Public Health Impacts of Projected 2050 Ozone Concentrations in Mecklenburg County, NC

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Outline

- Primer on ozone
- Walk through the health impact formula
- Describe our data inputs and results

Ozone Creation

Volatile Organic Compounds (VOCs)

Nitrogen Oxides (NOx)

Emissions

Ozone (O_3)

Ozone Reduction

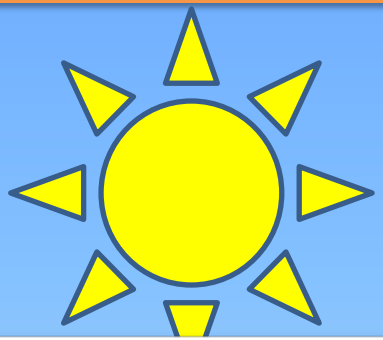
Volatile Organic Compounds (VOCs)

Nitrogen Oxides (NOx)

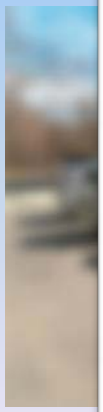
Ozone (O_3)

Emissions

Ozone Reduction

Volatile Organic Compounds (VOCs) + Nitrogen Oxides (NOx) +  → Ozone (O_3)

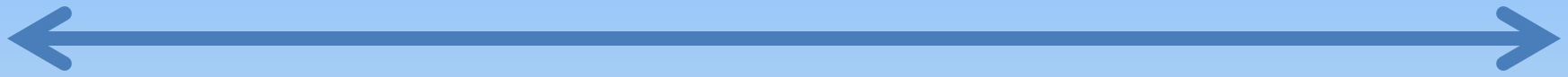
Emissions



Your Best Guess?

How will ozone concentrations change in Mecklenburg County NC from today to 2050?

-20% -10% No Change +10% +20%



Project Overview

Combine data on:

- Emergency department visits (current)
- Concentration-response associations from the epidemiological literature
- Ozone levels (current and projected)
- Population (current and projected)

to estimate the future burden of emergency department visits in Mecklenburg County, NC in 2050.

PLEASE NOTE:
These are preliminary results and should not be distributed or cited.

