4.5 EVIDENCE OF CHANGES IN CLIMATE AND ENVIRONMENT

The evidence for climate change is the records of the change in climate through thermometer readings, recordings of earlier spring, glacier retreat, reading the rise in temperature from reading ice cores, sea level rising, the ocean getting warmer and ocean acidification.

Evidence of changes in climate and the environment is abundant and diverse, coming from various sources including scientific research, observations, and data analysis. Here are some key pieces of evidence:

1. **Temperature Records:**

   Global surface temperatures have been rising over the past century, with the last few decades experiencing particularly rapid warming. This is evidenced by instrumental records from weather stations, satellites, and other monitoring systems.

2. **Glacial Retreat and Ice Loss:**

   Glaciers and ice sheets around the world have been shrinking at an accelerating rate. This is evident in observations of glacial retreat, melting ice caps, and reductions in ice volume in regions like Greenland and Antarctica.

3. **Sea Level Rise:**

   Sea levels have been rising due to thermal expansion of seawater and the melting of ice caps and glaciers. Satellite altimetry and tide gauge measurements show a clear upward trend in global sea levels over the past century.

4. **Extreme Weather Events:**

   There has been an increase in the frequency and intensity of extreme weather events such as heat waves, hurricanes, droughts, and heavy precipitation events. While no single event can be attributed solely to climate change, the overall trend is consistent with climate model projections.

5. **Ocean Acidification:**

   The absorption of excess atmospheric carbon dioxide by the oceans has led to ocean acidification, resulting in a decrease in pH levels. This has significant

implications for marine ecosystems, particularly coral reefs and shell-forming organisms.

6. **Changes in Biological Systems:**

   There have been shifts in the distribution and behavior of plant and animal species, as well as changes in phenology (the timing of biological events such as flowering and migration). These changes are consistent with a warming climate and are documented in numerous studies.

7. **Decline in Arctic Sea Ice:**

   Arctic sea ice extent has been declining rapidly, with the summer minimum reaching record lows in recent years. Satellite observations show a significant decrease in the extent and thickness of Arctic sea ice compared to historical records.

8. **Ocean Warming:**

   The oceans have been absorbing the majority of the excess heat trapped by greenhouse gases, leading to significant warming of ocean waters. This has implications for marine ecosystems, including coral bleaching and changes in ocean circulation patterns.

These pieces of evidence, along with many others, collectively demonstrate the reality of climate change and its impacts on the environment. They underscore the urgency of taking action to mitigate greenhouse gas emissions and adapt to the changing climate.

Future changes will depend on many factors

- NRC Climate Stabilization Targets increase in greenhouse gas concentrations
- Natural influences on climate (e.g., from volcanic activity and changes in the sun's intensity) and natural processes within the climate system (e.g., changes in ocean circulation patterns)

Scientists use computer models of the climate system to better understand these issues and project future climate changes.

