



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

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Our world today...

⑩ **..is in crisis**

⑩ Climate change is happening; not about the future. **But now**

⑩ Leading to variable weather events

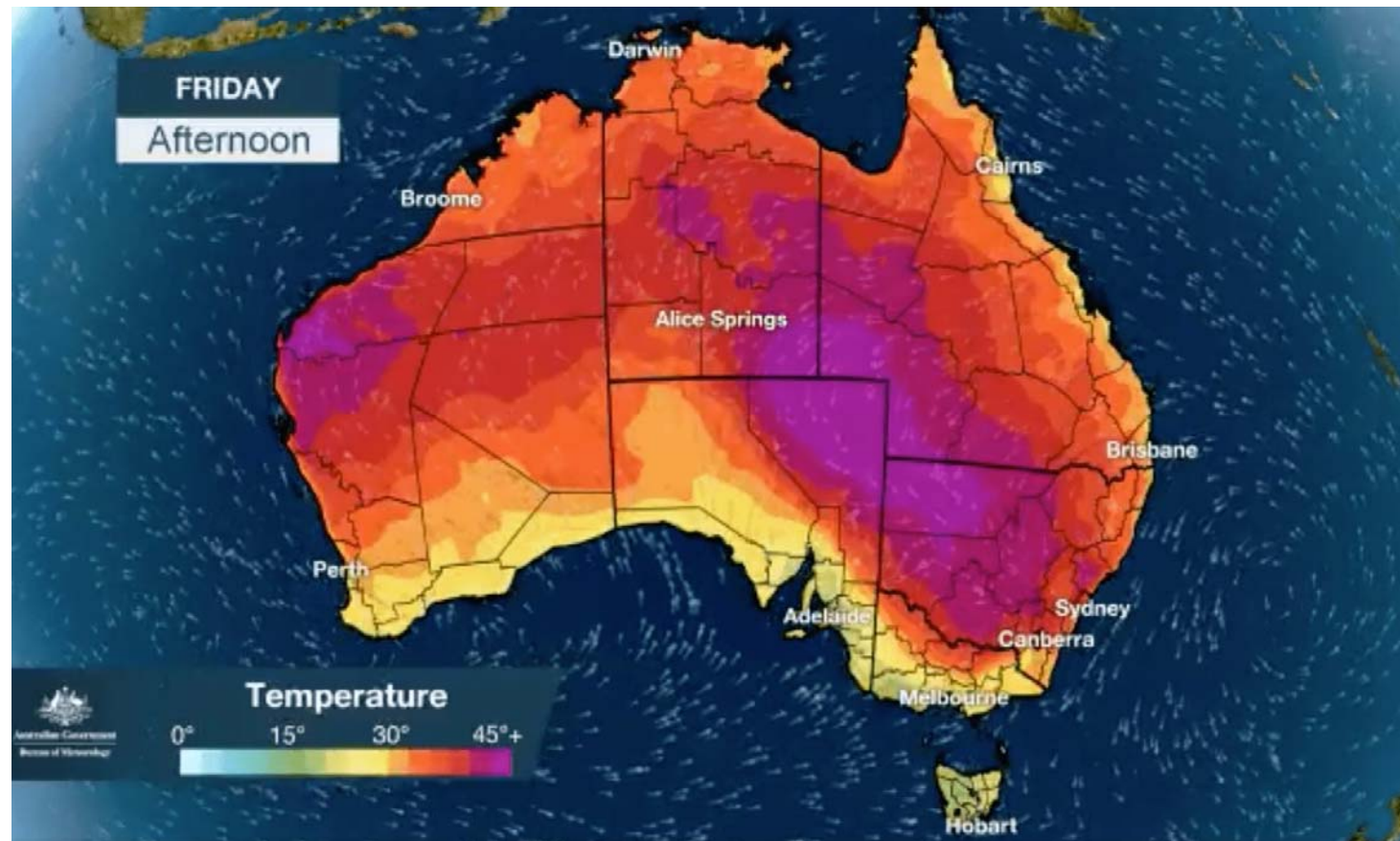
⑩ Leading to devastating impacts on the poorest, who are not responsible for stock of emissions in the atmosphere



New Record

- ⑩ **World Meteorological Organization, Geneva,**
- ⑩ Levels of heat-trapping greenhouse gases in the atmosphere have reached another new record high
- ⑩ 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.
- ⑩ The increase in CO₂ from 2016 to 2017 was about the same as the average growth rate over the last decade

Age of extreme blistering heat and blasting cold



But really Climate change?



November 21, 2018 and now January 2019

Donald Trump @President of US

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



Weather variability or climate change?



- ⑩ What is climate change?
- ⑩ Natural variable weather or is this different?
- ⑩ Floods normal or different?
- ⑩ Droughts always happened so why blame climate change?
- ⑩ What is this new normal?



Weather vs climate

- ⑩ The difference between weather and climate is a measure of time,”
- ⑩ 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.
- ⑩ Behaving differently



New normal....

