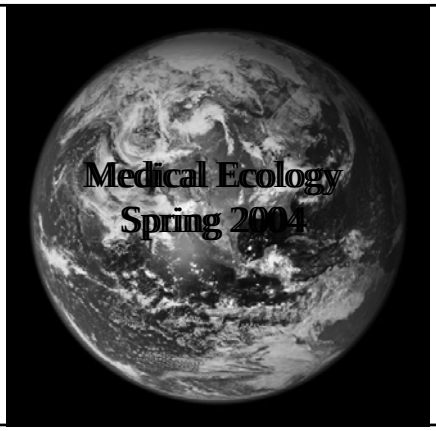
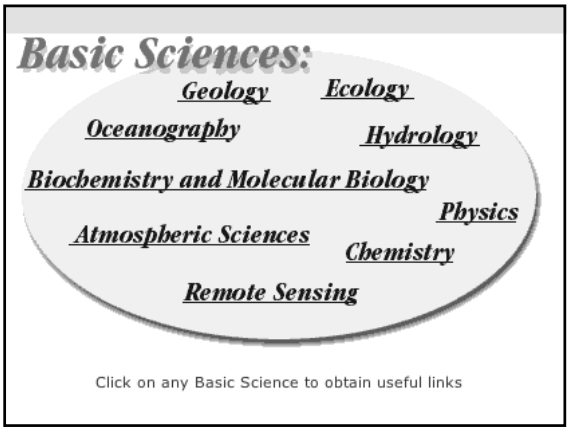
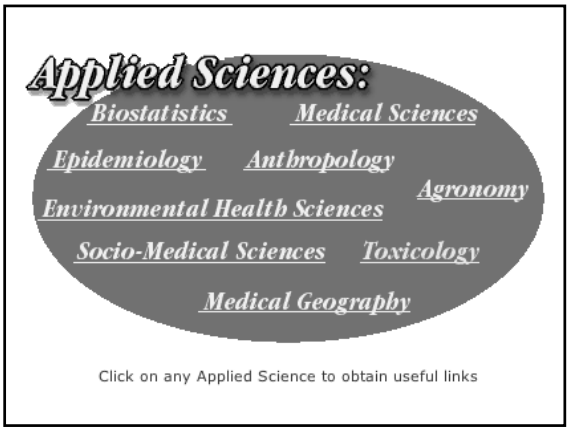
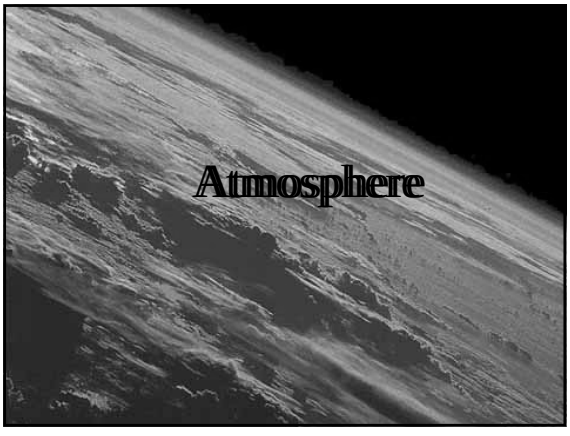




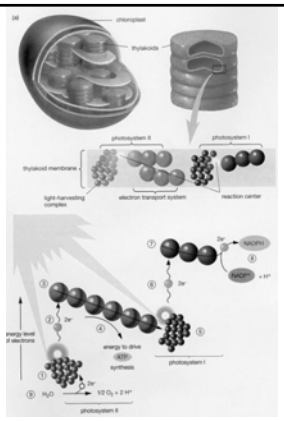


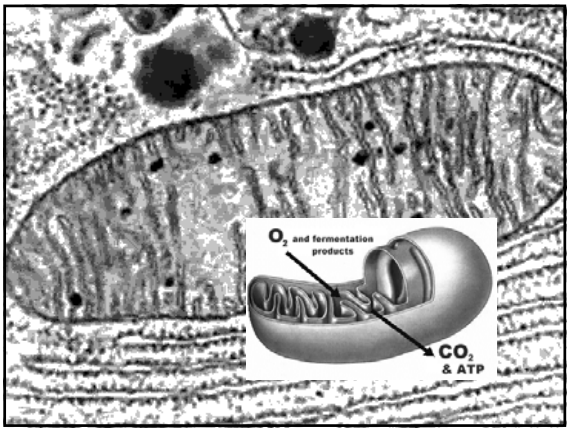
The Atmosphere
Water
Food
Infectious Diseases



