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INDIA · HEATWAVE TRENDS IN A CHANGING CLIMATE

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TABLE OF CONTENTS

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GREENPEACE
ग्रीनपीस

SUMMARY

Summers in India are hot, particularly in inland areas without the regulation from the oceans. Although it is not uncommon for maximum temperatures to exceed 35°C in May, the consistently worsening trend of very hot days is worrying. The hottest days for India have increased from 40 days/year in the 1950s to 100 days/year in the 2020s. This sharp increase and a heat index of over 35°C has significant health impacts that the population is already experiencing. But a matter of greater concern is the fact that multiple climate models have projected that the scenario will worsen significantly. In such a situation the temperature will increase by 4°C on average by the end of the century; which means unprecedented and prolonged heatwaves, more frequent extreme weather events, increased hospitalizations even leading up to fatalities and irreparable impacts on agriculture and wildlife risking our food and nutritional security.

Unfortunately, as always, it will be the vulnerable communities who will face the crisis at its worst form. The most vulnerable populations, including the urban poor, outdoor workers, women, children, senior citizens, sexual minorities etc are at a significantly greater risk, as they lack adequate access to protective measures. Governments must fortify the resilience of such vulnerable populations by immediately providing aid in a just and equitable manner. State and city authorities must strengthen the public health system, and coordinate with meteorological agencies to relay timely warnings and advisories to citizens.

Photo Credit: Kapil Kajal

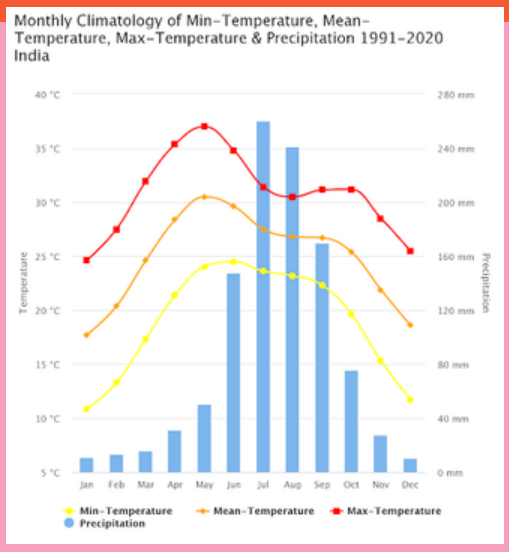
As long term measures, urban planning must provide for and maintain adequate green cover which includes rooftop gardening, community nutritional gardens, parks, mini forests, road-side tree cover and water bodies. Additionally, governments, corporations, and the civil society must prioritize just transition in energy, transport, agriculture, and other sectors to tackle climate change. Reducing the CO2 emissions, by shifting to renewables and phasing out internal combustion engines, contribute to reducing the rate of warming in the long run. Phasing out fossil fuels, particularly for energy and transportation systems, is the most practical and immediate solution to tackling climate change and protecting public health. If we do not act now, the threat is only going to amplify in frequency, duration, and magnitude.

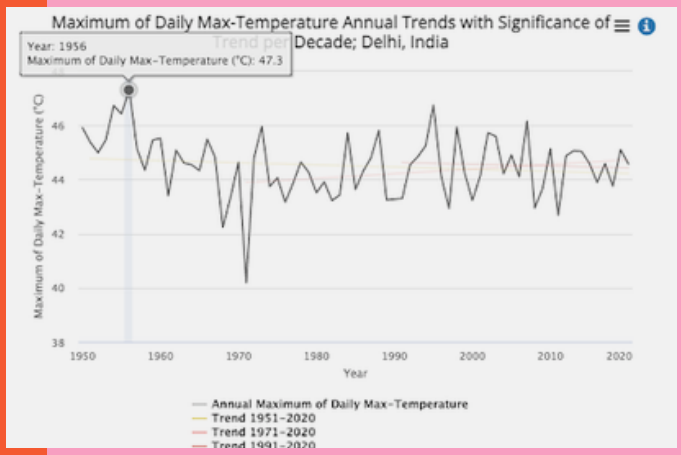
There will be more heatwaves, more wildfires and it will be too late.

Photo Credit: Kapil Kajal

THE SEASONS

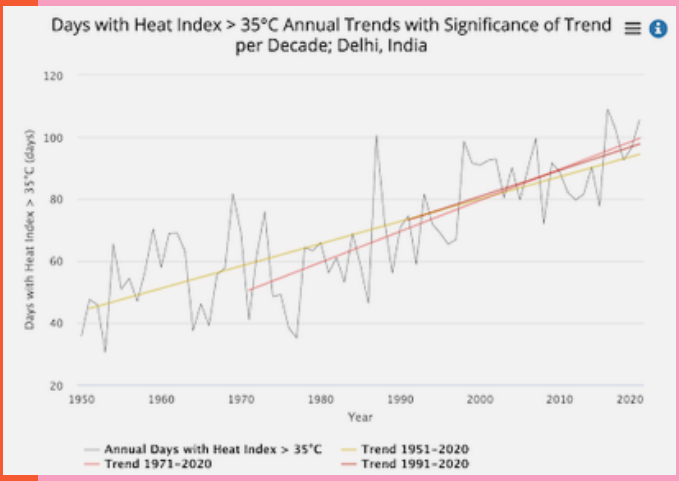
The typical Indian seasons include Winter (Jan, Feb, Mar), Summer (Apr, May, Jun), Monsoon (Jul, Aug, Sep), and Retreating of Monsoon (Oct, Nov, Dec). The beginning of April indicates the start of the Summer season, which is hot and dry. The summer season heats up the interior, and the temperature contrast between the land and the sea fuels the monsoon season in late June.
(Fig source[1])





In Delhi, the highest recorded temperature of 47.3°C was in 1956, according to the data from the Climate Change Knowledge Portal, World Bank Group. The high temperature is fatal and causes severe health issues, but it does not appear every day. Instead, the same research provides another alarming dataset.

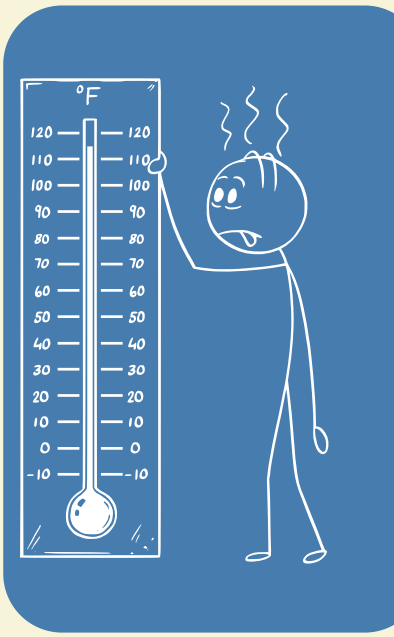
Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature. A higher[2] heat index is recorded with increased humidity as the human body is unable to cool down effectively by sweating. The dataset shows a significant upwards trend in the past 70 years, where the number of days with heat index greater than 35°C rose from 40 days/year in the 1950s to 100 days/year in the 2020s.



1. Source: https://climateknowledgeportal.worldbank.org/country/india
2. Source: https://databank.worldbank.org/metadataglossary/environment-social-and-governance-(esg)-data/series/EN.CLC.HEAT.XD

HEALTH HAZARDS OF HEAT INDEX OVER 35°C

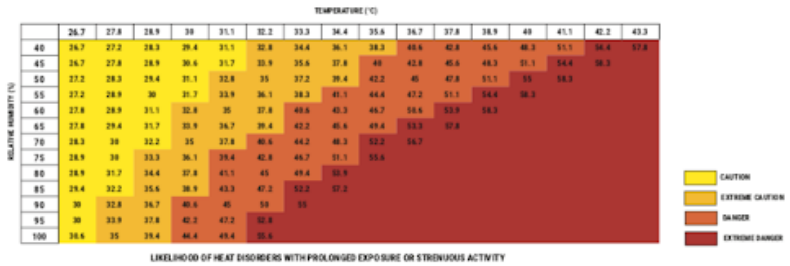
Heat Index of over 35°C falls in the “Extreme Caution” category, which can trigger heat cramps and heat exhaustion. Beyond a certain level of temperature and relative humidity, the cooling effect of sweating does not regulate body temperature effectively, causing heat cramps, heat exhaustion and heatstroke.



