CAP LTER Seventeenth All Scientists Meeting
and Annual Poster Symposium
January 16, 2015
Skysong, Scottsdale, Arizona

8:00 am Registration, coffee, and tea

8:30 am **Welcome and Introduction of Keynote Speaker**
Nancy Grimm, PI and Director of CAP LTER; Professor, School of Life Sciences

8:40 am **Keynote Presentation**
Thinking More Like a River: Recent Lessons in Floodplain Restoration from Oregon's Willamette River
David Hulse, Philip H. Knight Professor in Landscape Architecture, University of Oregon

9:40 am **Panel Discussion**
Using Scenarios to Think About the Future of Cities
Nancy Grimm, moderator
- David Hulse, Professor, University of Oregon
- Patrick Graham, Director, The Nature Conservancy of Arizona
- Manjana Milkoreit, Postdoctoral Research Fellow, Walton Sustainability Solutions Initiatives, Arizona State University
- Mark Hartmann, Chief Sustainability Officer, City of Phoenix
- Katharine Jacobs, Director, Center for Climate Adaptation Science and Solutions, University of Arizona
- David Iwaniec, Postdoctoral Research Scientist, Arizona State University

10:30 am **Poster Session #1**

12:00 pm **Lunch**

1:30 pm **Planning for the CAP4 Proposal: Gallery Walk for Group Input**
Dan Childers, CAP4 Director Designate

2:30 pm **Poster Session #2**

4:00 pm **Adjourn for CAPpy Hour; location TBA**

2015 CAP LTER Symposium

Posters are listed alphabetically by first author with poster location number in parentheses.

Poster Session #1	Poster Session #2
Ackley et al. (1)	Learned and Hall (2)
Alvarez-Guevara and Ball (3)	Li et al. (4)
Banville et al. (5)	MacNeille (6)
Bergin and Ball (7)	Marcotte et al. (8)
Betzel et al. (9)	McAtee et al. (10)
Burnette et al. (11)	Middel et al. (12)
Chipman et al. (13)	Minn et al. (14)
Dastan et al. (15)	Montgomery et al. (16)
Davidson et al. (17)	Munoz-Encinas et al. (18)
Eager et al. (19)	Ramos et al. (20)
Eneboe et al. (21)	Rohan-Kohl et al. (22)
Gade et al. (23)	Rose et al. (24)
Grimm et al. (25)	D. Sampson et al. (26)
Gryniewicz and Martin (27)	M. Sampson et al. (28)
Häb et al. (29)	Shaw et al. (30)
Handler et al. (31)	Singh et al. (32)
Heavenrich et al. (33)	Sokolowski and Fox (34)
Hester and Larson (35)	J. Song et al. (36)
Hopkins et al. (37)	Y. Song and Gurney (38)
Hutton and McGraw (39)	Stotts et al. (40)
Jia et al. (41)	Stutz and Bateman (42)
Johnson et al. (43)	Suchy et al. (44)
Jones et al. (45)	Sullivan and York (46)
Kaml et al. (47)	Weaver et al. (48)
Kane and York (49)	Yang and Wang (50)
Kouteib et al. (51)	Yu et al. (52)
Kruke et al. (53)	Q. Zhao et al. (54)
Kuras et al. (55)	X. Zhao and Wang (56)

Speaker Bio

David Hulse
Philip H. Knight Professor, University of Oregon

David Hulse is Philip H. Knight Professor and former Chair in Landscape Architecture at the University of Oregon and a founding member of the University's Institute for a Sustainable Environment. With expertise in using GIS to facilitate land use planning and natural resource decision-making, he has worked extensively as a landscape planner in the U.S. and abroad. Current efforts include work with colleagues at NSF, NOAA, Meyer Memorial Trust, Oregon Watershed Enhancement Board and Oregon State University on development of spatial decision support systems for creating and evaluating alternative land and water use futures in the Pacific Northwest. Hulse is a graduate of Harvard University, a Fulbright Scholar, a recipient of US IALE's Distinguished Landscape Practitioner Award, a recipient of a group award of the 2012 International RiverPrize for work in the Willamette basin, and in 2012 was named by Design Intelligence as one of the 25 Most Admired Teachers nationally in environmental planning and design.

Thinking More like a River: Recent Lessons in Floodplain Restoration from Oregon's Willamette River

Along Oregon's Willamette River and its floodplain, a unique partnership of funders, practitioners, and research scientists has created an integrated strategy to narrow the gap between need and capacity for ecosystem restoration, and to strengthen the impact of locally led conservation and restoration efforts. As is the case with most U.S. rivers, no basin-wide river authority oversees the management and protection of the Willamette River. Instead, dozens of entities – serving a wide range of rural, urban, and suburban communities – are involved in a multitude of stewardship activities. Underpinning this partnership effort is a broad body of previous and ongoing scientific research, including a citizen-led mapped guiding vision of a restored Willamette River Basin ("The Conservation 2050 Scenario"), as well as a simple diagrammatic explanation of how the river system functions, how restoration goals emerge from this understanding, and what to monitor to determine if these goals are being met. A recent addition to the scientific underpinning is a spatial template and corresponding database known as “SLICES”. The SLICES framework (http://ise.uoregon.edu/SLICES/Main.html) uses a simple mapping approach of dividing the river into “SLICES” of the floodplain orthogonal to the floodplain's main axis. Information is gathered, quantified and publicly reported for each slice on key indicators of river and floodplain health, corresponding to the restoration goals mentioned above: complexity of the river channel and its habitats, number of native fish species, and extent of floodplain forest. SLICES is being used by restoration funders to identify and prioritize potential areas for restoration, by restoration practitioners to strengthen their proposals for restoration funding, and by the research community to track progress toward restoration goals in the river and its floodplain. Together, these three devices, a spatially-explicit conservation guiding vision, a simple diagram showing how system function leads to restoration goals which guides monitoring, and a spatial information framework for restoration prioritization and change tracking, are accelerating the pace and effectiveness of floodplain restoration.

List of Posters

***Indicates student poster.**

BIOGEOCHEMICAL PATTERNS, PROCESSES, AND HUMAN OUTCOMES

Eagar, Jershon, Denise Napolitano, Aurelie Marcotte, and Pierre Herckes.** ***A study of the organic composition of haboob particulate matter.

Heavenrich, Hannah, and Sharon J. Hall.** ***Hidden pools of nitrate in emerging sustainable landscapes**.**

Jones, Lindsey M., Hannah Heavenrich, and Sharon J. Hall.** ***Soil texture heterogeneity in urbanized arid landscapes.

Li, Jialun, Matei Georgescu, Peter Hyde, Alex Mahalov, and Mohamed Moustaoui. ***Phoenix ozone variation due to urbanization and regional transport.***

MacNeille, Benjamin.** ***Microbial air pollution control: Exploring Phoenix's urban phyllosphere**.**

Marcotte, Aurelie R., Jershon Eagar, Denise Napolitano, and Pierre Herckes.** ***Chemical characterization of time resolved haboob samples from Phoenix, AZ.

Ramos, Jorge, Patricia Susanto, and Dan Childers.** ***The role of macrophytes in the greenhouse gas fluxes from the Tres Rios constructed wetland in Phoenix, AZ.

Rose, Christy J., Paul Westerhoff, and Pierre Herckes.** ***Chloroform formation from swimming pool disinfection: A significant source of atmospheric chloroform in Phoenix?

Sampson, Marena E., Lindsey D. Pollard, Monica M. Palta, Nancy B. Grimm, and Rebecca L. Hale.** ***How soil may be controlling our air: A look at greenhouse gas emissions from an urban landscape.

Shaw, Julea, Sharon J. Hall, and Jennifer Learned.** ***Patterns of surface rock cover and implications for plant, water, and nutrient dynamics at long-term ecological research sites in Phoenix, AZ.

Song, Yang, and Kevin Gurney.** ***Spatiotemporal variations of on-road CO_2 emissions for Maricopa County, Arizona**.**

Suchy, Amanda K., Monica M. Palta, Daniel L. Childers, and Juliet C. Stromberg.** ***Small- and large-scale drivers of denitrification patterns in "accidental" urban wetlands in Phoenix, Arizona.

Yu, Rong, Benjamin L. Ruddell, Minseok Kang, and Dan Childers.** ***Dynamical sensitivity of terrestrial eco-climate systems to climate forcings: Global eco-climate process network modeling at FLUXNET sites.

CLIMATE, ECOSYSTEMS, AND PEOPLE

Bergin, Kelly L., and Becky A. Ball.** ***Impacts of altered precipitation on aboveground-belowground interactions in the Sonoran Desert.

Betzel, Summer, Evan R. Kuras, David M. Hondula, Christopher Dastan, Jason Eneboe, Miranda Kaml, Mary Munoz, Lauren Rohan-Kohl, Mara Sevig, Marianna Singh, Benjamin Ruddell, and Sharon L. Harlan.** ***Relationship between activity level and individually experienced temperature among an elderly population in Phoenix, AZ.

Chipman, Danielle, Kelli L. Larson, Dave White, and Amber Wutich.** ***I will survive: Perceptions of personal and global climate change risks.

Dastan, Christopher, Evan R. Kuras, David M. Hondula, Summer Betzel, Jason Eneboe, Miranda Kaml, Mary Munoz, Lauren Rohan-Kohl, Mara Sevig, Marianna Singh, Benjamin Ruddell, and Sharon L. Harlan.** ***The Coffelt case: Individually experienced temperature and changes to Coffelt Park and resident housing.

Eneboe, Jason, Evan R. Kuras, David M. Hondula, Summer Betzel, Christopher Dastan, Miranda Kaml, Mary Munoz, Lauren Rohan-Kohl, Mara Sevig, Marianna Singh, Benjamin Ruddell, and Sharon L. Harlan.** ***Calculating heat vulnerability indexes through the use of individually experienced temperatures in the Phoenix, Arizona metropolitan area.

Gade, Kristin J., Steven Olmsted, Darcy Anderson, Thor Anderson, and Josh DeFlorio. ***Extreme weather vulnerability assessment - pilot study for the Arizona Department of Transportation.***

Häb, Kathrin, Benjamin L. Ruddell, and Ariane Middel.** ***Sensor lag correction for mobile air temperature measurements in an urban microclimate context.

Kaml, Miranda, Evan R. Kuras, David M. Hondula, Summer Betzel, Christopher Dastan, Jason Eneboe, Mary Munoz, Lauren Rohan-Kohl, Mara Sevig, Marianna Singh, Benjamin Ruddell, Sharon L. Harlan.** ***Effects of health on individual experienced temperatures.

Kruke, Laurel.** ***Climate change knowledge, beliefs, and behaviors: A profile of high school students in Phoenix, AZ.

Kuras, Evan R., David M. Hondula, Summer Betzel, Christopher Dastan, Jason Eneboe, Miranda Kaml, Mary Munoz, Lauren Rohan-Kohl, Mara Sevig, Marianna Singh, Benjamin Ruddell, and Sharon L. Harlan. *Measuring individually experienced temperatures in Phoenix, AZ: A new method for research and education in urban environmental science.

Learned, Jenni, and Sharon J. Hall. *Microclimate patterns of residential landcapes across the US.*

Middel, Ariane, Nancy Joan Selover, Nalini Chhetri, Björn Hagen, Benjamin Mackowski, and Chhatrapalsinh Jaydevsinh Sisodiya. *Microclimate effects of photovoltaic canopies: Ongoing research projects.*

Munoz Encinas, Mary, Evan R. Kuras, David M. Hondula, Summer Betzel, Christopher Dastan, Jason Eneboe, Miranda Kaml, Lauren Rohan-Kohl, Mara Sevig, Marianna Singh, Benjamin Ruddell, and Sharon L. Harlan. *Individually experienced temperatures and sense of place: An exploration of the social construct and its relation to personal heat exposure.

