12.335 / 12.835 Experimental Atmospheric Chemistry

Lab Report #1 –Fast Photochemistry

Due October 16, 2014 by 1:30 PM

Lab Report Format:

This lab report should be typewritten and submitted in an electronic format.
It is expected that the report will be written in paragraph form and have proper grammar, spelling, and punctuation. This lab report should contain the following sections:

Title

- Provide a title for the lab. It should reflect what the experiment was or what the results were. Avoid a title like "Lab1: Fast Photochemistry".

Author

- Your name

Abstract

- Please write an abstract.

Introduction

In the introduction, please address the following questions:

- What is the importance of studying air pollution?
- What are the concerns associated with each of the species we are measuring?
- Describe the sources and losses of the pollutants that we measured. Be sure to consider both primary and secondary sources.
- What are the natural and anthropogenic emissions at our site?

Methods

- Describe the instrumentation we used. Discuss the main measurement principles for each instrument (i.e., describe how the instrument works). Include the name/type of instrument (company name and model number) and the precision and accuracy of the instrument.

- Make sure to specify whether the instrument is factory calibrated or has been calibrated in lab and how.

- Describe the instrument site and instrument settings (e.g., recording 1-minute average, etc.

Results

- Create a time series of the data for all the species. This includes O_3 (calibrated), NO, NO_2, CO, PM1.0, PM2.5, PM10, and UV flux. You can do time-averaged data (e.g., 10-minute averaged data) if that is easier to see, or whatever you think is best for interpreting the data.

- For the ozone data, you will need to correct the data using the calibration that we did in the Lab. Plot the calibration curve (i.e., Measured vs. Actual) and describe how you use it to correct the Ozone data. Make sure you give the values for the offset and the slope.

- Describe the data – are there any correlations between different species? Is there a diurnal cycle? Do you notice anything different or unusual? Remember, in the Results section you want to present your results and basic analysis; the interpretation will come in the Discussion section.

Discussion

In this section you will want to interpret your data. Think about the lecture note as a guide for your interpretations. Here are some guidelines:

- Discuss the relationship between NO, NO_2, and/or NO_x and O_3. Also look at the UV data and describe the relationships. Describe the atmospheric chemistry occurring.

- Discuss the diurnal cycle of the pollutants and explain why you do or don't see a pattern. Think about the chemistry, the emission sources, and the meteorology.

- Discuss the relationship between the particulate matter and CO (and possibly other species?) based on the time series. Explain why you see this.

- Are there any periods where you see very low concentrations? Why do you think the concentrations are so low?

In analyzing the data, it might be helpful to look at the Weather Underground meteorological data. Again, the website is:

http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=KMACAMBR9
(or just search for weather station KMACAMBR9). You can download the data as a comma-delimited file and then analyze it alongside your other data.

In addition to the above discussion, a back-trajectory modeling and wind rose plots should be incorporated in the discussion section to provide additional information.

Lagrangian Modeling – HYSPLIT

To look at the sources of the air masses reaching Cambridge, we will use the HYSPLIT Trajectory Model to calculate back-trajectories for the air masses.

- Use this link to access the model: http://www.arl.noaa.gov/HYSPLIT_info.php
- Choose one trajectory and Normal
- The lat-long of Cambridge is 42°22'25"N and 71°06'38"W
- Use whatever meteorology you like. Note: You need to choose the week of data you want to look at from the drop-down menu.
- Run the trajectory in the backward direction. Choose your start time (this should be 24 hours before the time of interest).
- Total Run Time: 24 hours, start a new trajectory every: 6 hours, Max Number of Trajectories: 4, level 1 height: 500 meters AGL
- Zoom: 70 – 100
- Then "Request trajectory". The page will refresh itself every 10 seconds until the file is finished and then a FIG link will show up.
- Note: Time goes from right to left.

Comment on the air mass origins (and show your figures) and what the concentrations of our species are. Discuss the atmospheric chemistry occurring in the air masses that reach our site.

Wind Rose Plots

You can make wind rose plots using the **wind_rose.m** MATLAB® file.
Simply load your data into Matlab. Then, call the function (make sure it is in the folder you are working in!) using **wind_rose(wind_direction_data, pollutant_data)**. The data you send have to be the same length and they have to have times matching up. Since the meteorological data is 10-minute averaged, you'll need to average your pollutants by 10 minutes. Wind direction data can come from Weather Underground.

The magnitude of the wind bars is the frequency of wind in that direction, so you want to pay attention to the colors, which represent the magnitude of the pollutant. You could even separate out the data into "clean" and "polluted" times and plot the wind roses separately to help identify sources.

Comment on the wind direction for high and low concentrations of the atmospheric gases/particulates measured. Do these coincide with any sources? If not, speculate on why your data suggest it. Do any of the pollutants seem to have coinciding sources?

Conclusions

Write a conclusions section summarizing the lab.

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