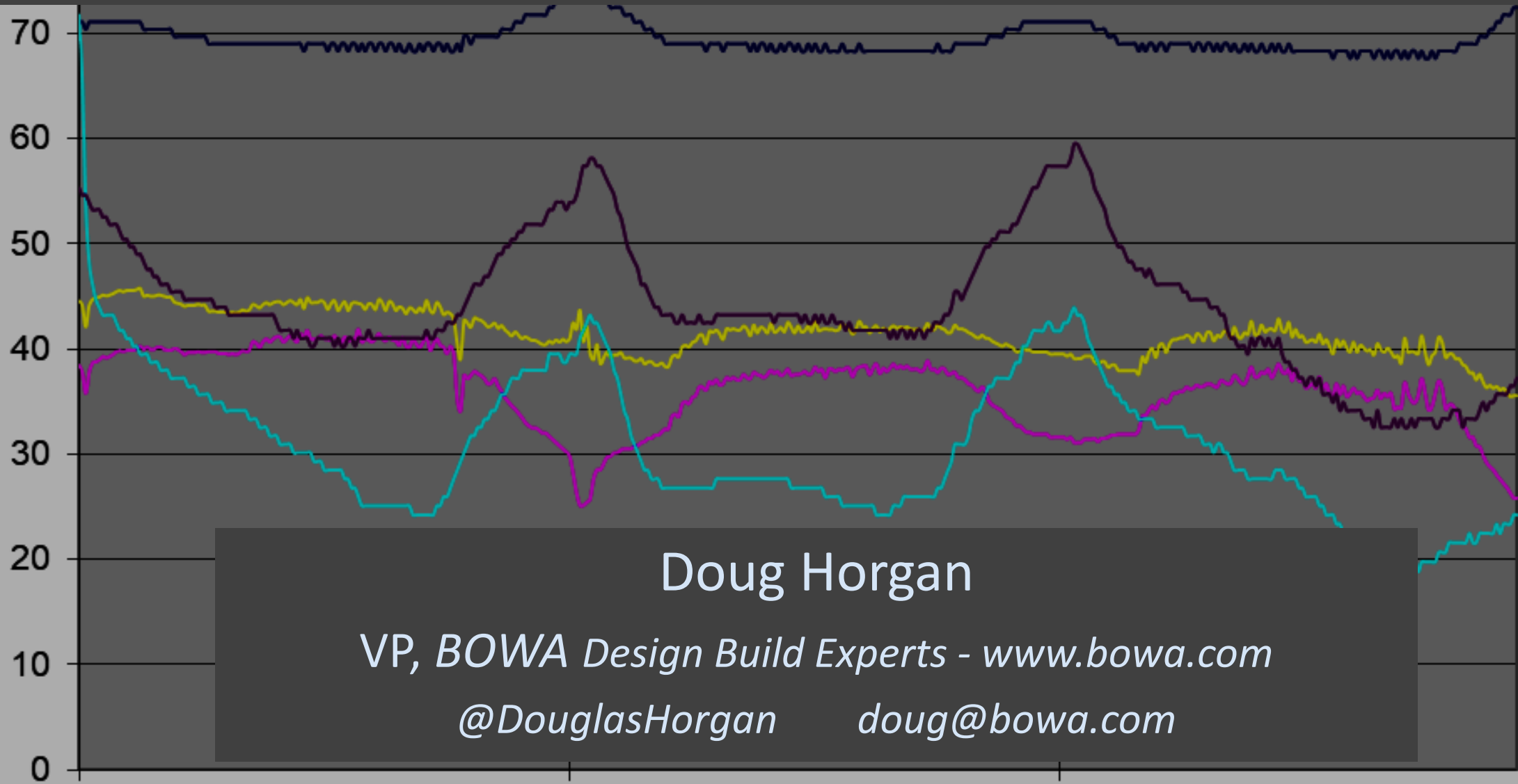


# Advanced Monitoring & Building Diagnostics



**Experience is what you get...**

...when you don't get what you wanted.

