Managing Heat Waves in Affordable Housing

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Strong Roots. Big Plans

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(PI: C. Andrews)

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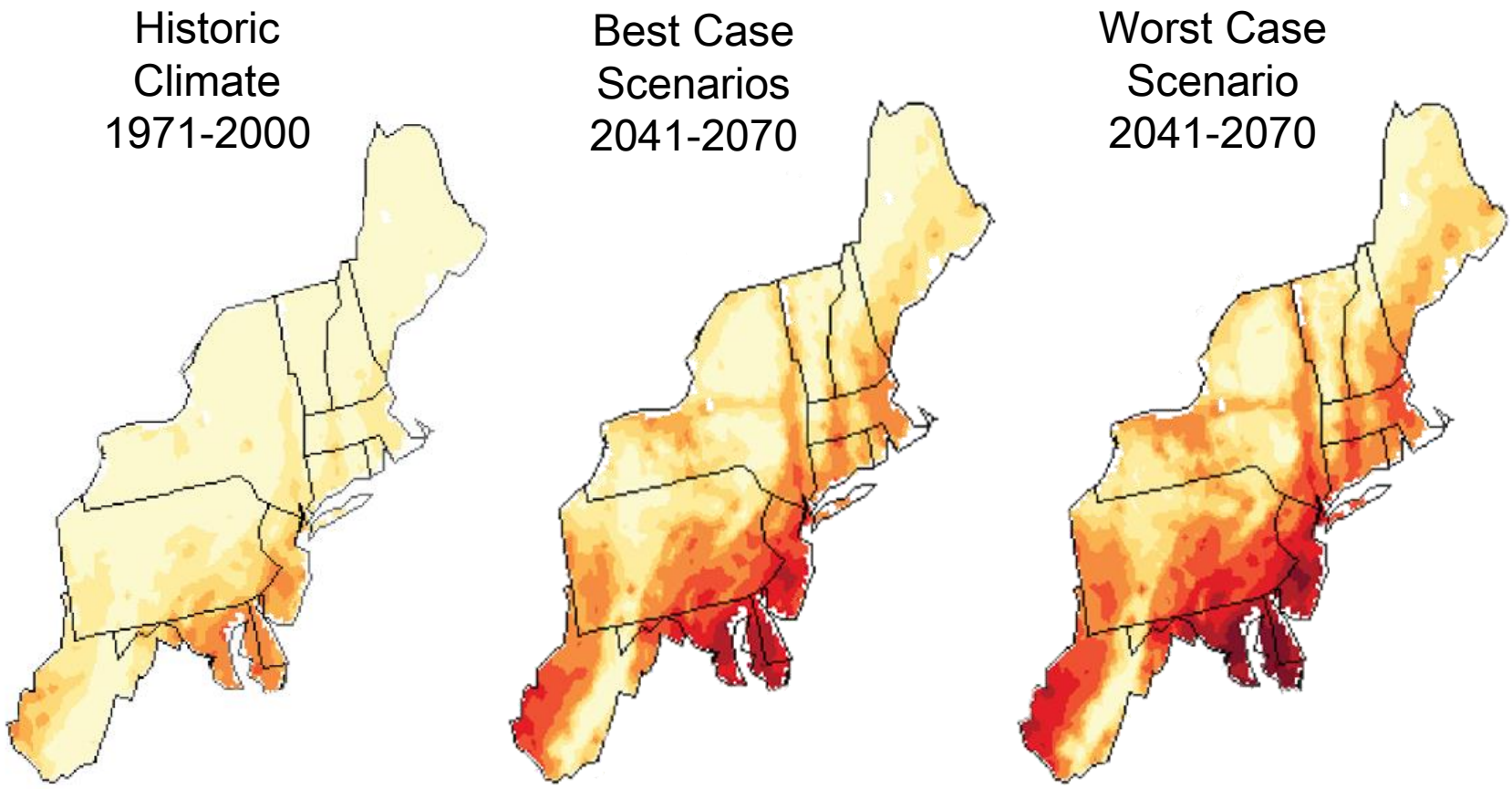
- Introduction (Clinton Andrews, Rutgers University)
- Research Approach & Results (Gedi Mainelis, Rutgers University)
- Key Findings & Implications (Jennifer Senick, Rutgers University)
- Implications for Planning Practice (Jessica Kemp, Center for Planning Excellence)

Introduction

- Motivation
  - Society needs more effective ways to address big problems such as climate change, obesity
  - How much agency do individual people really have?
  - Who can act, in what ways?
- Approach
  - Look at a specific problem, in detail
  - How do vulnerable urban seniors living in public housing cope with summer heat waves?
  - Multidisciplinary study funded by NSF
- Location
  - Housing Authority of the City of Elizabeth, NJ

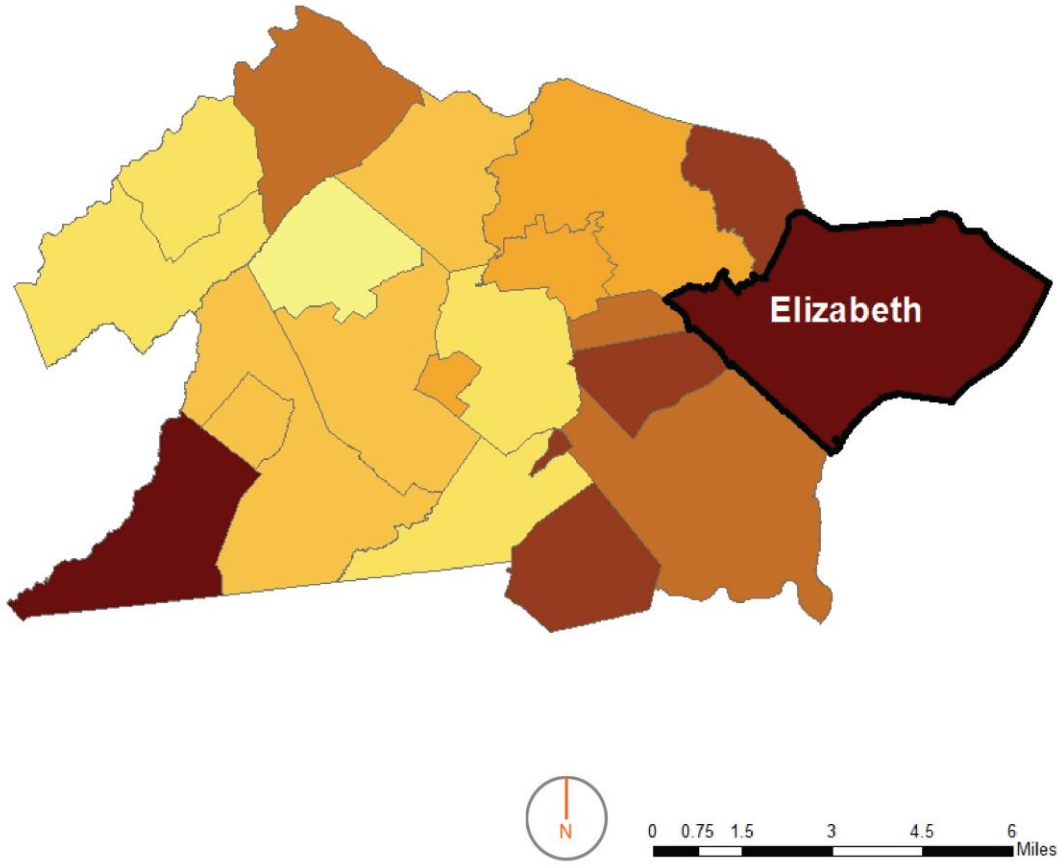
New Jersey's Changing Climate



National Climate Assessment, 2014

Why Elizabeth, NJ:

High % of total hospitalizations that are due to asthma

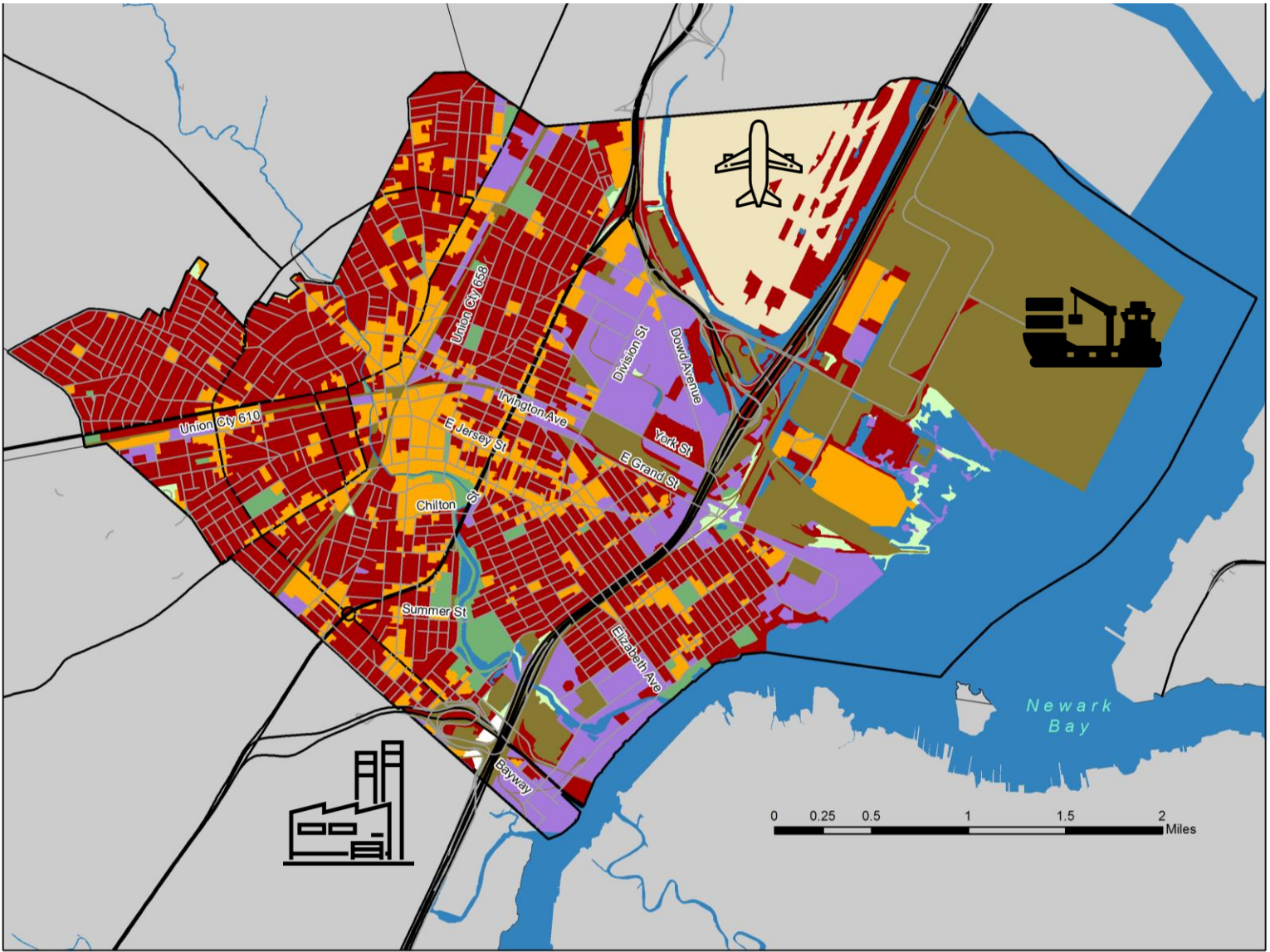


Union County, NJ (2008-2015)

% of Asthma Hospitalizations

- 9.3% - 9.9%
- 10% - 12%
- 12.1% - 12.7%
- 12.8% - 13.8%
- 13.9% - 15.6%
- 15.7% - 18.5%
- 18.6% - 21.5%

Land Use in Elizabeth, NJ



Close proximity to:

Newark Airport

Port Newark Marine Terminal

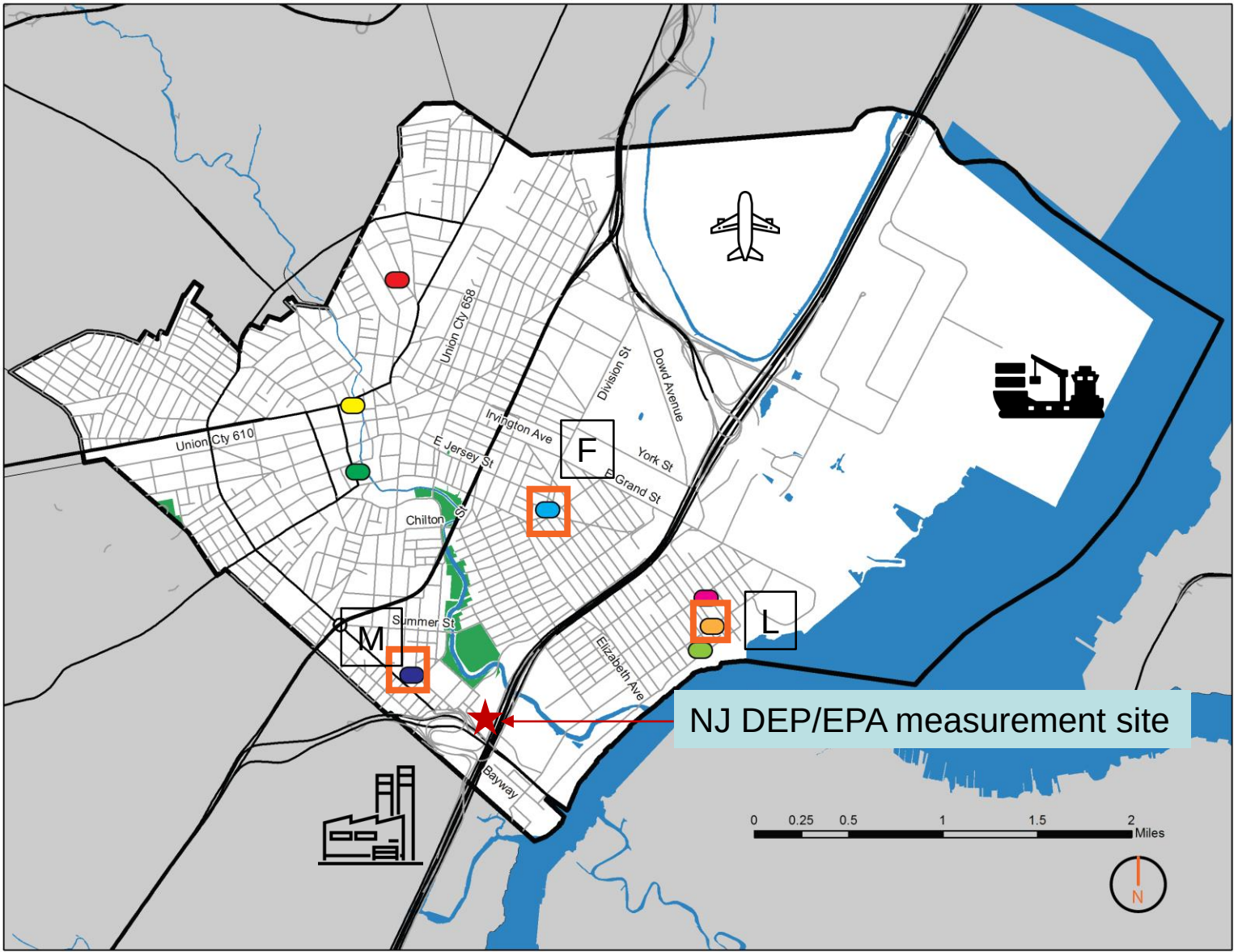
Chemical refineries

Highways

Land Use/Land Cover

- Airport Facilities
- Urban/Residential
- Water
- Recreational Land
- Commercial/Services
- Forest
- Industrial
- Roadways/Transportation

