HIDROMOD

MOHIDing| 11th and 12th December 2019, Lisbon

PCOMS – improvement of the light extinction parametrization

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INTRODUCTION

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CONCLUSIONS

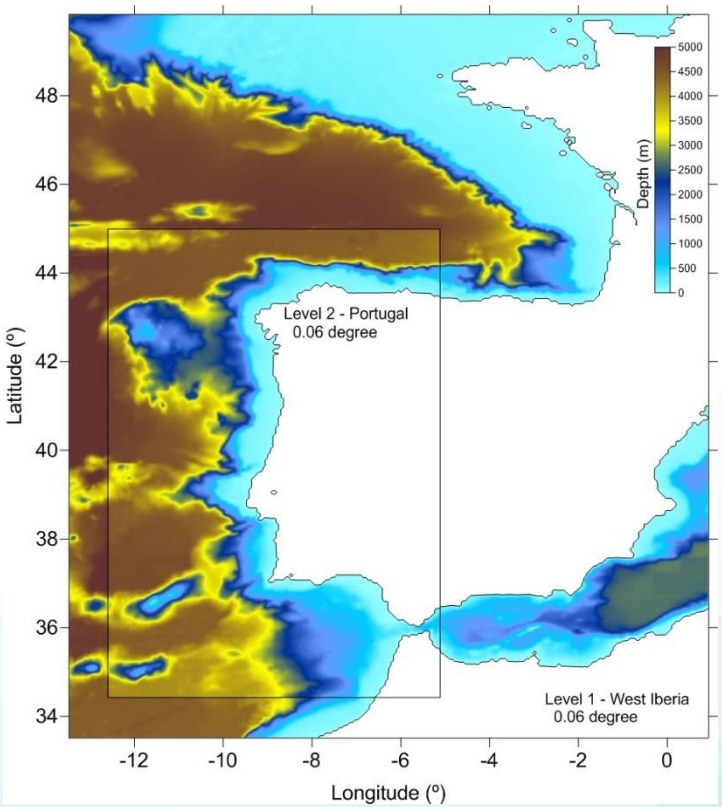
Introduction

PCOMS 3D is a three-dimensional model that uses the MOHID numerical model and simulates the general circulation of the Portuguese coast.

It is run in forecast mode by IST (Mateus et al., 2012) and HIDROMOD.

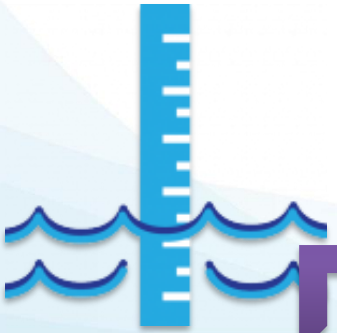
It has a horizontal resolution mesh of about 6 km and provides forecasts for the next 5.5 days, updated daily.

The open boundary condition is defined based on a solution that results from the linear sum of the global tidal solution FES2014 and the low frequency CMEMS Global solution.

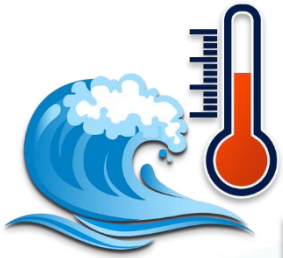


Objective

In the HIDROMOD, the prediction of SEA LEVEL and the WATER TEMPERATURE are very important! The goal of this analysis was to understand how we could improve the present model configuration !



Sea level



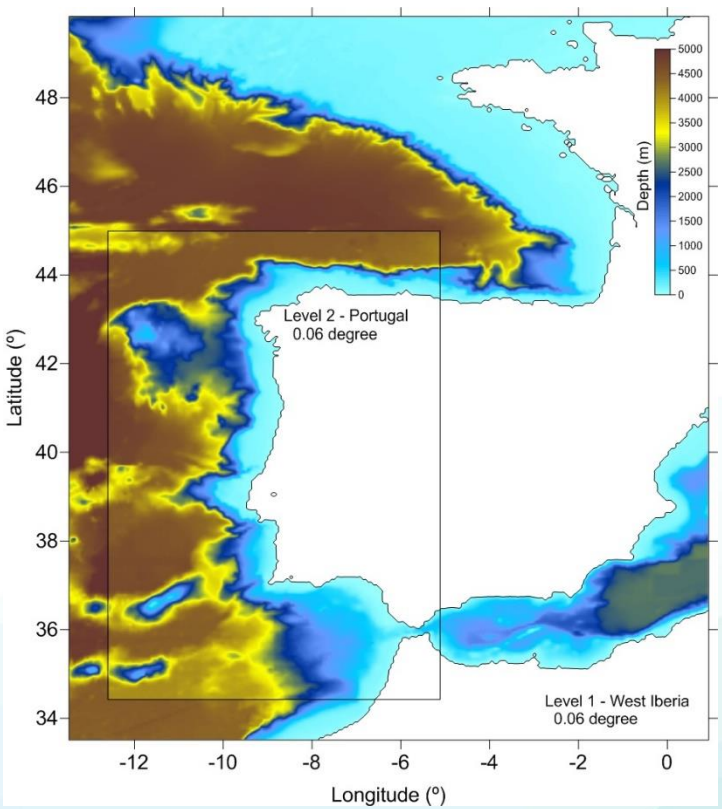
Water temperature

Methodology

One year simulation : **2017**

Boundary conditions:

- Global tidal solution FES2014;
- Sea level from a hourly CMEMS Global solution (8 km of horizontal resolution);
- Water temperature, salinity and currents from a daily CMEMS Global solution (8 km of horizontal resolution);
- Meteorology (wind, atmospheric pressure and heat fluxes) from ERA Interim.

