A Case Study: Public Health Response to a Wood Smoke Health Complaint

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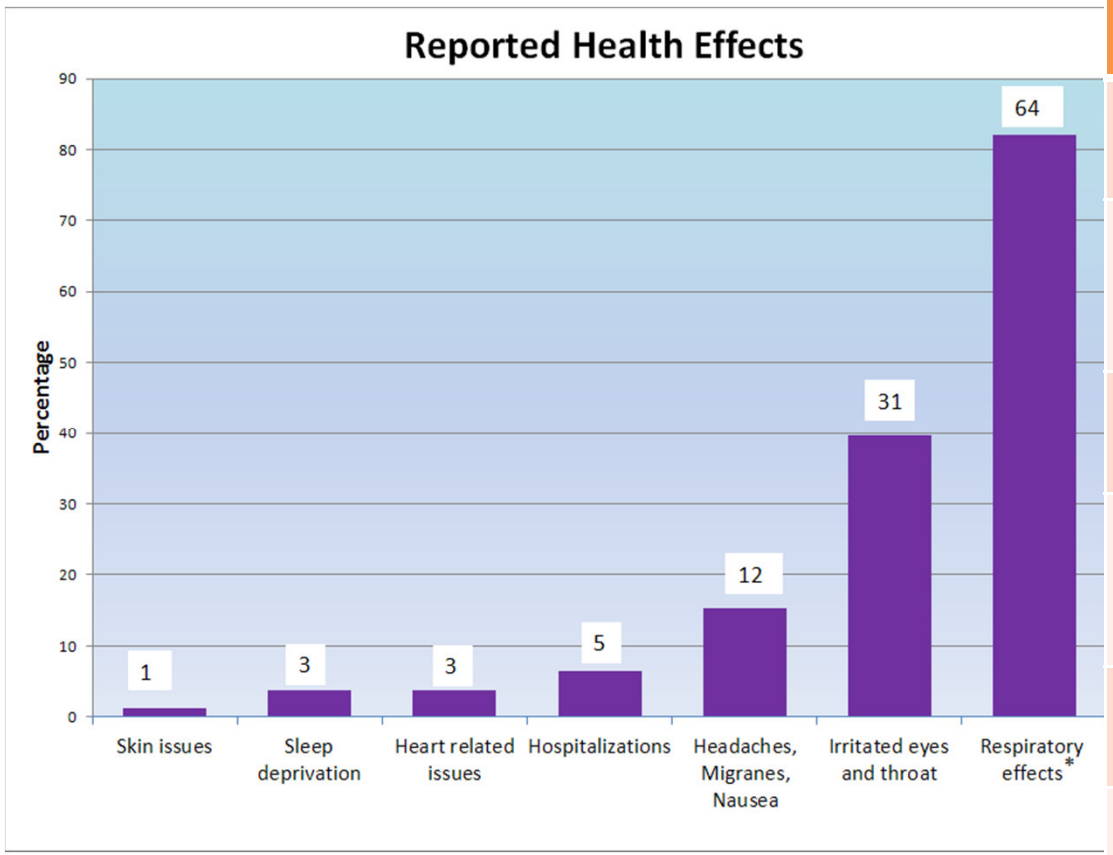
Smoke Complaints

- BTSA receives complaints re: residential burning (wood smoke, garbage, backyard campfires)
- Since 2005, BTSA received wood smoke complaints from 78 citizens*
  - 56% are outdoor hydronic heaters
  - 25% indoor wood stoves
  - 19% indoor hydronic heaters, fireplaces, wood stoves, campfires/firepits
- BTSA provides smoke health effects information, provides advice/guidance, and technical support to local health depts.
- NYSDEC Part 247(Outdoor Wood Boilers) effective January 28, 2011

**** Only represents those citizens that called BTSA since 2005.***

Research shows that in rural NY >90% of carbonaceous (EC/OC) $PM_{2.5}$ is wood smoke and winter night-time town/village peak levels exceed >100 mcg/m^3 on winter nights (NYSERDA, 2008; 2010)

Summary of Health and "Quality of Life" Complaints Reported to BTSA (since 2005)



*Respiratory effects = asthma, bronchitis, cough, chest tightness, sinus problems

Quality of Life Complaints	No.	%
Cannot go outdoors/ use yard; Poor visibility; Smell	70	90.1
Smoke enters complainant's home; Smoke on clothes and pets	45	57.6
Boarded up windows; Cannot open windows	20	25.7
Soot deposition on property; Trees in yard chemically burned	4	5.1
Smoke sets off fire alarms; Fire Department Called	4	5.1
Installed an air purifier system; Excessive A/C use	3	3.8
Considering or actually moving	2	2.5

What's in Wood Smoke?

