

# Final Prospectus for the Impacts of Climate Change on Human Health in the United States: A Scientific Assessment

10/8/2014

## I. Overview

As part of the President's Climate Action Plan and ongoing efforts within the U.S. Global Change Research Program (USGCRP), the Interagency Crosscutting Group on Climate Change and Human Health (CCHHG) and a subset of the Interagency National Climate Assessment Working Group (INCA) Final This data-driven technical synthesis and assessment will be an interagency product of the USGCRP, organized by the CCHHG.

The USGCRP Climate and Health Assessment will be an evidence-based, quantitative assessment of observed and projected climate change impacts on human health in the United States. Development of the assessment will leverage existing activities of the CCHHG and INCA members, aggregate and assess current quantitative research on human health impacts of climate change, and summarize the current state of the science. The USGCRP Climate and Health Assessment will extend the work begun under the 2008 Synthesis and Assessment Product 4.6 (SAP 4.6) Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems and the third National Climate Assessment (NCA) by using modeling and analysis tools to quantify, where possible, projected national-scale impacts of climate change on human health. Such analyses will attempt to identify and bound impact uncertainties, as well as better define changes in attributable epidemiological risks, particularly for populations of concern, with the goal of informing public health authorities and other public planning and resource management entities.

The lead and coordinating Federal agencies for the USGCRP Climate and Health Assessment are the Centers for Disease Control and Prevention (CDC), Environmental Protection Agency (EPA), National Institutes of Health (NIH), and National Oceanic and Atmospheric Administration (NOAA).

## II. Proposed Focus Areas

The proposed scope of the USGCRP Climate and Health Assessment will cover the following eight focus areas, which will each comprise a report chapter:

1. Thermal Extremes
2. Air Quality
3. Vectorborne and Zoonotic Disease
4. Water-related Illness
5. Food Safety, Nutrition, and Distribution
6. Extreme Weather and Climate Events
7. Mental Health and Well-Being
8. Risk Factors and Populations of Concern

The authors will review and assess the peer-reviewed literature in each focus area in order to summarize the state of the science regarding observed and projected health-related climate change impacts (addressing both morbidity and mortality for the various types of health outcomes). To the extent a detailed breakdown of evidence is supported by the scientific literature, the authors will attempt to distinguish between changes in risk, changes in exposure, and changes in outcomes, and characterize the strength of evidence for each “link” in the causal pathway. Populations that are particularly vulnerable to specific health impacts will be identified within each chapter, and also in a comprehensive chapter on risk factors and populations of concern. Detailed assessment of climate science, however, is outside the scope of this report; rather this report relies on the NCA and already peer-reviewed assessments of climate change and climate scenarios.

Four chapters of the USGCRP Climate and Health Assessment will highlight recent modeling and/or quantitative analyses of the projected impacts of climate change on human health in the following areas:

1. Extreme Temperature Morbidity and Mortality
2. Air Quality (Ozone) Morbidity and Mortality
3. Ecological modeling for Lyme Disease risk
4. Ecological modeling for Vibrio and Alexandrium-related illness risk

The sections below provide more detail on the scope of observations and projections that will be included in each report chapter.

### A. Observed Climate Change Impacts on Human Health

Where possible, the USGCRP Climate and Health Assessment will identify relationships between global, national, and regional climate changes and associated impacts on human health in the United States over the last century. Each chapter will include a “state of the science” overview aimed at understanding observed impacts and developing/maintaining climate-health indicators. Because the impacts of climate change on health are complex and often dependent on multiple confounding socioeconomic and

environmental factors, the methodology for developing appropriate climate and health indicators is challenging and still emerging.

The authors will leverage current efforts across multiple agencies to understand observed impacts of climate change on human health in the US, including the USGCRP NCA indicator work and ongoing efforts at the EPA, CDC (through the Environmental Public Health Tracking Network), NIH (in collaboration with the World Health Organization), and others.

It is often difficult to attribute the exact impact of climate on many health indicators due to confounding factors, such as the ability of communities to prepare for and respond to the risks posed by climate change or the vulnerabilities of different populations and communities. However, such indicators will be instrumental not only in tracking and measuring health impacts of climate change, but also in identifying areas where public health intervention is most needed or likely to be most effective. A more comprehensive assessment of observed changes across the chapter subject areas will collectively demonstrate and communicate how risks to the health of Americans have changed, and may continue to do so under climate change.

