National Institutes of Health
Turning Discovery Into Health

NIH Climate Change and Health Initiative 2023 Annual Report

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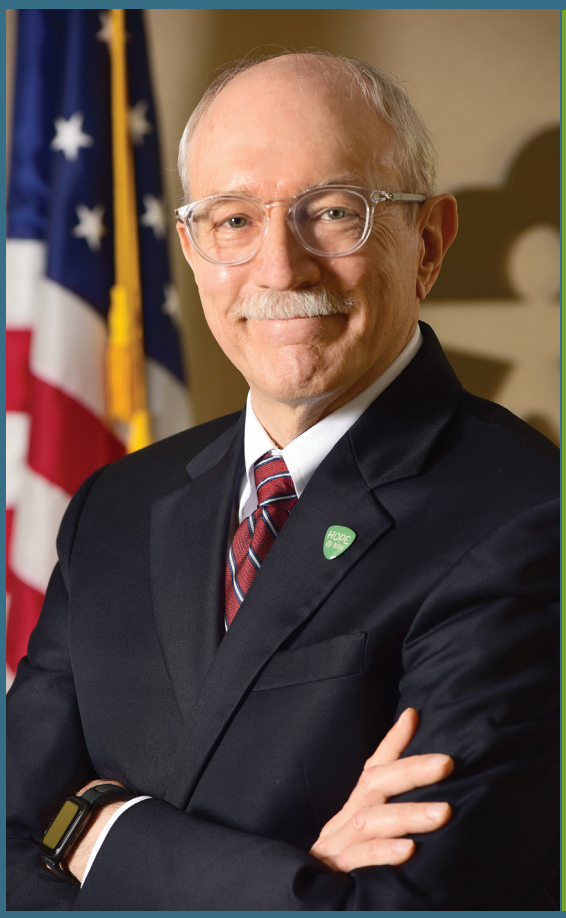
CCHI Executive Committee Message

Letter from the Chair, NIH Climate Change and Health Initiative Executive Committee



There is mounting scientific evidence showing that climate change is significantly altering our environment and influencing human health. We experienced these effects in 2023, when extreme heat covered most of the United States and parts of Europe, and when wildfires in Canada and Hawaii brought destruction and increased air pollution, making it difficult to breathe. As climate-related events like these become more frequent and severe, it is imperative to support the research needed to understand, and address, the health impacts of the changing climate, especially for communities in the U.S. and throughout the world that already experience social and environmental inequities.

Nurturing partnerships and fostering collaboration is one of my guiding values as an NIH leader. I strongly believe that the only way to address this urgent public health threat is to do it collaboratively, using an "All of NIH" approach. Supporting research on the health consequences from a changing climate touches the missions of all NIH institutes, centers, and offices.

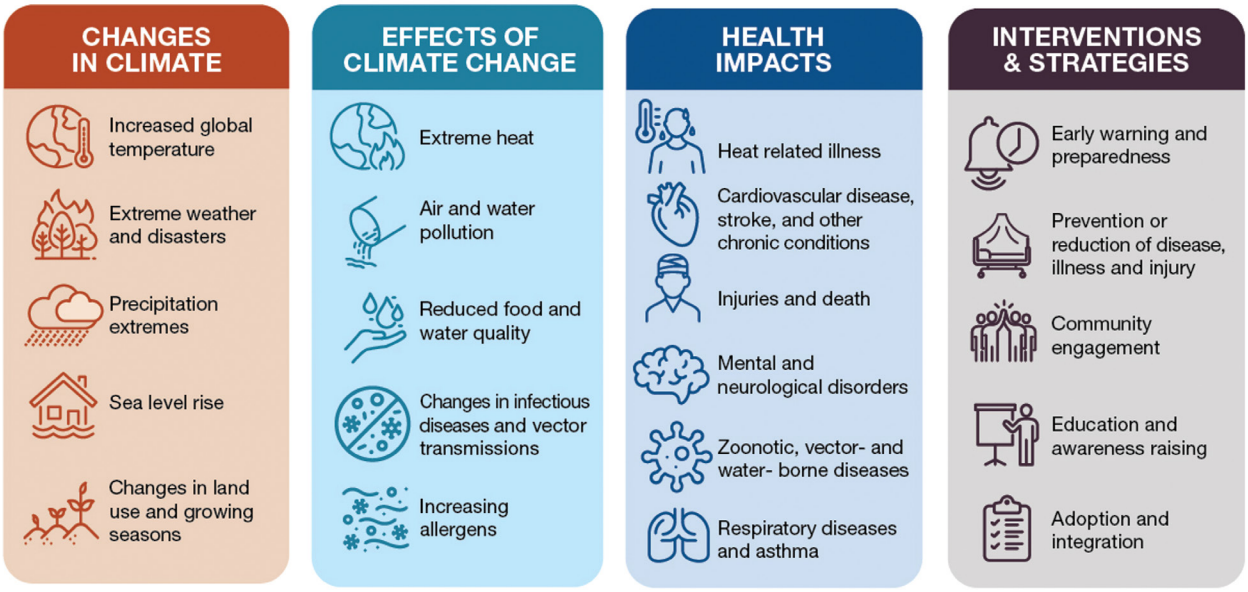
I am proud to join with other members of the Executive Committee, and the hundreds of people working across the National Institutes of Health (NIH), on what we refer to as the NIH Climate Change and Health Initiative (CCHI).

By working together, NIH institutes and centers can harness their technologies, innovative research approaches, and talent to advance the science of climate change and health. At the heart of the initiative is a push for transdisciplinary, team-based science that boosts training, research capacity, and community engagement.

In this inaugural annual report, you will read about our first big steps and the significant progress achieved in our first year to advance the science of climate change and health. We expanded our research portfolio and established the scientific infrastructure necessary for a sustainable and thriving community of practice.

I am optimistic that by addressing climate change through collaborative research, the scientific progress we make together can prevent disease and improve health outcomes in the U.S. and around the globe.

With gratitude,
Rick Woychik, Ph.D.



Source: NIH Climate Change and Health Initiative (https://www.nih.gov/climateandhealth)

Program Overview

Year after year, the world continues to see and experience the negative impacts that climate change has on communities and on quality of life. Produced by the US Global Change Research Program (USGCRP), the Fifth National Climate Assessment analyzes the impacts of climate change in the U.S. and concluded that: "It is an established fact that climate change is harming physical, mental, spiritual, and community health and well-being through the increasing frequency and intensity of extreme events, increasing cases of infectious and vector-borne diseases, and declines in food and water quality and security. Climate-related hazards will continue to grow, increasing morbidity and mortality across all regions of the US."[1]

Therefore, the United States and other countries have been taking action to address and combat climate change. In response to the White House and Executive Order 14008: Tackling the Climate Crisis at Home and Abroad,[2] NIH developed an NIH-wide Climate Change and Health (CCH) Initiative in 2021 to focus efforts on growing the NIH climate change and health research portfolio and investigator community. The NIH Climate Change and Health Initiative (CCHI) is an urgent, cross-cutting NIH effort to reduce health threats from climate change across the lifespan and build health resilience in individuals, communities, and nations around the world, especially among those at highest risk.

The NIH Climate Change and Health Initiative Strategic Framework guides the NIH research initiative on the impacts of climate change on human health. It is a product of the NIH CCH Working Group and includes scientific community and stakeholder input. The framework informs NIH research investments in the near term and informs the planning of such investments over the long term to generate knowledge vital for responding to the challenges of global climate change to the health and well-being of current and future generations.

