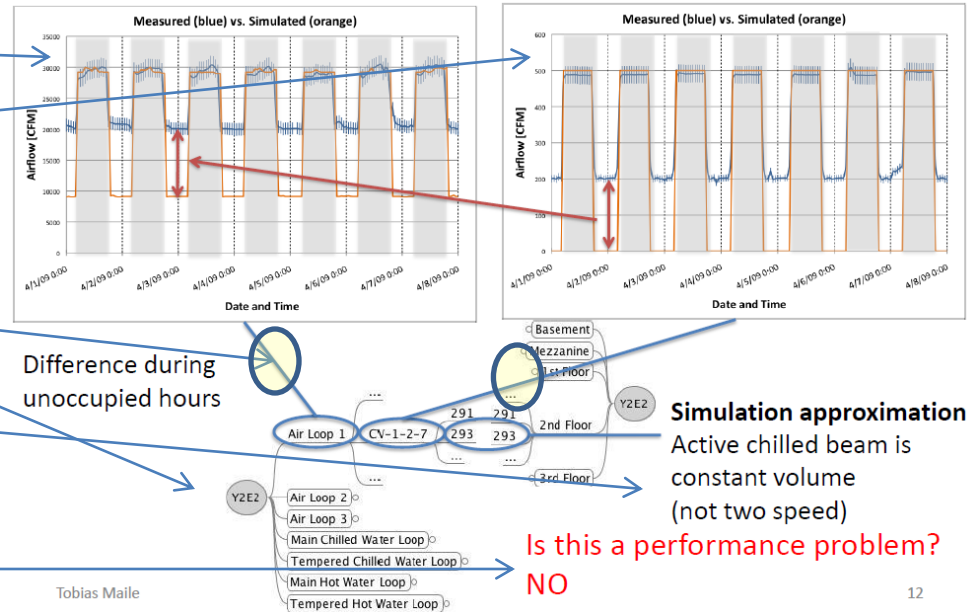


# Example graphs

## Features:

- System data
- Component data
- Hierarchies
- Hierarchy – data links
- Comment (about function)
- Status

## Example comparison continued



Features; Implication(s)?

# Example graphs

## Missing

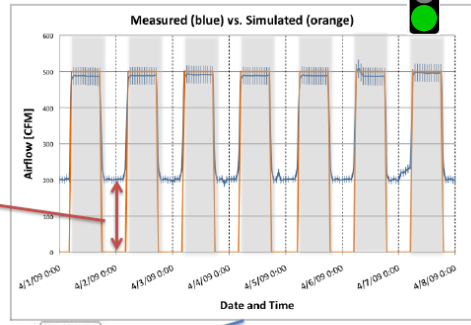
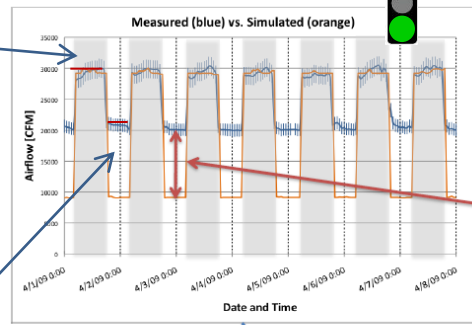
- Operating modes annotated w/comments on intent for modes
- Traffic lights for each mode
- Explanation of traffic light

Occupied:  
Air flow increased

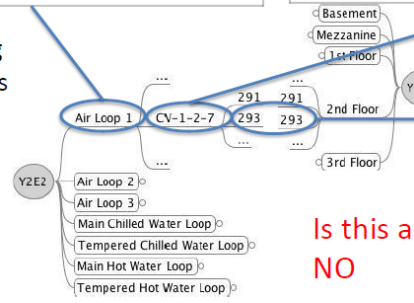
Un-Occupied:  
low air flow to many zones

No difference between measured and simulated data during occupied hours  
→ no performance problem

Example comparison continued



Difference during unoccupied hours



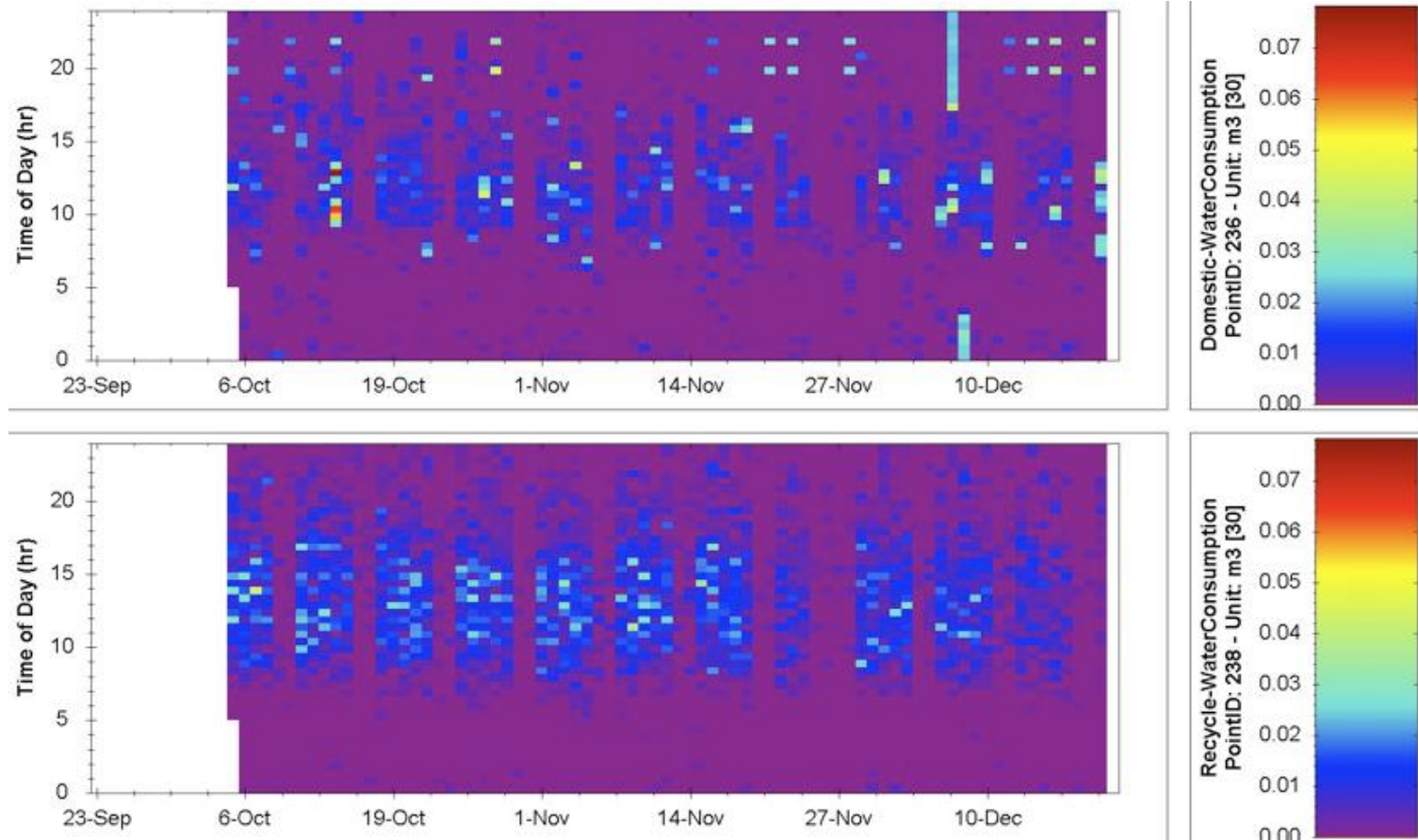
**Simulation approximation**  
Active chilled beam is constant volume (not two speed)

Is this a performance problem?  
**NO**

Tobias Maile

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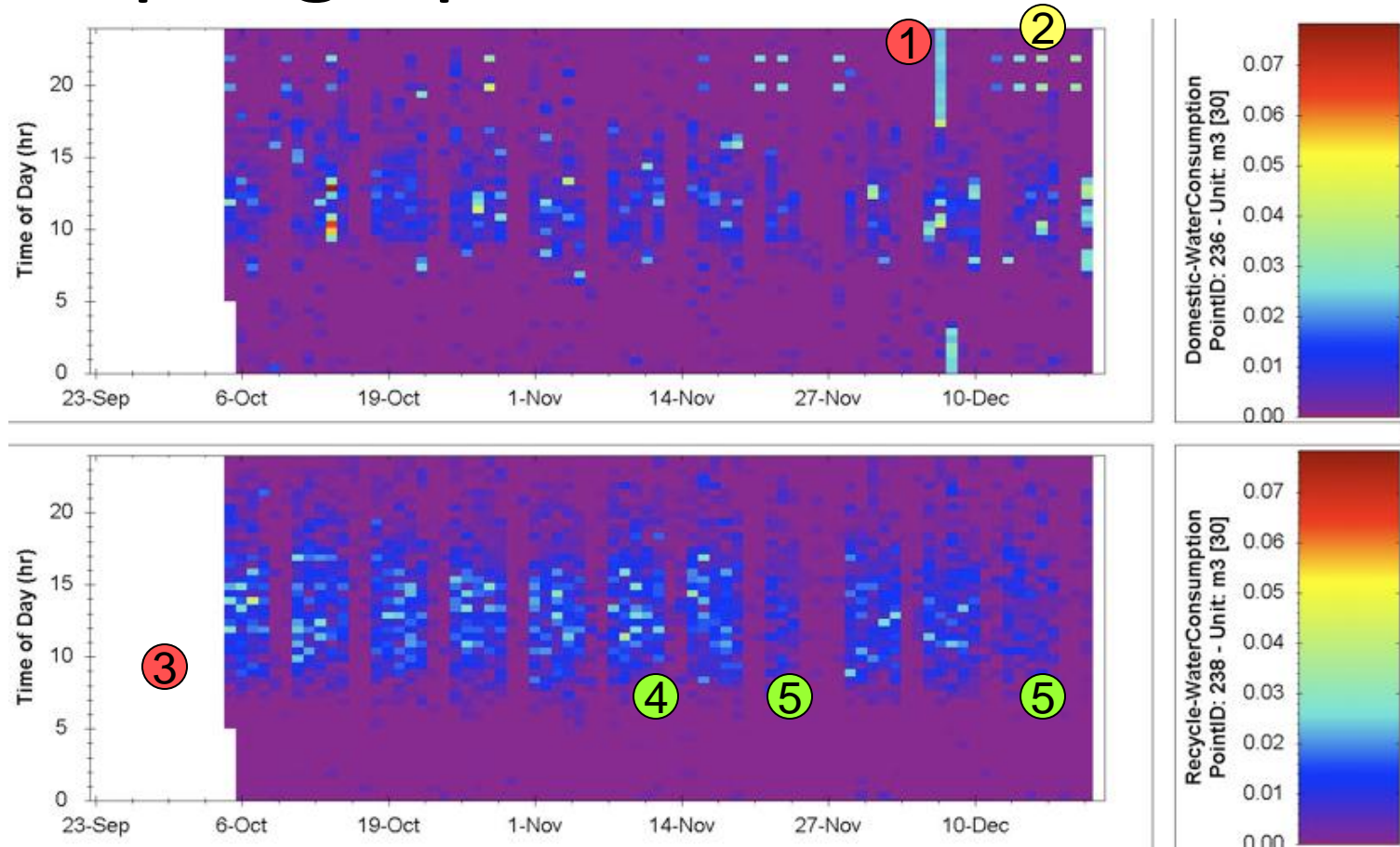
# Example graphs



Consistencies? Inconsistencies? Improvements?

Features; Implication(s)?

# Example graphs

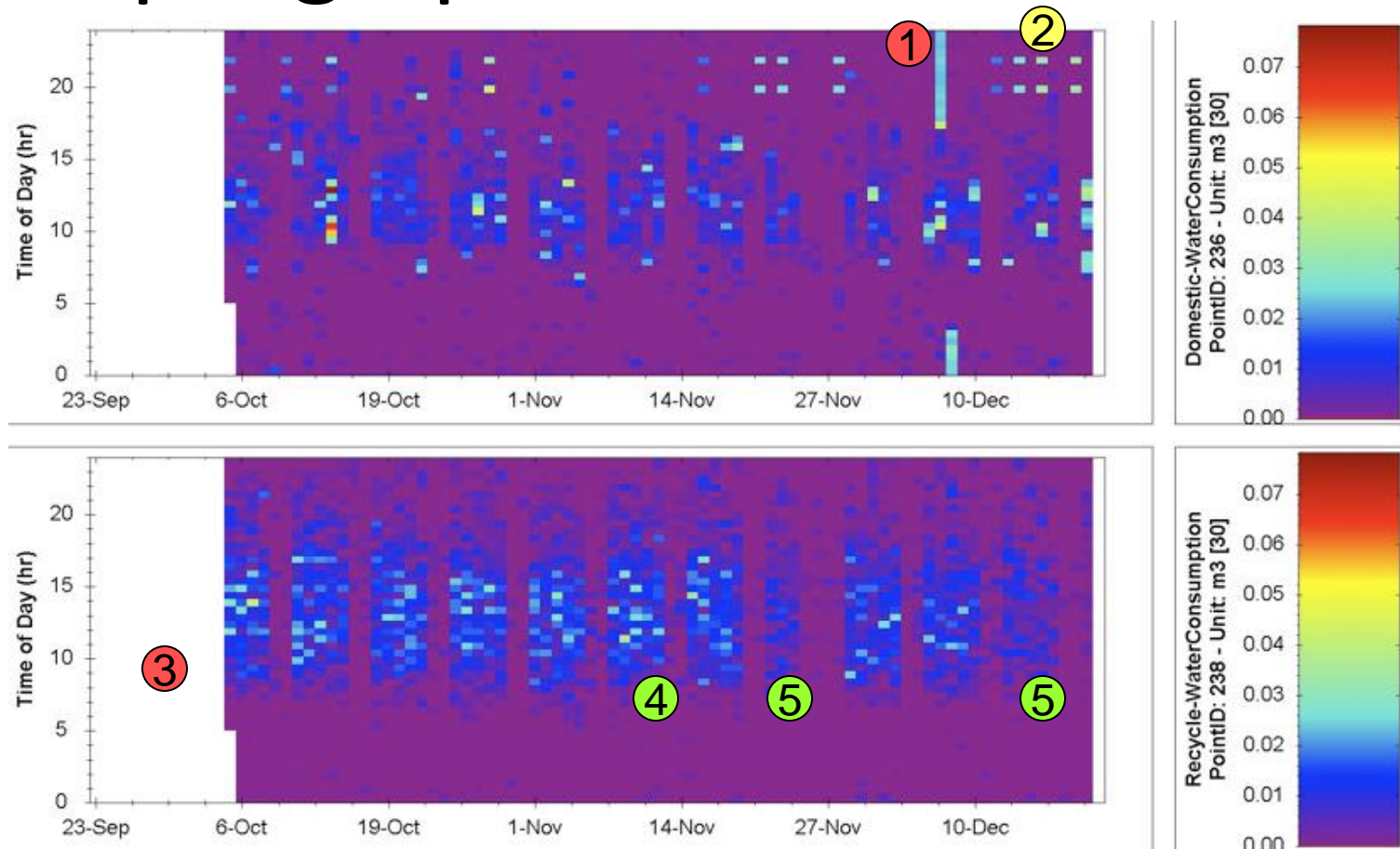


Features  
of data

5/10/2011

1. Water running throughout the night (faucet left on)
2. Water used at regular intervals at 8pm and 10pm
3. Missing data
4. Water usage follows occupancy trends
5. Water usage drops during holidays

# Example graphs



1. Annotate!
2. Provide operational status – suggestions here?

Features; Implication(s)?

