Analysis of Ital1 Data from Nov 12,2022-Mar30 2023

Colony	Entrance faces	Wrap	Slatted Rack?	Upper Entrance With wind block	Lower Entrance
Sask1	South	Cozy (R8)	Yes	No	1.8”x3/8”
Sask2	South	Cozy (R8)	No	No	1.8”x3/8”
Ital1	South	Cozy (R8)	Yes	1/2” x 3/8”	½ oval – 1” x 3/8”
Sask3	South	Cozy (R8)	No	1/2” x 3/8”	½ oval – 1” x 3/8”
Stalker	North	3 layers of R3.7 Colony quilt (R11.1)	No	1/2” x 3/8”	½ oval – 1” x 3/8”

Ital1: Top/bottom entrance; slatted Rack

11/12/22@ noon:
- returned sensors to under inner cover & added shim with weather stripping
- total height between 1 1/2"--> 1 3/4" depending on compression of weather stripping

11/17/22@ noon :
- wrapped colony & reduced entrances

1/17 or 18 – bees flying mostly using top entrance

1/19/23 (3:30)
- Top of cluster in west side box4 – added ½ lb sugar brick

2/8/23 (9:30) – plenty of food

2/15/23 (1:15)
- LOTS of bees up at box 4
- Bees easting sugar brick near east sensor; Added ½ lb sugar brick;

2/27/23 (11:15)
- Eating sugar brick – added another 1/2lb brick
- LOTS of bees in box 4 - top
- Added ½ pollen patty (global)

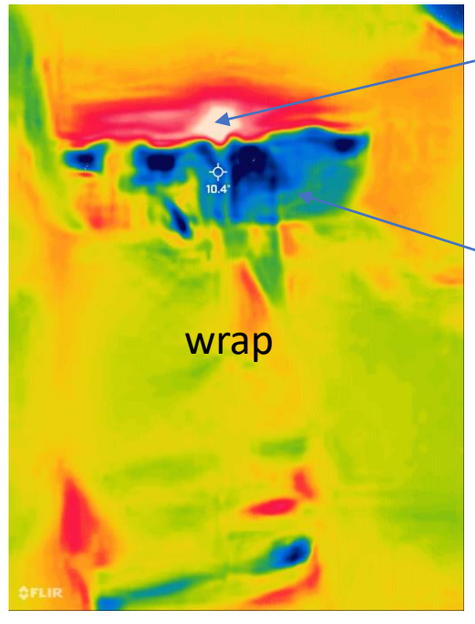
3/3/23
- lots of cleansing flights in apiary – wasn't home so didn't see which colonies
- They are only using the top entrance on any cleansing flights.

3/9/23 (noonish)
- Pollen patty gone another ½ added

3/18/23 (10:30ish)
- Tons of bees in box4
- Added another ½ patty

3/27/23 (4:15ish)
- Still has sugar
- Added another ½ patty

3/29/23 (3:00ish)
- Added medium with 3 partial honey Frames,5 drawn comb + frame feeder



Taken 3/9/23 @5am – heat is coming out the upper entrance in the inner cover

Date	Ital1	Notes
5/26/2022	0.0%	
5/29/1022		Pinched queen
7/1/2022		At least 4 frames with eggs/larva
7/22/2022	Not tested	Treated Formic
8/31/2022	0.50%	Treated Sask2 with Formic
10/8/2022	6.33%	Treated Ital1 OA dribble

Mite Test Data (Alcohol Wash)

Definitions

- **Vapor Density = Absolute humidity :** (expressed as grams of water vapor per cubic meter volume of air) is **a measure of the actual amount of water vapor (moisture) in the air, regardless of the air's temperature**. (from weather.gov).
  - Absolute humidity is also referred to as vapor density of the air.
  - The equation used to calculate this is :
    - (0.611*10) * Power(2.71828,(17.502*T)/(T+240.9)) * (RH*2.18647)/(273.15+T)
    - Where RH is the relative humidity as measured by broodminder and T measured temp In Celsius

- **Relative humidity** also measures water vapor but **RELATIVE** to the temperature of the air. It is expressed as the amount of water vapor in the air as a **percentage** of the total amount that **could** be held at its current temperature. (www.zehnderamerica.com)

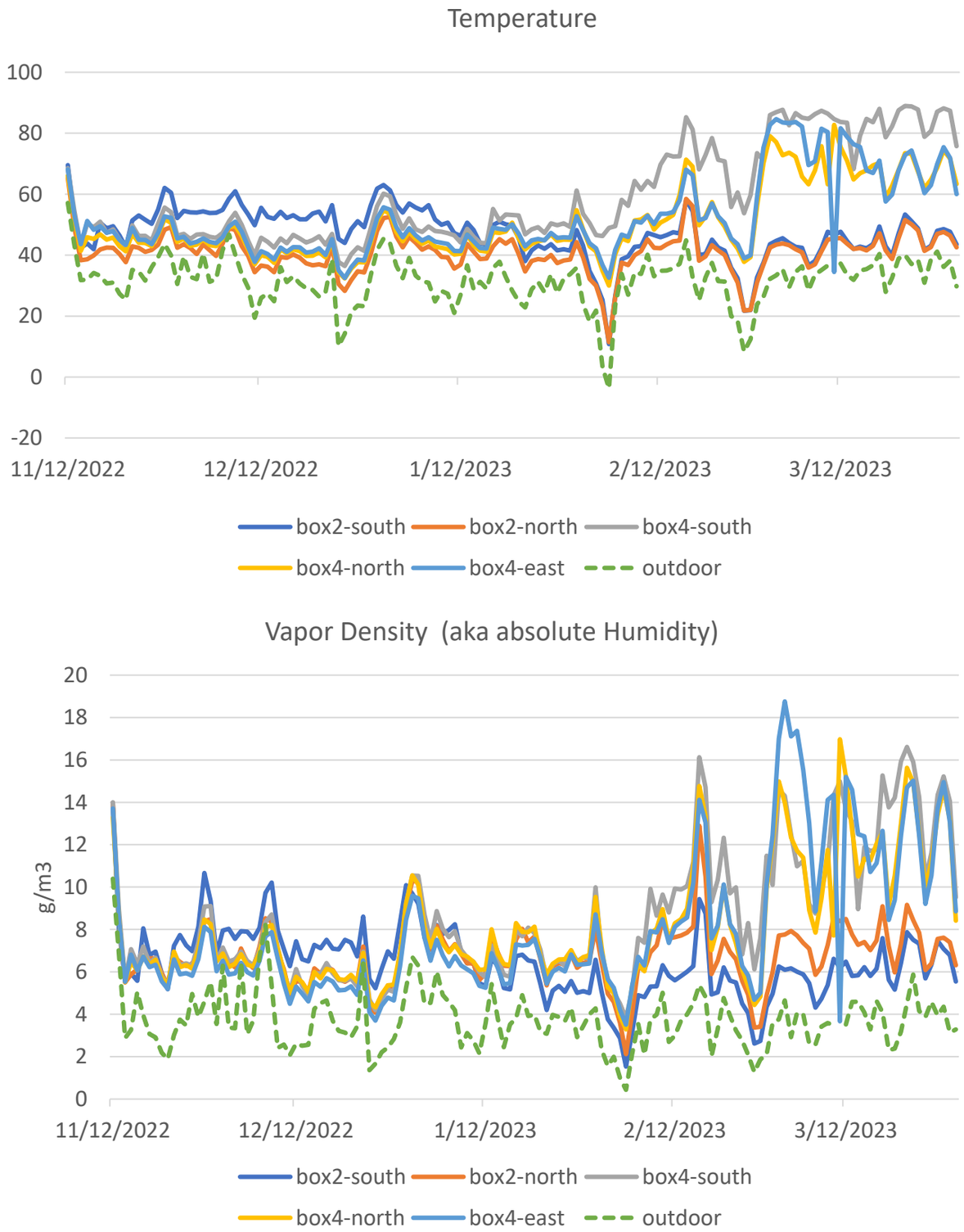
- **Vapor Pressure Deficit (VPD)** is a measure of how much more “room” there is for humidity (water vapor) in the air, at the current temperature

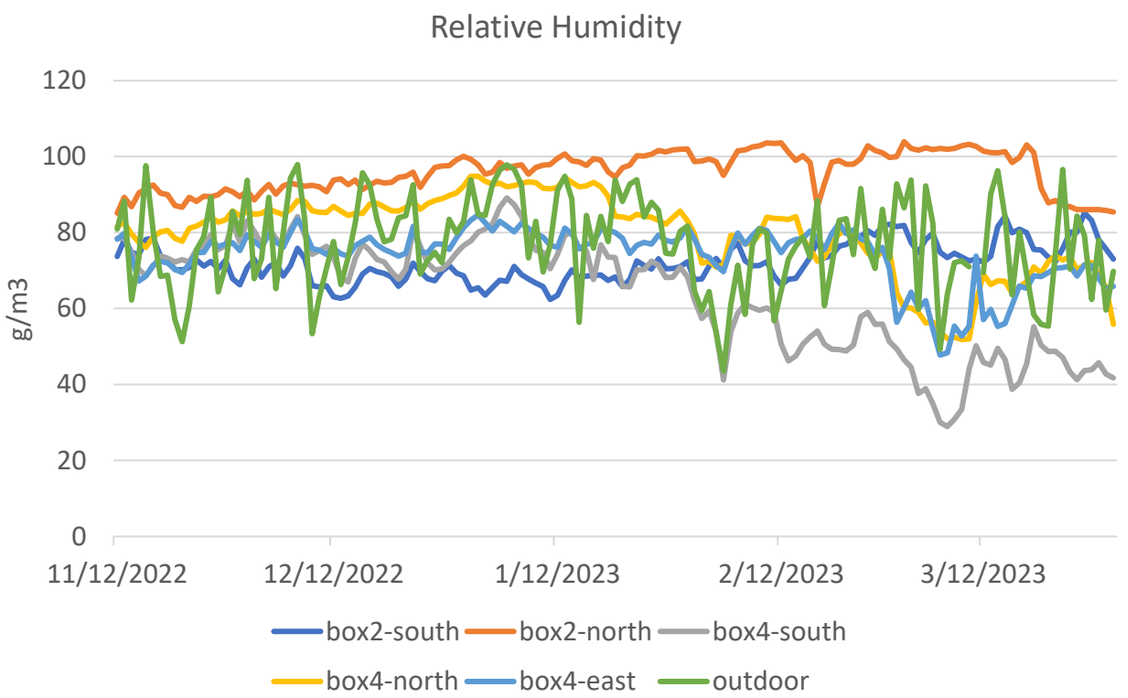
Notes from Etienne Tardif on Bee-L forum

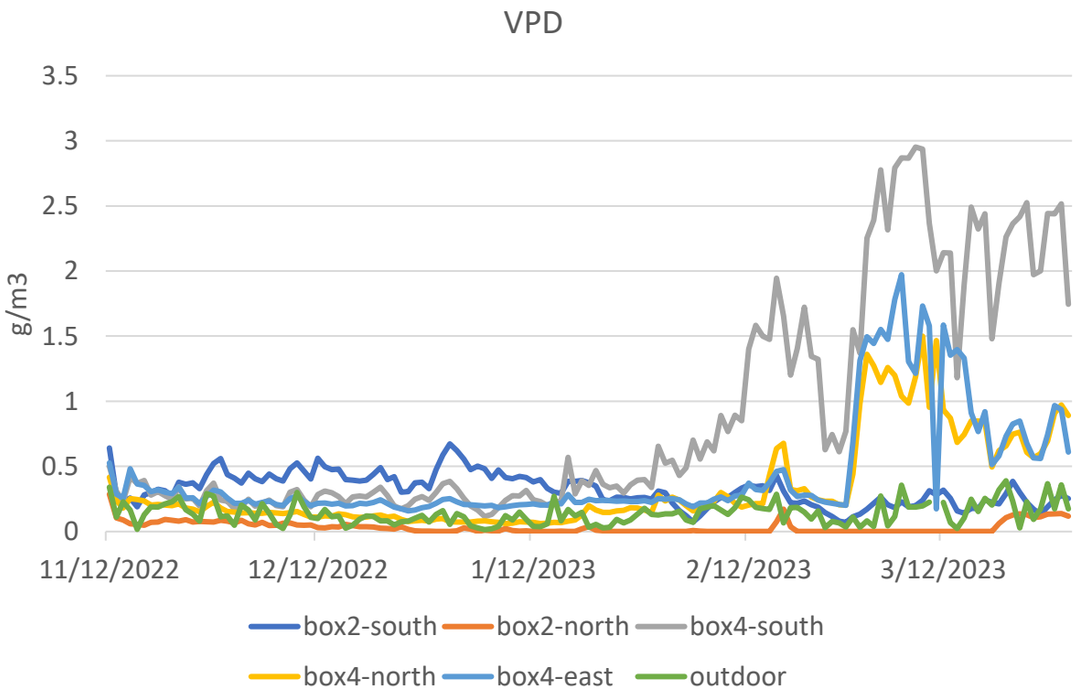
- 1) Moisture conservation - Bees seem to prefer 60-75%RH (@18C) 10-15g/m3 (moisture content) in cluster or in the "hot“ hive.
- Remember that air at 100%RH 0C only contains 4.85g/m3, so even in warmish very humid winters, bees are required to up regulate moisture via metabolic processes to maintain their setpoint. I believe bees under certain conditions purposefully generate moist heat for the purpose of humidifying which also results in internal condensation both of which increases the in hive RH during very dry cold periods -30C Air @100% RH 0.46g/m3 .
- We do know that bees have mastered evaporative cooling which can also be used to humidify air at cooler temperatures, ok in a hot hive but not practical when bees are tightly clustered.

