Sonic Boom

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5. Sonic Boom

In News: Researchers have successfully used **seismometers** to detect **sonic booms** produced by **space debris re-entering Earth's atmosphere**, highlighting cross-linkages between atmospheric physics and earth sciences.

What is a Sonic Boom?

- A **sonic boom** is a **loud, thunder-like sound** produced when an object travels **faster than the speed of sound (Mach 1)**.
- Commonly associated with **supersonic aircraft**, missiles, and **re-entering space debris**.

How is a Sonic Boom Formed?

1. As an object moves at supersonic speed, it **compresses air molecules** faster than sound waves can propagate.
2. This creates **shock waves** that merge into a **cone-shaped wave (Mach cone)**.
3. When this shock wave reaches the ground, it is heard as a **sonic boom**.

Key Characteristics

1. Sonic booms release **large amounts of acoustic energy**.
2. The sound is not continuous but heard as a **sudden explosive noise**.
3. Long aircraft can produce **double booms**:

- One from the nose (leading edge)
- One from the tail (trailing edge)

Factors Affecting Intensity

The loudness and impact depend on:

1. **Altitude** of the object (higher altitude - weaker boom)
2. **Size and weight** of the object
3. **Shape and length** of the aircraft
4. **Flight maneuvers**
5. **Atmospheric conditions**:

oTemperature

oAir pressure

oWind speed and direction

6Larger and heavier objects displace more air - **stronger shock waves**.

Visible Effects

1. Sometimes a **cloud or cone-shaped vapor** is seen around the aircraft.
2. This is **not the sound**, but **condensed water vapour** formed due to rapid pressure changes caused by shock waves.

Impacts

1. Can **shatter glass windows**
2. Cause structural vibrations
3. Generally **low risk to human life**, but repeated exposure may cause disturbance

Scientific Significance

1. Detection using **seismometers** shows that sonic booms can be recorded as **ground vibrations**.
2. Helps in:

- Tracking re-entering space debris
- Improving aerospace safety
- Understanding atmospheric–seismic interactions