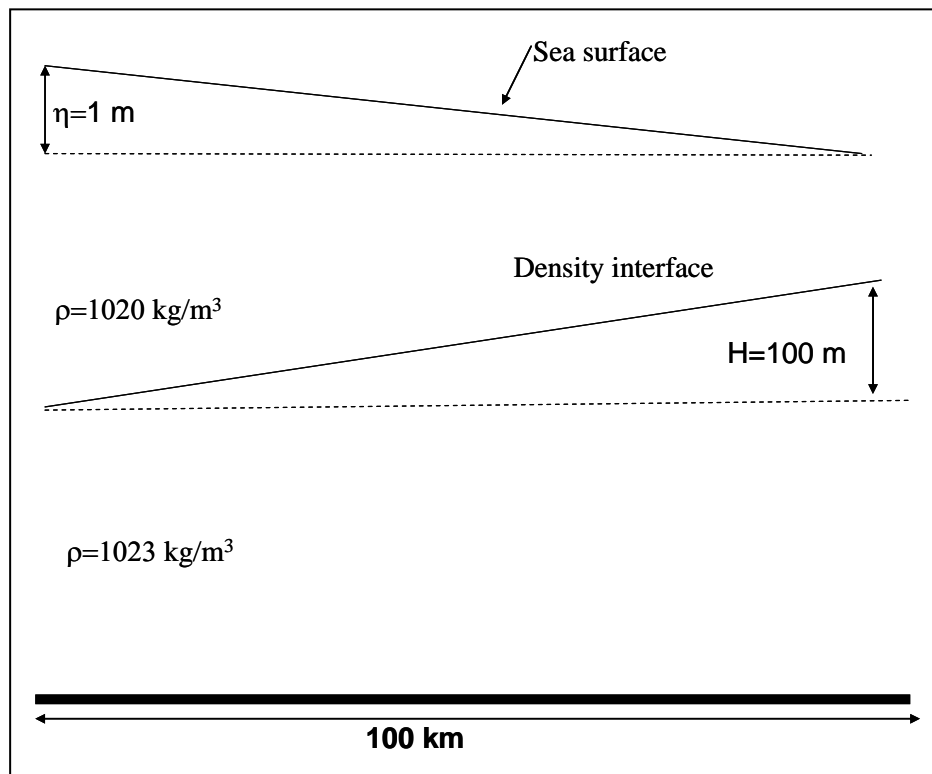


- 1) Figure 1 depicts a two-layer water column with a tilting sea surface and a tilting density interface. Assume that the flow is geostrophic and  $f=10^{-4} \text{ s}^{-1}$
- Calculate the horizontal velocity in the upper and lower layer
  - Indicate the direction of the flow in the bottom Ekman Layer
  - Consider a case where the sea-level tilt is the same as in the figure, but the interface tilt changed such that it exactly canceled the pressure gradient in the lower layer. Calculate the tilt, in terms of the variable  $H$ , in this case.
  - How would this change the flow in the bottom Ekman layer?

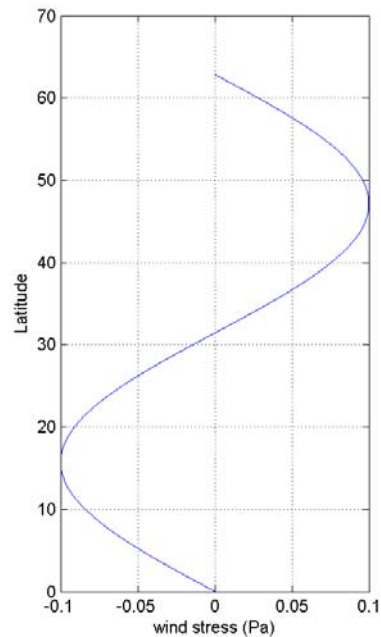


- 2) The panel to the right depicts a hypothetical latitudinal variation in the east/west wind stress. The stress is modeled as

$$\tau = 0.1 * \sin(\text{latitude}/10)$$

and there is no wind stress in the north/south direction.

- a) Assuming that the Coriolis frequency is constant ( $f$  plane) and equal to  $10^{-4}$ . Derive an expression for the vertical motion at the base of the Ekman layer as a function of latitude.



- b) Now assume that this wind stress field occurs on a Beta plane, draw a schematic showing the structure of the ocean gyres that this wind field would drive. What are the latitudes that separate ocean gyres?

- c) Still using the beta plane approximation to derive the expression for the north/south mass transport. What is the relationship between the maximum and minimum north/south transports and the wind stress curl?