Tutorial 04 CROCO: Sediments - Idealized Cases

1. Purpose

In this tutorial we will learn to run several idealized cases that include the sediment module in CROCO.

1.1. Installation

```
mkdir CONFIG
cd CONFIG
cp ~/../instructor01/CONFIG/create_config.bash .
nano create_config.bash
```

to edit the file and modify the following lines to

```
MACHINE="LEFTRARU"

CROCO_DIR=/home/courses/instructor01/MODEL_git/croco/croco
TOOLS_DIR=/home/courses/instructor01/MODEL_git/croco/croco_tools

MY_CONFIG_NAME=BENG_CLASSIC

# Home and Work configuration directories
# ---------------------------------------
MY_CONFIG_HOME=${PWD}
MY_CONFIG_WORK=${PWD}

options=( all-dev )
```

Now type

```
./create_config.bash
```

And we are all set to start.

1.2. Basic Steps

The basic steps to run an idealized case are:

1. Edit **cppdefs.h**
2. Compile using **jobcomp**
3. Select the correct **.in** file from **TEST_CASES** directory
4. Run compiled executable **croco**
5. Plot using Matlab scripts in **TEST_CASES** directory

2. SANDBAR

This test case is part of an effort to develop a comprehensive 3D nearshore model that predicts onshore and offshore sandbar migrations under storm and post-storm conditions, without the need to modify the model setting parameters. In this test, we attempt to reproduce the results of sandbar migration experiments, the European Large Installation Plan (LIP) experiments, which were carried out at full scale in Delft Hydraulics's Delta Flume (Roelvink and Reniers, 1995).

2.1. Configuration

```
#define  SANDBAR         /* Bar-generating Flume Example */
```

Notice that there are several options for the **SANDBAR** case

```
# define SANDBAR_OFFSHORE /* LIP-1B */
# undef  SANDBAR_ONSHORE  /* LIP-1C */
# undef  OPENMP
# undef  MPI
# undef  NBQ
```

After compilation we can use

```
./croco TEST_CASES/croco.in.Sandbar
```

or, if we compiled with the NBQ option

```
./croco TEST_CASES/croco.in.Sandbar_nbq
```

```
croco.in.Sandbar  croco.in.Sandbar_1B  croco.in.Sandbar_1B_nbq
croco.in.Sandbar_1C  croco.in.Sandbar_1C_nbq croco.in.Sandbar_nbq
```

```
plot_sandbar.m      sediment_sandbar_1B.in      sediment_sandbar_1C.in
sediment_sandbar.in
plot_sandbar_nbq.m  sediment_sandbar_1B_nbq.in
sediment_sandbar_1C_nbq.in
```

