Analyzing Heat and Land Use Change for Phoenix Region: 1985 to 2010

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Background

The urban heat island is an emerging issue for many urban areas. Recent research suggests that the effects of increased urbanization on temperatures could be as high or higher than those resulting from climate change (Chapman, Watson, Salazar, Thatcher, & McAlpine, 2017). `

Problem Statement

Urbanization is characterized by increases in land cover types, such as asphalt and concrete, which are noted for heat retention. While, rapidly urbanizing contexts like Phoenix, are already known for extremely high temperatures, a lot remains to be explored on how temperature increases over time, have corresponded to changes in land cover types due to increasing urbanization (Wang, Myint, Wang & Song, 2016)

Research Question

What has been the relationship between urban temperatures and changes in landcover from types noted to retain less heat to types noted for heat retention in Phoenix for a 25-year period from 1985 to 2010.

Methods and Tools

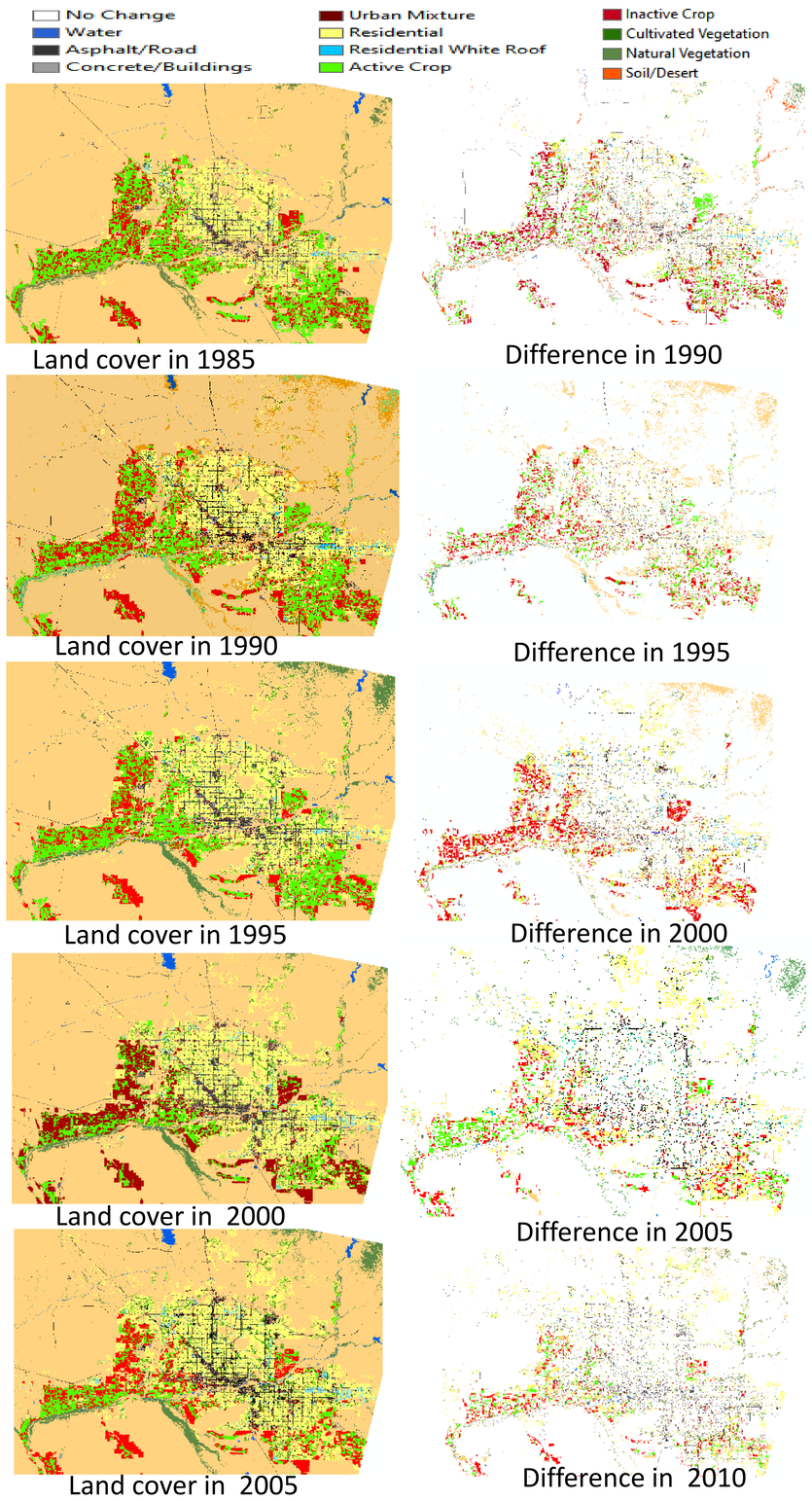
To Date

- In 5 year intervals land cover transitions in CAP LTER land use and land cover (LULC) shapefiles for the past 25 years were determined
- A 30 x 30 m fishnet was created in Arc Map and superimposed on landcover transition shapefiles to extrapolate landcover transition values
- Extrapolated fishnet points were analyzed in R studio to determine land cover transition distributions.
- MODIS surface temperature for June 26th 2010 compared to 2010 Land Cover Classes

Future

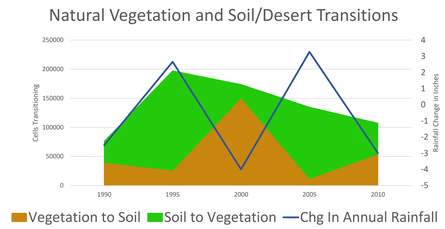
- Historical air temperature data from regional AZMET and MesoWest stations for time period of 1985 to 2015 will be extrapolated across fishnet..
- Spatial and non spatial analysis of correlation between temperature change and land use change for key land use cover transitions will be conducted

