



# Basics of Climate Change: Science Behind the stories

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OVERVIEW

CONTENT

INSIGHTS

READINGS

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## WHAT YOU'LL LEARN

**INTRODUCTION  
TO CLIMATE  
CHANGE  
SCIENCE**

**GREENHOUSE  
GASES  
AND EFFECTS**

**CLIMATE AND  
GLOBAL  
ENVIRONMENTAL  
CHANGES**

**THE  
IMPORTANCE  
OF CLIMATE  
SCIENCE**

## WORKPLACE IMPACT

### FOSTER AWARENESS

Creating awareness and sensitization about climate change

### LEARN FACTS

Learn accurate facts and increase knowledge base

### ADAPT AND ACT WISELY

To act judiciously  
Reduce, Resuse, Recycle

# What Is Climate?

## Weather

“What is happening  
in the atmosphere  
at any given time”

## Climate

“Average weather  
over longer time  
frames”

Source: [World Meteorological Organization](#)

# What is Climate Change?



Climate **Change** is the change in average conditions of a particular place over a long period of time



*Climate change causes more extreme and unpredictable events around the world.*



Climate is what you expect, Weather is what you get!

# Climate Change and Global Warming



## Global Warming

Refers to the overall warming of the planet, based on average temperature over the entire surface of the Earth



## Climate Change

Refers to changes in climate characteristics, including temperature, humidity, rainfall, wind, and severe weather events over long term periods

Further information: [WMO Website](#)

- **Earth's climate is not constant.**

It has **warmed**




and **cooled**

For **BILLIONS** of years!

It is the **RATE** that current climate change is happening that is different from what happened in the past. Since ~1800, the average **global** surface temperature has risen by about 1 degree Celsius.

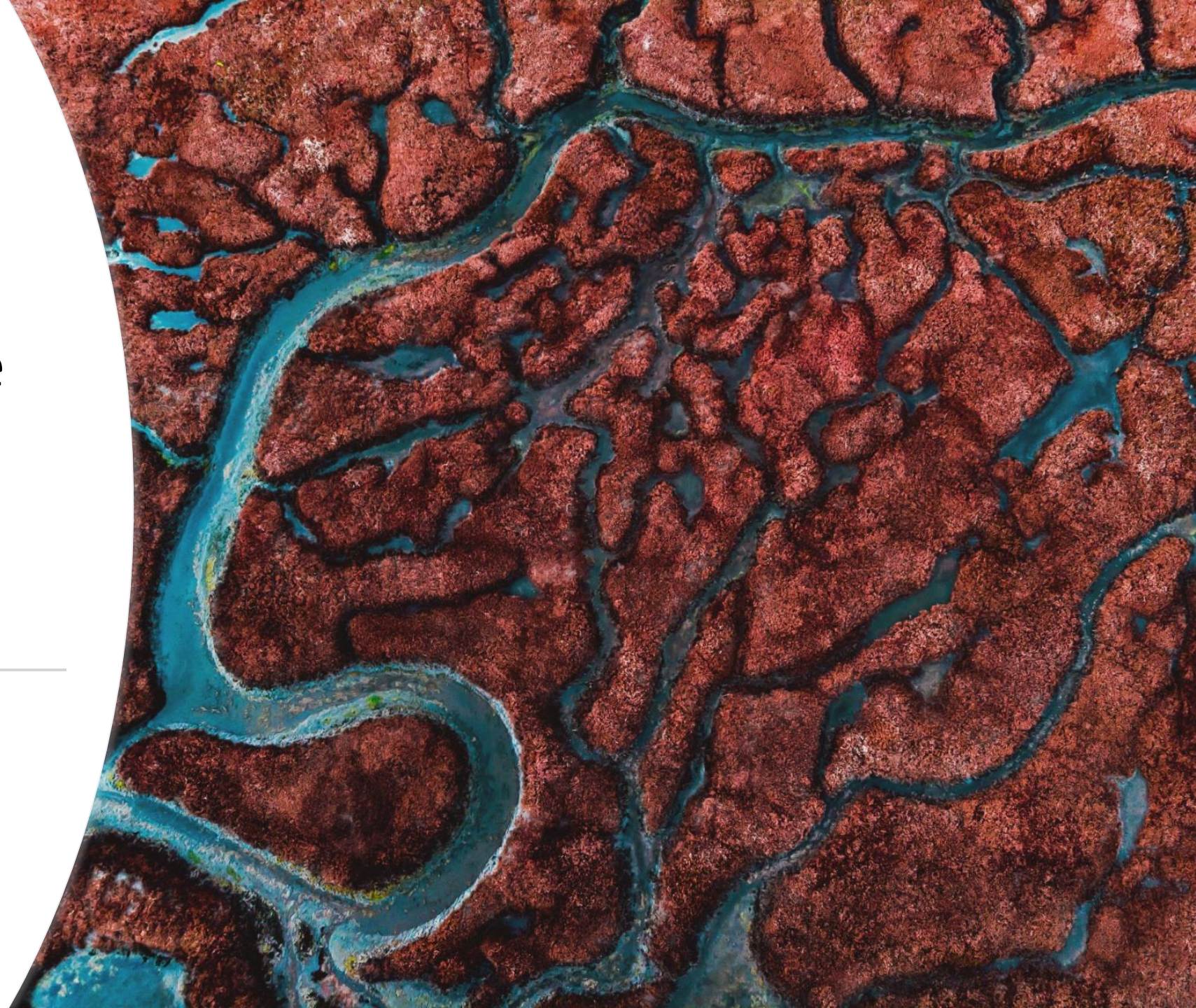




Why is the Climate  
Changing??

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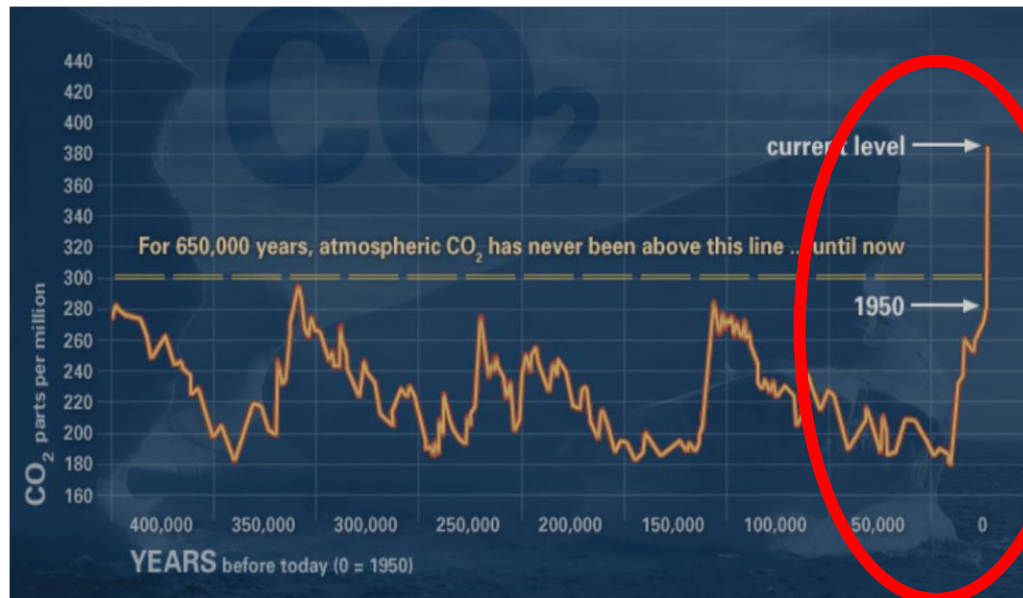
**Natural Causes**  
**Anthropogenic**  
**Causes**





# Scientific Evidence for Human Induced Climate Change

The amount of CO<sub>2</sub> in the atmosphere has always fluctuated. However the amount of CO<sub>2</sub> has quickly risen during the last 150 years.



This graph from NASA shows that since 1950, atmospheric CO<sub>2</sub> has gone up by 100 ppm (parts per million)



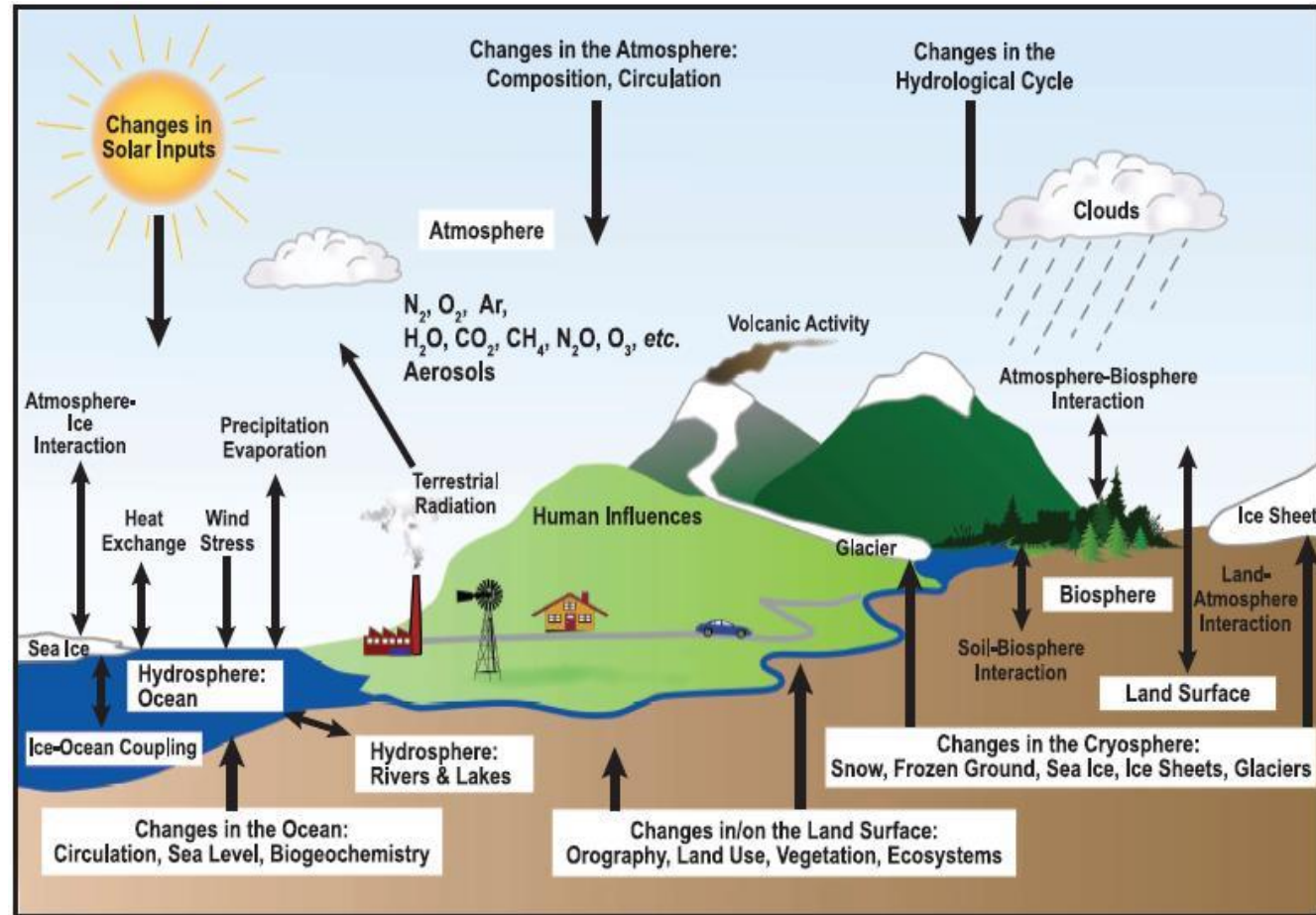
This giant sign in New York City illustrates 'the number of metric tones of greenhouse gasses in the atmosphere'. In less than 6 days, the total had gone up by over 344,041,589...**so the number of metric tones rises by 1000 every second...the weight of 700 cars!**

# Climate Change vs Accelerating Climate change

So how is human induced climate change different?  
According to NASA, the **rate of change is TEN times faster** than the Earth's usual rate of recovery to warmer temperatures after an ice age.

The IPCC project that the average global temperature will probably rise more than 2 degrees Celsius in the next 100 years.

# Complexity of the Global Climate System



Source: [IPCC 2007](#), p96. Further information: [WMO Website](#)





# Natural Factors that influence climate

Factors which influence Earth's climate more than all others combined:

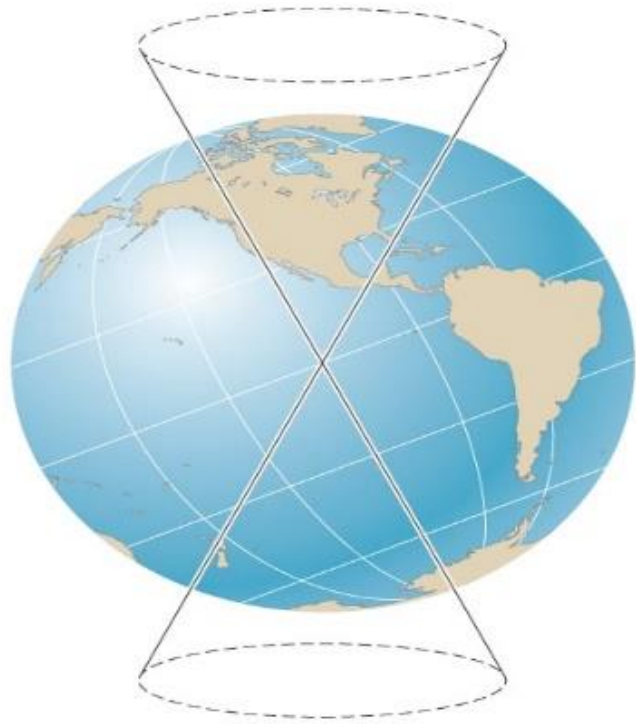
1. The sun, which provides most of Earth's energy

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2. The atmosphere, which both absorbs energy from the sun and reflects it back into space

3. The oceans, which stores and transports heat and moisture

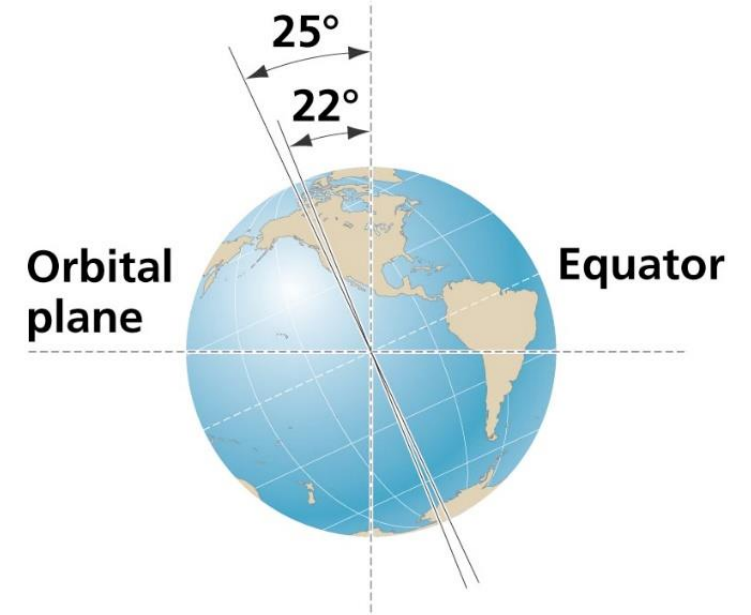
4. The Earth's Changes in the axis



**(a) Axial wobble**



**(c) Variation of orbit**



**(b) Variation of tilt**

*Wobble of  
Earth's axis*

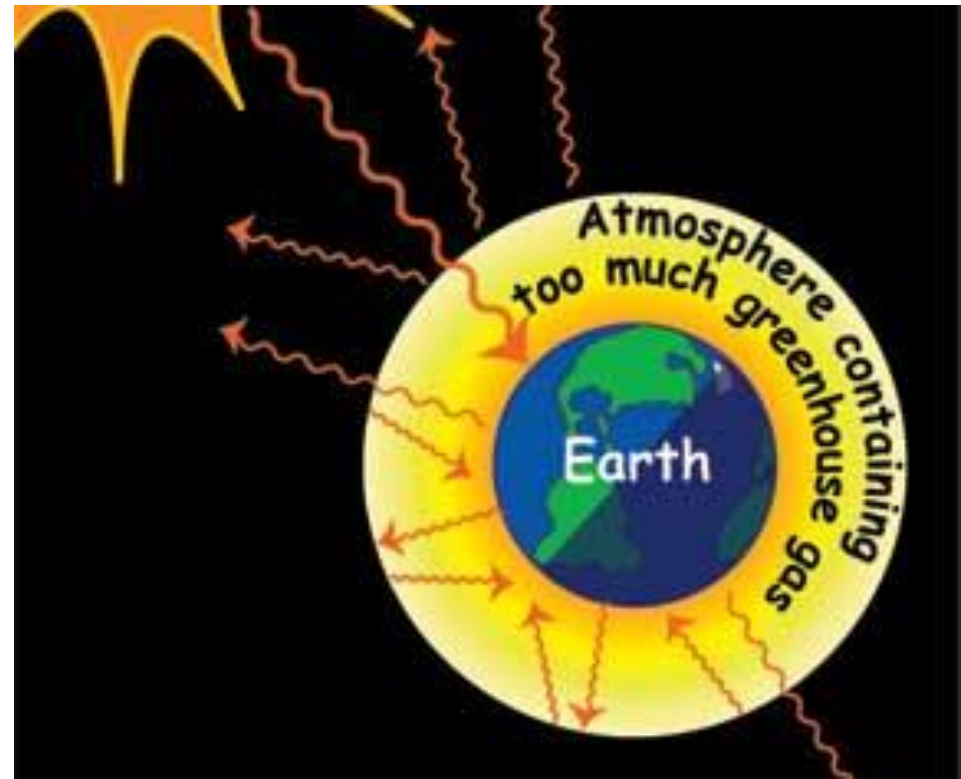
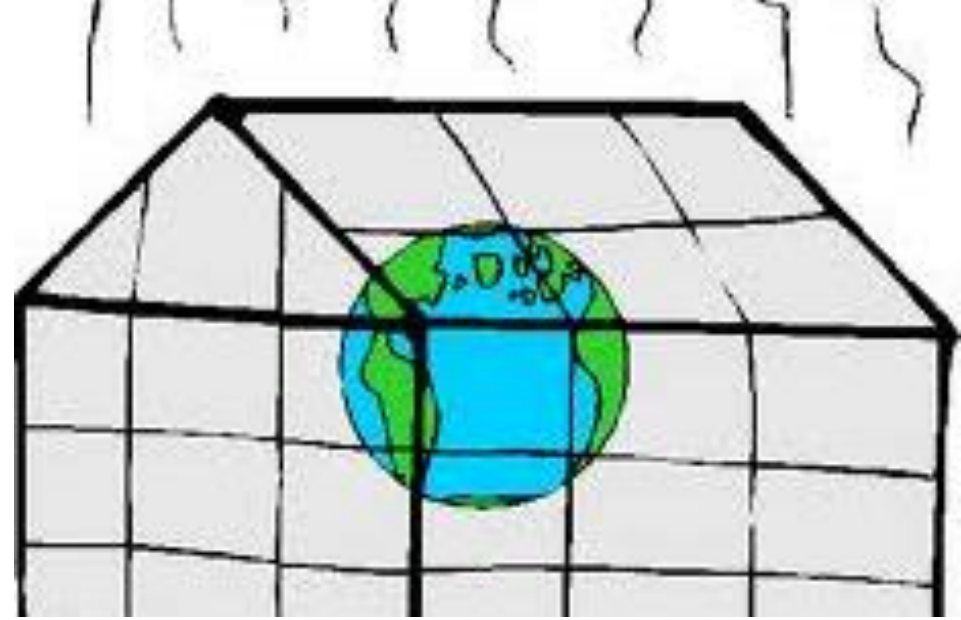
# Milankovitch cycles affect climate

These 3 types of cycles also affect climate in the long term

# The greenhouse effect

- Greenhouse gasses (including CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>, O<sub>3</sub>, SF<sub>6</sub>, CFC) accumulate in the atmosphere. They absorb thermal radiation (heat) from the Earth's surface, and redirect it back down to the Earth, heating up our planet. This is called the GREENHOUSE EFFECT.

- **The greenhouse effect is natural.**





...without the Greenhouse Effect, the Earth would be too cold for life (we certainly wouldn't be here). In fact, scientists say it might look a bit like MARS...

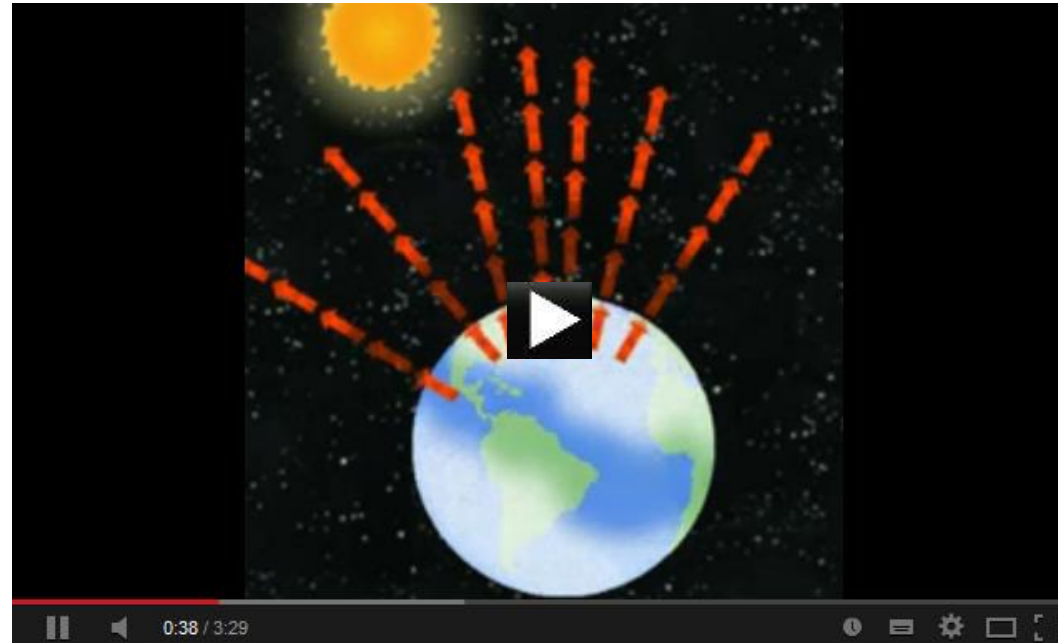
... Adding millions of tonnes of greenhouse gasses (including extra CO<sub>2</sub>) to the atmosphere each year makes the greenhouse effect 'too efficient'







# NASA Video on the Greenhouse Effect



Video: Understand how water vapor, carbon dioxide, and other gases cause the Earth's greenhouse effect

