Health Risks from Climate Variability and Change in the Upper Midwest

EPA STAR Grant Project

Annual Conference of the APHA

Washington, Nov. 6, 2007

Jonathan Patz, MD, MPH

SAGE , Nelson Institute for Environmental Studies

& The Department of Population Health Sciences

University of Wisconsin – Madison

EPA STAR GRANT

Climate change health risks for Wisconsin & Chicago

University of Wisconsin – Madison

Wisconsin Dept. Health and Family Services

National Center for Atmospheric Research (NCAR)

Collaborators:

University of Wisconsin–Madison

Jonathan. Patz, Tracey Holloway, Marty Kanarek, Chris Uejio, Steve Vavrus, Grace Wahba

Wisconsin Dept. Health and Family Services

Henry Anderson, MD, Marni Bekkedal, Larry Hanrahan

National Center for Atmospheric Research (NCAR)

Linda Mearns,Steve Sain, Bo Li

Consultants: Kris Ebi and Sari Kovats

Since 1853, there has been a 25 percent decrease in the amount of time Lake Mendota remains frozen over during the winter.

(John Magnuson et al., Science 2000)

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HEALTH EFFECTS OF CLIMATE CHANGE

CLIMATE CHANGE

Temperature Rise [1]
Sea level Rise [2]
Hydrologic Extremes

[1] **3°C** by yr. 2100
[2] **40 cm** " "
IPCC estimates

Patz, 1998

Urban Heat Island Effect	Heat Stress Cardiorespiratory failure
Air Pollution & Aeroallergens	Respiratory diseases, e.g., COPD & Asthma
Vector-borne Diseases	Malaria Dengue Encephalitis Hantavirus Rift Valley Fever
Water-borne Diseases	Cholera Cyclospora Cryptosporidiosis Campylobacter Leptospirosis
Water resources & food supply	Malnutrition Diarrhea Toxic Red Tides
Mental Health **Environmental Refugees**	Forced Migration Overcrowding Infectious diseases Human Conflicts

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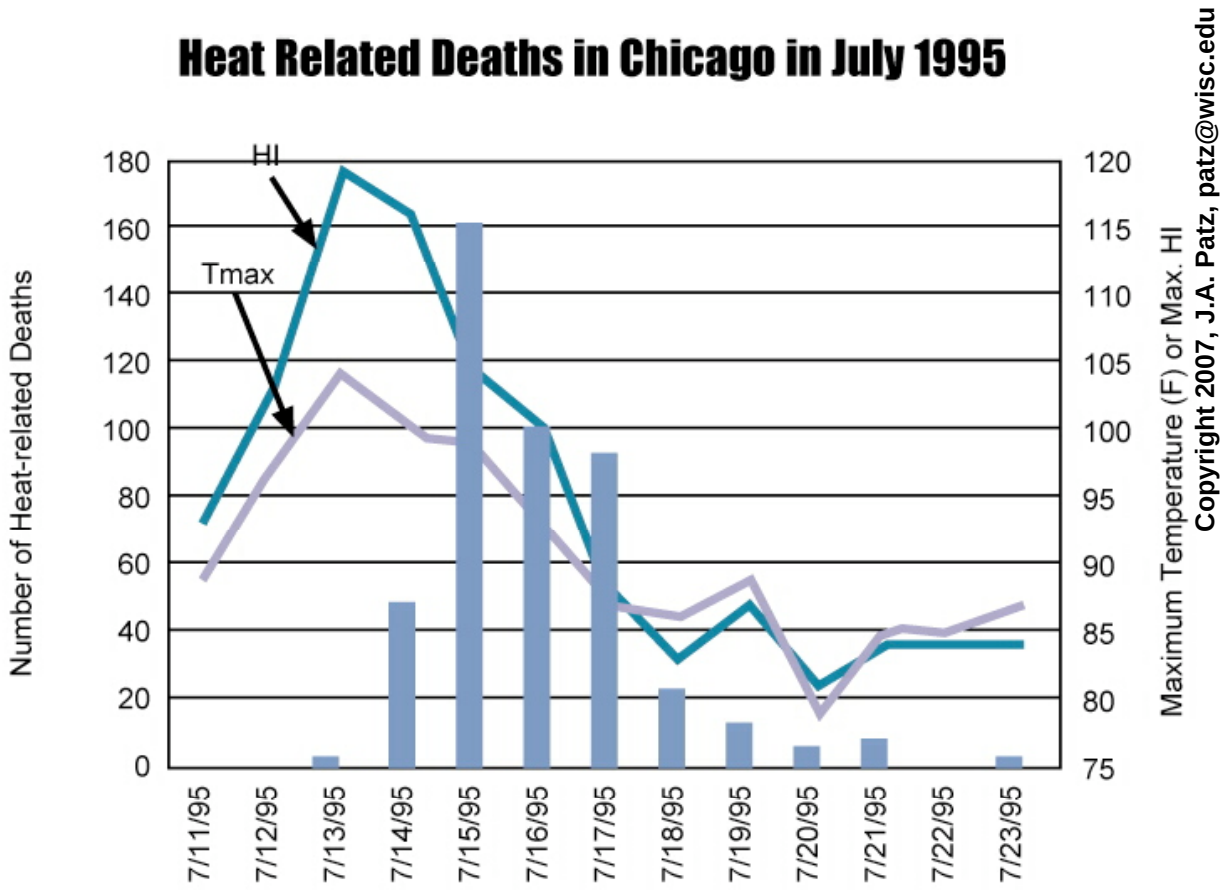
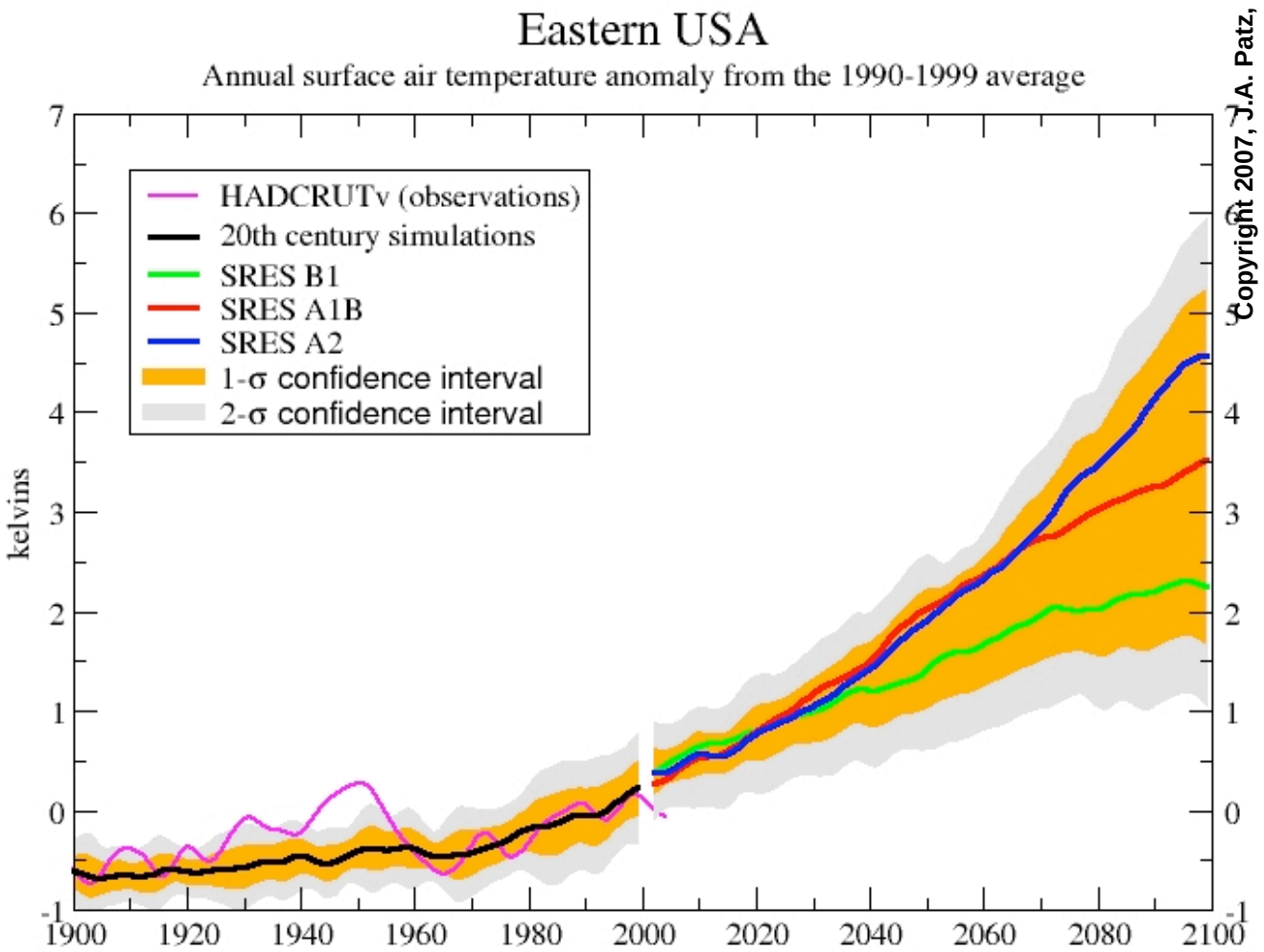


Figure 3: This graph tracks the maximum temperature (Tmax), heat index (HI), and heat-related deaths in Chicago each day from July 11 to 23, 1995. The gray line shows maximum daily temperature, the blue line shows the heat index, and the bars indicate the number of deaths each day. Source: NOAA/NCDC.

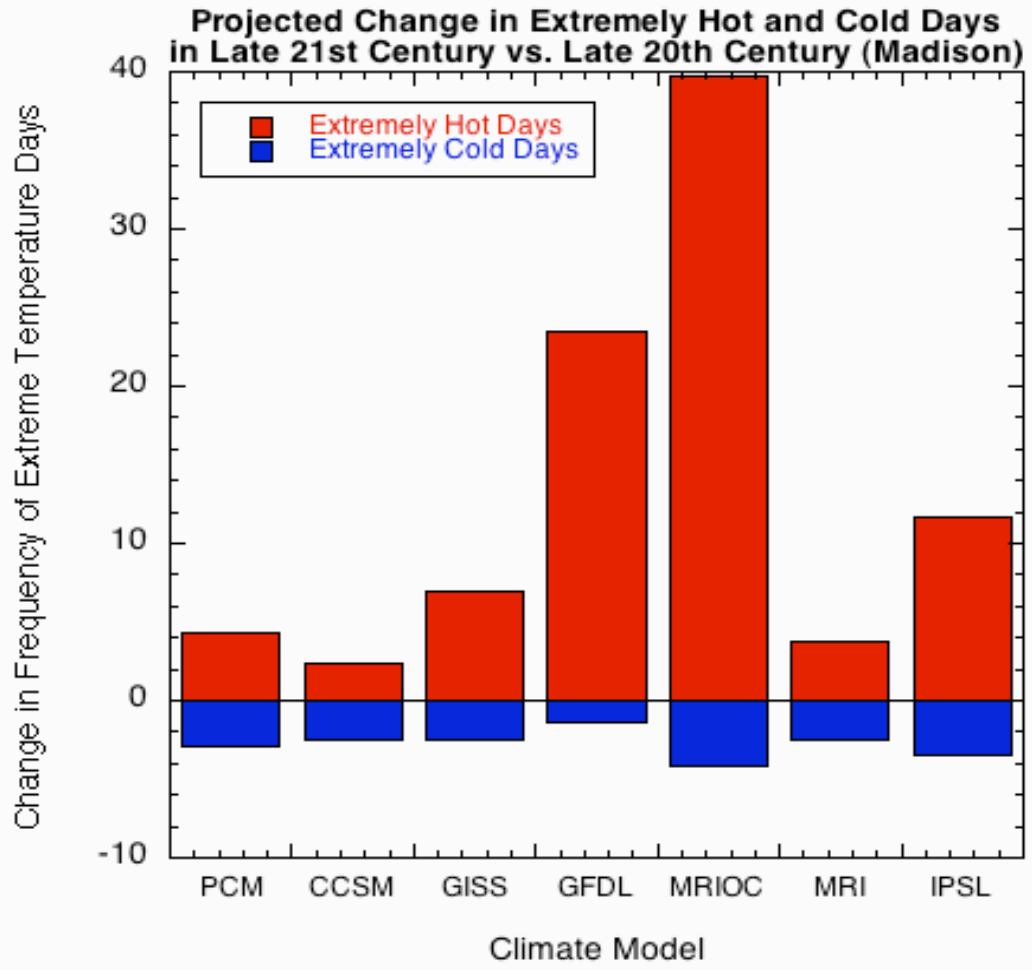
IPCC Projections



Data

- Hospital Discharge Data (includes admission date and ER visits) from 1989-2005
- Tmax & min, precip, RH
- Air pollution: EPA Air Quality System data (PM10 and ozone -- summer season
- Beach closing data from DNR