***Rohan-Kohl, Lauren, Evan R. Kuras, David M. Hondula, Summer Betzel, Christopher Dastan, Jason Eneboe, Miranda Kaml, Mary Munoz, Mara Sevig, Marianna Singh, Benjamin Ruddell, and Sharon L. Harlan. *From teaching to trails: Occupation, heat exposure, and leisure time physical activity in Phoenix, Arizona*.**

Singh, Marianna, Evan R. Kuras, David M. Hondula, Summer Betzel, Christopher Dastan, Jason Eneboe, Miranda Kaml, Mary Munoz, Lauren Rohan-Kohl, Mara Sevig, Benjamin Ruddell, and Sharon L. Harlan. *Individually experienced temperature,what it means in the greater Phoenix area.

Song, Jiyun, Zhihua Wang, Enrique R. Vivoni, Giuseppe Marscaro, and Benjamin L. Ruddell. *Investigating the impacts of urbanization on regional hydrometeorology by coupling an urban canopy model with a distributed hydrological model.

HUMAN DECISIONS AND BIODIVERSITY

Ackley, Jeffrey W., Jianguo Wu, Michael Angilletta, Soe Myint, and Brian Sullivan. *Rich lizards: How affluence and land cover influence the diversity and abundance of desert reptiles persisting in an urban landscape.

Alvarez Guevara, Jessica, and Becky Ball. *How urbanization alters the top-down influence of herbivores on plant communities.

Banville, Mélanie J., Heather L. Bateman, Stevan R. Earl, and Paige S. Warren*. Urbanization contributes to simplified riparian bird communities.*

Burnette, Riley, Heather L. Bateman, and Yun Kang*. *Seasonality and land cover type drive aphid dynamics in an arid city.

****Gryniewicz, Greg F., and Chris A. Martin. An analysis of life history strategies of* Parkinsonia *and* Prosopis *trees within the CAP LTER study area.***

Hutton, Pierce, and Kevin J. McGraw. *Urbanization alters molt dynamics in a common desert songbird.

Jia, Jessica, Elizabeth A. Wentz, and Kelli L. Larson. *Parcel level landscape vegetation tradeoffs.

Johnson, James Chadwick, Dale Stevens, Annika Vannan, Katie Bratsch, and Jesse Lam. *Arthropod pests on an urban heat island: Temperature effects on the behavior of black widows and their prey.*

Kouteib, Soukaina, Scott Davies, and Pierre J. Deviche*. *Adjusting to urban life: endocrine and immune responses of a songbird to acute stress.

Montgomery, Brett J., Logan L. Salaki, and Heather L. Bateman. *Wildlife strikes at airports: What are the contributing factors?

Sokolowski, Matt, and Peter Fox. *Factors controlling invasive mussel distribution in Arizona.

Stutz, Jean C. and Heather L. Bateman. *Living in the city: Arbuscular mycorrhizal fungi in Phoenix and the surrounding desert.*

Weaver, Melinda, Russell.A. Ligon, Melanie Mousel, and Kevin J. McGraw. *Avian anthrophobia? Behavioral and physiological responses of house finches across urban gradient in predator presence.

LAND USE, LAND COVER, LAND ARCHITECTURE, AND ECOSYSTEM SERVICES

Kane, Kevin, and Abigail M. York. *Hazards of change: A survival analysis approach toward the development of agricultural land in Arizona.

Minn, Michael, Jonathan A. Greenberg, Nathan Pavlovic, Jennifer M. Fraterrigo, V. Kelly Turner, and Bethany B. Cutts. *Detection of foreclosure-related landscape management changes using Landsat.*

Sullivan, Abigail, and Abigail York. *The impact of institutional heterogeneity: A mixed methods approach to understanding management outcomes of the invasive mile-a-minute weed (*Mikania micrantha*) in Chitwan, Nepal.

***Zhao, Qunshan, Elizabeth A. Wentz, and Alan T. Murray. *Tree shade optimization in an urban desert environment*.**

***Zhao, Xiaoxi, and Zhi-Hua Wang. *Effect of shade trees on building energy efficiency*.**

SUSTAINABLE FUTURES

Davidson, Melissa, David M. Iwaniec, and Nancy B. Grimm. *Planning for climate change and extreme events.

Grimm, Nancy B., Charles L. Redman, Mikhail V. Chester, David Iwaniec, P. Timon McPhearson, Thaddeus R. Miller, and Tischa Muñoz-Erickson. *Urban resilience to extremes: A proposed Sustainability Research Network.*

WATER DYNAMICS IN A DESERT CITY

Handler, Amalia, Amanda Suchy, Nancy B. Grimm, Monica M. Palta, and Daniel L. Childers. *Hydrologic and chemical connectivity between surface and soils in an urban accidental wetland: Implications for nitrogen removal.

***Hester, Cyrus H., and Kelli L. Larson. *A multi-method analysis of water demands and management in metropolitan North Carolina*.**

Hopkins, Kristina G., Nathaniel B. Morse, Daniel J. Bain, Neil D. Bettez, Nancy B. Grimm, Jennifer L. Morse, and Monica M. Palta. *Characterizing hydrologic alterations following urbanization using gradient and long-term approaches.*

***McAtee, Hannah, Holly Vins, Jonathan Maupin, Amber Wutich, Alexandra Brewis, Rhian Stotts, Melissa Beresford, and Christopher Roberts. *The Science of Water Art: Children's perspectives on water and the environment in Guatemala*.**

Sampson, David A., Ray Quay, and Dave D. White. *A browser interface to WaterSim 5.0.*

Stotts, Rhian, Margaret Du Bray, Jacelyn Rice, Paul Westerhoff, Amber Wutich, Alexandra Brewis. *Public perceptions of wastewater treatment and reuse in Phoenix, AZ: Results of the global ethnohydrology study.

***Yang, Jiachuan, and Zhi-Hua Wang. *Shift of paradigm in urban irrigation: Finding the optimal scheme for building energy efficiency*.**

Abstracts

All abstracts are listed alphabetically by first author. * indicates student poster.

Ackley, J. W.[1], J. Wu[1,2], M. Angilletta[1], S. Myint[3], and B. Sullivan[4].** ***Rich lizards: How affluence and land cover influence the diversity and abundance of desert reptiles persisting in an urban landscape.

Fourteen native lizard species inhabit the desert surrounding Phoenix, AZ, USA, but only two occur within heavily developed areas. This pattern is best explained by a combination of socioeconomic status, land-cover, and location. Lizard diversity is highest in affluent areas and lizard abundance is greatest near large patches of open desert. The percentage of building cover had a strong negative impact on both diversity and abundance. Despite Phoenix's intense urban heat island effect, which strongly constrains the potential activity and microhabitat use of lizards in summer, thermal patterns have not yet impacted their distribution and relative abundance at larger scales. As Phoenix emerges from an economic recession, efforts to restrict urban sprawl and encourage higher density development could lower water and energy use while benefiting lizards in undisturbed habitats. However, this would likely exacerbate the urban heat island effect, and pose a threat to native species within the urban landscape.

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Alvarez Guevara, J., and B. Ball.** ***How urbanization alters the top-down influence of herbivores on plant communities.

Desert ecosystems are one of the fastest urbanizing areas on the planet. This rapid shift has the potential to alter the abundances and species richness of both herbivore and plant communities; herbivores, for example, are expected to be more abundant in cities due to the concentration of food resources. Despite this assumption, however, previous research conducted in urban Phoenix has shown that top-down herbivory led to equally reduced biomass within and outside the city. Since there are no published data reporting the abundance and density of herbivores within and outside Phoenix, it is unclear whether this lack of difference in herbivory is the result of unaltered herbivore populations or altered activity levels that counteract abundance differences. Vertebrate herbivore populations were surveyed at four sites inside and four sites outside of the city core in order to determine whether herbivore communities differ significantly between urban and rural sites. In order to census species composition and abundance at these sites, 100 Sherman traps and 16 larger wire traps that are designed to attract and capture small vertebrates such as mice, rats, and squirrels were set at each site for two consecutive trap nights. Results suggest that abundances within the city core are greater than those in more rural areas, and that dominant species differ with individual sites.

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Banville, M. J.[1], H. L. Bateman[1,2], S. R. Earl[1], and P. S. Warren[1,3]. *Urbanization contributes to simplified riparian bird communities*.

Riparian zones provide critical resources for wildlife and are biodiversity hotspots. Biotic communities of riparian zones may be affected by urbanization as alterations to land use and land cover occur in the surrounding landscape. Since 2001, the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) program has been monitoring bird populations within the Phoenix metropolitan area and its immediate surroundings. We examined bird assemblages at 12 riparian monitoring sites that feature natural or engineered settings with perennial or ephemeral flows (4 riparian categories). We used long-term data to address three questions: (1) How does bird community composition differ among seasons and riparian categories, (2) How do environmental characteristics of riparian categories vary at site- and landscape-levels?, and (3) How have the riparian bird communities at these sites changed over time? We found that spring and winter bird communities have different migrant populations. We found that different riparian categories have different bird assemblages: engineered riparian sites support more urban-adapted bird species, whereas natural riparian sites support more specialists. Differences across riparian categories are explained by environmental variables at both the site- and landscape-levels. Over time, decreases in abundance, species richness, and diversity are observed in riparian bird communities of all categories. Bird communities in natural settings appear to have changed more in composition than communities at engineered sites. Overall, the riparian bird community is shifting toward more urban-adapted, resident species that are characteristic of riparian sites with less water and more impervious surface.

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Bergin, K. L., and B. A. Ball. *Impacts of altered precipitation on aboveground-belowground interactions in the Sonoran Desert.

Altered precipitation patterns resulting from climate change will have significant consequences in water-limited desert ecosystems. There is an increasing body of research on aboveground plant responses to altered precipitation in deserts, but not so for belowground communities. Given that the soil community is responsible for large portions of nutrient cycling, understanding the response of the soil community to altered precipitation regimes, both directly and indirectly through aboveground linkages, is key to understanding implications of climate change for biogeochemical processes in the Sonoran Desert. To determine how aboveground-belowground interactions change under altered precipitation patterns, we artificially manipulated precipitation amount and frequency during the monsoon season over three different plant types to determine the consequences for the soil community. In the field, we simulated 5 mm pulse events (the average summer size for CAP sites over the past 5 years) plus a 50% increase in size (7.5 mm) either every 2 weeks (simulating the average number of summer events occurring over the past 5 years, spread evenly) or monthly (~50% reduced frequency). The four pulse treatments were applied to the basal area under three aboveground types: *Larrea tridentata*, *Ambrosia deltoidea*, and the interplant space. Seventy-two soil samples of approximately 550 grams each were collected; 36 at the beginning and 36 at the end of the season. Invertebrates were extracted from the soil via heptane flotation. Sample analysis is ongoing, and we predict there will be a change in composition and abundance of soil fauna as a result of the differing precipitation patterns.

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Betzel S.[1], E.R. Kuras[2], D.M. Hondula[3,4], C. Dastan[1], J. Eneboe[4], M. Kaml[1], M. Munoz[5], L. Rohan-Kohl[1], M. Sevig[1], M. Singh[1], B. Ruddell[5,6], S. L. Harlan[1].** ***Relationship between activity level and individually experienced temperature among an elderly population in Phoenix, AZ.

As people age, their bodies' ability to efficiently thermoregulate declines, thus increasing the physiological susceptible of the elderly to heat-related illness and mortality during high temperature conditions. Concern about heat-related risks may therefore inhibit the elderly from partaking in daily activities. Despite our knowledge that the elderly are more vulnerable to negative heat-health outcomes, there is competing evidence as to what the primary cause of mortality is, from housing characteristics, access to air conditioning, socioeconomics, and social isolation. In this study, we examine the effect of different activity levels on heat exposure for an elderly population. We recruited 80 residents of greater Phoenix to carry around air temperature sensors that would passively record Individually Experienced Temperatures (IETs) for a week in September, 2014. Some participants also completed activity logs during the study period. We investigated the relationship between IET and age among participants over 50 years of age within the sample (hereafter the "50+ group"). The IETs of the 50+ group were analyzed during the daytime and nighttime hours. Intensity range of the activities among the 50+ group was also determined. The 50+ group had homogeneous nighttime IETs, but throughout the day, IETs were more variable. Activity intensity levels were similar among the elderly, who reported partaking in medium and higher activity levels early in the morning, and low levels through the daytime. Through the lens of IET and detailed activity data, we can better determine the contribution of age and activity levels to heat exposure under high temperature conditions.

