

Supplementary material

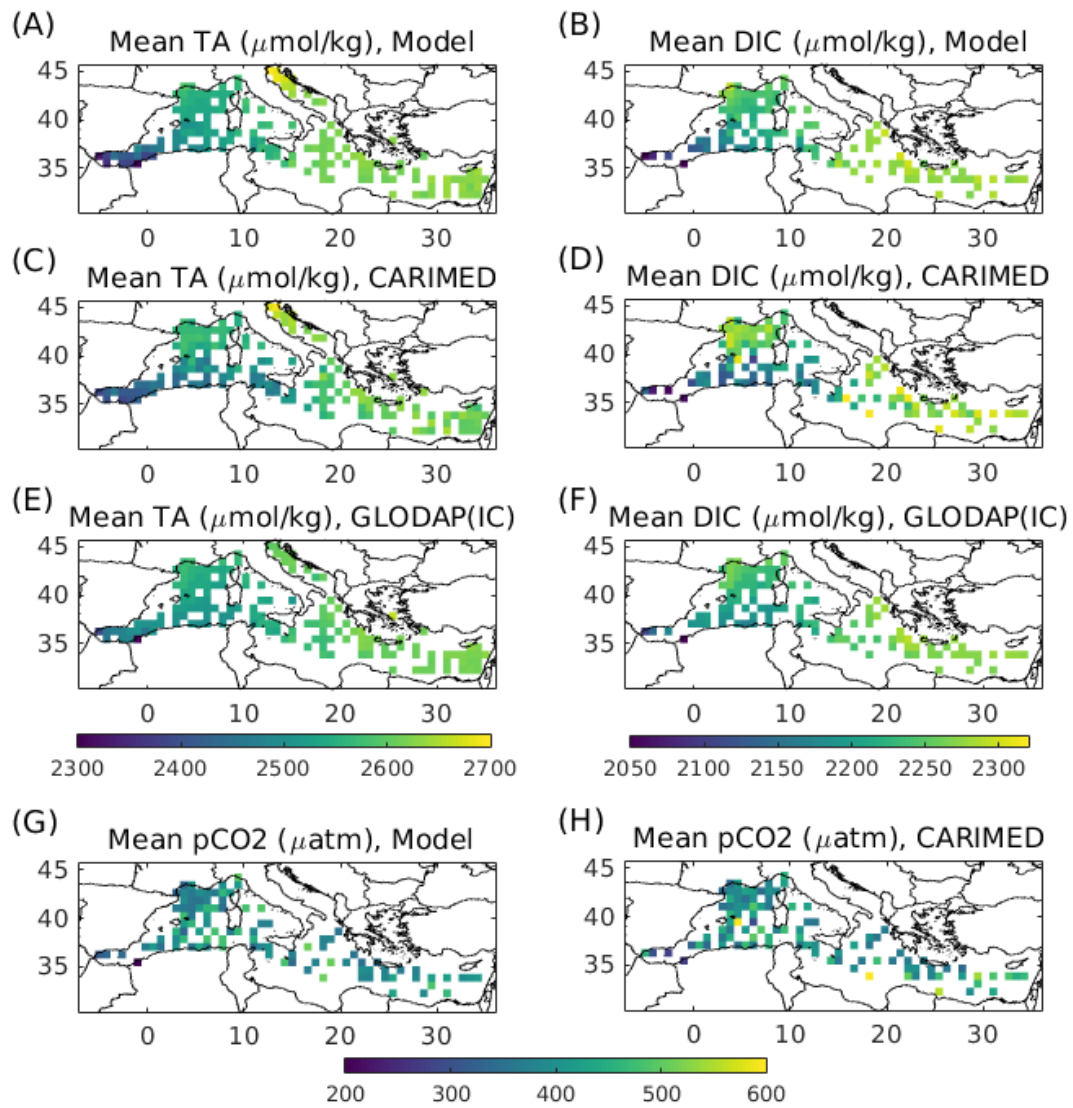


Figure S.1: Mean (2010-2022) simulated surface (A) total alkalinity ($\mu\text{mol/kg}$, TA), (B) dissolved inorganic carbon ($\mu\text{mol/kg}$, DIC) and (G) pCO_2 (μatm), against CARIMED data for (C) total alkalinity ($\mu\text{mol/kg}$, TA), (D) dissolved inorganic carbon ($\mu\text{mol/kg}$, DIC) and (H) pCO_2 (μatm). Initial model TA/DIC (GLODAP-IC) are also shown in (E), (F). Model values are extracted on the same locations and seasons with the data.

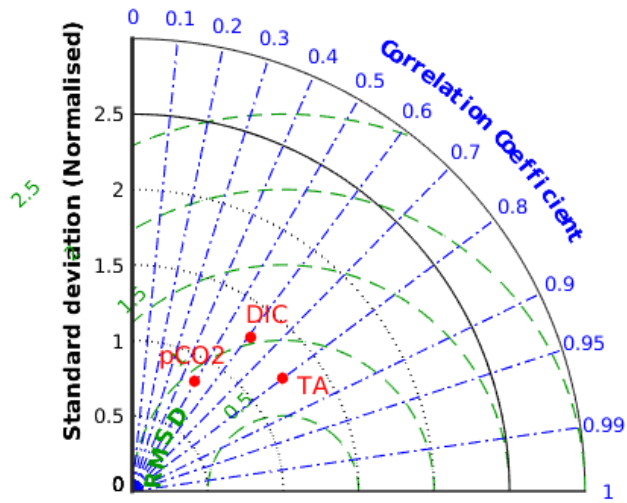


Figure S.2: Taylor diagram of model simulated mean (2010-2022) surface DIC, TA and pCO₂ against CARIMED in situ data (same locations and seasons) (see Figure S.1).

