Reminders:

- Reading Chapter 10
- Homework #10 due today at 5 pm
- Inquire/Inform #2 due today in class
- Extra Credit #6 due Friday (in class)
- Exam #3 details will be given on Wednesday.
  → The exam is in class the Wednesday after break (Dec. 3)
- Deadline for changing research topics is this Friday.

Exam #3 Details…

The exam is in class on Wednesday, December 03, 2008.

The exam will be open textbook (R&K) and calculators are allowed. You will not be allowed to use other outside notes. Thus, make sure to bring the book and a calculator to the exam!

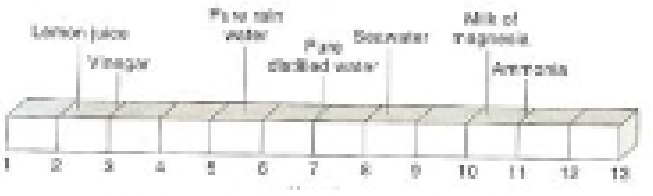
The exam will cover all of the material in Chapters 5, 6, 9, and 10 of the R&K text, homework assignments #8-10, and lecture material through and including Monday, December 1, 2008.

The exam problems will be similar to homework assignments, in class worked out problems, and issues discussed in the text or in lecture.

A practice exam (and solutions) are available on the web page.

Measure of Acidity

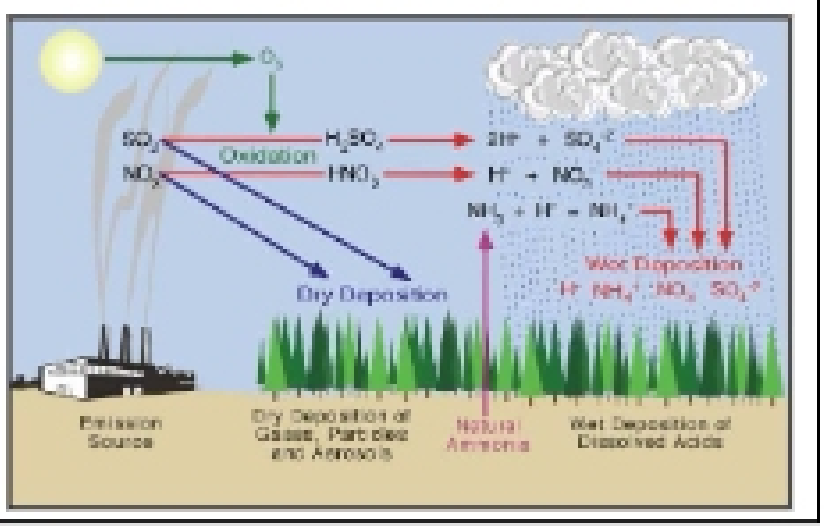
H_2O+CO_2

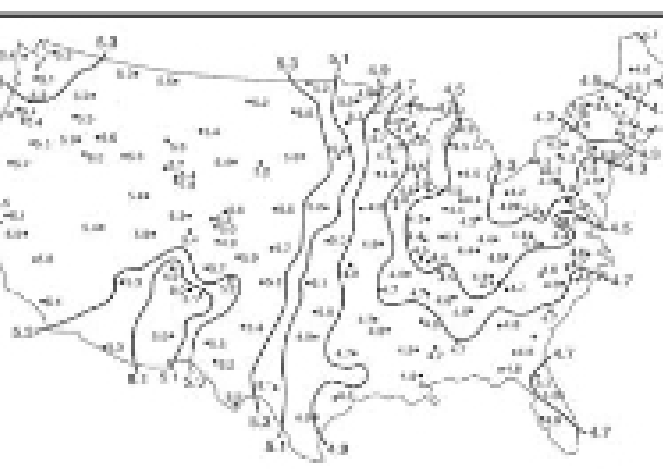


pH value

Each unit is factor of 10 in concentration

Acid Rain (Wet and Dry Deposition)





