Carbon Dioxide and its Isotopic Composition in Salt Lake City 2001-2017

Nicholas Bitter, John Lin, Ryan Bares, Ben Fasoli

THE UNIVERSITY OF UTAH

1. Abstract

Flask data collected over 16 years in the Salt Lake Valley offers observations of atmospheric CO_2 and its isotopic components, δ13C and O18. Utilizing the isotopic signatures of these flasks, we examine changes in gasoline combustion, natural gas combustion, and plant respiration of CO_2 over time. Prior to 2008, gasoline combustion and plant respiration were the dominant source of atmospheric CO_2 while after 2008, the data shows an increase in CO_2 resulting from Natural gas combustion. Meteorological factors including temperature, wind speed, and precipitation are identified as covariates with CO_2 originating from fossil fuel combustion.

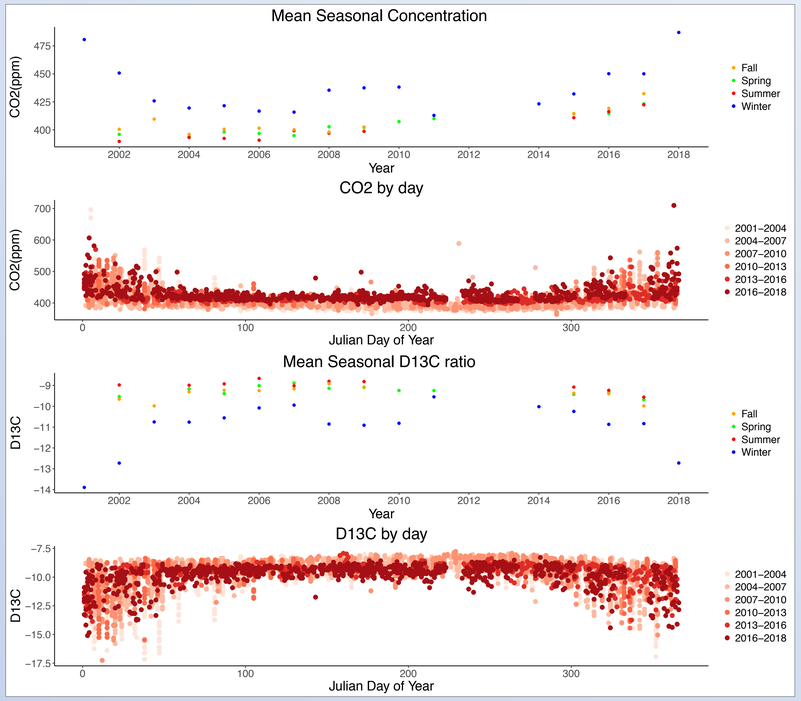
2. Method

- Source pollutants of CO_2 can be identified through Miller-Tans method. The Process involves finding slope for the equation:

$$\delta_{obs}C_{obs} - \delta_{bg}C_{bg} = \delta_s(C_{obs} - C_{bg})$$

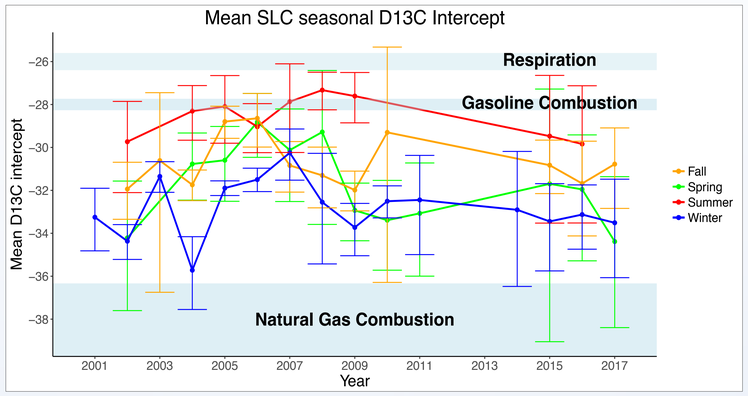
- The value of δ_s than can be compared to the slope of known signatures for Natural Gas Combustion, Respiration, and Gasoline combustion environments.

