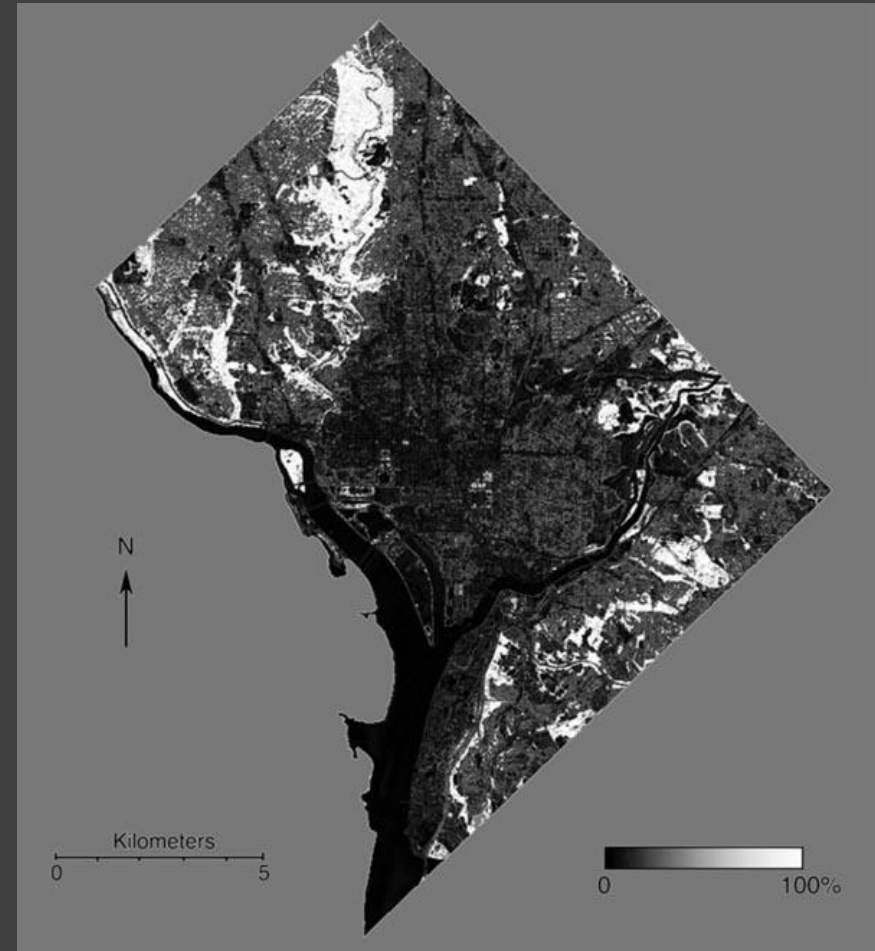


# Historic Changes in DC Tree Cover and Implications for the Future

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Center for Earth and Planetary Studies



Smithsonian  
*National Air and Space Museum*

# Historic Urban Tree Cover Variability

## **Improved Measures of Historic Urban Tree Cover**

Research has focused on making improved measures of past changes in urban tree cover over decadal periods.

## **Urban Tree Cover Variability**

Application of improved methods used to determine how urban tree cover changed in the District of Columbia between 1984-2004.

## **Factors Related to Tree Cover Changes**

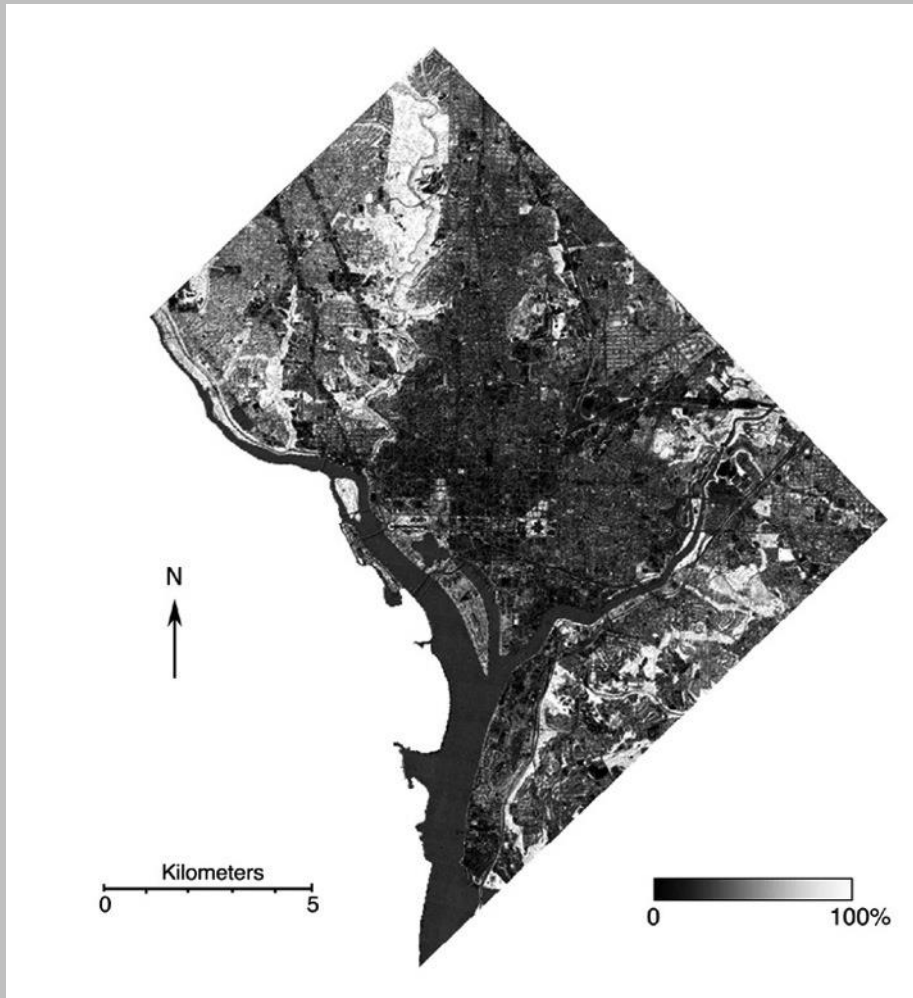
Factors related to tree cover spatial variability and links between tree cover and urban land use patterns were identified.

