12.804 — Geostrophic adjustment — numerical experiments

We have a code for solving the one–dimensional shallow water equations

$$\frac{Du}{Dt} - fv = -h_x$$
$$\frac{Dv}{Dt} + fu = 0$$
$$\frac{Dh}{Dt} + hu_x = 0$$

but written in transport form.

The initial condition is originally

$$h = 1 + amp * \exp(-0.5x^2)$$
$$u = v = 0$$

with $amp = 0.2$. Try other amplitudes, rotation rates, initial velocity conditions, etc.

Things to try:

· Figure out the scaling and what "reasonable" values of f and amplitude might be.
· Calculate the geostrophic final state using linearized dynamics and compare to a time average of h and v.
· Calculate the energies in the gravity waves and in the geostrophic state. How do they depend on the parameters?
· Add the mass slowly:

$$\frac{Dh}{Dt} + hu_x = \begin{cases} amp * \exp(-0.5x^2)/T & 0 < t < T \\ 0 & \text{else} \end{cases}$$
$$h(x,0) = 1$$

You can make your own copies of the programs for modification by changing to a suitable subdirectory in an xterm and entering the following line while the program is loaded:

`cp /tmp/mocha-$USER/* .`

For this project the main file is `swe.m` and you can edit it to change options.