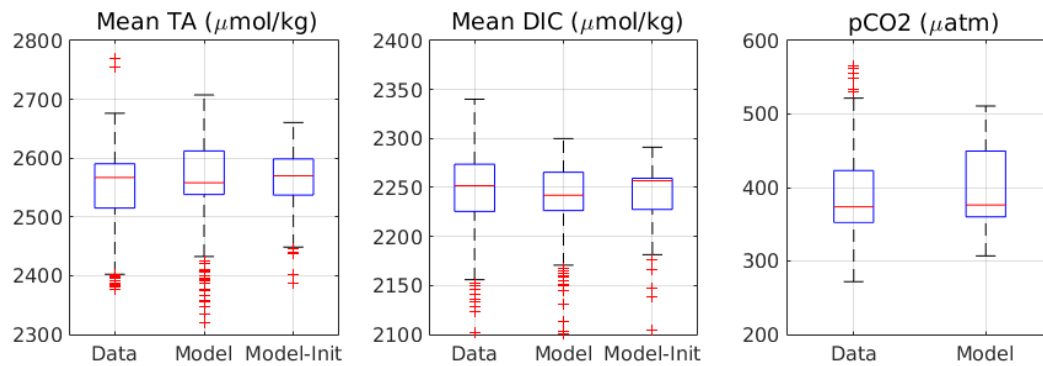


Figure S.3: Boxplots of model simulated mean (2010-2022) TA ($\mu\text{mol}/\text{kg}$, left), DIC ($\mu\text{mol}/\text{kg}$, middle) and pCO₂ (μatm , right) against CARIMED in situ data (same locations and seasons) (see Figure S.1).

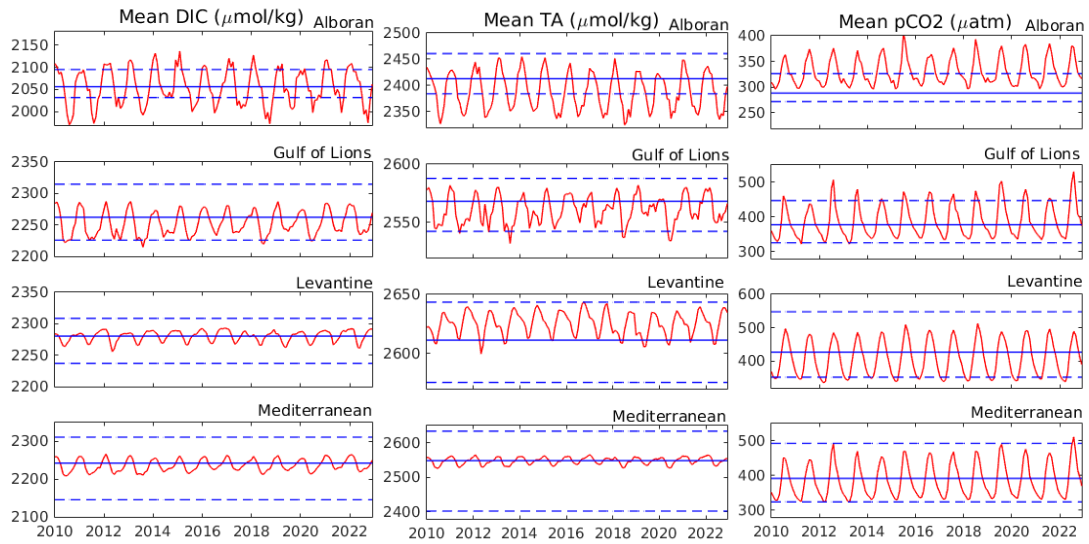


Figure S.4: Model simulated DIC ($\mu\text{mol/kg}$, left), TA ($\mu\text{mol/kg}$, middle) and pCO_2 (μatm , right), averaged (taking only data point locations) over Alboran ($0.5\text{-}5.3^\circ\text{W}$, $35\text{-}38^\circ\text{N}$), Gulf of Lions ($3\text{-}6^\circ\text{E}$, $40.8\text{-}43^\circ\text{N}$), Levantine basin ($22\text{-}36^\circ\text{E}$, $30\text{-}35^\circ\text{N}$) and basin-scale, against CARIMED data mean (blue solid line), 5% and 95% percentiles (blue dash lines) in the same areas.

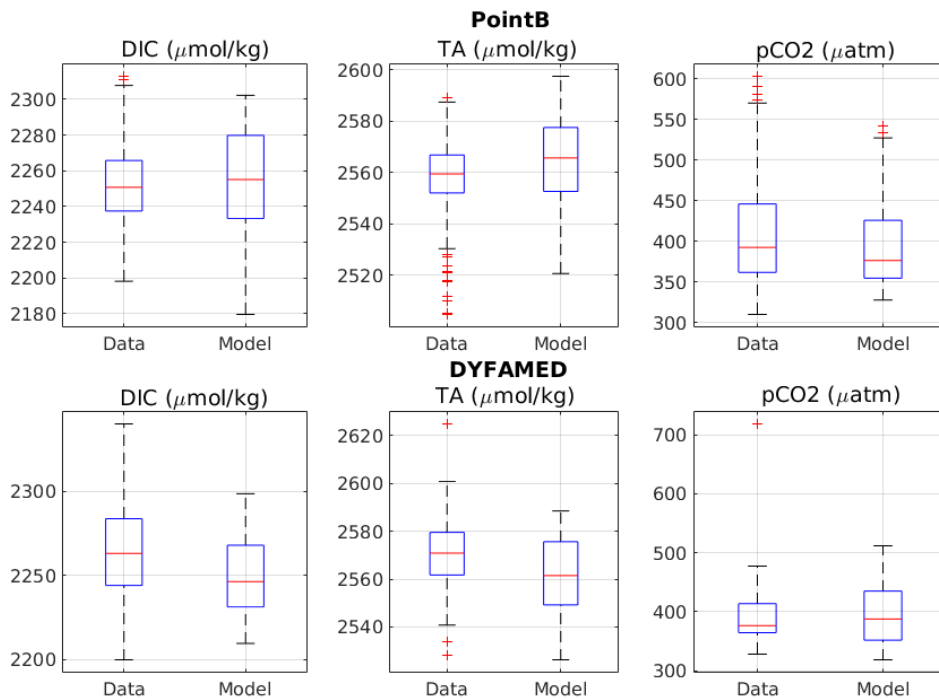


Figure S.5: Boxplots of model (Model) simulated DIC ($\mu\text{mol/kg}$, left), TA ($\mu\text{mol/kg}$, middle), and pCO_2 (μatm , right), against in situ data (Data) at DYFAMED (bottom) and Villefranche-PointB (top) sites (see Figure 3). Median (red line) and 25th/75th percentiles are indicated.