Housing Authority of the City of Elizabeth

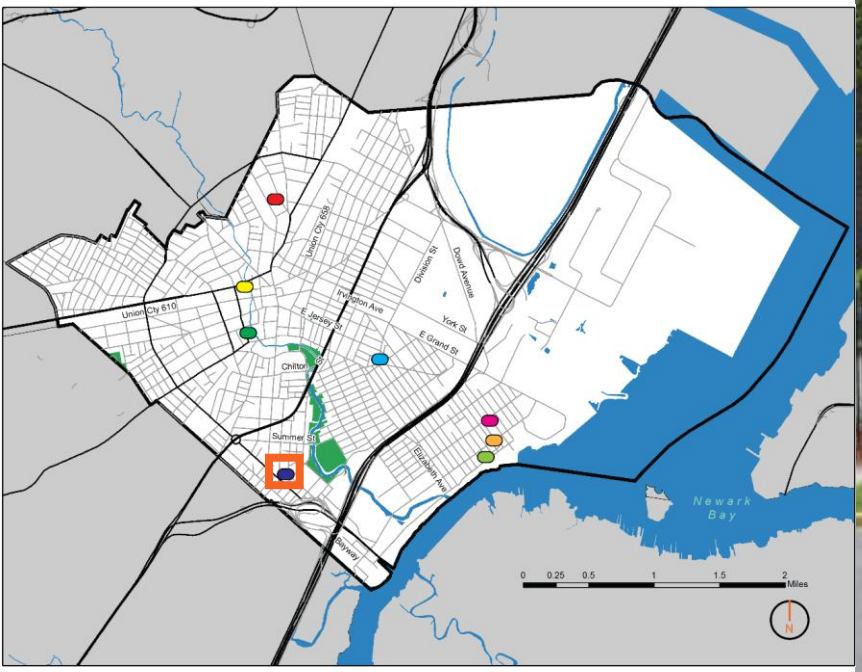


HACE Properties
- O'Donnell Dempsey Towers
- Kennedy Arms
- Farley Towers
- Ford Leonard Towers
- Mravlag Manor
- Heritage Village
- 205 1st St
- Marina Village

HOUSING AUTHORITY OF THE CITY OF ELIZABETH
HACE 1938

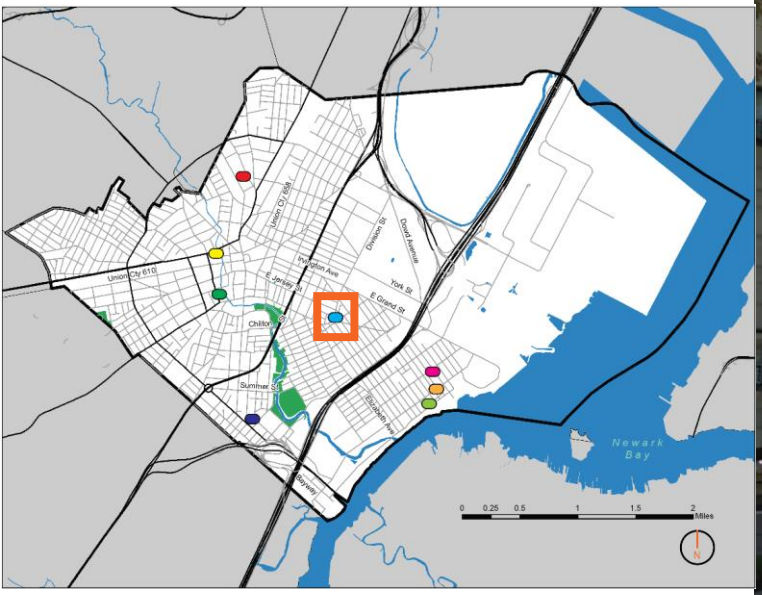
Mravlag Manor (Site M)

- 421 Units in 15 three-story walk-ups
- New roofs, fire escapes, heaters + bathrooms
- On-site community room and event space
- Social + financial support services



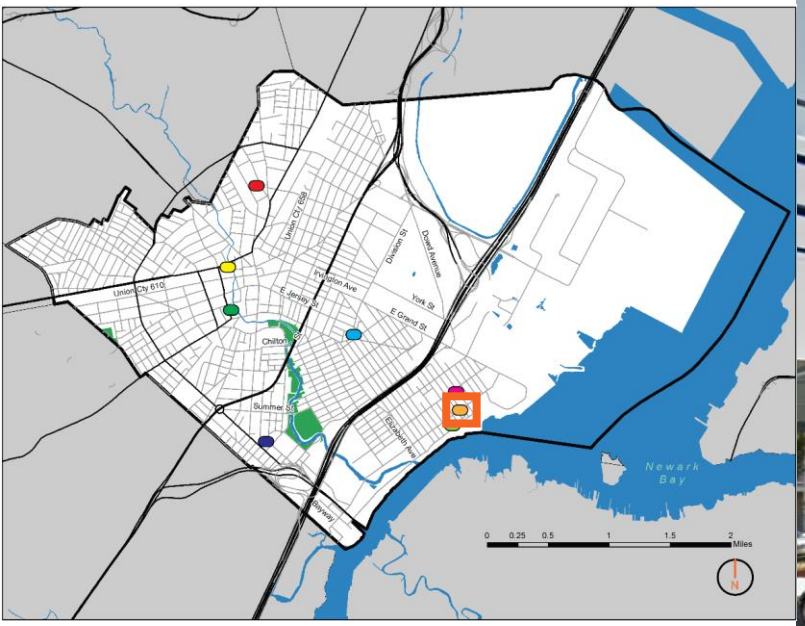
Ford Leonard Towers (Site F)

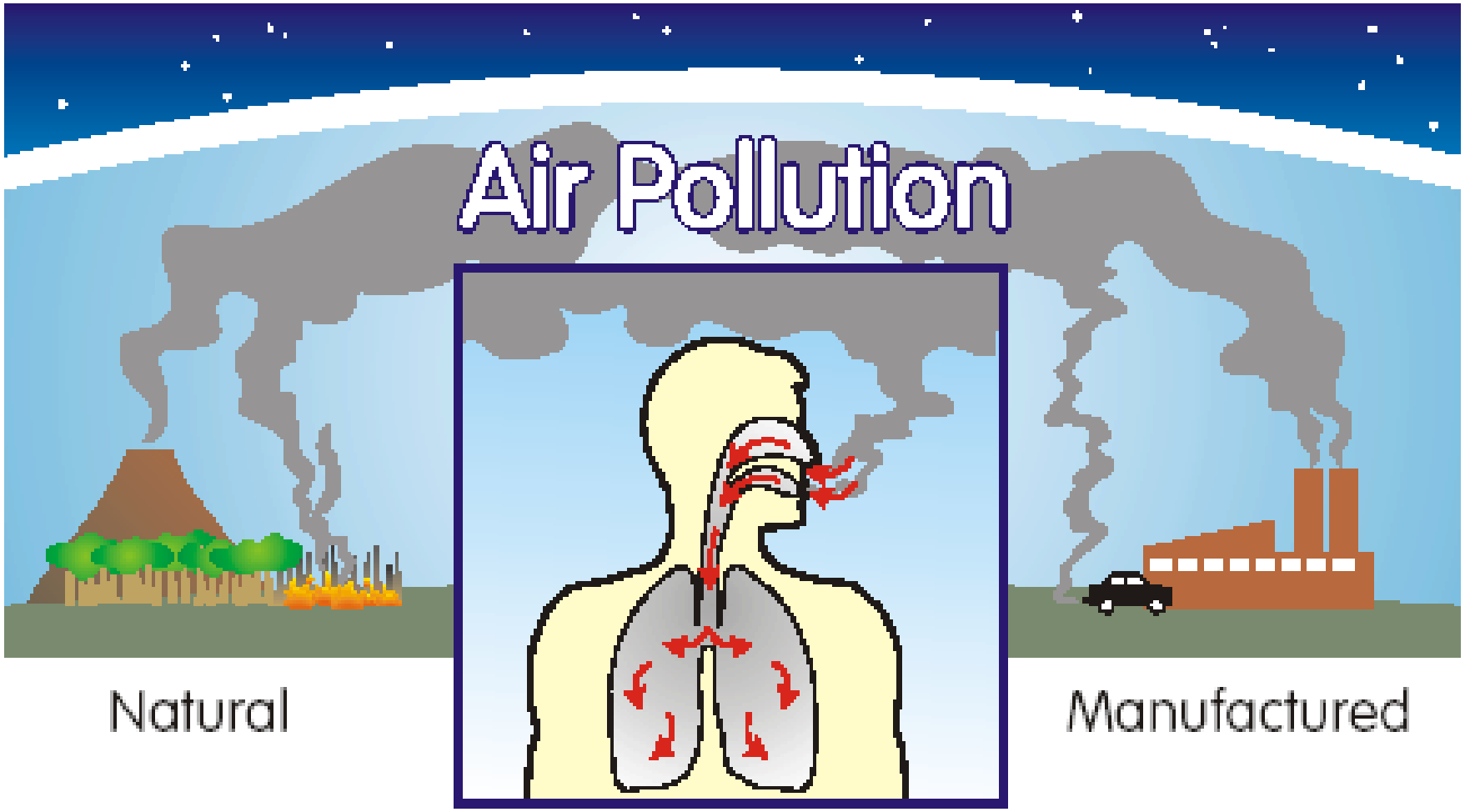
- 121 Units
- 11-stories (1 building)
- Extensive upgrades
- Community Space

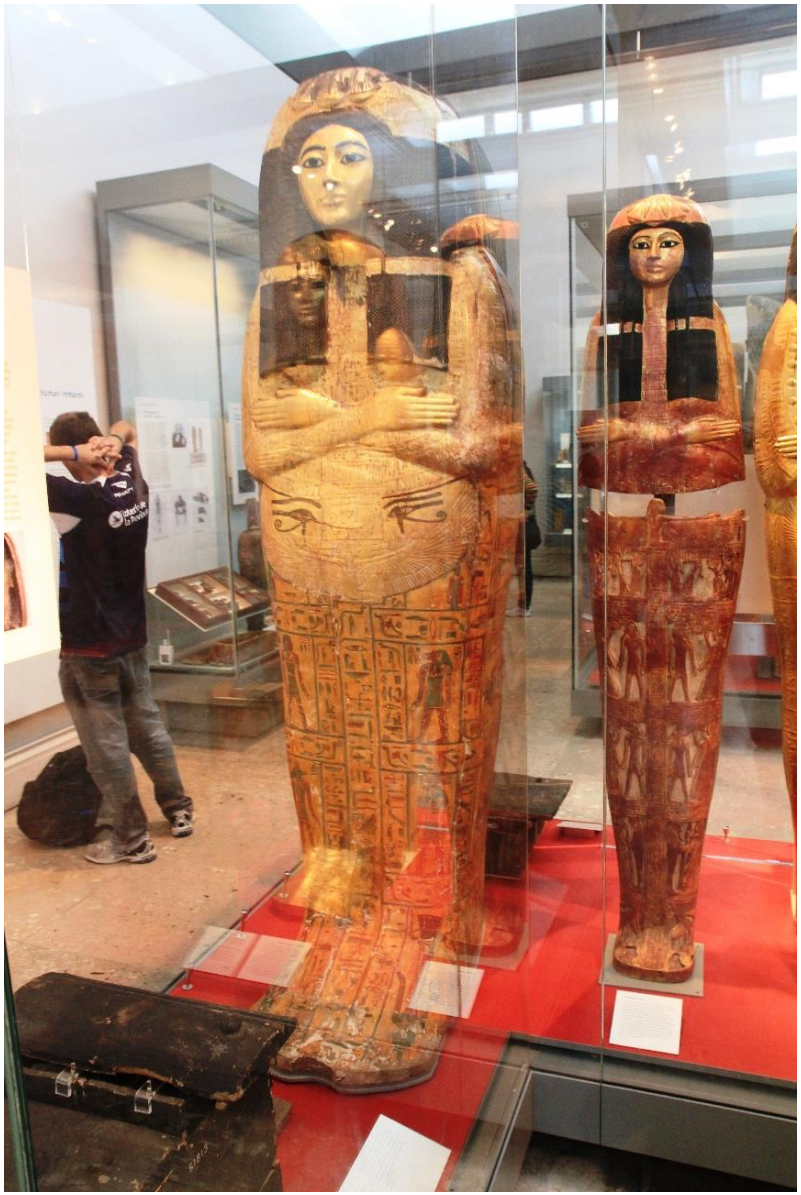


205 First Street (Site L)

- 30 Senior-only units
- Newest HACE property
- LEED Gold
- All units have access to central air




Air Pollution
Natural
Manufactured



Picture from a British museum in London

NEW KINGDOM, c.1279–1213 BC

Burial assemblage of the lady Henutmehyt

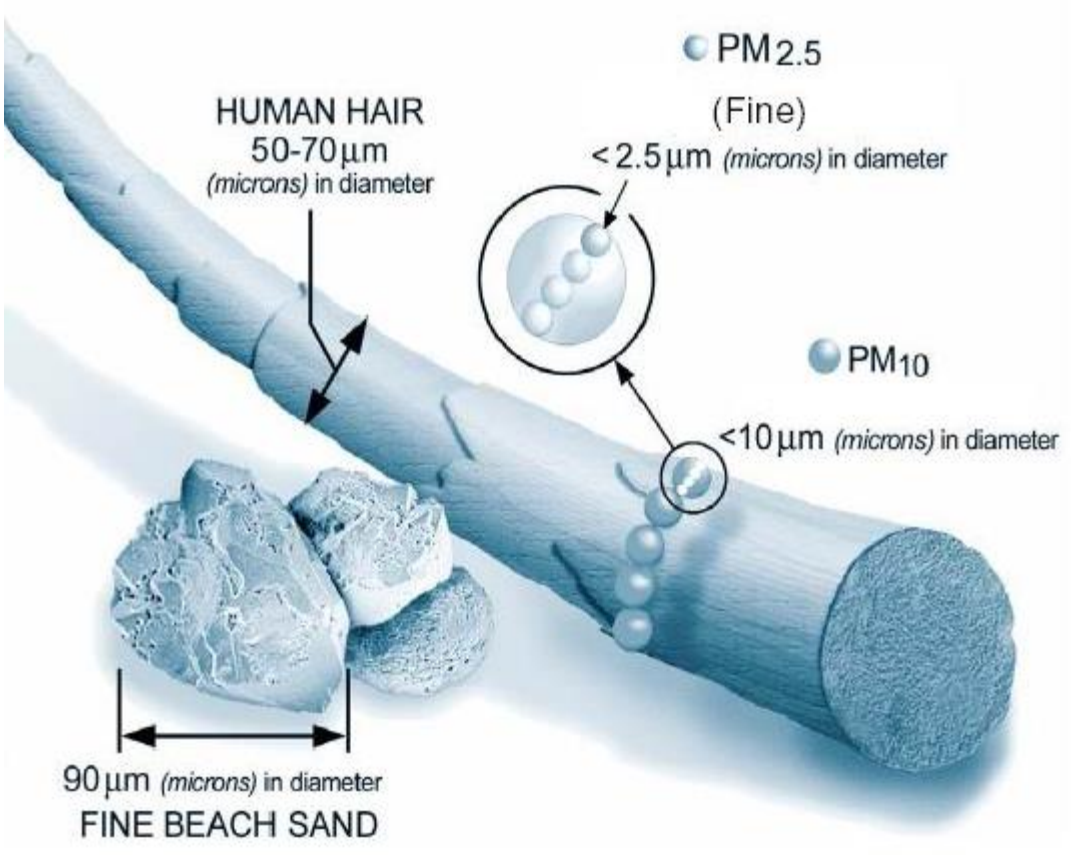
This rich assemblage of objects was found by inhabitants of the Theban West Bank in or before 1904. The majority of the pieces were purchased for the British Museum between 1905 and 1913. From the style of the individual items the burial can be dated to the 19th Dynasty, probably to within the reign of Ramesses II (about 1279-1213 BC).

