EAS Ocean Modeling | Homework #3   Waves
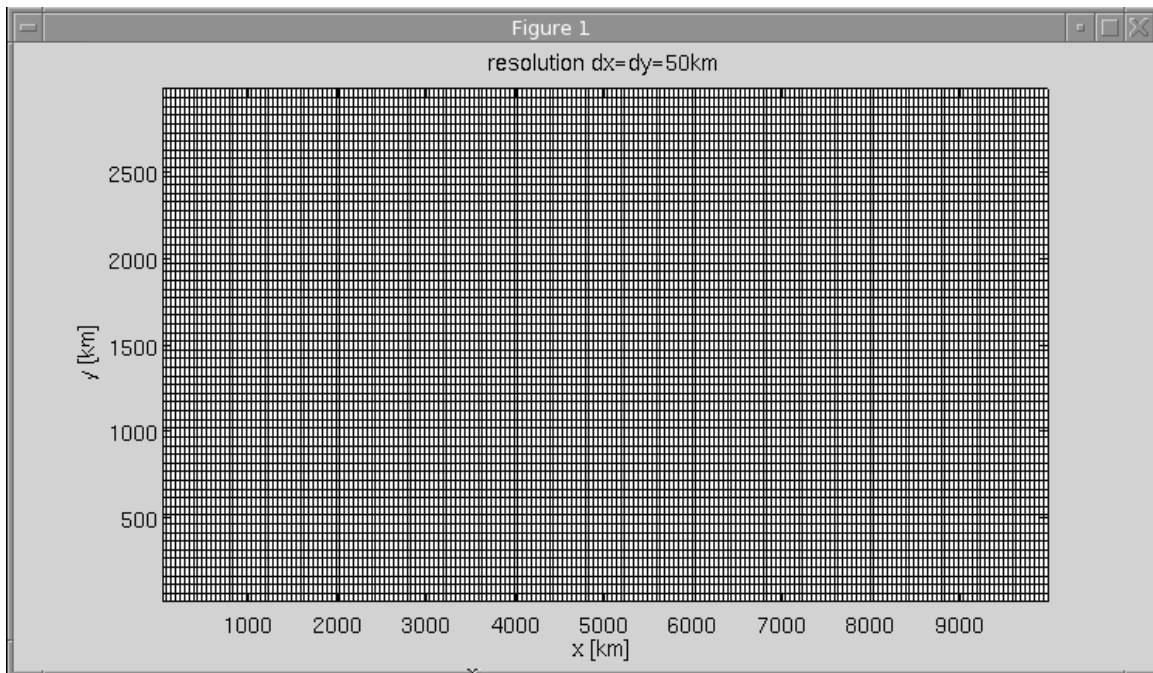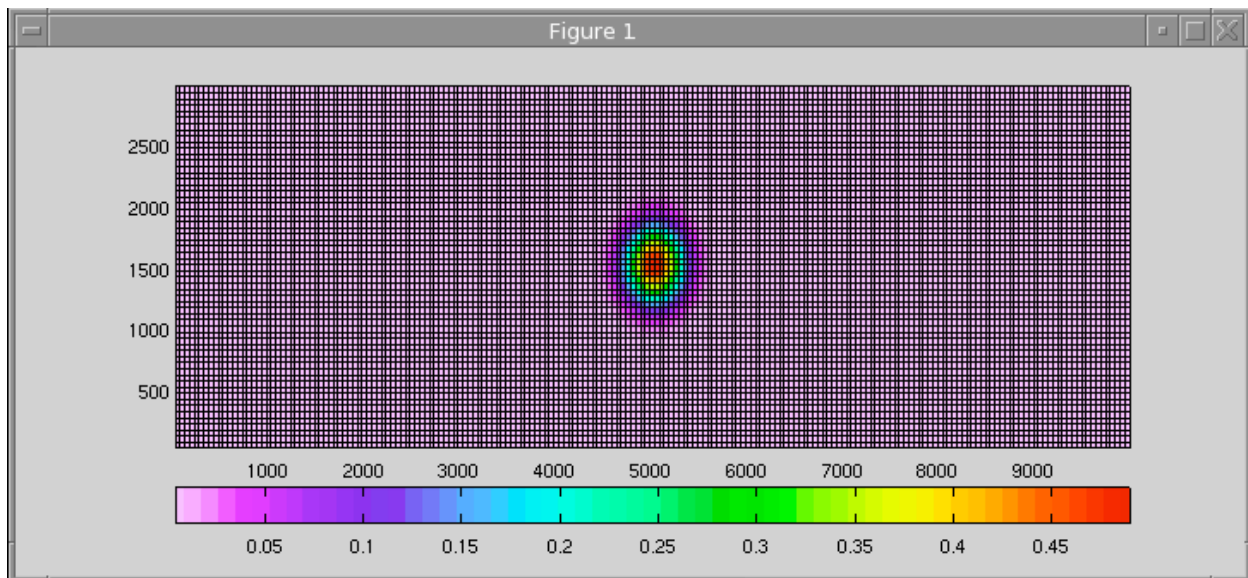

