



Making the Connection:

# Climate Changes Allergies and Asthma

May 9, 2016, 1:30 pm EDT



# Welcome



# Welcome

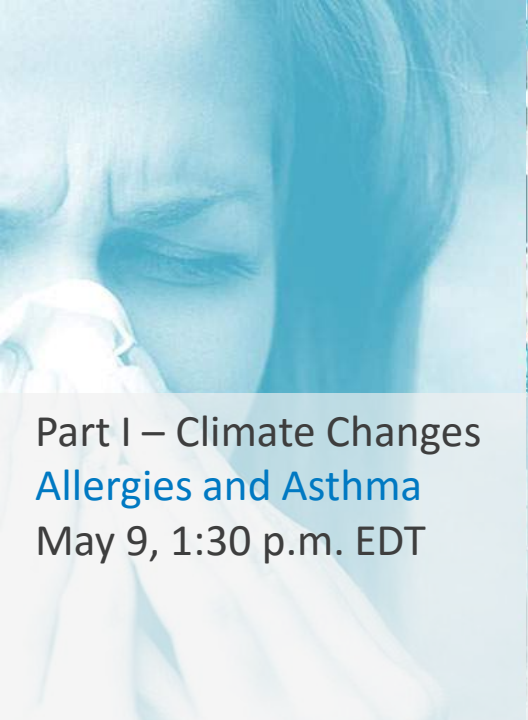


**Regina Davis Moss, PhD, MPH, MCHES**

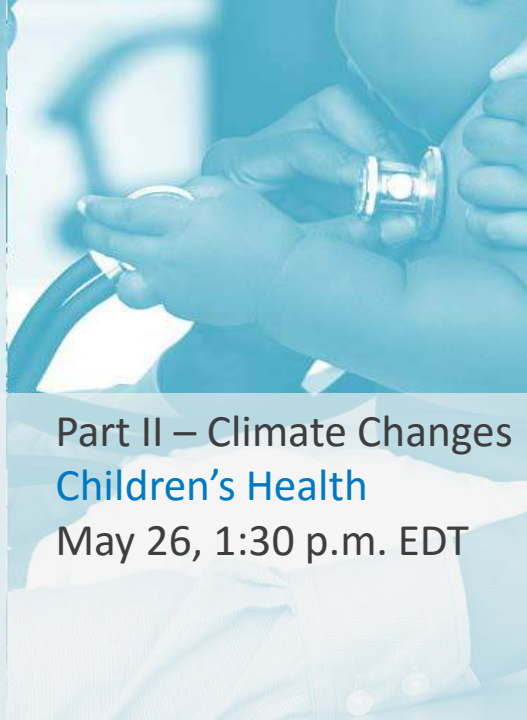
Associate Executive Director  
Public Health Policy and Practice  
American Public Health Association







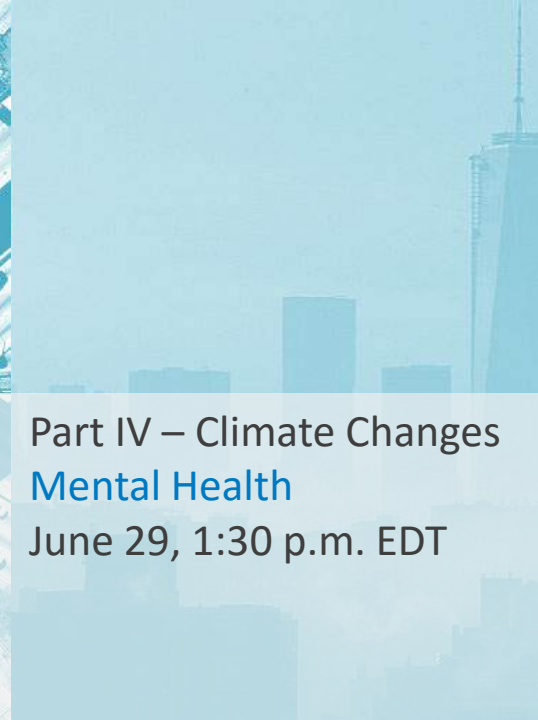
Part I – Climate Changes  
**Allergies and Asthma**  
May 9, 1:30 p.m. EDT



Part II – Climate Changes  
**Children's Health**  
May 26, 1:30 p.m. EDT



Part III – Changing Climate  
through **Healthy  
Community Design** and  
**Transportation**  
June 7, 1:30 p.m. EDT



Part IV – Climate Changes  
**Mental Health**  
June 29, 1:30 p.m. EDT

Making the Connection:

# Climate Changes Health

webinar series



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Follow the conversation on social media using the hashtags **#APHAWebinar** and **#ClimateChangesHealth**. For more information on how climate change impacts health, please visit [www.apha.org/climate](http://www.apha.org/climate).

# Moderator



**Mark Mitchell, MD, MPH**

Chair, Council on Medical Legislation  
Co-Chair, Commission on Environmental Health  
National Medical Association



# Presenter



## **David B. Peden, MD, MS, FAAAAI**

Senior Associate Dean for Translational Research  
Chief, Division of Pediatric Allergy, Immunology & Rheumatology,  
Department of Pediatrics  
Director, Center for Environmental Medicine, Asthma & Lung Biology  
University of North Carolina at Chapel Hill School of Medicine  
&  
President-Elect, American Academy of Allergy, Asthma and  
Immunology

# Disclosures

- FEDERAL FUNDING
- US Environmental Protection Agency
- National Institute of Environmental Health Sciences
- National Center for Advancing Translational Sciences
- National Institute of Allergy and Infectious Diseases
  
- CORPORATE /ORGANIZATIONAL
- Associate Editor, JACI
- Board of Directors, AAAAI
- Springer (Editor, Current Allergy and Asthma Reports)
- Up-to-Date
- Glaxo Smith Kilne (Clinical Trial)





# Climate Change and Ambient Air Pollution

Outdoor pollution

# **General facts about pollutant exposure and asthma exacerbation**

- Generally, increases in asthma exacerbation occurs 24-48 hours after the pollutant exposure
- Often, exacerbations occur with pollutant exposures less than current NAAQS standards
- Pollutants enhance response to allergen

# Actions of Inhaled Pollutants

- Ozone

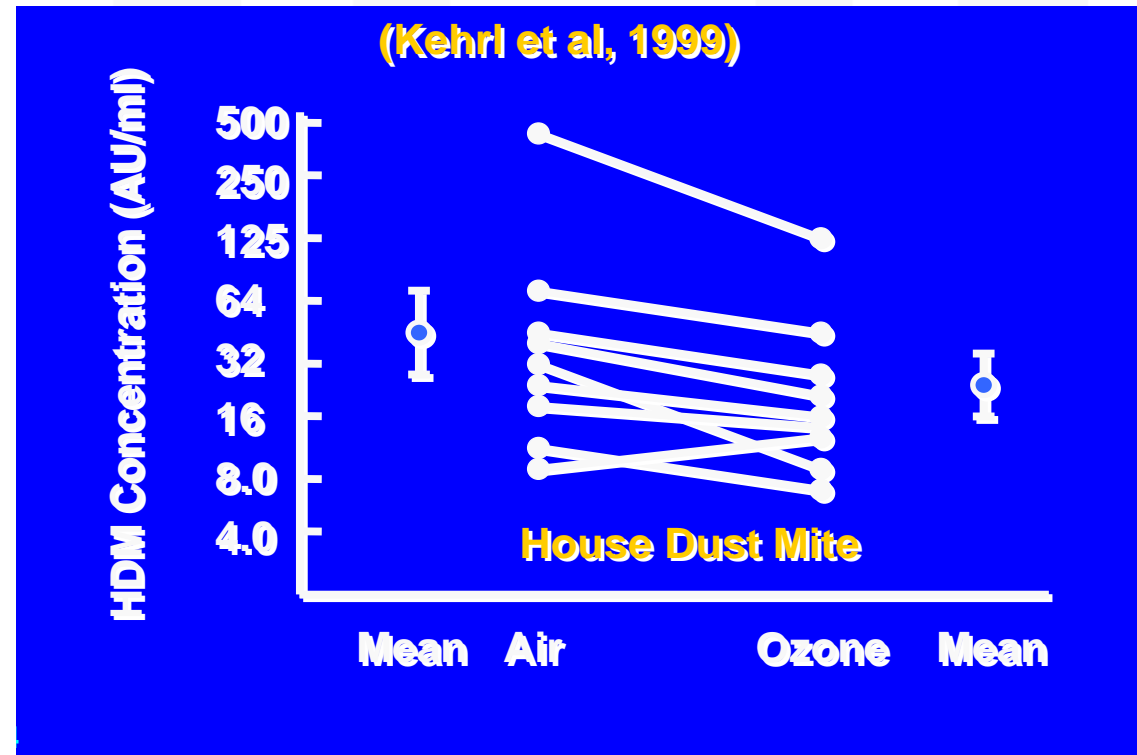
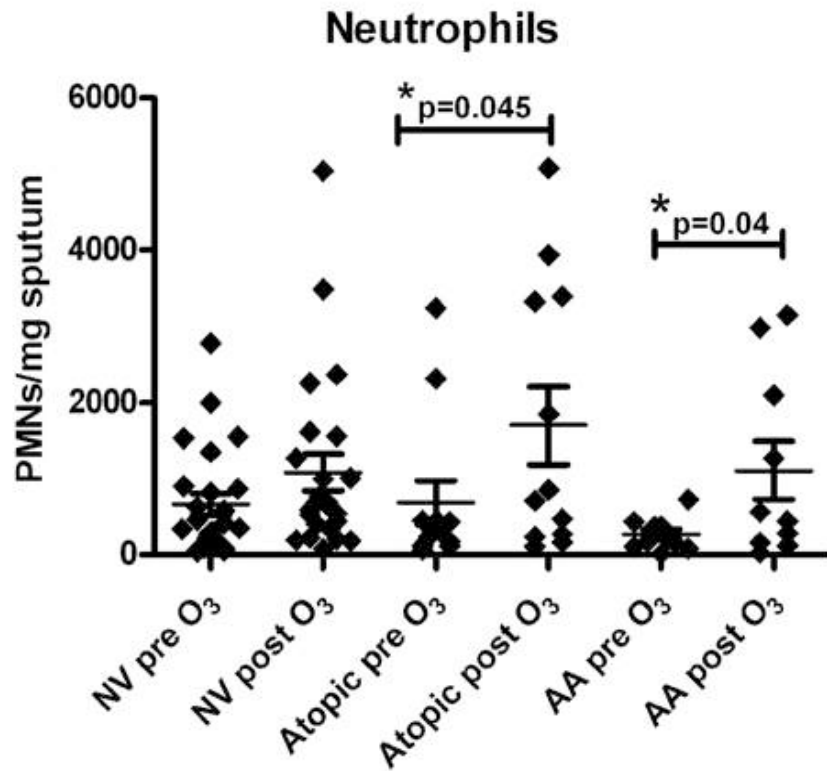
- » Acute airway inflammation
- » Increased airway reactivity
- » Temporarily immediate decrease in lung function
- » Increased airway reactivity (twitchiness)