Korey Stringer Institute's Recommendations Based on NOAA's Heat Index Chart

ALERT LEVEL	RECOMMENDED ACTIONS
RED- EXTREME DANGER	1. Cancel and/or postpone activity to cooler time of the day.
ORANGE- DANGER	1. Maximum of 1 hour of training. Consider postponing activity to cooler time of the day. 2. Schedule at least 4 rest breaks of 4 minutes each within the hour. 3. Recheck the environmental condition every 30 minutes to monitor for changes. 4. Have cooling stations for before, during and after exercise. 5. No additional conditioning allowed in the same day.
GOLD- EXTREME CAUTION	1. Maximum of 2 hour of training. Consider postponing activity to cooler time of the day. 2. Schedule at least 4 rest breaks of 4 minutes each within each hour, or a 10 minute break every 30 minutes of training. 3. Recheck the environmental condition every 30 minutes to monitor for changes. 4. Have cooling stations for before, during and after exercise.
BRIGHT YELLOW- CAUTION	1. Optional water breaks every 30 minutes for 10 minutes in duration. Coordinate breaks with assigned contest officials. 2. Preparation of cooling modalities (example: ice towels) is recommended.

National Oceanic and Atmospheric Administration's (NOAA) National Weather Service Heat Index



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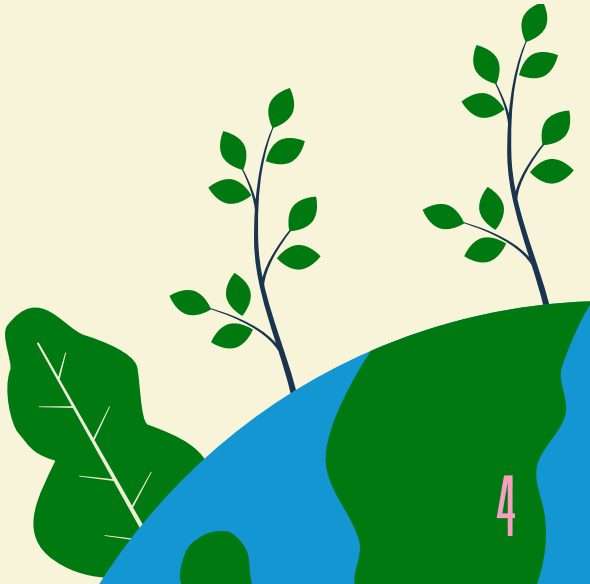

3. Source: https://kestrelinstruments.com/mwdownloads/download/link/id/11

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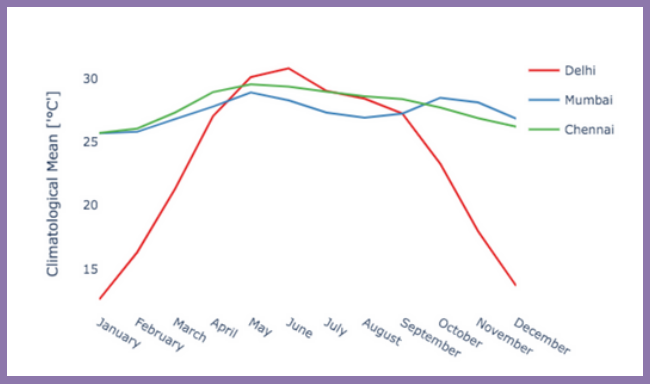
ग्रीनपीस

CITIES

IN THE INLAND AREAS HAVE A WIDER ANNUAL TEMPERATURE RANGE THAN COASTAL CITIES.

Inland cities like Delhi, Lucknow, Patna, Jaipur, and Kolkata share a similar temperature pattern, while coastal cities of Mumbai and Chennai benefit from the regulating effect of the sea. The coastal cities have an average temperature range less than 5 degrees, in comparison to inland cities with a temperature range of 20 degrees. Bengaluru, Hyderabad, and Pune have a relatively different pattern despite being inland due to their topography.

