



ISLAND



Spatio-temporal variability of primary production at Lastovo Island during summer

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Workshop: Modelling Primary Production Department of Physics, Faculty of Science, University of Split

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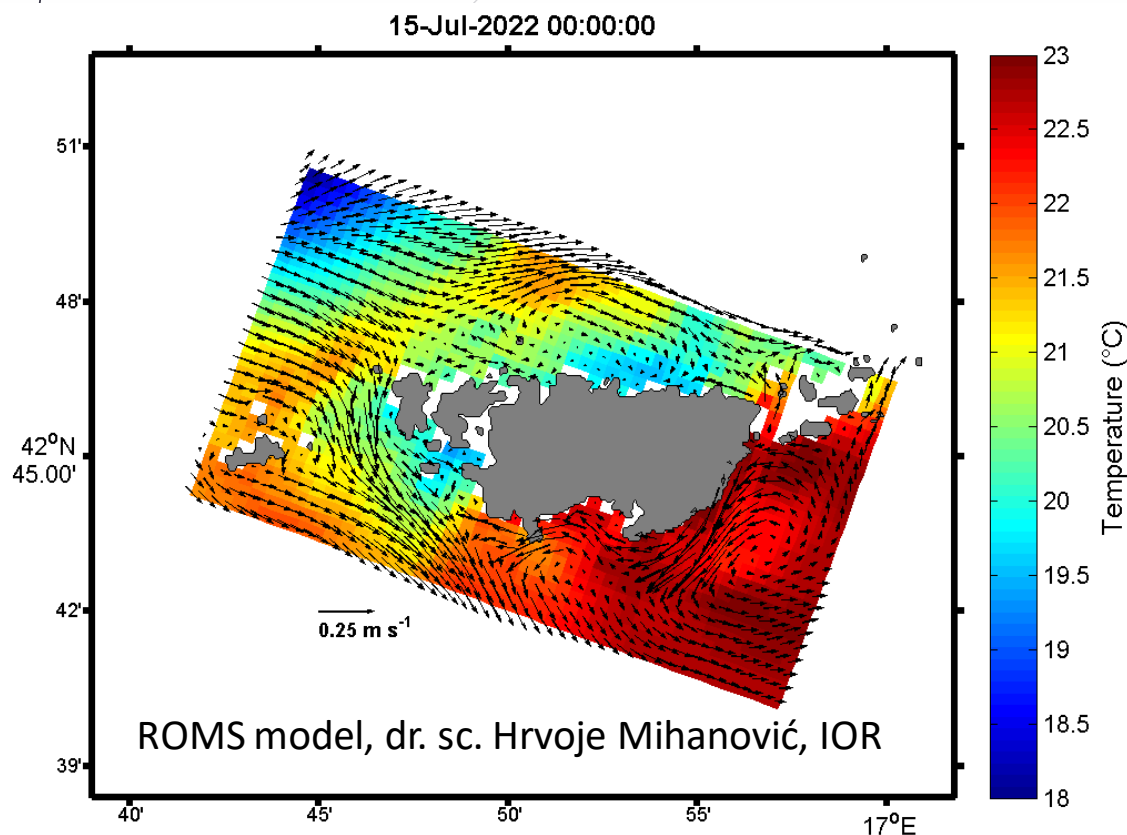
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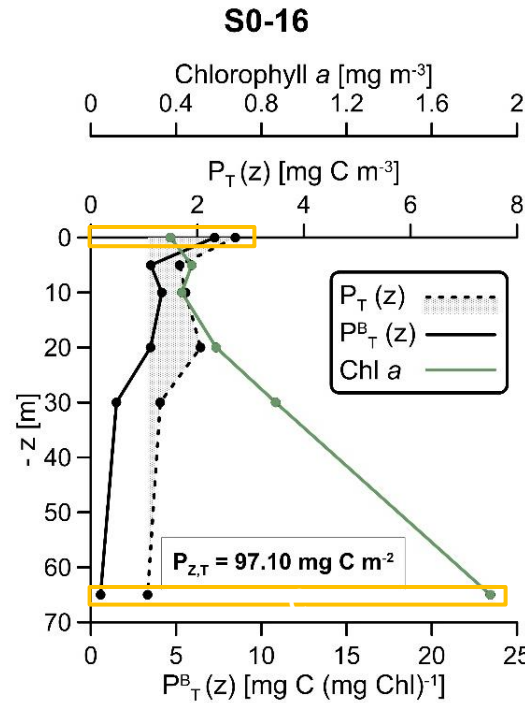
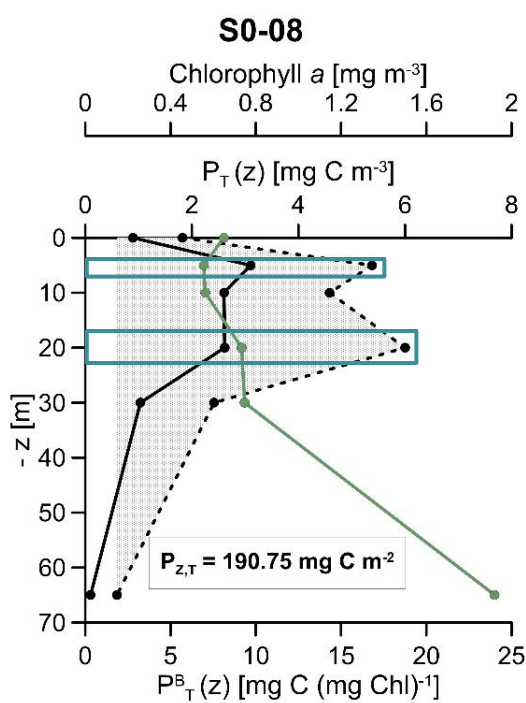
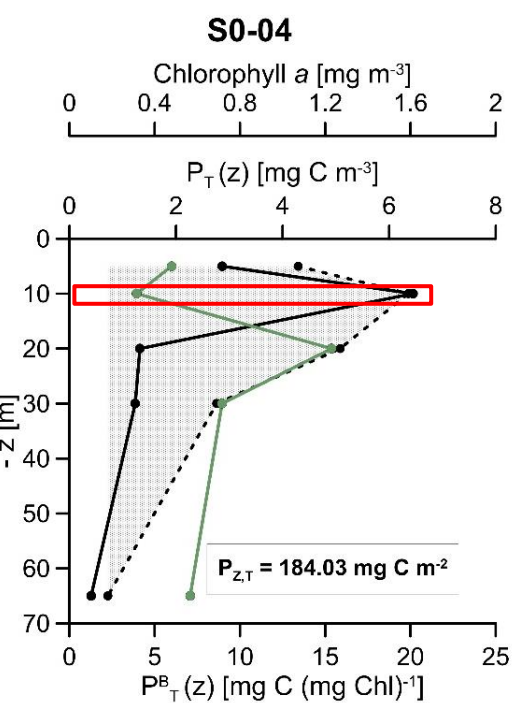
- type of coastal-trapped wave
- occurring during stratification
- thermocline vertical oscillations up to 30 meters
- supporting mechanisms that can increase NPP

Main hypothesis:

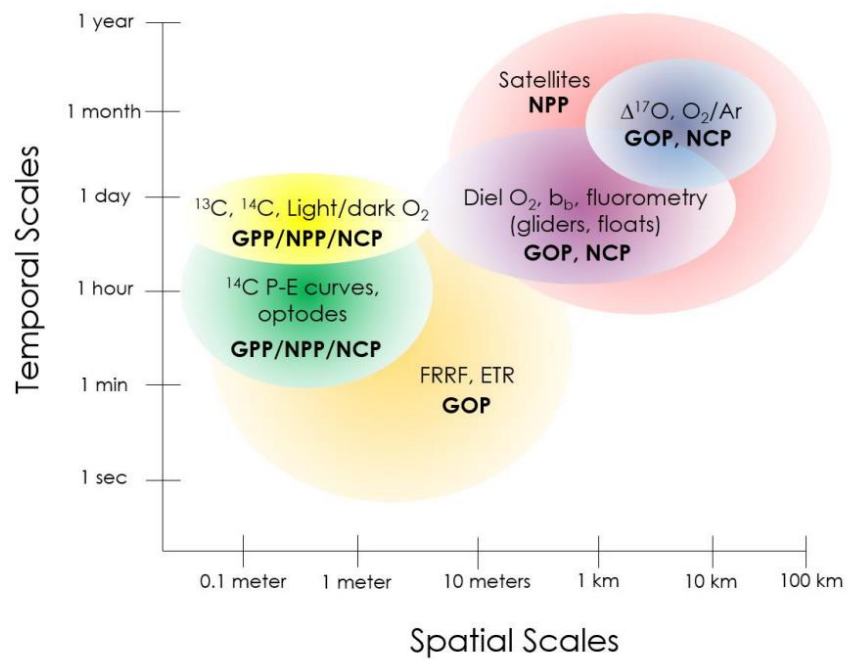
ITWs are a key driver of NPP in the stratified oligotrophic waters of the Lastovo Archipelago.

