

Course: Dynamics 1
Exercise: 16. November 2006

1. The mean temperature in the layer between 75 and 50kPa decreases eastward by $3^\circ C/100 km$. If the 75-kPa geostrophic wind is from the southeast at 20m/s, what is the geostrophic wind speed and direction at 50 kPa? Let $f = 10^{-4} s^{-1}$.

2. Suppose that a vertical column of the atmosphere is initially isothermal from 90 to 50 kPa. The geostrophic wind is 10m/s from the south at 90kPa, 10m/s from the west at 70 kPa, and 20m/s from the west at 50kPa. Calculate the mean horizontal temperature gradients in the two layers 90-70kPa and 70-50 kPa. Compute the rate of advective temperature change in each layer.

3. Show that the geostrophic balance in isothermal coordinates may be written:

$$f \vec{V}_g = \vec{k} \times \nabla (RT \ln p + \Phi)$$

where Φ is the geopotential.

4. Show that the thermal wind is related to the geopotential through the relation:

$$\vec{V}_T = \frac{1}{f} \vec{k} \times \nabla (\Phi_1 - \Phi_0)$$

where Φ_1 and Φ_0 is the geopotential on two isobaric surfaces ($p_0 > p_1$) .

5. Show that geostrophic flow in isobaric coordinates is incompressible.