Modelación Aplicada del Océano

Curso Básico - CROCO

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Anuncios

- Hoy: **Biogeoquímica**

Biogeoquímica

Aspectos Generales

- Existen varias formas de representar los procesos biológicos en CROCO
- Todas ellas son simplificaciones que se basan en los modelos de caja (*box model*), en las cuales son contenedores de una serie de variables (e.g. clorofila), y donde hay flechas que representan conversiones entre una y otra variable
- Estas conversiones son tasas de cambio que parametrizan procesos
- Estas tasas de cambio dependen de parámetros que pueden o **no** haber sido medidos en la zona de interés. En caso de no tener mediciones, usamos valores de la literatura, para ese u otro lugar
- Además tenemos el transporte desde otros lados, el efecto de la capa de mezcla, la temperatura...
- Si la física está mal, la Biogeoquímica no saldrá bien

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CROCO - cppdefs.h

- Hay 4 modelos bioquímicos en CROCO

```
define BIOLOGY
biology.F
```

- Un modelo NPZD (5 componentes)

```
define BIO_NChlPZD
bio_NChlPZD.F
(+ oxígeno)
```

- Un modelo NPZD2 (7 componentes)

```
define BIO_N2ChlPZD2
bio_N2ChlPZD2.F
(+ oxígeno)
```

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CROCO - cppdefs.h

- Un modelo llamado BioEBUS (13 componentes)
  (Eastern Boundary Upwelling Systems)
  basado en el nitrógeno, como moneda de intercambio.

  ```
  define BIO_BioEBUS
  bio_BioEBUS.F
  (+ oxígeno)
  ```

- Un modelo llamado PISCES (24 componentes)
  (Pelagic Interactions Scheme for Carbon and Ecosystems Studies)
  basado en el carbono, como moneda de intercambio

  ```
  define PISCES
  Un directorio completo
  ```

  (PISCES $\rightarrow$ PISCES v2)

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CROCO_TOOLS

Archivos de Entrada

- Condiciones de Borde (CLM/BRY)

```
make_clim_npzd          make_bry_npzd
make_clim_pisces        make_bry_pisces
make_clim_bioebus       make_bry_bioebus
```

- Condiciones Iniciales

```
make_ini_npzd
make_ini_pisces
make_ini_bioebus
```

- Extras

```
make_dust (Fe)
Nutrientes en ríos
```

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CROCO - croco.in

Variables Consideradas

- croco.in

```
primary_history_fields: zeta UBAR VBAR  U  V wrtT(1:NT)
                          T    T    T    T  T    30*T
```

- Bioquímica de ríos

```
psource:   Nsrc  Isrc  Jsrc  Dsrc  Qbar [m3/s] Lsrc T S
DIC Alkali O2 CaCO3 PO4 POC Si NPhy MiZoo Doc DPhy MeZoo
BSi Fe BFe GOC SFe DFe DSi NFe NChl DChl NO3 NH4 Tsrc
            28
   288  274     0    -648      T T F F T F T F T T T F T
   T F F F F F F F F T T T T 9.8 0.1 0 0 325 0 0.214 0
   118 0.117 0.047 0 0.273 0.109 0 0 0 0 0 0 0 0 0.234
   0.546 1.86 0.74
```

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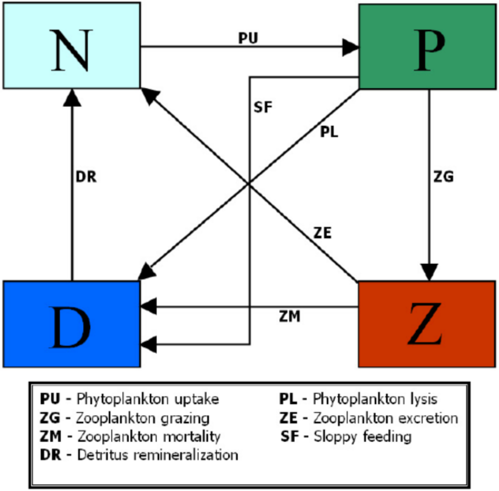
NPChlZD



