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Urban Resilience to
Extremes Sustainability
Research Network

www.URExSRN.net



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Overarching UREx SRN Goals

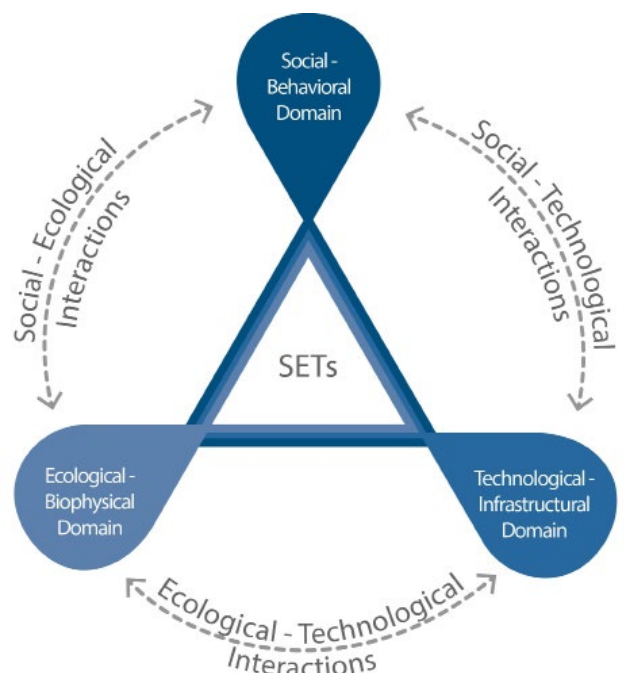
Climate change is widely considered to be one of the greatest challenges to global sustainability, with extreme events being the most immediate way that people experience this phenomenon. Urban areas are particularly vulnerable to these events given their location, high concentration of people, and increasingly complex and interdependent infrastructure. Impacts of Hurricane Katrina, Superstorm Sandy, and other disasters demonstrate not just failures in built infrastructure, they highlight the inadequacy of institutions, resources, and information systems to prepare for and respond to such events now, and especially to future increases in frequency and magnitude of extreme events. Thus, there is an urgent need for scholars of urban systems from multiple disciplines to work together with policy makers, managers, and other practitioners to address this challenge: the collision course of urbanization and climate change.

Our Vision. A network of collaborating interdisciplinary scientists and practitioners from diverse world cities working together to promote, design, and implement urban infrastructure that is resilient in the face of future extreme events, provides ecosystem services, improves social well-being, and exploits new technologies in ways that benefit all segments of urban populations.

Our Mission. Starting with nine network cities—six continental U.S. and three Latin American, home to over 35 million residents—and expanding in future years, the UREx SRN will co-produce the knowledge needed to promote resilient infrastructure in a future that will look very different from today. The extreme events that this project will focus on include urban flooding, coastal storms, regional droughts, and extreme heat waves. The UREx team will link SRN scientists, students, local practitioners, planners, industry, NGOs, and other stakeholders across >25 institutions (including partners) and >70 collaborators to co-produce data, models, images, stories, and on-the-ground projects that show how a new resilient infrastructure can be developed. Infrastructure that is flexible, adaptable, safe-to-fail, socially equitable, and ecologically based will enhance urban resilience in the face of a higher incidence of extreme events, more culturally diverse communities, and continued urbanization pressures. Ultimately, the UREx SRN will help accelerate knowledge generation and application to encourage innovative strategies towards urban sustainability.

Strategic goals:

- 1) Build a network of cities, institutions, and student, post-doctoral, and faculty researchers to explore resilience of cities to the expected increase in frequency and intensity of weather-related extreme events;
- 2) Develop novel theoretical frameworks for social-ecological-technological systems (SETS) that express a vision of sustainable, integrated urban infrastructure that is flexible, adaptable, safe-to-fail, socially equitable, and ecologically based;
- 3) Work with practitioners and decision makers, as well as a cadre of graduate and postdoctoral fellows, to co-produce knowledge (Vogel et al. 2007) that facilitates data-driven visioning and ultimately transitions to a sustainable future for urban infrastructure and, by extension, the fabric of urban social-ecological-technological sustainability; and
- 4) Create a model for incorporating assessment, learning, and adjustment in response to evaluative feedback in a large, transdisciplinary, multi-institutional, multi-national research network (note that most activities for this goal are described in “Opportunities for Training” and “Impact on Development of Human Resources” sections).



Network Partners



Common Abbreviations

Task Forces (TF) and Working groups (WG): City Comparisons (CCWG), Climate & Hydrologic Extremes (CHEX), Comparative Urban Futures (CUF), Computation and Visualization (CompViz), Education & Diversity (EDWG), Governance Analysis (GA), Green Infrastructure (GI), Knowledge-to-Action (KtA), Network Evaluation (NEWG), Social-Ecological-Technological Systems (SETS), Survey Results Across Cities (SRAC), Transitions & Implementation (TIWG), Urban Flooding (UF). Other: All-Hands Meeting (AHM), Early-Career Symposium (ECS), workshop (WK), urban heat island (UHI), data visualization (dataviz), Weather Research and Forecasting Model (WRF)

Cities: Atlanta (ATL), Baltimore (BAL), Hermosillo (HMO), Miami (MIA), New York City (NYC), Phoenix (PHX), Portland (PDX), San Juan (SJ), Syracuse (SYR), Valdivia (VAL)

City research teams (institutions): Atlanta (GSU), Baltimore (Cary Institute, UMBC); Hermosillo (ITSON, Universidad de Sonora, ASU); Miami (Clark U, FIU); New York City (TNS, NYU, CUNY-ASRC, CUNY-HC); Phoenix (ASU); Portland (PSU); San Juan (UPR); Syracuse (SU); Valdivia (UACH, ASU).

Other institutions/organizations/projects (lead role, if any): NCSU (CHEX lead); UB (HTF Lead); USDN (Practitioner lead); UOEEE (Education Evaluator at ASU); Maricopa County Industrial Development Authority (MC IDA); Universidad de Sonora (Unison); Urban Systems Lab (USL); Resilient Coastal Cities (RC2) Smart & Connected Communities (SCC); Resilient Urban Latin America (RULA); International Research Experience for Students (IRES); Healthy Urban Environments (HUE); Nature-Based Solutions for Urban Resilience in the Anthropocene (NATURA)

Accomplishments

Major Activities

Network Wide

- Held Scenarios WK 1 and 2 for Portland (9/19, 11/19), Scenarios WK 2 for Hermosillo (2/20) and Valdivia (3/20), and two virtual AHMs (11/19, 4/20)
- Created UREx Data Portal with city/thematic landing pages, data policies, procedures, security, and eRAMS instructions
- ECS Committee organized to conduct 4 virtual symposia 7/20-11/20 (www.get-sets.com)
- Continued development of UREx DataViz platform to synthesize city data
- Coordinated all governance document analyses being analyzed for three UREx synthesis papers in prep
- Established KtA TF to develop products based on UREx science and scenarios to share with practitioner partners
- Leveraged UREx for several grant opportunities: NSF INTERN Supplements (\$39K, \$49K); NSF Accel-Net: Nature-Based Solutions for Urban Resilience in the Anthropocene (NATURA)–\$2M, 5 y; NSF Convergence: Converging SETS for Urban Resilience–\$3.5M, 2-5 y
- Continued work on previously leveraged grants: 1) RC2 SCC, 2) RULA IRES, and 3) HUE
- Deployed UOEEE's GF-PF survey to new 2019 cohort and alumni survey to all emeritus fellows

City Specific

Baltimore

- Supported SWG modeling team on scenario strategies for LU/LC models (PF Matsler)
- Led a sea level rise and groundwater flooding project in NYC, BALT, and MIA with McPhearson (TNS) (PF Rosenzweig, Welty)
- Collaborated with Kelleher (SU) to assess land use in Digital Surface Model-derived topographic bluespots (Rosenzweig)
- Developed a dual-drainage model for a subwatershed of Jones Falls and partnered with Dept. of Public Works to quantify Baltimore's urban flooding problems using the EPA SWMM model (Welty, Rosenzweig)
- Carried out various GIS data activities including acquiring, curating and fulfilling data requests for Baltimore area spatial datasets for UREx researchers (Lagrosa)
- Supervised historic land-change analysis for Baltimore and processed historic aerial photos (Lagrosa)

Hermosillo

- Completed Scenarios WK2
- IMPLAN conducted 5 workshops using UREx methodology to expand scenario themes
- Launched an environmental monitoring program in collaboration with UES, Unison and IMPLAN
- Conducted a study in collaboration with UNAM to better understand and characterize the role of soils in providing urban ecosystem services
- Analyzed Digital Elevation Models as input to a bidimensional hydraulic model
- Linked analysis of extreme rainfall events with photographic evidence and emergency calls to predict flood-prone areas and calibrate the existing urban hydrological model
- Prepared CHIRPS and NLDAS datasets, including BIAS corrections using available rain gauges inside the city

Miami

- Continued fieldwork on the effectiveness of GI and shoreline projects in protecting water quality in several waterbodies (GF Smith)
- Worked within Idrisi Terrset and ArcGIS to continue to spatially join and match scale/resolution across spatially explicit SETS variables relevant to climate vulnerability across Miami-Dade County
- Acquired and spatially joined FEMA data on hurricane damage claims at the state, regional and county levels to the MIA GeoDatabase
- Evaluated multiple spatial scenarios of spatial vulnerability to flooding for Miami-Dade county, using sensitivity analysis to assess impacts of participatory rankings of criteria
- Analyzed several case studies of knowledge co-production for climate resilience decision making in the greater Miami area (GF Hobbins)
- Identified hotspots of poor water quality through time and space based on time-series analysis of dataset acquired for Miami-Dade County

New York

- Mapped the sources (Metadata) of all the layers currently on the DataViz platform (Sauter, Tomateo)
- Finalized qualitative (RESQ, renderings) and quantitative (CA model) outputs from VAL Scenarios WK1 and facilitated HMO WK2 (Cook, PF Mustafa)
- Developed future land-use visions for VAL, produced 2nd round of future land use for VAL, HMO, and BAL based on city teams' feedback, and developed future "business-as-usual" scenario of all US cities (Mustafa, Cook)
- Developed detailed transitions and implementation plans for prioritized strategies in BAL (in collaboration with practitioners) and worked with MIA team to integrate UREx scenarios / visions in the City of Miami upcoming Climate Adaptation Plan
- Developed land-surface temperature projection maps for MIA, BAL and HMO (PF Ortiz, McPhearson)
- Obtained a larger national database of projects from the EPA to analyze (in response to the GIF analysis publication in Climate, 3/19)
- Conducted decision-making support tool workshops in Miami and New York (Solecki)*
- Continued development of Climate Coast TF (initiative focused on coupling policy transition framework, sea level risk perception, and development trajectories at the UREx coastal city sites)*

Phoenix

- Won funding for and began leveraged projects SETS Convergence (Chester, Grimm; NSF), NATURA (Grimm; NSF); continued HUE work (Redman; MC IDA)
- Hosted scenario strategies workshop; analyzed strategies using Q-sort (PF Emeritus Berbés-Blázquez, PF Kim)
- Explored how system-level resilience of natural systems could provide inspiration for designing resilient infrastructure (GF Helmrich)
- Measured ecosystem services of urban ecological infrastructure in Phoenix (GF Elser)
- Examined how people are affected by power outages across three cities (GA Andresen)
- Assessed scenarios in terms of resilience, equity, and sustainability (Berbés-Blázquez)
- Developed renderings and visualization products from scenarios as requested by practitioners (GF Kuhn)
- Began 2020 REU summer program (virtually)
- Executed heat action plans developed during the Nature's Cooling Systems project (GF Emeritus Guardaro, HUE)

Portland

- Completed Scenarios WK 1 and DRAAG Workshop (variation on Scenarios WK 2)
- Planned for fifth AHM in Portland

Portland Continued..

