Lightning and Climate Change

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Earth is heating up

• In 2020 the concentration of carbon dioxide was the highest in 3 million years at 411.3 parts per million.
• Carbon dioxide is a long living green house gas and traps the heat in the atmosphere.
• This has caused the Earth to heat up by 1.2 degree Celsius since pre industrial times.
• 2020 was the joint warmest year ever recorded along with 2016
• 2010-2020 was the warmest decade
Climate Crisis

• The 9 climate tipping points could be crossed faster than before and at lower levels of warming (1.5-2°C)
• Losses of Amazon rain forests, boreal forests, permafrost, Arctic sea ice, coral reefs, Atlantic circulations, Greenland ice sheet, East Antarctic and West Antarctic ice sheets
• Current trend puts us at a warming of between 3-5°C which will be far beyond the point of no return
• US$ 232 billion losses caused by natural disasters in 2019. US$ 229 billion by weather related disasters
• 2009-2019 was the costliest decade in terms of climate disasters at US$ 2.98 trillion as compared to 1.88 trillion from 2000-2009
Warming affects extreme weather

- Change in character of extreme weather
- Increases frequency intensity of cyclones.
- Extreme rainfall events which induce floods, flash floods and landslides
- Dust, hail and thunderstorms with lightning
- Disruption of the monsoon leading to cycles of floods and droughts
- Cold waves and cold days with ground frost
- Heat waves with wild fires
- Heavy snowfall leading to avalanches
Causes of Lightning

• Lightning occurs as part of a convective storm system
• Such storms can form over land and ocean - thunderstorms and cyclones
• Super cooled ice crystals in clouds exchange charges and create a charge imbalance
• When a cloud cannot hold this excess charge lightning strikes between two clouds or between cloud and Earth
• About 45 flashes of lightning occur globally every second
Lightning and global warming

• As the earth heats up there is more moisture and air circulation in the atmosphere which increases the chances of formation of storms
• As storms increase so does lightning
• Lightning is a clear indicator of storminess
• Lightning was added to the Global Climate Observing System’s list of Essential Climate Variables in 2016
• For every one degree rise in global temperature the frequency of lightning strikes increases by 12 percent
• The rise in lightning strikes in Brazil has been linked to global warming
• In India lightning strikes may increase by up to 50 percent by the end of the century
• Coastal and hilly regions are most vulnerable
• A 10 year study connected increase in cyclones to increase in lightning in coastal areas in India
Lightning in the Arctic

- Lightning strikes in Arctic countries have gone up from 18,000 in 2010 to 150,000 in 2020.
- The share of the Arctic region in global lightning strikes increased from 0.2 to 0.6 percent.
- Northern Siberia has most lightning strikes.
- Lightning should be rare in the Arctic but it isn't anymore.
- Scientists attribute this to climate change.
Interconnectedness of Lightning

• Heat waves can cause wildfires in forested areas
• Wildfires release smoke which can form pyrocumulonimbus clouds
• These clouds can generate mini storms which can cause lightning strikes
• These lightning strikes can ignite more wildfires creating a loop
• This is what happened during the recent heat waves in Canada where 710117 strikes were observed in a single night
• 82 percent of bushfires between November 2019 and February 2020 in Victoria, Australia were caused by lightning strikes which wiped out 1.5 million ha of forests
Global climatic factors

• Canadian heat waves were caused by the blocking of the sub tropical jet stream
• Arctic Oscillation and Jet stream, El Nino Southern Oscillation, North Atlantic Oscillation, Siberian High
• Rate of arctic warming is triple the rest of the world due to a feedback loop
• This is causing disruption to the Arctic jet stream which is becoming wavy
• Cold winds that are normally conserved inside the jet stream are moving out periodically causing a cascade of effects and extreme weather events including heat waves and storms
Warming Arctic driving extreme weather

Linked to severe winter storms in US and Europe, heatwave at North Pole

**Normal circumstances**
- Strong jet stream and polar vortex hold freezing cold air in the Arctic and warm air in lower latitudes

**Arctic warms faster than lower latitudes**
- Jet stream and polar vortex weaken, allowing Arctic air to move south and warm air to move north

Source: NOAA

Source: AFP News Agency
• Wind systems in the lower latitudes including western disturbances, monsoon trade winds and cyclones are getting disrupted
• El Nino Southern Oscillation (ENSO) is the cyclic warming of eastern and central Pacific Ocean
• It has been connected to droughts and erratic monsoon in India
• El Nino events are going to intensify under a warming climate
Rare dust storms of 2018

- In 100 days beginning February there were 44 storms across 16 states
- 423 people were killed and 785 people were injured
- Most people were killed due to lightning
- Main cause was the interaction of western disturbances with low pressure areas over Indo Gangetic Plains
- The anomalous western disturbances were caused by the wavyness of the Arctic Jet Stream
Lightning deaths in India

- Between 2012 and 2019 21,572 people were killed due to lightning across India, according to NCRB data.
- Between 2016 and 2019, 37 percent of all deaths due to natural calamities have been caused by lightning strikes.
- From 2012 to 2019 maximum deaths occurred in Madhya Pradesh, Odisha, Bihar, Maharashtra and Jharkhand.
- In this period Madhya Pradesh alone recorded 3575 deaths due to lightning strikes.
- Most of the natural calamity deaths (by percentage) in Chattisgarh, Kerala, Tamil Nadu and West Bengal were caused by lightning.
Few links to important stories


https://www.downtoearth.org.in/news/natural-disasters/-andhra-pradesh-lightning-strikes-were-not-record-breaking--60468

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Thank you