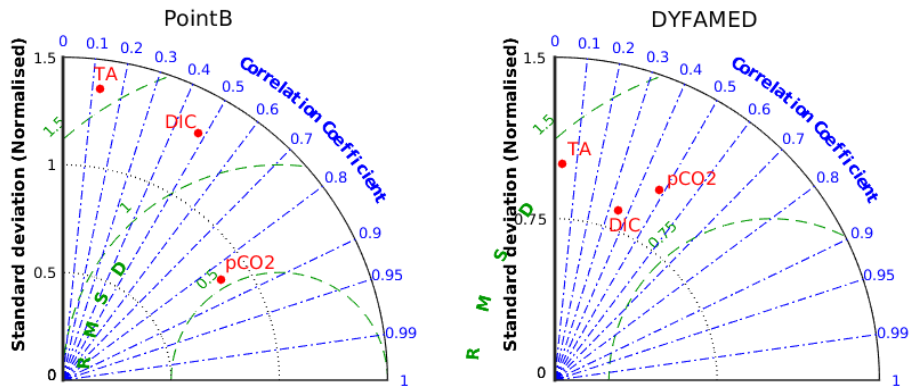


Figure S.6: Taylor diagram of model simulated DIC, TA, and pCO₂, against in situ data at DYFAMED (right) and Villefranche-PointB (left) sites (see Figure 3).

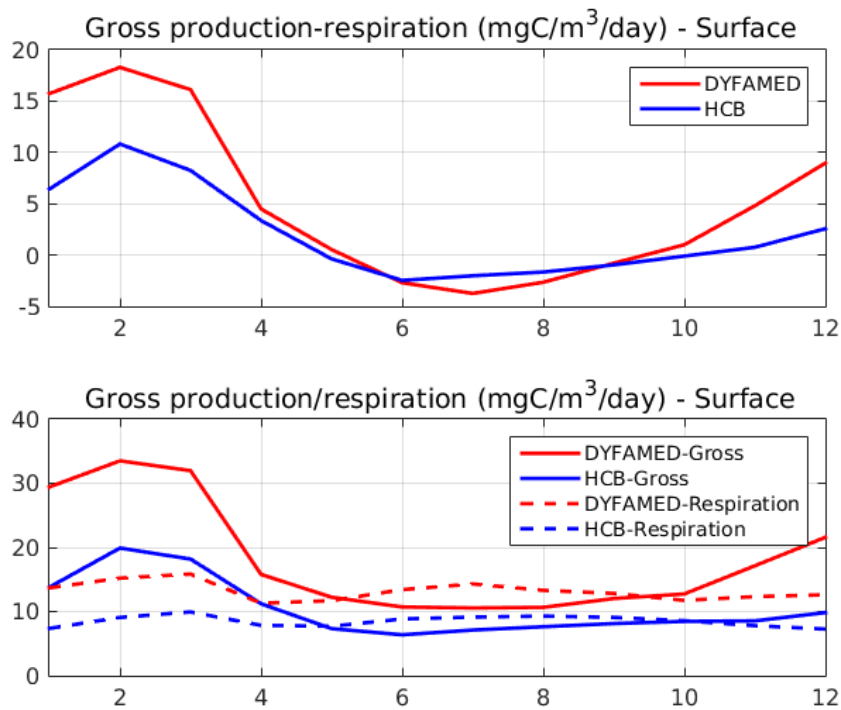


Figure S.7: Simulated mean (2010-2022) monthly climatology of surface net CO₂ uptake (gross primary production-community respiration, mgC/m³/day, top), as well as gross production (mgC/m³/day, continuous lines, bottom) and community respiration (mgC/m³/day, dashed lines, bottom) at DYFAMED (red lines) and HCB (blue lines).

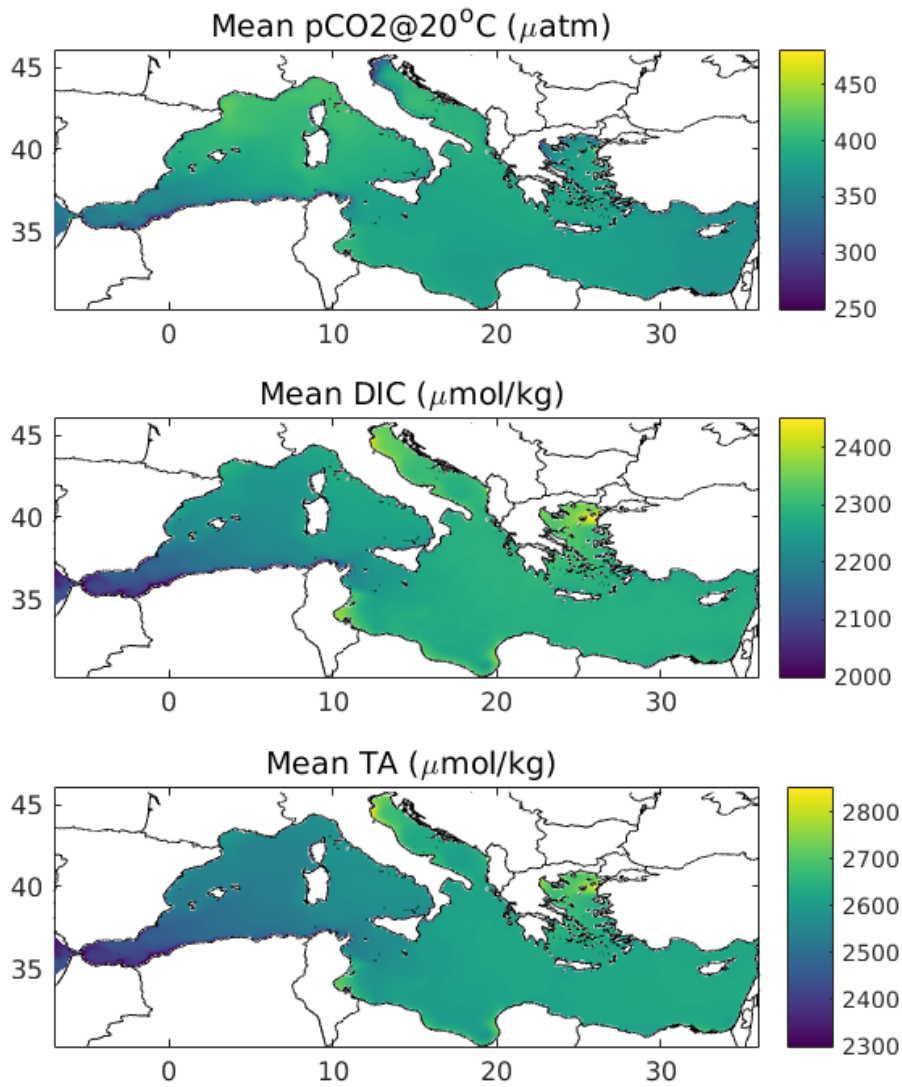


Figure S.8: Simulated mean (2010-2022) TA ($\mu mol/kg$, bottom), DIC ($\mu mol/kg$, middle) and $pCO_2@20^\circ C$ (μatm , top).

