Global Urban Observation (I): International Collaboration Opportunities

NASA GEO Subtask SB-04

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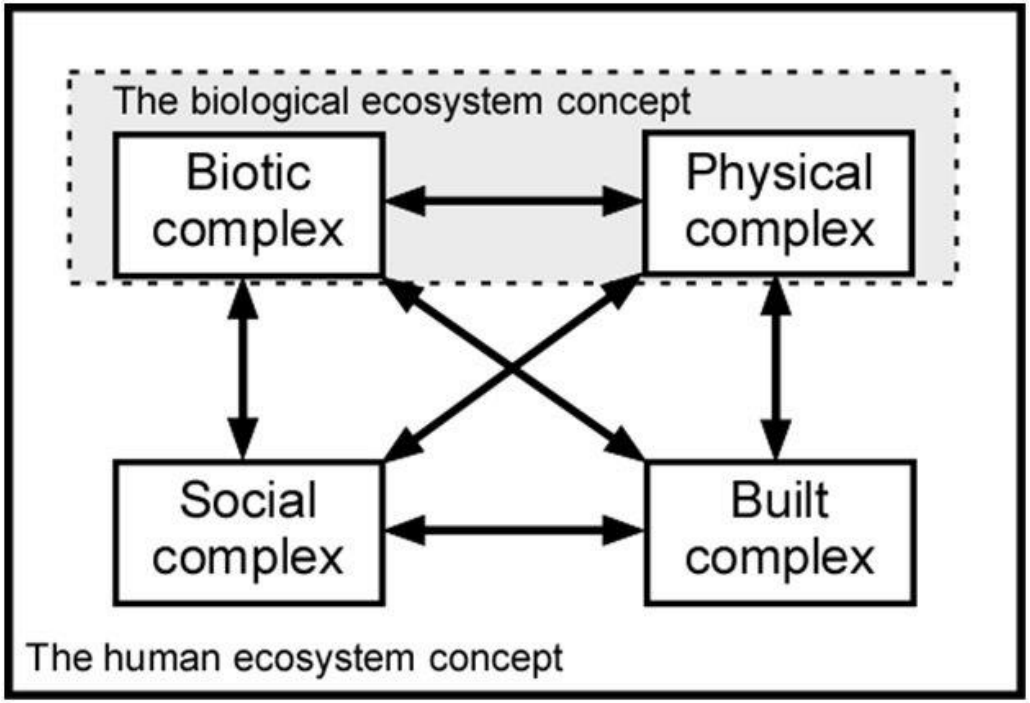
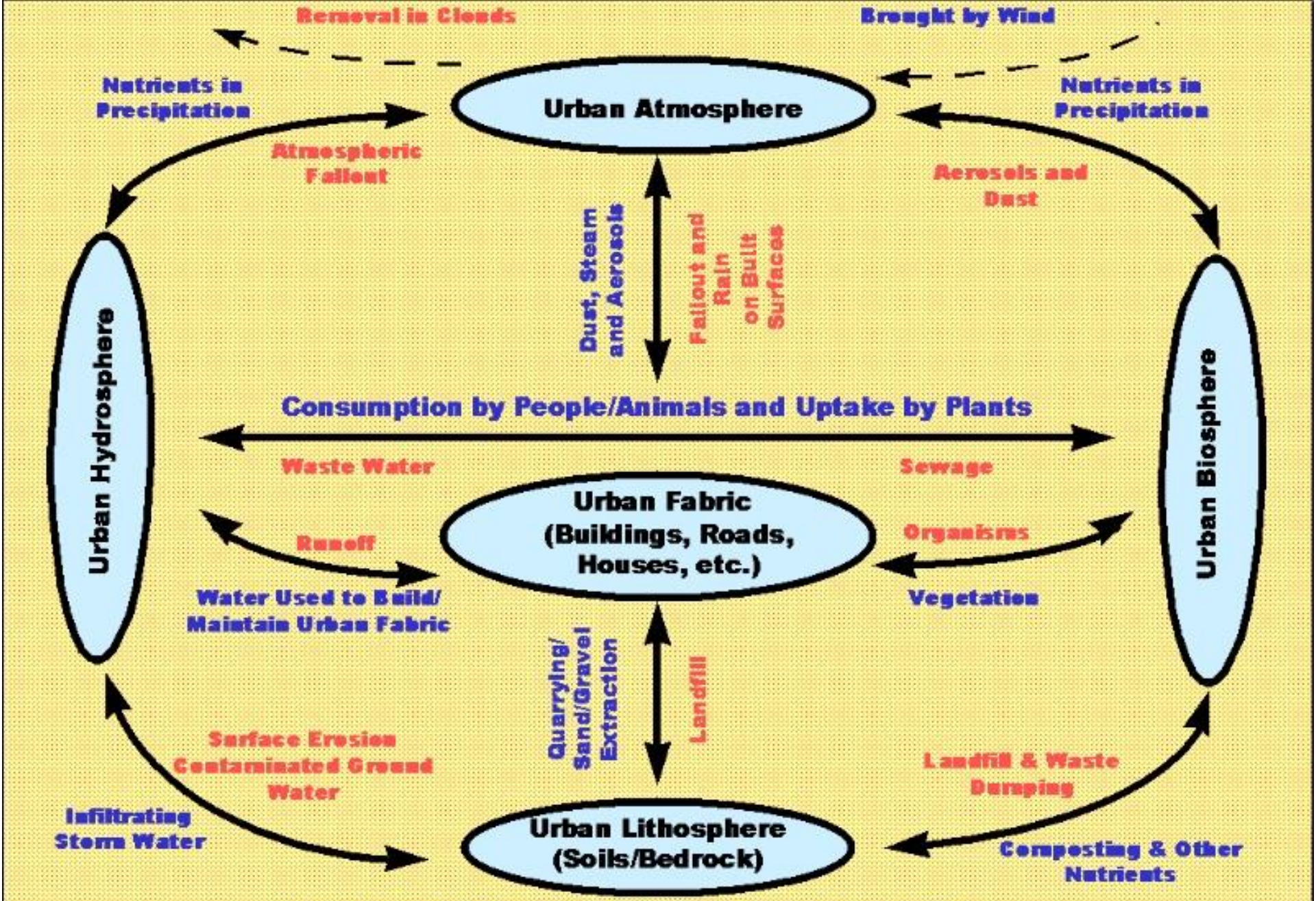
- In studying urban areas, it is useful to analyze the urban environment as an ‘urban ecosystem’ to provide perspectives on how the various physical, biophysical, land-atmosphere, and social aspects of urban areas act as a synergistic whole to create ‘the city’.

- The urban ecosystem is complex and must be broken up into its constituent parts to examine the linkages between the cycles that function within the overall ecosystem.





URBAN ECOSYSTEM CYCLES

(Revised from Douglas, 1983, P. 68)

- Intrinsic to SB-04 is to produce up-to-date information on the state and dynamics of urban ecosystems from local to global scales.

- Within this context, the observation and assessment of how cities grow and change in land cover/land use through time, and how this growth affects the land-atmosphere interactions is paramount.

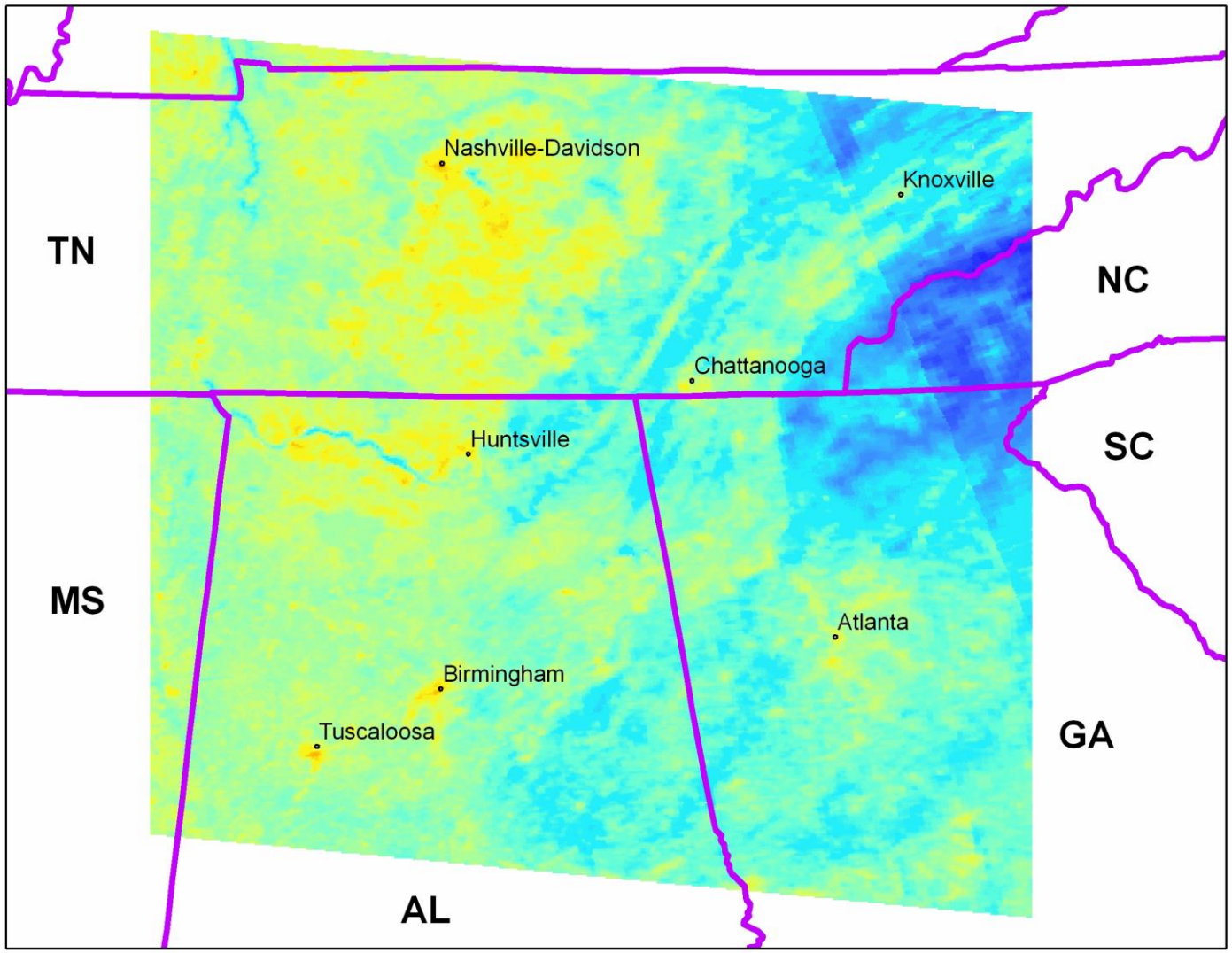
- Satellite data are of critical importance to observe and measure how changes in the urban surface affect land surface-atmosphere energy exchanges.