Go to http://www.o3d.org/ROMS-Tutorial/tutorials.html, and complete tutorials section 5.

1) Create a new application in `roms-examples/shallow2D`. In MATLAB build an analytical grid (`roms-examples/shallow2D/input/shallow2d-grid.nc`) with dimensions 3,000x10,000 km as shown in the figure below, with dx=dy=50km, constant depth of 200m and constant Coriolis parameter for a reference latitude of 30N. If you have trouble building such a grid you can look in the file:
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/matlib/sw_CreateGrid.m`

2) Now create an initial condition file containing a Gaussian bump in sea surface height of 0.5m and length-scale of 300km in both the X and Y directions. You need to copy the following MATLB script:
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/matlib/sw_CreateGrid.m`

3) Now configure the ROMS model to solve the linearized shallow water model in the `roms-src/Applications` directory. You will also need to edit the `mod_params.F` and `analytical.F` files. If you have trouble you can copy the files in your source directory:

```
/neo/GFD_Class/gfd_root/roms-src/Applications/SHALLOW2D_cppdefs.h
/neo/GFD_Class/gfd_root/roms-src/Applications/SHALLOW2D_compile
/neo/GFD_Class/gfd_root/roms-src/Nonlinear/analytical.F
/neo/GFD_Class/gfd_root/roms-src/Modules/mod_params.F
```

Save the ROMS executable in your
```
roms-examples/shallow2D/bin/SHALLOW2D-roms
```

4) Next you need to prepare the input parameter file:
`roms-examples/shallow2D/input/shallow2D.in`
To run the model for 180 days, with `DT=240s`. You will need to save the solution every 4 hours in the history file and at least 1 days averages in the average output file. If you have trouble you can copy the input file:
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/input/shallow2D.in`

Inertial-Gravity Waves
Run the model using the qsub command and make a movie of the inertial gravity waves radiating form the bump along with the final adjusted geostrophic balance. You can do this using the MATLAB script below, which you should copy in your shallow2D/matlib directory:
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/matlib/plot_fplane_waves.m`

Kelvin Waves
Change the initial conditions and place the bump on the eastern boundary. Run the model again and make a movie of the transient and timeaveraged solution. Use the MATLAB script
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/matlib/plot_kelvin_waves.m`
How fast does the wave take to travel along the Northen boundary? What is the length-scale of wave disturbance from the coast into the interior? Does it match the Rossby deformation radius?

Rossby Waves

Change the initial conditions and place the bump in the middle of the domain. Change also the gridfile by adding a beta term in the Coriolis. Run the model again and make a movie of the transient and time averaged solution. Use the MATLAB script
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/matlib/plot_rossby_waves.m`
How fast does the wave move? Comment on the solution at the final model time.

Topographic Waves

Change the initial conditions and place the bump in the middle of the domain. Change also the gridfile by adding setting a constant depth 200m with a slope in the y-direction such that the topographic waves will propagate to the east with a phase speed 3 time slower than the Rossby waves of the problem before. Run the model again and make a movie of the transient and time averaged solution. Use the MATLAB script
`/neo/GFD_Class/gfd_root/roms-examples/shallow2D/matlib/plot_alfa_waves.m`
You can play with this example and add back the beta term and watch the interference between the Rossby and Topograpic waves. What happens if both topographic and Rossby waves go in the same direction but with different speeds?

Tropical barotropic waves

Take the tropical pacific grid you generated in the previous homework and configure it to run the shallow water model. As initial condition place a bump of 1m heights in west boundary on the equator. Run the model and make some plots of the propagating waves. Plot also a timeseries of SSH at one point on the equator. Do you see an oscillation? Does it have preferred frequency? If so can you explain it?