

## Activity 2 - Run an idealized ocean basin II

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### 1. Barotropic vorticity equation

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

See <https://jgula.fr/ModNum/HughesDeCuevas01.pdf>  
and [https://jgula.fr/ModNum/diagnostics\\_croco.pdf](https://jgula.fr/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].
- What is the first order balance over the interior of the gyres? What about the western boundary current?

### 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 what happens if you remove the latitudinal variation of the Coriolis parameter (beta-effect), to test the theory of Stommel. To change the value of beta, you need to copy and edit the file `ana_grid.F` :

```
# if defined BASIN
    depth=5000.
    f0=1.E-4
    beta=0
```

- 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.