Peat Bog Wildfire Smoke Exposure in Rural North Carolina Is Associated with Cardio-Pulmonary Emergency Department Visits

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Pocosin Wildlife Refuge Wildfire NC 2008

A Case Study in Health and Economic Impacts, Environmental Health Disparities and Evaluation of Potential Risk Reduction Measures

Office of Research and Development
National Health and Environmental Effects Research Laboratory

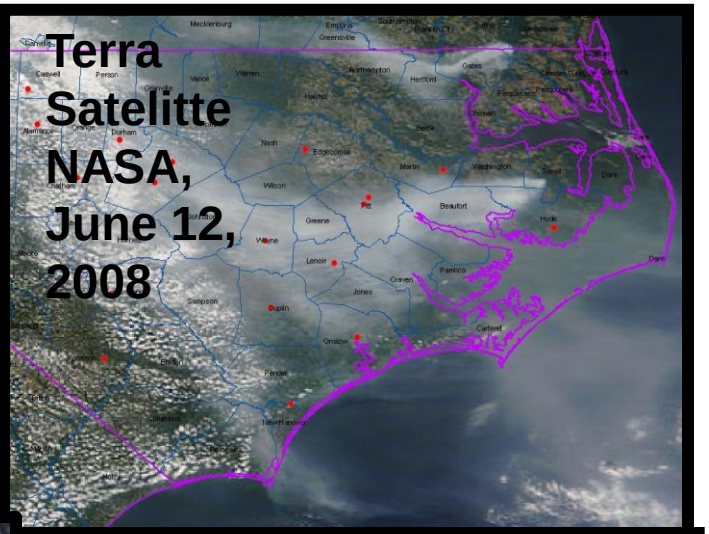
2008 Pocosin Lakes National Wildlife Refuge Wildfire

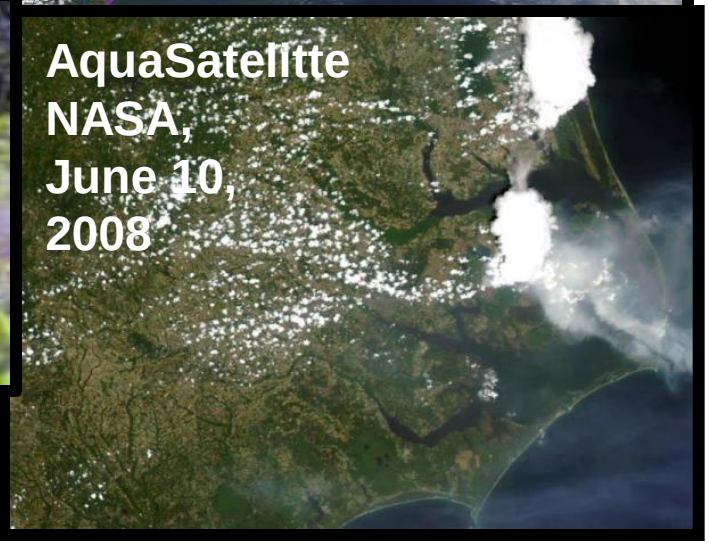
Satellite image showing the location of Evans Road Fire in the Pocosin Lakes National Wildlife Refuge, NC

- Evans Road Fire
- Initiated by lightning strike on June 1, 2008
- Burned 40,704 acres of peat bogs
- On average peat was 3ft in deep, up to 15ft
- Suppression efforts cost approx. $20M, 2 billion gallons of water, 202 days
- 400 local, County, State and Federal personnel + volunteers

www.fws.gov/pocosinlakes/news/ERF/news-erf-out.html

Good and Bad Days





Photos Greenville, NC
Courtesy of Teresa Cascio

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Pocosin Lakes National Wildlife Refuge.
Photo by Dale Suiter, USFWS

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Disclaimer

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Case Study

The goal is to evaluate impacts from multiple aspects:

1) Health Impacts
   - Emergency Department visits for cardio-respiratory visits
   - Co-morbidities
   - Characterizing Toxicity
   - Comparison to the effects observed following Pains Bay fire in 2011

2) Environmental Health Disparities
   - Evaluating the role of community characteristics on differentiating the risk from adverse outcomes following the exposure.

3) Economic Impacts
   - Evaluation of actual and perceived cost to the community welfare
   - Evaluation of potential risk reduction measures

4) Contribution to the Ambient Air Pollution
   - Improving emissions and contribution of smoldering in the atmospheric chemical models for regional and global transport