Projected change in number of extremely hot and cold days, southern Wisconsin- 7 GCMs by the late 21st century



Courtesy: S. Vavrus

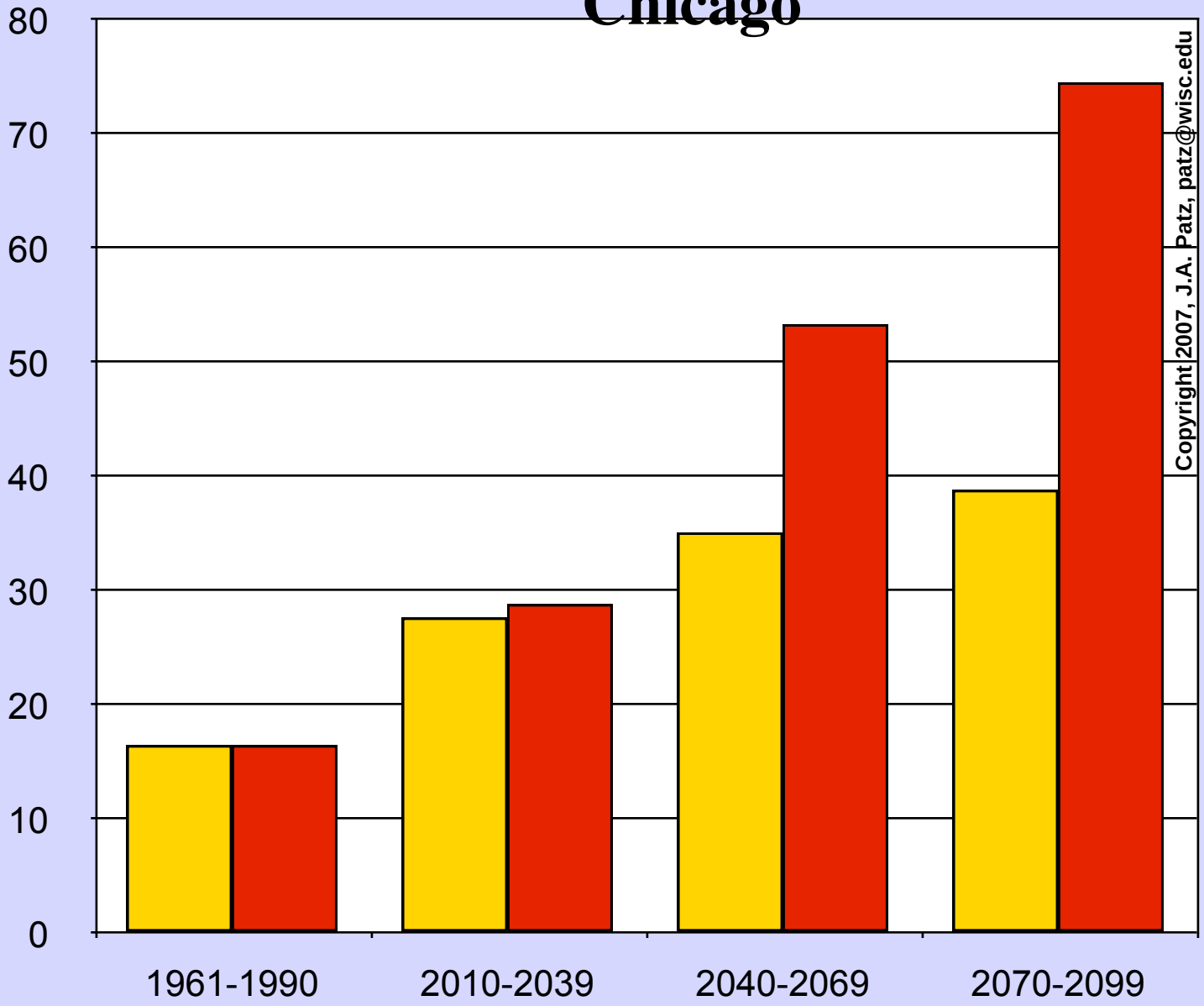
University of Wisconsin-Madison

Unpublished data

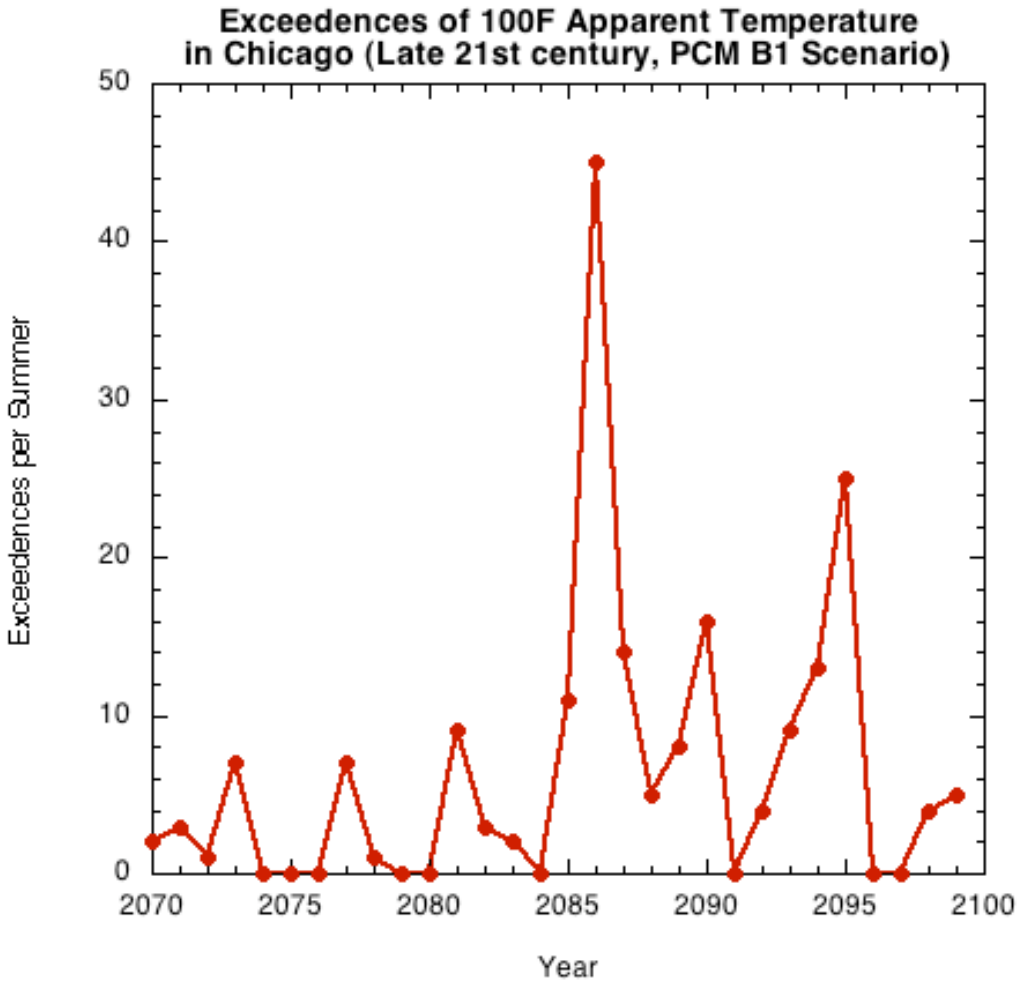
EPA STAR Grant project

J Patz, PI

Chicago



Projected exceedences of maximum daily 100°F apparent temperature in Chicago by the late 21st century, based on the PCM climate model's B1 emissions scenario



Courtesy: S. Vavrus

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Unpublished data

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Note: this much variability will make planning extremely difficult

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CLIMATE CHANGE

Regional health impacts from North America to Africa

PLASMON OPTICS
Towards the perfect lens

EMERGING DISEASES
The Typhoid Mary factor

STAR FORMATION
Boost for a collapsing theory

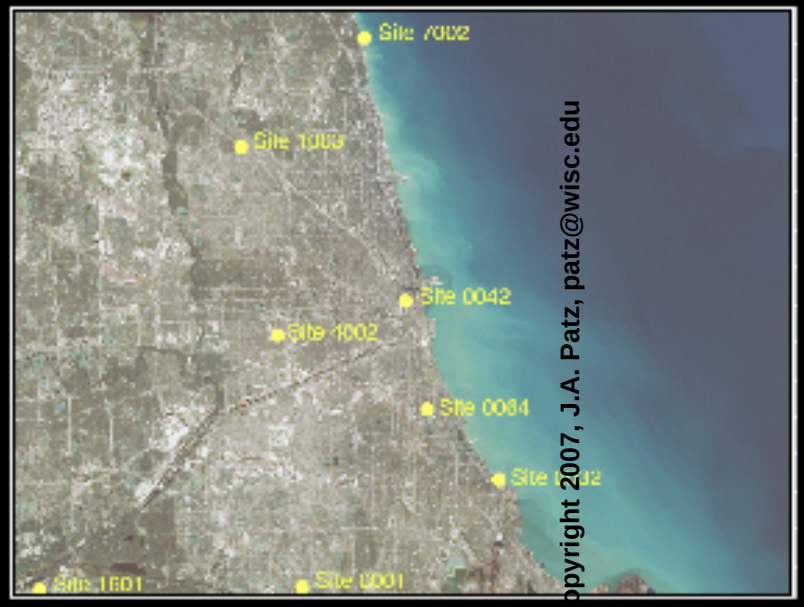
- **"The severity and duration of summertime regional air pollution episodes are projected to increase in the Northeast and Midwest US by 2045-2052 due to climate-change-induced decreases in the frequency of surface cyclones."** (IPCC, 2007)

