1. Consider the following situation: There is no diabatic forcing on the air. The geostrophic wind at 1000 mb is from the west at 10 m/s. There is no vertical wind component. The layer mean temperature increases eastward at 1°C per 100 km. You know the vertical wind shear of the 1000-500 mb layer is southerly, but do not know the shear magnitude. Can you compute the local time rate of change of layer mean temperature owing to advection in the 1000-500 mb layer? If not, please describe what additional information you would need to solve the problem. If yes, please express your answer in K per hour.

Your starting point is:

\[
\frac{dT}{dt} = \frac{\partial T}{\partial t} + \vec{U} \cdot \nabla T.
\]