Yes We Can
Reduce Global Warming

We Already Have

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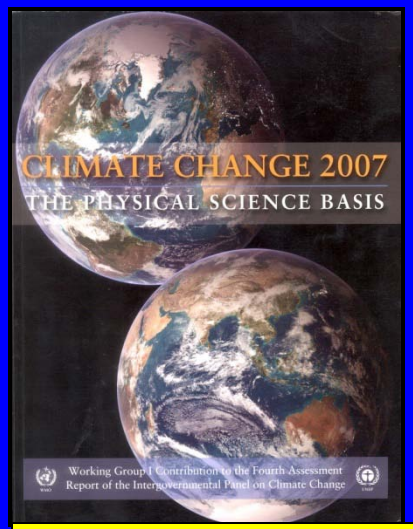
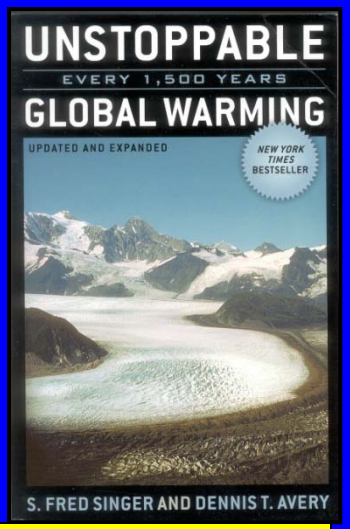
The Global Warming Controversy

We Must Act Now	It Is Inevitable
BLAME MAN	BLAME NATURE
Nobel Prize	NYT Best Seller
IPCC/Gore	Singer/Others





I Suggest An Alternative

? Initiates Climate Change?

Emphasize EMISSIONS of Greenhouse Gases

Carbon Dioxide (CO_2)

IPCC/Gore/Singer

SO_2 Initiates Climate Change

Emphasize CONSUMPTION of Greenhouse Gases

Sulfur Dioxide (SO_2)

Ward

The atmospheric vacuum cleaner

The atmospheric shower bath

Oxidizing Capacity

The atmosphere cleans out pollutants by oxidizing them

This makes the molecules larger, causing them to settle to earth or to be washed out by rain

Oxidation applies to gases such as: sulfur dioxide, carbon monoxide methane, ethane, various oxides of nitrogen and many other greenhouse gases

But What About Carbon Dioxide (CO_2)?

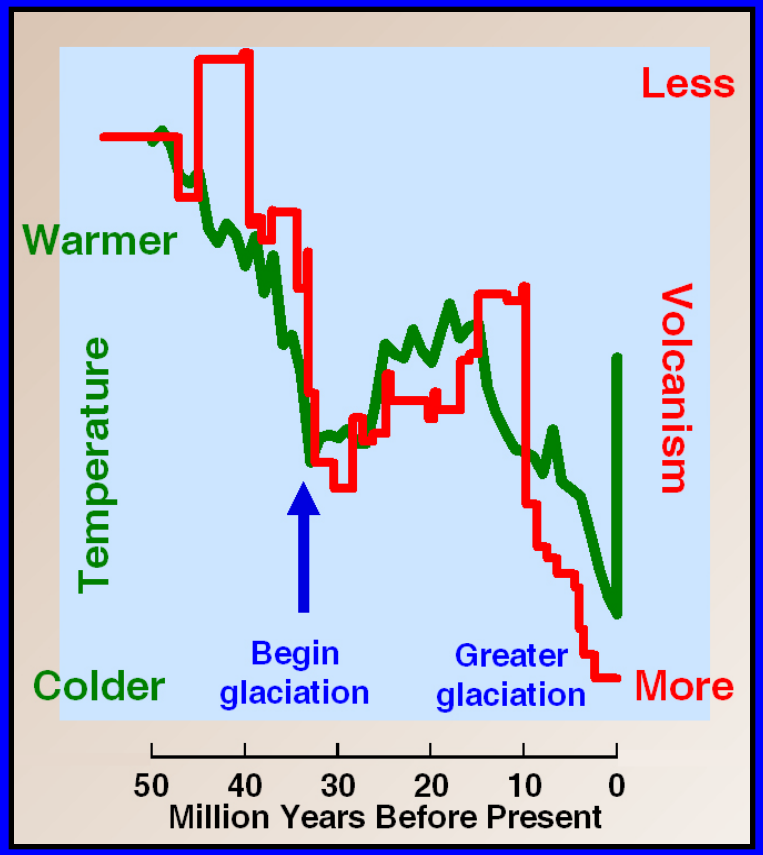
Carbon Dioxide provides the fizz in sodas
It is most soluble in cold water

Before man, the amount of CO_2 was primarily a function of ocean temperature

Increases in CO_2 typically lagged increases in temperature by 500 to 1000 years

Man emitting 8 Gt carbon/year
CO_2 is a greenhouse gas
CO_2 compounds GW
CO_2 does not initiate GW

Volcanoes cause cooling and ice ages



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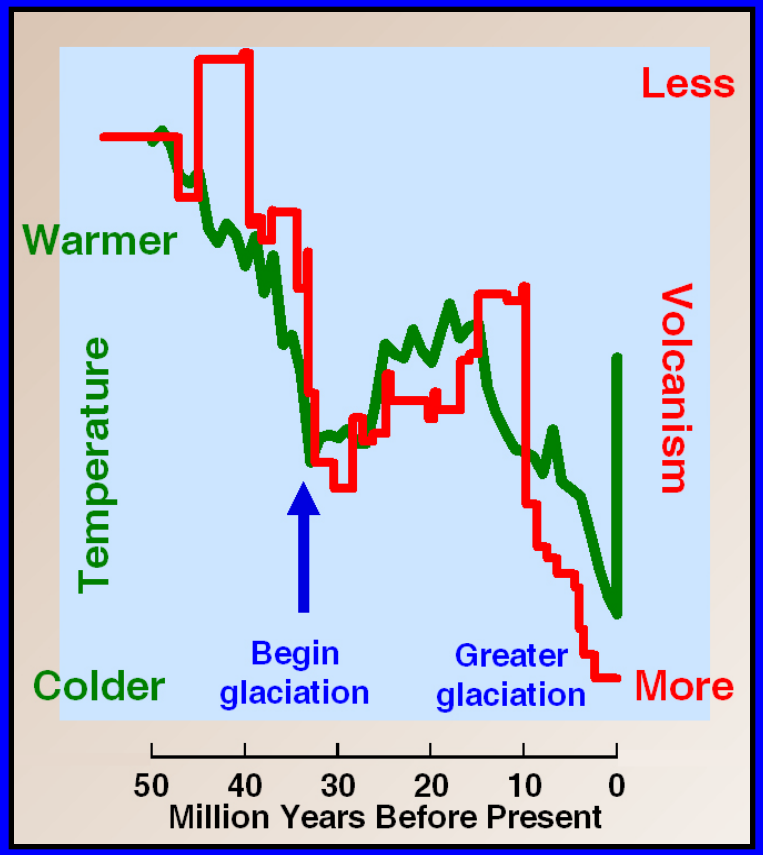
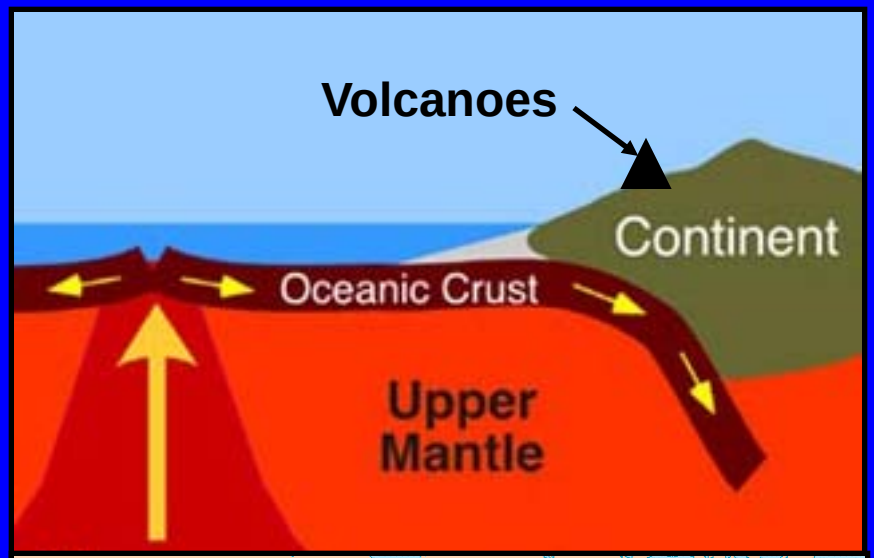
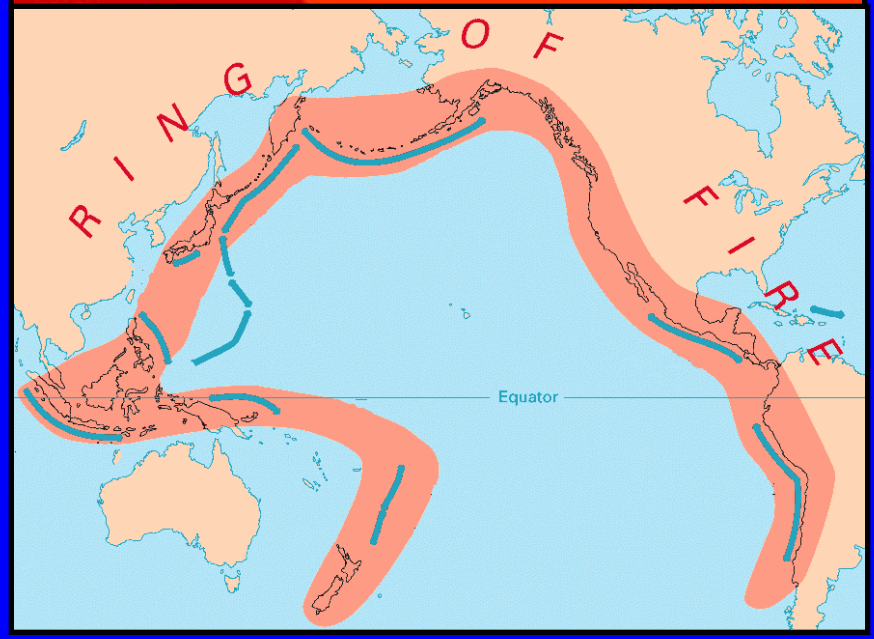
Volcanoes cause cooling and ice ages

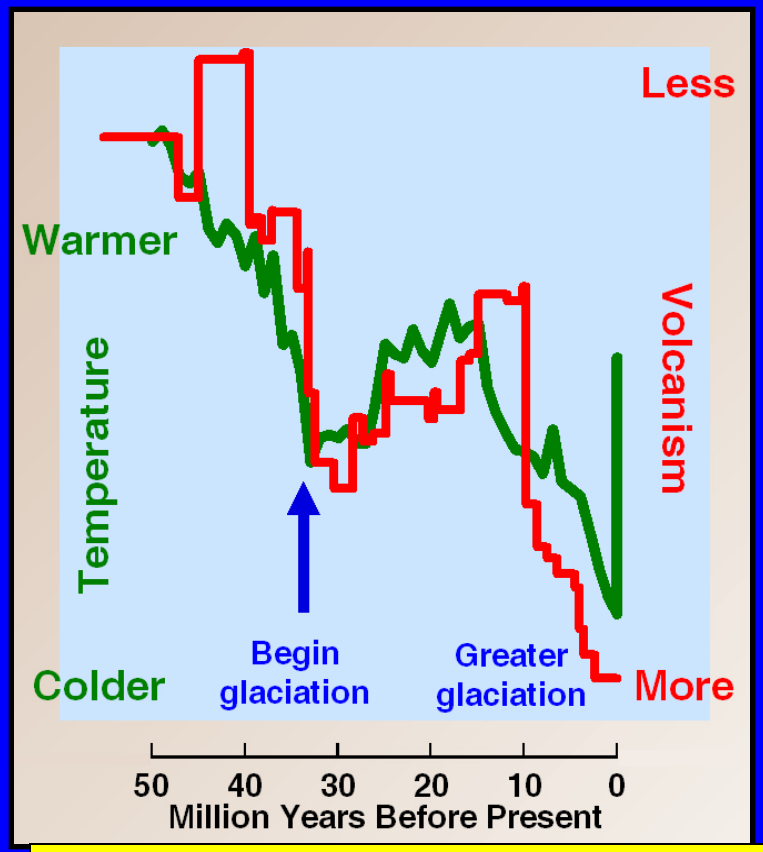






An Enigma, A Mystery

Volcanoes cause cooling and ice ages



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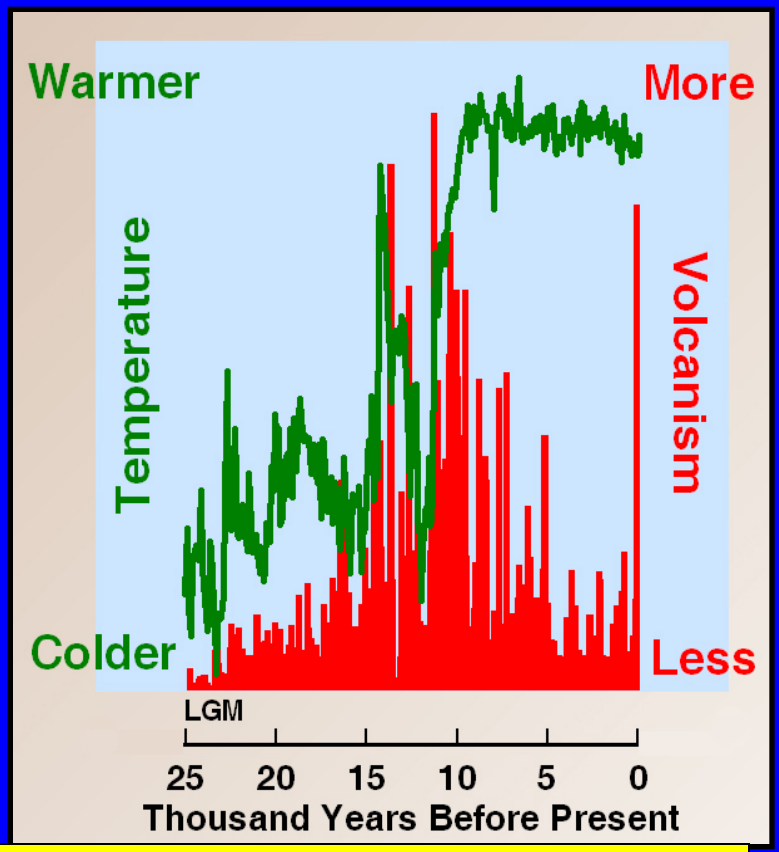
Volcanoes cause warming and the ends of ice ages



Sulfur Dioxide

The most voluminous, chemically active, volcanic gas

Trident Volcano, SW Alaska, 1963

Mt. Pinatubo in the Philippines erupts in June, 1991

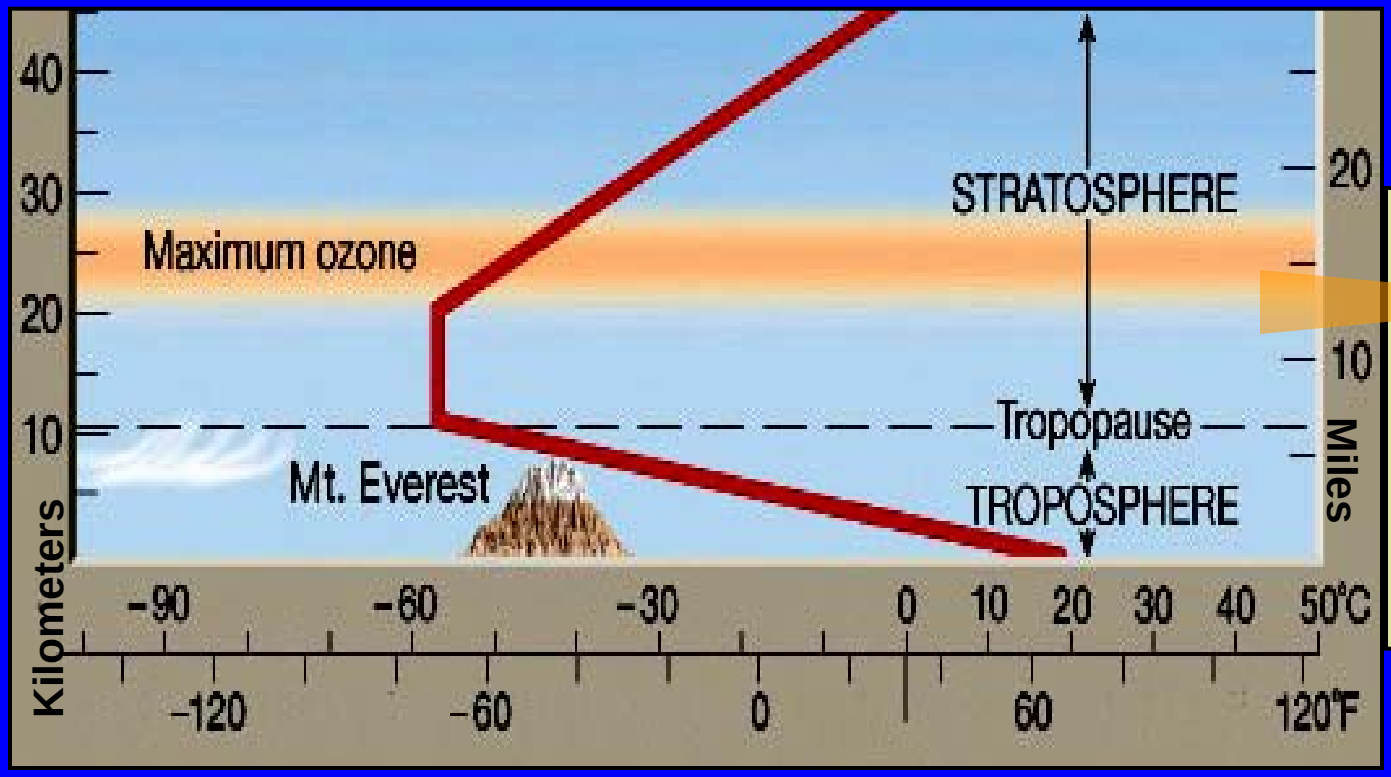
Large Volcanic Eruptions Form Aerosols

An aerosol is a gaseous suspension of fine solid or liquid particles

17 megatons of SO_2 erupted from Pinatubo formed an aerosol

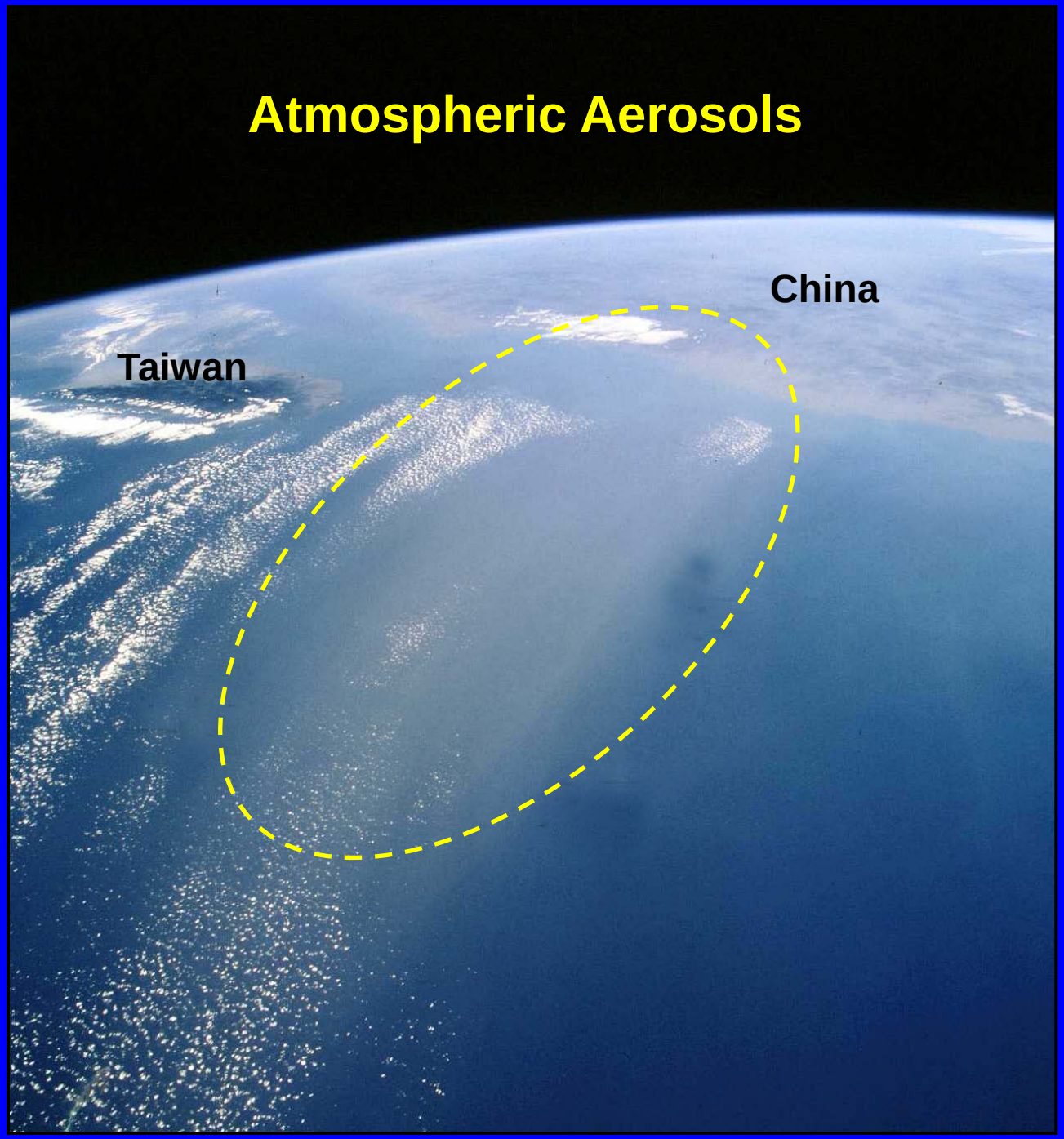
12 to 14 miles high

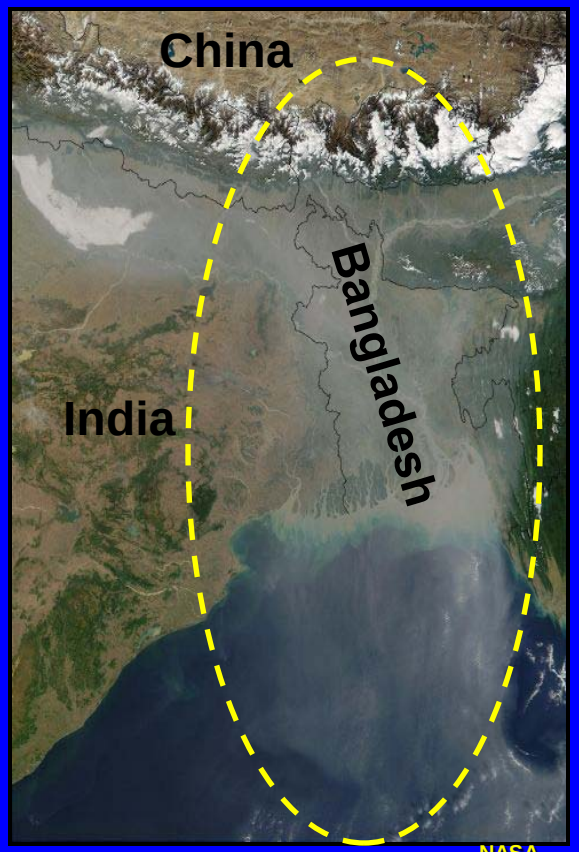
99% pure sulfuric acid + water



kidsgeo.com

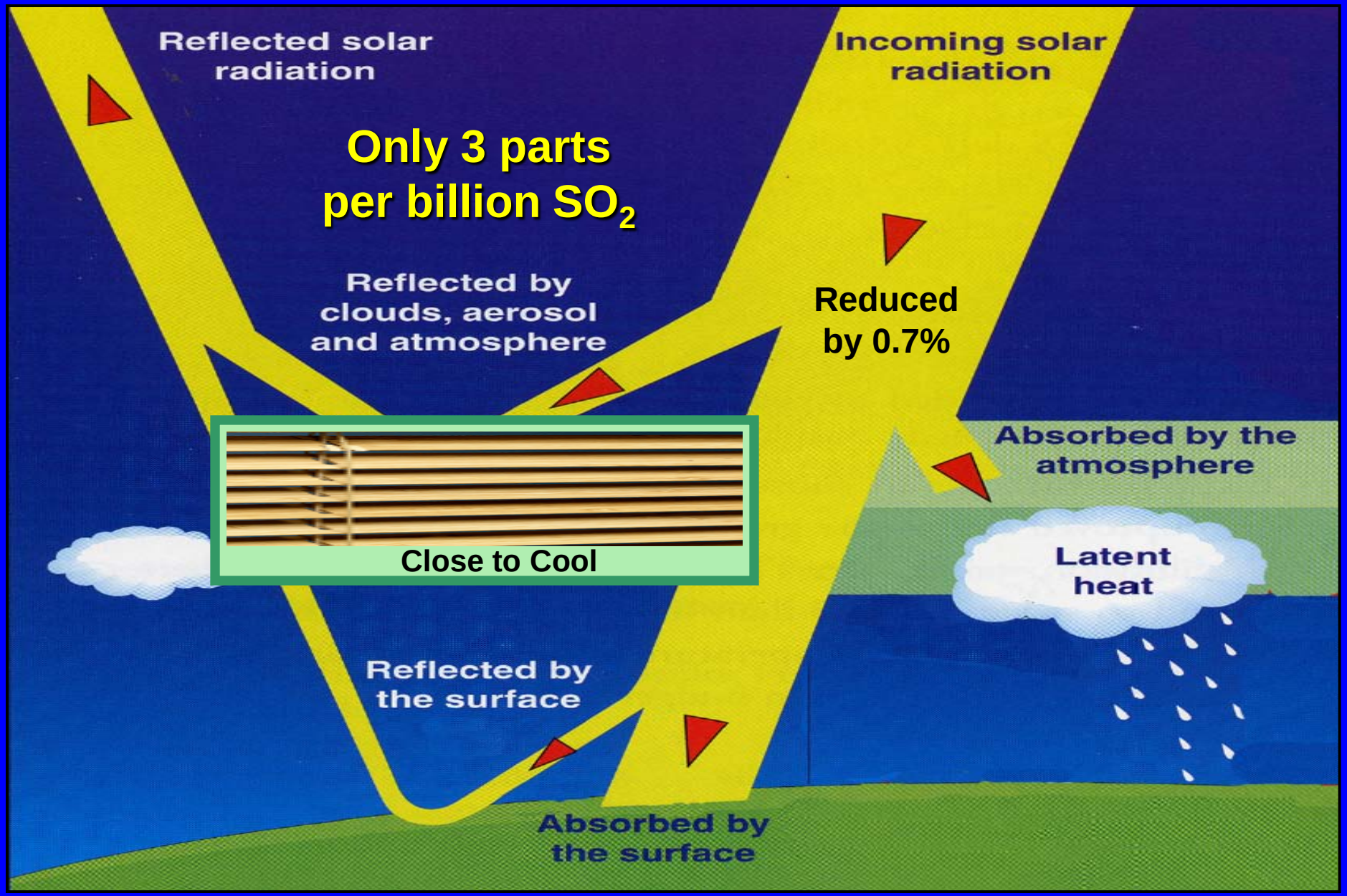
Atmospheric Aerosols





NASA

Aerosols Reflect Sunlight



Effects of Pinatubo

Temperature ↓ 0.9°F for 3 years

Diffuse radiation ↑

Photosynthesis ↑ 23%

Carbon dioxide ↓

Carbon Monoxide ↑

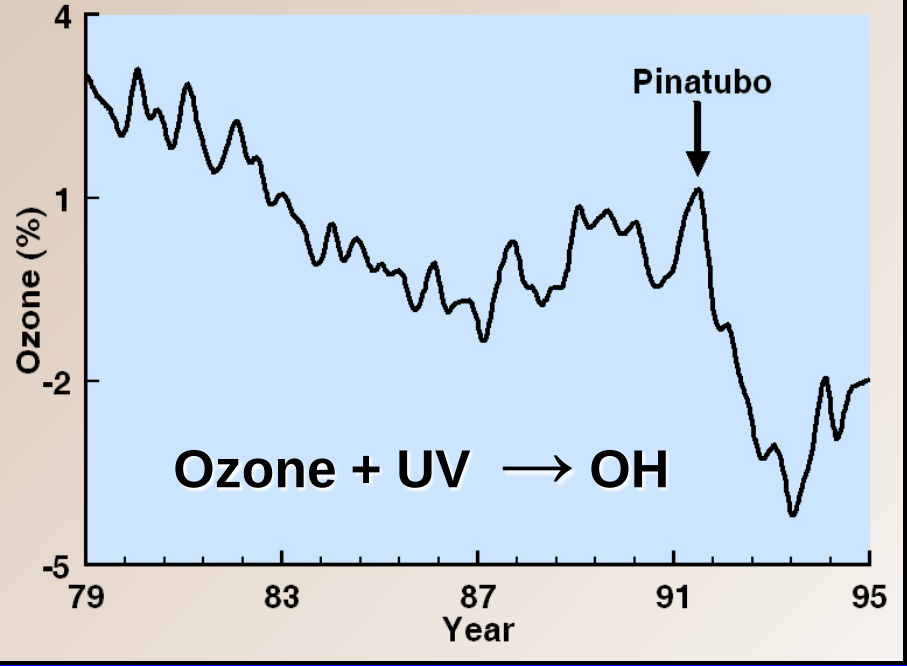
Methane ↑

Oxidizing capacity ↓

Ozone ↓ 5%

OH ↓ 10% for year

Close to Cool



$SO_2 + OH + M \rightarrow HSO_3 + M$

$HSO_3 + O_2 \rightarrow HO_2 + SO_3$

$SO_3 + H_2O + M \rightarrow H_2SO_4$

Where M is either N_2 or O_2

Individual large volcanic eruptions cause 3 years of cooling

10+ years for the atmosphere to recover

2000 Pinatubo, Philippines
Katmai. Alaska
Krakatoa, Indonesia
TAMBORA, INDONESIA
Santa Maria, Guatemala
Shiveluch, Kamchatka

Long Island, New Guinea
Billy Mitchell, Aleutian Is.
Huaynaputina, Peru

1500 Kuwae, Vanatu

Quilotoa, Ecuador

1000 CHANGBAISHAN, CHINA
Ceboruca, Mexico

Dakataua, New Britain

Churchill, Aleutian, Is.

Pago, New Britain

500 Rabaul, New Britain
Ilopango, El Salvador

Ksudach, Kamchatka
TAUPO, NEW ZEALAND

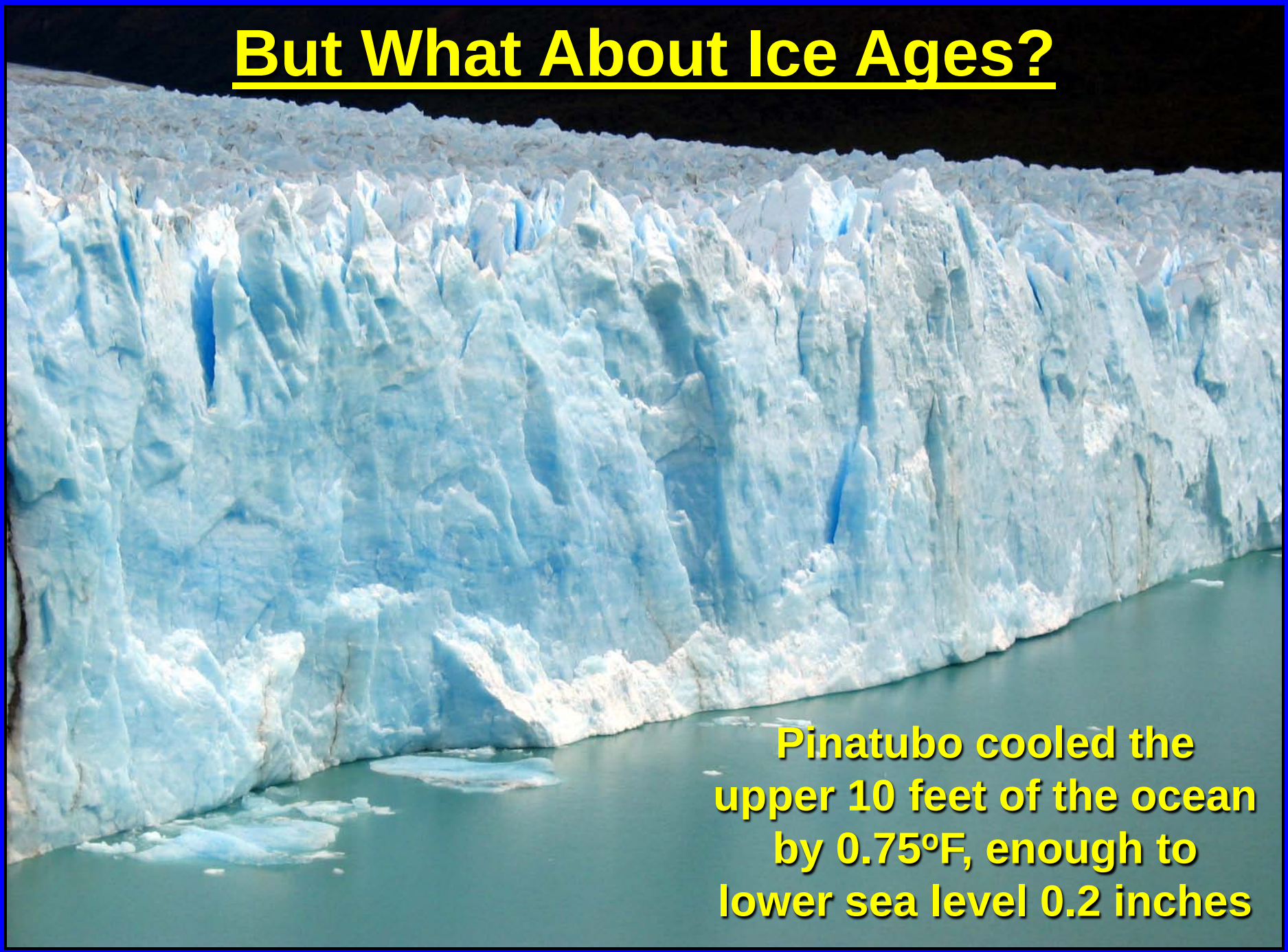
Churchill, Aleutian, Is.

Ambrym, Vanatu

0

One per century

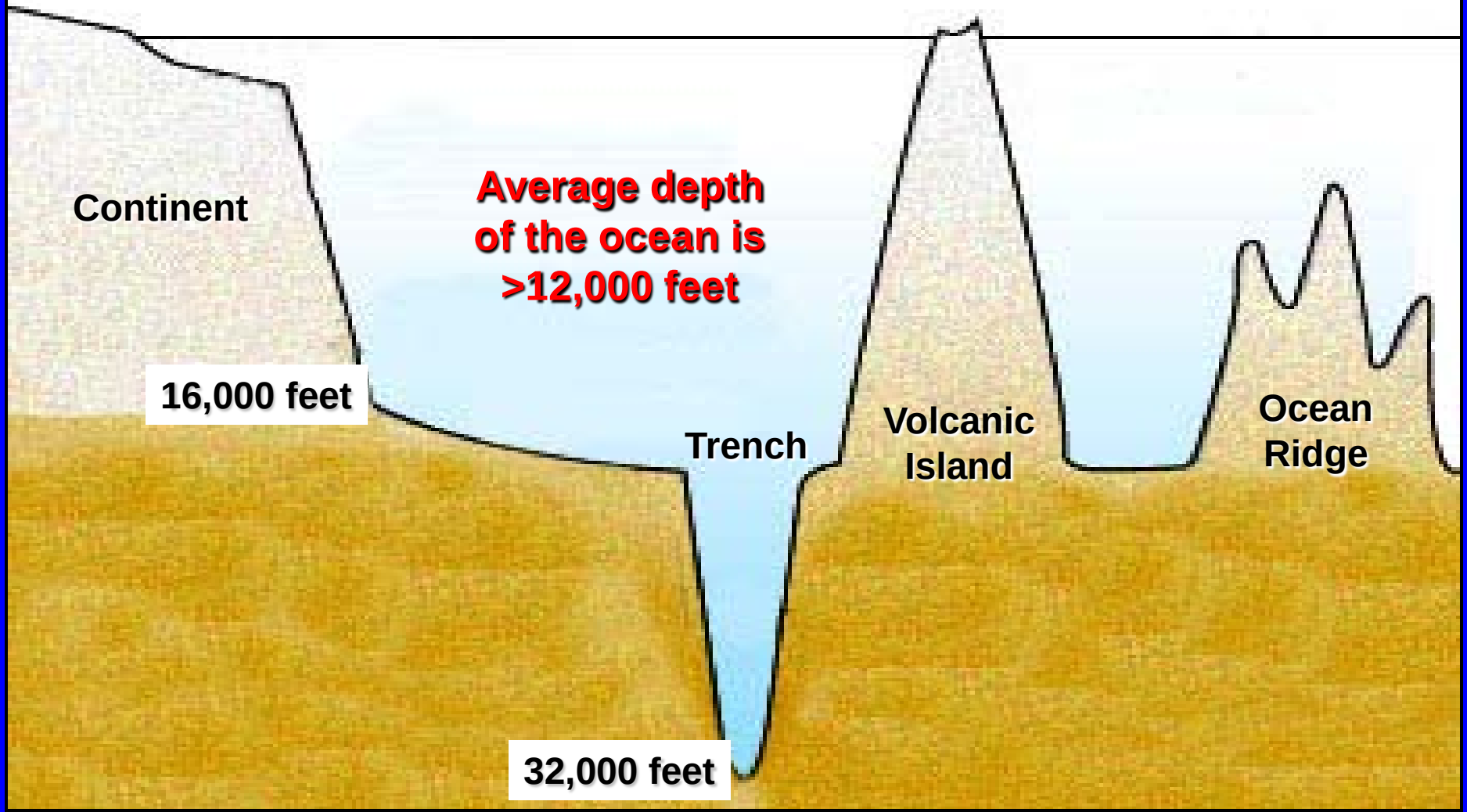
But What About Ice Ages?

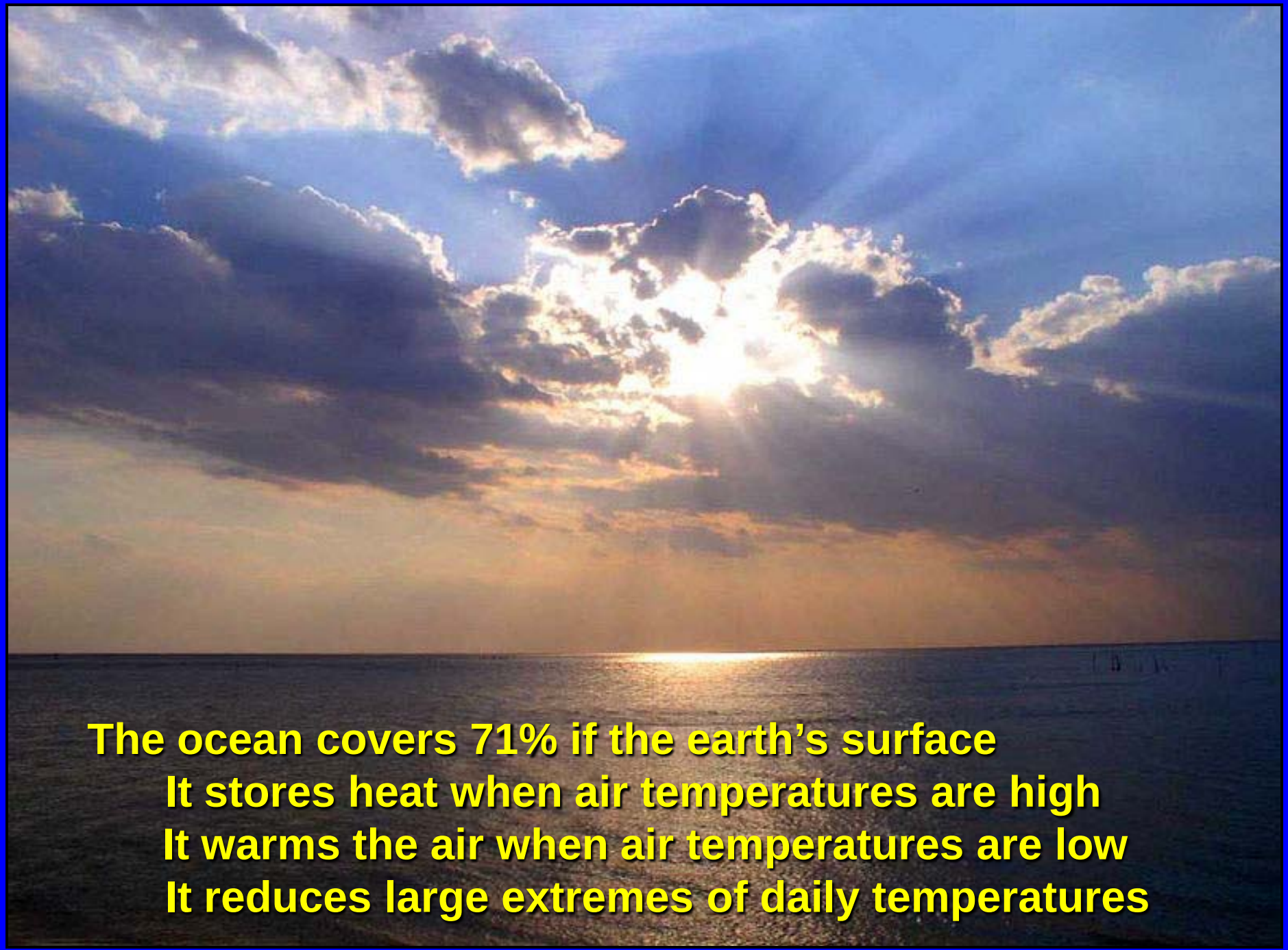


Pinatubo cooled the upper 10 feet of the ocean by 0.75ºF, enough to lower sea level 0.2 inches

The ocean has a huge capacity for heat!

12 feet of ocean depth stores the same amount of heat as the whole atmosphere





The ocean covers 71% if the earth's surface

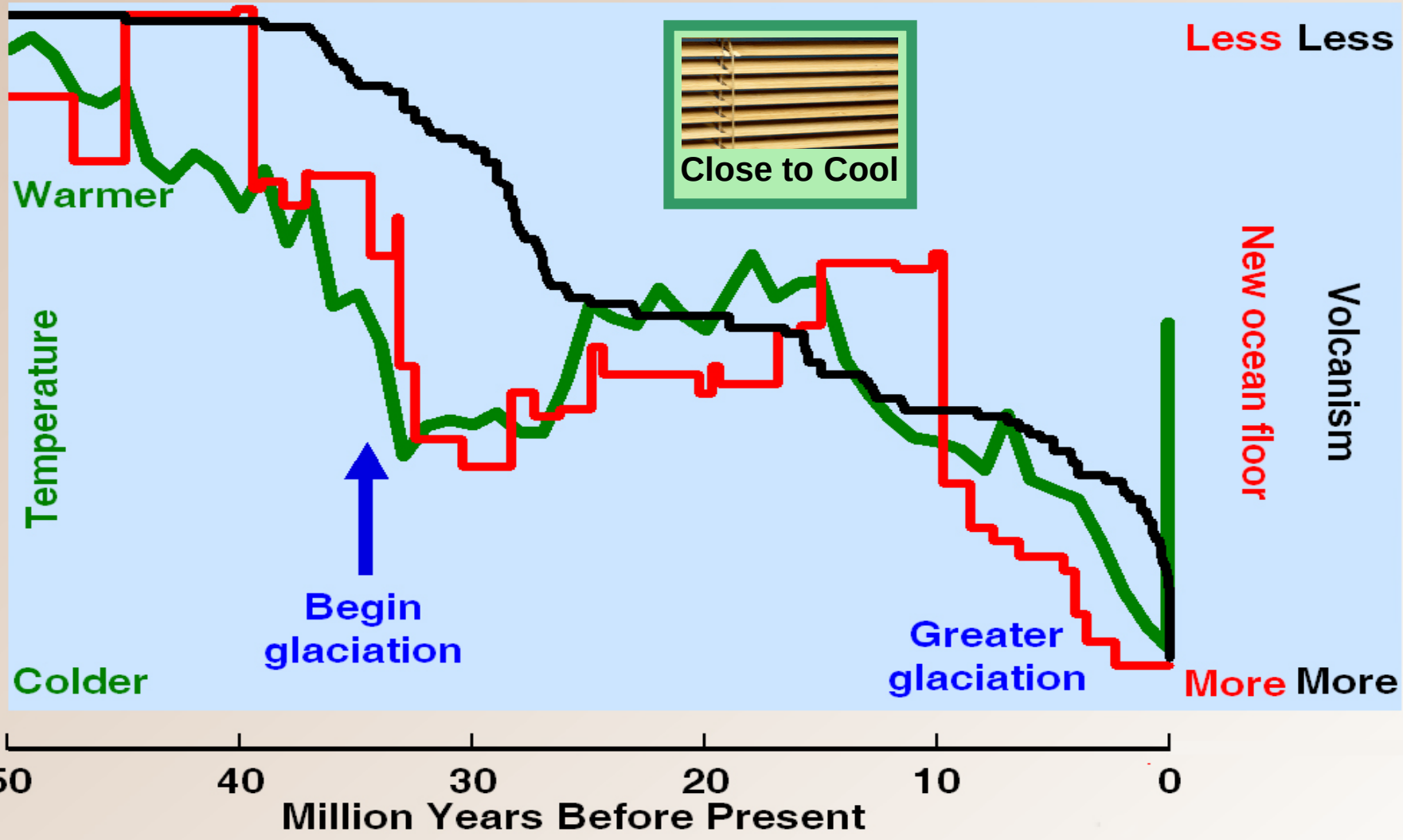
It stores heat when air temperatures are high

