Investigating Forest Conversion across Several Scales of Urbanization in the Eastern United States

Yi-Jei Wu[1], Valerie A. Thomas[1], Robert D. Oliver[2]
[1]Department of Forest Resources and Environmental Conservation, Virginia Tech
[2]Department of Geography, Virginia Tech

Introduction

In 2003, the *Micropolitan Statistical Area (µSA)* was introduced as a new county-level census designation to capture the transitional areas of urbanization between low density areas (i.e., rural) and high density Metropolitan Statistical Areas (MSAs). The new Micropolitan (µSA) areas are anchored by an urban center that has a population range from 10,000 to 49,999 (U.S. OMB, 2003) and an identifiable commuting pattern to neighboring regions. Previous research has demonstrated that µSA regions were unique (in comparison to rural and metropolitan) areas with regards to land converted to development from 2001 to 2006 (Oliver and Thomas, 2014). There remains a need and an opportunity to better understand land cover dynamics in these areas. These new spatial units have the potential to reveal how politically determined boundaries may ultimately influence land cover change.

Study Area

- This research examines 4 key megaregions (as identified by American 2050) on the east coast: Florida, Piedmont Atlantic, Northeast, and Great Lakes.
- All 4 megaregions are located in the same EPA Ecological Region Level I class: Eastern Temperate Forests
- Total area represents approximately 10% of the United States
- Total population represents 40% of the United States of America total population

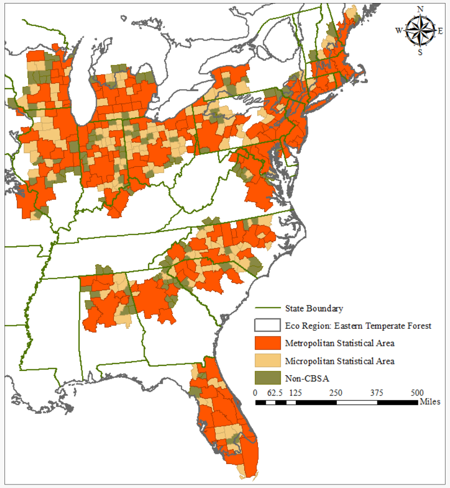


Figure 1. The distribution of the 3 CBSA categories in the 4 East-Coast megaregions.

Objectives

- To compare landcover change, specifically forest dynamics, across a large number of µSAs in four eastern megaregions and to determine if they behave differently from MSAs and Non-CBSAs.
- To assess whether forest change dynamics for µSAs differs across the 4 eastern US megaregions
- To identify areas where patterns (i.e. unexpected land cover change) may indicate/reflect drivers at the micropolitan scale.
- To assess the impact of using forest and developed classes in NCLD, compared to a 'canopy cover' class using annual Landsat data, when assessing canopy dynamics at the micropolitan scale.

Methods

- Compute statistics to compare NLCD land cover (2001-2006) at multiple geographic scales
  - Across CBSA designations
  - For µSAs across the 4 eastern megaregions
- Investigate canopy cover in 2001-2006 period using Landsat annual data

Results

- Generally, the Great Lakes and Northeast megaregion have net forest net loss from 2001-2006 (Figure 2).
  - In µSAs, total forest change does fall between the calculated loss between rural (less forest loss) and MSAs (higher loss).
- Distinct areas of forest gain were noted in the Piedmont Atlantic and Florida megaregions.
  - Of interest is the distinct separation in forest dynamics along the state border separating North Carolina and South Carolina.
- Significant loss is evident in Georgia
- µSAs of the Piedmont Atlantic megaregion have the most dynamic forest change compared to other megaregions' µSAs.

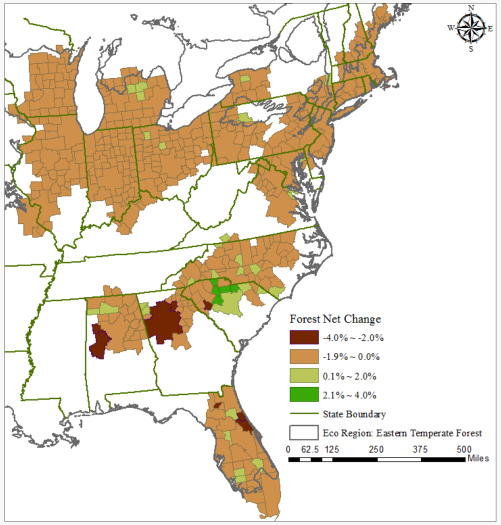
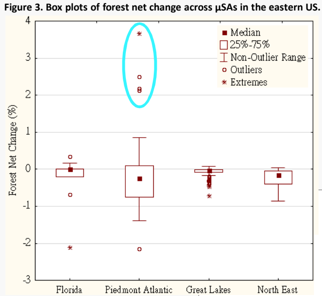


Figure 2. Forest net change between 2001 and 2006 at the scale of the census designation, calculated from NLCD.

