

Climate and Health at NOAA: Climate Information to predict health risk, reduce impacts and enhance resilience



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NOAA Climate Program Office

NWS Climate Services Meeting
May 12, 2016

Walk Through

- What are Climate-related health activities within NOAA-NOAA One Health Group
- What is the NOAA role on USGCRP for health?
- How is climate incorporated in future human health scenarios and health planning?
- What are the ways in which the NWS Climate Services Program can contribute to NOAA's health efforts and vice versa?

NOAA One Health Goals

This NOAA-wide Group will advance NOAA's science and services to inform health decisions through:
*improved understanding of the linkages between environmental conditions and health outcomes, and
delivery of useful prediction products, data and tools*



**Animal
Health**



**Human
Health**



**Ecosystem
Health**

Thematic areas include:

- **Wildlife and Zoonotic Disease**
- **Air Quality**
- **Heat (Thermal Extremes)**
- **Vector-Borne Disease**
- **Water-borne Illness**
- **Natural Products**
- **Safe Food**
- **Arctic**

NOAA One Health Group

Tasks and Functions

Tasks include:

- Communicating relevant science and services to health decision makers
- Identifying and promoting innovative science and services
- Developing tools and technologies
- Facilitating transfer of research to applications
- Promoting commercialization of applications
- Creating and leveraging strategic health partnerships
- Engaging stakeholders

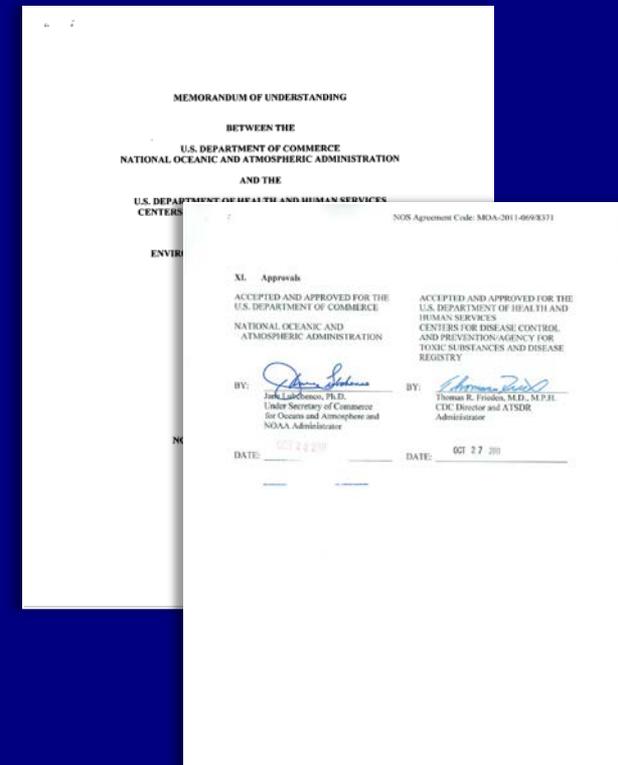
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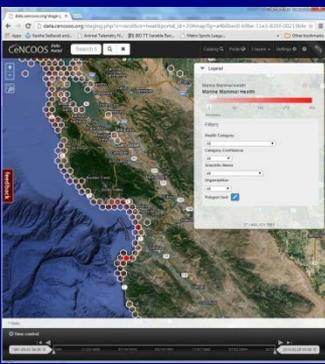
- Communicating relevant science and services to health decision makers;
- Identifying and promoting innovative science and services
- Coordinates and Implements the NOAA/CDC MOU
- Providing and ensuring health community connection with Ecological Forecasting Roadmap
 - Strong ties to Food and Drug Administration
 - Connections to CDC and State Health Departments
- Coordinating NOAA engagements with public health community

NOAA and CDC

Memorandum of Understanding

- NOAA has a comprehensive interagency MOU with Centers for Disease Control and Prevention (CDC)
 - Signed October 2011 by Administrators Dr. Lubchenco and Dr. Frieden
 - Cross NOAA and 5 CDC Divisions
- Provides a formal cooperative framework to further collaborative efforts for:
 - preparedness and planning
 - integrated data management
 - surveillance and monitoring
 - prediction and forecasting
 - emergency response and assessment
 - communication and capacity development, including rotational assignments





NOAA One Health Theme Marine Zoonotics



NOAA Permit 932-1905-
MA009526

■ Goal/Scope

Determining the cause of disease in marine mammals, understanding changes in trends of health and disease with environmental changes, and inform ecosystem, population, public health risks of environmental change.

■ NOAA Participants

NMFS Marine Mammal Health and Stranding Response Program; NMFS SC/Regions; NCCOS

■ Activities

- Baseline Marine Mammal Health & Disease Surveillance
- Unusual Mortality Event and Outbreak Investigations
- Marine Mammal Health M.A.P.

■ Other Partners

CDC, EPA, FDA, MMC, NAVY, NPS, USCG, USDA, USFWS, USGS, State Wildlife Health Agencies, IOOS, NAPHV, WDA, CCWHC, EU Wildlife Health, Australian Wildlife Health Network, FAO, OIE, IWC, Regional/state stranding and diagnostic labs

NOAA One Health Air Quality Theme

■ Goal/Scope

- Increase synergy and coordination between the NOAA line offices on air quality products and services
- Engage partners to gather requirements for air quality, mercury and radiological modeling to provide decision support services
- Develop collaborations with CDC and NIH on projects that study linkages between air quality and respiratory and cardiovascular health

NOAA Participants:

Name	Office	Title
Richard Artz	OAR	Deputy Director, Air Resources Laboratory
Richard Fulton	OAR	OWAQ Air Quality Portfolio Manager
Larry Horowitz	OAR	Physical Scientist
Margaret Kerchner	OAR	Program Analyst
Shobha Kondragunta	NESDIS	Research Physical Scientist
Jim Roberts	OAR	Research Chemist
Ivanka Stajner	NWS	Manager for the National Air Quality Forecast Capability
Eric Williams	OAR	Deputy Director for Planning, ESRL/CSD

■ Activities

- Monthly Meetings (1st Tuesdays)
- National Air Quality Forecast Capability (NAQFC) [*Operational*] – new public PM2.5 predictions
- Atmospheric Dispersion Modeling
- Fire Influence Regional and Global Environments Experiment (FIREX)
- Global Health Burden of Anthropogenic O3 and PM2.5 [*Research*]
- Remote sensing of air quality in support of air quality monitoring and forecasting [*Operational*]

■ Partners



- Comprehensive Nuclear Test Ban Treaty Organization
- State departments and local emergency managers
- DOE's Idaho National Laboratory
- Nevada National Security Site

The Impact of **Wildfires** on Air Quality, Human Health, and Climate

A 2015-2019 focus of the NOAA ESRL Chemical Sciences Division

Motivation: The “New Normal” for Wildfires

A warmer and drier climate is expected to lead to more frequent and more intense fires near or within populated areas.

Wildfires Affect Air Quality and Health. Wildfires emit substantial amounts of volatile and semi-volatile organic materials and nitrogen oxides that form ozone and organic particulate material. Direct emissions of toxic pollutants can affect first responders and local residents. In addition, the formation of other pollutants as the air is transported can lead to harmful exposures for populations in regions far removed from wildfires.

Wildfires Affect Climate. Wildfires release large amounts of carbon dioxide, black carbon, brown carbon, and ozone precursors into the atmosphere. These emissions affect climate via changes in radiative balance and cloud properties on regional and even global scales.



What is Needed?

- Information on
- fire emissions, especially from different source materials
 - transport and chemical transformations in fire plumes
 - evolution and dynamics of fires and fire plumes

Why?