It Depends – what's being burned, combustion temperature and available combustion air

- Fine Particles ($PM_{2.5}$) – Tiny airborne droplets or particles 2.5 microns or less in diameter
- Inorganic gases – carbon monoxide, oxides of nitrogen and sulfur, carbon dioxide, acid gases
- Organic chemicals – aldehydes, benzene, toluene, styrene, dioxins
- Metals

What are $PM_{2.5}$ health effects?

- Short-term increases in exposure can be irritating to the eyes, nasal passages and airways
- Inhaled $PM_{2.5}$ can exacerbate respiratory symptoms (*e.g.*, asthma)
- Inhaled $PM_{2.5}$ can exacerbate cardiovascular symptoms (*e.g.*, chest pain, heart rhythm changes, heart attack)

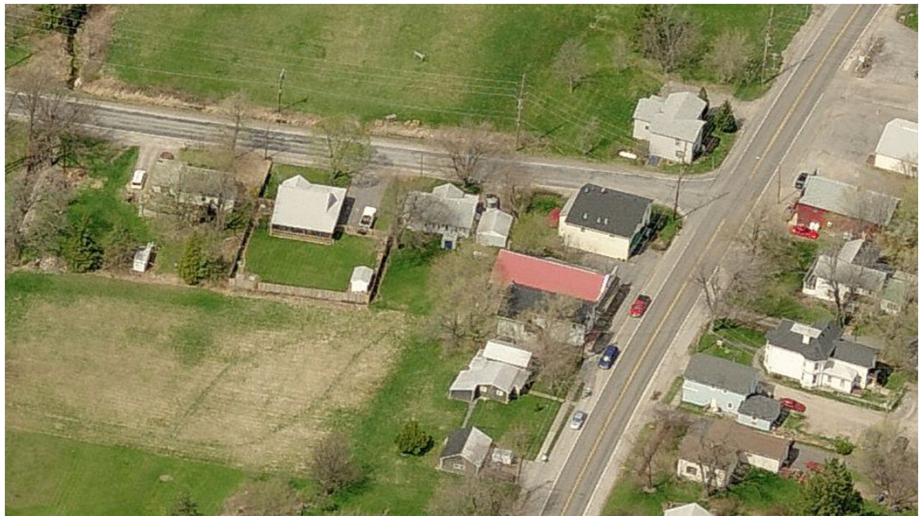
US EPA on Sub-daily $PM_{2.5}$ Exposures

"recent studies provide additional evidence for cardiovascular effects associated with sub-daily (*e.g.*, one to several hours) exposure to PM, especially effects related to cardiac ischemia, vasomotor function, and more subtle changes in markers of systemic inflammation, hemostasis, thrombosis and coagulation."

June 29, 2012 Federal Register, Volume 77, No. 126, page 38923

Public Health Nuisance Action
Outdoor Hydronic Heater (OWHH)

