REMOTE SENSING AND CLIMATE FROM NORTH TO SOUTH IN CAP LTER

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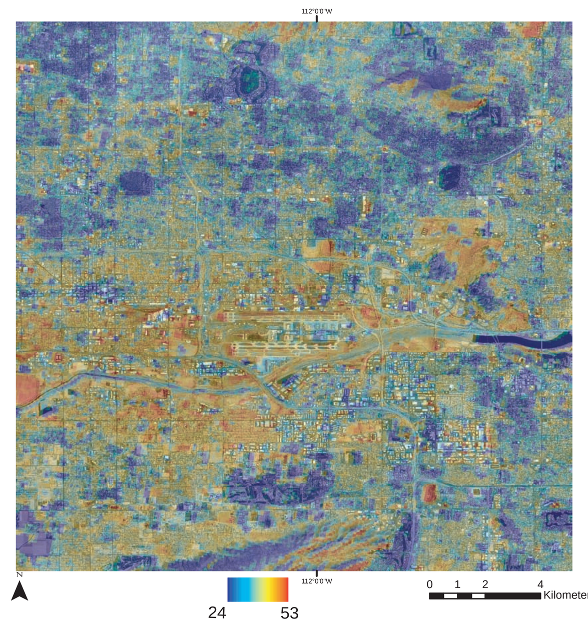
Introduction

This study relates remotely-sensed thermal patterns, vegetation indexes, weather data, and terrain characteristics across a portion of CAP LTER. Only four dates are illustrated but there is a substantial archive of all of these data for further analysis of year-round climo-remote sensing relationships. The implications of utilizing remote sensing are important for the ecology and human quality of life in this desert region. The themal images shown in this study depict a complex relationship between terrain, land cover, and vegetation.

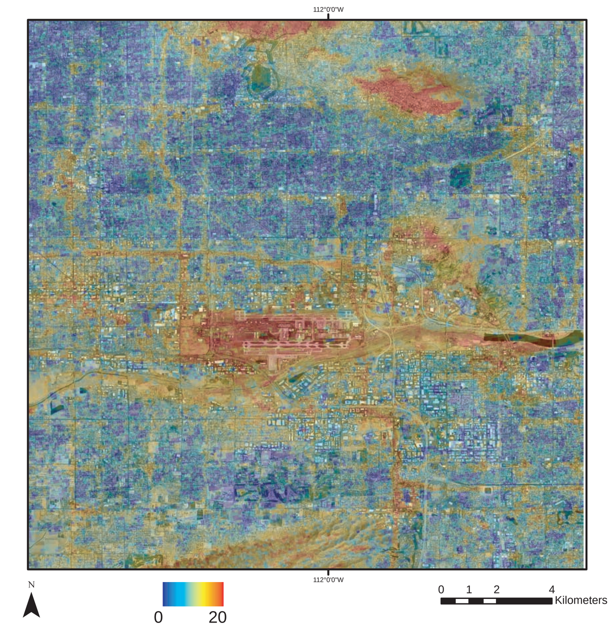
Past research in remote sensing and urban climate linked surface temperature patterns and atmospheric profiles of temperature and also illustrated complexities (Voogt and Oke, 2003). This study does not pretend to solve these problems (e.g. actual surface seen by sensor, thermal anisotropy), but the study does reveal a general terrain and land cover correspondence. The relationship we see is the expected result between near-surface atmospheric conditions and ground surface characteristics.