....is weird and extreme weather events

⑩ **Extreme rainfall** – getting rain of entire year in a matter of few hours

⑩ **Extreme heat** – higher and more intense

⑩ **Extreme dust storms** – more heat means more fierce and deadly storms

⑩ **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

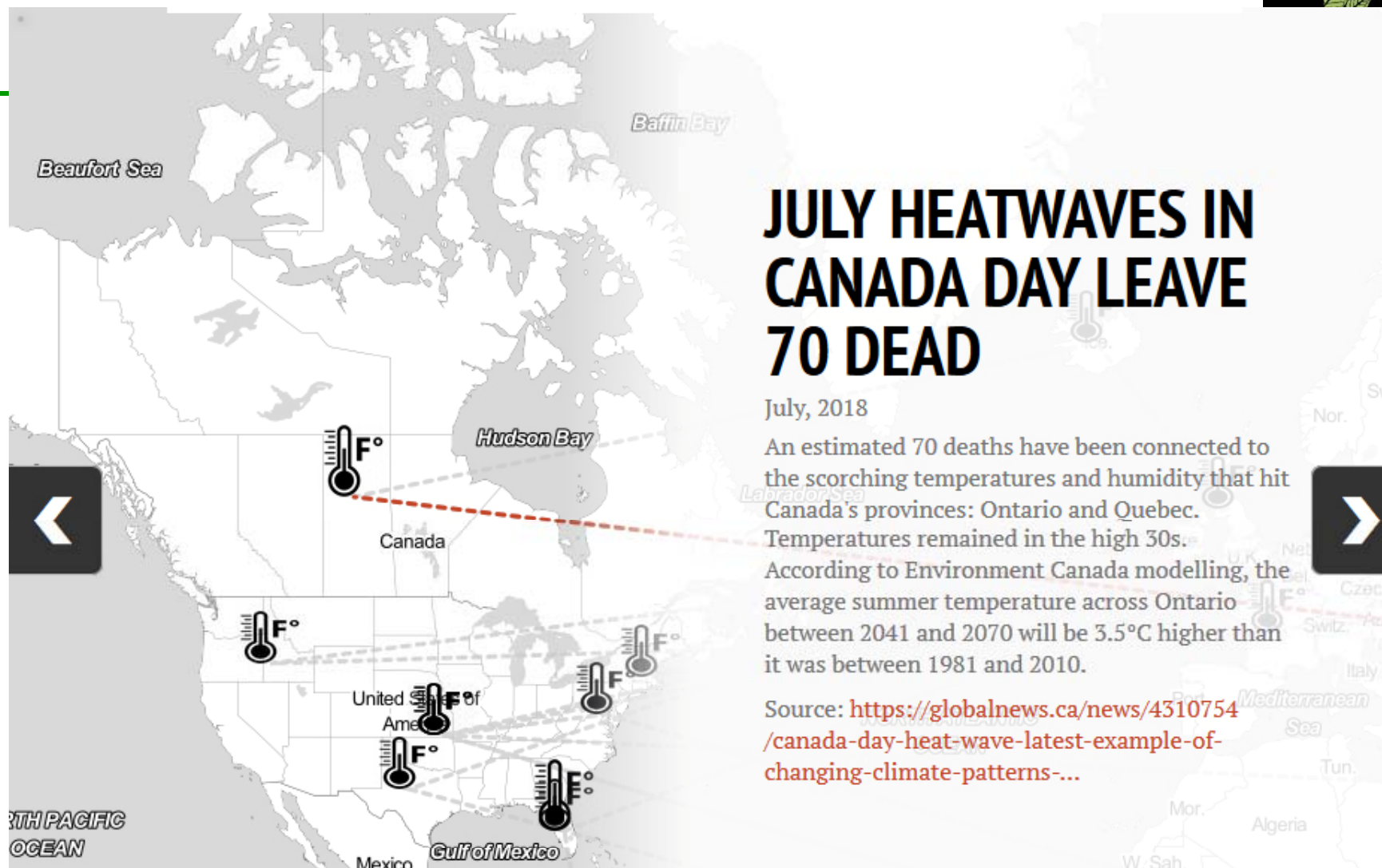


JAPAN'S WORST RAINS IN 50 YEARS

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

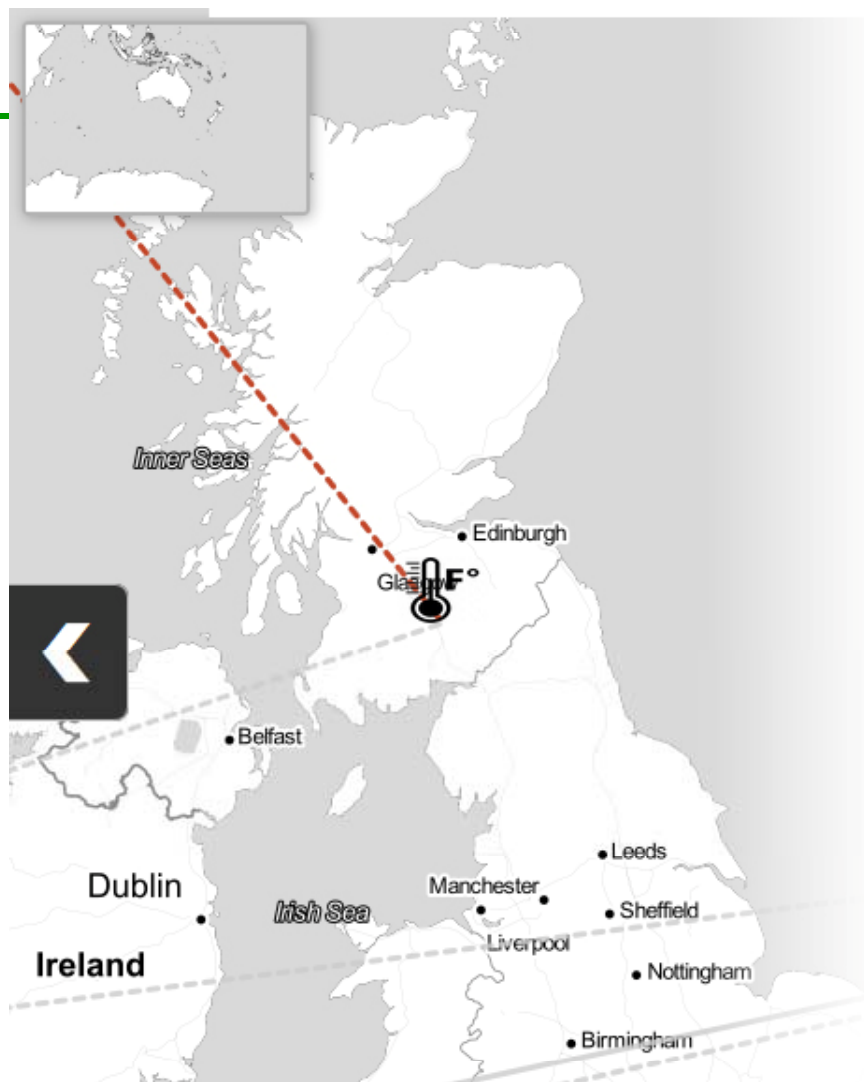
July, 2018

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 Reykjavik 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...>

