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PERSPECTIVES

Beyond the Name: Understanding the Full Impact of Tropical Cyclones

Our perspectives feature the viewpoints of our subject matter experts on current topics and emerging trends.

INTRODUCTION

During the deep summer and early fall, all eyes are on the tropics in areas prone to hurricane activity. Most storms begin as "invests," or areas of rain shower and thunderstorm activity that is closely monitored by hurricane forecasters. Some of these invests (or tropical waves) eventually become named tropical storms and even hurricanes, while others come and go without ever receiving a name.

In this article, we discuss various types of tropical cyclones across the globe including their features, risks, and naming conventions. We examine how categorization may affect storm reporting and warnings and offer some considerations for both the insurance industry and emergency management agencies.

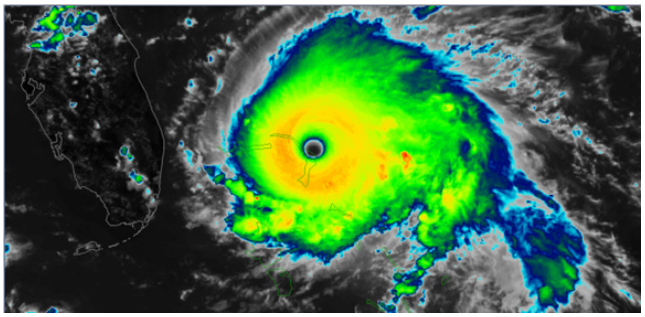

***Figure 1** - Satellite imagery of Hurricane Dorian on September 1, 2019, making landfall on the Abaco Islands in the Bahamas (Source: NOAA Weather & Climate Toolkit).*

NAMED STORMS: A GLOBAL PERSPECTIVE

Names of tropical cyclones are usually set by the World Meteorological Organization (WMO), and there are 10 different ocean basins around the world which are given a list of names each year. Two exceptions to this are the South Atlantic, which receives names from the Brazilian Navy Hydrographic Center, and the Southeast Pacific, which on rare occasions experiences tropical cyclones and may receive an unofficial name by monitoring agencies or researchers.

In North America, the two ocean basins of most interest are the Eastern North Pacific and the North Atlantic, which includes the Caribbean Sea and the Gulf of Mexico. In Hawaii, the Central North Pacific names are utilized.

In addition to geographical characteristics, tropical cyclones are also named based on different meteorological features depending on ocean basin and strength. In North America, these storms are generally tropical depressions, tropical storms, and hurricanes. However, in the Western Pacific, hurricanes are referred to as typhoons, and in the South Pacific and Indian Oceans, they are generically referred to as cyclones.

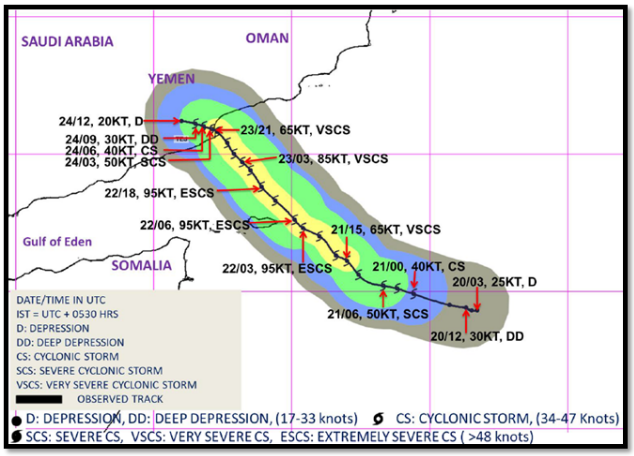

***Figure 2** - Forecast for the Cyclone Tej, which eventually became an Extremely Severe Cyclonic Storm (ESCS) in 2023 (Source: RSMC New Delhi).*

It is important to note that in the United States, winter storms are not officially named. While certain commercial organizations name winter storm events, these names are not officially recognized by the National Oceanic and Atmospheric Administration (NOAA). Only tropical cyclones are named in the United States.

THE DYNAMICS OF TROPICAL CYCLONES AND THEIR IMPACT

Impacts from tropical cyclones vary widely based on location, intensity, and forward speed. Tropical cyclones do not always make landfall; therefore, their maximum intensity is never realized on or near land. Some make landfall in rural or unpopulated areas and, despite their intensity, result in lower monetary damage values In the northern hemisphere, the front-right quadrant of a tropical cyclone is often the most intense for winds, tornadoes, storm surge, and rainfall due to the counterclockwise spin of the storm. In the southern hemisphere, the front-left quadrant generally carries similar characteristics since tropical cyclones spin clockwise south of the equator.

