The Earth Institute has represented, since its founding in 1996, a new kind of endeavor, one that would seek to match the complexity of the challenge of global sustainability, with an approach that transcended particular academic disciplines and the intellectual limits of particular schools. Twenty years later, the Earth Institute offers a model for the collaboration of faculty and researchers in the natural sciences, social sciences, and humanities, as well as law, public health, engineering, architecture and urban planning that is unique in its reach and effectiveness, not only within the University but also nationally and internationally.

With over two dozen centers and programs and over 750 scientists, postdoctoral fellows and staff, the Earth Institute has identified and implemented transdisciplinary research projects that address all aspects of the climate change challenge – from the physical systems and human interactions, to the legal and policy framework and communication of risks.

What distinguishes the Earth Institute from many other university-based organizations is our holistic approach. Climate-based research at the Earth Institute spans multiple disciplines. The Earth Institute offers some of the most distinctive world-class scientific and technical tools to study climate change and its impacts and offer practical, measurable solutions. Another unique aspect of our work is our willingness to engage directly with stakeholders in long-term efforts to improve our understanding of climate change and potential solutions, help introduce new technologies, policies and institutional approaches to solve real-world problems, and evaluate what does or does not work.

Examples of our scientific and technical capabilities include: Earth system modeling and prediction, seasonal climate forecasting and monitoring, climate vulnerability and adaptation assessment, big data analytics and transdisciplinary data integration, geospatial analysis and Internet-based mapping tools, multi-hazard risk assessment and modeling, social impact assessment and project evaluation, information system design and implementation, legal and institutional design and evaluation, social surveys and field monitoring, mobile app development and crowd-sourcing tools, long-term data preservation and access, and conflict resolution and peacebuilding.
The “Climate Response” at the Earth Institute: Columbia University has highlighted “climate response” as a key priority. “Climate Response” defined by the Earth Institute includes three components: 1) understanding the Earth’s climate, 2) mitigating the effects of global climate change, and 3) developing and implementing tools for resiliency and adaptation to the impacts of climate change already at our door.

Understanding
Understanding the basic science of climate is an important prerequisite for any research into and activity taken on in response to the climate challenge. Reliable prediction is vital both to humankind’s future and to the well-being of the planet. Earth Institute climate scientists work to understand and predict climate change and variability through a transdisciplinary approach that integrates basic and applied research. Scientists research the basic physics of the Earth’s climate in order to document its change and to build an understanding of its controlling forces. Scientists engage in research across the natural and physical sciences including paleo-climate, geochemistry and geophysics, ocean and climate physics, and terrestrial and marine geology in an effort to improve our observation, computation and theory related to understanding, anticipating and managing climate.

The Earth Institute is also playing a unique role in development and utilization of cutting-edge scientific research in climate forecasting and climate change projections, to inform decision-making and planning and help shape approaches to building climate resilience. If we can understand our climate system, we can prepare reliable projections of future global and regional climate trends. This will enable informed management of a sustainable society and help safeguard humankind’s future as well as the planet’s well-being.

Mitigation
Columbia University has the expertise to evaluate the severity of near-term changes to climate at regional and national scales, assess the likely economic and social impacts of those changes, and work with national, international and non-governmental organizations to develop plans to anticipate and mitigate those impacts. Our research in climate and society investigates humankind’s role as both drivers of and responders to global climate and ways in which we can better utilize our understanding of climate variability and change to improve human welfare. We are examining the economics of climate change mitigation, and the complex processes at play in international climate negotiation, as well as the legal and political context of policies relating to climate change mitigation. We are studying extreme weather events, both in the present and future climate, in order to develop solutions to mitigate risks to human life and property. The Earth Institute is at the forefront of developing technologies and policy solutions to help ensure a sustainable energy future. The institute’s researchers are dedicated to creating the next generation of carbon capture and storage technologies, and addressing important questions related to renewable energy, nuclear power and the conversion of solid waste into usable energy.

Adaptation
The Earth Institute is also devoted to studying and working with communities to utilize climate information to prepare for the effects of climate change already occurring. We study infrastructure solutions, model the movements of urban populations, optimize risk communication, and coordinate within various law and policy frameworks to address infrastructure planning and evacuation. This requires building trust with the communities, developing objective measures of progress and improving data and information systems, and taking into account societal values, perceptions and behavior in crafting practical solutions. We are especially well-equipped to assess the risks to coastal cities from disastrous storms in both the present and future climates. This research involves understanding large-scale changes in atmosphere and ocean properties, including sea level rise as well as storm dynamics. We also conduct education and outreach to ensure effective transfer of key research results to private enterprise, civic stakeholders and the public at large.
The following summary presents the Earth Institute centers, programs, and affiliated faculty who are engaging in some aspect of “the climate response.”

The Lamont-Doherty Earth Observatory

The Lamont-Doherty Earth Observatory (LDEO) is one of the largest and most distinguished Earth science research institutions in the world. Its scientists study the planet from its deepest interior to the outer reaches of its atmosphere, on every continent and in every ocean. The Lamont-Doherty Earth Observatory has been a leading environmental science center for over 65 years. Lamont “firsts” include being the first to show the role of the global ocean in climate and the first quantitative prediction of El Niño events.