The inscriptions entitle Henutmehyt 'Lady of the House' (i.e. married woman) and Chantress of Amen-Ra in the temple of Karnak. This was a common title, but Henutmehyt's comprehensive burial outfit, and the fine craftsmanship and rich gilding of her coffins indicate that she was of very high status.

The surviving fragments of her mummy indicate that Henutmehyt had a maximum height of 158 cm, and wore her own hair, which was reddish-brown in colour. Studies of lung tissue from the jackal-headed canopic jar revealed that Henutmehyt suffered from several illnesses including emphysema, indicating that she died at an advanced age. She also suffered from anthracosis (a build-up of carbon deposits in the lung), an ailment prevalent in ancient Egypt, where open hearths polluted the living environment with smoke.

Particulate pollution

- PM_{10} (particles below 10 μm)
- $PM_{2.5}$ (particles below 2.5 μm); fine particles
- $PM_{2.5}$ are able to penetrate deep into the lung due to their small size
- The size and composition of the particles are important characteristics with respect to health

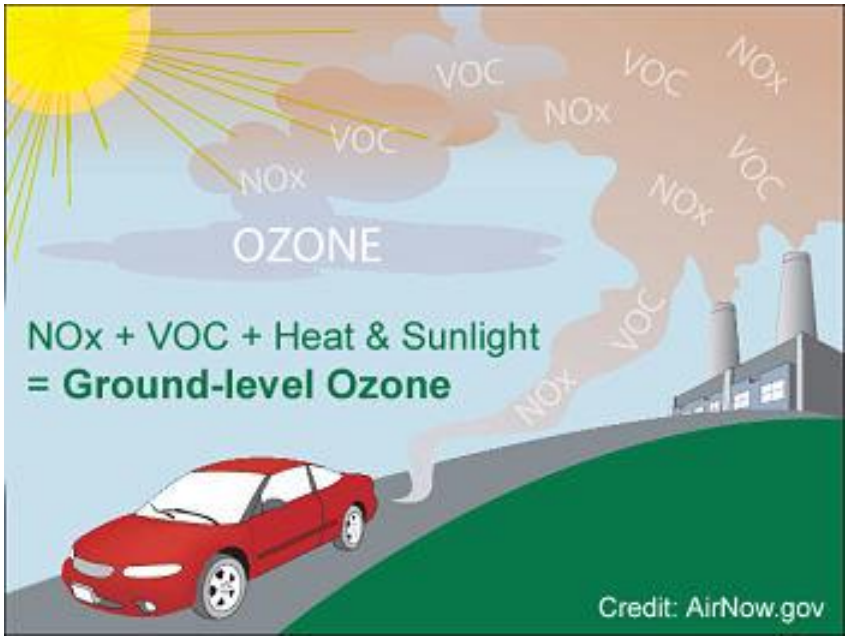


Exposure to PM has been shown to lead to:

- premature death in people with heart or lung disease
- nonfatal heart attacks
- irregular heartbeat
- aggravated asthma
- decreased lung function
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

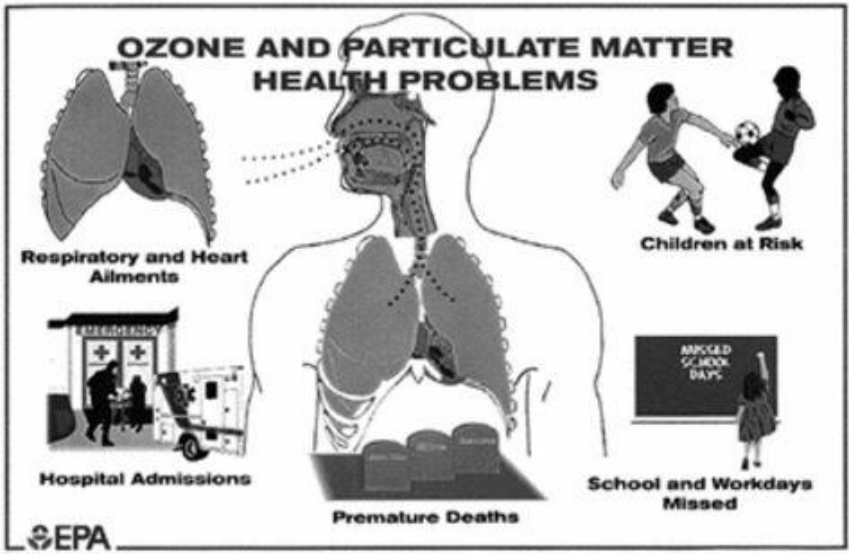
Ground-level Ozone (O_3)

- Exposure to ozone may trigger chest pain, coughing, throat irritation, and airway inflammation.
- It also can reduce lung function and harm lung tissue.
- Can worsen bronchitis, emphysema, and asthma, leading to increased medical care.



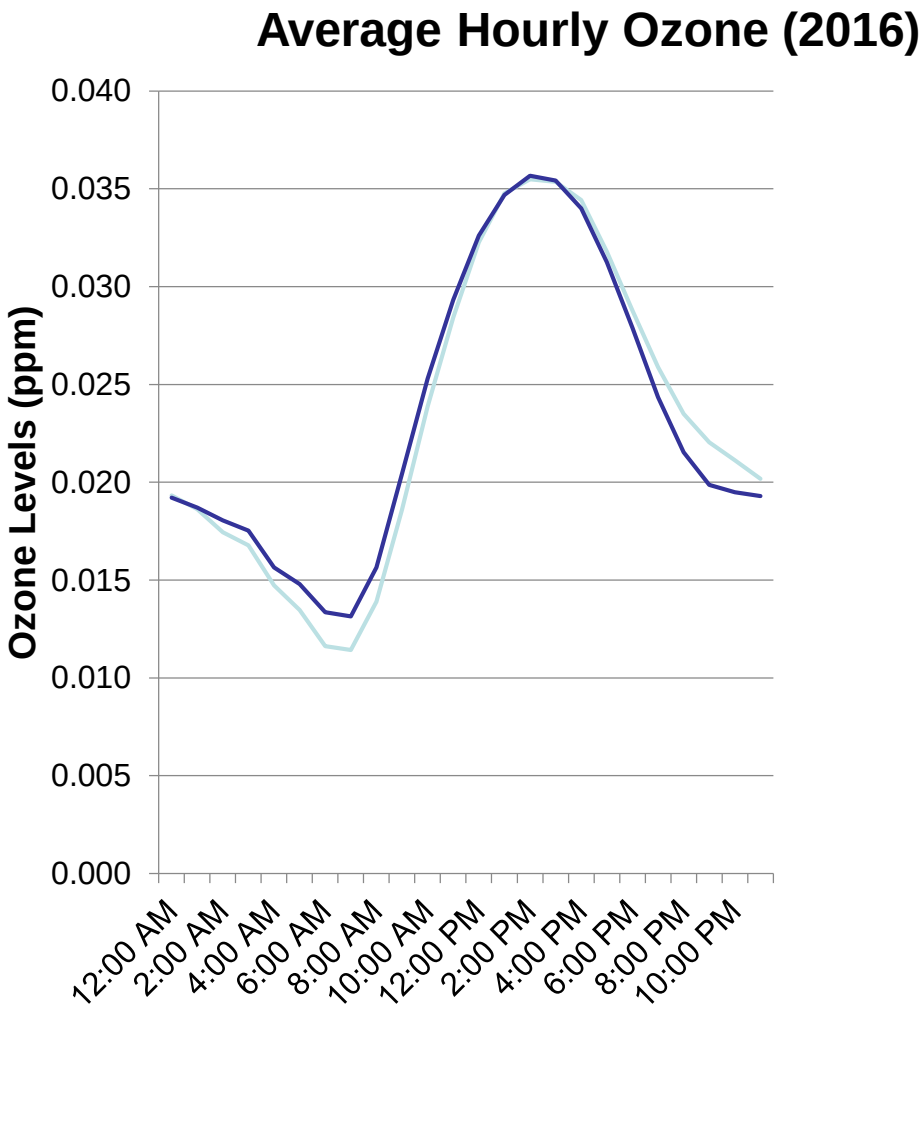
Indoor air quality and health

- People spend 90% of time indoors, so indoor exposures to air pollutants contribute to health effects
- Outdoor air quality ≈ f(emissions, weather)
- Indoor air quality ≈ f (outdoor air quality, building design, occupant behavior)
- No standards for indoor PM
- Individual health outcomes vary, even for similar exposures

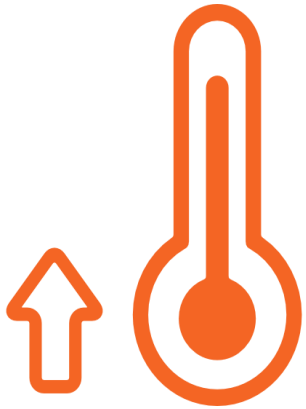


Air Quality Report 2015, NJ DEP

Heat Waves + Air Quality



- Ground-level Ozone levels vary significantly throughout the day
- High temperature associated with higher levels of ozone
- Ozone, PM2.5, PM10, CO_2 + high temperature have negative effects on health



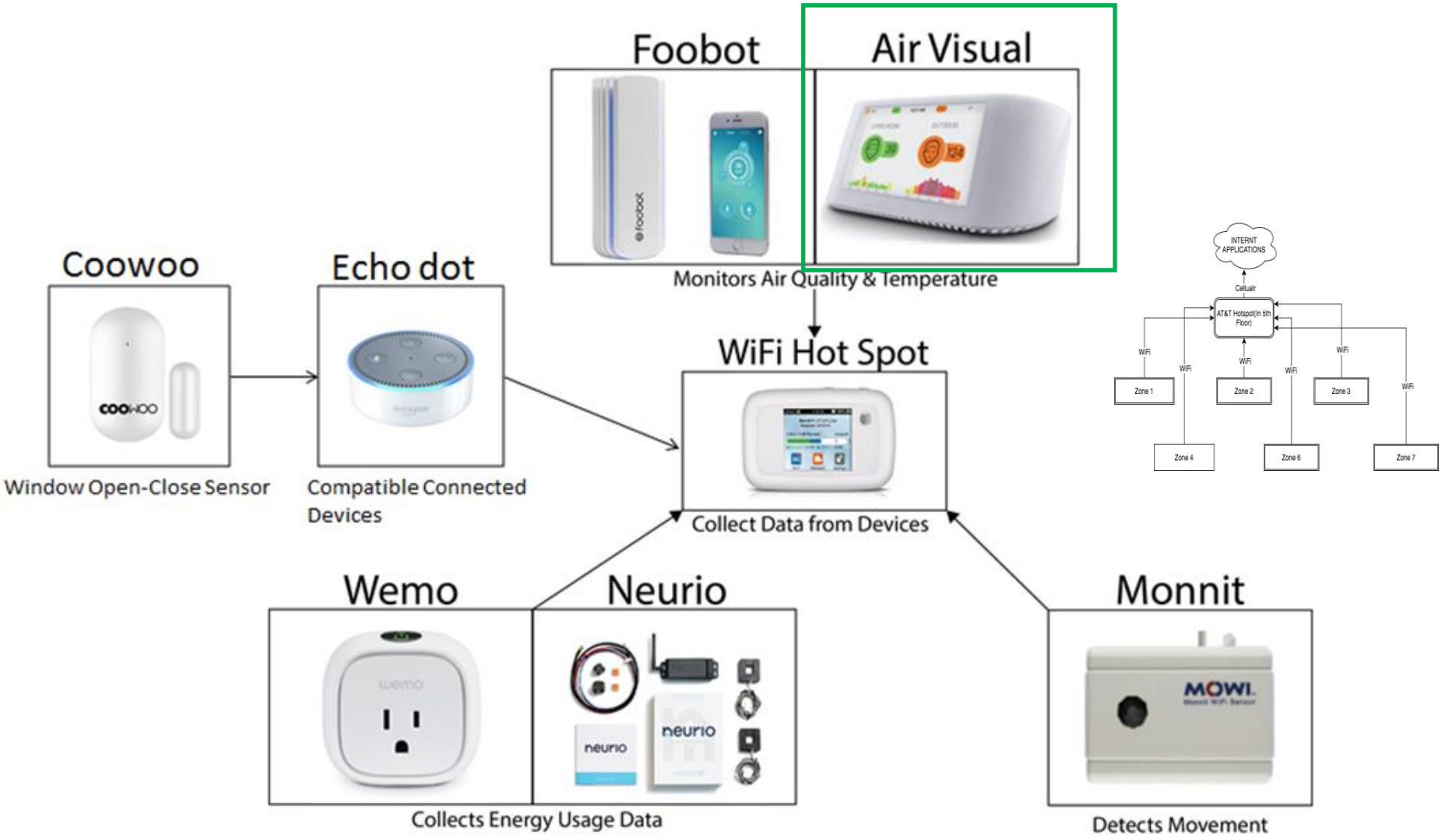
Study design

- Location: Elizabeth, NJ; 24 households in Housing Authority of the City of Elizabeth (HACE)
  - 3 different buildings
- Baseline interviews on SES, health, coping strategies, etc.
- Follow-up interviews; especially during heatwaves
- Continuous outdoor measurements using sensors
- Continuous indoor measurements (24 apts) using sensors
- Empty apartment: continuous measurements using sensors
- Study timeframe: July 1 – September 30