- Led urban flood vulnerability analysis across network cities using the SETS framework (Chang)
- Developing edited volume on researcher-practitioner collaboration; chapters co-authored by UREx researcher-practitioner teams (Shandas)

San Juan

- Continued post-scenario workshop transition initiatives
- Developed “Story Maps” for all San Juan scenarios (GF Hobbins (ASU), Muñoz-Erickson (IITF))
- Led comparison studies of urban resilience governance across UREx cities (Muñoz-Erickson, IITF)
- Coordinated a “Heat Awareness Week” with Ecoexploratorio, NWS-San Juan Office, and other academias to offer a full week of webinars related to heat, May 11-15, 2020 (Méndez Lázaro)*

Syracuse

- Produced and distributed Scenarios WK1 report
- Continued research on green roof functionality (Davidson and students)
- Led an initial data analysis of UREx surveys for all network cities (Davidson, SRAC TF)

Valdivia

- Completed Scenarios WK2
- Continued collaboration with practitioners and Ministry of Infrastructure to examine VAL wetlands’ role in stormwater management
- Cross-city comparisons including VAL future scenarios and ecosystem services, heat and flood vulnerability, and knowledge systems survey
- Modeled potential of VAL urban wetlands to mitigate flooding (GF Sauer)
- Provided scientific expertise to Chile’s Ministry of the Environment new national law protecting urban wetlands, and aided Chile’s Ministry of Housing and Urbanism in urban wetland classification, based on GF Sauer’s research

Atlanta

- Uploaded scenario analysis, validations, final products, and eRAMS data submissions - scenario themes and goals, strategy inventories, timelines, models (for HMO, NYC, SJ, and VAL), narratives, RESQ assessment and renderings (for HMO, SJ, and VAL), scenario reports for city practitioners
- Governance document analysis for SYR, MIA, and VAL
- Developed Scenario Primer 2.0 (Mannetti)
- Co-led cross-city scenario analysis (CUFTF; Mannetti) and cross-methods analysis (GATF; Iwaniec)

Not City Specific

- Used WRF model to simulate 2 historical extreme precipitation events: 1) the West Baltimore/Ellicott city 2016 urban cloudburst; and 2) the Portland 2015 Atmospheric River flooding (Kunkel, NCSU)
- Worked on methodology to model future warm environment using daily weather pattern data instead of monthly averages (Kunkel)
- Research to understand the atmospheric conditions affecting flooding events examined the roles of atmospheric water vapor and weather systems as modulators of extreme precipitation magnitude (Kunkel)
- Completed heat exposure and sensitivity analyses for SYR, PDX, MIA, and BAL (Hamstead, UB)
- Coordinated metadata preparation with the UREx data portal team (Hamstead)

Specific Objectives

Network Wide

- Complete YR5 scenarios WK for Portland, Valdivia, and Hermosillo
- Retain and recruit top scholars to join the UREx
- Publish in top-tier journals
- Provide outreach and impact to key: 1) academic communities through journal publication, presentations at conferences and workshops; and 2) city decision-makers through participatory settings, digital and print reporting and distribution of decision support tools and products, and presentations at non-academic meetings
- Develop and promote conceptual frameworks for resilience, SETS, and equity and sustainability in urban systems
- Continue engagement and capacity building with city practitioners from network cities to develop long- and short-term resilience planning strategies from a SETS perspective, via scenario workshops, interactive DataViz platform, and data sharing

City Specific

Phoenix

Network Leadership:

- Continue to build the UREx network, strengthen interactions among nodes, and maintain organizational infrastructure to support activities at all institutions, among all workshop groups, and within all cities
- Develop concrete plans for continuation of the UREx network beyond the funding period, including integrating UREx participants into NATURA network
- Infuse concern for equity, future thinking, SETS thinking, and awareness of cultural and other diversity into all UREx activities

Research:

- Develop the methodology and qualitatively assess resilience, equity, and sustainability as reflected in future scenarios for all cities (Berbés-Blázquez)
- Plan and implement additional follow-up scenarios workshops and other strategies to engage municipal and community partners in resilient Phoenix (Grimm, Berbés-Blázquez, Iwaniec (GSU), Cook (Barnard))
- Support research in Latin American cities through student exchanges
- Continue collaboration with HUE (Redman); including Heat Ready City work, analyzing cooling center networks to identify gaps in service for vulnerable populations, developing effective heat health communications strategies (Guardaro)
- Determine any species-level differences between tree species in terms of their daytime cooling ecosystem services (GF Elser)
- Identify the core concepts of resilient infrastructure in practice and theory, survey and evaluate core concepts and Life's Principles, and then assess how infrastructure managers can utilize survey findings to create more resilient infrastructure (GF Helmrich)
- Determine the enabling and constraining factors that make flood risk knowledge actionable for climate resilience decisions and policies (GF Hobbins)
- Develop impactful communication and visualization products and needs for our city partners (Berbés-Blázquez, GF Kuhn)

Baltimore

- Provide Scenarios Workshop Report results to stakeholders
- Collaborate with practitioners to provide actionable science to support pluvial and groundwater flooding resilience in UREx Cities
- Use bluespot and other terrain modeling results for intracity research in UREx cities
- Complete 1D-2D dual-drainage model for a subwatershed of Jones Falls
- Develop an urban flood events database to support intercity comparisons research on recent flooding events in UREx SRN cities located in the United States
- Provide GIS and other data on Baltimore to the network as requested

Hermosillo

- Develop materials for and host Scenarios WK 2 (renderings, future land-use maps, etc.)
- Document flooding events and their specific climate characteristics and consequences
- Develop a comprehensive environmental education program for the city

Miami

- Complete fieldwork associated with urban water quality and performance of shoreline and other green infrastructure interventions (GFs Garriga, Smith)
- Complete analyses of interviews and archival documents, publish two scoping articles and manuscripts (Grove, PF Barnett)
- Complete GeoDatabase integration across GIS platforms and SETS domains for Miami
- Obtain and spatially join FEMA hurricane damage claims data at three hierarchically nested scales (state, regional and county levels) to the Miami GeoDatabase
- Sensitivity analysis of multi-criteria evaluation derived spatial vulnerability scenarios for Miami-Dade county, and testing for impacts of alternate factor weights
- R-based statistical analysis and data visualization to summarize urban climate vulnerability literature review/meta-analysis

New York

- Build, maintain and enhance interactive UREx DataViz platform to advance SETS understanding of network cities
- Support modeling and develop an analytical understanding of each city's past, current, and future land changes and impacts on future flooding and temperature projections (e.g. via cellular automata land-change modeling and flood and temp. projections)
- Integrate human behavior into Infrastructure usage patterns
- Develop engineering and science intersections related to indicators
- Provide innovative approaches for the implementation for GI
- Link infrastructure connectivity research to increase resilience in multiple ways
- Revise and resubmit manuscript associated with flood risk and risk perception (derived from the extremes database and stakeholder survey)*
- Write-up results of the policy transition framework and application to decision support tools including Macro Adaptation Resilience Tool (MART) and the Post Extreme Event Learning Tool (PELT)*

Portland

- Support DRRAG and the City of Portland in developing transformative visions and strategies for urban resilience
- Support DRRAG in developing viable, transformative forms of governance for urban resilience which could be taken to City leadership and realized
- Conduct spatial analysis to identify the hotspots of vulnerability areas in each SETS dimension

San Juan

- Develop visualization products from Scenarios WK 2 to better communicate with practitioners

Syracuse

- Conduct analysis of governance survey results from all UREx cities; analyze UREx survey results to look at practitioner perceptions of climate risks, their preferred solutions, and how they use climate resilience data and knowledge
- Evaluate green roof hydrologic performance

Valdivia

- Develop strong analytical understanding of urban ecosystems in Valdivia, and provide useful and concrete data/outputs (e.g. future climate projections, ecological and social assessments of urban wetlands, ecosystem services) to Valdivia stakeholders that can be used for decision support
- Determine how locals in Valdivia perceived urban wetlands and the ecosystem services that they provide (via survey analysis) (GF Elser, ASU)
- Train and give students opportunities in urban and wetland ecosystem ecology, and engaging with stakeholders

Atlanta

- Co-develop, validate, and explore scenarios pathways of climate resilience for UREx cities
- Comparative research on scenario outputs across the UREx SRN cities to examine scenario typologies, key SETS strategies to build resilience, and actors framings of climate resilience in different socio-political and biophysical contexts (GSU, ASU, TNS, Barnard)
- Analysis of UREx survey results to look at practitioner perceptions of climate risks, the solutions they prefer to be integrated into public policy making and investments, and how they use climate resilience data and knowledge
- Analysis of municipal governance documents among UREx cities to examine the existing policy goals, strategies, targets, and metrics to address climate change

Not City Specific

NCSU

- Develop or retrieve state-of-the-art statistically-downscaled climate model data for each of the UREx network cities
- Compute and analyze climate extreme indices (statistical measures of extreme temperature and precipitation events) based on the downscaled climate data for each of the UREx network cities
- Produce extreme precipitation design storms that incorporate potential future climate change through dynamic downscaling
- Communicate the state-of-the-science with respect to climate and hydrological extremes to the network

Univ. at Buffalo

- Support the Scenarios Workshops and modeling team's future heat projections work
- Align heat analysis projects across the UREx
- Disseminate SWG and HTF-related findings to student, scholarly, and practitioner audiences

Significant Results

Phoenix

Network Leadership:

- Analysis of network surveys reveals that participants value personal relationships developed through the network and see them as future collaborations (Fig. 1), that the network has become larger but more distributed (Fig. 2), and that individuals have experienced greater connection with researchers outside their own disciplines (Fig. 3)
- A network focus on knowledge to action through building relationships with practitioners is highly valued (Fig. 4)
- UREx network members have been strong contributors to the new NATURA global network of networks

Research:

- Qualitative assessments of scenarios (resilience, equity, and sustainability) are now complete for SJ, VAL, HMO, and PHX
- No significant differences between Phoenix's native and non-native trees in how much they lowered temperature (GF Elser)
- Resilient infrastructure (RI) theory aligns well with Life's Principles (LP), but RI practice only occasionally aligns with LP (Helmrich)
- Iterative knowledge co-production processes are needed that integrate knowledge and perspectives from diverse stakeholders and build long-term producer and user relationships (Hobbins)
- During power outages, 75.6% reported not owning a generator but 59% have a carbon monoxide detector in their home. During their longest outage, 61% reported not leaving their home, 50% having to throw food out, and 74% not receiving assistance (Andresen)
- Mesa city managers were convened to present and discuss heat action plans resulting in proposal submissions, as well as placemaking and shading projects. Edison Eastlake community incorporated elements of the heat action planning process into neighborhood redesign (HUE, Guardaro)

Baltimore

- A commentary is being submitted based on the outcomes of the Urban Flood Modeling workshop (Rosenzweig with other UREx researchers and practitioners)
- Preliminary SWMM model of a Baltimore sewershed included a workflow for filling in missing pipe attribute data (undergrad Mowery, supervised by Welty and Rosenzweig)
- Land cover change in Baltimore City between 1927 and 2007 revealed based on historical imagery

Hermosillo

- A database with relevant spatial information was created using inputs from participants in Scenarios WK 1, with future scenarios model outputs from the SWG modeling group presented in the second workshop (Fig. 6)
- Scenarios WK 2 resulted in a series of specific strategies that will help urban planners prioritize actions in the short, medium and long term
- Follow-up working groups from WK 2 further developed themes to be used in developing general plans and GI plans for Hermosillo

Miami

- Field work continues to document effectiveness of GI changes on water quality dynamics
- Cross-site hydrologic studies link the scales of spatiotemporal variability in stream flow to urbanization, and are supportive of an urban flood pulse concept
- Geodatabase development complete and best visualization candidates shared with MIA team for online dissemination
- FEMA datasets acquired, cleaned up, checked for spatial precision, summarized, and integrated with Miami geodatabase
- Multiple scenarios generated highlight the complexity and spatial implications of prioritizing SETS factors for the specific case of flood vulnerability in Miami, allowing the examination of synergies and tradeoffs (e.g. between SETS domains)
- Analysis of the published literature reveals areas of convergence and gaps in scientific studies examining cities' vulnerability to extreme climate events

