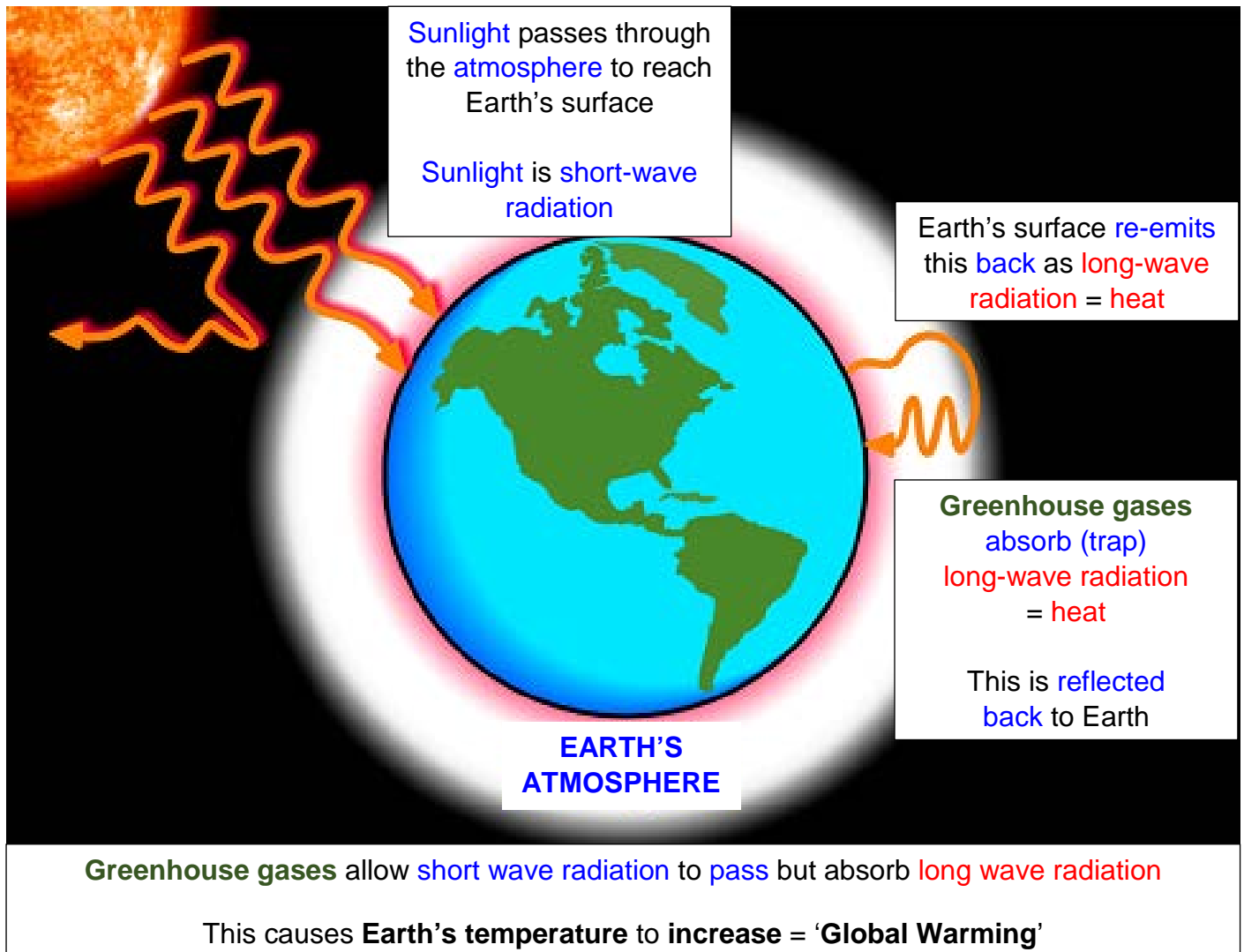


A. CAUSE

- The main **greenhouse gases** are **carbon dioxide**, **methane**, **water vapour** and **nitrogen oxide**.
- **Carbon dioxide** is released by **burning fossil fuels**.
- **Methane** is released from **cows**, **marshes** and **rice fields**.



