



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

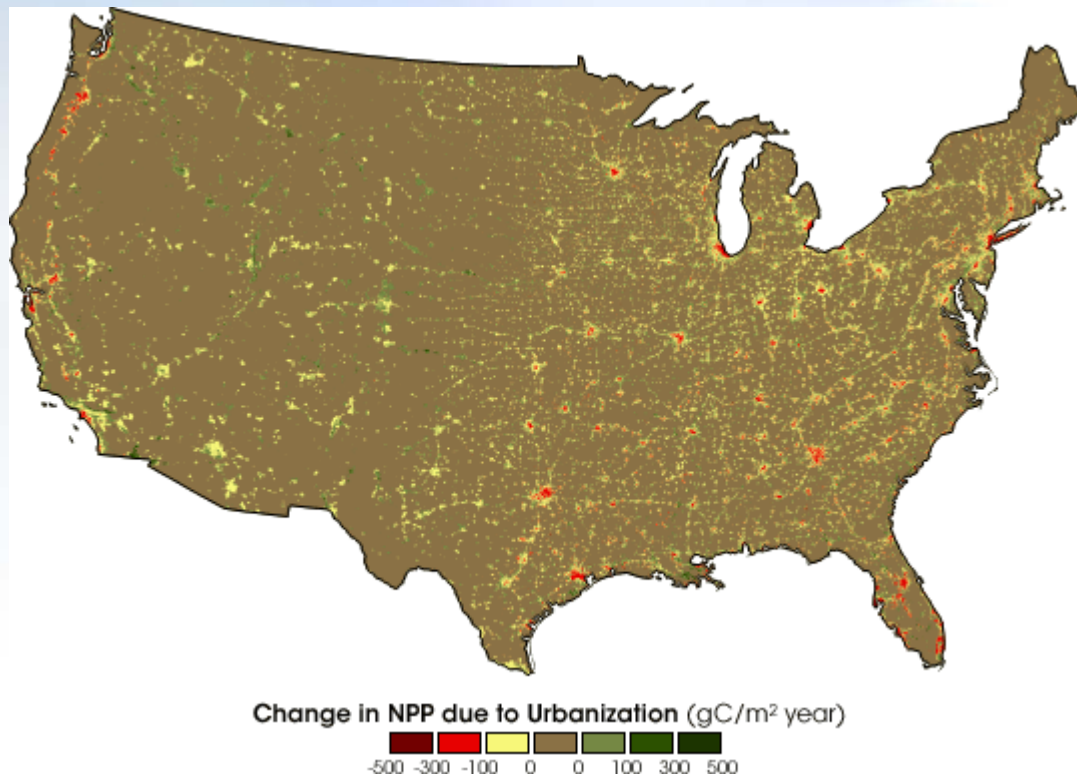
Marshall Space Flight Center

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



