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# How sprawl shapes public parks in an urban system: Spatial analysis of historical urban growth in Orlando Metropolitan Region, Florida, USA

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# Motivation and Study scope

- Land system science (LSS): land use and land cover (LULC) changes
- Landscape resources and LSS

**Complex Relationship Between Human and Landscape**

- Integration of spatial-temporal planning
- Geodesign application

- **A descriptive paper**
- **To set up a regional understanding about parks**

# Stage of knowledge

**Urbanization to urban sprawl**
(Seto & Reenberg, 2014)

- **Land patterns alternation**

- Eliminating the possibility of preservation of large and community scale landscape (Ewing, 2008; Schneider, 1970)

- **A classic case of human adaptation:** land use decision and settlement patterns (Olding-Smee et al., 2013; Murtha, 2015)
- **Past LULC measurements serves as a platform**: studying the interacting social, physical, and ecological system of parks (Turner et al., 2007)

- **Previous studies: sites and functions of parks** (Kaczynski et al., 2008)
- **Few studies use public parks as an interpretive indicator to understand the urbanized context**

# Study design & Objectives

## A case study:

- Orlando Metropolitan Region, Florida, USA

## Historical growth study via land cover analysis:

- Continue understand parks by LULC analysis
- Supplements and reinforcing the pilot study results (land use analysis from 1970s and 2010s)

## Objectives:

- To explore the types of land morphology that characterize parks.
- To determine what major changes had occurred and under what conditions they occurred.
- To understand how sprawl affects the regional conditions of surrounding public parks.

# Method

## 1) Data standardization

- Land cover data from Multi-Resolution Land Characteristics (MRLC)
- Public park and county boundaries data from the Florida Geography Data Library (FGDL)

## 2) Geo-processing

- Land cover distribution analysis: quantified land cover on years of 2001, 2006, 2011, and 2016
- Land cover conversion for periods of 2001-2006, 2006-2011, 2011-2016
- Sprawl and public parks: ratio analysis to compare urban land areas by years to the public parks at the alignment of the sprawl buffers.

# Results

## 1) Land cover distribution analysis

- Nonurban land: **a declining trend** in deciduous forest, evergreen forest, mixed forest, and hay pasture.
- Hay pasture decreased most with 2% of lands in which areas of 8,087 hectares changed.
- **A significant rise** in developed (urban) lands, increased from 34% in 2001 to 38% in 2016.

**Table 1:** Land cover analysis in years of 2001, 2006, 2011, and 2016 in Orlando Metropolitan Region

| Code | Land cover | 2001% | 2006% | 2011% | 2016% |
|---|---|---|---|---|---|
| 11 | Open Water | 9.32 | 10 | 9.69 | 9.72 |
| 21 | Developed, Open Space | 14.81 | 15.11 | 15.31 | 15.66 |
| 22 | Developed, Low Intensity | 11.59 | 12.07 | 12.65 | 13.02 |
| 23 | Developed, Medium Intensity | 5.4 | 6.11 | 6.87 | 7.24 |
| 24 | Developed, High Intensity | 1.71 | 1.95 | 2.24 | 2.36 |
| 31 | Barren Land | 0.42 | 0.35 | 0.36 | 0.39 |
| 41 | Deciduous Forest | 0.05 | 0.06 | 0.05 | 0.04 |
| 42 | Evergreen Forest | 7.35 | 6.74 | 6.24 | 6.18 |
| 43 | Mixed Forest | 1 | 0.86 | 0.83 | 0.8 |
| 52 | Shrub/Scrub | 2.16 | 1.75 | 1.91 | 1.57 |
| 71 | Herbaceous | 0.75 | 1.17 | 0.91 | 0.98 |
| 81 | Hay/Pasture | 11.98 | 10.96 | 10.25 | 9.66 |
| 82 | Cultivated Crops | 0.77 | 0.8 | 0.71 | 0.61 |
| 90 | Woody Wetlands | 26.87 | 26.05 | 25.97 | 26.09 |
| 95 | Emergent Herbaceous Wetlands | 5.8 | 6.03 | 6.02 | 5.68 |
| | Total | 1 | 1 | 1 | 1 |

# Results

## 2) Land cover conversion analysis

*Nonurban to urban:*

- Hay/pasture, which contributed 6,452 hectares to urban lands growth.
- Evergreen forest and woody wetlands which both dropped by more than 2000 hectares.
- A total area of 16,612 hectares of non-urban lands were converted to urban lands.