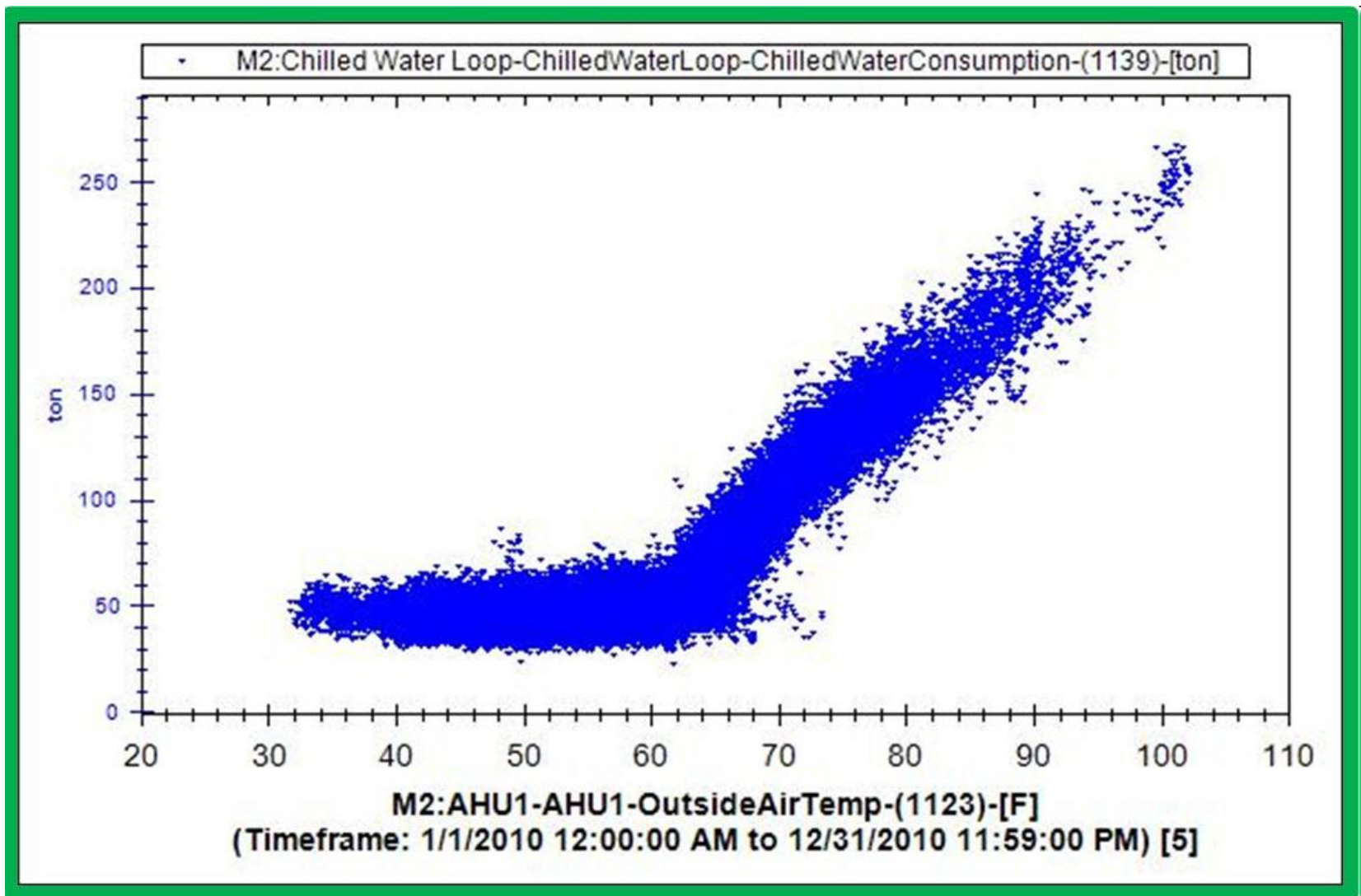


Figure 2 – Scatter Plot of Relationship between Chilled Water Consumption and Exterior Temperature of Y2E2 Building for the 2010 Year

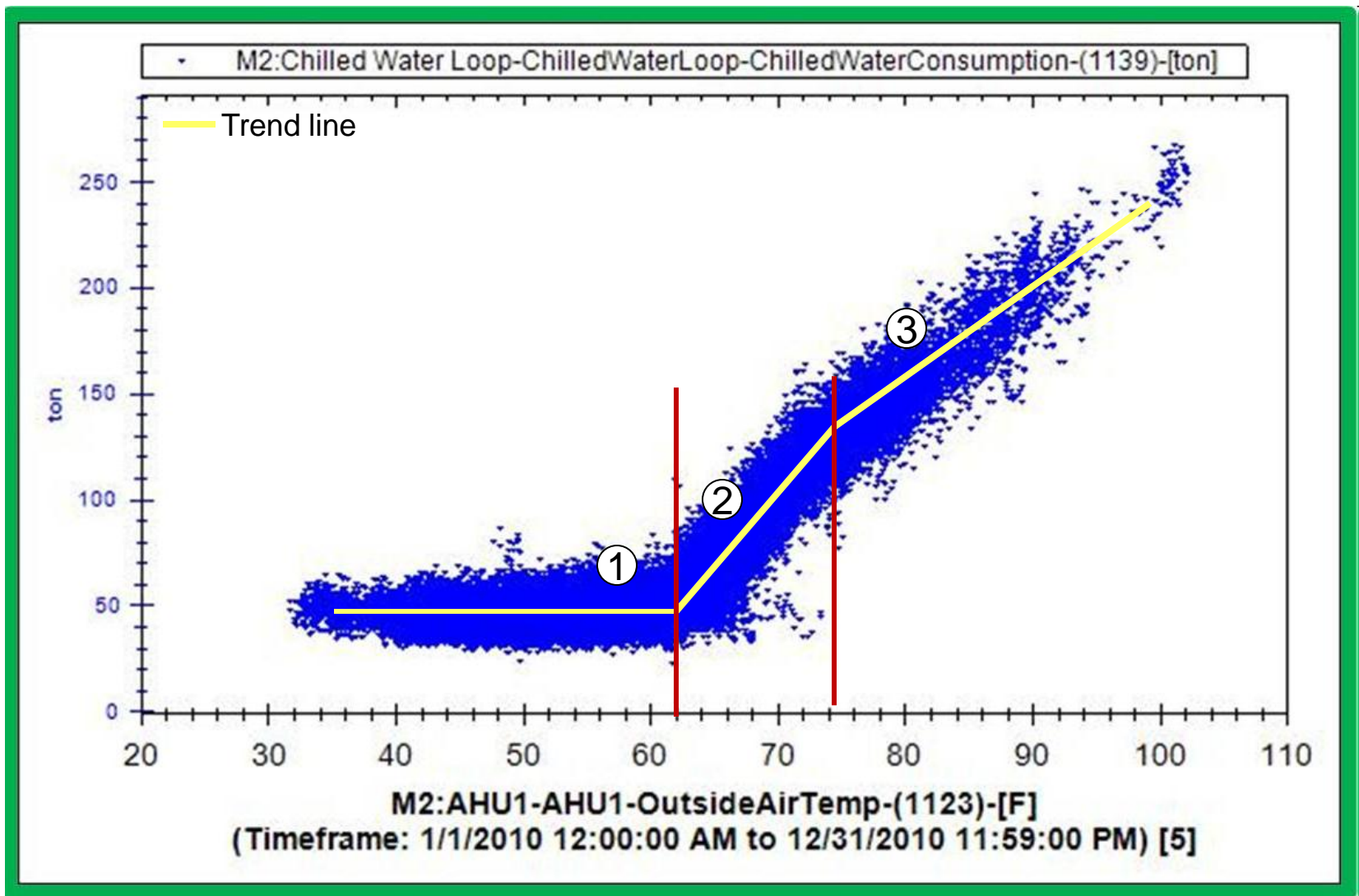
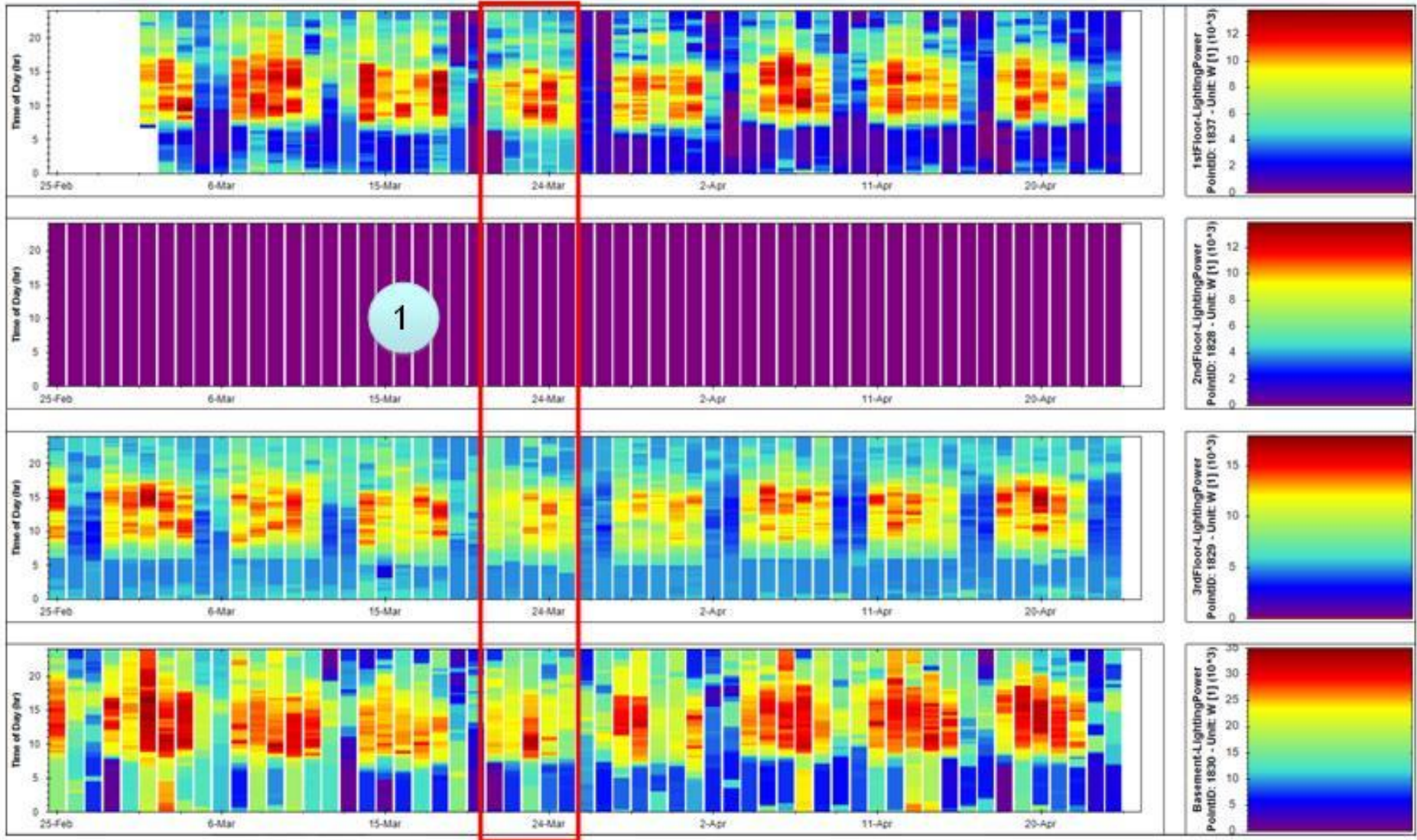


Figure 2 – Scatter Plot of Relationship between Chilled Water Consumption and Exterior Temperature of Y2E2 Building for the 2010 Year

1. Baseline chilled water usage
2. Direct relationship between chilled water consumption and OAT
3. Slope slightly decreases for OAT > threshold (region 3)

