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TAKING THE PULSE OF OUR PLANET FROM SPACE

Potential Fishing Zone identification with Sentinel-3 data for sustainable development in fisheries

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23 May 2022

Scope

The purpose of this project is the creation of a comprehensive system for managing, analyzing, and disseminating satellite data products to fisheries management bodies. The sub-objectives are divided into:

- Useful **indices identification** and extraction from remote sensing data.
- Methodology establishment for **Potential Fishing Zone identification**.
- Creation of the **Geospatial Web Service.**

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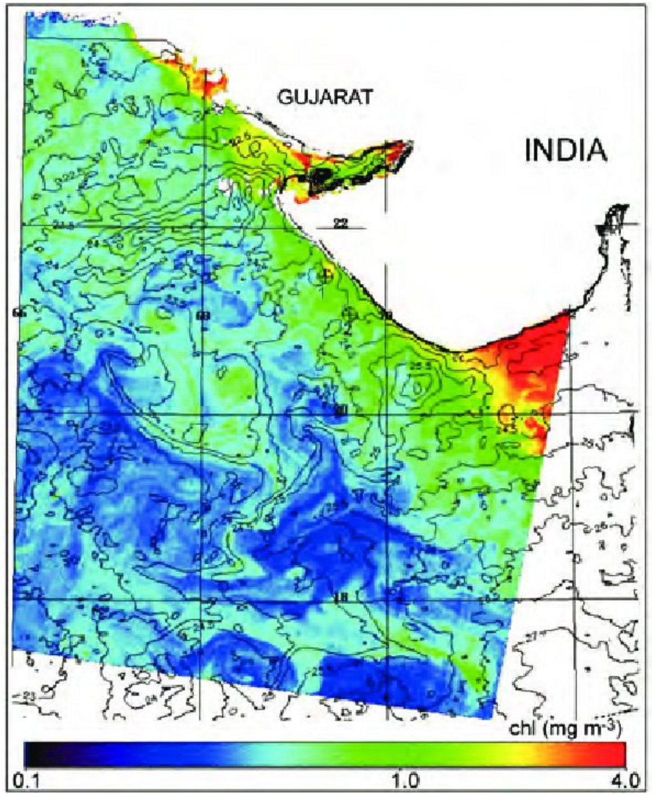
What are Potential Fishing Zones

Potential Fishing Zones (PFZ) data give information for the probable spatial distribution of surface-dwelling pelagic fish populations. They usually consist of an overlay of Chlorophyll and Sea Surface Temperature data.

It has been showcased that they can contribute:

- In raising production by 2-5 times.
- In the reduction of searching time by 30-70%.

(Department of Space, Indian Space Research Organization)



The basics

The methodology focuses on an indirect approach, by evaluating the oceanographic conditions most favorable for the target species.

- Ocean **Circulation** (Mesoscale and Sub-Mesoscale formations)
- **Chlorophyll-a** Concentration (CHL)
- Sea Surface **Temperature** Distribution (SST)