- A key component that governs the cycling of energy between the urban atmosphere, biosphere, hydrosphere, and land surface (urban fabric) is the Urban Heat Island effect (UHI).

- Integral to understanding the dynamics of the UHI is how urban growth and change in land cover/land use impact the factors that drive the UHI effect.

- SB-04 will serve as a fulcrum for collecting data from many different satellite platforms at varying spectral, spatial and temporal resolutions for use in observing, measuring, and modeling the characteristics that force the development of the UHI.

NASA/MODIS Land Surface Temperature at 1:30 PM (June 27, 2012)



Prepared by:
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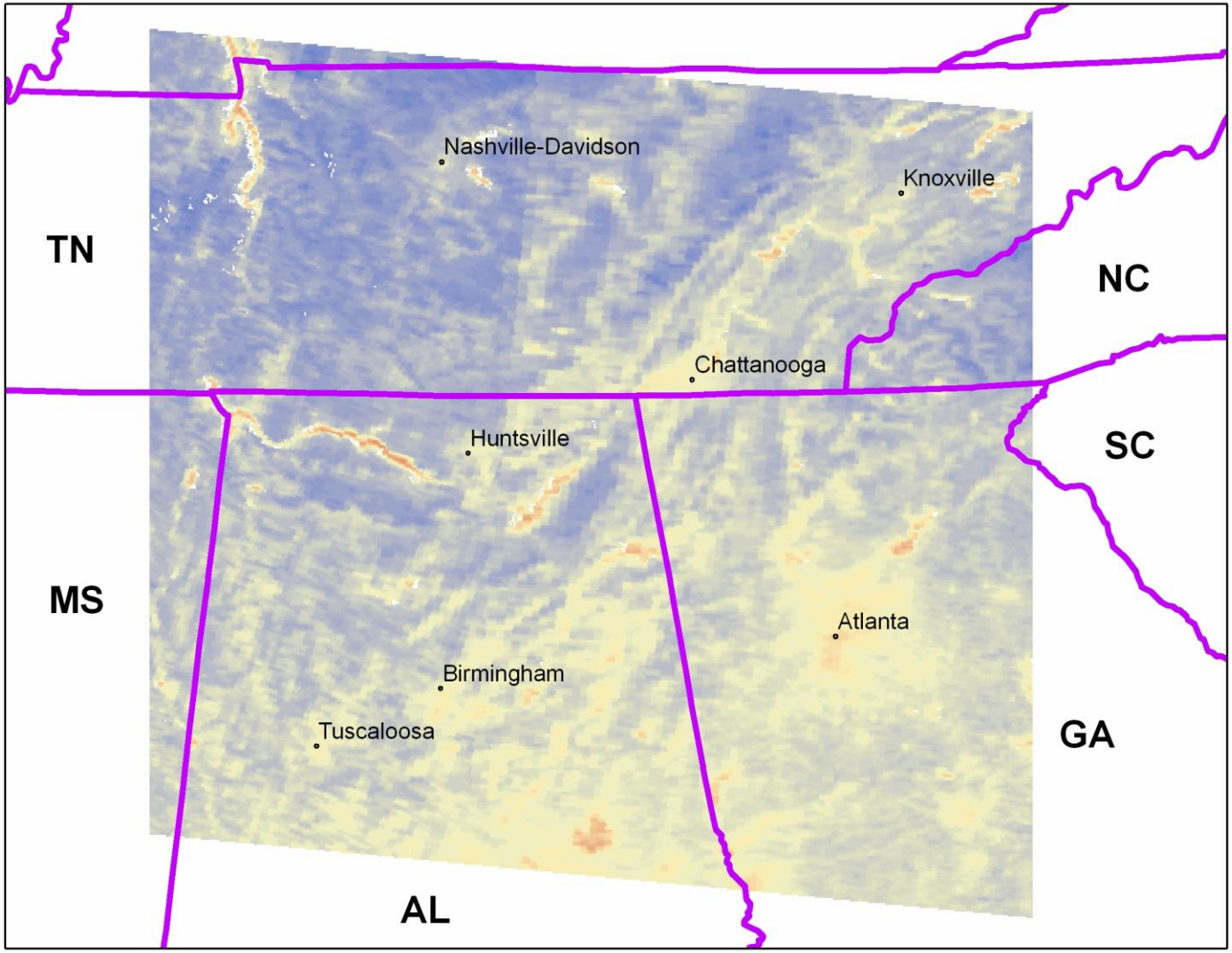
USRA at NASA/MSFC
mohammad.alhamdan@nasa.gov
July 17, 2012

0 15 30 60 90 120 Miles

N

USRA NASA NSSTC

NASA/MODIS Land Surface Temperature at 1:30 AM (June 27, 2012)



Degrees Fahrenheit

92

41

STATES

Major Cities

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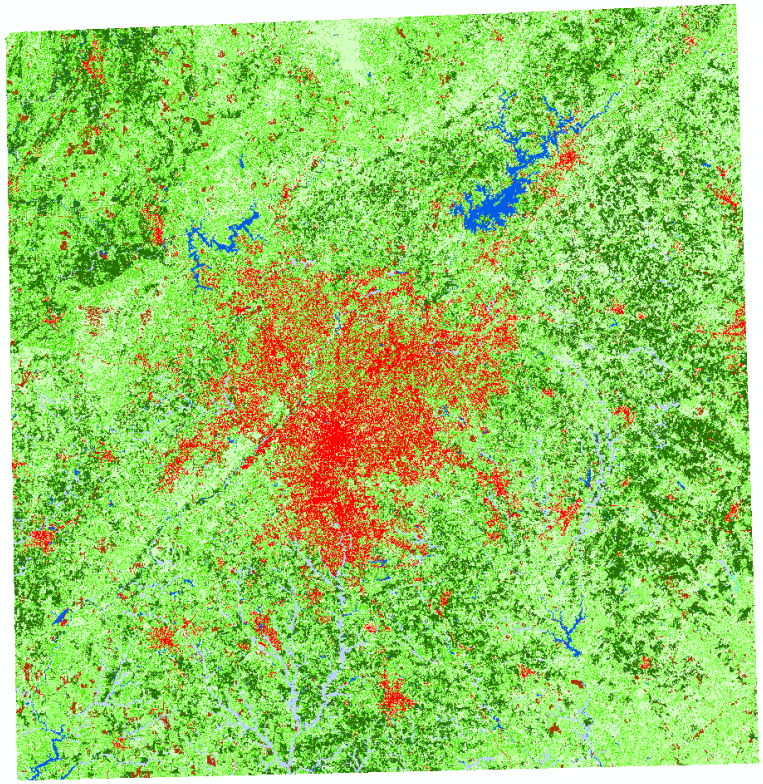
0 15 30 60 90 120 Miles

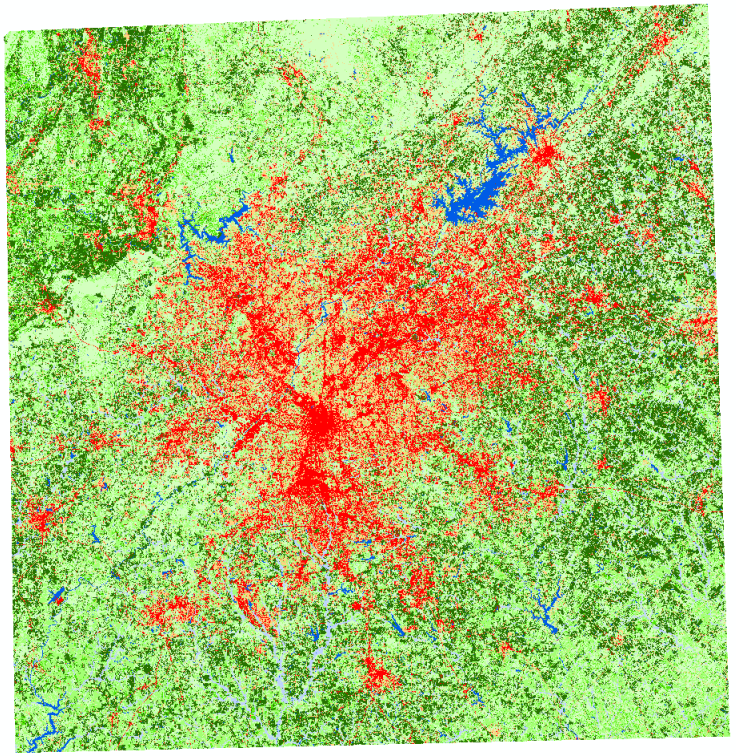
N

USRA NASA NSSTC

Landsat-derived (NLCD) land cover for the Atlanta metropolitan area for 1992 and 2006



