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RESEARCH ARTICLE

A Note on "Weather and Climate" and "Global Warming and Climate Change": Their Mutual Interactions

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ABSTRACT

Earth's climate is dynamic, and it is always changing through the natural cycles. What we are experiencing now is part of this system only. Furthermore, general circulation patterns over different parts of the globe are part of this. They are highly region-specific systems. We discussed the differences between weather and climate, global warming and climate change, and their mutual interactions. Furthermore, we discussed some clarifications on these two parameters. In fact, the World Meteorological Organization, an intergovernmental panel on climate change, and the United Nations Framework Convention on Climate Change presented definitions for the word "climate change". However, these institutions rarely adhere to their own definitions. The weather and the climate describe the same thing, the state of the atmosphere, but at different time scales. The weather is what you experience. The climate is the average of the weather patterns in a location over a longer period of time, usually 30 years or more. Climate change refers to long-term patterns of temperature and rainfall that are quite different from averages, namely the climate. Global warming is a component of climate change in terms of the trend in temperature. The rainfall has no trend but presents natural cyclic variation that varies from region to region and country to country, but the global average has no meaning. In the case of Indian temperature data, minimum temperature presented a linearly increasing pattern due to the urban heat island effect, while maximum temperature presented depression during 1931–1960. This is associated with the 60-year rainfall cycle, wherein 1931-1960 is above the average rainfall part of the cycle, which is a wet period. The temperature pattern followed in opposition to the rainfall. In the case of temperature, Australia's sea surface temperature and surface air temperatures presented a 120-year cycle. The surface air temperature presented a trend of 0.63°C for 1951–2100. 50% of it is global warming, which is given as 0.313°C, which is less than the global average annual temperature trend part of global warming (0.45/0.40°C), and thus the Northern Hemisphere value is higher than the global value. The sea surface temperature hasn't presented a trend and thus shows zero global warming.

Key words: Carbon dioxide rainfall, climate, climate change, global warming, inter-governmental panel on climate change, temperature, United Nationsframe work convention on climate change, weather, world meteorological organization

INTRODUCTION

Earth's climate is dynamic, and it is always changing through the natural cycles. What we are experiencing now is part of this system only. Furthermore, general circulation patterns over different parts of the globe are part of this. They are highly region-specific systems. The World Meteorological Organization of the United Nations brought out a manual on "Climate Change", wherein it discussed methods to separate natural-inbuilt variations from man-induced trends.[1] This manual was prepared

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by eminent meteorologists from meteorological departments around the world. (late) Shri. K. N. Rao from the India Meteorological Department [IMD] was one of them.

People of all walks of life make statements attributing weather aberrations to global warming, forgetting the fact, "When was, the period, in human history to which some person, in some location or the other, wasn't feeling that some recent day, month or season has been very unusual in some dry, wet, hot, or cold?" Several civilizations have gone into history.[1]

Unfortunately, neither the UN nor the US nor Pope Francis have put realistic emphasis on pollution reduction, as with this component there are ramifications for multinational companies interests. They lobbied with the groups preparing the draft to be presented at the Paris meeting related to COP21 on November 30–December 12, 2015, and were successful.[1]

WEATHER AND CLIMATE

Introduction

It is a common practice to use the word climate to refer to the word weather, and the word climate change is used to refer to the word global warming. They are highly variable in meteorological terms. The word weather describes the conditions outside right now in a specific place. For example, if you see that it's raining outside right now, that's a way to describe today's weather. Rain, snow, wind, hurricanes, tornadoes – these are all weather events. The climate describes the weather conditions that are expected in a region at a particular time of the year. A region's climate is determined by observing its weather over a period of many years, generally 30 years or more.

Weather

The weather is the state of the atmosphere at a place and time as regards heat, dryness, sunshine, wind, temperature, rain, etc. The weather is a mix of the events that happen each day in our atmosphere. The weather is different in different parts of the world. It refers to changes over minutes, hours, days, and weeks. In the first 2 weeks of April 2024, Hyderabad presented cool conditions followed by hot conditions. That is, the weather is the state of the atmosphere, describing, for example, the degree to which it is hot or cold, wet or dry, calm or stormy, clear or cloudy. On the Earth, most weather phenomena occur in the lowest layer of the planet's atmosphere, the troposhere [Figure 1].

The Earth's weather system is a chaotic system; as a result, small changes to one part of the system can grow to have large effects on the system as a whole. Human attempts to control the weather have occurred throughout history, and there is evidence that human activities such as urbanization, agriculture, and industry are modifying the weather patterns.

The weather occurs primarily due to air pressure, temperature, and moisture differences from one place to another. These differences can occur due to the sun's angle at any particular spot, which varies by latitude in the tropics [Figure 2]. In other words, the farther from the tropics one is located, the lower the sun's angle is, which causes those locations to be cooler due to the spread of the sunlight over a greater surface.

The strong temperature contrast between the polar and tropical air gives rise to the large-scale atmospheric circulation cells and the jet stream.[2] The climate system [Figure 3; as per the Inter-governmental Panel on Climate Change (IPCC)] and energy circulation, the hydrological cycle [Figure 4 -- a common figure], played an

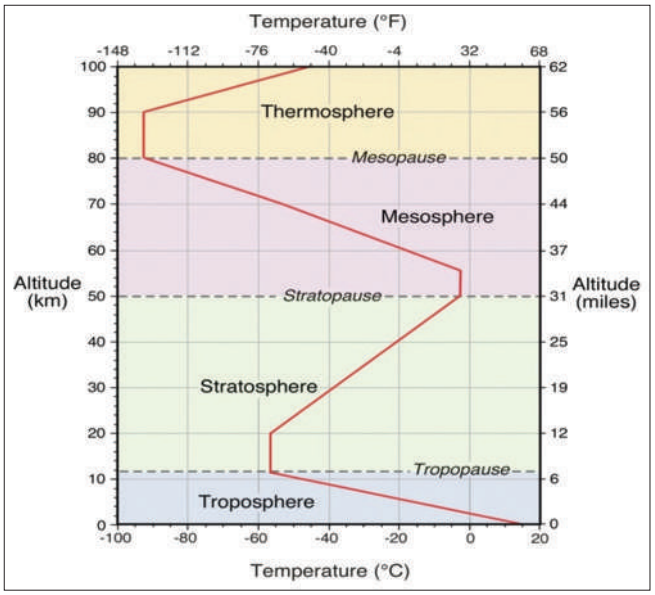

Figure 1: Temperature pattern with altitude

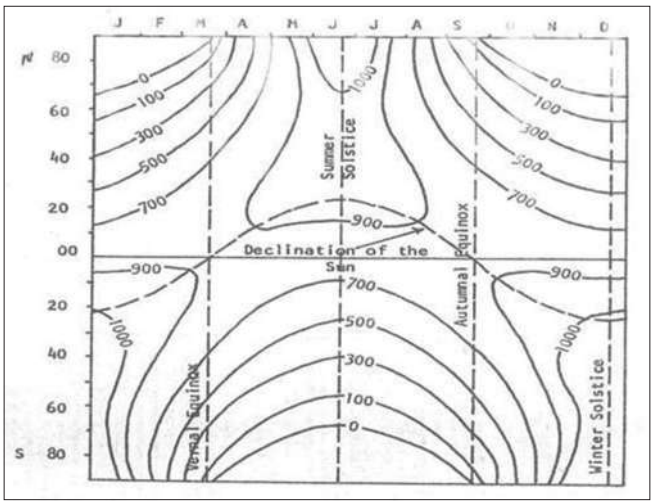

Figure 2: Total solar radiation recieved on the top of the Atmosphere

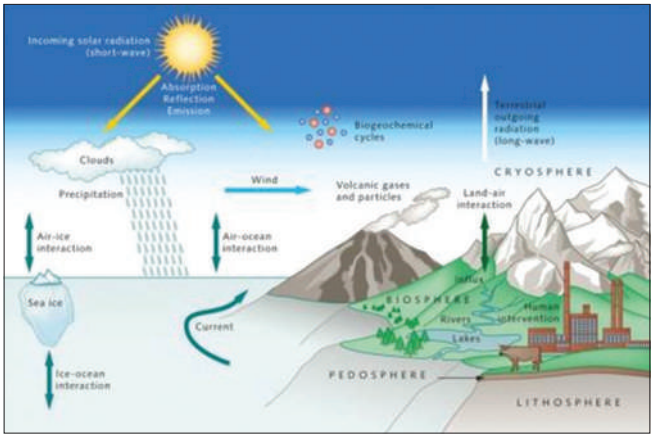

Figure 3: Climate system as defined by inter-governmental panel on climate change – atmosphere, hydrosphere, cryosphere, land surface, biosphere

important role in the weather in the mid-latitudes, such as extratropical cyclones, which are caused by instabilities of the jet stream flow. The weather systems in the tropics, such as monsoons, organized thunderstorm systems, and cyclone systems, are caused by different processes.

