



National Institute of Environmental Health Sciences
Your Environment. Your Health.

Population Scenarios for Modeling Health Impacts of Climate Change

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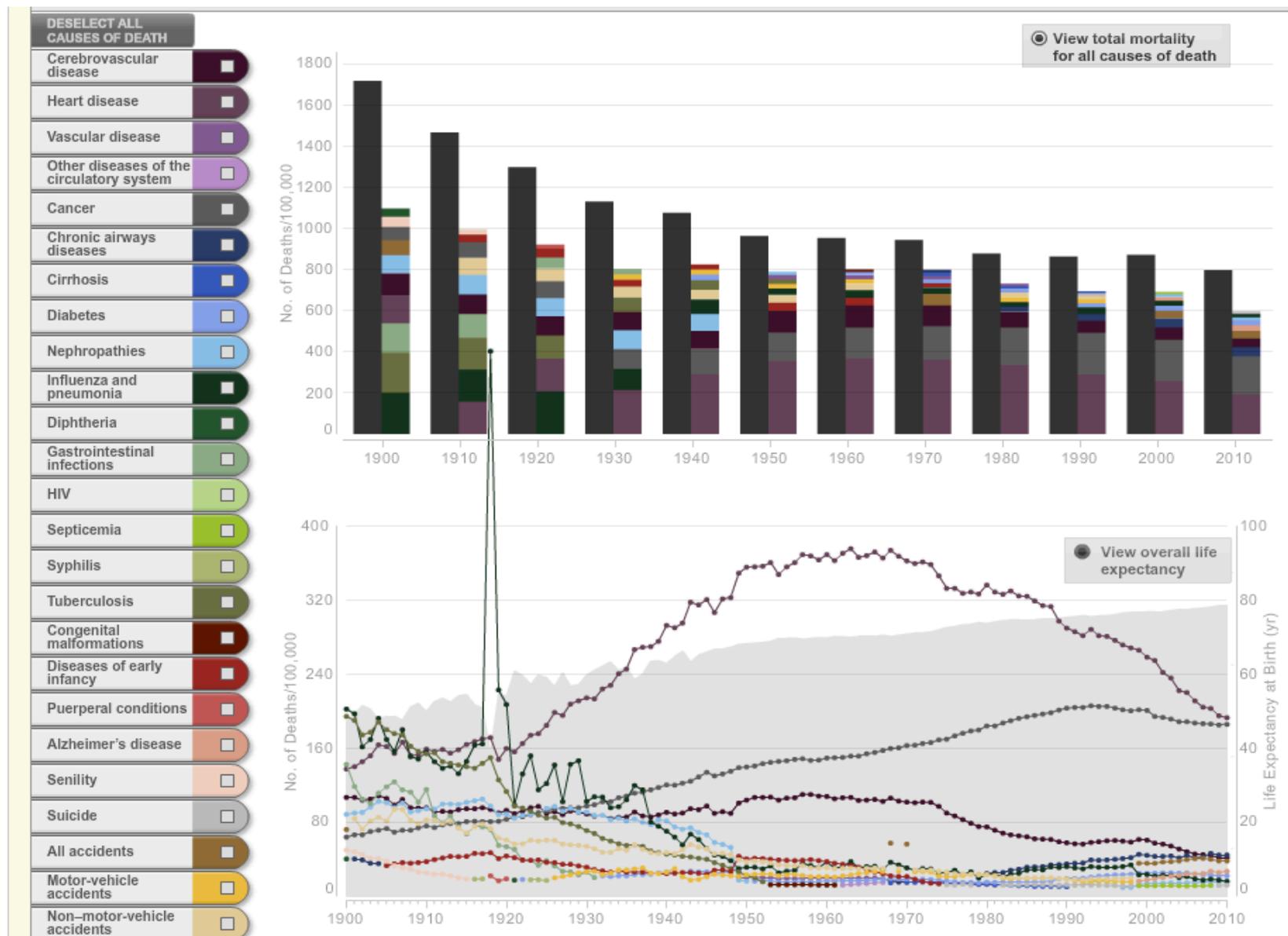
Populations Scenarios Workshop
Washington, DC
June 23, 2014



Population Scenarios--1914

- Urbanization, crowding, setup for infectious diseases and pandemics?
- Technological advance, soaring GDP, individual wealth, social disparities?
- Climatic change, economic collapse, poverty, famine, population displacement?
- Industrialization, resource conflicts, large-scale warfare, food shortages?

