Investigating the Changes in Vegetation Coverage in Megacities in the World Using Google Earth Engine

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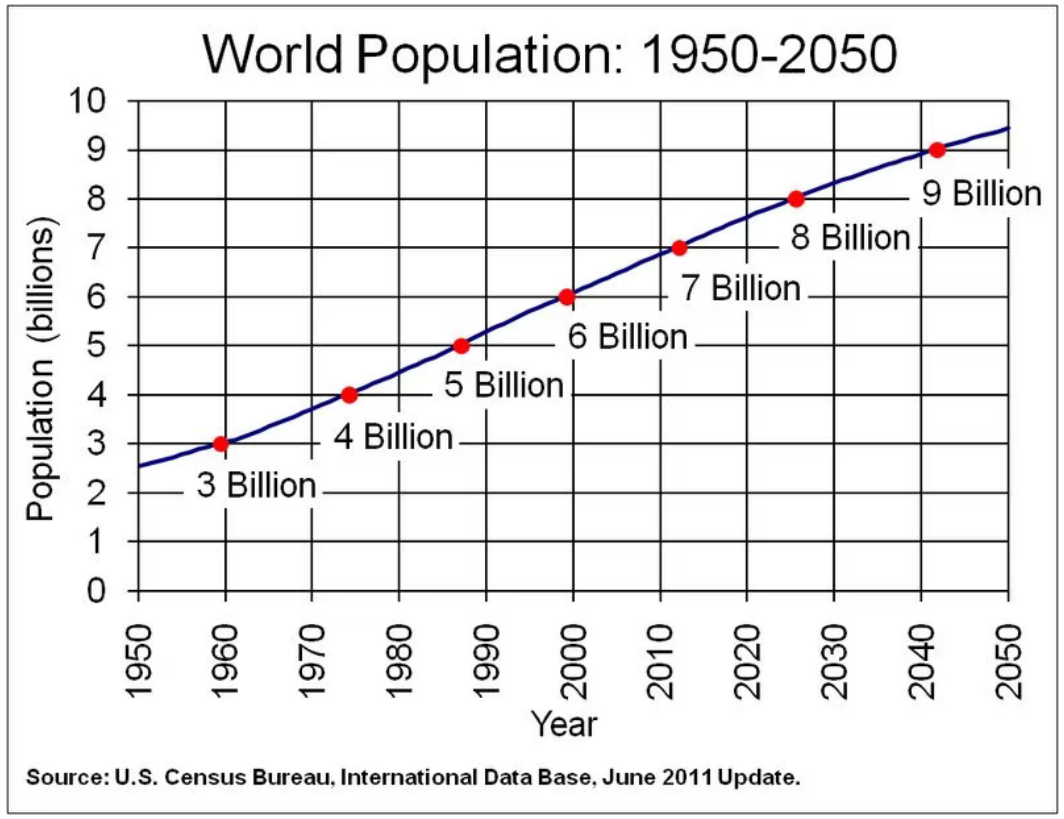
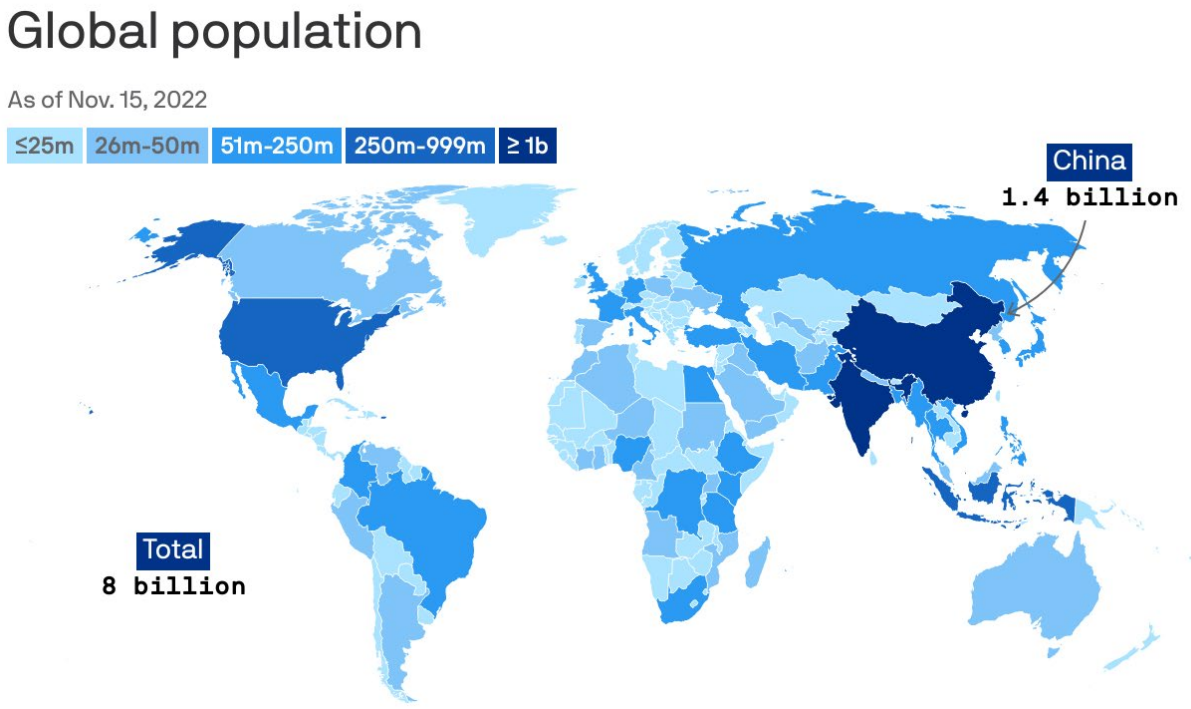
Population Growth and Urbanization

- The world's urban population has grown from 2.5 billion to 7.88 billion from 1950 to 2023 and projected to grow to about 9 billion by 2050.

- Global urbanization is the response to accommodate the excess population.



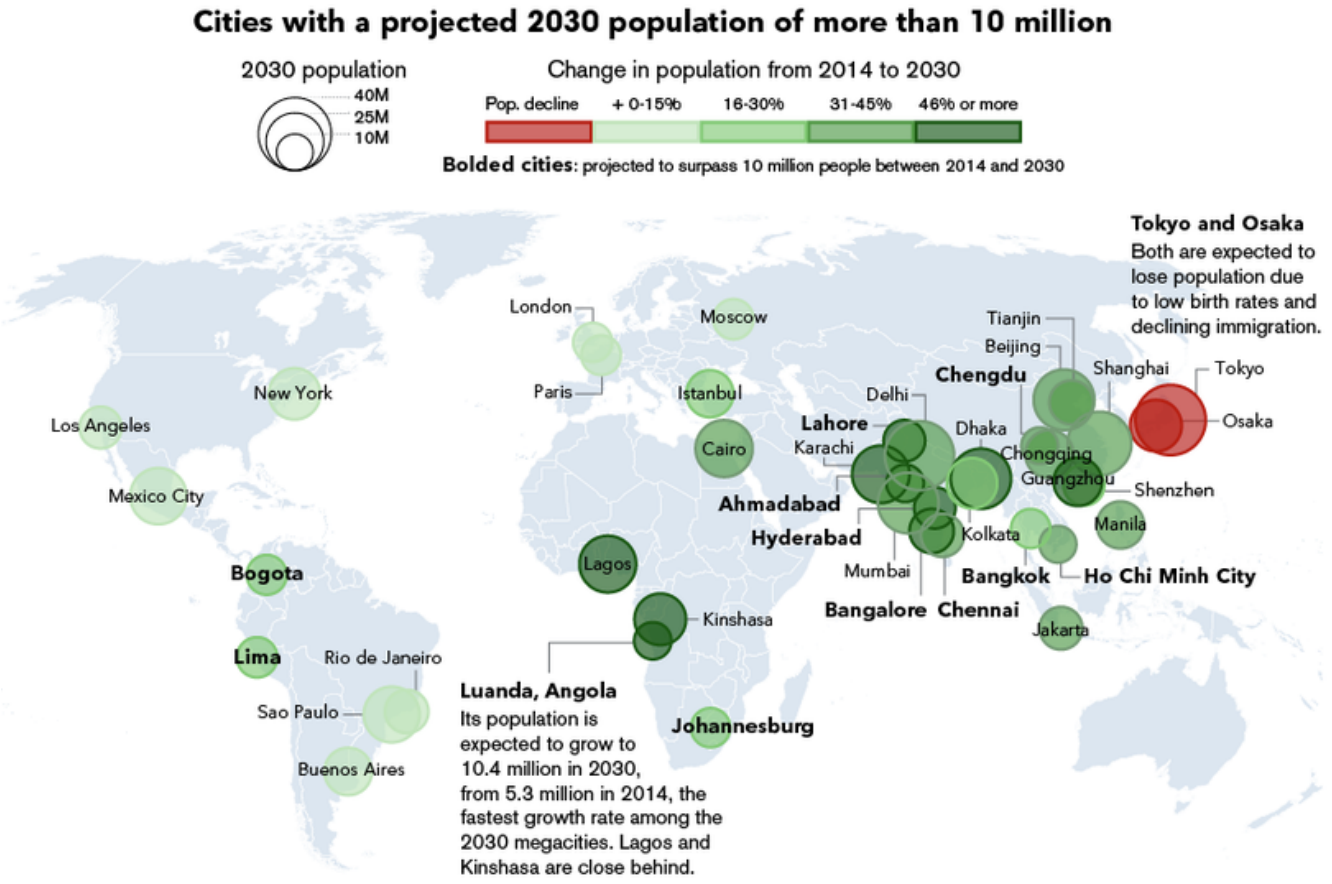


Source: https://www.axios.com/2022/11/14/global-population-8-billion-data-world-humans-un

Megacities

A megacity is defined as any metropolitan area with a population exceeding 10 million. Globally, the number of megacities is projected to rise from 33 to 43 by 2030.

