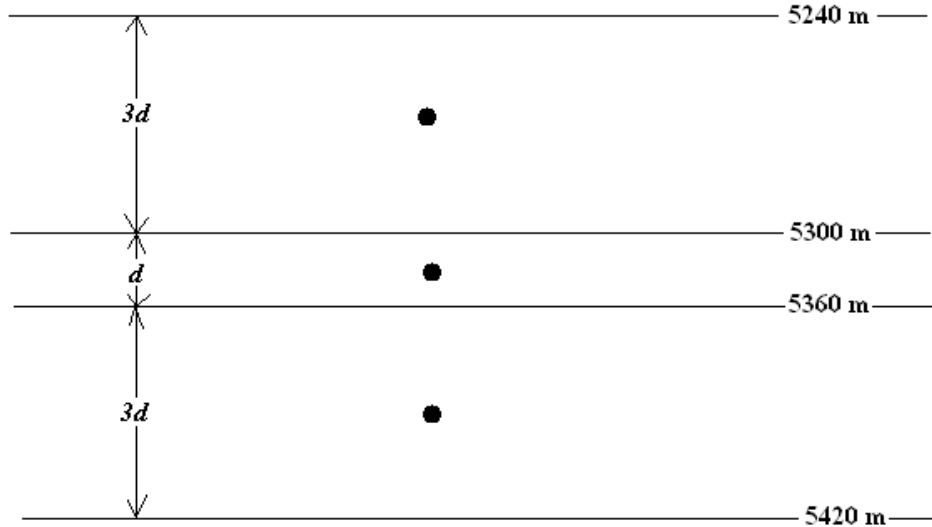


ESCI 342 – Atmospheric Dynamics I
Answers to Selected Exercises for Lesson 9

2. The diagram below shows contours of 1000 – 500 mb thickness.



- a. Assume the 1000 mb geostrophic wind is SW at 5 m/s. At the three black dots draw wind barbs representing the geostrophic wind direction and speed at 500 mb. Use a latitude of 45 N, and $d = 175$ km.

Answer: The wind at the outer points is from 254° at 13 m/s. The wind at the middle point is from 263° at 31 m/s.

3. Show that $\frac{D\vec{V}}{Dt} = -\frac{1}{\rho}\nabla p - \hat{k} \times f\vec{V}$ can be written as $\frac{D\vec{V}}{Dt} = \hat{k} \times f(\vec{V}_g - \vec{V})$.

Answer: By definition, $-\frac{1}{\rho}\nabla p \equiv \hat{k} \times f\vec{V}_g$.

6. b. For the regular high and the regular low, is $\partial V/\partial p$ greater than or less than $\partial V_g/\partial p$? (Assume that the isotherms are parallel with the contours, so that the radius of curvature doesn't change with height.)

Answer: Since $\frac{\partial V}{\partial p} = \frac{1}{\sqrt{1 + \frac{4}{fR}V_g}} \frac{\partial V_g}{\partial p}$, and since for the regular low $R > 0$, then

$$\frac{\partial V}{\partial p} < \frac{\partial V_g}{\partial p}. \text{ Similarly, for the regular high } R < 0, \text{ so that } \frac{\partial V}{\partial p} > \frac{\partial V_g}{\partial p}.$$

(Note that since p increases downward, then with respect to height we have that for the low $\frac{\partial V}{\partial z} > \frac{\partial V_g}{\partial z}$ and for the high $\frac{\partial V}{\partial z} < \frac{\partial V_g}{\partial z}$.