SMOKE EFFECTS

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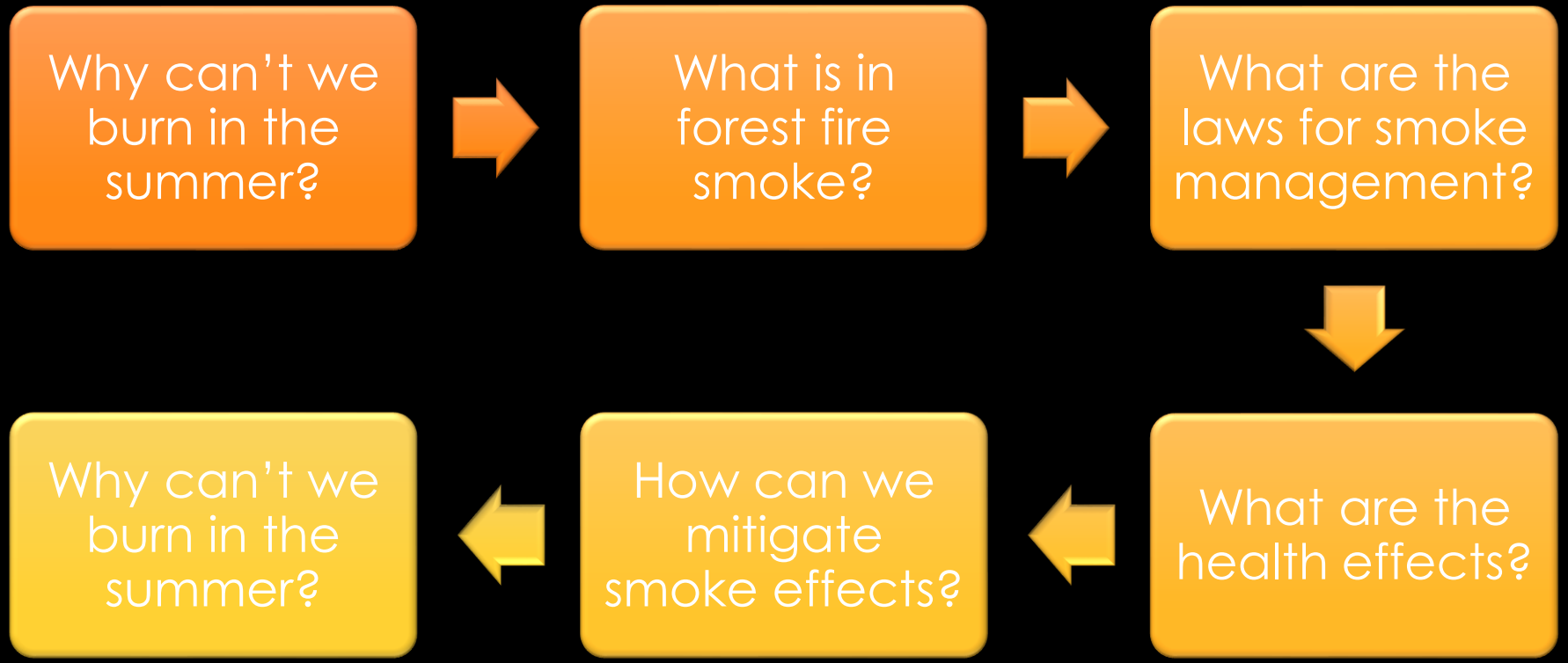
MY PATH TO THE SMOKE WORLD



WHY CAN'T WE BURN IN THE SUMMER?

01

Air quality/ Ozone

02

Too many people down the shore freaking out.

03

Too much smoldering.

WHAT IS IN FOREST FIRE SMOKE?

- Carbon dioxide
- Water vapor
- Carbon monoxide
- **Particulate matter (PM)**
- **Hydrocarbons and other organic chemicals**
- **Nitrogen oxides**
- Trace minerals and …
- Several thousand other compounds depending on fuels

CARBON MONOXIDE

- Carbon monoxide levels are highest during smoldering stage.

WHAT IS $PM_{2.5}$?

80 -90% of wildfire smoke, by mass, is within the fine particle size class of 2.5 micrometers in diameter or smaller ($PM_{2.5}$).

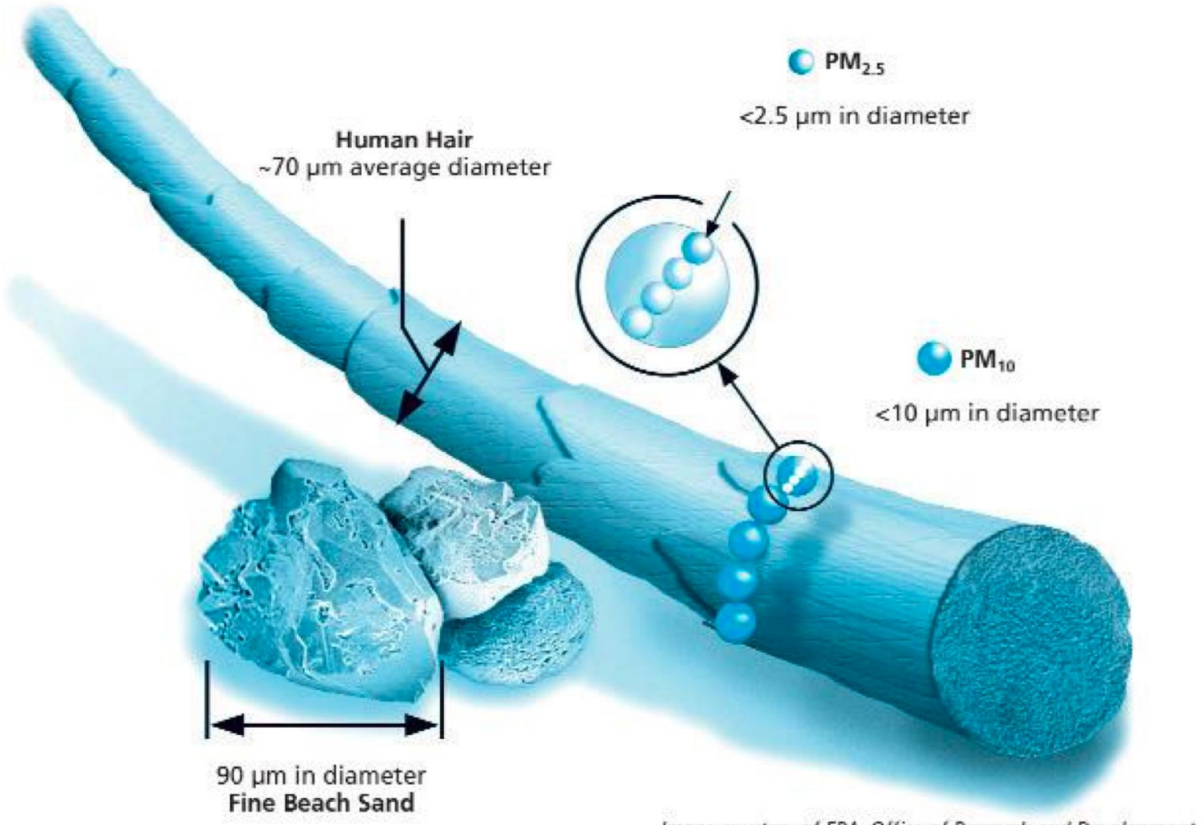


Image courtesy of EPA, Office of Research and Development

Tony Ward, PhD
School of Public & Community Health Sciences
University of Montana