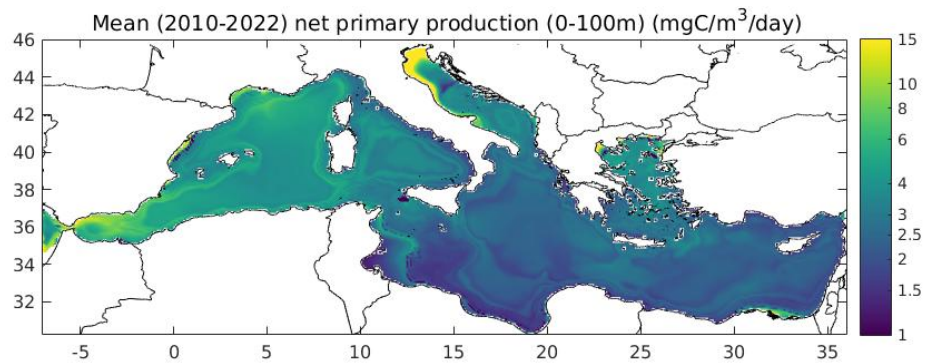


Figure S.9: Simulated mean (2010-2022) net primary production (0-100m average) ($mgC/m^3/day$).

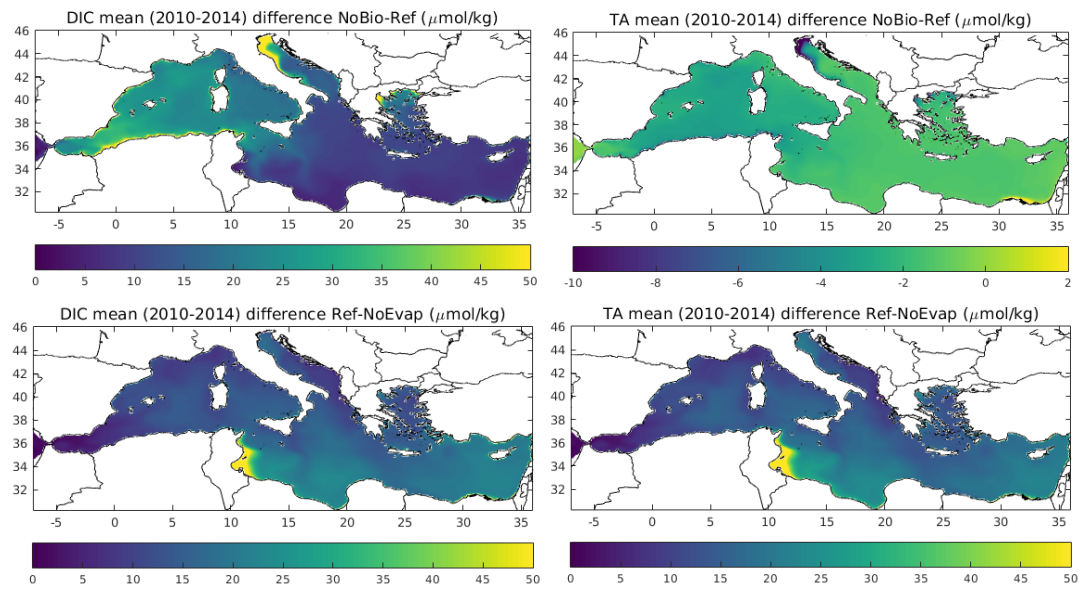


Figure S.10: Simulated mean (2010-2014) difference of TA ($\mu\text{mol/kg}$, right), and DIC ($\mu\text{mol/kg}$, left), between reference simulation and the simulation without the effect of net evaporation (Ref-NoEvap, bottom) and without the effect of biology (NoBio-Ref, top).

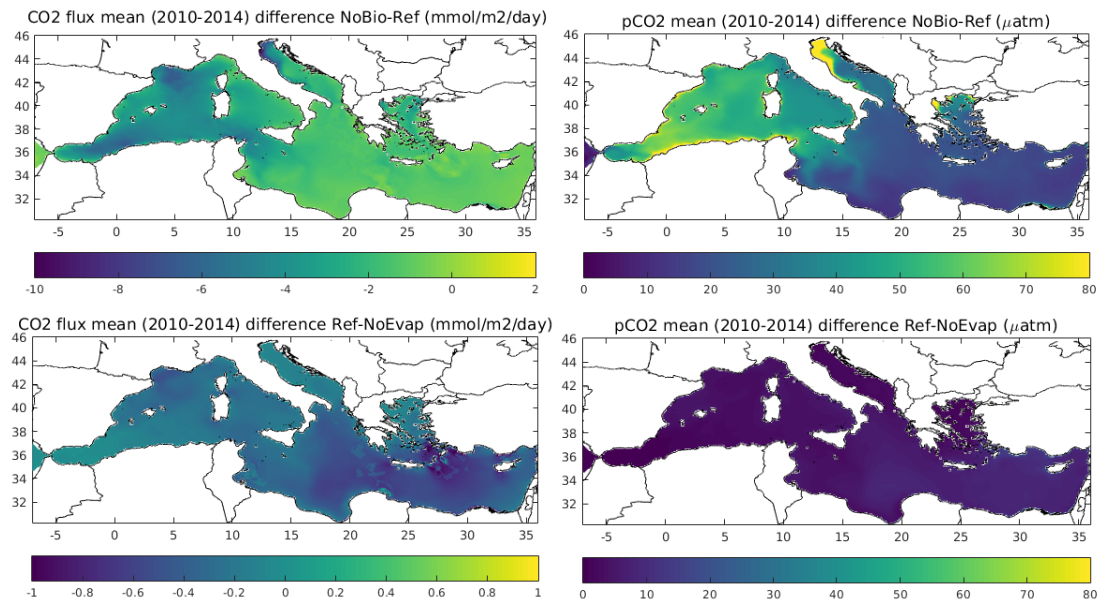


Figure S.11: Simulated mean (2010-2014) difference of pCO_2 (μatm , right) and CO_2 air-sea flux ($\text{mmol/m}^2/\text{day}$, left), between the reference simulation and the simulation without the effect of net evaporation (Ref-NoEvap, bottom) and without the effect of biology (NoBio-Ref, top).