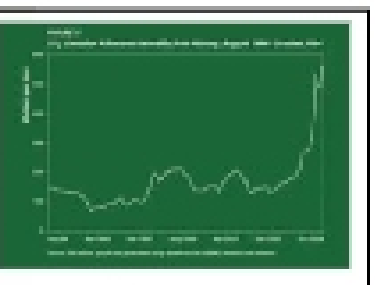
EPA's SO2 auction results

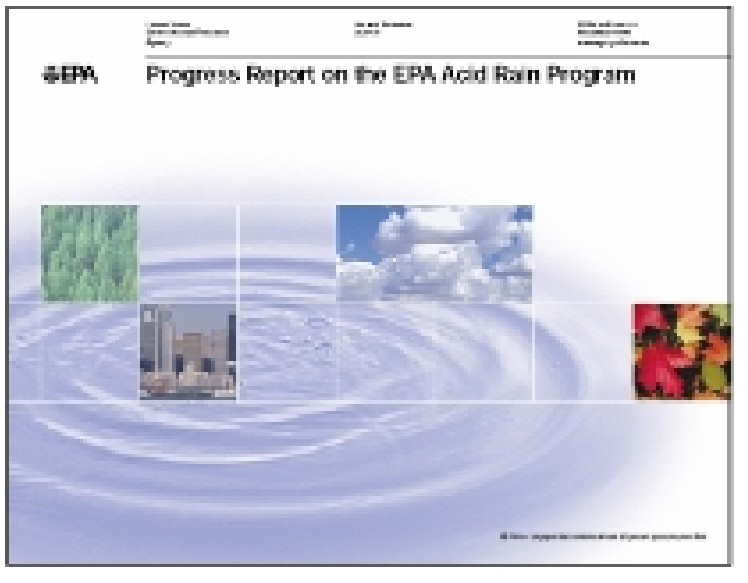
EPA Announces Results of the Nation's Annual Sulfur Dioxide Auctions

(3/27/08) On March 25, 2008, EPA held the acid rain auction giving private citizens, brokers and power plants the opportunity to buy and sell sulfur dioxide (SO2) allowances, as part of the cap and trade program to reduce acid rain. When fully implemented in 2010, the Acid Rain Program will have cut SO2 emissions by 50 percent from 1990 levels. …

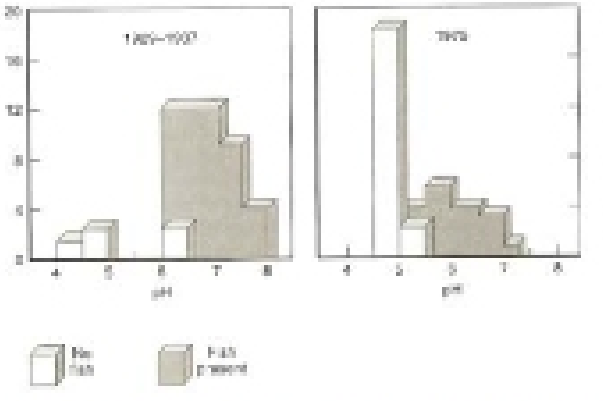
The auction includes two types of allowances: 125,658 offered for use in 2008 and 125,000 additional allowances offered seven years in advance to help provide stability in planning for capital investments. These advance allowances will be available for use in 2015. The number of allowances a source purchases will not permit them to emit SO2 at a level that would violate the health-based national ambient air quality standard. The weighted average of winning bids for 2008 is $359.91.

31 of the 125,000 bids in the spot market were purchased by various groups (e.g., Acid Rain Retirement Fund, Baton College Environmental Economics) for the purposes of taking a ton of SO2 off the market.





Adirondack Lakes



Very poor conditions in the mid-1970's due to acid rain.

1990 Acid Rain Program established under the Clean Air Act

Note that some measures are staged and thus only took effect later.

For SO2, the program has a mandatory cap on emissions nationwide from electric utilities.

These are allocated in terms of allowances which can then be "banked for future use" or sold.

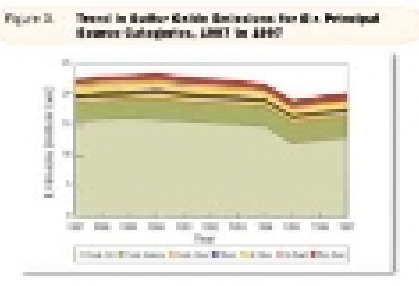
For NOx, emission limits are placed for each source type.

