



Global Warming & Climate Change

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Plan of Talk

- ❑ Weather & Climate?
- ❑ Why Climate Matters?
- ❑ How Climate System Works?
- ❑ Climate Change – Is it real?
- ❑ Causes of Climate Change?
 - ❑ Natural
 - ❑ Anthropogenic
- ❑ Potential Effects of Climate Change
- ❑ Climate Change & Human Health
- ❑ Australian Bush Fires – Case Study
- ❑ Cyclone Amphan - Case
- ❑ Building Climate Resilience
- ❑ Climate Response – India
- ❑ Sustainability Path.....



Weather & Climate?

WEATHER

WHAT YOU GET

CONDITIONS OF THE
ATMOSPHERE OVER A SHORT
PERIOD OF TIME

CAN CHANGE WITHIN
MINUTES OR HOURS



Saturday



Sunday

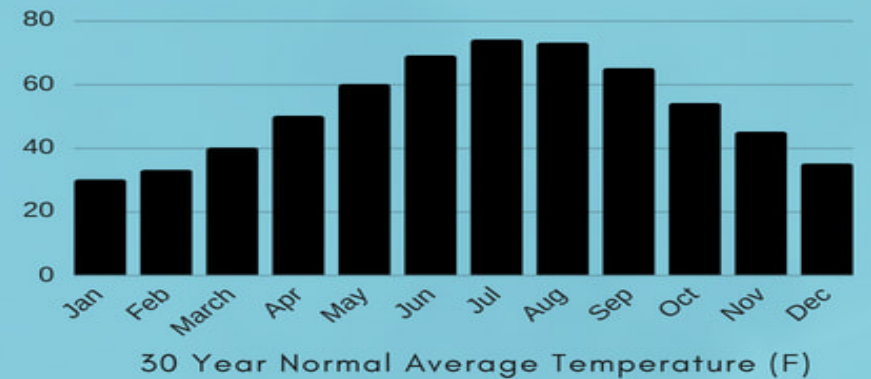
VS

CLIMATE

WHAT YOU EXPECT

HOW THE ATMOSPHERE BEHAVES
OVER A LONG PERIOD OF TIME
AND SPACE

AVERAGE REGIONAL WEATHER
PATTERN OVER DECADES

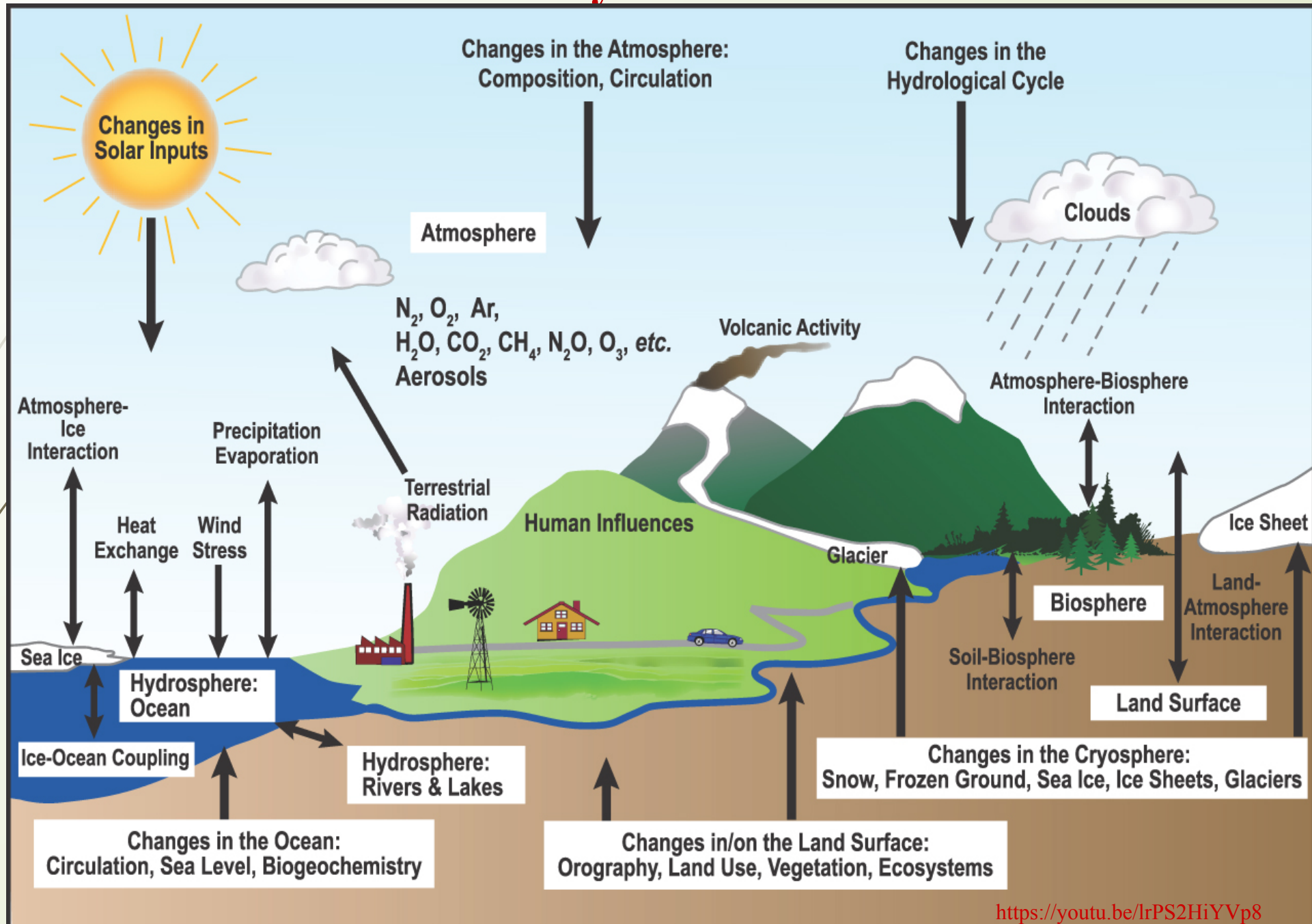


Weather is what's happening outside your window right now.

Why Climate Matters?

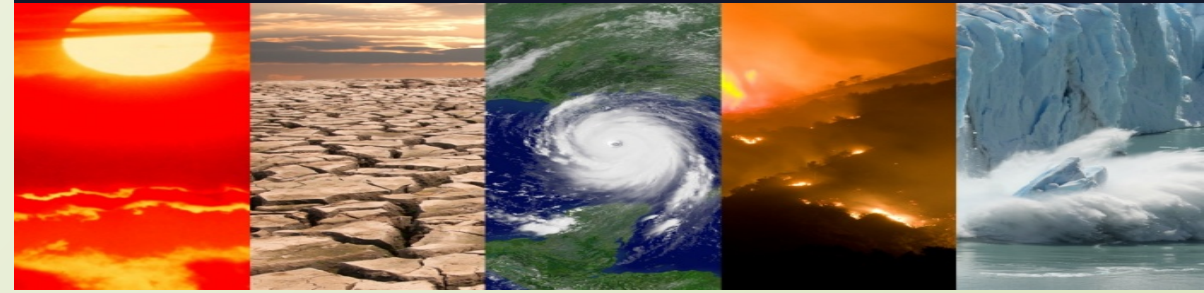
- **Climate controls :**
 - Evolution of Earth & its ecosystems
 - Human habits & habitat
 - Progress of civilization
- **Climate affects our quality of life** – food production, energy production and consumption, water availability, environmental diversity.
- **Successful crop production** – climate affect all phases of plant growth.
- Weather conditions (rain fall, humidity etc.) control occurrence of **pests** and **diseases**.
- **Flooding** and **storms** show how much weather and climate can affect our lives.
- **Design and construction** without consideration of likely **climate conditions** can be very **costly** and have consequences for **human safety**.

How Climate System Works?



Climate Change – Is it real?