## **Implications for Future Planning**

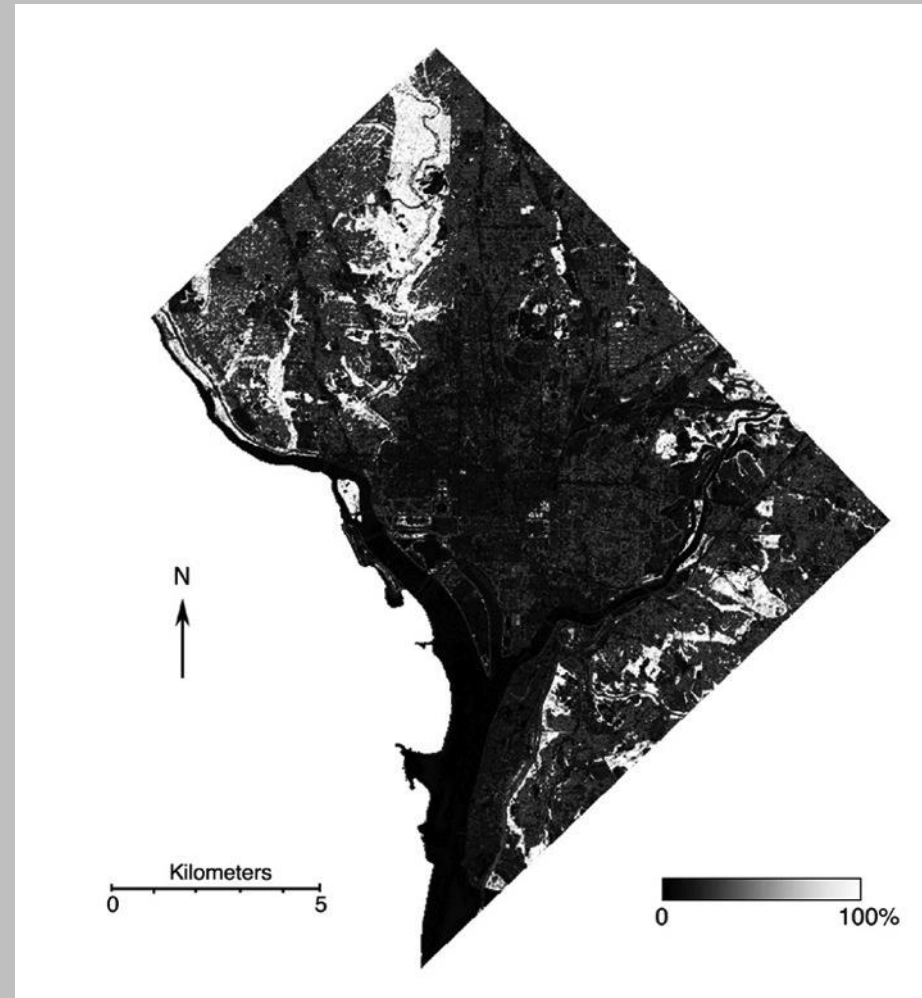
Observations of past tree cover variability have implications for future planning and management.

# Improved Monitoring of Past Urban Tree Cover

Different methods available to estimate tree cover with archival satellite data.



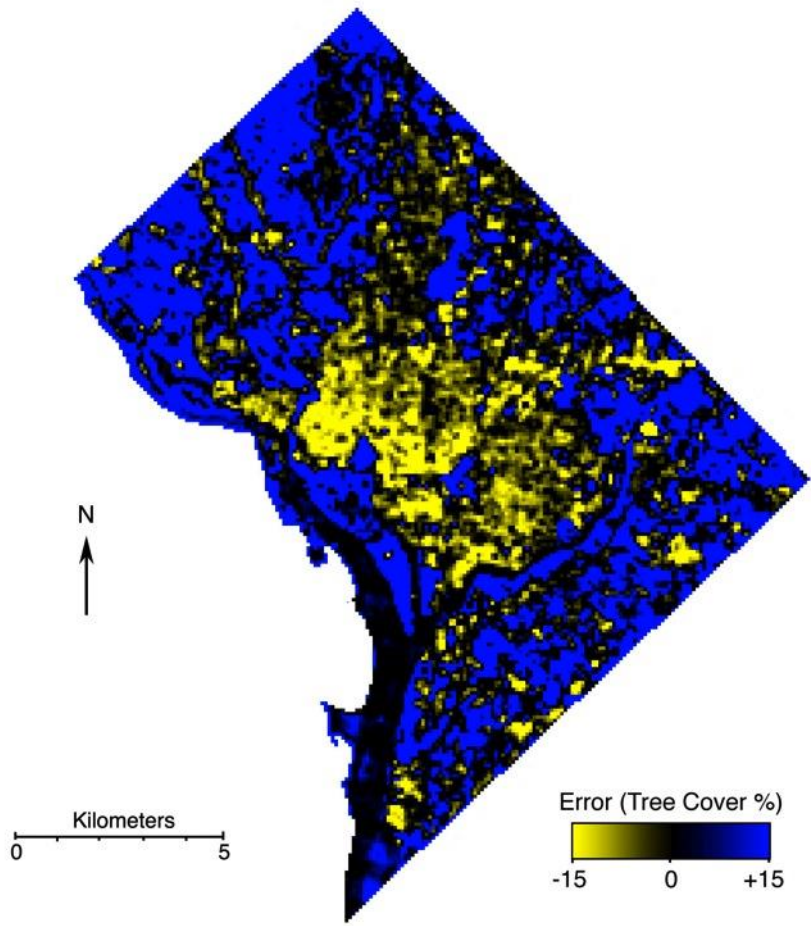
2000 Tree Cover: Spectral Mixture Analysis