Daily **mean** values

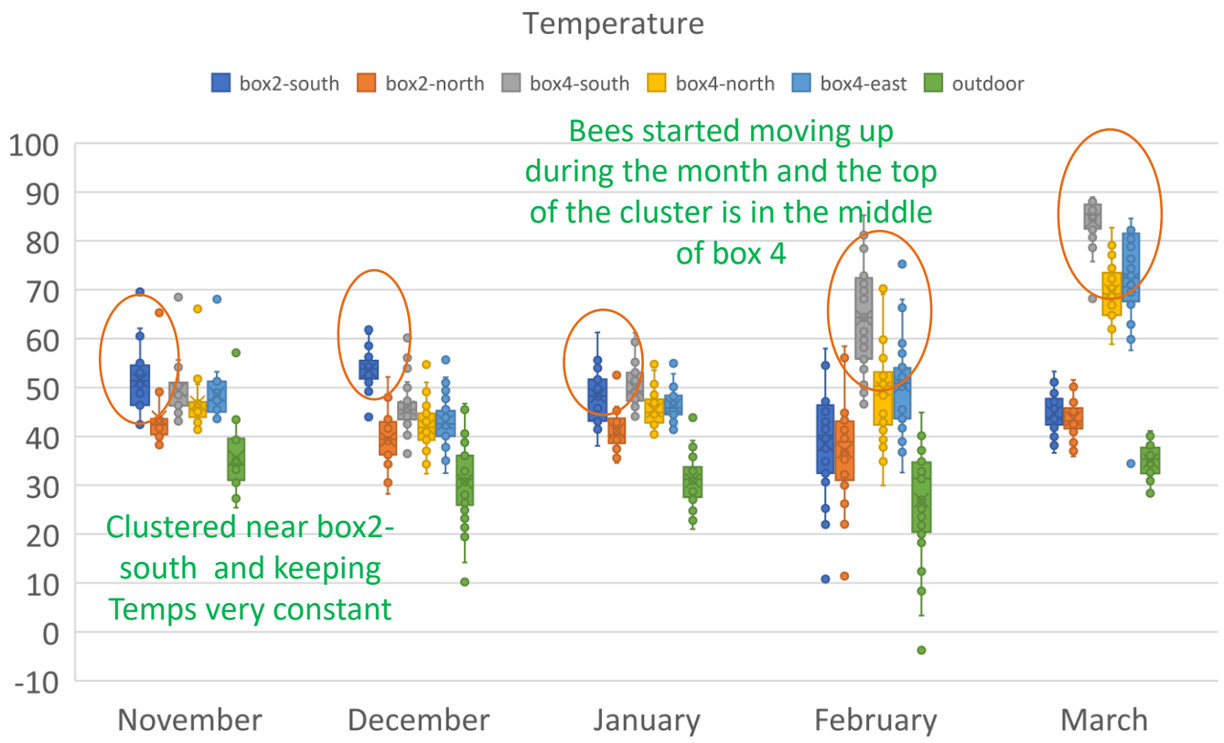
Mean Daily Values - Ital1 (slatted rack, top/bottom entrance)

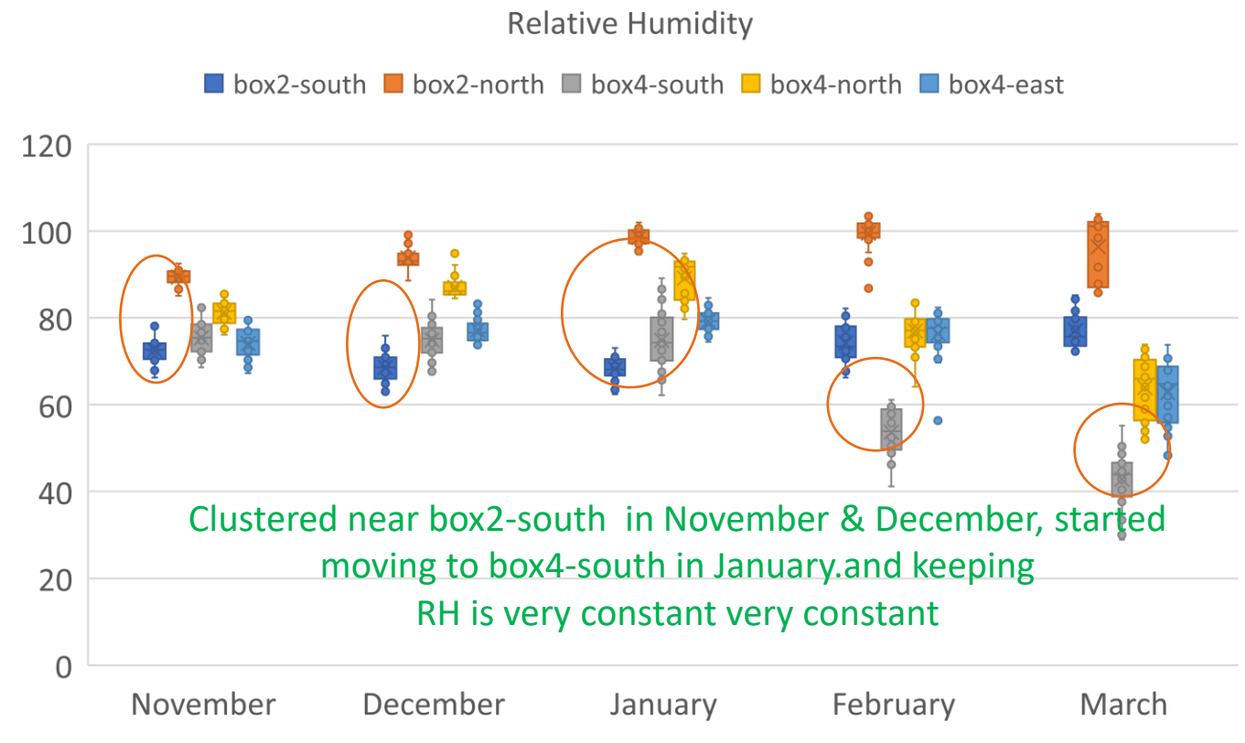


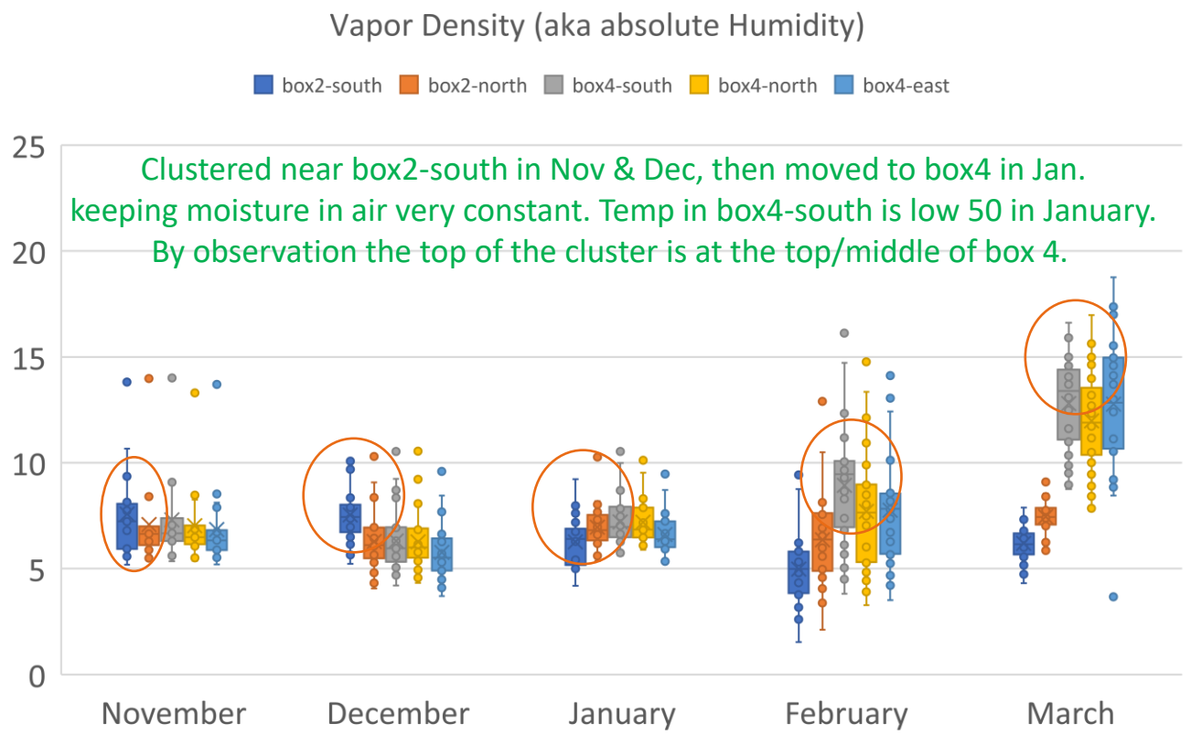


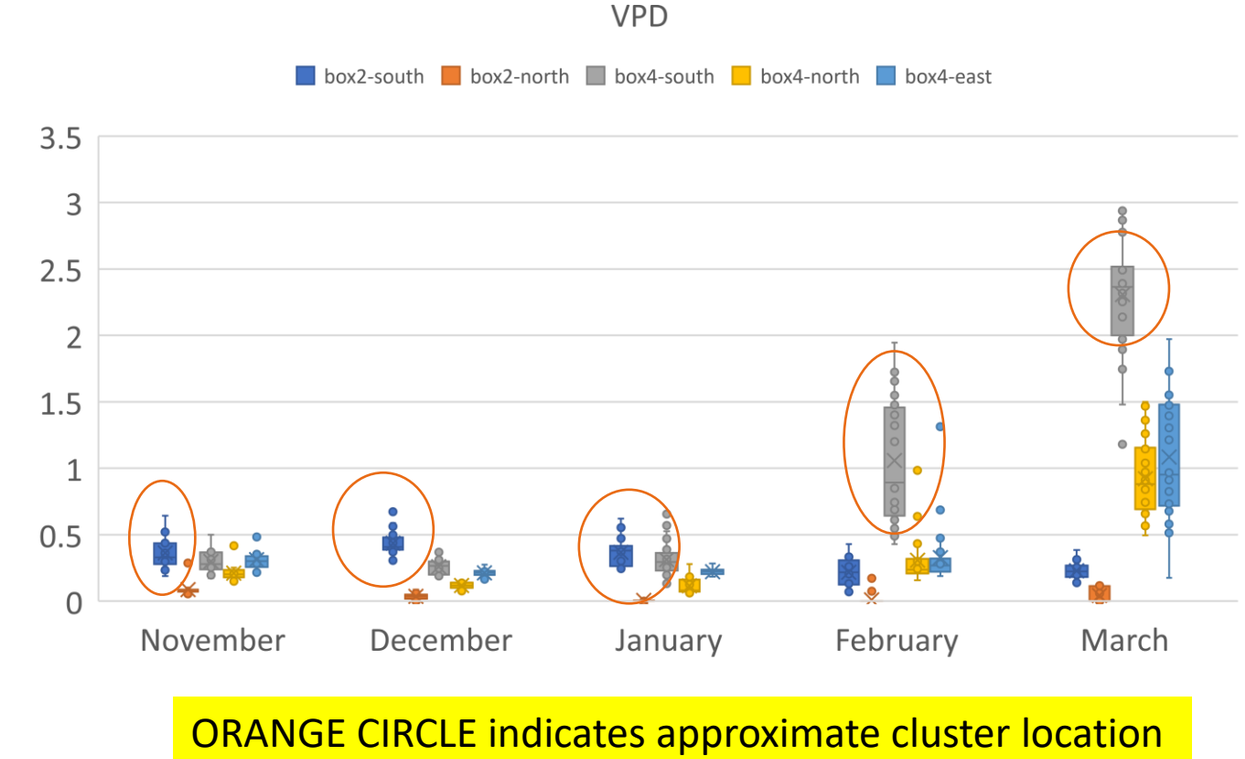


Mean Daily Values - Ital1 (slatted rack, top/bottom entrance)









ORANGE CIRCLE indicates approximate cluster location

Colony moved from box2-south to box4-south in February. In March there were LOTS of bees in the colony.