Norway

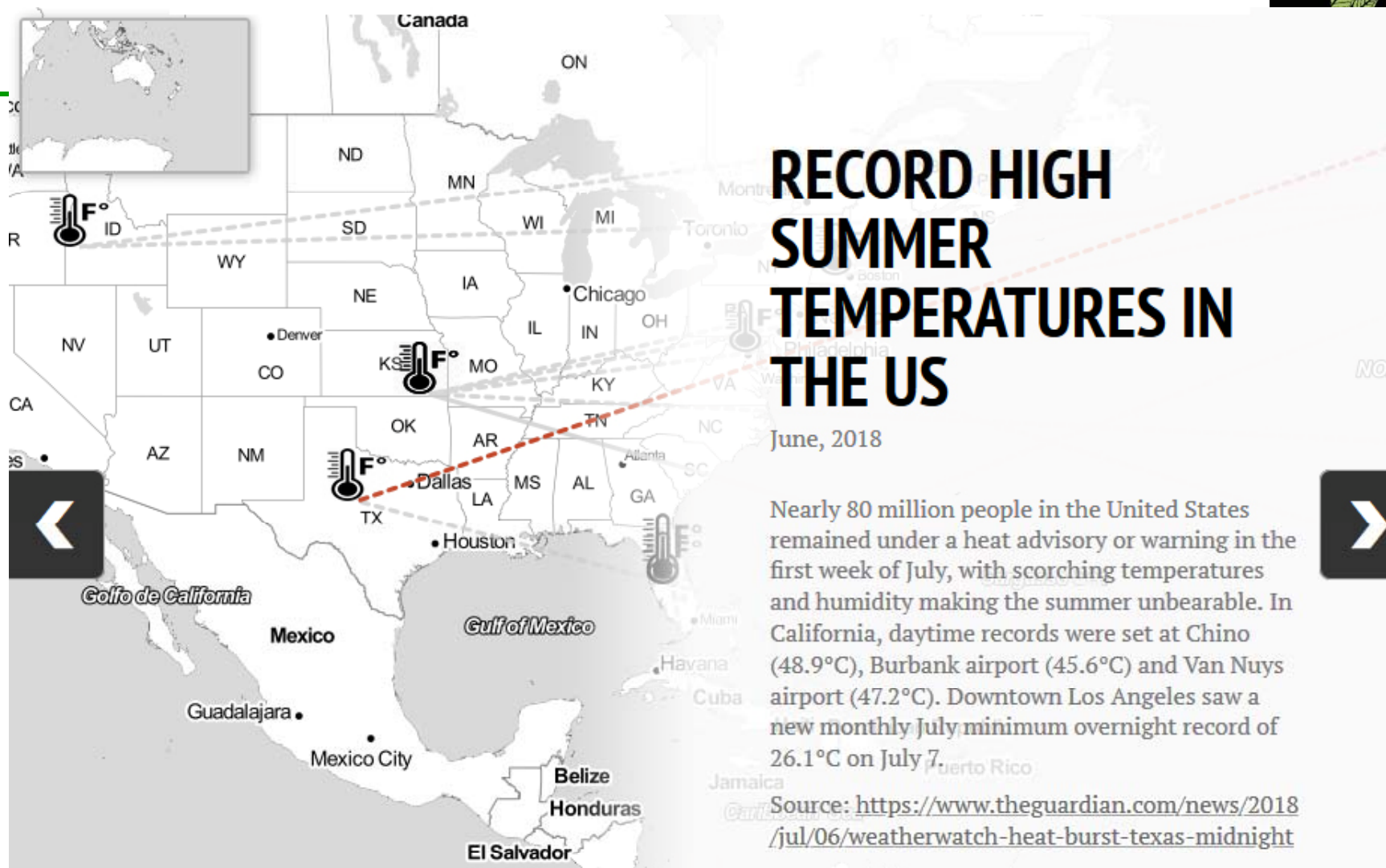


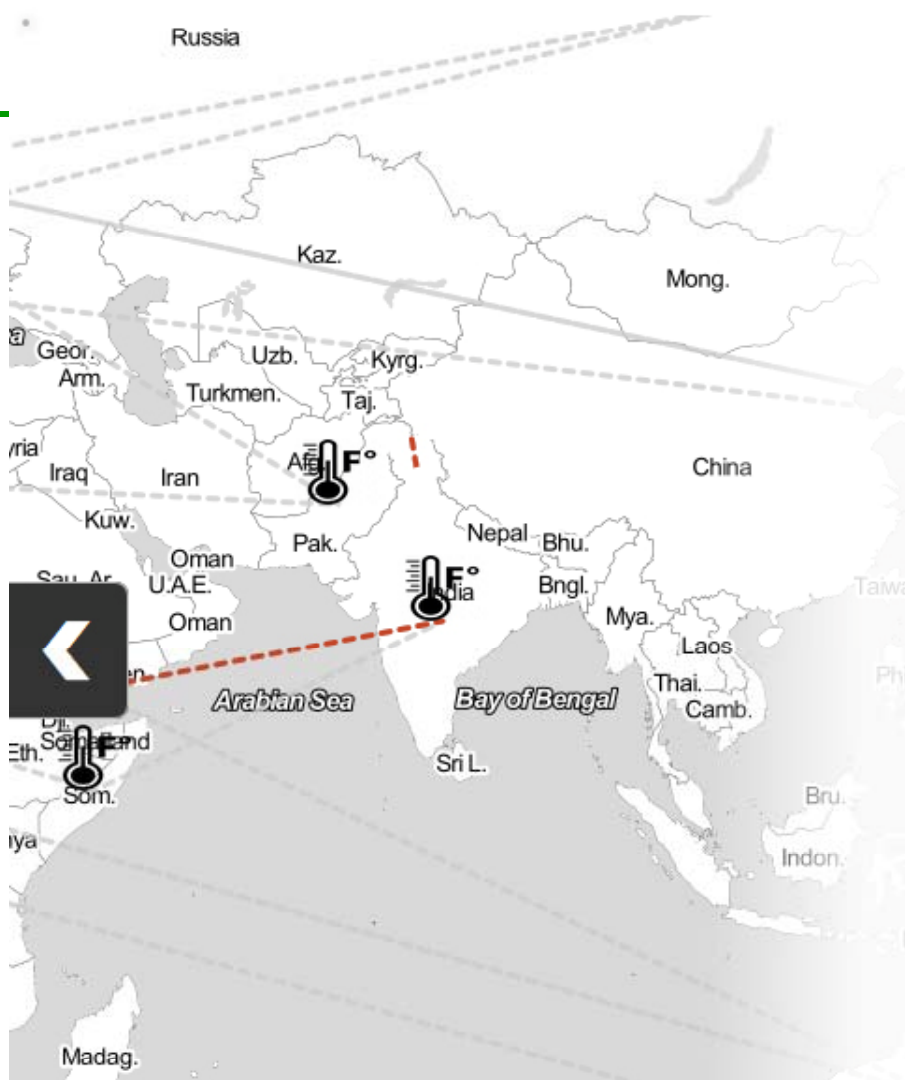
UK IS EXPERIENCING ITS LONGEST HEATWAVE SINCE 1976

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 been 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>