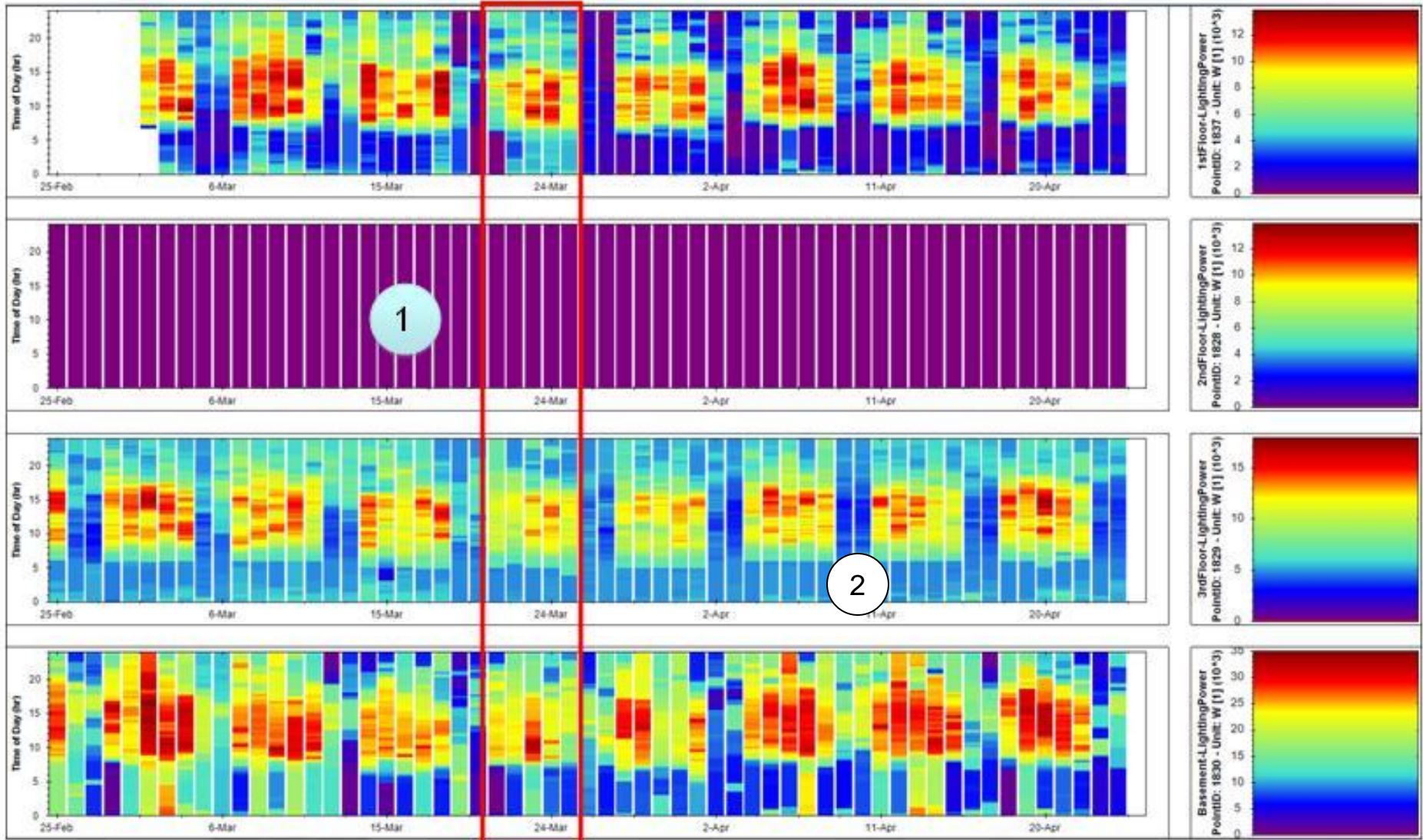


# Indoor Lighting





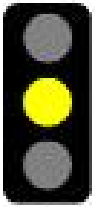
# Indoor Lighting



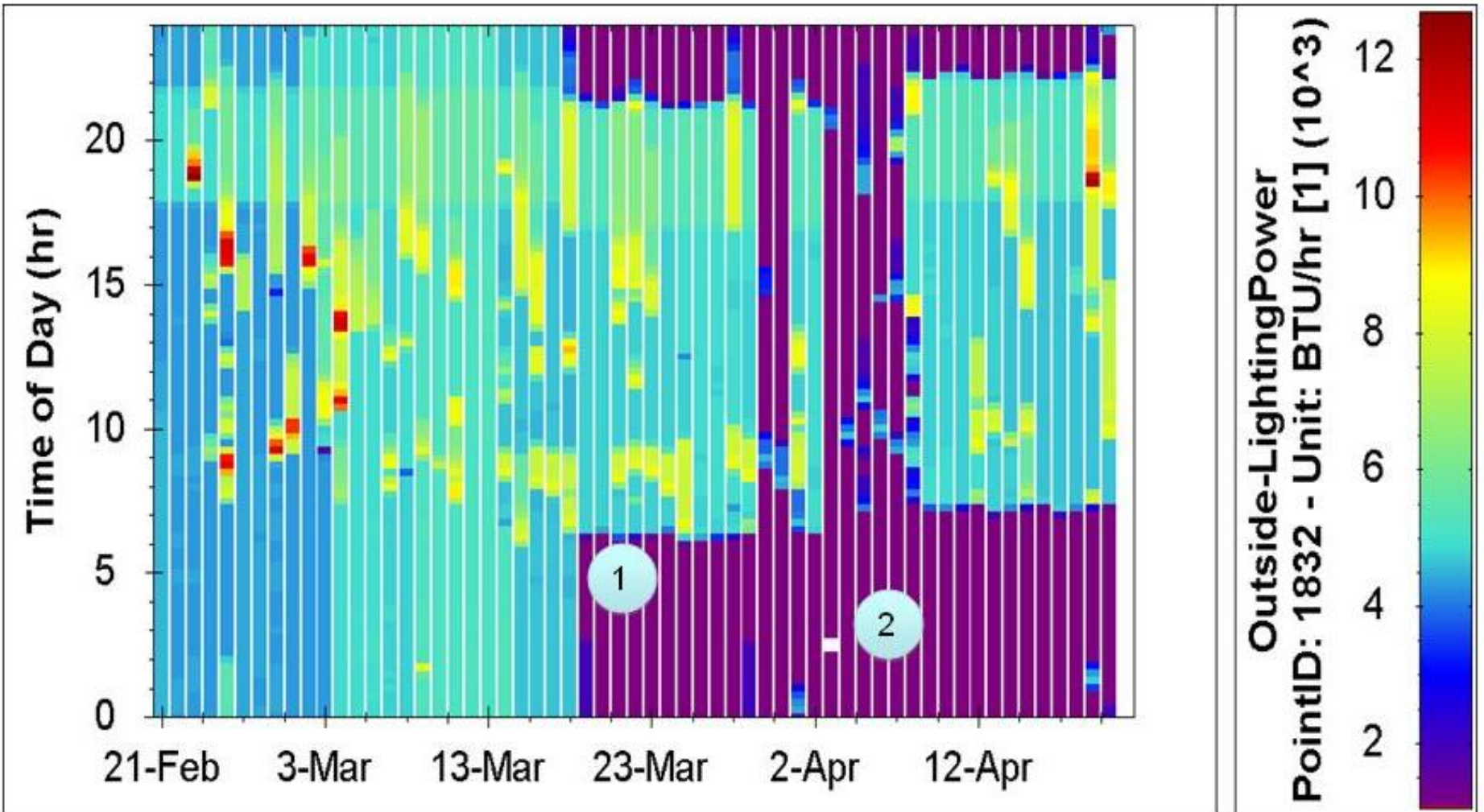
1. Missing data

5/10/2011

2. High unoccupied power usage compared to occupied usage and other floors

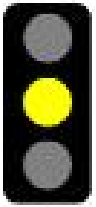


Outdoor Lighting

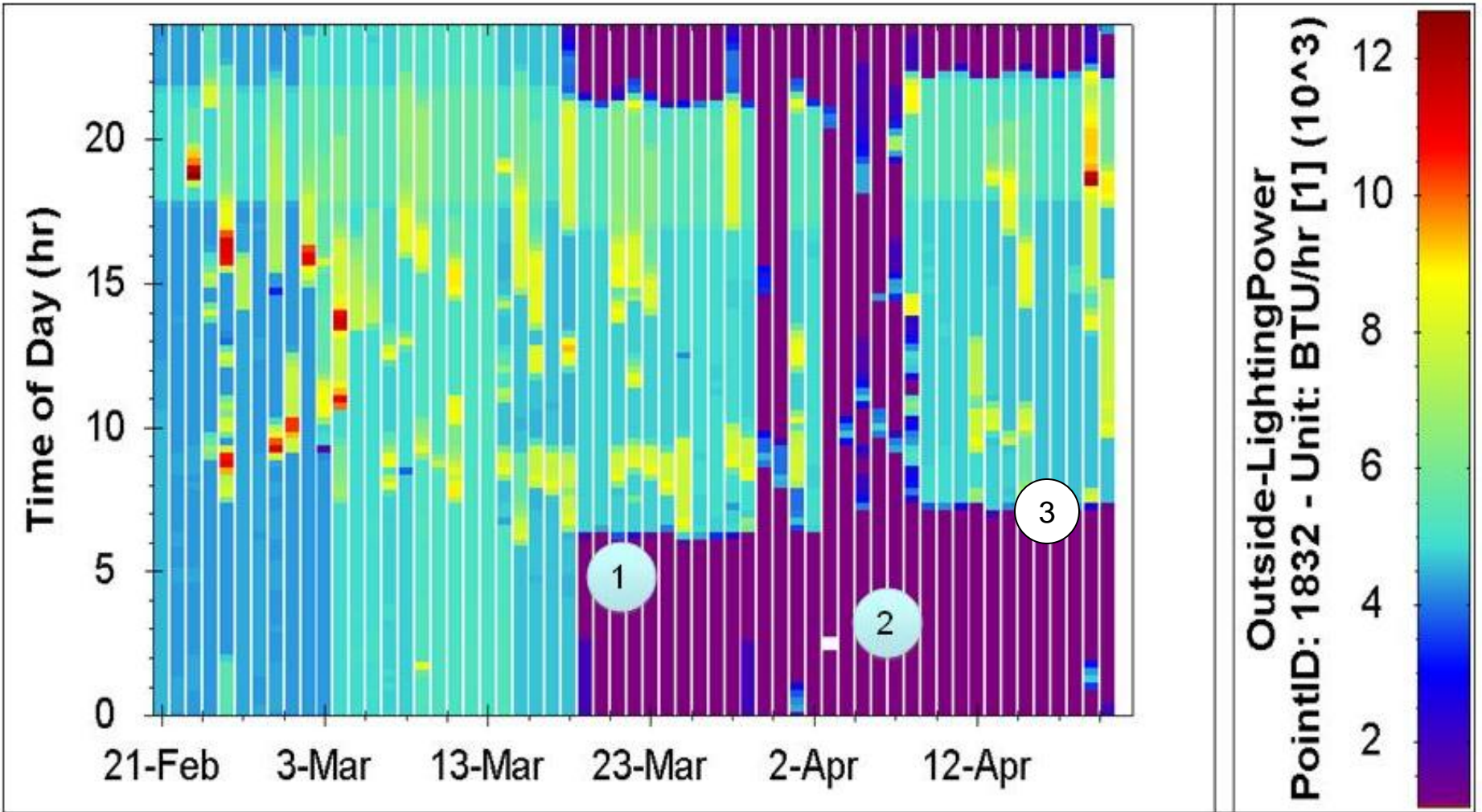


Consistencies? Inconsistencies? Improvements?

Features; Implication(s)?



