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TAKING THE PULSE
OF OUR PLANET FROM SPACE



Monitoring dissolved oxygen near aquaculture sites using satellite data and machine learning

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Satellite sensors are able to detect parameters which affect the optical properties of water at specific wavelengths (e.g. chl-a)

- Unlikely to record the concentration of dissolved oxygen directly from satellite sensors
- Estimation indirectly as a result of its correlation with other parameters



Estimation of dissolved oxygen

- a. estimation
- b. correlation

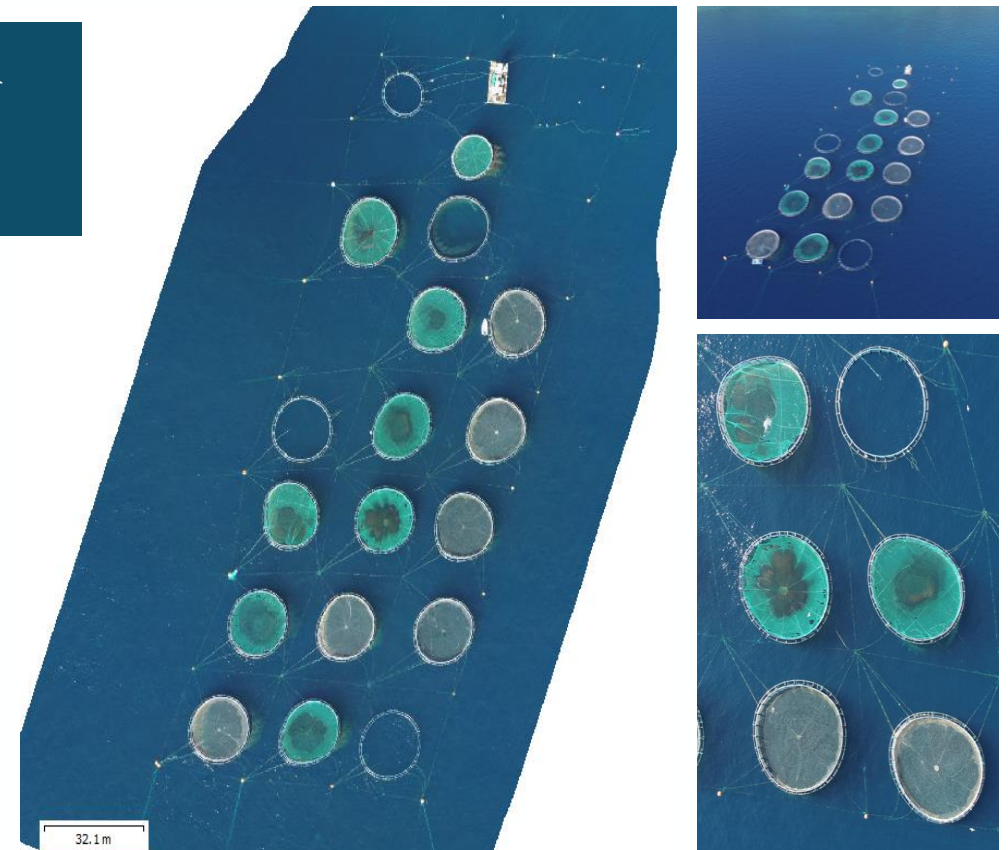
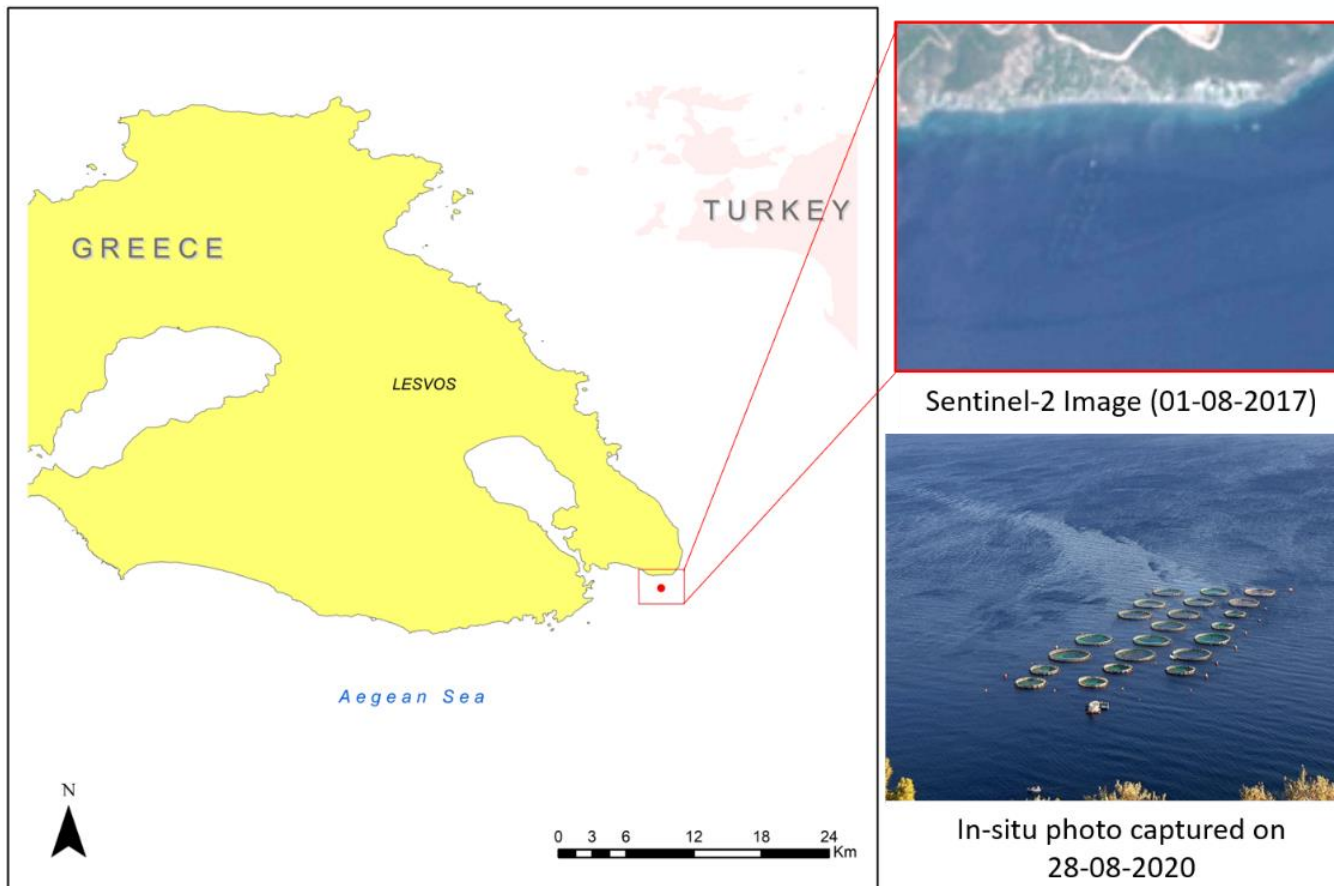