Scientists at LDEO study the Earth’s climate in order to document its change and to build an understanding of its controlling forces. Its scientists study Earth’s climate dynamics, from sea ice and polar ice sheets, to the oceans and atmosphere, to the response of land and marine ecosystems, and they excel in the development of cutting-edge computer models.

Its scientists conduct research on past climate and past environments, including information from deep-sea and lake-bottom sediment cores, samples from coral reefs and ice cores, and growth rings of trees. Marine and freshwater sediment cores allow scientists to look at Earth’s history over the last several million years. Scientists have examined leaf wax from plant material preserved in cores to link major climate changes with fundamental evolutionary events in the history of plants, animals, and humans. LDEO’s Tree-Ring Lab scientists use tree-ring records from around the world to improve our understanding of past climate and environmental history. Current research concentrates on the use of tree-ring data networks to study regional climate, global climate teleconnections, and anthropogenic impacts on forest growth. Current research at Lamont also includes work on carbon capture and storage in subsurface reservoirs – showing for the first time that carbon dioxide can be pumped into the Earth and changed chemically showing for the first time that carbon dioxide can be pumped into the Earth and changed chemically and the role of the global ocean in climate and the first quantitative prediction of El Niño events.

Key scientists and faculty include: Lisa Goddard, Director and Senior Research Scientist; Walter Baethgen, Senior Research Scientist; Daniel Osgood, Research Scientist; Andrew Robertson, Senior Research Scientist; Jeffrey Shaman, Associate Professor of Environmental Health Sciences.

The Center for Climate Systems Research

The Center for Climate Systems Research (CCSR), which is closely affiliated with NASA’s Goddard Institute for Space Studies, works to provide an enhanced understanding of the Earth’s climate sensitivity and variability, and the forcing and feedback mechanisms that control them. The center focuses on long-term climate changes that have the potential to impact human populations and environmental stability. CCSR investigates the chain of causes and effects linking climate and its impacts, utilizing the global climate models, physically based impact models, chemical tracer models, and interdisciplinary teams.

Key scientists include: Susanne Bauer, Director and Senior Research Scientist; Radley Horton, Associate Research Scientist; Cynthia Rosenzweig, Adjunct Senior Research Scientist; Gavin Schmidt, Adjunct Senior Research Scientist and GISS Director.

The Center for International Earth Science Information Network

The Center for International Earth Science Information Network (CIESIN) works at the intersection of the social, natural, and information sciences, and specializes in on-line data and information management, spatial data integration and training, and interdisciplinary research related to human interactions in the environment. CIESIN's mission is to provide access to and enhance the use of information worldwide, serving the needs of science and public and private decision making. Among other activities, CIESIN leads research on coastal climate resilience through vulnerability mapping and assessments, as well as gathering and integrating diverse data in water, health, and coastal zone management.

Key scientists include: Robert Chen, Director and Senior Research Scientist; Marc Levy, Deputy Director and Senior Staff Associate.

The National Center for Disaster Preparedness

The National Center for Disaster Preparedness (NCDP) is incorporating assessments of climate-specific impacts and vulnerabilities in its work on planning for, responding to, and recovering from disasters. NCDP has a special focus on climate adaptation research with direct relevance to policy and practice. NCDP researchers are intensely interested in what makes a community resilient in the face of a disaster: why are some individuals, households, and places quicker to recover than others? Its research seeks to create a knowledge base that will guide government, foundations, and others as they work to build—or rebuild—resilient communities.
Key faculty include: Irwin Redlener, Director; Professor of Health Policy & Management at CUMC; Professor of Clinical Pediatrics, College of Physicians & Surgeons.
▶ ncdp.columbia.edu

The Sabin Center for Climate Change Law
The Sabin Center for Climate Change Law, a joint center with the Columbia Law School, develops legal techniques to fight climate change, trains students and lawyers in their use, and provides up-to-date resources on key topics in climate law and regulation. It is a partner to and resource for public-interest legal institutions engaged in climate work. It also addresses a critical need for the systematic development of legal techniques to fight climate change outside of the realm of judicial litigation.
Key faculty include: Michael Gerrard, Director; Andrew Sabin Professor of Professional Practice in the Faculty of Law.
▶ law.columbia.edu/climate-change

The Research Program on Sustainability Policy and Management
The Research Program on Sustainability Policy and Management seeks to better understand the mechanisms behind sustainability management, in order to develop and promote more effective public policies and organizational practices. Its team analyzes sustainability strategies and initiatives, examines methods of valuing sustainability policies and the ways in which they foster innovative, cross-disciplinary scholarship.
Key faculty include: Steven Cohen, Director; Professor of Professional Practice in International and Public Affairs; Executive Director and Chief Operating Officer, The Earth Institute; Satyajit Bose, Lecturer in the Discipline of Economics; Dong Guo, Associate Research Scientist.
▶ spm.ei.columbia.edu