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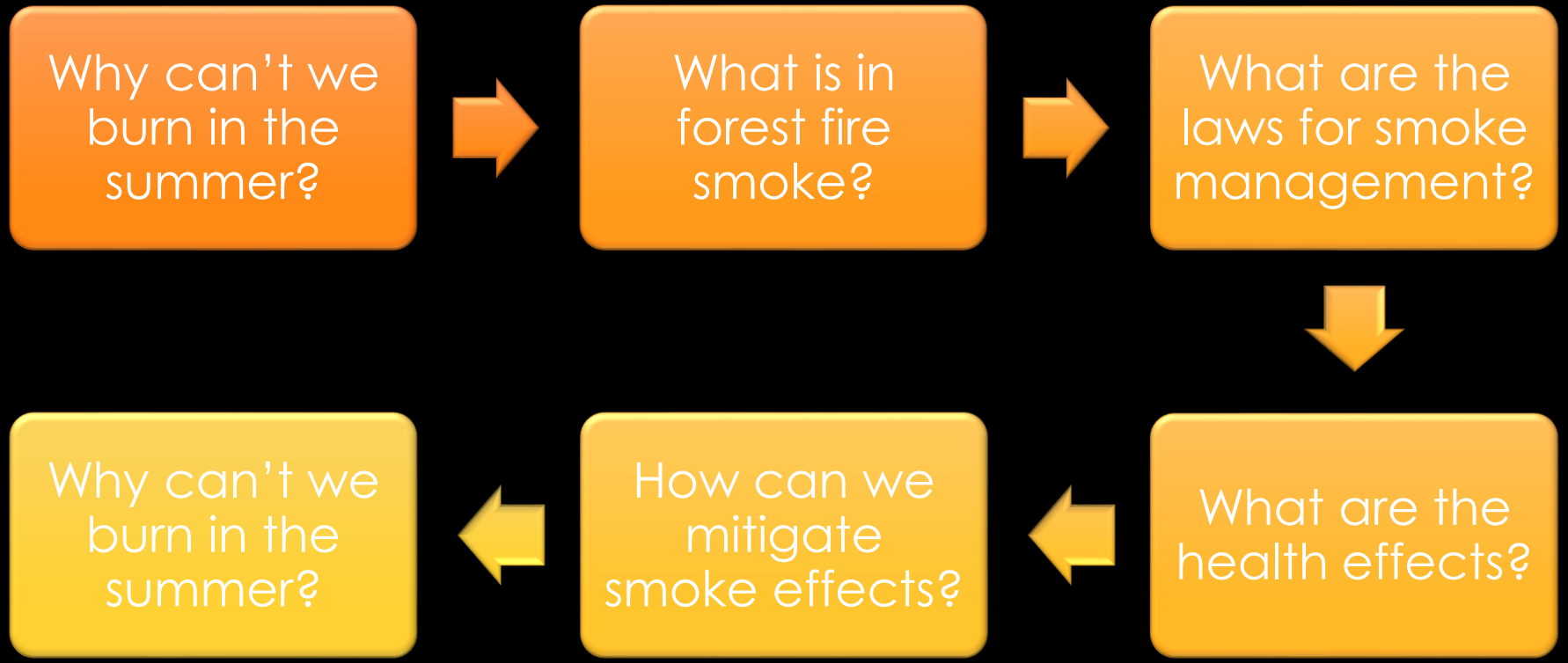


WHAT ARE THE LAWS FOR SMOKE MANAGEMENT?

Clean air act (1970)

EPA regulates – Green Book:

- Carbon monoxide
- Lead
- Nitrogen dioxide
- **Ozone – can't be over .075ppm in 8-hour period**
- Sulfur dioxide
- **Particulate matter (PM2.5) – can't be over 35 micrograms/m^3 in 24-hr period**

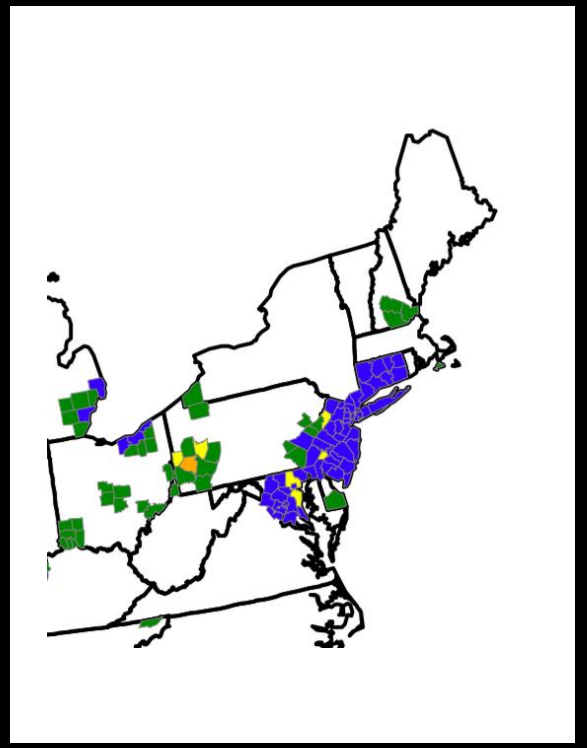
NAAQS

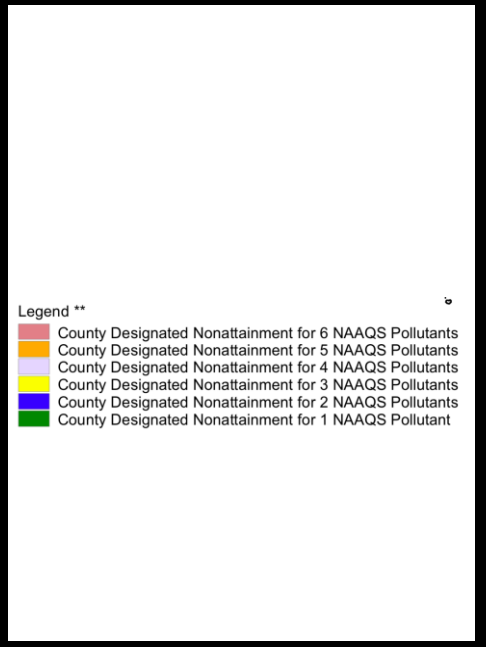
State air quality officials track pollutants (with federal funding

Non-attainment means it does not meet national ambient air quality standards (NAAQS).

