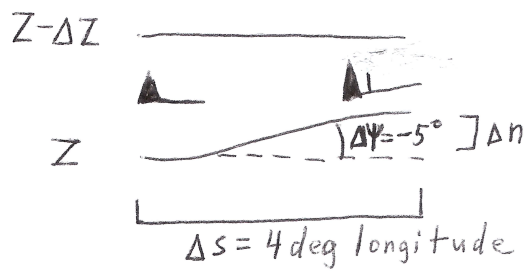
7) Divergence $\frac{\pi}{4}$

For the map below, answer the following questions. Show all calculations in an ordered, neat, detailed manner. You are at $45^o\ N$ latitude, the upwind observation is 50 kts, and the downwind observation is 55 kts. Assume $\Delta n = 2$ deg, $\Delta s = 4$ deg, and $\Delta\psi = -5^o$. Don't forget to convert all values to metric units and to radians.



$\Delta n = 2$ deg $= 222000$ m

$\Delta s = (4 \text{ deg}) \cos(\frac{\pi}{4}) = 313955$ m

$|\vec{V}|_{upwind} = 50$ kts $= 25.7$ m s^{-1}

$|\vec{V}|_{downwind} = 55$ kts $= 28.3$ m s^{-1}

$\Delta\psi = (-5^o)(\pi/180) = -0.08726$ rad

a) Compute $|\vec{V}|\frac{\partial \psi}{\partial n} \approx \frac{|\vec{V}|_{upwind} + |\vec{V}|_{downwind}}{2}\frac{\Delta\psi}{\Delta n}$ (2 pts)

$$\approx \left(\frac{25.7\ m s^{-1} + 28.3\ m s^{-1}}{2}\right)\left(\frac{-0.08726}{222000\ m}\right)$$

$$\approx \boxed{-1.0613 \times 10^{-5}\ s^{-1}}$$

b) Is this directional divergence or directional convergence? (1 pt)

directional convergence, also called confluence

c) Compute $\frac{\partial |\vec{V}|}{\partial s} \approx \frac{|\vec{V}|_{downwind} - |\vec{V}|_{upwind}}{\Delta s}$ (2 pts)

$$\approx \frac{28.3 - 25.7\ m s^{-1}}{313955\ m} \approx \boxed{+8.2814 \times 10^{-6}\ s^{-1}}$$

d) Is this speed convergence or speed divergence? (1 pt)

speed divergence

e) Compute $\nabla \cdot \vec{V}_H$. (2 pts)

$$\nabla \cdot \vec{V}_H = |\vec{V}|\frac{\partial \psi}{\partial n} + \frac{\partial |\vec{V}|}{\partial s} = a + c = \boxed{-2.33 \times 10^{-6}\ s^{-1}}$$

f) Which term dominates --- b or d? (1 pt)

b, Directional convergence