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Burnette, R., H. Bateman, and Y. Kang.** ***Seasonality and land cover type drive aphid dynamics in an arid city.

Urbanization can create novel ecosystems comprised of community assemblages atypical from the surrounding landscape. A trend of urban biotic communities is an increase in abundance of generalist species (or urbanophiles) coupled with a decrease in biodiversity. Aphids have been hypothesized to be an arthropod urbanophile due to their ability to maintain higher abundance in cities. We used a CAP LTER long-term dataset to evaluate how aphid abundance is effected by both season and habitat/land cover type in Phoenix, Arizona. We defined habitat types as agriculture, urban mesic (residential), urban xeric (residential), desert remnant, and desert. We compared the mechanisms driving aphid abundance and proposed a mathematical model parallel to our empirical study to help increase our understanding of the patterns we observed. There was a clear separation of abundance along a gradient of water availability rather than urbanization level. The two habitat types with the highest water availability, agriculture and urban mesic, had two times greater abundance than the three drier habitats. Desert habitats had a higher overall abundance than both urban xeric and desert remnant habitats. Similar seasonal patterns were observed despite the level of urbanization; aphid abundance was the highest in the spring and the

lowest in the summer across all habitat types. Overall, our model based on seasonal growth rate explained 40% of aphid population dynamics. We conclude that aphids take advantage of fragmented patches in cities containing increased resources and moisture availability, but are primarily driven by habitat characteristics and seasonal change as opposed to land use.

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Chipman, D.[1], K. Larson[1,2], D. White[3], and A. Wutich[4]. *I will survive: Perceptions of personal and global climate change risks.

Although people may recognize the potential harmful effects of climate change, they do not always perceive themselves as vulnerable to these effects. This analysis examines survey responses to two questions that asked participants to rate both personal risk and global risk for climate change impacts on food production, biodiversity, water availability, natural disasters, coastal changes, standard of living, and disease. We then look at how these risk perceptions vary based on a country's level of development and other factors. The current literature on risk perceptions lacks sufficient discussion of how subjective views of climate change impacts vary across geographic contexts, and this study aims to fill that gap by examining a variety of risk perceptions across eight different countries using comparisons of closed-ended survey data. The work is based on data from Arizona State University's Global Ethnohydrology Study in 2012, which consisted of in-person surveys and interviews about climate change uncertainty in Australia, China, Fiji, Mexico, New Zealand, Switzerland, the United Kingdom, and the United States. The results show that the developing countries in this study – China, Fiji, and Mexico – tend to be more concerned about the effects of climate change. Survey respondents in several of the high-polluting developed countries, such as Australia and the United Kingdom, consistently show less concern about climate change risks. Overall, most people exhibit a trend towards distancing themselves from the problems of climate change, acknowledging the global risks while expressing less concern that they will be personally affected.

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***Dastan, C.[1], E. R. Kuras[2], D. M. Hondula[3,4], S. Betzel[1], J. Eneboe[4], M. Kaml[1], M. Munoz[5], L. Rohan-Kohl[1], M. Sevig[1], M. Singh[1], B. Ruddell[5,6], and S. L. Harlan[1]. *The Coffelt Case: Individually experienced temperature and changes to Coffelt Park and resident housing*.**

Low-income communities are more susceptible to heat-related illness and mortality. The Coffelt-Lamoreaux public housing neighborhood (hereafter "Coffelt") in Phoenix, Arizona, sheds light on these vulnerabilities through the impending housing and park renovations aimed at heat stress mitigation. Research within this neighborhood seeks to investigate how measured IETs (Individually Experienced Temperatures) and OATs (Outdoor Ambient Temperatures) can help explain both individual and community-level heat vulnerabilities. Current research focuses on neighborhoods as an observable unit for heat exposure study. Meanwhile, individual temperature data has yet to be collected and integrated into community-level vulnerability analyses. In this study, the research team distributed iButtons (personal temperature sensors) to 13 study participants in Coffelt. Surveys and interviews were conducted to reveal how residents experience temperature locally and personally. A key informant interview with the local Manager at the Housing Authority of Maricopa County

Center was held to detail Coffelt developments. This interview provided commentary on the park and housing renovations and helps explain how infrastructural needs pertain to neighborhood and individual heat mitigation. After data collection the research team developed a two-page document for participants to view their own data within the context of their neighborhood. This document illustrates pictographic notes on the impending infrastructural changes to homes and the park and Coffelt aggregate temperature data. These housing and park changes will be examined predominantly using the key informant's feedback. This research hopes to further evaluate the infrastructural conclusions of the HIA and their efficacy through the perspective of community members and our key informant.

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***Davidson, M.[1], D. Iwaniec[2], and N. B. Grimm[2,3]. *Developing adaptive, strategic, and transformational scenario futures for Central Arizona*.**

With the majority of the global population now living in cities, urban development and planning is, and will continue to be, a decisive factor in the well-being of societies worldwide. In the central Arizona-Phoenix region where urban, agricultural, and desert systems coexist, complex and changing interactions between people, infrastructure, land, water, energy, and climate present an array of challenges. Regional planning must account for these unique and diverse conditions important to human and environmental well-being.

This research focuses on regional planning for extreme events (i.e., heat, drought, and flooding). A main objective is to explore how different cities and governance institutions in the region are thinking about their long-term future development and specifically how they account for climatic extremes. By analyzing long-range planning documents, we have identified key priorities and strategies that decision-makers are using to frame and address these challenges. Importantly, we have identified synergies and conflicts within and among the different governance institutions. Next steps include working with stakeholders and researchers to better understand their diverse and interacting priorities, and working together to co-develop scenarios that enable an exploration of alternative futures. Following a pair of researcher workshops in Spring 2014, we held the first of a series of multiple-stakeholder workshops in fall 2014, exploring ideas for three distinct types of sustainable future scenarios.

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Eagar, J., D. Napolitano, A. Marcotte, and P. Herckes. *A study of the organic composition of haboob particulate matter.

Each July marks the beginning of the summer monsoon season in the southwestern United States. Storms originating south of Phoenix create cold fronts that travel northwest towards Phoenix. The presence of loose soil along the storm's path, as well as its downward trajectory into the Valley, causes a wall of sand and dust (known as a haboob) to be suspended into the air and commingle with urban particulate matter (PM). However, the composition of haboob dust is not well known and it remains unclear whether the composition of haboob dust significantly impacts background urban PM. During the

July-September monsoon seasons of 2013 and 2014, haboob PM and background urban PM samples were collected in Tempe, Arizona. The PM2.5 fractions (PM with aerodynamic diameters less than 2.5 micrometers) were analyzed by thermal optical transmittance to determine differences in atmospheric concentrations of organic and elemental carbon in background urban PM and haboob PM. The samples were then analyzed by GC/MS to identify n alkanes, polycyclic aromatic hydrocarbons (PAH), and oxy polycyclic aromatic compounds (OPAC). During haboob events, we have observed increases in the ratio of organic carbon to elemental carbon, as well as increases in the carbon preference index of long-chain n alkanes, both of which corroborate an influx of biogenic material. Brief increases in elemental carbon concentrations and PAH concentrations have also been observed, which may suggest a resuspension of anthropogenic material during haboob events.

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Calculating heat vulnerability indexes through the use of individually experienced temperatures in the Phoenix, Arizona metropolitan area.

Human exposure to heat has increasingly become a prominent issue in public health within the Phoenix, Arizona metropolitan area. Past studies have measured human susceptibility to heat utilizing demographic factors along with surface or outdoor ambient temperatures within certain urban neighborhoods. These studies are limited in that by only using stationary temperature measurements, the range of possible temperatures actually experienced by people living in the same area are not accounted for, especially as individuals move within and beyond their neighborhood boundaries. The purpose of this project is to utilize Individually Experienced Temperatures (IETs) in place of previous methods of measuring temperature to more holistically represent the average actual heat exposure for residents belonging to a neighborhood. By integrating IETs into previous calculations of Heat Vulnerability Indexes (HVIs), which also consist of demographic and environmental factors, a more accurate assessment can be made about the levels of vulnerability for certain groups. Geographic information systems (GIS) were used to create spatial analyses in order to determine each neighborhoods level of risk in relation to their IETs, vegetation, and urbanization, while official 2010 Census reports were used to represent demographic data. The results suggest higher HVIs for neighborhoods with larger minority representation, lower socioeconomic status, lower normalized difference vegetation indexes (NDVIs), and higher percent of urbanization. These results align with previous studies relating to HVI, but will serve to push forward the conversation of heat vulnerability and help identify the mechanisms and drivers of vulnerability of higher risk populations.

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Gade, K. J.[1], S. Olmsted[1], D. Anderson[2], T. Anderson[3], and J. DeFlorio[4]. *Extreme weather vulnerability assessment - pilot study for the Arizona Department of Transportation.*

The Arizona Department of Transporattion (ADOT) conducted a pilot study to assess the vulnerability of its infrastructure to extreme weather, including high temperatures, drought and intense storms within the context of the surrounding landscape. Understanding the risks and identifying vulnerable sections of the roads will allow ADOT to spend construction and maintenance dollars more efficiently while improving public safety. The pilot study focused on a 322-mile study corridor from Nogales through Tucson, Phoenix and up to Flagstaff. The analysis considered high temperatures, drought, and intense storms and how they contribute to dust storms, wildfire and flash flooding as well as how these stressors affect pavement, bridges and culverts, and road closures.

The pilot study was based on a framework for vulnerability assessment and adaptation developed by the Federal Highway Administration. Nineteen groups are piloting the framework; ADOT's study is one of the first to consider multiple biotic communities in the analysis. The objectives of the study were to (1) identify and prioritize vulnerable assets and stressors of most concern within the study corridor and (2) assess the effects of extreme weather stressors in different biotic communities within the study corridor with the goal of developing model approaches for assessing transportation infrastructure throughout the state. Input was gathered from a large number of internal and external stakeholders. The results of the pilot study will be used to inform further research, both more intense analysis of portions of the initial study corridor as well as extending the analysis to additional roads in the state highway system.

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Grimm, N. B.[1,2], C. L. Redman[2], M. V. Chester[2,3], D. Iwaniec[2], P. T. McPhearson[4], T. R. Miller[5], and T. A. Muñoz-Erickson[6]. *Urban resilience to extremes: A proposed Sustainability Research Network*.

The Urban Resilience to Extremes Sustainability Research Network (UREx SRN) will develop a new, more holistic framework for integrating Social, Ecological and Technical System (SETS) dimensions for conceptualizing, analyzing, and supporting urban infrastructure decisions in the face of climatic uncertainty. Climate change is widely considered 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, concentration of people, and increasingly complex and interdependent infrastructure. An interdisciplinary UREx SRN team will develop a diverse suite of methods and tools to assess how infrastructure can be resilient, provide ecosystem services, improve social well being, and exploit new technologies in ways that benefit all segments of urban populations.

The network of six continental U.S. (Syracuse, New York, Baltimore, Miami, Portland, and Phoenix) and three Latin American cities (San Juan, Hermosillo, and Valdivia) includes over 35 million residents and is a basis for expansion to other cities in the Western Hemisphere. Research will address the questions, 1) how do SETS domains interact to generate vulnerability or resilience to climate-related extreme events, and 2) how can urban SETS dynamics be guided along more resilient, equitable, and sustainable trajectories? Eight working groups (WGs) will work together to answer these questions. WGs include interdisciplinary research and integral educational activities targeting graduate and

post-doctoral fellows, and aimed at developing a model for co-producing effective and robust decision-support tools.

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Gryniewicz G., and C. Martin. *An analysis of life history strategies of* Parkinsonia *and* Prosopis *trees within the CAP LTER study area.

