



*Supplement of*

**Subsurface oxygen maximum in oligotrophic marine ecosystems:  
mapping the interaction between physical and biogeochemical processes**

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## Equations

- Oxygen regulating factor to switch between aerobic and anaerobic conditions for bacterioplankton:

$$f_B^{O_2} = \frac{O_2^3}{O_2^3 + h_B^3} \quad (S1)$$

in which  $h_B^{O_2}$  is the oxygen concentration at which metabolic functionalities are halved.

- Nitrification rate:

$$\left. \frac{dA}{dt} \right|^{nit} = \Lambda_A^{nit} f_n^T \frac{O_2}{O_2 + h_{O_2}} A \quad (S2)$$

in which  $\Lambda_A^{nit}$  is the constant specific nitrification rate,  $h_{O_2}$  the half saturation oxygen concentration and  $f_n^T$  the temperature regulating factor expressed as:

$$f_n^T = Q_{10,n}^{\frac{T-10}{10}} \quad (S3)$$

where  $Q_{10,n}$  is the characteristic coefficient for nitrification.

- Reoxidation rate:

$$\left. \frac{dR_{eq}}{dt} \right|^{reox} = \Lambda_{R_{eq}}^{reox} \frac{O_2}{O_2 + h_{O_2}} R_{eq} \quad (S4)$$

in which  $\Lambda_{R_{eq}}^{reox}$  is the constant specific daily reoxidation rate and  $h_{O_2}$  the half saturation oxygen concentration.

## Tables

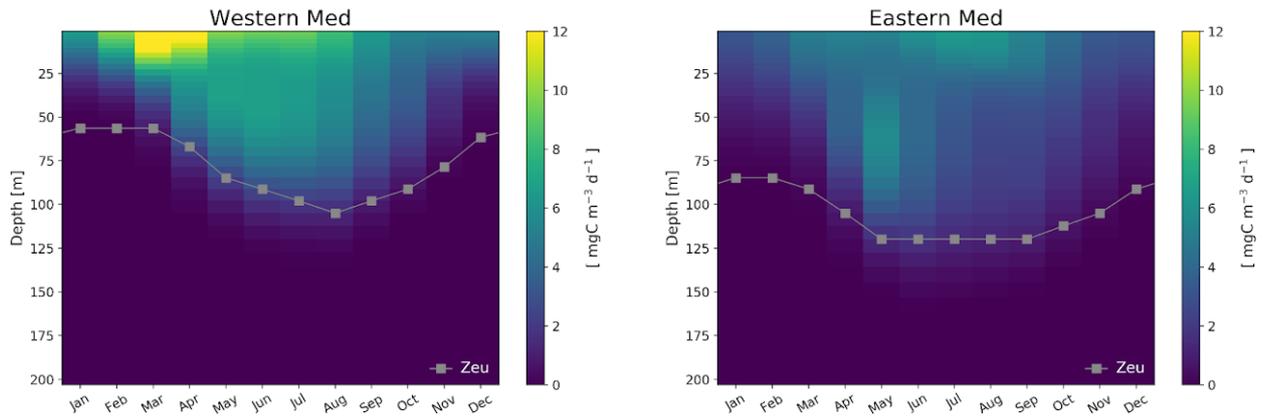
Symbol	Units	Value	Description
$\Omega_c^{O_2}$	mmolO <sub>2</sub> mgC <sup>-1</sup>	1/12	Stoichiometric coefficient for production and respiration
$\Omega_n^{O_2}$	mmolO <sub>2</sub> mmolN <sup>-1</sup>	2	Stoichiometric coefficient for nitrification reaction
$\Omega_r^{O_2}$	mmolO <sub>2</sub> (mmolHS <sup>-</sup> ) <sup>-1</sup>	2	Stoichiometric coefficient for anaerobic reaction
$h_{O_2}$	mmolO <sub>2</sub> m <sup>-3</sup>	10	Half saturation for nitrification and reoxidation
$h_B^{O_2}$	mmolO <sub>2</sub> m <sup>-3</sup>	30	Half saturation constant for oxygen limitation (bacterioplankton)
$\Lambda_A^{nit}$	d <sup>-1</sup>	0.01	Specific nitrification rate at 10 °C
$Q_{10,n}$	-	2.367	Characteristic Q10 factor for nitrification
$\Lambda_{Req}^{reox}$	d <sup>-1</sup>	0.05	Specific daily reoxidation rate of reduction equivalents

ST1: Model parameters defined in Sect. 2.1.

