Synoptic Meteorology I

**Lab 8: Fronts**

Wednesday November 2nd, 2022

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Due: November 9th, 2022, at 2:30pm

**Objectives**:

* Examine changes in frontal structure with height using surface, 850 hPa, and 700 hPa charts.
* Understand the relationship between upper-level jets, the thermal wind, and fronts.

**Things to know:**

Feel free to use the Internet and collaborate with your colleagues when answering these questions. For Parts II and III, the requested plots must be obtained using the Jupyter Notebooks 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: Identifying Fronts at the Surface and Aloft (70 pts)**

1. Complete Parts I and II of the Jupyter Notebook (15 pts)
2. Using the surface map you created for April 13th, 2018, identify the warm front and cold front. Use appropriate colors and symbols for each front. Explain your placement for each front. (10 pts)
3. Using your map for April 13th, 2018, identify the dryline. Use appropriate colors and symbols. Explain your placement for the dryline. (5 pts)
4. Using the surface and upper-air maps you created for January 5th, 2022, identify the cold front on the surface and on each upper-level chart. Explain your placement for the front for each level. (12.5 pts)
5. Describe what is happening to the cold front with increasing height. Does its location and/or intensity change? Does it become easier or harder to identify? (7.5 pts)
6. Using the surface and upper-air maps you created for January 5th, 2022, identify the warm front on the surface and on each upper-level chart. Explain your placement for the front for each level. (12.5 pts)
7. Describe what is happening to the warm front with increasing height. Does its location and/or intensity change? Does it become easier or harder to identify? (7.5 pts)

**Part II: Fronts and Jets (15 pts)**

1. Complete Part III of the Jupyter Notebook. (5 pts)
2. Using the 300 hPa map you created in Part III of the Jupyter Notebook and your maps for January 5th, 2022 from earlier in the lab, where is the jet stream in relation to your identified frontal zones? Does thermal-wind balance support the placement of these frontal zones? (10 pts)

**Part III: Fronts and Lows (15 pts)**

1. In your 700 hPa maps for January 5th, 2022 at 0000 UTC and 1200 UTC, identify regions of strong cold- and warm-air advection. (5 pts)
2. Where does the surface low move over time in relation to your analyzed warm- and cold-air advection? (5 pts)
3. Where does the surface low move in respect to the 500 hPa wind on January 5th, 2022 at 0000 UTC? (5 pts)

**Part IV: Lake and Land Breezes (Graduate Students Only; 10 pts)**

1. In the questions below, assuming that only the temperatures of the lake water and the land surface control land and lake breezes, identify if a lake breeze, land breeze, or no breeze is possible. Discuss why. (2 pts each)
   1. Warm lake water temperatures and cold air temperatures overland.
   2. Cold lake water temperatures and cold air temperatures overland.
   3. Cold lake water temperatures and warm air temperatures overland.
2. We can identify lake breezes on surface charts using a similar process to that which we use to identify fronts.: identify areas in which there is a sharp change in temperature over a short distance and a wind shift associated with an onshore wind near the lake. In the figure below, use a blue line to identify the lake breeze on the western shore of Lake Michigan. (4 pts)

Chart

Description automatically generated