Facilitating integrated assessments of climate and land use change impacts

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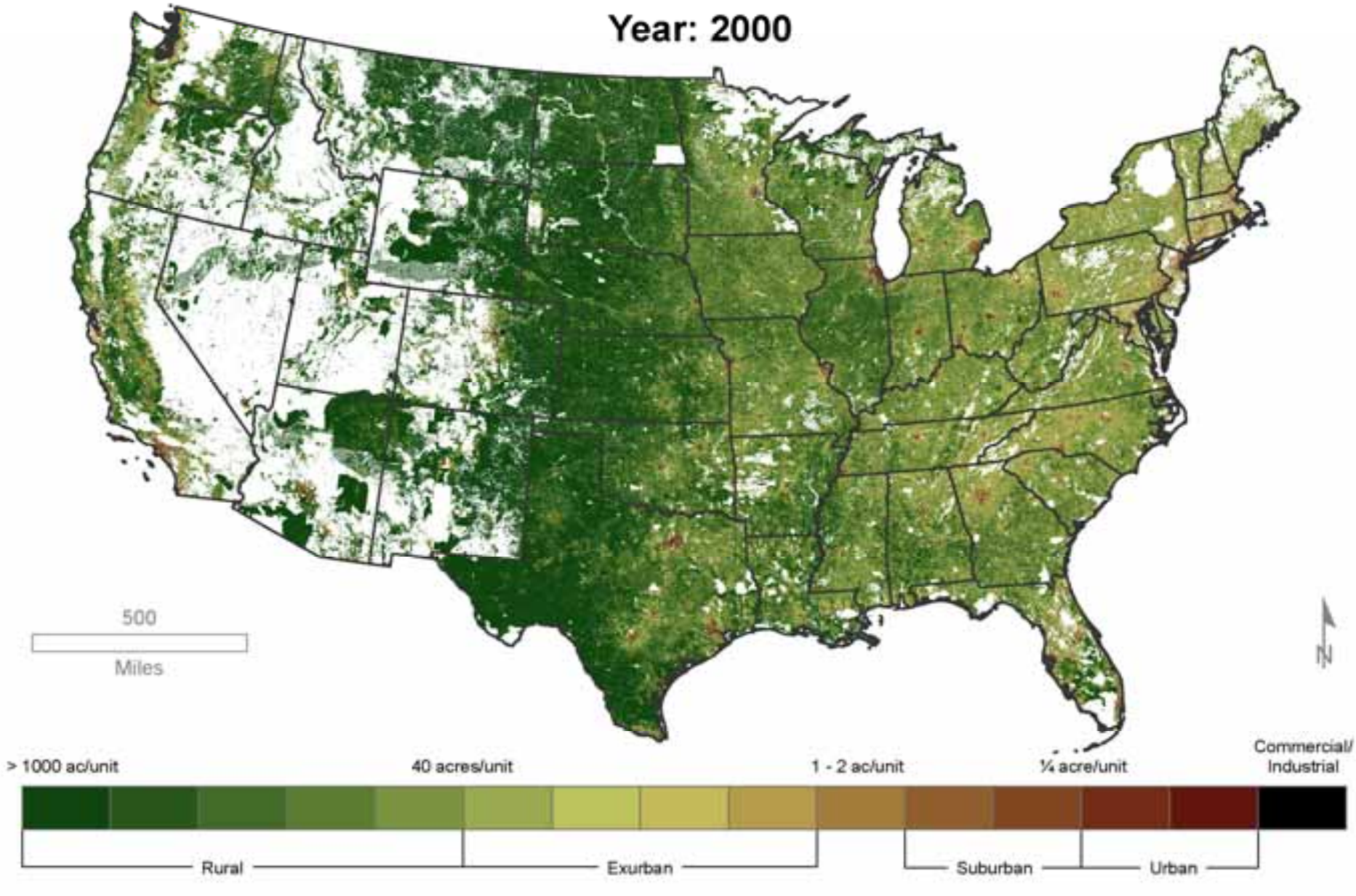
Integrated Climate and Land Use Scenarios

Growth Scenario: A2

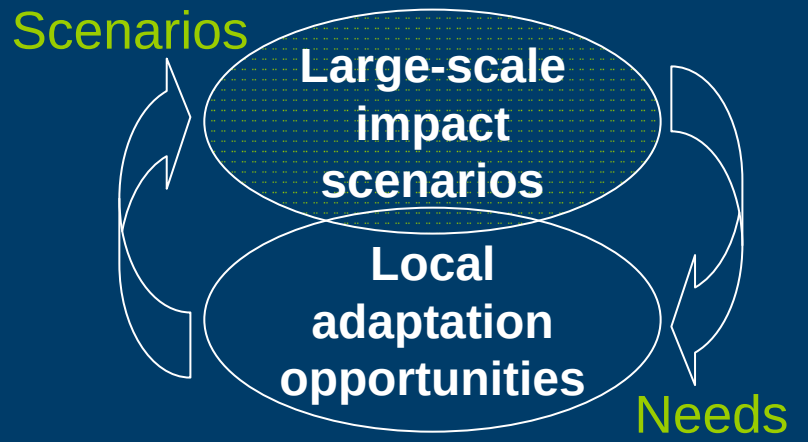
Year: 2000



Integrated climate and land use change scenarios

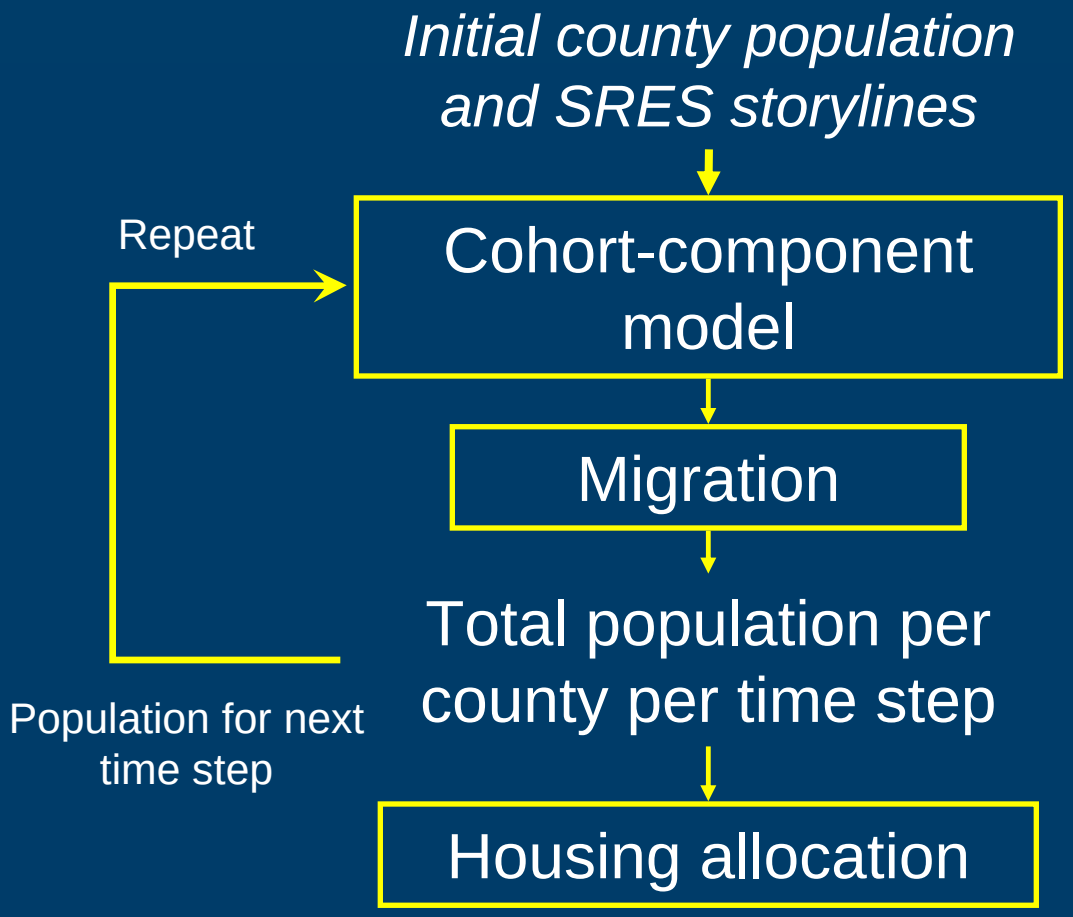
Goals:

- Create seamless land use scenarios for the conterminous United States consistent with IPCC emissions storylines (SRES)
- Provide consistent benchmarks for local and regional land use studies
- Identify geographic areas where climate-land use interactions may exacerbate impacts or create adaptation opportunities