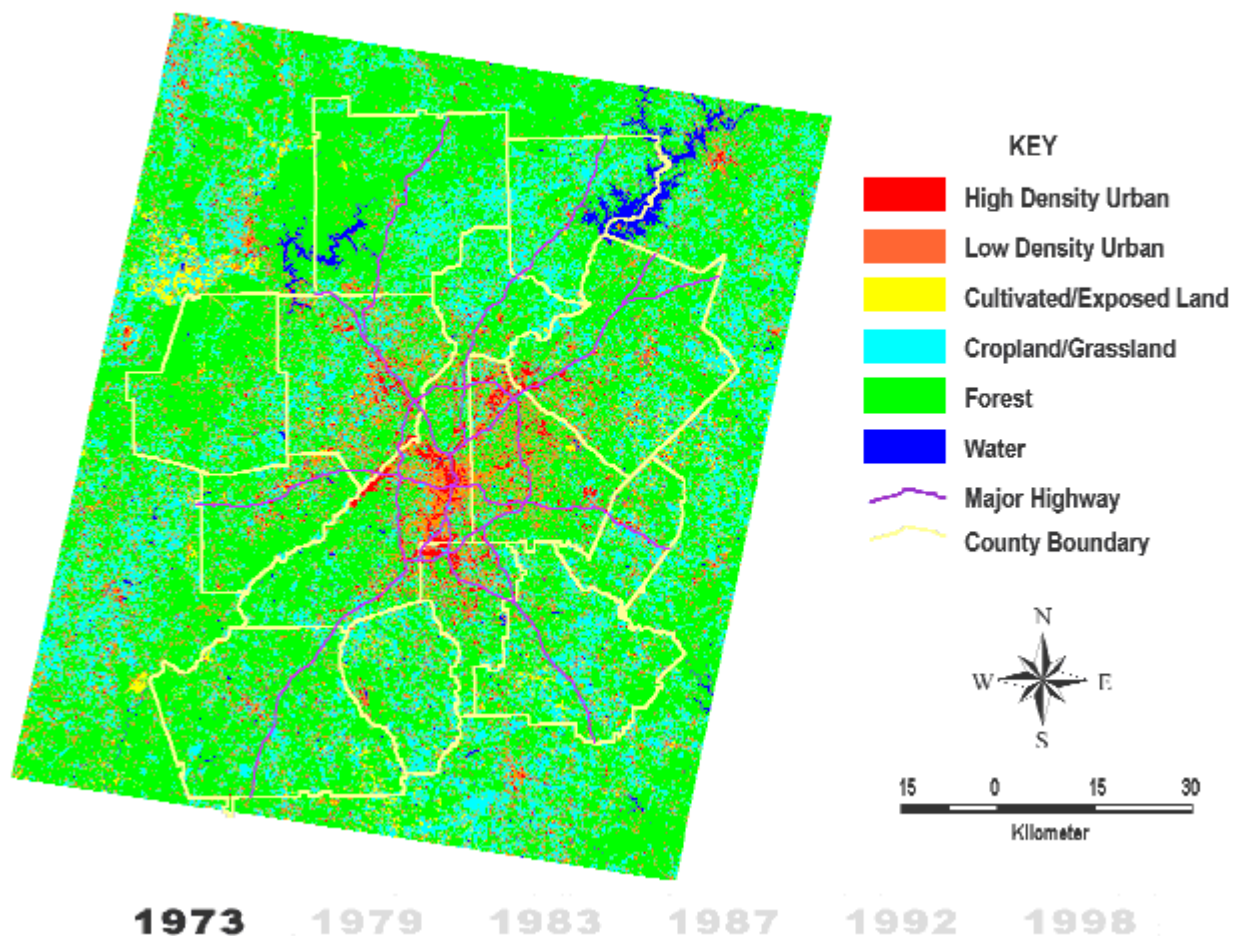
Urbanization Impacts

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



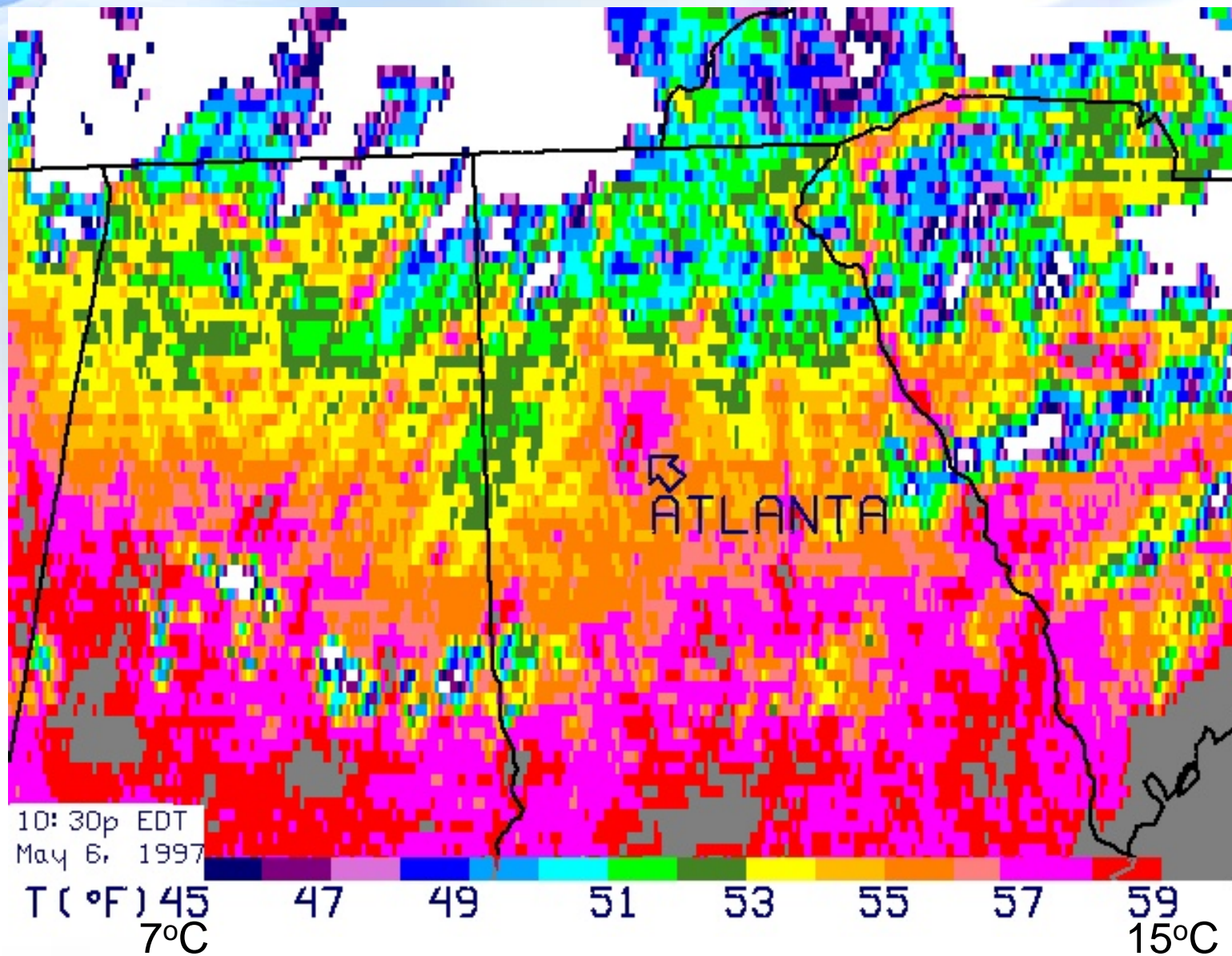