New York

- Final analysis for energy burden of adoption of air conditioning in NYC in addition to landscape-based heat risk projections and urban greening impacts; WRF simulations of changes to surface dynamics from the SJ future scenarios under extreme heat conditions (Ortiz, McPhearson, Mustafa)
- Developed temperature projection summaries for SJ and VAL for use in scenario projections. Geoprocessed SJ land use/buildings data; Expanded analysis of climate change impacts on global AC performance (Ortiz)
- Processed and synthesized data from UREx city teams (PDX, MIA, SYR, SJ) into appropriate forms for viewing on web platform (Steele)
- Development and implementation of indicators for SETS will become a unique contribution to the indicators lit in the UFV synthesis paper as a major challenge and constraint to indicator development is populating and testing indicators with real data
- Obtained significant insights into GIF from analyzing one large nationwide convenience sample with significant transferrable characteristics of the financing arena; found that there are dependencies on conventional forms of finance, such as grants, and limited variability existed in the types of financial tools used
- There is increasing interest in financing GI (e.g., from legislation, government funding programs, financial communities, GI users)
- Developed extensive work connections with the Miami team (conducted a joint workshop and ultimately developed a follow up workshop report and follow up proposal for funding with NOAA) (Solecki)*

Portland

- Scenario WK 1 participants stated that the workshop resulted in a paradigm shift in city thinking around urban resilience, from a “survive” to a “thrive” mindset
- Scenarios WK 2 was co-produced with DRRAG and resulted in four distinct models of urban resilience governance. The workshop was very well received, with some saying they achieved a year’s work within a day.
- Open Educational Resource textbook on community resilience to climate change published by PSU Library
- Leadership on the UFV TF has produced maps of social, ecological, and technological vulnerability for six UREx cities

Syracuse

- Developed a framework for selecting a GCM subset for heatwave studies for each city that showed GCMs have different performances in the simulation of historical heatwaves and GCMs with a more robust ocean-modeling component provide a better prediction of heatwaves in coastal cities. (GF Shafiei Shiva)

Valdivia

- Established a long-term relationship with a cohesive group of city stakeholders who discuss strategies that can make Valdivia more resilient and engage in cross-city connections with other UREx practitioners
- Leveraged UREx work to support additional opportunities for local stakeholders from Activa Valdivia, FORECOS, and the municipality in urban sustainability and resilience work on the ground
- Discovered and quantified the phenomenon of an “evapotranspirative tide” in Valdivia’s urban wetlands
- Produced model results showing seasonal changes in the flood mitigation services of Valdivia’s urban wetlands
- Valdivia local stakeholders rated the wetlands as being most important in providing cultural and regulating ecosystem services, and perceived personal benefit increased when living in proximity to wetlands

Atlanta

- Scenario development has been used to promote the development of innovative solutions and to explore interactions and trade-offs among strategies for resilient, sustainable, equitable cities
- UREx co-developed scenario visions enhanced anticipatory (long-term >40 year time horizons), transformative (transition pathways approach in scenario co-development process), systems (SETS emphasis in scenario co-development process, modeling, and assessments), and normative (bringing together with diverse stakeholders) capacities, which are fundamentally new visions compared to current plans

Not City Specific

NCSU

- Completed a full stochastic ensemble of simulations of the West Baltimore/Ellicott city 2016 urban cloudburst event using WRF, as well as for a Portland Atmospheric River flooding event and a preliminary future ensemble

UB

- By applying environmental justice theory to the outcomes of Hurricane Maria in PR traces ways in which misrecognition, distributional injustice, procedural injustice, and other forms of social separateness produce climate inequity and vulnerability to extreme weather
- Developed the thermally Resilient Communities Collaborative framework for designing a thermal management system, which describes how governance networks solve collective action problems and elevate experiences of marginalized communities
- Linked hot microclimates to historical processes of exclusion and oppression

Key Outcomes & Other Achievements

Network Wide

- The network so far has engaged over 200 researchers and more than 230 practitioners across 10 cities. Eleven PFs and PAs and over 50 GFs and GAs are participating, as well as over 30 emeritus fellows and alumni associates; >55% women and minorities*. Seventeen theses or dissertations have been completed* and 11 graduate or postdoctoral fellows have moved into postdoctoral or faculty positions.
- UREx published 39 articles in YR5 (with 3 more accepted and 17 additional under review)
- Coordinated work across 18 institutions and ten cities to build a community of urban resilience researchers, including a diverse team of faculty researchers, PFs, GFs, and GAs (Figs. 1-3)
- UREx members led the session, “Co-Producing Urban Transformative Visions for Resilience to Extreme Events,” at the 2019 Transformations Conference in Santiago, Chile and also gave over a dozen presentations (10/19)
- Network contributed substantially to the Environmental Science & Policy’s Special Issue on Knowledge Systems for Urban Resilience, including members on the editorial team (Muñoz-Erickson, Matsler)
- Coordinated planning, organization, and execution of YR5 Scenarios Workshops
- Scenario WK1 Reports have been finalized for all core cities
- Produced the SRN Multi-modal Mentorship Guidelines
- Member Awards/Appointments: Grimm, McPhearson, Pickett, and Elmqvist were recipients of the ESA’s Sustainability Science Award. McPhearson also received ESA’s Innovation in Sustainability Science Award (ceremony held 8/19); PI Mendez-Lazaro was appointed to PR Governor’s Committee of Experts and Advisers on Climate Change (9/19); Valdivia co-lead Barbosa was appointed to the Ministry of Science in Chile (10/19); PI Zimmerman received the 2019 Society for Risk Analysis (SRA) Distinguished Achievement Award (12/19) and was invited as a technical advisory group member, NYC Mayor’s Office of Resiliency; co-director, Grimm, was elected to the National Academy of Sciences (inducted 4/20); PF Emeritus McPhillips received the 2020 Best Paper Award from the ASCE Journal of Sustainable Water in the Built Environment; PI McPhearson and PF Rosenzweig were appointed to the NYC Panel on Climate Change (6/20)

City Specific

Baltimore

- Matsler led the successful proposal for the ECS, and continues to be a mentor to and collaborator on graduate-student-led GI projects
- Rosenzweig was appointed to the New York City Panel on Climate Change
- Groffman is a co-PI on an urban-focused Critical Zone Observatory proposal (led by Welty) that has been recommended for funding by NSF

Hermosillo

- Completed research on Heat Island, governance, air pollution, health hazards, urban monitoring, carbon fluxes
- Results for the extreme heat characterization for the city of Hermosillo have already been included in the official documents created by the city government. The Public Development Plan was updated in 2017 and it included an analysis of the extreme heat for the city of Hermosillo conducted by the UREx team
- The RULA IRES summer program (summer 2019) generated additional information on effects of extreme heat on the bus system (GF Dzyuban, ASU) and validation of flood prone areas (GF Sauer, ASU)
- Funding was received from the GIZ agency and FORDECYT to conduct green infrastructure and water security projects

Miami

- Led collaborative work on urban climate vulnerability literature review/meta-analysis (Roy Chowdhury)
- Conference presentation in an “innovative and immersive” session leveraged UREx-related results towards seeking solutions to land challenges of the Anthropocene.

New York

- Presented combined climate-land change-driven impacts from co-produced land cover scenarios in San Juan, PR at 2020 AMS Annual Meeting (Ortiz); Presented Valdivia co-produced land use scenarios during the 2020 AMS Annual Meeting (Mustafa)
- Co-organized sessions and presented UREx SRN findings in Santiago Chile at the Transformations Conference (10/19 Cook) and at the Ecological Society of America meeting (8/19; Louisville, KY; Cook)
- Increased attention of scholars, practitioners, and the media to GI and other infrastructure-related elements (Zimmerman)
- 2018-2020: Invited Member, Programme Committee for the 2nd International Conference Water, Megacities and Global Change, Paris, France (Zimmerman)
- Hosted a Climate Coast workshop at the 5th UREx AHM and developed a statement of follow on activities (Solecki)*

Phoenix

- PFs Kim presented at the AGU Fall 2019 meeting (12/19) and Hobbins presented at the international Transformations Conference in Santiago, Chile (10/19)
- GF Emeritus Guardaro was a panelist for the Sustainability and Security seminar series, “Preparing for the Health Effects of Extreme Heat,” and for the EPA Health and Equity webinar kickoff
- Grimm, Guardaro, and Hartman (City of Phoenix) co-led Meeting of the Minds Workshop: Urban Heat, Green Infrastructure & Health Outcomes - Approaches, Solutions and Adaptation (2/20)
- PF Markolf was awarded 3 grants to continue his air quality and heat research: Zimin Institute for Smart & Sustainable Cities (Lead-PI, \$98K); ASU Knowledge Exchange for Resilience, Heat Resilience in Mobile Homes Innovation Challenge (\$20K); HUE (Co-Lead PI, \$50K)

Portland

- Supported City of Portland in resilience efforts via two workshops
- Developed an accessible, no-cost resource on climate change resilience for students, faculty, and others (Open Educational Resource)
- Coproduced four models of urban resilience governance with DRRAG

San Juan

- Continued to promote the Latin America and Caribbean Cities Task Force (LACTF) to serve as a platform for research and transition initiatives in our LAC cities (Muñoz-Erickson)
- Developed story maps (Esri) for each of the SJ scenarios and other concepts (i.e., GI) in both English and Spanish (Hobbins (ASU), Muñoz-Erickson)

Syracuse

- Ongoing work at the Convention Center green roof shows that soil moisture content is a major determinant of evapotranspiration rate from the roof

Valdivia

- Coordinated co-edited UREx book on “Resilient Urban Futures” (McPhearson, Cook) and wrote chapters on co-production (Cook)
- Provided scientific expertise to Chile’s Ministry of the Environment on the country’s new law protecting urban wetlands, using the results of Sauer’s ongoing research (GF Sauer)
- Aided the Chile’s Ministry of Housing and Urbanism in an urban wetland classification effort, which directly resulted in the conservation of a Valdivian wetland under consideration of rezoning (GF Sauer)
- Interacted directly with land developer to infuse UREx research and framing into development plans and improve outcomes of anticipated residential development on a wetland in Valdivia

Atlanta

- All UREx cities have co-produced alternative scenarios of positive futures for urban climate resilience
- The scenarios participatory setting has enhanced the capacity for transdisciplinary research among UREx city teams and with practitioners expressing enthusiasm for continued engagement on this work. City practitioners and researchers have continued engagement using the scenarios work and Hermosillo is incorporating scenario products in municipal plans.

Not City Specific

- The major determining factor modulating the magnitude of extreme precipitation events is atmospheric water vapor while the strength of weather systems plays a secondary role. This provides a scientifically-defensible foundation for incorporation of global warming considerations into design storms. (Kunkel, NCSU)

Opportunities for Training & Professional Development

Network Wide

- Provided an opportunity for eight early career researchers to design and host an Early-Career Symposium (Get Ready, Get SETS: GI!) in collaboration with Cleo Institute, a Miami-based non-profit organization for climate education. The three symposia (now virtual) will focus on cultivating the next generation of leaders for urban resilience, particularly on equitable and multi-functional GI implementation for the new climate normal.
- Awarded internal grad grants to 6 grad students (\$2-4k/each) to further their UREx-related research; ran NSF-style panel with UREx PFs Matsler, Ortiz, and Rosenzweig and previous awardees Andresen, Dzyuban, and Gilbertson to review and recommend grants to be funded
- PFs and GFs continue to lead TFs and WGs, present research results at dozens of national and international meetings (with support of UREx), and contribute to Future Cities Podcast episodes
- Training and mentoring UREx GFs, GAs, and PFs across the network; multi-modal mentoring guidelines produced and shared (see attachment)
- GFs and PFs report high impact of the program on their interdisciplinary and collaborative skills; a majority is satisfied with the collaborative outcomes of the working groups and nearly all report satisfaction with the overall UREx experience (Fig. 5)
- Supported student and postdoc writing and publications for academic journals, stakeholder reports, and broader outreach venues for generating press and impact of their work
- Connecting UREx researchers, GFs, GAs, and PFs to relevant stakeholders
- Brought UREx research into the classroom through interdisciplinary courses (e.g., Urban Ecology, Urban Resilience, Design, etc.)

