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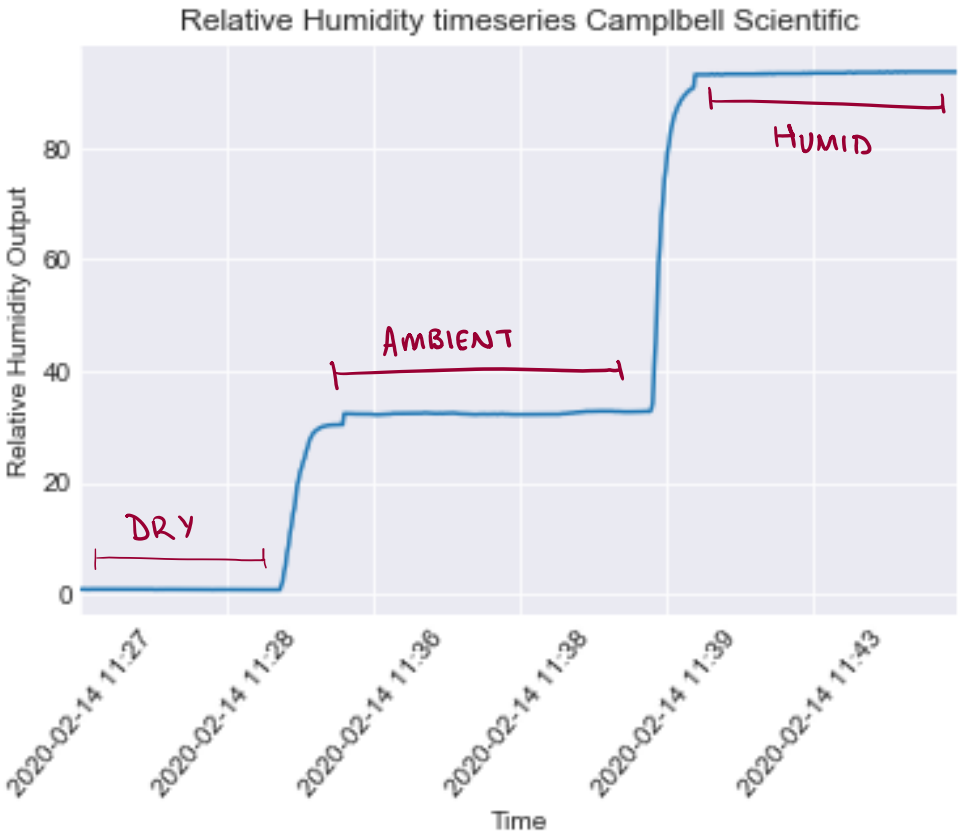
ATSC 303 Lab 6 – Hygrometry

Lab Questions:

1.

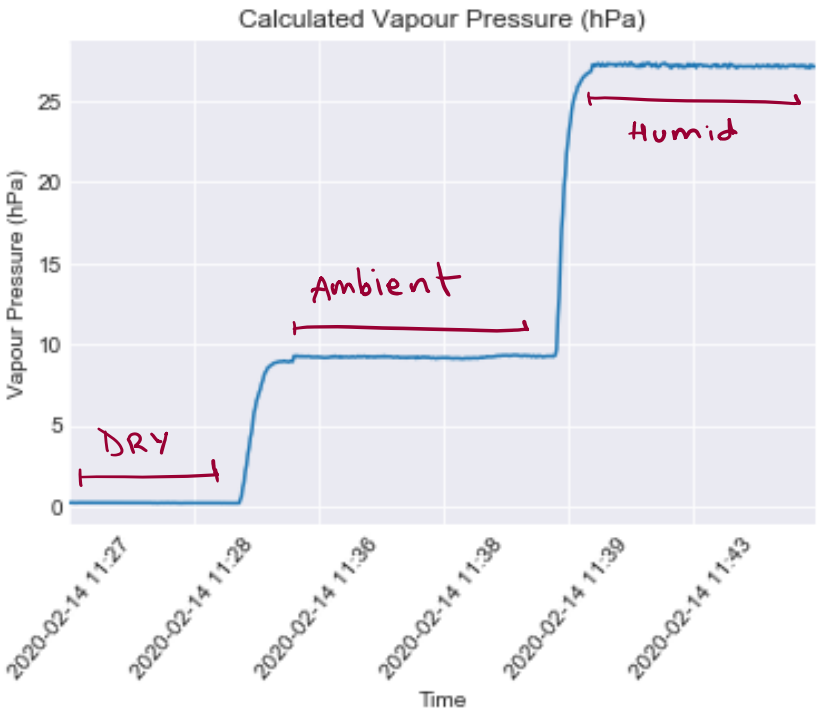


2. The formula used to find vapour pressure (e) was as follows:

$$saturation\ pressure\ (e_s) = A * \exp\left[\frac{B\ T}{T + C}\right]$$

$where, A = 6.112\ hPa, B = 17.67\ and\ C = 243.5\ ℃\ \ form\ Harrison\ 6.4$

$$Vapour\ pressure\ (e) = \frac{relative\ humidity\ \times\ e_s}{100}\ form\ Harrison\ 6.9$$



3. The values generated are as follows:

$$mixing\ ratio(r) = \frac{\varepsilon * e}{P - e} \quad from\ Stull\ 4.4$$

$$\varepsilon = 622\ g\ kg^{-1}$$

	Average RH	Average Temp	Mixing ratio
dry	6.111700	23.816444	1.123647
ambient	37.801958	23.285375	6.792036
humid	93.486667	23.571611	17.377711

4. The following table was generated:

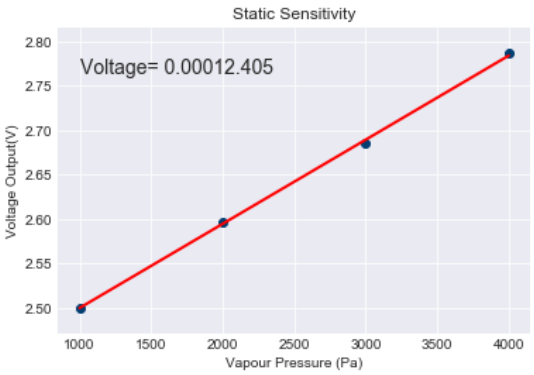
Time(s)	Dry bulb T	Wet bulb T
0.00	22.40	13.70
30.00	22.50	13.60
60.00	22.80	13.80
90.00	22.70	13.60
120.00	22.50	13.70
150.00	22.50	13.50
180.00	22.40	13.60
Average:	22.54	13.64

Using the graph on the right on lecture slide 15, the relative humidity can be estimated at 33%. This is a little less than that of the ambient setting measured by the datalogger. I feel the datalogger has the more accurate to true value because there are fewer human errors while using it to measure.

5. The sources of error are:

Campbell Scientific	Assmann
- If the desiccant did was not enough or the pack was not sealed properly the dry RH could be wrong - Breathing on the sensor or moving too close to it changed values	- Needs to be well ventilated so holding it too close might impede the ventilation - Need to keep water off the dry bulb which is harder while refilling - Since we were holding it close to us, and breathing on it this could affect the RH - Need wick to be clean

6. No 1 second for a sampling frequency seems too high for real life forecasting since most humidity changes happen at a timescale longer than a second. I also think it is not the right sampling frequency because the sensor itself takes a while to reach equilibrium after each measurement.
7. The presence of salt will make the wet bulb read too low (i.e if the vapour pressure decreases, the wet bulb temperature also decreases)
8. This might cool the dry bulb as well since the wet bulb evaporates the water on it which creates cooling and the difference between the wet and the dry is used to predict RH and other variables. Hence there should be no water on the dry bulb.
9. This is because the film coating experiences dimension changes and the carbon particles move apart, creating larger resistance.
10. Formulas used: $\frac{change\ in\ output}{change\ in\ vapour\ pressure}$
    a. $\frac{2.596-2.500\ V}{2000-1000\ Pa} = \frac{0.096\ V}{1000\ Pa} = 0.000096\ V\ Pa^{-1}$
    b. This is a linear sensor since the plot below shows a very straight line covering almost all the points.



11. Formation of frost or dew on the mirror is detected optically with an LED (lightemitting diode) and one or more photodetectors which sense the change in light scattering when frost of dew forms on the mirror. Two photodetectors will receive the reflected light from a smooth surface but one will not be illuminated unless the light is scattered at the surface by dew or frost.