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METEOROLOGICAL DISASTERS ARE TORNADO, TYPHOON, TWISTER, STORM, HURRICANE AND CYCLONE: ALL ARE RELATED TO CLIMATE

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ABSTRACT

Cyclones, typhoons, and hurricanes are the exact same weather phenomenon—large, rotating tropical storms that form over warm ocean waters—differing only by the region where they occur, while a tornado is a much smaller, violently rotating column of air that forms over land. What they are: Massive, organized systems of clouds and thunderstorms with low pressure at the center and wind speeds of at least 74 mph (119 km/h). Where they happen: Hurricanes: Form over the North Atlantic Ocean, central and eastern North Pacific Ocean, and the Caribbean/Gulf of Mexico. Typhoons: Form over the Northwest Pacific Ocean (near Japan, the Philippines, and China). Cyclones: Form over the South Pacific Ocean and the Indian Ocean (near India, Sri Lanka, and Australia). Scale and Duration: They span hundreds of miles across and can last for days or over a week. Tornadoes: What they are: A narrow, violently rotating column of air that extends from a severe thunderstorm (often a supercell) down to the ground. Where they happen: They form over land, with the highest frequency in North America (the U.S. "Tornado Alley"), though they can occur globally. Scale and Duration: They are much smaller—usually less than a mile wide—and typically last only a few minutes to less than an hour, though their localized winds can reach over 300 mph (480 km/h).

KEYWORDS: tornado, cyclone, twister, hurricane, storm.

INTRODUCTION

A **tornado**—also commonly called a twister or a whirlwind—is a narrow, violently rotating column of air that extends from the base of a thunderstorm down to the ground.

Key Characteristics

Appearance: They often show up as a visible condensation funnel made of water droplets, dust, and debris.

Wind Speeds: Most have winds under 110 mph (180 km/h), while the most extreme and violent storms can exceed 300 mph (480 km/h).

Duration: Many last less than 15 minutes, though severe ones can stay on the ground for an hour or more.

Sound: They often produce a loud roar that sounds like a freight train or a waterfall.

How They Form

Clashing Air Masses: They typically form when warm, moist air meets cold, dry air, creating atmospheric instability.

Wind Shear: Changes in wind speed and direction with height cause the air to spin horizontally.

Updrafts: Strong updrafts inside severe thunderstorms (especially supercells) tilt that spinning rotation vertically, allowing it to touch the ground.



Figure-1: Tornado.

Key Differences

Storms: Can span hundreds or thousands of square miles and last for hours, days, or even weeks (like a hurricane).

Tornadoes: Are much localized, usually measuring just yards to a few hundred feet across when touching the ground. A tornado is different altogether—it's a funnel cloud. Tornadoes are much smaller in scale than hurricanes.

Duration

Storms: Persist for a long time—ranging from a couple of hours for a standard thunderstorm to several days for a major weather system.

Tornadoes: Touch down rapidly and typically last only a few minutes (though rare ones can persist for over an hour).

Wind Speed & Destruction

Storms: Feature strong, widespread winds (often 50–90 mph) that cause broad, general damage via heavy rain, flooding, or hail.

Tornadoes: Feature hyper-concentrated, violently rotating winds that can exceed 200 mph (EF3 to EF5 intensity), causing catastrophic, narrow tracks of selective destruction.

Where They Form

Storms: Can form over warm ocean waters (hurricanes) or land (thunderstorms, blizzards).

Tornadoes: Form almost exclusively over land when warm, humid air clashes violently with cold, dry air beneath a severe thunderstorm.

Tornadoes form when warm, humid air near the ground collides with cool, dry air aloft, creating an unstable atmosphere and strong wind shear (winds changing speed and direction with height).

Key Ingredients for Formation

Warm, Moist Surface Air: Usually flows north from a warm body of water, such as the Gulf of Mexico in the United States.

Cool, Dry Air Aloft: Moves in from higher elevations or northern regions, creating a strong temperature contrast.

Wind Shear: Winds blowing at different speeds and directions at various altitudes create a horizontal spinning tube of air in the lower atmosphere.

Lifting Mechanism: A strong updraft (rising warm air) inside a powerful rotating thunderstorm—known as a supercell—tilts that horizontal spinning air into a vertical column.