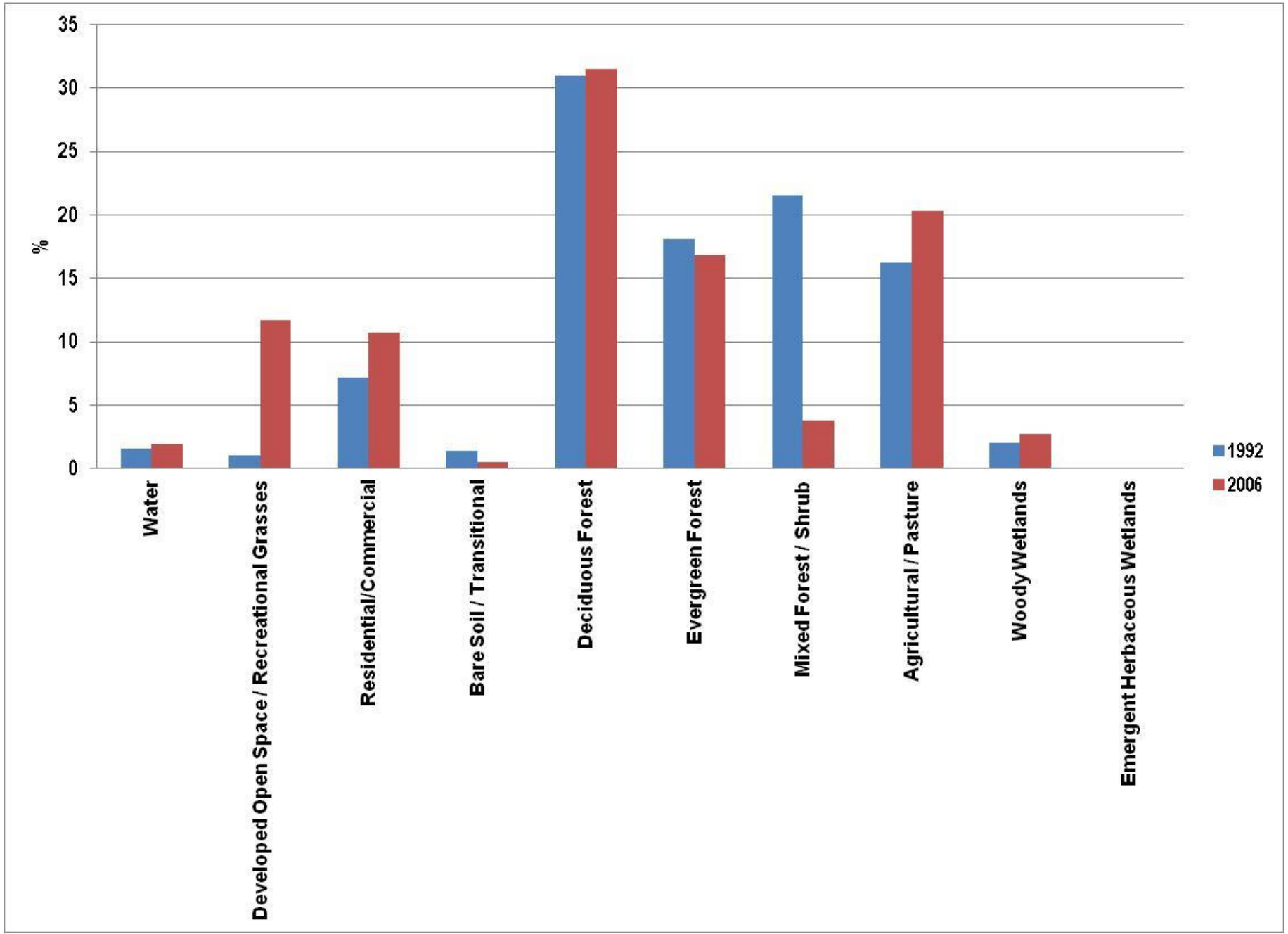
1992



2006

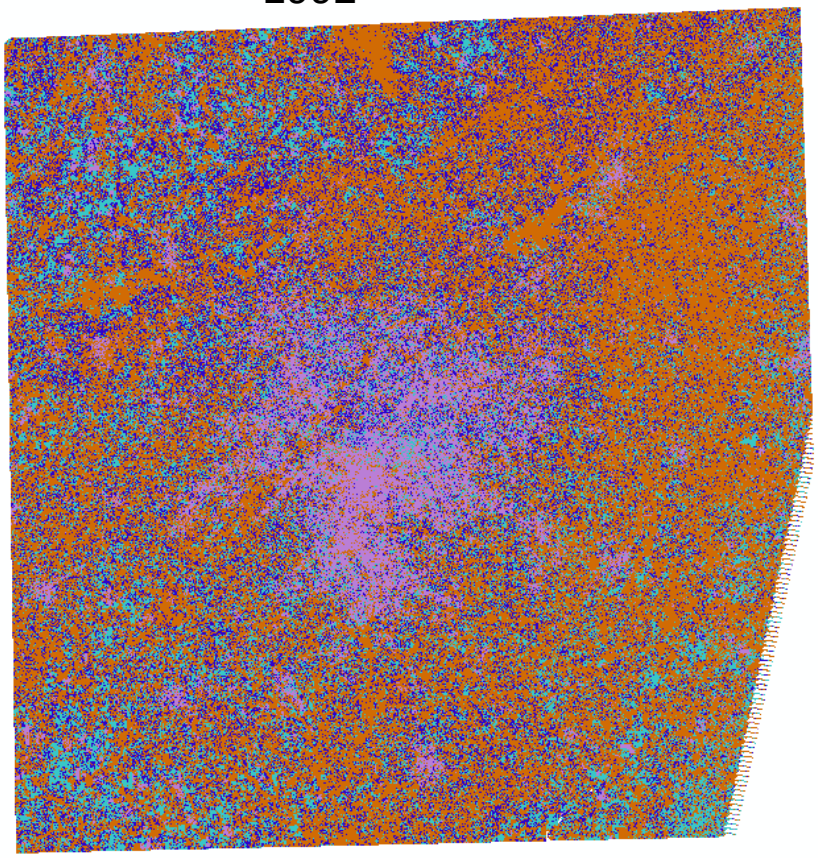
- Water
- Developed Open Space/Recreational Grasses
- Residential/Commercial
- Bare Soil / Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest / Shrub
- Agricultural / Pasture
- Woody Wetlands
- Emergent Herbaceous Wetlands

Landsat-derived (NLCD) land cover for the Atlanta metropolitan area for 1992 and 2006