2.2. Results

Using the script **plot_sandbar.m** we get

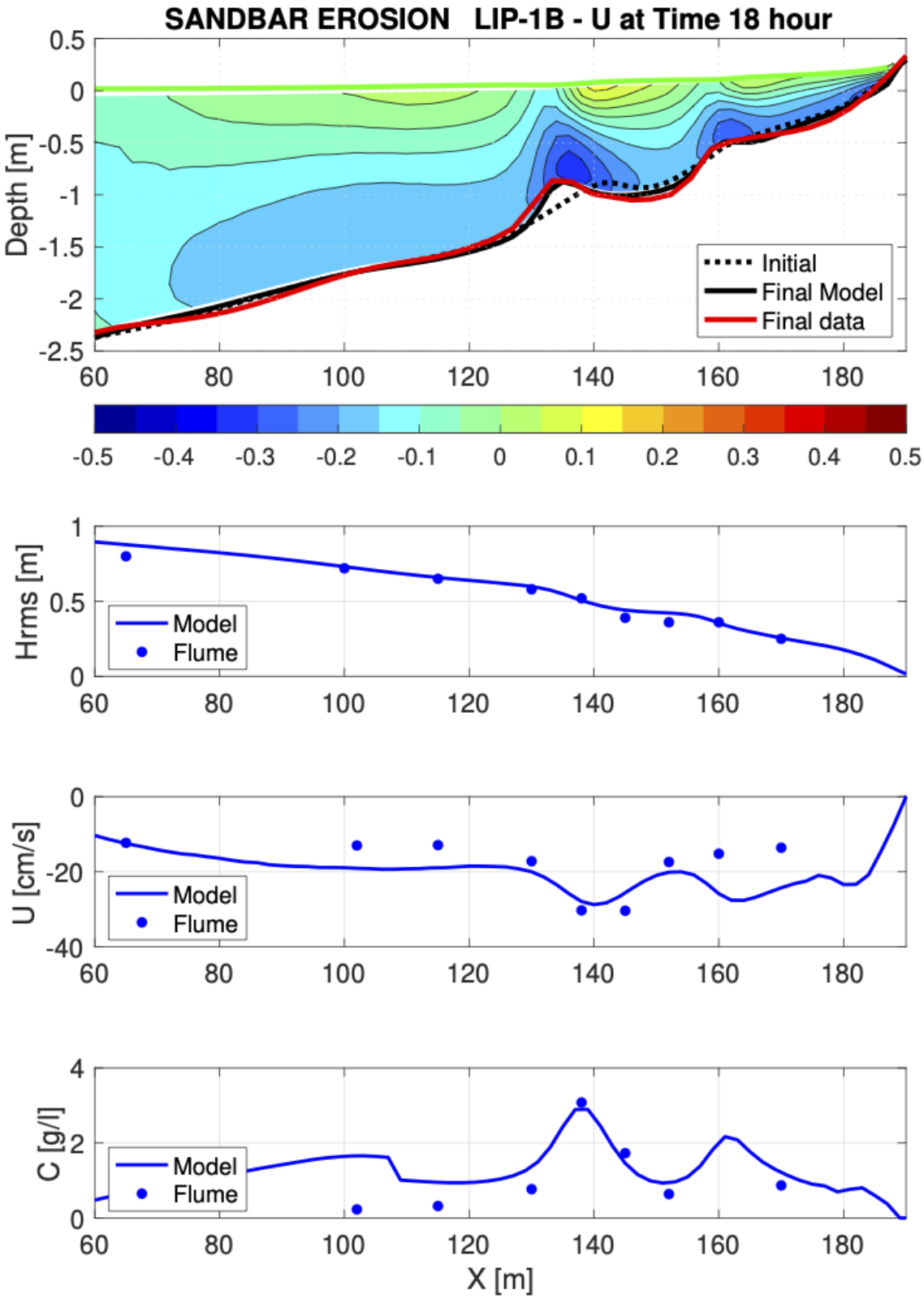

Figura 1: Test case Sediments : Sandbar

3. RIP

Rip currents are strong, seaward flows formed by longshore variation of the wave-induced momentum flux. They are responsible for the recirculation of water accumulated on a beach by a weaker and broader shoreward flow. Here, we consider longshore variation of the wave-induced momentum flux due to breaking at barred bottom topography with an imposed longshore perturbation, as in Weir et al. (2010) but in the 3D case. The basin is rectangular (768 m by 768 m) and the topography is constant over time and based on field surveys at Duck, North Carolina. Shore-normal, monochoromatic waves (1m, 10s) are imposed at the offshore boundary and propagate through the WKB wave model coupled with the 3D circulation model (Uchiyama et al., 2011). The domain is periodic in the alongshore direction. We assume that the nearshore boundary is reflectionless, and there is no net outflow at the offshore boundary.

