

Long-Term Spatial–Temporal Analysis of Land Cover and Land Surface Temperature Changes in Chatham County, Georgia

INTRODUCTION

This study uses Google Earth Engine as a tool to retrieve, process and synthesize satellite imagery to understand the long-term spatial-temporal relationships of land cover changes and land surface temperature (LST) variations.

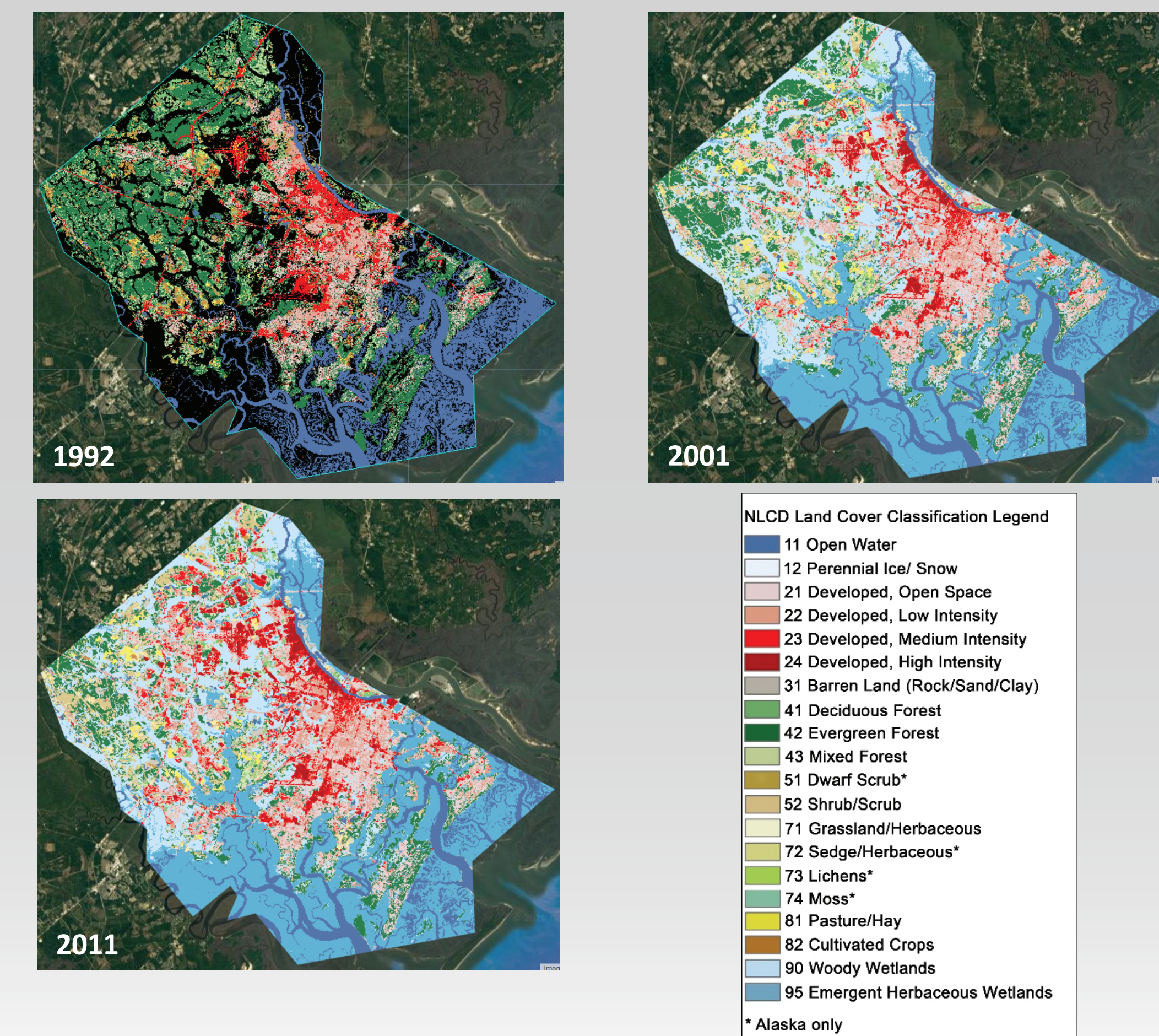
It uses thermal satellite imagery as a proxy to understand the occurrence of urban canopy heat island and its relationship to land cover changes.

