Experimental Atmospheric Chemistry

Fall 2014
12.335 (U)
12.835 (G)
Tu/Th 1:30-3:00

Image courtesy of Laura Kelsey Meredith.
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Profs. Ron Prinn & Shuhei Ono and Dr. Karin Ardon-Dryer

TAs: Sarvesh Garimella and Maria Zawadowicz

12.335/12.835
FALL 2014
COURSE
OVERVIEW
9-4-14

Introduction to the atmospheric chemistry involved in **climate change**, **air pollution** and **biogeochemical cycles** using a combination of **hands-on laboratory**, **field studies**, and **simple computer models**. Lectures will be accompanied by field trips to collect air samples for the analysis of **gases, aerosols and clouds** by the students.

FIRST CLASS: THURSDAY SEPTEMBER 4

Prereq.: 5.111 or 5.112, or permission of instructor 2-4-6 Credit (U and G)

This course satisifes the Communication Intensive in the Major (CI-M) requirement for Course 12 majors in Area 2 (Atmospheres, Oceans and Climate)

12.335 /12.835: Experimental Atmospheric Chemistry
Syllabus and Grading: Fall 2014
Tuesday and Thursday, 1:30–3:00 PM

This course is an introduction to the atmospheric chemistry involved in climate change, air pollution and biogeochemical cycles using a combination of hands-on laboratory, field studies and simple computer models. Lectures will be accompanied by field trips to collect samples for the analysis of gases and aerosols by the students.

Lab Reports (70%):
For the first lab report, please answer the questions directly in complete sentences, with attached graphs if necessary. The first lab report will be graded for (1) scientific content and (2) effectiveness of communication and returned approximately one week after it is handed in. You will then revise the lab report and resubmit it for partial additional credit. The following reports will progressively become more like a short research paper.

Presentations (20%):
Each student will present 2 of the 3 labs. ALL students will give a presentation for the first lab section and then decide between either the second or the third. The presentations will be 10-15 minutes and discuss the background, importance, data used, analysis and results.

General Participation (10%):
You will be expected to participate in and ask questions during class. This includes questions during the laboratory presentation. There will be feedback questionnaires based on each set of presentations, which will be handed in at the start of the next class.

CI-M credit:
This course satisfies the Communication Intensive in the Major (CI-M) requirement for Course 12 majors in Area 2 (Atmospheres, Oceans and Climate).

12.335/12.835 Experimental Atmospheric Chemistry: Additional Grading Policies

Laboratory reports

Lab reports are due at the start of the class *after* the presentations are completed. This will allow you to incorporate comments from the presentations into your lab report. We caution that you should *start* the report well before the presentation day, if you wait until afterward as may not have sufficient time to finish. Comments/grades on lab reports are returned approximately one week later. Students will revise the *first* lab report based on the comments to earn back partial credit by the *resubmission due date*, which is 1 week after the lab reports are returned. ***Late lab reports are penalized by making the maximum possible grade be a declining fraction of full credit.*** Lab reports have a maximum of 75% credit if turned in a day late and 50% credit when turned in two days late. Lab reports turned in more than two days late will have a maximum grade of 25%. This policy is also in effect for the resubmitted reports after the *resubmission due date*. *The report **MUST** be resubmitted for CI-M credit.* Furthermore, if the first report is not resubmitted an additional 25% will be subtracted from the original grade (e. g. an original grade of 90% will instead become 65%).