1. ASTER Thermal Imagery

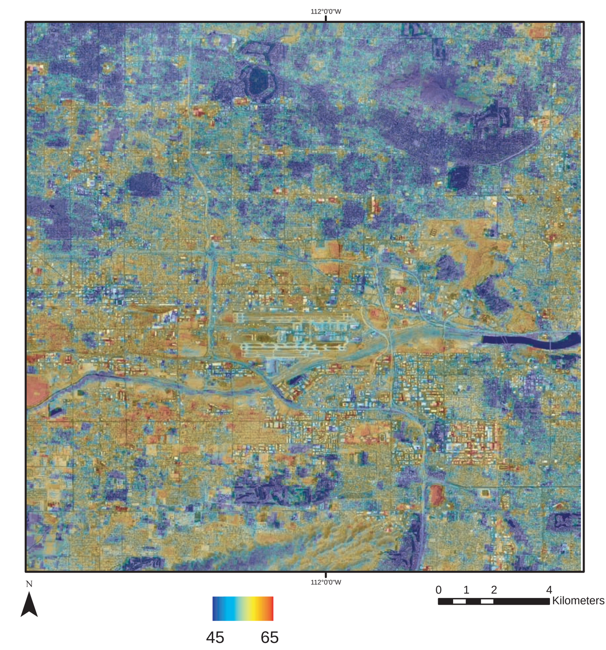
10/7/04 11:20am



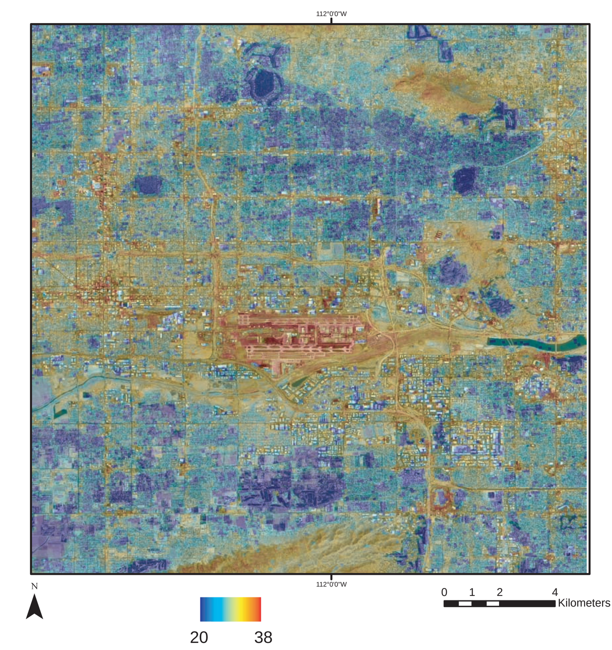
11/21/03 10:30pm



6/17/04 11:20am



6/07/04 10:40pm



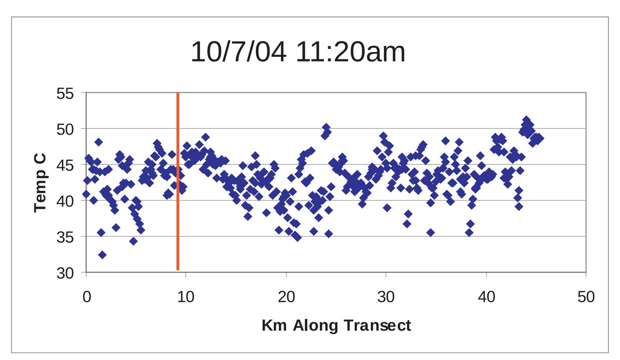
ASTER thermal imagery acquired for the Phoenix area. Both summer and winter, and day and night images are shown. Note temperature ranges for each image in degrees C. Daytime imagery resolution is 15m, nighttime is 90m

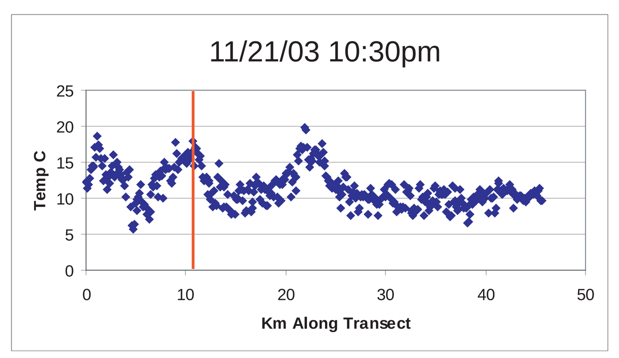
Note urbanized heat island at night, esp. as seen at Sky Harbor airport. Also terrain features on north and south scene edges retain heat at night.