The Initiative's investments lead to collaborative and transformative science focused on the four core elements and supporting areas of science illustrated in Figure 1. The four core elements that guide NIH investments in climate change and health research are:

Health Effects Research: Scientific investigation of the influences of climate change on health outcomes, including spatial and temporal scales, pathways, mechanisms, and risks at specific times of vulnerability across the lifespan, as well as risks to special populations including children, older adults, women, pregnant people, differently abled persons, and others. Such research will inform the identification of trends, prediction of risks, and adoption of actions to prevent or respond to negative health outcomes.

Health Equity: Emphasis and integration throughout the Initiative on recognizing and responding to the needs of populations most at risk of climate change impacts to their health. Health equity requires elevation of the concerns and rights of under-resourced and historically disadvantaged communities, underserved and health disparate populations in the U.S. and in low- and middle-income countries (LMICs), including communities burdened by environmental injustice. Bringing focused attention to the lived experiences of the most affected individuals and communities will ensure the benefits of scientific discovery create greater health equity.

Intervention Science: Science that provides the evidence base for development and implementation of timely, effective strategies to prevent disease and disability and promote health. Intervention research uses experimental, modeling, and evaluative methods to study and design interventions to improve health, including engineered solutions, institutional and infrastructure changes, clinical, social, behavioral, and communication tools that influence beneficial decision-making. The urgency of a changing climate provides the imperative for research that can guide both individual actions and policies at the community and population levels to improve health outcomes now and in the future.

> **"The health impacts from climate change touch upon the mission area of most all ICOs at NIH, which is why it is necessary to build a strong trans-NIH approach to addressing these impacts. The NIH-wide Climate Change and Health Initiative's strategic vision and four core pillars are informed by our colleagues across NIH, as well as from sources across federal agencies, and academic, community, industry, and professional organizations. NIH aims to develop a range of multidisciplinary opportunities and partnerships to support innovative and translatable science. We hope that the science the CCHI supports will inform public health solutions to climate change and address health equity to protect all communities now and in the future."**
>
> ***— Gwen Collman, Ph.D., NIEHS, NIH CCHI Strategic Advisor***

Training and Capacity Building: Transmission of the fundamental knowledge and skills to conduct transdisciplinary climate and health science, develop innovative supporting technologies, and translate findings to facilitate understanding of, and adaptation to, the growing threat of climate change on health. Efforts should include training and education on climate change and health at all curriculum levels, as well as allied professions, including law, media, economics, and others. Training should be provided to community members to facilitate their active participation in research design and implementation through community scientist partnerships.

The supporting areas of science of these four core elements for climate change and health research represent highly relevant and important fields of inquiry:

- Adaptation Research
- Basic and Mechanistic Studies
- Behavioral and Social Sciences Research
- Data Integration
- Disaster Research Response
- Dissemination and Implementation Science
- Epidemiology and Predictive Modeling
- Exposure and Risk Assessment
- Systems Science

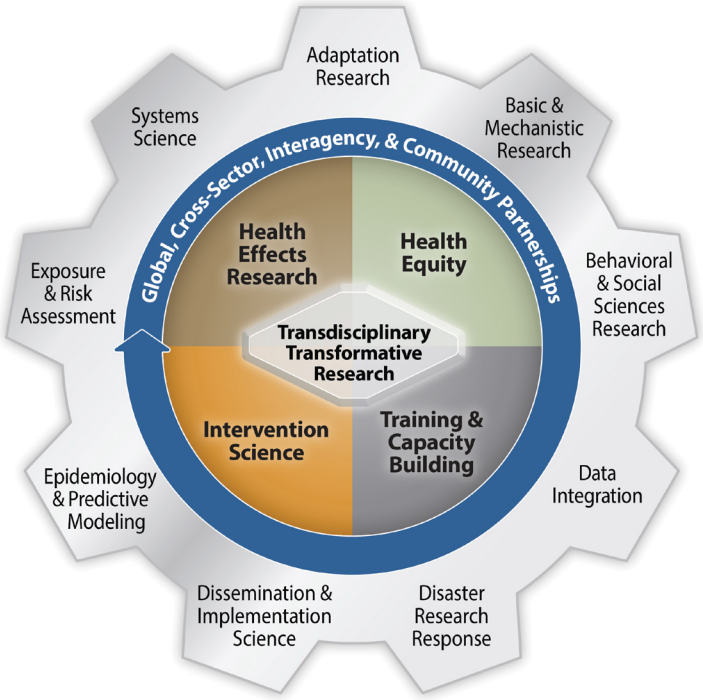


FIGURE 1: NIH Climate Change and Health Initiative Strategic Framework

Goals and Objectives

The goal of this NIH-wide effort is to reduce health threats from climate change across the lifespan and build health resilience in individuals, communities, and nations around the world, especially among those at highest risk. This goal is continuously being worked towards by:

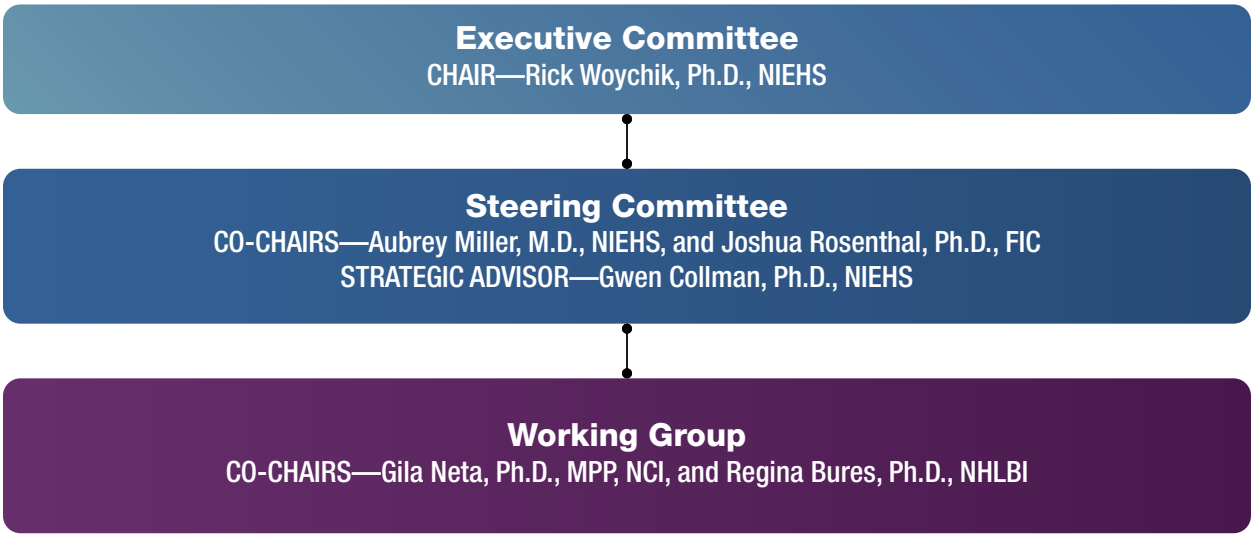
- Identifying risks and optimizing benefits to the health of individuals, communities, and populations from actions to mitigate or adapt to climate change.
- Developing the necessary research infrastructure and workforce to enable the generation of timely and relevant knowledge, drawing from the full spectrum of biomedical disciplines.
- Leveraging partnerships with other scientific and social disciplines and organizations to achieve the most impactful results.
- Innovating across the research translation continuum to ensure findings are credible, accessible, and actionable for achieving these goals.

Governance Structure

Strategic oversight of the NIH CCHI has originally been provided by an Executive Committee (EC) comprising the Directors of seven NIH Institutes and Centers (ICs). The NIEHS Director, Rick Woychik, Ph.D., chairs the Executive Committee and NIEHS provides the Initiative's administrative home. In December of 2023, the EC decided to expand to include any IC Director who was interested in joining. Thus, the EC has expanded with 5 additional IC Directors, bringing the total to 12. Each Director of the Executive Committee has designated IC staff to serve as their representatives on the Steering Committee (SC), which oversees the development and monitoring of the many programs and funding opportunities of the NIH CCHI. In 2023, the SC has expanded to 24 members, representing 13 different institutes, centers, and offices (ICOs), which is nearly double the size that the governing body was in the previous year.