Presentations and Participation

Presentations will be submitted to the TAs via email before the start of the (first) presentation class. This will allow the TAs to have presentation on the course computer for that class. Absence will only be excused with a doctor's note or other similar documentation (see below). In only this case students will be given the opportunity to make up the presentation in a future class. *Presentations represent 20% of the final grade.*

Students will show up for *all* presentations regardless of if they are presenting. During each presentation you will be expected to participate by asking questions of your peers. You will also return a feedback report on the presentations the next day of class. *Participation in class and presentations represents 10% of the final grade.*

Field Trips and Laboratory Work

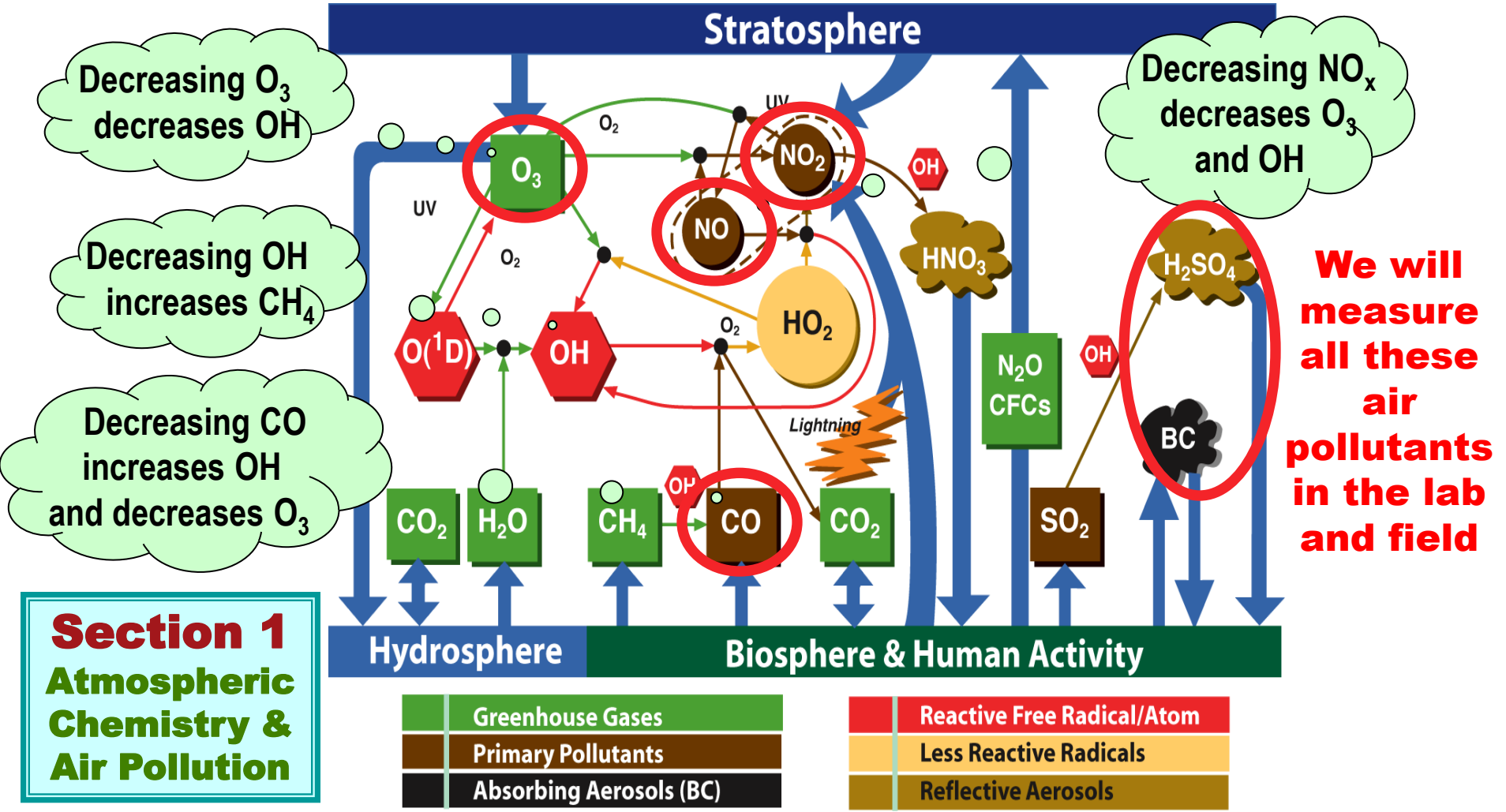
Students must make all field trips and show up for all laboratory experiments. *If* the TA can manage, a make-up field trip or laboratory appointment can be offered *but this should not be expected*.