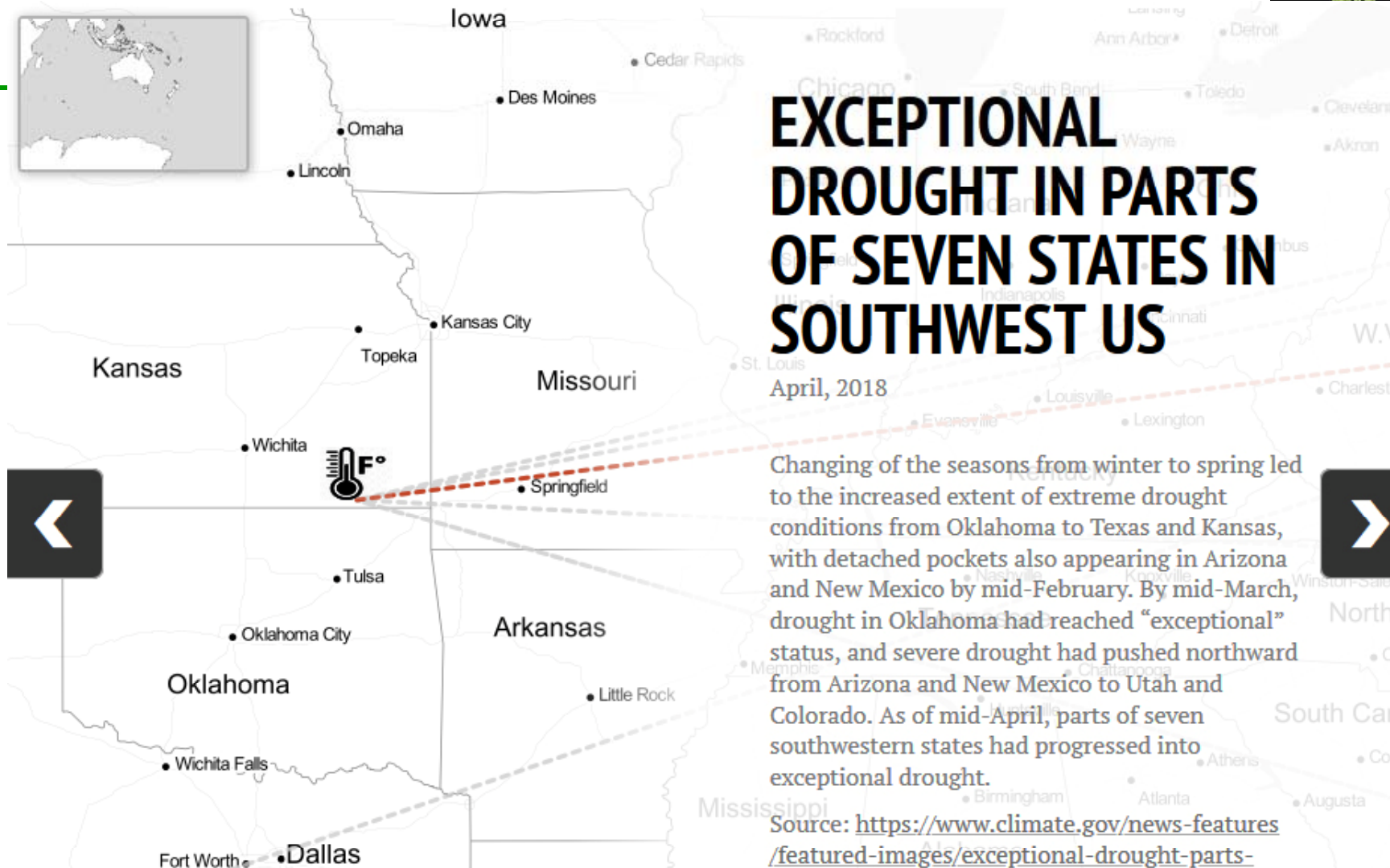


UNPRECEDENTED STORM SEASON IN INDIA

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





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>



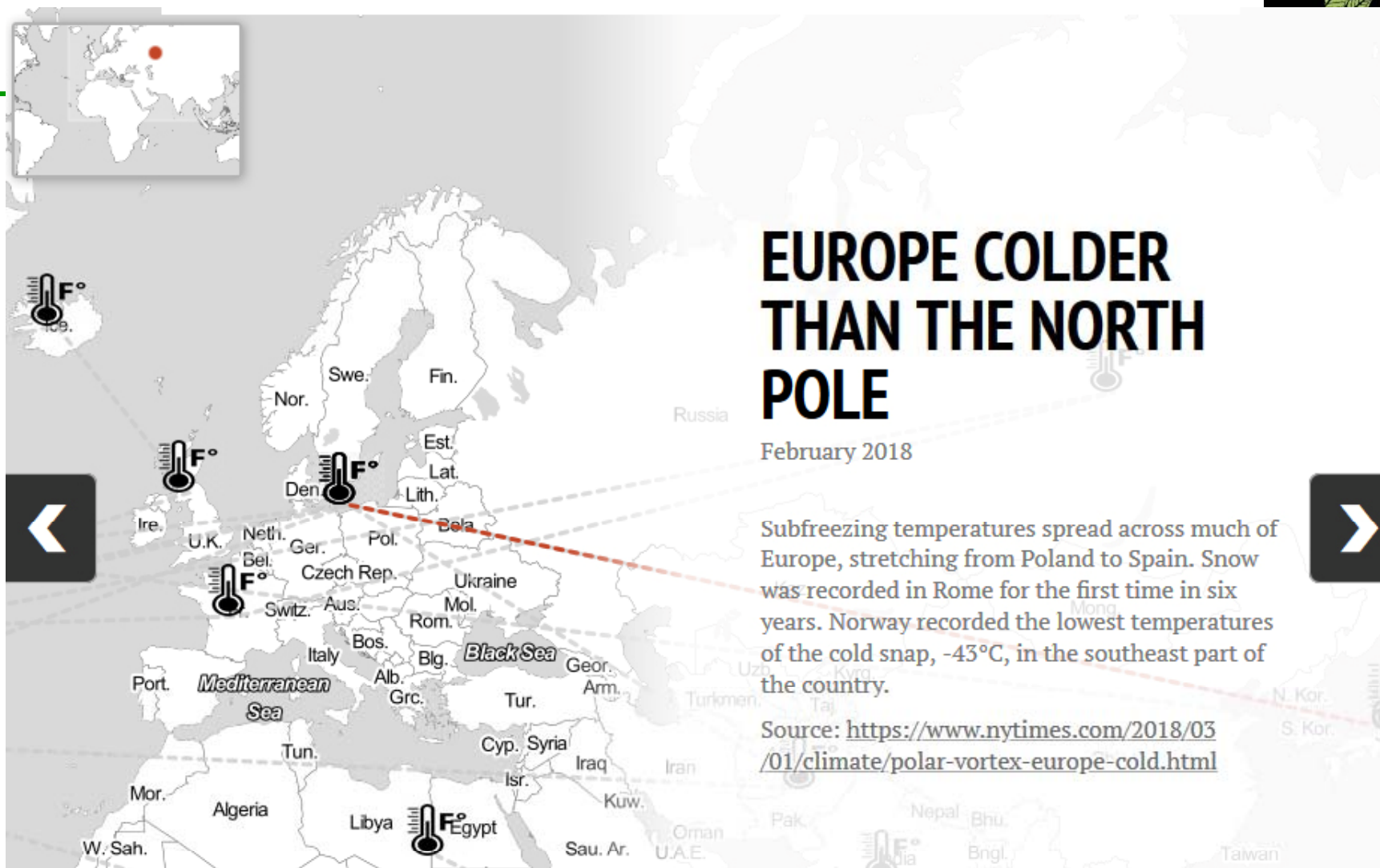


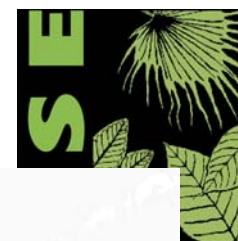
HOTTEST APRIL DAY IN HISTORY OF THE EARTH RECORDED IN PAKISTAN

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>





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>

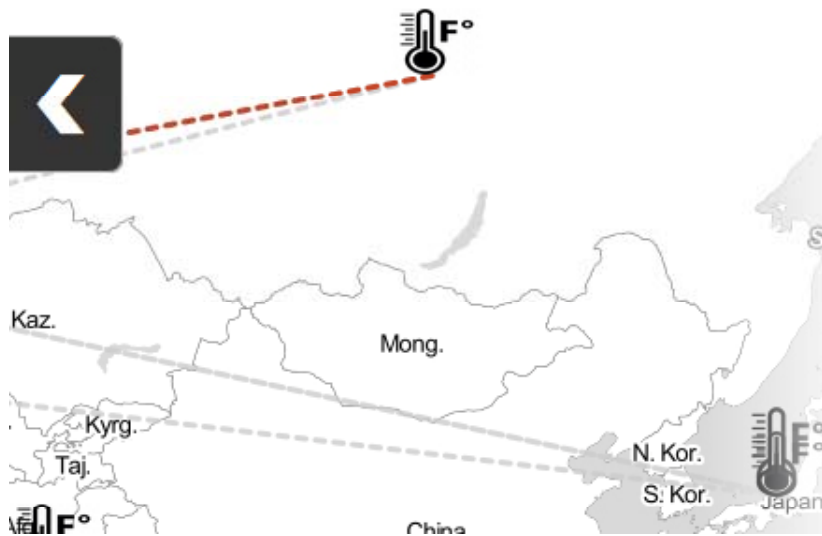


RUSSIA BRAVES COLD TEMPERATURES OF -67 C, COLDER THAN MOST THERMOMETERS GO

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.