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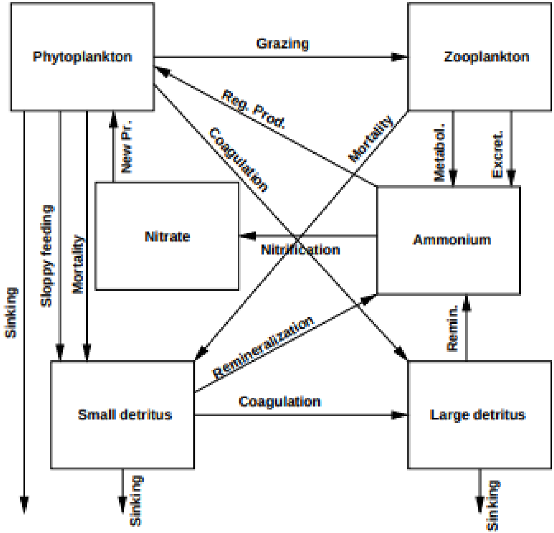
N2PChlZD2



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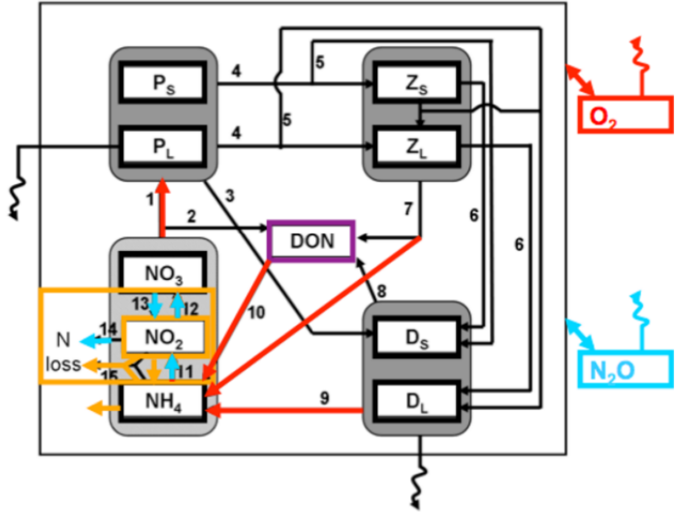
BioEBUS



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PISCES

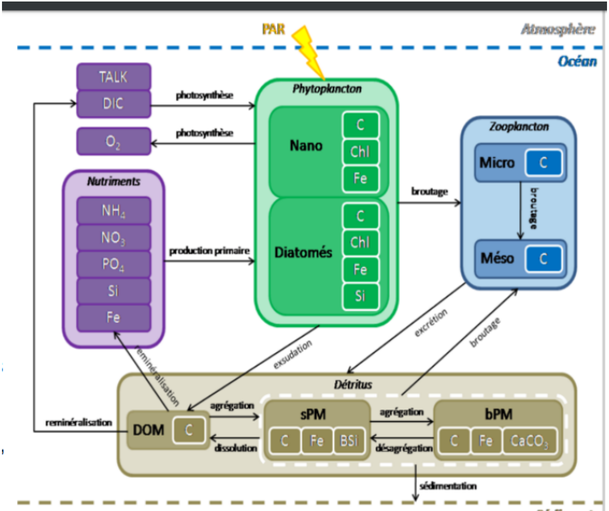

Figure from Carolina Dufour

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Aspectos Prácticos

- Aumentan el tiempo de cálculo en 2-4 veces
- Técnicamente, pueden ser calculados *off-line*
- Pueden incluir aportes atmosféricos o de ríos
- Escasa información para validar
  - Color de Océano (SeaWiffs) Chl-a
  - WOA, CARS
  - Mediciones
- MUY escasa información sobre los parámetros que usan

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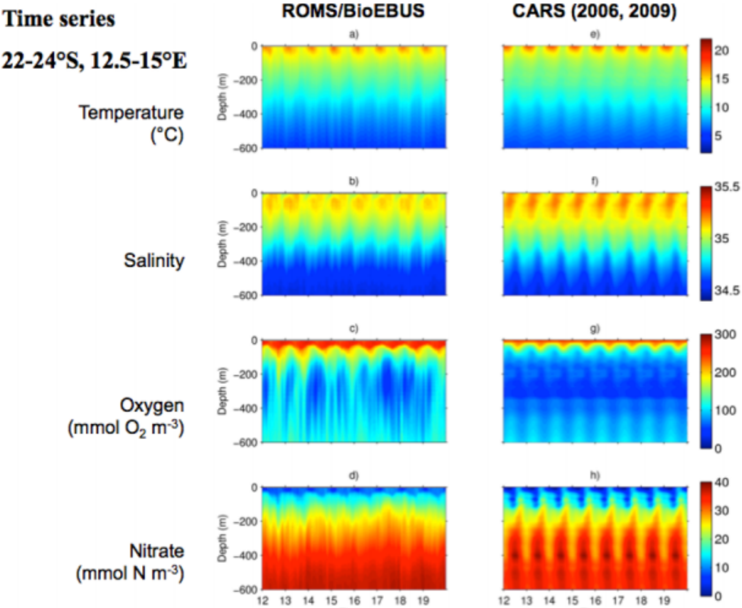
Validación BioEBUS