Statement on Group Work

You will be working in groups during laboratory and field experiments and are free to collaborate on the measurements and other group work that will form the basis of your individual presentations and reports. However, all the slides in your presentations and all the text and graphs in your reports should be your own work. ***Copying another person's assignment text, data or figures will not be tolerated and will result in a lower grade.*** All work should be fully referenced. For a general discussion of academic integrity at MIT, please see http://web.mit.edu/academicintegrity/.

Special Circumstances

The penalties described above can be forgiven under special circumstances (for example, personal reasons, health reasons, etc.) if the student provides documentation from Student Services, a doctor or another reputable source.



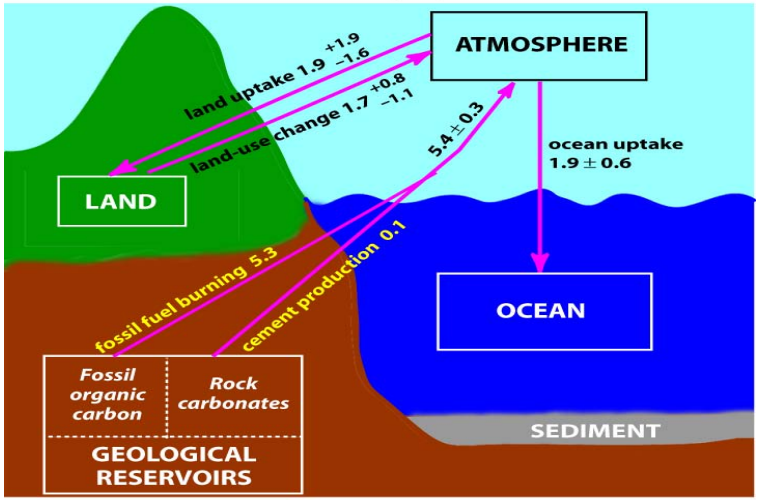
Section 1
Atmospheric Chemistry & Air Pollution

Summary of the chemistry in the troposphere important in air pollution and climate. VOCs (not shown) are similar to CH_4 in their reactions with OH, but they form acids, aldehydes and ketones in addition to CO.

Section 2
CO_2 & CLIMATE

CO_2 & Climate Change Part 1: Flux Chamber and Portable CO_2 Sensor

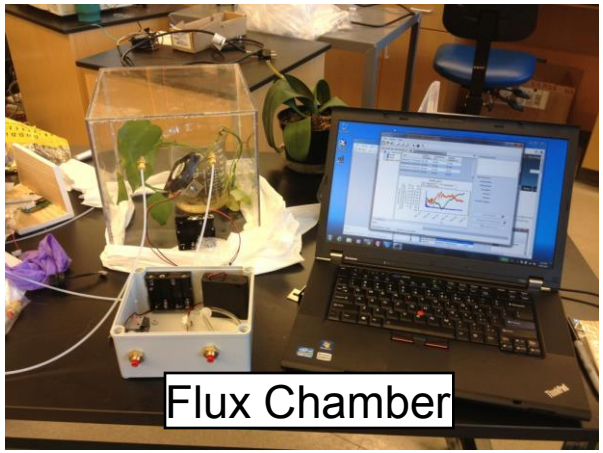
GLOBAL CARBON FLUXES
(1980s, PgC/year)