It warms the air when air temperatures are low

It reduces large extremes of daily temperatures

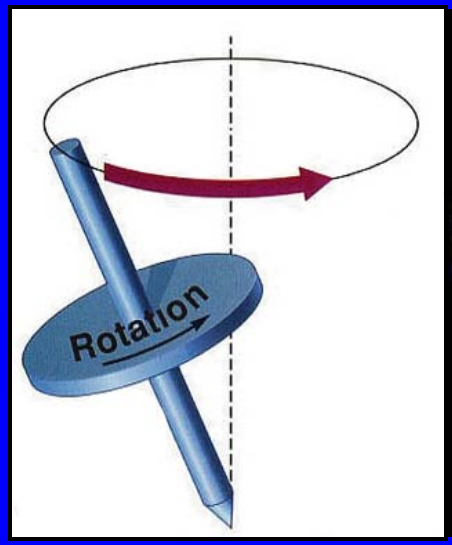

To move the earth into an ice age,
you must cool the ocean

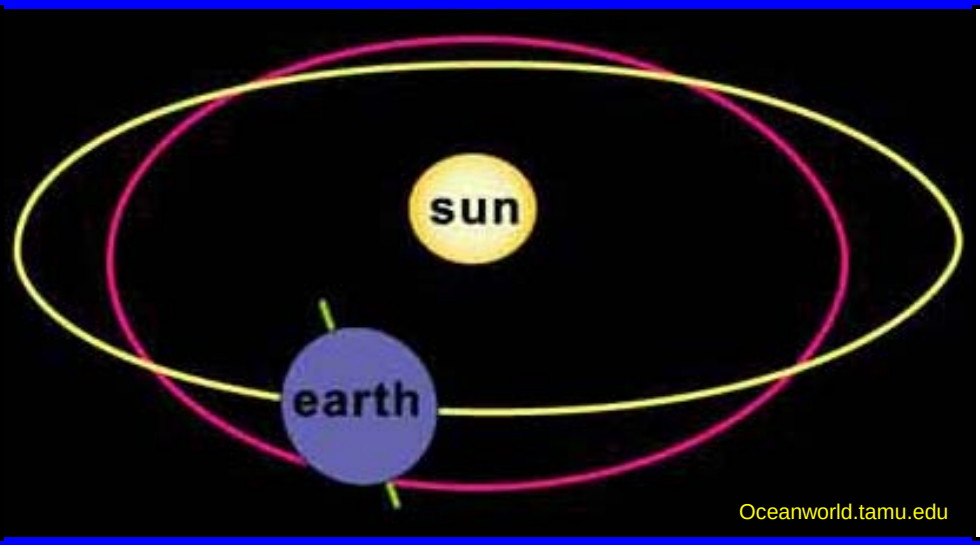
A sequence of large volcanic eruptions ratcheted the world into the last glacial epoch

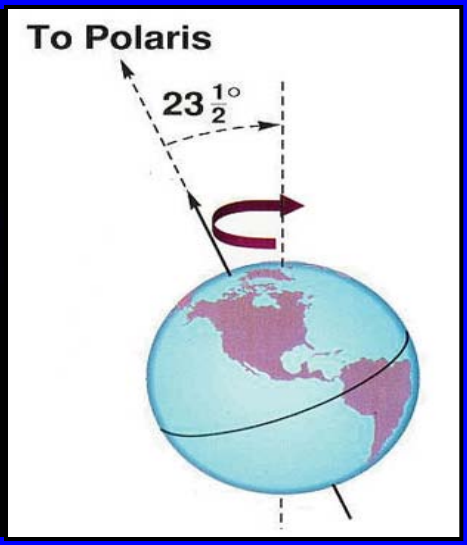


Milutin Milanković proposed in 1924 the only widely accepted theory of ice ages

Insolation = Energy received from the sun







Precession

23,000 yrs
and
26,000 yrs

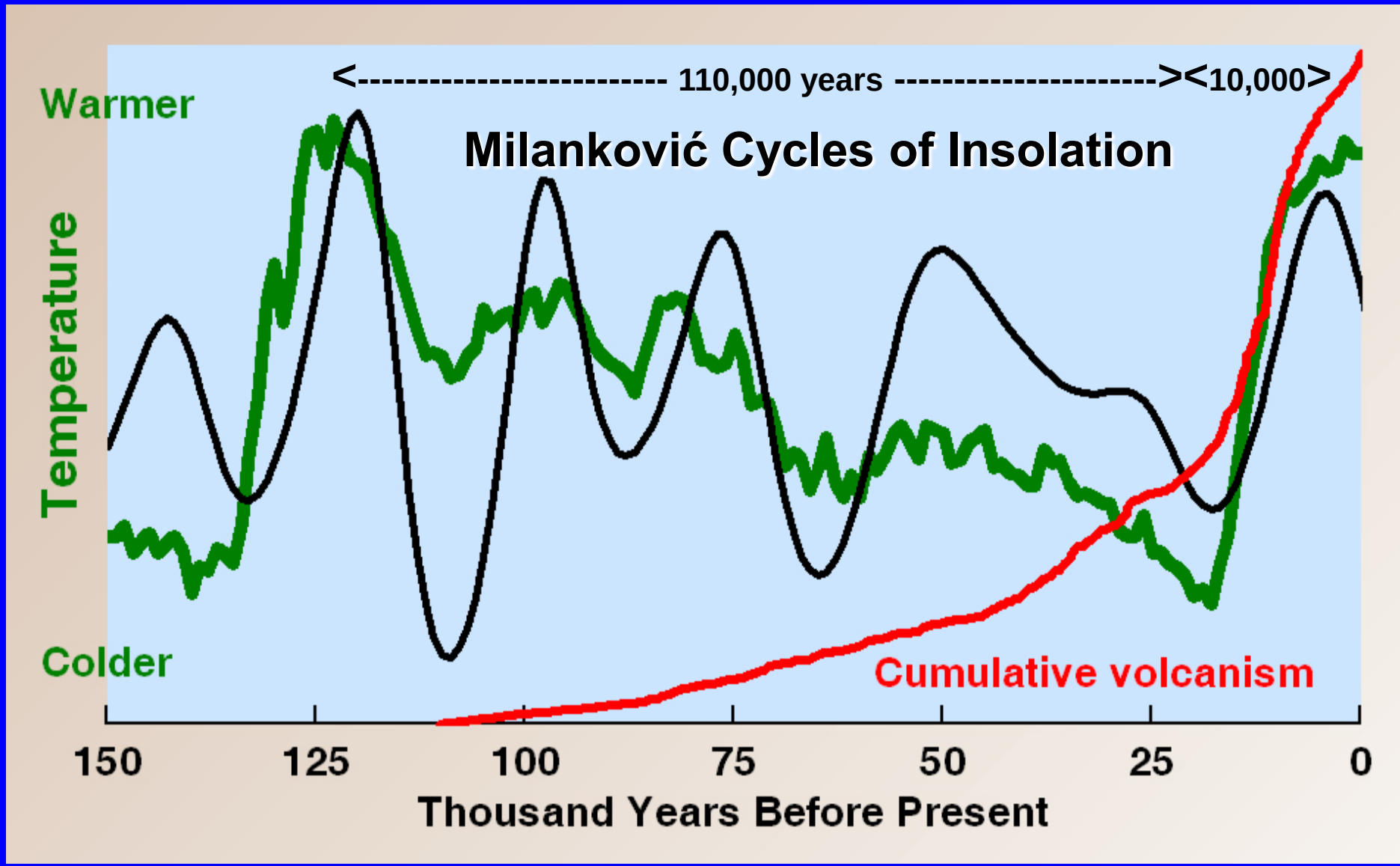
Eccentricity

100,000 yrs
to
400,000 yrs

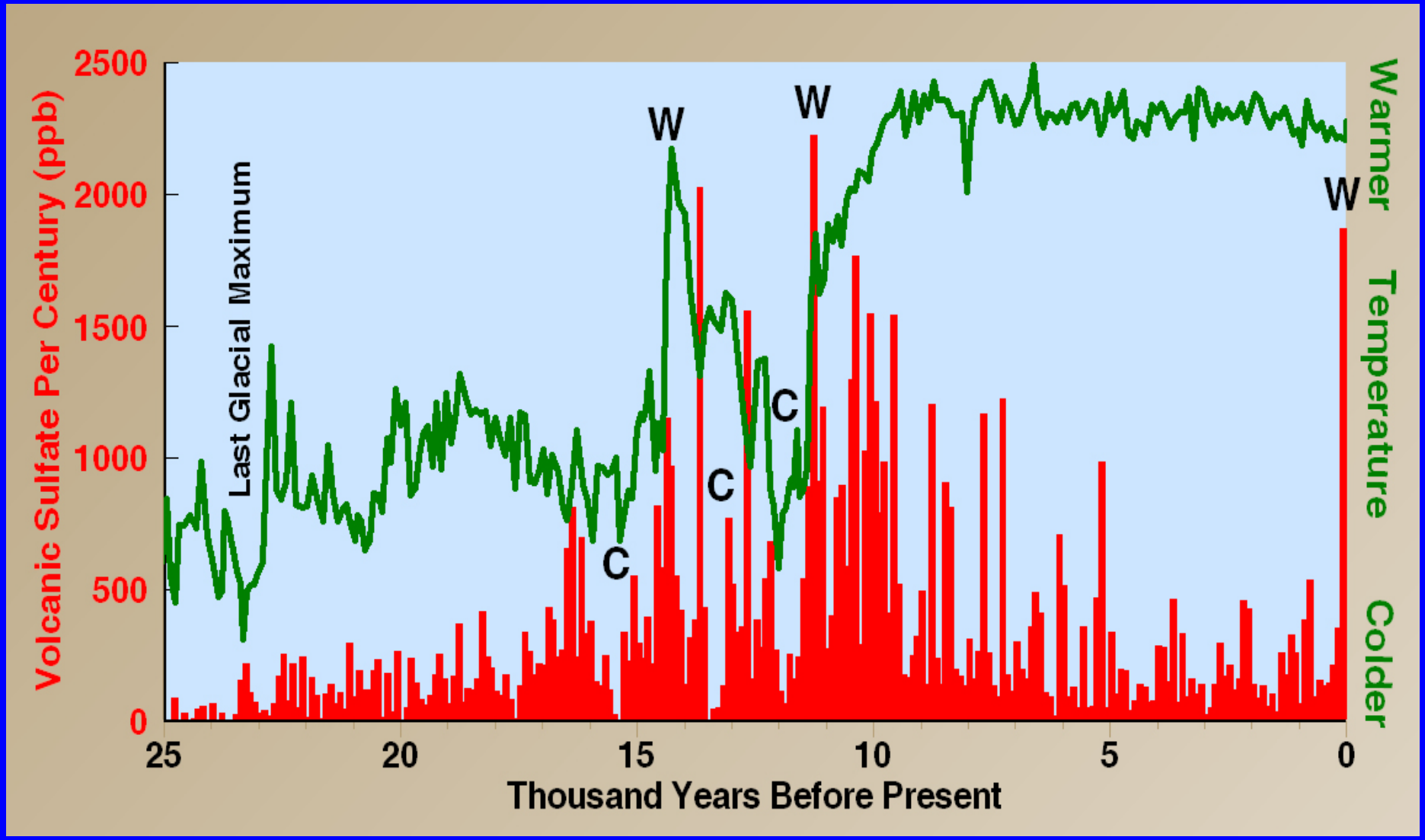
Tilt

41,000 yrs

Milanković Cycles Have An Effect But Something Else Is Going On



Greatest Warming = Greatest Volcanism



Note comparison of current warming with greatest post-glacial warming

VOLCANOES CAUSE WARMING TOO?

A major shock to nearly all climatologists and many others!

How do we know? How good are the data?


GISP2 Drill Hole at
72 36'N 38 30'W
1989-1992
Greenland Ice Sheet Project Two
GISP2

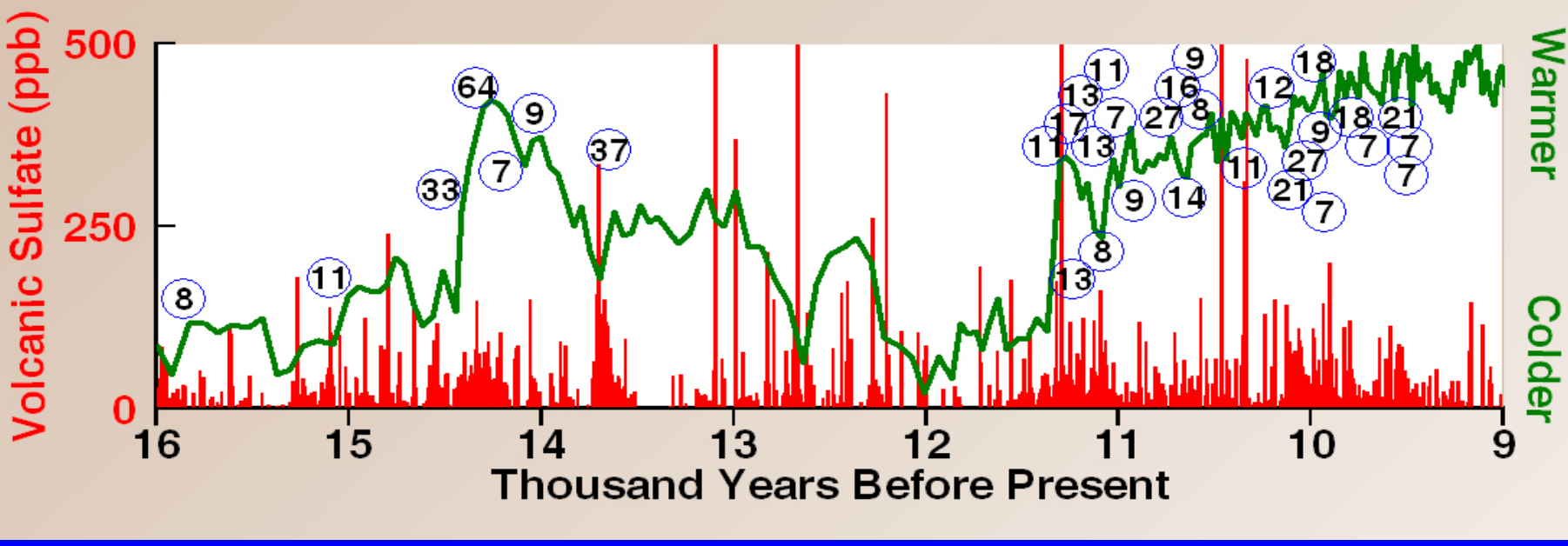
GISP2 Drill Hole
Drilled 1989-1993

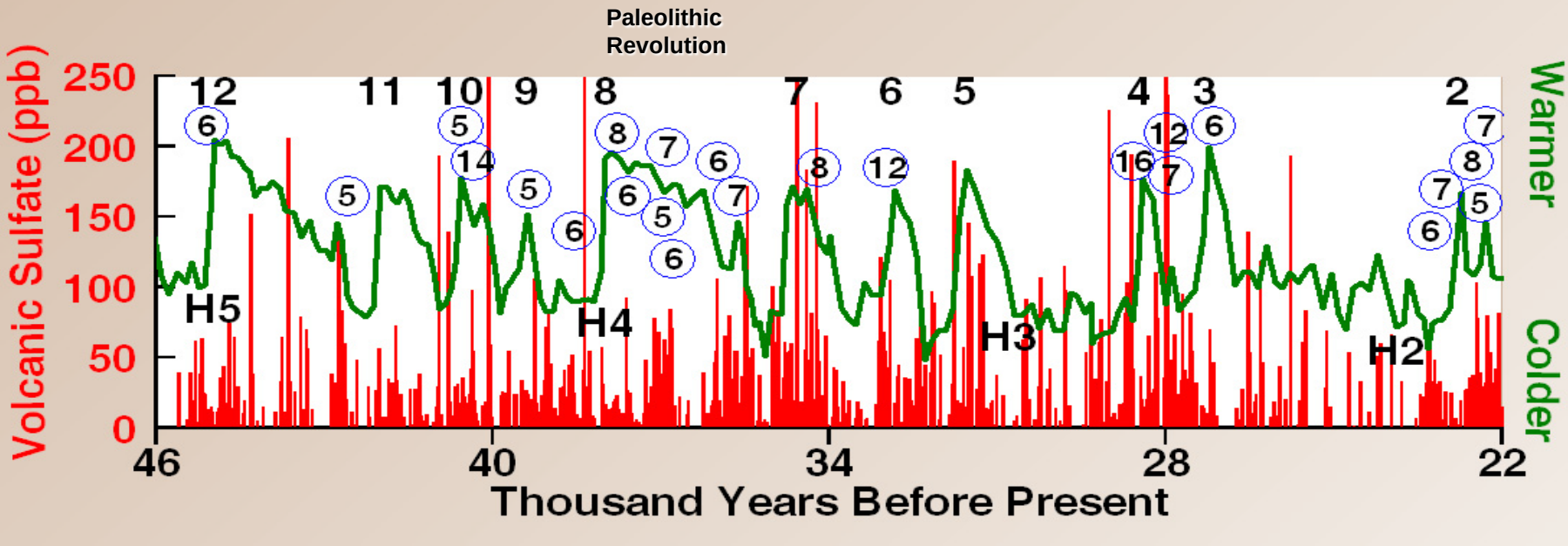
Recovered 10,017 feet or 1.9 miles of ice

Oldest ice with sulfate recovered is 110,345 years

Layers sampled usually represent 2 years back to 11,500 years.