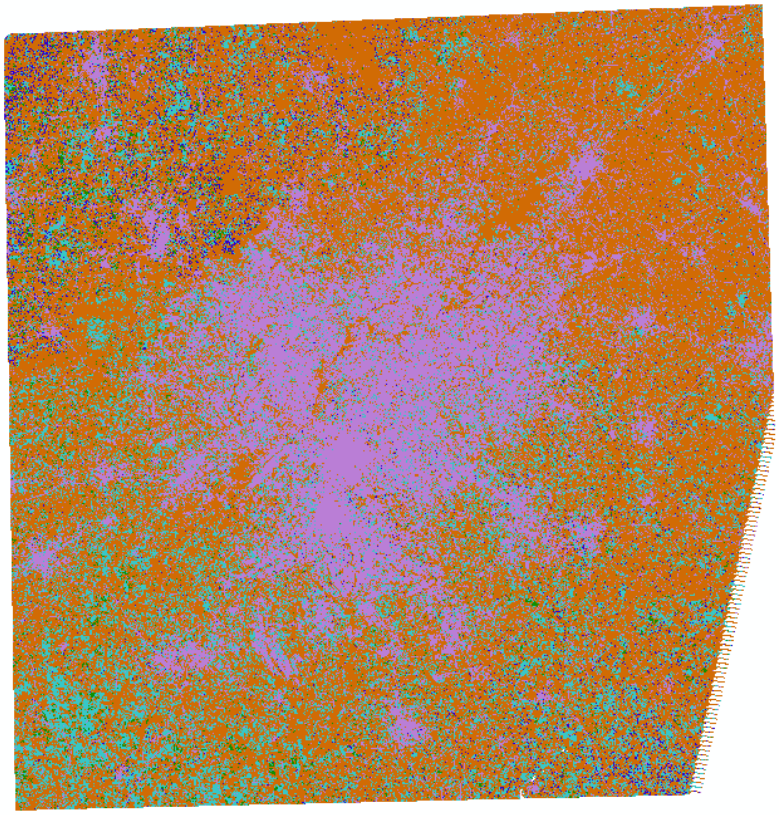


Landsat-derived Emissivity for the Atlanta metropolitan area for 1992 and 2006

1992



2006

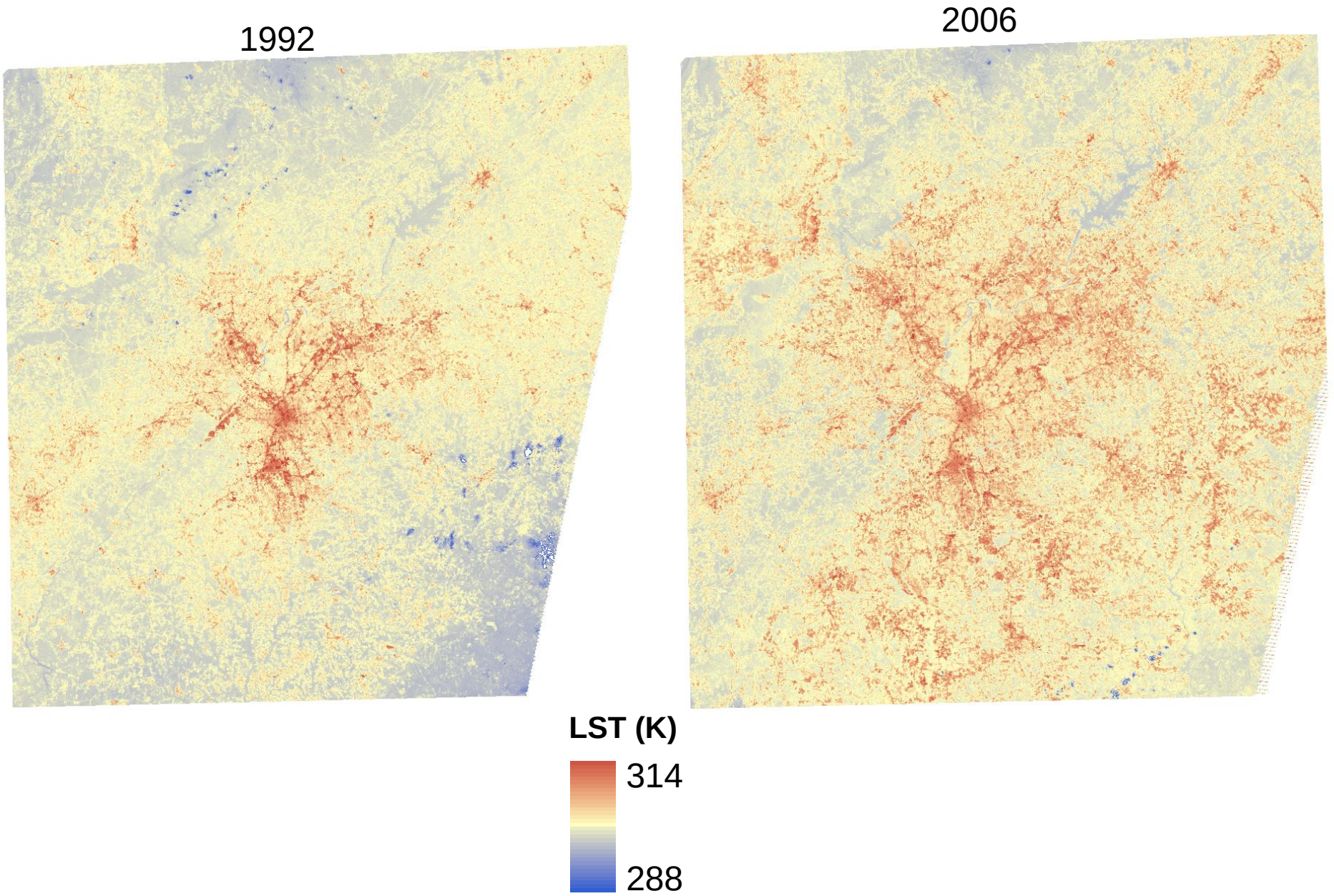


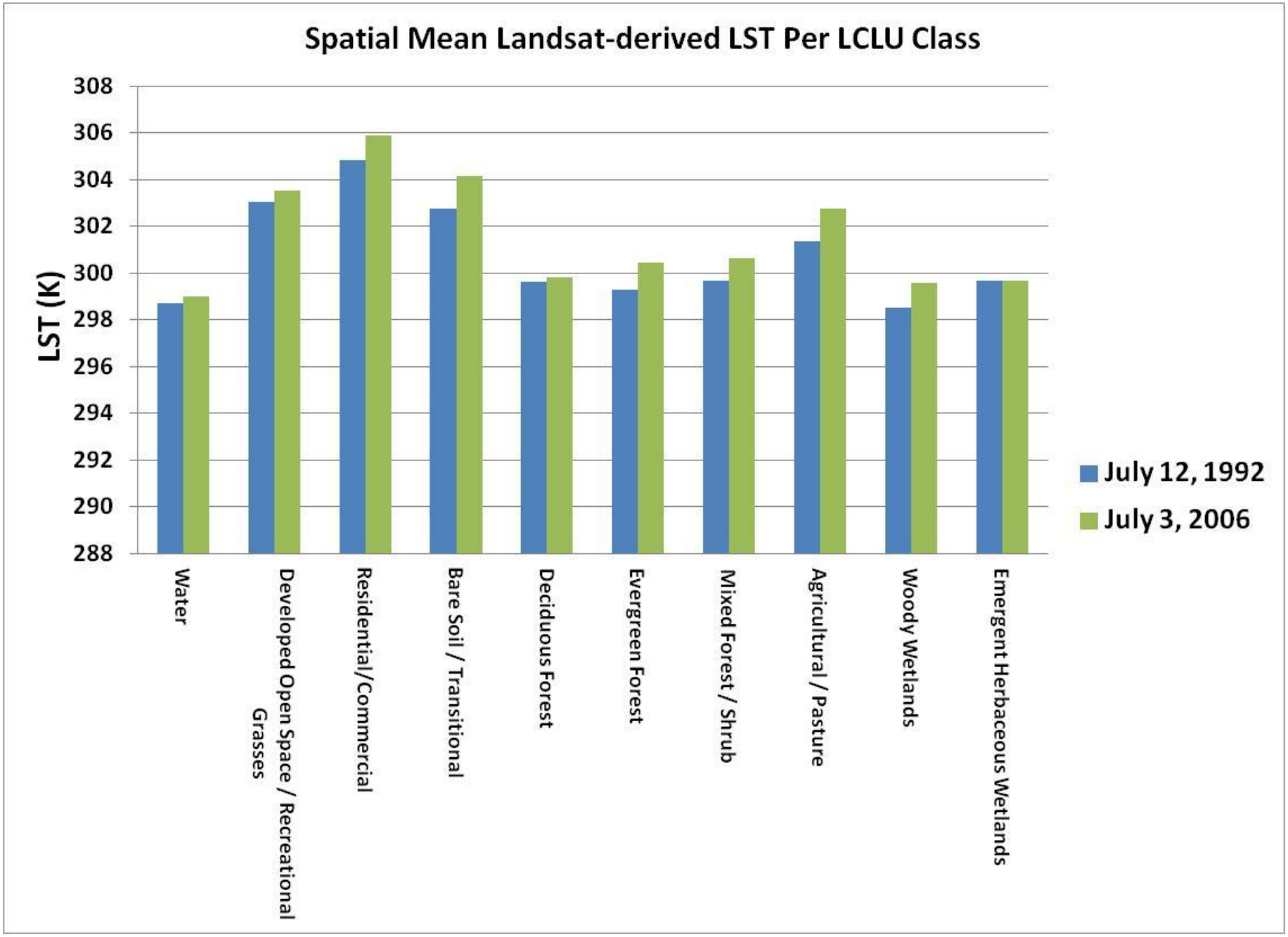
Emissivity

- 0.969 (Used for Bare Soil; and Developed Pixels)
- 0.974 (Used for Shrub Pixels)
- 0.980 (Used for Crops Pixels)
- 0.989 (Used for Deciduous Forests (assuming they're mostly Broadleaf); Wetlands, and Water Pixels)
- 0.9895 (Used for Mixed Forests Pixels)
- 0.990 (Used for Evergreen Pixels (assuming they're mostly Needle))

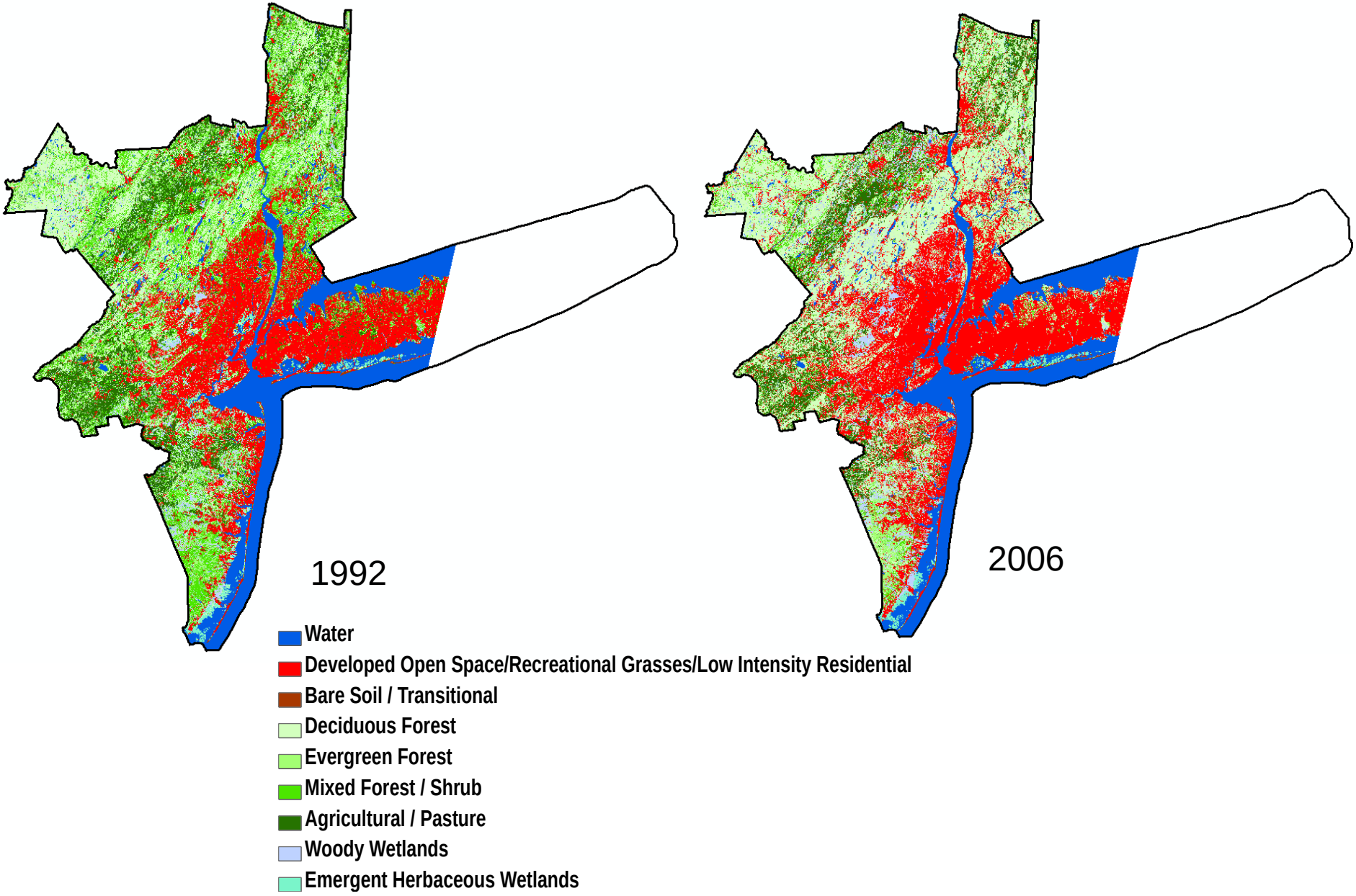
Based on a look-up table in Snyder et al. 1998 and given that our analysis is for a period when the vegetation is green.