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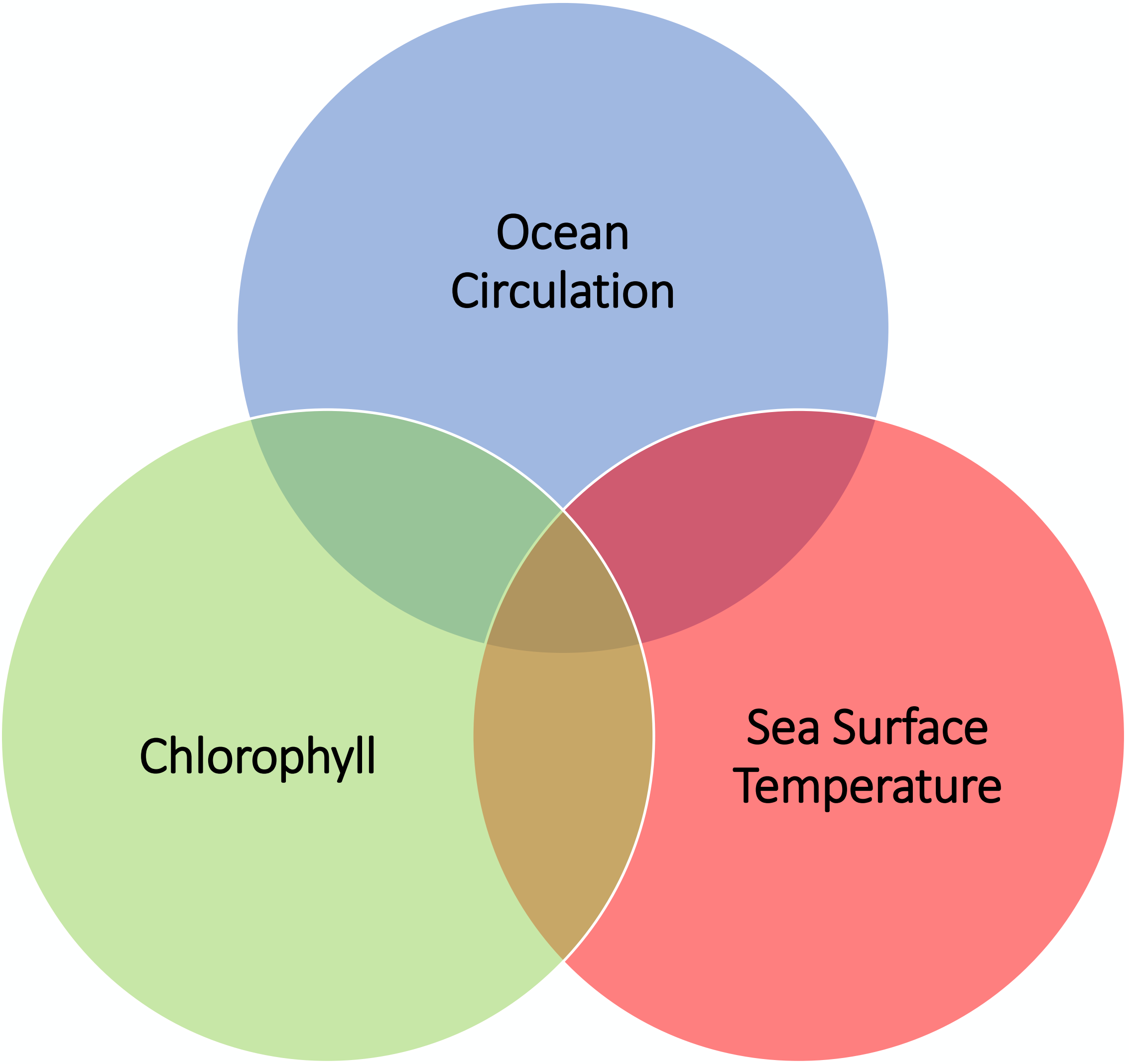
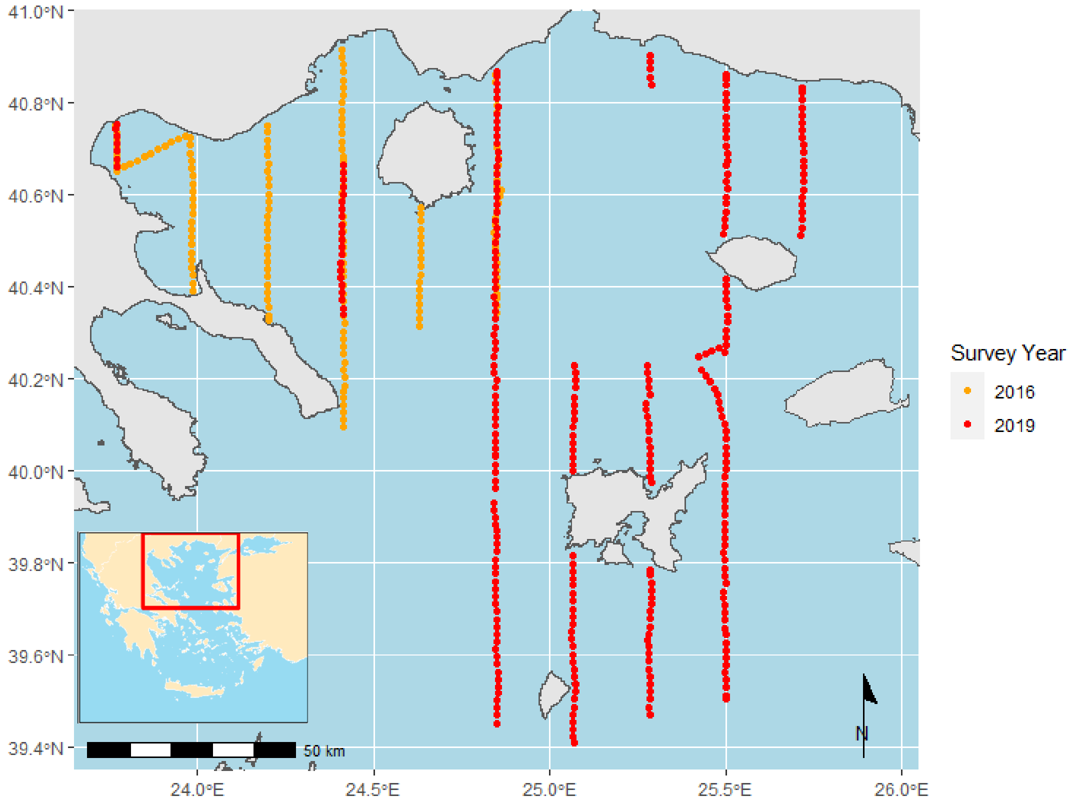
Potential Fishing Zone Identification



