Weather variability or climate change: de-coding the extreme events that are defining our today

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New Record

- **World Meteorological Organization, Geneva,**
- **November 22, 2018 -**
- Levels of heat-trapping greenhouse gases in the atmosphere have reached **another new record high**
- There is no sign of a reversal in this trend, which is driving long-term climate change, sea level rise, ocean acidification and more extreme weather.
- Globally averaged concentrations of carbon dioxide (CO_2) reached 405.5 parts per million (ppm) in 2017, up from 403.3 ppm in 2016 and 400.1 ppm in 2015.
- The increase in CO_2 from 2016 to 2017 was about the same as the average growth rate over the last decade.

Our world today…

- **..is in crisis**
- Climate change is happening; not about the future. **But now**
- Leading to variable weather events
- Leading to devastating impacts on the poorest, <u>who are not responsible for stock of emissions in the atmosphere</u>
- <u>**..But**</u>

Climate change?

November 21, 2018

Donald Trump @President of US

“Brutal and Extended Cold Blast could shatter ALL RECORDS - Whatever happened to Global Warming?”


WE'RE GOING TO HAVE GREAT CLIMATE!
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Weather variability or climate change?

- What is climate change?
- Natural variable weather or is this <u>different</u>?
- Floods normal or <u>different</u>?
- Droughts always happened so <u>why blame climate change</u>?
- What is this new normal?

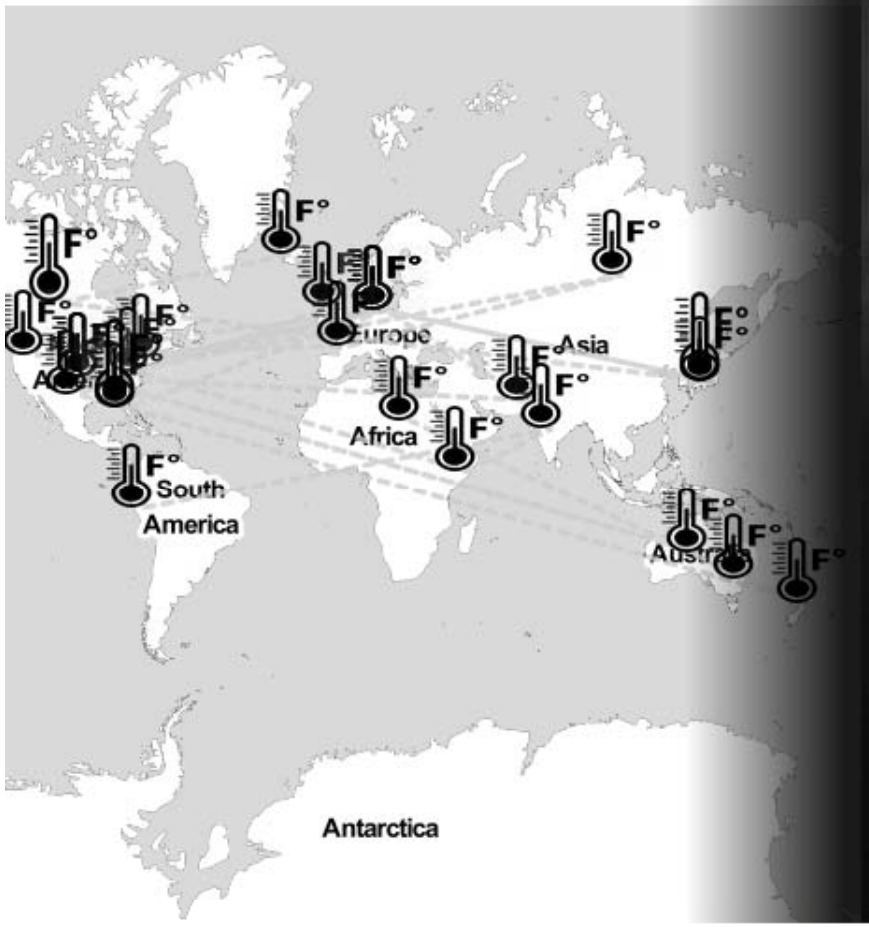
Weather vs climate

- The difference between weather and climate is a measure of time,”
- Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere ‘behaves’ over relatively long periods of time.
- Behaving differently

New normal....

....is weird and extreme weather events

- **Extreme rainfall** – getting rain of entire year in a matter of few hours
- **Extreme heat** – higher and more intense
- **Extreme dust storms** – more heat means more fierce and deadly storms
- **More tropical storms** – frequency is increasing



EXTREME IS THE NEW NORMAL

How climate change affects extreme weather around the world

The world has seen 16 record-breaking hottest years since 2000. In fact, global surface temperatures are already rising about 20 times faster than the Earth's fastest natural climate change, during the transition in and out of ice ages. There has been an 8-inch rise in global sea levels over the last century. The rate of rise has nearly doubled in the last two decades. Human-induced climate change is quite clearly the culprit.

Start Exploring

JAPAN'S WORST RAINS IN 50 YEARS

July, 2018

More than 127 people have died and millions were told to leave their homes to escape flooding after rainfall over a two-day period in parts of western and central Japan exceeded a 50-year-old record. Nearly 60 people are missing.

Source: https://qz.com/1323398/japans-worst-rains-in-50-years-have-left-thousands-of-people-in-danger/

JULY HEATWAVES IN CANADA DAY LEAVE 70 DEAD

July, 2018

An estimated 70 deaths have been connected to the scorching temperatures and humidity that hit Canada's provinces: Ontario and Quebec. Temperatures remained in the high 30s. According to Environment Canada modelling, the average summer temperature across Ontario between 2041 and 2070 will be 3.5°C higher than it was between 1981 and 2010.

Source: https://globalnews.ca/news/4310754/canada-day-heat-wave-latest-example-of-changing-climate-patterns-...

ICELAND: HAVING THE WORST SUMMER FOR 100 YEARS

July, 2018

Greyest, wettest summer since 1914, preceded by rain every single day in May.

According to Icelandic meteorologist Trausti Jonsson, the UK heatwave is to blame for Iceland's struggling ice-cream vendors, outdoor pools and campsites. "The people of Reykjavík are paying for the sunshine in England and southern Scandinavia," he said, thanks to high pressure over western Europe changing the jet stream and pushing clouds over the north of the continent.

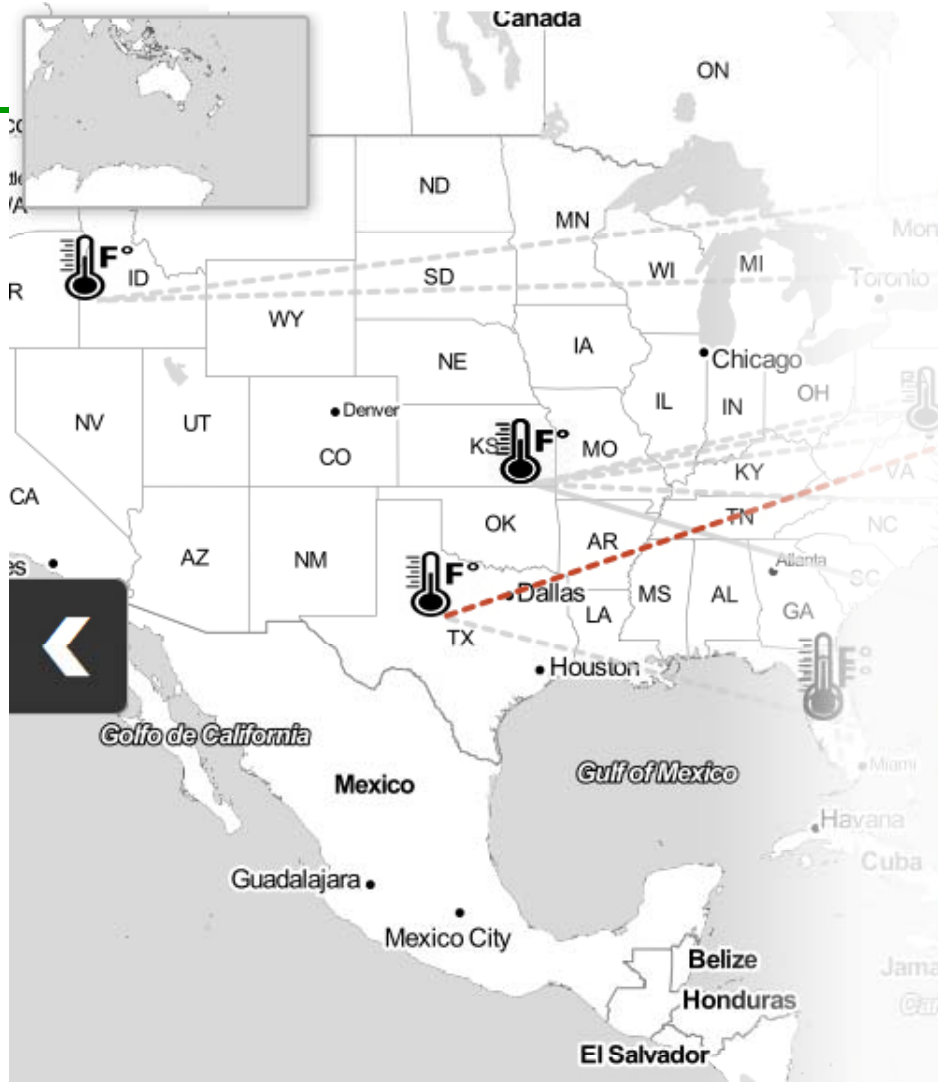
Source: https://www.theguardian.com/science/shortcuts/2018/jul/06/iceland-is-having-the-worst-summer-for-100...

UK IS EXPERIENCING ITS LONGEST HEATWAVE SINCE 1976

June 2018

Britain had the second-hottest June on record, and much of the country had the driest June. That weather that has persisted into July, driving up water use even as reservoir and river levels fall. Temperatures across southern Britain have bee hovering in the upper 20°Cs through next week with highs of 30°C or 31°C possible into next weekend. UK weather charts show the possibility of temperatures touching 35°C mark in some parts. Record temperatures have been stopping many people from getting a proper rest as they struggle to get to sleep in rooms that are uncomfortably warm.

Source: https://www.nytimes.com/2018/07/04/world/europe/uk-ireland-heat-wave.html

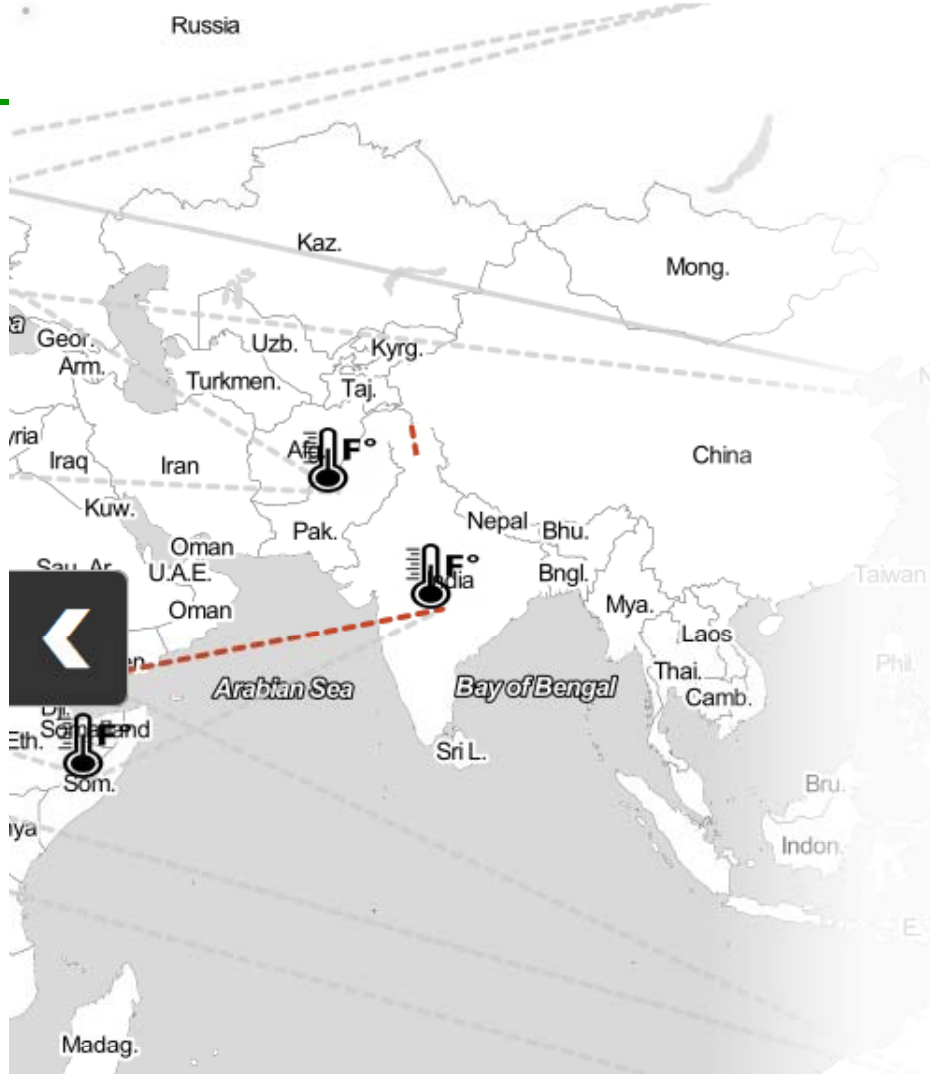


RECORD HIGH SUMMER TEMPERATURES IN THE US

June, 2018

Nearly 80 million people in the United States remained under a heat advisory or warning in the first week of July, with scorching temperatures and humidity making the summer unbearable. In California, daytime records were set at Chino (48.9°C), Burbank airport (45.6°C) and Van Nuys airport (47.2°C). Downtown Los Angeles saw a new monthly July minimum overnight record of 26.1°C on July 7.

Source: https://www.theguardian.com/news/2018/jul/06/weatherwatch-heat-burst-texas-midnight



UNPRECEDENTED STORM SEASON IN INDIA

May, 2018

An unprecedented storm season, which lasted for more than 100 days, led to the deaths of more than 500 people, with 306 people having lost their lives in Uttar Pradesh alone, between April 1 and June 13. There are clear indications of how general trend of warming is exacerbating stormy weather during the pre-monsoon season.

Source: https://www.washingtonpost.com/news/capital-weather-gang/wp/2018/05/03/india-dust-storm-uttar-pradesh-rajasthan-officials-say-at-least-100-dead/?utm_term=.1b3bc8d5ecf5

EXCEPTIONAL DROUGHT IN PARTS OF SEVEN STATES IN SOUTHWEST US

April, 2018

Changing of the seasons from winter to spring led to the increased extent of extreme drought conditions from Oklahoma to Texas and Kansas, with detached pockets also appearing in Arizona and New Mexico by mid-February. By mid-March, drought in Oklahoma had reached "exceptional" status, and severe drought had pushed northward from Arizona and New Mexico to Utah and Colorado. As of mid-April, parts of seven southwestern states had progressed into exceptional drought.

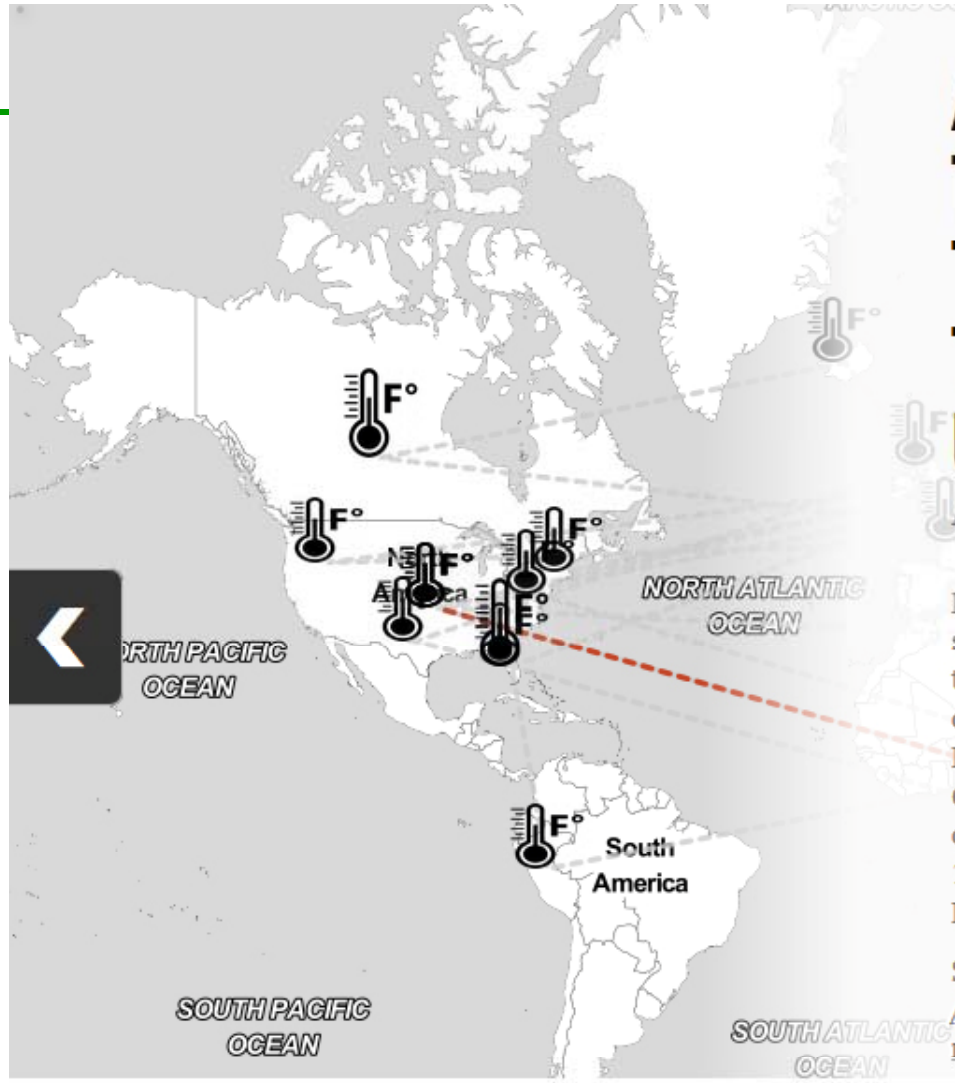
Source: https://www.climate.gov/news-features/featured-images/exceptional-drought-parts-

AUSTRALIA BROKE HEAT RECORDS FOR APRIL

April, 2018

April 9 was the hottest April day on record in Australia, with a national average of 34.9°C, eclipsing a record set in 2005. The country's hotter-than-usual spell primarily affected the northwest. Before 2018, nowhere in Australia had a recorded temperature higher than 45°C. That number was broken four times, with Western Australia's Mardie Station and Roebourne recording the highest temperatures of 45.9°C in the last days of March.

Source: https://mashable.com/2018/04/13/australia-heat-records-bom/#uLRA6ewoqiqf



APRIL 2018 WAS THE COLDEST IN TWO DECADES FOR THE CONTINENTAL US

April, 2018

New record for lowest temperature was set in two states in the US—Iowa and Wisconsin. Both had the coldest April in 124 years of records. Eight others states east of the Rockies—Illinois, Kansas, Michigan, Minnesota, Missouri, Nebraska, Oklahoma and South Dakota—had their second-coldest April. This year's April was among the top 10 coldest on record for 22 states east of the Rockies.

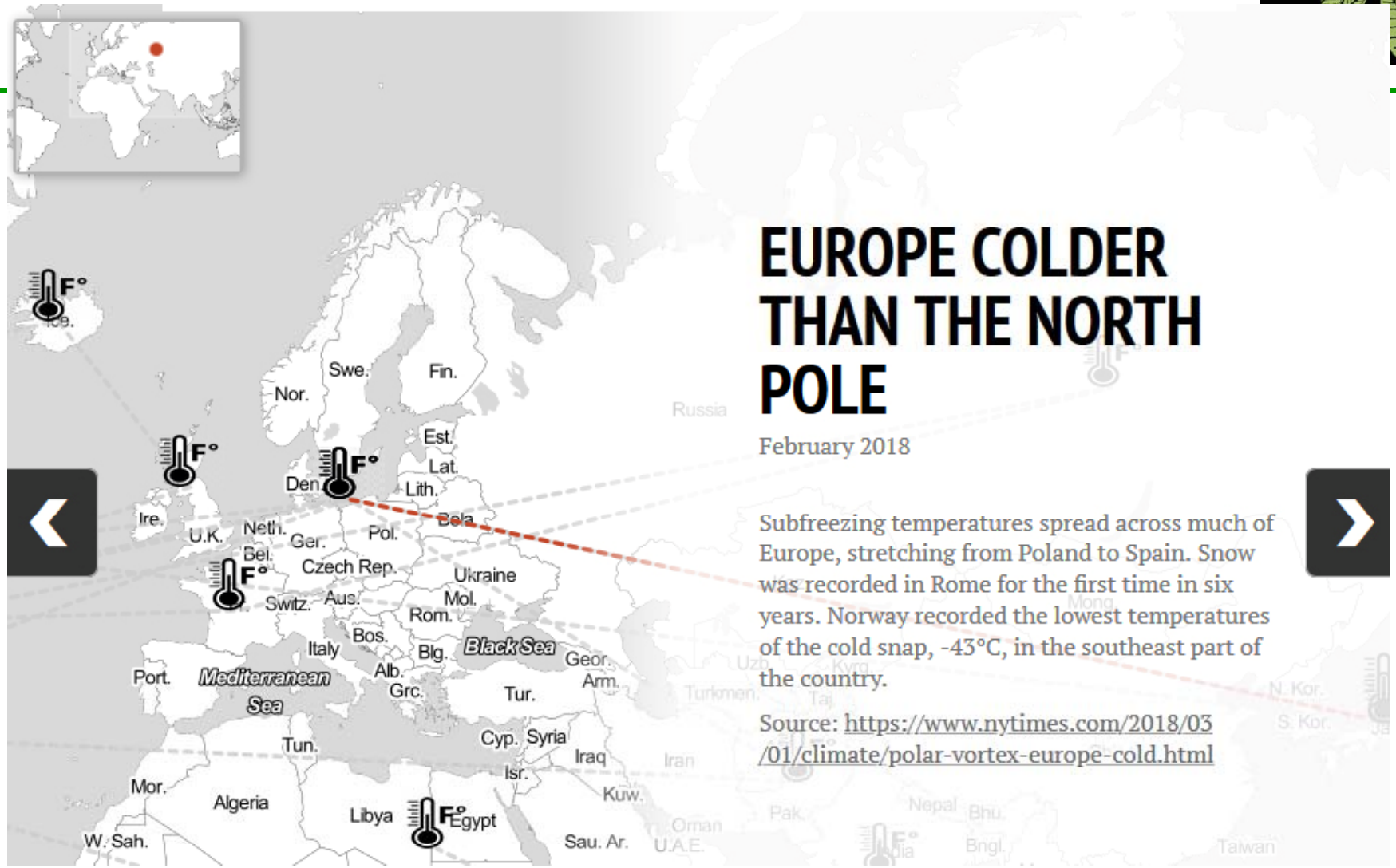
Source: http://www.nydailynews.com/news/national/record-breaking-cold-hit-northeastern-u-s-weekend-article-1.3914650

HOTTEST APRIL DAY IN HISTORY OF THE EARTH RECORDED IN PAKISTAN

April, 2018

Pakistan endured the hottest-ever day recorded on earth during the month of April as temperatures exceeded 50°C. A peak of 50.2°C was measured in Nawabshah, Sindh Province, in the southeast of the country on April 30, according to figures from the World Meteorological Organization.

Source: https://www.independent.co.uk/news/world/asia/april-temperatures-hottest-day-earth-records-karachi-nawabshah-heat-wave-a8336001.html



EUROPE COLDER THAN THE NORTH POLE

February 2018

Subfreezing temperatures spread across much of Europe, stretching from Poland to Spain. Snow was recorded in Rome for the first time in six years. Norway recorded the lowest temperatures of the cold snap, -43°C, in the southeast part of the country.

Source: https://www.nytimes.com/2018/03/01/climate/polar-vortex-europe-cold.html

WESTERN JAPAN FACES ITS COLDEST WINTER IN 32 YEARS

February 2018

On February 6, more than 1,000 vehicles were stranded by heavy snow in the Fukui Prefecture in western Honshu. Those stuck had to be dug out by the military. After a meeting, Japan's Meteorological Agency declared that La Nina was to blame for the unusually cold conditions.

Source: https://www.aljazeera.com/news/2018/03/la-nina-triggers-extreme-weather-japan-australia-180306090055000.html

RUSSIA BRAVES COLD TEMPERATURES OF -67 C, COLDER THAN MOST THERMOMETERS GO

January 2018

Even thermometers can't keep up with the plunging temperatures in Russia's remote Yakutia region, which hit minus 67 degrees Celsius in some areas Tuesday.

In Yakutia — a region of 1 million people about 3,300 miles (5,300 kilometers) east of Moscow — students routinely go to school even in minus 40 degrees. But school was canceled Tuesday throughout the region and police ordered parents to keep their children inside.

FRANCE SEES WORST RAINS IN 50 YEARS

January 2018

Rivers swollen by France's heaviest rains in 50 years have engulfed quays in Paris, swallowed up gardens and roads, halted riverboat cruises and raised concerns about climate change. The floods caused damage to 242 towns along rivers and tributaries.

Source: http://www.chicagotribune.com/news/nationworld/ct-paris-france-flooding-20180129-story.html

SAHARA DESERT, THE HOTTEST IN THE WORLD, RECEIVED 16 INCHES OF SNOW

January 2018

For the third time in the last 40 years, and second time in less than two years, the Sahara Desert had its encounter with snow. While the small Algerian town of Ain Sefra itself saw an inch or two, the sand dunes on its outskirts were blanketed by more than 16 inches (40cm) snow. Prior to that, snow had not been in this region since February 18, 1979.

Source: http://www.dailymail.co.uk/news/article-5246347/Snow-Sahara-desert-time-40-years.html

India extremes: New Normal

- https://www.downtoearth.org.in/dte-infographics/61502_extreme_anomaly_india.html

Attribution to climate

- All of these weather events are far beyond normal variability **called stationarity** as it followed past patterns
- Science of attribution: not perfect but indicative of what is happening
- “Climate change has:
- more than doubled the likelihood of the European heatwave
- tripled the likelihood of drought in Cape Town”

Double-whammy makes for “manmade” disasters

- Combination of our mismanagement of our local environment **and**
- Increased frequency and intensity of extreme and variable weather
- Not natural disaster anymore.
- Manmade devastation

India connections: New Normal

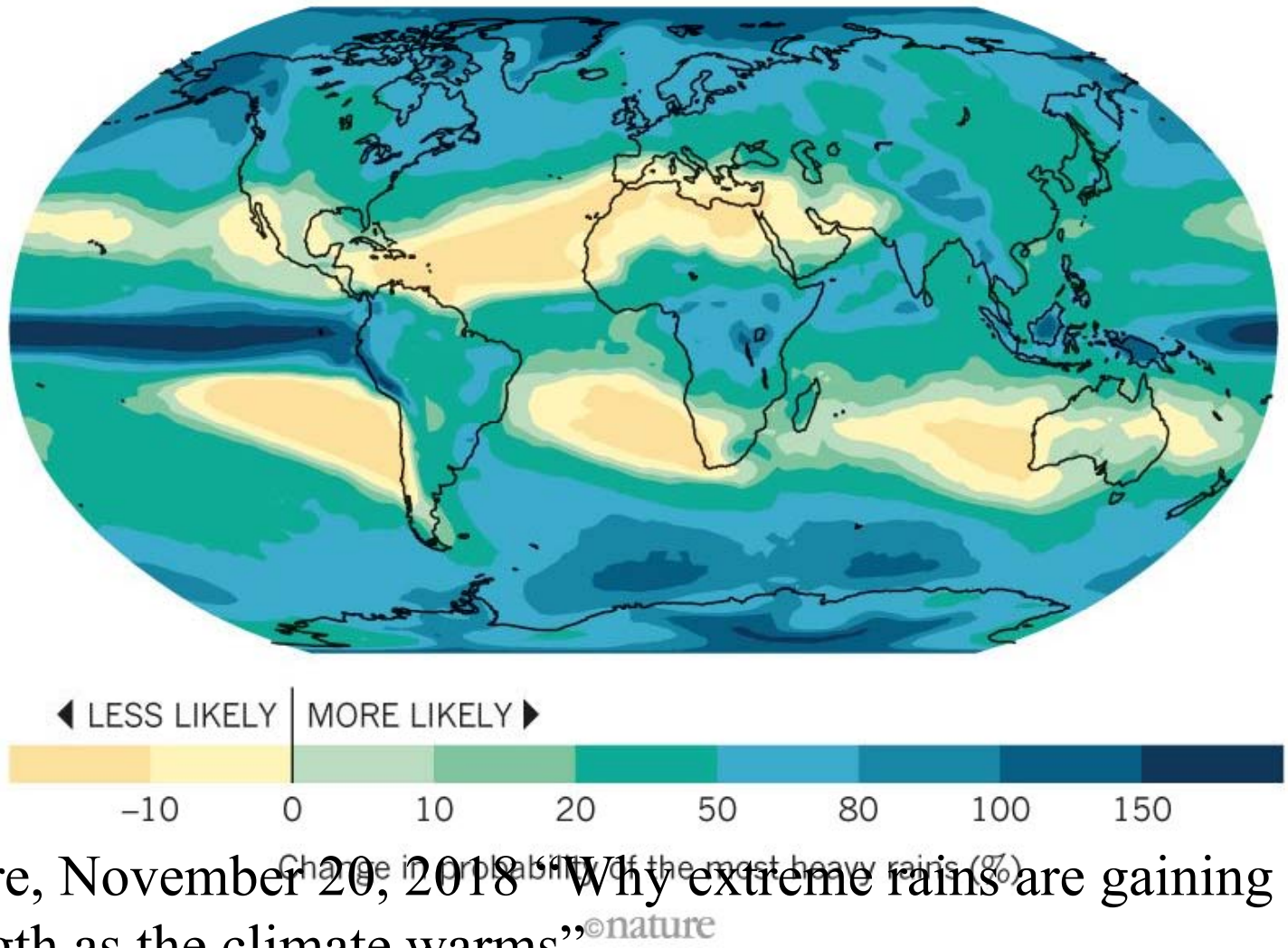
- Dust storms 2018: April-May
- Over 50 dust storms killed over 500 and destroyed homes and crops
- Why: global-local connections

- **A**. Western Disturbance changing – getting longer; link to weakened Arctic Jet Stream – warmer Arctic and difference reduced ocean
- **B**. Bay of Bengal getting warmer – more cyclones; more heavy rain. Colliding with WD, that are more frequent and late
- **C**. Intense heat spikes (Pakistan/north India) which is making ground dry
- **D.** Combined with groundwater overuse; lack of moisture; deforestation
- **Deadly**

Extr

HEAVY RAIN

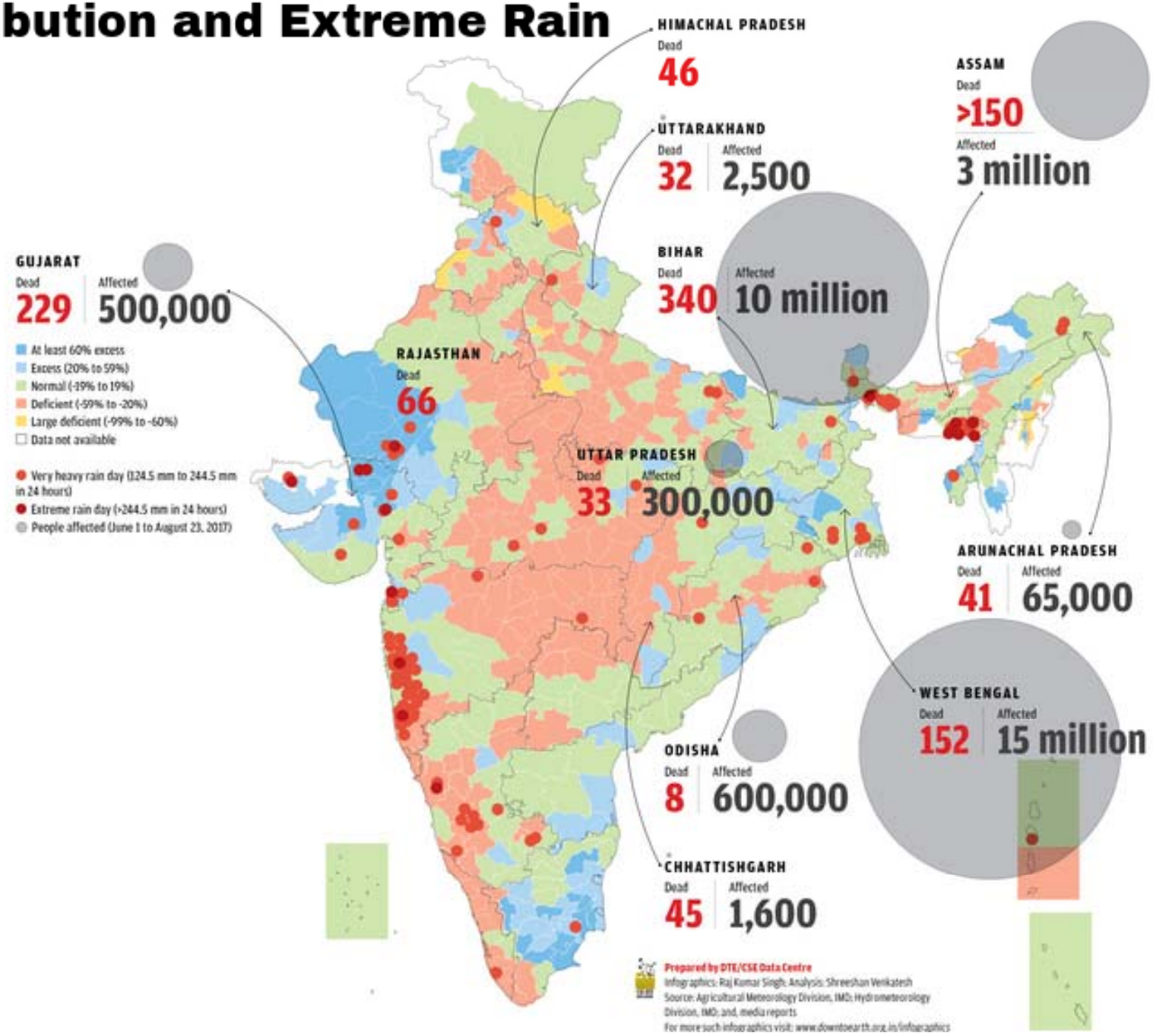
A climate model simulating daily precipitation changes suggests that if the planet warms by 3 °C, most land areas would see substantially more heavy rains.



Nature, November 20, 2018 "Why extreme rains are gaining strength as the climate warms"

Monsoon 2017

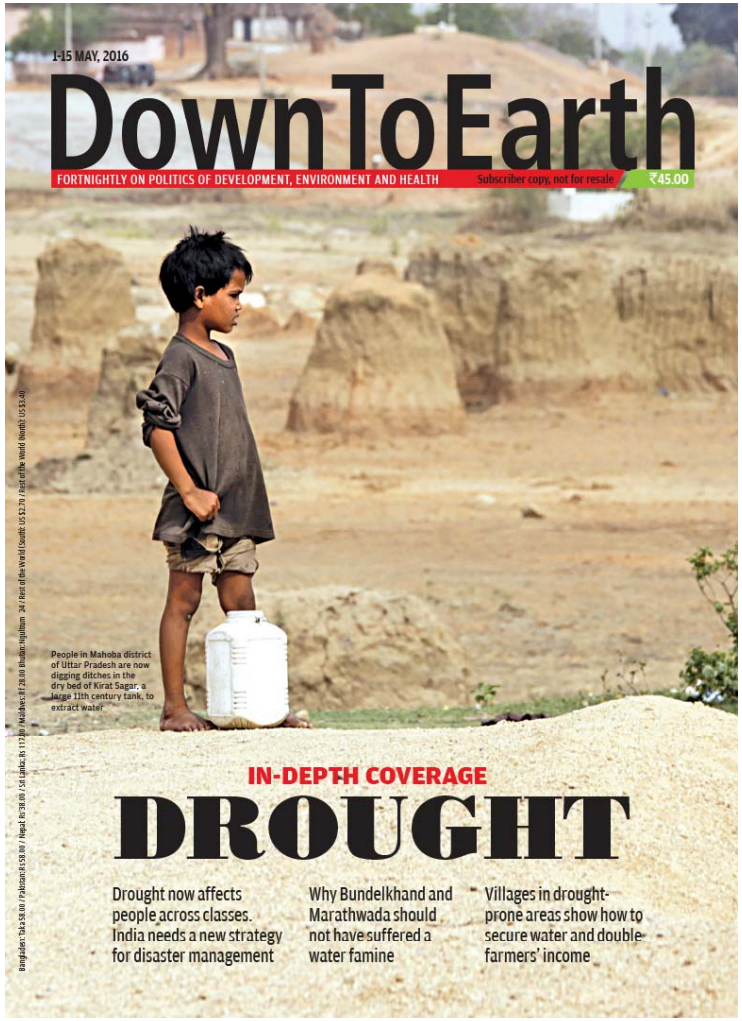
Distribution and Extreme Rain



Double deadly for us: Results in cycle of flood-drought

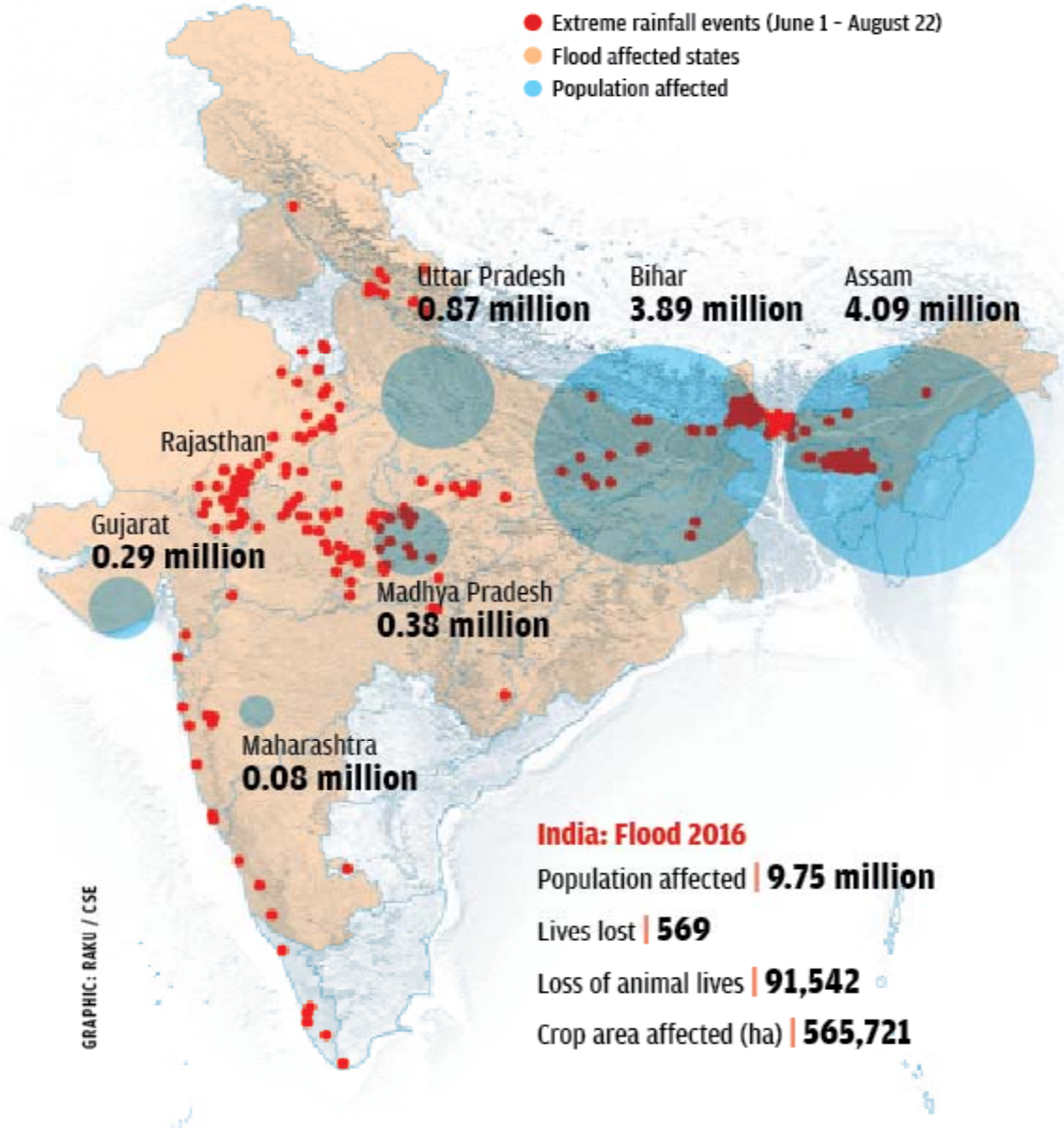
- Extreme rainfall means floods
- But worse, it means that water flows away; is not captured or harvested
- Leads to droughts
- Impacts on farmers – struggling for subsistence
- Impacts on water supply in cities

From crippling drought to deluge



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



GRAPHIC: RAKU / CSE

Kerala flood: extreme rain and lack of preparedness

- Many rivers; short distance from Western Ghats to sea; high rainfall; many dams storing water
- August 2018: Kerala received some 771 mm of rainfall just in 15-20 days, of which 75 per cent was received in just 8 days
- Dams were full: Last few years of drought meant that managers want to store the last drop
- Rain came; dams opened; **flood became deluge**

Kerala: rebuild for new normal

Plan deliberately for drainage – every river, steam, pond, paddy field and city – should be mapped and protected at all costs.

Every home, institution, village and city must be required to do rainwater harvesting so that rain can be channelized and recharged. The forest ecosystem must be built through deliberate policies that provide benefits to people.

Its plantation areas must be managed so that there is soil conservation.

But in age of climate change: Not enough

- Recognize that all we do to do better land, water, forest management will not be enough
- Need science of forecasting; need much better preparedness
- In this case, needed information about the possible ‘extreme rain’ so that dams were managed better

Can’t adapt; can’t cope with spiraling temperature

- Recognise that enough is enough
- Can’t ‘manage’ extreme events
- Have to reduce emissions; have to mitigate
- This is the beginning

What do we do?

- Recognize the **human face** of this manmade disaster
- Recognize the **urgency** of climate change
- Recognize the need to do **differently** to cope and to deal with climate change
- How and what?

Change is here

Change is here to stay and it will become more of deadly as temperatures continue to spiral and this spiral gets out hand.

It is also clear that today the poor in the world are the victims of this ‘manmade’ disaster – local or global.

Rich do not die in sandstorms. Rich do not lose their livelihoods when the next cyclonic system hits.

But the fact is that this weird weather is portend of what awaits us.

The change is not linear—it is not predictable.

Climate change at the end will be an equalizer – it will impact all.