This is a novel approach that compares changes in land cover to changes in land surface temperature, and links the relationships between urbanization and surface heating, depicting the occurrence of SUHI and its potential intensification over time.

This study finds that surface temperatures and land cover changes, during a 20-year period, are linked to the loss of forested and wetland land cover types, in Chatham County, Georgia, USA.

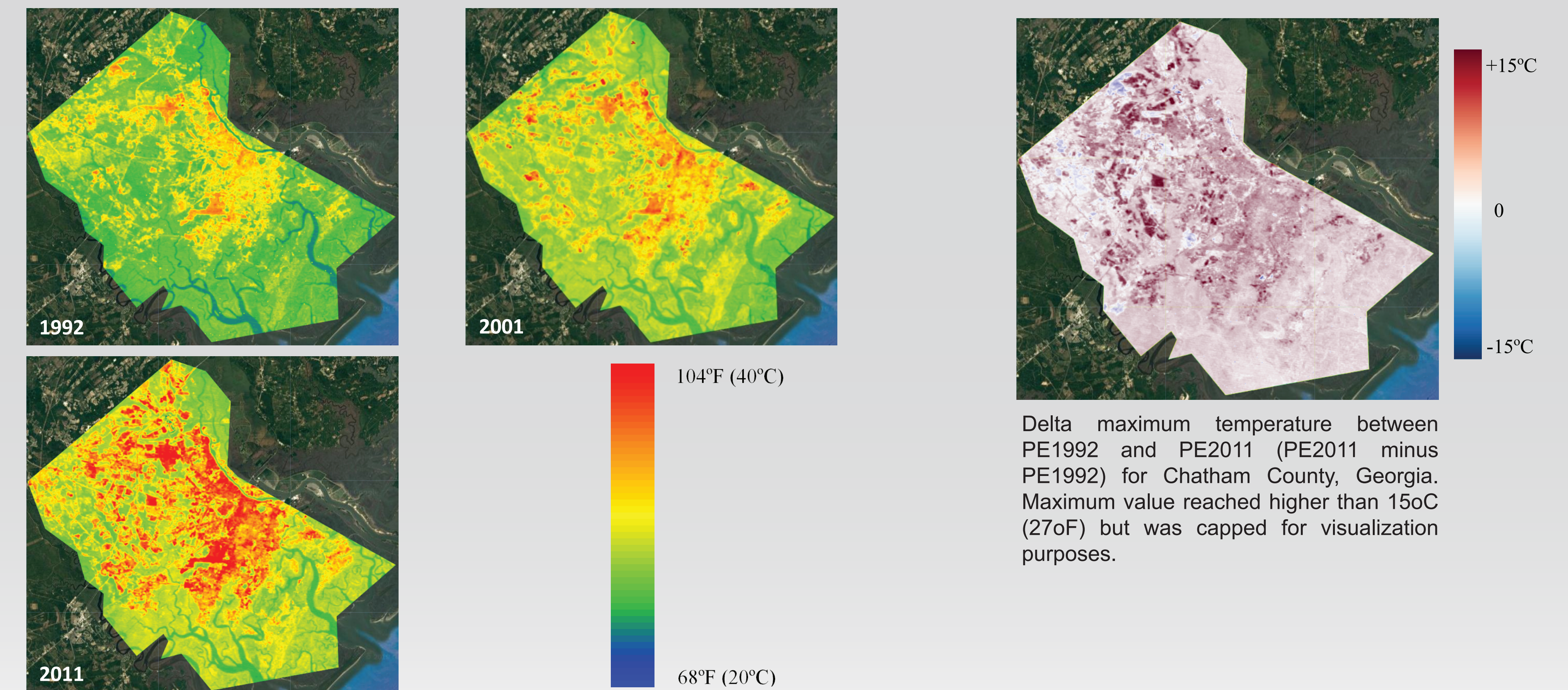
RESULTS

Land cover changes between 1992 to 2011



National Land Cover Dataset images for Chatham County, Georgia, US, depicting the changes in land cover over time.