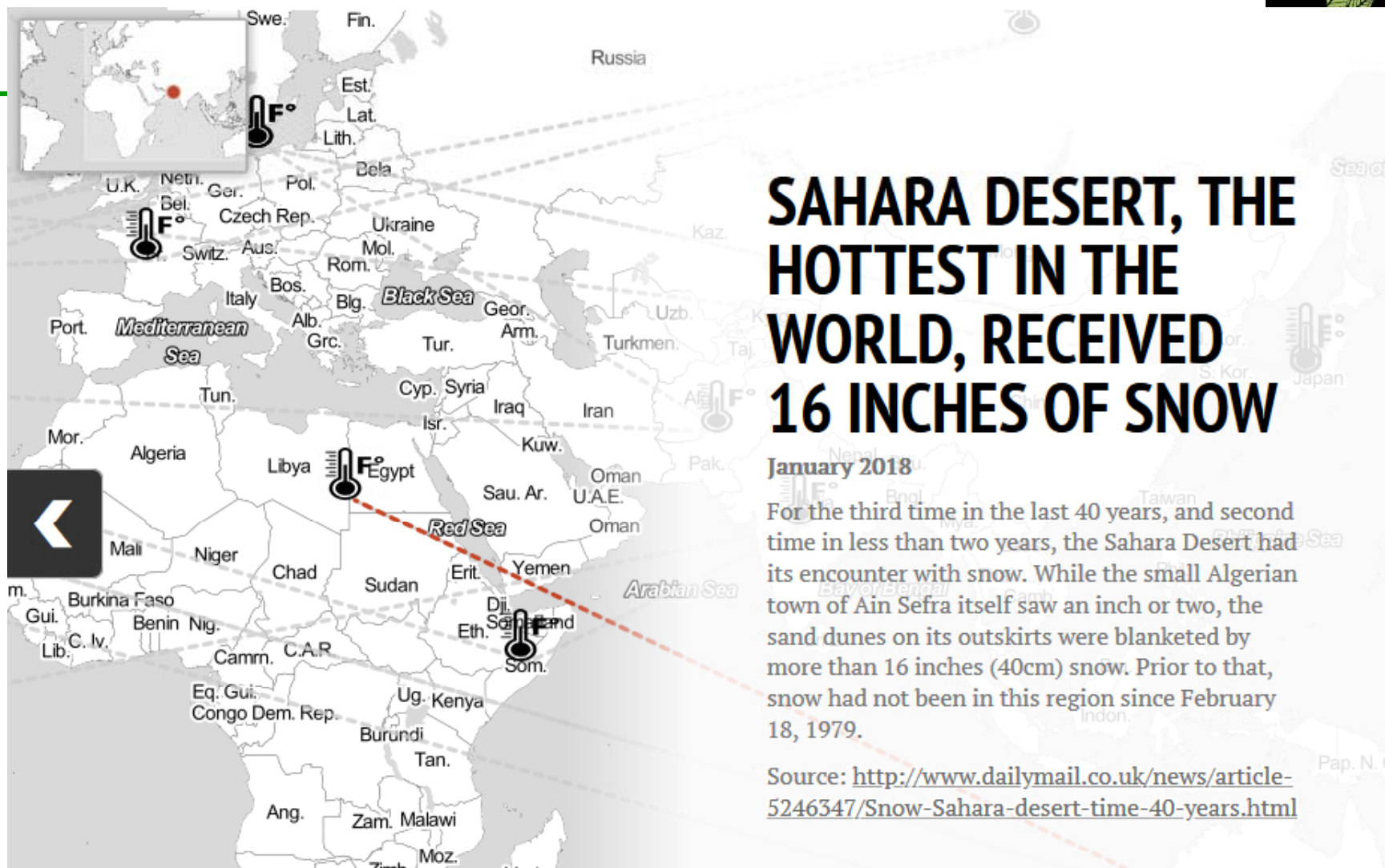


January 2018

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>

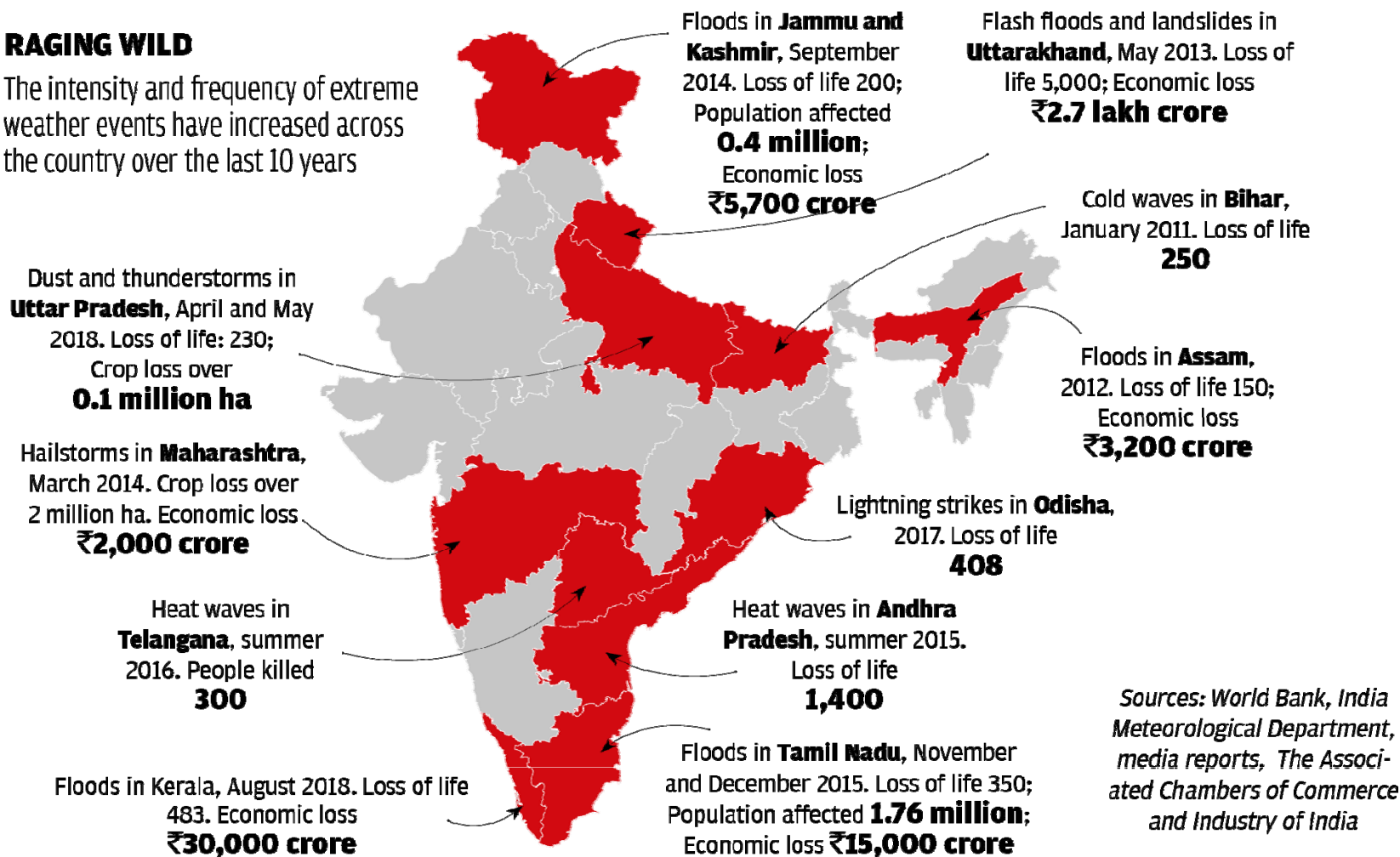


India extremes: New Normal

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

RAGING WILD

The intensity and frequency of extreme weather events have increased across the country over the last 10 years



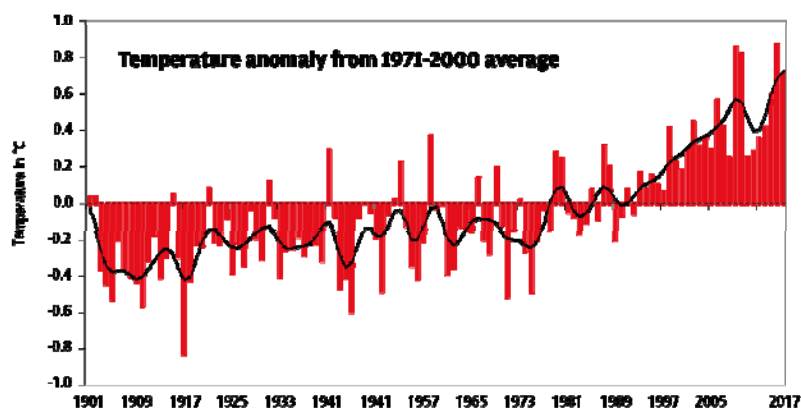
Sources: World Bank, India Meteorological Department, media reports, The Associated Chambers of Commerce and Industry of India



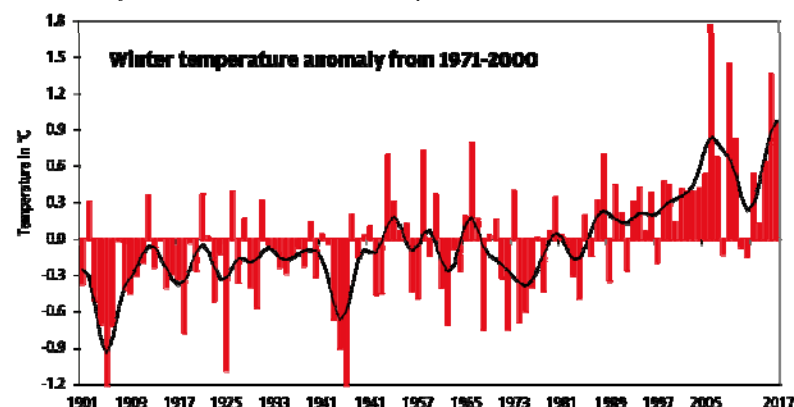
STATE OF CLIMATE CHANGE

Climate during 2017 over India was substantially warmer. The annual mean temperature for the country in 2017 was $+0.71^{\circ}\text{C}$ above the 1971-2000 average, thus making it the fourth warmest year on record since the nationwide records commenced in 1901. Higher mean temperatures during the winter season (January- February) and the postmonsoon season (October-December) mainly accounted for the above normal annual temperature for 2017

