# Problem Set 5: SIO 221B, Data Analysis

*due Friday, November 15, 2002*

**1. (10 pts)** A matrix **A** is defined as

$$\mathbf{A} = \begin{bmatrix} 1 & 3 \\ -3 & 1 \\ 2 & 2 \end{bmatrix}$$

Using the eigenvector relations between the singular values, $\mathbf{u}_i$, and $\mathbf{v}_i$, find the complete SVD for **A**. Do not use a singular value decomposition program.

**2. (20 pts)** Suppose we have observations of horizontal velocity from a moored array of current meters, as described in the following table:

| $x$ (km) | $y$ (km) | $u$ (cm/s) | $v$ (cm/s) |
|---|---|---|---|
| 10. | 0. | 35.5 | 21.3 |
| 0. | 10. | 53.5 | 30.4 |
| -10. | 0. | 49.2 | 24.8 |
| 0. | -10. | 33.5 | 18.4 |
| 0. | 0. | 43.5 | 25.5 |

A. Fit planes to the measurements of $u$ and $v$ and calculate the following:

i. The coefficient of each function in the fit.

ii. The mapped values of velocity at each instrument.

iii. The misfit as measured by the L2 norm.

iv. The vorticity, $\partial v/\partial x - \partial u/\partial y$, and divergence, $\partial u/\partial x + \partial v/\partial y$.

v. The covariance matrix of the model coefficients, assuming that the standard deviation of each component of velocity is 3.0 cm/s and that the error is uncorrelated between instruments.

vi. The resulting error in area-averaged velocity, vorticity, and divergence.

B. Enforce the constraint that the flow has zero divergence, and redo i-vi above. Discuss the differences between the two sets of results.

C. Suppose one of the instruments failed. (You choose which one.) Redo the calculations and discuss the results.

**3. (bonus)** Choose any oceanographic or climate record that you like. Least-squares fit a function of your choice to the data. Discuss the method of fitting that you have used, uncertainties in the results, and the goodness of fit. If you e-mail me a graphic summarizing your results (preferably in postscript, pdf, gif, or jpg) I'll bring them to class for discussion and will post them on the web.