PINK indicate approximate area of the cluster

Monthly Stats – Mean Values

Slatted – Top & Bottom Entrance (Ital1)

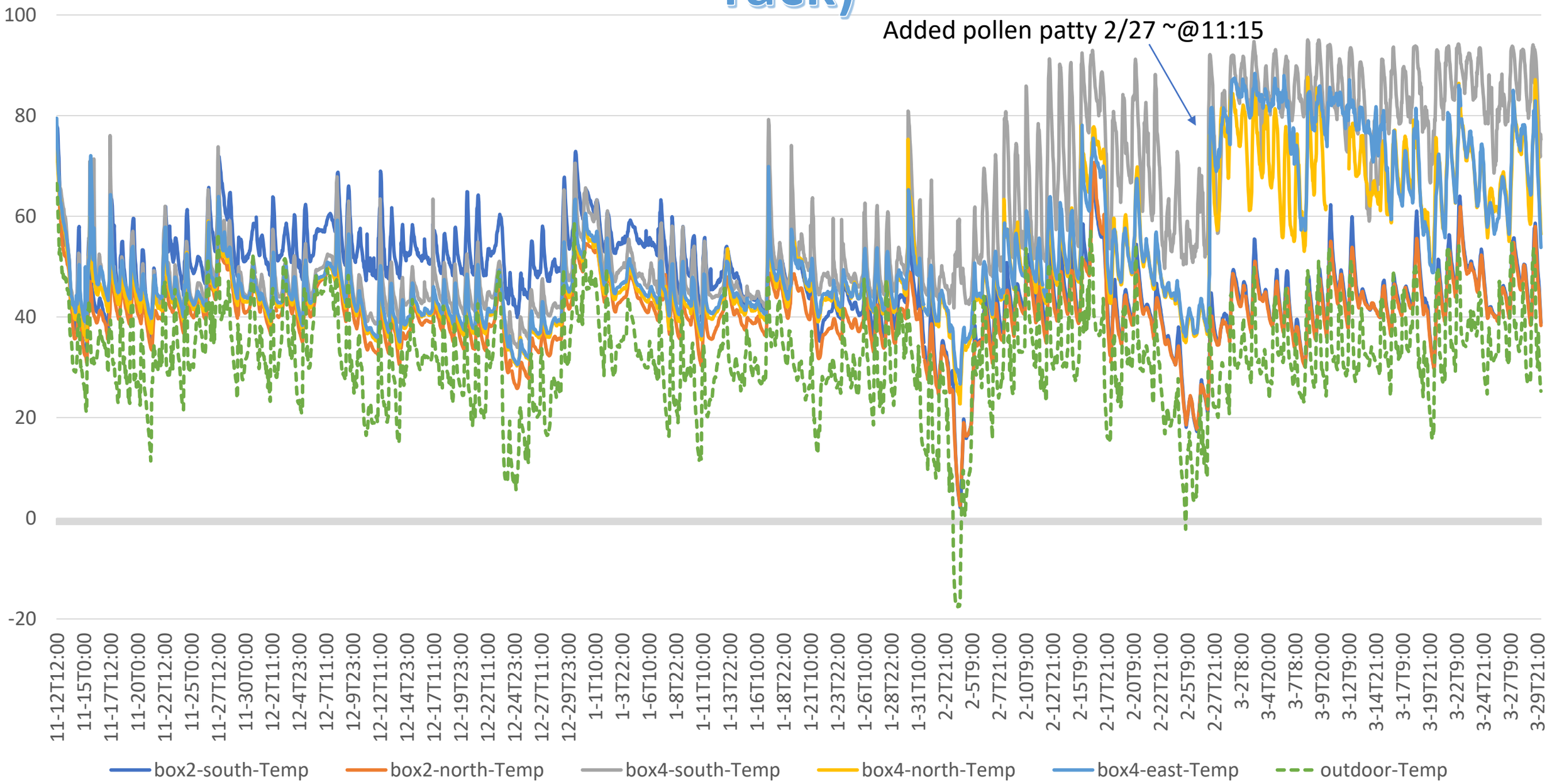
Ital1	Temp(F)					Vapor Density(g/m3)				
	Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar
box2-south	51.00	53.61	48.47	38.47	44.78	7.41	7.54	6.29	4.98	6.21
box2-north	43.19	39.37	41.24	37.06	43.68	6.89	6.28	6.97	6.37	7.48
box4-south	49.03	45.84	49.85	64.24	84.44	7.11	6.30	7.22	8.93	12.87
box4-north	46.30	41.98	45.34	49.72	69.35	6.85	6.27	7.20	7.70	11.94
box4-east	48.11	42.84	46.22	50.52	73.76	6.66	5.76	6.61	7.76	13.30
outdoor	35.03	30.74	31.13	26.90	35.09	4.12	3.78	3.91	3.02	3.78

Looking at the temps corresponding vapor densities, all colonies look pretty similar :

- if the temps at the sensor are in the 70s/80s Vapor density is 12-14
- temps in the 60s, vapor density is 9-11
- temps in the 50s , vapor density is 7-8
- temps in the 40s,vapor density is 6-7 (There is one case – sask2, box4 east that is closer to 8 in Nov)
- temps in the 30s,vapor density = 5-6 (but outdoor vapor density is in the 4 rang)

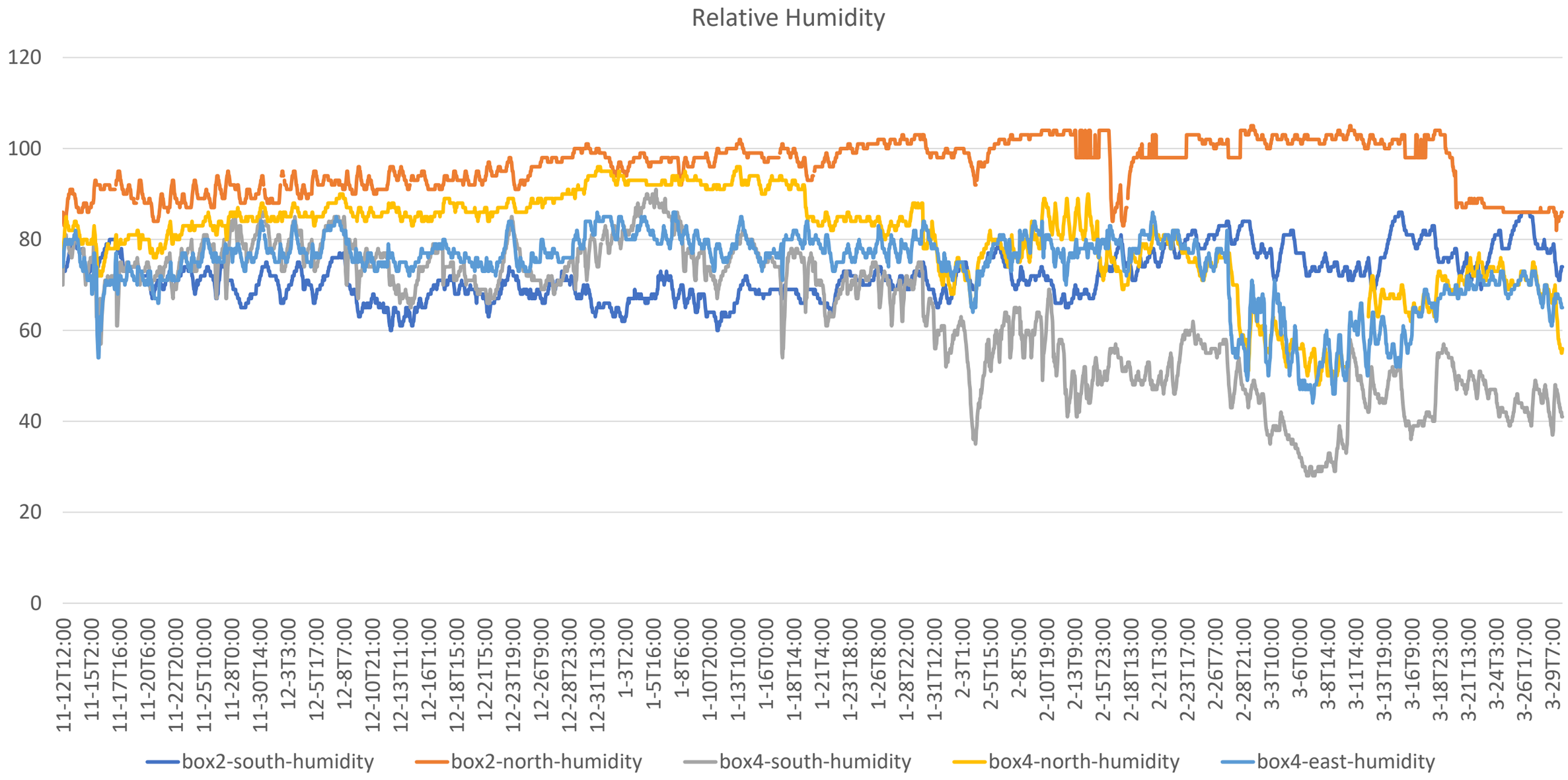
All data points

Temperature Ital1 (top/bottom entrance, slatted rack)



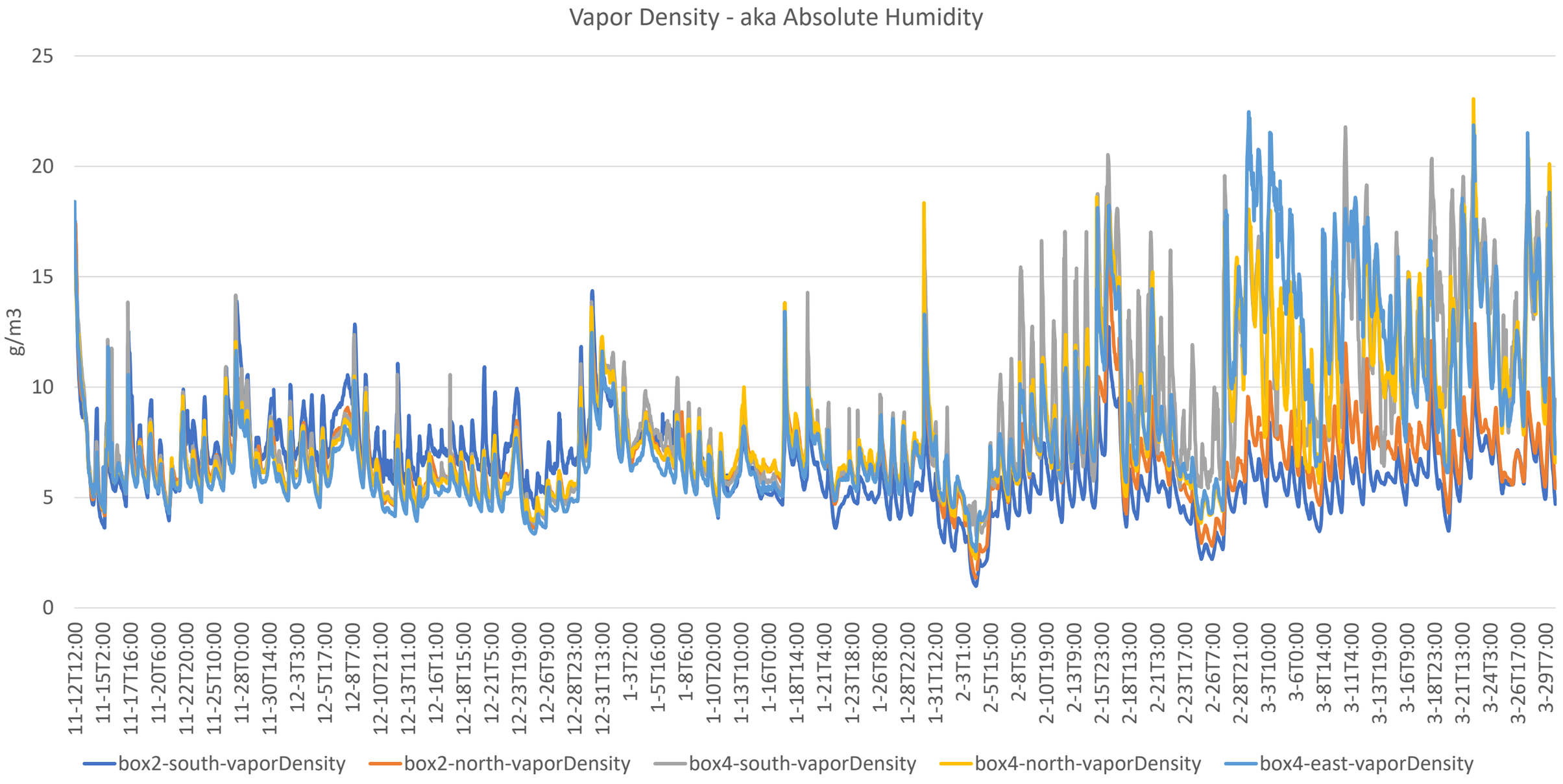
- Bees have been clustered around box4-south since mid Jan..
- Note the temp in box2-north on 2/3 when we had the -18 temps. – it is almost 0!
- During most of Feb, there have been LOTS of bees on the frames in box 4 (by observation). Adding the pollen patty seemed to have spread out the bees across more sensors)
- Have been going through pollen patties fast in March but not consuming much of sugar bricks

