

Houston Green UFORE

(Urban Forest Effects)



Purpose: To build tools and systems that help state and local groups monitor and guide the development of green infrastructure to improve the quality of life in Houston.



Houston Green

Houston Area Urban Ecosystem Analysis



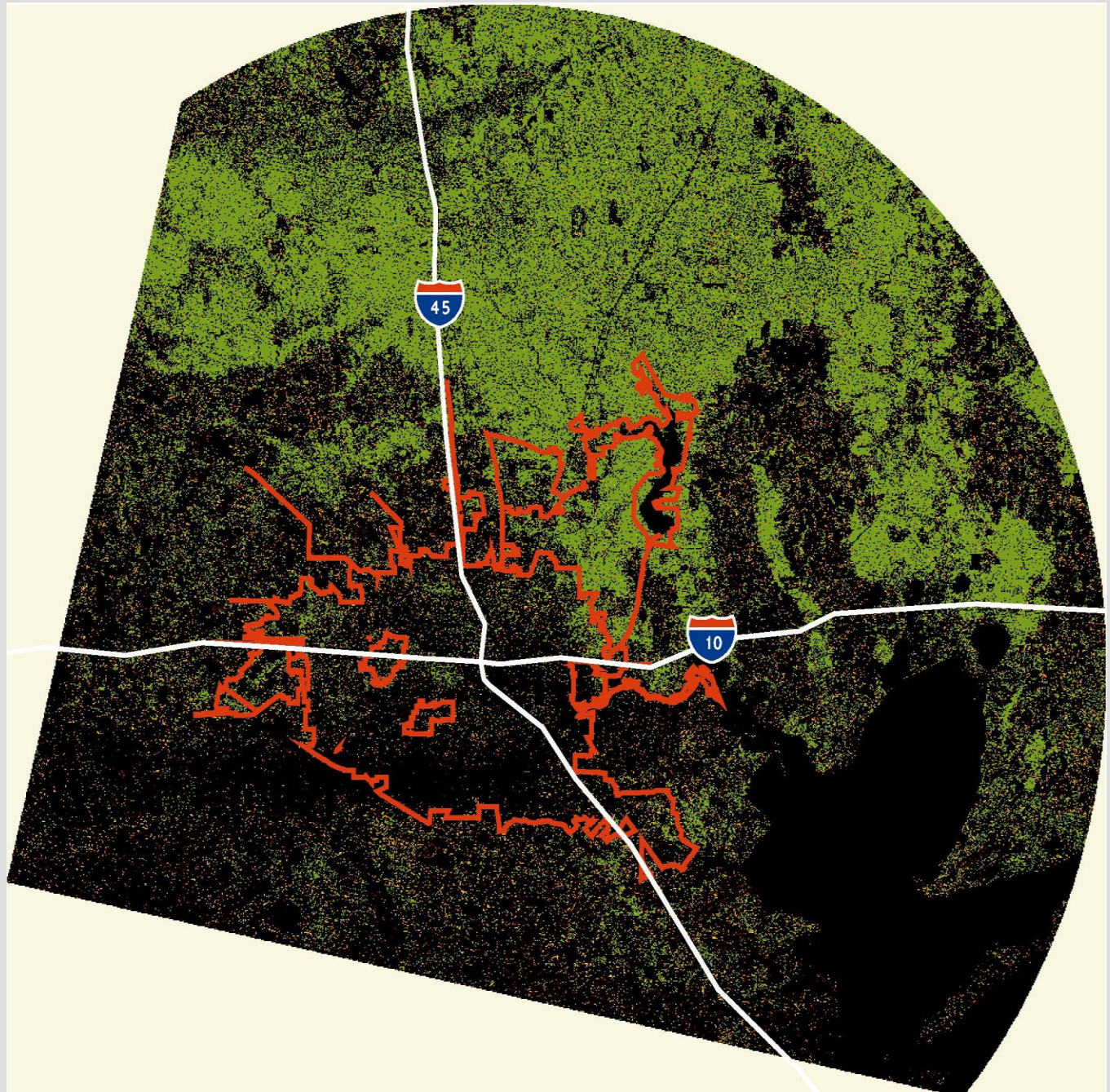


Houston Area Urban Ecosystem Analysis

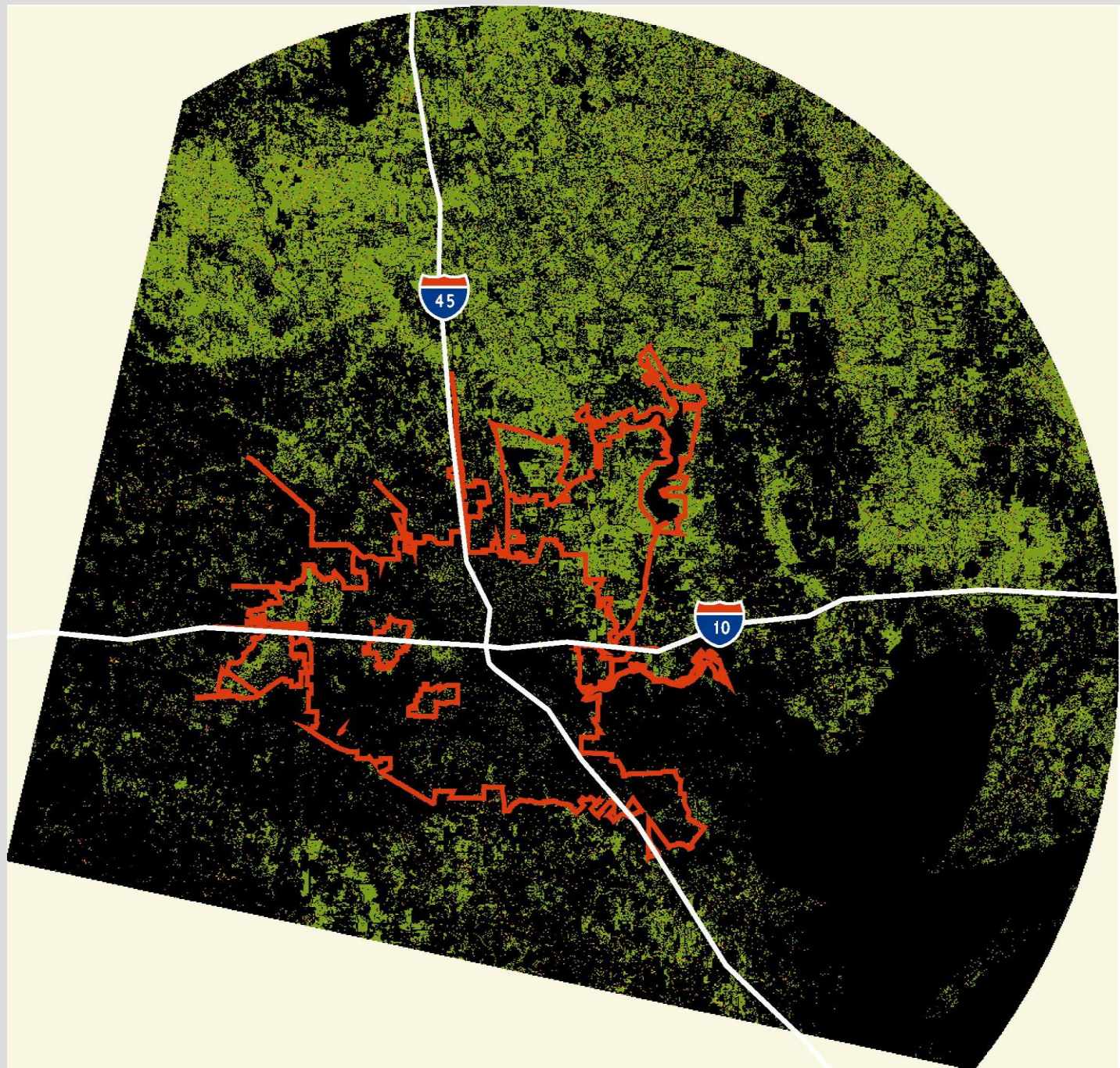
Goals:

- **Quantify benefits of Houston-area urban forests**
- **Provide information to support public policy decisions and the work of local nonprofits and agencies**