Report: http://www.epa.gov/ncea; go to Global Change -> Land-Use Scenarios

ICLUS Conceptual Diagram



Scale & Resolution

- Demography, migration, and housing density for **conterminous U.S.**
- Demography and migration at **county level**
- Housing density allocated at **1 ha resolution** by county

Global Emissions Scenarios

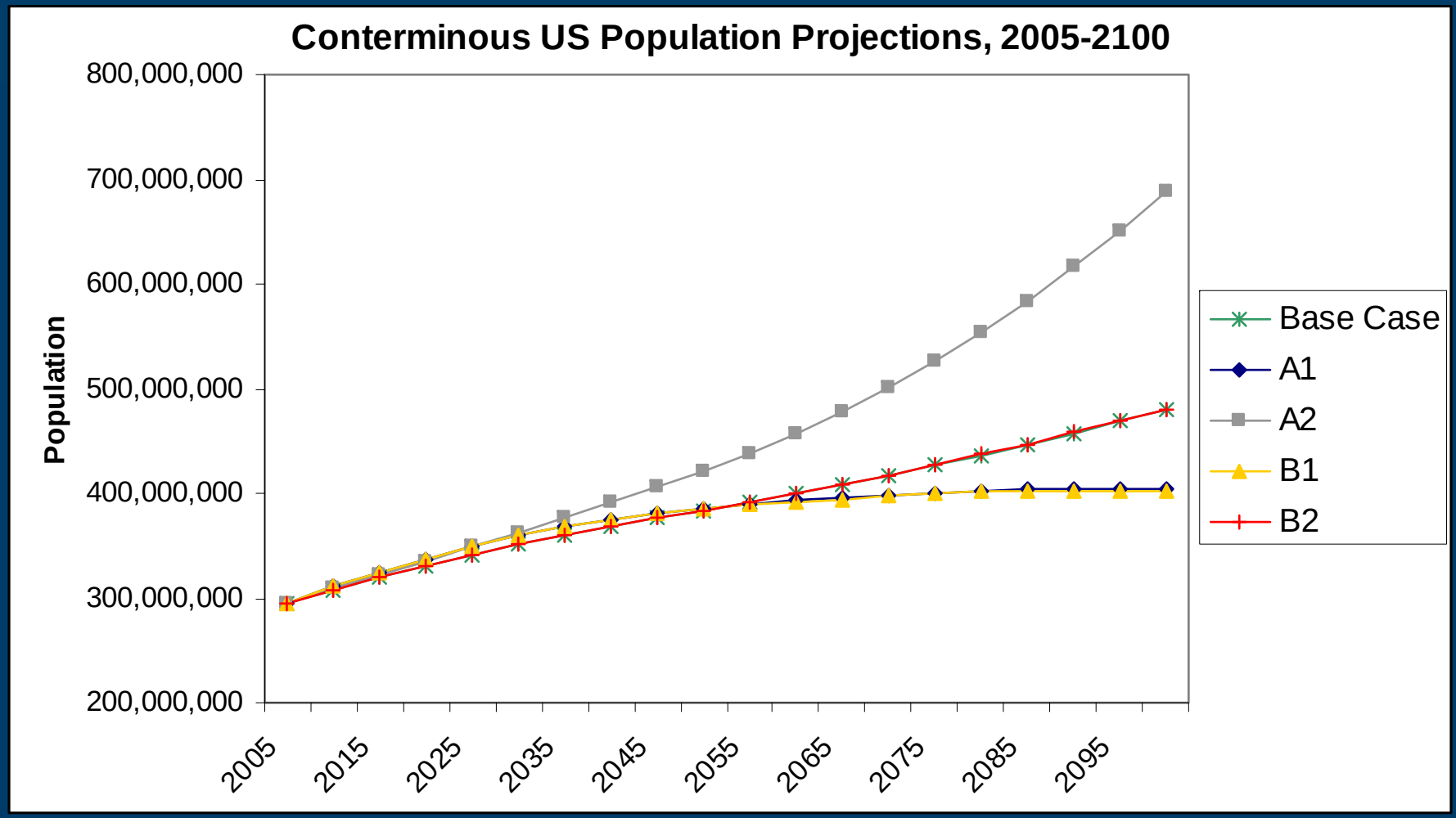
Interpretation of SRES for US

Global Scenario	Demographic Model			Spatial Allocation Model	
	Fertility	*Domestic migration*	*Net int'l migration*	*Household size*	*Urban Form*
A1: fast econ. dev.; med. pop growth; high global integration	Low	High	High	Smaller (-15%)	No change
B1: med. pop growth; high global integration; rapid social dev.	Low	Low	High	Smaller (-15%)	Slight compact
A2: regional focus, slower econ. growth; low/med int'l migr.; high pop growth	High	High	Low	Larger (+15%)	No change
B2: moderate econ. dev.; med. pop growth; med int'l migr.	Medium	Low	Low	No change	Slight compact
Baseline: US Census medium scen.	Medium	Medium	Medium	No change	No change

Data Sources for Demographic Modeling

- U.S. Census Bureau's City and County Data Book
  - County population data
- U.S. Census Bureau components of change rates
  - Year 2005 start
  - Middle series used as baseline
- National Center for Health Statistics for county populations
  - Bridged-Race Vintage 2006 dataset
- U.S. Census Bureau data for net international migration
- PUMS data for domestic migration between 1995-2000
  - Transformed to county-to-county flows
  - Two age groups: 0-49 and 50+

