

Using NASA Data and Models to Improve Heat Watch/Warning Systems for Decision Support

NASA Public Health Review, 2011

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September 15, 2011



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Model Development

UPDATE ON ACTIVITIES FOR PAST YEAR (YEAR 2, 2010- 2011)



Summer of 2011 notable

- Multiple Extreme Heat Alerts in each of our cities
- Hottest summer in 75 years across U.S.
- In most of our study areas worst summer heat in extent since 1934.
- This should set the stage for full implementation and extensibility of our results and activities.



Filtering of Mortality from Analog EHE's

- Mortality data collected for all our cities
 - All geocoded for each study area and incorporated into models
 - Issues with data
 - Do not have data from this past summer yet...
 - Philadelphia mortalities this summer...



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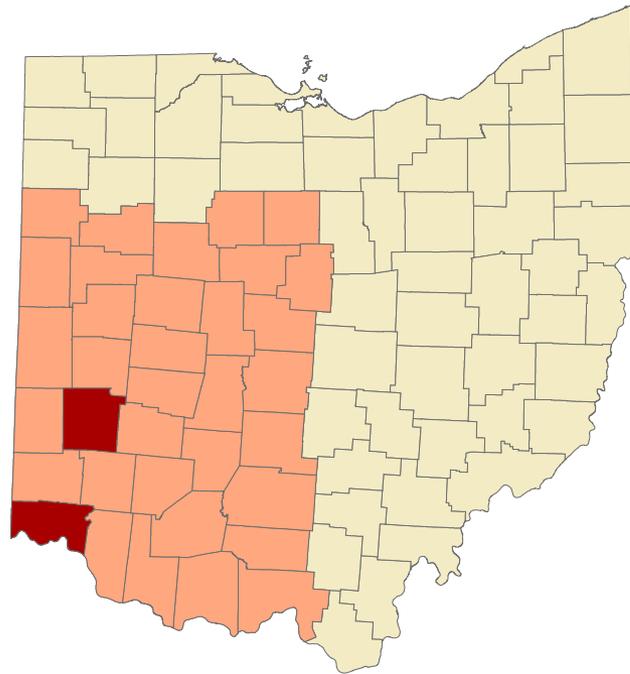


Current Heat Health Alert Systems: Overview of Deficiencies

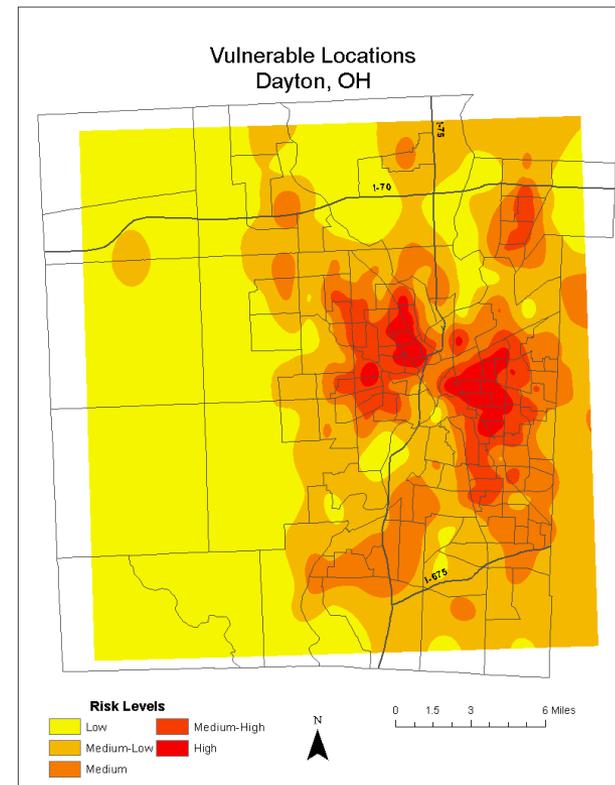
- Much of the deficiency has to do with spatial specificity. Where are the vulnerable? Where are the “hot spots”? Both thermal and health-related.
- “Current protocols for issuing heat alerts using synoptic weather models are very good”.
 - Current research is beginning to reconsider this statement (cf: Matte, 2010)