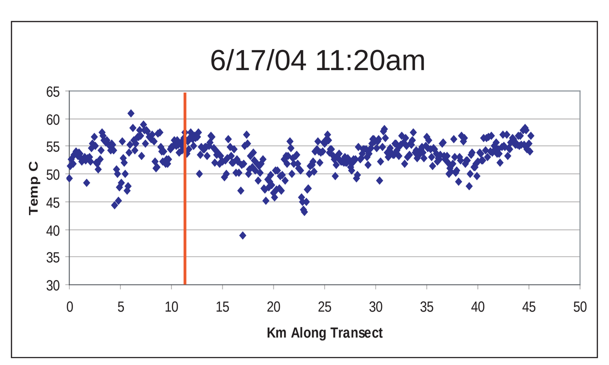
Daytime surface heating is evident, particularly at center of scene.

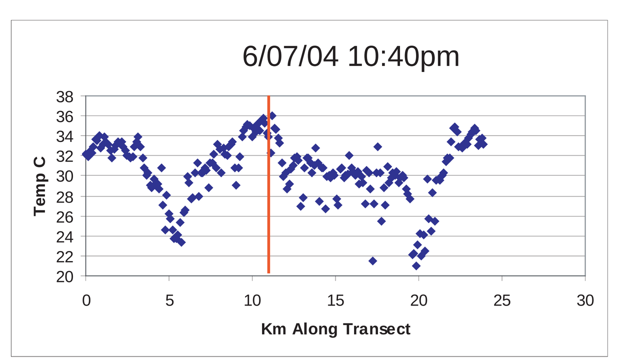
Mitigation strategies for excessive heating (e.g. airport) are part of a City of Phoenix grant and agenda of an ASU-UHI group (http://www.urbanheat.org/).

Temperature Transects

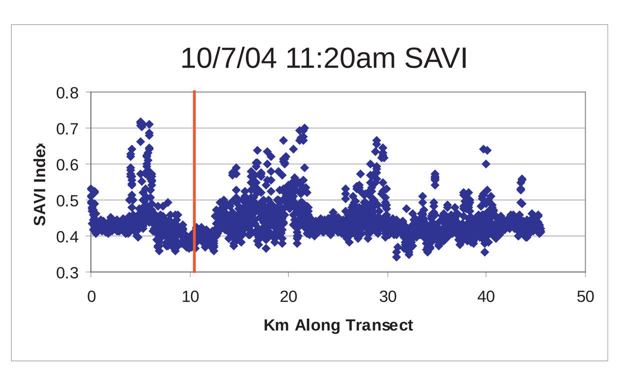


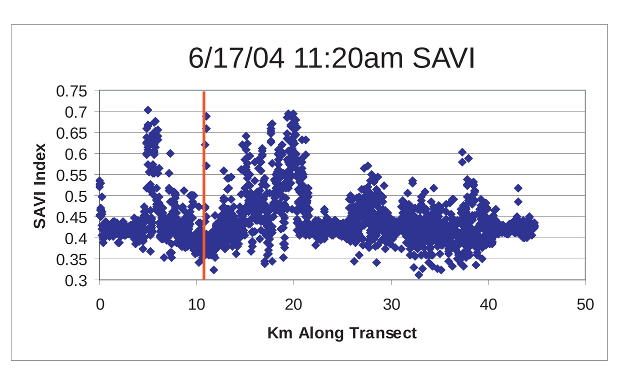






Vegetation Transects





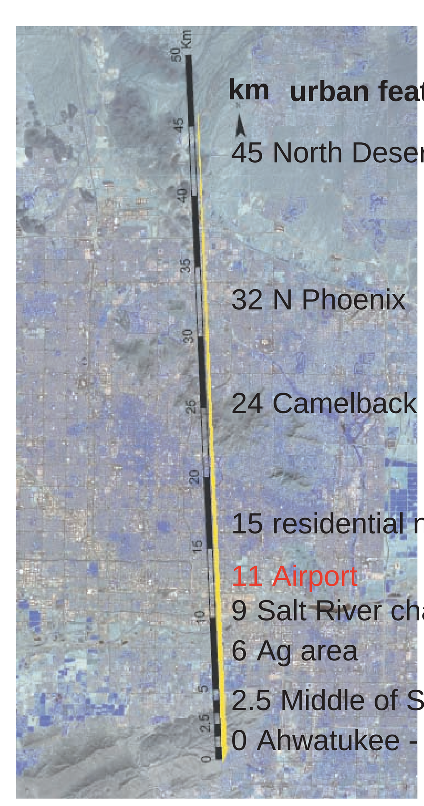
2. North South Transect

Note index image for north-south transect through city below.