Blue circles contain the number of contiguous layers with volcanic sulfate





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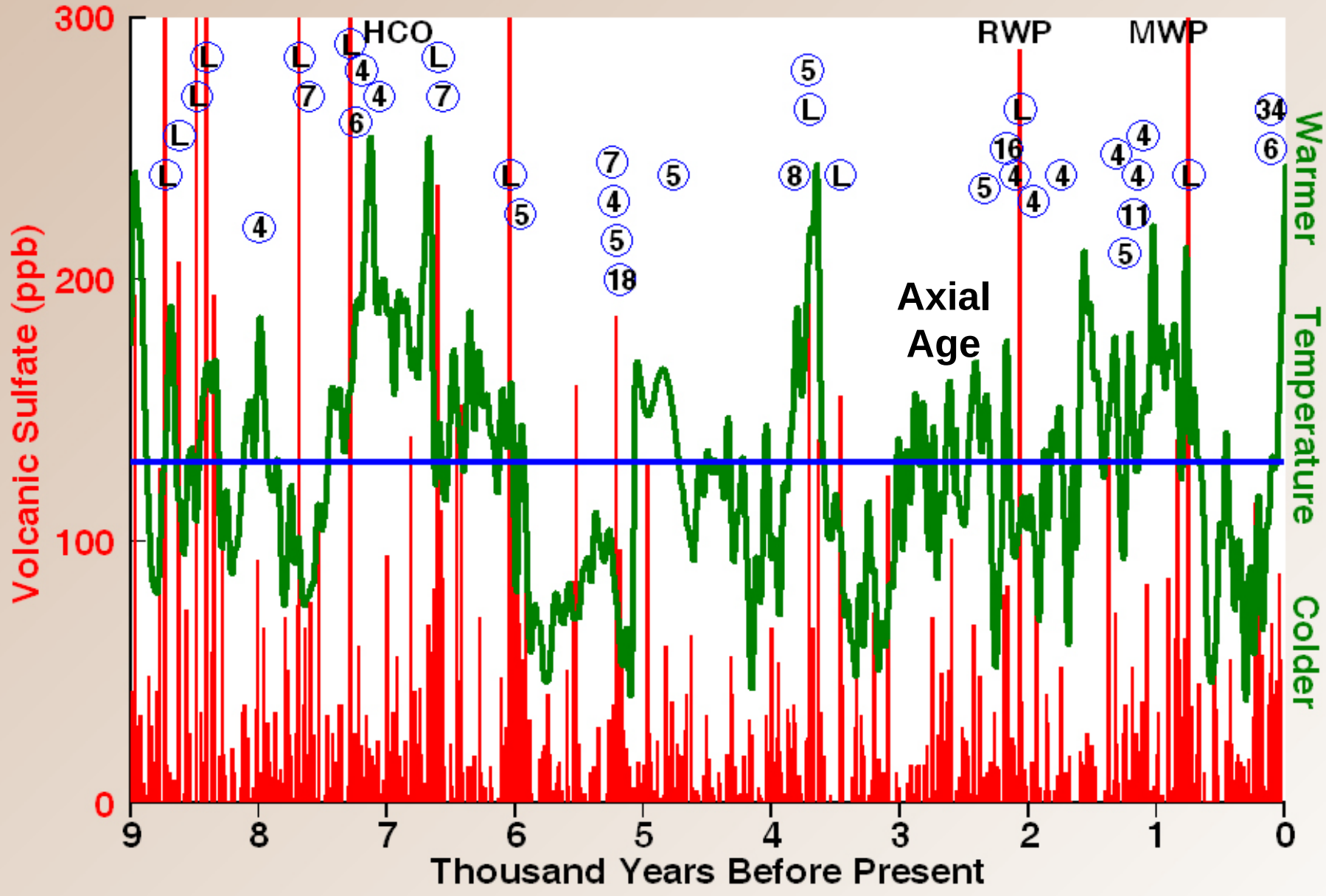


What is going on?

Close to Warm

Sulfur dioxide reacts quickly with OH

Too much sulfur dioxide leaves no OH

Concentrations of greenhouse gases increase

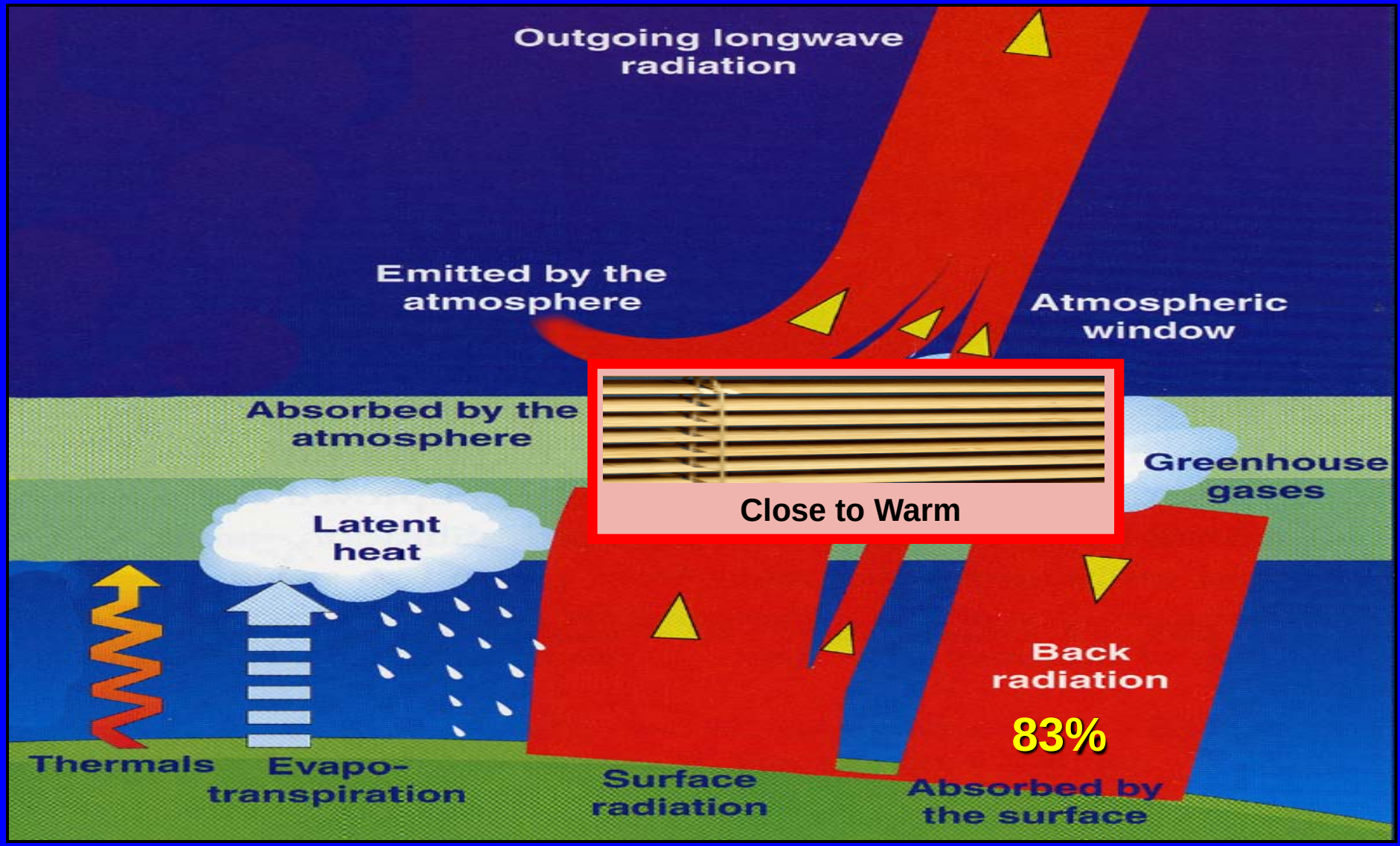
OH is formed by ultraviolet sunlight reacting with ozone

Ozone is in short supply

OH is in short supply

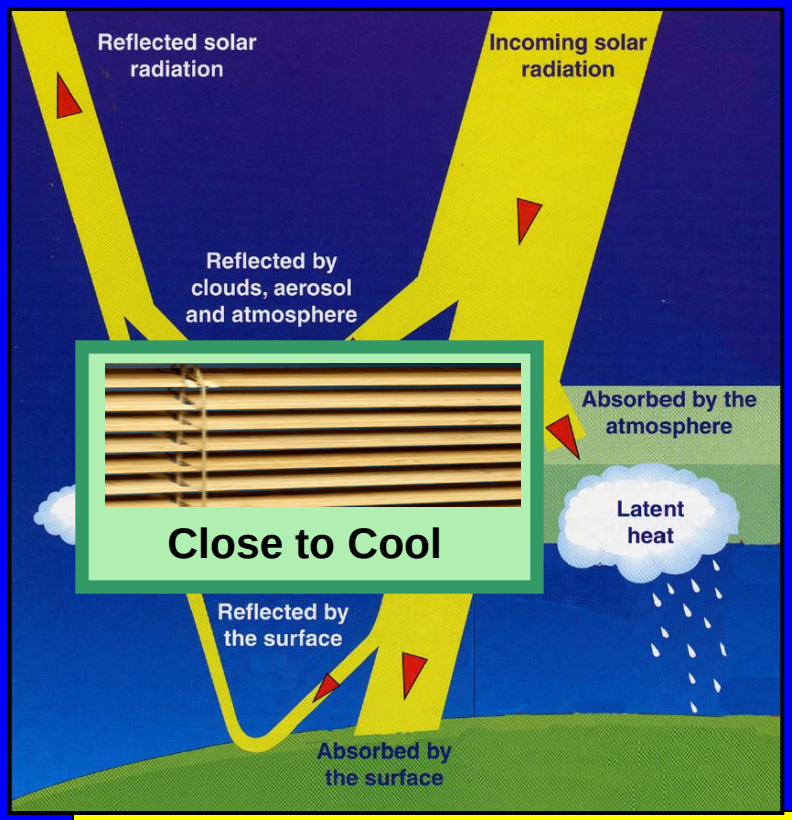
They are formed only on the sunlit side of the earth

A High Rate of SO_2 Lowers Oxidizing Capacity Causing Greenhouse Gases to Accumulate