- PM

- » Acute airway inflammation
- » Some increased airway reactivity (twitchiness)
- » May decrease lung function
- » CV effects
  - Coagulation
  - HRV



## Asthmatics are more susceptible to ozone effects and have increased response to allergens after ozone exposure





## Air Quality Index for Ozone

Index Values (Conc. Range)	Air Quality Descriptors	Cautionary Statements for Ozone
0 – 50 (0-60 ppb)	Good	<b>No health impacts are expected when air quality is in this range.</b>
51 – 100 (61-75 ppb)	Moderate	<b>Unusually sensitive people should consider limiting prolonged outdoor exertion</b>
101 – 150 (76-104 ppb)	Unhealthy for Sensitive Groups	<b>Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion</b>
151 – 200 (105-115 ppb)	Unhealthy	<b>Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children should limit prolonged outdoor exertion.</b>
201 – 300 (116-374 ppb)	Very Unhealthy	<b>Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.</b>





# AQI-PM

**Air Quality Guide for Particle Pollution**

Adjective	Air Quality Index (AQI)	Concentration PM 2.5 (ug/m <sup>3</sup> - 1-3 hr. avg.)	Cautionary Statement	Health Effects Statement
Good	0-50	0-38	None	
Moderate	51-100	39-88	Unusually sensitive people should consider reducing prolonged or heavy exertion	
Unhealthy for Sensitive Groups	101-150	89-138	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly.
Unhealthy	151-200	139-351	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; increased respiratory effects in general population.
Very Unhealthy Alert	201-300	352-526	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.	Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.
Hazardous	300+	526+	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.	Significant aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; significant increase in respiratory effects in general population.

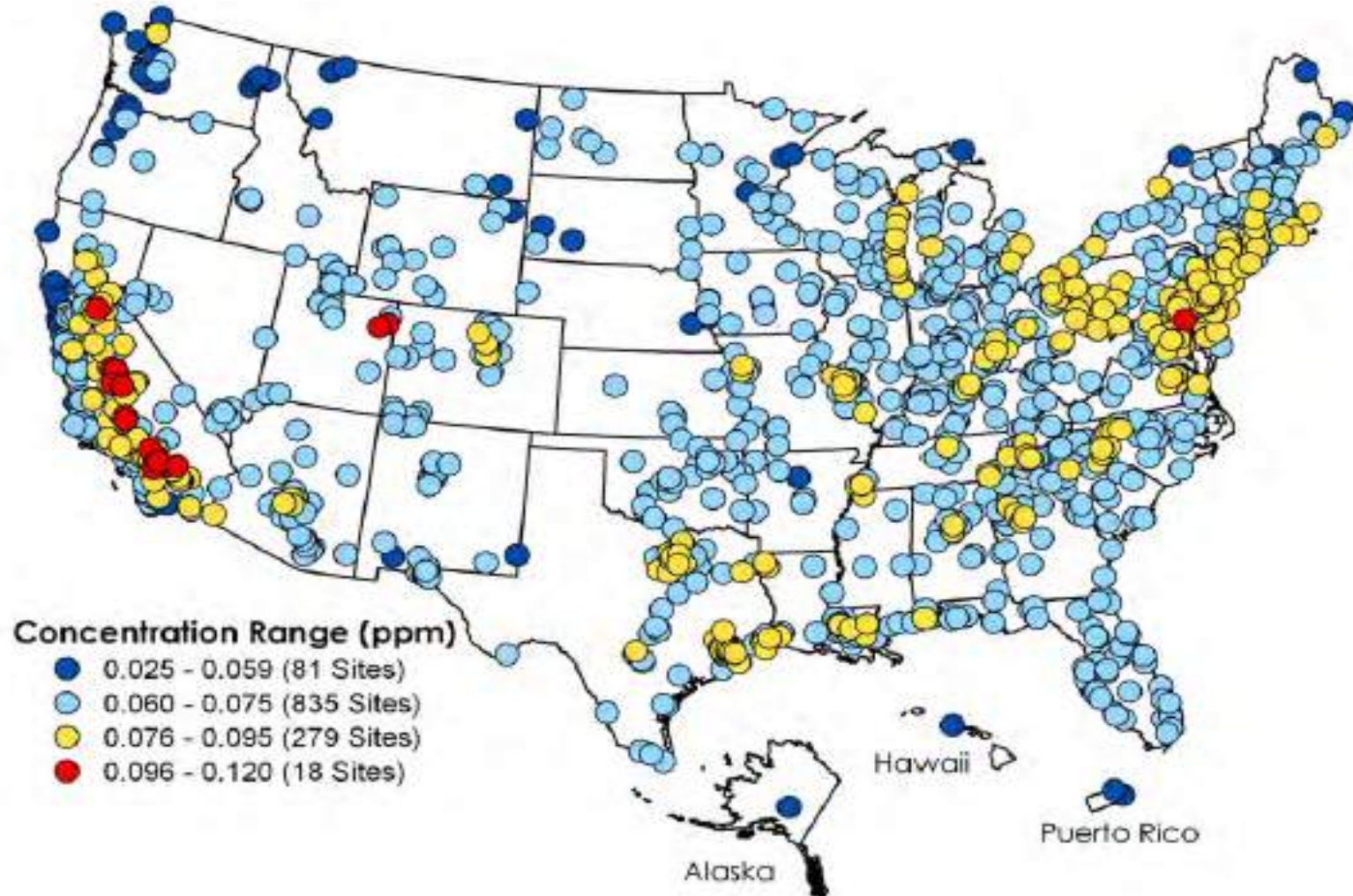
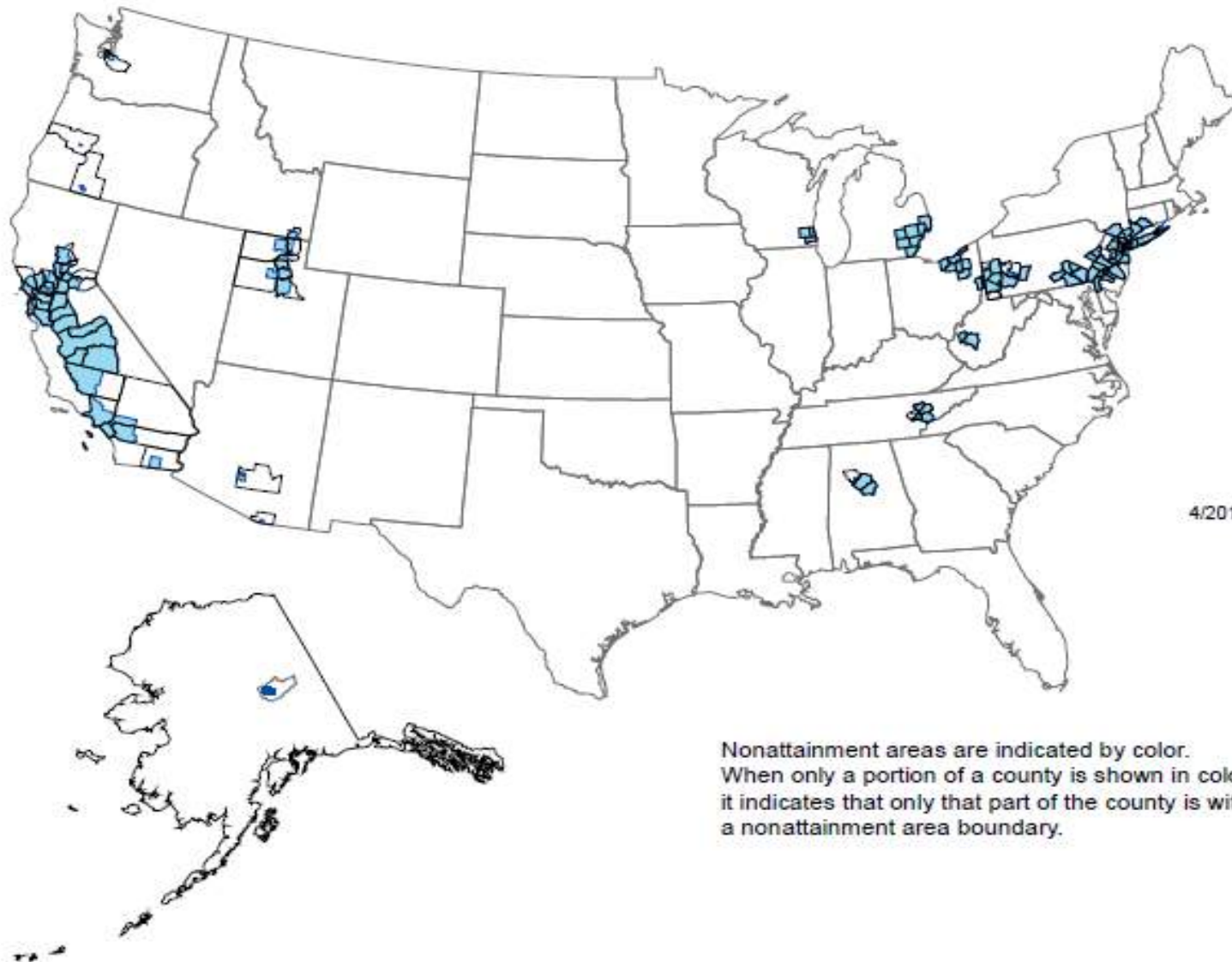


Figure 8. Ozone concentrations in ppm, 2010 (fourth highest daily maximum 8-hour concentration).



