

Unit 4

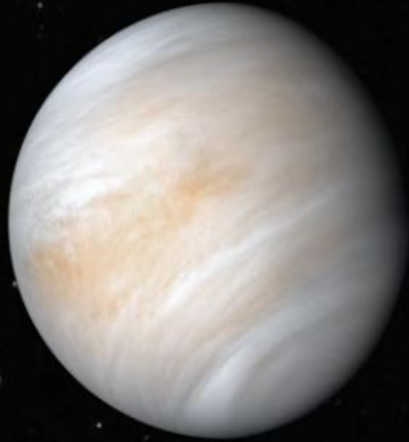
Earth's Atmosphere, Weather, and Climate

LO.4.1. Students explain the elements and factors influencing Earth's atmospheric conditions and affecting weather and climate.

Lesson 1: Evolution of Earth's Atmosphere

Learning Target: I can describe the evolution and composition of the Earth's atmosphere.

96% Carbon dioxide
3.5% Nitrogen



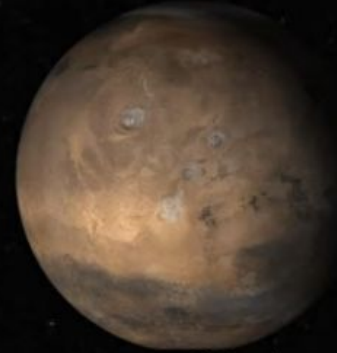
Venus
110 million km
from the Sun

78% Nitrogen
21% Oxygen



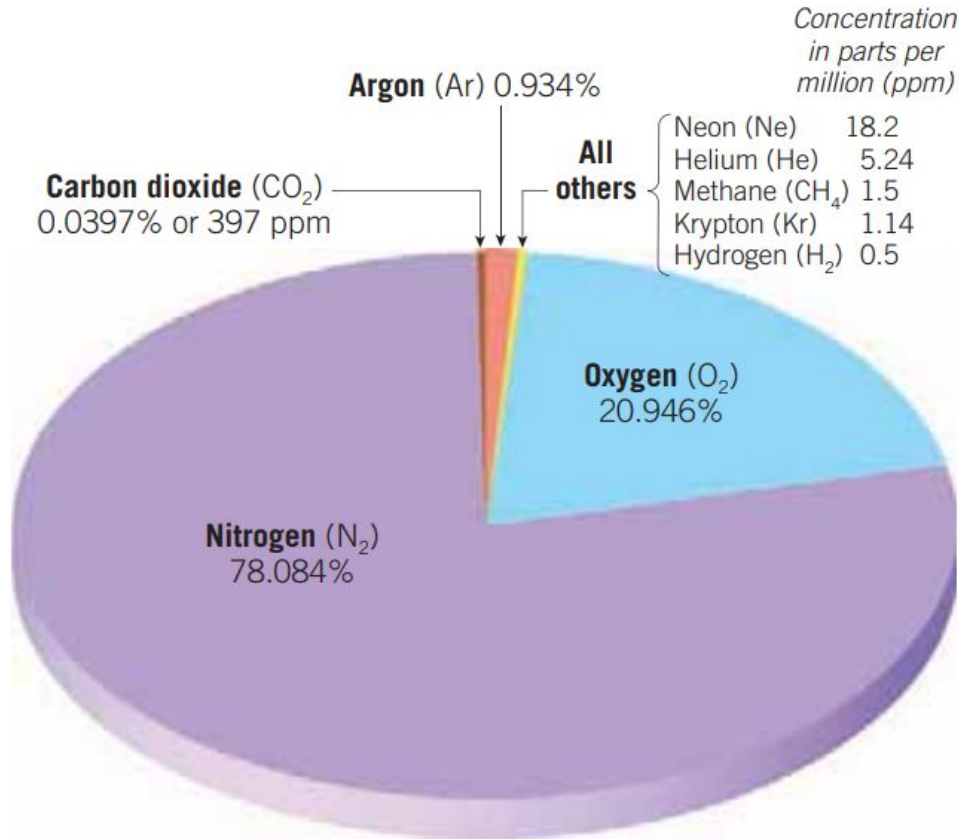
Planet Earth
150 million km
from the Sun

95% Carbon dioxide
2.7% Nitrogen



Mars
220 million km
from the Sun

Composition of Earth's atmosphere



How did we get to this state?

96% Carbon dioxide
3.5% Nitrogen



Venus
110 million km
from the Sun

Carbon dioxide
Nitrogen
Water vapor
Methane
Ammonia

Atmospheric composition
of early earth



Planet Earth
150 million km
from the Sun

95% Carbon dioxide
2.7% Nitrogen



Mars
220 million km
from the Sun

~4 billion years ago

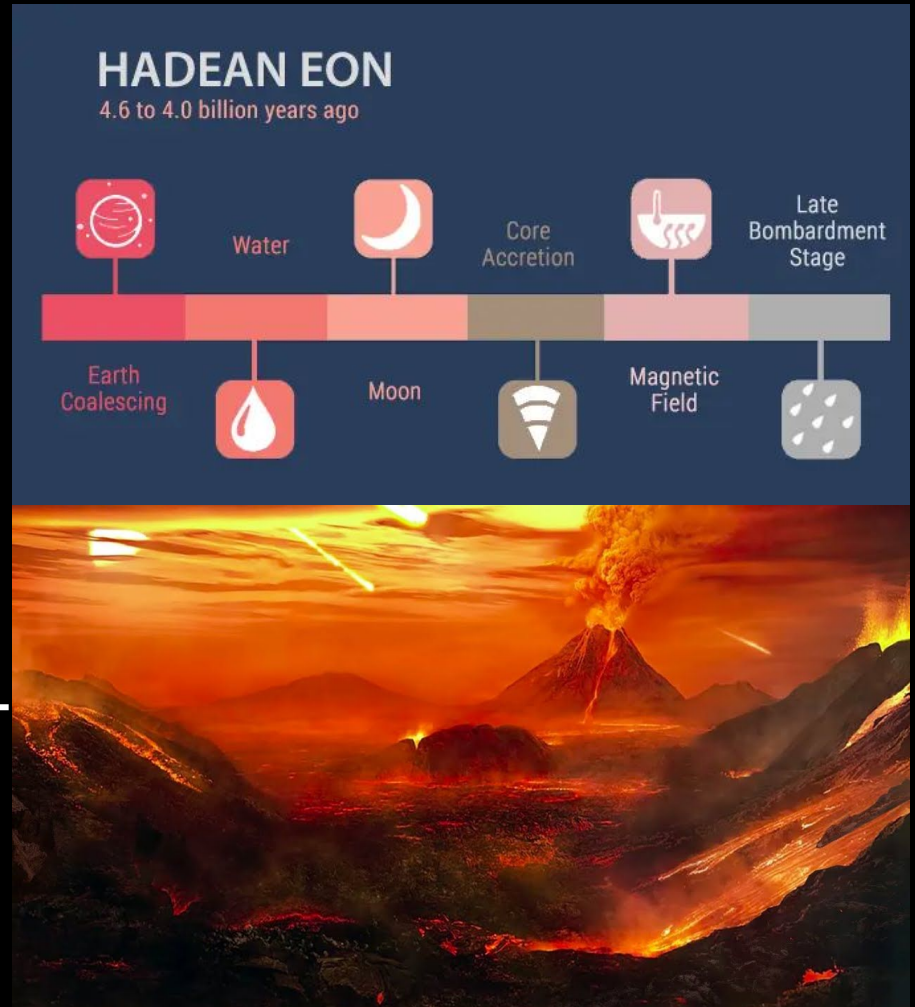
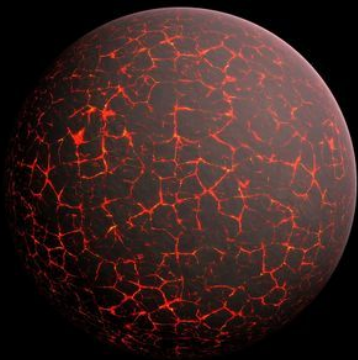
Carbon dioxide
Nitrogen
Water vapor
Methane
Ammonia

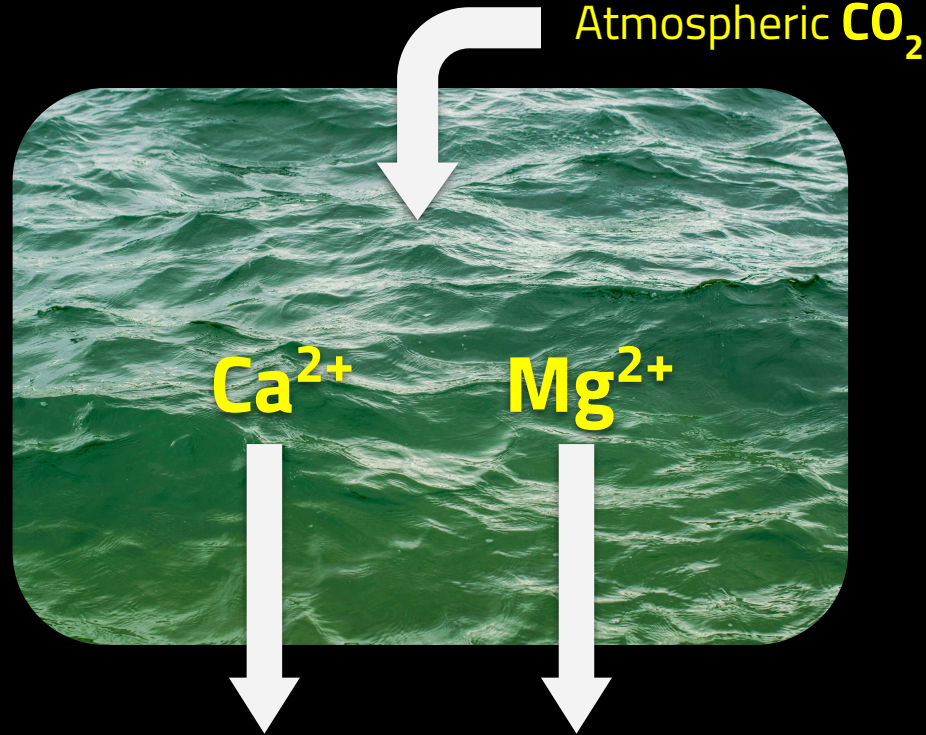


Current era

Nitrogen
Oxygen
Trace elements



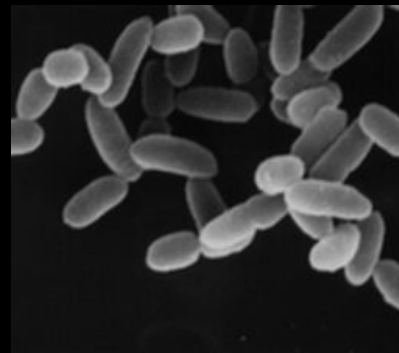
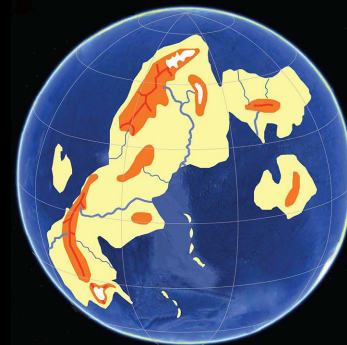
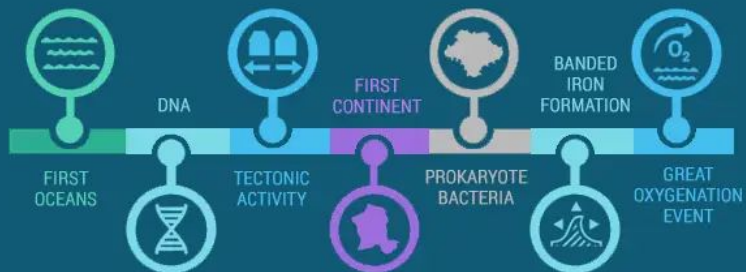




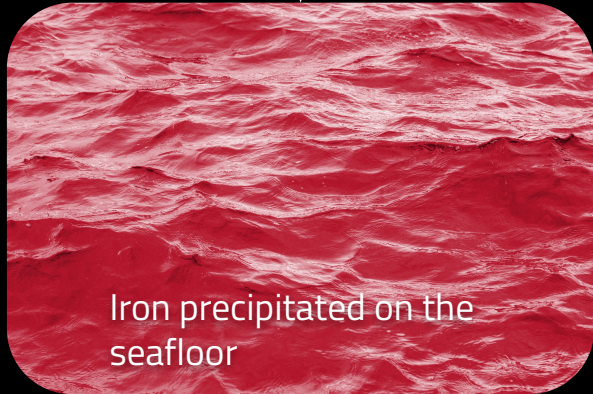
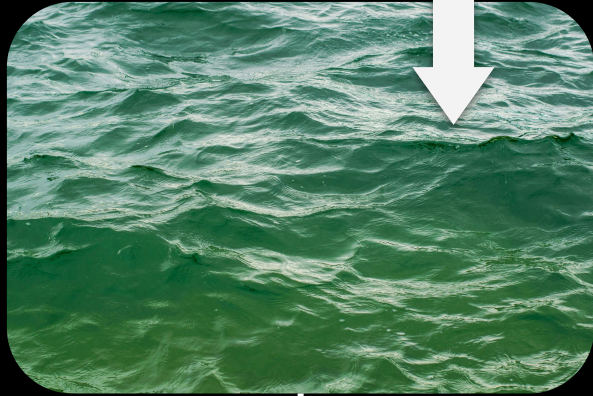
Precipitated and locked in sediments and rocks

ARCHEAN ERA

4.0 to 2.5 billion years ago



Atmospheric O_2

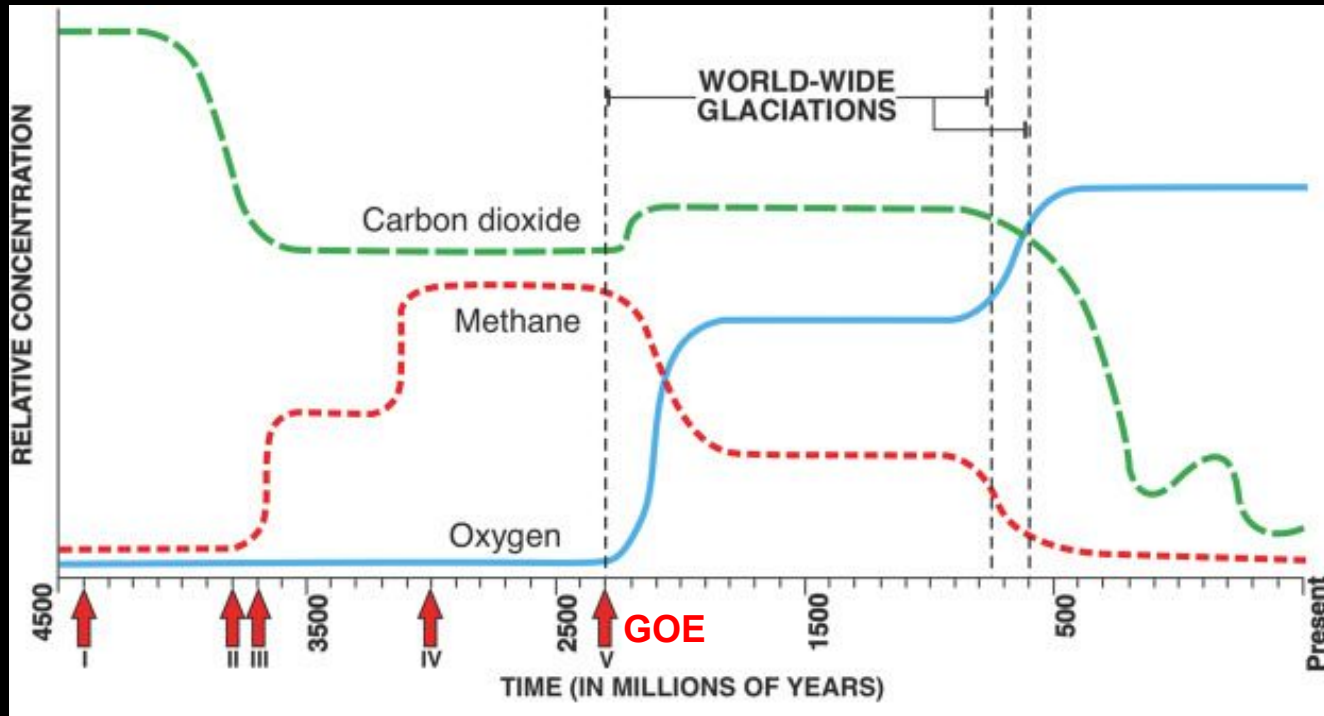


Iron precipitated on the seafloor



Banded iron formation

Great Oxidation Event (GOE) ~2.3 to 2.2 bya



PROTEROZOIC EON

2500 to 541 million years ago



OXYGEN
CRISIS



FIRST
EUKARYOTES



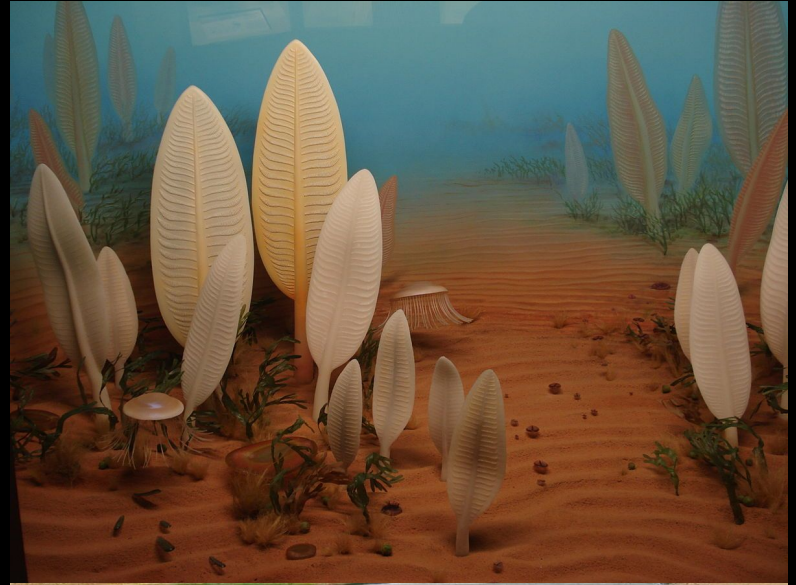
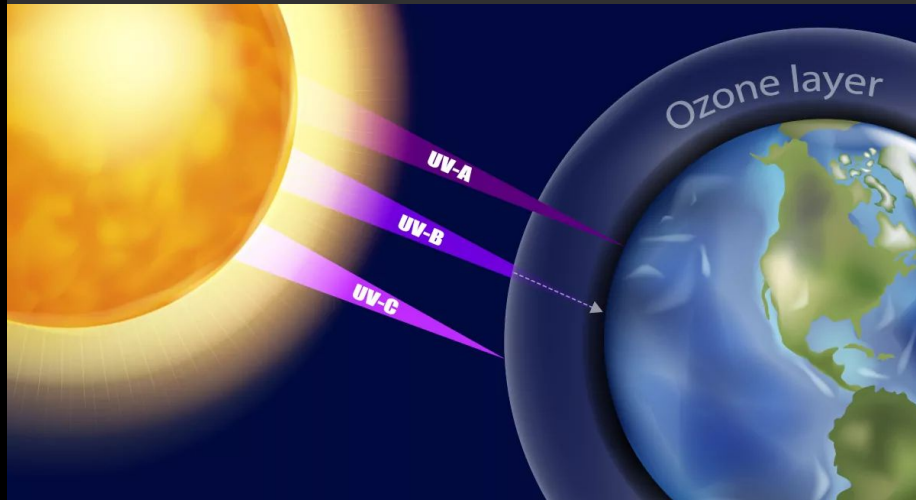
SNOWBALL
EARTH



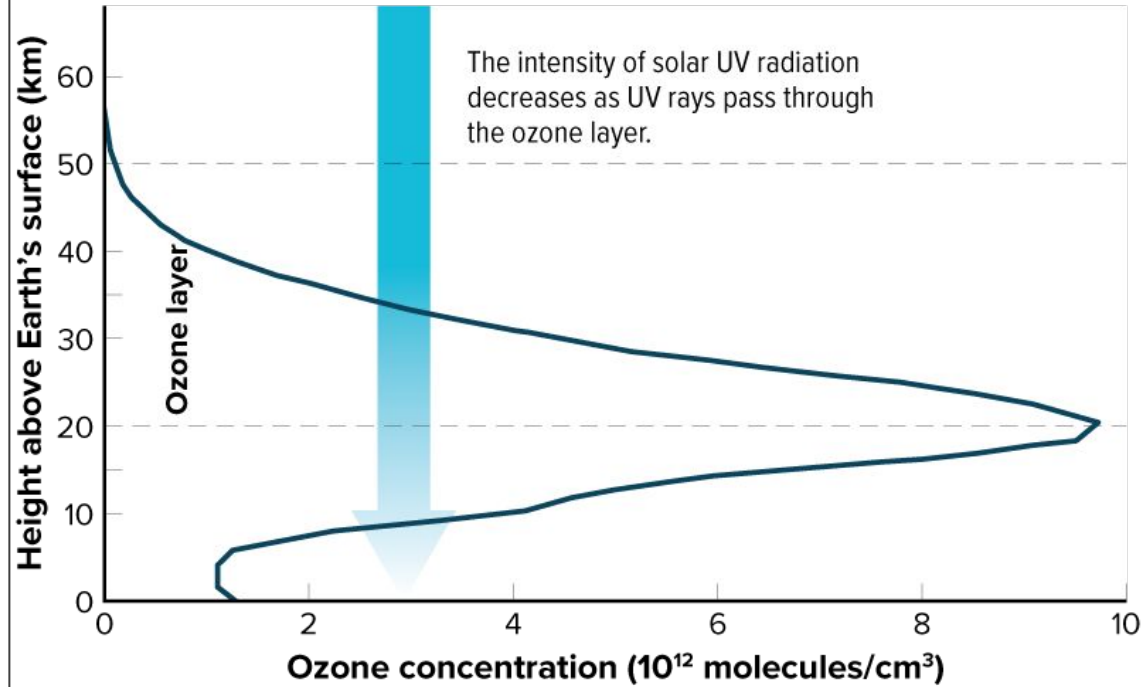
MULTICELLULAR
LIFE



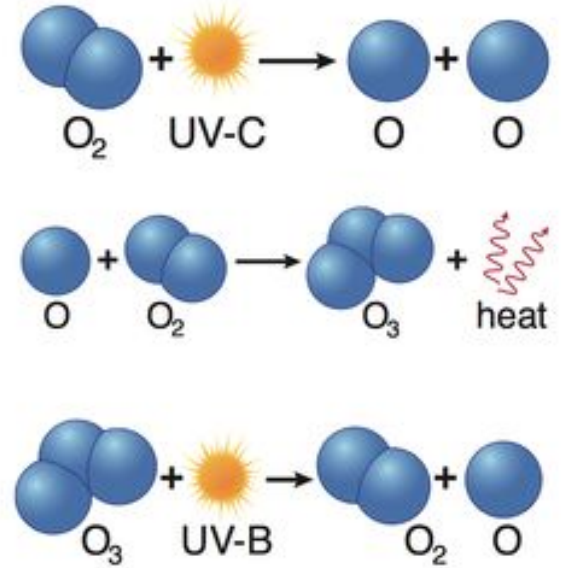
OZONE
STABILIZATION

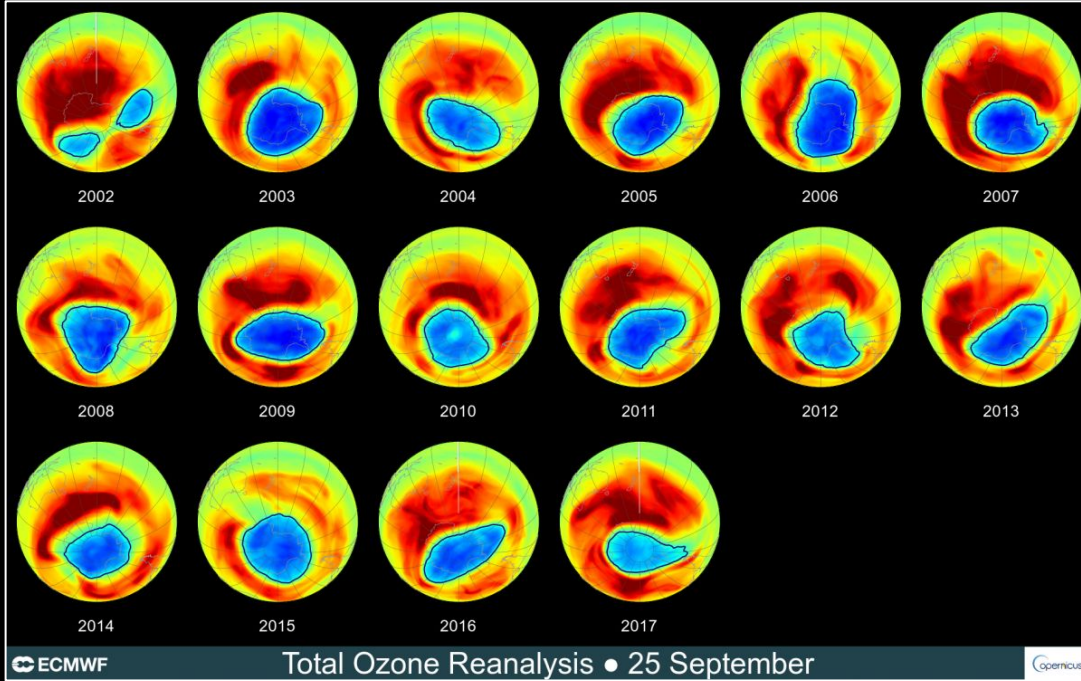


Change in Ozone with Height



Natural ozone production & destruction





OZONE-DEPLETING SUBSTANCES CAN BE FOUND IN THESE PRODUCTS:



Refrigerator



Fire extinguisher



Air-conditioning



Solvent



Foam Insulation

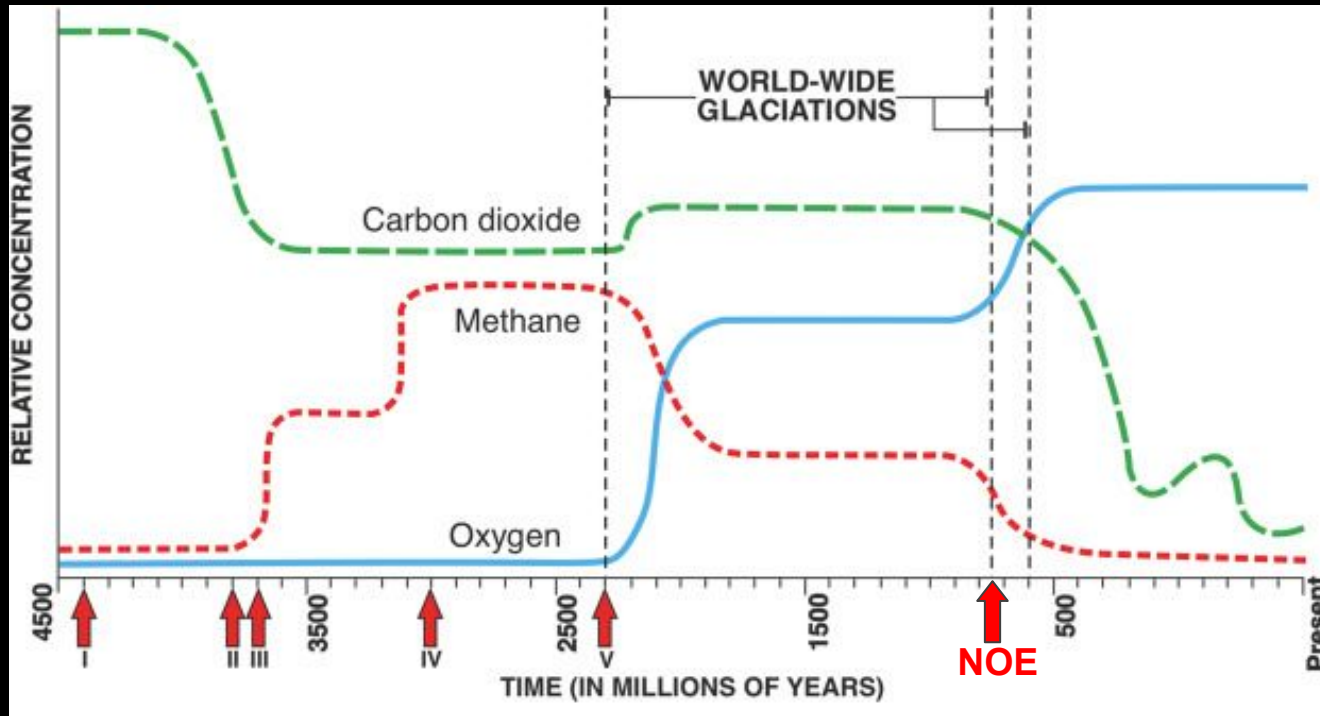


Aerosol

Montreal Protocol (1987)

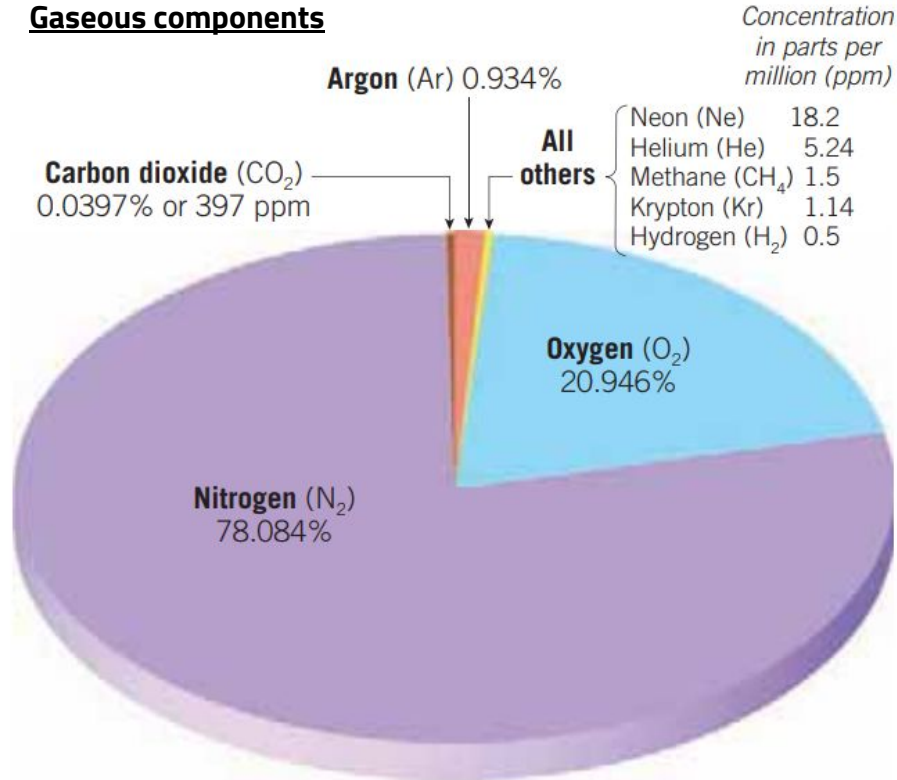
International agreement aimed at protecting the ozone layer by regulating the use of ozone-depleting substances.

Neoproterozoic Oxidation Event (NOE) ~800 to 542 mya



Composition of Earth's atmosphere

Gaseous components



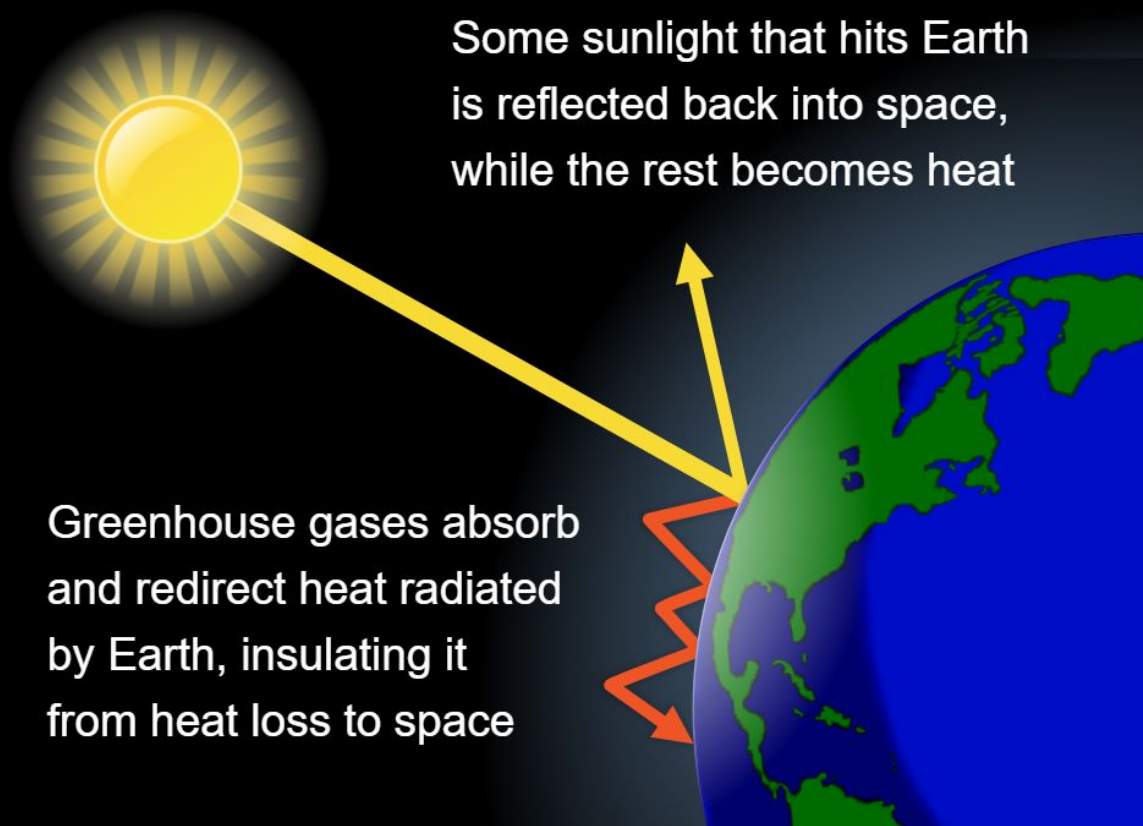
Variable components: important substances in the atmosphere that vary between time and locations

Water vapor: constitutes about 0% to 4% of the atmosphere by volume, depending on temperature and humidity conditions

Ozone: concentrated in a zone 20-50 km from the surface; constitutes 0.0012% of the atmosphere

Aerosols: tiny suspended particles in the air (dust, soot, and others) that could affect air quality and weather

The Greenhouse Effect



Planets and atmospheres

Mars

Thin atmosphere

(Almost all CO₂ in ground)

Average temperature : - 50°C



Earth

0,03% of CO₂ in the atmosphere

Average temperature : + 15°C



Venus

Thick atmosphere

containing 96% of CO₂

Average temperature : + 420°C



GRAPHIC DESIGN : PHILIPPE REKACEWICZ

Sources: Calvin J. Hamilton, Views of the solar system, www.planetscapes.com; Bill Arnett, The nine planets, a multimedia tour of the solar system, www.seds.org/billa/tnp/nineplanets.html

