GLOBAL ENVIRONMENTAL ISSUES

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Global Environmental Issues

1. The Greenhouse Effect and Global Warming
2. Climate Change
3. Ozone Layer Depletion
4. Acid Rain
4. Desertification

GLOBAL ENVIRONMENTAL ISSUES

A variety of environmental problems affect our entire world.

- Globalization
- Over population

- Earths' natural processes transform local problems into international issues.

- Largest global Environmental issues-
  - Acid rain
  - Global warming
  - Ozone depletion
  - Smog
  - Water population
  - Natural resource depletion
  - Rain forest destruction

WHAT ARE ENVIRONMENTAL ISSUES?

Environmental issues are any such issues created due to **human activities** and cause **harm to the environment.**

- Environmental issues are harmful effects of human activity on the biophysical environment.
- They relate to the anthropogenic effects on the natural environment, which are loosely divided into causes, effects and mitigation, noting that effects are interconnected and can cause new effects.
- Environmental Issues are interconnected, that means one issue accelerate the other e.g. water pollution accelerate the rate of air pollution causes global warming.

The Greenhouse Effect and Global Warming

The Greenhouse Effect and Global Warming

Greenhouse Gas Induced Global Warming

Since the industrial revolution got into full swing in the 19th century we have been burning ever increasing amounts of fossil fuels (coal, oil, gasoline, natural gas) in electric generating plants, manufacturing plants, trains, automobiles, airplanes, etc.

Burning releases CO_2 into the atmosphere (much the same as respiration does).

The Greenhouse Effect and Global Warming

- Photosynthesis and respiration in plants, animals, fungi, bacteria, etc. exchange carbon between the CO_2 in the atmosphere and carbon compounds in organisms.
- But humans are now putting this natural carbon cycle out of balance.
- Because of the emission of CO_2 long-stored in fossil fuels the percentage of CO_2 in the atmosphere has increased from about 280 parts per million before the industrial revolution to over 360 parts per million and still rising.
  - 412 in Jan 2021 &
  - 418 ppm April 2022
  - 419.89 ppm April 2023
  - 423.6 ± 0.5 ppm (Feb 2024)
  - 424.07 parts per million (1 November 2024)
    - » Mauna Loa Observatory, Hawaii.

Latest		Change from previous year
Date	Reading	
Nov. 1, 2024	**424.07 ppm**	5.09 ppm increase (1.21 %)
Oct. 31, 2024	423.70 ppm	4.86 ppm increase (1.16 %)
Oct. 30, 2024	422.90 ppm	3.96 ppm increase (0.95 %)

Why Mauna Loa to measure CO2

- Mauna Loa Observatory's location marks an ideal spot for sampling Earth's air.
- It is located in Hawaii on the side of Mauna Loa, the world's largest active volcano.
- The observatory is approximately 3,400 meters (11,141 feet) above sea level and remains a long distance away from significant pollution sources (anthropogenic).

The Greenhouse Effect and Global Warming

- Sometime during the late 21st century the concentration of CO_2 will be twice what it was before the industrial revolution.
- With higher CO_2 concentrations come expectations of a stronger greenhouse effect and therefore warmer global temperatures.

The Greenhouse Effect and Global Warming

- This was originally proposed by a chemist named Arrhenius about a century ago.
- Global average temperatures have risen by a small, but measurable amount in the past 100 years, apparently in large part because of the higher level of atmospheric CO_2.
- Global average temperatures are expected to be on the order of 2-5°C (3.6-9°F) higher by the time CO_2 doubles the pre-industrial concentration.
- The temperature rise will be small in the tropics but much greater at high latitudes.

The Greenhouse Effect

The *Greenhouse Effect* is a natural procedure that helps in heating of the earth's surface and atmosphere (**planetary warming**).

The greenhouse effect is **the way in which heat is trapped close to Earth's surface by "greenhouse gases."** These heat-trapping gases can be thought of as a blanket wrapped around Earth.

The greenhouse effect is a process that occurs after energy emitted from Earth's goes through its atmosphere and heats the atmosphere and lithosphere .

It is attributed to the fact that some atmospheric molecules, **like CO_2, H_2O, CH_4** can modify the **planet's energy budget** by absorbing the **long wave thermal radiation** emitted from the earth's surface.

*Without Greenhouse Effect the earth's mean temperature near to **surface would be -18° C,** instead of the current of **15° C** and the life in earth would be impossible.*

Greenhouse Effect

Carbon dioxide (CO_2) and other greenhouse gases act like a blanket, absorbing IR radiation and preventing it from escaping into outer space.

Greenhouse Effect **:** a natural procedure that helps in heating of the earth's surface and atmosphere (**planetary warming**).

The net effect is the gradual heating of Earth's atmosphere and surface, a process known as global warming.

The Greenhouse Effect and Global Warming

Carbon dioxide (CO_2) is an atmospheric constituent that plays several vital roles in the environment.

- It absorbs infrared radiation in the atmosphere.
- It plays a crucial role in the **weathering** of rocks.
- It is the raw material for photosynthesis and its carbon is incorporated into organic matter in the biosphere and may eventually be stored in the Earth as fossil fuels.

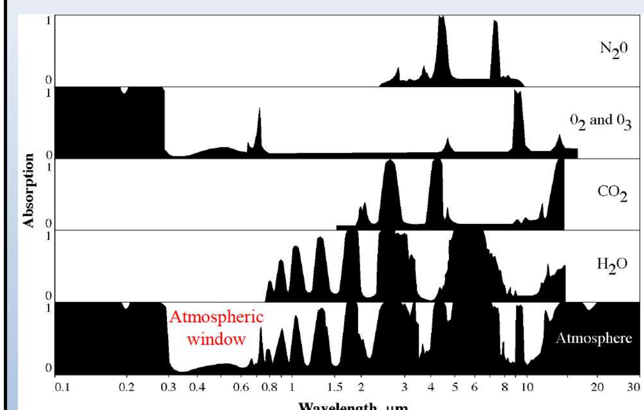
The Greenhouse Effect and Global Warming

- While the dominant gases of the atmosphere (nitrogen and oxygen) are transparent to infrared, the so-called greenhouse gasses, primarily water vapor (H_2O), CO_2, and methane (CH_4), absorb some of the infrared radiation.
- They collect this heat energy and hold it in the atmosphere, delaying its passage back out of the atmosphere.
- Carbon dioxide, for example, absorbs energy at a variety of wavelengths between 2,000 and 15,000 nanometers
  - a range that overlaps with that of infrared energy.
- As CO2 soaks up this infrared energy, it vibrates and re-emits the infrared energy back in all directions.

The Greenhouse Effect and Global Warming

- Most of the sun's energy that falls on the Earth's surface is in the visible light portion of the electromagnetic spectrum.
- This is in large part because the Earth's atmosphere is transparent to these wavelengths (we all know that with a functioning ozone layer, the higher frequencies like ultraviolet are mostly screened out).

Absorption of the Sun's Incident Electromagnetic Energy in the Region from 0.1 to 30 μm by Various Atmospheric Gases

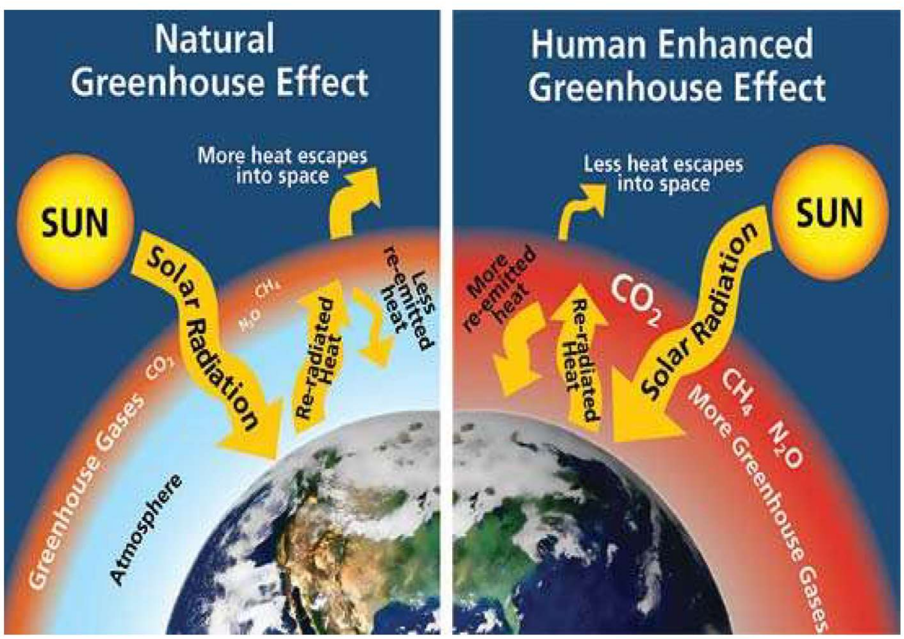


a) The *absorption* of EMR energy by various atmospheric gases.
b) Absorption characteristics of N_2O, O_2 and O_3, CO_2, and H_2O,
c) cumulative result of all at one time.
d) "closes down" in certain portions of the spectrum while "atmospheric windows" exist in other regions

Atmospheric absorption, scattering, and reflectance reduce the amount of solar irradiance reaching the Earth's surface at sea level.

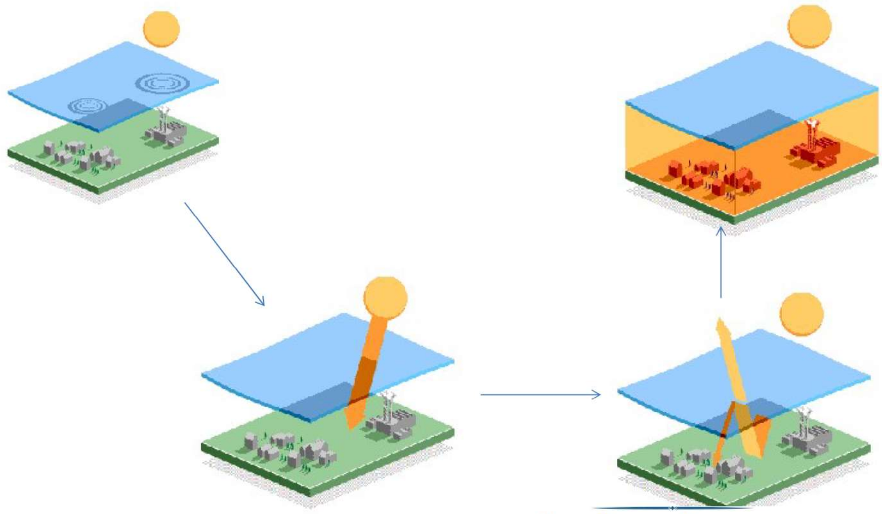
Greenhouse Gases and Global Change

- Infrared radiation emitted from Earth's surface is absorbed by water vapor, CO2, and other trace gases in the troposphere, creating a situation known as the Greenhouse effect.
- Can have too much of a good thing – Venus has runaway greenhouse effect with average surface temperature of 885°F.



The Greenhouse Effect

Schematic diagram of the greenhouse effect production.



The Greenhouse Effect and Global Warming

- Part of the sunlight is reflected back into space, depending on the albedo or reflectivity of the surface.
- [**Albedo** is the measure of the reflectivity of a material. A high **albedo** means it reflects a lot of light and a low **albedo** means it absorbs a lot of light. An **example** of a high **albedo** material is snow and ice].
- Part of the sunlight is absorbed by the Earth and held as thermal energy.
- This heat is then re-radiated in the form of longer wavelength infrared radiation.