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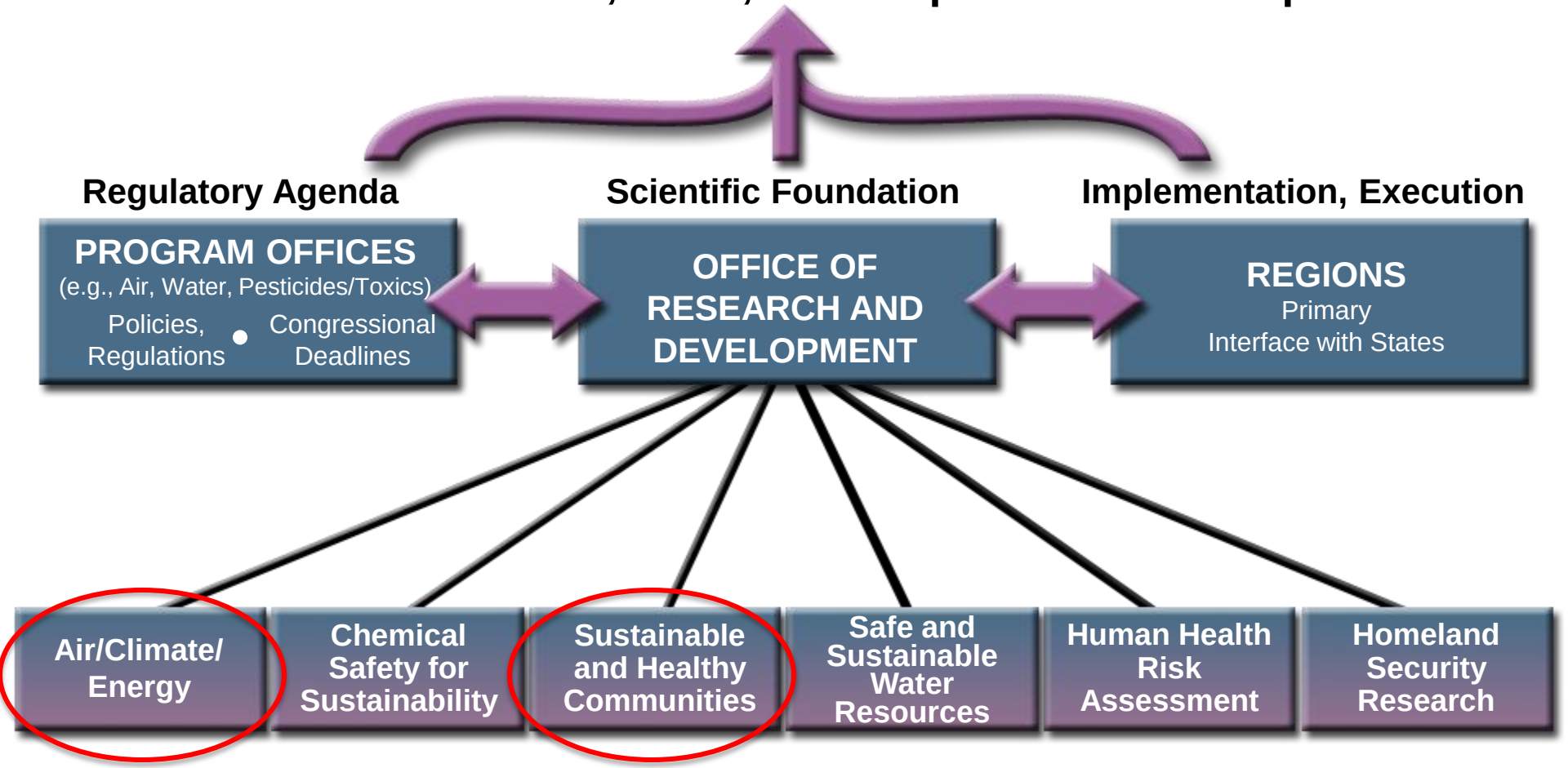
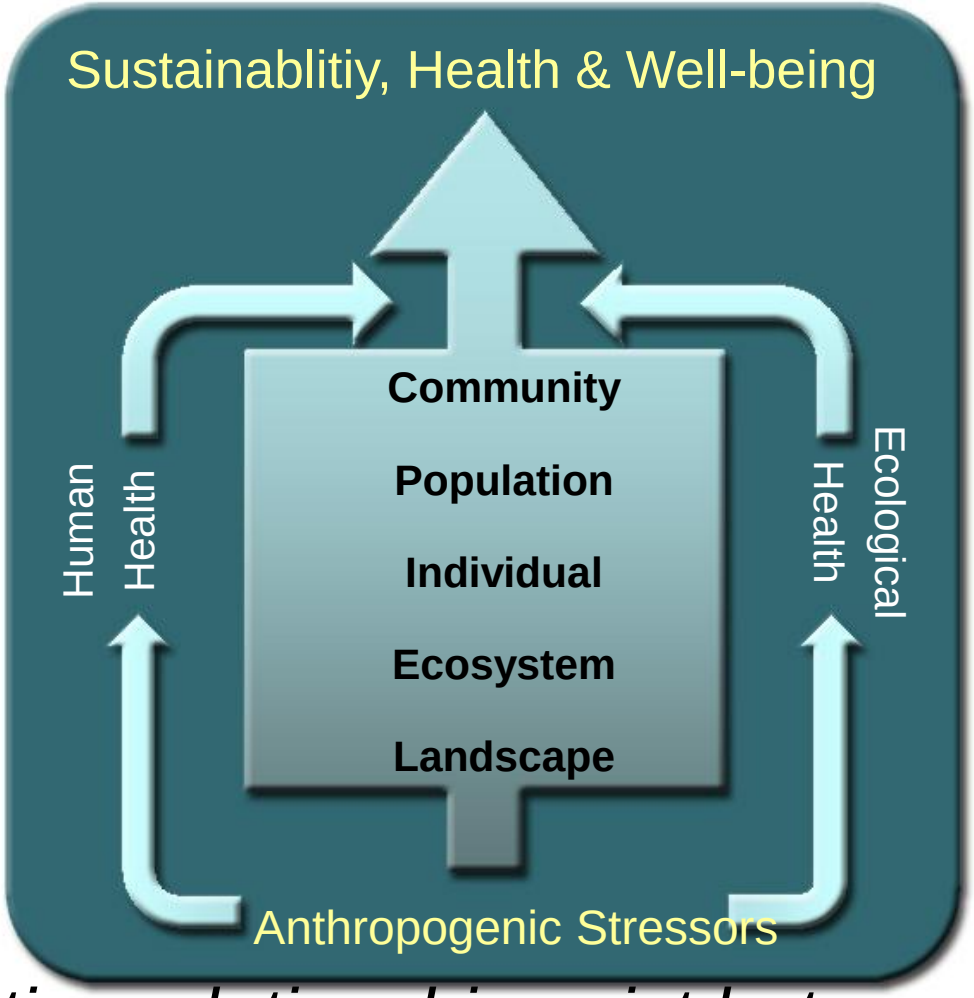
EPA's Mission:

Protect human health and safeguard the natural environment – air, water, land – upon which life depends



NHEERL Integrates Human Health and Ecological Sciences



Does a positive relationship exist between sustainable ecological practice, health and well-being?