- In 2018, 48 cities had populations between 5 and 10 million people, and by 2030, it is projected that 10 of those cities will become megacities.
- 28 additional cities will cross the 5 million mark between 2018 and 2030
- By 2030, 66 cities are projected to have a population between 5 and 10 million
- inhabitants (United Nations, 2018).



Source: http://www.bloomberg.com/infographics/2014-09-09/global-megacities-by-2030.html

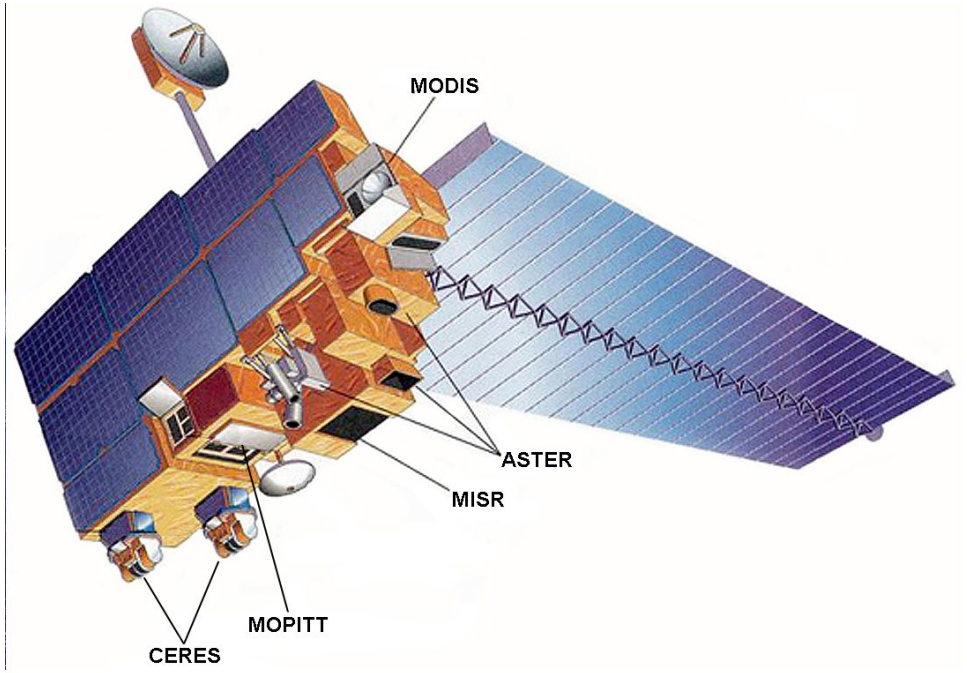
Objectives of the Current Study

It is particularly important to understand how the growth of megacities will impact climate change across the globe. Studies on megacities at different spatial and temporal scales will be required to understand their local-to-global implications. Mapping the changes in vegetation coverages is particularly important in this regard.

- This study looks at 13 selected megacities across the globe using a long-term time-series analysis of greenness and vegetative health between 2000 and 2020.

- Using Google Earth Engine, MODIS Terra Vegetative Indices were used to analyze greenness and vegetation coverage in these areas.

- This research is ongoing. Preliminary results will be presented and discussed.



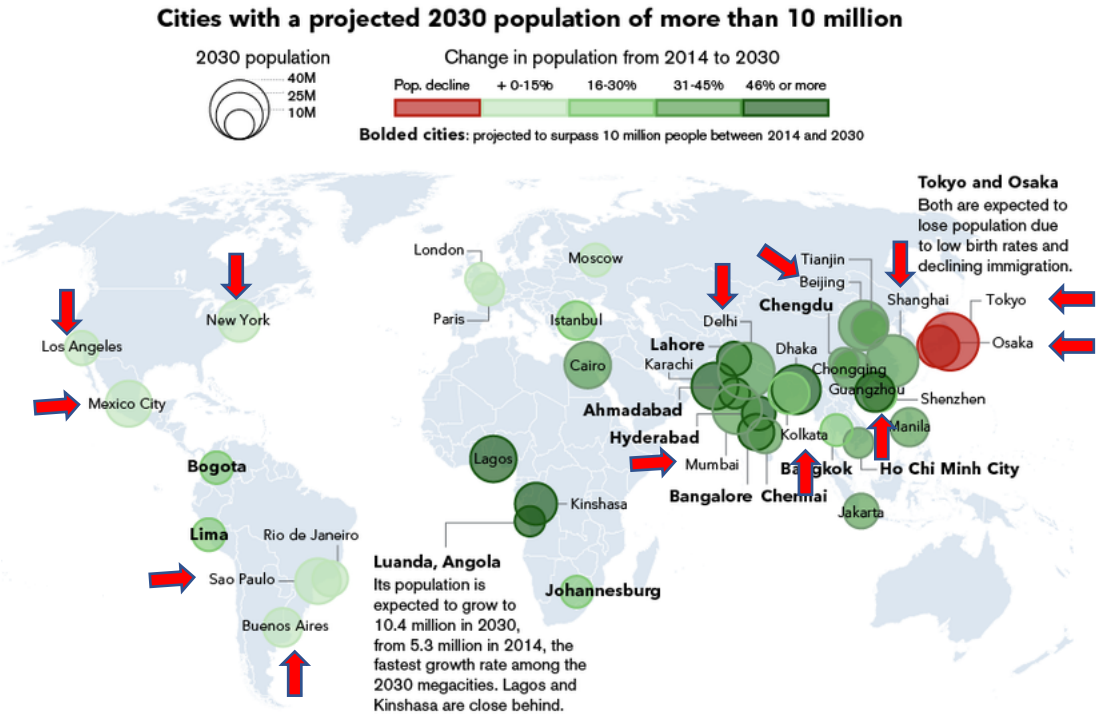
Source: https://www.nasa.gov/directorates/heo/scan/services/missions/earth/Terra.html

Google Earth Engine

Study Site

This study explored 13 megacities across the globe using a long-term time-series analysis of greenness and vegetative health between 2000 and 2020.

City	Population in thousands (United Nations, 2018)
Tokyo, Japan	37.468
Delhi, India	28.514
Shanghai, China	25.582
São Paulo, Brazil	21.650
Mexico City, Mexico	21.581
Mumbai, India	19.980
Beijing, China	19.618
Osaka, Tokyo	19.281
New York City, New York, United States	18.819
Buenos Aires, Argentina	14.967
Kolkata, India	14.681
Las Angeles, California, United States	12.458
Guangzhou, China	12.638



