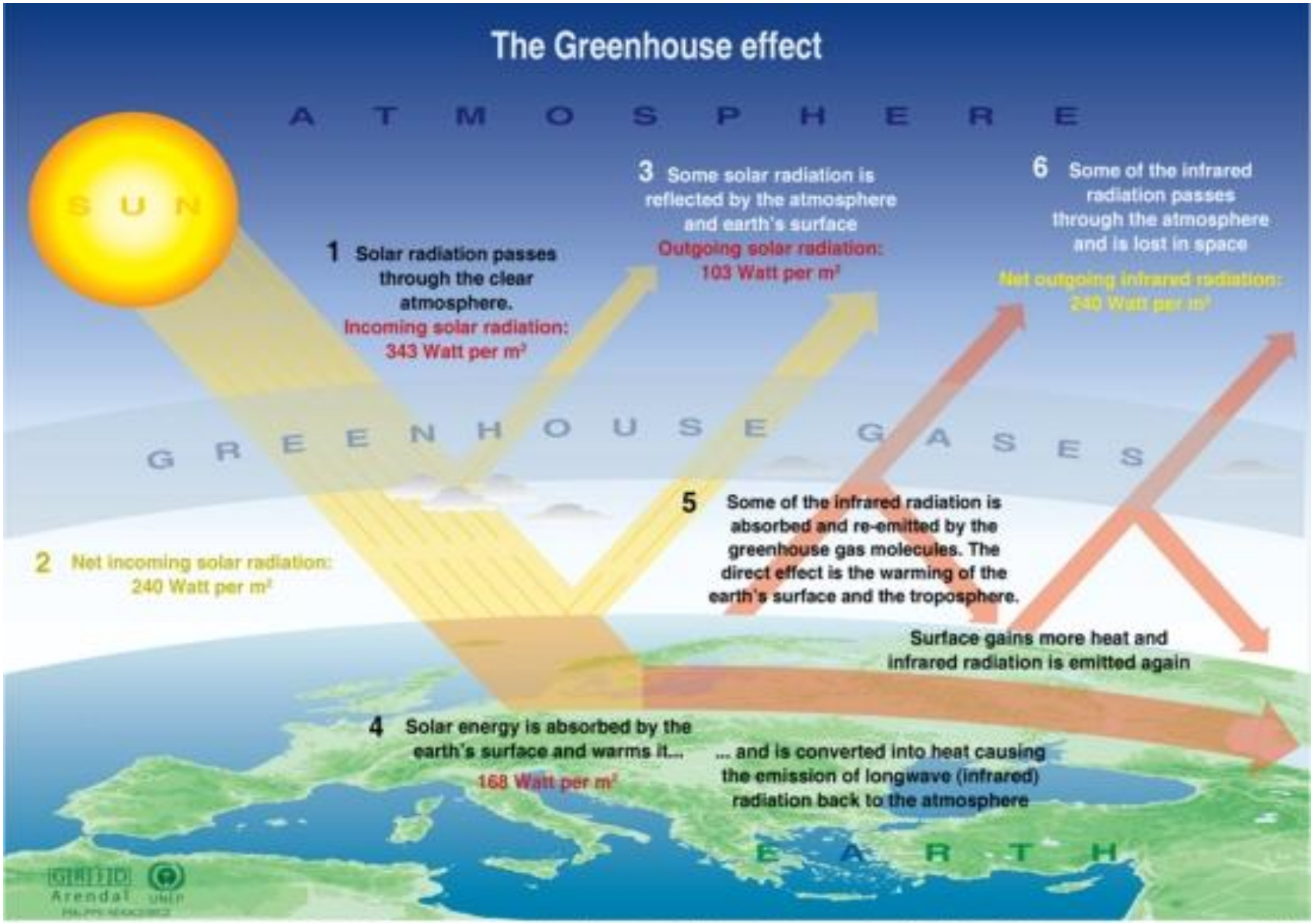
4.4 Climate change

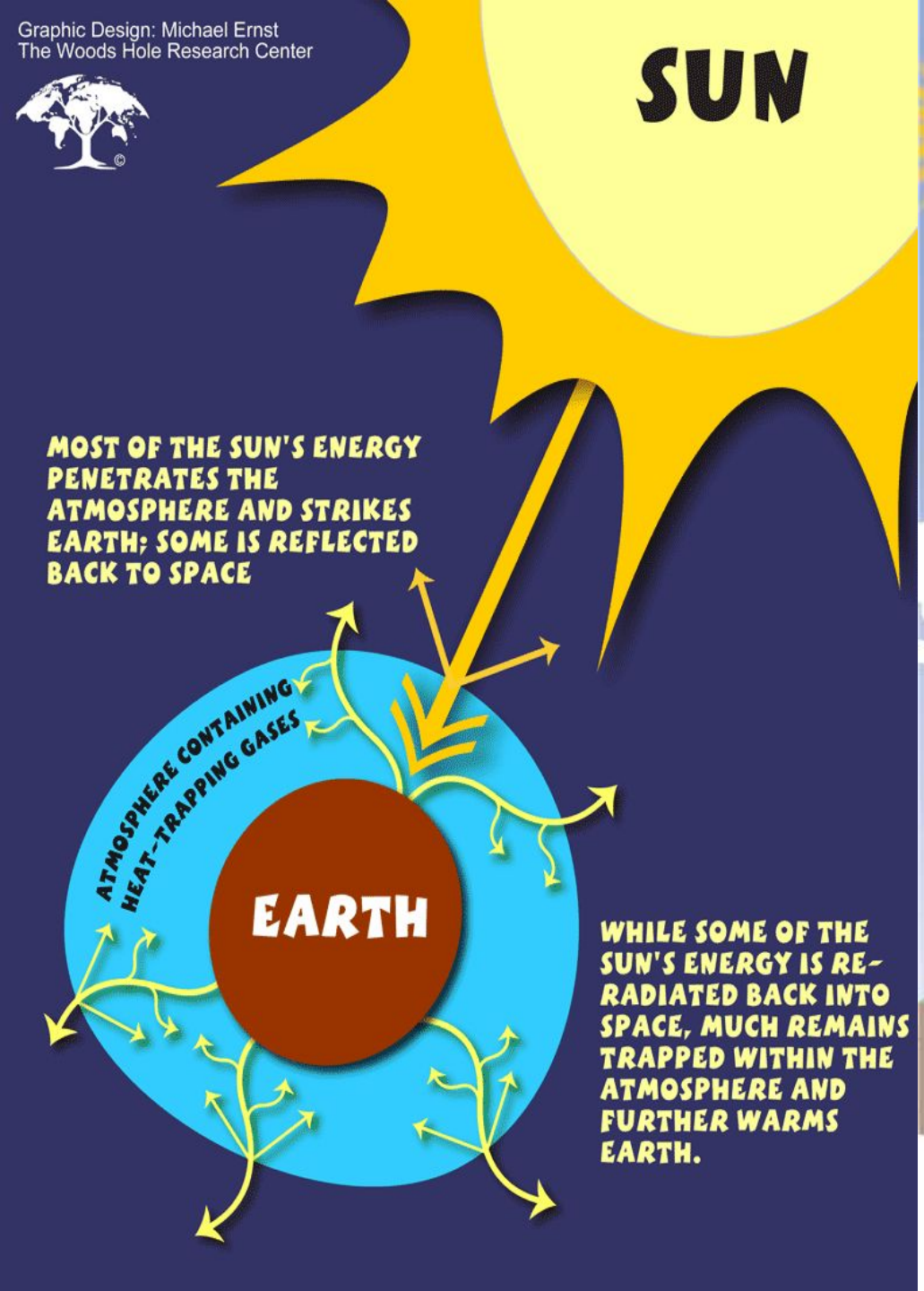


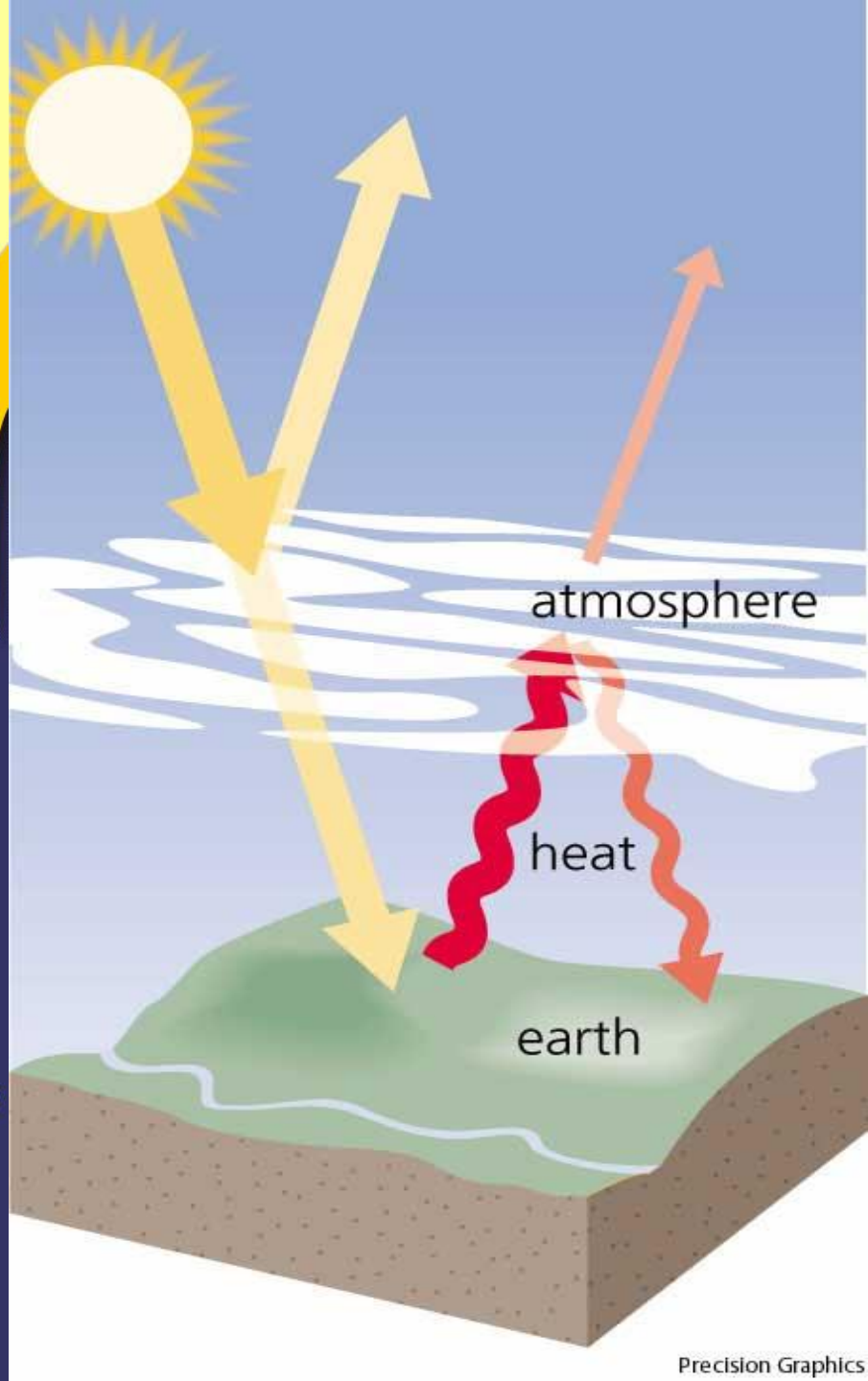
Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

the greenhouse effect

- natural phenomenon, in which the greenhouse gases captures the energy from the sun as heat in earths atmosphere
- life on earth would not be possible without the greenhouse effect
- the most common greenhouse gases are; carbon dioxide (CO_2), water vapour (H_2O), methane (CH_4), nitrogen oxides (NO_x)