Study Area & Data



<u>Satellite Data:</u>

- Sentinel-3 OLCI
- Sentinel-3 SLSTR

Model training and daily input

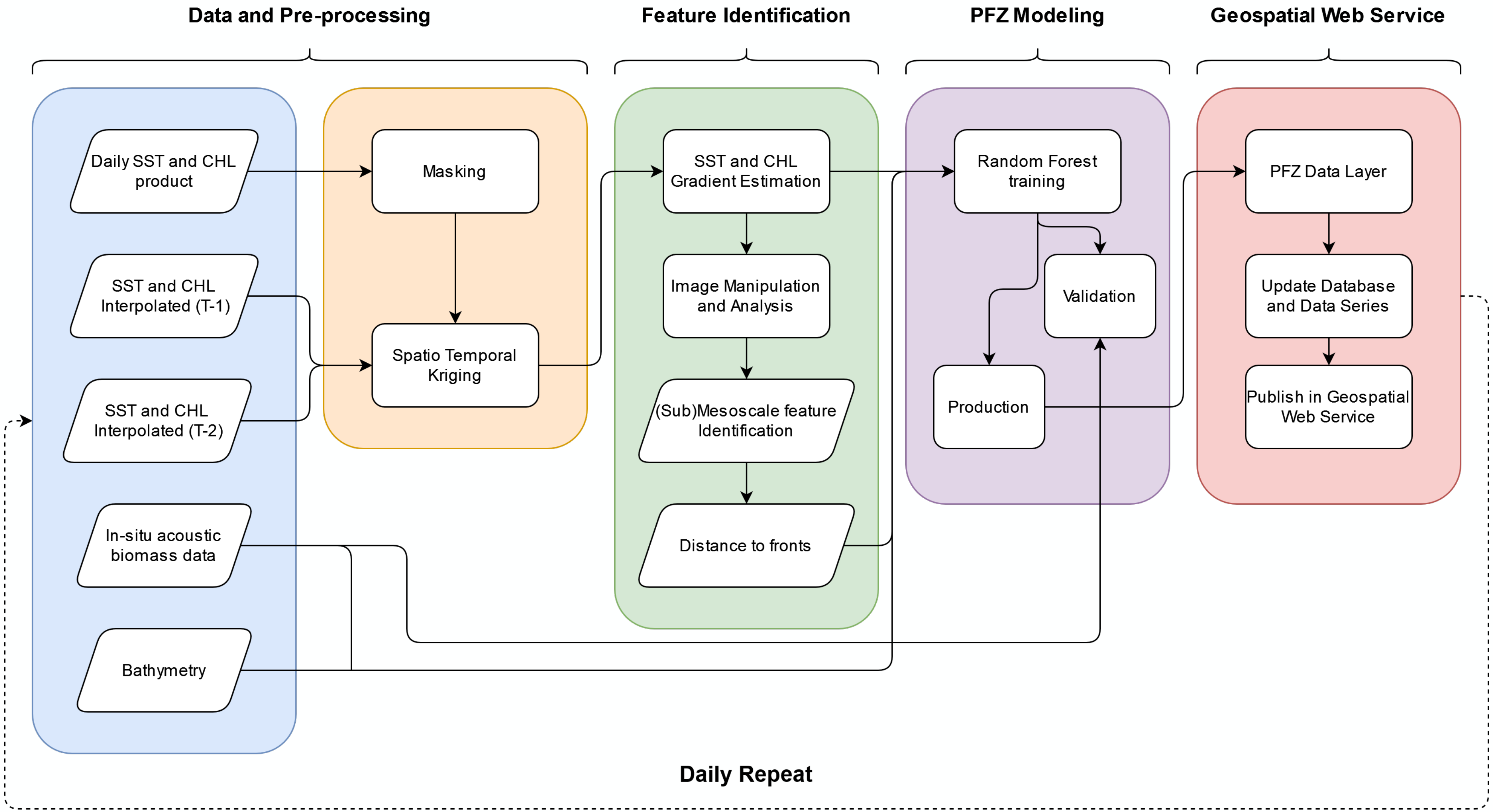
<u>*in-situ* measurments</u>:

Acoustic biomass data for:

- *Engraulis encrasicolus* (Anchovy)
- *Sardina pilchardus* (Sardine)