*Urban to other types of urban:*

- No open space was gained from 2001 to 2016, which converted to residential patterns.
- Low intensity areas converted to higher density patterns, but none of the areas converted back.

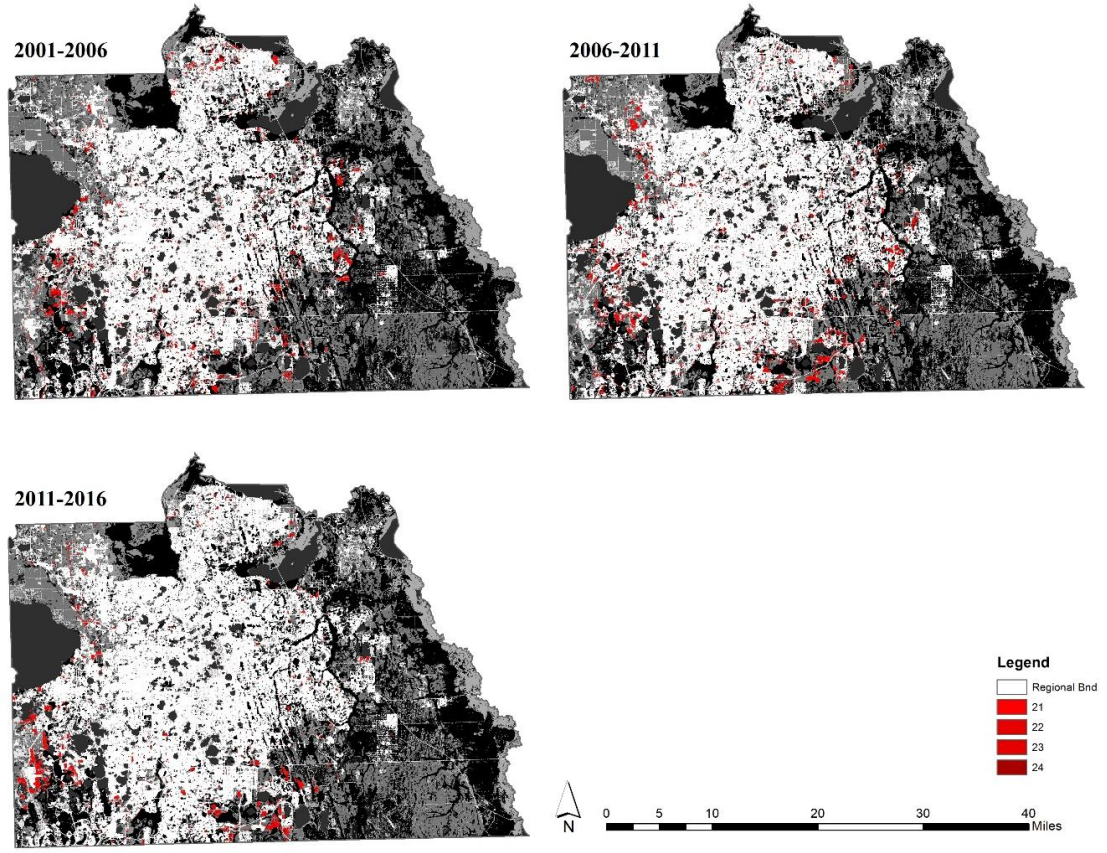



**Figure 1:** Land cover conversions from 2001 to 2006, 2006 to 2011, and 2011 to 2016 in Orlando Metropolitan Region

# Results

## 3) Sprawl and public parks

- The distribution of key land-cover categories in each ring from 2001 to 2016 (Fig.2).
- We found that woody wetlands occupied a greater proportion of land in the buffer rings of 12–18 miles.
- Developed open space, developed low, and developed medium accounted for most of the area between 6 and 12 miles.
- Open water, hay pasture, evergreen forest, and evergreen herbaceous wetlands occupied large areas between 14 and 18 miles.

