Monitoring 1985-2005 land use and land cover change in the Phoenix metropolitan area: distance and direction

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Objective

Examine the temporal (1985-2005) and spatial pattern of land use and land cover change in three cardinal urban growth directions, and at differing distances from the Phoenix metropolitan area center.

Introduction

In the past decades, urbanization has rapidly and profoundly changed the land surfaces in Phoenix. Changes of land use and land cover, especially from the expansion of residential areas, directly impact ecosystem functioning, biodiversity, and local and regional climate. Previous studies have shown that in the past 30 years, of the land within metropolitan area that has been converted into some category of urban use, 54% was agricultural and 40% was desert land. Of the converted land, 70% has become residential areas (Keys et al. 2007). In order to obtain a better understanding in temporal and spatial pattern of land cover and land use change, we examined the spatial patterns of urbanization in the Phoenix metropolitan area, especially for residential land use and land cover change from 1985 to 2005. We also believe that neighborhoods in different direction and distance from city center develop in different ways.

Methods

Using the 1985-1990-1998-2005 land-use and land-cover classification thematic layers, we quantified the land use and land cover change in a 20-year time frame in high-growth areas through ArcGIS. Previous study has shown that Phoenix's the urban expansion mainly occurred in the southeast(1), northeast (2), and northwest (3) quadrants of the Phoenix metropolitan area (Moeller unpublished). Hence our analysis subdivided the study area (CAP region) into three cardinal quadrants, and subdivided them into five kilometer rings.

Study Area:

Phoenix metropolitan area, within a radius of 50 km from city center.

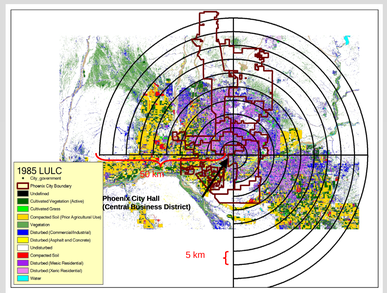


Figure1: CAP region with multiple rings surround city center

Table1: Definition of expert system class

Class	Properties
Cultivated vegetation	Actively photosynthesizing vegetation, with agricultural water rights
Cultivated grass	Actively photosynthesizing vegetation, in urban park areas
Vegetation	Actively photosynthesizing vegetation
Fluvial and lacustrine sediments (canals)	Mixed lithology gravels and soil associated with water transport features
Water	Standing or flowing water
Undisturbed	Undisturbed soil and native vegetation, bedrock outcrops
Compacted soil (Fallow agricultural use)	Disturbed soil with agricultural water rights
Compacted soil	Disturbed or bladed soil
Disturbed (commercial/industrial)	Mixed asphalt, concrete, soil, vegetation, and building materials, dense spatial texture
Disturbed (asphalt and concrete)	Mixed asphalt and concrete
Disturbed (mesic residential)	Built materials, vegetation cover greater than bare soil, dense spatial texture
Disturbed (xeric residential)	Built materials, vegetation cover less than bare soil; dense spatial texture

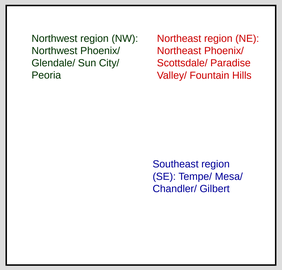
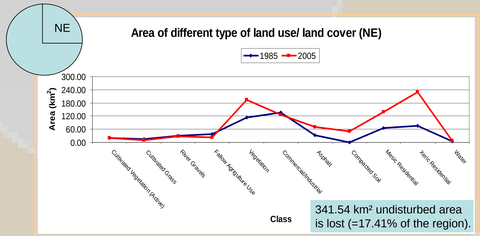
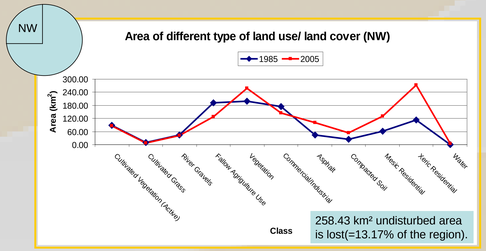