Natural Greenhouse Effect

More Heat Escapes
Into Space

Less
Re-emitted
Heat

Re-radiated
Heat

Greenhouse Gases

Human Enhanced Greenhouse Effect

Less Heat Escapes
Into Space

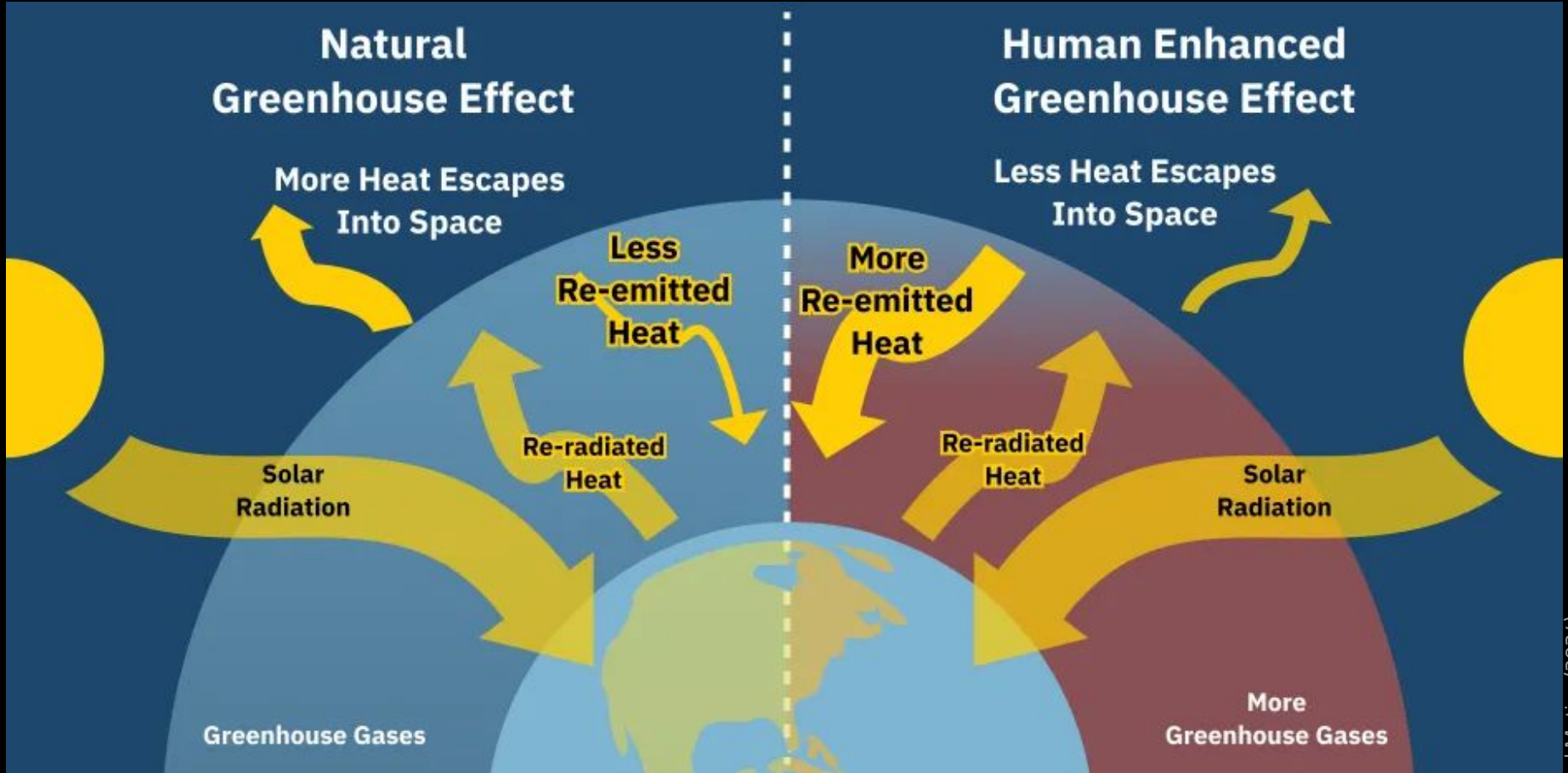
More
Re-emitted
Heat

Re-radiated
Heat

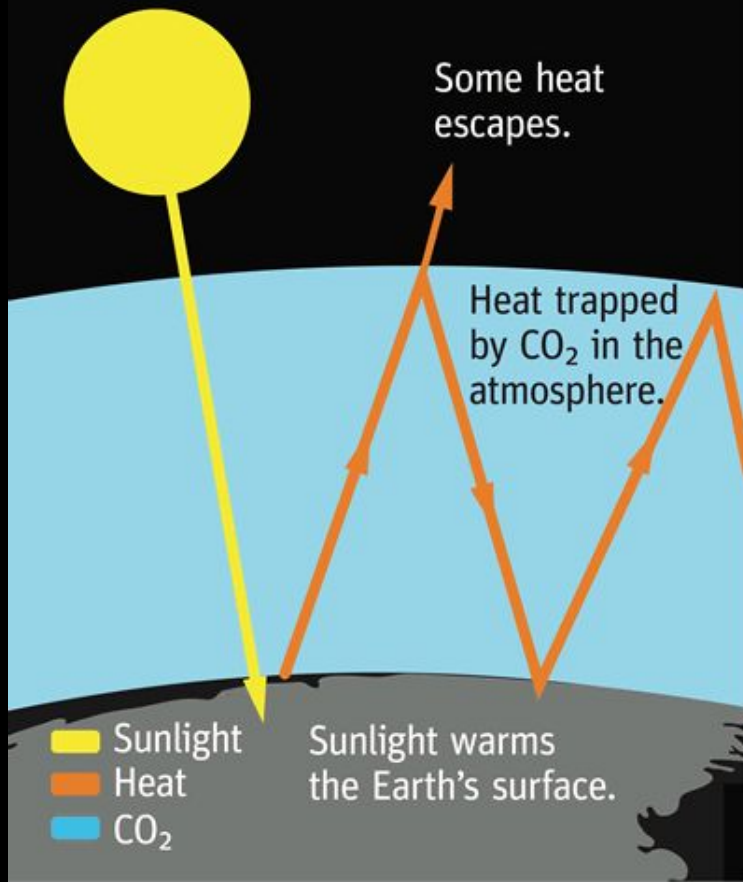