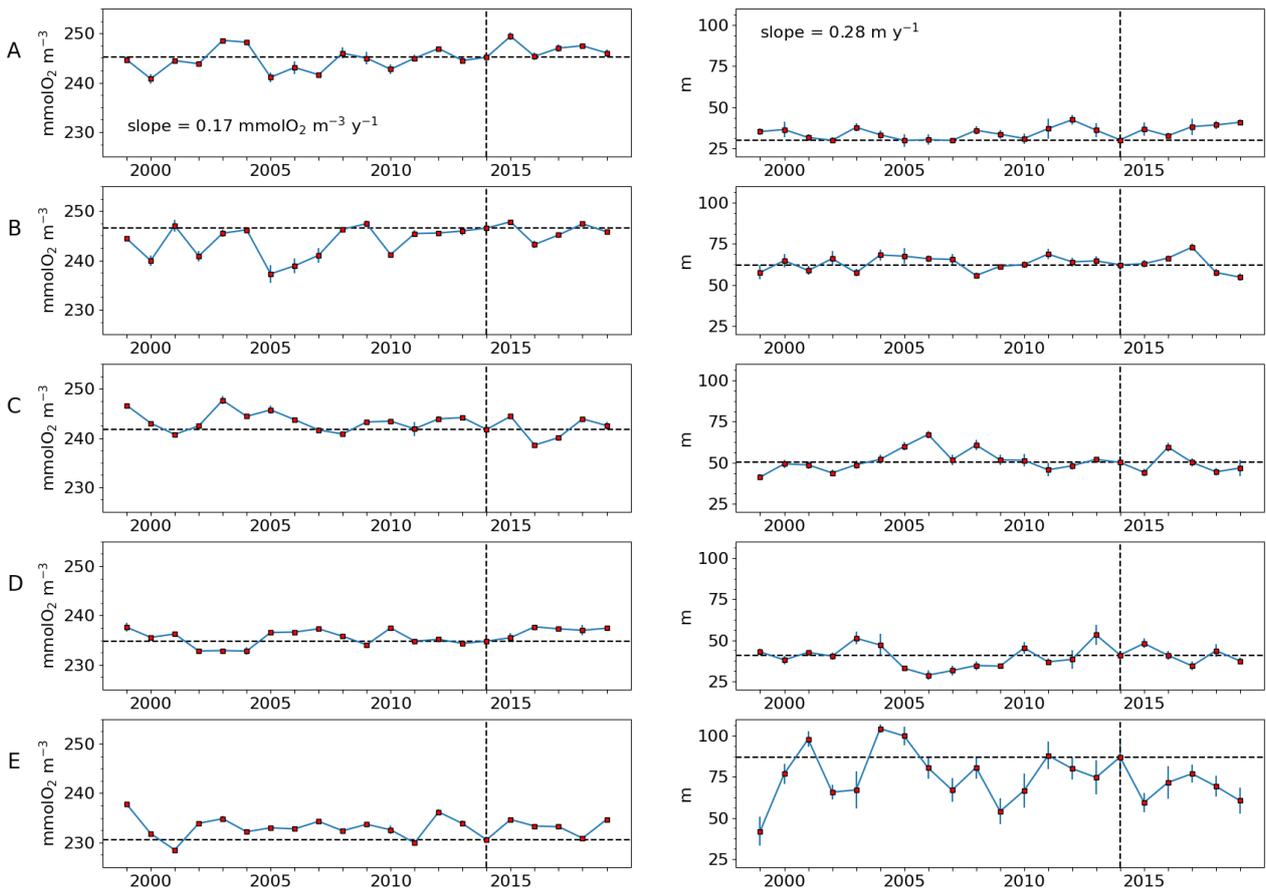
	Emodnet_int	BGC-Argo	Stations		
	No. O <sub>2</sub> profiles	No. O <sub>2</sub> profiles	No. GPP profiles	No. CR profiles	No. NCP profiles
alb	6	x	x	x	x
swm	34	602	1	1	2
nwm	1327	2623	(7)	8 (7)	(7)
tyr	147	587	2	2	3
adr	14	179	x	x	x
aeg	232	x	1	1	1
ion	315	897	7	7	8
lev	338	949	4	4	4