Relative Humidity Ital1 (slatted rack, top/bottom entrance)



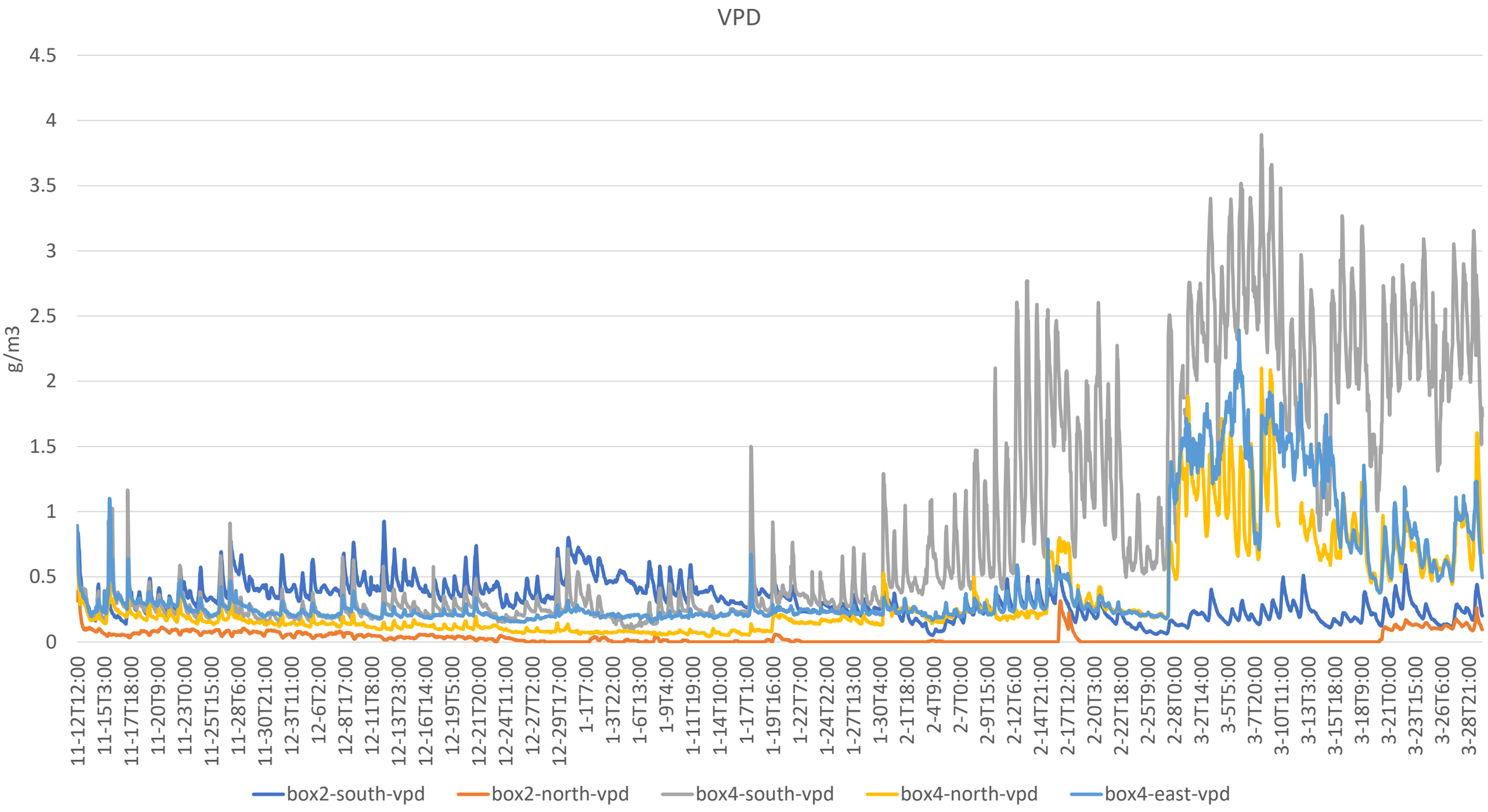
*Bees are clustered near box4-south Sensor.
Relative Humidity at all of the sensors is as expected..
However, the drop in the box2-north RH on 2/16-17 is interesting – The temp on that sensor was up close to 70 at one point during that time.. The outdoor temp hit a max of 54ish (will show graphs of this time later in the slides.
The drop in box2-north RH starting in mid March is also interesting.

Vapor Density – Ital1 (slatted rack, top/bottom entrance)



- Vapor Density Seems to vary quite around the cluster which is surprising – is this due to temps changing during the day?
  - There are really big swings in box4 north..

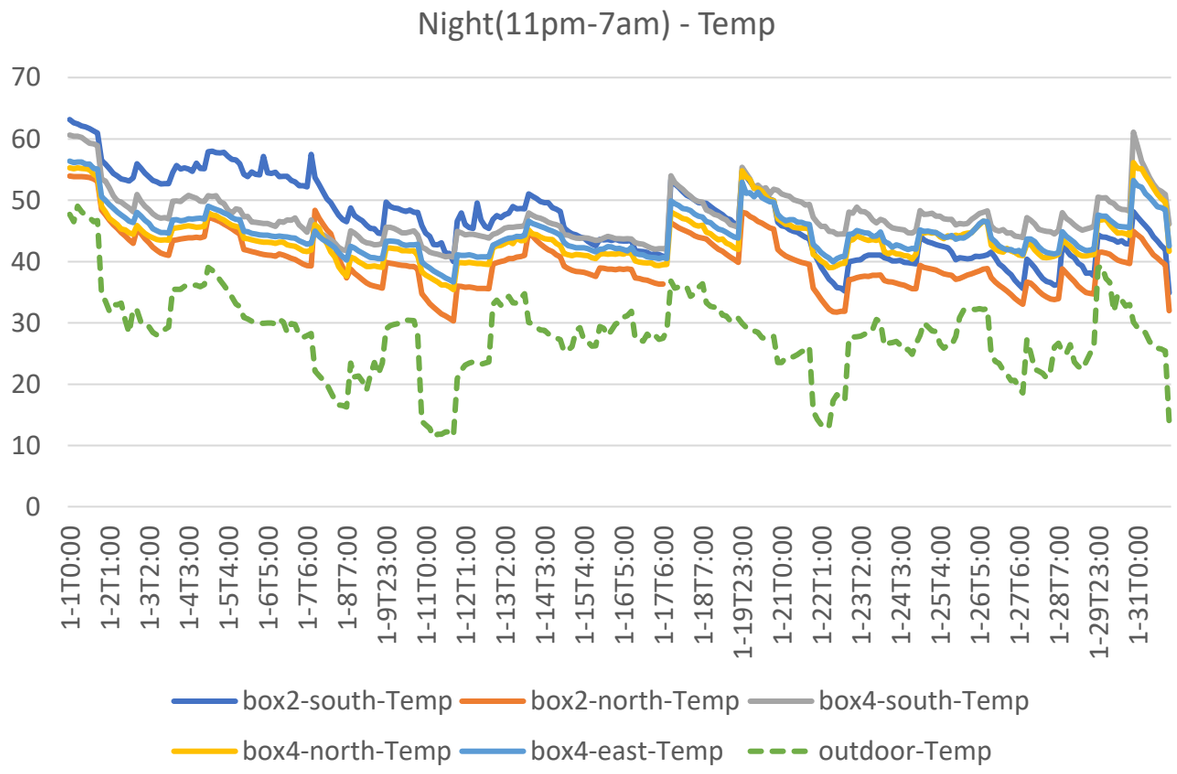
VPD– Ital1 (slatted rack, top/bottom entrance)

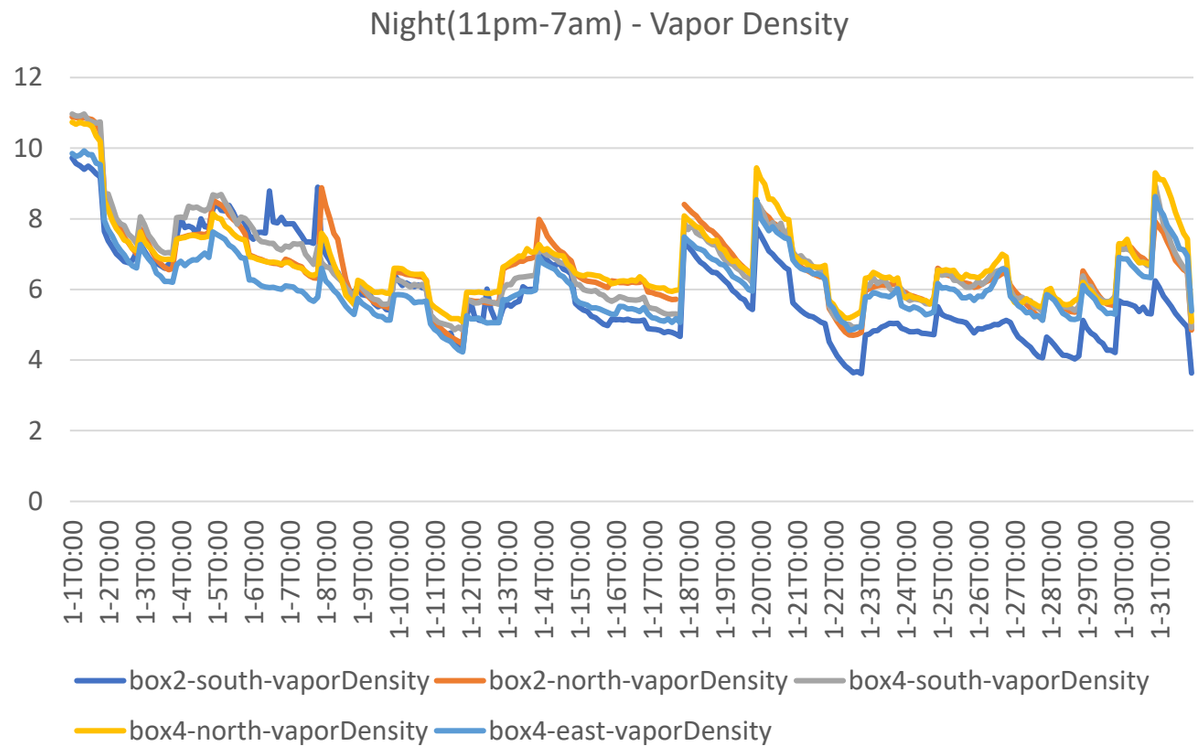


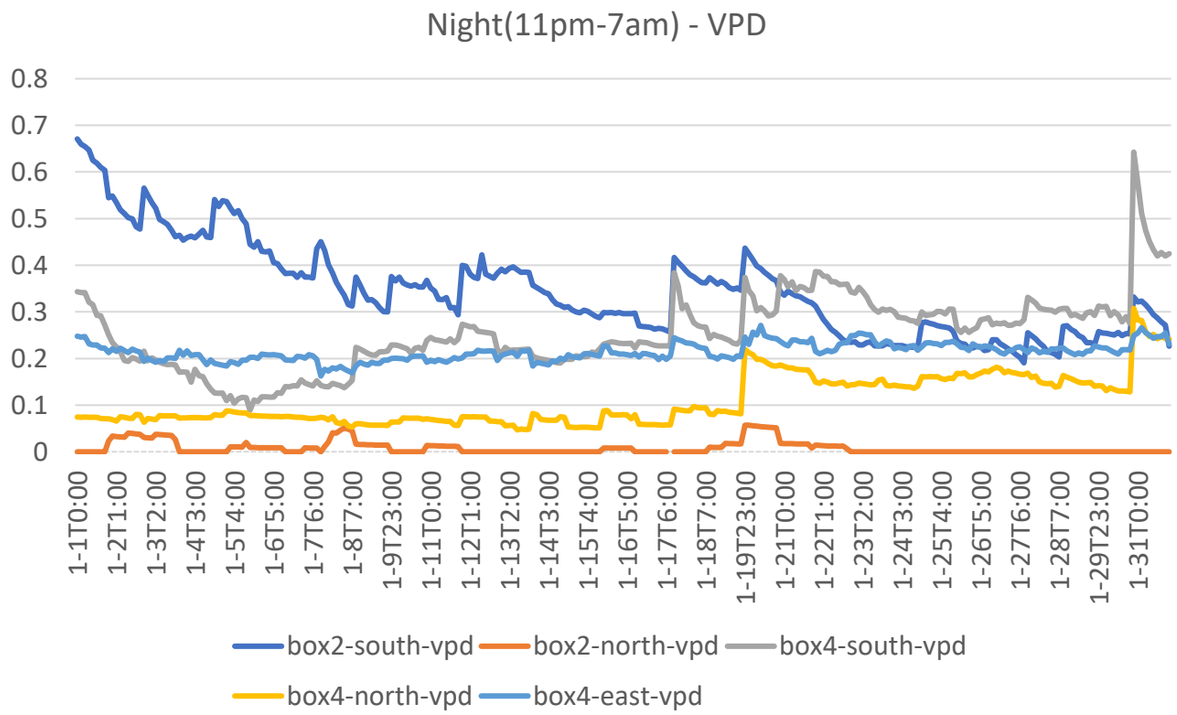
- The amount of water the air can hold (VPD) tracks the temp – interesting how much it varies near the cluster (box4-south)

