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Urban Expansion and Carbon Emissions

Introduction

It is predicted by the UN that by 2050, 68% of the world's population will live in urban areas- a 2.5 billion person increase. With such, it is important to consider the implications on the climate. CO_2 emissions are a popular indicator of an area's effect on climate change. In addition, Cities themselves tend to have lower emissions per capita than their suburban extensions. A weak correlation in American cities between recent growth and CO_2 emissions was found (Glaeser et al, 2008). For these reasons, it was decided to test the relationship between urban expansion and CO_2 emissions in cities around the world. The purpose of this experiment was to test the correlation between CO_2 emissions within large and growing cities with the built-up area and built-up area rate of increase. It was hypothesized that large cities would have larger emissions per hectare of the built-up area and that both groups would see an increase in emissions as the built-up area increased.

Methods

In order to test this hypothesis, cities were chosen from the atlas of urban expansion and separated into two categories- large cities and growing cities. 15 cities per category were chosen. Large cities were classified as having the greatest population in 2015, and growing cities as Having the greatest annual change percentage from 1990-2015. City emissions were determined by multiplying the country's CO_2 emissions per capita in a given year by its urban extent

population. The annual change in BUA and BUA Density were tested against the Urban Extent Emissions for each group. The results were graphed for selected time periods with outliers excluded, and the R squared value was used to determine the significance of results. An R squared value above 0.9 was considered significant.

Results

It was found that there is no significant relationship between the rate of increase in BUA and rate of increase in CO_2 emissions in either large or growing cities. There is however a clear positive correlation between the two in large cities. Similar relationships occurred between BUA density in each group. Neither R squared value was significant, but the positive correlation in growing cities between density and emissions was clear.

