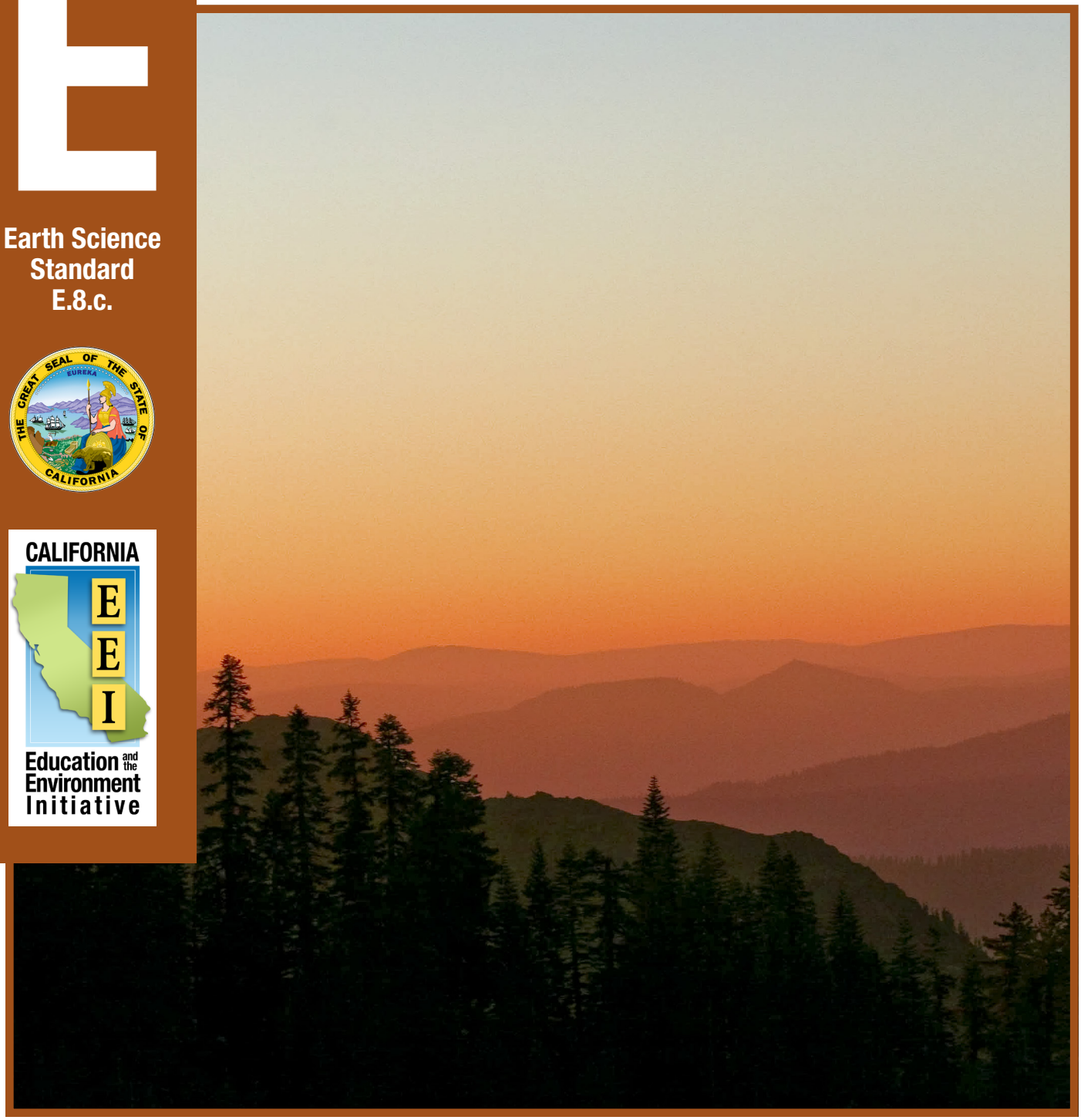
Visual Aids

California Education and the Environment Initiative

Earth Science
Standard
E.8.c.



Living Under One Roof

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency

California Natural Resources Agency

Office of the Secretary of Education

California State Board of Education

California Department of Education

California Integrated Waste Management Board

Key Leadership for the Education and Environment Initiative:

Linda Adams, Secretary, California Environmental Protection Agency

Patty Zwarts, Deputy Secretary for Policy and Legislation, California Environmental Protection Agency

Andrea Lewis, Assistant Secretary for Education and Quality Programs, California Environmental Protection Agency

Mark Leary, Executive Director, California Integrated Waste Management Board

Mindy Fox, Director, Office of Education and the Environment, California Integrated Waste Management Board

Key Partners:

Special thanks to **Heal the Bay,** sponsor of the EEI law, for their partnership and participation in reviewing portions of the EEI curriculum.

Valuable assistance with maps, photos, videos and design was provided by the **National Geographic Society** under a contract with the State of California.

Office of Education and the Environment

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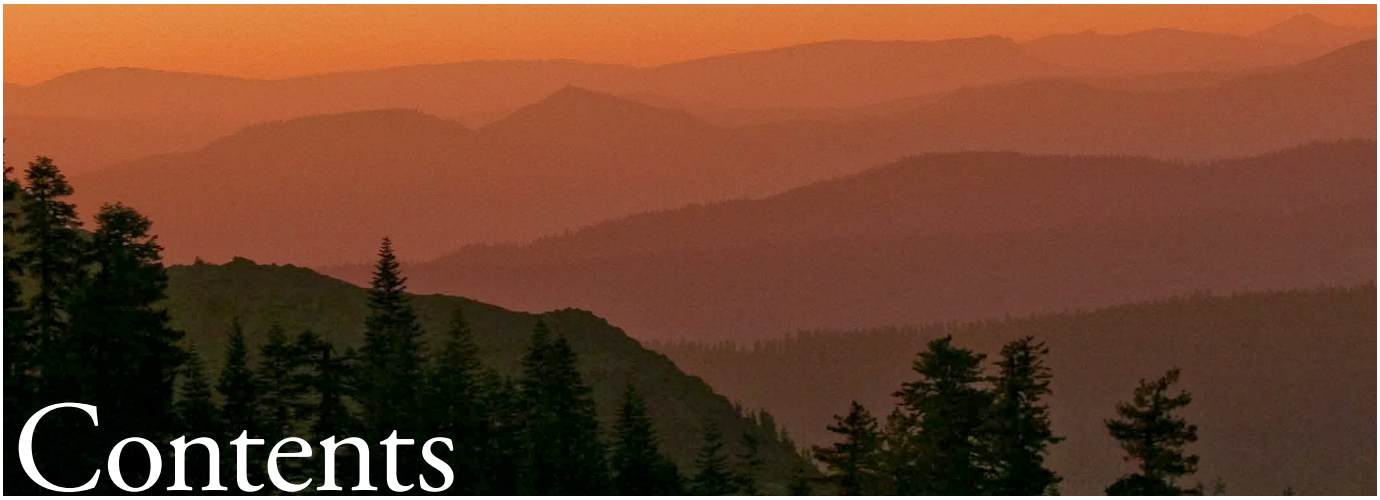
http://www.calepa.ca.gov/Education/EEI/