Model training and validation

Methodology: Overview



Methodology: Pre-processing

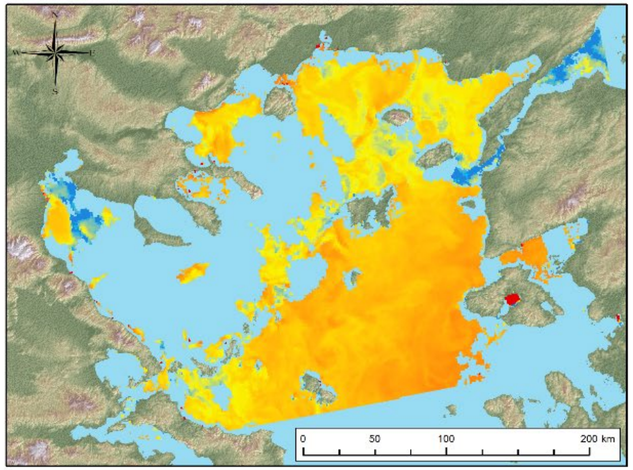
3 Kriging models tested:

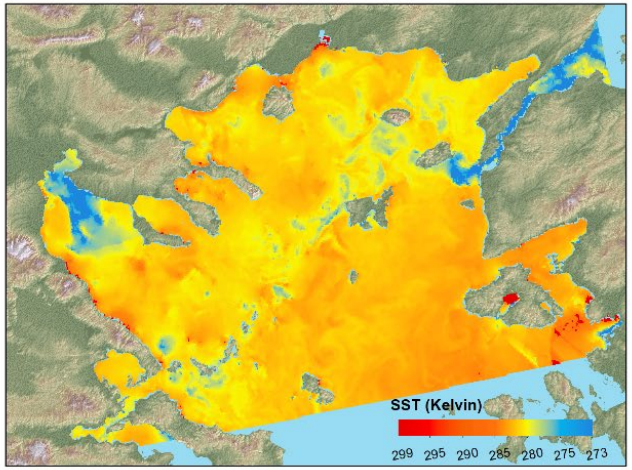
- Ordinary Kriging: P ~ 1
- SpatioTemporal: P ~ (T-1)
- SpatioTemporal: P ~ (T-1) + (T-2)

Where P the parameter to be interpolated and T the day to be interpolated

Evaluation:

- “Leave in - Leave out” (n_t = 8500, n_v = 500)
- MAE και RMSE





MAE Index

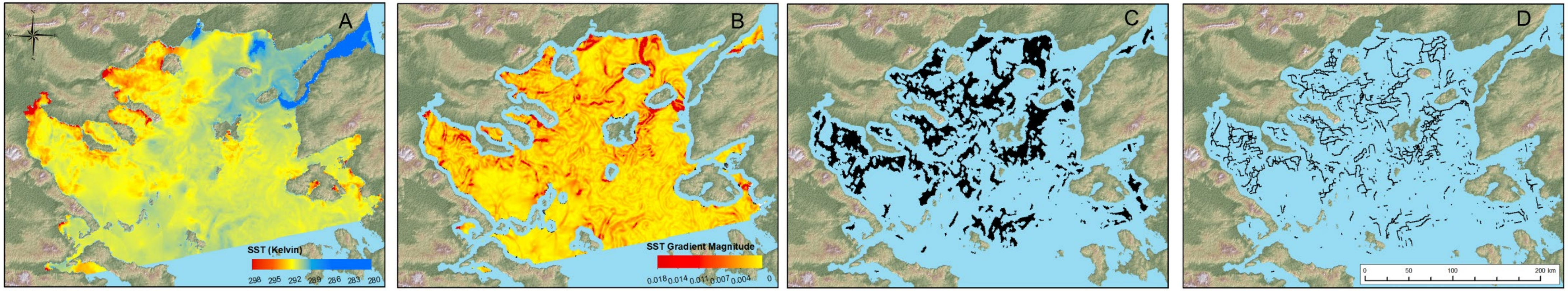
Formula	07/05/2020	09/05/2020	13/05/2020
SST ~ 1	0.0653	0.0815	0.0987
SST ~ (T-1)	0.0660	0.0755	0.0834
SST ~ (T-1) + (T-2)	0.0720	0.0760	0.0759

RMSE

Formula	07/05/2020	09/05/2020	13/05/2020
SST ~ 1	0.1428	0.1739	0.1596
SST ~ (T-1)	0.1202	0.1336	0.1228
SST ~ (T-1) + (T-2)	0.1276	0.1230	0.1163

Methodology: Oceanic Fronts

Spatio-temporal Interpolation → Gradient Estimation → Adaptive threshold → Thinning - Skeletonization