URL: <http://www.youtube.com/watch?v=ZzCA60WnoMk>

# Green House Gasses

Carbon di- oxide  $\text{CO}_2$

Methane  $\text{CH}_4$

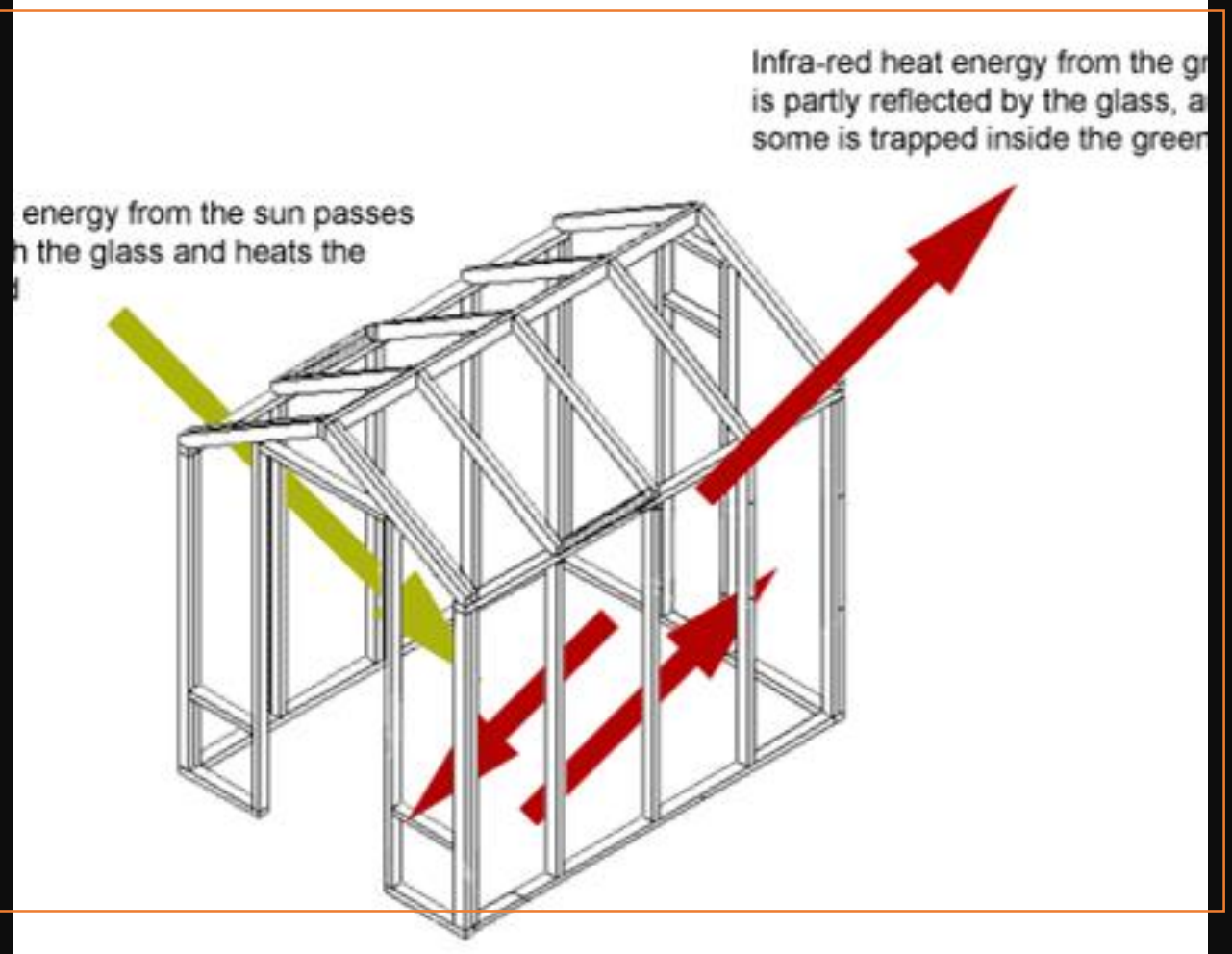
Nitrous Oxide  $\text{N}_2\text{O}$

Chloro Fluoro carbon CFC

Ozone  $\text{O}_3$

$\text{SF}_6$

# Understanding Global Warming and Greenhouse Gases –



# Greenhouse gases



Atmospheric gases that absorb the emanating radiation are **greenhouse gases**.



By absorbing and re-emitting this radiation, they warm Earth's atmosphere and surface, like a greenhouse.



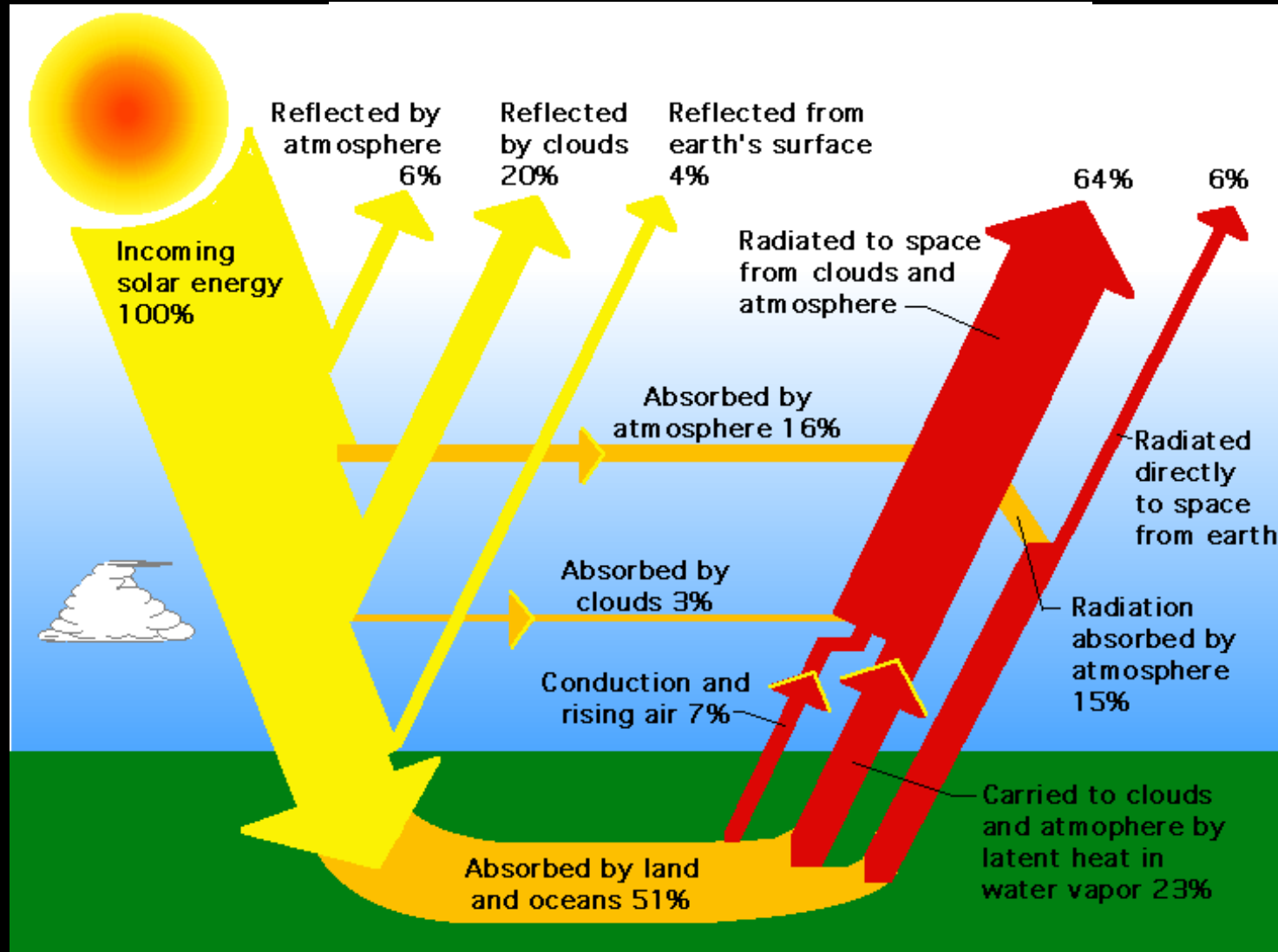
This is popularly called the **greenhouse effect**.



*Global warming potential* = the relative ability of one molecule of a given greenhouse gas to contribute to global warming.



# Earth's Energy Budget



# Carbon dioxide

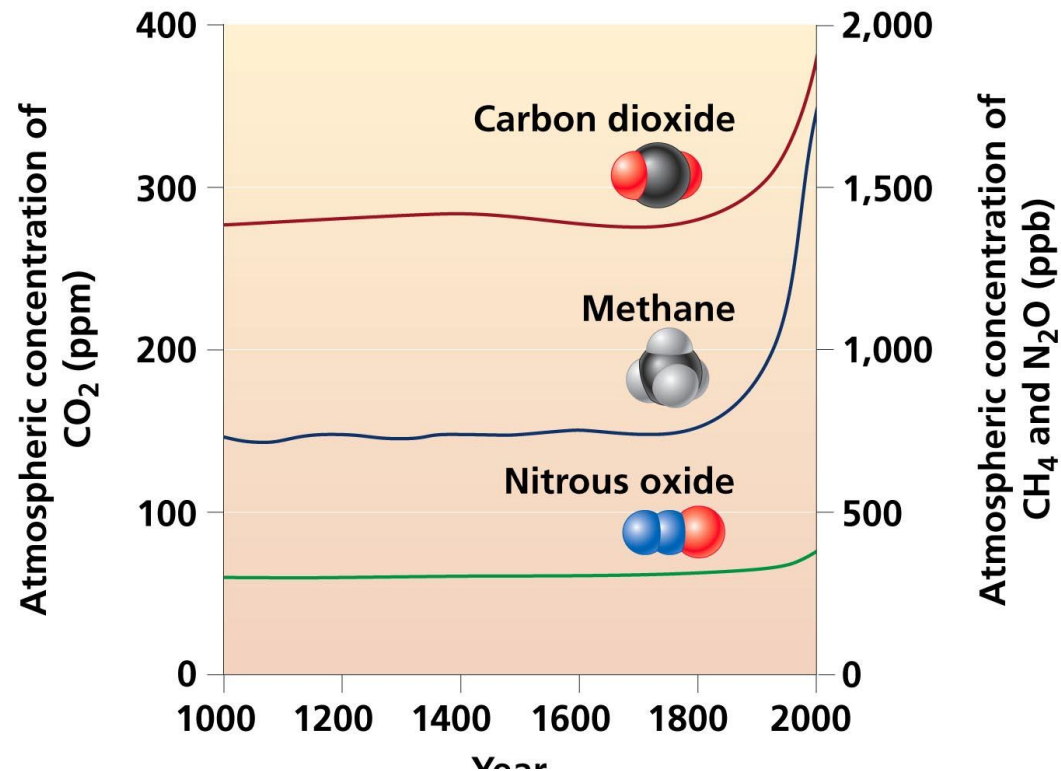
- Carbon dioxide = primary greenhouse gas

**Table 18.1 Global Warming Potentials of Four Greenhouse Gases**

<b>Greenhouse gas</b>	<b>Relative heat-trapping ability (in CO<sub>2</sub> equivalents)</b>
Carbon dioxide	1
Methane	23
Nitrous oxide	296
Hydrochlorofluorocarbon HFC-23	12,000

Data from Intergovernmental Panel on Climate Change, 2001. *Climate change 2001: The scientific basis.*

# Carbon dioxide increase



- *CO<sub>2</sub> concentration has increased 33% in the past 200 years.*
- *It is now at its highest level in 400,000 years, and probably 20 million years.*