Variation in climate has been shown to shape properties and assemblages of trees based on their life history strategies. Wood specific gravity is an easily measured indicator of tree life history strategy because it measures the density of structural tissues a tree species allocates to anchorage, support, and strength and is directly correlated to the amount of carbon sequestered. Trees growing in arid climates might divert energy from the production of dense wood to production of new tissue growth when water is available. Wood specific gravity of two Sonoran Desert tree genera, *Parkinsonia* and *Prosopis* were investigated within the CAP LTER study area. *Parkinsonia* and *Prosopis* trees of the same size class growing in irrigated, managed landscapes and in the undeveloped Sonoran Desert with no irrigation were non-destructively sampled using an incremental borer. Our results show that *Parkinsonia* and *Prosopis* trees growing in managed landscapes have significantly lower wood specific gravity compared to trees growing in undeveloped Sonoran Desert conditions. We attribute this difference to irrigation used in managed landscapes. Our results suggest that landscape irrigation practices used in arid climates affect life history strategy of two native Sonoran Desert trees, which has important implications for horticultural management and estimating ecosystems services, especially above-ground carbon stocks.

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Häb, K.[1], B. L. Ruddell[2], and A. Middel[3]. *Sensor lag correction for mobile air temperature measurements in an urban microclimate context.

Mobile transect measurements are a common technique to retrieve data with a high spatial resolution along a specific route. In urban climate studies, transects are conducted to gain insight into canopy-layer urban heat island characteristics, park cool islands and their intensity, or the impact of certain land-use configurations on microclimate or thermal comfort. For all of these research objectives, finding correlations between meteorologically relevant data and the land use surrounding the sensors is one of the most important research tasks.

However, measurement data retrieved during mobile measurement campaigns underlie various error sources, with one critical problem being the inertia of sensors in adapting to the quickly varying signals sent by the traversed microenvironments along a transect route. If a sensor has a time constant that is high relative to physical microclimate scale and platform velocity, it becomes difficult to relate the measured values to the heterogeneous surroundings of the sensor. In order to account for this problem, we optimize and evaluate an approach for the correction of measurements for an urban microclimate setting. Using a digital experiment, values for a set of three correction parameters are derived: moving average window size, transfer function setup, and linear time shift. The resulting correction

procedure produces consistent improvements for air temperature data recorded during a mobile measurement campaign. [Material is to be concurrently submitted to *Urban Climate*.]

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Handler, A.[1], A. Suchy[1], N. B. Grimm[1], M. Palta[2], and D. L. Childers[3]. *Hydrologic and chemical connectivity between surface and soils in an urban accidental wetland: Implications for nitrogen removal.

Wetland ecosystems are ideal for excess nutrient removal, featuring abundant vegetation and microbial communities which support attenuation of dissolved nutrients. Nitrogen, a common surface water pollutant in the form of nitrate (NO_3^-), can be transformed by microbial communities to nitrogen gas (N_2 and N_2O) through the process of denitrification, effectively permanently removing the nitrogen from the system. Denitrification requires low oxygen and high organic carbon concentrations that are characteristic of wetlands soils. However, if nitrogen enters wetlands through the surface water, exchange between the surface and subsurface compartments is required to facilitate nitrogen removal. We examined the amount of hydrologic and chemical exchange between the surface water and subsurface porewater in the Salt River channel accidental wetlands in Phoenix, Arizona. Based on low recovery during well slug tests, we inferred the subsurface was highly hydraulically conductive. Yet, sample water from wells was often comingled with gases, indicating either low hydraulic conductivity or that the system lacks water below a short depth (~50 cm). Conservative ion concentrations were similar between the surface and subsurface water, indicating chemical exchange between the compartments. Nitrate concentrations were lower in the subsurface porewater than the surface water, indicating that the surface water supplies NO_3^- to the subsurface where it is transformed or assimilated. Low dissolved oxygen and high dissolved organic carbon concentrations in porewater suggest that the subsurface can support denitrification. These data suggest that there is chemical exchange between the surface and subsurface water, but the wetlands may be perched above an impermeable layer.

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***Heavenrich, H., and S. J. Hall. *Hidden pools of nitrate in emerging sustainable landscapes*.**

Cities are increasingly adopting sustainability principles to provide ecosystem services and reduce climate impacts. In Phoenix, homeowners are offered rebates to convert water-intensive lawns to xeric landscapes; yards composed of rock groundcover and drought-tolerant shrubs. This landscape conversion reduces residential water and fertilizer use and thus is promoted for sustainability. However, lawns can contain as much nitrogen as agricultural soils, mostly within a dense network of actively growing roots. After conversion, moist soils and limited plant nutrient uptake could result in rapid biogeochemical transformation of the organic nitrogen to nitrate, with short-term implications for nutrient retention and groundwater quality. In this research, I compare soil nutrient retention and cycling in xeric and turfgrass yards along a chronosequence of time-since-lawn-conversion to explore what happens to this large pool of accumulated nitrogen. We found that nitrogen in xeric yards varies significantly with time, soil depth, and in relation to landscape plants.

Nitrate concentrations differ between turf and xeric yards, with younger xeric yards (converted within the last four years) ranging from 16-20 ug N/g soil, compared to less than 5 ug N/g soil under turfgrass yards. The relationship between time and nitrate concentrations is highly influenced by management practices, such as irrigation and the presence of a plastic barrier. This research is the first to explore the ecological outcomes and temporal dynamics of an increasingly common, 'sustainable' land use practice that is universally promoted in US cities.

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Hester, C. M.[1], and K. L. Larson[1,2]. *A multi-method analysis of water demands and management in metropolitan North Carolina.

The urbanized center of North Carolina – including Raleigh, Cary, and the Piedmont Triangle – has experienced one of the fastest growing populations in the United States. This growth has also promoted exurban development, shifting land-use patterns, and changing water demands. During this same period, the State has suffered two of the worst droughts on record (1998-2002 and 2005-2008). Traditionally a water-rich environment, governance in the region was never structured to holistically respond to shortages. This situation presents significant challenges for water managers striving to sustainably provide high-quality water in the face of social and environmental change. In this way, the Urban Crescent of North Carolina presents an opportune site for investigating water management at the confluence of rapid urbanization, environmental change, and governance regimes. Here, we apply a mixed-methods approach integrating geospatial and policy analyses at multiple scales to better understand metropolitan water use trends. Time-series data are used to study the influence of drought, land-use, population growth, and policy interventions on water withdrawals in the study area from 1985 to present. Cities are found to vary in their growth rates, per capita water demand, and irrigation policies. Future research will build upon these preliminary findings and directly engage water managers to highlight their perspectives on the drivers, opportunities, and challenges affecting water resources in a shifting socioecological system. This in-depth, place-based analysis will also inform a cross-state comparative approach to water management throughout the American Sunbelt.

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Hopkins, K. G.[1,2], N. B. Morse[3], D. J. Bain[1], N. D. Bettez[4], N. B. Grimm[5], J. L. Morse[6], and M. M. Palta[5]. *Characterizing hydrologic alterations following urbanization using gradient and long-term approaches.*

Linking the type and timing of hydrologic changes with patterns of urban growth is essential to identifying the underlying mechanisms that drive declines in urban aquatic ecosystems and to understanding the drivers of regional variability in hydrologic response. We characterize stream flow changes in nine U.S. cities using two approaches 1) urbanization gradients and 2) long-term (>40 years) watershed studies. Hydrologic change was characterized using USGS stream flow records and a suite of hydrologic indices. Results from the gradient approach indicate heterogeneity in the type and magnitude of hydrologic responses. Study watersheds in glaciated terrains had less frequent high-flow events and longer high-flow durations compared to similarly developed watersheds in non-glaciated terrains. Our result suggest differences in physical characteristics associated with low relief and high water storage capacity likely buffer the severity of hydrologic changes. Results from the long-term approach indicate significant increases in high-flow frequency and runoff

efficiency. In three watersheds, there was a rapid (10-15 years) shift toward more frequent high-flow events between 1969 and 1976. The intensity of development during the peak growth period had the strongest association with the magnitude of high-flow changes, while the timing of high-flow changes was mainly driven by the development trajectory of each watershed. Our results underscore the need to refine urban stream syndrome theory to incorporate the impact of gradual versus rapid urban hydrologic changes on aquatic ecosystem function, as well as recognize that the dominant drivers of hydrologic changes are heterogeneous among urban watersheds and change through time.

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Hutton, P., and K. J. McGraw. *Urbanization alters molt dynamics in a common desert songbird.

Only recently have urban ecologists begun to focus on how urbanization alters the physiology and behavior of animals. For example, much work has centered on urban modifications of stress and breeding in birds. However, the impact of urbanization on another major avian life history trait – molt – is unknown. Because molt is a condition-dependent physiological process we hypothesized that the onset, completion, and intensity of molt is modulated by urbanization in a widespread desert and urban-dwelling passerine, the house finch (*Haemorhous mexicanus*). Given, in prior work, that we have found that urban finches are in worse condition (i.e., less colorful, more heavily parasitized) than rural finches, we predicted that urban birds would molt at a slower rate and begin and end the molt period later. Over the course of 14 weeks, we tracked the molt progress of colorful feathers in male and female finches at four sites spanning an urbanization gradient in Phoenix, AZ. We found no difference in the start or finish date of molt between urban and rural birds, but rural birds peaked at a higher rate of molt. This latter result is consistent with our prior work indicating that urban birds are in poorer condition during the molt period than rural birds. As feathers serve many critical functions, such as thermoregulation, water-proofing, crypsis, and visual communication, alteration of molt dynamics may have potential fitness costs by extending the duration of this vulnerable state. Building on previous work, this study demonstrates that local human activity alters all stages of avian life.

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***Jia, J.[1], E. A. Wentz[1], K. L. Larson[1,2]. *Parcel level landscape vegetation trade-offs*.**

Outdoor water consumption accounts for a significant percentage of residential water consumption and municipal water demands. In an effort to conserve water, cities in the desert Southwest have recently encouraged low water-use landscaping practices. However, water-intensive landscape features have been shown to reduce the heat release associated with the urban heat island effect (UHI), which is becoming a growing concern for cities whose populations are increasingly vulnerable to the effects of prolonged heat exposure. Previous research has shown that the relationship between irrigated vegetation, water demand, and urban heating is non-linear and must be better understood if cities are to improve sustainability. Past studies have been conducted at census tract scales using landscape coverage characteristics but have not yet incorporated detailed landscape

variables at the parcel level. This research introduces previously unavailable fine-resolution vegetation height data to analyze how vegetation, temperature, and other attributes affect parcel-level water consumption. QuickBird and LiDAR remote sensing imagery (0.00646m/pixel), MASTER temperature data (approximately 7m/pixel) and household water billing data are combined to analyze landscape trade-offs for single-family residential homes in a study area within Tempe, Arizona. We hypothesize that 1) water consumption will increase with large canopy coverage 2) turf grass area will consume more water than tree canopy cover, 3) houses that experience higher daytime temperatures consume less water, and 4) houses that experience higher daytime temperatures will have a lower average vegetation height. We hope that findings contribute to the better understanding of landscape trade-offs for the urban environment.

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Johnson, J. C. , D. Stevens, A. Vannan, K. Bratsch, and J. Lam. ***Arthropod pests on an urban heat island: Temperature effects on the behavior of black widows and their prey.***

Urbanization can result in dramatic changes to the natural landscape (e.g., habitat fragmentation, water supplementation, elevated temperatures). Certain species, termed 'urban exploiters', flourish in urban centers, sometimes outcompeting native biodiversity. However, the mechanism by which urban exploiters are able to dominate in urban ecosystems is not yet well understood. The black widow spider, *Latrodectus hesperus*, is a super-abundant urban pest species native to the desert Southwest. Here we examine the effect of elevated temperatures on the behavioral repertoire of black widows and their most abundant urban prey species, the decorated cricket (*Gryllodes sigillatus*). In particular, the urban heat island (UHI) in Phoenix, AZ, has resulted in elevated nighttime temperatures. Specifically, with past CAP support, we have used ibuttons to show that urban black widows experience a 4-6 °C elevation in temperature relative to their desert counterparts. Thus, we test the hypothesis that the UHI affects the behavior (e.g., courtship, dispersal, activity) and population biology of black widows and their prey. We predict that the UHI will have a net positive effect on urban exploiters, though it is possible that some of the extreme heat we documented in urban black widow refuges at night (e.g., 40 °C) approaches the thermal tolerance of arthropods and thus could have a negative effect on performance.

