

1. Based on my experience living on the front range, I would expect to find a greater wind source during the summer rather than the winter because there's a greater temperature differential, thus causing a greater pressure differential and more winds during the summer than in the winter. This could be proven or disproven by measuring temperature data during the summer and winter and determining which season has the greater temperature differential.
2. The tower that is to the East of the 4.0 Met tower is the DOE 1.5MW turbine, so the 4.0 Met tower provides data inflow for the DOE 1.5MW turbine
3. Downloaded 2018 files
4.
  - a. Given instructions
  - b. The temporal frequency of both files was 10 minutes, or in other words the data was updated every ten minutes in both files
  - c. For June, there should be 4,320 entries for June, but for the given data file there are only 2,789 entries. For December there should be 4,464 entries, but for the given data file, there are only 3,083 entries.
  - d. The missing entries could be explained by the missing days from each month. For December, the 6<sup>th</sup> through the 13<sup>th</sup> was missing from the file, which would account for the lack of data entries, and for June the last 10 days of the month were missing. This data could be missing due to equipment not functioning due to maintenance or perhaps power outages, but there are multiple reasons why this data could be missing.
5.
  - a. According to the plots given in the question, cup anemometers are located at heights of 2,10,30,35,55,80,85,105,120, and 130 meters above the ground.
  - b. Sonic cups are located at heights of 14,40,60,72,100, and 120 metres above the ground according to the provided graphs
  - c. Temperature measurements are taken at heights of roughly 2,35,87, and 122 meters above the ground, according to the provided plots.

6.

	June Speed (cup_130m)	June Speed (cup_80 m)	December Speed (cup_130m)	December Speed (cup_80 m)
Mean	4.79 m/s	4.75 m/s	5.39 m/s	5.10 m/s
Std Dev	2.95 m/s	2.75 m/s	3.99 m/s	3.79 m/s
Median	4.06 m/s	4.00 m/s	4.20 m/s	3.97 m/s
Minimum	0.12 m/s	0.26 m/s	0.02 m/s	0.04 m/s
Maximum	18.13 m/s	17.13 m/s	20.36 m/s	19.94 m/s

7.

- a. At the top of the tower, the mean values are similar, but they are higher in December by a little more than half of a meter per second
- b. At the hub height, the mean values are closer together, however December still has a higher mean wind speed by roughly 0.35 meters per second

- c. At the top of the tower, the median values are very similar, only being different by 0.14 meters per second, with December having the slightly higher median wind speed. This is also the same month that showed higher mean values
  - d. At hub height, the median values are very similar, differing only by 0.03 meters per second. June has higher median values in this case, however this is not the month which had the higher mean value.
  - e. At the max height (130 m), the minimum value differs by only 0.1 meters per second, but the maximum value differs by 2.23 meters per second. At hub height (80 m), the minimum differs by 0.22 meters per second, while the maximum differs by 2.81 meters per second.
- 8.
- a. Mean wind direction is not usually a reliable calculation because large or various outliers will affect the mean of a dataset, but will not affect the mode, which is more representative of the actual wind direction.
  - b. A mode for the wind data cannot be calculated while the data is in its current format because it is not partitioned into recurring values due to the given accuracy of the data (no exact same values in dataset)
  - c. Mode calculated in Matlab and used to fill in table below

	June Direction (Vane_122m)	June Direction (Vane_87m)	December Direction (Vane_122m)	December Direction (Vane_87 m)
Mode	330 degs.	270 degs.	300 degs.	270 degs.

- d. Table above filled out
  - e. The calculation should not include calm conditions.
- 9.
- a. Standard air density found at sea level is  $1.225 \text{ kg/m}^3$ . Boulder should have a lower air density than what is found at sea level because it is at a higher elevation. You would expect winter air density to be greater than summer air density due to the lower temperatures in winter, causing the air to settle lower and cause a greater atmospheric pressure and density.
  - b. The average air density for December measured at the 87 meter height is  $1.0215 \text{ Kg/m}^3$  and is  $0.9536 \text{ Kg/m}^3$  for June.
  - c. Calculated values in Matlab
  - d. Using the 80 meter height wind speed data and 87 meter height air density data, the month of June had a calculated 109.98 W energy density, and the month of December had a calculated 204.49 W energy density.
10. My original hypothesis stated in question 1 was not correct. After analyzing the given data, it is clear that winter has an overall greater wind source than summer does along the front range.