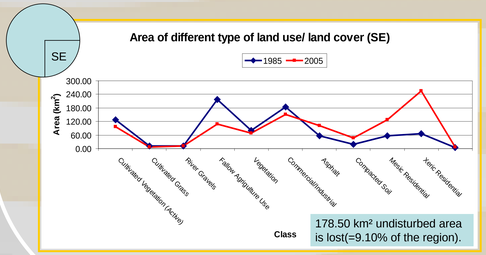
Figure2: Cities within three fast growing regions

Results

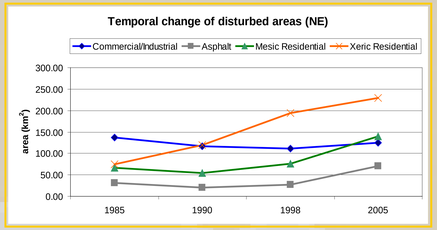
1. Area of different type of land use/land cover



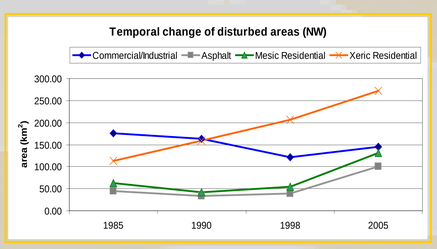




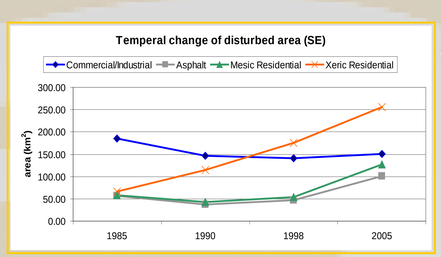
2. Temporal change of disturbed areas (1985-2005)



Northeast region:
Asphalt surfaces doubled; xeric residential areas increased 3 times; mesic residential areas doubled.



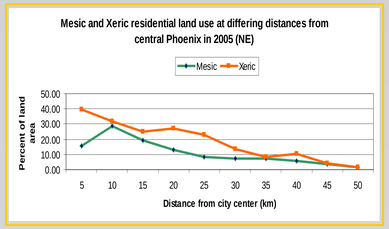
Northwest region:
Asphalt surfaces doubled; mesic and xeric residential areas doubled.



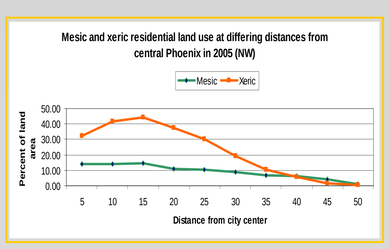
Southeast region:
Asphalt surface increased 1.6 times; xeric residential area increased 4.2 times; mesic residential areas doubled.

3. Different residential land use at differing distances from city center in 2005

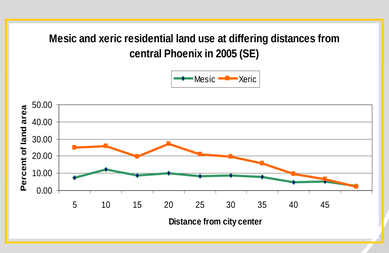
Northeast region:
High percentage of xeric residential area was observed in the area that is 0-5 km away from city center; the largest percent of mesic residential area was in the area that is 5-10 km away from city center.



Northwest region:
High percentage of xeric residential area appeared in the area that is 5-20km away from city center.



Southeast region:
Xeric residential area is apparent in the area that is 15-20 km away from city center.



Conclusion

1. The growth patterns in different part of the city for four period are heterogeneous.
2. As we expected, increase of residential area and a significant decrease of undisturbed area were the two major land use land cover changes during 1985-2005.
3. For the area that changed from non-urban to urban, the largest area loss in agricultural land (7.13%) occurred in the southeast region; the largest area loss in undisturbed area (17.41%) (desert) occurred in northeast region within twenty years (1985-2005).
4. Within twenty years (1985-2005), growth rates of xeric residential land use in every region were larger than mesic one, especially in newly developed southwest region.