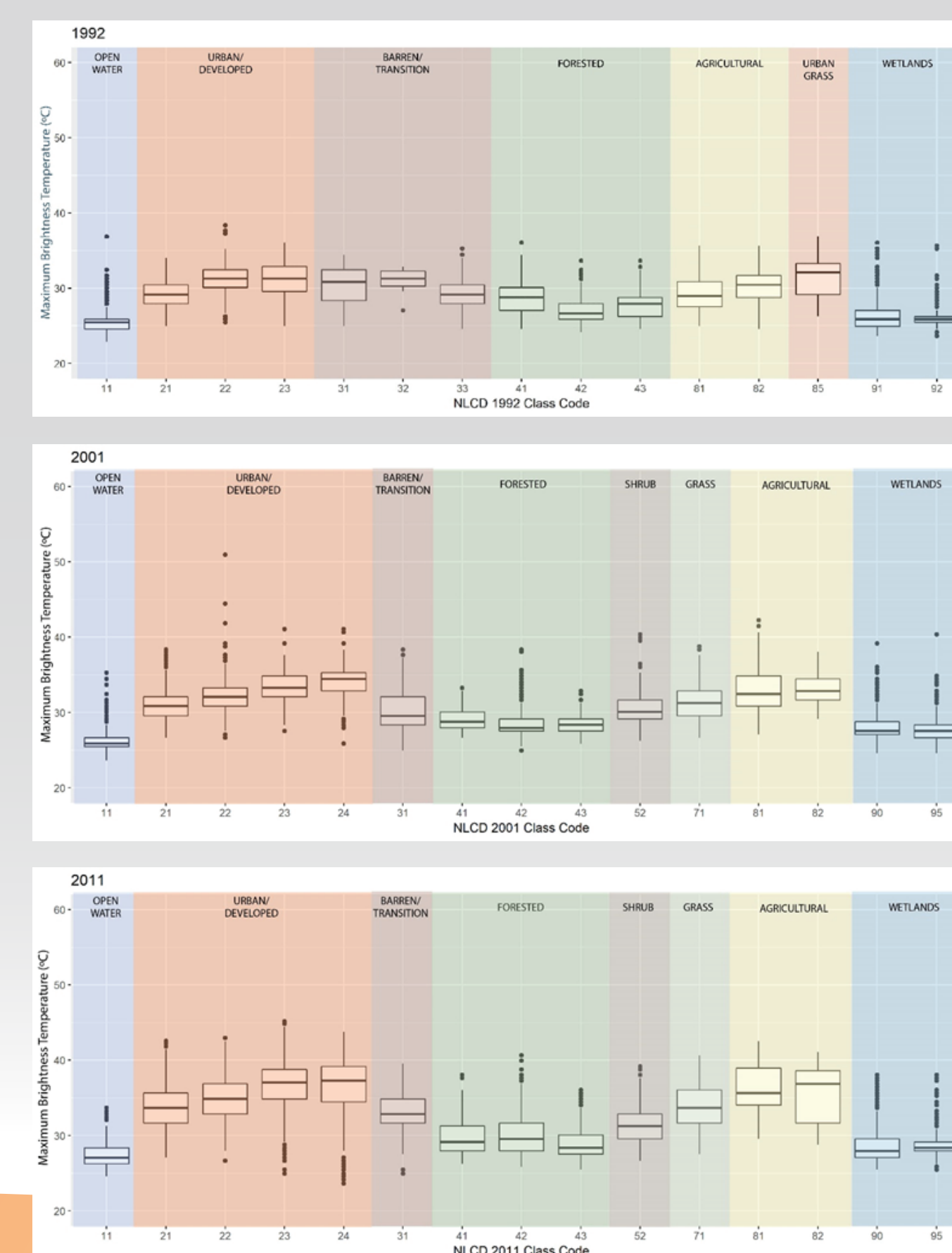
Maximum brightness temperature changes between 1992 and 2011