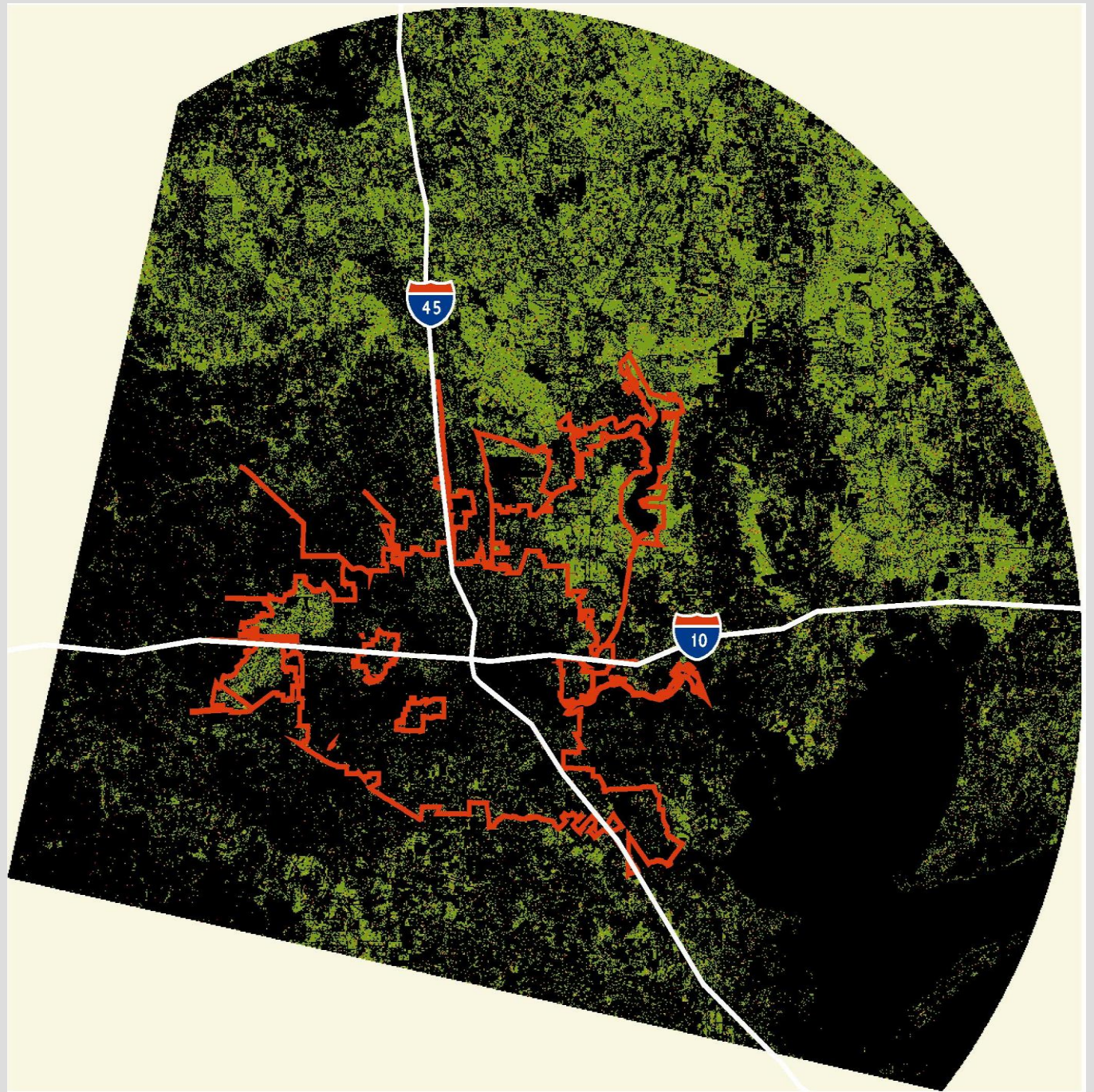
1972 Tree Canopy



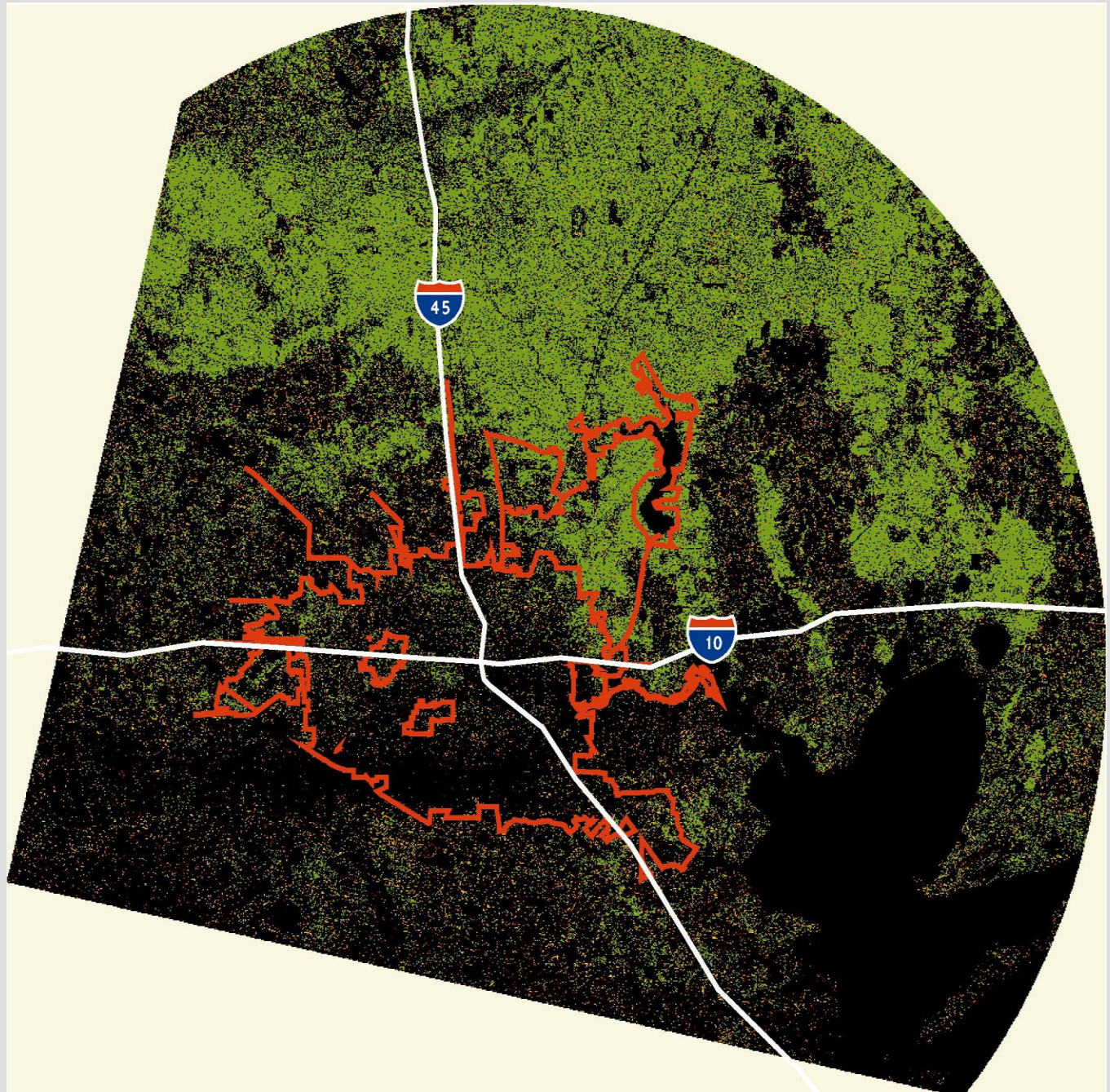
1984 Tree Canopy



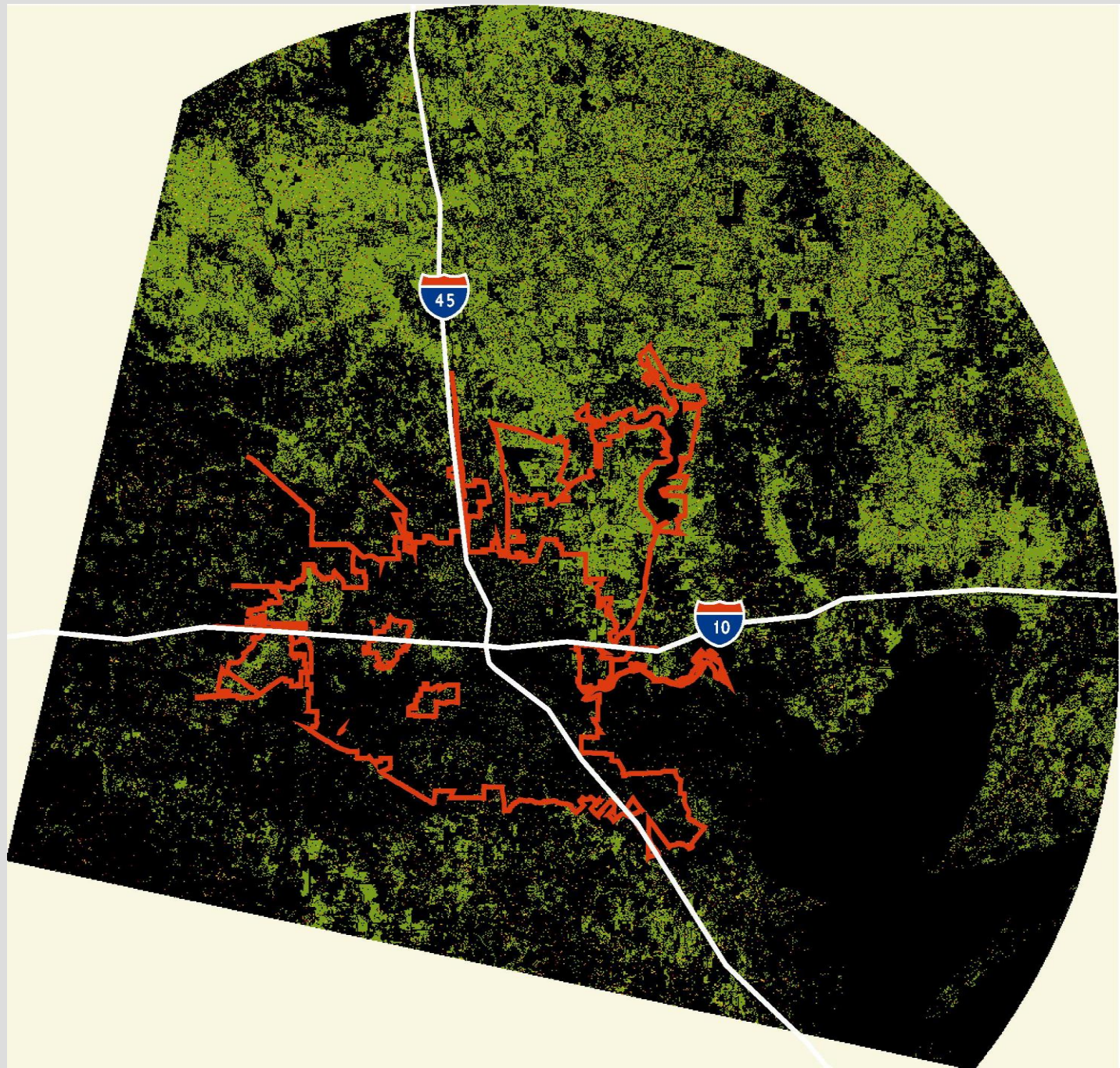
1999 Tree Canopy



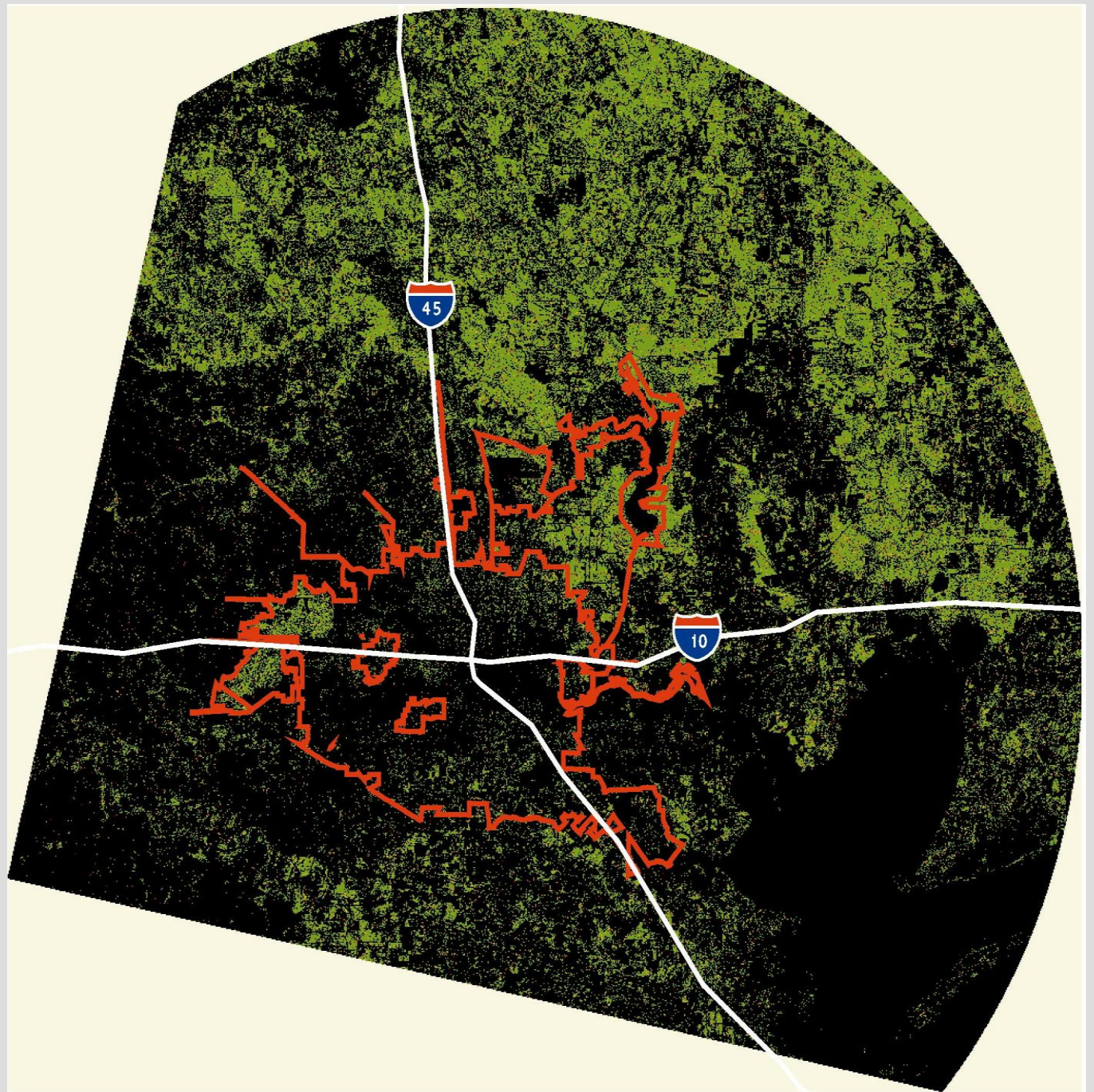
1972 Tree Canopy



1984 Tree Canopy



1999 Tree Canopy





Houston Area Urban Ecosystem Analysis

Findings: Houston Metropolitan Area has had significant loss of tree cover.

- Current canopy level is 27%, down 16 percent since 1972.

Air Pollution: 83 million pounds removed annually at a value of \$208 million.

Stormwater Management: \$1.33 billion in avoided retention/detention costs.

Energy Use: Annual energy savings from trees is \$26 million.