Spatial Specificity in Heat-Related Warnings: The Past and the Future

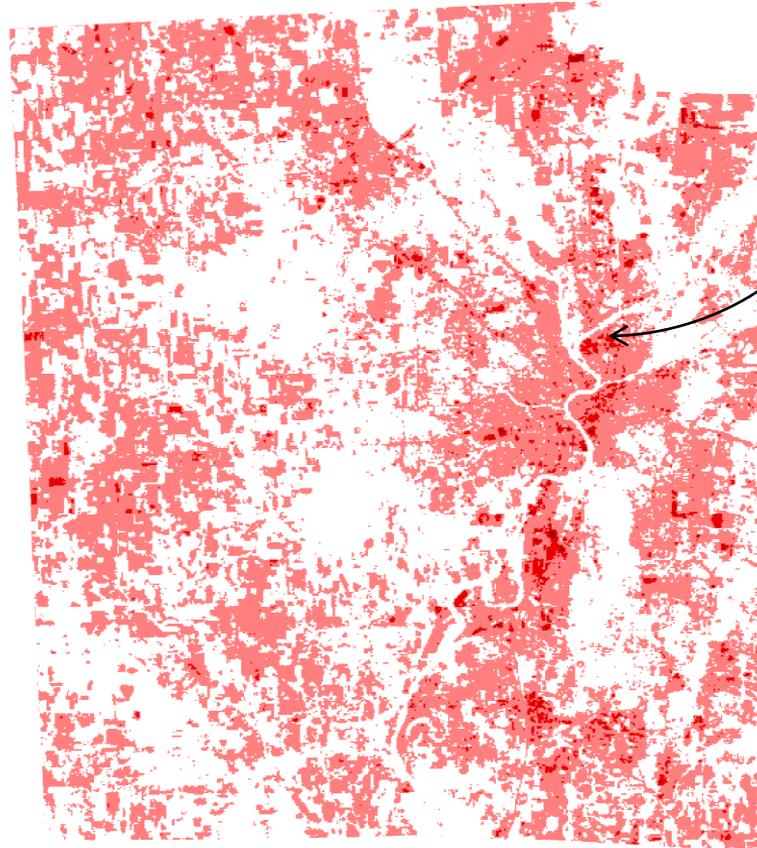
Current Systems



Developing Systems



The “Discontinuous” UHI



*The Micro-UHI
Effect (Dayton)*



Important Data Considerations

- Currently exploring downscaling MODIS to Landsat ETM+ and TM resolutions. Having varying levels of success...
- This will give us the ability to provide daily guidance to each city
- Re-calibrate on each “good” Landsat ETM+, Landsat TM, or ASTER as we can find it available or task the sensor?

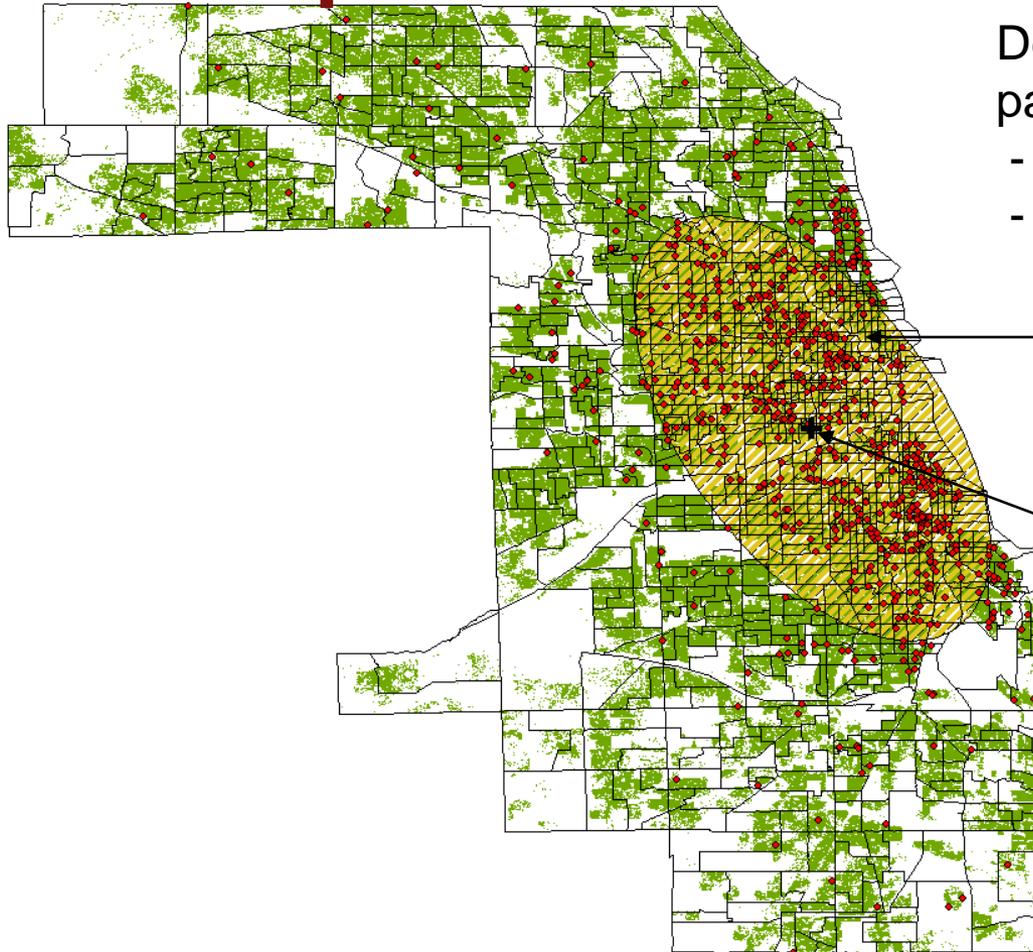
Important Data Considerations

- Use census socioeconomic data at the census tract/block group level
 - Minority populations, lower income, lower educational attainment, and aged population
 - Extract residential land use for population density calculation