City Specific

Baltimore (Cary Institute, UMBC)

- PF Matsler leads GIRC TF synthesis work, and is now finalizing a manuscript outlining key challenges and recommendations
- PF Rosenzweig leads UFTF city comparisons project to analyze an urban flood events database for US UREx cities
- Rosenzweig collaborated with Herreros-Cantis (TNS), Kim (ASU), and practitioners from Baltimore and NYC to host a virtual workshop, “Overcoming Technical Barriers in Urban Flood Modeling” (2/20)
- Rosenzweig chaired a session on Nonstationary Impacts in Urban Hydrology: Water, Energy, and Society (H44E) at the AGU Fall Meeting in San Francisco, CA (12/19)
- Matsler created, recruited for, and led the organization of three green infrastructure sessions (12 presentations) for the American Association of Geographers (AAG) annual meeting in 4/20 (cancelled due to COVID-19)
- Matsler was invited to submit an abstract and was accepted to present an Inspire Talk at the Ecological Society of America (ESA) annual conference
- Matsler continues to be a mentor to and collaborator on graduate-student-led GI projects
- Rosenzweig and Welty (UMBC) co-supervised 4 UMBC undergraduates to identify urban flooding problems using SWMM modeling, with the bulk of the substantive work being done within the past year (2019-2020) by Mowery (UMBC)
- Two undergraduate students were trained to use SWMM modeling software and to assimilate various GIS data sets as input, in summer and fall 2019 (supervised by Welty), and another to continue georectification and classification tasks in spring 2020 (supervised by Lagrosa)

Hermosillo (ITSON)

- Fruitful collaboration with researchers from other Sonora universities (and members of the extended UREx network, ASU, PSU, Univ. de Sonora (USON), and TNS)
- The Hermosillo research team has expanded significantly with the help of USON, Univ. Estatal de Sonora (UES) and Colegio de Sonora (COLSON)
- A new collaboration on urban hydrology and risks of flooding has started with Dr. LAURENT COURTY from the Mexican Institute of Water Technologies

Miami (FIU, Clark U)

- Through NSF-supported Center for Research Excellence in Science and Technology (CREST CACHÉ) grant, we are increasing participation of PhD students from underrepresented groups in UREx. UREx researchers Kominoski is on the leadership team and Gaiser and Troxler are collaborators of CREST CACHÉ. Through in-kind support from the CREST CACHÉ, we instrumented a sensor buoy in the Coral Gables Waterway in spring 2019 to continuously record water quality data that will be used in the dissertations of GFs Smith and Garriga. The data will be showcased in data visualization platforms at the Coral Gables Museum for students and community members.

New York City (TNS, NYU, CUNY-HC)

- Trained and mentored undergraduate students, UREx GFs and PFs, and multiple Research Associates, including promoting publication of their work
- Brought UREx research into the classroom through three course offerings of “Urban Resilience” taught at TNS with UREx members as guest speakers
- A recent GF at NYU was able to develop skills in analyzing GIF data
- Provided research opportunities for five CUNY - HC students and enhanced their connection to the Institute for Sustainable Cities at Hunter College and the UREx network*

Phoenix (ASU)

- Provided GF Sauer a 6-month opportunity to continue his dissertation research in a LA city (Valdivia)
- Supported GFs Cordero and Morrison to participate in the Portland Scenarios Workshops (9/19, 11/19)
- Awarded 4 summer REU opportunities (6/20-8/20) and combined with CAP LTER, UWIN, NASA and Grimm Lab (N=16, including 2 SEEDS SPURS fellows) to provide a summer 'course' on research and professional development; ASU mentors include GF Emeritus Guardaro, PF Kim, PF Emeritus Berbés-Blázquez, and Senior GF Elser
- PFs Kim, Mannetti (GSU), and Markolf, with co-PI Grimm, hosted and led URRG, weekly reading group for GFs and GAs (academic year)
- The URRG in Spring 2020 hosted invited guests from non-academic careers, allowing GFs and GAs to read about and ask questions of visitors regarding their experience in these careers
- GFs: Emeritus Guardaro co-wrote a Meeting of the Minds blog post with Perea (CHISPA AZ); Elser submitted a NSF INTERN Supplement Proposal to collaborate with The Nature Conservancy
- PFs: Kim co-led CUFTF and CCWG; Emeritus Feagan led publication for the SCC planning grant and development of a problem-based learning scenario for the ECS; Ahmad co-hosted 2nd eRAMS webinar (10/19)
- International GA, López Meneses (from the Universitat Politècnica de Catalunya) wrote a piece "Sembrando resiliencia: ideas desde el Sur al Norte para la implementación" for the UREx SRN blog, and he is collaborating on the next RULA IRES program (anticipated to be in Bogotá, Colombia next year)

Portland (PSU)

- Supported GFs Hellman, Cordero (ASU) and Morrison (ASU) working with SWG and governance, as well as GF Pallathadka working with UFV TF

San Juan (UPR)

- Mentored UREx GFs, specifically on the Resilience Governance Survey and Knowledge-Action TF (Muñoz-Erickson)
- Mentored GF Hobbins on INTERN project and PF Emeritus Feagan in professional development (Muñoz-Erickson)
- Trained and mentored grad students on Evaluating the effectiveness of Early Warning Systems (e.g. Heat, Floods), environmental health, Extreme events impacts on Public Health, Quality of Life and well-being (Méndez-Lázaro)*
- Mentored REU student at ASU working on financing opportunities for resilience projects in San Juan (Muñoz-Erickson)*

Syracuse (SU)

- GA Eger was awarded a NSF INTERN supplement (\$31,461) and also the 2019 EMPOWER Professional Development Training seed grant to present at a workshop in Krakow, Poland with Geoff Millard (\$3995)
- GF Shafiei Shiva presented his work on selecting GCMs for local heatwave studies at AGU 2019
- Undergrads Cultra and Wojcik participated in the 2020 REU summer program (mentored by C. Davidson)

Valdivia (AUCh)

- GF Sauer assisted a AUCh undergraduate student in developing their thesis on the topic of wetland conservation in Valdivia

Atlanta (GSU)

- We provide training and professional development for transdisciplinary research and participatory facilitation to UREx GFs and PFs

Not City Specific

- Trained two students in editorial review and one student in thermal and social data analysis (UB)

**Updated information*

Disseminating Results to Communities of Interest

Network Wide

- Presented at local, national, and international conferences (>100 in YR5 alone) and led several sessions (AGU Fall 2019, AMS100, ESA2019, 2019 Transformations Conference)
- Published 2 books (plus 2 forthcoming), 8 book chapters (4 UREx cited), and 64 journal articles (39 UREx cited); 9 more UREx publications are awaiting publication, 21 are currently under review, and several more are about to be submitted
- Published pieces in popular science outlets (e.g., Nature of Cities and other venues) and also communicated work via media outlets to broad audiences: Rolling Stones, New York Times, New York Times 2, NOAA, Penn State News, GGWash, NAU News, Deutsche Welle (DW), GSU News, Phys.org, VICE News
- Produced stakeholder reports, informational materials, and factsheets on UREx projects
- GFs and PFs led a podcast called “Future Cities Podcast” with 13 episodes published in Y5
- Contributed significantly to Environmental Science & Policy’s Special Issue on Knowledge Systems for Urban Resilience, the first collection of papers on innovations required in knowledge systems (and co-production of knowledge) to build resilience to extreme events
- Continued to highlight key UREx work in the network Digests and Newsletters

City Specific

Baltimore

- Continued work with the Urban Waters Partnership has allowed multiple presentations of Baltimore Scenarios Workshop results as they have become available (final presentation to be given July 2020)
- Participated in the RAND Urban Stormwater Workshop on July 16-17 2019 in NYC (Rosenzweig)
- Presented UREx research/results at: 1) the NYC Department of Environmental Protection Climate Week brown bag series in NYC, 9/19 (Rosenzweig); 2) the Water Utility Climate Alliance meeting, 5/20 (Rosenzweig); and 3) the International Association for Landscape Ecology North America (Lagrosa)

Hermosillo

- We continue to have a strong relationship with the municipal government through IMPLAN. The urban development plan was updated and it incorporated heat and flooding vulnerability maps developed by the UREx team. A new plan focusing on the strategic plans to incorporate green infrastructure.
- The municipal planning agency updated the flooding and heat waves vulnerability analysis using our results and they continued generating heat prevention campaigns, which now included additional shelters and assessments of the urban transit system users

Miami

- Engaged in the Biscayne Bay Health initiative and helped organize the annual public health summit where UREx projects were discussed
- Continuing work with FIU’s Sea Level Solutions Center to implement “King Tide Days” for citizen science engagement in documenting flooding
- Conducted workshop on Macro Adaptation Resiliency Tool with practitioners in Miami with Solecki (CUNY-HC)
- Clark collaborates with the Miami team’s efforts and practitioner outreach, leading Miami geospatial databases and analyses, including the implementation of the Miami Scenarios workshop and ensuing initiatives and products.

New York

- Organized and presented at symposium, Resilient Futures: New Thinking on Climate Change at the New School (New York) sharing the Lab's work around the globe on UREx related activities and research; featuring UREx Research Collaborator Munoz-Erickson, and UPR lead Mendez Lazaro (10/19) (Sauter, McPhearson)
- Co-organized Building a Resilient Future conference (9/19) at The New School, in collaboration with the Global Resilience Partnership, including presentations from McPhearson and the NYC UREx team
- Finalized a map viewer portal and final report with city partners from the NYC Stormwater Resiliency project using a SETS approach and UREx leveraged data to stakeholders from ORR, DEP and other city agencies (McPhearson, Cook, Sauter, and others from the USL)
- Met with The Nature Conservancy and NYC Department of Environmental Protection to discuss data visualization strategy for green roof research, 8/19 (McPhearson, Herreros-Cantis)
- Invited presentation and panel members of NYC Climate Change panel at Barnard College (3/20, postponed due to COVID; Ortiz, Cook)

Phoenix

- Kept calendar, maintained communications across network
- Enhanced website by expanding the 'Products' tab (added Data Visualization Portal and Data Visualization Platform, as well as a Best Practices page) and adding a Research Themes page under the 'Research' tab
- Presented invited talk at urban hydrology session of the American Geophysical Union (12/19, Grimm)

Portland

- Provided Scenario Workshop results to DRRAG, including dissemination of the Scenario WK 1 Report

San Juan

- Network 'maps' for 4 years of UREx collaborative research
- Reports and briefs to communicate UREx scenario outcomes, including Story Maps
- Working on a manuscript of the data generated for 2019 Summer Heat Campaign in San Juan (de la Flor, Diaz, Rey Torres, Vangas Medina, Mendez Lazaro)*

Syracuse

- Disseminated Scenarios WK 1 Report to local practitioners
- Presented at an engineering capstone practicum for Civil and Environmental Engineers with strong emphasis on urban sustainability and water resources (Chandler)
- Presented on lead in drinking water to 100 undergraduate students at SU (Kelleher)

Valdivia

- UREx co-produced future scenarios and modeling outputs from Valdivia were presented by Valdivia's lead practitioner team (Lamarca, Barbosa, Maira, Schueftan) and utilized in a workshop with ~35 local stakeholders to further develop urban planning initiatives in Valdivia (3/20)
- Interacting directly with a local land developer to integrate UREx research and framing into the development plans and improve the outcome of anticipated residential development on a wetland in Valdivia
- Ongoing coordinated learning and stormwater management model building between UREx researchers and the Region de los Rios Water Management Office of the Ministry of Infrastructure

Atlanta (GSU)

- Scenario workshops are conducted as a co-production process among researchers, practitioners, and community leaders
- Summary reports of the scenario workshops are prepared for each city to synthesize key findings and for broader dissemination
- Follow up meetings with workshop participants conducted to discuss key findings
- City-specific data visualization products of the scenario outputs have been developed (Story map, factsheets, and infographics)

Not City Specific

Univ. at Buffalo

- Presented a paper on landscape analysis for microclimate detection at the IALE conference in Milan (Hamstead, Cook-Barnard)
- Presented UREx HTF findings at an invited talk at the College of Engineering Trivandrum, in Kerala, India (Hamstead)

Year 6 Plans

Network Wide

- Carry out remaining scenario workshops for applicable cities, and complete guidebook for workshop 2 for cities to hold on their own
- Continue training and mentoring current GFs and PFs, and support the GF/PF-led early career symposium
- Continue strong publication record and collaborating/co-authoring with UREx network
- Continue dissemination of research to academic and practitioner audiences via publication, popular articles, podcast, website, and info sheets
- Continue course development, mentoring, training, and dissemination
- Support ongoing resilience work of the SETS Convergence and NATURA projects, involving UREx participants when possible
- Invite and encourage UREx GFs and PFs to join the NATURA early career network
- Submit and support additional NSF proposals to support UREx activities beyond YR6

City Specific

Baltimore

- Finalize manuscripts: 'Sea level rise impacts on groundwater levels and implications for flood risk in coastal cities' for submission to Nature Climate Change (expected submission 7/20), and 'Historic Stream Burial and Future Cloudburst Flood Hazard' (expected submission 7/20)
- Continue leading coding work and manuscript preparation for the Urban Flood Events Database through 7/20, with an expected 8/20 submission (Rosenzweig)

Baltimore Continued..

