

Urban Integrated Field Laboratories

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Science underpinning equitable climate and energy solutions for urban regions

Urban systems consist of interdependent environment, ecological, infrastructure, and human components. Understanding the predictability of these systems and their interactions with climate is a crucial challenge.

To meet this challenge, the Earth and Environmental Systems Sciences Division within the U.S. Department of Energy's (DOE) Biological and Environmental Research program supports four Urban Integrated Field Laboratories (UIFLs). Focusing on Baltimore, Chicago, Southeast Texas, and an Arizona urban megaregion, each UIFL represents diverse demographic characteristics, differing climate-induced pressures on people and infrastructures, and unique geographic and climatic settings.

Research Goals and Approaches

The multidisciplinary UIFL projects emphasize the basic sciences of climate, environmental, ecological, and urban changes that affect these regions. Research aims to inform equitable climate and energy solutions that will strengthen community-scale resilience across urban landscapes.

UIFL researchers leverage state-of-the-art field observations, data assimilation, modeling, model-data fusion, uncertainty quantification, and data

analytics to provide new insight into urban systems. Research combines new observations with high-resolution and highly detailed urban modeling for scientific analysis.

Research Teams and Partners

UIFL teams span diverse institutions, including DOE national laboratories, academic and non-profit research institutions, other federal agencies, and private-sector organizations. UIFLs provide opportunities to inspire, train, and support leading scientists from various organizations, including minority-serving institutions (MSIs), motivated to address the global climate and energy challenges of the 21st century.

Local organizations and MSIs have significant roles in each UIFL management team to help advance and inform environmental justice. UIFLs engage a diverse workforce encompassing the many communities, identities, races, ethnicities, backgrounds, abilities, cultures, and beliefs of the American people, including underserved communities.

BSEC: Baltimore Social-Environmental Collaborative

The BSEC UIFL seeks a new paradigm for urban climate research with a focus on Baltimore, a metropolitan area representative of the climate challenges faced by many midsized industrial U.S. cities. Baltimore also represents eastern "rust belt" cities that face

Science Challenges

- Understand climate changes and their impacts on all scales across urban regions.
- Evaluate the mitigation potential for emerging energy technologies that can be deployed to urban and suburban regions.
- Address environmental justice by enabling neighborhood-scale evaluation of climate impacts and energy needs.



Baltimore Social-Environmental Collaborative (BSEC) and Community Research on Climate and Urban Science (CROCUS). BSEC in Baltimore focuses on climate challenges that many midsized industrial cities must address (left). Focused on the Chicago region, CROCUS uses observational and modeling capabilities to address ways to mitigate climate change that will be useful to other major U.S. cities (right).



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interlinked challenges of aging infrastructure, stagnant populations, increased heat and flood risk, and inequitable burdens of air and water pollution.

BSEC begins with community priorities (human health and safety, affordable energy, transportation equity, and others) and city government priorities (clean waterways, decarbonization, and functioning infrastructure). The team then designs observation networks and models that will deliver the climate science capable of supporting those priorities.

CROCUS: Community Research on Climate and Urban Science

The CROCUS UIFL is a community-driven scientific effort to understand interactions between cities and climate. The large CROCUS team is led by Argonne National Laboratory and includes scientific, educational, and community organizations. CROCUS will advance urban science in the highly diverse Chicago region as a playbook that can be used by other major cities.

The Chicago region presents formidable opportunities for novel science. The region is reclaimed from a swamp and nestled between understudied, but critically important, Lake Michigan and former prairie land now converted to agriculture. CROCUS will enable just, long-term societal benefits from climate mitigation and adaptation, such as reducing emissions and adapting neighborhoods to address future climate change effects.

SETx: Southeast Texas

The SETx IFL study area, specifically the Beaumont-Port Arthur region, represents the climate adaptation needs, population diversity and vulnerability, and ecological richness that characterize many urban centers along the Gulf Coast.

The Gulf Coast contains an extensive and diverse range of natural features and human settlements, with a disproportionate number of vulnerable communities. The region faces regular “acute-on-chronic” hazards in which short-notice technological and natural stressors (e.g., coastal storms and oil spills) occur alongside long-term chronic environmental, industrial, and social stressors (e.g., subsidence, population growth, and toxic pollution).

The long-term goals for SETx are to provide quantitative understanding of projected climate change impacts and improve resilience science and community resilience through new and generalizable theories of change.

SW-IFL: Southwest Urban Corridor

SW-IFL, led by Arizona State University, will study a rapidly urbanizing megaregion stretching across Arizona from the Mexican border to the Navajo (Diné) Nation.

Most of the megaregion’s urban areas routinely experience 30 or more days of temperatures above 110°F each summer. The growing population is stressed by the complex interactions of extreme heat, atmospheric pollutants, and limited water. SW-IFL will seek to provide scientists and decision-makers with high-quality, relevant knowledge capable of guiding responses to these environmental concerns.



Southeast Texas (SETx). The Gulf Coast region has unique challenges and needs including acute-on-chronic hazards, along with long-term environmental, industrial, and social stressors, which SETx is working to address (above).



Southwest Urban Corridor (SW-IFL). SW-IFL represents one of the fastest-growing urban corridors in the United States, including Tucson, Phoenix, and Flagstaff, Arizona (above).

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