Population Density
Calculated by **Area** of
Residential Land Use



Important Data Considerations



Death certificates collected for past analog events

- Geocode locations of mortality
- Further explore spatial distribution

1 SDE for Mortality

Mean Center of Mortality

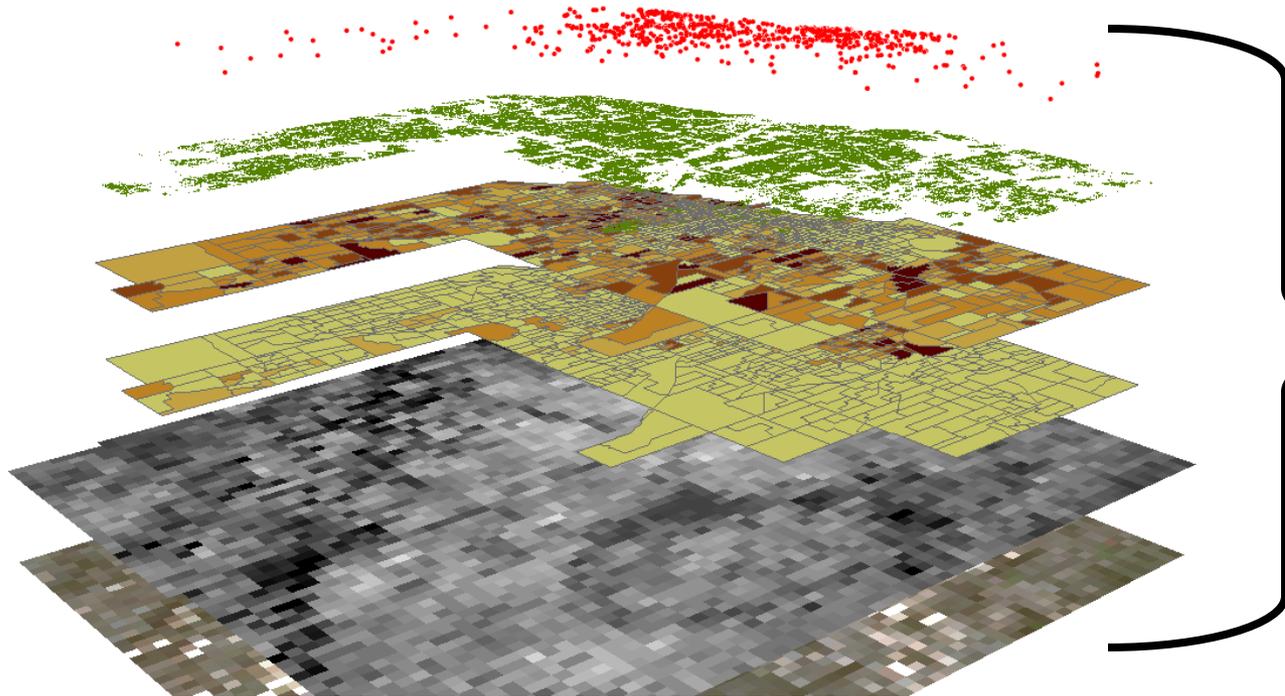
Mortalities have been randomly offset by 50-100 meters.



Issues with Census 2010 data

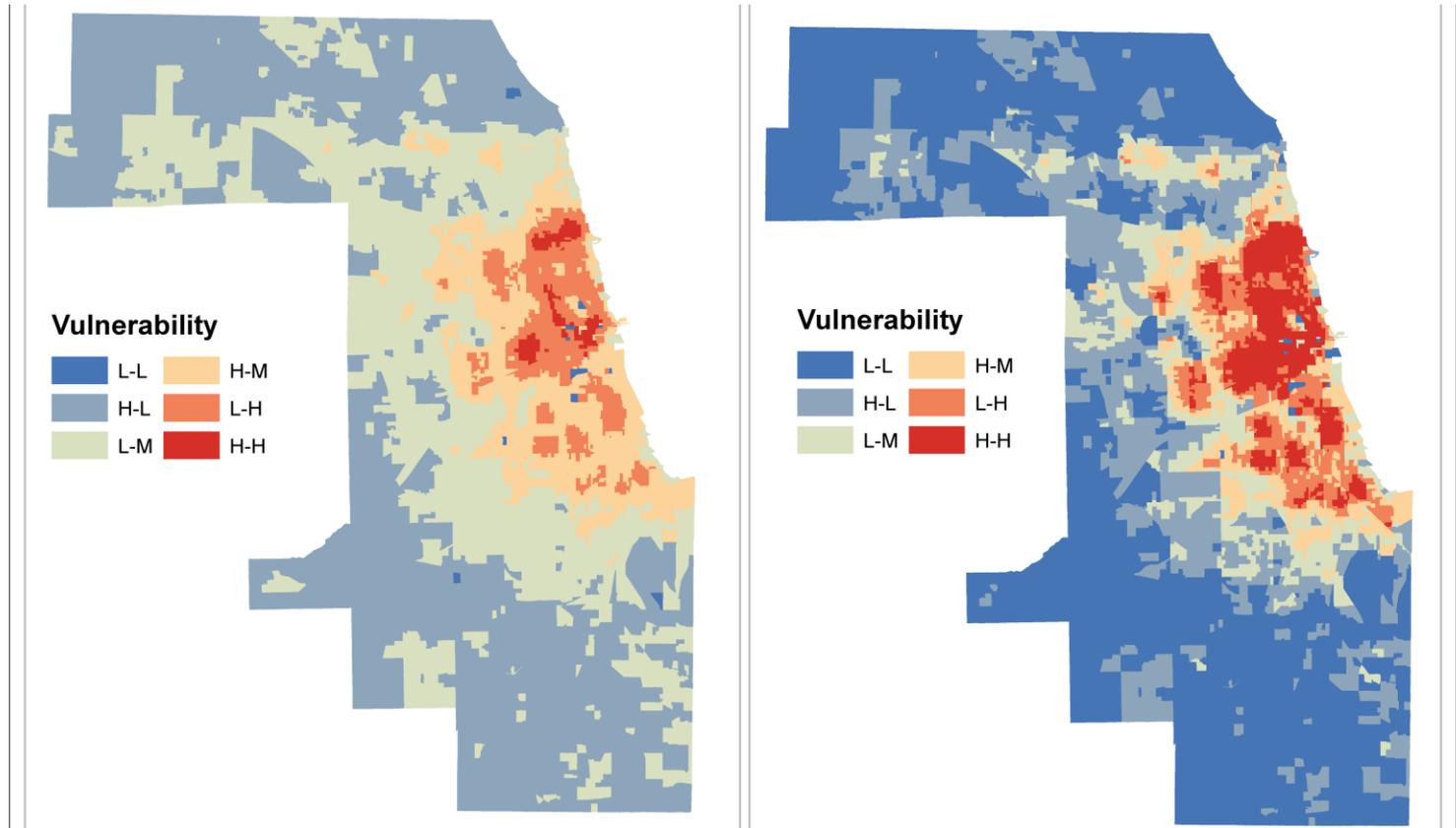
- This has slowed implementation
- 2010 data that is useful for our project is just now becoming available (Census Bureau estimated data would be available in June of 2011)
- Different variables for a few of the vulnerability indicators
- We will need to concatenate a few variables to overcome the discrepancies in the decadal census