Sensor Measurements

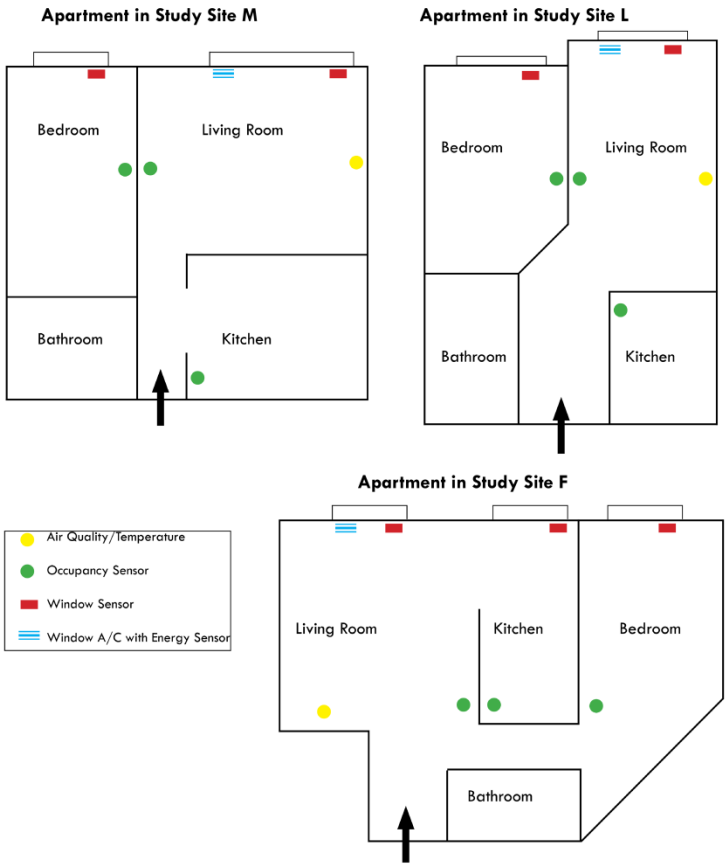
- PM2.5, temperature, humidity measured by AirVisual consumer-grade devices
- Ozone (outdoors + empty apartment). POM from 2B Tech.
- Window open/close sensor
- Occupancy sensor
- AC usage sensor
- Electricity usage sensor
- All sensors connected to cloud

Consumer-grade sensors in apartments



PM measurements. Outdoor site

Apartment Plans and Sensor Locations

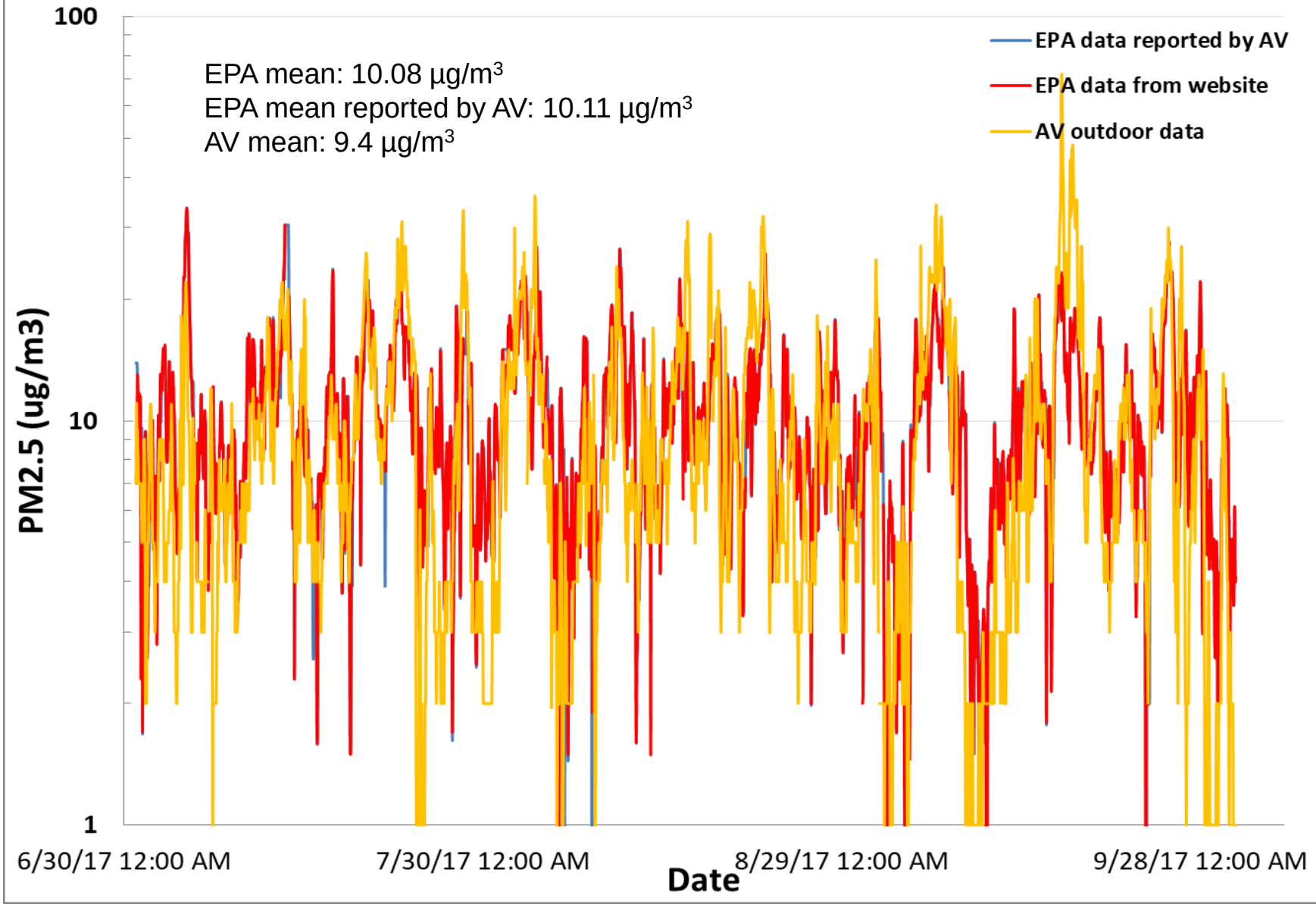


RUTGERS

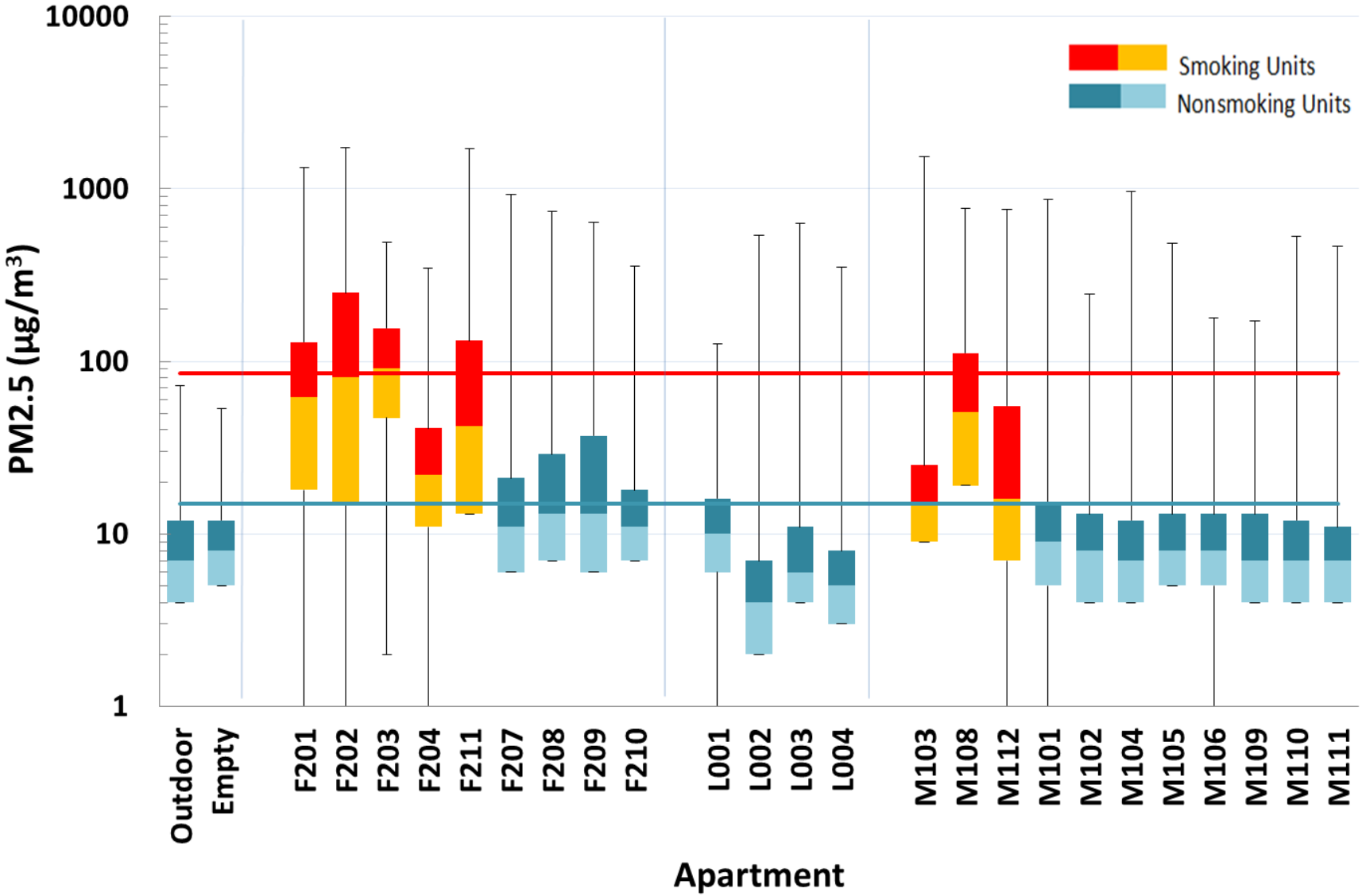
Name	Status	AQI	PM2.5 In	PM2.5 Out	CO_2	Temp	Hum
empty	OFF	AQI 12 Good	3 µg/m³	6.9 µg/m³	408 ppm	77 °F	66 %
f201	OFF	AQI 110 Unhealthy for SG	39 µg/m³	6.9 µg/m³	415 ppm	77 °F	66 %
f202	on	AQI 274 Very Unhealthy	224 µg/m³	6.9 µg/m³	524 ppm	82.4 °F	59 %
f203	OFF	AQI 55 Moderate	14 µg/m³	6.9 µg/m³	422 ppm	78.8 °F	65 %
f204	OFF	AQI 50 Good	12 µg/m³	6.9 µg/m³	497 ppm	78.8 °F	62 %
f207	OFF	AQI 74 Moderate	23 µg/m³	6.9 µg/m³	461 ppm	78.8 °F	66 %
f207 check ...	OFF	AQI 76 Moderate	24 µg/m³	6.9 µg/m³	451 ppm	78.8 °F	67 %
f208	on	AQI 409 Hazardous	363 µg/m³	6.9 µg/m³	797 ppm	80.6 °F	72 %
f209	Offline	AQI 29 Good	7 µg/m³	6.3 µg/m³	613 ppm	75.2 °F	54 %
f210	OFF	AQI 29 Good	7 µg/m³	6.9 µg/m³	474 ppm	77 °F	68 %
f211	OFF	AQI 175 Unhealthy	102 µg/m³	6.9 µg/m³	418 ppm	75.2 °F	57 %
l001	on	AQI 37 Good	9 µg/m³	6.9 µg/m³	601 ppm	77 °F	59 %
l002	OFF	AQI 25 Good	6 µg/m³	6.9 µg/m³	427 ppm	78.8 °F	61 %
l003	OFF	AQI 25 Good	6 µg/m³	6.9 µg/m³	462 ppm	80.6 °F	63 %
l003 check ...	OFF	AQI 29 Good	7 µg/m³	6.9 µg/m³	459 ppm	80.6 °F	60 %
l004	on	AQI 17 Good	4 µg/m³	6.9 µg/m³	482 ppm	78.8 °F	65 %
m101	on	AQI 21 Good	5 µg/m³	6.9 µg/m³	709 ppm	75.2 °F	68 %
m102	on	AQI 21 Good	5 µg/m³	6.9 µg/m³	445 ppm	78.8 °F	65 %
m103	OFF	AQI 21 Good	5 µg/m³	6.9 µg/m³	464 ppm	78.8 °F	63 %
m104	on	AQI 21 Good	5 µg/m³	6.9 µg/m³	974 ppm	73.4 °F	55 %
m105	on	AQI 17 Good	4 µg/m³	6.9 µg/m³	450 ppm	80.6 °F	62 %
m106	on	AQI 12 Good	3 µg/m³	6.9 µg/m³	428 ppm	77 °F	66 %
m108	OFF	AQI 110 Unhealthy for SG	39 µg/m³	6.9 µg/m³	438 ppm	80.6 °F	61 %
m109	OFF	AQI 12 Good	3 µg/m³	6.9 µg/m³	460 ppm	78.8 °F	62 %
m109 chec...	OFF	AQI 17 Good	4 µg/m³	6.9 µg/m³	465 ppm	80.6 °F	63 %
m110	OFF	AQI 17 Good	4 µg/m³	6.9 µg/m³	414 ppm	77 °F	67 %
m111	OFF	AQI 17 Good	4 µg/m³	6.9 µg/m³	567 ppm	80.6 °F	60 %
m112	on	AQI 21 Good	5 µg/m³	6.9 µg/m³	400 ppm	78.8 °F	62 %
outdoor	OFF	AQI 21 Good	5 µg/m³	6.9 µg/m³	415 ppm	78.8 °F	64 %

