Coastal-Ocean variability in primary production in the Canary Current upwelling region: comparison among in situ and satellite-derived estimates

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Background:

- Eastern Boundary Upwelling Ecosystems (EBUE's) accounts for ~5% of ocean primary production (PP) supporting up to 20% of the global fish catch[1] though they represent 1% of world ocean surface.
- The Canary Current EBUE (CanC-EBUE), unlike other EBUE, has been unabatedly warming, and decreasing (or at least not increasing) in wind intensity during the last 60 years. However, past trends in net primary production are uncertain, due to differences in the outputs of remote sensing models and the lack of *in situ* data to validate these models in the region[2].

Goal:

In order to validate PP models estimations in the CanC-EBUE, we compared four widely-used models – the Vertically Generalized Production Model (VGPM)[3] and its variant based on Eppley's description of the growth function (Eppley)[4], the Carbon-based Production Model (CbPM)[5], and the Carbon, Absorption and Fluorescence Euphotic-resolving model (CAFE)[6]- with *in situ* primary production (PP) data.

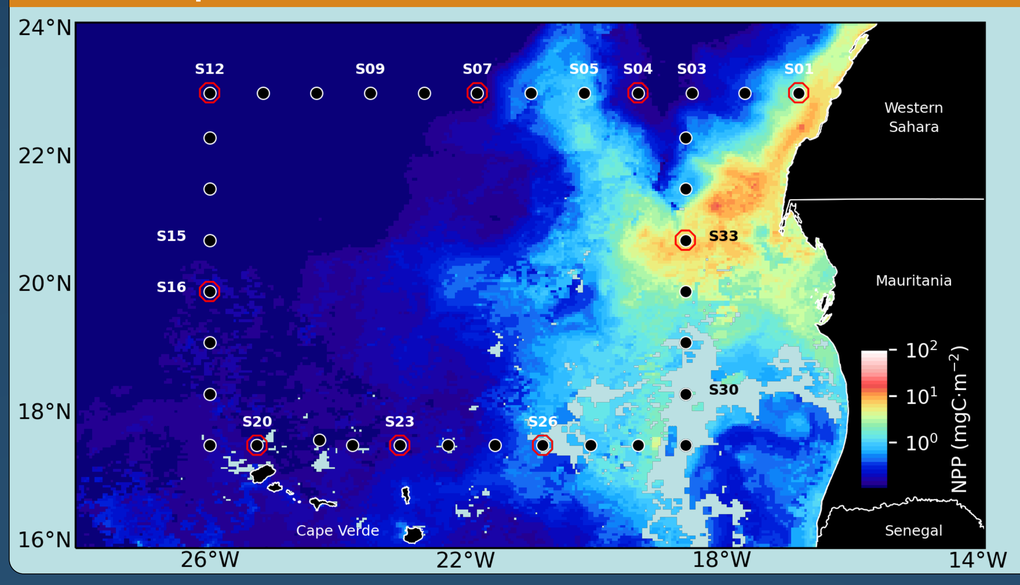
Chl *a*-based Productivity Models

Y_i	X_i	Slope	R^2_{adj}	F-sta	p-value
^{14}C	VGPM	0.891	0.75	30.14	<0.001
^{13}C	VGPM	0.541	-0.10	0.25	0.63
O_2	VGPM	0.463	0.40	5.01	0.08
^{14}C	Eppley	0.771	0.68	22.45	<0.01
^{13}C	Eppley	0.469	-0.11	0.23	0.65
O_2	Eppley	0.437	0.39	4.88	0.08

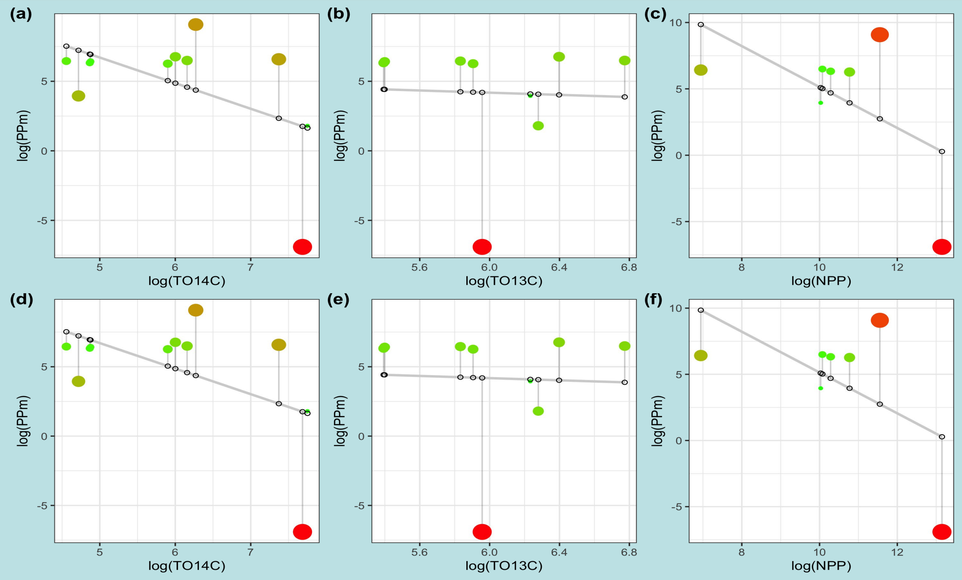
Reduced Major Axis (RMA) linear regression for in situ measurements (^{14}C, ^{13}C and O_2) vs VGPM and Eppley estimation of NPP.

- Chlorophyll-based productivity models (ChlPM) presented highest correlation with ^{14}C measurements.
- VGPM gave the best NPP estimations.
- Both ChlPM were poor correlated with ^{13}C measurements

Station Map



B-based Productivity Models



Fitted (grey dots) vs actual (color dots) data for in situ measurements (^{14}C, ^{13}C and O_2) and CbPM (a, b and c) and CAFE estimations (d, e and f).

- Phytoplankton biomass-based productivity models (BPM) provide the poorest NPP estimations. Average R^2_{adj} for BPM were 0.15 ± 0.09
- ^{14}C and O_2 measurements were negatively correlated with both BPM.

Methods:

- **Satellite:** all data was downloaded from Oregon State University Ocean Productivity site[7]:
  - VGPM
  - VGPM-Eppley
  - CbPM
  - CAFE
  - Chlorophyll *a* (Chl *a*)
  - *Phytoplankton biomass (B)*
- ***In situ*** **:** 11 stations across the transition zone expanding from the coastal upwelling to the open ocean waters at the Cape Verde Frontal Zone (red dots in station map):
  - ^{14}C-uptake
  - ^{13}C-uptake
  - O_2-Winkler (NCP)
  - Chla *a* (Fluorometry)
  - B (size to carbon convesion; Flowcytometry and microscopy)

Satellite-derived Chl *a* and B

Y_i	X_i	Slope	R^2_{adj}	F-sta	p-value
Chl *a*	Chl a_S	0.926	0.51	11.38	<0.01
B	B_S	1.189	0.80	41.48	<0.001

Reduced Major Axis (RMA) linear regression for in situ and satellite-derived Chl *a* and B. S stands for satellite-derived.

- B presented higher correlations with satellite estimations compare with Chl *a*.

Conclusions

- Only the ChlPM , i.e., the VGPM and Eppely, were significantly correlated with *in situ* estimates, yet these are among the first-described models in the literature
- Models based on B, however, did not correlate with *in situ* PP estimations, in spite that satellite-derived B presented better correlations than Chl *a* with the *in situ* data.

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