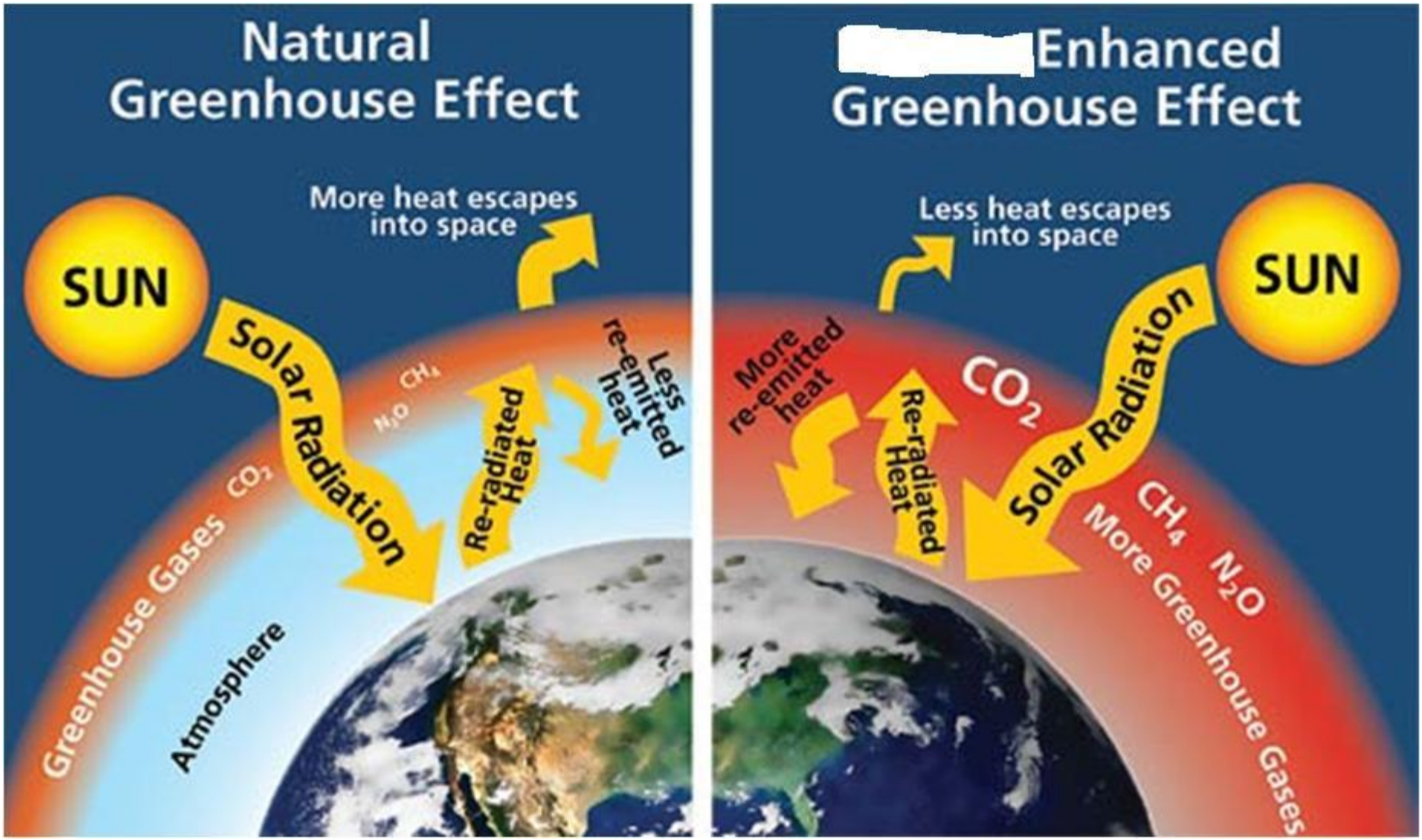
Graphic Design: Michael Ernst
The Woods Hole Research Center





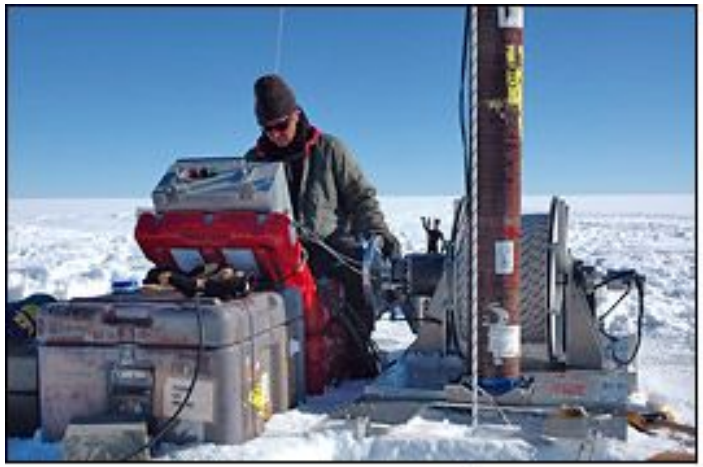
an enhanced greenhouse effect

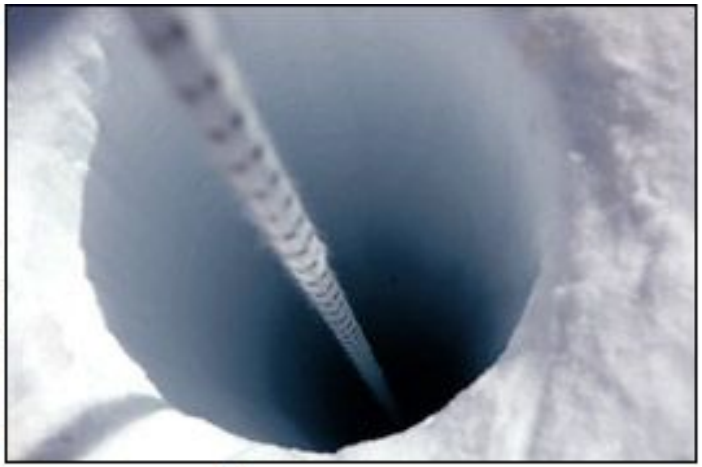
reusults in global warming


Natural
Greenhouse Effect
More heat escapes
into space
SUN
Solar Radiation
Re-radiated
Heat
Less
re-emitted
heat
CH_4
N_2O
CO_2
Greenhouse Gases
Atmosphere
Enhanced
Greenhouse Effect
Less heat escapes
into space
SUN
More
re-emitted
heat
Re-radiated
Heat
CO_2
Solar Radiation
CH_4 N_2O
More Greenhouse Gases

global warming

- the composition of the atmospheric gases change over time
- with the help of drilled ice cores the changes of greenhouse gases over time can be studied (CH_4 , CO_2)
- changes in the amount of certain greenhouse gases correlates with the change of temperature

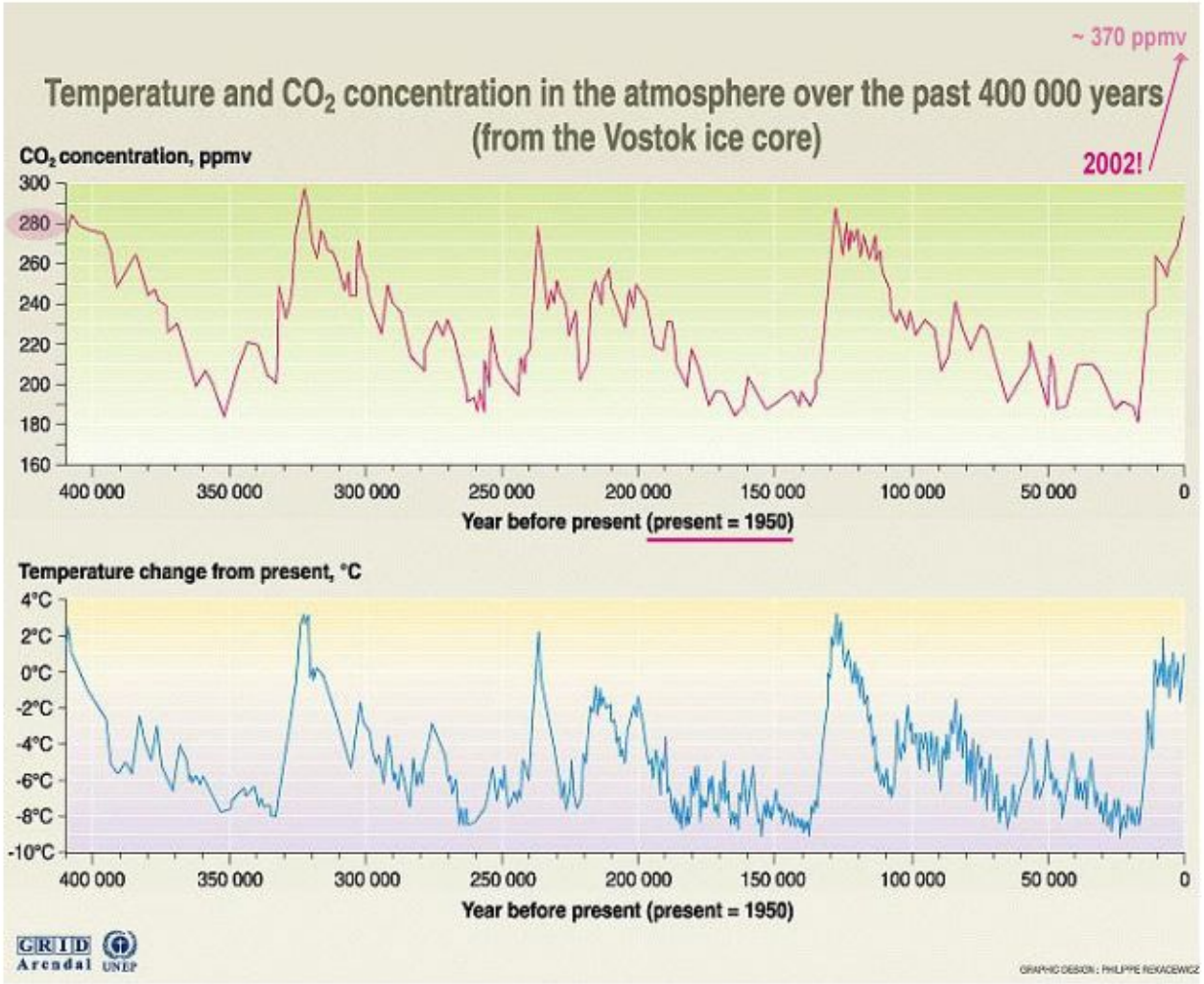




Environmental Data Include:

- **A** Temperature ($\delta^{18}O$, $\delta^{2}H$)
- **B** Atmospheric Chemistry
- **C** Net Accumulation
- **D** Dustiness of Atmosphere
- **E** Vegetation Changes
- **F** Volcanic History
- **G** Anthropogenic Emissions
- **H** Entrapped Microorganisms