- **Climate change?**
- **CO₂ increased by about 35%** during industrial era.
- **Global Avg. Earth's Temperature Rise - 1°C.**
- **Warming Oceans - 0.13°C per decade.**
- **Shrinking Ice Sheets - Greenland and Antarctic.**
- **Glacial Retreat - Alps, Himalayas, Andes, Rockies, Alaska and Africa.**
- **Sea level rise -18 cm during last century. Predicted rise - 1 m by 2100.**
- **Extreme events – Rain, Cyclones, Heat & Cold Waves.**
- **Ocean Acidification – 30% increase since industrial revolution.**



Causes of Climate Change

Natural Causes:

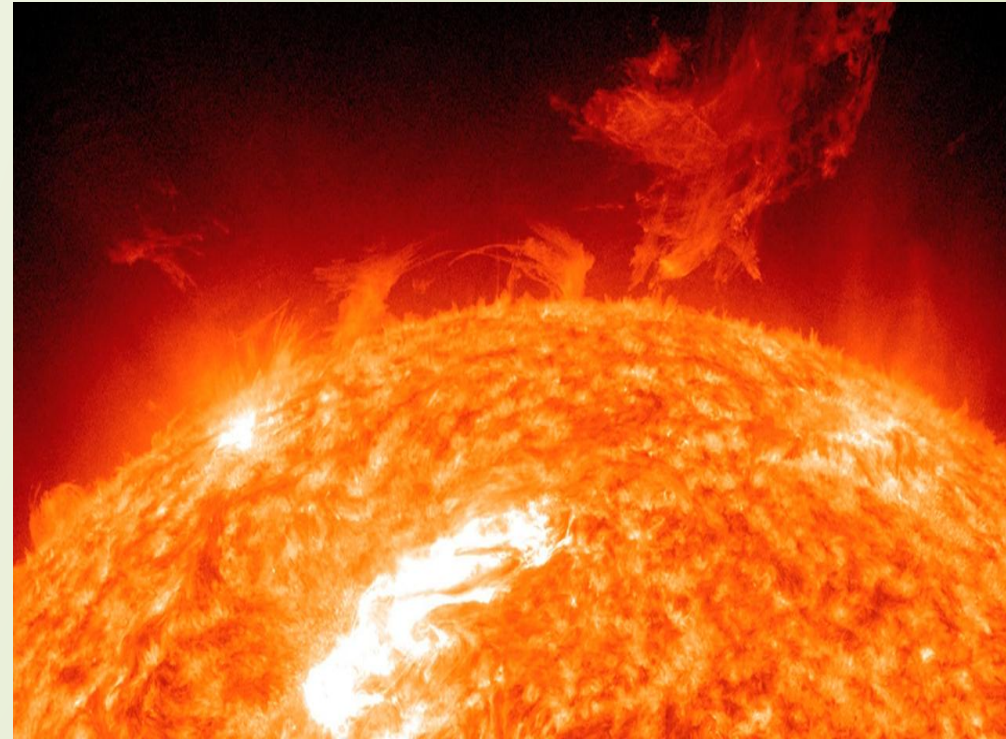
- ❑ Solar Radiation Variability
- ❑ Earth's Orbit & Tilt variability
- ❑ Plate Tectonics
- ❑ Volcanic Activity
- ❑ El Nino Southern Oscillation(ENSO)

Anthropogenic Causes:

- ❑ Changes in Green House Effect:
 - ❑ Fossil fuels burning
 - ❑ Deforestation
 - ❑ Waste management
 - ❑ Unsustainable farming
- ❑ Changes in Albedo
 - ❑ Land use change
 - ❑ Deforestation
 - ❑ Pollution

Solar Radiation Variability

- ❑ Sun has powered almost everything on Earth since life began, including its climate.
- ❑ Sun follows a natural **11-year cycle** of small ups and downs in intensity - but the effect on Earth's climate is **small**.
- ❑ The fluctuations in the solar cycle impacts Earth's **global temperature** by about **0.1 degree Celsius**, slightly hotter during solar maximum and cooler during solar minimum



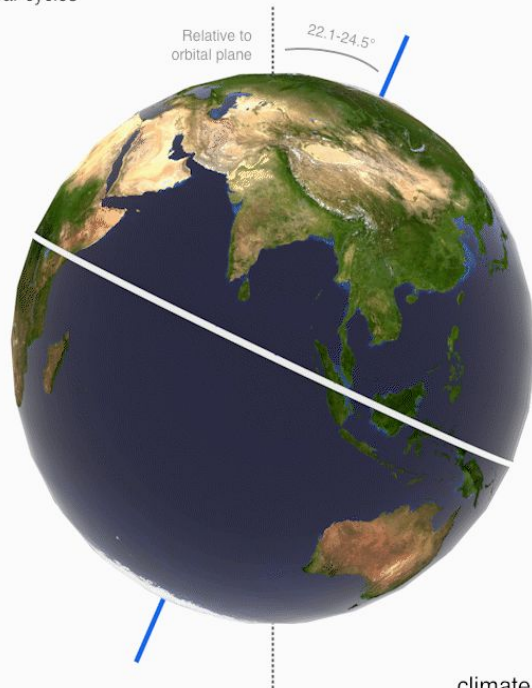
Earth's Orbit & Tilt

- Changes in Earth's orbit and tilt affect the amount of sunlight reaching Earth's surface.
- Milankovitch cycles:** cause about 25% variation in the amount of incoming insolation at Earth's mid-latitudes.
 - Shape of Earth's orbit (**Eccentricity**).
 - Angle Earth's axis is tilted with respect to Earth's orbital plane (**Obliquity**).
 - Direction Earth's axis of rotation is pointed (**Precession**).

variability

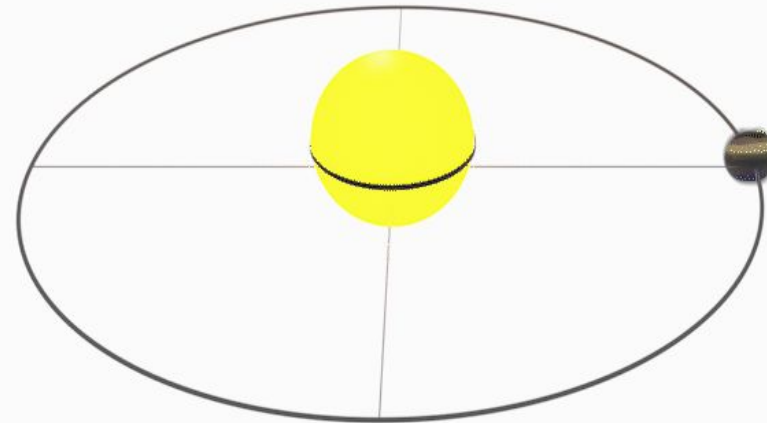
Changes in Obliquity (Tilt)

41,000-year cycles



Changes in Eccentricity (Orbit Shape)

100,000-year cycles



*Changes in eccentricity exaggerated so the effect can be seen. Earth's orbit shape varies between 0.0034 (almost a perfect circle) to 0.058 (slightly elliptical).

Axial Precession (Wobble)

