



NAS Sustainable Urban Systems Forum

An Approach to Modeling, Metrics, and Future Scenarios for Urban Systems Using Remote Sensing: A Case Study of Atlanta, GA

Dale A. Quattrochi

NASA

Earth Science Office

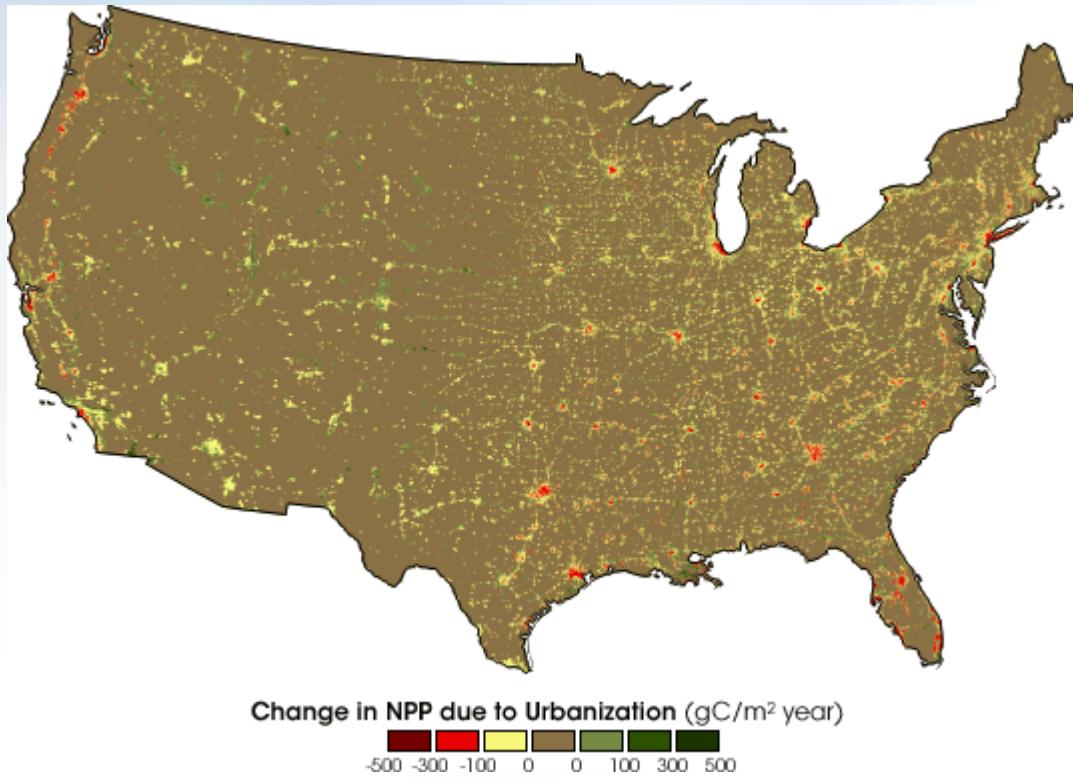
Marshall Space Flight Center

Huntsville, Alabama





U.S. Urbanization



- Total Impervious Surface Area of Continental U.S. is 112,610 km² (Slightly smaller than the state of Ohio)

Source: EOS, June 2004

Urbanization Impacts

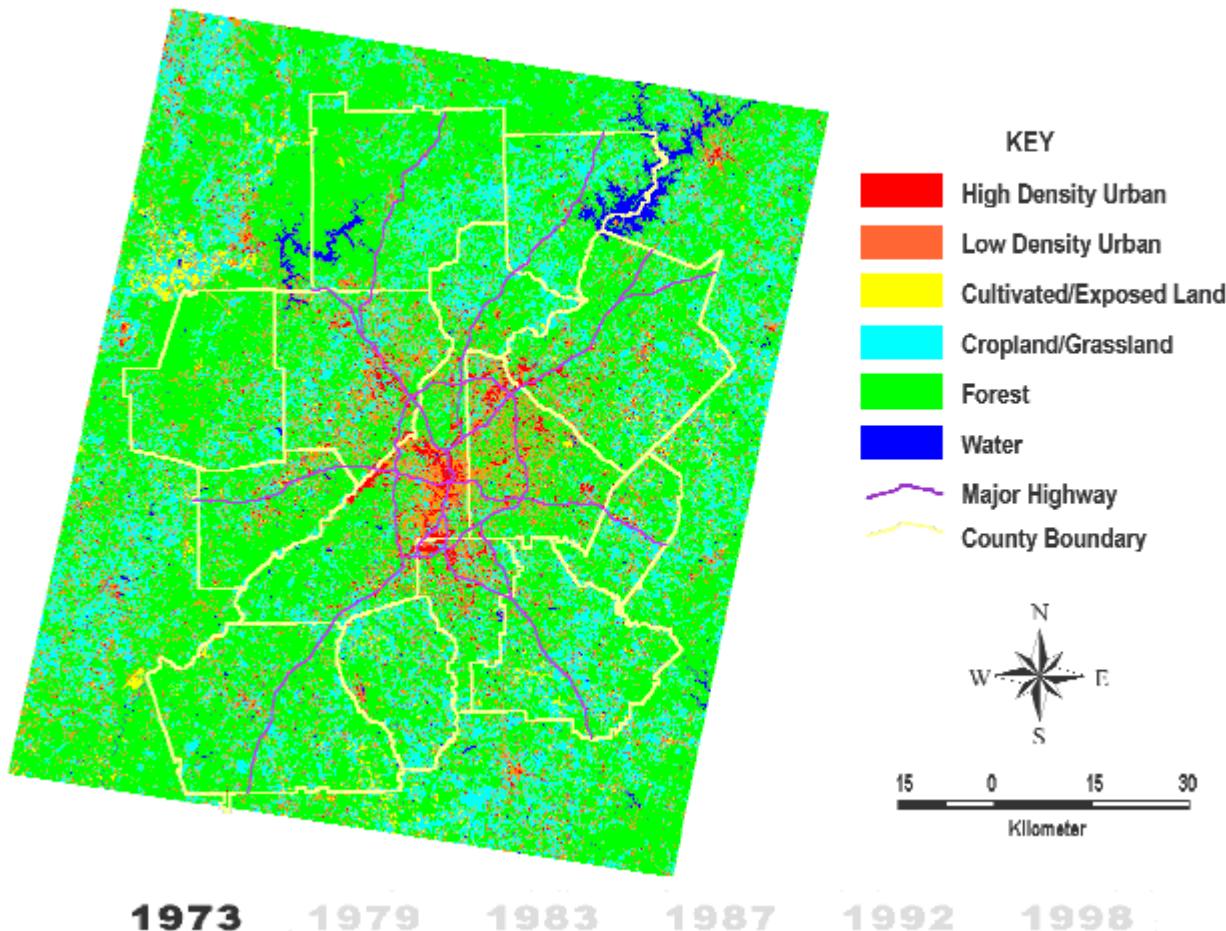
- Increases Surface Runoff
- Reduces Carbon Sequestration
- Alters Energy Balance





