Oxygen and Carbon Dioxide Measurements in Harvard Forest
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My work this summer was a continuation of years of work to determine the ratio of oxygen consumed to carbon dioxide produced in the local biosphere at Harvard Forest, a 4000 acre research forest in Petersham, Massachusetts. This work began in 2004, where Bowdoin students assisted Professor Mark Battle in designing and constructing a system that collects and analyzes air. The air is taken in from an intake either above or below the forest canopy, purged of water vapor and metered to a constant flow before arriving at analyzers measuring Oxygen and Carbon Dioxide content. Data was collected from 2006-2013. Data collection halted when the system began breaking down. My task was to get the system functioning and able to collect more data. With new data, we will be able to see how climate change and warming in the forest has affected the O_2:CO_2 ratio five years later.

My primary task was to rehabilitate the ARMADILLO measurement system (Figure 1) to a usable state. This equipment takes in atmospheric air through a pump and passes the air through both a -90°C and a 5°C chiller traps to freeze or condense any water vapor in the air. The air then passes through mass flow controllers, a pressure/flow controller, and metering values in order to get air flows at a constant 50 cc/min. The air then arrives at a the LICOR Li-7000, an NDIR CO_2 analyzer, and a Oxzilla II from Sable Systems, a fuel cell based O_2 analyzer. Atmospheric air is ran against air of known concentrations, and differential measurements are made to determine O_2 and CO_2 content in the atmosphere. Throughout the summer, I tested, troubleshooted, and repaired each component of the system. The system was reinstalled at Harvard Forest on July 17th, and will begin taking data again in the near future.

In addition to hardware, I worked on code that will improve the quality of the existing and future oxygen data. As air passes through the fuel cells of the Oxzilla, a greater O_2 content will result in a greater readout value. In accordance with the ideal gas law, if the air pressure increases in the fuel cell, there will be more air passing through the cell, and thus more O_2 will be present. The Oxzilla can correct output O_2 values due to pressure increase, but only receives pressure information from one fuel cell at a time, leading to overcorrection of output in one cell. My code finds the pressure that opposite would most likely be, and uses this value to correct oxygen readings.

This work has accelerated progress on the project significantly, as new data will be able to be collected soon. Being able to compare the O_2:CO_2 ratio at Harvard Forest from 2006-2013 to what it is now will give great insight to the consequences and realities of climate change.

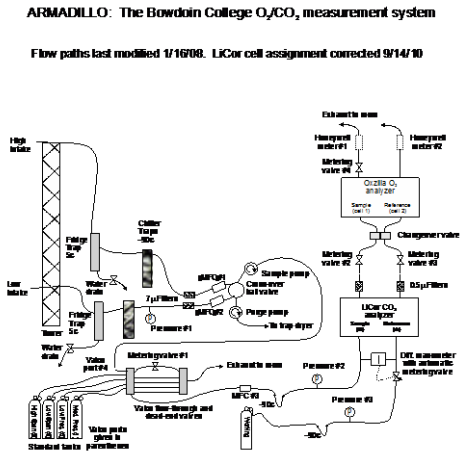

Figure 1 (Credit: Mark Battle)

Faculty Mentor: Mark Battle
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