*--Dan Stanford*

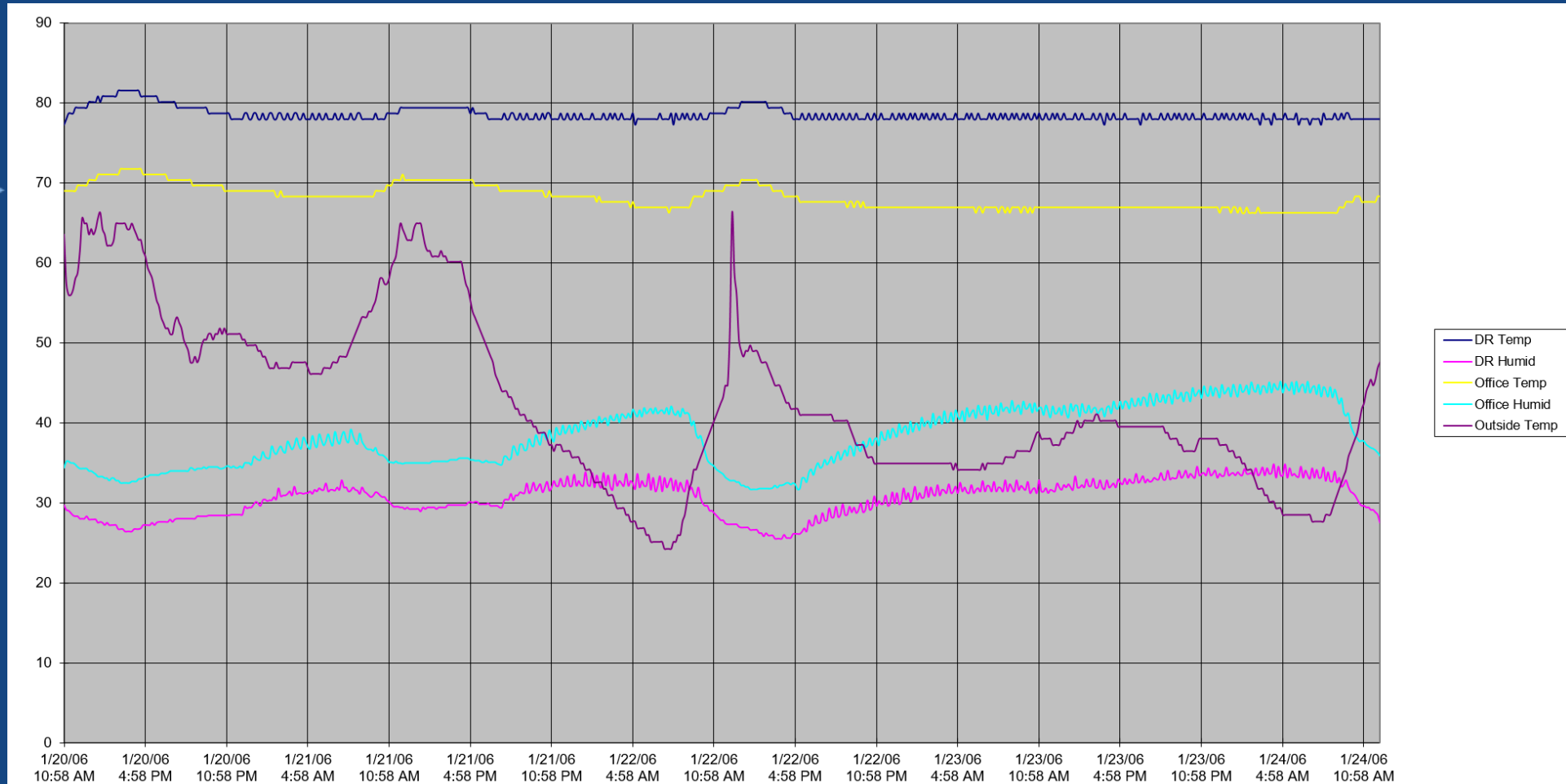
# HVAC Investigation Setup

- Outdoor
- At thermostat
- Problem room
- Non-problem room



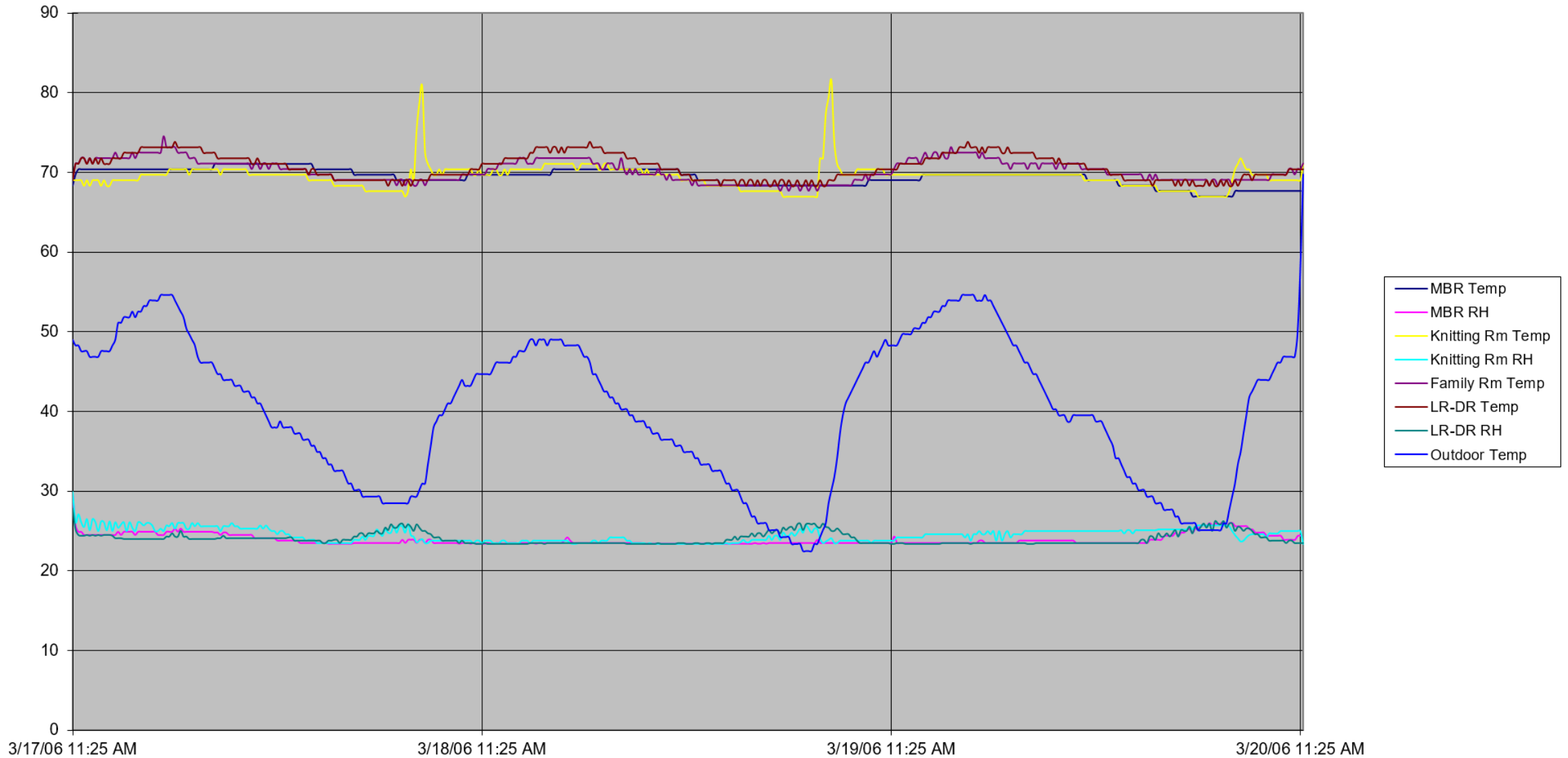
# Lesson Learned: Careful with thermostats