NAS Sustainable Urban Systems Forum

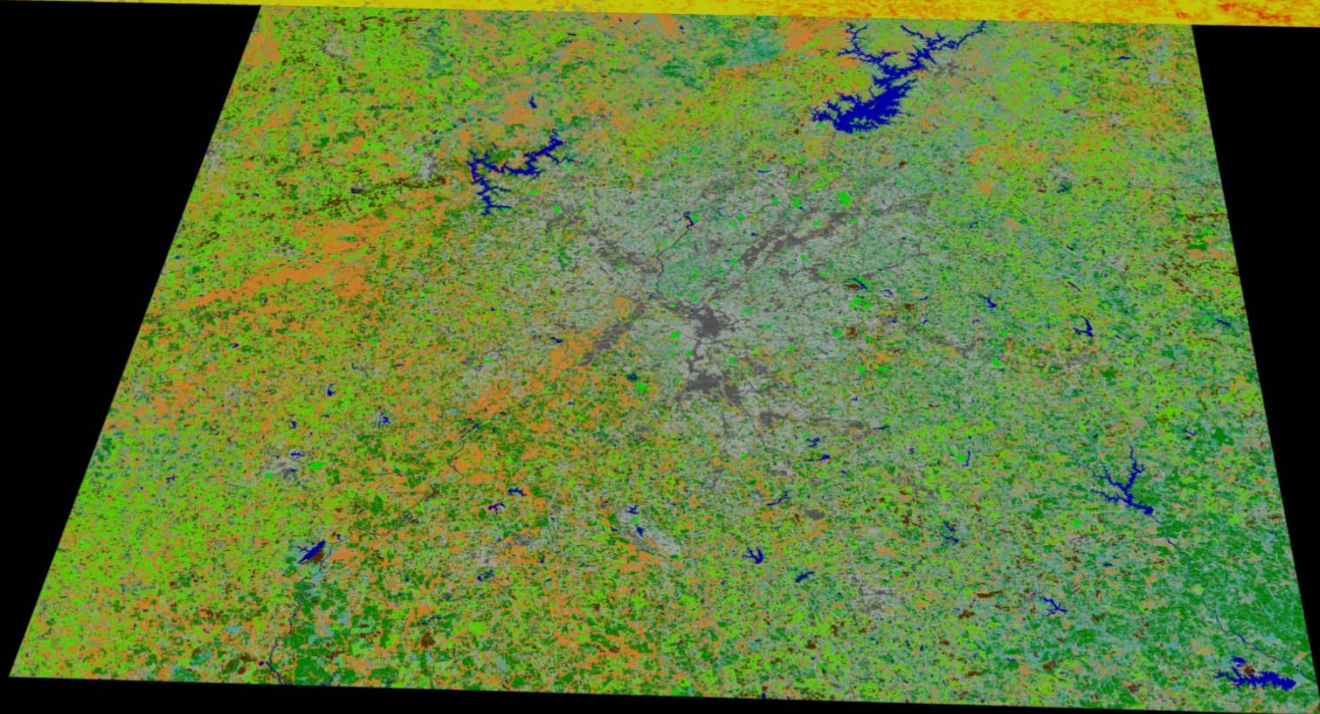
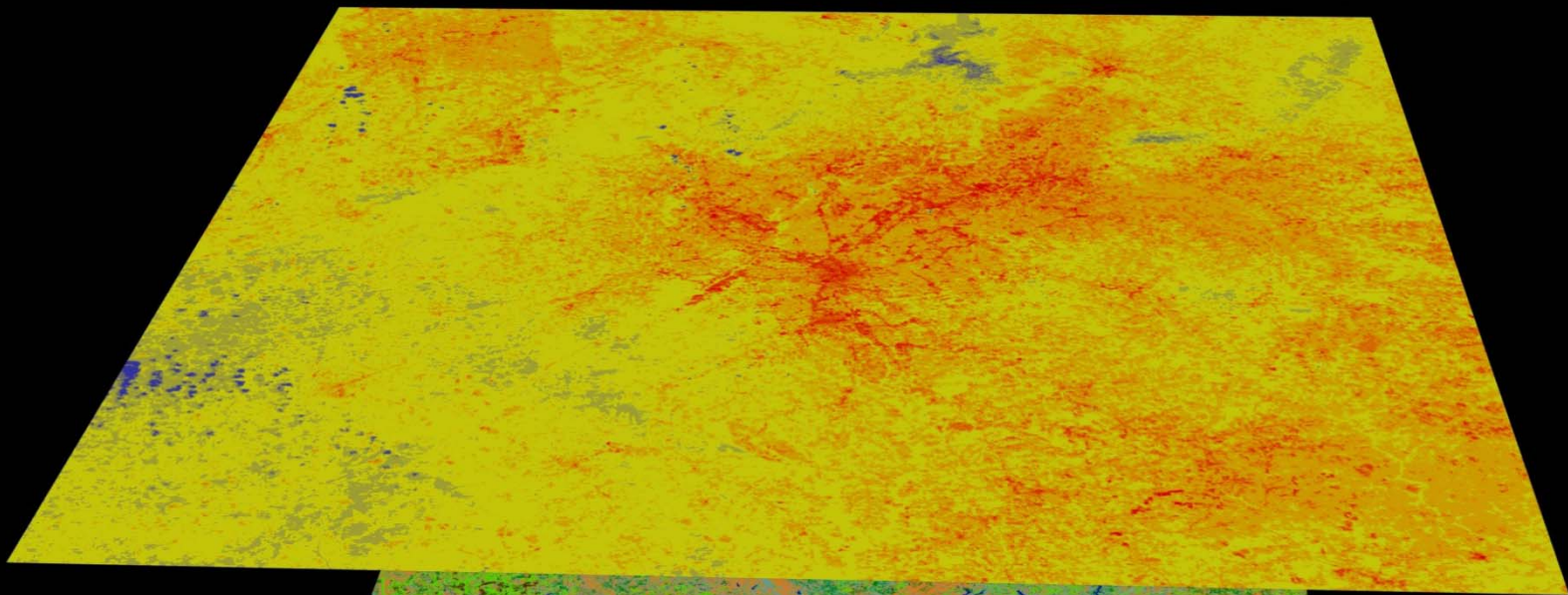
Changes in Land Use/Cover, Atlanta: 1973-1998