Changing Burden of Disease in the US, NEJM 2012

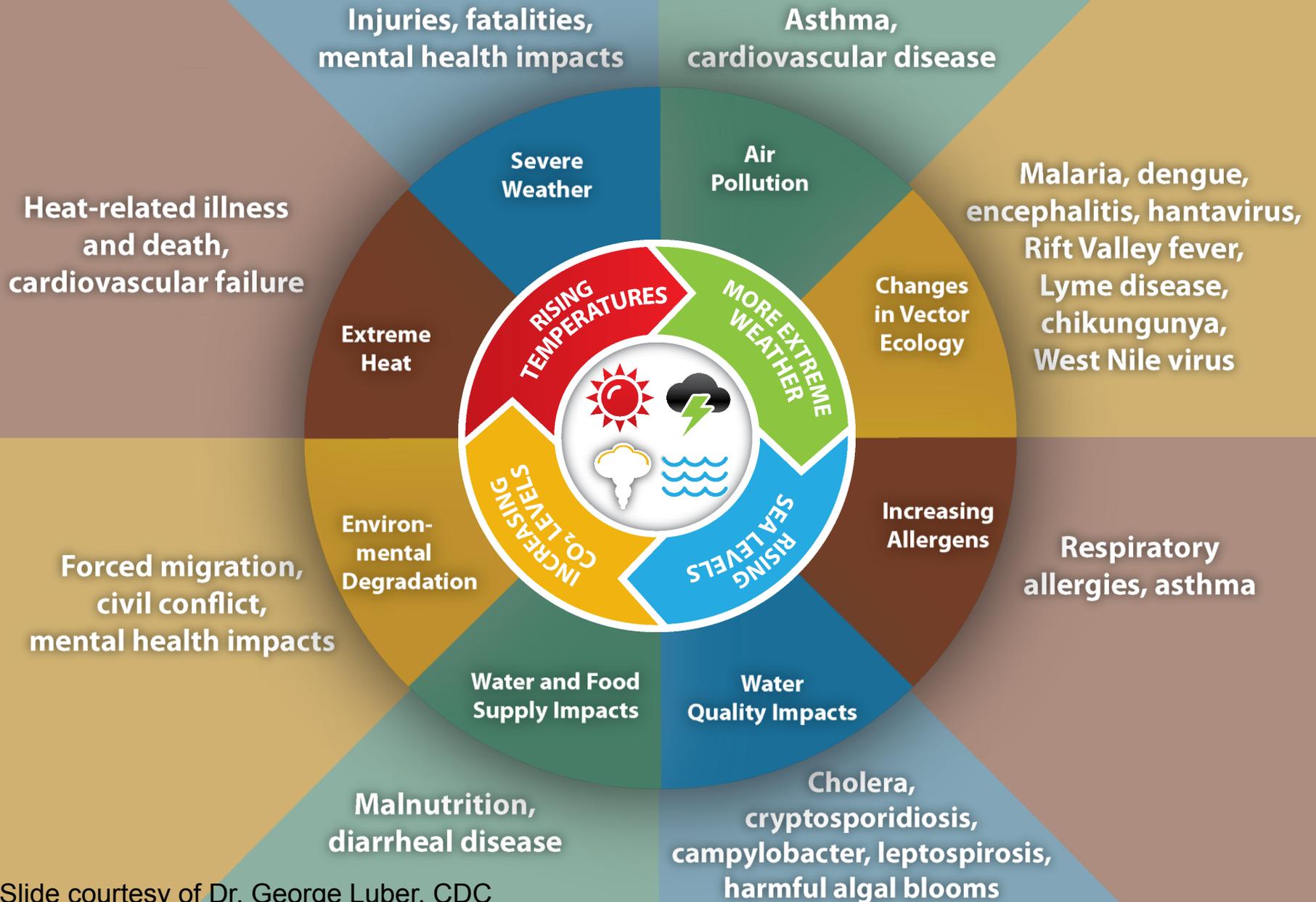




**The future ain't what it used to
be...**



Impact of Climate Change on Human Health



What are some of the questions “health folks” ask?

- How will future heatwaves affect deaths and hospitalizations from heart, lung, kidney disease?
- How will heat and altered winds, etc. affect air pollutant concentrations?
- How will changes in tick or mosquito populations affect disease rates?