Figure 1: Drone image from Agrilia, Lesvos (N. Aegean Sea)



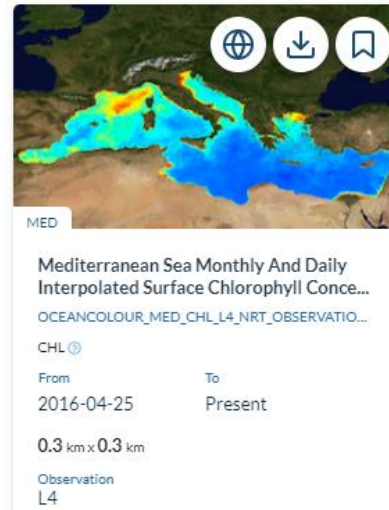
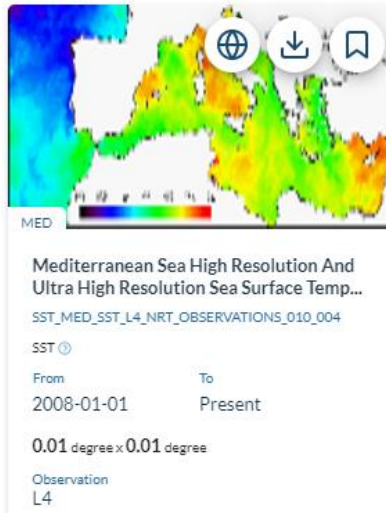
- Capacity: 180T/year
- Temperature: 14°C to 24°C
- Salinity: 39 psu
- Avg. depth: 50m.