- Continue GI and Stormwater Management collaborations: Opportunities and Challenges, which will be submitted for publication in the Proceedings of EAUMEGA 2020: The Second International Conference on Water, Megacities, and Global Change (8/20) and presented at the conference by Zimmerman (NYU) in Paris, France, 12/20 (Rosenzweig)
- Continue to serve as part of the Baltimore Urban Waters Flood Science Steering Team and co-organize a workshop on Baltimore Flood Science and Policy in collaboration with the Baltimore Urban Waters Partnership, 7/20 (Rosenzweig)
- Participate as part of the Design For Justice Working Group of the NATURA network (Rosenzweig)
- Continue to serve on the Executive Management Team and the GI and SETS WG/TF (Groffman)

Phoenix

- Continue research on resilience to heat in collaboration with the City of Phoenix, TNC, and Maricopa County, through collaboration with leveraged HUE grant
- Finish REU program in summer 2020, in collaboration with CAP LTER and other groups
- Submit manuscript on comparative assessment of scenarios (RESQ) at two scales (local, regional) (Berbés-Blázquez, et al.)
- Contribute to urban flood vulnerability analyses and publication in late summer 2020 (Cheng, Grimm, PF Kim, GF Sauer)
- Complete analyses of the use of ecosystem service concepts in scenario visions for UREx cities, based in part of REU projects, and prepare for publication
- Continue leading SETS Convergence (Chester) and NATURA (Grimm, PF Kim) projects that leveraged UREx
- Finalize inputs to eRAMS UREX data repository and landing pages for all cities, WGs, TFs, and other projects (PF Ahmad)
- Complete and submit UREx-based dissertation research (GFs Elser, Sauer)

Portland

- Continue to support City of Portland partners on resilience (which has become more important with the COVID 19 pandemic)
- Collaborate with City of Portland to submit NSF CIVIC proposal
- Complete writing a manuscript summarizing urban flood vulnerability in six UREx network cities (Chang, GF Pallathadka)
- Continue working on the relationship pluvial flooding and green infrastructure (in collaboration with ASU)

New York

- Complete future scenarios cellular automata models for PHX, MIA, SYR, and PDX
- Write up results from multiple modeling outputs
- Advance heat and heat risk projections together with analyzed outputs from the SWG's land use land cover projections
- Complete the Climate Coast TF projects (Solecki, CUNY-HC)

San Juan

- Coordinate the Latin America and Caribbean Cities Task Force (LACTF) with the NATURA Latin America regional note, to serve as a platform for research and transition initiatives in multiple LAC cities
- Facilitate research collaborations among the network's coastal cities
- Continue to generate strategies via the KtA TF for sharing and disseminating UREx science products with the network's practitioners and community partners
- Continue to support GF Hobbins' INTERN supplement research with the USDA Forest Service in San Juan

Syracuse

- Complete analysis of governance survey results, examining variability in preferred strategies among the nine UREx cities to mitigate the impacts of climate change, and prepare publication
- Continue projects on the Convention Center Green Roof, including areal coverage of Sedum species, estimates of evapotranspiration, water-storage performance over time, and heat flow through the roof

Atlanta

- Scenario assessment and validation for Miami, Phoenix, Portland, and Syracuse
- Synthesis products from cross-city analysis research
- Continue follow-up meetings with stakeholders and city-specific data visualization products

Not City Specific

NCSU

- New methods to incorporate global warming into WRF simulations of extreme precipitation events will be completed and applied to the case studies. Simulations will be completed and analyzed.
- Compute extreme rainfall design values that incorporate global warming for UREx cities and provide to practitioners
- Produce new design storms for Baltimore, Portland and Phoenix using the WRF simulations

UB

- Submit UREx Resilient Urban Futures co-edited volume, two papers on environmental injustice and heat, and one paper on landscape analysis of the scenarios working group

Impacts

Impact on the Development of the Principal Disciplines of the Project

- Our research represents a long-term futures approach for resilience and sustainability
- SETS framing is proving central to reconceptualizing convergent science and urban sustainability and resilience science, a key contribution of UREx
- Publications resulting from this work highlight advancements through a novel scenario development framework and SETS-based assessments of future scenarios for city-specific and cross-city comparisons of urban resilience (Iwaniec et al. 2020a, b). The work has also advanced the field's conceptualization of transformative change and lays out key criteria for sustainability transformation research (Iwaniec et al. 2019).
- The role of nature-based solutions through green infrastructure is a key opportunity highlighted in UREx. Climate change resilience in cities needs to focus on vulnerable groups and highlight need for social justice in implementation and actions.
- Advanced techniques, including projection modeling and participatory visioning, are being deployed to examine and explore future resilience and vulnerabilities for cities in the face of diverse extreme events. Integration of participatory scenarios, spatially explicit landuse/landcover modeling, and regional climate models, which can help benchmark the performance of co-produced scenarios in terms of explicitly modeled physical processes.
- Network analysis of the UREx membership and connections over time will be a key contribution to the understanding of how these transdisciplinary research networks function and to provide recommendations to the NSF for future design of these large collaborative research networks
- Knowledge and information exchanges undertaken with other network participants in urban planning
- Cross-referencing and dissemination of publications and presentations
- Academic products are being incorporated directly in public policy documents. For example, the methodologies to conduct Hermosillo's future scenarios workshops were incorporated by IMPLAN to conduct FIVE additional workshops that allowed participants to provide more in depth information and feedback to future urban planning strategies.)
- Regional and urban scale hydrological analysis continue to be developed and we hope to raise more awareness of the physical and socio-economic factors affecting the vulnerability and adaptive capacity of the city of Hermosillo to climate change.
- Network researchers are developing a focus on climate risk perception and extreme events within geography
- We are focused on examining issues of injustice related to the impacts of extreme heat, and urban weather extremes and climate change more broadly. While the public health, landscape ecology, and climatological research on extreme heat is well developed, it has not been fully integrated with environmental justice theory and scholarship, and therefore fails to fully account for fundamental ways in which heat injustice is produced. Our team has broad this social science lens to begin making an integrated and theoretical contribution to the study of extreme heat vulnerability. This effort services to develop both the social science (urban planning) discipline itself, by examining how planning practices relate to heat vulnerability and health outcomes, as well as its relation to other disciplines (also applies to "other disciplines" section).
- We are furthering knowledge of performance of green roofs and other green infrastructure, as we can now model their performance better and we know how to collect measurement data on their performance.
- Developing heat wave analysis tools and data set for UREx SRN cities across the USA. These tools are published in public repositories.
- We are developing a multi-criteria decision-making tool for heat wave hazard mapping and classification in urban areas. This method improves risk analysis by creating a spatial and temporal distribution of natural hazards, considering components of one hazard or combination of different hazards.
- The approach being developed to quantify resilience and design resilient networks will be useful for improving urban systems
- Actively working to develop a focus on climate risk perception and extreme events within geography and environmental science. We have worked with Hunter College's Institute for Sustainable Cities and the Public Policy Institute, and a series of discussion and presentations occurred throughout the year on campus*

Impact on Other Disciplines

- This project is inter- and transdisciplinary in nature. Discussions among personnel across the project have contributed to their interdisciplinary education, as well as to the education of GFs and PFs. For example, Urban Ecology as a field is being advanced by integrating inter- and trans-disciplinary perspectives on resilience and SETS framing. Work in the Urban Systems Lab at The New School is helping advance development of an urban systems science based on a SETS conceptual framework with multiple conceptual papers and empirical case studies in development for 2021.
- SETS framing is an example of convergence research; SETS framing for convergence research has impacts on social, environmental, and engineering disciplines— contributing both to the individual disciplinary perspectives but also to advance trans- and interdisciplinary perspectives such as urban systems, sustainability, and resilience
- Emphasis on transdisciplinary collaboration and impacts for convergence research
- Emphasis on the need to incorporate equity and social justice throughout the research program
- Being able to share and integrate experiences from the physical sciences with social scientists
- The Innovation Plazas, which are cross-city dialogues on changing approaches to urban resilience, continue to encourage communication across disciplines and sectors
- The Resilience Governance Survey is not only having an impact on the field of scenarios and participatory future development as a tool to examine existing governance conditions, strategies, and visions, but also on the field of urban sustainability transitions as a large cross-city comparison of the ways in which cities are steering urban resilience approaches and solutions, what governance networks are forming, and how these compare across different urban contexts, including across cities in Latin America.
- Integrating the SETS framework in project activities in inter-institutional and transdisciplinary institutes (such as the Science and Resilience Institute at Jamaica Bay in New York City)
- The approach being developed to quantify resilience and design resilient networks will be useful for improving urban systems will be broadly applicable to all kinds of dynamic systems in areas beyond sustainability and resilience. For example, this work can result in better ways of ensuring safety of industrial systems, and for detecting abnormal operation in manufacturing processes.
- Interaction with urban infrastructure historians initially at the May 30-June 1, 2017 NYU Paris Conference, Interdisciplinary Perspectives on Urban Infrastructure History and the Social Sciences, Paris, France and the Year 3 conference in Vienna, and subsequent book consisting of conference papers has now been submitted to publisher (June 2020).
- Climate Science: Providing exchanges with climate scientists regarding infrastructure impacts through the New York Panel on Climate Change (NPCC), discussions with Dr. Kunkel (UREx SRN collaborator), the GI paper in Climate, and selected practitioners, via publications accepted for Urban Climate and ongoing work on a Climatic Change
- Impacts on other disciplines have occurred through publications, presentations and product development: (1) engineering (e.g., TRB as author/co-author, work with the NYU Tandon School of Engineering), and invited presentations at Vanderbilt University; (2) science (climate science, risk analysis as author/co-author/presenter) and environment (green infrastructure); (3) social sectors such as history (NYU History conference advisor and co-author); (4) urban planning (ACSP conference presenter; student and faculty interactions on GI).
- Public Finance through the research on GI finance and transit oriented development follow-ups
- Through UREx SRN research, post-docs, students, and leveraged funding, the Ecology and Evolution department at UACH has benefited from an ongoing discussions, seminars, and research on urban ecology, resilience, and sustainability. Likewise, the UREx SRN has impacted the work of the municipality of Valdivia through ongoing discussions about the urban resilience and integrated green and gray infrastructure management.
- The Valdivia UREx team has been interacting directly with a land developer to integrate UREx research and framing into the development plans and improve the outcome of anticipated residential development on a wetland in Valdivia
- SETS framework also continues to be integrated into project activities at the Science and Resilience Institute At Jamaica Bay, an inter-institutional and transdisciplinary institute in NYC, and with interdisciplinary colleagues at Stony Brook University, Monmouth University, and Rutgers University*