ST2: Number of profiles of O<sub>2</sub> and GPP, CR and NCP used in the validation procedure (with references for the observations indicated in the text). The time periods for the observations are: 1999-2016 for Emodnet\_int and 2013-2019 for BGC-Argo float oxygen concentration (first and second column, respectively); 1999-2000, 2002-2003, 2006-2008, 2017 for planktonic metabolism observations (last three columns, where parentheses indicate coastal data).

## Figures



**Figure S1:** Hovmöller plot of net primary production in western (left) and eastern Mediterranean (right) in 1999-2019 reanalysis simulation. Gray squares represent the euphotic depth (Ze), i.e. the depth at which the modelled PAR is 1% of its surface value.



**Figure S2:** Spatial mean of the 1999-2019 annual summer values of the SOM concentration (first column) and depth (second column) within the A-E areas (rows) indicated in Fig. 6b of the manuscript. For each year, vertical bars indicate the spatial standard deviation. Trend significance has been evaluated by Mann-Kendall test ( $p=0.05$ ) and the slope computed by Theil-Sen method has been provided in the plot in case of significant trend. Horizontal and vertical dashed lines refer to the year 2014 extensively discussed in the text.

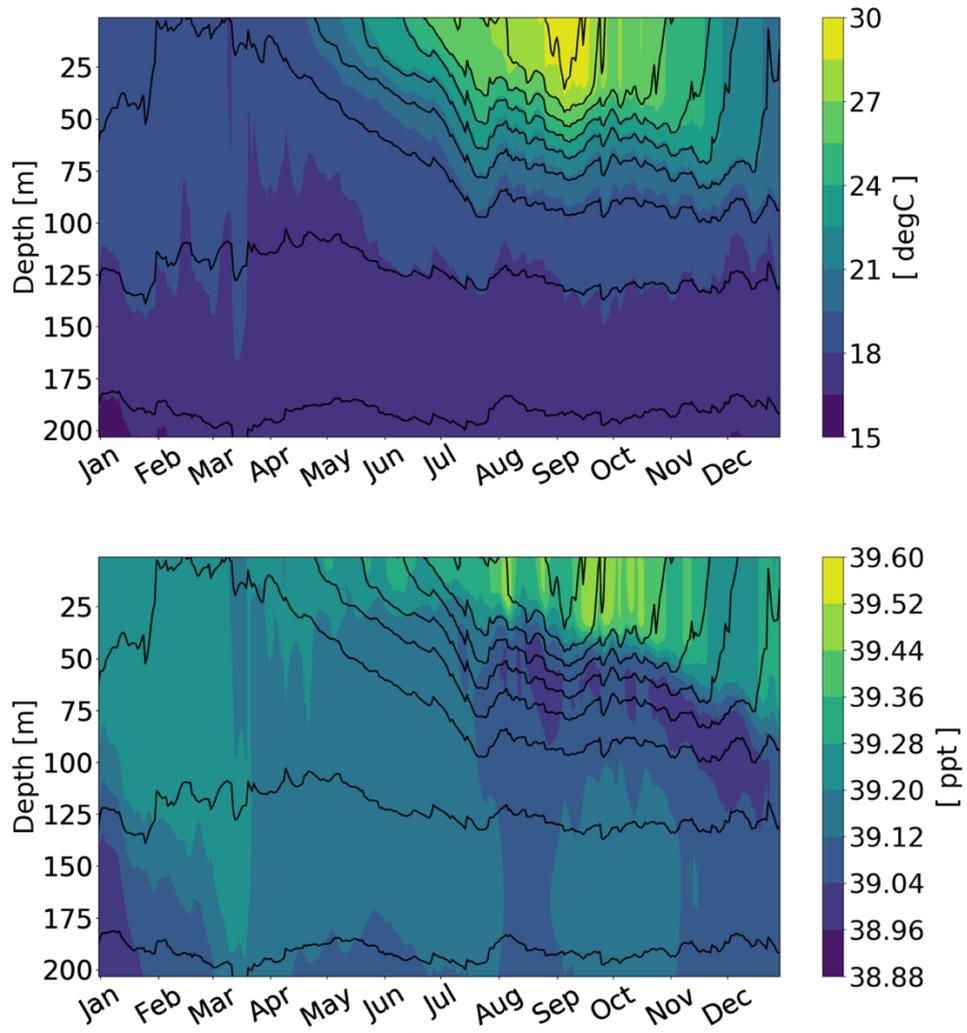
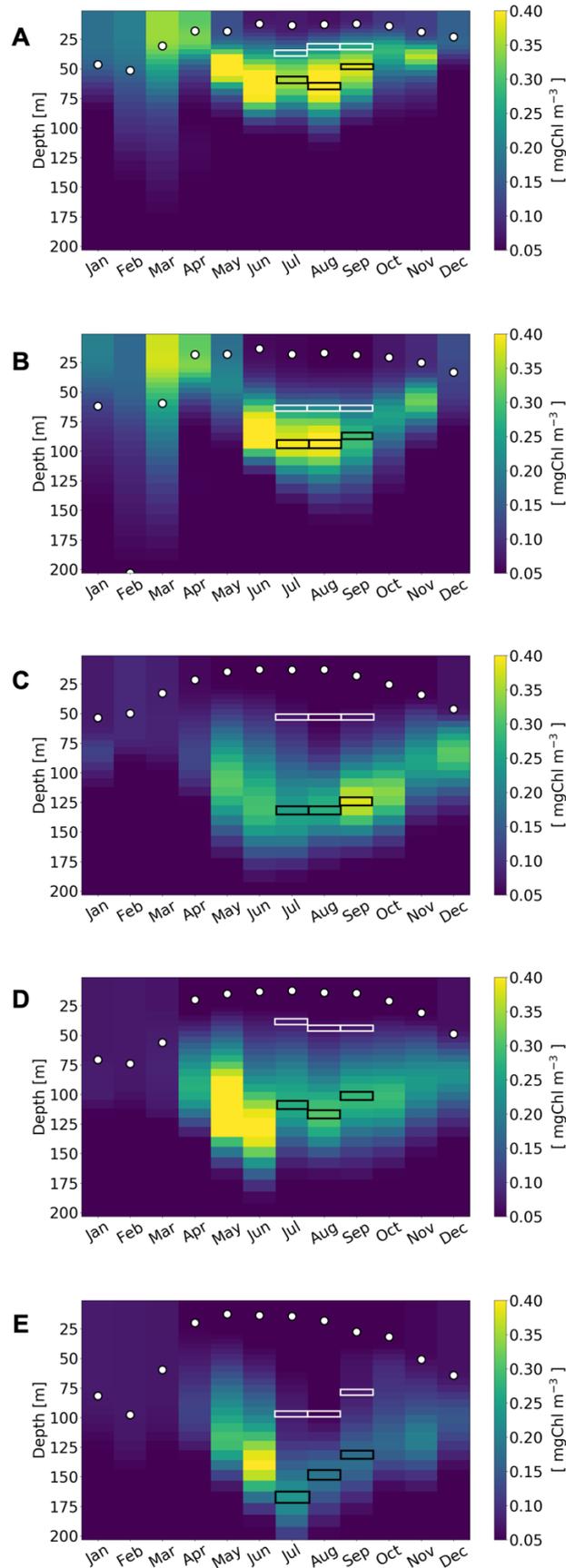


Figure S3: Hovmöller plot of model-derived temperature (top) and salinity (down), with density contours (in black) in E area (Fig. 7) in 2014.



**Figure S4: Hovmöller plot of mean model-derived monthly chlorophyll concentration in the Mediterranean areas indicated in Fig. 6 in 2014. White circles indicate the depth of the mixed layer, black and white rectangles the depth of DCM and SOM in the summer period (JAS months), respectively.**