NAS Sustainable Urban Systems Forum

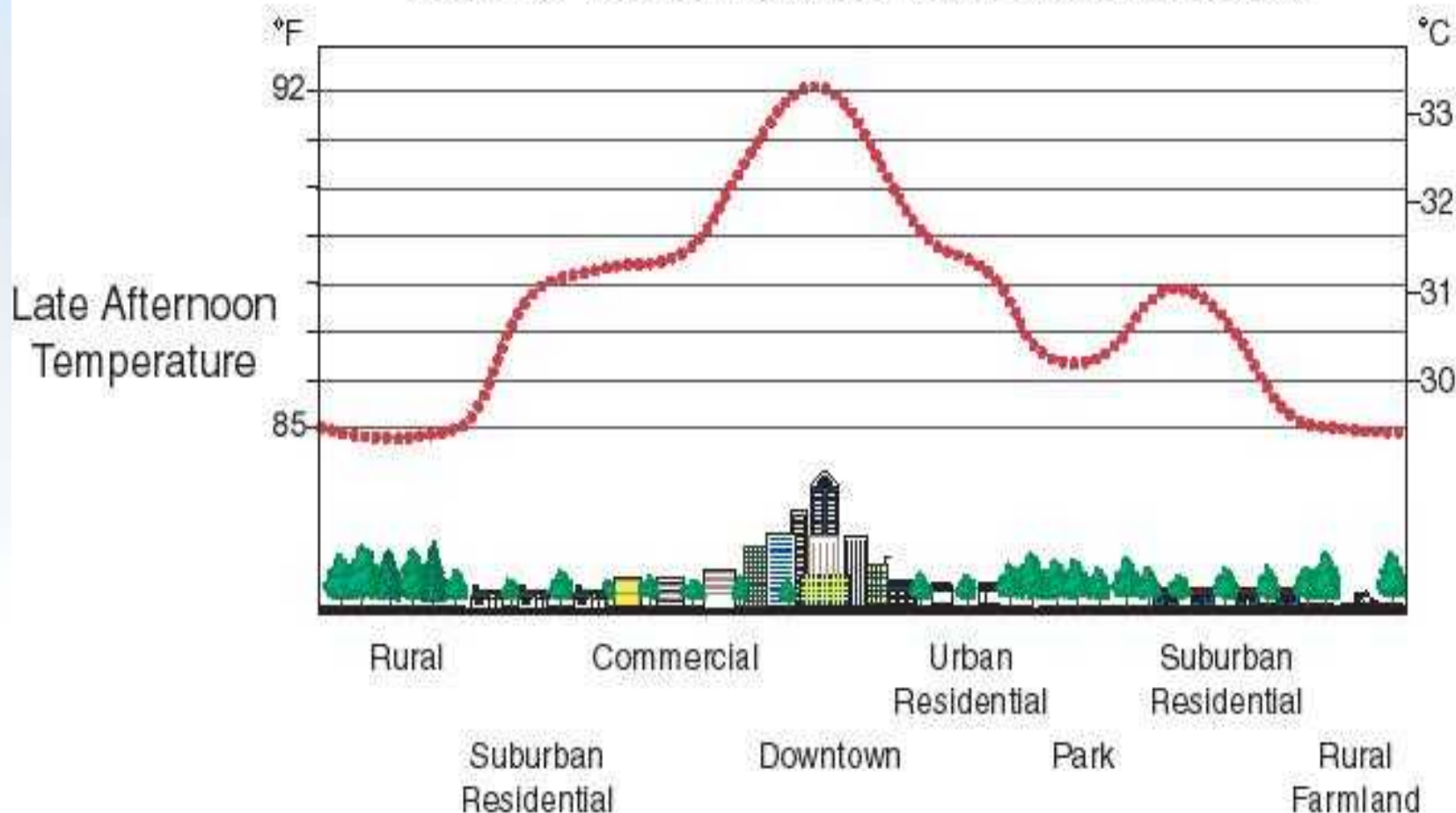






NAS Sustainable Urban Systems Forum

Sketch of an Urban Heat-Island Profile





NAS Sustainable Urban Systems Forum

Mission to Planet Earth

National Aeronautics and Space Administration



Urban Remote Sensing and Air Quality Models

Volatile Organic Compounds
+ Nitrogen Oxides
+ Sunlight
→ Ozone



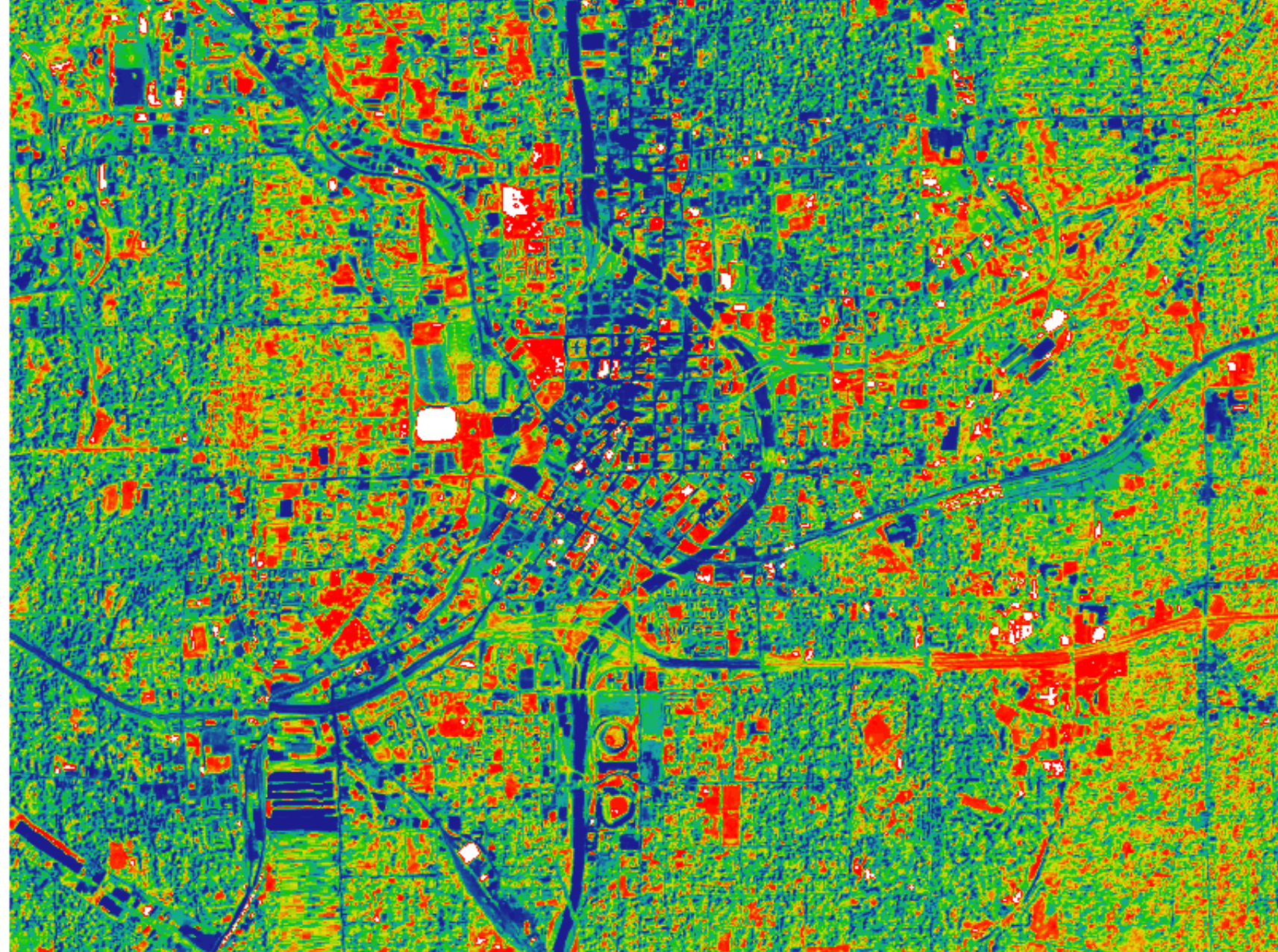
- Air pollution remains a National issue.
- Temperature increases the ozone levels.
- Urban heat island has major effect on temperature and height of mixing layer.
- Measurement program is defining land use patterns and relationship to heat production.
- Remote sensing data are being used to improve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