Top of communicating thermostat: +9 degrees



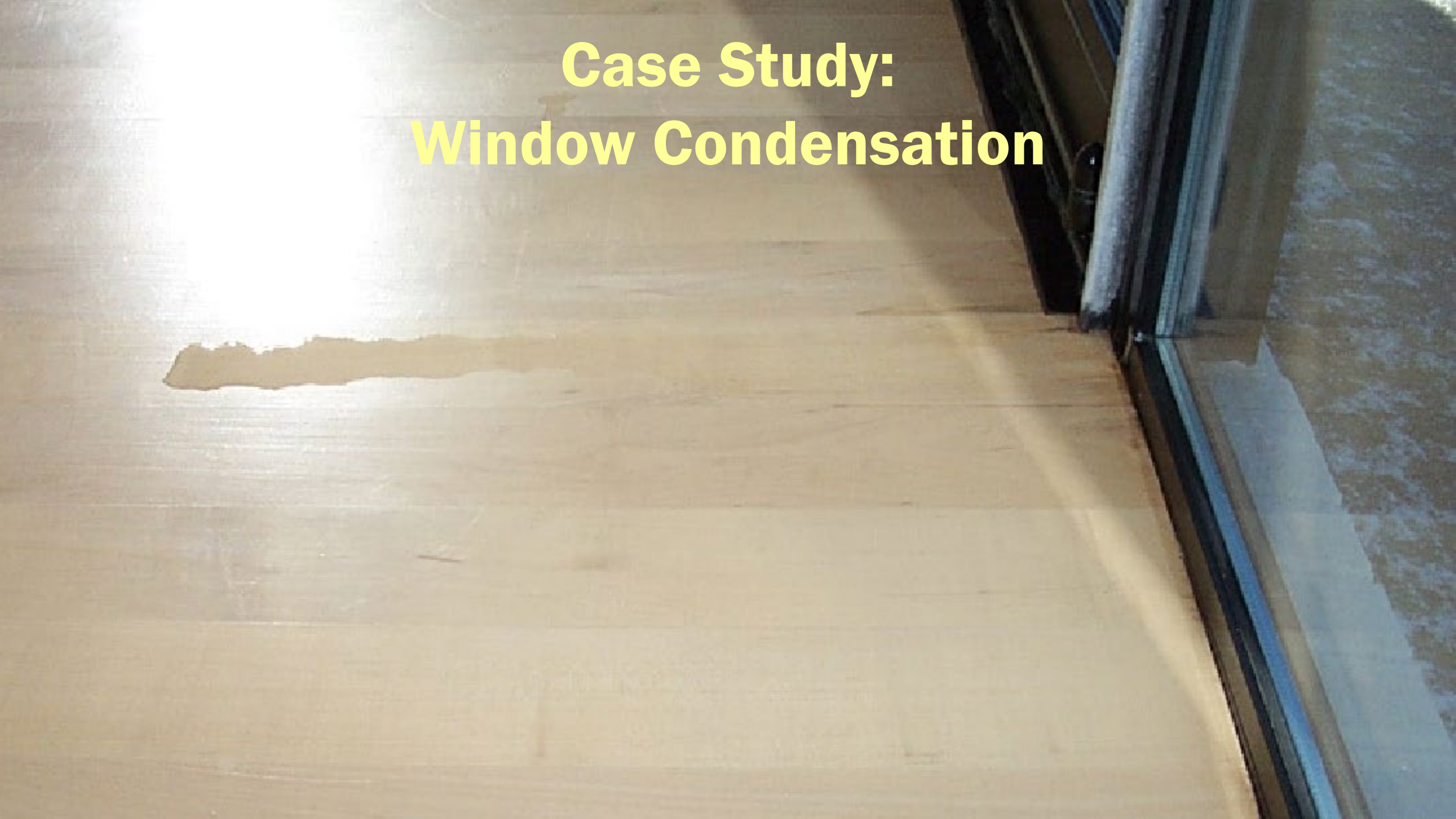


# What are the yellow spikes?





# Case Study: Window Condensation





**“We’ve used these before without problems!”**



Without data, you're just another person with  
an opinion.