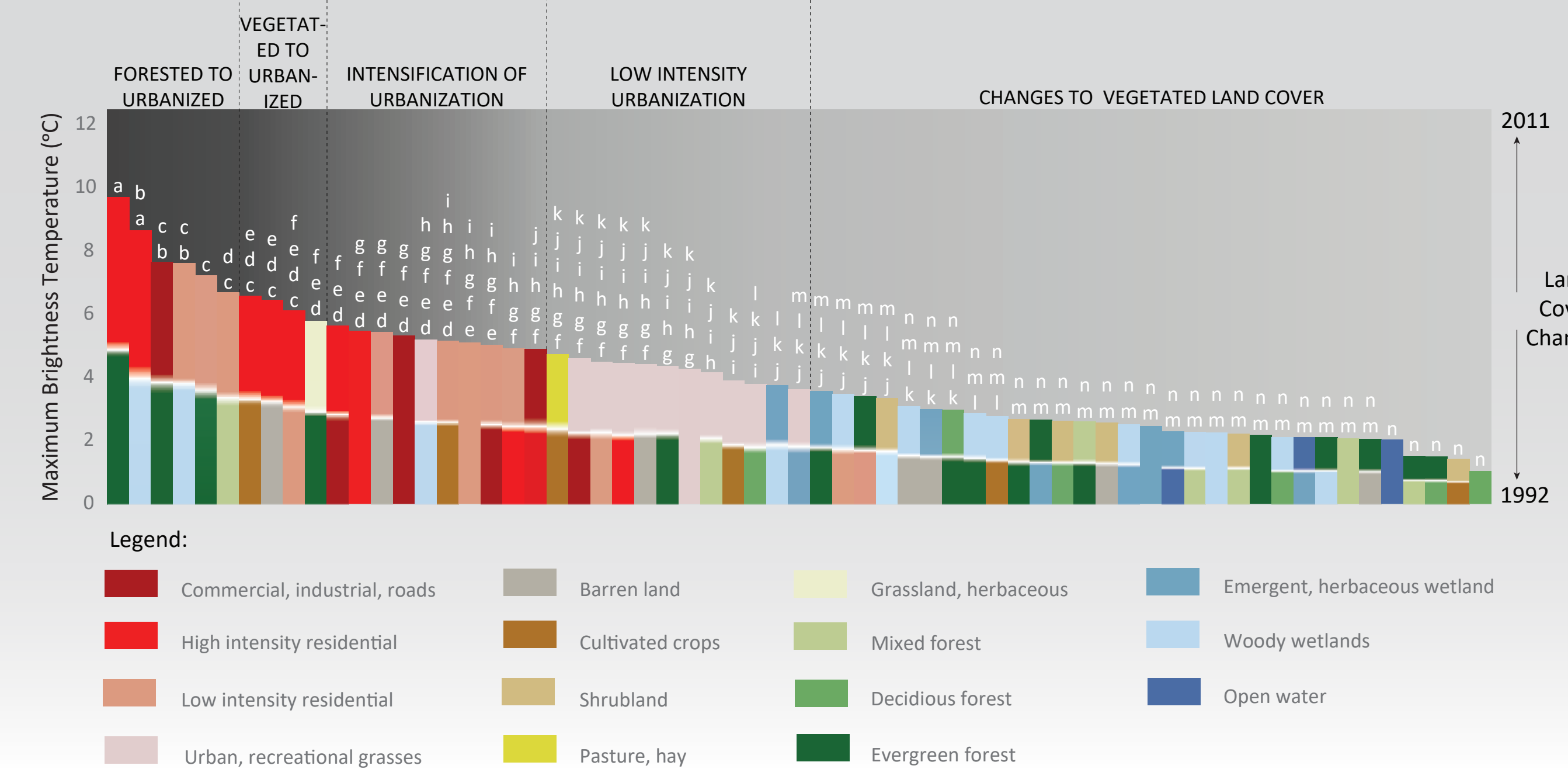
Delta maximum temperature between PE1992 and PE2011 (PE2011 minus PE1992) for Chatham County, Georgia. Maximum value reached higher than 15°C (27°F) but was capped for visualization purposes.

Relationship between land cover change and brightness temperature increases

Maximum brightness temperature per land cover type for each studied period in Chatham County, Georgia. Temperature measured in degrees Celsius (°C).



STATISTICAL ANALYSIS OF LAND SURFACE TEMPERATURE RESPONSE TO LAND COVER CHANGES



CONCLUSION

A dynamic understanding of variables can enable urban climatologists and planners to co-define possible thresholds that derive from changes in urban form and alter climatic interactions.