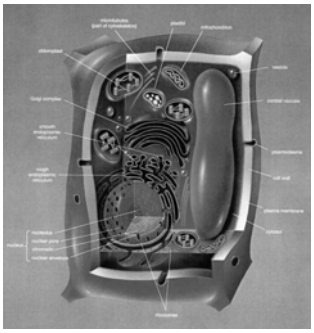
THE GEOLOGIC TIME SCALE

Eon	Era	Period		Epoch	M. Years	Major Event
PHANEROZOIC	CENOZOIC	Quaternary		Holocene	0.01	
				Pleistocene	1.6	1st Hominids
		TERTIARY	Neogene	Pliocene	5.3	
				Miocene	23.7	
			Paleogene	Oligocene	36.6	
				Eocene	57.9	
				Paleocene	66	
	MESOZOIC	Cretaceous			144	Dinosaurs
		Jurassic			208	
		Triassic			245	
	PALEOZOIC	Permian			286	
		Carboniferous	Pennsylvanian		320	
			Mississippian		360	
		Devonian			408	
		Silurian			428	1st Land Plants
		Ordovician			505	
		Cambrian			540	
PRECAMBRIAN	Proterozoic Eon				2500	1st Eukaryotes
	Archean Eon				3800	1st Prokaryotes
					4600	





Typical Plant Cell



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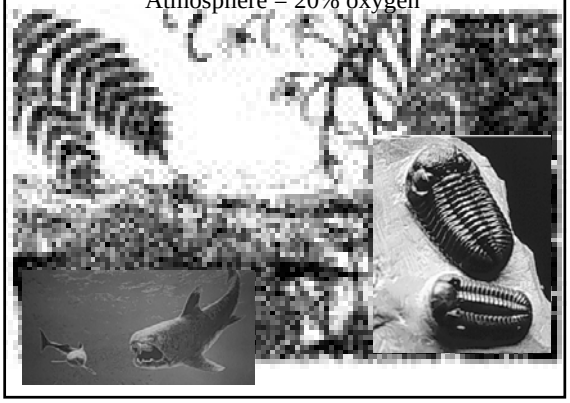
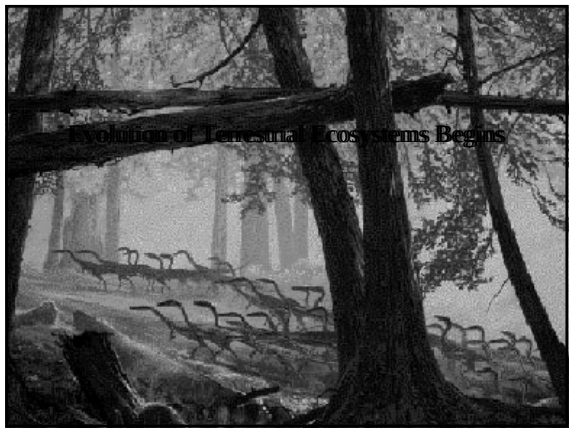
		Cambrian			540	
PRECAMBRIAN	Proterozoic Eon				2500	1st Eukaryotes
	Archean Eon				3800	1st Prokaryotes
					4600	