Percentage change during and after ITWs in July 2023

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Variable	z [m]	During ITWs	After ITWs
$P^B_{z,T}$	integrated	-14.62	-47.27
$P_{z,T}$	integrated	3.65	-49.09
$P^B_T(z)$	0	/	158.95
	5	8.21	-63.68
	10	-59.61	-48.83
	20	97.90	-57.17
	30	-16.12	-53.54
	65	-75.63	83.61
$P_T(z)$	0	/	48.69
	5	25.44	-69.02
	10	-27.92	-61.19
	20	18.12	-65.66
	30	-12.43	-46.09
	65	-17.38	79.21
$(Exp_i - Exp_{i-1})/Exp_{i-1} \times 100$			



How NPP
changes with
time?



**Ocean
Colour**

What is spatial
distribution of
NPP?

Are there
effects of ITWs
on spatio-
temporal
trends?

SPATIO-TEMPORAL TRENDS OF NPP AT LASTOVO ISLAND

Revealed by ocean colour remote sensing operational products released by CNR-ISMAR for the Copernicus Marine Environment Monitoring Services (CMEMS)



Copernicus primary production operational product

Satellite chlorophyll *a* observations are linked to PP through the coupling of an **atmospheric radiative transfer model** (Tanre et al., 1979) with a **bio-optical representation of phytoplankton absorption and scattering** (Morel, 1991) at global scale (Antoine and Morel, 1996)

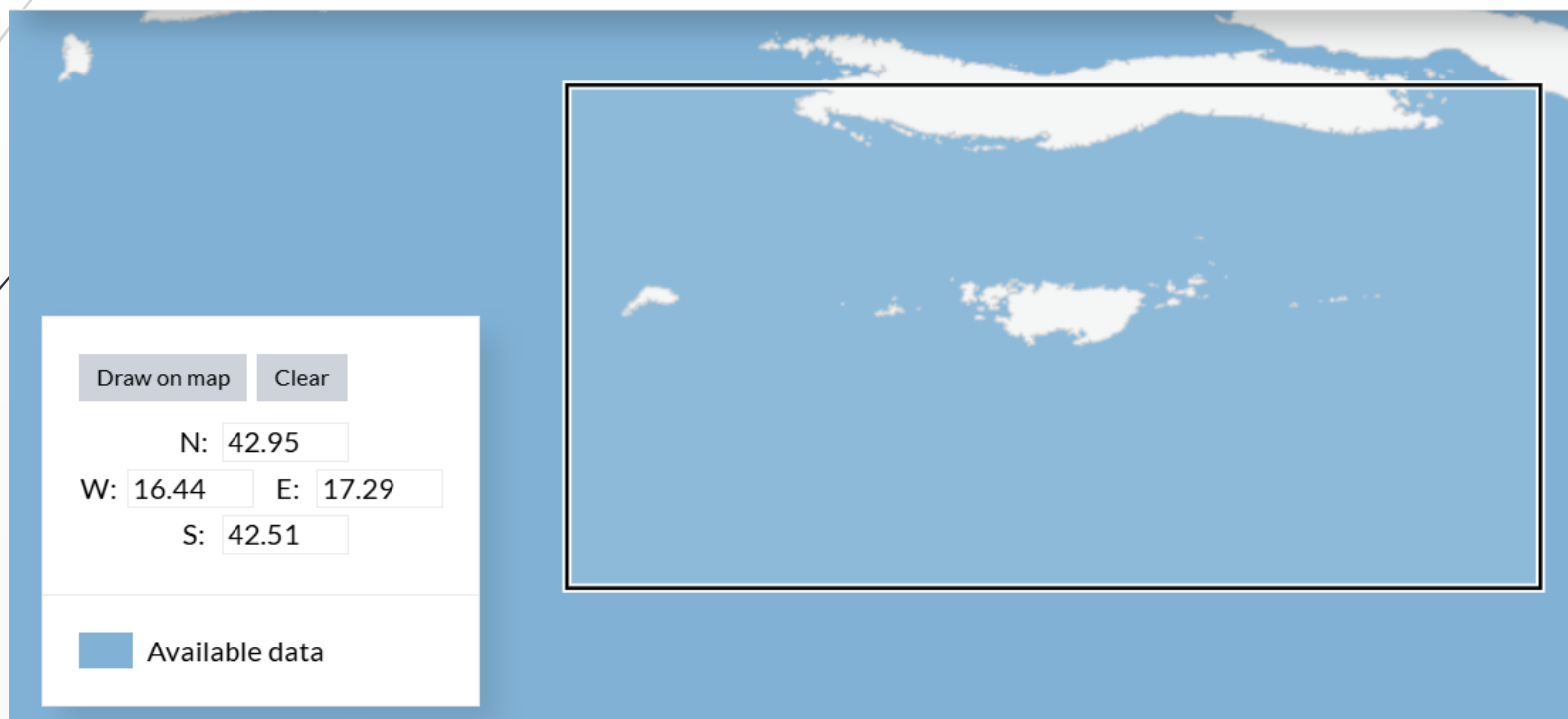
$$P = 12 \text{ } Chl(z) \times a^*_{chl} \times PAR(z, t, \lambda) \times \varphi(chl, T)$$

- where *12* is the carbon molar weight to express the PP as mass;
- *Chl(z)* is the **chlorophyll concentration profile**;
- *a* is the **chlorophyll-specific absorption coefficient**, expressed as a function of chlorophyll concentration;
- *PAR(z, t, λ)* is the **photosynthetically available radiation** at depth *z*, time *t*, and wavelength *λ*;
- *φ(chl, T)* is the **photosynthetic quantum yield**, formulated as a **function of chlorophyll and temperature**, which expresses the efficiency of converting captured energy into carbon.