- Example of AV website
- All data presented here are based on 1-hr averages

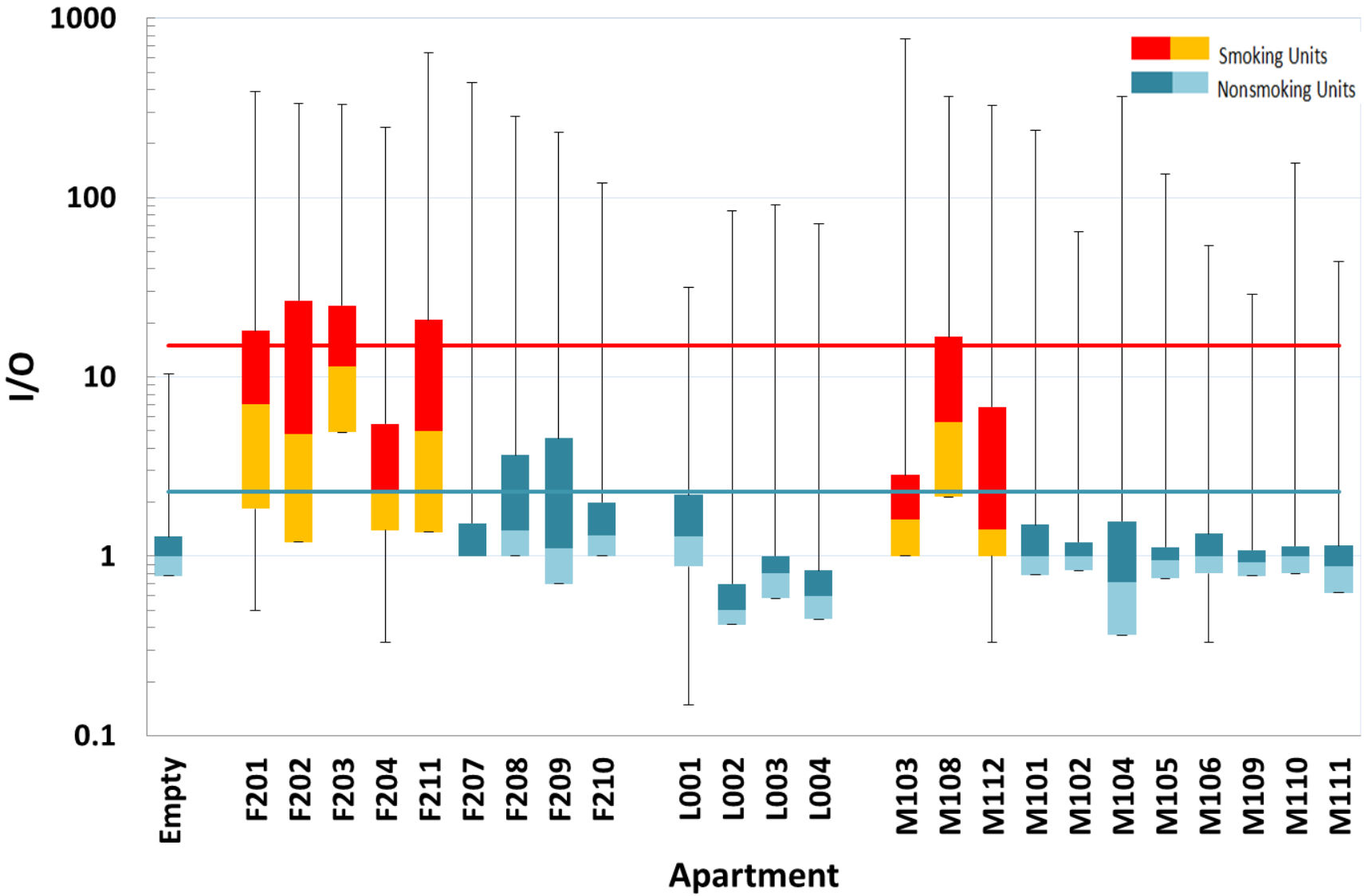
PM 2.5 correlation

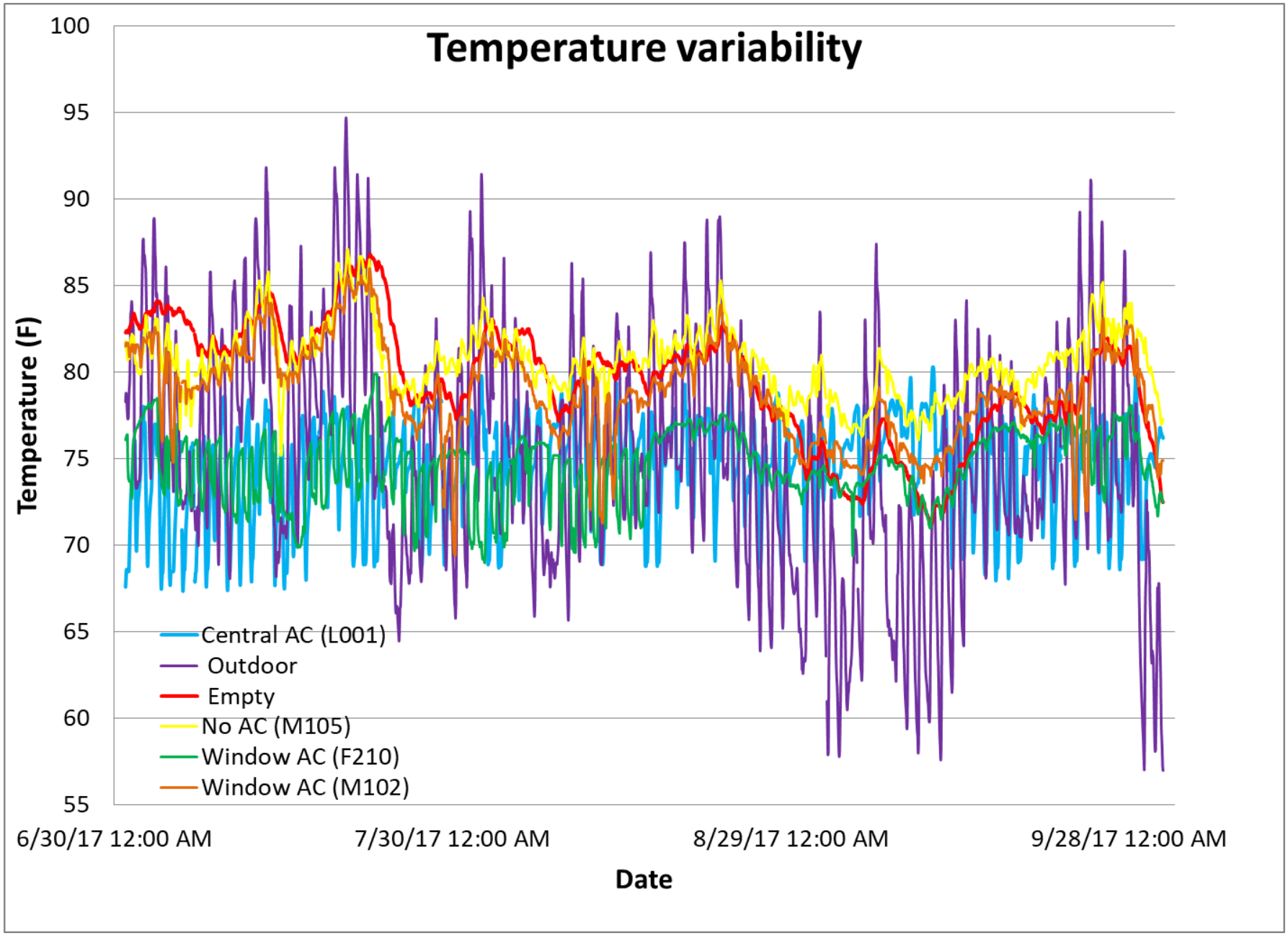


PM2.5 Concentration



Indoor/Outdoor Ratios

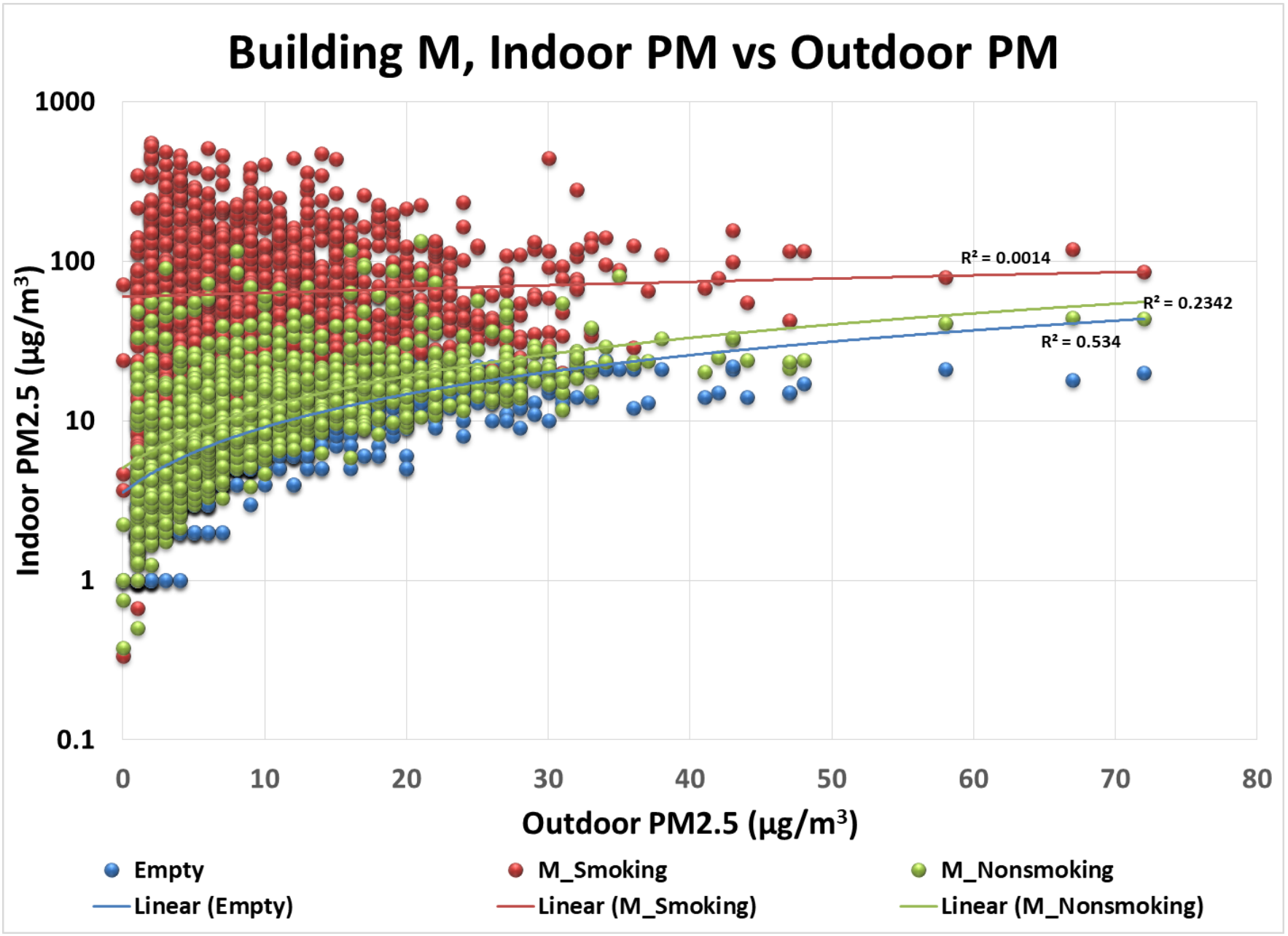


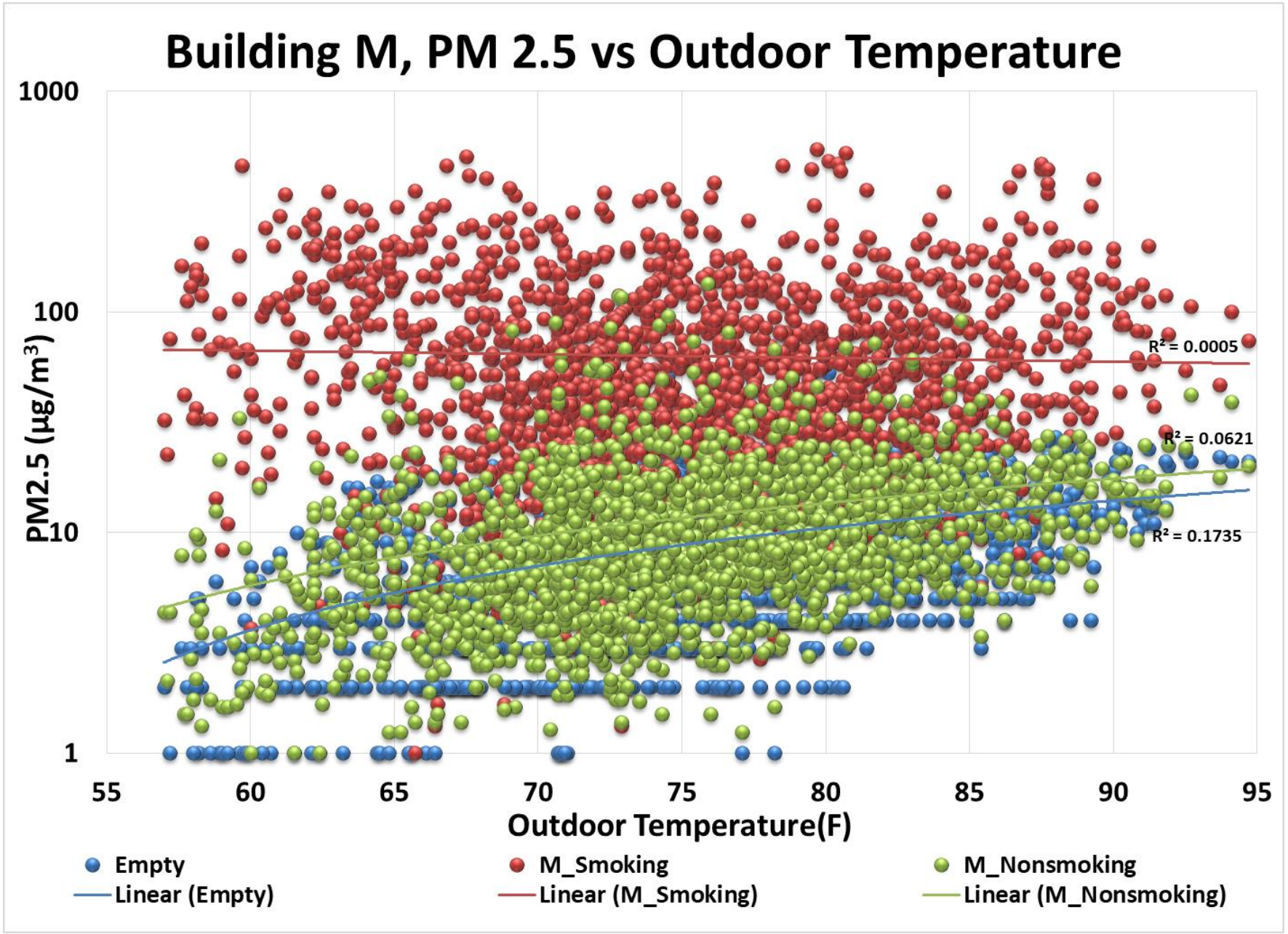

Temperature variability
100
95
90
85
80
75
70
65
60
55
Temperature (F)
Central AC (L001)
Outdoor
Empty
No AC (M105)
Window AC (F210)
Window AC (M102)
6/30/17 12:00 AM
7/30/17 12:00 AM
8/29/17 12:00 AM
9/28/17 12:00 AM
Date