An NIH CCH Working Group was established to assist in developing the priorities of the Initiative and supporting the growth of the program and its partnerships. The Working Group now includes over 180 representatives from 25 ICOs. In 2023, CCHI leadership expanded to include two new co-chairs of the Working Group, from the National Cancer Institute (NCI) and the National Heart, Lung, and Blood Institute (NHLBI).

Overall, in 2023, the participation of NIH ICOs working on the NIH CCHI has increased. With the expanded interest across NIH, the CCH Working Group, Steering Committee, and even the Executive Committee is expected to continue growing in this next year.



NIH Climate Change and Health Executive Committee Members

National Institute of Environmental Health Sciences (NIEHS)

- Rick Woychik, Ph.D., Chair

Fogarty International Center (FIC)

- Peter Kilmarx, M.D.
- Roger Glass, M.D., Ph.D. (*former*)

National Cancer Institute (NCI)*

- W. Kimryn Rathmell, M.D., Ph.D., M.M.H.C.

National Center for Complementary and Integrative Health (NCCIH)*

- Helene Langevin, M.D.

National Heart, Lung, and Blood Institute (NHLBI)

- Gary Gibbons, M.D.

National Institute on Aging (NIA)*

- Richard Hodes, M.D.

National Institute of Allergy and Infectious Diseases (NIAID)*

- Jeanne Marrazzo, M.D., M.P.H.

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)*

- Lindsey Criswell, M.D., M.P.H., D.Sc.

National Institute of Child Health and Human Development (NICHD)

- Diana Bianchi, M.D.

National Institute of Mental Health (NIMH)

- Joshua Gordon, M.D., Ph.D.

National Institute on Minority Health and Health Disparities (NIMHD)

- Eliseo Pérez-Stable, M.D.

National Institute of Nursing Research (NINR)

- Shannon Zenk, Ph.D., MPH, RN, FAAN

* New IC joining the NIH Climate Change and Health Executive Committee In 2024.

NIH Climate Change and Health Steering Committee Members

Fogarty International Center (FIC)

- **Flora Katz,** Director, Division of International Training and Research
- **Aspen Reese,** Health Scientist, AAAS Fellow*
- **Joshua Rosenthal,** Senior Scientist, Division of Epidemiology and Population Studies and Co-Chair of the NIH CCHI

National Cancer Institute (NCI)

- **Curt DellaValle,** Program Director, Epidemiology and Genomics Research Program
- **Gila Neta,** Program Director, Implementation Science and Co-Chair of the NIH CCH Working Group

National Heart, Lung, and Blood Institute (NHLBI)

- **Larry Fine,** Senior Advisor
- **Mary Masterson,** Program Director, Center for Translation Research & Implementation Science
- **Regina Bures,** Senior Scientific Advisor and Co-Chair of the NIH CCH Working Group

National Institute on Aging (NIA)

- **Emerald Nguyen,** Social and Behavioral Science Administrator, Population and Social Processes

National Institute of Allergy and Infectious Diseases (NIAID)

- **Lee Hall,** Chief, Parasitology and International Programs Branch

National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)

- **Susana Serrate-Sztein,** Associate Director for Strategic Initiatives

Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)

- **Guillermina Girardi,** Health Scientist Program Officer
- **Randy Capps,** Program Director, Population Dynamics

National Institute of Environmental Health Sciences (NIEHS)

- **Gwen Collman,** Director, Office of Scientific Coordination, Planning and Evaluation and Strategic Advisor to the NIH CCHI
- **Aubrey Miller,** Deputy Director, Scientific Coordination and Co-Chair of the NIH CCHI
- **Claudia Thompson,** Chief, Population Health Branch, Division of Extramural Research and Training
- **Ashlinn Quinn,** Program Officer, Population Health Branch, Division of Extramural Research and Training

National Institute of Mental Health (NIMH)

- **Megan Kinnane,** Senior Advisor to the Director of NIMH
- **Holly Campbell-Rosen,** Program Officer, Center for Global Mental Health Research

National Institute on Minority Health and Health Disparities (NIMHD)

- **Larissa Aviles-Santa,** Director, Division of Clinical and Health Services Research
- **Gabriel Lai,** Program Director, Division of Integrative Biological and Behavioral Sciences

National Institute of Nursing Research (NINR)

- **Elizabeth Perruccio,** Program Director
- **Louise Rosenbaum,** Science Policy Analyst*

National Center for Complementary and Integrative Health (NCCIH)

- **Emmeline Edwards,** Director, Division of Extramural Research

Office of Nutrition Research (ONR)

- **Andrew Bremer,** Director of the NIH Office of Nutrition Research*

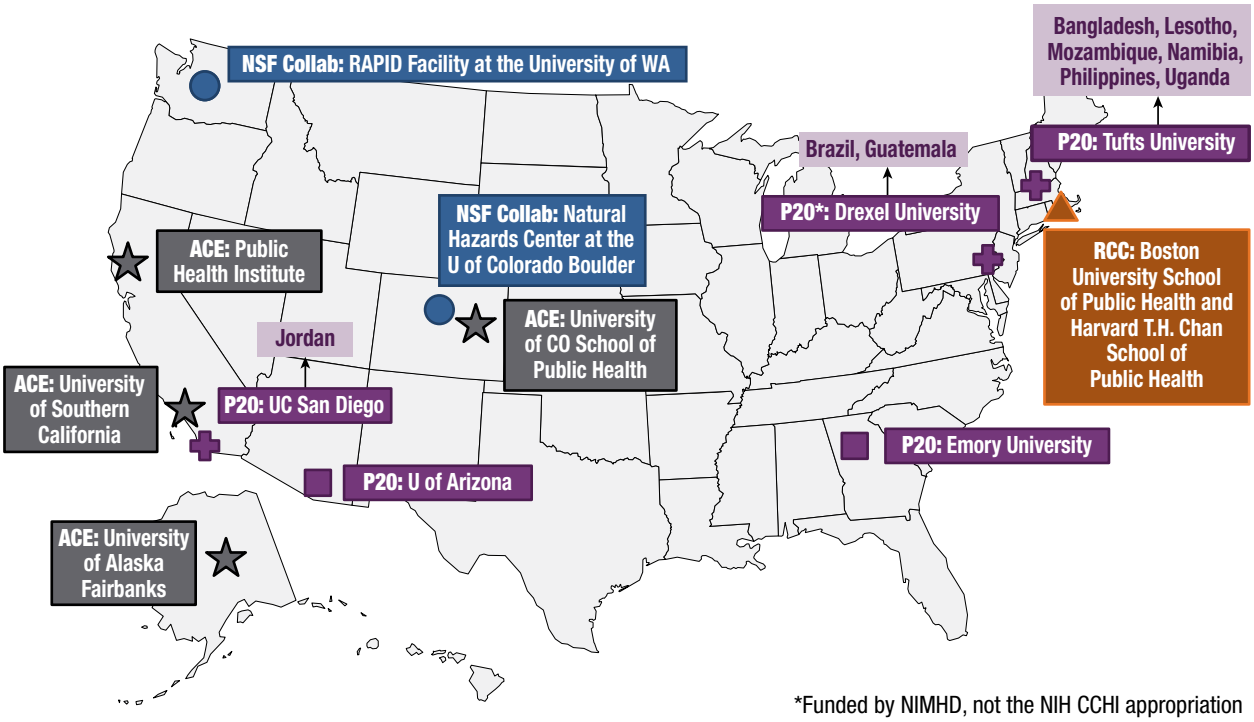
* 2023 SC members who have contributed their time and energy to the initiative but have retired or moved to other ICs.

