Synoptic Meteorology I

**Lab 1: Meteorological Data**

Wednesday September 7th, 2022

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Due: September 14th, 2022, at 2:30pm

**Objectives:**

Learn how to decode METARs and station model plots.

Learn how to isopleth surface and upper-air data.

Learn how to perform basic operations on METAR and rawinsonde data using Python.

**Things to know:**

Feel free to use the Internet and collaborate with your colleagues when answering these questions. In Parts II, III, and IV, the requested data and plots must be obtained using the Python notebook on our JupyterHub before you can complete the questions. Be sure to review the concepts covered in this notebook rather than just complete the tasks it requires, as you may be asked to use these concepts in a future lab.

**Part I: METARs (25 pts)**

Please convert all values: Time to Central Daylight Time, temperature and dewpoint to degrees Fahrenheit, sea-level pressure (if available) to hPa, altimeter may be left in in Hg, and wind speed to MPH.

1. (8 pts) Decode the following METAR:

*KSTC 051853Z 18005KT 10SM CLR 31/18 A2992 RMK AO2*

1. (9 pts) Write down and decode the 1900 UTC METAR for Milwaukee, WI on September 7, 2022.

(Note: METAR data can be found at https://www.aviationweather.gov/metar/data or http://weather.rap.ucar.edu/surface/. You must decode the METAR yourself; you cannot use an automated decoding utility to do so.)

1. (8 pts) Decode the following METAR:

*KTPH 051856Z AUTO VRB04KT 3SM RA BR BKN015 BKN023 OVC044 19/17 A3017 RMK AO2 SLP148 P0005 T01890167*

**Part II: Creating Station Plots (30 pts)**

1. (12 pts) Decode the following station plot in its entirety.

Chart, scatter chart

Description automatically generated

1. (8 pts) Complete Part I of the Lab 1 Jupyter Notebook. Include your code (as a .ipynb Jupyter Notebook, submitted as an upload to your private GitHub repository) with your completed assignment.
2. (10 pts) Create a station model plot for the Madison, WI observation resulting from question 5.

**Part III: Decoding Upper-Air Station Plots (25 pts)**

1. (12.5 pts) Decode the following 500 hPa upper-air station plot.

Diagram, schematic

Description automatically generated

1. (12.5 pts) Complete Part II of the Lab 1 Jupyter Notebook. Using the data you retrieved in the Jupyter Notebook Part II, encode the 300 hPa observations for Green Bay, WI (KGRB) with T/Td separate, into an upper-air station plot.

**Part IV: Interpreting Geostationary Satellite Data (20 pts)**

1. (5 pts) Complete Part III of the Lab 1 Jupyter Notebook. Include your code (as a .ipynb Jupyter Notebook, submitted as an upload to your private GitHub repository) and both satellite images with your completed assignment.
2. (5 pts) Using the GOES-16 visible satellite you created in question 9, identify one cloudy and one non-cloudy/clear area.
3. (10 pts) How do the cloudy and non-cloudy areas that you identified from your GOES-16 visible satellite image appear in the GOES-16 longwave infrared satellite image that you created? Why do these regions appear as they do in this image?

**Part V: Assessing Instrument Error (10 pts; Graduate Students Only)**

1. (5 pts)Decode the following METAR:

*KLLQ 162238Z AUTO 30003KT 8SM -TSRA BKN060 BKN080 OVC095 26/23 A2992 RMK AO2 RAB28 TSB38 P0004 T02560233*

1. (5 pts) Given the typical observational-error magnitudes for these quantities, list the ranges of temperature, pressure, and wind speed that the METAR observation above can reliably represent.