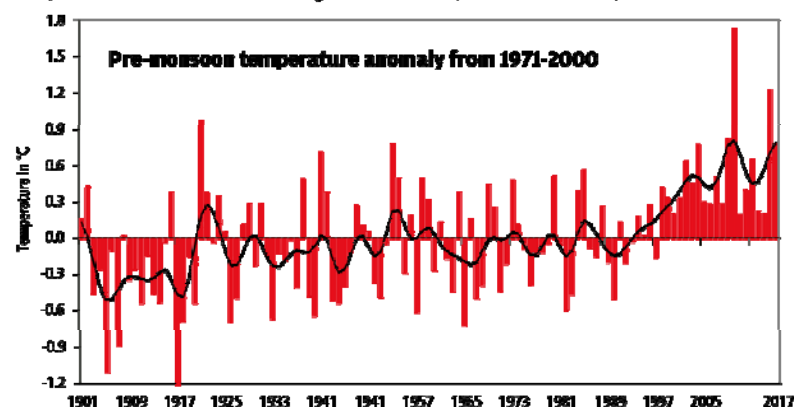
Too hot to handle | 11 out of the 15 warmest years were from the past fifteen years



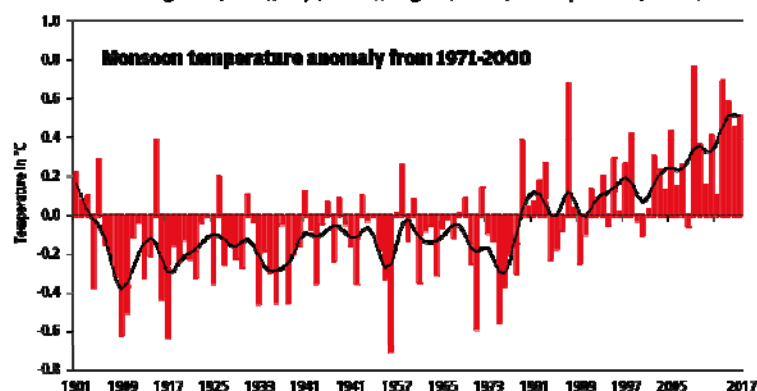
Winter | The mean temperature for the winter season in 2007 was the fourth highest since 1901. January was the ninth warmest and February was the fourth warmest since 1901



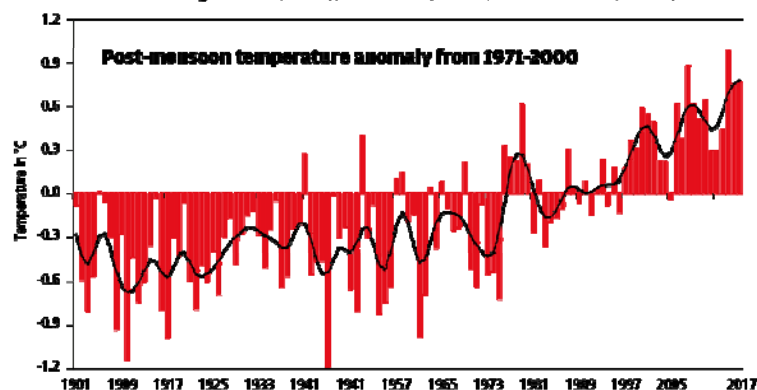
Pre-monsoon | The 2007 pre-monsoon was the sixth warmest since 1901. The mean temperature was above normal during March (0.5°C), April (1.04°C) and May (0.77°C)



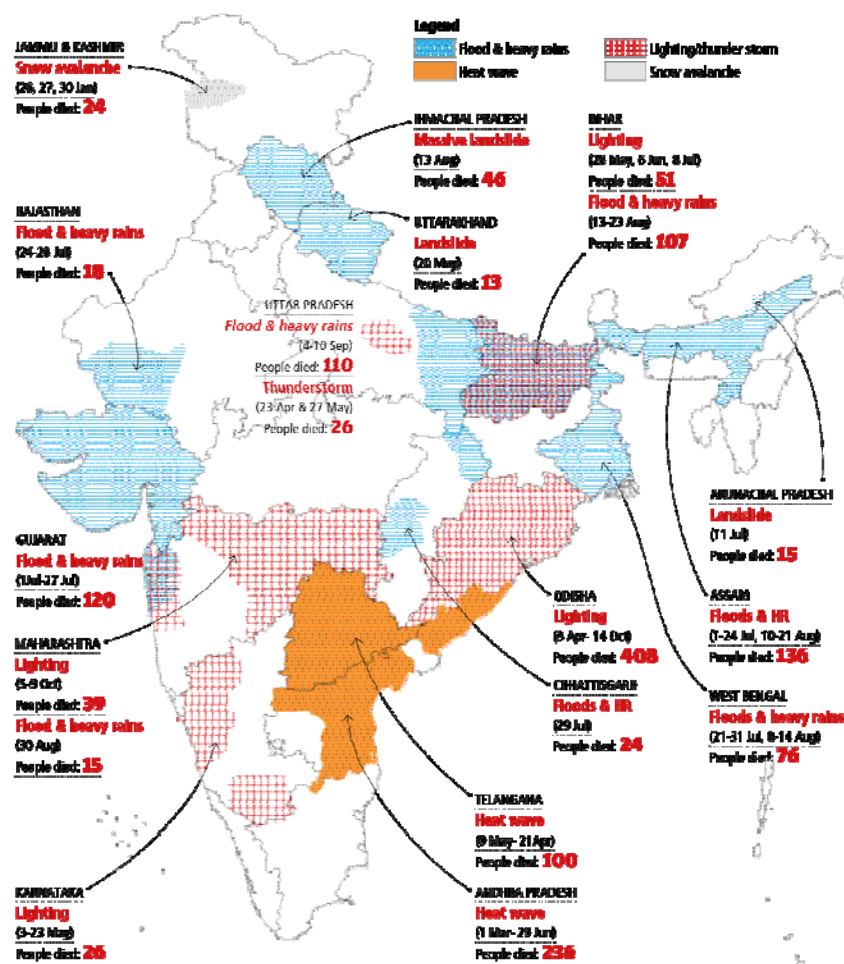
Monsoon | The 2017 monsoon was the 5th warmest since 1901. The mean temperature was above normal during June (0.2 °C), July (0.39 °C), August (0.63 °C) and September (0.82 °C)



Post-monsoon season | 2017 was the 3rd warmest since 1901. The mean temperature was above normal during October (1.11 °C), November (0.49 °C) and December (0.69 °C)



Extreme weather | While heat wave claimed 375 lives, lightning killed another 750 in 2017



Source: Annual Climate Summary-2017 released by Ministry of Earth Sciences in 2018



Attribution to climate

- ⑩ All of these weather events are far beyond normal variability **called stationarity** as it followed past patterns
- ⑩ Science of attribution: not perfect but indicative of what is happening
- ⑩ “Climate change has:
- ⑩ more than doubled the likelihood of the European heatwave
- ⑩ tripled the likelihood of drought in Cape Town”

Double-whammy makes for “manmade” disasters



- ⑩ Combination of our mismanagement of our local environment
- ⑩ and
- ⑩ Increased frequency and intensity of extreme and variable weather
- ⑩ Not natural disaster anymore.
- ⑩ Manmade devastation



India connections: New Normal

- ⑩ Dust storms 2018: April-May
- ⑩ Over 50 dust storms killed over 500 and destroyed homes and crops
- ⑩ Why: global-local connections

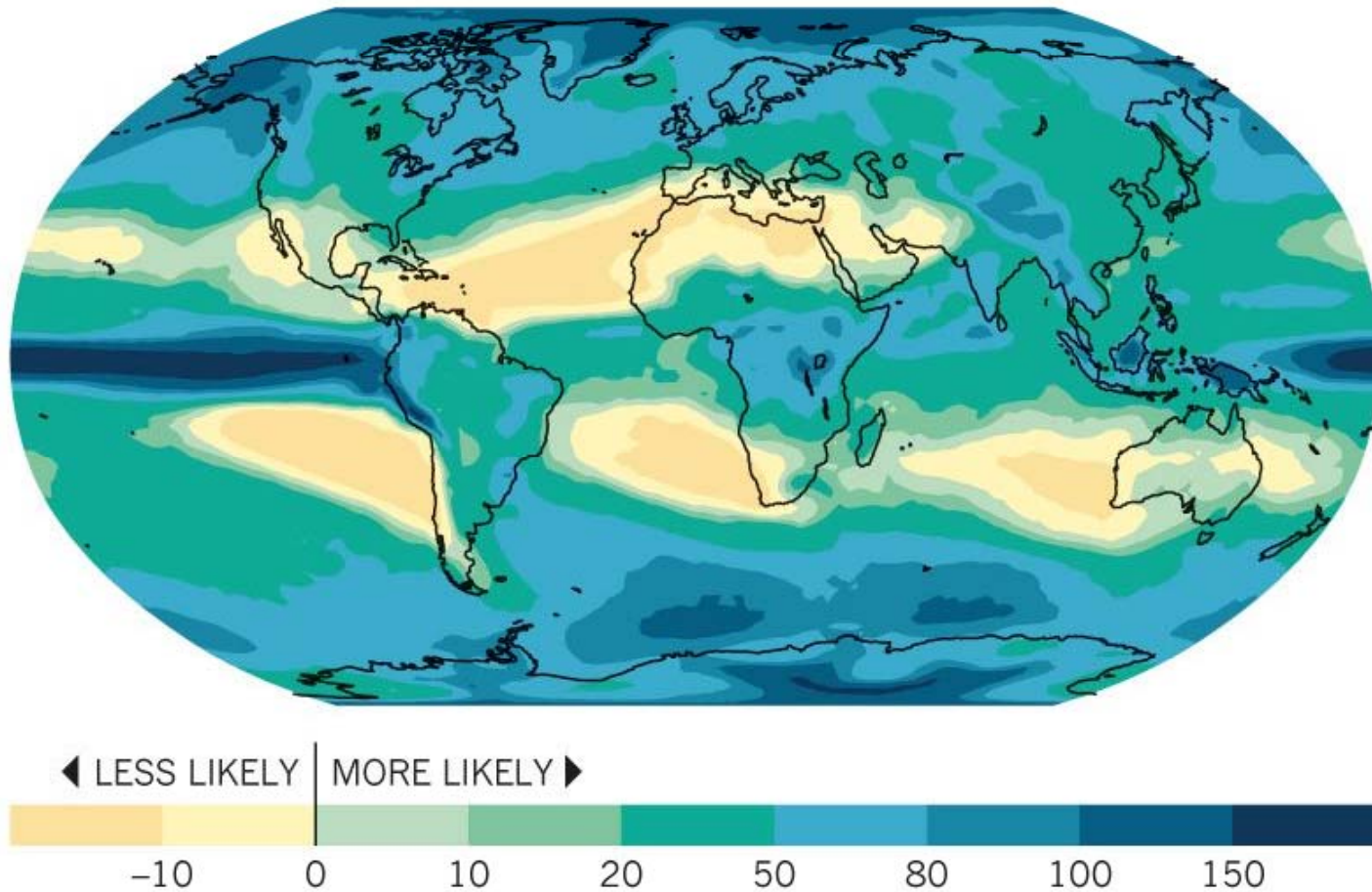


- 10 **A.** Western Disturbance changing – getting longer; link to weakened Arctic Jet Stream – warmer Arctic and difference reduced ocean
- 10 **B.** Bay of Bengal getting warmer – more cyclones; more heavy rain. Colliding with WD, that are more frequent and late
- 10 **C.** Intense heat spikes (Pakistan/north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

Extr

HEAVY RAIN

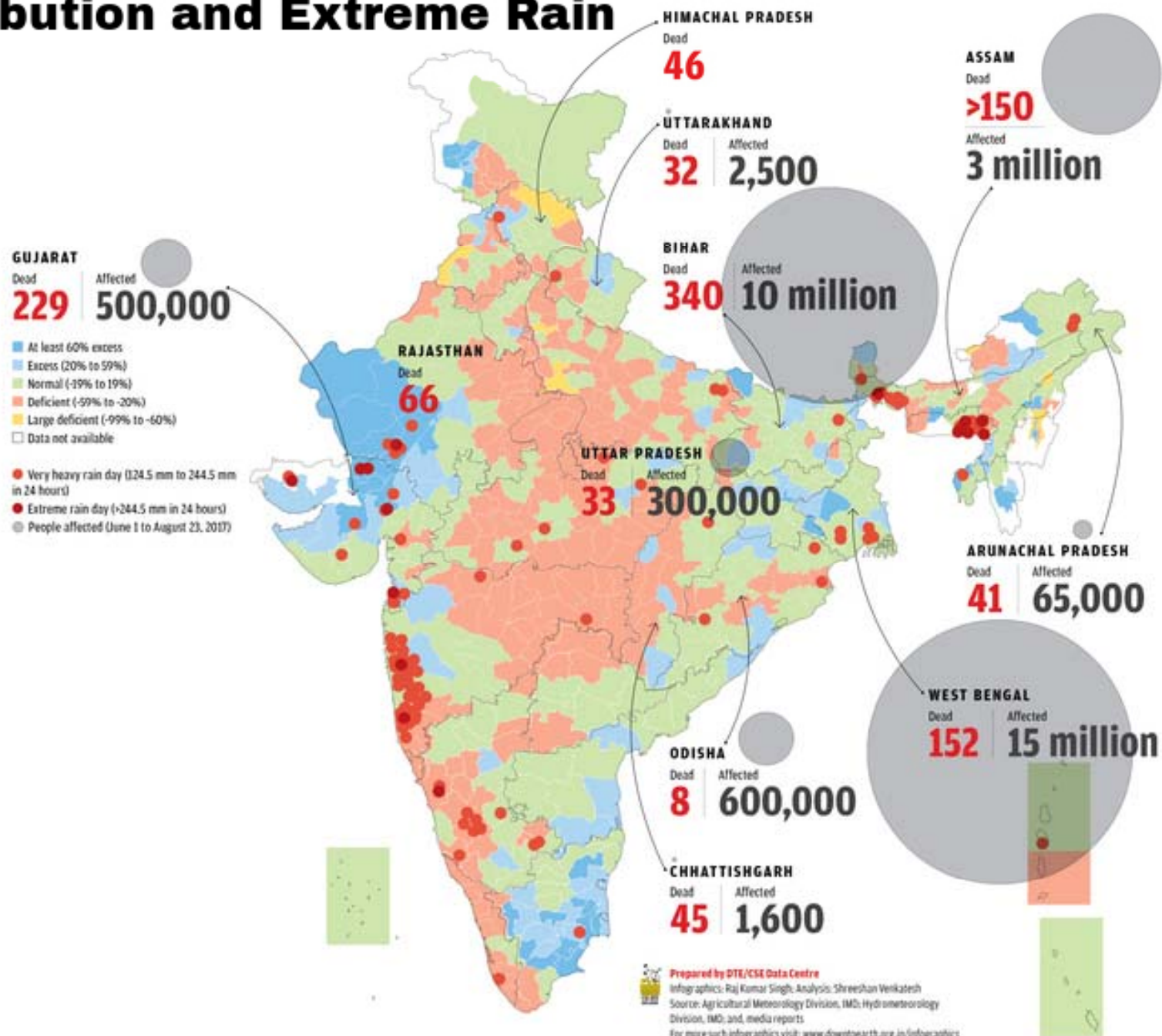
A climate model simulating daily precipitation changes suggests that if the planet warms by 3 °C, most land areas would see substantially more heavy rains.