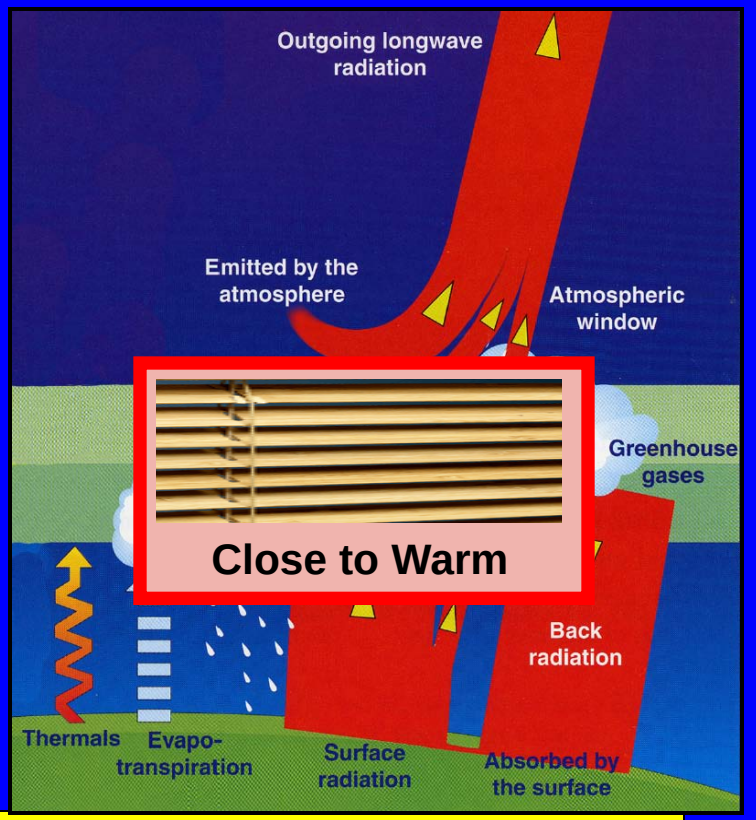


An Enigma Resolved

Volcanoes cause cooling and ice ages



Volcanoes cause warming and the ends of ice ages



Greenhouse Gases in the Atmosphere

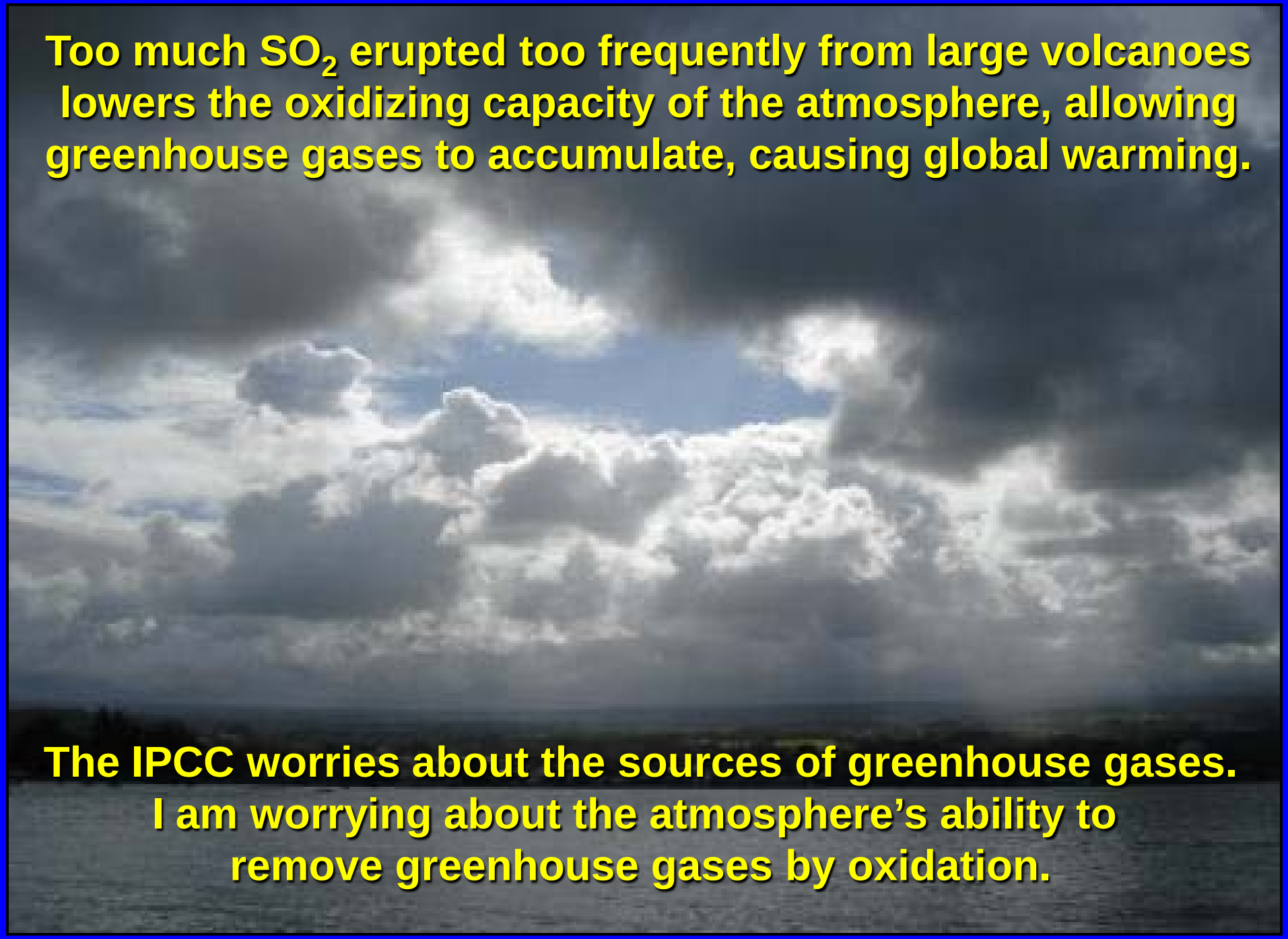
Equal

Emissions – Oxidized Pollutants

Pollutants

Oxidized Pollutants

Oxidizer


Too much SO_2 erupted too frequently from large volcanoes lowers the oxidizing capacity of the atmosphere, allowing greenhouse gases to accumulate, causing global warming.
The IPCC worries about the sources of greenhouse gases.
I am worrying about the atmosphere's ability to remove greenhouse gases by oxidation.

Eruption of Lakigigar, Iceland 1783, VEI = 4

3.5 mi^3 basalt
17 mi-long fissure
122 Mt SO_2
(5 times Pinatubo)

Deaths
10,521 Iceland
20,000 England
16,000 France
Japan, Alaska

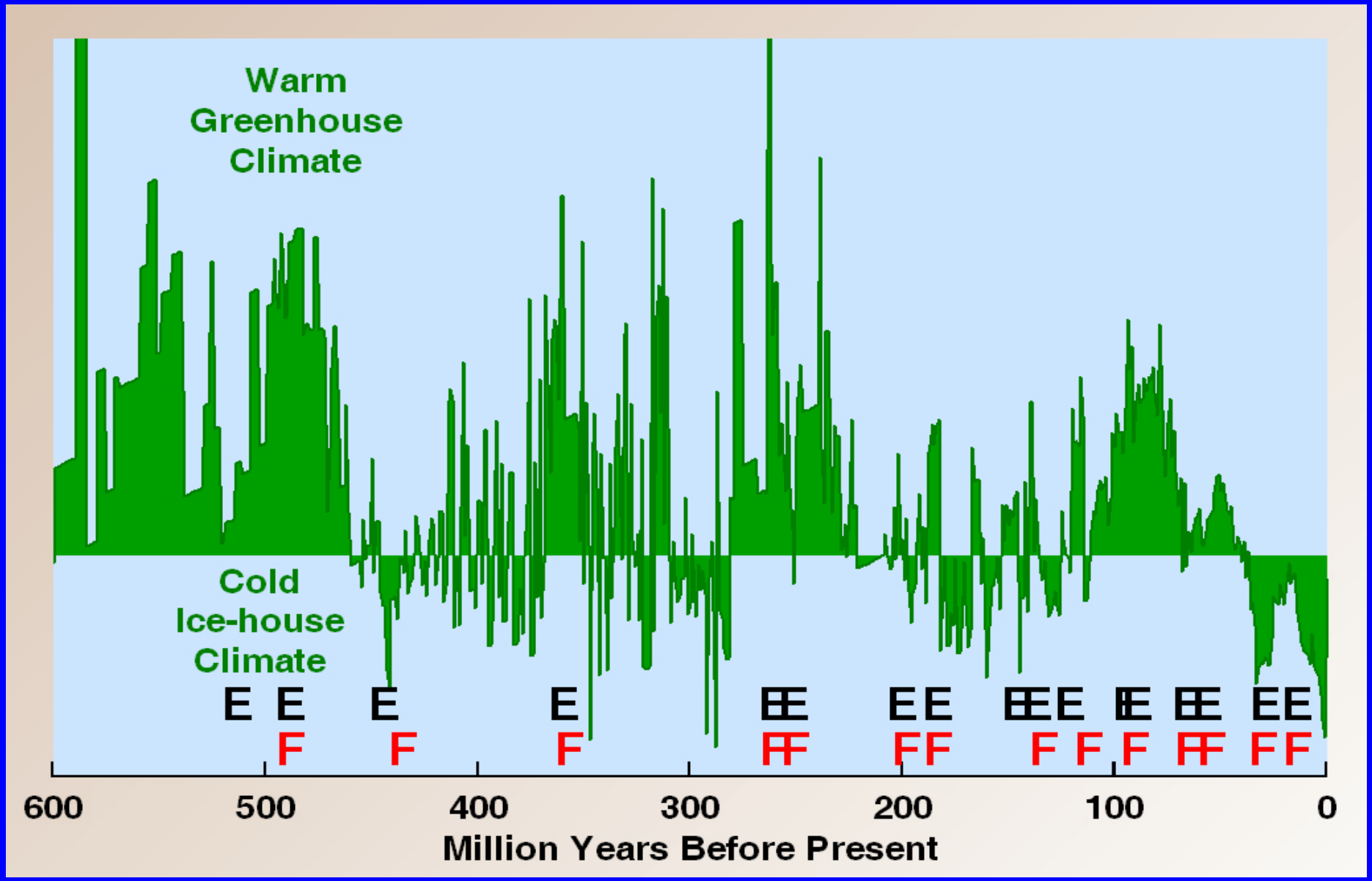
Trees and crops damaged from acid rain from Iceland to Scandinavia to Italy

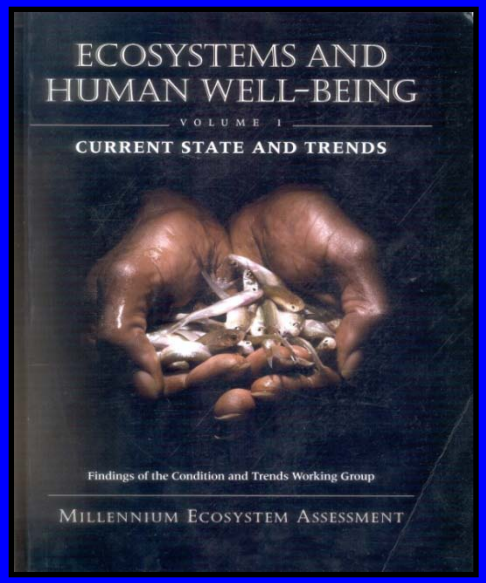
Very cold, harsh summer from Iceland to Siberia
Very dry and hot in western Europe
Winter 1783-4 one of most severe on record
Crops failed 1783 thru 1788
Helped spawn French Revolution in 1789

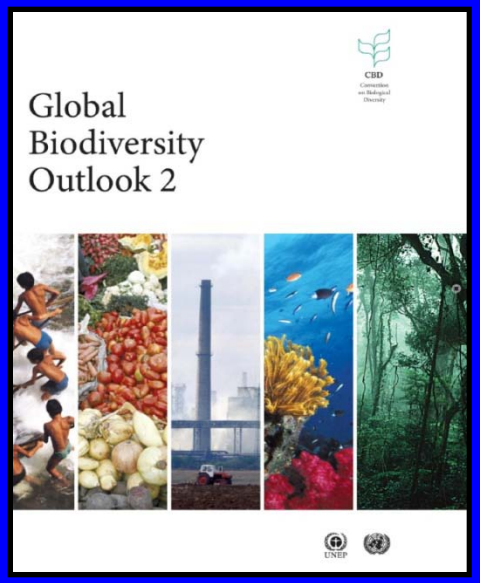
Basaltic eruptions typically erupt 10 to 100 times more gases per km^3 than silicic volcanoes

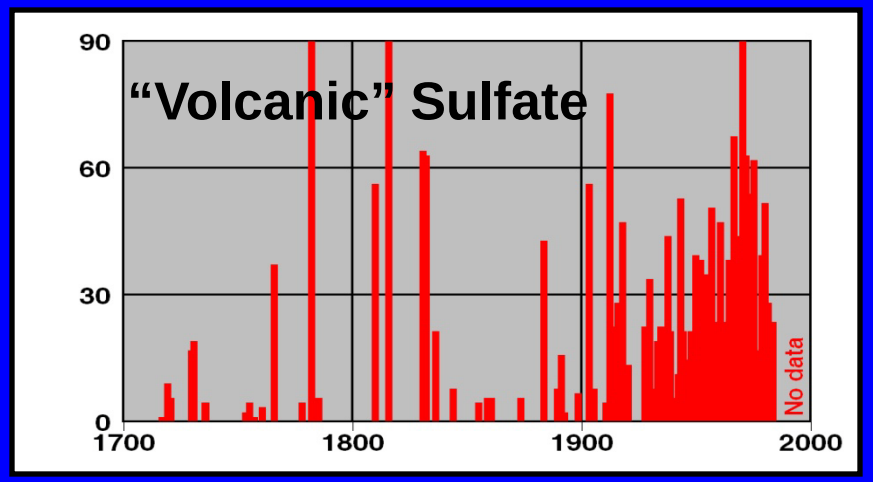

Imagine the fury of 200,000 Laki eruptions
Chaiten Volcano
Southern Chile
The Siberian Traps in northern Russia erupted 720,000 cubic miles of basalt 249 million years ago covering an area almost as large as Washington, Oregon, California, and Nevada!
UPI Photo/Carlos Gutierrez