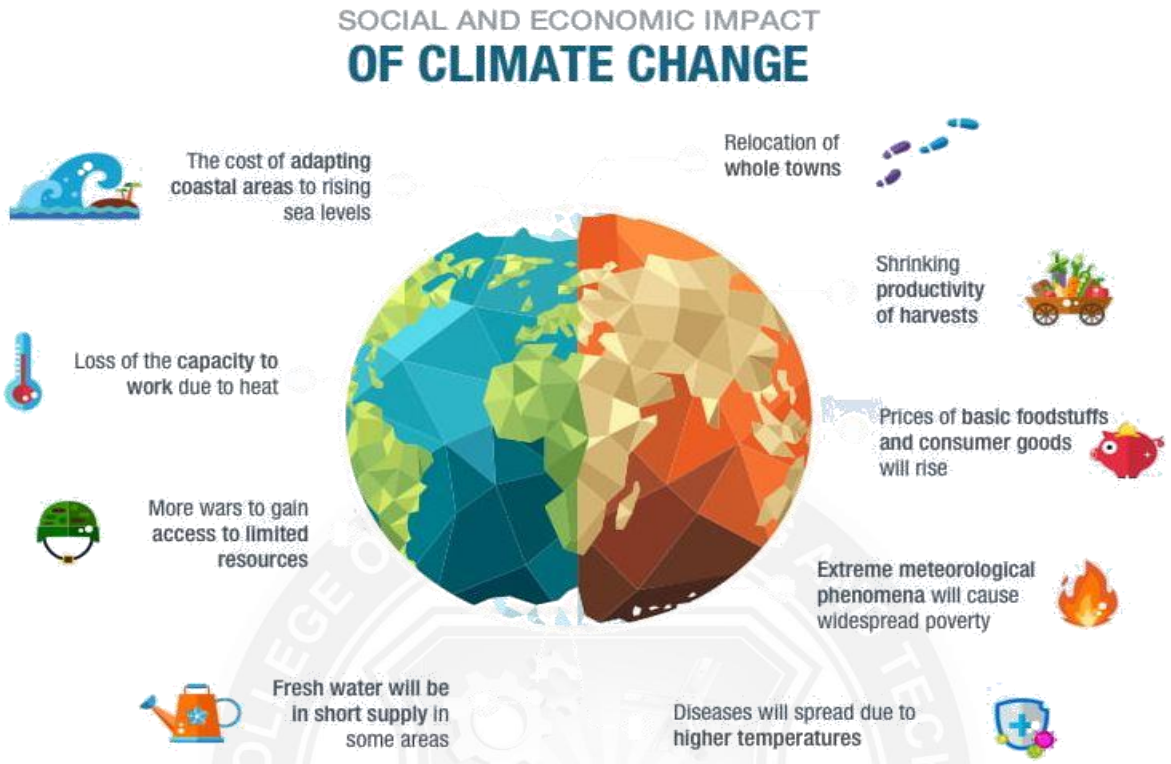

FIG. 4.5.1 EVIDENCE OF CHANGES IN CLIMATE AND ENVIRONMENT

EVIDENCE FOR CLIMATE CHANGE TYPES

Evidence for climate change can be found in recording the environment through scientific instruments over the years, but also by reading natural sources that record how the climate was and comparing it with how it is changing now. These records show changes in temperature, weather, and landscapes. Let's look at the different types of evidence.

Thermometer readings

By comparing present thermometer readings with the past, it is obvious to see that the Earth's temperature is rising. There has been a 1 degree Celsius in rise average surface air temperature since the year 1900. There are also records that 2016 and 2022 are the warmest years on record.

Earlier spring

There have been signs of a seasonal shift, where spring arrives earlier and winter is less cold. This has had an effect on migrating, nesting, and hibernating wildlife.

Glacier retreat

The increase in rising temperature has caused the glaciers to melt and retreat, there is also an increase in sea ice melting in the Arctic. This has been recorded through photography in the past 50 to 100 years where there has been evidence of melted glaciers.

Arctic sea ice melting

The sea ice in the Arctic Ocean has been melting more in the summer than refreezing in the winter due to global warming and leading to the decline of Arctic sea ice. Arctic sea ice helps maintain the low temperatures and has an albedo effect on the climate. This means that declining Arctic sea ice leads to increasing ocean heat.

Ice cores

Ice cores are samples of ice removed from an ice sheet or a glacier, many of them are taken from Antarctica and Greenland. From the ice cores, scientists are able to read past atmospheric gas concentrations. The ice core is made from many layers of snow, which traps air in the ice. So from this, they can read the temperature of each year from 400,000 years ago. By comparing the temperatures from 400,000 years ago with the temperatures in the last decade, it is clear evidence that there has been a rapid increase in temperatures.

Sea level rising

The global average sea level has risen 20 centimetres in the last century and in the past two decades has doubled compared to the last century. It is still accelerating every year.

EVIDENCE FOR CLIMATE CHANGE DEVELOPMENT

The latest IPCC climate reports predict that the negative impacts of climate change are developing faster than predicted 10 years ago. This report shows the urgency of the situation as climate change develops. There are many that are vulnerable to climate change with between 3.3 billion and 3.6 billion people's places they call home at risk. This is 40 % of the earth's population. It is also said that the changes that the global temperature rise is causing may become irreversible when the rise in temperature reaches 1.5 degrees celsius above. The report may be alarming however it is important to build predictions based on facts

and evidence to help governments to understand the reality of this situation and act toward changing the way human activity is affecting the climate.

Evidence for Climate Change facts

Although it is confusing and frightening to have to face the reality of climate change, there are facts that back up and are evidence for climate change.

- There is the most CO2 in the air in the past two million years.
- 1.2 trillion tonnes of ice are melting each year. As a reference, a combination of all human-made things is 1.1 trillion tonnes.
- In 2019, 302.4 billion work hours have been lost through being too hot to work.
- Severe hot weather events used to happen on average once every 10 years between 1850 and 1900 but now likely occur 2.8 times every 10 years.
- Heavy rains and floods have quadrupled since the 1980s and doubled since 2004.