1.4. Propagation and dissipation of waves

- Review of mechanisms *(see Thorpe75.pdf):*

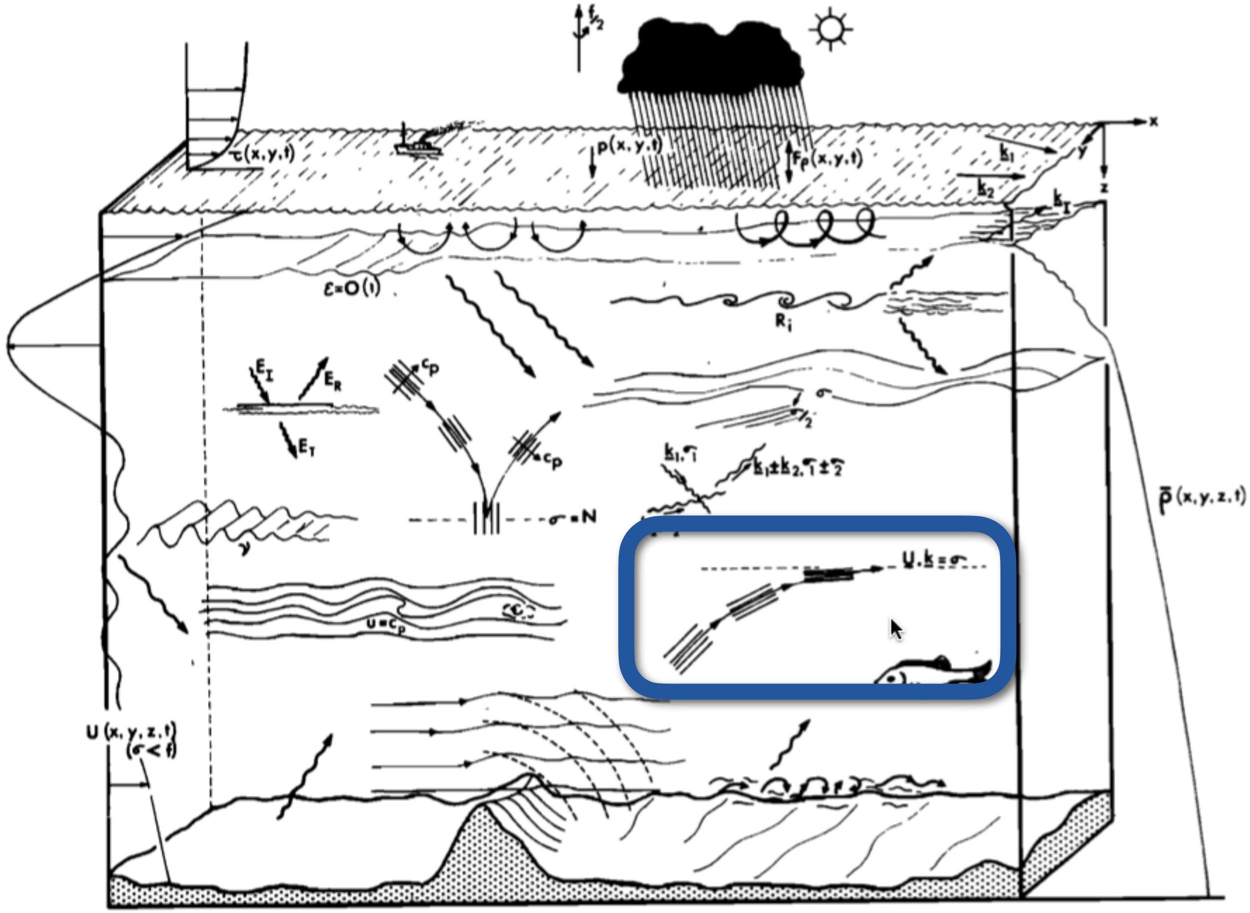


Fig. 5. Physical processes affecting internal waves.