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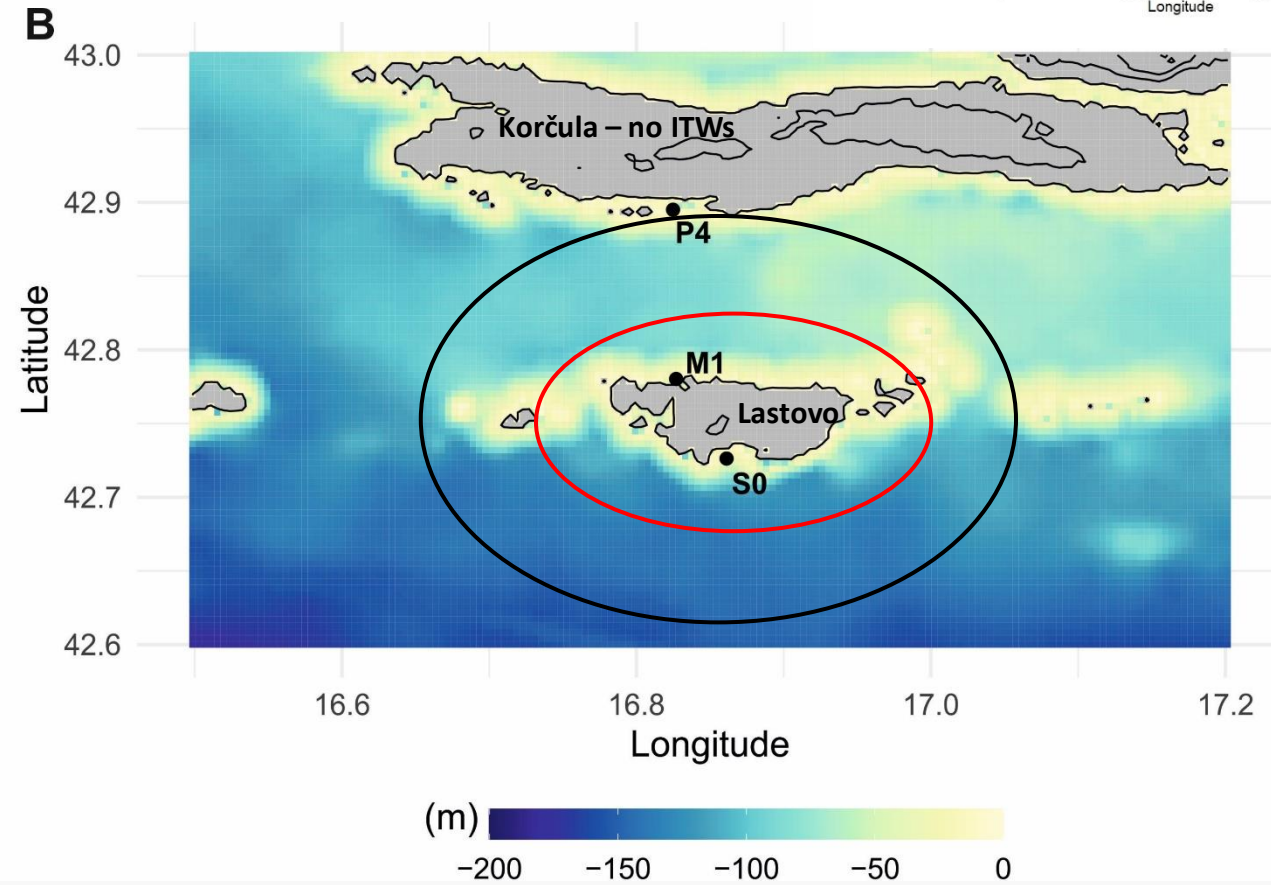
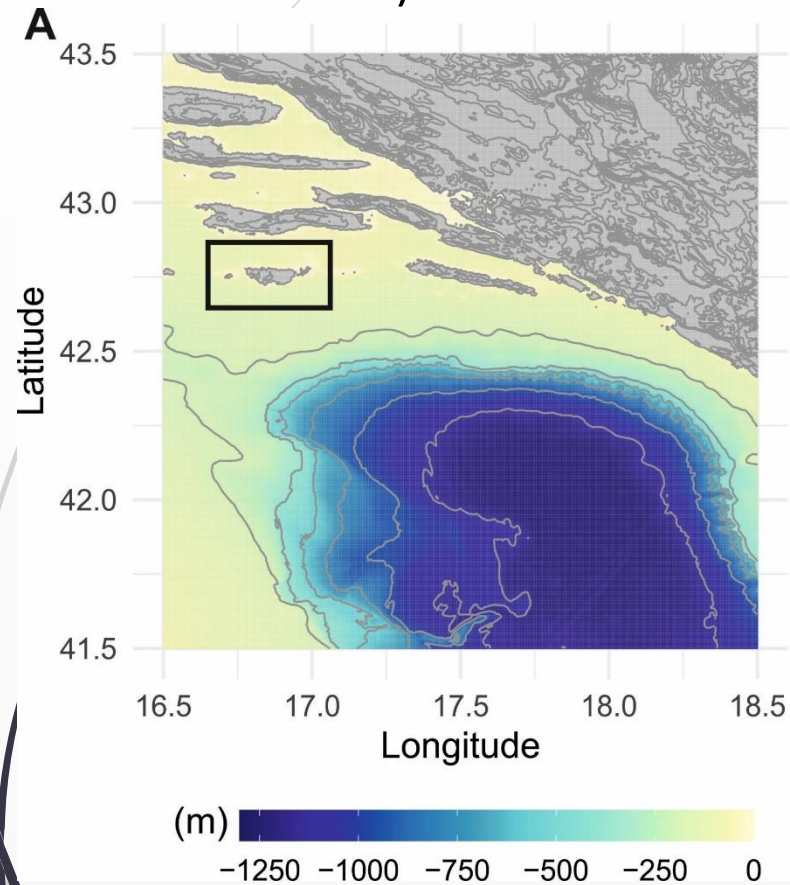
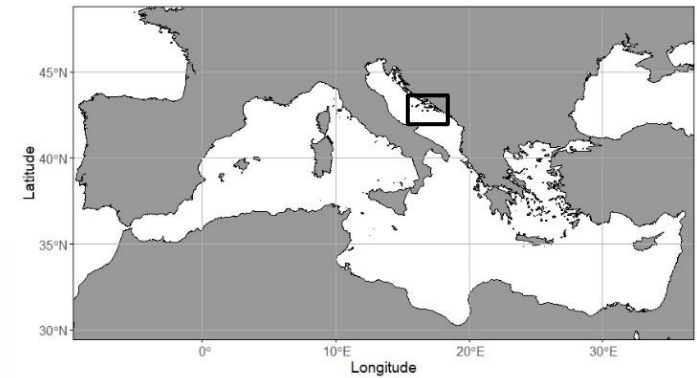
Search and download of products from the **Copernicus Marine Data Store** (<https://data.marine.copernicus.eu/products> database) using the **Copernicus Marine Toolbox**

-x 16.44 -X 17.29 -y 42.51 -Y 42.95



Pixels at two different distances from the coast of Lastovo Island were extracted:

- closer to the shoreline (ITWs effect is the strongest)
- across a wider belt (ITWs effect is decreasing away from the coast)



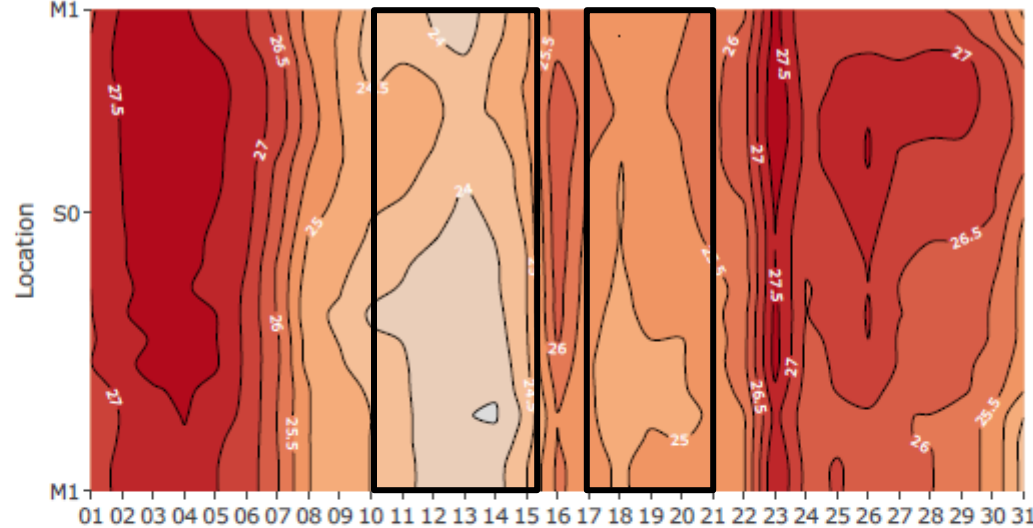
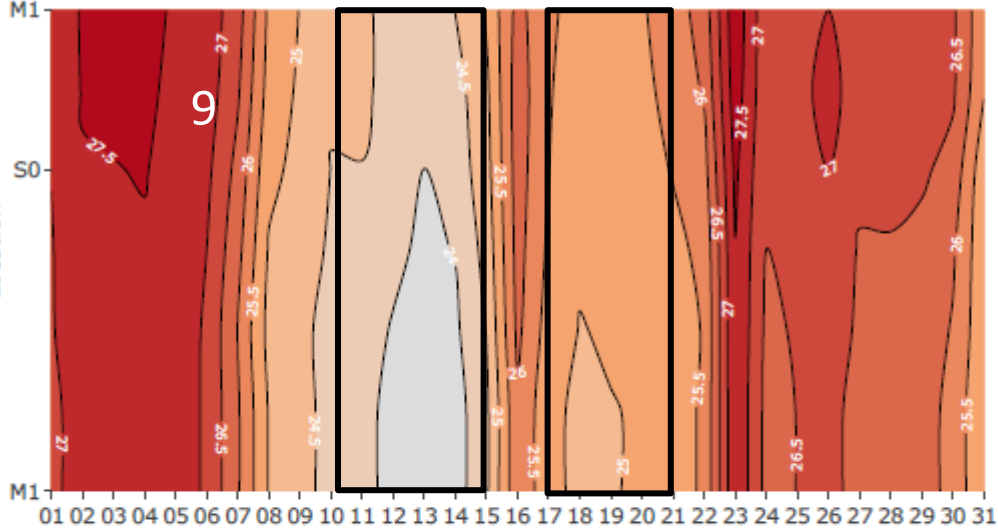
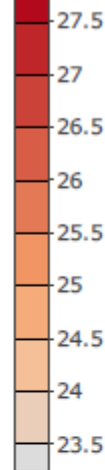
1 - 4 km

10 - 14 km

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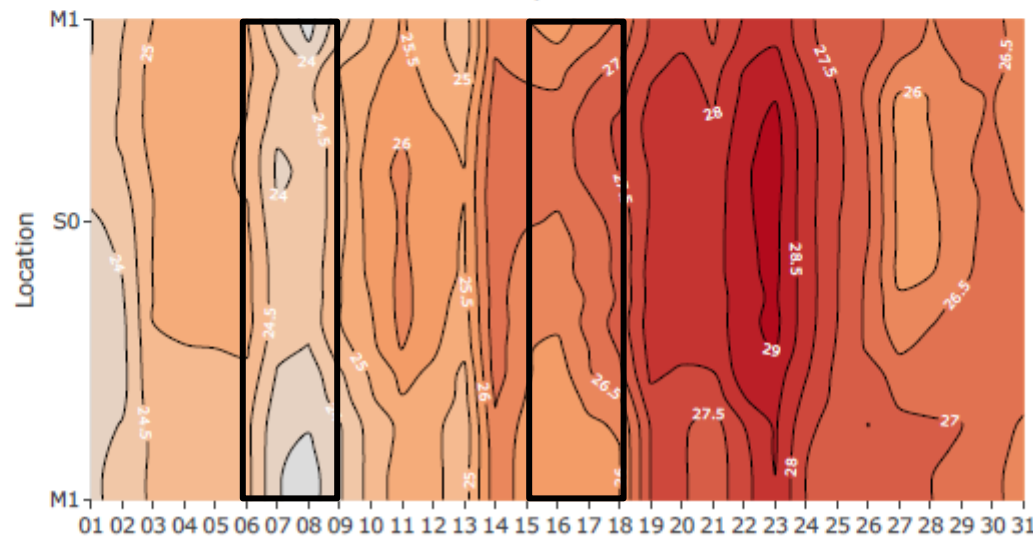
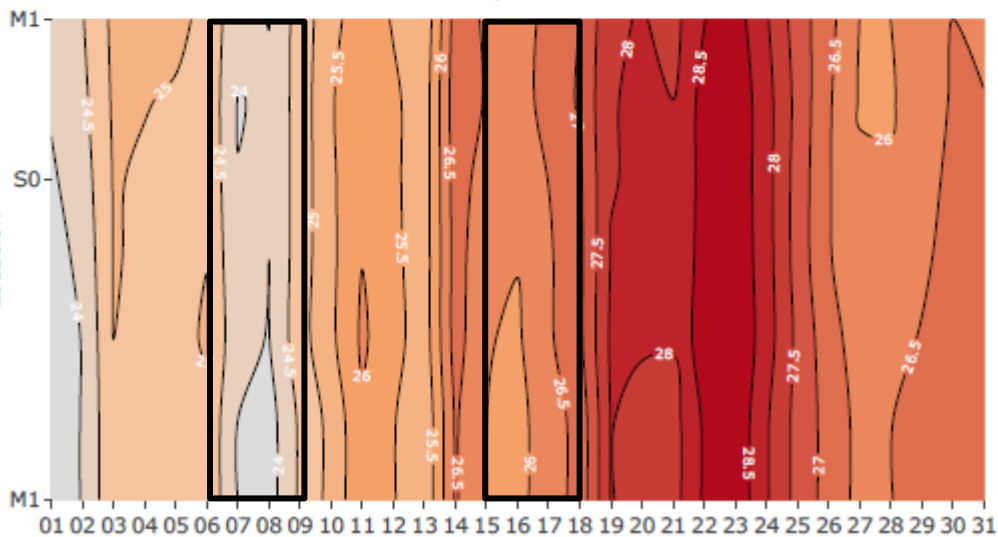
cmems_SST_MED_SST_L4_REP_OBSERVATIONS_010_021_analysed_sst(10 - 14 km)

SST [°C]



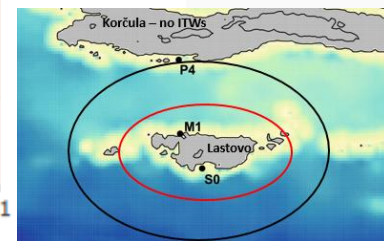
July 2022

July 2022



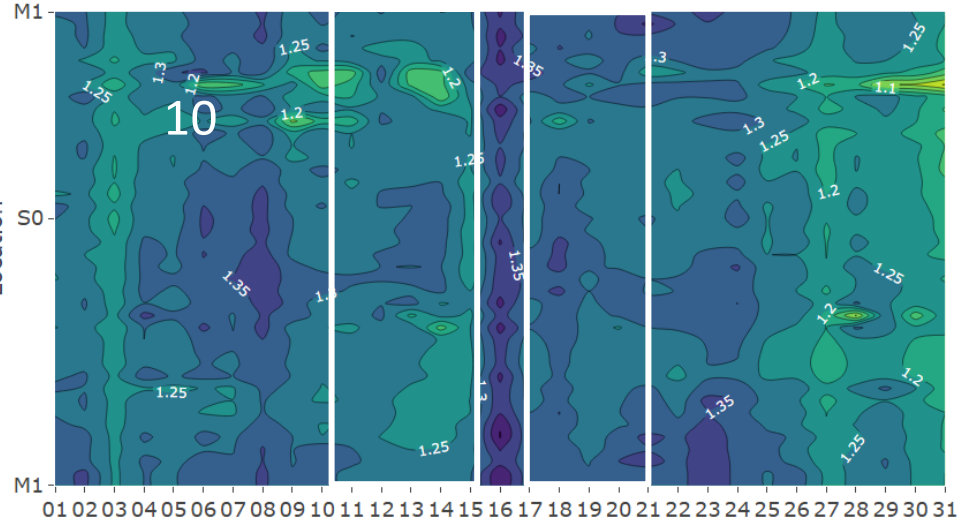
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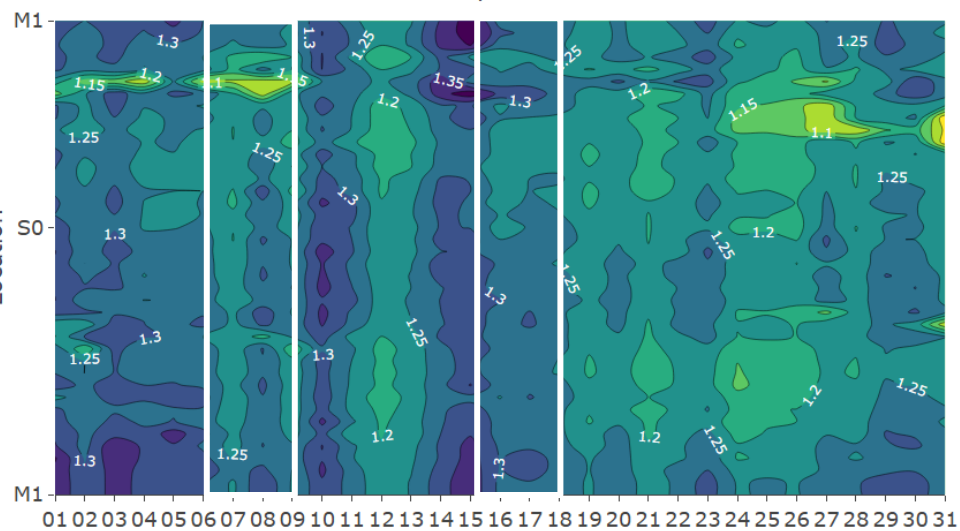