How the Funnel Develops

Mesocyclone: The thunderstorm's updraft starts rotating, forming a broad spinning core called a mesocyclone. A mesocyclone is a large, rotating updraft of air inside a severe thunderstorm (typically 2 to 6 miles wide), whereas a tornado is a much smaller, violently rotating column of air that extends from the base of a thunderstorm to the ground.

Funnel Cloud: As the rotation speeds up and tightens, a visible funnel cloud drops down from the base of the storm cloud.

Touchdown: When the rotating funnel makes contact with the ground, it officially becomes a tornado.

The main difference between a cyclone and a tornado is their size, where they form, and how long they last.

Cyclones

Where they form: Over warm ocean waters in tropical or subtropical regions (such as the South Pacific and Indian Oceans). (In the Atlantic, similar storms are called hurricanes; in the northwest Pacific, they are called typhoons).

Size: Massive, often hundreds of miles wide.

Lifespan: Lasts for days or even weeks.

Wind Speed & Measurement: Sustained winds typically reach 74 to 200+ mph and are measured using the Saffir-Simpson scale.

Main Hazards: High winds, heavy rain, massive flooding, and storm surges.



Figure-2: Cyclone.

Tornadoes

Where they form: Over land from severe thunderstorms when warm and cold air masses collide.

Size: Much smaller, usually ranging from a few hundred yards to about a mile wide.

Lifespan: Short-lived, lasting only a few minutes to a couple of hours.

Wind Speed & Measurement: Can reach violent speeds of 40 to over 300 mph, measured using the Enhanced Fujita (EF) scale.

Main Hazards: Extremely violent localized rotation, flying debris, hail, and strong funnel winds.

A **hurricane** (also called a tropical cyclone, typhoon, or cyclone) is much bigger than a tornado.

Size Differences

Tornadoes: Typically only a few hundred meters across (with the largest on record reaching up to about 2 to 2.5 miles wide).

Hurricanes: Generally span 300 miles (482 km) or more across, sometimes stretching over 1,000 miles.

Other Systems Bigger Than a Tornado

Supercell Thunderstorms: The parent storms that spawn tornadoes are massive storm cells or multi-cell complexes that dwarf the tornado itself.

Squall Lines: Long, continuous lines of organized thunderstorms that can stretch for hundreds of miles.

Hurricanes, cyclones, and typhoons are the exact same weather phenomenon—a large tropical storm system—while tornadoes are a completely different and much smaller storm type that forms over land.

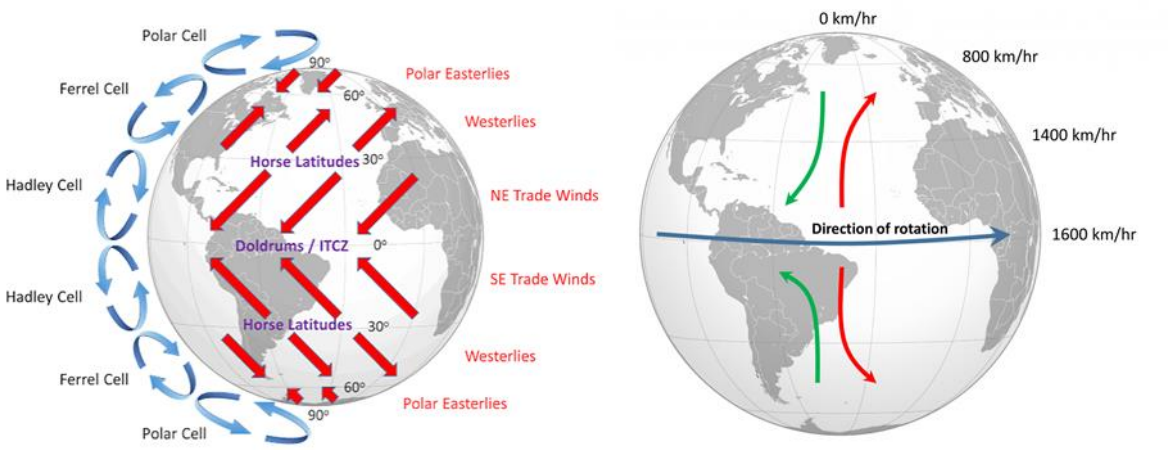


Figure-3: Coriolis Effect.