Impact on the Development of Human Resources

- In Y5, UREx supported (in whole or in part) 10 PFs and over 30 GFs and GAs; UREx also appointed a Senior GF (Elser, ASU)
- PFs and GFs coordinated and/or co-led several working groups (CCWG–Kim, ASU; CHeX–Gray, NCSU; TIWG–Hobbins, ASU; SWG–Mannetti, GSU, and Lloyd, GSU; CompViz– Mustafa, TNS; Data Management–Ahmad, ASU; SETS–Markolf, ASU; NEWG–Morrison and Cordero, ASU); task forces (GI–Matsler, Cary; Comparative Urban Futures–Mannetti, GSU, Kim, ASU; Heat–Guardaro, ASU; Urban Flooding–Rosenzweig, CUNY-ASRC; Future Cities Podcast–Elser, ASU)
- Emeritus PFs Cook (TNS), Feagan (ASU), Markolf (ASU), McPhillips (ASU), and Rosenzweig (CUNY-ASRC) and GFs Navarro (ITSON), Guardaro (ASU), and Dzyuban (ASU) leveraged their experience on the UREx SRN to obtain positions: Cook a faculty position at Barnard College, Feagan a research faculty position at ASU’s School for the Future of Innovation and Society, Markolf a faculty position at UC Merced, McPhillips a faculty position at Penn State, Rosenzweig a faculty position at Sarah Lawrence College, Navarro a faculty position at the Universidad Estatal de Sonora, Guardaro a research faculty position at ASU’s School of Sustainability, and Dzyuban a research fellow (postdoc) position at an international institution (Singapore Management University)
- Providing research, presentation, and publication opportunities for postdocs and graduate students (co-authored 21 UREx publications in YR5, 5 awaiting publication, 15 currently under review, and 3 more submitted)
- PF Matsler (Cary Institute) and GF Gray (NCSU) led successful proposals for the UREx SRN’s Early Career Symposium call. ESC members also include GFs Smith (FIU), Helmrich (ASU), and Elser (ASU), PF Markolf (ASU), and emeritus PFs McPhillips (Penn state) and Feagan (ASU).
- ASU supported GF Sauer’s research travel to Valdivia, as well as two GFs (Cordero, Morrison) to work with the Portland Team
- PF Rosenzweig (CUNY-ASRC) supervised an undergraduate on a project to map buried streams and present-day urban hydrography in East Baltimore
- UMBC work has contributed to the development of technical skills of several researchers (Lagrosa, Mowery, Lanagan)
- Welty (UMBC) mentored Mowery (UMBC) in preparing his first conference presentation (poster) of his career
- Through FIU’s Sea Level Solutions Interdisciplinary Research and Design Studio, we are training the next generation of architects and scientists to work collaboratively, think critically about integrating and assessing SETs as integral to building resilience in south Florida and co-producing safe to fail, locally relevant, project designs
- NYU’s training of graduate students in urban planning and public policy even following their graduation, and special training venues listed in the report
- UB has worked with urban leaders in Buffalo and Tempe to develop a framework for managing thermal extremes. While practitioners have a good grasp of the nature of the problems that heat and cold pose for urban communities, they lack frameworks for integrating practices across sectors and effectively, proactively reaching people who are in need.
- GF Emeritus Guardaro (ASU) co-led the AZ Heat Preparedness and Resiliency WG to collaborate and coordinate heat mitigation and adaptation activities across the state, especially with emergency preparations like cooling centers during the pandemic
- ITSON GA Vizuetto launched a comparative study to demonstrate the utility of GI in capturing urban dust that contains heavy metals, GA Molina is comparing and calibrating different urban dust sensors and validating satellite-based estimates, and GA Icedo is researching risk perceptions of air pollution and heat waves
- Hermosillo team expanded with the addition of Dr. Pablo Reyes (Epidemiologist and public health expert), Dr. Gerardo Alvarez (Public health expert), Dr. Alan Navarro (Social Scientist and Geographer), Dr. Carmen Ortega (Paleoclimatologist), and Dr. Diana Meza Figueroa (Medical Geology)
- There are educational benefits for people attending UREx presentations, and through the dissemination of publications
- Mentored students (graduate and undergrad) at Hunter College and CUNY Graduate Center, and at Stony Brook University, Monmouth University, and Rutgers University (Solecki)*

Impact on Physical Resources that Form Infrastructure

- Understanding of inter-relationships with other SETS domains of urban systems
- Successful use of Zoom technology to participate in UREx meetings, and other meetings with subgroups; Effective use of web-based or internet-based platforms to exchange information including Google Drive and Dropbox. Knowledge building and applications for infrastructure interconnections and social impacts.

Impact on Institutional Resources that Form Infrastructure

- Academic products being incorporated directly in public policy documents
- The need to address governance and social inequity in both climate impacts and current suite of solutions
- Communication frameworks and approaches used along with library resources
- Revealing gaps in institutional capacity and organization to develop a robust climate change indicator and monitoring system
- Cities continue to expand on our collaborative work to work with the community, and our work on resilience governance opens up new pathways to collaborate with practitioners and think about SETS governance
- Changed City of Portland's mindset on urban resilience from "survive disasters" to "thrive and transform in the face of disasters" (this is from feedback from them). Also built capacity for thinking about and designing urban resilience governance in the City of Portland's Disaster Resilience and Recovery Action Group (DRRAG), resulting in four distinct, co-produced models for urban resilience governance. These are being workshopped for City leadership.

Impact on Information Resources that Form Infrastructure

- Data gaps must be filled but existing data can be harnessed with new technologies and computational approaches
- Development and application of databases and database development skills; Use of GIS and statistical analysis for information resources
- Enhance understanding of climate change adaptation indicator and monitoring activities, opportunities, and challenges
- The visualization platform concept developed as part of the Resilient Coastal Cities project has potential to maximize connectivity and knowledge exchange among community-based organizations, NGOs, and municipal practitioners doing resilience work in their coastal cities

Impact on Technology Transfer

- eRAMS as a Platform for Data Storage and Management: Data management is an essential and integral part for the urban resilience to extremes sustainability research network (UREx SRN), as most research on urban resilience not only requires data but also generates vital information for future research on resilience and sustainability. Thus, a platform to store and share the outcomes of any project is also essential. To store and manage UREx data we are introducing eRAMS—an NSF-funded data repository—as a data management and storage platform. We have already migrated several datasets from our google drive to eRAMS and different working groups have started using eRAMS for their projects. Moreover, to access the data, we are also building websites for each dataset, which includes metadata and a download link. Our goal is to store and organize all available UREx data in eRAMS so that any UREx member can conveniently access the necessary data.
- Data Visualization Platform was leveraged in our collaboration with the NYC Mayor's Office and DEP on the NYC Stormwater Resiliency Study, as well as the NSF Converging Social, Ecological, and Technological Infrastructure Systems (SETS) for Urban Resilience project. Databases developed are currently being used by multiple institutions and projects for collaborations globally including Melbourne, Beijing, Stockholm as cases for urban comparative research advanced from the databases and data visualization capability developed in the USL as part of UREx.

- The UREx SRN collaboration portal continues to facilitate transferring information across groups and researchers. This has been an improvement given the capabilities in the lead university. Similarly, the capability of hosting and recording video conferences using Zoom has been a great addition to help foster education and sharing of information and knowledge.
- Unique database construction and application and use of GIS and data extraction skills adaptable to other situations, research questions, and academic and practitioner users

Impact on Society Beyond Science & Technology

- The UREx SRN is bringing diverse stakeholders together (many for the first time ever) to discuss and create shared values; most scenarios (if not all) are fundamentally new visions compared to current plans and policy; hence, most are novel visions over a longer term than any existing plan and with more diverse voices than existing city visions
- Practitioners are actively looking for funding and other methods for implementing UREx research
- The network is helping communities better understand extreme events and opportunities for enhancing resilience
- New tools for urban planning, and policy, development of urban futures approach for positive visioning at local and regional scales, and support for climate resilience planning in diverse cities in the U.S. and Latin America.
- Insights obtained on (1) how infrastructure interacts with extreme events in order to anticipate those events; and (2) how measures to mitigate and adapt to those impacts provide society with ways to reduce consequences of extreme events that are related directly or indirectly to extreme events.
- “Future Cities Podcast” published 11 episodes in Y5, as well as 4 mini “current events” episodes, that are widely available on several podcast apps. This podcast was created by UREx fellows and features UREx scientists and practitioners talking about their work (see Table)*

YR5 Episodes of the Future Cities Podcast	
Resilience to heat and floods in Hermosillo, México	8/6/2019
Hurricanes, wetlands, and nutrients - Oh my!	9/7/2019
Air quality and microbes - Philadelphia	10/1/2019
Solid waste buildup and the threats to flood resilience	11/1/2019
Digging our own climate graves - Understanding the barriers to green infrastructure	12/2/2019
Infrastructure and climate change	1/2/2020
Urban agriculture and greening phoenix	2/2/2020
Mini-episodes: 1) Infrastructure & climate change 2) Urban agriculture 3) Urban ecology 4) Trees to help our cities breathe	1/20/2020 2/19/2020 3/4/2020 4/26/2020
Improve our cities through urban ecology	3/19/2020
Trees to help our cities breathe	4/1/2020
Resilience in the face of COVID-19	5/6/2020
Infrastructure Resilience and Biomimicry	6/1/2020

Changes

Changes in Approach and Reason for Change

- The project was granted a No-Cost Extension (NCE) to complete work that was delayed in previous years; eleven subcontracts were also extended to support remaining key projects
- A new subaward was established with the Urban Sustainability Directors Network (Baja) to help bridge the gap between the practitioners and researchers
- Since March 2020, all meetings have been virtual due to COVID-19
- Integration of landuse/landcover simulations with WRF regional climate simulations for the Baltimore area was implemented to explore changes in land-atmosphere feedbacks between scenarios during a heat wave event

Delays & Plans to Resolve Them

- Our fifth Annual All-Hands Meeting, scheduled to be in Portland on April 1-3, 2020, was cancelled due to COVID-19. The network converted the in-person meeting to a successful 2-day virtual event. We would like to hold a final in-person meeting, but no date has been set because of uncertainty with the pandemic situation.
- The primary challenge is related to diverse / distinct data sets in each city. Data translation continues to be a significant bottleneck for both modeling and DataViz, but has improved significantly. We have made more clear data form requirements, hired new experts to support data translation, and streamlined between the project where data is being gathered, translated, and delivered across multiple WGs.

Changes that have a Significant Impact on Expenditures

- Travel restrictions due to COVID-19 requires a reconsideration of remaining funds

Products

Books

In Preparation

- Zimmerman, R. *The Sustainability Imperative for Urban Infrastructure Networked Systems – How critical interconnections can simplify complexity*, Springer Nature Switzerland AG. Cham, Switzerland.

Awaiting Publication

- Hamstead, Z.A., D. Iwaniec, T. McPhearson, M. Berbés-Blázquez, E.M. Cook, and T. Munoz-Erickson. *Resilient Urban Futures*, Springer Urban Book Series.

UREx Related

Awaiting Publication

- Soffer, J., J. Heathcott, and R. Zimmerman. *Urban Infrastructure: Interdisciplinary Perspectives from History and the Social Sciences*, University of Pittsburgh Press. Pittsburgh, PA.

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- Chandler, D., K. Grove, and S. Wakefield (2020). *Resilience in the Anthropocene Governance and Politics at the End of the World*, Routledge. ISBN: 978-1-138-38742-3
- Shandas, V., C. Skelhorn, and S. Ferwati (2020). *Urban Adaptation to Climate Change: The Role of Urban Form in Mediating Rising Temperatures*, SpringerBriefs in Environmental Science. ISBN: 978-3-030-26586-1

Book Chapters

Under Review

- Kim, Y., L. Mannetti, D. Iwaniec, N. Grimm, M. Berbés-Blázquez, and S. Markolf. *Social, ecological, and technological strategies for climate adaptation*. *Resilient Urban Futures* Z. Hamstead, M. Berbés-Blázquez, E. Cook, D. Iwaniec, T. McPhearson, T. Muñoz-Erickson. Springer Urban Book Series.

Awaiting Publication/Accepted

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- Hamstead, Z.A. and J. Sauer. *Mapping vulnerability to weather extremes: Heat and flood assessment approaches*. *Resilient Urban Futures* Hamstead, Z.A., D. Iwaniec, T. McPhearson, M. Berbés-Blázquez, E. Cook, and T. Munoz-Erickson. Springer Urban Book Series.
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Awaiting Publication/Accepted Continued..