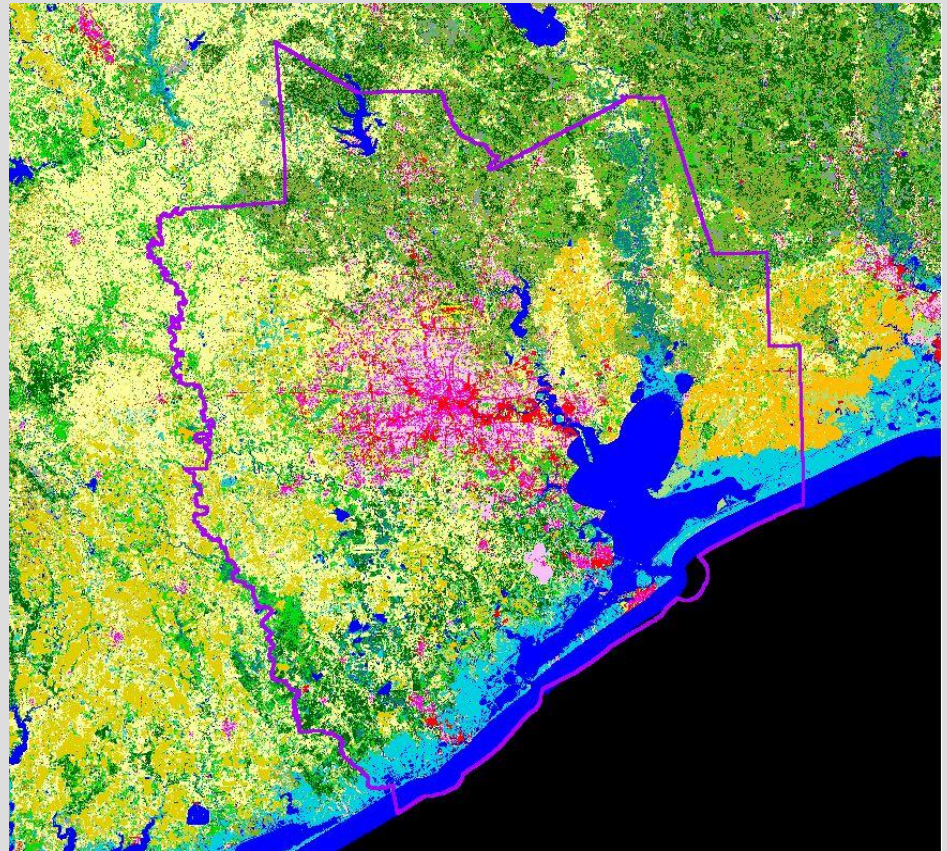


The UFORE model is currently designed to provide estimates of:

- Urban forest structure by land use type. Forest structure data includes such variables as species composition, number of trees, diameter, tree density, tree health, leaf area, leaf and tree biomass, and species diversity.
- Amount of pollution removed by the urban forest and associated percent air quality improvement throughout the year. Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter (<10 microns).
- Urban forest volatile organic compound (VOC) emissions and the relative impact of tree species on net ozone and carbon monoxide formation throughout the year.
- Total carbon stored and net carbon annually sequestered.
- Effects on building energy use and consequent effects on carbon dioxide emissions from power plants.
- Compensatory value of the forest, as well as the value of air pollution removal and carbon storage and sequestration.

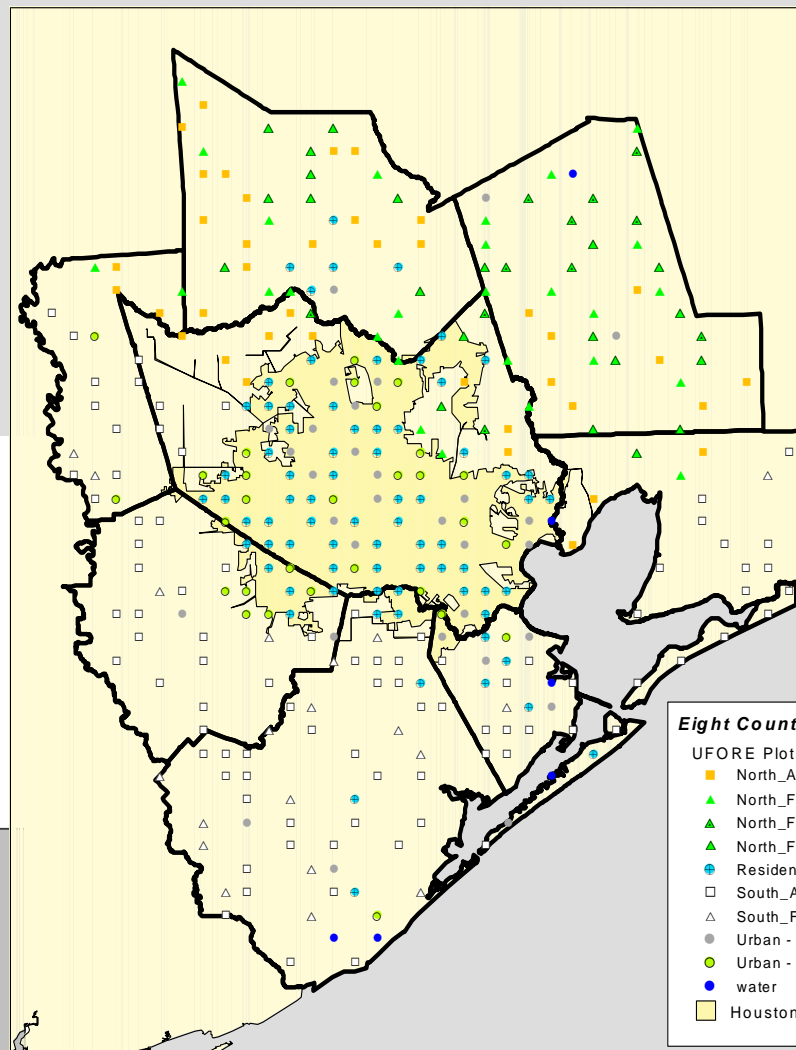
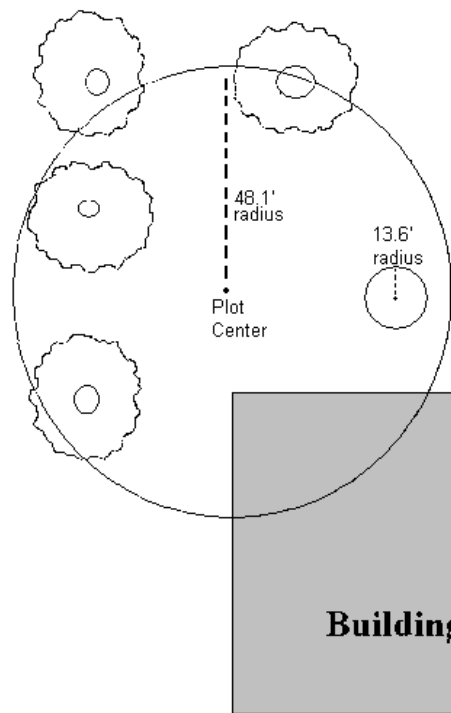
Houston UFORE 8-County Study Area

- Field analysis of tree species, sizes and conditions
- Regional analysis of land cover and land use
- Integrated ozone modeling incorporating the latest field data and modeling techniques



Field Data Collection

- 332 1/6 acre plots with 1/75 microplots for trees less than 5" dbh



Land-use type	Number of plots
Southern agricultural/range	86
Residential	68
Northern agricultural/range	38
Urban green	30
Urban built	30
Northern forest broadleaf	26
Northern forest mixed	20
Southern forest	17
Northern forest conifer	11
Water	6

Eight County Study Area

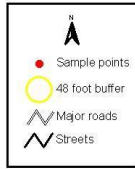
UFORE Plot Locations

- North_Ag-Range
- ▲ North_Forest-BL
- ▲ North_Forest-CONF
- ▲ North_Forest-Mixed
- Residential
- South_Ag-Range
- △ South_Forest
- Urban - Built
- Urban - Green
- water
- Houston Urbanized Area

UFORE Sample Points

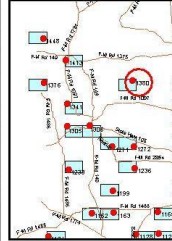


LEGEND



Sample - UTM Coordinates
N 3374926.71 E 250287.49

INDEX MAP



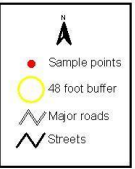
Gulf Coast Institute
2013 F007 Sample Points Report 11/16/13
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SCALE 1:2,000

UFORE Sample Points

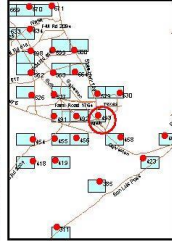


LEGEND



Sample - UTM Coordinates
N 3260109.60 E 311010.68

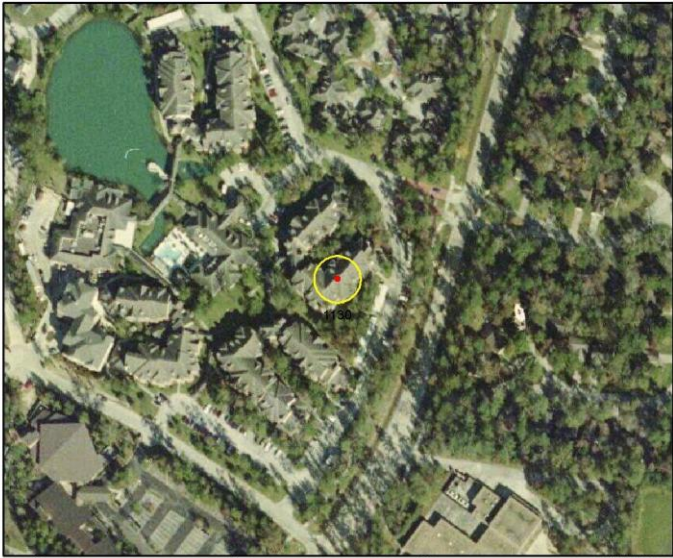
INDEX MAP



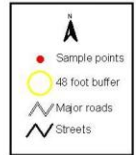
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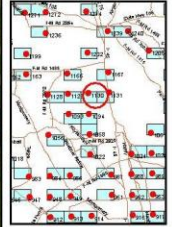


LEGEND



Sample - UTM Coordinates
N 3340226.97 E 259221.63

INDEX MAP



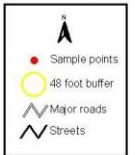
Gulf Coast Institute
2013 F007 Sample Points Report 11/16/13
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UFORE Sample Points

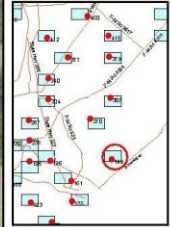


LEGEND



Sample - UTM Coordinates
N 3211479.63 E 290266.02

INDEX MAP



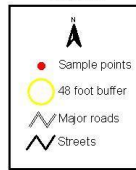
Gulf Coast Institute
2013 F007 Sample Points Report 11/16/13
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UFORE Sample Points

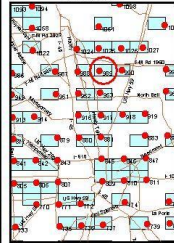


LEGEND



Sample - UTM Coordinates
N 33202138.30 E 273484.00

INDEX MAP



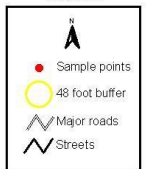
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SCALE 1:2,000

