Laboration 2:
The role of solid boundaries:
Evolution of an initial disturbance

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Aim

The aim of this assignment is to gain understanding of the influence solid boundaries have on geophysical flows. Although applicable to some situations in the atmosphere, the influence of lateral boundaries is more important in the world oceans. In this assignment you will use a simple shallow water model with solid boundaries. You will test two different initial conditions; an initial disturbance and a system initially at rest with added forcing, and look at how they evolve in time.

Part 1 - Gaussian disturbance

Model setup

- Program an infinite coast by setting an open boundary in the north side of the domain and solid boundary in the south side.

- Impose periodic boundary conditions in the x-direction.

- Program a new initial condition that describes a Gaussian disturbance of reasonable size of the h-field centered in the middle of the coast, so that the disturbance is "cut" by the wall.

- Introduce a reduced gravity in the system.

Experiment

- Run the model for two different cases; the North Atlantic ($L = 1 \cdot 10^7$ m , $H = 1000$ m) and the Baltic Sea ($L = 1 \cdot 10^6$ m , $H = 30$ m).
- Do any particular kind of waves show up?

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- How can you identify those kind of waves? (phase speed, shape, ...)
- Connect your results to the theory.
- Run the model again for both cases (North Atlantic and the Baltic Sea) using different settings, e.g. changing resolution.
- Look at a cross-section of the wave, and estimate its phase speed.
- Compare your results to the theory.

Part 2 - Equatorial beta-plane

In this part of the assignment you are supposed to study waves that appear on an equatorial β-plane.

Model setup

- Change the initial condition to a Gaussian disturbance programmed in the middle of the domain.
- Program a new Coriolis parameter so that it corresponds to an equatorial β-plane ($f = \beta y$). Try to take advantage of LOGICAL here so that you easy can change between β-plane or f-plane, and do it where you add the coriolis to the rest of the equations. This will help you control the code and get help if you have problems. Remember to place the equator ($y = 0$) in the middle of your domain. This means shifting the coordinates vy_t and vy_v.
- You have to remember to introduce a reduced gravity in the code.

Experiment

- Run the model using values responding to the Pacific Ocean ($L = 2 \cdot 10^7$ m , $H = 1000$ m)
- Why do you need a reduced gravity for this simulation?
- Identify the waves in the model
- Do the waves correspond to theory?
- Can these waves be observed in the real ocean?

Good luck!

and remember, if you're stuck with the programming, ask for help by your classmates or by the assistent.