Figure 3. Box plots of forest net change across µSAs in the eastern US.



- Anomalous forest growth is evident at the micropolitan scale in the Piedmont Atlantic megaregion (circled in Figure 3).
- These µSAs are spatially clustered (Figure 4)

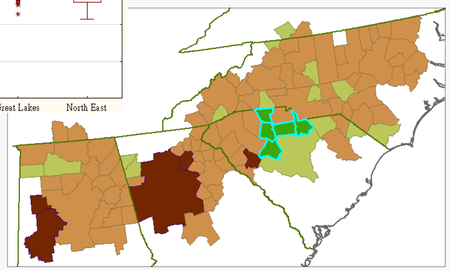


Figure 4. Spatial clustering of anomalous forest growth at the scale of the census regions.

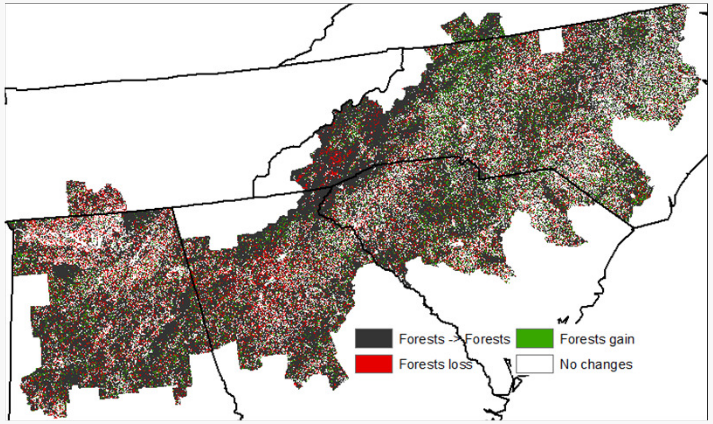


Figure 5. Forest net change between 2001 and 2006 at the 30 m pixel level, calculated from yearly Landsat images in Google Earth Engine.

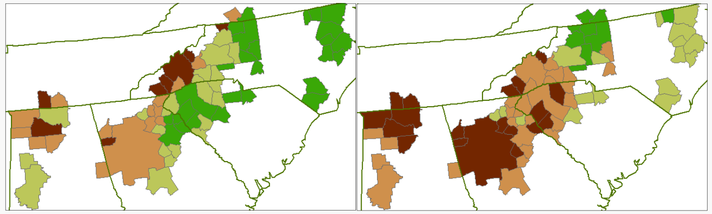


Figure 6. Forest net change between (a) 2001 – 2003 (b) 2001 – 2006 at the scale of the census designation, calculated from Landsat imagery, Google Earth Engine. There are some areas excluded because of cloud-cover in 2003 summer imagery.

Discussion

- The NLCD analysis shows a clear pattern of forest loss/gain along the border of North Carolina and South Carolina, suggesting that the development activities in the two are different.
  - The pattern is not evident in the canopy cover analysis with annual data.
- The forest cover in Georgia experienced significant loss in both analyses
- These results suggest that the definition of forests and developed land has a big impact on our understanding of forest dynamics at the micropolitan scale.
  - In NLCD, many locations have significant canopy cover, but are excluded from forest. These include parks, golf courses, and urban street trees.
  - When assessing forest land in developed regions such as the South-Eastern US, the NLCD change product is not directly comparable to canopy cover change products (for example, the Global Forest Change map by Hansen et al. 2013).

Selected References

- R. D. Oliver and V. A. Thomas (2014). Micropolitan areas: Exploring the linkages between demography and land-cover change in the United States cities. *Cities 38*: 84 – 94.
- M. C. Hansen, P. V. Potapov, R. Moore, and et al (2013). High-resolution Global Maps of 21st-century Forest Cover Change. *Science 342*: 850 – 853.