NAS Sustainable Urban Systems Forum







Albedo



≤ 0.08



0.14



0.20



0.26



0.32



0.38



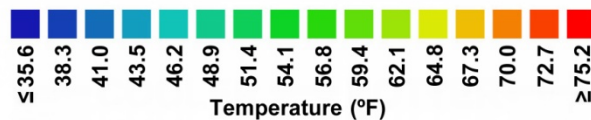
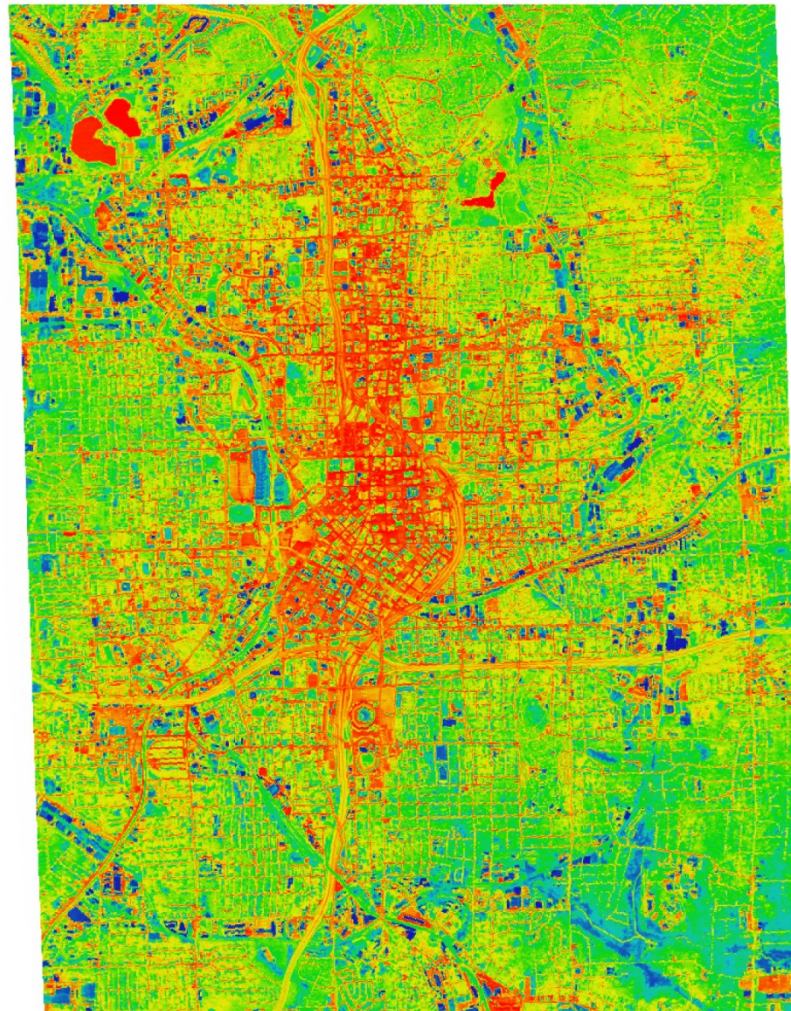
0.44



≥ 0.50



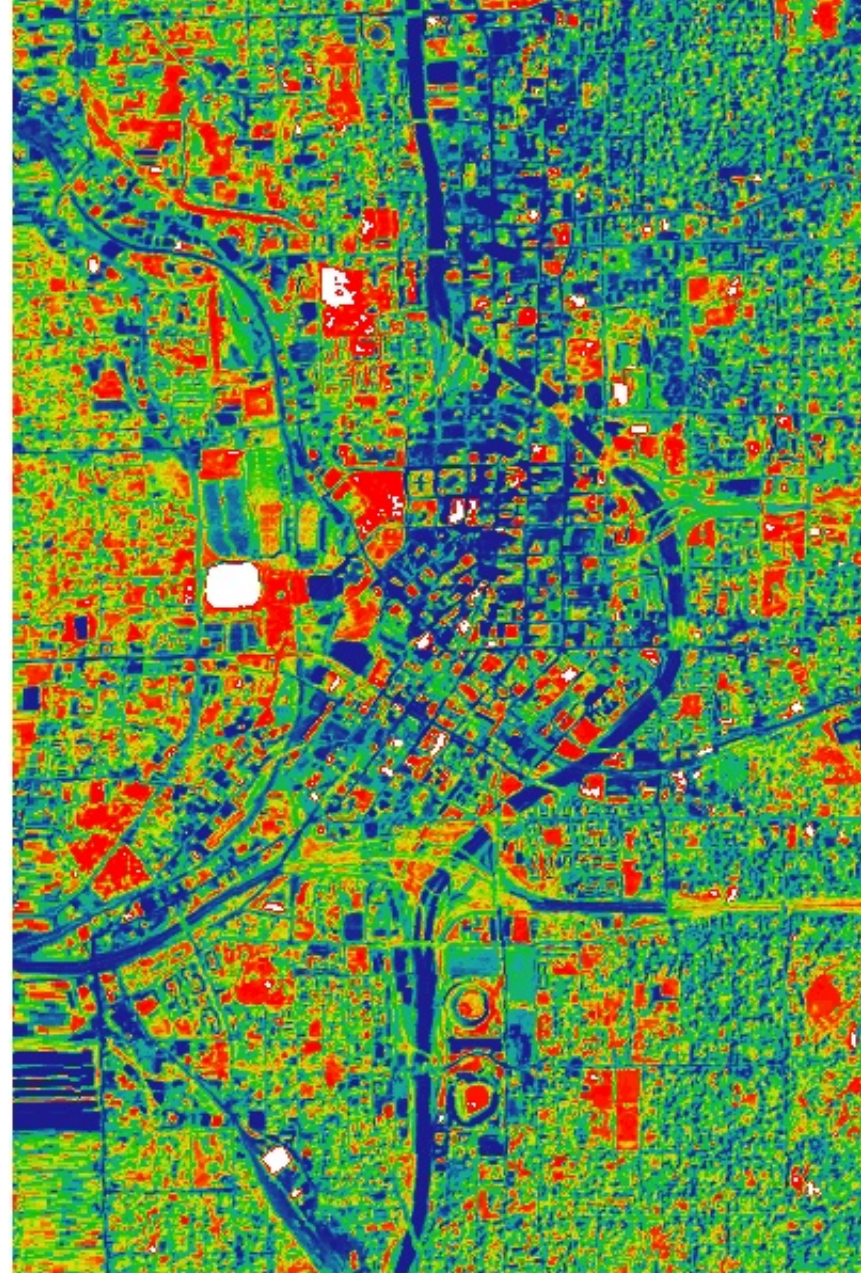
Atlanta Central Business District Night Data – May 1997