County by county list of non-attainment pollutants: https://www3.epa.gov/airquality/greenbook/ancl.html

Northeast smoke-derived pollutants - almost all ozone and some $PM_{2.5}$





CLASS 1 AREAS- FEDERAL

Areas that must show progress towards more visibility/less haze based on 20% best/worst days

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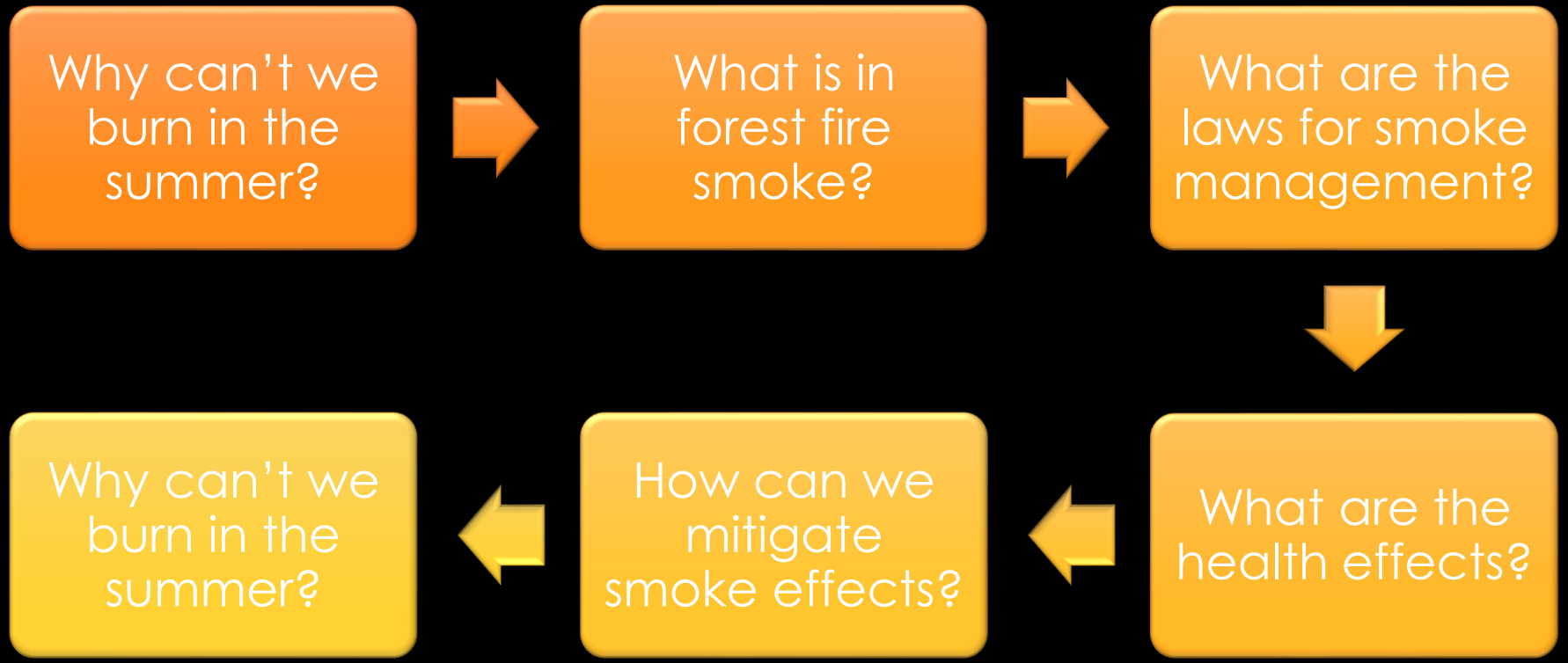
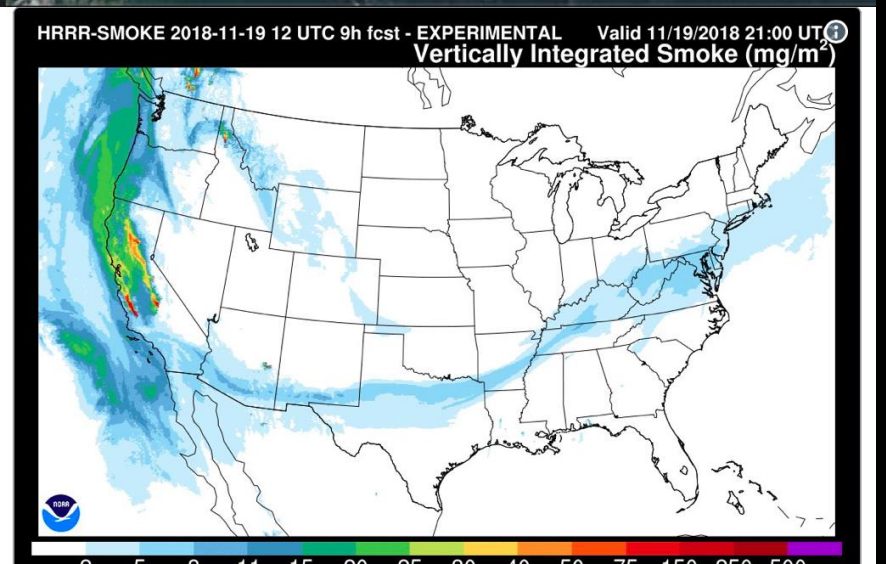


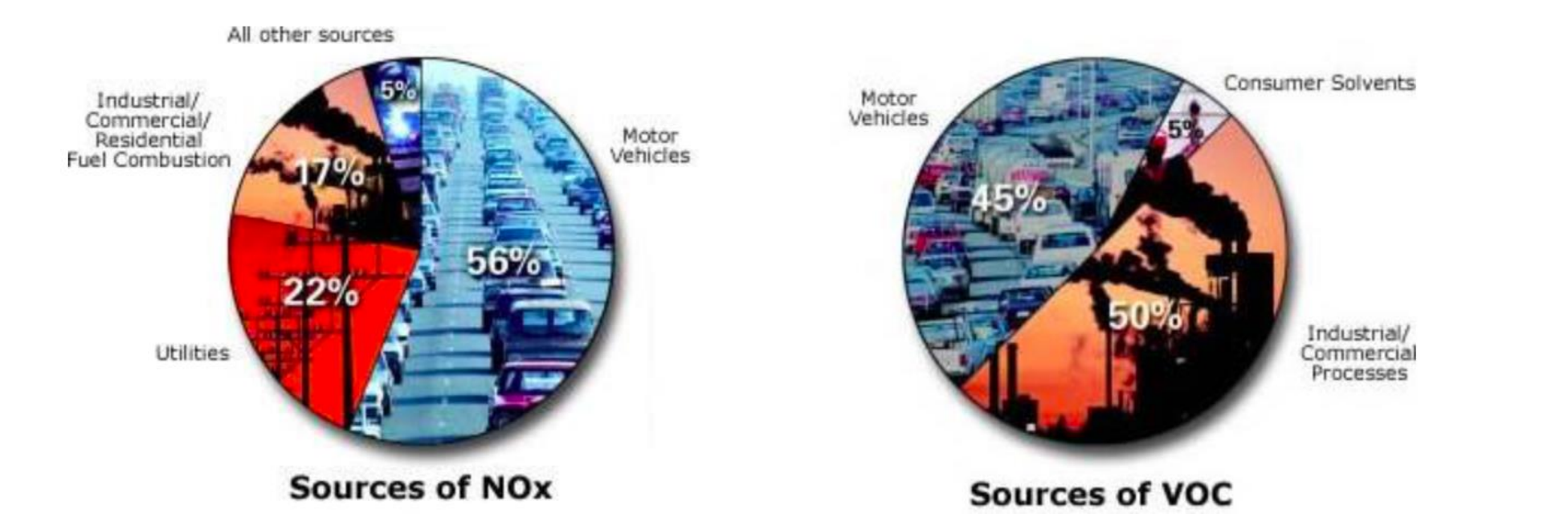


HAVE SMOKE, WILL TRAVEL

- Smoke can travel thousands of miles
- Worldwide it is estimated that 339,000 people die due to the effects of wildfire smoke each year. - Ward
- Traffic accidents

OH NO – O-ZONE!

