Communicating heat-health vulnerability in preparation for heat events:

Development and Assessment of the Internet-Based Heat Evaluation and Assessment Tool (I-HEAT)

Kathryn Conlon, MPH
Susan Maxwell, PhD
Robert Rommel
Natalie Sampson, MPH
Geoffrey Jacquez, PhD
Marie O'Neill, PhD

BioMedware
Geospatial Research and Software

M SPH

Heat and Health

- Heat leading cause of death due to weather
- Vulnerable populations
  - "Capacity to be harmed" (National Research Council)
  - Individual characteristics
  - Community characteristics
- Adverse health outcomes are preventable

Heat Health Preparedness

- To improve communication of population-level factors that contribute to heat-health vulnerability for emergency planning and response purposes

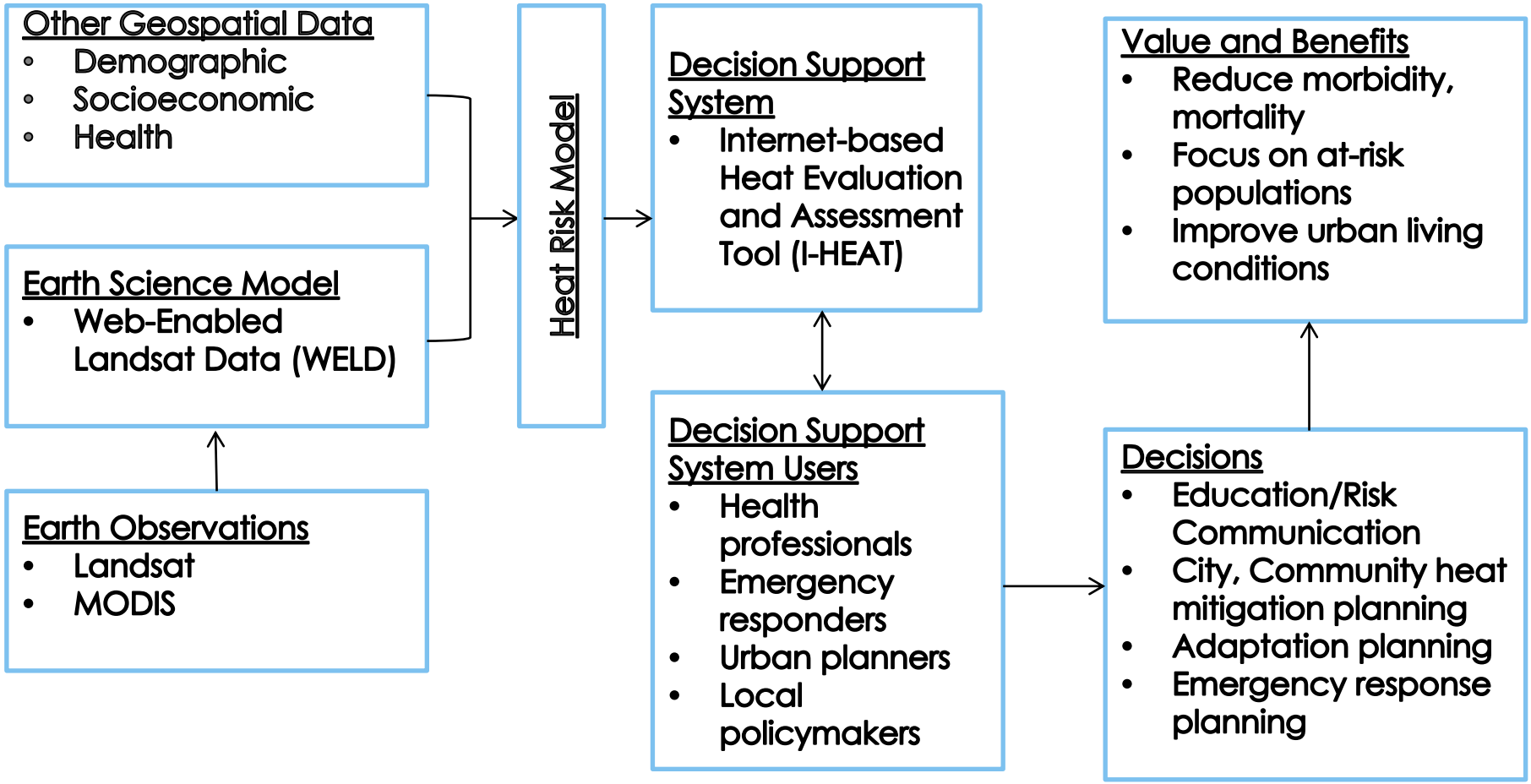
Heat Health Preparedness

- Urgent need for effective mapping, modeling tools for health organization use
- Innovative, advanced software tools to improve capability to mitigate, respond to heat events

Internet-based Heat Evaluation and Assessment Tool (I-HEAT)

- **Objective: Evaluate the feasibility of integrating multi-scale remotely sense imagery, demographic and health data in internet-based software to enable health professionals to rapidly identify populations at risk from extreme heat events.**
  - **Funded by U.S. National Aeronautics and Space Administration**
  - **Data inputs compiled with support from U.S. Centers for Disease Control and Prevention, U.S. Environmental Protection Agency**

Conceptual Framework



Mapping Community Determinants of Heat Vulnerability

Colleen E. Reid,[1,] Marie S. O'Neill,[2] Carina J. Gronlund,[2] Shannon J. Brines,[3] Daniel G. Brown,[3] Ana V. Diez-Roux,[2] and Joel Schwartz[4]*