Population Projections for ICLUS Scenarios

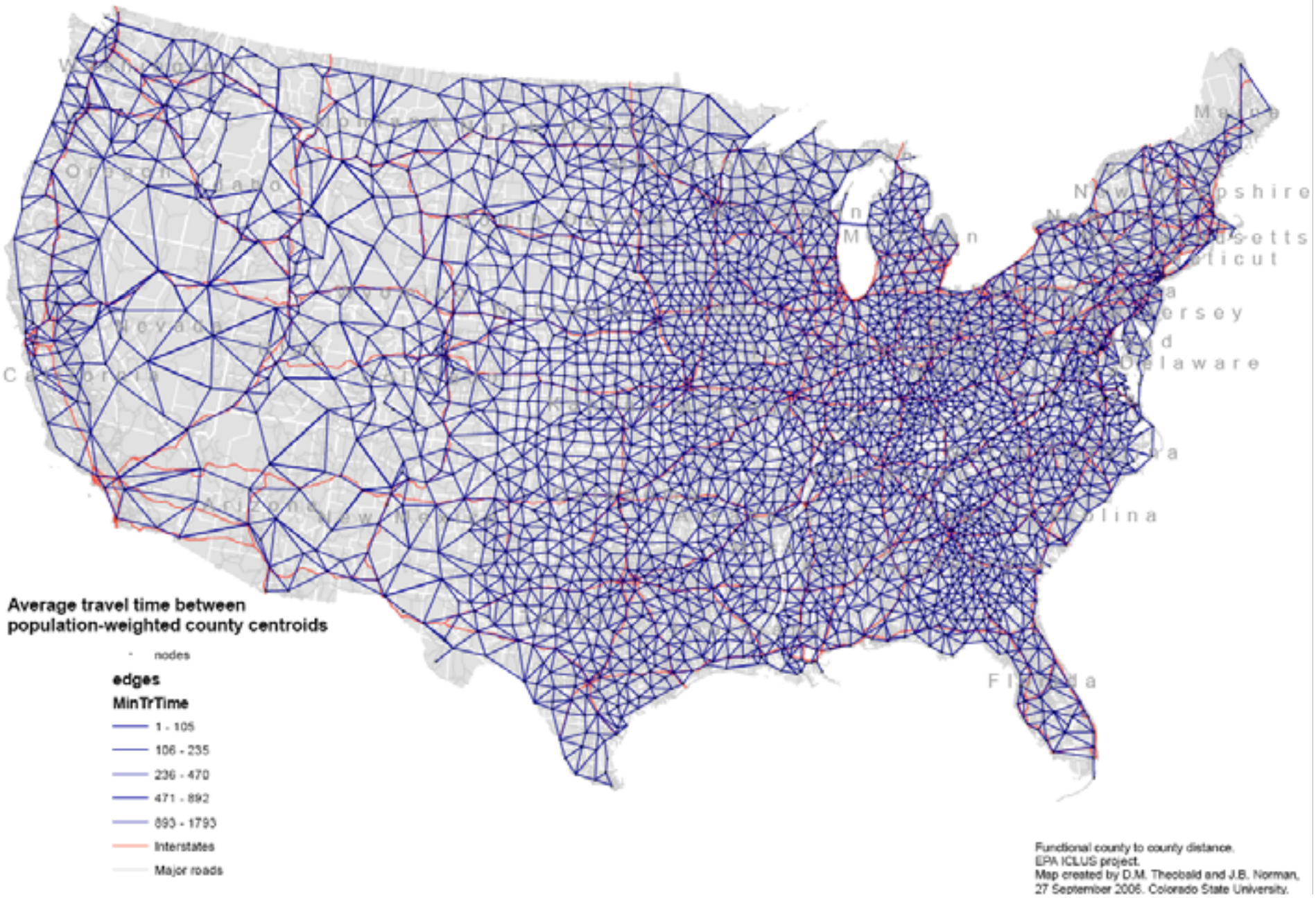


Amenity Information for Gravity Model for each county

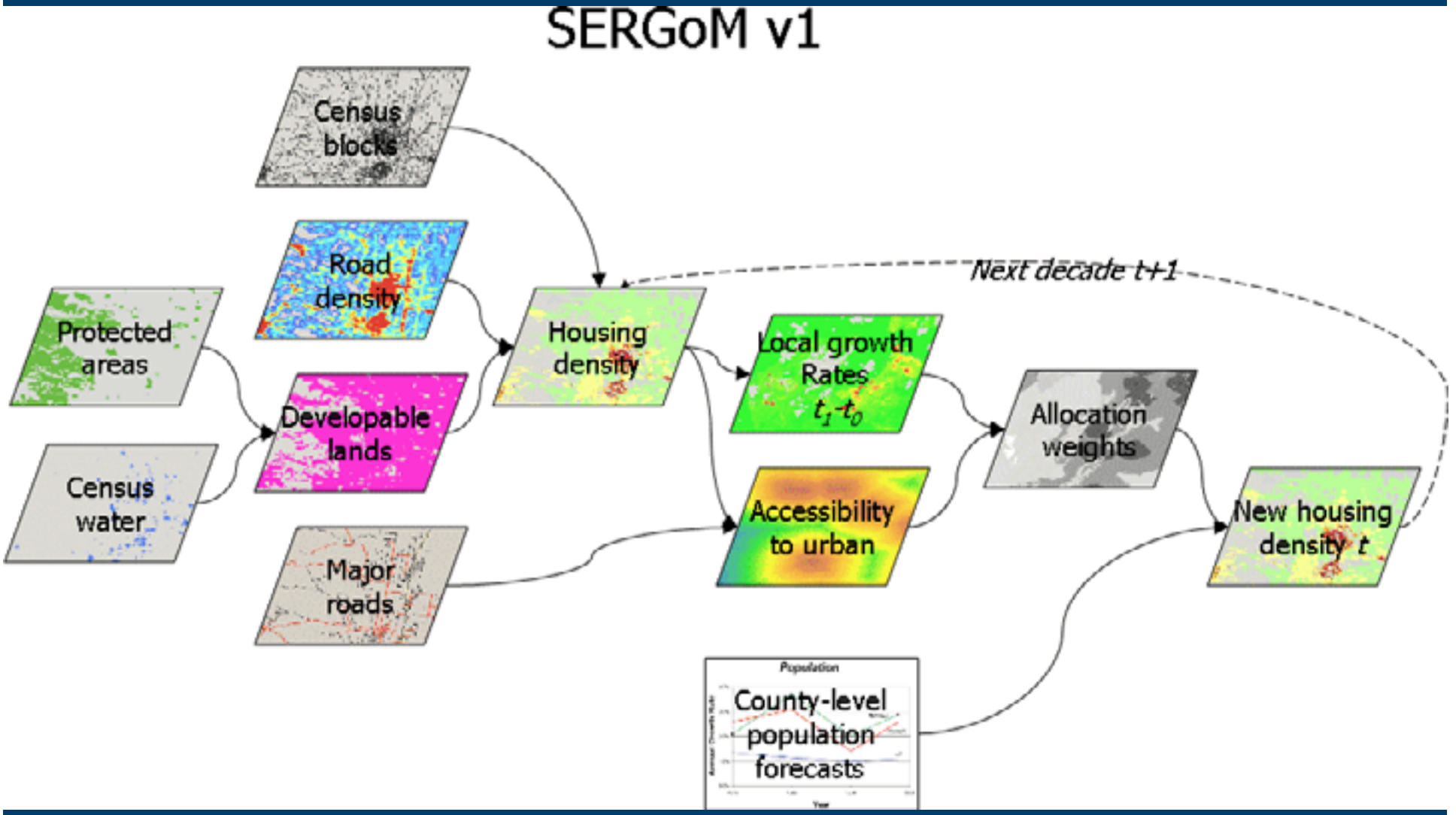
- Mean temperature for January, 1941-70
- Mean hours of sunlight for January, 1941-70
- Mean temperature for July, 1941-70
- Mean relative humidity for July, 1941-70