Data and Methods

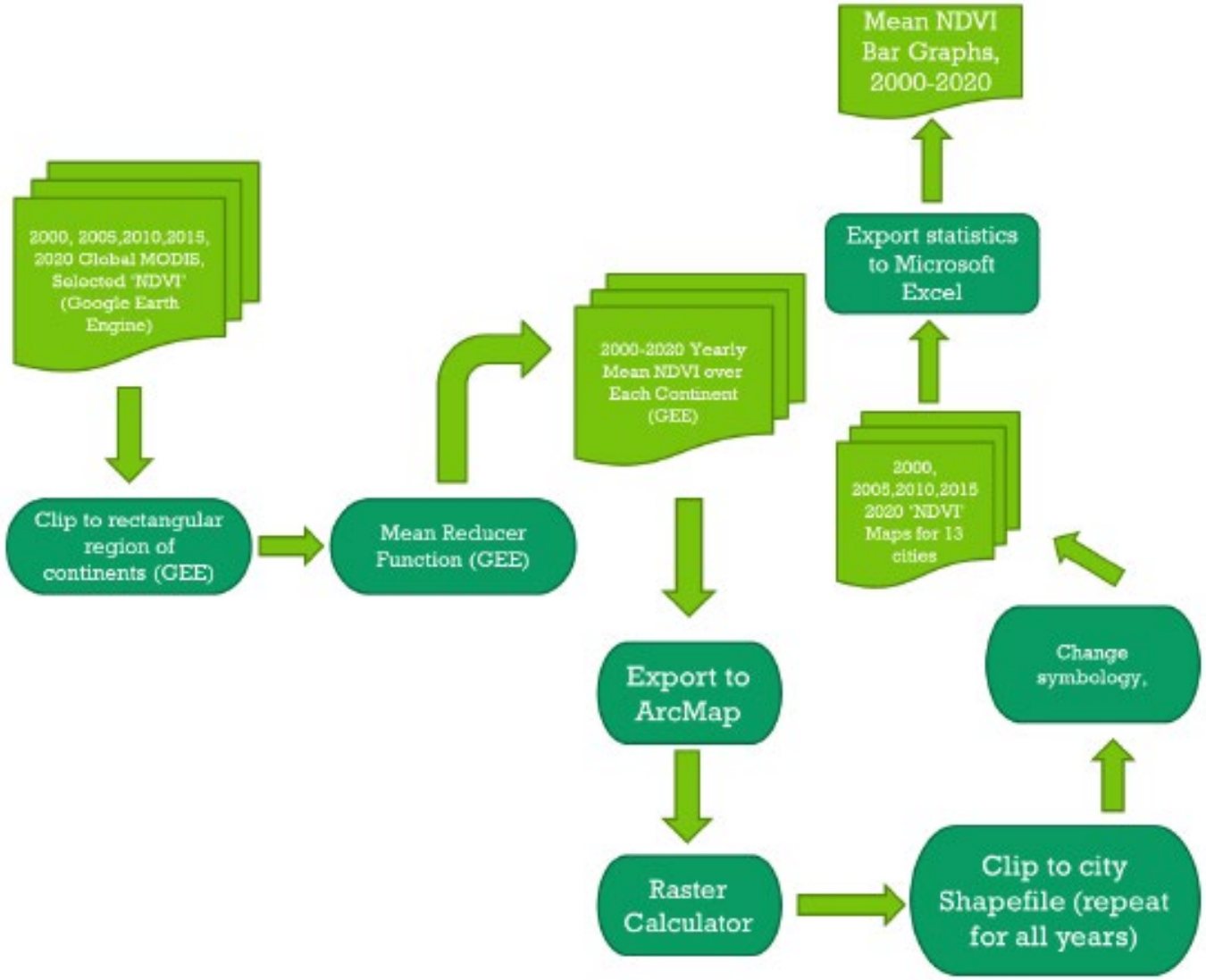
- Using Google Earth Engine, MODIS Terra Vegetative Indices were used as a proxy to analyze greenness and vegetative health.

- MODIS provides Vegetation Index Products (NDVI and EVI). These products are
- produced on 16-day intervals at multiple spatial resolutions.

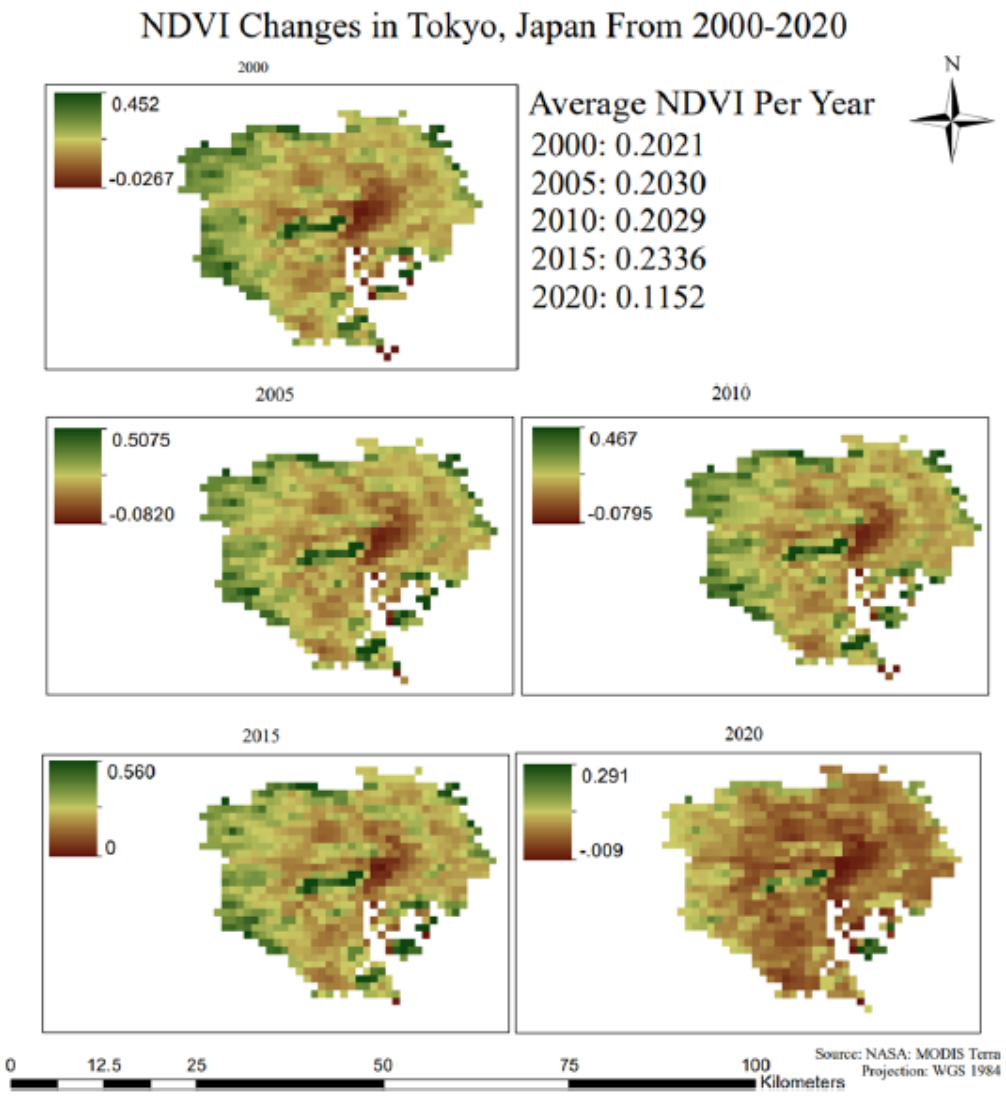
- The 1-kilometer scale was chosen for this analysis. NDVI is derived from atmospherically-corrected reflectance in the red and near-infrared wavelengths.

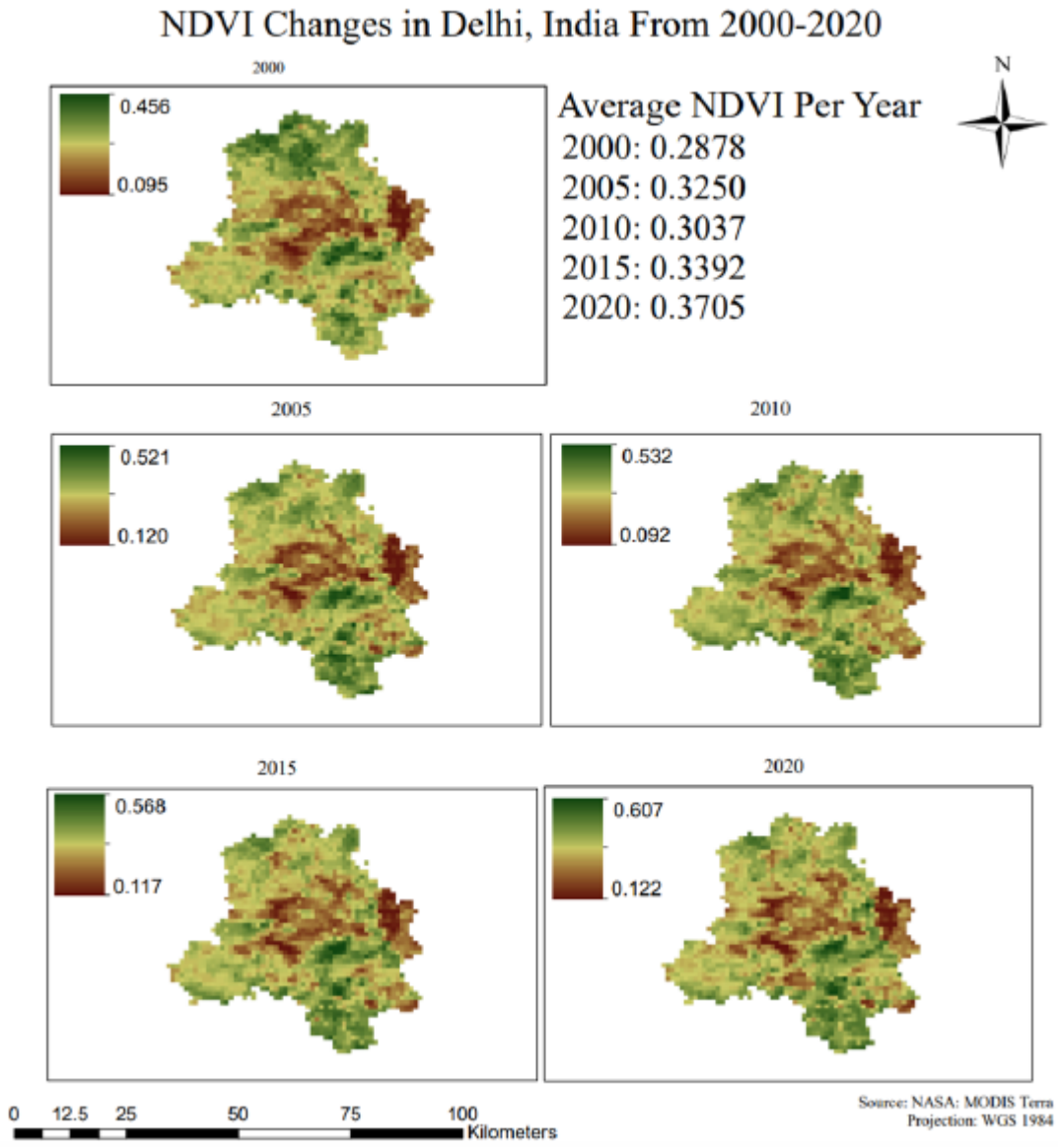
- Using the mean reducer function in Google Earth Engine (Figure 1), the mean NDVI pixel value over the course of a year was calculated to produce a single NDVI raster for each year.

