Tutorial 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

1.1.1. Cluster environment

First open a Linux terminal and connect to the cluster

```
ssh -XC yourlogin@leftraru.nlhpc.cl
```

or, from a OSX

```
ssh -Y yourlogin@leftraru.nlhpc.cl
```

```
mkdir andres
```

Get the code and the the crocotools codee :

```
cp -r croco andres
cp -r croco_tools andres
```

Now , we are going to create your Run directory

```
cd andres/croco
nano create_config.bash
```

to edit the file and modify the following lines to

```
MY_CONFIG_NAME=Run_Sedim
```

Now type :

```
./create_config.bash
```

And we are all set to start :

```
cd Run_Sedim
```

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
```

Remember to modify this

```
#undef REGIONAL
```

After compilation

```
ml purge
ml intel
ml croco/1.3
./jobcomp
```

we can use :

```
./croco TEST_CASES/croco.in.Sandbar_1B
```

You can run with different namelists :

```
croco.in.Sandbar  croco.in.Sandbar_1B
croco.in.Sandbar_1C
```

Namelist from sediment model are on TEST_CASES directory :

```
sediment_sandbar_1B.in      sediment_sandbar_1C.in
sediment_sandbar.in
```

You can do it as is:

```
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
addpath TEST_CASES
plot_sandbar
```

2.2. Results

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

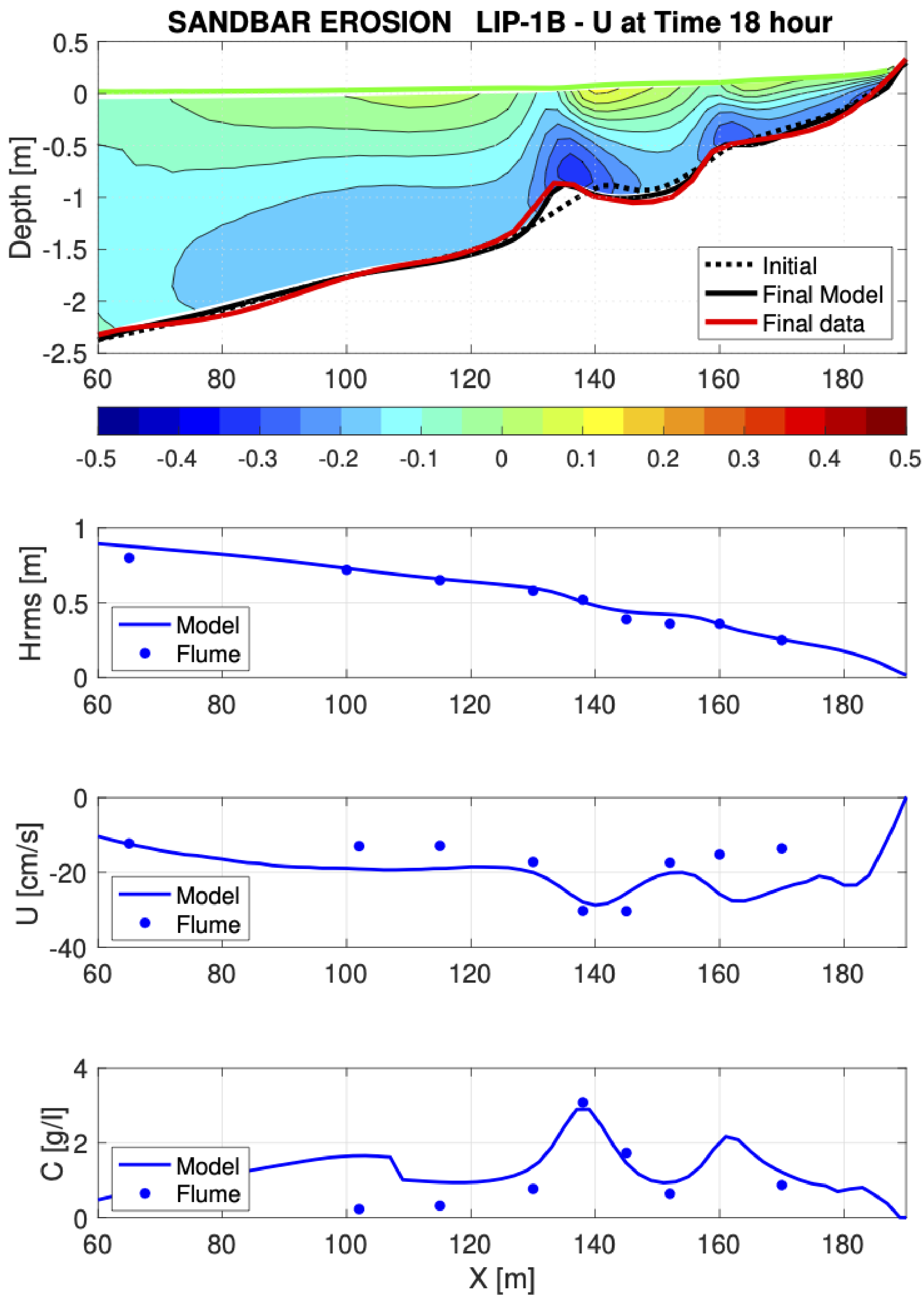

Figura 1: Test case Sediments : Sandbar

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