- To improve model predictions of fire and smoke behavior near a fire and transport of pollutants downwind from fires; and improve the value of satellite data products
- To understand effects of fire activity on climate, air quality, and ultimately public health



FIREX: Fire Influence on Regional and Global Environments Experiment

- FIREX is a 2015-2019 interagency collaborative research mission, led by NOAA ESRL CSD, to improve understanding of fire impacts on the environment and human health.
- FIREX has ground-based, aircraft, and fire-lab components.
- FIREX results will help provide a policy-relevant scientific basis for evaluating fire management approaches.
- Partners in FIREX are also principals in the Fire and Smoke Model Evaluation Experiment (FASMEE):
 - Joint Fire Science Program
 - USDA/US Forest Service
 - Desert Research Institute
 - US Environmental Protection Agency

Expected Payoffs

- Improved understanding of fire emissions and chemistry
- Better “fire weather” predictions for on-scene responders
- Quantitative assessments of human exposure to fire pollutants

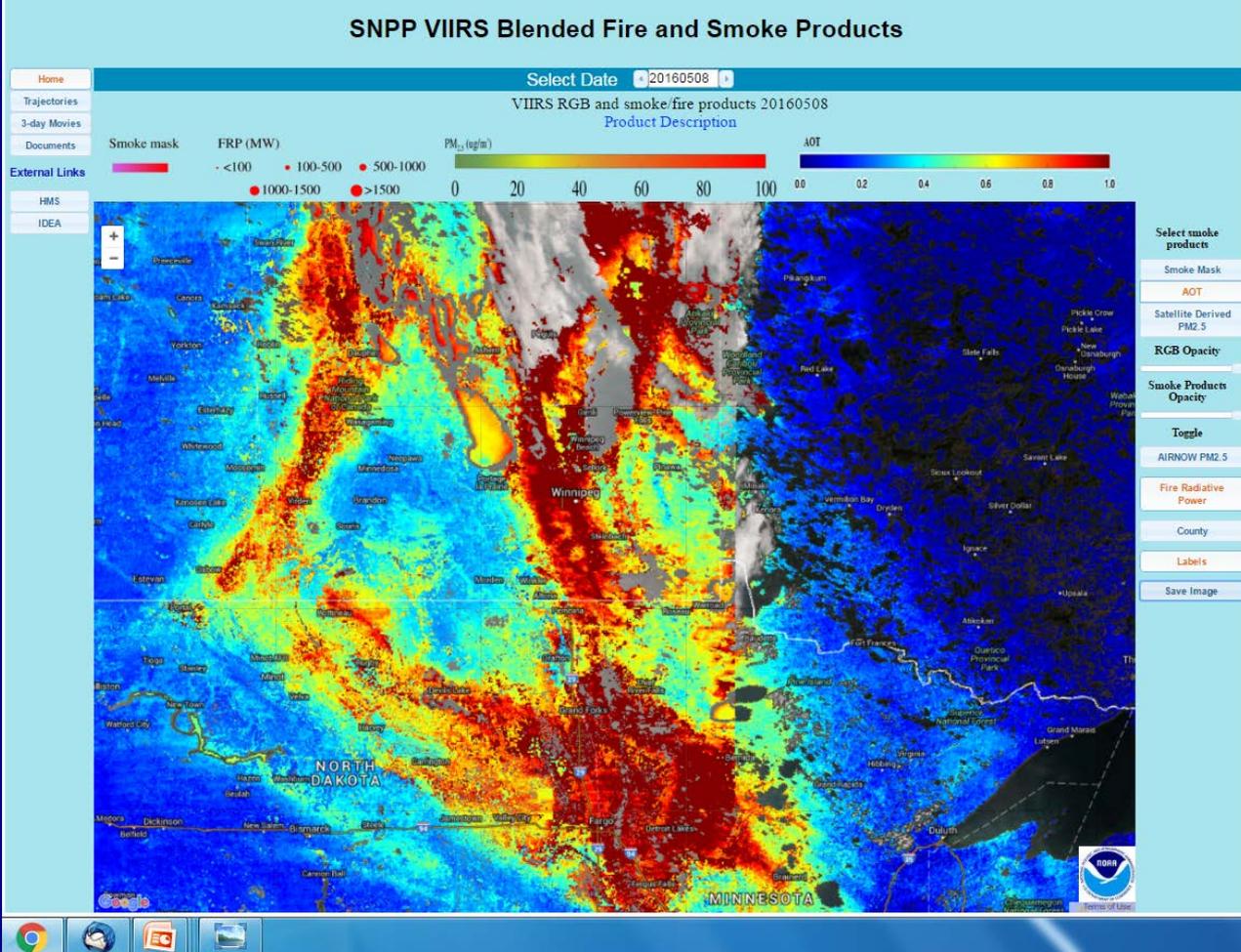


Air Quality Alerts and Public Health

More than 3 million premature deaths globally per year* due to poor air quality.

Satellite data help fill gaps in EPA ground monitors not dense enough to provide monitoring and warnings for 40 million people living in rural areas in the US.

Through a new "Fire & Smoke" initiative NESDIS is supporting the NWS field forecasters and Incident Meteorologists (IMETs) by providing near real time blended fire and smoke products from Suomi National Polar-orbiting Partnership Visible Infrared Imaging Radiometer Suite (SNPP VIIRS)



<http://www.star.nesdis.noaa.gov/smcd/spb/aq/eidea/>

Operational air quality forecasters rely on satellite-derived aerosol products to provide air quality alerts and warnings due to long-range and regional transport of smoke from fires. **Image above shows screen capture of May 8, 2016 smoke aerosol optical thickness from Ft. McMurray fires in Alberta, Canada (fires started May 4th). Transported smoke impacted surface air quality in the mid-West and as of May 11th continues to impact US air quality.**

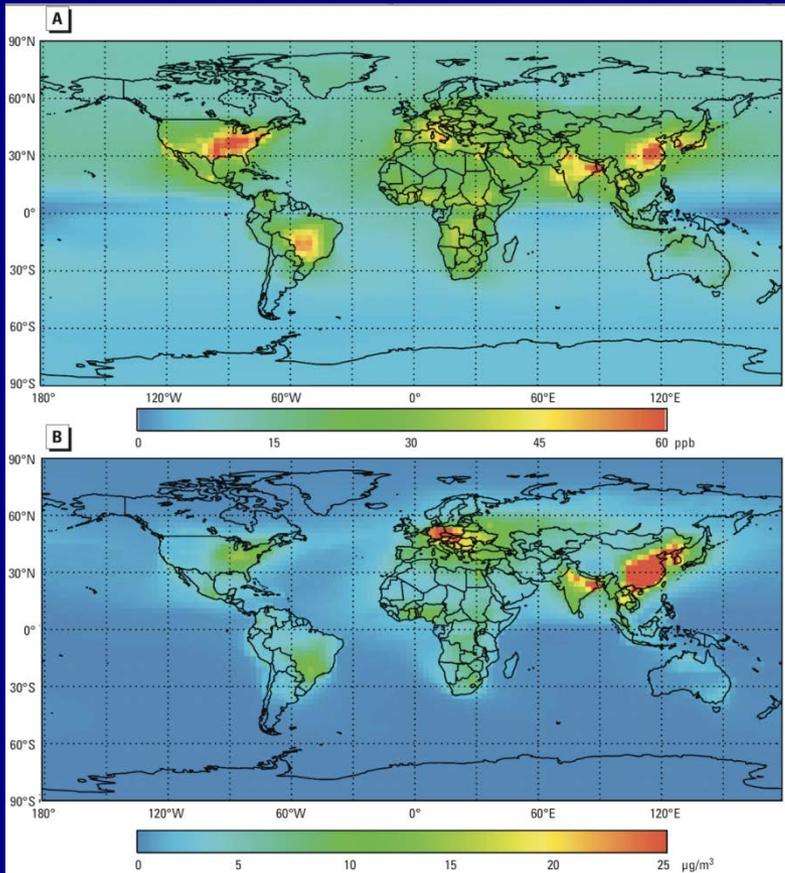
*Global Disease Burden project by Lim et al., The Lancet, 2012



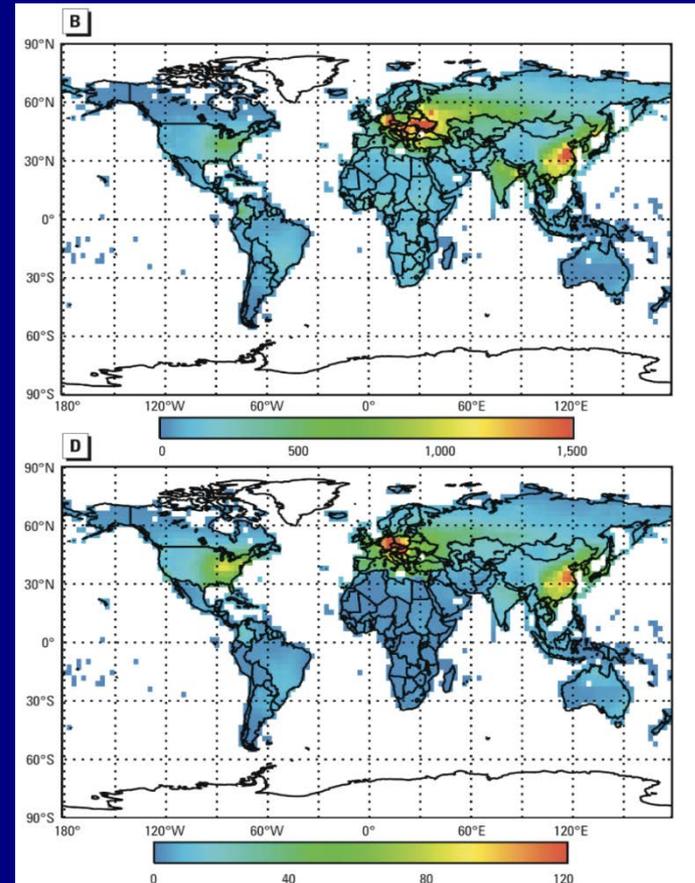
Global Health Burden of Anthropogenic O₃ and PM_{2.5}

Highlight: ARL and GFDL worked with health experts to estimate premature deaths from exposure to global air pollution using atmospheric models

Global O₃ (Top) & PM_{2.5} Levels



Resultant Cardiovascular deaths & lung cancer rates (per million)



Reference: Anenberg, S.C et al. 2010. *Environmental Health Perspective*, 118(9), 1189-1195.