Landsat-derived LST for the Atlanta metropolitan area for 1992 and 2006

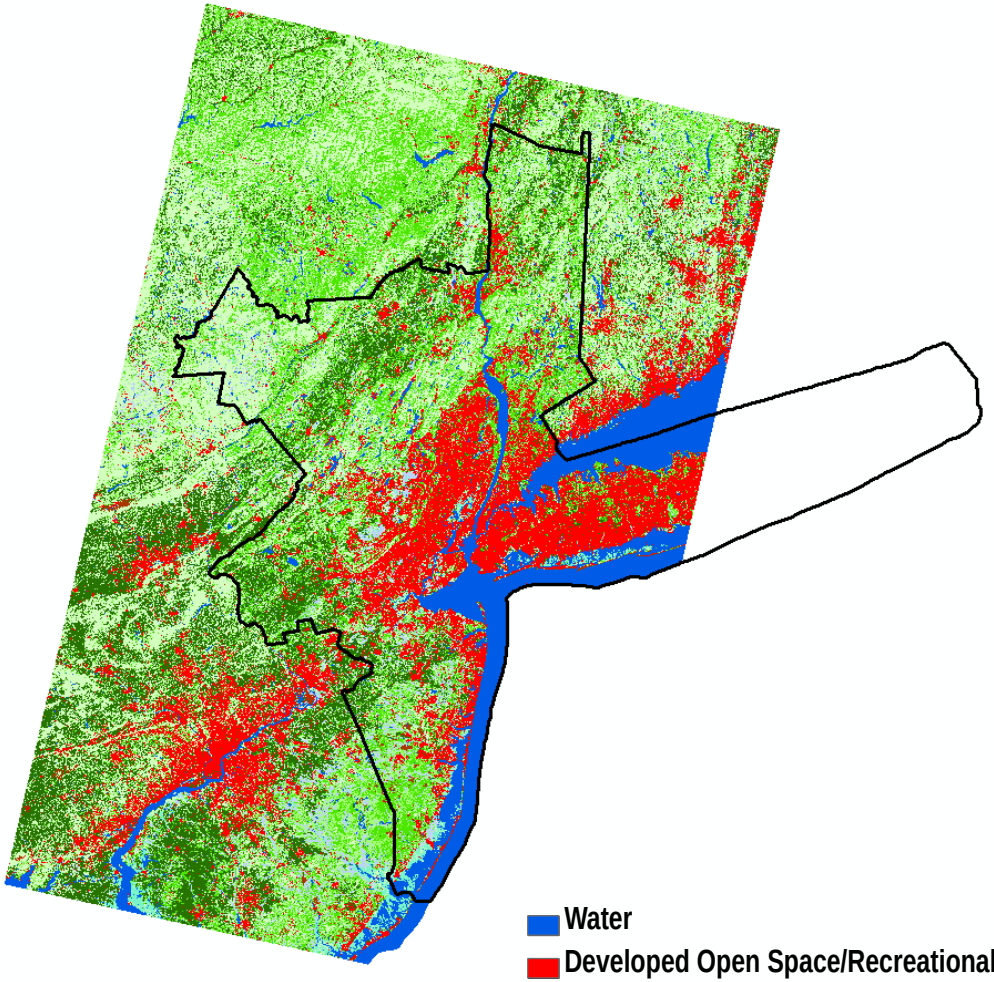



Spatial Mean Landsat-derived LST Per LCLU Class
LST (K)
308
306
304
302
300
298
296
294
292
290
288
Water
Developed Open Space / Recreational Grasses
Residential/Commercial
Bare Soil / Transitional
Deciduous Forest
Evergreen Forest
Mixed Forest / Shrub
Agricultural / Pasture
Woody Wetlands
Emergent Herbaceous Wetlands
July 12, 1992
July 3, 2006

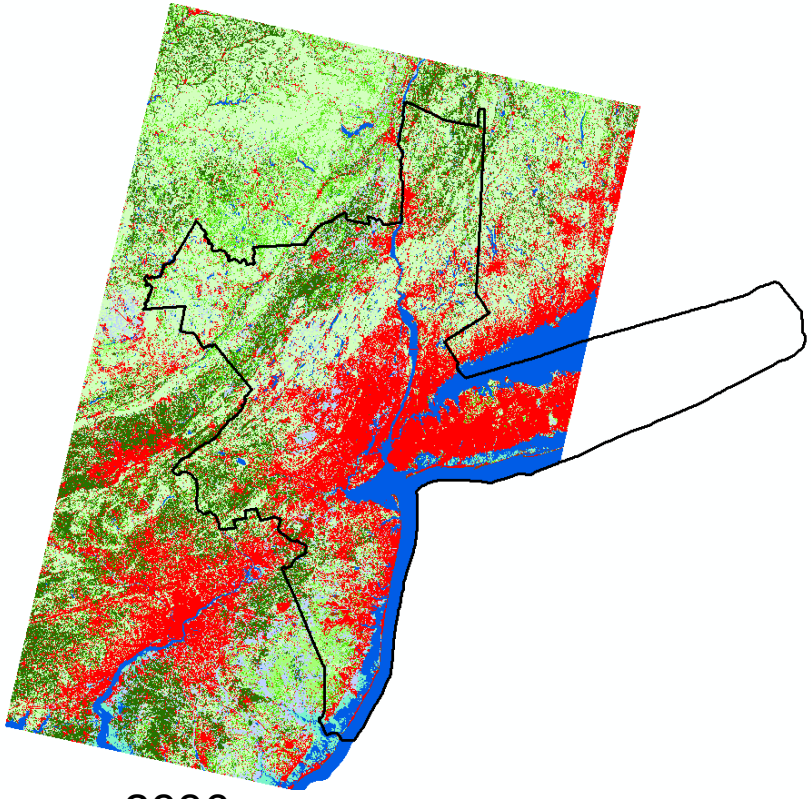
Landsat-derived land covers for 1992 and 2006 – New York City East Tile



Landsat-derived land cover (NLCD) for the New York City metropolitan area for 1992 and 2006



