Synoptic Meteorology II

**Lab 3: QG Height Tendency Equation**

Wednesday, March 1st, 2023

(100 pts)

Name:­­­­­­­ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Due: March 8th, 2023, at 2:30 pm

**Learning Objective**:

* Identify areas of geostrophic relative-vorticity advection and differential temperature advection and understand how they contribute to changes in geopotential height.

**Things to know:**

Feel free to use the Internet and collaborate with your colleagues when answering these questions. For Question 2, the requested plots must be obtained using the Jupyter Notebook on our JupyterHub before you can complete the questions.

**Part I: Explain Regions of Height Rises and Falls (65 pts)**

1. In the QG height tendency equation, what forcing term primarily causes:
   1. A trough/ridge to move? (3 pts)

* 1. A trough/ridge to amplify or decay? (3 pts)
  2. Are there any exceptions to the above? Explain. (4 pts)

1. Using the JupyterHub create the following maps for both January 17th, 2015 at 1800 UTC and January 18th, 2015 at 0000 UTC: (15 pts)
   1. 850 hPa temperature, wind barbs, and geopotential height
   2. 500 hPa absolute vorticity, wind barbs, and geopotential height
   3. 250 hPa wind speed, wind barbs, and geopotential height
2. Using the maps for January 17th, 2015 at 1800 UTC that you created in Question 2, assess each forcing term from the quasi-geostrophic height tendency equation at 500 hPa in eastern Nebraska. What will happen to the associated feature (trough/ridge) as time passes? Will it propagate and will it amplify or decay? Explain. (20 pts)
3. Using the maps for January 18th, 2015 at 0000 UTC that you created in Question 2, assess each forcing term from the quasi-geostrophic height tendency equation at 500 hPa in southwestern Georgia. What will happen to the associated feature (trough/ridge) as time passes? Will it propagate (and if so, will it do so faster/slower than the feature in eastern Nebraska in Question 3?) and will it amplify or decay? (Note: at 500 hPa, use a wind barb closest to the central part of the Florida panhandle when evaluating geostrophic vorticity advection.) (20 pts)

**Part II: Evaluating QG Height Tendency in Real-Time (35 pts)**

For this part, you are asked to pick an area of calculated 500 hPa geopotential-height rises/falls (positive or negative height tendency; shaded colors) from this time series of maps:

<https://apps.nssl.noaa.gov/tgalarneau/realtime/qg_new/HgtTendTot.html>

You may choose any area you would like. Print out the maps. Be sure to mark which one you have picked. From here, you will need to examine the following maps (make sure to be looking at the corresponding time you chose) and determine and **explain** what caused your selected height tendency value to change over time. Explain how the trough/ridge will move and if it will amplify/deamplify. Print out the maps at a later time to show if that happened or not.

700 hPa Height, Temperature, and Wind:

<https://apps.nssl.noaa.gov/tgalarneau/realtime/qg_new/700Wind.html>

500 hPa Height, Wind, and Geostrophic Absolute Vorticity:

<https://apps.nssl.noaa.gov/tgalarneau/realtime/qg_new/500Wind.html>

300 hPa Height, Temperature, and Wind:

<https://apps.nssl.noaa.gov/tgalarneau/realtime/qg_new/300Wind.html>

Include your maps with the lab! And remember, geopotential-height falls occur when the RHS of the equation is positive.

**Part III: Additional Applications of QG Height Tendency (Graduate Students Only; 10 pts)**

Using the maps below, use the quasi-geostrophic height tendency equation to explain why you would not expect the closed-off low over Wisconsin to propagate east.

Diagram

Description automatically generated

Chart, diagram

Description automatically generated