Atmosphere = 20% oxygen





Lynn Margoulis

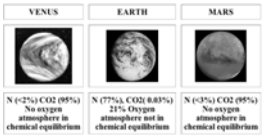
Mitochondrion

Each has a genome

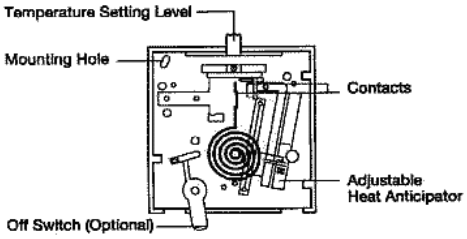
Chloroplast

The Gaia Hypothesis

James Lovelock

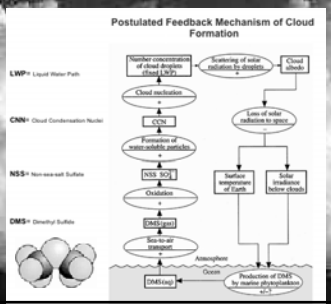


Thermostat



One Example Of How Gaia Hypothesis Works:

Cloud Formation



The Children's Ecology Project

The Secret Life of a Cloud:

Puffy's Story

By Dickson Despommier

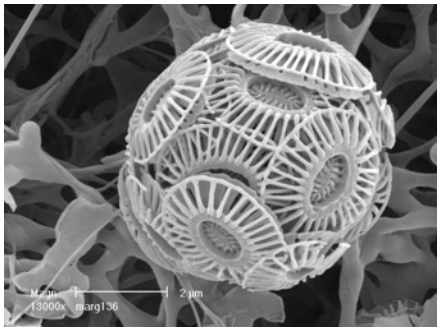
P.O. Box 280
New York, New York 10032

Tel: 212-781-6670
Fax: 212-781-1830

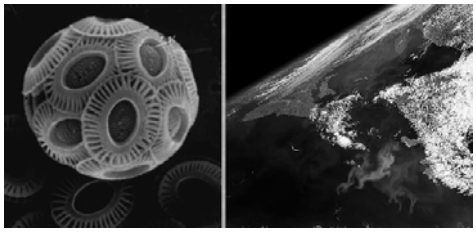
E-mail: ddd1@columbia.edu

Download PDF (43KB) Download DOC (61KB)

