Synoptic Meteorology I

**Lab 9: Jets and Other Force Balances**

Wednesday November 9th, 2022

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Due: November 30th, 2022, at 2:30pm

**Objectives**:

* Identify regions of upper-level convergence and divergence using the four-quadrant jet model and understand their respective relationships to vertical motions.
* Identify situations in which the wind is sub- and supergeostrophic and their corresponding effects on the four-quadrant jet model.

**Things to know:**

Feel free to use the Internet and collaborate with your colleagues when answering these questions. For Parts I and II, the requested plots must be obtained using the Jupyter Notebook on our JupyterHub before you can complete the questions. Be sure to review the concepts covered in these tutorials rather than just complete the tasks they require as you may be asked to use these concepts in a future lab.

**Part I: The Four-Quadrant Jet Model (50 pts)**

1. Complete the Jupyter Notebook for Lab 9. (15 pts)
2. Using the 300 hPa map of the total horizontal wind that you created for November 8th, 2021:
   1. Identify the jet maxima in your map by writing their general location(s) below. (4 pts)
   2. Describe which points (A-D) are in jet entrance and exit regions. (4 pts)
3. Using the ageostrophic wind map you created for November 8th, 2021:
   1. Describe the direction of the ageostrophic wind at points A-D. (4 pts)
   2. Explain why, dynamically, the observed ageostrophic wind flow pattern at each of these points is to be expected. (10 pts)
   3. Based on the ageostrophic wind, explain why you should expect either convergence or divergence (state which one) at points A-D. (8 pts)
   4. Are your expectations consistent with the observed convergence/divergence patterns in the divergence map that you created for November 8th, 2021? Note: divergence is positive and convergence is negative on this chart. Focus only on synoptic-scale features on your map when answering this question. (5 pts)

**Part II: Jets in Curved Flow (50 pts)**

1. Using your full wind map for October 18th, 2022:
   1. Based on the curvature in the flow, identify where you would expect sub and super-geostrophic flow. Explain your reasoning. (8 pts)
   2. Describe whether you would expect parcel accelerations or decelerations at locations A-B and C-D. Explain why. (8 pts)
   3. At points A-B and C-D, is the ageostrophic wind converging or diverging? (6 pts)
   4. Does your answer to question 4c match the areas of divergence and convergence in the divergence map you created for October 18th, 2022? Note: divergence is positive and convergence is negative on this chart. Focus only on synoptic-scale features on your map when answering this question. (4 pts)
2. Based on flow curvature alone, in what direction should the ageostrophic wind flow at points A-D for October 18th, 2022? Does it flow in the same direction as or opposite direction to the ageostrophic flow caused by the jet? Does this agree with the ageostrophic wind plotted on your ageostrophic wind map for the same date? (12 pts)
3. Divergence at upper levels causes rising vertical motions in the column of air beneath it as air rushes up to fill the void. Meanwhile, convergence at the upper levels causes sinking vertical motions below as air is forced vertically away from the level of maximum convergence. Knowing this, describe which quadrant of the jet (upper/lower and entrance/exit regions) and in what type of flow pattern (straight or curved jet) you would expect the strongest rising motions (or ascent). (12 pts)

**Part III: More with Curved Jets (Graduate Students Only; 10 pts)**

1. Using the attached images for August 29th, 2022:
   1. Based on the flow curvature between points A and B, identify where you would expect sub and super-geostrophic flow. Explain your reasoning. (4 pts)
   2. At points A and B, is the ageostrophic wind converging or diverging? (3 pts)
   3. Does your answer to 7b match the divergence map? Discuss. (3 pts)





