Approaches to Understand and Prepare for Climate-Driven Impacts

Tim Watkins
Director (Acting), CPHEA

Office of Research and Development
Center for Public Health and Environmental Assessment

ORD Climate Background

- ORD combines world-class expertise in all aspects and disciplines of environmental public health with cutting-edge research and assessment capabilities in ecology and climate science.

- ORD is positioned to investigate and characterize:
  - Climate mobilization of environmental pollutants
  - Ecosystem-mediated effects on human health and welfare
  - Future climate scenarios at varying scales
  - Combined impacts on communities, EJ implications, and pathways to resilience

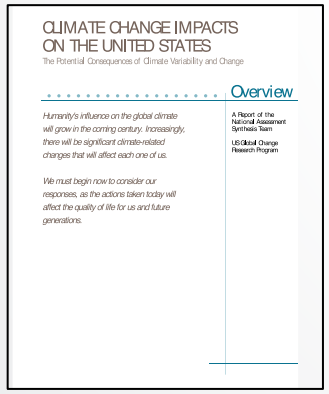
U.S. Global Change Research Program

- USGCRP began as a Presidential initiative in 1989
- Mandated by Congress in the U.S. Global Change Research Act (GCRA) of 1990 “to assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change”
- Overseen by Principals representing the 13 member agencies of the Subcommittee on Global Change Research (SGCR)

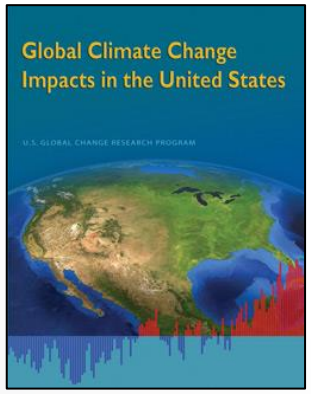
The National Climate Assessment

NCA1 through NCA4: 2000 to 2018

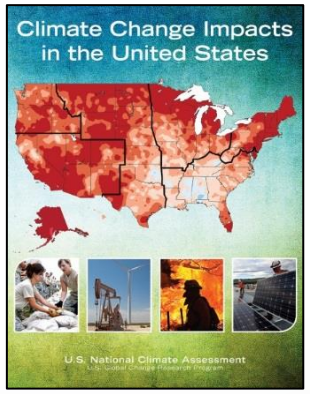
- USGCRP has produced four National Climate Assessments (NCAs)
- Each covers climate change science and impacts to sectors and regions in the United States
- Each NCA had a unique production process