Developing the Extreme Heat Vulnerability Index (EHVI)



**Risk to
Extreme Heat is
Hyper-dimensional**

Enhanced EHVI vs. EHVI





Community Outreach

- Series of focus groups for each city with appropriate organizations/personnel were conducted last fall
 - Dayton: September 10, 2010
 - Phoenix: October 5, 2010
 - Philadelphia: October 14, 2010



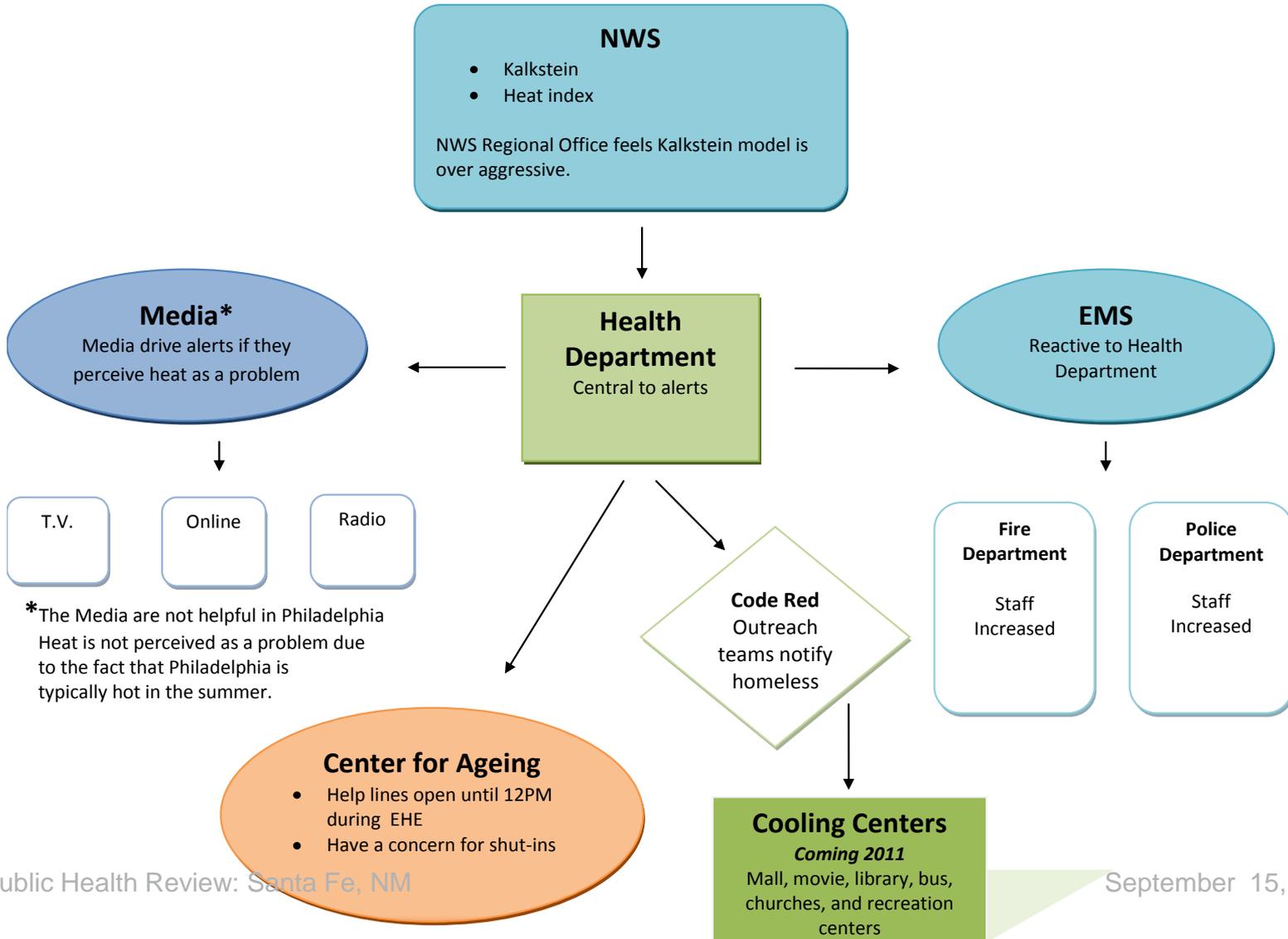
Community Outreach

- Dayton: 7 agencies / 18 participants
- Phoenix: 5 agencies / 15 participants
- Philadelphia: 5 agencies / 18 participants

- Beginning to reconsider our follow-up phone call surveys...