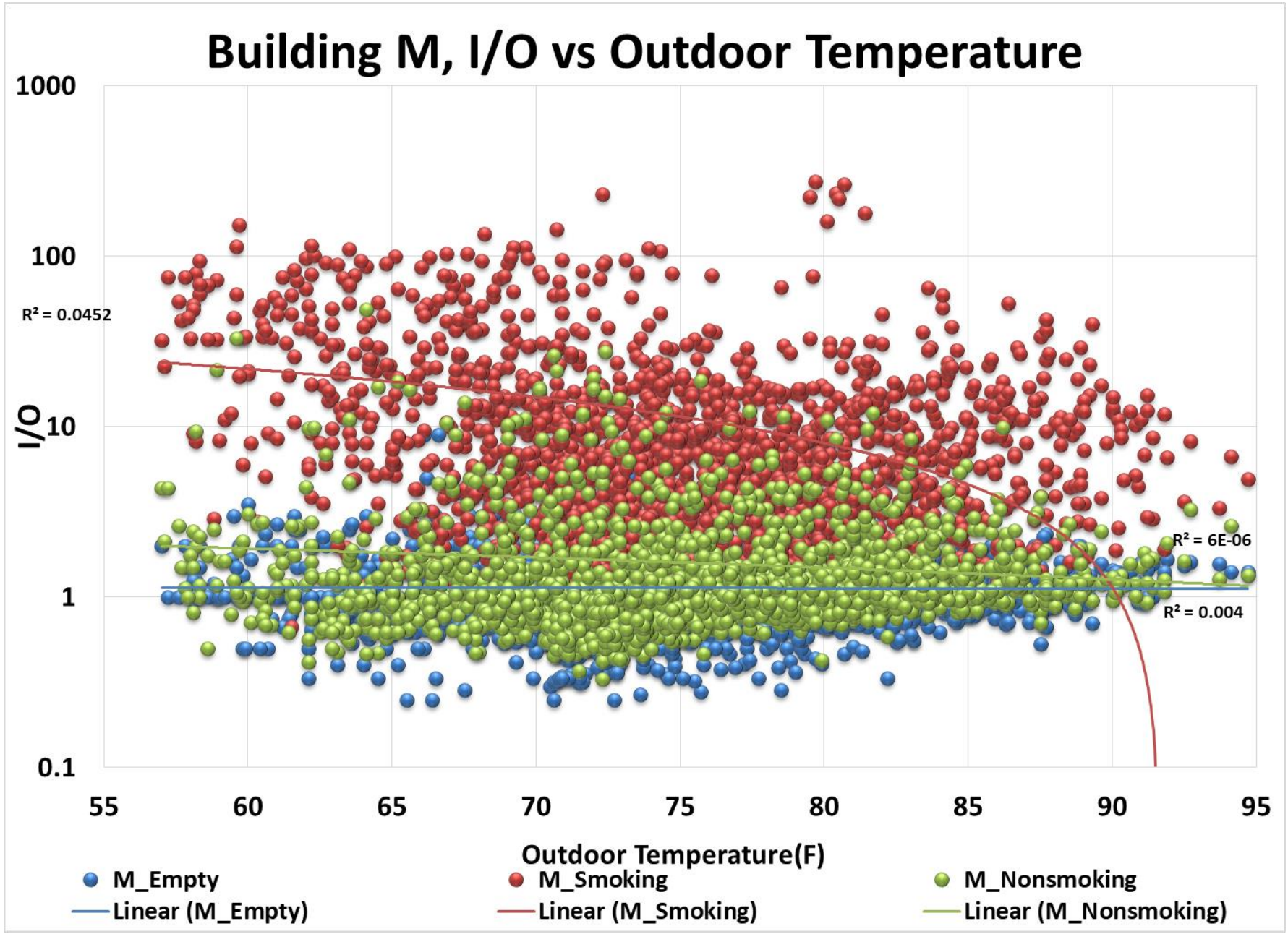
Temperature variability

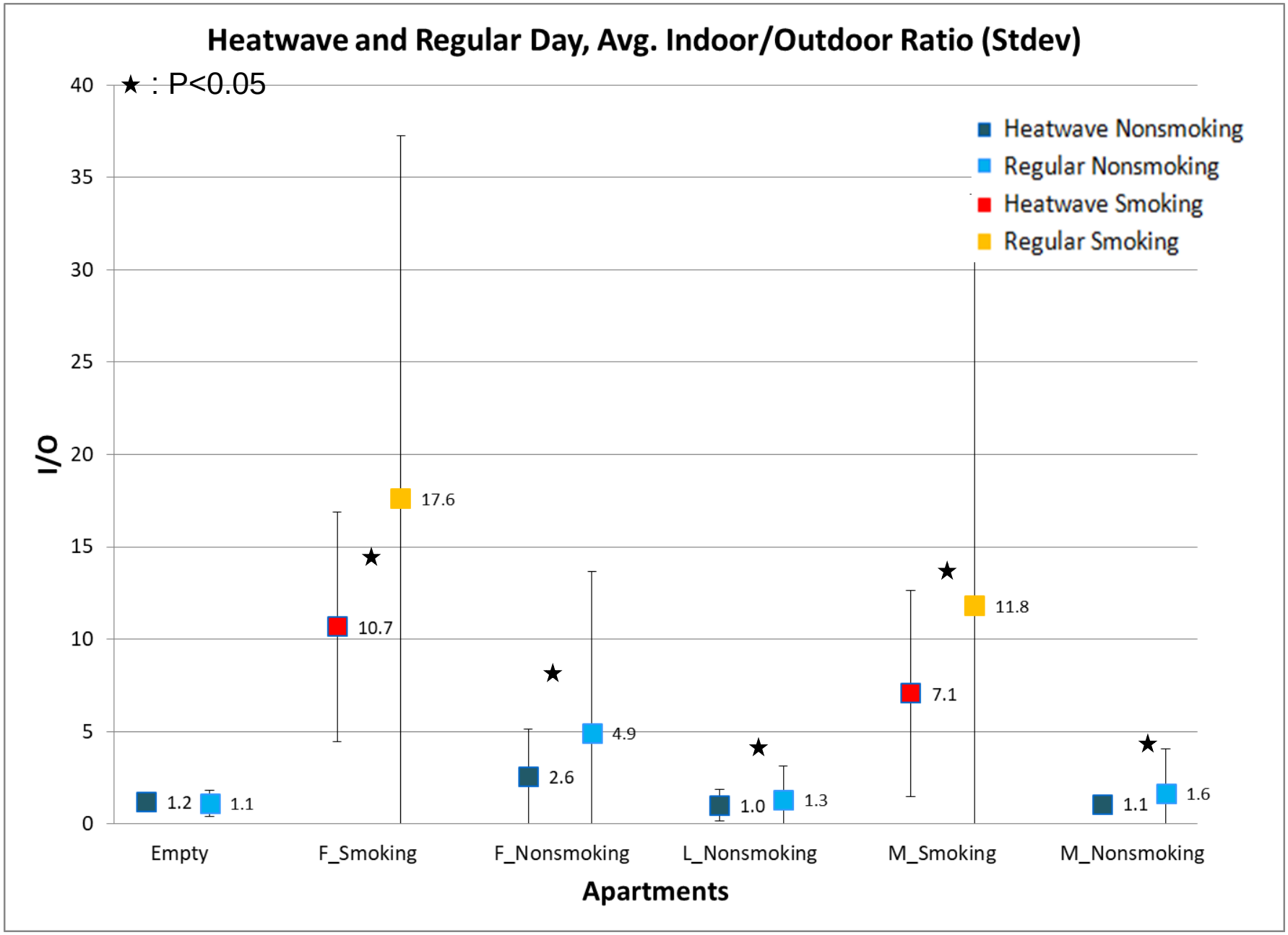
- Pearson correlation

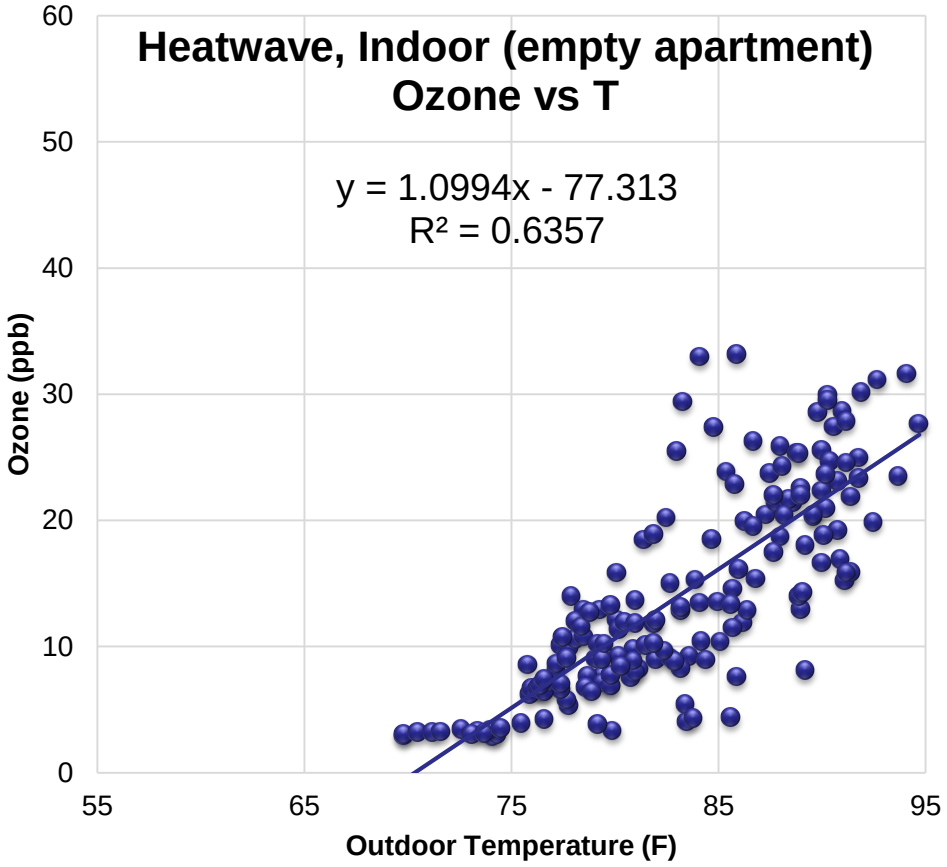
	Outdoor temperature
Outdoor temperature	1
Empty apartment	0.567
No AC (M105)	0.706
Window AC (F210)	0.072
Central AC (L001)	0.227
Window AC (M102)	0.614

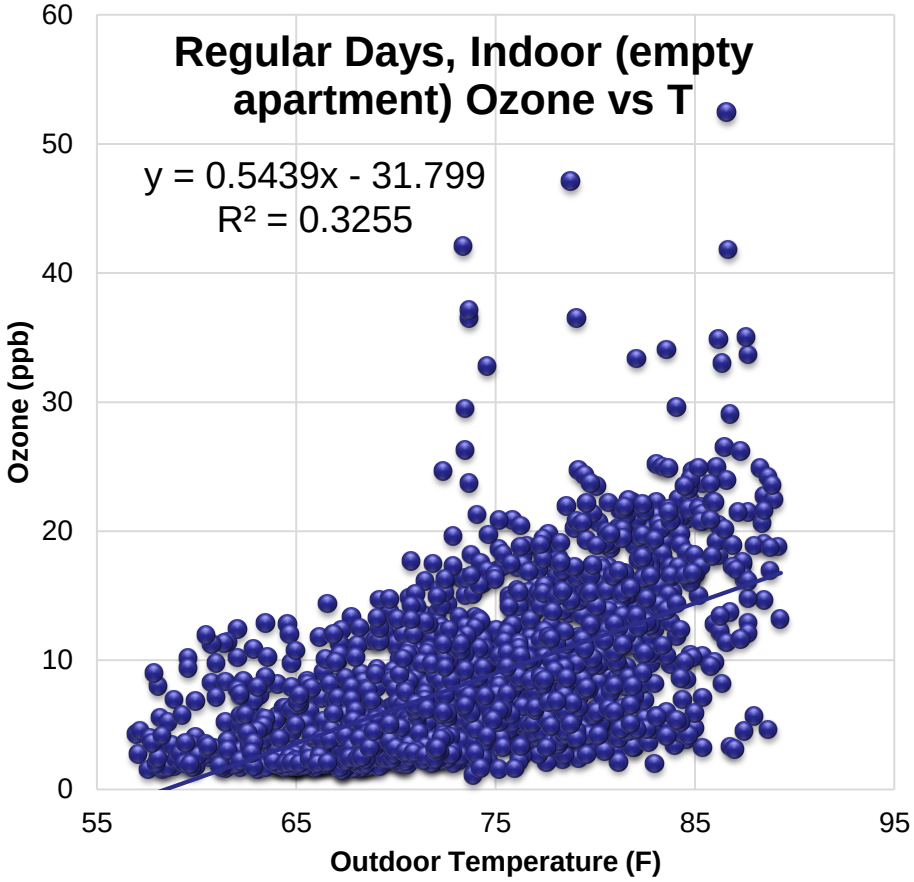

Building M, Indoor PM vs Outdoor PM
1000
100
10
1
0.1
Indoor PM2.5 (µg/m³)
0
10
20
30
40
50
60
70
80
Outdoor PM2.5 (µg/m³)
R² = 0.0014
R² = 0.2342
R² = 0.534
Empty
M_Smoking
M_Nonsmoking
Linear (Empty)
Linear (M_Smoking)
Linear (M_Nonsmoking)


Building M, PM 2.5 vs Outdoor Temperature
1000
100
10
1
PM2.5 (µg/m³)
R² = 0.0005
R² = 0.0621
R² = 0.1735
55
60
65
70
75
80
85
90
95
Outdoor Temperature(F)
Empty
M_Smoking
M_Nonsmoking
Linear (Empty)
Linear (M_Smoking)
Linear (M_Nonsmoking)


Building M, I/O vs Outdoor Temperature
1000
100
10
1
0.1
I/O
R² = 0.0452
R² = 6E-06
R² = 0.004
55
60
65
70
75
80
85
90
95
Outdoor Temperature(F)
M_Empty
M_Smoking
M_Nonsmoking
Linear (M_Empty)
Linear (M_Smoking)
Linear (M_Nonsmoking)