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Health Impacts of Air Pollution

Air Pollution Impacts Cardiovascular and Respiratory Health

- Most influential epidemiological and clinical studies demonstrating association are summarized in US EPA Integrated Science Assessment 2009.
- Criteria pollutants are: Ozone, Particulate Matter (PM_{10}, $PM_{2.5}$), Carbon Monoxide, Nitrogen Oxides, Sulfur Dioxide, and Lead
- Most research is based on urban pollution and emissions of burning fossil fuels
- In comparison to urban air pollution, substantially less is known about effects of biomass burning.
- Wildfires produce ~35% of ambient $PM_{2.5.}$
- Exacerbations of asthma and other respiratory symptoms are most commonly cited.

Health Impacts

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

Cardiovascular and Respiratory Emergency Department Visits

NC Disease Event Tracking and Epidemiologic Tool – NCDETECT

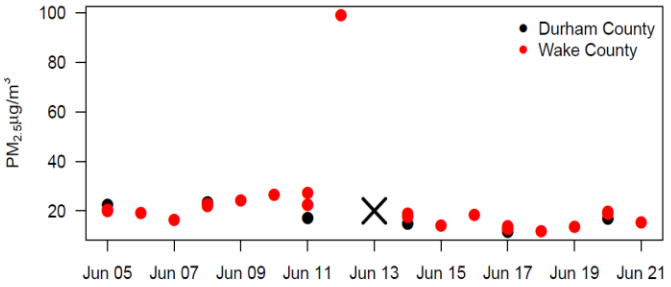
- early event detection and public health surveillance program
- 98% participation rate across the state
- county of residence, gender, age, and discharge diagnostic codes

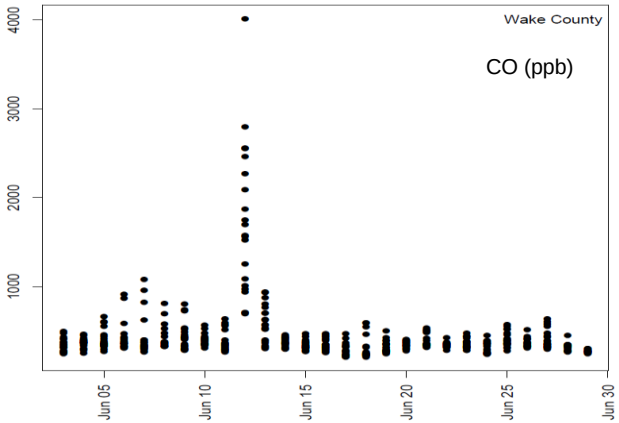
Exposed region was mostly rural, moderately populated with low background levels of air pollution

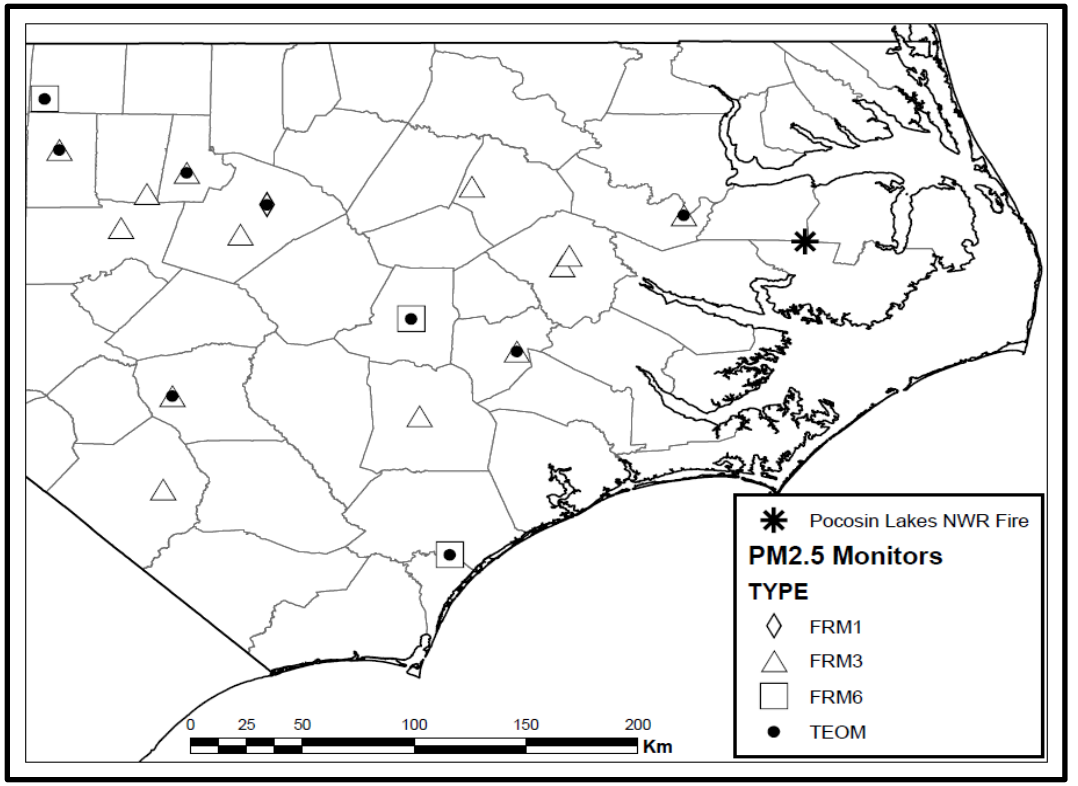
Federal and State Air Quality Monitoring

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

Fine and Coarse PM
(FRM, TEOM)