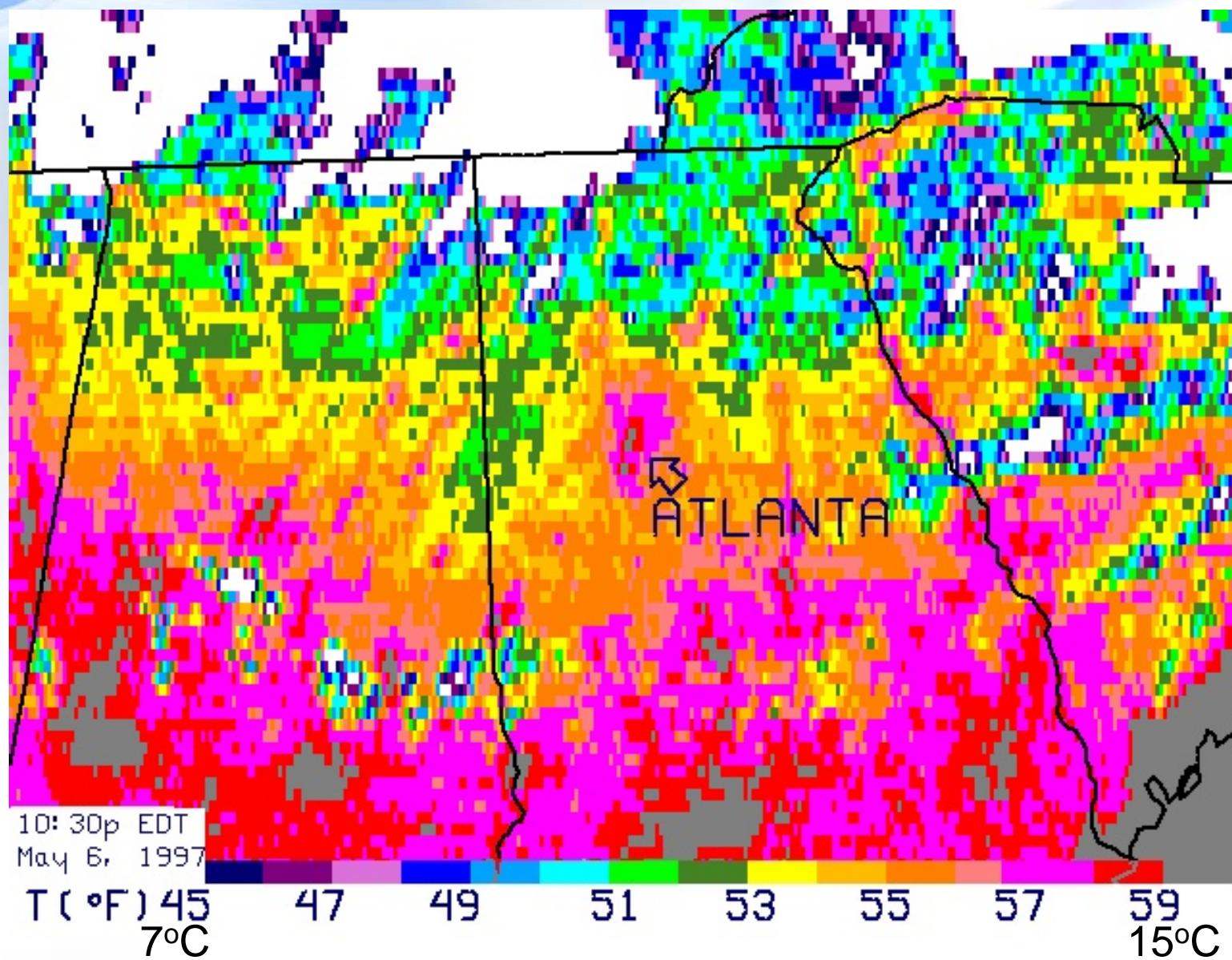
NAS Sustainable Urban Systems Forum

Changes in Land Use/Cover, Atlanta: 