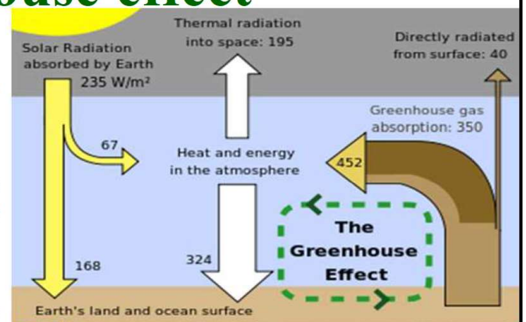
Greenhouse effect

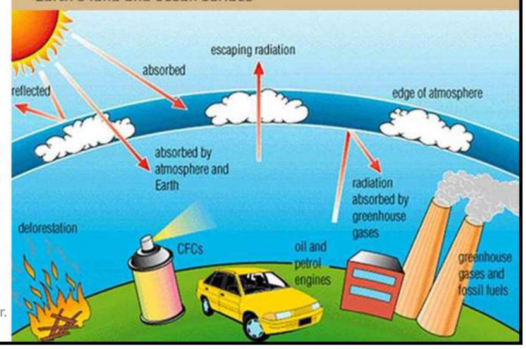
Problems of the Greenhouse Effect:

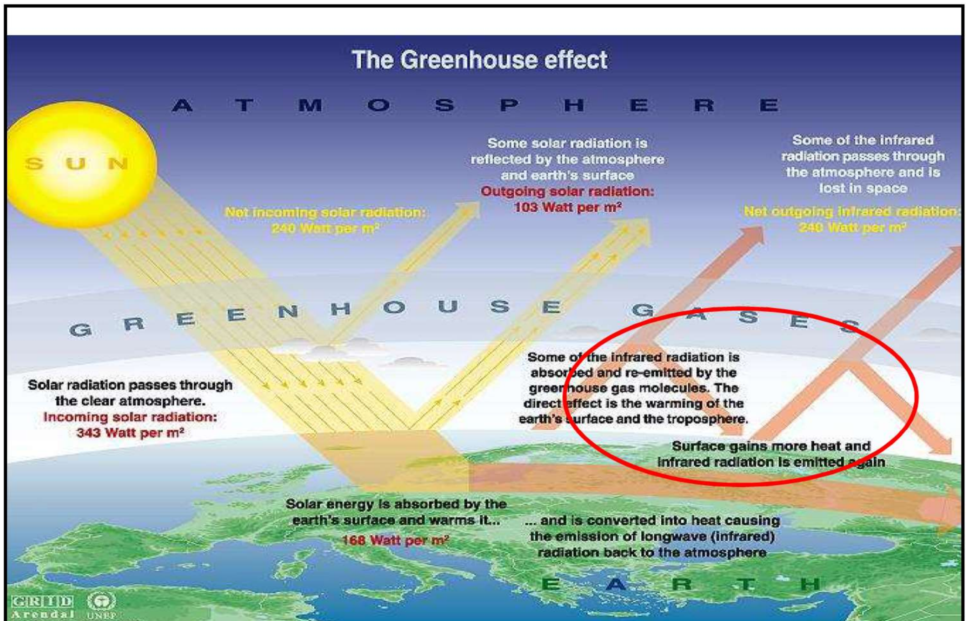
The greenhouse effect causes trouble by raising the temperature of the planet.

The actual rise is not much, but the Earth's ecosystem is very fragile, and small changes can have large effects.

A Panel on Climate Change has predicted that this rise of one degree will happen by the year 2025.







rces: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 5, 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 and Global Warming

Consequences of Global Warming

A whole host of consequences will result. Some are probably already occurring.

- Temperature measurements of the sea surface and deep ocean indicate that the oceans are warming.
- Rising ocean temperature causes rising sea level from thermal expansion of the water.
- Rising temperature also means melting glaciers and rising sea level through addition of melt water to the oceans.

Consequences of Global Warming

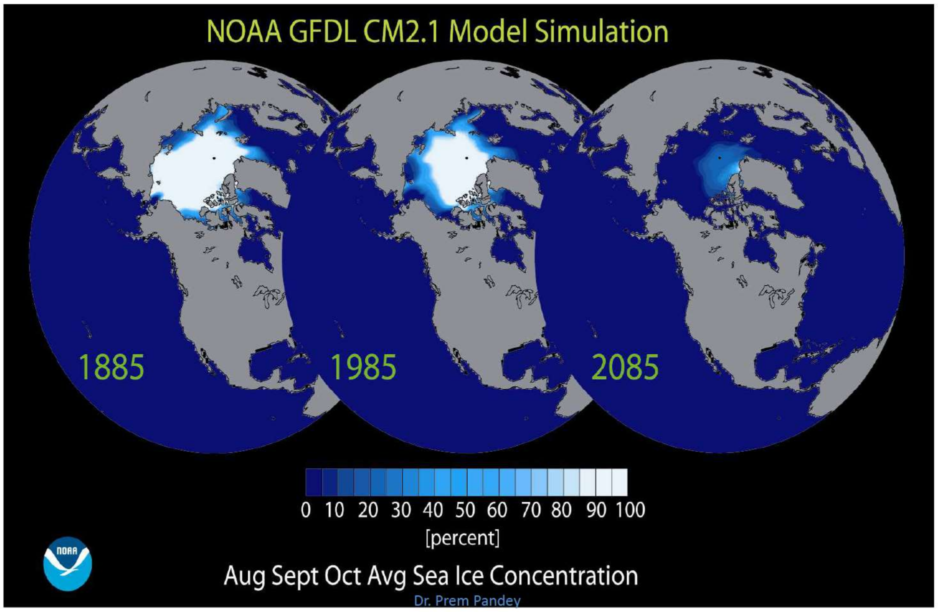
Sea level rose about 30 cm during the last century, mostly from thermal expansion of the oceans. Sea level is expected to rise closer to 1 meter during the coming century.

Rising sea level will cause:

- increasing coastal erosion,
- flooding, and
- property damage during coastal storms on top of the potential for major loss of life from storms in low-lying coastal countries like Bangladesh and island nations in the Indian and Pacific Oceans.

The Greenhouse Effect and Global Warming

- Warmer sea surface temperatures will result in more and stronger tropical storms (hurricanes and typhoons).
- Coastlines already ravaged by these storms will expect to see more strong storms than before, increasing the loss of life and damage to infrastructure.



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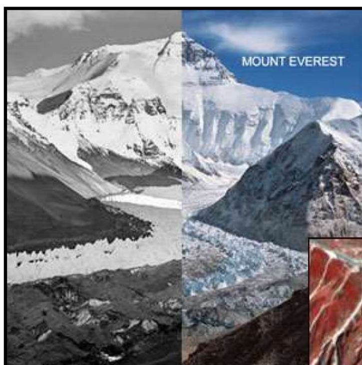
Melting Ice of the Arctic Sea and the existence of Polar Bear



Gangotri Glacier- Shrinking

Gangotri Glacier

The Greenhouse Effect and Global Warming

- It is much more difficult to predict how regional and local weather patterns will change but there will certainly be changes.
- While higher temperatures will produce more rainfall across the globe, the regional rainfall patterns will likely to be changed.

The Greenhouse Effect and Global Warming

- Some areas will get more, some areas will get less.
  - The timing of wet and dry periods may change.
  - But higher temperatures will also mean more evaporation.
  - Higher temperatures may also mean stronger storms with damaging winds.
- All of these mean new risks and changing conditions for agriculture.
- Soil moisture will be affected – 0.001 % resulting in other damages – agriculture- landslides…etc.

The Greenhouse Effect and Global Warming

- Centuries old farming practices will have to change.
- Some areas may go from being marginal to becoming a breadbasket region, while other regions may go from major agricultural production to marginal.

Soil moisture

Continuing declines in soil moisture can
  - increase the need for irrigation in agriculture and
  - lead to smaller yields and
  - even desertification, with potentially dramatic impacts on food production

The Greenhouse Effect and Global Warming

- Higher CO_2 allows plants to grow faster (more CO_2 enhances photosynthesis).
  - That would sound good for agriculture.
  - However, weed species tend to grow even better than crop plants under enhanced CO_2conditions so improved crop growth may be nullified by weed competition.
- Natural ecosystems will be hard pressed to keep up with the changing climate because the rate of change will be faster than typical long-term natural climate change.

The Greenhouse Effect and Global Warming

- Many species, especially plant species, will not be able to migrate to cooler areas fast enough to keep up with the warming of their habitats.
- And arctic species will have no place to go and may not be able to adapt to the new conditions.
- Severe summer heat in areas not used to it can lead to deaths. Higher heat and expansion of tropical areas may lead to increased incidence of malaria.

The Greenhouse Effect and Global Warming

- Moreover, leaders, societies, communities, local planners, farmers, health organizations, need to recognize the changing climate and rising sea level as they make plans for the future.
- Our citizens need to be educated as to likely changes and how best to deal with the changing conditions.

GLOBAL WARMING

- Global warming is changing our world. It is a global threat with real implications for everyone no matter where you live.
- Global warming is caused by a variety of gases and materials in our atmosphere; including huge amounts of carbon dioxide and methane from human activities such as extracting and burning fossil fuels, and clearing forests.
- These gases can trap heat in the atmosphere, causing steadily increasing temperatures.

Greenhouse effect

The last century, the anthropogenic activities have caused direct and/or indirect effects (increase) in the concentrations of the main greenhouse gases.

Scientists predict that this increase may be a positive feedback for the greenhouse effect, further increasing the planetary air temperature, thus making the planet warmer.

Greenhouse effect

Some scientists suggest that the mean planetary temperature has already increased by 0.3 to 0.6° C, from the beginning of 20^{th} century , due to increased anthropogenic activities and emissions.

The predictions show that till the mid of **21** century the mean planetary temperature may be increased up to 1 - 5° C.

Greenhouse Gases and Global Change

Facts:

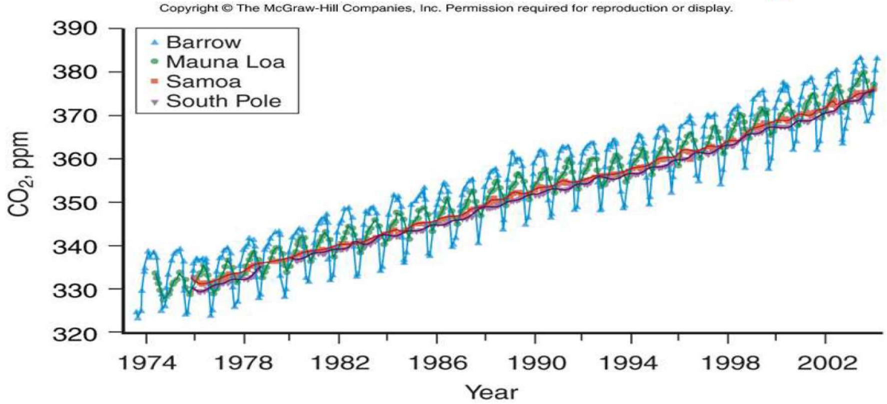
- The 20th century was the warmest in the last millennium
- 1990s were the warmest decade
- 1998 and 2005 tied as the warmest years in the last 1,000 years
- There may be a debate about the severity of global warming, but one trend is undeniable –
- The concentration of greenhouse gases in the Earth's atmosphere has steadily and measurably increased over the past two centuries.

The Greenhouse Effect

Increase of the greenhouse gases from 1750 to today

GREENHOUSE GAS	CONCENTRATION IN 1750	CONCENTRATION 1995	DIFFERENCE (%)	MAIN CAUSES
Carbon Dioxide (CO_2)	280 ppm	360 ppm 412 ppm (Jan 2021) 418 ppm (2022) 419.89 (2 April 23) 423 ppm (March 24	29	Forest fires, volcanoes, deforestation
Methane(CH_4)	722 ppb	1700 ppb 1834 ppb 2015)	143	Organic material, termites, biomass burning
Nitrous oxide (N_2O)	280 ppb	310 ppb 328 ppb (2013)	11	Forest, agriculture, agriculture medicines
CFC	0	900 ppt	Un-estimated	Fridges, air cool systems, sprays
Ozone (O_3)	237 ppb	337 ppb (2013) Depend on latitude and altitude	Decreased levels in stratosphere and increased in troposphere	Natural direct production in the stratosphere, man-made indirect in the troposphere

Greenhouse Gases and Global Change



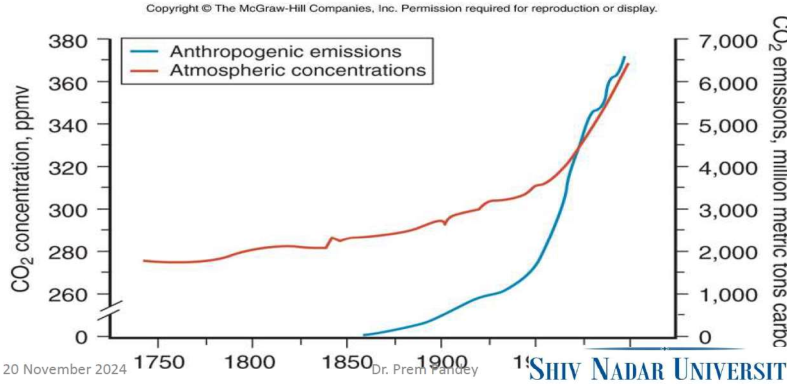
Saw tooth pattern = annual (seasonal) fluctuations in CO_2 due to plant activity

Overall increasing trend = Build up of CO_2 in atmosphere mainly due to human activities

Greenhouse Gases and Global Change

Overall, CO_2 in the atmosphere remained constant at 280 ppm on a global scale for several centuries prior to the industrial revolution.

