1. Introduction
Little research has been done to determine vertical ozone profiles, especially in environments such as the northern mixed forest where this field campaign is being run. What past research that has been done has shown that ozone levels generally decrease with decreasing height in the forest. Some propose a power series relationship where others have seen a more complex relationship with the highest levels being found in the mid canopy.

Knowing the ozone distribution in the forest will help us to understand the complex chemistry found within the forest, including that related to volatile organic compounds (VOCs) and changing forest conditions as part of a changing climate. This experiment was run as part of the CABINEX campaign, Community Atmosphere-Biosphere Interaction Experiments, at the PROPHET site. PROPHET 2009 is described as “Atmospheric Chemistry Impacts of Coupled Forest Succession and Climate Change.”

2. Objective
To determine a vertical profile of ozone in a mixed forest

3. The Site
On-Site measurements are being taken at the PROPHET site located at UMBS (University of Michigan Biological Station) near Pellston, Michigan as part of the multi-university CABINEX campaign. At the site the PROPHET tower stands 33 m tall. Also at the site is the WSU Mobile Lab where the ozone analyzers and many other instruments are housed. Sample line inlets are located at 34 m (flux line), 24 m (mid line), and 5 m (low line). The flux line is positioned well above the forest canopy; the mid line is positioned at the top of the canopy, and the low level line is located below the forest canopy.

4. Ozone Measuring Methods
The Dasibi and TECO ozone monitors used in this campaign use the fact that under known conditions, ozone will absorb a predictable amount of 253.7 nm UV radiation. Beer’s Law can be used to determine the mixing ratio of ozone in the sample. In this instrument a Hg lamp is used as the UV source. The amount of UV radiation absorbed by ozone can be related to an ozone mixing ratio in the sample air.

Beer’s Law solved for ozone mixing ratio in ppm states:

\[ C = \frac{10 P T}{L T} \ln \frac{I_0}{I} \]

By using Beer’s Law which calculates the mixing ratio based on a ratio of sample air to zero ozone air, the instruments are self-referencing. One of the two absorption cells in the instrument is always measuring sample air while the other measures zero ozone air. Every ten seconds the cells switch so that the one that was measuring sample air is now measuring zero ozone air and so forth. This guarantees that the cells receive the same amount of wear and that the zero is still accurate.

The instrument’s calculated mixing ratio is output in two ways, a digital display on the instrument and an analog output. Only analog output can be automatically put into a computer for analysis. The analog output is in the form of a voltage that is measured by a LabJack data acquisition device. The voltages correspond linearly to the displayed output.

Table 1. Measurement Range and Out Scale of Ozone Instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Range</th>
<th>Analog Output Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dasibi #471</td>
<td>0-1000 ppbv</td>
<td>0-1 Volts</td>
</tr>
<tr>
<td>Dasibi #472</td>
<td>0-1000 ppbv</td>
<td>0-2 Volts</td>
</tr>
<tr>
<td>Dasibi #473</td>
<td>0-1000 ppbv</td>
<td>0-1 Volts</td>
</tr>
<tr>
<td>TECO</td>
<td>0-500 ppbv</td>
<td>0-10 Volts</td>
</tr>
</tbody>
</table>

5. Calibration
While the instruments use Beer’s Law and are supposed to have already determined the mixing ratio, the instruments still need to be calibrated by introducing samples of known ozone concentration. After a sufficient number of points are taken, a correction equation can be found and applied to the data. This was done using a certified calibrator, which in turn has its own correction equation.

On each monitor there is a temperature/pressure correction switch. When turned on the ozone mixing ratio is determined at the measured temperature and pressure, when turned off the ratio is determined as if STP condition existed. To correct for the switch being turned off, Beer’s Law tells us that we need to multiply by standard pressure multiplied by measured temperature over measured pressure multiplied by standard temperature.

6. Results
The preliminary results show a distinct nighttime ozone profile. When the sun rises and convective mixing is stronger, the gradient seems to disappear. The mid and flux lines remain close at all times since both inlets are above the majority of the foliage where ozone deposition takes place.

7. Future Research
The CABINEX campaign will continue through August 8, 2009. The results as laid out in this poster are still in the beginning stages of analysis. When the campaign has come to a close it will be possible to relate these results to those taken by other instruments to determine complex forest atmosphere relationships, notably with BVOCs, aerosols, and HOx.

8. Acknowledgments
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