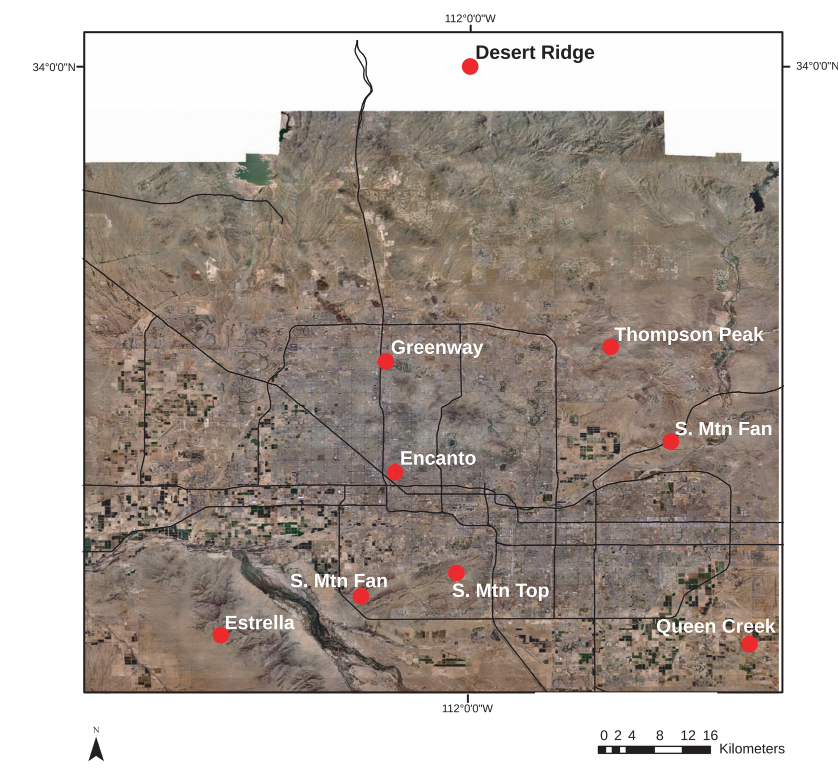
On the left are the same four dates as ASTER scenes showing detailed surface temperature transects.

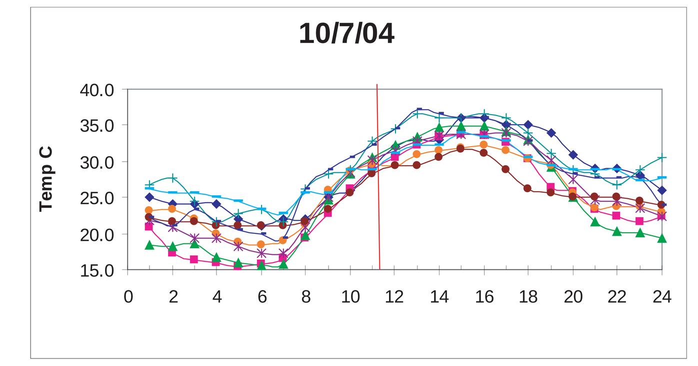
Night transects show the airport region highest terrain to be warmest. Daytime transects also show the air port region to be quite warm.

