CAPLTER CLIMATE

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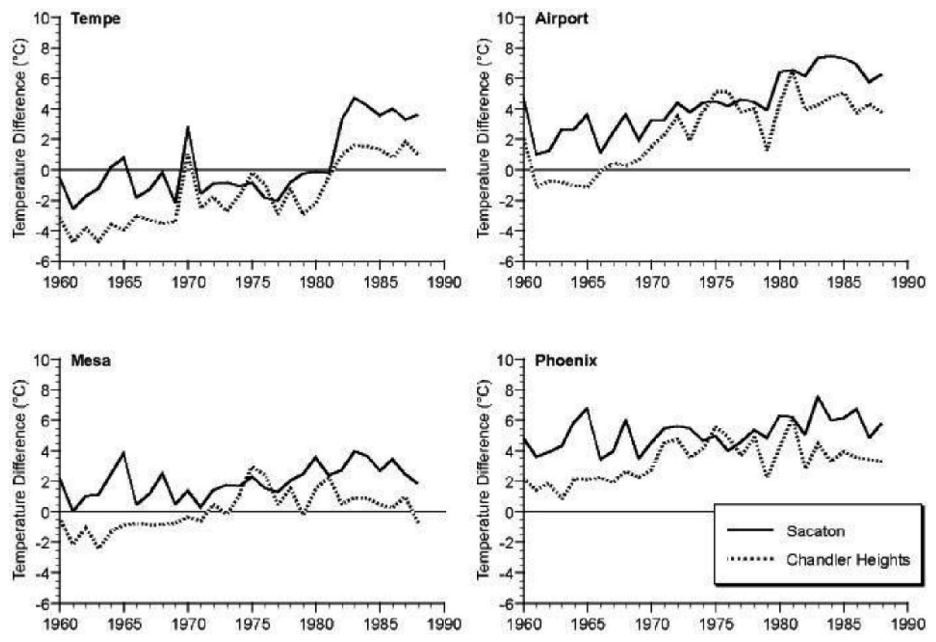
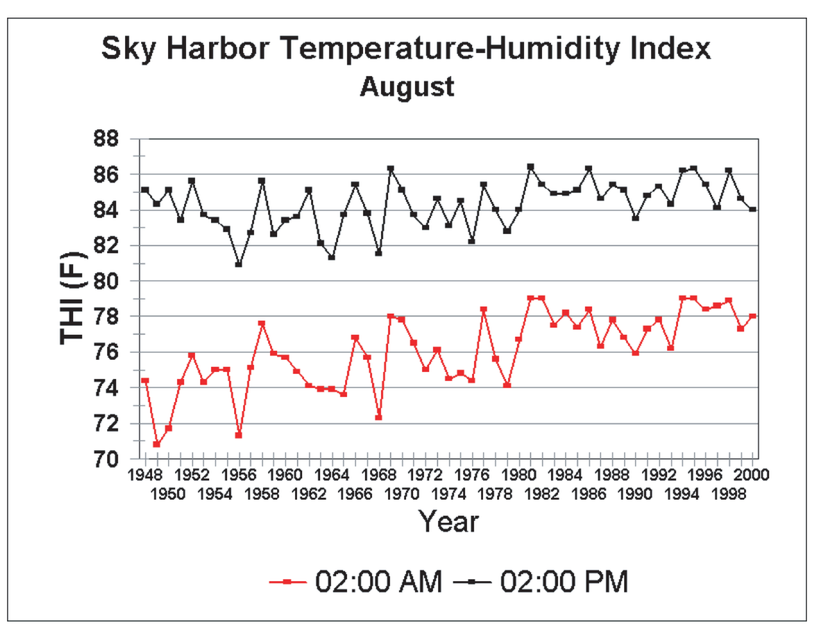
The climate system is an important part of earth's geosystem and is studied at each LTER site. CAPLTER ecosystem components are driven from without by long-term, inter-decadal, and quasi-periodic atmospheric variations. Climate within CAPLTER is not only a function of global/regional forces, but of city population growth and associated aerosol emissions, land cover/land use changes, existence of water across variable terrain in central AZ, and the terrain itself. CAPLTER scientists (in coordination with BES as well) have conducted new climate research through: (a) mobile temperature/humidity transects across urban-rural gradients, (b) urban-rural, long-term weather data comparisons, (c) land cover change detection of the urban fringe with remote sensing, (d) special sites to observe wet/dry deposition, and (e) initiation of new monitoring stations in and out of the city. Future climate-related research is geared toward: (a) micro-meso scale monitoring/modeling of urban climate and ecosystem change and feedbacks, (b) further analyses of historical weather records linking global/regional signals to local change, and (c) development of cross-site (BES) and independent studies on mass, energy, and momentum flux processes in urban and rural areas.