NOAA One Health Theme Vector-borne Disease

- Pandemic Prediction and Forecasting Science and Technology Working Group-OSTP/NSC
 - Dengue Forecasting Opportunity Launched June (DengueForecasting.noaa.gov)
 - Dengue and El Nino—Forecasting in South Asia/Malaysia Workshop (NCEI)
 - Rift Valley Fever Notification (multi-agency)
- NCEP International Desks
 - Two Climate and Health Workshops: Senegal (July), Tanzania (August)
 - Clim-Health Africa partner
- NOAA Role PPFST:
 - Working Group Representation, Andy Stern (NWS), Juli Trtanj (OAR), Michelle Hawkins (NWS)
 - NCEI/CICS (Jesse Bell) provided ALL of the environmental data and code
 - NWS stood up in record time the Dengue Forecasting website
 - NOAA Comms, NWS and CPO Comm/Ed actively engaged in the communications
 - **Much research on which this is based was funded by NOAA/CPO with other agencies**



Emerging Health Risk Notification, 18 Dec 2015, El Niño and Rift Valley fever (RVF) risk, east Africa. This Notification is a pilot effort of an interagency working group that integrates Federal expertise to synthesize risk information and response options for biological threats to US citizens and interests. The Notification is provided to USG operational biosurveillance centers for analysis and dissemination. *The views expressed do not necessarily represent those of all departments and agencies that participate in the Pandemic Prediction and Forecasting Science and Technology Working Group.*

Summary: *The risk of El Niño-driven RVF outbreaks is high in east Africa. Intensified efforts within the next 30 days are needed to mitigate the threat. Countries at risk likely require additional assistance with animal vaccination and mosquito control, key measures to minimize RVF activity.*

Major east Africa outbreaks coincided with strong El Niño events in 1997-8 and 2006-7. The current potential for RVF outbreaks is of US importance for at least 2 reasons:

Regional health and economic impacts: The 2006-7 outbreaks in Kenya, Somalia, Tanzania, Sudan, and Madagascar are estimated to have caused > 200,000 human infections with > 500 deaths [5], and cost Kenya alone \$22 million from livestock losses and

El Niño status and possible global health impacts. NOAA's El Niño advisory [1] predicts the current El Niño will peak during the Northern Hemisphere



CHARTER
of the
PANDEMIC PREDICTION AND FORECASTING SCIENCE AND TECHNOLOGY
WORKING GROUP
SUBCOMMITTEE ON BIOLOGICAL DEFENSE RESEARCH AND DEVELOPMENT
COMMITTEE ON HOMELAND AND NATIONAL SECURITY
NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

A. Official Designation

The Pandemic Prediction and Forecasting Science and Technology Working Group (WG) is hereby established by the National Science and Technology Council, Committee on Homeland and National Security, Sub-Committee on Biological Defense Research and Development (CPO).

B. Purpose and Scope

The purpose of the PPFST WG is to provide a focused forum to coordinate and synthesize information on biological threats to the United States and to coordinate the development of a national strategy to address such threats. The WG will coordinate the development of a national strategy to address such threats. The WG will coordinate the development of a national strategy to address such threats.

C. Functions

The WG will coordinate the development of a national strategy to address such threats. The WG will coordinate the development of a national strategy to address such threats.

Discussions underway to build a National Infectious Disease Forecasting System/Center/ Capacity

Arctic – Operationalizing a One Health Approach

- **NMFS Marine Mammal Health and Stranding Response goals in the Arctic?**
 - Marine mammal populations and emergency response in the Arctic
 - Marine mammal populations and increased anthropogenic impacts in the Arctic
 - Marine mammal health surveillance - species-specific health surveillance sampling program for stranding network, subsistence harvested animals, live capture release programs and other partners
 - Marine mammals and public health –Food safety and Security due to reliance on subsistence foods
- **Key Partners**
 - NMFS OPR MMHSRP, NMFS AKR, AKFSC, USFWS, ANOs, NOS ORR, USGS, IWC, AOOS, AK State Dept of Health, Alaska Native Tribal Health Consortium, AK CDC, Marine Mammal Stranding Network, Alaska communities and other partners
- **Active but still diffuse engagement across NOAA, with USGCRP CCHHG, Multiple other agencies, and State to develop One Health Approach**

NOAA One Health Theme: Water-Related Illness

■ Goal/Scope

Facilitate and coordinate internally on research and product development for WRI

Build links with CDC, State Health Departments and Internationally

Support connections with EFR, GFCS, and GEO

■ NOAA Participants

NCCOS, NWFSC, GLERL, MMHSRP, AOML, OER, NCEI, NESDIS STAR, GFDL, RISAs, COCA

■ Activities

– Develop HAB and vibrio products for state health departments, shellfish and beach managers

– Provide research and operational capacity to other countries and international organizations

– Develop and validate EFR products and connections with health community

– Develop projections for the USGCRP Climate and Health Assessments

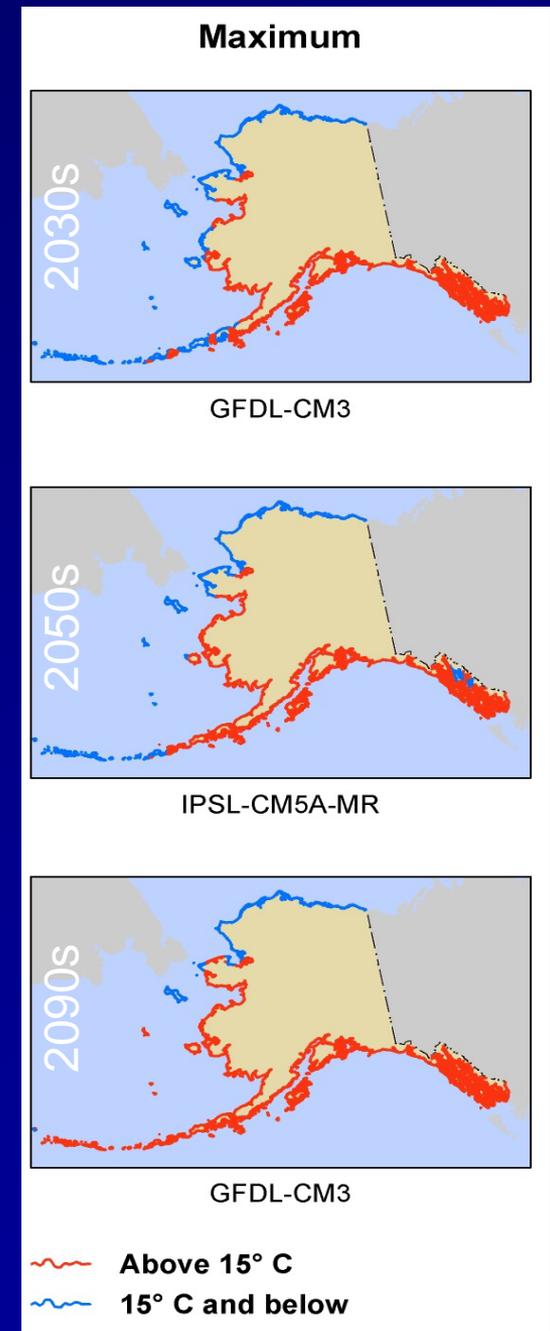
■ Other Partners

CDC, FDA, Shellfish growers, WHO, EU, State Health Departments-MD, WA, MS, FL, OH, WI, RI