The Greenhouse Effect is a **natural** process that has been **artificially speeded up** by **humans**

If there were **no greenhouse gases** around Earth, its temperature would be nearer **-18°C**

In exams, **do not mention The Ozone Layer**

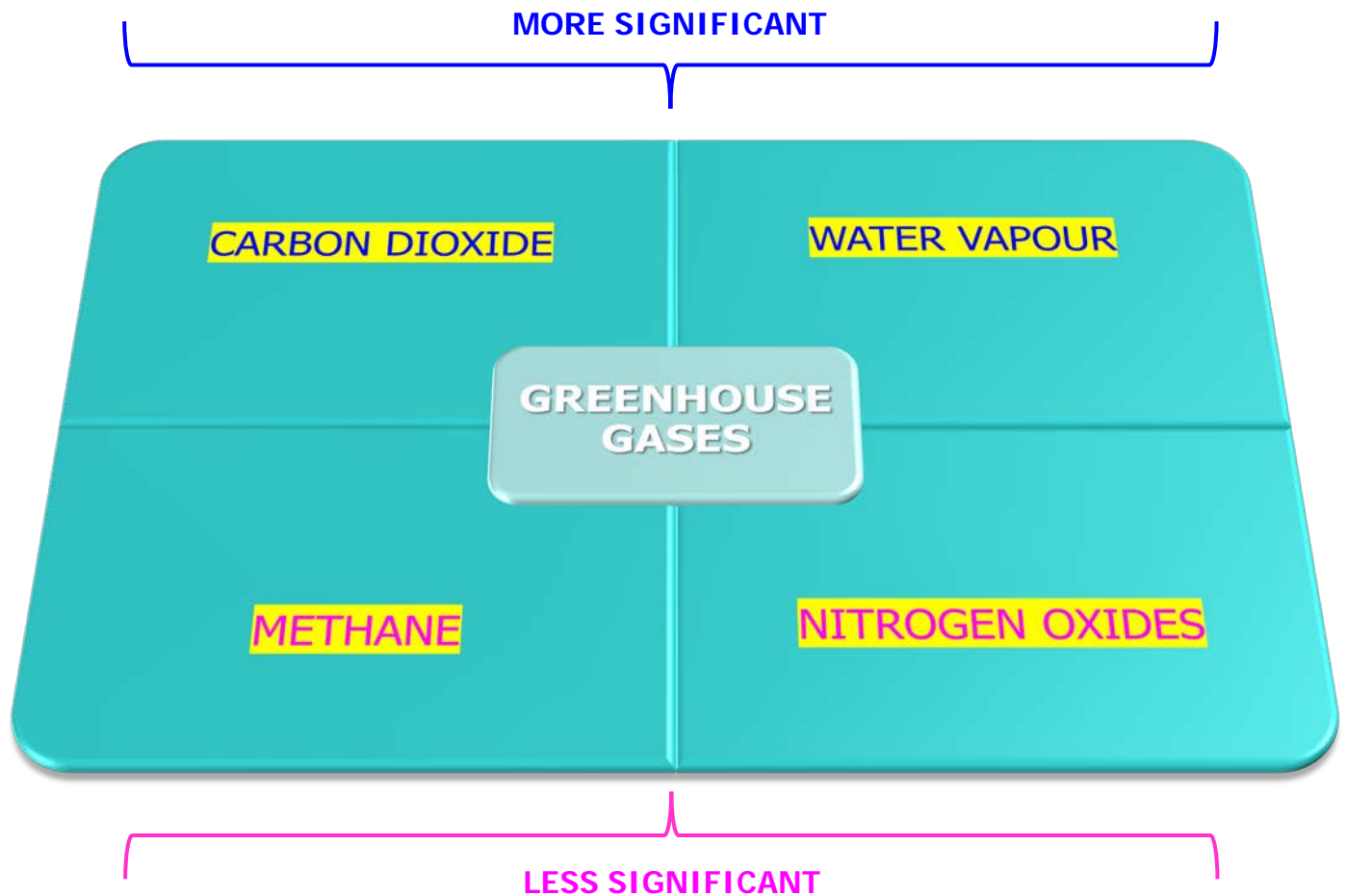
This is a **completely different phenomenon**

Two other common misconceptions and errors seen in exams:

'Greenhouse gases absorb the **sun's radiation** that passes through the atmosphere' = **X**

'Greenhouse gases absorb **sunlight** that is reflected off the Earth's surface' = **X**

B. THE MAIN GREENHOUSE GASES

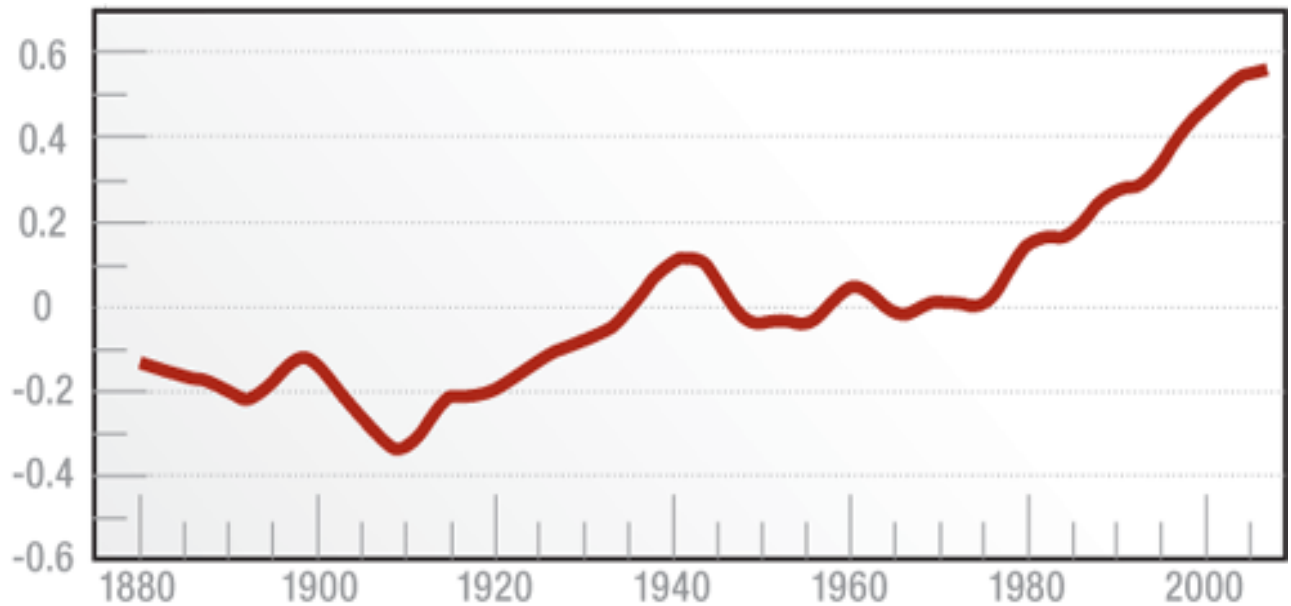


- **Contribution** of a gas towards **The Greenhouse Effect** depends on its:
 - **ability** to **absorb** long wave radiation
 - **concentration** in the **atmosphere**
- **Carbon dioxide** is the **main contributor**.

Let us now look at some evidence that **CO₂** is **responsible** for **global warming**.