```
matlab -nodesktop
start
make_rip
```

which gives the file

```
rip_grd.nc
```

and the plots

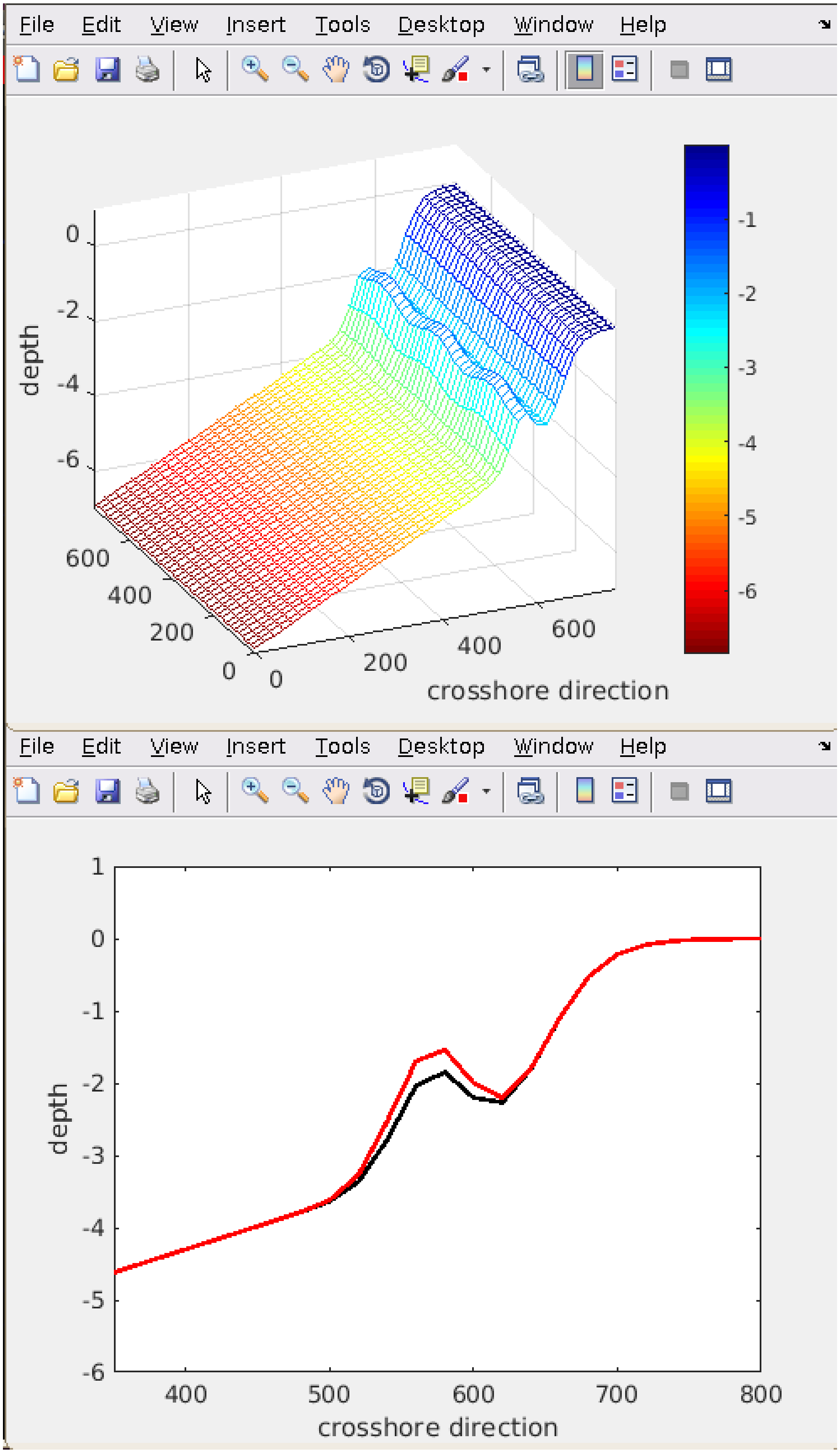

Figura 2: Bathymetry for the RIP case

Now for no tides experiment, just do :

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

For tide experiment, define ANA_TIDES on cppdefs.h , compile and type :