1



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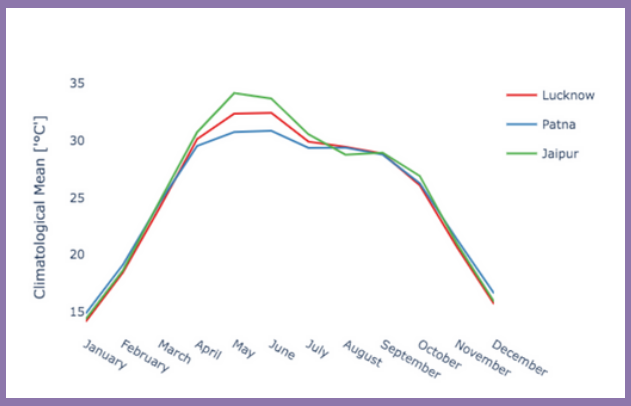

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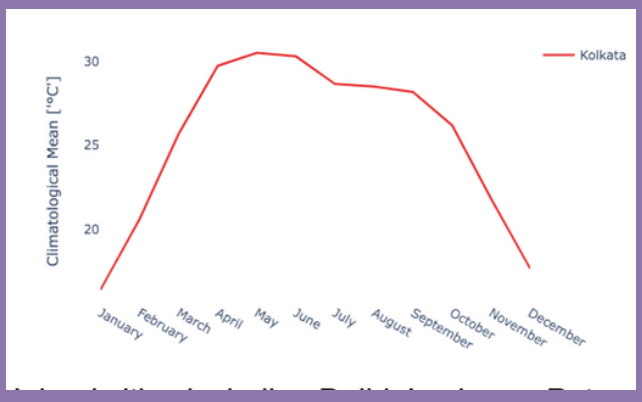

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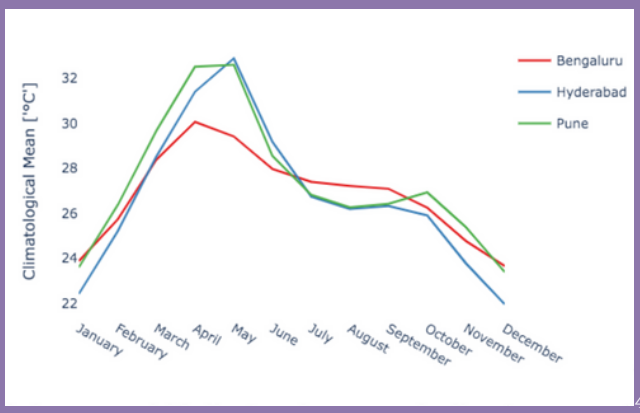

Hence, during heatwaves as temperatures spike in inland cities, coastal areas will experience lesser temperature variation in contrast. However, the humidity from the sea will create muggy weather conditions.

4. Source: Dataset | https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels?tab=overview | The results contain modified Copernicus Climate Change Service information 2020. Neither the European Commission nor ECMWF is responsible for any use that may be made of the Copernicus information or data it contains. | Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J-N. (2018): ERA5 hourly data on single levels from 1979 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS). (Accessed on 5-Apr-2022), 10.24381/cds.adbb2d47 | DOI: 10.24381/cds.adbb2d47

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PROJECTION

THE PROJECTION IS BASED ON THE IPCC AR6 REPORT. 3 DISTINCTIVE SCENARIOS ARE SELECTED TO REPRESENT IN THE FOLLOWING PROJECTIONS. THEY ARE:[5]

- **SSP1 - 2.6 NET-ZERO AFTER 2050**
- **SSP2 - 4.5 BUSINESS AS USUAL**
- **SSP5 - 8.5 EXTREME WITH DOUBLING CO2 IN 2050**

NET-ZERO AFTER 2050

SSP1-2.6: In this scenario, global CO2 emissions are cut severely, but not at optimum speed, reaching net-zero only after 2050. It imagines the same socioeconomic shifts towards sustainability as SSP1-1.9 (most optimistic scenario where CO2 emissions reach net zero around 2050). Temperatures stabilize around 1.8°C higher by the end of the century in this scenario.

