

Exercises

- 11.1** Using scale analysis, determine under what conditions the β -plane is an acceptable approximation to the rotating sphere.
- 11.2** Assess the accuracy of geostrophic balance for Rossby waves.
- 11.3** For the parameters used in connection with stationary waves (i.e., the values of $d, n = 0, k, f$, and β – and taking $h = 10.4$ km) find that value of k for which σ (for Rossby waves) is a maximum.
- 11.4** Write down the horizontal momentum equations for perturbations u', v', p' in a form applicable to an equatorial β -plane, that is, with $f = \beta y$. Assume a solution with $v' = 0$, and

$$u' = \text{Re}\{u'_0 \exp i(\omega t - kx)\}.$$

Show that in this case the amplitude u'_0 varies with the latitude as

$$\exp\left(\frac{-\beta y^2 k}{2\omega}\right)$$

Note that for a satisfactory solution k must be positive, that is, the wave must be eastward moving. Plot the pressure field associated with the variation in zonal velocity u' . These are equatorial Kelvin waves; they have been observed in the stratosphere.