

Analysis of Sask2 Data from Nov12-Mar4 2022

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"

Sask2: bottom entrance; NO 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

2/15/23 (1:15)

- Saw a few bees up at box 4
- Added ½ lb sugar brick in case they needed it.

2/27/23 (11:15)

- Hadn't touched brick
- Bees were all down in colony
- Added ½ pollen patty (global)

3/3/23

- lots of cleansing flights in apiary – wasn't home so didn't see which colonies

3/9/23 (noonish)

- Hadn't touched pollen patty or Sugar
- Starting to see top of cluster in south-west corner

3/18/23 (10:30ish)

- Lots of bees in box 4 – had started to consume pollen patty
- No sugar – added 1 brick

3/27/23 (4:15ish)

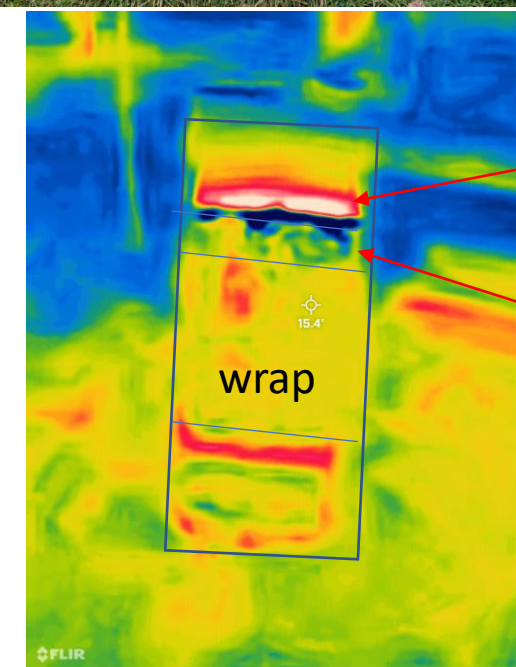
- No sugar – added 1 brick
- Using lower entrance

3/29/23 (3pmish)

- Added medium with 3 partial Honey frames, 5 drawn frames & Frame feeder

Date	Sask2	Notes
5/26/2022	0.40%	
6/27/2022	0.50%	
7/22/2022	7.27%	Treated Formic
8/31/2022	6.00%	Treated Sask2 with Formic
10/8/2022	4.00%	Treated Sask2 OA dribble

Mite Test Data (Alcohol Wash)



Seam between Inner cover & super with insulation

Reflectix

Taken 3/9/23 @5am – heat is coming out the seam between the inner cover and the box with the insulation

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 :
 - $(0.611 \cdot 10) * \text{Power}(2.71828, (17.502 * T) / (T + 240.9)) * (RH * 2.18647) / (273.15 + T)$
 - 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

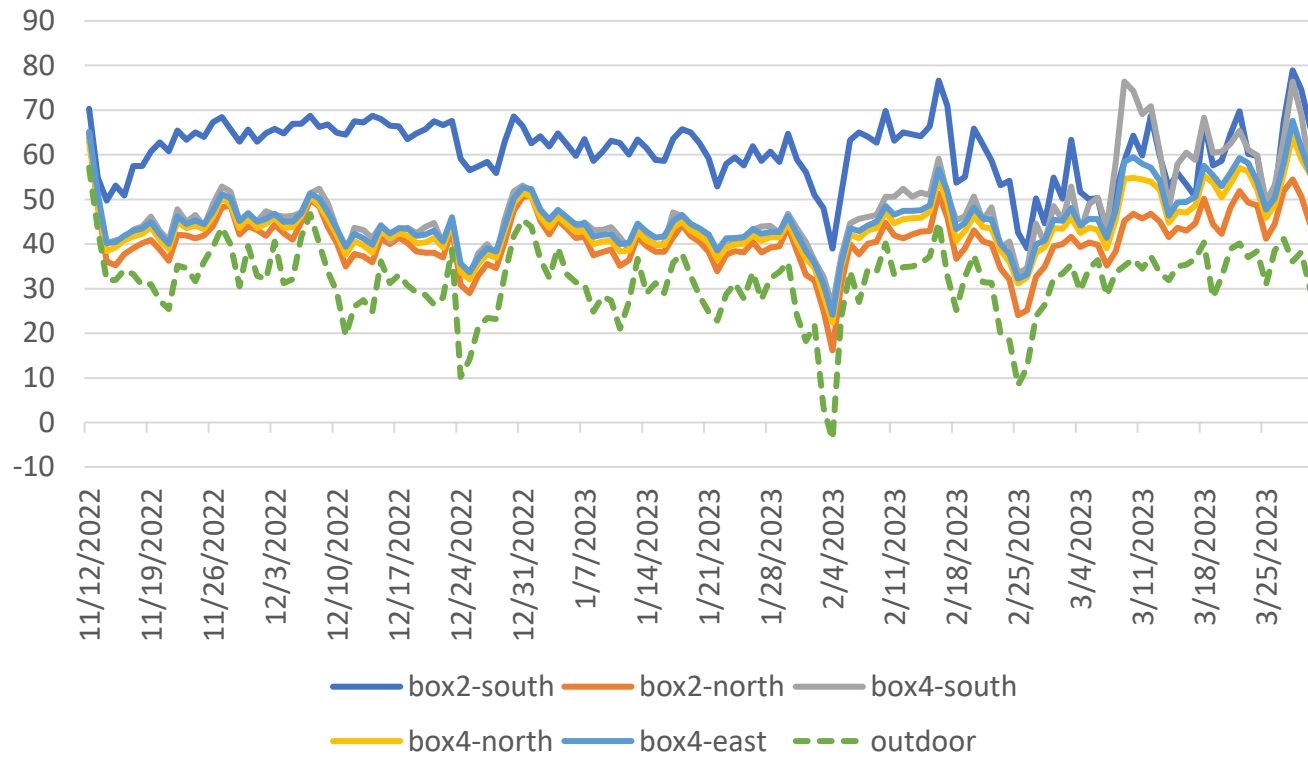
Notes from Etienne Tardif on Bee-L forum

- 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.

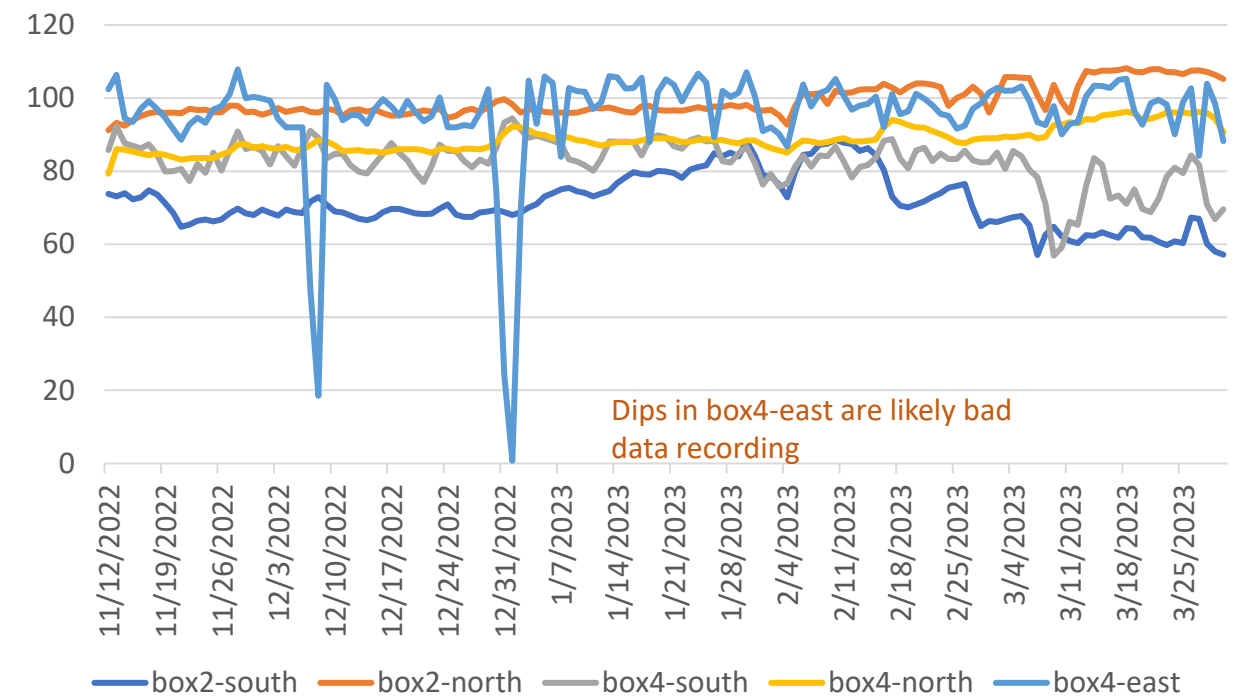
Daily mean values

Mean Daily Values – Sask2 (No rack, bottom entrance only)