Health Impact Formula

Change in health outcome

B

Concentration-response functions from epidemiological literature

$$\Delta H = H_0 \left(1 - e^{-\beta \Delta Ozone}\right) * Population$$

A

Baseline incidence – e.g. Asthma ED visits from 2006-2011

C

Change in ozone concentrations

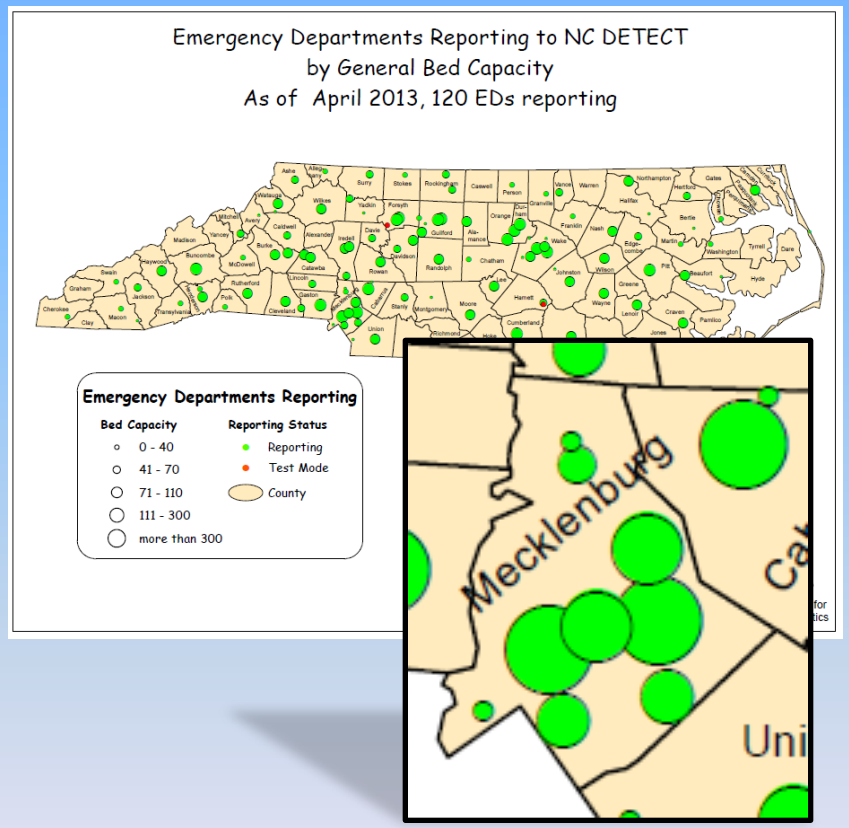
D

Population at risk

A Health Data

NC DETECT

- State-wide surveillance data
- Primary data elements used:
  - ICD-9-CM diagnosis codes (up to 11)
  - Age / sex
  - Patient county of residence
  - Visit date/time
- Obtained via a data use agreement with state DPH data owners



9 hospitals within Mecklenburg County

A Asthma ED Visit Incidence Rates

Age Group	Gender	Asthma ED Visit Count (April-October, 2006-2011*)	Population (%) (Mean, 2006-2011)	Incidence Rate (per person-day*)	Average Count per Day
0-19	Female	2246	123321 (13.8)	1.51E-05	1.9
	Male	3872	127737 (14.3)	2.51E-05	3.2
20-44	Female	3157	182447 (20.4)	1.43E-05	2.6
	Male	2117	174691 (19.6)	1.00E-05	1.7
45-64	Female	1605	108978 (12.2)	1.22E-05	1.3
	Male	975	98713 (11.1)	0.82E-05	0.8
65+	Female	494	46046 (5.2)	0.89E-05	0.4
	Male	205	31242 (3.5)	0.54E-05	0.2
Total		14671	893176	1.36E-5	12.1

Data Source: NC DETECT, Apr-Oct 2006-2011

*74 days were determined to have data quality problems and were dropped from both the numerator and denominator.

B

Concentration-Response Functions

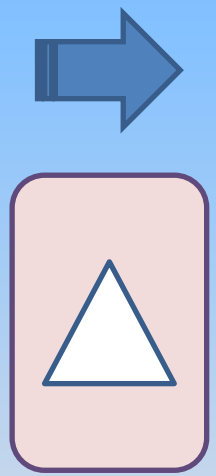
Study	Incidence Rate Ratio	β
Peel et al., 2005 Atlanta, GA	1.022 (0.996, 1.049) per 25 ppb increment 2.2% increase in asthma ED visits per 25 ppb increase in ozone	0.000870 (0.000529)

C Change in ozone

Current Ozone Concentrations
2006-2011

MONITOR DATA
Mean Daily Maximum
8 Hour Average (ppb):

Data Source: U.S. EPA Air Quality System
Mean of 3 monitors within county,
April-October

