Supplementary Material

Equations

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

$$f_B^{O_2} = \frac{o_2^3}{o_2^3 + h_B^{O_2}} \quad (S1)$$

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 Λ_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:

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

in which Λ_{Req}^{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$_2$ mgC^{-1}	12	Stoichiometric coefficient for production and respiration
$\Omega_n^{O_2}$	mmolO$_2$ mmolN^{-1}	2	Stoichiometric coefficient for nitrification reaction
$\Omega_r^{O_2}$	mmolO$_2$ (mmolHS$^-$)$^{-1}$	2	Stoichiometric coefficient for anaerobic reaction
h_{O_2}	mmolO$_2$ m^{-3}	10	Half saturation for nitrification and reoxidation
$h_B^{O_2}$	mmolO$_2$ m^{-3}	30	Half saturation constant for oxygen limitation (bacterioplankton)
Λ_A^{nit}	d^{-1}	0.01	Specific nitrification rate at 10 °C
$Q_{10,n}$	-	2.367	Characteristic Q10 factor for nitrification
$\Lambda_{R_{eq}}^{reox}$	d^{-1}	0.05	Specific daily reoxidation rate of reduction equivalents

ST1: Model parameters defined in Sect. 2.1.

	Emodnet_int	BGC-Argo	Stations		
	No. O$_2$ profiles	No. O$_2$ 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$_2$ 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
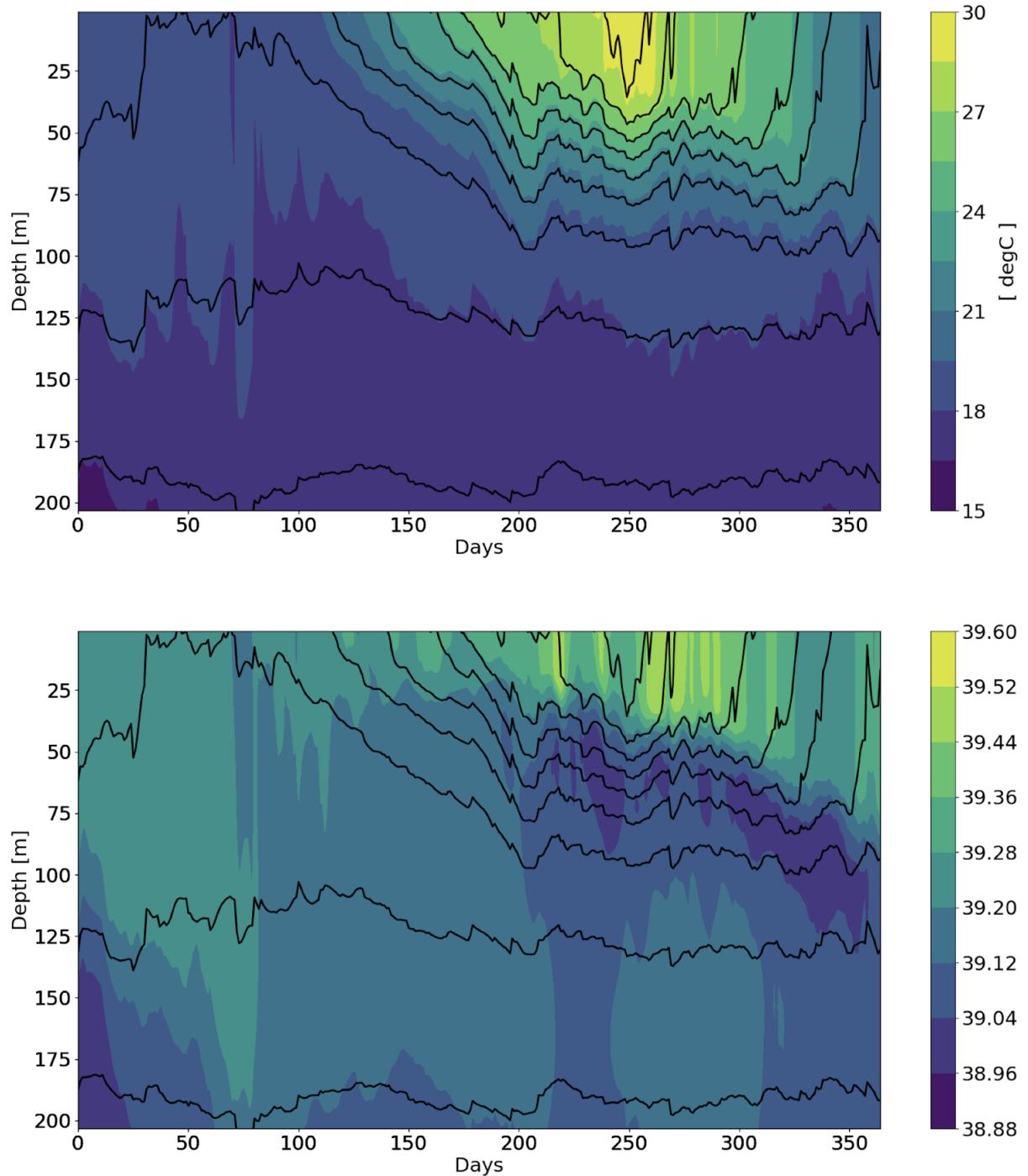
Figure S1: Hovmöller plot of model-derived temperature (top) and salinity (down), with density contours (in black) in E area (Fig. 7) in 2014.
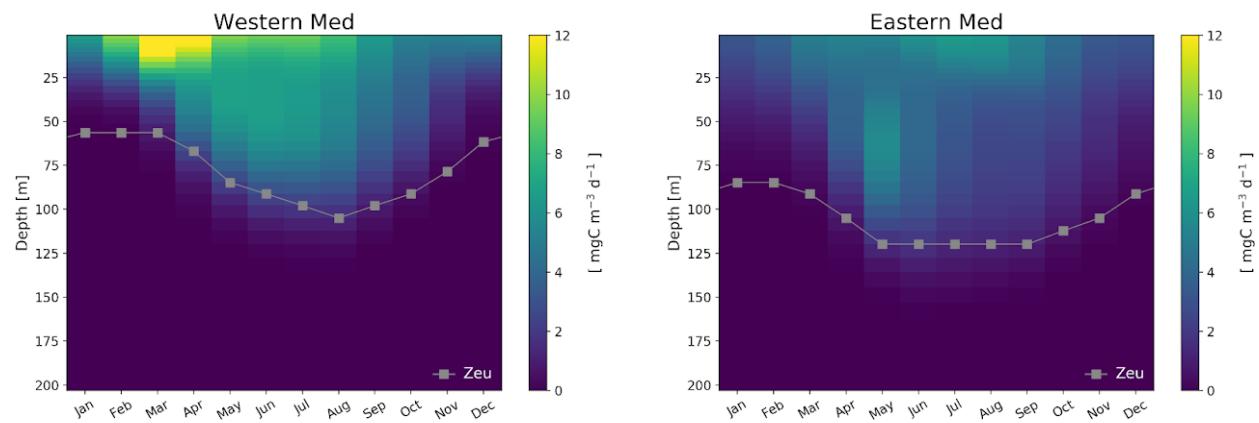
Figure S2: Hovmöller plot of net community production in western (left) and eastern Mediterranean (right) in 1999-2019 reanalysis simulation. Gray squares represent the euphotic depth (Zeu), i.e. the depth at which the modelled PAR is 1% of its surface value.
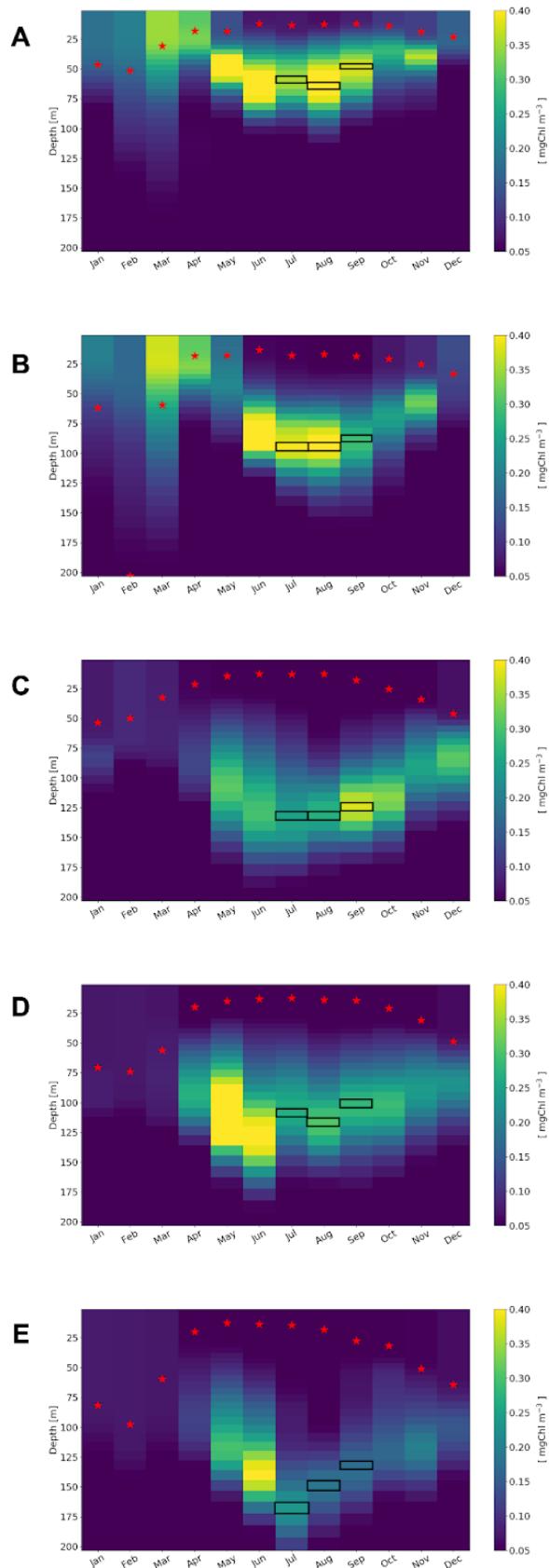
Figure S3: Hovmöller plot of mean model-derived monthly chlorophyll concentration in the Mediterranean sites indicated in Fig. 7 in 2014. Red asterisks represent the mixed layer depth, black rectangles the maximum value along the vertical direction in the summer period (JAS months).