Synoptic Meteorology I

**Lab 12: Soundings/Skew-T, Part II**

Wednesday, December 14th, 2022

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Due: December 21st, 2022, at 2:30pm

**Objectives**:

* Use the layer method to determine the effects of vertical motions on stability.
* Understand when to use the parcel and layer methods.
* Understand how to quantify CAPE and CIN for different parcel types (e.g., surface-based, mixed-layer, and elevated/most-unstable).

**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 Notebooks on our JupyterHub before you can complete the questions. For all question if asked to compute anything in the paper worksheet it must be done by hand and not by Python using MetPy.

**Part I: Parcel Method, Continued**

1. Complete Parts I and II Jupyter Notebook exercise on the JupyterHub. (5 pts)
2. Using the equivalent potential temperature plot you created for OUN on May 20th, 2013 at 1200 UTC, find the most-unstable parcel. Using the Skew-*T*/ln-*p* diagram for May 20th, 2013 at 1200 UTC, **Lift the most-unstable parcel** and find and record on the sounding by pen or pencil the (2 pts each):
3. LCL
4. LFC
5. EL
6. CAPE (shaded)
7. CIN (hatched)
8. Using the Skew-*T*/ln-*p* diagram you created for MPX on July 12th, 2016 at 0000 UTC, “mix” (i.e., estimate the average mixing ratio and potential temperature over) the layer from the surface to 100 hPa above the surface. Then, **lifting the mixed-layer parcel**, find and record on the sounding the (2 pts each):
9. Mixing Condensation Level (MCL, or the LCL for the mixed-layer parcel)
10. LFC
11. EL
12. CAPE (shaded)
13. CIN (hatched)
14. Use the Skew-*T*/ln-*p* diagram you created for ILX on February 2nd, 2011 at 0000 UTC to answer the following questions:
15. Find the most-unstable parcel. Lift the most-unstable parcel and find and record on the sounding by pen or pencil the:
    1. LCL (2 pts)
    2. LFC (2 pts)
    3. EL (2 pts)
    4. CAPE (shaded; 2 pts)
    5. CIN (hatched; 2 pts)
    6. Would you have identified any surface-based and/or mixed-layer CAPE for this sounding? Explain (4 pts).
16. What type of precipitation, if any, is most likely occurring at the surface in the sounding? Explain your answer. (6 pts)

**Part II: The Layer Method**

1. Use the Skew-*T*/ln-*p* diagram you created for OUN on May 20th, 2013 at 1200 UTC to answer:
2. Find the equivalent potential temperature () for an air parcel originating at the surface. Next, find for an air parcel originating from 850 hPa. (Yes, both traces go off the sounding. Just infer the values of the surface and 850 hPa in relation to each other.) What is the sign of between the surface and 850 hPa, and does this sign for imply stable, unstable, or neutral conditions? (7.5 pts)
3. Lift the layer from the surface and 850 hPa until both the top and bottom of the layer are saturated. Next, lift the layer moist adiabatically another 200 hPa. Finally, lift the layer moist adiabatically again another 200 hPa. What is happening to the stability of the layer as it is being lifted? (7.5 pts)

1. Use the Skew-*T*/ln-*p* diagram you created for OUN on May 3rd, 1999 at 1200 UTC to answer:
2. Lift a layer from the surface to 850 hPa until both the top and bottom of the layer are saturated. Next, lift the layer moist adiabatically another 200 hPa. Finally, lift the layer moist adiabatically again another 200 hPa. What is happening to the stability of the layer as it is being lifted? (7.5 pts)
3. Lift the layer of the inversion (~850mb-825 mb) until both the top and bottom of the layer are saturated. Next, lift the layer moist adiabatically another 200 hPa. Finally, lift the layer moist adiabatically again another 200 hPa. What is happening to the stability of the layer as it is being lifted? (7.5 pts)
4. Based on (a) and (b), which of the two layers is more potentially unstable? Explain your answer. (5 pts)
5. Use the Skew-*T*/ln-*p* diagram you created for OUN on May 19th, 2013 at 1200 UTC to answer questions a and b:
6. Using the parcel method, lift the surface-based air parcel. Find and record on the sounding the LCL, LFC, EL, and shade any CAPE and hatch any CIN. Determine the stability in the 840 hPa – 650 hPa and 875 hPa – 850 hPa layers using the parcel method. (7.5 pts)
7. Using the layer method, lift the layer from the surface to 850 hPa (after the dewpoint and temperature lines spread apart) until both the top and bottom of the layer are saturated. Then, lift the layer moist adiabatically another 300 hPa. What is the potential stability of the layer that is being lifted using the layer method? (7.5 pts)
8. Expand on your answers for a and b. How can the stability of the sounding be different between the parcel method and the layer method? (5 pts)

**Part III: Further Assessing Stability (Graduate Students Only; 10 pts)**

Using the attached Skew-*T*/ln-*p* diagram and the parcel method:

1. Find all areas in the temperature trace that are absolutely unstable (e.g., 925-850 hPa; 3.33 pts)
2. Find all areas in the temperature trace that are conditionally unstable (e.g., 925-850 hPa; 3.33 pts)
3. Find all areas in the temperature trace that are absolutely stable (e.g., 925-850 hPa; 3.33 pts)

Chart

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