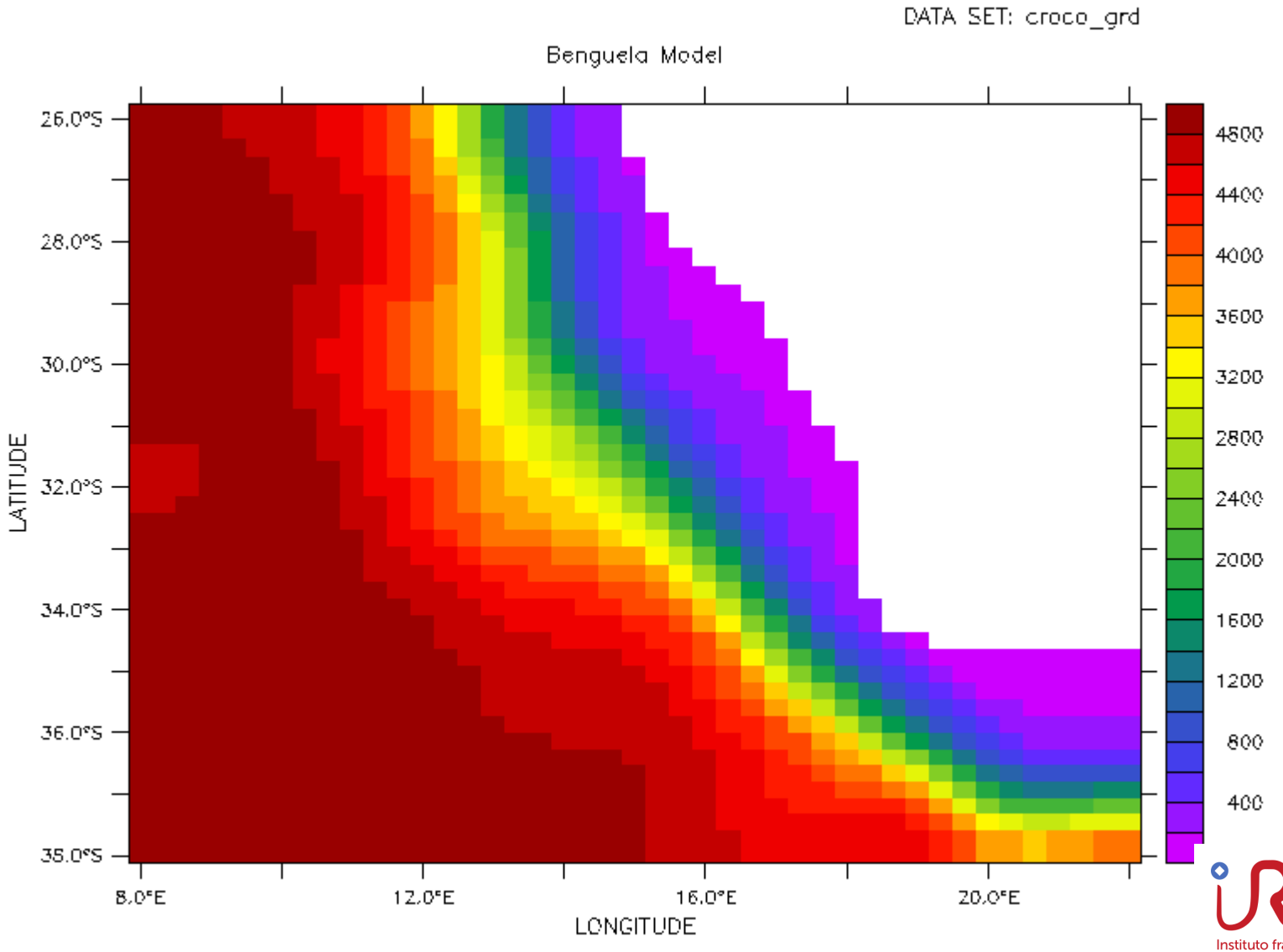
Presentation of the Benguela CROCO test configuration

CROCO
Coastal and Regional Ocean COmmunity model



bottom topography (meters)

Institut de Recherche pour le Développement FRANCE
Instituto francés de Investigación para el Desarrollo

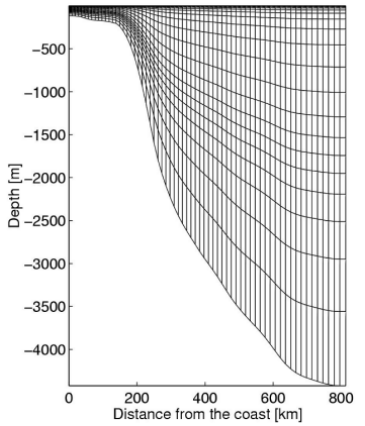
A few words about the CROCO model

- CROCO is an ocean model developped at IRD, INRIA, Ifremer, CNRS and SHOM (french institutes)

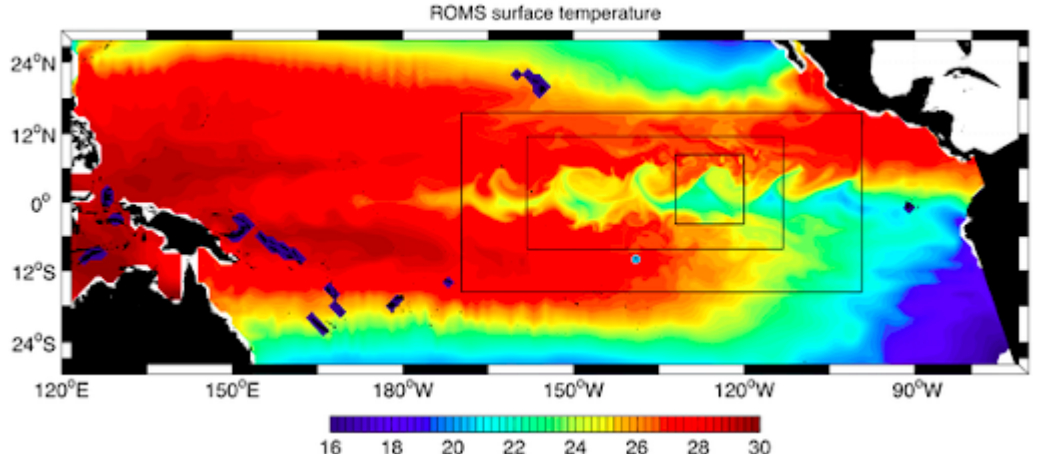
- It is the “next generation “ of ROMS_AGRIF, one of ROMS model branches

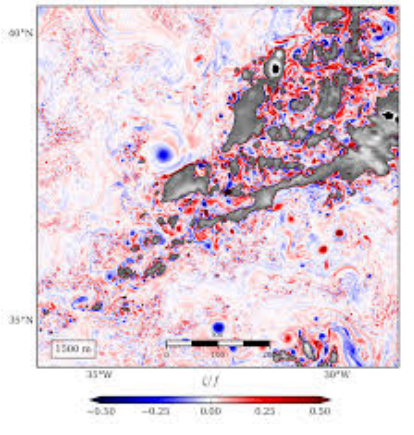
- CROCO is mainly used for regional ocean modeling, can be coupled to biogeochemical models (e.g. PISCES), waves, atmosphere, sediment (see information in https://www.croco-ocean.org)

- CROCO has sigma coordinates



- CROCO can also have embedded zooms





The Benguela CROCO test configuration

- Benguela configuration used to test and implement new parameterizations in CROCO (initially developped by Pierrick Penven, IRD)

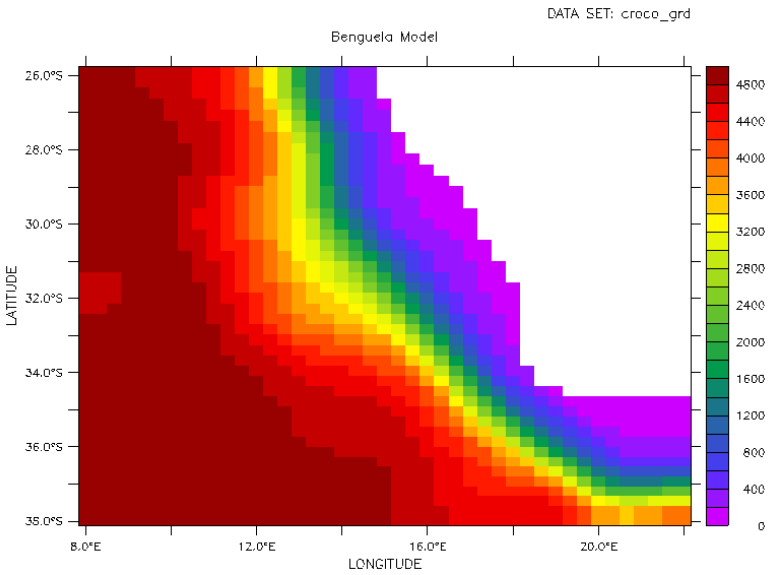
- Low resolution: 1/3°, small number of grid point: nx=41,ny=42, n_sigma=32 (vertical)

- inputs files are netcdf files created using CROCO preprocessing tools (Matlab)

  (see information in https://www.croco-ocean.org/documentation/)

The pre-processing tools will be used this afternoon

We will describe briefly the netcdf input files needed for CROCO-PISCES



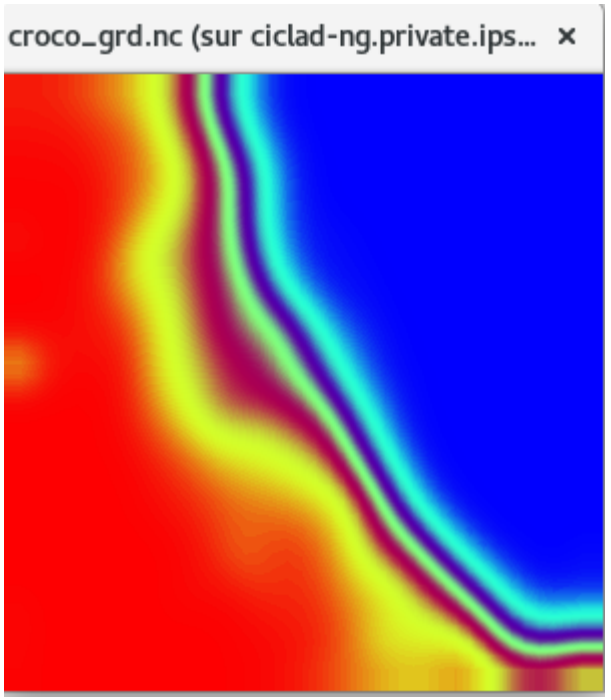
Bottom topography of the model (ferret plot)

the Benguela CROCO test configuration

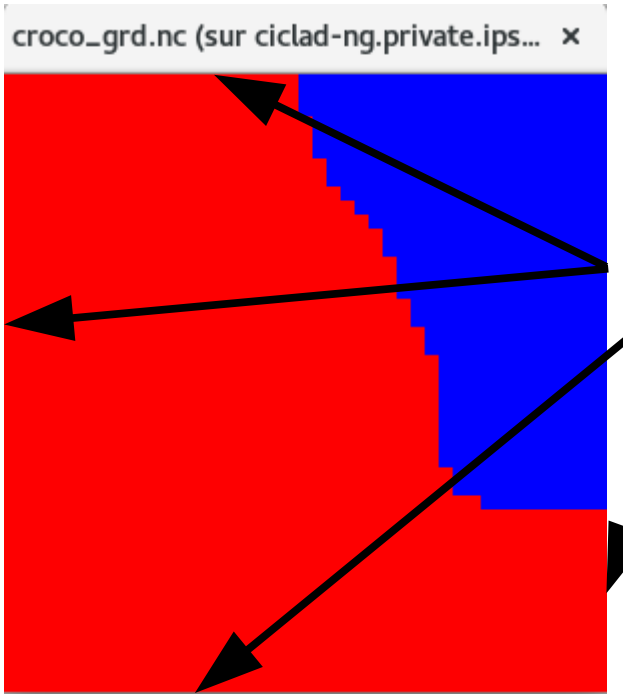
- **croco_grd.nc**: 2D (x,y) grid file containing the bottom topography (h), land mask (mask_rho), and other grid parameters.