Emerging Research Support

With the NIH Climate Change and Health Initiative's first dedicated congressional appropriation of $40 million, fiscal year 2023 represented a significant milestone for climate change and health research at NIH as the Initiative issued its first project awards and opened several impactful funding announcements.

The CCHI launched in fiscal year 2022 with funds contributed by participating ICOs. The Initiative's growth in fiscal year 2023 led to a 134% increase in applications focused on climate change and a 59% increase in awards made, compared to that of fiscal year 2022.

NIH CCH Centers Across the Country



*Funded by NIMHD, not the NIH CCHI appropriation

NSF Collaboration (NSF Collab)

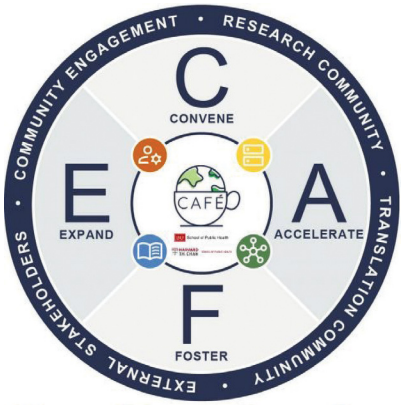
Research Coordinating Center (RCC)

Alliance for Community Engagement (ACE)

Exploratory Grants for Climate Change and Health Research Center (P20)
International Focus

Major Programs Launched

Climate Change and Health Research Coordinating Center (RCC)



Announced in June 2022, RFA-ES-22-003 solicited applications from eligible institutions to develop a Research Coordinating Center (RCC) to support the development of an NIH CCH Community of Practice (CoP) by managing and supporting current CCH research and capacity building efforts and supporting the expansion of the CoP in the long term.

Announced in Summer 2023, NIH awarded a three-year grant to Boston University School of Public Health and Harvard T.H. Chan School of Public Health to serve as the Research Coordinating Center (RCC) for this NIH-wide effort to reduce the health impacts of climate change. Referred to as the CAFÉ, the RCC will Convene, Accelerate, Foster, and Expand the global climate change and health community of practice. To accelerate the translation of research into practical solutions, the CAFÉ RCC will engage a diverse array of researchers and other stakeholders across government agencies, non-governmental and community-based organizations, academia, industry, foundations, and potential funders.

Exploratory Grants for Climate Change and Health Research Center Development (P20s)

Announced in Spring 2023, the Exploratory Grants for Climate Change and Health Research Center Development RFA-ES-23-007 were created to "support the development of an innovative research environment to foster and sustain a transdisciplinary program of fundamental and applied research to explore the complex impacts of climate change on health and to develop action-oriented strategies that protect health and build resiliency at the individual, community, national and global levels." This RFA had two receipt dates in 2023. In October 2023, the first of these exploratory center awards were announced. Each will help develop action-oriented strategies that protect health and build resiliency to climate change at the individual, community, national, and global levels. A second set of awards will be announced in 2024.

The 2023 exploratory center awards were made to:

Drexel Climate Change and Urban Health Research Center (CCUH)

Drexel University | Principal Investigator: Ana Diez Roux

The CCUH aims to build institutional capacity at Drexel and at three partner sites included in this formative Center (University of California Berkeley, University of São Paulo in Brazil, and INCAP in Guatemala) to support action-oriented research on the impacts of climate change on population health and health inequities in diverse cities across the Americas. The center will support research to understand what cities can do to protect the growing urban populations of the world from the adverse effects of climate change in ways that promote health and equity.

Emory Climate & Health Actionable Research and Translation Center (CHART)

Emory University | Principal Investigator: Yang Liu

CHART aims to become a hub that will advance and translate research on climate risks to protect the health of under-resourced urban populations. The Center's research project will be focused on heat-related illness in Atlanta, GA, and will examine factors related to physiologic susceptibility and factors along exposure pathways that may lead to disparities in illness outcomes.

Futureproofing Health: Developing a Center for Resilient Health in Disasters

Tufts University | Principal Investigator: Erin Coughlan de Perez

The Center for Climate and Health glObal Research on Disasters (CORD) will support the development of feasible, actionable, and culturally appropriate Anticipatory Action plans to prevent and/or ameliorate health impacts associated with climate-related disasters. CORD will build research infrastructure and enable cutting-edge research via 6 case studies conducted in under-served at risk communities in the Global South (Bangladesh, Lesotho, Mozambique, Namibia, Philippines, Uganda).

Southwest Center on Resilience for Climate Change and Health (SCORCH)

University of Arizona | Principal Investigators: Kacey Ernst, Mona Arora, and Joseph Hoover

SCORCH's focus is on climate change-exacerbated health threats to arid land communities and adaptation efforts by Indigenous, Latinx, low-resource urban, and rural communities in the Southwestern United States and globally. Three research focus groups will include: 1) health effects of extreme weather events, 2) forecasting and early warning, and 3) adaptive responses to the built environment.

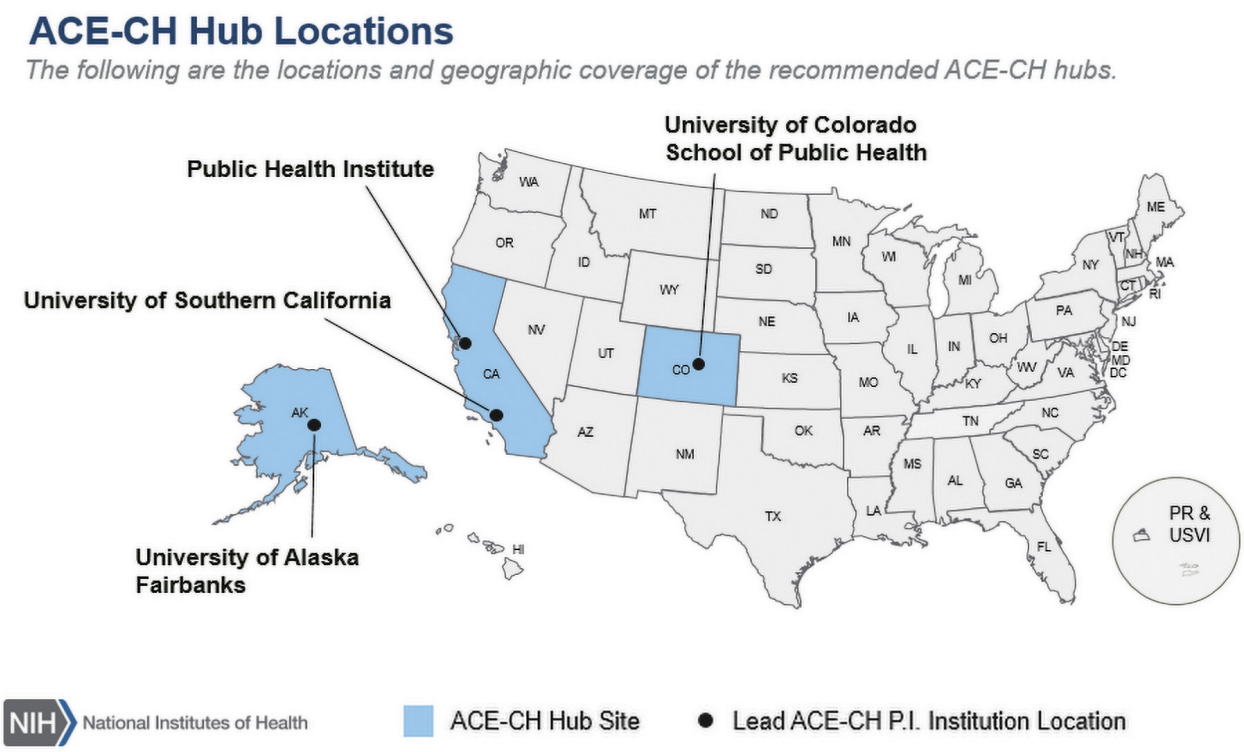
Global Center on Climate Change and Water Energy Food Health Systems

University of California, San Diego | Principal Investigator: Wael Al-Delaimy

The Global Center on Climate Change and Water Energy Food Health Systems (GC3WEFH) will work on water scarcity and health in vulnerable communities in the Middle East, in the context of the Water-Energy-Food-Health nexus and climate change. The center's research will address the impacts of climate change on water, energy, food, and health systems in the climate-vulnerable communities of the Azraq Basin in Jordan.