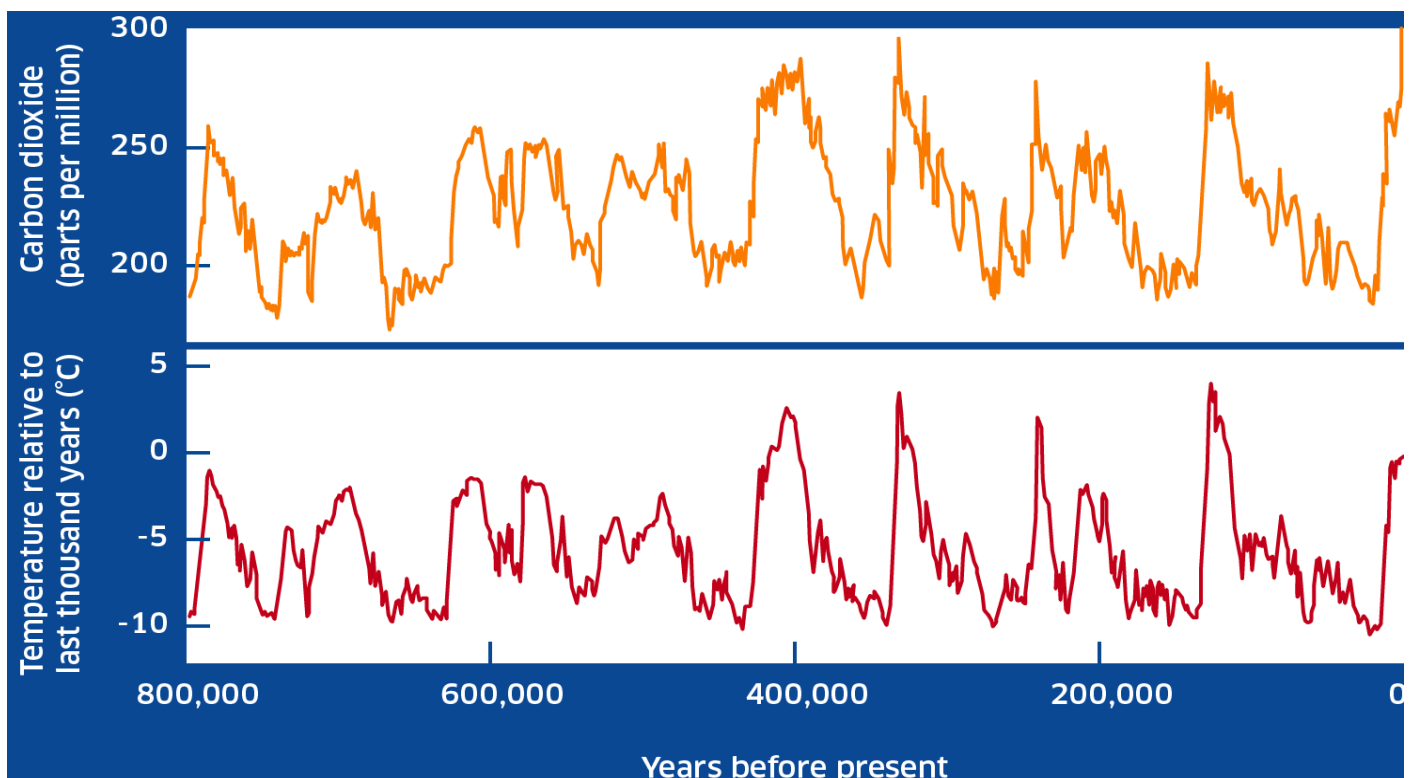
C. RISE OF THE GLOBAL MEAN TEMPERATURE SINCE 1880