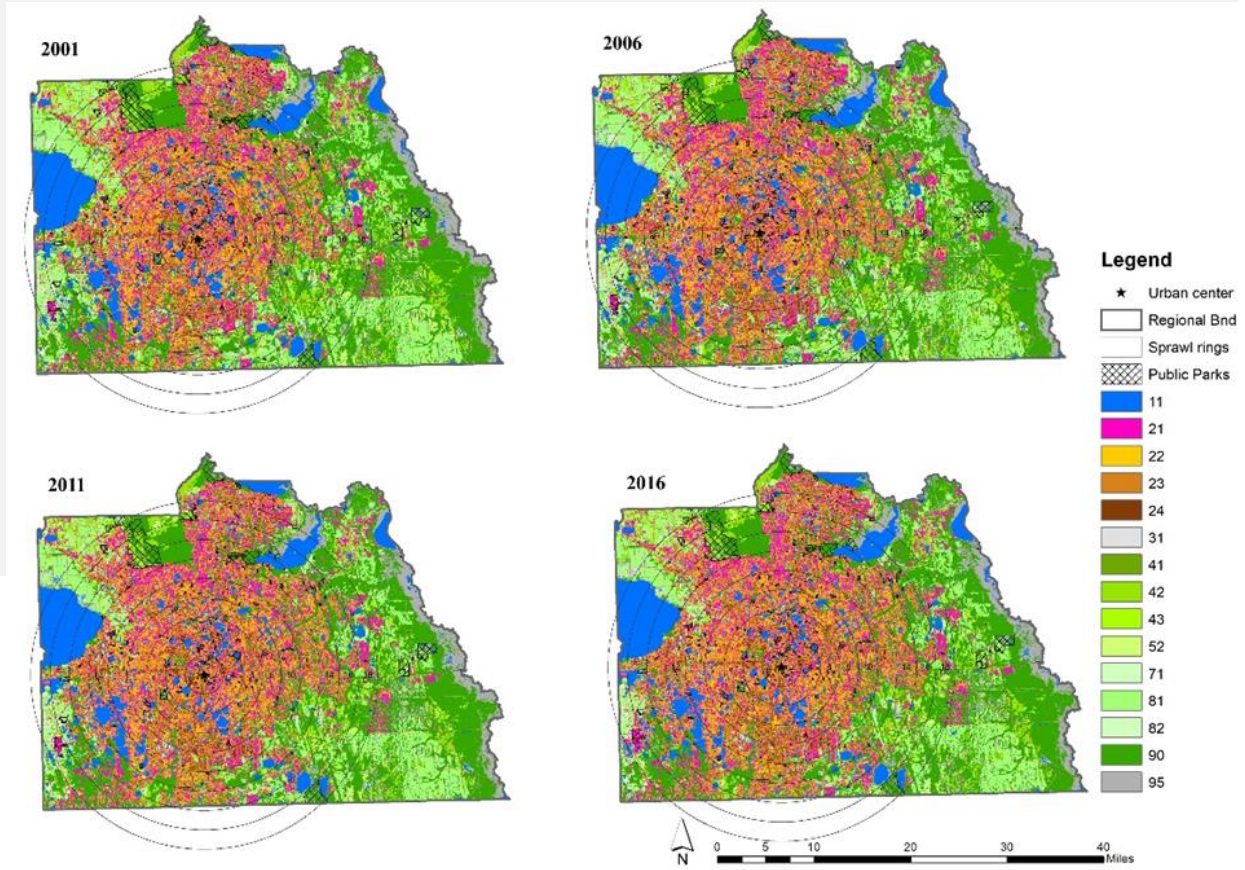



**Fig.2:** Land cover distribution and sprawl buffers between 2001 and 2016 in Orlando Metropolitan

# 2) Ratio analysis of each buffers' urban