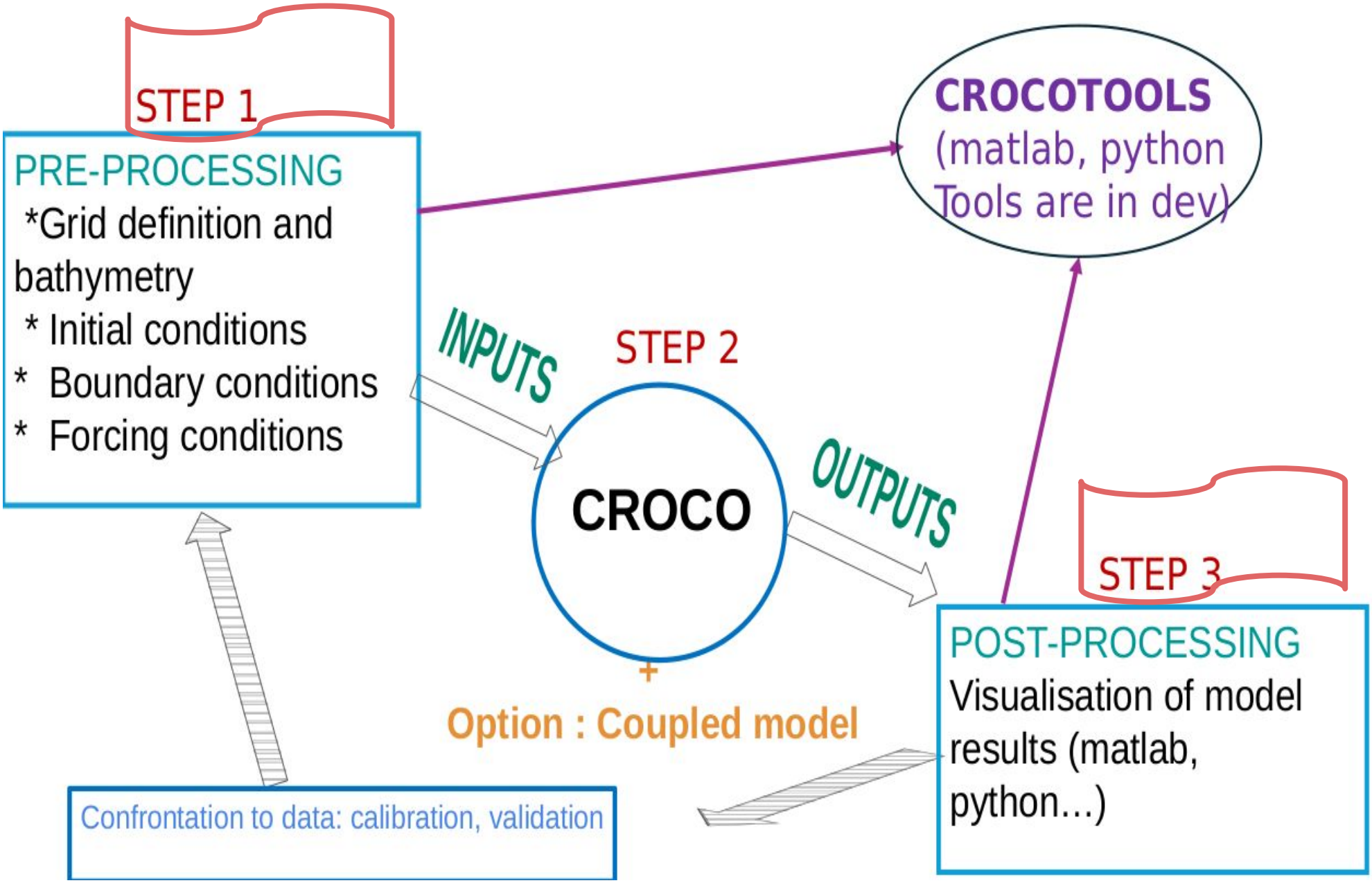
Introduction to CROCO_TOOLS

Outline

- Review
- Crocotools for preprocessing
- Crocotools for postprocessing

REVIEW

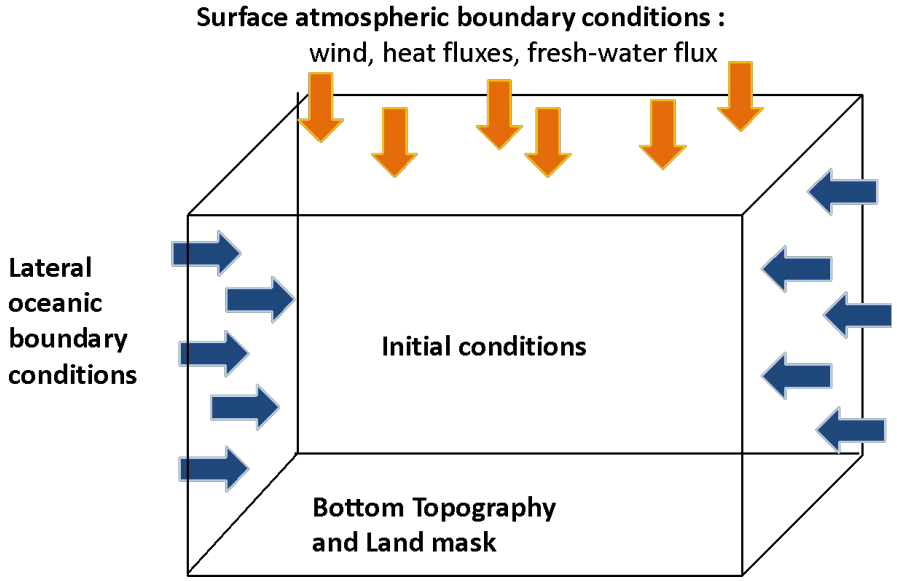

STEP 1
PRE-PROCESSING
*Grid definition and bathymetry
* Initial conditions
* Boundary conditions
* Forcing conditions
CROCOTOOLS
(matlab, python
Tools are in dev)
INPUTS
STEP 2
CROCO
OUTPUTS
STEP 3
POST-PROCESSING
Visualisation of model results (matlab, python…)
+
Option : Coupled model
Confrontation to data: calibration, validation

STEP1 : Prepare input files for CROCO Model

I Pre-processing phase :

Input files creation :

- Grid file : containing grid, mask, bathymetry all metrics needed by CROCO
  =>croco_grd.nc
- Initialisation file : containing initial stratification (T ,S) , initial current and elevation values => croco_ini.nc
- Boundary file : containing all needed variables on OB => croco_bry.nc
- Forcing file : containing atmospheric forcing, tides…=> croco_frc.nc (croco_blk.nc if bulk formula for atmospheric forcing)
- and eventually a climatological file => croco_clm.nc



STEP1 : Prepare input files for CROCO Model

TO GENERATE THESE FILES WE NEED