*--W. Edwards Deming*

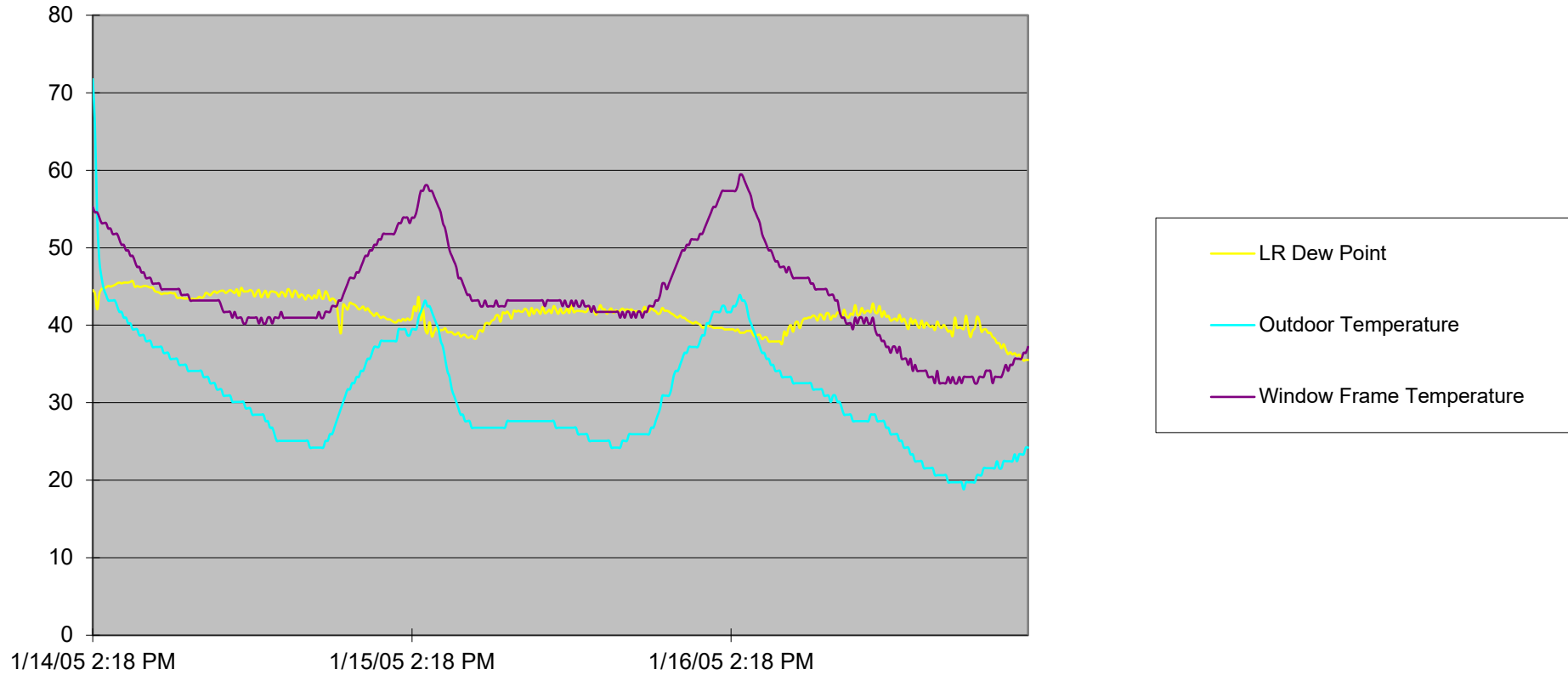


# Data & Diagnosis

Chart 1

	A	B	C	D	E	F	G
1	Date Time	Indoor Air Tem	Room RH	Indoor Air Dev	Outdoor Air Temperature	Window Mullion Temperature	LR Temperature 2
2	1/14/05 2:18 PM	71.08	38.5	44.56	71.77	55.28	71.77
3	1/14/05 2:28 PM	71.08	37.8	44.1	65.59	54.58	71.08
4	1/14/05 2:38 PM	70.39	35.8	42.06	53.89	54.58	70.39
5	1/14/05 2:48 PM	71.08	37.8	44.1	48.25	53.89	71.08
6	1/14/05 2:58 PM	71.08	38.7	44.68	46.1	53.19	71.08
7	1/14/05 3:08 PM	71.08	38.8	44.78	44.65	53.19	71.08
8	1/14/05 3:18 PM	71.08	39	44.9	43.92	53.19	71.08
9	1/14/05 3:28 PM	71.08	39.3	45.1	43.19	52.49	71.08
10	1/14/05 3:38 PM	71.08	39.2	45	43.19	52.49	71.08
11	1/14/05 3:48 PM	71.08	39.3	45.1	43.19	51.79	71.08
12	1/14/05 3:58 PM	71.08	39.5	45.22	43.19	51.79	71.08
13	1/14/05 4:08 PM	71.08	39.8	45.42	42.46	51.79	71.08
14	1/14/05 4:18 PM	71.08	39.9	45.52	41.72	51.08	71.08
15	1/14/05 4:28 PM	71.08	39.8	45.42	41.72	50.38	71.08
16	1/14/05 4:38 PM	71.08	39.9	45.52	40.97	50.38	71.08
17	1/14/05 4:48 PM	71.08	39.9	45.52	40.97	49.67	71.08
18	1/14/05 4:58 PM	71.08	39.9	45.52	40.23	49.67	71.08
19	1/14/05 5:08 PM	71.08	40.1	45.62	40.23	48.96	71.08
20	1/14/05 5:18 PM	71.08	40.3	45.72	39.48	48.96	71.08
21	1/14/05 5:28 PM	70.39	40	44.98	39.48	48.25	71.08
22	1/14/05 5:38 PM	70.39	40.2	45.08	39.48	47.53	71.08
23	1/14/05 5:48 PM	70.39	40	44.98	38.72	47.53	70.39
24	1/14/05 5:58 PM	70.39	40	44.98	38.72	46.82	70.39
25	1/14/05 6:08 PM	70.39	40.2	45.08	38.72	46.82	70.39
26	1/14/05 6:18 PM	70.39	40.2	45.08	37.97	46.1	70.39