More
Greenhouse Gases

Solar
Radiation

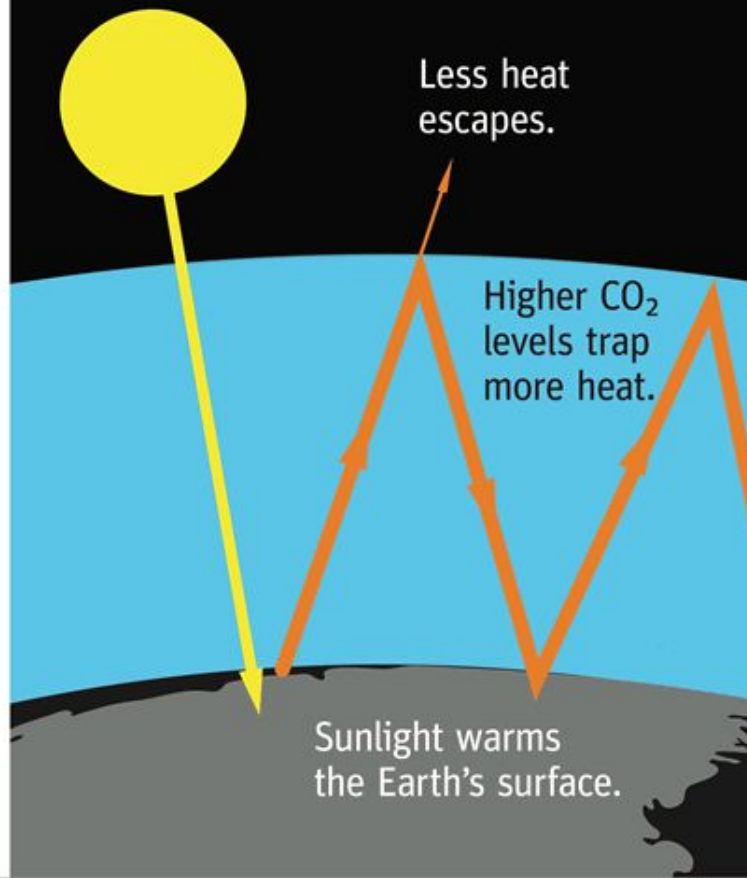
Solar
Radiation



ATMOSPHERE WITH LOWER CO₂ LEVELS



ATMOSPHERE WITH HIGHER CO₂ LEVELS



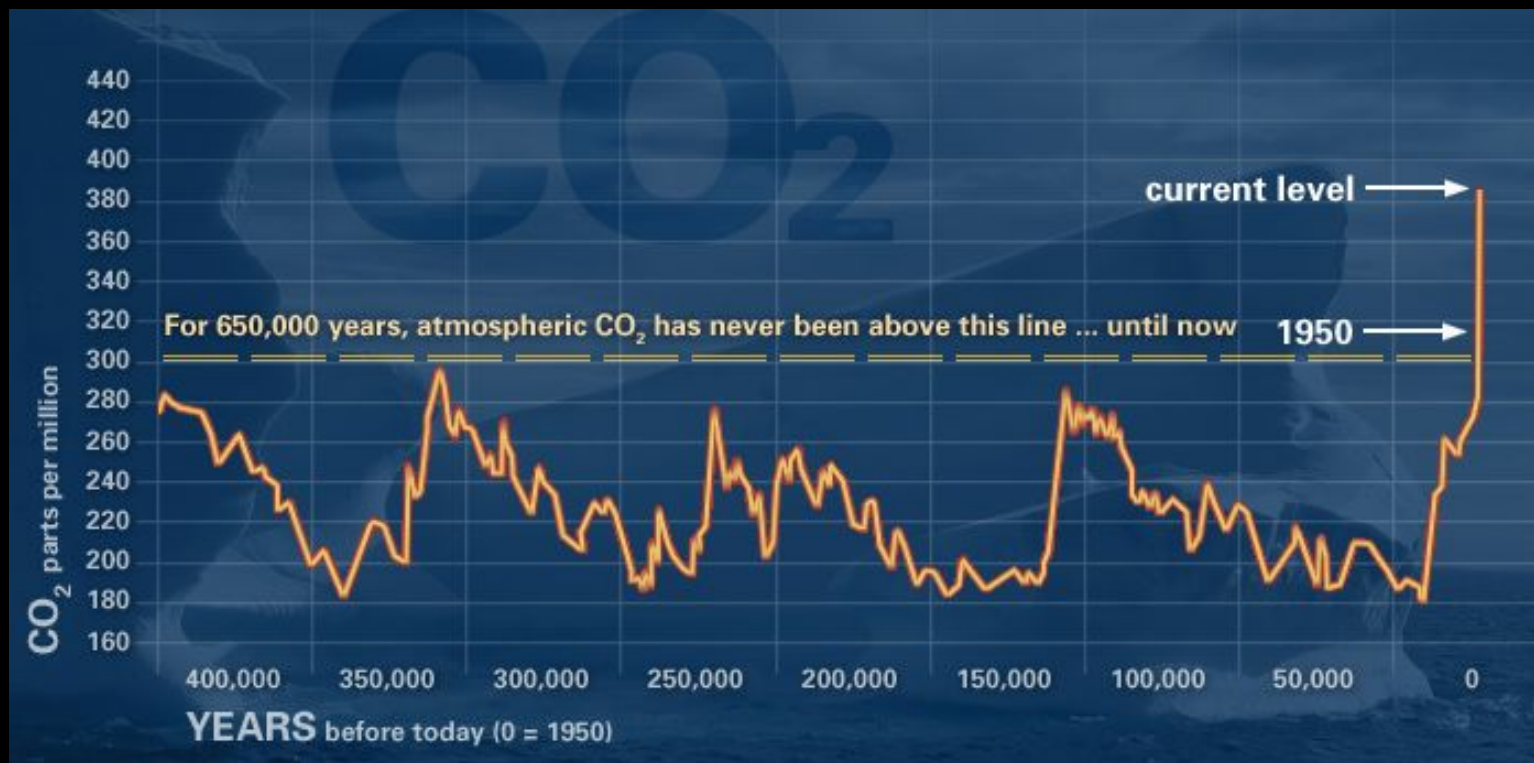


Image: https://climate.nasa.gov/images/evidence_CO2.jpg