Global datasets for :

Bathymetry: GEBCO 1', Etopo2, SRTM30, ….
Atmospheric fields :COADS, QuikSCAT, CFSR, WRF…
"Realistic" stratification data : MEDAR **…..**
Ocean general circulation models (OGCM)to set on OBC's : :
WOA_2009, SODA, ECCO, Mercator, …
Outputs of Tidal models: FES2020, TUGO, MOG2D,TPXO…

STEP1 : Prepare the input files for CROCO Model

You have to edit at first

crocotools_param.m

```
(base) moncef@Z640:~/CROCO/croco_tools-v2.0.0$ ls
Aforc_CFSR      Coupling_tools                Nesting_tools              README.md   UTILITIES
Aforc_ECMWF     crocotools_param.m            oct_start.m                Rivers      Visualization_tools
Aforc_ERA5      Diagnostic_tools              Oforc_OGCM                 RUNOFF_DAI
Aforc_NCEP      example_job_prepro_matlab.pbs Opendap_tools              start.m
Aforc_QuikSCAT  Forecast_tools                Opendap_tools_no_loaddap   Tides
CHANGELOG.md    job_prepro_matlab.pbs         Preprocessing_tools        Town
```

“BENGULA_LR” TEST CASE

STEP1 : Prepare the input files

CONFIGURATION NAME

Limits of the model domain

horizontal resolution

Number of vertical levels

sigma coordinates coefficients, transformation type.