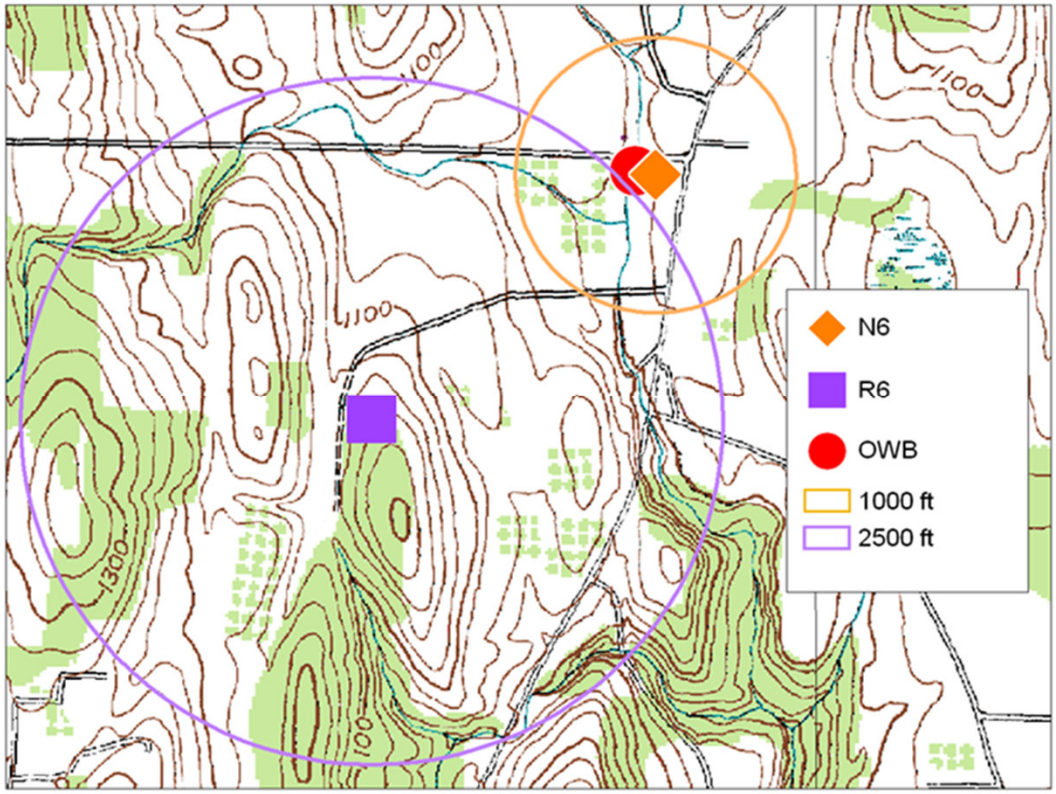
- 1998: Neighborhood complaints began, 1 complainant documented health problems
- Town work to resolve situation (raise stack)
- 2007: Town law, subject OWHH 'grand-fathered'
- 2008: DEC Administrative Action undertaken, despite difficulty obtaining opacity violation



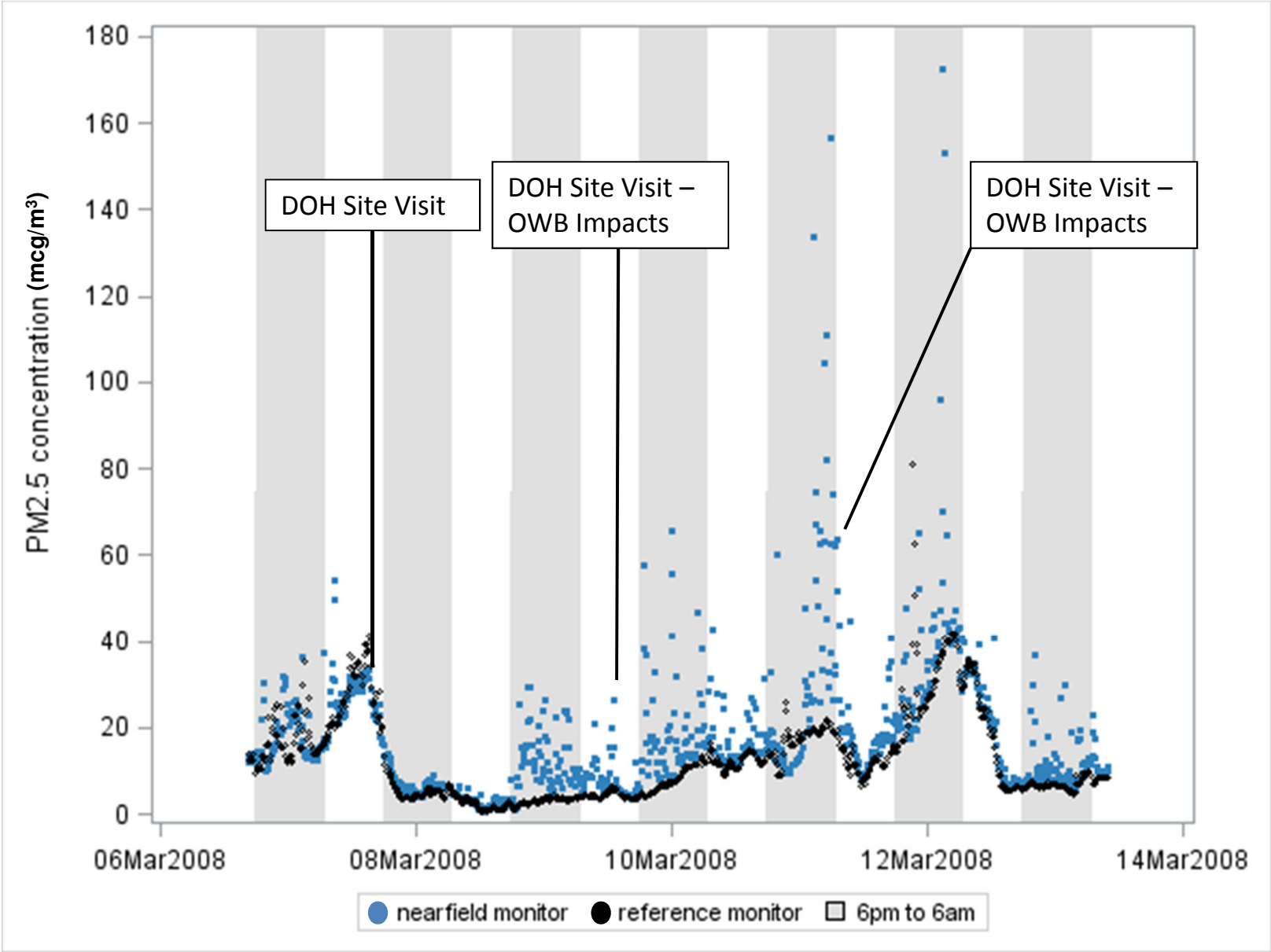
- Part 8 NYS Sanitary Code (Nuisances Which May Affect Life and Health)
- April 2008: Local Health Officer investigated, probable existence of a nuisance, but lacked direct evidence
- BTSA provided technical assistance – air monitoring & Town Board of Health hearing testimony
- Sept. 2008: Case settled prior to final determination, OWHH owner removed device