"Urban Heat Island"



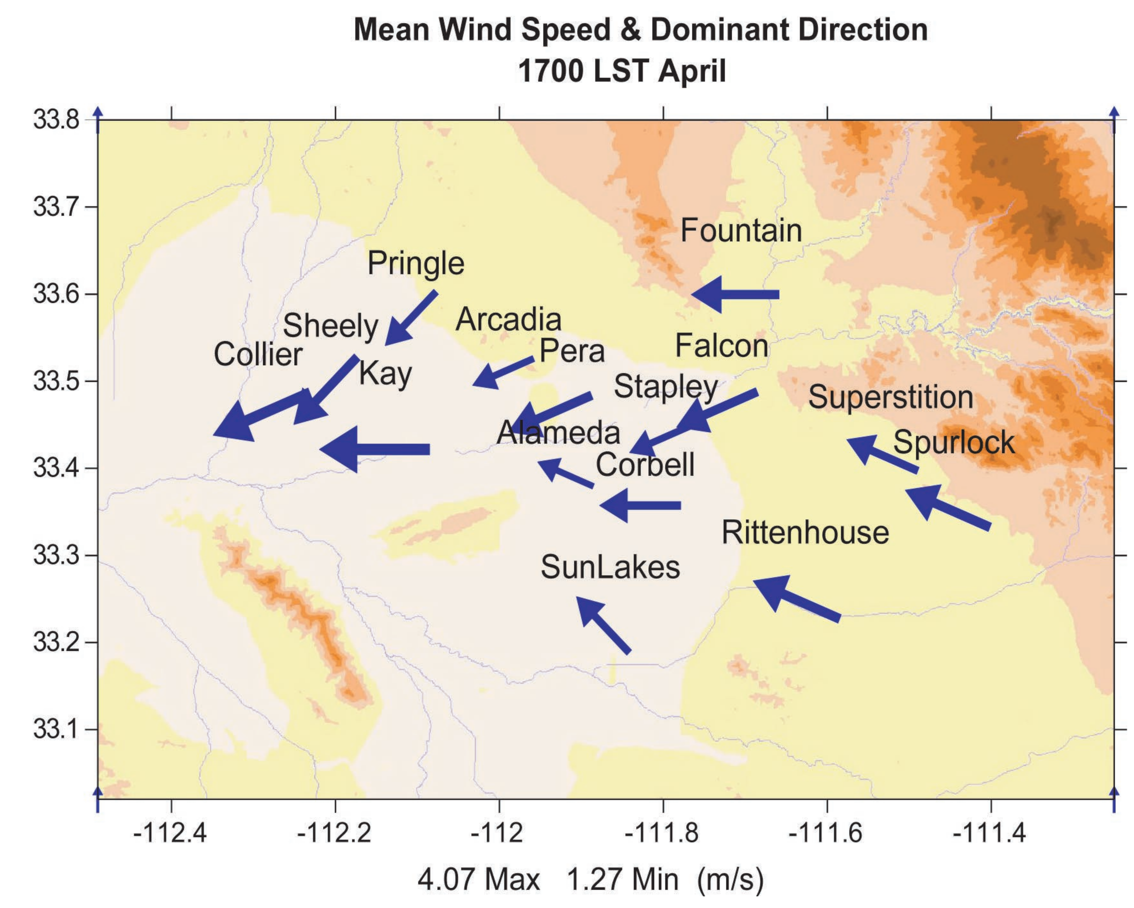
Comparison between rural (Sacaton, Chandler Heights) and urban (Tempe, Airport, Mesa, and Phoenix) sites illustrating increased but moderating temperatures in the city interior.