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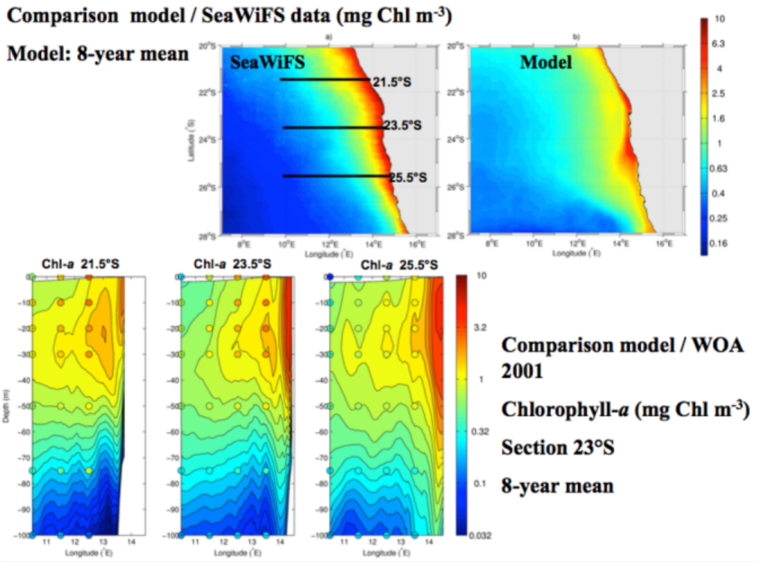
Validación BioEBUS



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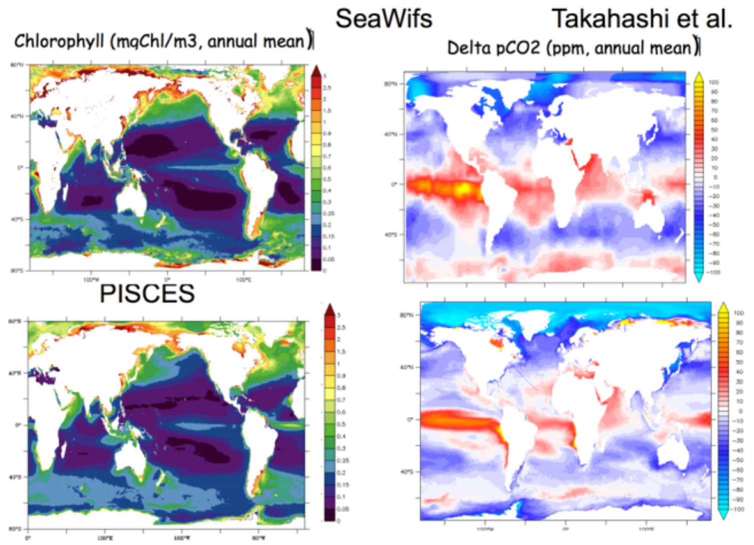
Validación PISCES



