Climate and Health: Overview from the United States
NOAA, the US Climate Health Assessment, the National Integrated Heat Health Information System, and International Engagement

Juli M. Trtanj
One Health Lead, Climate and Weather Extremes Integration Lead
NOAA Climate Program Office

OCG Climate and Health Summit
June 21, 2016
Walk Through

- Overview of US Global Change Research Program Climate Change and Human Health Interagency Crosscutting Group
- The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment: overview and follow on actions
- The NOAA One Health Group
- The National Integrated Heat Health Information System (NIHHIS) and Global Heat-Health Information Network
- International Activities
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

USGCRP established by law in 1990: Thirteen Federal Agencies
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...
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
Process and People

What was the process for development?

- Driven by the USGCRP Interagency Crosscutting Group on Climate Change and Human Health (CCHHG)
- Coordinated by the EPA
- Written by a team of ~100 Federal employees, contractors, and grantees from eight U.S. Federal agencies: HHS (NIH, CDC, NIOSH, ASPR, FDA, SAMHSA), NOAA, EPA, USDA, NASA, USGS, DOD (USUHS), VA
- Extensively reviewed by the public and experts, including a committee of the National Academies of Sciences and the 13 Federal agencies of the USGCRP; draws from a large body of scientific peer-reviewed research
• 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.
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
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.
Climate change affects human health in two main ways:

1. Changing the severity or frequency of health problems that are already affected by climate or weather factors
2. Creating unprecedented or unanticipated health problems or health threats in places where they have not previously occurred.
CCHHG Next Steps

- Develop Science/Research Plan
- Cross Agency Investigator Meeting (Feb 2017)
- National Climate Assessment-focus on Regions
- International engagement coordination: India, GEO, GFCS, US/Mexico/Canda
- Climate and Health Training and Capacity Building
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

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

### Functions include:
- 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 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**

<table>
<thead>
<tr>
<th>Climate models</th>
<th>Projected % of Alaskan shoreline with SST &gt; 15°C during August (Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2030s</td>
</tr>
<tr>
<td>GFDL</td>
<td>22.0%</td>
</tr>
<tr>
<td>IPSL</td>
<td>30.7%</td>
</tr>
<tr>
<td>Nor_ESM1_M</td>
<td>13.1%</td>
</tr>
<tr>
<td>Nor_ESM1_ME</td>
<td>20.7%</td>
</tr>
</tbody>
</table>
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)
Develop and coordinate networks of practitioners.

Advance regionally-linked earth system observations and prediction capabilities.

Construct risk profiles: the role of rates of change in trends, frequency, and magnitude of extremes at different scales.

Capacity and Coordination: Integrate Research, Observations, and Assessments into integrated information on critical transitions and capacity for response.

Overcoming impediments - Do this for a long time.
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.

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

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

| International Network | • Knowledge sharing  
<table>
<thead>
<tr>
<th></th>
<th>• Cooperative research</th>
</tr>
</thead>
</table>
| National              | • Agency-level coordination of resources and services  
|                       | • Shared set of core questions |
| Regional Engagements  | • Regional understanding of geography  
|                       | • Co-development of climate and health tools and services |
| Local Pilots          | • Deep knowledge of vulnerability and effective interventions & communication |

NIHHIS is a global network that integrates partners’ knowledge, experience, and activities to effect a coordinated response to heat-health at many levels.
The National Integrated Heat Health Information System

NIHHIS Framework: core questions for all pilots

- Institutional Capacity and Partnerships
- Data and Forecast Products
- Heat Parameters and Health Outcomes
- Engagement & Communication Strategies

NIHHIS Network: international partners and local-regional pilots

NIHHIS interagency web portal (climate.gov/nihhis)
Heat-Health Information along the Weather-Climate Continuum

- Climate Outlooks
- Climate Predictions
- Weather Forecasts
- Warnings

Forecast Lead Time:
- Years
- Seasons
- Months
- 2 weeks
- 1 week
- Days
- Hours
- Minutes