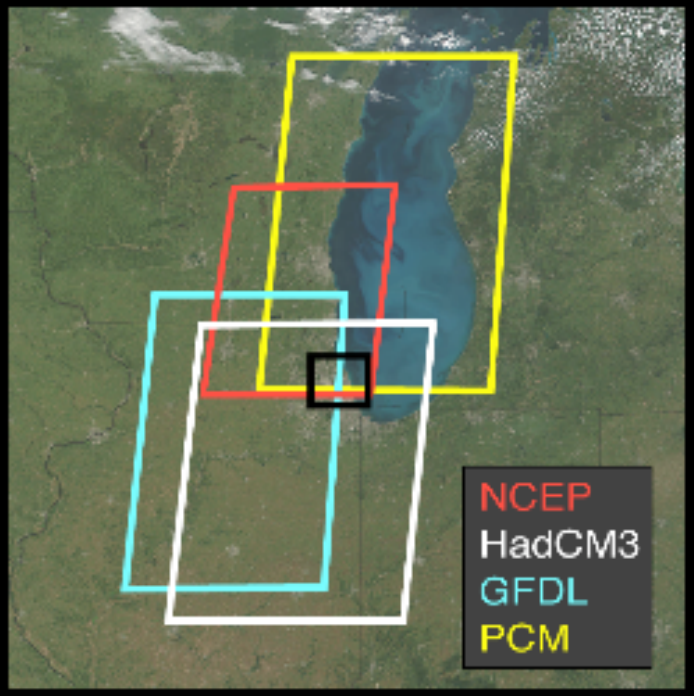
- **"The severity and duration of summertime regional air pollution episodes are projected to increase in the Northeast and Midwest US by 2045-2052 due to climate-change-induced decreases in the frequency of surface cyclones."** (IPCC, 2007)

- **By 2050, warming alone may increase by 68% the number of Red Ozone Alert days across the Eastern US.** (IPCC, 2007 -Bell et al, 2006)

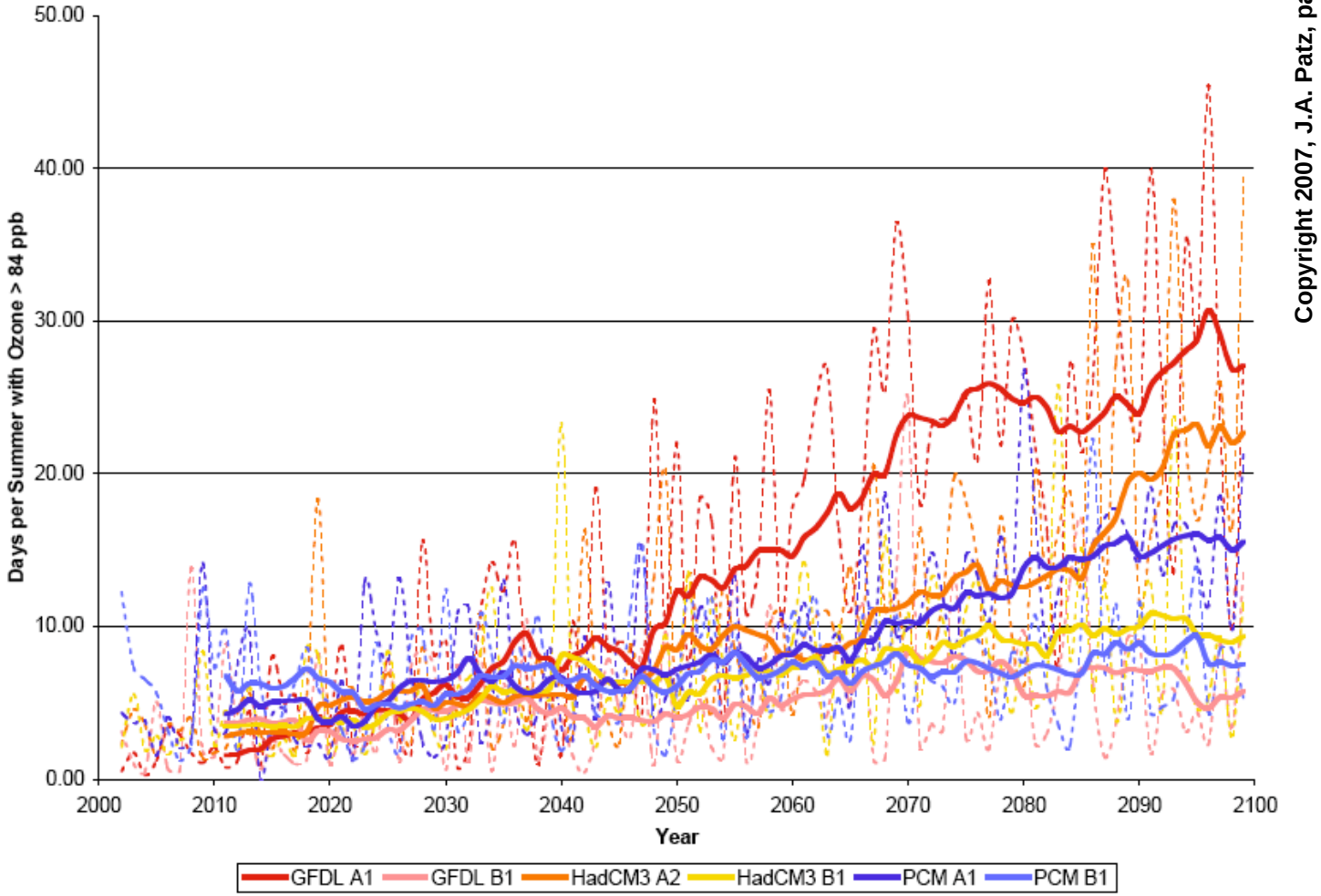
Climate Change and Air Pollution Modeling for Chicago