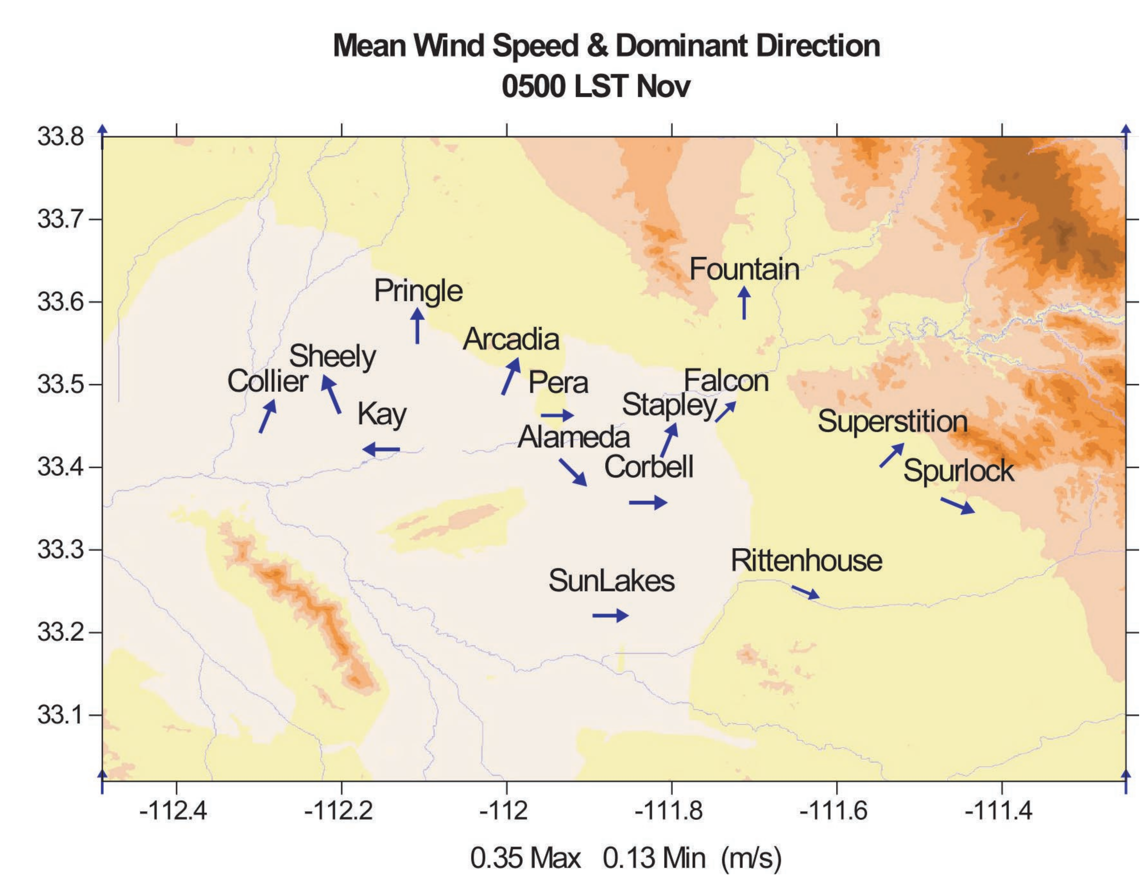
Temperature-Humidity Index at Phoenix Sky Harbor Airport. THI values below 65 are comfortable for most people, while about half the population suffer some discomfort about 75 and most people are uncomfortable above 80.

A significant increase in both afternoon and nighttime discomfort is seen between 1952 and 1982. With the metropolitan area's growth moving to the urban fringe, beginning in the early to mid- 1980's, central Phoenix has experienced a leveling off of both temperature and dew point in August in the afternoon and at night.