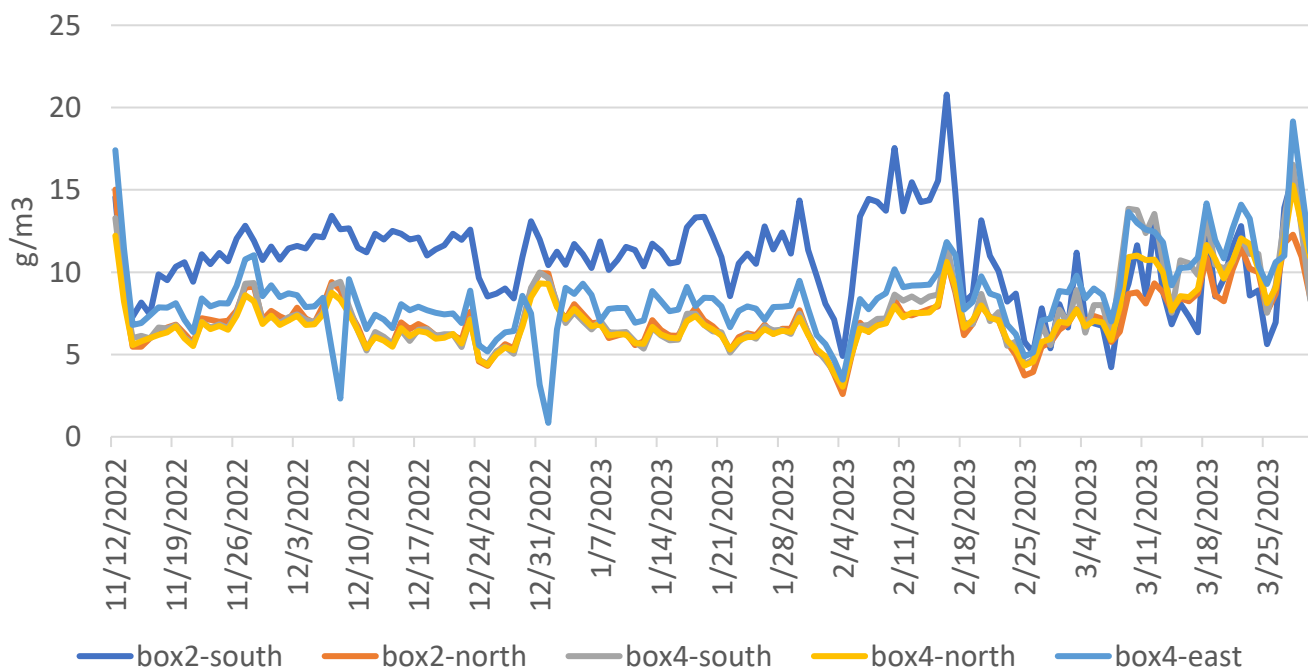
Temperature



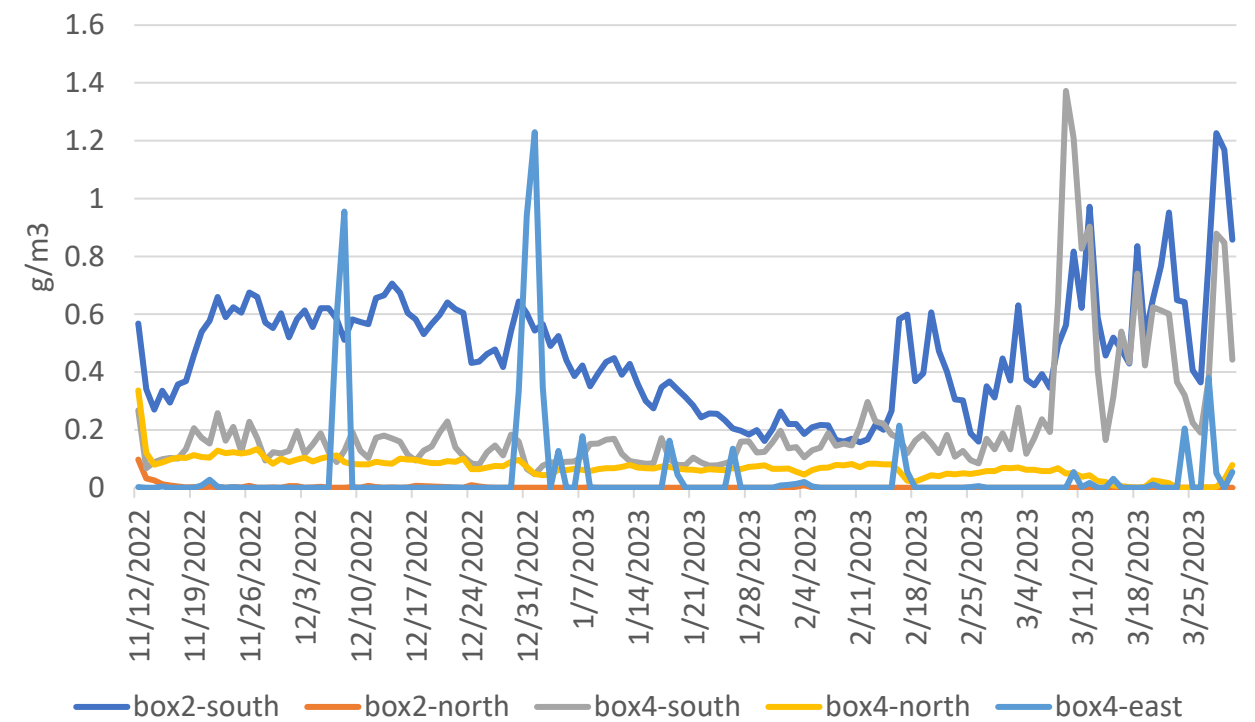
Relative Humidity



Vapor Density

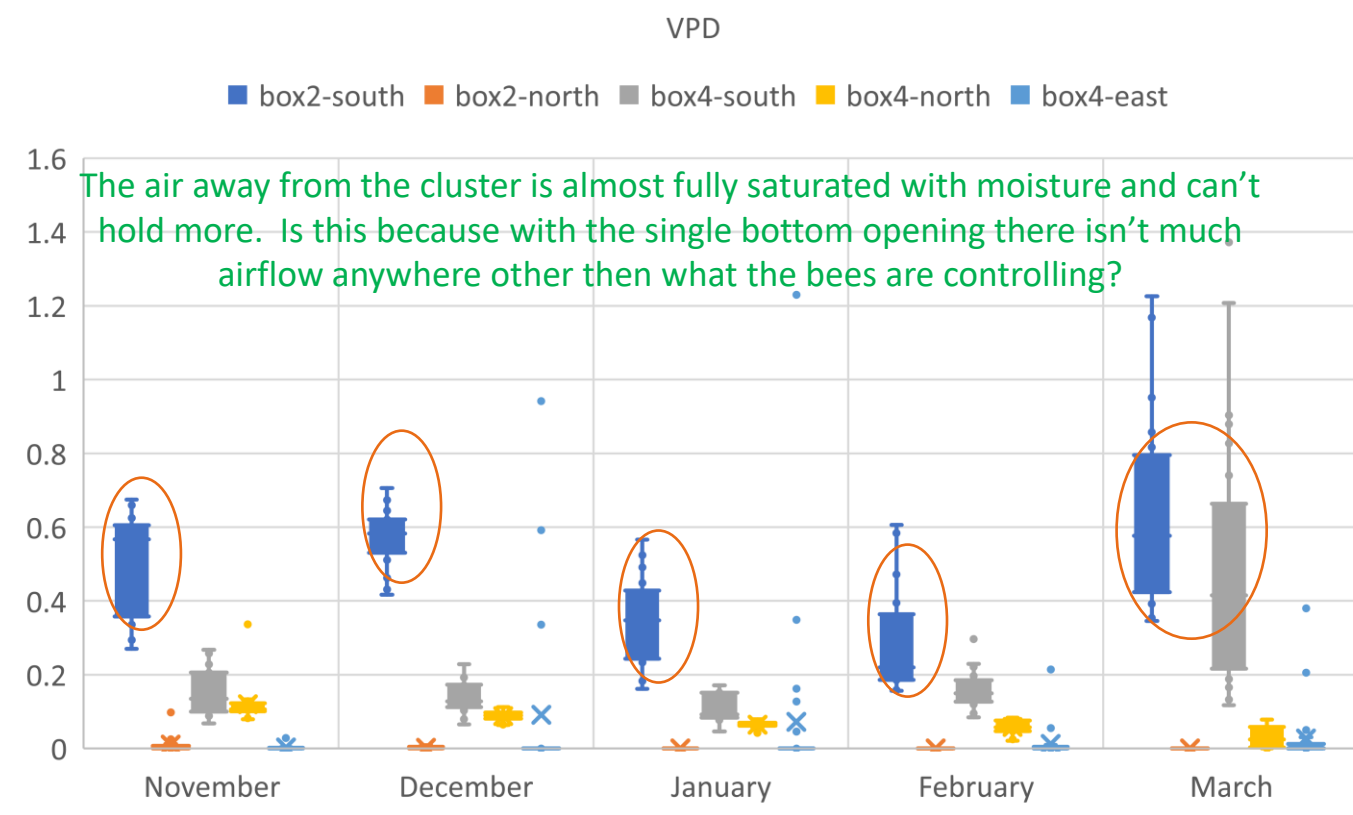
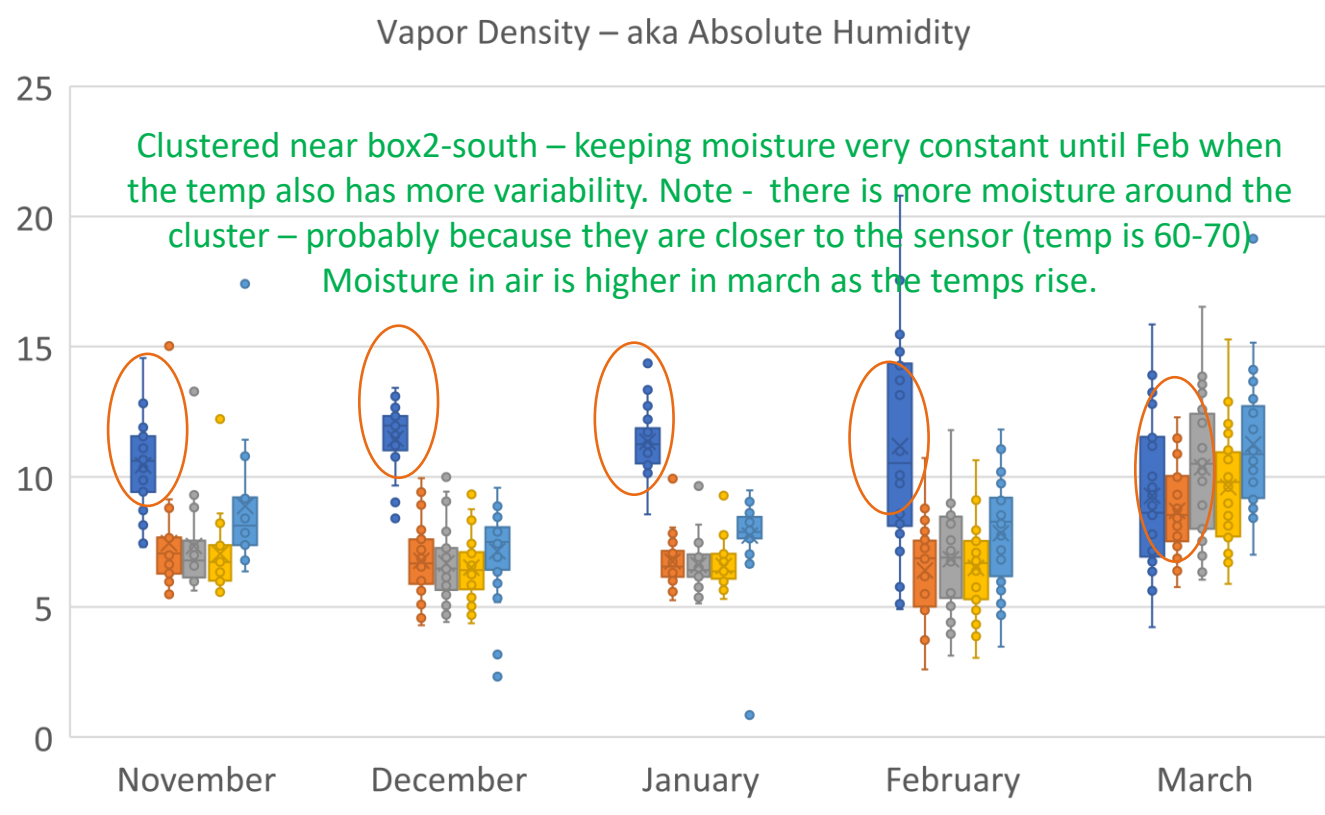
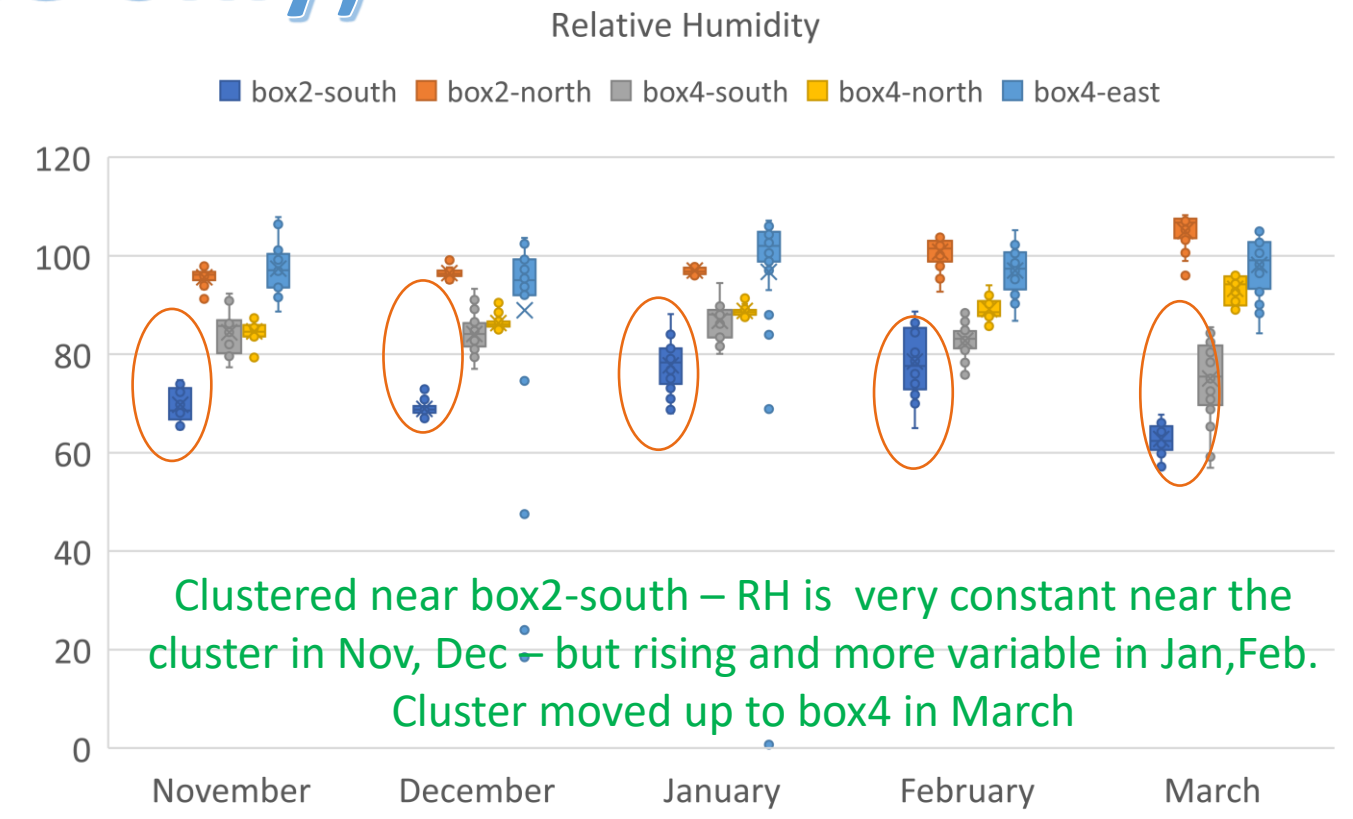
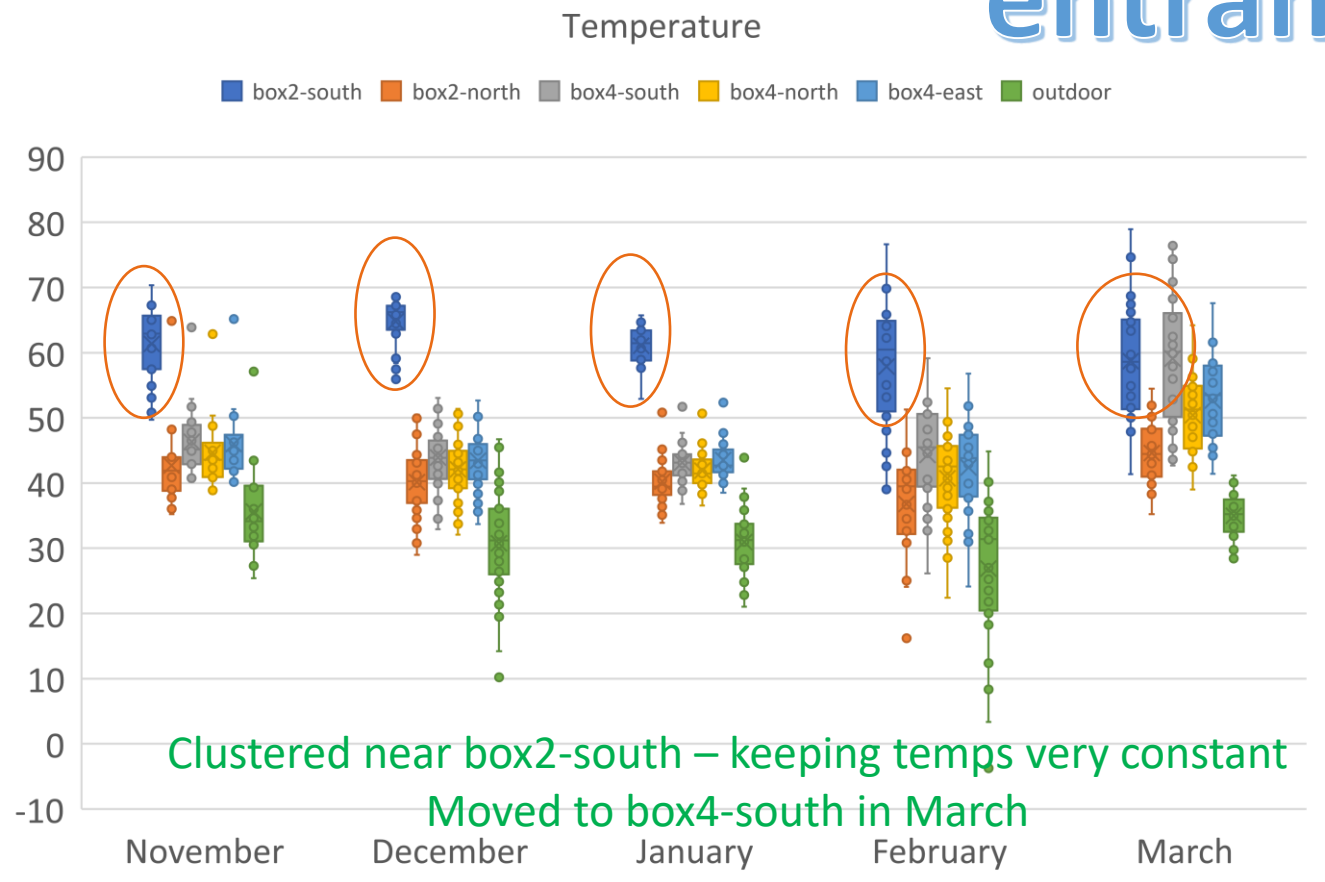