BUSINESS AS USUAL

SSP2-4.5: This is a “middle of the road” scenario. CO2 emissions hover around current levels before starting to fall mid-century, but do not reach net-zero by 2100. Socioeconomic factors follow their historic trends, with no notable shifts. Progress toward sustainability is slow, with development and income growing unevenly. In this scenario, temperatures rise 2.7°C by the end of the century.

EXTREME WITH DOUBLING CO2 IN 2050

SSP5-8.5: This is a future to avoid at all costs. Current CO2 emissions levels roughly double by 2050. The global economy grows quickly, but this growth is fueled by exploiting fossil fuels and energy-intensive lifestyles. By 2100, the average global temperature is a scorching 4.4°C higher.

5. Source: https://www.reuters.com/business/environment/un-climate-reports-five-futures-decoded-2021-08-09/

DELHI

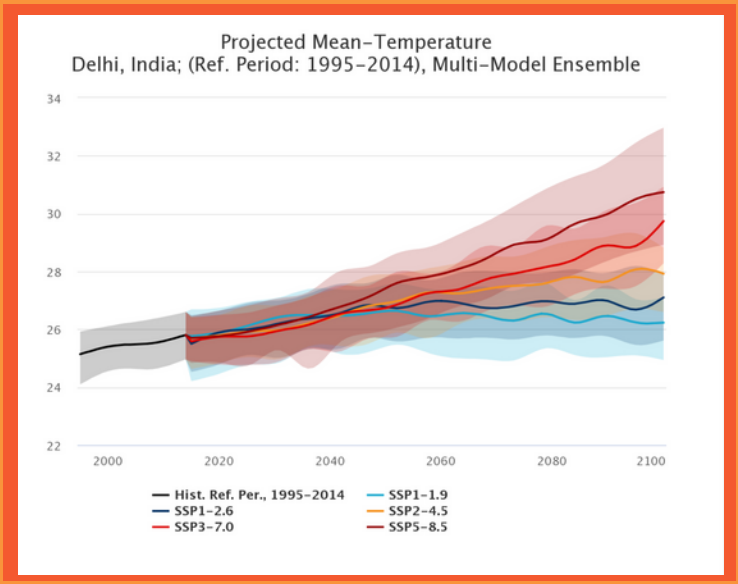
In the SSP5-8.5 scenario, in the 2080 to 2099 period, Delhi will be 5°C warmer than now on average, and the maximum temperature will be 4°C higher. In some extreme years, the maximum temperature can go up to 48.19°C.[6]

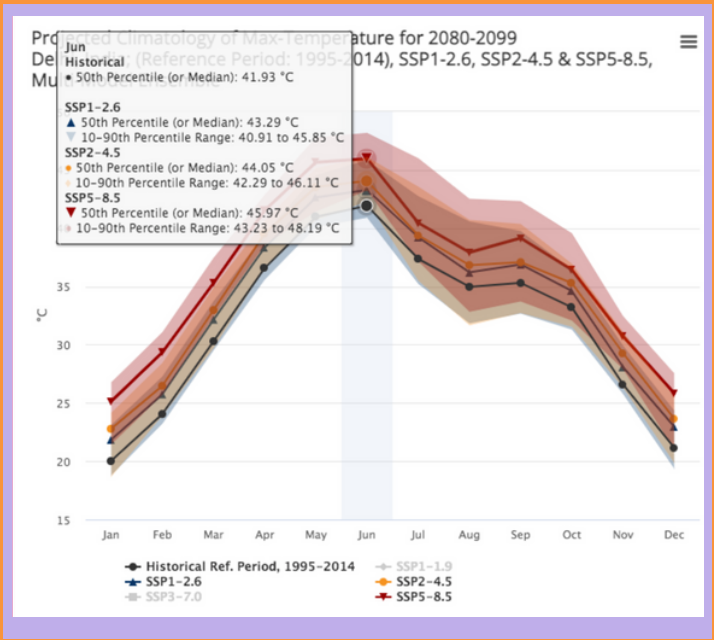
5°C
warmer than now on average

4°C
hotter

48.19°C
maximum temp can reach

Projection for 2080-2099	
Annual mean temperature in 2020	26°C (median of 1995-2014)
In SSP5-8.5	31°C (median) +5°C warmer
Annual max temperature	41.93°C (median of 1995-2014)
In SSP5-8.5	45.97°C (median) +4.04°C hotter
	48.19°C (Extreme)





