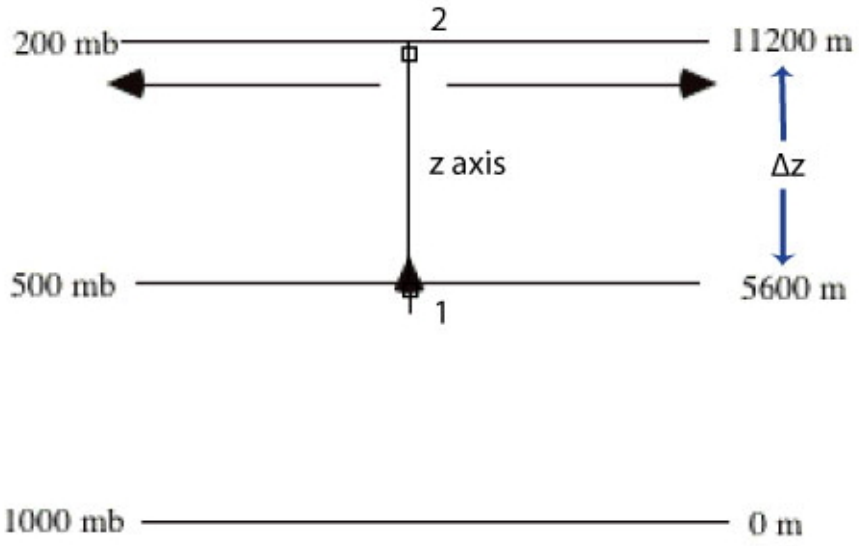
San Francisco State University Name _____
Department of Earth & Climate Sciences Spring 2018

ERTH 260--Inclass Exercise #13: Dine's Compensation and Forced Lofting (100 points)

On a given day, the horizontal divergence in the layer from 500 mb to the Tropopause at 200 mb is calculated to be 1.5 X 10^{-5} sec^{-1} You are asked to compute the vertical motion that would occur at 500 mb (in cm s^{-1}) in "compensation" to this divergence. An important (helpful) constraint is that vertical motion is always zero at the tropopause and at the ground.



Drawing to help you conceptualize what is going on.

$$\left(DIV_h\right)_{UpperTrop} = -\left(w_2 - w_1 / \Delta z\right) \qquad (1)$$

Equation (1) is the Simplified Equation of Continuity expressing Dine's Compensation.

1. Multiply both sides of equation (1) by Δz to get Equation (2).

(2)

2. Solve Equation (2) for the vertical motion at level 1, w_1 to get Equation (3)

(3)

3. Substitute the finite difference equivalent $\Delta z = z_2 - z_1$ to get Equation (4).

(4)

4. Insert the constraints of the problem:

   $w_2 = 0$, $z_2 = 11200$ m, $z_1 = 5600$ m, and $DIV_h = 1.5 \text{ X } 10^{-5} \text{ sec}^{-1}$ to obtain w_1, which is really w at the 500 mb level, the Level of Non-Divergence.

   Make sure you have proper units, and the answer is in cm s^{-1}.