CROCO Webinars #1

Python pre-processing tools for CROCO – 2.0.3

Friday, February 6th, 2026 at 1:30 PM (France time)

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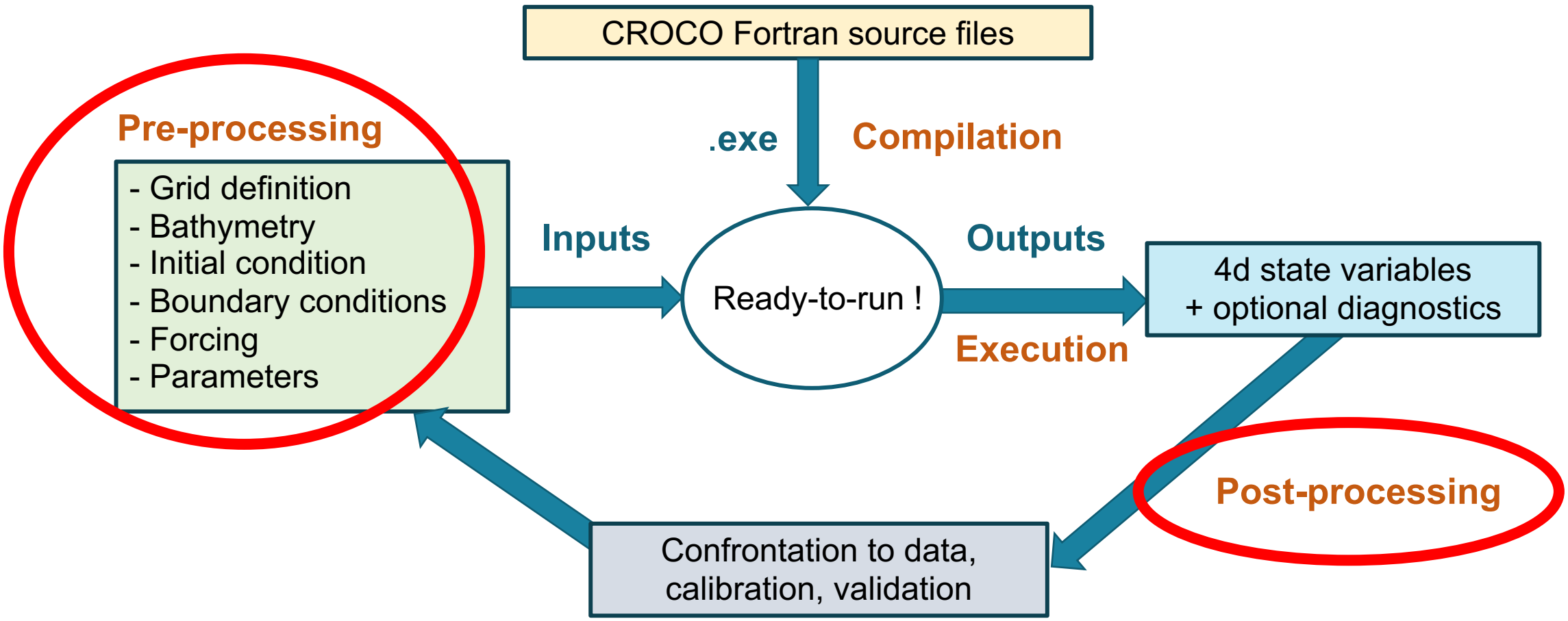
On behalf of the CROCO pytools development team

CROCO
Coastal and Regional Ocean COmmunity model

cnrs Ifremer Inria IRD SHOM Communauté d'universités et établissements de Toulouse

Why do we need tools ?

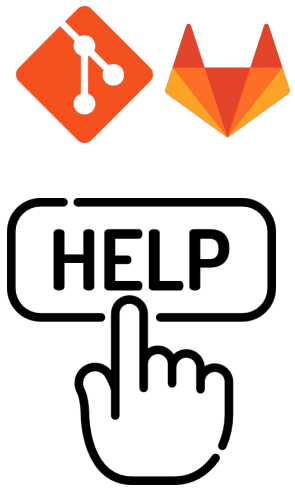


What is CROCO_PYTOOLS ?

It's a python toolbox for pre-processing, post-processing, and visualization for CROCO

It includes :

- **prepro:** preparation of input files required to run realistic CROCO simulations
- xcroco: analysis of CROCO outputs using xarray and xgcm



Code repository:

https://gitlab.inria.fr/croco-ocean/croco_pytools

Documentation:

https://croco-ocean.gitlabpages.inria.fr/croco_pytools

Forum:

https://forum.croco-ocean.org/

Installation

env.yml → python environment → f2py compilation → Ready to use

Python environment :

Pre-configured environment provided: env.yml
Includes all Python dependencies (e.g., NumPy, matplotlib, f2py)
Create and activate, example with conda:

```
conda env create -f env.yml
conda activate croco_pyenv
```

Fortran tools, interfaced through f2py : must be compiled

Some routines are written in Fortran and must be compiled
Compilation example:

```
cd prepro/Modules/tools_fort_routines
make
```

Improve on Apple chip

Reference and tutorial :

https://croco-ocean.gitlabpages.inria.fr/croco_pytools/prepro/tuto.env.html

Preprocessing pipeline

Splitting the preparation of CROCO inputs into independent steps:

Grid > Initial conditions > Boundary conditions > (Tides) > (Rivers)

CROCO_FILES READY !

What CROCO_PYTOOLS/prepro provides

- Python scripts & notebooks (`make_*.py`, `nb_*.ipynb`)
- Configurable via `.ini` files (see Examples)
- Data readers (variable mapping dictionary `readers.jsonc`)
- Download tools included (`download_*.py`)

Use separate `.ini` files per step, or a single merged configuration file for the whole pipeline

Downloading data

Scripts available for : **ERA5**, **GLOFAS**, **HYCOM** and **Mercator** products

Use -h or --help to have usage informations

Configuration file with parameters :

- to request an extent from a CROCO grid netcdf file or a specified area,
- to choose a product and the variables needed
- to request a specific period of time …

Download scripts can be long to run if you request a large amount of data

Accounts needed :

- ERA5: define your ~/.cdsapirc with key & url https://cds.climate.copernicus.eu/api
- GLOFAS: define your ~/.cdsapirc with key & url https://ewds.climate.copernicus.eu/api
- MERCATOR: provide login and password directly with command options
  or provide credentials file ~/.copernicusmarine/.copernicusmarine-credentials

Follow up copernicus API

Make grid

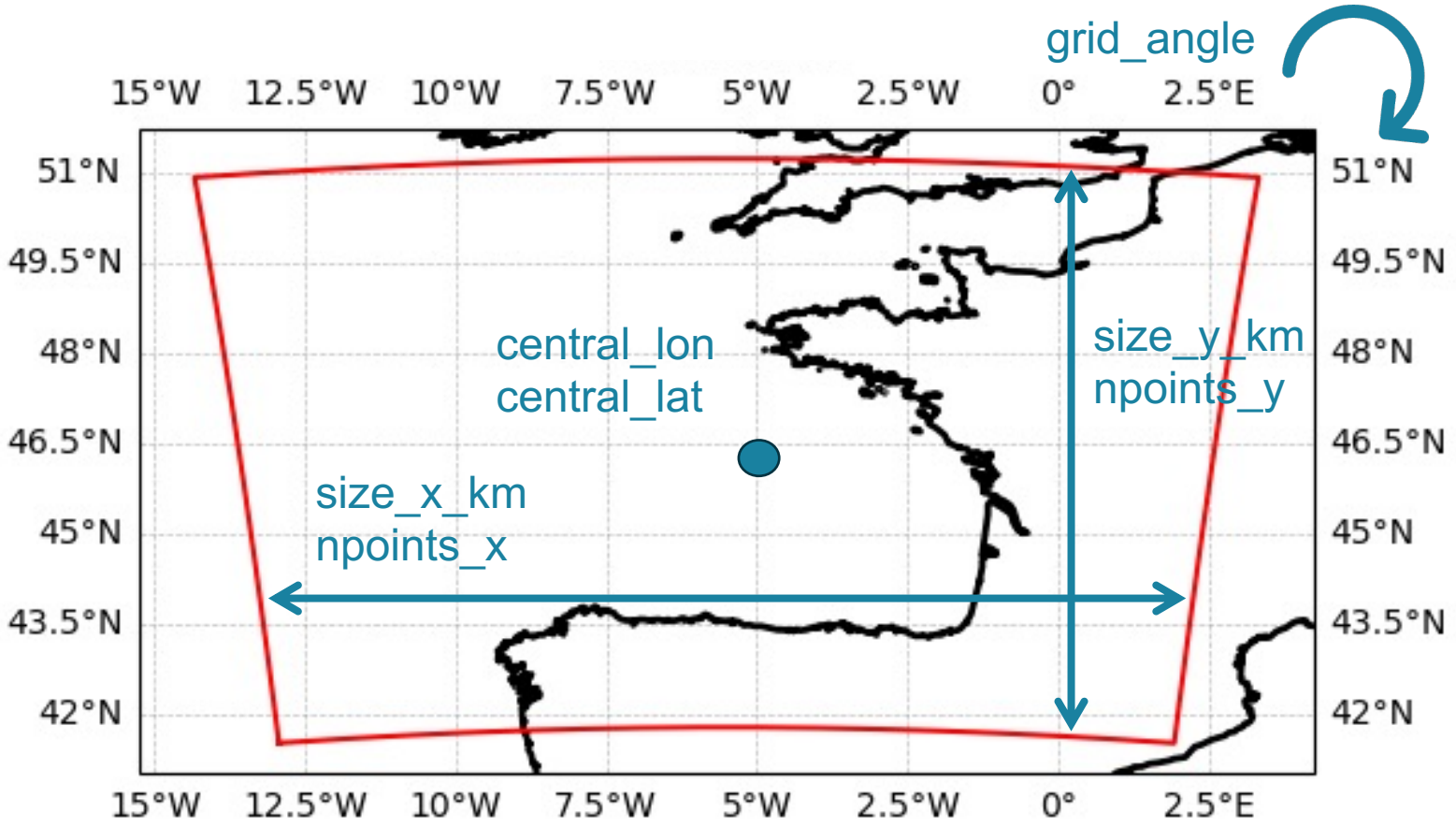
How to make a grid ? ./make_grid.py my_grid_configuration.ini

Tutorial in the documentation

To remember:

- Input data must be gridded (raster only, no vector data)
- Grid uses Oblique Mercator projection
- Several smoothing methods are available
- Isolated waterbodies can be masked