Figure 2: The study site is located in north Aegean Sea, near the coastline of the Greek Lesvos Island.

- Satellite Level 4 multi-platform observations
- Daily chl-a and sst
- 358 entries for one-year (2021)

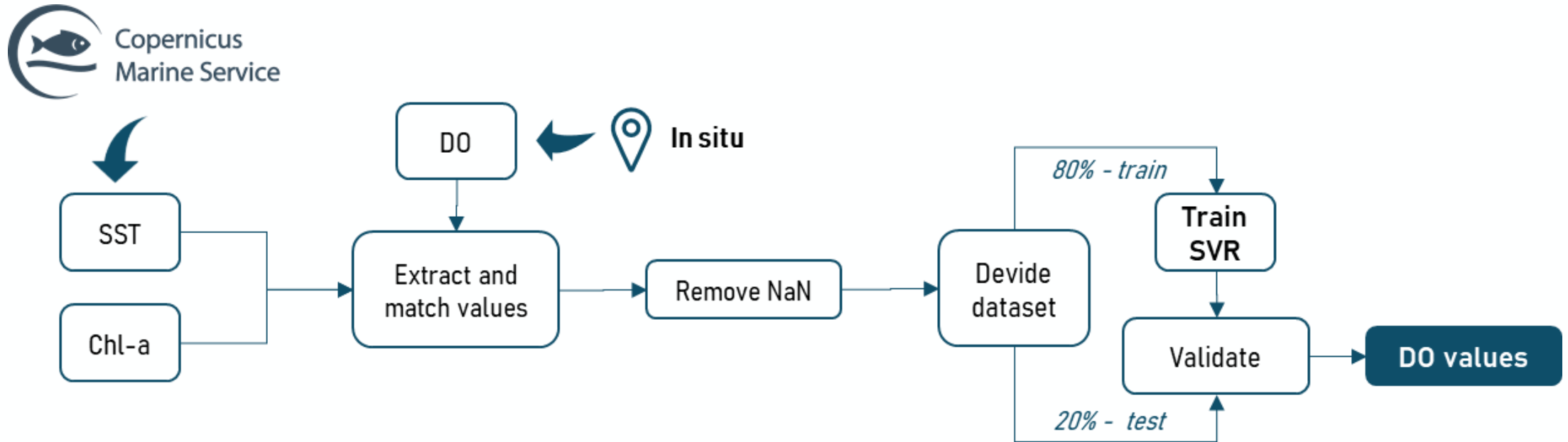
- In situ measurements (Oxy Guard)
- Daily DO and sst
- 365 entries for one-year (2021)