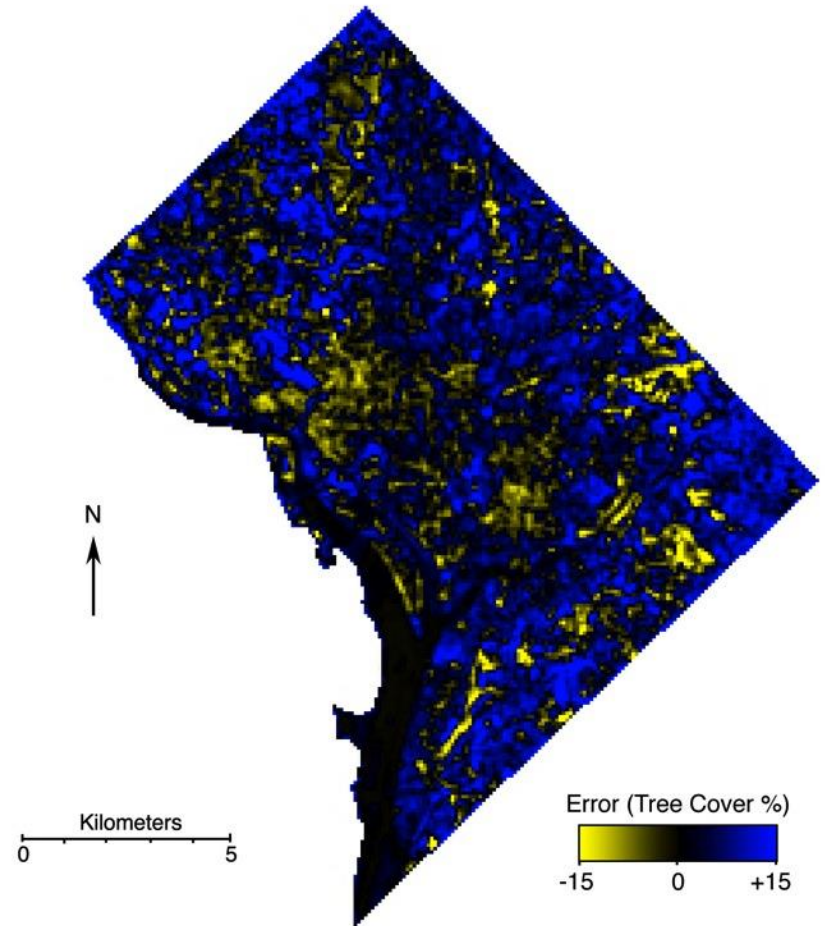
2000 Tree Cover: Support Vector Regression

# Improved Monitoring of Past Urban Tree Cover

New methods provide consistent results across land use types.



