Urban Vulnerability Assessment for the Health and Infrastructure Sectors

Lead: Cynthia Rosenzweig (NASA GISS)

Team members: Radley Horton (Columbia University / NASA GISS), Dale Quattrochi (NASA MSFC), Stuart Gaffin (Columbia University / NASA GISS)

Mission and Year 1 Activities

Explore regional vulnerabilities to climate variability and change in urban areas using an end-to-end approach that combines:

1) Downscaled Climate Projections (from CMIP phases 3 and 5 global climate models from GISS and the wider ensemble)

2) Urban Heat Island Analysis and Mitigation Scenarios

3) Monitoring of Urban Climate and Green Infrastructure

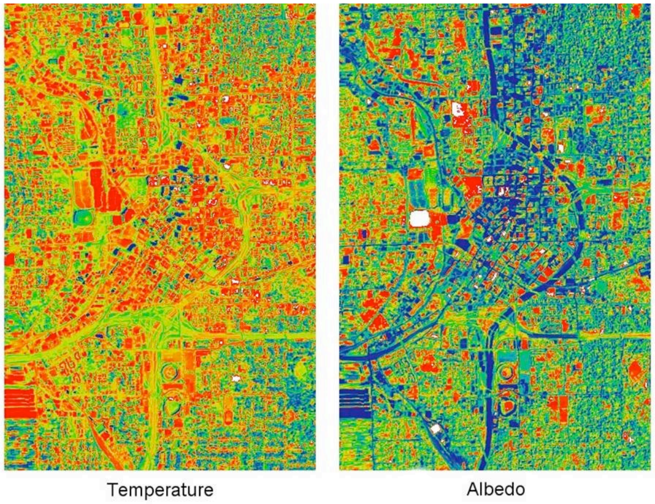
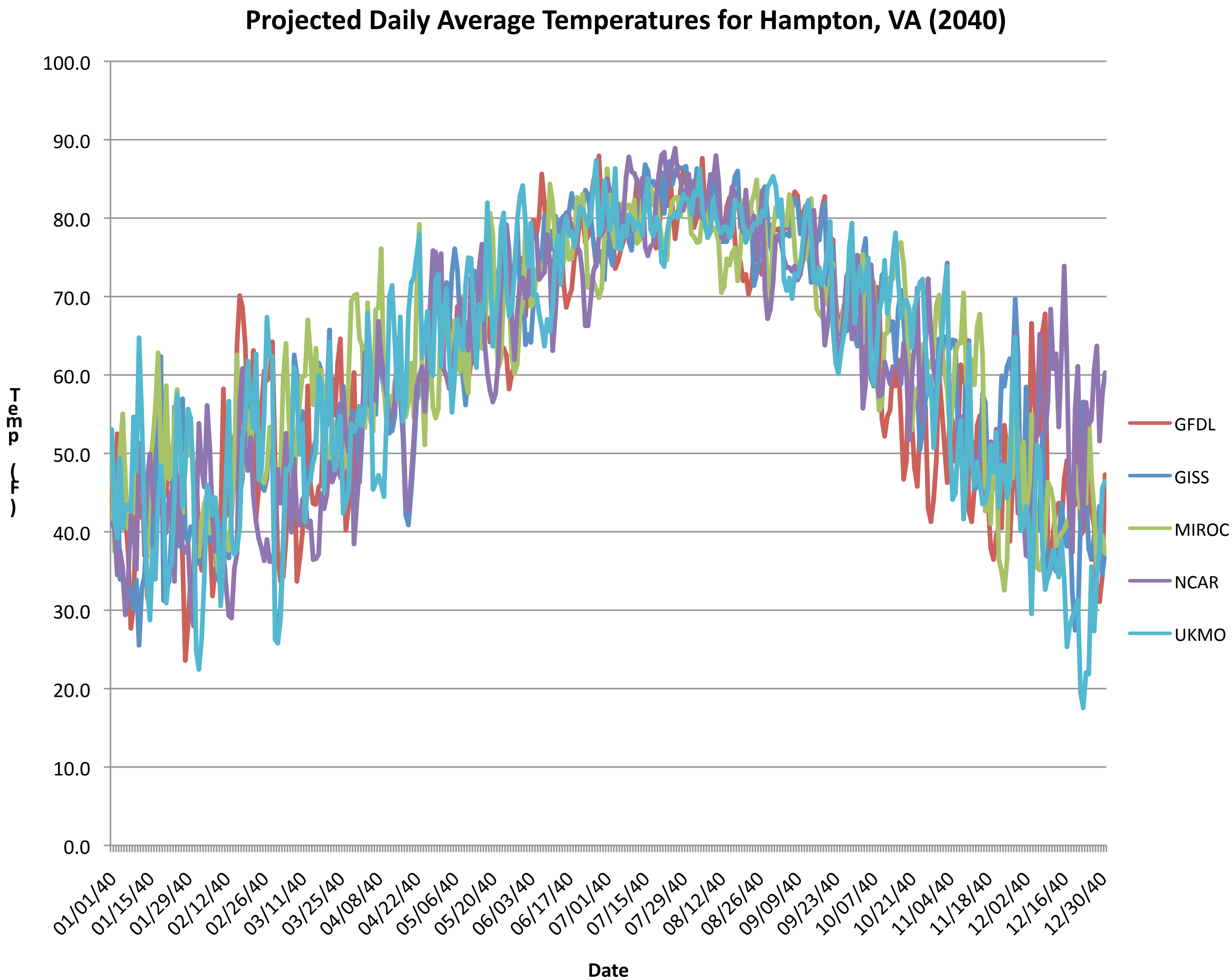