Anthropogenic emissions of greenhouse gases such as CO_2 rapidly increased in recent decades.



Greenhouse Gases and Global Change

- Most anthropogenic emissions come from consumption of fossil fuels and deforestation.
- About half of what we produce is taken back into carbon sinks in biosphere and oceans – the rest is left in atmosphere.

Global Warming Potential

- GWP (global warming potential) of (GHGs) warm the Earth by absorbing energy and slowing the rate at which the energy escapes to space;
  - they act like a blanket insulating the Earth. Different GHGs can have different effects on the Earth's warming.
- Two key ways in which GHGs differ from each other are:
  1. Their ability to absorb energy (their "radiative efficiency"), and
  2. how long they stay in the atmosphere (also known as their "lifetime").

Global Warming Potential

CO_2 has a longer lifetime (decades to hundreds of years) but absorbs less heat.

Methane absorbs a lot of heat, but remains in the atmosphere for much shorter time periods.

- Methane is a powerful greenhouses gas with a 100-year global warming potential 28-34 times that of CO2.
- Measured over a 20-year period, that ratio grows to 84-86 times.
- In general, GWP of methane is 21 times greater than that of CO_2.

Greenhouse Gases and Global Warming Potential

Greenhouse gas	Atmospheric lifetime, years	Global warming potential (GWP for 100 years)
Carbon dioxide	50–200	1
Methane	12	21- 34
Nitrous oxide	120	273 - on 100 year scale
HFCs	1–300	140–11,700

CO_2, by definition, has a GWP of 1 regardless of the time period used, because it is the gas being used as the reference.

High-GWP gases & Global Warming Potential

- Chlorofluorocarbons (CFCs),
- hydrofluorocarbons (HFCs),
- hydrochlorofluorocarbons (HCFCs),
- perfluorocarbons (PFCs), and
- sulfur hexafluoride (SF_6)

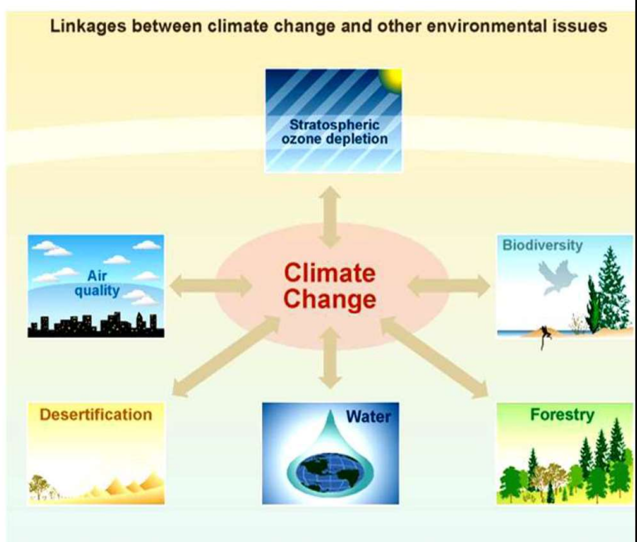
high-GWP gases because, for a given amount of mass, they trap substantially more heat than CO_2.

(The GWPs for these gases can be in the thousands or tens of thousands.)

Climate Change and environmental impacts

Greenhouse gas emissions are expected to lead to climatic changes in the 21st century and beyond.

These changes will potentially have wide-ranging effects on the natural environment as well as on human societies and economies.



The Greenhouse Effect and Global Warming

What Can We Do About Global Warming?

- We can't realistically stop the rise of CO_2 in the near term, but we can slow it and therefore reduce the consequences that will occur.

What Can We Do About Global Warming?

- More fuel-efficient cars, less frivolous driving, more use of mass transit, improved insulation to decrease the fuel burned to heat and cool our homes, more efficient appliances,
- Saving energy by using efficient devices, use of fluorescent rather than incandescent light bulbs, and careful monitoring of home electricity usage (turn off the lights and TV when not using them) can reduce our energy needs.

The Greenhouse Effect and Global Warming

- *What Can We Do About Global Warming? – reduce CO2 imprint…..!*

- Alternative Fuels: Conversion to alternatives like wind and solar power which don't burn fossil fuels and emit CO_2 into the atmosphere.
- Planting large areas with trees will consume CO_2 as the trees grow, until the forests mature.
- Stopping deforestation in the tropical forests around the world, especially in the Amazon and Indonesian rain forests, will keep that carbon in the forest rather than sending it back into the atmosphere as the trees are burned or decay and are not replaced by more.

The Greenhouse Effect and Global Warming

- Other techniques have also been proposed such as the chemical removal of CO_2 from smokestacks and burial in deep underground reservoirs.
- Though only certain areas can benefit from this, or disposal in the deep ocean where they will form a semi-stable compound under the cold temperatures and high pressures, though the CO_2 could too easily come bubbling back up.

Climate System

The key to understanding global climate change is to first understand what global climate is, and how it operates.

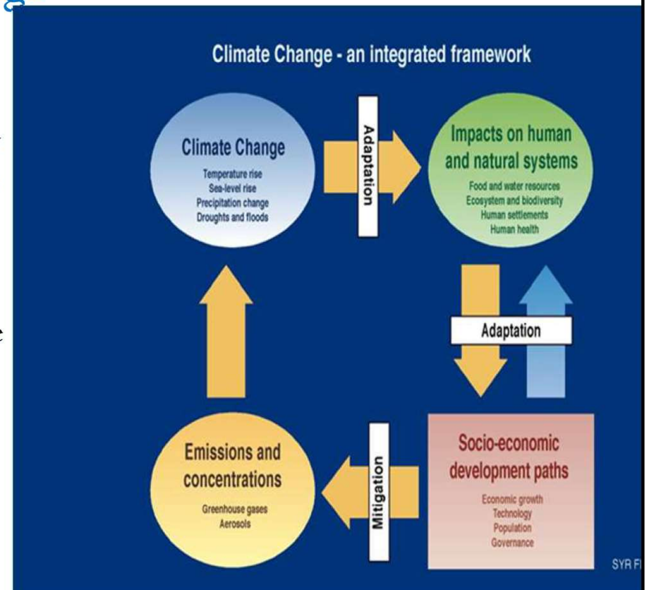
The global climate system is a consequence of and a link between the Atmosphere, oceans (Hydrosphere), the ice sheets (Cryosphere), living organisms (Biosphere) and the soils, sediments and rocks (Geosphere).

Climate System

- Only by consideration of the climate system in these terms it is possible to understand the flows and cycles of energy and matter in the atmosphere, an understanding which is required to investigate the causes (and effects) of climatic change.
  - Weather refers to short term atmospheric conditions, while
  - climate is the weather of a specific region averaged over a long period of time.

Climate Change

When we refer to Environment we mainly concern Climate, either local, regional and global.
The main topic regarding Climate is the Climate Change, either natural and/or anthropogenic.



Climate change

"Climate change" is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years).

Climate change refers to long-term changes.

Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions (i.e., more or fewer extreme weather events).

Climate change

Factors that can shape climate are called climate forcings or "forcing mechanisms".

These include processes such as

- variations in solar radiation,
- variations in the Earth's orbit,
- variations in the albedo.
- mountain-building and
- continental drift and
- changes in greenhouse gas concentrations.

(albedo *(the proportion of the incident light or radiation that is reflected by a surface, typically that of a planet or moon)* or reflectivity of the continents and oceans,)

Climate change

Forcing mechanisms can be either "internal" or "external".

- Internal forcing mechanisms are natural processes within the climate system itself (e.g., the thermo-haline circulation- *the movement of seawater in a pattern of flow dependent on variations in temperature, which give rise to changes in salt content and hence in density.).*
- External forcing mechanisms can be either natural (e.g., changes in solar output) or anthropogenic (e.g., increased emissions of greenhouse gases).

Climate change

Whether the initial forcing mechanism is internal or external, the response of the climate system might be

- fast (e.g., a sudden cooling due to airborne volcanic ash reflecting sunlight),
- slow (e.g. thermal expansion of warming ocean water), or
- a combination (e.g., sudden loss of albedo in the arctic ocean as sea ice melts, followed by more gradual thermal expansion of the water).

Climate change

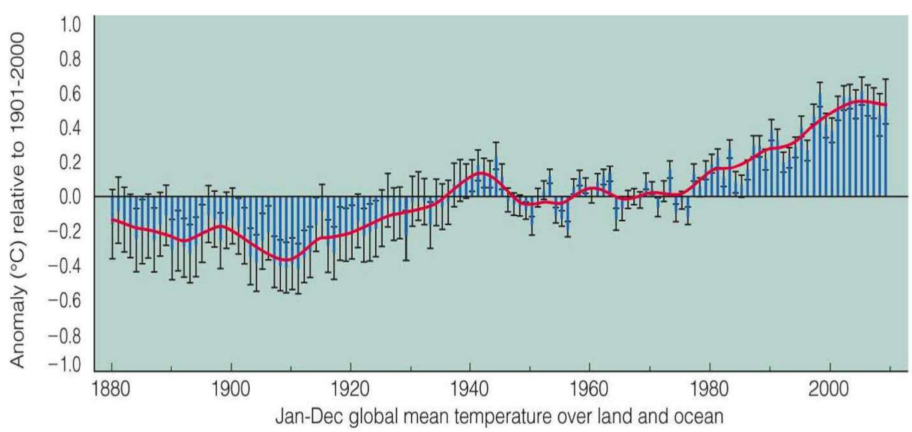
- Therefore, the climate system can respond abruptly, but the full response to forcing mechanisms might not be fully developed for centuries or even longer.

Evidence of Climatic Change

Trends that persist for a decade or more probably signal a shift to a new regime

- Instrumental tracking has only been available for the last century, and this has shown a recent temperature increase of less than 1°C
- Coupled with this seemingly minute temperature change are shrinking glaciers, less sea ice, latitudinal limits of some plants and animals have expanded toward the poles

Evidence of Climatic Change



Evidence of Climatic Change

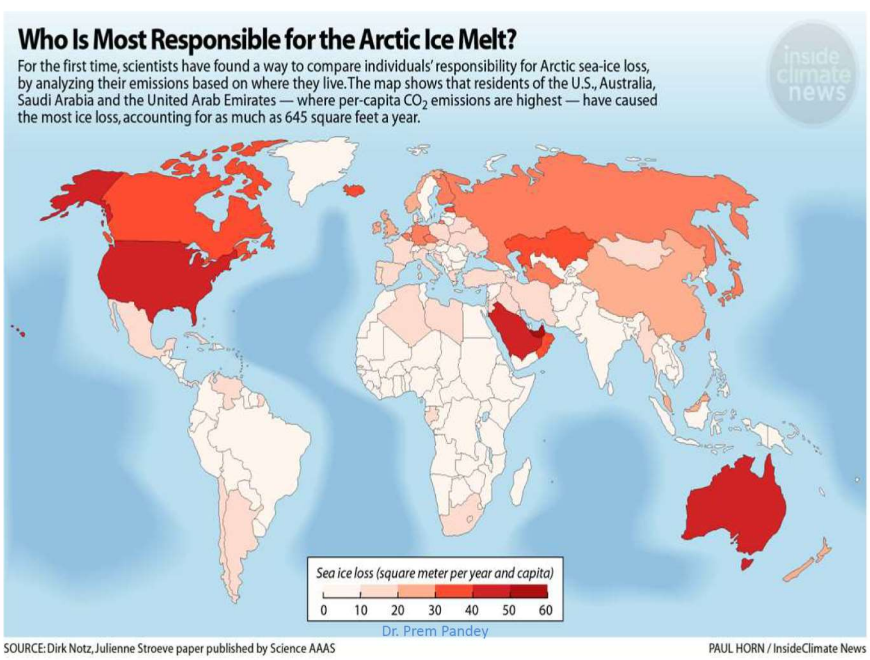
- The majority of evidence of climatic change comes from the geologic record
- Climates of ancient times are referred to as paleo-climates, fossils and other anomalous features tell us of many dramatically different climates from those in present-day localities

Evidence of Climatic Change

- Scientists reconstructing paleo-climates rely on records of natural events that closely mimic climate
  - Climate proxy records
- Though they lack the precision of instrumental data, proxy records from different localities can add up to a detailed picture of climatic trends

Evidence of Climatic Change

- Cores obtained from the Greenland and Antarctic Ice Sheets provide continuous records of weather conditions for hundreds of thousands of years
  - Glacier ice is laid down in annual layers
- Measurements of oxygen isotopes in glacier ice.
  - enable scientists to estimate the air temperature when that snow accumulated,
  - the trapped air also provides a sample of the ambient air at the time



Evidence of Climatic Change

Records of Climate Change

Climate change is recorded in archaeological data, historical records, and even works of art.

