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CLIMATE CHANGE WITH SPECIAL REFERENCE TO RISK FACING SMALL ISLAND STATES

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Abstract*—Climate change is the burning issue of the current era. Because of the advancement in the technology and accelerated use of fuels have lead to the increasing concentration of the Greenhouse gases. Greenhouse gases affect the climate system very badly. The Climate of the Earth varies naturally because of a variety of cosmological and geological processes but Climate change refers to an additional and relatively rapid change induced by human actions. The average temperature of the Earth is increasing very rapidly over the past 30 years and because of that the snow is melting on the glaciers and the sea water level is increasing gradually rapidly and as a result of that many temperature sensitive systems / processes have been disturbed and changed over the past two decades. The additional change of several degree centigrade (^{o}C) with in a century will disrupt the foundations of life on Earth.

Keywords-solar output; glaciers; kilimanjaro; rise of sea water level

I. INTRODUCTION

Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). Climate change may be limited to a specific region, or may occur across the whole Earth. It can be caused by recurring, often cyclical climate patterns such as El Niño-Southern Oscillation, or come in the form of more singular events such as the Dust Bowl.

In recent usage, especially in the context of environmental policy, climate change usually refers to changes in modern climate. It may be qualified as anthropogenic climate change, more generally known as "global warming" or "anthropogenic global warming" (AGW).

II. SOLAR OUTPUT

The sun is the predominant source for energy input to the Earth. Both long- and short-term variations in solar intensity are known to affect global climate.

Early in Earth's history the sun emitted only 70% as much power as it does today. With the same atmospheric composition as exists today, liquid water should not have existed on Earth. However, there is evidence for the presence of water on the early Earth, in the Hadean and Archean eons, leading to what is known as the faint young sun paradox. Hypothesized solutions to this paradox include a vastly different atmosphere, with much higher concentrations of greenhouse gases than currently exist Over the following approximately 4 billion years, the energy output of the sun increased and atmospheric composition changed, with the oxygenation of the atmosphere being the most notable alteration. The luminosity of the sun will continue to increase as it follows the main sequence. These changes in luminosity, and the sun's ultimate death as it becomes a red giant and then a white dwarf, will have large effects on climate, with the red giant phase possibly ending life on Earth.

Solar output also varies on shorter time scales, including the 11-year solar cycle and longer-term modulations. The 11-year sunspot cycle produces low-latitude warming and high-latitude cooling over limited areas of statistical significance in the stratosphere with an amplitude of approximately 1.5°C. But although "variability associated with the 11-yr solar cycle has a significant influence on stratospheric temperatures. ...there is still no consensus on the exact magnitude and spatial structure". These stratospheric variations are consistent with the idea that excess equatorial heating can drive thermal winds. In the near-surface troposphere, there is only a small change in temperature (on the order of a tenth of a degree, and only statistically significant in limited areas underneath the peaks in stratospheric zonal wind speed) due to the 11-year solar cycle. Solar intensity variations are considered to have been influential in triggering the Little Ice Age, and for some of the warming observed from 1900 to 1950. The cyclical nature of the sun's energy output is not yet fully understood; it differs from the very slow change that is happening within the sun as it ages and evolves, with some studies pointing toward solar radiation increases from cyclical sunspot activity affecting global warming.

III. GLACIERS

Glaciers are considered among the most sensitive indicators of climate change, advancing when climate cools (for example, during the period known as the Little Ice Age) and retreating when climate warms. Glaciers grow and shrink, both contributing to natural variability and amplifying externally forced changes. A world glacier inventory has been compiled since the 1970s. Initially based mainly on aerial photographs and maps, this

compilation has resulted in a detailed inventory of more than 100,000 glaciers covering a total area of approximately 240,000 km^2 and, in preliminary estimates, for the recording of the remaining ice cover estimated to be around 445,000 km^2. The World Glacier Monitoring Service collects data annually on glacier retreat and glacier mass balance From this data, glaciers worldwide have been found to be shrinking significantly, with strong glacier retreats in the 1940s, stable or growing conditions during the 1920s and 1970s, and again retreating from the mid 1980s to present. Mass balance data indicate 17 consecutive years of negative glacier mass balance.