smoothing topography option

crocotools_param.m

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
isoctave=exist('octave_config_info');
%
%  CROCO title names and directories
%
CROCO_title  = 'Benguela Model';
CROCO_config = 'Benguela_LR';
%
% Grid dimensions:
%
lonmin =   8;   % Minimum longitude [degree east]
lonmax =  22;   % Maximum longitude [degree east]
latmin = -38;   % Minimum latitude  [degree north]
latmax = -26;   % Maximum latitude  [degree north]
%
% Grid resolution [degree]
%
dl = 1/3;
%
% Number of vertical Levels (! should be the same in param.h !)
%
N = 32;
%
%  Vertical grid parameters (! should be the same in croco.in !)
%
theta_s    =  7.;
theta_b    =  2.;
hc         = 200.;
vtransform =  2.; % s-coordinate type (1: old- ; 2: new- coordinates)
                  % ! take care to define NEW_S_COORD cpp-key in cppdefs.h
%
% Topography: choice of filter
%
topo_smooth =  1; % 1: old ; 2: new filter (better but slower)
%
% Minimum depth at the shore [m] (depends on the resolution,
% rule of thumb: dl=1, hmin=300, dl=1/4, hmin=150, ...)
% This affect the filtering since it works on grad(h)/h.
%
hmin = 75;
%
% Maximum depth at the shore [m] (to prevent the generation
% of too big walls along the coast)
%
hmax_coast = 500;
%
% Maximum depth [m] (cut the topography to prevent
% extrapolations below WOA data)
%
hmax = 6000;
%
```

Line 1, Column 1

STEP1 : Prepare the input files

smoothing bathymetry coeff

Two ways of interpolation of data set onto horizontal grid

Process plots if any

```
% Slope parameter (r=grad(h)/h) maximum value for topography smoothing
%
rtarget = 0.25;
%
% Number of pass of a selective filter to reduce the isolated
% seamounts on the deep ocean.
%
n_filter_deep_topo=4;
%
% Number of pass of a single hanning filter at the end of the
% smooting procedure to ensure that there is no 2DX noise in the
% topography.
%
n_filter_final=2;
%
%  GSHSS user defined coastline (see m_map)
%  XXX_f.mat      Full resolution data
%  XXX_h.mat      High resolution data
%  XXX_i.mat      Intermediate resolution data
%  XXX_l.mat      Low resolution data
%  XXX_c.mat      Crude resolution data
%
coastfileplot = 'coastline_l.mat';
coastfilemask = 'coastline_l_mask.mat';
%
% Objective analysis decorrelation scale [m]
% (if Roa=0: nearest extrapolation method; crude but much cheaper)
%
%Roa=300e3;
Roa=0;
%
interp_method = 'spline'; % Interpolation method: 'linear' or 'spline'
%
makeplot      = 0;     % 1: create graphics after each preprocessing step
%
%
```

crocotools_param.m

STEP1 : Prepare the input files

```
% 2 - Generic file and directory names
%  CROCOTOOLS directory
CROCOTOOLS_dir = '../';
%  Run directory
RUN_dir=[pwd,'/'];
%  CROCO input netcdf files directory
CROCO_files_dir=[RUN_dir,'CROCO_FILES/'];
%  Global data directory (etopo, coads, datasets download from ftp, etc..)
DATADIR='../../croco_tools/';
%  Forcing data directory (ncep, quikscat, datasets download with opendap,
FORC_DATA_DIR = [RUN_dir,'DATA/'];
%
if (isoctave == 0)
        eval(['!mkdir ',CROCO_files_dir])
else
        system(['mkdir ',CROCO_files_dir])
end
% CROCO file names (grid, forcing, bulk, climatology, initial)
grdname  = [CROCO_files_dir,'croco_grd.nc'];
frcname  = [CROCO_files_dir,'croco_frc.nc'];
blkname  = [CROCO_files_dir,'croco_blk.nc'];
clmname  = [CROCO_files_dir,'croco_clm.nc'];
bryname  = [CROCO_files_dir,'croco_bry.nc'];
ininame  = [CROCO_files_dir,'croco_ini.nc'];
bioname  = [CROCO_files_dir,'croco_frcbio.nc']; % Iron Dust forcing for PISCES
rivname =  [CROCO_files_dir,'croco_runoff.nc'];
%
%  Topography netcdf file name (ETOPO 2 or any other netcdf file
%  in the same format)
%
topofile = [DATADIR,'Topo/etopo2.nc'];
%
%
```

CROCO input files names and location

bathymetry data base path

crocotools_param.m

COADS atmospheric data directory

monthly atmospheric forcing data with repetition of a typical year of 360 days

monthly SST data

OBC's definition must be identical with that you will precise in your **cppdefs.h**. 0= closed

create initial file, climatology file and boundary file

must be identical to dstart in **croco.in**

crocotools_param.m