Where quantitative national indicators are not available, or where health impacts are too secondary or indirect in nature to attribute to climate change, a qualitative examination of the state of the science will provide context for these additional health threats and may serve to identify areas for future research. Further investigation of the impacts of climate change on Americans' overall well-being and welfare, though important, is beyond the scope of this report.

## **B. Projected Changes in Health Risks**

While certain advances in the state of the science over the last five years are evident, research on projected changes in future health risk under different climate scenarios is in varying stages of development. As such, each chapter of the USGCRP Climate and Health Assessment will seek to summarize the literature on modeling and quantification efforts regarding climate impacts on human health. The authors will pay special attention to research that frames risks in terms of probability-based changes in exposure, vulnerability, and adaptive capacity.

As stated previously, four chapters will include additional quantitative analyses to evaluate a range of possible changes in future health-related climate impacts and risks: (1) Extreme Temperature Morbidity and Mortality; (2) Air Quality (Ozone) Morbidity and Mortality; (3) Ecological modeling for Lyme Disease risk; (4) Ecological modeling for Vibrio and Alexandrium-related illness risk. The authors will leverage existing or ongoing peer-reviewed research or analytical efforts to derive additional quantitative analyses developed specifically for this report. This work will identify areas where probabilistic changes in attributable risks can be characterized, and where scientific uncertainty has been better defined since the publication of SAP 4.6. Consistent with guidance for the third NCA, each chapter will report confidence levels and likelihood of specific impacts across a range of scenarios and possible outcomes,

and will articulate all standards or modeling assumptions. See Appendices 1 and 5 of the third NCA<sup>1</sup> for more guidance details; in addition, the author guidance handbook specific to this Climate and Health Assessment will be made available on the USGCRP website.

For certain health outcomes, research that characterizes human health risks in terms of probability-based changes in exposure or vulnerability may provide a way to contextualize health risks in terms relevant for public health officials and planners. For example, the relationship between projected temperature increases and certain waterborne pathogens (e.g., *Vibrio* bacteria) is well known, but the link between projected changes in exposure to these pathogens and the projected increase in disease incidence remain uncertain. Thus, a probability-based metric of changes in vulnerability may be used to simply and clearly communicate changes in risk into the future and under alternative climate scenarios where a robust national projection in the annual number of cases of such diseases is not possible to derive at this time. Where appropriate, such risk-based framing will be highly valuable to informing efforts aimed at preventing or responding to climate change impacts. In addition, this chapter may provide a framework for conveying complex changes in risk under uncertainty by mapping especially vulnerable populations or sites specifically related to environmental justice concerns.

### C. Other Report Scope Considerations

**Geographical Scope:** The focus of the USGCRP Climate and Health Assessment is on human health impacts within the United States, but authors may include existing literature on global impacts, linkages, and implications where appropriate and relevant to the United States. For instance, global studies may be considered for certain impact areas where there is a lack of long-term, consistent historical monitoring, such as the health impacts of extreme weather events. In other cases, cross-border or regional studies may be more appropriate where risk is not homogenous across the nation, such as the spread of Lyme Disease along the U.S.-Canada border region. Within each topic area, the authors will attempt to address geographic differences in climate health risks—including urban vs. rural—to the extent scientifically justified, technically feasible, and able to be examined within the resources available for the report.

**Timescales:** While climate change is observed and measured on long-term (30+ years) time scales, decision frameworks for public health officials and regional planners are often based on much shorter time scales, determined by epidemiological, political, and/or budgeting factors. To the extent it is addressed in the peer-reviewed literature, the authors will include discussion of the implications of overlaying impact trends that occur on typical climatological time frames (e.g., from changes in extreme weather events to end-of-century projections of impacts such as sea level rise) on top of data from epidemiological time frames (e.g., from immediate or episodic health threats to cumulative exposure or the appearance of developmental effects).

**Scenarios and Uncertainty:** To the extent possible given available resources, the authors will use multiple climate change emissions scenarios. Uncertainty will be characterized as qualitative confidence

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<sup>1</sup> <http://nca2014.globalchange.gov/downloads>

levels and, where possible, quantitative probabilistic likelihoods of specific impacts across a range of scenarios and possible outcomes. Measures of uncertainty will be based on scientific evidence, statistical analysis of observations or model results, and expert judgment. The USGCRP Climate and Health Assessment will follow NCA guidelines for transparent reporting of likelihood, confidence, and uncertainty findings (see Appendices 1 and 5 of the third NCA for more details).