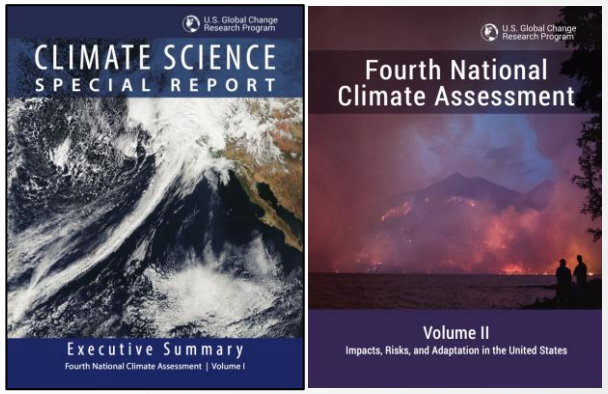
NCA1



NCA2



NCA3



NCA4

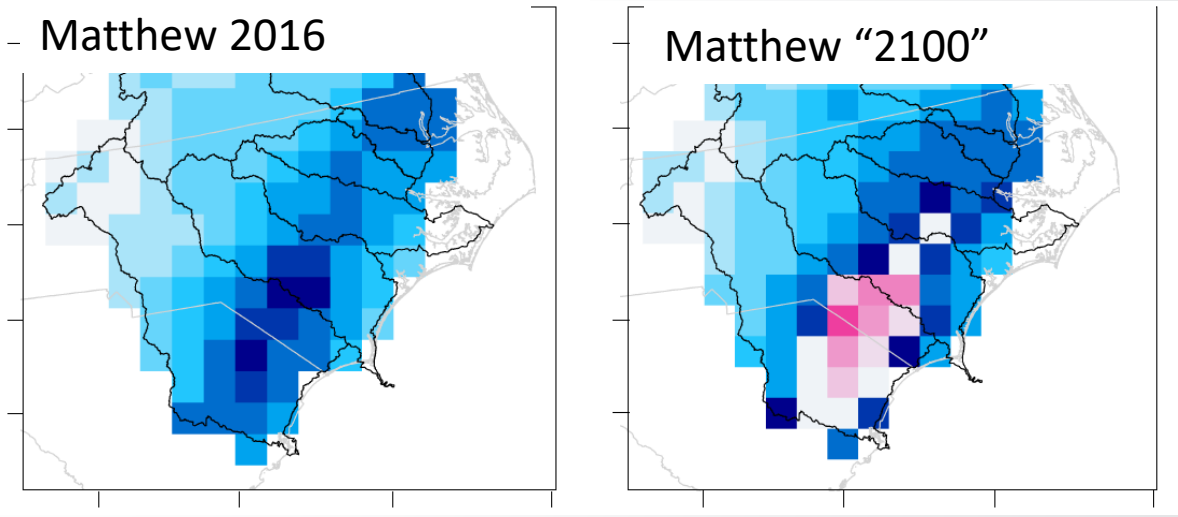
Examples of ORD Climate Research

Stormwater Management

Resiliency Planning

Forested Watersheds

Climate Refugia



Scenarios

Water Quality and Aquatic Resources

Hydroclimatic Change Effects on Stormwater Management

Need:

- Best management practices (BMPs) designed to detain, infiltrate and filter urban runoff are central to CWA/SDWA programs for water quality protection
- Previous studies suggest climate change can significantly impact BMP performance; ability to reduce pollutant loads
- Guidance is needed to ensure BMP design is resilient to climate change

Approach:

- Conducting a national-scale assessment of hydroclimatic change effects on stormwater runoff and BMP sizing at ~2500 U.S. locations
- Based on simulations with the Stormwater Management Model driven by projected mid-century changes in precipitation

Goals:

- Results will identify range of future changes to which adaptation may be needed in different regions of the U.S.
- Help identify regional assets and vulnerabilities; planning for resilience and risk reduction

Adaptation Planning Frameworks for Resilient Natural Resources

Ecosystem Managers Need:

- Tools for translating vulnerability information into design of climate-smart management interventions
- Guidance on how to integrate adaptive resilience planning throughout the steps of existing planning processes

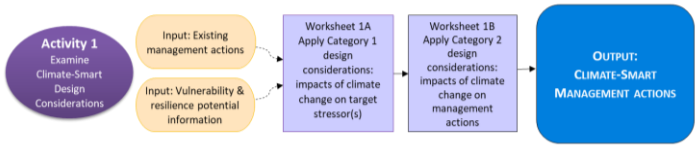
Approach:

- Collaborations through Federal, State, Territory, Regional and NGO partnerships (e.g., U.S. Coral Reef Task Force, Chesapeake Bay Program)
- Human-centered design and place-based testing of tools with coral reef and wetland scientists and practitioners

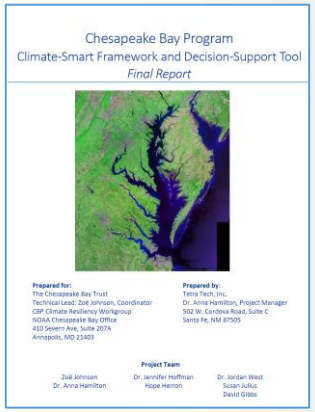


Accomplishments:

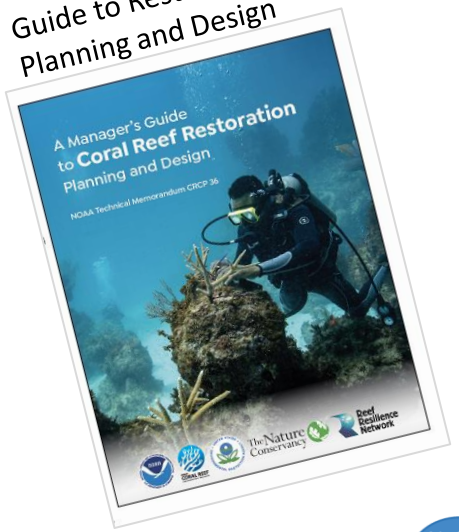
Adaptation Design Tool



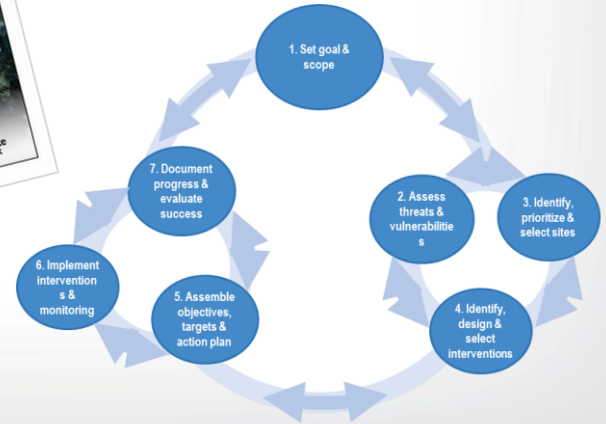
Climate-Smart Framework and Decision Support Tool



Guide to Restoration Planning and Design



Adaptation Planning Cycle for Resilient Natural Resources

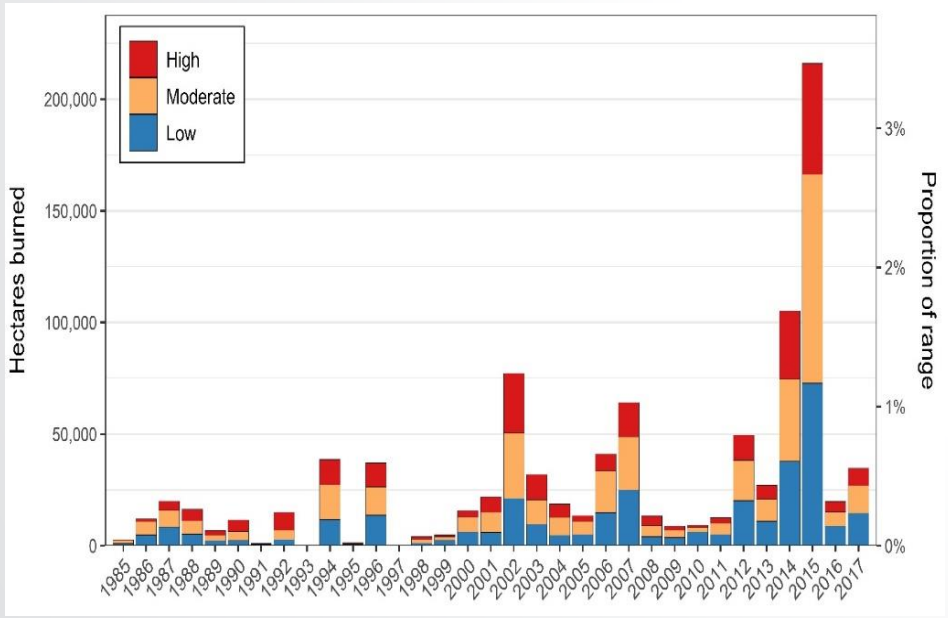


Ecosystem Effects

Climate change impacts on forested watersheds are driven by drought and wildfire in western U.S.

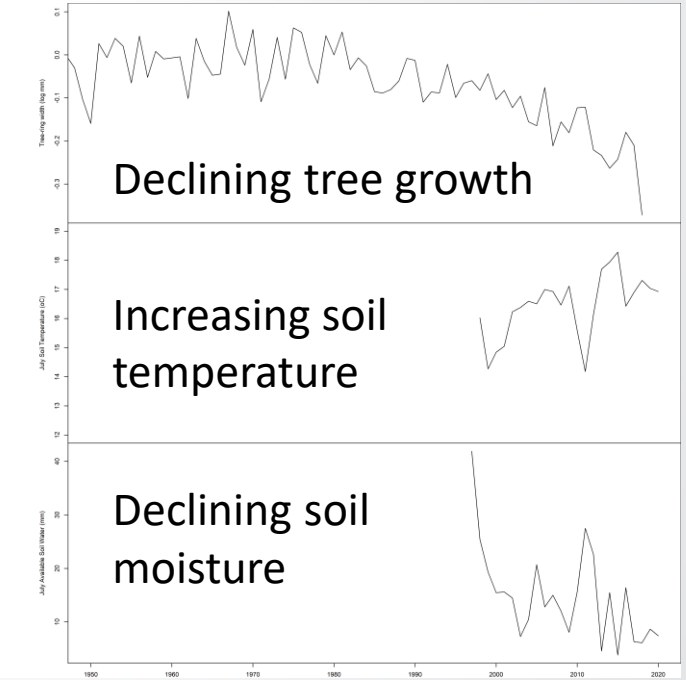
- Field studies show fire suppression over the past century and prolonged drought (megadrought 1990-present unprecedented in 700 years in OR) are impacting forest health.
- Indicators of climate change in forested watersheds:

Increasing trend in acres burned



Increasing tree mortality due to drought interactions with pests and disease

Decreasing forest productivity



Climate Refugia for Salmon

Challenges

- Failure to attain water temperature standards
- Temperature-related mortality of ESA-listed salmon and steelhead populations
- Implications for Tribal Treaty rights, Orcas, among many others

Research Findings

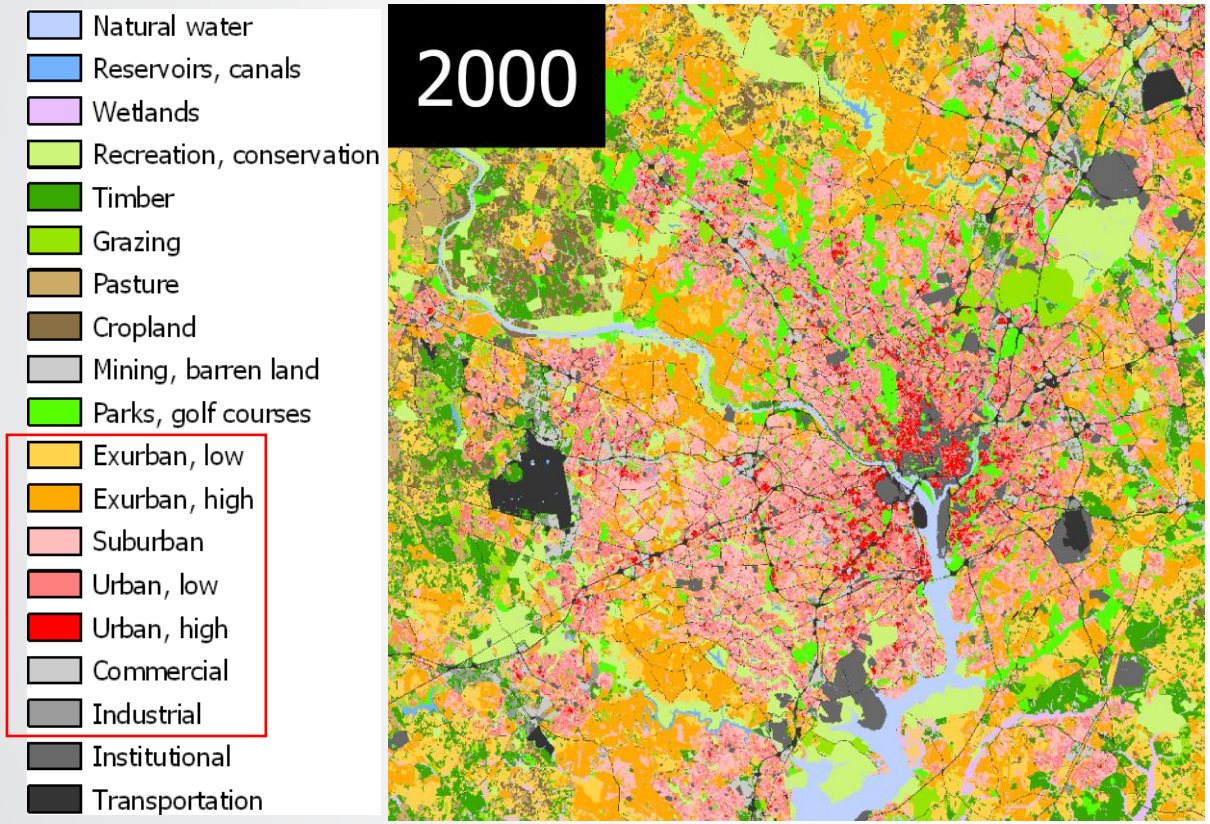
- Cold water refuges increasingly critical for migrating salmon
- Groundwater can help buffer climate effects
- Seasonal connectivity is vital
- Human land and water use can exacerbate climate impacts to fish, BUT…