Land cover change : 5 year interval periods

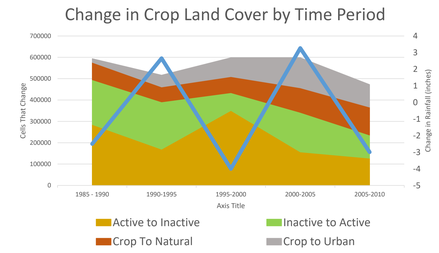


Results

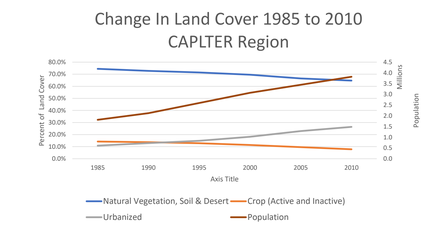
1. There is periodic change back and forth between Natural Vegetation and Soil / Desert that tracks with changes in rain fall.



2. There is a cyclic pattern of transition back and forth between inactive and active crop land cover over the time range that follows a pattern of rain fall.



3. The land cover associated with urban areas has increased at a steady annual rate of 3.6 percent, with, residential land cover being the largest category.



4. The primary source of change to residential land cover is from natural areas (vegetation and soil), 70% to 80% with some coming from crop land cover (active and inactive), 10% to 20%
5. There appears to be some level of noise in the land cover data, with noise defined as land cover classes that change back and forth over time. Some is natural change as in 1 and 2 above, some is classification remnants.
6. The average surface temperature of land cover classes varies from 90 F to 118 F. Regional average surface temperature has likely increased as much as 6 F and decreased 3 F as different land cover changes occurred over study time period.

Land Cover		Avg	Std Dev
1	Water	89.8	46.8
2	Asphalt	117.1	36.1
3	Concrete/Buildings	116.3	37.9
4	Urban mixture	115.7	36.3
5	Residential	114.7	36.4
6	Residential white	113.5	36.0
7	Active crop	97.8	41.2
8	Inactive crop	117.0	39.2
9	Cultivated vegetation	105.9	37.7
10	Natural vegetation	107.2	40.9
11	soil desert	117.7	37.7

Next Steps

- How are average surface daytime and nighttime temperatures at different scales affected by land cover transitions?
- What is the relationship between changes in air temperature (daytime and nighttime) statistics and changes in land cover over time at different scales?

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