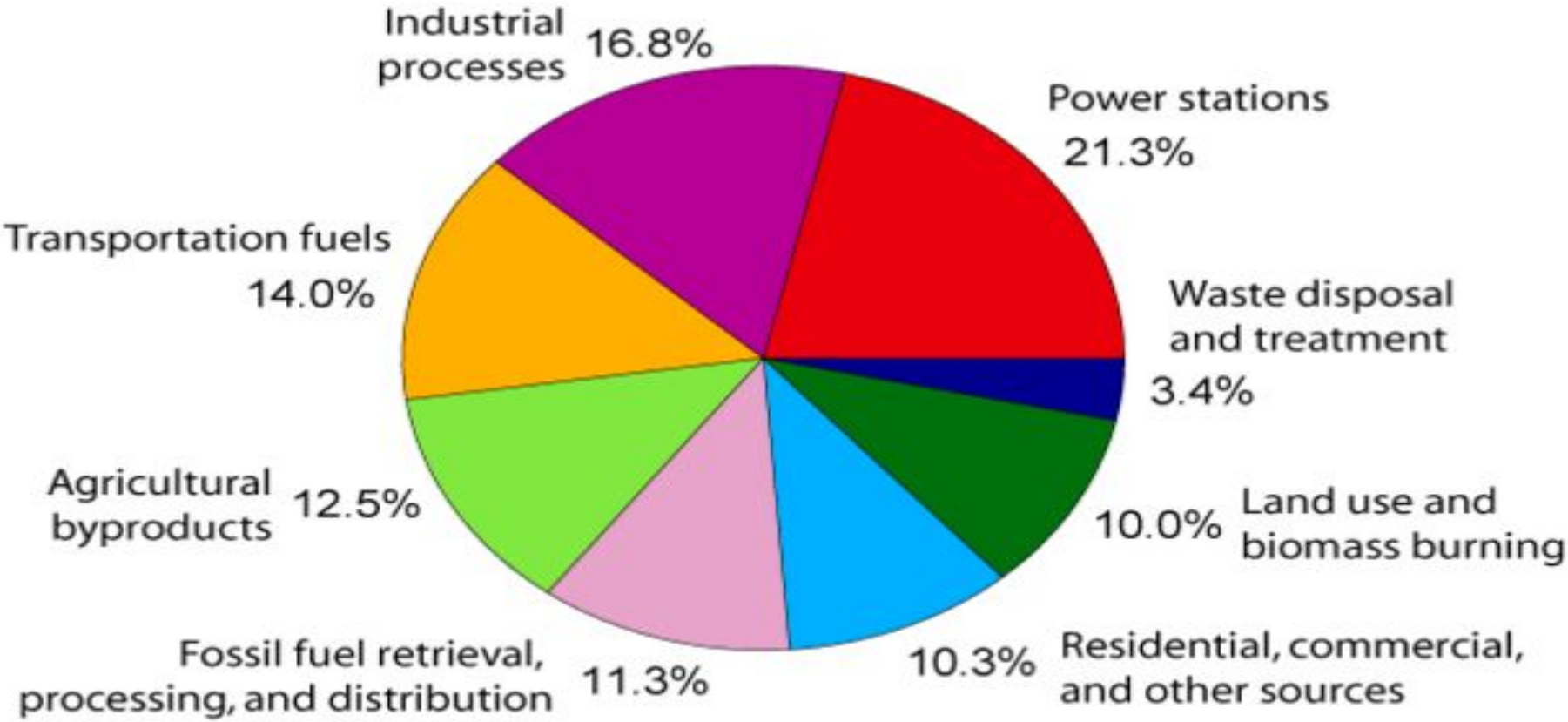
data obtained from ice cores drilled in Vostok, Antarctica, shows us that there has been a natural change on the amount of CO2 over time

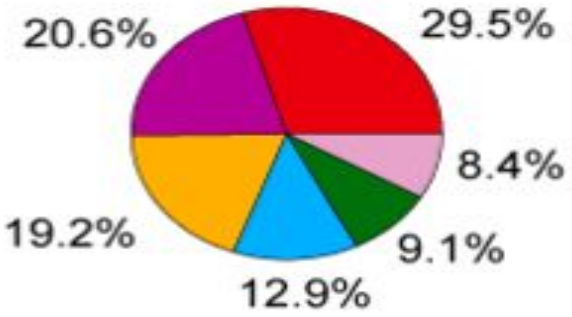


Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, Nature 399 (3JUne), pp 429-436, 1999.