Heatwave and Regular Day, Avg. Indoor/Outdoor Ratio (Stdev)
★ : P<0.05
Heatwave Nonsmoking
Regular Nonsmoking
Heatwave Smoking
Regular Smoking
I/O
40
35
30
25
20
15
10
5
0
1.2
1.1
10.7
17.6
2.6
4.9
1.0
1.3
7.1
11.8
1.1
1.6
Empty
F_Smoking
F_Nonsmoking
L_Nonsmoking
M_Smoking
M_Nonsmoking
Apartments





Pearson Correlation	
	Outdoor Temperature
Outdoor Temperature	1
Outdoor Ozone	0.833
Indoor Ozone	0.797

Preliminary conclusions

- Air Visual nodes performed reasonably well
- Highly variable PM2.5 and its I/O ratios among apartments
- Clear role of smoking in indoor PM2.5 concentrations
- Strong correlation between outdoor T and indoor ozone, especially during hot days
- Hot days have beneficial effect on IAQ?!
  - If one can afford air conditioning, or rather air filtration option

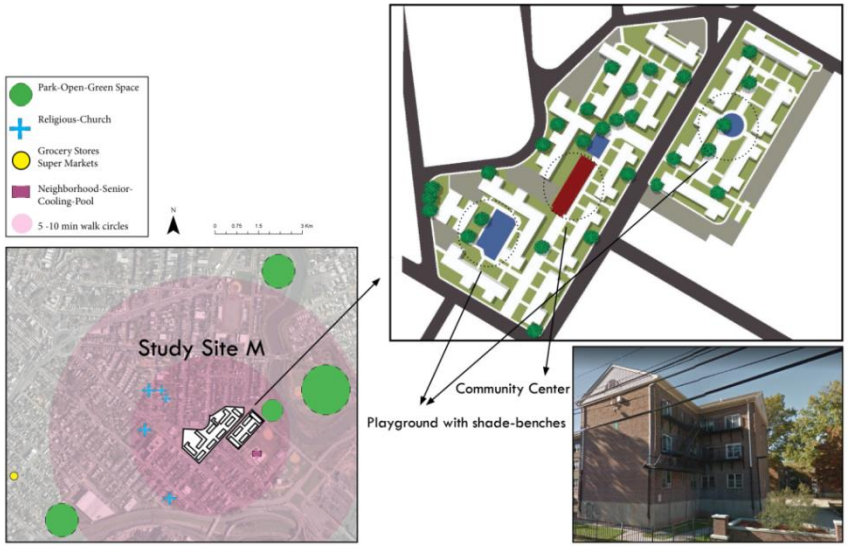
Experience with Air Visuals

- Strong WiFi signal needed
- Some showed erroneously high CO2 levels. Improved after 1 week
- Appearance of extreme PM readings after 1-2 months (5/28 units). 4/5 returned to normal after cleaning with compressed air
- 3/28 units became non-chargeable
- Some data points were omitted. 0.83% of all
- Some issues reporting EPA outdoor data. 27.4% of values were different 4% of values different by 5 µg/m3 or more. 9.5% differed by 20% or more
- PM10 data not reliable
- PM2.5, CO2, temperature, and humidity highly correlated with high-end instruments
- All data could be read via app and website. Enterprise license is needed.
- Data download via web: 5 min and 1 hr. frequency
- When AV is connected to a laptop, data frequency is 10 sec.
- Real-time display of EPA outdoor data
- Retains information about WiFi connection
- Can run on batteries

How do vulnerable populations in public housing cope with heat waves ?

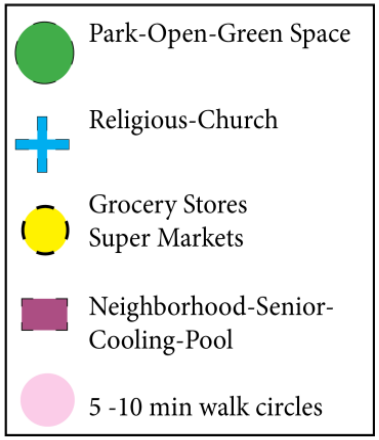
- What do seniors living in public housing do during heat waves?
- High risk of heat stroke, dehydration, asthma, falls
- Mostly no central air conditioning, some can’t afford to run window AC units
- Cool drinks, wet clothes, open windows, use fans, leave apartment?
- Alternatives accessed through formal and informal group affiliations?
- **Effect of high temperatures on IAQ**

Physical characteristics of the study sites



Study Site M and its Surroundings ((NJGIN), 2016; Maps, 2017)

Study Site F and its Surroundings ((NJGIN), 2016; Maps, 2017)



Study Site L and its Surroundings ((NJGIN), 2016; Maps, 2017)

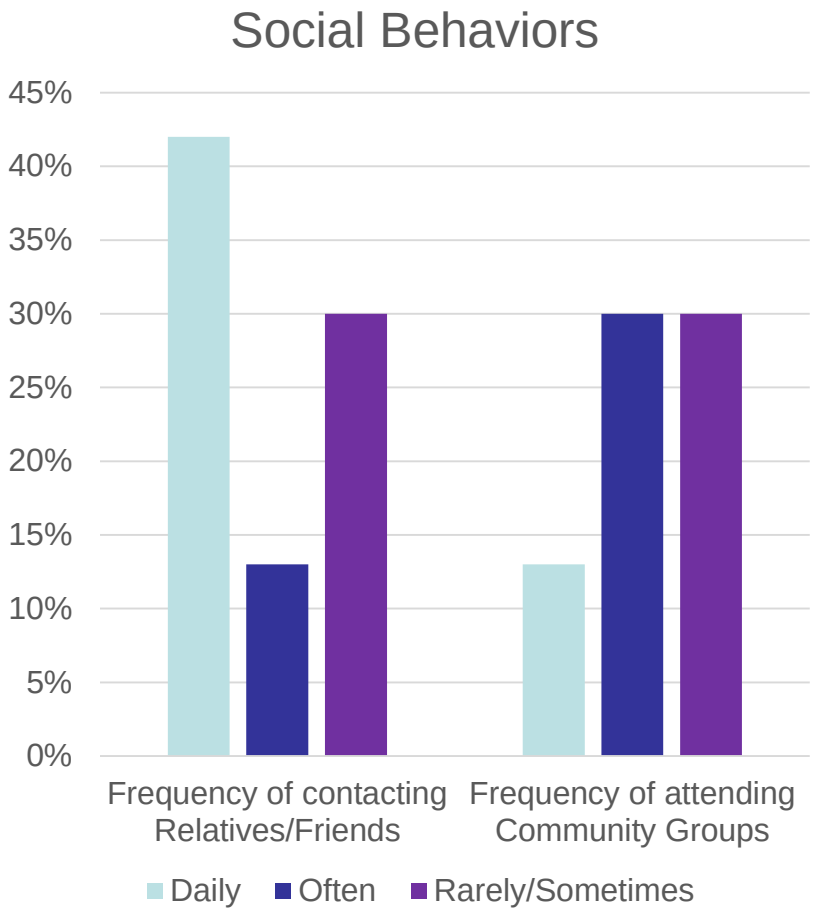
Social, Economic and Health Characteristics of Residents

Question	Answer	% of responses
Gender	Female	84%
	Male	16%
Age	55-64	34%
	65-74	45%
	75-84	21%
Education	Elementary school	4%
	Secondary school	21%
	High school	63%
Income	< 10,000	80%
	10,000-19,999	16%
	20,000-39,999	4%

Question	Answer	% of responses
Overall Health	Very Poor	4.25%
	Fair	54%
	Good	37.5%
	Somewhat good	4.25%
Chronic Condition exacerbated by Heat	Yes	50%
	No	50%
Medical Care because of Heat	Yes	13%
	No	83%

Baseline interview (n = 24)

Social Behaviors of Residents (Baseline Conditions)



Baseline interview (n = 24)

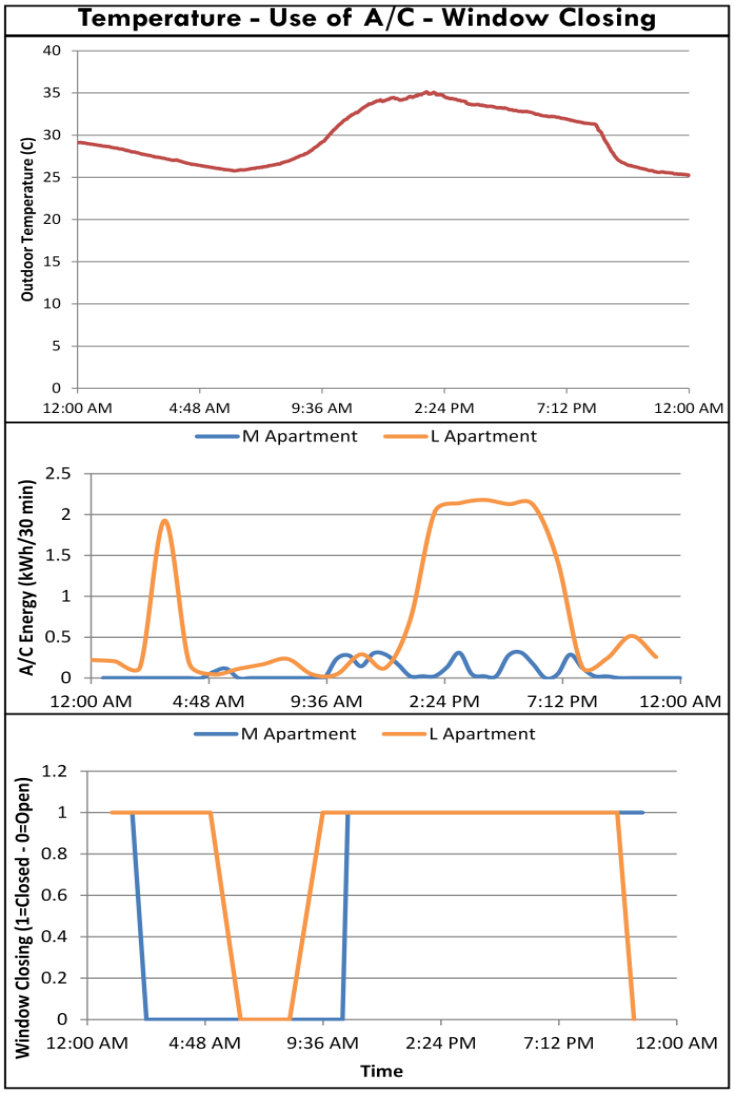
Additionally, 70% of respondents participate in Community Groups

Frequencies of Adaptive Actions During Heat Waves

	Baseline (N=24)	Heat Wave Days (N=96)
Adjustable Fan	75%	75%
Open Windows	46%	67%
Close Windows	83%	91%
A/C	79%	81%
Clothing Adjustment	63%	48%
Avoid Oven	--	51%
Avoid Stove	--	22%
Avoid Candles	--	16%
Avoid Smoking	--	12%
Leave Apartment*	80%	63%

Baseline Interviews vs. Actual Heat Waves Summer 2017
*Not necessarily in search for a cooler place (only 5% left in search of a cooler place)

Occupants' Adaptive Actions in Typical Apartments M, and L on a Peak Heat Wave Day (July 20, 2017)



Adaptive Actions by Study Site

	M (N=49)	F (N=7)	L (N=4)
Adjust Fan	**82%**	57%	50%
Close Windows	82%	100%	100%
A/C	91%	100%	50%
Clothing Adjustment	**73%**	29%	25%
Avoid Oven	91%	57%	25%
Avoid Stove	73%	14%	25%
Avoid Candles	45%	0%	0%
Avoid Smoking	45%	0%	0%
Leave Apartment*	91%	71%	100%

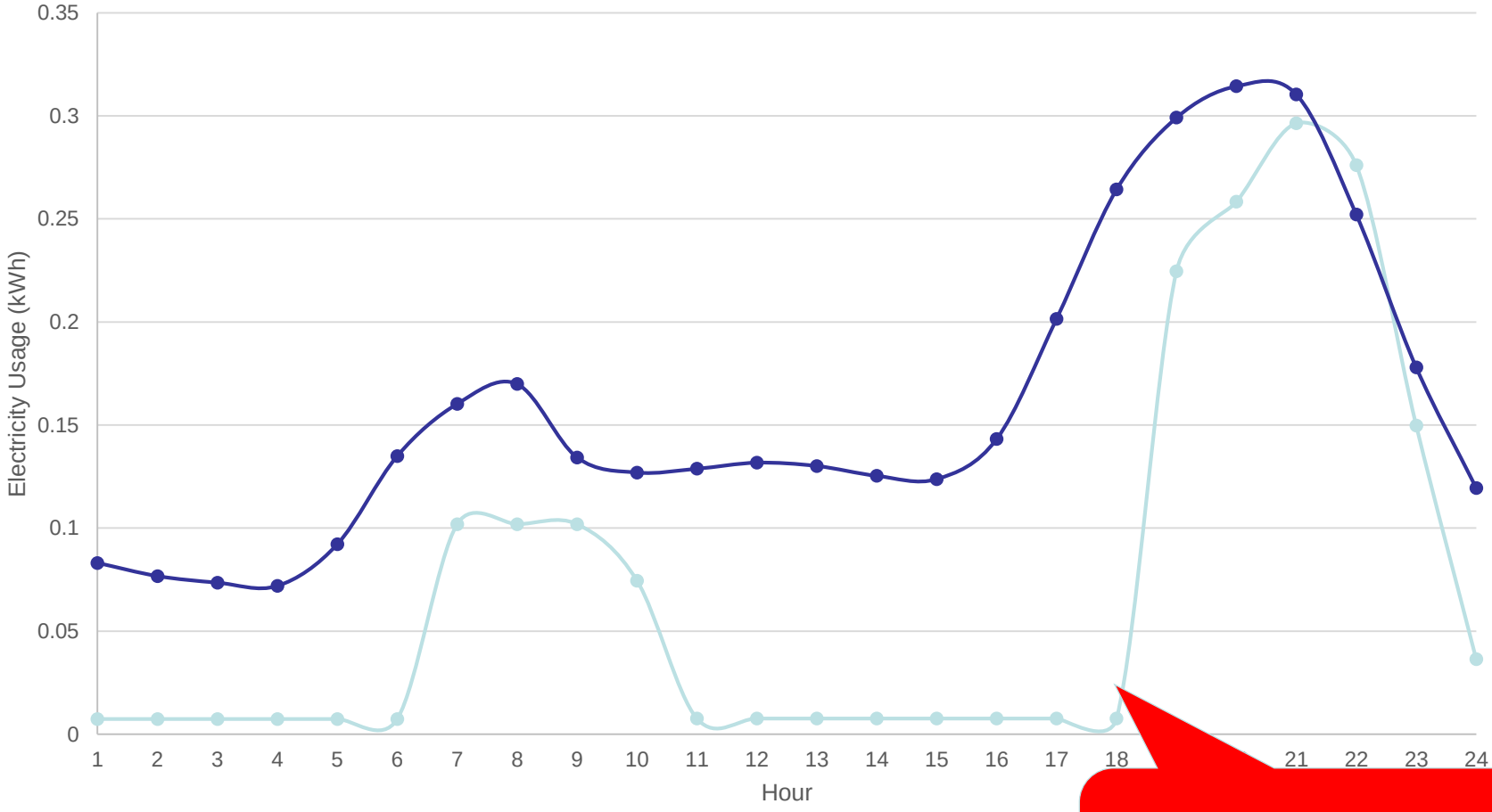
Reported during the heat wave of July 17-21, 2017 (n = 96)