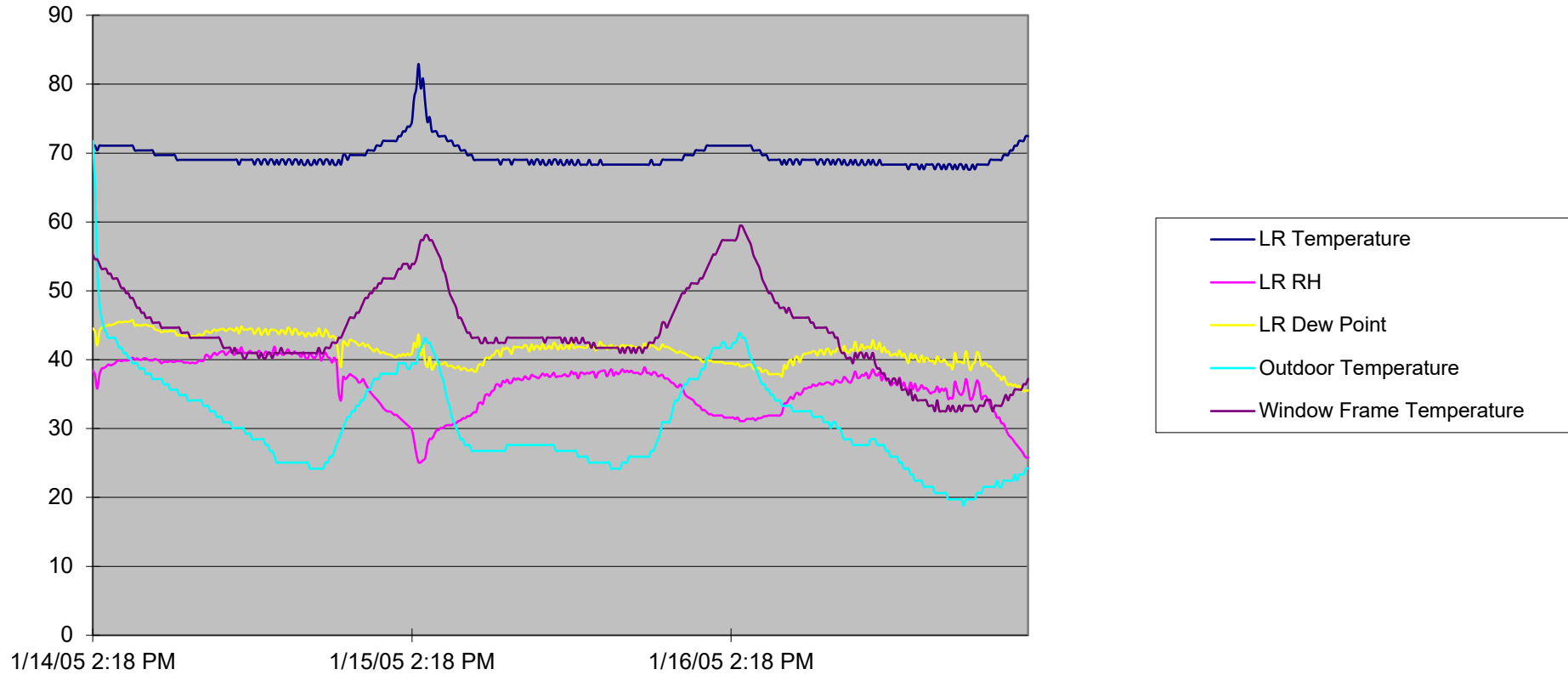
Windows 1/14/05--1/17/05



# Results

- Simple view, only most relevant info

Windows 1/14/05--1/17/05

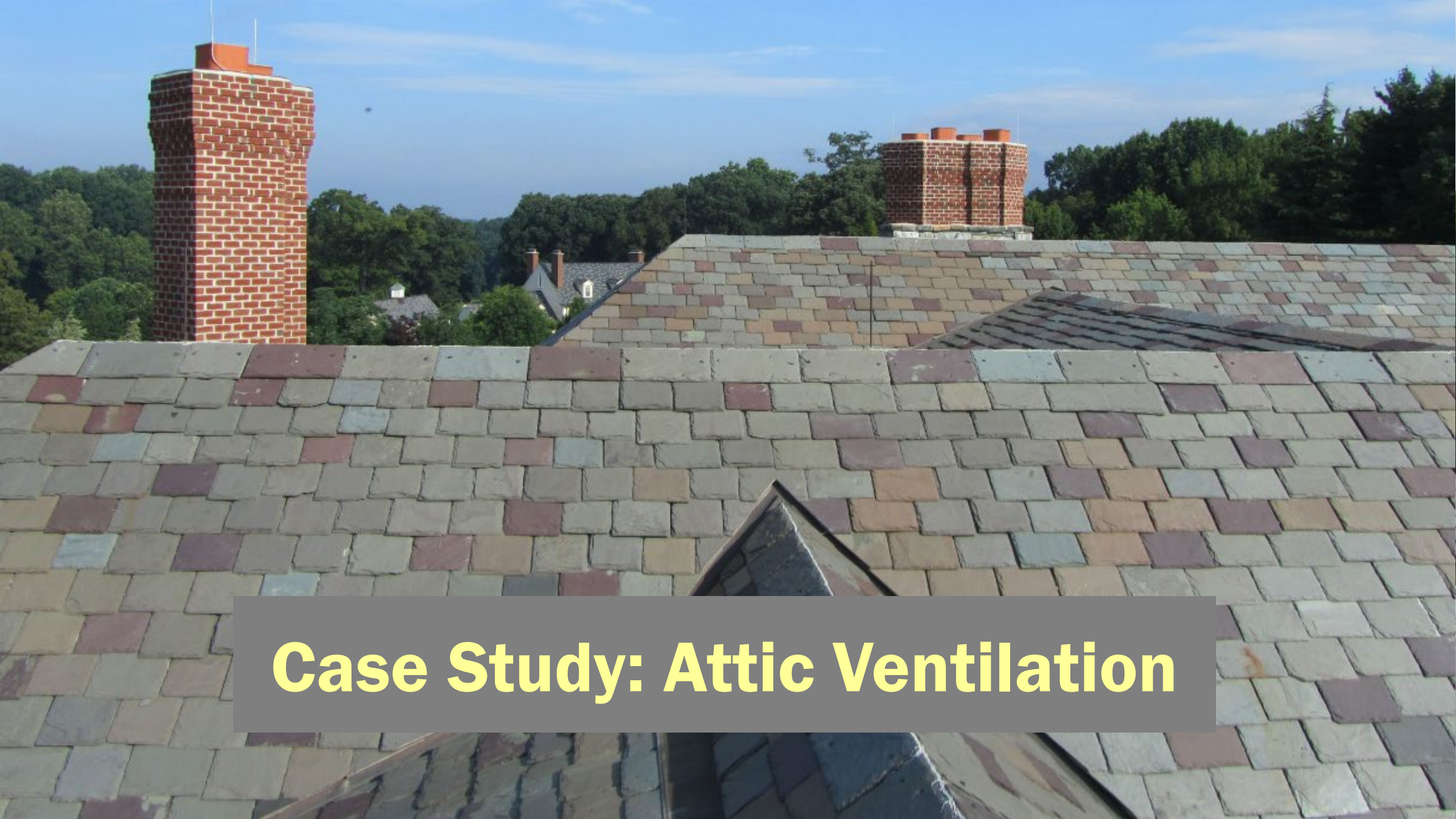


## “The whole story”

- Good for some people, not simple

# Lessons Learned

- Start & keep together, as QA for sensors