Gasses: O3, NOx, CO

CMAQ 9 Day Run

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

Courtesy of AMAD, NERL, US EPA

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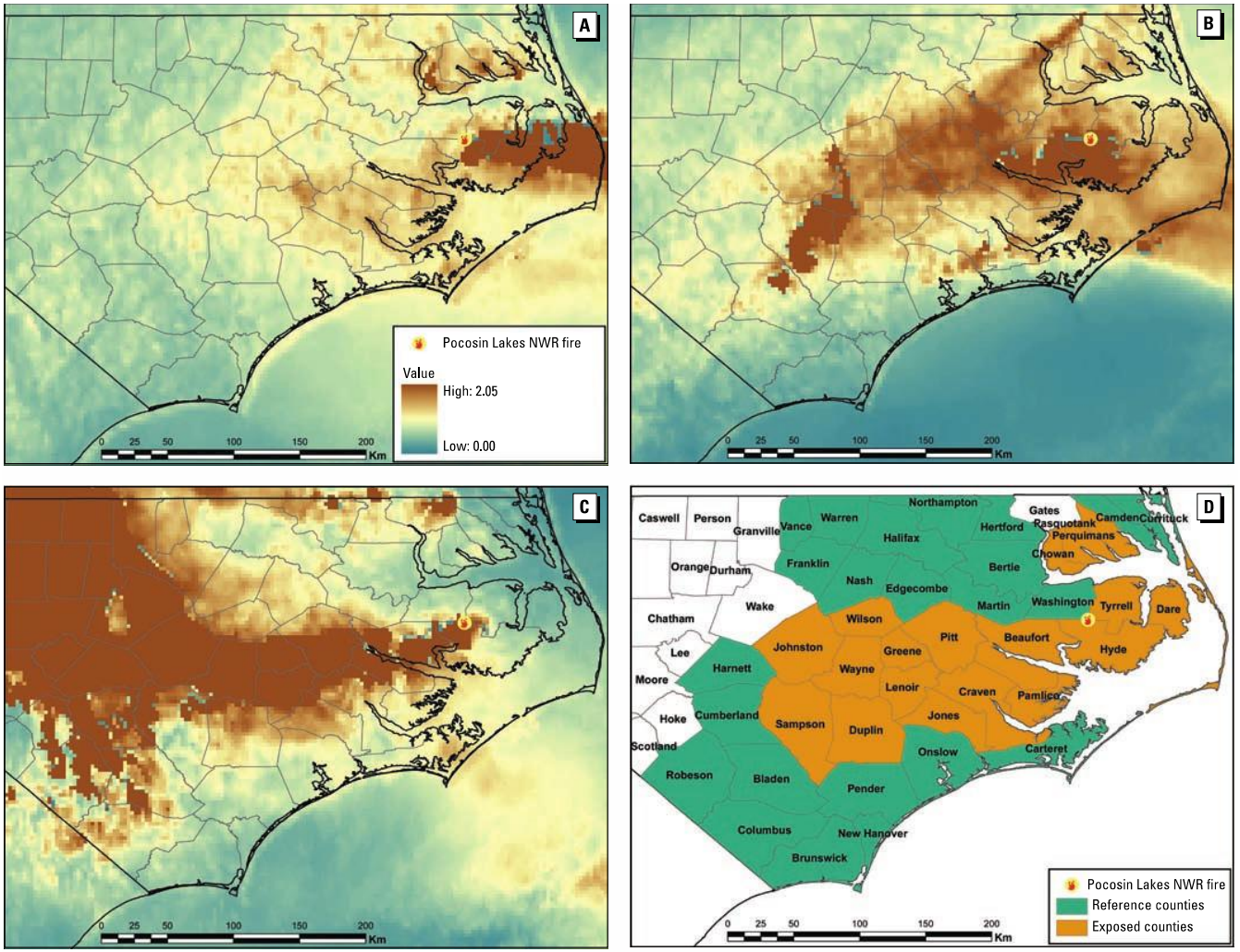
Satellite Derived AOD
Used to Define Region Most Impacted by the Smoke

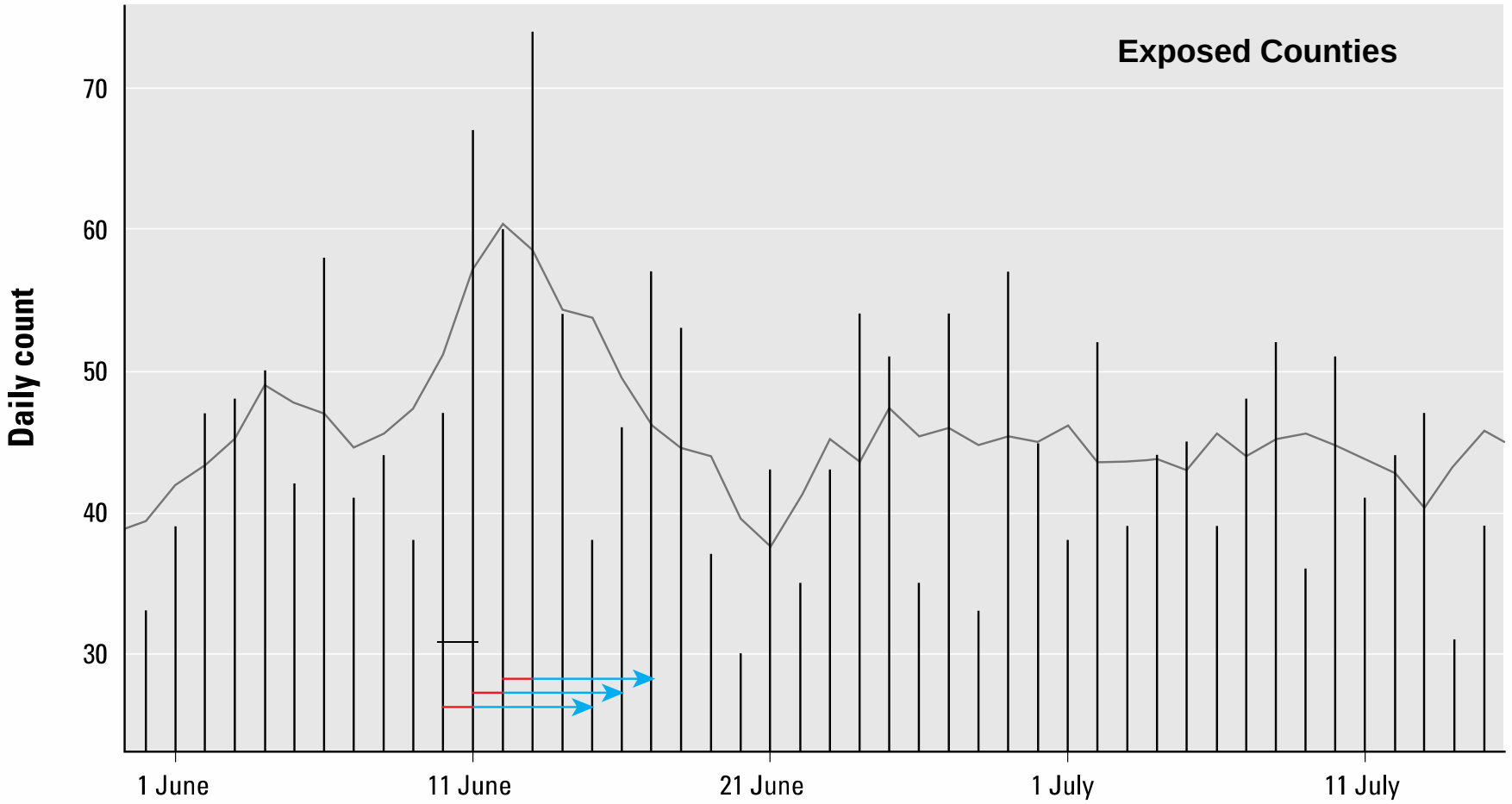
2008 Pocosin Lakes National Wildlife Refuge Peat Fire