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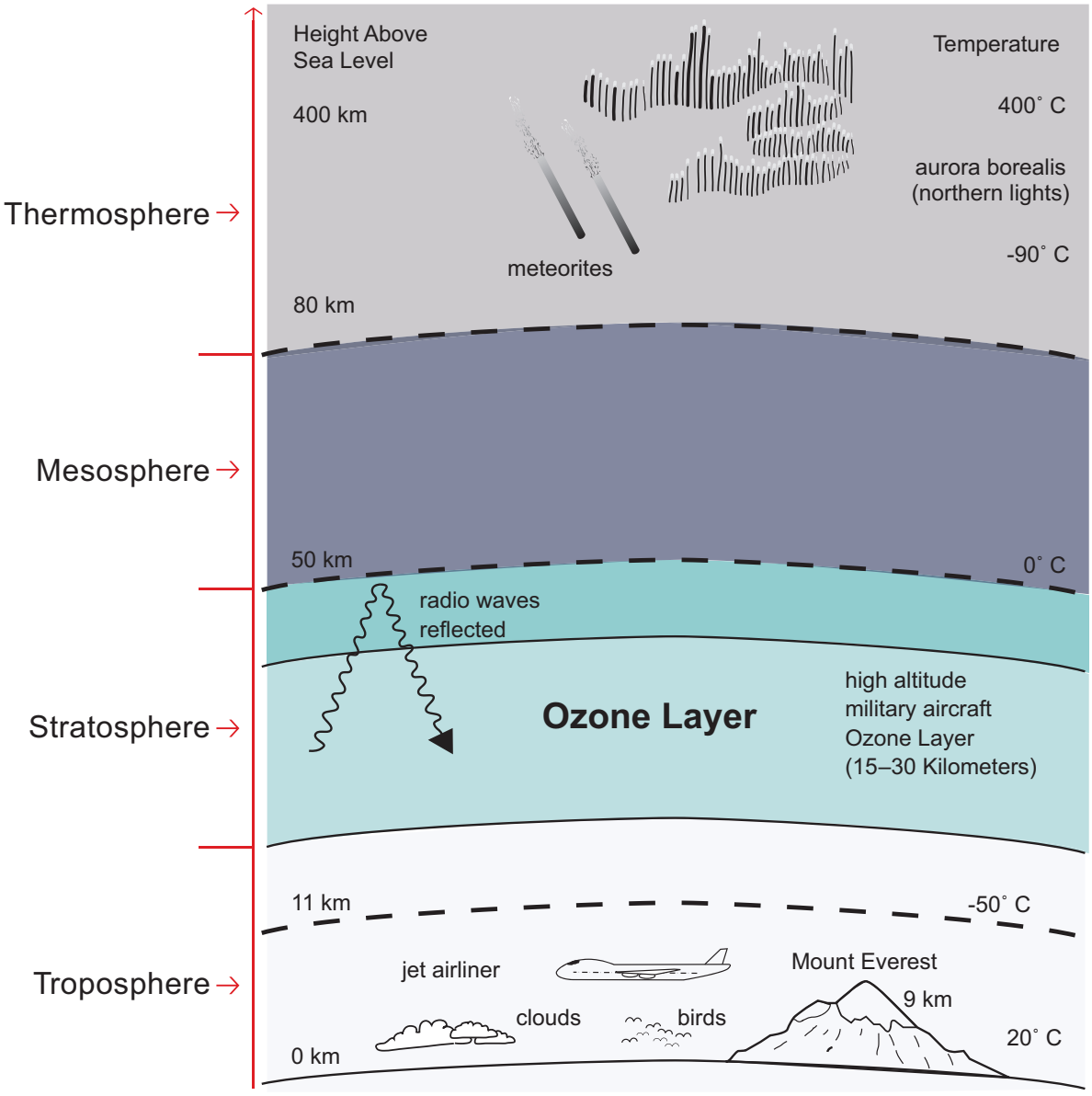
Lesson 5 Miracle Products of the 1930s to 1970s

Lesson 6 Saving the Ozone Layer

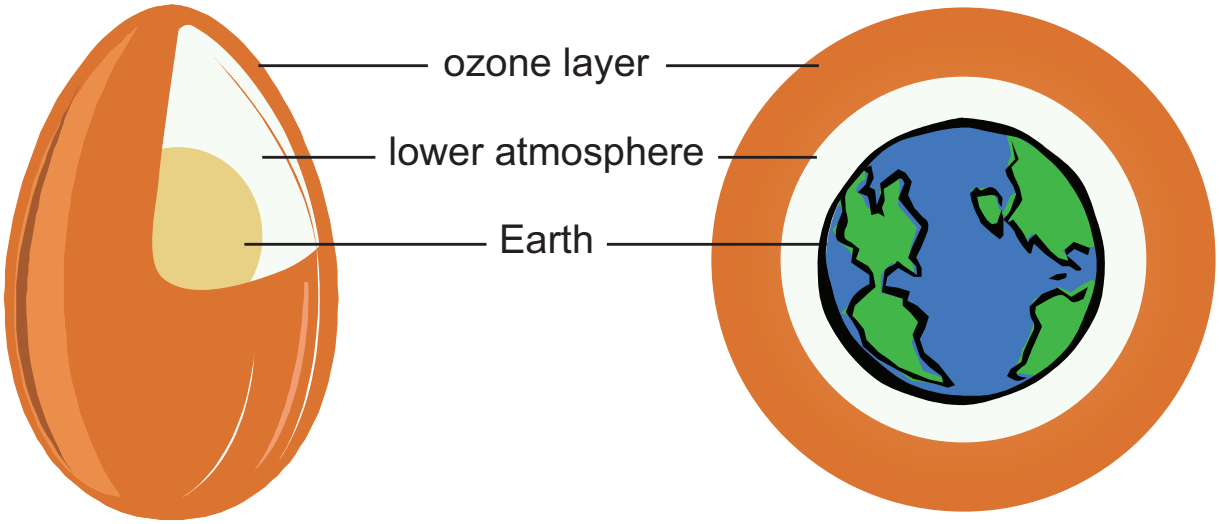
VA #1 UV Overexposure: Sunburn

VA #2 Where in Earth's Atmosphere Is the Ozone Layer?

This is the atmosphere profile averaged over the year and over Earth.