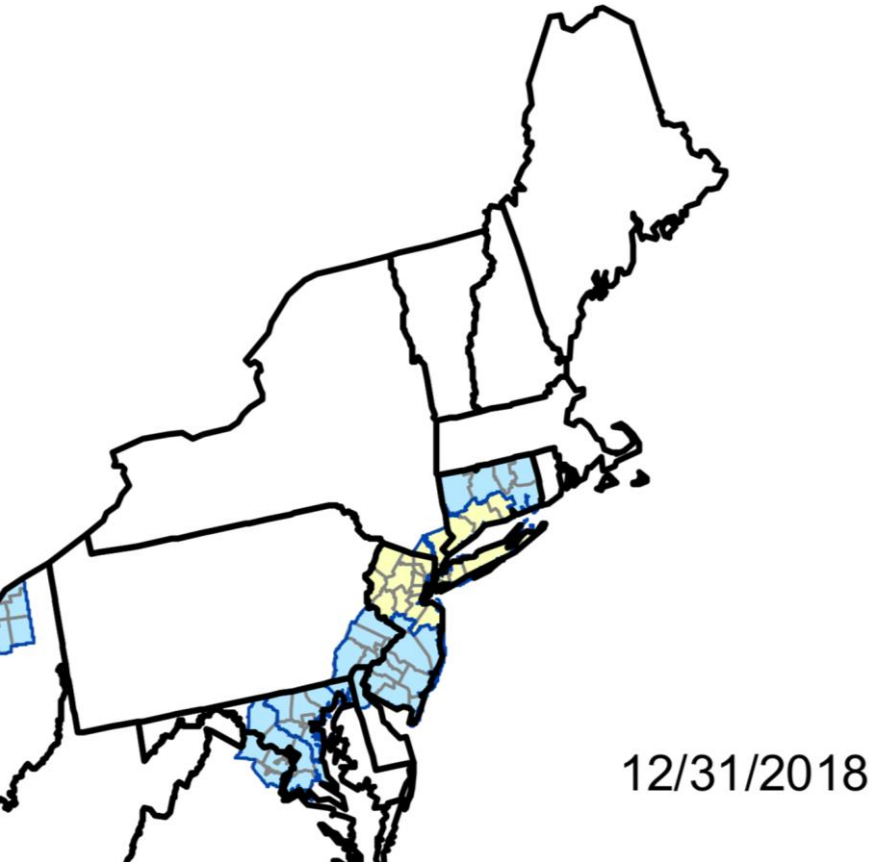
- Ozone! "Good up high, bad nearby."
- Volatile organic compounds (VOCs) and nitrogen oxides from cars/factories + sun = ozone (O_3)
- Smoke can interact with pollutants in urban air to create ozone[1].



[1]Steven J. Brey, Emily V. Fischer. **Smoke in the City: How Often and Where Does Smoke Impact Summertime Ozone in the United States?** *Environmental Science & Technology*, 2016

OZONE HEALTH EFFECTS

- Makes it hard to breathe deeply
- Affects outdoor workers
- Increases in asthma attacks
- Could cause asthma or damage lungs

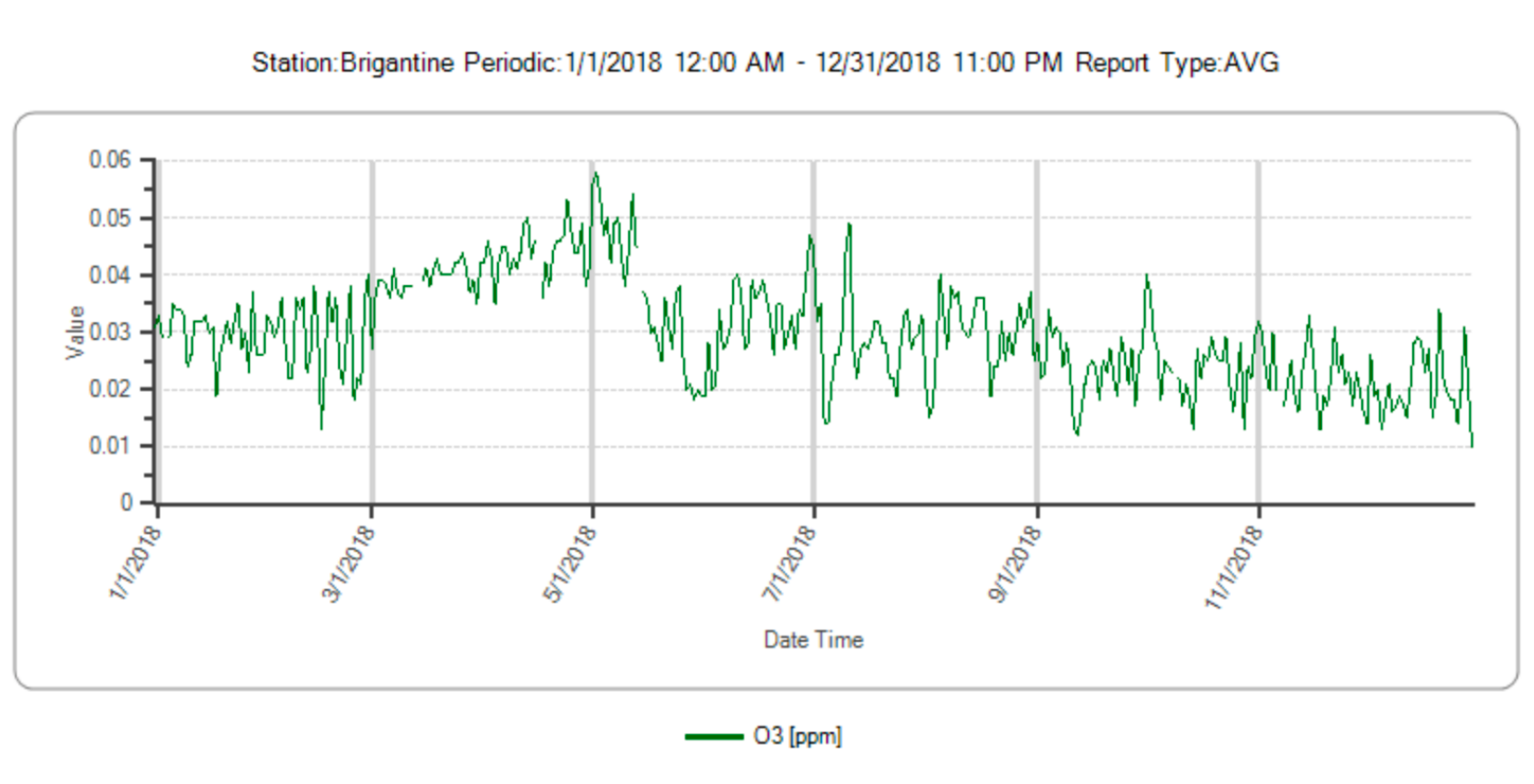


WHO NEEDS TO WORRY?

