



Spatial Analysis of Urban Carbon Footprints in the U.S.

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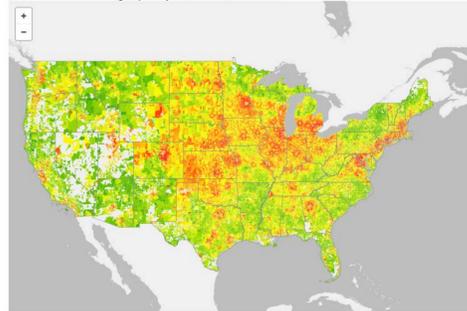
ABSTRACT

Understanding the spatial distribution of carbon footprints in the United States can help understand urban form, develop sustainable policy, and make strides towards a more sustainable civilization. This project investigates carbon emissions across 275 metropolitan statistical areas revealing an issue of scale when studying U.S. cities. No statistically significant results developed via this study, but a better understanding of urban spatial analysis can be deduced.

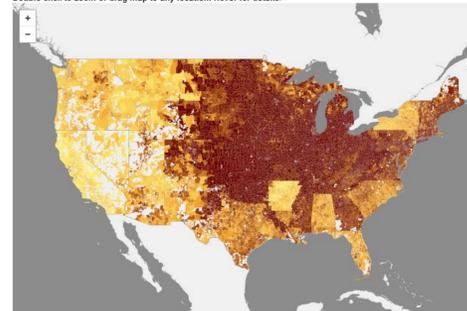
Cool Climate Network Data:

The average carbon footprint per household data is created using the National Household Travel Survey, the Residential Energy Consumption Survey, the Consumer Expenditures Survey, and additional data sets consistent with predicting consumption values for water, waste, and building construction. These surveys were used to predict the contribution of travel, energy, and consumption of goods to household carbon footprint.

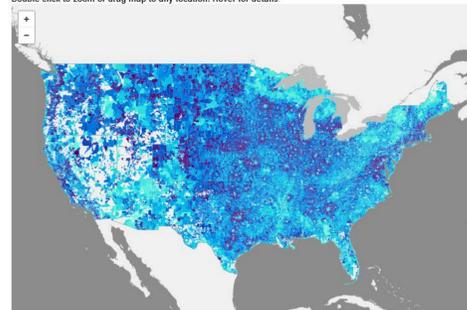
Average Annual Household Carbon Footprint by Zip Code
Double click to zoom or drag map to any location. Hover for details.



Average Household Energy Carbon Footprint by Zip Code
Double click to zoom or drag map to any location. Hover for details.



Average Vehicle Miles Traveled by Zip Code
Double click to zoom or drag map to any location. Hover for details.



Carbon Emissions in U.S. Cities

Suburbanization:

- Suburbs account for ~50% of total U.S. household carbon footprint
- Population dense central cities have considerably lower carbon footprints, but more extensive suburbs resulting in higher net average carbon footprints.
- Population dense suburbs typically have higher incomes translating to higher consumption and greenhouse gas emissions.

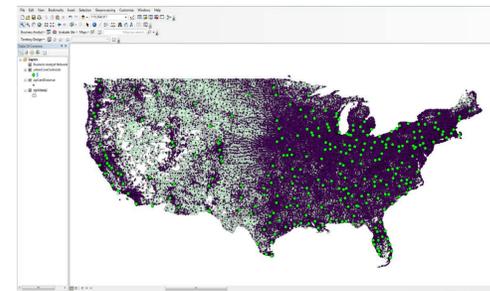
Results:

- National results do not indicate any statistically significant relationship between distance from urban core and average annual household carbon footprint
- The same null hypothesis was found among the additional variables tested (VMT, Average Household Income, Population Density).
- The results for the Atlanta MSA are consistent with the national findings.

Methods:

GIS:

- Create centroid for every zip code in U.S.
- Calculate distance from urban core zip code centroid



Conclusions:

This study examined 275 MSAs in the United States to indicate a relationship between a zip code tabulation area's total average annual household carbon footprint and its distance from the urban core as a large-scale study at a fine geographic resolution. The statistical analyses support a null hypothesis of no relationship between distance.

In the case of the one-way analysis of variance of total average annual HCF among the classes of distances, there was a decreasing total average annual household carbon footprint, which is contrary to the expected finding based on previous literature.

This study brings to light the issue of Modifiable Areal Unit Problems. U.S. cities have developed in many forms. This leaves room for high levels of scale variance that can cause problems in such large scale studies.

Statistical Analysis:

- The correlation among average annual household carbon footprints, income, and vehicle miles traveled, and distance from urban core was examined using Pearson's R coefficient
- One way ANOVA compared the following means: average annual household carbon footprint, services, goods, food, housing, transit, vehicle miles travelled, and income between each of the groups defined by distance to the core zip code.