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Jones, L. M., H. Heavenrich, and S. J. Hall.** ***Soil texture heterogeneity in urbanized arid landscapes**.**

Soil texture, determined by the relative amount of sand, silt, and clay in the soil, affects the fertility and structure of the soil, as well as the infiltration rates and water holding capacity. In an attempt to conserve water, the City of Tempe offers residents a rebate for converting their yard to a more water-efficient landscape. This conversion from high water use grassy lawns, or mesic landscapes, to low water use landscaping, or xeric landscapes could have unintended consequences because of changes in ecosystem structure. Our research aims to answer the question: how does the conversion of highly managed residential yards from mesic to xeric landscapes affect soil texture over time? We used the hydrometer, which uses the known rates of sedimentation of sand (40 seconds) and silt (7 hours), to determine the amount of sand, silt, and clay in each sample. Six mesic sites and 40 xeric sites involved in the City of Tempe's conversion rebate program were included in

the study. Samples were taken from 0-15 cm, 15-30 cm, and 30-45 cm depths, and from under and in between plants. We hypothesize that the xeric yards will have sandier soils when compared to the mesic yards because of higher rates of infiltration. If more infiltration occurs in xeric sites because of less organic matter being present at the surface, then the clay minerals may be leached to lower in the soil profile. These findings will have important implications for irrigation practices and the sustainable management of urban landscapes.

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Heat can have an adverse effect on health, especially for individuals with pre-existing chronic diseases. Under extreme heat conditions, an individual's health status may alter their experience with temperature through adaptive behaviors. This study explores how individuals with different health statuses experience heat in Phoenix, Arizona. The Individually Experienced Temperature (IET) Lab at ASU recruited 80 participants to carry around air temperature sensors as they went about their daily lives for a one-week period in September, 2014. Participants were also asked to evaluate their health compared to their peers using pre-determined categories. We paired participants that evaluated themselves with “fair” or “poor” health (“low health group”) with those who evaluated themselves as in “good” or “excellent” health (“high health group”) while controlling for relative age, race, gender, and neighborhood of residence. We compared the groups in terms of average IET and thermal comfort during all hours, daytime hours (12PM-6PM), and nighttime hours (12AM-6AM). We found that the high health group measured higher average IETs during the study week compared to the low health group. Daytime IETs were significantly higher for the high health group, while nighttime IETs showed no relationship. Self-reported thermal comfort is included in the analysis determining whether the high health group felt more comfortable in the same temperatures than the low health group. By understanding the relationship between health statuses and thermal experience, we can help prevent against heat related illness.

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Kane, K.[1], and A. M. York[2]. *Hazards of change: A survival analysis approach toward the development of agricultural land in Arizona.

The Phoenix, Arizona metropolitan area has sustained one of the United States' fastest population growth rates for half a century. The prevalence of open land – both agricultural and desert – has facilitated continued construction of large-lot housing, keeping costs and densities low but raising concerns over water use and sustainability. Previous work indicates that the recent recession substantially changed residential development trends away from greenfield development toward more established neighborhoods with a richer variety of neighbors, while the impact of zoning and finance on residential development patterns remains ambiguous. Spatial analysis of development patterns at the fine-grained, parcel-level has been a mainstay of urban geographers; however, survival analysis has yet

to be widely adopted as a method for understanding drivers of the timing of development despite its robust explanatory potential and simultaneous consideration of spatial and temporal characteristics. Using two decades of residential completion data, remotely sensed imagery, and a Cox Proportional Hazards model, this research examines greenfield development by linking time-varying price trends in real estate and agricultural commodities alongside spatial drivers of residential location such as intraurban location and physical land characteristics. This long-term assessment of development trends advances the state of the art in urban land use change modeling while also seeking to understand specific changes in a rapidly changing desert city.

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Kouteib, S., S. Davies, P. J. Deviche.** ***Adjusting to urban life: Endocrine and immune responses of a songbird to acute stress.

Urbanization profoundly impacts the environment, creating novel habitats that differ vastly from surrounding non-urban habitats. This transformation may result in urban birds adjusting phenotypically such that they are better suited for the opportunities and challenges of their new habitats. To address this question, we compared free-ranging adult male Abert's Towhees, *Melozone aberti*, sampled during their breeding season in urban (n = 16) and surrounding non-urban (n = 20) areas in metropolitan Phoenix, Arizona. Birds were caught and bled within two minutes (Initial), restrained for 60 minutes, bled again (Stress), measured, and released on site. Urban towhees were heavier and had longer wings than non-urban birds, but were in similar body condition and had similar visible fat reserves and sizes of the cloacal protuberance, an androgen-dependent secondary sexual characteristic. Urban birds had lower Initial plasma corticosterone (CORT) than non-urban birds, but the two groups of towhees increased plasma CORT to similar levels during stress, suggesting higher stress sensitivity in urban settings. The lysis and agglutination capacities of blood did not differ between non-urban and urban towhees, but in both groups decreased during stress, suggesting rapid modulation of immune function during a stressful event. In summary, the adjustment of Abert's Towhees to urban areas involves changes in body size and in the endocrine, but not immune, response to acute stress. Supported by BCS-1026865, Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER).

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Kruke, L.** ***Climate change knowledge, beliefs, and behaviors: A profile of high school students in Phoenix, AZ.

Climate change is a complex challenge that today's youth will encounter and be tasked to solve. Literature on climate change knowledge in youth shows that they have often heard of the concept, but do not show deep understanding of what it is. While young people may be less knowledgeable than adults about climate change, they are more likely to believe it is happening, and that it is a result of human influence on the environment. Youth also tend to confuse concepts such as global warming and ozone depletion, and cannot always accurately describe the causes and impacts of climate change. It is critical to understand how students acquire knowledge and form beliefs about climate change so that communication and education can better cater towards this important population. This research focuses on a group of teenagers, ages 16-18, in the Phoenix, AZ area. Through surveys, students' knowledge and beliefs about climate change were collected and analyzed. Information about behavior choices was also collected through surveys, and supplemented with small group

interviews, to understand how beliefs about climate change are related to particular behavior choices. Using regression analysis and correlation matrices, the significance and direction of the relationships between knowledge and beliefs, and beliefs and behavior, are determined. These findings will contribute to currently limited research about youth's beliefs and knowledge about climate change, and can begin to provide insights about how to encourage behavior that can help young people deal with this challenge in the future.

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***Kuras, E. R.[1], D. M. Hondula[2,3], S. Betzel[4], C. Dastan[4], J. Eneboe[3], M. Kaml[4], M. Munoz[5], L. Rohan-Kohl[4], M. Sevig[4], M. Singh[4], B. Ruddell[5,6], and S. L. Harlan[4].**
Measuring individually experienced temperatures in Phoenix, AZ: A new method for research and education in urban environmental science.

Urban environmental health hazards, including exposure to extreme heat, have become increasingly important to understand in light of ongoing climate change and urbanization. Most current knowledge about heat-health risks is based on measurements of outdoor air temperatures. Further, neighborhoods are often considered a homogenous and appropriate unit with which to assess risk and implement intervention strategies. Little is known about temperatures individuals actually experience within neighborhoods and cities, given differential access to cooling resources, complex activity patterns, and heterogeneous thermal and social environments. This poster summarizes results from an examination of individually experienced temperatures (IETs) within and between neighborhoods in Phoenix, Arizona. In September 2014, 80 research participants were recruited from five Phoenix-area neighborhoods, equipped with air temperature sensors that recorded IETs as they went about their daily lives, completed surveys and activity log phone calls, and participated in exit interviews. As part of a research-for-credit experience, eight ASU undergraduate students were engaged with every aspect of the research process. The research team found that 1) variance in mean IET was relatively equal within each neighborhood and 2) significant differences existed in average mean IETs between neighborhoods. Data collected in this study help explain how intra-city differences in outdoor temperatures manifest themselves into IETs of urban residents. Individual differences are an overlooked determinant of heat exposure and should be better integrated into heat-health research and intervention strategies. Beyond providing an innovative assessment of human-environment interactions, the IET framework offers rich opportunities for engaging undergraduate students in an interdisciplinary research effort.

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Learned, J., and S. J. Hall. ***Microclimate patterns of residential landscapes across the US.***

Urban development has altered the physical and biological properties of native ecosystems worldwide. Climate phenomena, such as the Urban Heat Island (UHI) and Park Cool Island (PCI), are frequently used to illustrate how cities differ from rural lands. The UHI describes the result of heat retention within the built environment, which may be locally mitigated by vegetation (PCI). We wondered: Are large-scale climate trends like UHI

detectable at microclimate levels? To investigate, we installed sensors to monitor the air temperature within yards (residential landscapes) and native landscapes of six US cities from unique climate zones; Los Angeles, Phoenix, Minneapolis, Baltimore, Miami, and Boston. We hypothesized that microclimate trends would be similar among cities, and that microclimate patterns would predominate over large-scale climate trends within residential landscapes, especially when atmospheric mixing is low.

Air temperature data were collected between Aug. 2012 and Oct. 2014. Temperatures of residential landscapes are significantly different than native landscapes, particularly during calmer pre-sunrise hours. Lower daily minimum temperatures result in a greater diurnal temperature range (DTR) for residences compared to reference habitat. The pattern is seen in all six cities, despite the variability of climate zones. Our results suggest that microclimates in residential landscapes can create local heat sinks within the built environment that may alleviate UHI effects in some cities. Additionally, microclimates found in yards follow similar trends among cities, which can contribute to homogenization of urban environments across the US.

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Li, J.[1], M. Georgescu[2], P. Hyde[3], A. Mahalov[4], and M. Moustaoui[4]. *Phoenix ozone variation due to urbanization and regional transport.*

Lower tropospheric ozone (O_3) is harmful to human beings, crops and natural ecosystems and it is one of the six criteria pollutants regulated by the US EPA. A better understanding and attribution of the sources impacting ozone concentrations ([O_3]) in Phoenix is necessary in order to develop effective air quality management strategies to achieve the ever more stringent US air quality standards.

In this study, WRR-Chem is used to investigate the impacts of Phoenix urbanization and southern California anthropogenic emissions (SCAEs) on Phoenix ground-level [O_3]. Our results, based on case studies, indicate that: (1) Phoenix urbanization resulted in ground-level [O_3] increasing 10-20 ppbv during nighttime but negligible changes during daytime. (2) While the contributions of Phoenix local anthropogenic emissions to Phoenix daily maximum 8-hr average (DMA8) [O_3] dominated, the contributions of SCAEs to Phoenix DMA8 [O_3] was from a few ppb to over 30 ppbv (10-30% to total DMA8 [O_3]), depending on case and location. (3) The contributions of biogenic emissions to Phoenix DMA8 [O_3] was 10-30 ppbv.

Our studies demonstrate that, reducing the SCAEs can decrease the DMA8 [O_3] exceedance days or locations in Phoenix. From pollution control point of view, our simulations indicate that reducing the emissions emitted in Phoenix is the key to attain the standard. With favorable synoptic wind fields, emissions from southern California affect ground-level [O_3] in the Phoenix metropolitan area significantly. Therefore, the results indicate that Phoenix would benefit from regional emission controls to reach federal attainment status.

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MacNeille, B.** ***Microbial air pollution control: Exploring Phoenix's urban phyllosphere.

Urban areas worldwide are experiencing an influx of human population resulting in multi-scalar environmental changes, including diminished air quality. Motor vehicle transportation is a major contributor to air pollution in the fine particle (PM 2.5) range, which is associated with adverse health effects and mortality. One strategy employed by the City of Phoenix to improve air quality is planting trees near roadsides, which intercept and trap air pollutants. Less studied are the microbial colonizers on the surfaces of plant tissues (i.e., the phyllosphere). The microorganisms inhabiting the phyllosphere may play an important role in urban biogeochemical cycling, but not enough is known about their function and composition in cities to account for their ability mitigate air pollution.