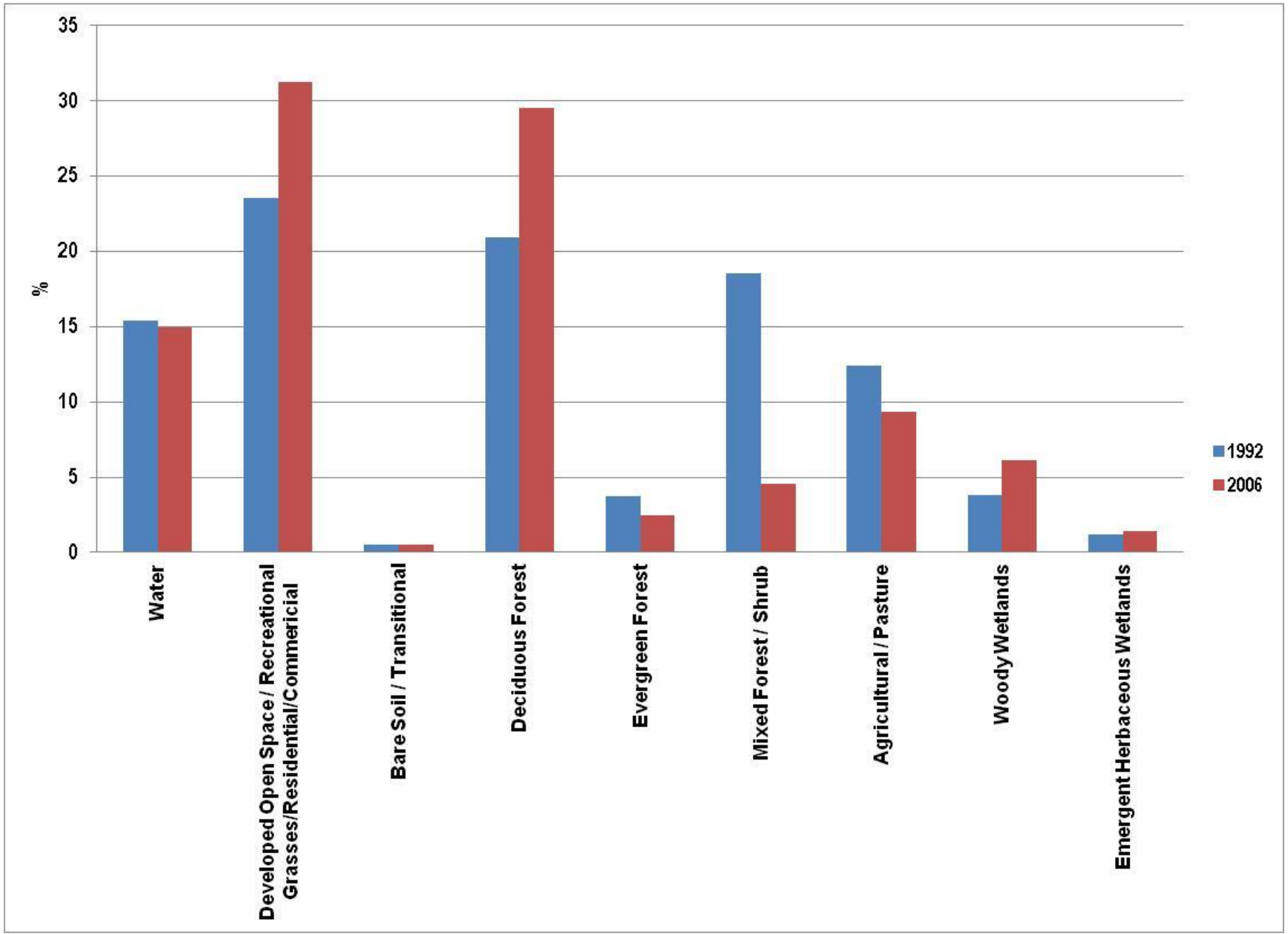
1992



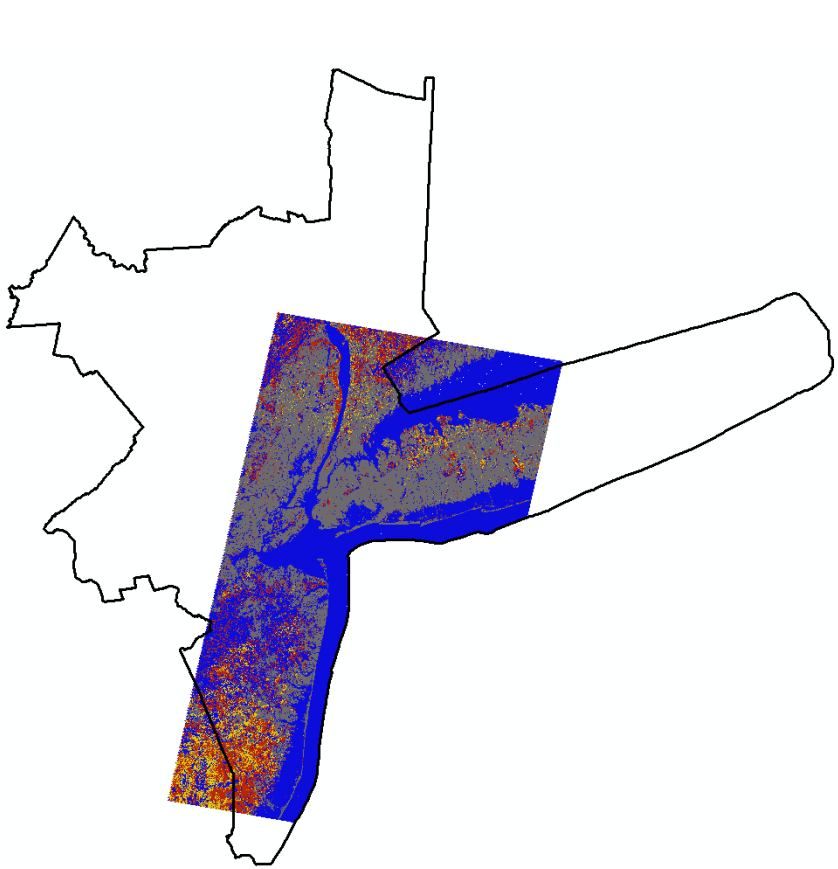
2006

- Water
- Developed Open Space/Recreational Grasses/Low Intensity Residential
- Bare Soil / Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest / Shrub
- Agricultural / Pasture
- Woody Wetlands
- Emergent Herbaceous Wetlands

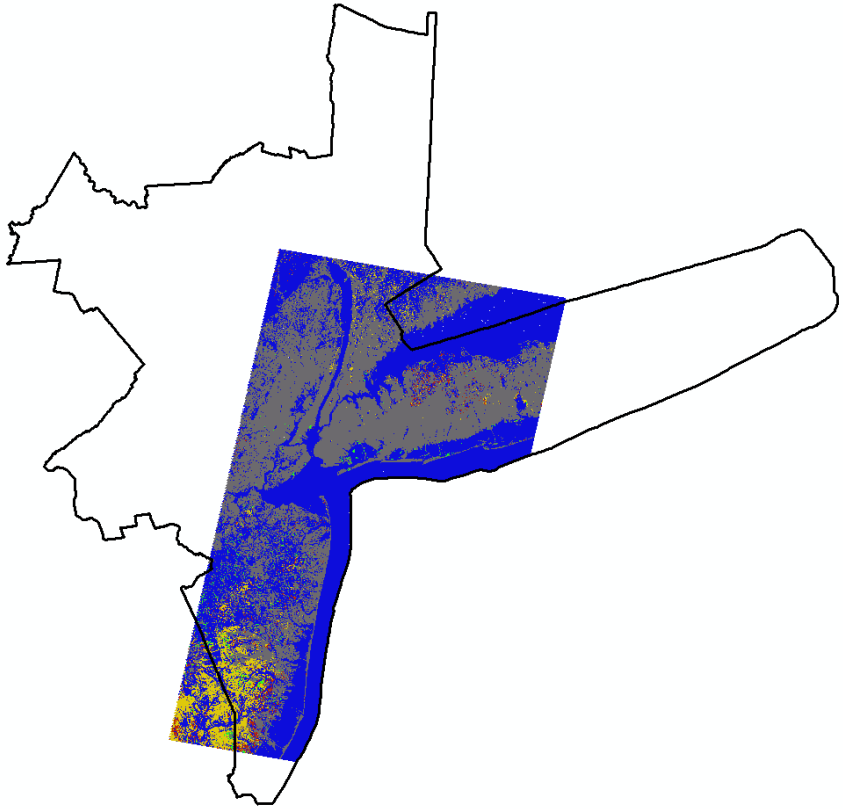
Landsat-derived land cover - New York City metropolitan Area for 1992 and 2006