UFORE Sample Points

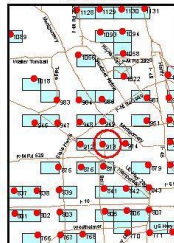


LEGEND



Sample - UTM Coordinates
N 3310828.72 E 253488.76

INDEX MAP



400 0 400 800 Feet

SCALE 1:2,000

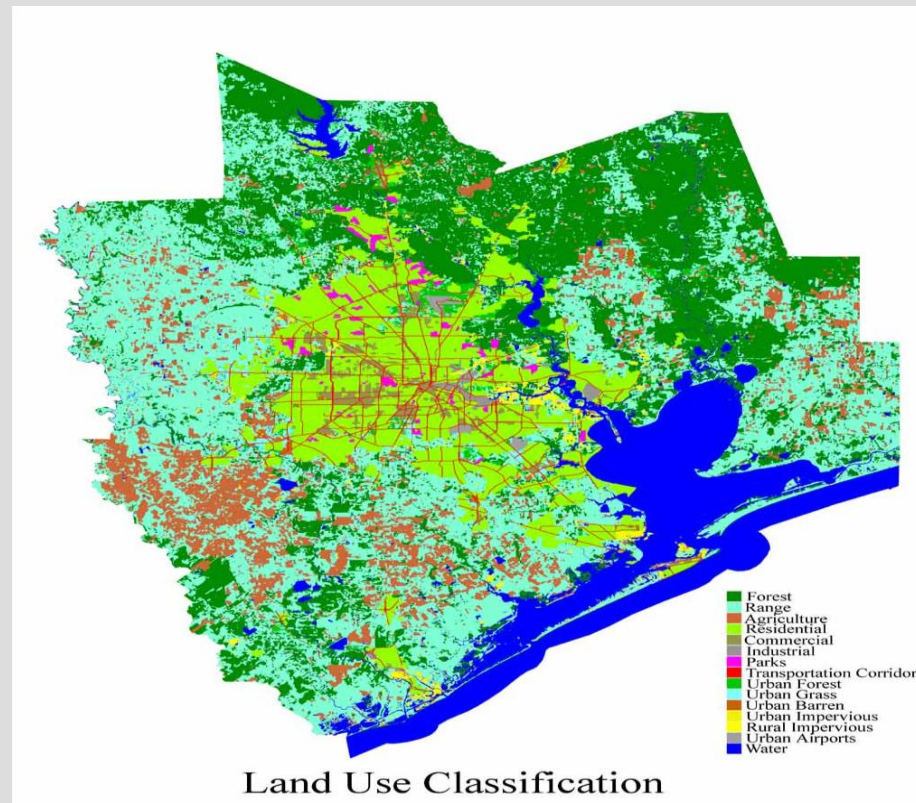
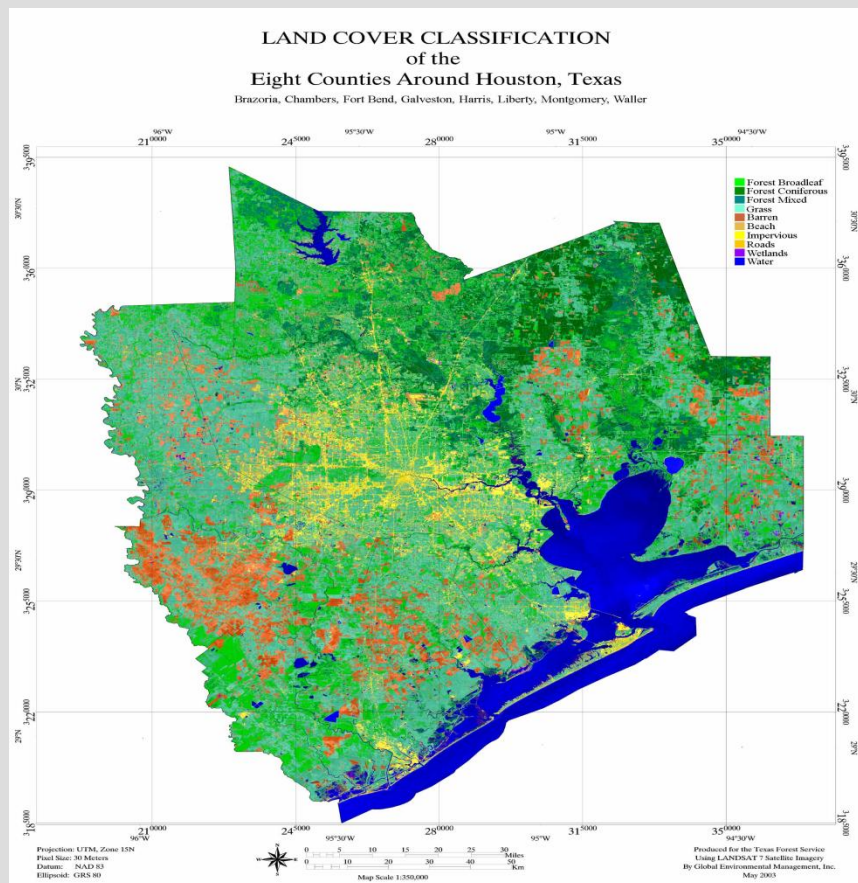


msm 11/20/02 UFORE Urban Inventory Plot Data Sheet

PLOT ID = 1093		DATE = WA		CREW = 12/17		PHOTO #S =													
PLOT SKETCH AND NOTES FOR PLOT RELOCATION																			
PLOT ADDRESS: 25115 Butterwick Dr. Spring, TX 77389				PLOT CONTACT INFO (for non-residential plots): Name & Title: (Brown ?) Zimmerman, Chad + Melanie Phone #: 281-357-1133															
NOTES:				SKETCH MAP															
				No. of actual land uses: 1															
				Plot center staked?: Y / <input checked="" type="checkbox"/>															
				Aspect (degrees): Slope (%):															
LOCATING LANDMARKS (Identify at least two objects)																			
Description		Distance (ft.)		Direction (deg.)															
Object #1																			
Object #2																			
Object #3																			
LAND USE AND COVER (Describe on separate sheet for more than one use)																			
ACTUAL LAND USE	R			% OF PLOT IN THIS USE	100			PLOT TREE COVER (%)	40			PLOT SHRUB COVER (%)	10			PLANTABLE SPACE (%)	15		
GROUND COVER	%LOG	%MNT	%TAR	OTHER IMP	%SOIL	%PERM ROCK	%DUFF MULCH	%SEED-LINGS	%BARN GRASS	%URBAN GRASS	%AG CROPS	HERB NY	WOOD	OTHER PERV					
	25	25			5				45										
SHRUB	SPECIES	HEIGHT	% AREA	% LEAF															
	Sagopal	2'	10	90															
	Holly	4'	5	65															
	Li9	3	5	70															
	Yucc	4	5	70															
OTHER REMARKS:																			

Land Cover / Use Classification

Combined latest satellite imagery to classify land use and land cover



Land cover/use maps produced by
Global Environmental
Management, Inc. (GEM, Inc.)

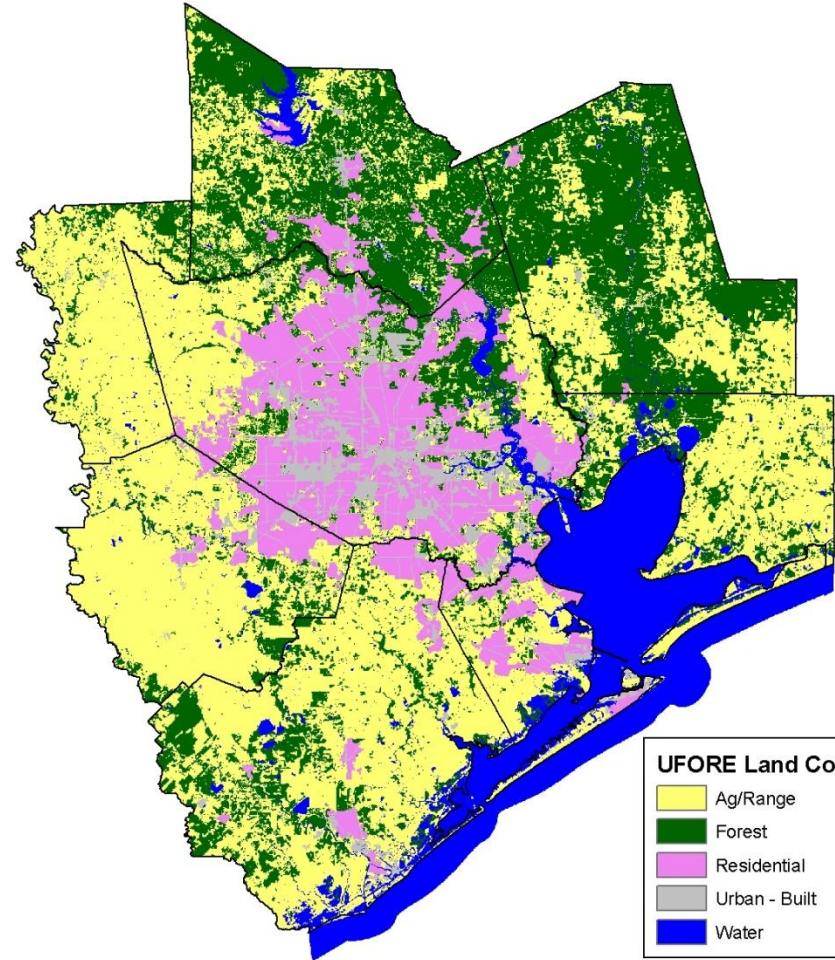
Houston Area Results

Cover Types

- Ag/Range lands 48%
 - North 13%
 - South 35%

- Forest 28%
 - North 22%
 - South 6%

- Developed lands 24%
 - Residential 13%
 - Urban Built 5.5%
 - Urban Green 5.5%



UFORE Land Cover

- Ag/Range
- Forest
- Residential
- Urban - Built
- Water

Houston Area Results

- Number of trees: 663 million
- Most common species: Chinese tallow (23%)
- All oak species: 14.6%
- Regional tree cover: 23.6%
- Annual benefits: \$455 million
- Structural value: \$206 billion



Houston Area Results

Tree Density's

Land Cover Type	Area Sq.Miles	Trees Millions	Density Trees Sq/Mile	Species
South Forest	400.2	88.8	221,771	20
North Forest	1,321.9	382.3	289,209	69
South Ag/Range	2,110.1	71.8	34,009	12
North Ag/Range	794.3	36.6	90,345	15
Residential	782.2	43.9	56,137	36
Urban – Green	327.4	33.9	103,434	26
Urban – Built	327.4	5.9	18,097	14
Total	6063.6	663.1	106,951*	70**

*Average Density

** Total Primary Tree Species Identified in analysis

Most Common Trees

- Chinese tallow tree 23.0%
- Loblolly pine 18.7%
- All Oaks 14.6%
- Cedar elm 6.9%
- Water oak 5.4%
- Hawthorn 4.8%
- Sweetgum 4.6%
- Sugarberry 4.1%
- Green ash 3.7%
- Baldcypress 3.3%

Exotics

The percent exotic from each of the land classifications are:

N. Ag/Range — 8.5%

N Forest BL — 19.7%

N. Forest Co — 12.4%

N Forest Mi — 14.4%

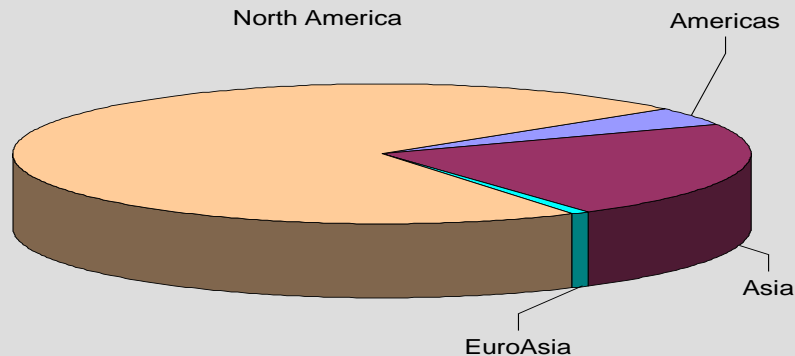
Residential — 38.1%

S. Ag/Range — 78.7%

S. Forest — 24.9%

Urban Built — 14%

Most of the trees found within the study were native to North America (72%) and out of the native trees (65%) are native to the State of Texas.