1973-1998



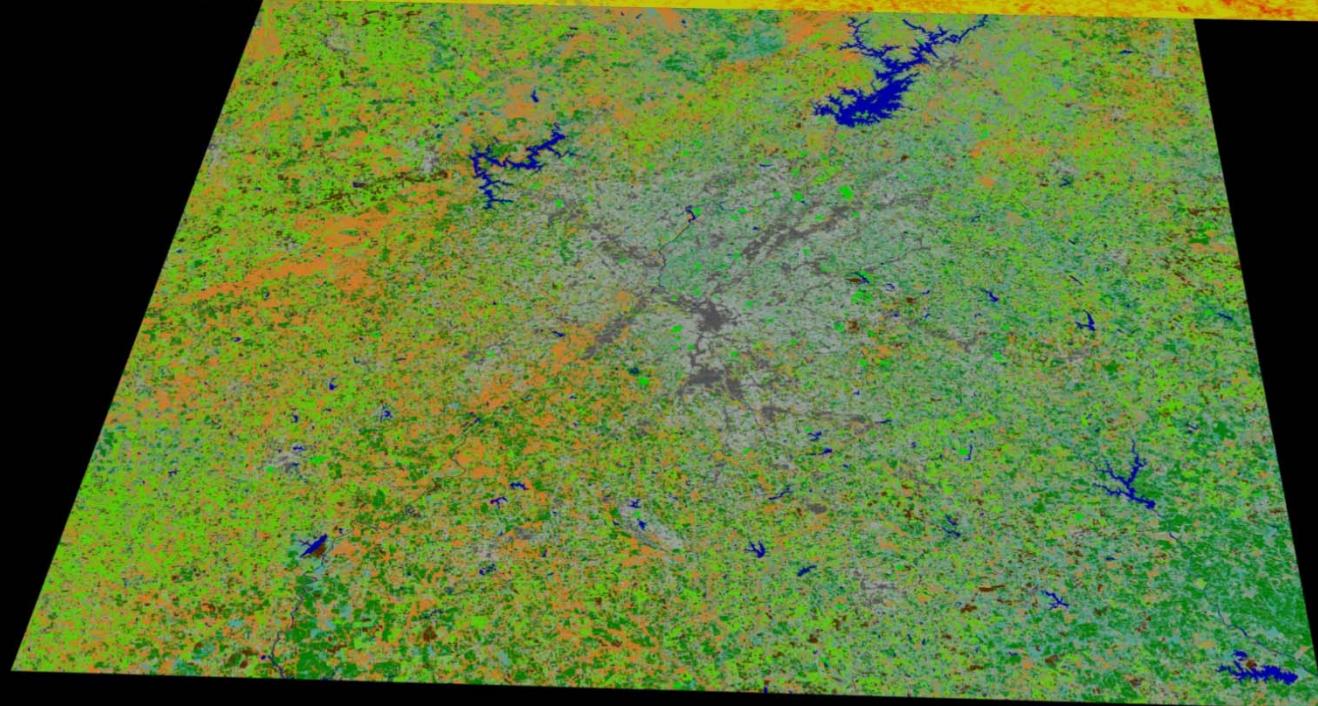
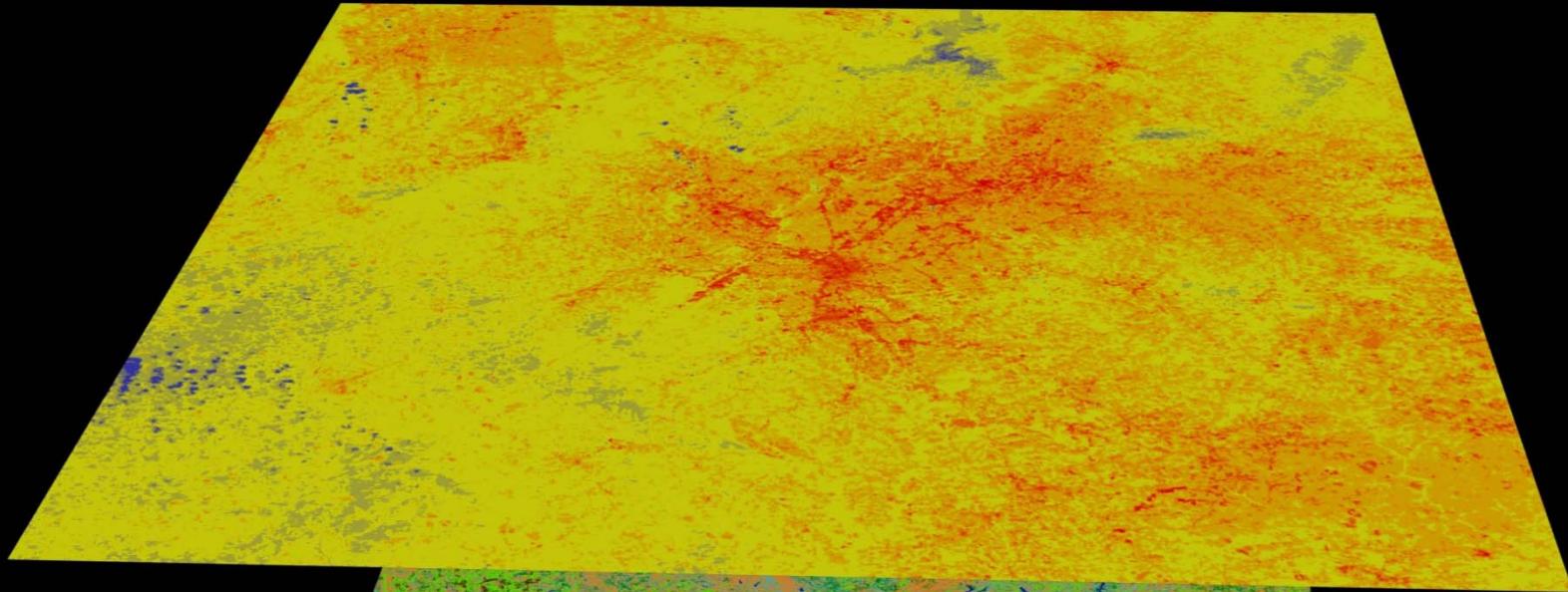