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

Monsoon 2017

Distribution and Extreme Rain

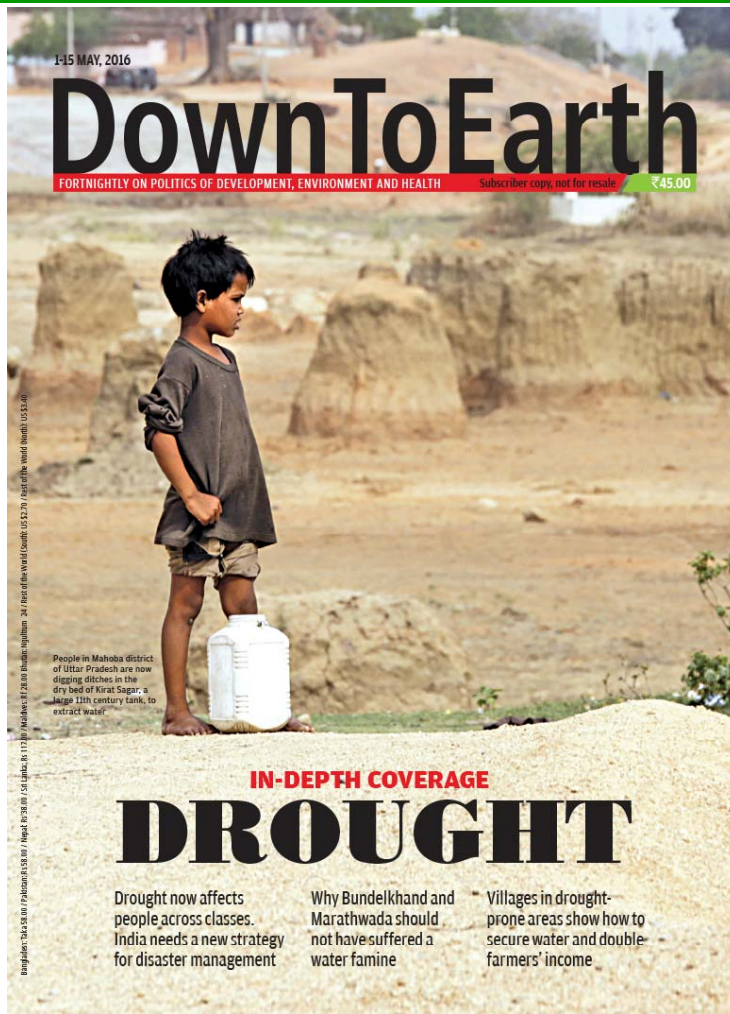


Double deadly for us: Results in cycle of flood-drought



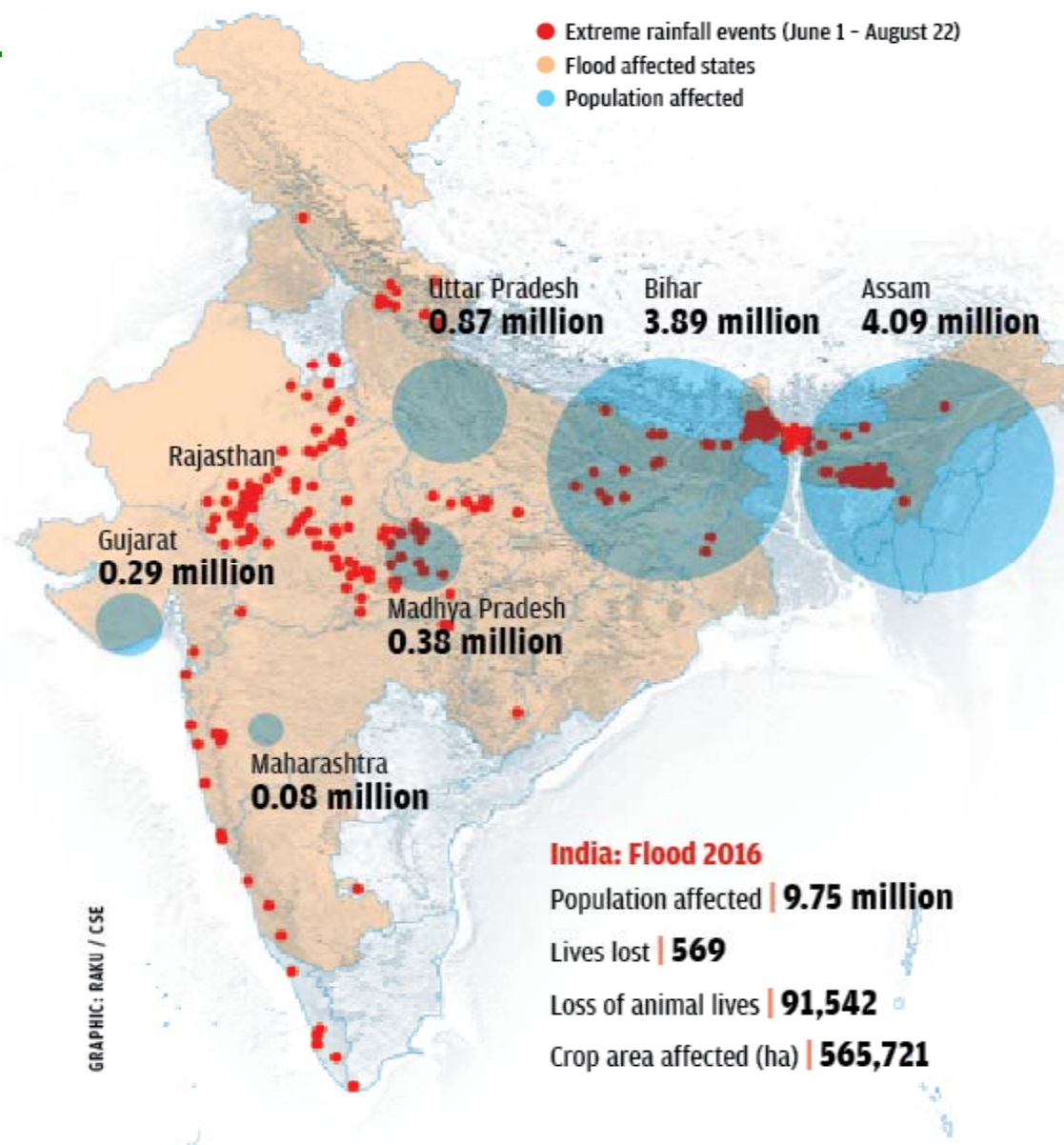
- ⑩ Extreme rainfall means floods
- ⑩ But worse, it means that water flows away; is not captured or harvested
- ⑩ Leads to droughts
- ⑩ Impacts on farmers – struggling for subsistence
- ⑩ Impacts on water supply in cities

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



Kerala flood: extreme rain and lack of preparedness



- ⑩ Many rivers; short distance from Western Ghats to sea; high rainfall; many dams storing water
- ⑩ 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
- ⑩ Dams were full: Last few years of drought meant that managers want to store the last drop
- ⑩ Rain came; dams opened; **flood became deluge**



Kerala: rebuild for new normal

Plan deliberately for drainage – every river, stream, 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



- ⑩ Recognize that all we do to do better land, water, forest management will not be enough
- ⑩ Need science of forecasting; need much better preparedness
- ⑩ 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



- ⑩ Recognise that enough is enough
- ⑩ Can't 'manage' extreme events
- ⑩ Have to reduce emissions; have to mitigate
- ⑩ Poor impacted today; Rich will be hit tomorrow
- ⑩ Need cooperation in agreement to cut emissions. **Not happening**

Paris agreement: backward movement



- ⑩ Equity lost
- ⑩ Based on what countries can do (as little as possible)
- ⑩ Based on what rich countries can pay (as little as possible)
- ⑩ Carbon budget – what world can emit – finished by rich. Now poor have no space left. But without equity cooperation not possible

Not acceptable. Never

