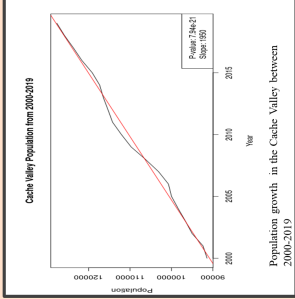


Impact of Population Trends in Relation to CO₂ Emissions in the Cache Valley

Linda Arterburn¹, John Lin², Derek Mallia², James Mineau²

1. Motivation

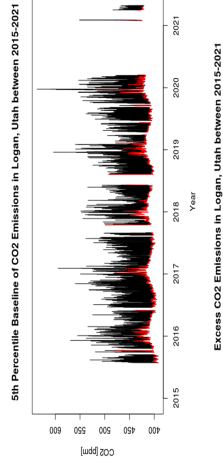
The Utah Urban Carbon Dioxide Network is a network of stationary measurement sites deployed across Utah to measure CO₂. With the effects of climate change getting worse, more cities are looking to reduce their carbon emissions; therefore, tracking and analyzing CO₂ emissions is essential. Salt Lake City has pledged to reduce greenhouse gas emissions by 2040. CO₂ emissions can be produced due to biological processes, agriculture, and human interactions. To have a better understanding of CO₂ emissions it is essential to analyze data at various timescales. This data can lead to a better understanding of greenhouse gas emissions and aid in future emission reduction targets.



2. Excess CO₂ measurements

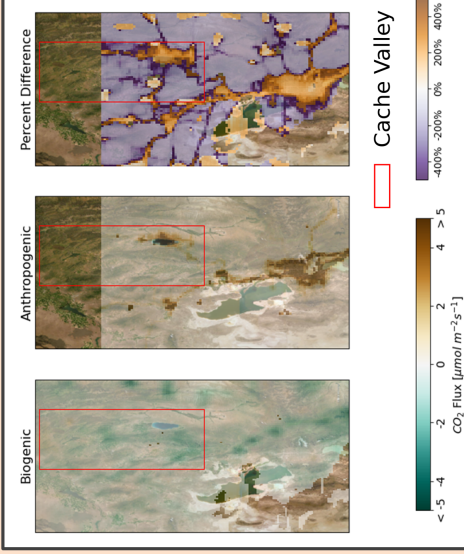
The excess CO₂ is calculated and analyzed to represent the local human emissions and biological emissions.

- A baseline was calculated and subtracted from the original data from the UUCON site in Logan, Utah to create the graph of the excess CO₂. The baseline was made using the 5th percentile of the data and a rolling window over a 3-day time window.
- The excess CO₂ emissions were significantly less than the initial data recorded, as the initial data was approximately three times larger than the data after the baseline was subtracted from it.

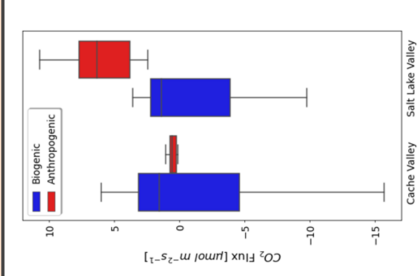


Top: This graph shows the original CO₂ emission data and the baseline that was subtracted from the data to result in the excess CO₂ emission data.
 Bottom: This graph shows the excess CO₂ from the UUCON site in Logan, Utah that represents the local biological emissions produced in and surrounding Logan, Utah as well as other emissions in the Cache Valley.

3. CO₂ Fluxes in the Cache Valley

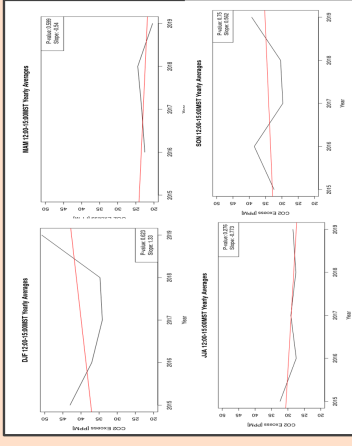


Biogenic and anthropogenic images of fluxes of CO₂ in the Cache Valley.



5. Preliminary conclusions

- Excess CO₂ emissions in the Cache Valley are produced as a result of biological processes such as agriculture, plant respiration, and biological processes as opposed to human processes. Anthropogenic CO₂ emissions are present in Cache Valley, however they are not large enough to have a significant impact on CO₂ concentrations in the valley.
- Despite anthropogenic CO₂ emissions seeing limited changes in trends, there is significant year to year variability in CO₂.



These graphs depict the excess CO₂ for each season averaged per year between 12:00-15:00. The data is plotted for 1000 observations. For statistical significance between the years, the P-values were above 0.05 for each trendline.

6. Future work?

The data collected supports the idea that a majority of the excess CO₂ is related to the biological processes of plants, agriculture, and biological processes opposed to the human activities in the Cache Valley. Comparing and contrasting the results in Cache Valley with larger cities and towns and relating drought conditions to variability are other studies to be done in the future.

Acknowledgements

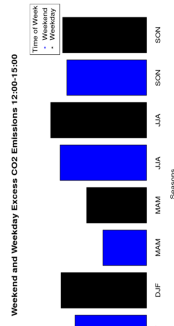
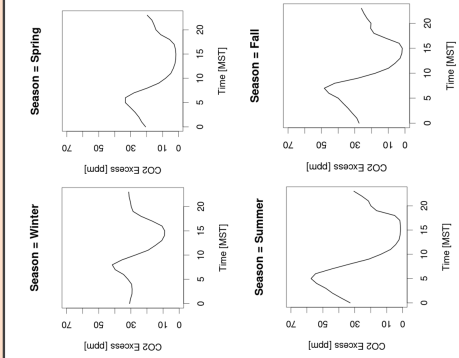


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4. Seasonal Excess CO₂ comparisons

Excess CO₂ Emissions were averaged by season and plotted to analyze the results found. The main takeaways were

- The excess CO₂ emissions were significantly higher in the summer than in the winter, which opposed what was originally expected.
- During the 12:00-15:00 period of the day where CO₂ emissions are most stable the CO₂ emissions are higher in the summer months than in the winter months for the weekdays and the weekends.



This is a graph depicting the data recorded for Logan, Utah from 2015-2021 averaged amongst the 4 seasons between the hours of 12:00-15:00, when excess CO₂ emissions are most stable.

These graphs depict the excess CO₂ emissions in Logan, Utah during the seasons in the meteorological order averaged for each hour in the day.