Synoptic Meteorology I

**Lab 3: Isoplething Surface Data**

Wednesday September 21st, 2022

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Due: September 28th, 2022, at 2:30pm

**Objectives:**

* Isopleth a surface chart and use it to identify important meteorological features.
* Learn how to create useful maps.
* Learn how to plot surface data in Python.

**Things to know:**

Feel free to use the Internet and collaborate with your colleagues when answering these questions. For Part II, the requested data and 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 this tutorial rather than just complete the tasks it requires as you may be asked to use these concepts in a future lab.

**Part I: Creating Useful Maps (20 pts)**

Here are some elements of good meteorological plots:

* Choose a useful title.
* Pick a colormap that intuitively displays the data (e.g., one in which color variations are subtle except when there is a physical reason for a sharp variation), clearly delineates changing values, and can be interpreted by people who are colorblind.
* Contour the data at an appropriate frequency.
* Space wind barbs appropriately.
* Label your units (often in the title).
* Label your contours appropriately.
* Label your color bar.
* Plot the appropriate amount of geographic data.
* Don’t try to plot too many variables.

In this section, you will be asked to find two maps – one that meets the “good” criteria listed above and one that violates those criteria. Below is a list of websites where you can find meteorological maps. Some of the listed websites have good maps, and some have bad maps. This list is not a complete list of all websites available to find weather maps, and you are encouraged to find more.

* [https://mtarchive.geol.iastate.edu/](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fmtarchive.geol.iastate.edu%2F&data=05%7C01%7Cmpvossen%40uwm.edu%7C934b2c4e5cf747a8498d08da884ae855%7C0bca7ac3fcb64efd89eb6de97603cf21%7C0%7C0%7C637972152558531287%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=kUh0mC0HtRrQBvK0HJghIefrjTLRju8XqLLqY1wTKag%3D&reserved=0)
* [https://www.atmos.albany.edu/student/abentley/realtime.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.atmos.albany.edu%2Fstudent%2Fabentley%2Frealtime.html&data=05%7C01%7Cmpvossen%40uwm.edu%7C934b2c4e5cf747a8498d08da884ae855%7C0bca7ac3fcb64efd89eb6de97603cf21%7C0%7C0%7C637972152558687524%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=SXlaUqq%2BdP%2BrasOuvzgRHUYTlgWZcaC1ljlLD1gKr7I%3D&reserved=0)
* <http://arctic.som.ou.edu/tburg/products/>
* [https://www.atmos.albany.edu/student/kgriffin/maps/namer.html](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.atmos.albany.edu%2Fstudent%2Fkgriffin%2Fmaps%2Fnamer.html&data=05%7C01%7Cmpvossen%40uwm.edu%7C934b2c4e5cf747a8498d08da884ae855%7C0bca7ac3fcb64efd89eb6de97603cf21%7C0%7C0%7C637972152558531287%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=A0l40LcG%2BMHEiPo3X9ikIX%2FjGyQncGJ6YXqxGQBHgSc%3D&reserved=0)
* [https://www.wxcaster.com/conus\_0012\_us\_models.htm](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.wxcaster.com%2Fconus_0012_us_models.htm&data=05%7C01%7Cmpvossen%40uwm.edu%7C934b2c4e5cf747a8498d08da884ae855%7C0bca7ac3fcb64efd89eb6de97603cf21%7C0%7C0%7C637972152558687524%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=eippgr662BSQw5ZCAM7WB4981isntslwYoYNOBGaLP8%3D&reserved=0)
* [http://www.meteo.psu.edu/fxg1/ewall.html](https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.meteo.psu.edu%2Ffxg1%2Fewall.html&data=05%7C01%7Cmpvossen%40uwm.edu%7C934b2c4e5cf747a8498d08da884ae855%7C0bca7ac3fcb64efd89eb6de97603cf21%7C0%7C0%7C637972152558687524%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=1Ry4pfcAgHB%2BmokSyjprcrYZKkaVMc5bHobzwIOtHyA%3D&reserved=0)
* [https://weather.cod.edu/forecast/](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fweather.cod.edu%2Fforecast%2F&data=05%7C01%7Cmpvossen%40uwm.edu%7C934b2c4e5cf747a8498d08da884ae855%7C0bca7ac3fcb64efd89eb6de97603cf21%7C0%7C0%7C637972152558687524%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=tzX6CA9XMJI26UGg9%2FYWYD0%2FxQ1tCi7C7sVt%2BBNCFUs%3D&reserved=0)
* <https://www.tropicaltidbits.com/analysis/models/>
* <https://home.pivotalweather.com/>
* <https://www.weathernerds.org/>