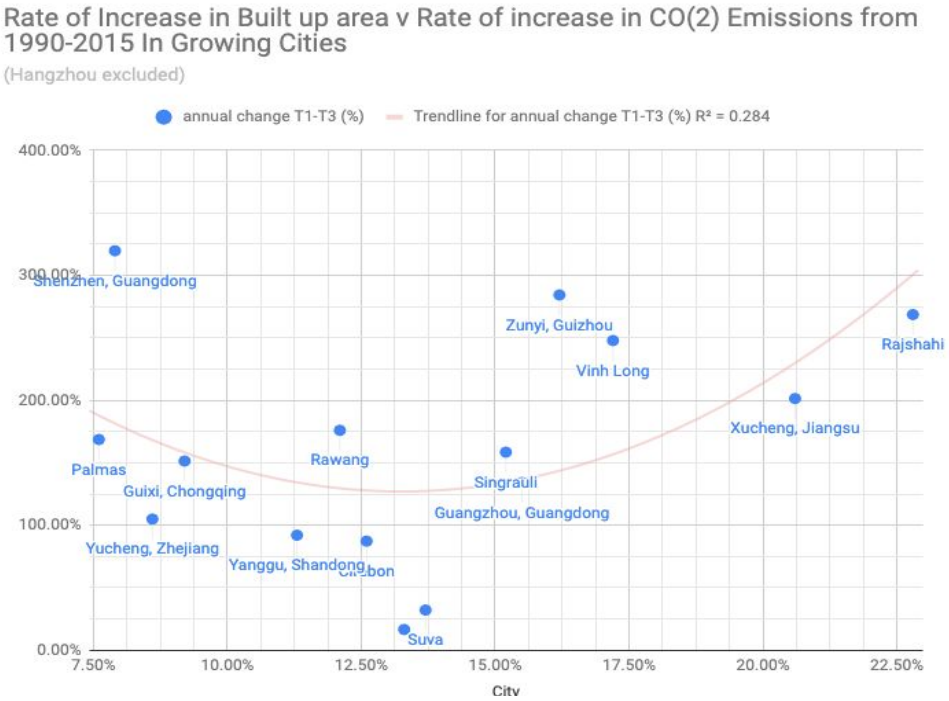

Figure 1

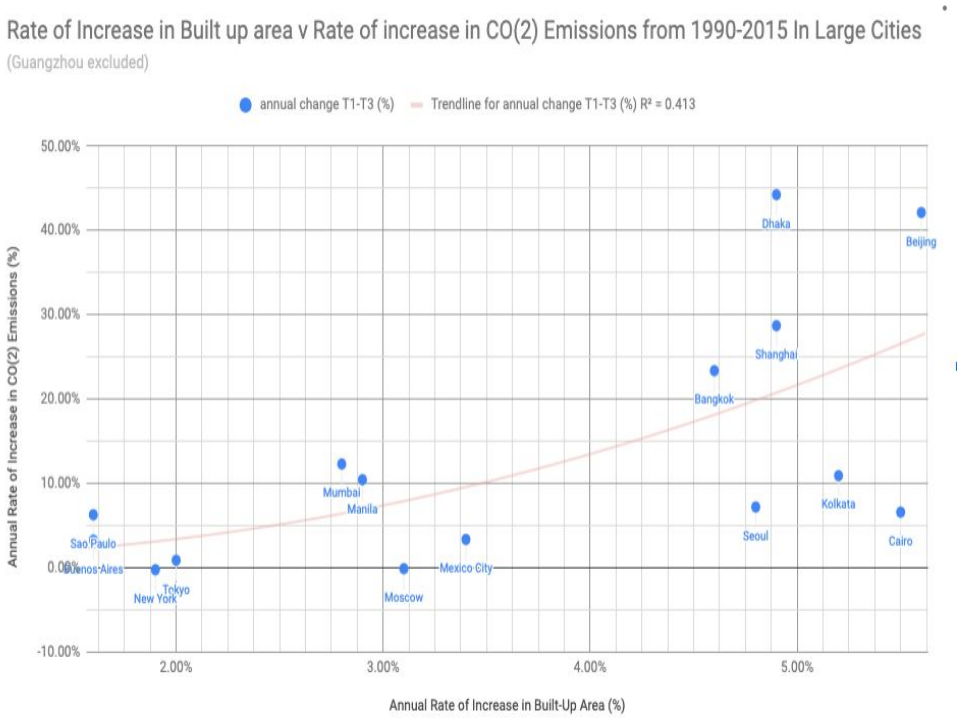

Figure 2

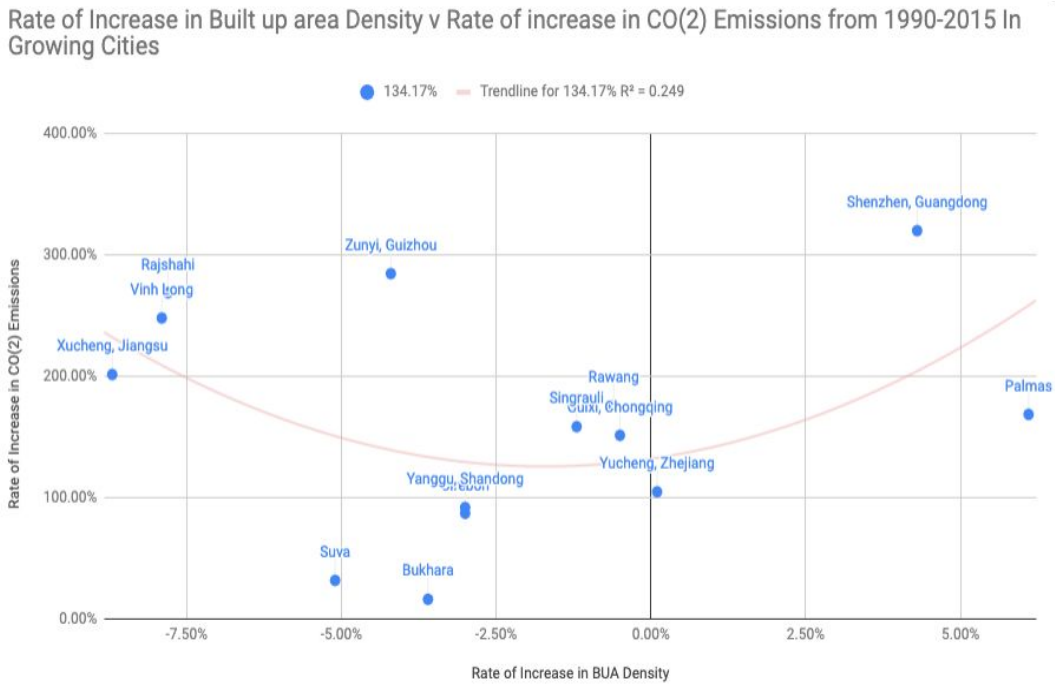

Figure 3

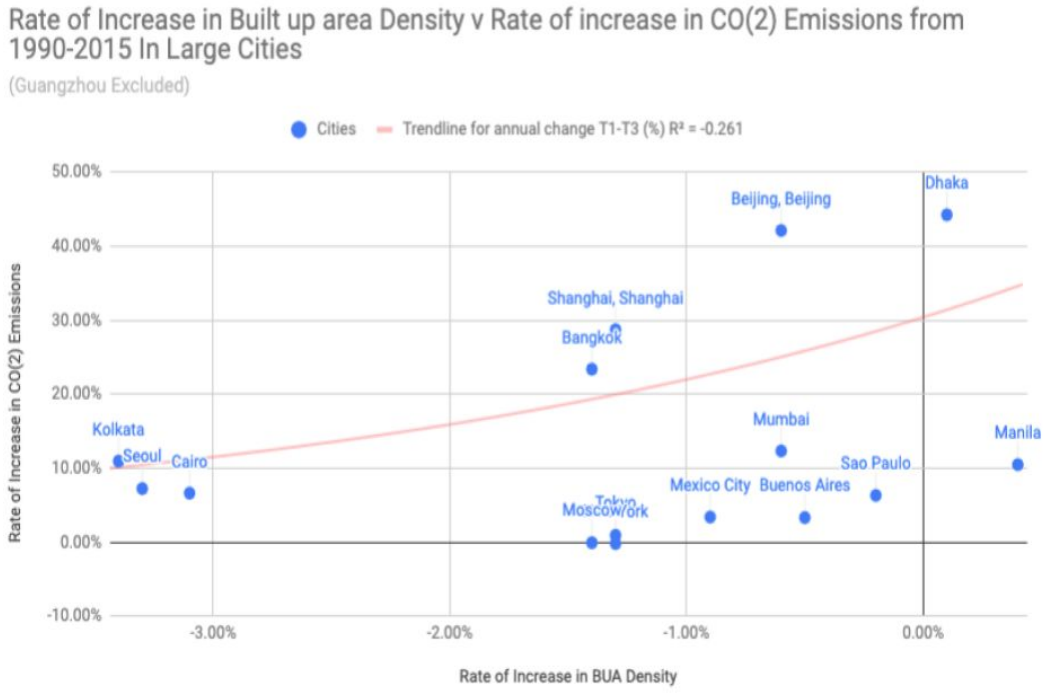

Figure 4

Discussion

The lack of a clear correlation between emissions and BUA and BUA density could be attributed to the global sample of cities used, as regional trends were not separated and accounted for. There lacks a uniform method for testing GHG Emissions in cities around the world. As such, the method used in this study is not uniform to current research in the field, likely leading to discrepancies with preexisting global trends. A source of error can be found in the determination of the emissions of a city; the emissions per capita within urban areas varies from those of the entire country. It does not vary uniformly around the world, either. This likely largely depends on the wealth distribution within each country, and the urbanization metrics of the suburbs or other urbanized areas. The relationship between growth and emissions differs in

large cities and growing cities, as seen by the trendlines for each dataset. This was predicted, as larger and more developed cities tend to differ in their emissions from the growing cities in the developing world. If enhanced, such results can lead to a formation for a global strategy to reduce emissions most effectively. This could include planning and policy recommendation. Based on the positive correlation between BUA Increase and CO_2 emissions in Larger cities, it is recommended that expanding cities take increased measures for green expansion.

Future research should include The analysis of trends in emissions for types of cities by global region, the definition of a uniform method to analyze CO_2 emissions for all cities around the world, and the development of a function to predict emissions based on expansion.

Work Cited

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