You can use ncview to look at the files: “ncview file.nc”

Bottom topography



Land mask (0 for land, 1 for ocean)



Presentation of the Benguela CROCO test configuration

- **croco_clm.nc**: 4D (x,y,z,t) U,V,T,S,zeta in the model domain from **World Ocean Atlas**

  BGC variables: GLODAP & ORCA2- PISCES (global run) climatologies

  nutrients (**NO3,PO4, S**i, Fer) + oxygen (**O2**) + DIC,DOC, TALK (carbonates)

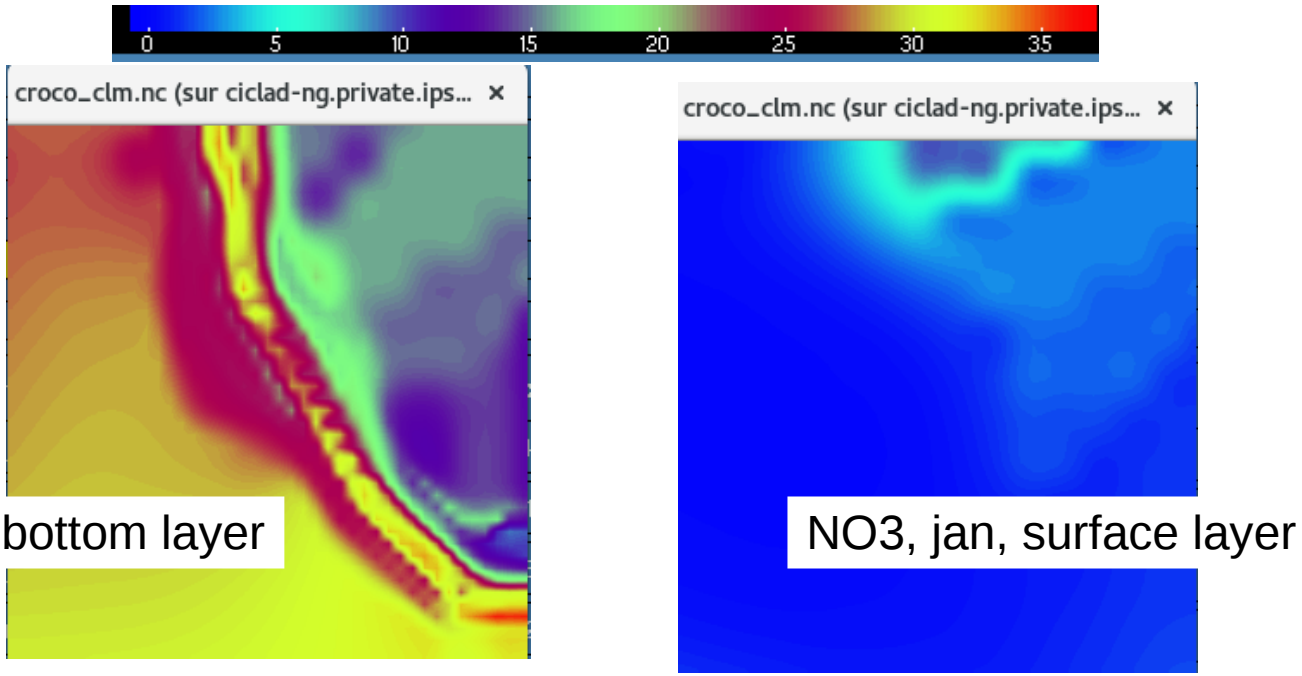
  U,V are computed using geostrophy and a level of reference at 1000 m

  Only values near the 4 open boundaries are used

  Other PISCES variables (e.g. phyto, zoo,…) = constant

  at boundaries

  time=12 values = monthly climatology



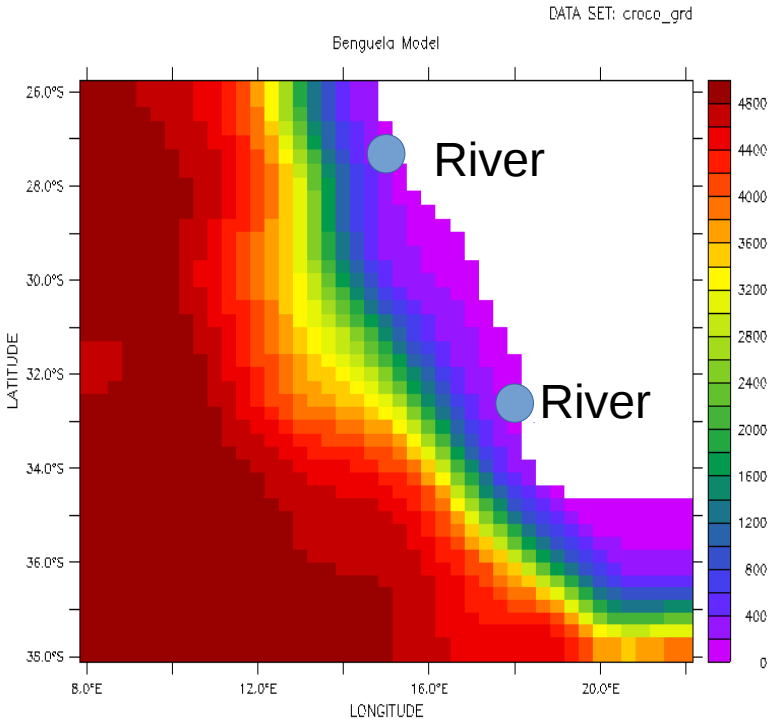
NO3, jan, bottom layer

NO3, jan, surface layer

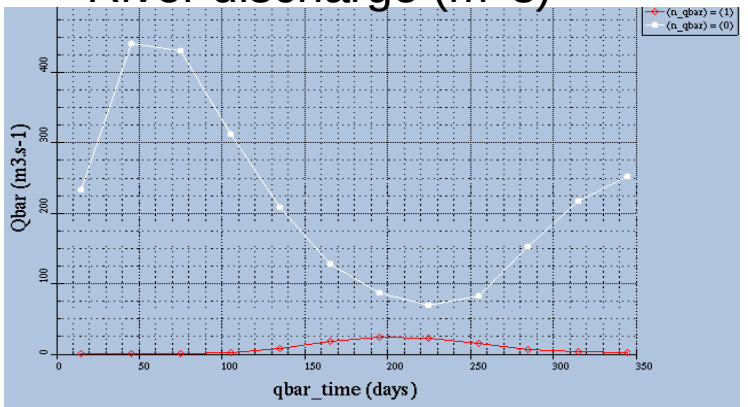
Presentation of the Benguela CROCO test configuration

- **croco_runoff.nc**: 1 D file (t) with river outflow: here two rivers in the region

From global monthly runoff climatology containing 925 biggest rivers over the world, Dai and Trenberth, 2000

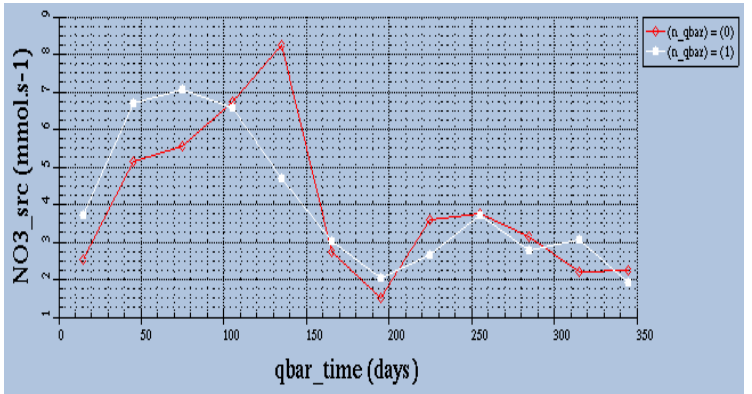


River discharge (m^3/s)



runoff discharge from runoff forcing file (Dai and Trenberth

River NO3 concentration (µmol/kg)



runoff no3 conc. from runoff forcing file (Dai and Trenberth,

=> not used in the practical sessions

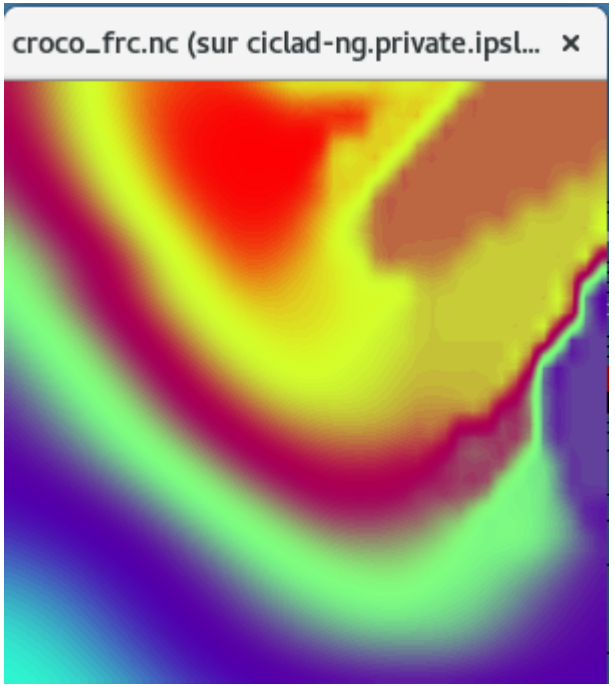
Presentation of the Benguela CROCO test configuration

- **croco_frc.nc**: 3D (x,y,t) atmospheric forcing file containing the wind stress, heat and freshwater fluxes.

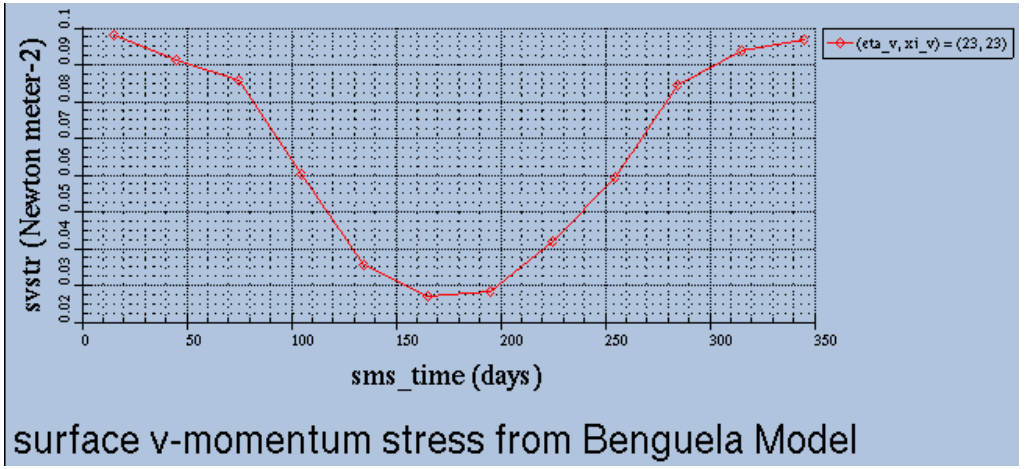
  Climatological forcing (12 months) from Quikscat (Wind stress) and COADS (fluxes)

  ocean values are interpolated over land

Meridional wind stress (january)
from Quikscat climatology

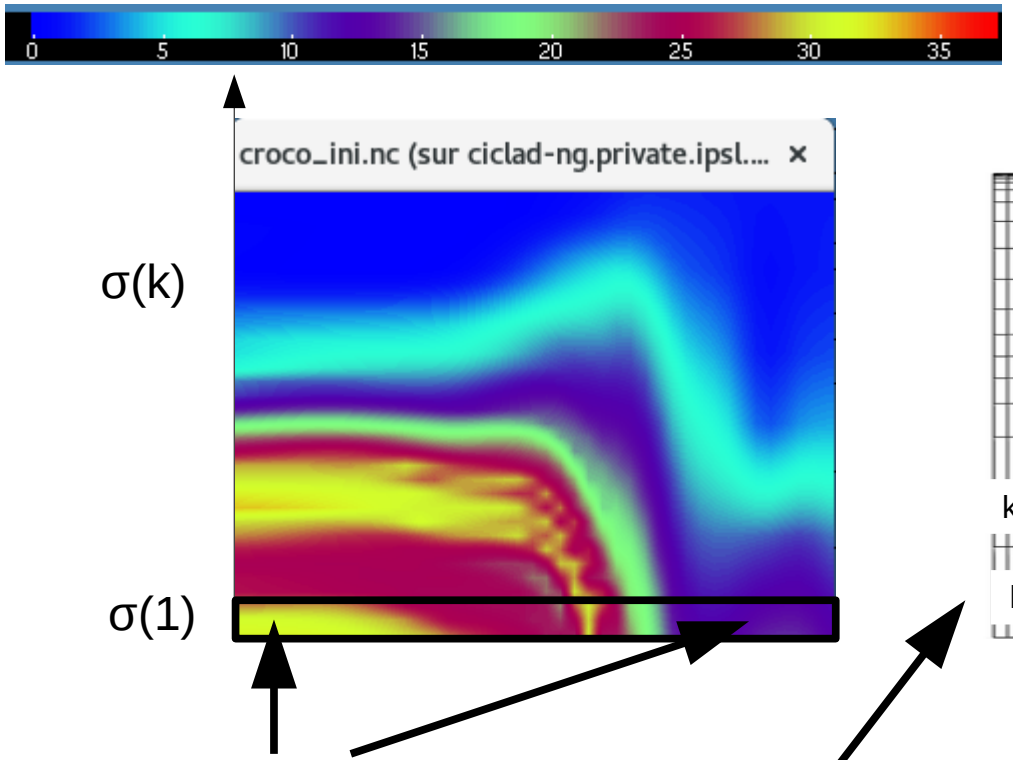


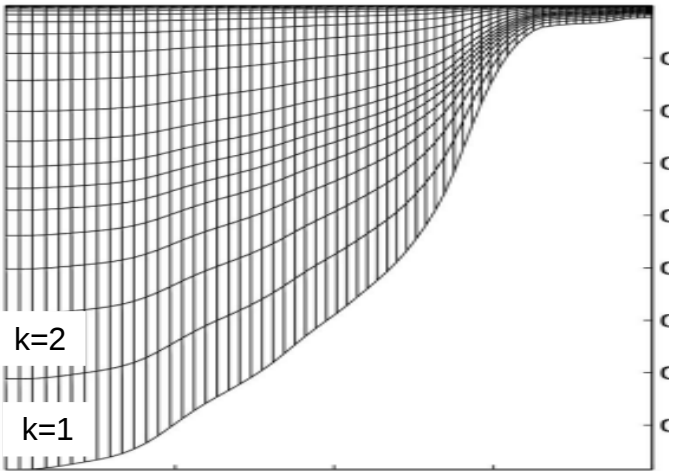
Seasonal cycle of meridional wind stress