Source: NASA / EPA



Temperature



Albedo

Atlanta, GA - May 1997



Impervious Surfaces





NAS Sustainable Urban Systems Forum





NAS Sustainable Urban Systems Forum



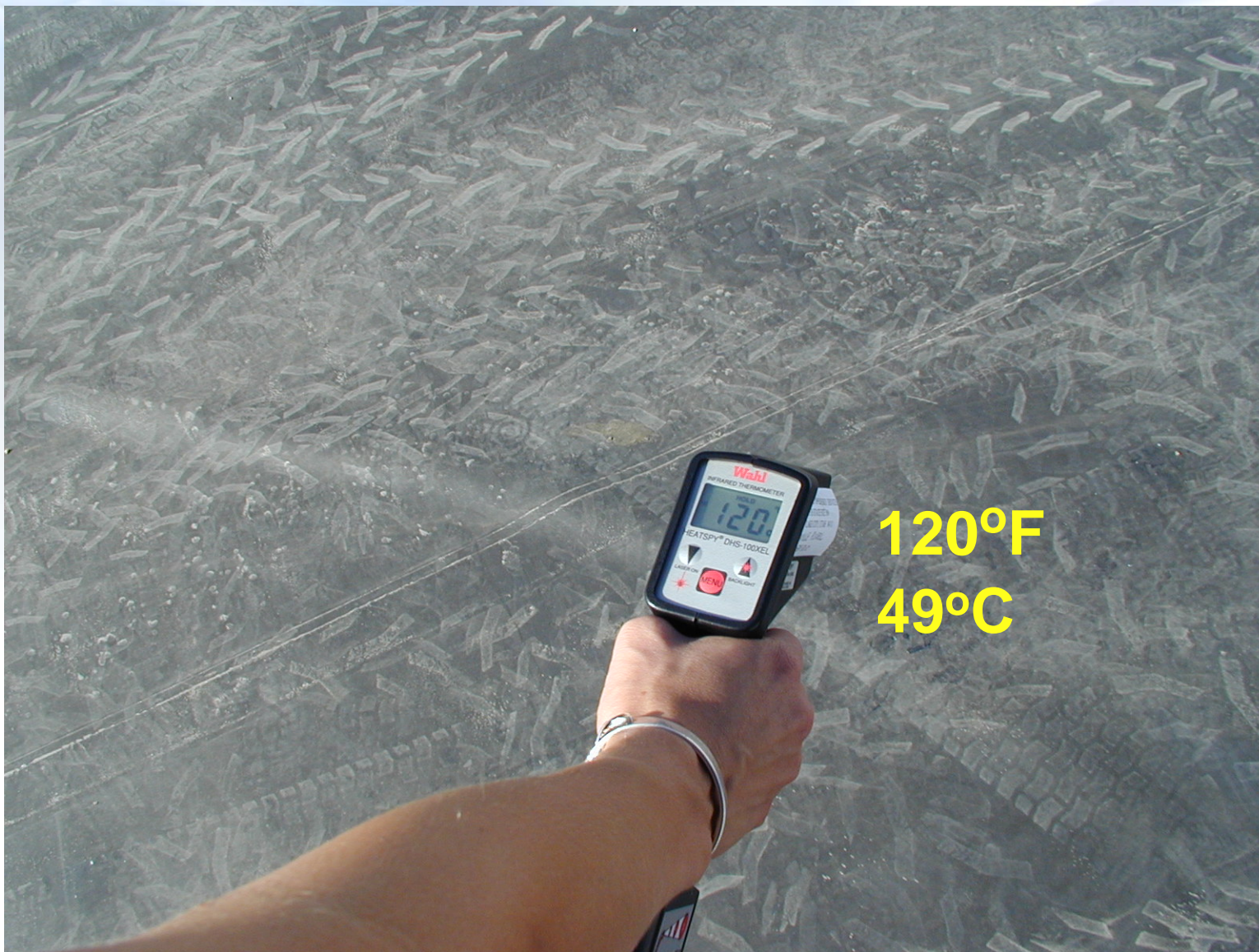


NAS Sustainable Urban Systems Forum



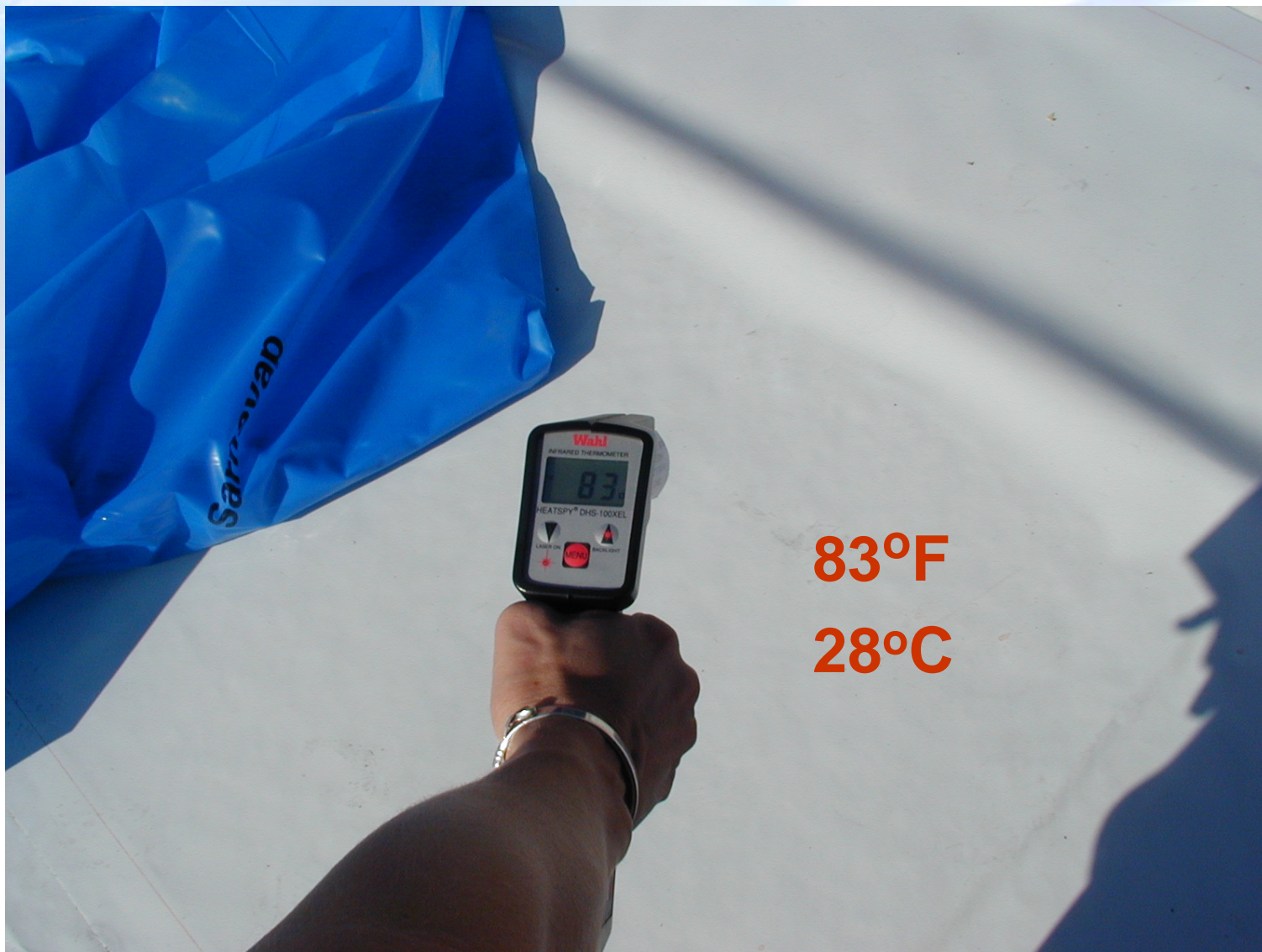


NAS Sustainable Urban Systems Forum





NAS Sustainable Urban Systems Forum





NAS Sustainable Urban Systems Forum

Mitigation Measures

■ Green roofs





NAS Sustainable Urban Systems Forum

Mitigation Measures

- **Less impervious land cover**