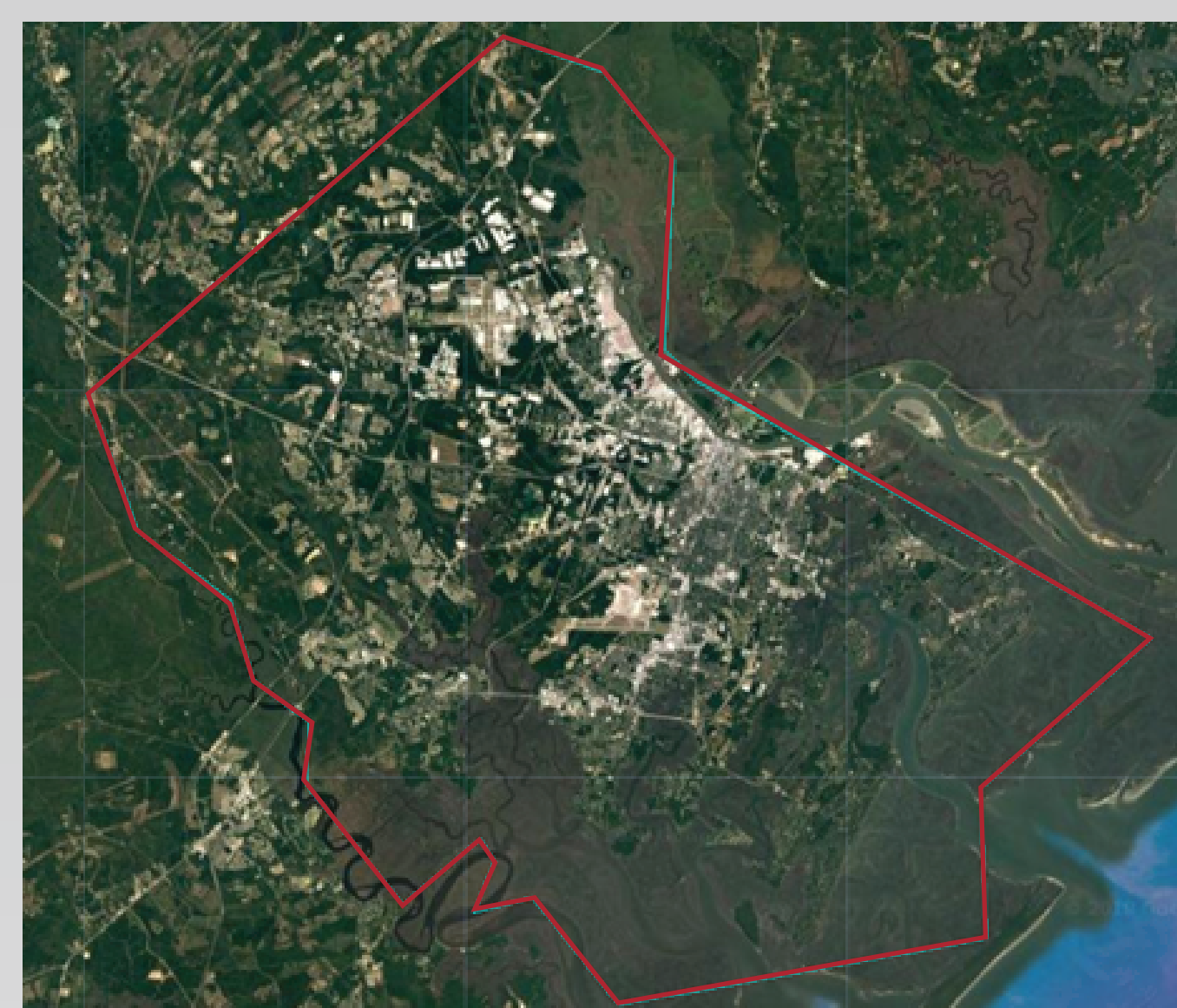
The results of this study depict the relationship between land cover and brightness temperature changes, reinforcing previous findings that clearly link urbanization to SUHI. However, through a spatial-temporal analysis of the case study, this study clearly demonstrates an increase in surface temperatures during the 20-year studied period and links it to the loss of forested and wetland land cover types, specifically evergreen forests and woody wetlands areas. More importantly, these results confirm this paper's hypothesis that certain types of land uses lead to higher LSTs over time.

Urban development is responsible for the highest values, and urbanized areas that did not change land cover type showed significantly higher LSTs than vegetated land cover types.

CASE STUDY

Chatham County, Georgia, USA

Chatham County is known for its extensive tree canopy cover. Likewise, its capital, the city of Savannah, is well-known for its tree covered historic downtown, permeated by plazas and street boulevards. Yet it is also the most urbanized area in coastal Georgia.



A heat vulnerability study by Maier et al. (2014) identified Chatham as one of the most vulnerable counties in the state. Reports cite Savannah as a potentially at-risk city for extreme heat exposure and indicate the need to identify and mitigate heat related risk factors (ASTHOCCC 2014, USGCRP 2016). Furthermore, KC, Shepherd and Gaither (2015) found that overall the county is highly vulnerable to climate and has a moderate to high vulnerability to climate change, compared to other counties in the Georgia.

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