TUTORIAL 04:
CREATE MY CROCO CLIM CONFIG

In this tutorial, we go through all the steps to prepare our first CROCO configuration. We will connect to the super-computer LENGAU and use Matlab together with the CROCO tools to generate CROCO input files from climatological datasets. We will then run our first simulation on the CHPC cluster.

STEP 1: Logging onto the Lengau HPC cluster and go into your CROCO working directory

→ From a terminal/konsole, execute the following instruction:

```
ssh -X login@lengau.chpc.ac.za
```

Replace **login** with your corresponding account number.

→ Reserve one interactive processor to do the pre-processing steps (**STEP 4** from **#TUTORIAL01**):

```
[login@login2 ~]$ qsubi1
[login@cnode0220 ~]$
```

→ Go into your **croco-v2.0.1** directory (**lustre/CROCO/croco-v2.0.1**):

```
[login@cnode0220 ~]$ cd lustre/CROCO/croco-v2.0.1
[login@cnode0220 croco-v2.0.1]$
```

→ Go into your **Run_Clim** working directory. If it does not exist (or if you want to recreate your grid), repeat the **STEP 2** from **#TUTORIAL02** (edit **create_config.bash** and execute it):

```
[login@cnode0220 ]$ cd Run_Clim
[login@cnode0220 Run_Clim]$
[login@cnode0220 Run_Clim]$
```

OR

```
[login@cnode0220 ]$ ./create_config.bash
[login@cnode0220 ]$ cd Run_Clim
[login@cnode0220 Run_Clim]$
```

STEP 2: Creating CROCO input files for Run_Clim

→ It is done with **MATLAB**

→ Launch **MATLAB** with the command **matlab -nodesktop** (or the alias **mat**):

```
[login@cnode0220 Run_Clim]$ matlab -nodesktop
[login@cnode0220 Run_Clim]$
```

→ Execute the command start and open **crocotools_param.m** using the Matlab command edit:

```
>> start
>> edit crocotools_param
```

➥ Activate the creation of graphics after each pre-processing step by changing **makeplot=0** to **makeplot=1** at line 130.

GRID & MASK

→ (Optional) Create your CROCO grid using the Matlab command make_grid:

```
>> make_grid
>>
```

➥ Parameters for this script can be found in section 1 of **crocotools_param.m** ("1- Configuration parameters") at line 43.

➥ This script will create your horizontal/vertical grid (position of the grid point, size of the grid cells, bottom topography, land mask, etc…) using information from the global etopo2 data base. The grid will be stored in the NetCDF file **CROCO_FILES/croco_grd.nc**

→ Remember the size of your grid (LLm,MMm)

SURFACE FORCING

→ Create your CROCO surface forcing files:

```
>> make_forcing
>>
```

➥ Parameters for this script can be found in section 3 of **crocotools_param.m** ("3- Surface forcing parameters") at line 197.

➥ This script will create your model surface forcing (surface wind stress, surface heat fluxes, surface freshwater flux), using data from the global COADS 2005 database. The surface forcing will be stored in the NetCDF file **CROCO_FILES/croco_frc.nc**

➥ (Off Matlab) You can look at the COADS05 atlas:

```
[login@cnode0220 Run_Clim]$ cd ../../croco_tools-v2.0.1/DATASETS_CROCOTOOLS/COADS05
[login@cnode0220 COADS05]$ ncview precip.cdf
```

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```
>> make_bulk
>>
```

➥ Parameters for this script can be found in section 3 of crocotools_param.m ("3- Surface forcing parameters) at line 197.

➥ This script will create your model surface forcing using bulk formulae: temperature at 2m, humidity at 2m, wind (u and v) at 10m and solar radiation, using data from the global COADS database. The surface bulk forcing will be stored in the NetCDF file **CROCO_FILES/croco_blk.nc**

```
>> make_QSCAT_clim
>>
```

➥ Parameters for this script can be found in section 3 of crocotools_param.m ("3- Surface forcing parameters) at line 197.

➥ This script will extrapolate and interpolate surface data from QuickSCAT SCOW Climatology to get surface wind stress forcing. The surface forcing stress (variables sustr, svstr) will replace the one already stored in the NetCDF file **CROCO_FILES/croco_frc.nc** (estimated from COADS, see make_forcing).

➥ (Off Matlab) You can look at the QuikSCAT SCOW climatological fields:

```
[login@cnode0220 Topo]$ cd ../QuikSCAT_clim
[login@cnode0220 QuikSCAT_clim]$ ncview roms_SCOW_*.nc
```

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NOT MANDATORY

INITIAL & BOUNDARY CONDITIONS

→ Create your CROCO initial and boundary conditions. ⚠ The following steps (make_clim, make_bry and make_ini) required to have run make_forcing first.