automatic download from CMEMS



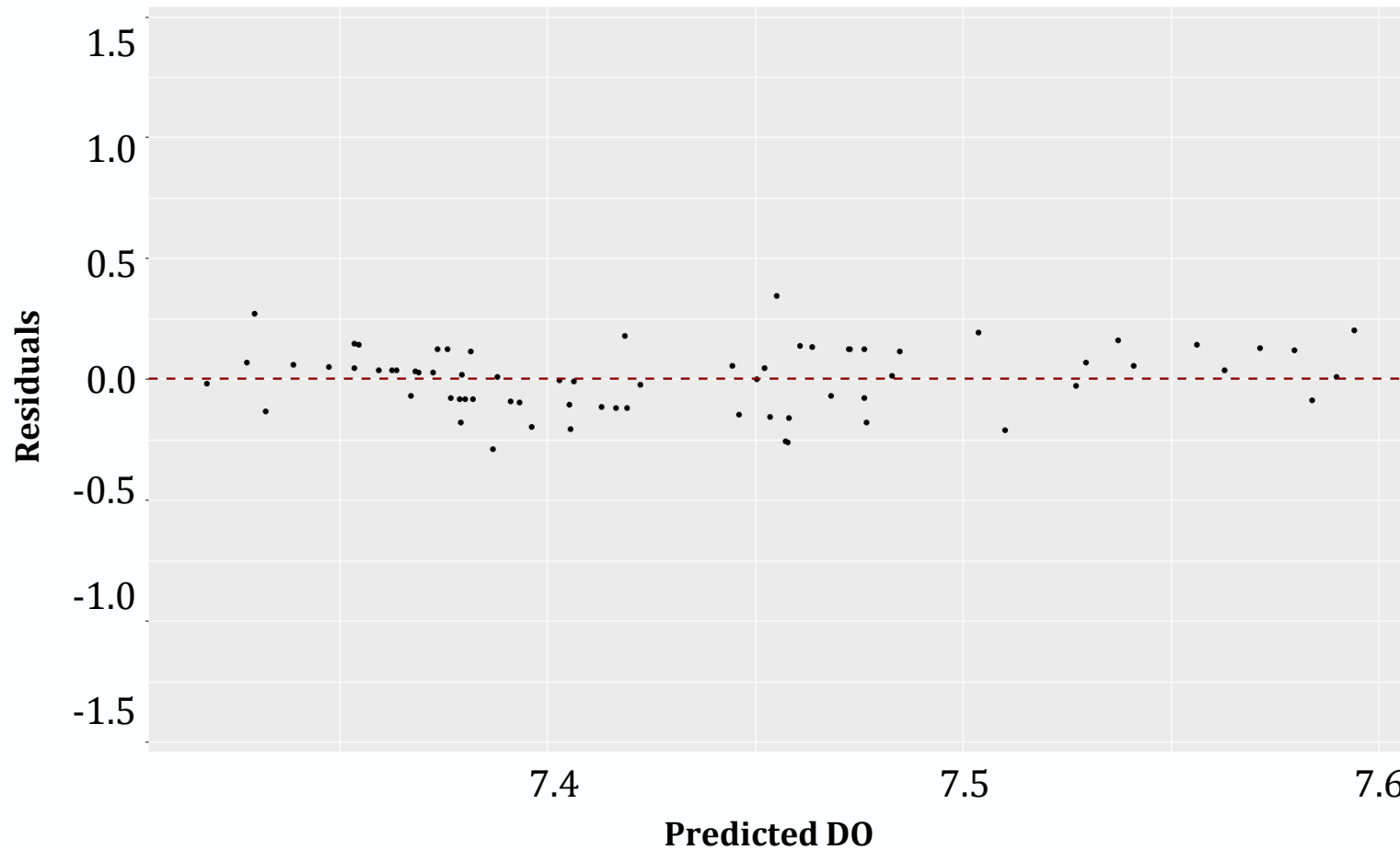
*OCEANCOLOUR_MED_CHL_L4_NRT_OBSERVATIONS_009_041
 *MEDSEA_ANALYSIS_FORECAST_BIO_006_014-TDS
 *SST_MED_SST_L4_NRT_OBSERVATIONS_010_004
 *MEDSEA_ANALYSIS_FORECAST_PHY_006_013-TDS

Date	SST	DO
1/1/2021	16,0	7,4
2/1/2021	16,0	7,4
3/1/2021	16,0	7,5
4/1/2021	16,0	7,6
5/1/2021	17,0	7,6
6/1/2021	17,0	7,7
7/1/2021	17,0	7,8
8/1/2021	17,0	7,8
9/1/2021	17,0	7,8
10/1/2021	17,0	7,8
11/1/2021	17,0	7,8
12/1/2021	16,0	7,4
13/1/2021	16,0	7,4
14/1/2021	16,0	7,5
15/1/2021	16,0	7,4
16/1/2021	16,0	7,5
17/1/2021	16,0	7,4



- **Input:** CMEMS and field measures
- Create data frame with chl-a, sst, do
- Train SVR (Support Vector Regression) model
- Validate results
- **Output:** DO maps, timeseries and correlation