Spondylidis, S., Topouzelis, K., Kavroudakis, D., Vaitis, M. (2020). Mesoscale Ocean Feature Identification in the North Aegean Sea with the Use of Sentinel-3 Data. J. Mar. Sci. Eng. 2020, 8, 740. DOI: https://doi.org/10.3390/jmse8100740

Results: Random Forest – Model Selection

esa

Anchovy Models

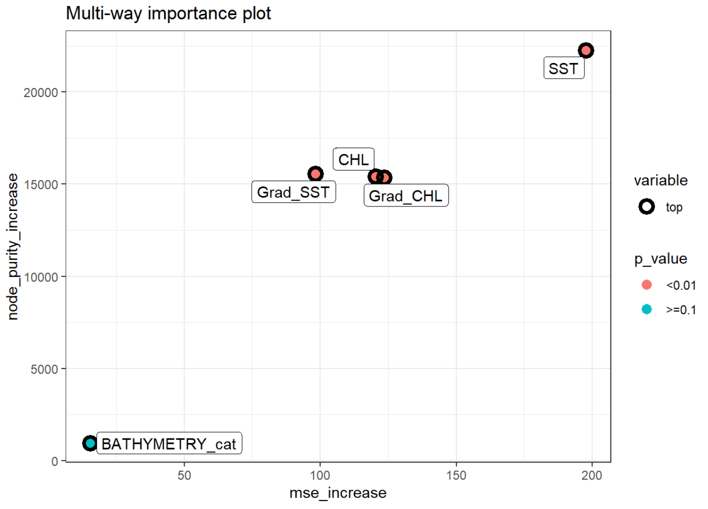
a/a Model	Fronts	Bathymetry	MBE	MAE	RMSE	Selection
1	Distance	Continuous	0.98	5.25	9.19	✖ No
2	Distance	Categorical	1.96	6.90	15.16	✖ No
3	Magnitude	Continuous	0.57	4.66	8.39	✖ No
4	Magnitude	Categorical	1.01	4.41	7.66	✔ Yes

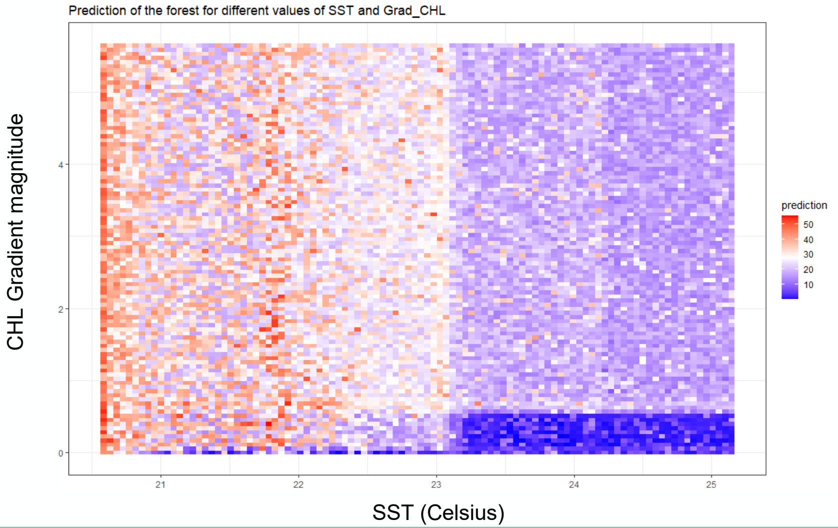
Sardine Models

a/a Model	Fronts	Bathymetry	MBE	MAE	RMSE	Selection
1	Distance	Continuous	2.24	4.11	10.49	✔ Yes
2	Distance	Categorical	1.93	4.52	11.79	✖ No
3	Magnitude	Continuous	1.93	5.72	12.90	✖ No
4	Magnitude	Categorical	2.11	5.40	14.54	✖ No

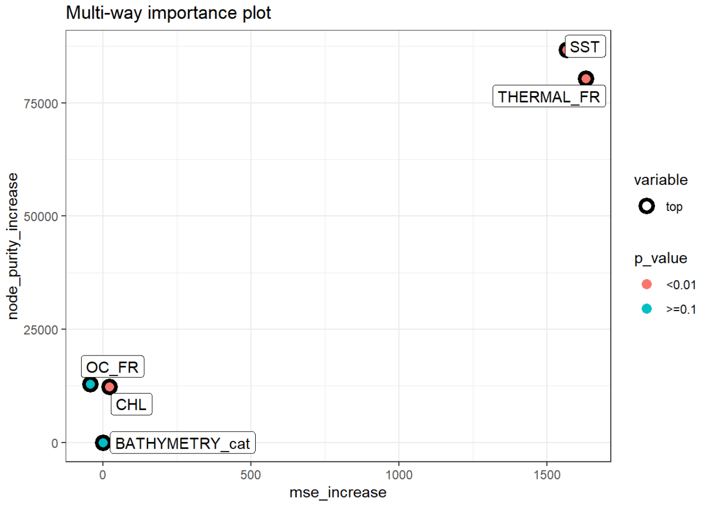
Results: Random Forest – Variable Importance