Day vs Night Data
By Month

January –Night – Ital1 (slatted rack, top/bottom entrance)

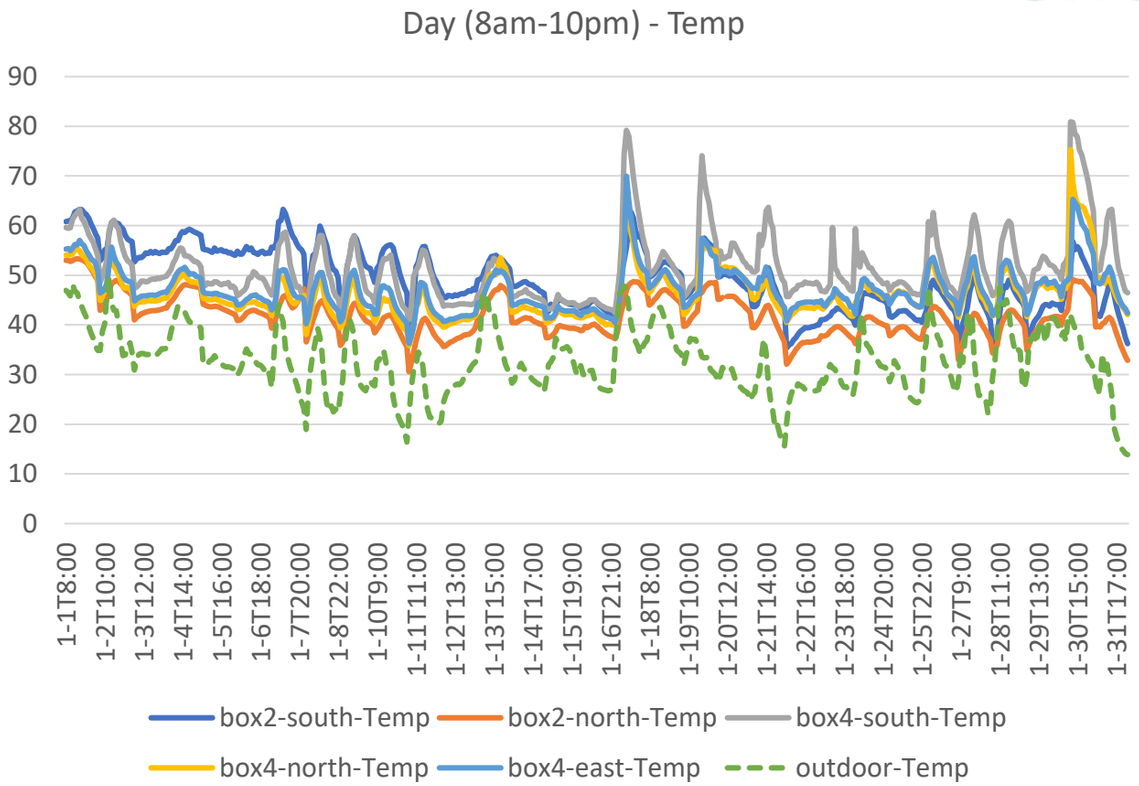


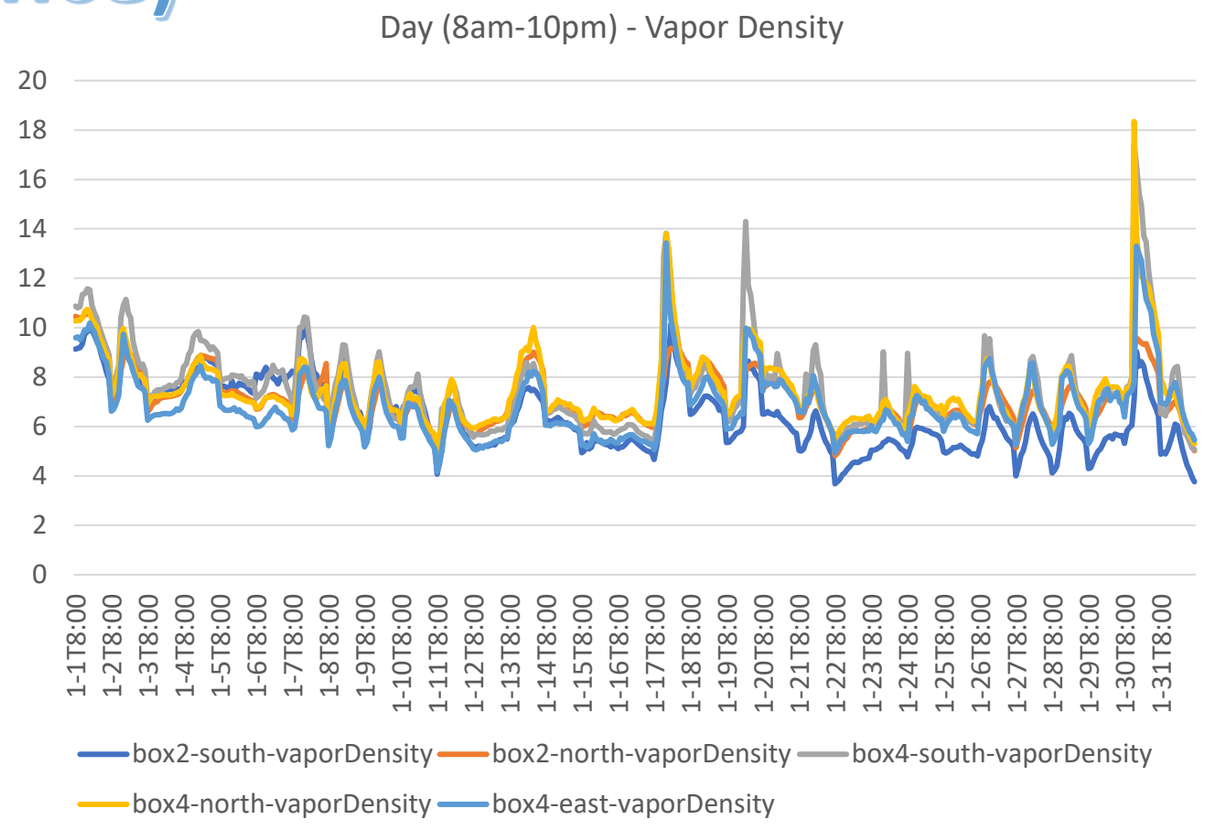


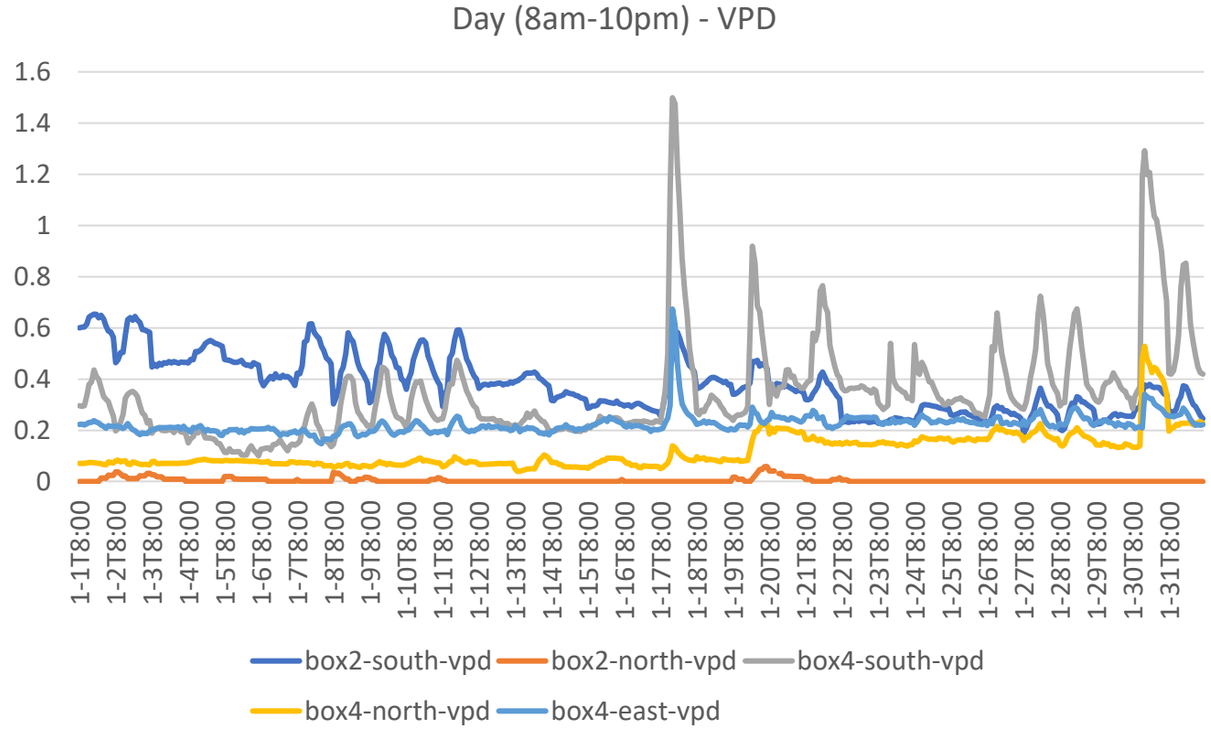


- Bees are nearest the box4-south sensor in the 2nd ½ of Jan
- But the temps at all the sensors is very close together – with box2-north being the coldest spot.
- The vapor density (aka absolute humidity) at all of the sensors is very similar through most of the month – with box2-south in having less moisture than the other areas
- Box4-north area has the most moisture (but not by a lot)
- Looking at VPD – the box2-north sensor shows close to complete saturation – which makes sense since it is the coldest area. Box4-north is the next most saturated. This make sense since these two spots are furthest from the airflow between the entrances.

January –Day – Ital1 (slatted rack, top/bottom entrance)