1 - 4 km

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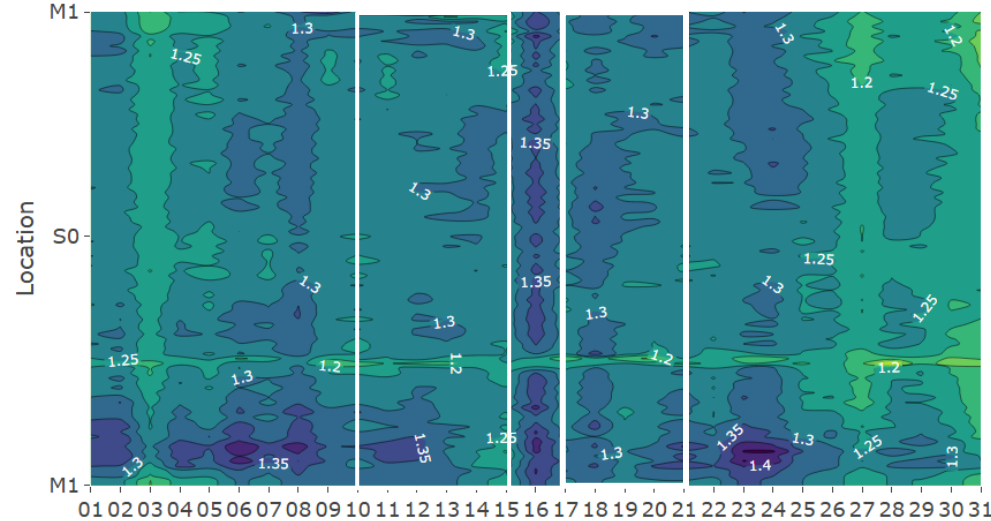
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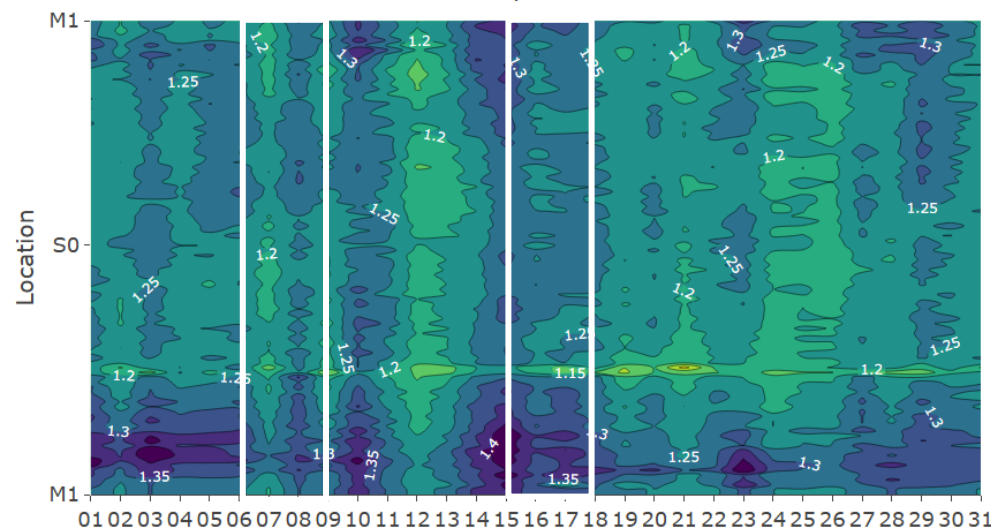
July 2023

10 - 14 km

cmems_obs-oc_med_bgc-plankton_my_l4-gapfree-multi-1km_P1D(10 - 14 km)

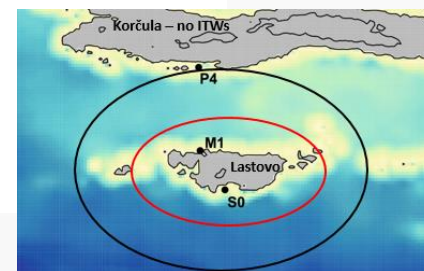
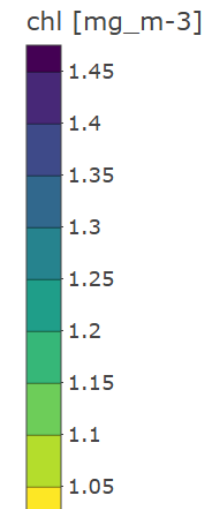


July 2022



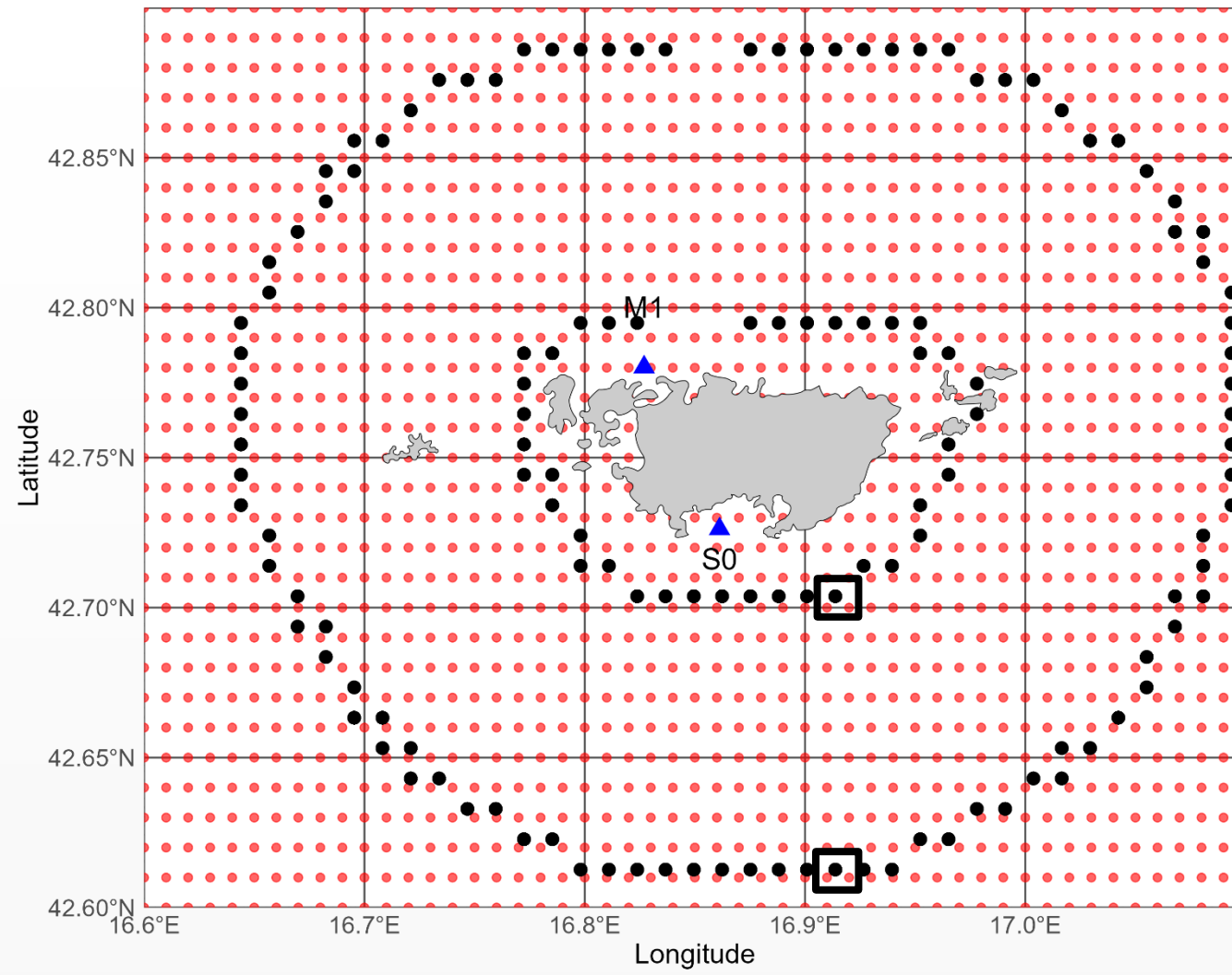
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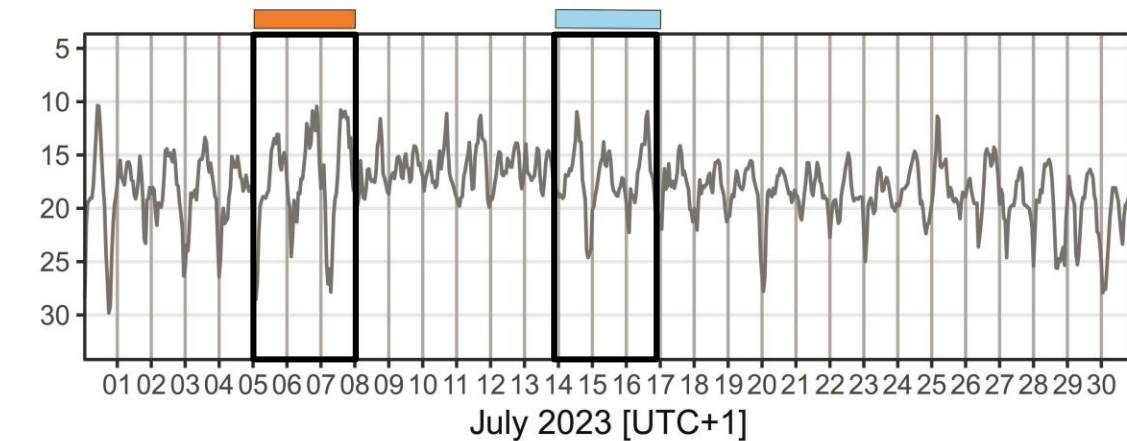
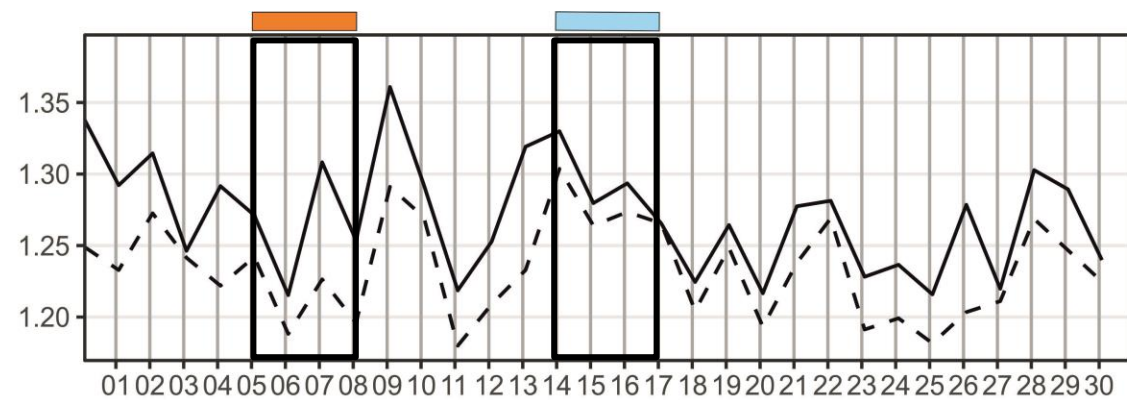
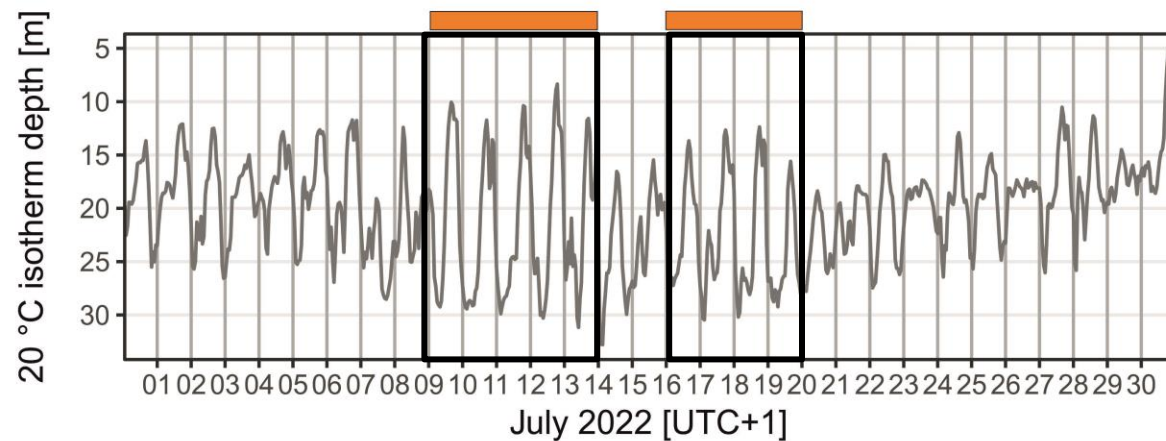
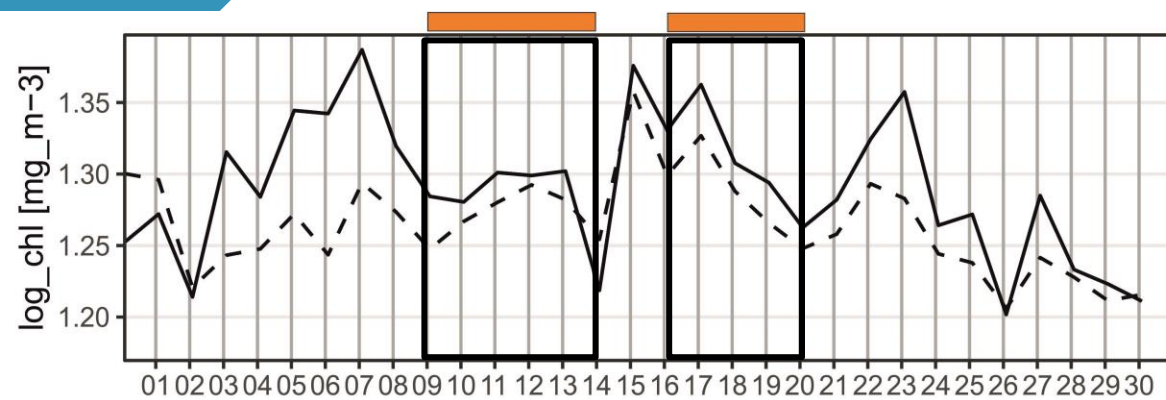
log₁₀chl