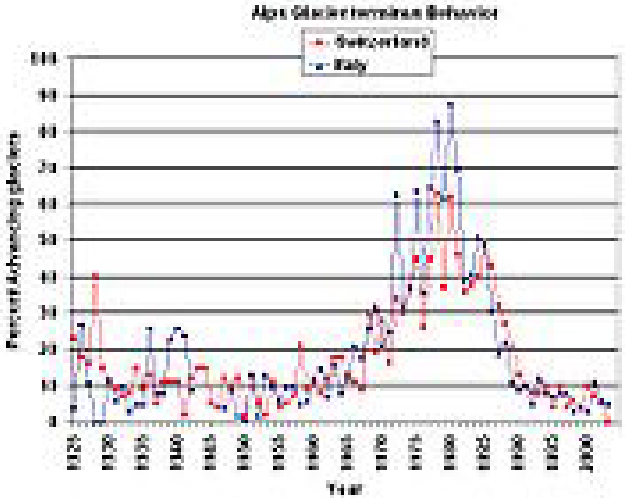

Figure 1. Percentage of advancing glaciers in the Alps in the last 80 years

The most significant climate processes since the middle to late Pliocene (approximately 3 million years ago) are the glacial and interglacial cycles. The present interglacial period (the Holocene) has lasted about 11,700 years. Shaped by orbital variations, responses such as the rise and fall of continental ice sheets and significant sea-level changes helped create the climate. Other changes, including Heinrich events, Dansgaard–Oeschger events and the Younger Dryas, however, illustrate how glacial variations may also influence climate without the forcing effect of orbital changes.

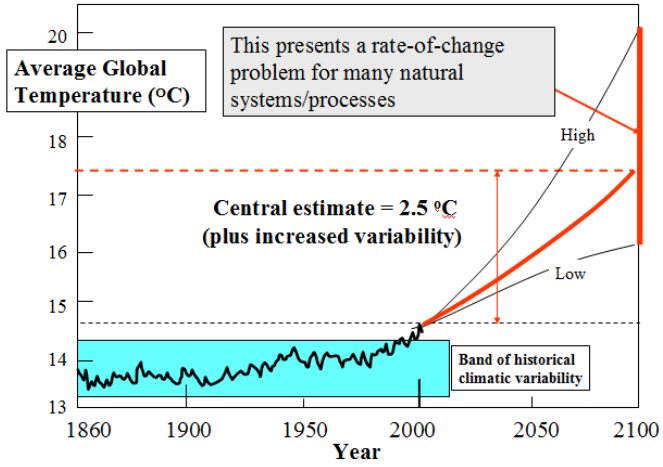

Figure 2. Accelerated increase in average temperature of the Earth surface

Glaciers leave behind moraines that contain a wealth of material - including organic matter that may be accurately dated - recording the periods in which a glacier advanced and retreated. Similarly, by tephrochronological techniques, the lack of glacier cover can be identified by the presence of soil or volcanic tephra horizons whose date of deposit may also be precisely ascertained.

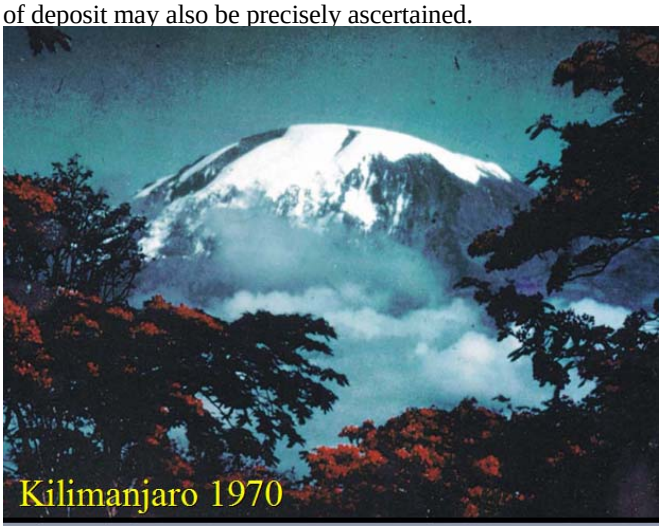

Figure 3. Ice on Kilimonjaro in 1970

The above figure shows the ice cover on the mountain Kilimanjaro in the year 1970B.C. Almost the whole mountain is covered by the ice, but because of the effect of the climate change the snow has started melting and the rate of melting is quite rapid that by the year 2010 B.C., the mountain Kilimanjaro is almost totally exposed and all the ice has been melt and it can be seen in the figure below:

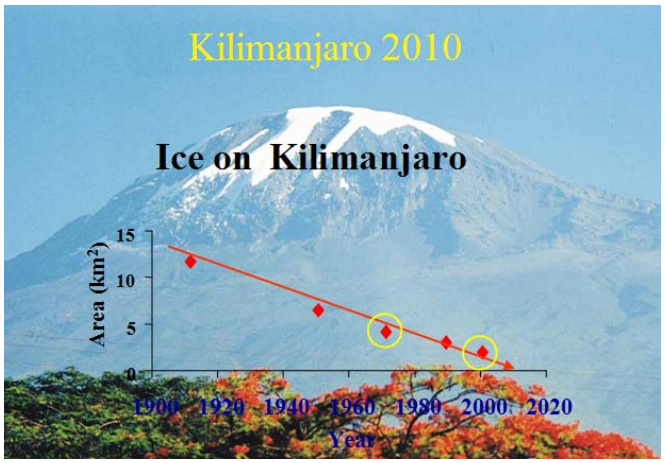

Figure 4. Ice on Kilimonjaro 2010

The global average temperature and the rate at which it is being increased is shown in the figure. The figure shows the Global average temperature (°C) over the past millennium and it shows that the average temperature rise is terrific during the last couple of decades and it will tend to be more rapid in the upcoming decades.

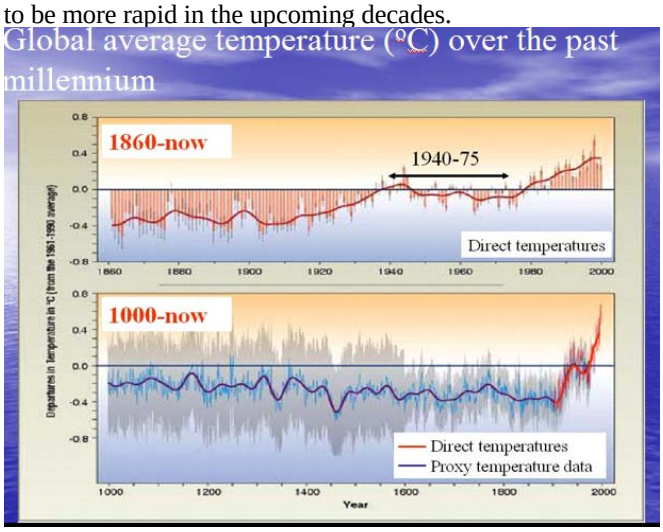

Figure 5. Global average temperature (°C) over the past millenium

IV. Impact Of Climate Change On India

India is among countries most threatened by climate change with experts warning that rising temperatures will lead to more floods, heat waves, storms, rising sea levels and unpredictable farm yields.

Here are the main potential effects of climate change on a country which is the world's seventh largest in area and is home to 1.1 billion people, a sixth of humanity.

Figure 6. Flooded street in Porbander, 400 km (248 miles) west of the western Indian city of Ahmedabad, July 27, 2009

A. Monsoon

Various studies show that surface air temperatures in India are going up at the rate of 0.4 degrees Celsius every 100 years, particularly during the post-monsoon and winter seasons. While mean winter temperatures could increase by as much as 3.2 degrees Celsius in the 2050s, summer temperatures could go up by 2.2 degrees Celsius in the 2050s, spurring climate variability.

Extreme temperatures and heat spells could alter patterns of monsoon rains, vital for India's agriculture and water needs. Scientists warn that India will experience a decline in summer rainfall by 2050. The monsoon accounts for almost 70 percent of the country's total annual rainfall. Winter rains are also predicted to fall by 10-20 percent. Higher temperatures also mean faster melting of Himalayan glaciers and as the melting season coincides with the monsoon season, any intensification of the monsoon is likely to contribute to flood disasters in the Himalayan catchment.

B. Agriculture

Agriculture will be adversely affected not only by an increase or decrease in the overall amounts of rainfall, but also by shifts in the timing of the rainfall. Higher temperatures reduce the total duration of a crop cycle, leading to a lower yield per unit area, especially for India's wheat and paddy crops.

Soil erosion, increased numbers of pests and weeds brought by climate change will also affect agriculture in India. For instance, the amount of moisture in the soil will be affected by changes in factors such as rainfall, runoff and evaporation.

C. Rising Seas

A 10-year study in and around the Bay of Bengal points to the sea rising 3.14 mm a year in the mangrove swamps of the Sunderbans delta against a global average

of 2 mm, threatening the low-lying area which is home to about 4 million people.