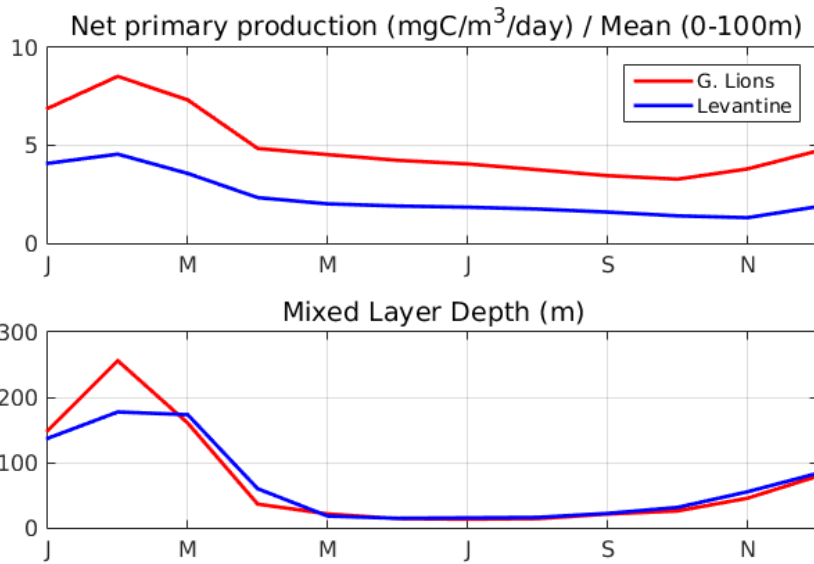


Figure S.12: Mean monthly climatology of net primary production mean 0-100m (top, mgC/m³/day) and mixed layer depth (MLD) (bottom, m), averaged in the Gulf of Lions (3-6°E, 40.8-43°N) and Levantine basin (22-36°E, 30-35°N). MLD has been calculated following Monterey and Levitus (1997).

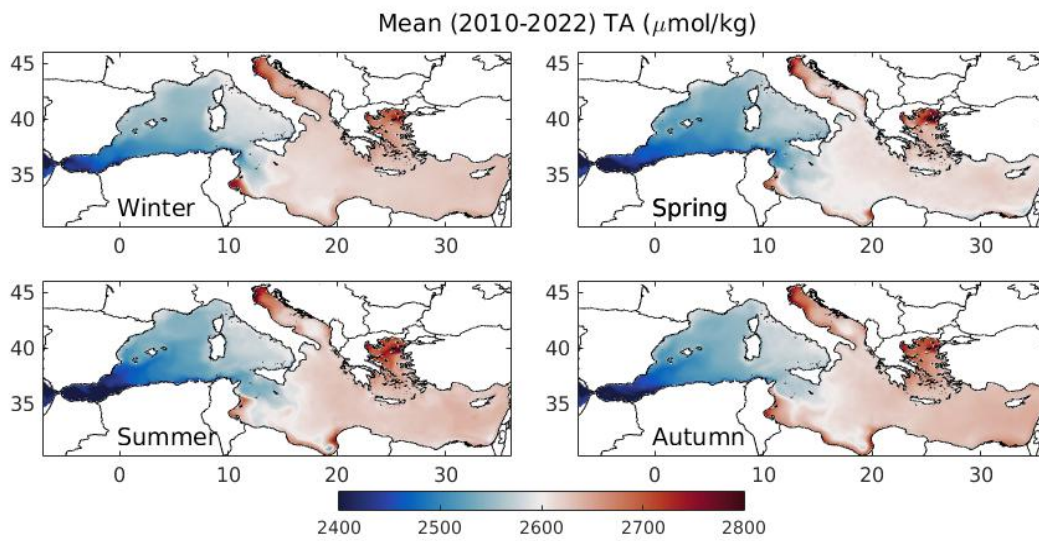


Figure S.13: Simulated surface seasonal mean (2010-2022) total alkalinity (TA, μmol/kg).

Mean (2010-2017) SSH (m)