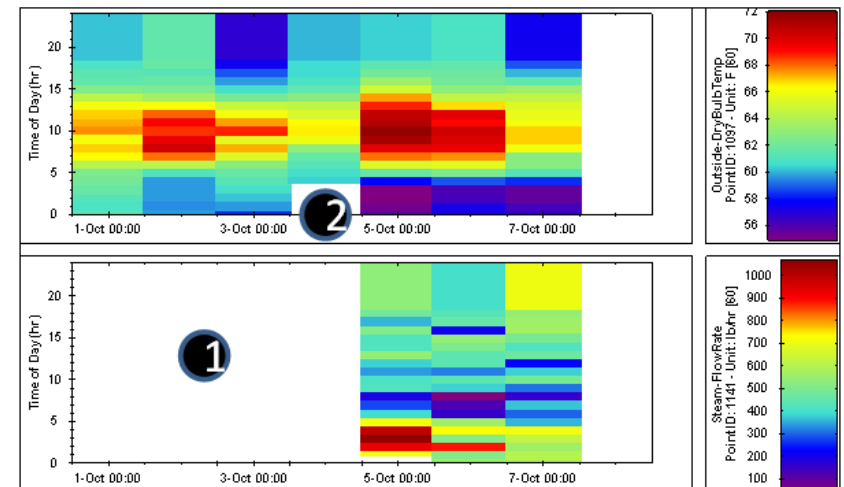
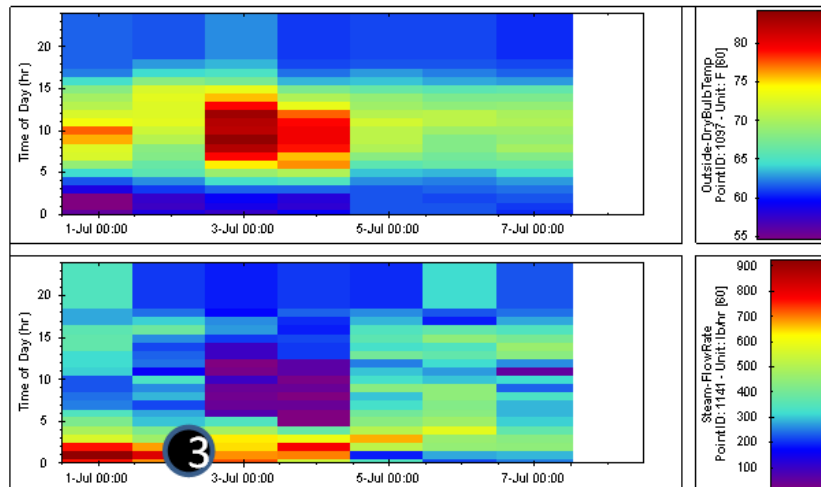
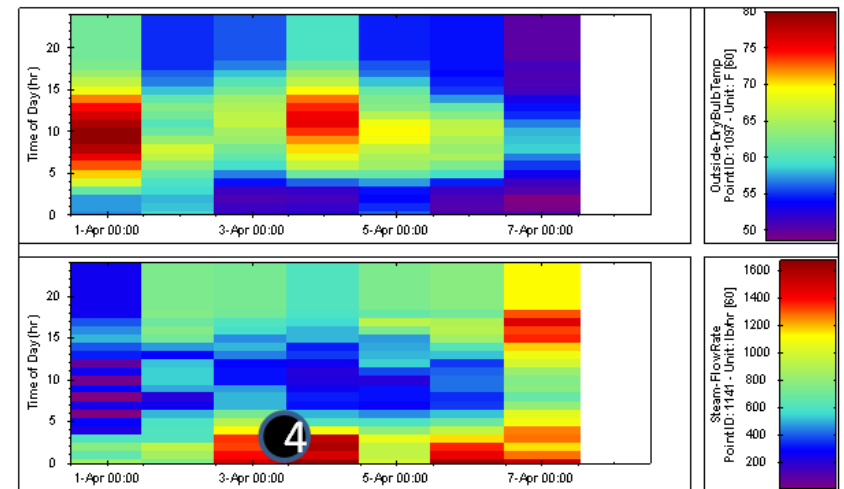
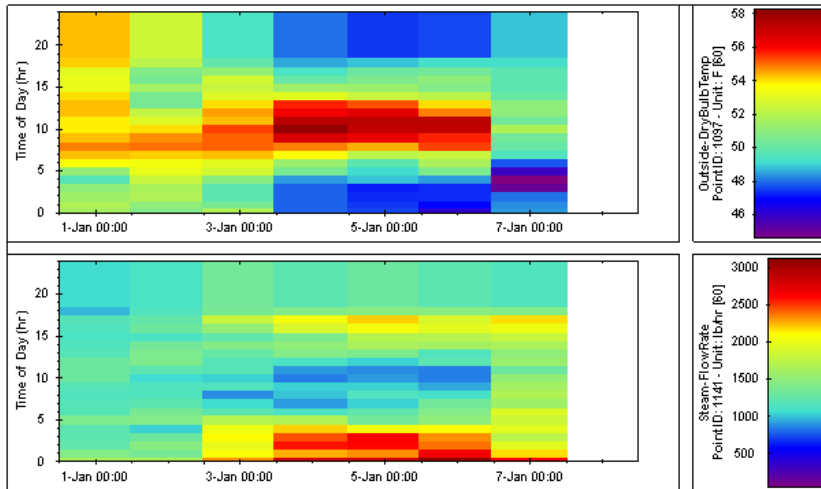
## Outdoor Lighting



1. Drop in unoccupied power usage
2. Missing datum
3. Outside lighting usage higher in the daytime than at night

5/18/2011

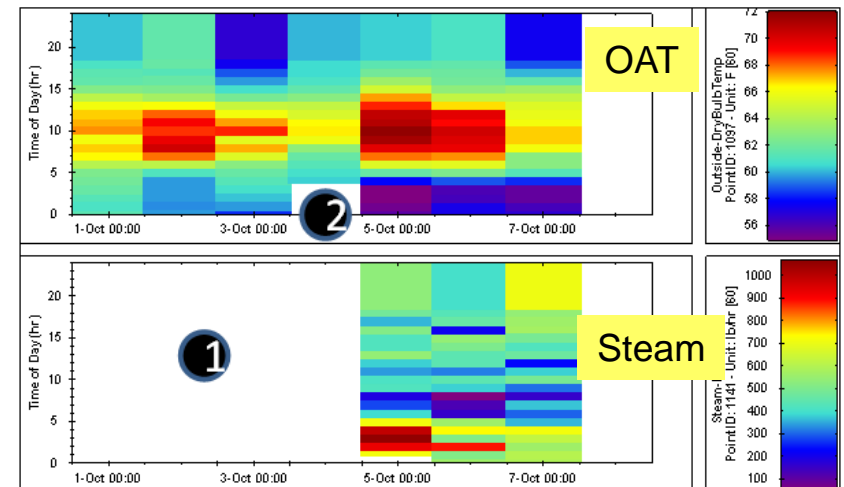
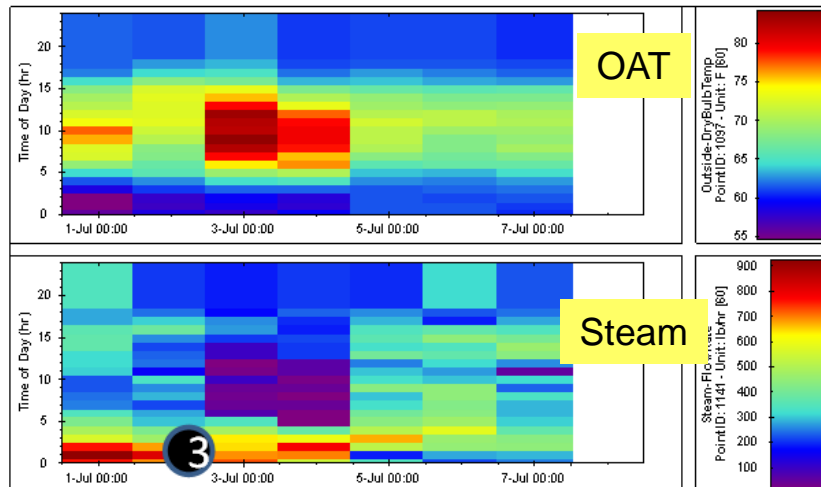
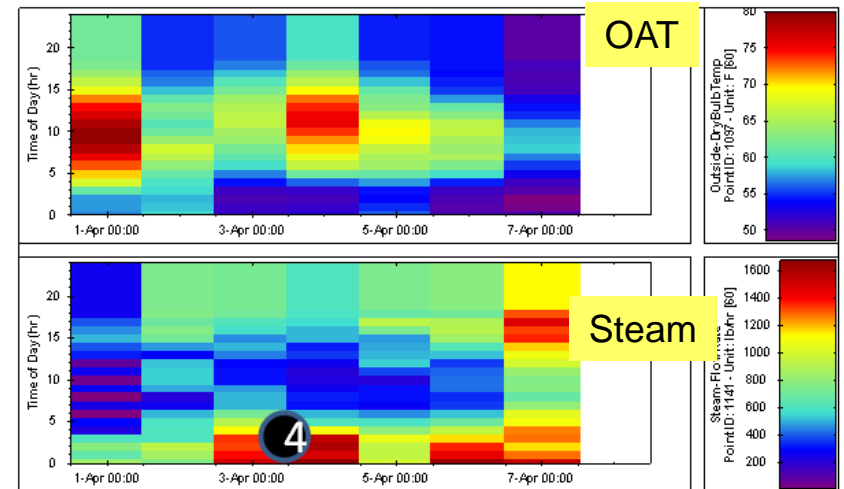
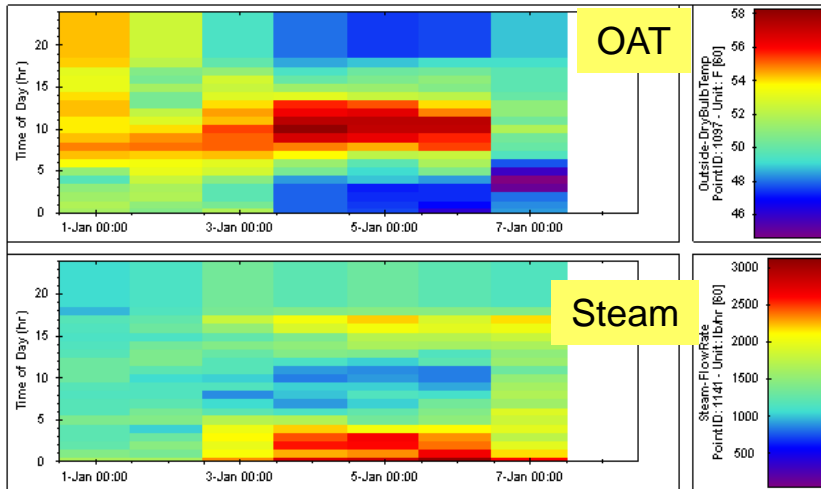
# Outside Air Temperature vs Steam Flow Rate



Consistencies? Inconsistencies? Improvements?

Features; Implication(s)?

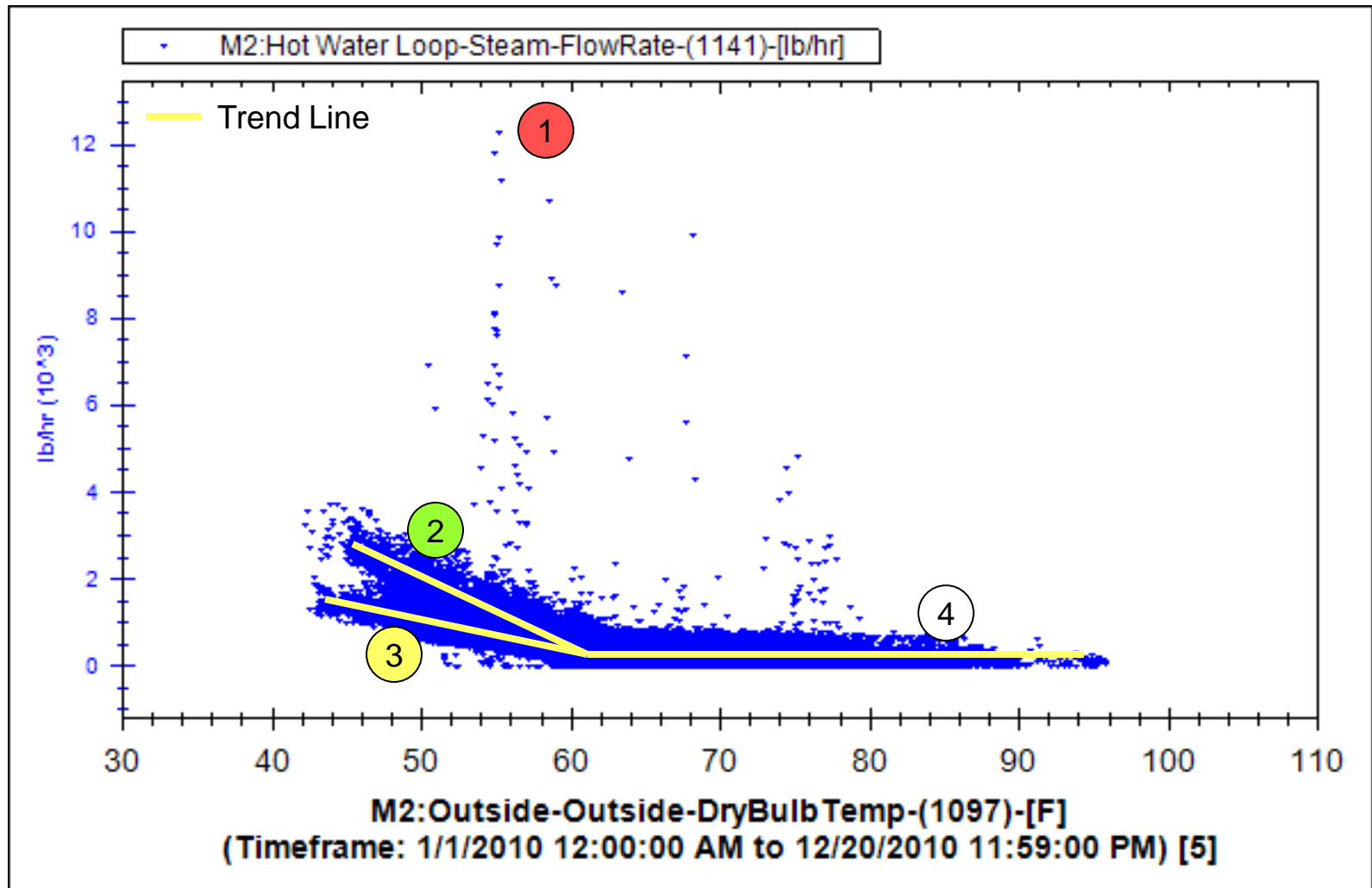
# Outside Air Temperature vs Steam Flow Rate



Consistencies? Inconsistencies? Improvements?

Features; Implication(s)?