Coccolithic Phytoplankton

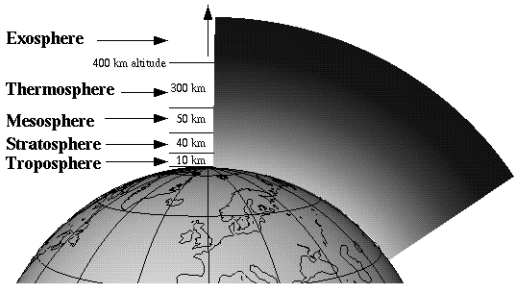


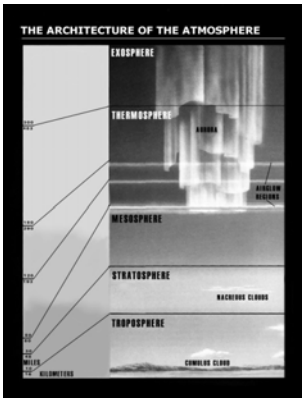
Emiliania huxleyi Home Page

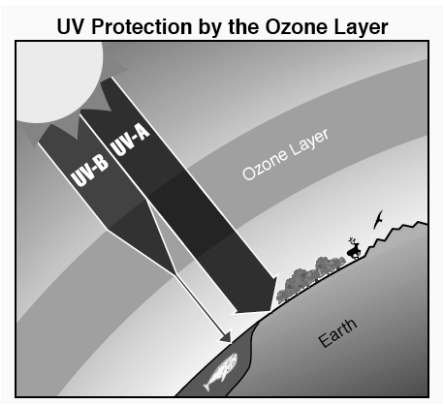


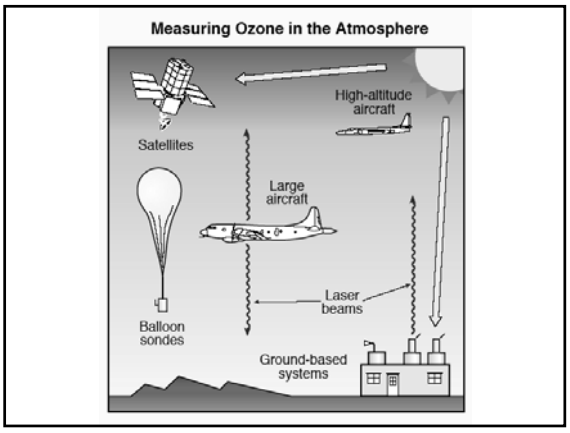
http://www.soes.soton.ac.uk/staff/tt/

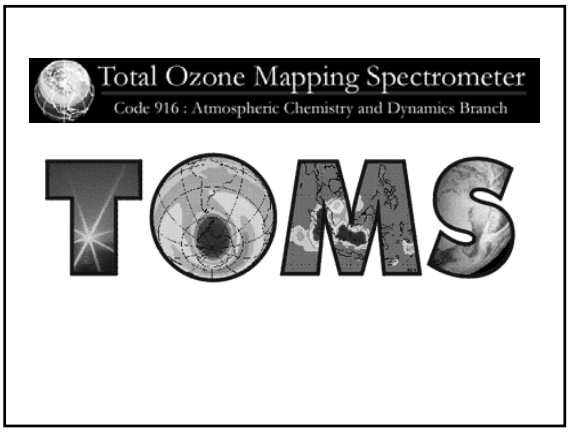
Layers Of The Atmosphere

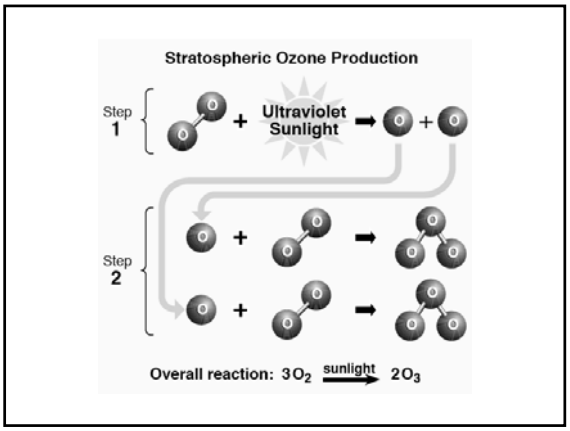


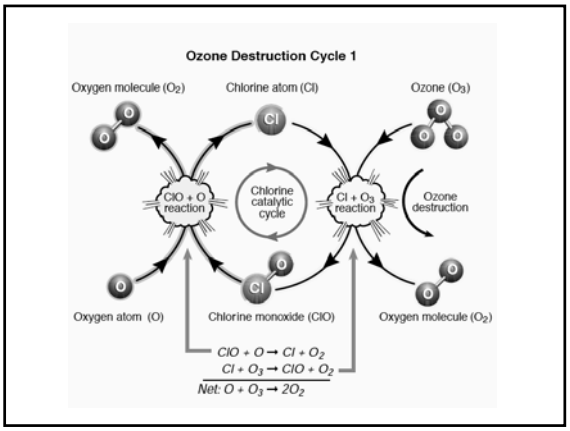


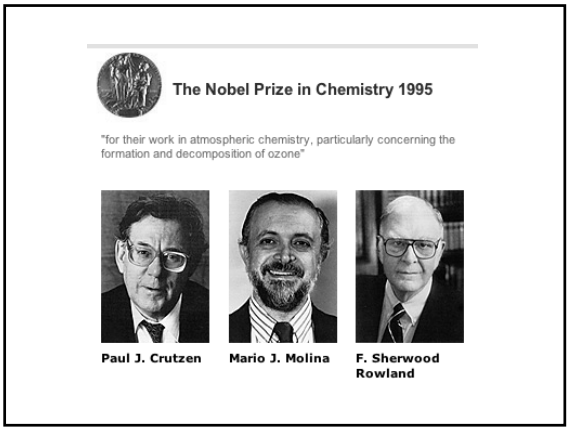


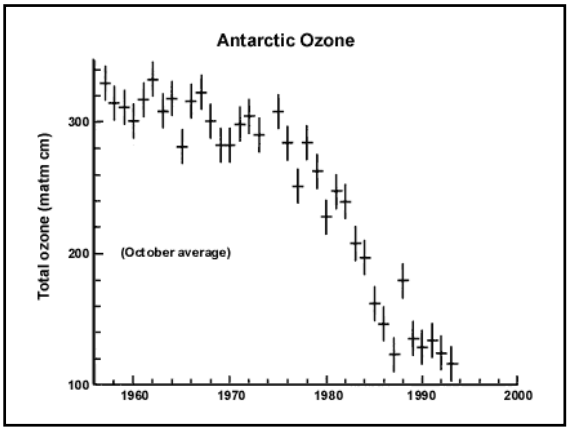

Measuring Ozone in the Atmosphere
Satellites
High-altitude aircraft
Large aircraft
Balloon sondes
Laser beams
Ground-based systems


Total Ozone Mapping Spectrometer
Code 916 : Atmospheric Chemistry and Dynamics Branch
TOMS

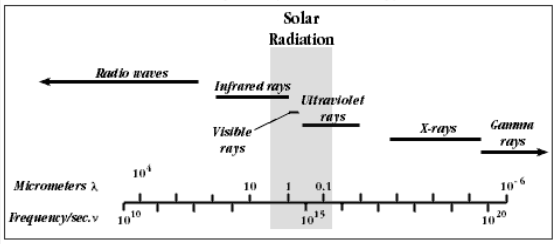

Stratospheric Ozone Production
Step 1
Ultraviolet Sunlight
Step 2
Overall reaction: 3O2 sunlight 2O3


Ozone Destruction Cycle 1
Oxygen molecule (O2)
Chlorine atom (Cl)
Ozone (O3)
ClO + O reaction
Chlorine catalytic cycle
Cl + O3 reaction
Ozone destruction
Oxygen atom (O)
Chlorine monoxide (ClO)
Oxygen molecule (O2)