Landsat-derived Emissivity for 1992 and 2006 – New York City East Tile



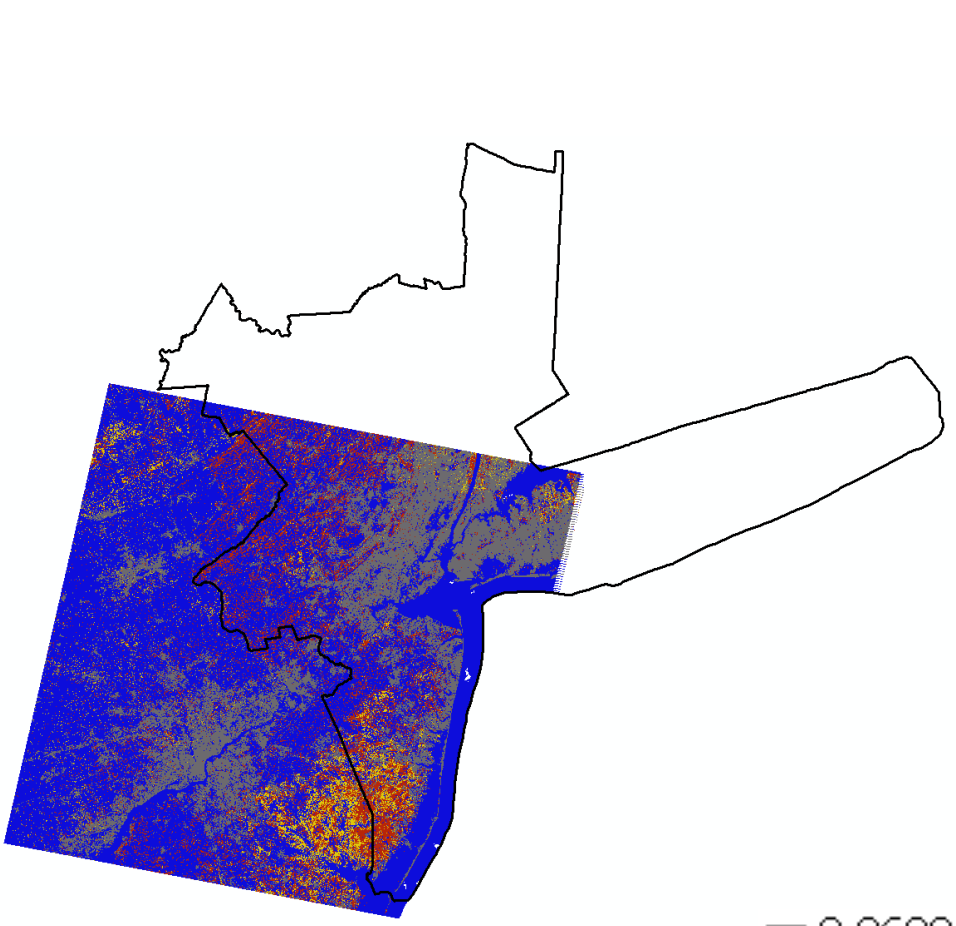
1992



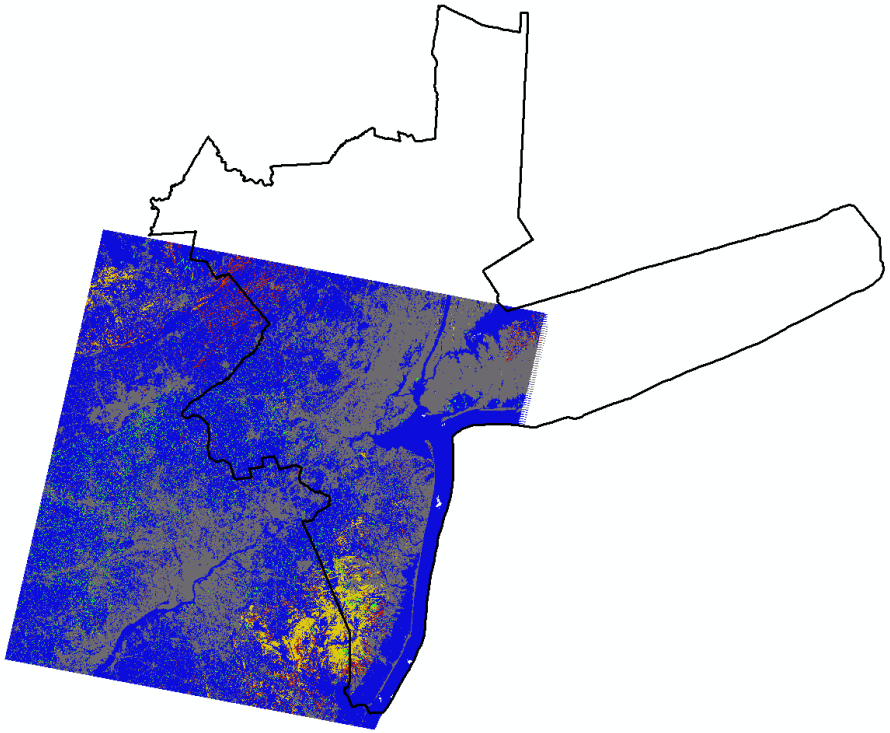
2006

- 0.9690
- 0.9740
- 0.9890
- 0.9895
- 0.9900

Landsat-derived Emissivity for 1992 and 2006 – New York City West Tile



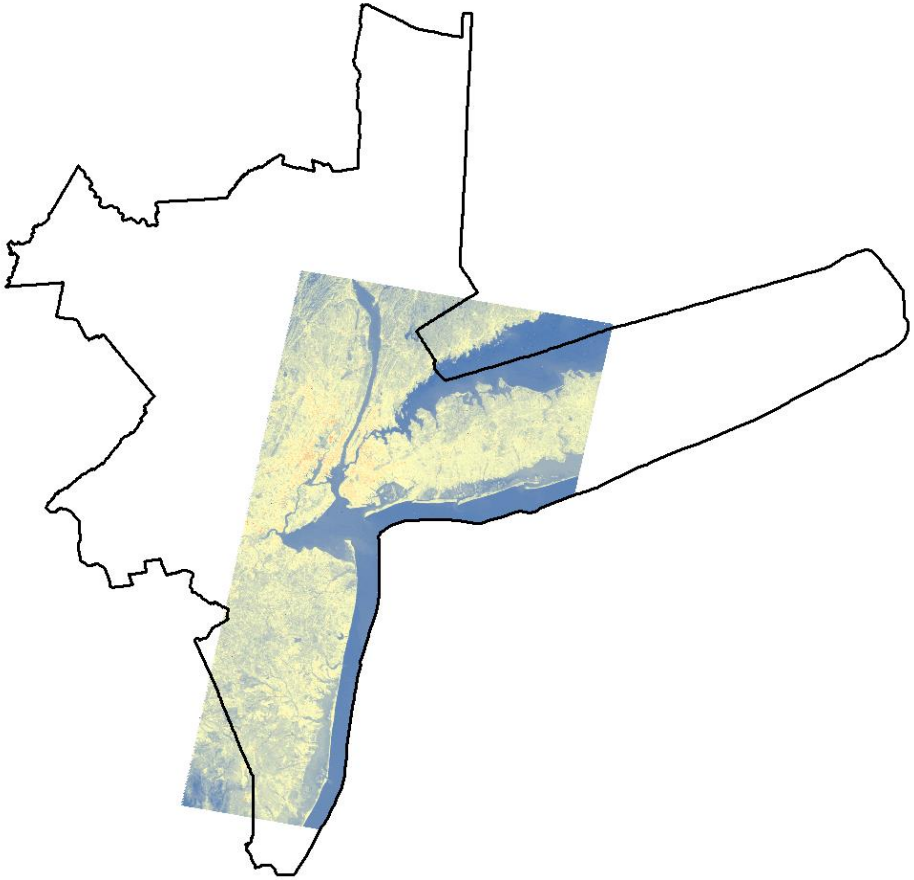
1992



2006

0.9690
0.9740
0.9890
0.9895
0.9900

Landsat-derived LST April 11, 1991 – New York City East Tile

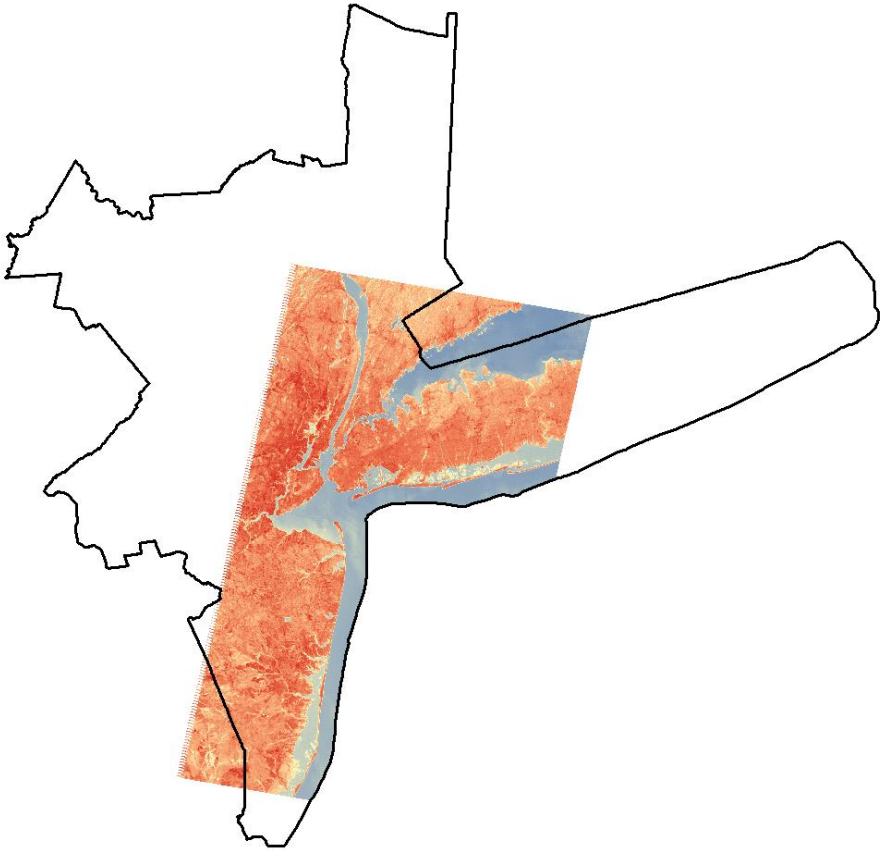


1992

LST (K)

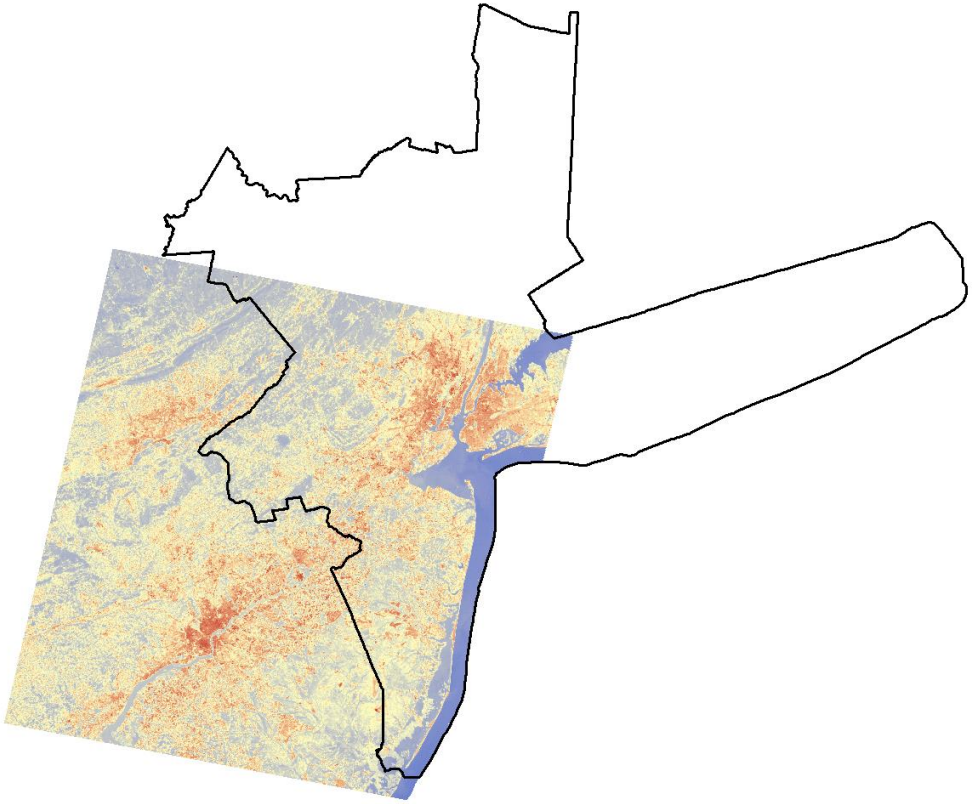
312

276



2006

Landsat-derived LST May 20, 1991 – New York City West Tile

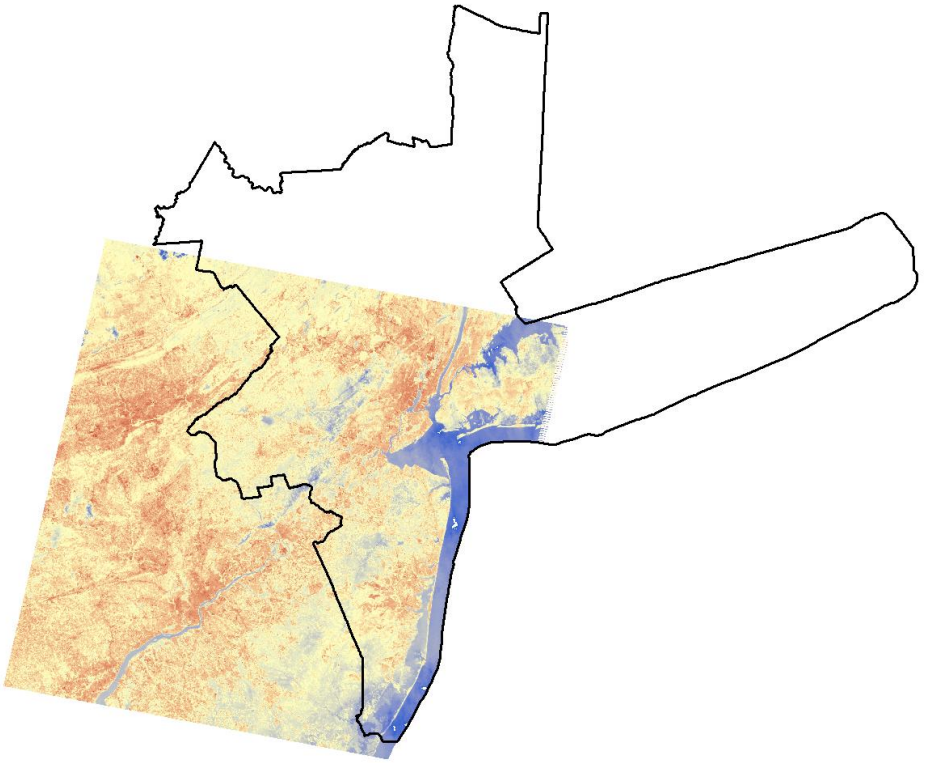


1992

LST (K)