## Outside Air Temperature vs Flow Rate: Scatter for Comparisons/Signatures



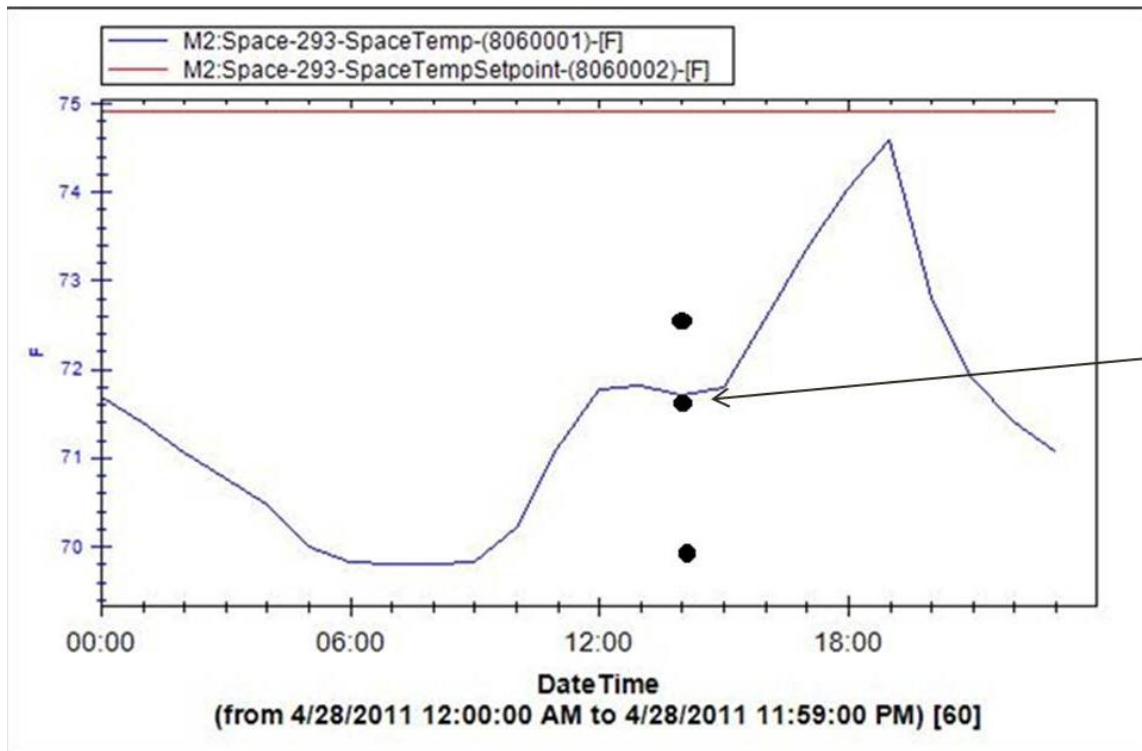
1. Anomaly
2. Steam flow inversely proportional to dry-bulb Outside air temperature (good!)
3. Second trend line for same outside temperature range: occupied vs. unoccupied?
4. Baseline steam flow

# Handheld vs. BMS Measurements

Location of Measurement	Fancy Thermometer (°F)
Ceiling	71.6
Middle	72.6
Ground	70.7

Why lower at ceiling?

Figure 9 - Space 293 Temperature Measurements



Data Points fairly consistent with BMS measurements. The values are very close to each other at the time of measurement (2:10 PM).

Figure 10 - Space 293 BMS Measurements Graph with Manual Points Plotted

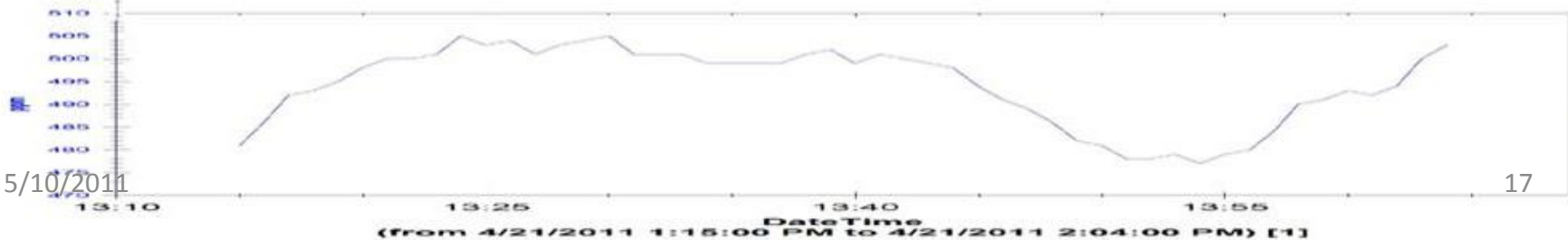
694

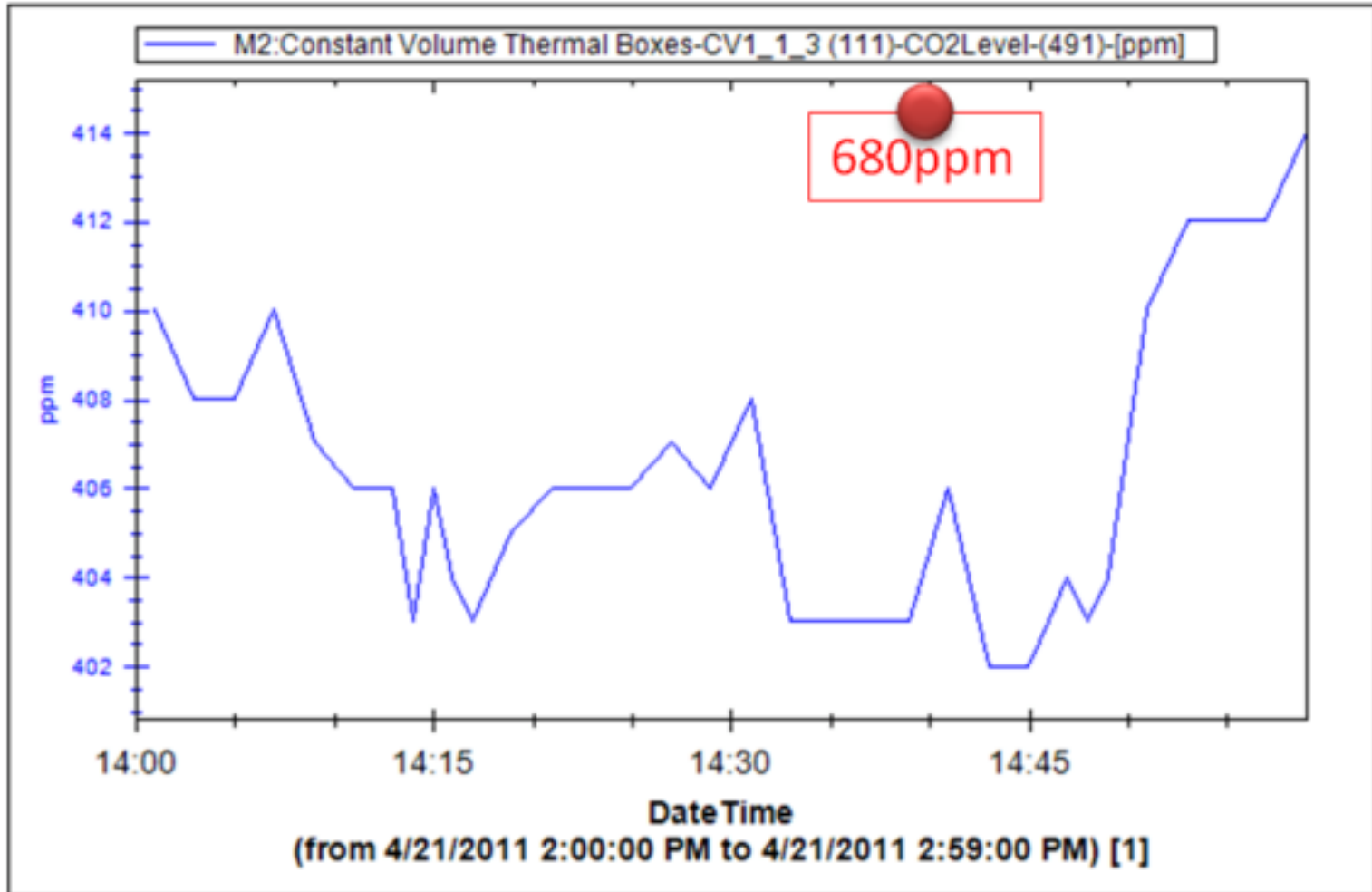
Floor (measured)

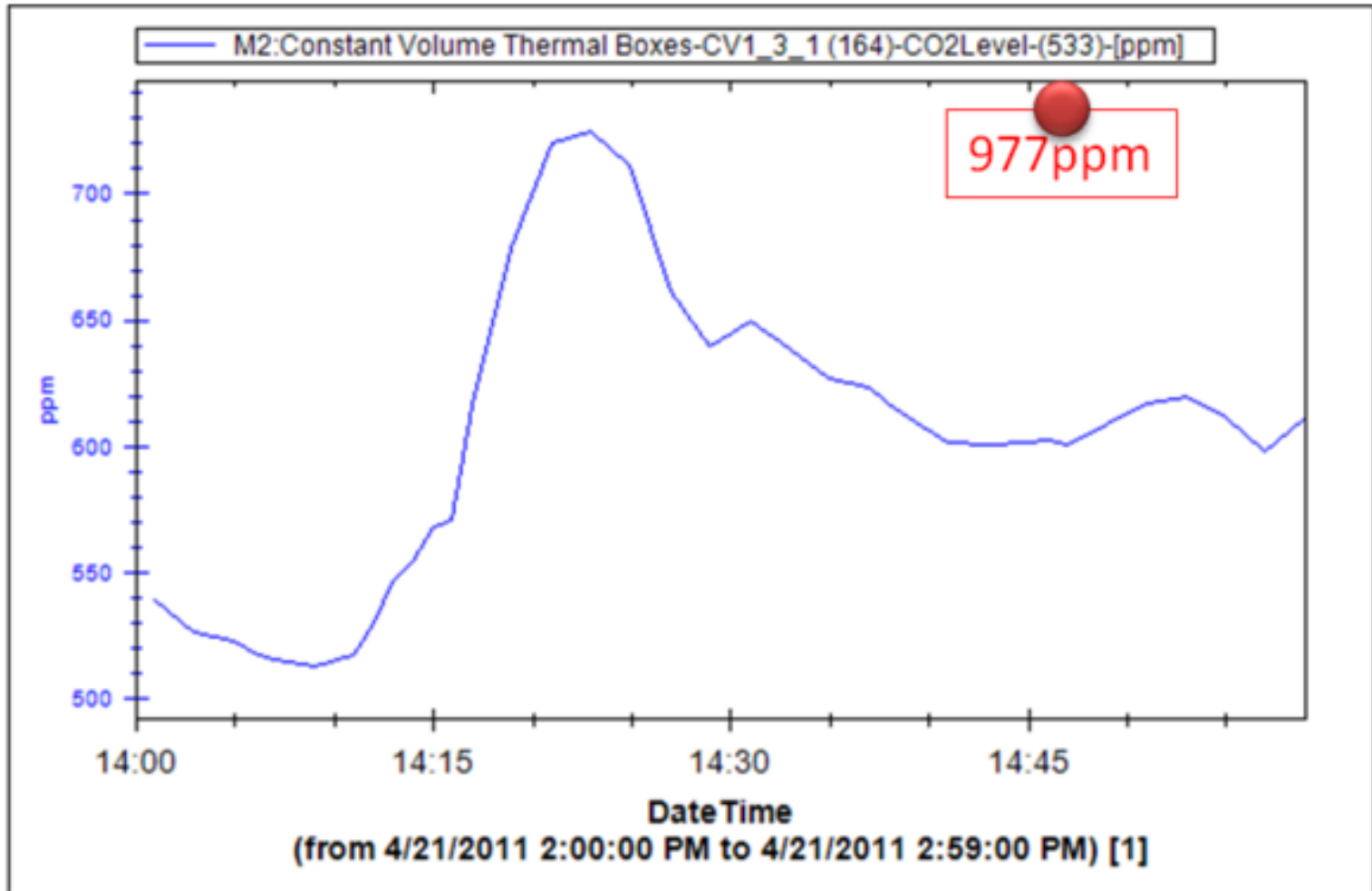
680

Ceiling (measured)

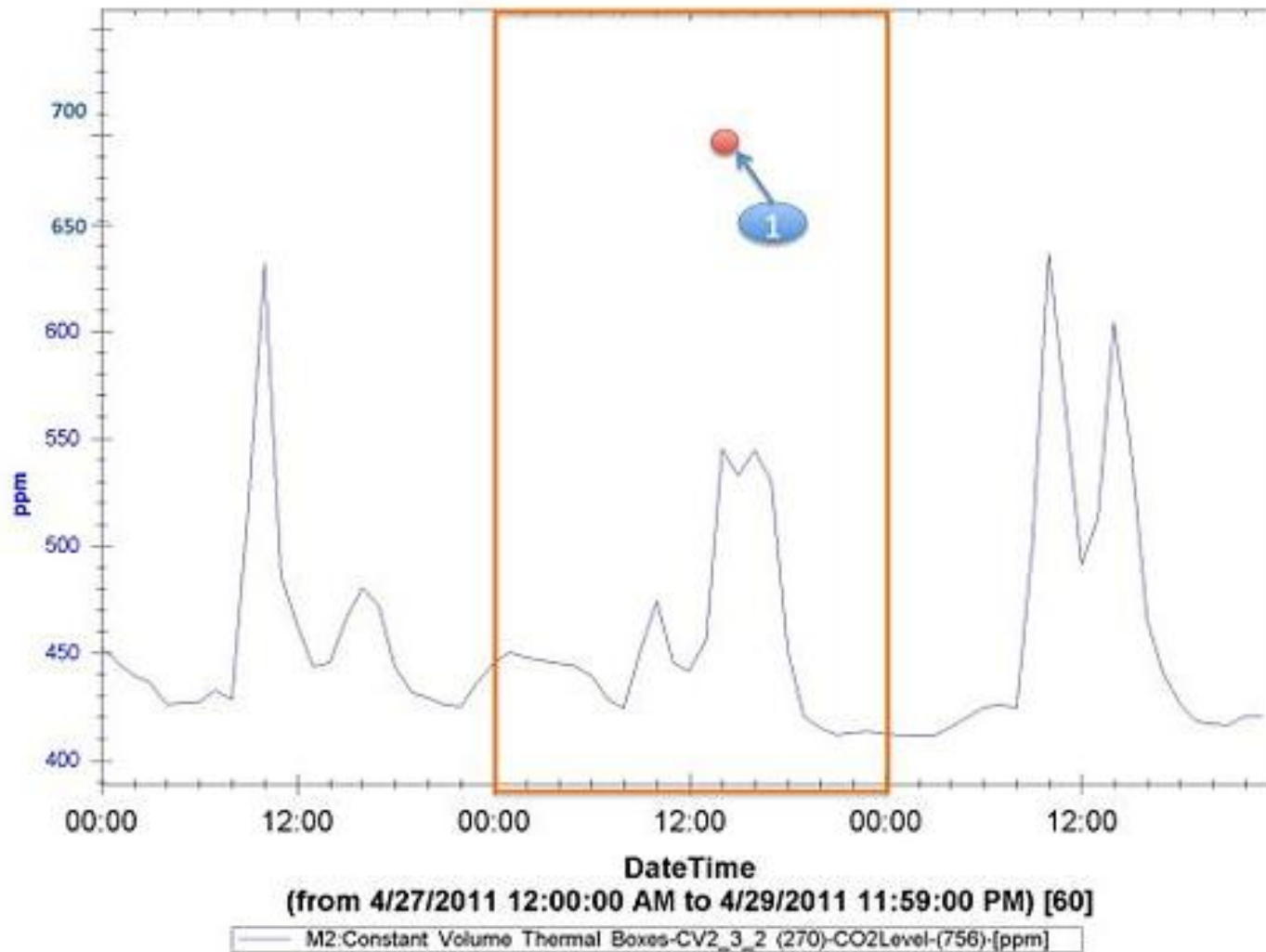
M2:Constant Volume Thermal Boxes-CV2\_3\_2 (270)-CO2Level-(756)-[ppm]



