



# Heat Dome

**For Prelims:** Heat Dome, Jet Stream, Climate Change

**For Mains:** Important Geophysical Phenomena

## Why in News?

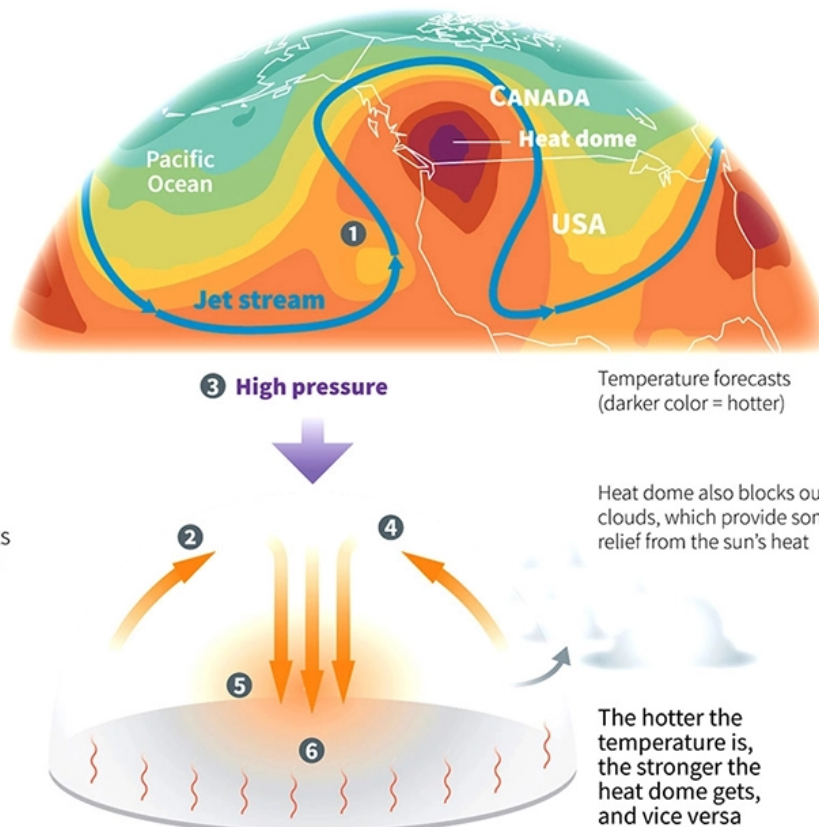
Several countries in Europe recorded their hottest January weather ever in 2023 with temperatures 10 to 20 degrees Celsius above average.

- These included **Poland, Denmark, the Czech Republic, the Netherlands, Belarus, Lithuania and Latvia.**
- Experts said that the **continent is experiencing an extremely warm spell** because of the **formation of a heat dome over the region.**
- In 2021, a heat dome formed over western Canada and the US, causing deadly [heat waves](#).
- **Another heat dome settled over the US in September 2022** and raised temperatures to a new high.

## // 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**



## What is a Heat Dome and Heat Wave?

### ▪ Heat Dome:

- A **heat dome occurs when an area of high-pressure traps warm air over a region, just like a lid on a pot**, for an extended period of time.
- The **longer that air remains trapped, the more the sun works to heat the air**, producing warmer conditions with every passing day.
- Heat domes **generally stay for a few days but sometimes they can extend up to weeks**, which might cause deadly heat waves.
- Scientists suggest that **any region of high pressure, whether a heat dome or not, forces air to sink and once it reaches the ground**, it gets compressed and becomes even warmer.
- Moreover, **when air sinks, it gets drier and further raises the temperature of the area**.

### ▪ Heat Domes and the Jet Stream:

- The heat dome's formation is **related to the behaviour of the jet stream**.
  - Jet streams are relatively narrow bands of strong wind in the upper levels of the atmosphere
- The **jet stream is believed to have a wave-like pattern** that keeps moving from north to south and then north again.
- **When these waves get bigger and elongated**, they move slowly and sometimes can become stationary.
- This is **when a high-pressure system gets stuck** and leads to the occurrence of a heat dome.
- **Although heat domes are likely to have always existed**, researchers say that [climate change](#) may be making them more intense and longer.
- They suggest with the rising temperatures, it is expected that the jet stream will become more wavy and will have larger deviations, causing more frequent extreme heat events.

## What are the 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 fueled 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.