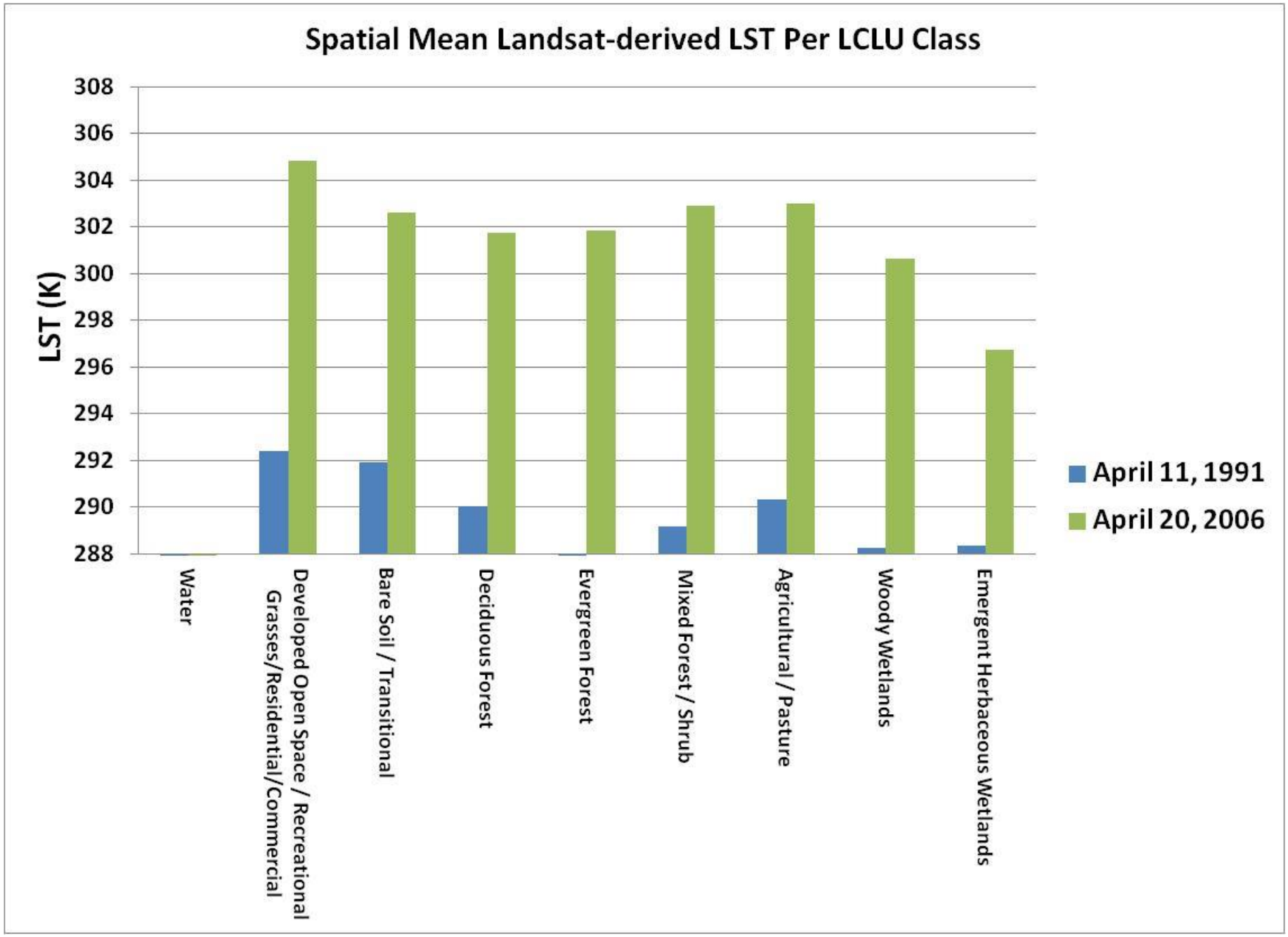
314

280

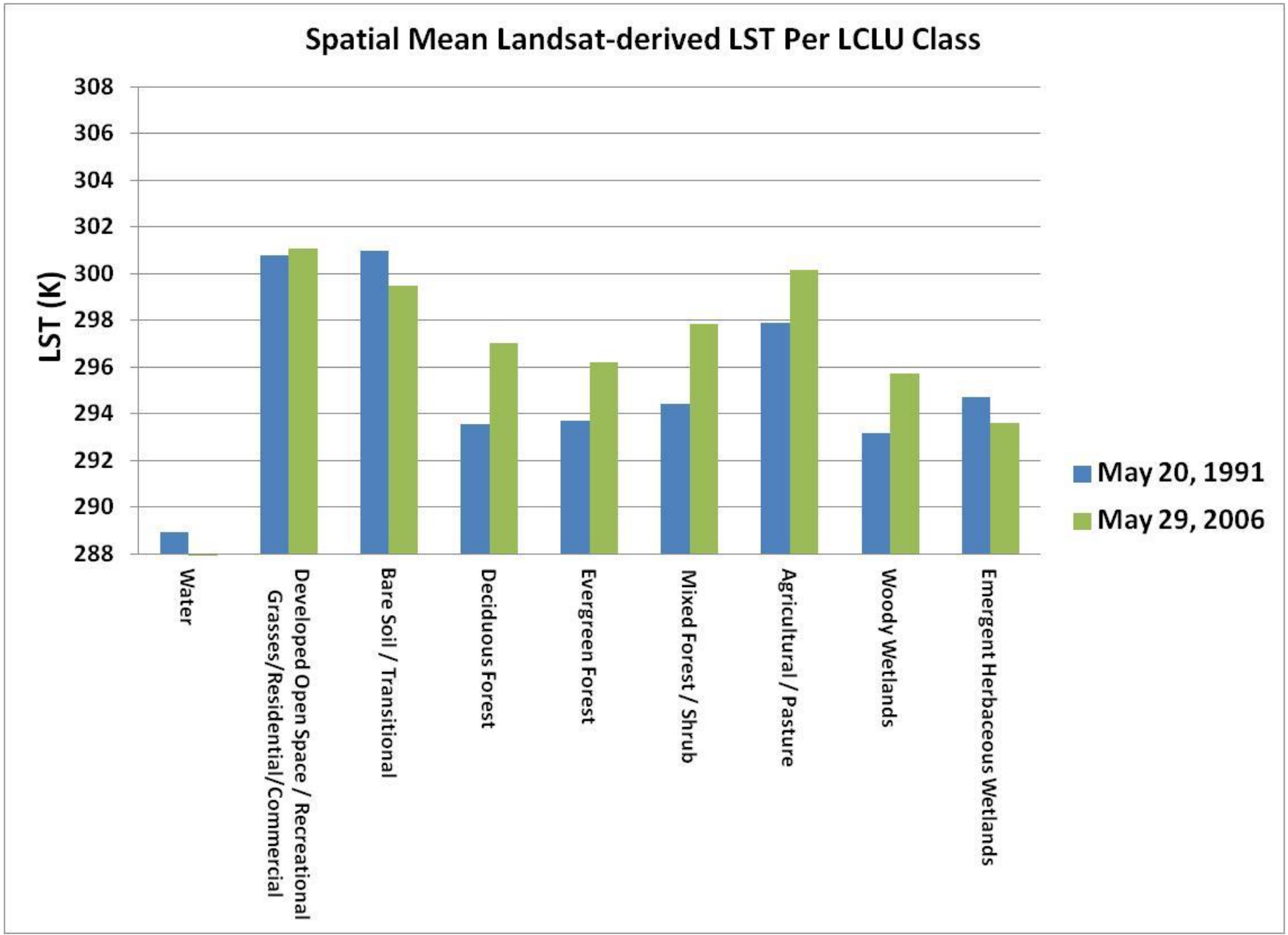


2006

New York City - East Tile



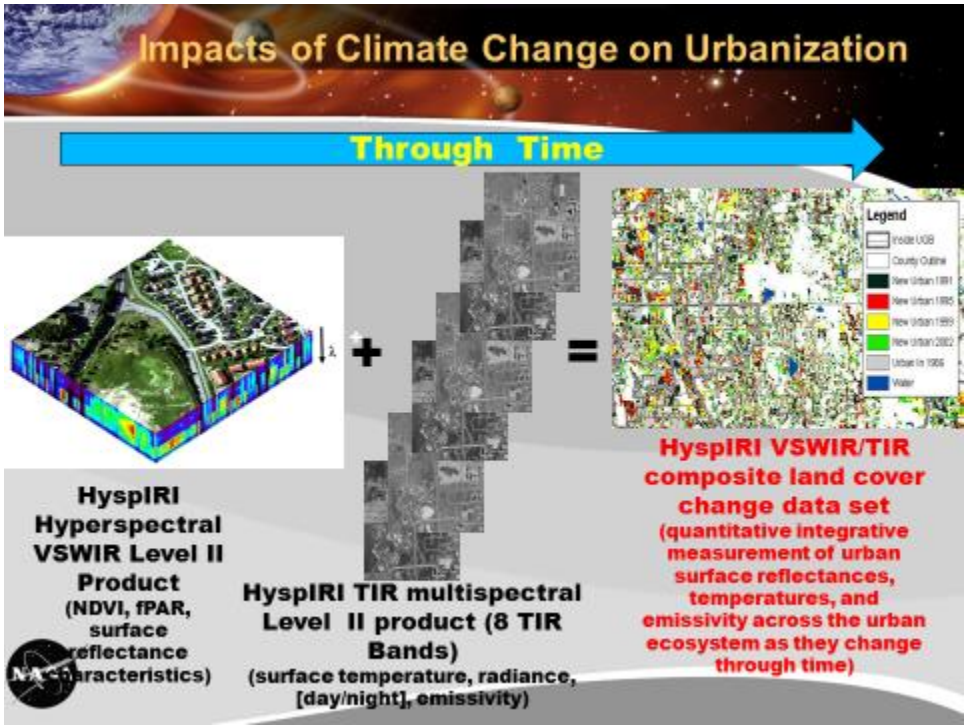
New York City – West Tile



Summary

- SB-04 will offer the opportunity to collect and access satellite data from many different international Earth observation platforms for developing a better understanding of urban land cover/land use change dynamics.

- This will offer a multiscaled approach (spectral, spatial, and temporal) that is not currently available because the data from different satellite systems are not integrated into a system that can be easily accessed.



- These data will be of immense importance in developing a better understanding of the urban ecosystem and how the cycling of land-atmosphere interactions comes together to form the ‘urban atmosphere’.

- Within this purview, we will have a multitude of satellite data types that can be used to better observe, measure, and model the components that drive the UHI at local, regional, and global scales.

- These data will also be extremely important in evaluating how global climate change will impact urban areas, and provide policy and decision-makers with data and models that can be used to mitigate and adapt to climate change at the urban level.

Landsat-derived LST for the Atlanta metropolitan area for 1992 and 2006