Spectral Mixture Analysis

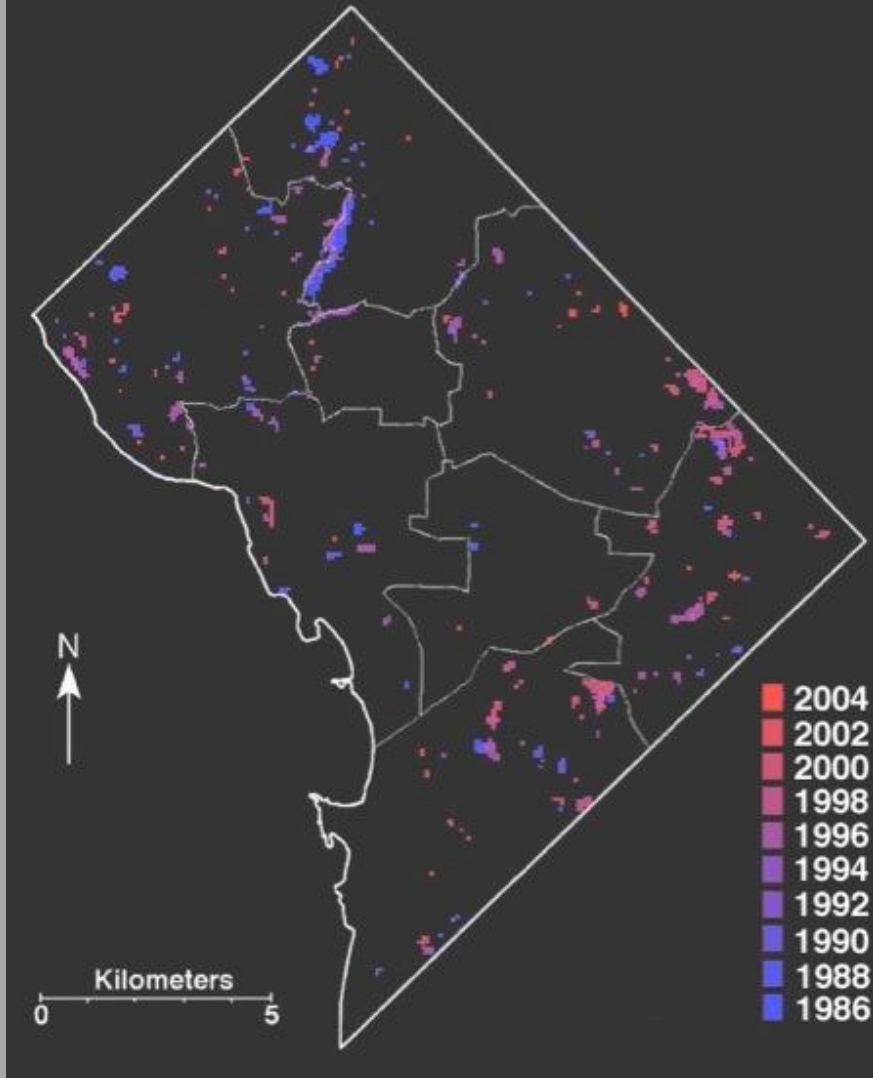


Support Vector Regression

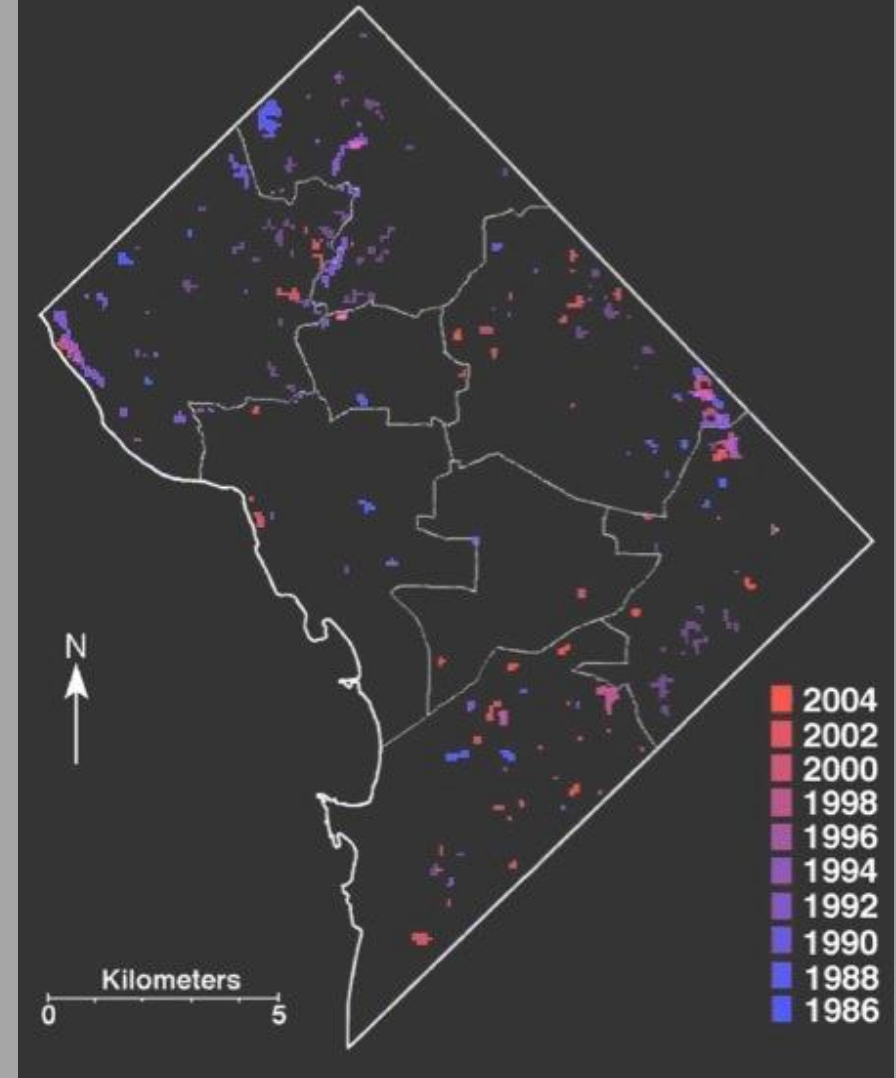


# Tree Cover Variability 1984-2004

## Areas of Tree Cover Increase

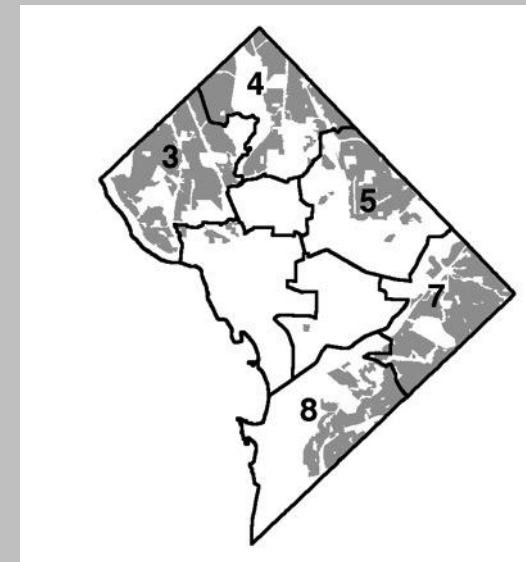
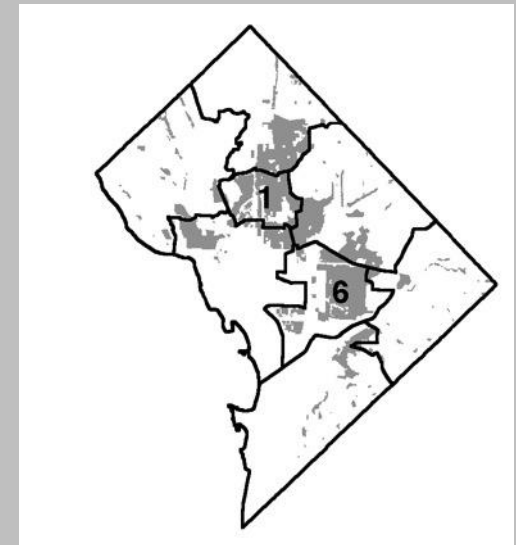
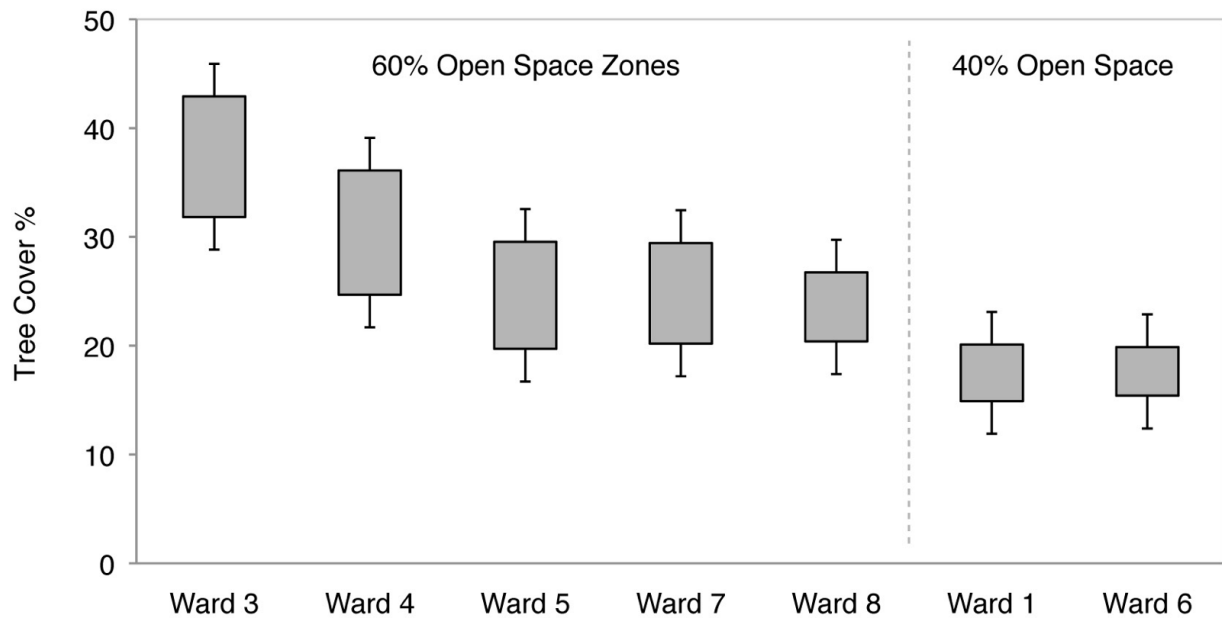