croco_grd.nc

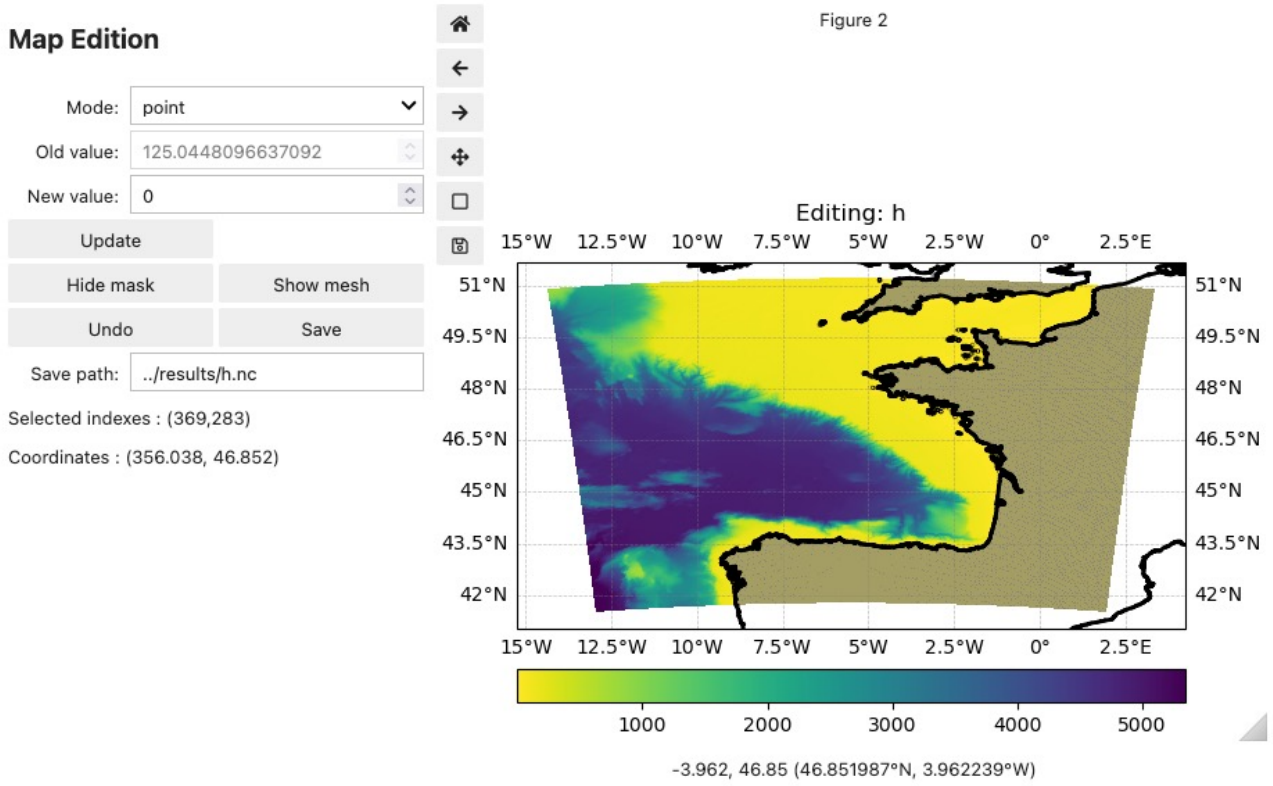


Edit the result with grid widget

How to update bathymetry « h » or mask « maskr » ? Editor demonstration

To remember :

- Point or rectangle selection
- Leave zoom mode to select a point
- Save button does NOT update croco_grd.nc directly
- After editing, bathymetry smoothing should usually be applied again



