



AAETI

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Climate change and Extreme Weather

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Earth is heating up

- In 2018 the concentration of green house gases was the highest in 3 million years at 407.8 parts per million.
- 80 percent of this was carbon dioxide which is a long living gas.
- This has caused the Earth to heat up by 1.1 degree Celsius since pre industrial times.
- 2019 was the second warmest year ever recorded
- 2009-2019 was the warmest decade



Climate emergency

- 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 and 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
- Heavy snowfall leading to avalanches



Extreme weather in India

- Every month in the last two years has had at least one of these extreme weather events
- Some of them can be explained by natural climate cycles of Earth's atmosphere like El Nino Southern Oscillation
- Others have a clear imprint of global warming



Cyclone Fani

- Longest lived cyclone ever recorded in the Bay of Bengal
- Second severe cyclone that formed in April and made landfall in 128 years
- Wind speeds reached 215 km/hr, even 90 km inland.
- Killed 89 people and caused damages of 52,000 crores
- Slowing down of winds around the cyclone - global phenomenon that is less understood

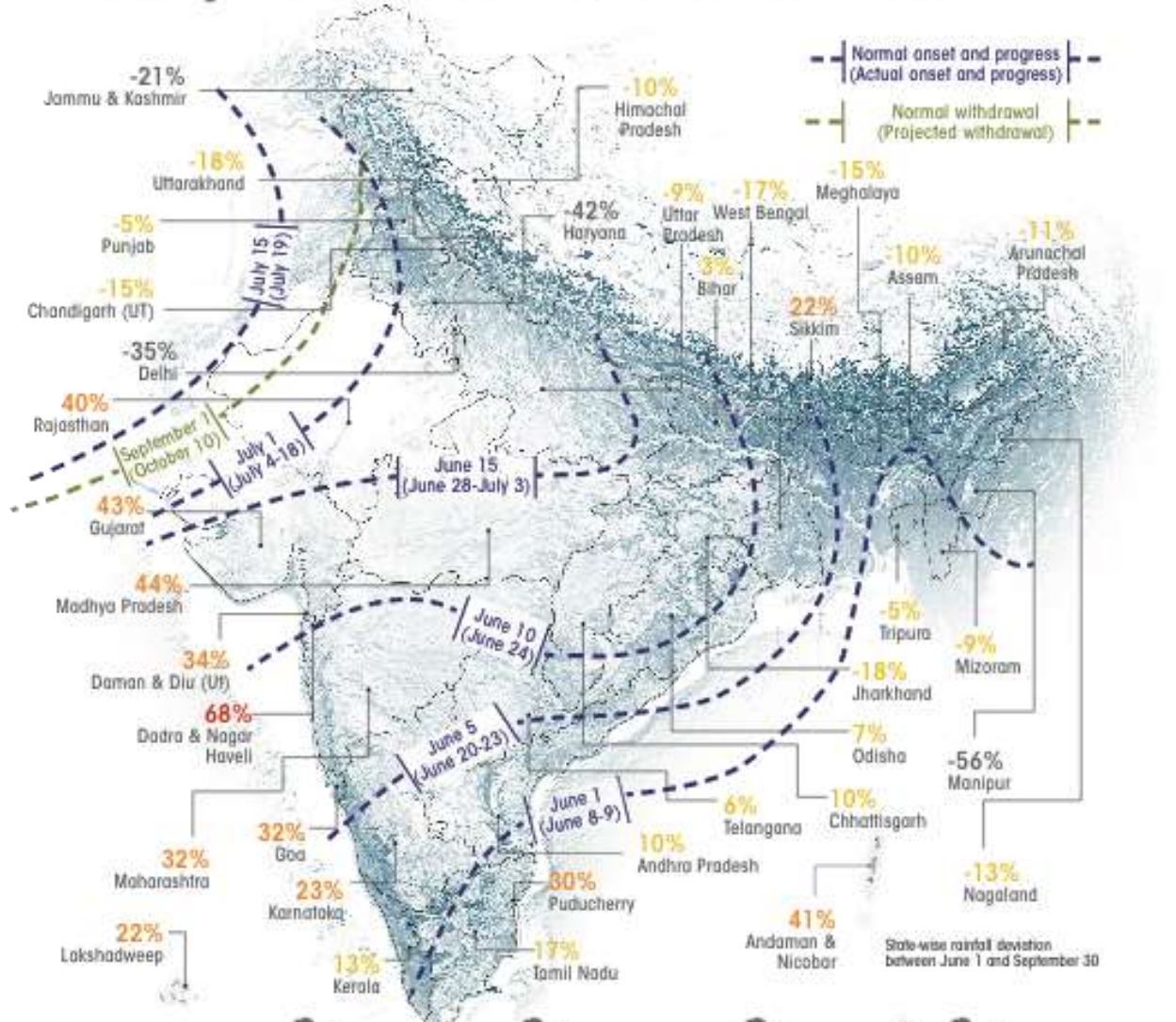


Erratic 2019 Monsoon

- Delayed by a week
- Was sluggish in the first month due to cyclone Vayu
- 31 states and union territories faced rainfall deficit of more than 25 percent. 16 had deficit of more than 40
- Changed character in mid July. 12 states received 60 percent surplus rains in that week
- In next three months caused floods in 22 states killing 2,100 people. Most intense in 25 years
- Extended into mid October
- Monsoon character is changing

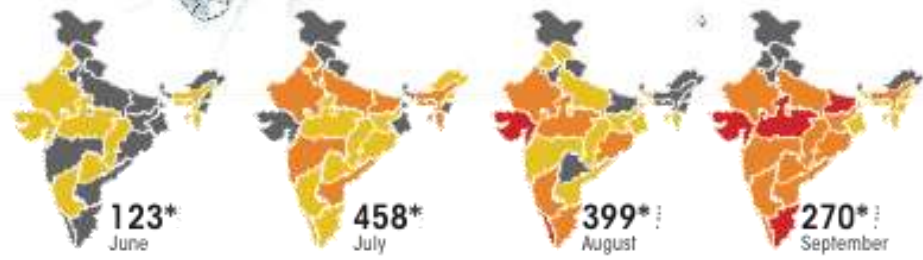


delayed made this monsoon the wettest in 25 years. Even its withdrawal, which should have started on September 1, is delayed by 40 days



DOWNPOUR

This monsoon saw 1,250* very high rain days



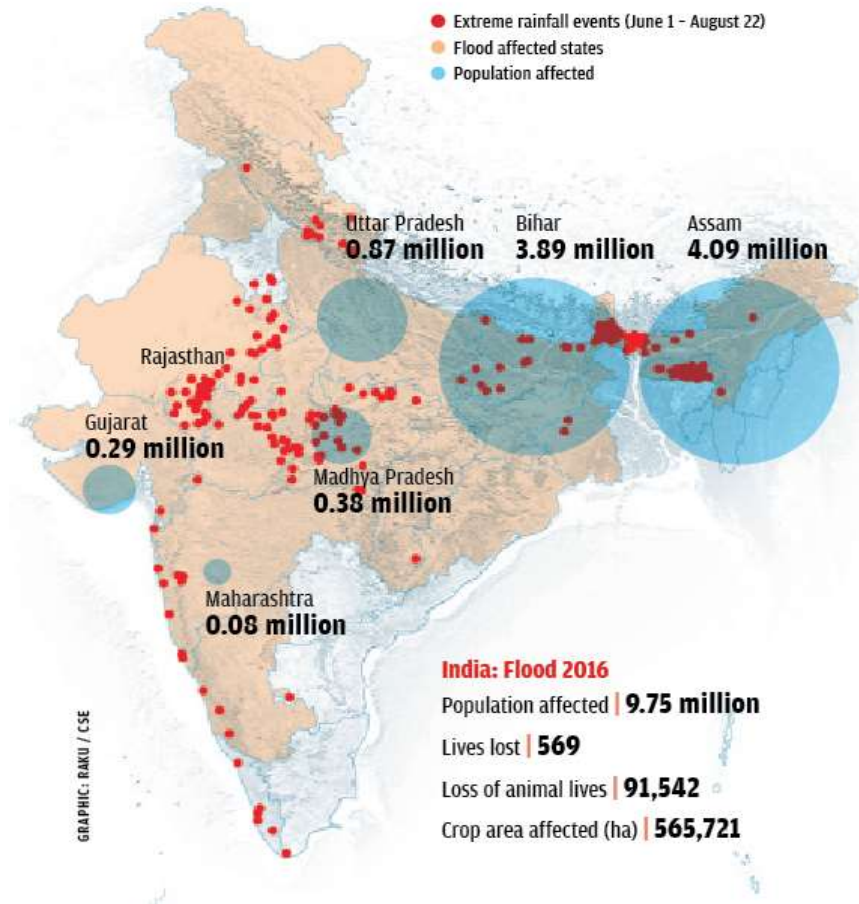
● Large Excess (>60%) ● Excess (20 to 60%) ● Normal (-19% to 19%) ● Deficient (-20 to -60%)