Co-investigator: Tracey Holloway



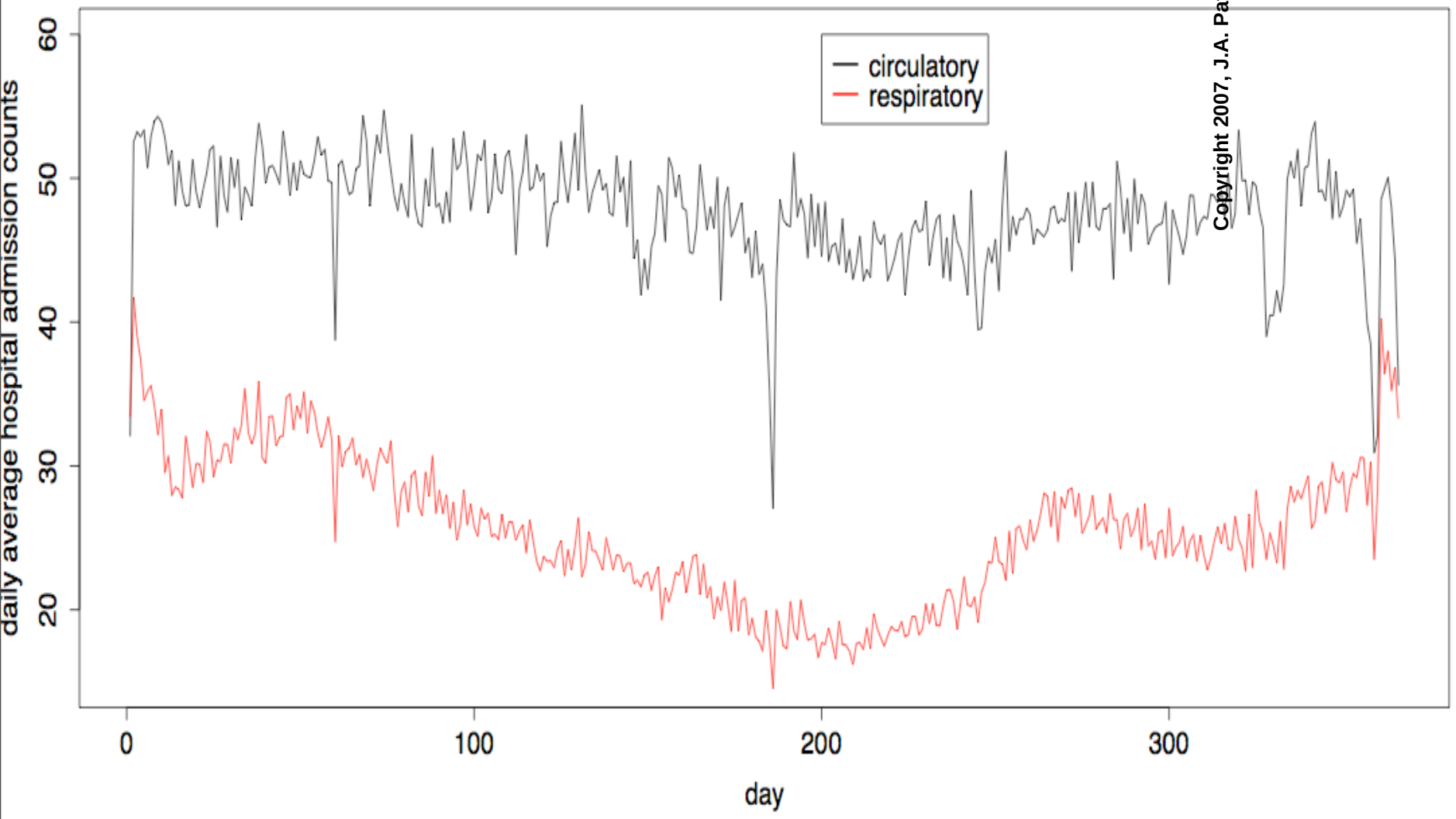


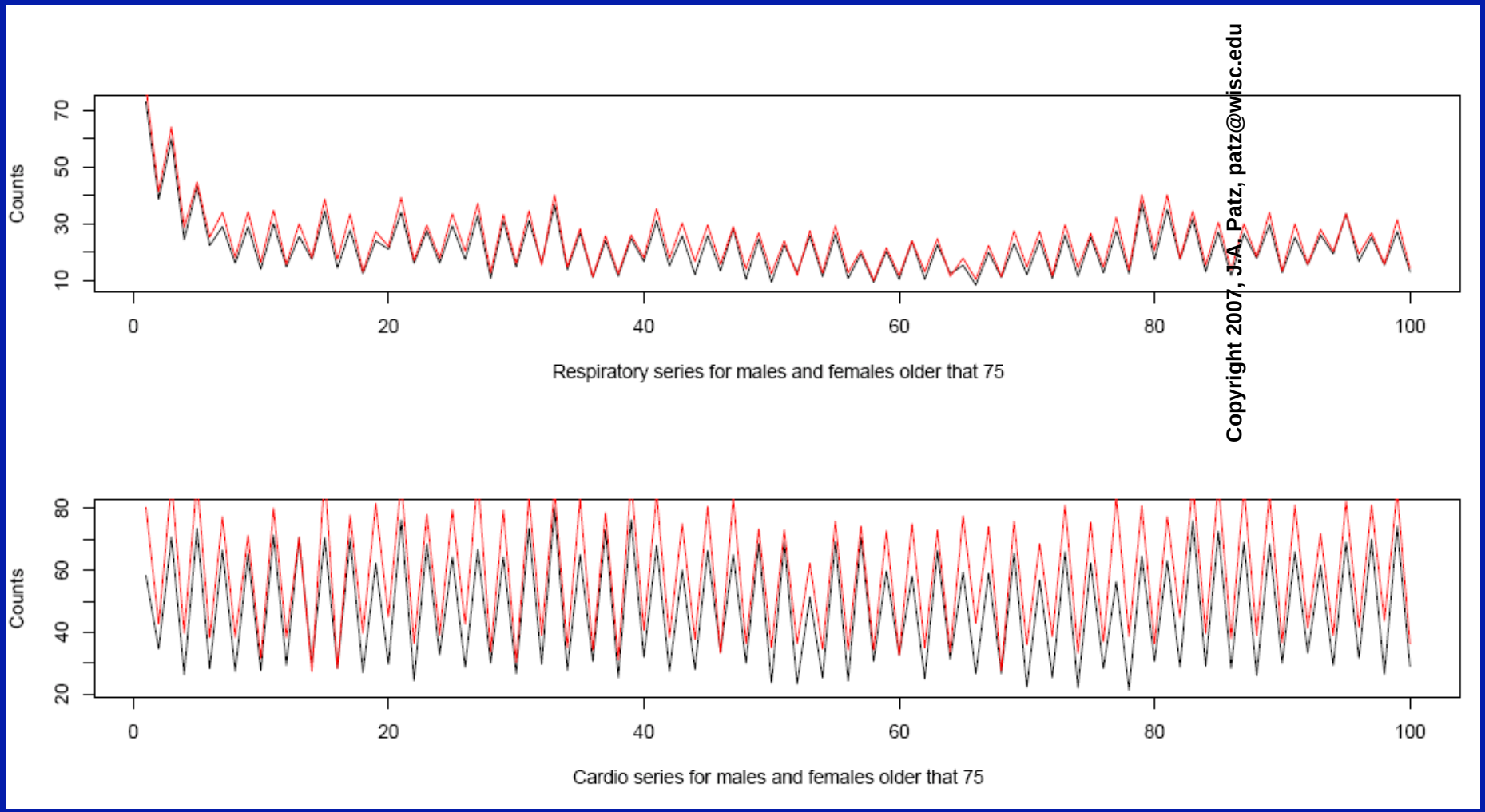
Days per summer (June, July, August) with O3 above the NAAQS limit of 84 ppb. Colored, solid lines reflect the 10-year running mean of exceedances for each model (mean across SDSM ensembles, and across the study sites). Colored dotted lines reflect year-to-year exeedance values (mean across SDSM ensembles, and across the study sites).