Figure 1. The image on the left illustrates daytime surface heating for urban surfaces across the Atlanta Georgia Central Business District (CBD) as derived from NASA aircraft data. White and red colors indicate very warm surfaces (~40-50°C). Green relates to surfaces of moderately warm temperatures (~25-30°C). Blue indicates cool surfaces (e.g., vegetation, shadows) (~15-20°C). Surface temperatures are reflected in the albedo image on the right where warm surfaces are dark (i.e., low reflectivity) and cooler surfaces are in red and green (i.e., higher reflectivity). The images show how urban surface characteristics influence temperature and albedo as UHI drivers (Quattrochi et al., 2000).

Statistical Downscaling Procedure

- **Datasets required**
  - Observed daily climate data (maximum and minimum temperature) for a single station for a thirty year period (ideally 1970-1999).
  - Future projection climate outputs (monthly) are needed for the gridbox that covers the observed climate station. The outputs are from the 16 GCMs used in the Bias Corrected Spatially Disaggregated (BCSD; Maurer et al. 2007 http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/dcpInterface.html#Welcome) projections, at 1/8th degree spatial resolution for a given emissions scenario and 30-year timeslice.
- **Step 1** – Compute monthly mean temperature (from daily values) and rank the values separately for each of the 12 calendar months.
- **Step 2** – For each month and year, calculate the daily temperature anomaly (for maximum and minimum) by subtracting the monthly mean from the daily value.
- **Step 3** – Rank the future mean temperature values for each calendar month (for a given scenario, timeslice, and each GCM).
- **Step 4** – Match the 'rank' of the first month of the first year of the future series to the same 'rank' in the observations. The daily temperature anomalies from the observed month are then added to the future monthly means to form the future daily projected series.
  - For example, if January 2040 (the starting point for the 2050s timeslice) is the 4th warmest January in the 30 year future timeslice, the 4th warmest January in the observed 30 year record is found.
- **Step 5** – Repeat for all 12 months and 30 years for each GCM, timeslice, and emissions scenario.

Downscaling Results



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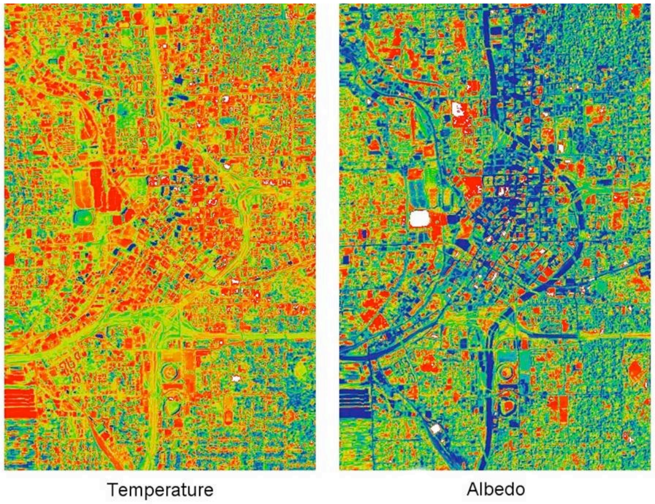