Use jupyter-forward if you are on remote computer

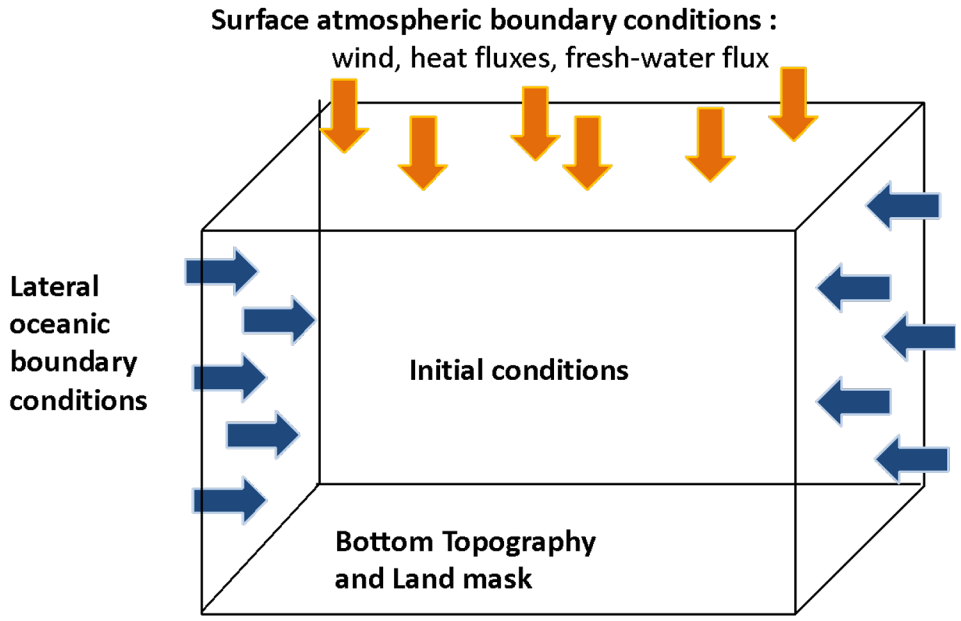
Make_ini and make_bry

How to generate the initial and boundary conditions ?
./make_ini.py my_ibc_configuration.ini
./make_bry.py my_ibc_configuration.ini

Interpolation :
Z-coordinate > S-coordinate : general case
S-coordinate > S-coordinate : zoom offline case

To remember :

- S-coordinate parameters must be coherent with CROCO parameters (N, hc, theta_s, theta_b)



croco_ini_xxx_YxxxxMxx.nc
croco_bry_xxx_YxxxxMxx.nc

NEW

Example with BGC tracers available

Make_tides

How to make tidal forcing file ?
./make_tides.py my_tides_configuration.ini

Careful with CROCO param coherency :

- Ntides
- Precompilation keys : #TIDE_MAS #USE_CALENDAR #SSH_TIDES #UV_TIDES #POT_TIDES

Check the tide atlas use : Re_Im or Amp_phase format

Check readers.jsonc file

Unless using TIDEMAS, correction at a fixed date, update to do at every restart file for long run

croco_frc_xxx.nc

All FES tide waves now available with correction

Make_rivers

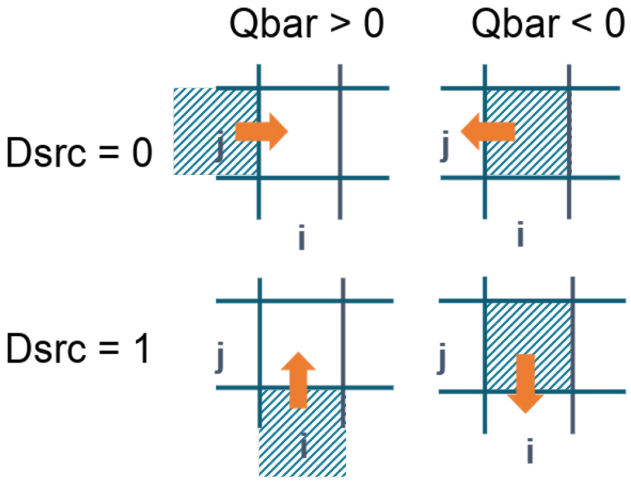
How to make runoff forcing file ?

./make_rivers.py my_rivers_configuration.ini

# input_file	Lon	Lat/Qmin
river.nc	-2.05	47.30
loire.dat	-2.05	47.30
Rhone.txt	4.82	43.37
2ddata.nc	X	10

Rivers data can have different format :

- 2D netcdf file, like GLOFAS product
- 1D netcdf file (temporal series of one river)
- 1D netcdf file (temporal series of several rivers)
- Text file (one for each river)



Make_rivers output
- croco_runoff.nc
- text file to complete croco.in psource section

Rivers widget

How to update rivers ? Editor demonstration

To remember :

- Leave zoom mode to select a river
- On save, misplaced rivers are moved
- This widget does NOT support PSOURCE_MASS option