## PM-2.5 Nonattainment Areas (2006 Standard)



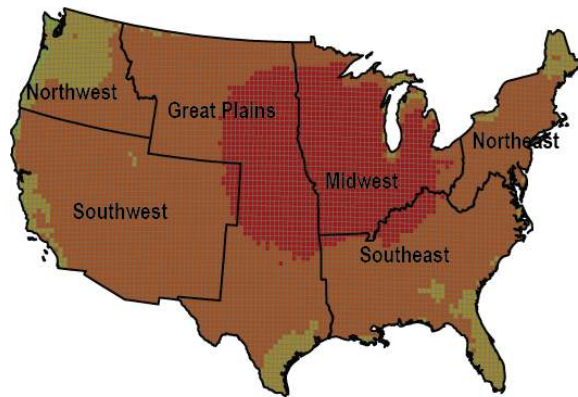
Nonattainment areas are indicated by color.  
When only a portion of a county is shown in color,  
it indicates that only that part of the county is within  
a nonattainment area boundary.



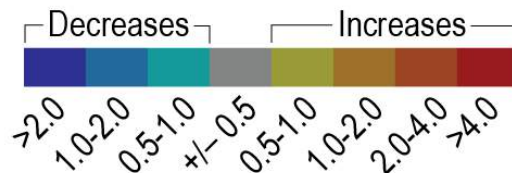


# Anticipated increases in ozone levels in 2030 due to increased greenhouse gas emissions

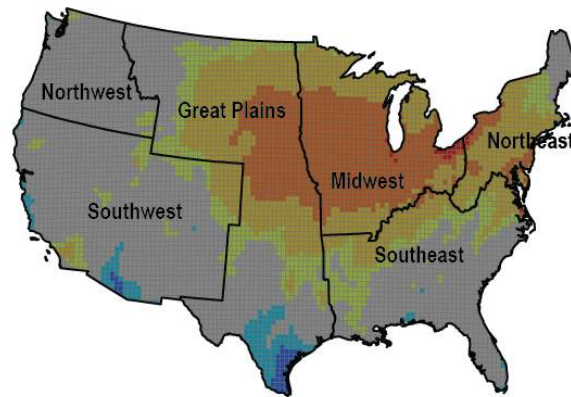
Change in Average Daily Maximum Temperature



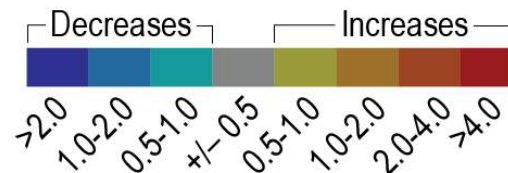
Change in Temperature (°F)



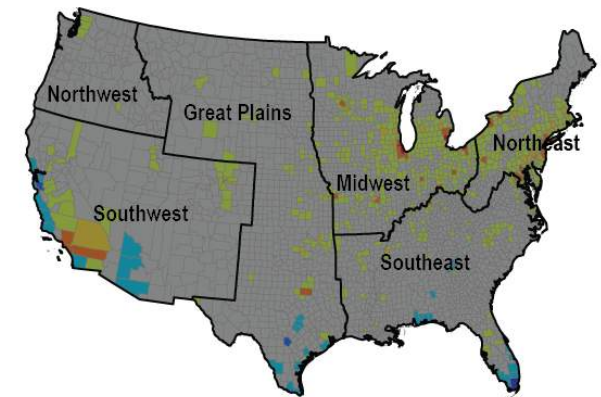
Change in Daily 8-hr Maximum Ozone



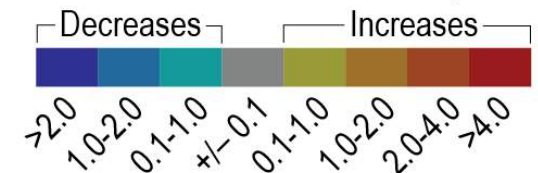
Climate-Attributable Change in Summer Season Daily 8-hr Maximum Ozone (ppb)



Excess Ozone-Related Deaths



Climate-Attributable Change in Ozone-Related Premature Deaths by County



Similar increases in particulate matter as well



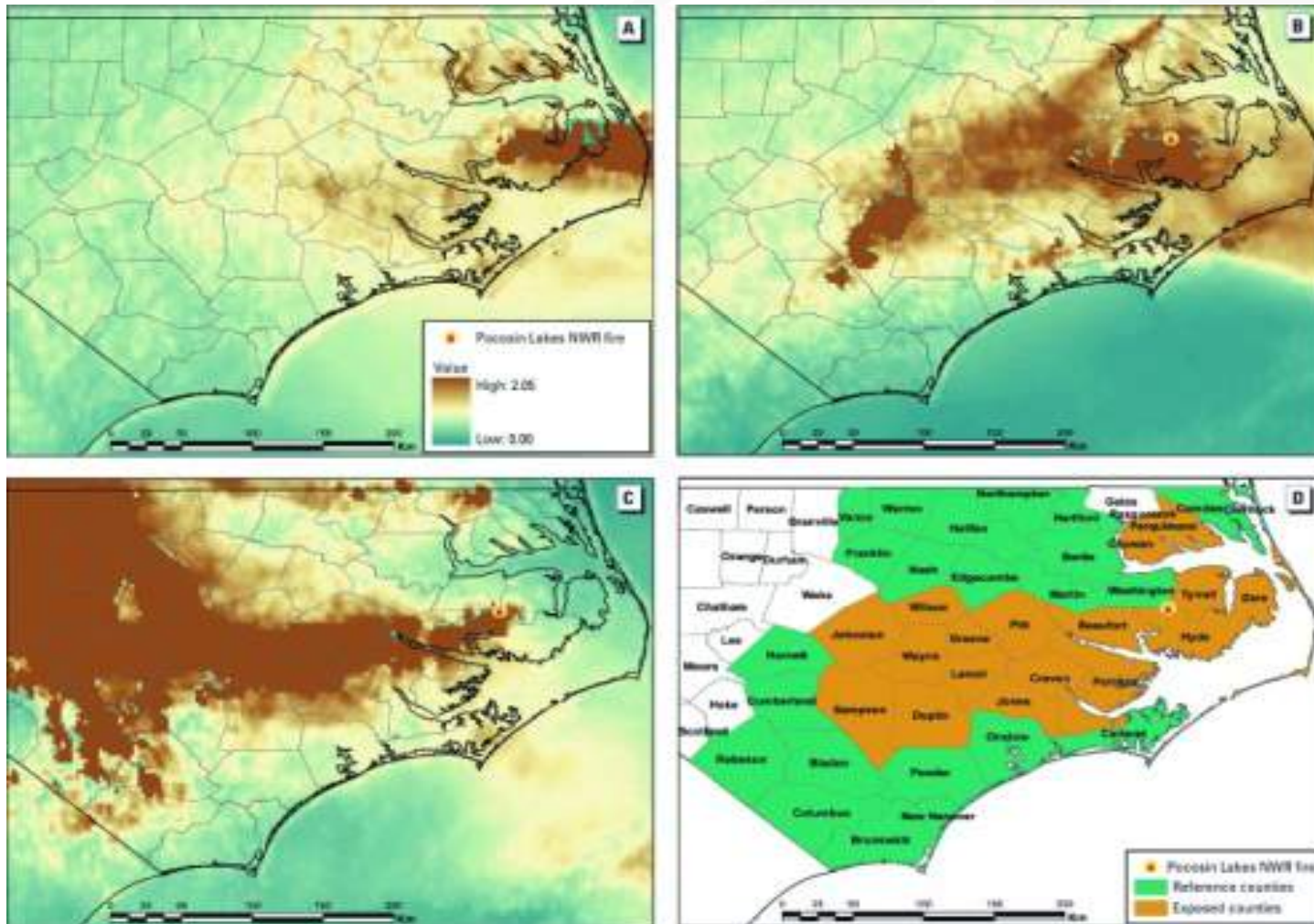
# Wildfires and woodsmoke

An emerging threat



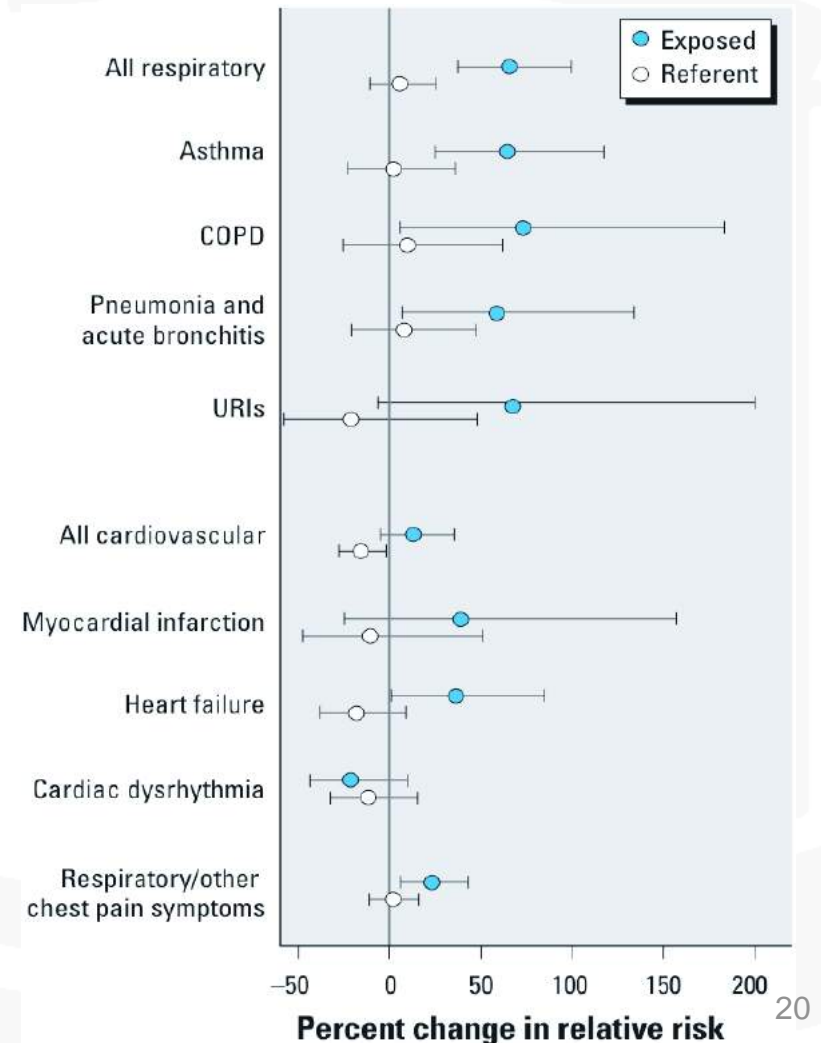
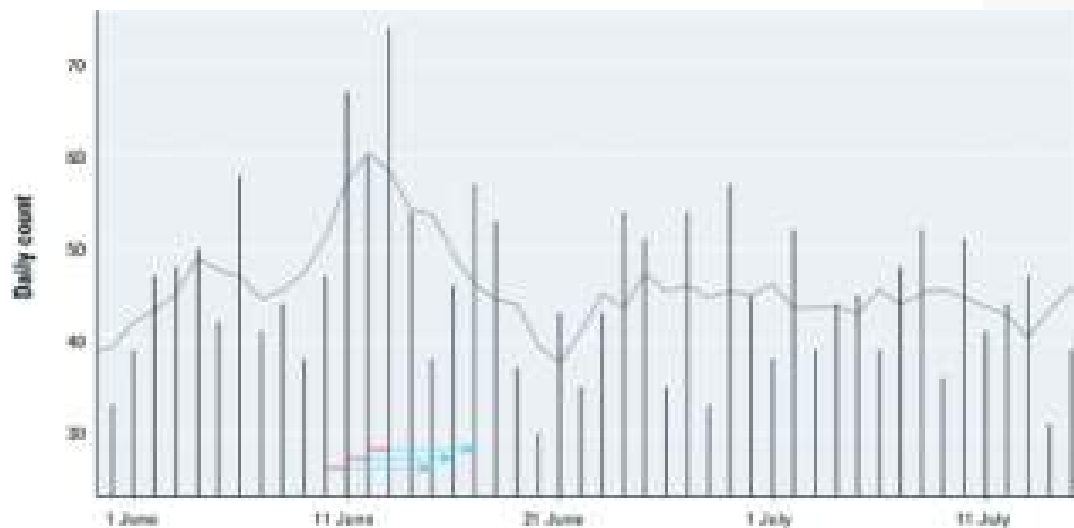