**Adaptation, Mitigation, and Economic Valuation:** It is outside the scope of this report to comprehensively assess the peer-reviewed literature on climate change mitigation, adaptation, the health-related costs of climate change, and health co-benefits that may be associated with climate mitigation, adaptation and resilience strategies. Rather, the focus of this report is on quantifying health risks and impacts. The report will not include explicit discussions of policy recommendations regarding mitigation or adaptation, though scientific literature assessed in the report may identify and cite factors related to adaptive capacity that create or alleviate vulnerability to health impacts (e.g., air conditioning), and may include modeling parameters that make certain assumptions about emissions pathways or adaptive capacity in order to project climate impacts on human health. This information helps build the integrated knowledge base needed to understand, predict, and respond to these changes, and may help inform mitigation or adaptation decisions and other strategies in the public health arena.

**Complex Linkages, Cumulative Effects, and Potentially Confounding Factors:** Many factors will affect the impact of climate change on human health; not all of these factors will be addressed in this report. For example, a population's vulnerability (1) may be affected by direct climate changes or by non-climate factors (e.g., changes in population dynamics, economic development, education, infrastructure, behavior, technology, and ecosystems); (2) may differ across regions and in urban, rural, and coastal communities; and (3) may be influenced by individual vulnerability factors such as age, socioeconomic status, and existing physical and/or mental illness or disability. In addition, climate change or other non-climate factors will cause changes in adaptive capacity, ranging from an individual's ability to acclimatize to different meteorological conditions to a community's ability to prepare for and recover from damage, injuries, and lives lost due to extreme weather events. These considerations will be briefly summarized in the introductory chapter(s) of the USGCRP Climate and Health Assessment. However, projections of many of the factors listed above, and many other compounding, secondary, or indirect climate effects, though important to consider as part of a comprehensive assessment of changes in risks, may be beyond the scope of this report or may be only briefly addressed in the context of emerging issues and research needs.

**Emerging Issues and Research Needs:** While the goal of the USGCRP Climate and Health Assessment is to highlight the current state of the science regarding climate impacts on health, emerging issues and research needs will be briefly summarized for each chapter. A comprehensive research gap analyses and development of research protocols is outside the scope of this report, but the CCHHG will consider these ideas for facilitating or coordinating future research in this area.

### **III. Process**

#### **A. Audience, and Communicating Health Risks Associated with Climate Change**

The USGCRP Climate and Health Assessment will be designed to inform public health officials, urban planners, decision makers, and other stakeholders within and outside of government who are interested in better understanding the risks climate change presents to human health. The goal is to provide these groups with updated information on the observed and projected impacts of climate change on human health and changes in risk to health. Though the report will not include policy recommendations, this information may help inform mitigation or adaptation decisions and other preventative strategies. Better definitions of health risk and uncertainty will improve hazard identification and allow for better-coordinated responses to the impacts of climate change on human health. To that end, the USGCRP Climate and Health Assessment will also highlight ongoing research focused on quantifying the risks to health associated with climate change.

#### **B. Lead Authors, Contributing Authors, and Required Expertise**

As a federal interagency report, the report will be written only by federal employees, contractors, or affiliates. Authors have been selected based on their demonstrated subject matter expertise, their relevant publications and knowledge of specific topics designated in the draft outline, their demonstrated writing abilities and accomplishments, and their availability, such that they can aid in the development of a robust scientific, technical assessment.

Lead Authors include a selection of CCHHG members, attendees of an initial CCHHG scoping workshop, and other federal employees and affiliates identified through existing agency collaborations and networks. Contributing Authors with relevant subject matter expertise were nominated by lead authors, CCHHG or other interagency members, and the general public (through the public federal register notice, issued on February 7, 2014, calling for Contributing Author nominations). Where needed to fill gaps in expertise, additional subject matter experts were selected to be Contributing Authors through an independent process led by an EPA contractor based on expertise (e.g., scholarly publications, etc.) and other criteria.

Collectively, the Lead and Contributing Authors will be responsible for preparing the initial draft of the report, including the text and any analysis required to synthesize the underlying studies from the existing peer-reviewed literature that serves as the basis for the report. Lead Authors will decide how best to organize their respective teams, including division of responsibility and time requirements among the Contributing and Lead Authors. In addition, Lead Authors and Contributing Authors will be responsible for reviewing relevant literature submissions made through the Federal Register Notice Call for Information (see section E below) and for responding to public comments on the draft report. All authors should be accomplished writers and have demonstrated technical backgrounds in at least one field relevant to the impacts of climate change on human health in the United States.