Presentation of the Benguela CROCO test configuration

- **croco_ini.nc**: 3D (x,y,z) initial condition file (here january, so identical to 1st file of croco_clm.nc)



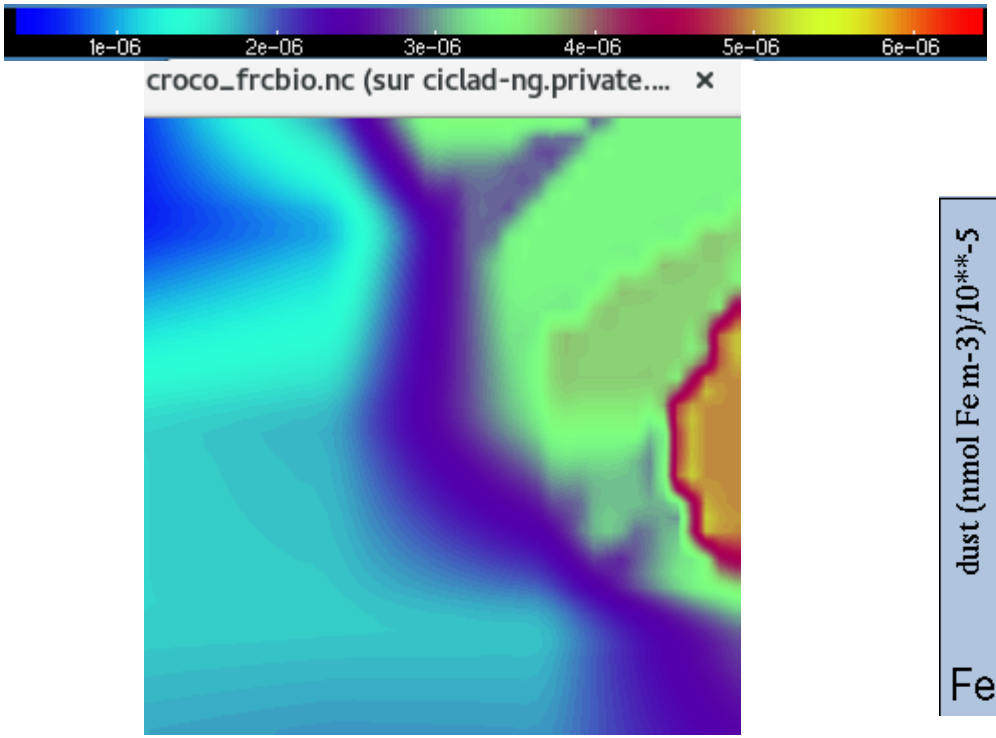


Values in the first layer (k=1):
bottom NO3: high concentration at depth offshore and low concentration nearshore on shelf

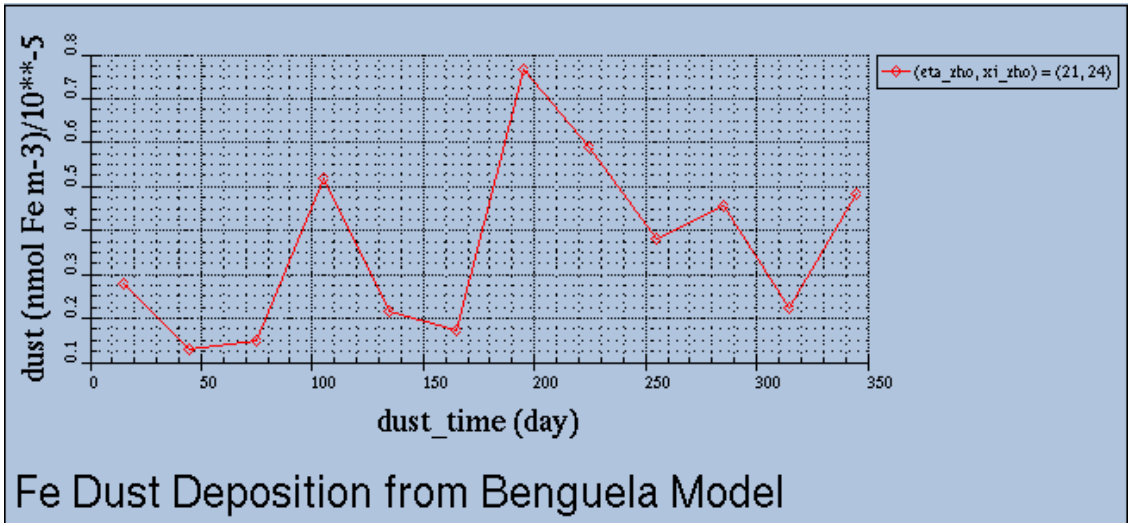
Presentation of the Benguela CROCO test configuration

- **croco_frcbio.nc**: 3D (x,y,t) iron dust deposition file (climatological)

dust, january



Seasonal cycle of dust deposition



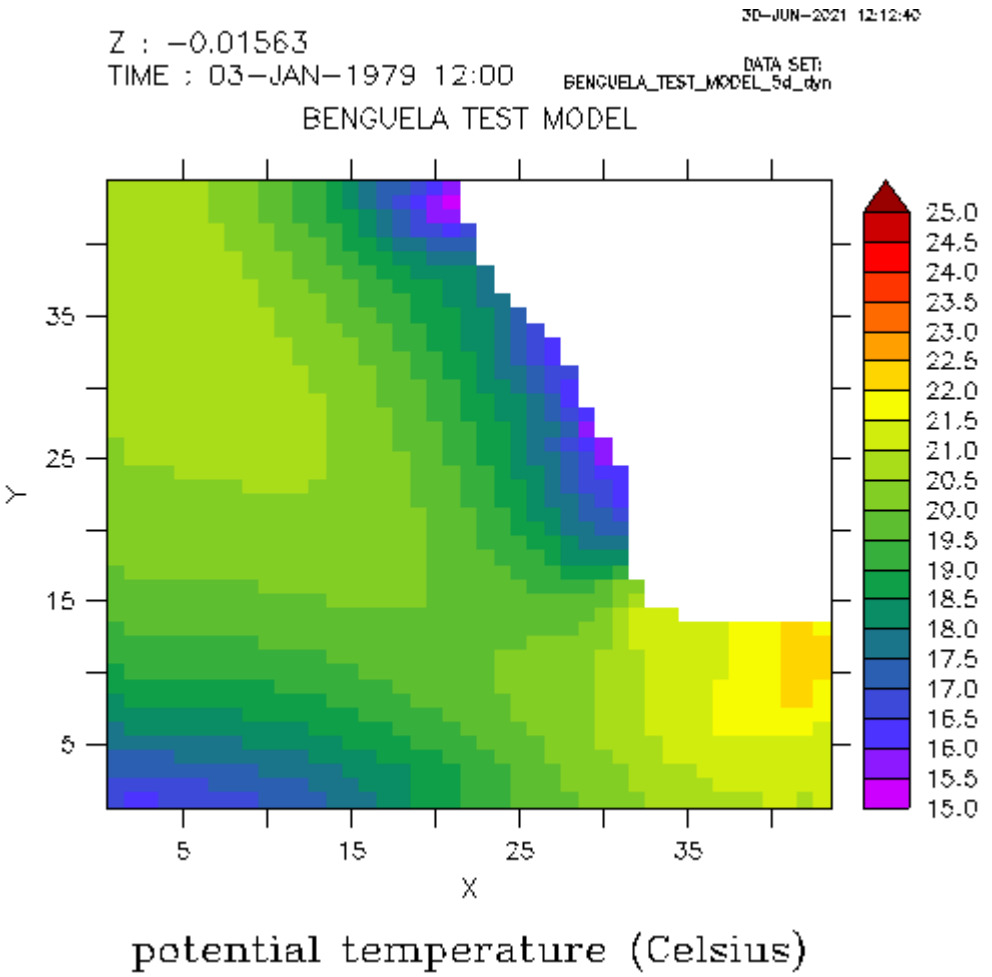
Overview of the model output

(reference simulation, 1 month)

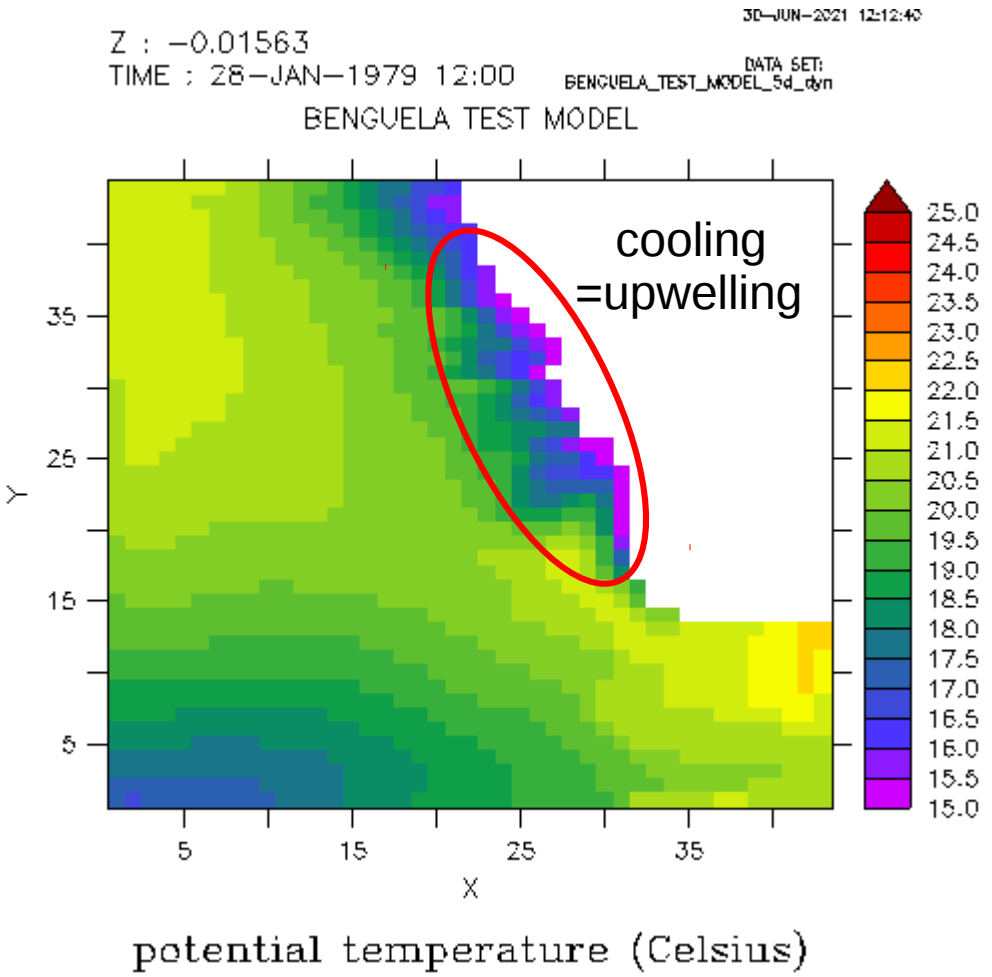
Overview of the model output (1 month of simulation)

SST

First output (0-5 days average)