# Aerial Photos of exposed areas of NC with 2008 Eastern NC wildfires





# Asthma ED visits and risk of adverse health outcomes with the wildfires

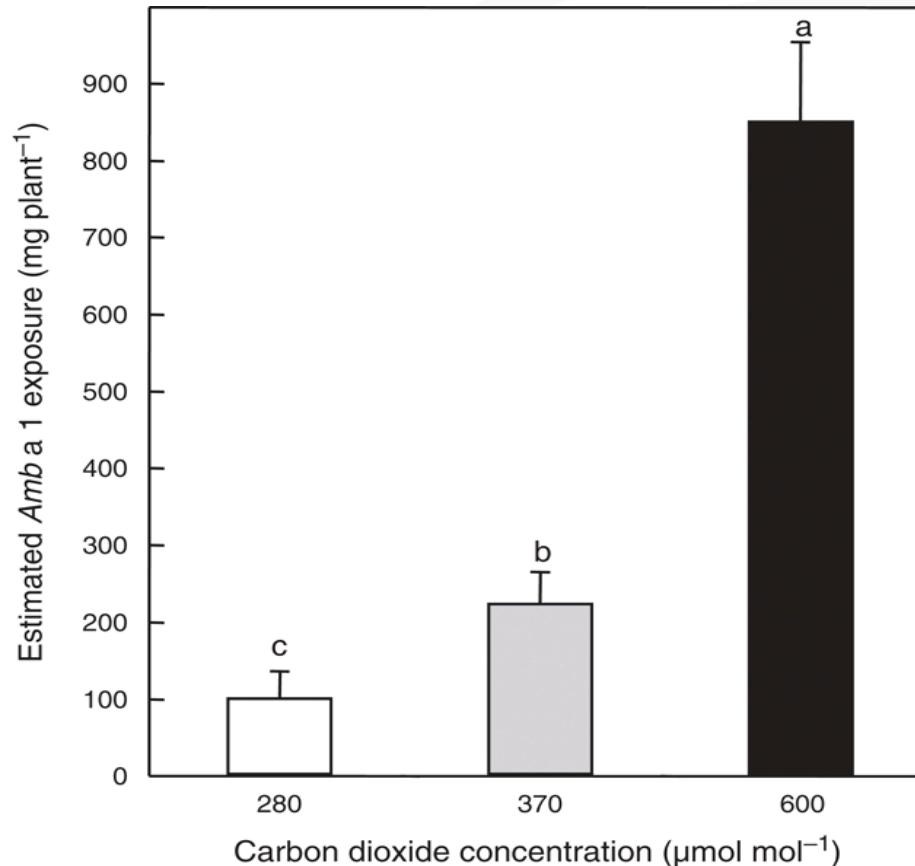




# Climate Change: Impact on Allergens and Viruses



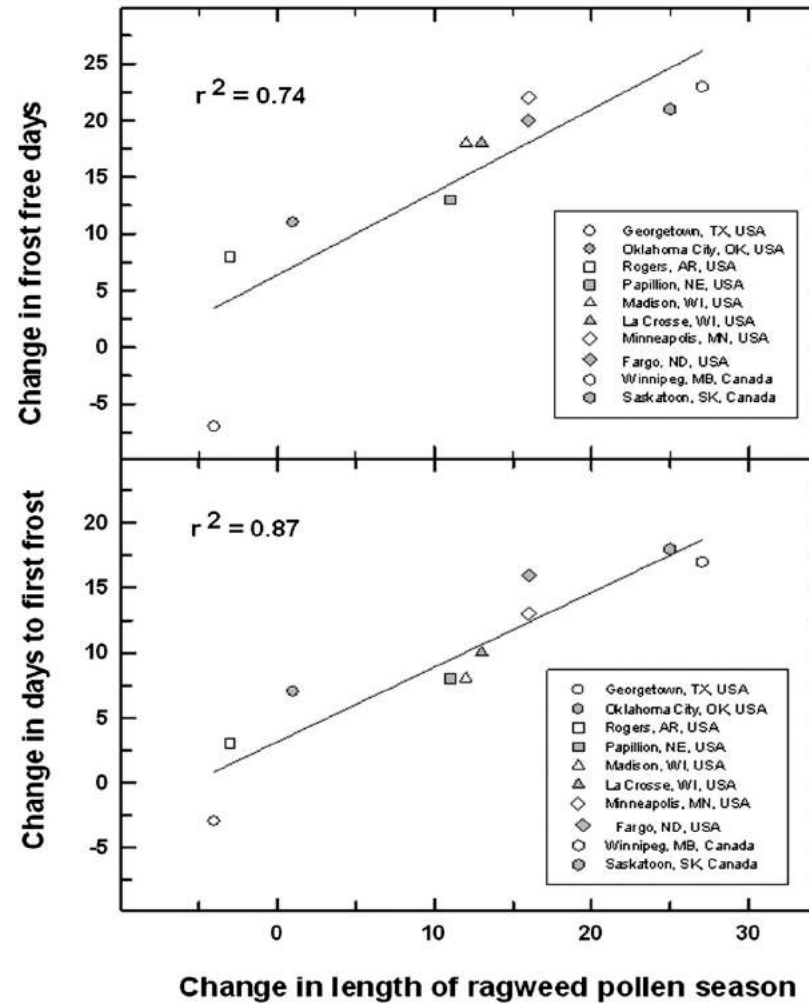
Singer BD, Ziska LH, Frenz DA, Gebhard DE, Straka JG (2005) Increasing *Amb a 1* content in common ragweed (*Ambrosia artemisiifolia*) pollen as a function of rising atmospheric CO<sub>2</sub> concentration. *Functional Plant Biology* 32, 667–670.



Increased CO<sub>2</sub> linked to increased Ragweed Pollen and increased *Amb a 1* concentration/mg pollen

# Change in the length (days) of ragweed pollen season as a function of frost-free days with latitude for the period 1995–2009.

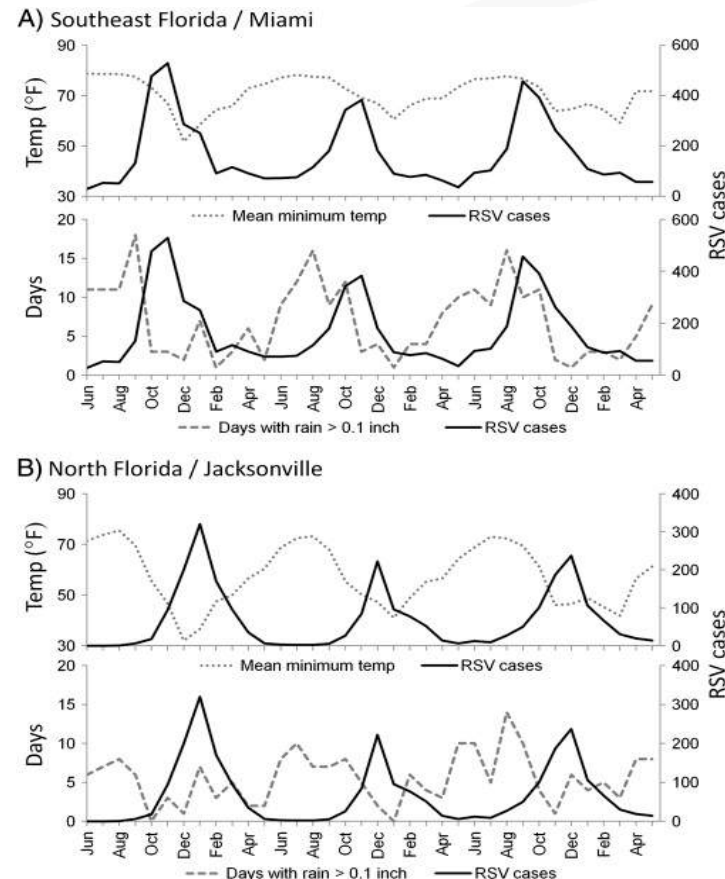
1995–2009



Ziska L et al. PNAS 2011;108:4248-4251



Fig. 2. RSV incidence in Florida compared to temperature and rainfall (June 2010 to May 2013).