```
./croco TEST_CASES/croco.in.Rip_tides
```

To plot use

```
plot_rip.m
```

3.2. Results

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

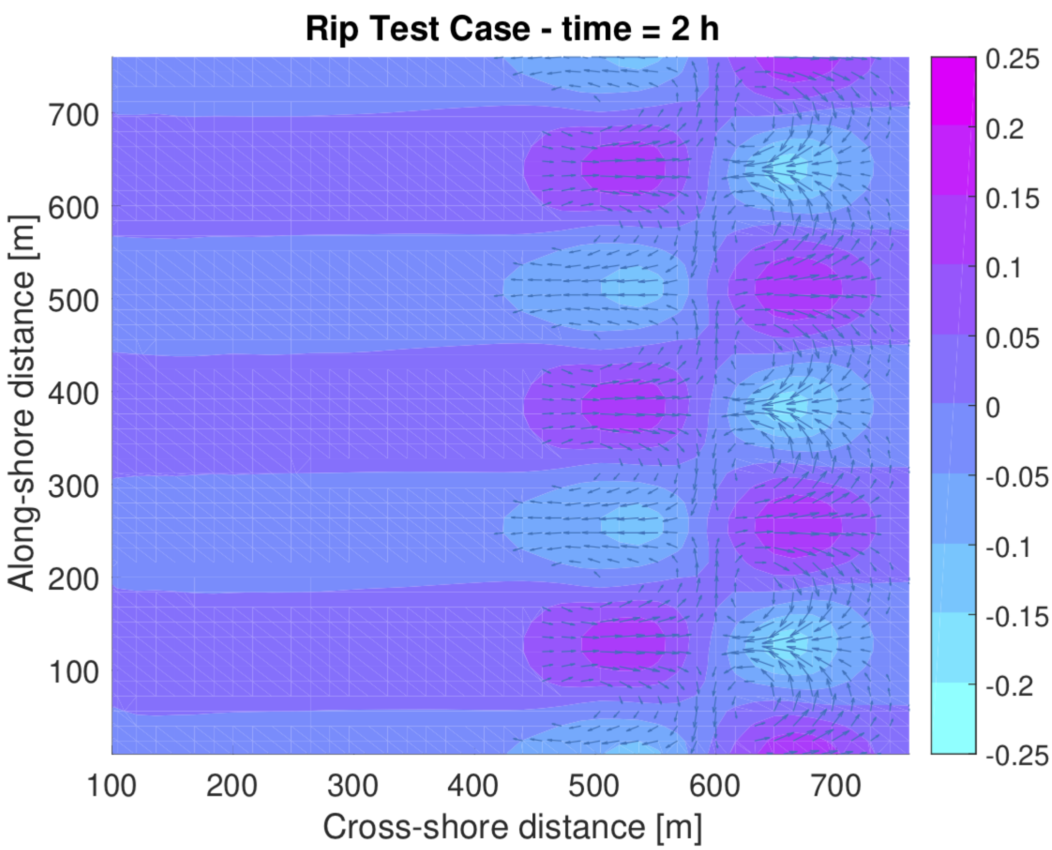

Figura 3: Test case Sediments : RIP

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

# define SED_TOY_ROUSE         Rouse
# undef  SED_TOY_CONSOLID      Consolidation
# undef  SED_TOY_RESUSP        Erosion and sediment resuspension
# undef  SED_TOY_FLOC          Flocculation
```