- It is worth noting that because MODIS Terra products were not available until February 18, 2000, January 1-February 17th were omitted from the dataset analysis.



Preliminary Results





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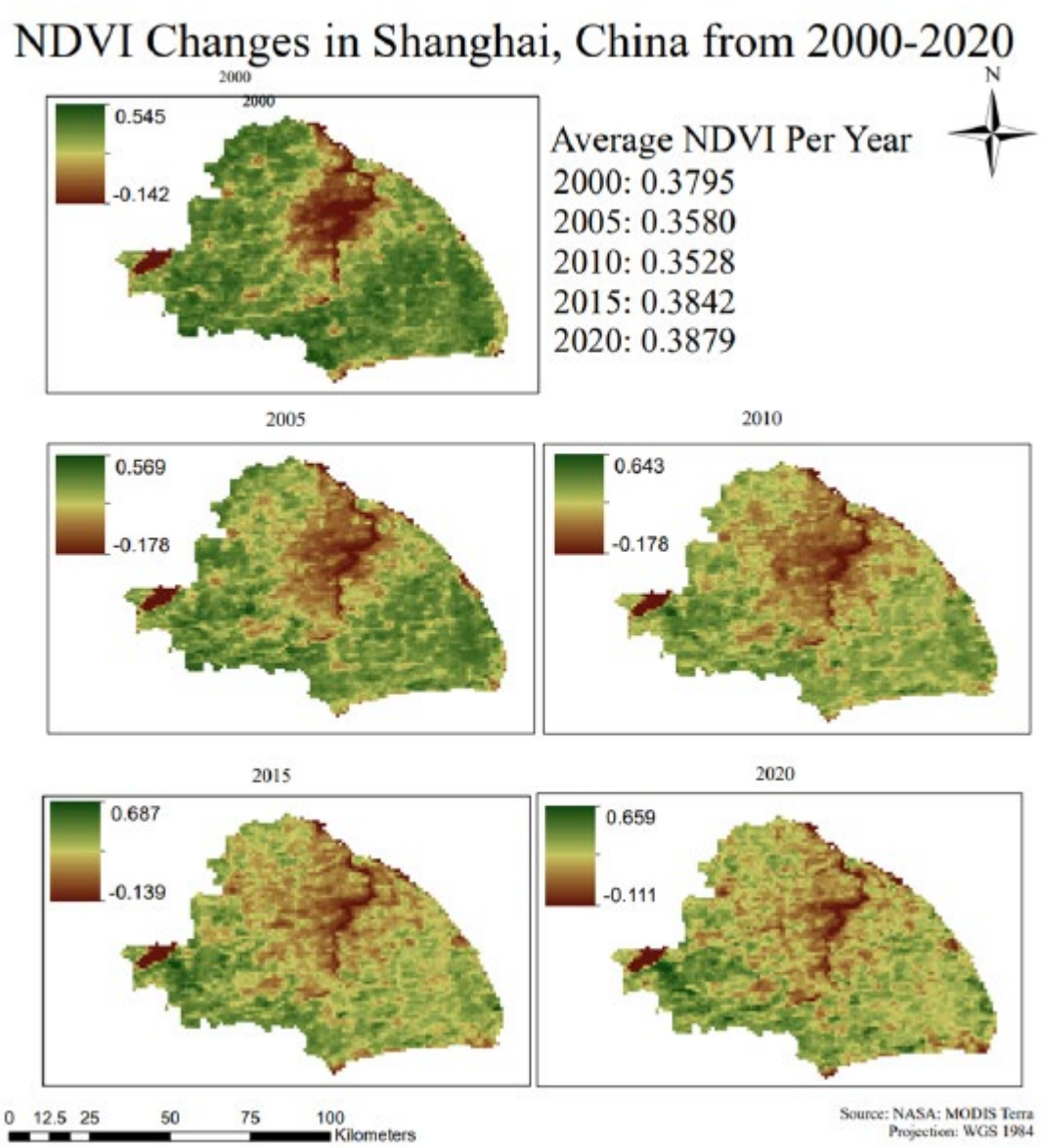