The objective of this project is to: 1) characterize the composition and biogeochemical function of microbial communities inhabiting the urban phyllosphere of city trees in Phoenix; 2) evaluate community variation due to differences in local air quality and host tree species. I use molecular techniques to quantify the density, community composition, and prevalence of select functional genes within microbial communities inhabiting leaf surfaces in tandem with digital photography of sampled trees to estimate total leaf area. Together, these techniques provide estimates of the microbial phyllospheric function of each tree's canopy. My ultimate goals are to create ecological knowledge about this “new” urban environment and to inform strategic tree planting and management of the Phoenix urban forest.

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Marcotte, A. R., J. Eagar, D. Napolitano, and P. Herckes.** ***Chemical characterization of time resolved haboob samples from Phoenix, AZ.

During the summer months in Arizona, very intense dust storms, or haboobs, can occur. These dust storms can last from minutes to hours and can alter the aerosol content greatly on short time scales. Monsoon-like storms sometimes follow haboobs, which can scavenge the aerosol particles that were brought in by the dust storm. Understanding haboobs is of great importance in the Phoenix area as they can increase particulate matter (PM) and bring an influx of PM material from other locations. Deposition of PM may alter soil and water chemistry in the affected areas. This study aims to characterize trace metals and inorganic ions in time resolved haboob PM to examine the effect on air quality in the Phoenix area. During the summer of 2013 and 2014, background urban PM samples and the PM of haboob events ($PM_{2.5}$ and $PM_{>2.5}$) were collected on the Arizona State University Tempe campus. Samples were collected before, during, and after haboobs to determine the time resolved effect of haboobs on PM in the Phoenix area. Samples were analyzed for trace metals by inductively coupled plasma mass spectrometry (ICP-MS), soluble iron content by a ferrozine/UV-Vis method, and major inorganic species by ion chromatography (IC). Changes in composition with a focus on differences and communalities between haboob and non-haboob aerosols will be discussed. The duration of a haboob's effect on ambient PM concentrations will also be examined. A more complete understanding of the effect of haboobs on the Phoenix area could be helpful in making health recommendations for residents during the summer months.

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McAtee, H., H. Vins, J. Maupin, A. Wutich, A. Brewis, R. Stotts, M. Beresford, and C. Roberts.** ***The Science of Water Art: Children's perspectives on water and the environment in Guatemala.

Children's drawings are increasingly being used to assess understanding and diagnose misconceptions about water issues and the environment. As part of Arizona State University's Global Ethnohydrology Study and Community Health and Medical Anthropology Field School, 315 pieces of artwork from 158 Guatemalan schoolchildren, ages 9-10, were collected using ethnographic field methods. The children were asked to draw two pieces of art: one showing how they saw water being used in their neighborhood today and one showing how they imagined water would be used in their neighborhood 100 years from now. Using content analysis, the drawings were coded for the presence of vegetation, scarcity, pollution, commercial sources, existing technology, technological innovation, domestic use, and natural sources of water. The study finds that (1) boys are significantly more likely than girls to draw more negative depictions of water (i.e., pollution and scarcity), and (2) boys are significantly more likely than girls to depict the natural world (i.e., vegetation and natural sources of water). Additionally, (1) students' drawings of the future contain significantly more pollution and scarcity than those in the present, and (2) both boys and girls depict existing technology significantly more often in the drawings of today than the drawings of the future. Through examining gendered perceptions and future expectations of climate change and water issues, this study explores possible areas of intervention in environmental education in a developing country.

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Middel, A.[1], N. J. Selover[2], N. Chhetri[3], B. Hagen[2], B. Mackowski[1], and C. J. Sisodiya[1]. ***Microclimate effects of photovoltaic canopies: Ongoing research projects.***

We present ongoing projects that quantify the impact of photovoltaic canopies on microclimate and thermal comfort through observations and surveys. 18 shielded sensors were installed on Lot 59, at the Memorial Union, and near the Gammage Auditorium to continuously monitor temperature and humidity at 5-minute intervals for a full year. At each site, two sensors were mounted underneath the canopy structure; four sensors were deployed nearby in sun-exposed locations and under trees. The sensors provide data for three research studies. The first study investigates diurnal thermal comfort benefits of shade at the Memorial Union during pre-monsoon summer. A field study was conducted in mid-June 2014 to observe hourly radiant heat measures, solar radiation, and surface temperatures underneath the stationary sensors. Comfort indices were calculated to compare pedestrian comfort in shaded and sun-exposed locations. Pedestrians were surveyed about their thermal sensation to statistically link the calculated indices to perceived comfort. This study will give insight into the personal, environmental, and psychological factors driving thermal comfort. The second study examines the rate at which interiors of vehicles heat up during simulated 1-hour summertime shopping trips when parked in the sun and in the shade of photovoltaic canopies on Lot 59. This study highlights the importance of covered parking for the thermal comfort of drivers and to reduce A/C loads. The third study is a seasonal assessment of comfort, microclimate, and the urban heat island, comparing each study site, shaded and sun-exposed locations, for different times of day throughout the year.

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Minn, M.[1], J. A. Greenberg[2], N. Pavlovic[2], J. M. Fratirrigo[1], V. K. Turner[3], and B. B. Cutts[1]. *Detection of foreclosure-related landscape management changes using Landsat.*

This report presents the results of research into the use of Landsat Normalized Difference Vegetation Index (NDVI) data to detect event-driven changes in urban landscape management at the parcel level. By comparing parcel-level estimates of NDVI with tract-level NDVI norms before and after foreclosure auctions, we demonstrate the potential for using this methodology to detect the possibility of vacancy and/or foreclosure-related changes in yard management. For this phase of the project we have focused on Maricopa County (Phoenix) Arizona, which has a arid climate that presents both advantages and challenges for remotely-sensed landscape management change detection. This work will contribute to a broader project looking at the direct environmental effects of foreclosure as well as the ways in which changes in yard management practices differ across space as they are mediated by individual idiosyncrasies as well as complex social norms encoded in formal and informal institutions.

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Montgomery, B. J.[1], L. L. Salaki[2], and H. L. Bateman[3]. *Wildlife strikes at airports: What are the contributing factors?

In the U.S., less than 20 percent of wildlife strikes are reported, which leaves a large portion of incidents unaccounted for. Although wildlife strikes at airports often go unreported, since the early 1990s the number of wildlife strikes has increased 5-fold and the number of damaging strikes has increased 1.5-fold. Goals for this project include determining if biological and landscape variables are good predictors of wildlife strikes. We define the response variable as number of reported wildlife strikes per 10,000 airport operations. We studied 30 large airports in the western U.S. and 7 major airports around Phoenix, Arizona. In Phoenix, airports varied from having 1.28 strikes per year per 10,000 operations to having 57.81 strikes from 2009 to 2013. We determined bird richness by using the citizen-science database "eBird," and measured species richness within a 15 kilometer area of each airport. Bird richness at hotspots ranged from 131 to 320 species. Seasonal differences were determined using a chi-square analysis for the 7 Phoenix metropolitan airports as well as the 30 western U.S. airports. Our results showed that there is a seasonal difference in wildlife strikes in the majority of our airports. We will also use land-use data from CAP LTER to determine any environmental factors such as vicinity to water, tree cover, or flyways located within 5 kilometers from airports using ArcGIS. These results are important because they are helpful in determining the factors influencing wildlife strikes based on the number of strikes reported.

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Munoz Encinas, M.[1], E. R. Kuras[2], D. M. Hondula[3,4], S. Betzel[5], C. Dastan[5], J. Eneboe[4], M. Kaml[5], L. Rohan-Kohl[5], M. Sevig[5], M. Singh[5], B. Ruddell[1,6], and S. L. Harlan[5]. *Individually experienced temperatures and sense of place: An exploration of the social construct and its relation to personal heat exposure.

Sense of Place, a multidimensional construct of emotional and cultural attachment to a specific geographical location, can highly influence people's behaviors and attitudes regarding the activities they carry out day by day. These activities determine time spent outside and affect personal exposure to heat, an excess of which can have adverse effects on health. The level of Sense of Place and the extent to which it influences Individually Experienced Temperatures (IETs) was studied in two neighborhoods in the Phoenix Metropolitan area; Thunderhill, an Ahwatukee residential community, and Coffelt-Lamoreaux, a public housing project in Central City South. IETs of participants within each neighborhood were recorded via iButton temperature sensors during a one-week period in September 2014. IETs were analyzed and contextualized with qualitative Sense of Place data gathered through surveys and interviews. Residents of Thunderhill presented a high level of Sense of Place, while Coffelt-Lamoreaux residents had very low levels. In terms of temperature, Thunderhill participants had lower average daily and weekly IETs and Coffelt-Lamoreaux participants recorded marginally higher average daily and weekly IETs. Participants from both neighborhoods carried out constant outside activities, though it is the nature of these events that made the difference; leisure vs. necessity. These findings will help us further understand human-environment interactions, as well as social complexity in urban areas.

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Ramos, J.[1], P. Susanto[1], and D. Childers[2]. *The role of macrophytes in the greenhouse gas fluxes from the Tres Rios constructed wetland in Phoenix, AZ.

Macrophytes can increase nutrient retention in wetlands constructed to reduce nutrient pollution and for this reason, *Typha* spp., are frequently planted in constructed wetlands (CW). However, these macrophytes also play a role as a significant pathway of methane (CH_4) and nitrous oxide (N_2O) emissions from wetlands. Their aerenchyma structure, allows them to transport oxygen to their roots, as well as to ventilate gases directly from the roots to the atmosphere. With a new macrophyte-specific gas chamber, we are investigating CH_4 and N_2O fluxes from *Typha* spp. at Tres Rios CW. During July and November of 2014, we collected gas fluxes from two subsites (shoreline and water) at the inlet and outlet transects of the CW. The fluxes were collected at 15-min intervals over a 45-min flux time at two times of day (morning and afternoon) from two *Typha* spp. heights (low and high). Preliminary analysis shows that CH_4 fluxes are not different between, transects, subsites, time, and plant height. However, July CH_4 fluxes are significantly greater from lower parts *Typha* spp. and show an interaction effect between with subsite and transect factors. N_2O fluxes are not different between transect, subsite, and time. In contrast to CH_4, November N_2O fluxes are greater from higher parts of *Typha* spp. and show a significant interaction effect with subsite. As we continue to sample in the upcoming months, we hope to contribute to a more precise and comprehensive quantification of GHG emission from the Tres Rios CW in Phoenix, AZ.

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Rohan-Kohl, L.[1], E. R. Kuras[2], D. M. Hondula[3,4], S. Betzel[1], C. Dastan[1], J. Eneboe[4], M. Kaml[1], M. Munoz[5], M. Sevig[1], M. Singh[1], B. Ruddell[5,6], and S. L. Harlan[1]. *From teaching to trails: Occupation, heat exposure, and leisure time physical activity in Phoenix, Arizona.

Heat is an important part of daily life in the urban area of Phoenix, Arizona; it often causes changes in routines, habits, and activities of valley residents. While it has been shown that workplace heat exposure is a major health concern and that certain occupations require more heat exposure than others, less attention has been paid to Leisure Time Physical Activities (LTPA) as affected by workplace heat exposure. In Phoenix, heat exposure becomes even more important to study in the context of an individual's occupations, and income can be a factor in determining an individual's vulnerability or adaptive capacity to heat exposure. In this paper, we look at the relationship between heat exposure, occupation, income, and LTPA. By measuring individually experienced temperatures (IET) and gathering other qualitative data from participants in 5 Phoenix neighborhoods during a weeklong study, we found that the amount of heat exposure during an individual's workday can be associated with changes in LTPA heat exposure. Income differentials between people and neighborhoods can also be associated with varying heat exposure during LTPA. These results suggest that analyses of heat exposure must be considered in all aspects of an individual's life, including the workplace, the home, and other leisure-related places; heat exposure in all three spaces of an individual's life likely influences the choices made about LTPA. This study contributes to an overall understanding of how occupation affects one's health in relation to IETs and heat exposure. Though a prolonged period of high seasonal temperatures poses significant health risks in Phoenix, the dangers of occupational heat exposure and its relation to indoor/outdoor choices in LTPA are applicable to the summertime heat waves in most climates.