3.1. Configuration

```
#define  RIP             /* Rip Current Test Case */
```

Compile and load Matlab to create the **rip_grd.nc** file

```
ml purge
ml Matlab/2017
LD_PRELOAD=/home/lmod/software/Core/ifort/2019.2.187-GCC-8.2.0-2.31.1/
compilers_and_libraries_2019.6.324/
linux/compiler/lib/intel64/libirc.so
matlab -nodesktop -nosplash
start
make_rip
```

which gives the file

```
rip_grd.nc
```

and the plots

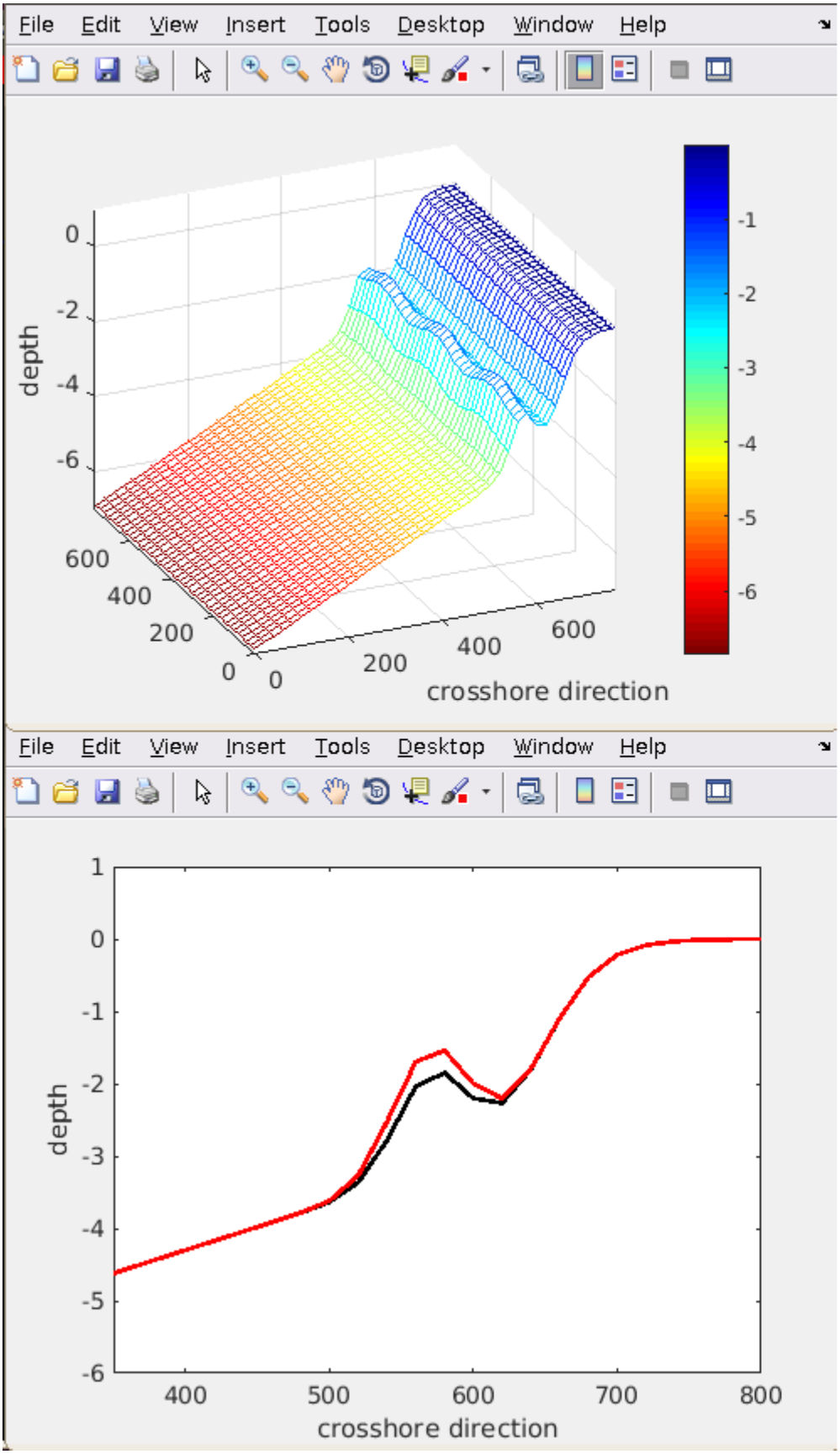

Figura 2: Bathymetry for the RIP case

Now do

```
./croco TEST_CASES/croco.in.Rip
```

or

```
croco.in.Rip  croco.in.Rip_tides
```

To plot use

```
plot_rip.m
```

3.2. Results

