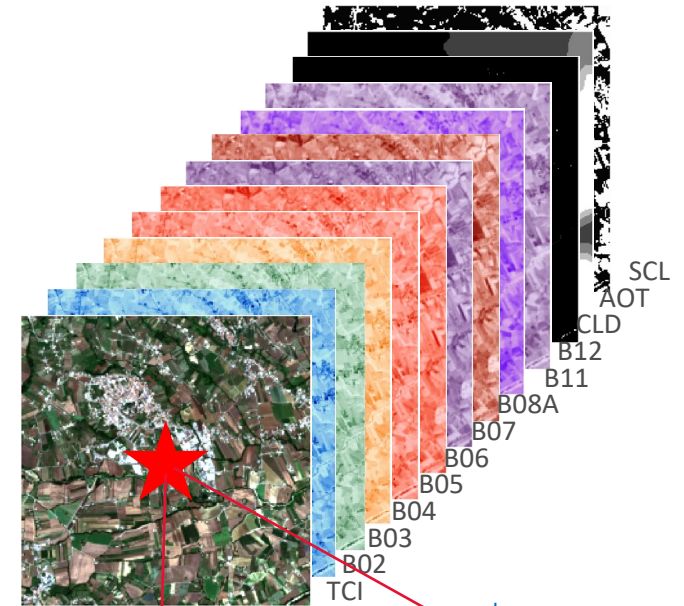
Ad alta risoluzione spaziale

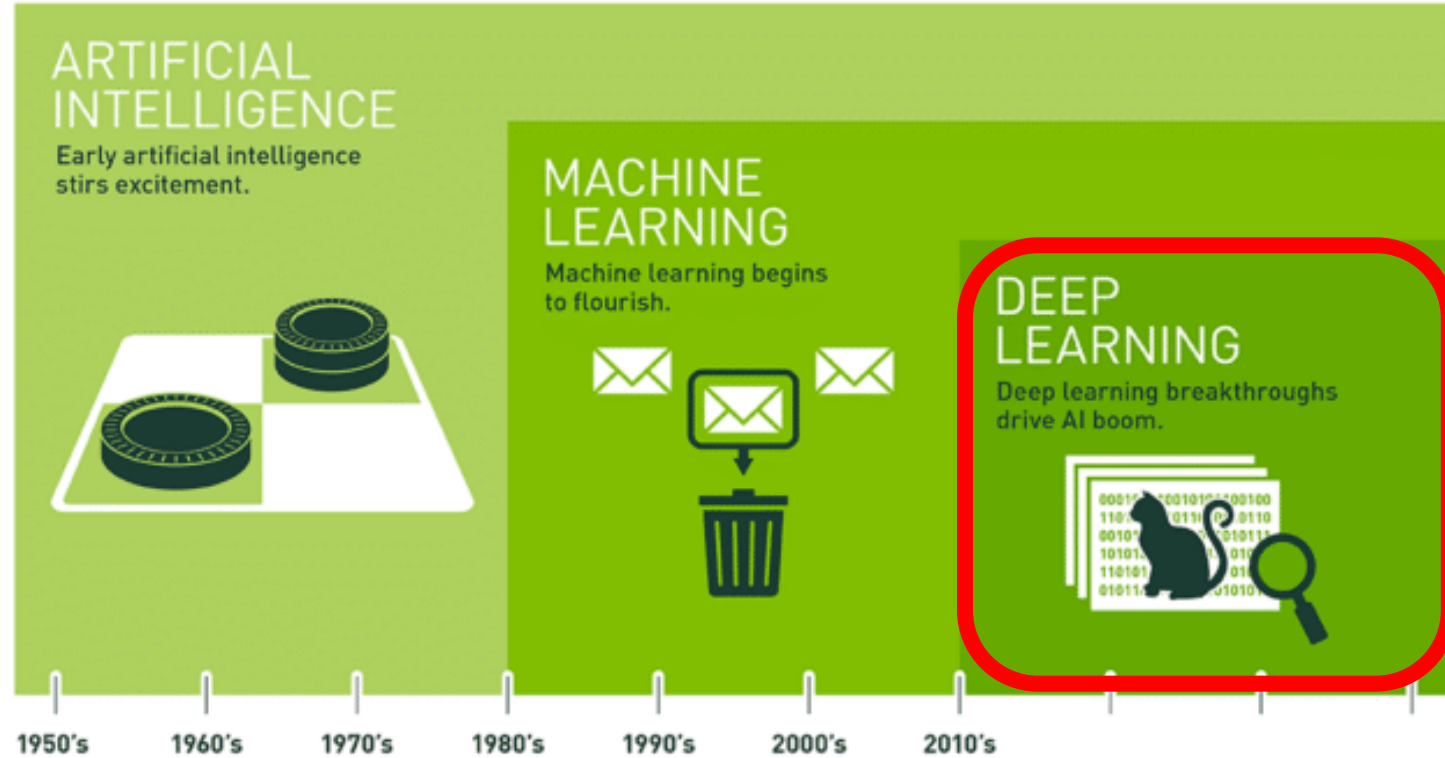


Acquisizione in un ampio raggio dello spettro elettromagnetico

