UBC ATSC 303 2024/25W
Lab 5 – Barometry (/77)

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Quick resources:

- The history of barometers Click here (YouTube link)
- Why we don't get crushed by Atmospheric Pressure: Click here (YouTube link)
- High air pressure and Low air pressure: Click here (YouTube link)

Learning Goals

By the end of this lab, you should be able to:

1. Be confident in your handling of the physical sensors and software covered in this lab.
2. Read, interpret, and compare the pressure from different barometers.
3. Apply appropriate corrections to raw pressure data.
4. Convert between pressure units.
5. Reinforce the learning goals from the lecture and demo.

Background

Barometry lecture

WMO Ch. 3

Harrison: Ch. 7

Safety

- The Eco-celli barometer is very fragile, **please do not touch it**. Also, **no more than four people** at a time should surround it while taking their readings.
- Do not crowd around any barometer, this may bias the measurements.

Method

Manually recording pressure data from multiple barometers and manipulating the data.

Equipment:

- Eco-celli barometer (station pressure)
- Kestrel pocket weather tracker barometer **x 2** (SLP)
- RM Young 61205V barometer (with laptop/datalogger) (station pressure)
- ESB rooftop weather station barometer: Link here (SLP)
- YVR airport altimeter setting: Link here (SLP)

1. Manually record pressure from each of these 6 barometers every 15 minutes, approximately on the quarter-hour mark. Data from the ESB rooftop station and the RM Young barometer will be automatically saved so read the pressure from the other sensors before these two each time. **Note:** you can check your manual observations against the automated ones when we post them after the lab.

2. You should record pressure data a minimum of 6 times from each station (i.e., at least 1.5 hours).

3. Remember to record the time of your observation.

The following corrections should be applied to each sensor **AFTER** you record raw data:

- apply gravity correction to the Eco-celli barometer.
- apply sea-level reduction to the RM Young AND the Eco-celli barometer.
- no corrections for the Kestrels and the ESB rooftop station (they have been corrected for elevation already and display sea level pressure)
- convert all readings into kPa (if they are not already)

Some potentially helpful correction equations:

- Lecture note equations (slides 23-27, 43-46)
- WMO No.8 eq. 3.2, equations in Annex 3.A

Lab Report (/30)

In the lab report, you should include the following:

- one graph of the raw data: compare the 6 sensors on the same graph (check your units)
- separate graph of the corrected data: compare the 6 sensors on the same graph.
- separate graph showing the difference between raw and calibrated data, if there is a significant difference (0.1 hPa and over)
- any other graphs showing interesting trends or observations in the data, if applicable
- list how you corrected your data where applicable.
- list any potential errors and assumptions you made.
- a 1-page max. discussion about your graphed results (what do you think was the actual sea-level pressure, why the barometers might be reading differently from each other, any outlying data, etc.)

<u>Lab Questions (based on lecture and readings)</u>

1. What was the value of the gravity correction(s)? Did it make a difference when compared to the sensor's significant figures? **(/2)**

2. What was the value of the sea-level reduction? Did it make a difference when compared to the sensor's significant figures? **(/2)**

3. Which barometer do you think is the most accurate and why? **(/2)**

4. Which barometer do you think has the highest resolution and why? **(/2)**

5. Which barometer do you think is the least accurate and why? **(/2)**

6. Which barometer do you think has the lowest resolution and why? **(/2)**

7. When you adjust your pressure reading to sea level, e.g. with the RM Young 61205V and the Eco-celli, why is your answer probably different than the sea level pressure reported at YVR airport? (hint: think about the equation(s) used, any assumptions we are making, and weather conditions) **(/3)**

8. For what situations is gravity correction important for pressure measurements, and for what situations is it not? (Short answer, in your own words.) **(/2)**

9. Calculate (on a spreadsheet) and plot the variation of sea-level gravitational acceleration with latitude. (Hint, use eq. 3.A.6 from WMO-8 chapter 3, annex 3. A) **(/4)**

10. For the latitude of Vancouver, plot local gravitational acceleration *g* vs elevation *H* above sea level for
    (a) over land having terrain elevation of 500 m; **(/2)**
    (b) over the ocean of depth 1 km; and **(/2)**
    (c) at a shoreline at a 50% mix of land from (a) and ocean from (b). **(/2)**
    (Hint, use slide 27 and eqs. 3.A.7-9 from WMO-8 chapter 3, Annex 3.A)

11. Compare (discuss, plot using a spreadsheet) the equations for pressure reduction to sea level for the WMO equations in WMO-8 Chapter 3, vs. the reduction equation from Stull's textbook (as presented in Lecture, and in the lecture notes online; see slide 46). **(/4)**

12. With respect to the mercury barometer, how much inaccuracy can we tolerate in the measurement of temperature if we want the pressure error $\leq$ 0.05 hPa? Assume the pressure is 960 hPa. **(/3)**

13. Name three corrections commonly used with a mercury barometer. **(/3)**

14. Calculate the static sensitivity of a mercury barometer. How could you increase the static sensitivity of a mercury barometer? **(/3)**

15. What is the dynamic wind error when the wind speed is 20 m s^{-1}? Why do we need to take temperature into account when calculating the dynamic wind error for very high wind speeds? **(/3)**

16. What is the raw output for the following sensors: a mercury barometer, and an aneroid barometer? **(/2)**

17. Why have aneroid barometers tended to replace mercury barometers? **(/2)**