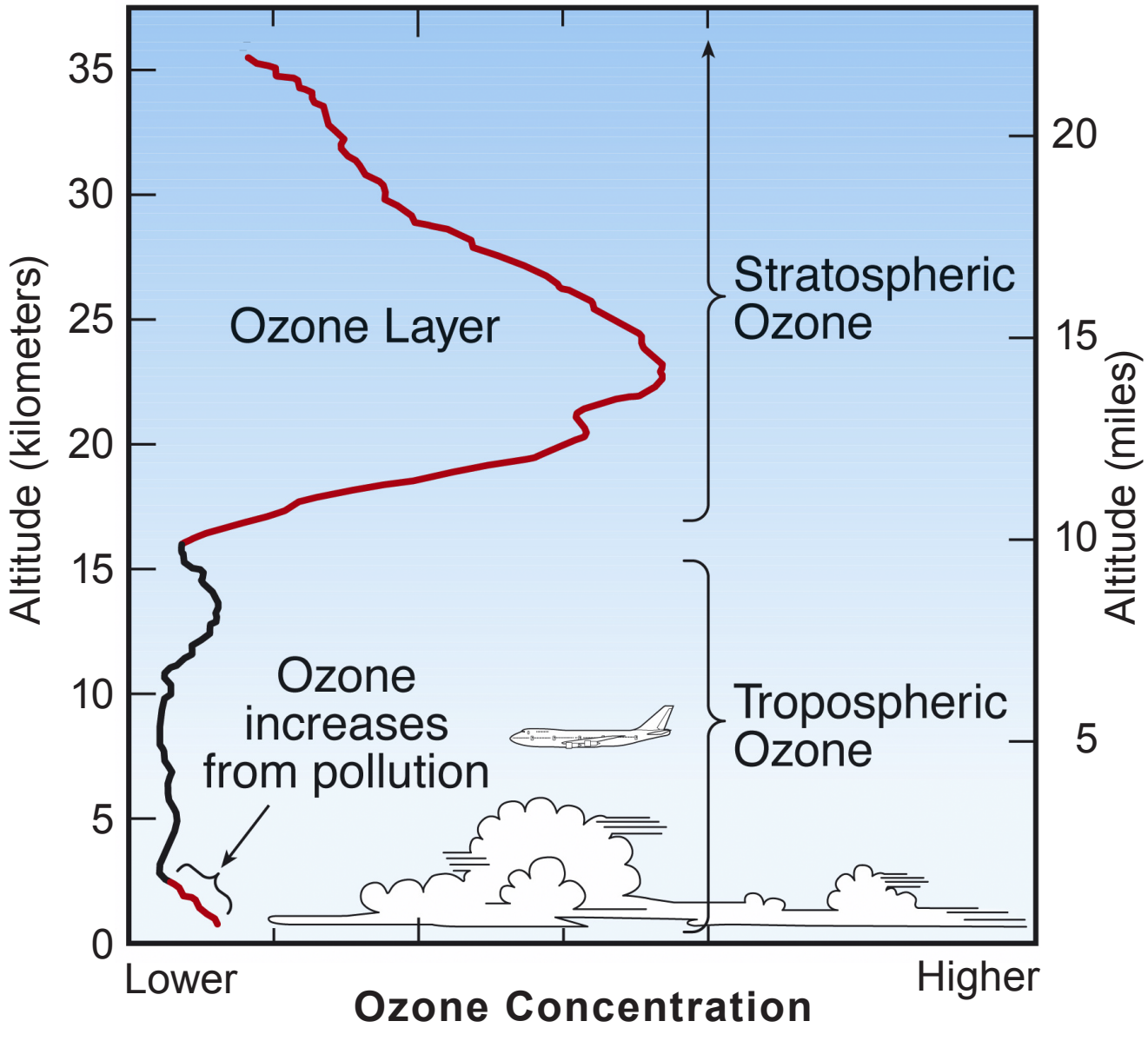


VA #3 Model of the Ozone Layer

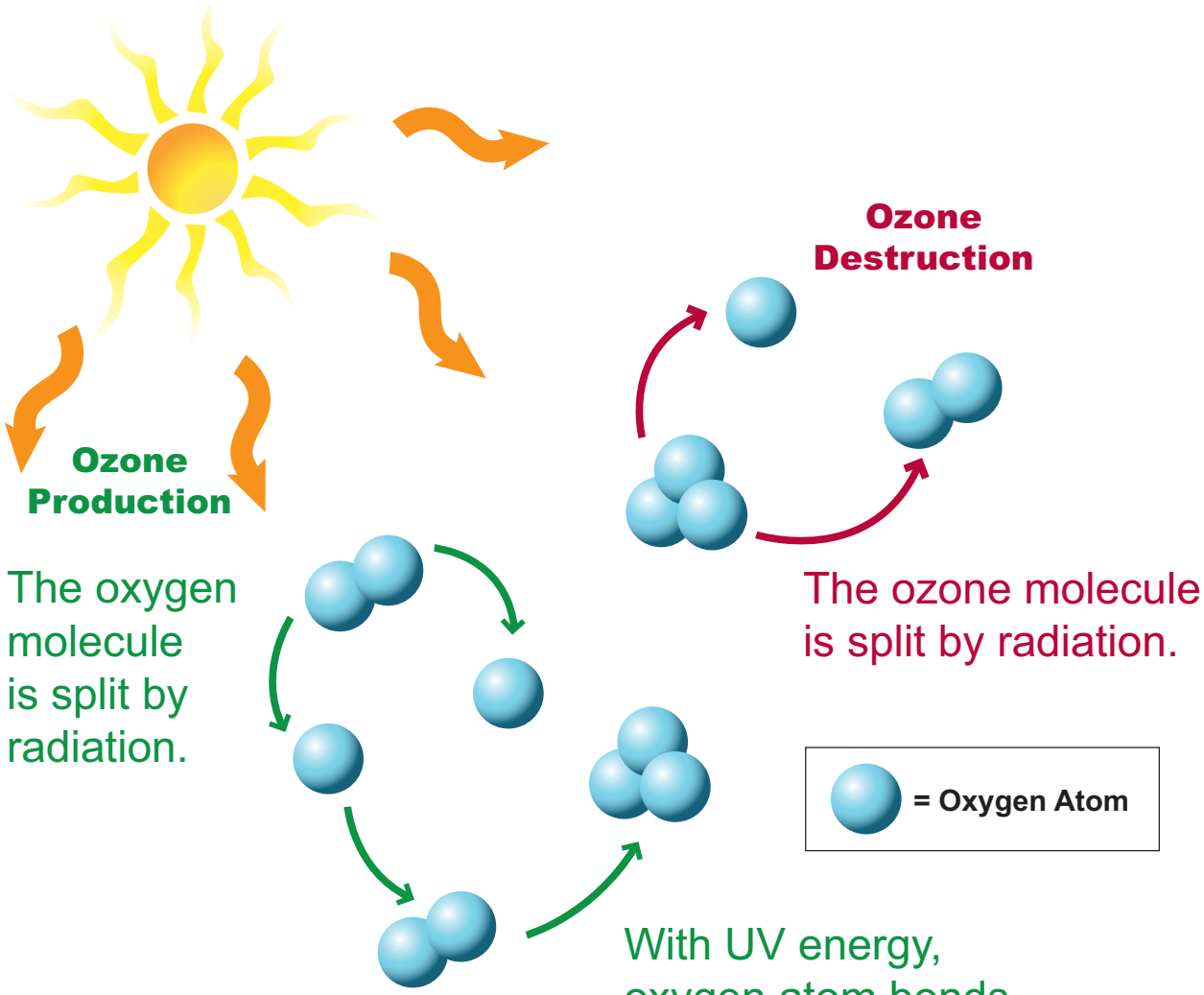


VA #4 Los Angeles Smog

VA #5 Ozone in the Atmosphere



VA #6 Natural Oxygen–Ozone Cycle



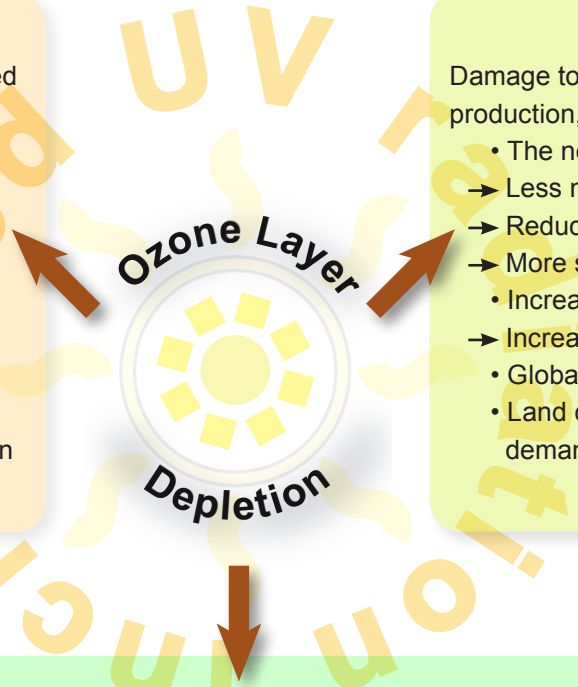
VA #7 Ozone Layer Connection

Phytoplankton

Damage to DNA causes reduced populations and/or altered species composition and may result in:

- Changes to the marine food web

→ Loss of local fisheries
→ Changes to ecosystem
→ Loss of global fisheries
→ Food shortage
→ Increased hunger/starvation
→ Increased cost for food



Crops

Damage to DNA causes reduced crop production, may result in:

- The need for more crop acreage

→ Less native vegetation
→ Reduced biodiversity
→ More soil erosion

- Increased costs for growing food

→ Increased cost for food

- Global food shortage
- Land competition from other demands—housing, natural areas

Human Communities

Overall, the effects of UV radiation on human health (eyes, immune system, skin) will cause an increased demand for more medical services. With aging and ever-increasing populations, demand for medical services will out weigh supply. Personal and governmental costs for health care will increase.

Cataracts & eye damage may result in:

- Demand for more community services

→ Increased taxes

- Need for more doctors to perform surgery

→ Tax already short supply of health care services

- Personal loss of freedom and movement

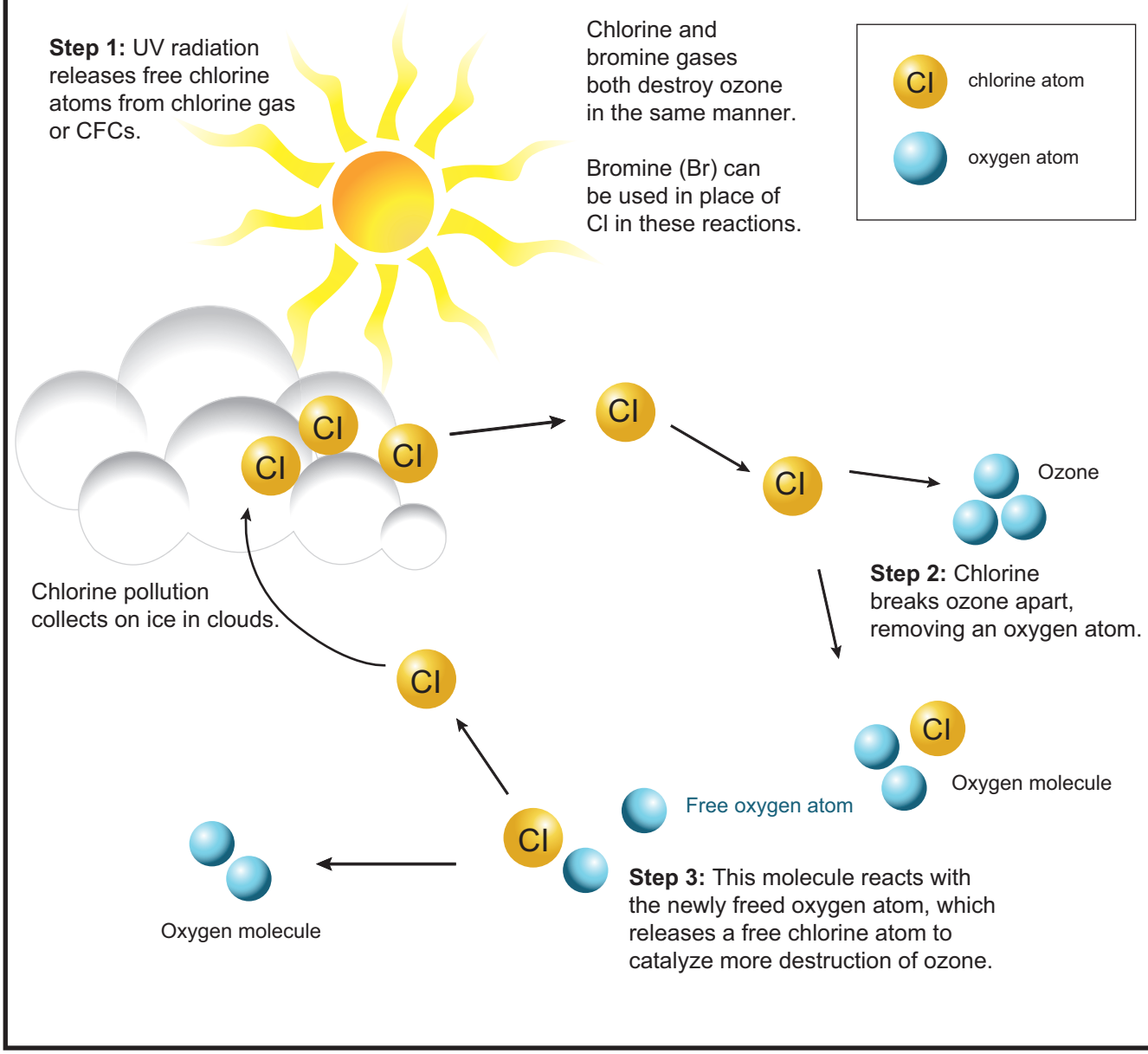
Weakened immune system may result in:

- More diseases →increased spreading of diseases
- Vaccine failure → more infectious diseases
- Return of plagues on a global level
- Increase in auto-immune diseases (HIV, arthritis, diabetes, MS)

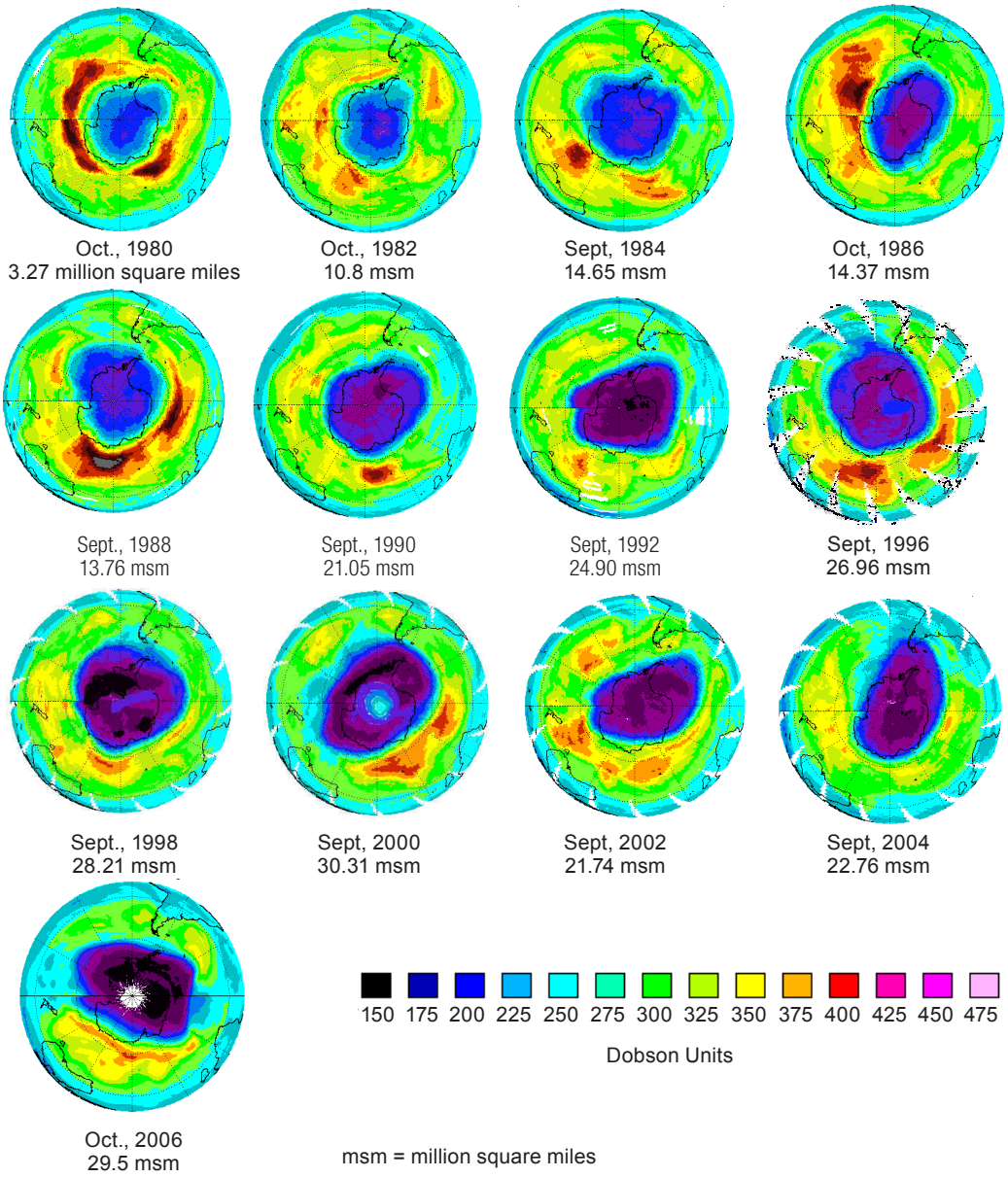
Skin Damage (DNA) may result in:

- Skin cancer → death is worst-case scenario
- Painful, costly treatment
- Premature aging/wrinkles → Self-esteem issues
- Increased demand for cosmetic treatments