6. Source:https://climateknowledgeportal.worldbank.org/country/india/climate-data-projections-expert

MUMBAI & PUNE

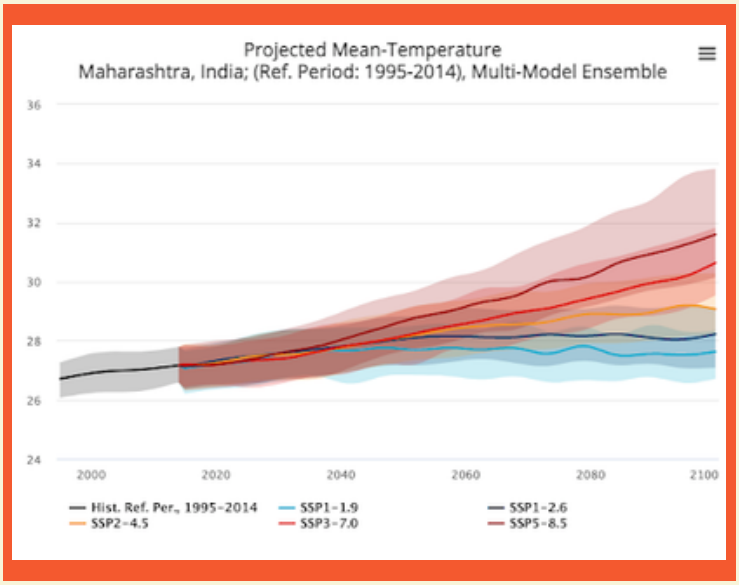
In the SSP5-8.5 scenario, in the 2080 to 2099 period, Mumbai & Pune will be 5°C warmer than now on average, and the maximum temperature will be 4.2°C higher. In some extreme years, the maximum temperature can go up to 45.4°C.[7]

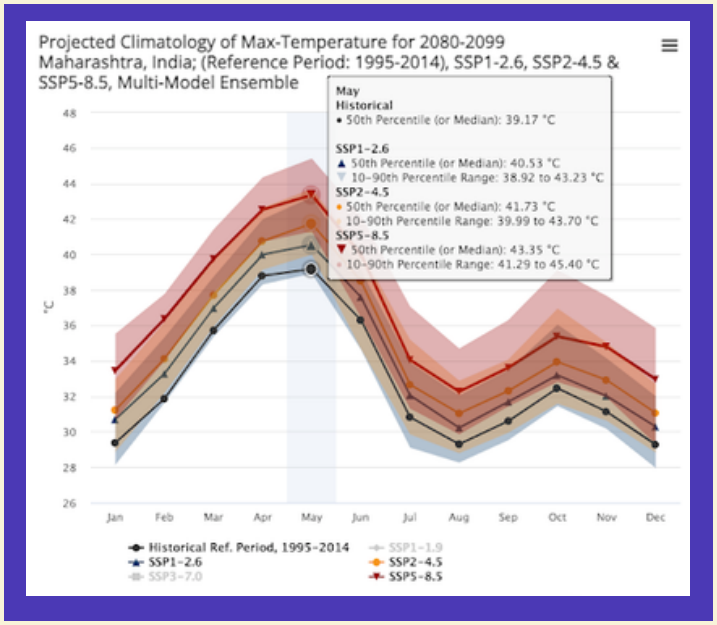
5°C
warmer than now on average

4.2°
hotter

45.4°C
maximum temp can reach

Projection for 2080-2099	
Annual mean temperature in 2020	27°C (median of 1995-2014)
In SSP5-8.5	32°C (median) +5°C warmer
Annual max temperature	39.17°C (median of 1995-2014)
In SSP5-8.5	43.35°C (median) +4.18°C hotter
	45.4°C (Extreme)