Rappold AG et al. Environ. Health Perspectives 2011

Daily Counts of Asthma ED Visits

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

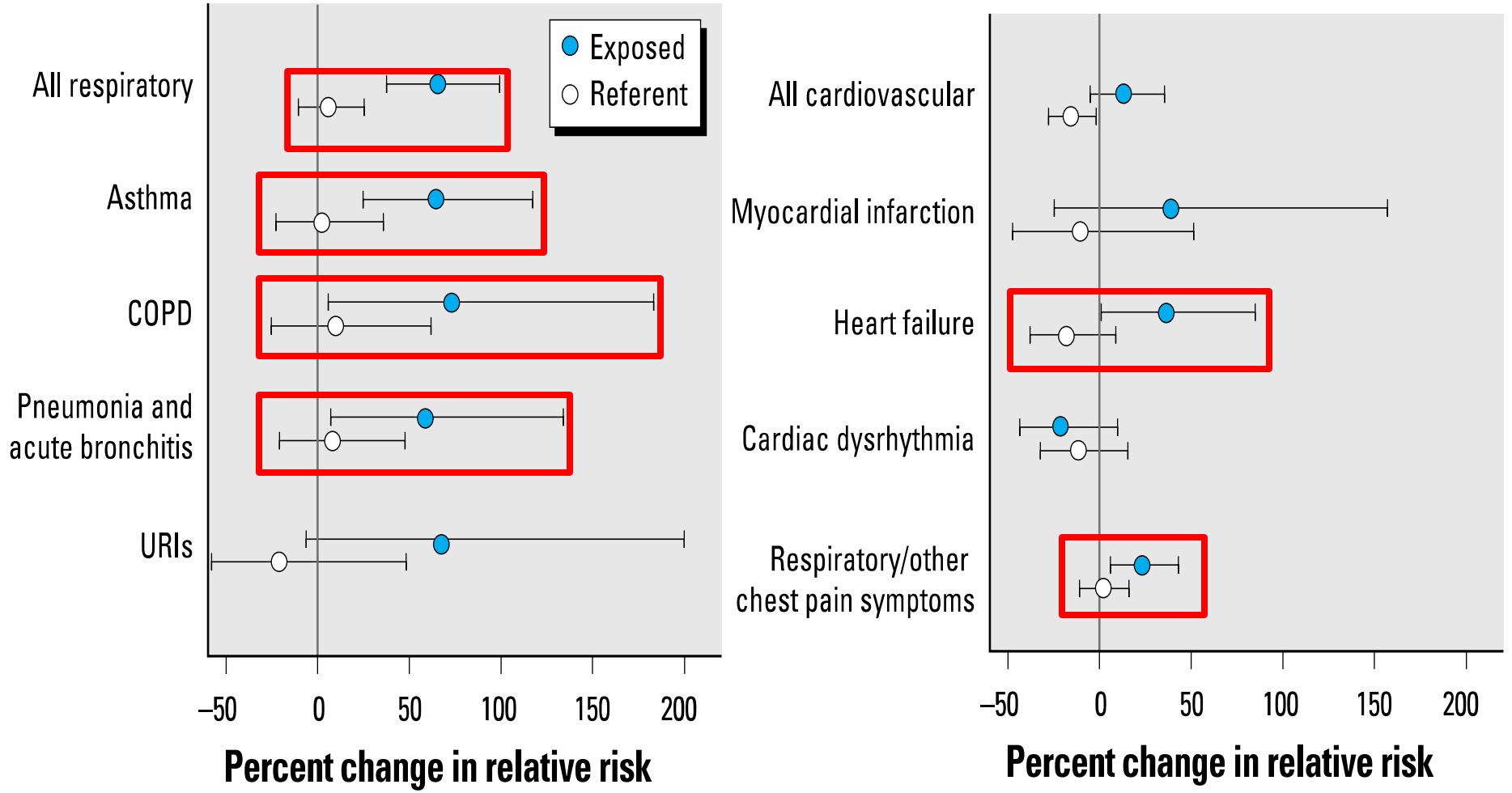


Arrows represent the 3 day of high exposure (red) and the subsequent 5 lag days (blue)

Rappold AG et al. Environ. Health Perspectives 2011

Wildfire 2008 - Regional Health Effects

2008 Pocosin Lakes National Wildlife Refuge Peat Fire



Percent change in cumulative RR by discharge diagnosis category for exposed and referent counties in NC during 3-day period of high exposure compared with the entire 6-week study period.