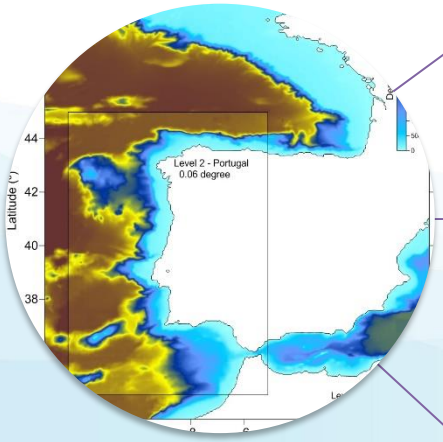


Mohid implementation:

https://github.com/Mohid-Water-Modelling-System/Mohid/tree/master/Samples/Coastal3D_Operational

Methodology

Improvements were made to the model including more processes. Three solutions were analysed:



Reference

- **Present configuration** (no rivers and constant light extinction coef.)

Reference + rivers

- **Rivers influence** (Water temperature and salinity) EMODnet

Guadalquivir, Guadiana, Sado, Tagus, Mondego, Vouga, Douro, Lima, Minho, Umia, Ulla, Lerez, Oitaven

Reference + rivers + biogeochemistry

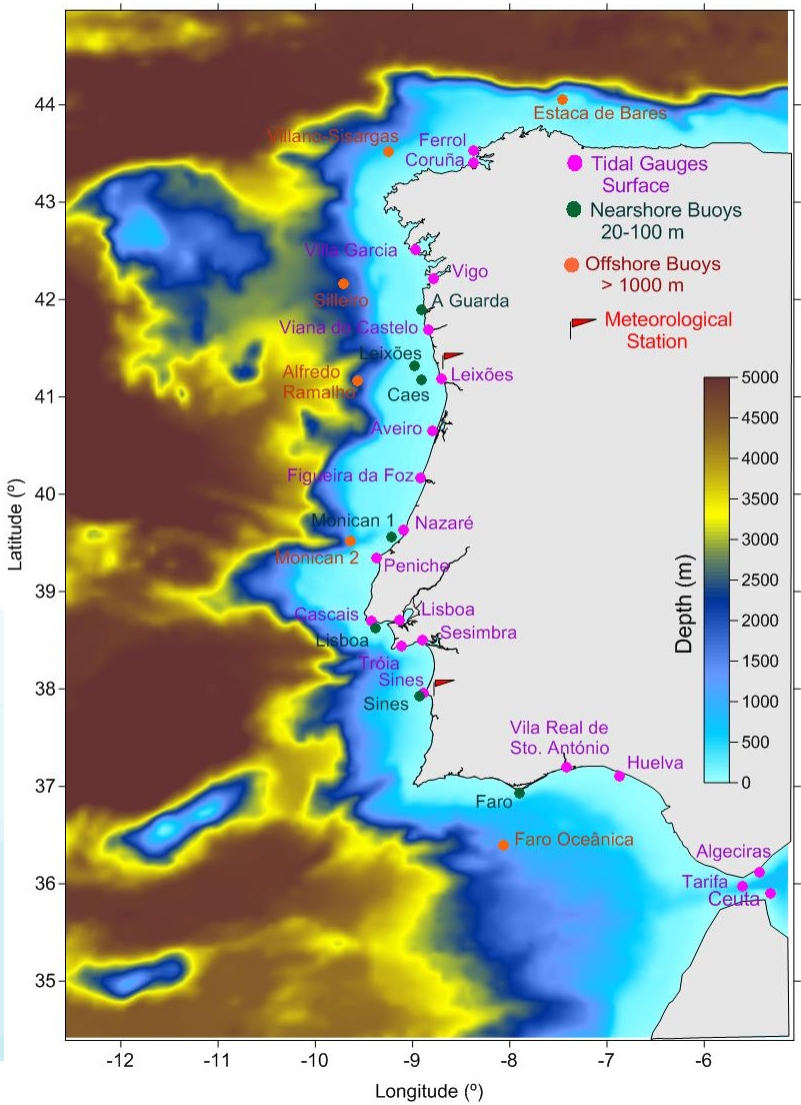
- **Rivers influence**
- **Light extinction** (chla, cohesive sediments)

With a dt of 120 seconds

Monitoring stations

Tide Gauges for the sea level validation:

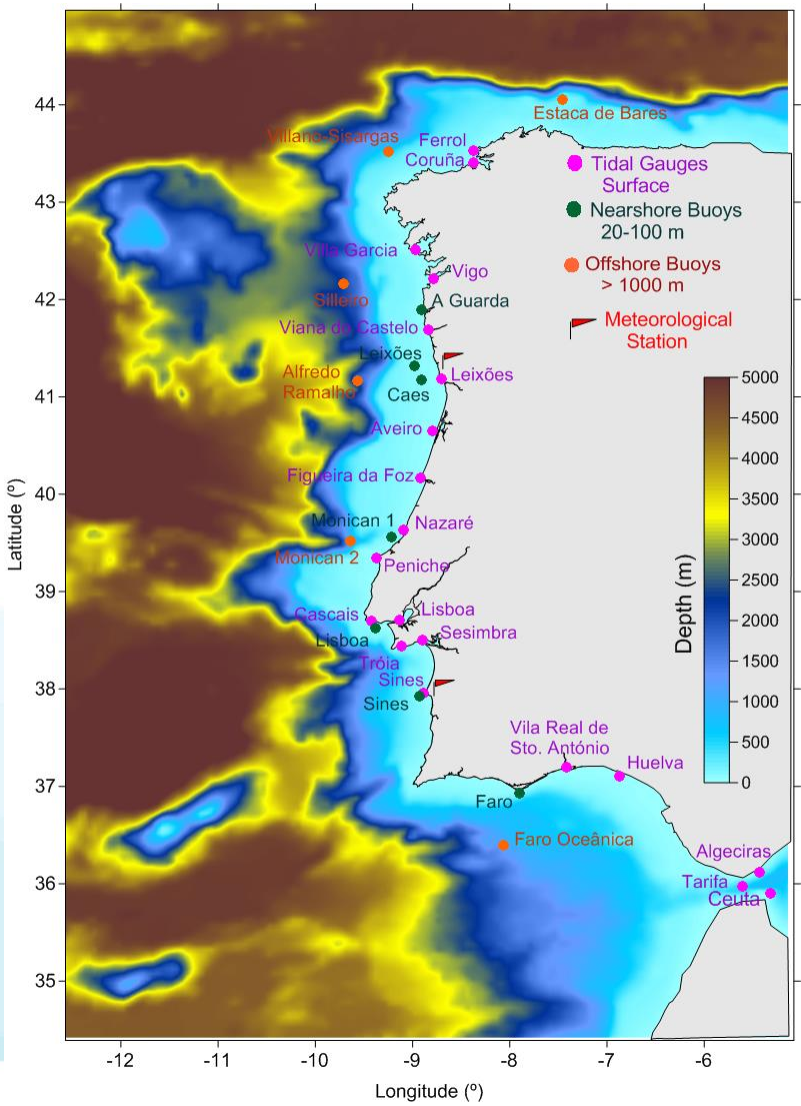
GLOSS	Algeciras
GLOSS	Cascais
GLOSS	Coruna
GLOSS	Ferrol
GLOSS	Huelva
GLOSS	Lagos
GLOSS	Tarifa
GLOSS	Vigo
GLOSS	VillaGarcia
Instituto Hidrografico	Aveiro
Instituto Hidrografico	Figueira da Foz
Instituto Hidrografico	Leixões
Instituto Hidrografico	Nazare
Instituto Hidrografico	Peniche
Instituto Hidrografico	Sesimbra
Instituto Hidrografico	Sines
Instituto Hidrografico	Viana do Castelo
Instituto Hidrografico	Vila Real de Santo António