Mediterranean Sea, Bio-Geo-Chemical, L4, monthly means, daily gapfree and climatology Satellite Observations (1997-ongoing) (CMEMS).

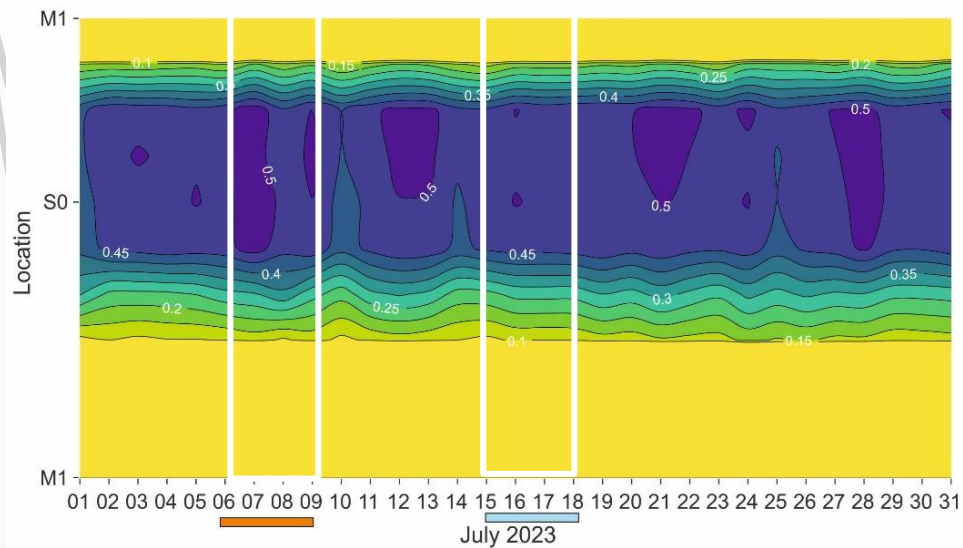
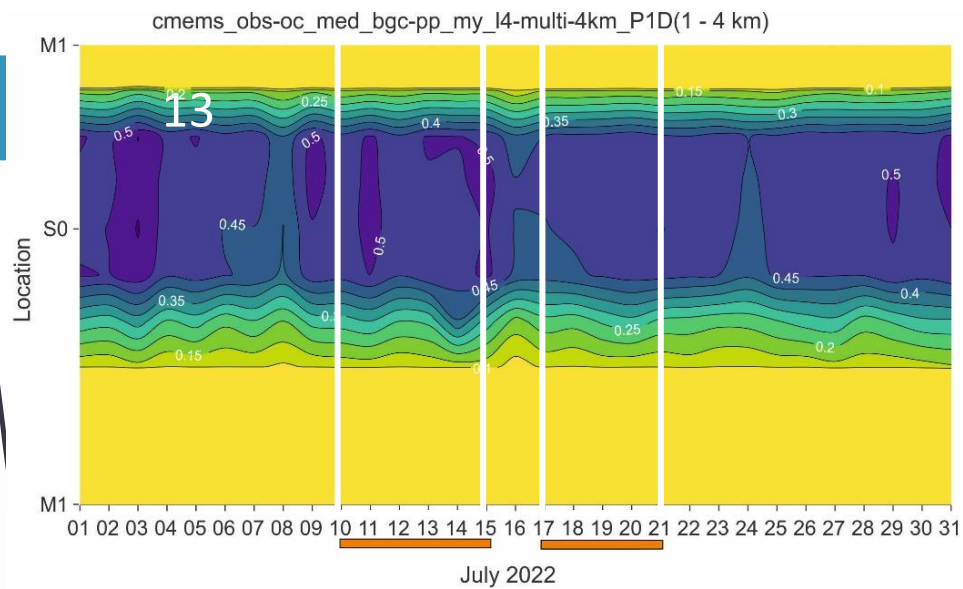
<https://doi.org/10.48670/moi-00300>