*Not necessarily in search for a cooler place (only 5% left in search of a cooler place)

Gas stove at Building M

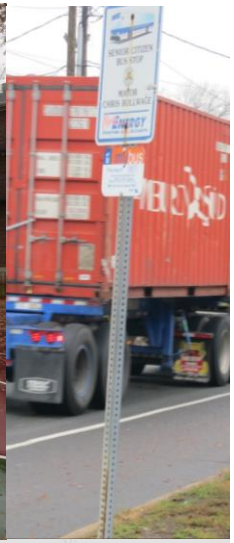
More than one way to cool off

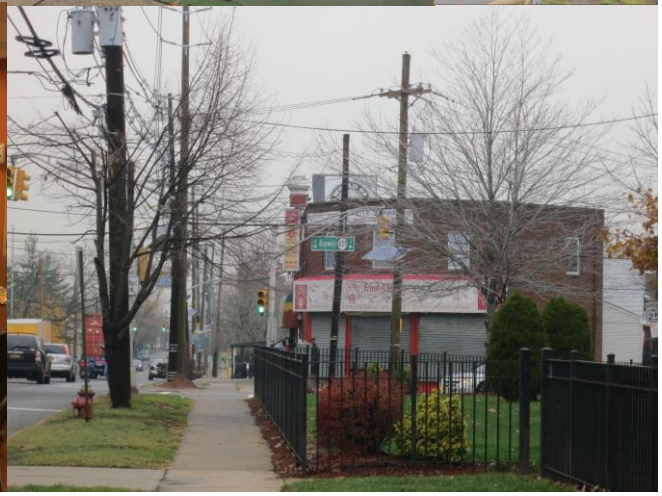
Simulations based on electricity usage on July 29th, 2016



Summing Up: Adaptive Options -- Buildings & Environs

Sample (N=96) Outdoor Adaptive Actions	
Within HACE	Lobby/Community Room-Center
	Outdoor Yard
	Community Gardens
Outside HACE	Visit Relative/Friend
	Shopping Store
	Senior Center
	City Cooling Room
	Park Nearby
	Library
	Public Pool
	Movie Theater
	Church
	Doctor/Hospital/Nursing Home/Pharmacy
	Food Pantries
	Walks around the Block
	Festivals





Resident preferences and suggestions for improvements

Use of Indoors (apartments) and Outdoors (within HACE boundaries) Comments from Exit Interviews (N=24)			
	F	L	M
Apartments	Better A/C, more windows, too much dust,		Better windows; there is too much air draft. Heaters in winter do not warm up the apt, summer inside is very hot, too much asbestos work in the buildings, sanding in preparation to get new windows,
Yards	Nice gardens, smoking, interacting, more flowers, sitting spaces and greenery would be good. Good when it is hot, but same people every day is boring and they get nosy and need bigger space		Shady areas are nice and used, but more trees and greenery are needed, also crazy mentality of people in the area scares a lot. But gardens are nice
Lobby/Cooling/ Community Center	They close it early; it is the same as staying in the apartment.		It is for people without families and without A/C, or it is outside the buildings and needs walking. Community center is nice when it has food events.

Resident preferences and suggestions for improvements

Use of amenities outside of HACE Comments Exit Interviews (N=24)			
	F	L	M
Parks	People rob and they need to be safer, but nice 3-4 small ones nearby.	Rosele Park	
Churches	Baptist in the corner	At East Jersey	
Libraries	A nice one in the area		Some library in the area would be good.
Senior Centers	Have nice activities	Senior Center Presbyterian, Steve Sanson Center, Ana Center, it is also a Cooling Center	Jefferson Square Town
Groceries	Nice and plenty within 5 min walk. New one in the division strt, Casablanca, Super-Super, also Walmart, IKEA, Jersey Gardens Mall, Super Market in Old Bridge. But more and bigger super markets would be nice.	ShopRite at Linden and Elmore, Jersey Gardens Mall	Colmado, Shop Rite in Elizabeth and Linden and Emerald Ave in Elizabeth, Jersey Gardens, Supremo, BJ's, Sam's, Walmart in Linden, Twin City, DDonuts
Pharmacy	Nice one in the corner when needed.		

Lifelong Elizabeth Survey Findings*

How far are you willing to walk from your home to a park or other destination?

Answer	Response	%
About a block	77	17%
2-3 blocks	119	27%
5-10 minute walk	102	23%
10-20 minute walk	89	20%
More than a 20 minute walk	62	14%
Total	449	100%

About 45 percent of respondents are willing or able to walk **no more than a few blocks** to a destination, but more than a third would take a walk greater than 10 minutes to reach a destination.

Survey fielded April-June 2016, based on AARP Age-Friendly Communities survey. n=532;
Courtesy Dr. Karen Lowrie, Rutgers University

Lifelong Elizabeth Survey Findings*

How concerned are you about your personal safety related to crime in your neighborhood?

Answer	Response	%
Very concerned	206	45%
Somewhat concerned	167	36%
Not very concerned	69	15%
Not at all concerned	16	3%
Total	458	100%

A relatively high percentage of respondents are concerned about personal safety, with **more than 80 percent at least somewhat concerned** and close to half the sample "very" concerned.

Survey fielded April-June 2016, based on AARP Age-Friendly Communities survey. n=532;
Courtesy Dr. Karen Lowrie, Rutgers University

Hypotheses and Findings

Hypothesis	Finding
1. Heat waves push residents to act and change key behaviors.	Supported *All residents changed activity patterns during heat waves.*
2. Background physical and social conditions constrain residents' actions.	Partially Supported *Increased outdoor temperatures push residents to act, however, considering limited funds, mobility issues and others, they cannot go far, making them highly dependent on the few nearby amenities and on other people for transportation.*
3. Apartment and building systems constitute the primary choice environment within which residents live and operate, and it is constraining.	Supported *The majority of residents reported staying indoors for most of the heat wave day, using A/C and closing windows. However, not all study sites have the same characteristics, with some supplying central A/C and others not, and with quite different building envelopes.*
4. Supportive social networks may offset possible infrastructure inadequacies.	Supported *Organizations such as Proceed played a very important role since they installed A/C units in apartments that didn't have them. Friends and families checked on each other.*
5. Residents are the primary agents in a heat wave situation. They pick their actions from a list of available options dependent on infrastructural systems, supportive networks, and nearby amenities, however they may not always act towards adaptation.	Supported *The residents themselves initiated most or all activity. Their actions defined how well or not they adapted, and was seen, they sometimes smoke inside, light candles, or house pets without caring or even realizing the health consequences.*

Thank you!

Back-up Slides

Let's recall the physical characteristics of the sites

	Study Site M	Study Site F	Study Site L
Year Built	1938	1967	2011
Total Floor Area	36,790 m^2	6,875 m^2	3,575 m^2
No. of Buildings	15	1	1
No. of Apartments	423 (~30/building)	121	31
No. of Stories	3	11	4
Apartment Size	1-bedroom	1-bedroom	1-bedroom
Central A/C	**No**	**No**	**Yes**
Back/Front Yard Available	**Yes**	**Yes**	**No**
Community/Cooling Center	Yes	Yes	Yes
Elevator	No	Yes	Yes
Residents	Seniors	Seniors	Seniors
Sample Size	11	9	4

Residents' General Environmental Comfort – not enough data here

	Most Frequent Answer
Frequency of Feeling Uncomfortably Warm	Sometimes(1 day/week)
Frequency of Air Drafts	Sometimes(1 day/week)
Frequency of Bad Odors	Sometimes(1 day/week)
Insects	Rarely to Sometimes
Comfort Conditions on Hottest Day of Year	Unbearable
Outdoor AQ During Summer	Somewhat Polluted

Baseline interview (n = 24)

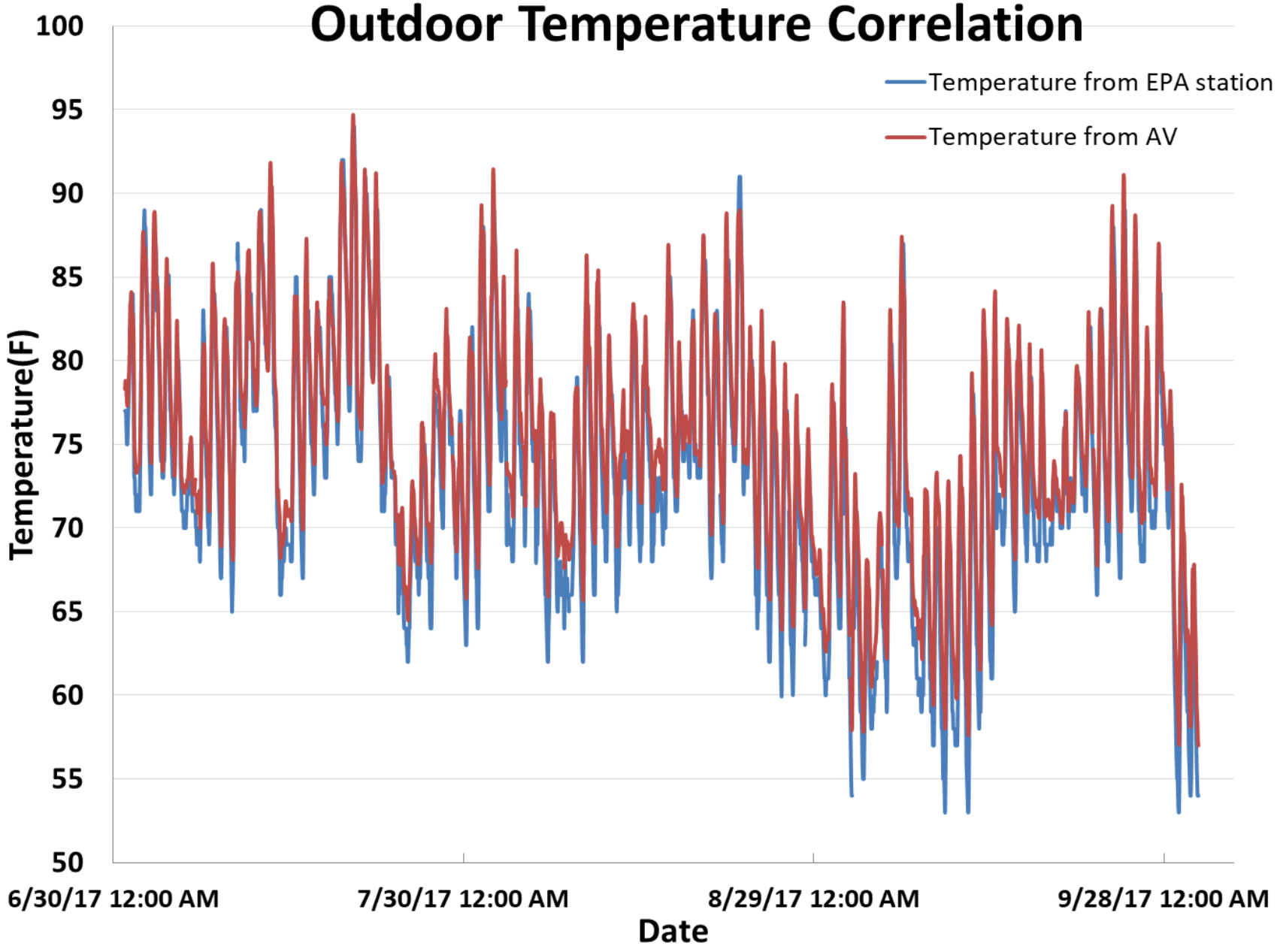
Frequencies of Adaptive Actions Taken during the Heat Wave Events of Summer 2017 among Each Site's Apartments.

Frequencies of Adaptive Actions Among Each Site's Apartments (N=96)						
	M (N=49)	**Most Frequent Time of Day**	**F (N=29)**	**Most Frequent Time of Day**	**L (N=18)**	**Most Frequent Time of Day**
Adjustable Fan	96%	Evening 4 pm-8 pm	66%	Evening-Night 4 pm-7 am	33%	Night 8 pm-7 am
Open Windows	80%	Morning 8 am-12 pm	62%	Morning-Evening 8 am-12 pm / 4 pm-8 pm	39%	Night 8 pm-7 am
Close Windows	88%	Afternoon-Evening 12 pm-8 pm	90%	Evening 4 pm-8 pm	100%	Morning-Evening 8 am-8 pm
A/C	78%	Afternoon-Evening 12 pm-8 pm	100%	Morning-Evening 8 am-8 pm	55%	Morning-Evening 8 am-8 pm
Clothing Adjustment	61%	Afternoon 12 pm-4 pm	41%	Afternoon 12 pm-4 pm	22%	Morning 8 am-12 pm
Avoid Oven	69%	Afternoon-Evening 12 pm-8 pm	48%	Morning 8 am-12 pm	6%	Morning-Night 8 am-7 am
Avoid Stove	30%	Morning-Afternoon-Evening 8 am-8 pm	21%	Afternoon-Night 12 pm-7 am	6%	Morning-Night 8 am-7 am
Avoid Candles	19%	Morning-Night 8 am-7 am	21%	Morning-Night 8 am-7 am	0%	-
Avoid Smoking	19%	Morning-Night 8 am-7 am	7%	Morning-Night 8 am-7 am	0%	-
Leave Apartment*	61%	-	62%	-	67%	-

*Not necessarily in search for a cooler place.

Adaptive Options within Resource Systems and Surroundings – lacks data, how many did this?

Sample (N=24)					
Where do people go when they leave the apartment?					
M		F		L	
Within HACE	Outside HACE	Within HACE	Outside HACE	Within HACE	Outside HACE
Community center	Visit relative/friend	Community room	Visit relative/friend	Community center	Visit relative/friend
Outside yard	Shopping mall	Community gardens	Senior center	Lobby	Shopping mall
	Park nearby	Front yard	Park nearby		City cooling center
	Movie theater		Public pool		
	Public pool		City cooling center		
	Library				


Outdoor Temperature Correlation
Temperature from EPA station
Temperature from AV
100
95
90
85
80
75
70
65
60
55
50
Temperature(F)
6/30/17 12:00 AM
7/30/17 12:00 AM
8/29/17 12:00 AM
9/28/17 12:00 AM
Date