Coastal Operational 3D – Sample (Version 1)

Goal

MOHID model implementation can be quite complex. It is important to provide MOHID users with MOHID implementations ready to run. These samples can be use as a first iteration in thematic implementations (e.g. sand transport, 3D coastal hydrodynamics).

Run mohid in operational (or forecast) mode in coastal environments.

Background

In the "mohid universe" there wasn't until recently no consolidated sample for running mohid in coastal systems (hydrodynamics + biogeochemical processes).

Each user made its implementation but there was no implementation that would synthesize what better mohid has to offer in operational implementations in coastal environments. This sample allow any Mohid user to efficiently implement Mohid in operational mode in coastal environments (hydrodynamics + biogeochemistry). This sample was already tested in different domains (Israel, Algeria, Morocco, Algarve, Madeira, Rias Baixas/Galicia).

Download

https://github.com/Mohid-Water-Modelling-System/Mohid/tree/master/Samples/Coastal3D_Operational

Rational

Run 1 = cold start and **Run 2 = hot start**

This sample allows:

- the **direct coupling to a global astronomic tidal solution** (e.g. FES2014). This avoids the traditional 2D model in the 1st level;
- sponges, biharmonic filter and horizontal turbulent viscosity calculated automatically;
- **in cold start (run 1)** the many specific keywords of a slow connection of forcing terms are set automatically (or internal);
- **remove layers of land automatically**. The geometry that is defined allows to implement a model in the Mariana Trench.
- etc.

The idea is with very few changes running the model in operating mode:

1. with different open boundary reference solutions, for example:
    a. cmems global + fes2014
    b. pcoms
    c. cmems ibi
2. with and without biogeochemical processes connected.

Geometry_x.dat

The geometry define has two domains. A surface one sigma until the depth of 20 m with 12 layers. A second cartesian bottom domain with 63 layers. At depths of 20 m the surface layer has a thickness of 90 cm. The layers thickness increases in depth at a rate of 10%. The discretization defined can simulate a maximum water column thickness of 12 302.50 m.

The relevant option is

```
REMOVE_LAND_BOTTOM_LAYERS : 1
```

This option allows the model to remove all layers with no water point. For example, if the user wants to run the model for bathymetry with a maximum depth of 19 m the model will remove 63 layers and maintain only the 12 layers of the sigma domain. The drawback of this option is that the user only after doing a first run (or some calculation) can know the number of layers of the model implemented.

Turbulence_x.dat

The option **VISC_TURB_SPONGE : 1** allows the model to compute automatically the horizontal turbulent viscosity coefficient evolution along a sponge layer near the open boundary.

```
<begin_viscosity_h>
DEFAULTVALUE              : 0
TYPE_ZUV                  : z
FILE_IN_TIME              : NONE
INITIALIZATION_METHOD     : Sponge
VISC_TURB_SPONGE          : 1
SPONGE_EVOLUTION          : 2
<end_viscosity_h>
```

For the domain area outside of the sponge layer a value equal to dx/100 (dx horizontal spatial step) is assumed. For the value in the outside limit of the sponge layer (open boundary) the follow value is assumed $0.1*dx^2/dt$ (dt model time step).

Hydrodynamic_x.dat

A central new keyword is the follow

```
OPERATIONAL_MODEL_DEFAULT : 1
```

With this keyword the model assumes the follow options:

- Advection of momentum horizontally and vertically solved using a 3rd upwind method with a flux limiter = total variation diminishing (TVD) scheme;

- If not 2D the baroclinic force is connected;
- For the open boundary is follow a boundary relaxation scheme for the velocities and radiation scheme (Flather, 1972) for the sea level;
- The reference solution is only defined via Assimilation.f90 module including the astronomic tide forcing;
- Wind and atmospheric pressure forced in assumed ON;
- Biharmonic filter is by default connected and the biharmonic filter coefficient is assumed to be equal to $dx_{min}^3/10$ and dx_{min} is the minimum horizontal spatial step;
- For the **cold start** the atmospheric and baroclinic forcing is connect in a gradual way along 2 days;

The user can control the reference solution using the follow keywords:

With this first one the user can consider in the reference solution the inverted barometer effect (1) or not (0) over the sea level:

IMPOSE_INVERTED_BAROMETER : 0

By default in the assimilation input data (assimilation_x.dat) two hydrodynamic solutions are defined. The first one results from the linear space/time interpolation of an hdf5 MOHID file. A second is defined base in the grid tidal harmonics solution (e.g. FES2014) from which sea level and barotropic velocities can be derived. With the follow keyword the user can assumed the reference solution based only the first solution (1) or in the linear sum of both solutions (0)

ASSIMILA_ONE_FIELD : 1

Two practical examples.

If the user wants to use the CMEMS Global solution (do not consider the inverted barometer effect) plus the global FES2014 tidal solution than the follow keywords must be used:

IMPOSE_INVERTED_BAROMETER : 1

ASSIMILA_ONE_FIELD : 0

If the user wants to use solution that have all the relevant processes (low frequency circulation, astronomic tide, inverted barometer effect) like PCOMS or CMEMS IBI the follow keywords must be used:

```
IMPOSE_INVERTED_BAROMETER : 0

ASSIMILA_ONE_FIELD              : 1
```

Assimilation_x.dat

For the cold start period default value of 5 days is assumed.

```
COLD_RELAX_PERIOD_DEFAULT :  432000.
```

The relaxation time scale in the open boundary is assumed equal to the time frequency of the reference solution (**FILE_DT : 1**).

```
<<begin_coef>>
DEFAULTVALUE              : 1e9
TYPE_ZUV                  : u
FILE_IN_TIME              : NONE
REMAIN_CONSTANT           : 1
INITIALIZATION_METHOD     : Sponge
FILE_DT                   : 1
<<end_coef>>
```