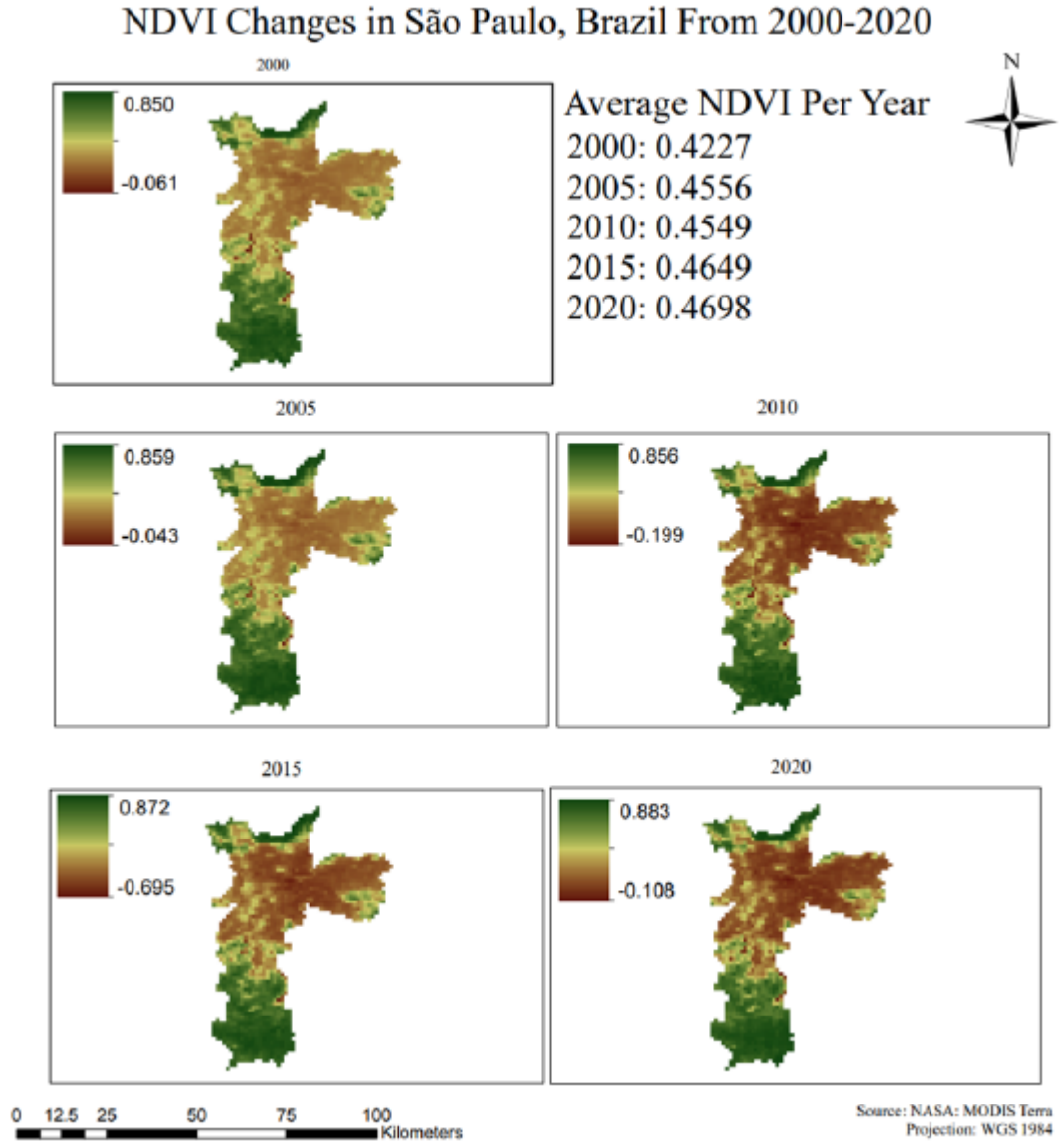

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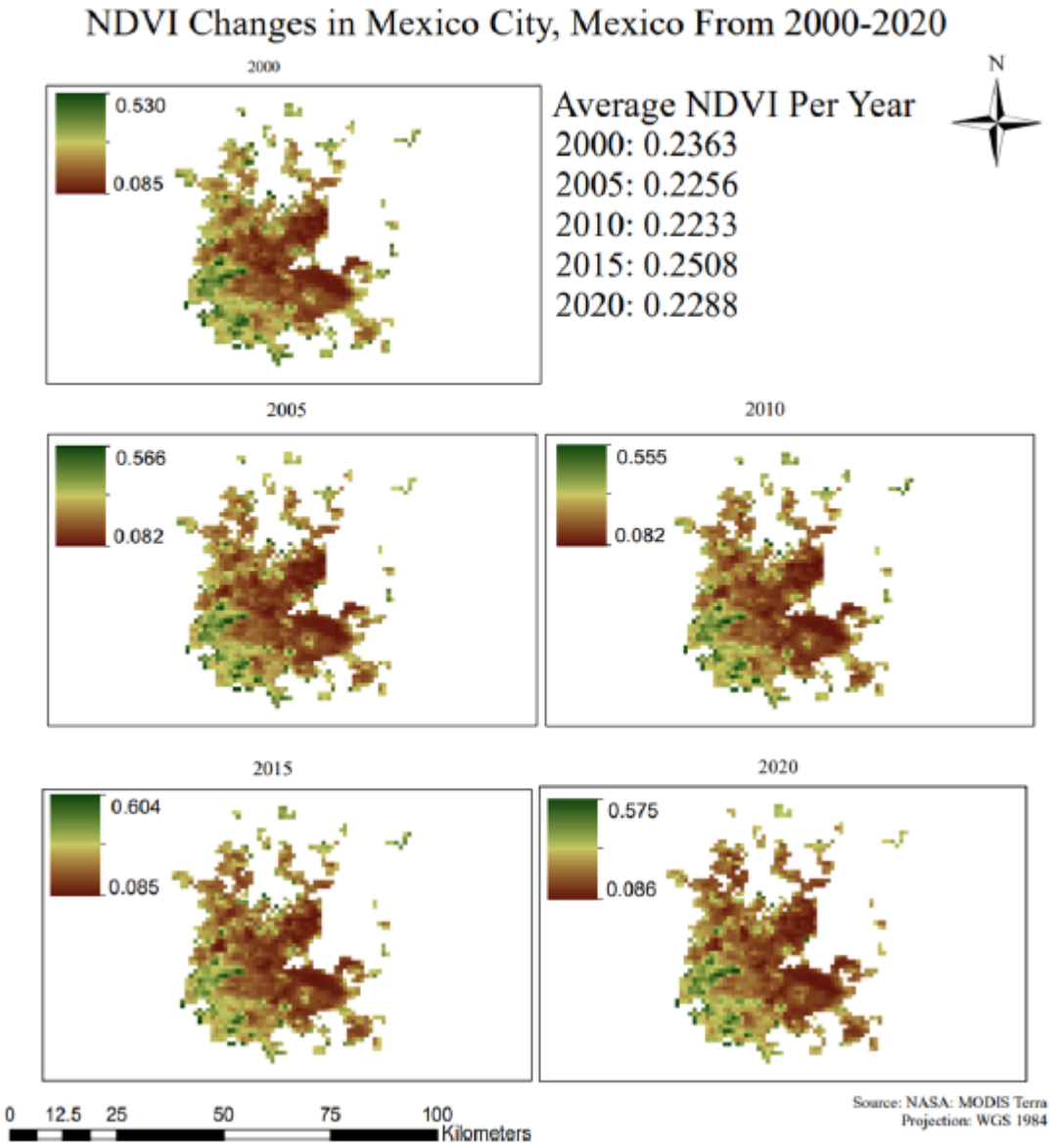