The Columbia Climate and Health Program
The Columbia Climate and Health Program (CCHP) at the Mailman School of Public Health fosters innovative, cross-disciplinary scholarship on the human health dimensions of climate change. Its goal is to advance society’s capacity to understand, anticipate, and prevent adverse health consequences. The program works to identify impacts, mechanisms, policy levers, and build a new workforce of well-trained professionals who can translate science into action.
Key faculty include: Jeffrey Shaman, Associate Professor of Environmental Health Sciences.
▶ mailman.columbia.edu/research/climate-and-health-program

The Lenfest Center for Sustainable Energy
The Lenfest Center for Sustainable Energy (LCSE) works to advance science and develop innovative technologies that provide sustainable energy while maintaining the stability of the Earth’s natural systems. LCSE researchers focus on the development of new scientific understandings, theories, models, novel materials, and technologies related to various aspects of sustainable energy. It frames its efforts in a larger context by coupling scientific research with policy and economics as well as public outreach and education.
Key faculty include: Alissa Park, Director; Lenfest Earth Institute Associate Professor of Climate Change.
▶ energy.columbia.edu

The Columbia Initiative on Extreme Weather and Climate
The Columbia Initiative on Extreme Weather and Climate is focused on understanding the risks to human life and property from extreme weather events, and on developing solutions to mitigate those risks. The initiative engages the broad and deep expertise that exists across Columbia University on all dimensions of this problem. With partners in the private sector, government, and academia, we work toward the goal of greater societal resilience to extreme weather and climate.
Key faculty include: Adam Sobel, Professor of Applied Physics and Applied Mathematics and of Earth and Environmental Sciences; Suzanna Camargo, Lamont Research Professor at the Lamont-Doherty Earth Observatory; George Deodatis, Santiago and Robertina Calatrava Family Professor of Civil Engineering; Chair, Department of Civil Engineering and Engineering Mechanics; Michael Tippett, Lecturer in the Discipline of Applied Mathematics in the Department of Applied Physics and Applied Mathematics.
▶ extremeweather.columbia.edu

The Columbia Water Center
The Columbia Water Center creatively tackles water challenges of a rapidly changing world where water and climate interact with food, energy, ecosystems, and urbanization. The center, in collaboration with other Earth Institute units and external partners, investigates the impact of climate variability on the provision of water and when and where it is needed. The center tackles the water scarcity challenge by considering water and climate interactions in a transdisciplinary way.
Key faculty include: Upmanu Lall, Alan and Carol Silberstein Professor of Earth and Environmental Engineering and of Civil Engineering and Engineering Mechanics; Pierre Gentine, Assistant Professor, Earth and Environmental Engineering.
▶ water.columbia.edu

The Sustainable Engineering Lab
The Earth Institute’s and The Fu Foundation School of Engineering and Applied Sciences’ Sustainable Engineering Lab uses engineering and software solutions to help make sustainable energy systems planning smarter and to improve energy delivery in the developing world.
Key faculty include: Vijay Modi, Professor of Mechanical Engineering.
▶ qsel.columbia.edu

The Urban Design Lab
The Urban Design Lab (UDL) addresses the need for a design-based approach to shaping the long-range future of sustainable urbanism. With SEAS and the Graduate School of Architecture, Planning and Preservation (GSAPP), the UDL’s work includes coastal city resiliency and climate change adaptation. Its work involves practical solutions at the policy and community levels, focusing on climate change as it relates to issues of socio-economic justice, information politics, psychological reactions, information technologies, urban design, and the responsibility of enterprises. It is also studying how urban green infrastructure can mitigate cites’ role in coastal zone pollution.
Key faculty include: Patricia Culligan, Co-Director; Professor of Civil Engineering and Engineering Mechanics; Associate Director, Data Science Institute; Richard Plunz, Co-Director; Professor of Architecture, Planning and Preservation.
▶ urbandesignlab.columbia.edu

Additional Earth Institute Faculty Work
Earth Institute faculty at the School of International and Public Affairs engage in research related to climate change from a wide variety of social science perspectives. Research focuses on how norms, customary law, resolutions, and treaties can be used to promote international cooperation on climate change mitigation. Faculty are also examining the economics of climate change and looking at the effects of changing weather conditions on agricultural output. Earth Institute Faculty in the Graduate School of Arts & Sciences research the impact of humanity’s transformation of the landscape on climate and ecosystems. Research includes projects using satellite imagery to track changes to the planet’s vegetation and their impacts on climate and ecosystems. Faculty from the Environmental Law Clinic at Columbia Law School have handled several important climate change cases, including its victory in a landmark decision from the Massachusetts Supreme Judicial Court in 2016 holding that the state must take additional actions to reduce greenhouse gas emissions.
Key faculty include: Scott Barrett, Lenfest Earth Institute Professor of Natural Resource Economics in the School of International and Public Affairs; Ruth DeFries, University Professor; Denning Family Professor of Sustainable Development in the Department of Ecology, Evolution and Environmental Biology; Edward Lloyd, Evan M. Frankel Clinical Professor of Environmental Law; Wolfram Schlenker, Associate Professor of International and Public Affairs in the School of International and Public Affairs.