26,000-year cycles

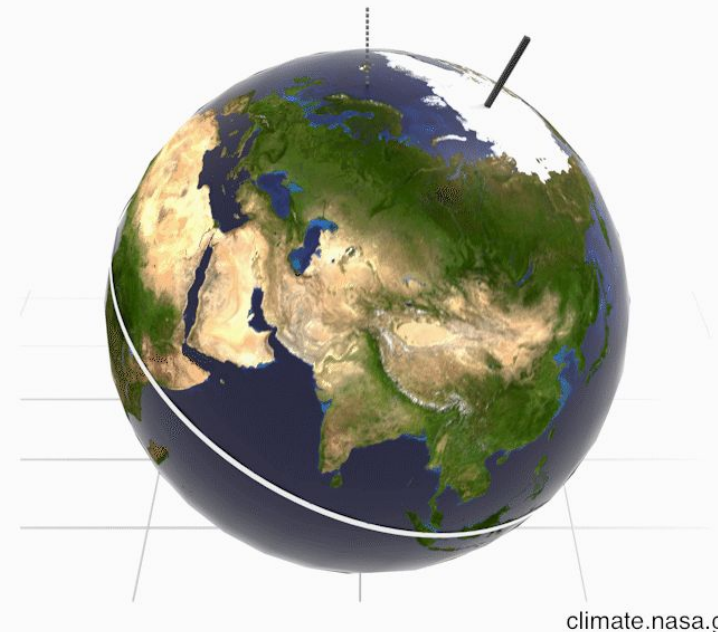
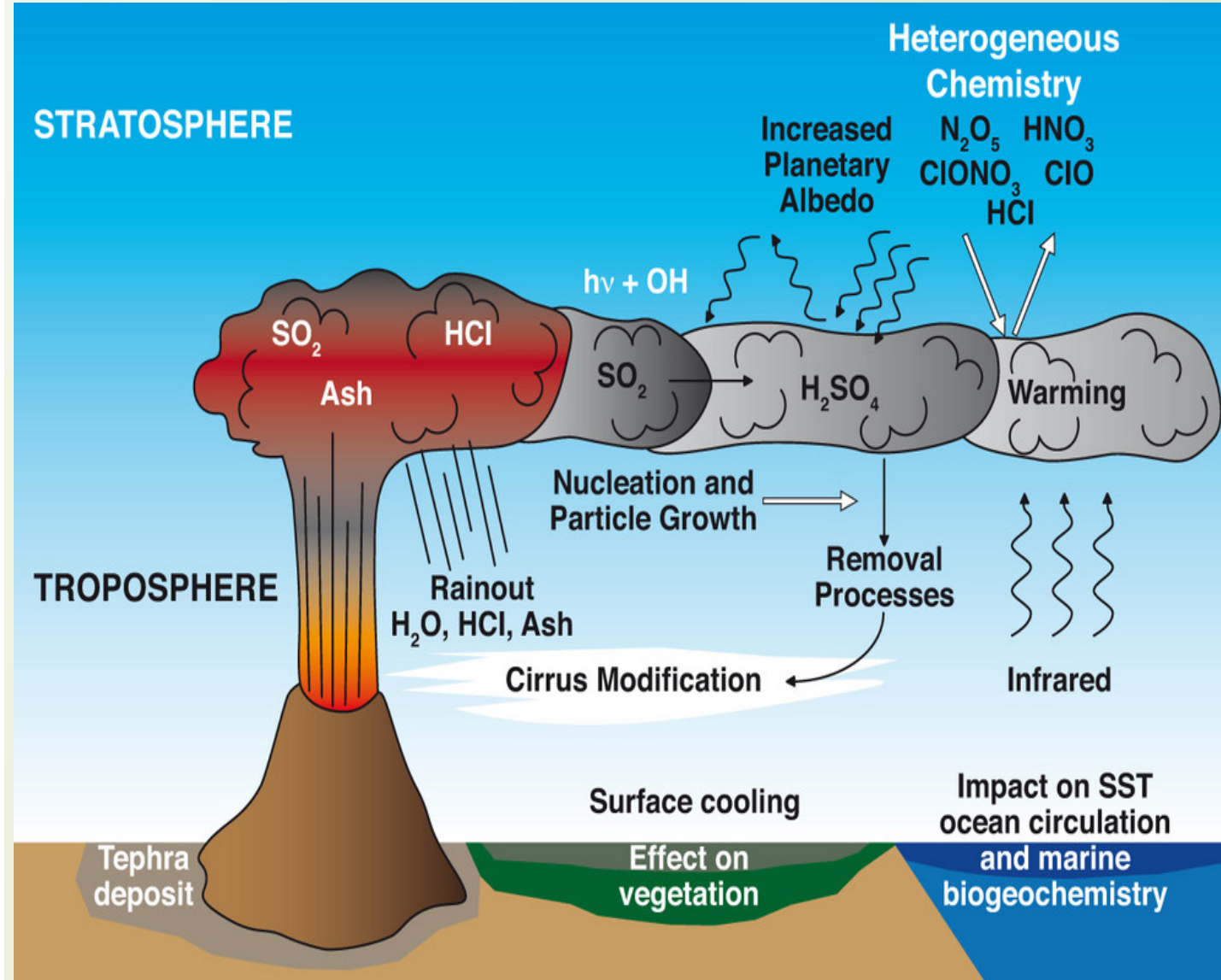
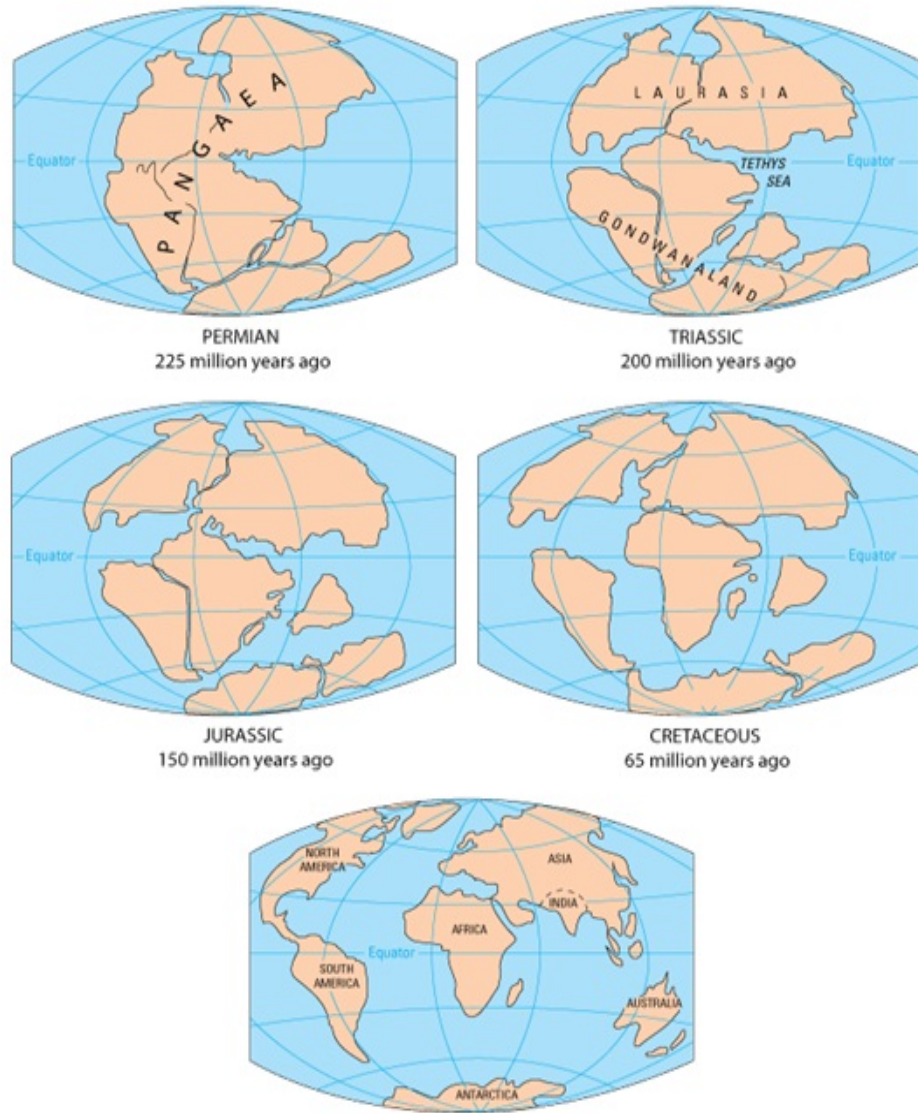


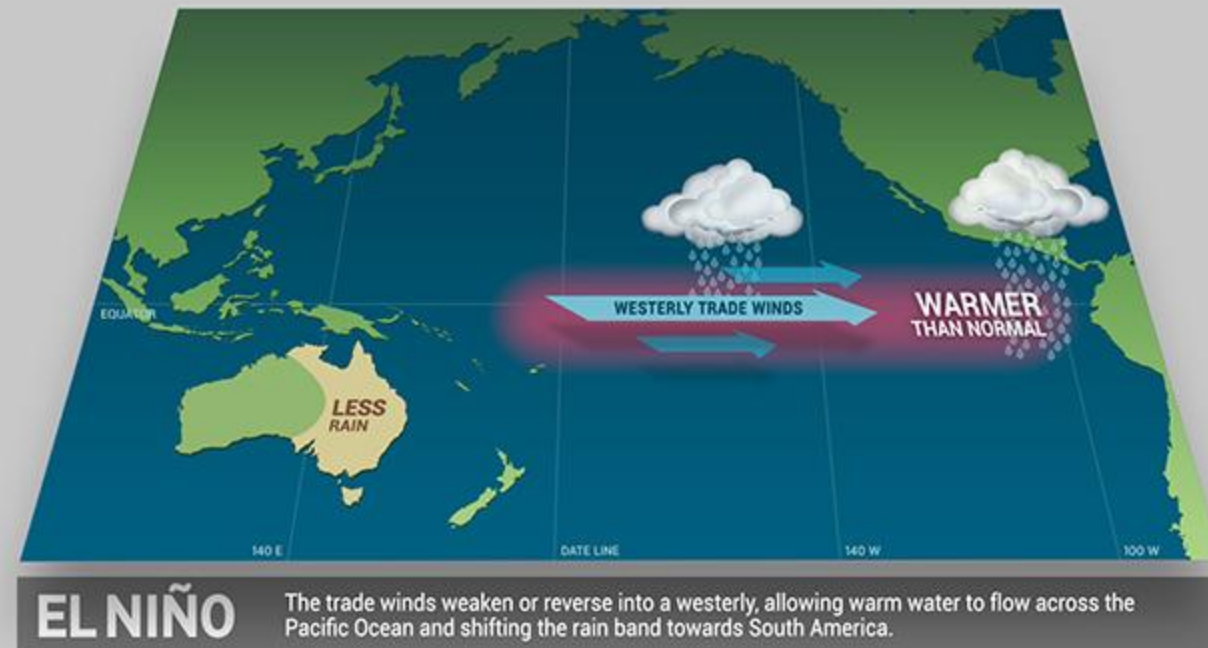
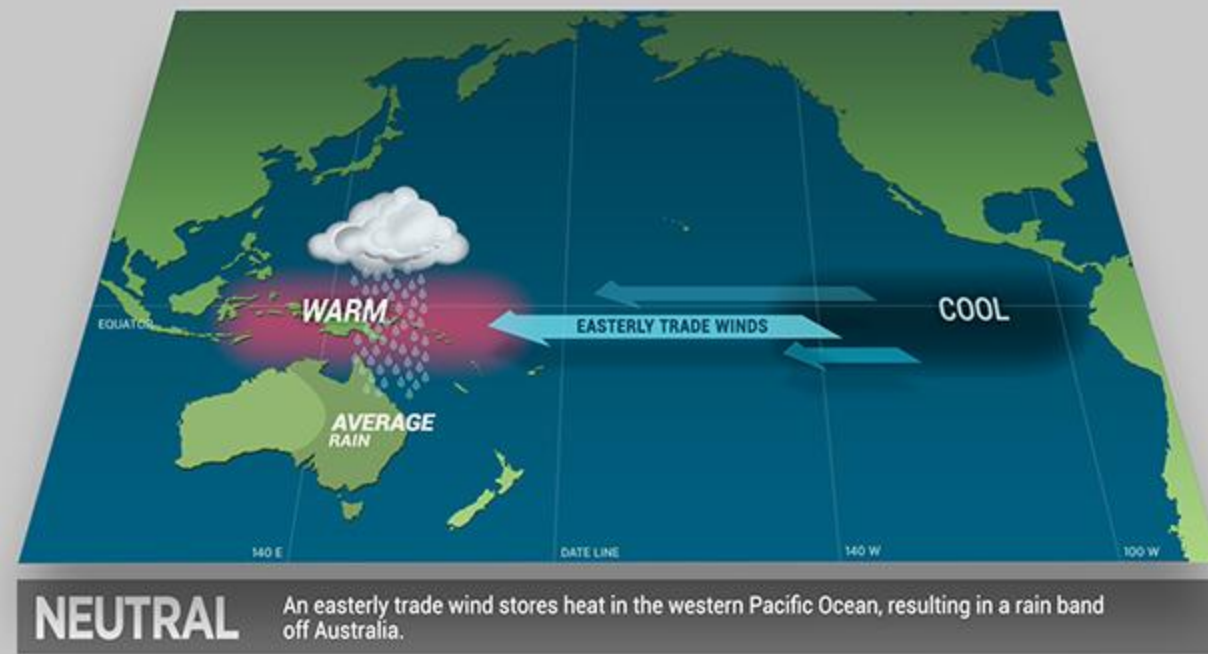
Plate Tectonics & Volcanic Activity