NAS Sustainable Urban Systems Forum



7

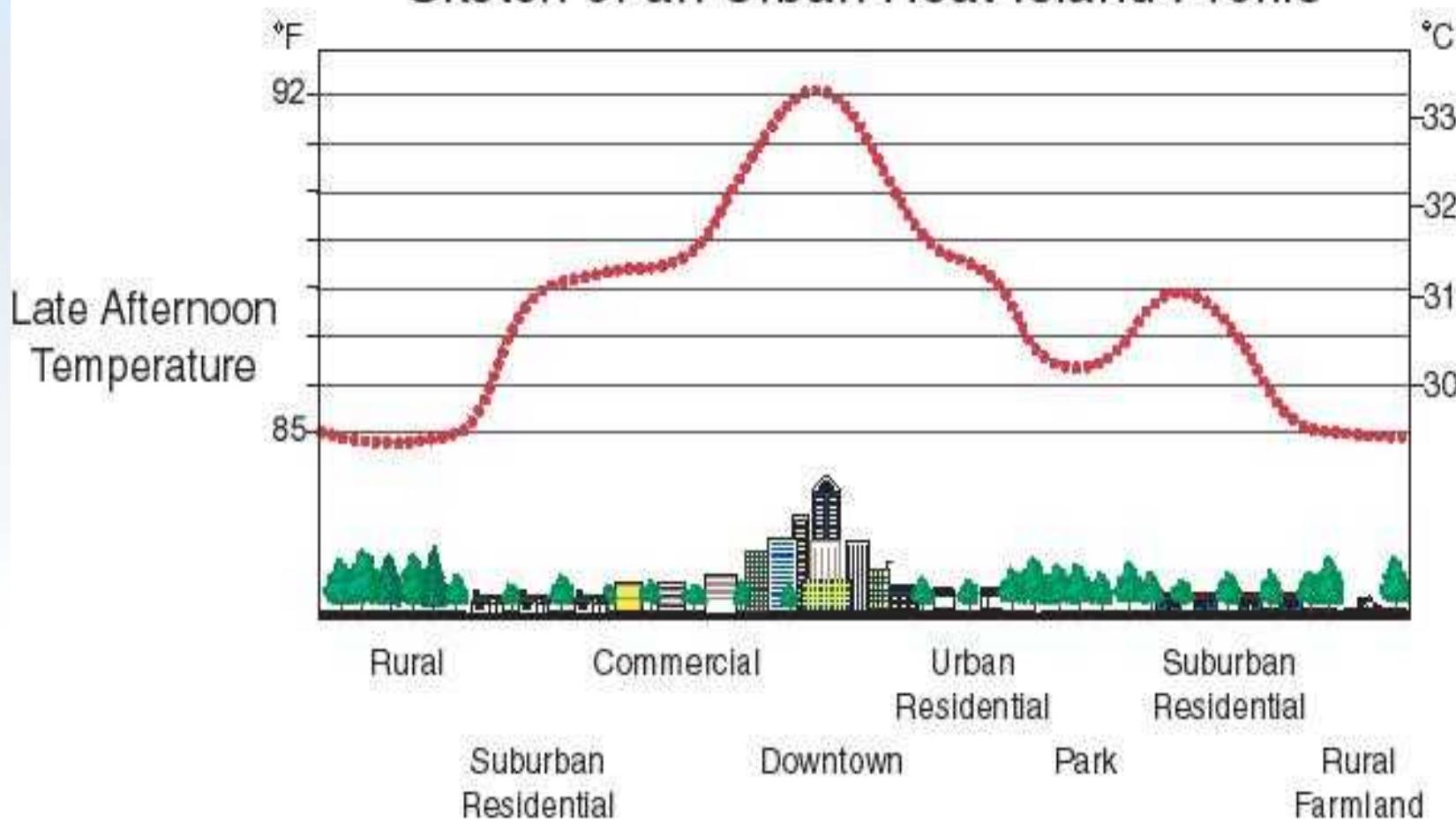






NAS Sustainable Urban Systems Forum

Sketch of an Urban Heat-Island Profile



Mission to Planet Earth
National Aeronautics and Space Administration



Volatile Organic Compounds
+ Nitrogen Oxides
+ Sunlight
→ Ozone



Urban Remote Sensing and Air Quality Models

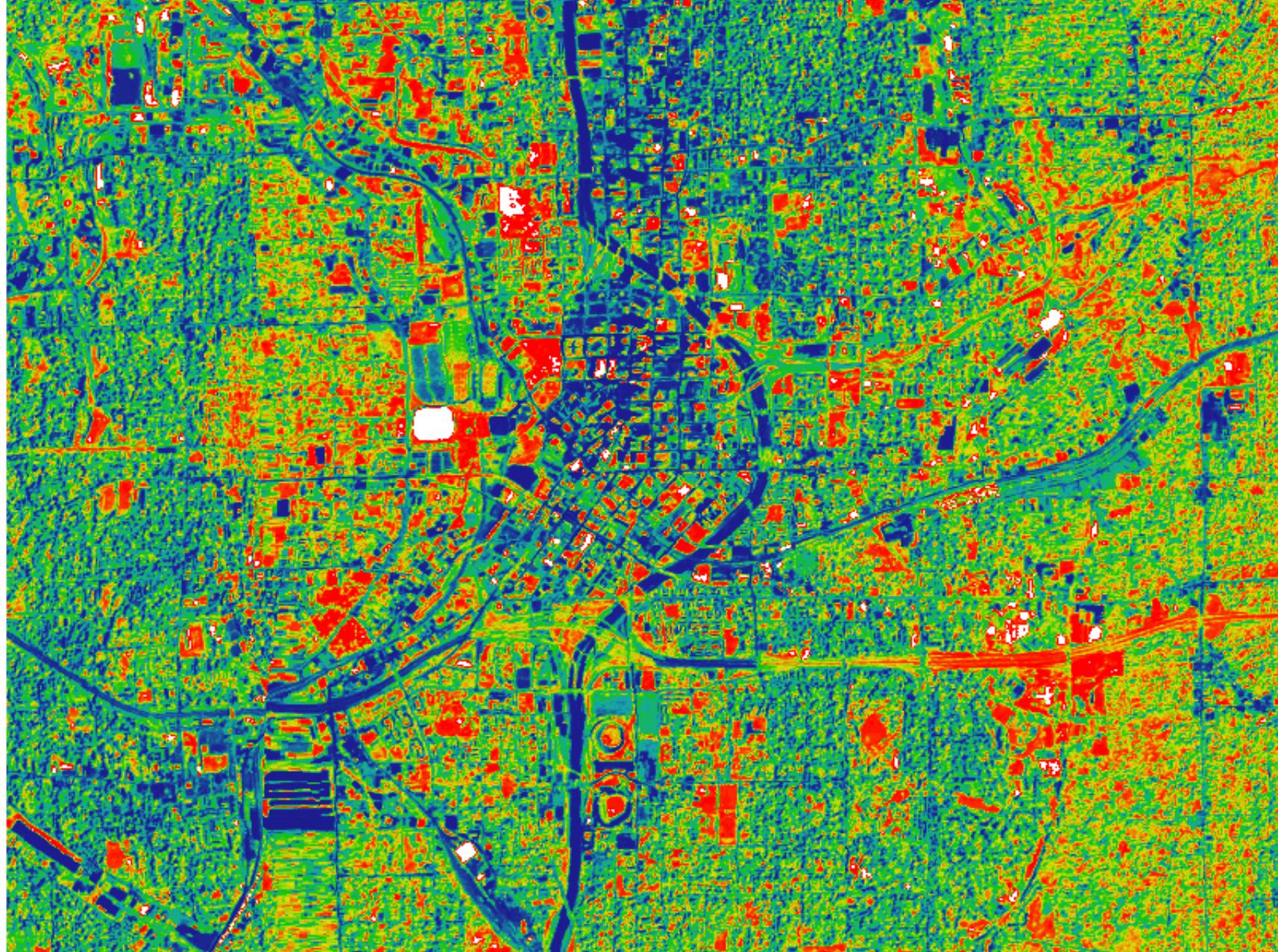
- Air pollution remains a National issue.
- Temperature increases the ozone levels.
- Urban heat island has major effect on temperature and height of mixing layer.
- Measurement program is defining land use patterns and relationship to heat production.
- Remote sensing data are being used to improve air quality modeling.



