Second Round Assignment

PART 1 **-**

The Industrial Revolution marked a major turning point in Earth's ecology and humans' relationship with their environment. The beginning of industrialization on 18th century saw drastic changes in climate which have been measured globally as increase in temperature, changes in precipitation and many other scales. The global mean surface temperature has increased by about 0.6 to 0.9° Celsius from 1880 to 2004 and 2005 was observed as the warmest year in last 130 years. Precipitation has increased by about 2% since 1900 significantly in high northern latitudes whereas drying has occurred in parts of the tropics and sub-tropics especially in the Sahel and southern Africa. Area affected by drought has likely increased since the 1970s. Earth's Cryosphere has also met changes in terms of declination of the mountain glaciers, snow cover and melting of polar ice caps in both the hemispheres. The extent of Arctic sea ice in 2009 was 24% below as in 1979 to 2000. Glaciers worldwide have lost more than 2,000 cubic miles of water since 1960. Average sea level worldwide has increased at a rate of 1.8 mm per year over 1961 to 2003 but there had been a rapid increase in the last ten years of this period at a rate of 3.1 mm per year. The ocean has become more acidic over the past 20 years. Since 1993, the thermal expansion of oceans has contributed 57% sea level rise whereas melting of polar ice-caps and glaciers contributing 28% and rest comes from the polar ice sheets. There has been an increase in the occurrences of warm nights implying a decrease in the distribution of daily minimum temperature. The length of the time that lakes stay frozen has also decreased at an average rate of one to two days per decade. The world is experiencing extreme weather events such as cyclones, hurricanes, droughts, heat waves and floods, resulting in the loss of life and property. The intensity and frequency of these events has increased in the recent decades. Rapid climate change affects ecosystems and the ability of species to adapt to these changes. So biodiversity loss has increased and many species either become extinct or are endangered.

The scientific evidences reveal that the observed increase in global average temperature and other climate changes since the industrial era is due to increase in anthropogenic GHG concentrations like CO_2, SO_2, NO_x, CH_4 etc., which comes from the combustion of fossil fuels, mainly used for transportation, heating and cooling of buildings and industrial applications. The energy sector contributes majorly to the emission of GHGs. Changes in land use pattern, changes in vegetation cover, urbanization and deforestation leads to change in climatic patterns at regional level. Anthropogenic contributions to aerosols (primarily sulphate, organic carbon, black carbon, nitrate and dust) during the combustion of fossil fuels; organic materials from the oxidation of VOCs (Volatile Organic Compounds); soot from fires; and mineral dust from wind-blown processes affect climate by scattering of sun rays, interacting with atmospheric gases, formation of smog with water and produce a cooling effect.

There are a number of natural factors responsible for climate change such as continental drift, volcanoes eruption, ocean currents, the earth's tilt and radiative forcing. Volcanic eruptions throw out large volumes of sulphur dioxide (SO_2), water vapour, dust and ash into the atmosphere influencing the climatic patterns for years. The climate of our earth is also affected by solar activities to some extent, such as solar flares and sunspots where solar maximum leads to warming up of earth and solar minimum leads to cooling of the earth. Radiative forcing has an impact on water systems where water evaporates from water bodies and water vapour being a GHG, contributes to the increase in warming and affects earth's energy balance. The continental drift brings out a change in the physical feature of the lithosphere, position of the land masses, mountains and water bodies leading to climate change. The earth's tilt affects the total amount and distribution of sunlight received by the earth. Changes in the tilt of the earth can affect the severity of the seasons. Oceans and global temperatures are also connected as warm waters create warmer temperatures and vice versa. The salinity difference in the ocean is thought to drive the global thermo-haline ocean circulation.

PART 2 **-**

V-CON (Varika's Climate Observation Network) comprises observations of all climate system components (atmosphere, oceans, land and cryosphere) and its objective is to define and encompass all the needs for observations in the climate system at regional, national and global level.

Designing of V-CON is based upon the involvement of students from schools across the world, where climate observing kits (with CO_2 analyzer, rain gauge, a 'mini weather station' installed in their school campus and other weather measuring instruments) are distributed among them. Metrological Observation System is set up in Science Centers and Planetaria in every country. Fishermen, Coast guards and forest guards are actively involved to measure soil temperature, pH & salinity of sea, precipitation, CO_2 emissions etc. They are provided with weather study kits which contain barometer, thermometer, psychrometer and a compact weather station. Instruments to measure GHG emissions are set up in the chimneys of various industries as well yearly analysis is manipulated of the amount of fossil fuels burnt by these industries. Instruments with transmitters are installed in vehicles to measure GHGs and other pollutants. Satellite based observation of all climate variables are also a part of V-CON.

The subsequent table puts forth the various networks/systems falling under V-CON along with the various equipments involved in measuring the four major domains of climate and its essential climate variables in a short and precise manner for easy understanding –

Domain	Network or System	Equipments	Essential Climate Variables(ECVs)
Atmospheric	Automated airport weather station network, Automated surface observing system, System for observation of halogenated green house gases (SOG), Global atmosphere watch network (GAW)	Weather Radar, Automatic weather station, Wind sensor, Wind profiler, Ceilometers, Radiosonde, Rain and precipitation sensors, Weather balloons, Weather transmitter Portable CO_2 and O_2 analyzer, Vaisala CARBOCAP series, CO_2 transmitter, Mass spectrometer Electron capture detector (ECD)	*Surface & Upper Air:* Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, Cloud properties, Surface Solar radiation *Composition:* Carbon dioxide, Methane, and other greenhouse gases, Ozone, Aerosols, CFCs and other pollutants
Oceanic	Automated weather sensor system, Maritime observation system, Satellite Observation Network	Radiosonde, Weather buoy, Weather sensor, Voluntary observing ships(VOS), SeaWiFS, Oceanographic buoy, Global drifter buoy, Refractometer	Temperature, salinity, Sea level, Sea state, Sea ice, Surface current, Ocean colour, Ocean acidity, Oxygen & Tracers, Carbon dioxide partial pressure
Land	Automated weather station network, Metrological Observations System, Medium-resolution satellite observations	Weather stations, MERIS, MODIS, Instruments for Gravimetric Analysis, Ordinary Climatological Stations	River discharge, water use, Groundwater, continental drift, leaf area index(LAI), soil carbon, above ground biomass, Fraction of absorbed photosynthetically active radiation(FAPAR), fire disturbance, soil moisture, Land cover(including vegetation type)
Cryosphere	Polar Plateau System, Continental Margin System, Remote Station Technology, NASA's GRACE Mission satellite	GPS installed on bed rock, Radar altimeters signal, Polar orbiting satellites, Radar Interferometers Velocity Measurements	Frozen lakes and rivers, snow cover, Glaciers and icecaps, ice sheets, permafrost

The V-CON Headquarter brings together the information of climate changing factors from students, Coast guards, forest guards, fisherman, transmitters in vehicles, airport operators, shipping corporation ports, industries, satellites and various other networks/systems and sub-networks under V-CON. These specific components affecting climate change are only measured under V-CON because they have a serious impact on all ecosystems especially human survival and development. A monthly as well as a detailed annual report is published measuring the factors affecting the climate and even giving the possible changes in the climate.

References

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