VPD



Mean Daily Values – Sask2 (No rack, bottom entrance only)

ORANGE CIRCLE indicates approximate cluster location



Bees stayed near box2-south until March when they moved up to box4-south.

PINK indicate approximate area of the cluster

Monthly Stats – Mean Values

NOT Slatted – Bottom entrance only (Sask2)

Sask2	Temp(F)					Vapor Density(g/m3)				
	Nov	Dec	Jan	Feb	Mar	Nov	Dec	Jan	Feb	Mar
box2-south	61.14	64.80	61.11	57.90	58.50	10.34	11.47	11.35	11.18	9.25
box2-north	42.13	40.10	40.28	36.85	44.62	7.25	6.75	6.76	6.41	8.70
box4-south	44.16	42.08	41.93	40.71	59.15	6.90	6.51	6.59	6.50	10.41
box4-north	45.83	43.90	43.13	44.30	50.27	7.17	6.67	6.62	6.84	9.57
box4-east	45.48	43.44	43.54	42.37	52.58	8.64	7.13	7.74	7.83	11.25
outdoor	35.03	30.74	31.13	26.90	35.09	4.12	3.78	3.91	3.02	3.78

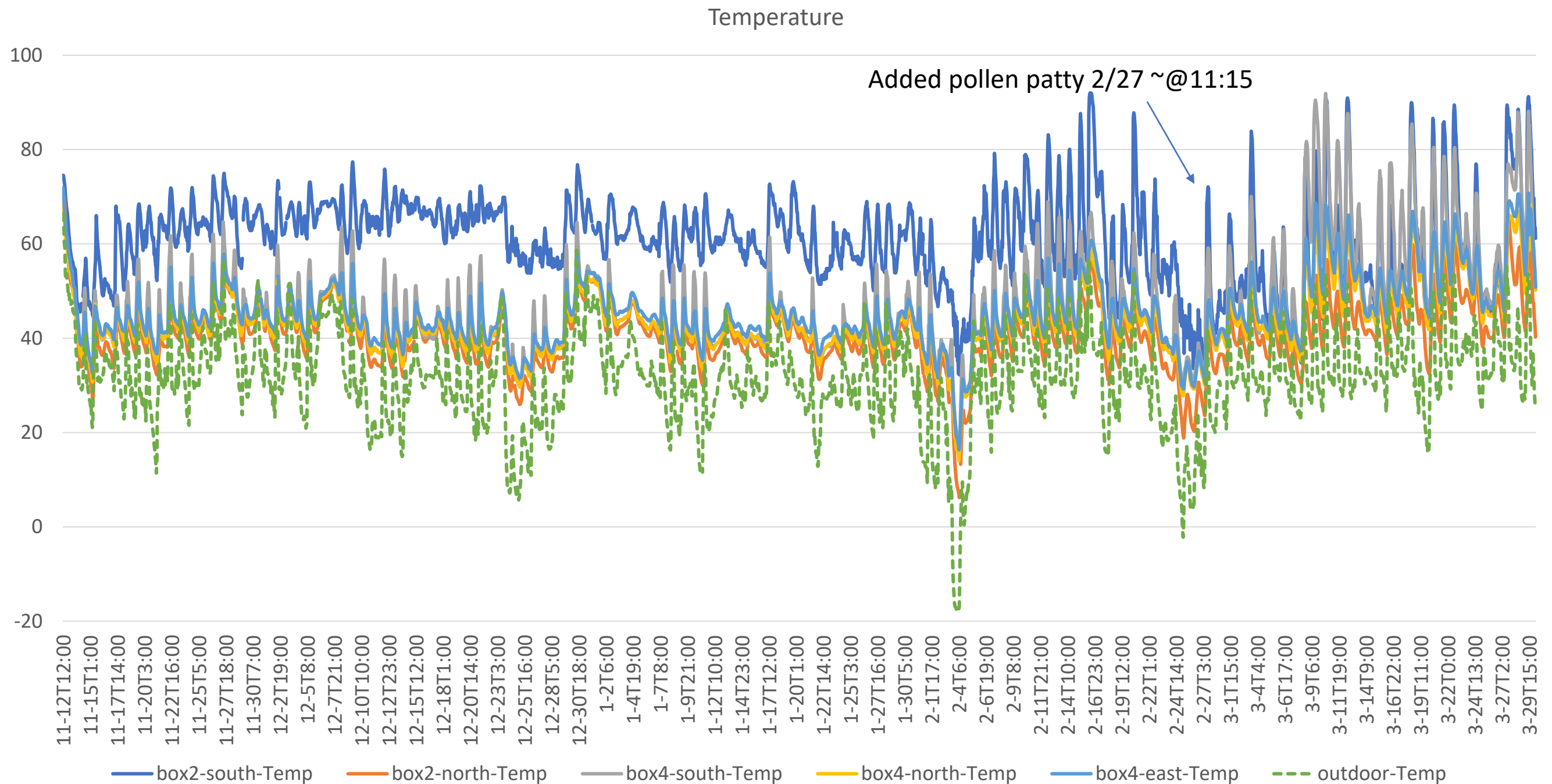
The box4-east sensor is really saturated in March (11.25)

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

- if the temps at the sensor are in the low 60s, vapor density is 9-11
- temps in the 50s , vapor density is 7-8
- temps in the 40s,vapor density is 6-7
- temps in the 30s,vapor density = 5-6 (but outdoor vapor density is in the 4 rang)

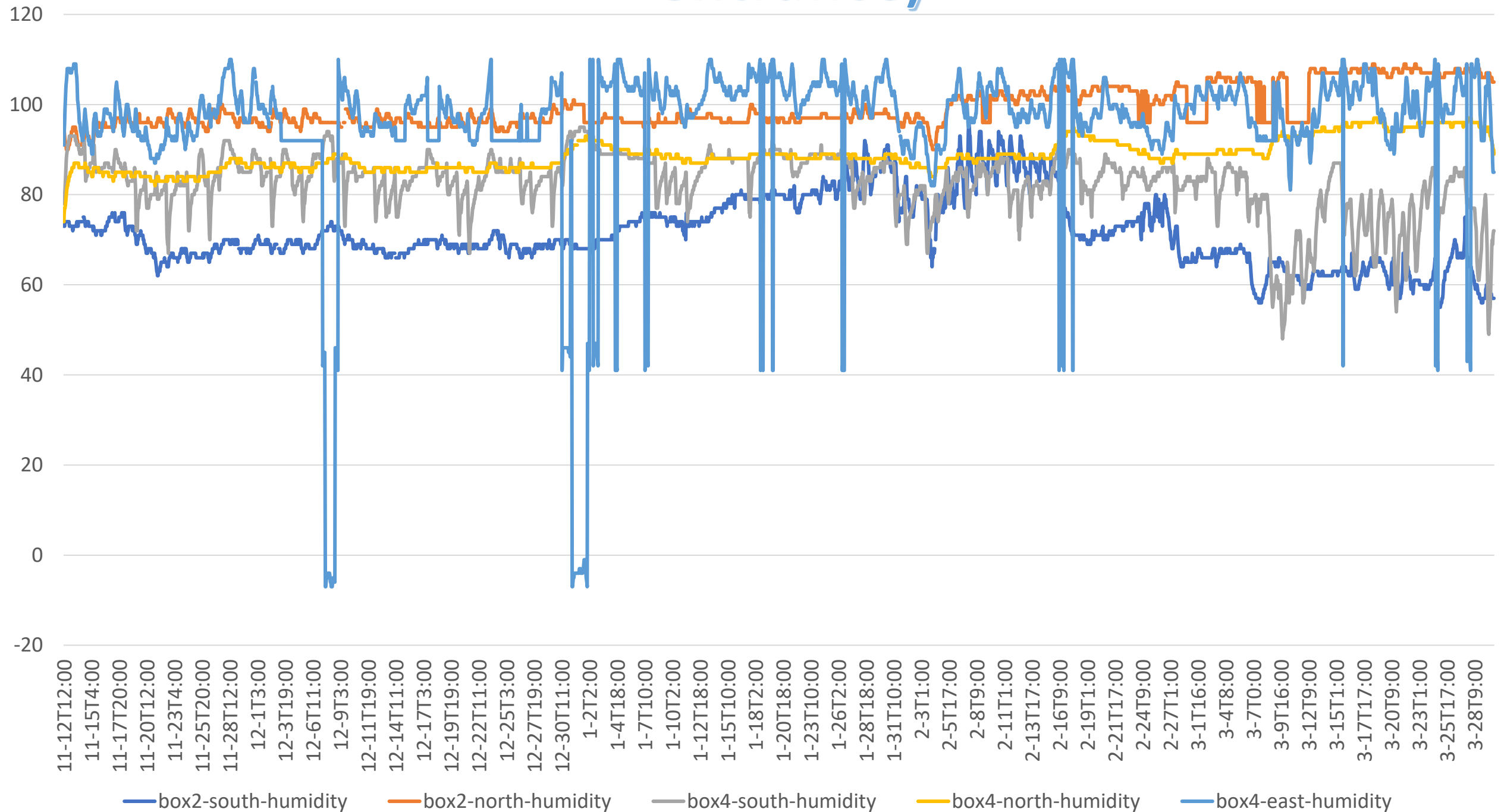
All data points

Temperature Sask2 (bottom entrance)



- Bees have been clustered around box2-south sensor for most of the winter. In Feb they started becoming more active and have ventured toward the box4-south sensor in late February. By March they were covering the top of box 4
- Note the temp in box2-north on 2/3 when we had the -18 temps.. The cluster must have tightened up as and moved more toward the middle of box2 – since we only had a temp of 40F at the box2-south sensor.