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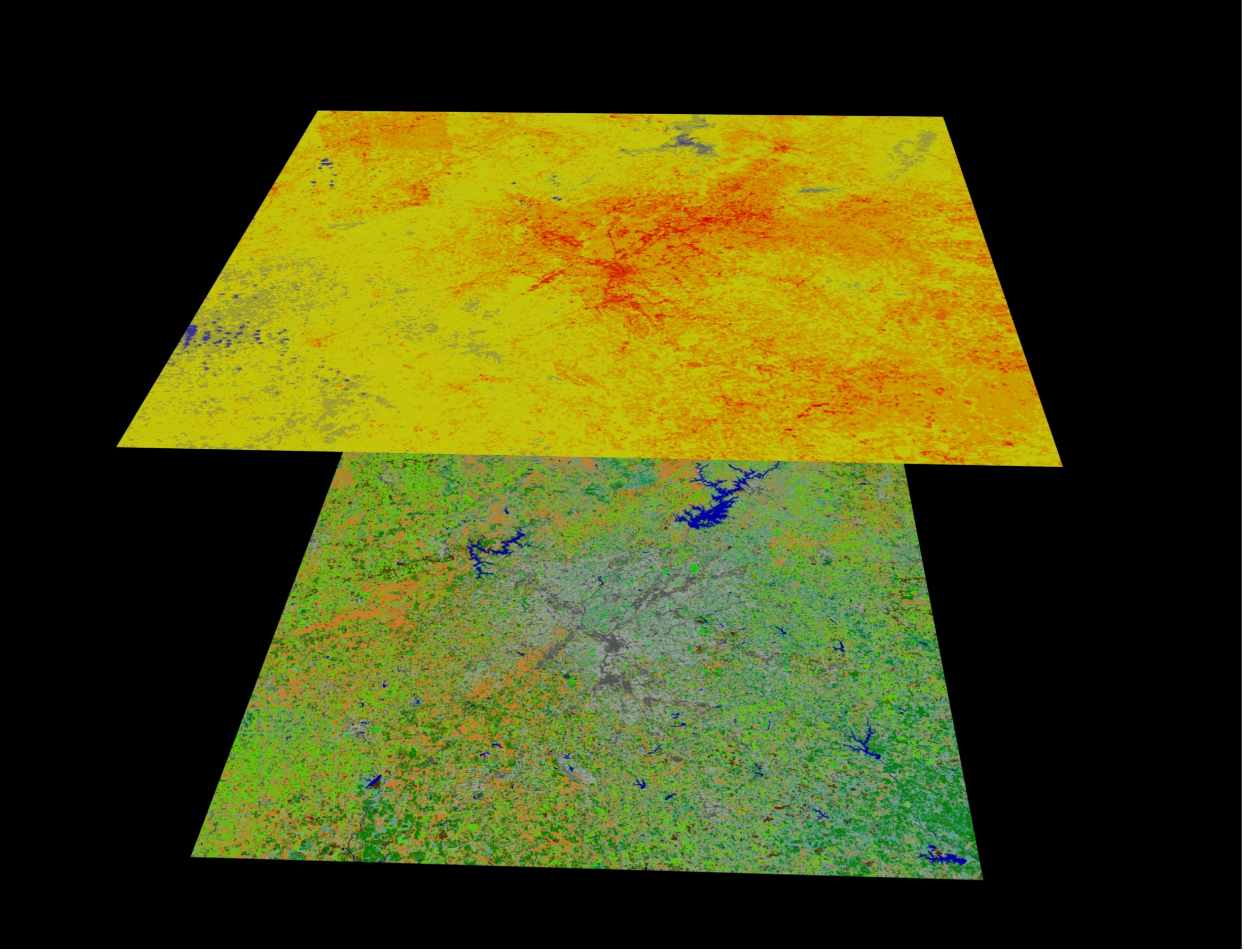
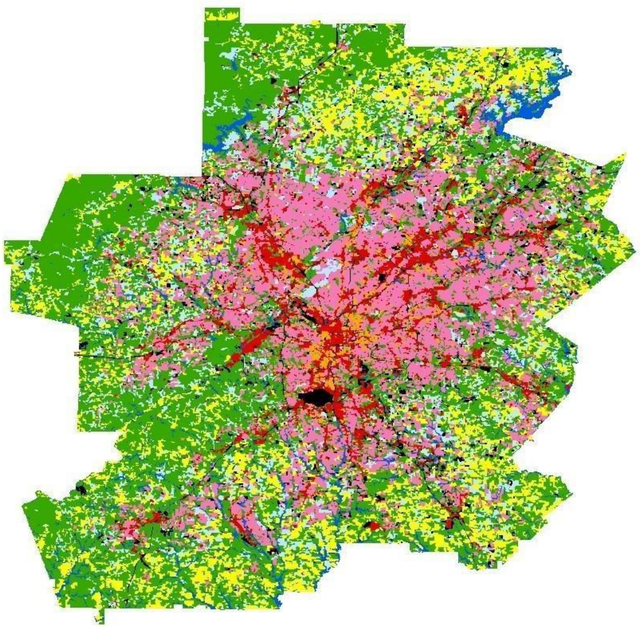