Using the script **plot_rip.m** we get

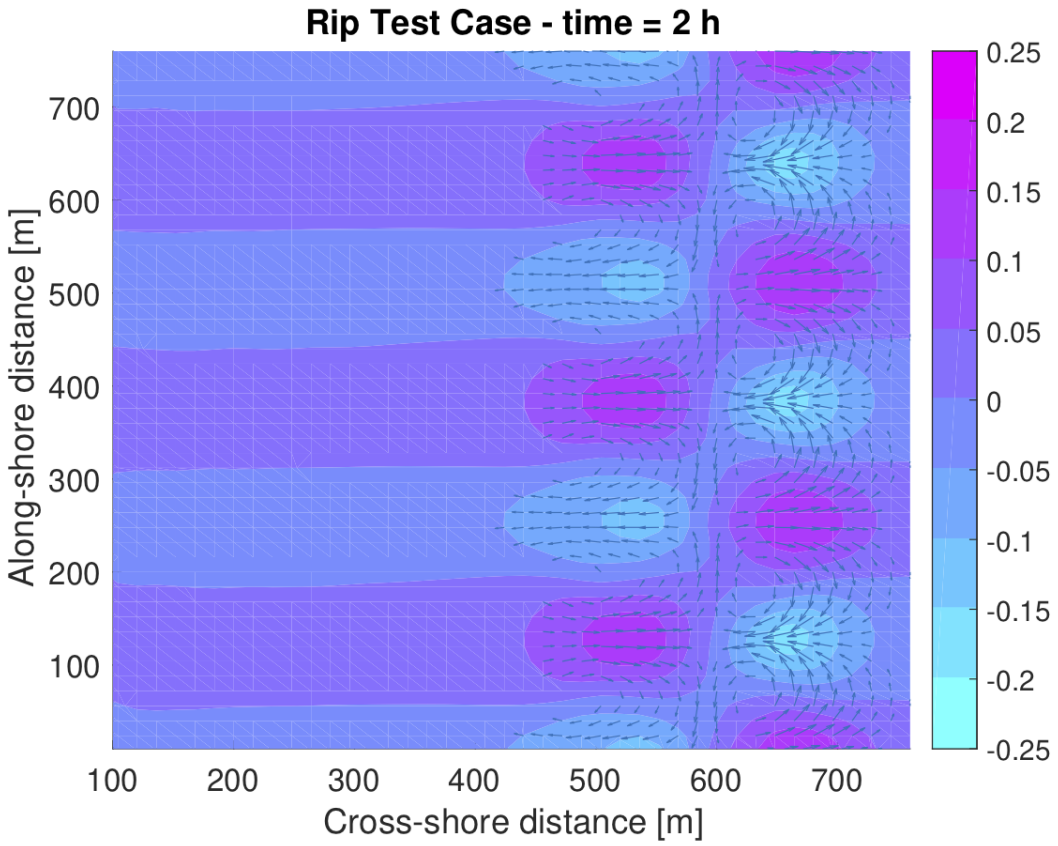

Figura 3: Test case Sediments : RIP

4. SED_TOY

Single column test case.

- ROUSE Case:Testing sediment suspension in a 1DV framework to verify the agreement with Rouse theory
- CONSOLID case : This 1DV test case exemplifies the sequence of depth-limited erosion, deposition, and compaction that characterizes the response of mixed and cohesive sediment in the model.
- RESUSP case : This 1DV test case to demonstrate the evolution of stratigraphy caused by resuspension and subsequent settling of different class of sediment during time-dependent bottom shear stress events.