VA #8 Ozone Destruction Process

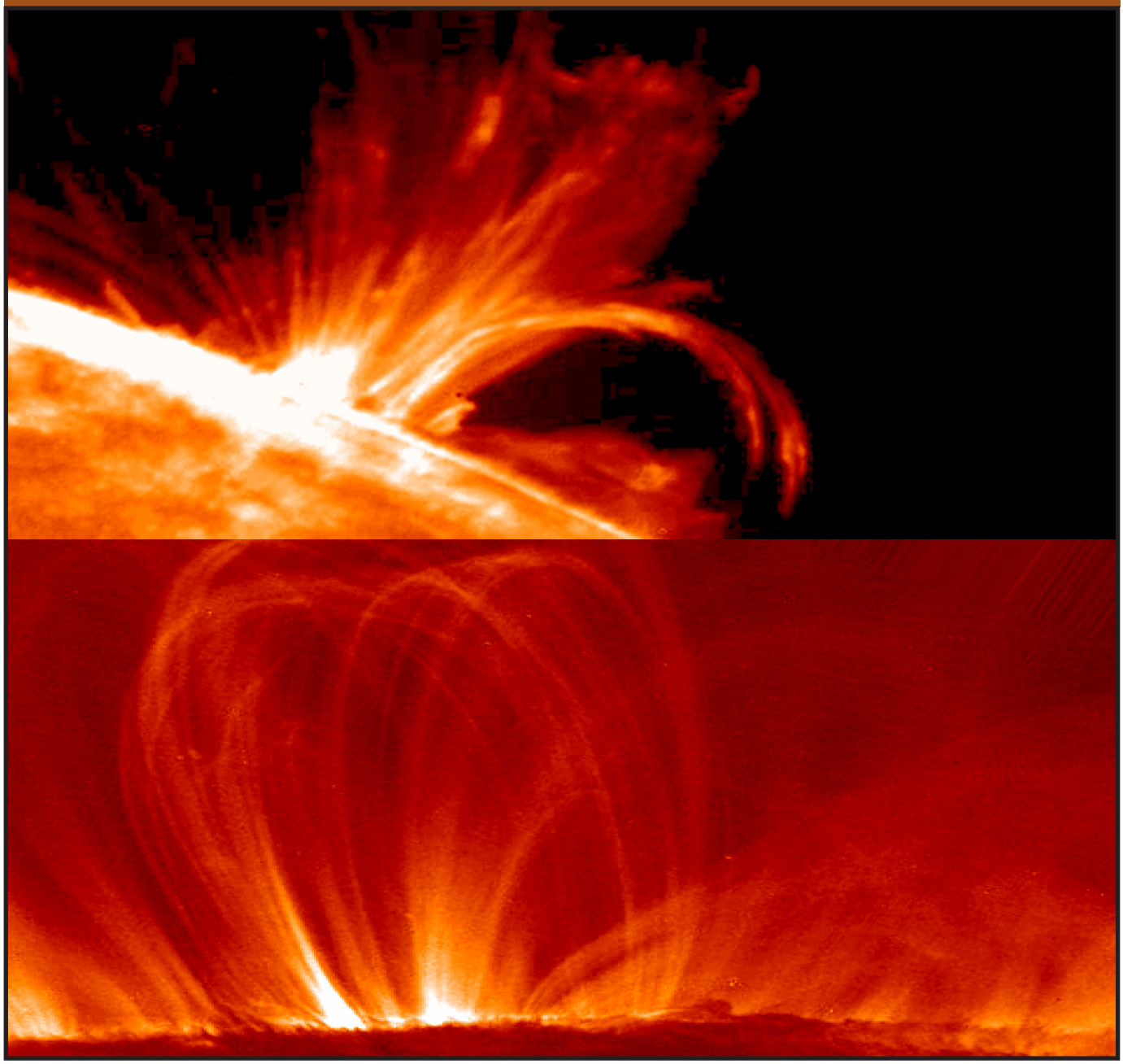


VA #9 Antarctic Ozone Hole Timeline



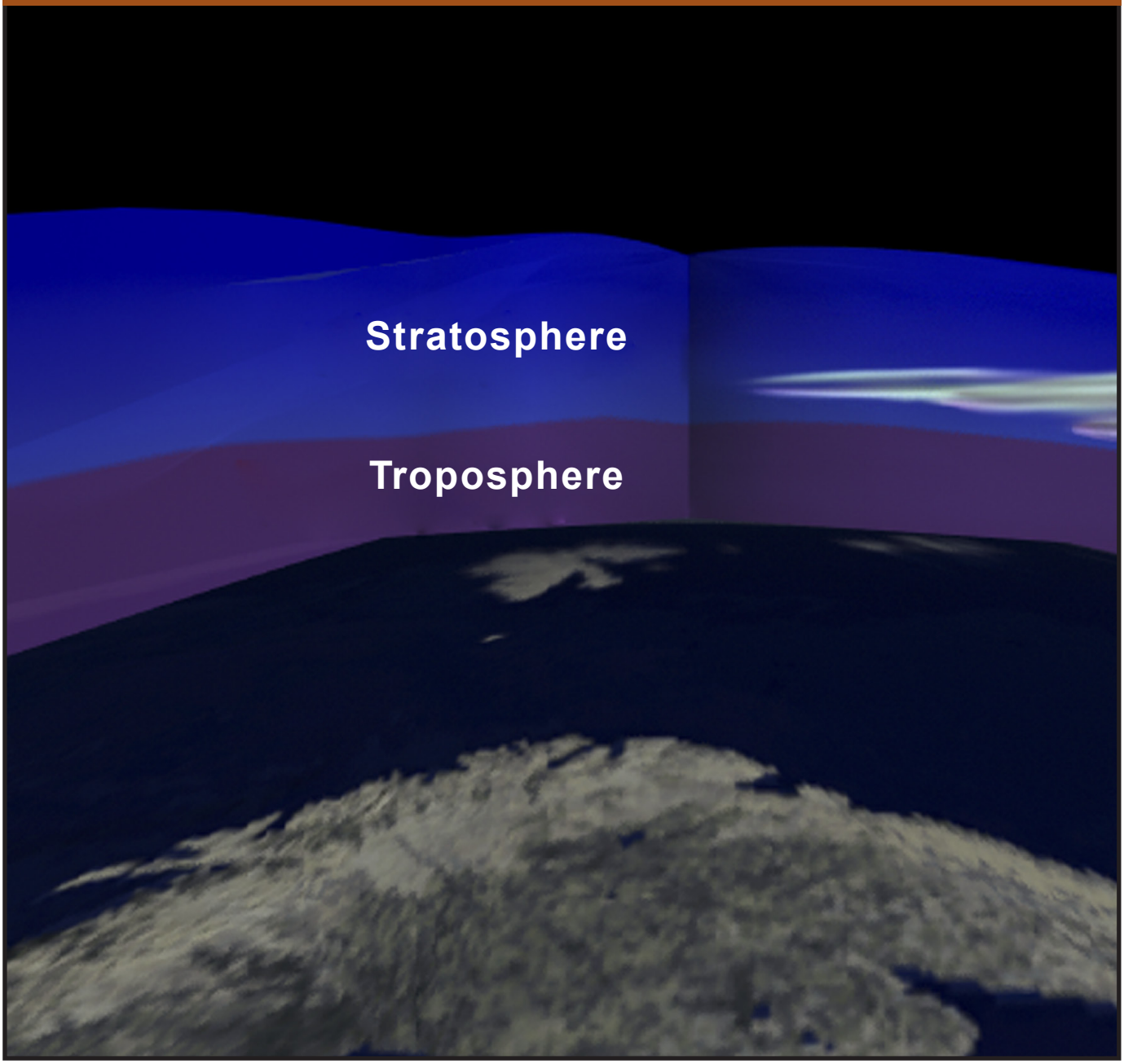
VA #10 Headlines about the Ozone Layer

VA #11 Solar Flares