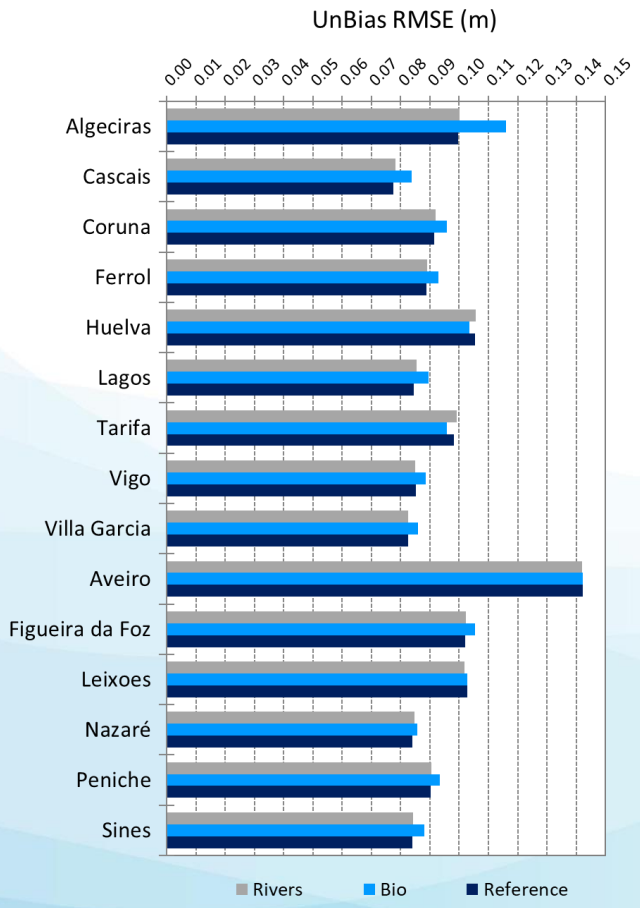
Monitoring stations

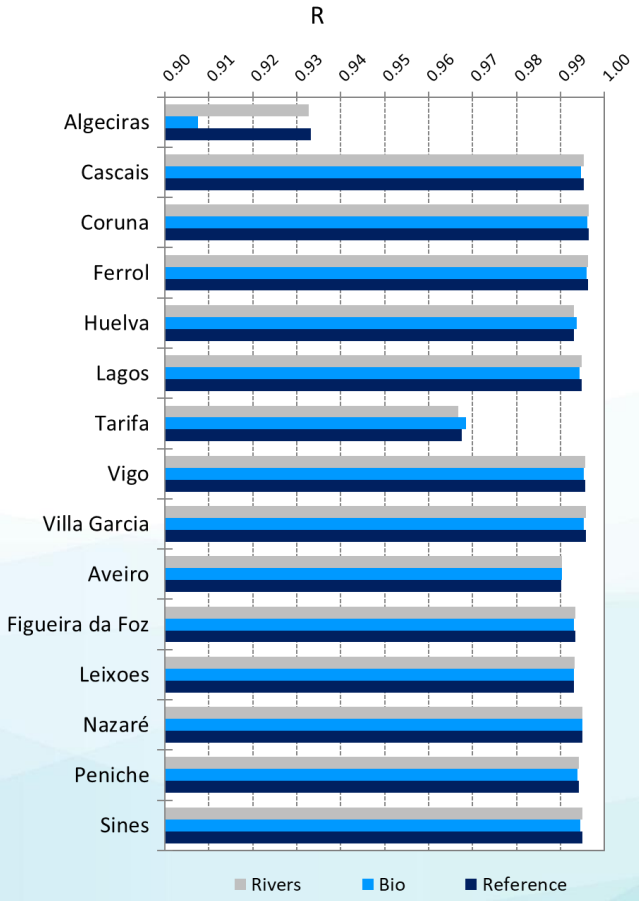
Buoys for the water temperature validation:

Puertos del Estado	PBares
Puertos del Estado	PSilleiro
Puertos del Estado	PSisargas
INESC Porto	PARamalho
Instituto Hidrográfico	Faro
Instituto Hidrográfico	Leixões
Instituto Hidrografico	Monican2
Instituto Hidrografico	Monican
Instituto Hidrográfico	Sines