Because the Earth's axis is tilted relative to its orbital plane, sunlight is incident at different angles at different times of the year. In June, the Northern Hemisphere is tilted toward the Sun, so at any given Northern Hemisphere latitude, sunlight falls more directly on that spot than in December. This effect causes seasons. Over 1000's of years, changes in the earth's orbital parameters affect the amount and distribution of the solar energy received at the top of the atmosphere [Figure 2] (Milankovitch cycles) with the latitudes and months.[1,3]

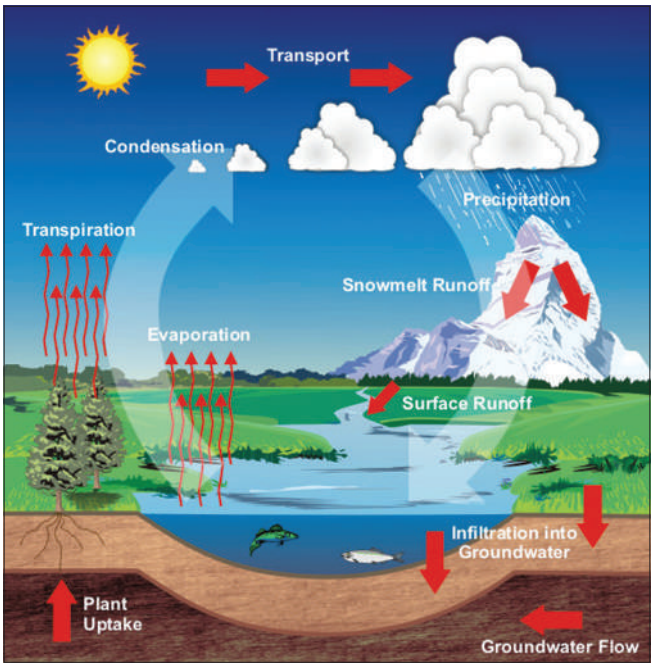

Figure 4: Hydrological cycle -- general

The uneven solar heating (the formation of zones of temperature and moisture gradients, or frontogenesis) can also be due to the weather itself in the form of cloudiness and precipitation. The higher altitudes are typically cooler than the lower altitudes, which is the result of higher surface temperatures and radiational heating, which produce the adiabatic lapse rate.

The surface temperature differences, in turn, cause the pressure differences. A hot surface warms the air above it, causing it to expand and lower the density and resulting surface air pressure. The resulting horizontal pressure gradient moves the air from higher to lower pressure regions, creating a wind, and the Earth's rotation then causes deflection of this airflow due to the Coriolis effect. The simple systems thus formed can then display emergent behavior to produce more complex systems and, thus, other weather phenomena. Large-scale examples include the Hadley cell, while a smaller-scale example would be the coastal breezes. The sea breeze and the land breeze are explained very simply.

Forecasters [center, state-wise] rely on a network of the radars, the satellites, the ocean buoys, the weather balloons, and the surface observations [the most important input] and supercomputers to provide timely [however, they primarily depend upon the input fed to them by the meteorologists] accurate,

to ahieve reliable forecasts. They also issue critical watches and warnings before extreme weather strikes. This is the same in most countries. When I was with IMD, DDGF used to forecast very accurately based on ground data and catch manipulated data.

Climate

The climate, on the other hand, changes more slowly. That's why we come to expect, for example, that the North-east will be cold and snowy in January and that the South will be hot and humid in July. Furthermore, the climate generally does not vary much over short distances, except in the mountains. Climate patterns emerge from long-term weather data. With the commencement of satellite data on the surface, observation networks have drastically come down since around 1970. These changes severely influence annual averages, particularly the temperature. The climate is about the long term. It is about using the weather data collected in the past to look for long-term trends over the past 30 years. The World Meteorological Organization (WMO) and the national meteorological departments created climate normals for 30-year periods [1931–1960, 1961–1990, 1991–2020, etc.]. Here, we must remember the fact that averages or means for any period are different from normal for a fixed, specified 30-year period.

Then scientists talk about climate; they're talking about the averages of measureable things such as the surface air or sea surface temperatures, the amount of rainfall, the solar radiation, and the evaporation,[4] often over a long time span of 30 years or more. In many locations around the US, weather and climate records have been kept for more than 140 years. It is also the case with IMD in India. NOAA is involved in a long-term effort to collect, quality control, and organize data to make it available to the public online. These long-term records enable scientists to detect climate patterns and trends.

GLOBAL WARMING AND CLIMATE CHANGE

Introduction

In recent times, the word "climate change" has been used to refer the word "global warming". However, climate change is different from global warming, the climate, and the weather. Mainly, the word climate change has been used as an adjective or as a de facto global warming. Some used global warming as human-caused climate change without understanding the real dynamics and definitions of the words "climate change" and"global warming". Climate change can occur naturally or through man-made causes, while global warming looks at one part of the man-induced causes. The rainfall has no such component, but the temperature has that with the data manipulations.

Climate change describes a change around the average conditions. Global climate change refers to the average of long-term changes over the entire Earth, at a place, at a region level, or at a country level. The Earth's climate has constantly been changing—even long before humans came into the picture. However, rainfall does not fit in this as it follows local, regional, and national levels only, but temperature is also used at the global level.

Climate change refers to any significant change in the measures of climate for extended periods of time, usually over decades or longer. This includes major, long-term changes in temperature, precipitation, etc., and how these changes affect life on the Earth. Human activities include the emission of heat-trapping greenhouse gases, such as carbon dioxide,into the atmosphere and changes in land use and land cover patterns, such as agriculture and urbanization. Natural causes range from regular pattern shifts in the dynamics of our oceans and atmosphere, such as El Nino-Southern Oscillation (ENSO), to volcanic eruptions that emit various gases, desert sand, and aerosols in the atmosphere, to long-term changes in the Earth's orbit around the Sun and variations in the amount of energy from the Sun that reaches the Earth.

Global warming is one aspect of climate change. Specifically, it relates to the recent [from 1951 as per the IPCC] on-going rise in the global average temperatures near the Earth's surface (the land, the ocean, or both). Global warming has primarily been due to the increase of heat-trapping pollutants, called greenhouse gases, that humans are adding to the atmosphere primarily by burning fossil fuels. Global warming is causing climate patterns to change. However, it is only one aspect of climate change. Carbon dioxide is not a pollutant; in fact, we inhale air, use oxygen, and release carbon

dioxide back into the air, which constitutes 96% of the total carbon dioxide in the atmosphere. In the literature, every now and then, researchers bring out new issues of greenhouse gases.

Reports say that around 1850, thermometer records began to provide global coverage. Between the 18th century and 1970, there was little net warming, as the warming impact of "the greenhouse gas emissions was offset by the cooling from sulfur dioxide emissions". Sulfur dioxide causes acid rain, but it also produces sulfate aerosols in the atmosphere, which reflect the sunlight and cause the so-called global dimming. After 1970, the increasing accumulation of greenhouse gases and controls on sulfur pollution led to a marked increase in the temperature. However, greenhouse gases are increasing with population growth. However, in reality, these are doubtful, as while preparing the averages, they pushed down the data at the start, which can be seen in the USA raw data series.

Reports say that "Different regions of the world warm at different rates. The pattern is independent of where the greenhouse gases are emitted because the gases persist long enough to diffuse across the planet. This is not basically true because the carbon dioxide is lower in the southern hemisphere over that in the northern hemisphere.[1,5,6]

Even if it is so, they are not the same as that of at the source. It is different between the northern and the southern hemispheres. The Northern Hemisphere and the North Pole have warmed much faster than the South Pole and the Southern Hemisphere. This is basically because land area in the Northern Hemisphere is far more than in the Southern Hemisphere, and vice versa, as in the case of area under water".

The principal component of climate change is natural variations in rainfall and temperature. It is beyond human control and needs to adapt to them. The other component is global warming, which has no impact as it is a global average and authorities are talking at the local level.

Global Warming

Sources of greenhouse components

Reports state that

Carbon dioxide **(**CO_2) emissions primarily come from the burning of fossil fuels to provide energy for transport, manufacturing, heating, and electricity. Additional CO_2 emissions come from deforestation and industrial processes, which include the CO_2 released by the chemical reactions for making cement, steel, aluminum, and fertilizer. Methane emissions come from livestock, manure, rice cultivation, landfills, wastewater, and coal mining, as well as oil and gas extraction. Nitrous oxide emissions largely come from the microbial decomposition of fertilizer. While methane only lasts in the atmosphere for an average of 12 years, CO_2 lasts much longer–more than 1000 years. Human-released CO_2 is the major component of the overall CO_2.

Carbon dioxide (CO_2) is the most commonly addressed greenhouse gas, and its atmospheric concentration is measured in parts per million (ppm). Methane (CH_4) and nitrous oxide (N_2O) are not that important for the global climate and are measured in parts per billion (ppb).

Carbon dioxide: 418.81 ppm = 150% of pre-industrial levels

Methane: 1889±2 ppb = 262% of pre-industrial levels

Nitrous oxide: 333.2±0.1 ppb = 123% of pre-industrial levels.

With the different versions of data, what is the real emission of CO_2 is a hypothetical inference only.

The[7,8] entire issue that runs around there is increasing greenhouse gases, and they are contributing to the rise in temperature. However, since 2000, they have struggled to get a scientifically defined value for the "Climate Sensitivity Factor (CSF)" that defines the link between greenhouse gases and temperature. However, they are following a "trial and error" approach with no real solution [Figure 5e]. This is the basic problem in the IPCC approach from top to bottom, as there are several variables with no clear cut, understanding or value, such as the words cloud cover, water vapor, and solar radiation, which are highly location-specific.

Systematic measurements of greenhouse gases started around 1960 [**s**ee WMO Fact Sheet]. The carbon dioxide concentrations in the atmosphere presented a linear increase with time [Figure 6a].