Most major mass extinctions are contemporaneous with massive flood basalt flows





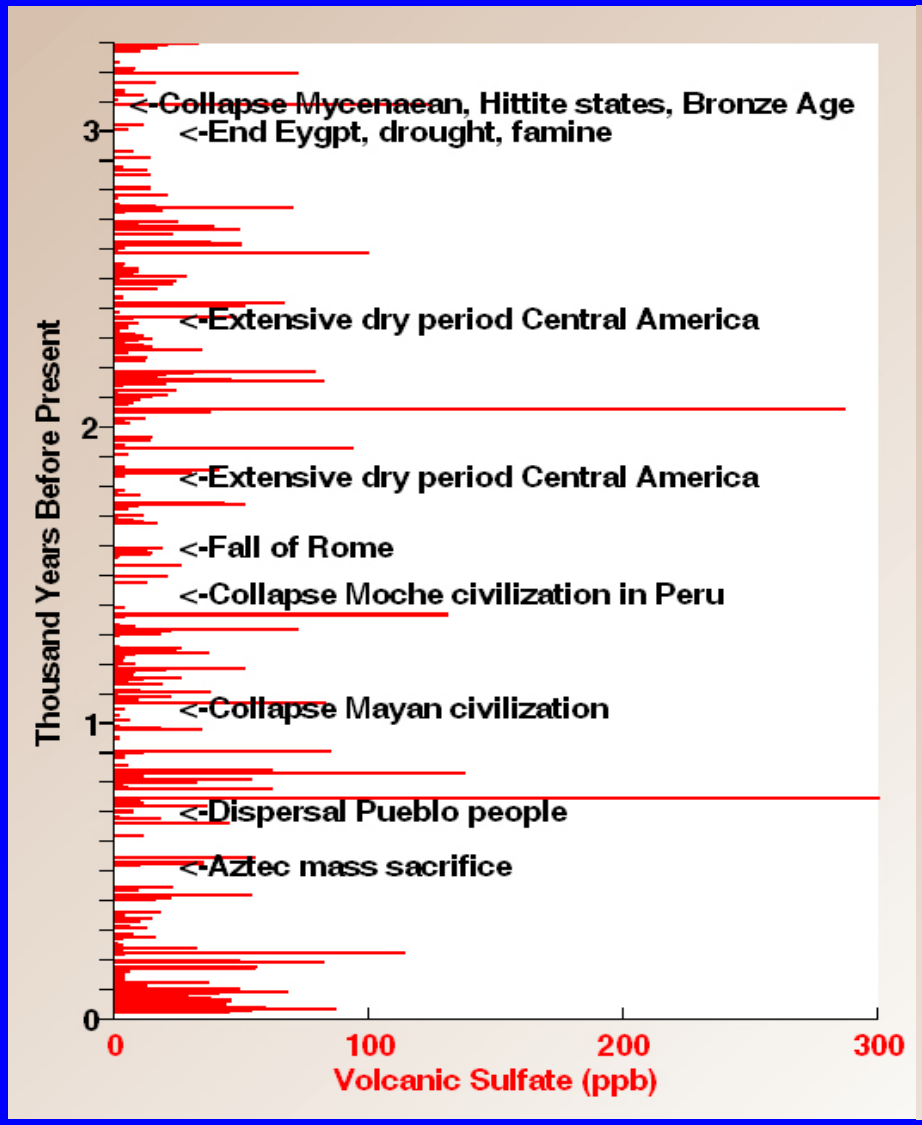


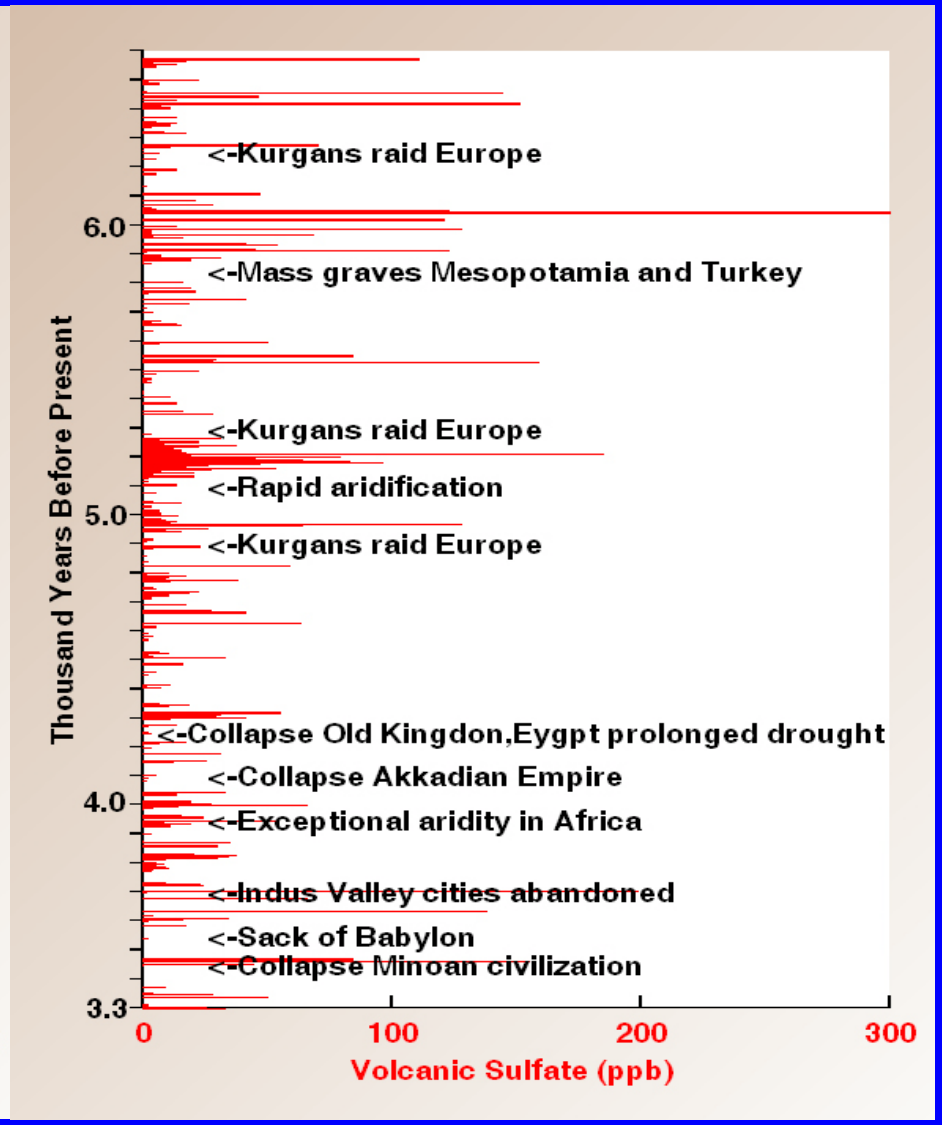


In 2005, 1360 scientists under the auspices of the United Nations and the Convention on Biological Diversity concluded:

"Humans are currently responsible for the sixth major extinction event in the history of the earth"

Times of no volcanism tend to be times of collapse of civilizations due to cooling and drought.

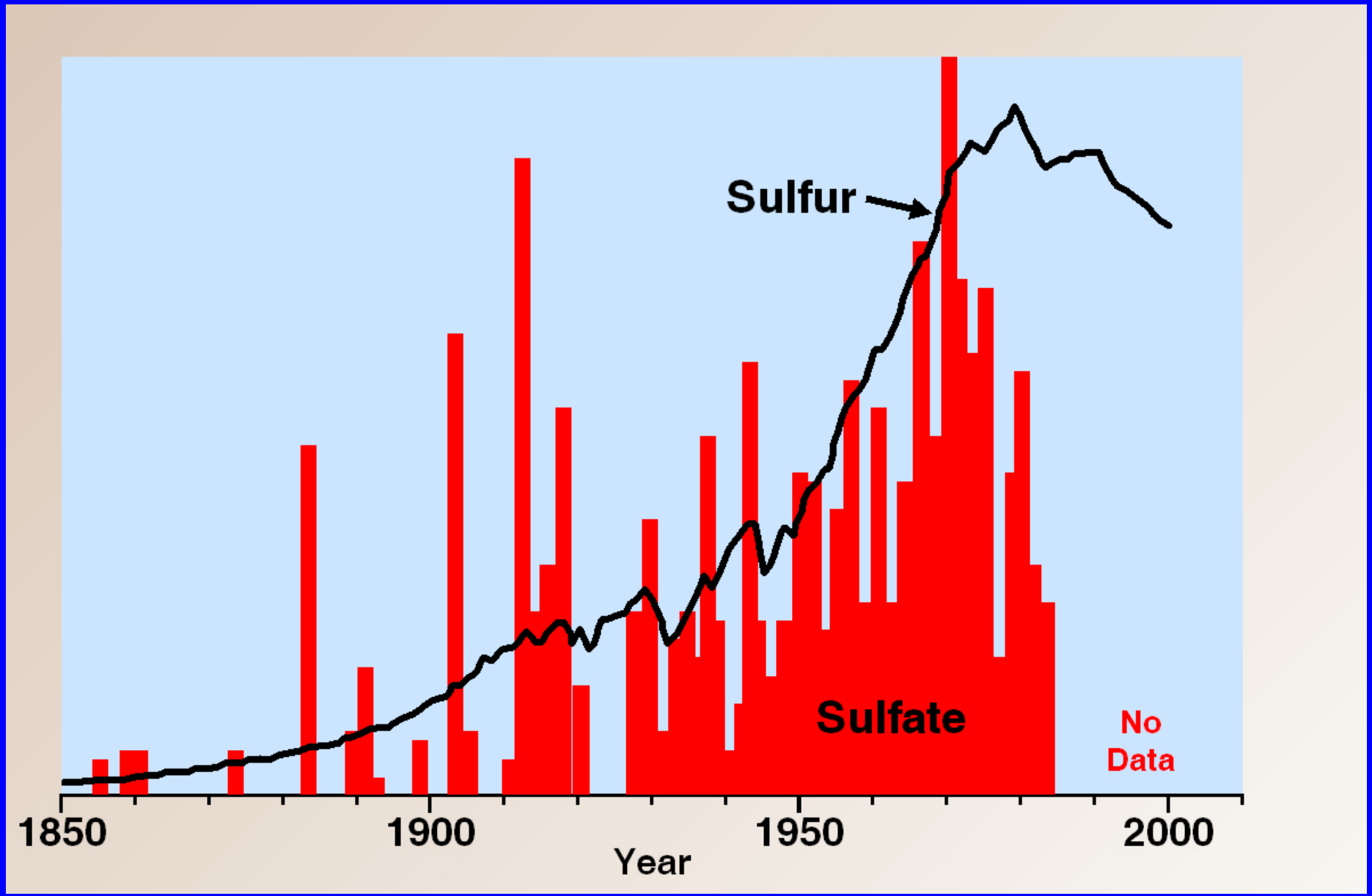




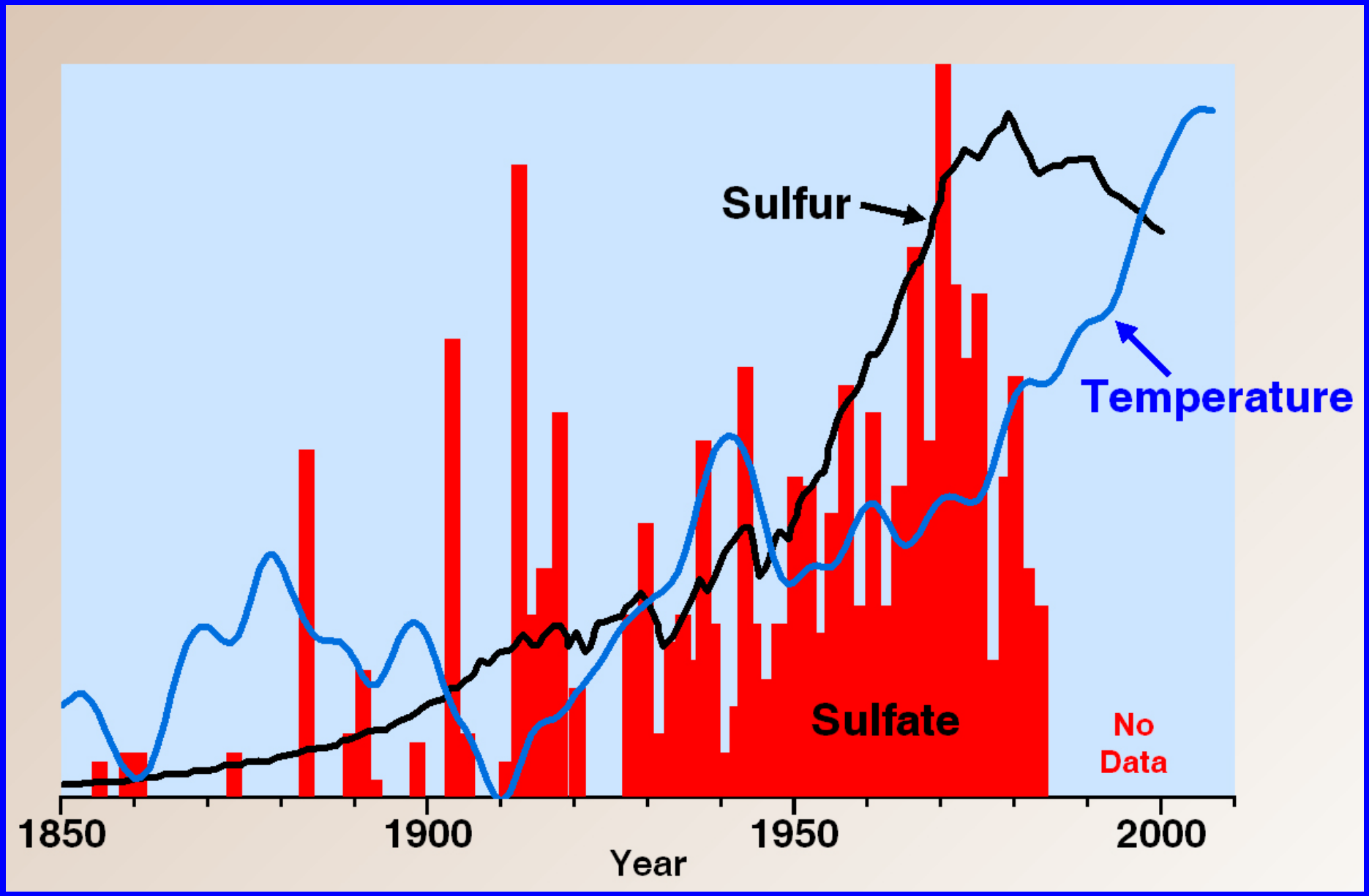
The Four Cardinal Rates of Volcanic Sulfur Emission

	Rate of Sulfur Emission	Eruption Rate	Effect
1	Low	No large volcanic eruptions for decades	Cooling and decadal drought
2	Moderate	One large volcanic eruption every few decades or longer	Cooling for a few years
3	High	More than one large volcanic eruption each year for decades	Global warming
4	Extreme	More than 100,000 large flood basaltic eruptions in less than one million years	Extreme global warming and mass extinctions

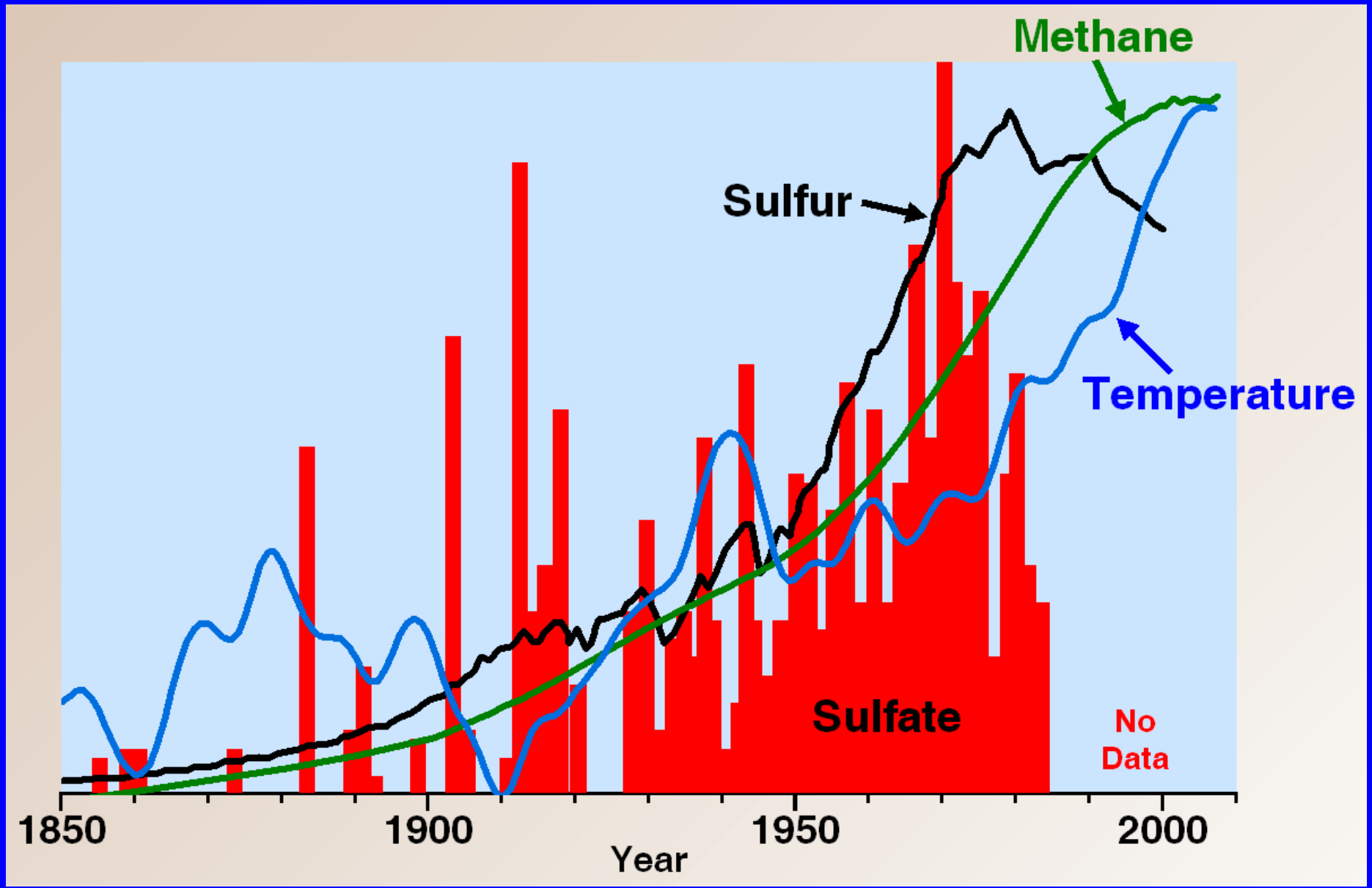
Burning fossil fuels increases sulfate deposited in Greenland