Results (1/3): Model Performance



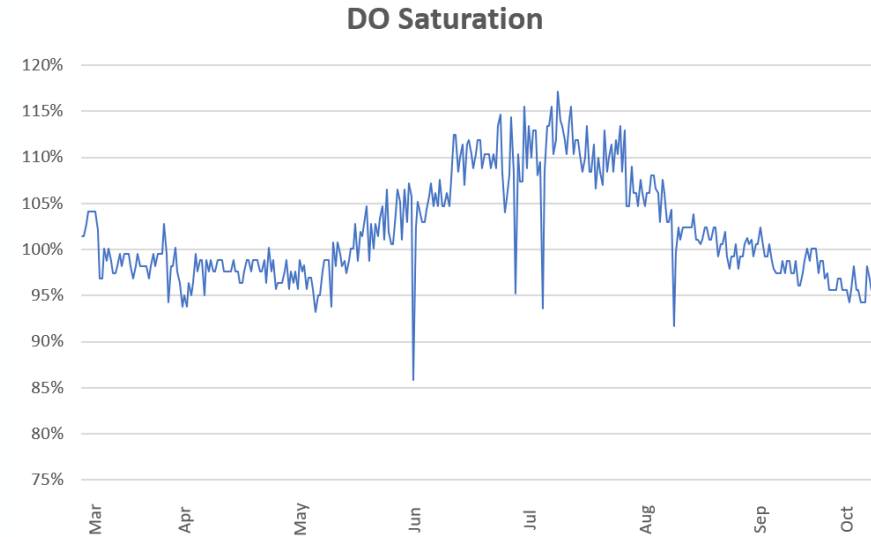
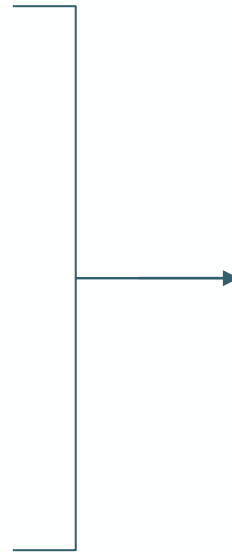
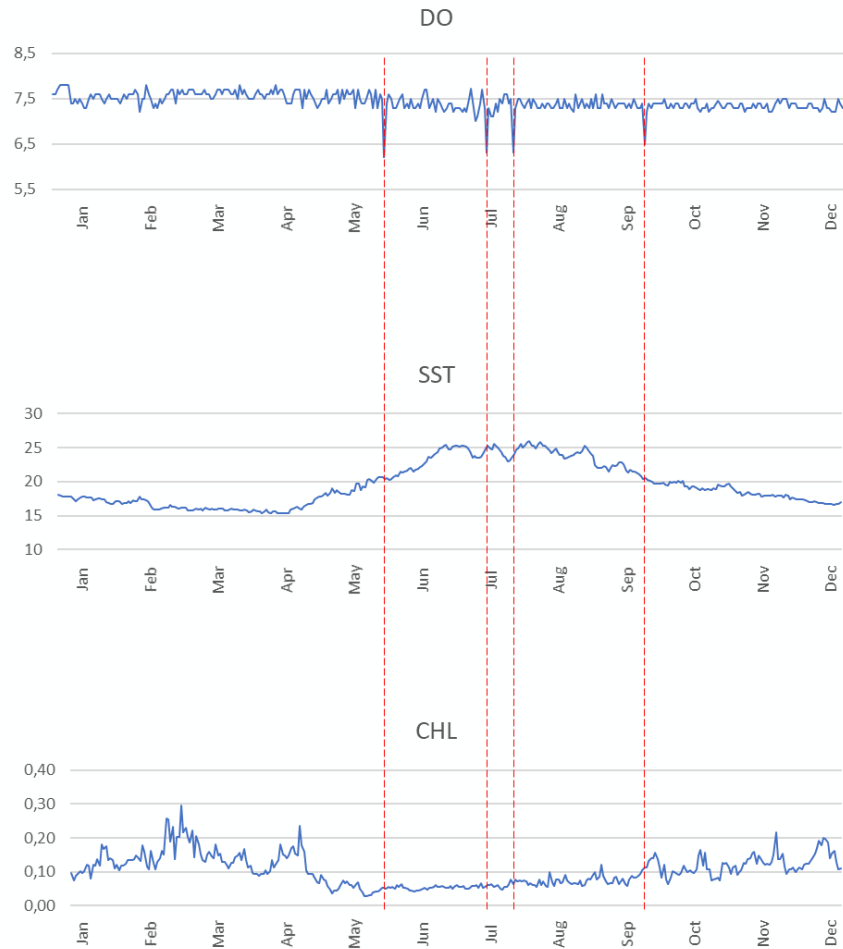
Precision:

MAE index = 0.11ppm

Accuracy:

Residual plot (even distribution around 0)

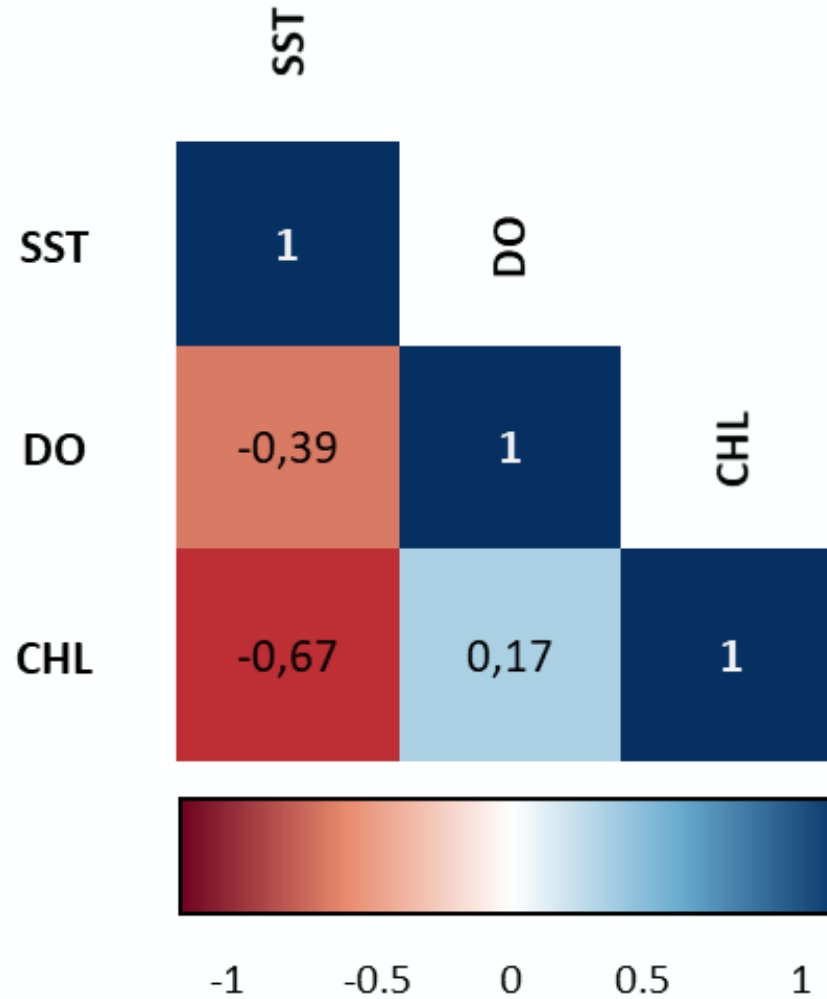
Results (2/3): Temporal Variability



Dissolved oxygen: 7-7.8 mg/l
Highest: winter-spring

DO Saturation > 85%
Highest: summer

Results (2/3): Temporal Variability



Results (3/3): Spatial Distribution

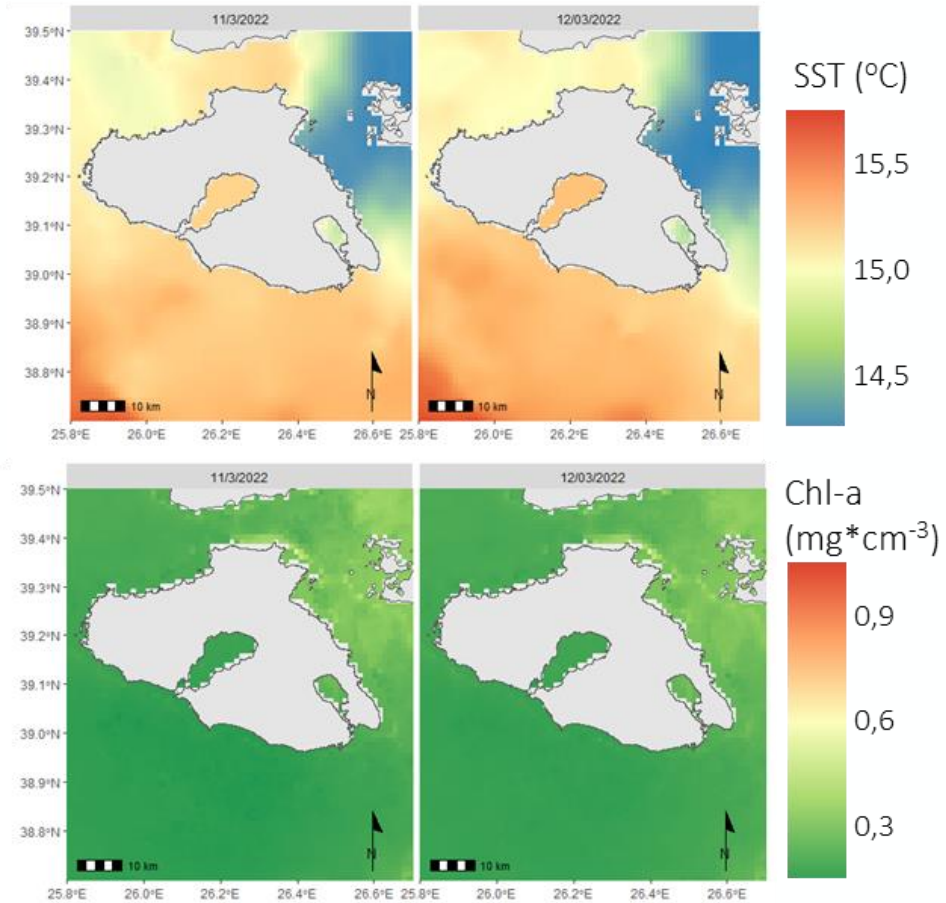


Figure 3: Sea surface temperature and chlorophyll-a maps derived from CMEMS data

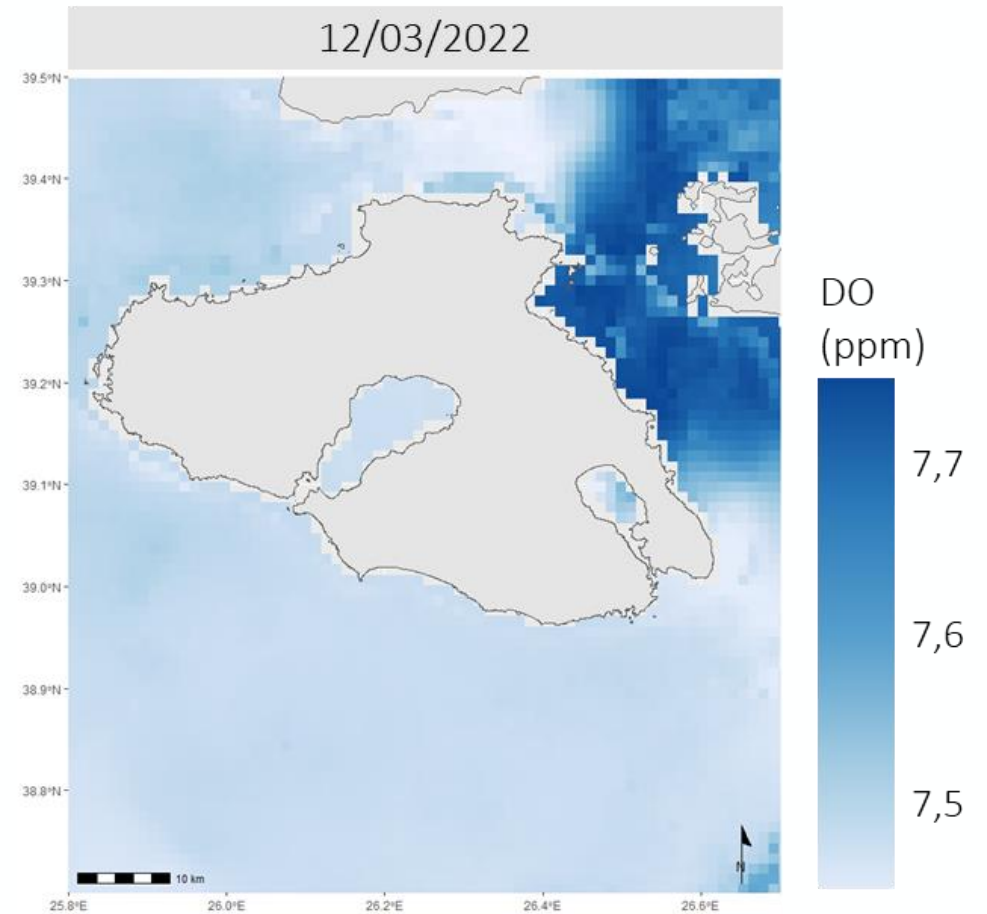


Figure 4: Dissolved oxygen map estimated as a result of its correlation with temperature and chl-a.