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Rose, C. J.[1], P. Westerhoff[2], and P. Herckes[1]. *Chloroform from swimming pools, a significant source of atmospheric chloroform in Phoenix?

Chloroform (CHCl3) is an important atmospheric pollutant by its direct health effects as well as by its contribution to photochemical smog formation. Chloroform outgassing from swimming pools is not typically considered a source of atmospheric $CHCl_3$ because swimming pools are scarce compared to other sources. However, large urban areas in hot climates such as Phoenix, AZ contain a substantial amount of swimming pools, potentially resulting in significant atmospheric fluxes. In this study, $CHCl_3$ formation potential (FP) from disinfection of swimming pools in Phoenix was investigated through laboratory experiments and annual $CHCl_3$ emission fluxes from swimming pools were estimated based on the experimental data. Swimming pool water and model contaminants were chlorinated in controlled laboratory experiments and $CHCl_3$ production during chlorination was determined using GC-MS following SPME extraction. Upon chlorination, all swimming pool water samples and contaminants produced chloroform. Chlorination of swimming pool water produced 0.005-0.134 mol $CHCl_3$/mol C and 0.004-0.062 mol $CHCl_3$/mol Cl_2 consumed. Chlorination of model contaminants produced 0.004-0.323 mol $CHCl_3$/mol C and 0.001-0.247 mol

$CHCl_3$/mol Cl_2 consumed. These numbers are comparable and indicate that the model contaminants react similarly to swimming pool water during chlorination. The $CHCl_3$ flux from swimming pools in Phoenix was estimated at approximately 3.9-4.3 Gg/yr and was found to be largely dependent on water temperature and wind speed while air temperature had little effect. This preliminary estimate is orders of magnitude larger than previous estimates of anthropogenic emissions in Phoenix suggesting that swimming pools might be a significant source of atmospheric $CHCl_3$ locally.

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Sampson, D. A., R. Quay, and D. D. White. ***A browser interface to WaterSim 5.0.***

The Decision Center for a Desert City has, since shortly after its inception, been developing a water policy and management model termed WaterSim. WaterSim is a water supply and demand model that simulates the spatial and temporal implications of climate change, water policy, and population growth on the water balance in the Phoenix Metropolitan Area. We developed WaterSim 5 to be used by researchers, educators, and water management stakeholders. Last year, at the 16th Annual All Scientist Meeting, we presented a prototype of a user interface to WaterSim 5.0. In this contribution we showcase our browser-based dynamic, adaptive interface to the model. This user interface can be used across multiple platforms (and multiple settings) that include tablets (e.g., iPad, Windows Surface, and Android devices), desk top computers, and use within the Decision Theater (an interactive immersive environment with computational resources built using state-of-the-art graphics technologies and a 260-degree, faceted seven screen layout to display panoramic computer graphics accommodating 25 people in a theater or discussion setting). Researchers are now able to use the analytics within the WaterSim UI for decision making research on, for example: 1) how cognition of information using different visualizations impacts policy choices, and 2) the framing of water issues based on policy choices under different climatic conditions.

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Sampson, M. E.[1], L. D. Pollard[1], M. M. Palta[1], N. B. Grimm[1], and R. L. Hale[2].** ***How soil may be controlling our air: A look at greenhouse gas emissions from an urban landscape.

Carbon dioxide, methane, and nitrous oxide (CO_2, CH_4, N_2O) are the most influential greenhouse gases (GHGs). Urban systems are potential hot spots for the production of these GHGs. Previous studies have examined the emissions of N_2O, CH_4, and CO_2 from mostly terrestrial habitats, as well as the role of periodic flooding on N_2O emissions in Phoenix, AZ. However, these studies did not examine the atmospheric emissions from both terrestrial and aquatic habitats in an urban area. The purpose of this study was to examine GHG emissions from a large range of habitat types found in the Phoenix metropolitan area to better understand if land use, season, or episodic flooding events in an urban landscape creates hot spots or hot moments of trace-gas emission. We also asked how these emissions may be controlled by differing soil conditions. We measured trace-gas emissions and soil characteristics in summer and fall 2013 from 14 different habitat types. We used chambers to measure emissions and collected soil samples to measure moisture, texture, and NO_3^- and NH_4^+ content of soils. While many habitat types had GHG emissions close to zero, soil wetlands had positive CO_2 and CH_4 fluxes except under wetted conditions. Xeric washes had

increased CO_2 and N_2O emissions in fall and summer after wetting treatments, whereas irrigated lawns switched from consuming CH_4 to producing CH_4 in experimentally wetted chambers over the designated 30 minutes. Patterns suggest that emissions may depend more on soil characteristics than habitat designations (i.e., human land use).

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Shaw, J., S. J. Hall, and J. Learned.** ***Patterns of surface rock cover and implications for plant, water, and nutrient dynamics at long-term ecological research sites in Phoenix, AZ.

Water and nutrient availability are the main drivers of net primary productivity (NPP) in arid ecosystems. Plant sensitivity to the primary limiting nutrient, nitrogen, varies depending on water availability. Therefore, factors that influence water availability would be expected to have an impact on NPP. Surface rocks have been shown to affect both infiltration and evaporation of water in soils, affecting water available to plants. Surface rock cover may also affect the abundance and distribution of arid land herbaceous plants by creating microclimates conducive to plant growth. However, the direct relationship between rock cover and aboveground net primary productivity (ANPP), a proxy for NPP, is not well understood. In this study, we aim to gain insight into the relationship between rock cover, ANPP, and soil nutrient availability. We are conducting a rock cover survey at the CAP LTER CNdep sites and using 4 years of data from annual plant biomass surveys to determine if there is a relationship between peak plant biomass and surface rock cover. Preliminary results from a subset of 10 of the rock cover survey sites do not show a significant relationship between biomass and any class of surface rock, which may be because the potential influence of precipitation was not considered in the initial analysis. Therefore, we plan to take precipitation into account once the survey is complete to provide clearer insight into the implications of surface rock patterns on ANPP.

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Singh M.[1], E. R. Kuras[2], D. M. Hondula[3,4], S. Betzel[1], C. Dastan[1], J. Eneboe[4], M. Kaml[1], M. Munoz[5], L. Rohan-Kohl[1], M. Sevig[1], B. Ruddell[5,6], and S. L. Harlan[1].** ***Individually experienced temperature,what it means in the greater Phoenix area.

Climate change and urbanization are affecting more and more people every day. In order to understand which individuals are most at risk of generating heat related illnesses and matters of prevention we need to understand how heat affects people, and if it does affect people differently requiring a more specialized approach. The severity of the effect of climate on health varies on many different levels from individual to community. A study was conducted to observe this variance and understand how people experience heat or temperature and whether it has this homogenous effect on a population. The study explored different factors that could be a cause for this variability from physiology and demographics to the built environment. Five different neighborhoods in the Phoenix area were used: Coffelt, Garfield, Thunderhill, Encanto-Palmcroft, and Power Ranch. The way the study was executed was by recruiting participants and having them complete a consent form and background survey, after that participants were given a sensor (ibutton) to wear for a week that recorded the air temperature that they were experiencing. In the end, eighty participants were recruited overall. From the data, a multivariate regression model was created to see if the individually experienced temperature (IET) of heat of an individual could be predicted from different factors such as age, race, gender, neighborhood residence, and

others that will be discussed further in the poster. Once the regression model is created an analysis of that model and what it tells us will be discussed in greater extent.

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Sokolowski, M., and P. Fox. *Factors controlling invasive mussel distribution in Arizona.

Dreissena bugensis, known commonly as the Quagga mussel, are an invasive mollusk species that was introduced to North America from its native Ukraine in 1989 by way of Lake Erie. Since then, the species has spread throughout the great lakes and in 2007 was first found in Lake Mead. The Quagga mussel continue to spread in the Colorado River basin and can now be found in the Central Arizona Project (CAP) canal system. The mussels are extremely disruptive to the natural ecology of North American freshwater ecosystems. Each individual organism can filter up to a liter of water per day and remove essential phytoplankton, zooplankton, and algae that makes up the base of the food chain in a body of freshwater. Additionally, the mussels also pose a threat to human water use by attaching to and damaging water intake valves at power and water treatment plants. They can also hurt the recreation industry by damaging boats, buoys, docks, and beaches. *Dreissena bugensis* larvae, known as veligers, have been found in Salt River Project canals as well as the CAP canals, yet for a currently unknown reason have not been able to establish adult colonies. This research focuses on identifying the factors that are preventing *Dreissena bugensis* from establishing in new water bodies which can potentially be used to control and stop the spread of the invasive species in North America. Experimentation is beginning in January 2015, and will test chemical parameters including conductivity and nitrogen, as well as microbial activity.

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Song, J.[1], Z. H. Wang[1], E. R. Vivoni[1,2], G. Marscaro[1], B. L. Ruddell[3]. *Investigating the impacts of urbanization on regional hydrometeorology by coupling an urban canopy model into a distributed hydrological model.

Rapid urbanization, associated with significant land-use, land-cover changes, will influence the hydrological responses in local and watershed scales. To investigate the impacts of urbanization on hydrometeorology, we coupled an urban canopy model (UCM) into a distributed hydrological model, viz. the TIN-based real-time integrated basin simulator (tRIBS). In the coupled tRIBS-UCM framework, a watershed is covered by a TIN network. Since the energy and water transport mechanisms in urban area and natural area are significantly different, each gridcell in the TIN network is divided into urban and natural parts. Surface hydrological processes in the urban part are parameterized by the UCM, while the natural ones are simulated by the tRIBS. The generated energy flux and runoff of each gridcell will be integrated to total energy and water balance in a watershed scale through the tRIBS platform. The new tRIBS-UCM framework will be first tested at point scale using measurements of the CAP flux tower at west Phoenix, AZ. Through the coupled tRIBS-UCM framework, representation of hydrometeorological responses of land surface, particularly those in a built environment, will be more realistic, and the impacts of urbanization on

regional hydrometeorology can be better assessed. The expected results will provide stakeholders more accurate hydrometeorological forecast and flood control, as well as better guidance on land management and ecohydrological services.

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Song, Y., and K. Gurney.** ***Spatiotemporal variations of on-road CO_2 emissions for Maricopa County, Arizona.

Quantification of the spatial and temporal characteristics of atmospheric CO_2 flux is a difficult yet essential component of carbon cycle research. The significance of fossil fuel carbon emissions in carbon budget/inversion studies stimulates the need for precise, complete and robust quantification of fossil fuel CO_2 emissions. Previous research on urban greenhouse gas inventories mostly focused on trend analysis and emissions categorization instead of interactive geospatial analyses and data exploration. In order to utilize atmospheric CO_2 measurements in a complete carbon monitoring system, the emission data product must be constructed with explicit space and time details. This study built a street-level on-road fossil fuel CO_2 emissions data product for Maricopa County with analysis of the spatiotemporal variations in these on-road emissions. Results showed that:

1. Majority of on-road CO_2 emissions in Maricopa County are from interstates I-10 and I-17. State Route 51, 60 and State Highway Loop 101, 202 consist the secondary biggest emissions.
2. Urban road segments inside Loop 101 and 202 generally have higher emissions compared to road segments in suburban/rural area in west Maricopa.
3. The temporal distribution showed that the peak hour of CO_2 emission is from 8 a.m. to 9 a.m. in the morning and 5 p.m. to 6 p.m. in the afternoon, primarily focused in Phoenix, Scottsdale, Mesa and Chandler, which is consistent with 2007 MAG report on freeway congestion.