7. Source: https://climateknowledgeportal.worldbank.org/country/india/climate-data-projections-expert

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CHENNAI

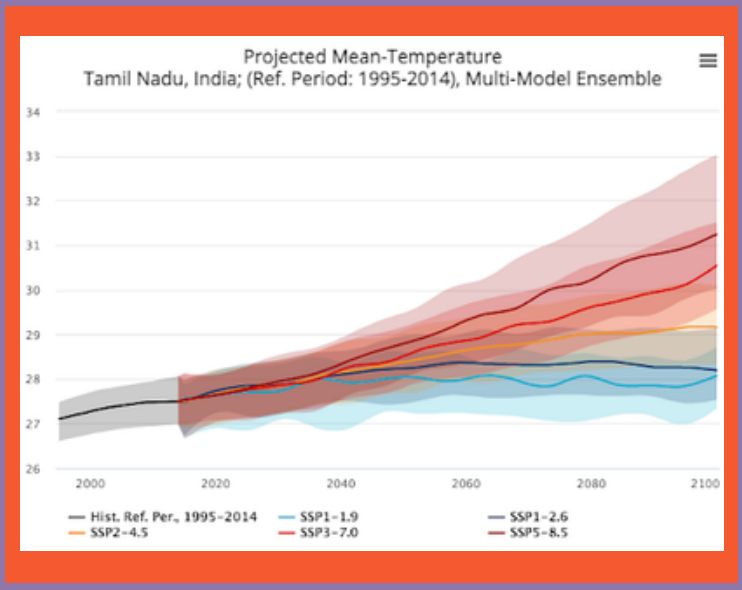
In the SSP5-8.5 scenario, in the 2080 to 2099 period, Chennai will be 4°C warmer than now on average, and the maximum temperature will be 3.7°C higher. In some extreme years, the maximum temperature can go up to 40.6°C.[8]

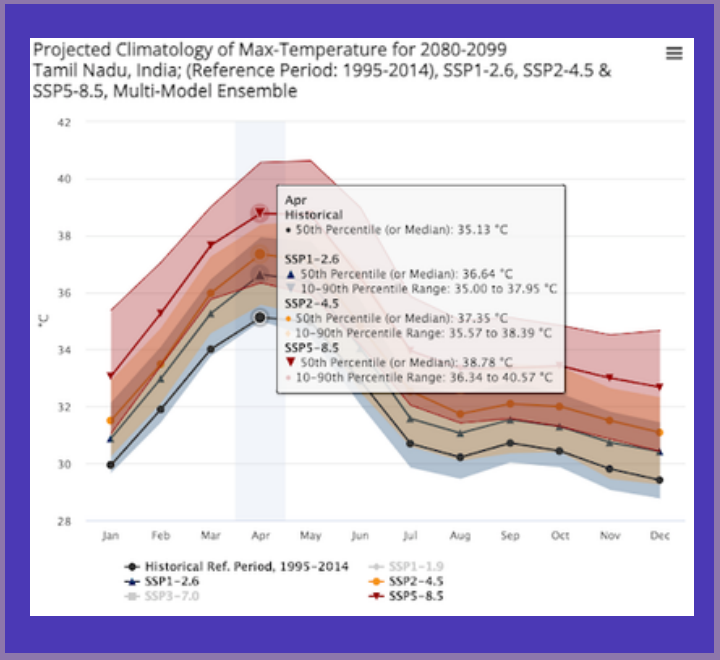
4°C
warmer than now on average

3.7°
hotter

40.6°C
maximum temp can reach

Projection for 2080-2099	
Annual mean temperature in 2020	27°C (median of 1995-2014)
In SSP5-8.5	31°C (median) +4°C warmer
Annual max temperature	35.13°C (median of 1995-2014)
In SSP5-8.5	38.78°C (median) +3.65°C hotter
	40.57°C (Extreme)