### C. Agency Roles

The CCHHG will be responsible for compiling and synthesizing contributions from all authors. From within the CCHHG, a steering committee for the USGCRP Climate and Health Assessment has been established to provide guidance and coordination to staff/authors. Lead agencies (CDC, EPA, NIH, NOAA) will provide staff support including, where appropriate, contractor support. EPA will serve a coordinating function to include providing support and facilitation of two planning workshops to bring together CCHHG members, federal agency experts, and supporting contractors, as appropriate. The workshops will serve to facilitate the scoping and development of report outlines and drafts, and to identify any model analyses or data retrieval needed for the assessment. EPA will work closely with the CCHHG Steering Committee to provide others (e.g., USGCRP) with regular progress updates.

### D. Information Quality and Peer Review

The USGCRP Climate and Health Assessment will follow the third NCA guidelines for preparing USGCRP products, with referenced materials derived primarily from the existing peer-reviewed scientific literature and consistent with guidance regarding use of non-peer-reviewed literature. The following cut-off dates will be applied for publications to be included in the USGCRP Climate and Health Assessment:

- For analyses being conducted by authors of the USGCRP Climate and Health Assessment (see Section II above):
  - October 31, 2014: Deadline for papers to be *submitted* to a peer reviewed journal
  - October 31, 2015: Deadline for papers to be *accepted* in a peer reviewed journal
- For all other papers being assessed and cited in the Health Assessment:
  - October 31, 2014: Deadline for papers to be *accepted* in a peer reviewed journal
  - Papers that are published after October 31, 2014 AND are submitted during the public comment process or NRC peer review will be assessed and may be cited.

Like the NCA, this report will follow federal information quality, transparency, and accessibility guidelines appropriate for a Highly Influential Scientific Assessment (HISA) (See Appendices 1 and 2 of the third NCA for more details). The report will undergo peer review by the National Research Council of the National Academy of Sciences, public review, and final interagency clearance.

### E. Process for Public Engagement and Publication

The CCHHG Steering Committee provided a number of opportunities for public engagement during the initial scoping phase, announcing the following via a February 7, 2014 Federal Register Notice issued by EPA on behalf of the USGCRP:

- (i) Request for Comments on Draft Report Prospectus: A 30-day call for comments on the objectives, proposed topics, and process as outlined in the Draft Prospectus.
- (ii) Call for Information: A 30-day call for submissions of recent, relevant, scientific and/or technical research studies on observed and/or projected climate change impacts on human health in the United States that have been peer-reviewed and published or accepted for publication.
- (iii) Nominations for Contributing Authors: A 30-day call for nominations of Contributing Authors to assist chapter author teams in the development of the USGCRP Climate and Health Assessment chapters or sections. Interested parties were invited to submit nominations of subject matter experts, with descriptions of relevant expertise and publications.
- (iv) Public Forum to Inform the USGCRP Climate and Health Assessment: A free and open public forum convened March 13, 2014 in Washington, D.C. to facilitate engagement with stakeholders, non-federal subject matter experts, and the interested public.

After completion of a Public Review Draft of the USGCRP Climate and Health Assessment, EPA on behalf of the USGCRP will issue a second Federal Register Notice to announce a 60-day public comment period for the draft report. The public will be able to view the draft and submit comments to an online docket available on the USGCRP's website. The CCHHG Steering Committee will also work to schedule side events, presentations at relevant conferences, and webinars to further engage the community of experts and the general public. Public comments received on the draft will be evaluated and used to inform the final report.

The CCHHG and USGCRP will publish the final report electronically and consider options for hard copy publication. They will also explore options for online integration with future phases of the USGCRP's Global Change Information System. A full communications plan for dissemination of the USGCRP Climate and Health Assessment findings will be developed by the lead and supporting agencies along with designated authors, with input and assistance from the USGCRP communications team. The CCHHG will consider issues of health/climate literacy among various communities when developing the communications plan. The CCHHG will consider various approaches for engaging different audiences, especially the public health community and populations of concern, in understanding key findings, messages and implications of the USGCRP Climate and Health Assessment.

## **F. Proposed Timing**

The USGCRP Climate and Health Assessment is designed to be released after the third and before the fourth National Climate Assessments. A draft is expected to be made available for public comment in early to mid 2015, with final publication expected in early 2016.