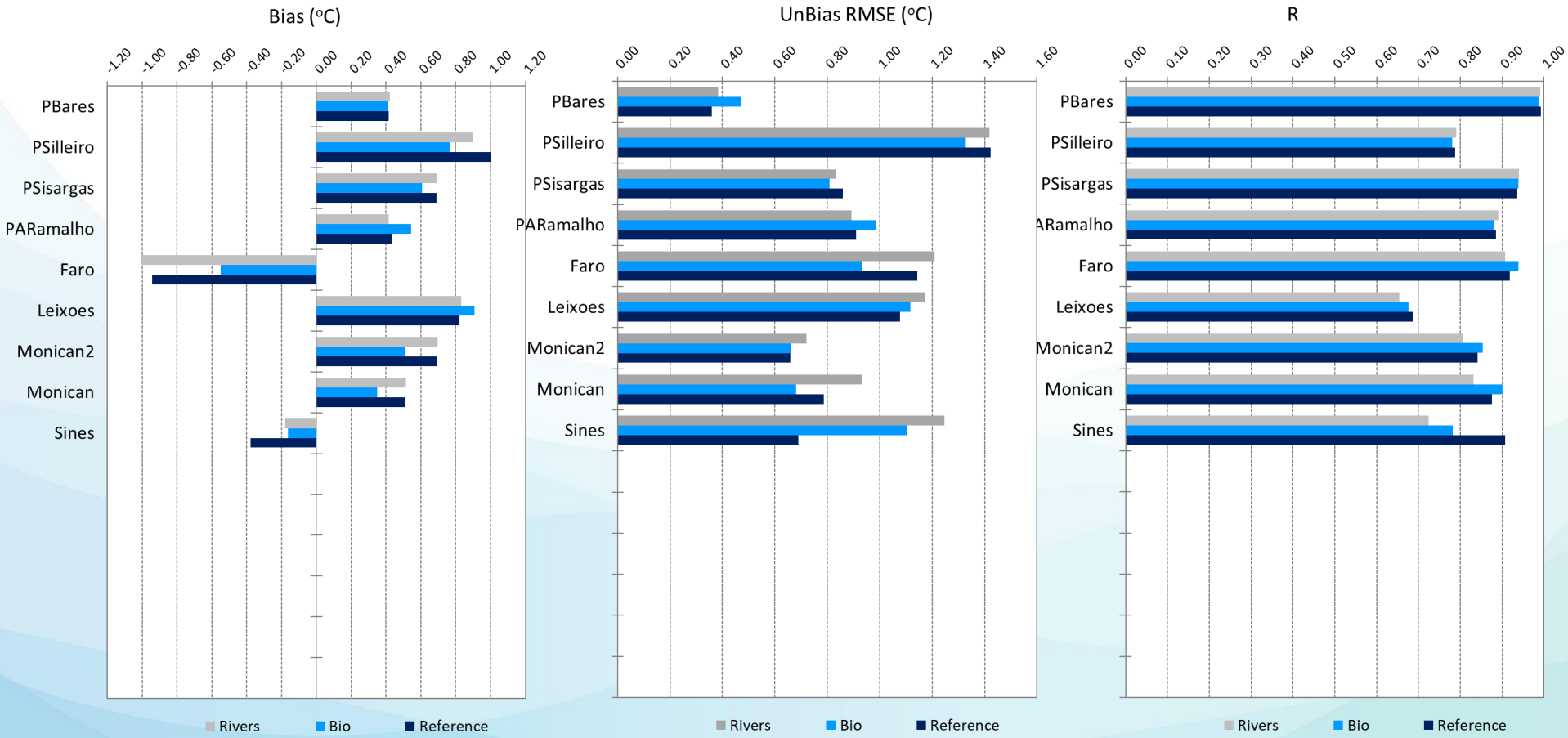


Results | Sea level





Results | Water temperature



Conclusions | Statistic means

Sea level	Rivers	Bio	Reference
Unbias RMSE (m)	0.094	0.097	0.094
Normalise unbias RMSE (m)	3.50	3.65	3.49
rcorr	0.989	0.987	0.989
SKILL	0.84	0.84	0.84

Considering all monitoring stations:

-Sea level and water temperature have similar results

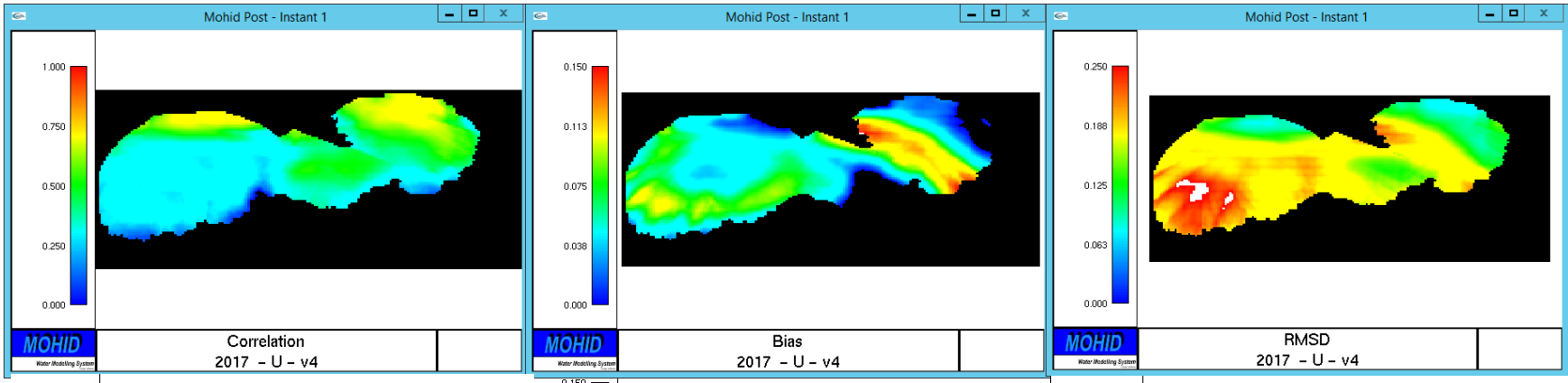
Water temperature	Rivers	Bio	Reference
BIAS (°C)	0.37	0.38	0.36
RMSE (°C)	1.18	1.06	1.10
Normalise RMSE (°C)	17.67	15.97	16.73
Unbias RMSE (°C)	0.98	0.90	0.88
Normalise unbias RMSE (°C)	14.66	13.52	13.39
rcorr	0.84	0.86	0.87
SKILL	0.86	0.88	0.88