ClO + O → Cl + O2
Cl + O3 → ClO + O2
Net: O + O3 → 2O2


The Nobel Prize in Chemistry 1995
"for their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone"
Paul J. Crutzen
Mario J. Molina
F. Sherwood Rowland


Antarctic Ozone
Total ozone (matm cm)
300
200
100
(October average)
1960
1970
1980
1990
2000

Electromagnetic Spectrum of Energy



CRS Issue Brief for Congress

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IB97003: Stratospheric Ozone Depletion: Implementation Issues

Larry Parker

Resources, Science, and Industry Division

July 12, 2000

http://www.NCSEonline.org/NLE/CRSreports/Stratospheric/strat-5.cfm?&CFID=12207930&CFTOKEN=7083239

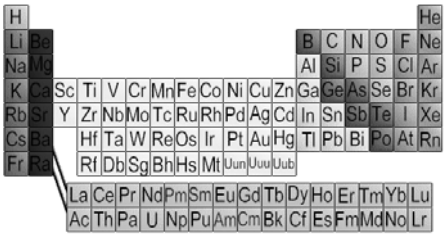
Table 1. Relative Ozone Depletion Potential (RODP), Global Warming Potential (GWP), and Atmospheric Lifetimes

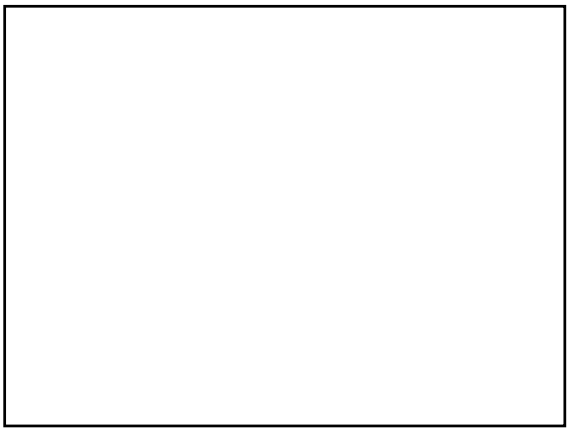
Compound	RODP*	GWP**	Lifetime (years)
CFC - 11 ***	1.0	50	50
CFC - 12 ***	1.0	102	108
CFC - 113 ***	0.8	85	88
CFC - 114	1.0	300	180
CFC - 115	0.6	1700	385
HCFC - 22	0.055	1600	13
HCFC - 123	0.016	90	1.4
HFC - 134a	0	1300	18