- Glacial deposits at current equator
- Fossilized palm trees in Greenland

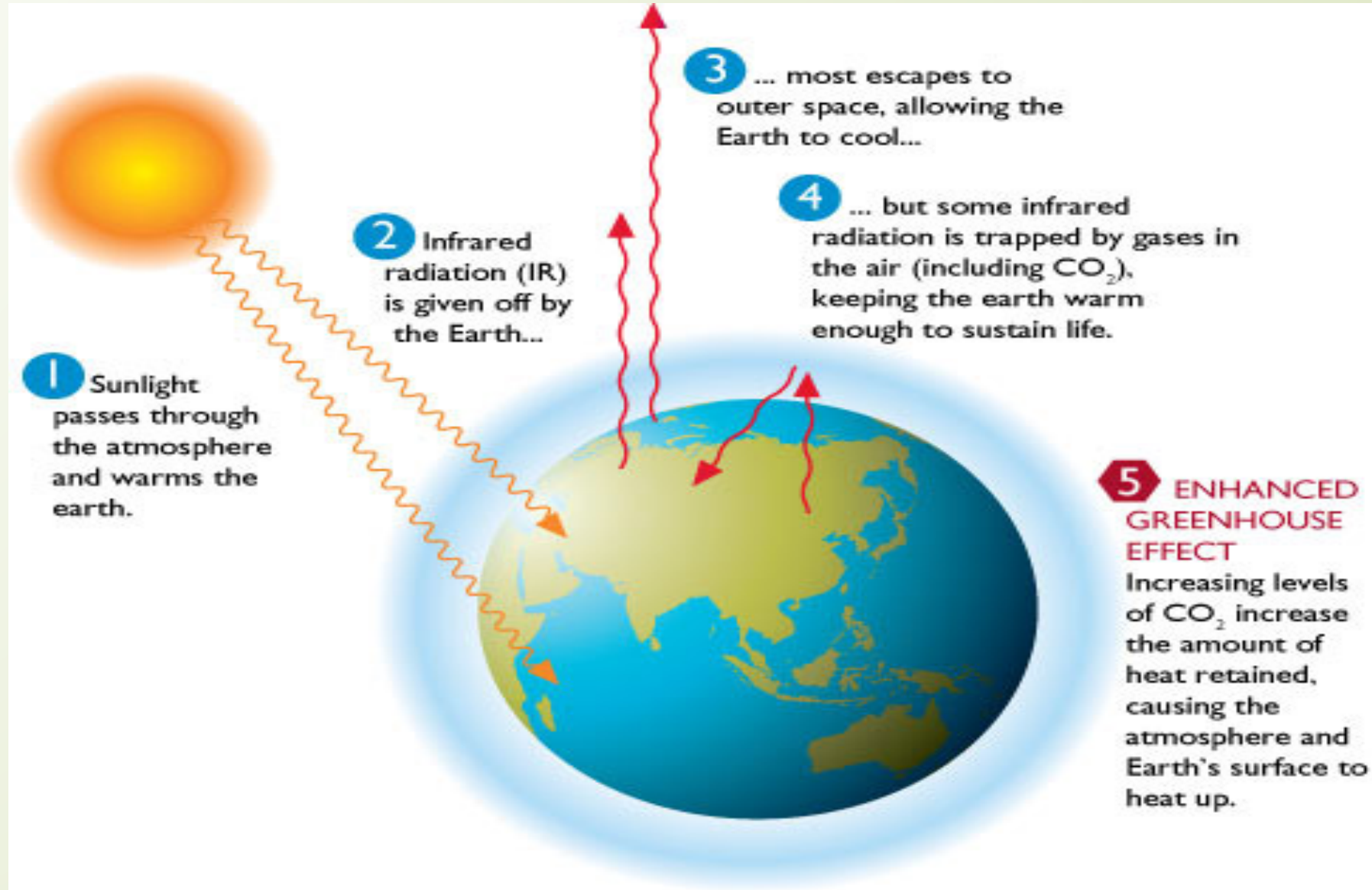
El-Nino Southern Oscillation (ENSO)

- ENSO is cycle of warm and cold sea surface temperature of tropical central and eastern Pacific Ocean.
- El Niño - high air pressure in Western Pacific and low air pressure in Eastern Pacific.
- ENSO cycle causes global changes in temperature and rainfall.

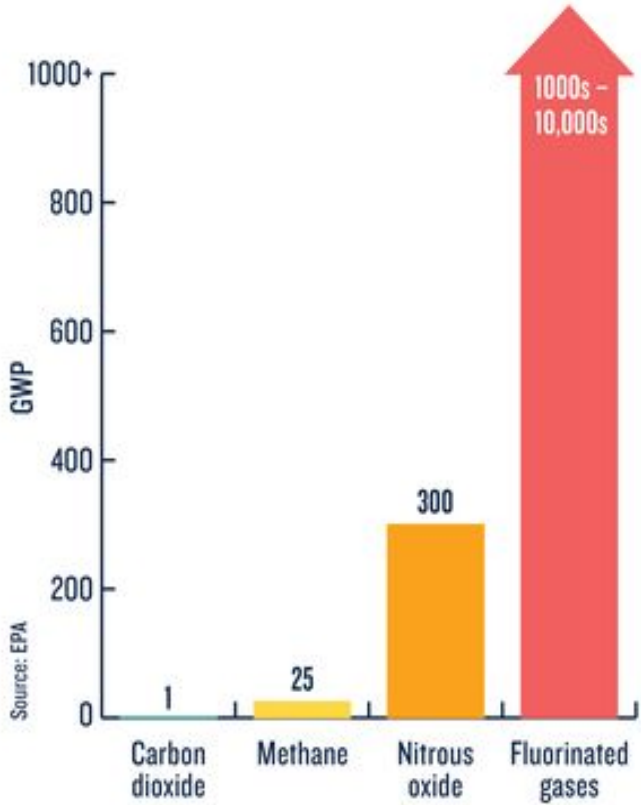


Changes in Green House Effect

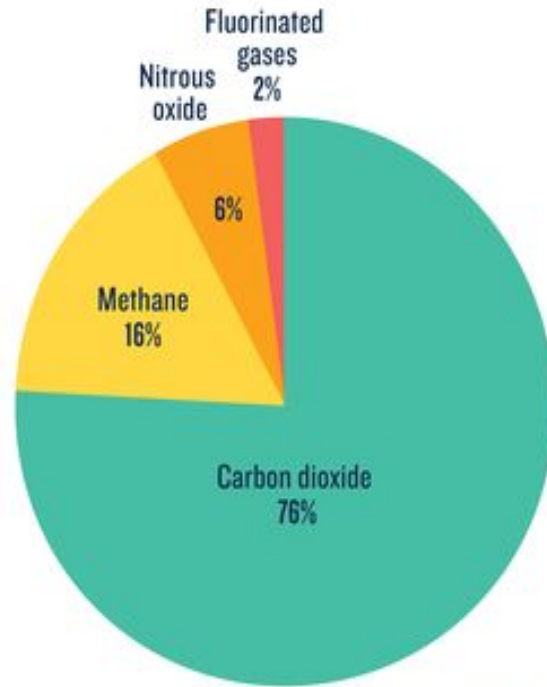
GHG's - CO₂, H₂O vapour, and CH₄ absorb energy (Heat) and slowdown heat loss to space – 'Life Supporting Warmth'.