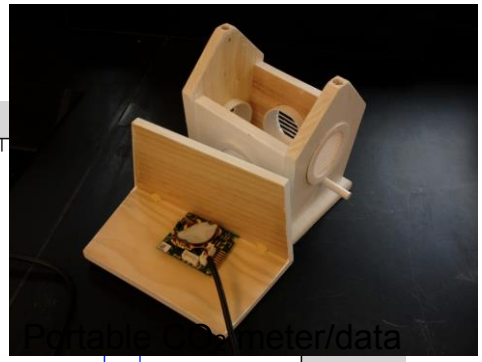


Source: IPCC, WG1, TAR

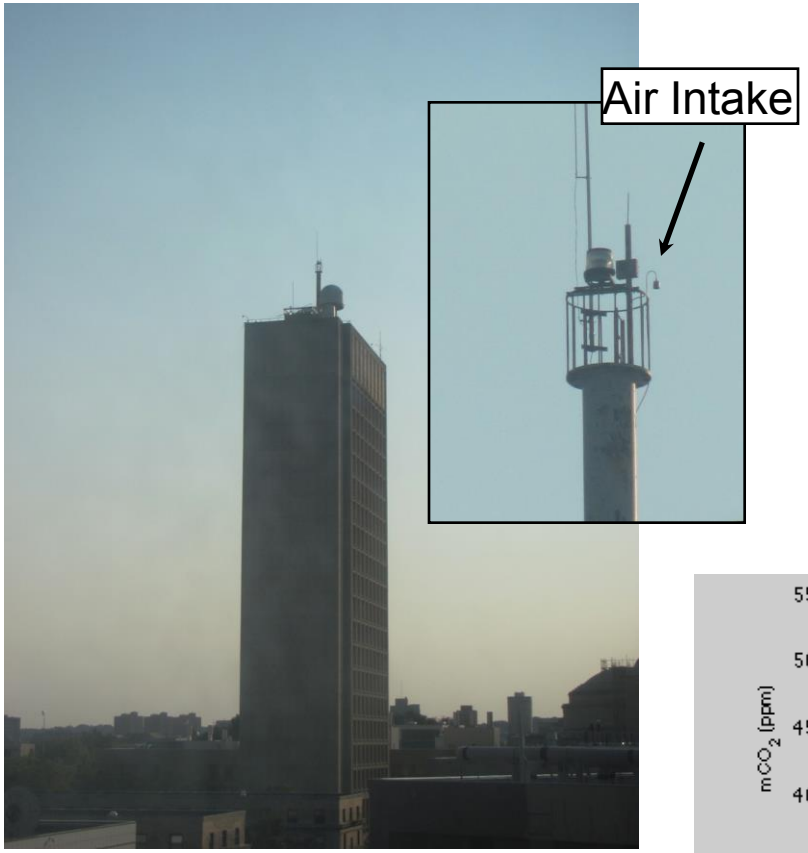
1-1) Flux chamber experiments to quantify CO_2 source/sink flux from soil/grass/tree

1-2) Deploy portable CO_2 sensors to examine local CO_2 hot spots.





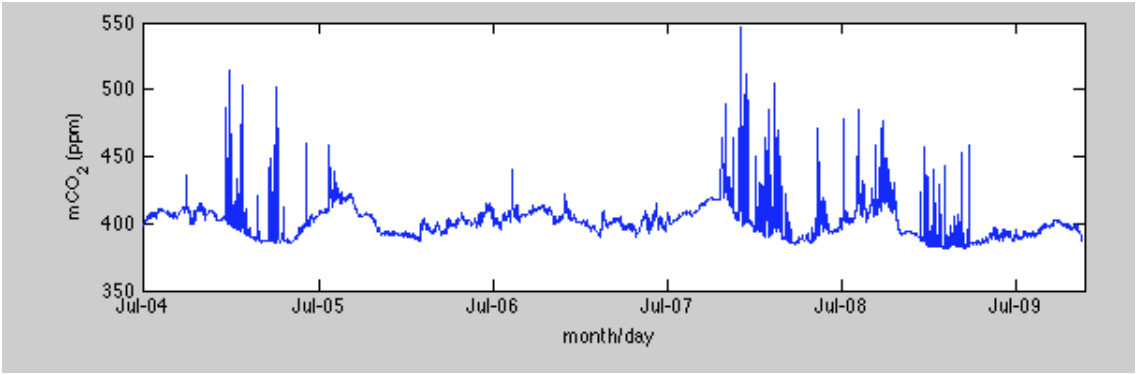
CO_2 & Climate Change
Part 2: CO_2 Cycle in Urban Environments