Figure 6b presents carbon dioxide variation with population growth during 1960–2015. It presented a linear increase. Here, a major part of the carbon dioxide released by human is not greenhouse gas.

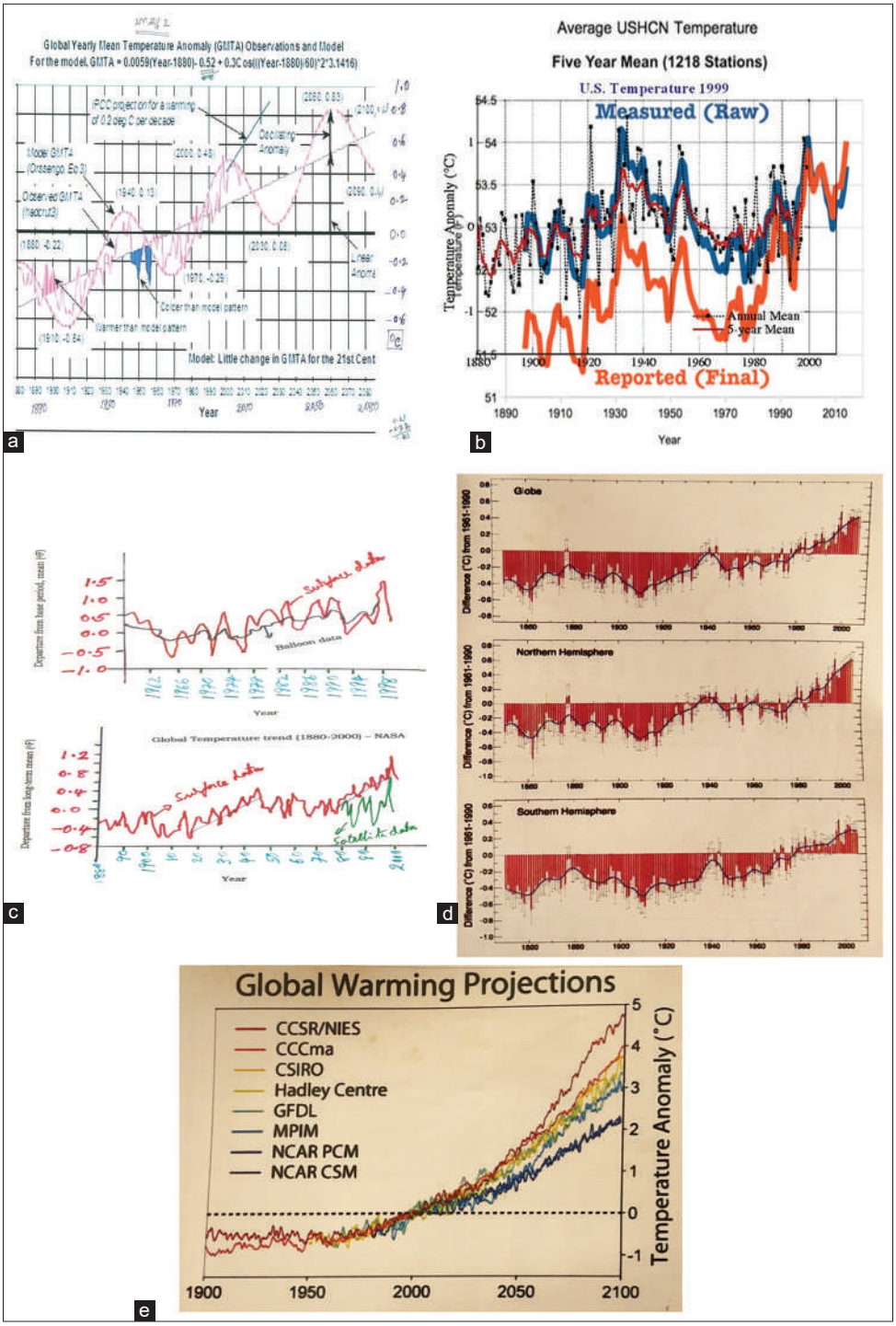

Figure 5: (a) The global average temperature anomaly for the period 1880–2010 presenting 60-year cycle with the inflexion point year as 1985. (b) Average U.S. historical climatology network annual temperature and superposed on it the 5 year mean of 1218 stations raw (measured) data and adjusted data (below red pattern-Reported [Final]). (c) The global average annual temperature series (bottom part) in red colour and satellite measured data series in green colour. (d) The global and hemispherical average temperature patterns during 1850–2006. (e) Projections of global warming under different model forms

This is clearly seen in the Southern Hemisphere, where there is less population, less carbon dioxide, and the lower average temperature with less land area and more sea surface area, and in the case of the Northern Hemisphere, where there is more population, more carbon dioxide, and higher average temperatures with more land area and less sea surface area.[5,6] Humans inhale air, use oxygen, and

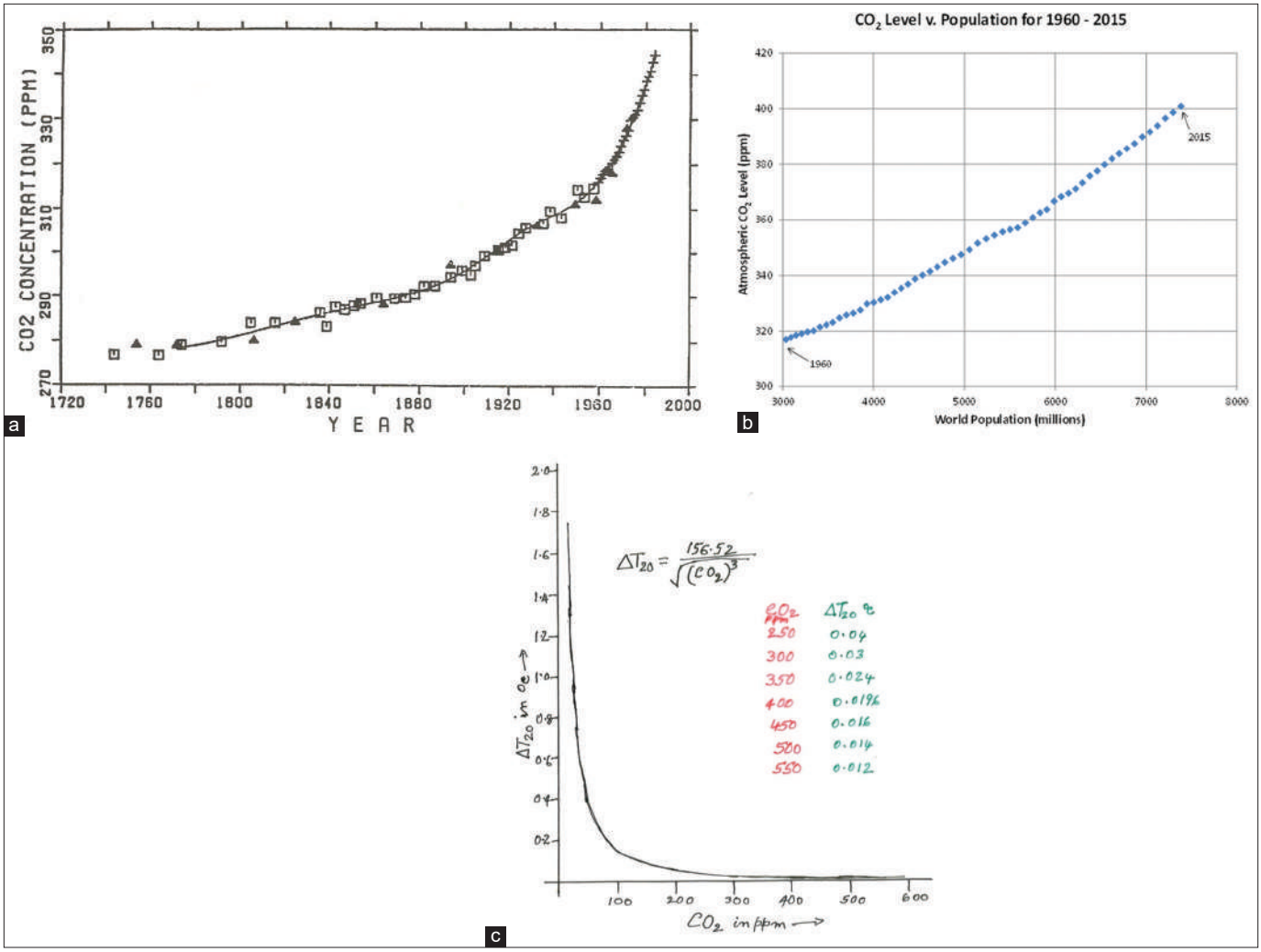

Figure 6: (a) Atmospheric carbon dioxide increase in the past 200 years, (b) Carbon dioxide versus population during 1960–2015. (c) ▲T ln °C versus CO2 in 20 ppm interval (Source: Dr. S. J. Reddy)

release carbon dioxide. However, the basic issue is that carbon dioxide contributes to the temperature in the presence of the cloud cover and the water vapor, wherein they directly interact with the sun's energy in raising the temperature.

Figure 6c presents the relationship between carbon dioxide and the change in temperature; here, carbon dioxide is the greenhouse gas component only. This is in line with Figure 6a and b, which means humans released carbon dioxide, which is eliminated in Figure 6c.