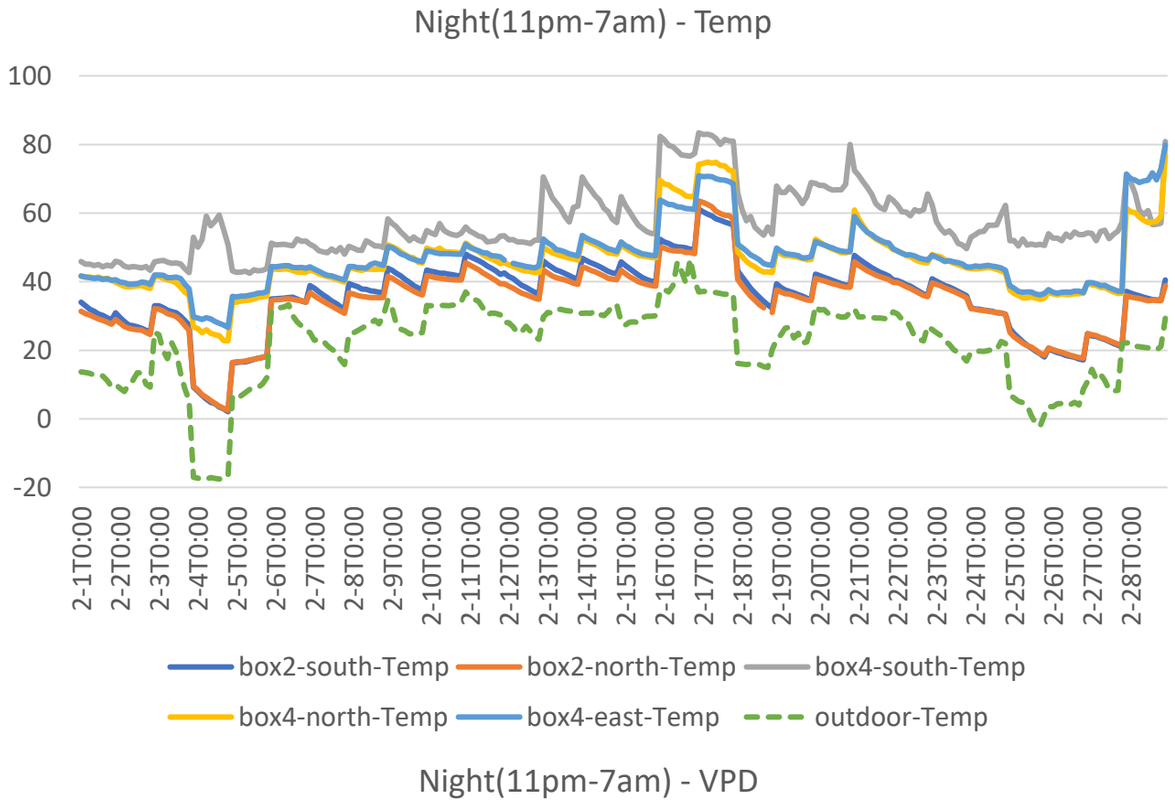


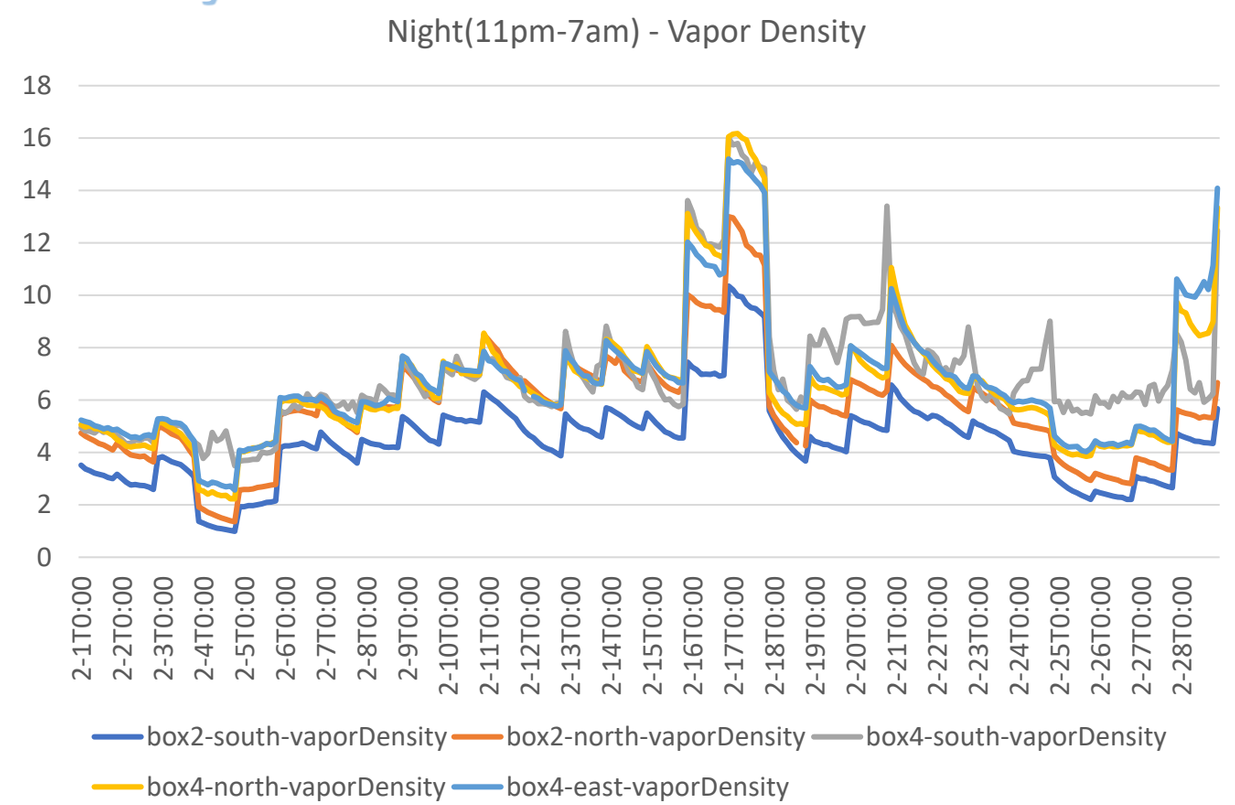


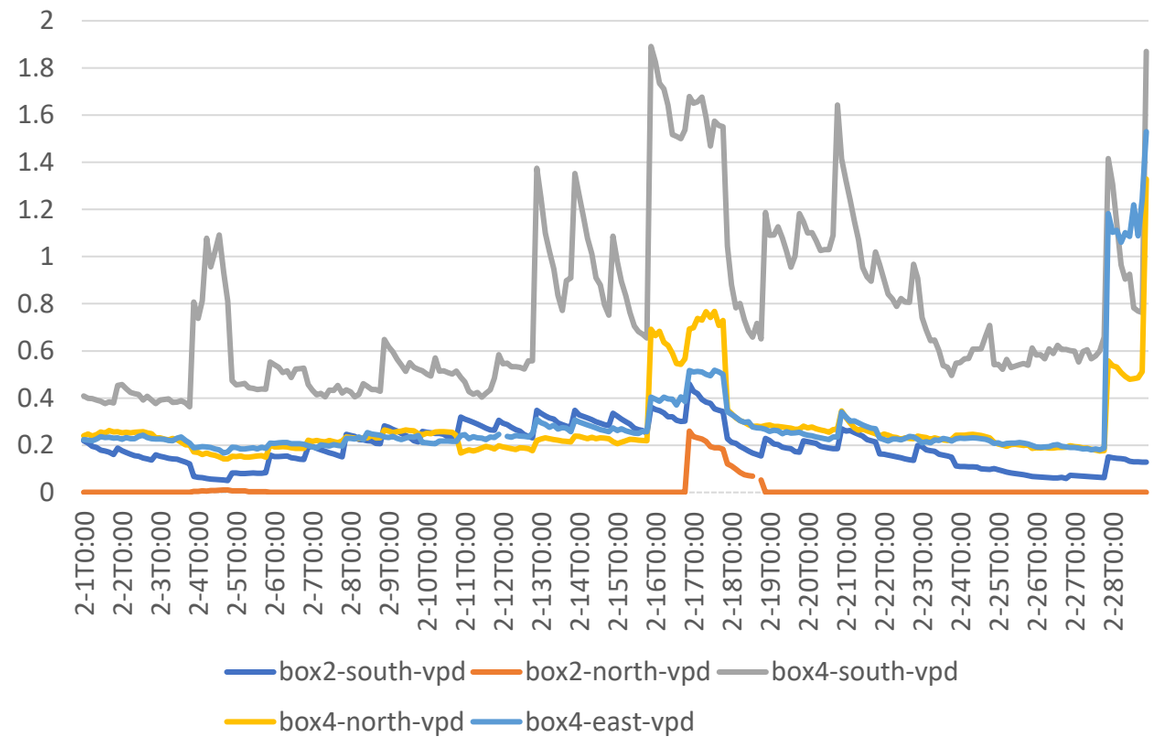


- Bees are near the box4-south sensor in the 2nd half of Jan
  - Similar observations to what is listed for the Jan-night.
- You can definitely see that the North sensors have the highest moisture in the air.. It will be interesting to see if there is any mold in those areas in the spring.
- The box4-east sensor has the next most moisture in the air – which again makes sense since it is out of the line of the air flow.
- It is still interesting how similar the vapor density is at all of the sensors.

Feb –Night – Ital1 (slatted rack, top/bottom entrance)

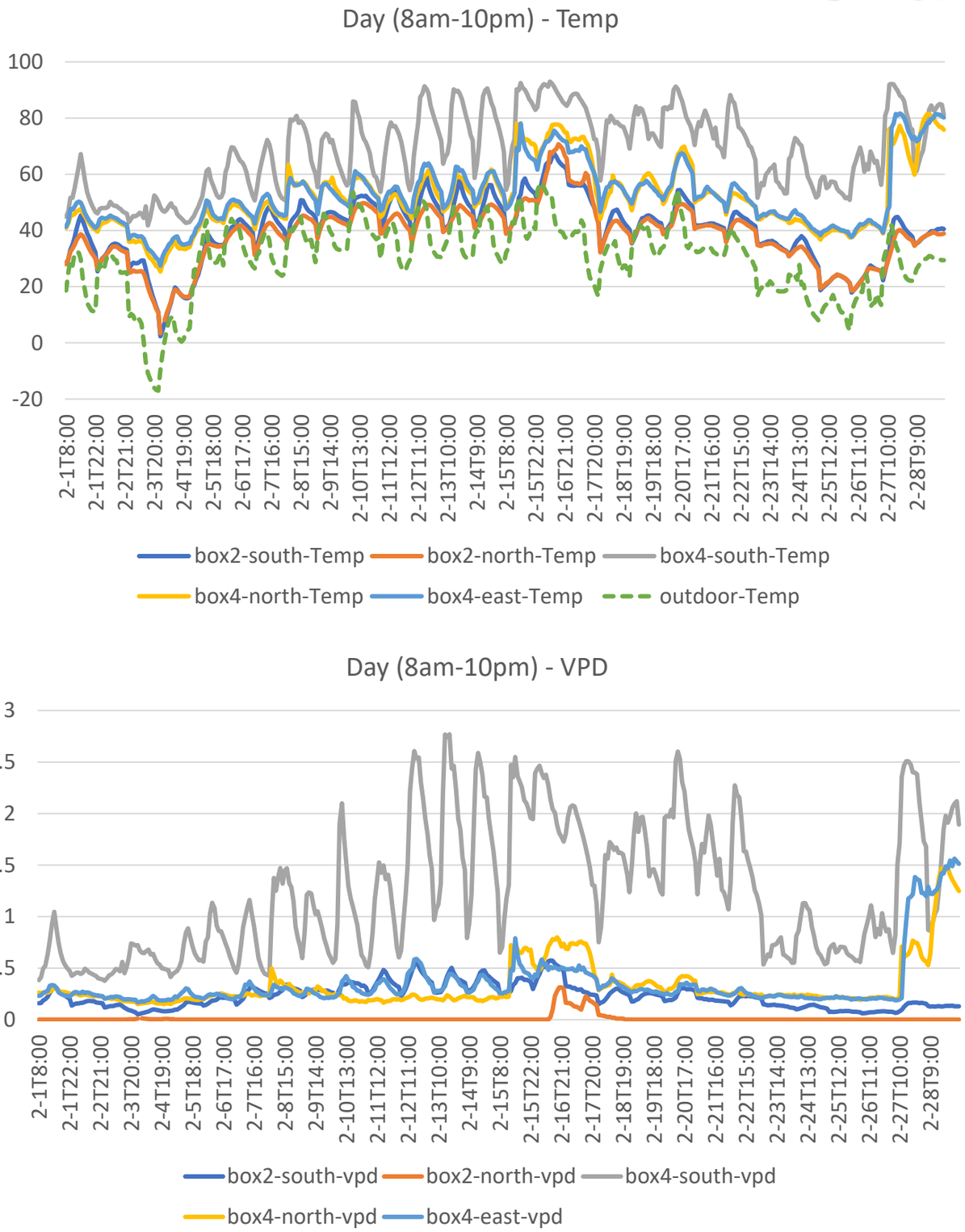


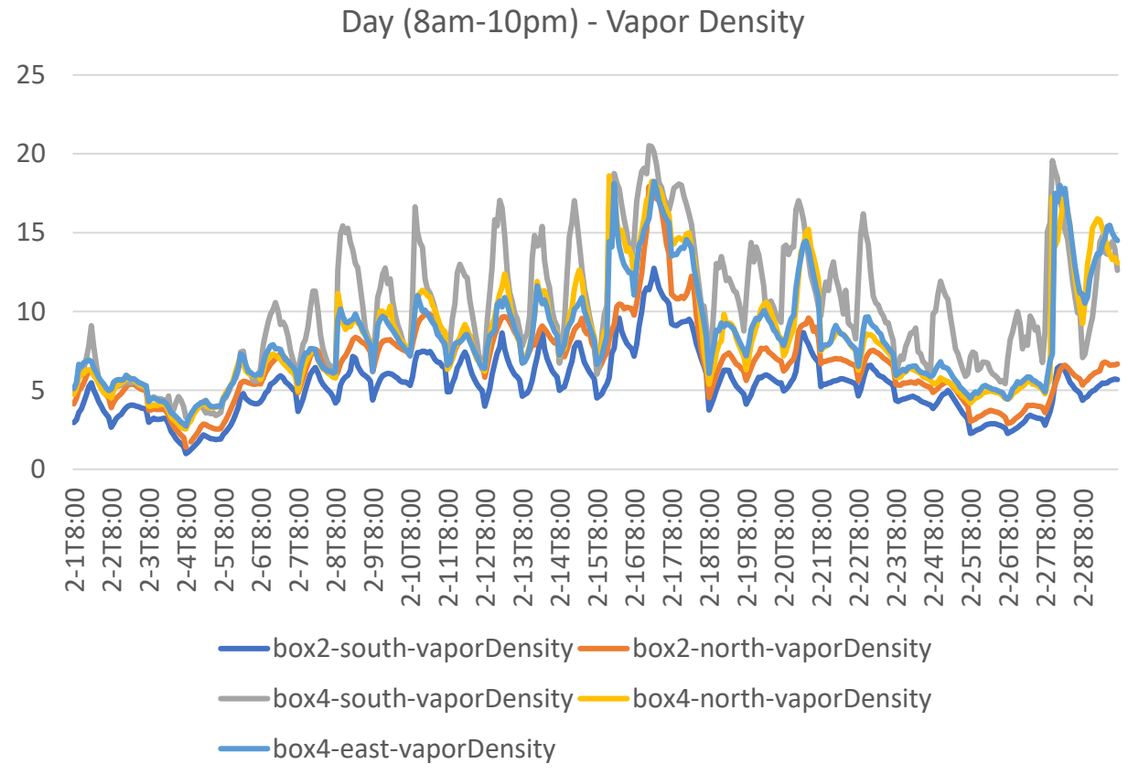




- Bees are near the box4-south sensor
- Note how cold the box2-south & box4-south sensors got on 2/4 (see later graphs with the dewpoints/temps in this area)
- Temps in the box2-north & south sensors are very similar – but the amount of moisture at box2-south is always less than box2-north. This makes sense because box2-south sensor is much closer to the air flow path.
- The area around the cluster & box4-south sensor is warm and can hold more air.