HOW GREENHOUSE GASES WARM OUR PLANET

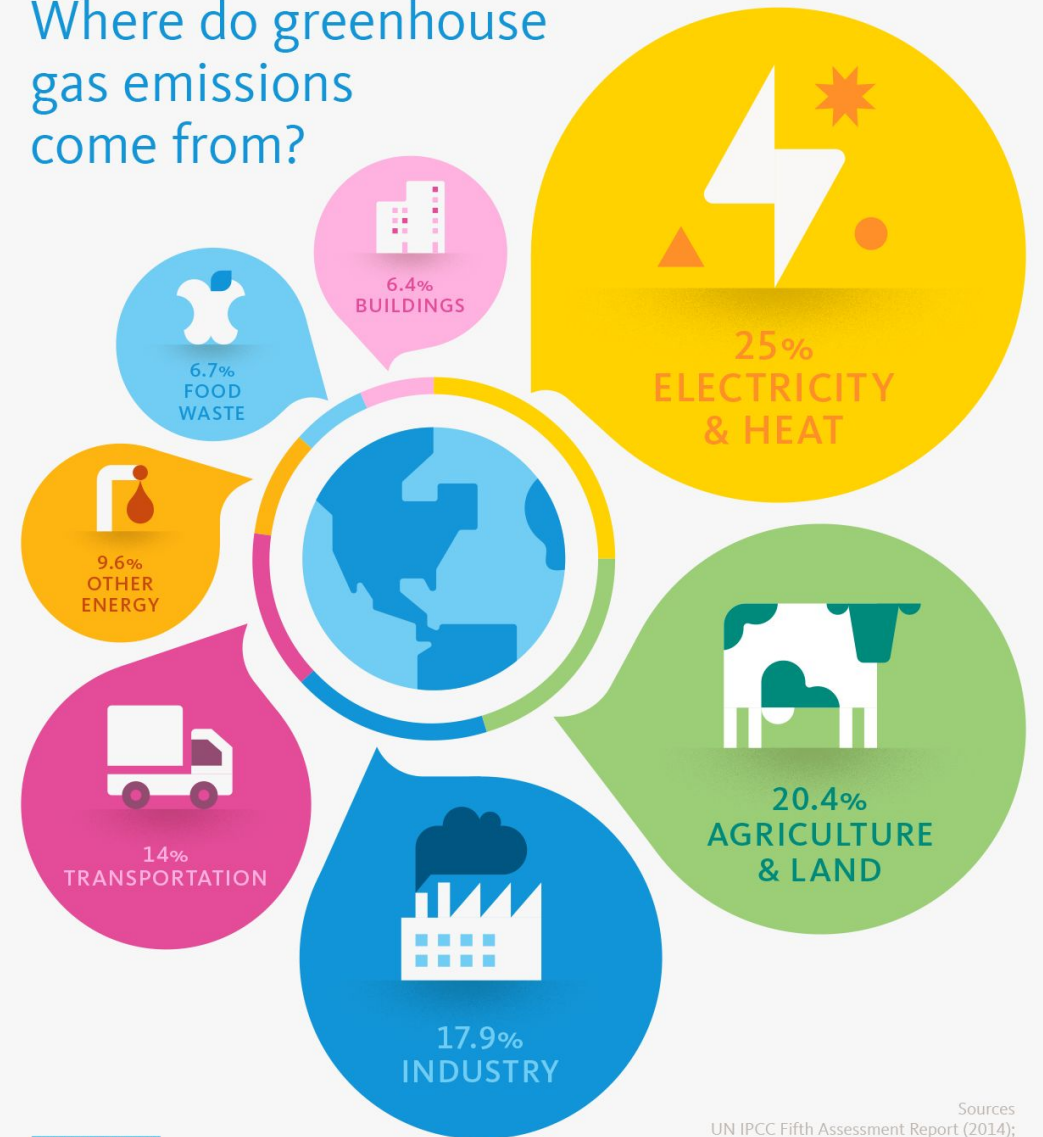


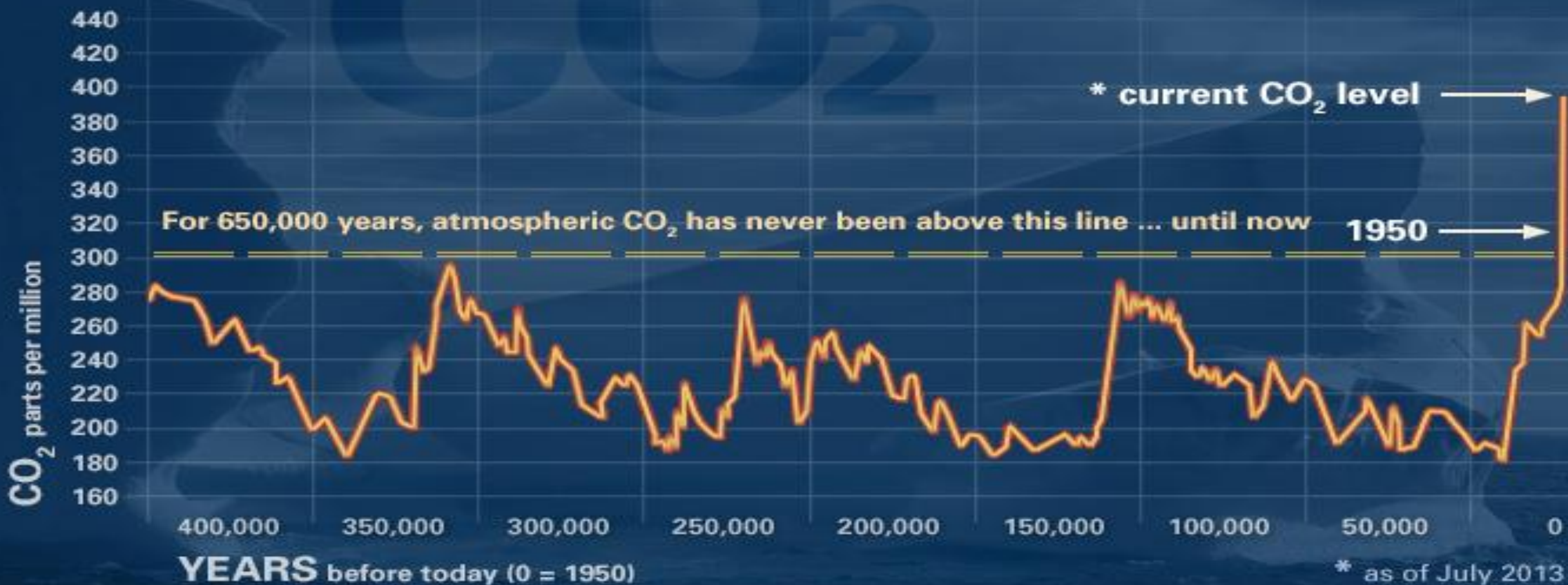
The global warming potential (GWP) of human-generated greenhouse gases is a measure of how much heat each gas traps in the atmosphere, relative to carbon dioxide.



How much each human-caused greenhouse gas contributes to total emissions around the globe.

Where do greenhouse gas emissions come from?

