

A Deeper Look into Indianapolis: CO₂ Emissions and Economic Conditions

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Abstract

Major cities across the United States account for nearly one-quarter of all global carbon dioxide emissions. Therefore Arizona State University researchers have set out to create a system that allows for all fossil fuel carbon dioxide emissions to be quantified at the scale of buildings, streets and factories. The system, named "Hestia", was first tested in Indianapolis, Indiana. In an attempt to better understand this first case study, the economic conditions of Indianapolis were researched and, in an exploration of the data product, the results from Hestia were considered and analyzed to better understand their contents. This showed Indianapolis to have a growing economy and emissions that change based on a model.

Introduction

The Hestia Project builds on the Vulcan Project, which quantified fossil fuel CO₂ in the United States at sub-county spatial resolution and temporal resolution for the year 2002 (Gurney, et al, 2009). Hestia has taken that information and adapted it into a bottom-up approach that models fossil fuel carbon dioxide emissions at the scale of individual buildings, road segments as well as industrial and electricity production facilities (Gurney et al, 2012). The data collected and analyzed from the Hestia Project encompasses the years 2002 to 2013 and ranges over eight different sectors: airport, commercial, industrial, mobility, non-road, residential, utility and rail.



Focus Questions

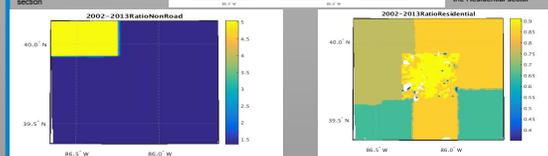
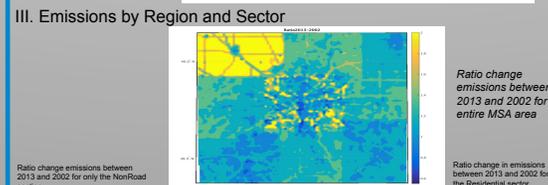
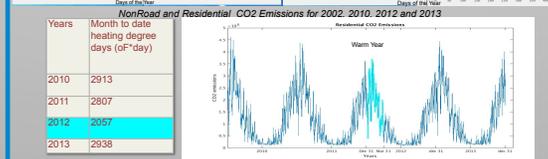
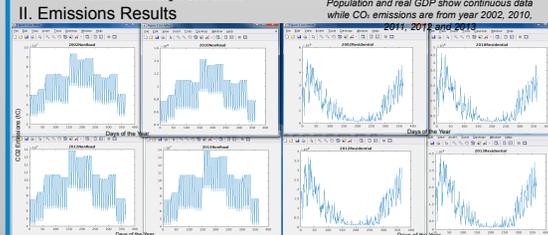
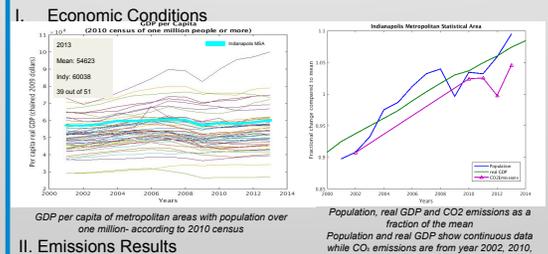
Focus questions:

- I. How have the economic conditions in Indianapolis changed overtime and how do they compare with other major United States cities?
- II. What do the carbon dioxide emission results from the Hestia Project show?
- III. What can the results from the Hestia Project help us understand about emission changes by region and sector?

Methods

- The economic information came from StatsIndiana and the U.S. Department of Commerce and then was loaded on the Matlab to find comparisons and trends.
- Using the given Hestia data the carbon dioxide emission results were analyzed on Matlab to find ratio changes between the different years.
- The heating degree days were calculated by information presented on Weather Underground.

Results



Discussion and Conclusions

I. Economic Conditions

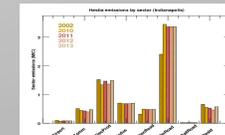
- Indianapolis MSA has an economy that is slightly above average with an overall growing population, GDP and rate of CO₂ emissions.
- The growth of rate CO₂ emissions is correlated with the growth rate of GDP. (GDP used to compute CO₂?)

II. Emissions Results

- The Hestia Project is a modelling program that takes the carbon dioxide emission data from 2002 and adjusts the yearly results in accordance to factors such as GDP.
- The total amount of carbon dioxide emissions in 2012 was lower because there was a warm winter and therefore the residential sector did not need to consume as much heat.

III. Emissions by Region and Sector

- The 2013/2002 ratio carbon dioxide emissions plot showed county level changes, with the most detail being in Marion County and the largest increase in Boone County.
- The NonRoad sector plot showed an increase in the level of emissions in Boone County. Causes for this increase over the 11 year period could be an increase in construction or a problem with the model.
- Results show that while there was a dip in emissions in 2012 due to the Residential sector, overall emissions increased during the 11 years which is largely due to the OnRoad (mobility) sector.



Emissions split by sectors to show which sector contributed the most to the amount of carbon dioxide emissions each year.
Graph made by T. Lauvaux

References

- Gurney, Kevin R., Igor Razilvanov, Yang Song, Yuyu Zhou, Bedrich Benes, and Michel Abdul-Massih. "Quantification of Fossil Fuel CO₂ Emissions on the Building/Street 2 Scale for a Large U.S. City." *Environmental Science and Technology* (2012): 1-9. Online.
- Leander, Sandy. "Study Maps Greenhouse Gas Emissions to Building, Street Level for U.S. Cities." *Research Matters: ASU Knowledge Enterprise Development*, 15 Oct. 2012. Web. 10 July 2015.
- "Population Estimates for Indiana Counties, 2000-2010." *Indiana County Population Estimates, 2000-2010*. StatsIndiana, 5 Oct. 2011. Web. 28 June 2015.
- "Quantifying Carbon Dioxide Emissions like Never Before." *Hestia Project*. Arizona State University, 2012. Web. 2 July 2015.
- "Real Gross Domestic Product by State Over Time." *States IN Profile*. StatsIndiana, 22 June 2015. Web. 29 June 2015.
- Regional Data." *U.S. Bureau of Economic Analysis (BEA)*. U.S. Department of Commerce, 2015. Web. 22 June 2015.
- "Unemployment Rates for Large Metropolitan Areas." *U.S. Bureau of Labor Statistics*. United States Department of Labor, 1 June 2015. Web. 22 June 2015.
- "Weather History for Indianapolis, IN | Weather Underground." *Weather Underground*. The Weather Channel, 2015. Web. 2 July 2015.

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