

Activity 2 - Run an idealized ocean basin II

1. Barotropic vorticity equation

- Write the barotropic vorticity equation including all terms of the model equations

See <https://mesharou.github.io/gula.com/ModNum/HughesDeCuevas01.pdf> and https://mesharou.github.io/gula.com/ModNum/diagnostics_croco.pdf

- Using your preferred language (python , matlab, julia, etc.) plot together the different terms of the barotropic vorticity budget averaged over the last 5 years of the simulation for the BASIN test case from Activity 1 [available in the basin_diags_vrt_avg.nc file].

2. Westward intensification of gyres (Stommel, 1948)

- Copy the BASIN test case from Activity 1 and create a new test case: (for example case2)
- Check the impact of the latitudinal variation of the Coriolis parameter (beta-effect), following the theory of Stommel. To change the value of beta, you need to copy and edit the file `ana_grid.F` and change the value of beta:

```
# if defined BASIN
    depth=5000.
    f0=1.E-4
    beta=2.E-11
```

- Plot the different terms of the barotropic vorticity budget averaged over the last 5 years of the simulation. Compare them with the previous one.

2. Viscous boundary layer (Munk, 1950)

- Use a weaker drag and no-slip lateral conditions (in the [croco.in](#))

```
bottom_drag:      RDRG(m/s),      RDRG2, Zob [m],  Cdb_min, Cdb_max
                  3.e-4            0.      0.      0.      0.
gamma2:           -1.
```

- Plot the different terms of the barotropic vorticity budget averaged over the last 5 years of the simulation. Compare them with the previous one.

2. Non-linear effects

- Check the impact of the non-linear terms (advection) by removing advection in the [cppdefs.h](#) :

```
# undef UV_ADV
```

- Plot the different terms of the barotropic vorticity budget averaged over the last 5 years of the simulation. Compare them with the previous one.

3. Make it more turbulent

- Decrease the explicit dissipation in the [croco.in](#)

```
lateral_visc:      VISC2,      VISC4      [m^2/sec for all]
                  100.      0.

tracer_diff2:      TNU2(1:NT)      [m^2/sec for all]
                  100.      0.
```

- Edit the file `param.h` and increase the number of points:

```
#if defined BASIN
    parameter (LLm0=120,    MMm0=100,    N=20)
```

- Find the largest possible barotropic and baroclinic time-steps
- plot the different terms of the barotropic vorticity budget averaged over the last 5 years of the simulation.