3. Results

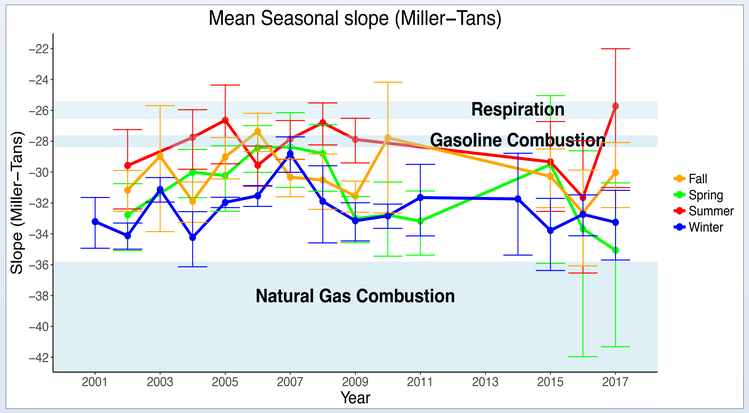


- Changes in CO_2 over time are larger in Spring, Summer, and Fall. Meteorological conditions are the biggest influence of CO_2 during the winter.
- More negative D13C values suggest an increase in CO_2 from anthropogenic fossil fuel combustion.

3. Results

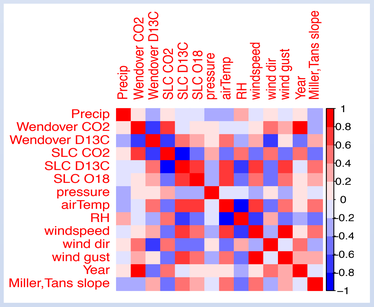


- Post- 2008 decrease suggests increase of CO_2 from natural gas combustion especially during the Spring from traditional Keeling Analysis.



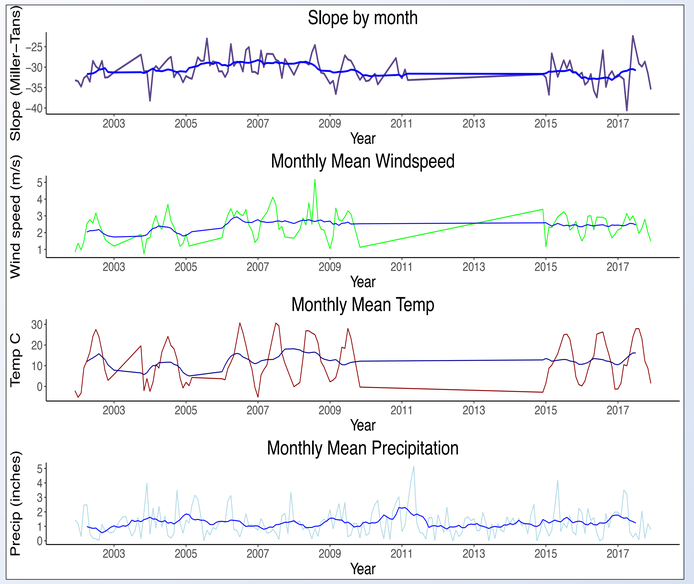
- Miller-Tans Method yields similar results.
- Stronger impact of plant respiration on CO_2 is observed.
- More prone to uncertainty then traditional Keeling analysis.

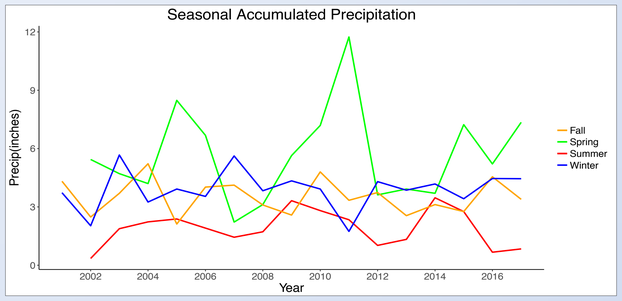
3.1 Meteorological Comparison



- Strong relations with wind speed, temperature, and precipitation for Miller-Tans slope values.

3.1 Meteorological Comparison





4. Conclusions

- Prior to 2008 an increase in plant respiration and/ or decrease in natural gas combustion was a significant source of CO_2 in Salt Lake City.
- Strong relations observed from increased wind speeds and lower CO_2, and less negative Miller-Tans slope values as background concentrations mixes with valley air.
- Lower temperatures are associated with increased natural gas combustion.
- Increased precipitation during the spring is associated with increased natural gas combustion in Spring and increased CO_2 respiration from plants during the Summer.

References

Miller, J., and P. Tans, 2003: Calculating isotopic fractionation from atmospheric measurements at various scales. *Tellus B: Chemical and Physical Meteorology*, 55, 207-214, doi:10.3402/tellusb.v55i2.16697.

Pataki, D., D. Bowling, J. Ehleringer, and J. Zobitz, 2006: High resolution atmospheric monitoring of urban carbon dioxide sources. *Geophysical Research Letters*, 33, doi:10.1029/2005gl024822.

Pataki, D., 2003: Seasonal cycle of carbon dioxide and its isotopic composition in an urban atmosphere: Anthropogenic and biogenic effects. *Journal of Geophysical Research*, 108, doi:10.1029/2003jd003865.