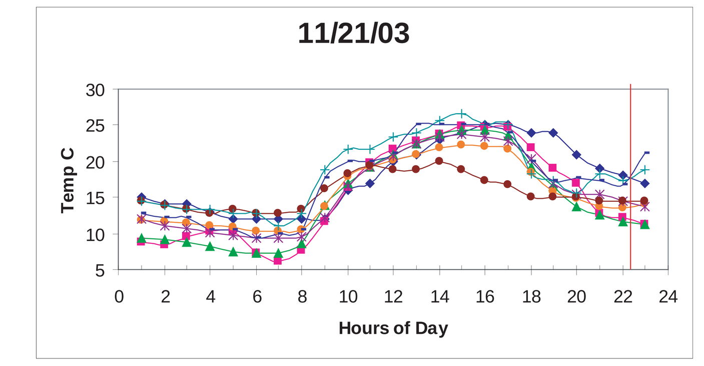
In general, there is a good relationship between SAVI and temperature. Some of the highest SAVI areas relate to the coolest locations

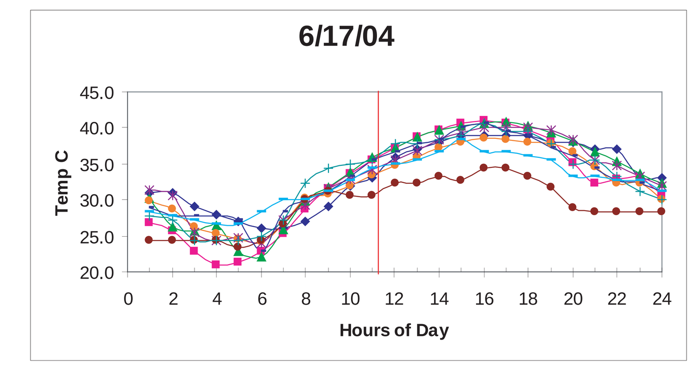


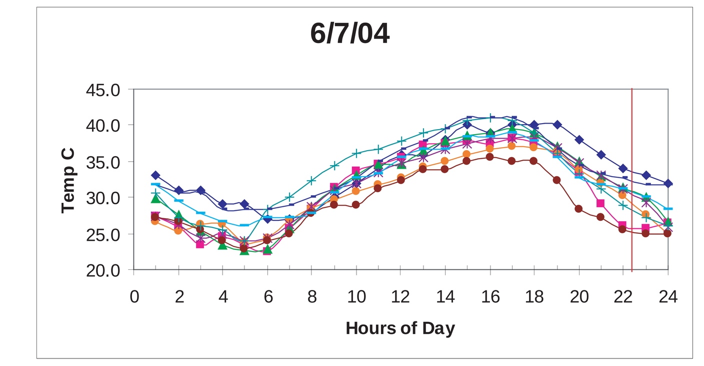
3. Air Temperature in Phoenix on Aster Scene Dates











Weather Stations

- skyharbor (1,104 feet)
- queencr (1,410 feet)
- encanto (1,099 feet)
- desertrid (1,700 feet)
- greenway (1,700 feet)
- thomps (1,700 feet)
- estrella (1,700 feet)
- smtnfan (1,250 feet)
- smtntop (1,250 feet)

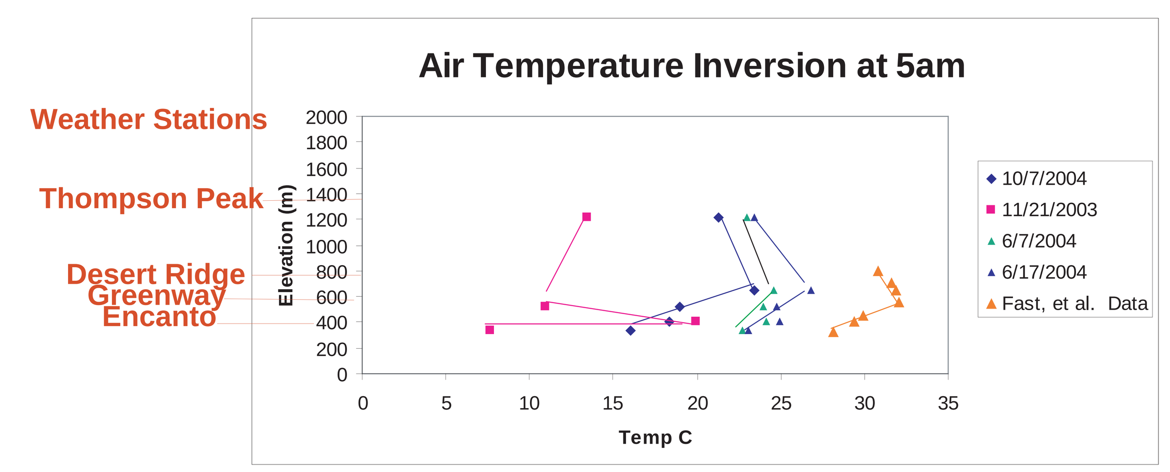
Landiscor 2003 map shows selected hourly weather stations in the region at differing elevations. (note table on right)

