SIO 217B Atmospheric and Climate Sciences II

Exercise #18

1. Download the file containing Z_{1000} data for 1993 March 14 00Z. Calculate geostrophic wind from the Z_{1000} data as in Exercise #10. Plot geostrophic wind vectors in the domain 20-50°N, 270-310°E. Calculate geostrophic relative vorticity as in Exercise #15. For more convenient numbers, multiply vorticity by 10^5. Plot contours of geostrophic vorticity over the geostrophic wind vectors using intervals of 20 (actually 20×10^{-5} s^{-1}). Note how vorticity is concentrated in the low pressure center, unlike the case for the trough at 500 hPa.

2. a) Write an equation for w_e, the vertical velocity at the top of the Ekman layer, in terms of geostrophic relative vorticity and any other necessary parameters.

   b) Calculate w_e assuming that the eddy viscosity coefficient has a constant value of 5 m^2 s^{-1}. Plot geostrophic wind vectors in the domain 20-50°N, 270-310°E. Add contours of w_e to the wind vectors using an interval of 2 cm s^{-1}.

   c) Compare the magnitude of w_e to the magnitude of w_{500} calculated in Exercise #13. Which is larger? Can convergence of surface wind in a low pressure center be the primary cause of upward motion in an extratropical cyclone?