1 Lagrangian diffusivities from Patch 3

from (Davis, 1987, 1991):

\[ \kappa_{ij}(x, \tau) = -\langle v'_i(t_0|x, t_0) \; r'_j(t_0 - \tau|x, t_0) \rangle_L \]  

(1)

The diffusivity at location \( x \) as a function of timelag \( \tau \) is defined as the Lagrangian average \( \langle \cdot \rangle_L \) (which is the average over all particles with the same time lag \( \tau \) that pass through \( x \)) of the product of the residual velocity of the particle passing through \( x \) at \( t_0 \) and the residual displacement of the particle at \( \tau \) reaching (\( \tau > 0 \)) or leaving (\( \tau < 0 \)) that point. Note \( v' \) and \( r' \) are both departures from the Lagrangian means.

This definition is equivalent to the integral of the Lagrangian velocity autocorrelation (yes, checked for the bins).

\[ \kappa_{ij}(x, \tau) = \int_{-\tau}^{0} d\tilde{\tau} \langle v'_i(t_0|x, t_0) \; v'_j(t_0 + \tilde{\tau}|x, t_0) \rangle_L \]  

(2)

1.1 Subtraction of different means

Figures 1 and 2 shows diffusivities as a function of timelag for 9 different bins, whose centers are located at 60°S and the first bin’s Western boundary is the longitude of deployment for Patch3. This corresponds to the bins in the center of the ACC where most floats travel. Binsize is 10° in longitude and 5° in latitude. In the figures, two different means are subtracted and compared to no-mean subtraction. Clearly, subtracting the Eulerian mean interpolated to the drifter velocities yields best convergence. There still is no convergence for the zonal diffusivities in some of the bins. To be done: compare subtraction of annual 1998 Eulerian mean to subtraction of two-year (1998-1999) mean.
1.2 Deployment time

Figure 3 shows the same as Figure 1 but now for the second deployment, which is 60 days later than the first one. The two are not terribly different, yet, another thing to do is to put the two deployments together and treat them as one. Do both deployments represent similar isopycnal surfaces?

1.3 Compare Eulerian and Lagrangian diffusivities

Figure 4 compares the Lagrangian (Eulerian 1998 mean removed) and Eulerian (Case FG) diffusivities for the 300 m and 800 m deployments. In general, Eulerian diffusivities are still smaller than the Lagrangian ones and there is no correlation.
Figure 1: P3D1DD300. First 9 panels: $\kappa_{y,y}$, last 9 panels: $\kappa_{x,x}$. blue: no mean removed, red: Lagrangian mean over all points with the same timelag removed, magenta: 1998 Eulerian mean interpolated to drifter velocities removed. Number is number of "deployment" points per bin, positive (negative) timelag refers to floats approaching (leaving) the deployment point.
Figure 2: same as figure 1 but for deployment depth 800 m.
Figure 3: P3DD300. blue: first deployment, red: second deployment.
Figure 4: Comparison of Eulerian and Lagrangian diffusivities. Upper: 300 m Deployment 1. Lower: 800 m Deployment 1.
References