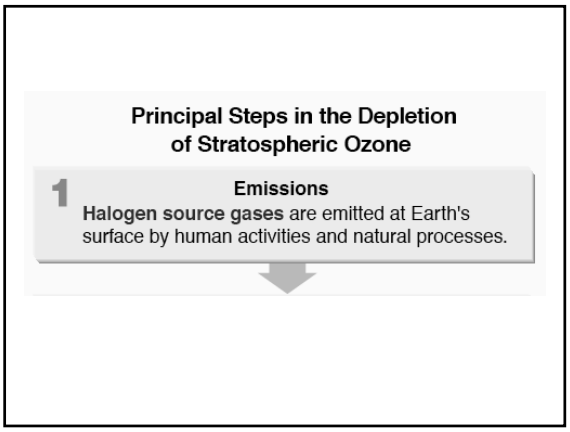
Montreal Protocol

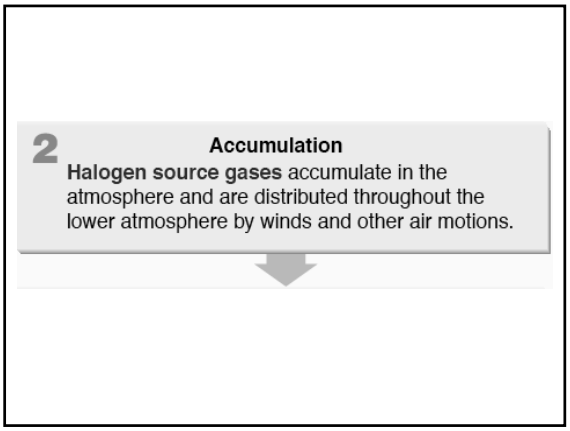
The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in 1987 as an international treaty to eliminate the production and consumption of ozone-depleting chemicals, with developing countries benefiting from a ten-year grace period.

