Improving the understanding of land-atmospheric energy and matter exchanges in hot urban systems

Abstract

Urban systems involve the complex interactions of weather conditions with the urban form affecting the transfer of matter and energy between the built environment and the atmosphere. These interactions in cities have an impact on water and energy usage, public health, and the overall quality of life. Due to limited information, however, there is a weak connection between scientific knowledge and actions that can benefit urban stakeholders in responding to extreme climatic events, in managing water and energy resources, and in reducing exposure to harmful pollutants, among others. To address this, we deployed four meteorological flux towers in the Phoenix metropolitan area during summer 2024. Each tower is equipped with an eddy covariance system and focuses on different urban land covers: a golf course, a conserved area with native vegetation, a residential neighborhood, and a parking lot next to a fuel station. Tower measurements of carbon, energy, and water transport were obtained during several heat waves as well as seasonal monsoon storms in the region. Our initial findings indicate that summer conditions at the sites were characterized as carbon sources at three of the four locations, except for the golf course park where irrigated vegetation was a carbon sink. We compared the water, energy and carbon dynamics during heat waves and for average conditions to identify the role of advected energy at each site. We also determined the sensitivity of each location to storm events. Our findings point to the important role of land cover differences across the sites and the need to base equitable mitigation strategies based on the urban characteristics.

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