Philadelphia Response Flow Chart



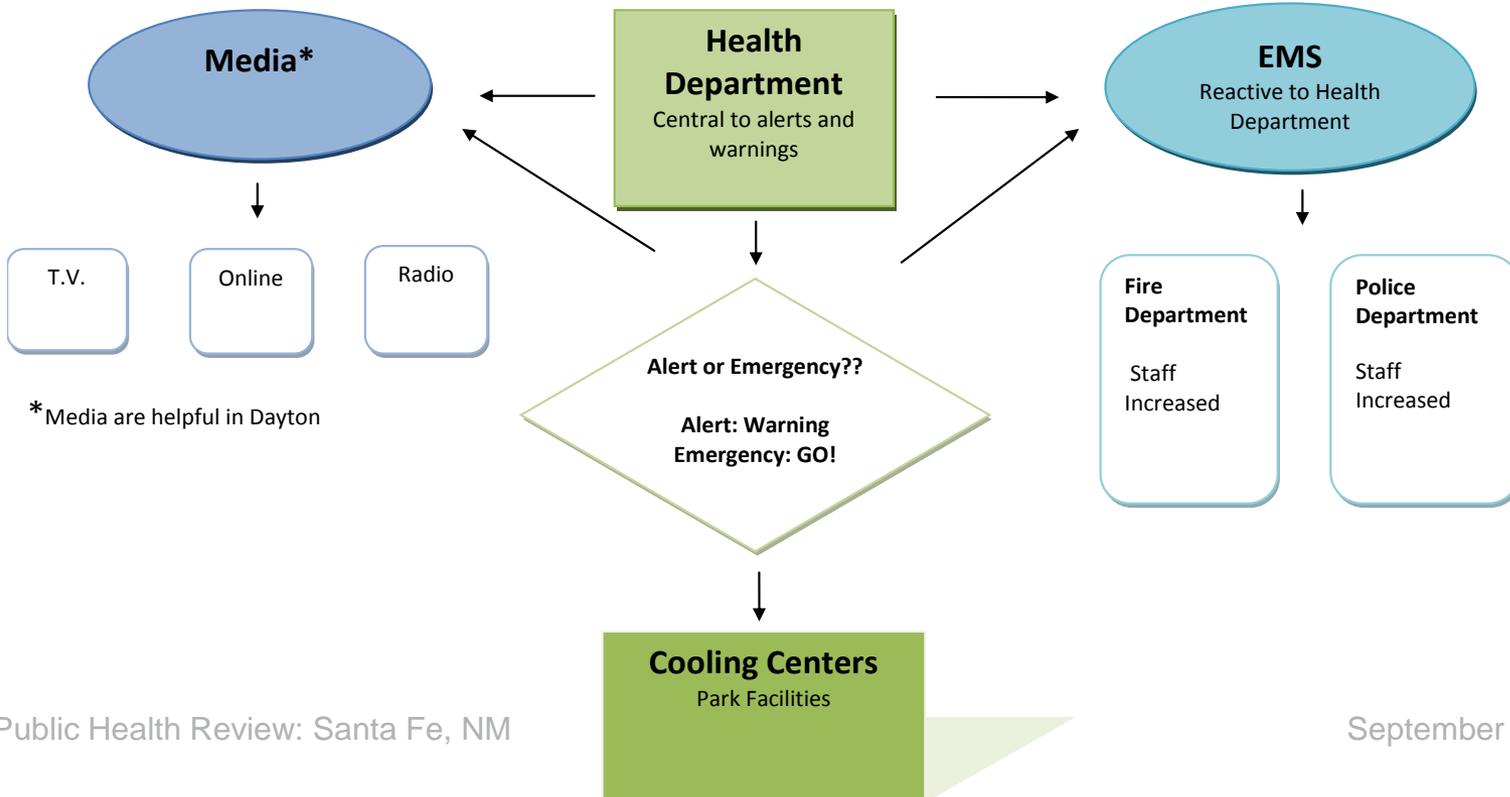


Dayton Response Flow Chart

NWS

- Temperature, Dew Point, and Heat Index based Models used
- Models Seven Day Outlook

Discrepancies between weather models among agencies create confusion as to when to issue an alert or emergency



*Media are helpful in Dayton



EHVI Tested with Neural Networks

- All outputs from 12-3-1 Multilayer Perceptron (MLP)[†]
- Different architectures need to be tried.
 - With different number of hidden nodes.
 - With different input variables.
 - Combination of both?
- Different networks need to be tried.
 - Self Organizing Maps (SOM)
 - This can also improve our EHVI

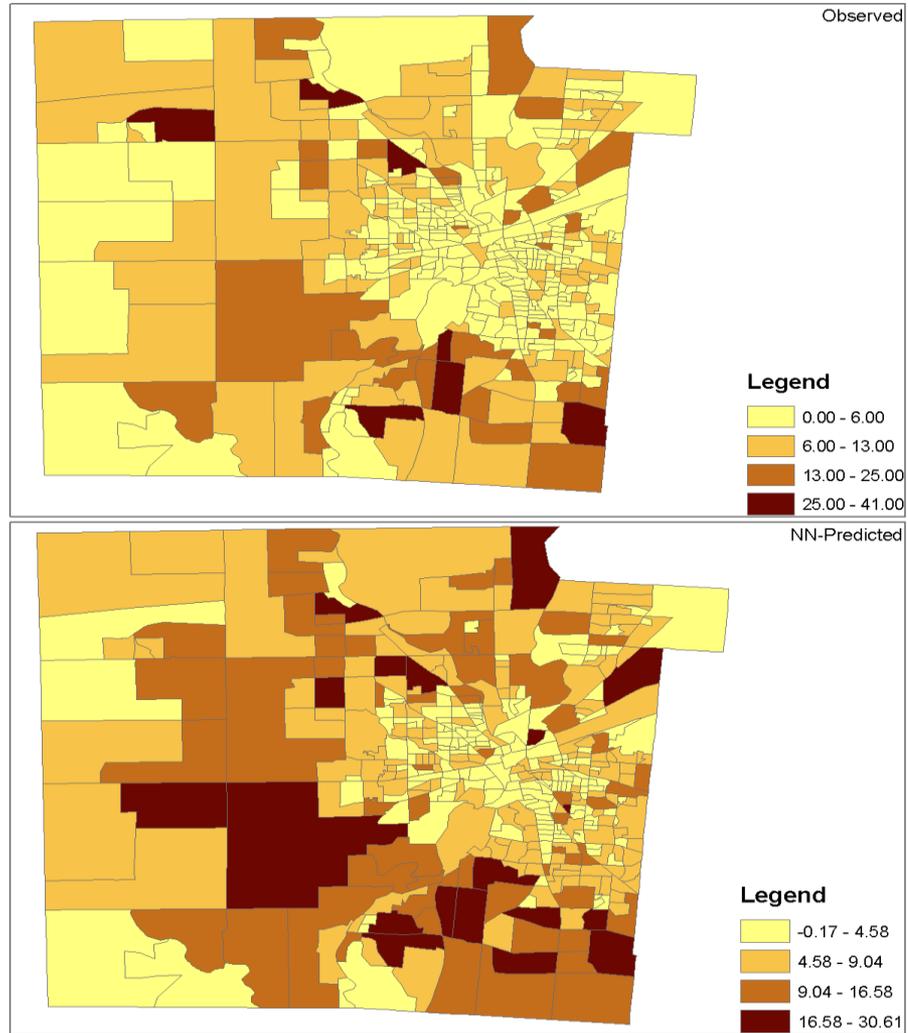
† Modern Applied Statistics with S (2002) by W. N. Venables and B. D. Ripley