Hourly air temperatures are illustrated for all stations for the four ASTER dates
Wind speeds and directions for the four dates are shown for Sky Harbor Airport.
A vertical red line shows the time the ASTER imagery was acquired for the date shown.

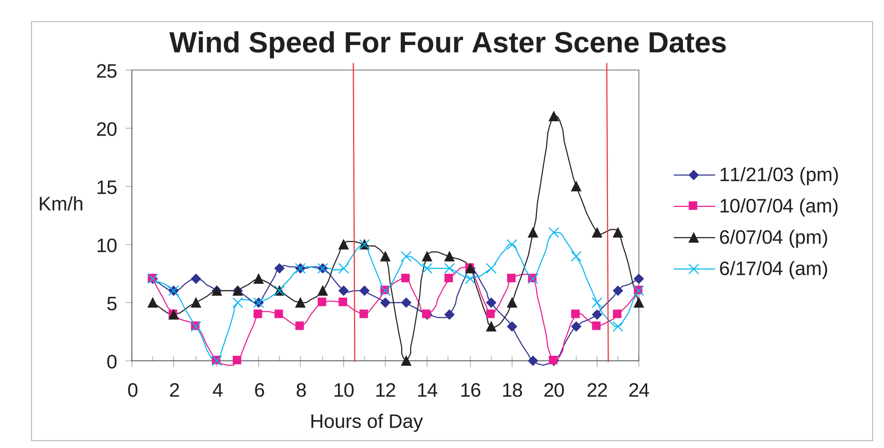
Dates shown experienced relatively low wind speeds, particularly at time of imagery. Diurnal wind direction patterns are very typical for this region

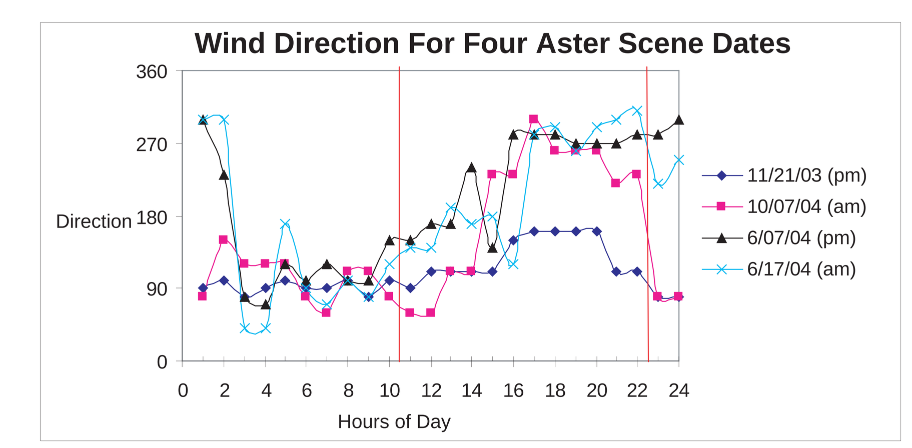
Generally, air temperatures in lower and upper areas of the terrain conform to patterns revealed in the ASTER surface temperature imagery At night, for example, inversions, both summer and winter, are evident. During the day, a cooling with height occurs. (there are notable exceptions due to slope aspect and surface heating)

4a. Elevation Effects



4b. Wind Speeds and Directions on Aster Scene Dates





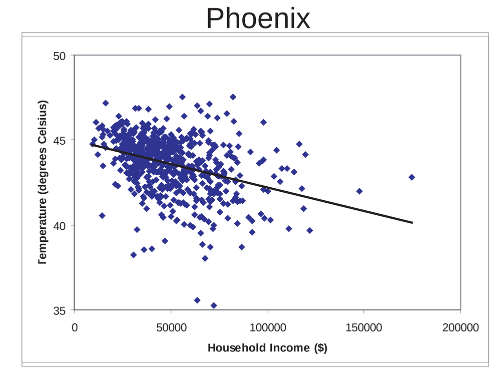
Using five of the weather stations, temperatures are shown for 5am with variation by elevation. Previous research has shown the existence of strong inversions in this region, on a year-round basis (Fast et al., 2005).