- In New Jersey we get ozone from regions to our East.
- Moderate .081-.093ppm
- Marginal .071-.081ppm

OZONE IN NJ

One day at Brigantine station with unhealthy (>.075 8-hr) ozone levels last year (5/1/2018)



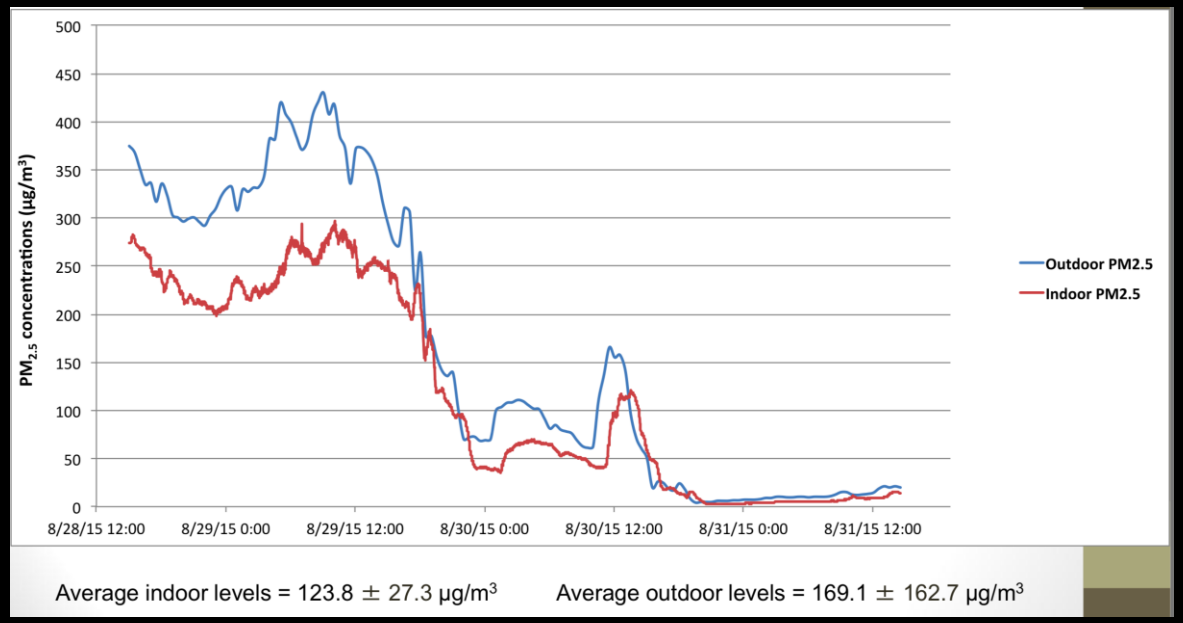
Find your air quality via state or AirNow.gov
Get daily updates from Enviroflash.info

$PM_{2.5}$ HEALTH EFFECTS

Particles penetrate deep into the lungs and cause respiratory disease - Ward

Indoor environment, resulting in elevated, prolonged exposures. - Ward

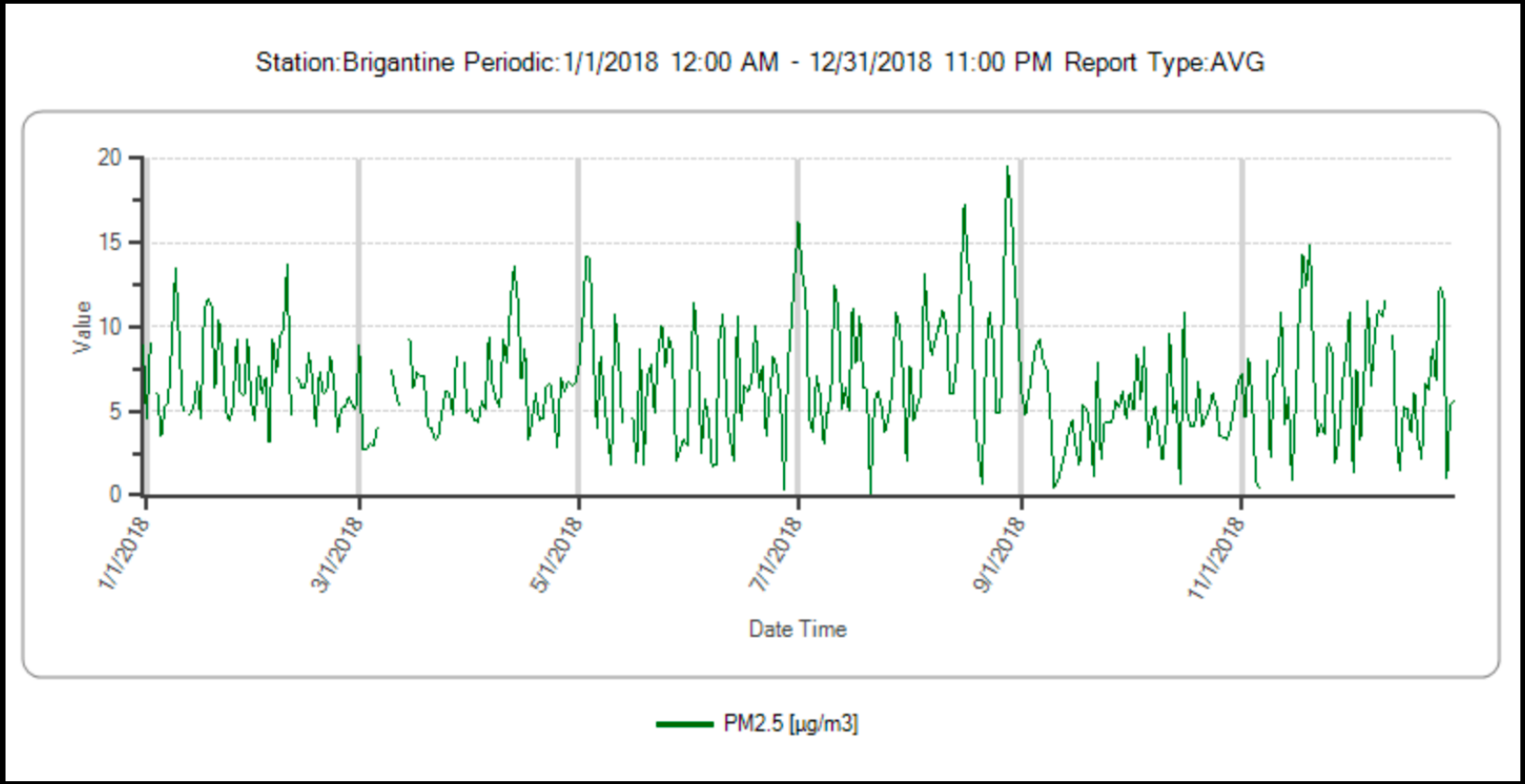
Indoor wipe samples from homes up to 50 km (30mi) from the fire tested positive for char – Ward