Current and Projected 2030 Land Use
13-county Atlanta Metro Area

Current (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

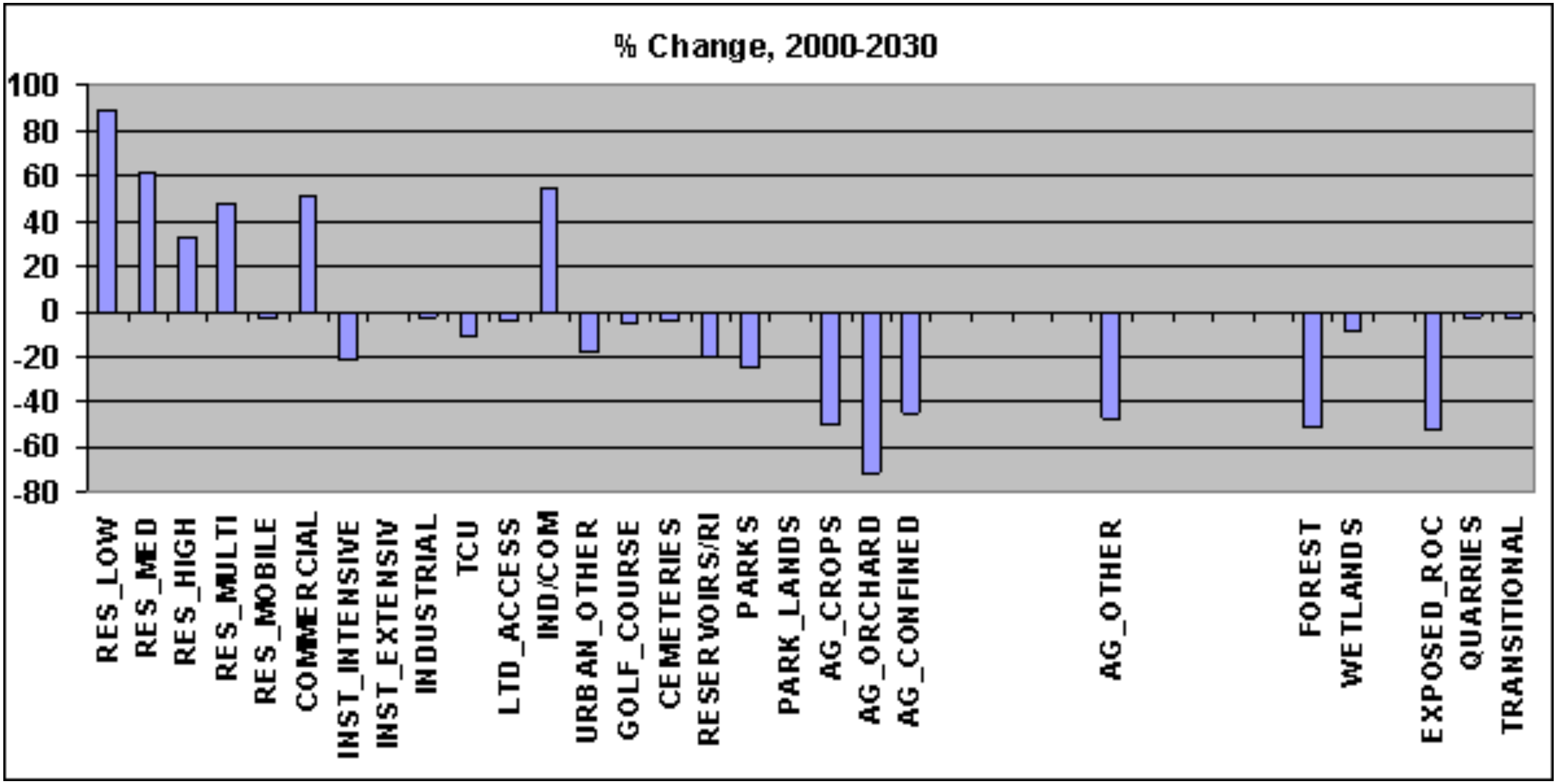
Projected (2030)

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).