Hurricanes, Cyclones, and Typhoons

• **What they are:** Massive, rotating tropical storm systems with an eye, heavy rainfall, and sustained winds of at least 74 mph (119 km/h). They form over warm ocean waters (usually above 26.5°C / 80°F).

• **Size and duration:** Typically 300 to 500 miles wide and last for days or weeks.

• **Rotation:** They spin counter clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere due to the Coriolis Effect. The **Coriolis Effect** is the apparent deflection of moving objects—such as wind, water, or aircraft—caused by the rotation of the Earth.

How It Works

• **Apparent Force:** The Coriolis force is an inertial or "pseudo-force," meaning it does not actually pull an object to the side physically. Instead, it happens because the observer is standing on a surface (Earth) that is rotating beneath the moving object.

• **Varying Speeds by Latitude:** Earth rotates faster at the equator (about 1,600 km/h or 1,000 mph) than it does near the poles, where rotational speed drops to nearly zero.

• Direction of Deflection
• In the Northern Hemisphere, objects deflect to the right of their path of motion.
• In the Southern Hemisphere, objects deflect to the left of their path of motion.
• **Magnitude:** The effect increases toward the poles and is zero at the equator. It only affects the direction of movement, not the speed.

Real-World Impacts
• **Weather Systems:** As high-pressure air rushes toward low-pressure centers, the Coriolis effect deflects the wind, causing storms and hurricanes to spin counter clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.
• **Ocean Currents:** It helps drive major global ocean circulation patterns and surface currents.
• **Aviation and Long-Range Travel:** Pilots flying long distances must factor in this trajectory shift so they do not miss their destination.
• **The Bathtub / Toilet Myth:** The Coriolis effect is too weak to influence small-scale items like a draining sink or toilet; the direction of water spinning down a drain depends on the shape of the basin and initial motion, not the Earth's rotation.

• Name differences by region
• **Hurricane:** Used in the North Atlantic Ocean, the Caribbean Sea, the Gulf of Mexico, and the central/eastern North Pacific.
• **Typhoon:** Used in the northwest Pacific Ocean (near Japan, China, and the Philippines).
• **Cyclone (or Tropical Cyclone):** Used in the South Pacific Ocean and the Indian Ocean (near Australia, India, and East Africa).



Figure-4: Tornado.

Tornadoes
• **What they are:** Violently rotating, funnel-shaped columns of air that extend from a severe thunderstorm down to the ground.
• **Where they form:** Exclusively over land from single thunderstorms.
• **Size and duration:** Much smaller (usually less than a mile wide) and short-lived, lasting anywhere from a few minutes to less than an hour.
• **Wind speeds:** Can have extreme, hyper-localized winds up to 300 mph (480 km/h).
• **Key difference:** According to community consensus on Reddit, tornadoes are high-speed spinning columns tied to individual land storms, whereas hurricanes, typhoons, and cyclones are massive, wide-area weather systems powered by warm oceans.

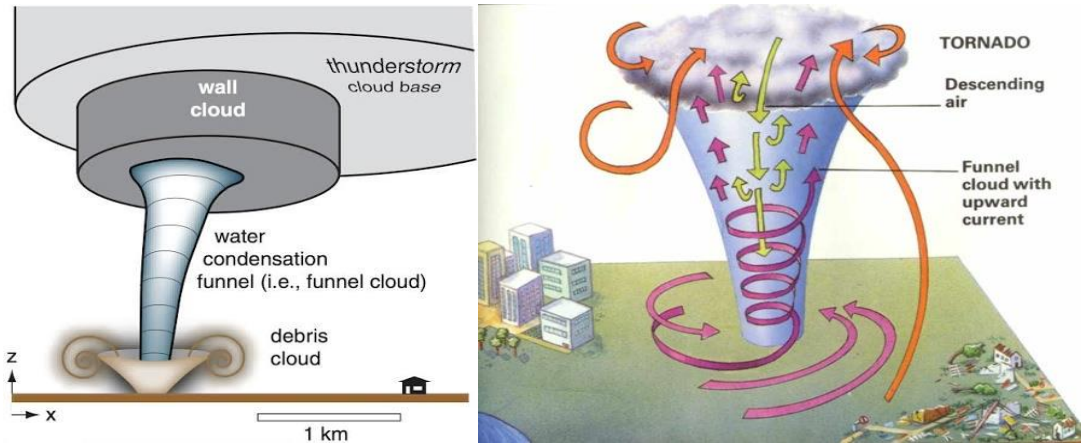


Figure-5: Funnel shaped vortex.