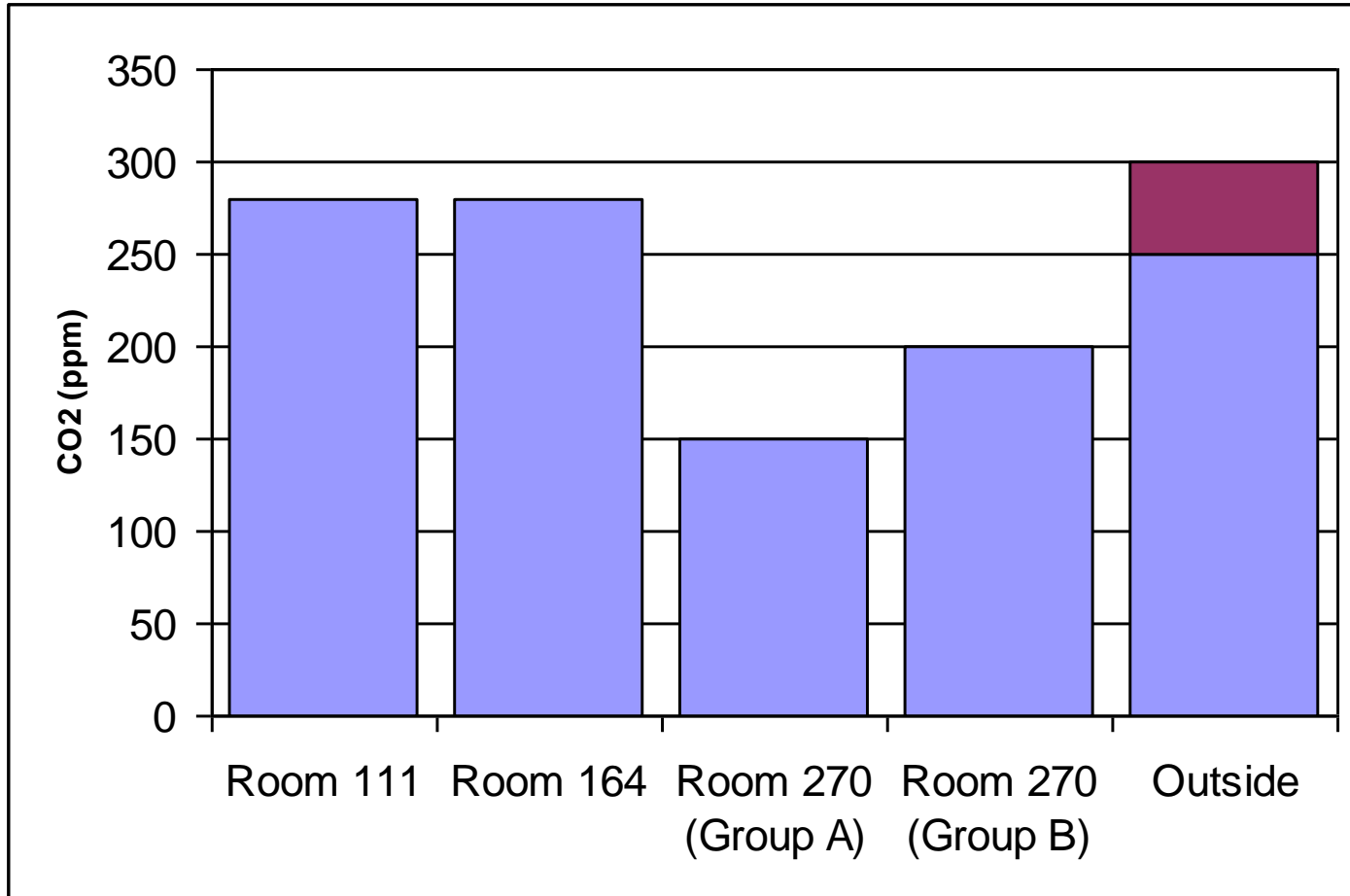




## CO2 Concentration



# Carbon Dioxide Status?

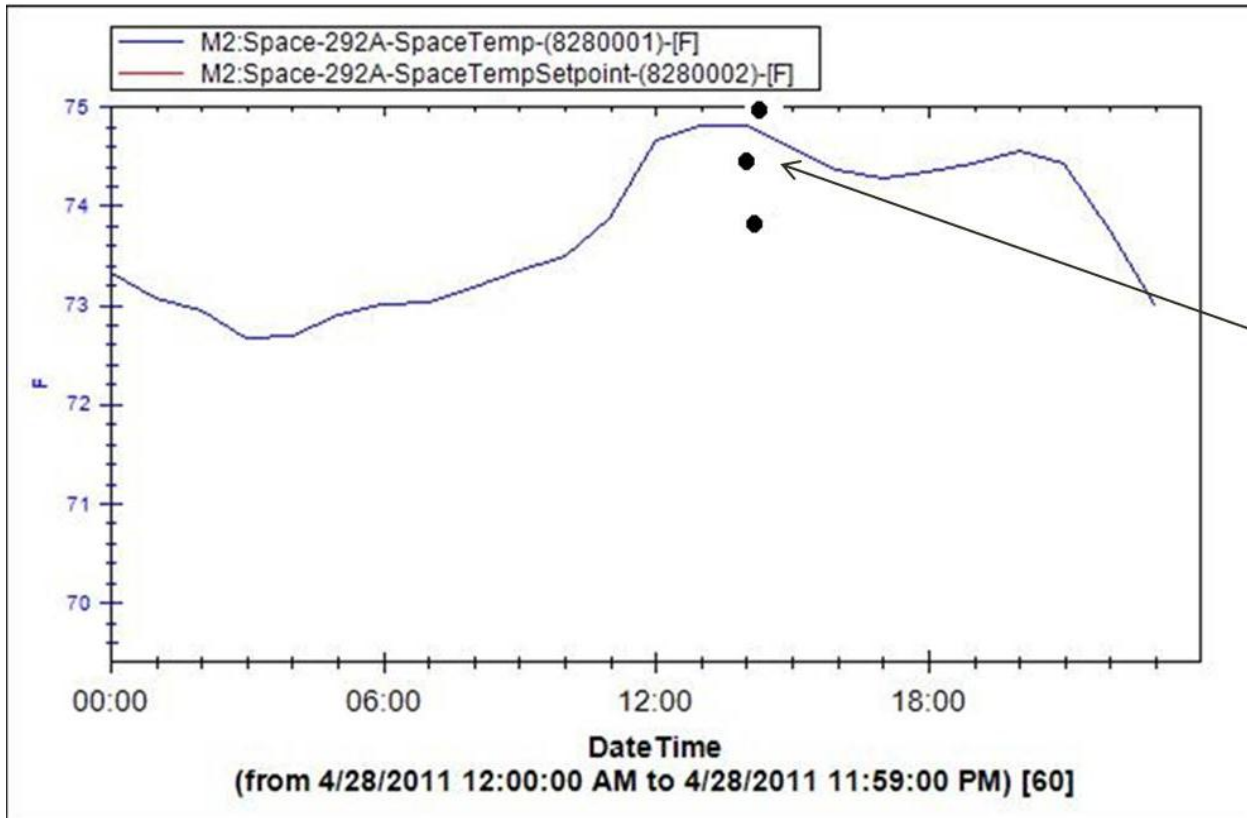


Variation from Handheld Device and Building Monitoring System

Features; Implication(s)?

Location of Measurement	Fancy Thermometer (°F)	Cheap Thermometer (°F)
Ceiling	74.5	
Middle	75.6	73.4
Ground	75.1	

**Figure 7 - Space 292A Temperature Measurements**

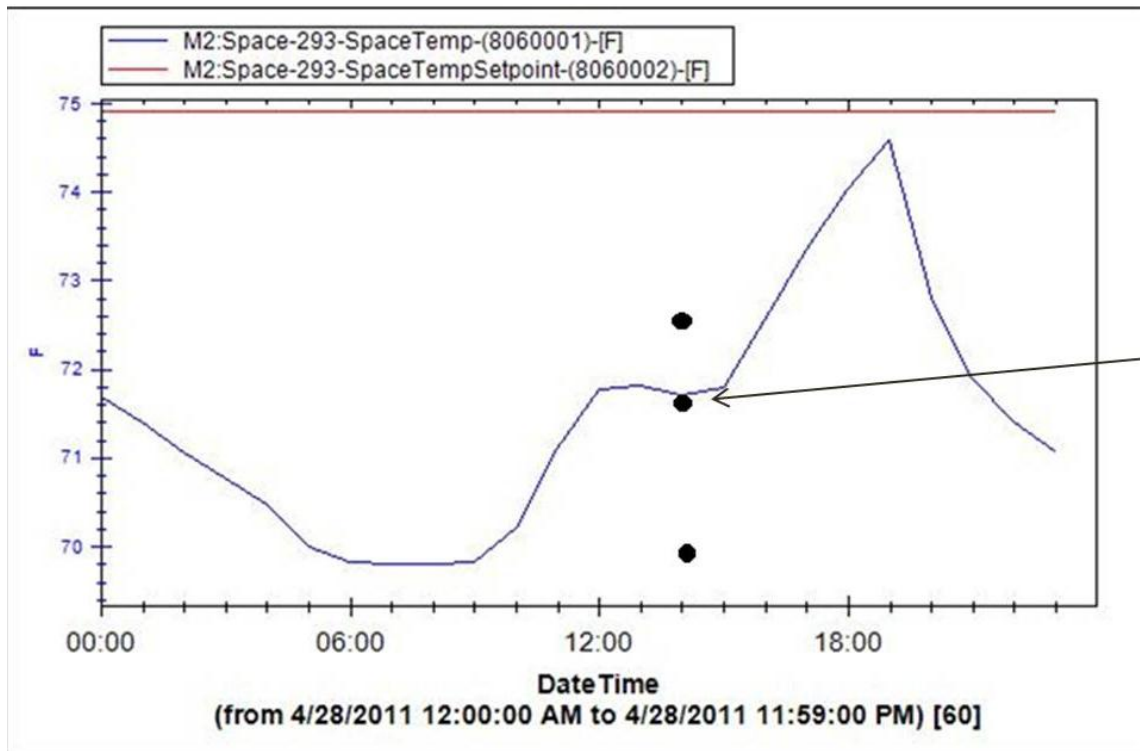


Data Points fairly consistent with BMS measurements. The values are very close to each other at the time of measurement (2:00 PM).

**Figure 8 - Space 292A BMS Measurements Graph with Manual Points Plotted**

Location of Measurement	Fancy Thermometer (°F)
Ceiling	71.6
Middle	72.6
Ground	70.7

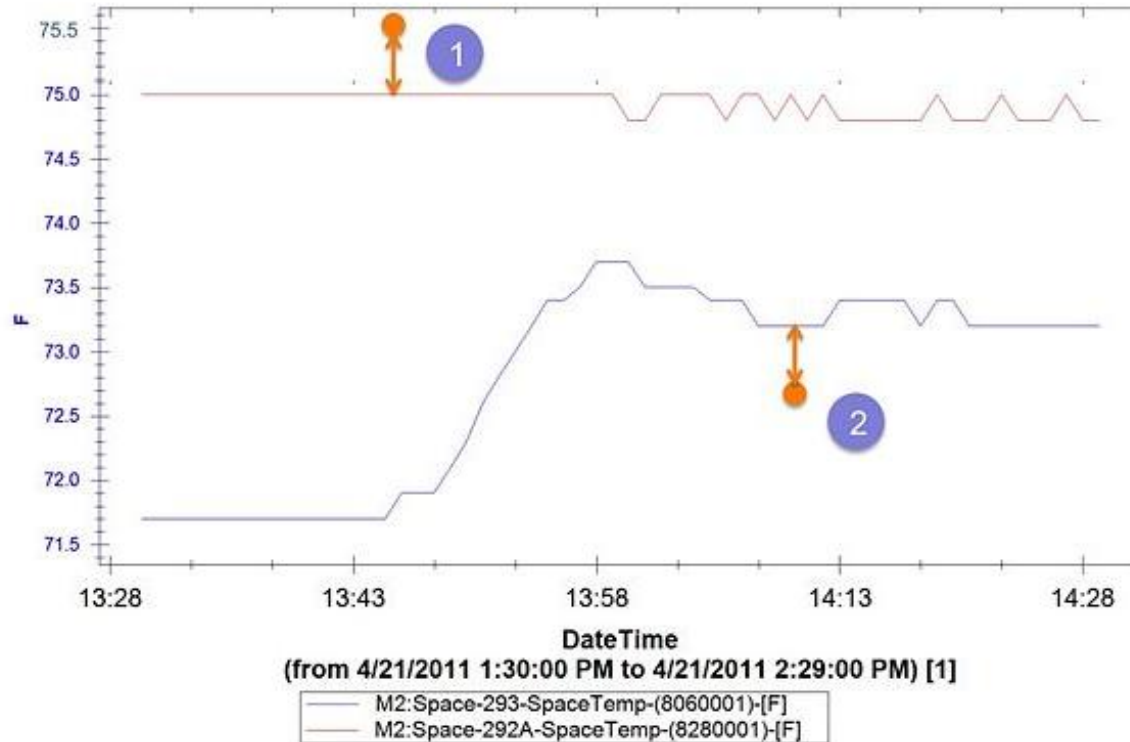
**Figure 9 - Space 293 Temperature Measurements**



Data Points fairly consistent with BMS measurements. The values are very close to each other at the time of measurement (2:10 PM).