Land Use Projections



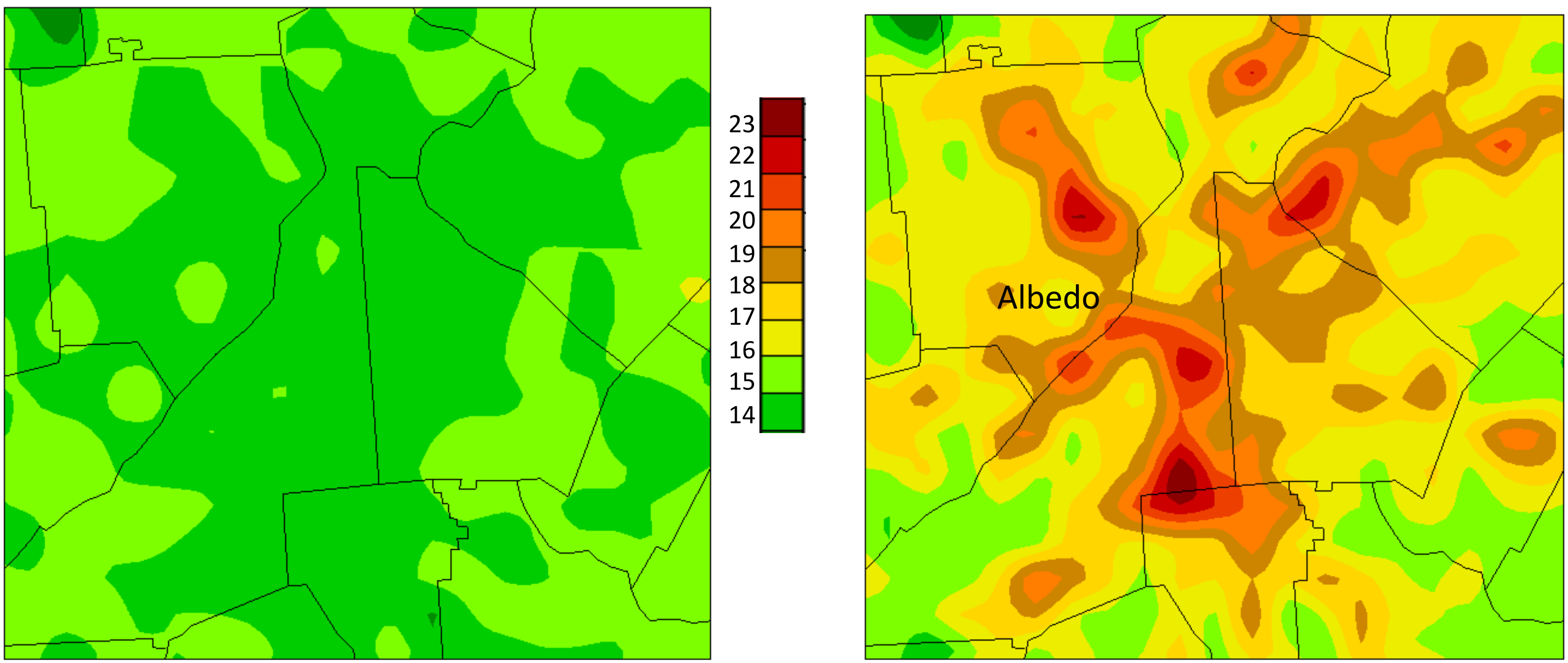
Source: Prescott College Spatial Growth Model