Paintings from the period 1550 – 1849 show more dark skies and clouds.

Pieter Bruegel's *Winter Landscape with Bird Trap* shows a time when European rivers were likely to freeze over, a rare event today.

© Scala/ Art Resource, NY
Source: http://en.wikipedia.org/wiki/Image:Instrumental_Temperature_Record.png

Records of Climate Change

- Many organisms lay down annual growth rings and are potentially useful for providing paleoclimate information
  - Trees
  - Corals
- Some lake sediments display distinctive alteration of parallel layers, a pair of these deposited in a single year is termed a varve and preserves a record of climatic variations

Records of Climate Change

Annual climate records can be found in tree rings, lake sediments, and ice layers.

Each year includes early-wood (light) and latewood (dark) growth.

- Wide rings occur during wet, warm years and
- Narrow rings during cold, dry years.

Usually it is necessary to match partial records from multiple trees to get a climate record.

Short-term climate change is recorded in tree rings (hundreds of years).

© Royalty Free/Corbis

Records of Climate Change

Cultural records indicate three distinct climate periods for the Northern Hemisphere in the last 1,000 years or so:

1. *Medieval warm period* - Temperatures were relatively warm from 1000 – 1450 A.D.
2. *The Little Ice Age* – A time of very cold temperatures but not really an ice age. Occurred for about 400 years after the medieval warm period.
3. By the end of the 19th century climate moderated leading to our present relatively warm temperatures, which exceed any in the last 1,000 years.

Records of Climate change

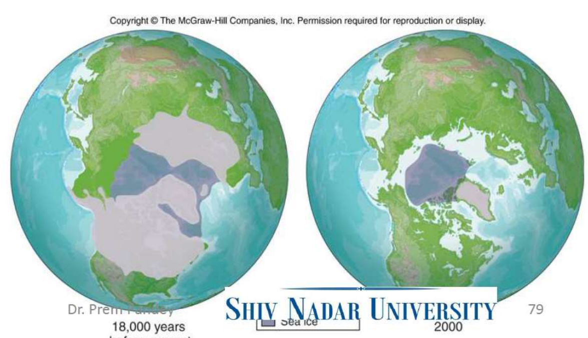
Climate records indicate that the Northern Hemisphere experienced glaciation (Ice Age) during the last 2 million years:

Lower sea level; Land bridge between Siberia and Alaska

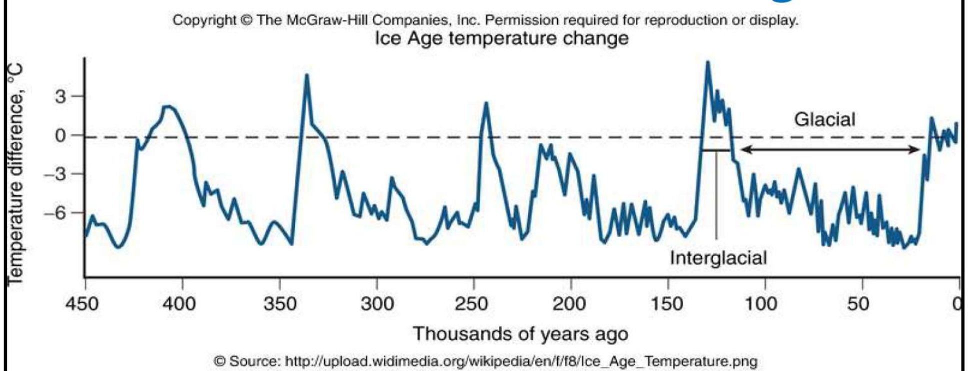
More forests in North America;

Western U.S. deserts were cooler

North America was dominated by a 3-kilometer thick (1.9 mile) continental glacier centered over Canada.



Records of Climate change



The last Ice Age is divided into cold glacial intervals and warmer inter-glacials. Temperatures during the glacials were at least 9-18°F colder than today. Based on the length of inter-glacials, <u>we are about 10,000 years away from entering another cold glacial interval.</u>

Climate Change and environmental impacts

- Impacts on one sector can also affect other sectors indirectly.
- To assess potential impacts, it is necessary to estimate the extent and magnitude of climate change.
- Although much progress has been made in understanding the climate system and climate change, projections of climate change and its impacts still contain many uncertainties, <u>particularly at the regional and local levels.</u>

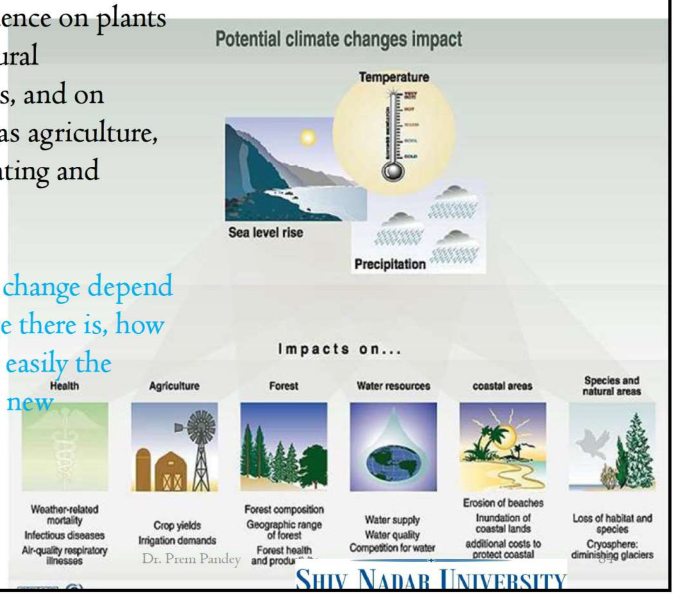
Climate change

- Weather changes all the time. The average pattern of weather, called climate, usually stays pretty much the same for centuries if it is left to itself.
- However, the earth is not being left alone. People are taking actions that can change the earth and its climate in significant ways.

Climate Change Impacts

Climate has a big influence on plants and animals in the natural environment, on oceans, and on human activities, such as agriculture, water supplies, and heating and cooling.

The effects of climate change depend upon how much change there is, how fast it occurs, and how easily the world can adapt to the new conditions.



Climate Change Impacts

The effects of climate change on people would change a lot from place-to-place. Economically developed societies, like those in North America, Europe and Japan, could use technology to reduce direct impacts.

For example, they might develop new crop varieties, construct new water systems, and limit coastal development.

Some northern countries, such as Canada and Russia, might even benefit from longer growing seasons and lower heating bills if the climate becomes warmer.

Climate Change Impacts

In contrast, economically less developed societies, like those in parts of Africa, Asia, and South America depend much more directly on climate, and could be hit much harder by sudden or large changes.

Places like coastal Bangladesh and low-lying islands, could be flooded by storms or rising sea level.

Climate Change Impacts

Droughts in Africa might become more serious.

Developing countries have far fewer resources for adapting to such changes. They may not be able to afford large projects such as sea walls or aqueducts.

Peasant farmers may have difficulty adopting new agricultural practices.

The resulting social tensions could lead to more political unrest, large-scale migrations, and serious international problems such as terrorism and wars.

IPCC Reports on Climate Change

What is the IPCC?

The Intergovernmental Panel on Climate Change (IPCC) is the international body for assessing the science related to climate change.

The IPCC was set up in 1988 by the World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP) to provide policymakers with regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.

The World Meteorological Organization (WMO) Headquarters in Geneva. IPCC Secretariat is hosted by WMO

IPCC

- As an intergovernmental body, membership of the IPCC is open to all member countries of the United Nations (UN) and WMO.
- Currently 195 countries are Members of the IPCC.
- Governments participate in the review process and the plenary Sessions, where main decisions about the IPCC work programme are taken and reports are accepted, adopted and approved.
- The IPCC Bureau Members, including the Chair, are also elected during the plenary Sessions.

Intergovernmental Panel on Climate Change (IPCC)

- IPCC assessments provide a scientific basis for governments at all levels to develop climate-related policies, and they underlie negotiations at the UN Climate Conference – the United Nations Framework Convention on Climate Change (UNFCCC).

- The assessments are policy-relevant but not policy-prescriptive:
  - they may present projections of future climate change based on different scenarios and
  - the risks that climate change poses and discuss the implications of response options,
  - but they do not tell policymakers what actions to take.

Functioning of IPCC

- Assessments of climate change by the IPCC, drawing on the work of hundreds of scientists from all over the world, enable policymakers at all levels of government to take sound, evidence-based decisions.
- They represent extraordinary value as the authors volunteer their time and expertise.
- The running costs of the Secretariat, including the organization of meetings and travel costs of delegates from developing countries and countries with economies in transition, are covered through the IPCC Trust Fund.

IPCC Reports

In 1990, the First IPCC Report (FAR- first Assessment Report)
- underlined the importance of climate change as a challenge with global consequences and requiring international cooperation.

Served as a basis of the UNFCC.

SAR- Second Assessment Report- of IPCC published in 1995. – an assessment of the then available scientific and socio-economic information on climate change.

Major assessments-
- GHGs are increasing,
- global climate has been changing, and will likely to continue to change, probably due to human influence. –

The Second IPCC Report entitled *"Impacts, Adaptation, and Vulnerability.*

IPCC Reports

The summaries of Reports for policy makers were released with evidence based information.

TAR- Third Assessment Report- Climate change 2001- for the Third IPCC Report entitled *"Mitigation of Climate Change"*.

AR4: 4th IPCC report was released on 18 Sep 2007.

The Fourth Report was delivered in stages, starting with Working Group I's report on the physical science basis, based on 9,200 peer-reviewed studies.

IPCC Reports

- The Fifth Assessment Report was finalized in 2014. As had been the case in the past, the outline of the AR5 was developed through a scoping process which involved climate change experts from all relevant disciplines and users of IPCC reports; in particular representatives from governments.

- The Synthesis Report was released on 2 November 2014, *in phases (though three working groups) in time to pave the way for negotiations on reducing carbon emissions at the* UN Climate Change Conference in Paris during late 2015

AR6 - IPCC Reports

- The Sixth Assessment Report was finalized in 2023.

- AR6 Synthesis report- climate change 2023.
  - AR6 Climate change 2022- Impacts, adaptation and vulnerability.
  - AR6 Climate change 2022: Mitigation of climate change, and Physical Science Basis.

Paris Agreement on Climate Change

- The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC) dealing with greenhouse gases emissions mitigation, adaptation and finance starting in the year 2020.
- The language of the agreement was negotiated by representatives of 195 countries at the 21st Conference of the Parties of the UNFCCC in Paris and adopted by consensus on 12 December 2015. It was opened for signature on 22 April 2016 (Earth Day) in a ceremony in New York City.
- As of 2 October 2016, 191 UNFCCC members, including India have signed the treaty, 62 of which have ratified it.

Paris Agreement on Climate Change

- The agreement will only enter into force provided that 55 countries that produce at least 55% of the world's greenhouse gas emissions ratify, accept, approve or accede to the agreement;
- although the minimum number of ratifications has been reached, the ratifying states do not produce the requisite percentage of greenhouse gases for the agreement to enter into force.
- Three aim of Paris agreement- Finance, technology and capacity building support- (Art. 9, 10, 11).
- the Paris agreement' five key points-
  - First universal climate agreement
  - Limit temperature well below 2° C
  - Helping poor nations.
  - Publishing greenhouse gas reduction targets.
  - Carbon neutral by 2050.

Findings-IPCC Reports

1. Warming of the atmosphere and ocean system is *unequivocal*. Many of the associated impacts such as sea level change (among other metrics) have occurred since 1950 at rates unprecedented in the historical record.
2. There is a clear human influence on the climate
3. It is *extremely likely* that human influence has been the dominant cause of observed warming since 1950, with the level of confidence having increased since the fourth report.
4. IPCC pointed out that the longer we wait to reduce our emissions, the more expensive it will become.

Historical climate metrics – IPCC Reports Findings

- It is likely (with medium confidence) that 1983–2013 was the warmest 30-year period for 1400 years.
- It is virtually certain the upper ocean warmed from 1971 to 2010. This ocean warming accounts, with high confidence, for 90% of the energy accumulation between 1971 and 2010.