4.1. Configuration

```
#define  SED_TOY         /* 1DV sediment toy Example */
```

then choose which case you want to run

```
*/                              /* Choose an experiment :              */
```

and use the correct .in file

```
croco.in.Sed_toy_consolid  croco.in.Sed_toy_floc
croco.in.Sed_toy_resusp  croco.in.Sed_toy_rouse
```

Now do

```
./croco TEST_CASES/croco.in.Sed_toy_rouse
```

Some auxiliary files in the **TEST_CASES** directory are

```
sediment_ana_dune.in
sediment_sed_toy_resusp.in
sediment_sed_toy_consolid.in
sediment_sed_toy_rouse.in
sediment_sed_toy_floc.in
```

4.2. Results

Using the script **plot_sed_toy_rouse.m** we get

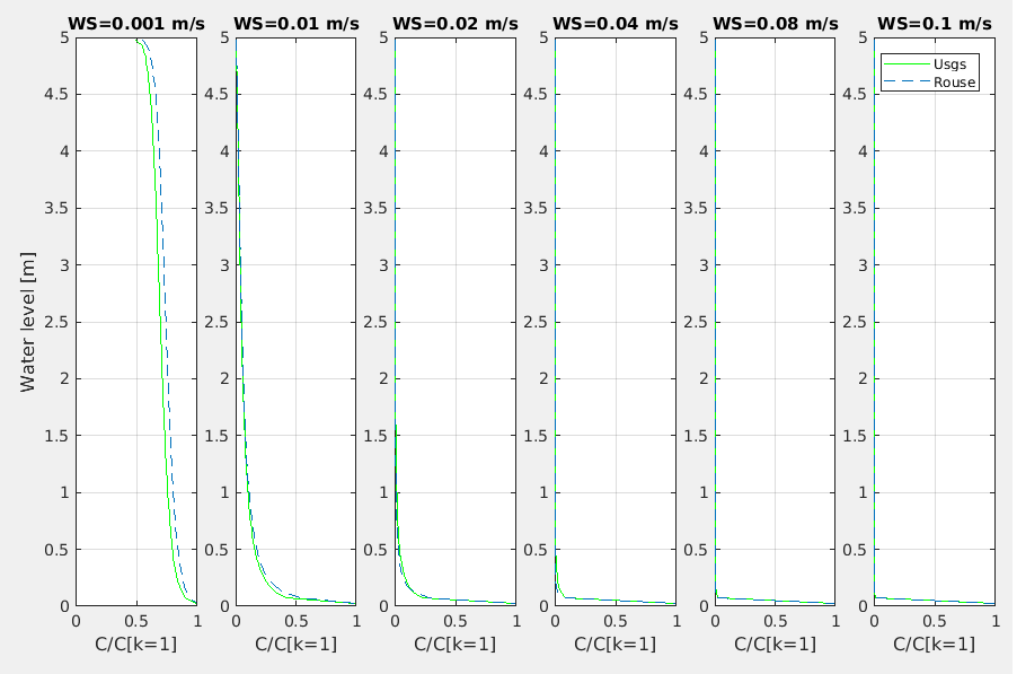

Figura 4: Test case Sediments : SED_TOY - USGS

5. Conclusion

In this tutorial you practiced some idealized cases in **CROCO** that include the **SEDIMENT** module.

For further information:
Andrés Sepúlveda (asepulveda@dgeo.udec.cl)
Developed by:
Rachid Benshila
Guillaume Morvan

6. References

Sediment
https://croco-ocean.gitlabpages.inria.fr/croco_doc/model/model.modules.sediment.html

Test Cases
https://croco-ocean.gitlabpages.inria.fr/croco_doc/model/model.test_cases.html

SANDBAR
Roelvink, J. A. and Reniers, A. (1995). Lip 11d delta flume experiments - data report. Technical report, Delft, The Netherlands, Delft Hydraulics

RIP
Weir, B., Uchiyama, Y.. (2010): A vortex force analysis of the interaction of rip currents and surface gravity wave JGR Vol. 116

Blaas, M., Dong, C., Marchesiello, P., McWilliams, J.C., Stolzenbach, K.D., 2007. Sediment-transport modeling on southern californian shelves: A roms case study. Continental Shelf Research 27, 832-853.