- Zimmerman, R. and C.E. Restrepo. Physical security: external applications. Encyclopedia of Security and Emergency Management L. R. Shapiro and M.-H. Maras. Springer Nature Switzerland AG 2020.
- Zimmerman, R., C.L. Redman, and S.A. Markolf. Extreme weather: challenges for infrastructure and society. Urban Infrastructure: Interdisciplinary Perspectives from History and the Social Sciences J. Soffer, J. Heathcott, and R. Zimmerman. University of Pittsburgh Press. Pittsburgh, PA.
- Zimmerman, R. The interdependencies of infrastructure. Urban Infrastructure: Interdisciplinary Perspectives from History and the Social Sciences J. Soffer, J. Heathcott, and R. Zimmerman. University of Pittsburgh Press. Pittsburgh, PA.
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- Muñoz-Erickson, T., S. Meerow, R. Hobbins, E.M. Cook, D.M. Iwaniec, M. Barbés-Blázquez, N.B. Grimm, A. Barnett, J. Cordero, T.R. Miller, F. Tandazo-Bustamante, A. Robles-Morua. Beyond bouncing back? Comparing and contesting urban resilience in US and Latin American contexts. *Global Environmental Change*.
- Rosenzweig, B., P. Herreros Cantis, Y. Kim, A. Cohn, K. Grove, J. Brock, J. Yesuf, P. Mistry, C. Welty, T. McPhearson, J. Sauer, and H. Kim. The Value of Urban Flood Modeling. *Earth's Future*.
- Welty, C., J. Moore, J. M. Duncan, J. T. Kemper, and P. M. Groffman. Spatial heterogeneity and temporal persistence of base-flow water quality in an urban watershed. *Hydrologic Processes*.

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- Matsler, M., S. Meerow, I. Mell, M. Pavao-Zuckerman, and D. Locke. The local colors of green infrastructure: reviewing terminology, theory, and practice. *Landscape & Urban Planning*.
- Meza-Figueroa, D., E. Pérez-Segura, F.M. Romero, A. Robles-Morúa, M.M. Meza-Montenegro, E. Vizueté-Jaramillo, A. Gómez-Alvarez, L. García-Rico, S. Martínez-Retama, and I. Mondaca-Fernández. Environmental fate of copper concentrates transported by train: importance of source in the oral bioaccessibility and exposure biomarkers in children. *Journal of Geochemical Exploration*.

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- Rozance, M., A. Denton, M. Matsler, Z. Grabowski, and W. Mayhugh (2019). Examining the scalar knowledge politics of risk within coastal sea level rise adaptation planning knowledge systems. *Environmental Science & Policy*. 99: 105. DOI: 10.1016/j.envsci.2019.05.024

Conference Presentations

Submitted

- Chang, H., A. Pallathadka, J. Sauer, R. Zimmerman, R. Brenner, C. Cheng, N. Grimm, D. Iwaniec, Y. Kim, R. Lloyd, T. McPhearson, B. Rosenzweig, T. Troxler, C. Welty (2020). Understanding Urban Flooding Vulnerability through a Social-Ecological-Technological Systems (SETS) lens. Natural Hazards Center Workshop on July 12-15, 2020.
- Zimmerman, R. (2020). Incorporating Public Acceptance into Planning Decisions for Autonomous Vehicles, Transportation group. Association of Collegiate Schools of Planning (ACSP) 60th Annual Conference, November 4-8, 2020. Toronto, Ontario Canada.

2020

- Dzyuban, Y., D. Hondula, M. Messerschmidt, J. Vanos, A. Middel, and P. Coseo (2020). Heat Walk: Perception of Thermal Comfort in Relation to Street Infrastructure. American Meteorological Society Annual Meeting, January 12-16, 2020. Boston, MA.
- Elser, S. R., N. B. Grimm, and A. Middel. (2020). Growing shade: daytime cooling ecosystem services of common street trees in Phoenix. CAP-LTER All Scientists' Meeting, January 17, 2020. Tempe, AZ.
- Grimm, N., and M. Berbés-Blázquez (2020). Future Phoenix scenarios. 2020 ASU Social Embeddedness Network Conference, March 24, 2020. Virtual.
- Guardaro, M., D. M. Hondula, M. Messerschmidt, N.B. Grimm, and C.L. Redman (January 12-16, 2020). Building Community Heat Action Plans Story by Story: A Three-Neighborhood Case Study (Poster). American Meteorological Society Annual Meeting, January 12-16, 2020. Boston, MA.
- Harold, G., L. E. Ortiz, and J. E. Gonzalez (2020). Adapting to extreme heat: Social, infrastructure, and atmospheric impacts of air conditioning adoption in megacities. American Meteorological Society Annual Meeting, January 12-16, 2020. Boston, MA.
- Kunkel, K.E. (2020). Observed climatological relationships between precipitable water and extreme precipitation in the contiguous United States, oral presentation. American Meteorological Society Annual Meeting, January 12-16, 2020. Boston, MA.
- Lagrosa, J. (2020). Baltimore Forest History Project: Land-use and Land Cover of Baltimore City in 1927. 2020 Annual Meeting of the International Association for Landscape Ecology North America (IALE-NA), May 10-14, 2020. Virtual.
- Mustafa, A., E. Cook, T. McPhearson, o. Barbosa, T. Munoz-Erickson, M. Berbés-Blázquez, N.B. Grimm (2020). Future Resilient Land-Use Visions for Valdivia, Chile. American Meteorological Society Annual Meeting, January 12-16, 2020. Boston, MA.
- Ortiz, L (2020). Combined climate-land change driven impacts from co-produced land cover scenarios in San Juan, PR. American Meteorological Society Annual Meeting, January 12-16, 2020. Boston, MA.
- Zimmerman, R. (2020). Integrating New Transportation Technologies into Existing Travel Modes: the Case of Autonomous Vehicles. NYU Urban Research Day, March 20, 2019. New York, NY.
- Zimmerman, R. (2020). The integration of big data for impacts of COVID19 decisions points on public service resilience. INFORMS 2020, November 8-11, 2020. Virtual.
- Zimmerman, R. and Q. Zhu (2020). Attitudes and Perceptions Potentially Associated with Behavior Toward Autonomous Vehicles. International Symposium for Sustainable Systems and Technology (ISSST) 2020, June 9-July 1, 2020. Virtual.

2019

- Berbés-Blázquez, M. E. Cook, N.B. Grimm, D. Iwaniec, T. Muñoz-Erickson, D. Wahl (2019). Assessing the Resilience, Sustainability, and Equity of Future Urban Visions. 2019 Transformations Conference, October 16-18, 2019. Santiago, Chile.
- Chang, H. (2019). Urban Flood Resilience Across the Pacific: Case Studies from Seoul, Tokyo, and Portland. American Water Resources Association Annual Conference, November 3-6, 2019. Salt Lake City, UT.

- Cook, E.M., M. Berbés-Blázquez, R. Carrero, N.B. Grimm, D.M. Iwaniec, T. McPhearson, P. Mendez-Lazaro, T.A. Munoz-Erickson, L. Ortiz, S. Santos Hernandez (2019). The future of San Juan, Puerto Rico: Assessing tradeoffs of co-developed future visions for a resilient San Juan. Ecological Society of America Annual Meeting, August 11-16, 2019. Louisville, KY.
- Cook, E.M., M. Berbés-Blázquez, R. Carrero, N.B. Grimm, D.M. Iwaniec, T. McPhearson, P. Mendez-Lazaro, T. Muñoz-Erickson, A. Mustafa, L. Ortiz, J. Santos-Hernandez (2019). The future of San Juan, Puerto Rico: Modeling bottom-up land use futures scenarios with diverse stakeholders. Ecological Society of America Annual Meeting, August 11-16, 2019. Louisville, KY.
- Matsler, M., L.E. McPhillips, B. Rosenzweig, P.M. Groffman, S. Elser, N.B. Grimm, H. Chang, and R. Zimmerman (2019). Green infrastructure implementation and performance: Lessons learned from nine US and Latin American cities in the Urban Resilience to Extremes Sustainability Research Network (UREx SRN). AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Matsler, M (2019). The Eco-Techno Spectrum as a Frame for Interdisciplinary Urban Nature Governance Research. 6th Workshop on the Ostrom Workshop (WOW6): Governance: Past, Present, and Future. Bloomington, IN.
- McPhearson, T. (2019). Codesigning Positive Urban Futures: The UREx Approach. Natural Capital Project Symposium, March 17-20, 2019. Stanford University, Palo Alto, CA.
- McPhillips, L.E., P. Coseo, M. Berbés-Blázquez, N.B. Grimm (2019). Urban resilience through transdisciplinary partnerships and socio-eco-technical solutions. Ecological Society of America Annual Meeting, August 11-16, 2019. Louisville, KY.
- Mowery, J., C. Welty, and B. Rosenzweig, K. Grove, J. Yesuf, M. O’Shea, and P. Mistry (2019). Developing a work flow for stormwater modeling in older cities having missing asset data. Baltimore Ecosystem Study 2019 Annual Meeting, October 23-24, 2019. Baltimore, MD.
- Muñoz-Erickson, T.A., E. Cook, M. Feagan, R. Hobbins, D. Iwaniec, C. Miller, T. Miller (2019). Anticipatory Knowledge Systems To Co-Produce Transformative Visions For Urban Resilience. 2019 International Transformations Conference, October 16-18, 2019. Santiago, Chile.
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- Muñoz-Erickson, T.A. (2019). The Complex Role of Science in Climate Action. The New School 100 year Anniversary – Resilience Futures, New York City and San Juan. New York, NY.
- Rajashekar, P. and D.G. Chandler (2019). Hydrologic attributes of selected green infrastructures. AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Robles-Morua, A. (2019). La red de investigación de Sustentabilidad de Resiliencia Urbana ante eventos extremos climáticos (UREx SRN): Avances de la ciudad de Hermosillo. 1er Congreso Latino de Investigación en Cambio Climático, October 7-11, 2019. Jiutepec, Mexico.
- Robles-Morua, A. (2019). Red de Investigación de Sustentabilidad y de Resiliencia Urbana ante Eventos Extremos Climáticos (UREx SRN): reporte de actividades de la ciudad de Hermosillo. 9o Congreso Nacional de Investigación en Cambio Climático, October 9-10, 2019. Cuernavaca, México.
- Redman, C.L. (2019). Transformations involve Uncertainty and Accepting Untested Ways of Thinking. 2019 Transformations Conference, October 16-18, 2019. Santiago, Chile.
- Rosenzweig, B. (2019). Cloudbursts in NYC and the need for a 3 Points Approach For Resilience. NYC Department of Environmental Protection Climate Week Brown Bag Series, September 23-29, 2019. Rego Park, NY.
- Rosenzweig, B., C. Welty, J. R. Sauer, L.E. McPhillips, C. Kelleher, and T. McPhearson (2019). Case studies of cloudbursts and ultra-urban floods: a socio-eco-technical assessment of pluvial flooding events in Baltimore and New York City. AGU 2019 Fall Meeting, December 9-13, 2019. San Francisco, CA.
- Rosenzweig, B., C Welty, J. Sauer, L. McPhillips, C. Kelleher, T. McPhearson (2019). Case studies of cloudbursts and ultra-urban floods: a socio-eco-technical assessment of pluvial flooding events in Baltimore and New York City (Poster). AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Rosenzweig, B. (2019). Historic stream burial and present-day pluvial flood risk: a case study of Harford Run. Baltimore Ecosystem Study 2019 Annual Meeting, October 23-24, 2019. Baltimore, MD.
- Shiva Shafiei, J., & Chandler, D. G. (2019). Projection of Future Heat Waves in the United States Based on Locally Selected GCMs. AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.