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DAYTON (Block Groups)

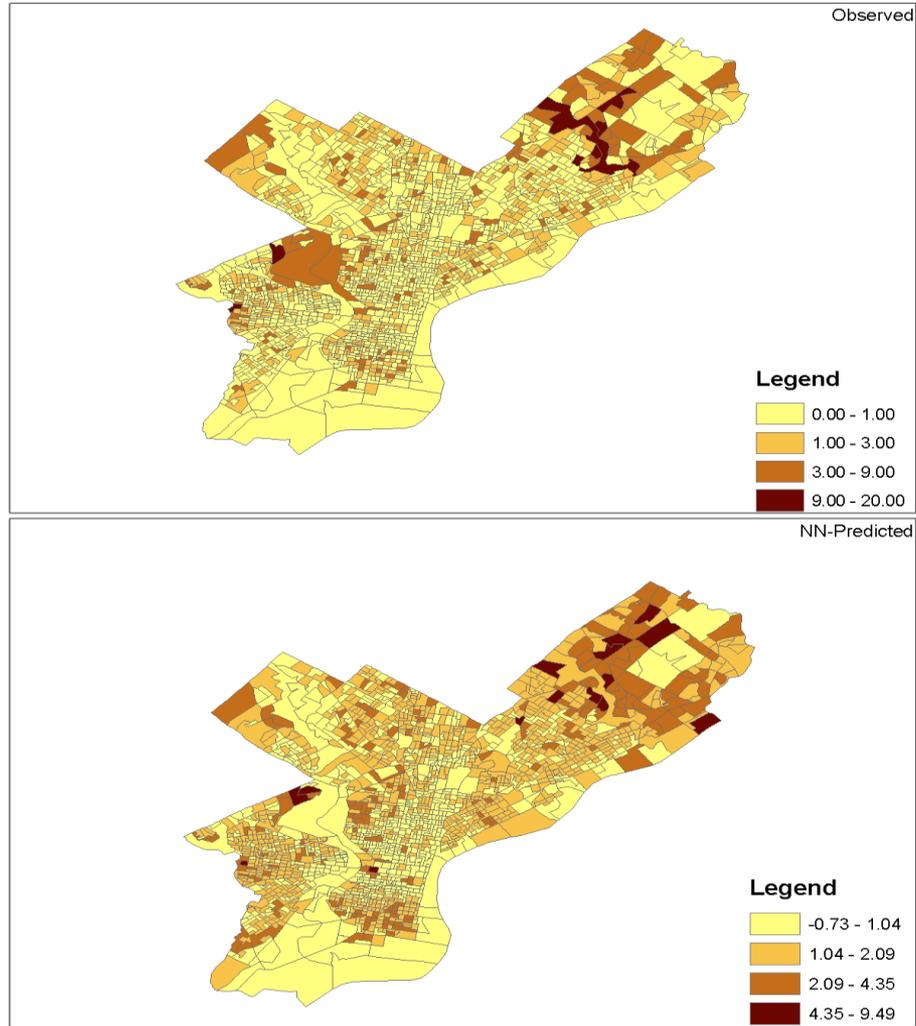




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PHILADELPHIA (Block Groups)