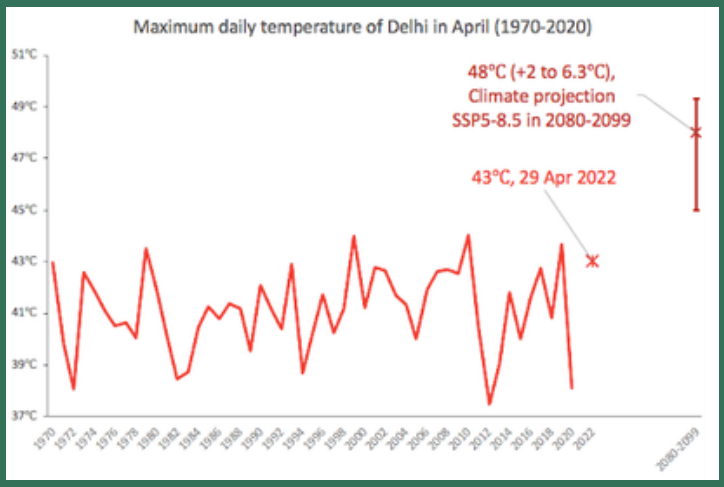


8. Source: https://climateknowledgeportal.worldbank.org/country/india/climate-data-projections-expert

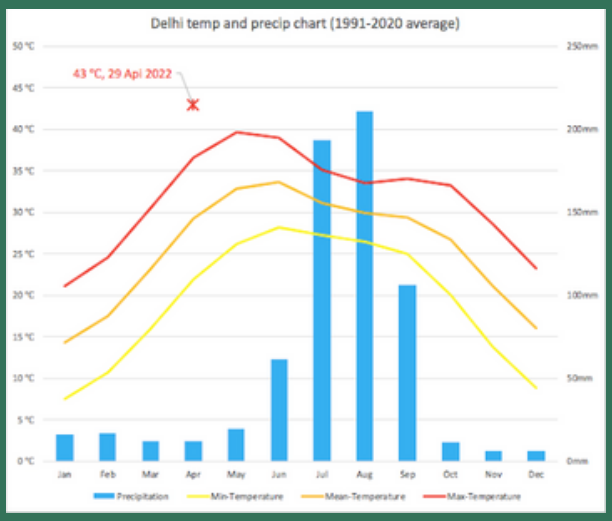
ADDITIONAL (29 APR 2022)

The following graph shows the historical maximum daily temperature for April from 1970-2020.

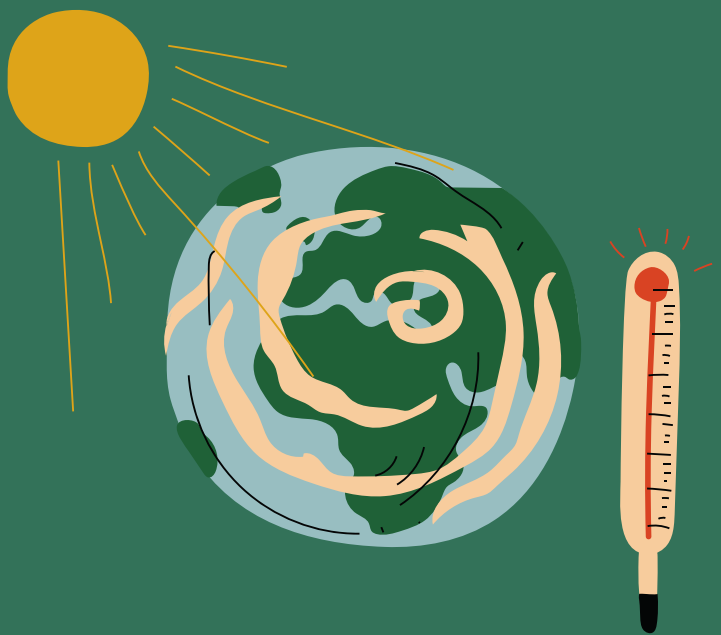
Only 4 years have recorded a value higher than 43°C.



In the following graph, the red line indicates the average maximum temperature between 1991-2020. The recent heatwave recorded a temperature of 43°C in Delhi. It is well above the average maximum temperature for the month of April.[9]



The graph also includes a climate projection using CMIP6 data, that predicts a daily maximum temperature of 48°C, in the SSP5-8.5 scenario in the time period of 2080-2099.[10]



* The dataset is a reanalysis, not actual observations, which means the data is reconstructed with computer modeling technique.

9.Source: https://climateknowledgeportal.worldbank.org/country/india/climate-data-historical
10. Source: https://climateknowledgeportal.worldbank.org/country/india/climate-data-projections-expert

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Greenpeace India is an independent campaigning organization that uses non-violent creative action to pave the way towards a greener, more peaceful world, and to confront the systems that threaten our environment.

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