ORD Research Integration:
Climate Change Research

Introduction

Climate change is an exceptionally complex issue that impacts nearly every EPA program and therefore cuts across all the ORD Programs, which requires a considerable degree of coordination and integration. The issue is led by the ACE Program, through a designated lead for climate who is charged with working across all the ORD programs. SSWR and SHC are the two programs that are most closely involved, with additional connections to HS, HHRA, and CSS. The climate integration effort adds value by identifying the diverse range of expertise needed to address the complexities of climate change, impacts, and responses and working across the ORD programs to apply the expertise to address the climate research needs of ORD's partners.

ORD's integrated climate research topic has four goals: (1) provide the scientific and technical information needed by EPA to achieve the Agency's strategic goals, in the context of a systems-oriented approach; (2) expand the capacity of EPA to employ systems analysis approaches to evaluate the environmental impacts of climate change, adaptation to those impacts, and mitigation to minimize those impacts; (3) develop tools, data, and solutions that address the challenges of climate change in ways that advance sustainability; and (4) anticipate the possible environmental impacts of large-scale deployment of new technologies and practices.

Integration

There are several lines of research in the ORD research programs that address climate change and its impacts. These research efforts are designed to address needs identified by each Program's primary partners. Under the SSWR program, research is being conducted to understand the impacts of climate on water utilities and approaches for adaptation; develop better models of hydrology and watershed responses to changes in climate, precipitation, and land use; and gain insight into changes in frequency and magnitude of extreme weather events, particularly related to water resources and vulnerability of treatment systems. The research on impacts of extreme events also supports efforts in HS to develop responses to emergencies such as flooding and subsequent disposal of disaster debris. Research in SHC to develop and maintain the National Atlas of Ecosystem Services is most closely related to climate change. Other research to understand community-scale approaches to materials management, transportation, and the built environment impact, and are impacted by, climate change. Health risk assessments developed in the HHRA program are increasingly incorporating impacts of climate change – direct impacts such as heat stress and indirect impacts including changes in ozone concentrations due to longer and more severe heat waves. Responses to climate change increasingly incorporate new materials, including nanomaterials, and concern over the potential global warming potential of new chemicals requires coordination with CSS.

Climate-related research in ACE includes developing a better understanding of how air quality and climate interact; evaluation of links between the energy system and greenhouse gas emissions; and assessment of the environmental impacts associated with GHG mitigation approaches and technologies. The climate component of the ACE program also includes research that supports or complements much

of the climate-related work in the other programs. Research is underway on impacts on aquatic ecosystems, water infrastructure, extreme events, combined atmospheric-hydrological modeling, and impacts to human health.

The approach of the climate research integration effort is to ensure program-specific research to address partner needs is coordinated with other efforts across ORD, to develop a common understanding of long-term research needs and directions, and to identify opportunities for collaboration. As the programs develop, the expectation is that climate research that is focused on a specific issue (e.g. water quality) would move out of the climate component of ACE and into the appropriate media-focused program (e.g. SSWR). Efforts that focus on cross-media integration, systems behavior, complexity, and emerging media-specific issues would remain in the global component of ACE.

Management Approach

ORD has dedicated a senior-level position (Deputy National Program Director for Climate) to lead the climate research integration effort. The integration builds upon ORD's cross-Lab/Center coordination of climate research (funded under a distinct Global Change Research budget[1]) over the past decade. Staff from all of the ORD Labs, Centers, and Programs are developing a Climate Research Roadmap to help guide ORD program decisions on climate research. A Climate Integration Team, with representatives from the ORD Laboratories and Centers, the six ORD research programs, and relevant partner offices (primarily OAR, OW, and the Regions) holds monthly calls to ensure continuing communication with partner offices. This includes expanded communication regarding activities of the US Global Change Research Program (USGCRP) and development of the EPA Adaptation Strategy.[2] Additional, focused discussions with designated NPD staff are also a key part of the cross-program integration effort.

Climate research in ORD is coordinated with research efforts at other Federal agencies (e.g. DOE, NOAA, NASA, and USDA) through the USGCRP and the Subcommittee on Water Availability and Quality, both part of the Committee on Environment, Natural Resources, and Sustainability (CENRS). EPA's role as the primary environmental regulatory agency greatly amplifies its ability to influence research directions across the federal government.

The Climate Integration Team has identified research efforts related to climate change across the ORD programs that is separate from research conducted under the Global Change budget, and developed research plans that incorporate climate-related research questions from partners. Additional effort is needed to identify future, cross-ORD directions for climate research; coordinate across programs to identify where such work can be done most effectively; and communicate future climate research directions. A key component of the integration effort is to identify opportunities for cross-program resource allocation. In 2012, for instance, resources from ACE were allocated to support research in the SSWR program, including efforts to develop hydrological models that incorporate the effects of a changing climate. Joint funding from ACE and SSWR was combined to fund extramural grants on the impacts of extreme weather events. Interactions with SHC, related to the National Atlas of

[1] Now incorporated into the ACE budget.

[2] An agency-wide adaptation strategy is required for each agency under Executive Order 13514. The EPA Adaptation Strategy specifies how the Agency will adapt to climate change to ensure that it is able to achieve its strategic goals in changing climate conditions.