Urban Sustainability, Public Health and Climate Change

Albedo Mitigation Simulation - 2030

2030 Business As Usual

High Albedo

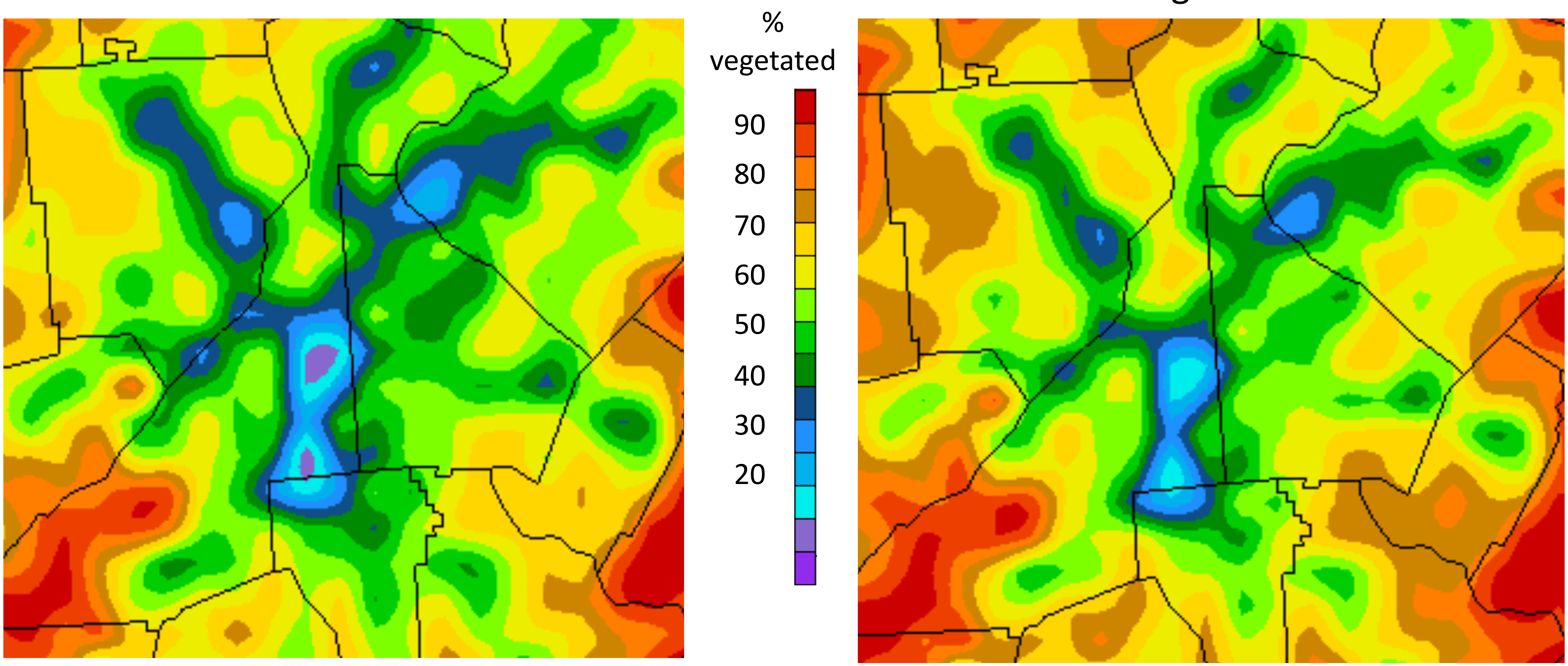


Urban Sustainability, Public Health and Climate Change

Vegetation Mitigation Simulation - 2030

2030 Business As Usual

2030 Mitigation Scenario



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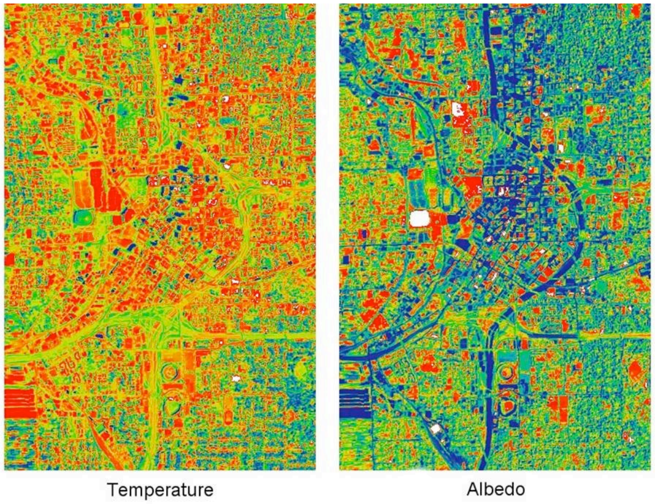
-Are native (non-sedum) plants retaining more water than the sedums traditionally used on greenroofs?

-how well do three different sensor methods for measuring water retention compare to each other?



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Hypothesis – Natives/Grasses retain more urban stormwater because they keep stomata open during day unlike sedums ?

Native (NYC) Grasses Planted on Regis HS in NYC

Sedum Plants on Con Ed Facility NYC

We compared the ET from these two projects over the same period of time.

The Native grasses (red) are showing ~32% increase in ET