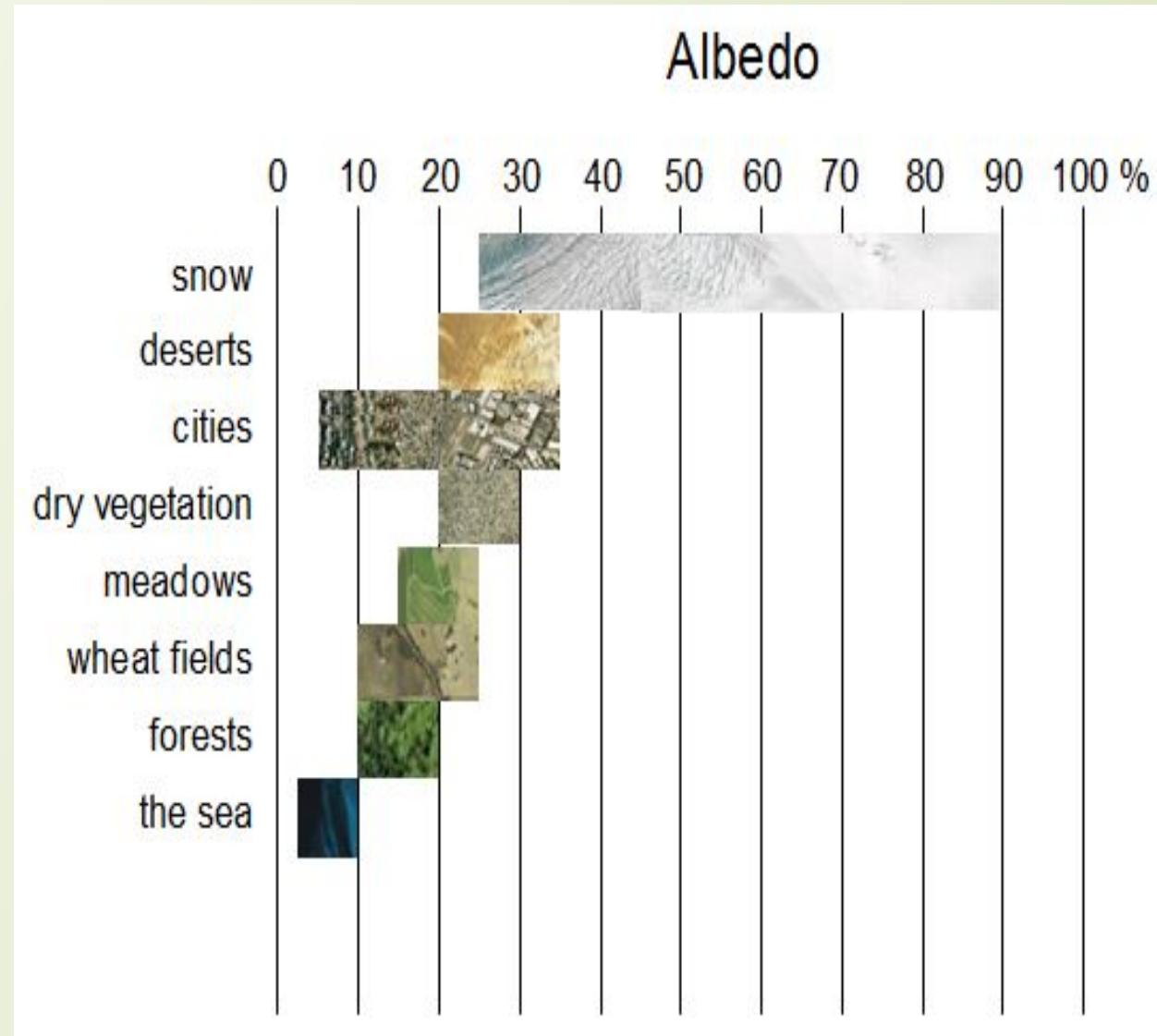




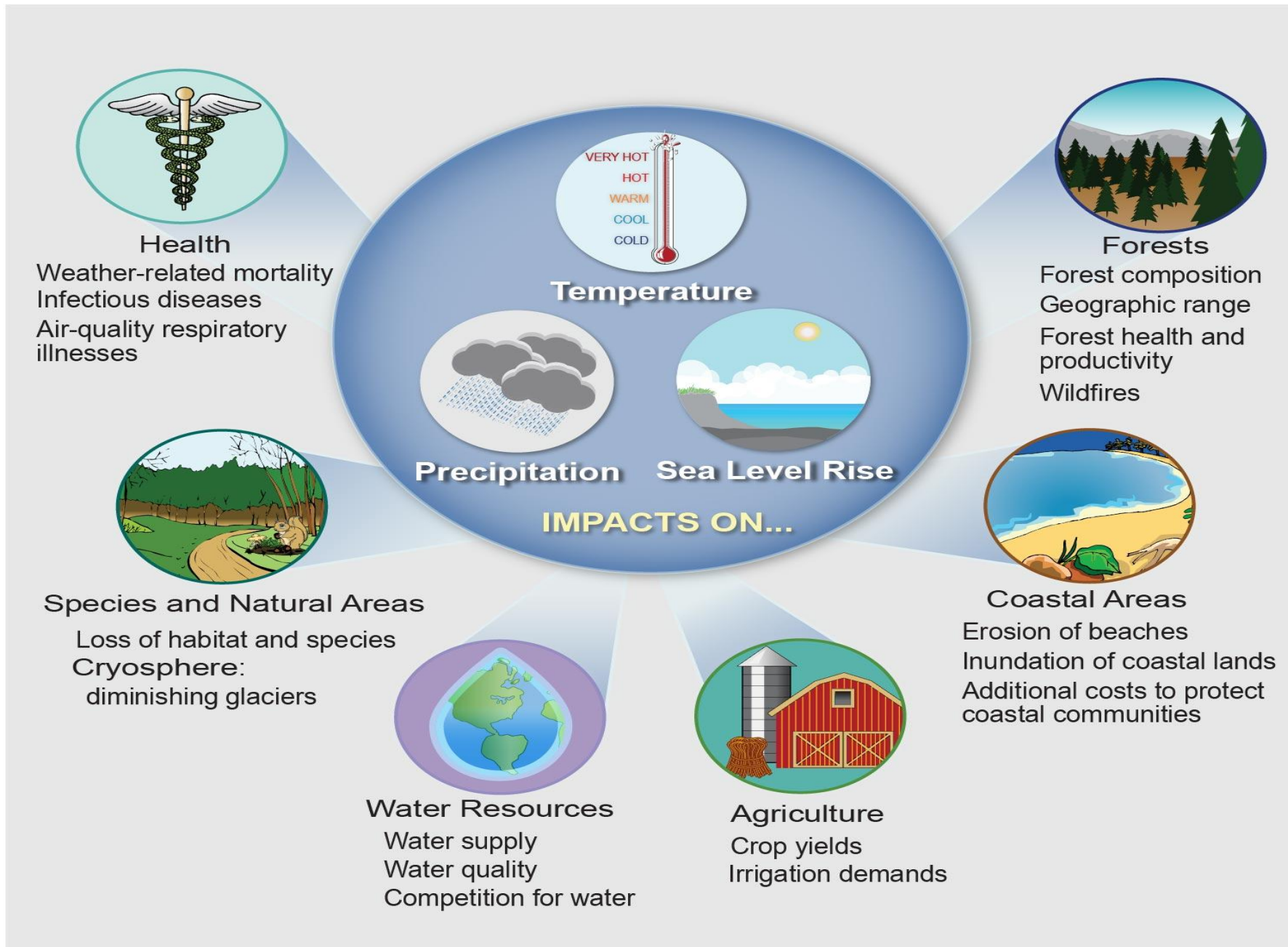
GLOBAL CLIMATE CHANGE
climate.nasa.gov

Changes in Albedo

- ❑ **Albedo** - amount of solar radiation (%) reflected from a surface.
- ❑ **Earth's albedo** - **30%**, Warms Earth's land, water, and atmosphere.
- ❑ **Cloud cover** - Higher albedo
- ❑ **Ice/ Snow (Cryosphere)** - Higher albedo
- ❑ **Deforestation** - Higher albedo (less evaporative cooling by **Transpiration**)
- ❑ **Reforestation** - Lower albedo
- ❑ **Urbanization** - Higher albedo
- ❑ **Aerosols** - small particles or liquid droplets in the atmosphere that can absorb or reflect sunlight.
- ❑ **Carbon Black** - absorb sunlight - warming effect
- ❑ **Volcanic particles** - reflect sunlight - cooling effect