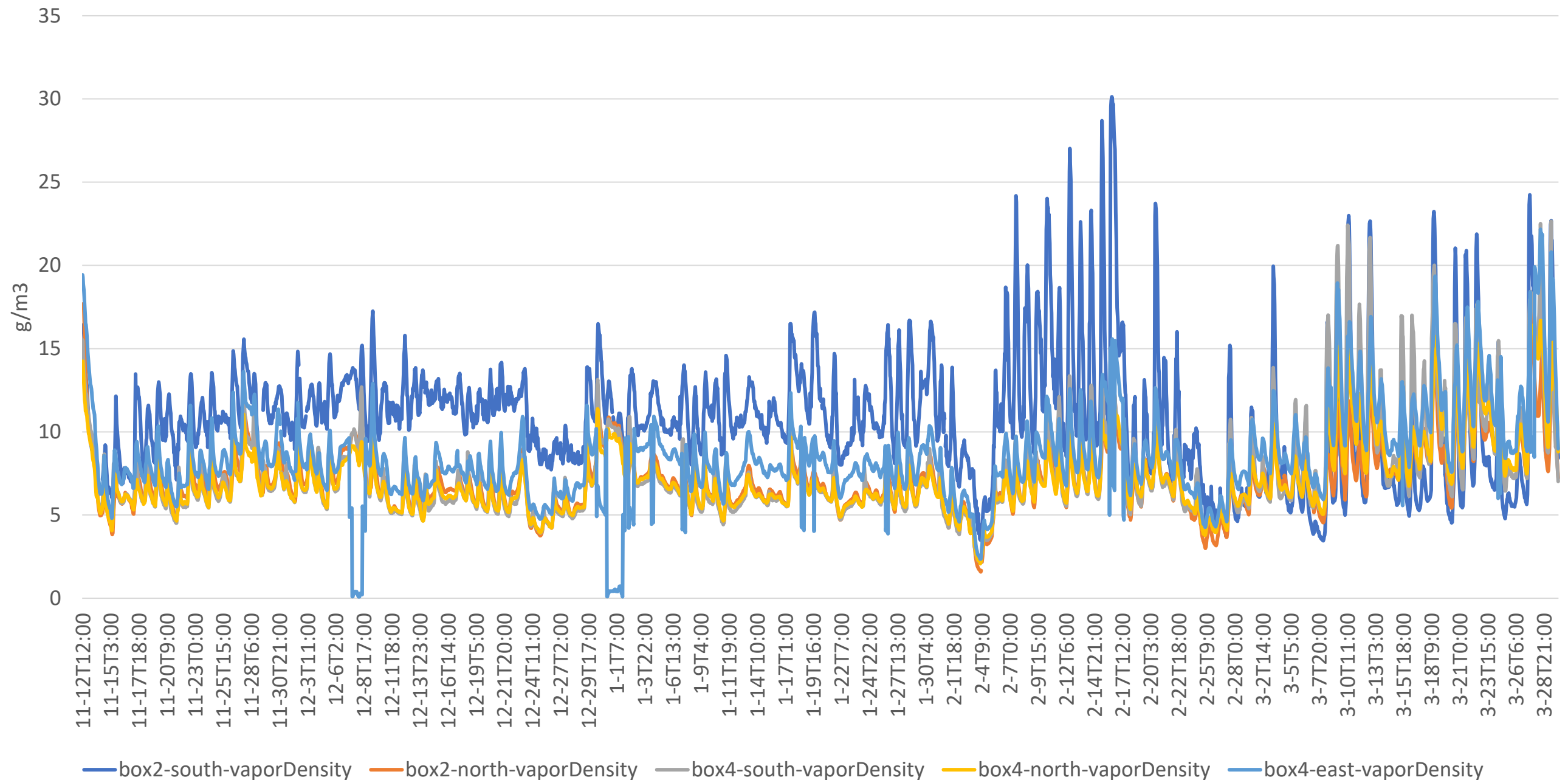
Relative Humidity Sask2 (No slatted rack, bottom entrance)



*Bees are clustered near box2-south Sensor until mid-feb when they started moving to box 4
 Are the drops in the RH at the box2-south sensor due to sensor failure or bee activity ?
 I don't trust a sensor that says there is 0/negative RH

Vapor Density – Sask2 (No slatted rack, bottom entrance)

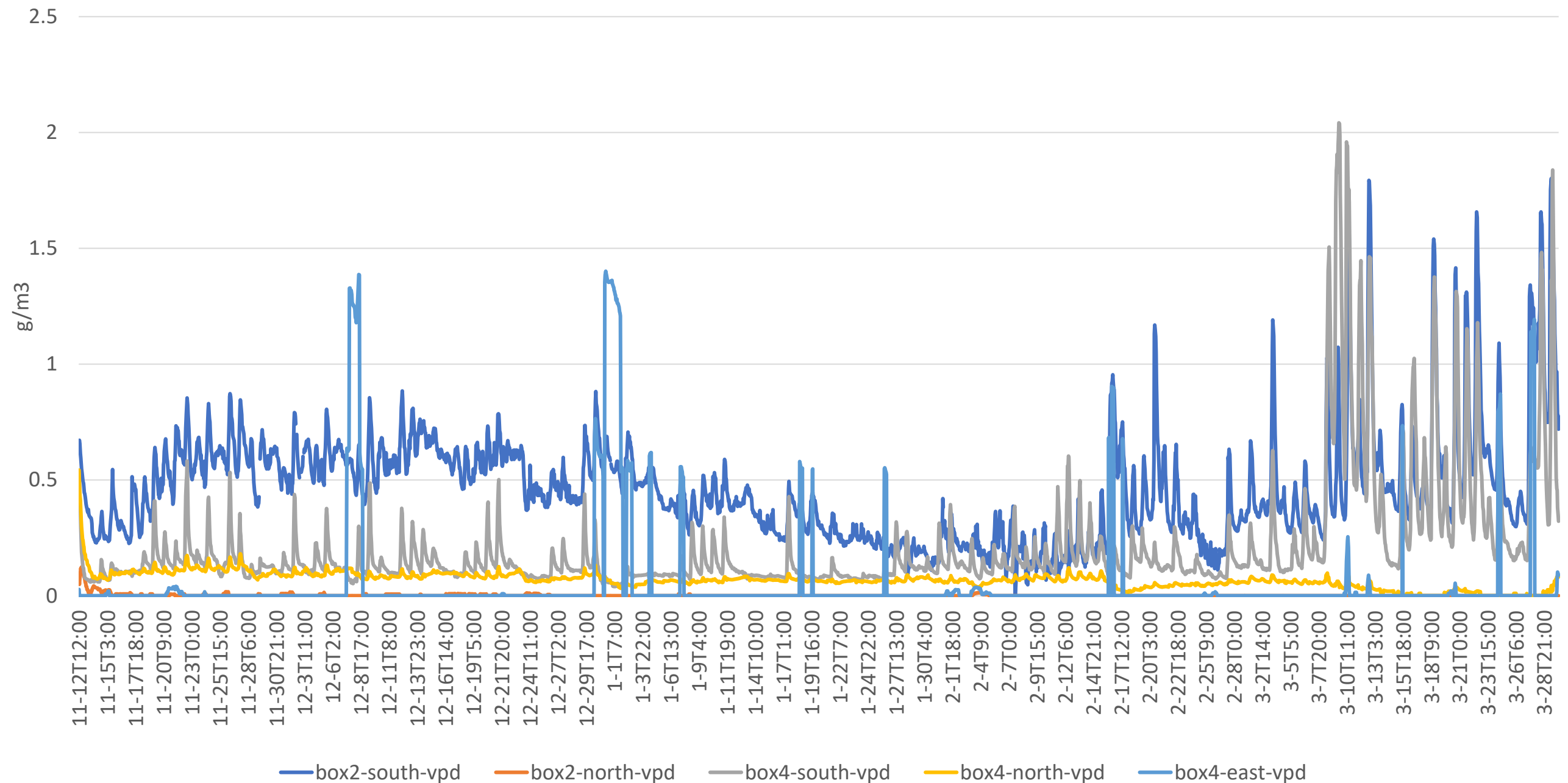
Vapor Density aka absolute humidity



- Vapor Density Seems to vary quite around the cluster which is surprising – is this due to temps changing during the day?

VPD– Sask2 (No slatted rack, bottom entrance)

Vapor Density aka absolute humidity

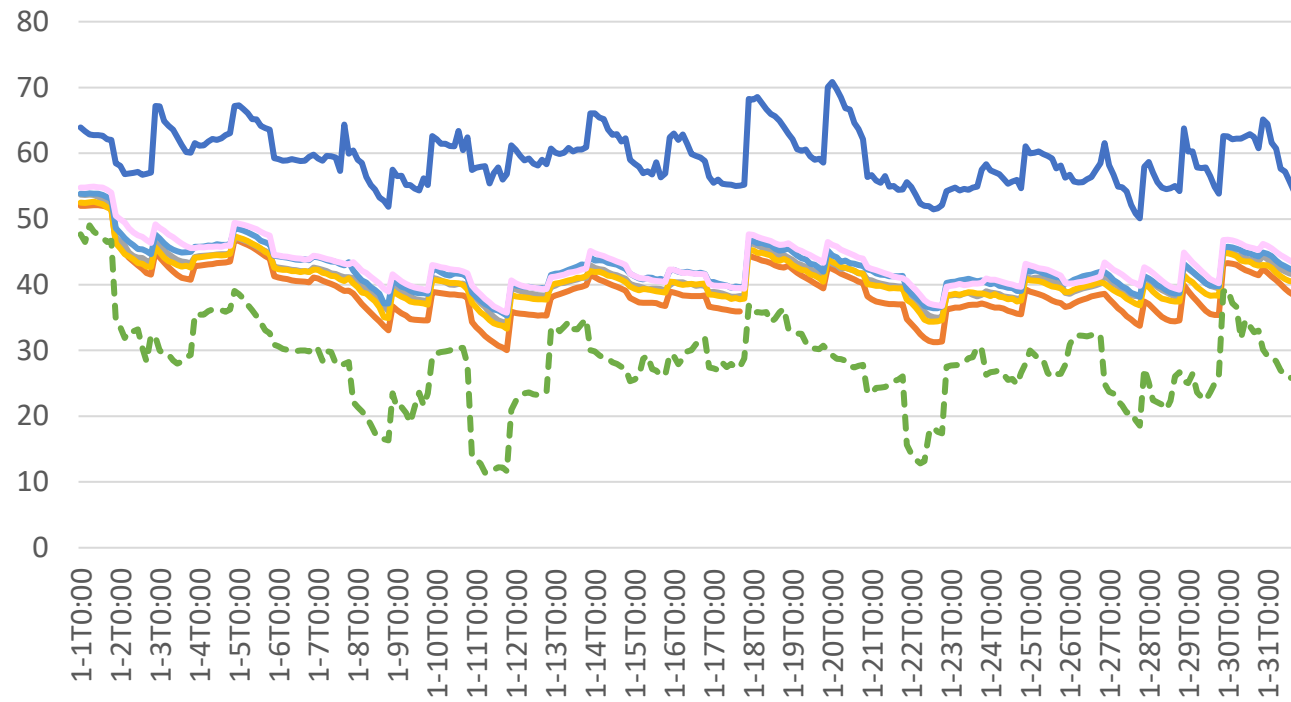


- The box2-north sensor is fully saturated.
- If you believe the box4-east sensor that area is also fully saturated most of the time.
- The cluster is controlling the moisture in the air near the box2-south sensor and the box4-south sensor
- There is no top entrance so I think the air must be flowing in the base up the front across the cluster to the top and then flow to the back and back out the lower entrance.

Day vs Night Data By Month

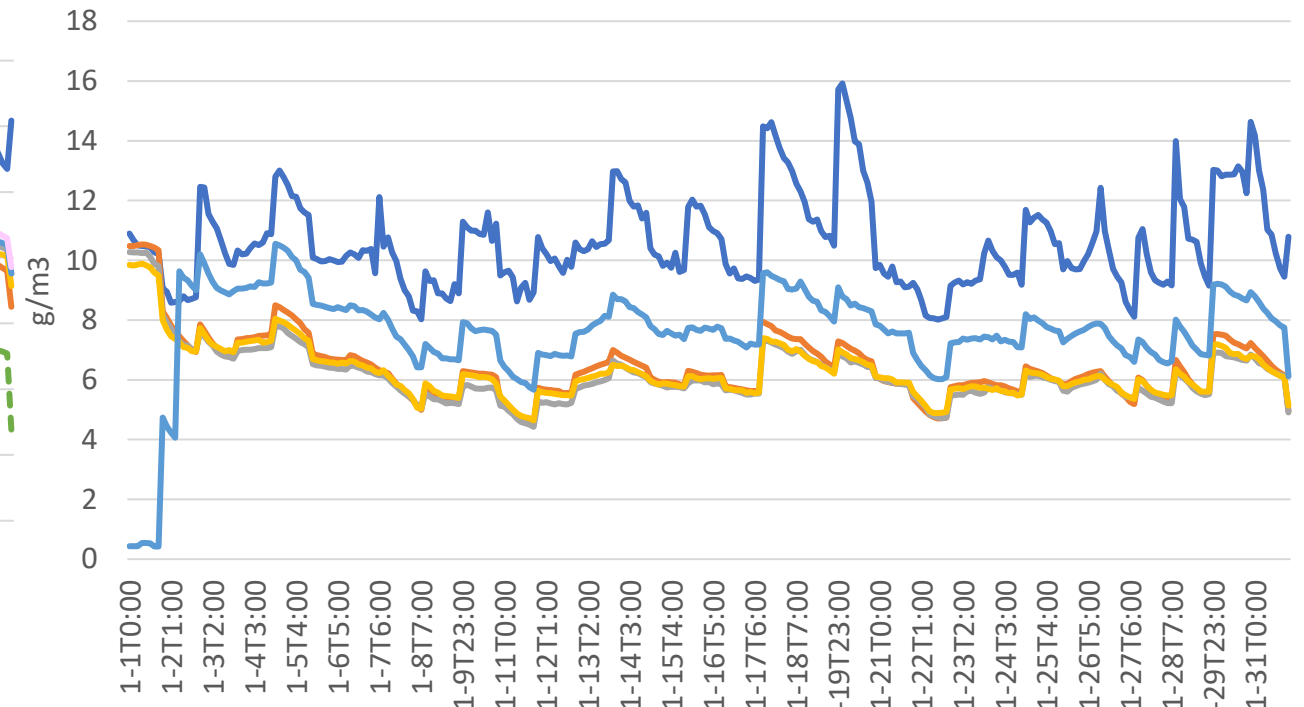
January –Night – Sask2 (NO slatted rack, no top entrance)