## Areas of Tree Cover Decrease



# Spatial Variability of DC Tree Cover Dynamics

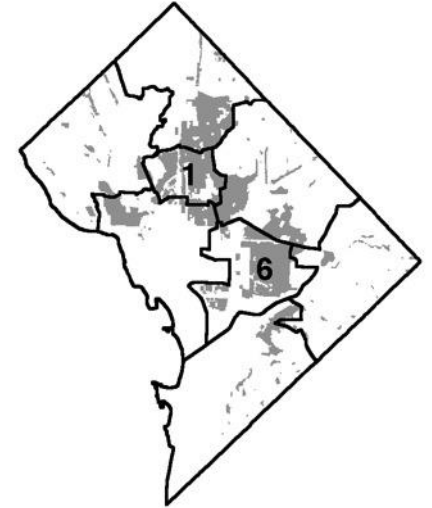
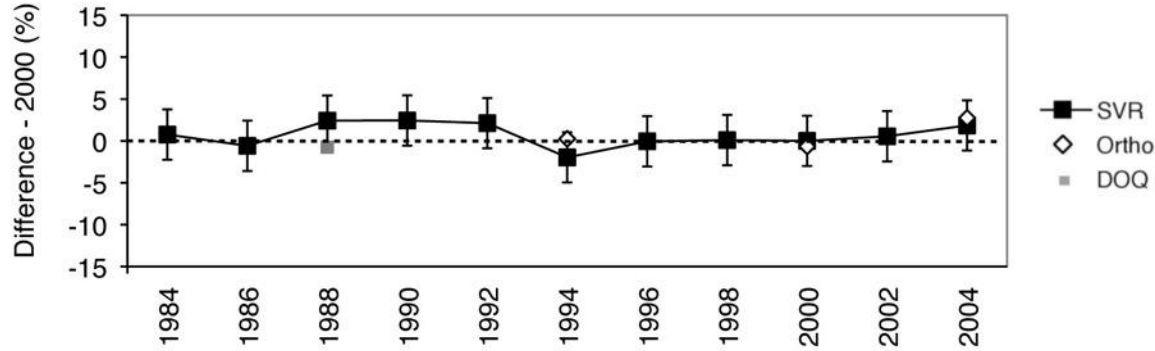
Tree cover and variability greater in low density residential  
60% open space zones



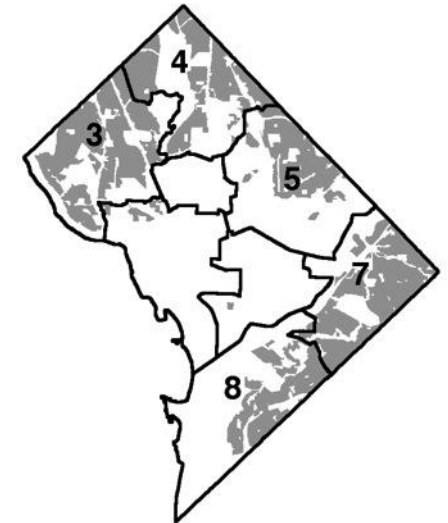
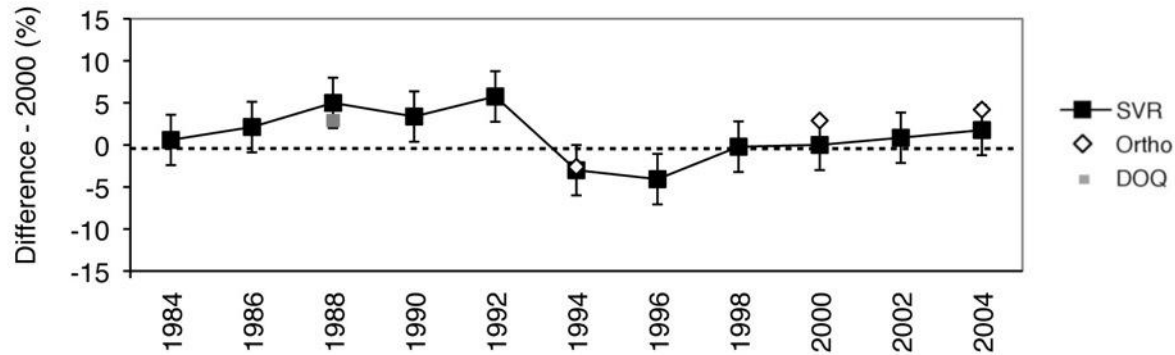
Tree cover and variability was greatest in Ward 3 low  
density residential zones.