**Figure 10 - Space 293 BMS Measurements Graph with Manual Points Plotted**

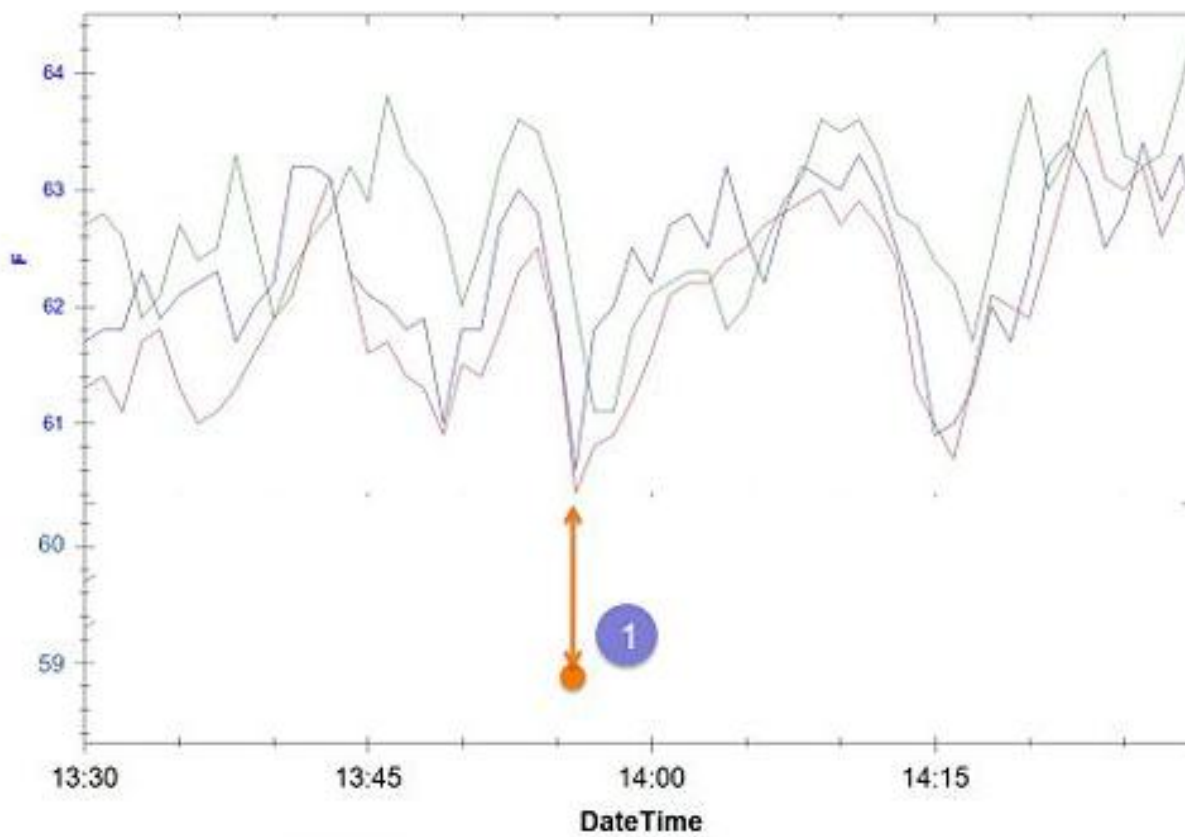
# Room 293 & 292A Measured vs. Recorded Space Temperature



Temp F	Room 292	Room 293	OAT
High	74.5	71.6	58.7
Sensor Level	75.6	72.6	
Low	75.1	70.7	
Furthest Wall	73.5	72.3	

Features; Implication(s)?

## Outdoor Air Temperature Measured vs. Recorded

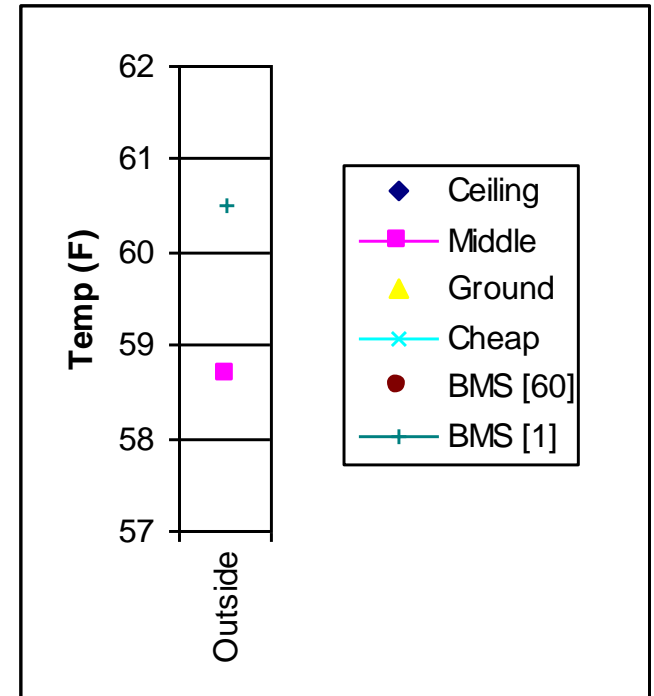
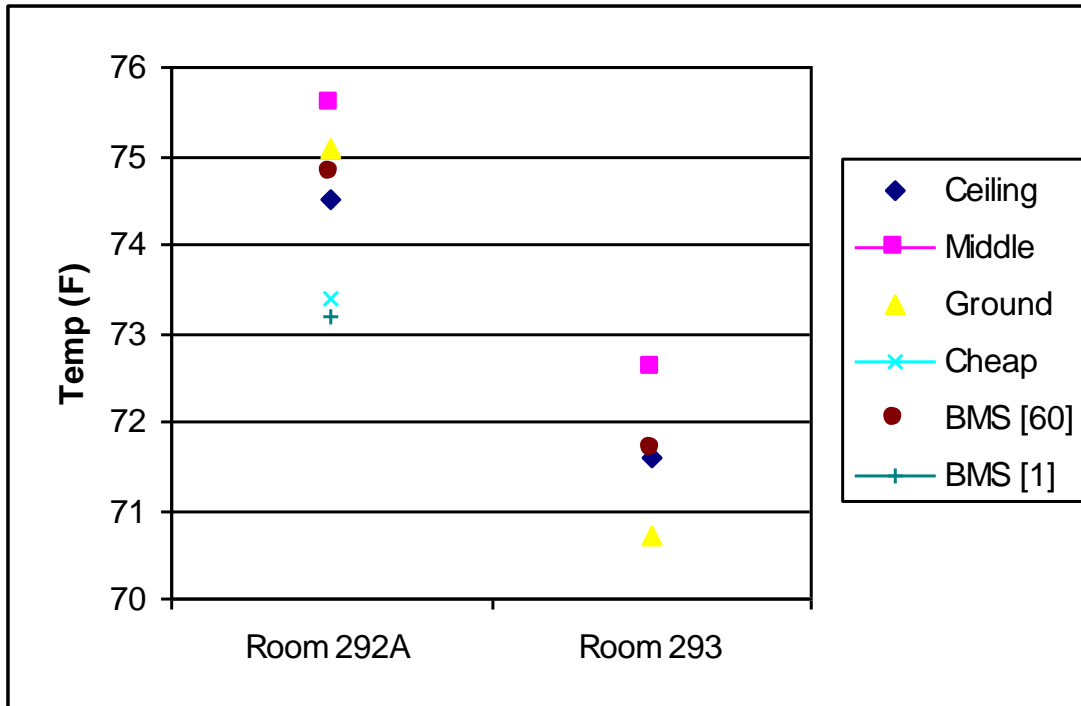


(from 4/21/2011 1:30:00 PM to 4/21/2011 2:29:00 PM) [1]

- M2:AHU1-AHU1-OutsideAirTemp-(1123)-[F]
- M2:AHU2-AHU2-OutsideAirTemp-(1124)-[F]
- M2:AHU3-AHU3-OutsideAirTemp-(1125)-[F]

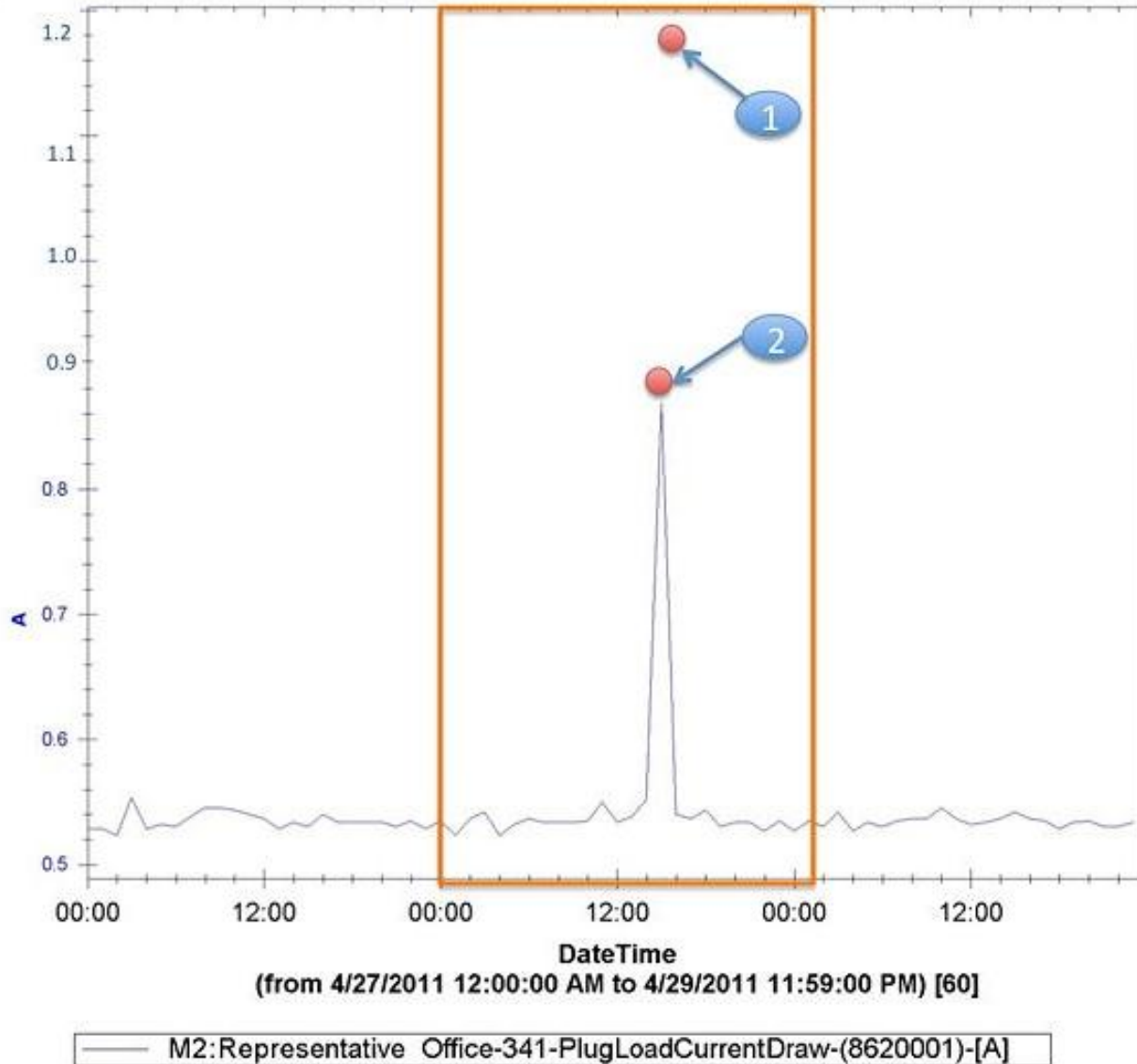
Features; Implication(s)?

# Space Temperature Status?



Features; Implication(s)?