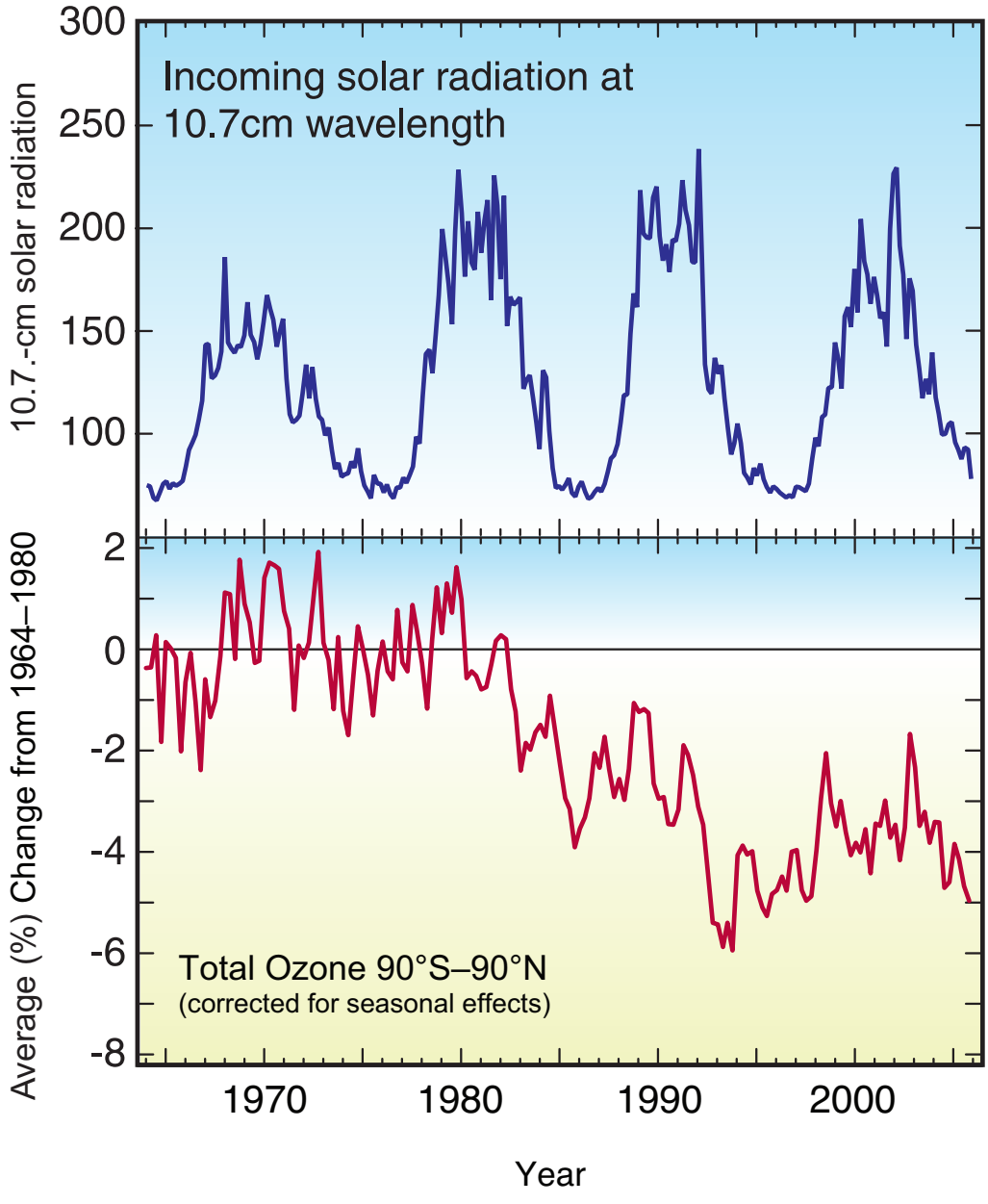


VA #12 Volcanic Eruptions

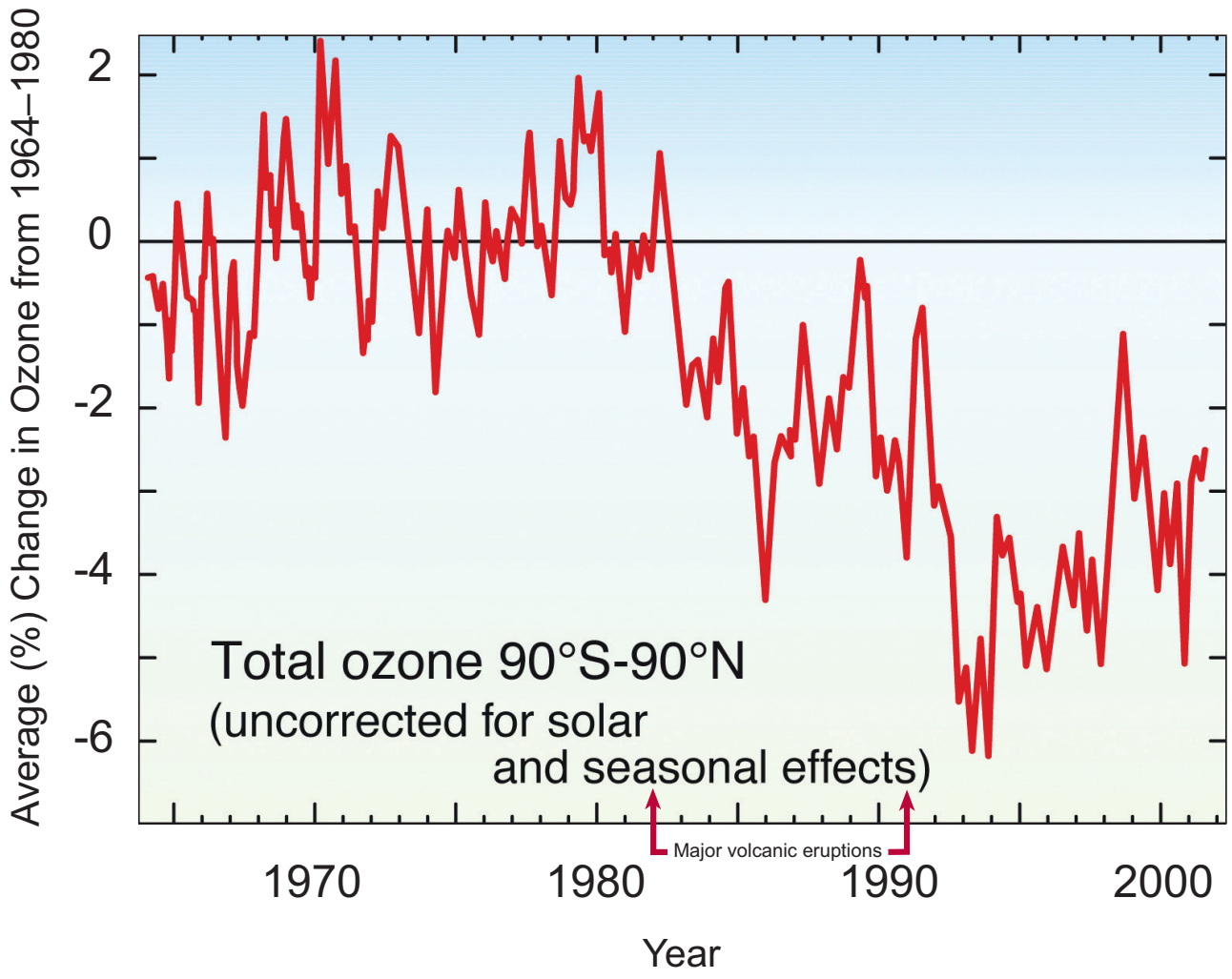
VA #13 Stratospheric Polar Clouds and the Ozone Layer



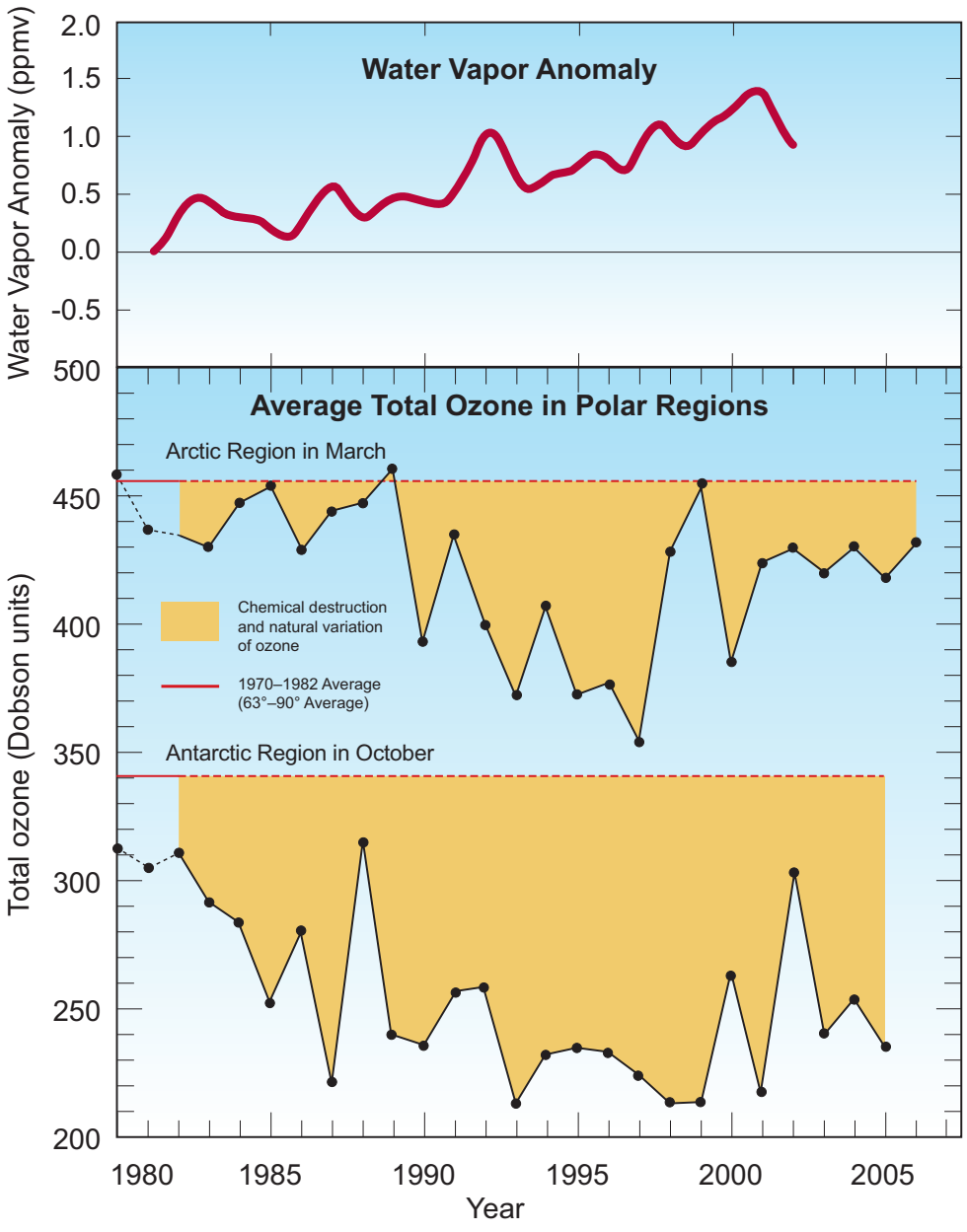
VA #14 Comparing Solar Flares to Ozone Levels



