

Answer 1

Climate change → Climate change refers to frequent violations of climate patterns. First, to decide on how climate appears for a geographical regions, observations are conducted for 30-35 years and then conclusions are drawn.

Climate change refers to that patterns / changes in climate that do not match the previous year climate.

Natural Reasons for climate change

① Volcanic eruptions - Volcanic eruptions pump out a lot of dust and ash, which block the sunlight. The ash particles are relatively heavy, so they fall and provide a cooling effect.

② Solar variations - Sunspots are temporary phenomenon that happen on the Sun's photosphere. These are regions of reduced temperature caused by concentration of magnetic flux. That could arise to few solar storms on Earth and brings along a cooling effect.

③ Earthquakes → Earthquakes occur due to shift in tectonic plates on Earth. So, earthquakes can lead to floods, change in wildlife, which also affects climate.

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### Man made Reasons for Climate change

① Pollution → Pollution is the biggest factor that contributes changes to climate change due to man made activities.

Pollution can be further classified into -

a) Soil Pollution → Addition of fertilizers/pesticides that lead to changes in crop development.

b) Air pollution → Addition of Greenhouse gases, other harmful gases from industries, cutting down of trees lead to air pollution. This leads to acid rain.

c) Water Pollution → Contamination of water by sewage/oil-spills / use of fertilizers and pesticides lead to water pollution.

② Forest fires → Due to accidental forest fires, a lot of dust and ash is pumped to atmosphere which lead to climate change.

Q.2 Atmospheric aerosols → Aerosols are microscopic particles of solid or liquid matter that is suspended in the atmosphere.

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→ These aerosols occur both in troposphere and stratosphere. These are stable from a few seconds to several months which provide a cooling effect on Earth.

Different sources of Aerosols from Earth's surface →

① Dust storm → Dust storm (sandstorm) is a meteorological phenomenon. Dust travel thousands of kilometres and inject a lot of aerosols into atmosphere.

② Biomass burning → Natural / man-made fires that destroy areas of forest and other vegetated surfaces is called biomass burning.

③ Volcanic activity → Volcanic eruptions dump a lot of dust / soot / ash into the atmosphere. These have catastrophic effect on nearby's places climate due to blockage of sun rays from aerosols.

④ Human Made Activity → A lot of industries dump their gases & waste into the atmosphere which contain aerosols.

80, from human activities, air pollution leads to smog and aerosols.

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⑤ Ocean surface process- Aerosols produced on ocean surface are mainly NaCl molecules but also small amounts of  $K^+$ ,  $Mg^{2+}$  ions.

The sea surface is subjected to winds and these lead to movement of aerosols to the atmosphere.

### Answer 3 Impact of climate change on Biodiversity

Due to human/ natural changes, climate change can severe impacts if precautionary measures are not taken-

Concerns for biodiversity →

① Ocean acidification → As water gets polluted, the rivers gets polluted as well. This increases the acidification of rivers/oceans which makes it unsuitable for aquatic life to survive.

② Melting sea ice → Due to greenhouse gases and global warming, glaciers are melting. This can lead to more melting of sea ice which also destroys habitats of flora and fauna there.

③ Sea level rise → Due to increasing melting of glaciers can melt and can lead to overflowing of rivers.

Small islands can get submerged into water.

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④ Disease and pests - Due to air pollution, there is a threat to life of birds. Due to water noise pollution, there can be a sudden outbreak of contagious diseases which can adversely affect humans and animals.

#### Possible Adaptations →

- ① Humans should give respect to the nature it deserves.
- ② Industries should not dump their waste in air / water to pose a threat to biodiversity.
- ③ Humans should also dump sewage / unwanted garbage in water. They should keep noise levels maintainable and should not burst crackers.
- ④ Accurate predictions of volcanic eruptions, earthquakes, floods can lead to better adaptation in case a natural climatic activity occurs.
- ⑤ Humans should prevent oil-spills and should not cut trees / instead plant a lot.
- ⑥ Avoid use of fertilizers / pesticides that destroy the soil and also lead to water pollution.

Q-4 Method to predict  
Geographical suitability of  
agricultural crops →

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As weather/climate changes of  
a geographic region due to natural / man-made  
reasons, we can make use of MaxEnt method.  
This method takes into consideration the  
changes in geographical suitability for a crop's  
growth.

MaxEnt - stands for Maximum Entropy modelling.  
It has two main components

① Entropy → The model (MaxEnt) one is calibrated  
to find out the distribution that is most  
spread out / closest to uniform.

② Constraints → These are rules that constrain the  
predicted distribution.

- MaxEnt uses presence and historic data.
- for a crop, it samples a bunch of environments where  
a crop can healthily grow and mature.
- MaxEnt chooses the distribution that maximizes  
the similarity existing environmental characteristics  
and environment properties of the total environment.

In, this way, we can predict the geographical  
suitability of agriculture crops as MaxEnt  
it properly select best locations using  
Machine Learning strategies.

Since, MaxEnt model builds iteratively and select the best model,

Regularization can be added to improve the model by

① Relaxing the constraints → We can take into account the confidence interval using mean and std of location predicted by MaxEnt and improve our understanding of what the model is doing.

② Setting constraints

③ Penalizing complexity → We can force MaxEnt to avoid optimization in areas of higher complexity and give simpler results.

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Q.5 Given

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Area covered by

Arctic ice = 3% area of surface of Earth

Land area = 29.5% of surface of Earth.

Earth's Radius = 6371 Km

Mass of Arctic ice sheet =  $0.04 \times 10^3 \text{ Kg/m}^2$

Find how much sea level would rise if entire Arctic ice will melt?

Solution

Mass of Arctic ice sheet = 3% Earth's area  $\times$  mass in  $\text{Kg/m}^2$

$$= \frac{3}{100} \times 4 \times 3.14 \times (6.3 \times 10^6)^2 \times 40 \text{ Kg/m}^2 \times \text{m}^2$$

$$= 3 \times 4 \times 3.14 \times (6.3)^2 \times 4 \times 10^{11} \text{ Kg}$$

$$= 6.11 \times 10^{14} \text{ Kg}$$

Let rise in sea level =  $x$

Mass of Arctic ice sheet = Area of ocean  $\times$  Density of  $\text{H}_2\text{O} \times (x)$

$$6.11 \times 10^{14} = (5.1 - 1.45) \times 10^{14} \times 997 \times (x)$$

$$\frac{6.11}{997 \times 3.65} = x$$

$$x = 1.67 \text{ meters.}$$

So, increase in sea level = 1.67 meters

if arctic ice melts