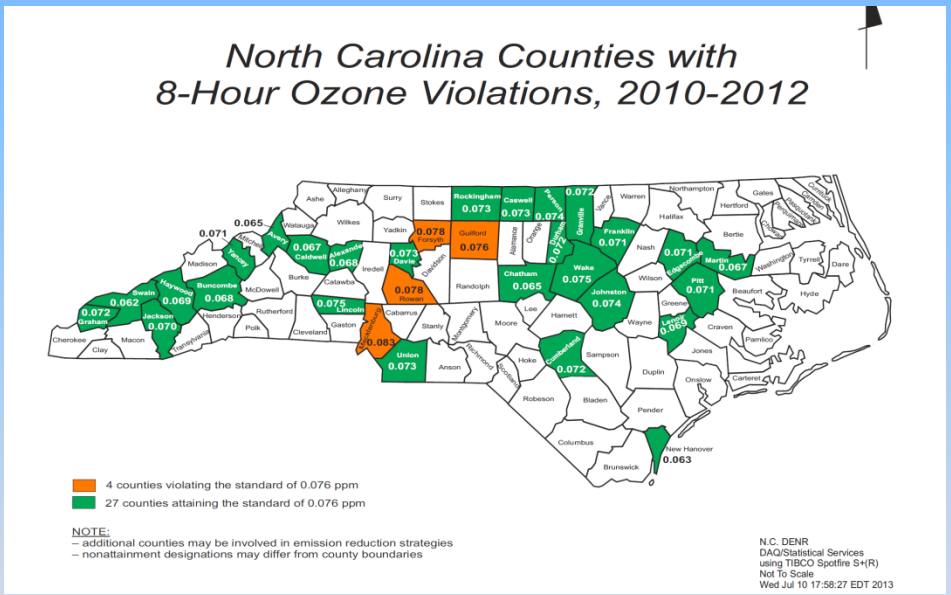


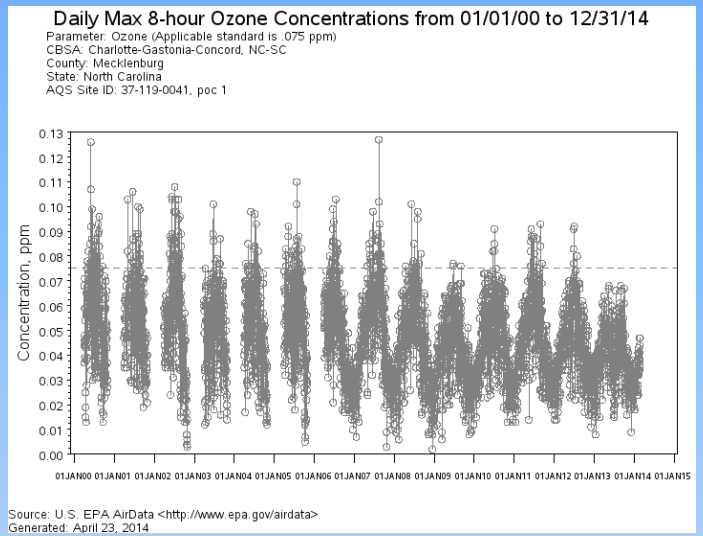
Future Ozone Projections
2050

MODEL DATA
Mean Daily Maximum
8 Hour Average (ppb):

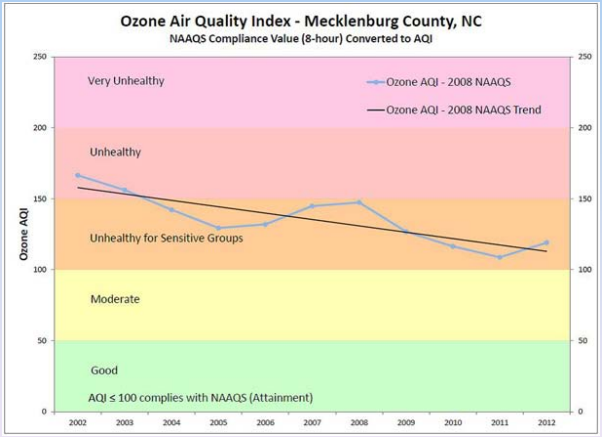
Data Source: GCM:
NCAR, Resolution: 12km, IPCC Scenario A1B, with Projected Anthropogenic Emissions Inventory, May-August

C Current Ozone





Source: http://daq.state.nc.us/monitor/data/o3design/o3nc10-12.pdf



Source: http://charmeck.org/mecklenburg/county/LUESA/SOER/Pages/AirQualityOzone.aspx