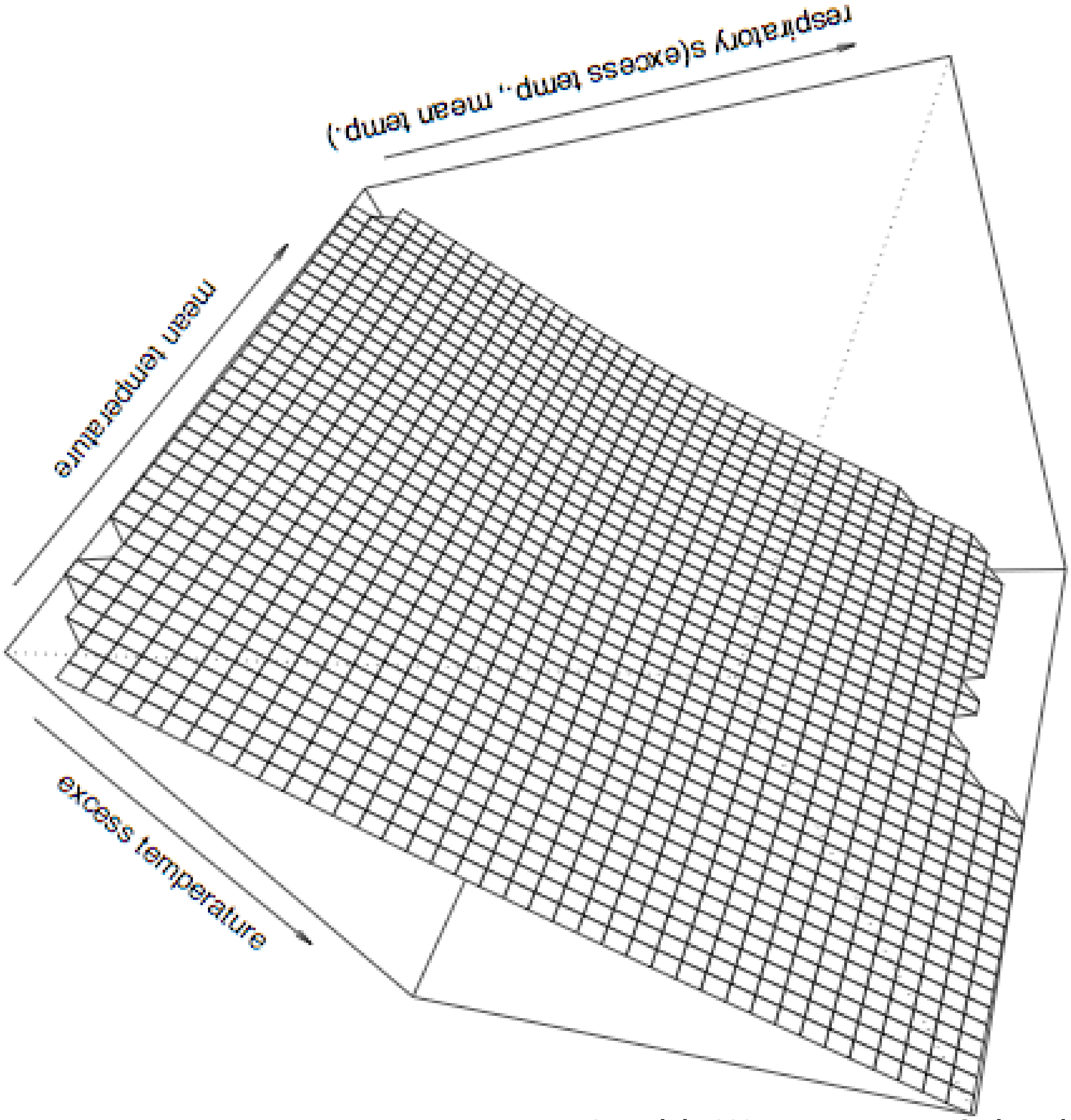


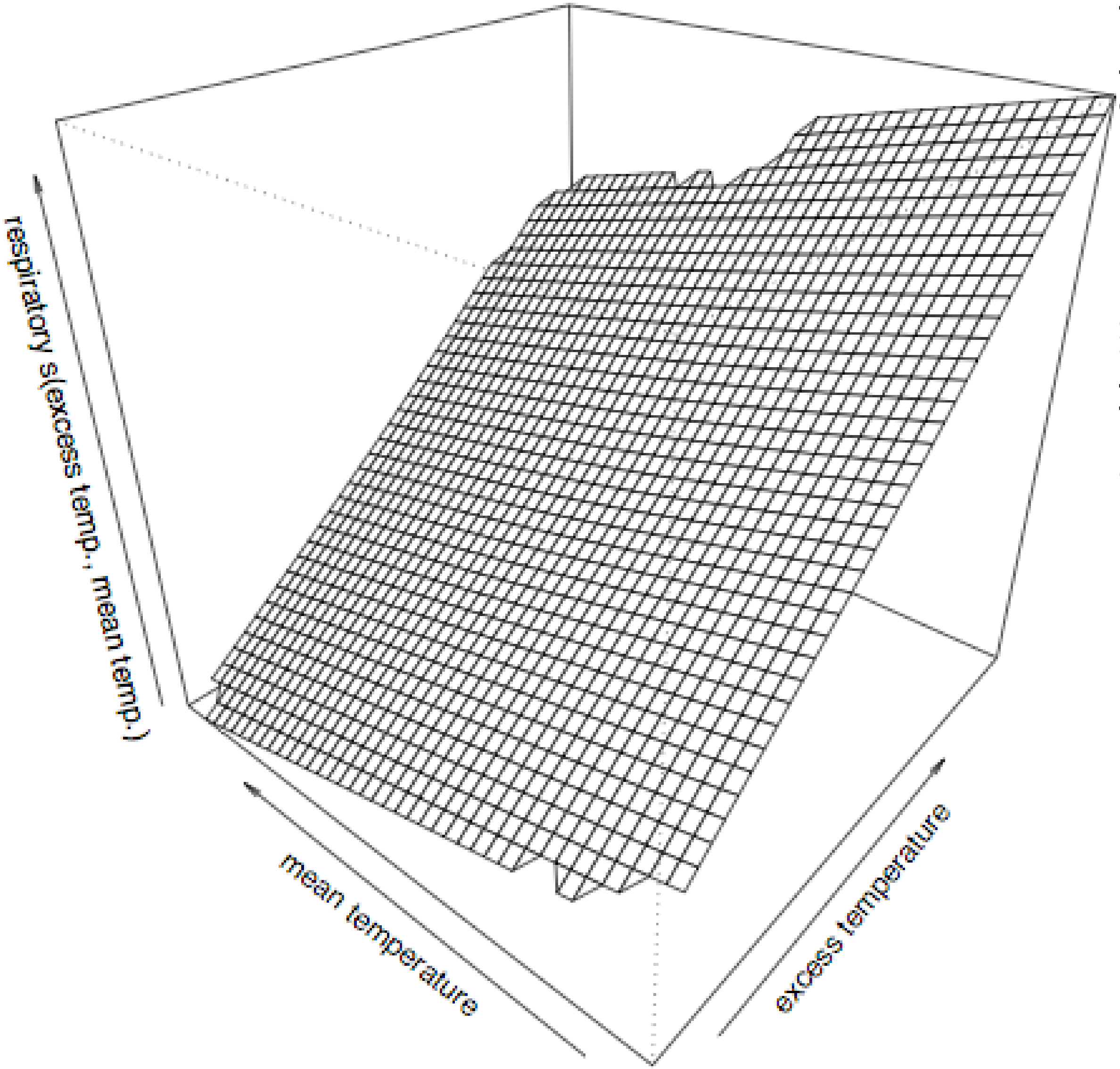
Holloway et al. in review

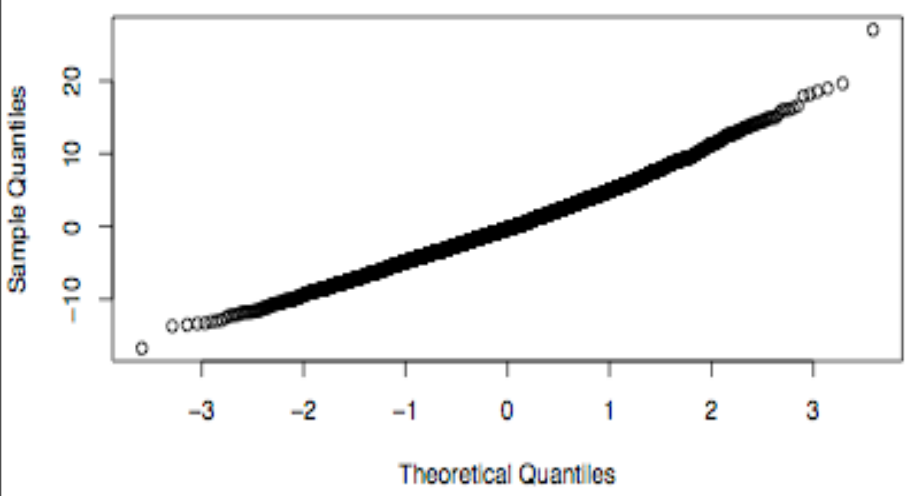
Time Series for Milwaukee

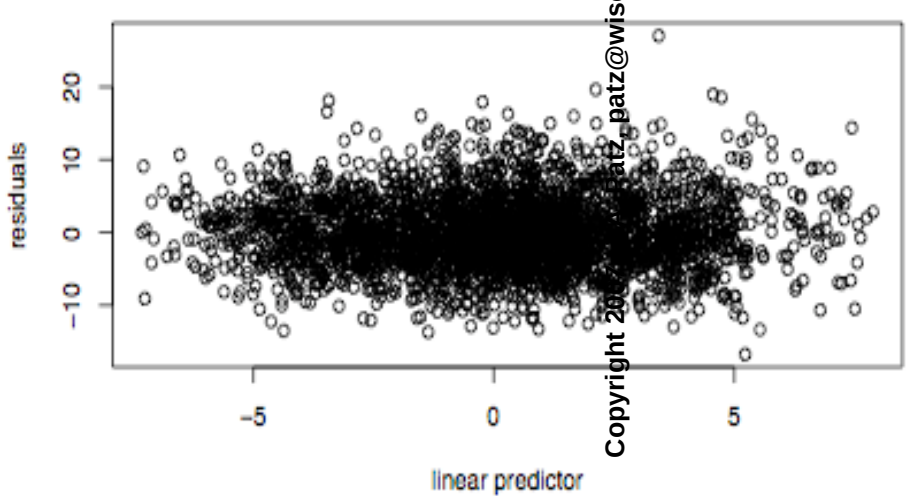


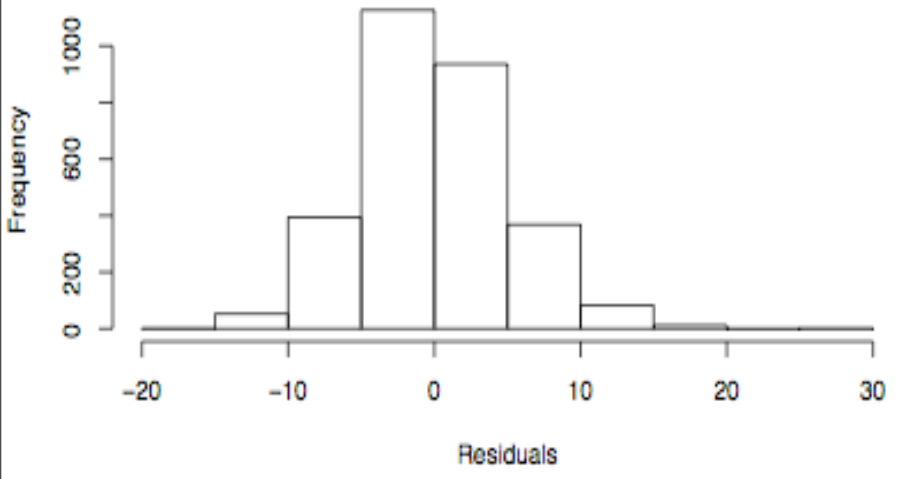


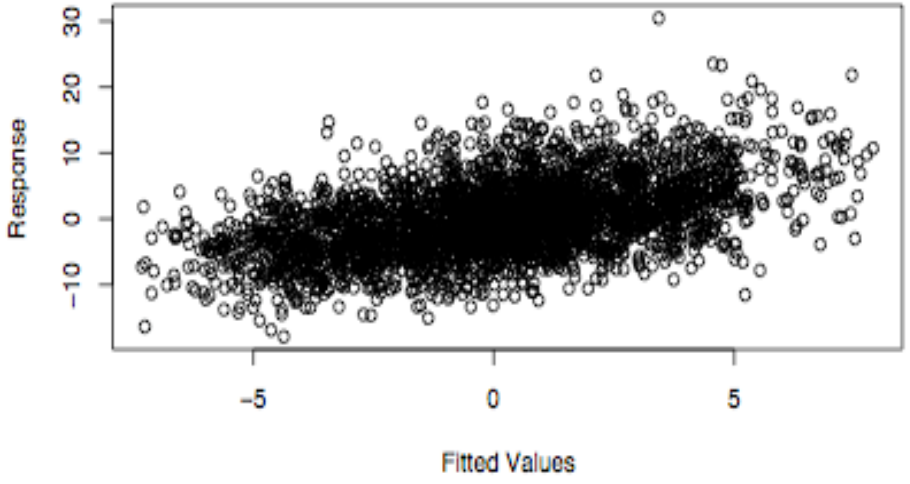


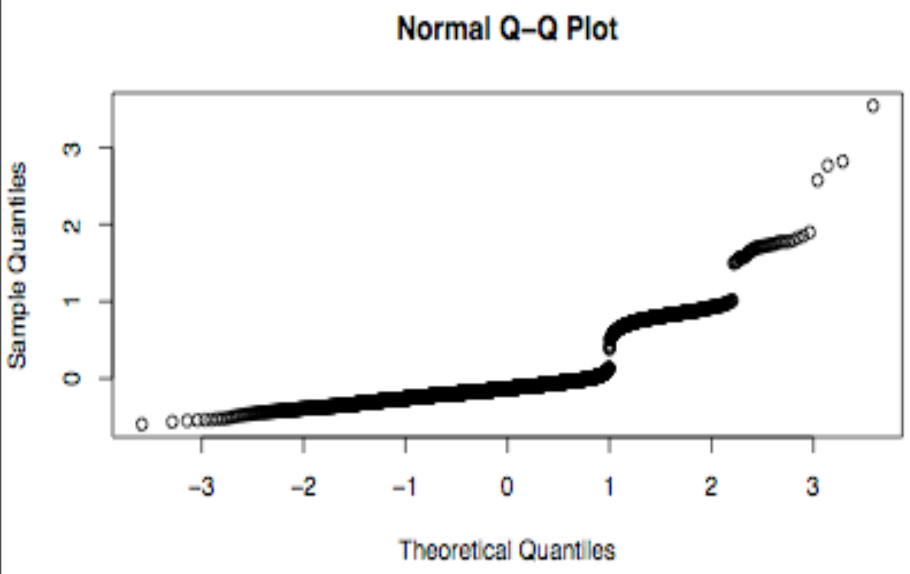


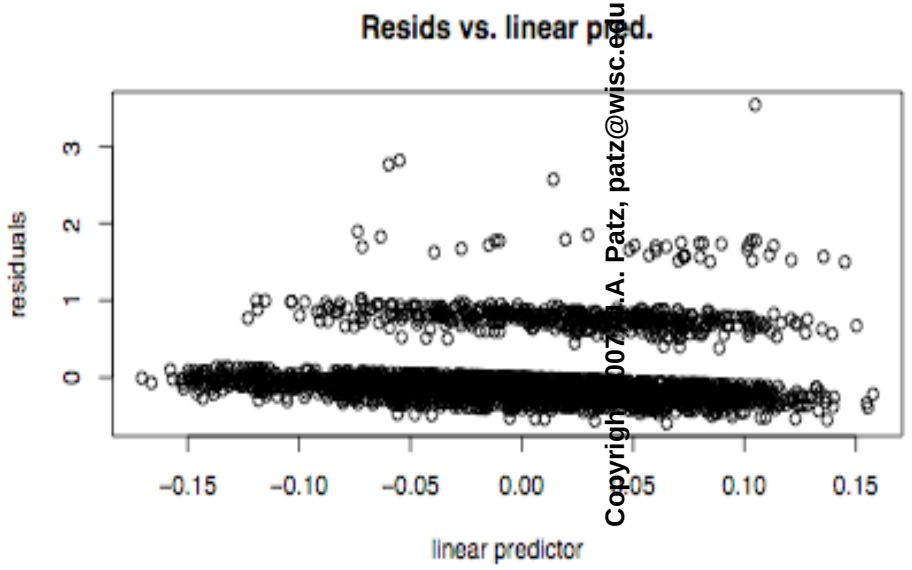


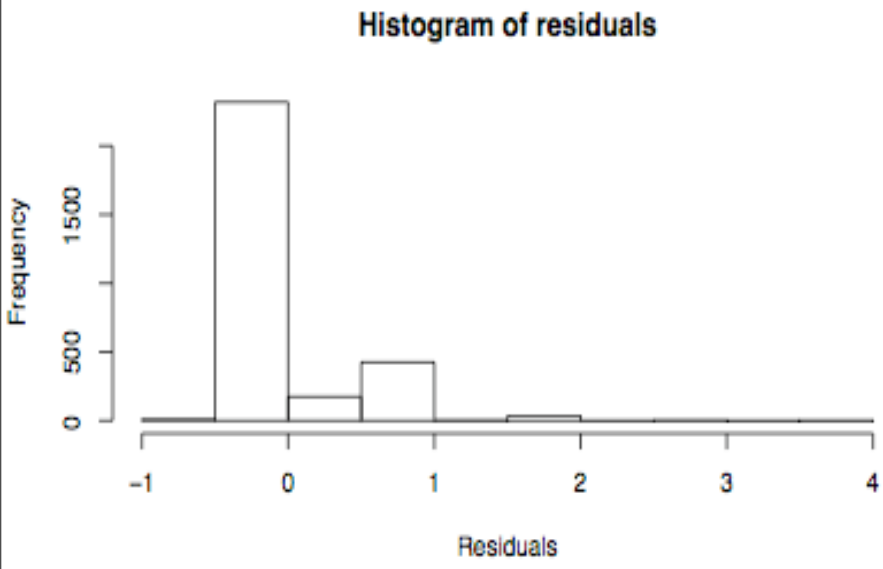


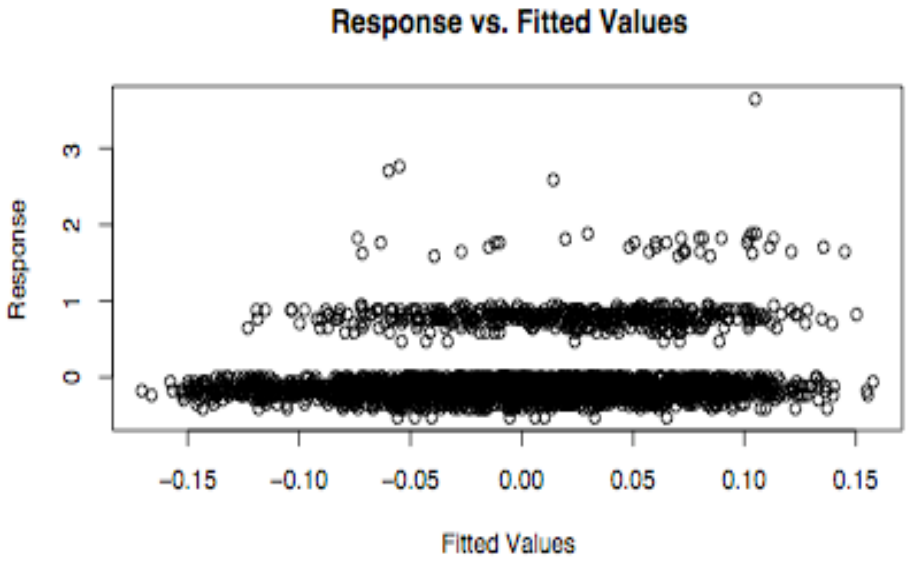