The simple equation

$$\textit{FutureRisk} = \textit{FuturePopulation} * \textit{FutureExposure} * \textit{FutureDose Response}$$

The complex challenges

- Dose Response- statistical relationship between measures of exposure and measures of disease
 - Often a relative risk- requires projected disease incidence
 - How does the literature address subpopulations or modifying factors?
 - How will “hidden” drivers change over time and are they accounted for?
- Future Exposure
 - What are the time and spatial scales of primary exposure parameters?
 - Secondary exposures and modifiers?
- Future Population
 - Do temporal, spatial scales, racial/ethnic, SES, demographic breakdowns match dose response literature?

Climate Change and Impacts on Human Health

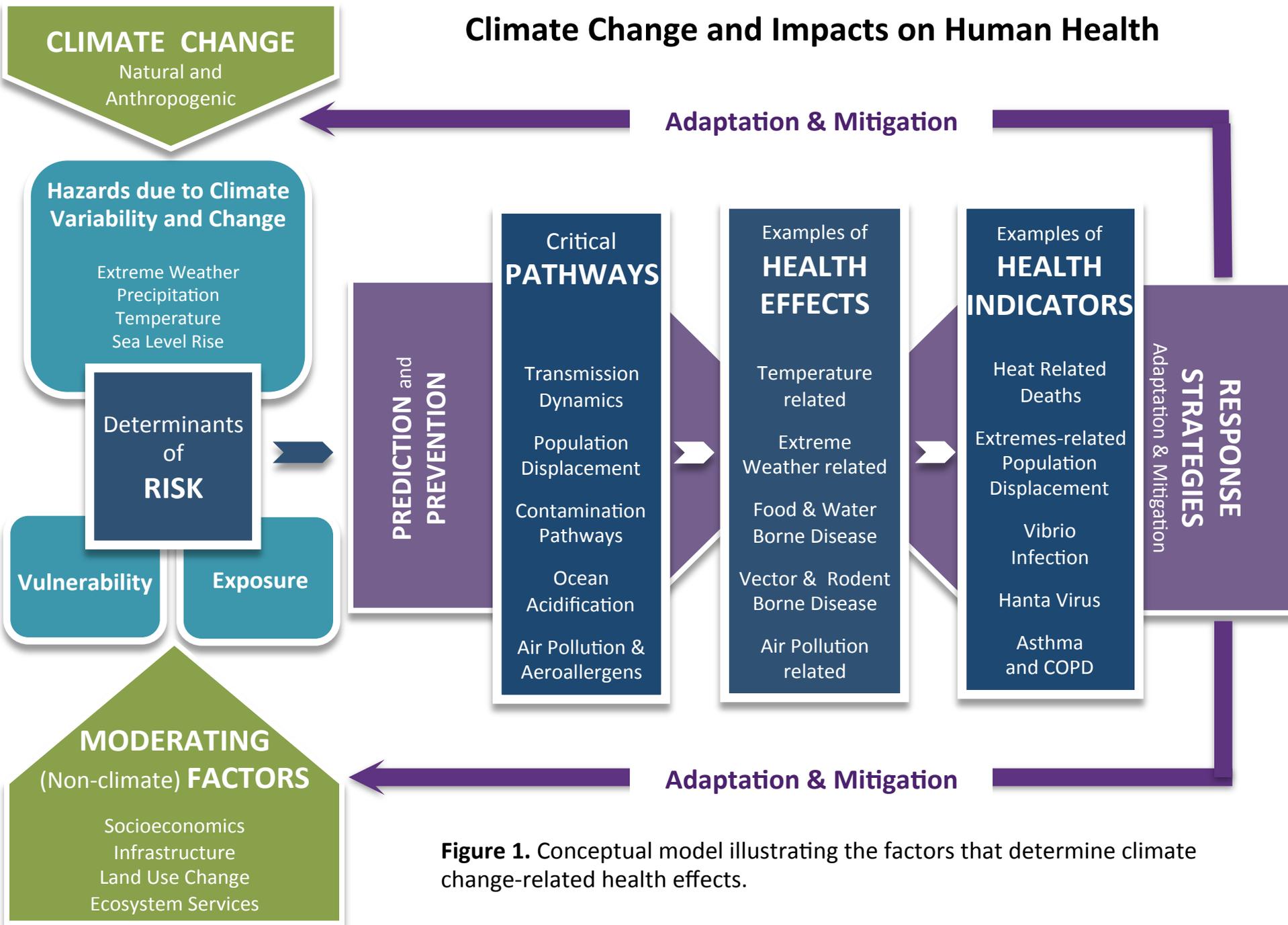


Figure 1. Conceptual model illustrating the factors that determine climate change-related health effects.