Alliance for Community Engagement (ACE-CH)

The NIH CCHI has provided funding to establish four hubs as part of the Alliance for Community Engagement on Climate and Health (ACE-CH). The alliance promotes sustainable strategies that address the impacts of climate change on vulnerable communities, while emphasizing health equity. The ACE-CH focuses on community-engaged research, capacity building, and outreach opportunities where factors associated with social determinants of health yield residents disproportionately affected by the health impacts of climate change. The ACE-CH models the successful NIH Community Engagement Alliance (CEAL) program led by the National Heart, Lung, and Blood Institute (NHLBI) and the National Institute on Minority Health and Health Disparities (NIMHD). The new grants for ACE-CH are administered by NHLBI. Work began in March 2023 at four awarded 'hubs.'



These hubs include:

Alaska Alliance for Community Engagement – Climate and Health (AK ACE-CH)

University of Alaska Fairbanks | Principal Investigator: Stacy Rasmus & Karsten Hueffer

The AK ACE-CH Hub focuses on Indigenous knowledge, attitudes, and beliefs about climate change and its impacts on health and well-being in Alaska. The hub will develop and pilot-test strategies to assess multi-level risk and resilience factors in rural Alaska Native communities in two highly impacted regions of the state.

Mountain West ACE-CH Hub: Climate Change Engagement Platform to Support Resilient Rural and Urban Communities

University of Colorado School of Public Health | Principal Investigators: Katherine Dickinson & Katherine James

The Mountain West ACE-CH hub is supporting climate change resilience among economically disadvantaged populations, communities of color, immigrants, and some occupational groups experiencing disproportionate health impacts in both urban and rural communities near Denver. The hub will develop scientifically rigorous surveys to measure climate change and air quality concerns, beliefs, behaviors, information sources, assets, and desires regarding environmental justice.

Community-driven Approaches to Environmental Justice and Health in the Face of the Climate Crisis in Southern California | Prioritizing Local Action for Climate Equity (PLACE)

University of Southern California, Principal Investigator: Jill Johnston

The University of Southern California PLACE hub focuses on community-driven approaches to environmental justice and health among families, immigrants, people of color, unhoused individuals, and elderly communities that are economically and socially marginalized in Los Angeles and the City of Carson. The hub will use spatial approaches to assess neighborhood-scale vulnerability, such as community air monitoring networks in climate justice neighborhoods.

Climate Health Adaptation and Resilience Mobilizing (CHARM) Lake County Project

Public Health Institute | Principal Investigator: Paul English

The Public Health Institute hub is establishing continuous community engagement structures with local Tribes and community-based organizations to reach American Indian Tribal communities, immigrants, and agricultural workers in Lake County, California. The hub will identify and understand health impacts of harmful algal blooms (HABs) and heat events on disproportionately affected populations and synthesize and apply findings to improve communication and collaboration in HABs and heat preparedness and response.

Other Investigator-Initiated Research

In addition to releasing specific funding opportunities to support the CCHI, NIH has a strong history of encouraging and supporting investigator-initiated research, where the researcher creates an application in an area of science NIH supports. Investigator-initiated research remains an important component of NIH's investments and represents a large amount of the climate change related research funded in fiscal year 2023.

Over the past year, the following 11 ICs supported investigator-initiated research related to climate change, representing an expansion over that of fiscal year 2022:

- **NHLBI**
- **NIA**
- **NIAID**
- **NIAMS**
- **NICHD**
- **NIDA**
- **NIEHS**
- **NIGMS**
- **NIMH**
- **NINDS**
- **OD**

Soon after the NIH CCHI launched, a Notice of Special Interest (NOSI): Climate Change and Health NOT-ES-22-006 was released in July 2022. This NOSI publicly describes NIH's interest in climate change and health research. This NOSI encourages applications that address the impact of climate change on health and well-being over the life course, including the health implications of climate change in the United States and globally. Similarly, the CCHI and NIEHS released two NOSIs that explored Innovative Technologies for Research on Climate Change and Human Health aimed at Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) applicants. NOT-ES-22-009 and NOT - ES-22-010 were open to applicants to "develop or adapt practical technologies for capturing the effects of climate change and extreme weather events on human health and to reduce the health threats posed by climate change across the lifespan."

In fiscal year 2023, five ICs funded applications that were received under these Notices —NIA, NIEHS, NICHD, NHLBI and NIMH. Notably, 14 NIH ICs signed onto the Notice of Special Interest (NOSI): Climate Change and Health NOT-ES-22-006, and it is anticipated that there will be additional expansion of applications under this notice in the future.

Investigator-Initiated Research Projects Examples

The rich diversity in topics, scientific areas, and studied health impacts of the climate change and health projects funded in fiscal year 2023 was significant. For more information on funded research projects that exemplify this diversity, click on the hyperlinked blue titles below.

Contaminant Metal Content in Wildfire Smoke and Neuroinflammation (R01)

University of New Mexico Health Sciences Center | Principal Investigators: Matthew Campen & Shahani Noor

In this project, researchers will utilize precise, laboratory-based exposure systems to address pulmonary and neuroinflammatory risks of wood smoke from metals-contaminated biomass obtained from regions in the Western U.S., such as the Laguna Pueblo and Navajo Nation. This research will help us understand how environmental stressors like wildland fire smoke promote cerebrovascular inflammation. (***Example of 'Heath Effects Research'***)

An equity-focused evaluation of a system-wide intervention to reduce mold in NYC public housing and its impact on asthma burden (F31)

Columbia University Health Sciences | Principal Investigator: Nina Flores

This project will evaluate disparities in domestic mold exposure and asthma morbidity both before and after a large-scale intervention in New York City public housing to reduce mold, by determining their distributions across climatic, neighborhood, building, and individual characteristics. This research will help to uncover where exposure burdens combine with social determinants to impact health in an era of climate change. This project will inform more equitable mold interventions and housing policies. *(**Example of 'Health Equity'**)*

Climate Change and Lung Health Training Program (T32)

University of Iowa | Principal Investigators: David Stoltz & Peter Thorne

The goal of this training program is to train students and postdoctoral fellows for cutting edge research in the pulmonary impacts of climate change and strategies to mitigate the effects. The program has mentors in four areas of emphasis: air pollution; allergens, airway biology, and environmental challenges; extreme weather, disasters, and global warming; and lung infections. The program aims to recruit and train a racially, gender, geographically (including rural), and socioeconomically diverse group of trainees who are prepared to tackle the health consequences of climate change, especially because those are the groups most vulnerable. (***Example of 'Training and Capacity Building'***)

After the flood: Optimal strategies to prevent malaria epidemics caused by severe flooding (R01)

University of North Carolina Chapel Hill | Principal Investigator: Ross Mathew Boyce

This project will evaluate the effectiveness of a targeted, time-limited malaria chemoprevention intervention with and without larval source management to reduce excess malaria burden in a perennial, high-transmission setting following severe flooding in rural western Uganda. Researchers will evaluate impacts of the interventions on the rate of transmission, as well as economic activities and income, health seeking and expenditures, and mental health and well-being. (***Example of 'Intervention Science'***)