Temp



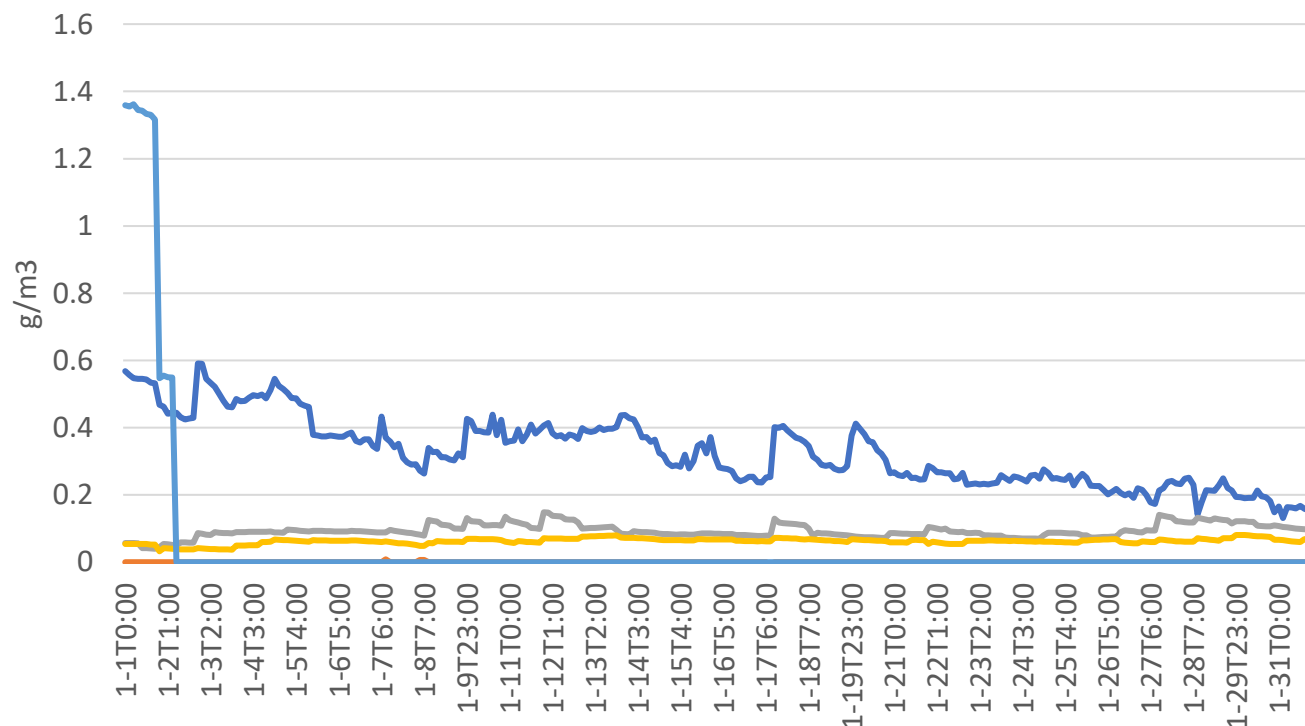
— box2-south-Temp — box2-north-Temp — box4-south-Temp
— box4-north-Temp — box4-east-Temp — box4-west-Temp
- - - outdoor-Temp

Vapor Density



— box2-south-vaporDensity — box2-north-vaporDensity — box4-south-vaporDensity
— box4-north-vaporDensity — box4-east-vaporDensity

VPD

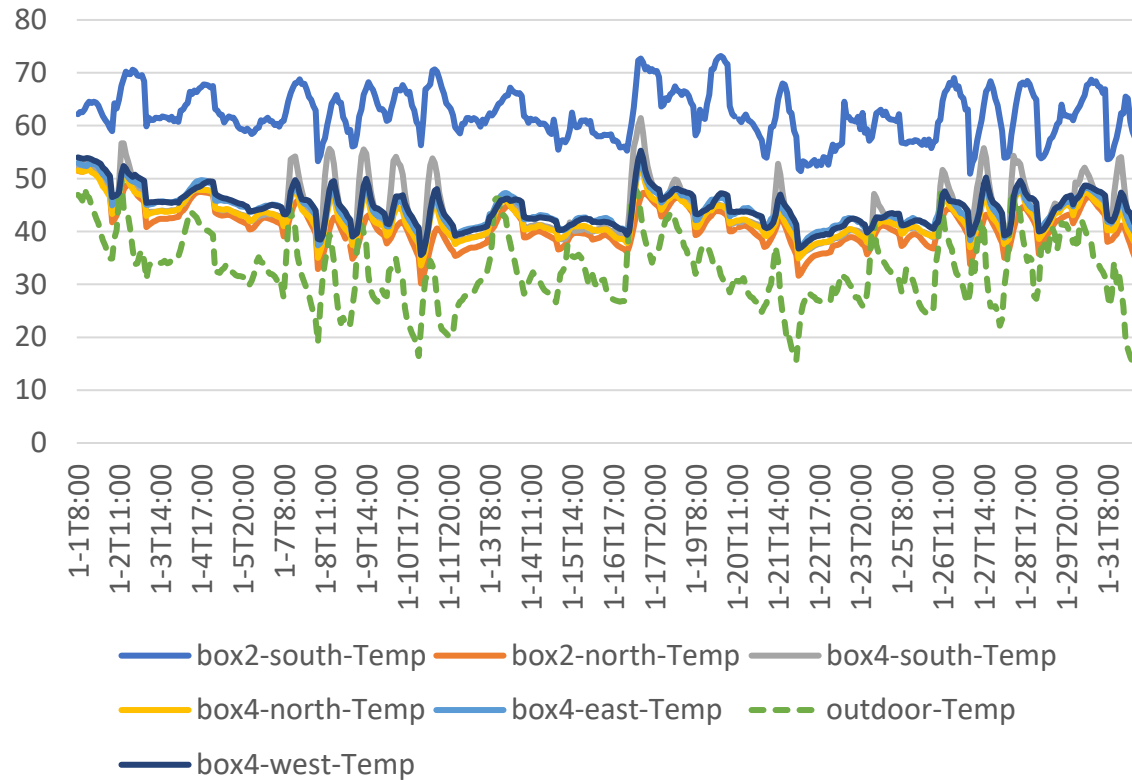


— box2-south-vpd — box2-north-vpd — box4-south-vpd
— box4-north-vpd — box4-east-vpd

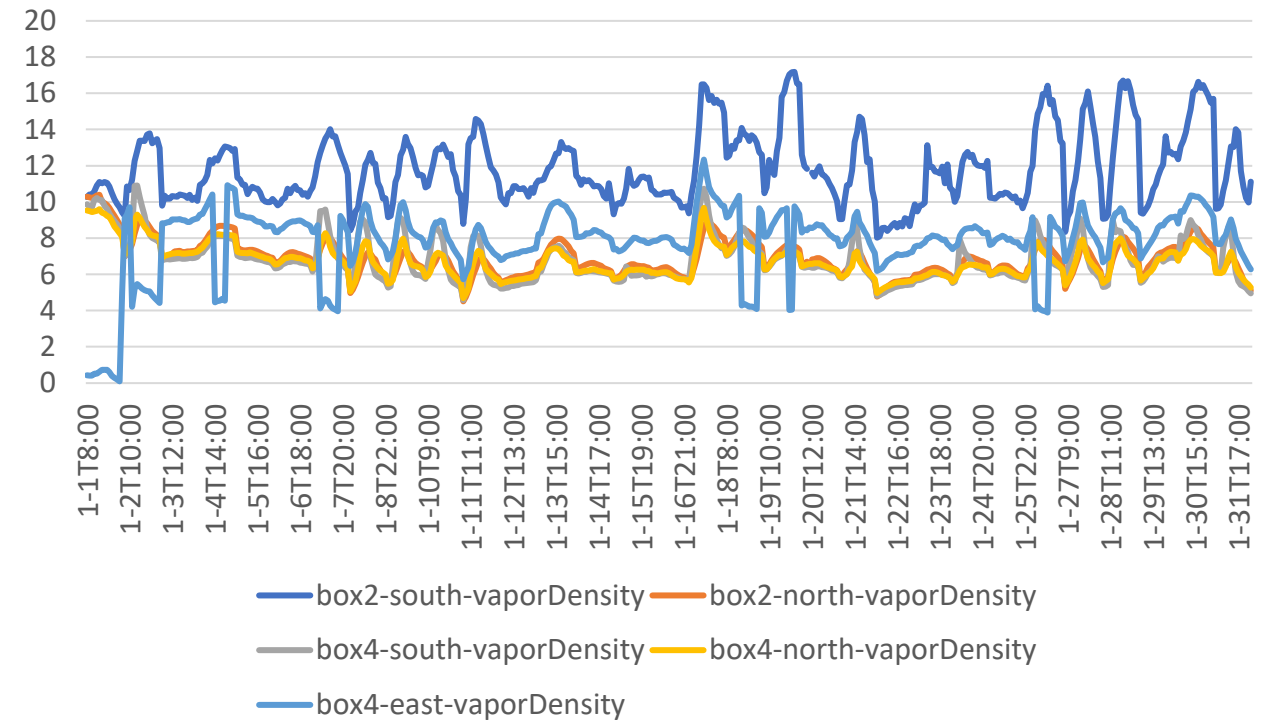
- Bees are near the box2-south sensor.
- The temp stays between around 60
- Not sure if we can trust the box4-east humidity – but if we can, vapor density looks higher than the other sensors at the same temp
- Looking at VPD – notice that the box2-north is 0 – which means 100% saturation.
- Also, box4-east is 0 – assuming we can trust that sensor, the air is 100% saturated.
- Toward the end of January, even the box2-south sensor is showing that not much more moisture can be held in the air.

January –Day – Sask2 (NO slatted rack, no top entrance)