NAS Sustainable Urban Systems Forum







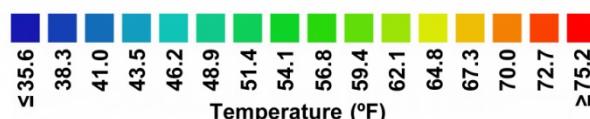
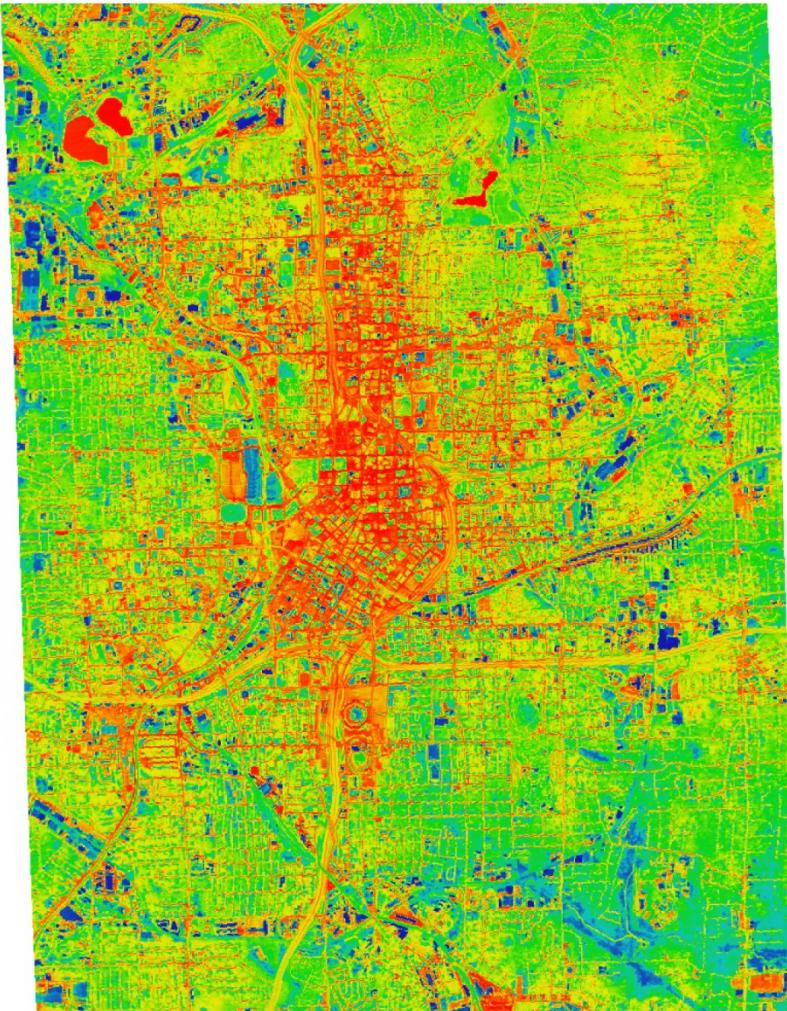
Albedo