The imagery and these data confirm the existence of strong inversions. Warming of local terrain seen in the ASTER imagery and the air temperature data may be a function of thermal inversions and thermal inertia patterns of fans and rock outcrops.

5. Socioeconomic Implications

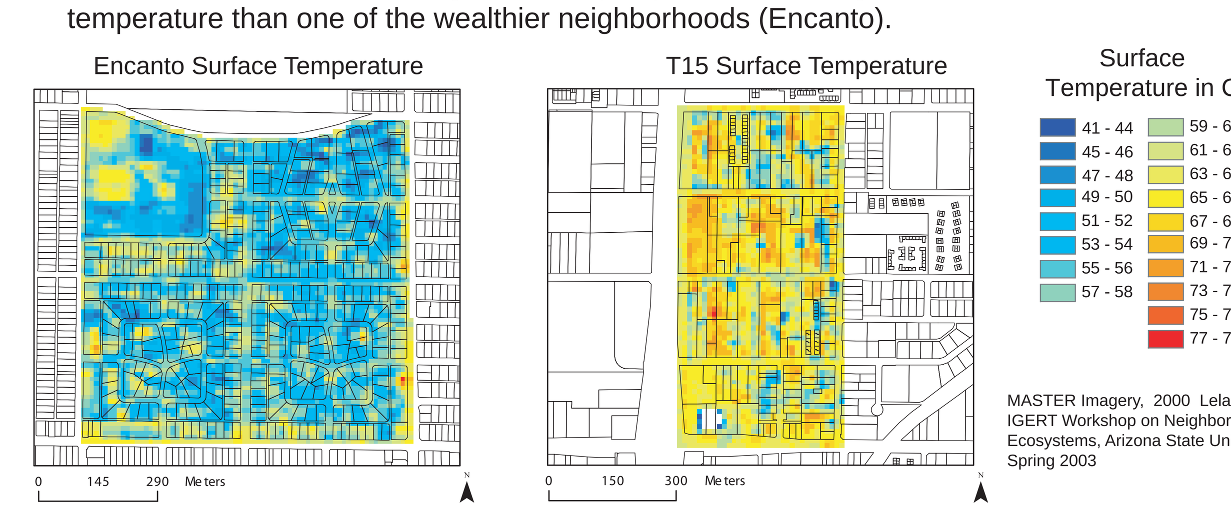
Previous research reveals the importance of remotely-sensed thermal patterns in Phoenix in assessing neighborhood processes, such as human comfort, energy and water use, and genera quality of life (Stefanov et al., 2004) ;(Harlan et al., 2003).

Regional Correlation of Temperature (C) with Median Household Income (Current $) for 652 Census Tracts in Phoenix



Source: U.S. Census and Landsat, 2000.
G. D. Jenerette, A. Brazel, S. Harlan, N. Jones, L. Larsen, W. Stefanov. Regional Relationships Between Social and Bioclimatological Components of an Urban Ecosystem. Arizona State University, manuscript, 2003.

The lowest income PASS neighborhood (T15) has a much higher surface temperature than one of the wealthier neighborhoods (Encanto).



MASTER Imagery, 2000 Lela Prashad, IGERT Workshop on Neighborhood Ecosystems, Arizona State University, Spring 2003

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Fast, J.D., Torcolini, J.C., Redman, R. (2005) Pseudo-vertical temperature profiles and the urban heat island measured by a temperature dataloger network in Phoenix, Journ. of App. Meteo., *in press.*

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Voogt, J. A. and Oke T.R., (1997), Complete urban surface temperatures, Journ. of App. Meteo., 36, 1117-1132.

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