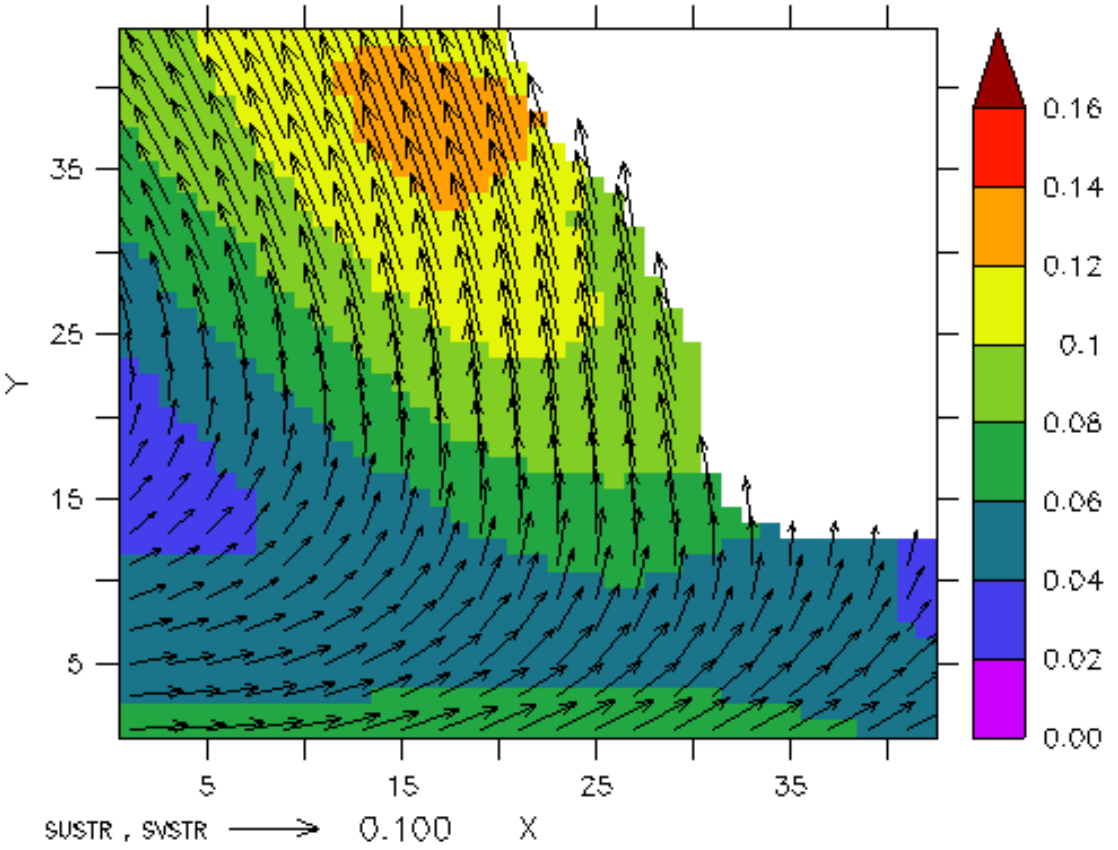
Last output (25-30 days average)



Ferret script : plot_xy_sst.jnl

Surface wind stress

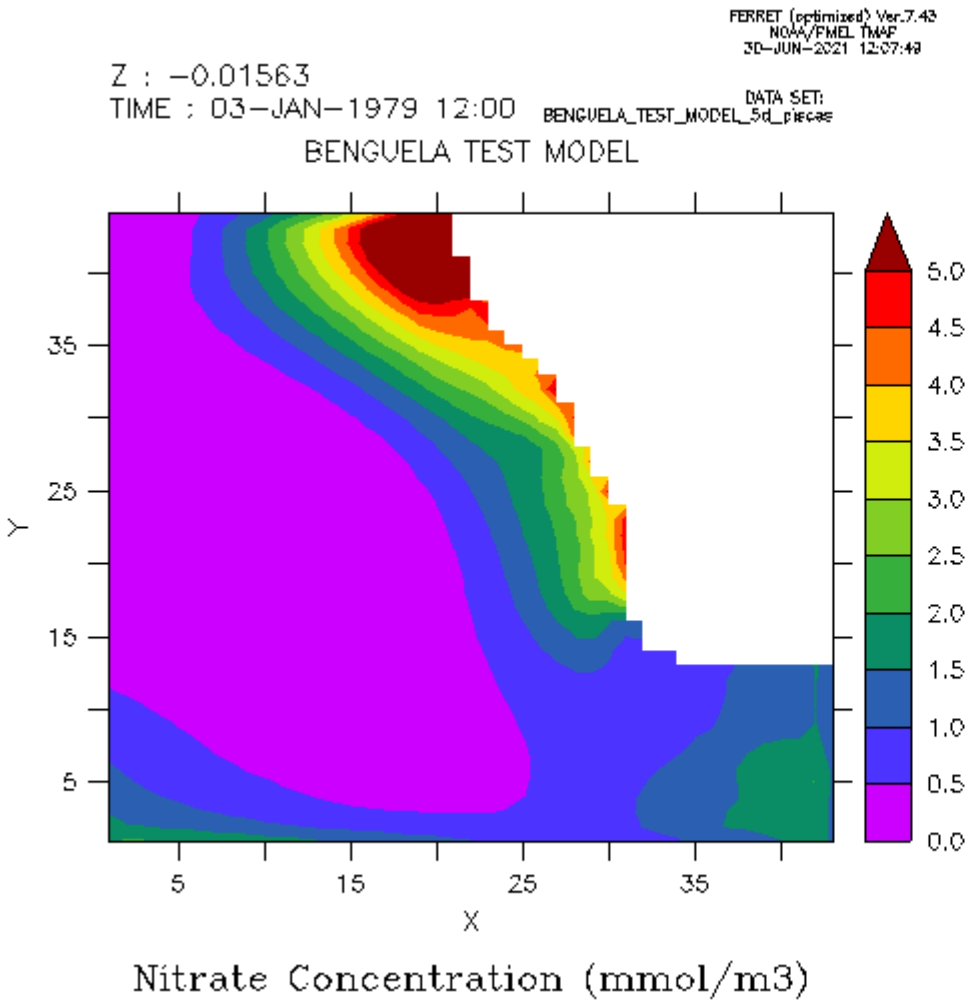
mean state (1-30 days average)



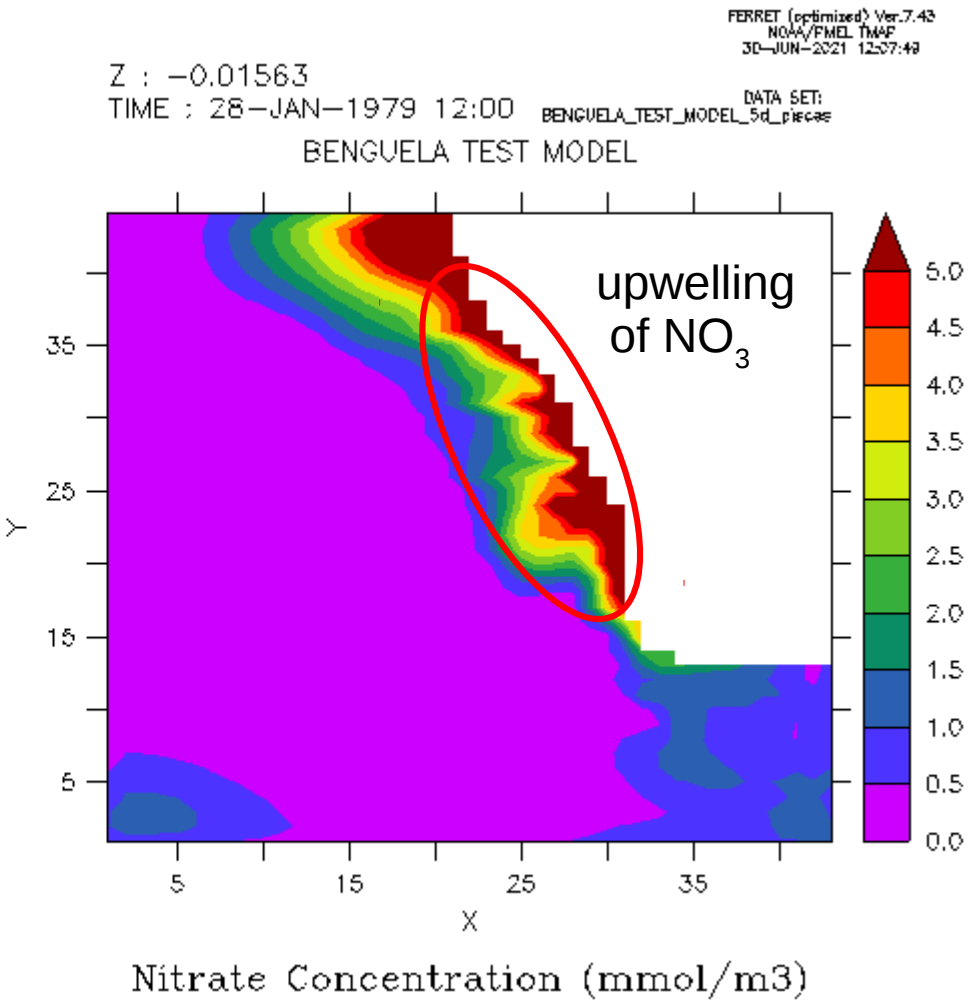
Ferret script : plot_xy_windstress.jnl

Surface Nitrate

First output (0-5 days average)



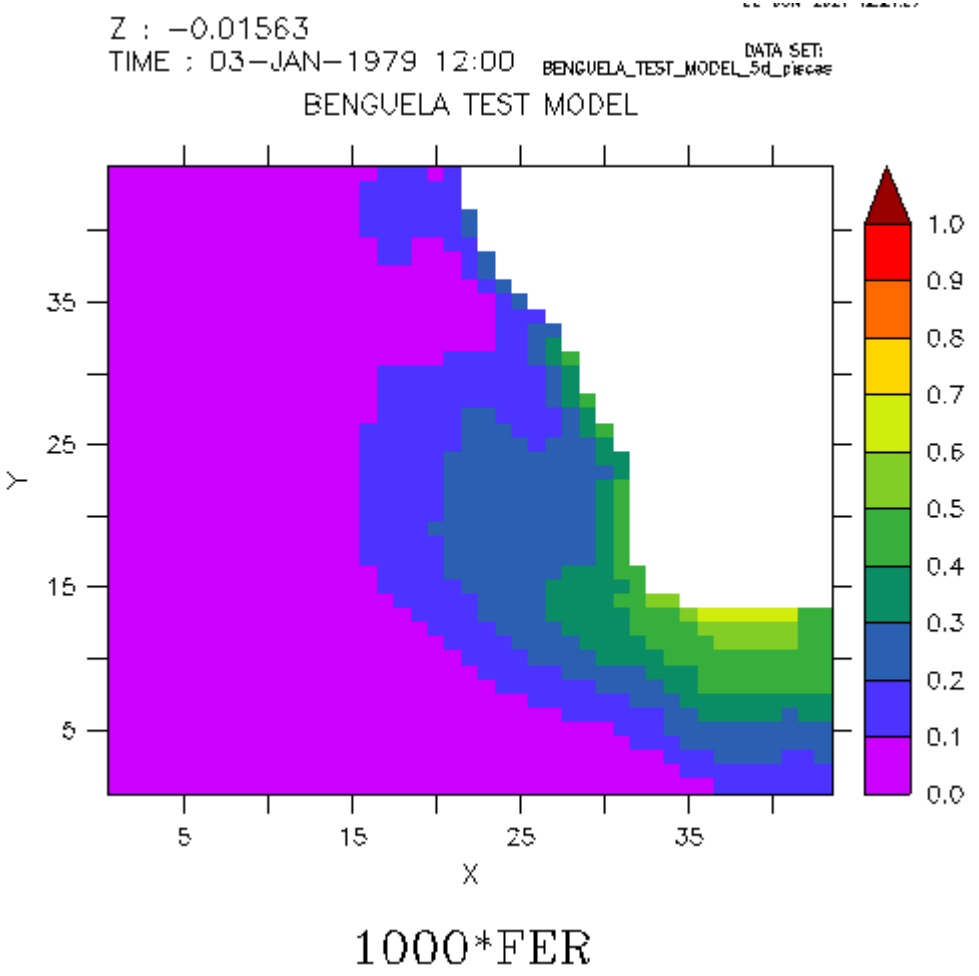
Last output (25-30 days average)