Overview: Spatial variation of wind in the region

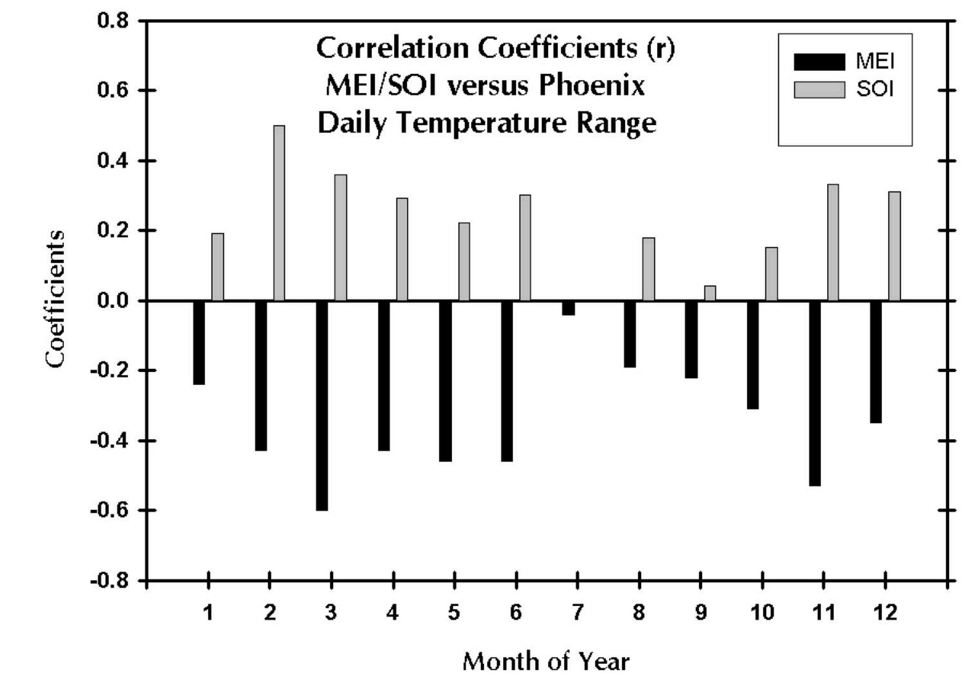


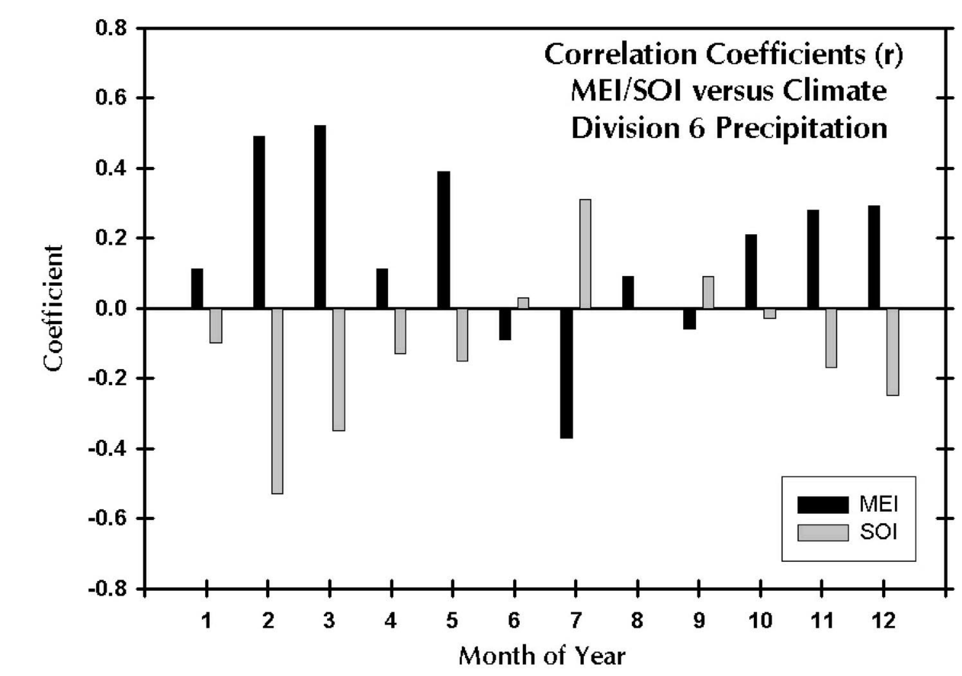
Afternoon easterly winds are not strictly a valley breeze phenomena, but reflect local roughness and topography. April has both the greatest spatial variation in wind speed and the highest mean wind speeds (9.1 mph) across the Phoenix Metropolitan area due to the transition from winter frontal systems to summer convective controls. The lack of a regional wind regime is important when looking at pollution plumes and sources of deposition.