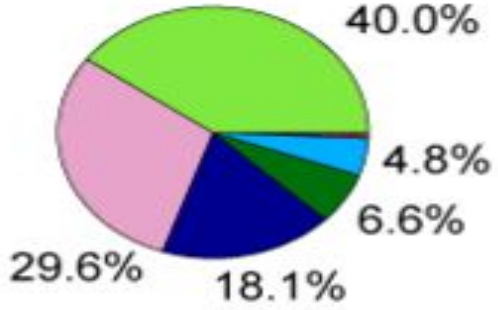
(Note: 2002 information added to diagram)

Annual Greenhouse Gas Emissions by Sector

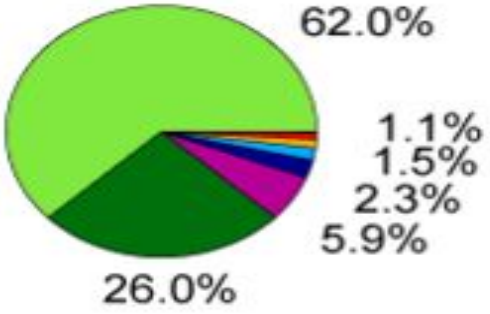




Carbon Dioxide
(72% of total)

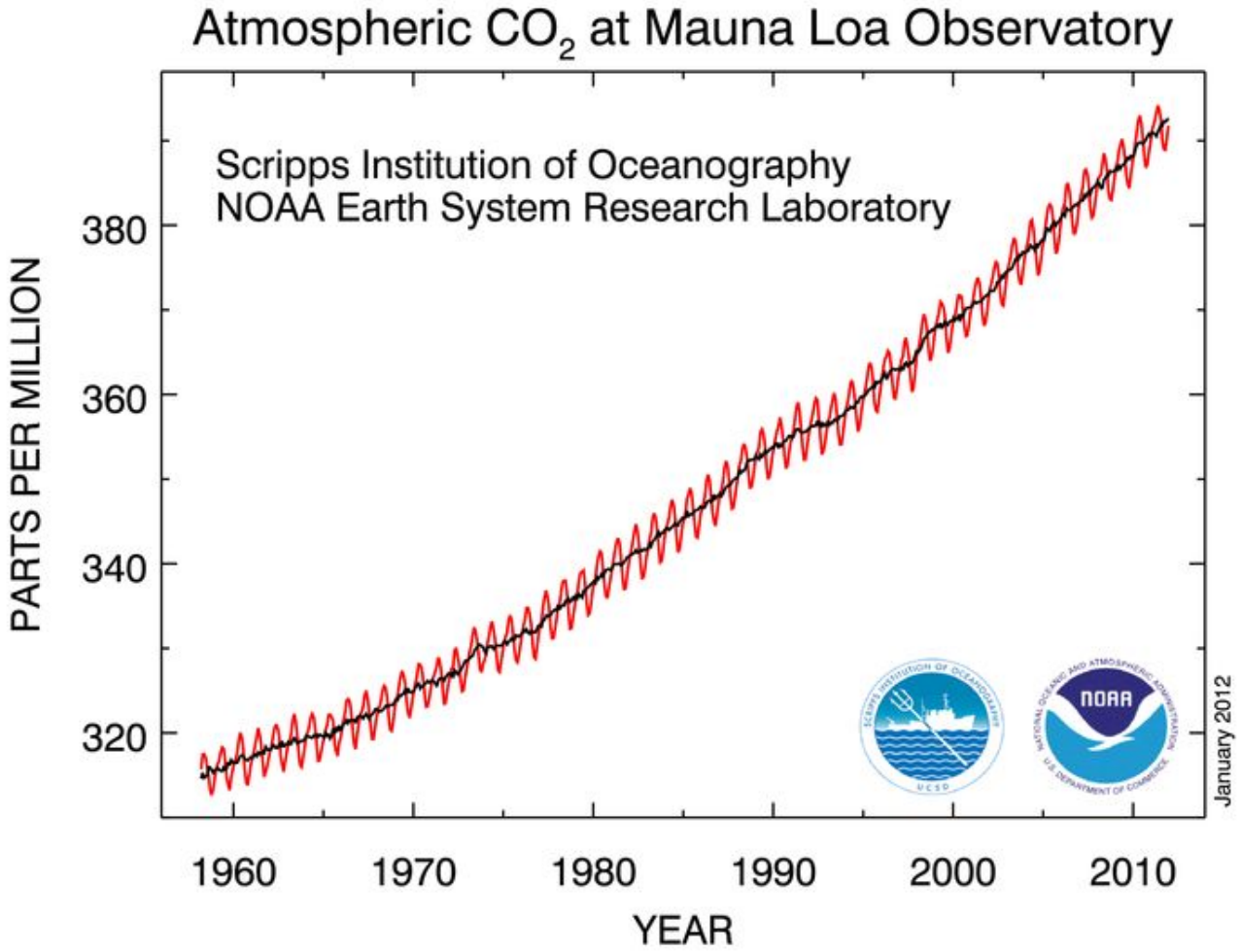


Methane
(18% of total)



