# The Geostrophic Wind

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## 1 Problem

One day recently a 100 km $hr^{-1}$ wind was observed to be blowing from west to east at an altitude of 10 km above Princeton. What was the direction and magnitude of the pressure gradient at 10 km? You may find it helpful to note that Princeton is at a latitude of 40° and the density of air at 10 km is $\rho = 0.37$ kg $m^{-3}$.

## 2 Solution

This is a question about the "geostrophic wind" which dominates the atmospheric circulation at heights exceeding about one kilometer above the ground. To good approximation, the Coriolis force is completely balanced by the pressure gradient, so at a latitude $\lambda$ and with the rotation rate of the earth $\Omega$.

$$2\rho\Omega v \sin\lambda = |\nabla p|, \tag{1}$$

with the pressure gradient at right angles to the velocity and low pressure on the left as you travel with the wind. For the conditions stated above, the pressure is increasing (as usual) at a maximum rate on a north to south direction, and the solution to (1) is $1.1 \times 10^{-3}$ N $m^{-3}$.