- Format results for audience. Use spreadsheet.



## Case Study: Attic Ventilation





- Low-pitch hip roofs
- Power ventilators
- **Is attic moisture controlled in winter?**

# Dew point or RH?

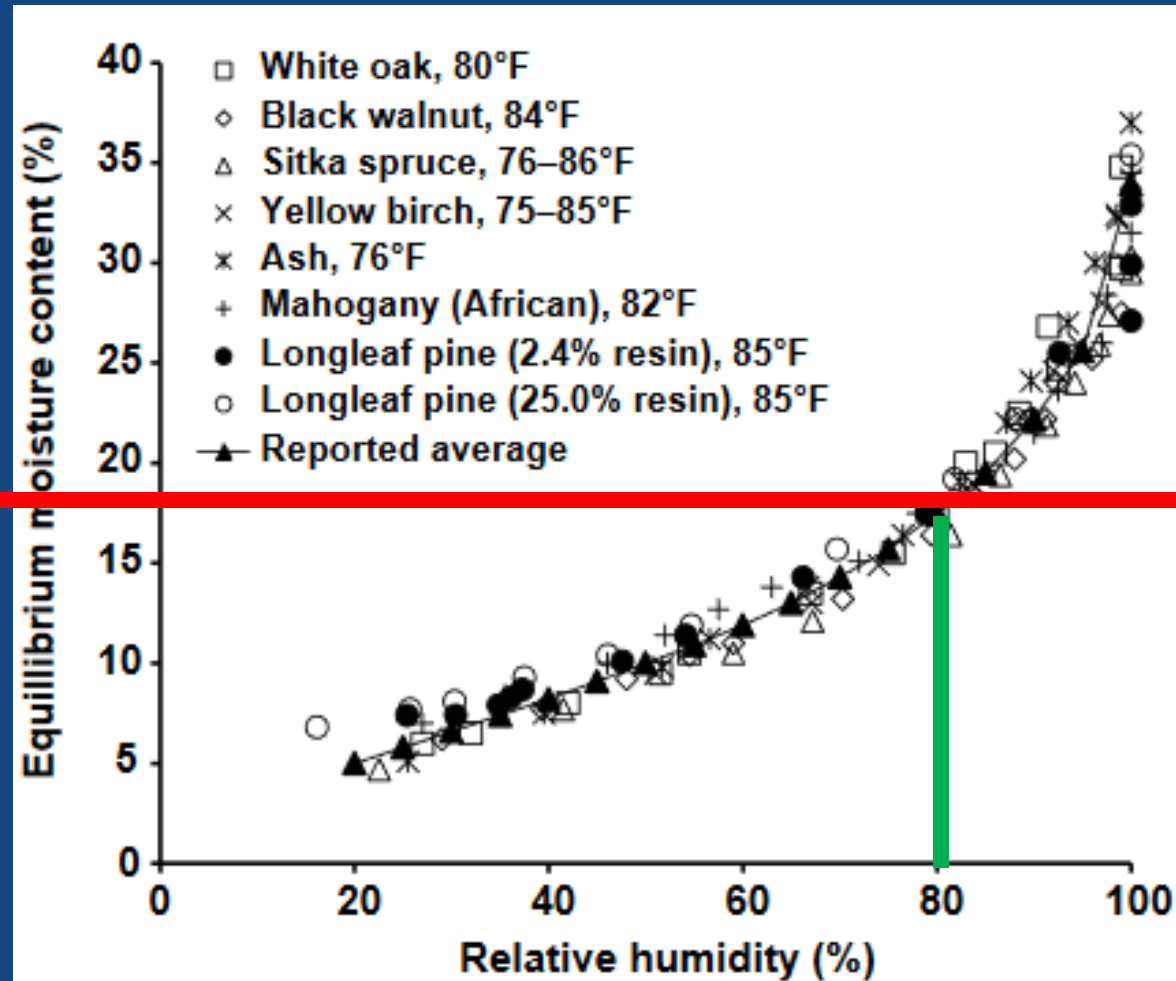


Figure 4. EMC data from Dunlap (1919).