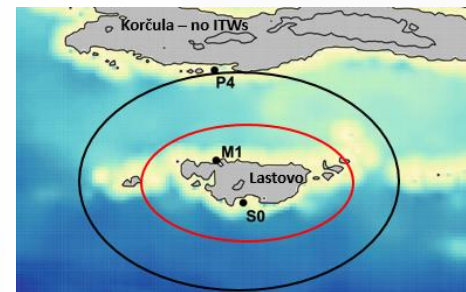
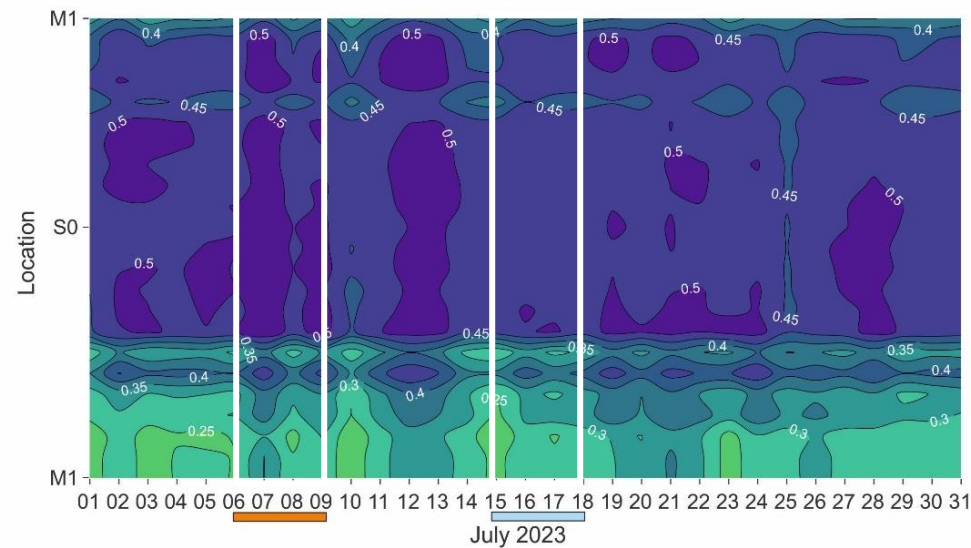
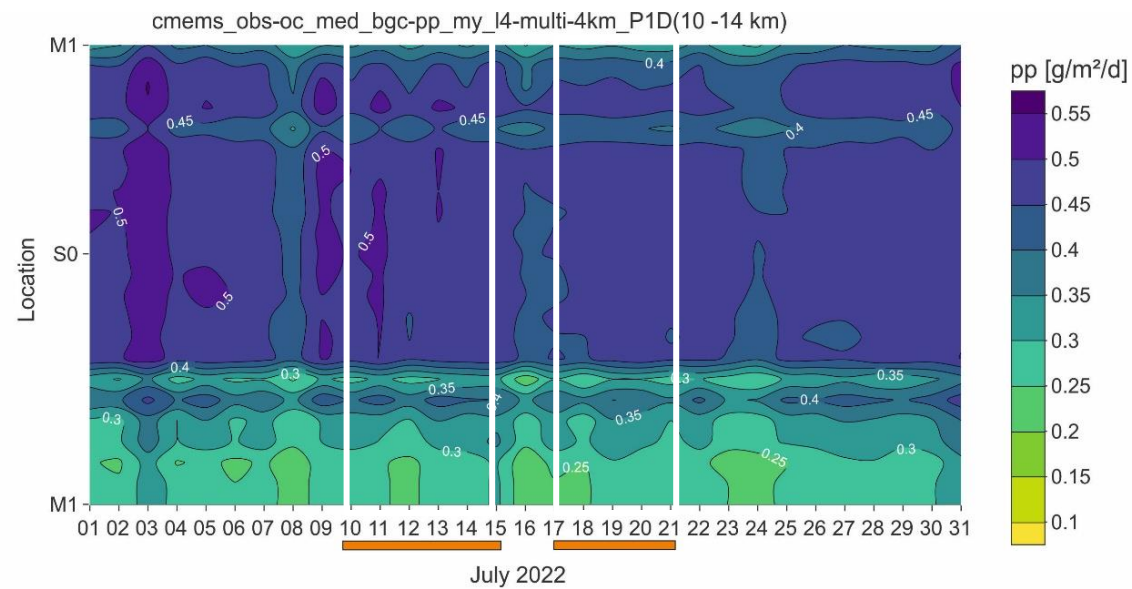