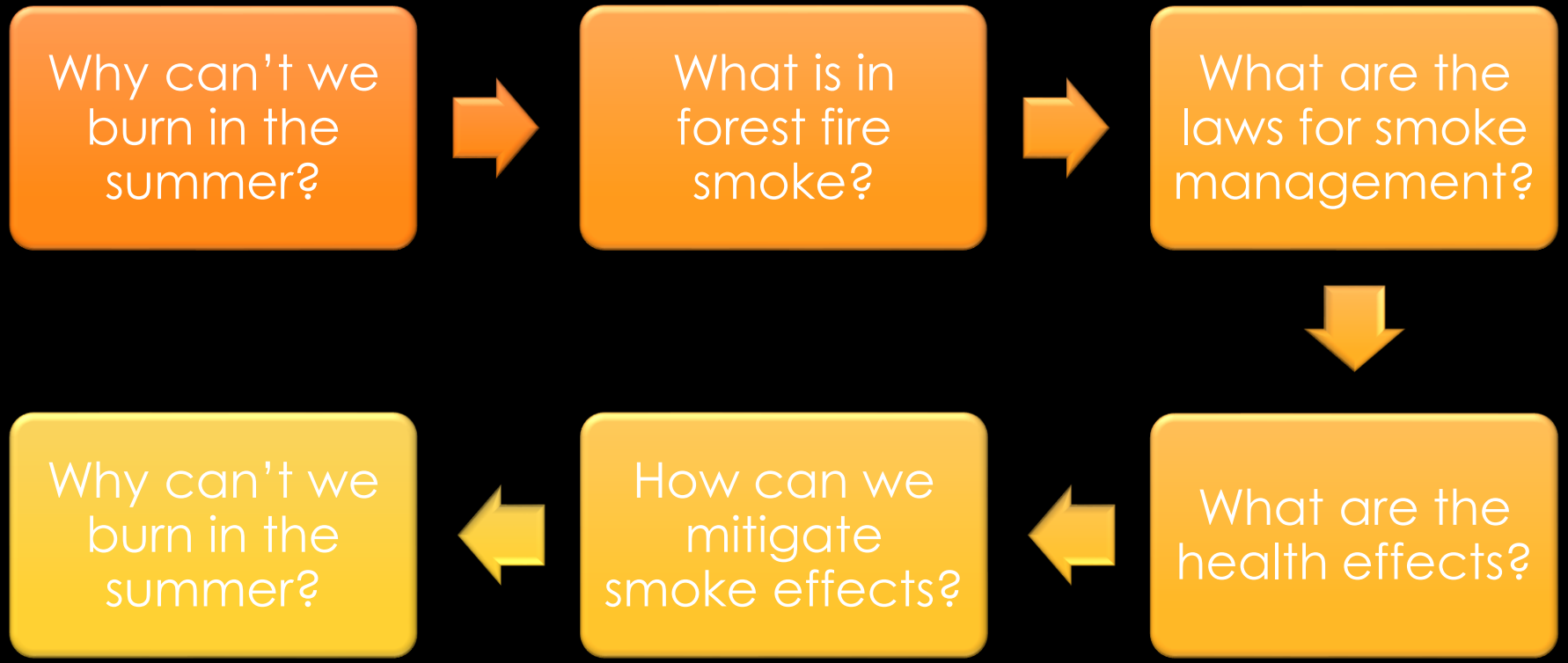
2017 Indoor $PM_{2.5}$ Study (Sept 7, 2017)

Location	Average ($\mu g/m^3$)	Max ($\mu g/m^3$)	Min ($\mu g/m^3$)
Children's Play Area	93.2 ± 15.4	123.2	66.2
Business Office	43.8 ± 12.1	73.4	27.3
Fitness Club	61.5 ± 16.4	94.1	29.7
High School	111.2 ± 39.2	209.7	41.2

$PM_{2.5}$ IN NJ


Station:Brigantine Periodic:1/1/2018 12:00 AM - 12/31/2018 11:00 PM Report Type:AVG
Value
20
15
10
5
0
1/1/2018
3/1/2018
5/1/2018
7/1/2018
9/1/2018
11/1/2018
Date Time
PM2.5 [µg/m3]

MY PATH TO THE SMOKE WORLD



IN THE HOME/ ON THE FIRE LINE

- Create a clean room
- Get an air filter
- Keep windows and doors closed
- Run A/C close fresh air filter if possible
- Community clean air shelter
- Do not rely on surgical masks, dust masks, or wet bandanas.
- “N95” Disposable Particulate Respirator

RALPH PERRON'S STUDY

Question: Are emissions from forest prescribed fire activities negatively affecting sensitive receptors?

Sensitive receptors = homes, highways, institutions

Portable monitoring device for PM and other pollutants (10—20 grand)