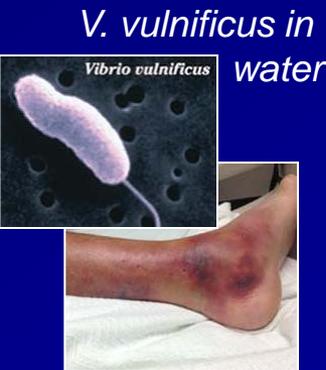
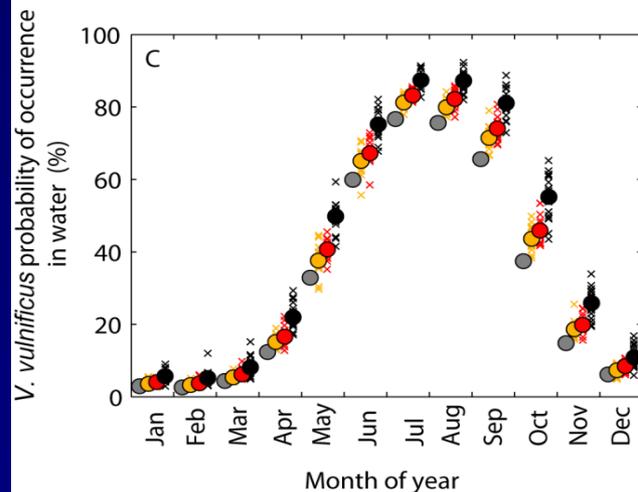
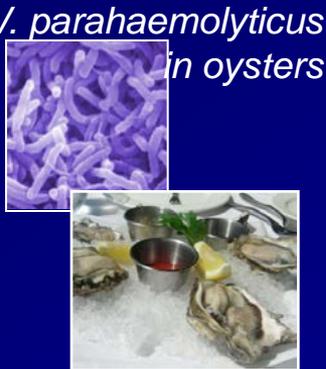
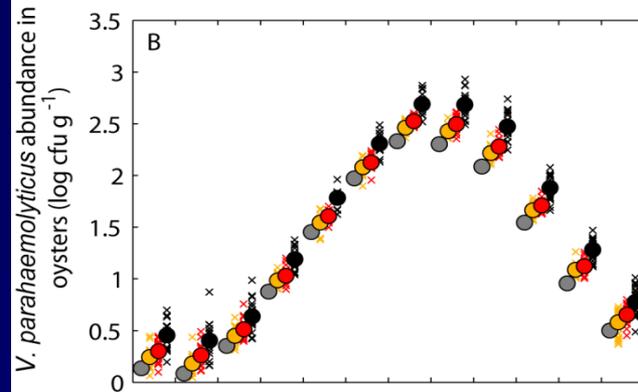
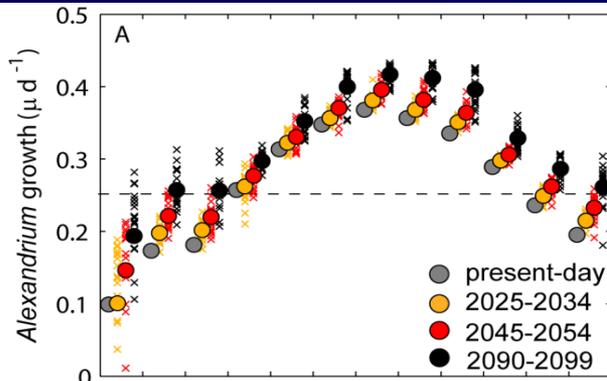
Changing Geographic Range for Vibrios: links with Ecological Forecasting Roadmap

- Potential for extensive **geographic range shifts** based on the temperature niche (SST > 15°C) for *Vibrio*

Climate models	Projected % of Alaskan shoreline with SST > 15°C during August (Average)		
	2030s	2050s	2090s
GFDL	22.0%	39.2%	79.6%
IPSL	30.7%	30.2%	62.1%
Nor_ESM1_M	13.1%	33.6%	51.5%
Nor_ESM1_ME	20.7%	28.0%	38.9%



Climate change impacts on coastal pathogens



- Statistically downscaled climate projections for the 2030s, 2050s, and 2100 from 21 CMIP5 models using RCP6.0
- Progressive expansion of the seasonal window for harmful algal blooms and pathogenic bacteria in U.S. coastal waters (Puget Sound and Chesapeake Bay)
- Managers will need to adapt monitoring and mitigation strategies to be prepared for human health risks outside of the typical season (Jacobs et. al, submitted)

One Health Theme: Heat (Thermal Extremes)

■ Goal/Scope

- **Identify requirements** for NOAA data, research, observations and services that enable public health partners to better prepare for and respond to extreme heat events.
- **Work in partnership** with public health agencies to leverage shared resources for heat health-related efforts that support our common life-saving missions
- **Develop collaborative studies** with health partners to better understand the health impacts of extreme heat and effective response solutions
- **Work with international partners** to share best practices; develop cross-boarder initiatives that result in reduced health impacts due to extreme heat
- **Work with social scientists** to better understand how heat risks are perceived and how communication of risks can be improved

■ NOAA Participants:

- NWS: Michelle Hawkins, Jannie Ferrell, Vankita Brown
- OAR: Juli Trtanj
- NESDIS: Stephanie Herring

■ Activities

- **National Integrated Heat Health Information System**
- Workshop on Climate Information Systems for Heat Health Early Warning NOAA-CDC Heat Health Summit
- Annual media briefing with OSHA
- Evolution of operational heat products and services
- Cross-border pilots with Canada
- Routine information sharing (heat data, product issuance, seminars and webinars)

■ Other Partners

- CDC
- OSHA
- Environment Canada
- Health Canada
- WMO

National Integrated Heat Health Information System (NIHHIS)

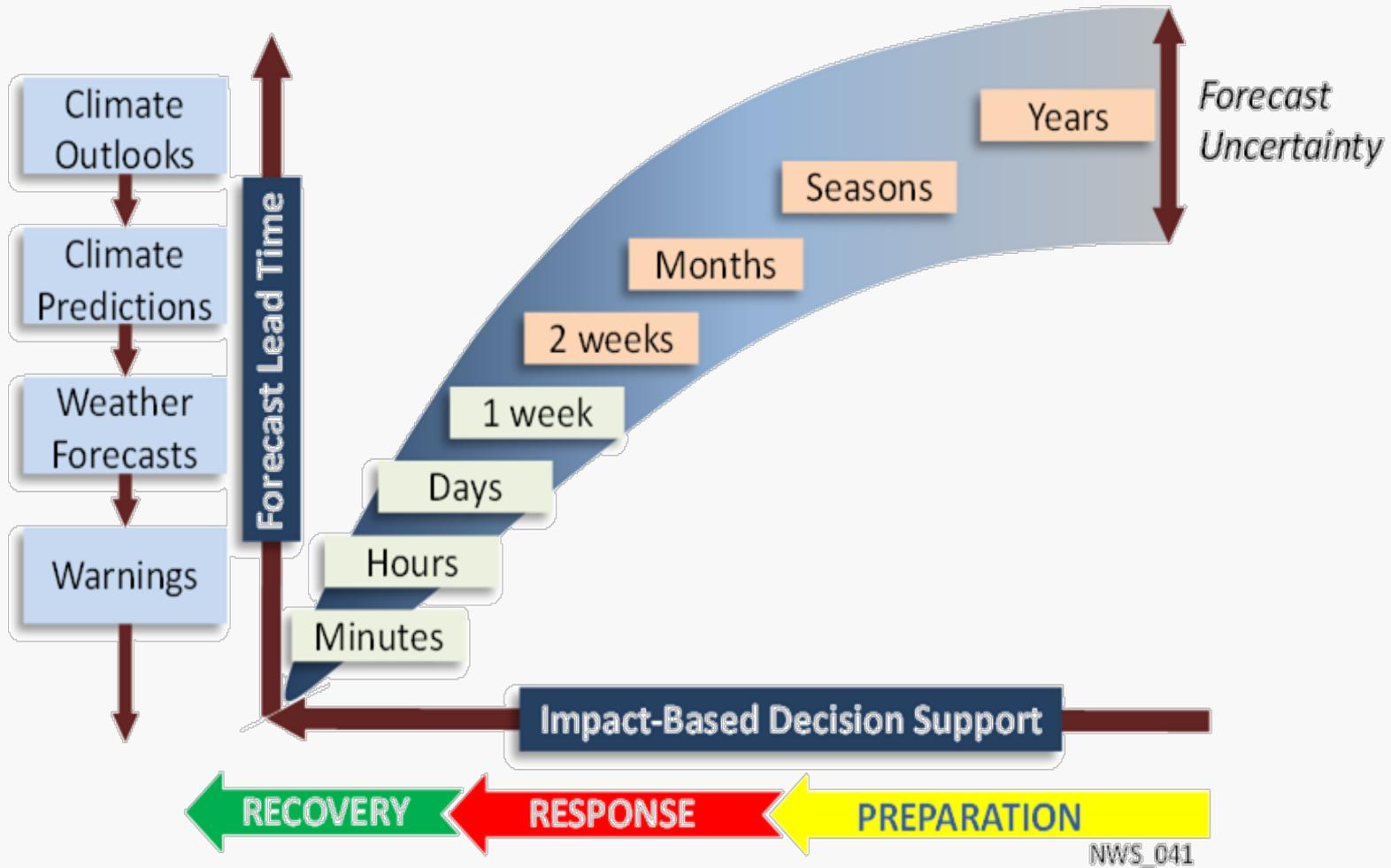
- Future extreme heat events will be more frequent, more intense, and longer in duration.(IPCC; US Natl. Climate Assessment)
- White House announced **NOAA and CDC** launch the National Integrated Heat Health Information System (NIHHIS) in 2015 to integrate heat information across agencies.
- NIHHIS designed to inform decision makers in many sectors including urban planning, design, construction, public health, emergency management, city government, energy, and transportation. It reduces heat-related impacts on many vulnerable groups including the elderly, children, athletes, pets, and outdoor workers.