Historical climate metrics – IPCC Reports Findings

- It can be said with *high confidence* that
  - the Greenland and Antarctic ice sheets have been losing mass in the last two decades and
  - Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent.
- There is *high confidence* that the sea level rise since the middle of the 19th century has been larger than the mean sea level rise of the prior two millennia.
- Concentration of greenhouse gases in the atmosphere has increased to levels unprecedented on earth in 800,000 years.
- Total radiative forcing of the earth system, relative to 1750, is positive and the most significant driver is the increase in CO_2's atmospheric concentration.

IPCC Reports

Reports provide:

(i) Climate Models provide confidence in the magnitude of global warming in response to past and future forcing.

(ii) Projections:

- Further warming will continue if emissions of greenhouse gases continue.
- The global surface temperature increase by the end of the 21st century is *likely* to exceed 1.5 °C relative to the 1850 to 1900 period for most scenarios, and is *likely* to exceed 2.0 °C for many scenarios
- The global water cycle will change, with increases in disparity between wet and dry regions, as well as wet and dry seasons, with some regional exceptions.

IPCC Reports

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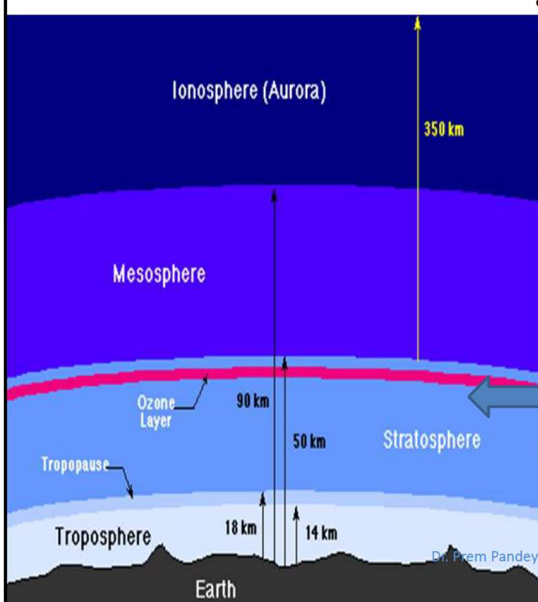
- The oceans will continue to warm, with heat extending to the deep ocean, affecting circulation patterns.
- Decreases are *very likely* in Arctic sea ice cover, Northern Hemisphere spring snow cover, and global glacier volume
- Global mean sea level will continue to rise at a rate *very likely* to exceed the rate of the past four decades
- Changes in climate will cause an increase in the rate of CO_2 production. Increased uptake by the oceans will increase the acidification of the oceans.
- Future surface temperatures will be largely determined by cumulative CO_2, which means climate change will continue even if CO_2 emissions are stopped.

Stratosphere (10/18-50 km)



- The Stratosphere is the second major layer of Earth's atmosphere, just above the Troposphere, and below the Mesosphere.
- It is stratified in temperature, with warmer layers higher up and cooler layers farther down. This is in contrast to the troposphere near the Earth's surface, which is cooler higher up and warmer farther down.
- The OZONE LAYER is situated at the Top of Staratosphere

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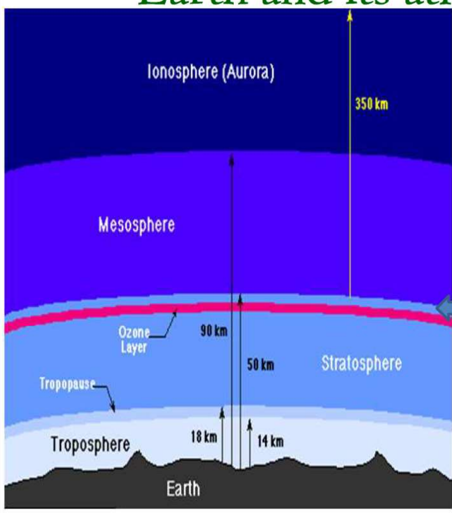
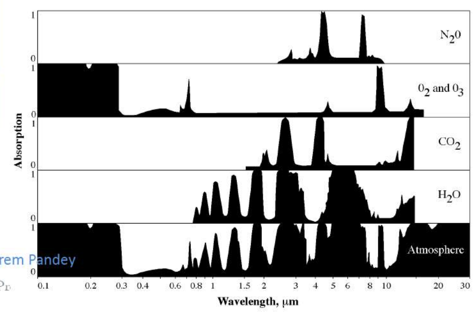
Earth and its atmosphere - Ozone



- It is mainly located in the upper portion of the stratosphere from approximately 35 km to 50 km above Earth's surface, though the thickness varies seasonally and geographically



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Ozone and the Stratosphere

The ozone layer is Earth's own sun block system that stops 97-99 % of the harmful incoming ultraviolet rays from reaching the planet's surface.

- 3 types of ultraviolet radiation – UVA, UVB, and UVC - their intensity varies throughout the seasons.
- UVC – shortest wavelength, most dangerous, filtered out by atmosphere
- UVA and UVB – cause skin cancer and wrinkles after repeated long-term exposure

- UV rays can penetrate your clothes..! -UV blocking fabrics - Wearing UPF clothes

- up to 80 percent of the sun's UV rays can pass through clouds and affect us.

Use of Sunscreen lotion for protection against UV

SPF 15 lotion blocks out ~92% of the UV that reaches Earth's surface

SPF measures sunscreen protection from UVB rays, the kind that cause sunburn and contribute to skin cancer.

The SPF (Sun Protection Factor) scale is not linear:

- SPF 15 blocks 93% of UVB rays
- SPF 30 blocks 97% of UVB rays
- SPF 50 blocks 98% of UVB rays

So, one way of looking at this is that SPF 30 sunscreen only gives you 4% more protection than SPF 15 sunscreen.)

Glass and UV radiation

- Glass filters out only one kind of radiation -- UVB rays.
- But UV-A rays, which penetrate deeper, can still get through.
- That's why many adults have more freckles on their right side than their left (based on which side they are), it's from UV exposure on that side through the car window when driving.

Ozone and the Stratosphere

Formation of ozone is cyclical:

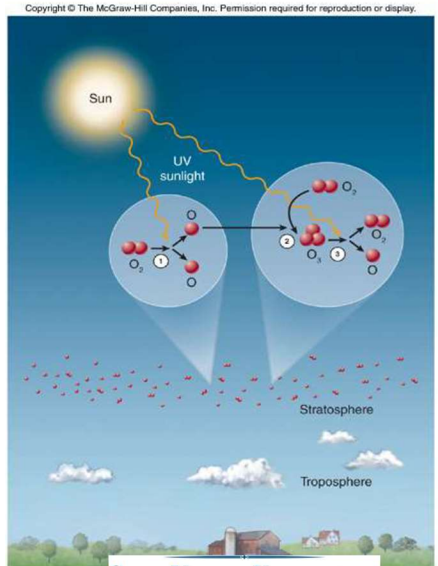
1. UV radiation breaks an O_2 molecule into two separate O atoms.

2. An individual O atom combines with a whole O_2 molecule to form an ozone molecule.

3. UVB strikes an ozone molecule and breaks it back down into an O_2 molecule and an O atom.

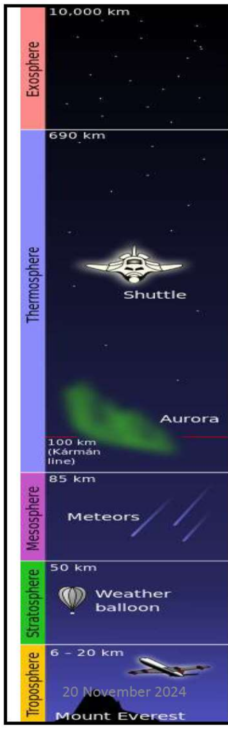
This O atom is then free to combine with another O_2 and make more ozone.

No long-term change in the concentration of ozone occurs.



Ozone depletion

- The three steps of natural ozone production and destruction in the stratosphere:
- (i) $O_2 + UV \rightarrow O + O$ (+ heat)
- (ii) $O_2 + O \rightarrow O_3$
- (iii) $O_3 + UV \rightarrow O_2 + O$ (+ heat)
  - UV radiation is converted from light to heat by the destruction of oxygen molecules and ozone molecules.
  - Temperature rises with increasing altitude in the stratosphere.



The ozone cycle

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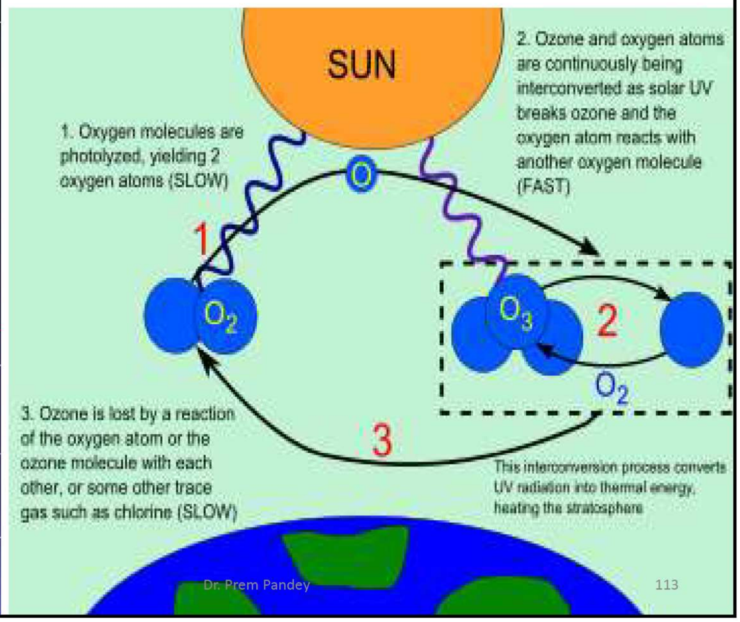


ODS- (Ozone depleting Substances)
&
Equivalent Effective Stratospheric Chlorine

- Chloro-fluorocarbons (CFCs) and other halogenated Ozone depleting Substances (ODS) are mainly responsible for man-made chemical ozone depletion.

- The total amount of effective halogens (chlorine and bromine) in the stratosphere can be calculated and are known as the Equivalent Effective Stratospheric Chlorine (EESC).

Ozone Depleting Substances

Ozone depleting substances are man-made gases that destroy ozone once the gases reach the ozone layer.

Ozone depleting substances include:

- Chloro-FluoroCarbons (CFCs)
- Hydro-Chloro-FluoroCarbons (HCFCs)
- Hydro-Bromo-FluroCarbons (HBFCs)
- Halons (were used in fire extinguishers)
- Methyl bromide (was used as fumigant. Fumigation is a method of pest control by suffocating pests with poison- CH3Br)
- Carbon tetrachloride (formerly widely used in fire extinguishers, refrigerant and as a cleaning agent)
- Methyl chloroform (solvent for organic compounds; used for cleaning metal parts and circuit boards - CH3Cl).

They have been used as:

- refrigerants in commercial, home and vehicle air conditioners and refrigerators
- foam blowing agents
- a component in electrical equipment
- industrial solvents
- solvents for cleaning (including dry cleaning)
- aerosol spray propellants
- fumigants.

Ozone depletion-Ozone hole

- Ozone depletion describes two distinct but related phenomena observed since the late 1970s:
  - a steady decline of about 4% in the total amount of ozone in Earth's stratosphere (the ozone layer),

    , and
  - a much larger springtime decrease in stratospheric ozone around Earth's polar regions.
- The latter phenomenon is referred to as the ozone hole.
- In addition to these well-known stratospheric phenomena, there are also springtime polar tropospheric ozone depletion events.

Ozone depletion

- The details of polar ozone hole formation differ from that of mid-latitude thinning but the most important process in both is catalytic destruction of ozone by atomic halogens.
- The main source of these halogen atoms in the stratosphere is photo-dissociation of man-made halocarbon refrigerants,
- solvents, propellants, and foam-blowing agents (CFCs, HCFCs, freons, halons).

Ozone depletion

- These compounds are transported into the stratosphere by winds after being emitted at the surface.
- Both types of ozone depletion were observed to increase as emissions of halocarbons increased.

Ozone depletion

Ozone can be destroyed by a number of free radical catalysts, the most important of which are

- hydroxyl radical (OH·),
- nitric oxide radical (NO·),
- chlorine radical (Cl·) and
- bromine radical (Br·).

The dot is a common notation to indicate that all of these species have an unpaired electron and are thus extremely reactive.