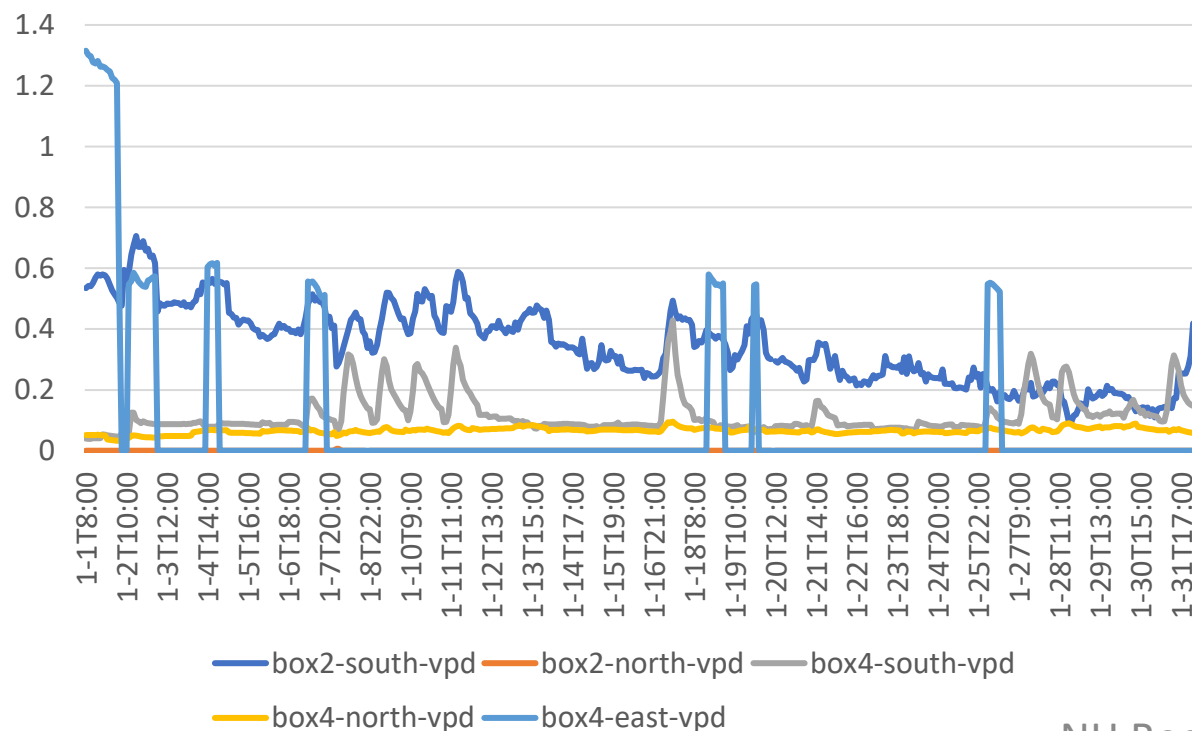
Day (8am-10pm) - Temp



Day (8am-10pm) - Vapor Density



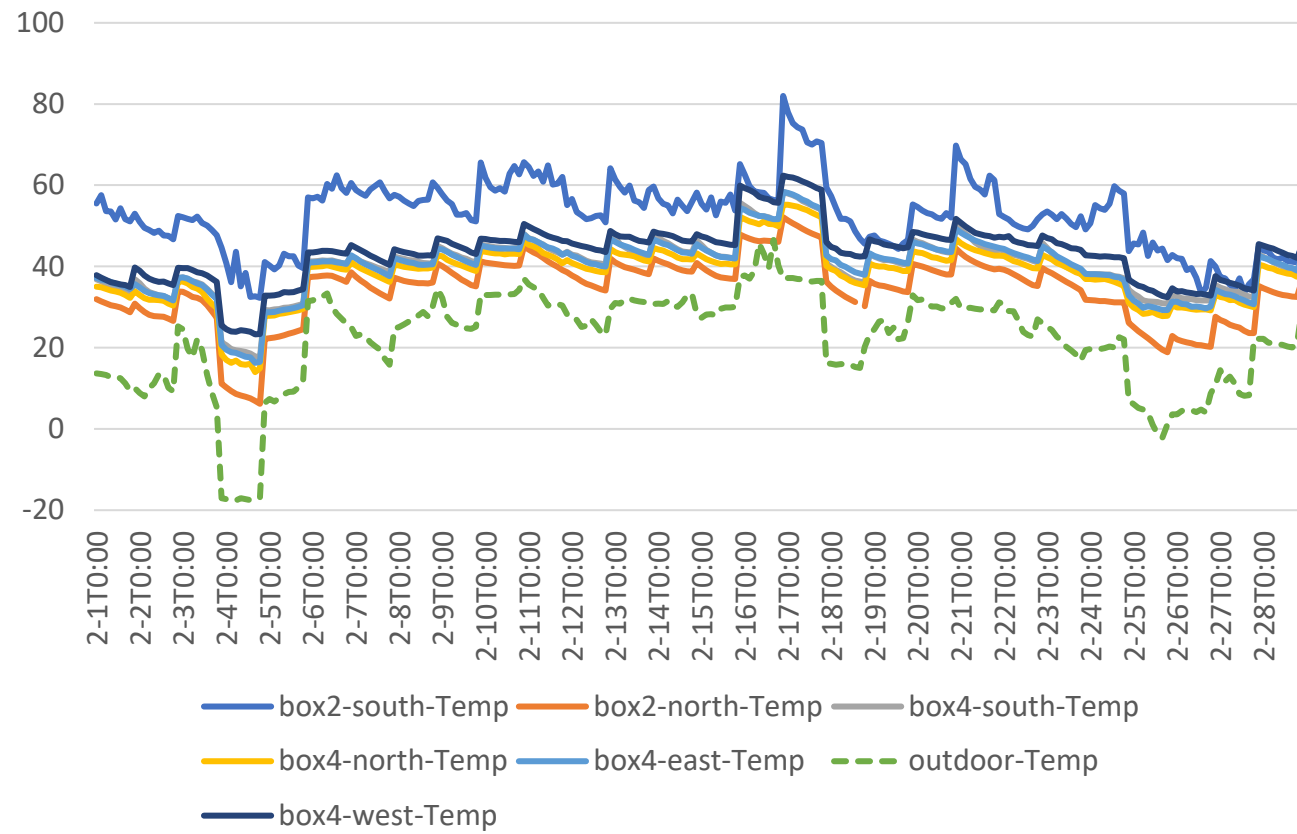
Day (8am-10pm) - VPD



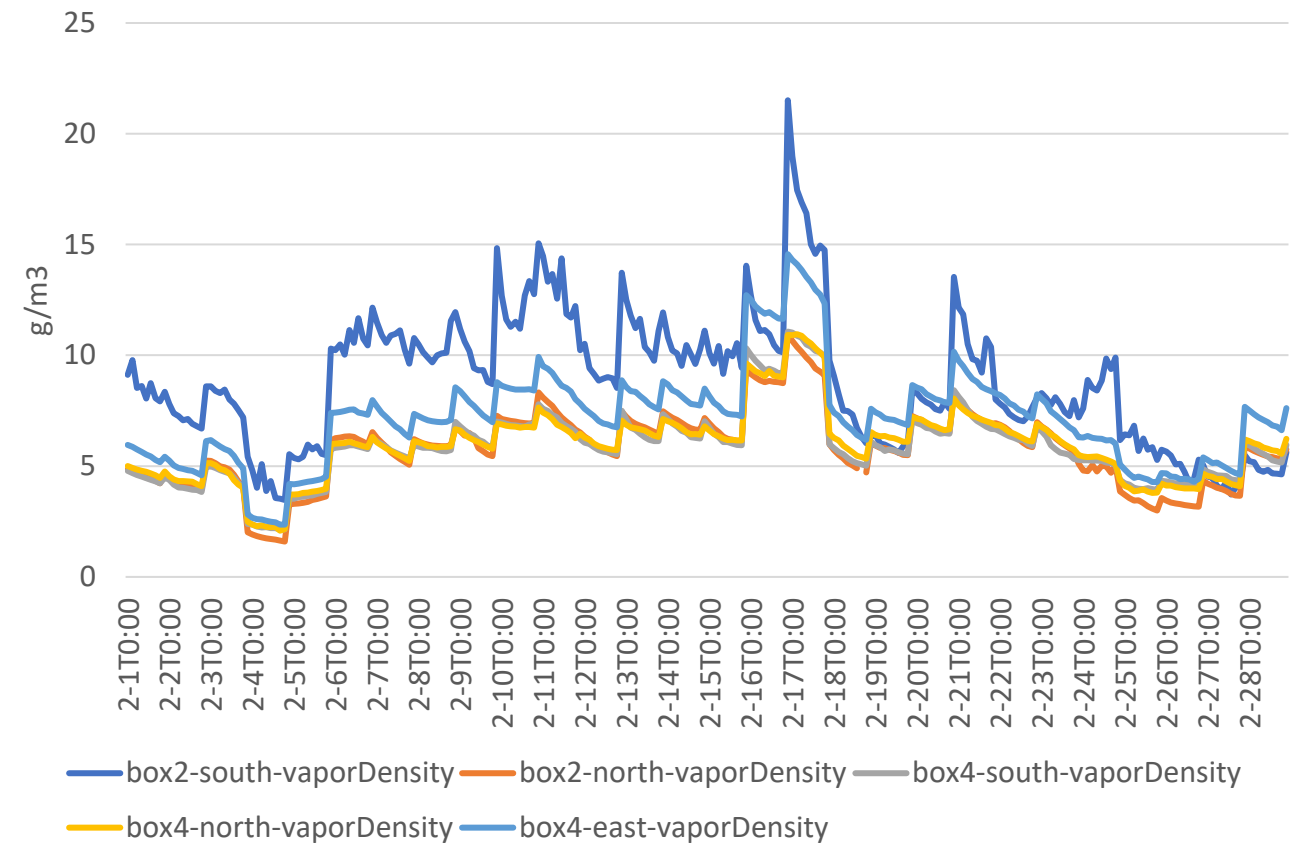
- Bees are near the box2-south sensor.
- Not sure I trust the humidity readings of box4-east
 - Box2-north air is completely saturated
- The air near box4-north and box4-south sensors isn't fully saturated but very moist – VPD = 0.1.
- The area around box2-south is getting more saturated as the month goes on.

Feb –Night – Sask2 (NO slatted rack, no top entrance)