1.4. Propagation and dissipation of waves

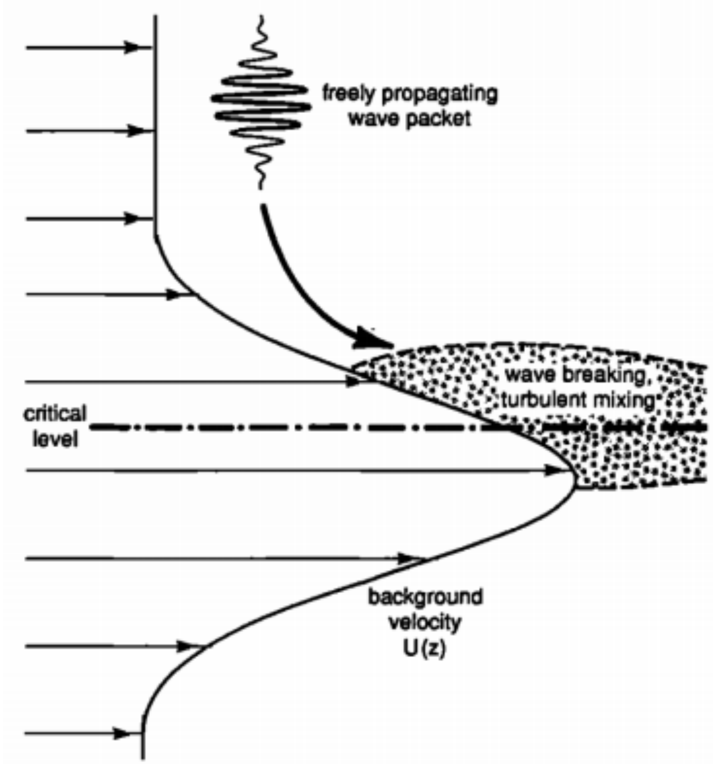
D. Critical layer absorption

A critical layer is a region where the velocity of the flow is equal to the phase speed of the waves **[Bretherton & Garrett, 1968]**

$$\omega = \vec{k} \cdot \vec{U}$$

At such level, energy is transferred to the mean flow and turbulence is generated.

(See LeBlond & Mysak, p 387)



[Winters & D'Asaro, 1989, 1995]

1.4. Propagation and dissipation of waves

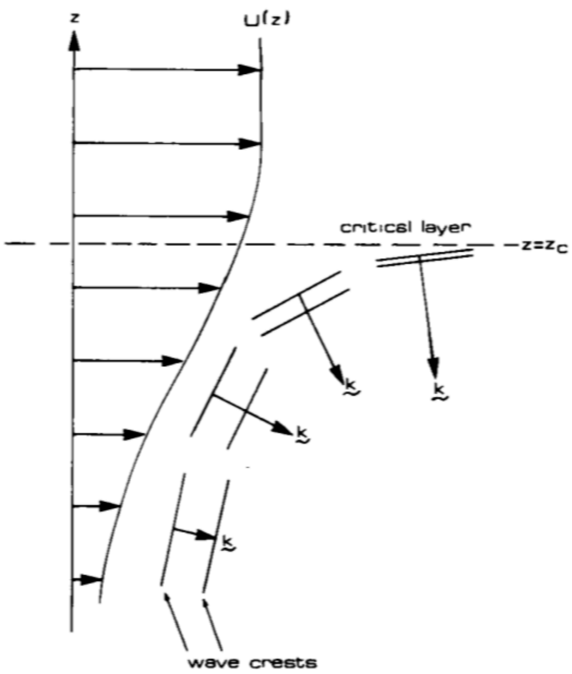
D. Critical layer absorption

- Activity:

We consider an internal wave propagating upward in a vertically sheared flow $\vec{U} = [U(z), 0, 0]$ (with no rotation for simplicity)

1. Write the vertical component of the group speed

2. Explain what happens when the wave reaches a critical layer



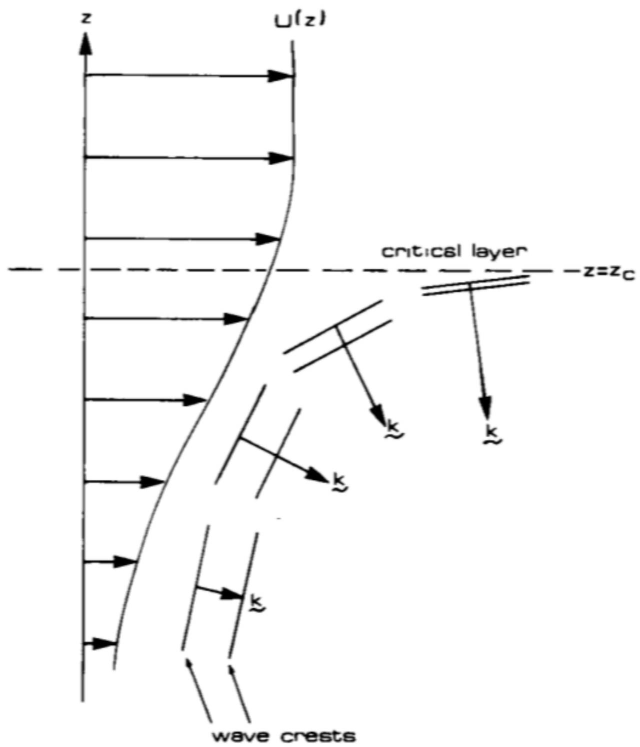
[LeBlond & Misak]

1.4. Propagation and dissipation of waves

D. Critical layer absorption

- For small wave in a presence of a vertical shear: If the background flow increases as a small wave approaches, it is stretched and rotated due to the shear until it's group velocity is nearly horizontal, wavelength increases infinitely, lending the wave's energy to the background.

- For large amplitude waves, the steepness of the wave causes breaking before absorption occurs.



[LeBlond & Misak]

1.4. Propagation and dissipation of waves

D. Critical layer absorption

- Short internal Lee waves have a high probability of encountering critical layers and be absorbed in the lower 1 km above ocean bottom: