



**CONCLAVE 2021**  
CSE's Annual Green Educator's Network Meet

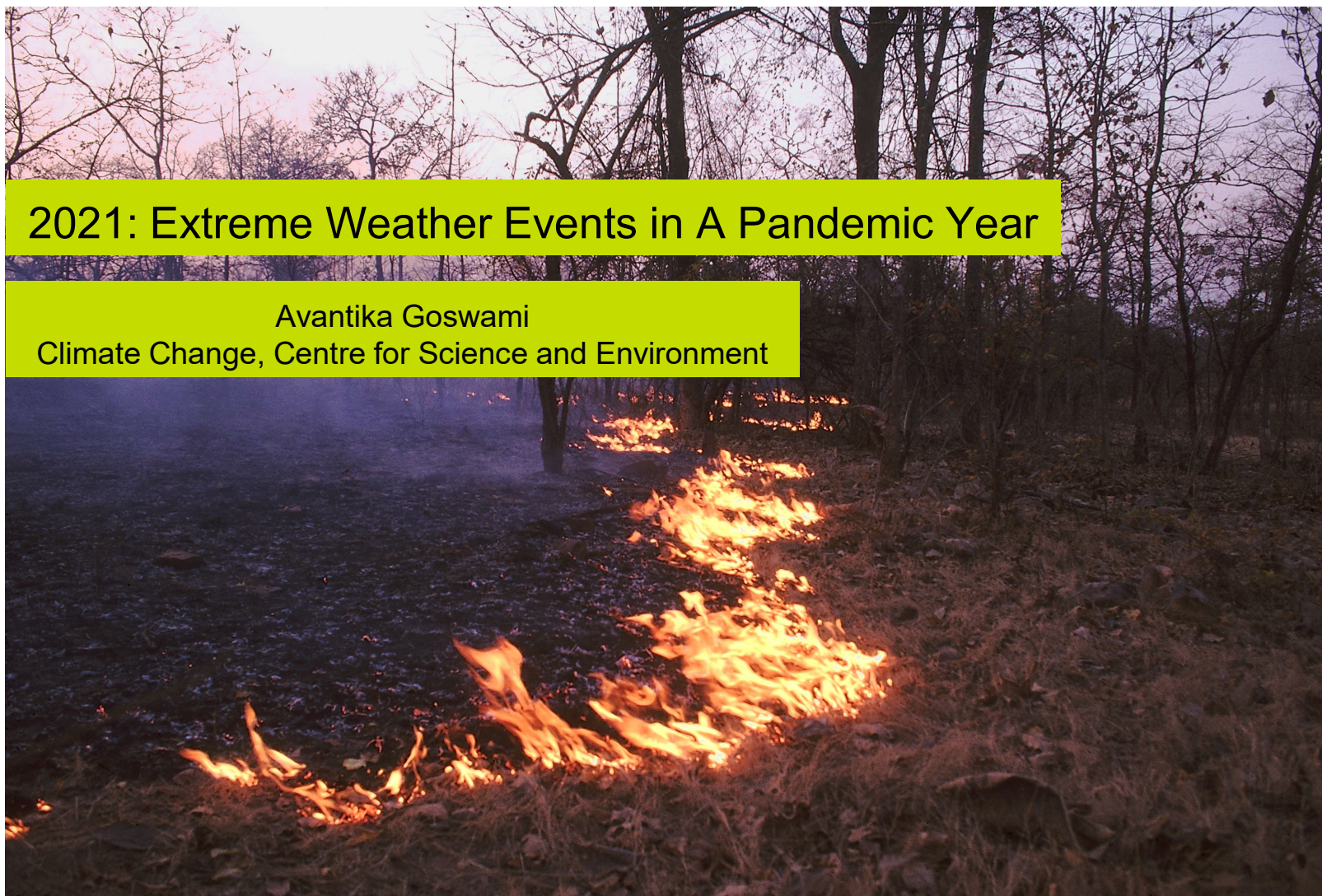
# The New World (Dis)order

Building a better and greener world in the post-pandemic era



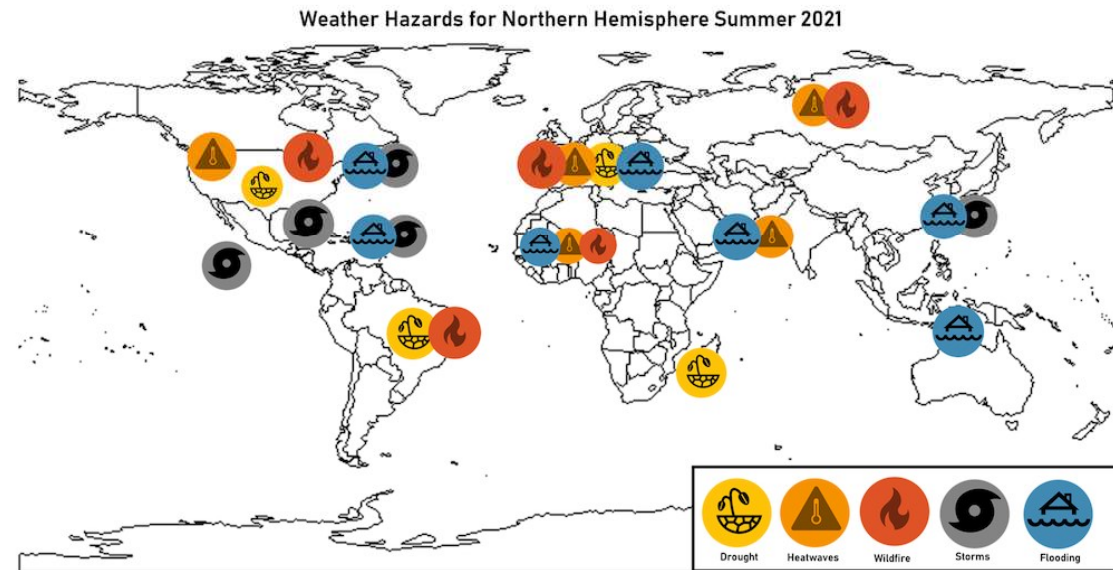
# 2021: Extreme Weather Events in A Pandemic Year

Avantika Goswami  
Climate Change, Centre for Science and Environment



# Extreme Weather in the Summer of 2021

- Cyclones and hurricanes
  - Hurricane Elsa, Barbados
  - Tropical Storm Grace, Haiti
  - Hurricane Henri and Ida, USA
  - Typhoon In-fa, China
  - Flooding, Nigeria
  - Flooding and landslides, India
  - Rainfall and flooding, UK, Turkey, Germany, Belgium
- Heatwaves
  - Pacific Northwest, USA and Canada
  - Siberia
  - Pakistan, Northern India, UAE
  - North Africa
  - UK, Spain, Italy, Greece
- Wildfires
  - Siberia, Algeria, Greece, Turkey, Israel, USA, Canada
- Drought
  - USA, Canada
  - Madagascar
  - Brazil



Source: [Carbon Brief](#)





# Extreme Weather Events in India

In 2020, the first wave of COVID-19 occurred in India alongside two of the world's 10 most costly climate disasters: Super Cyclone Amphan (\$14 billion in costs), and flooding due to extreme rainfall (\$10 billion in costs)

In 2021, the devastating second wave of COVID-19, caused 56% of total COVID deaths in India during its peak (235,986 deaths between April and June 2021). Almost in parallel, the country experienced a wave of extreme events from spring to summer:

- Mountain floods and landslides in Uttarakhand
- Cyclone Tauktae
- Erratic monsoon
- Summer heat wave
- Flooding due to extreme rainfall in Bihar, Himachal Pradesh, Goa, Gujarat and Maharashtra
- Lightning strikes in Rajasthan, Uttar Pradesh and Assam
- Deficit rainfall in Manipur, Ladakh and Gujarat

Ranking 2019 (2018)	Country	CRI score	Fatalities	Fatalities per 100 000 inhabitants	Absolute losses (in million US\$ PPP)	Losses per unit GDP in %	Human Development Index 2020 Ranking <sup>14</sup>
1 (54)	Mozambique	2.67	700	2.25	4 930.08	12.16	181
2 (132)	Zimbabwe	6.17	347	2.33	1 836.82	4.26	150
3 (135)	The Bahamas	6.50	56	14.70	4 758.21	31.59	58
4 (1)	Japan	14.50	290	0.23	28 899.79	0.53	19
5 (93)	Malawi	15.17	95	0.47	452.14	2.22	174
6 (24)	Islamic Republic of Afghanistan	16.00	191	0.51	548.73	0.67	169
7 (5)	India	16.67	2 267	0.17	68 812.35	0.72	131
8 (133)	South Sudan	17.33	185	1.38	85.86	0.74	185
9 (27)	Niger	18.17	117	0.50	219.58	0.74	189
10 (59)	Bolivia	19.67	33	0.29	798.91	0.76	107

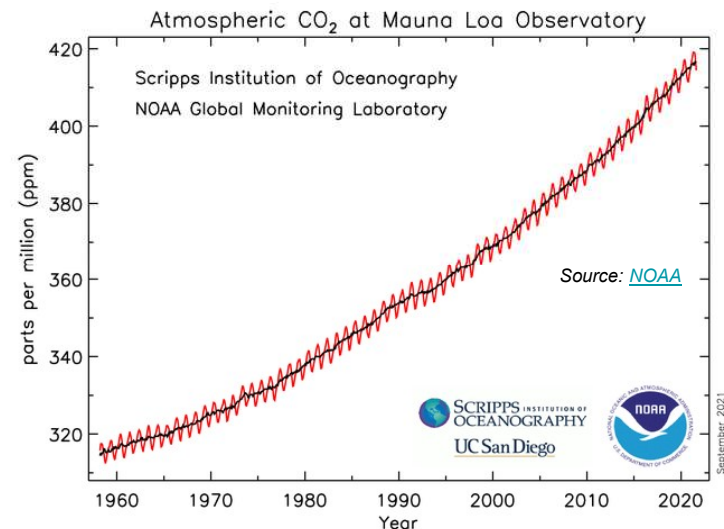
PPP = Purchasing Power Parities. GDP = Gross Domestic Product.

**India ranked 7<sup>th</sup> among the 10 countries most affected by extreme weather events in 2019 – Global Climate Risk Index 2021**



## The IPCC's Sixth Assessment Report (AR6)

- ❖ The current concentration of carbon dioxide is 414 parts per million (ppm), the level deemed 'safe' was 350 ppm
- ❖ Almost 100% of this has been caused by human-driven burning of fossil fuels and deforestation
- ❖ This has caused the Earth to heat up by 1.09 degrees Celsius since pre-industrial times (1850); the last decade was hotter than any period in the past 1,25,000 years
- ❖ There will be further warming in the coming decades unless there are immediate, strong, and rapid reductions to global emissions
- ❖ Every additional 0.5 degree of warming will increase hot extremes, extreme precipitation, and drought



*"It is indisputable that human activities are causing climate change, making extreme climate events including heat waves, heavy rainfall, and droughts, more frequent and severe."* – IPCC AR6, August 2021



# Climate Change and Extreme Weather Events

Some extreme weather events can be explained by the natural climate cycles of Earth's atmosphere like the El Nino Southern Oscillation. Others have a clear imprint of global warming...

- Increasing GHGs in the atmosphere lead to warming of the atmosphere and Earth's surface
- Reduced snow cover and drier soil lead worsen the impacts
- Warmer temperatures also lead to increasing water-holding capacity of the atmosphere, which leads to more extreme rainfall
- Extreme rainfall events induce floods, flash floods and landslides
- More water vapour and warmer oceans also increase the intensity of cyclones
- Disruption of the monsoon leads to cycles of floods and droughts
- Rising sea levels expose coastal areas to the impact of stronger winds and heavy rainfall



# Climate Change and Extreme Weather Events

**Attribution science has emerged as a growing field of climate research** - these studies assess whether – and to what extent – human-caused climate change have affected the frequency and/or intensity of extreme weather events

Extreme summer heat in India in 2010 and 2015 was attributed with high confidence to human-driven global warming

Floods in Germany and Belgium in July 2021 were intensified 3-19 per cent by climate change according to scientists

The unprecedented heat wave in Canada in July 2021 was deemed “*virtually impossible without human-caused climate change*”

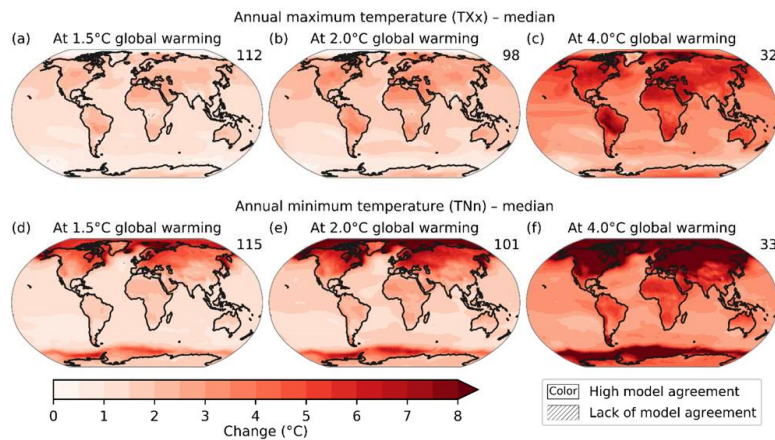
**Researchers have also predicted future patterns of extreme events in India**

Studies have found that...

.....as global CO<sub>2</sub> levels rise, there will be increased rainfall due to the South Asian monsoons (Brown University)

....and for every degree Celsius of warming, Indian monsoon rainfall will likely increase by about 5% (Potsdam Institute)

# The IPCC's Sixth Assessment Report (AR6)

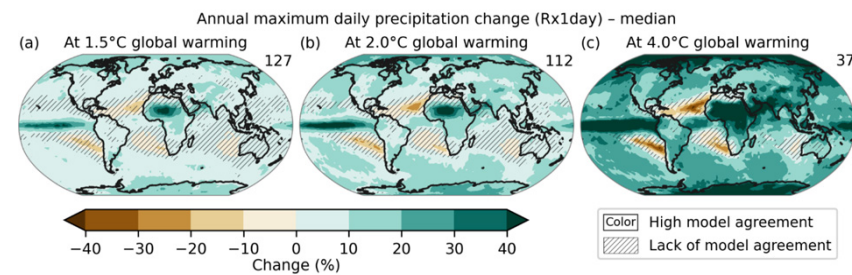


IPCC's projections for annual maximum temperature (top) and annual minimum temperature (bottom) under 1.5C (left), 2C (middle) and 4C (right) of warming

Rising temperatures will mean “the land area affected by increasing drought frequency and severity” will expand

Heavy rainfall will “generally become more frequent and more intense with additional global warming”

For India, heat extremes, extreme rainfall, droughts and flooding will become the new normal



Future projections of annual maximum daily precipitation under 1.5C (left), 2C (middle) and 4C (right) of warming





# The IPCC's Sixth Assessment Report (AR6)

	Observation	Future Projection	Future Projection - Interpretation
Extreme heat	<i>The frequency and intensity of hot extremes (including heatwaves) have increased and those of cold extremes have decreased on the global scale from 1950</i>	<i>Virtually certain the number of hot days and hot nights and the length, frequency, and/or intensity of warm spells or heat waves compared to 1995-2014 will increase over most land areas</i>	Longer, more frequent, more intense heat waves
Heavy rainfall	<i>The frequency and intensity of heavy rainfall events have likely increased at the global scale over a majority of land regions</i>	<i>Heavy rainfall will generally become more frequent and more intense with additional global warming</i>	More heavy rainfall events especially on a single day
Flooding	<i>Parts of Asia, southern South America, the north-east US, north-western Europe and the Amazon are seeing increased flooding</i>	<i>A larger fraction of land areas to be affected by an increase in river floods than by a decrease in river floods</i>	More places affected by flooding
Drought	<i>Increases in drought affecting crop yields and plant water stress are found on all continents and several regions</i>	<i>More regions are affected by increases in agricultural and ecological droughts with increasing global warming; even relatively small incremental increases in global warming (+0.5C) cause a worsening of droughts in some regions</i>	More crop failure, and water stress for trees and plants, and subsequently human food and livelihoods
Tropical Cyclones	<i>It is likely that the global proportion of category 3-5 tropical cyclone instances and the frequency of rapid intensification events have both increased globally over the past 40 years</i>	<i>Average peak tropical cyclone wind speeds and the proportion of category 4-5 tropical cyclones will very likely increase globally with warming</i>	Stronger cyclones, higher wind speeds
Compound events	<i>Land area affected by concurrent extremes has increased</i>	<i>Concurrent extreme events at different locations, but possibly affecting similar sectors (e.g., breadbaskets) in different regions, will become more frequent with increasing global warming, in particular above +2C of global warming</i>	Combined heatwaves, drought and wildfires, or combined heavy rain, flooding, and sea level rise will be observed



# The Impacts Span Several Sectors

- Economic losses
  - A disaster related to a weather, climate or water hazard occurred every day on average over the past 50 years – killing 115 people and causing US\$ 202 million in losses daily (WMO)
  - From 1970 to 2019, weather, climate and water hazards accounted for 50% of all disasters, 45% of all reported deaths and 74% of all reported economic losses (WMO)
  - US\$ 232 billion losses caused by natural disasters in 2019. US\$ 229 billion by weather related disasters
- Human lives and public health
  - Between 2000 and 2019, 4,75,000 deaths occurred directly due to more than 11,000 extreme weather events (Global Climate Risk Index)
- Worsening climate and biodiversity impacts
  - Wildfires around the world emitted more CO<sub>2</sub> in July and August 2021 than India does in one year (Copernicus)
- Displacement and safety
  - In 2020, extreme weather events displaced 55 million people worldwide, 929,000 in India alone (IDMC)
  - Extreme weather events are putting women and children at risk of modern slavery and human trafficking due to climate-related forced displacement and migration, such as the displacement caused in the Sundarbans due to Cyclone Amphan