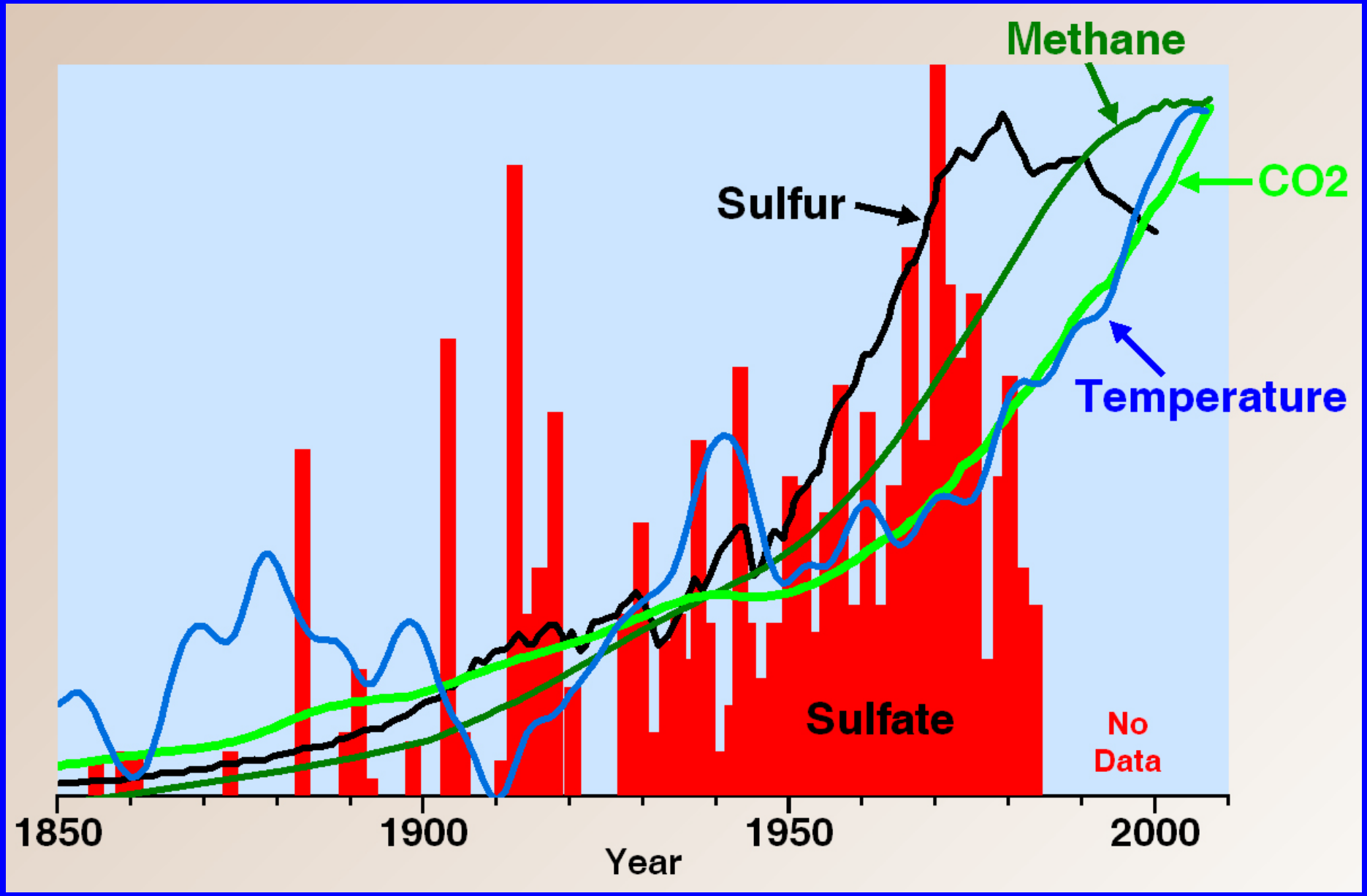
Burning fossil fuels appears to increase temperature



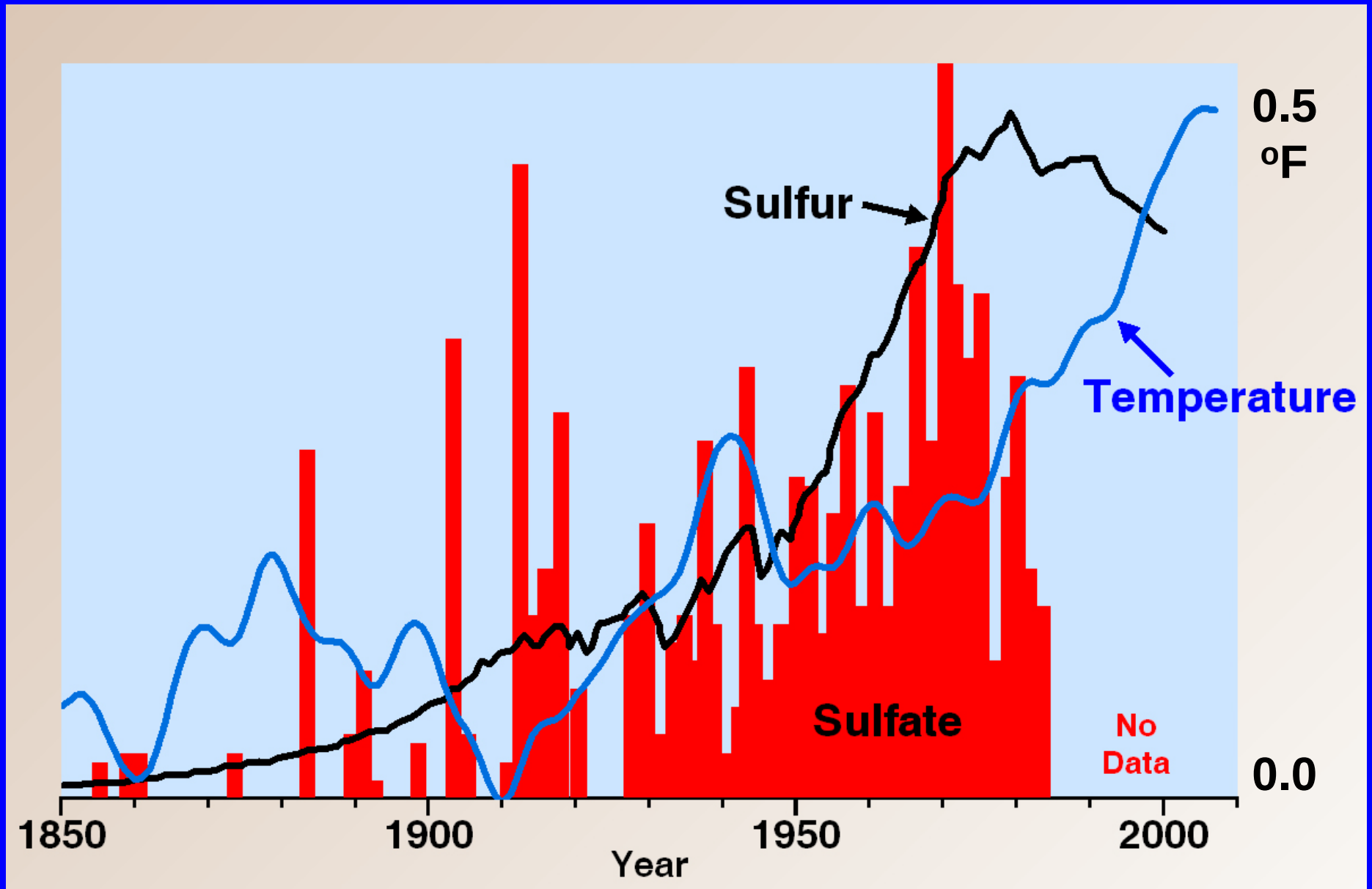
Decrease in sulfur followed by changes in methane and temperature



Meanwhile CO_2 shows no change



We have reset the thermostat on global temperature



Primary Conclusions

1) The RATE of volcanic eruptions initiates global climate change

2) No large volcanic eruptions for decades initiates global cooling and drought

3) A single large volcanic eruption initiates global cooling for a few years

4) Regular large volcanic eruptions every few years to decades ratchets the world into an ice age

5) Regular large volcanic eruptions every few months to years initiate global warming

6) Massive eruptions of flood basalts initiate mass extinctions

7) Human emissions of sulfur caused 20th century global warming

8) Efforts to reduce sulfur emissions in order to reduce acid rain slowed global warming in the last 30 years

Implications

1) Controlling SO_2 is more important than controlling CO_2

2) Good news: We know how to control SO_2

3) Sudden changes in climate have been caused by volcanoes not other options widely feared

4) We might be able to control the fluctuations by controlling SO_2 emissions

5) What do we do when large volcanic eruptions begin to occur every few months?

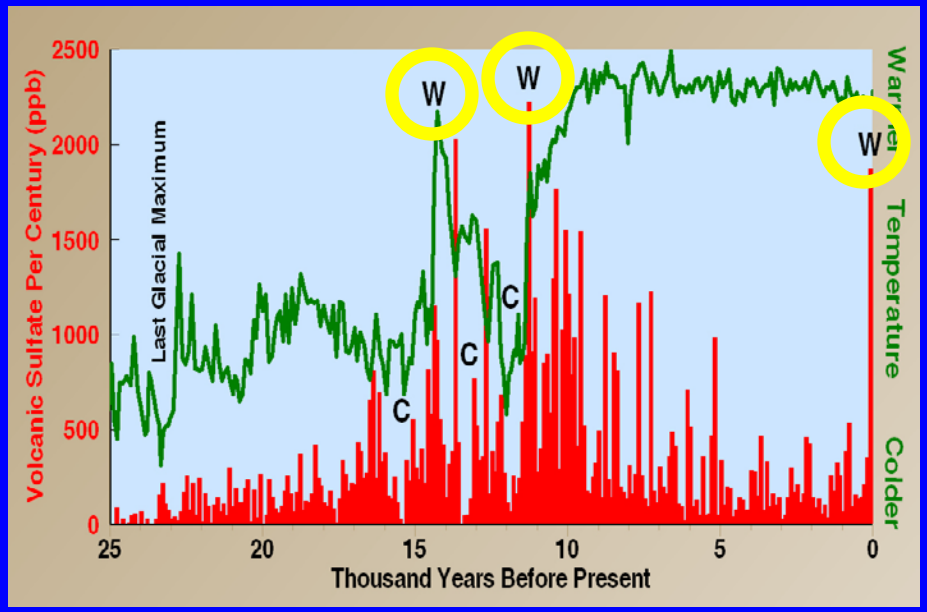
What Do Other Scientists Think?

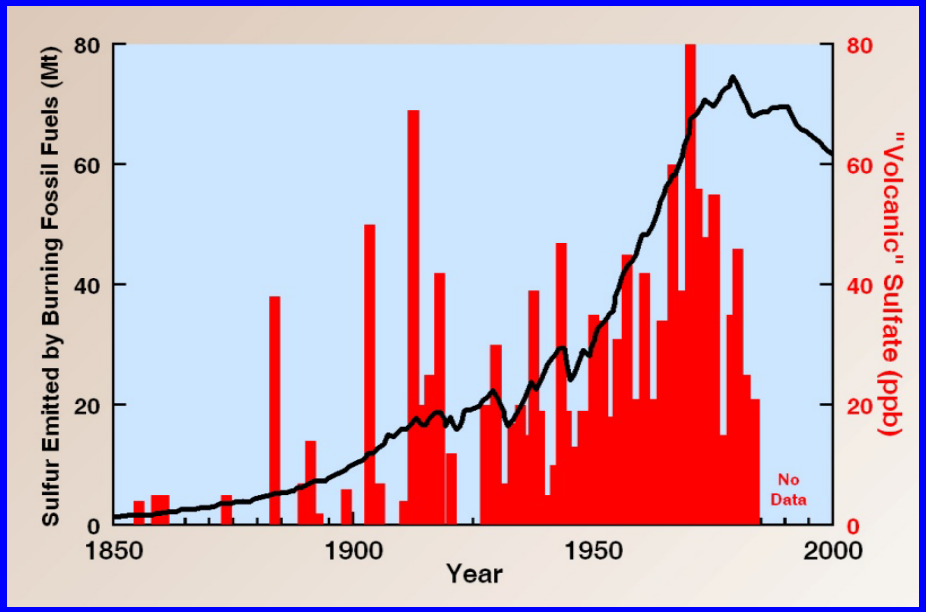
"To learn secrets of nature, we must first observe."

Francis Bacon

"Our Earth is talking to us and we must listen to it and decipher its message if we want to survive."

Pope Benedict





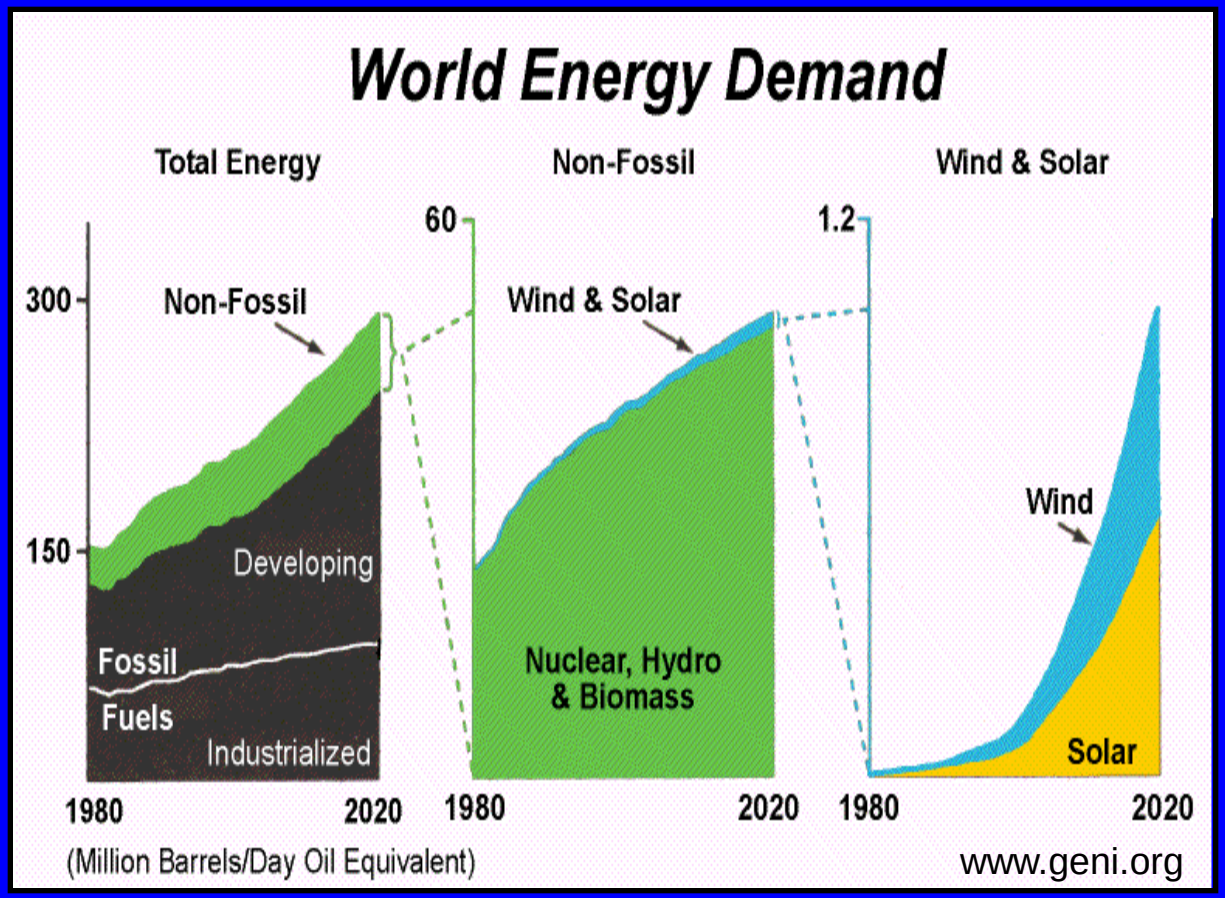
What Can You Do?

1. Help others understand that man is to blame for global warming, that man has produced the same sulfate anomalies in Greenland as volcanoes produced during times of maximum warming at the end of the last ice age.

2. Urge our government to lead international efforts to control sulfur dioxide emissions.

What Can You Do?

3. Recognize that energy is the staff of life, that world energy demands will outpace fossil fuels, and that the ultimate source of energy is the sun.














Our friends depend on us!