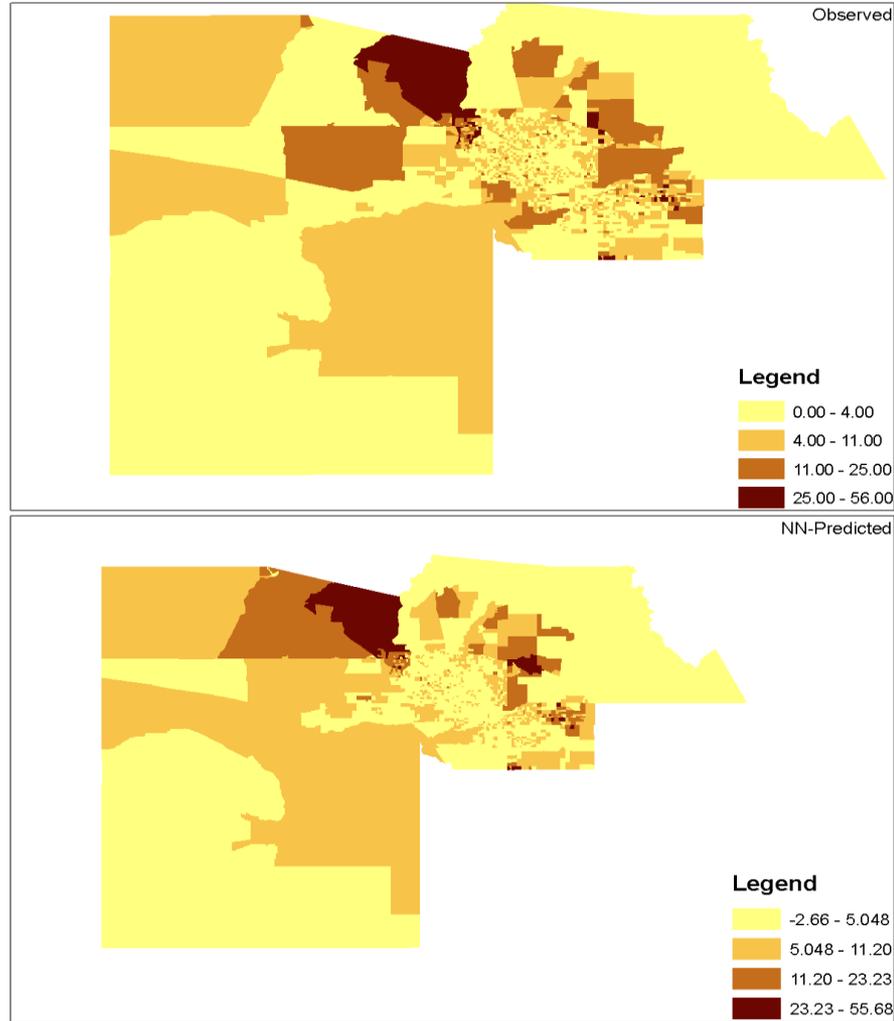




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PHOENIX (Block Groups)





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System and Interface Development

WEB-BASED SPATIAL DECISION SUPPORT SYSTEM



Extreme Heat Event Project

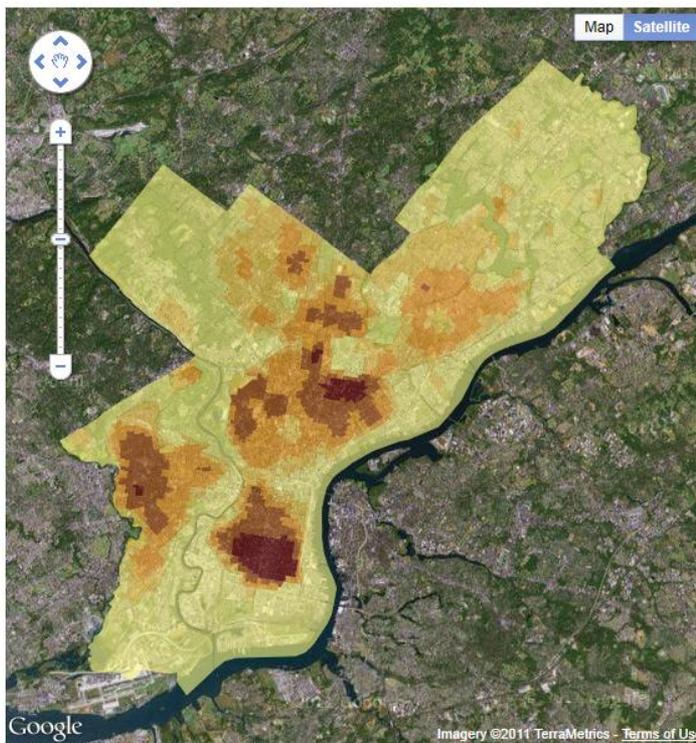
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Extreme Heat Event Project