```
coads_dir=[DATADIR,'COADS05/'];
% COADS time (for climatology runs)
coads_time=(15:30:345); % days: middle of each month
coads_cycle=360;          % repetition of a typical year of 360 days
%coads_time=(15.2188:30.4375:350.0313); % year of 365.25 days in case
%coads_cycle=365.25;                    % interannual QSCAT winds
% Pathfinder SST data used by pathfinder_sst.m
pathfinder_sst_name=[DATADIR,'SST_pathfinder/climato_pathfinder.nc'];
% 4 - Open boundaries and initial conditions parameters
%       used by make_clim.m, make_biol.m, make_bry.m
%       make_OGCM_*.m and make_OGCM_frcst.m
%  Open boundaries switches (! should be consistent with cppdefs.h !)

obc = [1 1 1 1]; % open boundaries (1=open , [S E N W])
%  Level of reference for geostrophy calculation
zref = -1000;

%  initial/boundary data options (1 = process)
%  (used in make_clim, make_biol, make_bry,
%   make_OGCM_*.m and make_OGCM_*frcst.m)
makeini      = 1;  % initial data
makeclim     = 1;  % climatological data (for boundaries and nudging layers)
makebry      = 1;  % lateral boundary data
makenpzd     = 0;  % initial and boundary data for NChlPZD and N2ChlPZD2 models
makebioebus= 0;  % initial and boundary data for BioEBUS model
makepisces = 0;  % initial and boundary data for PISCES model
makequota  = 0;  % initial and boundary data for quota version of PISCES model
%
%
makeoa       = 1;  % oa data (intermediate file)
makeZbry     = 1;  % boundary data in Z coordinate (intermediate file)
insitu2pot = 1;  % transform in-situ temperature to potential temperature
%
%  Day of initialisation for climatology experiments (=0 : 1st january 0h)
%
tini=0;
```

monthly climatological data directory,
time and cycle

```
% Select Climatology Atlas (temp, salt and biological variables) from:
%        - World Ocean Atlas directory (WOA2009)  OR ...
%        - CARS2009 climatology directory (CARS2009)
woa_dir       = [DATADIR,'WOA2009/'];
cars2009_dir  = [DATADIR,'CARS2009/'];
climato_dir   = woa_dir;
% Pisces biogeochemical seasonal climatology
woapisces_dir = [DATADIR,'WOAPISCES/'];  % only compatible with
woa_dir
% Surface chlorophyll seasonal climatology (SeaWifs)
chla_dir=[DATADIR,'SeaWifs/'];
% Runoff monthly seasonal climatology (Dai and Trenberth)
global_clim_riverdir=[DATADIR,'RUNOFF_DAI/'];
global_clim_rivername=[global_clim_riverdir,'Dai_Trenberth_runoff_global_
clim.nc'];
%  Set times and cycles for the boundary conditions: monthly climatology
woa_time=(15:30:345); % days: middle of each month
woa_cycle=360;    % repetition of a typical year of 360 days
%   For rivers setup : go in the routine Rivers/make_runoff.m to
%   setup your options
% 5 - Parameters for tidal forcing
tidename=[DATADIR,'TPXO7/TPXO7.nc']; %% TPXO file name (TPXO6 or
TPXO7)
% Self-Attraction and Loading GOT99.2 file name
sal_tides=1;
salname=[DATADIR,'GOT99.2/GOT99_SAL.nc'];
% Number of tides component to process
Ntides=10;
%
% Chose order from the rank in the TPXO file :
% "M2 S2 N2 K2 K1 O1 P1 Q1 Mf Mm"
% " 1  2  3  4  5  6  7  8  9 10"
tidalrank=[1 2 3 4 5 6 7 8 9 10];
```

if tide forcing is activated ,you must indicate this number in param.h

crocotools_param.m

reference model time 01/01/2000 0h 0min 0sec

forcing on OBC's with OGCM SODA from 01/2005 to 03/2005

As OGCM =SODA you will lunch make_OGCM_SODA to generate the bry file