Adaptation Needs, Opportunities

- Protecting and restoring cold water refuges
- Integrating the 4 dimensions of freshwater systems
- Valuing surface water – groundwater interactions
- Nature-based solutions (beaver-created wetlands)

Scenarios and Impacts

Integrated Climate and Land Use Scenarios (ICLUS)



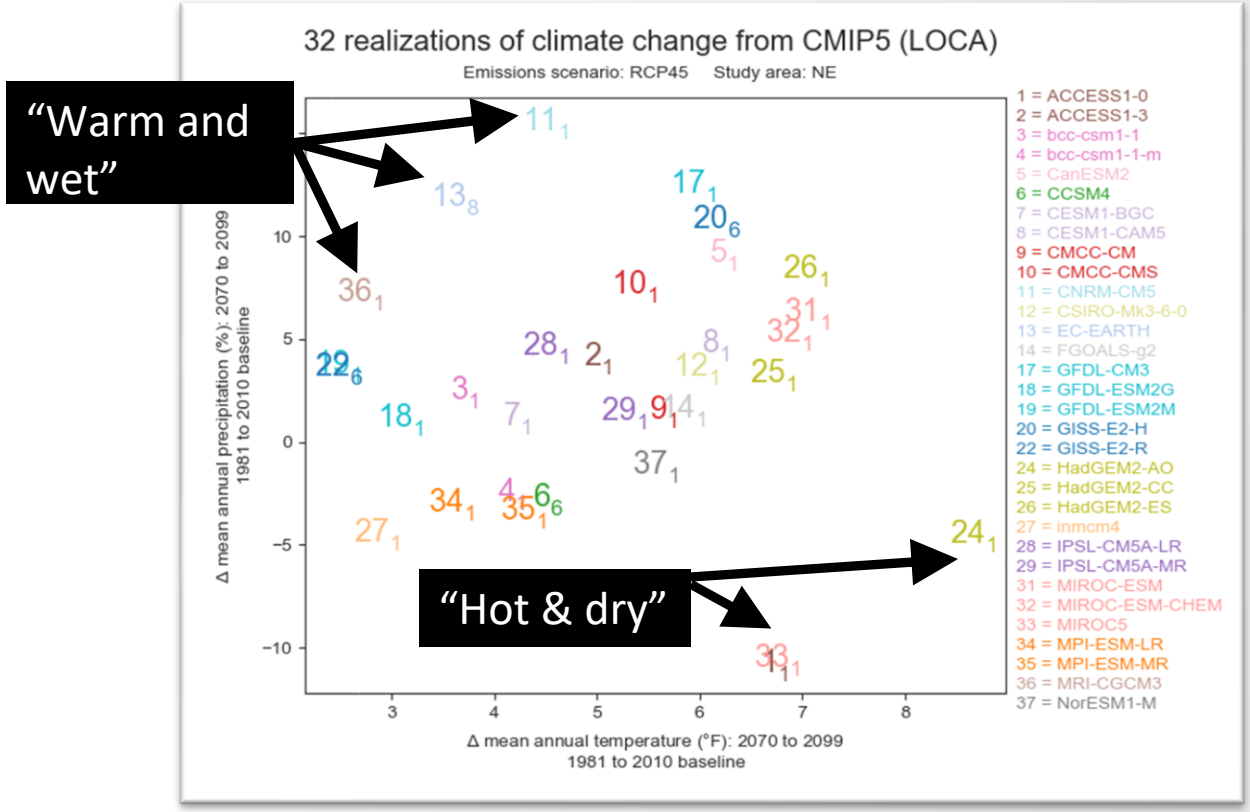
Washington, D.C.