Mitigation Measures

■ Shade trees



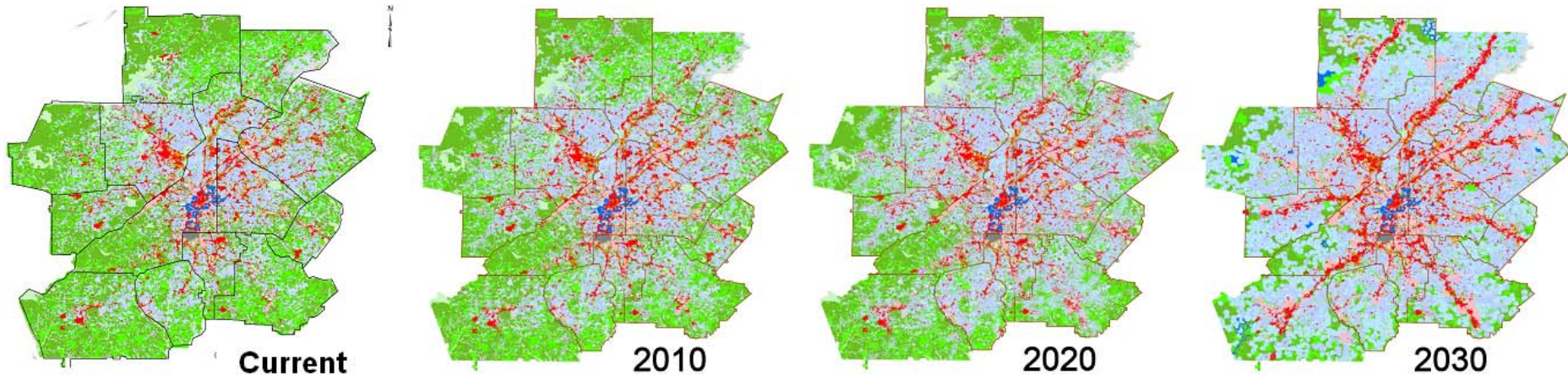


Mitigation Strategies


























Spatial Growth Modeling Results



Legend

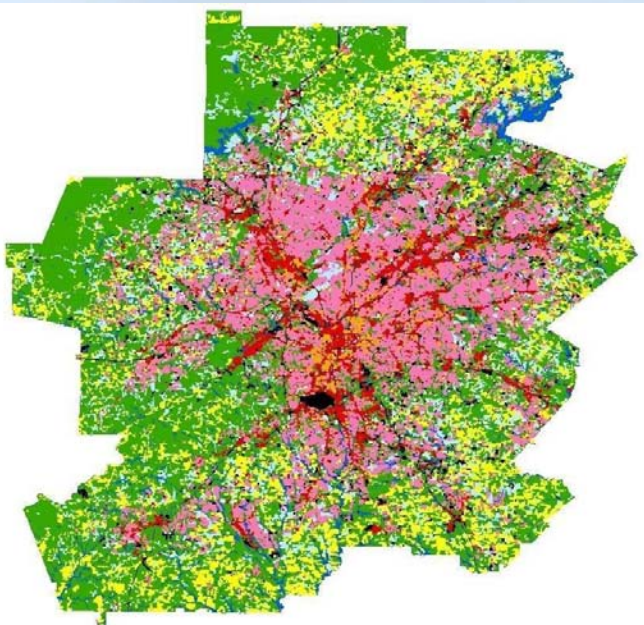
 AG_CONFINED	 COMMERCIAL	 LTD_ACCESS	 RES_MOBILE
 AG_CROPS	 FOREST	 PARKS	 RES_MULTI
 AG_ORCHARD	 IND/COM	 RESERVOIRS	 RIVERS
	 INDUSTRIAL	 RES_HIGH	 TCU
	 INST_EXTENSIVE	 RES_LOW	 TRANSITIONAL
	 INST_INTENSIVE	 RES_MED	 URBAN_OTHER





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

Current (1999)



Projected (2030)