# Spatial Variability of DC Tree Cover Dynamics

Tree Cover: 40% Open Space Zones



Tree Cover: 60% Open Space Zones

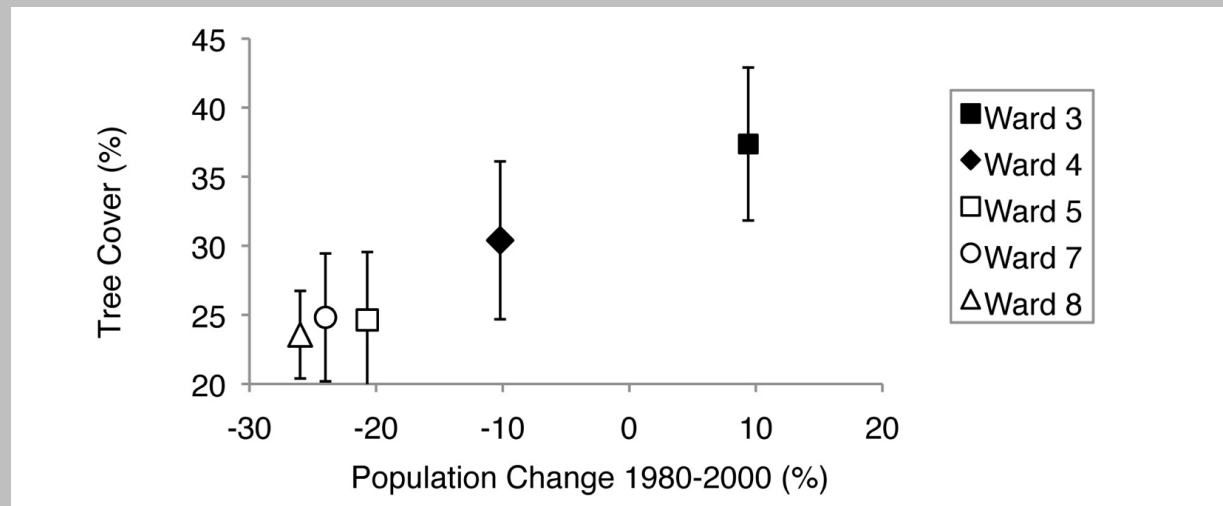
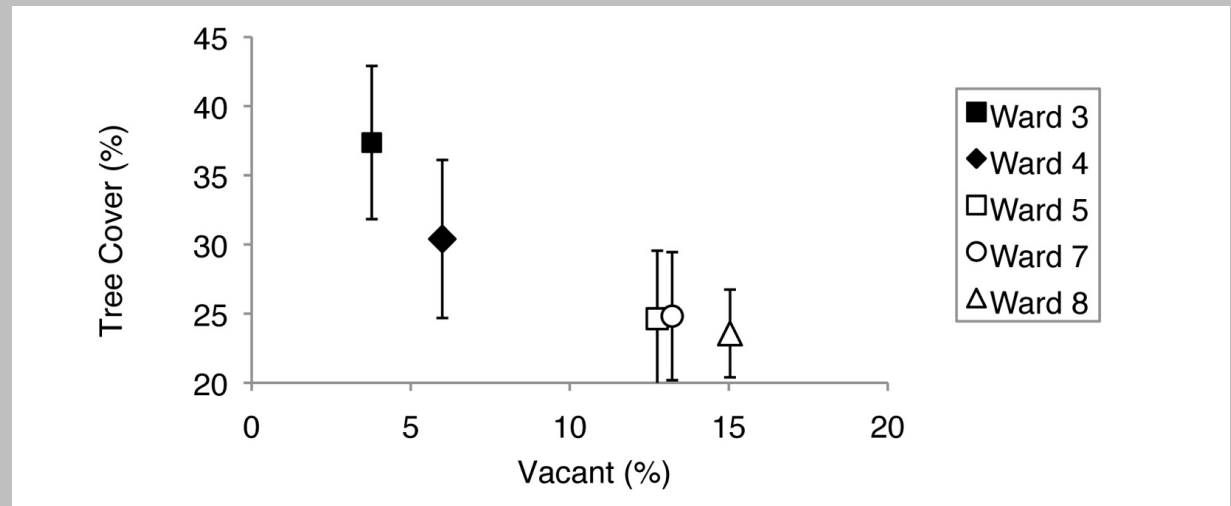


# Factors in DC Tree Cover Dynamics

Within low density residential zones:

Census tracts with high rates of 20-year population loss and property vacancy contained significantly less tree cover