Stuart Paynter, Peter D. Sly, Robert S. Ware, Gail Williams, Philip Weinstein

**The importance of the local environment in the transmission of respiratory syncytial virus ☆☆☆**

Science of The Total Environment, Volume 493, 2014, 521–525

<http://dx.doi.org/10.1016/j.scitotenv.2014.06.021>



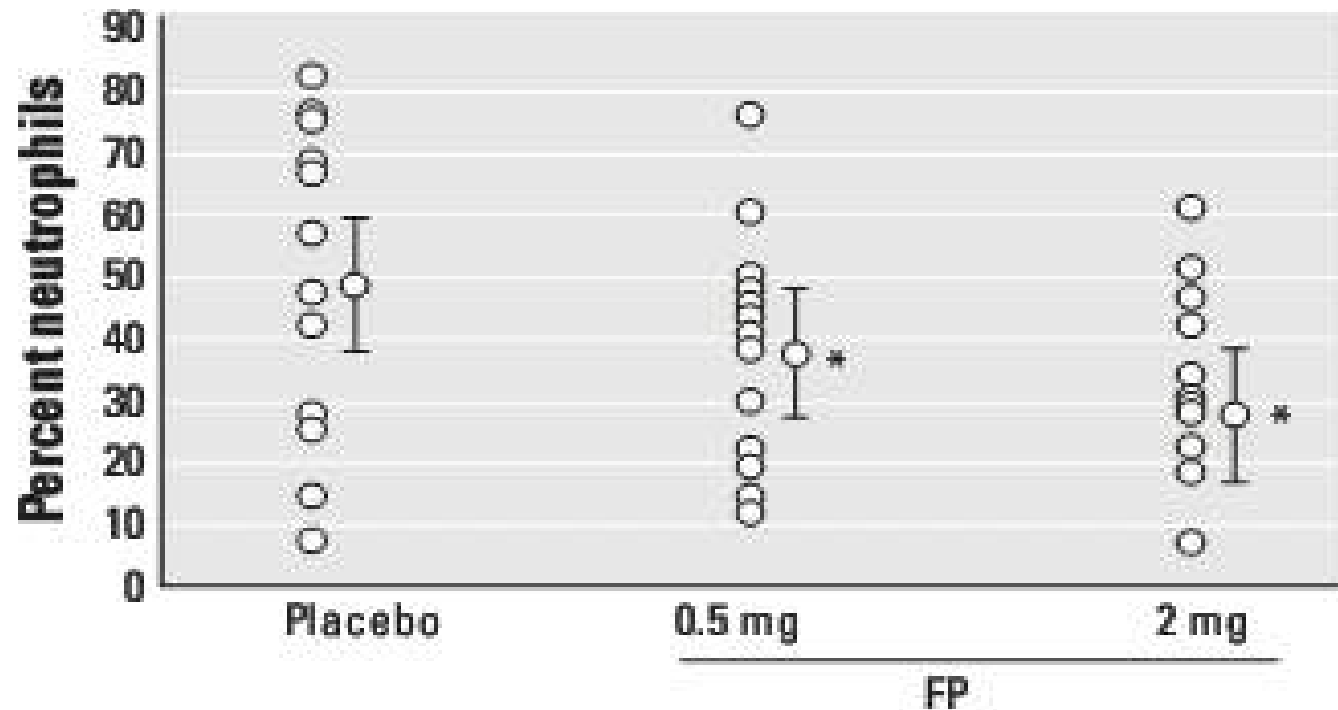
# Potential Interventions

Personal and Societal



## Fluticasone Propionate Protects against Ozone-Induced Airway Inflammation and Modified Immune Cell Activation Markers in Healthy Volunteers

Neil E. Alexis,<sup>1,2</sup> John C. Lay,<sup>1</sup> Angela Haczku,<sup>3</sup> Henry Gong,<sup>4,5</sup> William Linn,<sup>4,5</sup> Milan J. Hazucha,<sup>1</sup> Brad Harris,<sup>1</sup> Ruth Tal-Singer,<sup>6</sup> and David B. Peden<sup>1,2</sup>

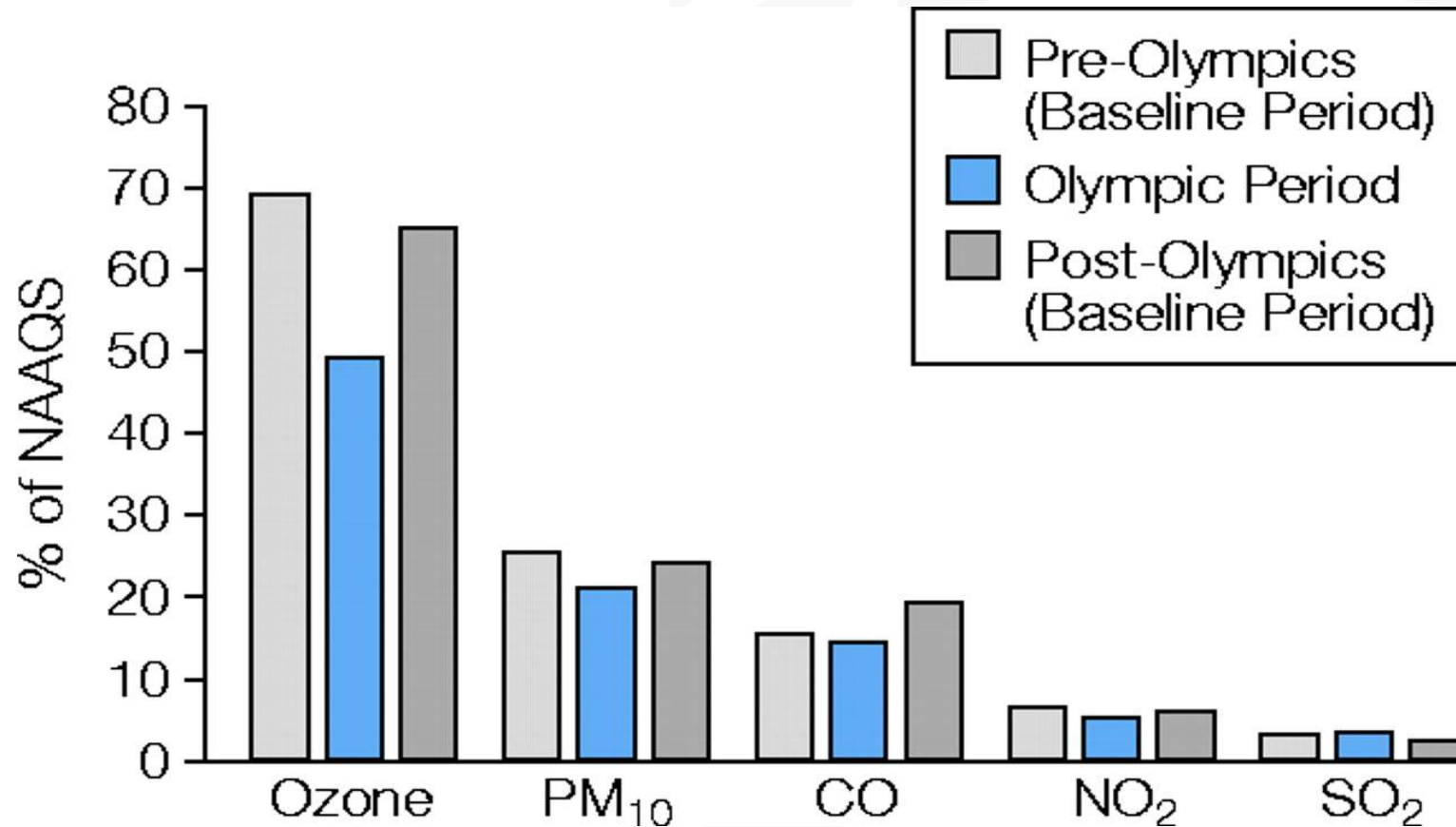


**Figure 2.** The percent sputum neutrophils after O<sub>3</sub> exposure for each pretreatment dose of FP (0.5 or 2 mg) or placebo.

\* $p < 0.05$  compared with placebo.



## Mean Levels of Major Pollutants Before, During, and After the 1996 Summer Olympic Games as a Percentage of the National Ambient Air Quality Standard (NAAQS)



Friedman, M. S. et al. JAMA 2001;285:897-905.

Friedman, M. S. et al. JAMA 2001;285:897-905.

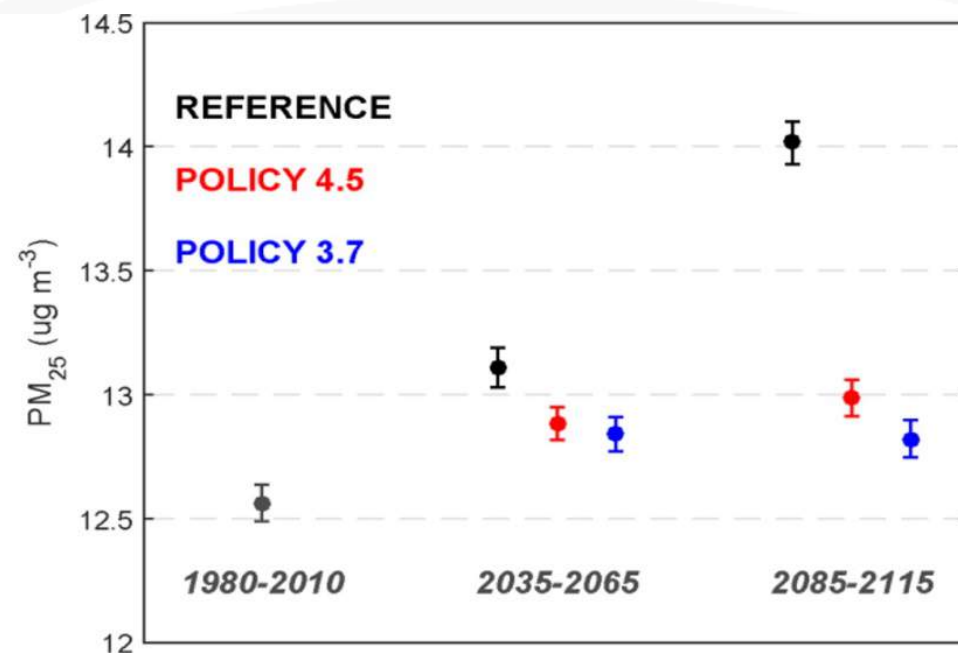
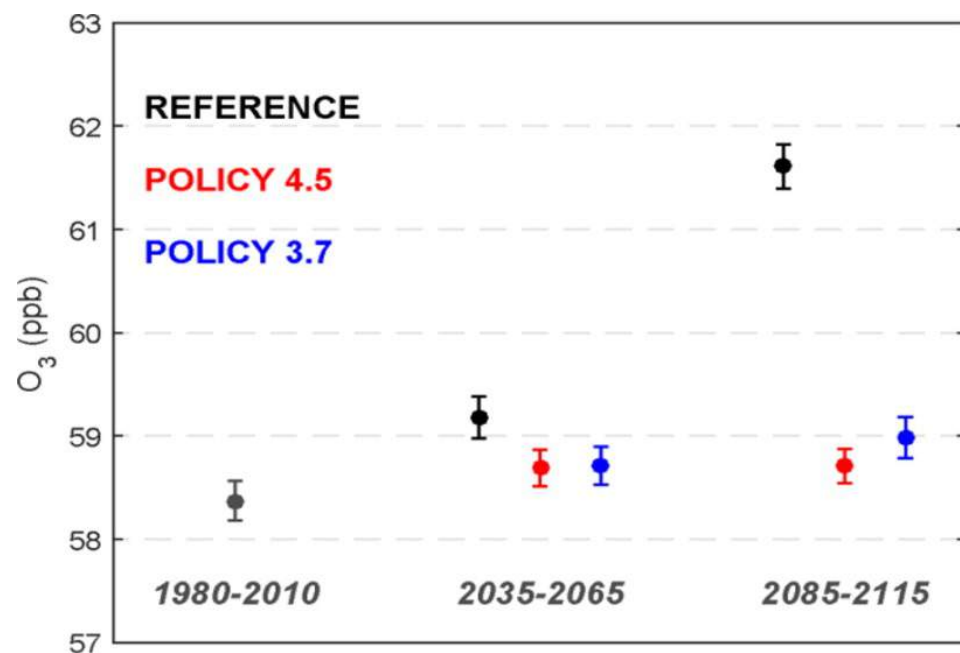
**Table 1.** Acute Asthma Events and Acute Nonasthma Events Among Children and Youth During the 1996 Summer Olympic Games Compared With the 1996 Summertime Baseline Period