The heating effect of carbon dioxide (CO_2) is non-linearly decreasing, and this is expressed by the following equation [approximately]:

$\blacktriangle T = 156.52/\sqrt{[(CO_2)^3]}$

Wherein ▲T is the °C, increase in atmospheric temperature per 20 ppm increment in CO_2.

Recent finding sulfuryl fluoride

California, a state known for advancing some of the strictest climate policies in the country, is the nation's top emitter of a little-known—but very persistent—greenhouse gas. Sulfuryl fluoride, a common pesticide for treating termites and other wood-infesting insects, lingers in the atmosphere for more than 40 years, trapping heat and sending it back down to the Earth, according to the study published Wednesday in "Communications Earth and Environment".

The Golden State is responsible for an enormous share of those sulfuryl fluoride releases, accounting for as much as 12% worldwide, per the study. All other U.S. states combined contribute up to 5% of those global emissions, the researchers found. "Other greenhouse gases like carbon dioxide and methane are found everywhere across the U.S.,"

senior author Scot Miller, an assistant professor of environmental health and engineering at Johns Hopkins University, said in a statement. “It really is a double-edged sword,” Miller said. “Sulfuryl fluoride is less harmful than the banned fumigants, but it also contributes to global warming.” The researchers were able to attribute the vast majority of California’s sulfuryl fluoride use to a practice called “structural fumigation”—sealing an infested target with an airtight tent, pumping the gas inside to eliminate the pests, and then venting it into the atmosphere. About 85% of California’s sulfuryl fluoride emissions stem from structural fumigation, while the remaining 15% come from fumigating agriculture and other commodities, according to the study.

Carbon dioxide

Last year was the hottest on record, and the Earth is headed toward a global warming of 2.7°, yet top fossil fuel and cement producers show a disregard for climate change and actively make things worse. A new Carbon Majors Database report found that just 57 companies were responsible for 80% of the global carbon dioxide emissions between 2016 and 2022. 38% of total emissions during this period came from nation-states, 37% from state-owned entities, and 25% from investor-owned companies. This number represents producers worldwide, including 87% of those assessed in Asia, 57% in Europe, and 43% in the North America. It is not a clear case of things slowly turning around, either. The International Energy Agency found coal consumption increased by 8% over the the 7 years to 8.3 billion tons—a record high. The report names state-owned Coal India as one of the top three carbon dioxide producers. Russia’s state-owned energy company Gazprom and state-owned oil firm Saudi Aramco rounded out the trio of worst offenders.

All these are valid when we show that what is the real value or function, like Figure 5c for CSF?

Scientists Say New Material Can Suck Carbon Out of Atmosphere “Faster Than Trees” by Sharon Adarlo, April 30, 2024. A team of scientists in the United Kingdom say they've discovered a porous material that has the potential to store large quantities of greenhouse gases, making it a possible new tool in the arsenal to fight climate change – used the word as de-facto “global warming”. The scientists detailed how they used computational models to develop this material in a newly published paper in the journal Nature Synthesis, arguing that certain features of the structure could make it excellent storage for carbon dioxide and sulphur hexafluoride, another powerful greenhouse gas. "This is an exciting discovery because we need new porous materials to help solve society's biggest challenges," engineering Professor Marc Little from Edinburgh's Heriot-Watt University said in a statement about the research. The new material, which acts like a cage made up of smaller molecules, is an organic super molecule made from oxygen, nitrogen and fluorine. "Planting trees is a very effective way to absorb carbon, but it’s very slow," said Little. "So we need a human intervention — like human-made molecules — to capture greenhouse gases efficiently from the environment more quickly."

Sources of non-greenhouse components

Reports state that “Air pollution, in the form of aerosols, affects the climate on a large scale. The aerosols scatter and absorb the solar radiation. From 1961 to 1990, a gradual reduction in the amount of sunlight reaching the Earth’s surface was observed. This phenomenon is popularly known as global dimming and is primarily attributed to sulfate aerosols produced by the combustion of fossil fuels with heavy sulfur concentrations, such as coal and bunker fuel. However, these were there in the past also, and this is not a new phenomena”. This is the antithesis of what is presented above para.

Reports also state that “The smaller contributions come from black carbon, organic carbon from the combustion of fossil fuels and biofuels, and from anthropogenic dust. Globally, aerosols have been declining since 1990 due to pollution controls, meaning that they no longer mask greenhouse gas warming as much. This is not true; national and international reports tell the otherway. Delhi [a polluted city] presents the highest pollution. The aerosols also have indirect effects on the Earth’s energy budget. The sulfate aerosols act as the cloud condensation nuclei and lead to clouds that have more and smaller cloud droplets. These clouds reflect solar radiation more efficiently than clouds with fewer and larger droplets.[9] They also reduce

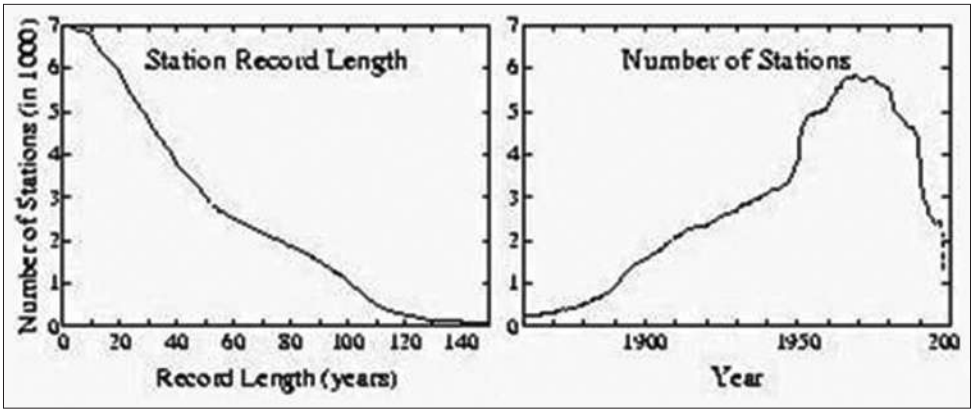

Figure 7: The accuracy of the temperature anomaly primarily relates to met data network (the ocean data scenario is very poor)

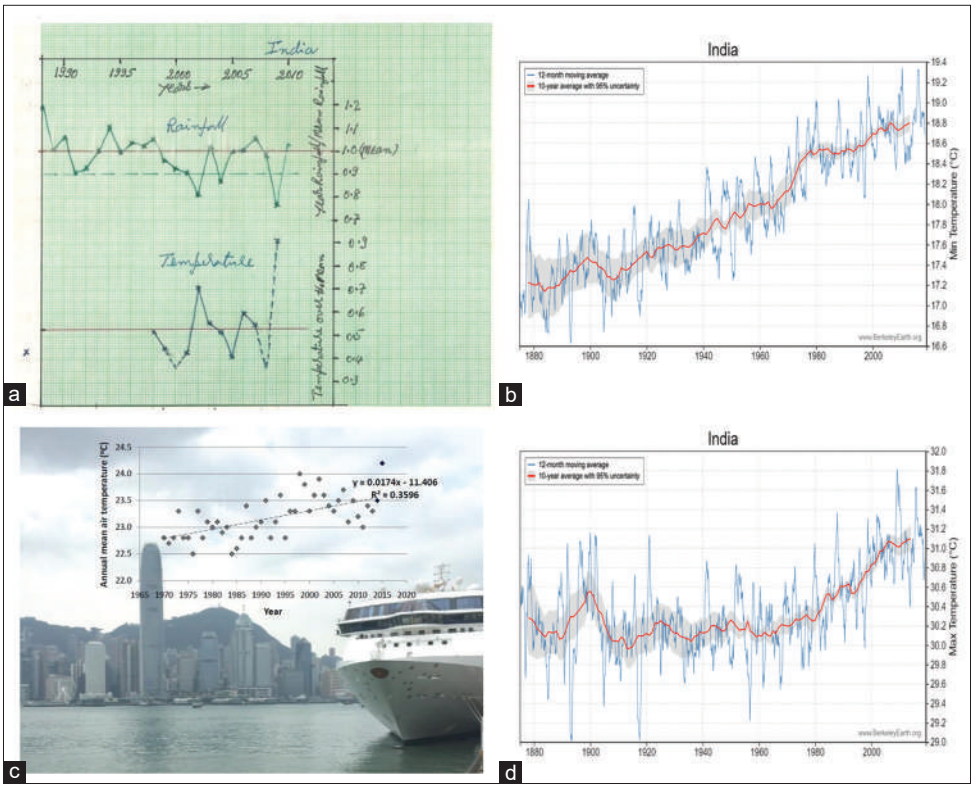

Figure 8: (a) Indian annual average maximum temperature. (b) India: Annual precipitation versus annual temperature. (c) Indian annual average minimum temperature. (d) Presents the Urban-heat-island-effect for Hong Kong-a linear increase with considerable year to year variations

the growth of raindrops, which makes the clouds more reflective of incoming sunlight. The indirect effects of the aerosols are the largest uncertainty in the radiative forcing. While the aerosols typically limit global warming by reflecting sunlight, the black carbon in soot that falls on the snow or ice can contribute to global warming. Not only does this increase the absorption of sunlight, it also increases the melting and sea-level rise. Limiting the new black carbon deposits in the Arctic could reduce global warming by 0.2°C by 2050. The effect of decreasing the sulfur content of fuel oil for the ships since 2020 is estimated to cause an additional 0.05°C increase in the global mean temperature by 2050".