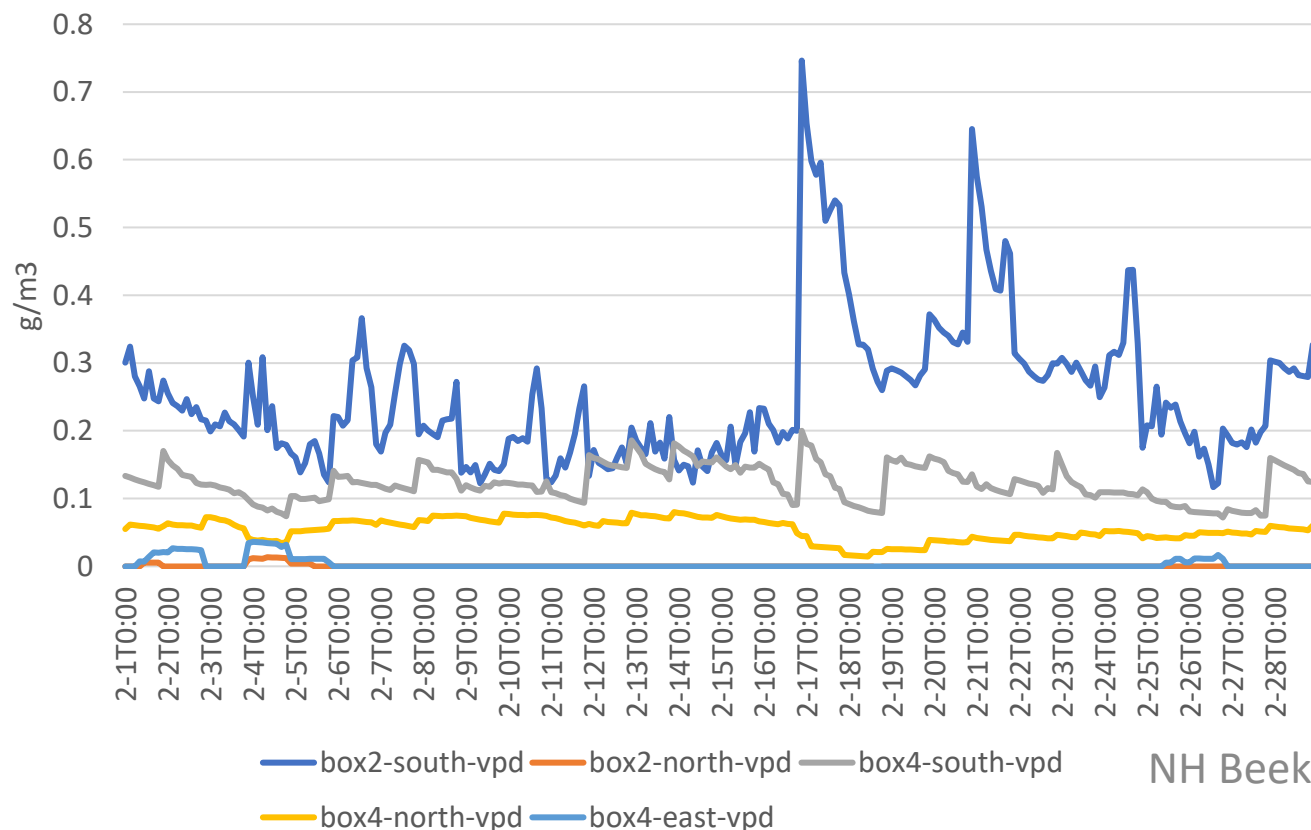
Temp



Vapor Density



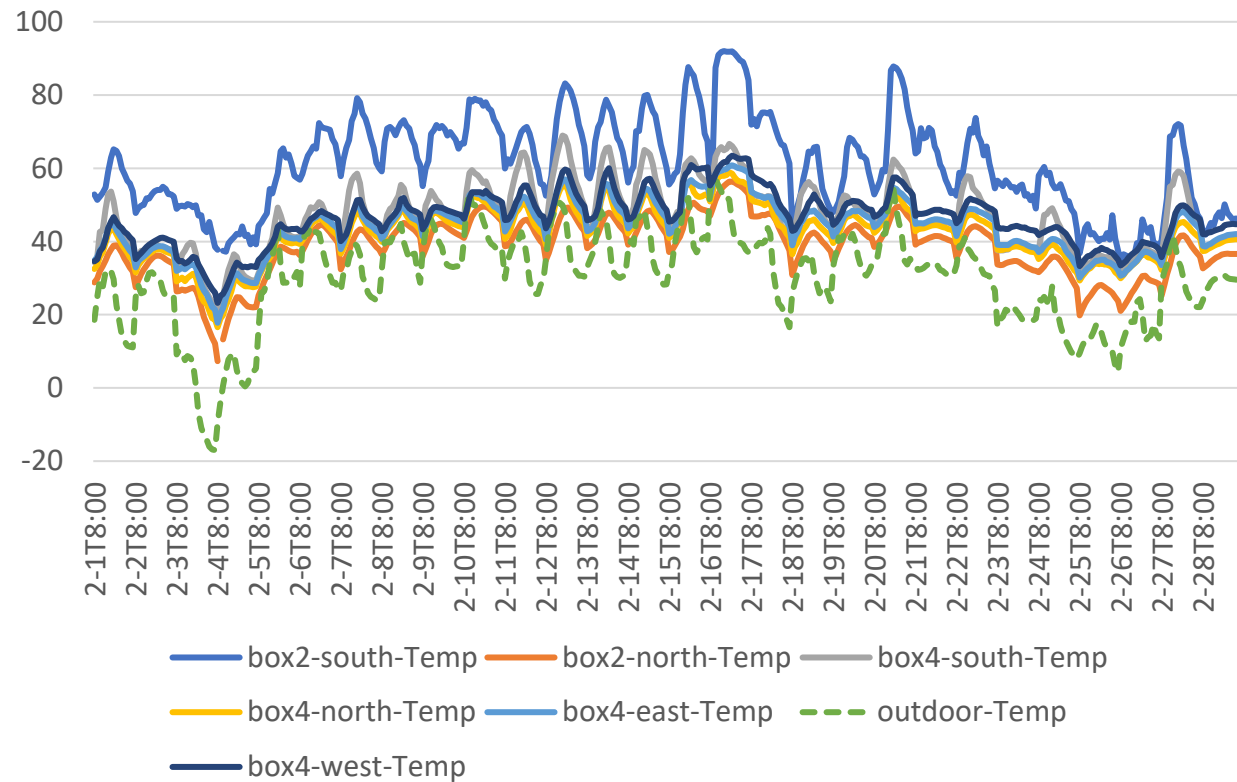
VPD



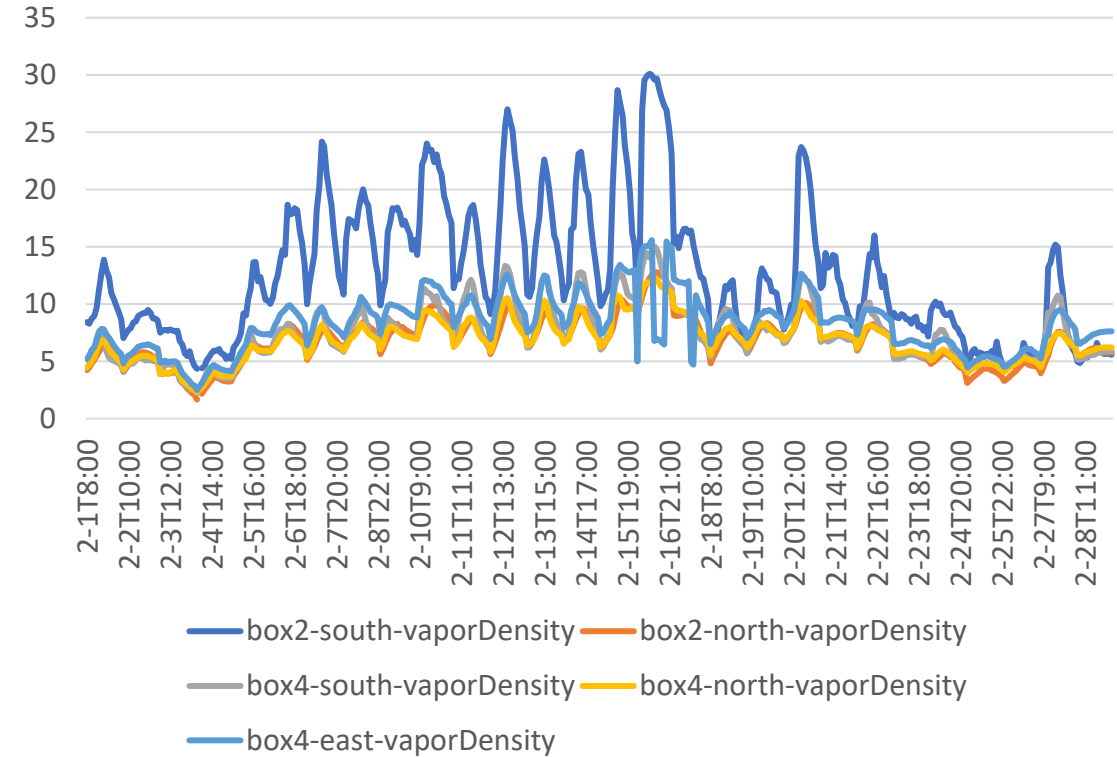
- Bees are near the box2-south sensor
- The sensors at box2-north and box4-east are still showing that those areas are fully saturated.
 - Box2-north is the coldest temps (orange)
- Box4-east is slightly warmer than box4 north – but again, I'm not sure I fully trust the humidity sensor on box 4-east

Feb -Day - Sask2 (NO slatted rack, no top entrance)

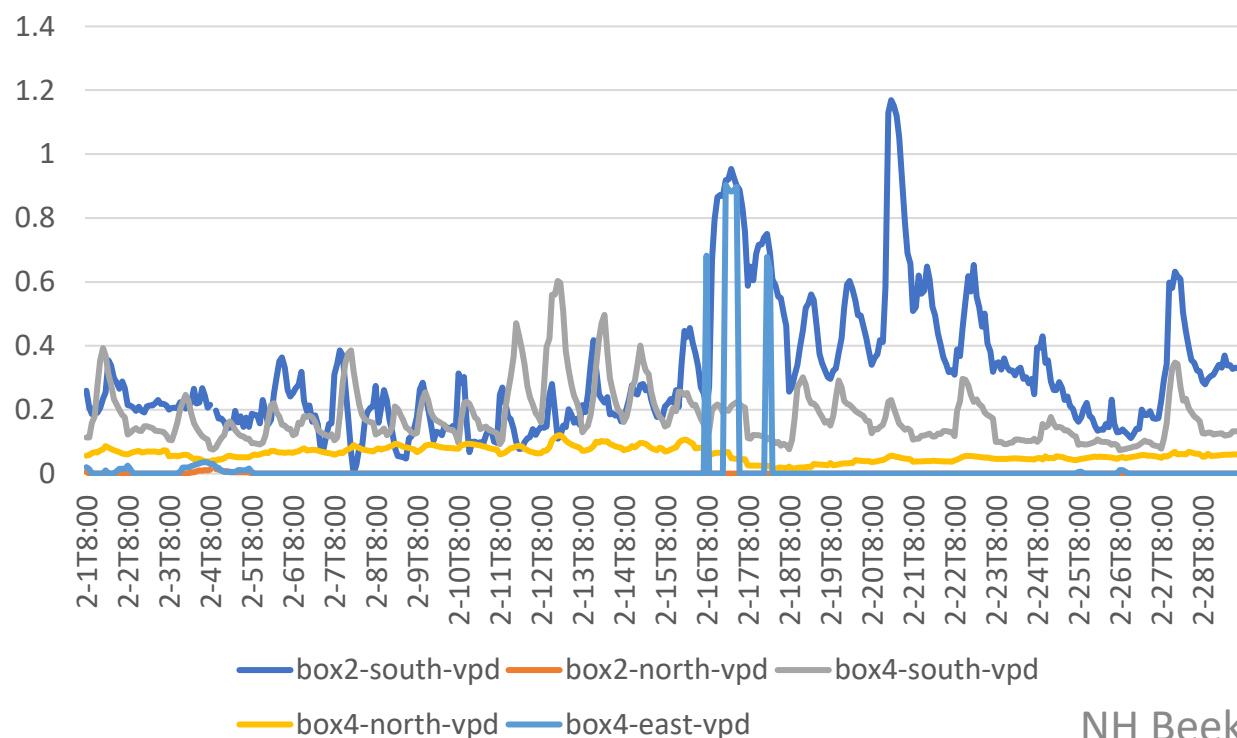
Day (8am-10pm) - Temp



Day (8am-10pm) - Vapor Density



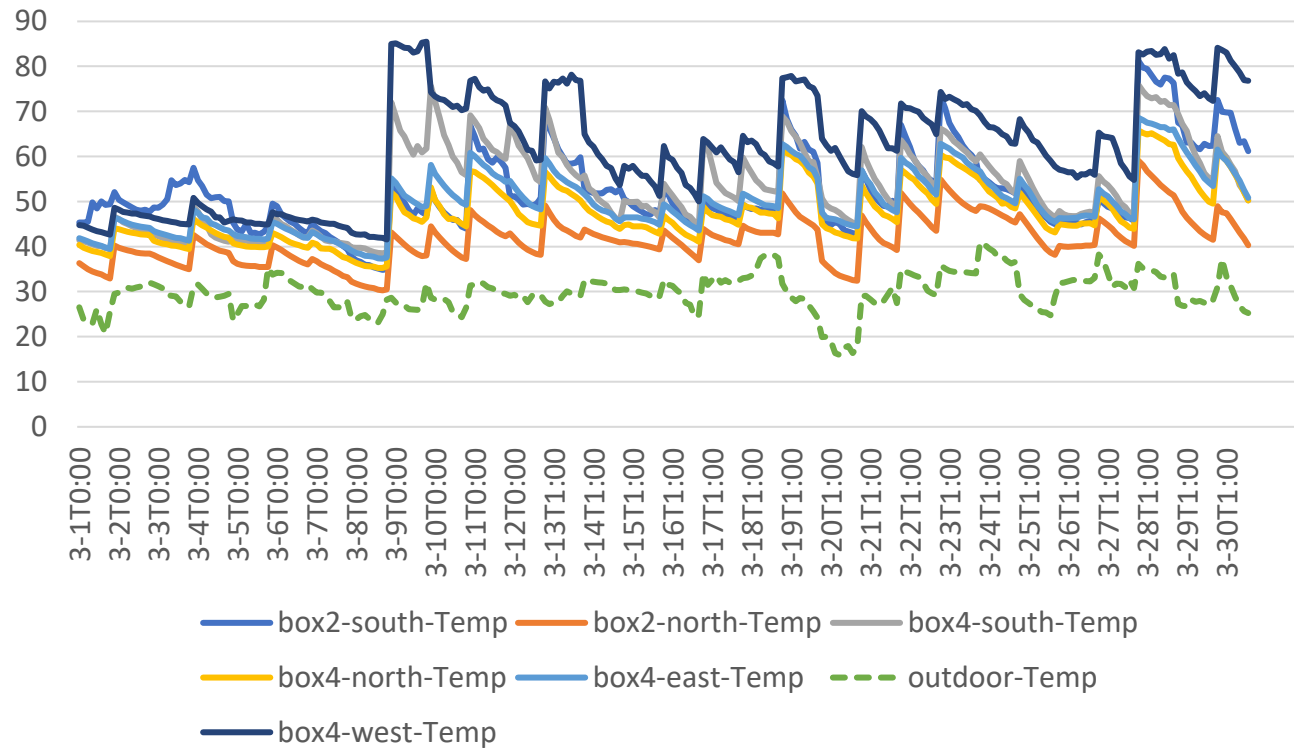
Day (8am-10pm) - VPD



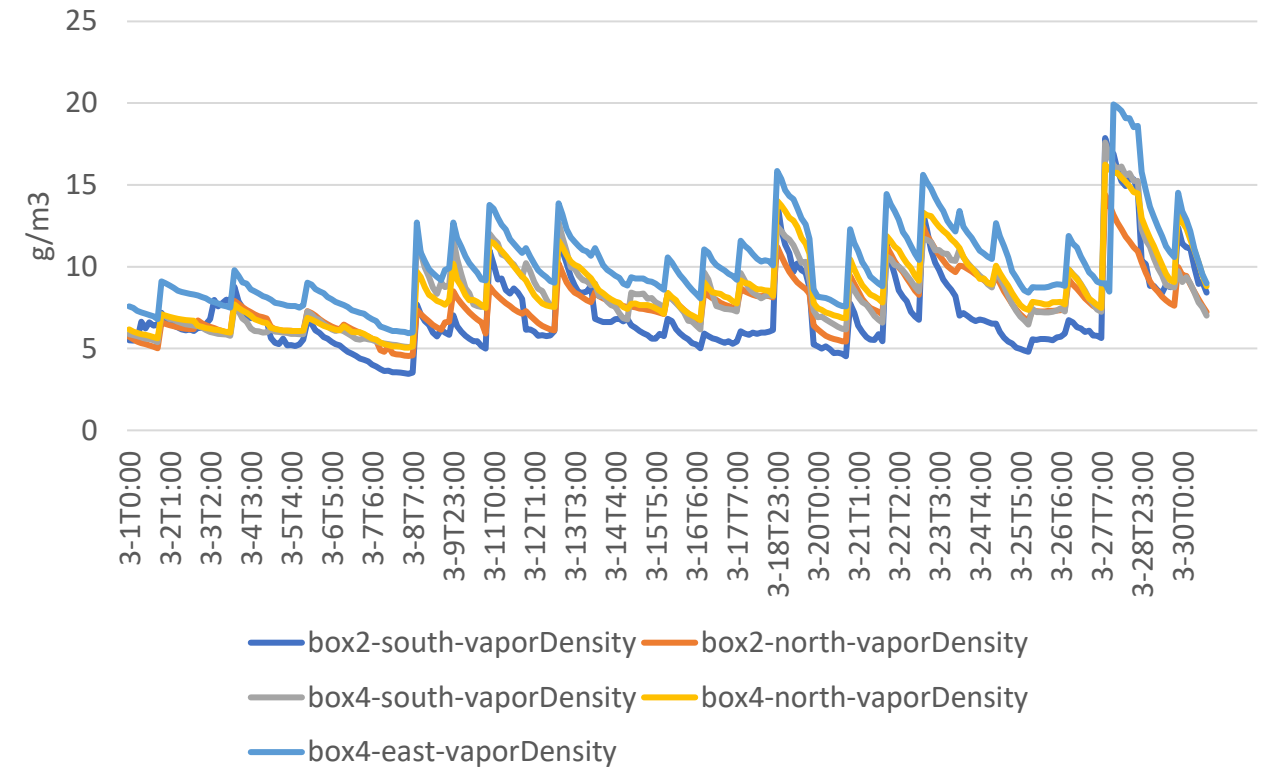
- Bees are near the box2-south sensor
- Air near the box2 north sensor is completely saturated during the day.. Comments about the other sensor apply here too.