The National Integrated Heat Health Information System weaves together existing pieces, identifies information needs and helps to develop needed weather and climate services.

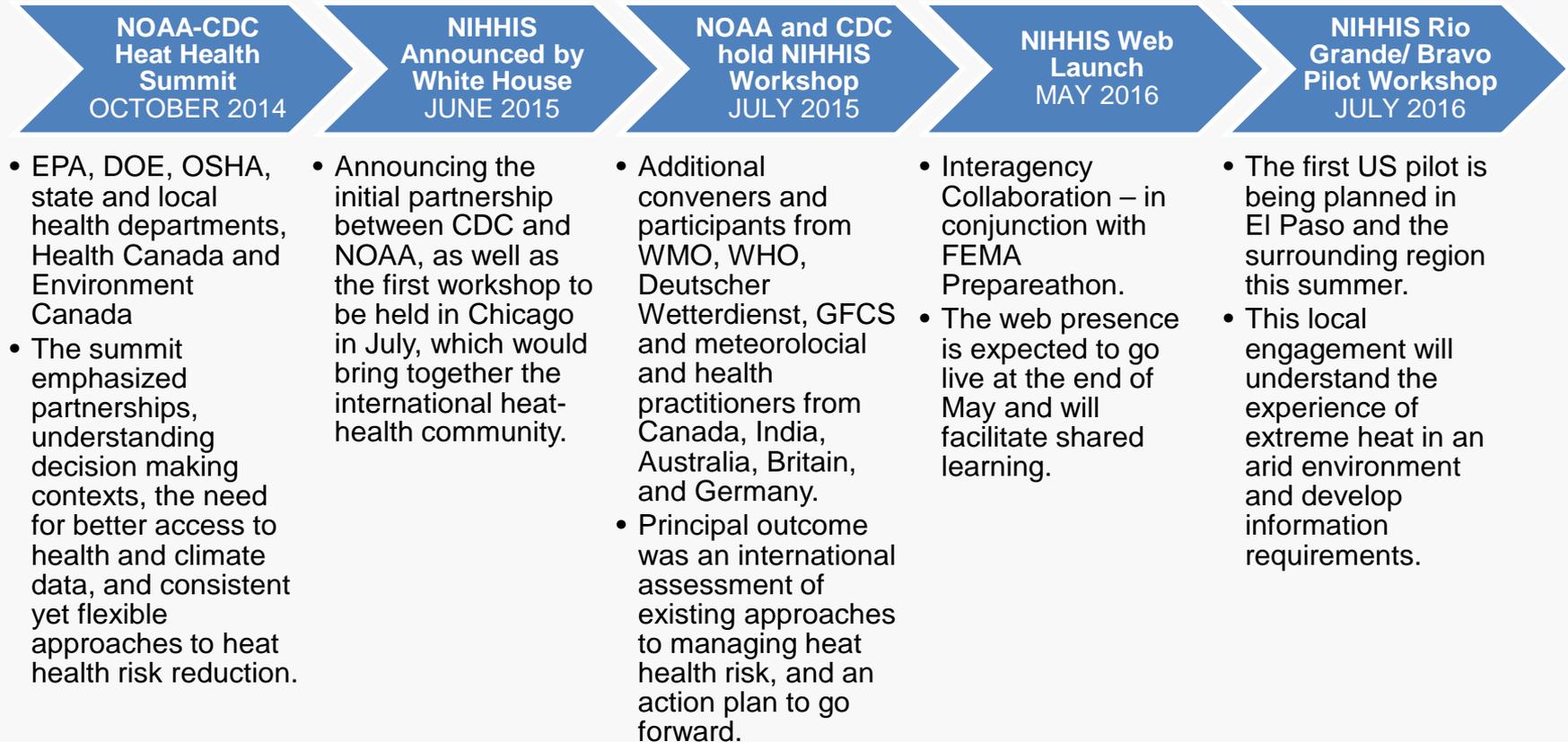
NIHHIS will facilitate an integrated approach to providing a suite of decision support services to reduce heat related illness and death

Heat-Health Information along the Weather-Climate Continuum

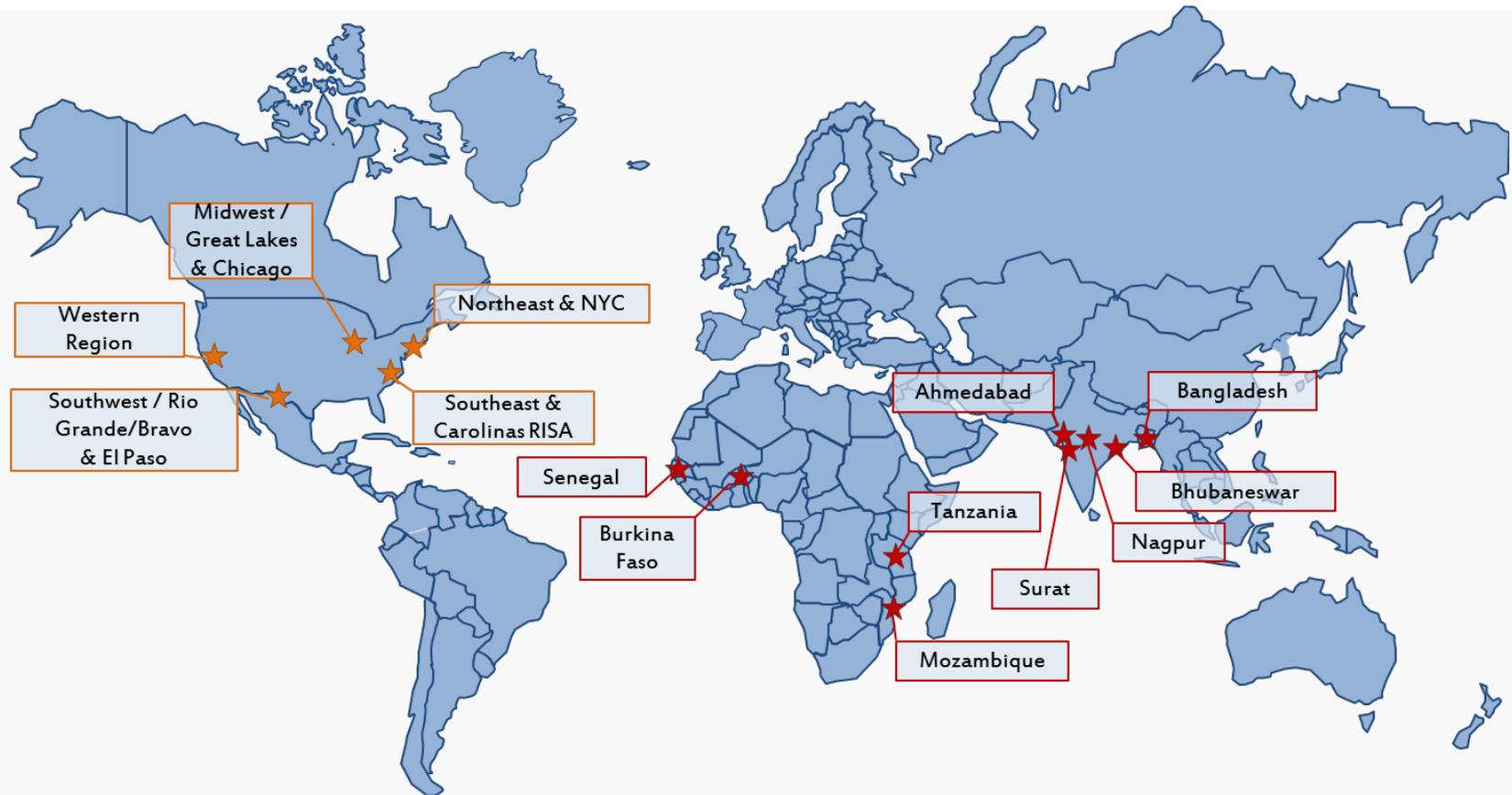


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NIHHIS: Impetus and Timeline