The urban heat island effect and the rural cold island effect, respectively, are heating and cooling factors. Figure 9d presents the urban heat island effect for Hong Kong. The rural cold island effect is associated with agriculture and water [irrigation] resources.

Solar component

As the Sun is the Earth's primary energy source, changes in incoming sunlight directly affect the climate system [Figure 3]. Solar irradiance has been measured directly by satellites, and indirect measurements are available from the early 1600s onward. Since 1880, there has been no upward trend in the amount of the sun's energy reaching the Earth [reaching to the top of the atmosphere[10] [Figure 2], but this is influenced by the sunspot cycle of 11 (10.5 ± 0.5) years, in contrast to the warming of the lower atmosphere (the troposhere).

Volcanic erruptions

Volcanic Eruptions: Explosive volcanic eruptions can release gases, dust, and ash that partially block the sunlight and reduce the temperatures, or they can send the water vapor into the atmosphere, which adds to the greenhouse gases and increases the temperatures. These impacts on the temperature only last for several years because both the water vapor and the volcanic material have low persistence in the atmosphere. The volcanic CO_2 emissions are more persistent, but they are equivalent to <1% of current human-caused CO_2 emissions. They may be less, but the impact on temperature is more important. The volcanic activity still represents the single largest natural impact (forcing) on the temperature in the industrial era; it is not only the factor, but the Sahara Dust Cloud and Thar Desert Dust Clouds, etc. do contribute to a reduction in the incoming and outgoing solar and net radiation intensities.

Importance of Meteorological Data Networks

The accuracy of meteorological data primarily relates to the spread of meteorological stations in both space and time; however, the ocean data scenario is very sparse or poor. Figure 7 presents the meteorological network for the USA: (1) meteorological stations and record lengths in years; and (2) change in the number of stations with time. Here the important point is that with satellite data measurements, meteorological stations started decreasing in number. This clearly shows that the length and number of stations are biased. Furthermore, until1950, the number of stations and the number of years were short, and here the global warming group was manipulated by bringing down the temperature during this period and showing a steep rise in the global temperature trend. Maybe because of this, the IPCC used 1951 as the starting year for global warming.

Definitions of Climate Change

WMO[11] brought out a manual titled "Climate Change". This was prepared by eminent meteorologists from different national meteorological services. They presented methods to separate long-term systematic variations from trends (if any). Later, the IPCC and the United Nations Framework Convention on Climate Change (UNFCCC) of United Nations organizations presented the following definitions:

1. IPCC-AR3 refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period [typically decades or longer]; change may be due to the natural internal processes, or the external forcings, the persistent anthropogenic changes in the composition of the atmosphere or the land use"
2. UNFCCC Article 1: A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over a comparable time period"
3. IPCC-AR5: It is extremely likely that more than half of the observed increase in global average surface temperature was caused by the anthropogenic increase in greenhouse gas concentrations and other anthropogenic forcings together. All this means that around 50% of the trend in global average temperature starting in 1951 is termed global warming. <50% is the component of land use and land cover components. From these definitions, climate change and global warming are presented as follows:
    - Natural variability (applicable to rainfall and temperature)
        - Irregular variations-inter-annual and intra-seasonal variations
        - Systematic variations, rhythmic

variations, or cyclic variations
- Human-induced variations (applicable for temperature)
  - Greenhouse effect component: more than half of the trend as per IPCC
    - Anthropogenic greenhouse gas effect (global warming)
    - Aerosol effects (volcanoes, dust storms, etc.)
  - Non-greenhouse effect component: ecological changes (land use and land cover changes)-less than half of the trend as per the IPCC
    - Urban-Heat-Island Effect-warming effect
    - Rural-Cold-Island Effect-cooling effect.

Reddy[1] presented the basic issues of climate change and global warming. According to United Nations entities, climate change has not one, but several definitions. In fact, they are nothing new from what has been presented in the WMO[11] "Climate Change" manual, but they have made some twists to create confusion. These are presented above.

The UNFCCC makes a distinction between "climate change" attributable to human activities altering the atmospheric composition and "climate variability" attributable to natural causes under external forcings. In its first definition, the IPCC differentiated between anthropogenic changes in the composition of the atmosphere and land use. In the second IPCC, it is human activity that alters the composition of the global atmosphere.

In the first definition, they used simply "atmosphere", and in the second, they used "global atmosphere". In the first, they referred to "Land use", and this was differentiated from anthopogenic (meaning new additions of greenhouse gases)". In the second, they used "human activity", but before it, they used "indirectly or directly", which may be to differentiate the greenhouse gases from the land use. All these were clearly defined by the WMO in 1966. Furthermore, regional circulation patterns over different seasons play a key role in year-to-year variations in extremes under natural variability. For example, western disturbances [Figure 9a] in the nort-west parts of India[2] will influence heat and cold waves in the summer and winter based on the high-pressure belt location around Nagpur [Figure 9a]. In the case of the northern parts of the USA and Canada, the circumpolar vortex plays an important role [Figure 9b]. Like Western disturbances in India that cause heat waves and cold waves under the circumpolar vortex that create the warm and cold effects.

The Indian prime minister released a note saying that the current floods in India are due to global warming. I sent my response, saying that it is not correct. Floods and droughts are part of the natural, systematic variations in precipitation. Human greed is the main cause of flood disasters in India.

Physical Drivers of Climate Change

The physical drivers of climate change: They present the carbon dioxide emissions by source since 1880. Carbon dioxide recording on a systematic basis started in 1960. Here, it is pertinent to note that human-released

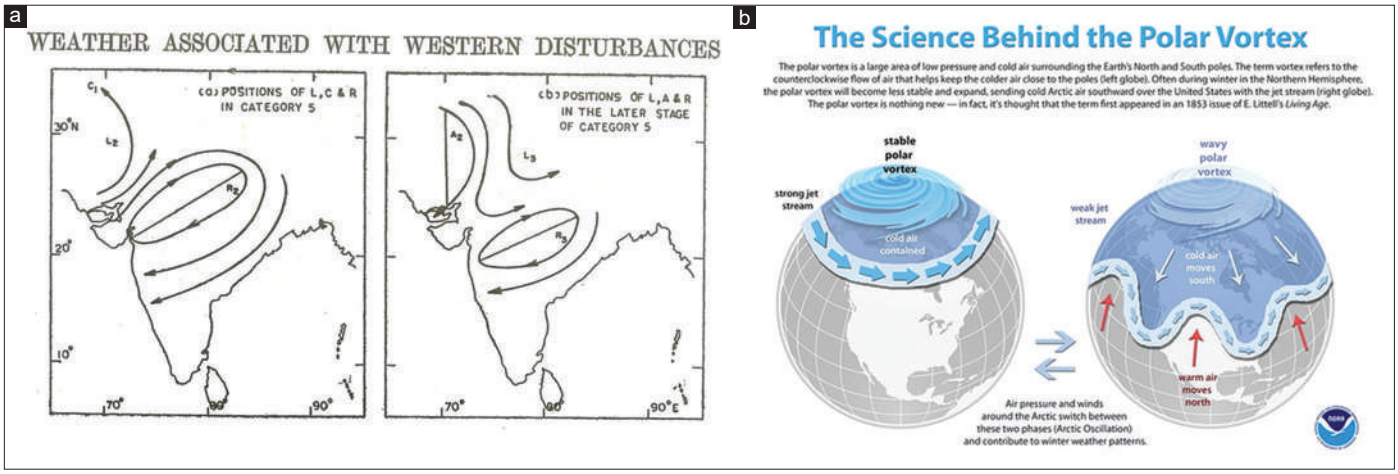

Figure 9: (a) Weather associated with western disturbances in the northwest India. (b) Circum polar vortex.

carbon dioxide contributes around 96% of the total carbon dioxide in the atmosphere; this part is not taken into account, which is not a greenhouse gas in the true sense. Carbon dioxide (CO_2) from fossil fuel use and industry is the single largest contributor to total emissions at 64%, while CO_2 from land use change and forestry accounts for 11% and methane (CH_4) contributes 18%. Source: IPCC Working G*roup* III, 2022. The land surface area (global tree cover: annual loss of carbon dioxide [CO_2])) is the most commonly addressed greenhouse gas, and its atmospheric concentration is measured in ppm. Methane (CH_4) and nitrous oxide (N_2O) are not extraordinarily important for the global climate and are measured by ppb. Carbon dioxide has more than 1000 years of life in the atmosphere, but methane and nitrous oxide have <40 years of life only, which means their contribution is negligible.

Carbon dioxide: 418.81 ppm = 150% of pre-industrial levels

Methane: 1889 ± 2 ppb = 262% of pre-industrial levels

Nitrous oxide: 333.2 ± 0.1 ppb = 123% of pre-industrial levels.

Thus, the main greenhouse gas is carbon dioxide, but only 4% of the carbon dioxide present in the atmosphere plays a role in global warming computations, and the rest, 96%, is released by humans and has no impact on global warming.