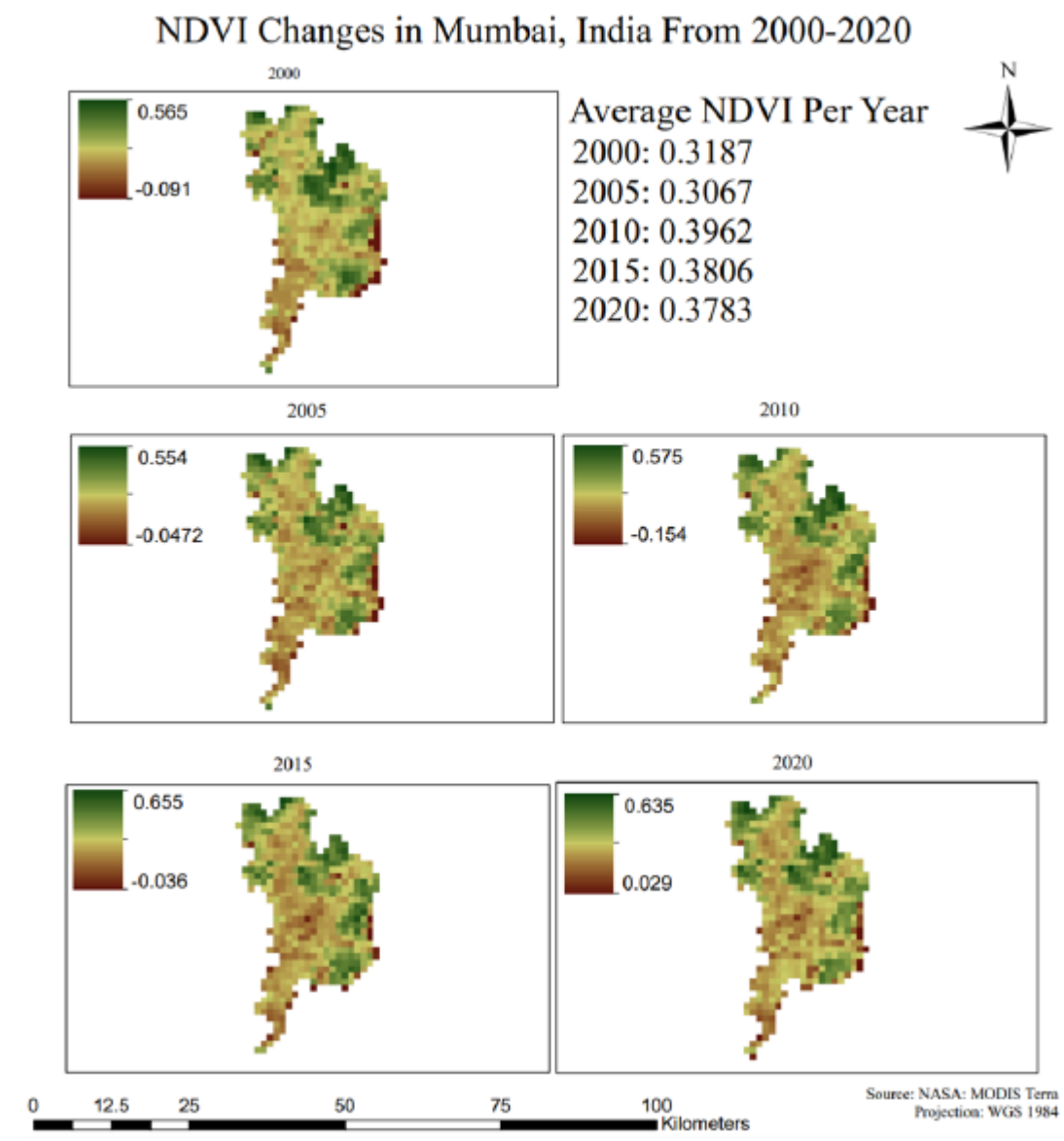

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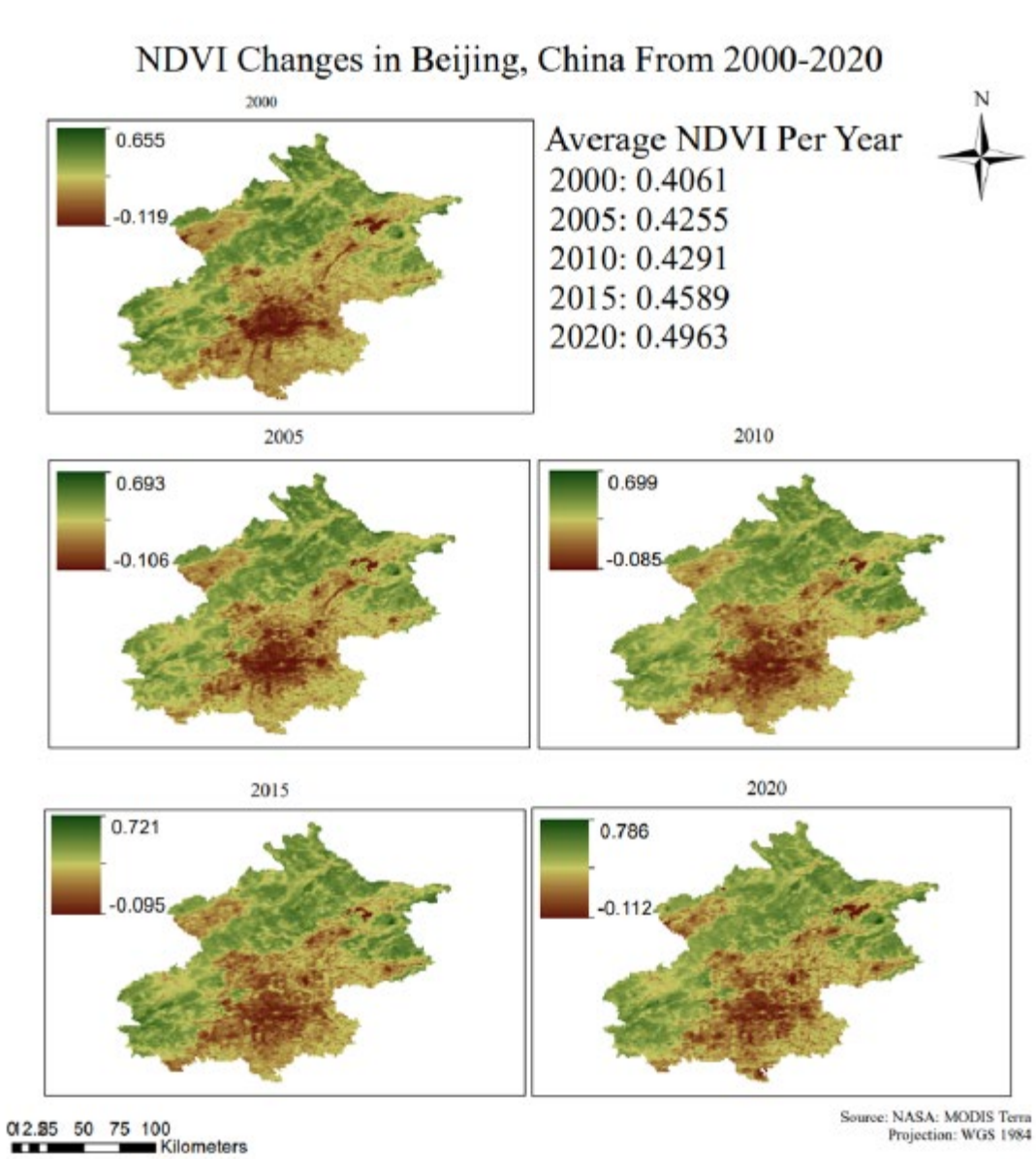

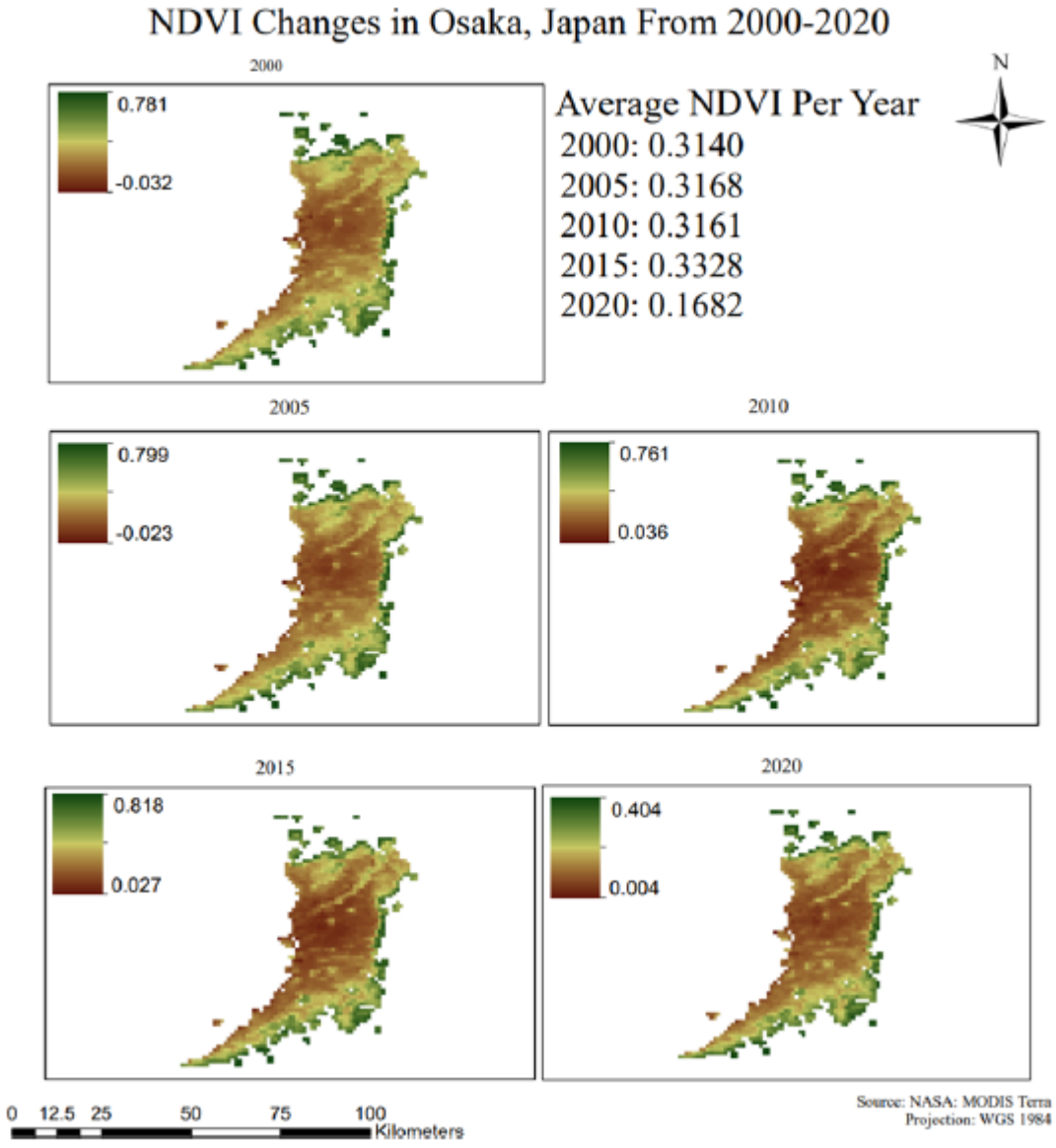

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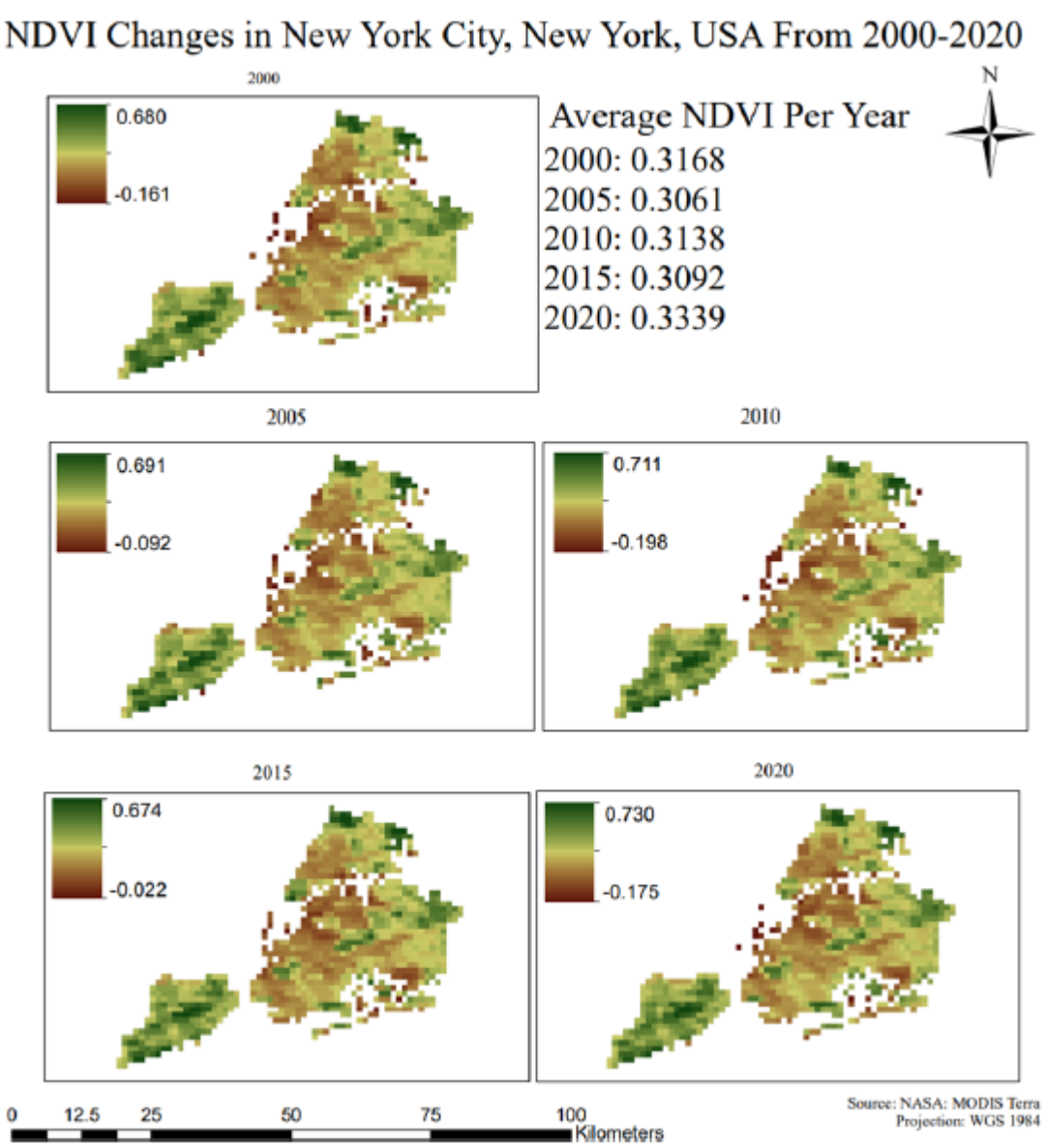