Climate Change and Health Indicators associated with Extreme Heat

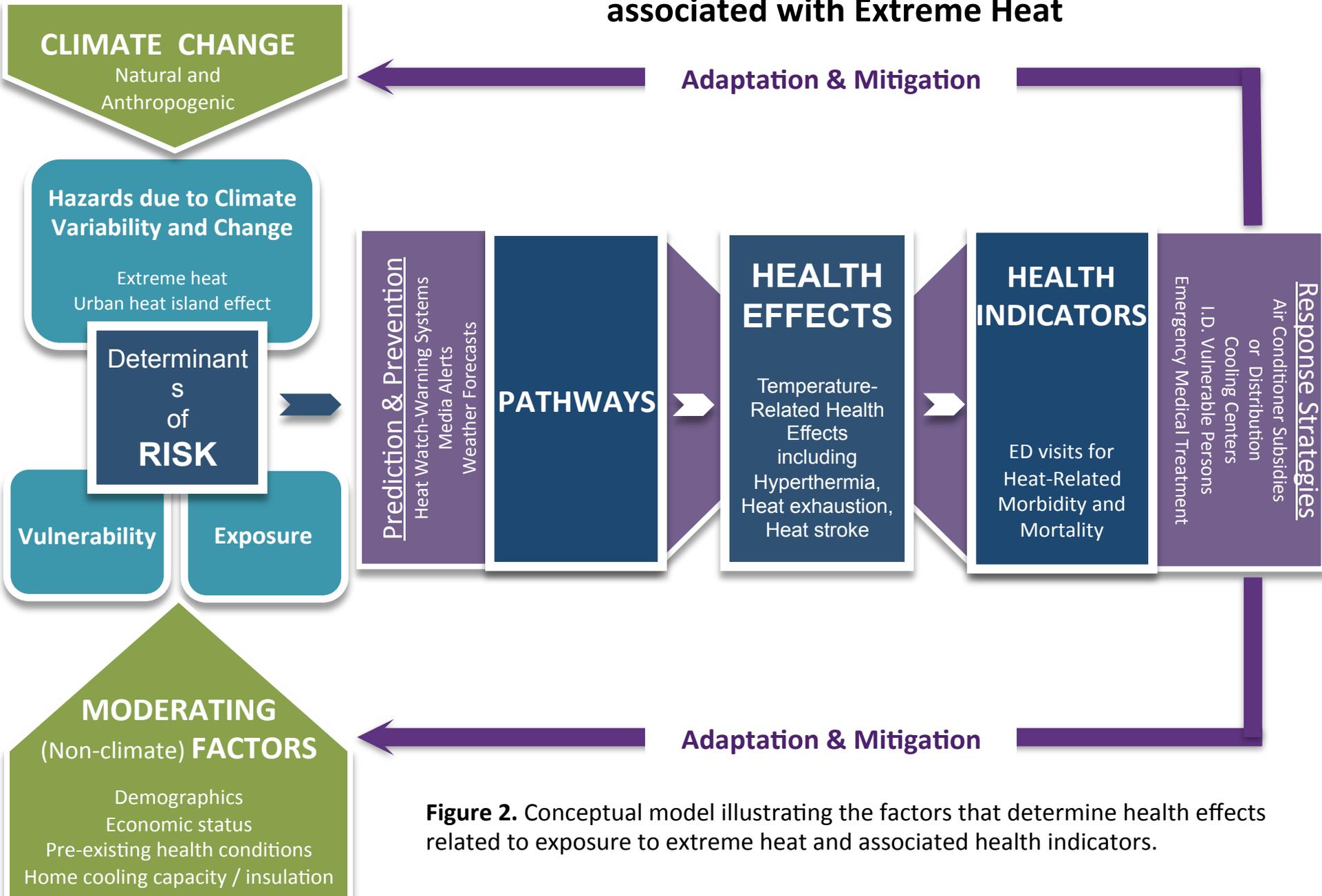


Figure 2. Conceptual model illustrating the factors that determine health effects related to exposure to extreme heat and associated health indicators.