Let me present a few facts that are influenced by global warming: There are several local and regional causes for the ice melt, such as smoke from religious sites and physical impacts that cause the melting or destruction of ice: sports, pilgrimage, deforestation with the increased population growth, infrastructure development, mountaineering, etc. In the Arctic and Antarcitica zones, in addition, there are several other activities like drilling for gas and oil, earthquakes, and volcanic activities that affect ice melting or ice destruction. IPCC and Al Gore shared the Nobel Prize for predicting that the Himalayan Glaciers will melt by 2035 and the Arctic will be ice-free in 5 years, but after receiving the award, they withdrew their assertions and expressed regrets for such reports but did not return the award money.

NATURAL VARIATIONS AND TRENDS SCENARIO

Global Temperature

Figure 5a presents the adjusted global average annual temperature anomaly time series of 1880–2010. The Ocean covers three-quarters of the global and the land surface area covering one-quarter only. The natural variability part of the global average annual temperature, which includes both the ocean and the land surface air temperature, presented a 60-year cycle varying between −0.3 and +0.3°C (cycle amplitude = 0.6°C). The trend presented 0.6°C/century. More than half is the greenhouse effect part, and this major component is global warming, starting in 1951. If we take it as 50% of the total trend, then global warming is 0.45°C for 150 years (1951–2100) and the trend for 1850–2100 is 1.34°C, and thus the global warming for 1951–2100 is 0.40°C. Less than half is the non-greenhouse effect–land use and land cover changes. The inflection point year is 1985; the inflection point refers to the change from below the average to above the average.

- Adjusted global average annual temperature time series of 1880 to 2010
- The natural variability presented in the 60-year cycle varied between −0.3 and +0.3°C; that is, the amplitude is 0.6°C
- Trend presented: 0.6°C/century
- More than half of the trend is the greenhouse effect part
    - This major component is global warming, starting from 1951
    - If we take it as 50% of the total trend, then global warming is 0.45°C for 1951–2100
- Less than half is the non-greenhouse effect due to land use and land cover changes, which is <0.45°C for 1951–2100

Figure 5b presents the adjusted USA temperature anomaly and the un-adjusted (raw data) temperature anomaly. With the raw data (unadjusted), no trend is observed, but the adjusted data presents a trend. They followed a 60-year cycle similar to the global annual average temperature anomaly.

Figure 5c presents[5] the global average annual temperature series (in red color) and superposed on this the satellite data series (in green color) taken from the internet (bottom figure). This satellite data series were later withdrawn from the internet, and it was replaced with adjusted data series that matches

with the adjusted surface measured data series. With the original satellite data, the surface data series well matched [Figure 5c], showing no trend from the year 1945 onward. Before the year 1945, the temperature series was low. The data series from 1880 to 1920 presented no trend, but from 1920 to 1945 it presented an increasing trend. The question arises: can we consider this as global warming? However, the pattern seen from 1880 to 1945 was repeated from 1945 to 2000. With the satellite data [Figure 5c], there is no trend (1951 onward) and thus zero global warming.

Reddy[5,6] presented the annual march of hemispheric average surface temperature for 1860 to 2000 [Figure 5d]. From 1950 to 2000 (1951 is the starting year of global warming as per the IPCC), the Southern Hemisphere temperature march showed lower than that of the Northern Hemisphere temperature march after 1951. That means the global annual average temperature, particularly, presents hemispheric differences. The average of that is the global average pattern [Figure 5d].

The global warming component of the global average annual data series is presented at 0.45/0.40°C (it represents the average of the Northern and Southern Hemispheres), and the same is true for the Southern Hemisphere, which is presented lower than the sea surface annual average temperature, which presents zero global warming, and the surface air temperature, the global warming is 0.313°C. That means the global warming component of the Southern Hemisphere is far lower than that of the Northern Hemisphere. This is also seen in Figure 5d. Figure 5e presents[5] the global warming trend as projected by different models (CCSR/NIES, CCCma, CSIRO, Hardley Centre, GFDL, MPIM, NCAR PCM, and NCAR CSM) and shows large differences. Eight models predicted temperature patterns from 1850 to 2100. These models can be grouped into four, with the predicted temperature in 2100 reaching as high as 2.5, 3.0, 4.0, and 4.9°C. This shows there is no clarity on the global warming policy or theory except following the trail and error mode. These show that there is no change up to 1950, whereas Figure 5e presents no change up to 1950, but Figure 5d presents change**.** All eight models predicted far away from the observed patterns. That means models have missed something.

Important issues

All the carbon dioxide in the atmosphere is not a greenhouse gas. Major part of the carbon dioxide in the atmosphere is human-released part (humans inhale the air, use oxygen, and release the carbon dioxide), which does not comes under greenhouse gases. Because of this, so far groups talking about global warming have not come up with the right value for CSF. I tried to achieve some solution, which is presented in Figure 6c. Figure 6a presents the carbon dioxide increase with time, though instrumental measurements started around 1960. Figure 6b presents a linear increase between population growth and the increase in carbon dioxide.

To get a glimpse of that future, scientists run experiments using computer models that simulate the Earth's climate. The IPCC uses a set of scenarios to try to understand what the future might look like. All the climate models work a little differently and

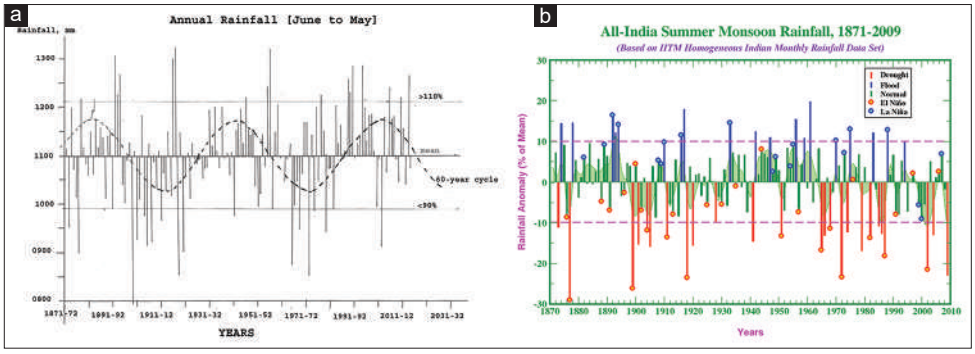

Figure 10: (a) All-India average annual Rainfall (June–May) 60 year cycle: 2 cycles completed-vetical lines observed average yearly rainfall and dotted predicted 60-year cycle. (b) During below the average 30-year period cycle (1897–1926; 1957–1986)-El Nino presents drought conditions and similar pattern with La Nina and floods is not seen

create different results. These clearly tell us one simple fact: they don't have a defined CSF**.** It is pertinent to note that climate change is not static but it is dynamic. Here, we must remember one important factor, namely in the greenhouse gas only the carbon dioxide released by human action is part of greenhouse gases (a small part of the total carbon dioxide in the atmosphere) excluding human-released carbon dioxide (a major part of the carbon dioxide in the atmosphere).

Indian Temperature

In the case of the Indian temperature data series, the maximum temperature [Figure 8a] presented depression during 1931–1960. The depression is associated with the rainfall cycle of 60 years [Figure 10], where in 1931–1960 was above the average rainfall cycle. Figure 8b presents the variation of Indian annual average rainfall (top) with Indian average annual temperature (bottom), wherein 2002–2009 are drought years with increased mean temperature. In the case of Indian temperature data, the annual average minimum temperature [Figure 8c] presented a linear increasing pattern due to the urban heat island effect (see, for example, Hong Kong urban heat island effect pattern [Figure 8d].

Australian Temperature

Different regions of the world warm at different rates. It is also different between the hemispheres. The Northern Hemisphere and the North Pole have warmed much faster than the South Pole and the Southern Hemisphere. This is basically because there is more land area and less ocean area in the Northern Hemisphere and less land area and more ocean area in the Southern Hemisphere.[5,6] The oceans and their marginal seas cover nearly three-quarters [70.8%] of the Earth's surface, and the