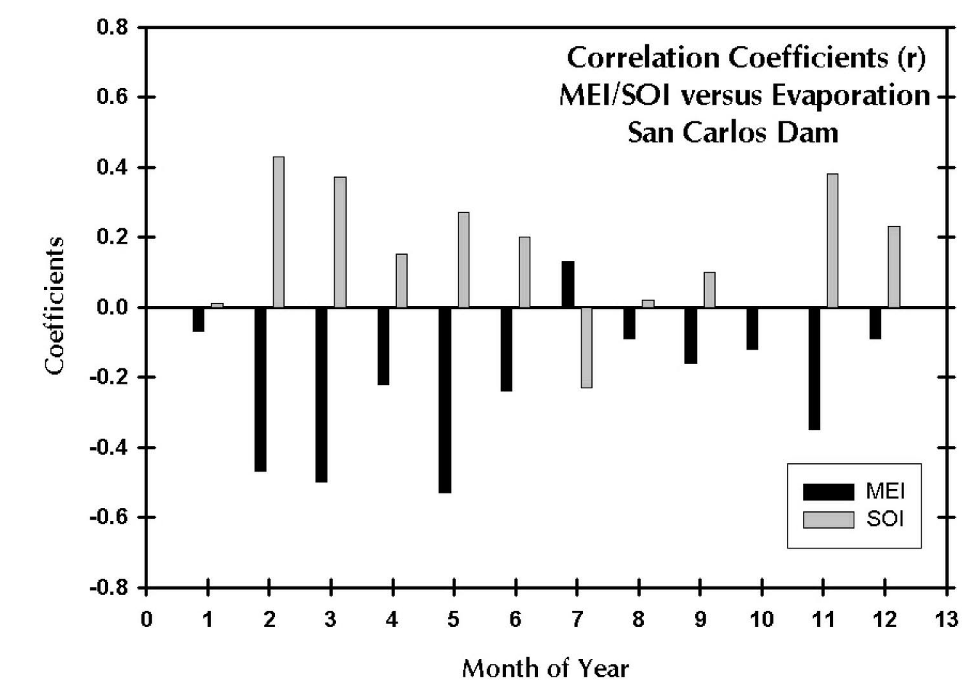


Morning winds in November are light and highly variable, but do reflect a downslope cold air drainage pattern in most locations. In most cases the river channels are a good indication of the downslope flow. Mean wind speeds are less than 1 mph (the lower threshold of measurement), so the wind is actually zero for much of the time. Direction is only measured when wind speeds are measured.

Overview: El Nino/Southern Oscillation drivers on climate





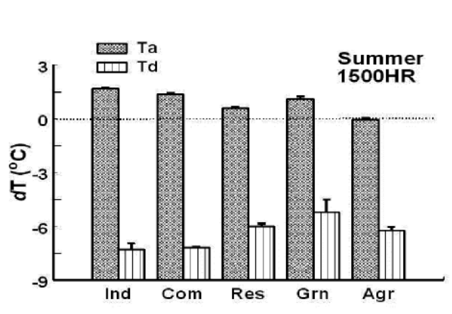


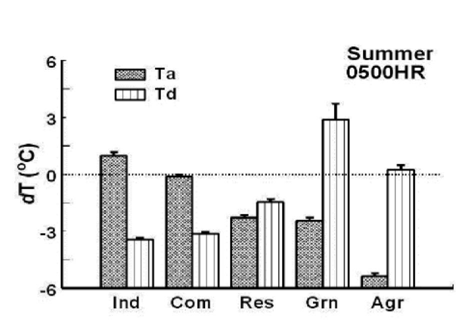
Correlation coefficents between MEI/SOI (Multivariate ENSO index and Southern Oscillation Index) and Daily Temperature, Division 6 Precipitation, and Evaporation.