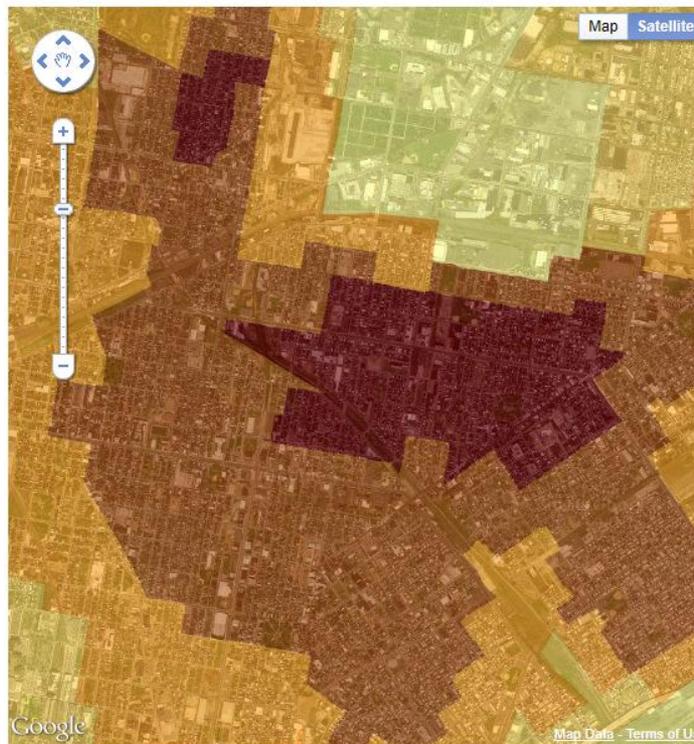
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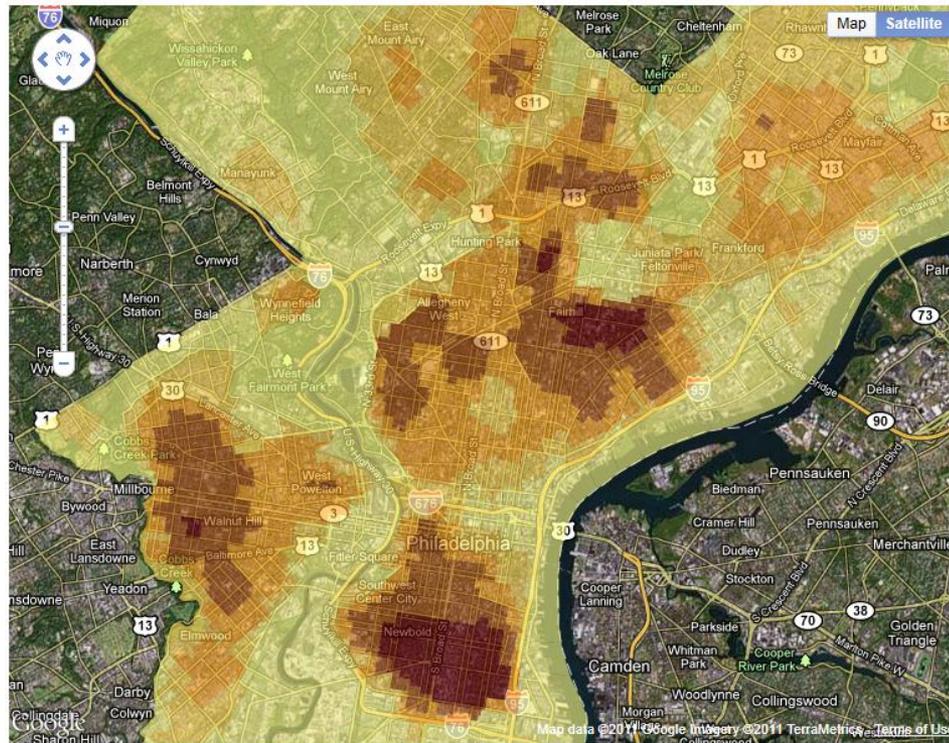
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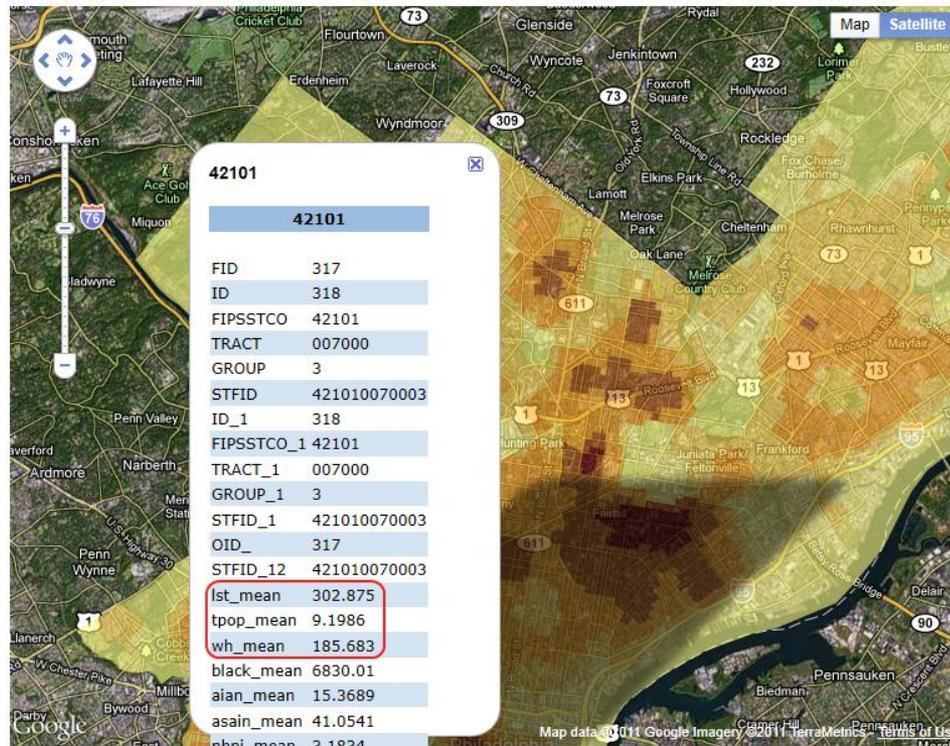
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Anticipated Improvement in Emergency Response Capacities

- Improved identification of the “hottest” areas of individual cities and the surrounding municipalities.
- Time-Distance information from central emergency response locations to the most vulnerable areas within a city. *Some cities want this some don't...*
- Intelligence-led location of cooling centers?



Anticipated Improvement in Emergency Response Capacities

- Improved identification of locations that are particularly vulnerable
- Improved ability to mitigate the health-related impacts. Especially, when coupled with currently developing heat-health communication toolkits.
<http://www.bt.cdc.gov/disasters/extremeheat/>
- Improved communication of events to especially vulnerable individuals/communities



Anticipated Activities for Coming Year

- Continue contact with focus group participants and actively search for needed participants. We are planning some webinars later this year/early next for training and further enhancement
- Implement the ensemble of models and begin full implementation in each city
- Collect mortality data for this past summer; further enhance interface for model re-runs



Anticipated Activities for Coming Year

- Continue work on MODIS downscaling for daily guidance in each city
- Explore new cities that would be very good test areas for spatial expansion of the system (Indianapolis, Chicago have already been identified, NYC, Oklahoma City are future possibilities)
- Explore expansion spatially to statewide system...
- Performance measures for activities...



Publicity (in addition to research publications)

- Our project has been on FOX and NBC affiliates in Indiana in summer 2010 and 2011. (They found us!!!)
- Live radio interviews
- Multiple newspaper articles
- We plan a more aggressive press release initiative with each of our cities before the heat of next season which will highlight our system



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A Special Thanks to My Collaborators

Indiana University:

Dr. Vijay Lulla, Ph.D.

Jeremy Webber, MS Cand.

Austin Stanforth, MS

CDC:

Dr. George Lubber, Ph.D.

Natasha Prudent, MPH

Marilyn DeSirios, Ph.D.

NASA Marshall:

Dr. Bill Crosson, Ph.D.

Dr. Dale Quattrochi, Ph.D.

Dr. Mohamad Al-Hamdan, Ph.D.

Sue Estes, MS

Maury Estes, MS

Sarah Hemmings, MS