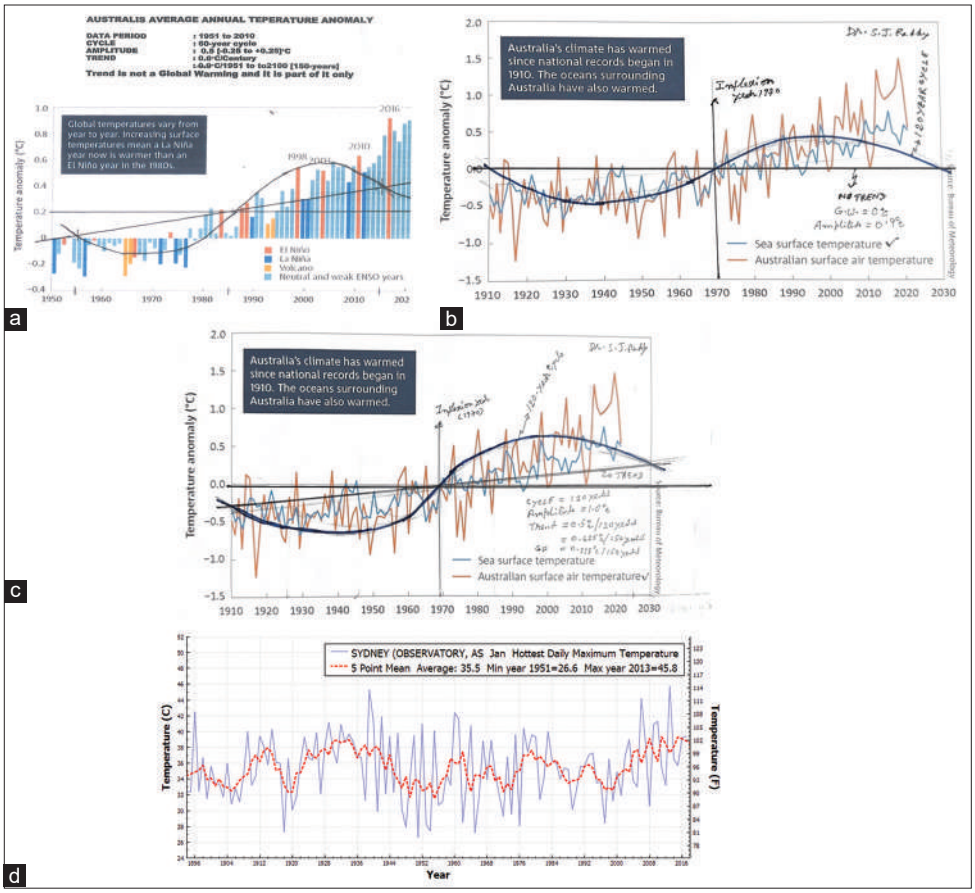

Figure 11: (a) Presents Australia annual average temperature anomaly data for 1950–2020 presenting 60-year cycle with the inflexion point year as 1985. (b) Presented Australia's average annual sea surface temperature anomaly – the curve is of 120-year cycle. (c) Presented Australia's average annual surface air temperature anomaly. (d) Sydney (observatory) hottest daily maximum temperature and 5 point mean average 35.5°C; min year 1951 = 26.6°C; max year 2013 = 45.8°C

exposed land occupies the remaining one-quarter (29.2%).

Figure 11a presents Australia's average annual surface air temperature anomaly data for the 1950–2020 presented 60-year cycle, and the inflexion point year is 1985. Here, the data arefor 75 years only. This presented 60-year cycle varied between −0.30 and +0.30 (cycle amplitude is 0.6°C) and trend of 0.6°C/century and 0.45°C for 1951–2100 (150 years) as the global warming component. This figure includes events such as El Nino, La Nina, Nuetral and weak ENSO years, and Valcano years. The temperatures varied from year to year. Increasing surface temperatures are seen even in La Nina year, which are warmer than El Nino years. In the 1980s, 1998, 2003, 2010, and 2016 presented higher temperatures during El Nino years.

Figure 11b and c present a Bureau of Meteorology graph demonstrating how Australia's climate has warmed since national records began in 1910. Figure 11b and c present the inflection year as 1970. In Figure 11b and c, the average annual sea surface and surface air temperature presented 120-year cycles. The parameters for sea surface and surface air temperature patterns for inflection years are 1970, and respectively, the cycle amplitudes are 1.00 (−0.5–+0.5)°C and 0.90 (−0.45–+0.45)°C. In the case of Australia, the sea surface temperature presented a 120-year cycle [Figure 11b] with no trend, and the surface air temperature presented [Figure 11c] a 120 year cycle with a trend of 0.63°C. Here, 50% of it is global warming, that is, 0.313°C for 1951–2100. This is lower than the global average temperature of 0.45°C. That means the global warming trend for the Northern Hemisphere is more than the global warming trend, which is >0.45°C.

The Sydney's hottest daily maximum temperature is for 1894 to 2018. This showed 3.6oC trend for 120 years, i.e. 3.0oC per century with the mean temperature of 35.5oC. The trend for 1951 to 2100 is 4.5oC and thus global warming for 1951 to 2100 it is 2.25oC which is 0.65% of the mean temperature. The amplitude presents -3.5 to +0.3.5oC [7.0 oC], which is 2.0% of the mean.

The present 120 year cycle with 1944-2004 forms below the average part of the cycle and above the average part of the 60-year is seen before 1944 and after 2004. That is the 120-year cycle presented opposite to Australia's average annual surface air temperature and average annual sea surface temperature [Figures 10b & c]; i.e., instead of below the average followed above the average the Sydney's temperature showed above the average followed by below the average pattern – see Figure 10d.

FEW OTHER ISSUES

Himalayan Glaciers

In 2014, a study of 2181 Himalayan glaciers from 2000 to 2011 showed that 86.6% of the glaciers were not receding (this was also informed to the Indian Parliament by the minister of forests and Environment and Climate Change after his return from the Paris meet in December 2015).[1] Subsequently, received heavy snowfall in the Himalayan zones. The Geological Survey of India is monitoring a few important glaciers in the Himalayan region. The Gongotri, one of them, feeds the main river Ganga. Due to the formation of a fault zone, the ice started receding, and now it started recovering. The IPCC predict that Himalayan glaciers will melt by 2035. With our counter on this, the IPCC withdrew this conclusion, regretting for the same. They announced this only after receiving Nobel Prize money.

Arctic Sea Ice Extent

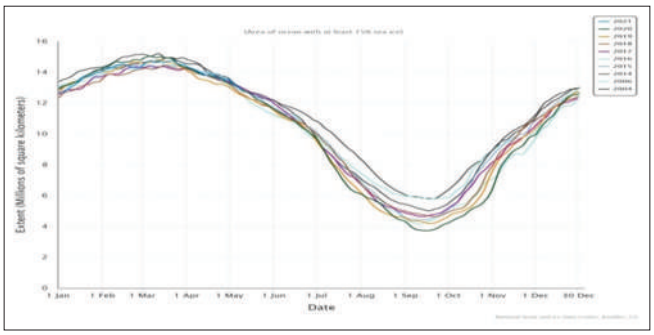

Figure 12: Seasonal march of "Arctic Sea Ice Extent" in millions of sq. km

Table 1: The relative sea level trends

Region	Range in mm/year	
	The lowest	The highest
Tropical and gulf of Mexico	1.5	6.0
North Pacific	2.5	−11.0
North Atlantic	1.0	6.0

Figure 13: Volcanic eruption with dust cloud

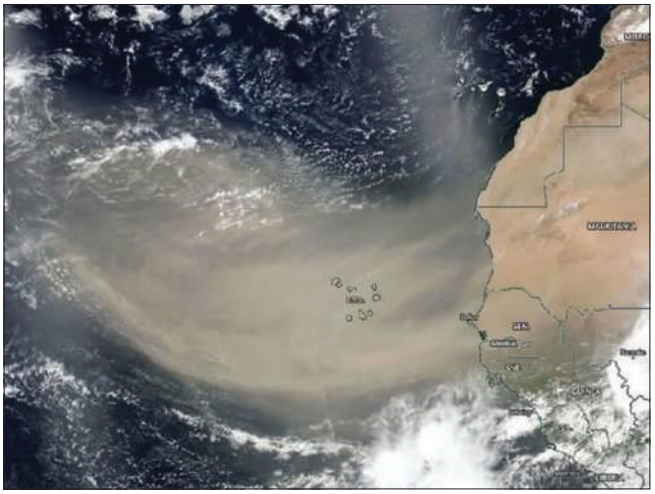

Figure 14: NASA-NOAA satellite captures Saharan dust cloud 6/2020: NASA Worldview

Figure 12 presents the seasonal march of "Arctic Sea Ice Extent" in millions of square kilometers. A minimum was observed between September and October, a maximum was observed in around March, and there was no significant change in the Aractic Sea Ice extent in around May. That means minimum and maximum pass through no significant change point in around May. Al Ggore, who jointly received the Nobel Prize with the IPCC, withdrew his conclusion, saying that the Arctic will be Ice-free in 5 years. He withdrew only after receiving Nobel Prize money.

Relative Sea Level Trends

Table 1 presents the relative sea level trends: "In the Tropical and the Gulf of Mexico, presented variations between 1.5 and 6.0 mm/year; the North Pacific 2.5–−11.0 mm/year; and the North Atlantic

Table 2: Southern oscillation versus Indian south-west monsoon rainfall (1880–2006)

SO	Number of years					
Events	D	BN	N	AN	E	Total
El Nino	7	5	5	0	1	18
Neutral	14	13	37	14	6	84
La Nina	0	0	7	7	10	24
Total	21	18	49	21	17	126

D: Deficit, BN: Below normal, N: Normal, AN: Above normal E: Excess rainfall years

1.0–6.0 mm/year". That means the North Pacific showed a fall in sea level. Are these differences due to elevation differences in coastal land? Probably may so! The important question is whether the changes in sea surface temperature cause sea level changes? The australian sea surface temperature presented 120 cycles with an amplitude of 0.63°C.

Average sea levels have risen worldwide due to global warming, according to research. A satellite image time lapse of one city's coastline is not enough to determine whether or not sea level rise has occurred, experts said. Multiple lines of evidence, including sea level rise, show that Earth's climate is changing. Sea level change cannot be diagnosed through satellite images of one beach.

Global warming results in sea level rise because water expands as it warms and melting ice sheets and glaciers increase the amount of water in ocean basins. Tide gauge and satellite data show that average global sea levels have risen 8 to 9 inches since 1880, according to the National Oceanic and Atmospheric Administration.

"It's close to a fool's errand to try to identify sea-level change from landscape-level imagery because sea-level change is just one input into landscape change," he said. "Beaches erode and are replenished from sediment supply all the time. Sea-level rise increases erosion, but if the sediment supply keeps pace, you can still get a steady state profile. It's the balance between the two that matters."