VOLUME 117 | NUMBER 11 | November 2009 • Environmental Health Perspectives

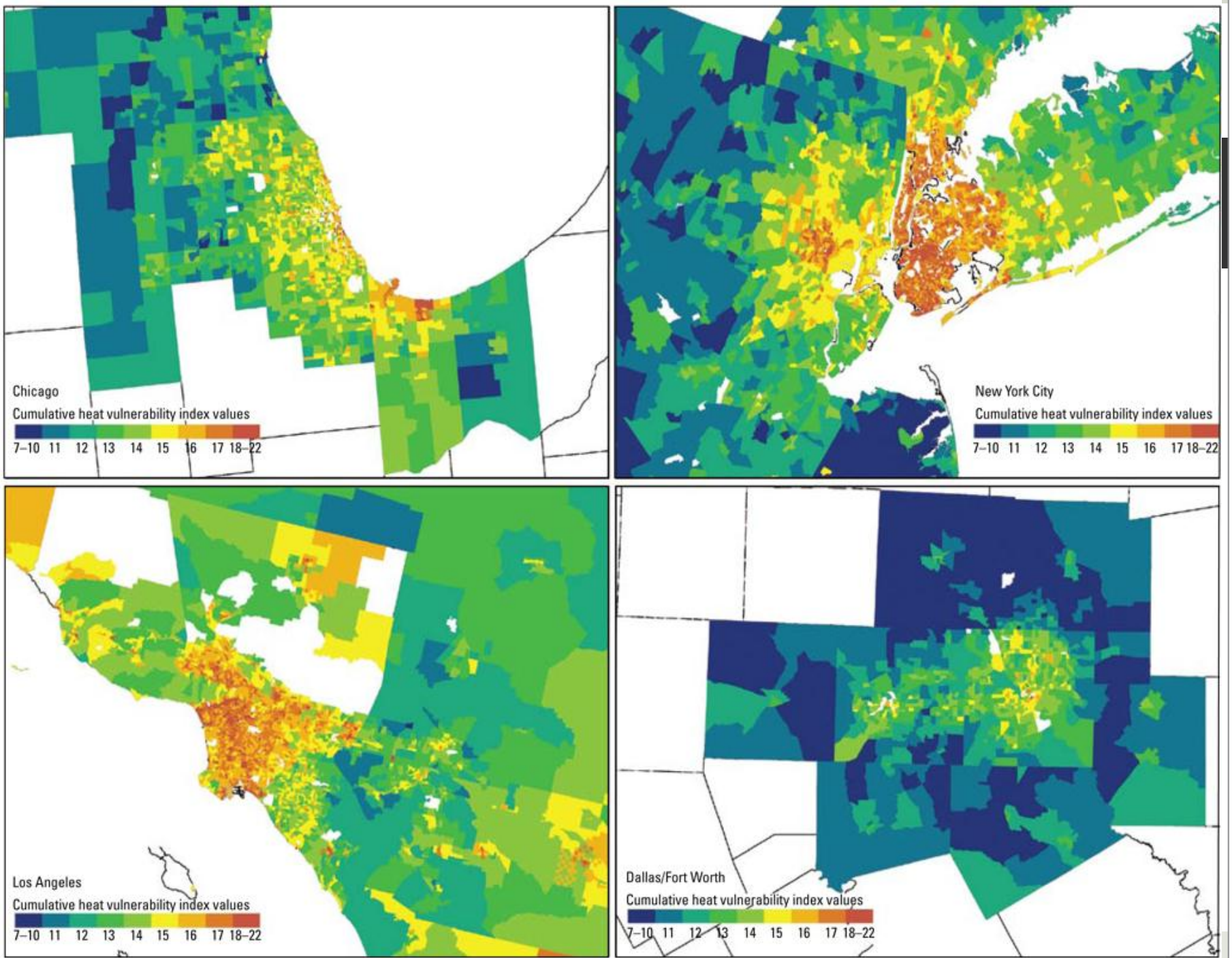
Data

- Heat Vulnerability Index
  - Place-based
  - Populations not equally vulnerable to effects of heat
  - Successful interventions need to know ***WHERE*** to find vulnerable populations

Category	Data Source (year)	Variable Definition
Demographic variables	US Census (2000)	Percent population below the poverty line
		Percent population with < HS diploma
		Percent populaiton, non-white
		Percent population living alone
		Percent population ≥ 65 years
		Percent population ≥ 65 years, living alone
Land cover	National Land Cover Database (2001)	Percent census tract area not covered in vegetation
Diabetes prevalence	Behavioral Risk Factor Surveillance System (2002)	Percent population ever diagnosed with diabetes
Air conditioning	American Housing Survey (2002)	Percent households without any central AC
		Percent households without any AC

*adapted from Reid et al., 2009

Computed Factor	Description
Factor 1	Social/Environmental Vulnerability
Factor 2	Social Isolation
Factor 3	Lack of AC
Factor 4	High Proportion of Elderly with Diabetes


Chicago
Cumulative heat vulnerability index values
7–10 11 12 13 14 15 16 17 18–22
New York City
Cumulative heat vulnerability index values
7–10 11 12 13 14 15 16 17 18–22
Los Angeles
Cumulative heat vulnerability index values
7–10 11 12 13 14 15 16 17 18–22
Dallas/Fort Worth
Cumulative heat vulnerability index values
7–10 11 12 13 14 15 16 17 18–22