≤ 0.08 0.14 0.20 0.26 0.32 0.38 0.44 ≥ 0.50

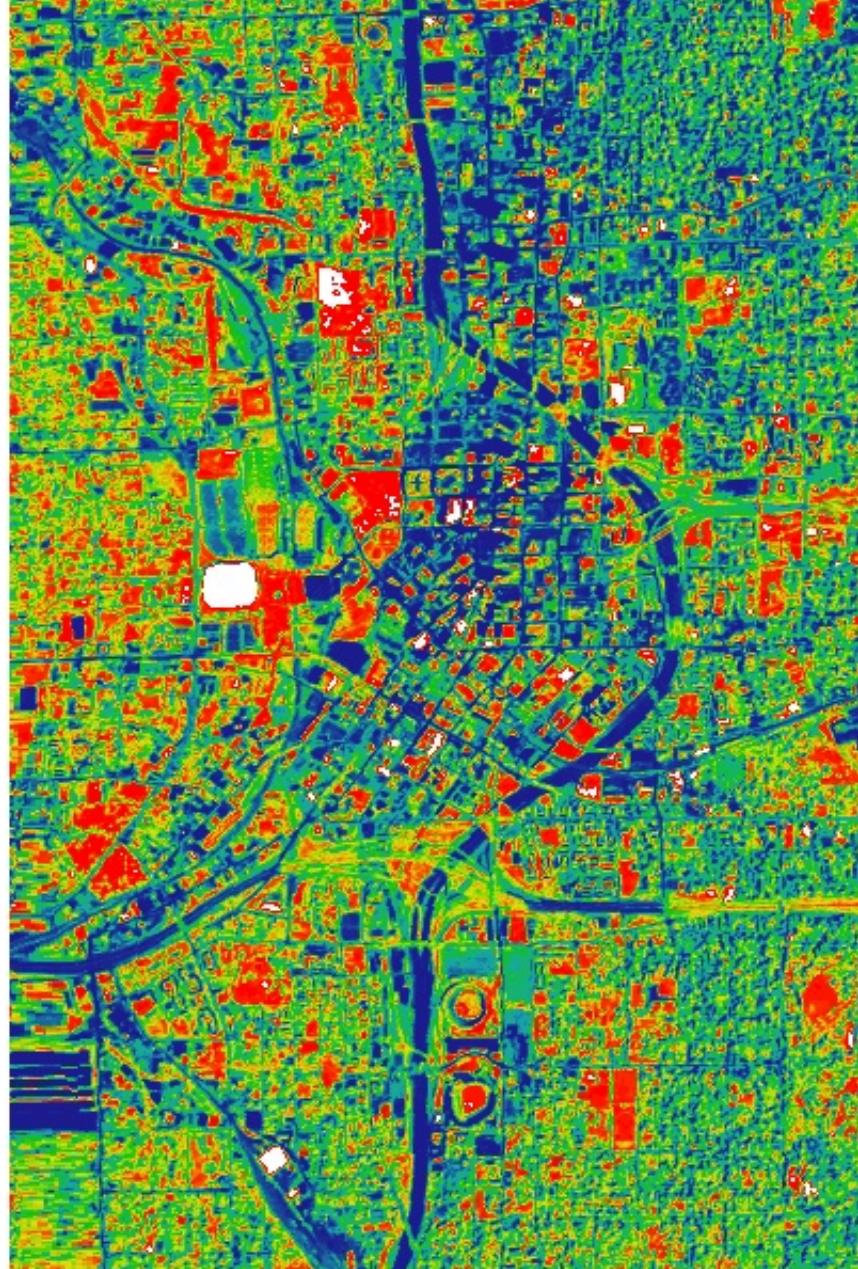


Atlanta Central Business District Night Data – May 1997





Temperature



Albedo

Atlanta, GA - May 1997



Impervious Surfaces





NAS Sustainable Urban Systems Forum





NAS Sustainable Urban Systems Forum





NAS Sustainable Urban Systems Forum



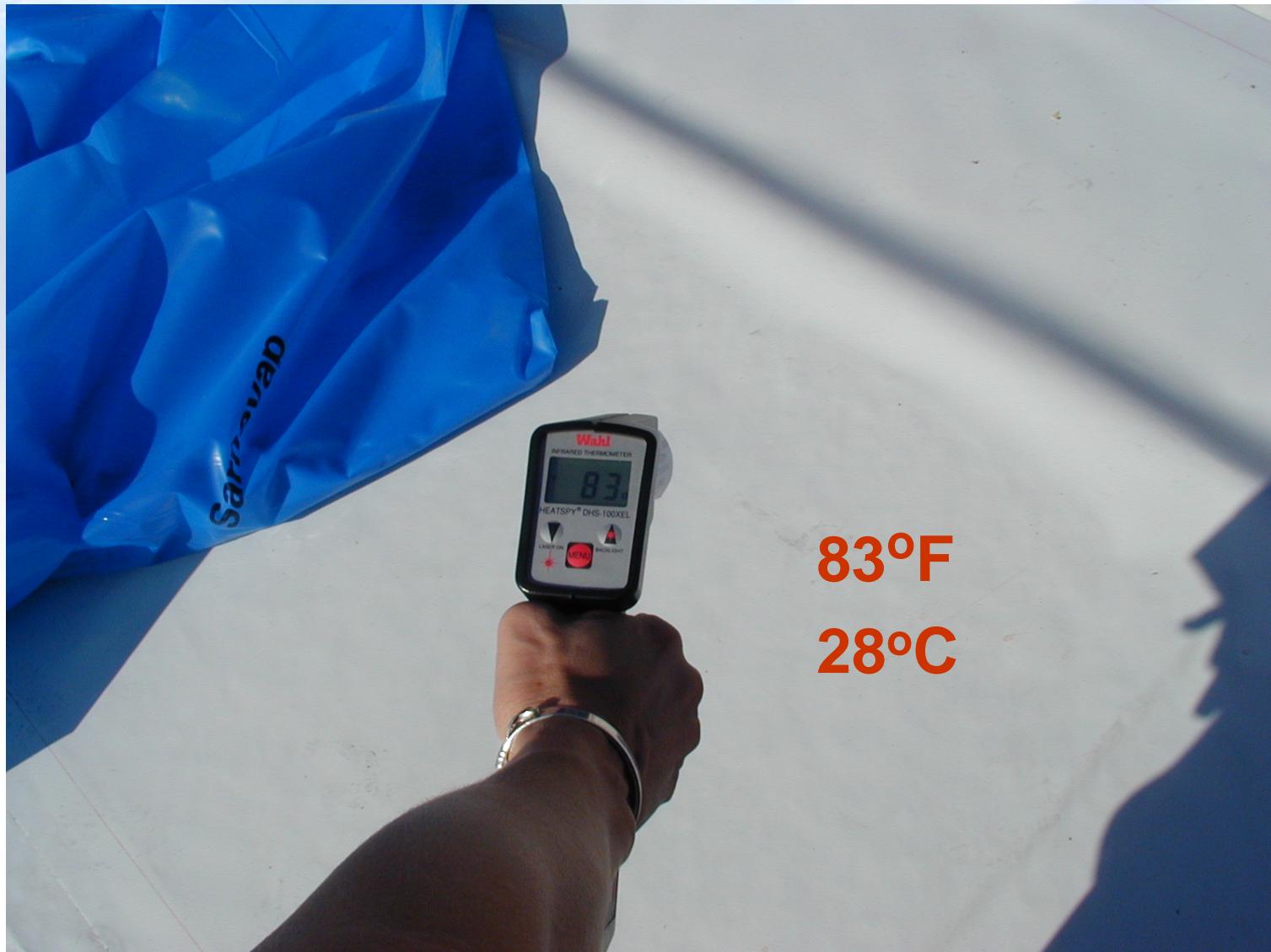


NAS Sustainable Urban Systems Forum





NAS Sustainable Urban Systems Forum





Mitigation Measures

■ Green roofs





Mitigation Measures

- **Less impervious land cover**





Mitigation Measures

- Shade trees



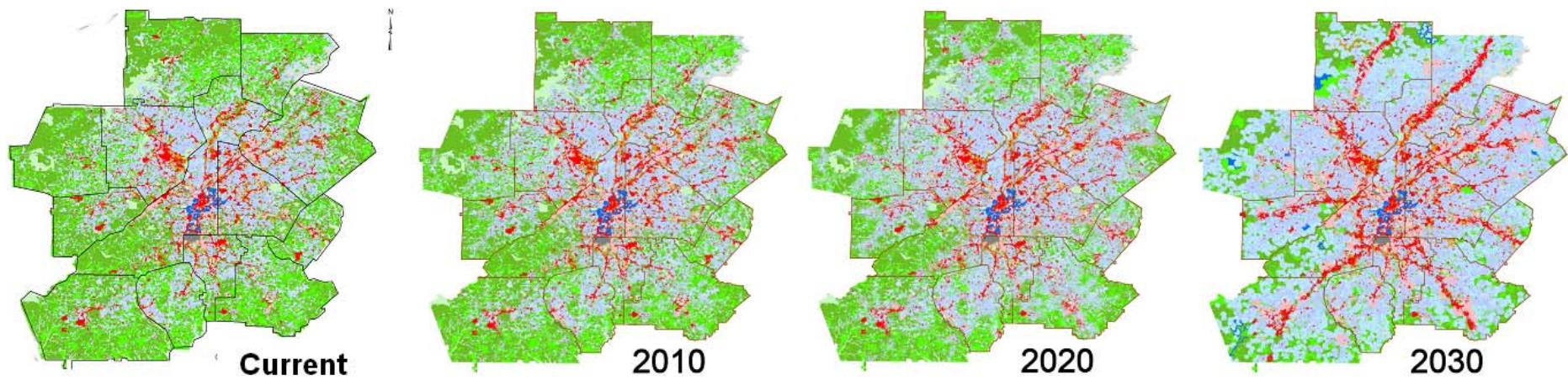


Mitigation Strategies





Spatial Growth Modeling Results



Legend