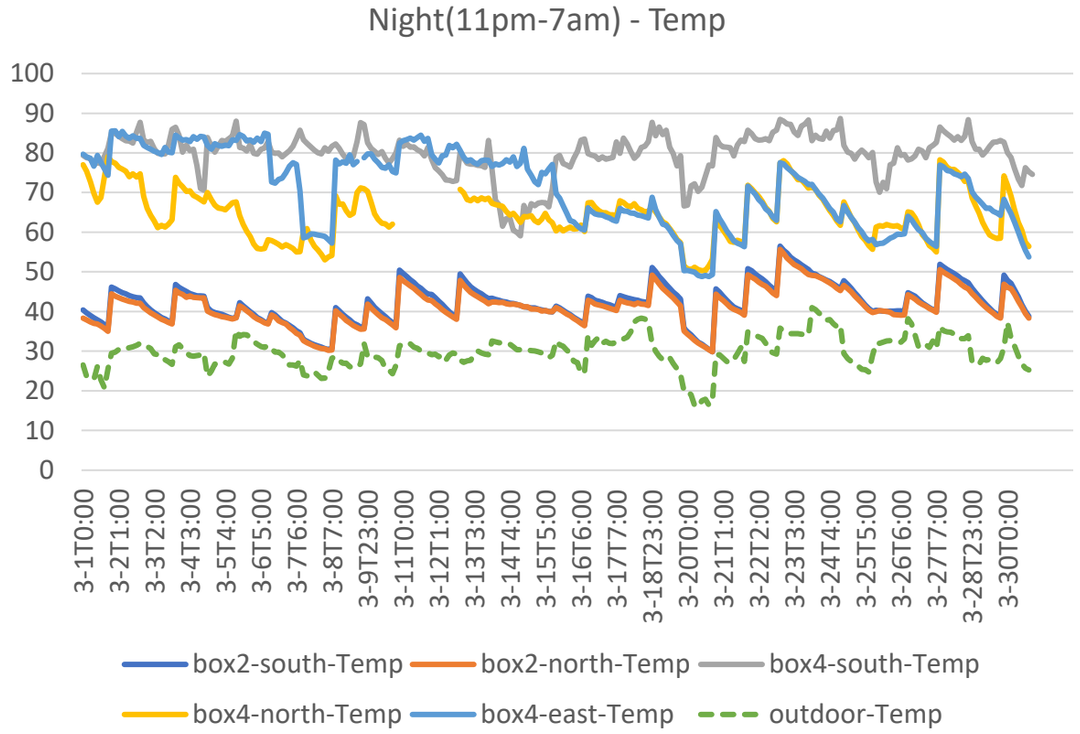
Feb –Day – Ital1 (slatted rack, top/bottom entrance)

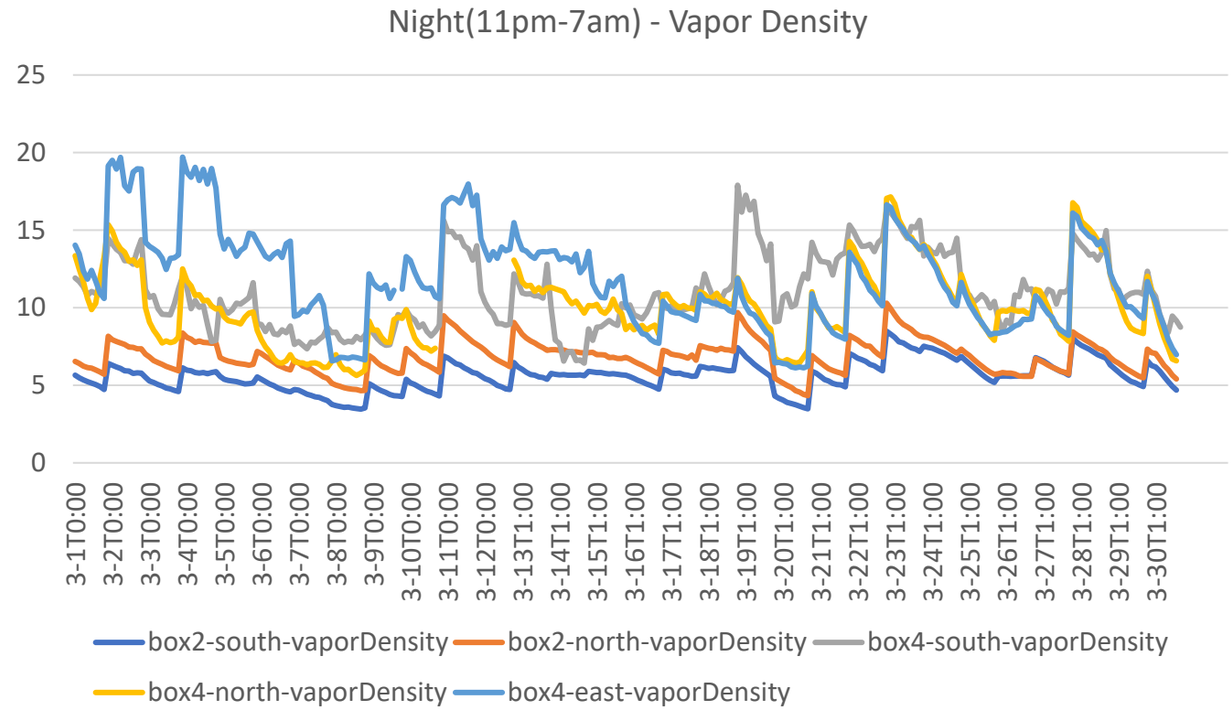


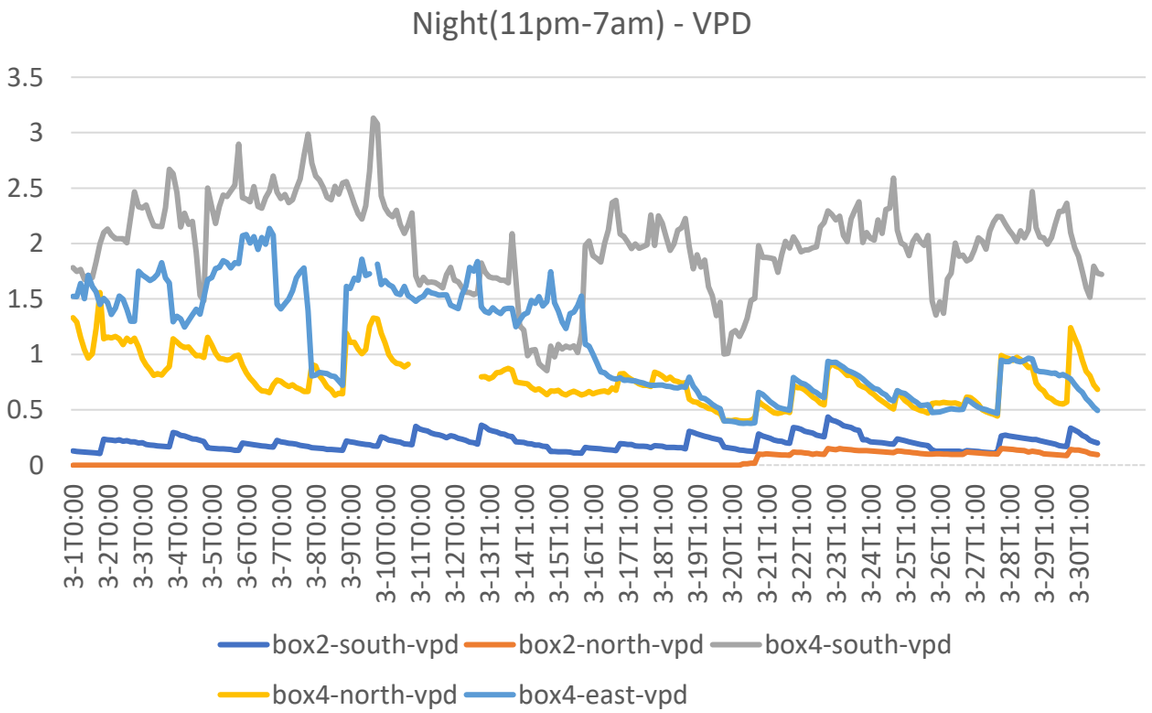


- Bees are near the box4-south sensor
- Moisture is maxed out at box2-north sensor.
- In the area of the cluster, the air is warm and therefore can hold a lot more moisture as is seen with the VPD.
- On sunny days, the south side heats up more than the north side (compare box2-north & south temps)

March –Night – Ital1 (slatted rack, top/bottom entrance)