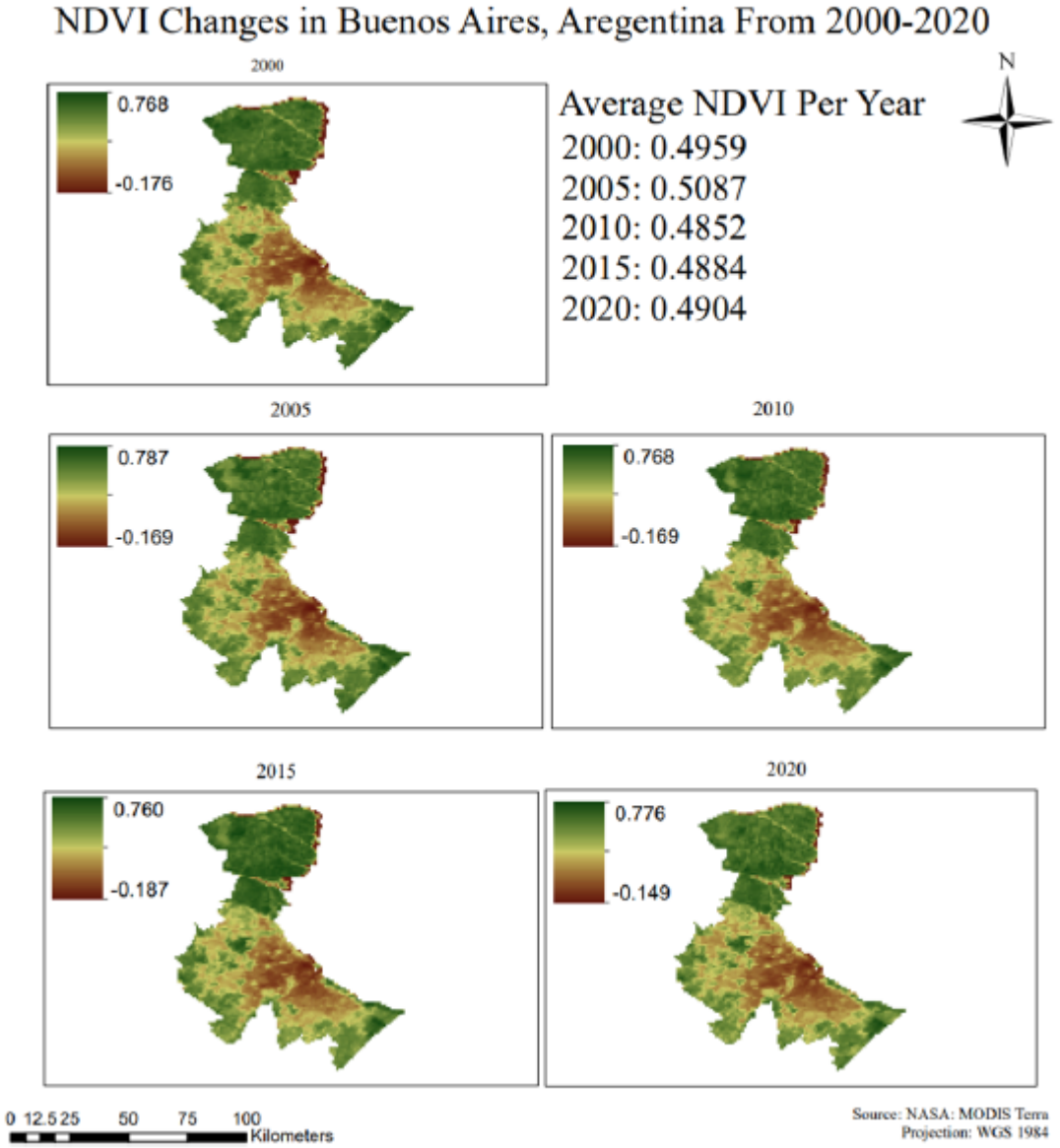

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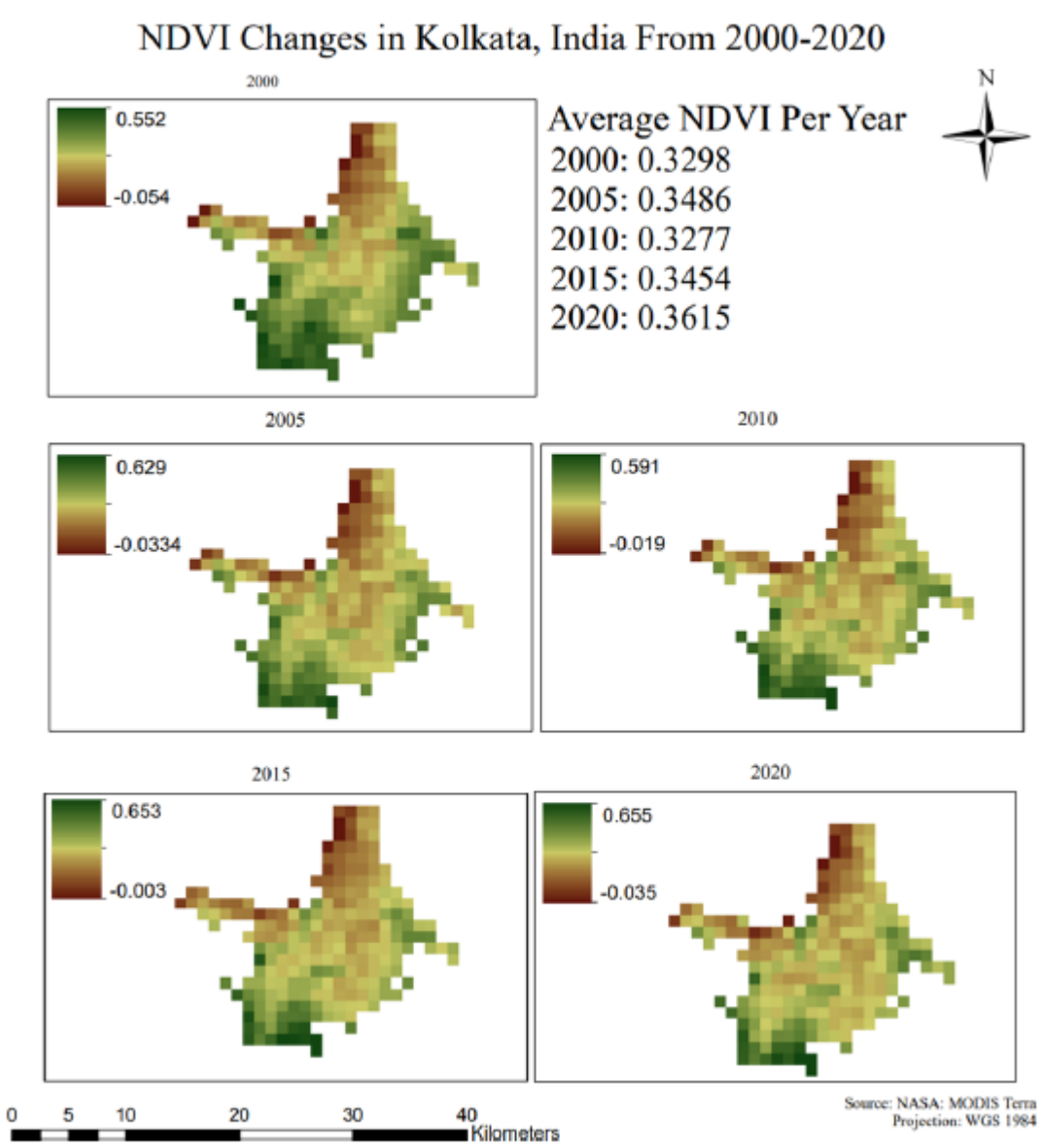