# Overview of Greenhouse Gases Regulated under the Kyoto Protocol

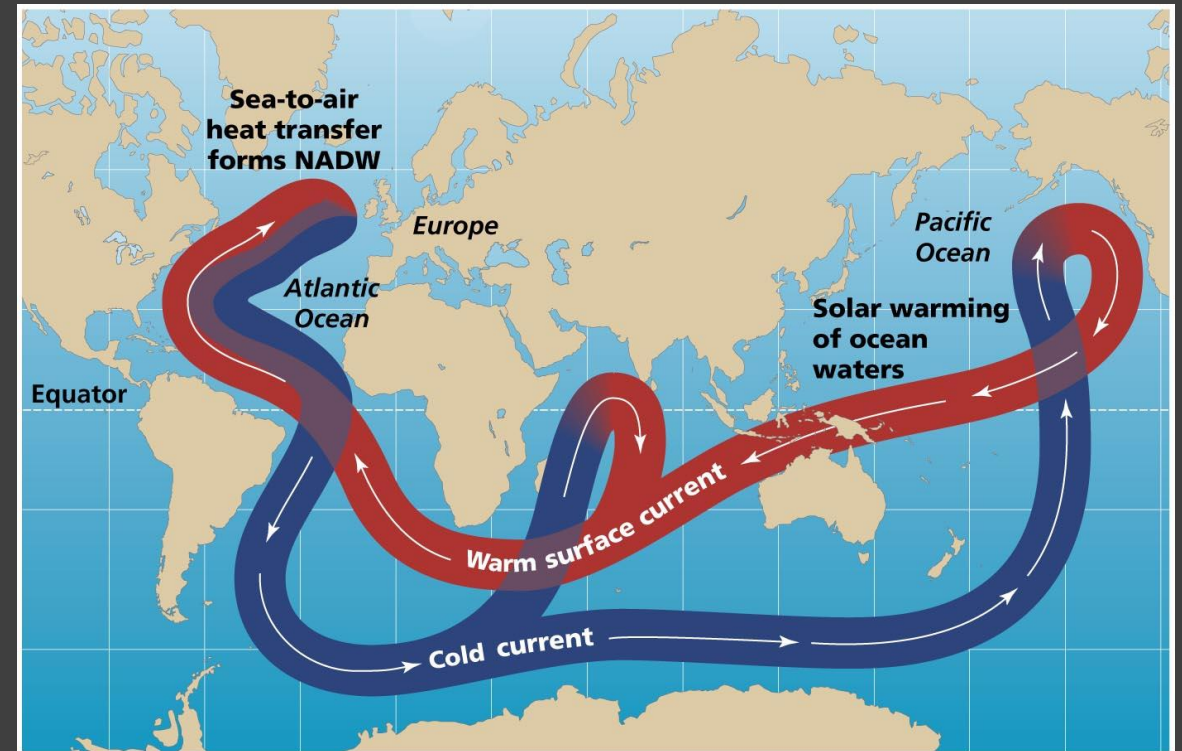
Greenhouse Gas	Global Warming Potential (GWP) (over 100 years)	% of Total Anthropogenic GHG Emissions (2010)
Carbon dioxide (CO <sub>2</sub> )	1	76%
Methane (CH <sub>4</sub> )	25	16%
Nitrous oxide (N <sub>2</sub> O)	298	6%
Hydrofluorocarbons (HFCs)	124-14,800	< 2%
Perfluorocarbons (PFCs)	7,390-12,200	< 2%
Sulphur hexafluoride (SF <sub>6</sub> )	22,800	< 2%
Nitrogen trifluoride (NF <sub>3</sub> )	17,200	< 2%

Source: Reproduced from IPCC 2007 and UNEP 2012



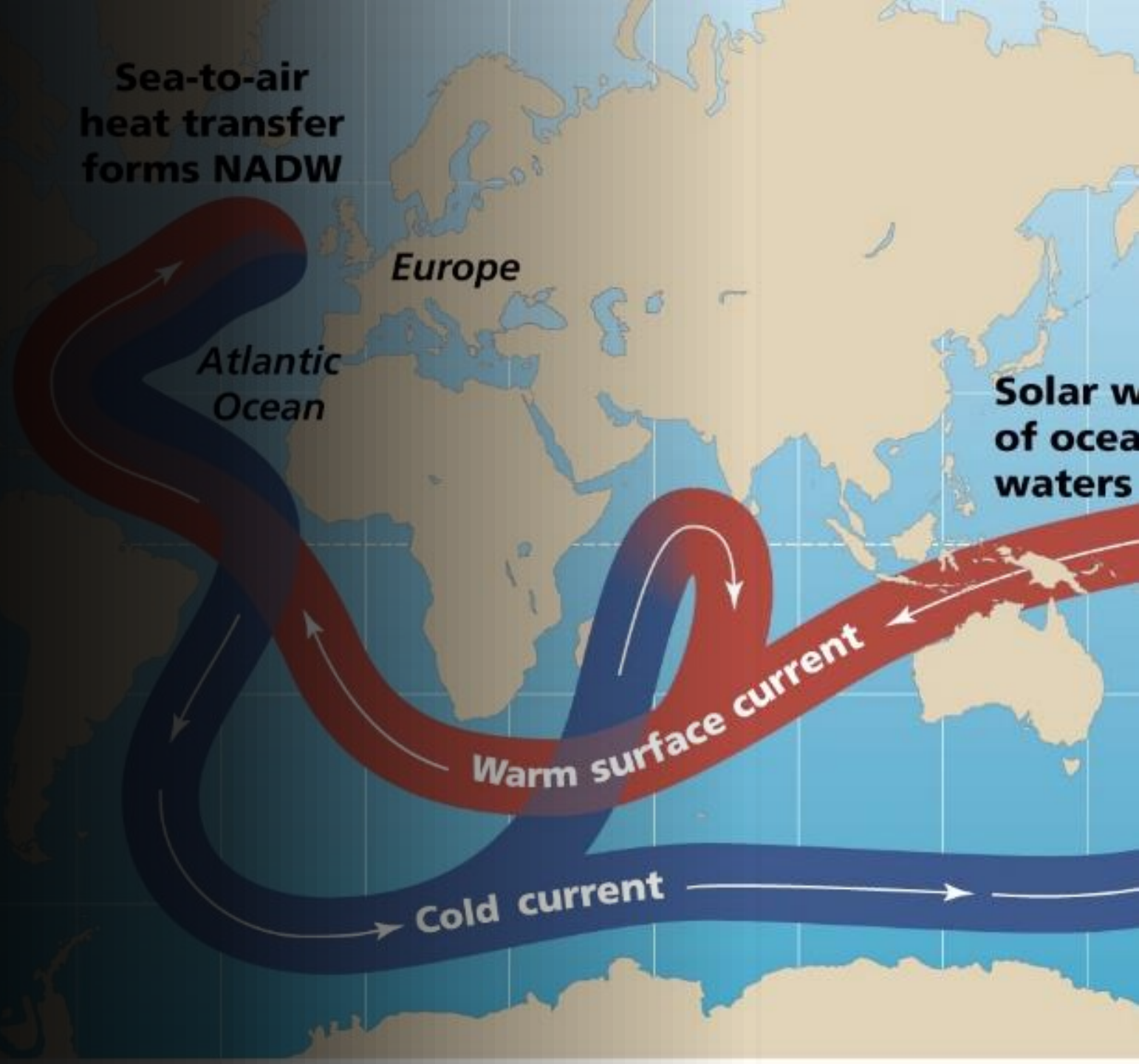
# Oceans and climate

- The oceans also affect the planet's climate
- Surface currents carry warm water from equatorial regions to the North Atlantic, then cool and sink