```
% 6 - Reference date and simulation times
%       (used for make_tides, make_CFSR (or make_NCEP), make_OGCM_*)
%
Yorig       = 2000;       % reference time for vector time
                          % in croco initial and forcing files
Ymin        = 2005;       % first forcing year
Ymax        = 2005;       % last  forcing year
Mmin        = 1;          % first forcing month
Mmax        = 3;          % last  forcing month
%
Dmin        = 1;          % Day of initialization
Hmin        = 0;          % Hour of initialization
Min_min     = 0;          % Minute of initialization
Smin        = 0;          % Second of initialization
%
SPIN_Long   = 0;          % SPIN-UP duration in Years
%
Mth_format  = '%02d';     % Number of digit for month on input files
% 7 - Parameters for Interannual forcing (SODA, mercator, CFSR, ERA5 ...)
                                        ......
makefrc     = 0;    % 1: create forcing files
makeblk     = 1;    % 1: create bulk files
QSCAT_blk   = 0;    % 1: a) correct NCEP frc/bulk files with
            %       u,v,wspd fields from daily QSCAT data
            %       b) download u,v,wspd in QSCAT frc file
add_tides   = 0;    % 1: add tides
add_waves   = 0;    % 1: add waves
% Options for make_OGCM_SODA or make_OGCM_mercator
OGCM        = 'SODA';     % Select OGCM: SODA or mercator
OGCM_dir    = [FORC_DATA_DIR,OGCM,'_',CROCO_config,'/'];  % OGCM data dir. [croco format]
bry_prefix  = [CROCO_files_dir,'croco_bry_',OGCM,'_'];    % generic boundary file name
clm_prefix  = [CROCO_files_dir,'croco_clm_',OGCM,'_'];    % generic climatology file name
ini_prefix  = [CROCO_files_dir,'croco_ini_',OGCM,'_'];    % generic initial file name
OGCM_prefix = [OGCM,'_'];                 % generic OGCM file name
```

NO TIDES NO WAVE FORCING

crocotools_param.m

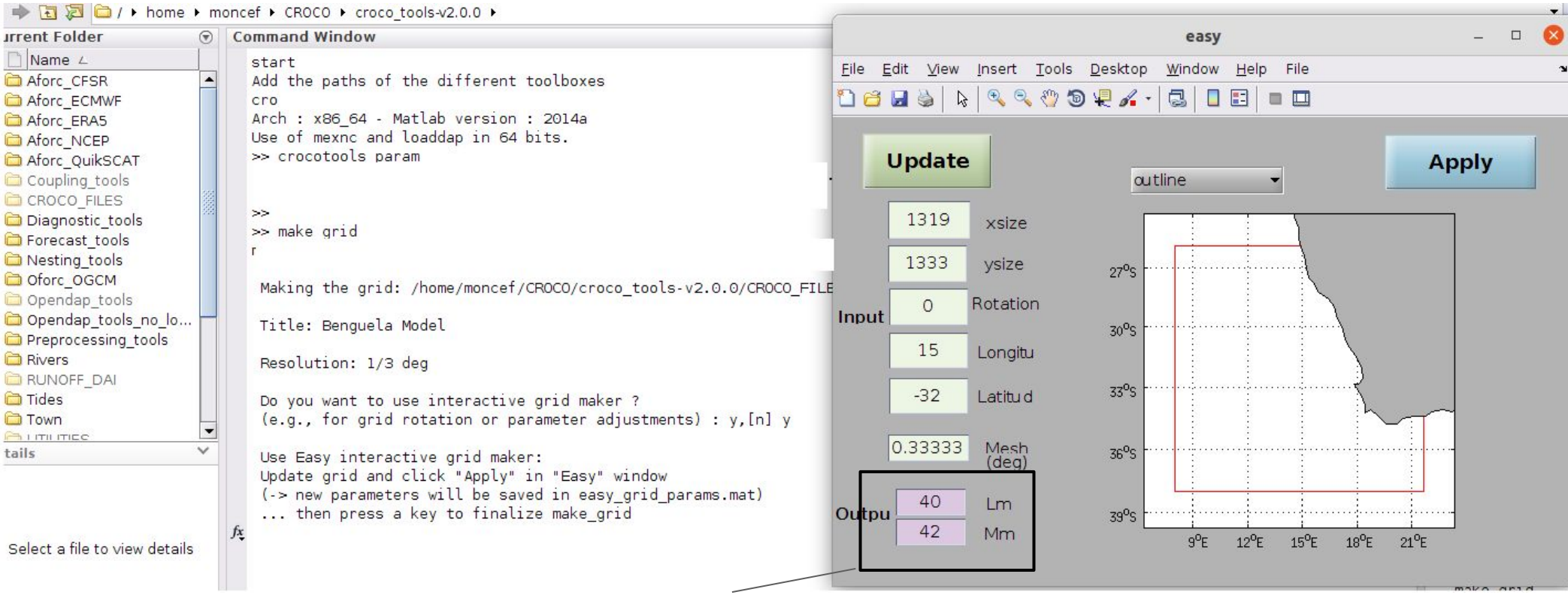
TP : Prepare the input files for BENGULA_LR

https://croco-ocean.gitlabpages.inria.fr/croco_doc/tutos/tutos.06.prepro.matlab.clim.html

Launch matlab then

start then
crocotools_param then
make_grid
y

edit manually the mask.



these values must be copied in **param.h**

TP : Prepare the input files for BENGULA_LR