INTERIM ASSESSMENT REPORT ON HUMAN HEALTH:

- **An Interagency Product**

coordinated by the Interagency Workgroup on Climate Change and Human Health (CCHHG) and written by federal experts (NIH, CDC, NOAA, EPA, others), with contractor support

- **A Scientific Assessment**

of existing research on the impacts of observed and projected climate change on human health in the United States, with a strong focus on impact quantification

- **An Interim Report**

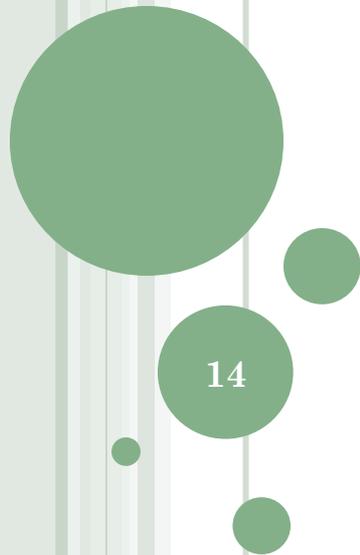
with an estimated publication date in late 2015 – after the Third NCA and before the Fourth NCA. It will build upon current draft NCA and 2008 US CCSP climate and health-focused SAP 4.6.

- **A Product with High Visibility**

USGCRP agencies and INCA identified climate impacts on human health as a high priority topic for a Special Report.. The report is featured in the President's Climate Action Plan and would be considered a Highly Influential Scientific Assessment (HISA) by OMB peer review guidelines.

TIMELINE

| MILESTONE | PROPOSED TIMEFRAME | RESPONSIBILITY |
|---|---------------------------|-----------------------|
| Federal Register Notice | Feb 7, 2014 | CCHHG, USGCRP |
| Public Forum | Mar 13, 2014 | USGCRP, EPA |
| Develop Final Author Team and Finalize Report Outline | Apr 2014 | CCHHG |
| Second Workshop | Summer 2014 ? - TBD | EPA |
| Deadline for Sci. Literature Contribution | Oct 31, 2014 | Authors |
| Draft Key Messages | Nov 2014 | Authors |
| 1st Draft Complete | Jan 2015 | Authors |
| Peer Review | Feb- Apr 2015 | CCHHG Agencies |
| Public Review Draft Complete | May 2015 | TBD |
| Public Review | May-July 2015 | Authors, CCHHG |
| Draft Final Complete | Aug 2015 | CCHHG/USGCRP |
| Internal Agency Reviews | Aug-Sept 2015 | Authors |
| Clearance Review | Oct 2015 | CCHHG/USGCRP |