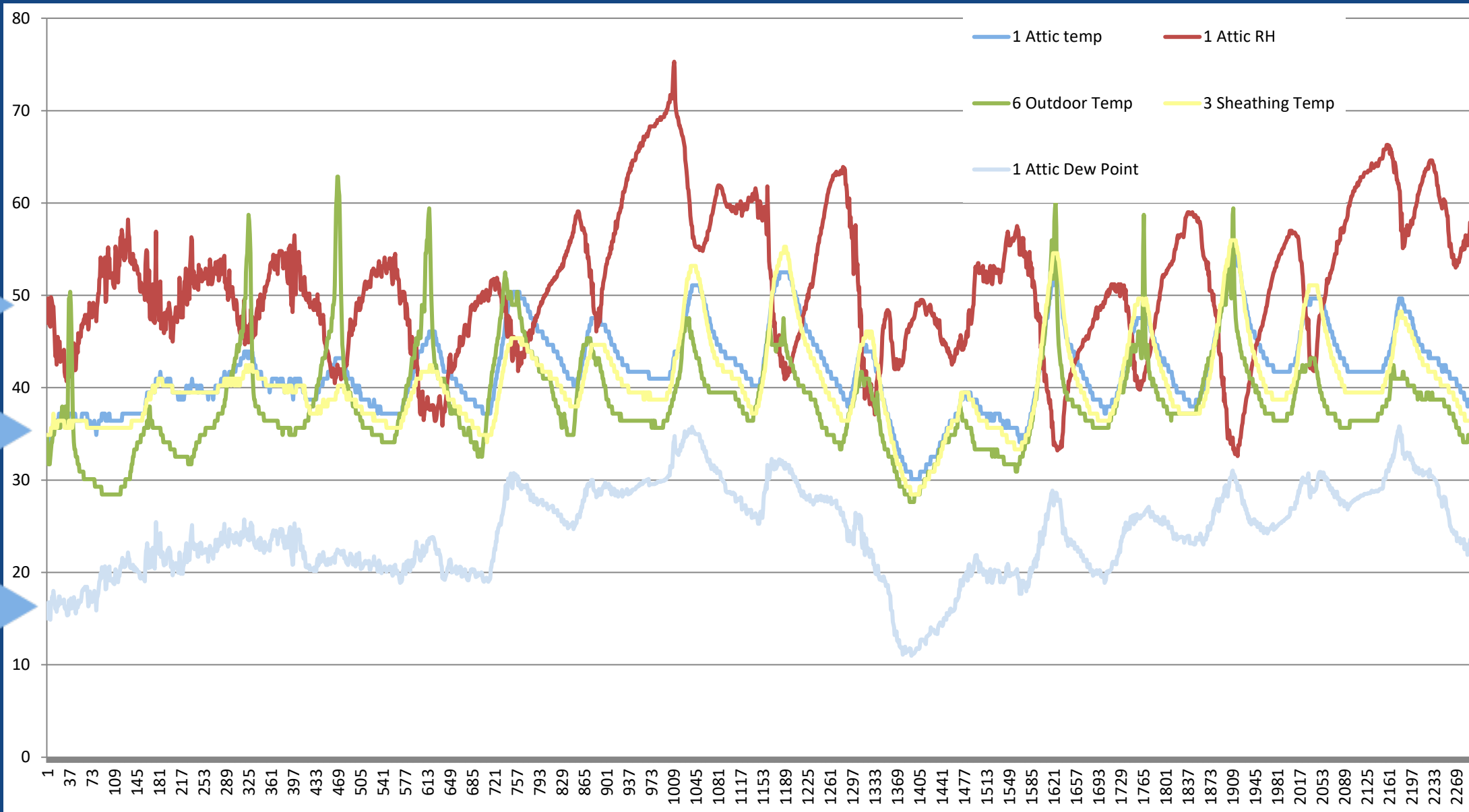
HOBO  
Temp  
External

394-2 NE  
KD-19 HT  
SYP

394-2 NE  
KD-19 HT  
SYP



# Data & Diagnostics



# Case study: Kitchen Overheating





# Situation:

- 8-zone HVAC system

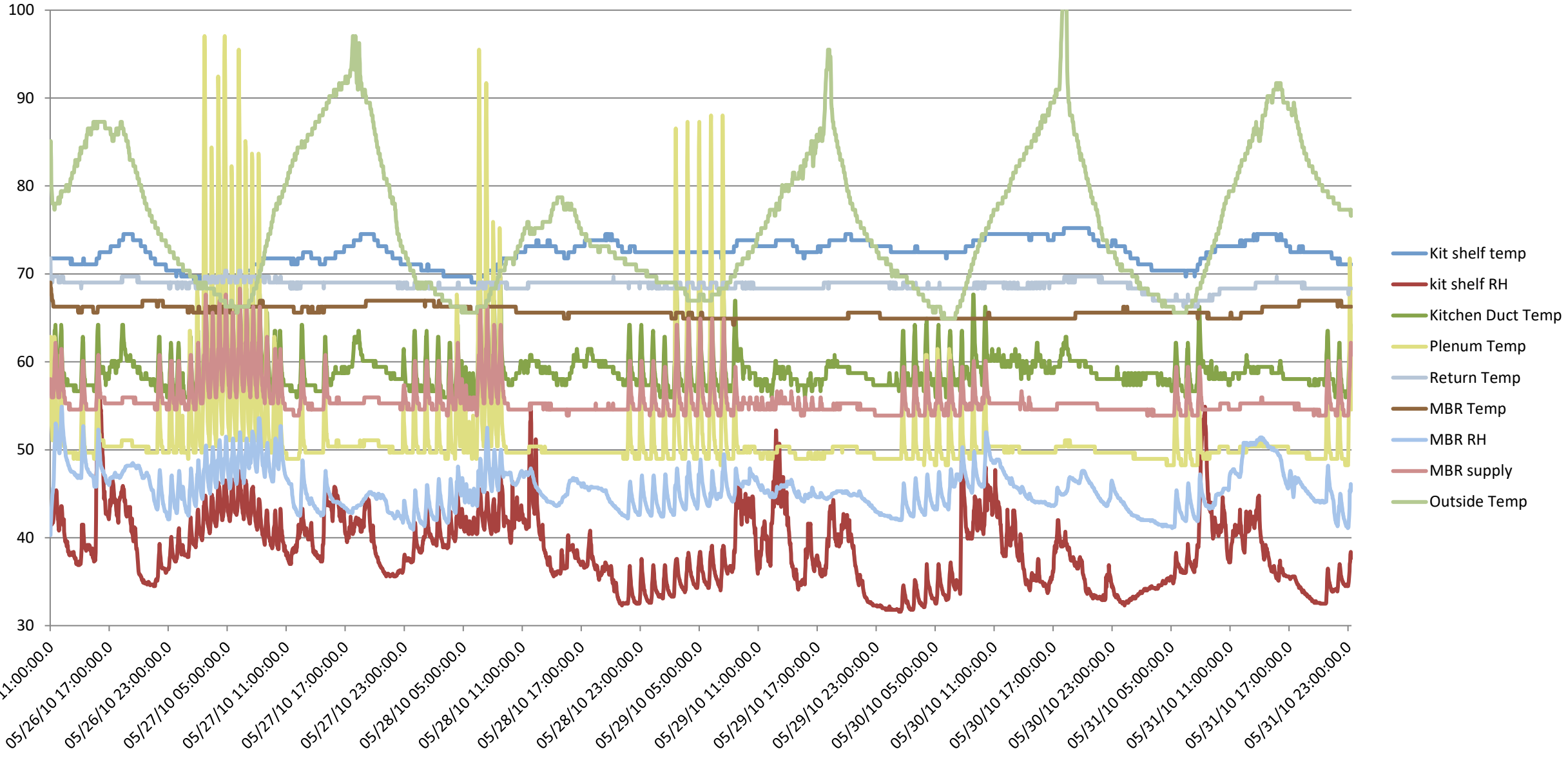
Zone 1 - Master Bed Room  
Zone 2 - Library  
Zone 3 - Bed Room over Breakfast  
Zone 4 - Bed Room<sup>(2)</sup> over Dining Room  
Zone 5 - Morning Room  
Zone 6 - Dining Room  
Zone 7 - Kitchen  
Zone 8 - Basement  
Zone 9 - Drawing Room  
Zone 10 - apartment  
ZONE 11 - BACK BR ABOVE KIT

# Setup:

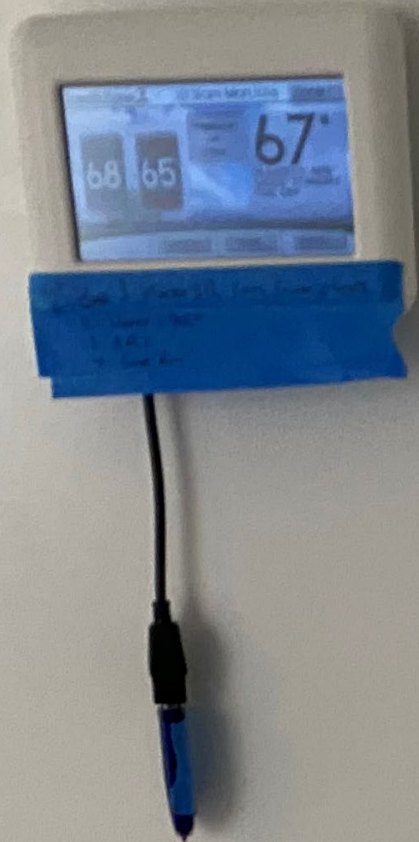
- Sensors at thermostats
- Interval
- Outdoor temp



# Data & Diagnostics



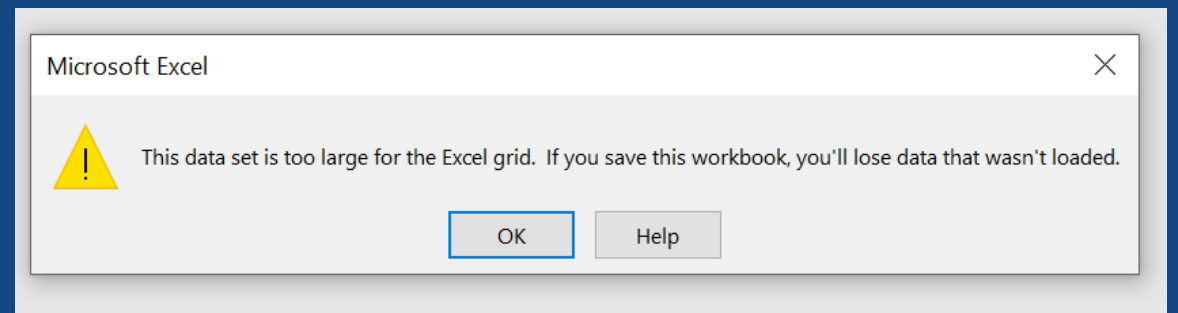
# Logging thermostats



# Is there such thing as too much data?

1048566	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048567	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048568	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048569	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048570	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048571	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048572	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048573	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048574	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048575	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25
1048576	45	0	375	68	66	663	0	0	25	0	208	72	61	677	0	0	25	0	208	72	69	695	0	0	25

- 66 state readings @ 15 second intervals
- 177,000 lines/month
- 75 seconds to open file





**Dan Rockwell** @Leaders... · 6h ▾

I asked John Maxwell what he learned from success & he said, Not as much as I learned from failure.

# Advanced Monitoring & Building Diagnostics