All of these have both natural and man-made sources; at the present time, most of the OH· and NO· in the stratosphere is of natural origin, but human activity has dramatically increased the levels of chlorine and bromine.

CFCs and Ozone Depletion

- What are CFCs (chlorofluorocarbons)?

- Volatile organic compounds (non-flammable, non-toxic) used as aerosol propellants and refrigerants Inert (non-reactive) gases that remain in the atmosphere for up to 200 years [CFC-11, CCl3F and CFC-12, CCl2F2]
- Can be broken down by photolysis (UV radiation) which frees chlorine atoms from the CFCs

Ozone depletion

- These elements are found in certain stable organic compounds, especially chlorofluorocarbons (CFCs), which may find their way to the stratosphere without being destroyed in the troposphere due to their low reactivity.
- Once in the stratosphere, the Cl and Br atoms are liberated from the parent compounds by the action of ultraviolet light, e.g.
- $CFCl_3$ + electromagnetic radiation → Cl· + ·$CFCl_2$

Ozone depletion

- The Cl and Br atoms can then destroy ozone molecules through a variety of catalytic cycles.
- In the simplest example of such a cycle, a chlorine atom reacts with an ozone molecule, taking an oxygen atom with it (forming ClO) and leaving a normal oxygen molecule.
- The chlorine monoxide (i.e., the ClO) can react with a second molecule of ozone (i.e., O3) to yield another chlorine atom and two molecules of oxygen.
- The chemical shorthand for these gas-phase reactions is:

Ozone depletion

- $Cl\cdot + O3 \rightarrow ClO + O2$: The chlorine atom changes an ozone molecule to ordinary oxygen
- $ClO + O3 \rightarrow Cl\cdot + 2\ O2$: The ClO from the previous reaction destroys a second ozone molecule and recreates the original chlorine atom, which can repeat the first reaction and continue to destroy ozone.

CFCs and Ozone Depletion

- Chlorine atoms react with ozone destroying an ozone molecule and creating chlorine monoxide and oxygen:
- $Cl + O_3 \rightarrow ClO + O_2$
- Chlorine monoxide reacts with oxygen atoms freeing up another chlorine atom available for breaking down ozone
- 80% of chlorine in the stratosphere comes from CFCs
- In 1978 per the Montreal Protocol the US banned aerosol sprays containing CFCs and phased out their production

Ozone depletion

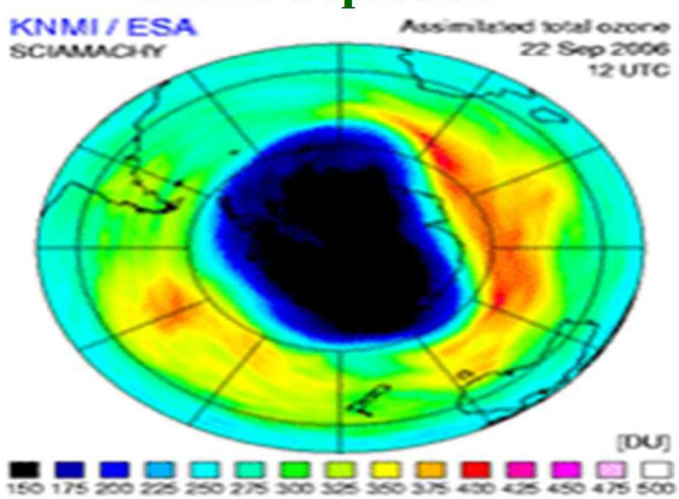


Image of the largest Antarctic ozone hole ever recorded (September 2006), over the Southern pole

Factors responsible for Ozone depletion

- The primary cause of ozone depletion is the presence of chlorine-containing source gases (primarily CFCs and related halocarbons).
- In the presence of UV light, these gases dissociate, releasing chlorine atoms, which then go on to catalyze ozone destruction.
- CFCs and other contributory substances are referred to as ozone-depleting substances (ODS).

CFCs and Ozone Depletion

Why is ozone depletion concentrated over Antarctica?

Unique weather patterns over Antarctica – Polar vortex

A polar vortex is an upper level low-pressure area lying near the Earth's pole.

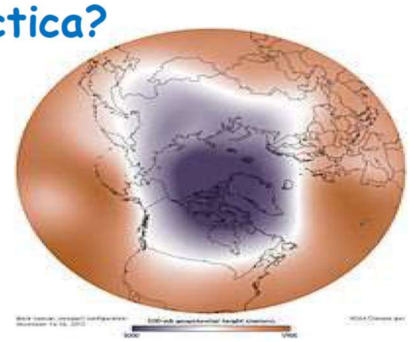
A large area of low pressure and cold air surrounding both of the Earth's poles

There are two polar vortices in the Earth's atmosphere, which overlie the North, and South Poles. ...

Beneath that lies a large mass of cold, dense arctic air.

Why is ozone depletion concentrated over Antarctica?

- **Polar vortex**

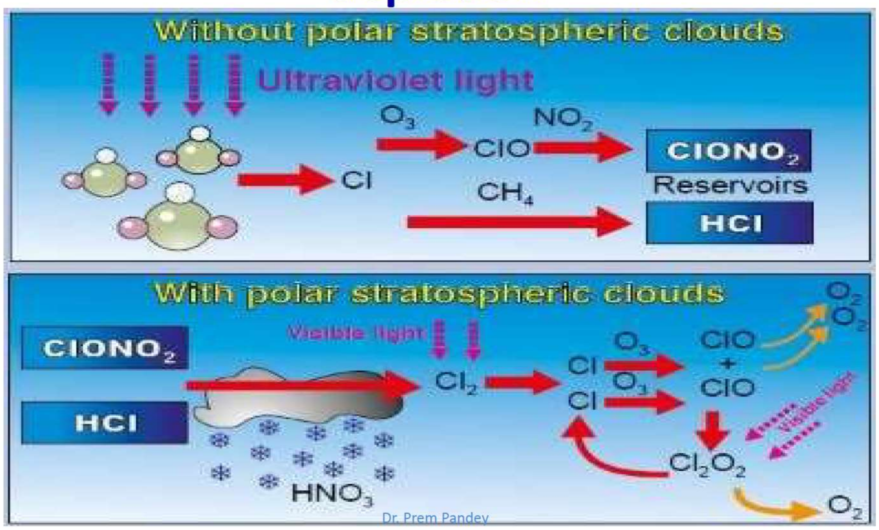


- Temperatures below -112°F (-80° C) June through August
- Leads to formation of polar stratospheric clouds (water + nitric acid)

Antarctic polar vortex and ozone depletion

- The chemistry of the Antarctic polar vortex has created severe ozone depletion.
- The nitric acid in polar stratospheric clouds reacts with chlorofluorocarbons to form chlorine, which catalyzes the photochemical destruction of ozone
- Polar Stratospheric Clouds or nacreous clouds contain water, nitric acid and/or sulfuric acid.
- They are formed mainly during the event of polar vertex in winter; more intense at south pole.
- The Cl-catalyzed ozone depletion is dramatically enhanced in the presence of polar stratospheric clouds (PSCs) .
- Finally this show , how polar vortex leads to ozone depletion.

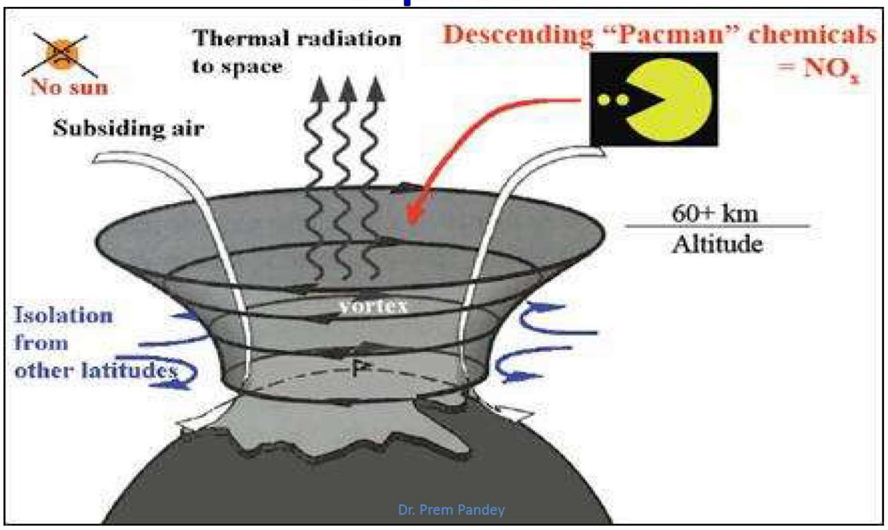
Antarctic polar vortex and ozone depletion



Antarctic polar vortex and ozone depletion

- Polar Stratospheric Clouds convert "**reservoir**" compounds into reactive free radicals (Cl and ClO).
- These free radicals deplete ozone as shown in the animation below.
- So Polar Stratospheric Clouds accelerate ozone depletion.

Antarctic polar vortex and ozone depletion



Why is ozone depletion concentrated over Antarctica?

- Ice particles in these clouds provide surfaces on which chemical reactions can occur, including the release of chlorine by chlorine bearing compounds
- In Spring temperature rises, processes that produce ozone outpace destruction and ozone begins to increase
- No polar stratospheric clouds elsewhere means less ozone loss elsewhere
- Ozone formation and destruction are temperature dependent phenomena

Acid Rain

Acid Rain

- Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions (low pH).
- It can have harmful effects on plants, aquatic animals and infrastructure.

Acid Rain

- "Acid rain" is a popular term referring to "the deposition of a mixture from Wet and Dry deposition.

  wet (rain, snow, sleet, fog, cloud-water, and dew)

  and

  dry (acidifying particles and gases) acidic components".

- Distilled water, once carbon dioxide is removed, has a neutral pH of 7.

Acid Rain

- Liquids with a pH less than 7 are acidic, and those with a pH greater than 7 are alkaline.
- "Clean" or unpolluted rain has an acidic pH, but usually no lower than 5.6, because carbon dioxide and water in the air react together to form carbonic acid, a weak acid according to the following reaction:

Acid Rain

- H_2O (l) + CO_2 (g) ⇌ H_2CO_3 (aq) Carbonic acid then can ionize in water forming low concentrations of hydronium and carbonate ions:

- H_2O (l) + H_2CO_3 (aq) ⇌ HCO_3^- (aq) + H_3O^+ (aq).
- However, unpolluted rain can also contain other chemicals which affect its pH (acidity level).
- A common example is nitric acid produced by electric discharge in the atmosphere such as lightning.
- Acid deposition as an environmental issue would include additional acids to H_2CO_3.

Acid rain

Formation of sulphuric acid and nitric acid as secondary pollutants results in a kind of pollution known as ACID RAIN. pH- 4.4 or less

Its excessive acidity causes environmental problems, such as destruction of vegetation and marine life and the corrosion and etching of buildings exposed to the atmosphere. Carbon dioxide in the atmosphere makes the rain acidic independently of pollution:

- $CO_2 + H_2O \quad H_2CO_3$ [PH=5.6]

Acid rain

Acid rain is formed by:

1. The presence of nitrogen oxides (nitric/nitrogen dioxide

$$N_2 + O_2 = 2NO$$

$$2NO + O_2 / O_3 = 2NO_2$$

$$3NO_2 + H_2O = 2HNO_3 + NO$$

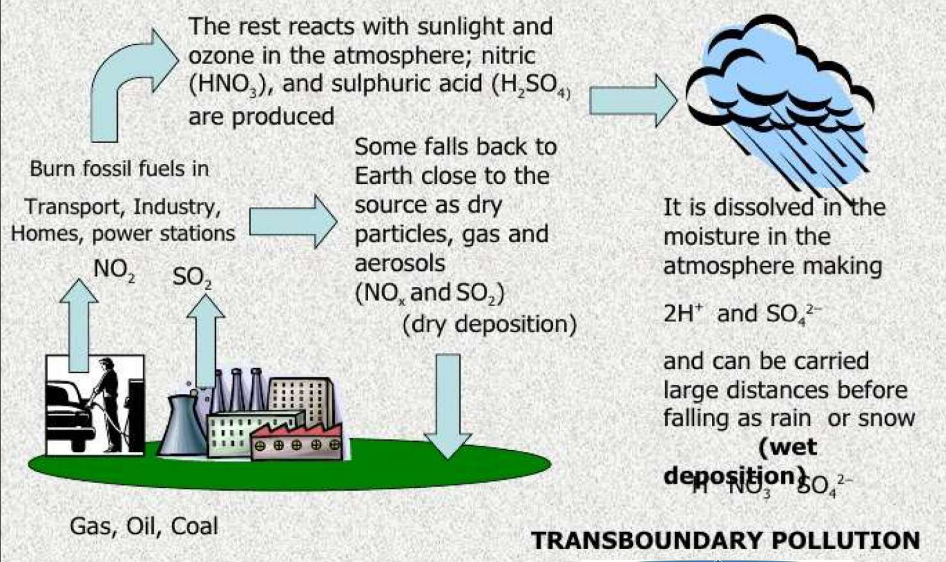
2. The presence of sulphur dioxide

$$SO_2 + 1/2O_2 = SO_3$$

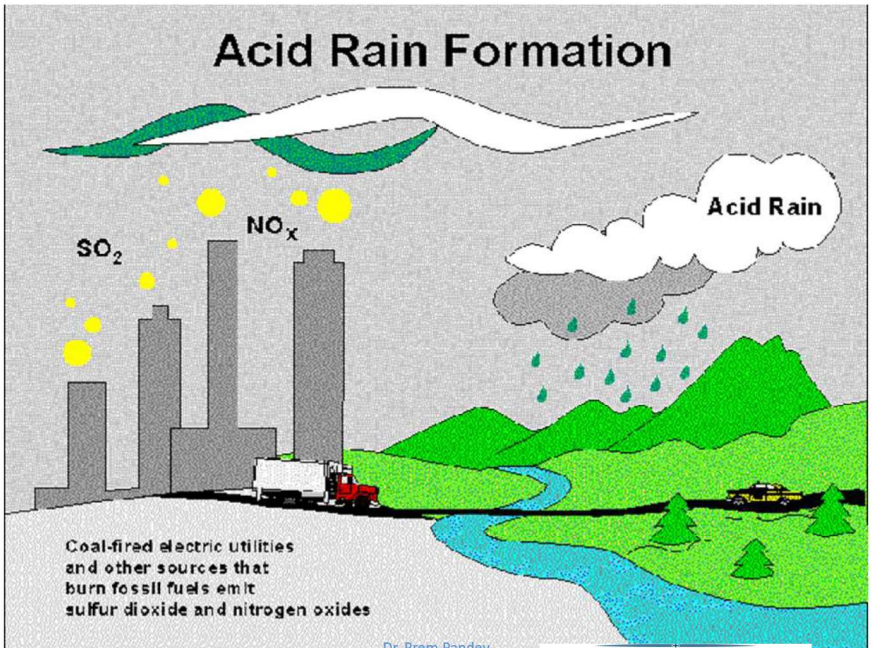
$$SO_3 + H_2O = H_2SO_4$$

3. the presence of hydrogen sulphide and chlorine

The Formation of Acid Rain



TRANSBOUNDARY POLLUTION



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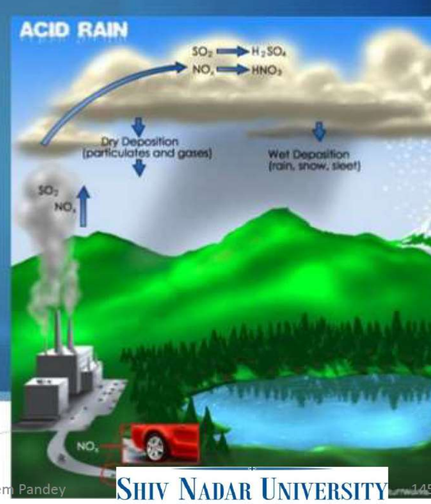
Acid rain, or acid deposition, is a mixture of sulphuric and nitric acids.

- **Wet deposition**
  - **rain**
  - **hail**
  - **snow**
  - **fog**
- **Dry deposition**
  - **gases and particles**



Harmful effects of acid rain

1. **Vegetation:** Acid rain makes the soil acidic diversely affecting plants and animals. The ions H^+, SO_4^{2-} and NO^{3-} leaches the nutrients from the soil. Acid rain also damages the leaves of the plants and retarding forests.
2. **Fertility of soil:** Acid rain inhibits the activity of symbiotic nitrogen-fixing bacteria present in the nodules of leguminous family.
3. **Aquatic life:** Changes in pH of fresh water affect the reproduction and survival of many species of fish.

Harmful effects of acid rain

4. **Buildings and monuments:** Extensive damage to buildings made of marbles, limestone, slate or mortar. Limestone is converted in to gypsum

$$CaCO_3 + H_2SO_4 \qquad CaSO_4 + H_2O + CO_2$$

5. **Ecological balance:** Acid rain is responsible for wiping out many bacteria and blue-green algae, thereby disrupting the whole ecological balance
6. **Human health:** Acidic conditions can play havoc with human nervous system, respiratory system and digestive system.

Prevention of acid rain via limitation of pollution emissions, using of catalytic converters, limitation of fossil fuel and bio-fuel burning

Acid Rain and Marine life

Solution Of Acid Rain

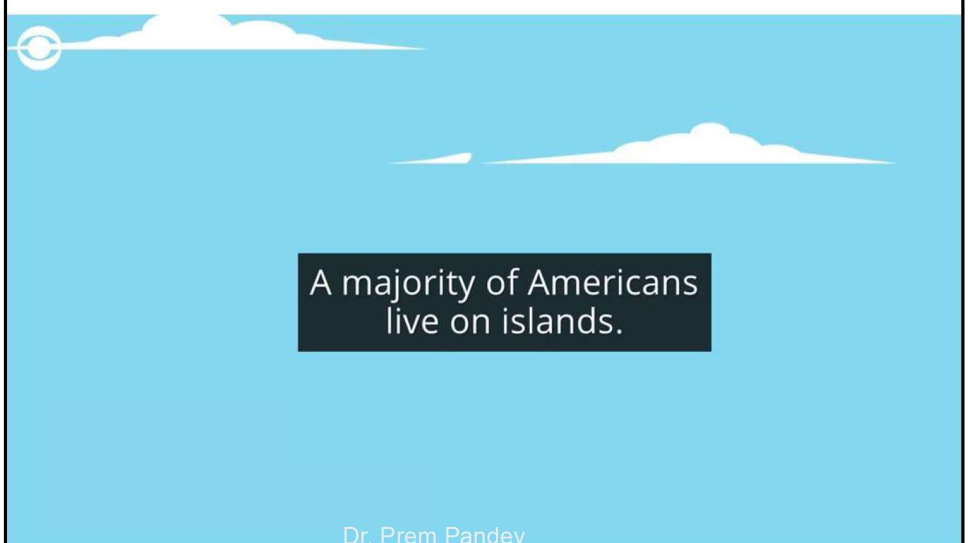
- Fit scrubbers into factory's chimneys, which are chemical filters that remove impurities such as sulphur from smoke.
- Cars can be fitted with special converters which remove dangerous chemicals.
- Governments need to spend more money on pollution control.
- Governments need to invest in researching different ways to produce energy.

CoNcLuSiOnS

- Acid rain is slowly destroying our planet. It is our responsibility to make sure that we protect the earth for future generations to enjoy.
- We should stop polluting, for example riding your car just to go to your neighbors five houses away from yours, or factories should

Urban Climate and Environment

20 November 2024 Dr. Prem Pandey SHIV NADAR UNIVERSITY 153



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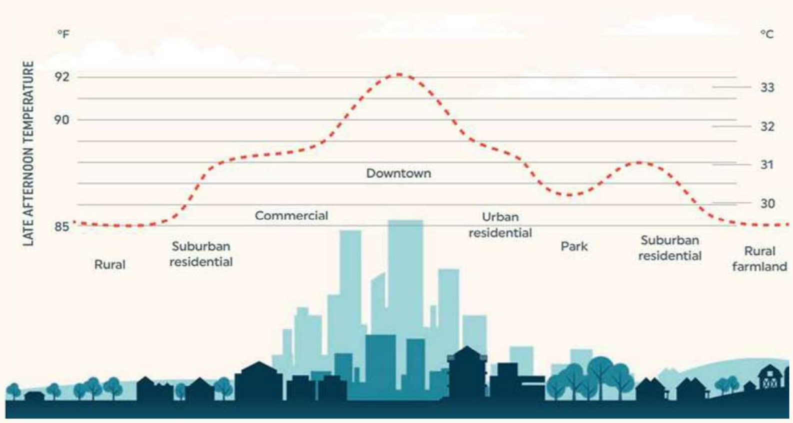

- The **urban heat island effect** causes cities to be warmer due to the absorptive properties of asphalt and pavement, and reduced air flow due to blocked winds.

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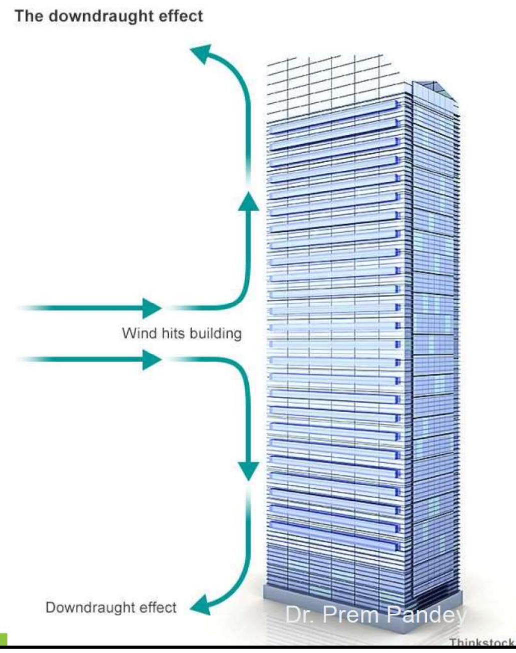
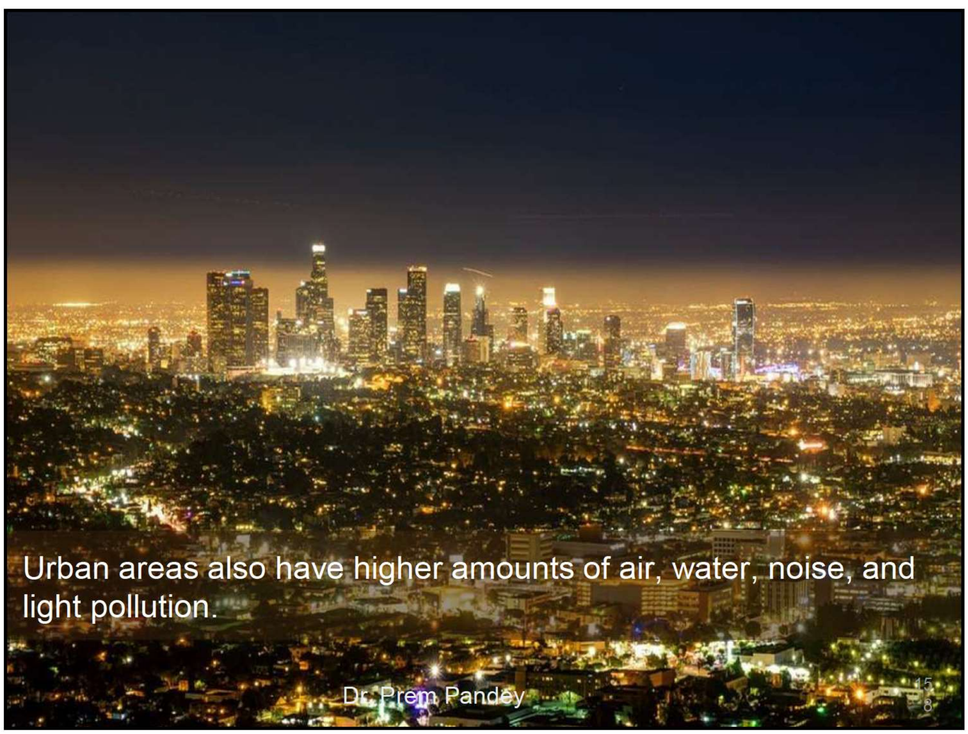


Large buildings block wind flow, causing updrafts and downdrafts.



Urban areas also have higher amounts of air, water, noise, and light pollution.