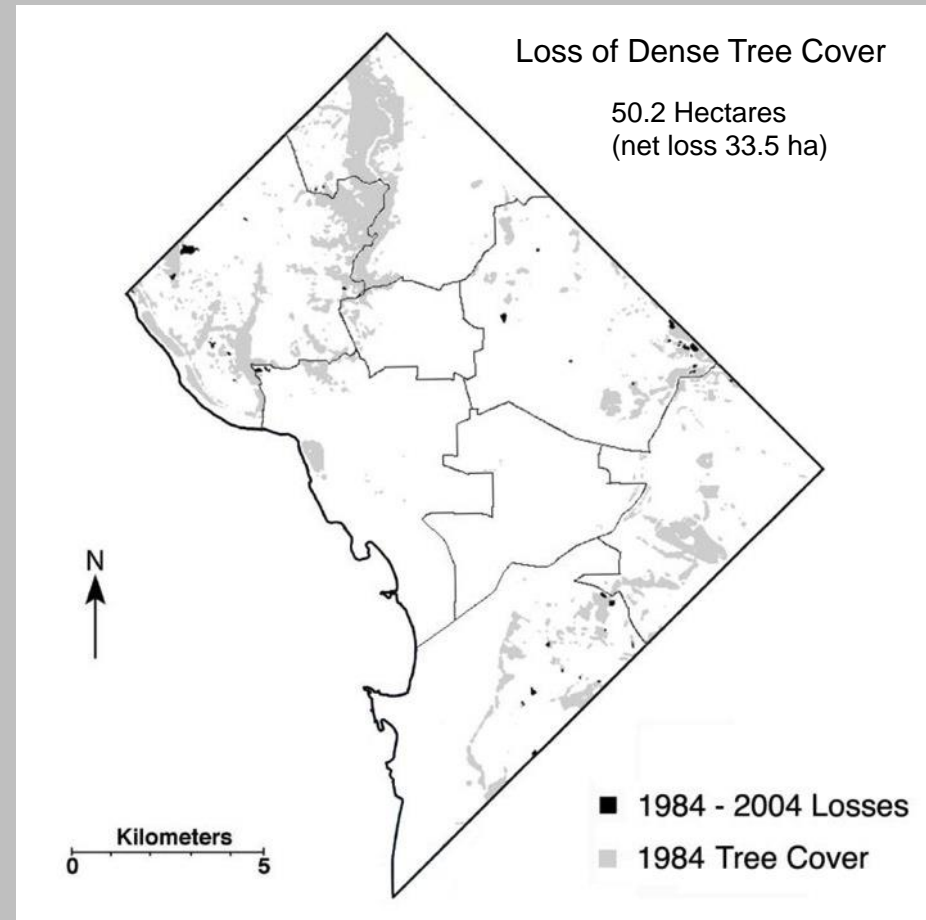
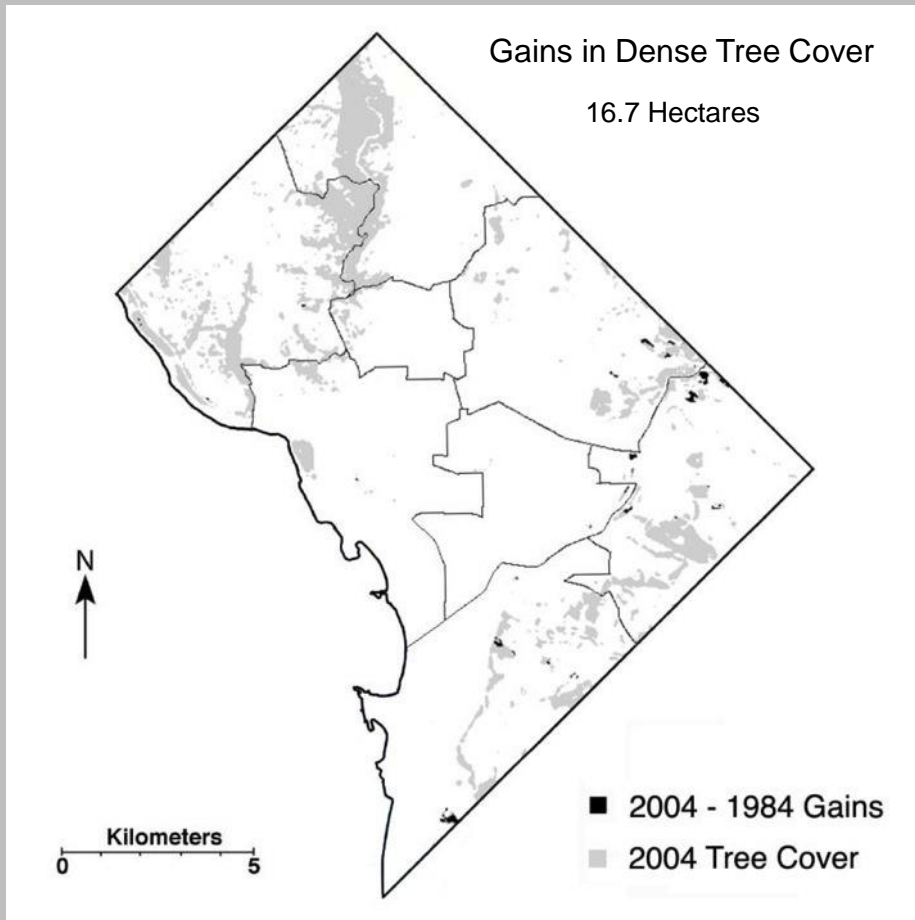
Variable	R <sup>2</sup>	p<0.05
Population Change	0.98	yes
Vacancy	0.91	yes
Owner Occupation	0.57	no
Detached Homes	0.53	no
Population Density	0.03	no