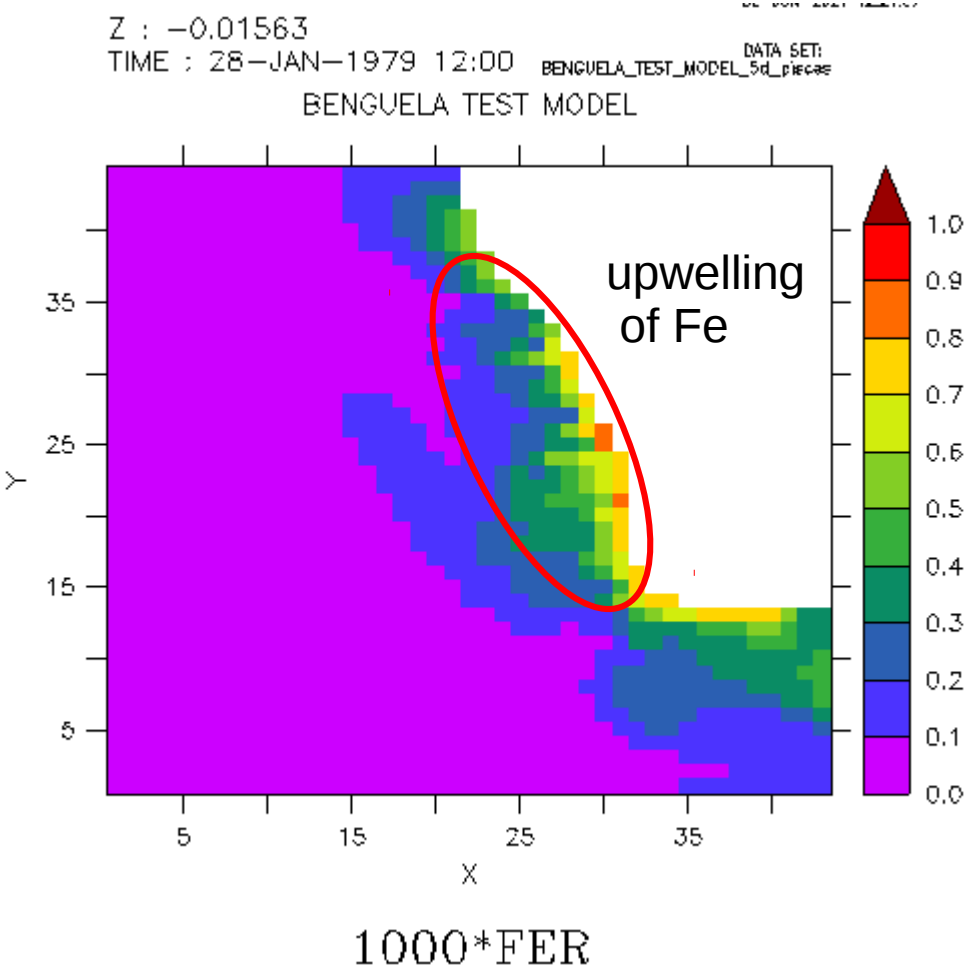
Ferret script : plot_xy_no3_surf.jnl

Surface Iron (in nanomol L^{-1})

First output (0-5 days average)



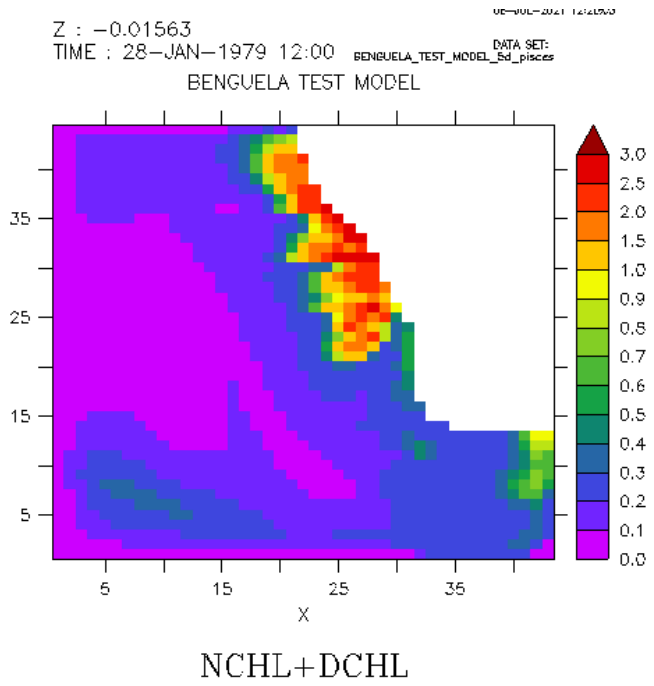
Last output (25-30 days average)



Ferret script : plot_xy_fe_surf.jnl

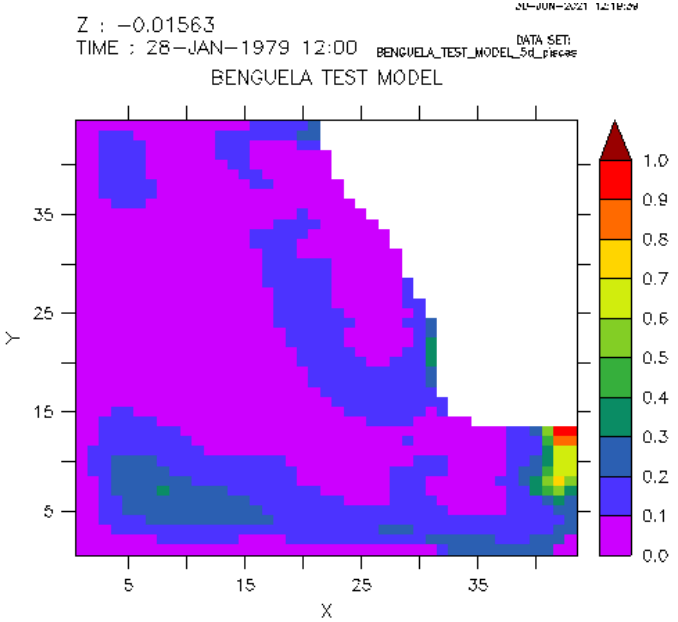
Surface chlorophyll

Total Chl (mgChl/m³)



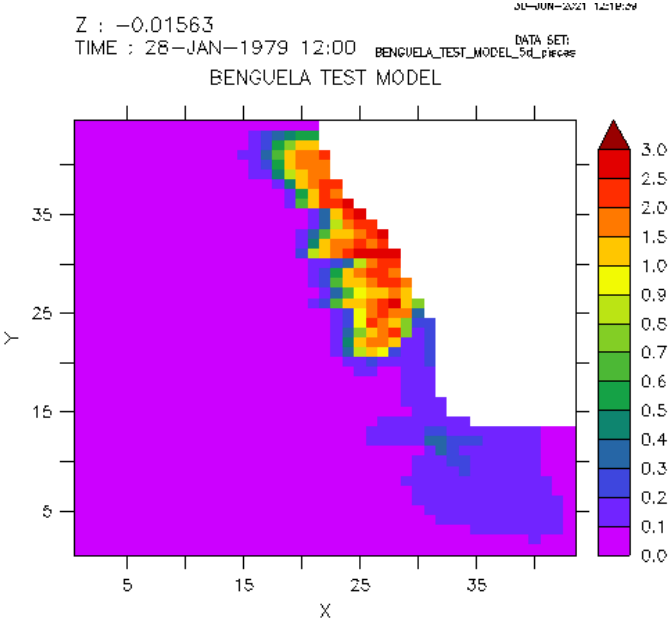
NCHL+DCHL

Chl in nanophyto



Nano chlorophyl Concentration (mg/m3)

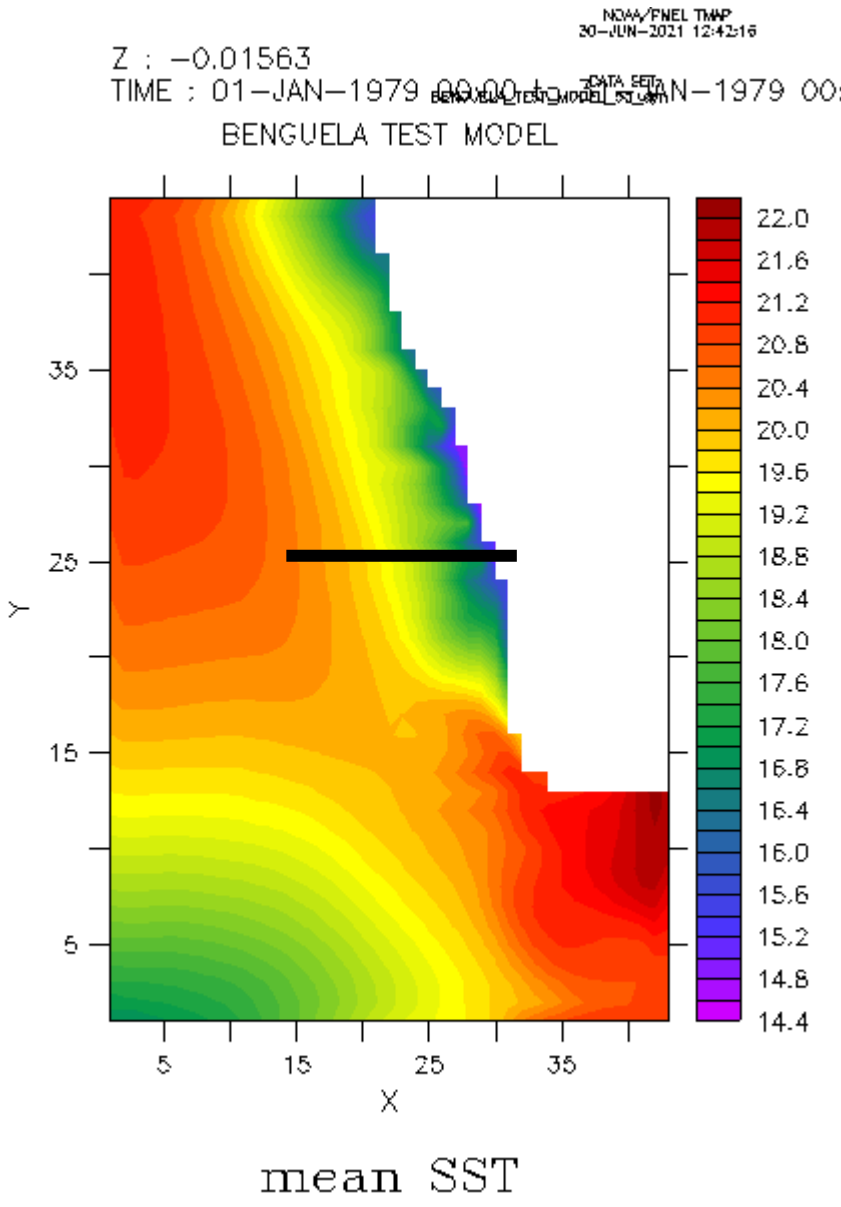
Chl in Diatoms



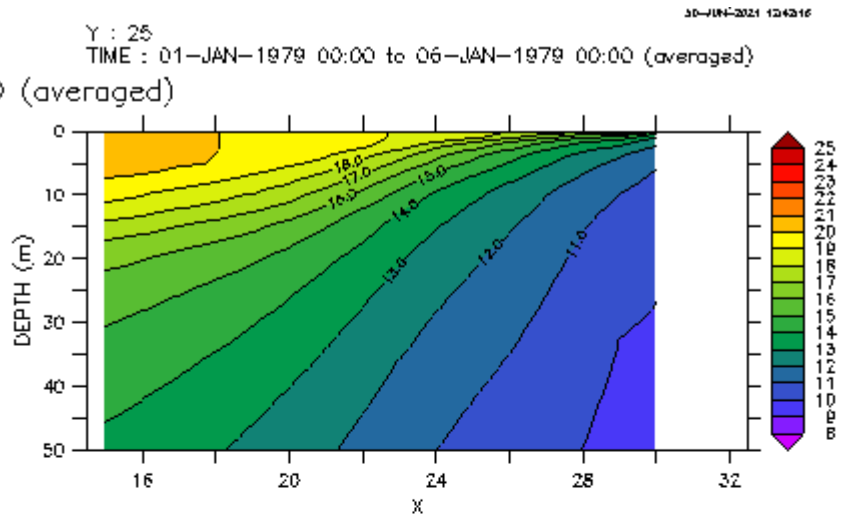
Diatoms chlorophyl Concentration (mg/m3)