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_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

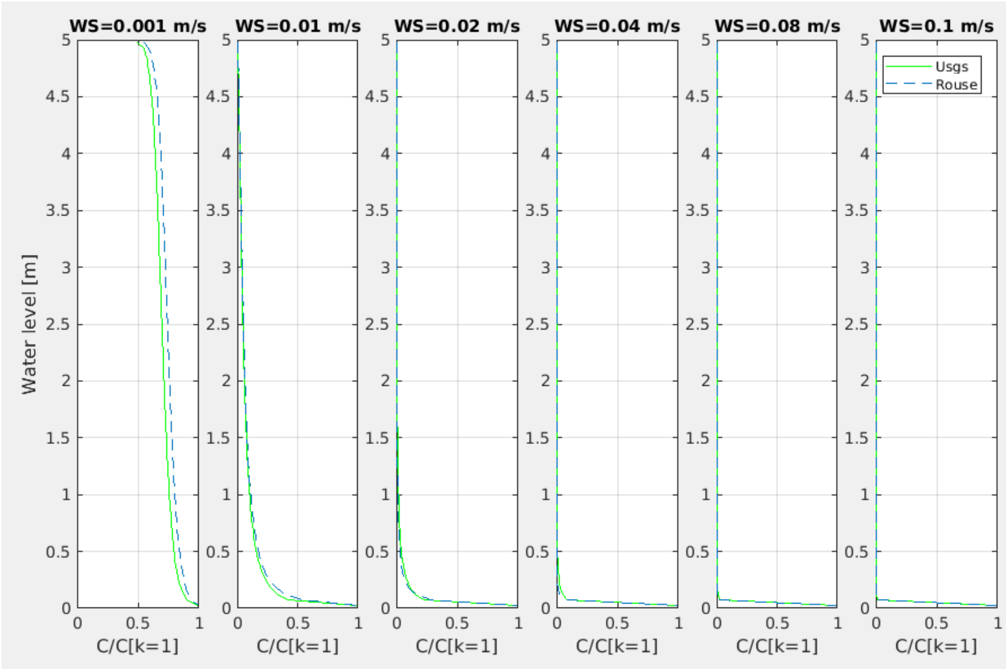

Figura 4: Test case Sediments : SED_TOY - USGS

5. Vilaine

Activate the following options in **cppdef.h**

```
#define  COASTAL
#undef REGIONAL

#define  VILAINE              /* Coastal Vilaine Test Case */

#define  MPI
```

This realistic test case allows us to analyze the model's ability to represent concentration of sediment close to the Vilaine river on South Britany.

```
https://en.wikipedia.org/wiki/Vilaine
```

It used Mustang Sediment model.