The **purpose** of this study was to develop a methodology for the estimation of dissolved oxygen in coastal aquaculture facilities, based on daily **CMEMS data** and **machine learning techniques**.

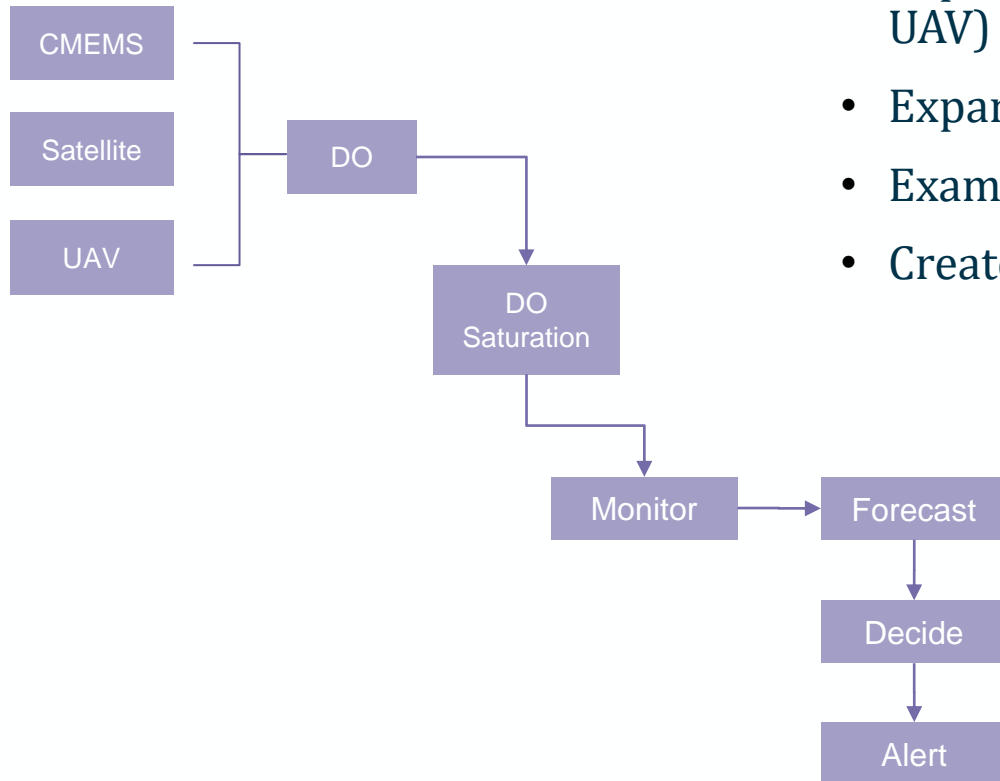


An *automated procedure* was developed for extracting the estimated **dissolved oxygen values** that can be used for creating maps and further analysis.

Our preliminary results show a promising approach for estimating DO at aquaculture sites, which paves the way for the development of real-time monitoring systems for aquaculture.

- Correlation between DO, SST and chl-a
 - High precision and accuracy
 - Detection of sudden drops/shifts
- Spatial scale – better representation

Future steps: Precision aquaculture



- Explore more data sources (Sentinel-2, Sentinel-3 and UAV)
- Expand dataset to other regions
- Examine the correlation with more parameters
- Create an automated service to predict and alert



Thank you for your attention!

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