Read the report carefully and let me know what you find "strange" or "inconsistent" in the scientific presentation....

Clicker Question

Report highlights some real success in reducing SO2.

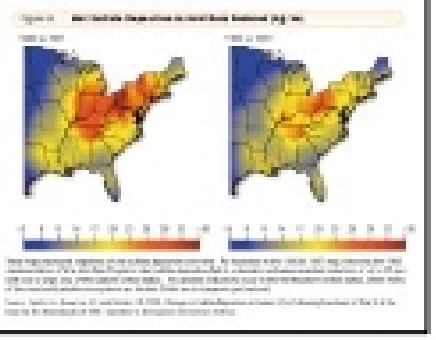
How would you categorize this graph over the 10 year period?



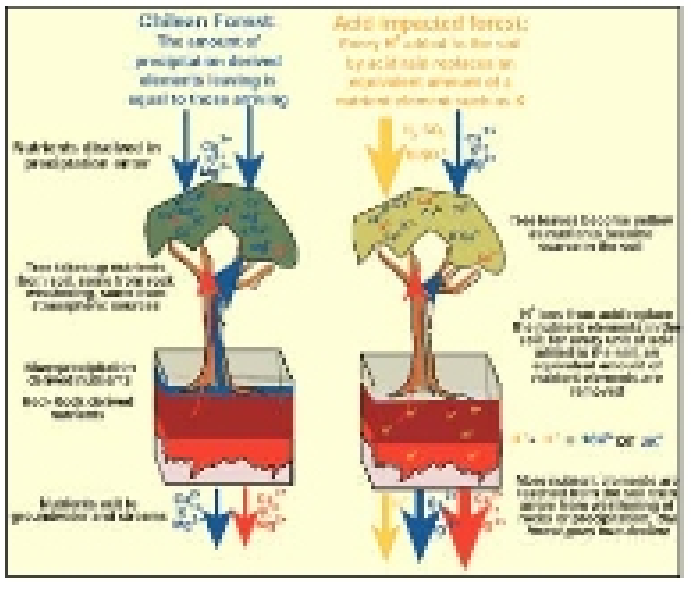
A) Not much change in SO2 emission
B) An increase in SO2 emission
C) A small decrease is SO2 emissions
D) A decrease, punctuated by a significant decease in 1995
E) None of the above

Different species affected differently by acidity of the water.

There have been substantial reductions in wet sulfate depositions.



"In spite of declining emissions and even declining surface water sulfate concentrations in the Adirondacks, lakes in this region are not showing any measurable increase in acid neutralizing capacity."



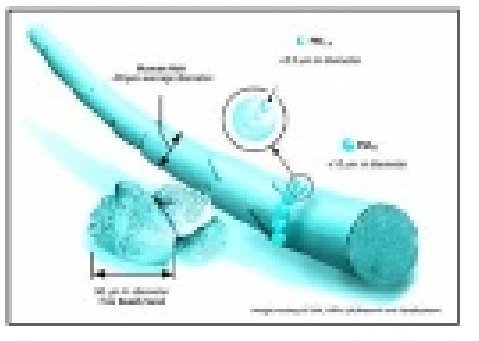
Particulates (Aerosols)