## Current Draw (Rm 292 Handheld vs Rm 341 BMS)



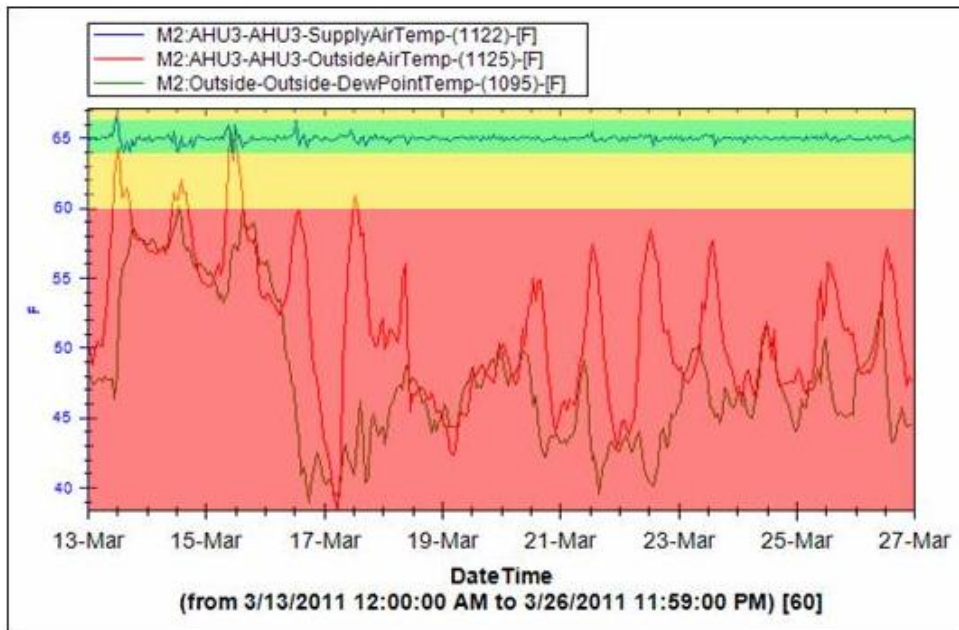
1. Five devices (lamp, 2 computers, 2 monitors)
2. One computer unplugged

5/10/2011

Features; Implication(s)?

# Supply/Outside Air Temperatures

We have chosen to assign this system a green status. The supply air temperature stays within one degree of the setpoint and is never closer than 5 F from the dewpoint temperature. Since the daytime temperatures never exceeded 68 F, morning warmup mode would be allowed to occur throughout the entire two weeks. However, the outdoor temperature was cooler than the supply temperature so we would not expect the temperature to drift upwards.

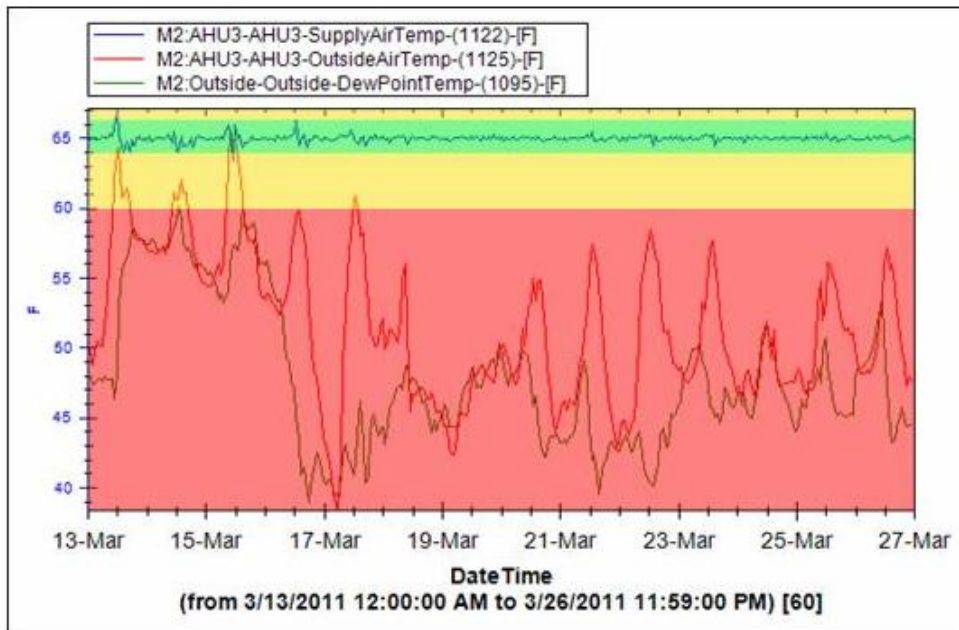


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- Rationale for identifying any green, yellow or red data regions;
- Modes of operation in functional intent

# Supply/Outside Air Temperatures

We have chosen to assign this system a green status. The supply air temperature stays within one degree of the setpoint and is never closer than 5 F from the dewpoint temperature. Since the daytime temperatures never exceeded 68 F, morning warmup mode would be allowed to occur throughout the entire two weeks. However, the outdoor temperature was cooler than the supply temperature so we would not expect the temperature to drift upwards.



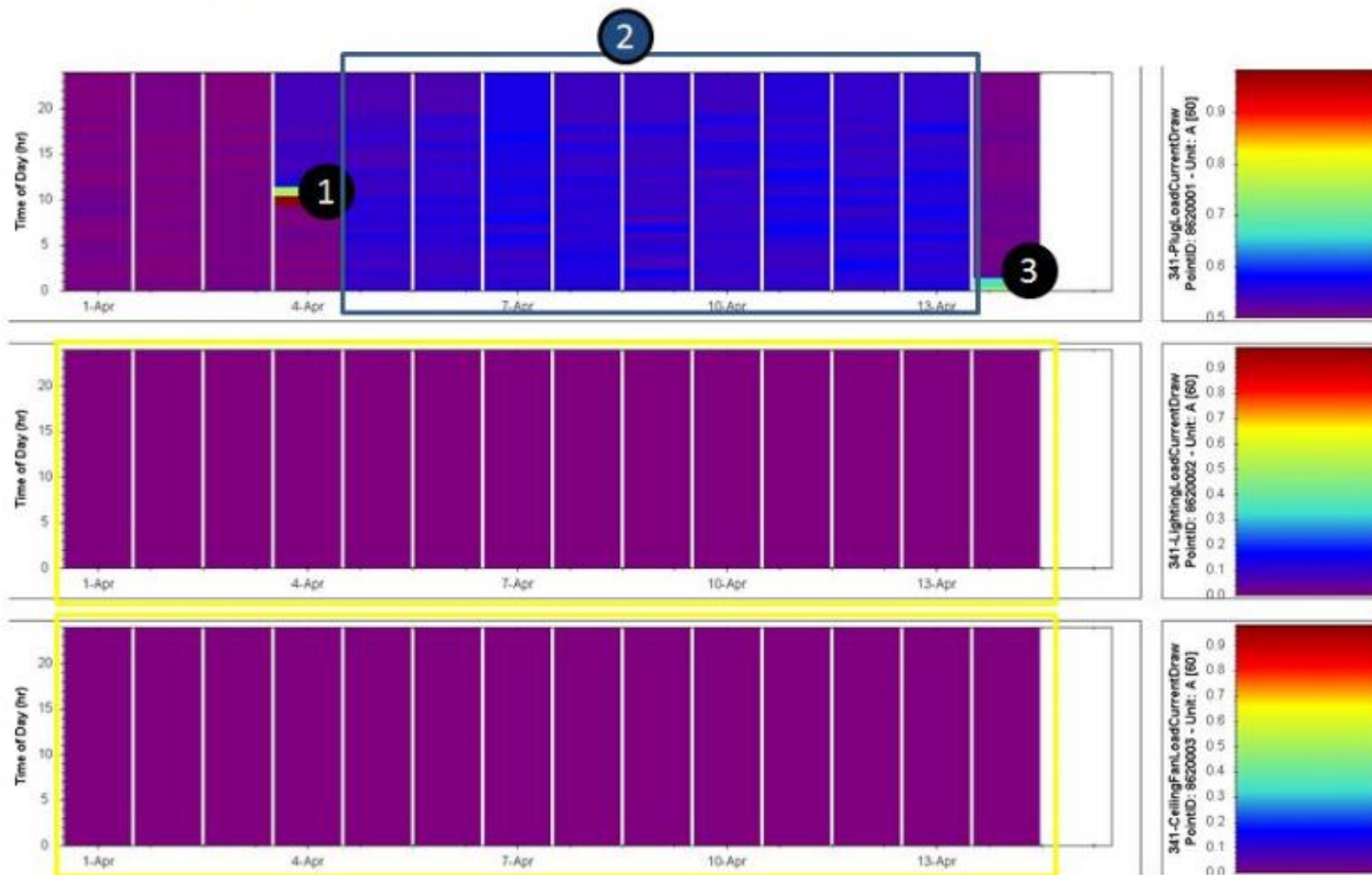
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- Relative fraction of energy use of system re building as a whole?
- Energy simulation exercise to confirm or disconfirm your intuition.

## PLUG LOAD CURRENT DRAW, LIGHTING LOAD CURRENT DRAW AND CEILING FAN LOAD CURRENT DRAW

[EDIT]

This is a comparison of the different load draws in the representative office 341 for plugs, lighting and ceiling fan. When someone is occupying the room, we expect these loads to fluctuate at different parts of the day (plug load - all day, lighting load - when lighting is needed, ceiling fan - when circulation is needed). We used a carpet plot so we can easily determine which plug loads are the largest, and therefore, be able to make recommendations on how to reduce energy. As seen below, there isn't much data for these three points. Point 1 represents the time when some plug load (i.e. laptop, lamp, etc.) is turned on and used. During section 2 for plug load, this electronic stays on in sleep mode and therefore draws less amps. At point 3, the electronic is used again and shut off. The graphs for lighting and ceiling are outlined with a yellow line because it is unclear whether or not that data is good. From those graphs, you can see that no amps are being drawn at any point in the 2 week period. This means that either the sensors are broken or that they are never used. It is difficult to put a traffic light on this type of data because there is a large range of data that is appropriate for these sensors and that these loads are driven by the occupant solely, not by outside/inside conditions.



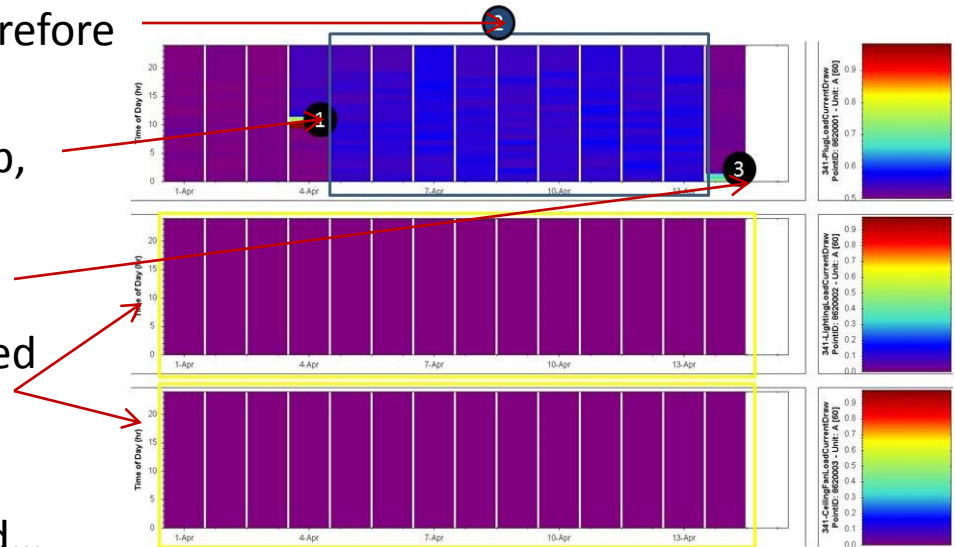
# Plug Load Current Draw, Lighting Load Current Draw, Ceiling Fan Load Current Draw

2. this electronic in sleep mode and therefore draws less amps.

1. time when some plug load (i.e., laptop, lamp, etc.) is turned on and used.

3. electronic is used again and shut off.

- graphs for lighting and ceiling outlined with a yellow line because unclear whether data are good.
  - no amps drawn in 2 week period... either sensors broken or load never used.
- *difficult to put traffic light on this type of data ..*
  - *large range of data appropriate for these sensors*
  - *loads driven by occupant, not outside/inside conditions.*



Features; Implication(s)?

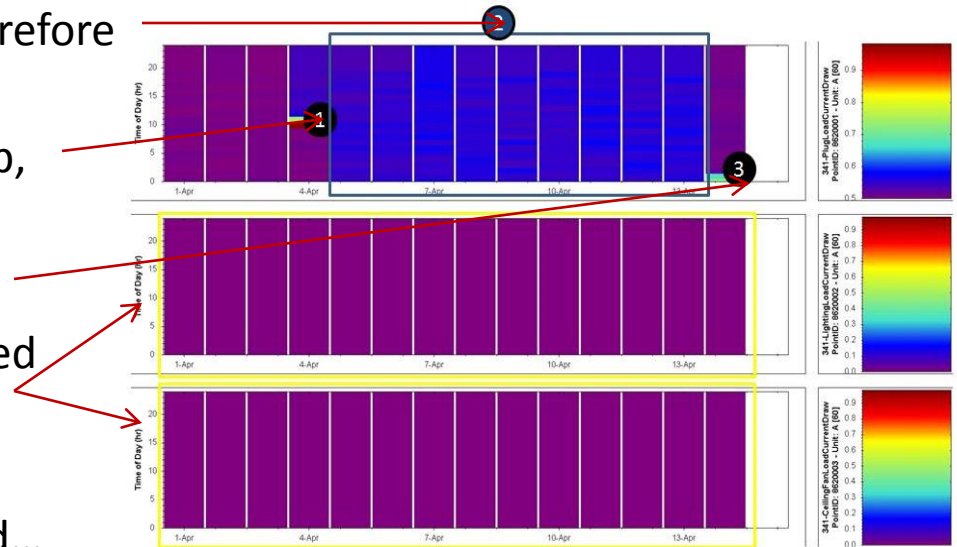
# Plug Load Current Draw, Lighting Load Current Draw, Ceiling Fan Load Current Draw

2. this electronic in sleep mode and therefore draws less amps.

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3. electronic is used again and shut off.

- graphs for lighting and ceiling outlined with a yellow line because unclear whether data are good.
  - no amps drawn in 2 week period... either sensors broken or load never used.
- *difficult to put traffic light on this type of data ..*
  - *large range of data appropriate for these sensors*
  - *loads driven by occupant, not outside/inside conditions.*



- Modes?
- Why 24 hour/day plug load draw (region 2)?
- Status (green/yellow/red)
- Relative fraction of energy use of components re building as a whole?
- Energy simulation exercise to confirm or disconfirm your intuition.