Warner, J.C., Sherwood, C.R., Signell, R.P., Harris, C.K., Arango, H.G., 2008. Development of a three- dimensional, regional, coupled wave, current, and sediment-transport model. Computers & Geosciences 34, 1284-1306.

Kalra, T., Sherwood, C., Warner, J., Rafati, Y., Hsu, T.J., 2019. Investigating bedload transport under asymmetrical waves using a coupled ocean-wave model. pp. 591-604.

Shafiei H., J. Chauchat, C. Bonamy, and P. Marchesiello, 2021: Numerical simulation of on-shore/off-shore sandbar migration using wave-cycle concept - application to a 3D wave-averaged oceanic model (CROCO), submitted to Ocean Modelling.

Appendix A: Old CROCO framework

You can recover the old CROCO code framework creating a configuration with **create_config.bash** by defining

```
# Configuration name
# ------------------
MY_CONFIG_NAME=BENG_CLASI
```

and

```
options=( all-dev )
```

so when you type

```
./create_config.bash
```

you get in the **BENG_CLASI** directory

```
-rw-r--r-- 1 student60 courses  32K Jan 19 11:27 cppdefs_dev.h
-rw-r--r-- 1 student60 courses  42K Jan 19 11:27 cppdefs.h
-rwxr-xr-x 1 student60 courses  24K Jan 19 11:27 create_config.bash.bck
drwxr-xr-x 2 student60 courses 4.0K Jan 19 11:27 CROCO_FILES
-rw-r--r-- 1 student60 courses 9.1K Jan 19 11:27 croco_forecast.in
-rw-r--r-- 1 student60 courses 9.1K Jan 19 11:27 croco_hindcast.in
-rw-r--r-- 1 student60 courses 8.9K Jan 19 11:27 croco.in
-rw-r--r-- 1 student60 courses 8.9K Jan 19 11:27 croco.in.1
-rw-r--r-- 1 student60 courses 8.9K Jan 19 11:27 croco_inter.in
-rw-r--r-- 1 student60 courses 1.6K Jan 19 11:27 croco_stations.in
-rw-r--r-- 1 student60 courses  18K Jan 19 11:27 crocotools_param.m
drwxr-xr-x 2 student60 courses 4.0K Jan 19 11:27 DATA
-rwxr-xr-x 1 student60 courses 9.4K Jan 19 11:27 jobcomp
drwxr-xr-x 2 student60 courses 4.0K Jan 19 11:27 MUSTANG_NAMELIST
drwxr-xr-x 2 student60 courses 4.0K Jan 19 11:27 NAMELIST_OANALYSIS
-rw-r--r-- 1 student60 courses 5.5K Jan 19 11:27 namelist_pisces_cfg
-rw-r--r-- 1 student60 courses 5.5K Jan 19 11:27 namelist_pisces_cfg.1
-rw-r--r-- 1 student60 courses  22K Jan 19 11:27 namelist_pisces_ref
-rw-r--r-- 1 student60 courses  22K Jan 19 11:27 namelist_pisces_ref.1
-rw-r--r-- 1 student60 courses 2.3K Jan 19 11:27 oct_start.m
-rw-r--r-- 1 student60 courses  31K Jan 19 11:27 param.h
-rwxr-xr-x 1 student60 courses 4.3K Jan 19 11:27 process_xios_xml.sh
-rwxr-xr-x 1 student60 courses 8.0K Jan 19 11:27 run_croco.bash
-rwxr-xr-x 1 student60 courses 7.3K Jan 19 11:27 run_croco_forecast.bash
-rwxr-xr-x 1 student60 courses  11K Jan 19 11:27 run_croco_inter.bash
-rw-r--r-- 1 student60 courses 2.8K Jan 19 11:27 sediment.in
-rw-r--r-- 1 student60 courses 4.2K Jan 19 11:27 start.m
drwxr-xr-x 3 student60 courses  16K Jan 19 11:27 TEST_CASES
-rw-r--r-- 1 student60 courses 1.2K Jan 19 11:27 town.dat
```