- Percent water area

USDA dataset, McGranahan, 1999

County to county functional distance



Spatial Allocation: SERGoM Functional Flow



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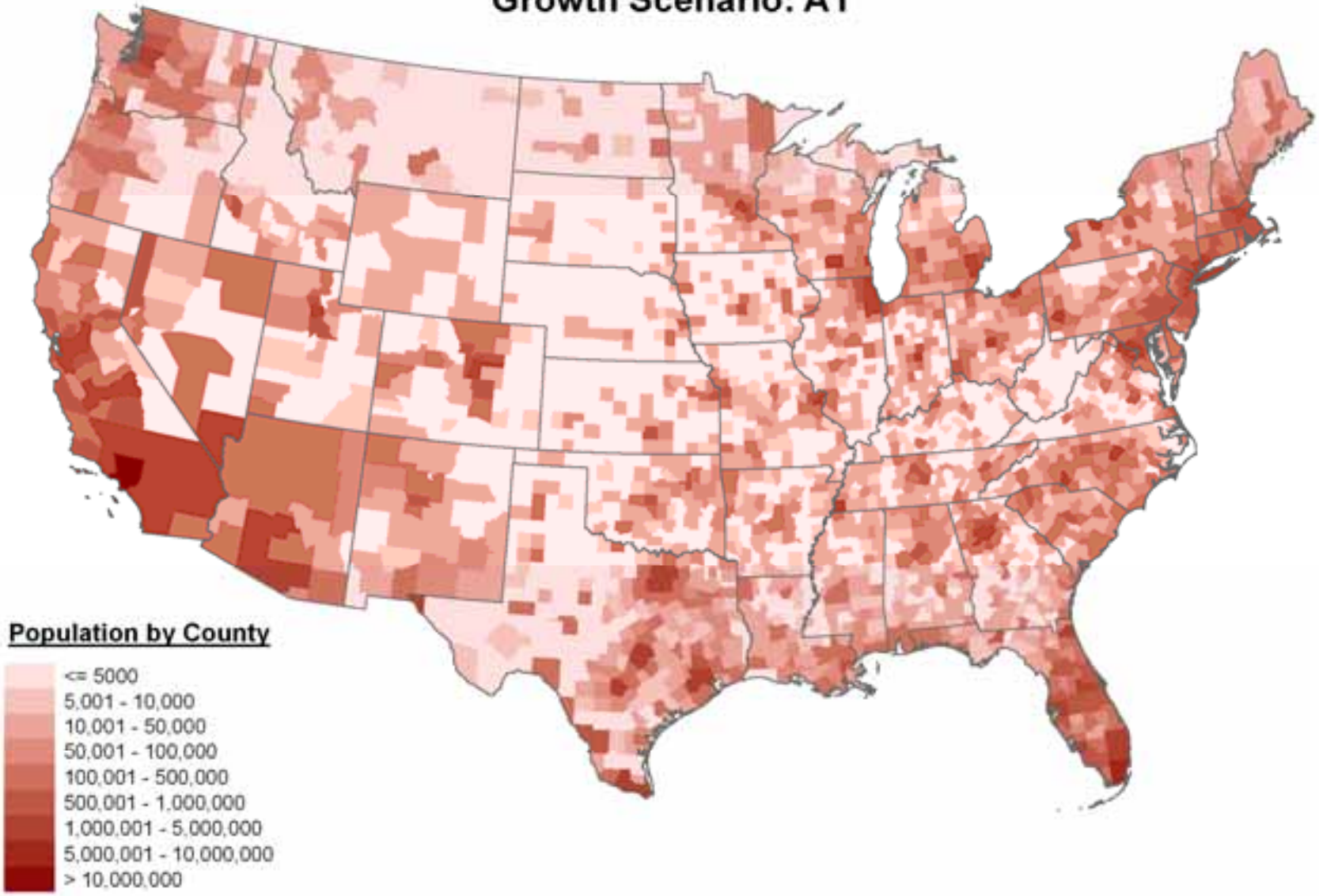
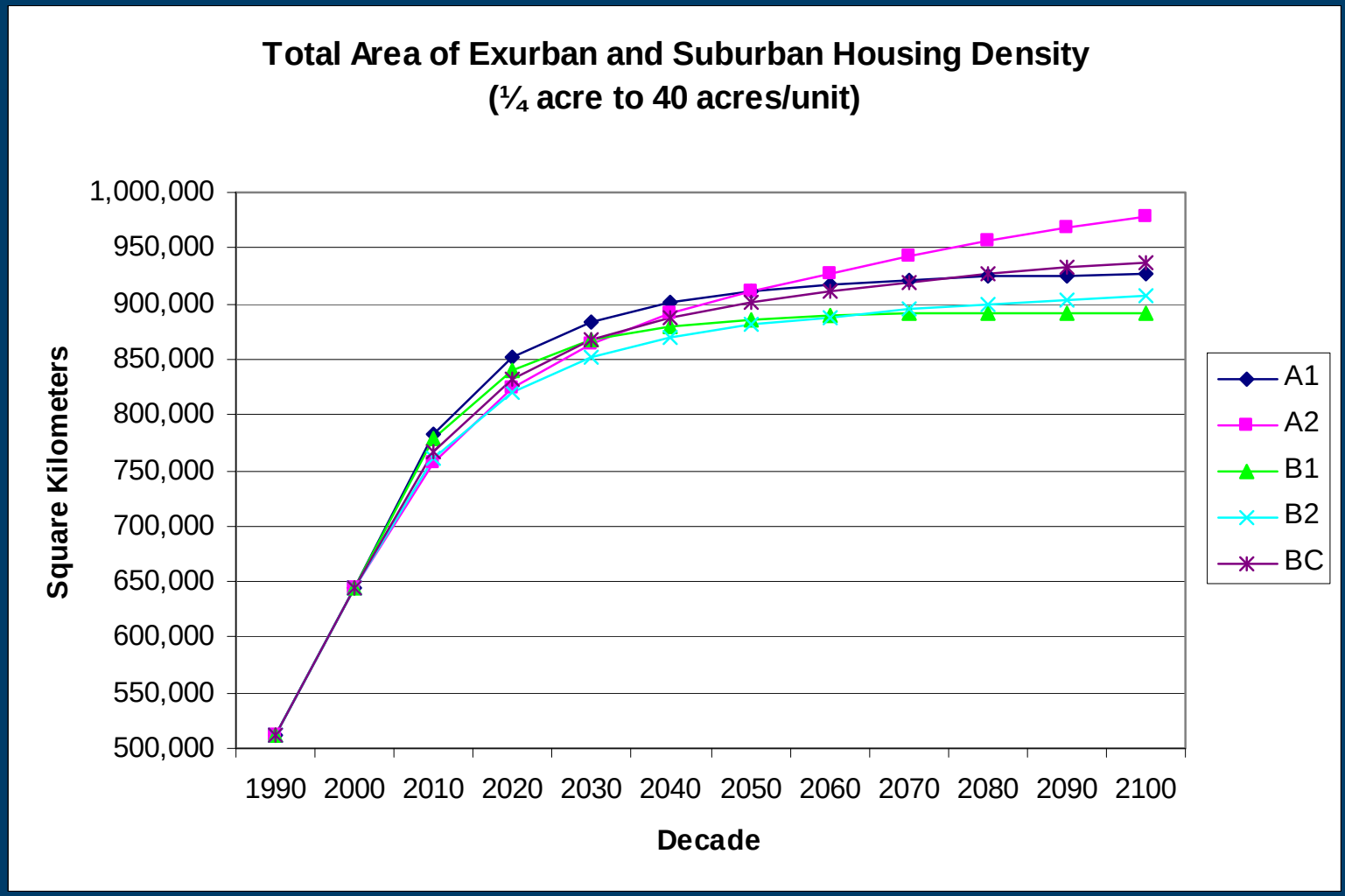
Results:
Population, Land Use, Impervious Surface