Data Source	Type of Asthma Event	Acute Asthma Events			Acute Nonasthma Events		
		Mean (SD) No. of Events Per Day			Mean (SD) No. of Events Per Day		
		Baseline Period*	Olympic Period†	% Change	Baseline Period*	Olympic Period†	% Change
Georgia Medicaid claims file	Emergency care and hospitalizations	4.23 (2.81)	2.47 (1.46)	-41.6	100.5 (18.6)	97.4 (16.4)	-3.1
Health maintenance organization	Emergency care, urgent care, and hospitalizations	1.36 (1.63)	0.76 (0.83)	-44.1	37.6 (19.6)	38.1 (18.4)	+1.3
Pediatric emergency departments	Emergency care and hospitalizations	4.77 (2.52)	4.24 (2.49)	-11.1	118.4 (20.5)	115.9 (15.9)	-2.1
Georgia Hospital Discharge Database	Hospitalizations	2.04 (1.53)	1.65 (1.50)	-19.1	19.7 (5.1)	19.9 (3.5)	+1.0

\*Defined as June 21–July 18 and August 5–September 1, 1996.

†Defined as July 19–August 4, 1996.





Ensemble-mean U.S.-average population-weighted annual 8-h-max O<sub>3</sub> and PM<sub>2.5</sub> in 2000, 2050, and 2100 under REF, POL4.5, and POL3.7 scenarios.

# Summary

- Asthma is characterized by increased response to a number of agents
  - » Air pollutants
  - » Allergens
  - » Viruses
- Climate Change will increase:
  - » Air pollutants
  - » Allergens
  - » Viral seasons
- It is still possible for:
  - » People to protect themselves from asthma attacks due to pollution and other agents
  - » Decrease the impact of climate change with environmental policy

# Presenter



**Mona Sarfaty, MD, MPH, FAAFP**

Director, Program on Climate and Health  
Center for Climate Change Communication  
George Mason University



# Making the Connection: Climate Changes Allergies and Asthma

**Mona Sarfaty, MD MPH FAAFP**



GEORGE MASON UNIVERSITY CENTER FOR CLIMATE CHANGE COMMUNICATION  
**PROGRAM ON CLIMATE & HEALTH**

# Presenter Disclosures

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**Mona Sarfaty**

**(1) The following personal financial relationships with commercial interests relevant to this presentation existed during the past 12 months:**

No financial relationships to disclose

# Outline

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- ❑ Significance of allergic and asthmatic disease
  - Prevalence
  - Symptoms
  - Cost – human and dollar
- ❑ How the changing climate is affecting allergy season and asthma
- ❑ What we learned by surveying physicians
- ❑ Health equity factors
- ❑ Public health approach to these problems



# Introduction

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- ❑ Allergies are a common cause of misery for many people
- ❑ Allergic runny nose (“hayfever” or “allergic rhinitis”) is the most widespread allergy condition
  - Symptoms: sneezing, nasal stuffiness (obstruction), itching, post nasal drip, cough, irritability, fatigue
  - Effects 10-30% of the population
  - 11 million office visits per year
  - It costs @\$11.2 billion / year to treat

## Allergic Rhinitis (Hayfever) Can Drain Human Potential

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- ❑ Associated with more absenteeism and more unproductive workdays for adults than any other condition
- ❑ Associated with cognitive and psychiatric issues in children and adults
- ❑ Children: may have lower exam scores, poor concentration, low self-esteem, impaired athletic performance
- ❑ Adults: may have depression, anxiety, lower quality of life scores

# Allergies are Changing due to Climate Change

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- ❑ Allergic rhinitis has 2 peaks per year: Spring and Fall
  - Both are coming earlier
- ❑ The allergy season is longer
- ❑ Geographic growth region for some allergies is growing
- ❑ Allergy season is more intense

Common complaint: *“allergy season is worse than last year”*

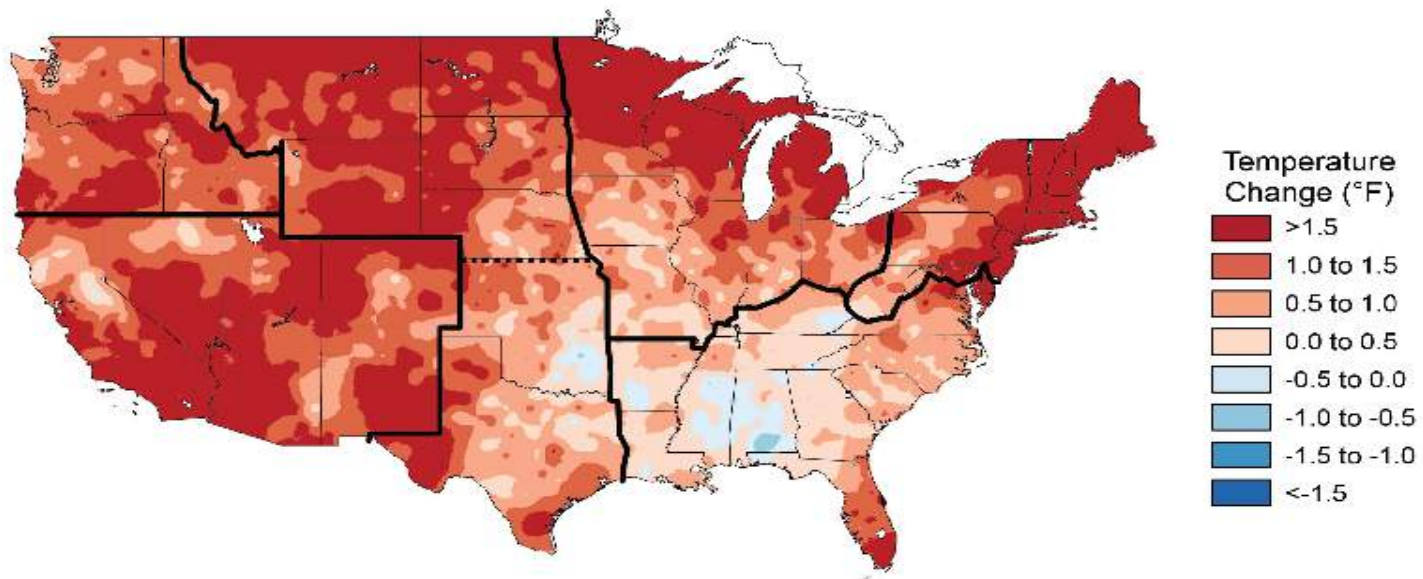
# Why is Allergy Season Longer and More Intense?

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- ❑ Average temperatures are higher
- ❑ Precipitation is greater in many places
- ❑ More carbon dioxide
- ❑ These climate change related factors affect plants in several ways:
  - Some plants have spread into new areas
  - Pollen season begins earlier and lasts longer
  - Existing plants may be more robust or grow better or produce more pollen
  - The inciting agent, typically the pollen, is actually different