Rivers Edition

Hide summary

Number of rivers: 5 **Number of points:** 7 **Number of splitted rivers:** 2

River	i	j	lon	lat	dsrc	qbardir
cems_glofas_ALL_0	171	17	-8.880	42.026	0	-1
cems_glofas_ALL_1	474	107	-1.454	43.620	0	-1
cems_glofas_ALL_2_split0	498	198	-0.711	45.220	1	1
cems_glofas_ALL_2_split1	497	198	-0.736	45.221	1	1
cems_glofas_ALL_3	437	305	-2.163	47.208	0	-1
cems_glofas_ALL_4_split0	517	434	0.195	49.440	0	-1
cems_glofas_ALL_4_split1	517	433	0.193	49.423	0	-1

River: None selected

Left click to select and move, right click to unselect

dsrc 0

qbardir -1

Delete selection | Add point to selecti...

Show mask | Show mesh

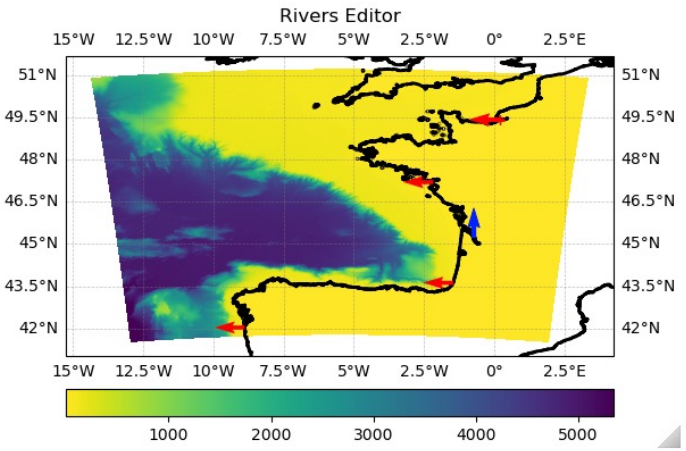
Undo

Save files

Rivers IN: ../results/river_demo/croco_runc

Rivers NC: ../results/river_demo/croco_runc

Figure 5



Use jupyter-forward if you are on remote computer

News

Last release 2.0.3 (early February 2026)

- Improve installation on Apple chip
- Update python environment to follow copernicus API change
- Add example for handling of other tracers than T,S in make_ini, make_bry
- Improve FES tide atlas handling
- Bugs fixes

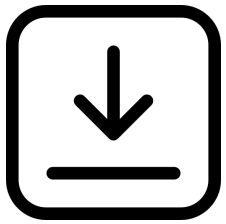
For now …

Still no widget to create grid, no multi-files handling to interpolate grid and no vector data (soundings) handling, no creation of river widget (just modification), no tracers in rivers input, only ONLINE atmospheric forcing available… … …

… Work in progress !

Feedback welcome ! https://forum.croco-ocean.org/

To conclude …



Code download

https://gitlab.inria.fr/croco-ocean/croco_pytools/-/releases

Help and details. Try Tutorials !

https://croco-ocean.gitlabpages.inria.fr/croco_pytools

Feedback welcome !

https://forum.croco-ocean.org/

Questions

Jupyter-forward example

Install jupyter-forward locally, see details in :

https://jupyter-forward.readthedocs.io/en/stable/

Example of command line :

```
jupyter-forward
        --port 8888
        --conda-env "/path_env_xxx"
        --notebook-dir "/path_nb_xxx/"
        --port-forwarding
        --shell "/bin/bash"
        --launch-command "qsub -N jlab -j oe -l select=1:ncpus=1:mem=8g -l walltime=9:00:00"
        xxx@xxx
```