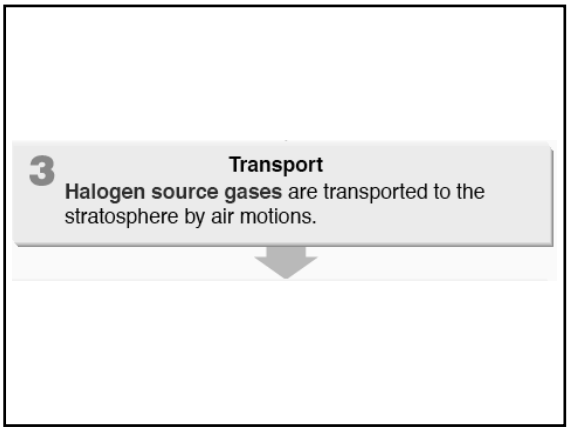
Periodic Table Of The Elements

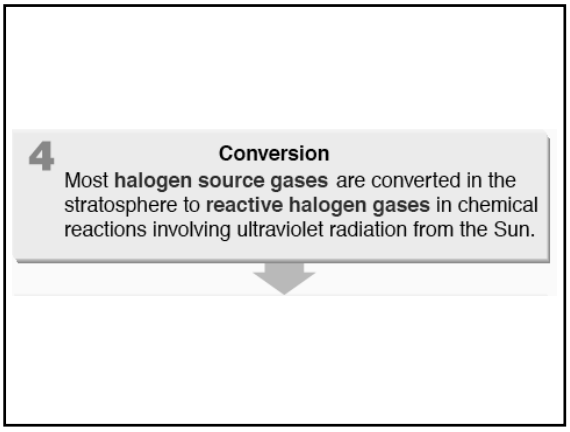


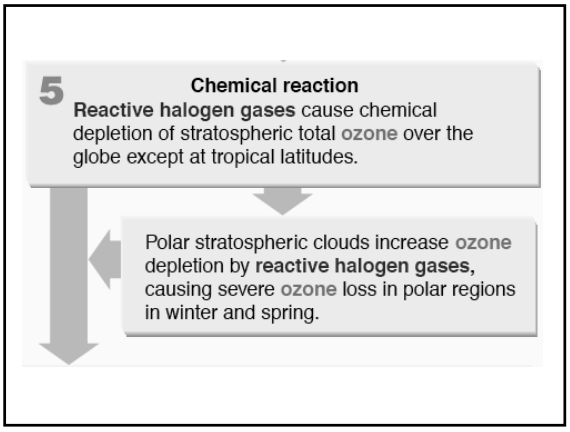



Principal Steps in the Depletion of Stratospheric Ozone
1
Emissions
Halogen source gases are emitted at Earth's surface by human activities and natural processes.


2
Accumulation
Halogen source gases accumulate in the atmosphere and are distributed throughout the lower atmosphere by winds and other air motions.

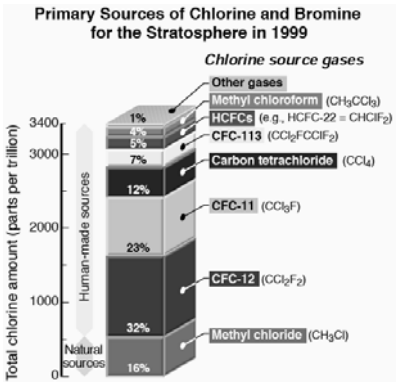

3
Transport
Halogen source gases are transported to the stratosphere by air motions.

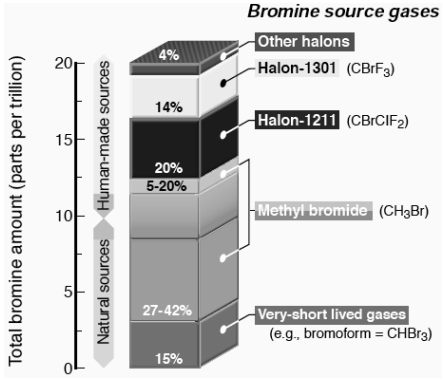

4
Conversion
Most halogen source gases are converted in the stratosphere to reactive halogen gases in chemical reactions involving ultraviolet radiation from the Sun.

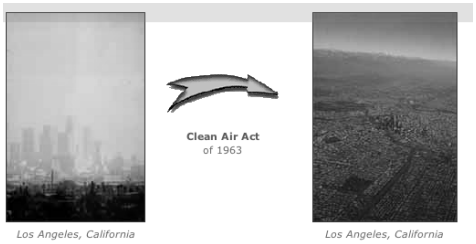

5
Chemical reaction
Reactive halogen gases cause chemical depletion of stratospheric total ozone over the globe except at tropical latitudes.
Polar stratospheric clouds increase ozone depletion by reactive halogen gases, causing severe ozone loss in polar regions in winter and spring.

6 **Removal**

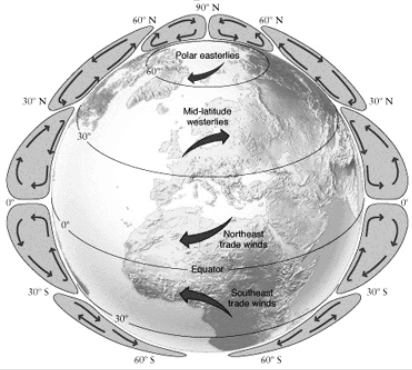
Air containing **reactive halogen gases** returns to the troposphere and these gases are removed from the air by moisture in clouds and rain.