```
make_forcing
make_bulk
make_bry      # or make_clim
make_ini
```

https://croco-ocean.gitlabpages.inria.fr/croco_doc/tutos/tutos.06.prepro.matlab.clim.html

STP3 : Visualise croco outputs (BENGUELA_LR)

matlab
start
crocotools_param
croco_gui

https://croco-ocean.gitlabpages.inria.fr/croco_doc/tutos/tutos.15.visu.matlab.html

On Seolane server

ssh -X userX@172.20.254.3

```
mkdir TRAINING
cd TRAINING

# alias of the dataset directory
ln -sf /home/COMMONDATA/data_tutos/DATASETS_CROCOTOOLS
~/TRAINING/CROCO/croco_tools/.
```

CROCO architecture

CROCO
Coastal and Regional Ocean COmmunity model

DATA

bathy, initial and boundary conditions, surface forcing, tides, rivers...

CROCO_DATASETS
(climatology)
Interannual datasets (e.g.
Mercator, ERA5…)

croco_tools

Tools for pre-processing, post-processing, diagnoses, visualisation

Matlab tools
Python tools

croco

Model, libraries (e.g. AGRIF) interfaces with other models, and scripts for running simulations

Model sources
Libraries
Scripts for run

CONFIGS

Where you will design and run your configurations

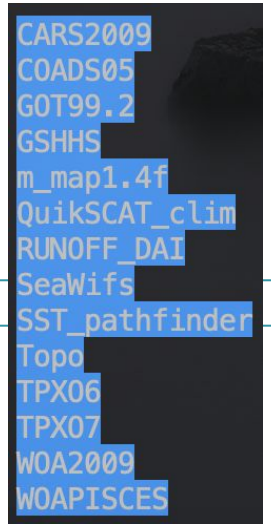
CROCO architecture

CROCO
Coastal and Regional Ocean COmmunity model

DATA

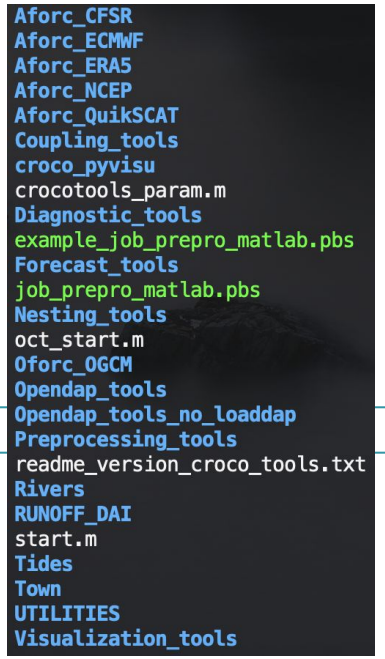
bathy, initial and boundary conditions, surface forcing, tides, rivers…

CROCO_DATASETS
(climatology)



croco_tools

Tools for pre-processing, post-processing, diagnoses, visualisation



croco

Model, libraries (e.g. AGRIF) interfaces with other models, and scripts for running simulations