Rappold AG et al. Environ. Health Perspectives 2011

Health Impacts Summary

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

Statistically significant changes in

- asthma
- COPD
- pneumonia and acute bronchitis,
- respiratory symptoms
- heart failure

as well as an increasing trend for

- myocardial infarction related visits and
- upper respiratory infections.

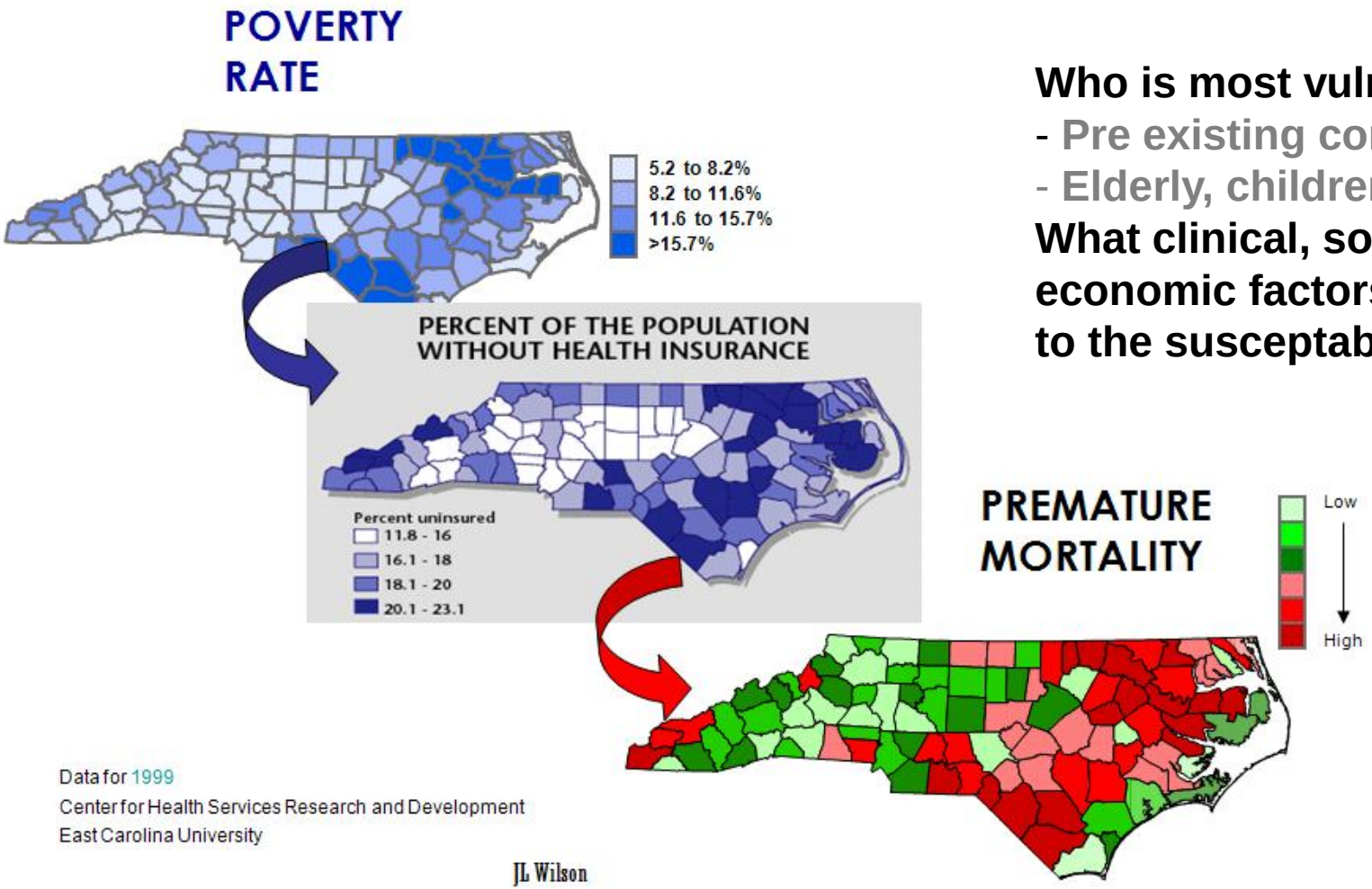
These results raised more questions

Q2: Susceptability and Health Disparities

Regional Convergence of Social Issues

Who is most vulnerable?
- Pre existing conditions
- Elderly, children

What clinical, social, and economic factors contribute to the susceptability?



Q3: Are peat fires different then forest fires

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

- Emissions are not well characterized in the National Emissions Inventory
- Smoldering vs. flaming and contribution to the ambient air pollution

- Organic composition and chemical properties of the fuel
- Determining in-vitro and in-vivo toxicity
- Concentration and duration of ground level exposures?