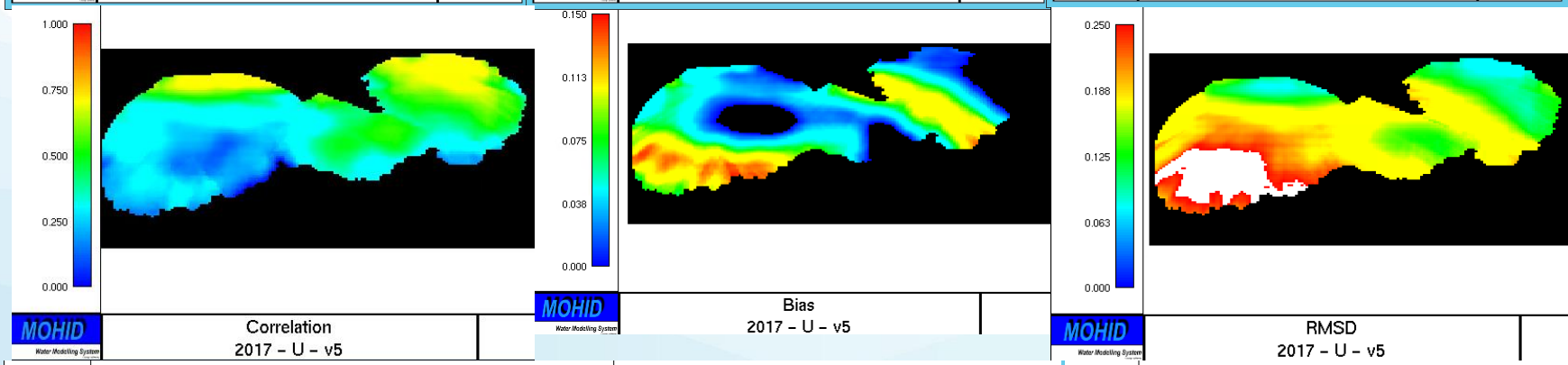
Radar HF Algarve vs Model

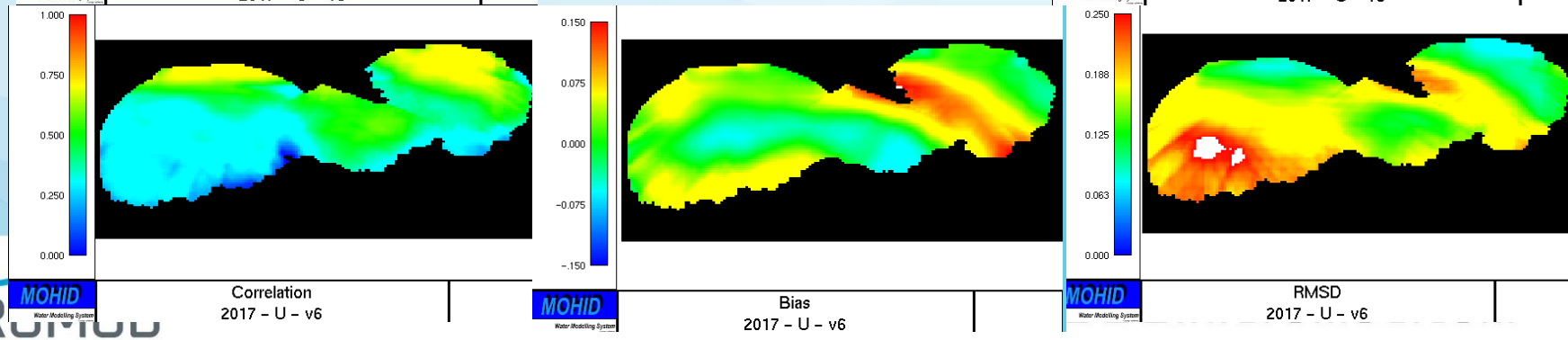
Ref (v4)

Rivers
(v5)

Bio (v6)

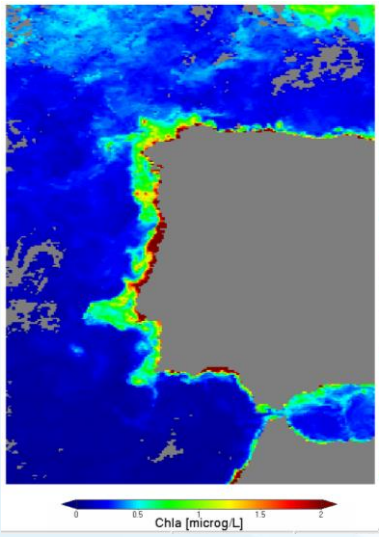


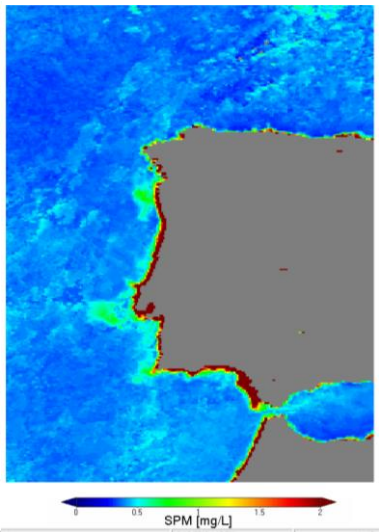


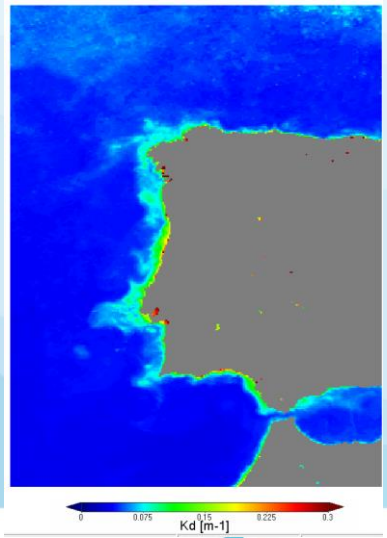


HIDROMOD
modelação em engenharia

Processes - Satellite Chla, SPM, Kd







Kd estimation	Correl	Bias	RMSD
Parsons + Portela (Chla, SPM)	0.895	0.032	0.034
Parsons (Chla)	0.879	0.018	0.020
Chla Regression	0.866	-0.001	0.005
Chla &SPM Regression	0.880	-0.001	0.005
Parsons + Portela Correct	0.895	0.000	0.007