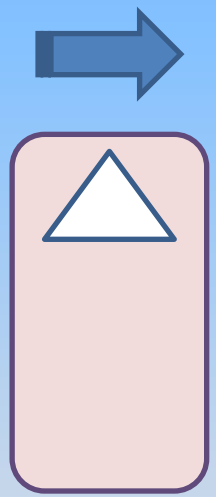
C Ozone Concentrations

Current Ozone Concentrations 2006-2011

Mean Daily Maximum 8 Hour Average (ppb):

51

Data Source: U.S. EPA Air Quality System
Mean of 3 monitors within county, April-October



Future Ozone Projections 2050

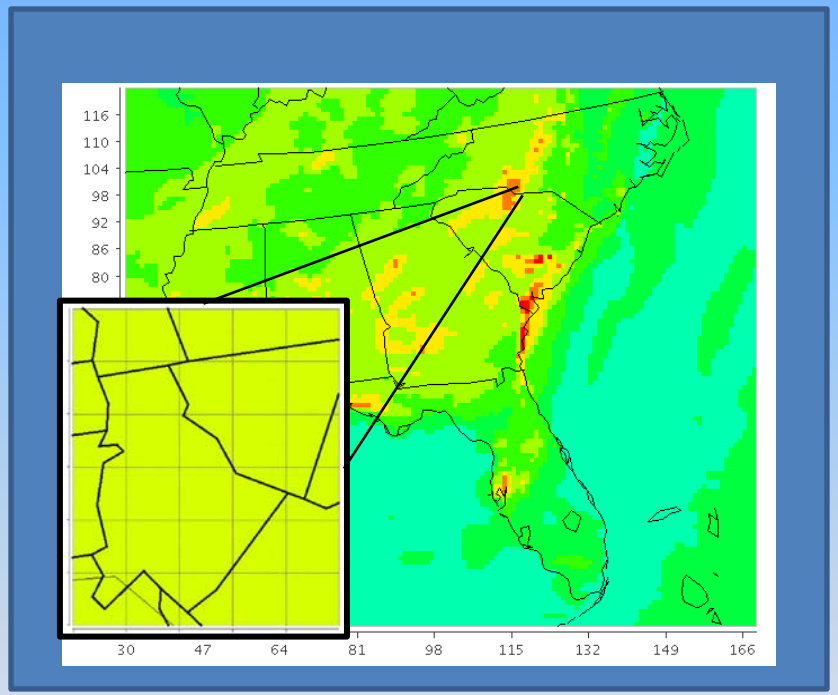
Mean Daily Maximum 8 Hour Average (ppb):

Data Source: GCM: NCAR, Resolution: 12km, IPCC Scenario A1B, with Projected Anthropogenic Emissions Inventory, May-August

C Air Quality Model

- Model years: 2048-2050
- IPCC A1B Scenario
- ★ Projected anthropogenic emissions inventory
- GCM: NCAR
- Future climate meteorology: CCSM 2050
- Downscaling: Analysis nudging technique
- 12km resolution

For more technical information, contact Adel Hanna at the UNC Institute for the Environment.



C

Future Air Quality Model Specifications

	Set to baseline levels?	Set to projected future levels?
Meteorology/ Climate		X
Biogenic Emissions	X	
Anthropogenic Emissions		X
Greenhouse Gas Scenario (IPCC SRES)		X (A1B)

C Ozone Concentrations

Current Ozone Concentrations 2006-2011

Mean Daily Maximum 8 Hour Average (ppb):

51

Data Source: U.S. EPA Air Quality System
Mean of 3 monitors within county, April-October

Future Ozone Projections 2050

Mean Daily Maximum 8 Hour Average (ppb):