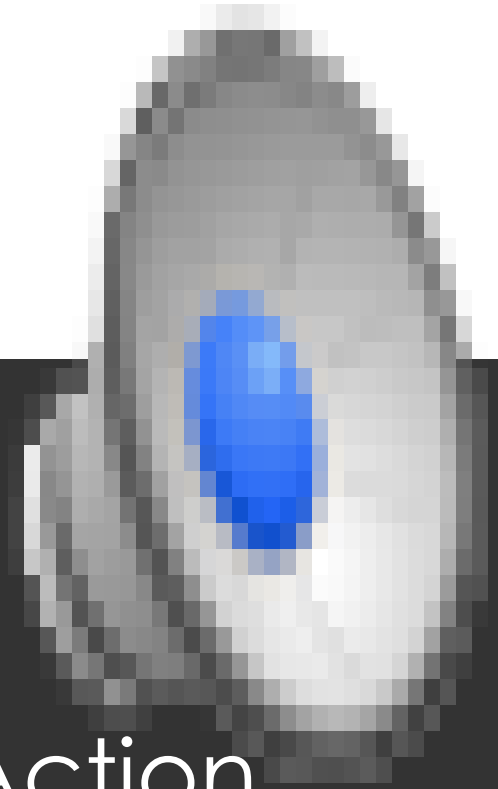
Data

- Temperature data
  - Landsat 5
  - Local surface temperature (120 meters), temporal repeat cycle 8-16 days)
- Vegetation
  - Normalized Difference Vegetative Index (from satellite imagery)
- Demographic data
  - 2000 Census

- "At-risk" (R) calculation:
  - R = f(D,E)
    - (D = demographic, E = environmental)
  - R = (x)(T) + (1-x)*HVI
  - T = temperature, rescaled 0 -1
  - HVI = Heat Vulnerability Index
  - x = relative weight of temperature and HVI

Software

- Ideally suited for representation, visualization and analysis of spatial patterns
- Web-based tool → ideal for collaborations
- Secured environment
- Supports:
  - Street map view
  - Satellite imagery
- Tabs:
  - "At-Risk" Areas
  - Temperature
  - Demographics
  - Vulnerability
  - About



I-HEAT in Action

Case Study – Detroit, Michigan

- **Our goal:** test the prototype tool as a case study, evaluating tool utility among users from local health departments, local community organizations, and city policymakers.

- **Detroit**, **Michigan**
  - Lacks heat wave warning system
  - Known disparities in heat exposure, heat-related health effects
  - Prior University of Michigan research in Detroit
    - Quantified heat risk perception
    - Identified prevention, intervention programs
    - Collaborated with residents, local government officials, community leaders

I-HEAT Workshop

"Heat & Health in Michigan: An Interactive Workshop on the Development of Risk Assessment Resources" May 2, 2012

- Organized with Michigan academic and government partners
- Participants:
  - State agencies
  - Local health departments
  - Emergency preparedness agencies
  - Academic institutions
  - Community-based, non-profit organizations
- 12-Question survey
- Semi-structured focus group

User Feedback

Participant Satisfaction with I-HEAT Data, Appearance, and Performance (n=22)

	Mean (SD)
Data types (e.g., temperature, vulnerability, demographics) decision-makers can select to view	3.86 (0.64)
User-friendliness of web interface (5 = easy to use, 1 = too complicated)	3.64 (1.09)
General appearance of web interface	4.09 (0.68)
Graphics of application (e.g., map output)	3.86 (0.79)
Performance (speed) of application	2.65 (1.11)

Possible responses: Extremely unsatisfied "1", Unsatisfied "2", Neither satisfied or unsatisfied "3", Satisfied "4", Extremely satisfied "5"

User Feedback

Participant Mean Likelihood of Using I-HEAT (n=20)

	Mean (SD)
Data types (e.g., temperature, vulnerability, demographics) decision-makers can select to view	3.71 (0.90)
If suggested improvements were addressed, how likely are you to use I-HEAT software if it were available for your region?	4.18 (0.61)

Possible responses: Extremely unlikely "1", Unlikely "2", Not sure "3", Likely "4", Extremely satisfied "5"

User Feedback – Future Updates

- Improvements needed on:
  - Performance
  - Terminology
    - "At-risk"
    - "Vulnerability"
  - Data updates
    - Heat vulnerability index
    - Temperature
    - Local inputs
  - Explicit mitigation/adaptation potentials

Acknowledgements

- NASA Contract: NNH11CD21C
- CDC R18EH000348
- EPA 832752010

- Robert Rommel
- Geoffrey Jacquez
- Susan Maxwell

- Marie O'Neill
- Natalie Sampson