Q4: Economic impacts

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

Recent History of Major Peatland Wildfires in NC[1] :

2008: - Evans Road Fire, 40K acres **($20M)** [1]

- South One Fire Great Dismal Swamp Fire **($12M)** [1]

2011: - Pains Bay Fire, 45 K acres **($14M)** [1]

- Juniper Road fire, 31K acres **($3.5M)** [1]
- Simmons Road Fire,
- Lateral West Great Dismal Swamp, 6.5K acres **($12.5M)** [1]

- All ignited by the lightning strike and spread rapidly due to drought

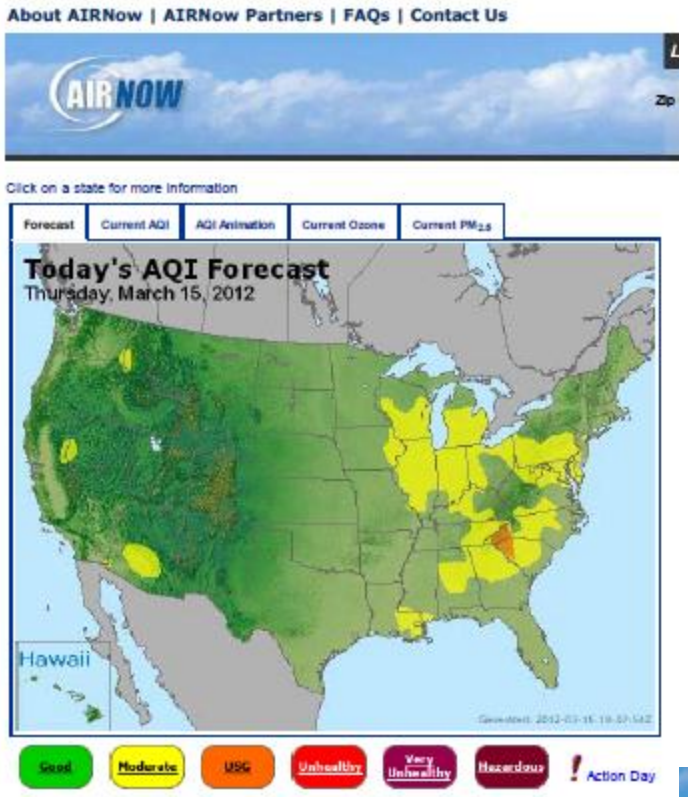
-Traditional return interval for major peat fires ~50 years[2]

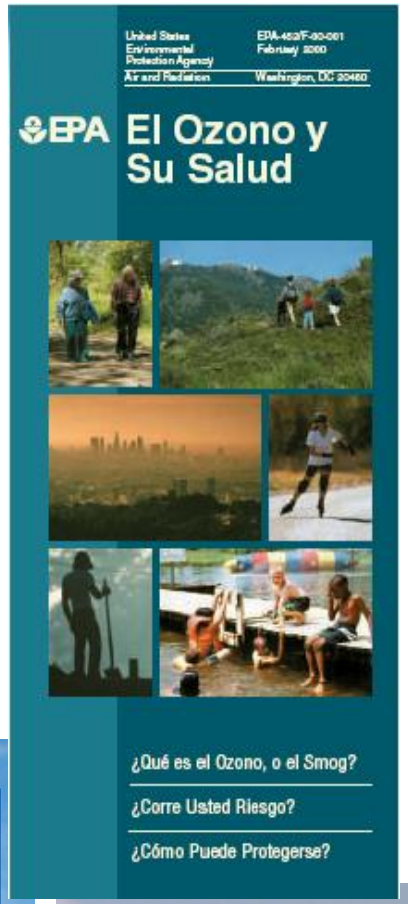
- *Economic impacts* include medical costs, loss of productivity and revenue from local tourism and other

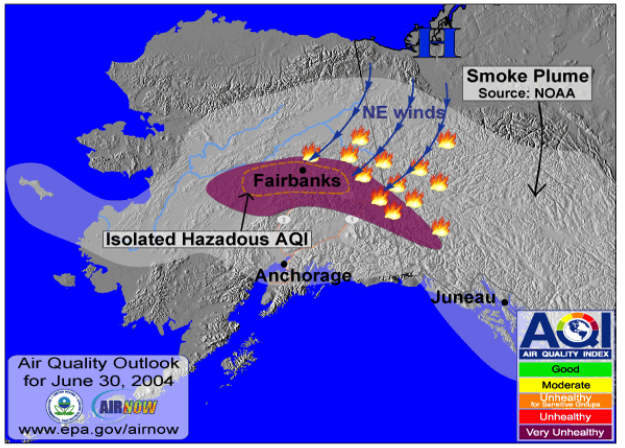
- What is the cost of the alternative solutions? And what are the alternatives ..

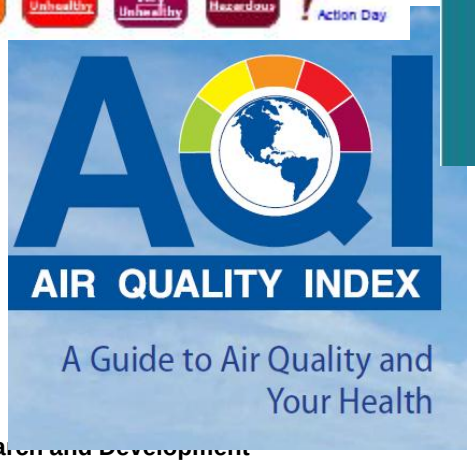
[1] InciWeb, Incident Information System, www.inciweb.org
[2]Courtesy of Sara Ward, USFWS

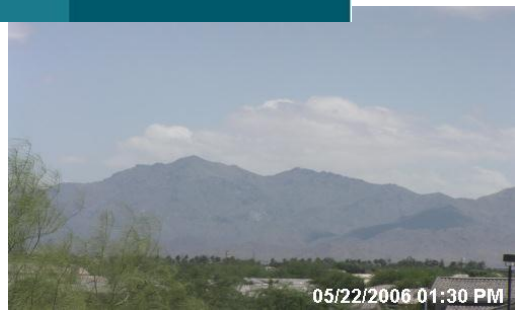
Q5: Evaluating of Potential Risk Reduction Measures Public Education











Q4: Evaluation of Potential Risk Reduction Measures

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

NC Division of Air Quality issues press releases and more recently daily Smoke Forecasting Maps for the region.

Press releases are picked up by local news media outlets and distributed with varied intensities.

