

SIO 217B Atmospheric and Climate Sciences II

Exercise #9

- Download the files containing Z_{500} , u_{500} , and v_{500} for 1993 March 14 00Z. Plot Z_{500} in the domain $20\text{-}50^\circ\text{N}$, $270\text{-}310^\circ\text{E}$ using the conventional units of geopotential decameters (dkm) with a contour interval of 6 (e.g., 534, 540, 546, etc. dkm). Add vectors of wind_{500} to the plot. It may be necessary to plot every other vector to reduce crowding.
 - Note that vectors of wind_{500} are more closely parallel to Z_{500} contours than was the case for $\text{wind}_{10\text{-m}}$ and SLP in Exercise #4. Why is this?
- Write down equations for calculating the zonal and meridional components of geostrophic wind from the gradient of geopotential height (Z) in spherical coordinates.
 - Using a centered finite difference method, calculate geostrophic wind from the Z_{500} data. Plot geostrophic wind vectors over Z_{500} contours in the domain $20\text{-}50^\circ\text{N}$, $270\text{-}310^\circ\text{E}$ using the same vector length scaling as for wind_{500} .
 - Look for locations on the plot that occur at widely different latitudes but have the same distance between Z_{500} contours. Are the geostrophic winds at those locations the same, or do they have different strengths? Why?
- Subtract the geostrophic wind from wind_{500} to obtain the ageostrophic component of wind_{500} . Plot ageostrophic wind vectors over Z_{500} contours in the domain $20\text{-}50^\circ\text{N}$, $270\text{-}310^\circ\text{E}$ using the same vector length scaling as for wind_{500} . Note that the ageostrophic component of the wind is much smaller at the 500-hPa level than is the case near the surface (Exercise #4).
- Calculate the scalar speed of wind_{500} and the scalar speed of the geostrophic wind. Subtract the geostrophic wind speed from the wind_{500} speed, and plot contours of the wind speed difference in the domain $20\text{-}50^\circ\text{N}$, $270\text{-}310^\circ\text{E}$. If possible, add Z_{500} contours using a different color or line pattern.
 - Note how wind_{500} speed is less than the geostrophic wind speed in the region of the Z_{500} trough and greater than the geostrophic wind speed in the region of the Z_{500} ridge. Explain why this is the case in terms of the balance of horizontal forces (real and inertial) that act on wind_{500} and the geostrophic wind.