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CURRENT AFFAIRS

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CLouDBURST

This article covers "Daily Current Affairs" and the topic details "Cloudburst". The topic "Cloudburst" has relevance in the Disaster management section of the UPSC CSE exam.

For Prelims:

Understanding Cloudbursts?

For Mains:

GS 3: Disaster management

Impact and Consequences?

Forecasting Challenges?

Way Forward?

Why in the news:

After experiencing heavy rainfall, Himachal Pradesh has witnessed landslides resulting in a tragic loss of at least 22 lives.

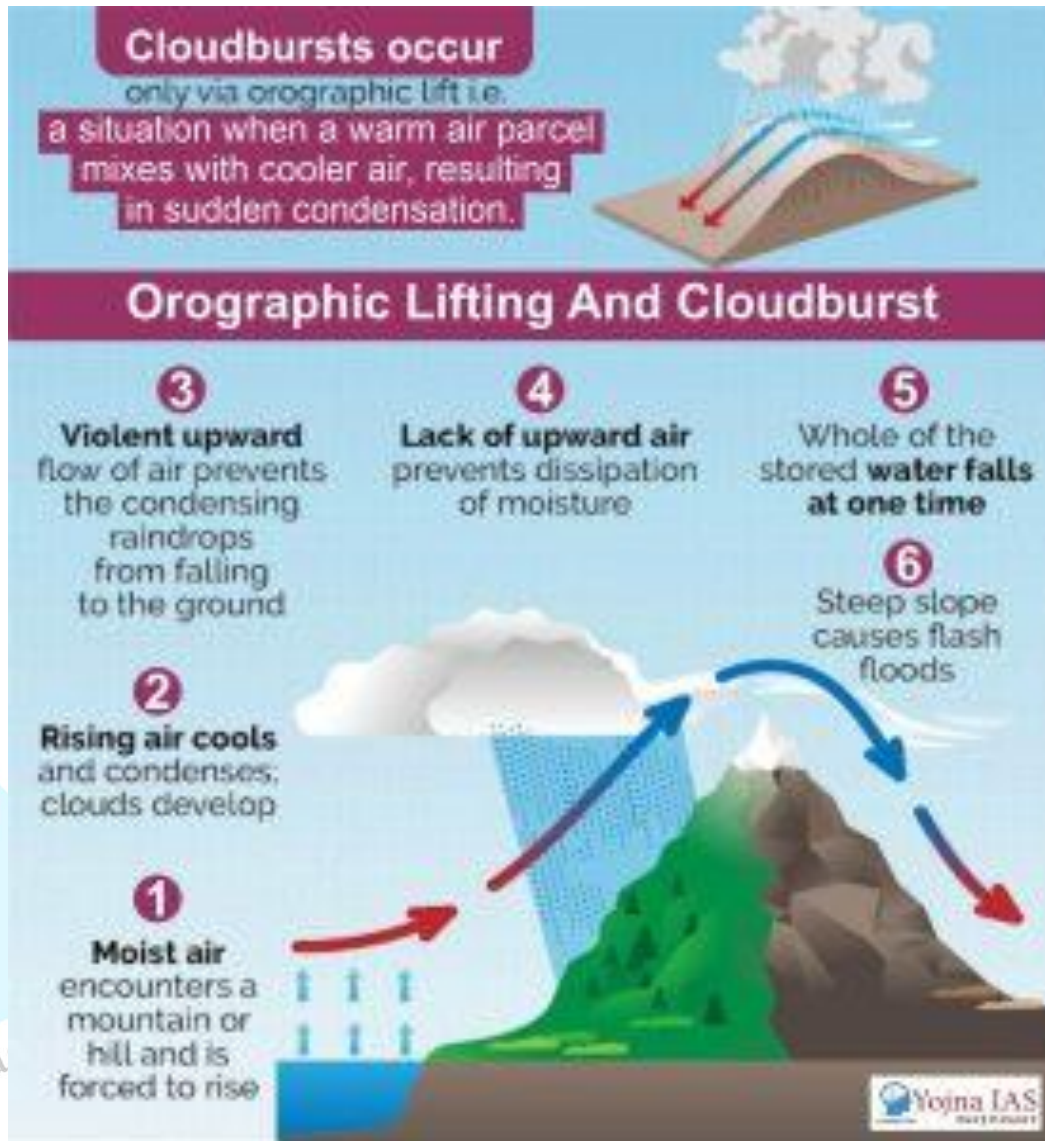
Understanding Cloudbursts:

- Cloudbursts are intense and localized bursts of rainfall, often occurring in hilly regions where the topography, wind patterns, and temperature variations create the right conditions.
- These events involve a remarkable amount of heavy rainfall, specifically 10 cm or more within the span of an hour, over a relatively small area approximately measuring 10 km x 10 km.

Formation:

- **Atmospheric Instability:** Cloudbursts often happen during conditions of atmospheric instability, commonly associated with convective weather patterns. These patterns involve the rapid upward movement of warm, moist air and the subsequent condensation of this air as it rises and cools.
- **Moisture Availability:** A key factor for cloudburst formation is the availability of abundant moisture in the atmosphere. This moisture-laden air rises and condenses as it encounters cooler altitudes, forming clouds.
- **Rapid Cloud Development:** The rapid updrafts of moist air create towering cloud formations known as cumulonimbus clouds. These clouds are characterized by their vertical development and can extend into the higher levels of the atmosphere.
- **Condensation and Precipitation:** As the warm, moist air rises and cools within the cumulonimbus clouds, water vapor condenses into water droplets. These droplets collide and merge, growing larger and heavier until they become too heavy for the cloud's updrafts to support.
- **Rainfall Onset:** The large, heavy water droplets formed within the cumulonimbus cloud begin to fall under gravity's influence. Because of the intense updrafts within the cloud, these droplets can be carried to higher altitudes within the cloud before they eventually fall to the ground.

- Intense Rainfall: As the raindrops fall, they accelerate due to gravity and can reach the ground at high speeds. This results in a sudden and intense burst of rainfall over a small area. The heavy rainfall can continue for a short duration, often less than an hour, and the amount of rain that falls during this time can be exceptionally high.



Magnitude of Cloudbursts:

- During a cloudburst, a relatively small area witnesses an astonishingly large amount of precipitation – around 10% of its yearly average rainfall – in the incredibly short span of an hour.
- To put this in context, India experiences an average annual rainfall of about 116 cm.
- Cloudbursts bring forth a much higher volume of rainfall than even the notorious Mumbai deluge of July 26, 2005.

Localized Impact and Consequences:

- The impact of cloudbursts is deeply localized, often triggering cascading events like landslides and flash floods in areas characterized by rugged terrain.

1. **Loss of Life and Injuries:**

- The rapid and unpredictable nature of flash floods caused by cloudbursts can result in serious injuries or fatalities among individuals caught in their path.

2. **Immediate Property Devastation:**

- Flash floods carry immense water force and can transport substantial debris, including boulders, leading to significant structural damage to homes. This damage can render residences uninhabitable and sweep away valuable property like vehicles.

3. **Disruption of Vital Infrastructure:**

- Infrastructure such as bridges and roadways can suffer structural harm from the force of floodwaters and debris, disrupting travel routes and making transportation impossible.
- Flash floods also pose a risk to utility systems, causing power, telephone, and cable lines to be knocked out, hampering communication and daily life.
- Floodwaters can infiltrate and contaminate groundwater sources, rendering tap water unsafe for consumption.

4. **Deposition of Sediment and Debris:**

- Cloudburst-induced floods often leave behind substantial deposits of silt and debris, creating obstacles for travel and necessitating expensive cleanup efforts.

5. **Economic Setbacks:**

- The aftermath of cloudbursts can lead to local businesses being unable to operate due to damage, and customers may face difficulties accessing these establishments.
- Such disruptions to business and commerce can result in economic losses for the affected area.