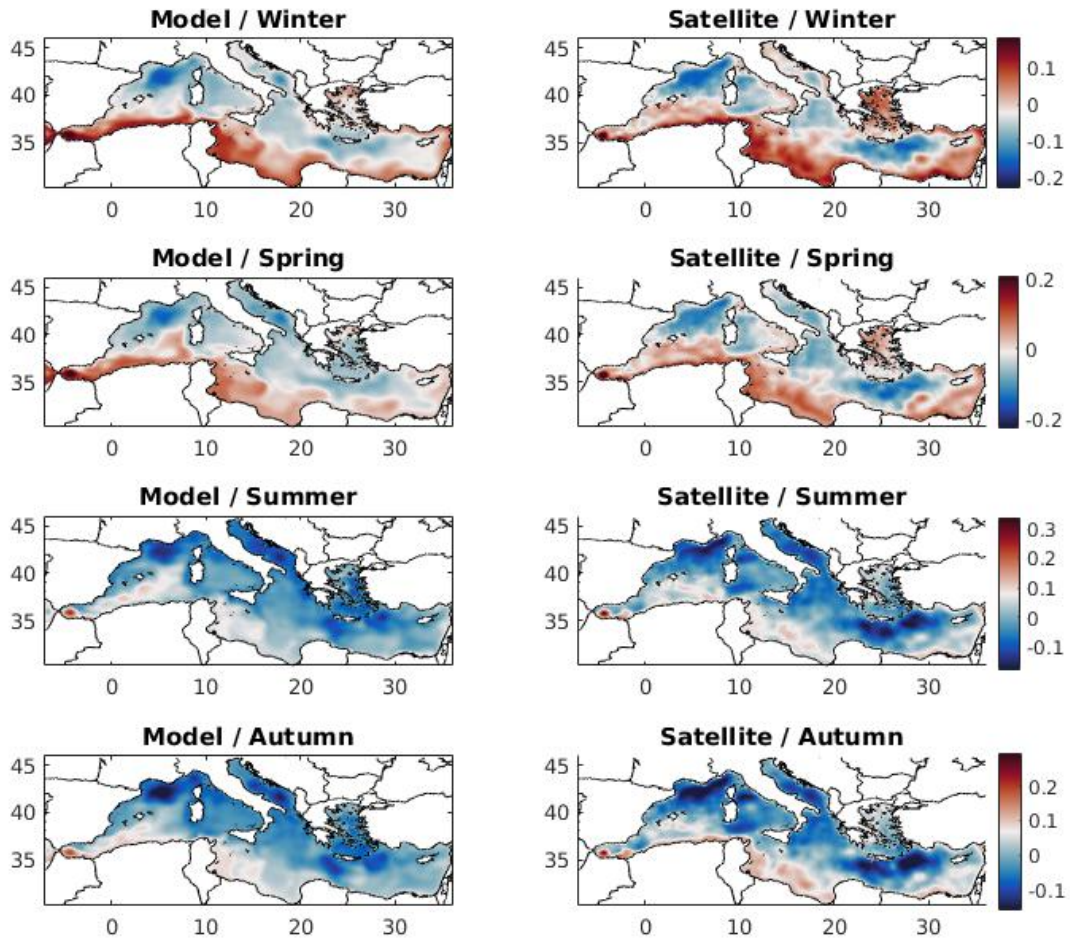


Figure S.14: Simulated seasonal mean (2010-2017) sea surface height (m), against satellite altimetry data (resolution 0.125°), obtained from the European Copernicus data base (<http://marine.copernicus.eu/>).

Mean SSS (2010-2019)

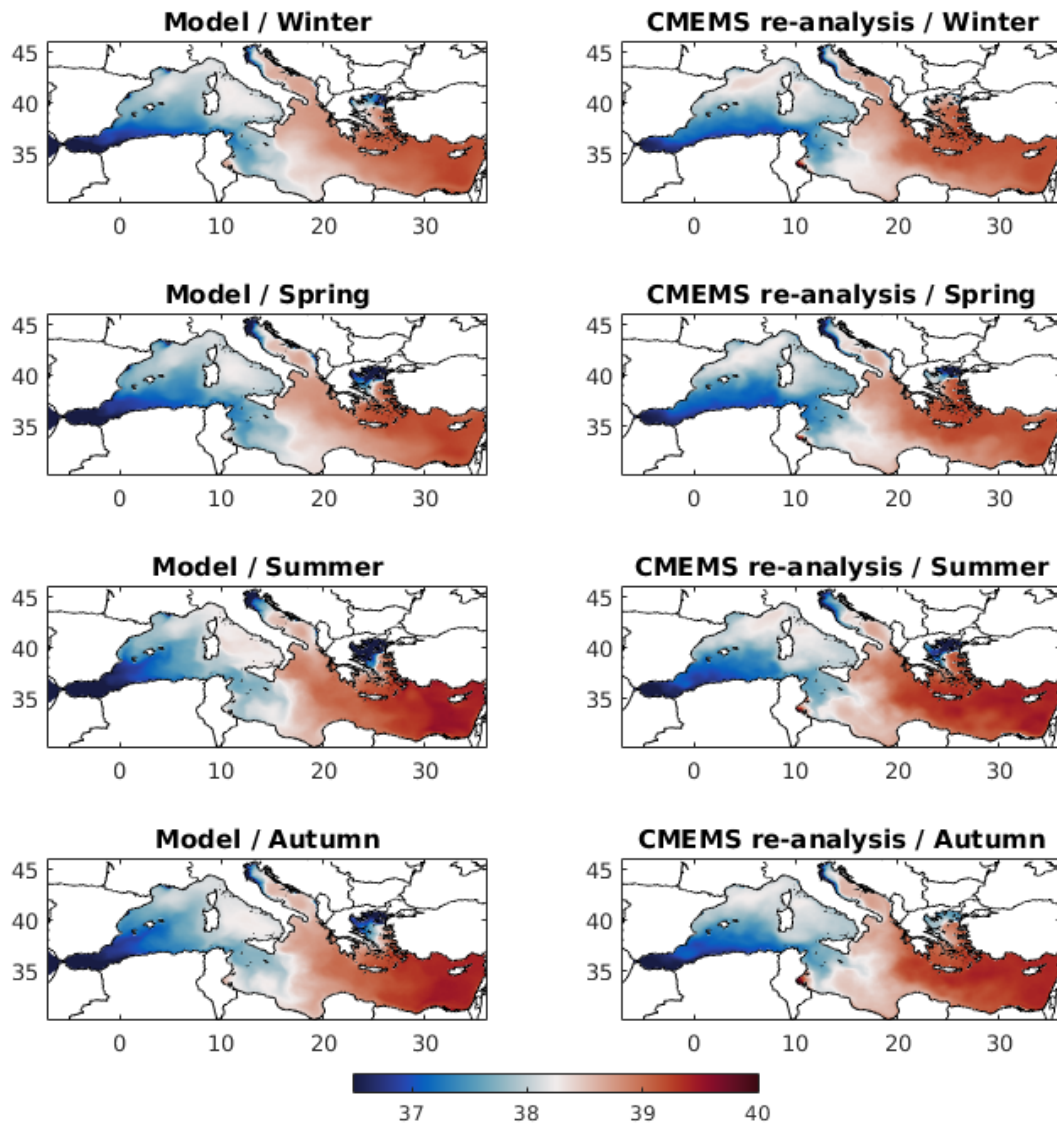


Figure S.15: Seasonal mean (2010-2019) simulated (left), against CMEMS re-analysis (right) surface salinity.

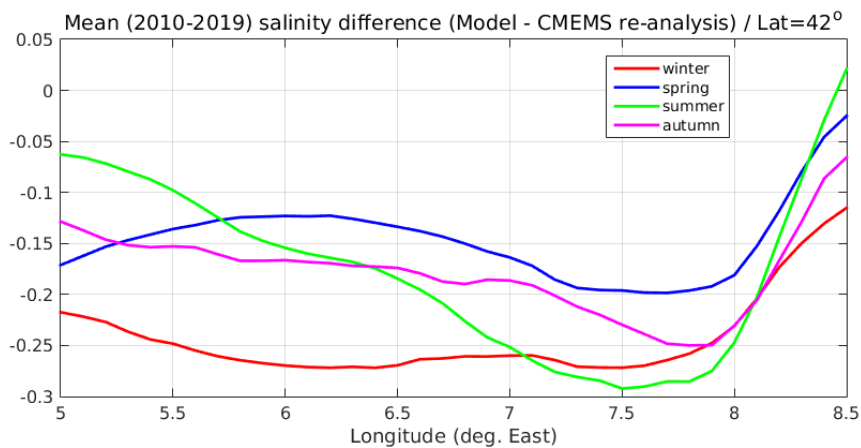


Figure S.16: Seasonal mean (2010-2019) difference between simulated and CMEMS re-analysis surface salinity along Lat=42°N.