Ferret scripts : plot_xy_chl_surf.jnl; plot_xy_nchl_dchl_surf.jnl

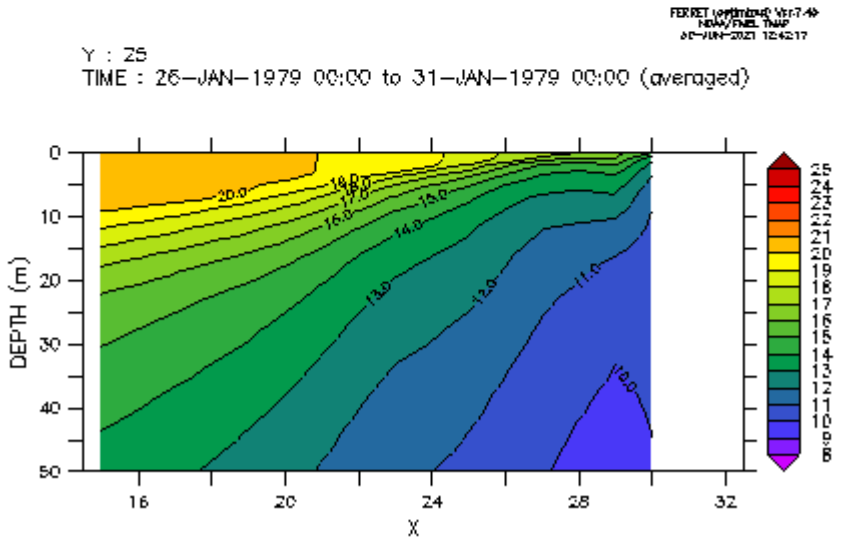
Temperature vertical section



mean SST



temperature, j=25,l=1

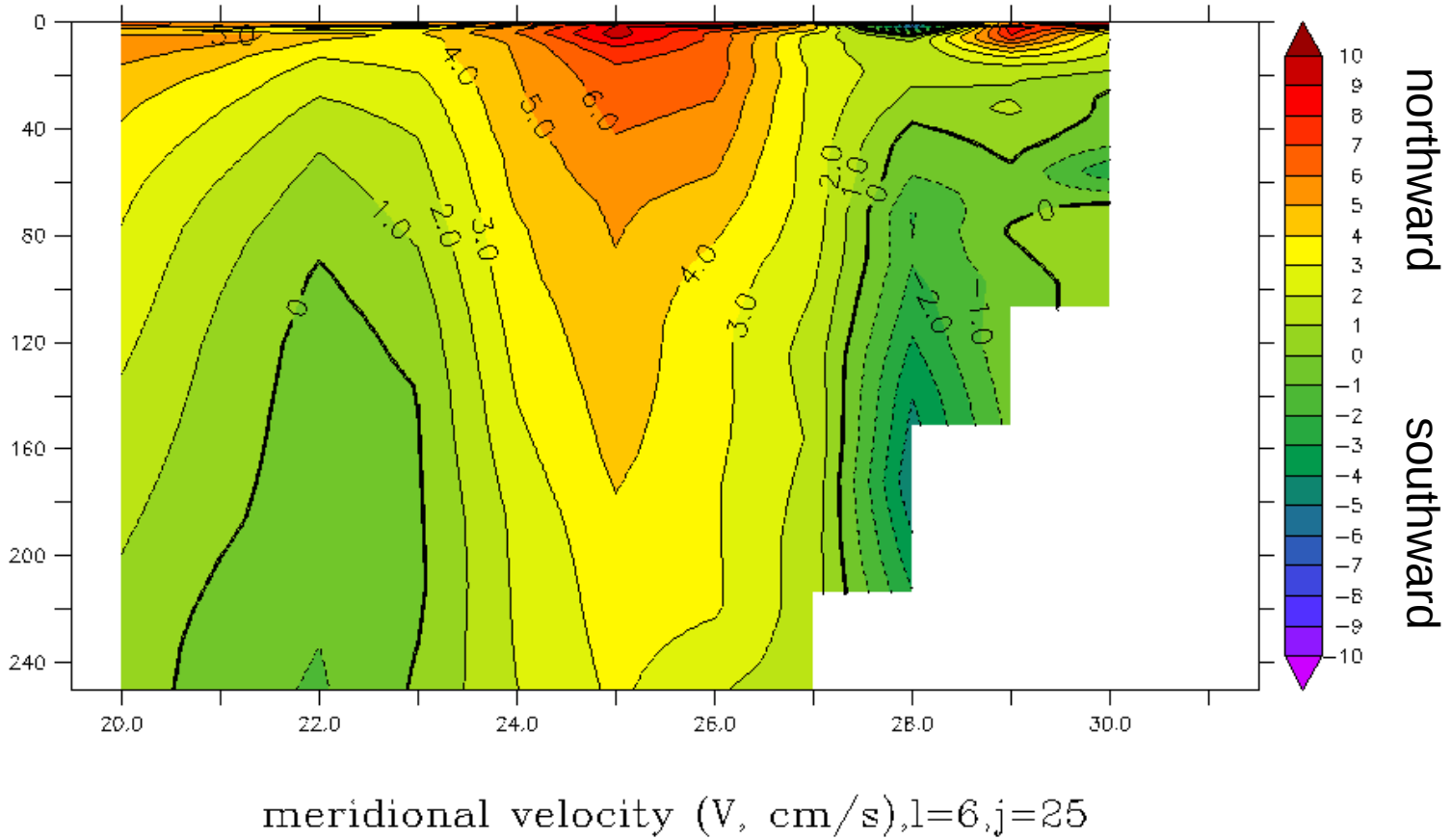


temperature, j=25,l=6

Ferret script : plot_xz_temp.jnl

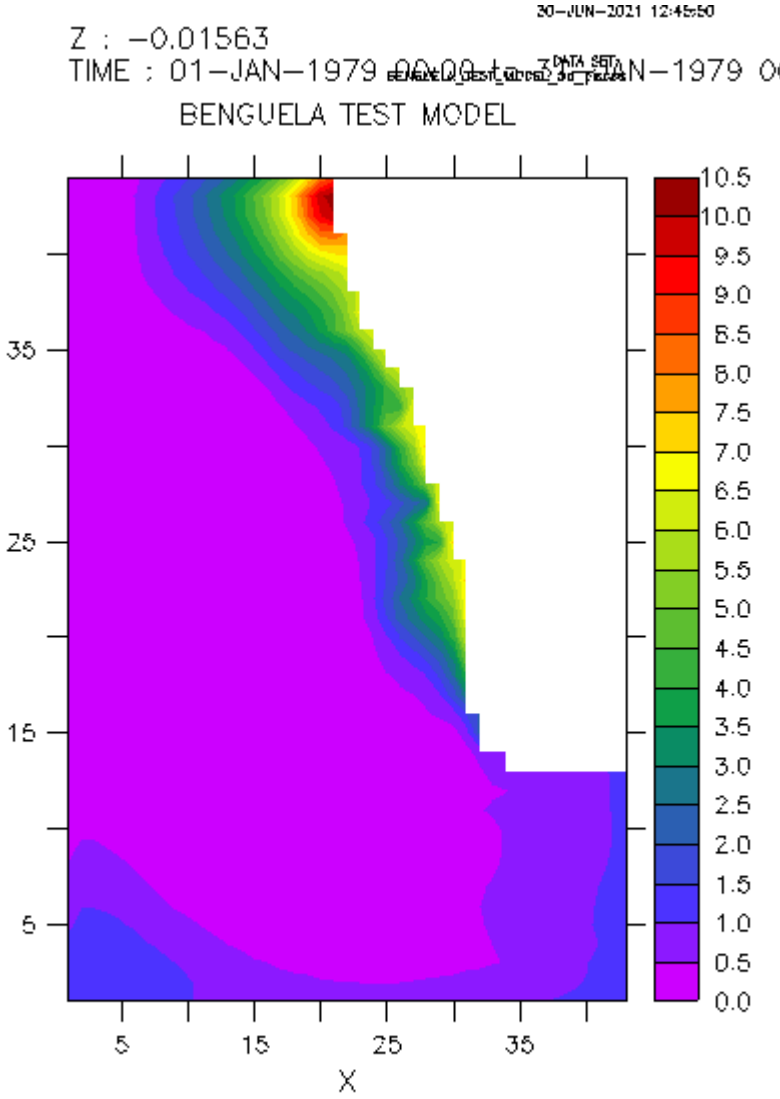
Meridional velocity section

mean state (25-30 days average)