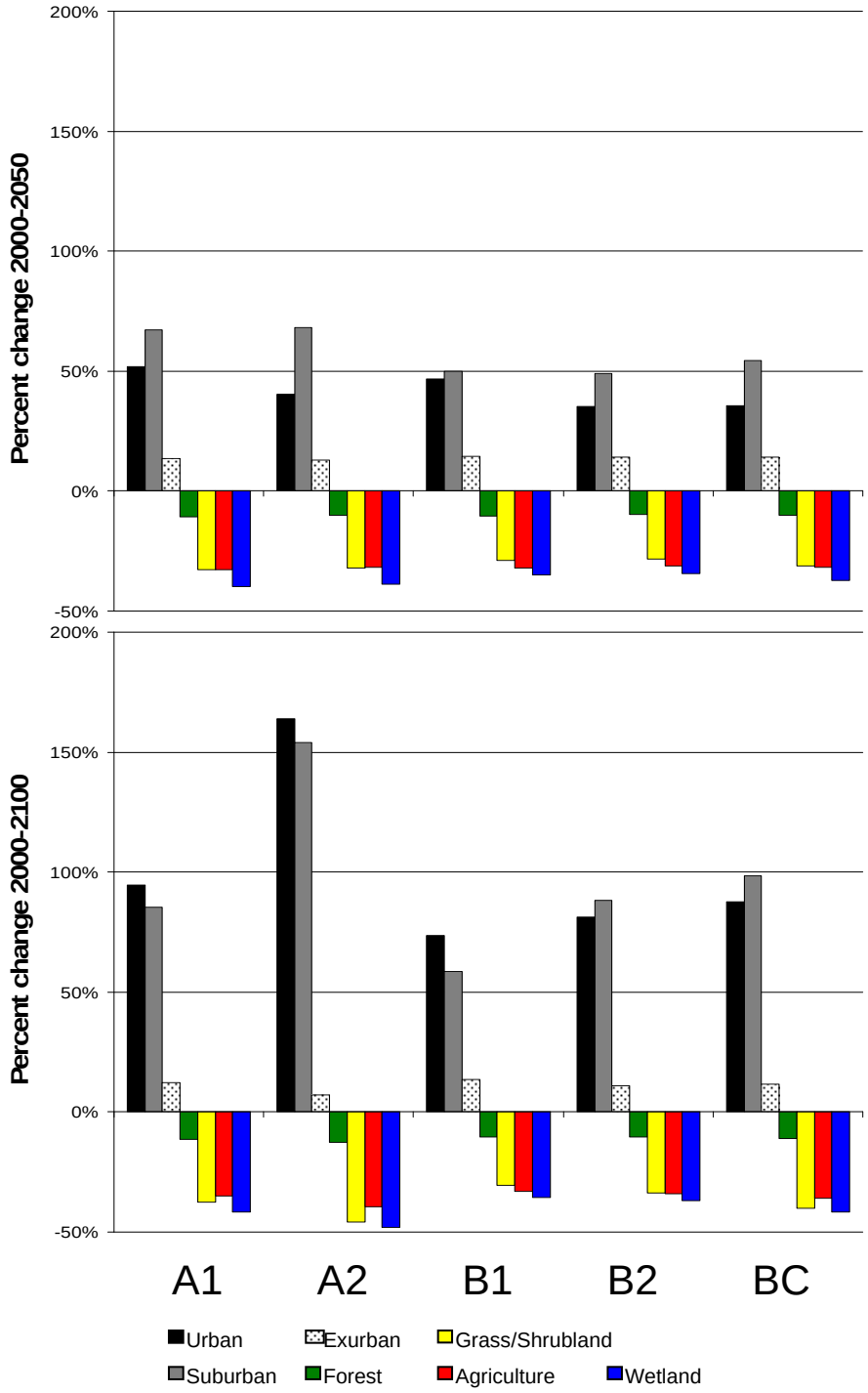
Year: 2050

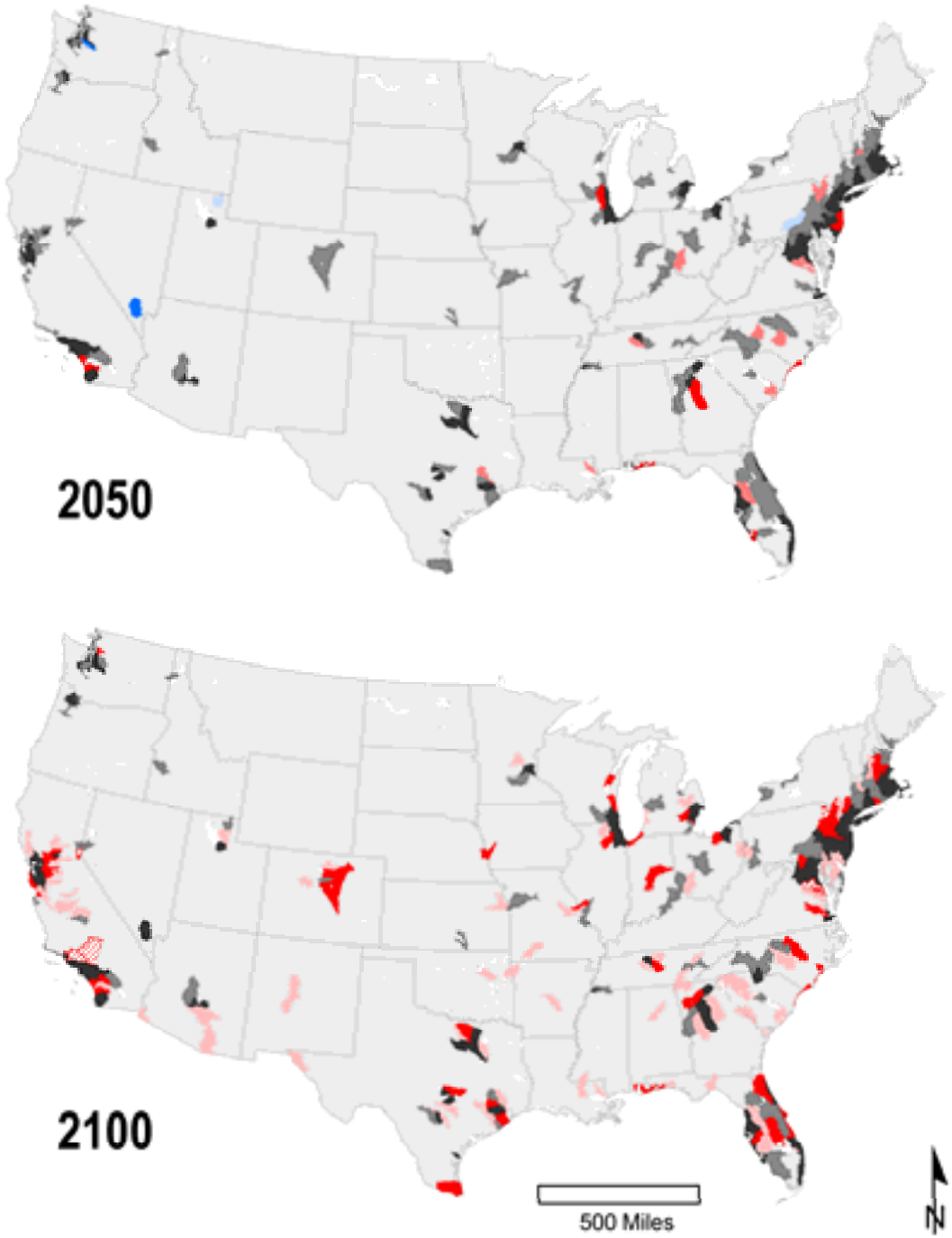
Growth Scenario: A1

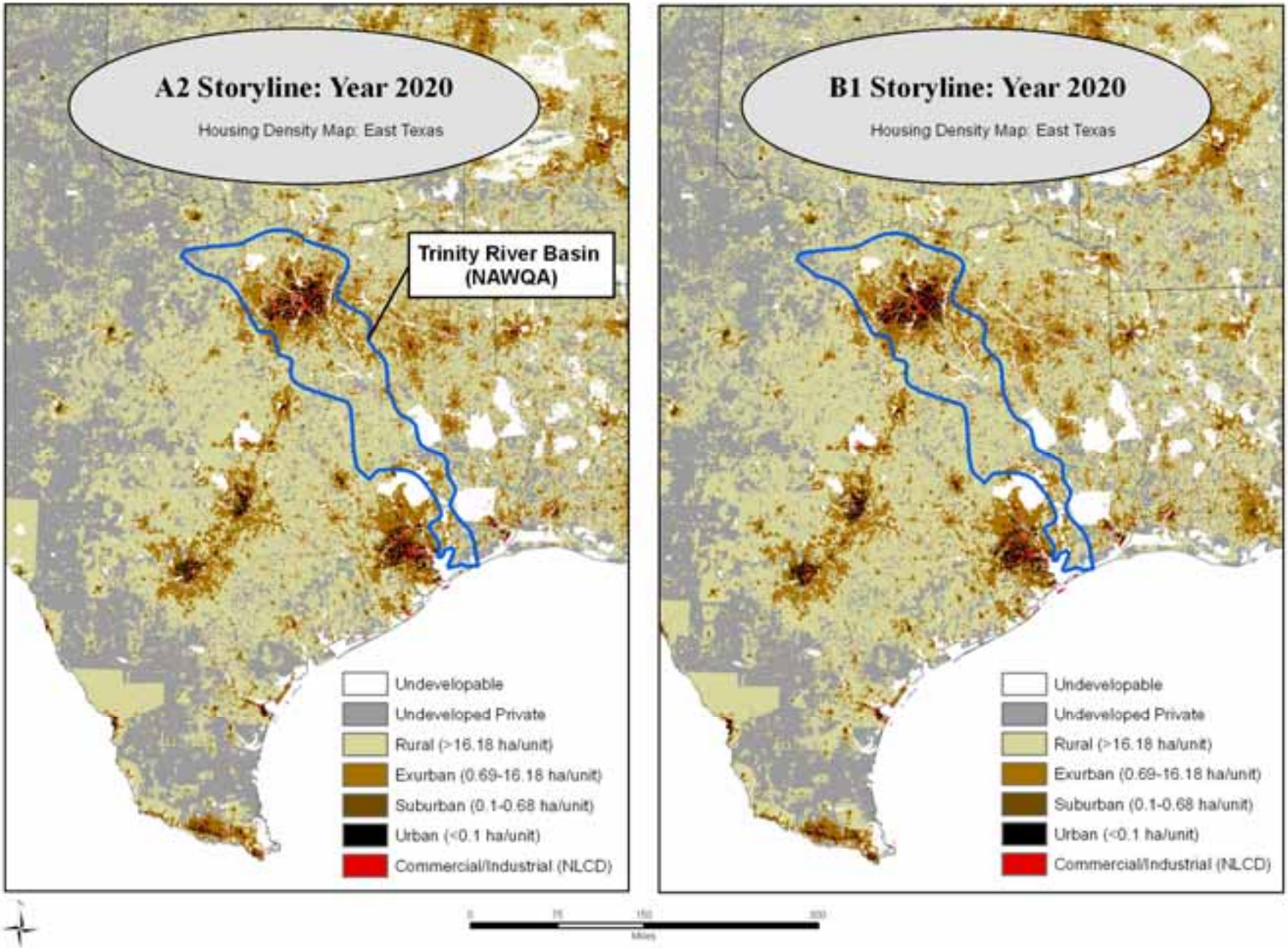


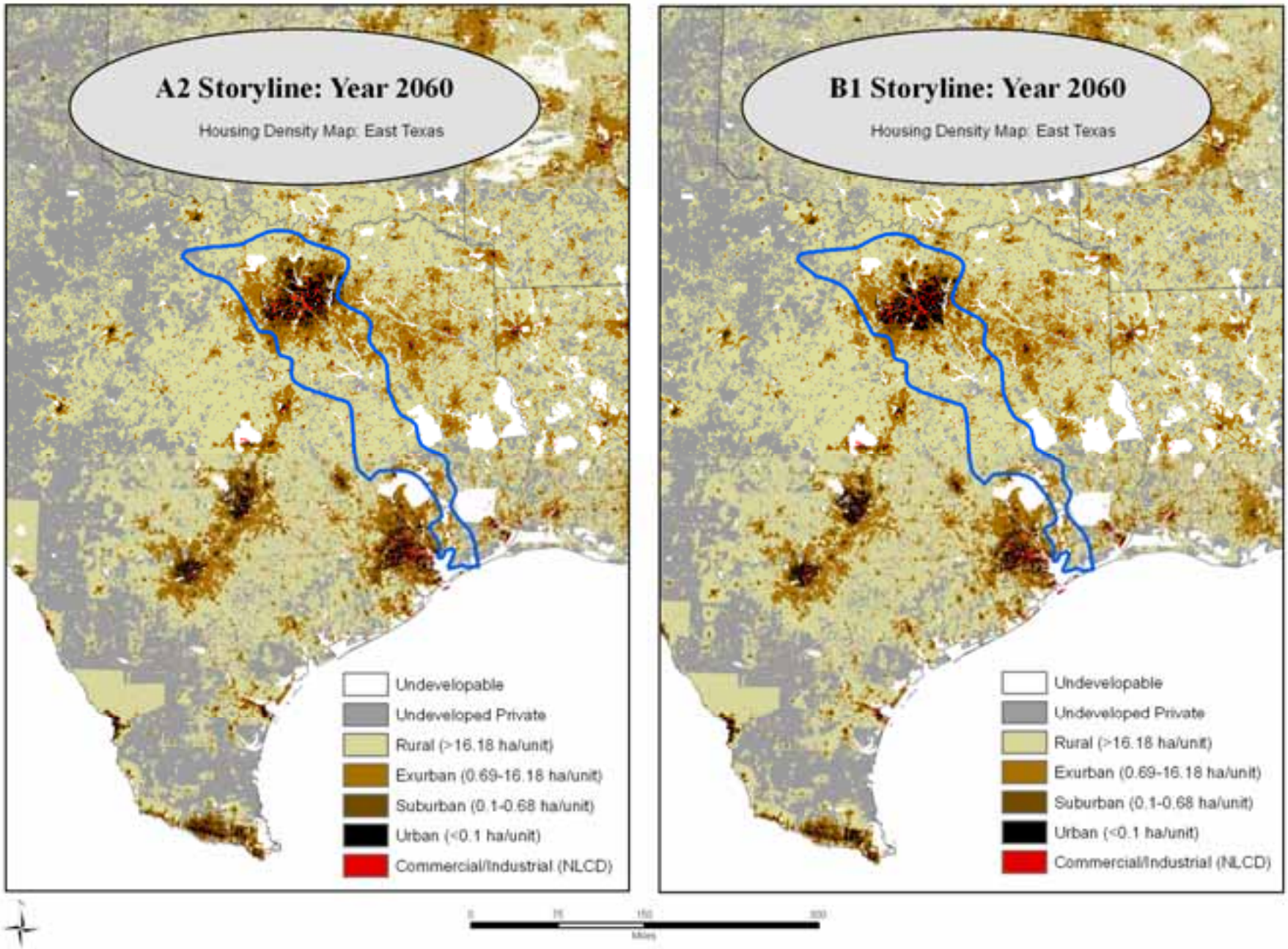
Housing Density Projections