Ecosystem Services, strengthen efforts in ACE and SSWR related to climate impacts on ecosystem health. Integration also occurs at the researcher level, when PIs propose and conduct research on a topic that addresses questions to support different programs.

Challenges

Climate research is driven by diverse, often near term, programmatic needs, and by complex, long term scientific questions. A fundamental challenge is to balance the long-term research directions with the short-term programmatic needs. A further challenge is the lack of a mandate for a full and coordinated response to climate change. The climate integration effort seeks to provide the near term scientific information while maintaining a long-term research direction that will position us to respond to Program and Regional Office science questions on climate.

The longer term research needs include expanded support for mitigation policy development, better means to incorporate uncertainty into decision making, the ability to evaluate complex and dynamic system behavior, the capacity to develop methods and information on life cycle impacts, and the ability to understand and address the connections between near-term, local actions and long-term, global impacts for adaptation and mitigation strategies.

Strengths

ORD draws on strong expertise within its Laboratories and Centers, particularly the context of supporting Agency decisions related to the impacts of climate change and climate change adaptation. ORD possesses leading expertise in modeling atmospheric transformation, transport, and fate of pollutants, assessment of and adaptation to climate impacts on public health and the environment, measurement of pollutants, and understanding the environmental impacts of energy systems. The STAR program provides additional, critical expertise that enables ORD to significantly expand the scope of its climate research. Development and support of RFAs on black carbon, extreme weather events, and cookstoves provide research results on emerging areas that support EPA priority science needs.

The climate research effort in ORD is also expanding its capabilities to incorporate social, behavioral, and economic sciences into its work by supporting issues that have an inherent behavioral content, such as supporting decisions on issues with significant uncertainty and methods for collaborative decision making. Over the past several years, a growing number of researchers with backgrounds in economics, decision science, public policy, and interdisciplinary fields such as technology and policy, have joined ORD and are building a growing publication record in these areas.

Cross-ORD Climate Research Activities

	ACE	SSWR	SHC	HHRA	HS
Air quality-climate interactions	Assessment of Implications of Climate Change for U.S. O_3 and PM GLIMPSE: An integrated tool for simultaneously improving air quality and taking action on climate change STAR: Investigation of black carbon's role in global to local scale climate and air quality			Integrated Science Assessments evaluating the effect of the criteria air pollutants on climate.	
Climate vulnerability of drinking water and water resources	(Joint w/SSWR) Regulatory vulnerabilities to climate change: water quality programs	(Joint w/ACE) Impact of Climate on Water Quality Programs Meta-analysis of climate-related watershed studies across SHC, SSWR, ACE, and partners			Methods and criteria to enhance resiliency to climate change and natural and technological disasters
Integrated atmospheric/ hydrological modeling	(Joint w/SSWR) Watershed modeling to assess hydrologic and biogeochemical sensitivity to climate and land use change	Watershed Modeling			

	ACE	SSWR	SHC	HHRA	HS
Impacts to aquatic ecosystems	National Vulnerability Assessment Methods Applied to Wetlands Assessing the vulnerability of near-coastal species and habitats to individual and multiple climate drivers at regional scales		Development of ecosystem services methods and metrics for national scale Atlas for Sustainability		
Health impacts of climate change	The Effects of Climate Change on Human Health and Well Being and supporting Ecosystem Services: Development of Modeling Tools for Sustainable Futures Impact of climate change on disease risk			Multipollutant Science Assessment: Health	
Land use and climate scenarios	Integrated climate and land use tools and datasets for impacts, vulnerability, and adaptation assessments	Correlating land use, stream chemistry and biological condition	Analytical Tools Interface for Landscape Analysis Land Use and Planning: Natural and Built Environment		

	ACE	SSWR	SHC	HHRA	HS
Regionally-focused climate impacts	Regional Coordination and Implementation of Climate Change Mitigation and Adaption; Region 10 Pilot Indicators of climate change in Pacific Northwest Forests	(Narragansett Bay) Determine how the drivers of change and disturbance (including climate), and improvements, related to nutrients affect ecosystem structure and function.	Pacific Northwest study on development of nationally applicable metrics, models, and decision support tools for estimating the production and value of ecosystem goods and services for sustainable communities		
Technology Evaluation	Assessing the Potential Role of Energy Technologies and Fuels Energy and Climate Assessment Using the MARKAL Model Pollutant behavior and partitioning within oxy-fuel combustion processes Evaluation of Cookstoves for Developing Countries STAR: Methods for mitigating public health and climatic impacts of residential cooking, heating, and lighting in the developing world	Water innovation Technology Cluster: Develop sustainable processes for contaminant (including nutrient) removal below the limits of current technologies that minimizes costs, energy consumption, environmental burden, chemical consumption, and associated greenhouse gases production	Tools and Approaches to Recover Energy from Wastes		

	ACE	SSWR	SHC	HHRA	HS
Impact of Climate-Related Extreme Weather Events	STAR: Impact of extreme events on air quality and water quality in the US from global change	Incorporate stormwater mgmt practices into watershed modeling tools Perform ground-truthing of EPA stormwater models Extend EPA's suite of stormwater modeling tools			
Water-Energy Nexus	Water Demands of Future Energy Portfolios under a Changing Climate				