area to the count and the area of parks

**Fig 3:** Ratio analysis: developed lands to per count of parks

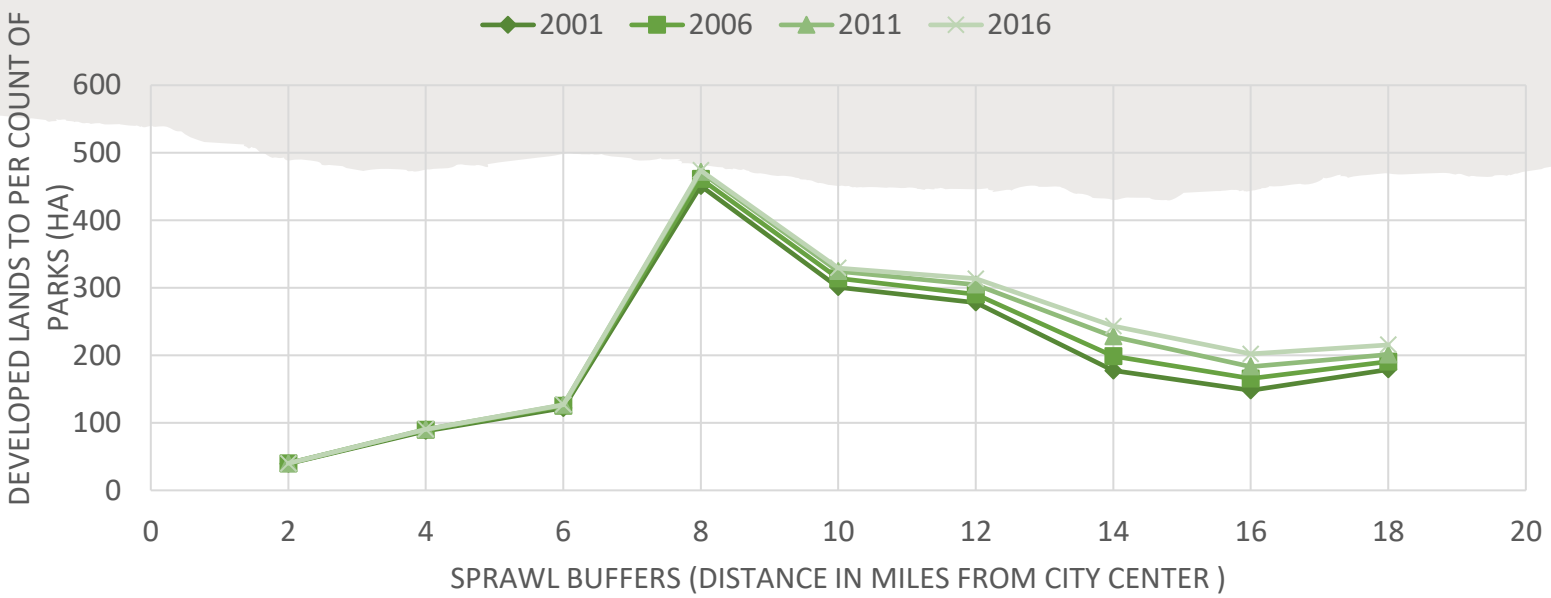
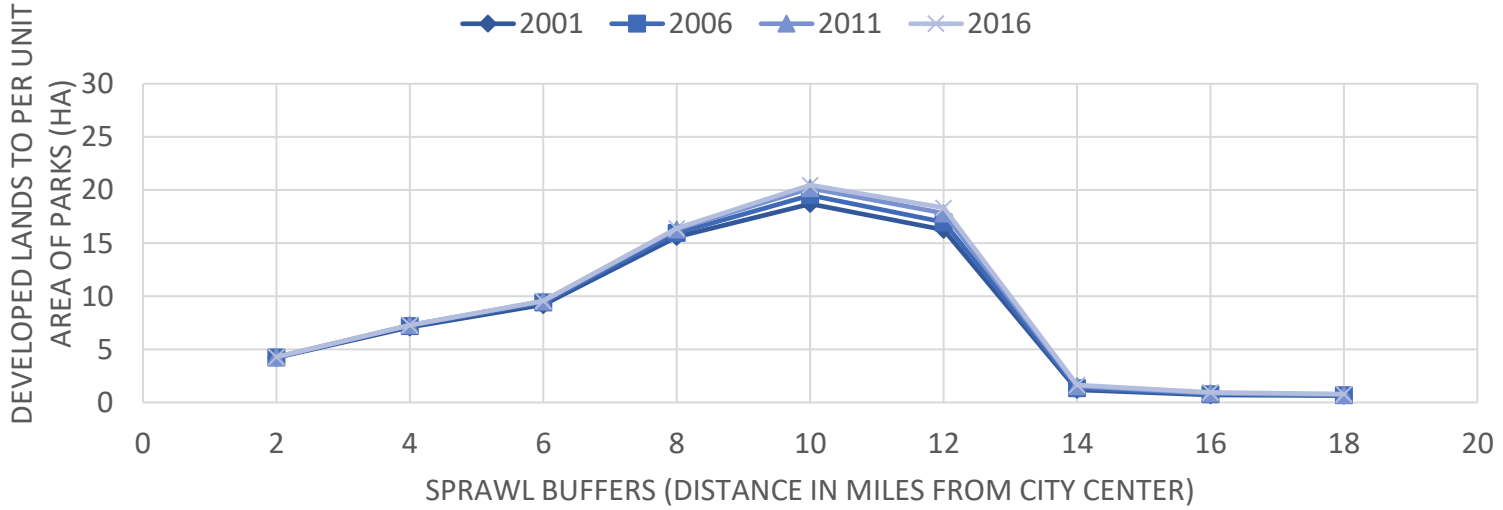



