



Lightning and Climate Change

Akshit Sangomla

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

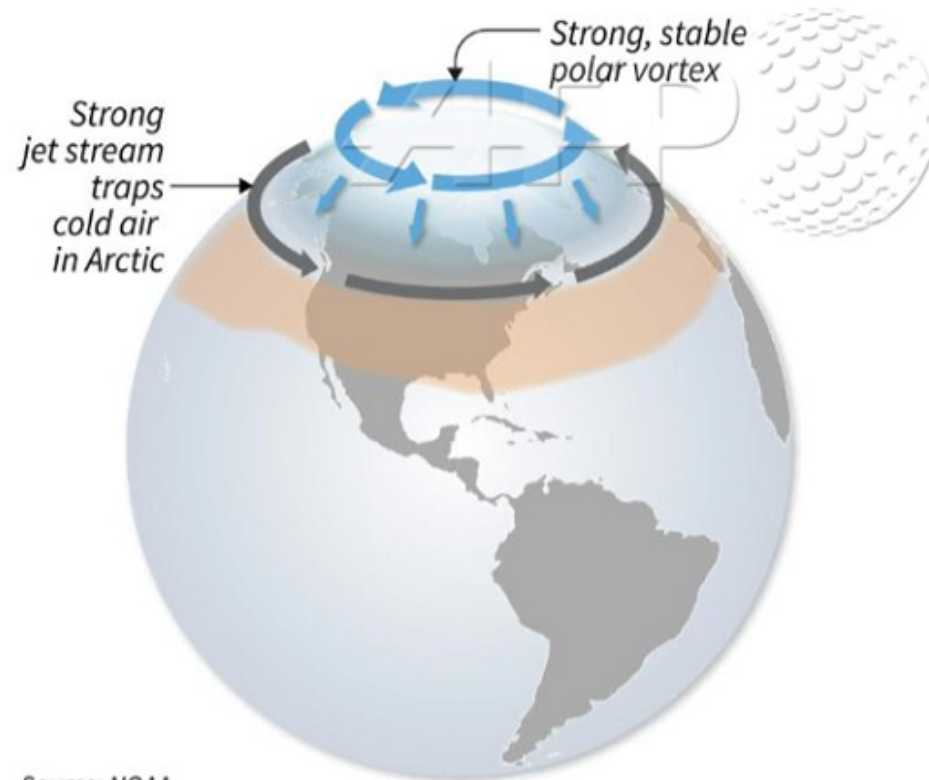


Warming Arctic driving extreme weather

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

► Normal circumstances

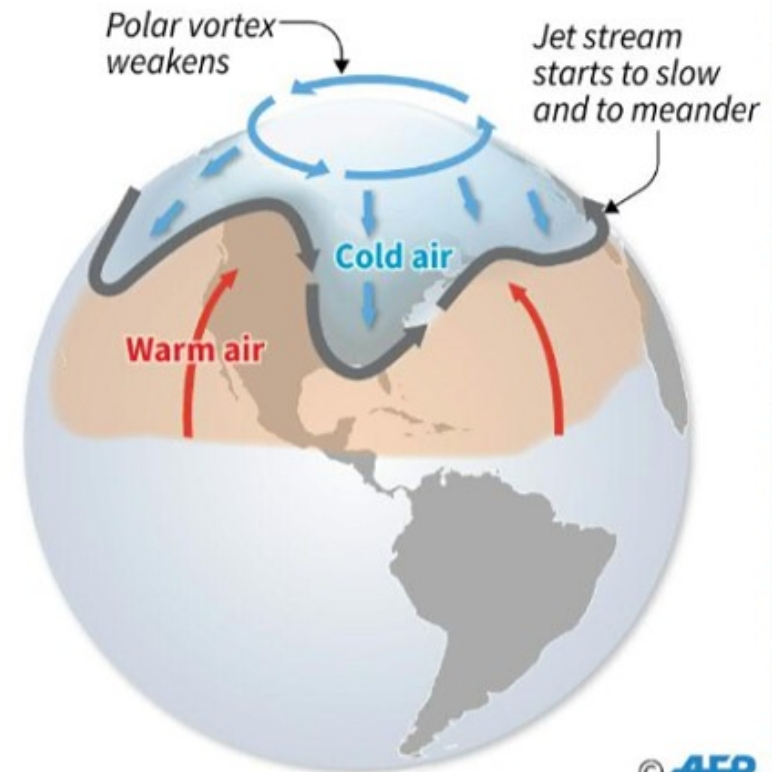
Strong jet stream and polar vortex hold freezing cold air in the Arctic and warm air in lower latitudes



Source: NOAA

► Arctic warms faster than lower latitudes

Jet stream and polar vortex weaken, allowing Arctic air to move south and warm air to move north



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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/climate-change/lightning-strikes-linked-to-climate-change-1-697-killed-in-a-year-in-india-77897>

<https://www.downtoearth.org.in/news/climate-change/what-caused-41-000-lightning-strikes-across-india-on-april-16--64068>



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

Email id: aks@se.sangamindia.org

Thank you