Chl-a (mg/m^3) mean (2010-2019)

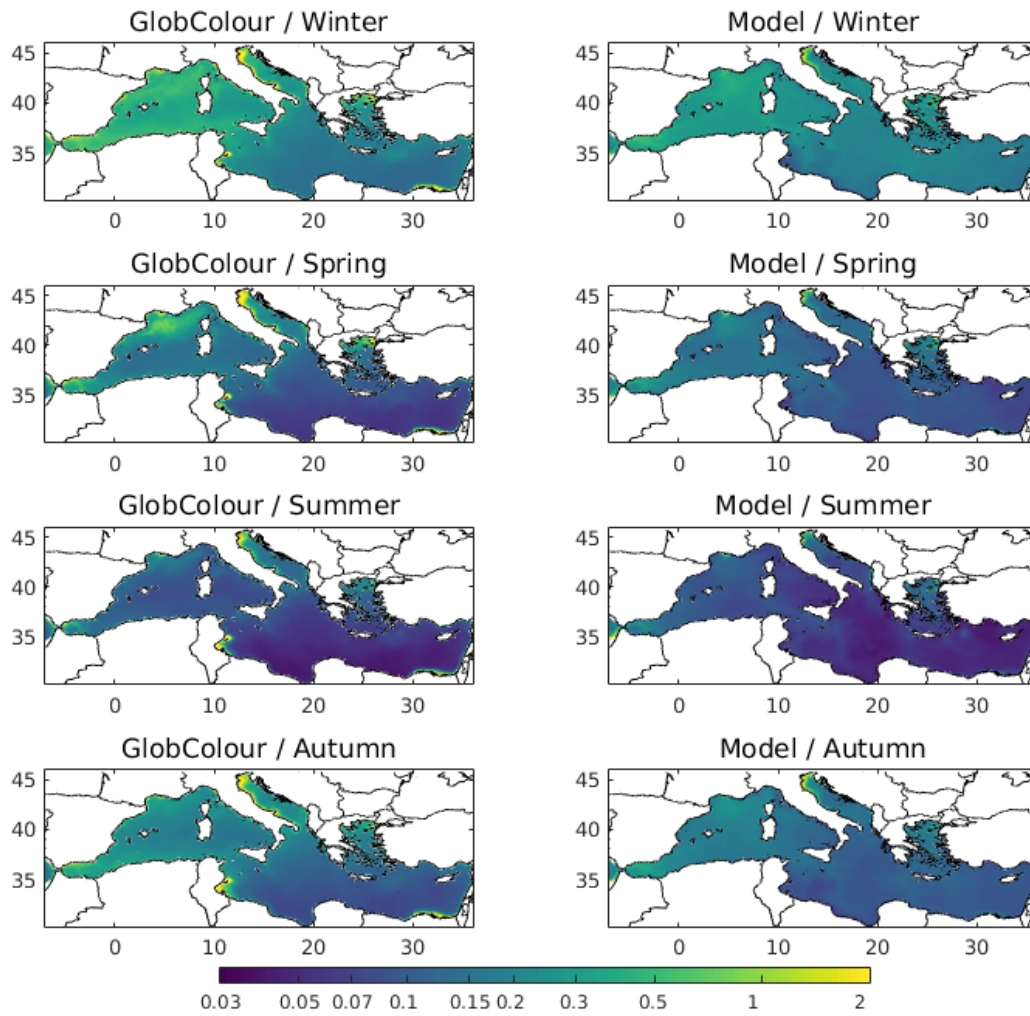


Figure S.17: Simulated (right) seasonal mean (2010-2019) against satellite Globcolour (~4 km resolution, www.globcolour.info) (left) surface Chl-a (mg/m^3).

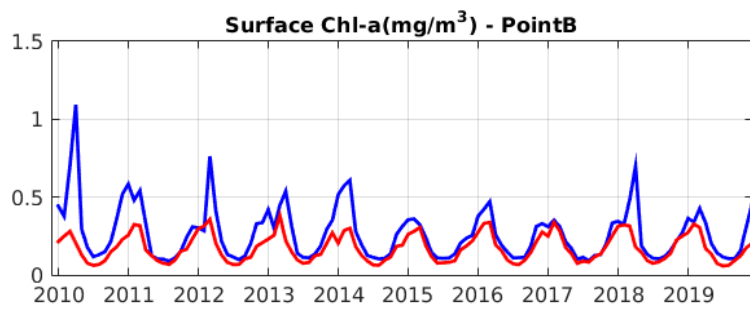
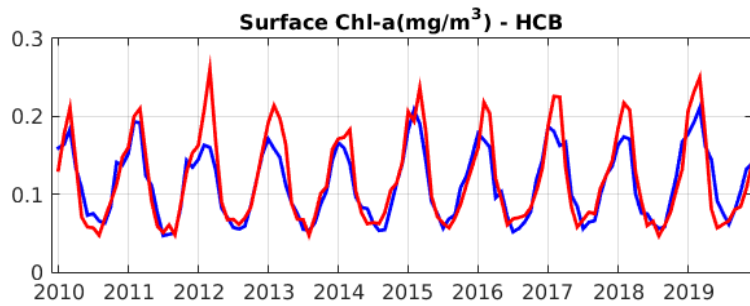
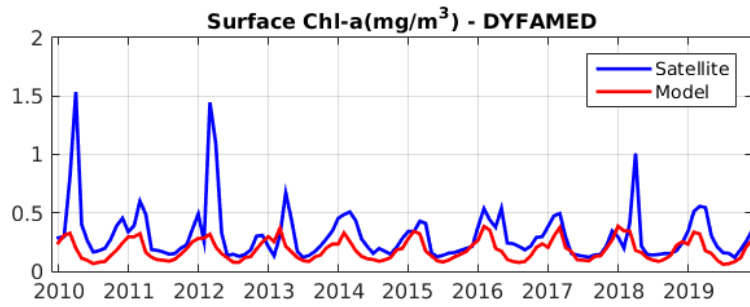


Figure S.18: Simulated (blue line) against satellite Globcolour (red line, www.globcolour.info) surface Chl-a (mg/m^3) at DYFAMED, Villefranche Point-B and HCB sites.