Goal : Evaluate direct health costs to the community under two scenarios:
- *without* the implementation of Smoke Forecasting
- *with* the implementation of Smoke Forecasting

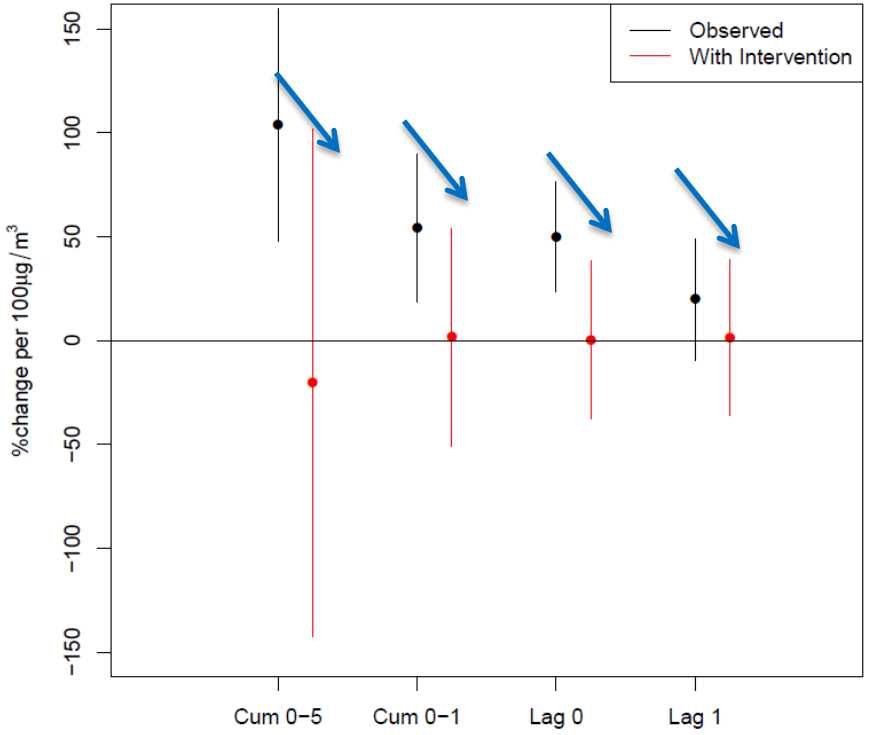
Smoke Forecasting Maps are based on NOAA's 24hr and 48 hr smoke plume prediction models.

Other smoke forecasting frameworks are also available and in operational mode, such as BlueSky.

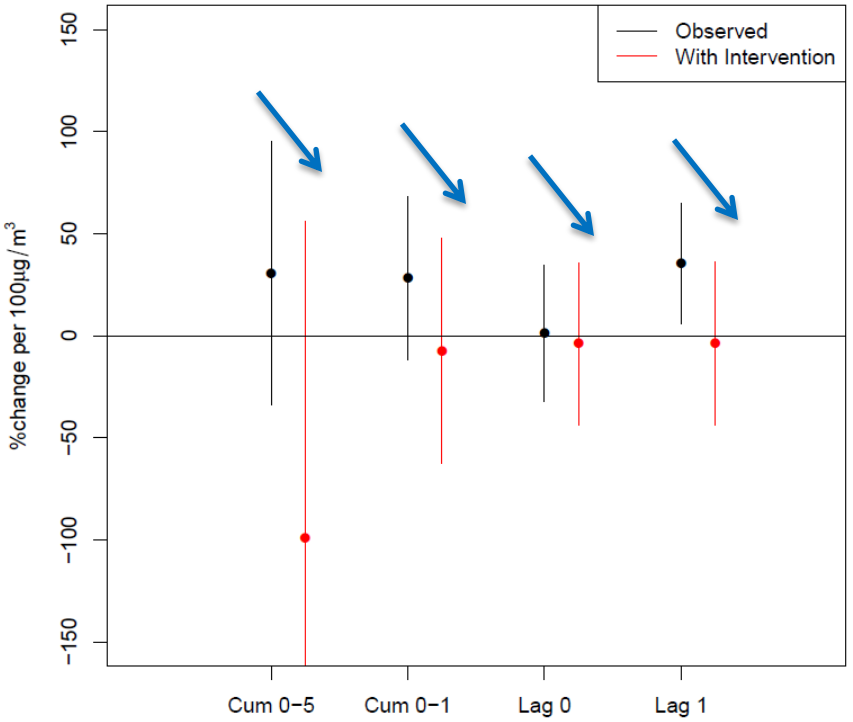
Evaluation of a Potential Risk Reduction Measure

work in progress

Asthma



Congestive Heart Failure



Based on NOAA 24 hour HYSPLIT forecast

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In conclusion…

- Frequency and intensity of fires in pocosins and wetlands are expected to exceed their historical rate due to prolonged drought conditions, land use practices and population changes.
- Fires have substantial impact on community health and economy.
- Peat fires have local and global impact on the environment.
- Opportunities for intervention through sustainable growth practices, improving health literacy of health care community and public, developing forecasting and disease management strategies.
- More research is needed on properties of peat fires.
- While no fire is alike we are looking forward to comparing the findings to other peat fires in NC by the end of the summer.

Peatland Wildfires in NC 2008/2011

2008 Pocosin Lakes National Wildlife Refuge Peat Fire

Why are Pocosin Wildfires More Frequent and Severe?[1]

- Land was ditched and drained in 60's for agriculture and peat mining
- Extensive drainage network limits duration of seasonal flooding, retention of rainfall
- Water table is lowered, peat is aerated & drier- highly ignitable
- Problem is exacerbated with prolonged drought in the region

Methods to prevent wildfires

- Suppression
- Preventing accumulation of fuel
- Restoration of hydrology
- Sustainable growth practices

Methods to prevent impacts on health effects

Improve literacy within public and community health care providers by
- outreach programs and communication with communities
- develop health action plans and disease management plans for those at high-risk from smoke exposure.

[1]*Courtesy of Sara Ward, USFWS*

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Thank you

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