Preventing Deaths Among Older Americans with Alzheimer's Disease and Other Related Dementias Exposed to Hurricanes (R01)

University of Michigan at Ann Arbor | Principal Investigators: Susan Anne Bell & Matthew A. Davis

This project will build understanding as to how disasters, such as hurricanes, affect older adults living with Alzheimer's disease and related dementias (ADRD). The central objective of this proposed project is to determine the extent to which exposure to hurricanes affects mortality among older adults living with ADRD – focused on identifying ways to reduce deaths. This research will help to develop knowledge around ADRD deaths following hurricane exposure with the intention of informing disaster preparedness policy for the ADRD population. (***Example of 'Adaptation Research'***)

Environmental and Epigenetic Modifiers of Susceptibility to Malignant Hyperthermia and Environmental Heat Stroke (R01)

Baylor College of Medicine | Principal Investigators: Susan Hamilton, James Dowling, & Robert Dirksen

This project will define the molecular mechanisms that underlie variability in malignant hyperthermia susceptibility and environmental heat stroke (EHS) penetrance, expressivity, sex-bias, and genetic discordance, as well as provide new information on the complex interplay of environment and genetics in these disorders. This research will lead to a new understanding of the drivers of EHS episodes and, ultimately, to strategies for their prevention. (***Example of 'Basic and Mechanistic Research'***)

Exposure to armed conflict, climate shocks, and the nutritional status of women and children (R03)

Pennsylvania State University | Principal Investigator: Brian Thiede

This research will use large-scale data on women's and children's nutrition, armed conflict, and climatic variability to examine the effects of conflict on nutritional status, evaluate if and how these effects are modified by climate shocks, and assess the role of hypothesized causal mechanisms. This project provides new cross-national evidence about the nutritional effects of conflict in Africa, fills evidence gaps about acute malnutrition in conflict settings, and integrates the emerging literatures on the health effects of conflict and climate. (***Example of 'Behavioral and Social Sciences Research'***)

Using massive, multi-regional EHR data to estimate the impacts of climate change on fungal disease epidemiology in the U.S. (R01)

University of Missouri-Kansas City | Principal Investigators: Theodore C. White, Mark Hoffman, & Justin V. Remais

This project will use a massive electronic health record and infectious disease surveillance database to characterize relationships between climate conditions and incidence of major fungal diseases across the U.S., quantify the historical and projected effects of anthropogenic climate change on incidence rates, and examine the role of social disadvantage in exacerbating future impacts. The findings of this research will increase our understanding of the climate epidemiology of major mycoses in the U.S., and the role of social disadvantage and resilience in moderating future impacts. (***Example of 'Data Integration'***)

Understanding the long-term effects of hurricanes on cardiovascular health and outcomes (K08)

Weill Medical College of Cornell University | Principal Investigator: Arnab Kumar Ghosh

This project will identify hurricane victims at high risk of cardiovascular disease (CVD) mortality and morbidity by measuring Hurricane Sandy's impact on New York City in 2012. It will lay the groundwork for a validation study using Medicare claims data from the devastating 2017 hurricane season. This work will allow public health authorities to better tailor pre-disaster evacuation and post-disaster CVD management that address disaster-related morbidity. (***Example of 'Disaster Research and Response'***)

Learning and Living with Wildfire Smoke: Creating Clean Air Environments in Schools through Youth Participatory Action Research (K99)

University of Washington | Principal Investigator: Savannah D'Evelyn

Through Youth Participatory Action Research (YPAR), this project will engage high school students to work within their school communities to increase local air quality knowledge, to implement interventions in their schools to reduce air pollution—particularly that caused by wildfire smoke—and train them to be more informed and proactive citizens. This project will describe the impact of a YPAR-based environmental health intervention and implementation program, and work toward a program that could be implemented in any school, regardless of the location or resources available. (***Example of 'Dissemination and Implementation Science'***)

Extreme Heat and Acute Myocardial Infarction: Effect Modifications by Sex, Medical History, and Air Pollution (R01)

Yale University | Principal Investigator: Kai Chen

The overall objectives of this project are to evaluate the effects of extreme heat and air pollution on acute myocardial infarction (AMI) and to identify potential effect modification by sex, socioeconomic status, medical history, and air pollution on the association between exposure to extreme heat and AMI risk. This research aims to lead to refined recommendations to protect vulnerable populations from extreme heat and/or air pollution events and will enable clinicians to provide evidence-based advice to vulnerable patients. (***Example of 'Epidemiology and Predictive Modelling'***)

Assessing the relationship between fungal pathogenicity and climate change and the risk of emergent pathogens in a changing climate (R16)

New Mexico State University Las Cruces | Principal Investigator: Adriana Romero Olivares

The objective of this project is to investigate the relationship between fungal pathogenicity and climate change to determine if stress-tolerance brought by global climate change triggers pathogenicity in soil fungi. This research will allow us to better plan for potential outbreaks of fungal infectious diseases under global climate change, develop contingency plans, and potential treatments. (***Example of 'Exposure and Risk Assessment'***)

The Planetary Child Health Observatory: an interdisciplinary research initiative and web-based dashboard for mapping enteric infectious diseases and their risk factors and interventions in LMICs (K01)

University of Virginia | Principal Investigator: Josh M. Colston

To identify areas of transmission risk and monitor enteric infectious disease (EID) burden trends under a changing climate, this project will apply a big data approach to the mapping of EIDs combining advanced molecular diagnostics and geostatistical analyses with global earth observation-derived datasets to provide generalizable estimates of the geographical distribution of these outcomes and their environmental drivers via an interactive web-based dashboard. This research will provide the data inputs that are urgently needed for targeting existing and novel interventions to priority populations LMICs. (***Example of 'Systems Science'***)

Development and testing of a smartphone-delivered climate adaptation and IPV and related stress intervention for residents of informal settlements in Kenya using ecological momentary approaches (R21)

Africa Mental Health Foundation | Principal Investigators: Christine Wayua & Samantha C. Winter

This project aims to pilot and test the feasibility and preliminary efficacy of a smartphone-delivered climate adaptation safety and harm reduction intervention for women experiencing intimate partner violence (IPV) in informal settlements in Kenya using ecological momentary approaches. The goals of this study are to provide women with a low-cost, accessible, smartphone-based tool that empowers them to develop, utilize, and revise personal safety and harm reduction strategies that are specifically responsive to climate- related IPV. (***Example of 'Global, Cross-Sector, Interagency, & Community Partnerships'***)

"Individuals living in poverty, with limited access to health and economic resources, and historically marginalized groups face greater risks and health impacts from extreme weather, particularly in lower-income countries. Alongside efforts to slow global warming, it's crucial to develop and enact programs guided by health experts to adapt to unavoidable climate threats. The NIH Climate Change and Health Initiative collaborates with the global research community to create innovative tools, technologies, and science-based strategies to help protect the most vulnerable from climate related health risks."

—Josh Rosenthal, Ph.D., FIC, NIH CCHI Co-Chair

Additional Programs and Activities

NIH Climate and Health Outcomes Research Data Systems (CHORDS)

In March 2023, NIEHS was awarded nearly $4 million over three years from the Patient-Centered Outcomes Research Trust Fund (PCORTF) in order to lead efforts integrating environmental data with health outcomes data. The CHORDS project is being implemented as an NIH-wide collaborative effort, involving a total of 7 ICs that participate in the Stakeholder Engagement Forum to bring their health-data expertise from NIEHS, NICHD, NHLBI, NCI, NIMHD, NIA, and NLM. This award from PCORTF is a first for NIEHS. The overall goal of the Climate and Health Outcomes Research Data Systems (CHORDS) project is to create a public resource that researchers can use to identify and reduce the health effects associated with environmental or climate-related events and improve patient and population outcomes. The health effects associated with wildfire smoke will be the initial focus of this data infrastructure project. The final project aims to include the following tools for climate and health researchers: public web catalog of resources, standardized linked datasets, toolkit for using the software and data processing, and communications regarding the new resources and addressing end users' needs. Climate and health researchers looking for standardized datasets and tools can utilize the health data sources that will appear on the resource, including data from the Agency for Healthcare Research and Quality, the CDC, and other partners.