Urban Forest Benefits Status:

State of the Urban Forest

- Report Complete analysis of urban forest health, structure, function and benefits
- Air Quality Report

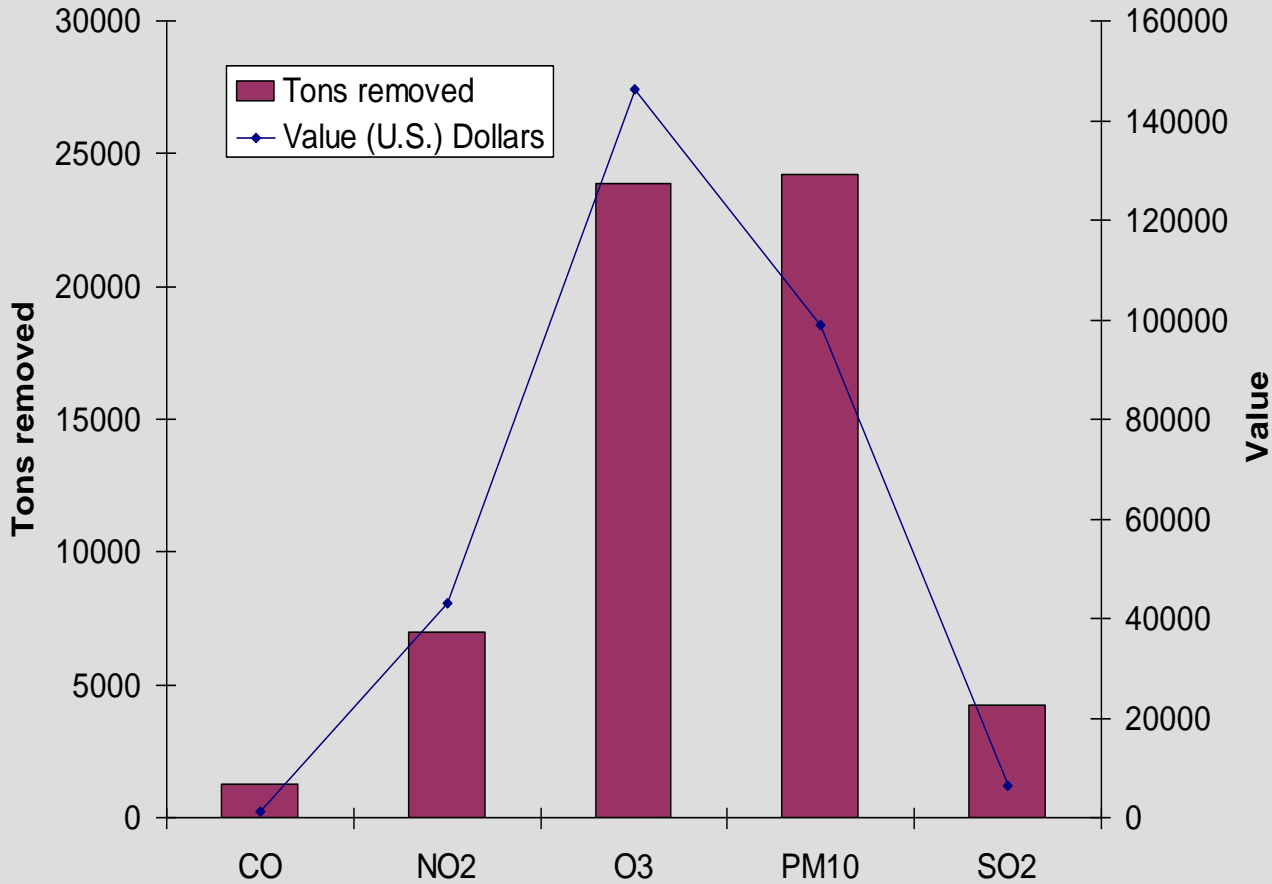
December 2004

Houston Metropolitan Area Report:

Analytical Assessment of
Structure, Function, and Value

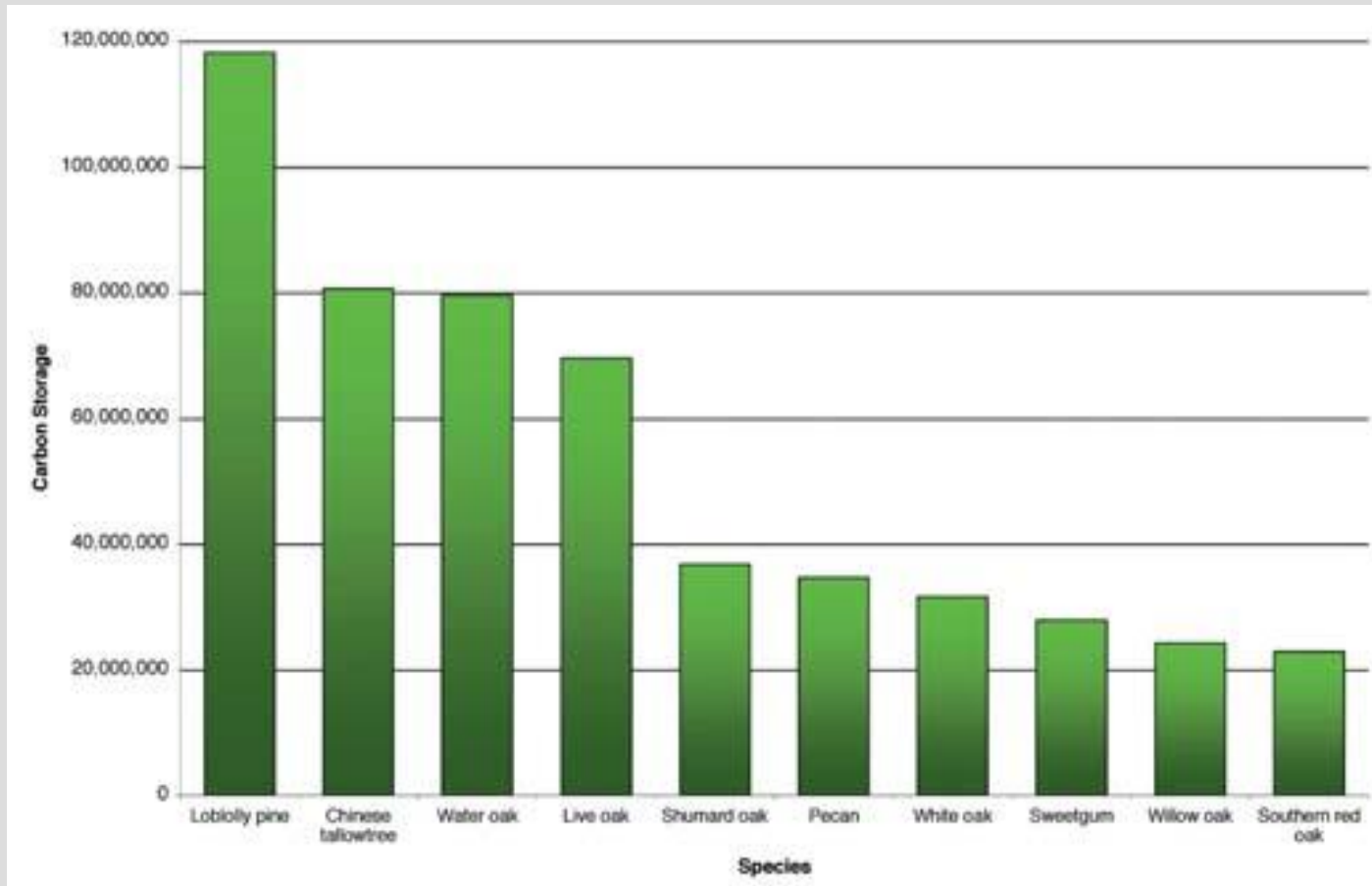


Air Pollution Removal



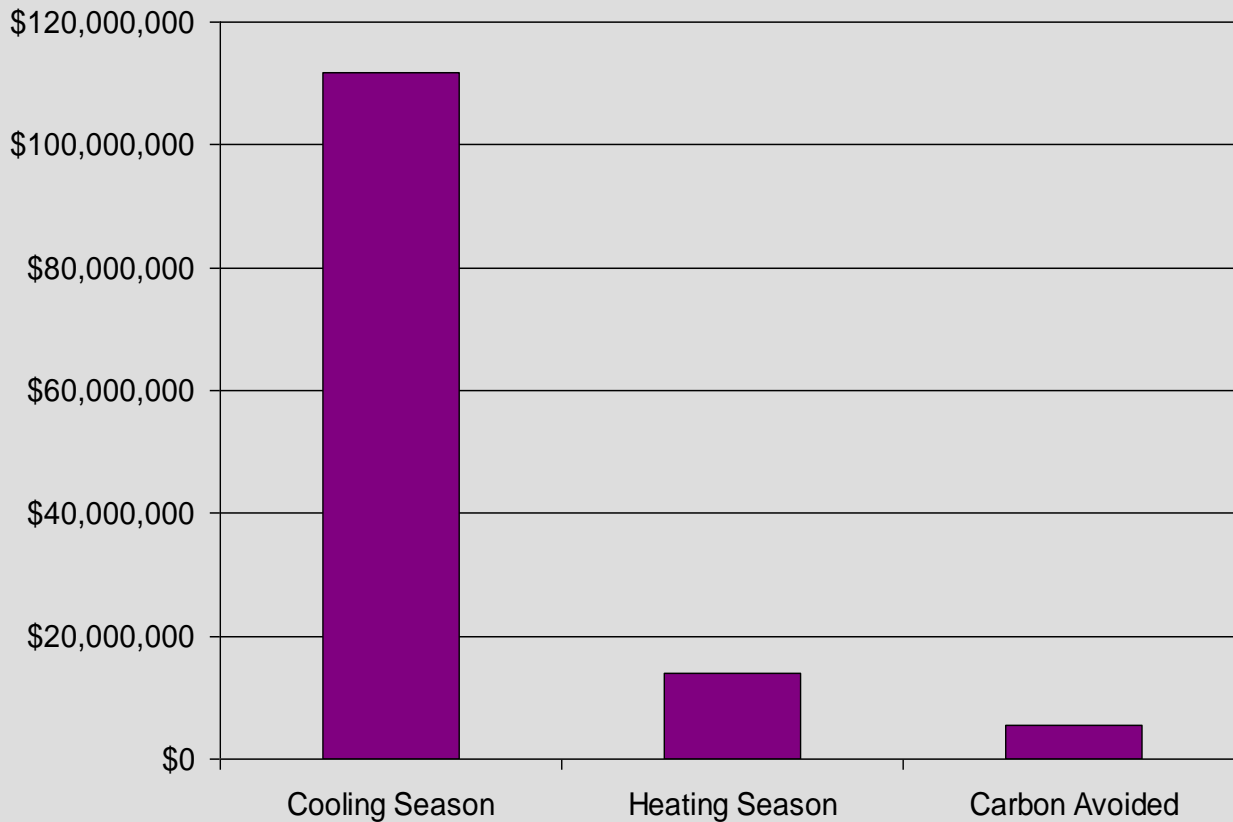
- 166 tons/day
- \$295.2 million / year

Carbon Storage and Sequestration



Trees in the Houston area store 39 million tons of carbon (\$721 million value) and annually sequesters 1.6 million tons of atmospheric carbon (\$29 million value).

Tree Effects on Building Energy Use



Trees in the Houston region provide \$131 million annually in direct and indirect energy savings.

Monetary Value of the Regional Forest

Structural Values:

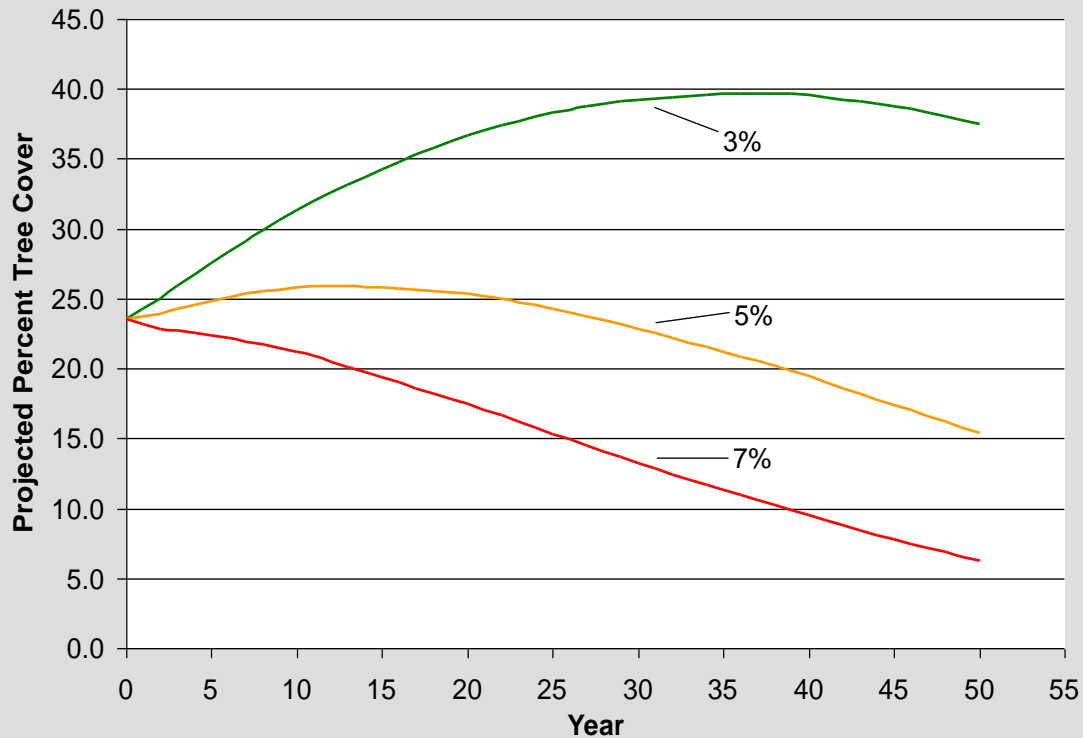
- Replacement or Compensatory value: \$205.8 billion (based on CTLA guidelines)
- Carbon Storage: \$721 million

Functional (Annual) Values:

- Carbon Sequestration: \$29 million
- Pollution Removal: \$295 million
- Energy Savings: \$131 million

Total Monetary Value is over \$206 billion

Houston's Region Forest Future

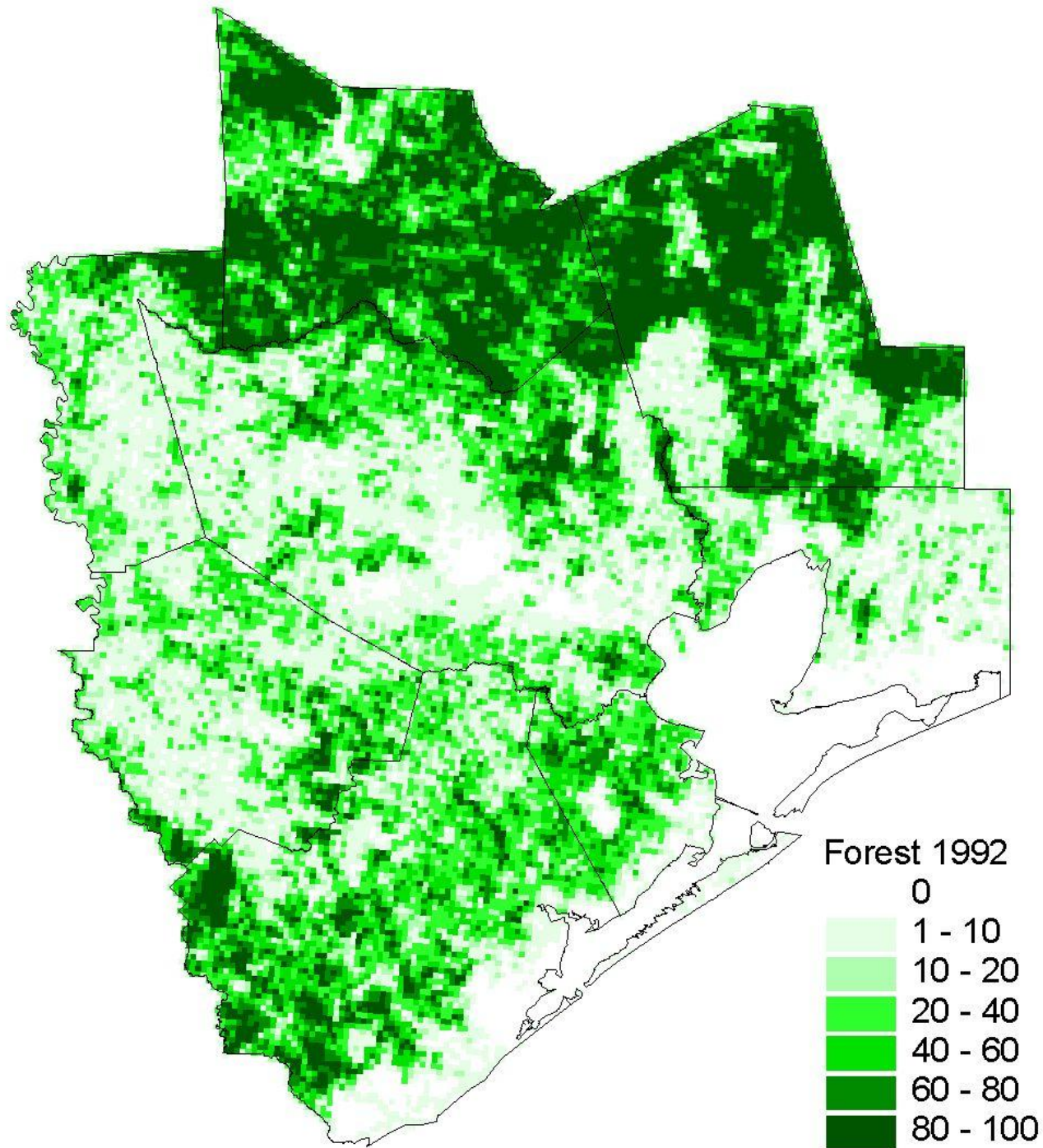


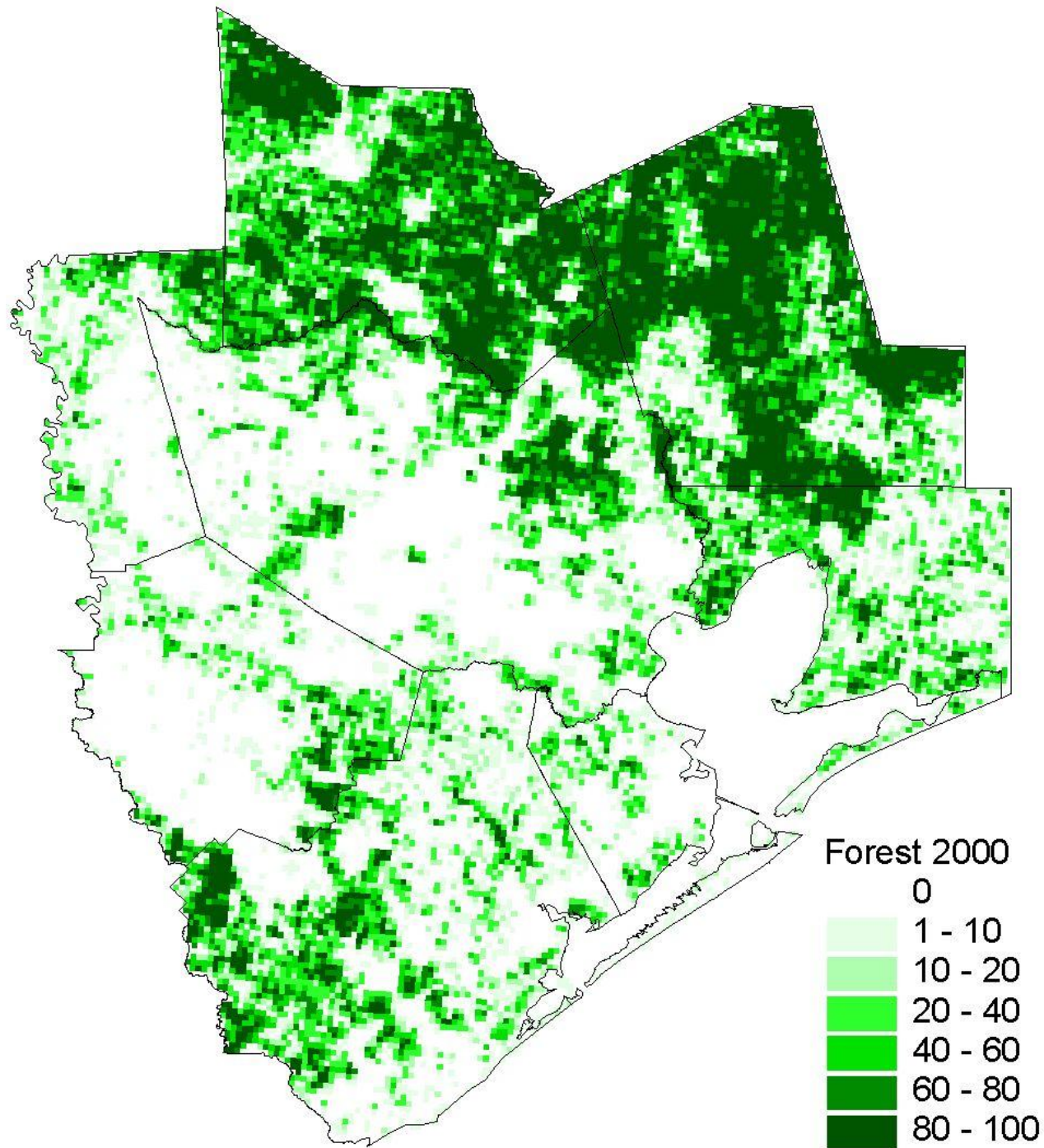
At a 7% mortality rate, approximately 2 million additional trees per year would be needed to maintain existing canopy coverage.