```
>> make_bry
>> make_ini
```

OR

```
>> make_clim
>>
```

➥ Parameters for these scripts can be found in section 4 of crocotools_param.m ("4- Open boundaries and initial conditions parameters) at line 222.

- Check your open boundary switches (line 230)
- You can choose which data set you would like to use: CARS2009 or WOA2009

➥ The scripts will create your model initial conditions and the boundary conditions (Temp, Salt, currents, SSH), using data from the global World Ocean Atlas (WOA2009) or CARS2009. The initial conditions will be stored in the NetCDF file **CROCO_FILES/croco_ini.nc**. The open boundary conditions will be stored in the NetCDF files **CROCO_FILES/croco_clm.nc** and/or **CROCO_FILES/croco_bry.nc**

➥ (Off Matlab) You can look at the WOA2009 or CARS2009 climatologies:

```
[login@cnode0220 QuikSCAT_clim]$ cd ../WOA2009
[login@cnode0220 WOA2009]$ ncview temp_month.nc
```

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→ exit Matlab, you are finished with **STEP 2**.

```
>> exit
>>
```

→ You can inspect all your input files stored in CROCO_FILES using the **ncdump** or **ncview** tools:

```
[login@cnode0220 WOA2009]$ cd ../../croco-v2.0.1/Run_Clim/CROCO_FILES/
[login@cnode0220 CROCO_FILES]$ ncdump -h croco_frc.nc
[login@cnode0220 CROCO_FILES]$ ncview croco_clm.nc
[login@cnode0220 Run_Clim]$ cd ..
```

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STEP 3: Compiling CROCO model

→ You will use a compiler (ifort) to convert FORTRAN programs into an executable. For this, you need to copy my `jobcomp_lengau` file into your **Run_Clim** directory:

```
cp /home/apps/chpc/earth/CROCCO_Workshop/CROCO_TRAINING_Basic/3_Some_files/jobcomp_lengau .
```

ADVICE

➥ You can check the differences between `jobcomp` and `jobcomp_lengau`:

```
[login@cnode0220 Run_Clim]$ meld jobcomp jobcomp_lengau
```

→ Edit the CROCO parameter file `param.h` using **vi** or **nedit**:

```
[login@cnode0220 Run_Clim]$ nedit param.h &
[login@cnode0220 Run_Clim]$
```

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➥ Create a new config (below line 199) by adding a 2-line **elif** statement, with a new config name and adjusted values for LLm0, MMm0, and N.
You can get these values by checking the size of your grid with `ncdump -h CROCO_FILES/croco_grd.nc` *and removing two ghost points from* `xi_rho` *and* `eta_rho`

➥ Check the parameters for the **parallelisation** (NP_XI, NP_ETA=4 line 251)

→ Edit the `cppdefs.h` file using **vi** or **nedit**:

```
[login@cnode0220 Run_Clim]$ nedit cppdefs.h &
[login@cnode0220 Run_Clim]$
```

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➥ At line 71, activate your config (ex: `#define BENGUELA_LR`).

➥ Activate MPI parallelization at line 74 (`# define MPI`).

➥ Define which of your boundaries are open or closed (lines 95-98).

➥ Activate the CPPKEYS for surface forcing choice (ex: `#define BULK_FLUX` line 170)

➥ Choose between bry or clm files for the open boundary conditions.

⚠ You cannot activate both CPPKEYS: `CLIMATOLOGY` (line 198) and `FRC_BRY` (line 212)

→ Compile CROCO using the `jobcomp_lengau` script:

```
[login@cnode0220 Run_Clim]$ ./jobcomp_lengau
[login@cnode0220 Run_Clim]$
```

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STEP 4: Running CROCO

→ To launch your simulation on the Lengau cluster using the PBS Pro job scheduler, you need to copy my `run_croco.pbs` file into your **Run_Clim** directory:

```
cp /home/apps/chpc/earth/CROCCO_Workshop/CROCO_TRAINING_Basic/3_Some_files/run_croco.pbs .
```

ADVICE

➥ You can check the differences between `run_croco.pbs` and `run_croco.bash`:

```
[login@cnode0220 Run_Clim]$ meld run_croco.pbs run_croco.bash
```

→ Edit the script **run_croco.pbs** using **vi** or **nedit**:

```
[login@cnode0220 Run_Clim]$ nedit run_croco.pbs &
[login@cnode0220 Run_Clim]$
```

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➥ Check the PBS scheduler parameters (mpiprocs consistent with **param.h**) and email.

➥ Check the path of your **Run_Clim** working directory.

➥ Check the user configurable section: Choose the time step wisely (DT, line 56) and adjust NBPROCS (line 37, consistent with **param.h**).

→ Edit the CROCO parameter file **croco_inter.in** using **vi** or **nedit**:

```
[login@cnode0220 Run_Clim]$ nedit croco_inter.in &
[login@cnode0220 Run_Clim]$
```

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➥ Fix your grid parameters at line 6: THETA_S, THETA_B, Hc (m)

➥ Check the outputs requested in sections:

- primary_history_fields and auxiliary_history_fields for instantaneaous outputs
- primary_averages and auxiliary_averages for averages

→ Launch your first simulation using the PBS command **qsub**:

```
[login@cnode0220 Run_Clim]$ qsub run_croco.pbs
[login@cnode0220 Run_Clim]$
```

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➥ Your simulation will start soon. You will receive an email.

➥ CROCO outputs (**avg/hist .nc**) will be stored in the directory: **./SCRATCH**

→ Debug:

- Output and error files from the **PBS** job are in **Run_Clim/run_croco.pbs.(o/e)xxxxxxx**
- The model log files (**croco_Y----M--.out**) are in **Run_Clim/SCRATCH**

STEP 5: Visualising model outputs

→ This can be done with **MATLAB**

→ Launch **matlab -nodesktop** (or the alias **mat**) to use the CROCO_TOOLS diagnostics:

```
>> start
>> edit croco_diags  and complete the configurable part
>> croco_diags
>> plot_diags
```

→ Use the croco_gui to visualize your outputs:

```
>>
```

➥ Have fun!

→ You can concatenate model outputs to visualize them easily in croco_gui:

```
[login@cnode0220 Run_Clim]$ cd SCRATCH
[login@cnode0220 SCRATCH]$ ncrcat croco_avg_Y2M[1-9].nc
croco_avg_Y2M1[0-2].nc croco_avg_Y2.nc
```

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STEP 6: Exiting

→ When you are done, exit Matlab:

```
>> exit
```

→ Give back the interactive node and logout from Lengau:

```
[login@cnode0220 Run_Clim]$ exit
logout
qsub: job 4416950.sched01 completed
[login@login2 ~]$ exit
```

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STEP 7: Check List

→ Here is the list of the essential commands that you must execute during this hands-on session. The following table can help you confirm that you have executed all of them:

		Commands	✌
STEP 1	1	ssh -X login@lengau.chpc.ac.za	
	2	qsubi1	
	3	cd lustre/CROCO/croco-v2.0.1	
	4	cd Run_Clim (or redo **STEP 2** from Tutorial 02)	
STEP 2	1	matlab -nodesktop	
	2	start	
	3	edit crocotools_param	
	4	(Optional) make_grid	
	5	make_forcing	
	6	(Optional) make_bulk	
	7	(Optional) make_QSCAT_clim	
	8	make_clim or make_bry; make_ini	
	9	exit	
STEP 3	1	cp /home/apps/chpc/earth/CROCCO_Workshop/CROCO_TRAINING_Basic/3_Some_files/jobcomp_lengau .	
	2	nedit param.h &	
	3	nedit cppdef.h &	
	4	./jobcomp_lengau	
STEP 4	1	cp /home/apps/chpc/earth/CROCCO_Workshop/CROCO_TRAINING_Basic/3_Some_files/run_croco.pbs .	
	2	nedit run_croco.pbs &	
	3	nedit croco_inter.in &	
	4	qsub run_croco.pbs	
STEP 5	1	matlab -nodesktop	
	2	start	
	3	edit croco_diags	
	4	croco_diags	
	5	plot_diags	
	6	croco_gui	
STEP 6	1	exit	
	2	exit	
	3	exit	

STEPS to design a CROCO Climatological configuration

⓪ Working Directory

in `~/croco-v2.0.1/` edit and execute `./create_config.bash`

❶ Model Inputs

- **Where?**

in `~/croco-v2.0.1/Run_Clim`

- **Which file(s) and param(s)?**

`crocotools_param.m`
- Grid param (horz/vert+topo),
- ***bulk/frc*** and ***bry/clim*** choice…

- **Which command(s)?**

`./matlab -nodesktop`

make_grid;
make_forcing; make_bulk;
make_QSCAT_clim.nc
make_clim; make_bry; make_ini;
make_runoff

- **Expected output(s)?**

`LLm, MMm, N`

`Run_Clim/CROCO_FILES`

croco_grd.nc croco_ini.nc
croco_frc.nc (croco_blk.nc)
croco_clim.n (croco_bry.nc)

❷ Compile

- **Where?**

in `~/croco-v2.0.1/Run_Clim`

- **Which file(s) and param(s)?**

`param.h`
- Grid param `LLm0, MMm0, N`
- MPI/OPENMP (nb procs)

`cppdefs.h`
- config, parallelization
- frc/blk choices
- clim/bry boundary forcing
- nesting, MPI_NOLAND, NC4PAR
- physical schemes, Rivers, etc…

- **Which command(s)?**

`./jobcomp` (`./jobcom_lengau`)

- **Expected output(s)?**

⇨ Model executable `croco`

❸ Run

- **Where?**

in `~/croco-v2.0.1/Run_Clim`

- **Which file(s) and param(s)?**

`Run_Clim/CROCO_FILES`

`croco_inter.in`
- Vertical grid parameters (streching)
- Variables to be saved
- Rivers

`run_croco.bash`
- input/output paths, nprocs
- DT, NAVG, simulation period
- restart (yes/no)

- **Which command(s)?**

`./run_croco.bash`
(`qsub run_croco.pbs`)

- **Expected output(s)?**

⇨ Model outputs
croco_avg.nc, croco_his.nc
in `Run_Clim/SCRATCH`