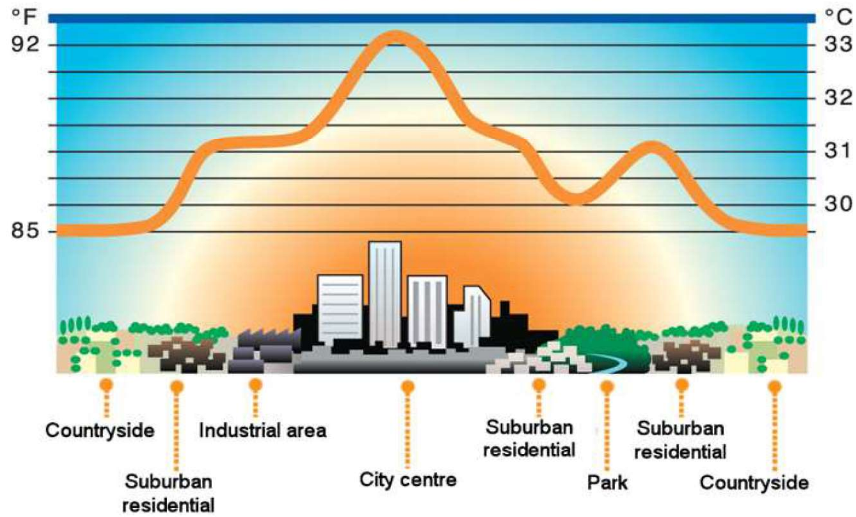
Urban Climate and Environment

- **"Cities and infrastructure have always been mutually interdependent and co-evolutionary. In fact, cities could not exist without infrastructure".**
- Today, urban climate, and specifically extreme heat, pose a threat to both urban residents and ecosystems.
- These new problems challenge us to redefine what constitutes infrastructure and necessary urban services.

Causes of urban heat extremes

- Urban heat extremes are the result of two distinct phenomena: the **UHI** (**urban heat island)** effect and the **global greenhouse effect.**
- **Urban heat islands (UHI) are defined as urban and suburban areas with elevated air temperatures relative to surrounding rural areas or wild lands.**
- Meteorologists first noted the presence of the UHI as early as the mid-1800s.

Urban heat island



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Causes of urban heat extremes

Urban heat islands are produced by <u>four factors</u>:

1. **The use of dark, dense paving and building materials;**
2. **The three-dimensional form of buildings, which absorb solar radiation and restrict air circulation;**
3. **Reduced abundance of vegetation, which decreases shade and restricts evapo-transpiration; and**
4. **The addition of waste heat from the anthropogenic sources mentioned above.**

The UHI effect has been the largest contributor to elevated urban temperatures in most cities world over the past half-century.

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Urban Climate and Environment

- **Extreme heat poses a threat to:**
  - **the liveability and sustainability of cities, and**
  - **disproportionally harms marginalized groups.**
- **The frequency of extreme heat events is expected to increase in the future as climate change intensifies urban heat island (UHI) effects.**

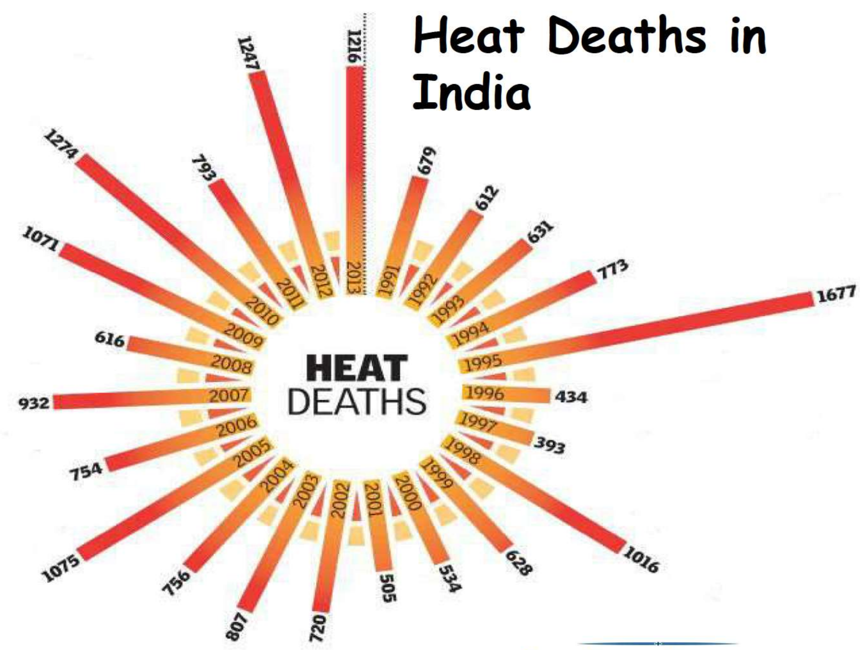
Urban heat extremes and deaths

- Heat extremes are responsible for **more deaths worldwide** than any other weather-related events
- Urban heat extremes are caused by a combination of the **urban heat island (UHI) effect and the global greenhouse effect,** as compared with baseline regional climate

Severity of extreme heat

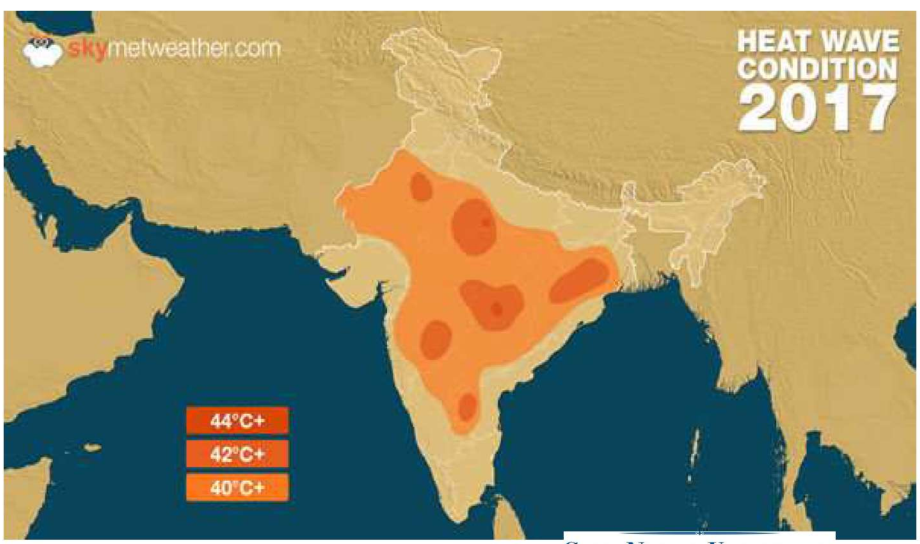
- The deadly potential of extreme heat was illustrated in the summer of 1995 in Chicago, Illinois, when a heat wave caused the **deaths of over 700 residents in just 5 days/**
- **Again in Europe in 2003, when over 70 000 residents of 12 different countries died as the result of a prolonged heat wave.**
- Extreme heat kills more people than any other weather-related factor; in the US, mortality rates increase by 4% during heat waves.

Heat Deaths in India



A shimmering haze of heat rises in a village in Adilabad, Telangana one of the regions that reeled under a hot spell (47°C) during May 2016.

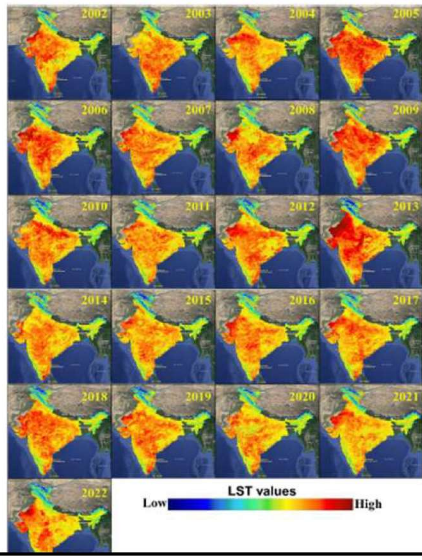
Heat Wave in India - 2017



Land surface temperature over India from 2002 to 2022

Summer season **winter season**

(Source: Maura; Pandey et al 2022)



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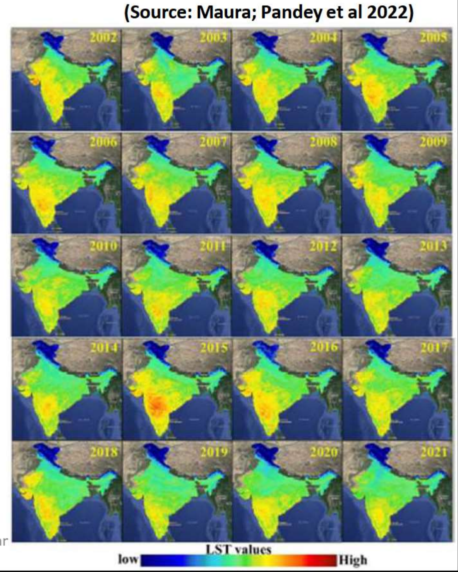


Severity of extreme heat

- Elevated temperatures negatively affect human health both directly and indirectly – causing dehydration,
- heat exhaustion, and
- potentially life-threatening heat stroke – and exacerbate existing medical conditions such as heart and kidney disease.
- Furthermore, the contribution of extreme heat to these types of medical conditions is under-reported on death certificates.

Urban tree cover

- The impacts of urban heat extremes are not limited to humans but extend to plants, animals, and ecosystems.
- **Given that planting trees is an important heat mitigation strategy, the impact of heat on urban tree vitality and diversity is an area of particular concern.**
- **"While trees in urban areas are becoming ever more important, they also have to cope with increasingly extreme climatic conditions, especially periods of heat and drought in summer".**

Urban Climate and Environment-Strategies

- To be effective, **heat mitigation strategies** must coordinate infrastructure systems through comprehensive planning, with special attention being given to vulnerable populations.
- Establishing new forms of infrastructure also requires creative funding strategies to meet the costs of implementation, operation, and maintenance.

Urban Climate and Environment

- **Microclimate mitigation efforts must move beyond exterior site-level strategies to consider land-use planning at the neighbourhood level and the role of passive cooling strategies for buildings.**
- **Green infrastructure offers benefits in the form of improved storm water management, air quality, carbon sequestration, and microclimate regulation.**

Urban Climate and Environment

Common UHI mitigation strategies – such as

- **cool pavements (light-colored surfacing or permeable pavements),**
- **cool roofs (often categorized as "white", "blue", or "green" roof strategies to differentiate the approaches), and**
- **increased planting of vegetation – vary in effectiveness depending on a city's baseline climate, as well as on city size and layout and**
- **Lastly reducing Waste heat.**

Urban Climate and Environment

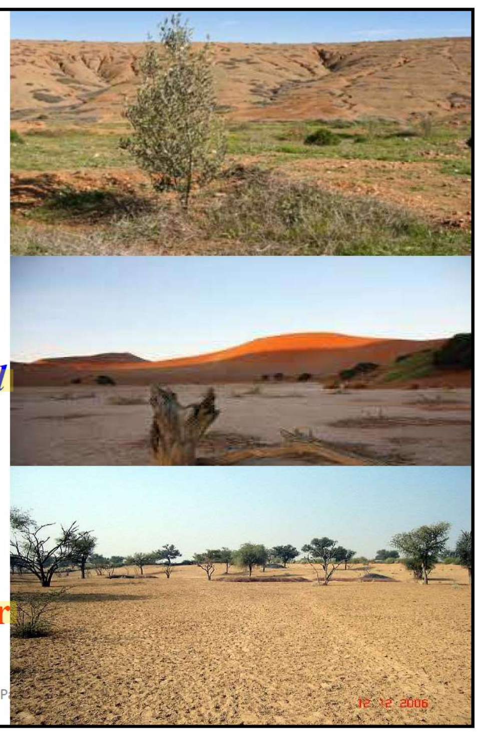
- **The effectiveness of different UHI mitigation strategies is dependent on a city's biophysical conditions and settlement patterns**
- **Combining the ecosystem services of microclimate regulation, storm water management, urban air quality, and carbon sequestration into one green-infrastructure "utility" has practical advantages for municipal funding and implementation**

Desertification

Under *the United Nations Convention to Combat Desertification (UNCCD):* (UNCCD), 'desertification' is defined as

"land degradation in arid, semi-arid, and dry sub-humid areas, resulting from various factors, including climate variations and human activity."

Desertification does not refer to the expansion of existing deserts.



Desertification

- Desertification occurs because dry land ecosystems, which cover over one third of the world's land area, are extremely vulnerable to over-exploitation and inappropriate land use.
- Poverty, political instability, deforestation, overgrazing and bad irrigation practices can all undermine the productivity of the land.
- 1.7 million sq. km. are in Indian sub continent
- Every year some 200,000 sq. km. of forests deteriorate to the point of zero economic yield.

Desertification- lopping of branches in semi-desert/ desert areas – Anthropogenic pressure


Thank You