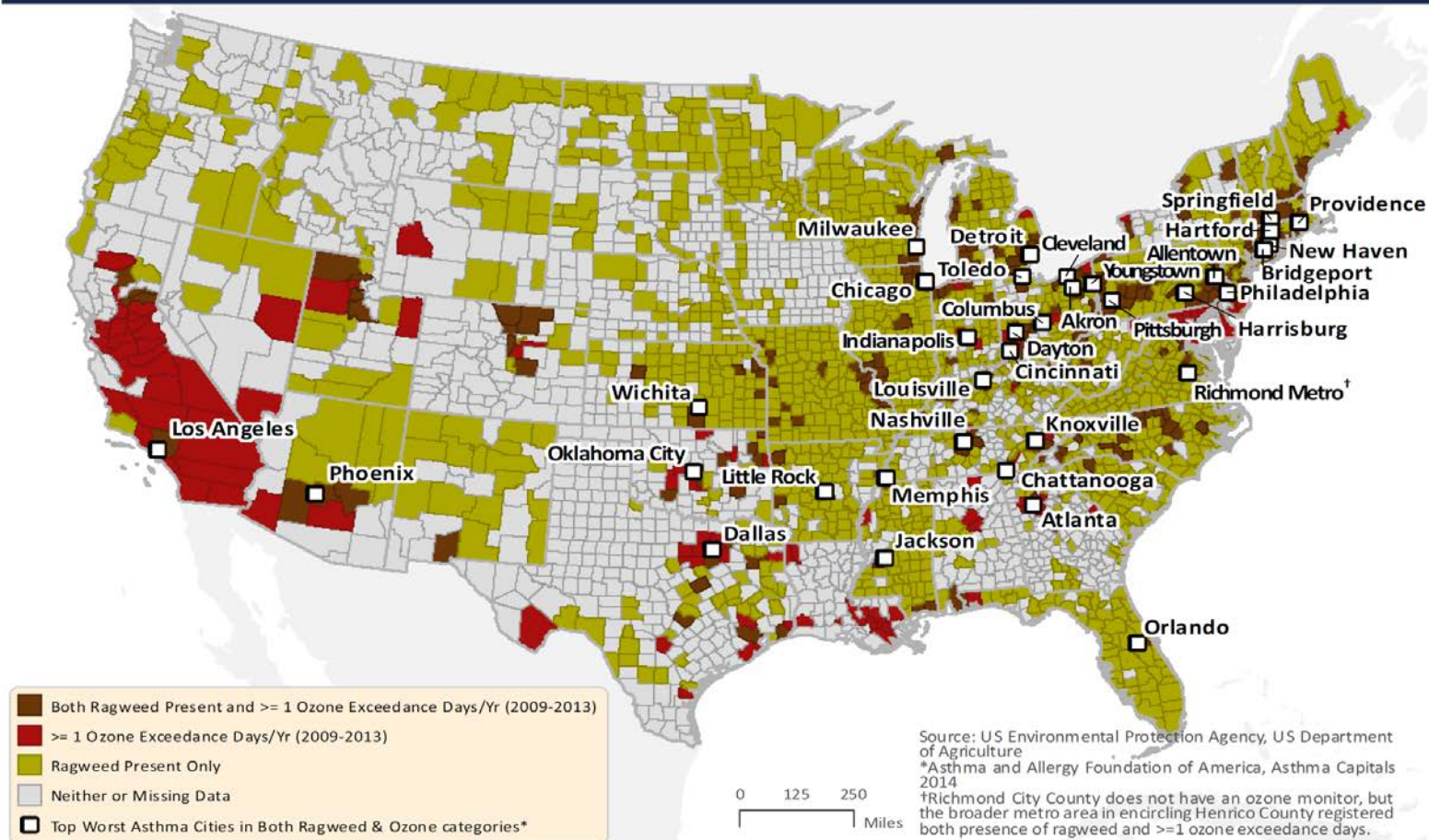
# Comparing 1991-2012 with 1900-1961

Observed U.S. Temperature Change



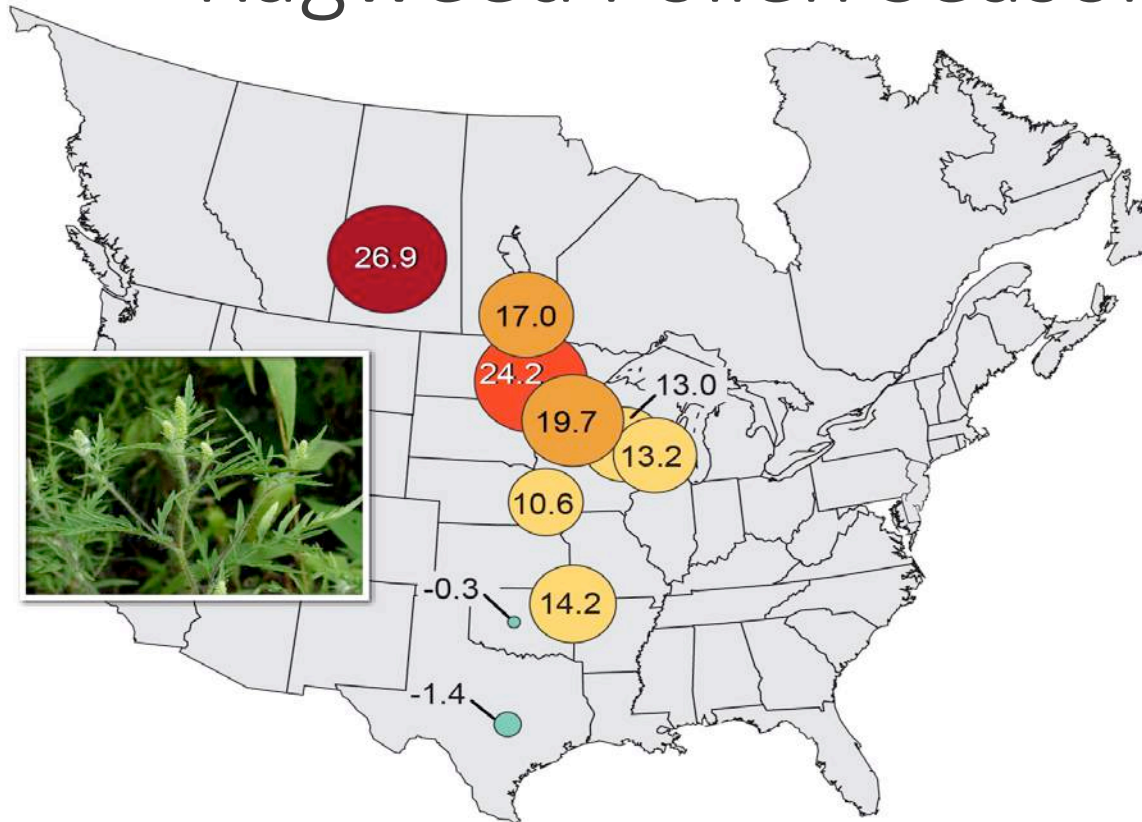
# Geographic Vulnerability

Figure 1. Intersection of Ragweed-Positive and Eight-Hour Ozone Exceedance-Positive Areas in the Continental United States





# Ragweed Pollen Season Lengthens



Map shows for how long ragweed pollen season has changed from 1995 to 2005. Many people are allergic to Ragweed.

<http://www.ars.usda.gov/> &  
U.S. National Climate Assessment

# Why are Allergy Seasons More Intense?

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- ❑ Study of ragweed pollen showed it is more allergenic due to the carbon dioxide enriched atmosphere (L Zizka, PhD)
  - How did they determine this:
    - Carbon dioxide level is not exactly the same in every part of the U.S.
    - Ragweed was grown in different places where carbon dioxide differed
    - Pollen analyzed and found to have different amounts of the allergenic component
- ❑ More pollen production where higher levels of carbon dioxide
- ❑ Greater mold growth in some areas (just mentioned)
- ❑ Deteriorating air quality

# Another Factor Causing Allergic Reactions is Mold

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- ❑ Mold growth (& spore production) associated with:
  - Increases in precipitation
  - Flooding and recurrent flooding
  - Increases in temperature and/or humidity
  - Plant decay (leaf litter)
  - Improper installation or management of air conditioning
- ❑ Mold allergy can cause coughing, wheezing, nasal & throat conditions, and adversely affect persons with asthma or weakened immune systems

**Extensive Mold Contamination of Ceiling and Walls**



(Source Terry Brennan,  
[http://www.epa.gov/mold/  
moldcourse/imagegallery5.html](http://www.epa.gov/mold/moldcourse/imagegallery5.html))

# Allergic Rhinitis Is Associated with Other Health Conditions

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- ❑ Red itchy eyes (conjunctivitis)
- ❑ Eczema, itchy rashes affecting the skin
- ❑ Worsening of asthma
  - Asthma affects 24 million people
  - Close relationship between asthma and allergies
    - 60% Pediatric Asthma is allergy related
    - 40% Adult Asthma is allergy related





# Asthma



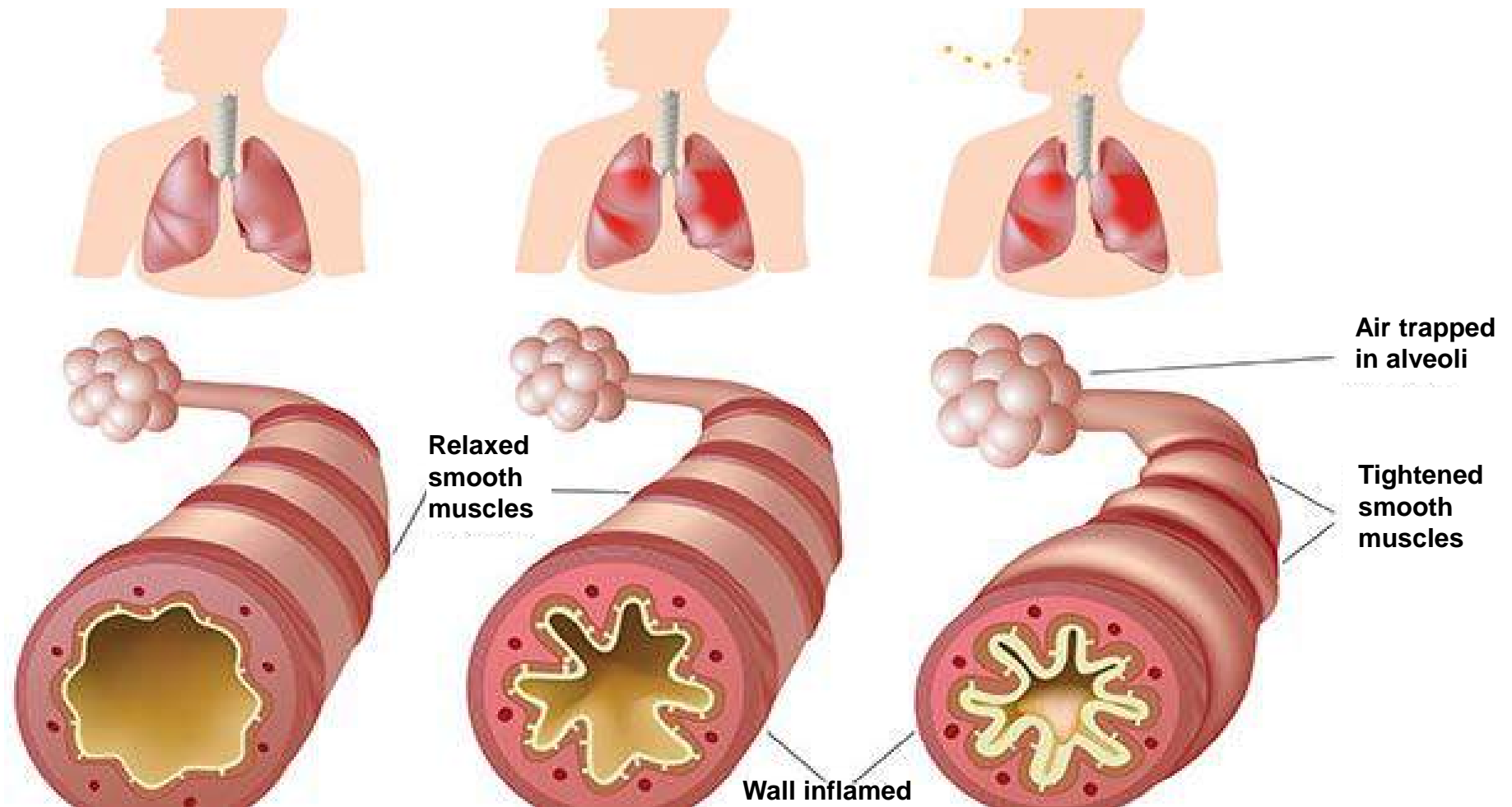
- ❑ The most common chronic disease of childhood but affects more adults than children
  - 7% of adults or 17.7 million have asthma (NHIS, 2014)
  - 8.6% of children or 6.3 million (NHIS, 2014), but 20% of children in many urban school systems
- ❑ Characterized by repeated episodes of coughing, wheezing, chest tightness, breathlessness
- ❑ Almost 2 million ED visits, .5 million hospitalizations, 3,630 deaths
- ❑ Cost \$56 billion per year (\$50 billion is direct) (2007)
  - 60% of children and 33% adults with an asthma attack miss school or work