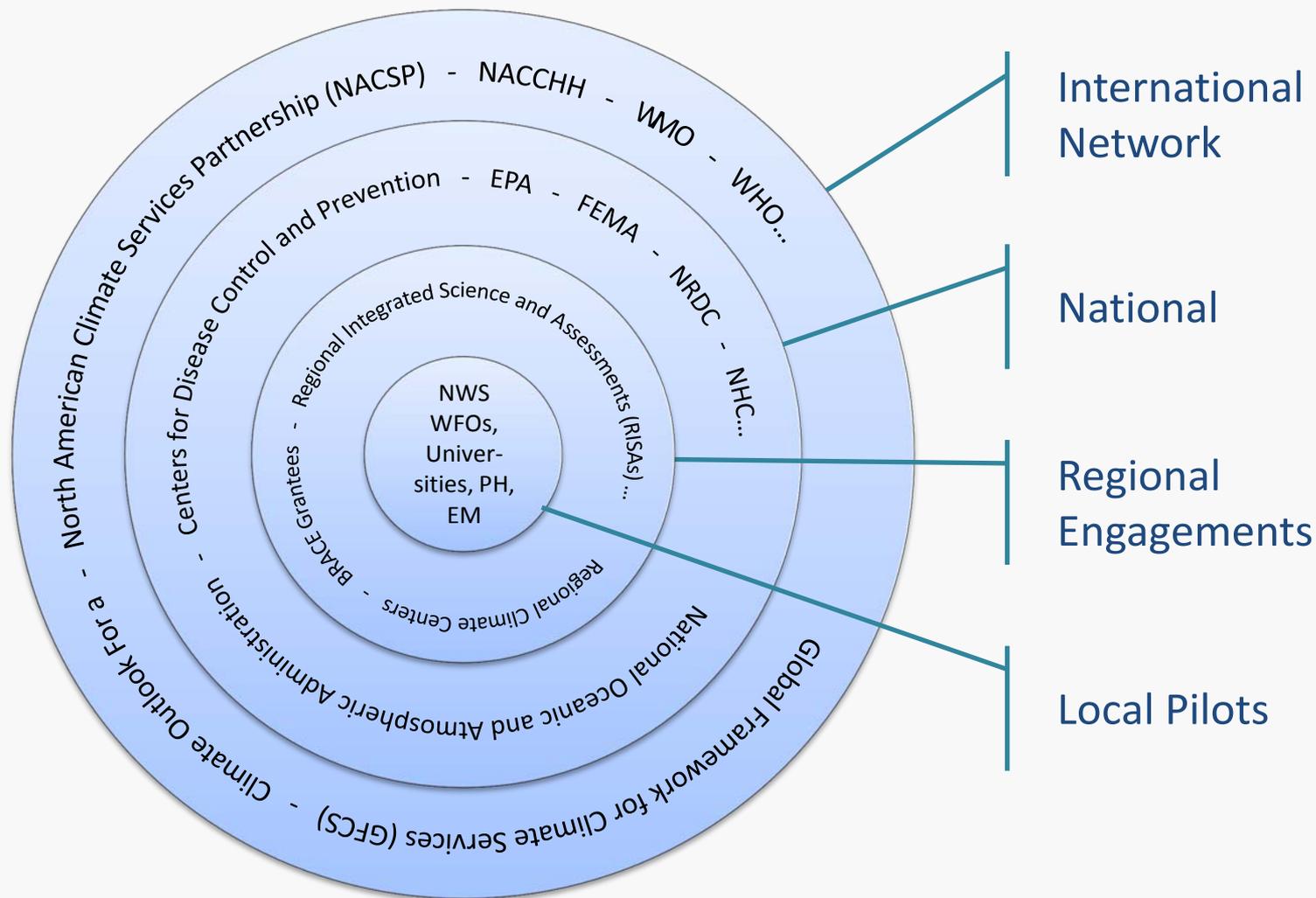


NIHHIS: US Pilots and International Network



The NIHHIS Network is composed of international knowledge-sharing partnerships and U.S. local pilots, but all address shared questions.

NIHHIS: Involvement of Partners at Every Level





Core Questions Across the NIHHIS Network

- **Institutional Capacity & Partnerships**
 - What institutional partners have you engaged to help define the needs (esp. bridging disciplines: health, env. science, emergency management); is that sustainable and if so, how and why?
- **Heat Parameters & Health Outcomes**
 - What heat parameters (tmax, tmin, heat index, etc) are most important for which specific population and in what geographic conditions?
- **Data and Forecast Products**
 - What data and forecast products, indicators, and monitoring is needed (at what spatial and temporal resolution & lead time) and what is currently being used by health professionals to make decisions?
- **Engagement and Communication Strategies**
 - What communication strategies are most effective both during an event and for long lead time planning (seasonal outlooks)?

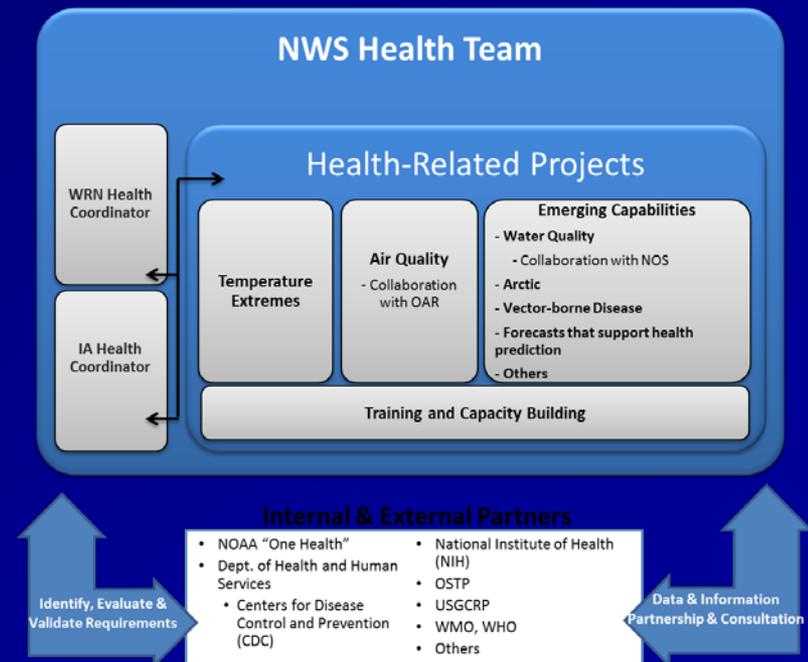
Recent and Upcoming NIHHIS Events

- Apr 4-10 National Public Health Week
- Apr 4 USGCRP Climate and Health Assessment Release
- Apr 23-May 3 FEMA PrepareAthon!
- Apr 25-26 South Asia Climate Outlook Forum SASCOF8 (w/ heat focus)
- Apr 26 Design for Risk Reduction Extreme Heat Report Release
- Apr 26-28 Heat focused Health Forum for SASCOF8
- Apr 28 CPO Webinar on Extreme Heat Prediction Improvement
- **May 22 NIHHIS Web Site Launch**
- **May 22-28 FEMA Prepareathon Extreme Heat Week**
- **May 24/26 NSC Extreme Heat Webinar (vulnerable populations focus)**
- Jul 13 RGB NIHHIS Pilot Focusing Workshop

NWS Health Team: Enabling Health Decisions

Federal, state and local partners rely on NWS' prediction, forecast, and risk communication expertise to inform health-related decisions

- Align NWS health-related activities with NWS strategic priorities and NOAA "One Health" framework
- Identify, evaluate, validate, and track health sector requirements
- Link health-related projects to appropriate NWS subject matter experts
- Facilitate regional and local engagement with key stakeholders in public health