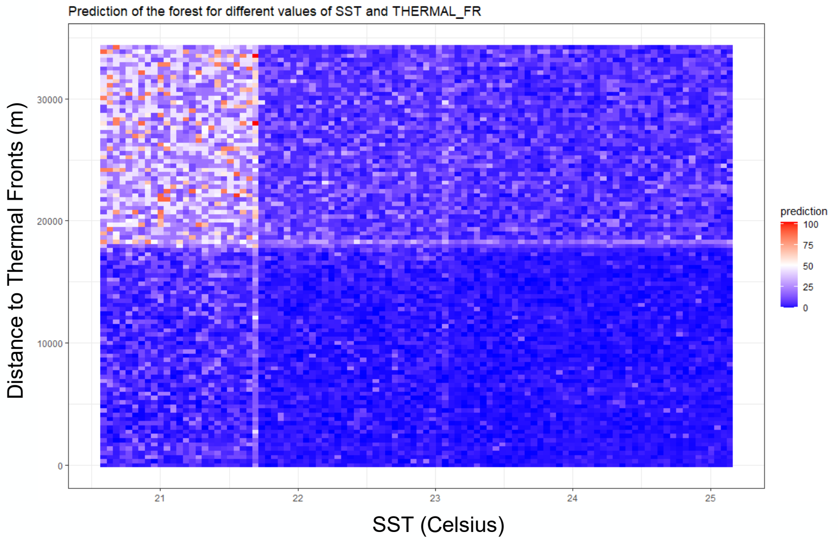
Anchovy Model





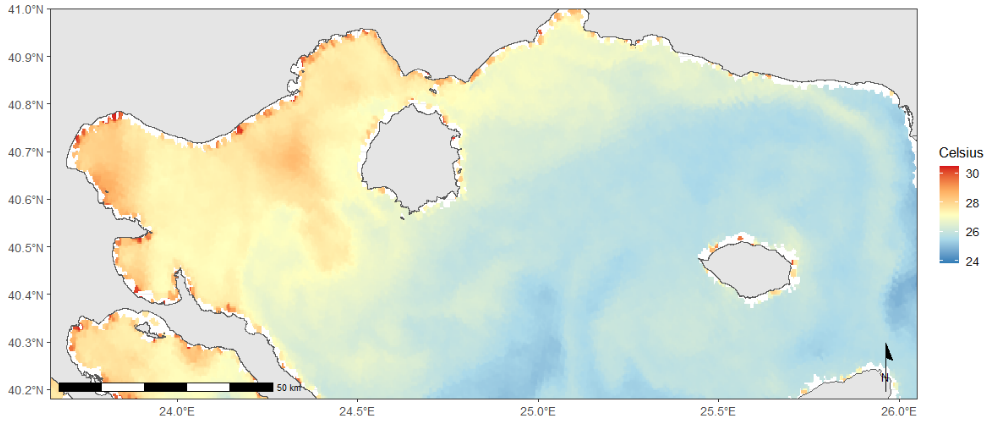
Sardine Model



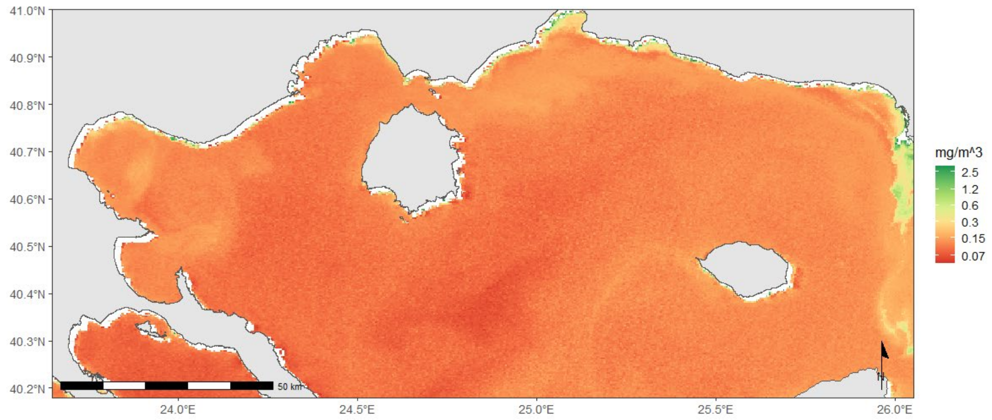


Results: Anchovy - Potential Fishing Zone maps

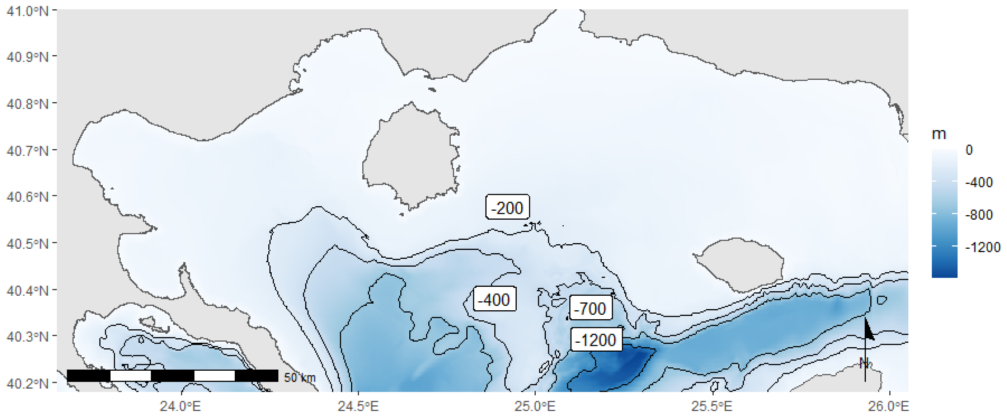
SST



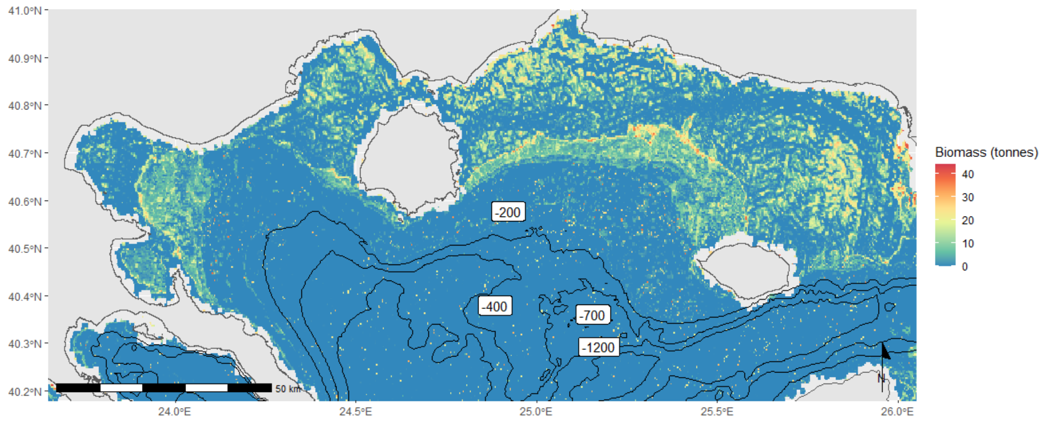
CHL



Bathymetry

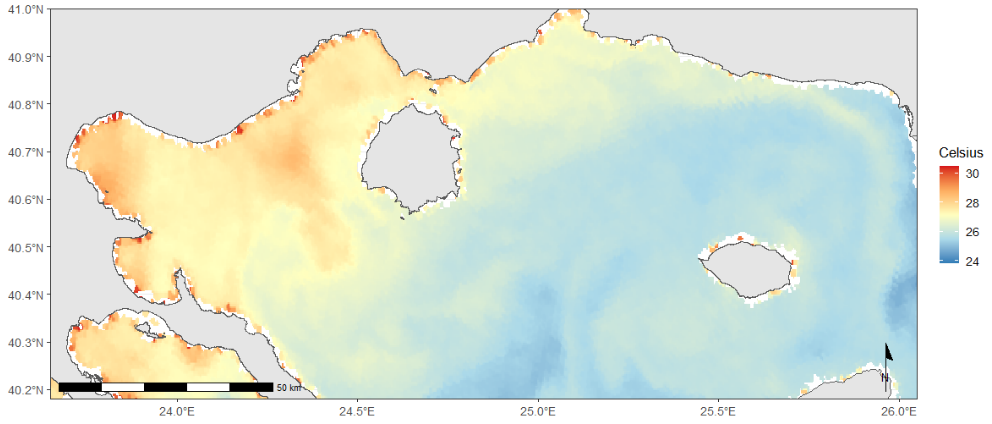


Anchovy PFZ

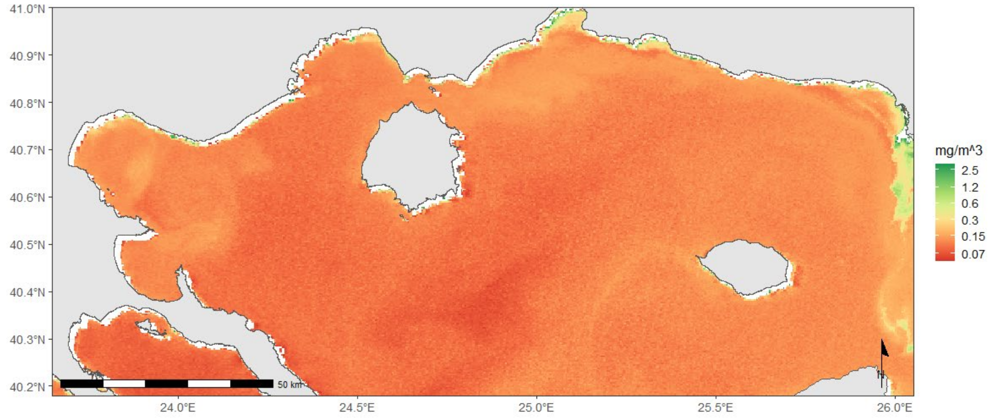


Results: Sardine - Potential Fishing Zone maps

