Using a High Altitude Balloon Platform to Measure Seasonal Ozone Flux over Agricultural Landscapes

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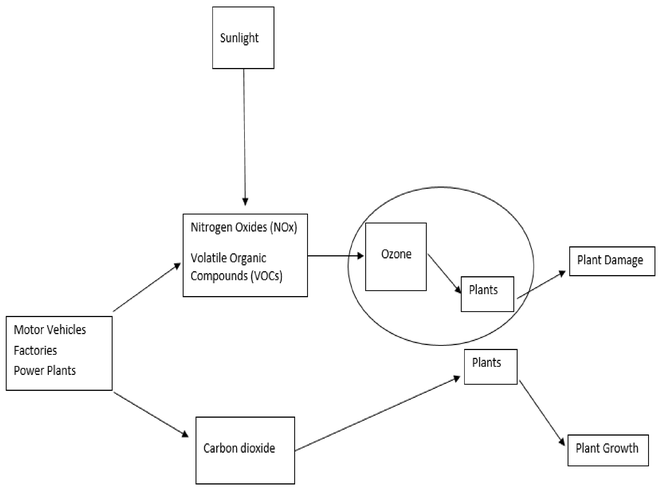
Project Summary

The concentration of greenhouse gasses (GHGs) in the atmosphere has continued to rise since the industrial era. This issue has had a multitude of negative impacts on all living things. Among the major GHGs are carbon dioxide, methane, nitrous oxide, and ozone. Ozone is of particular importance because it not only has the ability to trap heat in the atmosphere, but it also directly impacts organisms by causing harm to both plants and humans. The damage that ozone causes to plants is most closely linked to ozone uptake rather than ozone concentration. So, measuring ozone uptake is becoming critical for agronomists. Two common methods that are currently used for testing ozone uptake are using satellites and flux chambers. However, these methods each have various flaws. Testing ozone uptake with satellites is extremely expensive and difficult to maintain. Using flux chambers will only work on a very small scale and the results are actually an estimation based on stomatal conductance. The aim of this study is to use a high altitude balloon platform to directly measure ozone uptake. Recent studies by DePaul University students have shown that high-altitude balloons are an adequate method for documenting carbon dioxide flux in southern Illinois (Pocs 2014). The high altitude balloon is cheap, quick, and can document carbon dioxide concentration over large spatial areas. While these studies have shown how the balloon could work to document carbon dioxide flux, no such high altitude balloon studies have been performed to record ozone flux. My study will bridge this gap in knowledge. I hypothesize that the balloon platform will be successful in measuring ozone uptake. I also hypothesize that ozone uptake will vary directly with ozone concentration.