Nitrous Oxide
(9% of total)

atmospheric CO_2 at Mauna Lowa, Hawaii 1957 – 2010, shows a clear trend of rising levels of CO_2 in the atmosphere

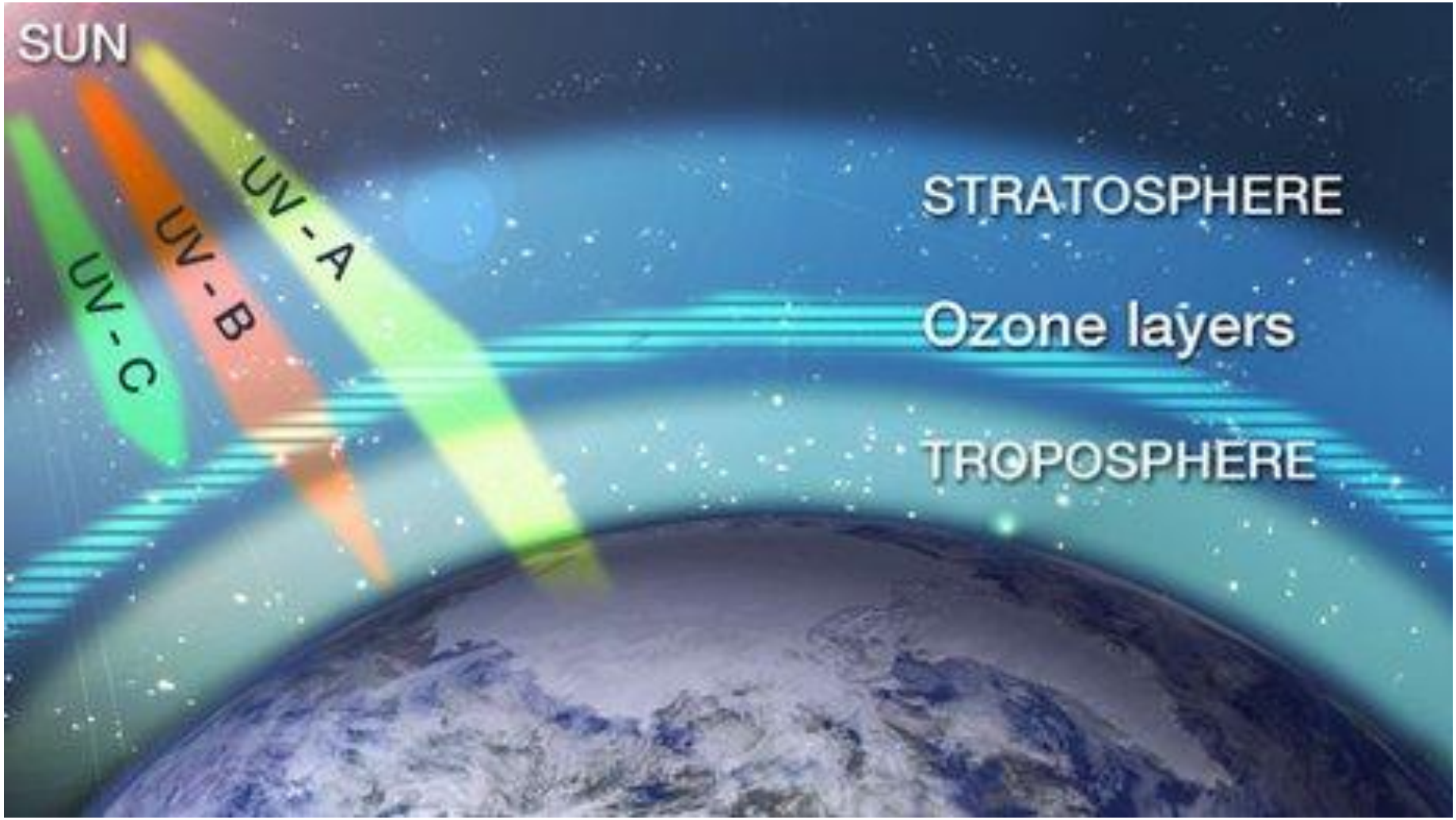


expected effects

- global temperature rises

- melting of polar ice caps and glaciers
- rising sea levels
- formation of deserts
- more floods
- less biodiversity (for instance coral reefs)
- more extreme weather events such as storms and floods
- extinction of species and disappearance of their habitats

the ozone layer has notning to do with global warming, instead it serves as a protection against solar radiation



what we can do to prevent global warming?