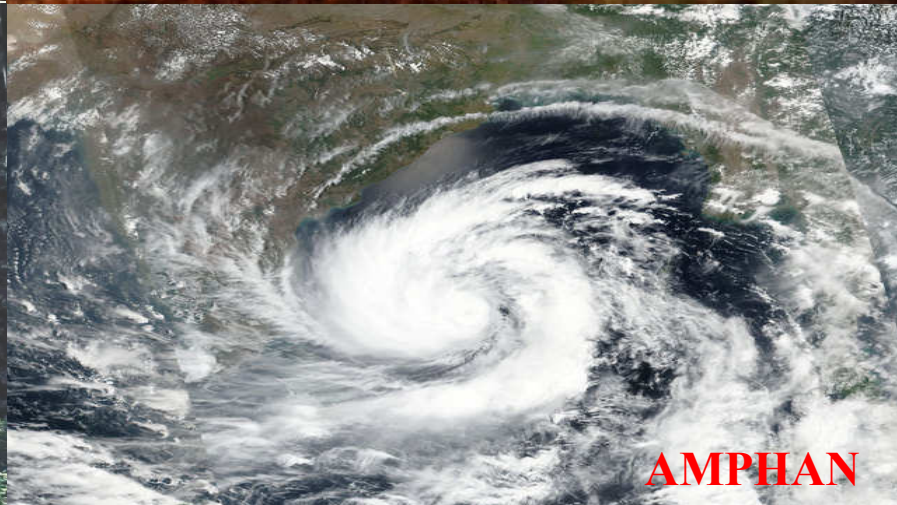


Potential Effects of Climate Change





110 Killed
(Up & Bihar)



AMPHAN



Assam
Floods

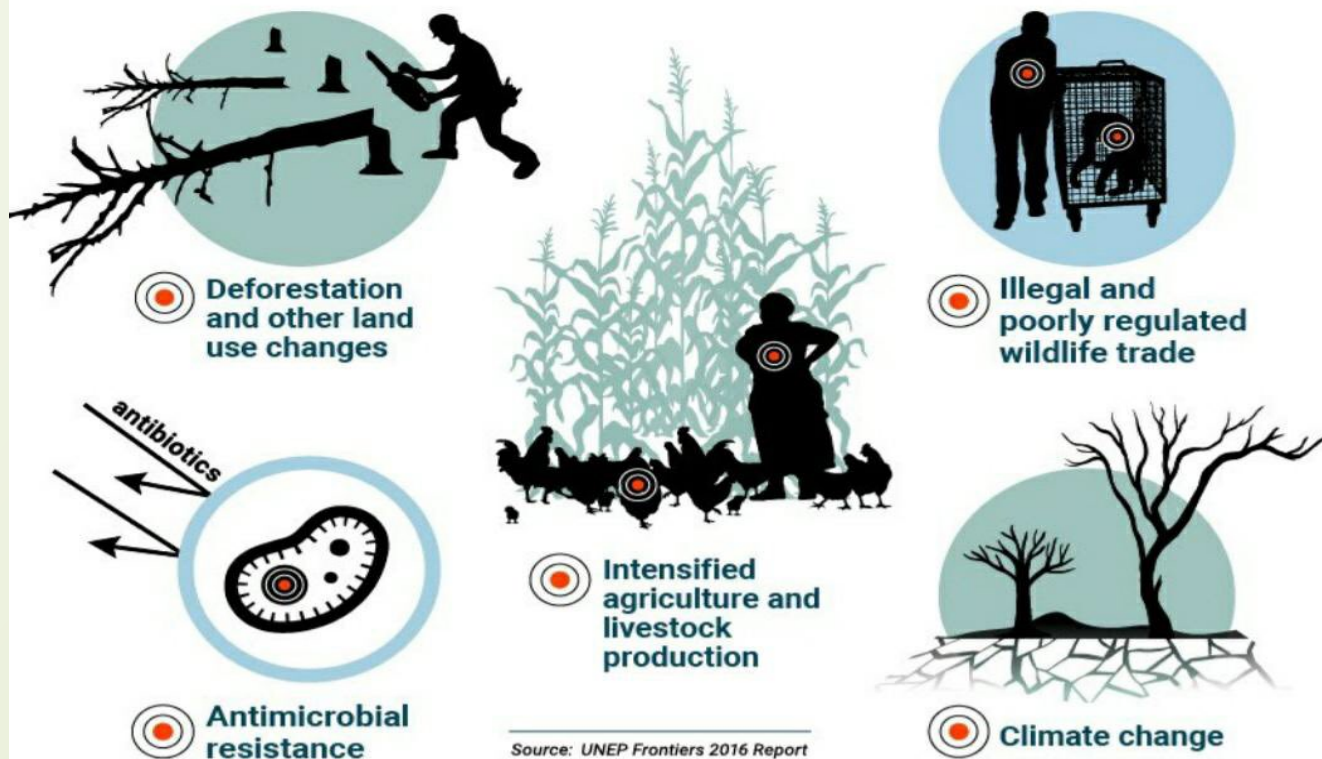


Climate Change & Human Health

- **Climate change** may shift habitats and bring wildlife, crops, livestock, and humans into contact with pathogens to which they have had less exposure and immunity.
- **Vector borne diseases** – Dengue & Malaria
- **Water borne diseases** - excess rainfall & floods – Diarrhea

<https://youtu.be/Pk-PUcXZfa8>

What factors are increasing zoonosis emergence? (Diseases transmitted from animals to humans)



#COVID19

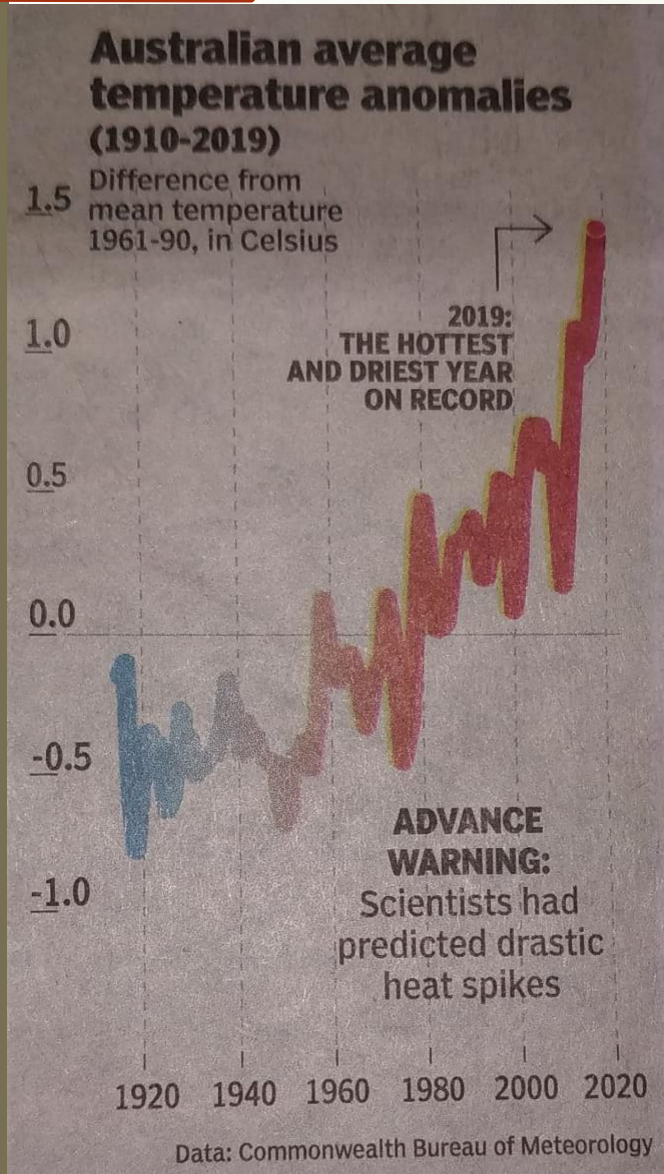
Australian Bush Fires – Case

Climate Change Warnings Went Unheeded, Now Australia Has Lost Billions of Species'

How does loss of such biodiversity impact human beings?

- ❑ Loss of 'Endemic' species is a 'Global' loss.
- ❑ Impacts food production – loss of pollinators.
- ❑ Seed and spore dispersal.
- ❑ Soil health maintenance - distribute & enrich nutrients.
- ❑ Ground water recharge – burrowing organisms.

Loss of such species means it's going to be much harder for ecosystems to recover after the fires.