MIT Green Building (~95 m)

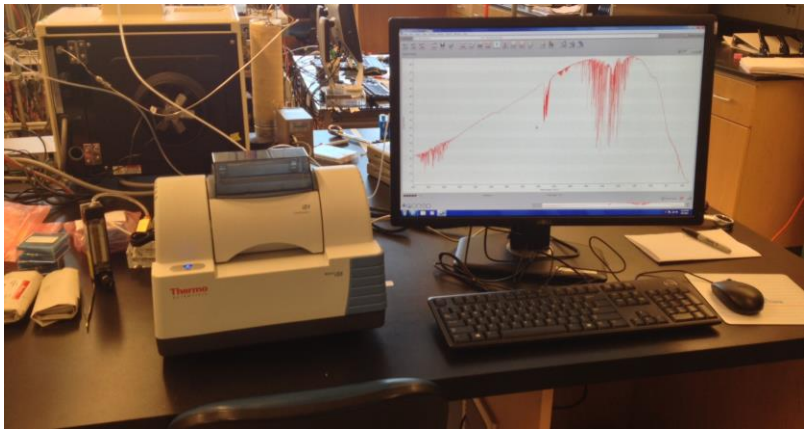
2-1) Examine the main controls of CO_2 in the urban environment from CO_2 measurements from air taken from the roof of the Green Building. e.g., diurnal cycles (amplitude, phase), pollution plume events.

2-2) Learn how to construct a simple box model

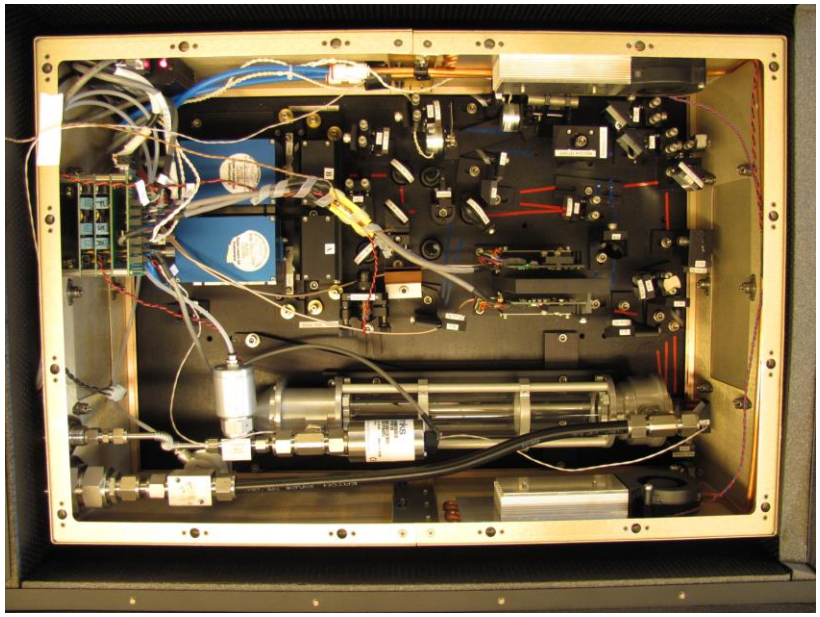


CO_2 mixing ratio data for July 4-9th

Explore different ways to measure CO_2



FTIR (Thermo is5)