VA #15 Comparing Volcanic Eruptions to Ozone Levels



VA #16 Comparing Stratospheric Clouds to Ozone Levels

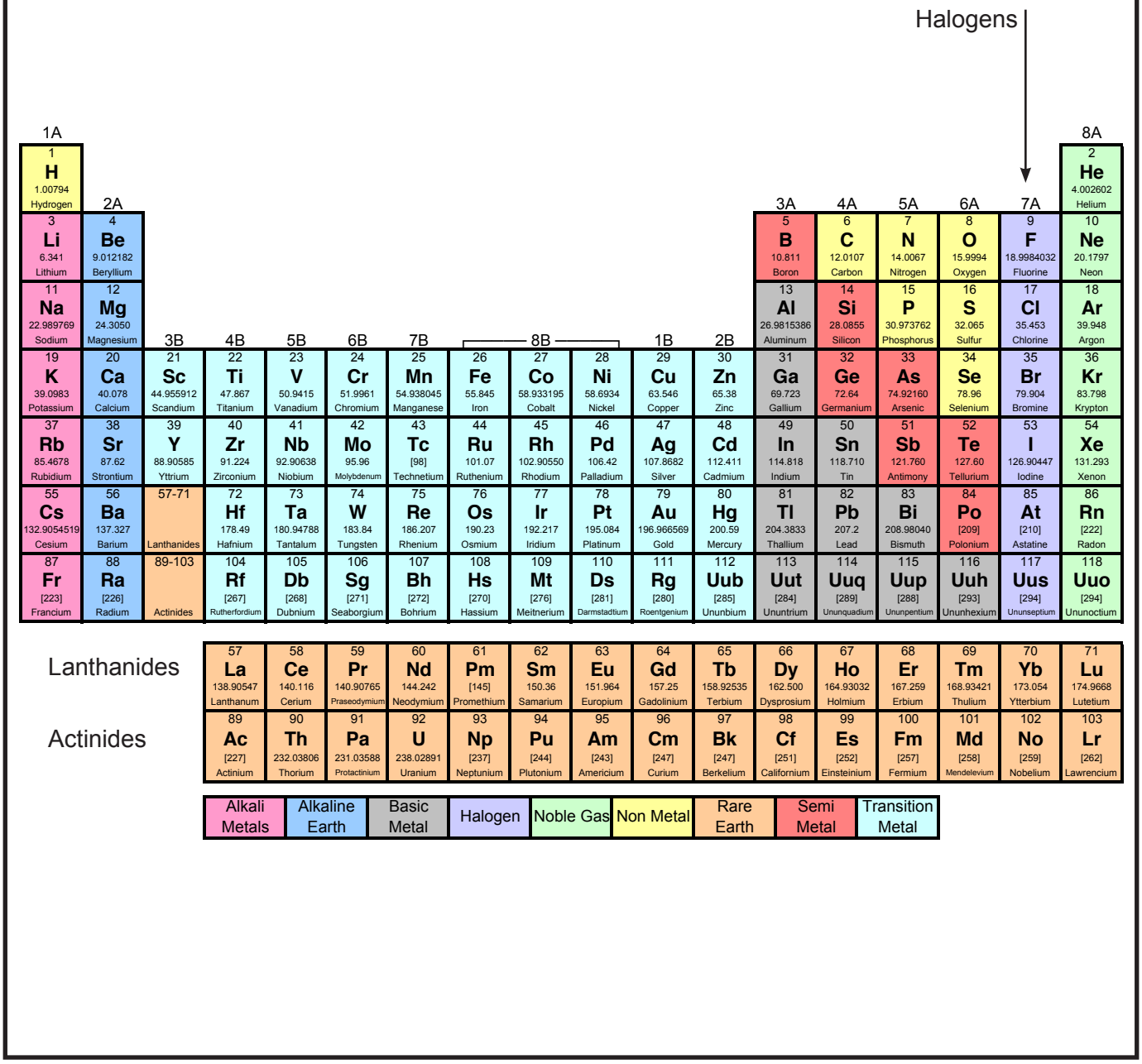


VA #17 Which Can You Live Without?

VA #18 Sources of Chlorine and Bromine Gas Emissions

Human Activities		
Product/Source	**Chemicals Involved**	**Catalyst in Ozone Destruction**
Air Conditioning		
Foams		
Aerosol sprays (spray paint, hair spray, cooking spray)		
Metered Dose Inhalers		
Refrigeration and coolants		
Solvents		
Fire Extinguishers		
Pesticides		
Natural Conditions		
Source	**Chemicals Involved**	**Catalyst in Ozone Destruction**
Volcanic Eruptions		
Solar Flares		
Stratospheric Polar Clouds		

VA #19 Periodic Table of Elements



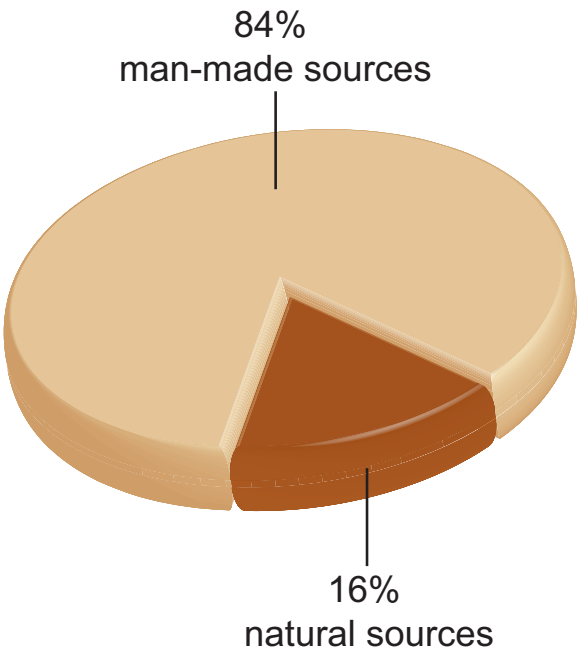
VA #20 Miracle Products' ODP

Man–made Products	Gas Emissions	Ozone-Depleting Potential (ODP)
Chlorine		
Air conditioning, coolants, foams, aerosol sprays, metered-dose inhalers, refrigeration	CFC-11	1.0
	CFC-12	1.0
	CFC-13	1.0
	HCFCs	0.02–0.12
	Carbon tetrachloride-CCl_4	0.73
Solvents	Methyl chloroform-CH_3CCl_3	0.12
Refrigeration	Methyl chloride-CH_3Cl	0.02
Bromine		
Fire retardants and fire extinguishers	Halon-1301	16.0
	Halon-1211	7.1
Pesticides	Methyl bromide - CH_3Br	0.51
Natural Sources	**Gas Emissions**	**Ozone-Depleting Potential (ODP)**
Chlorine		
Emissions from volcanic eruptions	Hydrogen chloride	Uncertain