# Health Equity Concerns

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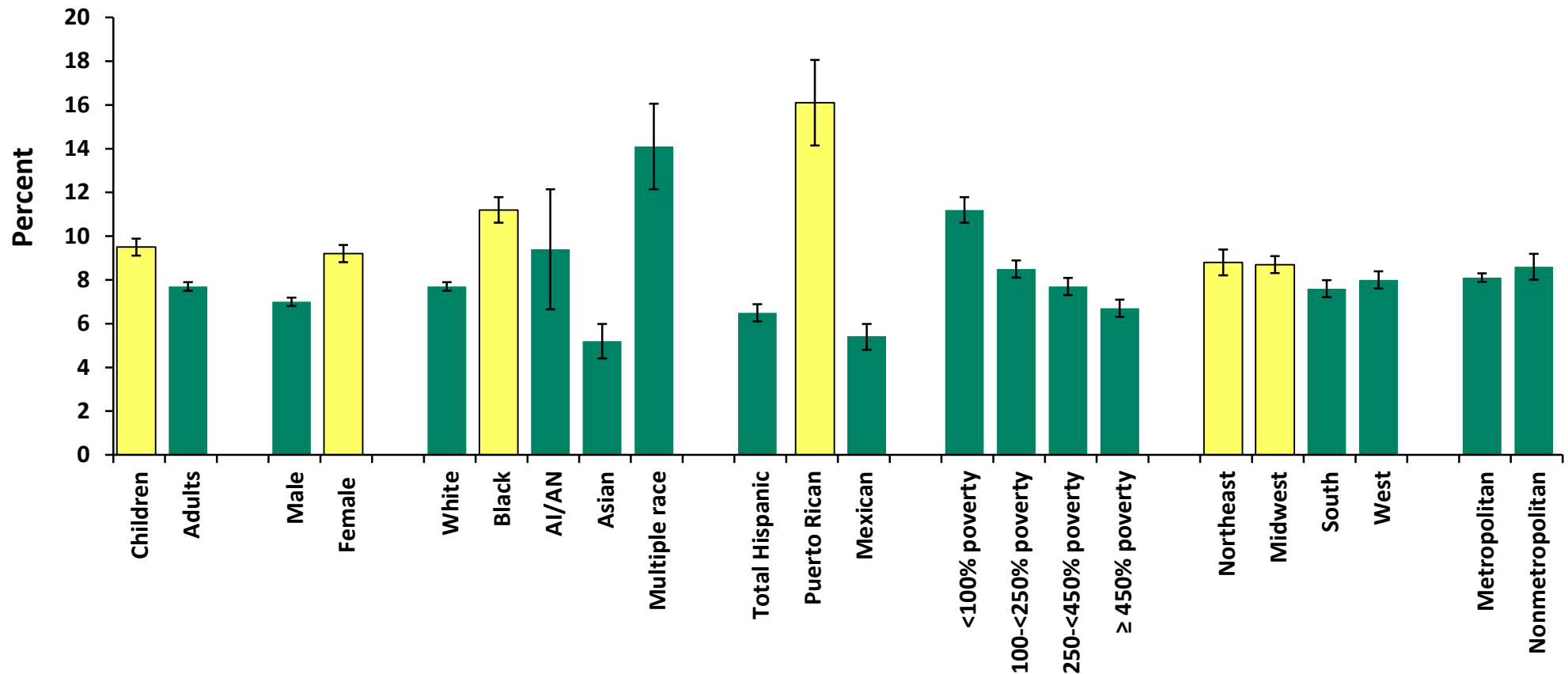
- ❑ Asthma is affected by a number of factors that are a problem for some populations more than others
- ❑ Especially factors that contribute to poorer quality environments:
  1. Outdoor air – ozone, particulates including dust, effluents from incinerators, smokestacks, and businesses that use certain chemicals
  2. Indoor air exposures in housing, school, work environments (mold, dust, insect danders)
- ❑ Due to connection what affects allergies, affects asthma



Pathogenesis: Ozone irritates the lungs and makes people more vulnerable to the effects of small particles and allergens.\*

(\*Rom WN, et al. Global Warming: A Challenge to all American Thoracic Society Members. Am J Respir Crit Care Med 2008; Vol 177: 1053-1057.)

Current Asthma Prevalence by Age Group, Sex, Race and Ethnicity, Poverty Status, Geographic Region, and Urbanicity: United States, Average Annual 2008-2010 (CDC)



# What We Have Learned From Surveying Doctors?

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- ❑ Program on Climate and Health, GMU, did 3 Surveys of medical societies representing a. lung specialists (ATS) b. allergists (AAAAI) c. African American physicians (NMA).
- ❑ 76% of physicians in 3 surveys indicated their own patients were experiencing air pollution related worsening of cardiorespiratory disease (including asthma); 63% indicated that climate change was causing their own patients to have more allergy symptoms and visits.
- ❑ We asked for anecdotes describing their patient experiences.

# Allergies and Asthma

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*I have more patients with asthma and allergies coming in with flares earlier and earlier in the year because pollen is produced earlier and earlier. (Tennessee)*

*Asthma triggered by seasonal allergies which have been getting worse over the past 5 years, with longer pollen periods due to warmer weather. (Nevada)*

*We all see each year the pollen counts breaking new records which directly impacts our allergic rhinitis and asthmatic patients. (North Carolina)*

*With the current fluctuations in weather, we have seen quite a few asthma exacerbations. People are used to having the weather be one way so they can predict when they may have trouble with their illness, but now they are finding it more difficult to do so. (Ohio)*

# Mold Allergies

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*[I have seen] Numerous patients with fall mold allergies whose symptoms now last well into December since the ground takes longer to freeze.  
(Michigan)*

*Mother and daughter who lived in a moldy house presented with asthmatic symptoms that were refractory to treatment until they were moved to a different environment. (Ohio)*

*Recent rainfall and flooding increased patient in-home exposure to mold and humidity, (this) resulted in asthma emergency visits and hospitalizations.(Unk)*



# Vulnerability: Multiple Threats

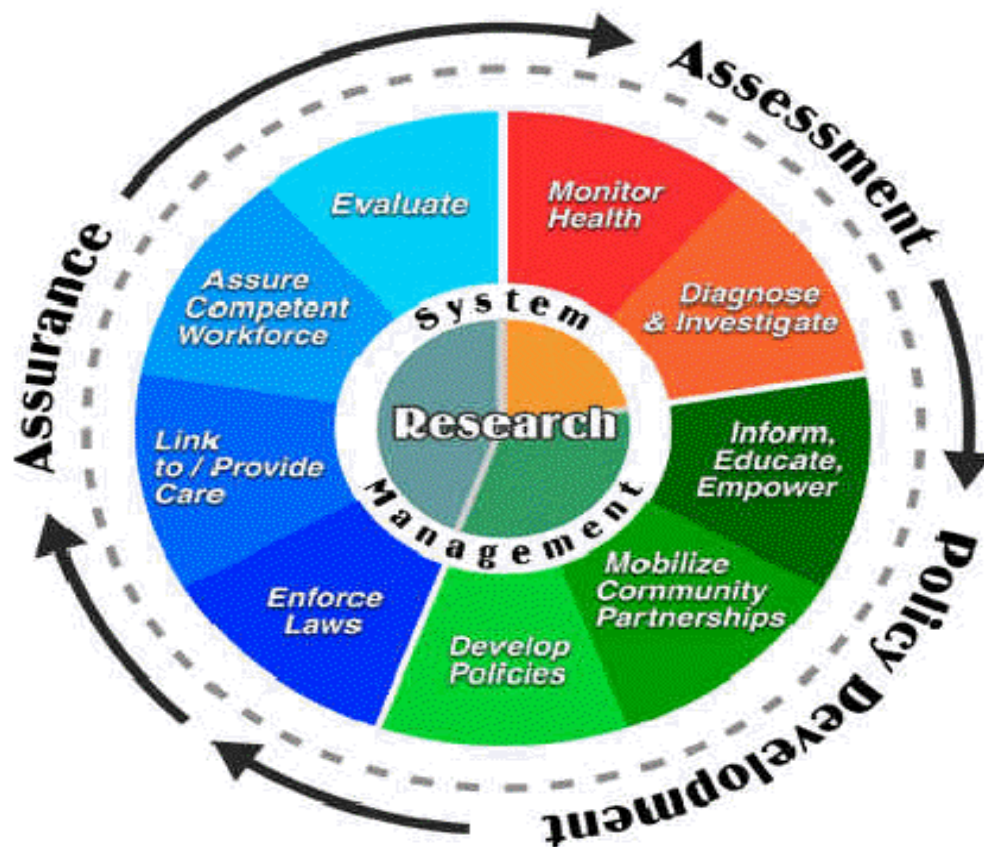
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*“...children with asthma with more frequent symptoms, exacerbations due to poor air quality; [air] inversions, high allergen counts, rental living accommodations with visible mold, living in areas with high winds, fires.”*

(Lung Specialist, Washington state)

# Public Health Approach

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# Conclusion

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- ❑ Allergy problems are common and occurring for longer seasons and at greater intensity due to conditions caused by climate change, including longer pollen seasons, higher carbon dioxide levels, and factors that support mold growth
- ❑ There is a substantial connection between allergies and asthma
- ❑ The risk factors for allergies and asthma are more severe in vulnerable communities where conditions for good health may be compromised and where environmental injustice has been at work
- ❑ Observations from surveyed physicians
- ❑ Public health approach can help address allergies and asthma

# Thank You!

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MSARFATY@GMU.EDU

# Questions and Answers



**Please submit  
questions  
through the  
chat box.**

For more info on upcoming *Climate Changes Health* webinars, visit [www.apha.org/climate-changes-health](http://www.apha.org/climate-changes-health)

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