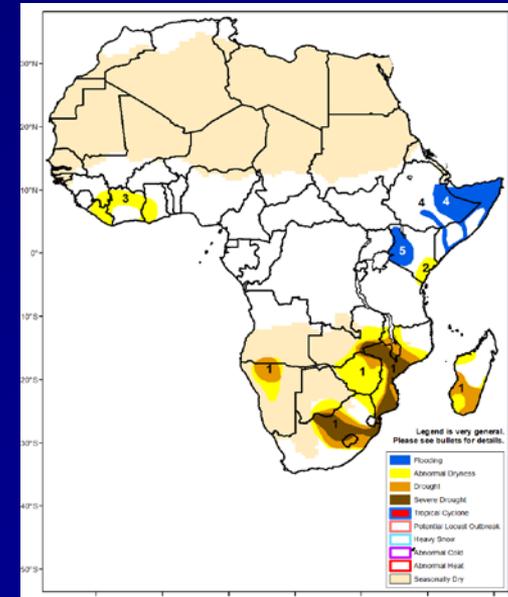
NWS Health Team: Enabling Health Decisions

NWS Health Team represents NWS in NOAA-wide, national and international engagements on health-related efforts

Exploring IDSS with Health Partners

- Disseminating lifesaving health information before/during/after weather, water, and climate disasters
- Jointly branded campaigns and graphics
- Investigating methods for warning and communicating extreme heat impacts
- Impacts on Children – Exploring opportunities for data sharing, co-messaging, and education
- Africa Desk – enabling health forecasting and prediction in Africa
- Pandemic Prediction Working Group
- ZIKA Preparedness and Response
- National Security Council Extreme Heat Action Plan

Weekly Hazards Outlook for USAID/FEWS



Extreme Heat
Heat related deaths are preventable

HEAT ALERTS: Know the difference.

HEAT OUTLOOK	HEAT WATCH	HEAT WARNING/ADVISORY
Potential for excessive heat event in 3 to 7 days.	Risk of excessive heat event in 24 to 72 hours.	Excessive heat event expected in next 18 hours.

weather.gov/heat #BeatTheHeat

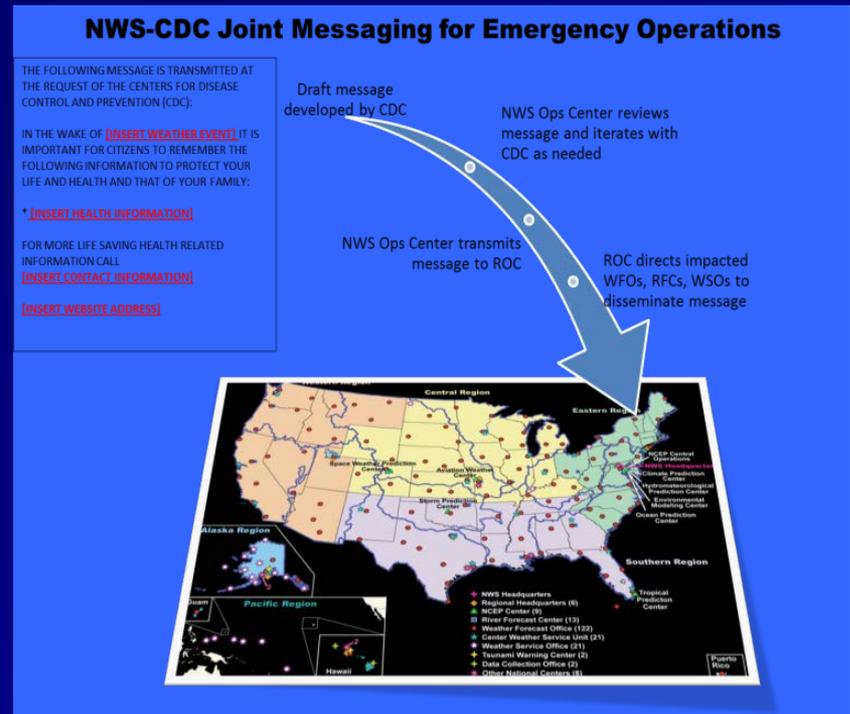
NIHHIS

NATIONAL INTEGRATED HEAT HEALTH INFORMATION SYSTEM



Joint Messaging with CDC

- NWS and CDC have joined together to disseminate credible, relevant and timely public health safety information before, during and after high impact weather, water and climate events through NWS dissemination channels
- Joint meetings and webinars
- In testing phase, potential application for emerging National Integrated Heat Health Information System (NIHHIS)



NOAA One Health and International

- Global Framework on Climate Services
- Group on Earth Observations
 - Water-borne lead, Vector borne,
 - Integrated Information Systems for Health Early Warning with WHO
- North American Climate Change and Human Health Partnership
- North American Climate Services Partnership
- Environment Canada MOU
- US/EU Marine Research, Marine Genomics, Climate and Health Research
- Clim-Health Africa

US Global Change Research Program: Interagency Crosscutting Group on Climate Change and Human Health (CCHHG)

Mission Statement:

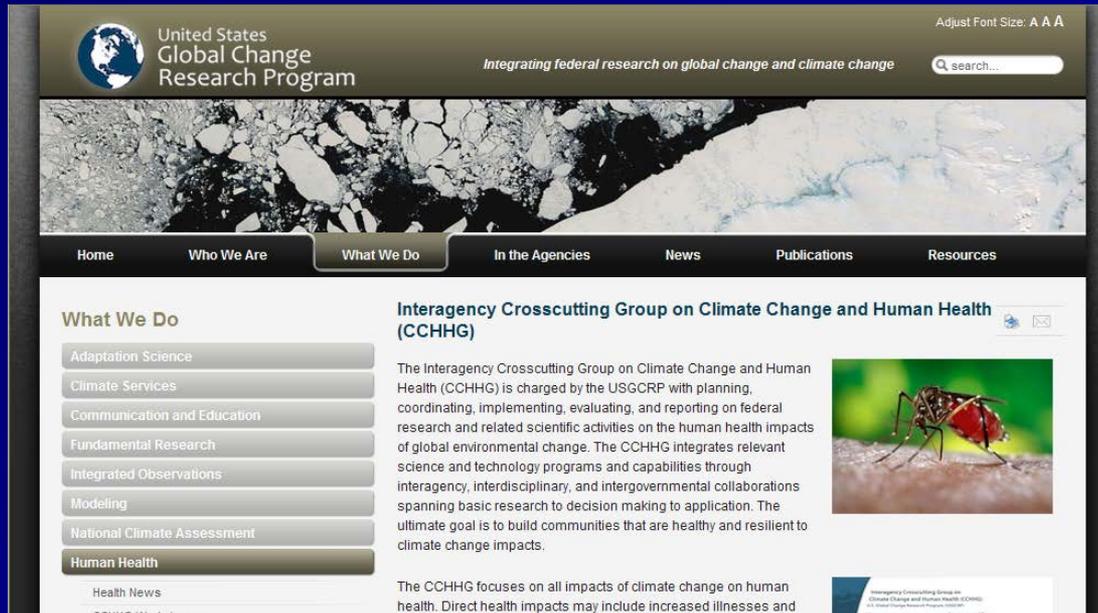
To promote and protect the Nation's public health by leading and coordinating Federal scientific activities related to climate change and human health in an end-to-end manner, from basic research through public health practice.

Foci:

- Advance scientific research and predictive modeling of health outcomes
- Produce data integration tools and products
- Support assessment activities
- Provide focal point and engage with Federal and non-Federal stakeholders, both domestically and internationally

CCHHG Membership

- Co-chaired by CDC, NOAA, and NIH
- Representatives from USAID, DOS, EPA, NIEHS, NASA, USGS, USDA, DHS, OSTP, DoD, HHS— ASPR, OASH, FDA...



The screenshot displays the website for the United States Global Change Research Program. The header includes the program's name, a globe icon, the tagline "Integrating federal research on global change and climate change", and a search bar. A navigation menu is located below the header. The main content area is titled "What We Do" and features a list of categories: Adaptation Science, Climate Services, Communication and Education, Fundamental Research, Integrated Observations, Modeling, National Climate Assessment, and Human Health. The "Human Health" category is highlighted. To the right, a section titled "Interagency Crosscutting Group on Climate Change and Human Health (CCHHG)" provides a description of the group's mission and goals. A photograph of a mosquito is shown next to the text. The footer of the page includes the text "The CCHHG focuses on all impacts of climate change on human health. Direct health impacts may include increased illnesses and..."

United States
Global Change
Research Program

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Integrating federal research on global change and climate change

search...