Extreme-rain floods

- Cannot hold water
- Destroys life when it floods
- Destroys life because of drought

Under water

Most of the floods this year were preceded by extreme rainfall events—a precipitation of 124.5 mm or more in a day



Record number of Cyclones

- Hikaa, Kyarr and Maha in Arabian Sea; Bulbul in Bay of Bengal in October-November
- Kyarr was of super cyclone category (wind speed > 221 km/hr)
- Maha was extremely severe (166-200 km/hr)
- Bulbul and Hikaa were very severe cyclones (118-165 km/hr)



- Six severe cyclones in 2019
- Six severe cyclones in 2018
- The last time there were more than 5 severe cyclones in back to back years was 1976-77
- Four severe cyclones in Arabian Sea which is not prone to cyclones
- Highest in 117 years. Indicates warmer than usual sea surface temperatures

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
- Wind speeds exceeded 130 km/hr. Maximum known speeds are between 90 and 100 km/hr
- Main cause was the interaction of western disturbances with low pressure areas over Indo Gangetic Plains



Global climatic factors

- Arctic Oscillation and Jetstream, El Nino Southern Oscillation, North Atlantic Oscillation, Siberian High
- Rate of arctic warming is double 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

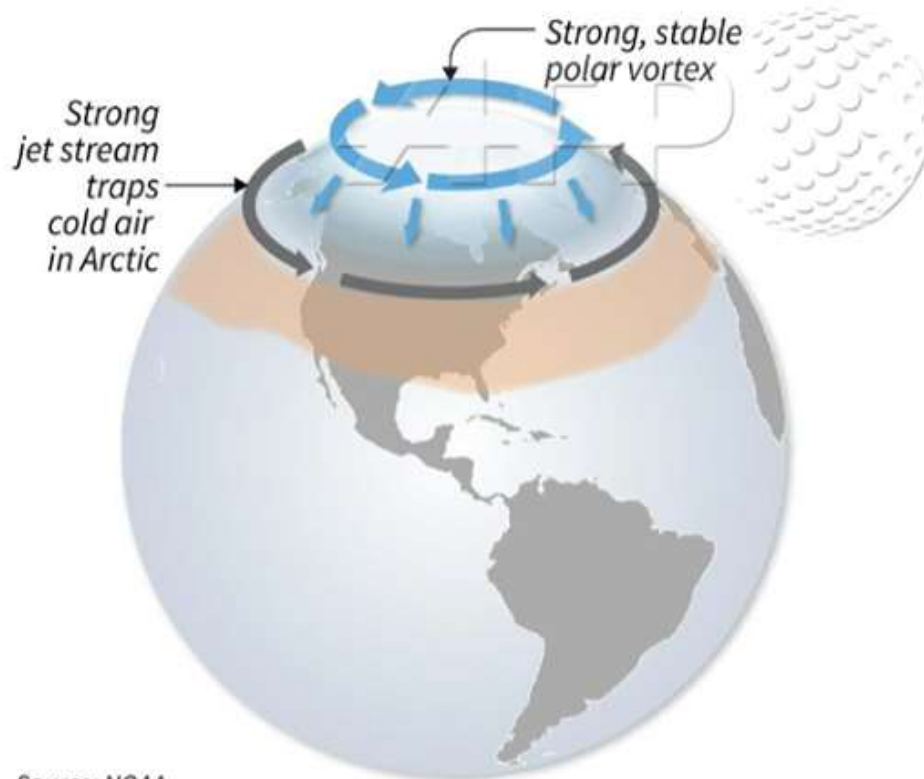


Warming Arctic driving extreme weather

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

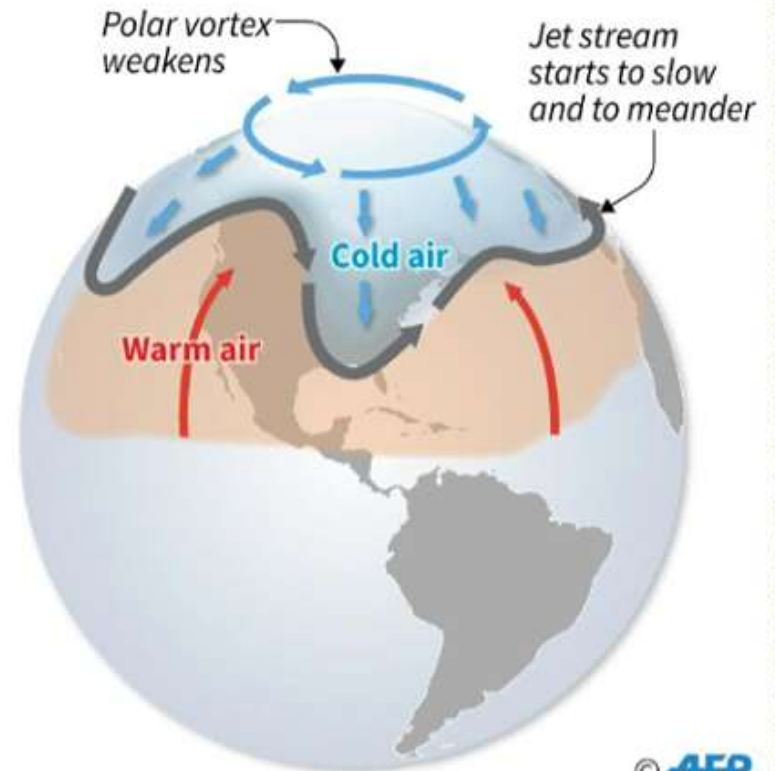
► Normal circumstances

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: AFP News Agency

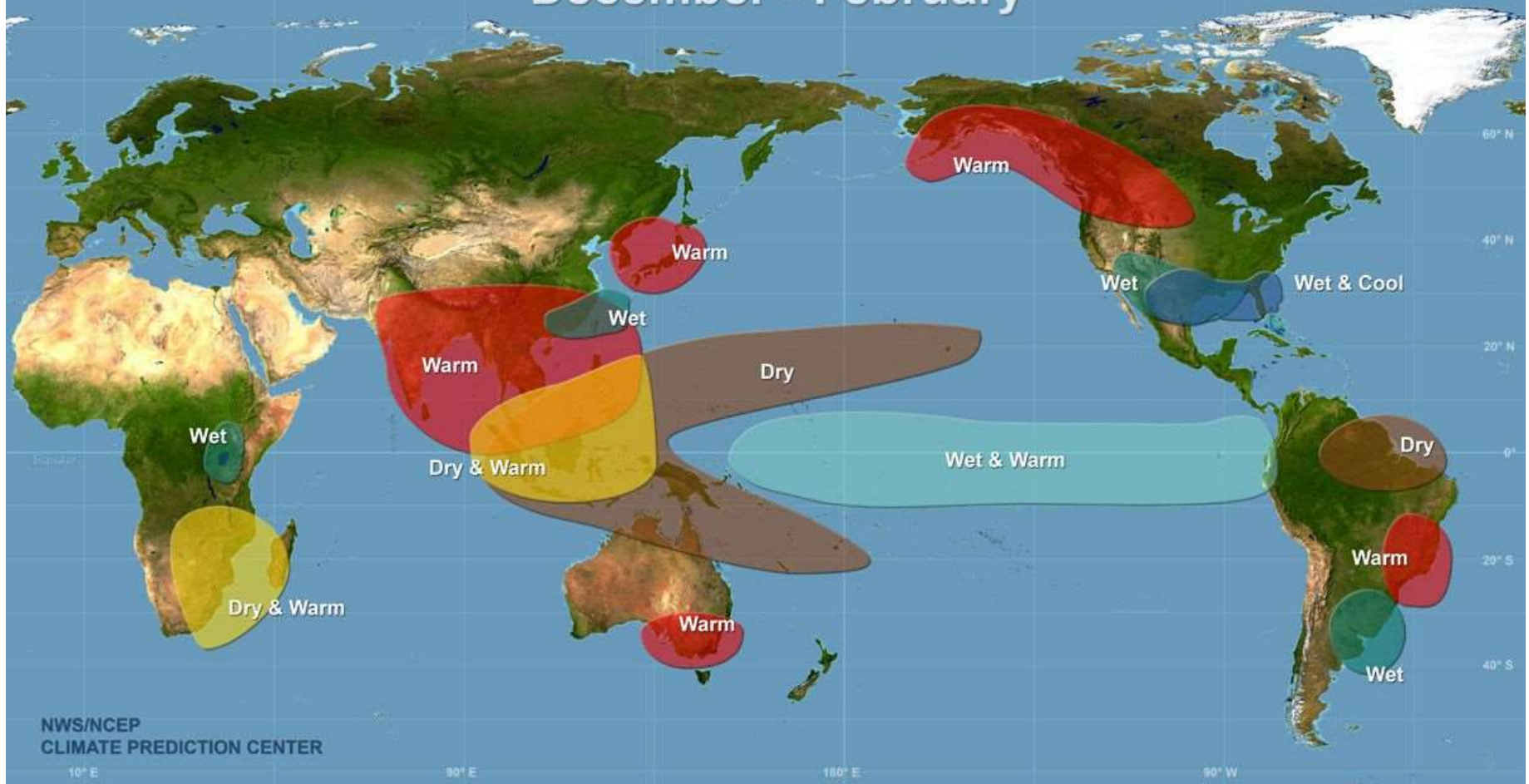
- Wind systems in the lower latitudes including western disturbances, monsoon trade winds and cyclones are getting disrupted
- El Nino Southern Oscillation (ENSO) is the cyclic warming of eastern and central Pacific Ocean
- It has been connected to droughts and erratic monsoon in India
- El Nino events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





Warm Episode Relationships

December - February



Source: National Oceanic and Atmospheric Administration

Attribution Science

- Calculates the chances that an extreme weather event has been caused by global warming
- The extensive heat waves of 2015-16 have been attributed to global warming with great certainty
- Still in early stages of development
- Will inform policy makers on the management and financing of adaptation



Few links to important stories

<https://www.downtoearth.org.in/coverage/climate-change/run-for-cover-100-days-44-storms-16-states-423-deaths-60743>

<https://www.downtoearth.org.in/coverage/natural-disasters/cyclone-fani-the-tale-of-a-weird-storm-64521>

<https://www.downtoearth.org.in/news/natural-disasters/cyclone-fani-opens-four-new-mouths-in-chilika-lake-increases-salinity-wipes-out-fish-65071>

<https://www.downtoearth.org.in/news/climate-change/communication-gap-bihar-floods-show-why-india-nepal-need-to-get-their-act-together-65961>

<https://www.downtoearth.org.in/coverage/climate-change/this-is-why-kerala-floods-were-the-worst-in-a-century-61491>



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Thank you