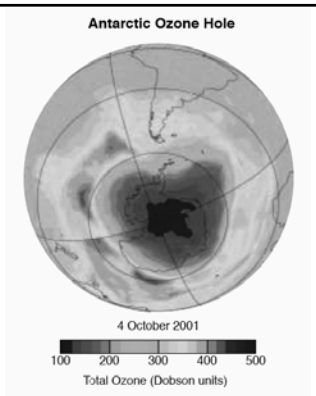
Global Atmospheric Circulation



Total Ozone Mapping Spectrometer

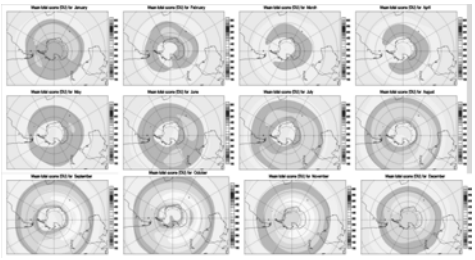
Code 916 : Atmospheric Chemistry and Dynamics Branch

TOMS



http://www.cmdl.noaa.gov/ozwv/ozsondes/spo/ozppp2001.html

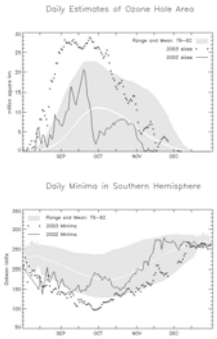
These maps show the mean 1978-1988 level estimated using Total Ozone Mapping Spectrometer (TOMS)data for all areas except the Antarctic and from the pre-1980 level estimated using Dobson data over the Antarctic.

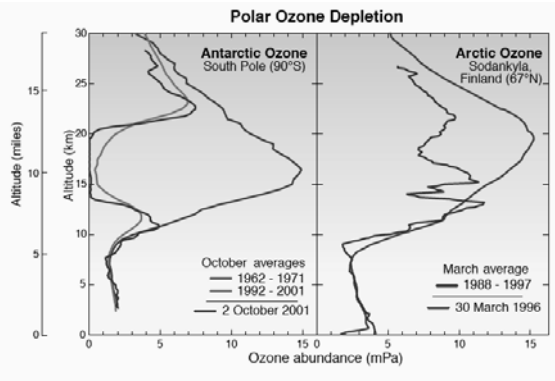


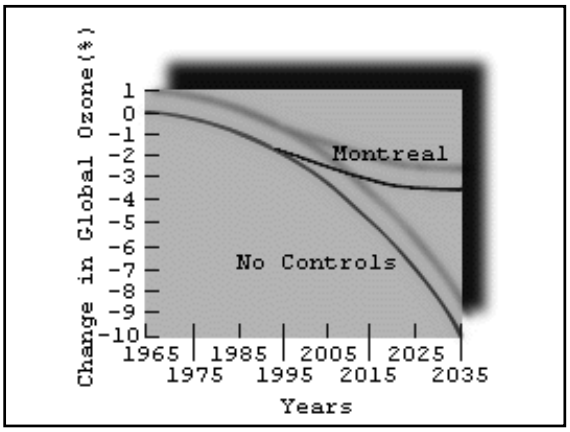
Ozone Hole over Antarctica

http://www.sdsc.edu/tmf/Examples/Ozone/ozone.html

Ozone Hole Monitoring







Reference archives

1.Envirolink Click on the Ozone folder. Note in particular the FAQ's by rparson(Robert Parson, Univ.of Colorado), they are by far the **best tutorials on Ozone depletion on the entire net!**

2.NOAA has written up several research summaries on History and overview of Ozone shield, Stratospheric Ozone and Tropospheric Ozone ; all written at a laymans level.

3. Earthwatch Radioscripts on Ozone :Earthwatch ph# is (608)263-3063, and I have found them to be quite helpful in giving further information and contacts used in their broadcasts.

4. NSF index this is the National Science Foundation's search index; type in 'ozone' and hit the enter key.

5. Galaxy directory service for EINET Contains a wide assortment of articles on different aspects of the depletion problem and the remedies for it; not necessarily the best place to start if you are just starting to learn about the problem. 7. Ozone lesson-plans from the University of Kansas Nice summaries of lesson plans which teach about the Ozone problem. You can download details of these lessons if you have Claris works.

9. CIESIN (Consortium for International Earth Science Information Networks) homepage this file has a nice summary of many the various protocals and international meetings that have been conducted in order to combat ozone depletion.

http://sedac.ciesin.org/ozone/docs/uvd-home.html