

### ATM 478/678 Mesoscale Dynamics Unit 3

1. Undergraduate students: Lenticularis clouds typically form in winter north of the Alaska Range. Explain their seasonality with respect to atmospheric conditions that favor the formation of gravity waves.
2. All students: Derive the group velocity for simple gravity waves.
3. Graduate students: A stationary gravity wave was excited by flow over elevated terrain. It has the form

$$w'(x, z) = W(z) e^{ikx}.$$

Its horizontal and vertical scales are short enough that the local conditions control the wave propagation. Assume that the upstream flow  $\bar{u}$  is independent of height, but the stratification varies according to

$$N^2(z) = N_o^2 \left( 1 - \frac{z^2}{H^2} \right)$$

Describe the wave propagation (a) for levels where the wave is propagates vertically, and (b) sketch the wave structure. For extra credit (c) determine the range of  $\bar{u}$  for which wave activity is trapped at the surface.