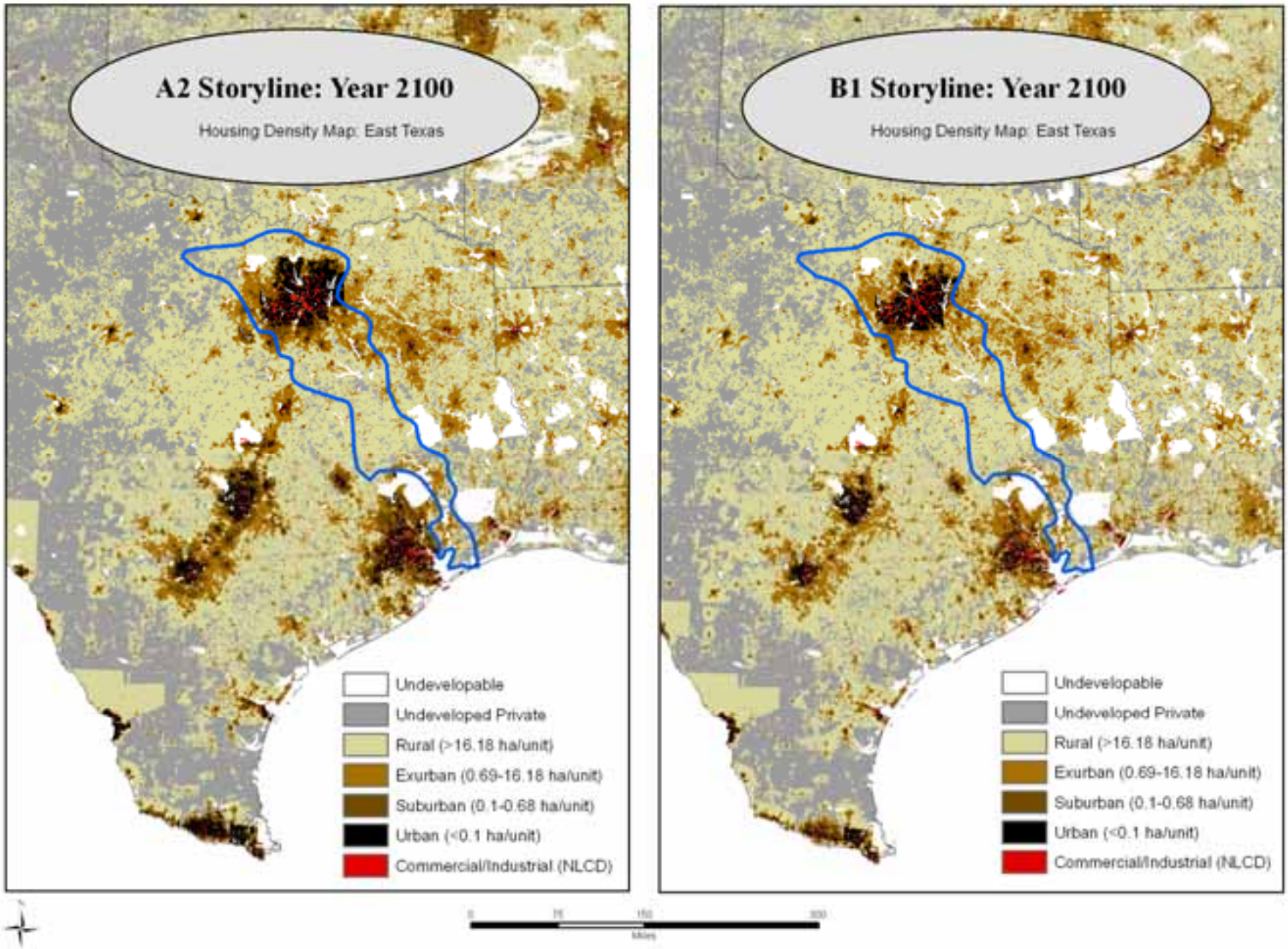


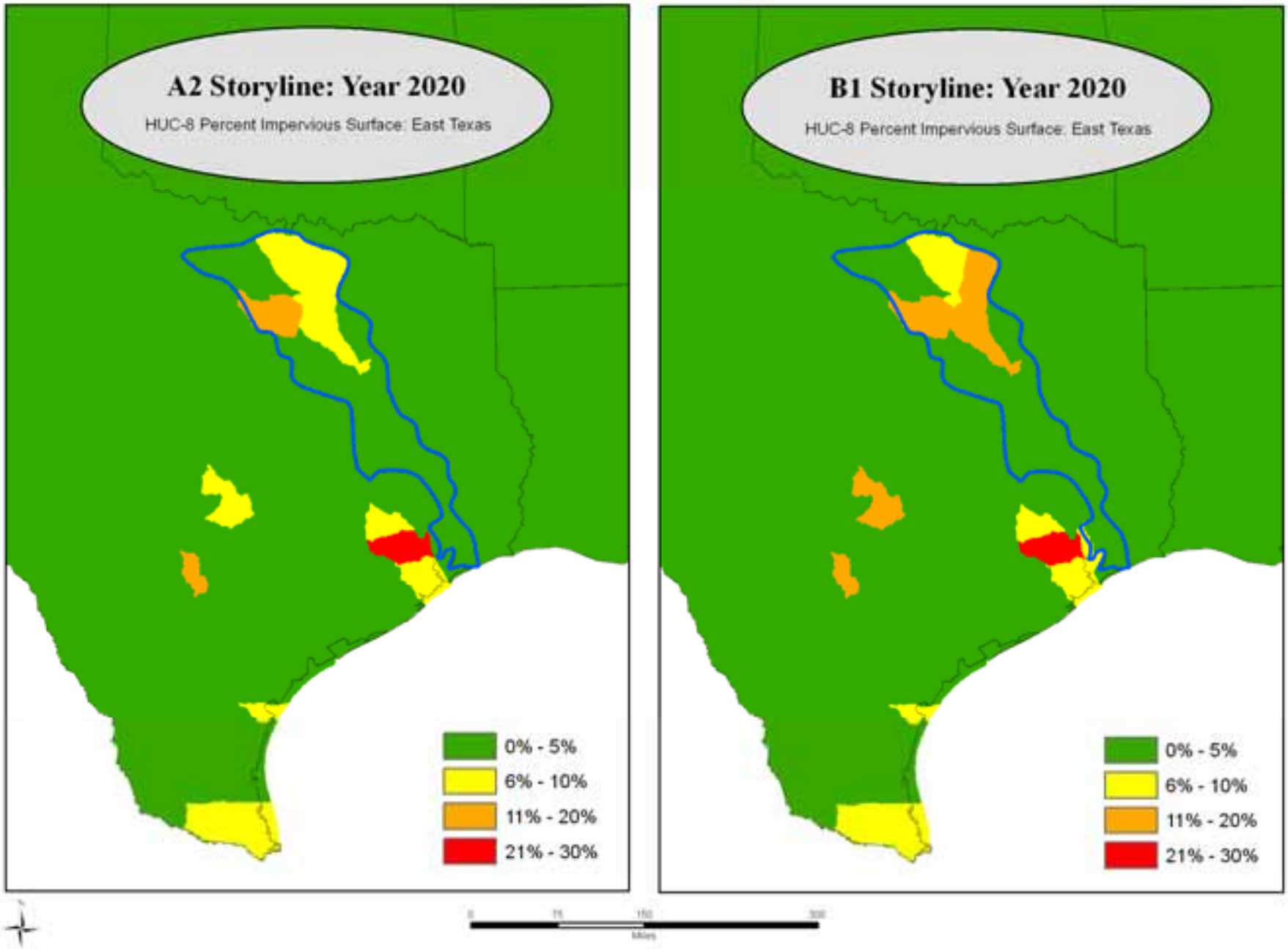

Percent change 2000-2050
200%
150%
100%
50%
0%
-50%
Percent change 2000-2100
200%
150%
100%
50%
0%
-50%
A1
A2
B1
B2
BC
Urban
Exurban
Grass/Shrubland
Suburban
Forest
Agriculture
Wetland