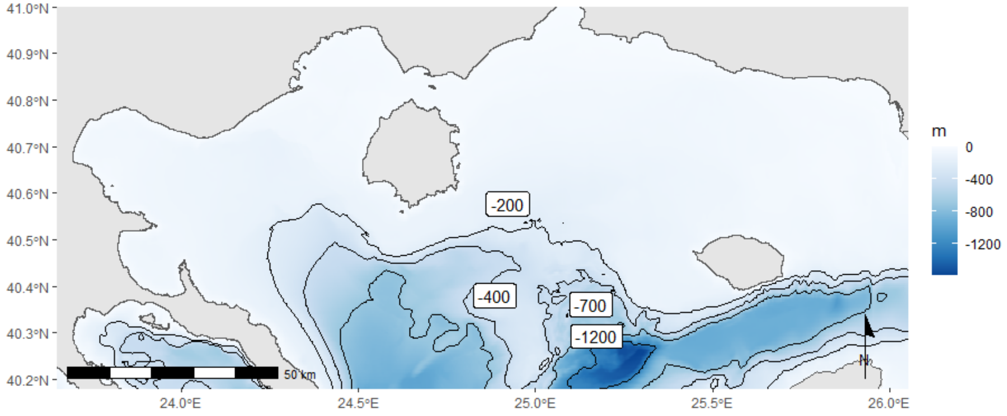
SST



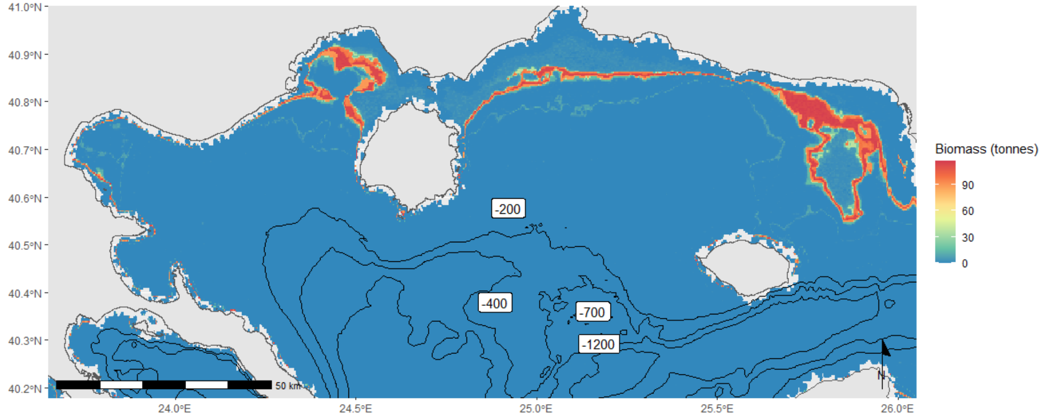
CHL



Bathymetry



Sardine PFZ



Conclusions

- **SST** is the dominant variable for both models.
- **Bathymetry** acts as a cutoff point beyond the -200m isobath.
- Both models present **low errors** at the scale of 4 tonnes.
- **Anchovy Vs Sardine** confidence level (Sardine's importance variable scores could indicate an overfitted model).

Next steps

- **More independent variables** could be considered (e.g., Dissolved Oxygen, Salinity).
- Polish the preprocessing methodology for **noisy data**.
- **Different models** (GAMs, logistic regression etc)
- More **fine-tuning** with additional data and different time frames (move from daily data to weekly).

Thank you for your attention!

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Acknowledgments

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