Home Who We Are What We Do In the Agencies News Publications Resources

What We Do

- Adaptation Science
- Climate Services
- Communication and Education
- Fundamental Research
- Integrated Observations
- Modeling
- National Climate Assessment
- Human Health**

Interagency Crosscutting Group on Climate Change and Human Health (CCHHG)

The Interagency Crosscutting Group on Climate Change and Human Health (CCHHG) is charged by the USGCRP with planning, coordinating, implementing, evaluating, and reporting on federal research and related scientific activities on the human health impacts of global environmental change. The CCHHG integrates relevant science and technology programs and capabilities through interagency, interdisciplinary, and intergovernmental collaborations spanning basic research to decision making to application. The ultimate goal is to build communities that are healthy and resilient to climate change impacts.



The CCHHG focuses on all impacts of climate change on human health. Direct health impacts may include increased illnesses and

USGCRP Climate and Health Assessment

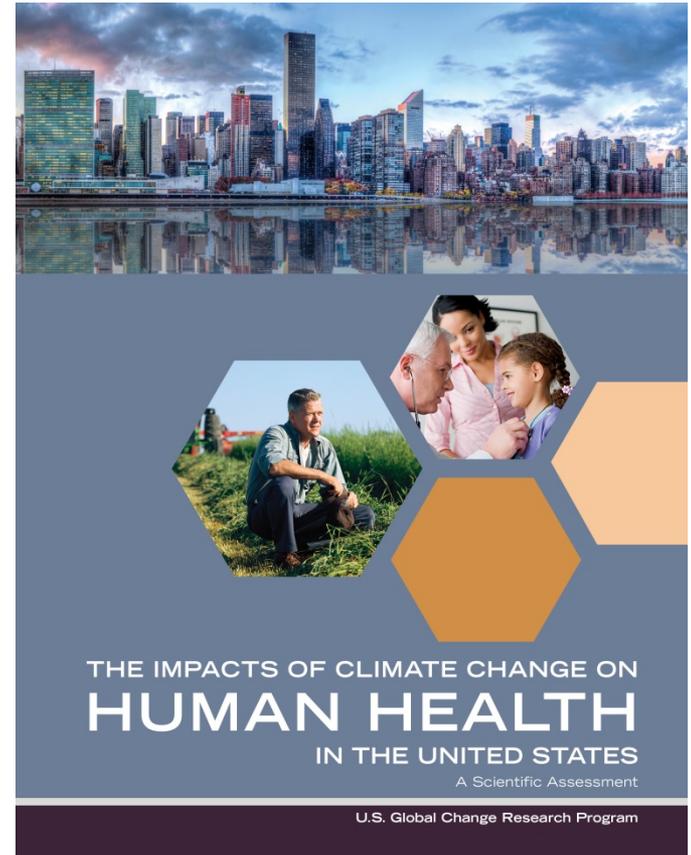
White House Released April 4, 2016!

What is the USGCRP Climate and Health Assessment?

- An Interagency product of the US Global Change Research Program (USGCRP)
- Part of the National Climate Assessment (NCA) sustained assessment process and called for under the President's Climate Action Plan

What is the purpose of the Climate and Health Assessment?

- Enhance understanding about the growing threat climate change poses to the health and well-being of Americans
- Inform decisions made by public health officials, planners, decision makers, and stakeholders



health2016/globalchange.gov



Top Line Messages of the Report

- 
- Climate change is a significant threat to the health of the American people.
 - Climate change exacerbates some existing health threats and creates new public health challenges.
 - This assessment significantly advances what we know about the impacts of climate change on public health, and the confidence with which we know it.
 - Every American is vulnerable to the health impacts associated with climate change.

Table of Contents

1. **Climate Change and Human Health (Introduction)**
2. **Temperature-Related Death and Illness**
3. **Air Quality Impacts**
4. **Extreme Events**
5. **Vectorborne Disease**
6. **Water-Related Illnesses**
7. **Food Safety, Nutrition, and Distribution**
8. **Mental Health and Well-Being**
9. **Populations of Concern**



NOAA Engagements in CHA

NOAA Authors:

Climate Change and Human Health/Modeling
Future Climate Impacts on Human Health

CA: Dave Easterling (NESDIS)

CA: Ken Kunkel (NESDIS)

Thermal Extremes:

CLA: Michelle Hawkins (NWS)

Water-related Illness:

CLA: Juli Trtanj (OAR)

CA: Tracy Collier (NMFS)

CA: John Jacobs (NOS)—new modeling

CA: Stephanie Moore (NMFS)—new modeling

CA: Ken Kunkel—new modeling

Extreme Weather and Climate:

CLA: Jesse Bell (NOAA/CDC affiliate)

CLA: Stephanie Herring (NESDIS)

CA: Carl Schreck (NESDIS)

CA: Ken Kunkel (NESDIS)

CA: Jen Runkel (CICS-NEDSDIS)

- The Report is under the auspices of the USGCRP Climate Change and Human Health Group:
 - Co-chairs: Juli Trtanj (NOAA), John Balbus (NIEHS/HHS), George Luber (CDC/HHS)
- Climate Data and Modeling support from NCEI—Ken Kunkel and Dave Easterling
- TSU Support—individual meetings with chapters, editing, graphics, hand holding.

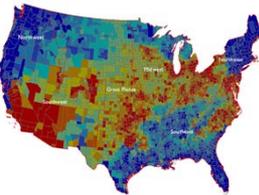


Significant Findings



Quantifies future increases in temperature-related deaths

- Confirms very high confidence in association between hotter- and colder-than-normal temperature and increased illness and death
- Quantifies the increase of thousands to tens of thousands of premature heat-related deaths projected in the summer due to climate change
- Assesses the impact of changes in tolerance to extreme heat on future deaths from heat



Confirms air quality impacts and provides likelihood for ozone, wildfire impacts

- Provides new likelihood assessment (likely) and high confidence that climate change will make it harder for any given regulatory approach to reduce ground-level ozone pollution, and that increased wildfires increase risk of premature death, adverse cardiovascular/respiratory outcomes
- Confirms high confidence that increases in airborne allergens will worsen allergy and asthma conditions and confirms indoor air health risks as significant emerging area

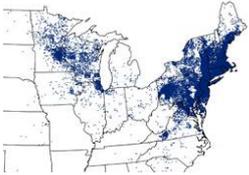


Connects changes in extreme events to increased exposure to health impacts

- Describes health impacts to extreme events with high confidence, including death, injury, or illness; exacerbation of underlying medical conditions; and adverse effects on mental health
- Identifies impacts to health from disruption of essential infrastructure
- High confidence that coastal flooding will impact vulnerable communities



Significant Findings



Provides likelihood of changing vector distribution, expands discussion of WNV

- Likely, high confidence in changing geographic and seasonal distribution of ticks carrying Lyme, and likely, medium confidence in increases in risk to human exposure
- Assessment of impacts of West Nile virus show very likely, high confidence in climate change influence on distribution, abundance, and prevalence of infection in mosquitoes



Details sources and pathways (drinking, recreational) of waterborne illness risk

- Disaggregates confidence and likelihood for changes in multiple water-related illnesses from Vibrio bacteria, marine harmful algae, freshwater harmful algae, and runoff sources
- Describes health impacts of water infrastructure damage or failures



First assessment of rising CO₂, climate on quality (nutritional value) of food

- Describes impacts of pathogens, toxins, and chemical contaminants in US food chain
- Assesses the large body of research establishing very likely, high confidence that nutritional value of food crops, such as wheat and rice, will decrease as rising levels of atmospheric CO₂ reduce concentrations of protein and essential minerals in most species



Significant Findings



Presents an important emerging area: increased mental health consequences

- Confirms Very High Confidence in extreme weather and climate related impacts including post-traumatic stress disorder (PTSD), depression, and anxiety, often at the same time
- Introduces issue of mental health impacts from the real and perceived threats of climate change and risks of heat exposure to people with pre-existing mental health illnesses or prescription medications



Details the ways in which climate change affects the health of us all

- People experience different inherent sensitivities to the impacts of climate change at different ages and life stages. For example, the findings confirm with very high confidence the very young and old are particularly sensitive to climate-related health impacts.



NWS Climate Services for Health?

- Recognizing and elevating breadth of NOAA capacity to address health community needs at multiple levels
- Supporting sustained engagement with public health professionals to define demand, articulate needs/requirements, test and evaluate effectiveness
- Supporting NOAA capacity to participate in and conduct collaborative research and transition to operations (heat, water, infectious disease)
- Empowering co-production of knowledge and operationalizing products that reduce health risk and save lives
- Engagement in One Health group, workshops, projects, pilots, local activities