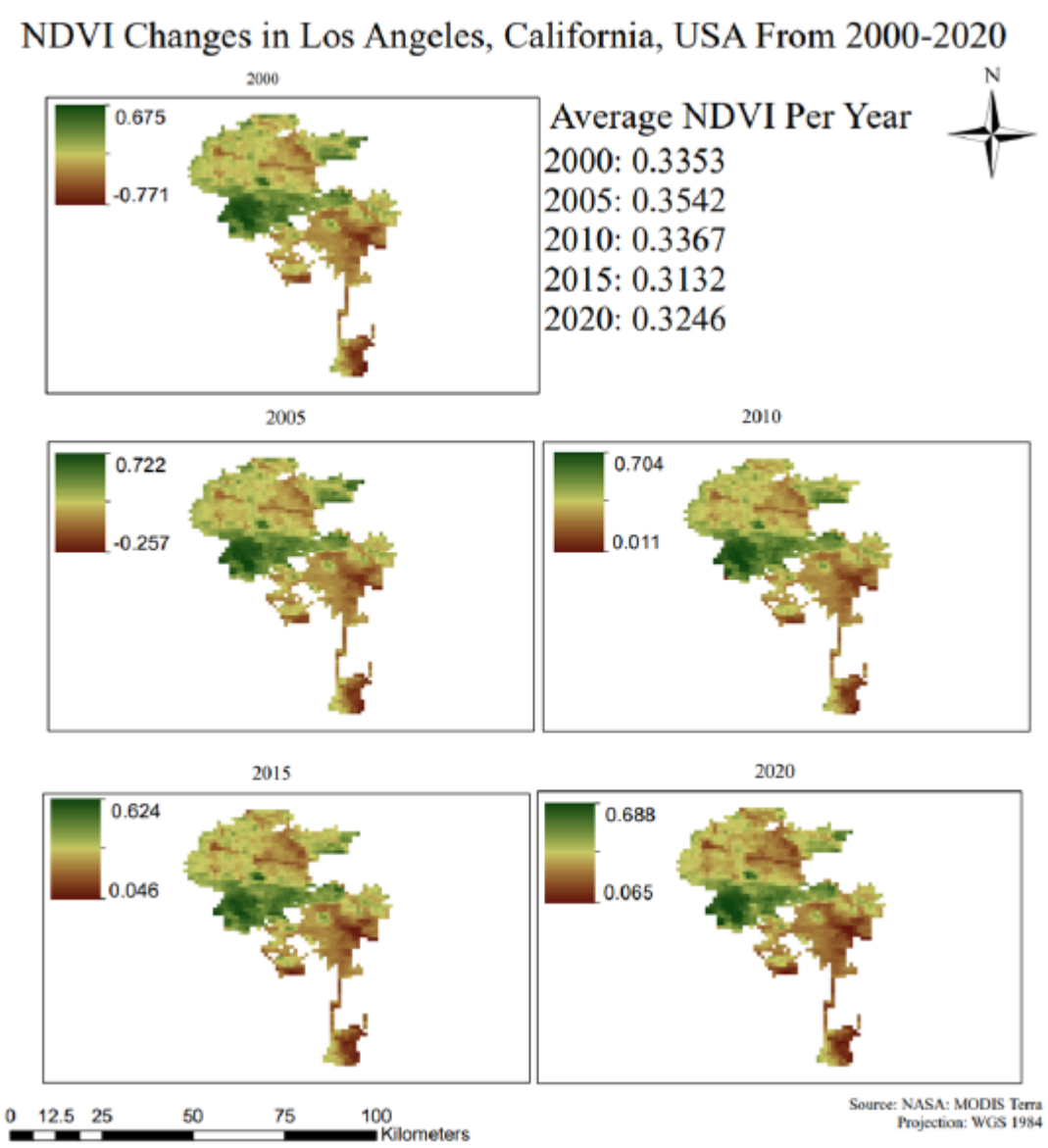

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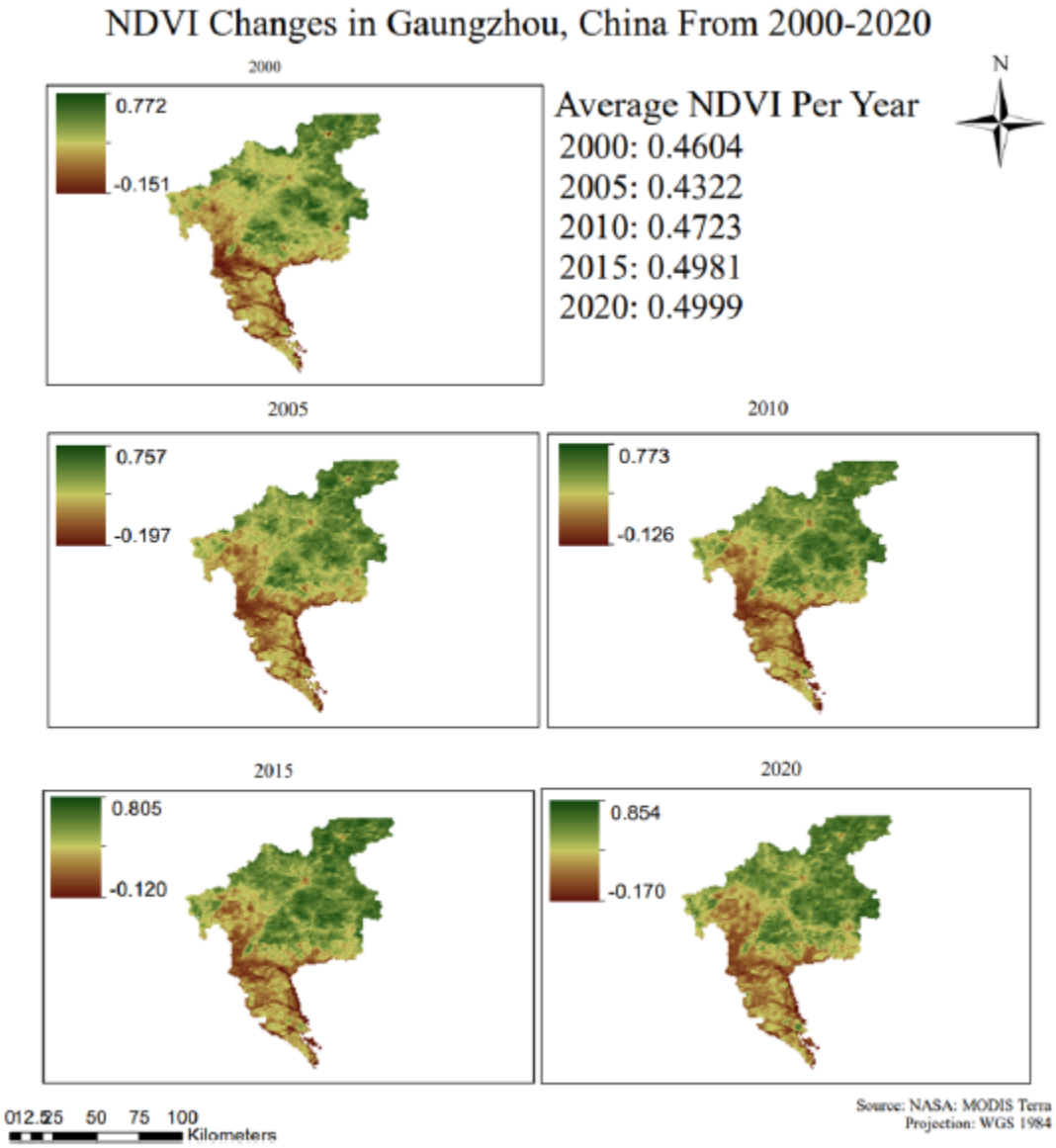

Preliminary Results

City	Percent Change in NDVI (+ indicated increase NDVI, - indicated decrease NDVI)
Tokyo, Japan	-42.998%
Delhi, India	+28.735%
Shanghai, China	+2.213%
São Paulo, Brazil	+11.143%
Mexico City, Mexico	-3.174%
Mumbai, India	+18.701%
Beijing, China	+22.210%
Osaka, Tokyo	-46.433%
New York City, New York, United States	+5.398%
Buenos Aires, Argentina	-1.215%
Kolkata, India	+9.611%
Los Angeles, California, United States	-3.191%
Guangzhou, China	+8.579%

Thank You!