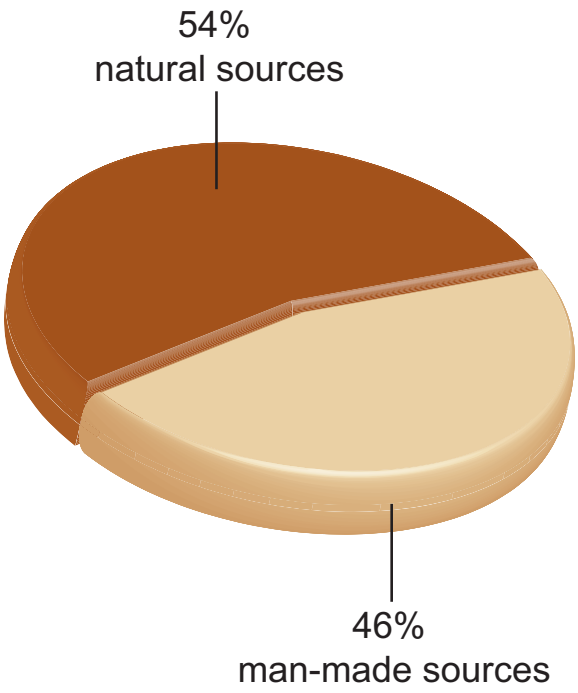
VA #21 Stratospheric Gas Sources

Primary Sources of Chlorine and Bromine Gasses for the Stratosphere in 2004

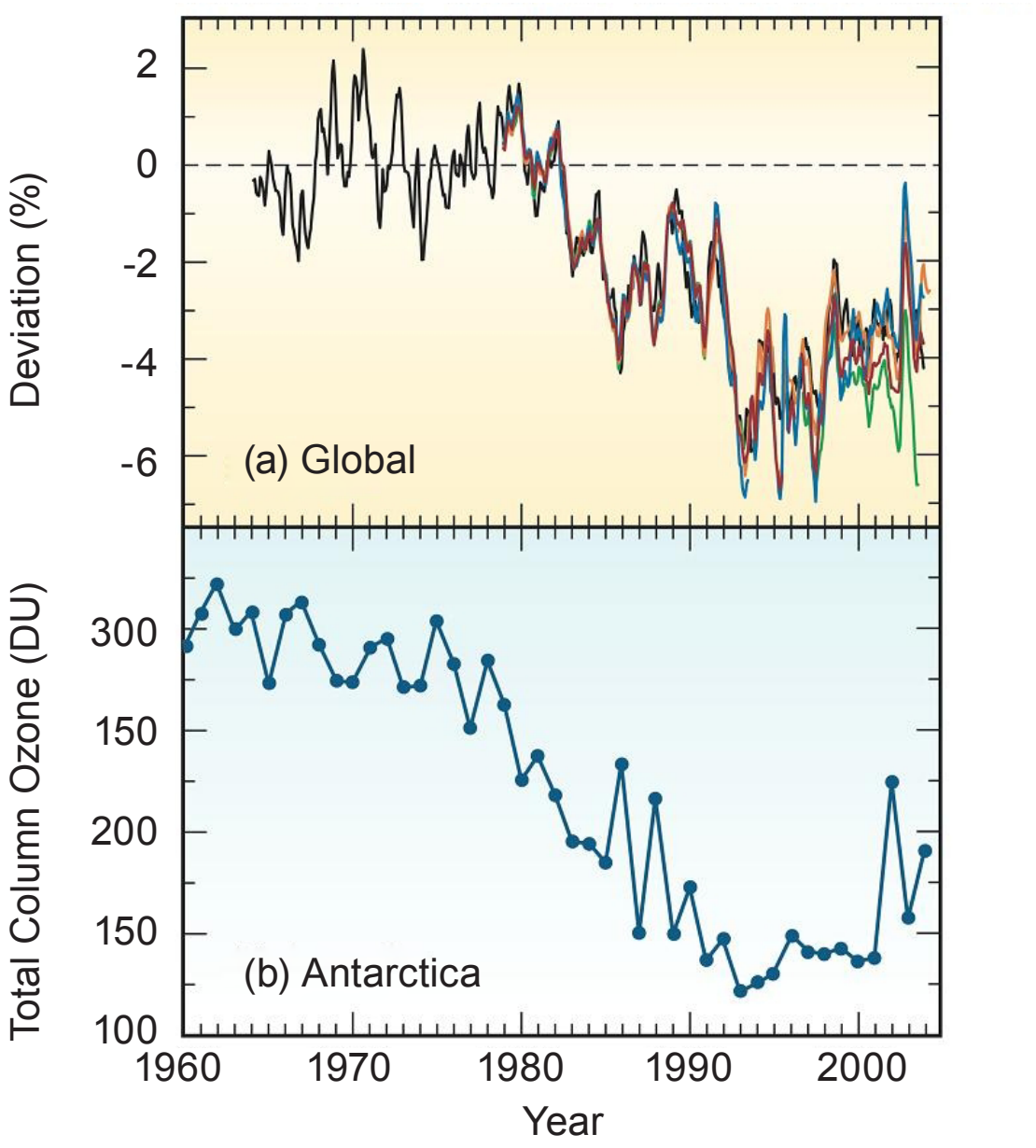
Chlorine Gasses
Total chlorine amount
= 3390 parts per trillion



Bromine Gasses
Total bromine amount
= 21.2 parts per trillion

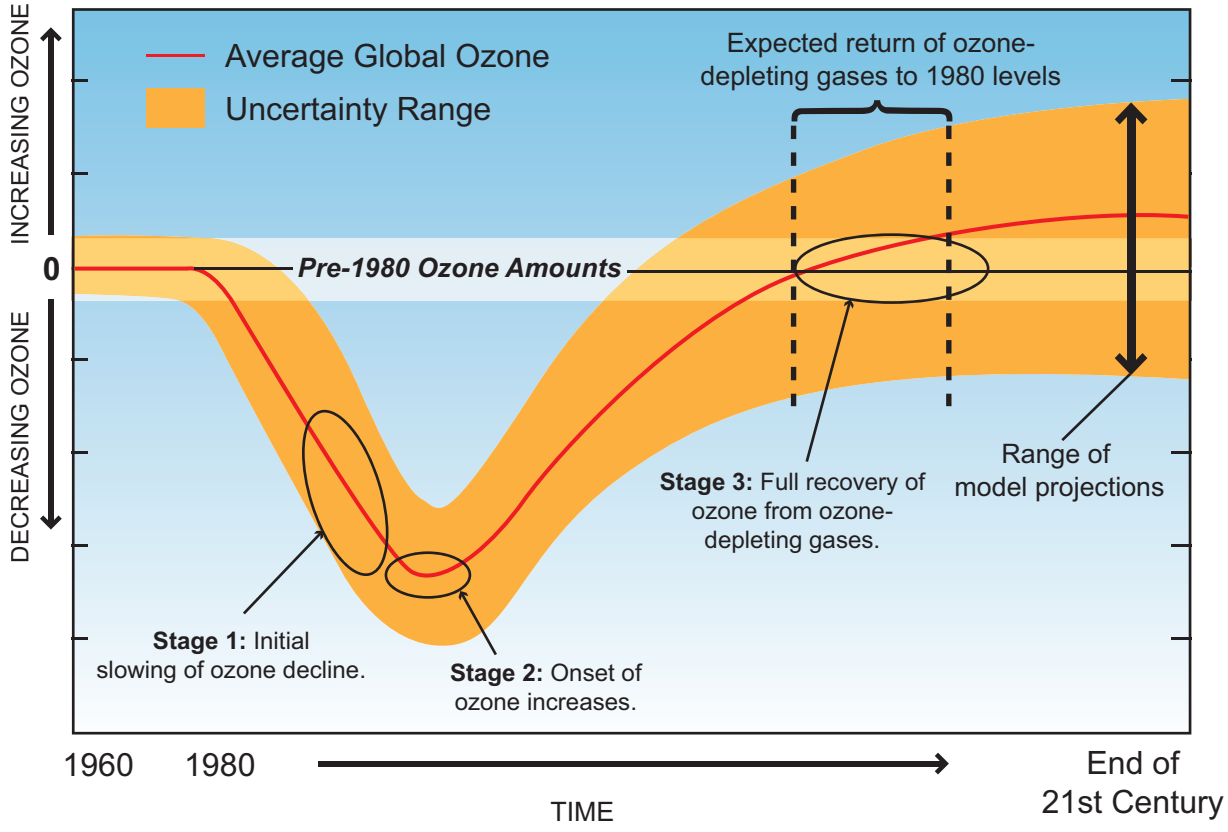


VA #22 Changes to the Ozone Layer



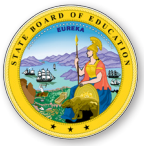
VA #23 Projected Recovery Stages of Global Ozone

Global Ozone Change from Pre-1980 Values



The timeline for recovery identifies three stages. The large uncertainty range illustrates natural ozone variability in the past and potential uncertainties in global model projections of future ozone amounts.

Source: http://www.esrl.noaa.gov/csd/assessments/2006/chapters/twentyquestions.pdf



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