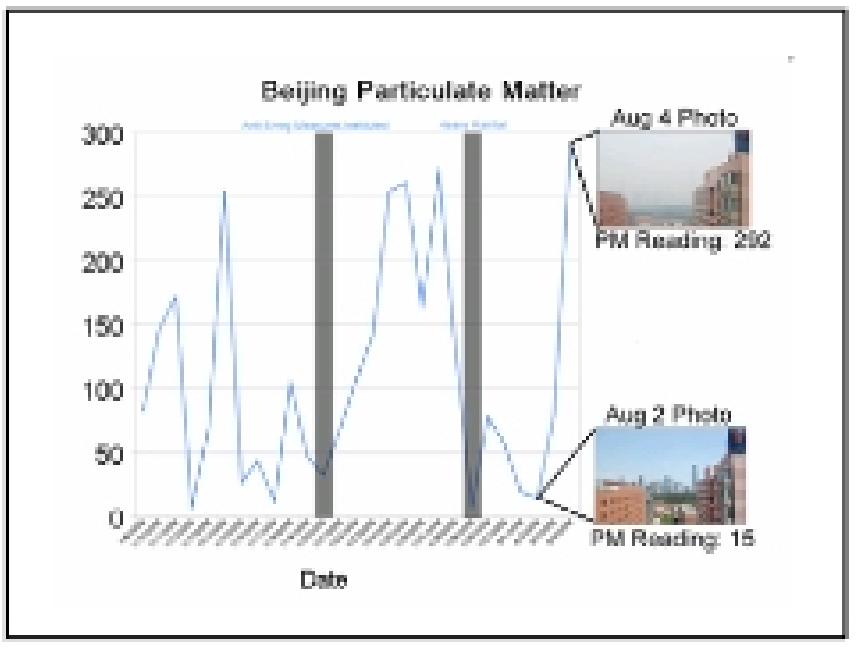
Particles smaller than about 100 μm (10^{-4} m)

Natural sources: wind-blown dust, fog, …

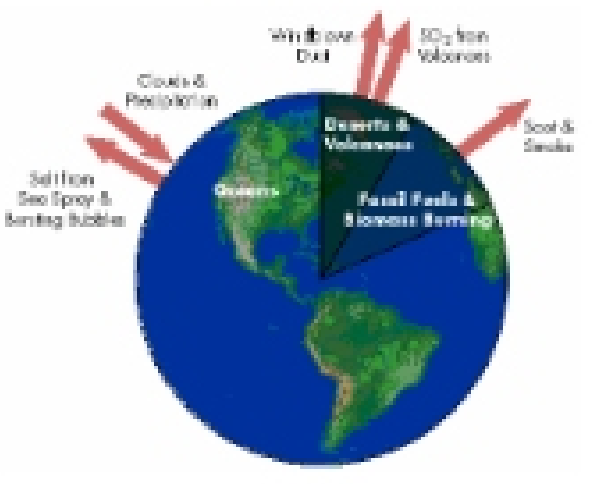
Produced during combustion of coal

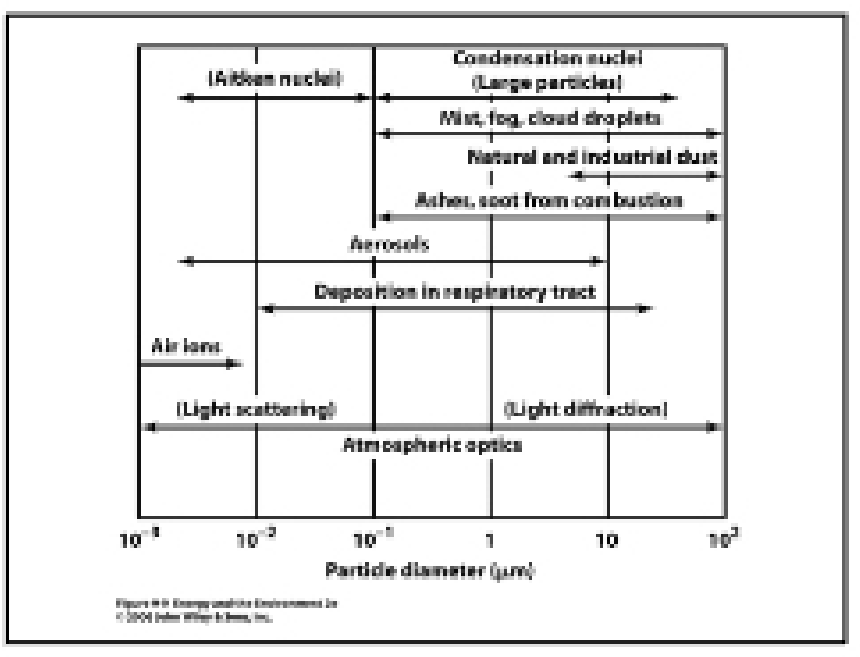
Particles scatter light, but too small to see individually





Aerosols





EPA Study