A tornado funnel mechanism involves the physical and thermodynamic processes that create a violently rotating column of air and its visible condensation cloud.

1. Rotation and Pressure Drop

• Vortex Formation: In a severe thunderstorm (typically a supercell), strong wind shear creates a horizontal spinning tube of air that a powerful updraft tilts into a vertical position, forming a mesocyclone.

Table-1: Difference between hurricane, typhoon, cyclone & tornado.

Feature	Hurricane/Typhoon/Cyclone	Tornado
Where it forms	Over warm ocean waters	Over land from thunderstorms
Size	300 to 500+ miles wide	Usually under 1 mile wide
Duration	Days to weeks	Minutes to an hour
Max Wind Speeds	74 to 190+ mph	Up to 300 mph
Naming	Based on geographic region	Not individually named

• **Low Pressure Core:** As the rotation tightens and concentrates conservation of angular momentum speeds up the spin, creating an intense low-pressure area at the centre (axis) of the vortex.



Figure-6: Deadly vortex of typhoon.

2. Adiabatic Cooling and Condensation

• Rapid Expansion: Air spiralling inward and upward into the core experiences a sharp drop in atmospheric pressure.

• Reaching the Dew Point: As the low-pressure air expands, it cools rapidly (adiabatic cooling). If the air is sufficiently moist, it reaches its saturation or dew point, causing water vapour to condense into tiny liquid water droplets.

• The Funnel Shape: Because pressure is lowest nearest the vortex centre and decreases with height, condensation often appears first just below the cloud base and extends downward as a conical condensation funnel.

3. Transition to a Tornado

• Surface Contact: A visible funnel cloud is not strictly a tornado until the rotating vortex and its associated damaging circulation make direct contact with the ground (or water).

Debris and Visibility: When the vortex hits the surface, it sweeps up dust, dirt, and debris, which often darkens or outlines the lower portion of the funnel. (Note: Tornadoes can exist even if the condensation funnel does not fully reach the ground, provided a damaging surface vortex is present).

Tornadoes look funnel-shaped because of how air pressure and condensation work at different heights between the storm cloud and the ground.

- **Low Air Pressure in the Core:** A tornado has a spinning core of intensely low air pressure.
- **Cooling and Condensation:** As warm, moist air is sucked into this rotating vortex, it expands and cools. When it reaches its dew point, water vapour condenses into tiny water droplets, making the core visible as a cloud.
- **Why It Tapers (Wide at the Top, Narrow at the Bottom):** Near the cloud base, the air is already cool and close to its saturation point, so even a small drop in pressure is enough to turn moisture into a visible cloud, making the funnel wide. Near the ground, the air is generally warmer and drier. It requires a much deeper, more concentrated drop in pressure (which only happens tightly in the centre of the vortex) to cause condensation, making the funnel narrow toward the surface.

The Invisible Rotator: The visible cloud funnel is only part of the story. The actual spinning column of air is often much wider than the visible condensation funnel, and it can extend all the way to the ground even if the cloud part hasn't fully formed or touched down. A mesocyclone is a storm-scale, rotating region of rising air (an updraft) within a severe thunderstorm, typically measuring 2 to 6 miles (3 to 10 km) in diameter.

Hurricanes, typhoons, and tornadoes are all violent rotating storms, but hurricanes and typhoons are the same type of large tropical storm with different names based on location, while tornadoes are much smaller, fast-spinning columns of air that form over land.

Hurricanes and Typhoons (and Tropical Cyclones)
What they are: Huge tropical storm systems that form over warm ocean waters with sustained winds of at least 74 mph (119 km/h).