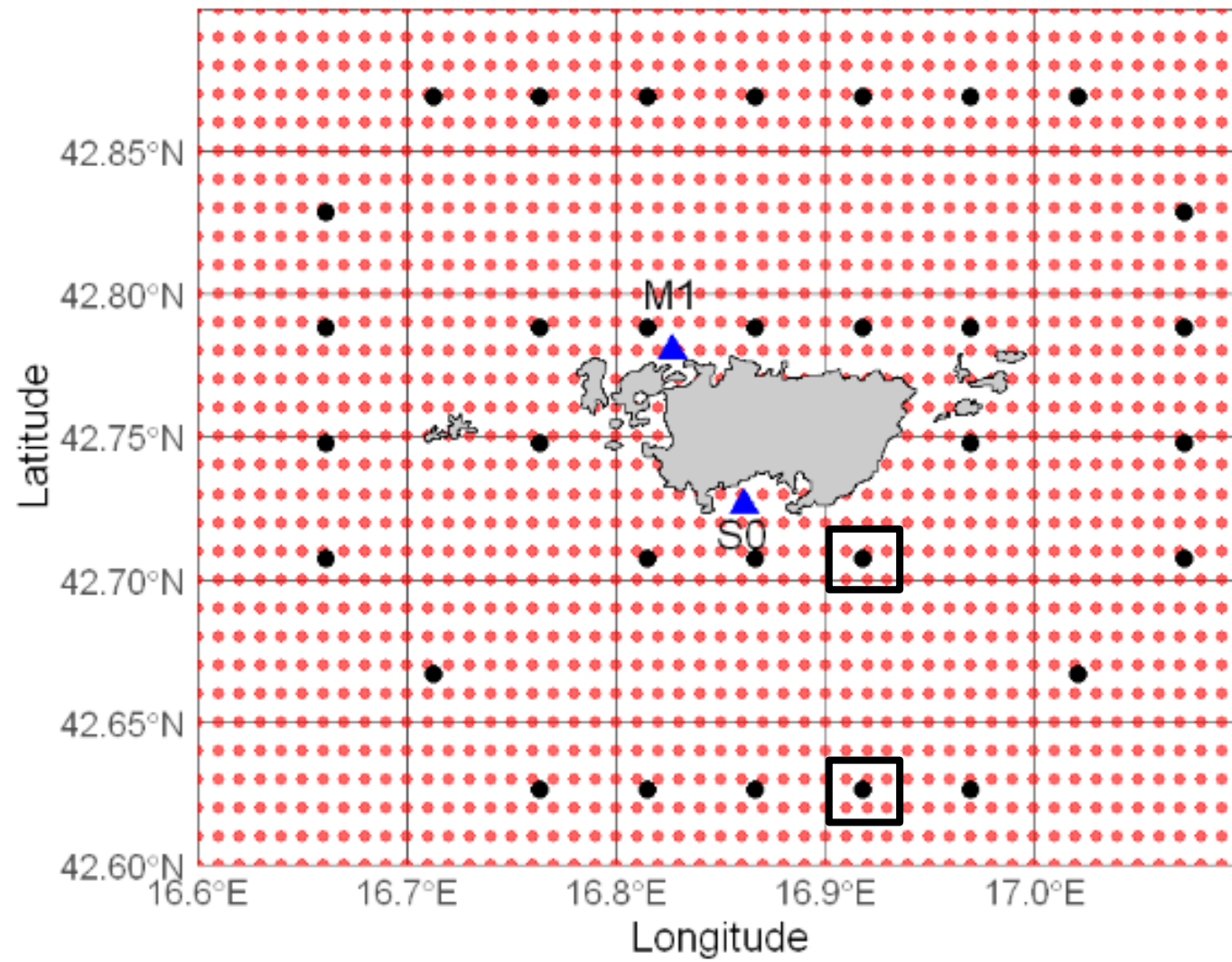
— d = 1-4 km - - d = 10-14 km

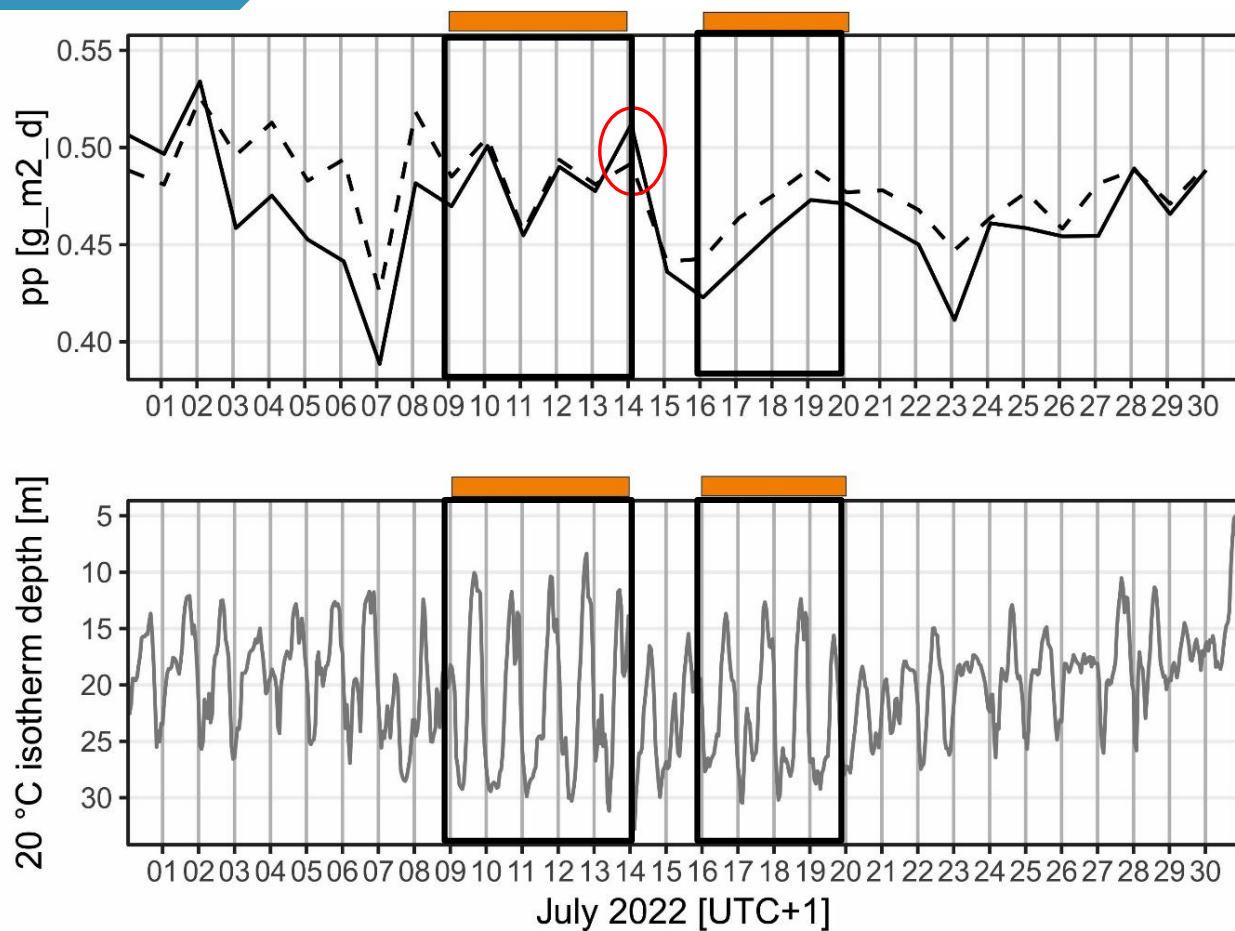
1 - 4 km



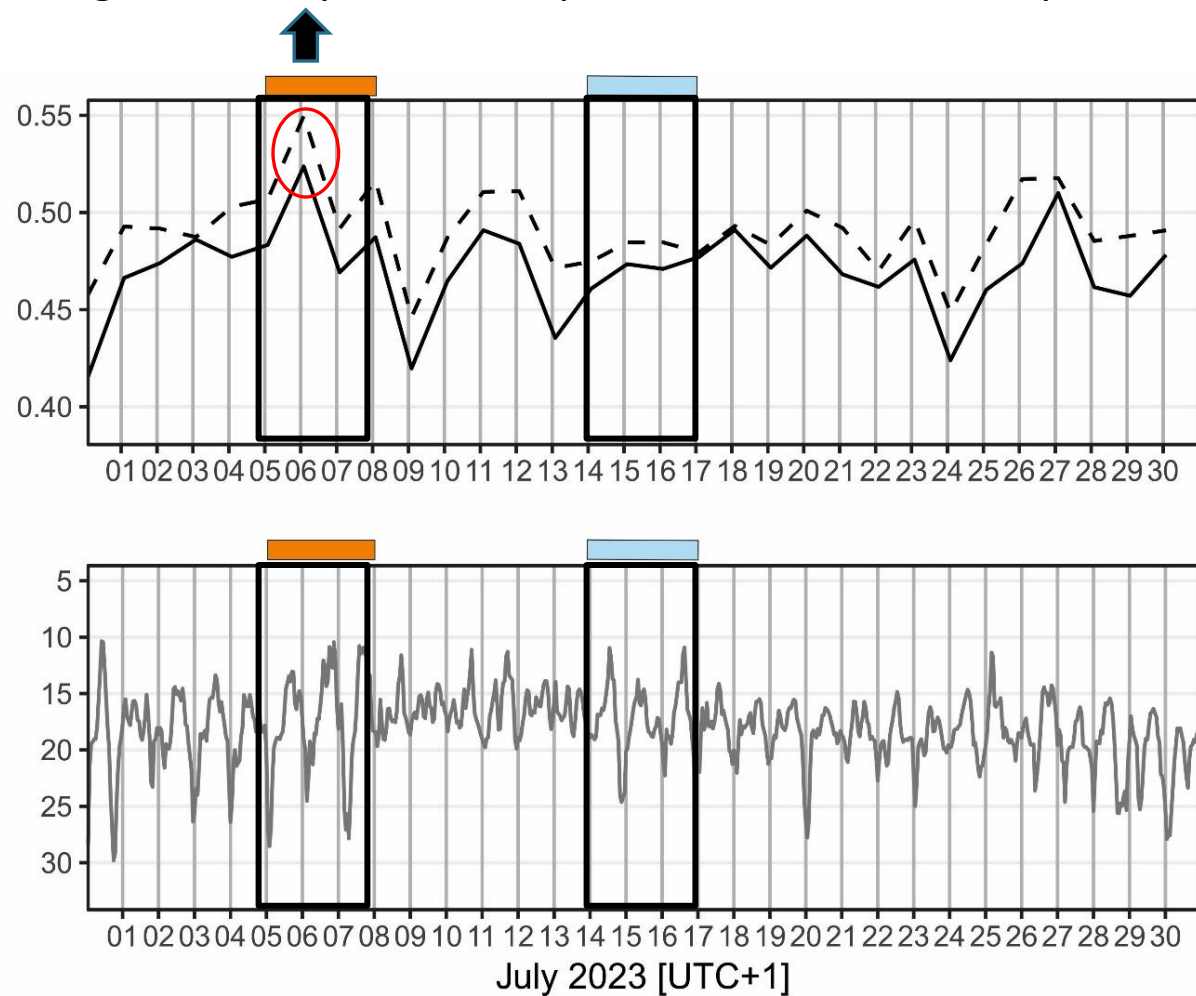
10 - 14 km







Peaking on 6th July, but our experiment was set two days later



- Spatial heterogeneity: Lastovo shows **uneven NPP distribution**, with the highest values in the **southern region**, potentially driven by the phase relationship between light and ITWs (Matek, 2025, in prep.; Jacobsen, 2025).
- Satellite observations: NPP and chlorophyll a data **show limited response to ITWs**, except for a notable NPP peak in July 2023 coinciding with an intense ITW episode

Future Steps

- Upscale spatial resolution of primary production to 1 km
- Integrate *in situ* PAR, chl a , and temperature profiles in the primary production model



Thank you for your attention!

Special thanks to the ISLAND project team who made this research possible, and Croatian Science Foundation for funding the project.