First, we are going to retrieve data to initialize Vilaine test case.

```
wget http://mosa.dgeo.udec.cl/CROCO2023/AdvancedCourse/Tutorial05/Run_VILAINE.tar.gz
tar -xvg Run_VILAINE.tar.gz
cp VILAINE/CROCO_FILES/*  CROCO_FILES
cp VILAINE/MUSTANG_NAMELIST/*  MUSTANG_NAMELIST

cp VILAINE/croco.in .
```

Extract the files and place them in the CROCO_FILES and MUSTANG_NAMELIST directories. Use the provided **croco.in** file.

We are going to use 12 CPUs, so we need to adapt the **param.h** file :

```
parameter (NP_XI=3,  NP_ETA=4,  NNODES=NP_XI*NP_ETA)
```

after compilation

```
ml purge
ml intel
ml croco/1.3
./jobcomp
```

launch the simulation

```
squeue run_nlhpc.bash
```

5.1. Results

Using the script **plot_vilaine.py** we get

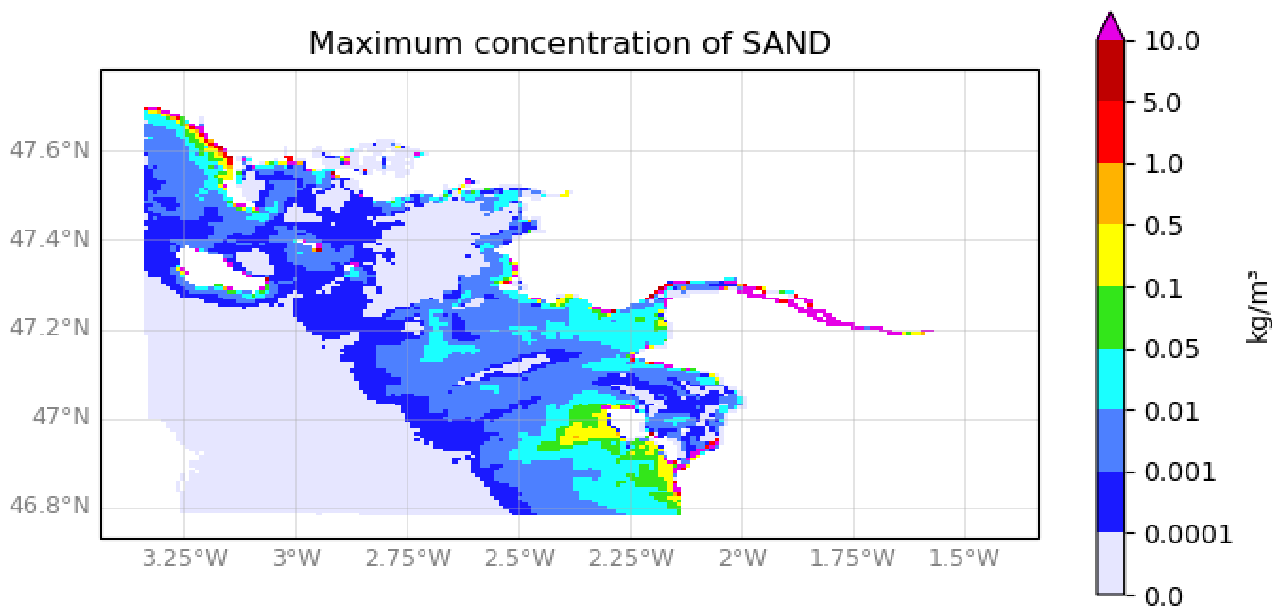

Figura 5: Test case Sediments : Vilaine - MUSTANG

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Andres Sepulveda

Developed by:
Rachid Benshila
Patrick Marchesiello
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.sediment.html

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

RIP
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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.

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