Feedbacks goals

A central goal of the CAP-LTER project is to understand how humans interact with the environment. Traditionally, this interaction has often been viewed in one dimension, that of human impacts upon the "natural" environment. Viewed more realistically, humans are part of that natural world, and well-being depends upon the quality of our biophysical environment. In ecosystems dominated by humans, such as cities, humans modify that environment substantially, and these modifications alter our well-being. These "feedbacks" can be negative or positive.

The goal of the "feedbacks" group is to examine the relationship between human alterations of the ecosystem and the impact of these alterations on our well-being. A natural starting point for a city in the desert is climate. The climate in Phoenix has become significantly warmer since urbanization: minimum temperatures have increased by 6-7C. This increase is the result of the well-known "heat island" effect. What is less well-understood is what impact this has on our well-being. Our "climate feedbacks" project is examining climate records and developing algorithms to quantify the impact of urban warming on human comfort, agricultural production (cotton and dairy production), the health of landscape plants and insects, and energy requirements for household heating and cooling. We anticipate that some feedbacks will be positive (e.g., less winter frost damage to oranges and earlier planting dates for cotton), whereas others (e.g., human comfort during the summer) will be negative.





Normalized mean air temperature (Ta) and dew point temperature (Td) along a microclimate transect of industrial (Ind), commercial (Com), residential (Res), greenbelt (Grn), and agricultural (Agr) land use for summer morning (0500 HR) and afternoon (1500 HR), 1999.

Acknowledgements
CAP-LTER
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Land cover change detection of the urban fringe with remote sensing