NIH Climate and Health Scholars Program

The NIH Climate and Health Scholars Program (CHSP) was established in 2023, directed by Dr. Adriana Costero-Saint Denis from NIAID, to bring climate and health scientists from outside the federal government to work with NIH staff to share their knowledge and expertise and help build NIH's climate and health research capacity. Each CH Scholar is hosted by an NIH ICO for a period of up to 11 months. During this time, the CH Scholars are invited to collaborate with NIH staff on a diverse array of research, training, and other relevant activities to share their scientific knowledge with NIH intramural investigators, program staff, and the broader NIH community. The CH Scholars develop workplans with their ICO Ambassadors—a designated point of contact at the host ICO—to outline specific activities to be achieved during their tenure. These activities are both at the ICO and NIH-wide levels.

In February 2023, NIH welcomed the inaugural class of CH Scholars. Each of the eight CH Scholars was hosted by one of the following ICOs: NIAID, NIMHD, NIEHS, NIA, NHLBI, FIC, NINR, and NCI. This first cohort collectively gave over fifty presentations to internal and external groups for knowledge and capacity building, contributed content and expertise to 22 NIH-wide and IC-specific Working Groups, and produced over 20 science and research products related to climate change and health—including portfolio analyses, manuscripts, white papers, reports, journal publications, and even a call for climate change adaptation case studies.

In October of 2023, NIH welcomed its second class of CH Scholars, comprised of researcher from 7 academic universities and organizations across the US and in South Africa. Each scholar is hosted by one of the following ICOs: All of Us Research Program, NIA, NIEHS, NIMHD, NIAID, NCI, and FIC. This current cohort will serve as NIH Climate and Health Scholars until September of 2024.

NIH Climate Change and Health Seminar Series

The NIH CCH Seminar Series aims to educate and inform the public about the human health implications of climate change. The seminar series presents monthly one-hour webinars from various NIH and external speakers who have expertise in a unique climate and health field. These webinars highlight work in the field of climate change while also promoting scientific, transdisciplinary discussion and collaboration in the concerted effort against an extreme threat to health.

In fiscal year 2023, there were a total of 11 CCH webinars in the series. Each webinar was attended by numerous individuals in the public and in the scientific research community.

The topics included:

- Climate Change and Cancer
- Addressing Health Disparities and Reducing Mortality due to Non-communicable Diseases During Climate-induced Disasters
- Protecting Human and Planetary Health: New Unique and Necessary Roles for Health Professionals
- Health Consequences of Climate Change with a Lens on Social Determinants of Health
- Climate Change Impacts on Neglected Tropical Diseases
- Disasters, and Food Security: Impacts and Disparities
- Considerations of Historical Climate Data and Exposure Metrics for Climate-Health Research
- Weatherizing Homes to Adapt to and Mitigate Climate Change
- Environmental Justice and Well-Being: Improving Energy Access to Empower Women in Rural India
- Older Adults' Vulnerability and Resilience to Disasters
- How Climate and Land Use Change Are Transforming the Landscape of Vector-Borne Disease

NIH Intramural Targeted Climate Change and Health Program (ITCCH)

In addition to supporting grantees, in February 2023, six internal research programs, known as intramural programs, across the NIH received funding designed to advance climate and health related research. The Intramural Targeted Climate Change & Health (ITCCH) funding program is a $2.1 million collaboration between NIEHS and the NIH Office of Intramural Research. The two-year awards will provide up to $200,000 annually to support research activities for NIH intramural investigators focused on basic and applied research on the health effects of climate change.

The February 2023 NIH ITCCH Awardees include:

- **Lindsey Criswell, M.D., D.Sc., M.P.H., Senior Investigator, NIAMS, CCHI EC Director:** "Effects of wildfire smoke exposure on the epigenome and health in a multi-ethnic cohort."
- **Una Grewal, Ph.D., M.P.H., Senior Investigator, NICHD:** "Climate change and its effects on reproductive health, pregnancy, and birth outcomes."
- **Edward Lakatta, M.D., Senior Investigator, NIA:** "Effects of climate change on cardiovascular aging and diseases."
- **Qing Lan, M.D., Ph.D., M.P.H., Senior Investigator, NCI:** "Combined effects of extreme climate and air pollution on multi-omics upper airway and plasma biomarkers related to risk of lung cancer."
- **Emily Ricotta, Ph.D., M.Sc., Independent Research Scholar, NIAID:** "Analysis of data management capacity in regions with high infectious disease spillover risk."
- **Dale Sandler, Ph.D. Senior Investigator, NIEHS:** "Characterizing the role of epigenetic adaptation in the relationship between extreme heat and metabolic dysfunction: A paired human and mouse study."

In December 2023, five additional research programs across the NIH received funding designed to advance climate and health related research.

- **Yogen Kanthi, M.D., Tenure-Track Investigator, NHLBI:** ""Wildfire Smoke Exposure and Vascular Thromboinflammation."
- **Lenore Launer, Ph.D., Senior Investigator, NIA:** "Effect of a climate change consequence on markers of senescence."
- **Leah Katzelnick, Ph.D., M.P.H, Tenure-Track Investigator, NIAID:** "Evaluating the impact of climate change on dengue virus evolution and disease burden."
- **Anne Marie Jukic, Ph.D., Tenure-Track Investigator, NIEHS:** "Endocrine disrupting effects of ambient temperature and climate on reproductive health."
- **Eugene Koonin, Ph.D., M.Sc., Senior Investigator NLM/NCBI:** "Quantifying the Effects of Climate Change on Expanding Vector Range and Global Viral Disease Burden."

NIH Climate and Health Initiative Partnerships

NSF-NIH Partnership

To more rapidly fund and support researchers interested in working on climate change related disasters, the NIH Climate Change and Health Initiative established an agreement with the US National Science Foundation (NSF) to provide funding to two centers housed at universities known for their disaster response expertise (University of Colorado Boulder and University of Washington).

With funding support from NIH, the University of Colorado Boulder Natural Hazards Center will provide rapid awards to eligible grantees to get into the field quickly after an extreme climate event to work with communities to start health-related research and gather time-sensitive data. Applications are now being accepted and available funds will support awards in the amount of $10,000 to $50,000 each until all funds are exhausted.

Additionally, with funding support from NIH, The University of Washington Natural Hazards Reconnaissance (RAPID) Facility will be offering technical instrumentation, training, and resources to researchers collecting perishable exposure and health data.

The centers will provide support for timely collection of perishable data and health research in response to climate-related disasters. The partnership enhances opportunities to bring climate science and related disciplines together with the growing NIH CCH and disaster research Communities of Practice.

"The recently formed NSF-NIH partnership for rapid disaster research response allows for scientists across disciplines to collaborate more effectively on climate disaster research. Through these two centers at the University of Washington and the University of Colorado-Boulder, NIH will be able to support the timely collection of perishable climate disaster related data, as well as provide instrumentation, resources, and trainings to researchers collecting perishable exposure and health data for climate disasters. This partnership allows NIH to fund rapid response disaster research, which typical NIH mechanisms do not often allow for."