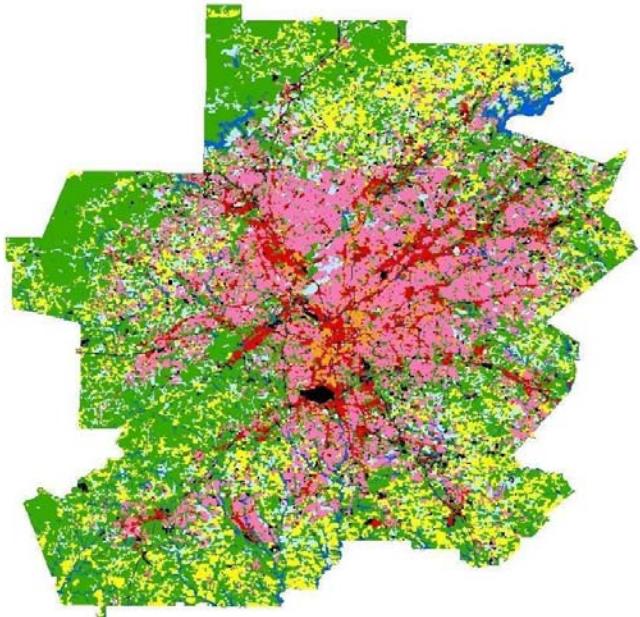
AG_CONFINED	COMMERCIAL	LTD_ACCESS	RES_MOBILE
AG_CROPS	FOREST	PARKS	RES_MULTI
AG_ORCHARD	IND/COM	RESERVOIRS	RIVERS
	INDUSTRIAL	RES_HIGH	TCU
	INST_EXTENSIVE	RES_LOW	TRANSITIONAL
	INST_INTENSIVE	RES_MED	URBAN_OTHER





Current and Projected 2030 Land Use 13-county Atlanta Metro Area

Current (1999)



Projected (2030)



The Spatial Growth Model (SGM) was used to project land use/land cover for the area to 2030.

Inputs to the model are current land use and current and projected population, employment, and road networks.

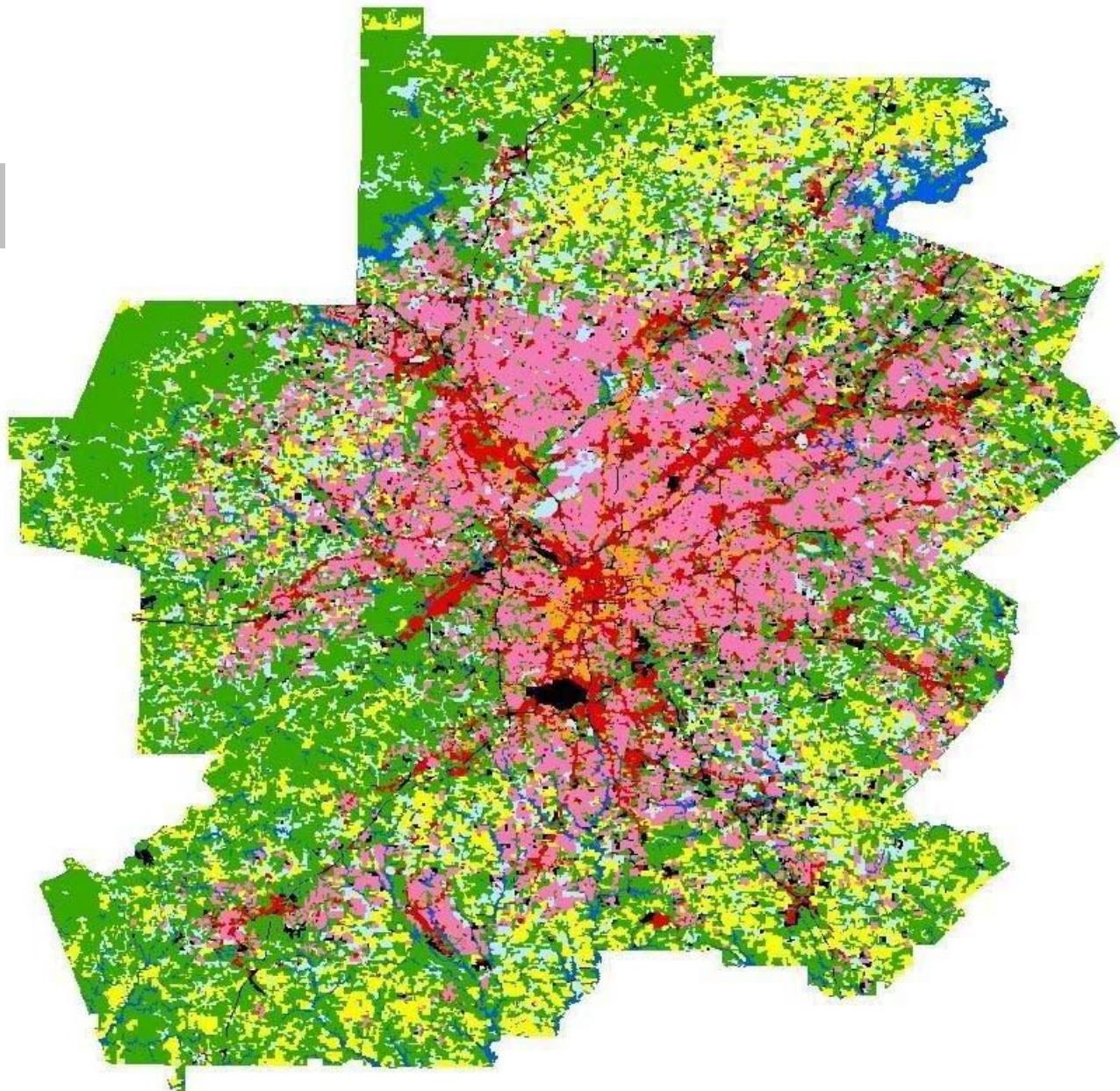
Current land use/land cover is defined by the LandPro99 data set created by the Atlanta Regional Commission (ARC).