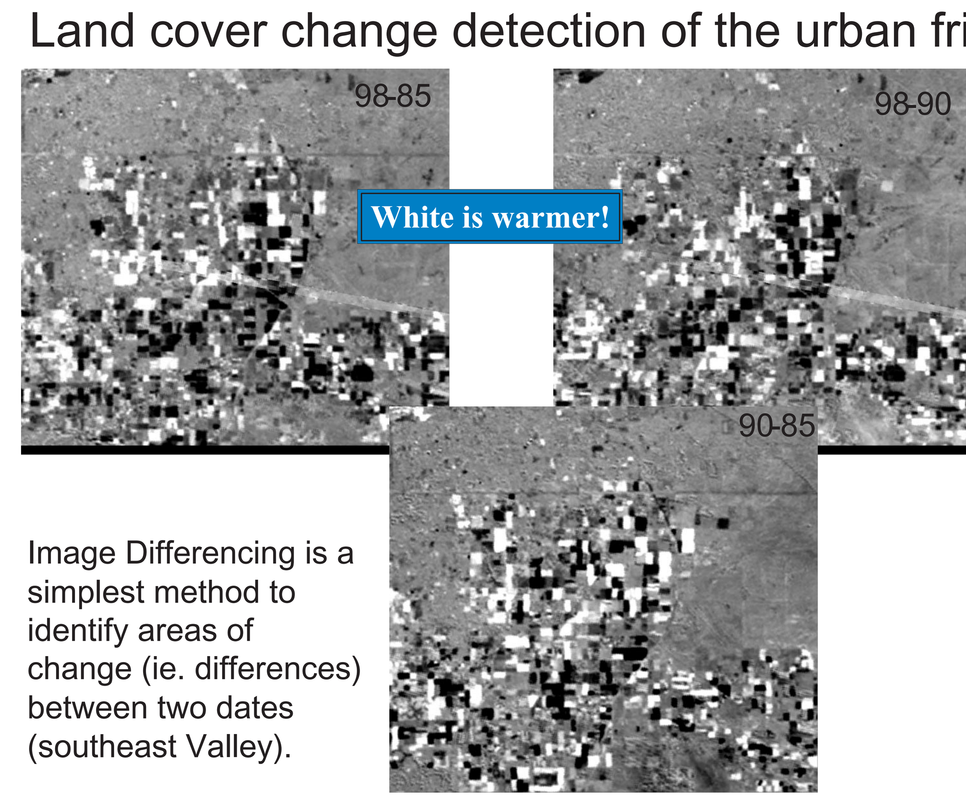
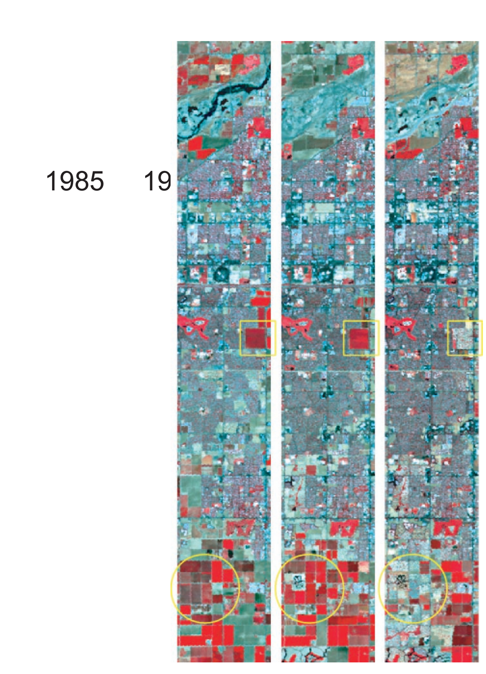
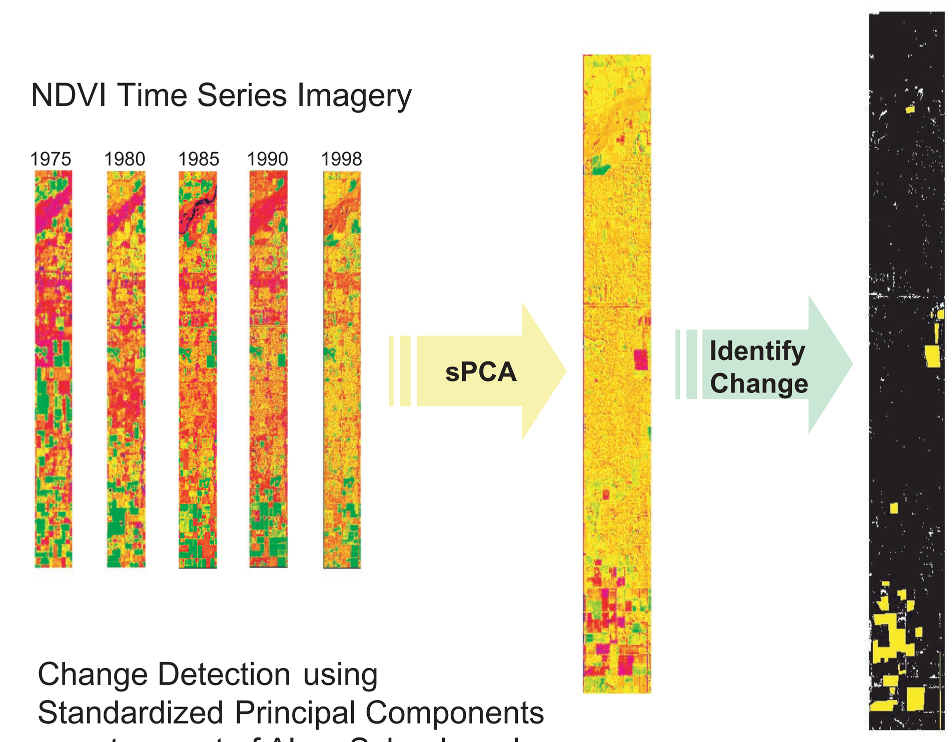


Image Differencing is a simplest method to identify areas of change (ie. differences) between two dates (southeast Valley).





Change Detection using Standardized Principal Components on a transect of Alma School road

Areas of Land Cover Change

This research found that there are dramatic differences between satellite images from 1985, 1990 and 1998, indicative of urban expansion, especially along the urban fringe in the southeast valley of the Phoenix Metropolitan Area. Large patches of warming are detected with the thermal band of Landsat data close to and along the urban fringe. Areas of land cover change over the past 15 years are outlined in yellow on the False Color enlargements of the Alma School Transect. The areas identified by the yellow squares exhibit a dramatic change in land cover between 1990 and 1998. There was also an increase in surface temperature in this area. The area denoted by yellow circles experienced more incremental land cover conversion from agriculture to urban from 1985 to 1998 as denoted by the satellite imagery. This area also shows an increasing trend in overall temperature.