45

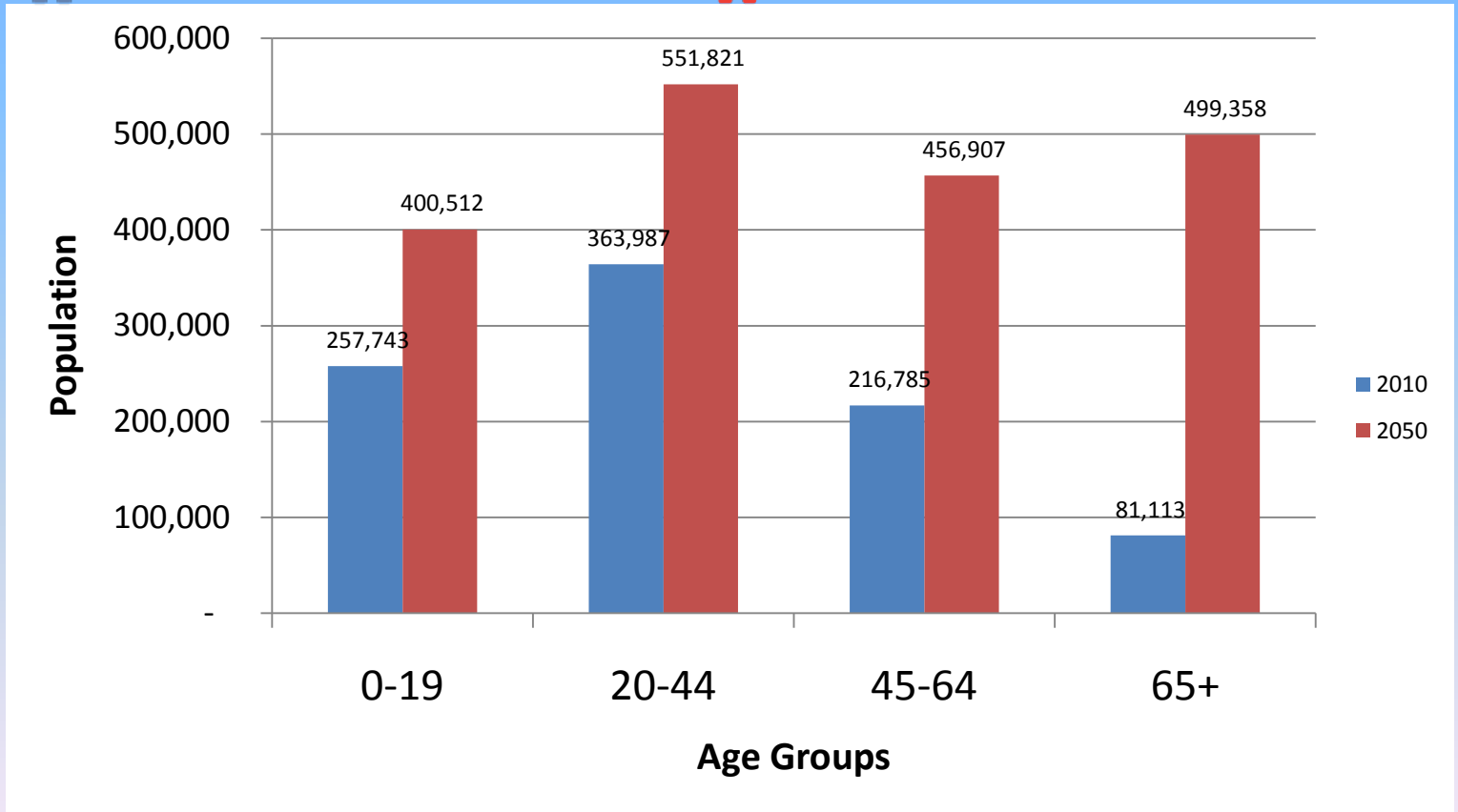
Data Source: GCM: NCAR, Resolution: 12km, IPCC Scenario A1B, with Projected Anthropogenic Emissions Inventory, May-August