Forecasting Challenges:

- Meteorological agencies such as the IMD can offer forecasts about the likelihood of heavy rainfall events occurring in advance. However, predicting the precise amount of rainfall at a specific location remains a complex challenge.
- Forecasts tend to become less accurate as they narrow down to smaller geographical areas. Despite advancements, our current technology still lacks the capability to predict individual cloudburst events with high accuracy.
- Alerts for heavy to very heavy rainfall can be issued with a window of 4 to 5 days. However, The potential for extreme rainfall, which might lead to conditions akin to cloudbursts, can only be forecasted approximately 6 to 12 hours before they occur.

Changing Patterns and Climate Impact:

- While there isn't definitive proof of an increasing trend in cloudbursts as defined by the IMD, there's a globally observed rise in extreme rainfall events attributed to the effects of climate change.
- India's rainfall pattern has undergone significant shifts, resulting in concentrated heavy rainfall over shorter periods, interspersed with extended dry spells. This altered pattern, linked to climate change, suggests the possibility of a higher frequency of cloudburst-like events in the future.

Way Forward

Addressing the challenges posed by cloudburst impacts requires a comprehensive approach involving preparedness, infrastructure development, and community engagement. Here's a path forward:

1. **Early Warning Systems:** Develop and implement advanced early warning systems to provide timely alerts about impending cloudbursts, giving residents and authorities the opportunity to take necessary precautions.
2. **Infrastructure Resilience:** Design and construct buildings, roads, and bridges that are more resilient to cloudburst-induced floods, incorporating features that can withstand the force of water and debris.
3. **Sustainable Urban Planning:** Implement effective urban planning strategies that consider the local topography and drainage systems, minimizing vulnerabilities to flash floods in urban areas.

4. **Community Education:** Raise awareness among local communities about the risks associated with cloudbursts and flash floods, providing them with knowledge on how to respond effectively during emergencies.
5. **Disaster Preparedness Training:** Conduct regular training and drills for residents and first responders to ensure they are well-prepared to handle cloudburst-related emergencies.
6. **Vegetation and Watershed Management:** Implement measures such as reforestation and sustainable land management practices to reduce soil erosion and improve watershed management, which can mitigate the intensity of flash floods.
7. **Early Recovery and Rehabilitation Plans:** Develop strategies for post-cloudburst recovery and rehabilitation, including providing support for affected communities, restoring damaged infrastructure, and addressing economic losses.
8. **Climate Change Adaptation:** Incorporate climate change adaptation measures into planning processes, recognizing that changing weather patterns may increase the frequency and severity of cloudbursts.

By adopting these forward-focused strategies, communities and governments can work together to reduce the impacts of cloudbursts and build resilience against their destructive effects.

SOURCE:

<https://indianexpress.com/article/explained/explained-climate/himachal-pradesh-cloudbursts-explained-8892242/>

Q.1 What meteorological conditions are typically associated with the occurrence of a cloudburst?

Options:

- (A) Low atmospheric humidity and stable air masses
- (B) High-pressure systems and clear skies
- (C) Convective weather patterns and abundant moisture
- (D) Low-altitude cloud cover and moderate temperatures

Answer: (C)

Q.2 Which sequence of atmospheric processes and conditions is most likely to lead to a cloudburst?

- (A) Moist air rises, forming cumulonimbus clouds, followed by rapid condensation and heavy rainfall.
- (B) Low atmospheric pressure causes moisture availability, leading to the formation of cumulus clouds and subsequent rainfall.
- (C) Warm air descends rapidly, creating cumulus clouds, and moisture condenses into rain droplets.
- (D) Stable atmospheric conditions with minimal moisture content result in the formation of stratus clouds and light drizzle.

ANSWER: (A)

Q.3 Analyze the localized impacts of cloudbursts on communities, infrastructure, and the environment. Also, highlight the importance of disaster preparedness in mitigating the impacts of cloudbursts.

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