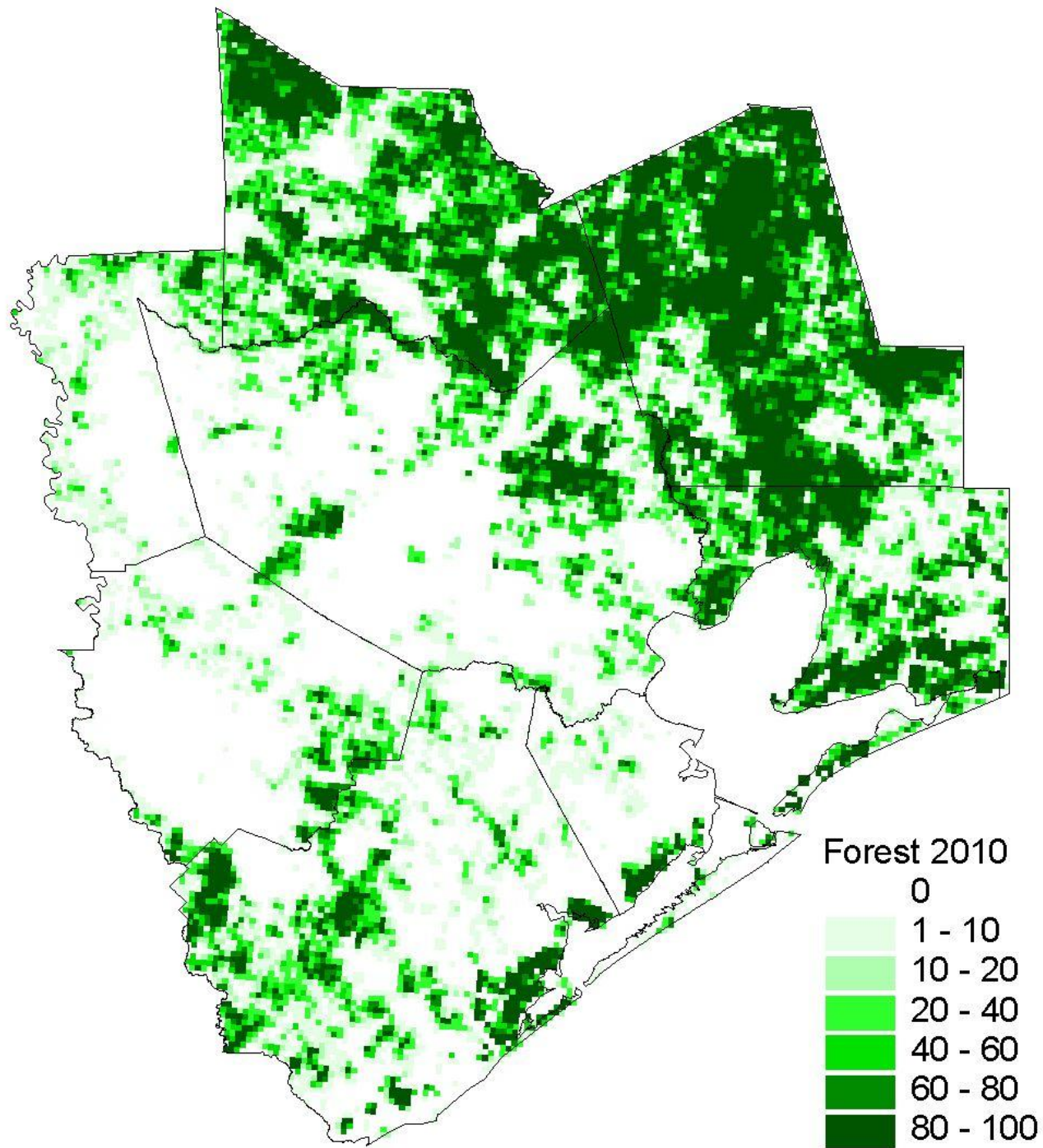
University of Houston

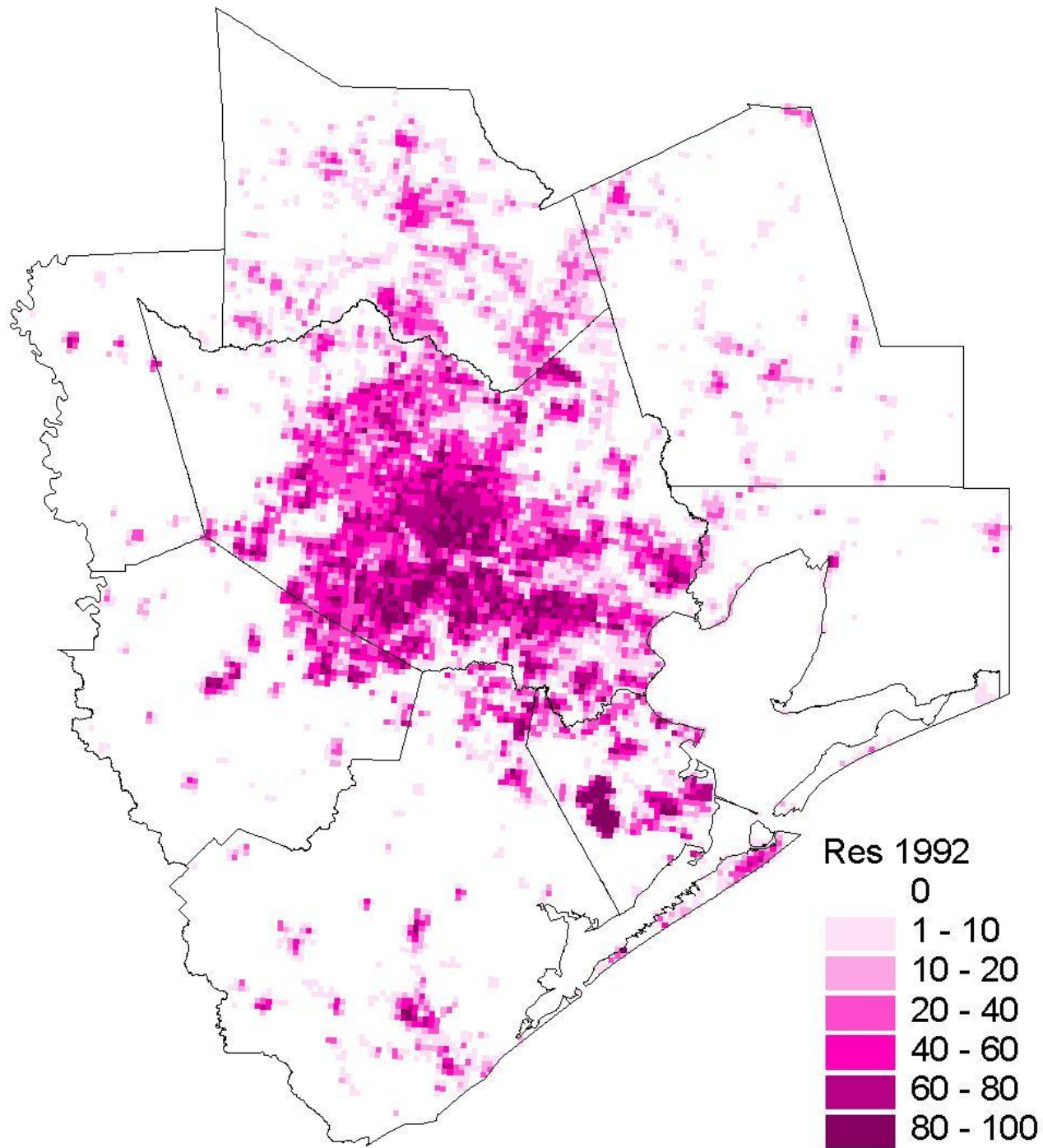
Effects of Land Cover Changes on the Air Quality in the Houston-Galveston Area

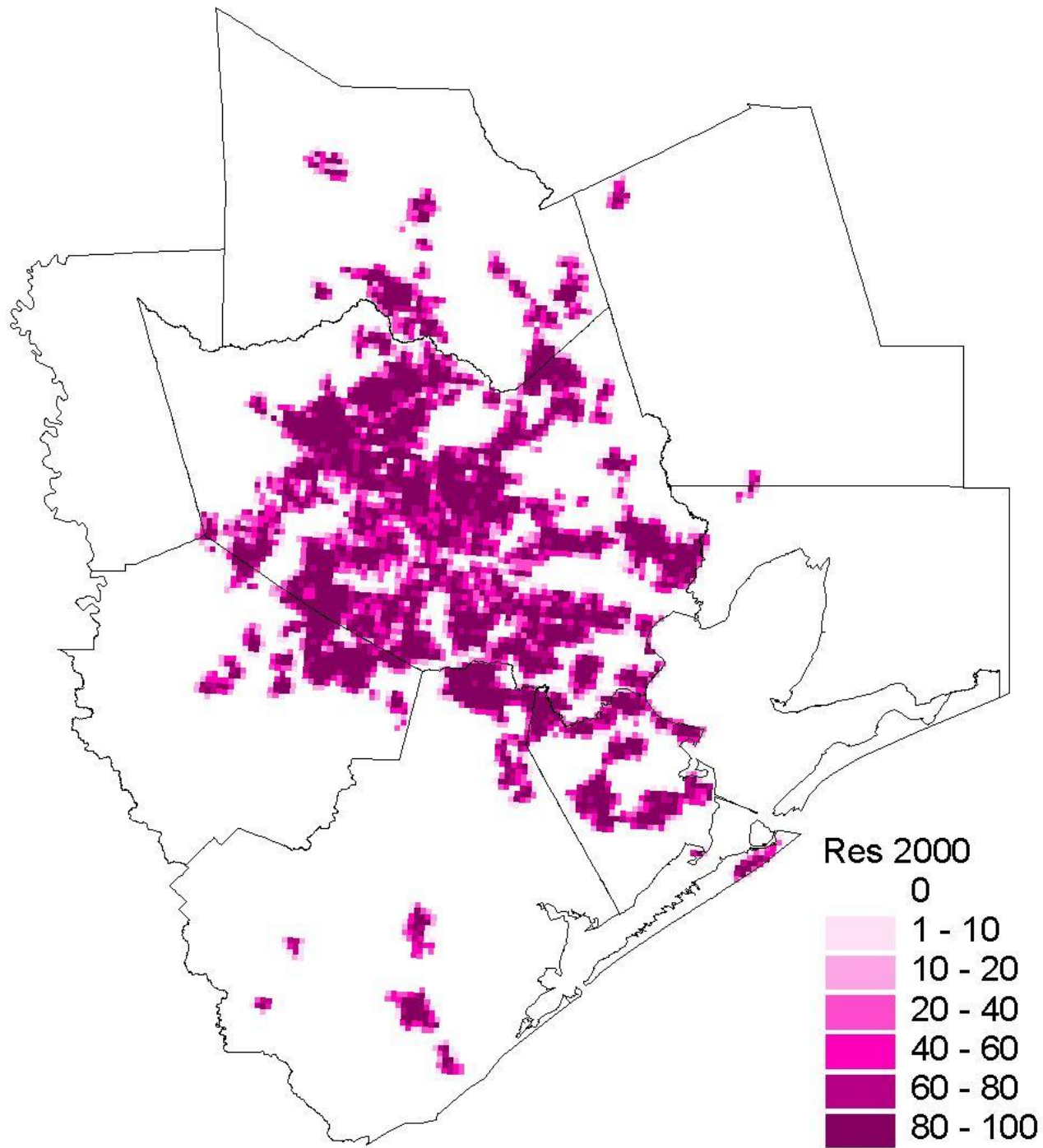
- **Conduct meteorological, emissions, and air quality sensitivity modeling**
- **Incorporate most up-to-date detailed land use and land cover data**
- **Working with latest air quality models to determine the effects of tree cover changes on ozone**
- **Integrates field data within models**