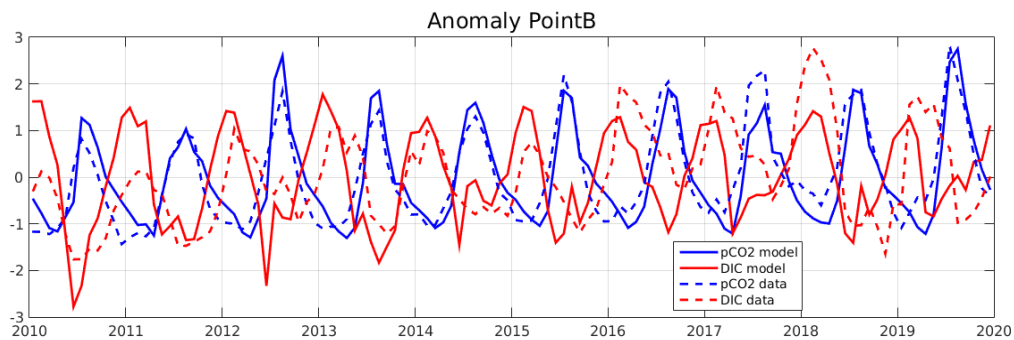
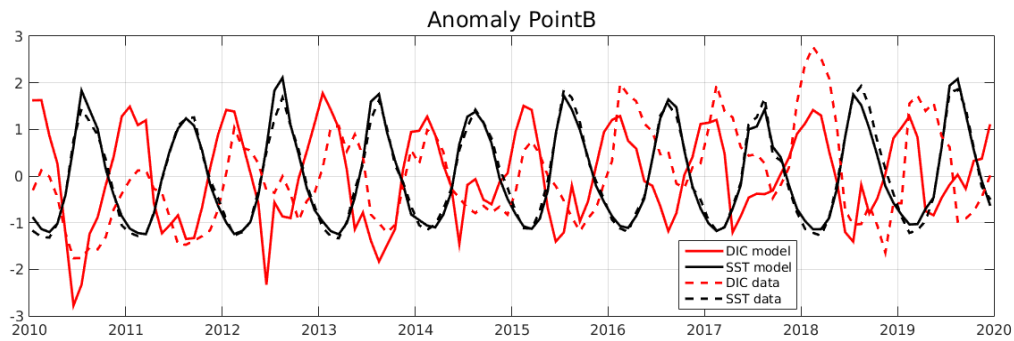


Figure S.19: Anomaly ($\text{var}-\text{mean}(\text{var})/\text{std}(\text{var})$) of model (solid lines) SST/DIC (top) and DIC/ pCO_2 (bottom), against in situ data (dashed lines) at Point-B station.

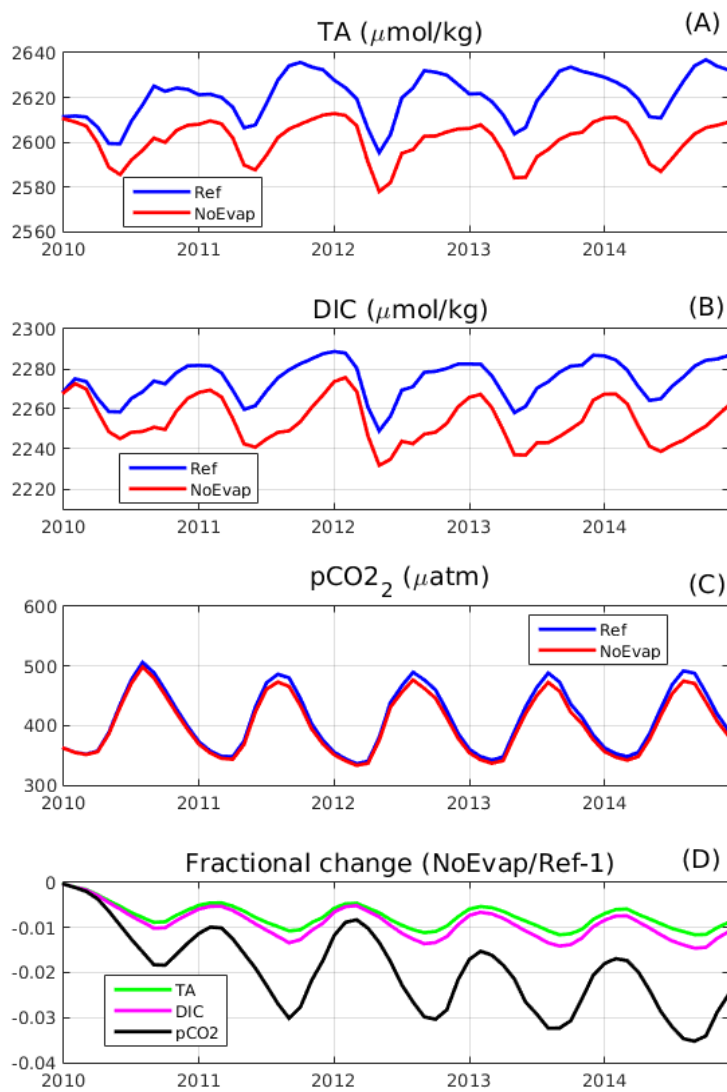


Figure S.20: Monthly mean surface (A) TA ($\mu\text{mol/kg}$), (B) DIC ($\mu\text{mol/kg}$) and (C) pCO₂ (μatm), averaged in the Levantine basin (22-36°E, 30-35°N), obtained from the reference simulation (Ref, blue line) and the simulation without E-P fluxes on TA and DIC (NoEvap, red line). The fractional change (NoEvap/Ref-1) variability between the two simulations for TA (green line), DIC (magenta line) and pCO₂ (black line) is also shown in (D).

References

Monterey, G., and S. Levitus (1997). Seasonal Variability of Mixed Layer Depth for the World Ocean, NOAA Atlas NESDIS 14, 100 pp., Natl. Oceanic and Atmos. Admin., Silver Spring, Md.