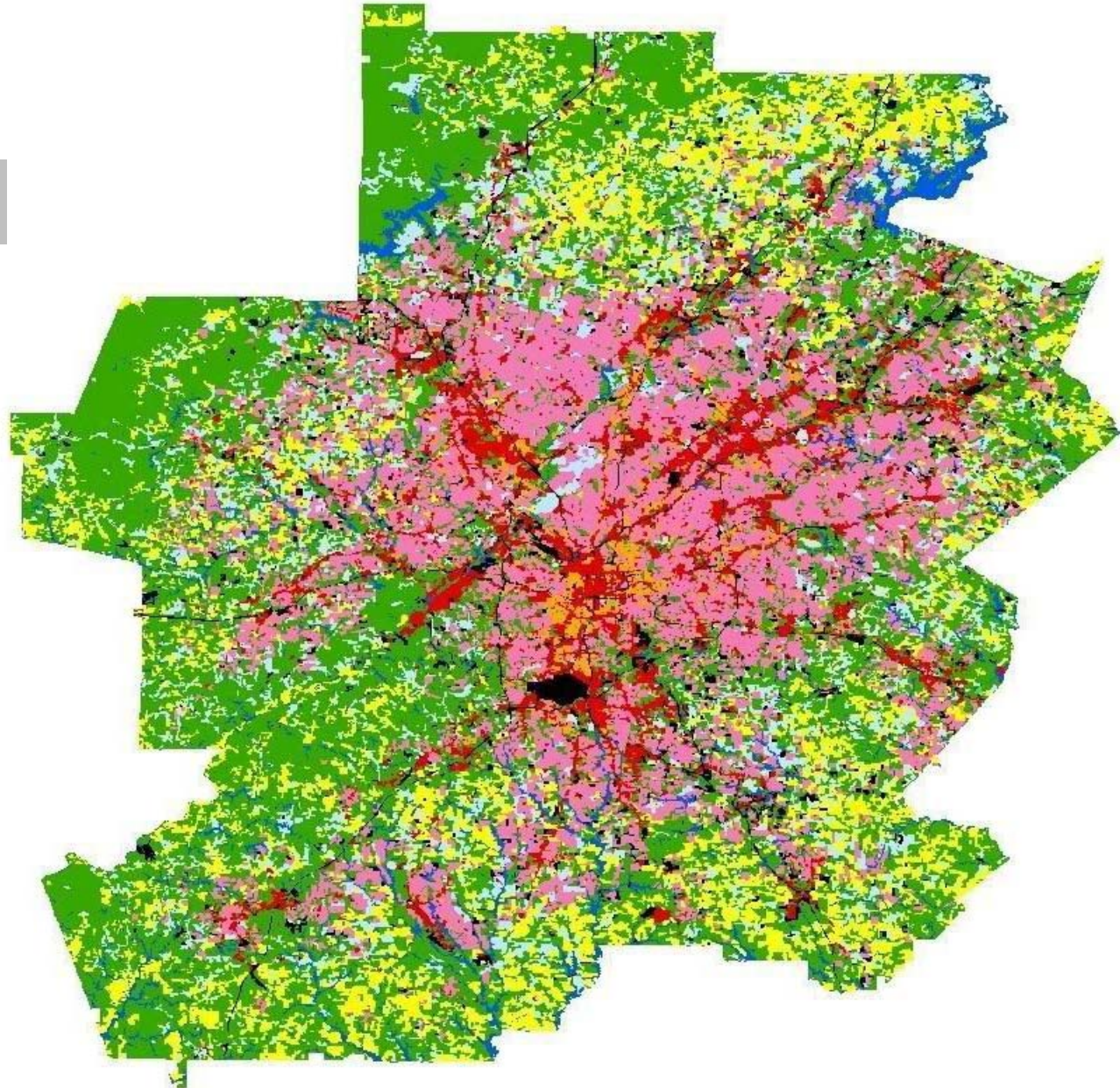


The Spatial Growth Model (SGM) was used to project land use/land cover for the area to 2030. Inputs to the model are current land use and current and projected population, employment, and road networks. Current land use/land cover is defined by the LandPro99 data set created by the Atlanta Regional Commission (ARC).



Atlanta Urban Heat Island and Air Quality Modeling Study

Land Use in 1999





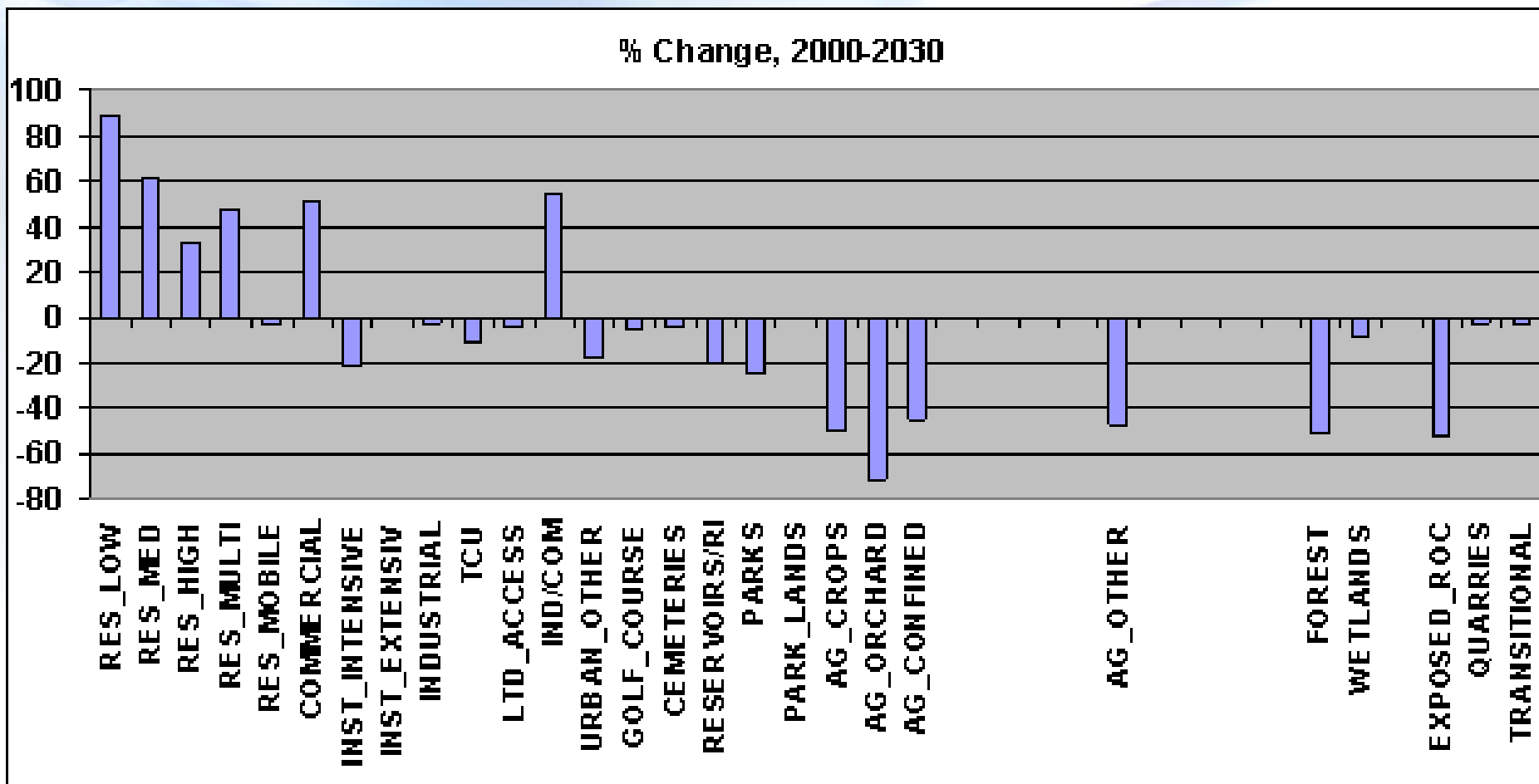
Atlanta Urban Heat Island and Air Quality Modeling Study

Projected Land Use in 2030





Land Use Projections



Source: Prescott College Spatial Growth Model