Conceptual Diagram

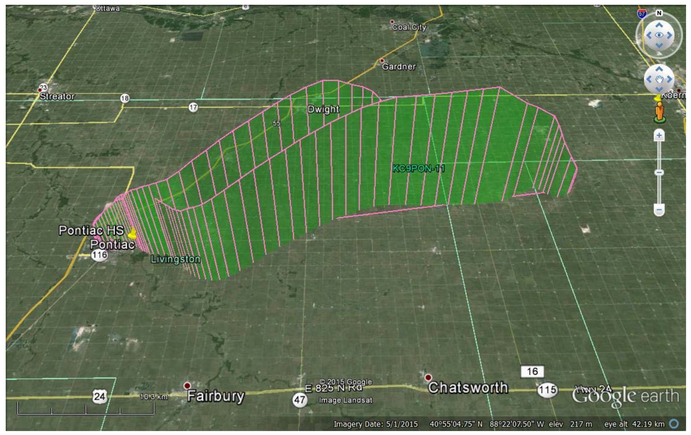


Hypotheses and Objectives

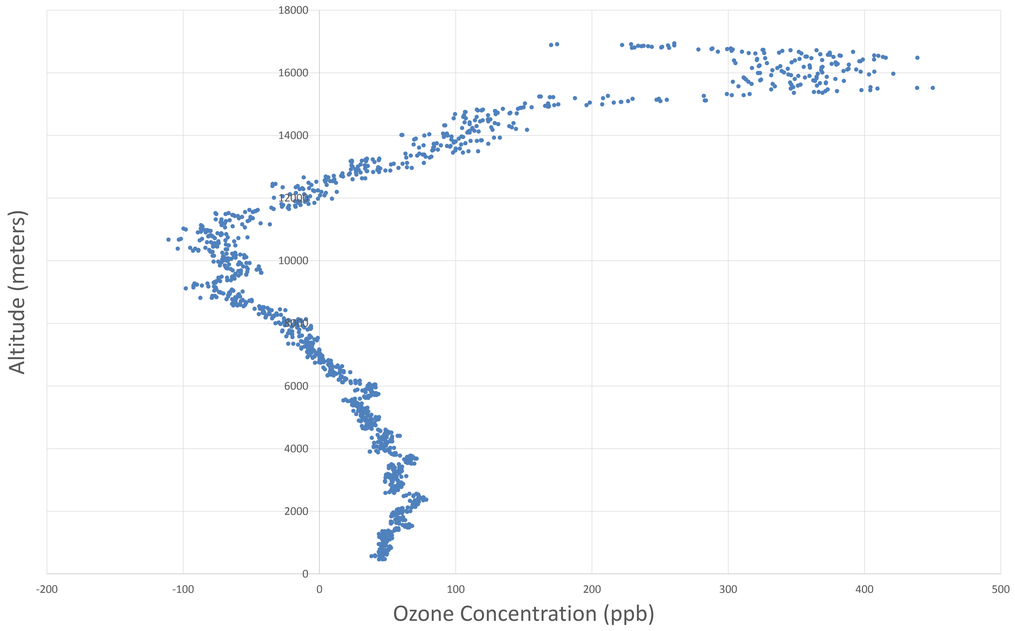
- **Objective 1:** The main objective of this study is to determine whether or not a balloon platform is suitable for determining surface ozone flux.
  - **Hypothesis 1a:** It is hypothesized that the high altitude balloon will be able to measure surface ozone flux because one has already successfully calculated carbon dioxide flux (Pocs 2014)
  - **Hypothesis 1b:** There will be a relatively high ozone uptake during the plant growing season and little to no ozone uptake during the winter.
- **Objective 2:** The second objective of this study is to determine how ozone concentration affects ozone uptake.
  - **Hypothesis 2:** We hypothesize that there will be a direct relationship between ozone concentration and ozone flux.
- **Objective 3:** To develop a more efficient balloon platform for documenting gas flux

Materials and Methods

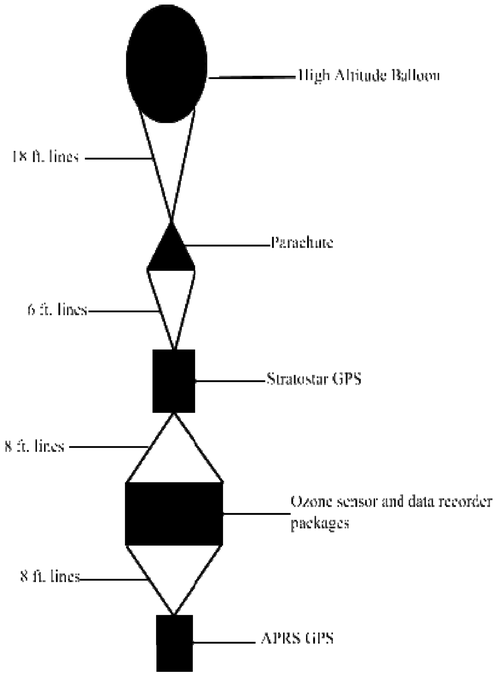
- Balloon platform shown to the right will be launched in central Illinois throughout the Summer
- The platform will be tracked by GPS and retrieved when it returns to the Earth's surface
- The ozone data obtained by the ozone sensor will be analyzed back in the lab to determine the ozone flux



Tracks from dual launch on Jun 19, 2015 launch



Ozone profile from Jun 1, 2015 single launch



Discussion

Although, three launches have been made so far this Summer, much more data and data analysis is necessary before any official conclusions can be made. This poster represents the preliminary plans for the project. Data will continue to be obtained throughout the Summer so that an official report can be assembled before the end of the next academic year (May 2016).

Source: Mike Davis, City Colleges, May 8, 2015 launch

Reference

Pocs, Monica (2014) "A High-altitude Balloon Platform for Exploring the Terrestrial Carbon Cycle," DePaul Discoveries: Vol. 3: Iss. 1, Article 2. Available at: http://via.library.depaul.edu/depaul-disc/vol3/iss1/2