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namelist_pisces

Equation name	Code name	Description
Phytoplankton		
α^I	pislope, pislope2	Initial slope of the PI curve
δ^I	excret	Exudation of DOC
$K_{PO_4}^{I,min}$	concnnh4, concdnh4	Minimum half-saturation constant for Phosphate
$K_{NH_4}^{I,min}$	concnnh4, concdnh4	Minimum half-saturation constant for Ammonium
$K_{NO_3}^{I,min}$	concnno3, concdno3	Minimum half-saturation constant for Nitrate
K_{Si}^1	xksi1	First parameter for Si/C
K_{Si}^2	xksi2	Second parameter for Si/C
$K_{Fe}^{I,min}$	concnfer, concdfer	Minimum half-saturation constant for Iron
S_{rat}^I	xsizern, xsizerd	Size ratio of phytoplankton
$\theta_m^{Si,D}$	grosip	Optimal Si/C uptake ratio of diatoms
$\theta_{opt}^{Fe,I}$	qnfelim, qdfelim	Optimal iron quota
$\theta_{max}^{Fe,I}$	fecnm, fednm	Maximum iron quota
m^I	mprat, mprat2	phytoplankton mortality rate
w^P	wchl	Minimum quadratic mortality of phytoplankton
w_{max}^D	wchld	Maximum quadratic mortality of diatoms
K_m	xkmort	Half-saturation constant for mortality
$\theta_{chl,max}$	chlcnm, chlcdm	Maximum Chl/C ratios of phytoplankton
I_{max}	xsizephy, xsizedia	Threshold concentration for size dependency
Zooplankton		
e_{max}^I	epsher, epsher2	Maximum growth efficiency of zooplankton
γ^I	sigma1, sigma2	Excretion as DOC
σ^I	unass1, unass2	Non-assimilated fraction
g_m^I	grazrat, grazrat2	Maximum grazing rate
K_G^I	xkgraz, xkgraz2	Half-saturation constant for grazing
g_{FF}^M	grazflux	Flux feeding rate
p_{P},γ_P^I	xpref2p, xprefp	Preferences for nanophytoplankton
p_{D},γ_D^I	xpref2d, xprefc	Preferences for diatoms
p_{POC},γ_{POC}^I	xpref2c, xprefpoc	Preferences for POC
p_Z^M	xprefz	Preference for microzooplankton
F_{thresh}^I	xthresh, xthresh2	Food threshold for zooplankton
P_{thresh}^I	xthreshphy, xthresh2phy	Nanophytoplankton threshold for zooplankton
D_{thresh}^I	xthreshdia, xthresh2dia	Diatoms threshold for zooplankton
POC_{thresh}^I	xthreshpoc, xthresh2poc	POC threshold for zooplankton
Z_{thresh}^M	xthresh2zoo	Microzooplankton threshold for mesozooplankton
m^I	mzrat, mzrat2	Mesozooplankton mortality
r^I	resrat, resrat2	Excretion rate

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namelist_pisces

Equation name	Code name	Description
ν^I	part, part2	Fraction of calcite that does not dissolve in guts
$\theta^{Fe,Zoo}$	ferat3	Fe/C ratio of zooplankton
Organic matter		
λ_{DOC}	xremik	Remineralization rate of DOC
K_{DOC}	xkdoc	Half-saturation constant for DOC remin.
K_{Fe}^{Bact}	concbfe	Fe half-saturation constant for DOC remin.
λ_{POC}	xremip	Degradation rate of POC
w_{POC}	wsbio	Sinking speed of POC
w_{GOC}^{min}	wsbio2	Minimum sinking speed of GOC
w_{dust}	wdust	Sinking speed of dust
λ_{Fe}	xlam1	Slope of scavenging rate of iron
λ_{Fe}^{dust}	xlamdust	Scavenging rate of iron by dust
λ_{CaCO3}	kdca	Dissolution rate of calcite
nca	nca	Exponent in the dissolution rate of calcite
χ_{lab}^{0}	xsilab	Proportion of the most labile phase in PSi
λ_{PSi}^{slow}	xsiremlab	Fast remineralization rate of PSi
λ_{PSi}^{fast}	xsirem	Slow remineralization rate of PSi
Nutrients		
λ_{NH_4}	nitrif	Maximum nitrification rate
$O_2^{min,1}$	oxymin	Half saturation constant for denitrification
L_T	ligand	Total ligand concentration
N_{fix}^{m}	nitrfix	Maximum rate of nitrogen fixation
K_{Fe}^{diaz}	concfediaz	Fe half-saturation constant of nitrogen fixation
E_{fix}	diazolight	Photosynthetic parameter of nitrogen fixation
Fe_{ice}	icefeinput	Iron concentration in sea ice
$F_{Fe,min}^{sed}$	sedfeinput	Maximum sediment flux of iron
Sol_{Fe}	dustsolub	Solubility of iron in dust
Stoichiometric ratios		
r_{CaCO3}	caco3r	Maximum rain ratio

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Referencias

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- BioEBUS

Gutknecht, E., Dadou, I., Le Vu, B., Cambon, G., Sudre, J. , Garçon, V., Machu, E., Rixen, T., Kock, A., Flohr, A., Paulmier, A., and Lavik, G.: Coupled physical/biogeochemical modeling including O2-dependent processes in the Eastern Boundary Upwelling Systems: application in the Benguela, Biogeosciences, 10, 3559-3591, doi:10.5194/bg-10-3559-2013, 2013.