# Factors in DC Tree Cover Dynamics

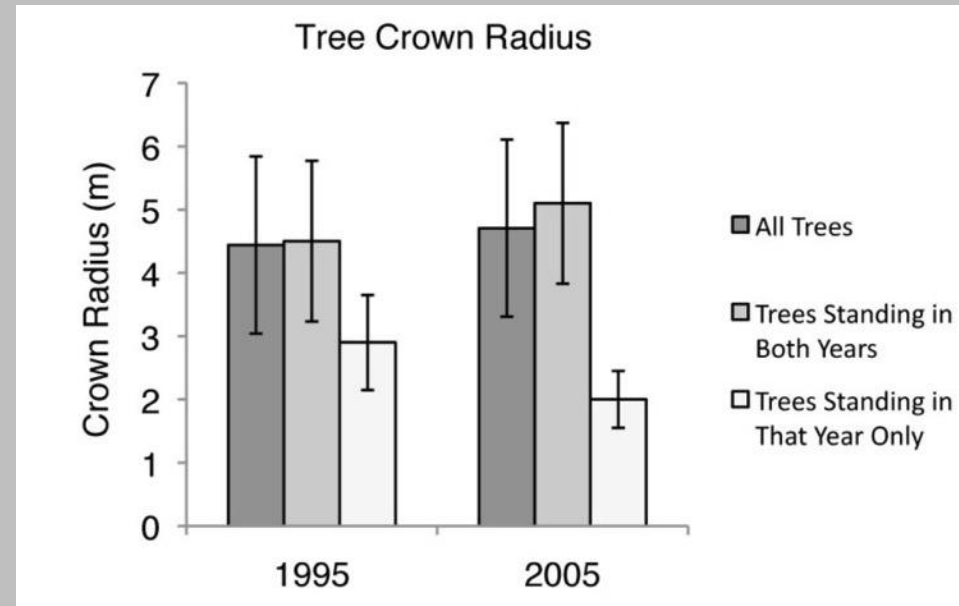
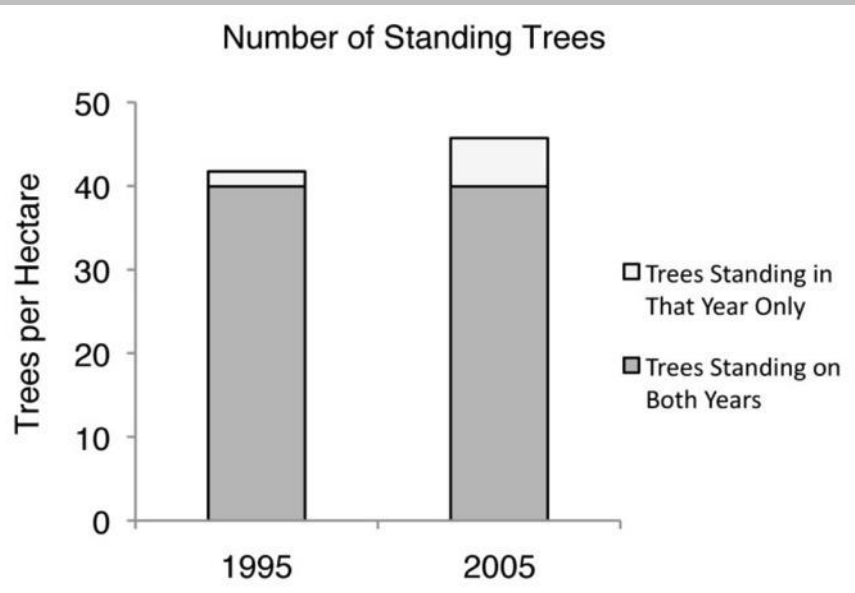
## Land Cover Change



Years	Change Total	Ward 2	Ward 3	Ward 4	Ward 5	Ward 7	Ward 8
1984-1988	9.6	2.4	4.1		3.2		
1988-1992	18.7	0.8	6.5	1.6	4.1		5.7
1992-1996	1.6		1.6				
1996-2000	3.2				3.2		
2000-2004	17.0		1.6		7.3	0.8	7.3
All Years	50.2	3.2	13.8	1.6	17.8	0.8	13.0

# Factors in DC Tree Cover Dynamics

## Fluctuation in Size and Number of Trees in Low Density Residential Zones



Tree Size: Small increase in mean crown radius. Precision limited by air photo resolution.

Number of trees: Net increase of 4.3 trees per hectare (1 tree every 2.3 years per ha)

Assuming no crown changes, number of trees accounts for 37% of canopy change.

# Factors in DC Tree Cover Dynamics

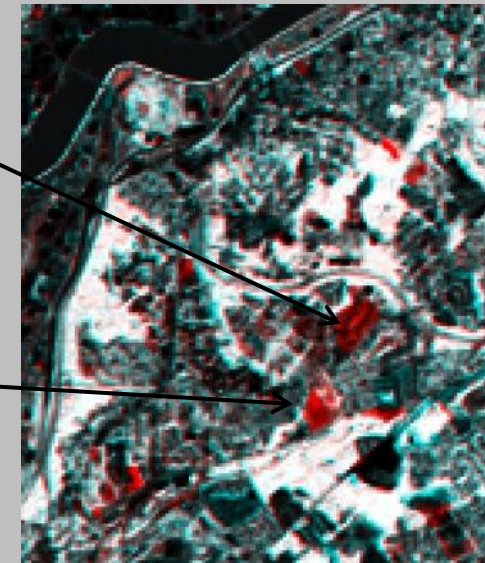
Example of neighborhood scale forest changes due to economic development of government land.



2002



2005



2000 - 2004  
Tree cover change

Suggests the importance of large plots undergoing conversion.



# Implications for Future Planning

**There was no overall trajectory for DC tree cover 1984-2004.**

City-wide tree cover remained between 22.1(+/-2.9)% and 28.8(+/-2.9)%.

**Variability driven by changes in low density residential zones.**

Tree cover declined 7.4(+/-5.4)% between 1990-1996 in low density residential zones then recovered.

**Land cover change impacts tree cover.**

50 ha of dense tree cover removed 1984-2004, but regrowth probable.  
Most development projects in ward 3 before 1994, then wards 5 & 8.

**Both planting and maintenance needed.**

Tree replacement and growth had large impact on canopy coverage.

# Implications for Future Planning

## **Valid comparisons in relative change are required.**

DC Tree cover varies 30-35% land surface area with different maps.  
Methods with high resolution data better suited for future monitoring.

## **Report uncertainty and perform error assessments.**

No method can reliably measure 0.1% changes in tree cover.  
Two measurements of change 2006-2011 with *the same data* showed either a 2% increase or 2% decrease.

## **Tree canopy goals**

Focus on low density residential zones.

Increasing tree cover in all low density residential zones to levels in ward 3 would raise DC tree cover by approximately 4% land area.