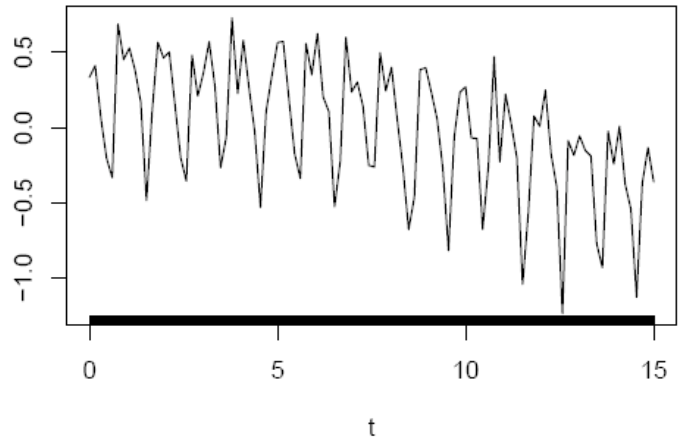


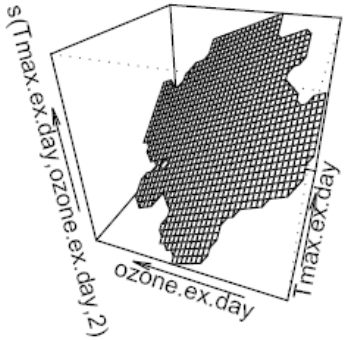


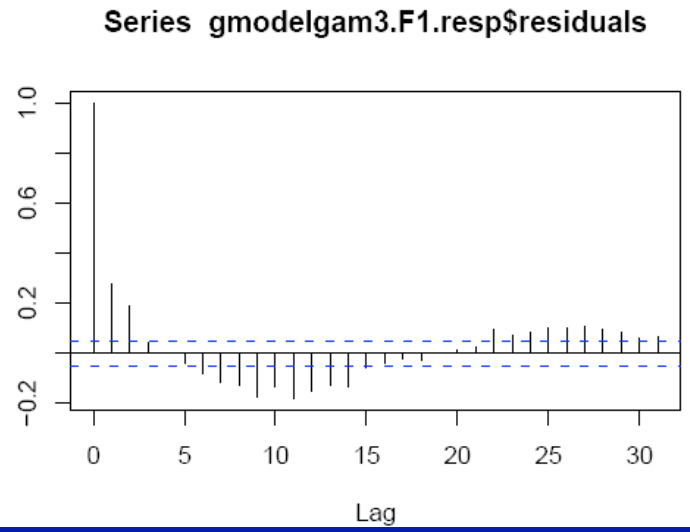


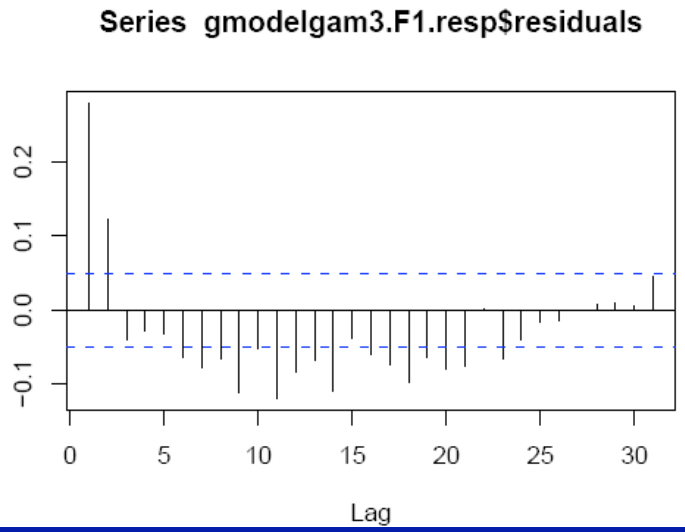




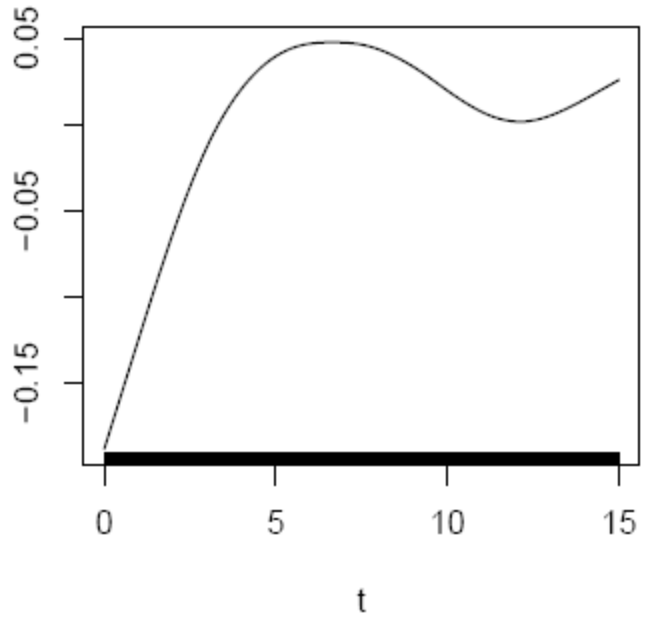


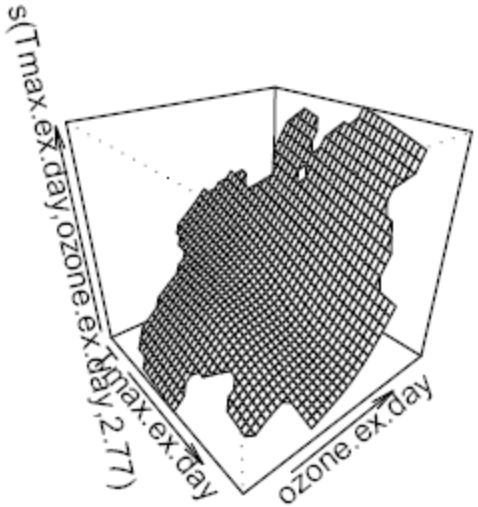






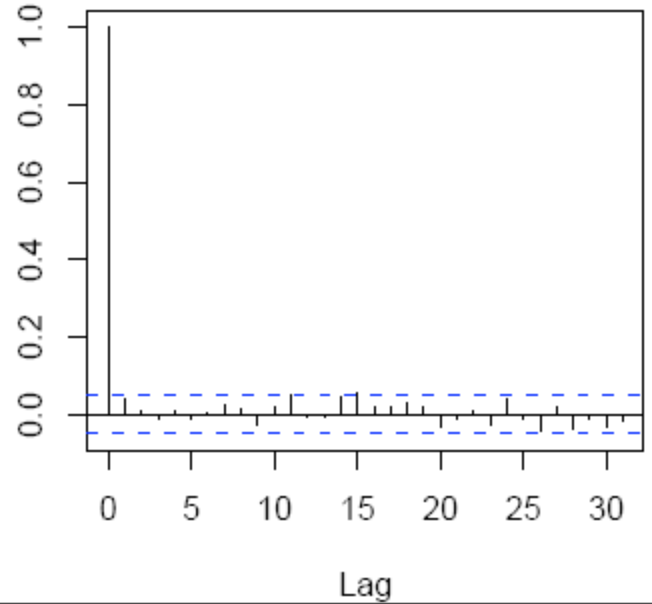
F1 resp

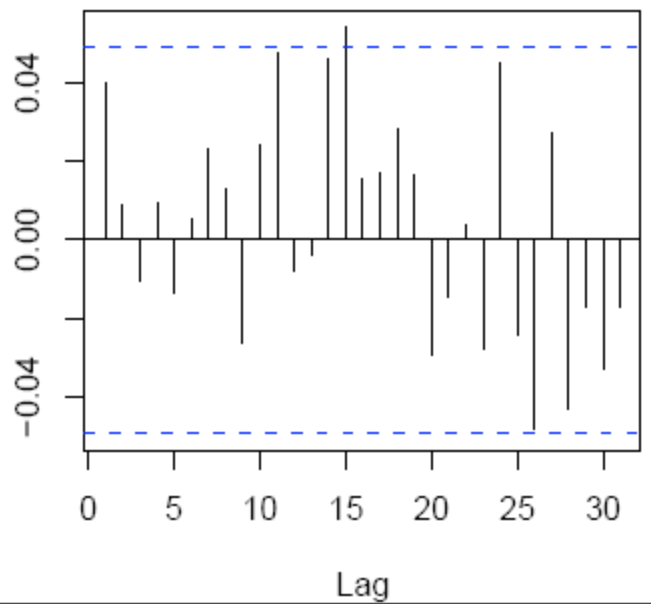




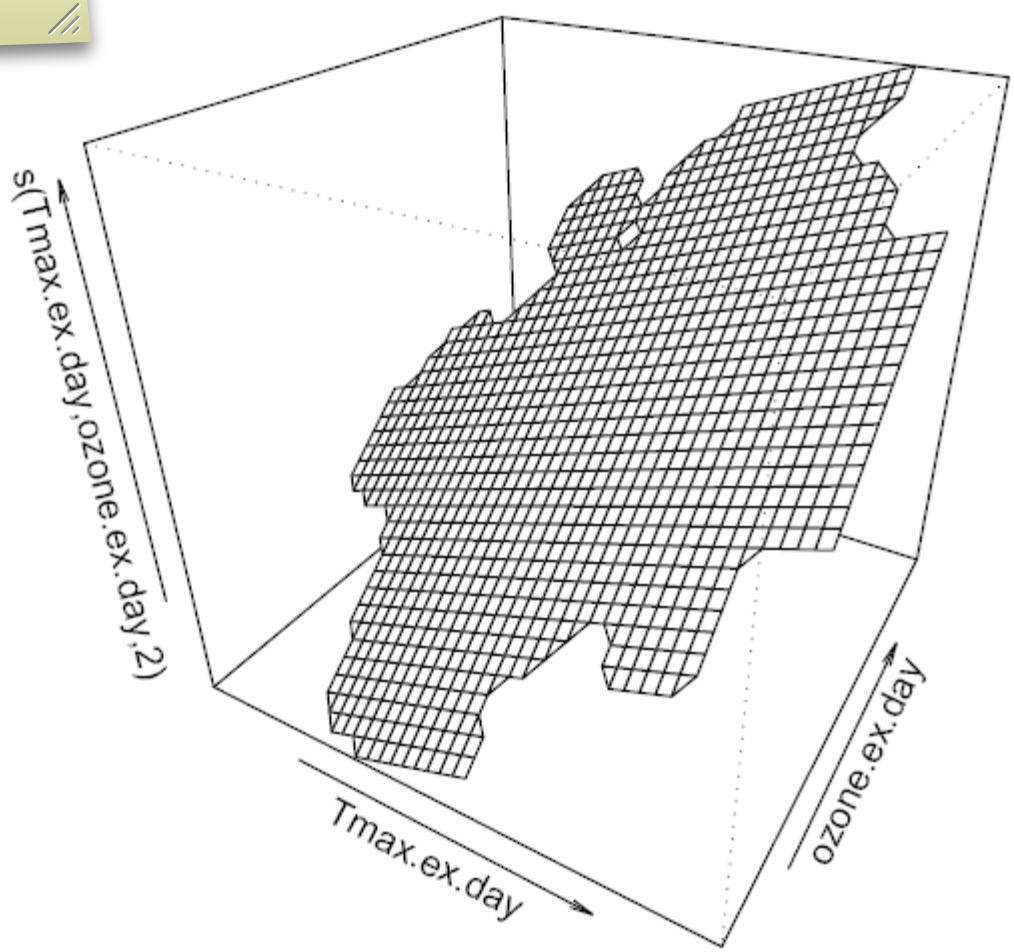
Series gmodelgam4.M1.cardio$residu Series gmodelgam4.M1.cardio$residu

M1 cardio





Jonathan Patz.