Chile

Vergara, O.A., Echevín, V., Sepúlveda, H.H. and Quiñones, R.A., 2017. Controlling factors of the seasonal variability of productivity in the southern Humboldt Current System (30-40° S): A biophysical modeling approach. Continental Shelf Research, 148, pp.89-103.

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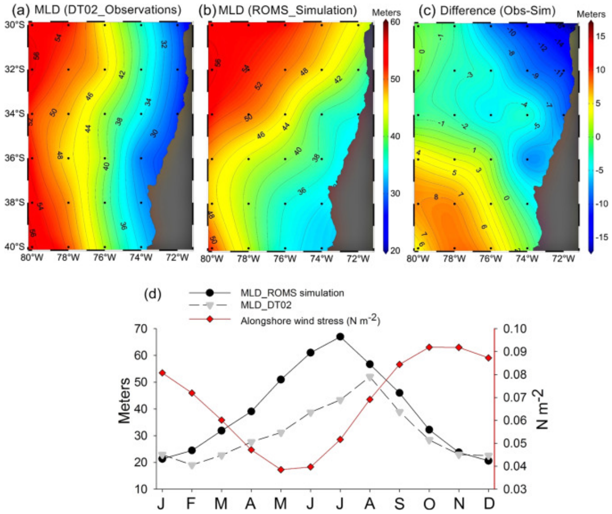
PISCES - Chile



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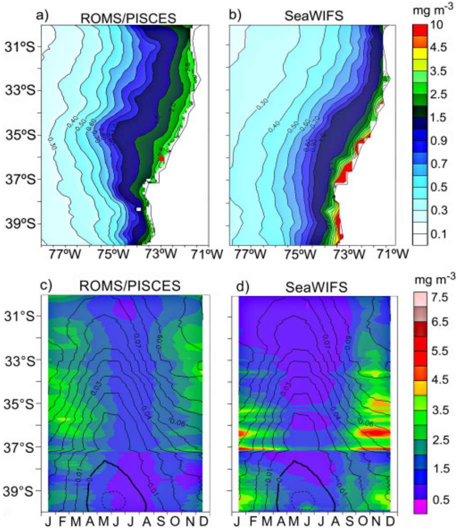
PISCES - Chile



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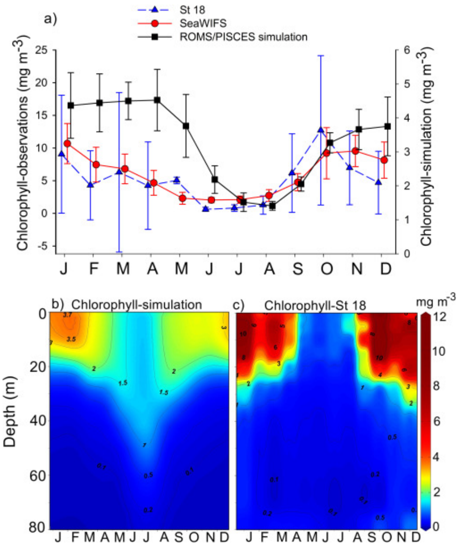
PISCES - Chile



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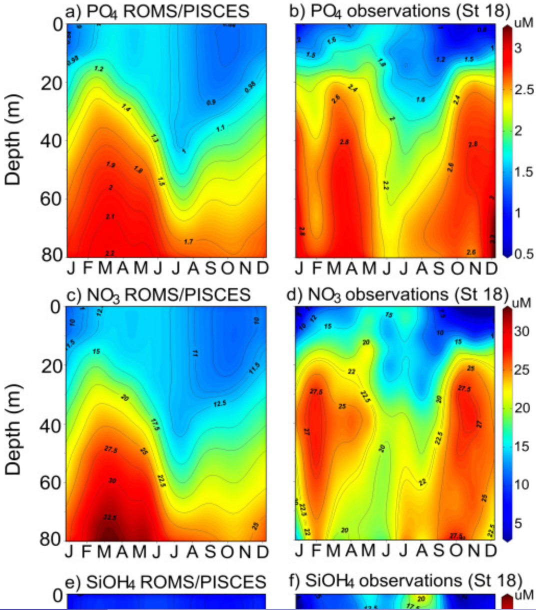
PISCES - Chile



