Graphical Modeling of Atmospheric Change

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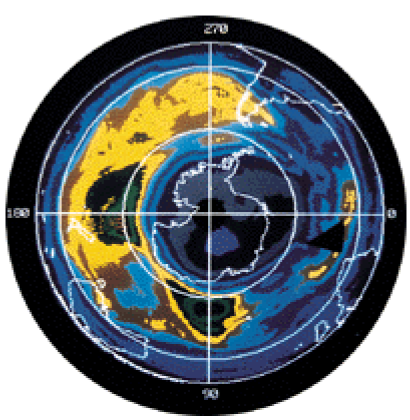
Abstract:

The goal is to create a model of the atmosphere over time, predicting it's strength given the increasing (and in this case, user controlled) amount of pollutants like greenhouse gases. Many projects are in place to save the ozone, and this model will assist in assessing the impact of anti-pollution movements and determine the long-term possible outcome giving the many and flexing parameters.

Background:

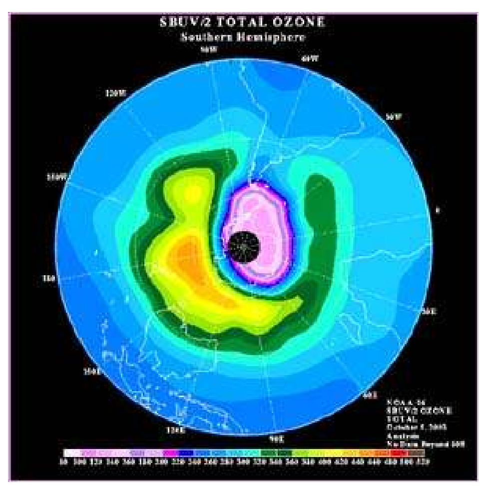
Ozone, a feared word in the media, is essential to life on Earth. Averaging about three molecules per ten million, O_3 is very rare, representing a minute fraction of atmospheric composition. Nearly 90% of all ozone is found in the stratosphere, the atmospheric layer between 10 and 40 km above the Earth's surface, where it shields the surface from ultra-violet radiation (UV-B). Ozone filters out the high energy radiation below 0.29 mircrometers, allowing only a small amount to reach the Earth's surface. Strongest at about 25 km altitude, this layer is known as the ozone layer; damages to this layer result in subsequent increases in UV-B radiation and risks of eye damage, skin cancer, and adverse effects on marine and plant life.

In the 1980's, scientists noticed a noticeable and dramatic increase in the amount of UV-B reaching the surface. At first, they began to suspect and then detect a steady thinning of the ozone layer. Scientific concern morphed into public alarm when the British Antarctic Survey announced the detection of the first Antarctic 'hole' in 1985. In truth, this ozone 'hole' is not a gap in the ozone layer at all; merely, it is a sharp decline in the stratospheric ozone concentrations over most of Antarctica for several months during the southern hemisphere spring. Continued research revealed and satellite data recorded depleting ozone levels over Antarctica growing worse with each passing year.



1985 Antarctic Hole

http://www.ucar.edu/communications/atmosphere-timeline.html



2003 Antarctic Hole

http://www.noaanews.noaa.gov/stories/s2099.htm

Research now shows that the ozone layer over Antarctica thins to 55-44% of its pre-1980s level. The result is up to a 70% deficiency for short time periods, and at some altitudes, ozone destruction is practically total. The picture above to the right shows the current satellite images of the ozone hole, now more than two and a half times the size of Europe.

Additionally, there is a potential ozone loss in the Arctic, reaching in 1998 levels comparable to Antarctic losses. These large losses in the Arctic over the last decade cannot be adequately explained by the current atmospheric models. In fact, recent models have failed to quantitatively explain present day ozone losses. This inhibits the ability to predict such deterioration and, ultimately, ozone recovery.

Introduction:

Once this problem was isolated, the international research community swarmed to define the cause. The scientific evidence showed that man-made chemicals such halocarbons and chlorocarbons were responsible for the observed depletions. These substances (also called CFCs) contain combinations of chlorine, fluoride, bromine, carbon, and hydrogen. CFCs have grown quite common through use in coolants, solvents, sterilants, and aerosol cans. When released in the lower atmosphere, such as through the use of an aerosol spray, they diffuse up into the stratosphere. They begin to react in a process resulting the the afore mentioned ozone molecule destruction.

Materials and Apparatus:

Results/Discussion:

So far, the program has modeled successfully the modern day deterioration of the atmosphere. The user is able to “switch” on or off the Montreal Protocol and see the difference the mere existance of the program.

Additionally, the user can watch the absorption rate and watch as the radiation reaches earth. The user is alerted when (or if) the radiation reaches dangerous levels. The solar flux is considered a constant, especially because on such a short time scale (through 3500) and the small fluctuations make a mediocre difference in the overall radiation to earth.

Next on the to-do list is continued research into the inter-workings of the atmosphere. I plan to expand on the time scale, and allow for atmospheric regeneration, which is expected (although not currently observable). Also, so far the user cannot change the amount of incoming radiation because (as stated above) the solar flux has been defined as constant. However, soon the ability to manipulate the IR flux will be added. A necessary complexity in the coding is allowing for the release of radiation emitted back from earth, which as of current is left unattended.

References/Appendixes:

Much credit goes to Netlogo, and the National Wildlife Association for posting so many articles concerning the future of the ozone.

The Montreal Protocol is my guide for regeneration programs.