Adding BGC tracers

If all tracers are in the same product, just add the tracers in the list and chck the readers.jsonc file.
If the tracers are in a different product than classical fields, make 2 downloads, see Examples/benguela_multifiles
Then in ibc.ini use prefix to indicate the right product where the variables are available

```
[IBC_Input_Files]
ibc_dir = ../data/DATA_IBC/GLORYS/
ibc_prefix = GLORYS_PHY

[Mercator_Download]
dataset = cmems_mod_glo_phy-all_my_0.25deg_P1
variables = ["uo_glor","vo_glor","thetao_glor
depths = [0,5000]
```

```
[IBC_Input_Files]
ibc_dir = ../data/DATA_IBC/GLORYS/
ibc_prefix = GLORYS_BIO

[Mercator_Download]
dataset = cmems_mod_glo_bgc_my_0.25deg_P1M-m
variables = ["chl","o2","no3","po4","si"]
depths = [0,5000]
```

```
[IBC_Options]
obc_dict = {'south':1, 'north':1,'west':1, 'east':1}
tracers = ["temp", "salt", "chl", "o2", "no3", "po4", "si"]
uv_conserv = 1
min_nb_valid_data = 4

[IBC_Input_Files]
ibc_reader = mercator_glorys_0.25deg
ibc_dir = ../data/DATA_IBC/GLORYS
ibc_prefix = GLORYS
ibc_extension = .nc
ibc_freq = 1M
ibc_multi_files = True
ibc_file_ssh = PHY
ibc_files_tracers = ["PHY", "PHY", "BIO", "BIO", "BIO", "BIO", "BIO"]
ibc_file_u = PHY
ibc_file_v = PHY
ini_filedate = Y2013M01
ini_idx = 0
```

Ini format

An INI file is a plain text file commonly used
to store configuration settings.

It is a simple and widely supported format that organizes information into sections and key-value pairs.

Example :

```
[Croco_Files]
croco_files_dir = ../results/CROCO_FILES
croco_grd_prefix = croco_grd

[Zoom_Options]
is_zoom = False
is_agrif = False
agrif_level = 0

[Grid_Position]
central_lon = 15.0
central_lat = -32.0
size_x_km = 1556
size_y_km = 1334
npoints_x = 41
npoints_y = 42
grid_angle = 0.0
```

Rivers input format

4 types :

- 2D netcdf file :
  - .nc extension
  - Qbar = variable with unit attribute in ['m3 s-1','m**3 s**-1','m3/s']
  - lon/lat : search by name and unit
- 1D netcdf file with one river :
  - .nc extension
  - Qbar = variable with unit attribute in ['m3 s-1','m**3 s**-1','m3/s']
- 1D netcdf file with several rivers :
  - .nc extension
  - Qbar = variable with unit attribute in ['m3 s-1','m**3 s**-1','m3/s']
  - lon/lat : search by name and unit
- text file : other extension than .nc

```
1950/01/01 12:00:00 730.000000
1950/01/02 12:00:00 695.000000
1950/01/03 12:00:00 675.000000
1950/01/04 12:00:00 645.000000
1950/01/05 12:00:00 610.000000
```

Readers.jsonc

```
{
    "Topo": {
      "etopo2022": {
        "lon": "lon",
        "lat": "lat",
        "topo": "z",
        "zaxis": "up"
      },
    },
…
```

```
…
    "Tides": {
      "tpxo9": {
        "lonr": "lon_z",
        "lonu": "lon_u",
        "lonv": "lon_v",
        "latr": "lat_z",
        "latu": "lat_u",
        "latv": "lat_v",
        "H_r": "hRe",
        "H_i": "hIm",
        "U_r": "uRe",
        "U_i": "uIm",
        "V_r": "vRe",
        "V_i": "vIm",
        "topor": "h",
        "topou": "hu",
        "topov": "hv",
        "invert_phase": true
      },
    },
…
```

```
…
    "IBC": {
      "mercator": {
        "depth": "depth",
        "lonr": "longitude",
        "lonu": "longitude",
        "lonv": "longitude",
        "latr": "latitude",
        "latu": "latitude",
        "latv": "latitude",
        "ssh": "zos",
        "temp": "thetao",
        "salt": "so",
        "u": "uo",
        "v": "vo",
        "time": "time",
        "time_dim": "time"
      },
    },
}
```