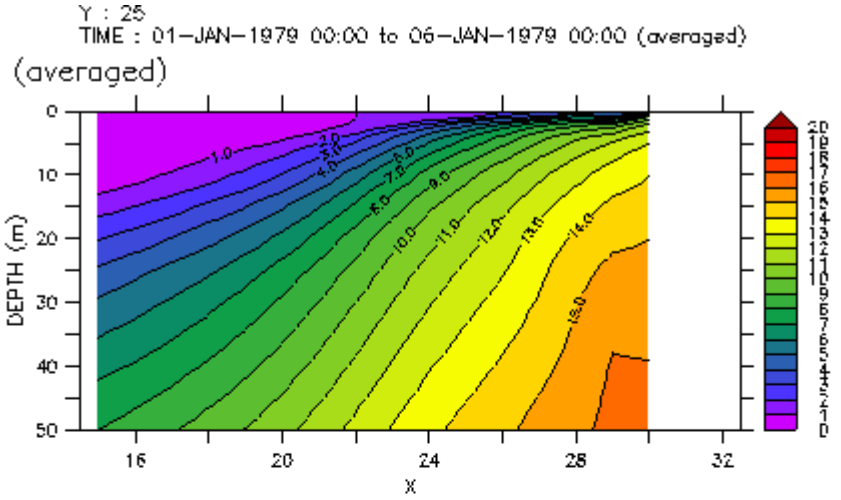


Ferret script : plot_xz_v.jnl

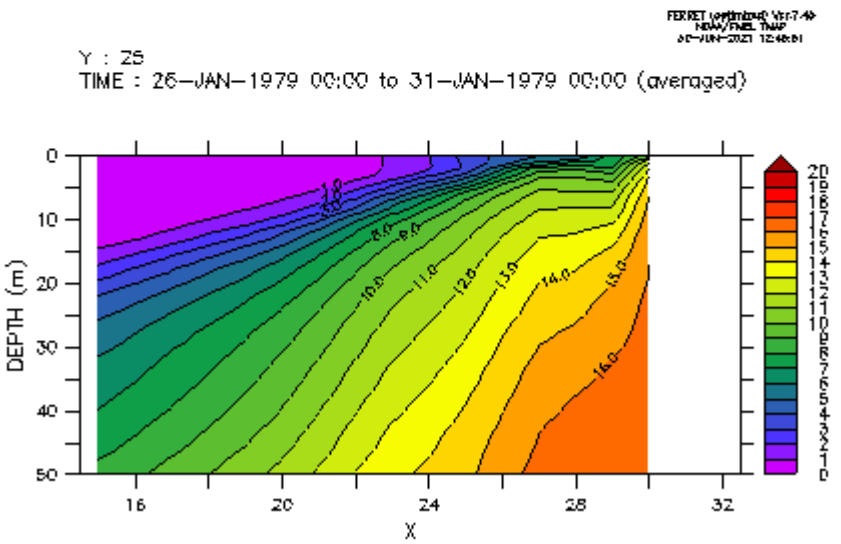
Nitrate section



mean surface NO3



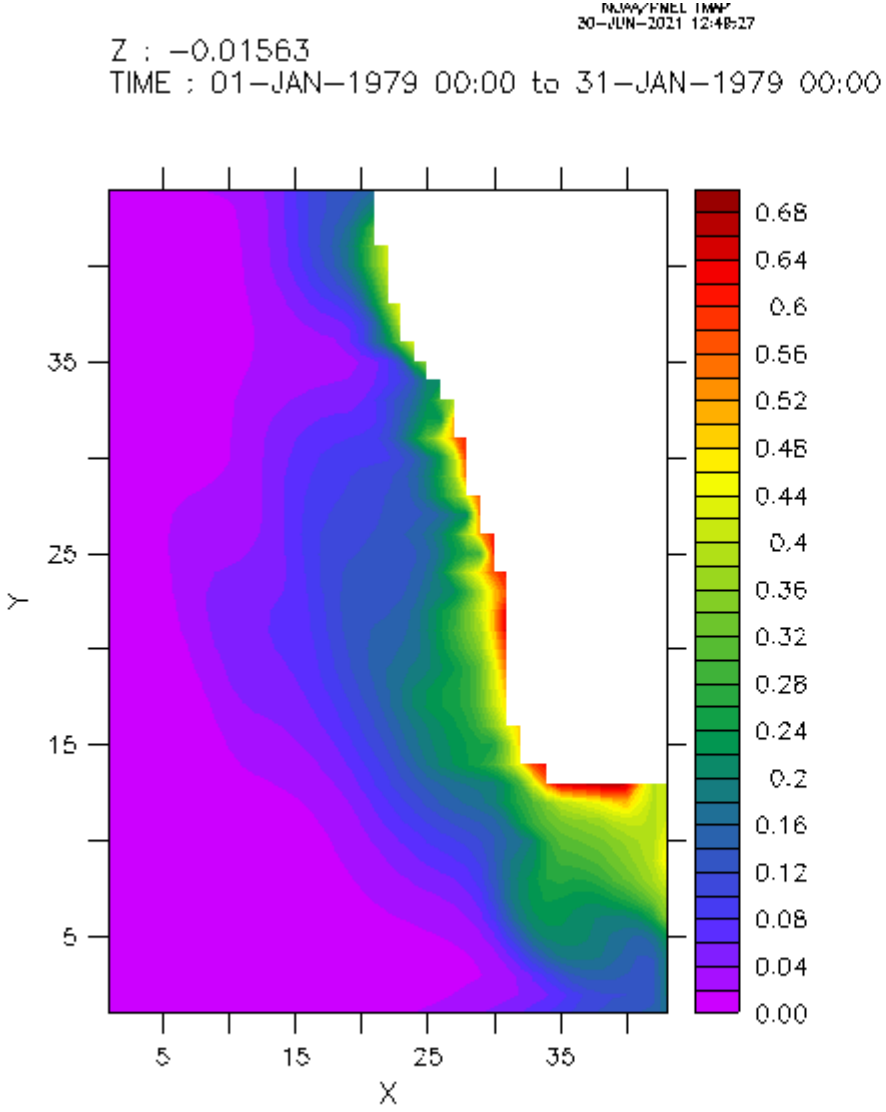
NO3, j=25,l=1



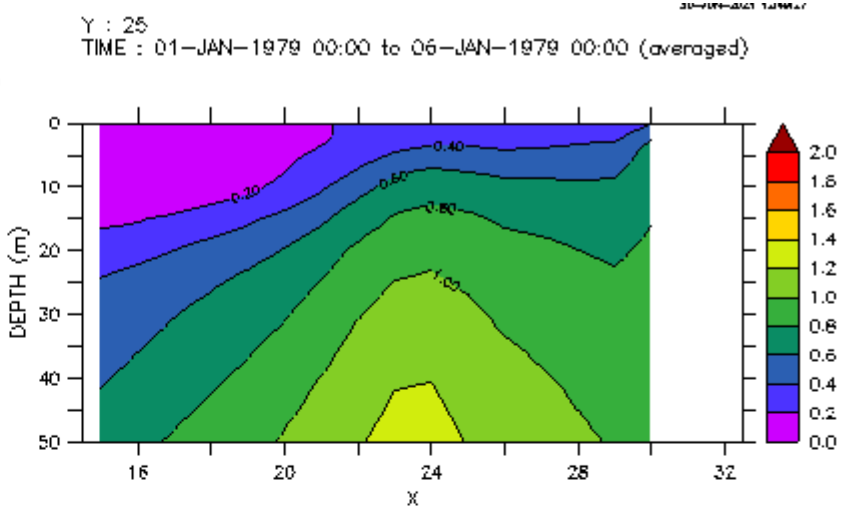
NO3, j=25,l=6

Ferret script : plot_xz_no3.jnl

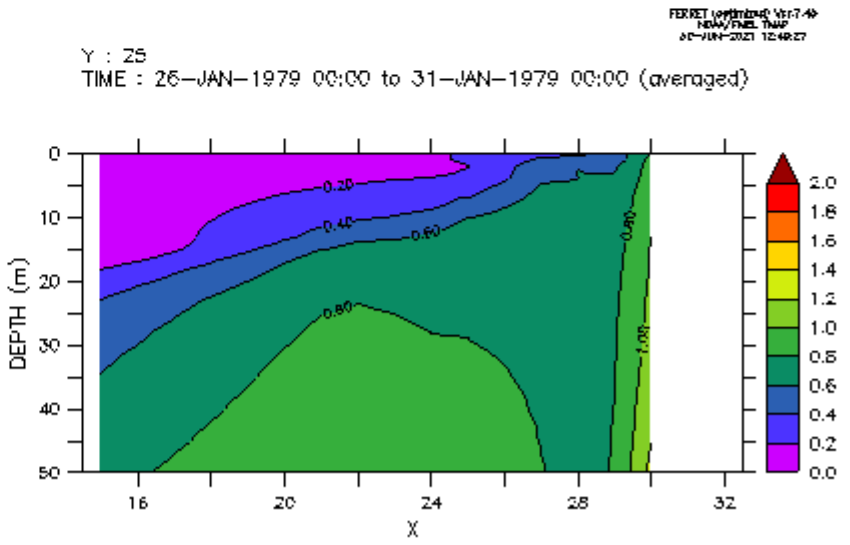
Fer section



mean surface fe



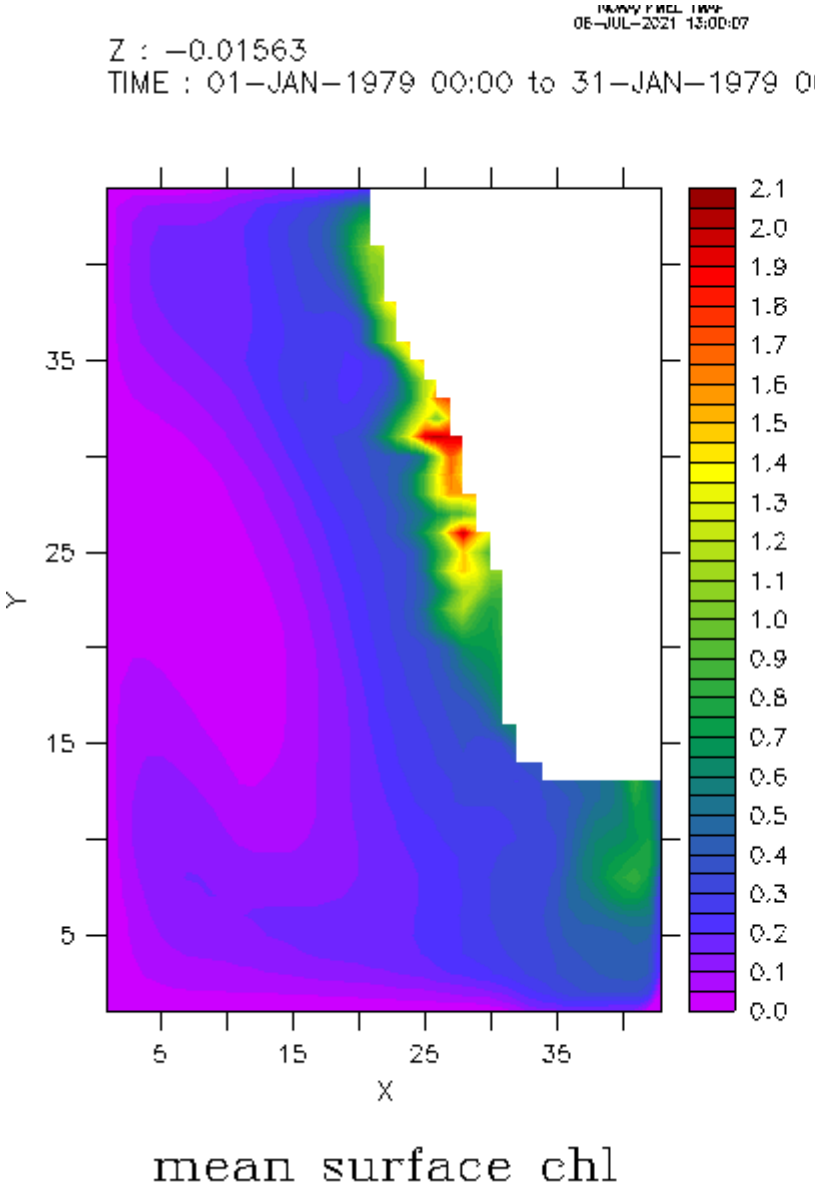
fer, j=25,l=1

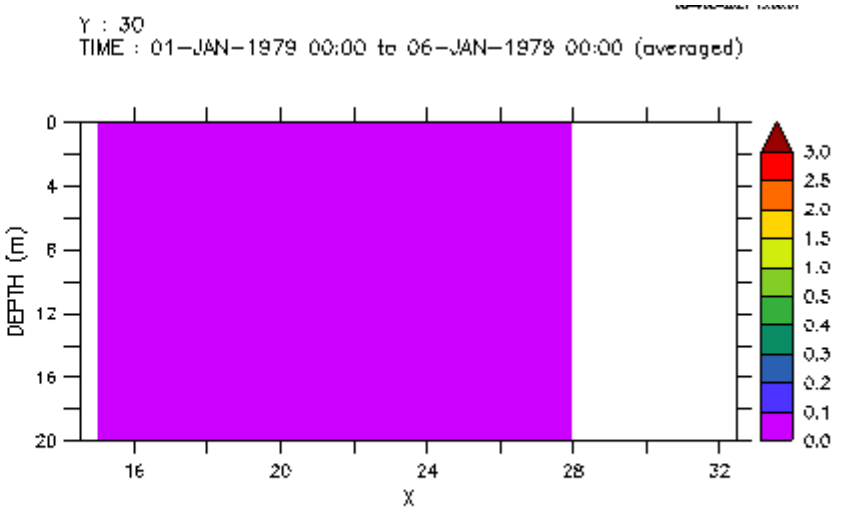


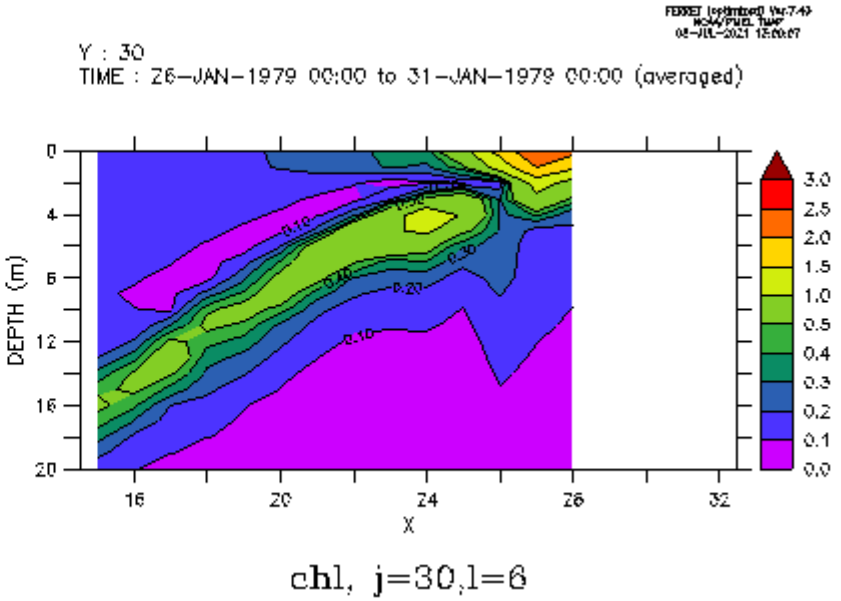
fer, j=25,l=6

Ferret script : plot_xz_fer.jnl

Total chlorophyll section

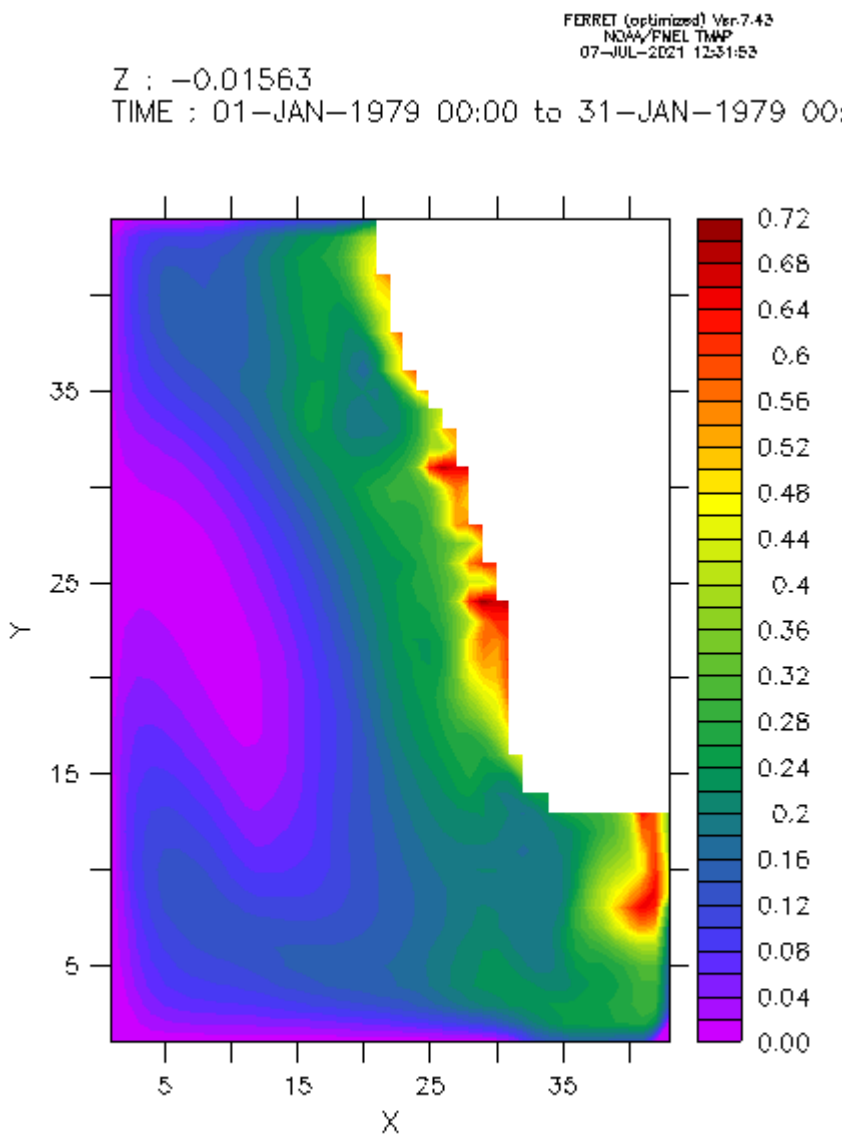




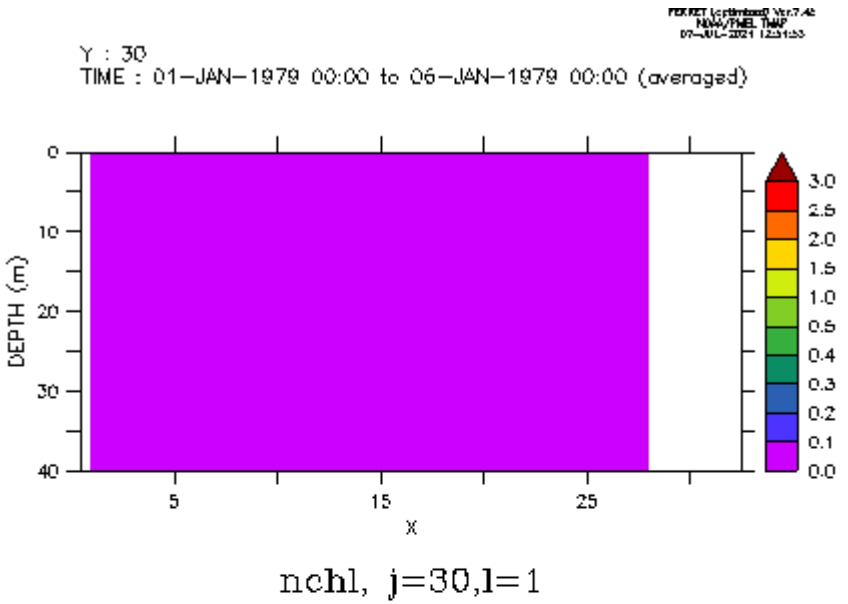


Ferret script : plot_xz_chl.jnl

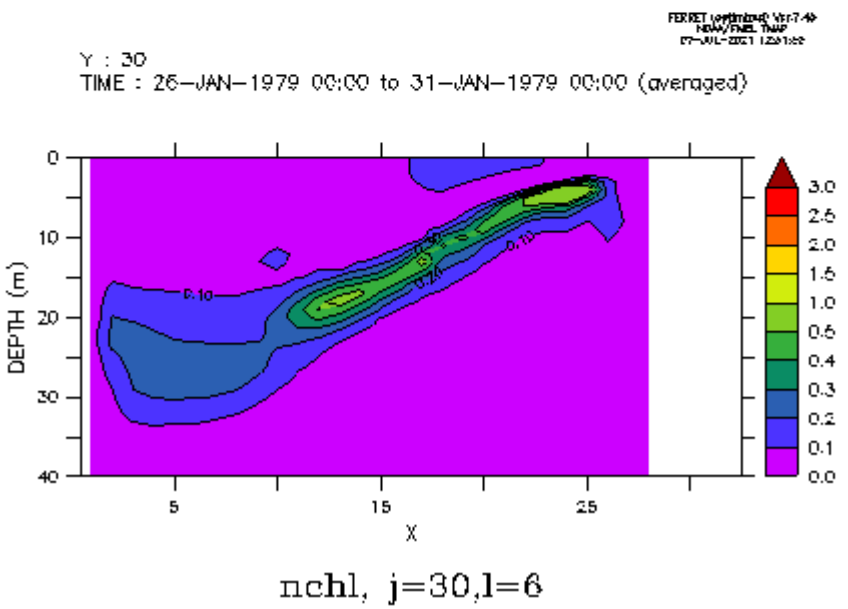
NCHL (chl in nanophyto) section



mean surface nchl



nchl, j=30,l=1



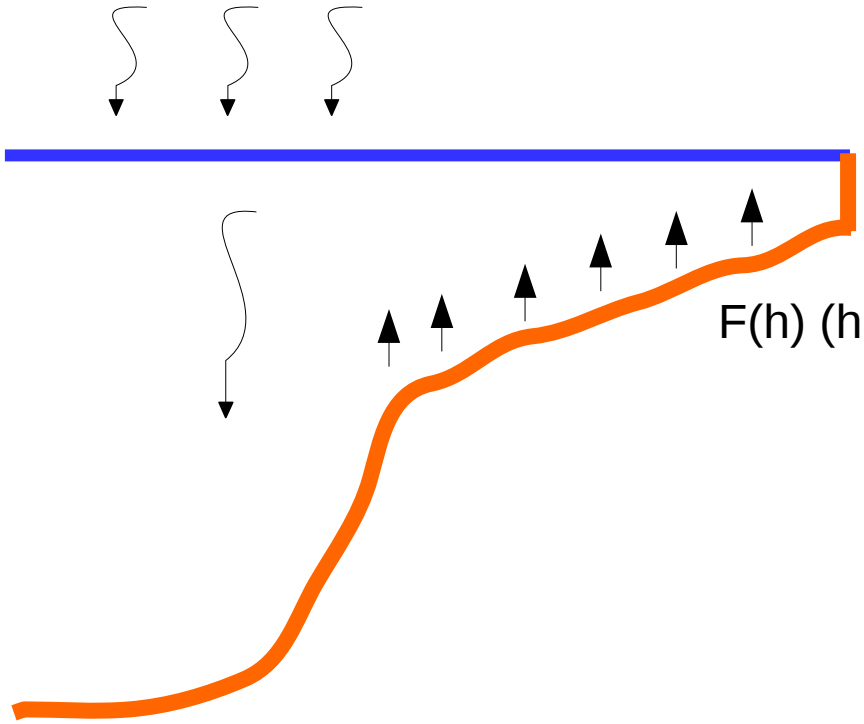
nchl, j=30,l=6

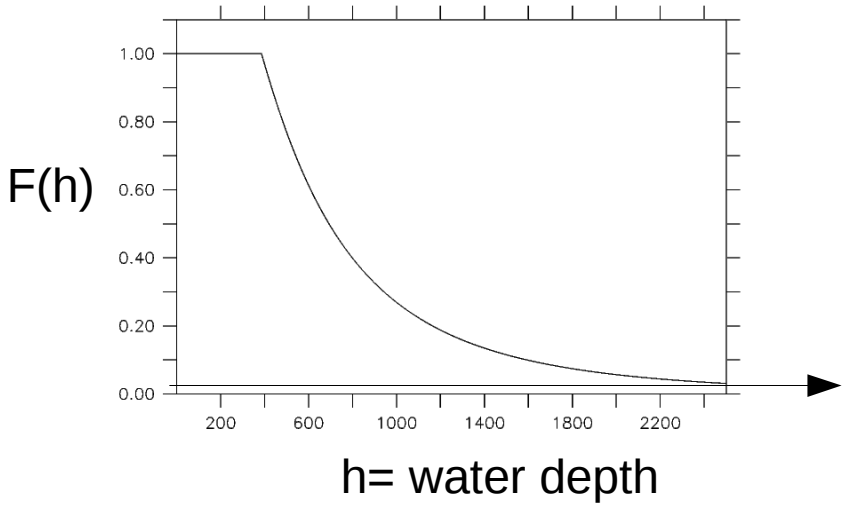
Ferret script : plot_xz_nchl.jnl