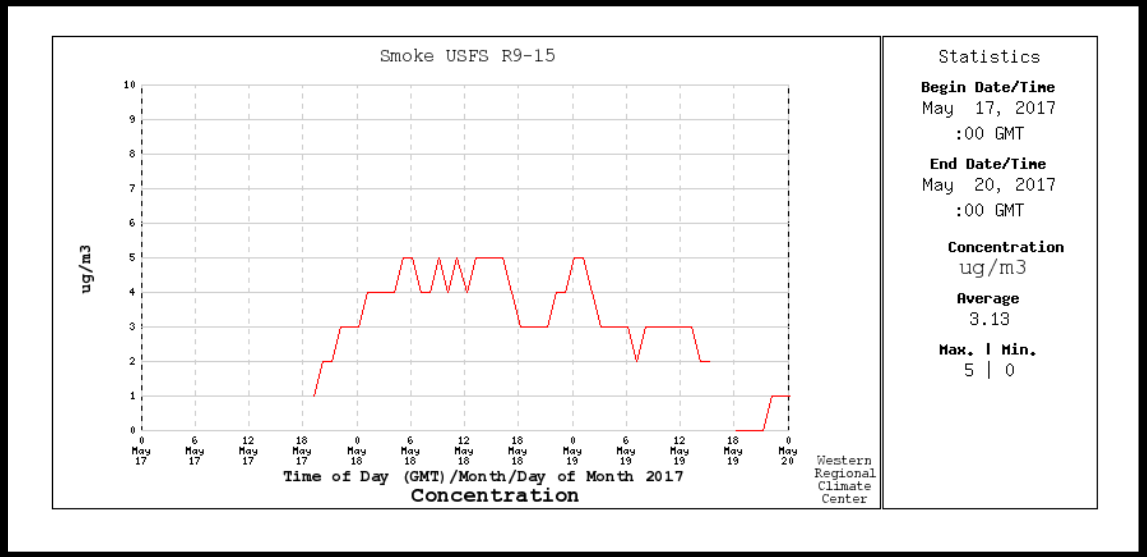
State highway

Glencliff State Sanatorium

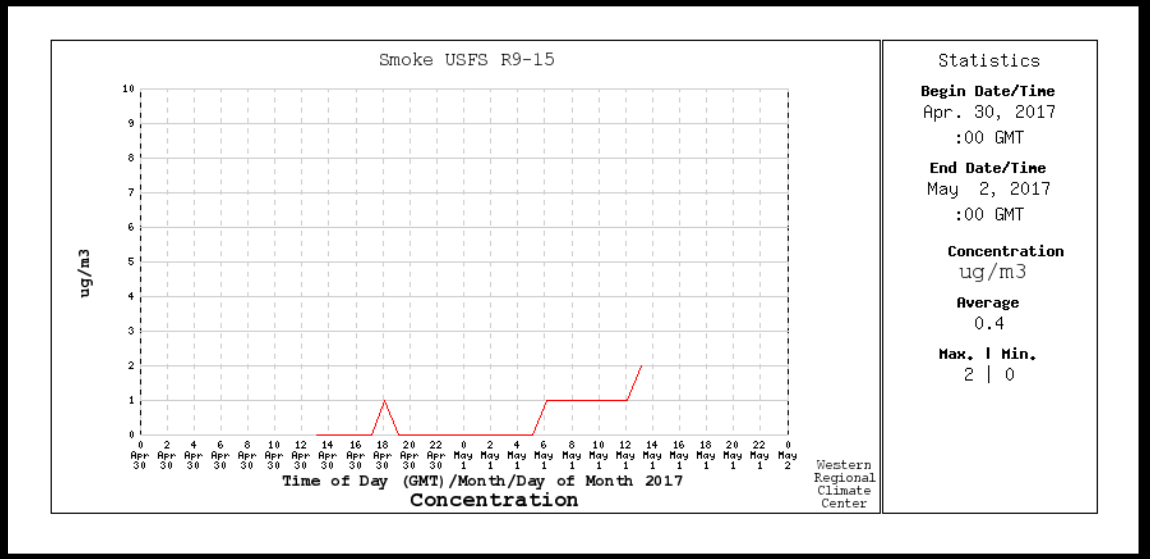
Cluster of homes

Rx fires in White Mountain National Forest

PM2.5 Fine Particulate Sample



2017 Hogsback Rx fire NH Route 25 (15 acre) understory burn – White Mountain National Forest 5-15 typical



2017 Pine Bend Brook Rx Fire near Sugar Hill Scenic Vista (14 acre)

RESULTS

- Vertical smoke dispersion
- Average less than 1 µg/m3 for Pine Brook fire
- Average less than 4 µg/m3 for Hogsback

Remember 35 µg/m3 over 24 hours is EPA limit

In general winds, lift, mixing height effects visibility or human health.

SMOKE MANAGEMENT PLANS

Most states have some version of a smoke management plan

Best practices include:

#1 EVALUATE SMOKE DISPERSION CONDITIONS TO MINIMIZE IMPACTS

#2 MONITOR EFFECTS OF FIRE ON AIR QUALITY

#3 RECORD BASIC SMOKE MANAGEMENT PRACTICES, FIRE ACTIVITY AND EFFECTS

#4 COMMUNICATE AND NOTIFY AUTHORITIES AND AFFECTED PUBLIC

#5 UTILIZE EMISSION REDUCTION TECHNIQUES WHENEVER POSSIBLE

#6 COLLABORATE WITH NEARBY BURNERS TO MANAGE SMOKE EMISSIONS

SMOKE DISPERSION MODELS

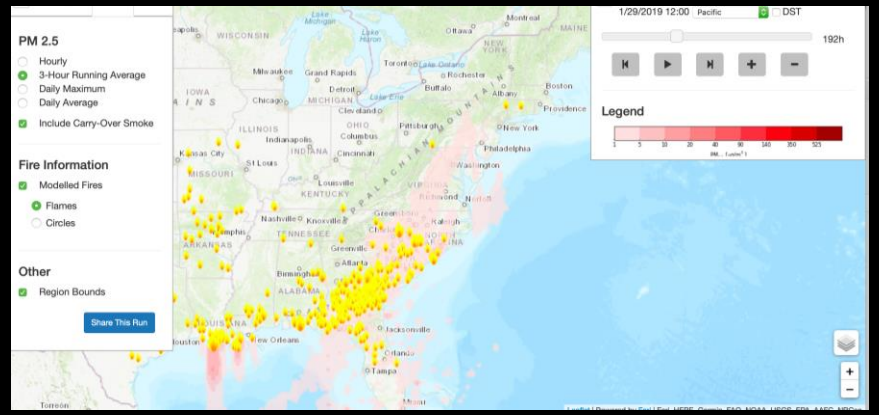
- V-smoke Web- Gaussian model

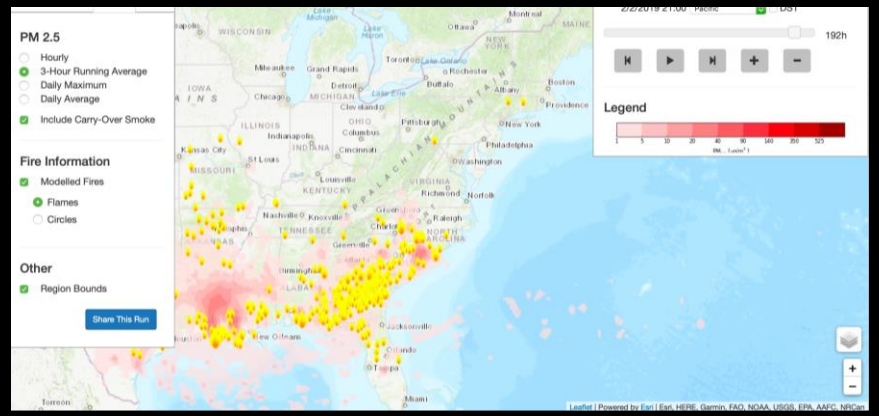
Quick estimates of smoke effects using mixing height, wind, and atmospheric stability

- Bluesky - Lagrangian particle models HYSPLIT and CALPUFF

Takes into account fuels and consumption to emissions relationships, cumulative effect of many fires.

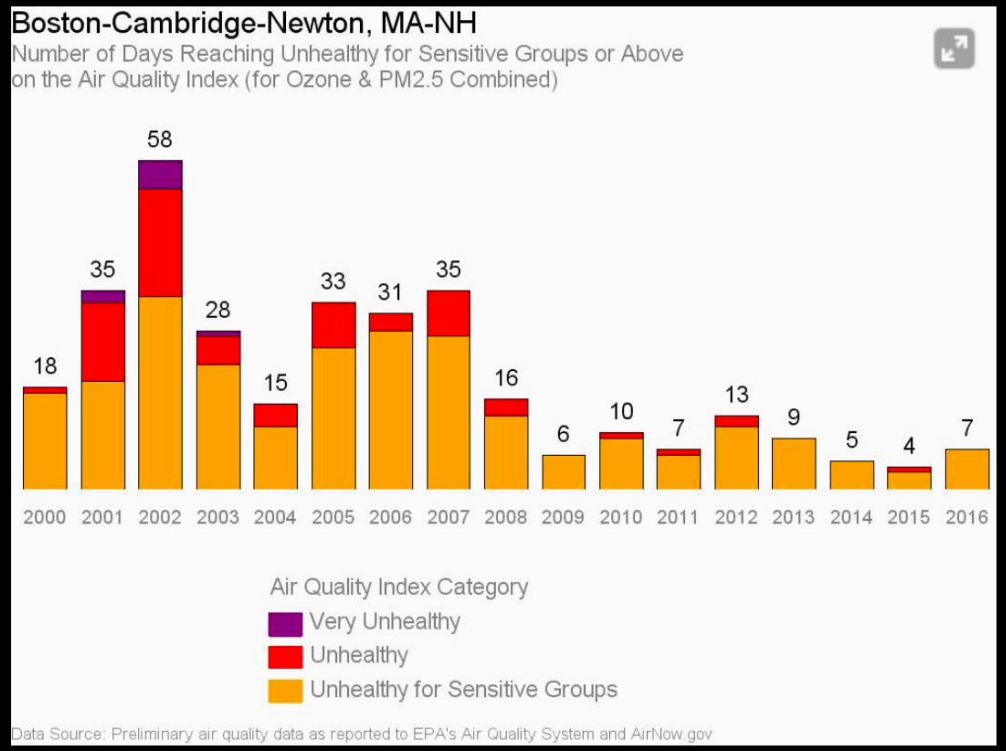
(see my research brief for more info)

