



Cloudbursts in Himachal Pradesh

For Prelims: Cloudbursts, Flash Floods, [Himalayas](#), [National Disaster Management Authority](#), [Internal Displacement Monitoring Centre](#).

For Mains: Causes, Impact and Mitigation from Cloudbursts and Flash floods, Factors Affecting the Rainfall in India, Mitigation measures for Flood Disaster

[Source: IE](#)

Why in News?

Recently, a cloudburst, leading to flash floods in Himachal Pradesh has killed many people and several missing.

- These floods caused significant destruction, including the washing away of several buildings, bridges, and roads, according to officials.

What is a Cloudburst?

- **About:**
 - According to the [India Meteorological Department \(IMD\)](#), cloudbursts are **sudden, heavy rainstorms** where more than **10 cm of rain falls in less than an hour over a small area, of about 10 square km**. They often happen in mountainous areas, especially in the Himalayas.
 - In the Indian Subcontinent, it generally occurs when a monsoon cloud drifts northwards, from the Bay of Bengal or the Arabian Sea across the plains then on to the Himalaya which **sometimes brings 75 mm of rain per hour**.
- **Causes:**
 - Cloudbursts occur when **strong upward currents of hot air prevent raindrops from falling**, allowing them to **grow larger** while new smaller drops form below.
 - This leads to a **significant accumulation of water in the atmosphere**, which is **released abruptly when the upward currents weaken**.
 - Cloudbursts frequently occur in the **hilly and mountainous areas** of the Indian subcontinent, largely due to the **region's complex topography**, which facilitates **orographic lifting**.
 - **Orographic lifting** occurs when **air rises and cools** as it travels up the windward side of a mountain.
 - This process **enhances cloud development** and rainfall as moist air ascends over the mountains, with monsoon dynamics and localised weather patterns further influencing these intense precipitation events.
- **Cloudburst are Different from Rainfall:**
 - **Rain is condensed water falling from a cloud** while **cloudburst is a sudden heavy rainstorm**.
 - Rain over **10 cm per hour** is categorised as a cloudburst.

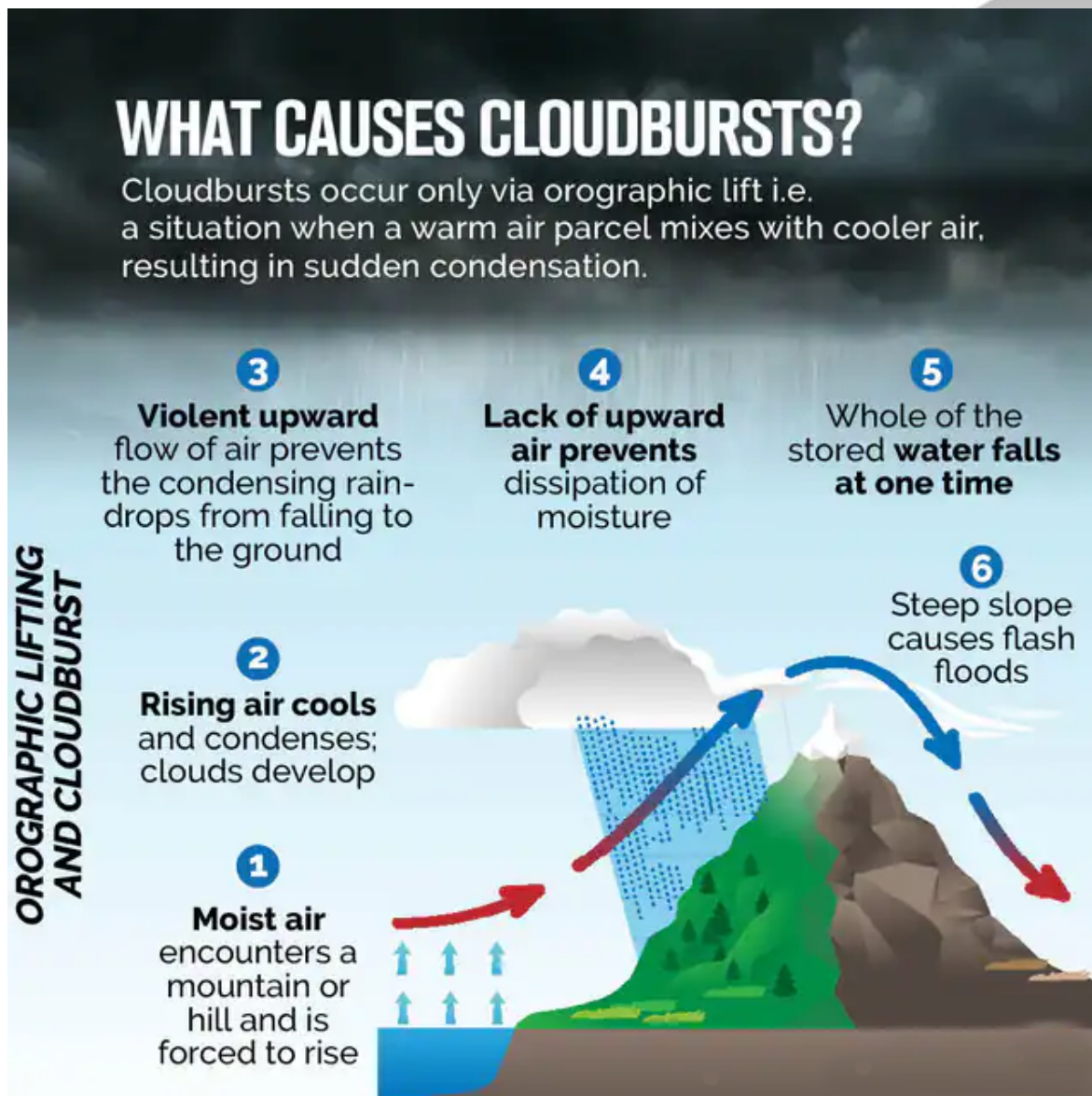
- The **cloudburst is a natural phenomenon**, but occurs quite unexpectedly, very abruptly, and rather drenching.