Climate change:

It's not just about warming.

Heavy precipitation is projected to increase

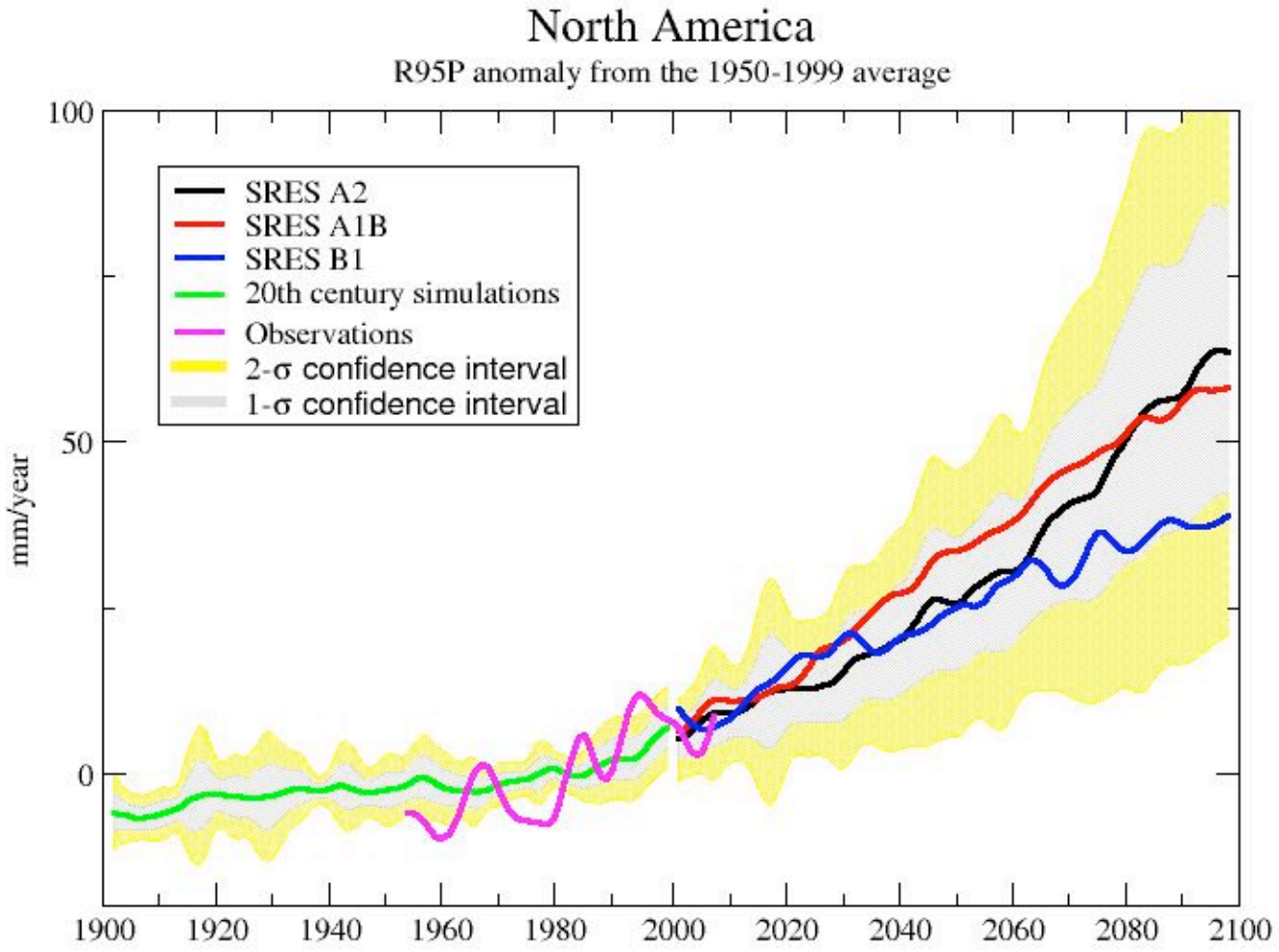


Figure courtesy of M. Wehner

Milwaukee 1993

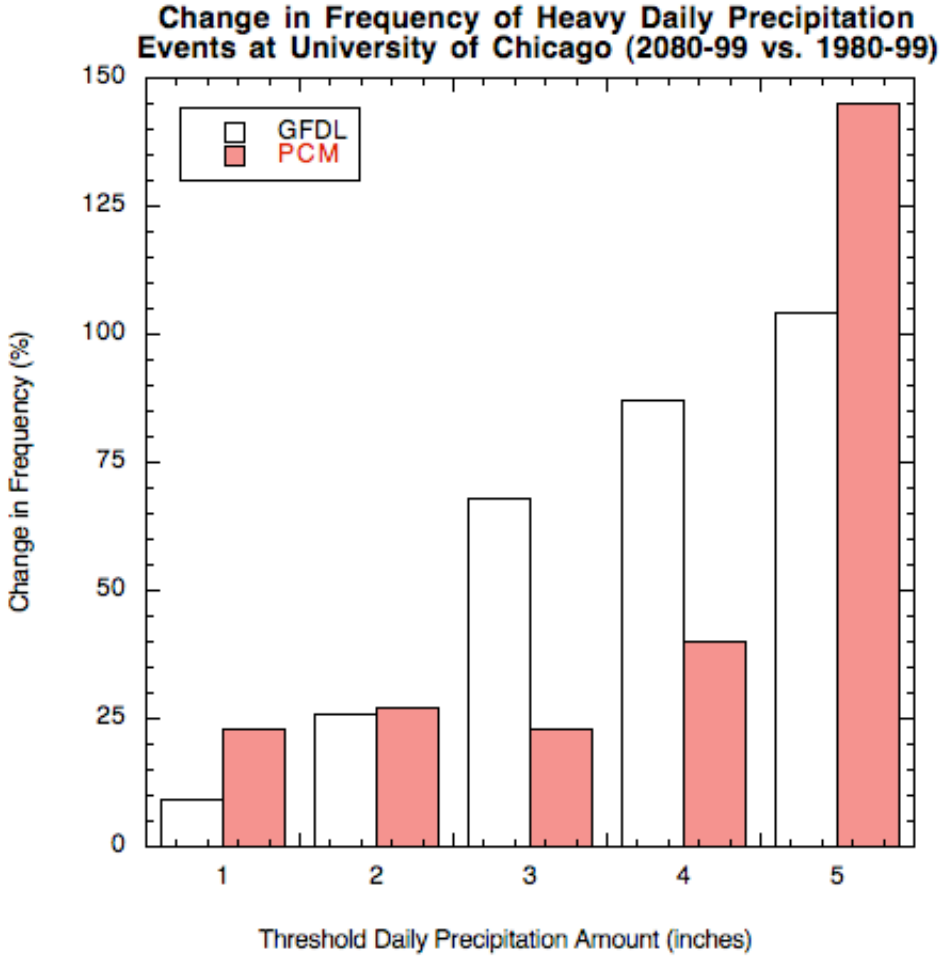
Cryptosporidiosis epidemic

405,000 exposed

54 fatalities

Preceded by heaviest rainfall in 50 years

Projected change in the frequency of heavy precipitation in Chicago by the late 21st century, based on downscaled climate model output from two GCMs used in the Chicago Climate Impact Assessment.



Courtesy: S. Vavrus

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Unpublished data

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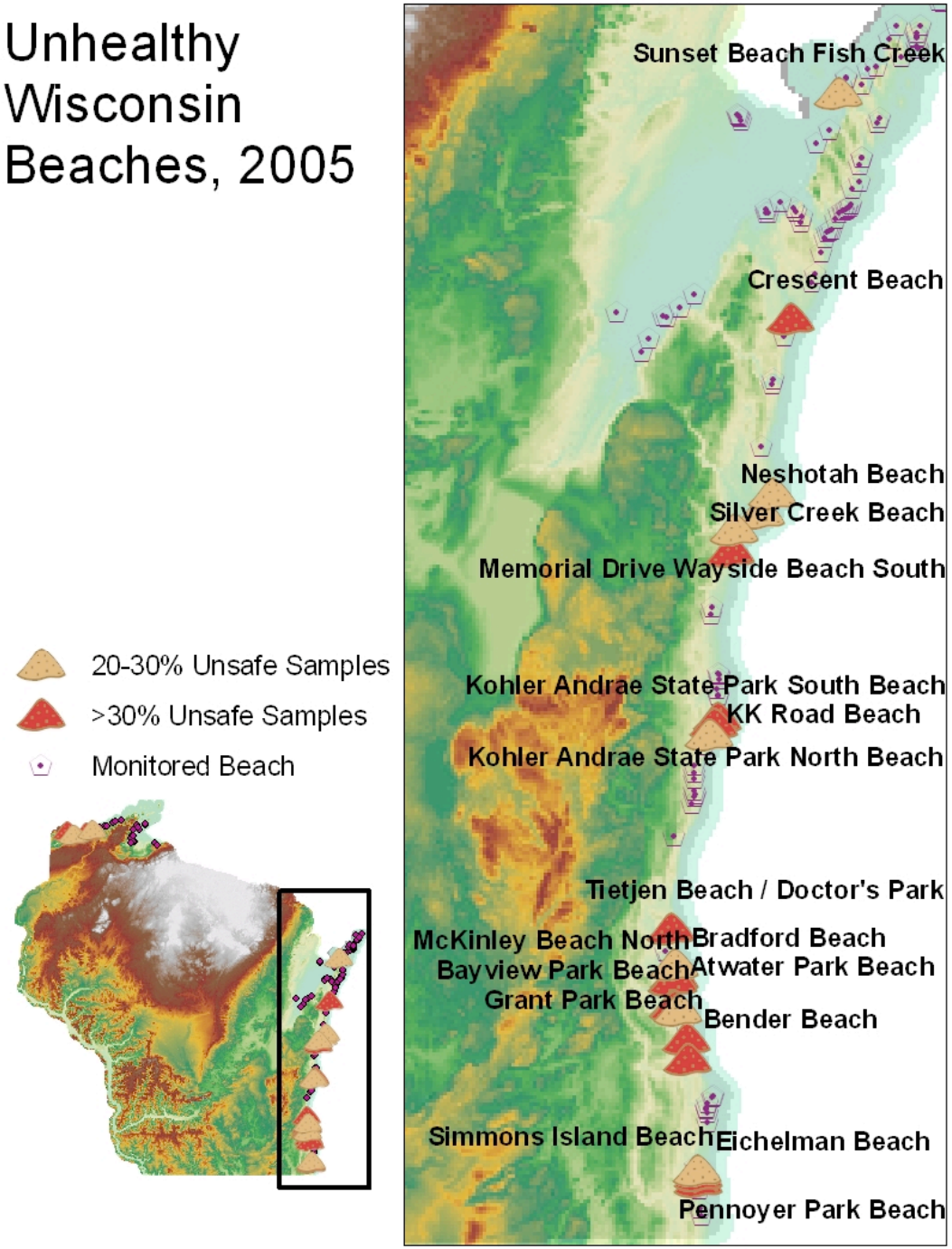
Unhealthy Wisconsin Beaches, 2005



