



Heat Waves and Heat Dome

Why in News

- The Pacific North-west, known for its moderate climate, is experiencing a “**historic**” heat wave. The heat wave is being described as a “**Heat Dome**”.
 - It has stretched emergency services, with at least 134 people dying suddenly since the last few days in parts of Canada.

Heat Waves and Heat Dome

▪ Heat Wave:

- A heat wave is a period of abnormally high temperatures, more than the normal maximum temperature that lasts for more than two days.
- Heat waves can occur with or without high humidity and have the potential to cover a large area, exposing a high number of people to **hazardous heat**.
- **Increasing Trend of Heat Waves:**
 - In the past few decades, heat waves have become larger, **affecting 25% more land area in the Northern Hemisphere** than they did in 1980.
 - Including the **ocean areas, heat waves have grown by 50%**.

▪ Heat Dome:

- A heat dome occurs when the atmosphere traps hot ocean air like a lid or cap.
- As per **National Oceanic and Atmospheric Administration (NOAA), USA**, a heat dome is created when strong high-pressure atmospheric conditions combine with weather patterns like [La Niña](#).
- They are **more likely to form during La Niña years** like 2021, when waters are cool in the eastern Pacific and warm in the western Pacific. creating vast areas of sweltering.
- **Duration of Heat Domes:**
 - According to NOAA, a heat dome typically lasts **a week**.
 - The formation after a week becomes too bog to keep standing and falls over, releasing the trapped air and ending the swelter.

▪ Causes of Formation of Heat Dome:

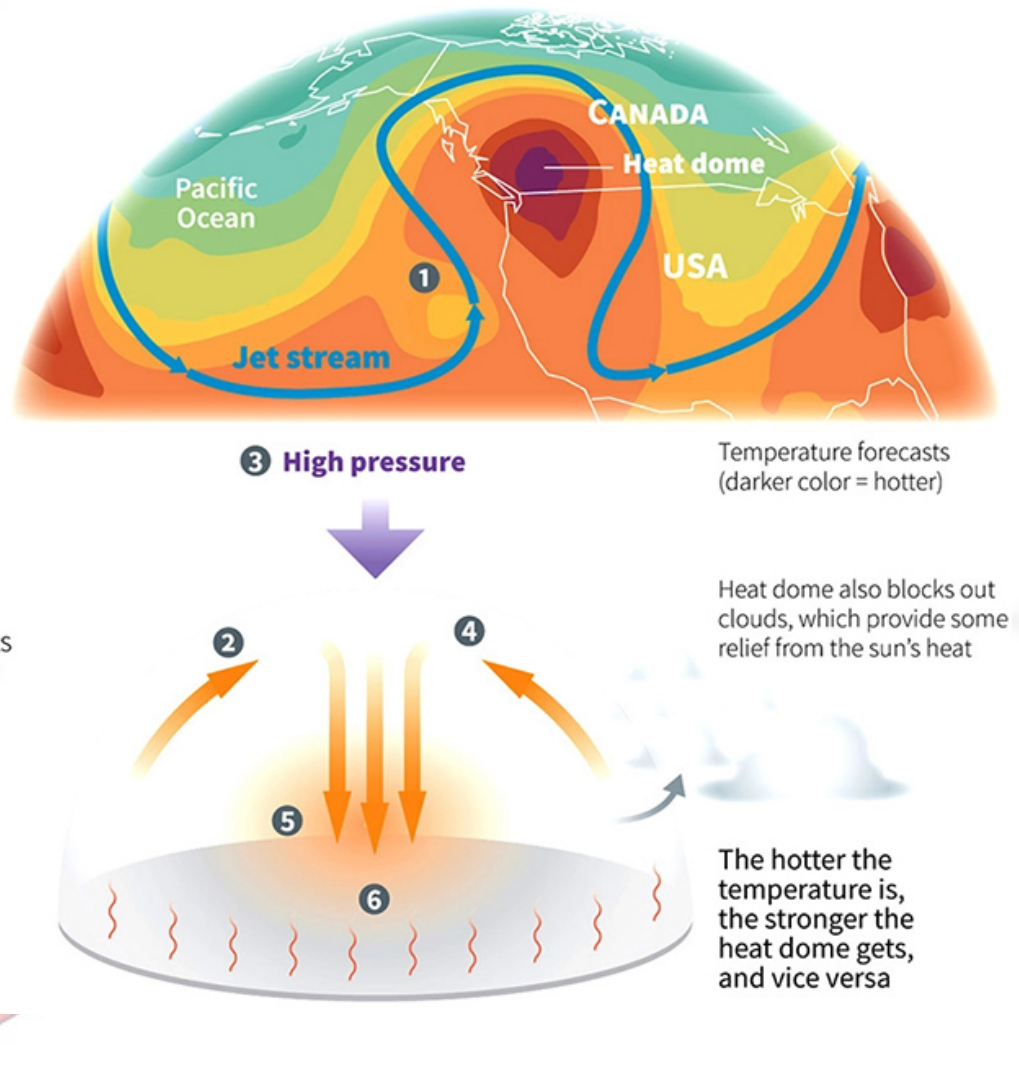
- **Change in Ocean Temperature:** The phenomenon begins when there is a **strong change (or gradient) in ocean temperatures**.
 - In the process known as **convection**, the gradient causes more warm air, heated by the ocean surface, to rise over the ocean surface.
 - As prevailing winds move the hot air east, the northern shifts of the jet stream trap the air and move it toward land, where it sinks, **resulting in heat waves**.
- **Change in Atmospheric Pressure:** Heat waves begin when **high pressure in the atmosphere moves in and pushes warm air** toward the ground. This effect is fuelled by heat rising from the ocean, creating an amplification loop.