## EO dataset

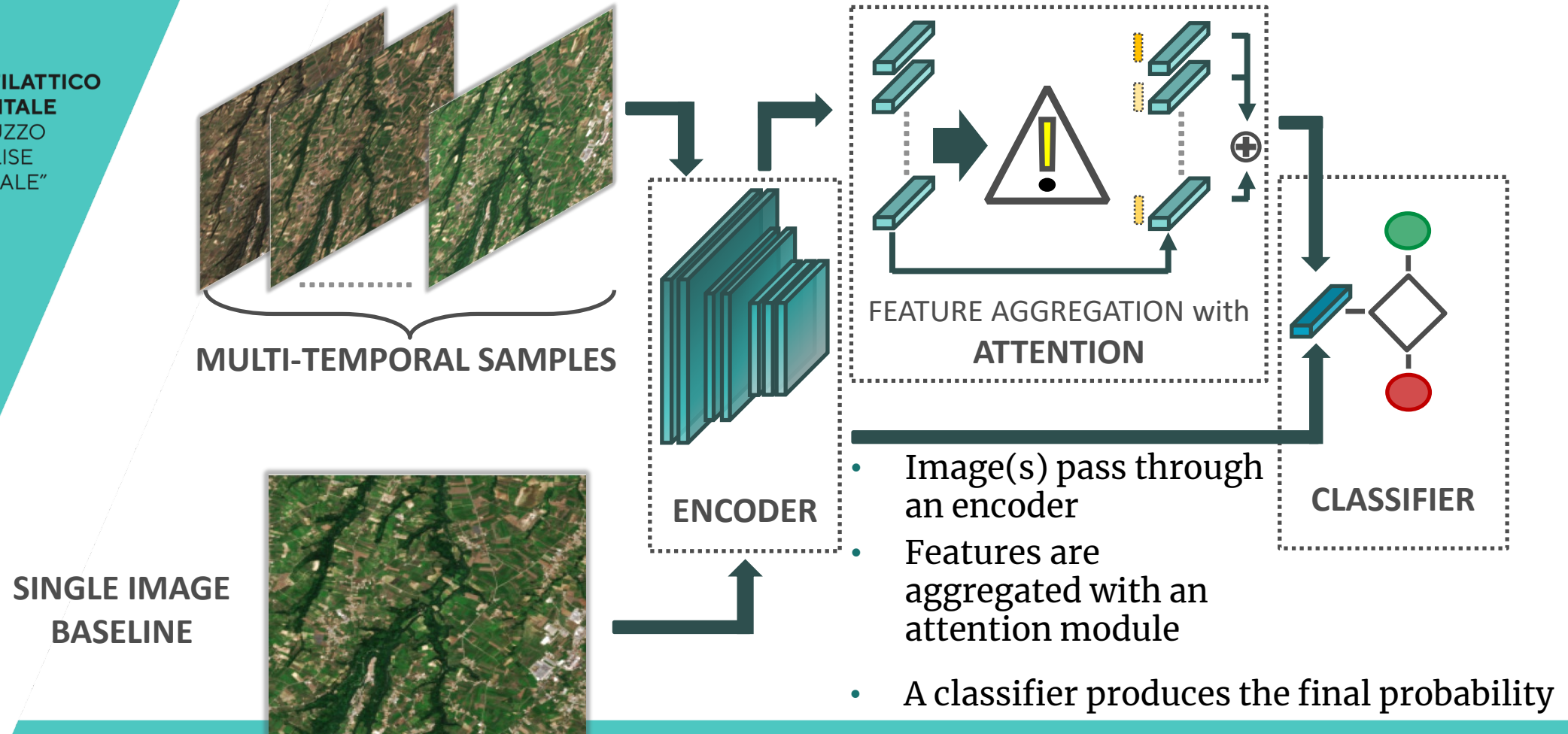
- Cropped around trap locations
- Squares of 224x224 pixels
- For each revisit time





Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

## Deep models





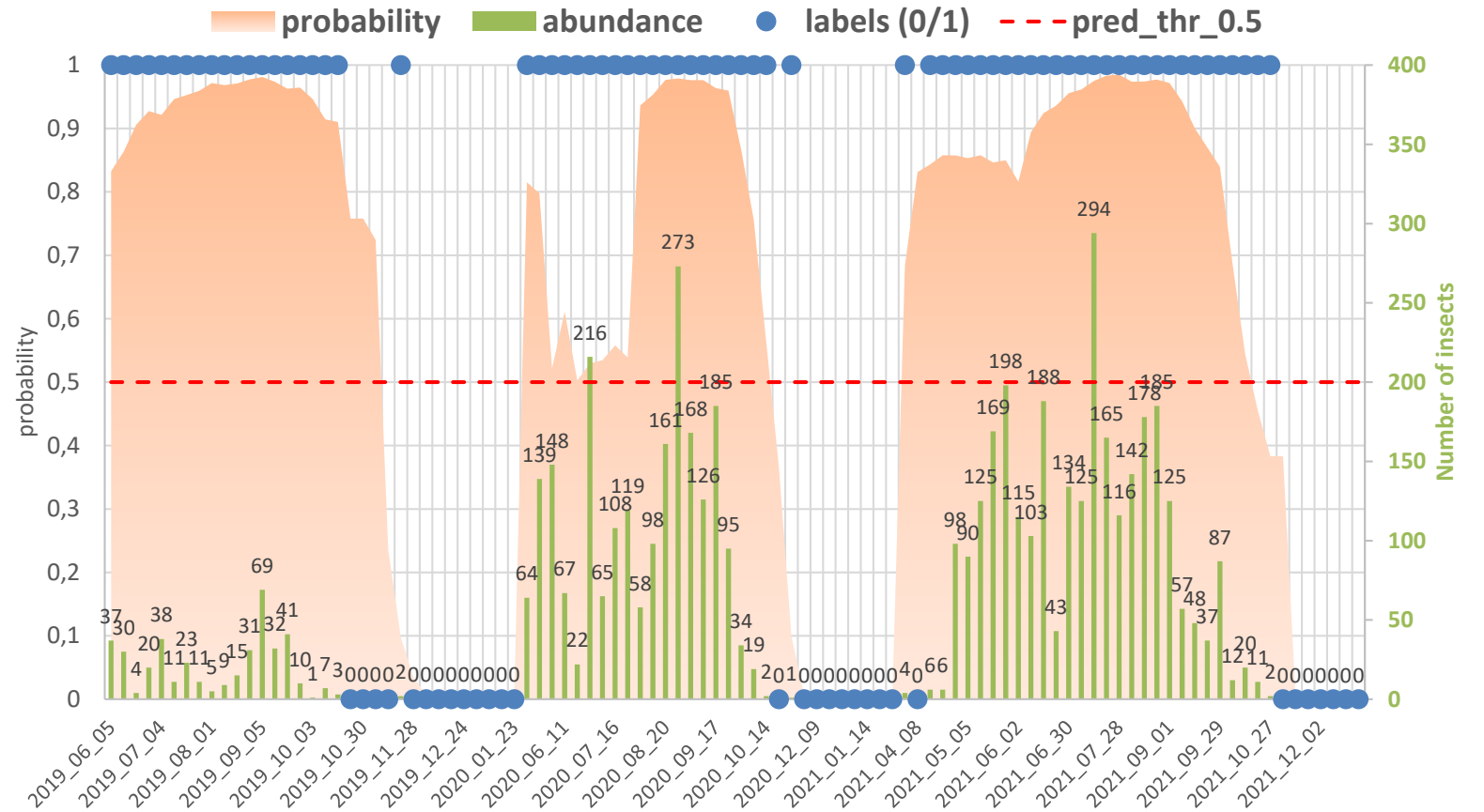
## Deep models

- 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

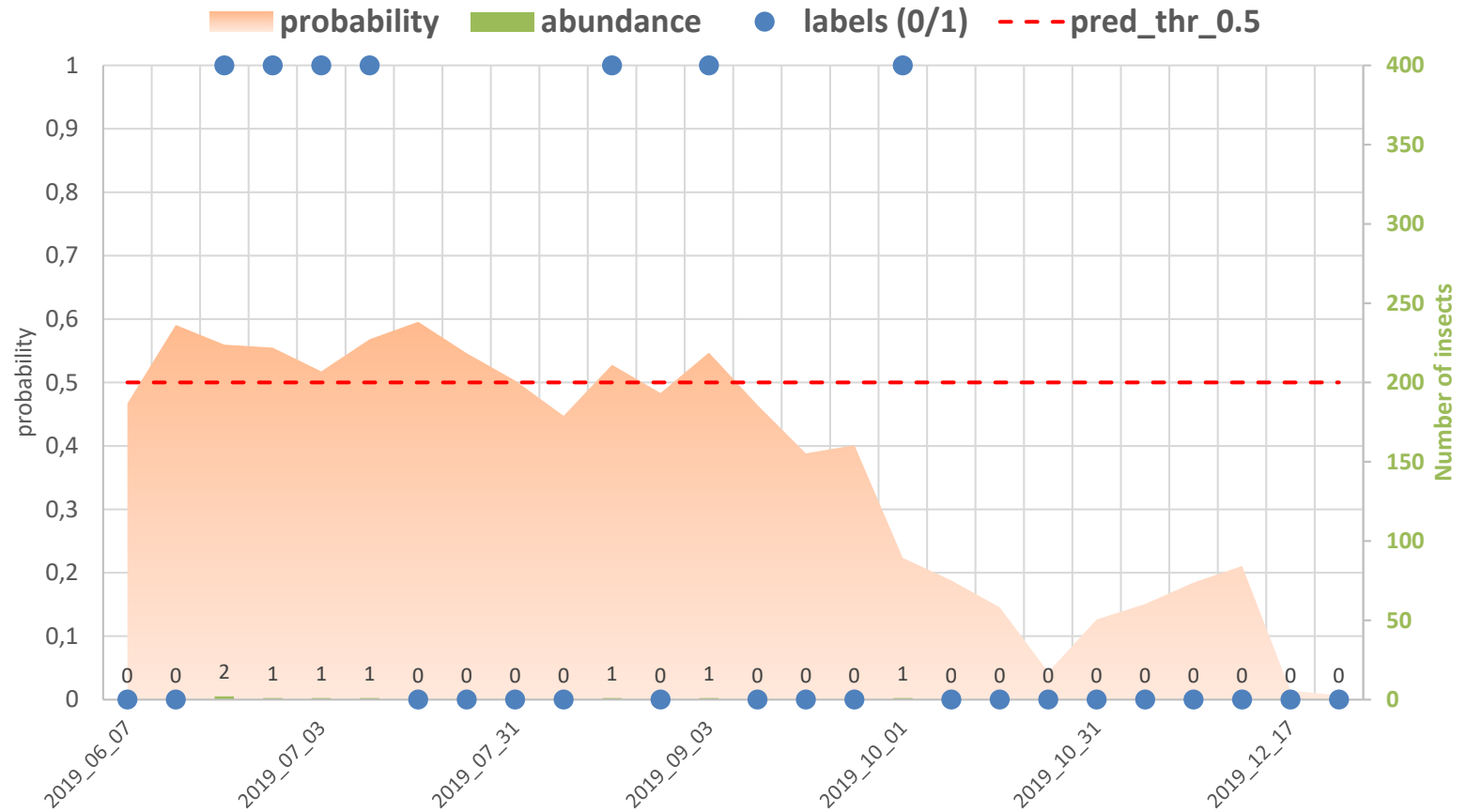
- Results are averaged across folds

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



## Site TE05\_NER

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



## 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



- *Culex pipiens* is widespread, as expected
- the temporal patterns is caught 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

## Conclusions



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