Spatial Expansion of the Greater Phoenix Urban Heat Island: 1990-2004

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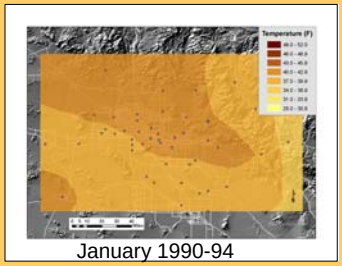
Overview

The urban heat island (UHI) is a well documented phenomenon and can be especially strong in urbanized desert regions such as Phoenix. Recent studies have shown magnitudes greater than 11 degrees Celsius during clear and calm atmospheric conditions. Rapid urbanization in Phoenix away from the core of the city has changed the surface land cover characteristics, expanding the UHI toward previously rural areas, which historically had lower minimum temperatures and larger diurnal temperature ranges. This study illustrates spatial expansion of UHI in the last fifteen years using a dense network of over seventy weather stations and spatial interpolation in GIS. Ordinary Kriging is used to create five-year mean minimum temperature layers (1990-94, 1995-99, 2000-04), which are then overlaid onto a Digital Elevation Model for Phoenix during the respective period. Work in progress involves the creation of an animated time series of temperature change in Phoenix. These maps will illustrate the impact of land cover change and urbanization on the temperature in Greater Phoenix, with the eventual goal of creating evapotranspiration maps to be visualized in 3-D at the Decision Theater. These maps will assist scientists and policy makers to make more informed decisions regarding environmental change, especially ones involved with the Decision Center for a Desert City (DCDC) and CAP LTER. In addition, these maps will aid researchers working to increase the accuracy of meso-scale meteorological models for Greater Phoenix and other rapidly urbanizing desert regions.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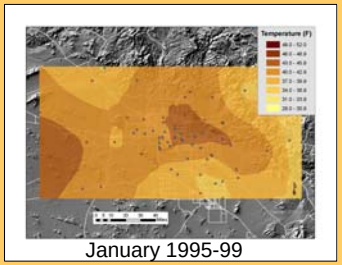
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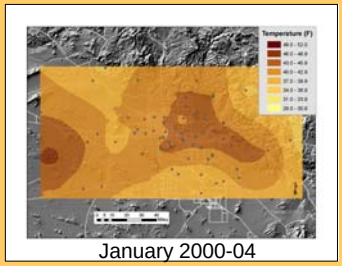
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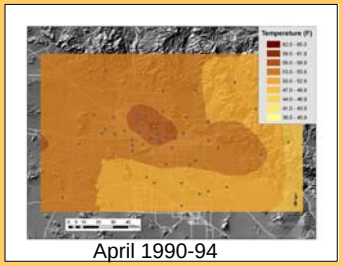
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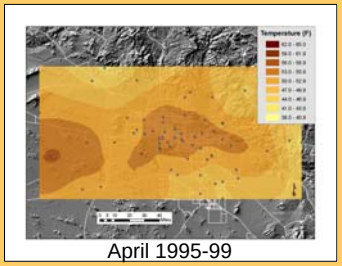
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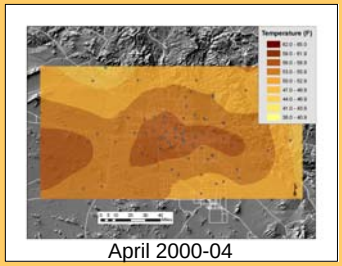
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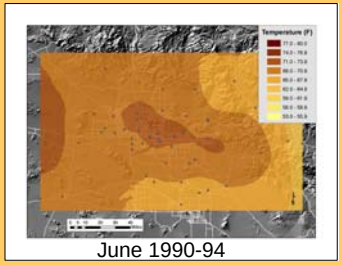
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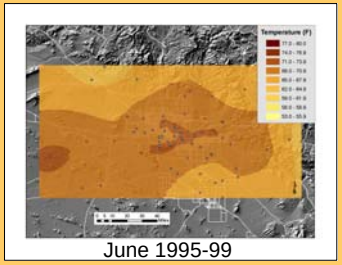
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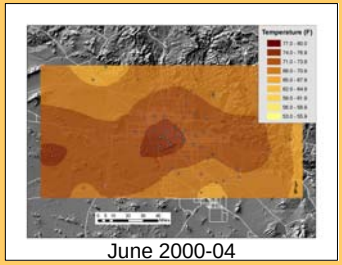
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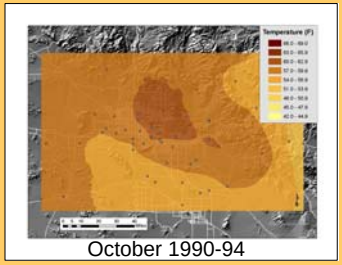
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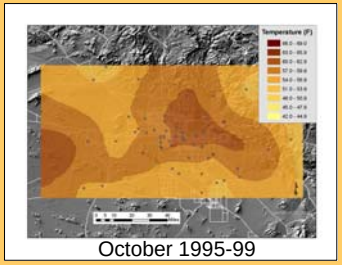
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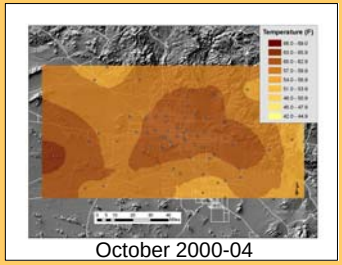
October 2000-04

Methods

Temperature data were collected from several weather station networks: Phoenix Real-Time Instrumentation for Surface Meteorological Studies (PRISMS), Arizona Meteorological Network (AZMET), Maricopa County Flood Control District, and over twenty co-op stations obtained from the National Climatic Data Center (NCDC). Data obtained from these networks were then systematically organized in an SPSS database to create point layers for GIS. Ordinary Kriging was found to be the optimal interpolation technique for this dataset. It was also found that the spherical model within the geostatistical analyst extension in GIS worked best for the dataset, providing the least amount of error. A caveat on the maps – patterns are generalized and are not meant to capture small scale patterns associated with urban canyons, shade, etc.

Work in Progress

Interpolated temperature maps clearly illustrate a spatial expansion of the heat island from left to right in all four seasons. The authors are currently working on creating maximum temperature maps as well as diurnal temperature change maps over the respective time period. Diurnal change maps will clearly define recent change at the urban fringe, which can then be compared with land use maps to determine the impact of rapid urbanization in areas which were formally open desert or agriculture. Time series animations of temperature change and expansion in Phoenix would help to illustrate annual and decadal change and allow the user to control the speed of the animation.

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