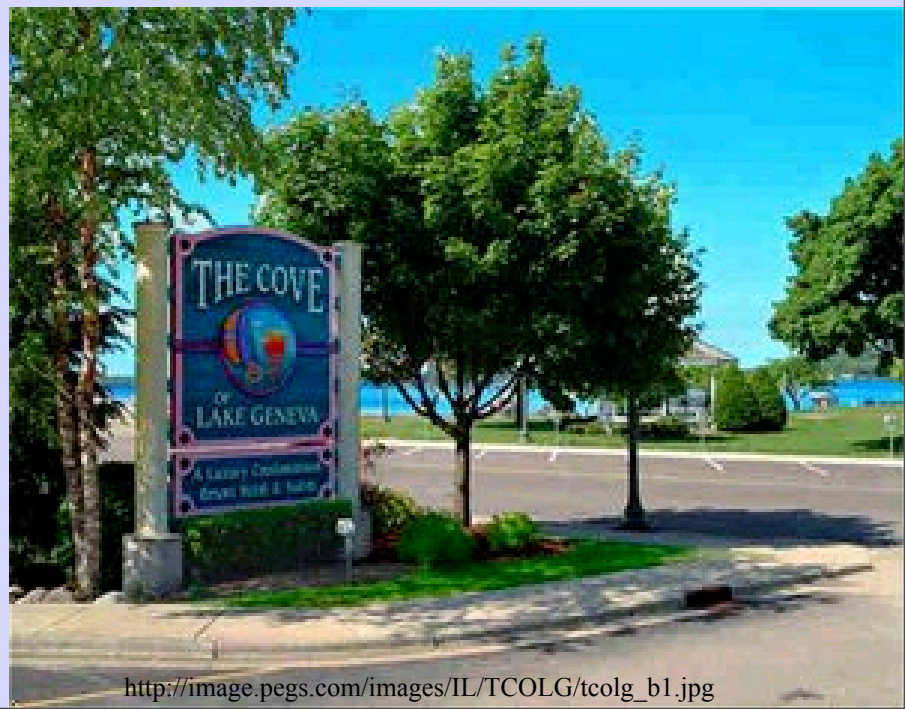
20-30% Unsafe Samples

>30% Unsafe Samples

Monitored Beach

Walworth County, WI; Big Foot Beach (N=83, R=.26)

Predictor	B	Standard Error	P-value	95% CI
Average Temperature	0.088	0.025	0.001	0.038 - 0.138
Gage Height	3.316	0.756	0.001	1.813 - 4.820

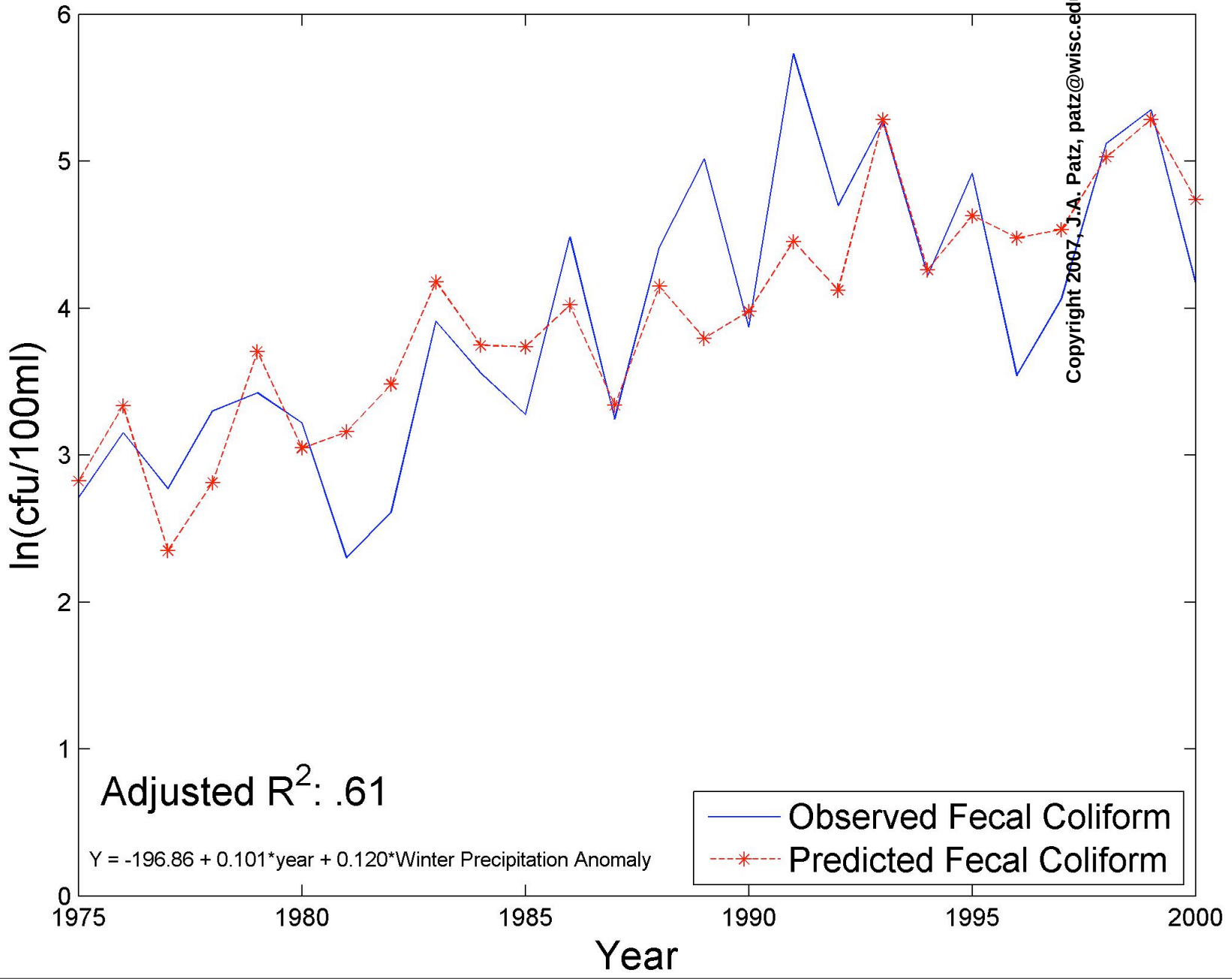


http://image.pegs.com/images/IL/TCOLG/tcolg_b1.jpg

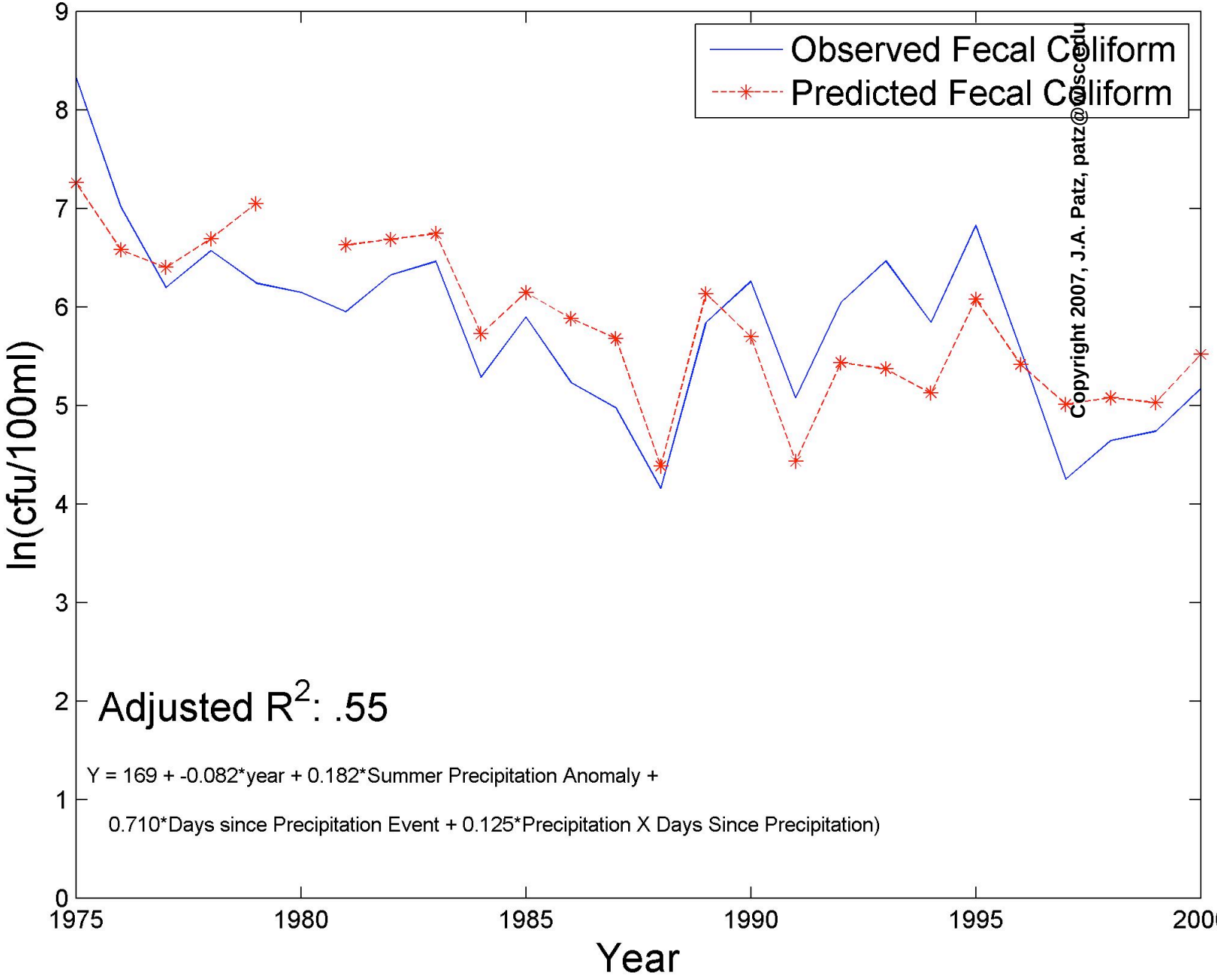
Daily Jackson County, WI; East Arbutus Beach (N=48, R=.55)

Predictor	B	Standard. Error	P-value	95% CI
Precipitation, at lake	1.141	0.413	0.008	0.038 1.974
Precipitation, (nearby watersheds)	0.137	0.065	0.042	0.005 0.269
Stream Discharge	1.025	0.179	0.001	0.664 - 1.386

Lake Geneva East Indicator Bacteria Timeseries



Town of Linn Mixing Zone Indicator Bacteria Timeseries



Next Steps

- Run all ICD codes for all cities
- Include adaption data (A/C & response plans --collab. W/ U Mich

Best part of this study thus far is close collaboration with and high interest from the State Health Department and WH DNR