Delta:
~6ppb
~11% decrease

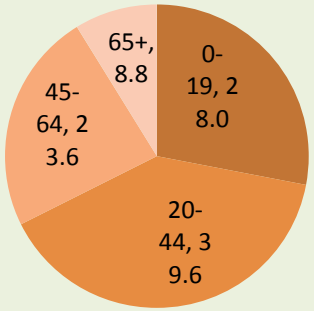
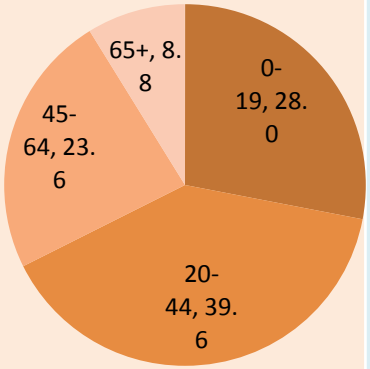
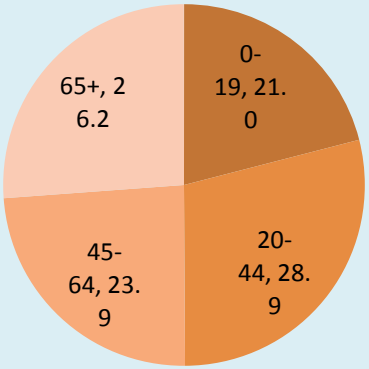
D Population Data

2010: 919,628
US Census 2010

2050: 1,908,598
US EPA ICLUS 1.3.2, A1 Scenario



D Population Scenarios

	(A) Constant Population (Held at 2010 Population Levels) Data Source: U.S. Census 2010	(B) 2050 Population Size, with 2010 Age-Sex Distribution Data Source: U.S. EPA ICLUS v1.3.2	(C) 2050 Population IPCC A1 Scenario Data Source: U.S. EPA ICLUS v1.3.2
Population Size	**919,628**	**1,908,598**	**1,908,598**
Demographic Profile			

Health Impact

	Asthma ED Visits Avoided, per warm season		
Age Group	**(A) Constant Population (Held at 2010 Population Levels) Data Source: U.S. Census 2010 Population size: 919,628**	**(B) 2050 Population Size, *with 2010 Age-Sex Distribution* Data Source: U.S. EPA ICLUS v1.3.2 Population size: 1,908,597**	**(C) 2050 Population IPCC A1 Scenario Data Source: U.S. EPA ICLUS v1.3.2 Population size: 1,908,597**
0-19	9.9	20.6	15.4
20-44	8.6	18	13.2
45-64	4.3	9	9.1
65+	1.2	2.4	7.1
Total	**24.0**	**49.9**	**44.7**

Health Impact

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Total	**24.0**	**49.9**	**44.7**

Seems small? Remember an average day sees about 12.1 asthma ED visits. This is roughly equivalent to removing 2 full days of visits from each warm season

Summary

- Projected ↓ summertime ozone concentrations for Mecklenburg County, due to ↓ anthropogenic emissions.
- ↓ in asthma emergency department morbidity, moderately sensitive to future population demographics.

Continued reductions in anthropogenic emissions are needed to offset climate-change-related increases in ozone and population dynamics

Next Steps

- Scaling up to whole state of North Carolina
- Age group / Sex /Disease specific concentration-response functions
  - Asthma
  - COPD
  - Cardiovascular diseases
- 2nd air quality projection for 2050 that uses current emissions levels for comparison.

Acknowledgements

- CISA Small Project Grant

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R832751010

- CDC BRACE (Lauren Thie)

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Note: Data were obtained from the NC DHHS/DPH NC DETECT system under a data use agreement. The NC DETECT Data Oversight Committee does not take responsibility for the scientific validity or accuracy of methodology, results, statistical analyses, or conclusions presented.

Questions / Contact Info

Age 36 in 2050

Age 41 in 2050

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