1. Using the “good” map guidelines, find a “good” map. Attach the map to this assignment and email it me ([mpvossen@uwm.edu](mailto:mpvossen@uwm.edu)) before class next week. Give a detailed description below of why the map you have chosen is a good map. (10 pts)
2. Using the “good” map guidelines, find a map that is a “bad” map (i.e., one that violates many of the criteria). Attach the map to this assignment and email it me ([mpvossen@uwm.edu](mailto:mpvossen@uwm.edu)) before class next week. Give a detailed description below of why the map you have chosen is a bad map. (10 pts)

**Part II: Isoplething the Surface Map (80 pts)**

1. Complete Part I of the Jupyter Notebook tutorial. (7.5 pts)
2. Using the surface map you created in Part I of the Jupyter Notebook tutorial, Isopleth the lines of constant sea-level pressure (called isobars) every 4 hPa using 1012 hPa as the base contour. (15 pts)
3. Identify any closed-off regions of High or Low pressure by drawing a blue “H” and a red “L,” respectively, at the location(s) of highest or lowest sea-level pressure. (5 pts)
4. Isopleth the lines of constant 2-m temperature (called isotherms) in red dashed lines every 10°F using 60°F as your base contour. (15 pts)
5. Isopleth the lines of constant 2-m dew-point temperature (called isodrosotherms) for 65°F and 70°F. Shade the area between the 65°F and the 70°F isodrosotherms in light green. Shade areas of 70+ °F dew-point temperature in dark green. (10 pts)
6. What is the general wind flow (clockwise or counter-clockwise) around the High and Low pressure systems? (5 pts)
7. Does the flow around high- and low-pressure systems tend to follow the isobars (yes, no, or somewhere in between)? If you answer “no” or “somewhere in between,” please also describe whether the flow is directed more from high toward low sea-level pressure or more from low toward high sea-level pressure. (5 pts)
8. Are higher 2-m dew point temperatures located on the north or south sides of the Low pressure system(s) you identified in #3? Hypothesize why this might be the case. (7.5 pts)
9. Fronts are characterized by a combination of a minimum in sea-level pressure or geopotential height as well as abruptly changing wind direction, temperature, and dew point temperature over a relatively short horizontal distance. Because they are located along minima in sea-level pressure, fronts are also connected to Low pressure systems. Identify any potential fronts (draw as a blue line with filled triangles directed away from the colder air), and describe your reasoning for your placement of the front. (10 pts)

**Part III: Relationships between surface and upper-air features (Graduate Students Only; 10 pts)**

In the section, please below use your upper-air charts from lab 2.

1. Are the surface low pressure systems found to the east or west of upper-level troughs? (2 pts)
2. Severe weather phenomenon (thunderstorms with hail, wind, and occasionally tornadoes) require three ingredients:
   1. An unstable atmosphere, often provided by a rich pool of warm, moist air.
   2. A lifting mechanism such as a front to “trigger” thunderstorm activity.
   3. Large vertical wind shear (wind speed increasing with increasing height and/or wind direction changing with increasing height).

Knowing this, use the surface and upper-level charts to identify an area where severe weather is most likely and explain your reasoning. (8 pts)