Here two issues one must see whether the global average global warming impacts localised patterns? Was there global warming since 1880 [IPCC reported the start of global warming is 1951]. Ocean/sea temperature presents the natural cyclic pattern – in Australian sea surface temperature hasn't showed any trend but presented 120 year cyclic pattern. Climate change is not global warming. The natural variability in rainfall showed different cyclic

patterns over different parts of the globe.

Vertical land motion − land rising or sinking due to geological factors or human behaviour − is yet another reason that images from one beach are inadequate to assess the existence of sea level rise. If land is rising in an area, local sea levels can be falling relative to the land, even while the global average is increasing. "Sea level rise is also not uniform everywhere because of wind and ocean current patterns," Chambers said. "Sea level along the east coast of the United States is rising a little faster than along the west coast for this reason." Tulum doesn't have a tide gauge station, Chambers said. But the closest stations in Progresso, Mexico, and Cape San Antonio, Cuba, have both measured steady sea level rise. Global sea level rise is only one symptom of climate change. Rather than drawing conclusions from images of one stretch of coastline, scientists have determined that Earth's climate is changing by analysing multiple lines of evidence. For instance, in addition to documenting global sea level rise, multiple climate agencies have detected a long-term rise in global temperatures.

Volcanic Aerosols and the Sahara Dust Cloud

Figure 13 presents the volcanic eruption and associated dust cloud, and Figure 14 presents the NASA-NOAA satellite that captures the Saharan dust cloud on 6/2020, reaching the USA: (NASA Worldview). They have an impact on the weather, particularly relative humidity and temperature.

Natural Variability in Solar Radiation and Rainfall

Natural variability in rainfall

The natural variability in rainfall (including dates of onset of the southwest monsoon over Kerala, India) studied for different countries, namely[12]— onset dates of the southwest monsoon over Kerala, India[13] Botswana rainfall[14], north-east Brazil[15], Mozambique, South Africa, Zimbabwe, Malawi[16], Ethiopia[1,9,3,17-21], and India.[21]

Figure 10a presents the natural variability in the all-India average annual rainfall data series (1871–1872 to 2014–2015–144 years).[21] The inflection year is 1985 only and presents a 60-year cycle. Two cycles have been completed, and the third cycle commensed (1987–1988 to 2016/17) and completed the above-average part of 30 years and started below-average part of 30 years (2017–2018 to 2046–2047).

Figure 10b presents the relationship of rainfall with ENSO factors, which is very important for agriculture planning as well as water resource planning. Table 2 presents 126 years of data under different categories: deficit, below normal, normal, above normal, and excess. The last part of the rainfall is doubtful in nature.

Solar and Net Radiation intensities[4,9,10,22]

The data were estimated using empirical formulas for 20 stations in the case of solar radiation intensity and 8 stations for the net radiation intensity. These were subjected to get the probable cycles.[22] The cycle present in the majority of the stations is a 10.5 ± 0.5[17] year cycle, which is termed as sunspot cycle. This cyclic variation influences the radiation reaching from the sun and the net radiation leaving from the earth's surface. This will influence the temperature at the surface.

CONCLUDING REMARKS

The climate is what you expect, and the weather is what you get. The climate patterns emerge from the long-term weather data. WMOs, national governments, foreign rulers (particularly Britishers), and other scientific organizations have established networks of weather-observing stations across the countries. With the commencement of satellite data affected on the surface observational networks, that has drastically come down since around 1970 in the USA. These changes severely influence annual averages, particularly temperatures.

The oceans and their marginal seas cover nearly three-quarters (70.8%) of the Earth's surface, and the exposed land occupies the remaining one-quarter (29.2%); that is, three-quarters are occupied by the oceans and one quarter by exposed land surface.

Because of this, different regions of the world warm at different rates. It is different between the hemispheres. The Northern Hemisphere and the North Pole warm much faster than the South Pole and Southern Hemisphere. This is basically because there is more land area and less ocean area in the

Northern Hemisphere and less land area and more ocean area in the Southern Hemisphere.[5,6]

Climate change describes a change around the average conditions. Global climate change refers to the average of long-term changes over the entire Earth. The Earth's climate has constantly been changing-even long before humans came into the picture. However, rainfall doesn't fit into this as it follows local, regional, and national-level changes in terms of land-to-sea factors, but the temperature in addition presents changes at the global level as well.

The raw data series of USA temperature showed no global warming trend, but the adjusted data series do show the global warming trend, basically because of bringing down the initial period temperature adjustment.

Climate change refers to significant changes in the measures of climate for the extended periods of time, usually over decades or longer. This includes major, long-term changes in the temperature, the precipitation, the ocean heat, the sea level, the sea ice extent, etc., and how these changes affect life on the Earth is a big question. To achieve this, we need to have unbiased estimates. Climate change results from both human activities and natural causes. This was discussed.

SUMMARY AND CONCLUSIONS

It is common practice to use climate to refer to the weather and climate change to refer to global warming. However, they are highly variable in meteorological terms. The weather describes the conditions outside right now in a specific place. The climate, on the other hand, describes the weather conditions that are expected in a place or region at a particular time of the year: it is usually rainy or usually dry; it is typically hot or typically cold, etc. A region's climate is determined by observing its weather over a period of many years-generally 30 years or more. Climate normal is different from the average climate, as the former is for 30 specified years like 1931–1960, 1961–1990, etc. Climate change describes a change around the average condition. Global climate change refers to the average of long-term changes over the entire Earth, at a place, at a region level, or at a country level. However, rainfall does not fit in this as it follows local, regional, and national levels only and not at the global level, but temperature in addition used at the global level. By linking the natural variability with ENSO, one gets a better forecast.

This article, in brief, presented the mutual interactions between the weather and the climate and global warming and climate change. The entire issue runs around there is an increasing greenhouse gases, more particularly carbon dioxide, as global warming takes place. In fact, a major part of the carbon dioxide is human-released, but it doesn't come under greenhouse gases. In the modeling to infer global warming, this fact is not taken into account. It is argued that the carbon dioxide that comes under the greenhouse gas component contributes to the rise in temperature. However, since 2000, they have struggled to get a scientifically defined value for "CSF" that defines the link between the greenhouse gases, the entire carbon dioxide, and the temperature. Because of this, modelers could not achieve the same results. As a result, they are simply following a "trial and error" approach with no real solution. Here, the natural variability in the temperature and the rainfall was not attempted. These are very important components in weather forecasting, long-term agriculture planning, and water resource management.

Global warming is one aspect of climate change. Climate change and global warming are often used interchangeably to mislead with their ignorance. To scientists, there is, but in general, the everyday conversation, people use both interchangeably. Even scientists and scientific organizations, the media, common men, including UN bodies, are using the word "climate change" invariably in place of the word "global warming."

The precipitation data series present the natural variability; for example, the All-India annual average precipitation/rainfall data series presented a 60-year cycle [systematic variation], and it has no trend. While the global average annual temperature also presented a 60-year cycle with a trend of 0.6°C/century. This consists of the global warming component (assumed to be 50% of the trend of 0.3°C/century) and the impact of other components such as aerosols from volcanoes, dust from the Sahara Desert or other deserts, etc. These

come under the greenhouse effect. By assuming that the global warming part is 50% of the trend, the global warming for 1951-2100 is 0.45°C. 1951 is the starting year of global warming as defined by the IPCC.

The non-greehouse effect consists of changes in land use and land cover that consists of the urban-heat-island effect, that is warming and the rural Cold-islan-effect, that is cooling effect. This component is less than half of the trend. This is highly variable country to country, state to state, region to region, and location to location based on rural cold-island effects, such as agricultural activity, and irrigation activity; urban heat island effects include growth in urban areas, construction activity, destruction of water bodies, air pollution, etc.

The rainfall presented different natural variabilities with country and station level; for example, Fortaleza in north-east Brazil presented a 52-year cycle, Beira in Mozambique presented 54 and 18-year cycles that include Zimbbwe stations, Mahalypye in Botswana presented a 60-year cycle, in Malawi and a few stations in Mozambique presented a 40-year cycle, in Ethiopia the prominent cycles are 28 and 36 years, and Durban in South Africa presented 66 and 22 year cycles.

Indian annual average rainfall presented a 60-year cycle (here the southwest monsoon rainfall received 78% of the annual rainfall and thus followed the annual rainfall cycle only), but Andhra Pradesh, before the bifurcation, presented a 132-year cycle as it receives rainfall during both the monsoons, namely the southwest and the northeast. The southwest and northeast monsoons rainfall presented a 56-year cycle, but in the opposite way. The number of cyclones per year in the Bay of Bengal presented the 56-year cycle pattern of the southwest monsoon of coastal Andhra.

The coldwaves and heat waves in India are presented by Western Disturbances and in the USA; it is by Circum Polar Vortex.

The temperature patterns presented hemispherical differences, wherein the Southern Hemisphere presented a lower global warming component than the Northern Hemisphere component. Furthermore, the same is seen in the annual average march of temperature. The sea surface temperature in Australia presented zero global warming, and the surface air temperature presented 0.313°C of global warming component. The same for the globe is 0.45/0.40°C, which is an average of the Northern and Southern Hemispheres. That means the global warming component of the Northern Hemisphere is more than 0.45/0.40°C.

The Sydney's temperature presented 120 year cycly similar to the temperature of surface air & ocean surface but in opposite phase.

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