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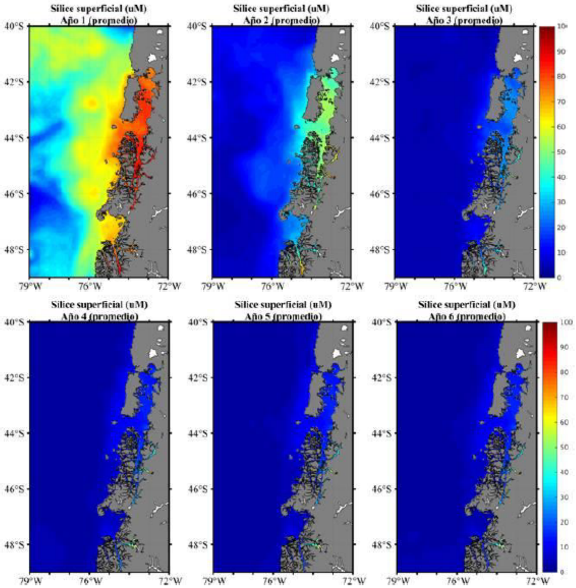
PISCES - Chile



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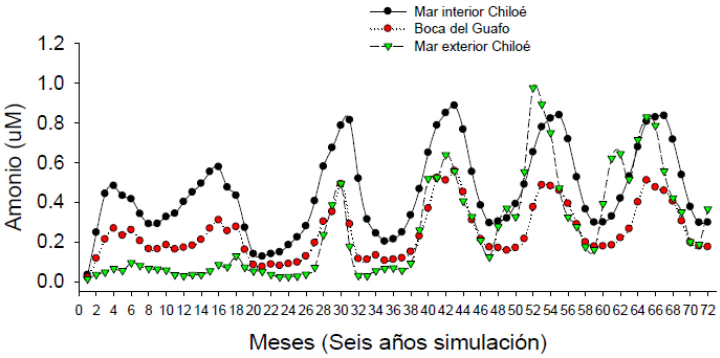

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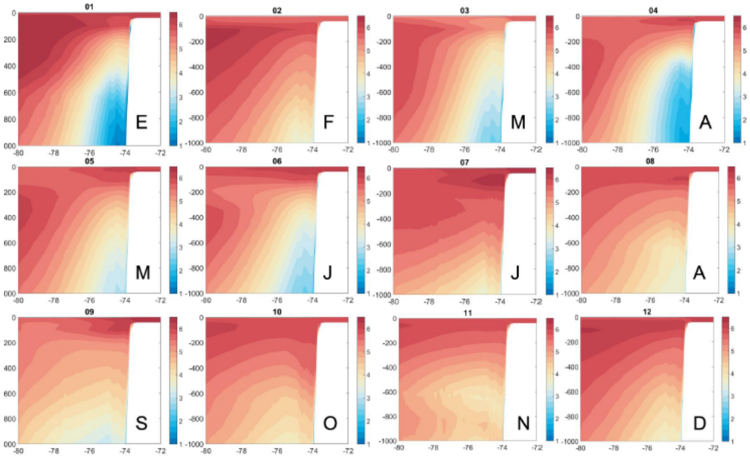
PISCES - Chile

Oxígeno (ml/L) frontera norte, enero-diciembre



Oxígeno (ml/L) frontera norte MERCATOR-PISCES enero a diciembre (E-D).

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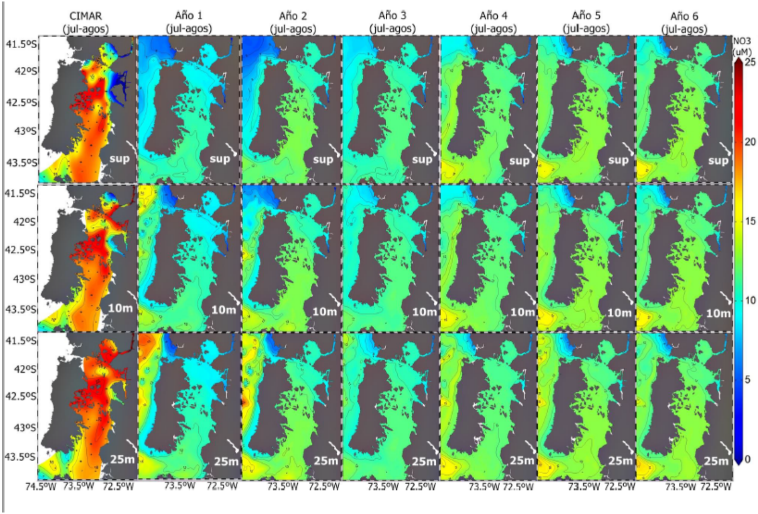
PISCES - Chile



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