▪ **Prediction:**

- There is **no satisfactory technique** for anticipating the occurrence of cloud bursts through **satellites and ground monitoring stations** because they **develop over a small area and for a period of time**.
- A **very fine net work of radars is required to be able to detect** the likelihood of a cloud burst and this would be expensive.
- Only the areas likely to receive heavy rainfall can be identified on a short range scale. Much of the **damage can be avoided by way of identifying the areas** and the meteorological situations that favour the occurrence of cloud bursts.

▪ **Examples of Cloudbursts:**

- **Uttarakhand Cloudburst (July 2021):** Devastating cloudbursts in Chamoli, Uttarkashi, and Pithoragarh **caused flash floods, landslides, and extensive damage to infrastructure and lives**.
- **Himachal Pradesh Cloudburst (August 2020):** Cloudbursts in Kullu, Lahaul-Spiti, and Kinnaur triggered landslides and flash floods, damaging roads, bridges, and houses.



What are the Consequences of Cloudbursts?

- **Flash floods:** [Flash floods](#) are **sudden, localised surges in water levels** during or **after** intense rainfall.
 - Flash flooding starts **within 6 or 3 hours of heavy rainfall**. It is typically caused by

intense thunderstorms but can also result from dam or levee breaks and mudslides.

- Factors like **rainfall intensity, location, land use, topography, vegetation, soil type, and water content** determine the speed and location of flash flooding.
- **Landslides:** A **landslide** is a **mass movement of material**, such as **rock, earth or debris, down a slope**. It can happen **suddenly or more slowly** over long periods of time.
 - Factors like heavy rainfall, erosion, and weathering can trigger landslides.
 - In India, landslides account for about **8% of global fatalities**, with **847 deaths** and thousands displaced from 2001 to 2021, according to research from IIT-Madras.
 - **Around 13.17% of India's area is susceptible to landslides**, with **4.75%** designated as "**very highly susceptible**."
 - **Sikkim is the most prone state**, while **Kerala has over 14%** of its land in the very high susceptibility category.
- **Mudflows:** It is a type of **water flow** characterised by its **high density and viscosity**, containing significant amounts of suspended particles and silt.
 - Mudflow can **only transport and deposit the coarsest materials**, leading to **irreversible sediment entrainment**, and it typically does not flow as far as regular water streams.

