

### Homework 11

1. Assume the geopotential field is described by the following expression:

$$\Phi = \Phi_0(p) + cf_0 \left\{ -y \left[ \cos \left( \frac{\pi p}{p_0} \right) + 1 \right] + \frac{\sin(k(x - ct))}{k} \right\},$$

where  $\Phi_0$  is a function of  $p$  alone,  $c$  is a constant speed,  $k$  a zonal wave number, and  $p_0 = 1000$  hPa.

- (a) Obtain the expression for the corresponding geostrophic wind.
- (b) Use the quasi-geostrophic vorticity equation to obtain the horizontal divergence ( $H = \nabla \cdot \bar{u}_a$ ) field consistent with  $\Phi$ . Assume that  $df/dy = 0$ .