Testing some parameters with PISCES (second day)

Iron flux from sediments = can be limiting (California, Peru,…)
Messié and Chavez (2015)

Dust containing Iron (croco_frcbio.nc)

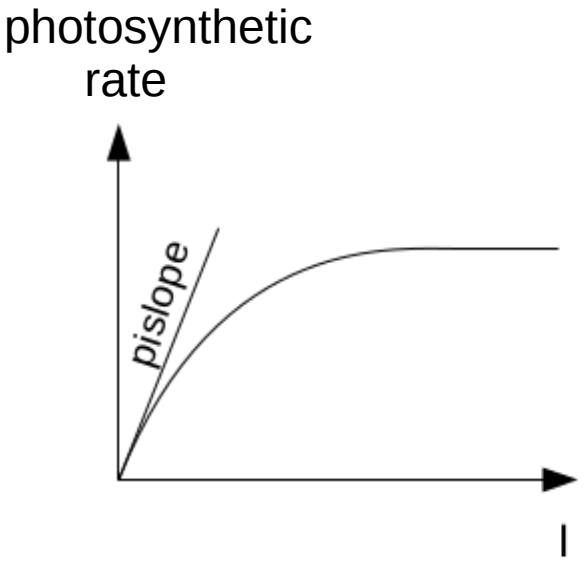


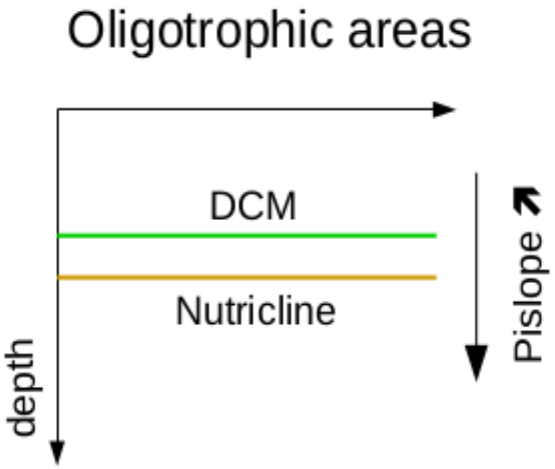


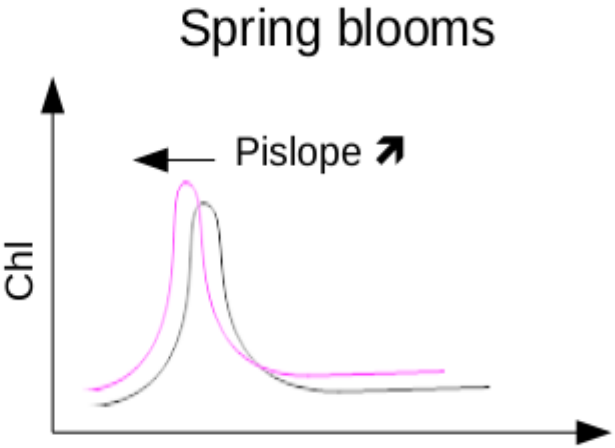
Sediment-derived iron flux from the sediment can be switched on/off in PISCES

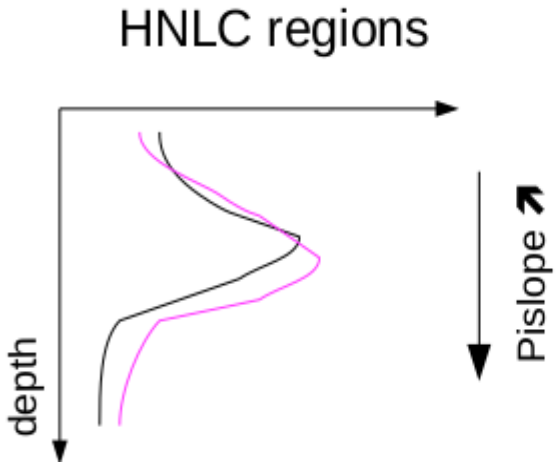
Testing some parameters with PISCES (second day)

pislope/pislope2
= photosynthesis-Irradiance relationship









Model results are very sensitive to pislope

It impacts all aspects of phytoplankton

Directly impacts Fe/C and Chl/C

Testing some parameters with PISCES (second day)

Grazing rates

- Results are very very sensitive to the grazing rates
- Mesozooplankton: easily predictable changes because at the end of the food web
- Microzooplankton: much more difficult because it grazes and it is grazed => non linear