Mar –Night – Sask2 (NO slatted rack, no top entrance)

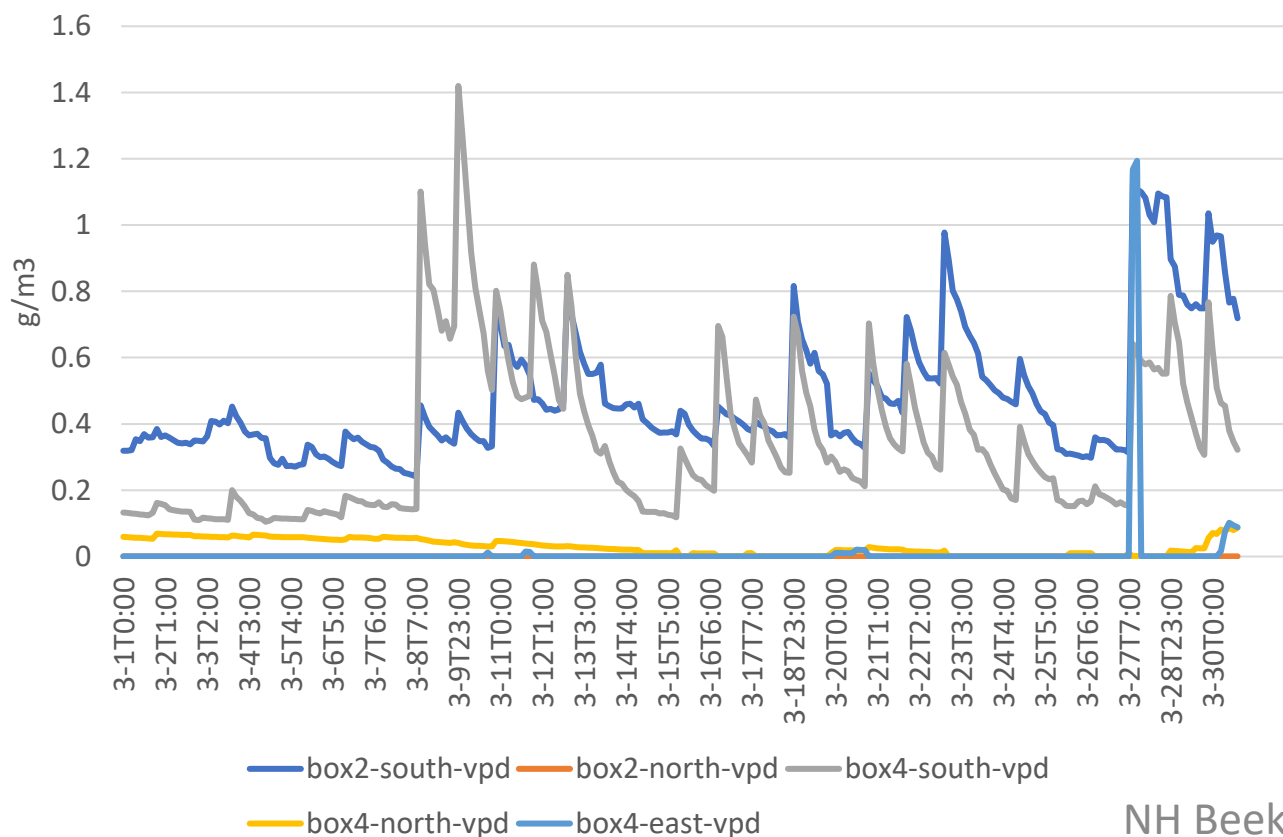
Temp



Vapor Density



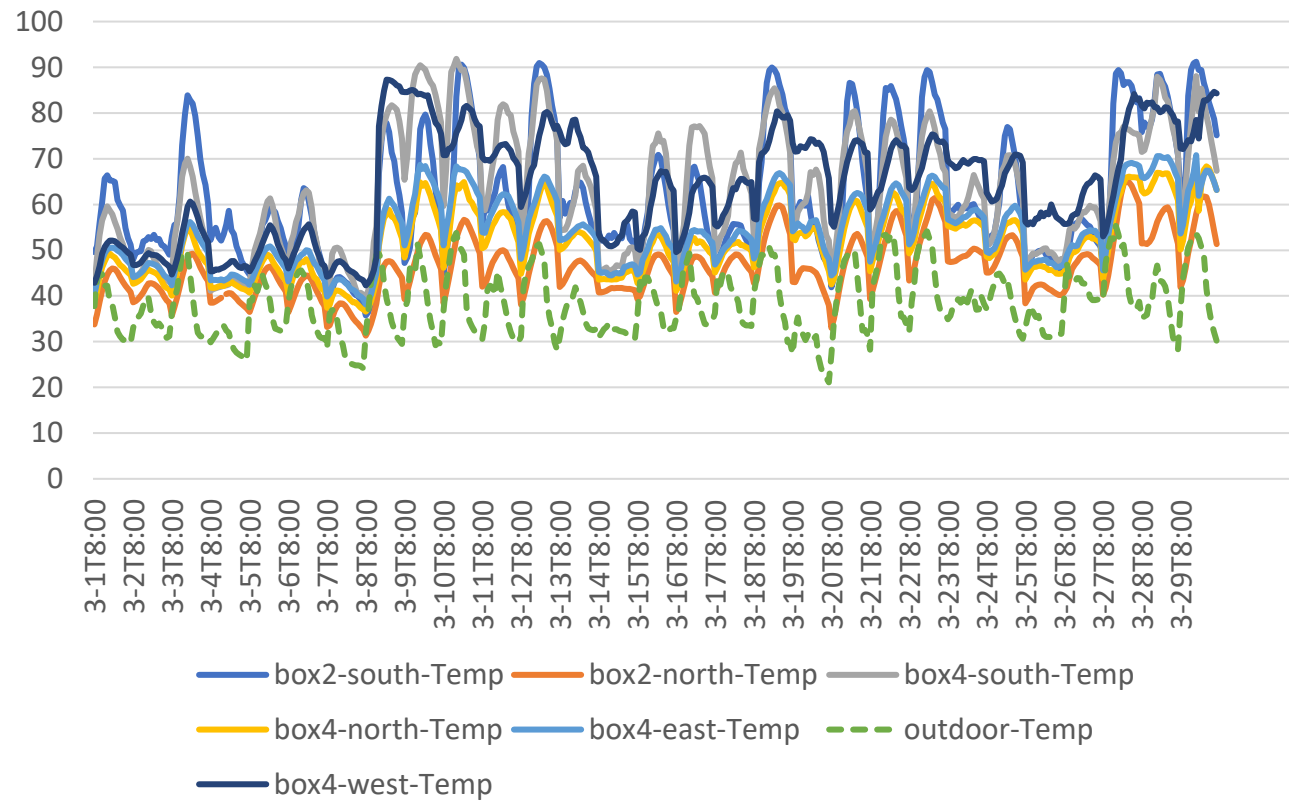
VPD



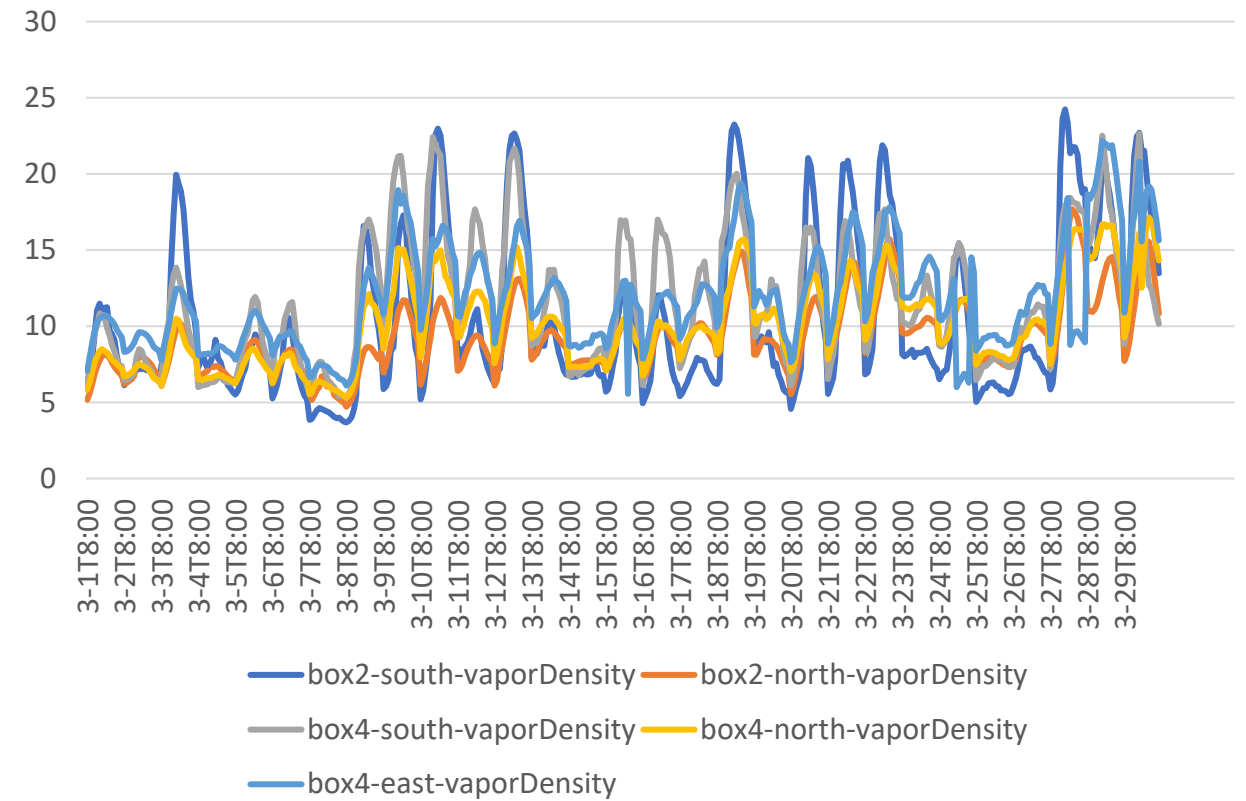
- Bees are moved up to box 4 on 3/9 – cluster is nearest to the west sensor, but there's lots of bees all over box4
 - Box4-west is a temp only sensor.
- The sensors at box2-north and box4-east are still showing that those areas are fully saturated. Box4-north is close to fully saturated.
 - Box2-north is the coldest temps (orange)
- Box4-east is slightly warmer than box4 north – but again, I'm not sure I fully trust the humidity sensor on box 4-east

Mar -Day - Sask2 (NO slatted rack, no top entrance)

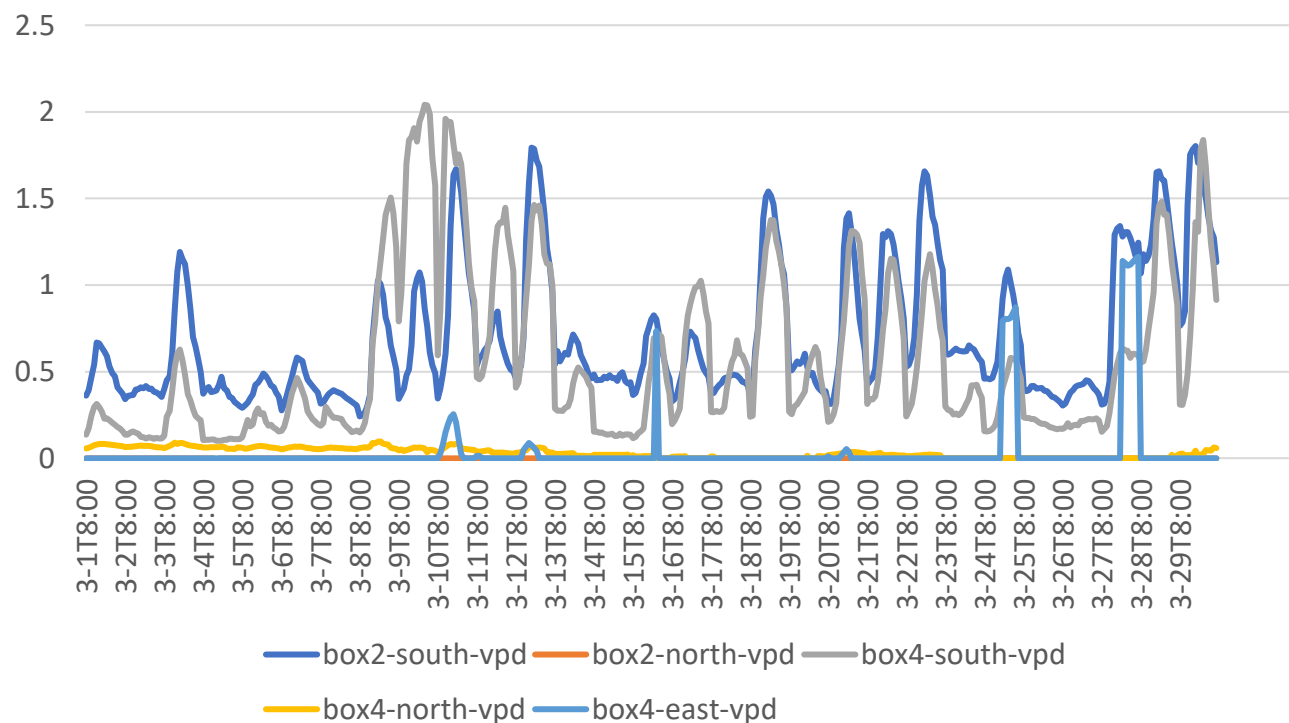
Day (8am-10pm) - Temp



Day (8am-10pm) - Vapor Density



Day (8am-10pm) - VPD



- Bees moved to box4 around March 8-9
- Air near the box2 north sensor is completely saturated curing the day.. Comments about the other sensor apply here too.