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MODELING TEAM CALL

**Interagency Special Report on the Impacts of Climate
Change on Human Health in the United States**

May 28th, 2014

TECHNICAL GUIDANCE ON CHAPTER PREPARATION: SOCIOECONOMIC SCENARIOS

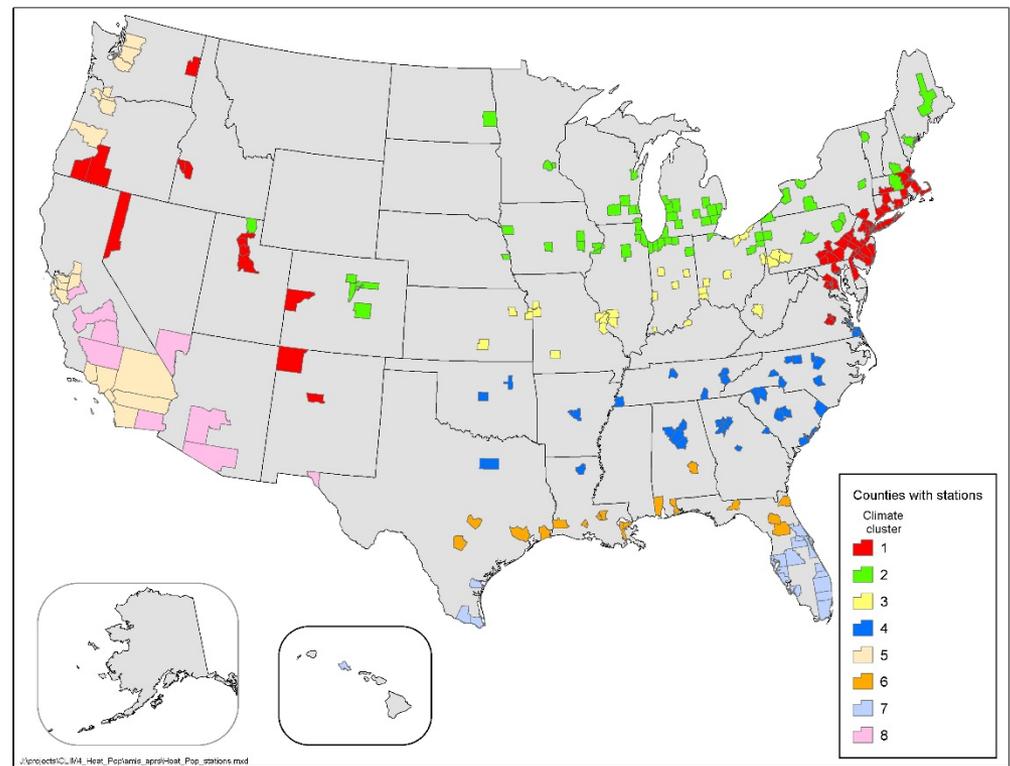
- The “Shared socio-economic pathways” (SSPs) are the socioeconomic complement to the RCP/CMIP climate scenarios
 - There are 5 general SSP narratives that include quantification of population (age, sex, education), urbanization, and economic development
- It is expected that these SSPs will be widely used in the next several years by the climate community and, therefore, are relevant to the development of climate assessments in the present.
- EPA’s Global Change Research Program has developed an Integrated Climate and Land Use Scenario tool (ICLUS)
 - Provides geographically resolved projections by gender, age, and ethnicity
 - ICLUS projections exist for the SRES scenarios, but not yet for the SSPs
- **Chapter Guidance is to use the ICLUS-A1B scenario as a primary input, with B2 as a sensitivity analysis, resources permitting**

QUANTITATIVE CASE STUDY FOR HEAT-MORTALITY PROJECTIONS

- Quantify the premature deaths in 100+ cities across the continental U.S. due to future climate-induced changes in extreme heat events
- Analytical approach:
 - Derive relative risk mortality estimates by month of the year from historical relationships in climate-based city clusters, using non-linear spline analysis, with a lag analysis of up to 5 days.
 - Use meta-analysis to determine relationship of mortality with age, gender, and other EJ characteristics where relationships are statistically significant. Use similar approach for air conditioning or other adaptation characteristics.
 - Apply to future climate scenarios drawn from CMIP5 ensemble, using simple statistical downscaling to match gridded model-based temperature to observed historical temperatures at the same weather stations used for the risk mortality derivations.

HEAT MORTALITY ANALYSIS CONSIDERATIONS

- Population analysis:
 - Which categories in ICLUS will match historical data metanalysis?
 - How to address population characteristics not included in ICLUS (e.g., air conditioning prevalence, income)



AIR QUALITY IMPACTS: METHODS

- Quantify ozone (and perhaps $PM_{2.5}$) related premature deaths and illnesses
- Details of new model simulations
 - 3 base (1995-2005) and 3 future (2025-2035) meteorological years to account for interannual variability
 - All simulations will utilize 2030 anthropogenic emissions from the Tier-3 final rule
 - Climate models: global GISS Model E2 and regional WRF 3.2.1, RCP 6.0 scenario
 - Photochemical air quality model: CMAQ v5.02
 - Benefits tool: BenMAP-CE 1.02 configured with ICLUS population projections

What are the “needs”?

- Population projections at fine demographic and spatial scales
- Population projections linked to key SES indicators
 - ICLUS an excellent base
 - Some more relevant to health- A/C, outdoor work,
- Science advancement for other health impacts
- Decisions based framework for SES scenarios
 - “What-if’s” linked to critical decisions
 - Coastal retreat, energy investments, social safety net

Conclusions

- Modeling of health impacts of climate change is in its formative stages
- Interim assessment report will help identify modeling gaps and needs
- Initial approaches for heat and air pollution using ICLUS, generating fine scale demographic/racial/ethnic projections
- Many research gaps for other health impacts



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Thank you!



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National Toxicology Program
U.S. Department of Health and Human Services



<http://www.niehs.nih.gov/geh>

<http://www.globalchange.gov/health-special-report>