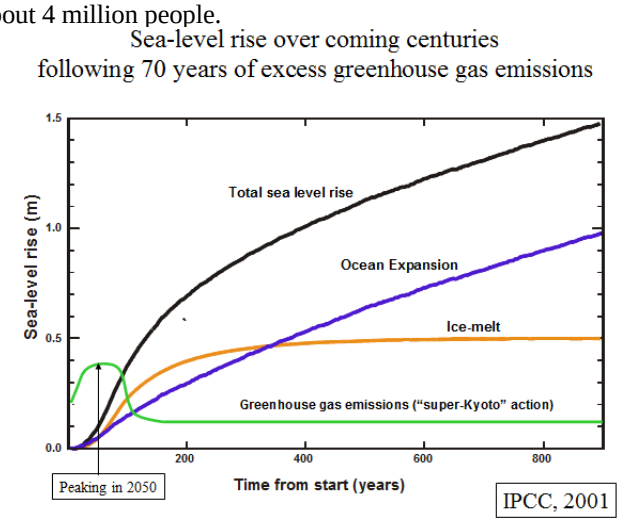

Figure 7. Sea-level rise over coming centuries following 70 years of excess greenhouse gas emission

A trend of sea level rise of 1 cm per decade has been recorded along the Indian coast. The major delta area of the Ganga, Brahmaputra and Indus rivers, which have large populations reliant on riverine resources, will be affected by changes in water regimes, salt water intrusions and land loss.

D. Health

Rise in temperature and change in humidity will adversely affect human health in India. Heat stress could result in heat cramps, heat exhaustion, heat stroke and weaken immune systems. Increased temperatures can increase the range of vector-borne diseases such as malaria, particularly in regions where minimum temperatures currently limited the spread of such diseases. (Sources: Greenpeace, UNDP, Centre for Science and Environment)

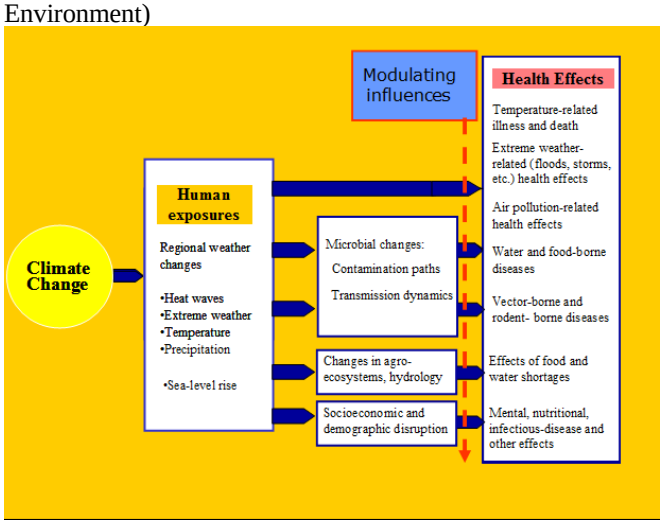

Figure 8. Climate change and its effect on human health

E. Environment

The climate change is induced because of the accelerated emission of the green house gases which is generated from the use of fuels to ride the vehicles, also the green house gases are formed by excessive use of refrigeration and air conditioning. The concentration of such gases has been increased in the large amount and it can be seen in the graph below:

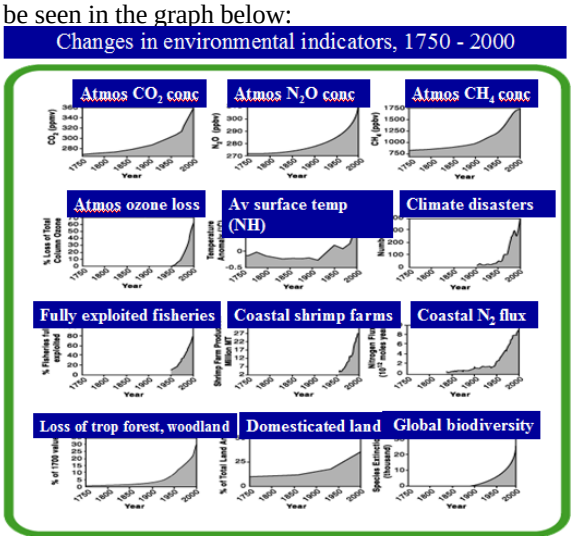

Figure 9. Change in Environmental Indicators

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