**Fig 4:** Ratio analysis: developed lands to per unit area of parks




- The ratio of developed lands to parks identified the 8-mile sprawl buffer as the turning point that is between two opposite trends: the climbing trend within the 8-mile buffer, and a declining trend beyond it (Fig 3).
- In figure 4, 10–12 miles contains the highest proportion of urban land. At the periphery of the Orlando metropolitan region, the lowest proportion of urban lands was found per unit area of parks.

# Summary

- **Urban lands** have maintained rapid growth, growing faster than other land-cover and vegetation categories.

- Evidence of the fact that not only the majority of **non-urban lands** have been converted to urban lands, but that **urban lands of open space and lower density residential areas** have been correspondingly converted to medium- and high-density housing patterns.

- At a regional scale, the ratio of urban lands to parks and park area in regions **outside the urban core is inconsistent and unbalanced**.

# Discussion & Outlook

- For a comprehensive urban systems analysis, we plan to investigate the exact land-use and land-cover changes between the **critical distances of 6 and 12 miles**.

- It suggests that we rethink urban issues from a long-term perspective and in a landscape dimension in order to **prioritize parks in the land system**.

- In the case of smaller parks that serve larger urban areas, we suggest several solutions for alternatives in **future geodesign**.

(1) expanding areas by land-use decisions
(2) enhancing the functionalities of parks, and
(3) designing the parks to be part of the green infrastructure, such as corridors to connect the public park system.

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**Thanks!**
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