- Important to assess the impacts of climate change together with population and land use dynamics
- The ICLUS project produces spatially explicit projections of population and land-use that are based on IPCC scenarios and pathways
- Reflects different assumptions about fertility, mortality, immigration, and movement within the US to calculate the need for new residential lands

https://www.epa.gov/gcx/about-iclus

Locating and Selecting Scenarios Online (LASSO)

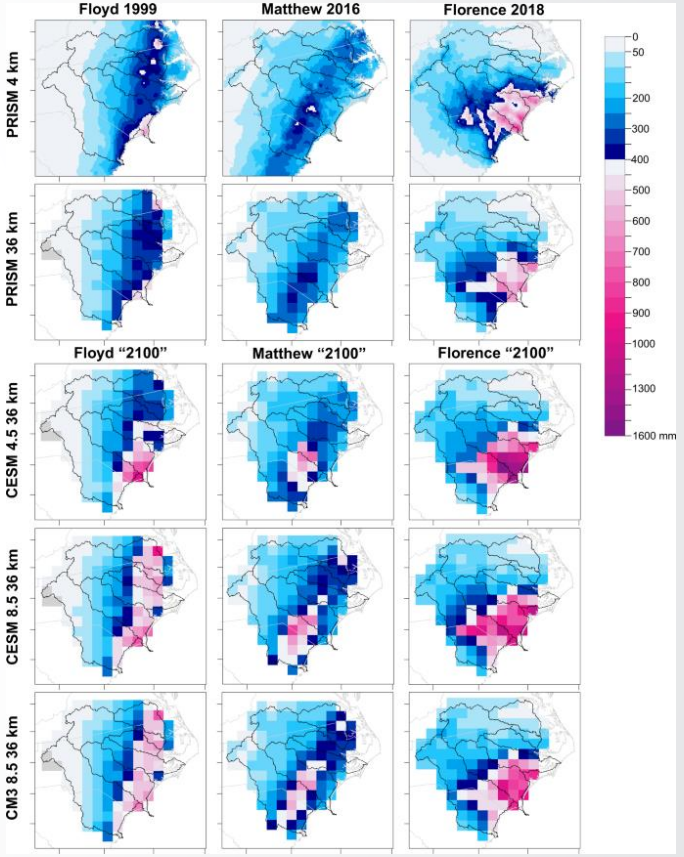
- LASSO is used to build a set of climate change projections to suit a given research question
- Step-by-step process to guide users in building a scatterplot showing variability in projections
- Users can use an interactive scatterplot widget to further customize their selections, then download maps, figures, and GIS-ready spatial data.



https://lasso.epa.gov/

Modeling Future Climate Change Impacts

- Need
  - Holistically explore climate change impacts on air quality, human health, ecosystems services, and infrastructure
  - Prepare for potential changes in future extreme weather events at regional and local levels
- Actions
  - Improved modeling techniques to better capture regional climate, including atmospheric circulation, summertime precipitation, effects of lakes, and extreme events.
  - Created a small ensemble of dynamically downscaled projections through 2100.
  - Refining modeling techniques and spatial/temporal resolutions for extreme events.
- Impacts
  - Demonstrated viability of modeling and its linkages to AQ and hydrology models for air and water extremes.
  - Data and techniques used in Climate Change Impacts and Risk Analysis (CIRA) 2.0 and inaugural chapters in 4th National Climate Assessment
  - Future regional climate, air quality, deposition, and hydrology data to support internal and external research on responses to changes to human health and ecosystems from climate change.



Catastrophic Rainfall Projections
Jalowska, Spero, & Bowden
(npj Climate and Atmospheric Science, 2021)

Summary

- ORD and EPA are leaders in multiple aspects of climate science and work together with other agencies to assess and respond to climate change
- ORD has several ongoing projects investigating the impacts of climate change on ecosystems and communities and solutions for adaptation
- CPHEA and CEMM conduct this research in close collaboration, along with other centers and offices in ORD
- Next we will have a panel discussion to describe our work in greater depth and hear from our partners in the program and regional offices

Thank You!