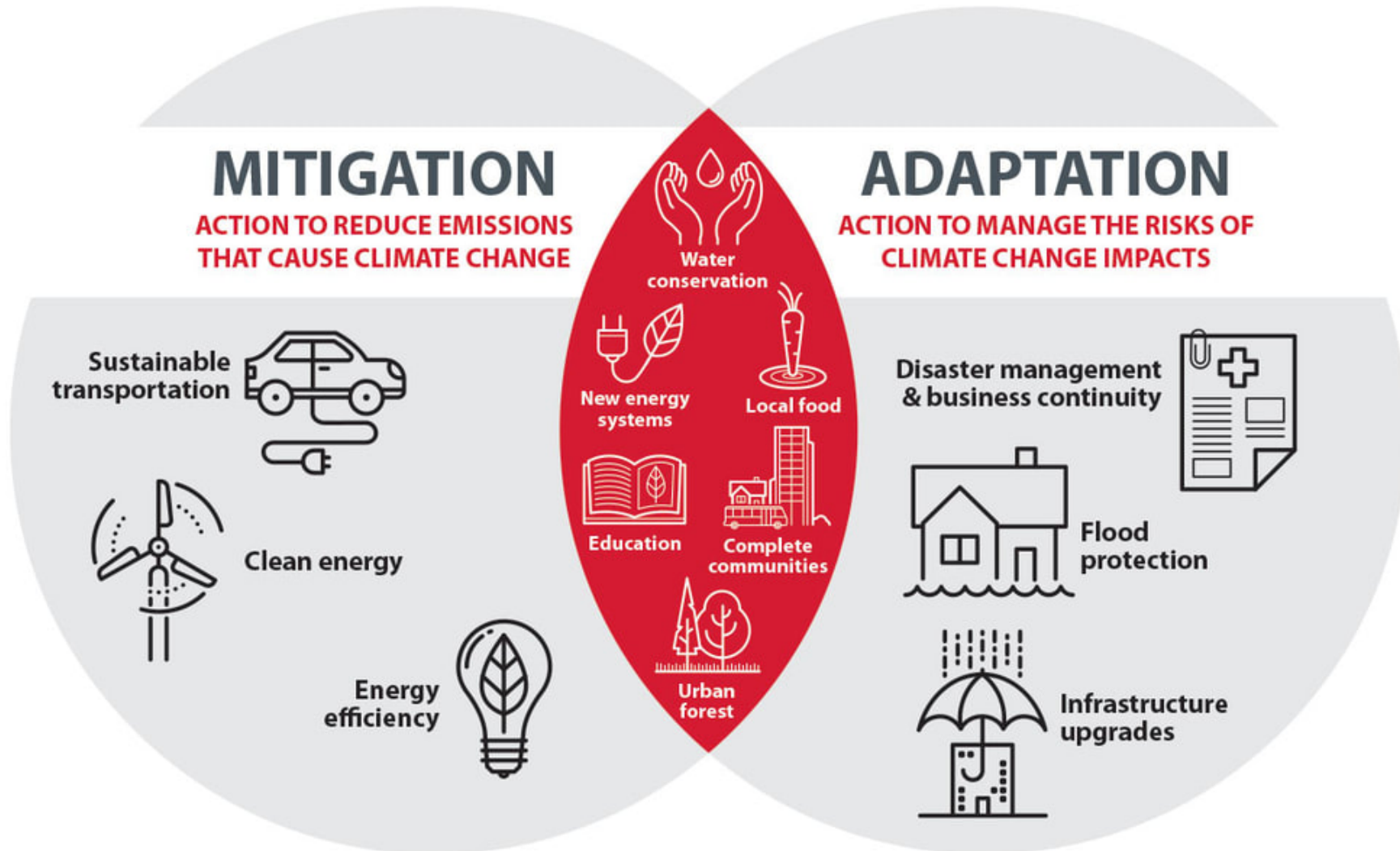
Cyclone Amphan – Case

Formed	16 May 2020
Dissipated	21 May 2020
Highest winds	<i>3-minute sustained:</i> 240 km/h (150 mph) <i>1-minute sustained:</i> 260 km/h (160 mph)
Lowest pressure	920 hPa (mbar); 27.17 inHg
Fatalities	128 total
Damage	> \$13.6 billion (2020 USD) (Costliest on record in the North Indian Ocean)
Areas affected	India (West Bengal, Odisha, Andaman Islands), Bangladesh, Sri Lanka, Bhutan



**Amphan near peak intensity
over the Bay of Bengal on May 18**

Building Climate Resilience



Climate Response - India

India's Climate Goals: Paris agreement (2016)

- To propagate a **healthy and sustainable way of living**.
- To adopt **climate friendly and cleaner** path for economic **development**.
- To create additional **carbon sink** through forest and tree cover by 2030.
- To **adapt to climate change** by investment in **vulnerable sectors** i.e. agriculture, water resources, Himalayan region, coastal regions, health and disaster management.
- To mobilize **domestic and new funds** to implement **mitigation and adaptation** actions.
- To **build framework** for quick diffusion of **climate technology** and **collaborative R&D**.

India is the world's *third largest emitter of greenhouse gases.*

Its rapid increase in electricity use in recent decades has been *fueled largely by coal.* However, it is now *quickly expanding its renewable power, particularly solar.*

India has ratified the Paris Agreement and *pledged a 33-35% reduction in emissions intensity by 2030, compared to 2005 levels.*

Emissions

per capita in 2015

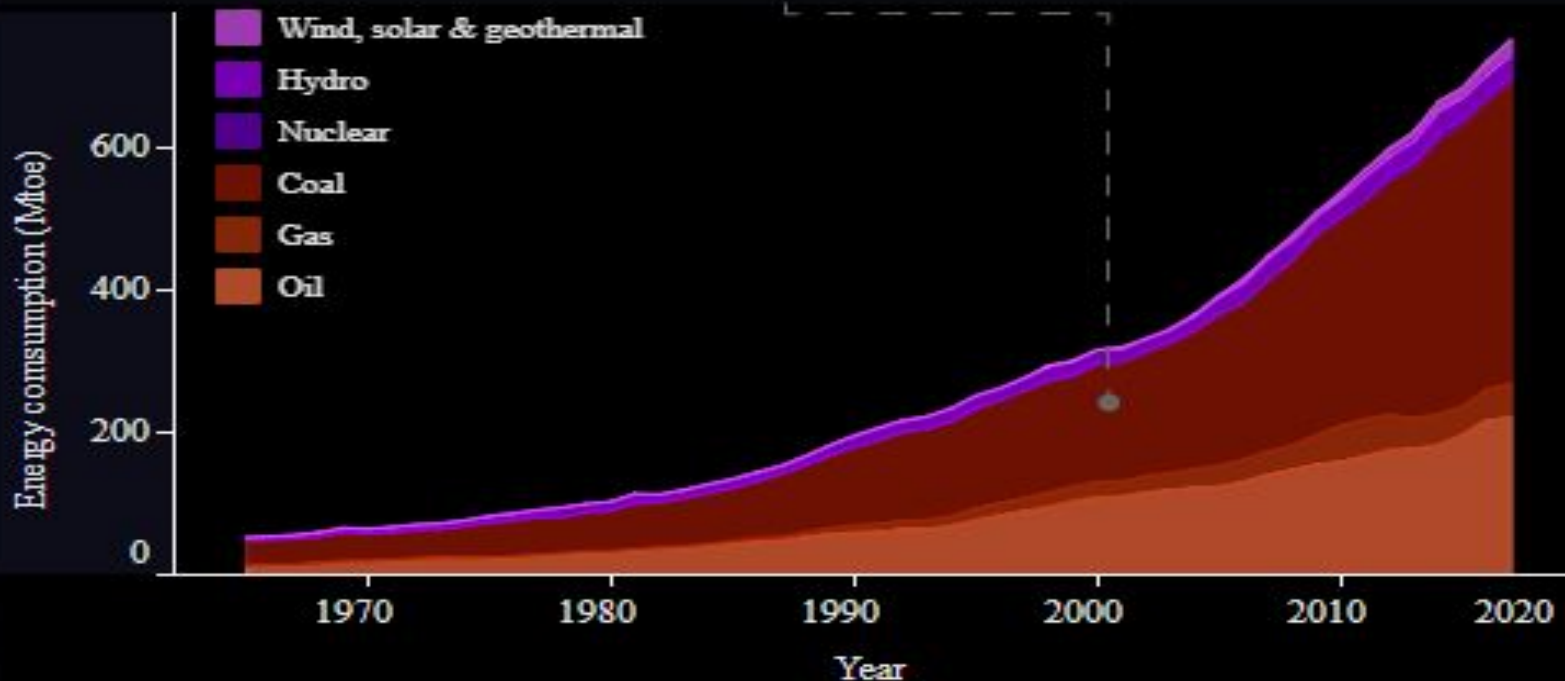
2.7 tonnes CO₂e



Energy consumption

by source

India's coal fleet has more than tripled since 2000. Plans for further expansion could have big implications for global emissions.



Paris Agreement

India has pledged to reduce the emissions intensity of its economy

33-35%

by 2030, compared to 2005 levels.

It also plans for 40% of installed electricity capacity to be renewable or nuclear by 2030.

National Action Plan on Climate Change

1. National Solar Mission
2. National Mission for Enhanced Energy Efficiency
3. National Mission on Sustainable Habitat
4. National Water Mission
5. National Mission for Sustaining the Himalayan Eco-system
6. National Mission for a Green India
7. National Mission for Sustainable Agriculture
8. National Mission on Strategic Knowledge for Climate Change

Sustainability Path.....

- ❑ Reduce emissions
- ❑ Save energy
- ❑ Put the 3 R's of sustainability into practice
- ❑ What about your diet? Eat low-carbon
- ❑ Act against forest loss
- ❑ Make demands from the government – Green products & Renewable energy

Think globally, act locally. Your actions are needed in the fight against climate change.

<https://youtu.be/EtW2rrLHs08>

6 actions preventing climate change



