

Geostrophic wind calculation example

If straight geopotential height contours of the 500 hPa surface at 60-m intervals are 100-km apart, calculate the geostrophic wind. Assume the latitude is 45°N.

Answer

The geostrophic wind blows parallel to the height contours with low heights to the left of the wind's direction in the northern hemisphere. The geostrophic wind results from a balance between the Pressure Gradient Force and the Coriolis Force – this can occur in steady, straight, frictionless flow.

$$f = 2\Omega \sin\phi = 2(7.292 \times 10^{-5} \text{s}^{-1}) \sin 45 = 2(7.292 \times 10^{-5} \text{s}^{-1}) \sin \frac{\pi}{4} = 1.03 \times 10^{-4} \text{s}^{-1}$$

$$V_g = -\frac{g}{f} \frac{dZ}{dn} \approx -\frac{g}{f} \frac{\Delta Z}{\Delta n} \approx -\left(\frac{9.8 \text{ms}^{-2}}{1.03 \times 10^{-4} \text{s}^{-1}}\right) \left(\frac{-60 \text{ m}}{100000 \text{ m}}\right) = 57 \text{ms}^{-1}$$