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Stotts, R.[1], M. Du Bray[1], J. Rice[2], P. Westerhoff[3], A. Wutich[1], and A. Brewis[1].** ***Public perceptions of wastewater treatment and reuse in Phoenix, AZ: Results of the global ethnohydrology study.

Treated wastewater represents an under-utilized resource that may alleviate concerns about water scarcity. While technological advances have made water recycling a viable option, public perceptions and acceptance of treated wastewater reuse have slowed the implementation of such projects. Understanding the general population's knowledge and perceptions of wastewater treatment may help to develop tools to sway opinions about treated wastewater re-use and help restructure wastewater use to ameliorate water scarcity concerns. With this goal in mind, the 2013 Global Ethnohydrology Study undertook ethnographic methods to explore the general knowledge of wastewater treatment and perceptions of its potential reuse by Phoenix residents. Using visual content analysis, we examine levels of understanding of wastewater treatment and reuse and compare this to assessments of disgust, risk perceptions, and the specific use intended. Our goal is to contribute to the literature on sustainable water resource management, focusing on overcoming social hindrances toward reclamation of treated wastewater for the potable water supply.

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Stutz, J. C., and H. L. Bateman. ***Living in the city: Arbuscular mycorrhizal fungi in Phoenix and the surrounding desert***.

We examined the impact of urbanization on arbuscular mycorrhizal fungal (AMF) communities to determine which habitat factors predict AMF occurrence and abundance. Arbuscular mycorrhizal fungal communities were characterized at 58 sites that were part of the Survey 200 project in urbanized/suburbanized areas of the Phoenix metropolitan area and in the surrounding Sonoran Desert. Urban/suburban sites differed in their land use history (developed directly from the desert or from agricultural land) and in time since development (ranging from 100 years to 1 year). When comparisons were made between AMF communities from urban/suburban areas and from the surrounding desert, species richness was significantly lower at urban/suburban sites in comparison to desert sites regardless of land use history. Using regression analysis, we found no significant relationship between species richness and time since development at urban/suburban sites. A total of 26 species were detected in the survey with many occurring at both urban/suburban and desert sites but further analysis found that AMF communities were dissimilar based on composition and abundance. Principle Components Analysis found certain soil and plant factors associated with urban and desert sites. Altered edaphic conditions and habitats associated with urbanization were linked to occurrence and abundance of several AMF species. These species-specific responses to urbanization were linked to increases in soil nutrients and the presence/absence of different types of landscape plants.

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Suchy, A. K[1]., M. M. Palta[2], D. L. Childers[3], and J. C. Stromberg[1].** ***Small- and large-scale drivers of denitrification patterns in "accidental" urban wetlands in Phoenix, Arizona.

Understanding spatial and temporal patterns of microbial conversion of nitrate (NO_3^-) to nitrogen (N) gas (denitrification) is important for predicting permanent losses of reactive N from systems. Much research on denitrification has occurred in non-urban or highly managed urban wetlands. However, in urban landscapes N-rich storm- and wastewater discharges create "accidental" wetlands not designed or managed to reduce N loads. These wetlands can contain novel soils and vegetation, and are subject to unique hydrologic conditions that could create spatial and temporal patterns of denitrification different from those predicted in non-urban counterparts. We measured denitrification potential (DP) on soils taken from nine wetlands forming at storm drain outfalls in Phoenix, AZ. Wetlands ranged from perennially flooded, to intermittently flooded, to ephemerally flooded. To assess spatial variation in denitrification, samples were taken from 3-4 dominant plant patch types within each wetland. To assess temporal variation in DP, samples were taken across three seasons differing in rainfall pattern. We found small- and large-scale spatiotemporal patterns in DP. DP varied among plant patches and was typically highest in patches of *Ludwigia peploides*, suggesting plant species may mediate within-wetland variations in denitrification. Responses in DP ranged among wetlands to season, which appeared to be driven in part by flood regime: DP in perennially-flooded wetlands was largely unchanged across seasons, DP in intermittently-flooded wetlands increased in the summer monsoon and decreased in

winter, and DP in ephemerally-flooded wetlands decreased in response to monsoons. This suggests temporally variable controls on denitrification at the whole-wetland scale.

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***Sullivan, A., and A. York. *The impact of institutional heterogeneity: A mixed methods approach to understanding management outcomes of the invasive mile-a-minute weed (*Mikania micrantha*) in Chitwan, Nepal*.**

Previous research has conveyed the important role that institutional arrangements play in mediating relationships between communities and the environment in social-ecological systems. Chitwan, Nepal is a rapidly urbanizing region adjacent to the internationally important Chitwan National Park. Community forests were formally established in the mid-1990s in order to provide opportunities to collect forest products and timber in forests that were largely self-governed. While the community forestry program in Nepal is considered one of the most successful in the world, a new social and ecological threat looms with the increasing invasion of the mile-a-minute weed, *Mikania micrantha*. Little is known about the impact of differential intuitional arrangements on the management of *Mikania* in community forests in Chitwan. Based on 29 semi-structured interviews conducted with 87 people in June 2014 in five case study community forests in Chitwan, differences in institutional arrangements and *Mikania* management efforts and outcomes are explored. An institutional analysis informs an exploration of differential governance capacity and collective action related to *Mikania* management, while a content analysis provides an understanding of reoccurring themes in the interviews and their implications for future social and ecological outcomes in the community forests. We find the relationship between governance capacity and collective action related to *Mikania* removal is multifaceted, with governance capacity and collective action similar in some forests, but diverging in others. These results have implications for successful efforts to manage the invasive *Mikania* plant, and other invasive plants, in the future.

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Weaver, M., R. A. Ligon, M. Mousel, and K. J. McGraw. *Avian anthrophobia? Behavioral and physiological responses of house finches across urban gradient in predator presence.

Urban environments present animals with many novel experiences, not the least of which is the physical presence or threat of humans. Cities are typically thought to harbor fewer predatory threats to wildlife because many native predators are not found in human-impacted areas. However, most studies on urban predation do not take human presence into account. In this study, we examined behavioral and physiological responses of a species (the house finch *Haemorhous mexicanus*) that is abundant in both natural and urban areas to the presence of humans and a native predator model (a mobile sharp-shinned hawk mount). During two field seasons (summer-fall and winter 2012-13), we captured birds at six sites across an urban gradient in Phoenix, Arizona, and measured breath rate (an indicator of stress) while in the hand. We then tested reactions in captivity to an approaching human and to a hawk flyover. We found that rural birds had lower breath rates while in the hand than urban birds, but that urban birds showed fewer stress-related behaviors (e.g., bill wipes, feather ruffles) than rural birds in response to a human approach. Urban and rural birds did not differ in their behavioral responses to the hawk. Behavioral results were

consistent during both seasons, but breath rate was not, indicating that rural birds vary in physiological responses across seasons. Our results suggest that physiological stress responses do not mirror behavioral ones in this cosmopolitan species and that urban and rural birds cope with human and/or confinement stress in unique ways.

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Yang, J., and Z. H. Wang.** ***Shift of paradigm in urban irrigation: Finding the optimal scheme for building energy efficiency.

Global population has been increasingly urbanized and turns the cities into great consumers of energy. In the United States, around 40% of the total final energy consumption in the cities is in the building sector. To lesson greenhouse gas emissions and to slow down depletion of non-renewable energy resources, recent years have seen a number of studies and initiatives to cut back the building energy consumption. While the objective for agricultural irrigation is focused on the yield of produces, irrigation of urban vegetation apparently needs a new paradigm. In this study, we applied an urban canopy model to assess the impact of various irrigation schemes and their impact on building energy efficiency in Phoenix. Considering the trade-off between water usage and energy consumption, we employed the total cost as the index to evaluate and compare performances of different schemes. Results show that the temperature-control irrigation scheme is the most efficient in saving building energy at the annual scale. Total annual saving depends on the threshold value of temperature beyond which irrigation is activated, and can be up to $2.5 per square meter wall area per year. In addition, the scheme can substantially enhance outdoor thermal comfort of pedestrians during hot summers. This study provides new insights to a potential new norm for urban irrigation using the measure of building energy efficiency in the context of energy-water nexus.

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Yu, R.[1], B. L. Ruddell[1], M. Kang[2], and D. Childers[3]. ***Dynamical sensitivity of terrestrial eco-climate systems to climate forcings: Global eco-climate process network modeling at FLUXNET sites.***

Scientific understanding of the impacts of climate change on the structure and dynamics of ecosystems is still limited by the complexity of matter and energy exchanges between biosphere and atmosphere. Here, we attempt to use a dynamical process network (DPN) approach to model the sensitivity of global ecosystems to climate forcings based on the worldwide FLUXNET datasets. This DPN approach can estimate observed coupled dynamics between functional subsystems at various temporal scales in a nonlinear system. We use net ecosystem exchange of CO_2 (NEE), air temperature, precipitation from eddy covariance measurements and related site description data (plant functional type, latitude, elevation, disturbance, etc.). The MODIS EVI is employed to capture phenological state of ecosystems. The DPN for each eco-climate system is calculated based on 30-minute flux time series data. We focus on two main couplings: from air temperature to NEE and from precipitation to NEE. The eco-climate system sensitivity model of the DPN is then built to examine the relationships between the DPN and climate forcings, phenology, and other environmental factors. A set of site-specific maps on the sensitivity of integrated eco-climate systems to climate forcings at the global scale are produced. This complex systems and functional network approach has the potential to qualitatively anticipate shifts in ecosystem state and

function using generally available timeseries data quantifying climate, phenology, and the fluxes of carbon, water, energy, or nutrients across an ecosystem boundary.

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***Zhao, Q.[1], E. A. Wentz[1], and A. T. Murray[2]. *Tree shade optimization in an urban desert environment*.**

Shade provided by trees, shrubs and other natural vegetation serves as a natural umbrella to mitigate insolation on residential and commercial buildings. In urban deserts strategically located tree shade potentially translates into significant energy and long-term cost savings as well as beneficial to human health and well-being. The goal of this research is to create and implement a methodology to solve true 3D optimization (3DOM) problems by combining remote sensing (RS), geographic information system (GIS), and spatial optimization. We implement 3DOM on a case study to maximize shade coverage on residential structures. We demonstrate and test our new methodology to maximize tree shade on a single-family house in Tempe, AZ, USA. RS serves as data source for building structures; GIS is used to derive coverage on 3D surfaces and provide environment for manipulating 3D objects directly; spatial optimization provided the optimal locations to maximize coverage. We differentiate spatial coverage on a 3D structure by calculating the shadow coverage on different house surfaces including windows and doors, facades and rooftops. Tree shade coverage in a 3D environment will provide more convincing results than in a 2D environment. Results show wisely relocating trees can improve shadow efficiency of a single-family house during summer months. Through this research, the optimal tree location will provide quantitative results to guide landscape design processes for building an ecologically friendly community.

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***Zhao, X., and Z.-H. Wang. *Effect of shade trees on building energy efficiency*.**

Building energy consumption makes up nearly half (47.6%) of the energy produced in the US every year. In cities, building energy consumption is strongly dependent on the ambient temperature, both increasing as a consequence of continuous urban expansion, landscape modification, and projected climate changes. The presence of trees in street canyons, on the other hand, can effectively reduce environmental temperature via shading effect. However, resolving shade trees in current urban land surface models presents a major challenge, especially in predicting the radiative heat exchange in canyons. In this paper, we incorporate shade trees into a single-layer urban canopy model, combining a Monte Carlo algorithm for view factors and the inverse matrix method for infinite radiative reflections among canyon facets. This novel numerical framework is applied to case studies using Phoenix metropolitan as a test bed. Results of simulations reveals that the presence of shade trees in a canopy can markedly affects radiative energy transport and reduce the canyon temperatures. It is also found that the cooling effect by tree shading is more significant than evapotranspiration, leading to considerable saving of building energy for cooling., In the future, the new algorithms will be incorporated into regional models, such as the Weather Research and Forecasting (WRF) model; and its applications will help to

promotes long-term sustainable development in urban ecosystems through environmental cooling and equivalent offset in greenhouse gas emission in built environments.

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