Why forecasting cloudbursts is a challenge

Efforts to monitor and forecast cloudbursts are still at a nascent stage

1 As per the IMD definition, over 100 mm of rainfall in one hour is called a cloudburst. It usually occurs over a small geographical region (20-30 sq. km)	updraft happens rapidly – 60-120 km/hr	precipitation radars are much smaller than the area of individual cloudburst events
2 Rainfall of 100 mm per hour translates to 100 litres for every square metre where a cloudburst occurs. For a small region of 20 sq. km, it is about two billion litres of water in an hour	4 Cloudbursts occur mostly over the rugged terrains over the Himalayas, Western Ghats , and northeastern hill States of India	7 Multiple doppler weather radars can monitor moving cloud droplets and help to provide forecast for the next three hours. But radars are expensive and installing them widely may not be feasible
3 Tall cumulonimbus clouds causing cloudbursts can develop quickly (in about 30 minutes) as the moisture	5 In India, cloudbursts often occur during the monsoon season, when the SW monsoon winds bring in copious amounts of moisture inland	8 The change in monsoon extremes and cloudbursts are in response to the 1-degree Celsius rise in global surface temperature
	6 Satellites fail to detect cloudburst systems as the resolution of the	

What is the Impact of Climate Change on Cloudburst?

- **Increased Atmospheric Moisture:** Rising global temperatures allow the atmosphere to hold more moisture. This **moisture-laden air** can lead to **more intense cloud formation** and increased potential for cloudbursts, especially in mountainous areas like the **Himalayas**.
- **Changes in Precipitation Patterns:** **Climate change can shift precipitation patterns**, causing some regions to experience prolonged dry periods while others face more intense rainfall events.
- **Altered Atmospheric Stability:** Higher temperatures can **destabilise the atmosphere**, leading to increased convective activity and more frequent **thunderstorms**, which are often linked to **cloudbursts**.
- **Glacier Retreat and Snowmelt:** Melting glaciers in regions like the Himalayas, driven by rising temperatures, are **releasing water more quickly**, potentially contributing to cloudburst events.
- **Land Use Changes:** Human activities such as **deforestation** and **urbanisation** can alter local climates and precipitation patterns, **affecting microclimates in mountainous areas** and potentially influencing cloudburst occurrences.

What are the Ways to Mitigate the Devastating Impact of Cloudbursts?

- **Early Warning Systems:** Develop effective early warning systems **to predict cloudbursts and**

provide timely alerts, allowing people to prepare and evacuate if necessary.

- **Urban Planning and Infrastructure:** Invest in resilient **urban planning** and infrastructure, such as stormwater drainage systems, retention ponds, and green spaces, **to manage excess water and reduce flooding**.
- **Watershed Management:** Implement practices to manage watersheds, like **reducing soil erosion and increasing soil infiltration**, to help control water flow and lessen the impact of cloudbursts.
- **Reforestation and Green Infrastructure:** Plant trees and **maintain green areas to absorb excess water**, reduce soil erosion, and **stabilise slopes**, helping to mitigate cloudburst effects.
- **Awareness and Education:** Educate communities about **cloudburst risks and train them on response and evacuation** procedures to ensure they take necessary precautions.
- **Sustainable Land Use Practices:** Promote land use practices that reduce vulnerability to cloudbursts, such as **avoiding construction in flood-prone areas**, controlling deforestation, and **implementing soil conservation measures**.
- **International Cooperation:** Work with neighbouring countries and international organisations to share best practices, technology, and **resources for managing cloudbursts, especially in shared river basins**.

Drishti Mains Question:

What are Cloudbursts and what are its mitigation strategies?

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UPSC Civil Services Examination Previous Year's Question (PYQs)

Prelims:

Q. La Nina is suspected to have caused recent floods in Australia. How is La Nina different from El Nino? **(2011)**

1. La Nina is characterised by an usually cold ocean temperature in the equatorial Indian Ocean whereas El Nino is characterised by unusually warm ocean temperature in the equatorial Pacific Ocean.
2. El Nino has an adverse effect on the south-west monsoon of India but La Nina has no effect on the monsoon climate.

Which of the statements given above is/are correct?

- (a)** 1 only
- (b)** 2 only
- (c)** Both 1 and 2
- (d)** Neither 1 nor 2

Ans: (d)

Mains

Q. With reference to the National Disaster Management Authority (NDMA) guidelines, discuss the measures to be adopted to mitigate the impact of recent incidents of cloudbursts in many places of Uttarakhand. **(2016)**