## Oceans and Climate Change

- If global warming causes enough of Greenland's ice sheet to melt, freshwater runoff into the north Atlantic could shut down current and abruptly change the climate of Europe and eastern North America
- Such "abrupt climate change" would not be as rapid and dramatic as in the fictional Hollywood movie *"The Day After Tomorrow,"* but would have major consequences nonetheless.



# Tools to Predict and Project Changes in the Climate



## Climate Prediction

A climate prediction or climate “forecast” is an attempt to produce an estimate of the actual evolution of the climate in the future.



## Emissions Scenario

Emissions scenarios describe future releases to the atmosphere of greenhouse gases, aerosols, and other pollutants and, along with information on land use and land cover, provide inputs to climate models.



## Climate Model

A numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for some of its known properties.



## Climate Projection

A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models.

# Climate Change Science Allows Us to:



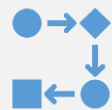
Understand how and why the climate is changing



Assess how humans are influencing the climate



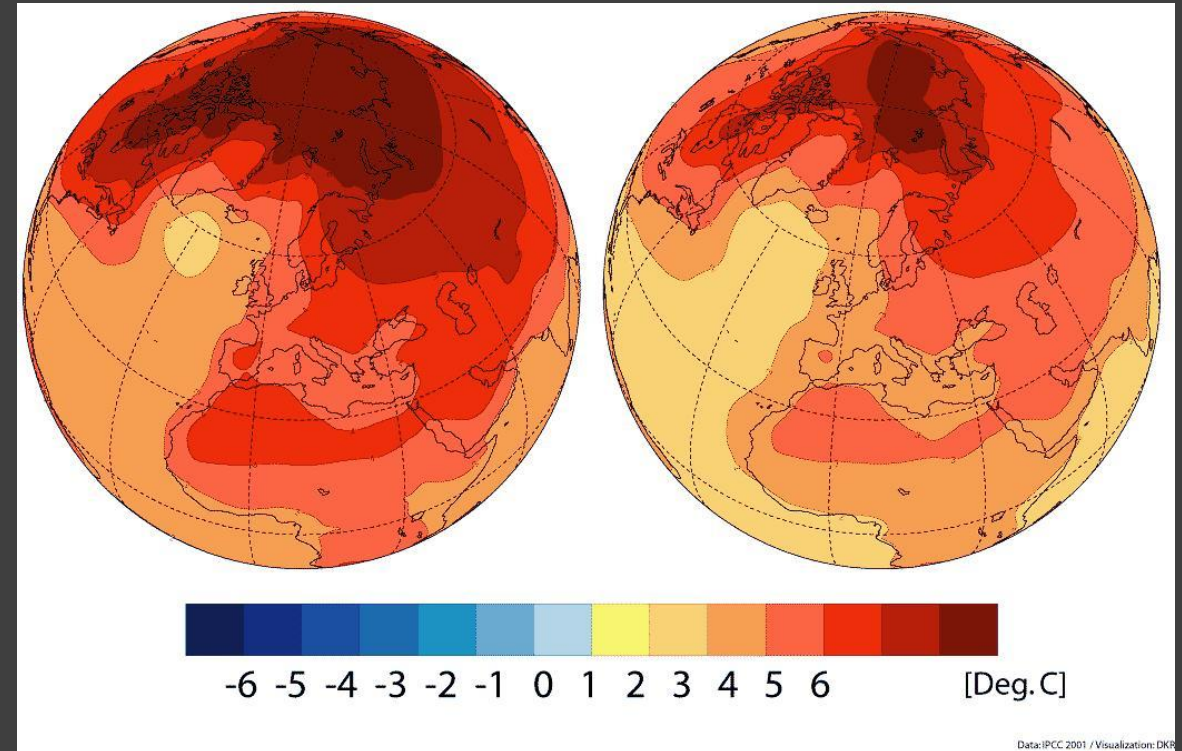
Project how the climate may change in the future



Support policy/decision-making and changes in behaviors

# Why is Climate Change Science Important?

- Sound weather data and forecasts
  - important for:
    - Short-term planning
    - Emergency response
- Climate models help to forecast long term climate scenarios
- Important input for vulnerability assessments and adaptation planning
- Fosters climate resilient development and avoids mal-adaption





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We understand well-understood physical mechanisms by which **changes in the amounts of greenhouse gases cause climate changes.**

We discussed the evidence that the concentrations of these gases in the atmosphere have increased and are still increasing rapidly, that ***climate change is occurring***, and that most of the recent change is almost certainly due to emissions of greenhouse gases ***caused by human activities***.

**Climate change is inevitable**; if emissions of greenhouse gases continue unabated, future changes will substantially exceed those that have occurred so far.

**Are Climate Changes of a few degrees,  
a cause for concern?**

# Quiz

1. What is Climate change, misinterpreted as?

(a) Global warming (b) nuclear winter (c) cloud burst (d) albedo

2. Fossil fuels, releases majorly which GHG

(a) carbon dioxide (b) carbon monoxide (c) water vapour (d) chlorinated compounds

3. Climate Change is the change in average conditions of a particular place over a period of ----- years

(a) 30 (b) 100 (c) 40 (d) 05

4. The average global surface temperature has risen by how many degree Celsius

(a) 1 (b) 10 (c) 0.1 (d) 0.001

5. What does GWP stands for

(a) Global Warming Potential (b) Global Warming Period (c) Global Warning Potential (d) Global Warming Potency

# References

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Thankyou