—Aubrey Miller, M.D., NIEHS, NIH CCHI Co-chair

CLIVAR

US Climate Variability and Predictability (CLIVAR) is a national research program with a mission to foster understanding and prediction of climate variability and change. The US CLIVAR Program contributes directly to the broader US Global Change Research Program (USGCRP) by coordinating and advancing research within the U.S. to improve the documentation, understanding, modeling, and prediction of variations in global and regional climate. US CLIVAR also provides US research and organizational contributions under United Nations auspices. Multiple Agencies participate in CLIVAR.

NIH investments in CLIVAR support a 3-year working group on climate change and health that brings together other non-NIH federal partners to address the pressing issue of climate change impacts on human health. Over 2023, the group involved in this collaboration has worked on papers that emphasize the scientific gaps and possible models for increasing interdisciplinary collaboration on climate and health through improved data management and accessibility, as well as papers that address the best practices for incorporating climate uncertainty into climate-driven predictions of health outcomes.

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Appendix: Other Relevant Climate and Health Activities at NIH

National Institute of Environmental Health Sciences Climate Change and Human Health Literature Portal

National Institute of Environmental Health Sciences

The National Institute of Environmental Health Sciences (NIEHS) Climate Change and Human Health Literature Portal is a free, open access, online bibliographic knowledge management tool and resource for individuals who want to find the most relevant scientific literature on the health implications of climate change. It currently provides access to a database of peer-reviewed research and studies published between 2007 and 2023. The goal of the Portal is to provide a global audience with ongoing access to this body of knowledge in order to facilitate research and inform decision and policy making that is protective of health.

NIEHS developed the portal after receiving feedback from academic and public health stakeholders that it was often difficult to access the most relevant studies on climate change and health because of the many disciplines and journals involved in the field. The search is evaluated and revised annually to refine results as well as to capture relevant resources in research literature.

The portal includes studies about the health impacts associated with exposures to climate variability (e.g., heat, extreme precipitation) and climate change (e.g., changing seasonality, longer term temperature changes). Scientific literature on the health impacts of weather-related natural disasters is also included, as are studies of related issues such as health benefits of actions aimed at reducing greenhouse gas emissions, health adaptation, and the resilience of health care facilities to extreme weather and climate events.

Click here to access the literature portal: https://tools.niehs.nih.gov/cchhl/

National Institute of Environmental Health Sciences Climate Change and Human Health Glossary

National Institute of Environmental Health Sciences

The NIEHS Climate Change and Human Health (CCHH) Glossary was launched in September 2023 and was developed by the Global Environmental Health Program. The Climate Change and Human Health Glossary is a free, open access, online curated database of terms relevant to the science of climate change and its impacts on health. It is also available in a mobile version. This glossary represents an ongoing effort by NIEHS to standardize scientific language related to climate change and health, and to improve data-sharing between researchers, policy makers, advocates, educators, health care providers and others.

By establishing a consistent terminology for climate change and health, the CCHH Glossary helps make the knowledge more accessible to a global audience. The field of climate change and health is rapidly expanding, encompassing multiple disciplines. Consequently, some terms related to climate change and health may have different uses and definitions across different disciplines. A standardized glossary will encourage clear communication, enable data harmonization, and improve mutual understanding of issues as the field increases in size and scope.

To develop the CCHH Glossary, potential terms were gathered from many relevant sources and existing glossaries. External review was provided by external stakeholders who are subject matter experts in the field. The resulting glossary consists of 330 terms and definitions, categorized by concept, with closely related terms identified for each entry. The team also included climate change and health-specific descriptions for terms that have multiple uses to highlight its uses in the field. Additionally, new terms can be suggested for the glossary, and the resource will be updated semi-annually to reflect the dynamic landscape of climate change and health.

Click here to access the glossary: https://tools.niehs.nih.gov/cchhglossary/

National Institute of Environmental Health Sciences Disaster Research Response (DR2) Resources Portal

National Institute of Environmental Health Sciences

The National Institute of Environmental Health Sciences (NIEHS) DR2 Resources Portal is a repository of data collection tools and related resources curated by the DR2 Program to empower human health research in response to disasters and public health emergencies. One can find questionnaires, data dictionaries,

protocols, common data elements, REDCap surveys, a NIH COVID-19 collection, and so much more.

The DR2 Resources Portal is one of the capstones of our program with over 500 resources and tools for increasing the speed and quality of research. These resources promote access to unpublished resources and promote standard measures, replication, and cross comparisons. Resources in the portal also aim to build new research protocols for disaster research investigations.

Click here to access the DR2 Resources Portal: https://tools.niehs.nih.gov/dr2/

Additionally, training materials, funding announcements, and other information are available on the DR2 program pages.

National Institute of Nursing Research Climate Change and Health Request for Information

The National Institute of Nursing Research (NINR) published a Request for Information (RFI) entitled: Advancing Nursing Research in Climate and Health (NOT-NR-23-018) in September 2023. Through this RFI, NINR sought comments and testimonies from the extramural scientific community, professional societies, and the general public regarding research gaps in which nursing research can make a difference and/or provide a unique perspective. With its holistic, contextualized perspective to improve health, focus on individuals and communities, and commitment to health equity, nursing science plays a major role in understanding and mitigating the impact of climate change on health.

National Cancer Institute Climate Change and Health Funding Opportunities

NCI published a pair of notice of funding opportunities (NOFOs), PAR-23-152 and PAR-23-153, with the aim of stimulating and supporting innovative research relevant to advancing the understanding of the effects of climate change across the cancer control continuum, from cancer etiology and cancer risks through survivorship, and ways to prevent or mitigate negative health effects. The NOFOs, titled “Impacts of climate change across the cancer control continuum”, support R21 (PAR-23-152) and R01 (PAR-23-153) research grants. These NOFOs are currently accepting applications and expire May 8, 2026.

National Cancer Institute 2023-2024 Cyber Discussion Series: Toward Disaster Resilient Healthcare Teams

The National Cancer Institute (NCI) developed a series of four webinars from May 4, 2023-March 7, 2024 that discussed lessons learned by researchers and cancer care delivery teams about how to continue cancer care and research operations across the cancer continuum during disasters. Also discussed was how to work effectively with clinical and community organizations, patients, and their families during some of our nation's most catastrophic events. The series emphasized care coordination needs among populations that experience cancer disparities (racial/ethnic minority, under-resourced and historically disadvantaged communities) and populations disproportionately affected by public health emergencies.

The topics include:

- Teaming, coordination challenges, and approaches to cancer care during disasters and public health emergencies
- Research examining disaster impact and resilience in cancer care delivery
- Global perspectives on cancer care teaming and resilience during natural and public health emergencies
- Patient and caregiver experiences navigating cancer care during emergencies

Fogarty International Center Global Climate Change and Health Case Studies

The Center for Global Health Studies (CGHS) of the Fogarty International Center (FIC) within the U.S. National Institutes of Health (NIH), as part of the NIH CCHI, invited submissions for global researchers to submit case studies detailing adaptation strategies that respond to the impact of climate change on public health.

For the purposes of the call, adaptation is broadly defined as the process of adjustment to actual and potential climate-led impacts. This collection aims to address current gaps in climate science literature regarding the impact of climate change adaptation on health. The goal of this collection is to identify and understand current or historical adaptation strategies that can be better harnessed to address deteriorating health outcomes using relevant and appropriate research approaches and methodologies. When complete, the collection will strengthen the evidence base around climate change adaptation and help identify research priorities and future research needs in this area.

National Institute of Mental Health Webinar

A Healthy Response to Climate Change: On January 19, 2023, NIMH hosted a webinar on Ecological Grief and Anxiety. The speaker presented her research examining how climate change is impacting Inuit communities on the frontline of climate change in the Arctic and Subarctic regions of northeast Canada. She described profound, cumulative, and complex mental health outcomes of climate change, as well as how "gritty hope" can furnish new ethical and political communities.


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