12.804 — Rossby Waves — Ocean data

Purpose

Examine the temperature and salinity data from the Local Dynamics Experiment to see if the motions correspond even approximately to the Rossby Wave dispersion relationship.

Data

Click on the link; this brings you a file containing the necessary Matlab programs and data. Follow the instructions for saving. The main routines are `loadctd`, which brings in the data and reports the starting and ending date, and `mapctd` or `oactd` which allow you to make maps using the Barnes scheme or Objective Analysis. Both of these take data from an irregular set of stations and put it on a regular grid. Note — the Barnes routine (described below) is also available in GEMPAK.

The data has been preselected to give four levels in the vertical. You will want to look at the different levels and probably the different fields as well. For looking at salinity, you may want to modify the `mapctd.m` file to subtract off 35 o/oo in order to get readable contour labels.

Comments on the Barnes scheme

This is a successive iteration routine. The values on the grid are first set to the average, and the initial residuals at the data points are then the measured values minus the average. We then calculate a new estimate on the grid by

$$new(x,y) = old(x,y) + \frac{\sum_i resid_i \times W(x_i - x, y_i - y)}{\sum_i W(x_i - x, y_i - y) + ehalf}$$

where $(x,\ y)$ are the grid point locations and $(x_i,\ y_i)$ are the data locations. The weighting function is chosen to fall off as a gaussian with distance (30 km is a reasonable scale at first). Corrections are applied for differences in distance of a 1^o latitude or longitude displacement.

The scheme then interpolates back (with linear interpolation) to get the values estimated at the data positions given the current grid values. This then gives a new estimate of the residual and of the error.

These steps are repeated until the residual is sufficiently low. Usually at some point, the scale of the Gaussian is reduced (so that grid values will mirror the nearby points more closely); however, it then becomes important to introduce an "ehalf" value which is non–zero, so that points for which $\sum W(x_i - x, y_i - y)$ is very small will not be altered by the algorithm. You can try various sequences of $(radius,\ ehalf)$ and see how the maps change.

To do:

From a sequence of maps, try to estimate the dominant wavenumber(s) and propagation speed. Compare with the Rossby wave dispersion relationship. The first mode deformation radius is about 47 km.