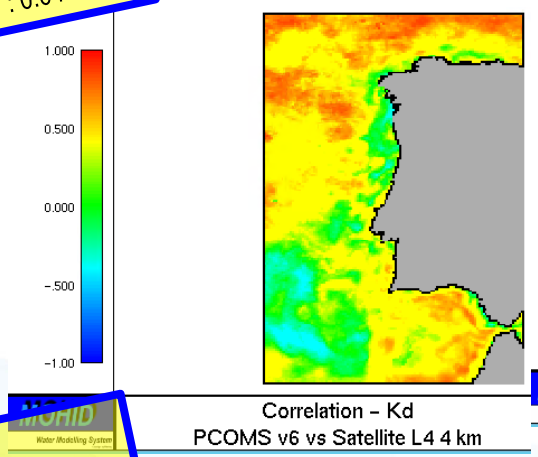
0.008

```
!Default 0.04 but can be adjust for better adjustment with observations
Coef = Me%CoefParsonsPortela

Me%ShortWave%ExtinctionCoefField3D(i,j,k) =                                    &
                Coef  + 0.0088 * (PhytoConcentration3D(i, j, k) * Phyto_UnitsCoef) + &
                0.054 * (PhytoConcentration3D(i, j, k) * Phyto_UnitsCoef) ** (2.0 / 3.0)

Me%ShortWave%ExtinctionCoefField3D(i,j,k) =                                    &
                Me%ShortWave%ExtinctionCoefField3D(i,j,k) +                &
                0.036 * (SPMConcentration3D(i, j, k) * SPM_UnitsCoef)
```

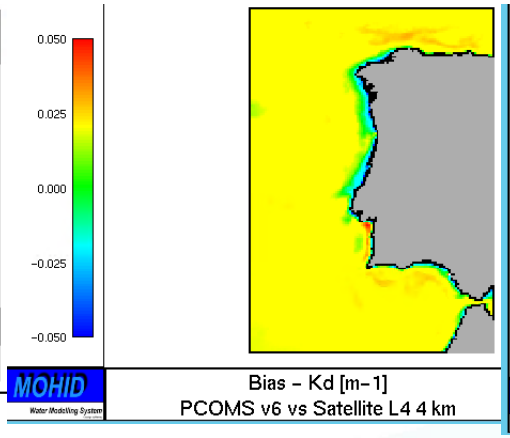
Validation PCOMS Bio – Kd Satellite vs Kd Model

Combined_ParsonsPortela
SW_EXTINCTION_TYPE : 4
!Default 0.04
COEF_PARSONS_PORTELA : 0.04

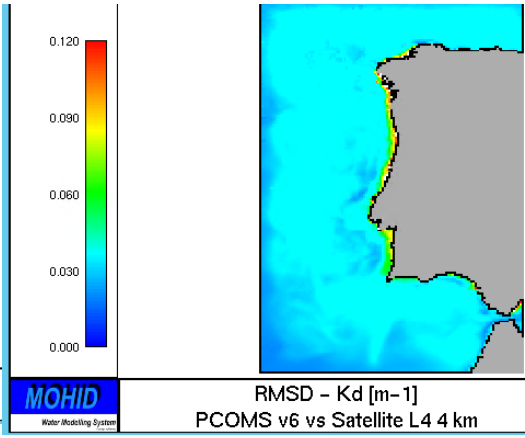
Satellite grid 4 km



Correlation – Kd
PCOMS v6 vs Satellite L4 4 km

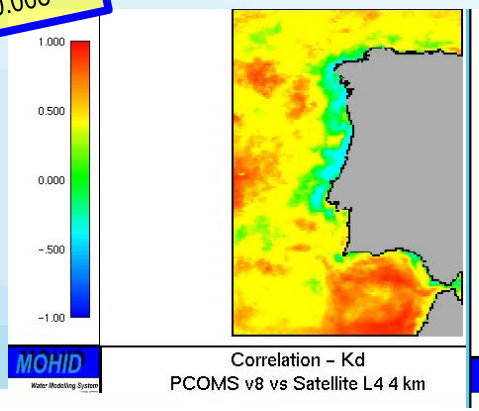


Bias – Kd [m-1]
PCOMS v6 vs Satellite L4 4 km

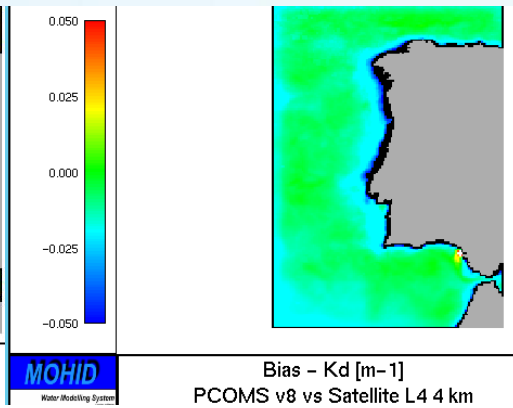


RMSD – Kd [m-1]
PCOMS v6 vs Satellite L4 4 km

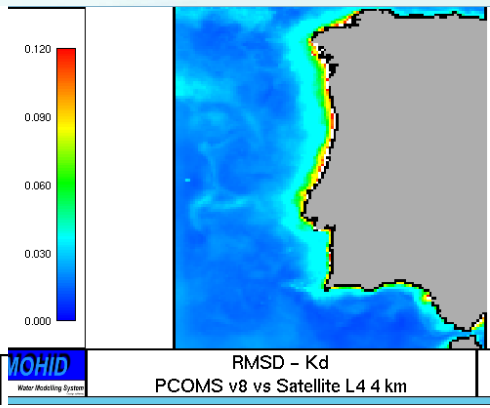
Combined_ParsonsPortela
SW_EXTINCTION_TYPE : 4
!Defaul 0.04
COEF_PARSONS_PORTELA : 0.008