Impact-Based Decision Support

Recovery → Response → Preparation

Forecast Uncertainty

National Integrated Heat Health Information System (NIHHIS)
NIHHIS Framework and Core Questions

• 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)?
Executing the Heat Wave Implementation Plan of the Disaster Reduction Grand Challenge

- White House NSTC Subcommittee on Disaster Reduction spun up a 2016 task force addressing the grand challenge.
- Launch of NIHHIS web portal to share interagency resources and coordinate an integrated approach to resilience.
- Multi-agency webinar featuring OSTP Director Dr. John Holdren and several distinguished guests to discuss community resilience needs and approaches to protect the most vulnerable from extreme heat.
- At risk groups include: athletes, older adults, children, emergency responders, outdoor workers, and pets.
Other USG Engagements

- OSTP Pandemic Prediction and Forecasting Science and Technology Group
- Climate Sustainable Resilient Development-Bangladesh, Ethiopia, Colombia
- Clim-Health Africa
- 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
- Global Framework on Climate Services
From Environmental Intelligence to Resilience

- Develop and coordinate networks of practitioners: map decision-making arrangements
- Advance regionally-linked earth system observations and prediction capabilities
- Construct risk profiles: the role of rates of change in trends, frequency, and magnitude of extremes at different scales
- Capacity and Coordination: Integrate Research, Observations, and Assessments into integrated information on critical transitions and capacity for response
- Overcoming impediments - Do this for a long time

Monitoring, Observations, and Forecasting

Impacts and Scenarios

Communication and Outreach

Planning and Preparedness

INTEGRATED INFORMATION
Key Gaps and Opportunities

What is a key application area / marketplace requirement? What is a key interoperability need / gap?
- Predictive models at the right scale and level of certainty
- Research collaborations targeted to application
- Public Health and Environmental Data integration

How best to support advancing interoperability standards, interoperability projects, or best practices.
- Platforms that allow public health data to be used and displayed along with more robust but often mismatched environmental data
- Test Beds
- Strengthen existing networks and research funding
- Ensure identification of data needs in each project
- Longer term sustained engagement needed—IIS for health

Is there opportunity for Spatial Data Infrastructure? What is needed / What are pathways forward?
- Longer term sustained engagement needed—IIS for health
Thank you!

Juli.Trtanj@noaa.gov
NIHHIS: Involvement of Partners at Every Level

International Network
National
Regional Engagements
Local Pilots
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
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

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:

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

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

Global O$_3$ (Top) & PM$_{2.5}$ Levels

Resultant Cardiovascular deaths & lung cancer rates (per million)

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 Nino 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.

**El Niño status and possible global health impacts:** NOAA’s El Niño advisory [1] predicts the current El Niño will likely develop and last through the Northern Hemisphere winter. 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 about $15 million from losses in livestock and trade.
- **RVF surveillance and response capacity:** Before the 2015-16 Rift Valley fever season, the number of laboratories with the capacity to detect and test for RVF in the region stood at 17. The region is dependent on RVF surveillance activities in other parts of the globe, particularly in the Americas, where the disease is endemic. The development of indigenous surveillance capacity is crucial as a contingency measure.

**CHARTER of the PANDEMIC PREDICTION AND FORECASTING SCIENCE AND TECHNOLOGY WORKING GROUP**

**A. Official Designation**
The Pandemic Prediction and Forecasting Science and Technology Working Group (WG) is hereby established by the Committee on Homeland and National Security of the National Science and Technology Council.

**B. Purpose and Scope**
The purpose of the WG is to provide a focused forum to coordinate infectious disease outbreak preparedness and response activities. The WG is intended to address the need for increased scientific and technological capacity and capability to support preparedness and response to emerging infectious disease outbreaks.

**C. Functions**
The WG will provide technical advice and guidance to the Interagency Coordinating Council (NITSC) and other interagency working groups, and will develop an interagency road map for the development of pandemic forecasting and forecasting system capacity.

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