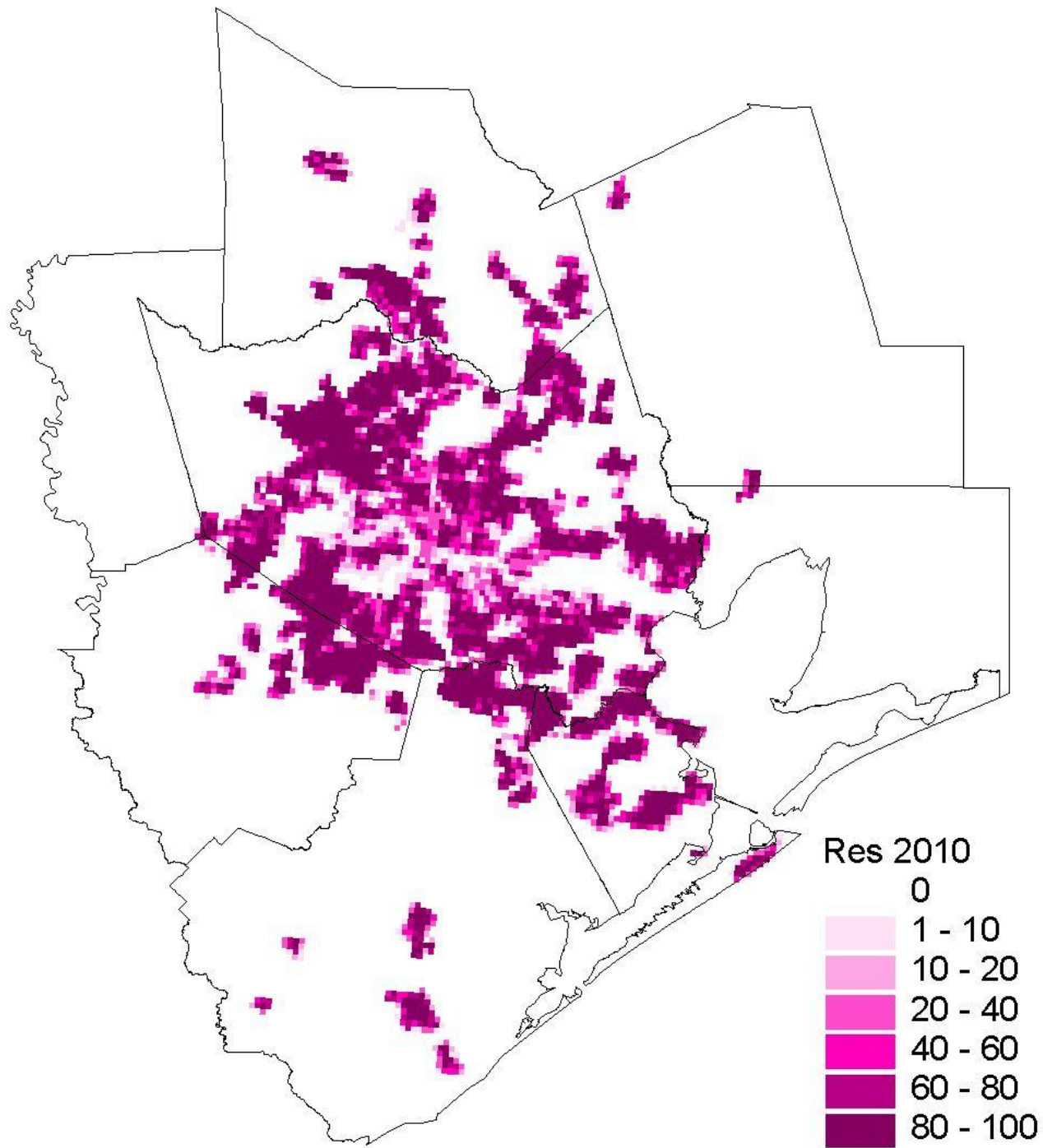












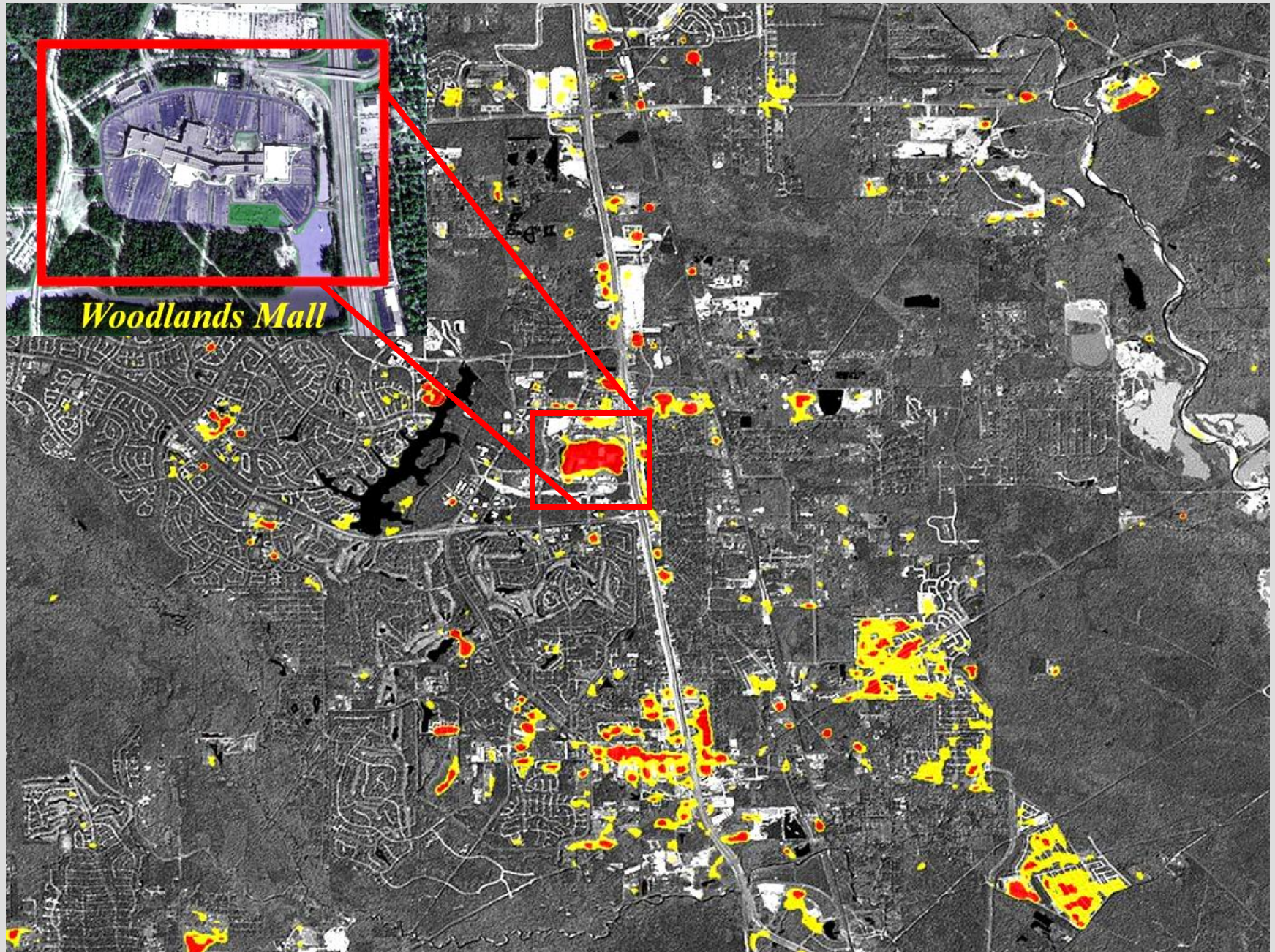
University of Houston

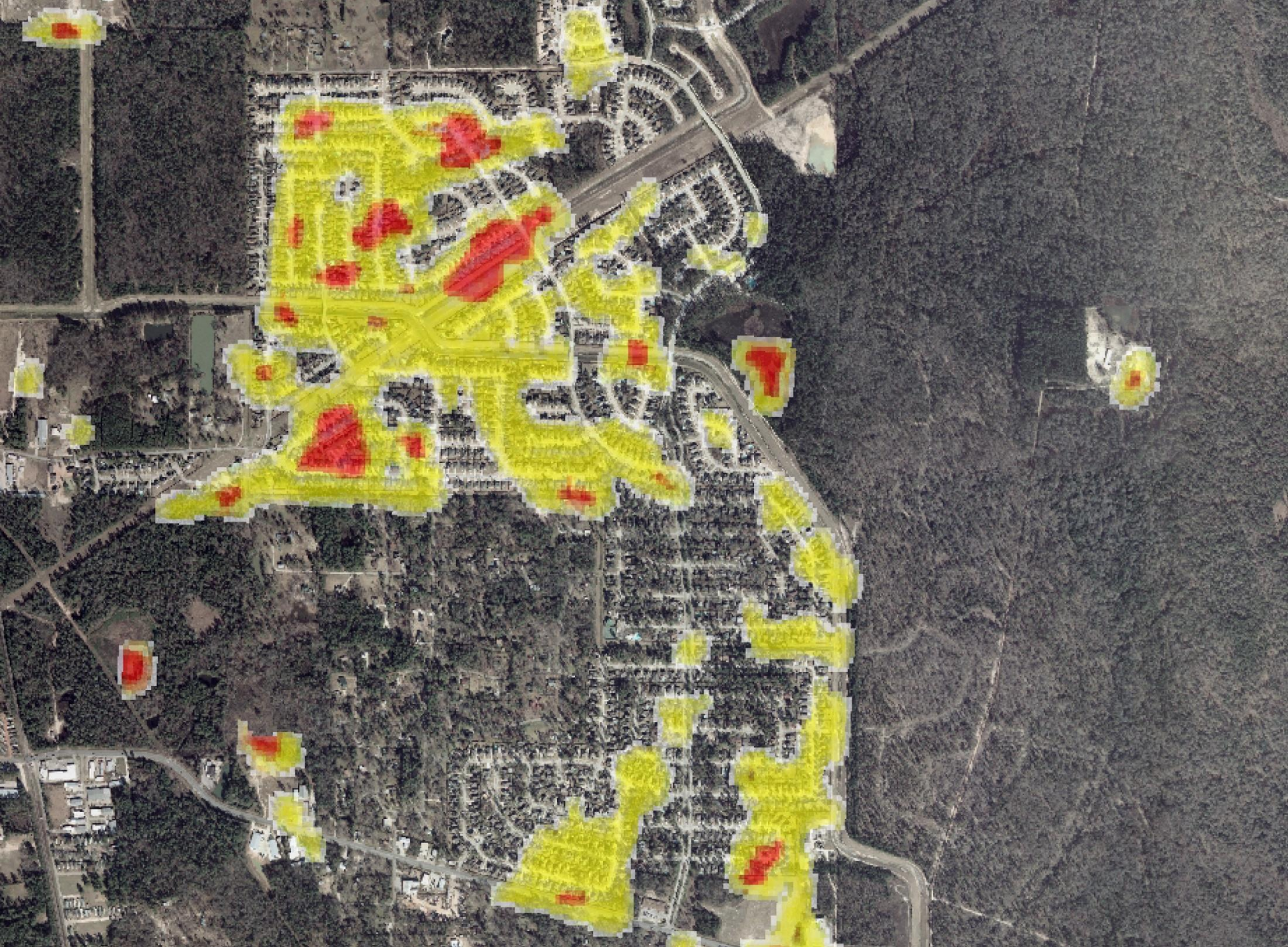
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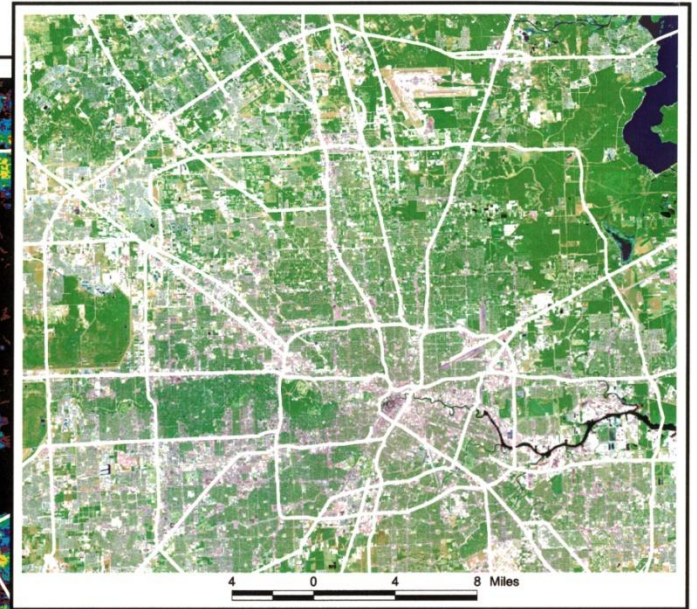
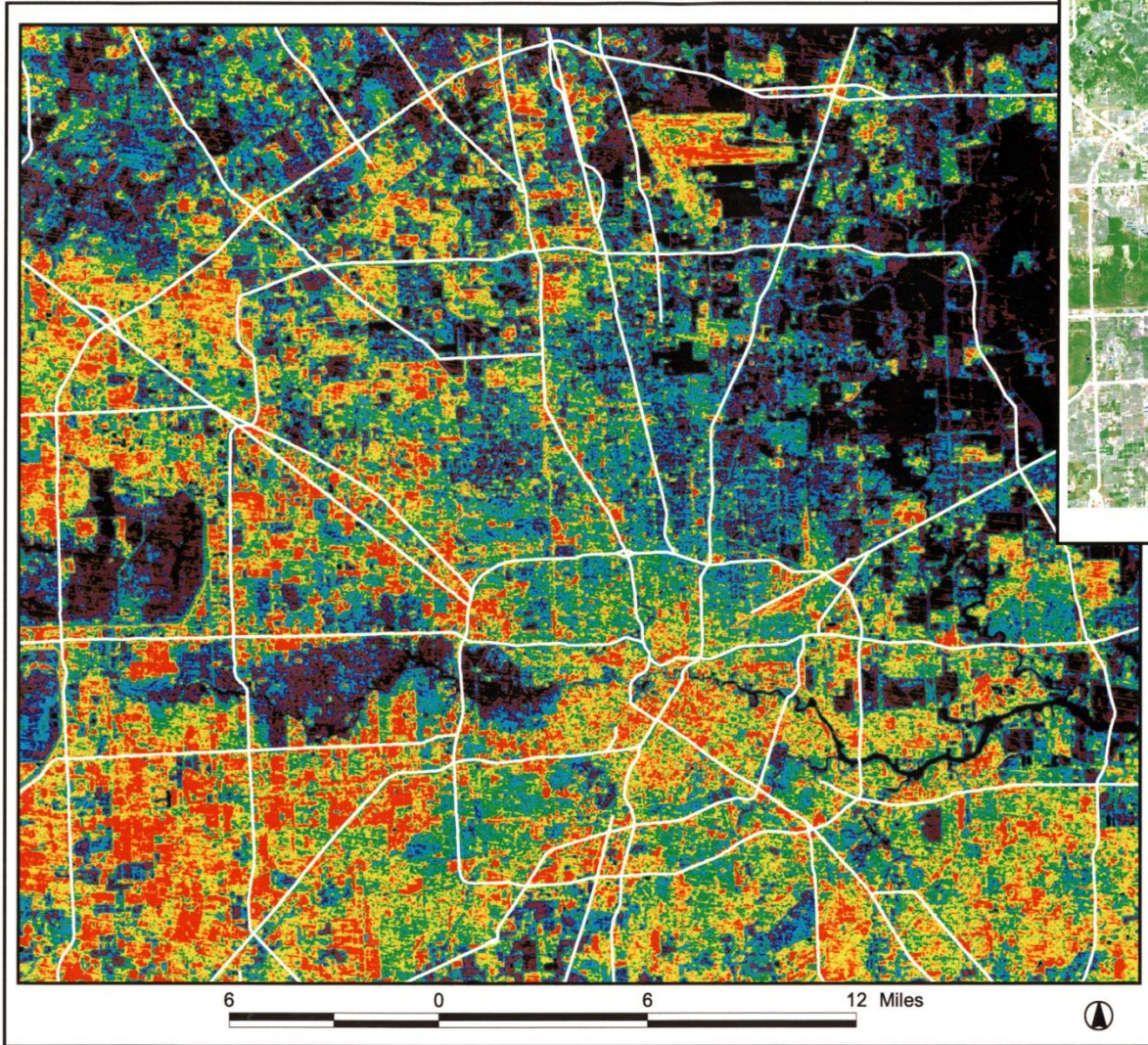
Preliminary Findings:

- ISOP emissions/voc's decrease
- Ambient air temperature increase
- Some (minimal) increase in overall ozone

GIS and Computer Tools







Houston Urban Heat Islands

Source

Landsat-7 ETM+
Thermal band (6L)
Acquired 09/20/1999



Gulf Coast Institute

2001 Kirby Suite 515 Houston TX 77019
issues@gulfcoastideas.org

GIS and Computer Tools Status

- Development of Windows based program to help partners/cooperators in determining best tree species for specific planting objectives.
- Development of GIS program that estimates future urban forest effects across the Houston area based on growth rates, mortality rates and changes in land use classes.

FUTURE EFFECTS

- **30 year grow-out scenarios**
- **Tree mortality**
- **Tree planting**
- **Tree growth**
- **Land use change**



Questions?