Correlation – Kd
PCOMS v8 vs Satellite L4 4 km



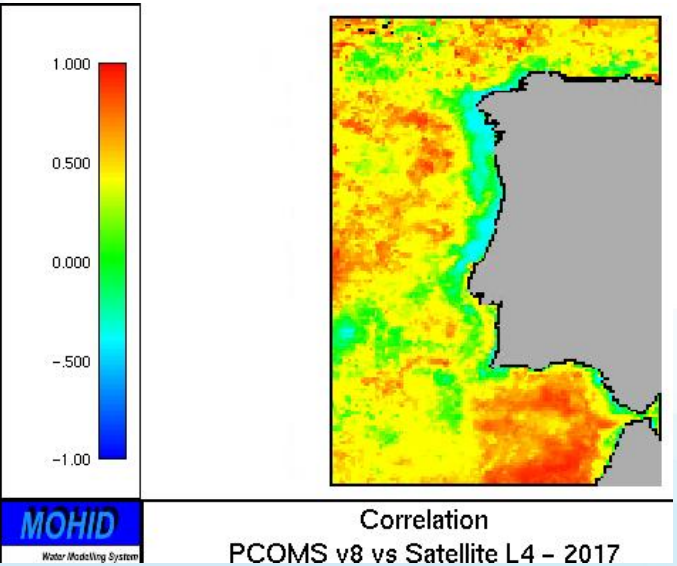
Bias – Kd [m-1]
PCOMS v8 vs Satellite L4 4 km



RMSD – Kd
PCOMS v8 vs Satellite L4 4 km

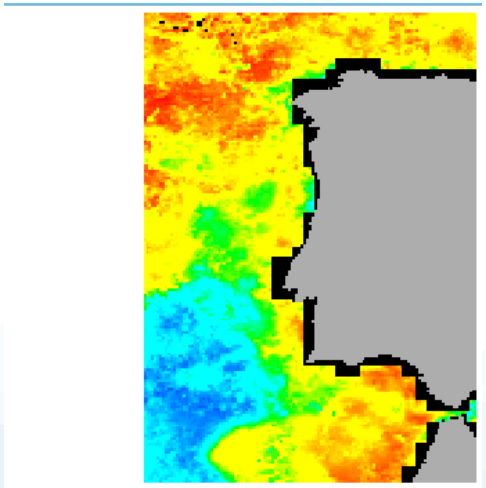
Validation Bio – Chl-a Satellite 4 km vs Phyto Model (v6&v8)

MOHID reference solution



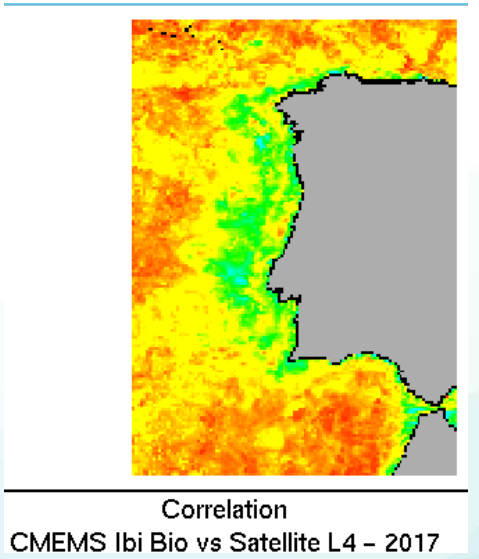
Correlation
PCOMS v8 vs Satellite L4 – 2017