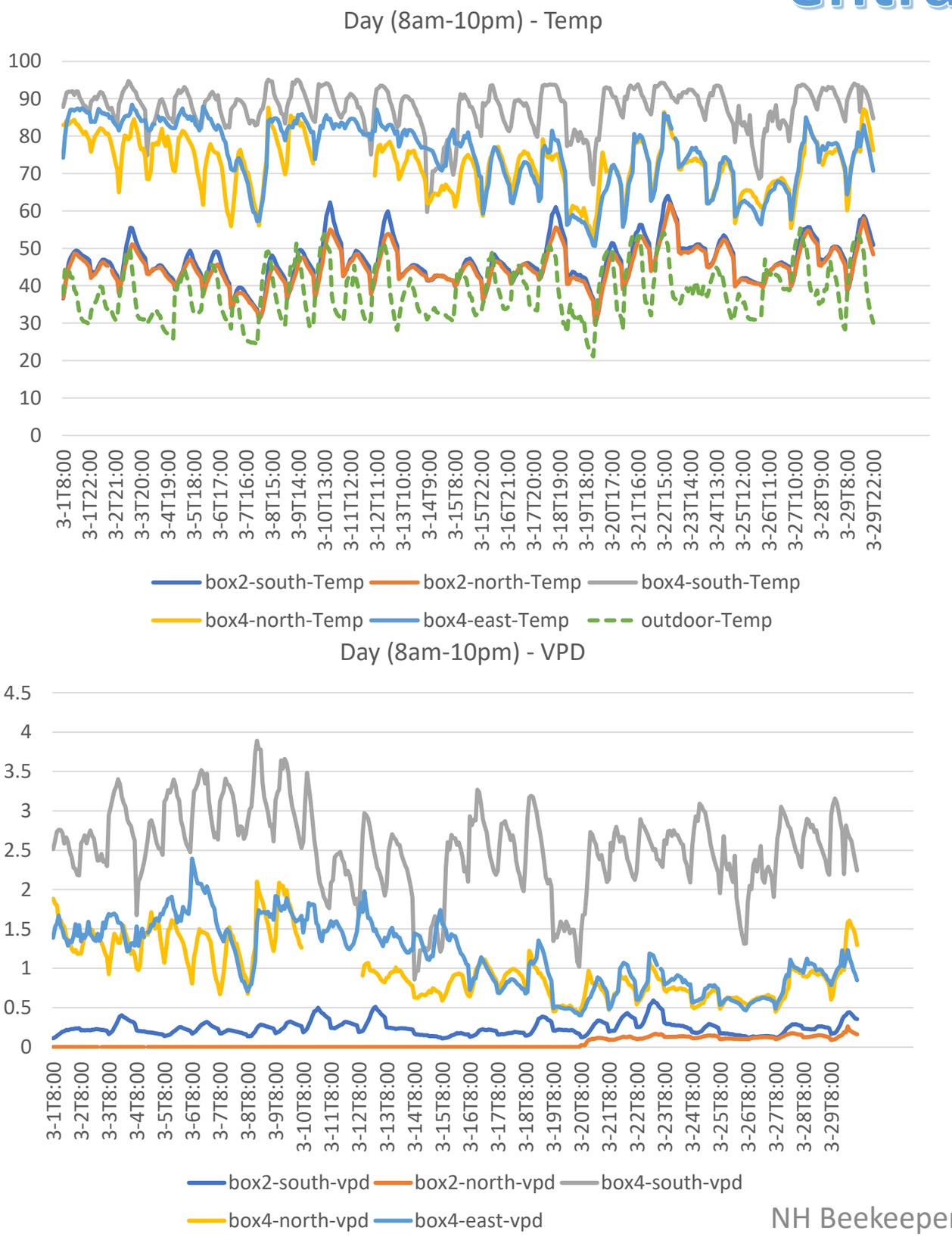


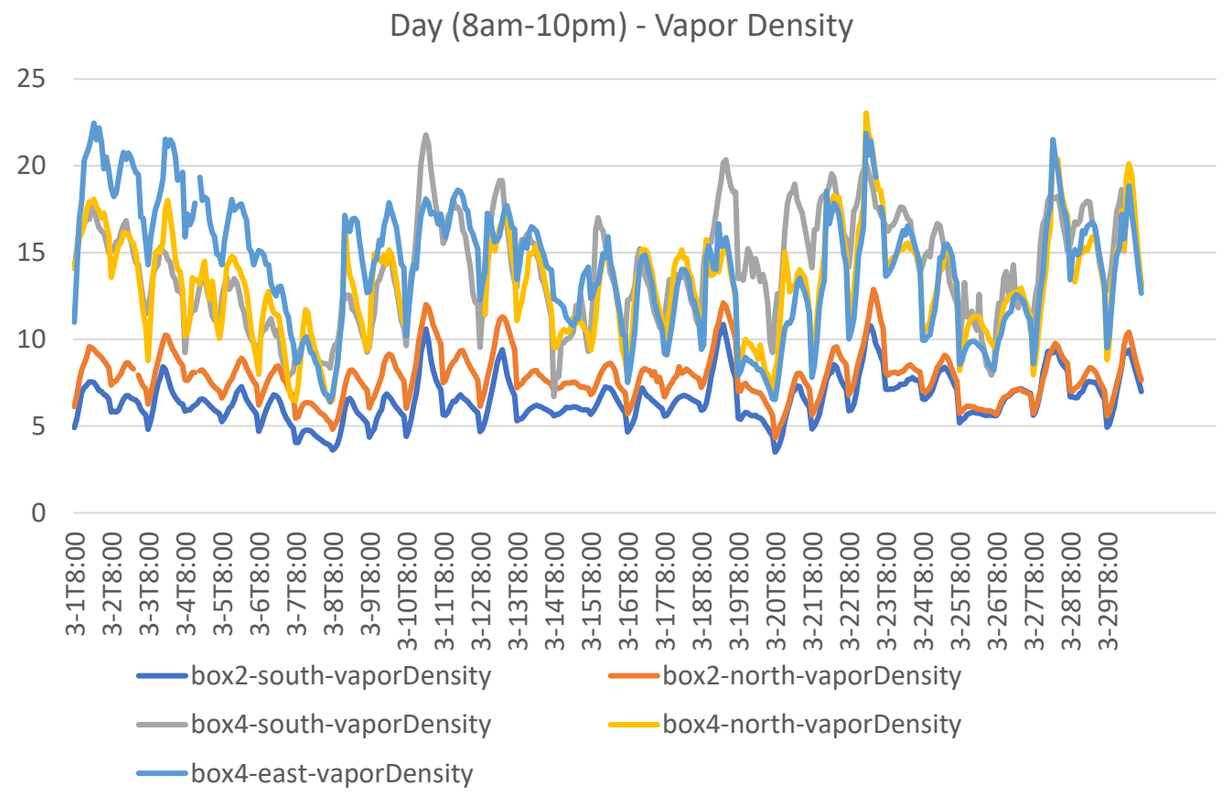




- Bees are clustered closest to the box4-south sensor – probably raising brood. (especially since they are going through pollen patties like crazy)
- The amount of moisture in the air (vapor density) is almost the same at all of the box4 sensors. In the last week of March
  - Box2-north is consistently the coldest
  - Even though the temps are very similar at box2-north and box2-south sensors, the north sensor area has more moisture (vapor density & VPD).
  - For some reason starting 3/21 the air near the north sensor dried out a little. Could this be due to the bees controlling the moisture more aggressively (fanning, etc) since they are raising brood?

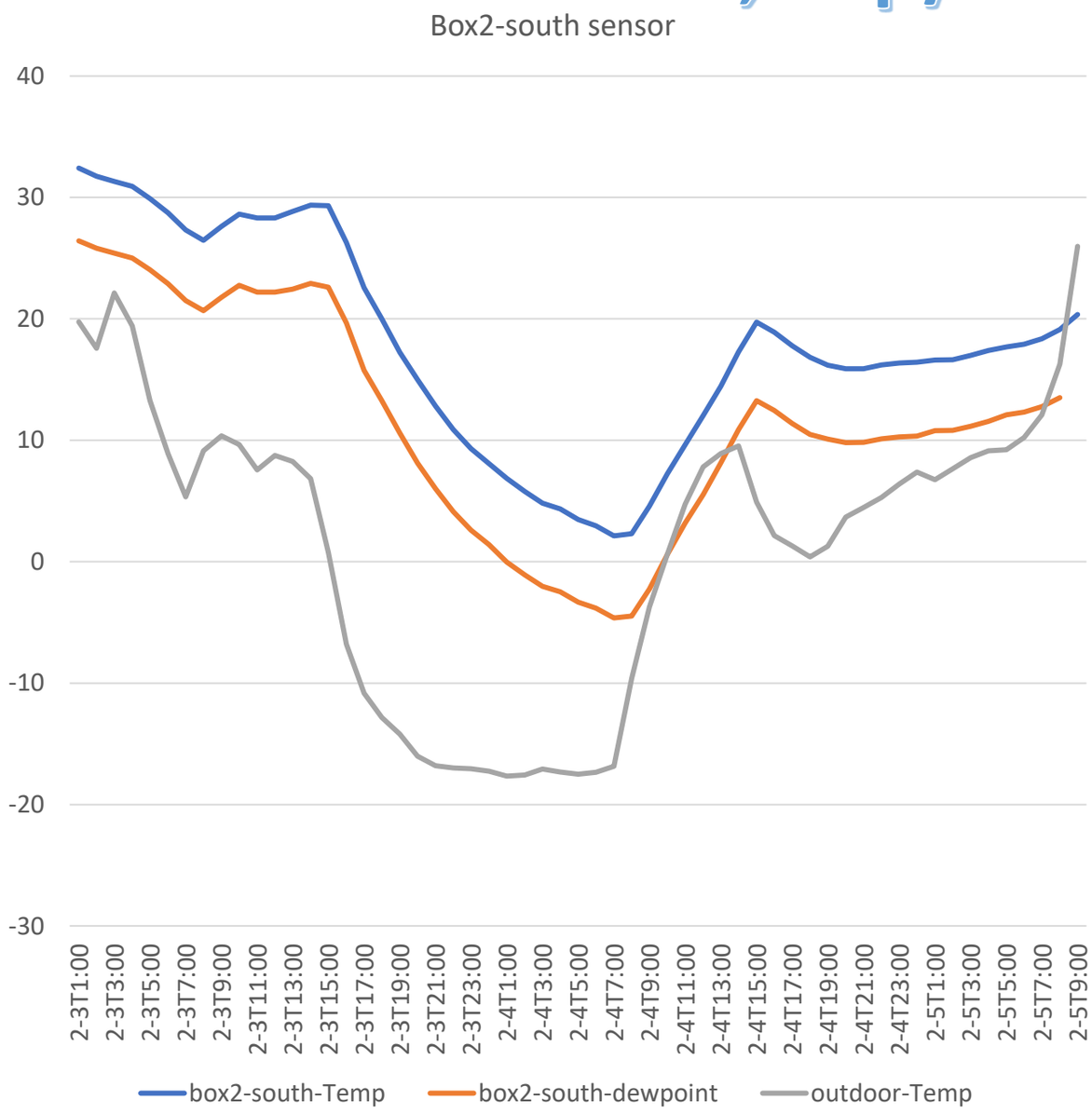
March –Day – Ital1 (slatted rack, top/bottom entrance)

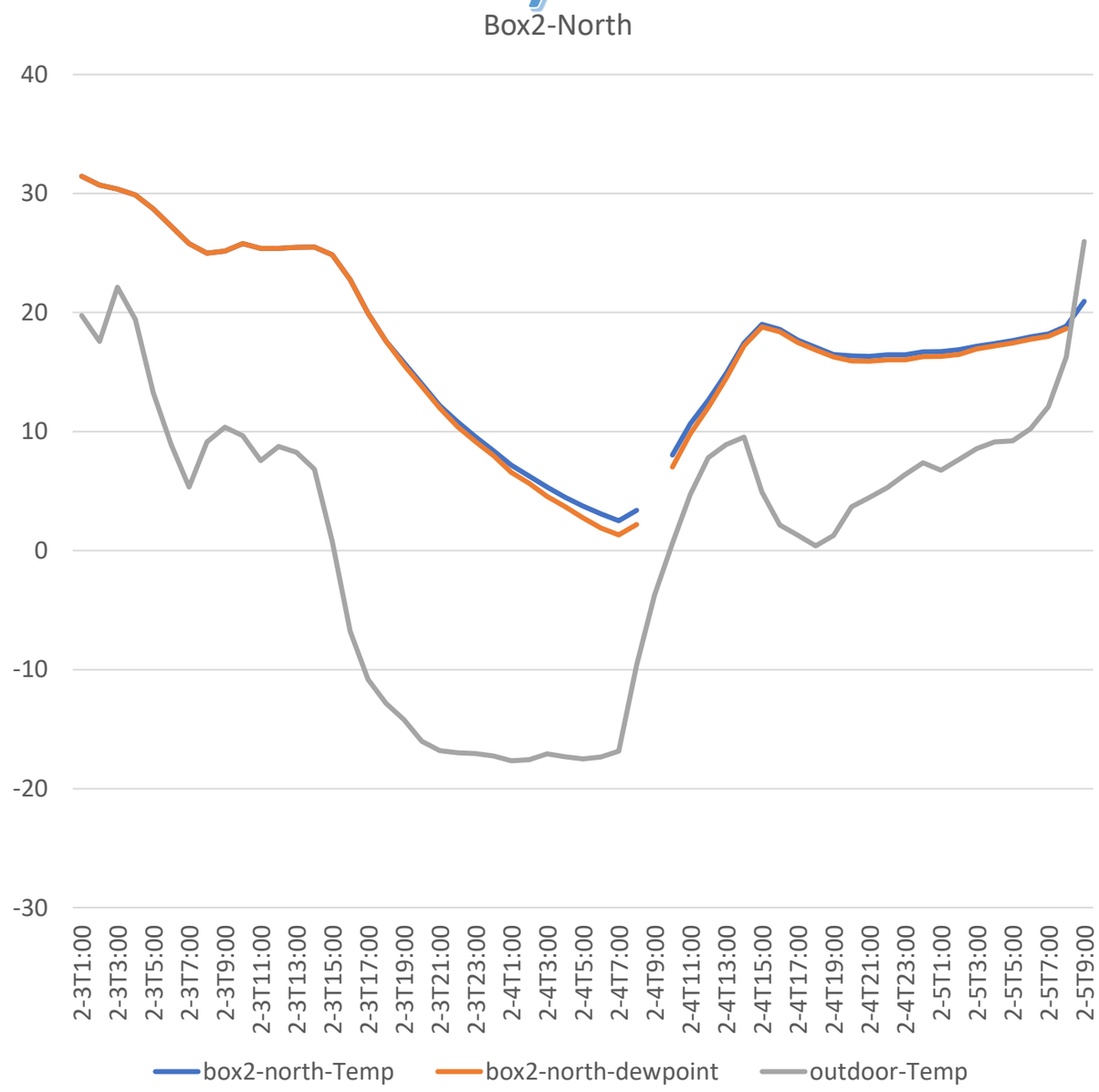




- Bees are near the box4-south sensor raising brood
- Similar observations to what is listed for the Mar-night.
- During Sunny days – the temp varies which also is affecting the Vapor Density and VPD.
- You can see how the sun heats the south side of the colony more than the north side (box2-south & box2-north sensors)
- Similarly, the moisture in the box2-south area is lower than the box2-north area most likely because the south side would be closer to the bottom to top air flow.

Dewpoint & Actual Temps - Feb 3-4 Ital1 (slatted rack, top/bottom entrance)





- At box2-south the dewpoint temps are always below the actual temp so there shouldn't be any condensation
- However, at box2-north, The dewpoint and actual temp is almost always the same so there is likely condensation in this area.