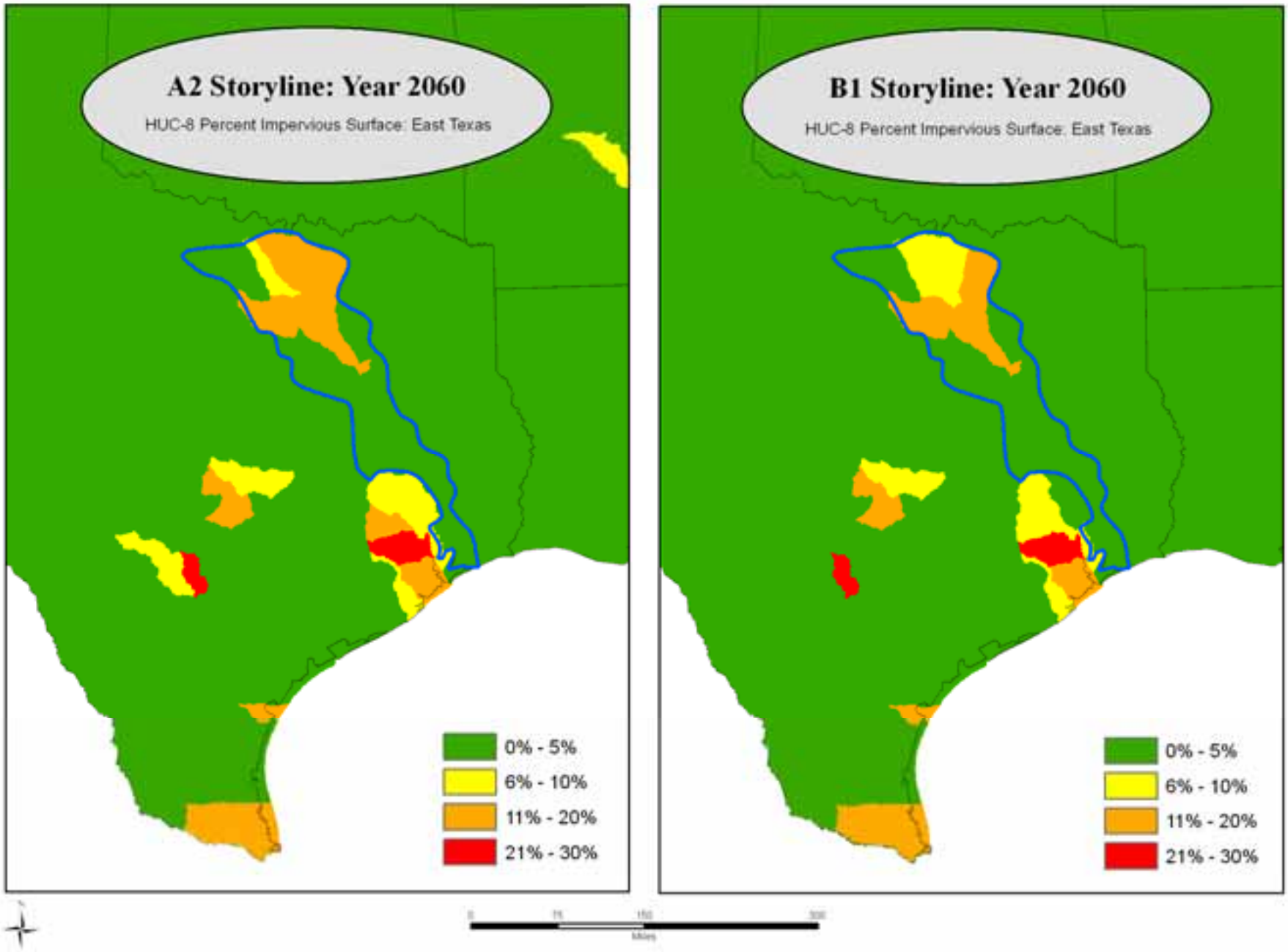

2050
2100
A2 Growth Scenario
B1 Growth Scenario
Unstressed or Lightly Stressed
Stressed
Impacted or Damaged
Impacted or Damaged
Stressed
Unstressed or Lightly Stressed
Unstressed: <1% impervious
Lightly Stressed: 1 - 5% impervious
Stressed: >5 - 10% impervious
Impacted: >10 - 25% impervious
Damaged: >25% impervious
500 Miles
N