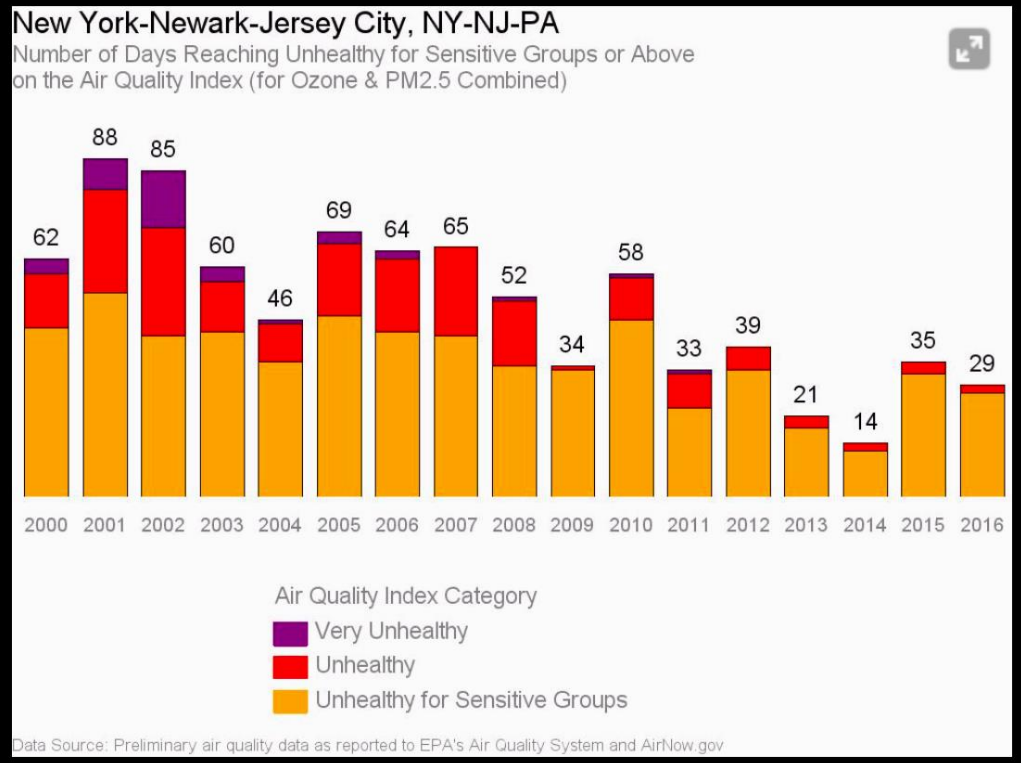




CLEAN AIR ACT IS WORKING!

Boston





Storymaps: https://cfpub.epa.gov/airnow/

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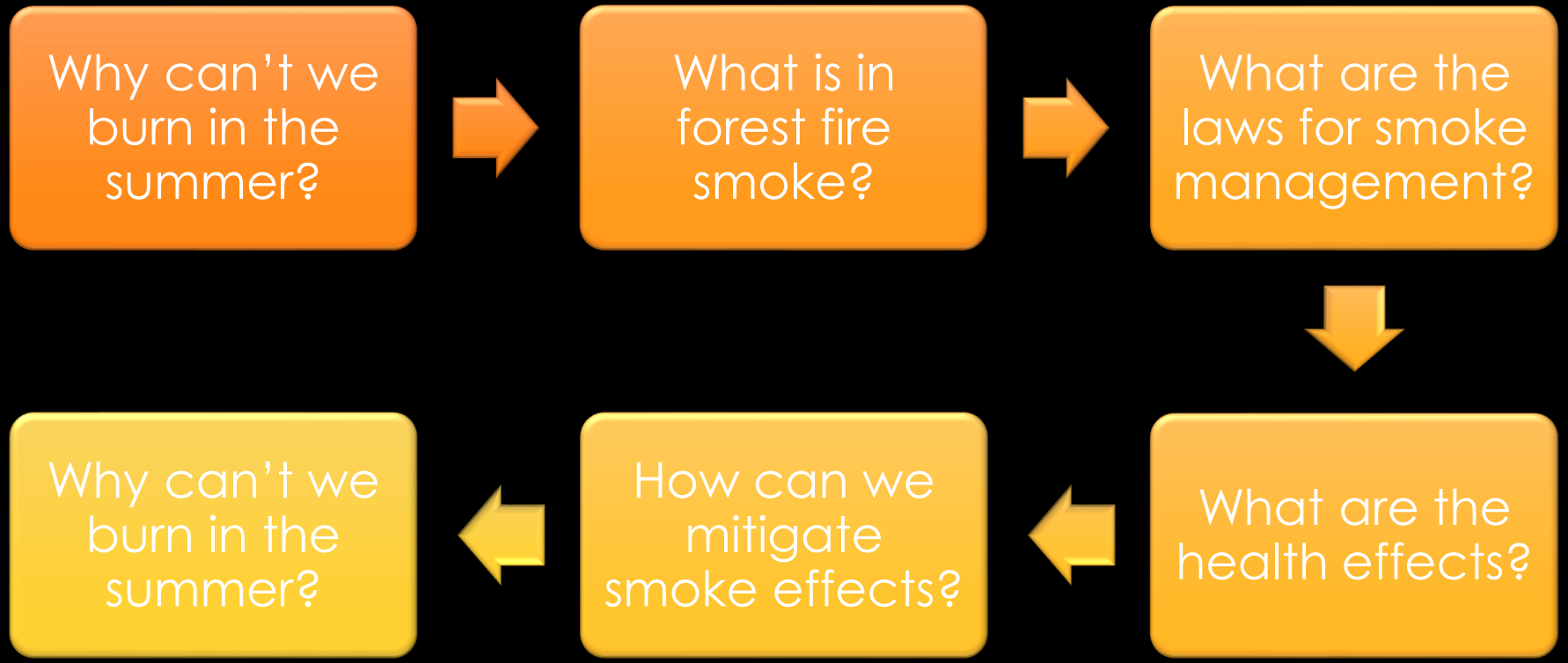

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Too much smoldering

WHEN TO WORRY

- If smoke from large wildfires is already drifting into your state.
- High ozone days (Check state air quality site or AirNow)
- Prescription is close to limits for wind/ variable winds predicted/ sea breeze
- Nighttime inversion could trap smoke near ground
- Potential highway or sensitive populations impacts
- It was supposed to rain/snow and it didn't

THANK YOU!