Where they happen
Hurricanes: North Atlantic Ocean and Northeast Pacific Ocean.
Typhoons: Northwest Pacific Ocean.
Cyclones: South Pacific and Indian Oceans.
Size: 300 to 500 miles (480 to 800 km) wide.
Lifespan: Last for days up to multiple weeks.
Rotation: Spin counter clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere due to the **Coriolis Effect.**

Tornadoes
What they are: Narrow, violently rotating columns of air that extend from a thunderstorm down to the ground.
Where they happen: Almost always over land, most frequently in the United States.
Size: Usually less than 0.6 miles (1 km) wide.
Lifespan: Last from a few seconds to a couple of hours.
Wind Speed: Can exceed 300 mph (483+ km/h), often making them more intense at their core than tropical storms.

The deadliest tornado in world history is the Daulatpur–Saturia tornado, which struck central Bangladesh on April 26, 1989, killing approximately 1,300 people.

The List of most Lethal Tornadoes in recorded global history include
• **Daulatpur–Saturia tornado (Bangladesh, April 26, 1989):** Estimated 1,300 deaths (deadliest globally).
• **Tri-State Tornado (United States – Missouri, Illinois, Indiana, March 18, 1925):** 695 deaths (deadliest in U.S. history).
• **Gopalgonj Tornado (Bangladesh, 1978):** Estimated 500 deaths.
• **Jamalpur Tornado (Bangladesh, 1975):** Estimated 500 deaths.
• **Great Natchez Tornado (United States – Mississippi, May 6, 1840):** 317 deaths.
• **Encarnación Tornado (Paraguay, September 20, 1926):** 300 to 500 deaths (deadliest in South America).
• **West Bengal Tornado (India, 1998):** Estimated 250 deaths.
• **Great St. Louis Tornado (United States – Missouri and Illinois, May 27, 1896):** 255+ deaths.
The deadliest tropical cyclone in recorded history is the Great Bhola Cyclone of 1970, which killed an estimated 300,000 to 500,000 people in present-day Bangladesh and India.

List of the Deadliest Tropical Cyclones Worldwide
• **Great Bhola Cyclone (1970)** – 300,000 to 500,000 deaths | Struck East Pakistan (now Bangladesh) and West Bengal, India, driven by a catastrophic 20-foot storm surge.



Figure-7: Deadly Tornado.

• **Hooghly River Cyclone (1737)** – ~300,000 deaths | Devastated the Calcutta and surrounding river region in India and Bangladesh.
• **Coringa Cyclone (1839)** – ~300,000 deaths | Struck the port city of Coringa in Andhra Pradesh, India, completely destroying the harbour and fleet.
• **Haiphong Typhoon (1881)** – ~300,000 deaths | Devastated Haiphong, Vietnam.
• **Backerganj Cyclone (1876)** – ~200,000 deaths | Hit the coast of Bakarganj (now Bangladesh), followed by severe flooding and a cholera outbreak.
• **Cyclone Nargis (2008)** – ~138,000+ deaths | Struck the Irrawaddy Delta in Myanmar, ranking as the deadliest tropical cyclone of the 21st century.
• **Bangladesh Cyclone (1991)** – ~138,866 deaths | A powerful Category 5 equivalent cyclone that battered the Chittagong district of Bangladesh with a massive storm surge.
• **Shantou Typhoon (1922)** – ~100,000 deaths | Struck Shantou, China, causing catastrophic storm surges and wind damage.

• **Bengal Cyclone (1942)** – ~61,000 deaths | Affected coastal regions of Bengal, India, and present-day Bangladesh.
• **Great Hurricane of 1780 (1780)** – 22,000 to 30,000 deaths | The deadliest Atlantic hurricane on record, sweeping through the Lesser Antilles and Caribbean.

CONCLUSION

A twister is a tornado—a violently rotating column of air that extends from a thunderstorm cloud down to the ground.
Scientific Name: There is no scientific difference between the two terms; tornado is the formal meteorological term, while twister is a common, informal word.
Appearance: They often show up as a visible condensation funnel made of water droplets, dust, and debris. Shapes can range from narrow ropes to massive, mile-wide wedge storms.
Wind Speeds: Most have winds under 110 mph (180 km/h), though extreme storms can exceed 300 mph (480 km/h).
Formation: They usually develop from severe super cell thunderstorms when warm, moist air meets cool, dry air, creating intense wind shear and rotating updrafts.

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