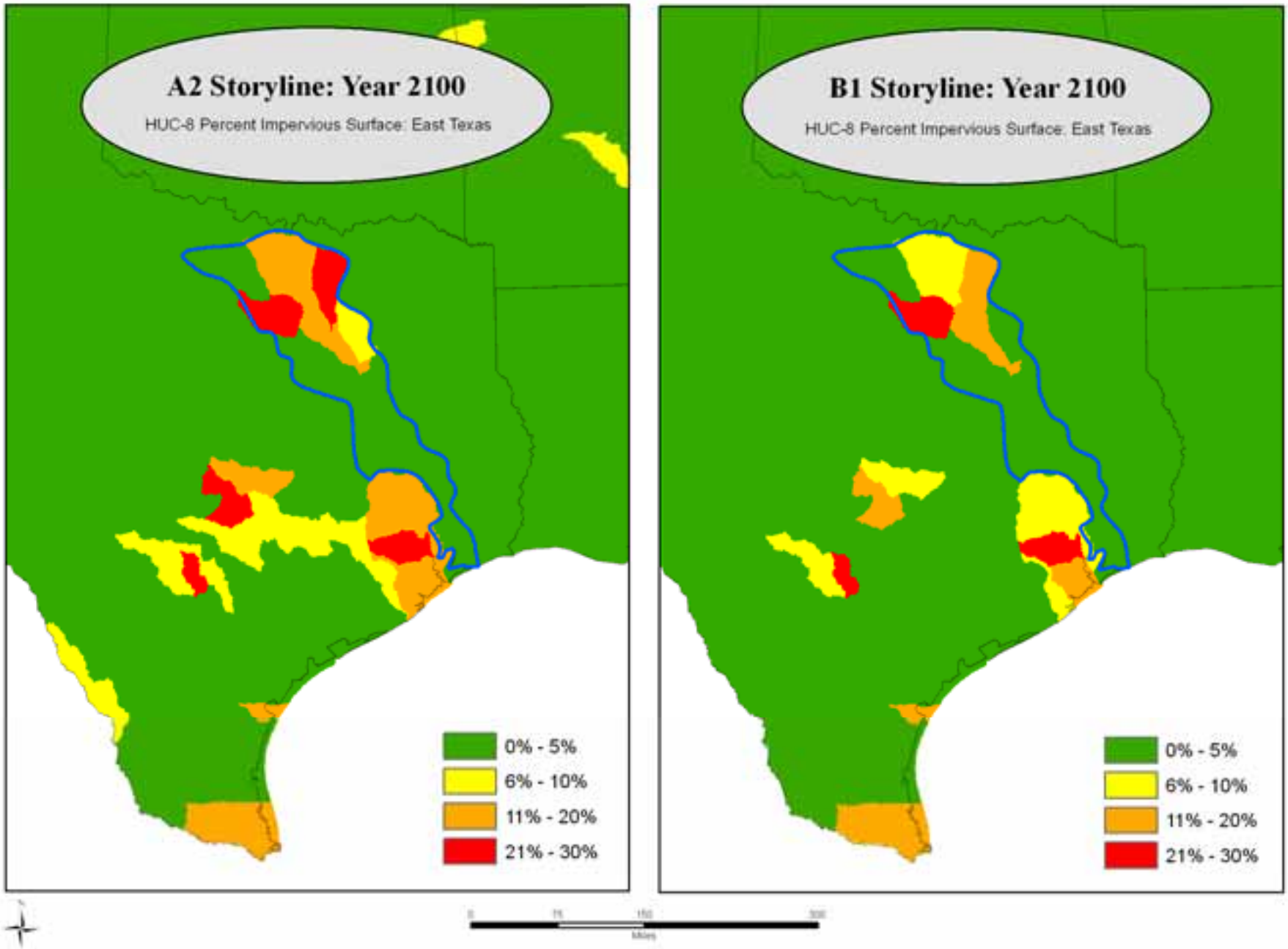

A2 Storyline: Year 2020
Housing Density Map: East Texas
Trinity River Basin (NAWQA)
Undevelopable
Undeveloped Private
Rural (>16.18 ha/unit)
Exurban (0.69-16.18 ha/unit)
Suburban (0.1-0.68 ha/unit)
Urban (<0.1 ha/unit)
Commercial/Industrial (NLCD)
B1 Storyline: Year 2020
Housing Density Map: East Texas
Undevelopable
Undeveloped Private
Rural (>16.18 ha/unit)
Exurban (0.69-16.18 ha/unit)
Suburban (0.1-0.68 ha/unit)
Urban (<0.1 ha/unit)
Commercial/Industrial (NLCD)


A2 Storyline: Year 2060
Housing Density Map: East Texas
B1 Storyline: Year 2060
Housing Density Map: East Texas
Undevelopable
Undeveloped Private
Rural (>16.18 ha/unit)
Exurban (0.69-16.18 ha/unit)
Suburban (0.1-0.68 ha/unit)
Urban (<0.1 ha/unit)
Commercial/Industrial (NLCD)
0
75
150
300
Miles


A2 Storyline: Year 2100
Housing Density Map: East Texas
B1 Storyline: Year 2100
Housing Density Map: East Texas
Undevelopable
Undeveloped Private
Rural (>16.18 ha/unit)
Exurban (0.69-16.18 ha/unit)
Suburban (0.1-0.68 ha/unit)
Urban (<0.1 ha/unit)
Commercial/Industrial (NLCD)
0
75
150
300
Miles


A2 Storyline: Year 2020
HUC-8 Percent Impervious Surface: East Texas
0% - 5%
6% - 10%
11% - 20%
21% - 30%
B1 Storyline: Year 2020
HUC-8 Percent Impervious Surface: East Texas
0% - 5%
6% - 10%
11% - 20%
21% - 30%


A2 Storyline: Year 2060
HUC-8 Percent Impervious Surface: East Texas
0% - 5%
6% - 10%
11% - 20%
21% - 30%
B1 Storyline: Year 2060
HUC-8 Percent Impervious Surface: East Texas
0% - 5%
6% - 10%
11% - 20%
21% - 30%


A2 Storyline: Year 2100
HUC-8 Percent Impervious Surface: East Texas
0% - 5%
6% - 10%
11% - 20%
21% - 30%
B1 Storyline: Year 2100
HUC-8 Percent Impervious Surface: East Texas
0% - 5%
6% - 10%
11% - 20%
21% - 30%

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Data and Script Tools

Data to Distribute

- County population by decade for each scenario (shapefile)
- Classified housing density (raster)
  - 14 classes of housing
  - commercial/industrial (static)
- Impervious surface cover (raster)
  - 1 sq. km
  - HUC-8

Capability of Geoprocessing Tool

- Re-create maps
  - county population
  - housing density (1 ha)
  - impervious surface cover (1 km^2)
- Customize SERGoM parameters
  - more/less compact development pattern
  - household size
- More detailed customization of Python code

Tools available upon request

Reclassify Housing Density

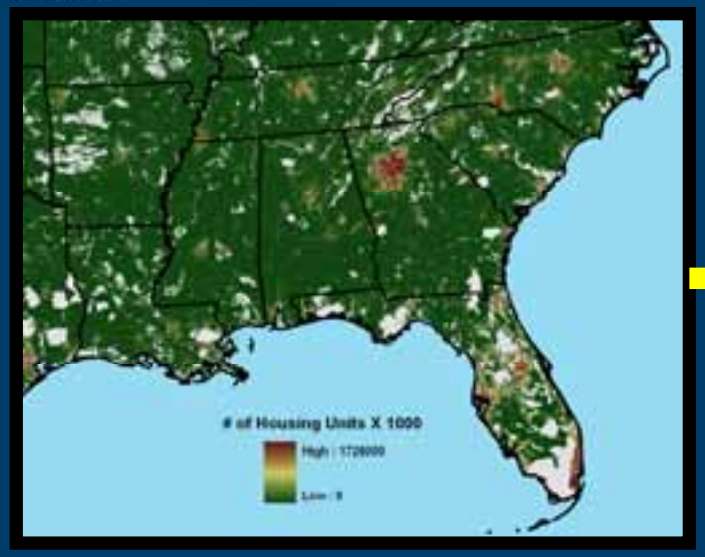
Continuous

4 Classes

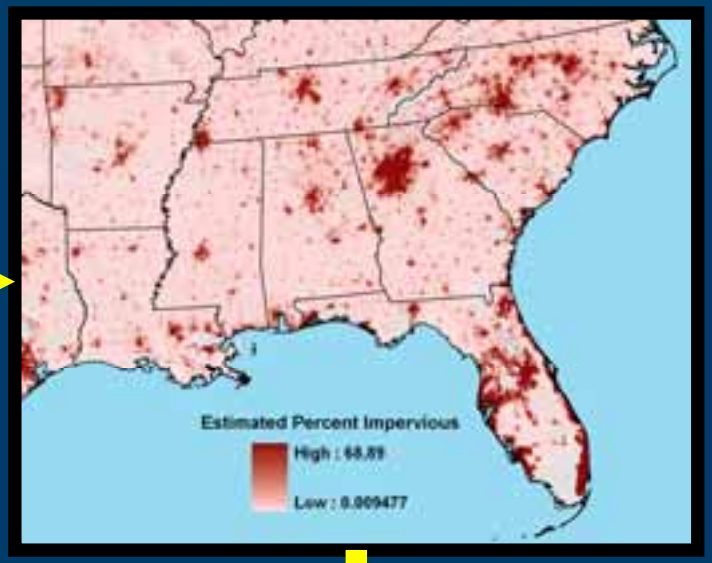
12 Classes

Estimate Percent Impervious

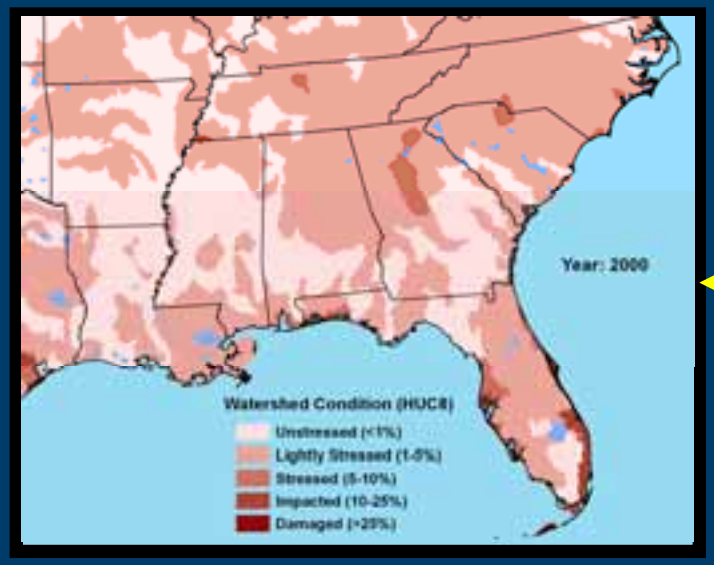
United States Environmental Protection Agency



Housing density



1 km^2 impervious



Watershed-scale impervious

Improvements & Additions to GIS Model

- Add reporting/comparison feature
  - text file of summary statistics of housing density and impervious surface cover
- Refine method to convert housing density back to population density
- Calculate emissions using estimate for housing density classes and vehicle miles traveled (VMTs)
- Other suggestions emerging from usability review

Improvements & Additions to ICLUS Model

- Create dynamic commercial/industrial component
  - Brown- and greyfield development
- Regionalize housing density patterns
- Integrate rail/metro to improve spatial allocation and connectivity
- Use projected climate information to alter future migration rates & patterns
- Use IRS county-county migration data (longer time period)

Land-Use Scenarios: National-Scale Housing-Density Scenarios Consistent with Climate Change Storylines (Final Report)

Available at www.epa.gov/ncea/global