Mean global temperature compared
with average from 1951-1980 /°C



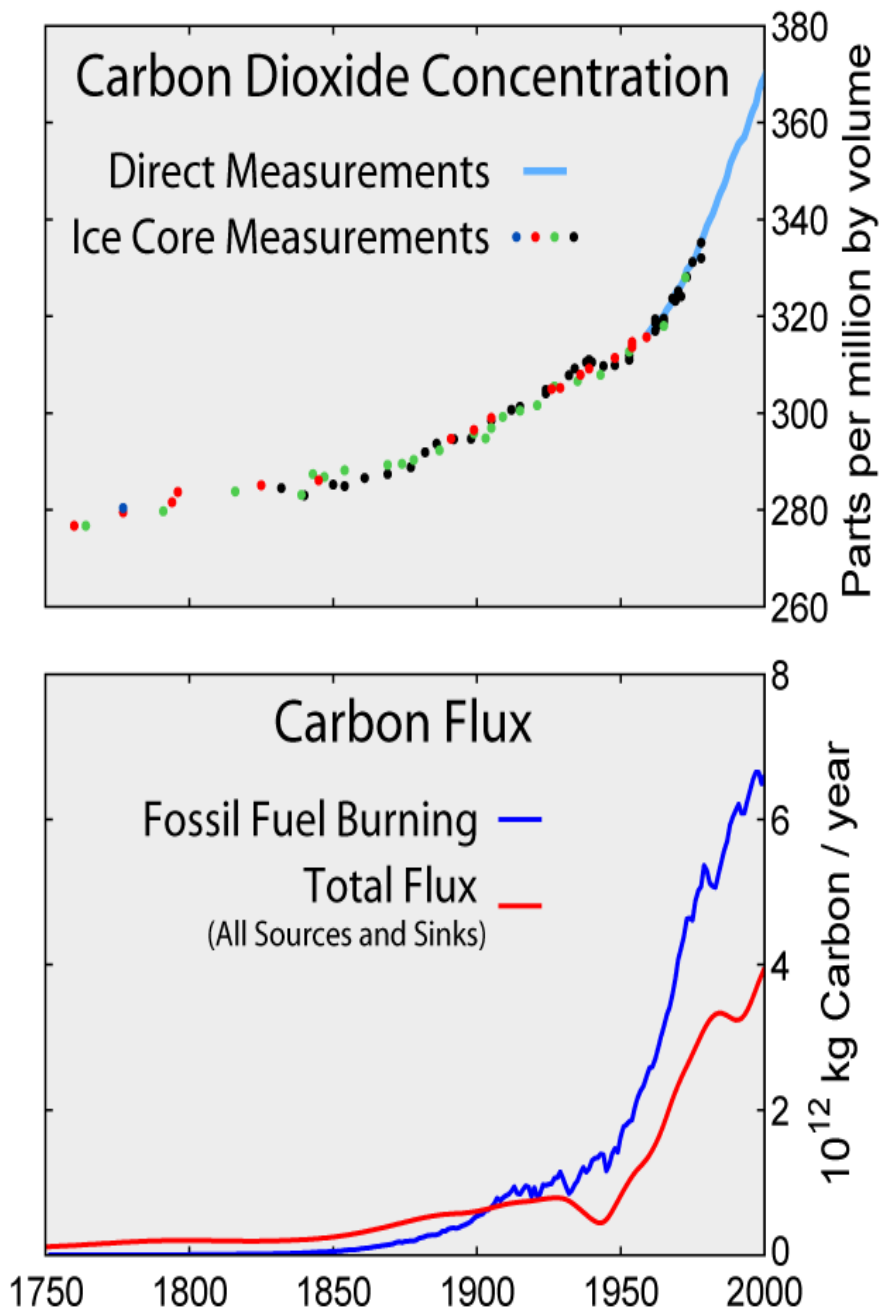
- **Earth's average temperature** has **increased** over the last **200 years**.
- Scientists have calculated that **without the Greenhouse effect**, the **mean temperature of Earth's surface** would be **-18°C**. The **actual value** is **30°C** **higher** than this.
- Beyond dispute that **concentrations of greenhouse gases** influence **global temperatures** and **climate change**.
- **Human activities** are **increasing** the **concentrations** of **greenhouse gases** in the **atmosphere**.

D. DRILLING FOR LONG COLUMNS OF ICE IN THE ANTARCTIC



- **Repeating pattern** of **rapid periods of warming** followed by **longer periods of gradual cooling**.
- This **correlates closely** with **changes in CO₂ concentrations**.
- BUT: **Correlation does not prove causation**.
- However, we **also know** that **CO₂ is a greenhouse gas**.
- At least **some** of the **temperature variations** over the last 800,000 years must have been due to the **CO₂ concentration rising and falling**.

E. CARBON EMISSIONS AND GLOBAL WARMING



Over the last 150 years, the **burning of fossil fuels** and the **CO₂ concentration** in the **atmosphere** have **both increased**

This trend has happened **faster and faster** since the **industrial revolution** 200 years ago.

Global temperatures also **increased** during this **same period** by 0.8°C, with **most of the increase happening since 1980** (see first graph in section C)

F. EFFECT OF CO₂ ON CORAL REEFS



- **50 billion tonnes** of **CO₂** have **dissolved in oceans** since the industrial revolution.
- **pH decreased** from 8.25 to 8.14 = **30% more acidic**
- $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{carbonic acid (splits)} \rightarrow \text{H}^+ + \text{HCO}_3^-$
- **H⁺** convert **carbonate** to **hydrogen carbonate** (H₂CO₃).
- This means there is **less carbonate** freely **available** for corals to use in their **skeletons**, which are made of **calcium carbonate**.
- So, **more corals die**.