Aerodyne Research
Tunable Infrared Laser Direct Absorption Spectroscopy

Gas Chromatography
Shimadzu GC-2014

Teledyne 360E

K033 from CO2meter.com

Section 3
Aerosols & Clouds

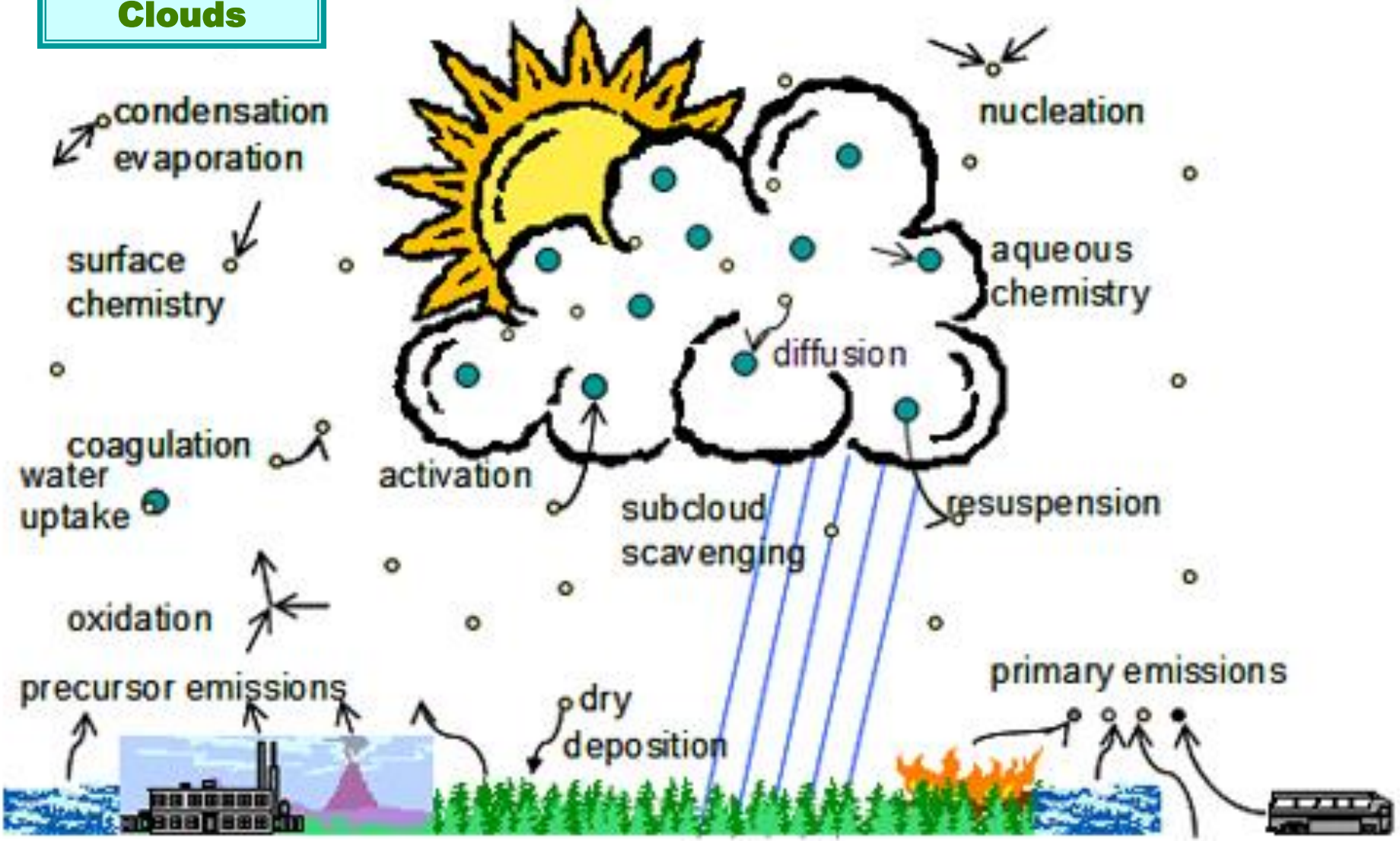


Image courtesy of Pacific Northwest National Laboratory.

Average Rain Drop
Size: 2 mm

Average Cloud Droplet
Size: .02 mm

Average Condensation
Nucleus
Size: .0002 mm

Figure by MIT OpenCourseWare.

THIS IS A HANDS-ON COURSE

NOW LET'S GO SEE THE LABS!

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