- The high-pressure system pressing down on the ground expands vertically, forcing other weather systems to change course.
 - It even minimizes wind and cloud cover, making the air more stifling.
 - This is also why a heat wave parks itself over an area for several days or longer.
- **Climate Change:** The rising temperatures lead to hotter weather. Heat waves have been a regular phenomenon on land.
 - However, **global warming has caused them to be hotter with a longer duration** and an increased frequency.
 - Scientists studying the climate tend to agree that the heat waves occurring today are more likely to be a result of climate change for which humans are responsible.

// The 'heat dome'

Occurs when the atmosphere traps hot ocean air like a lid or cap

- 1 In summer, the **jet stream** (which moves the air) shifts northward
- 2 **Hot** and stagnant air **expands** upwards
- 3 Strong and **high-pressure** atmospheric conditions combine with influences from La Nina act like a dome or cap
- 4 In a process known as **convection**, hot air attempts to escape but high pressure pushes it back down
- 5 Under the dome, the air sinks and **compresses**, releasing more heat
- 6 As winds move the hot air east, the jet stream traps the air where it sinks, resulting in **heat waves**



▪ Impact of Heat Waves and Heat Domes:

- **Risk of Wildfires:** The heat domes act as fuel to [wildfires](#), which destroys a lot of land area every year in countries like the US.
- **Prevents Cloud Formation:** The condition also **prevents clouds from forming**, allowing for more radiation from the sun to hit the ground.
- **Heat Strokes and Sudden Fatalities:** The very high temperatures or humid conditions pose an elevated risk of [heatstroke](#) or **heat exhaustion**.
- **Older people and people with chronic illness** such as [heart disease](#), [respiratory disease](#), and [diabetes](#) are **more susceptible to heatstroke**, as the

- body's ability to regulate heat deteriorates with age.
- Houses without air conditioners experience an unbearable rise in temperature of their home which can lead to **sudden deaths**.
- **Effect on Vegetation:** The trapping of heat can also **damage crops, dry out vegetation** and result in **droughts**.
- **Increased Energy Demands:** The sweltering heat wave also leads to rise in energy demand, especially electricity, leading to pushing up rates.
- **Power Related Issues:** Heat waves are often high mortality disasters.
 - Avoiding heat-related disasters depends on the resilience of the electrical grid, which can fail if electricity demand due to air conditioning use exceeds supply.
 - As a result, there is the **double risk of infrastructure failure and health impacts**.

Steps for Avoiding Heat Waves

▪ Individual Level:

- **Staying Hydrated:** Staying indoor and at rest in a very dry room with about 10% relative humidity, and drinking water constantly (for producing sweat), can help avoid overheating at temperatures as high as 46°C.
 - However, there is a limit to this, called the **wet-bulb temperature**, which considers heat and humidity, beyond which humans cannot tolerate high temperatures.
- **Altering Workout Routines:** Exercising early in the morning when it is still cool or in air conditioned indoor spaces.
 - Skipping workout routines can also be considered given the extreme heat.

▪ Public Level:

- **Public Cooling Shelters:** A number of emergency cooling shelters can be opened so that people without domestic air conditioning units can escape the heat.
 - Air-conditioned rooms and buildings are the biggest help to people caught under a heat dome.
- **Portable ACs:** Portable air-conditioning units, along with fans and even ice are also useful.

▪ Long Term Solutions:

- **Afforestation:** Trees don't just provide much-needed shade for a sweaty city. The water evaporating from their leaves can cool a neighborhood by a few degrees during the hottest periods.
 - Tree leaves also absorb and filter local air pollution; heat waves can worsen urban smog, which may put comorbids at risk.
- **Replacing Dark Roofs:** A big reason that cities are so much hotter than rural areas is that they are covered by dark roofs, roads and parking lots that absorb and retain heat.
 - Replacing the dark surfaces with lighter more reflective materials will result in a comparatively cooler environment.
- **Preparing for the Blackout:** A widespread blackout during a heat wave can leave millions of people without electricity for fans or air-conditioners.
 - Smarter grids and new forecasting tools could help electric utilities prepare for heat waves.
 - Using electronic controls to pre-cool buildings before temperatures peak in the daytime.

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