Tim Watkins
Director (Acting)
Center for Public Health and Environmental Assessment

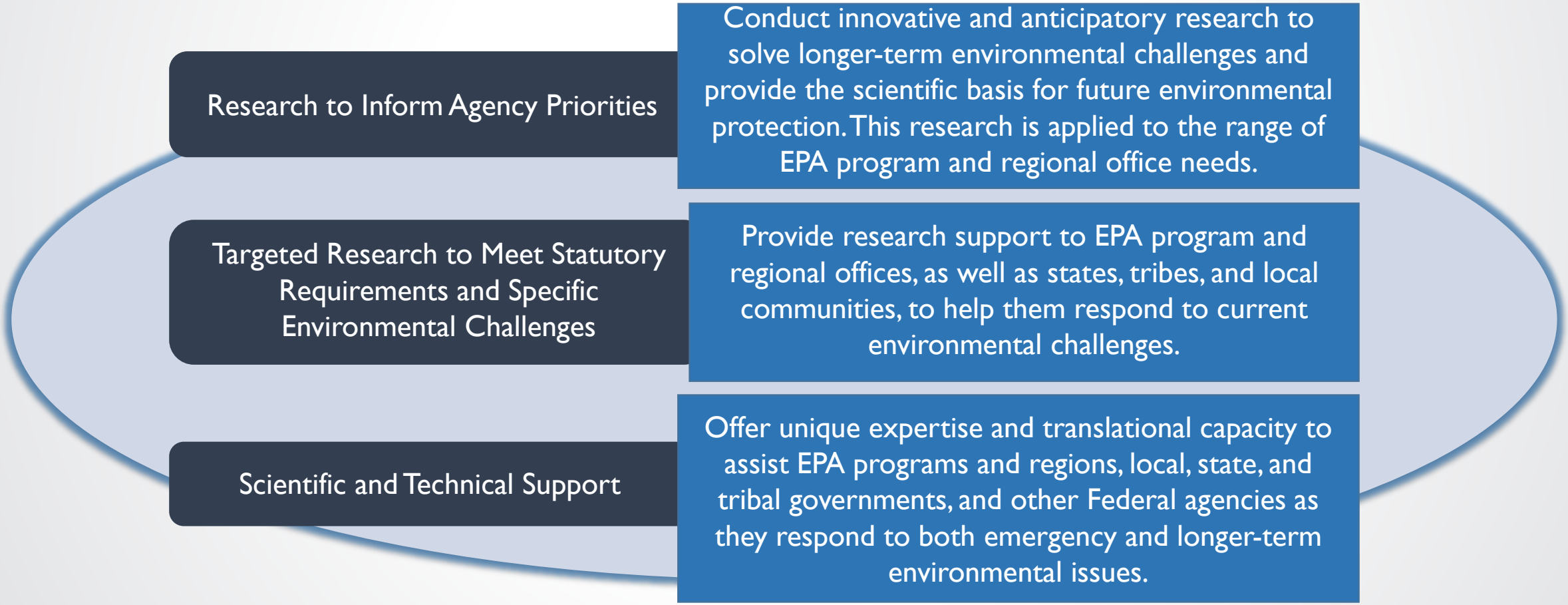
Supplemental Slides

EPA NCA4 Authors

Name	Org	Chapter	Role
Allison Crimmins	OAR/OAP	Health	Author
James McFarland	OAR/OAP	Mitigation	Author
Jeremy Martinich	OAR/OAP	Mitigation	CLA/CL
Michael Kolian	OAR/OAP	Overview	Author
Neal Fann	OAR/OAQPS	Air Quality	Author
Pat Dolwick	OAR/OAQPS	Air Quality	Author
Rob Pinder	OAR/OAQPS	Air Quality	Author
Darrell Winner	ORD IOAA A-E	Air Quality & Overview	Author
Susan Julius	ORD/NCEA	Built Env	CLA
Thomas Johnson	ORD/NCEA	Water	CLA
Chris Nolte	ORD/NERL	Air Quality	CLA/CL
James Wickham	ORD/NERL	Land Cover	Author
Tanya Spero	ORD/NERL	Air Quality	Author
Keely Maxwell	ORD/NHSRC	Built Env	CL
Michael Craghan	OW/OWOW	Coastal	Author
Laura Farris	R8	NGP	Author
former EPA employees			
Ben DeAngelo	NOAA	Mitigation & Overview	Author
Lesley Jantarasami	Oregon Dept of Energy	Tribal	CLA/CL
Anne Grambsch	Retired	Built Env	Author

EPA Research

ORD provides the scientific foundation for EPA to execute its mandate to protect human health and the environment.



Research Informed via Multiple Routes

Topics and structure are informed by listening to multiple sources over multiple years