- Smith, M.A., J. Kominoski, E. Gaiser, T. Troxler, O. Barbosa, N.B. Grimm (2019). A comparison of nutrient uptake dynamics in urban wetlands across different regional climates. Ecological Society of America Annual Meeting, August 11-16, 2020. Louisville, KY.
- Tandazo-Bustamante, F., A. Robles-Morúa T. Muñoz-Erickson, R. Hobbins (2019). Analysis of knowledge systems to assess communication processes with extreme climate events between stakeholders of Hermosillo. Fourteenth International Conference on Interdisciplinary Social Sciences, July 10-12, 2019. Mexico City, Mexico.
- Yang, Y. and C. Davidson (2019). Use of the CHAMPS Model for Simulating Moisture and Heat Flux on an Extensive Green Roof. Fourth ASCE International Conference on Sustainable Infrastructure, November 7-9, 2019. Los Angeles, CA.
- Zimmerman, R. (2019). A data-driven framework for user, provider, and community behavior toward infrastructure services risks. SRA 2019 Annual Meeting, December 8-12, 2019. Arlington, VA.
- Zimmerman, R. (2019). Challenges of Multimodal Networks Interconnecting Transportation Technologies: CAV and other Mode Innovations. UTRC Transportation Technology Symposium: Innovative Mobility Solutions. New York: New York Institute of Technology.

UREx Related

2020

- Coseo, P. and M. Berbés-Blázquez (2020). Scenario design through interdisciplinary community-research-teaching collaborations. 2020 ASU Social Embeddedness Network Conference. Tempe, AZ.
- Lim, T., C. Welty and J. Woodworth (2020). Optimal location planning for urban stormwater BMP performance and management: implications and limitations. Chesapeake Community Research Symposium.

2019

- Balderas Guzman, C, R. Wang, O. Muellerklein, C.G. Eger, M. Smith (2019). Urban stormwater signatures across the United States: A machine learning approach. AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Chalmers, A., J.B. Shanley, S. Sebestyen, S.W. Bailey, D.G. Chandler (2019). Sleepers River Research Watershed, Vermont USA. AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Charli-Joseph, L., H. Eakin, J.M. Siqueiros-García, B. Ruizpalacios, D. Manuel-Navarrete, R. Shelton (2019). Exploring Collective Agency for Sustainability Transformations: A Transdisciplinary Process in the Xochimilco SocialEcological System T-Lab. 2019 Transformations Conference, October 16-18, 2019. Santiago, Chile.
- C. Kelleher, W. Shuster, H Golden, S. Burkholder (2019). Re-envisioning urban landscapes: the impact of vacant lots on urban runoff. AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Grove, K. (2019). Destituting Resilience. Annual meeting of the Society for the Social Studies of Science (4S), September 4-7, 2019. New Orleans, LA.
- Hwang, K., D.G. Chandler, and G.N. Flerchinger (2019). Use of ground-based infrared thermometry on estimation of evapotranspiration under various moisture conditions. AGU 2019 Fall Meeting, December 9-13, 2019. San Francisco, CA.
- Manuel-Navarrete, D., L. Charli-Joseph, H. Eakin, M. Siqueiros-García, A. Ely (2019). Applying Technologies of the Self in Transformation Labs to Mobilize Agency. 2019 Transformations Conference, October 16-18, 2019. Santiago, Chile.
- McPhearson, T., M. Treglia, and R. Ilieva (2019). Mapping Supply and Demand of Green Roofs in New York City. New York State Department of Environmental Conservation (NY DEC) Regional Conservation Action Plan (ReCAP) Annual Meeting. New York, NY.
- McPhearson, T. (2019). Visualizing Green Roofs and Social Equity in New York City. New York Department of Environmental Conservation, RECAP conference. New York, NY.
- McPhillips, L.E., N. Morse, and M.T. Walter (2019). Hydrologic influences on nutrient cycling in stormwater detention basins. Ecological Society of America Annual Meeting, August 11-16, 2019. Louisville, KY.
- Millard, G, CG Eger, J Gerson (2019). Achieving data management, visualization, and analysis. 2019 International Conference for Mercury as a Global Pollutant, September 8-13, 2019. Krakow, Poland.

- Navarro-Estupiñan, J. and A. Robles-Morua (2019). Extreme Heat Events Analysis and its Relation to Social Vulnerability in Hermosillo, México. XXVI Reunion de Investigacion en Salud.
- Navarro-Estupiñan, J. (2019). Extreme Heat Events Analysis and its Relation to Social Vulnerability in Hermosillo, México. 9o Congreso Nacional de Investigación en Cambio Climático, October 10, 2019.
- Romero-Lankao, P., S.Young, D. Nychka, C. Rames, A/ Duvall, A. Wilson, D. Zimny-Schmitt, C. Neri (2019). Emerging Technology Adoption Across Settlements and Populations - A Typology. 2019 Transformations Conference, October 16-18, 2019. Santiago, Chile.
- Zahn, E., E. Bou-Zeid, J. A. Smith, M. L. Baeck, and C. Welty (2019). Temperature Surges Caused by Hot Runoff in Urban Watersheds. AGU Fall 2019 Meeting, December 9-13, 2019. San Francisco, CA.
- Solecki, W. (2019). Climate Change Impacts – Global and Local Perspectives. City of New York, Department of Environmental Protection, Workshop for Educators. New York, NY.

Other Publications/Products

Awaiting Publication

- Muñoz-Erickson, T.A, H. Eakin, M.C. Lemos. La Necesidad de Re-Pensar la Vulnerabilidad: Lecciones Aprendidas de los Huracanes Irma y María. A piece in the San Juan Bay Estuary Vulnerability Assessment Report.

2020

- Arizona State University (2020). [In the face of extreme climate events, ASU professor to link network of groups developing nature-based solutions](#). Phys.org (Nancy Grimm and Timon McPhearson were featured).
- Guardaro, M. and M. Perea (2020). [Heat Action Planning is Tackling Urban Heat at the Hyper-Local Level](#). Meeting of the Minds Blog.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Ciudad Justa y Habitable \(Just and Livable City\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=5f957fe913bc4225a9e761109b701f77>.
- Hobbins, R. and Muñoz-Erickson, T.A. (2020). [Infraestructura Verde \(Green Infrastructure\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=716064f61b7e4e42a6b93e46e38e5065>.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Inundaciones Costeras \(Coastal Flooding\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=50cd1ce4589a42519de878afcd2536d3>.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Inundaciones Ribereñas \(River Flooding\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=11962efd26cf4628b8c1c69e4e7c86ef>.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Inundaciones Urbanas \(Urban Flooding\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=55bcce6d7fc848b3addef3e336b682f5>.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Just and Livable City](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=ce9661ed91694565bdd84ff45e9656d1>.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Municipio Conectado \(Connected Municipality\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=07fe8ca00c5a4e298c78a7c9221210c4>.
- Hobbins, R. and T.A. Muñoz-Erickson (2020). [Seguridad Alimentaria y Energética \(Food and Energy Security\)](#). Story Map: <https://asu.maps.arcgis.com/apps/Cascade/index.html?appid=071e7baf4cae4675a625f61ee0ace474>.
- Zimmerman, R. (2020). Managing Adverse Human Behavior with Respect to Transportation Infrastructure Security. Lightning talk for the Physical Security subcommittee (ABR10(3)).
- Zimmerman, R. (2020). The Challenge of Physical Security Adaptation for Multi-Hazards for Resilient Transportation. Presented for the Transportation Research Board.

2019

- Bleiker, C (2019). [The US state at the forefront of extreme heat research](#). Deutsche Welle (Melissa Guardaro was featured).
- Chang, H. (2019). Human and flood interactions in the Anthropocene. Talk for the Center for Spatial Information Science at the University of Tokyo, Kashiwa.

- Chang, H. (2019). Urban Flood in the Anthropocene: Case studies from Seoul, Tokyo, and Portland, Global Hydrology Seminar. Talk for the Institute for Industrial Science, at the University of Tokyo.
- Giarratano, J. (2019). [Georgia State University Leads Atlanta in National Initiative to Help Cities Develop Resilience](#). GSU News (David Iwaniec was featured).
- Hamstead, Z (2019). Urban Climate Change. Talk at the College of Engineering Trivandrum, India.
- McPhearson, T., T. Munoz-Erickson, and P.A. Mendez Lazaro (2019). [Resilient Futures: New Thinking on Climate Change](#). Panel Discussion at The New School.
- Rosenzweig, B. (2019). Climate change and groundwater flooding in NYC. Presented to the New York City Mayors' Office of Emergency Management.
- Rosenzweig, B. (2019). Climate-Resilient Planning for Urban Stormwater and Wastewater Utilities. Participated in an invitation-only workshop hosted by the Rand Corporation in New York City.
- Troxler, T. (2019). Green infrastructure Research and Monitoring: Examples from cities in the Urban Resilience to Extremes (UREx) Sustainability Research Network. Presented at a workshop organized by Broward County on stormwater green infrastructure.
- Zimmerman, R. (2019). Presented "Closing Remarks: Insights and Future Directions" at the NSF Sustainable Urban Systems (SUS) workshop [DIG Around: Documenting Infrastructure and the Ground conditions Around it](#).

UREx Related

2020

- Allenby, B.R. and M. Chester (2020). [Learning From Engineers](#). Issues in Science and Technology.
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Audio Product

- **Future Cities Podcast:** <https://podcasts.apple.com/us/podcast/future-cities/id1285788731>

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- City of Baltimore, Department of Public Works
- City of Miami
- City of Miami Beach
- City of Phoenix
- City of Portland, Bureau of Env. Services
- City of Portland, Disaster Resilience and Recovery Action Group (DRRAG)
- City of Syracuse
- County of Erie
- Departamento de Vivienda
- EPA Urban Waters Partnership
- Federal Emergency Management Agency
- Flood Control District of Maricopa County
- Instituto Forestal
- Instituto Municipal de Planeación Urbana de Hermosillo (IMPLAN)
- Junta de Planificación de Puerto Rico
- Land Administration (San Juan)
- Manhattan Community Board 9 (MCB9)
- Metropolitan Transportation Authority (MTA)
- Miami-Dade County
- Multnomah County, Office of Public Health
- Multnomah County, Office of Sustainability
- Municipality of San Juan
- NOAA Coastal Zone Management Program
- NYC Department of City Planning
- NYC Department of Environmental Protection
- NYC Department Health and Mental Hygiene
- NYC Department of Parks
- NYC Mayor's Office of Recovery and Resiliency
- Oficina Municipal para el Cumplimiento y Planificación Ambiente
- Oficina de Gerencia y Presupuesto – Municipio de San Juan
- Onondaga County
- Port Authority of New York and New Jersey
- Portland Bureau of Emergency Management
- Portland Bureau of Planning and Sustainability
- Portland Water Bureau
- Puerto Rico Climate Change Council (Department of Environment and Natural Resources)
- Puerto Rico Emergency Management Agency
- Puerto Rico Planning Board
- Rockefeller Foundation 100 Resilient Cities
- South Florida Water Management District
- Subsecretaría de Desarrollo Regional y Administrativo, Regió
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- U.S. Geological Survey – Urban Waters Flood Team

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- Alliance for Innovation
- American Society of Landscape Architects
- Biosfera
- Centro Sor Isolina Ferré
- Centro de Humedales Río Cruces
- Chispa AZ
- Coalition of Communities of Color
- Corbin Hill Food Project
- Fundación Enrique Martín Coll
- La Maraña
- Lutheran Social Services of NY
- Natural Resources Defense Council
- Naturaleza y Cultura Internacional
- OPAL
- Proyecto ENLACE del Caño Martín Peña
- Red Ciudadana de Los Humedales Urbanos / Mesa de Humedales
- Reimagina PR
- San Juan Bay Estuary Program
- Science and Resilience Institute at Jamaica Bay (SRIJB)

Nonprofits Continued

- Stillmeadow Evangelical Free Church (Community Emergency Response/Resilience Hub)
- Teachers Pay Teachers
- The Nature Conservancy (TNC)
- TreePeople
- Urban Sustainability Directors Network (USDN)
- Valdivianos Sin Basura
- WEACT
- Waterfront Alliance

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- Abruña & Musgraves, Inc.
- Consolidated Edison
- Estudios Técnicos
- Green Building Council
- SavATree

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- Centro de Investigación en Diseño
- Colegio de Sonora
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