Study Design

- Deployed DataRAM 4000
  - Nephelometry – real-time $PM_{2.5}$ (smoke indicator)
  - complaint location (nearfield) 100 ft
  - Control location (reference) 2,600 ft
  - No other obvious substantial sources nearby
- Meteorological station (real-time)
- 1 week monitoring period (time-synced instruments)
- Observation logs and site visits

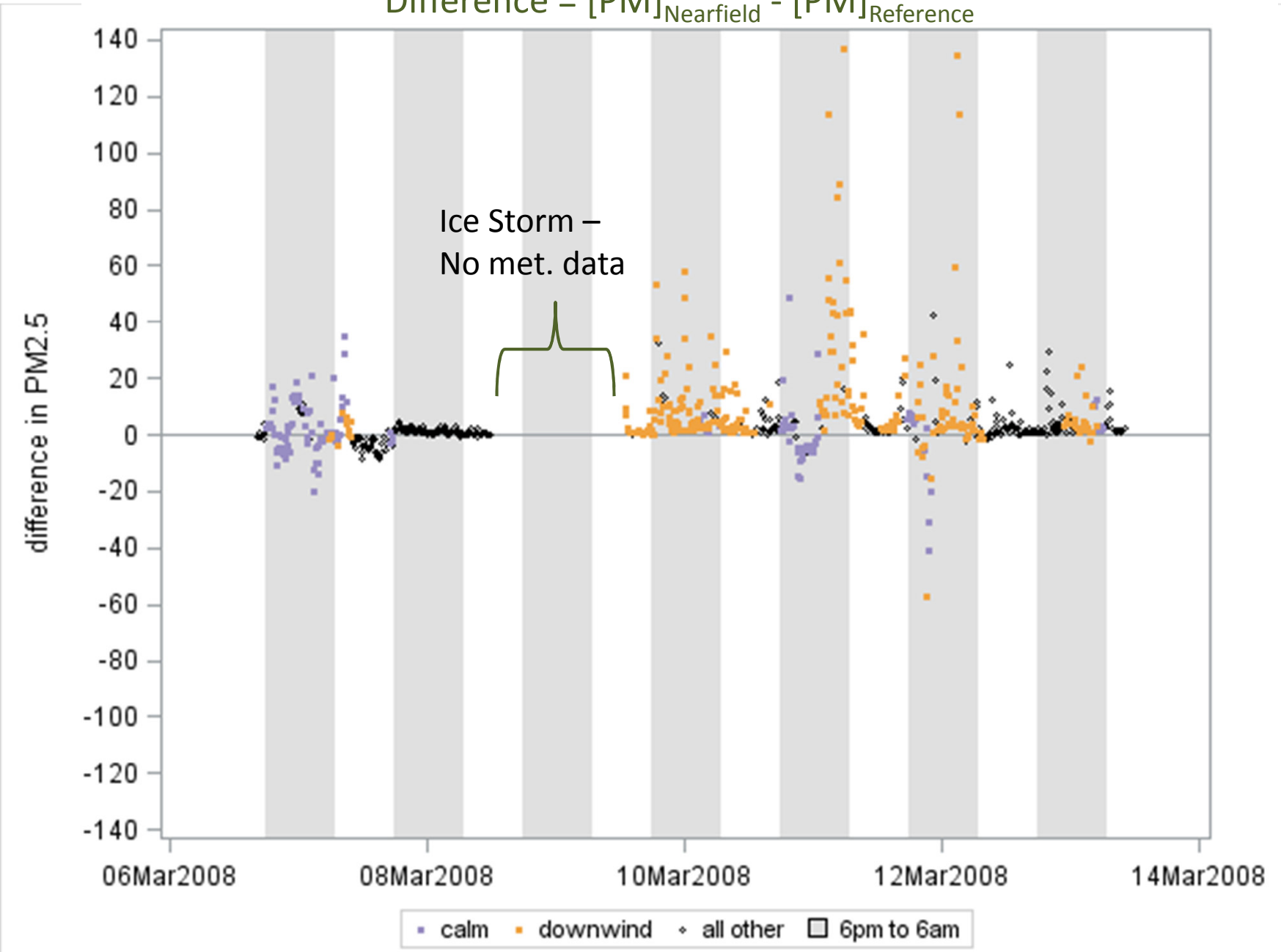


Time Series of Fine Particulate Concentrations



Longitudinal Graph of $PM_{2.5}$ Differences

Difference = $[PM]_{Nearfield}$ - $[PM]_{Reference}$



Case Study: Results

- $PM_{2.5}$ level averaged higher at the complaint location than the control location & smoke impacts observed frequently at night

	Nearfield (mcg/m^3)	Reference (mcg/m^3)
Geometric Mean	13.3	9.1
Minimum	0.8	0.7
Maximum	172.5	80.9

- Differences in $PM_{2.5}$ levels were greatest when the complaint location was down-wind and near control levels when upwind of OWHH
  - Downwind: Average $PM_{2.5}$ levels were 7.5 mcg/m^3 higher at nearfield than reference
  - Upwind: Average $PM_{2.5}$ levels were 0.66 mcg/m^3 higher at nearfield than reference

Case Study: Health Significance

- Monitoring results indicate increased average $PM_{2.5}$ air levels and more frequent elevated concentrations most likely due to smoke from the wood boiler
- As average daily $PM_{2.5}$ levels increase, exacerbation of respiratory or cardiac symptoms becomes more likely
- Long-term exposures to $PM_{2.5}$ from smoke and other sources are associated with development of cardiovascular and respiratory disease
- Degree of increased risk and nature of effects from exposure will depend on many factors influencing individual susceptibility

Summary

- Wood smoke can cause health effects, not unlike those consistent with $PM_{2.5}$ exposure - DOH recommends avoiding smoke exposure
- Although there are some limitations, simple field instrument techniques can be used to study wood smoke exposures and support enforcement actions
- Other BTSA work at OWHHs (including 5 non-complaint locations; *to be published*)
  - $PM_{2.5}$ levels significantly elevated at 5 of 6 monitoring locations near OWHHs relative to distant location ($p \leq 0.01$)
  - Downwind and calm winds (often at night) were associated with elevated $PM_{2.5}$ levels

***More information*:**

NYSDOH: http://www.health.ny.gov/environmental/outdoors/air/owb/

NYSDEC: http://www.dec.ny.gov/chemical/51986.html