Atlanta Urban Heat Island and Air Quality Modeling Study

Land Use in 1999

- Low Density Residential
- Med. Density Residential
- High Density Residential
- Commercial/Services
- Institutional
- TCU
- Industrial/Commercial
- Water
- Crops/Pasture
- Row Crops
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Woody Wetlands
- Quarries/Mines/Gravel Pits
- Transitional





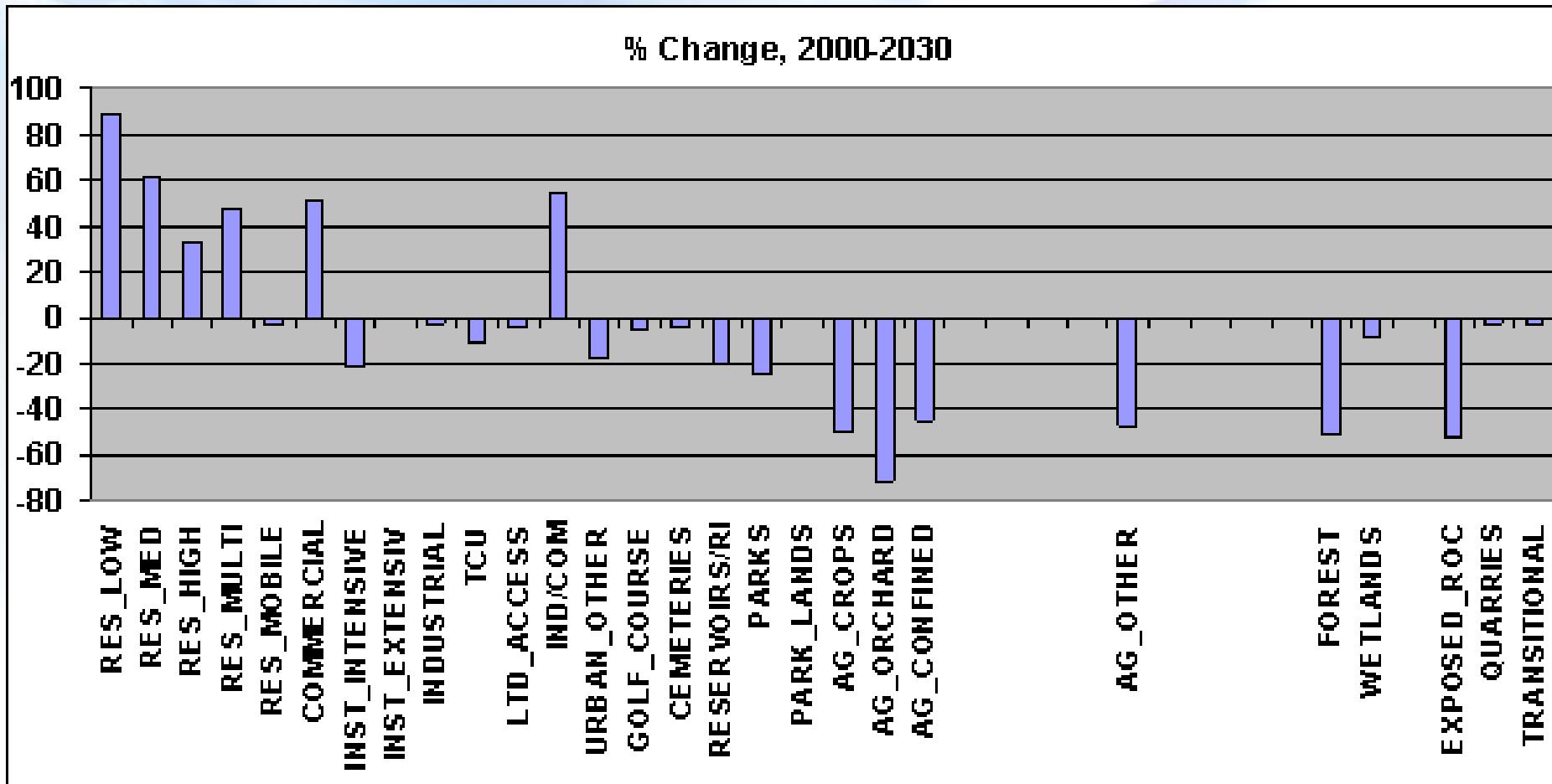
Atlanta Urban Heat Island and Air Quality Modeling Study

Projected Land Use in 2030

- Low Density Residential
- Med. Density Residential
- High Density Residential
- Commercial/Services
- Institutional
- TCU
- Industrial/Commercial
- Water
- Crops/Pasture
- Row Crops
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Woody Wetlands
- Quarries/Mines/Gravel Pits
- Transitional



Land Use Projections



Source: Prescott College Spatial Growth Model