Carbon



Correlation
CMEMS Global Bio vs Satellite L4 – 2017

Chla

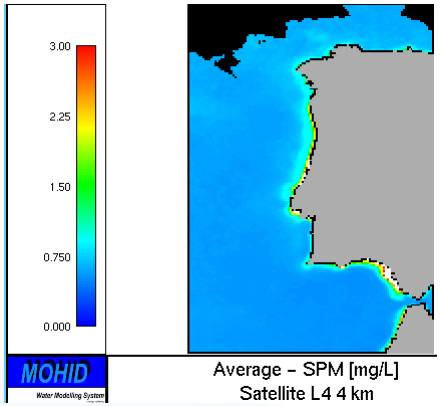


Correlation
CMEMS Ibi Bio vs Satellite L4 – 2017

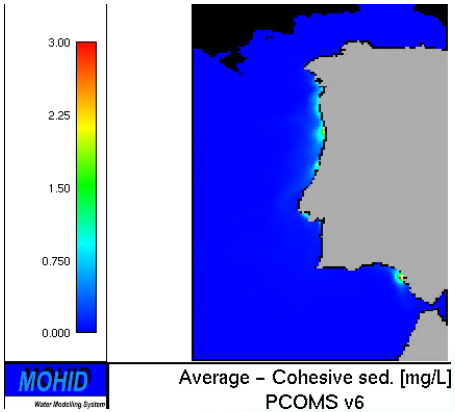
Chla

Validation Bio – SPM Satellite vs Cohesive sed. Model

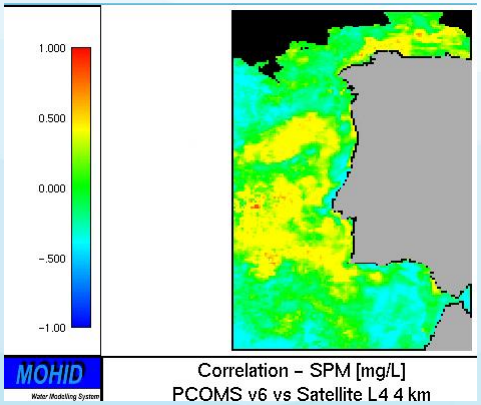
Satellite grid 4 km



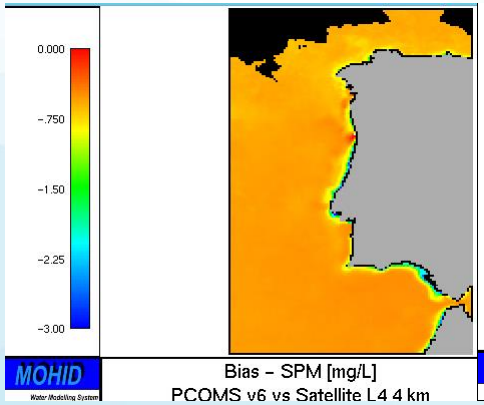
Average – SPM [mg/L]
Satellite L4 4 km



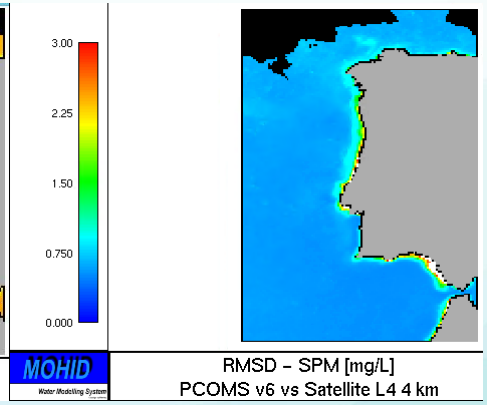
Average – Cohesive sed. [mg/L]
PCOMS v6



Correlation – SPM [mg/L]
PCOMS v6 vs Satellite L4 4 km



Bias – SPM [mg/L]
PCOMS v6 vs Satellite L4 4 km



RMSD – SPM [mg/L]
PCOMS v6 vs Satellite L4 4 km

MOHID configuration – PCOM3D Bio (Campuzano PhD)

Discharges_1.dat - Notepad

File Edit Format View Help

```
<begindischarge>
NAME                    : River Guadalquivir
K_CELL                  :  1
COORD_X                 : -6.319332
COORD_Y                 : 36.80695
VERTICAL_DISCHARGE      : 5
DATA_BASE_FILE          : ../../GeneralData/Discharges/Caudal/RiverGuadalquivir.dat
FLOW_COLUMN             : 2

<<beginproperty>>
NAME                    : salinity
UNITS                   : psu
DEFAULTVALUE            : 0.01
<<endproperty>>

<<beginproperty>>
NAME                    : temperature
UNITS                   : ºC
DEFAULTVALUE            : 10
TIME_SERIE_COLUMN       : 2
FILENAME                : ../../GeneralData/Discharges/Temperature/RiverGuadalquivir.dat
<<endproperty>>

<<beginproperty>>
NAME                    : inorganic phosphorus
UNITS                   : mgP/L
DEFAULTVALUE            : 0.3
<<endproperty>>

<<beginproperty>>
NAME                    : nitrate
UNITS                   : mg N/L
DEFAULTVALUE            : 1
<<endproperty>>
```

WaterQuality_2.dat - Notepad

File Edit Format View Help

```
NITROGEN        : 1
PHOSPHOR        : 1
PHYTO           : 1
ZOO             : 1
LARVAE          : 0
AGE             : 0
OXYGEN          : 1
BOD             : 0
DIATOMS         : 0
SILICA          : 0
BACTERIA        : 0
CILIATE         : 0
BOD             : 0

EXPLICIT        : 1
IMPLICIT        : 0
SEMIIMP         : 0

----------------------------FITOPLANKTON-------------------------------------------------------
GROWMAXF        : 2.0     !2.0      Phytoplankton Maximum gross growth rate
FENDREPC        : 0.0175  !0.0175   Endogenous respiration constant for phytoplankton
PHOTORES        : 0.125   !0.125    Fraction of actual photosynthesis which is oxidized by photorespiration for phytop
EXCRCONS        : 0.07    !0.07     Excretion Constant for phytoplankton
FMORTMAX        : 0.02    !0.02     Maximum Mortality Rate for phytoplankton
FMORTCON        : 0.3     !0.3      Mortality half-saturation rate for phytoplankton
ASS_EFIC        : 0.5     !0.8      Assimilation efficiency of the phytoplankton by zooplankton
NSATCONS        : 0.014   !0.014    Nitrogen half-saturation constant for phytoplankton
PSATCONS        : 0.001   !0.001    Phosphorus half-saturation constant for phytoplankton
PHOTOIN         : 121     !121      Optimum light intensity for phytoplankton photosynthesis
TOPTFMIN        : 10.     !25       Minimum temperature of the optimal interval for phytoplankton photosynthesis
TOPTFMAX        : 25.     !26.5     Maximum temperature of the optimal interval for phytoplankton photosynthesis
TFMIN           : 5.      !4        Minimum tolerable temperature for phytoplankton photosynthesis
TFMAX           : 35.     !37       Maximum tolerable temperature for phytoplankton photosynthesis
TFCONST1        : 0.05    !0.05     Constant to control temperature response curve shape on phytoplankton
TFCONST2        : 0.98    !0.98     Constant to control temperature response curve shape on phytoplankton
TFCONST3        : 0.98    !0.98     Constant to control temperature response curve shape on phytoplankton
TFCONST4        : 0.02    !0.02     Constant to control temperature response curve shape on phytoplankton
FRATIONC        : 0.18    !0.18     Phytoplankton Nitrogen/Carbon Ratio
FRATIOPC        : 0.024   !0.024    Phytoplankton Phosphorus/Carbon Ratio
FSOLEXCR        : 0.4     !0.25     Fraction of soluble inorganic material excreted  by phytoplankton
FDISSDON        : 0.5     !0.25     Fraction of dissolved organic material excreted  by phytoplankton
```

OBRIGADO!

HIDROMOD
modelação em engenharia

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