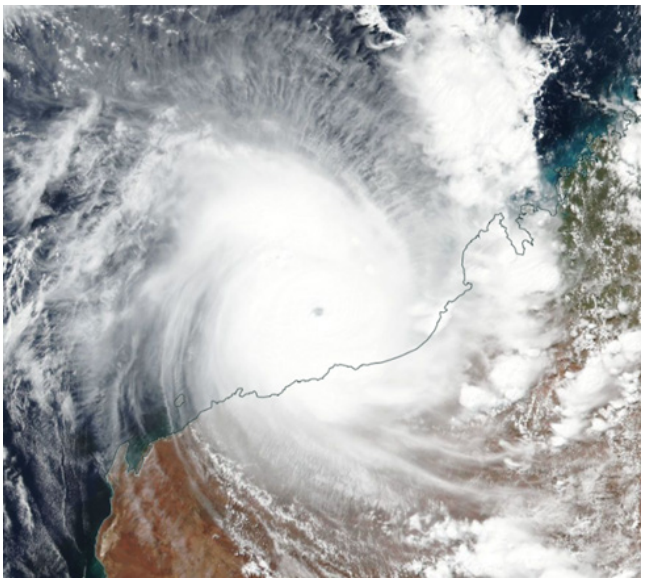

Figure 3 *- Satellite imagery of Severe Tropical Cyclone Ilsa on April 13, 2023, in northwestern Australia (Source: NASA Worldview).*

The Saffir Simpson Hurricane Wind Scale (SSHWS), which rates hurricanes on a scale of 1-to-5 based on one-minute maximum sustained wind speed, is only officially used in the Atlantic and Central and Eastern North Pacific basins. Different magnitudes and categories are used by meteorological agencies in other regions of the world responsible for monitoring tropical cyclones.

	Minimum Miles Per Hour	Minimum Knots	Minimum Km/Hr	Minimum Meters Per Second
Tropical Storm	39	34	63	17
Category 1	74	64	119	33
Category 2	96	83	154	43
Category 3	111	96	178	49
Category 4	131	114	210	59
Category 5	156	136	250	70
All Speeds Sustained (1-Minute Average; 10-meters; Unobstructed) | Source: U.S. National Hurricane Center				

Figure 4 *- The Saffir-Simpson Hurricane Wind Scale, including thresholds for tropical storms (Source: National Hurricane Center (2012 Revision).*

In North America, a hurricane's category is based on the one-minute maximum sustained wind speed somewhere within the storm (often at a point within the eyewall) at 10 meters above ground with unobstructed exposure. It is crucial to note that this maximum sustained wind is not the maximum wind everywhere within the hurricane, and in most cases of landfalling hurricanes, it is not recorded on land at all (generally due to friction).

The term "rapid intensification" is often used to describe hurricanes that quickly upgrade through the Saffir-Simpson scale. Hurricane Otis, for example, which devastated Acapulco, Guerrero, Mexico in 2023 strengthened from a tropical storm to a Category 5 hurricane (increasing about 104 MPH) in 21 hours. It also deepened (central atmospheric pressure was reduced) by about 72 millibars within the same period in a phenomenon known as "rapid deepening." Research has shown that hurricanes which both simultaneously rapidly intensify and rapidly deepen are statistically more likely to result in higher damage figures and fatalities than hurricanes that only undergo rapid intensification.

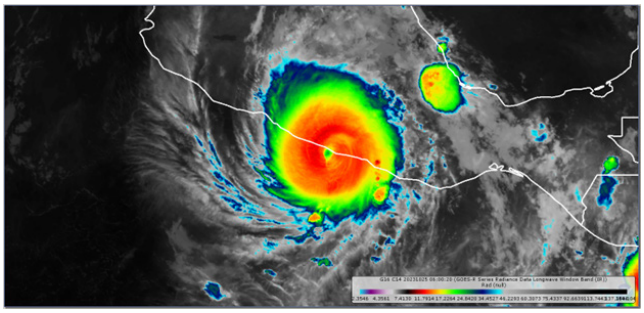

Figure 5 *- Infrared satellite image of Hurricane Otis on October 25, 2023 (Source: NOAA/Weather & Climate Toolkit).*

NAMED STORMS AND PROPERTY INSURANCE CLAIMS

The insurance industry commonly identifies tropical cyclones as "named storms." In North America, this term encompasses many (but not all) storm events in the tropics during hurricane season.

For example, Potential Tropical Cyclone One in 2022, which eventually became Tropical Storm Alex, resulted in torrential rainfall and flash flooding in portions of South Florida. The storm did not receive a name (or designation as a tropical cyclone) until after it departed the Florida peninsula, despite carrying breezy winds and heavy rain seemingly akin to a tropical storm and prompting a tropical storm warning. Post storm, the National Hurricane Center (NHC) indicated Potential Tropical Cyclone One did not have a closed low-level circulation required to be classified as a tropical cyclone and to receive a name while over Florida.

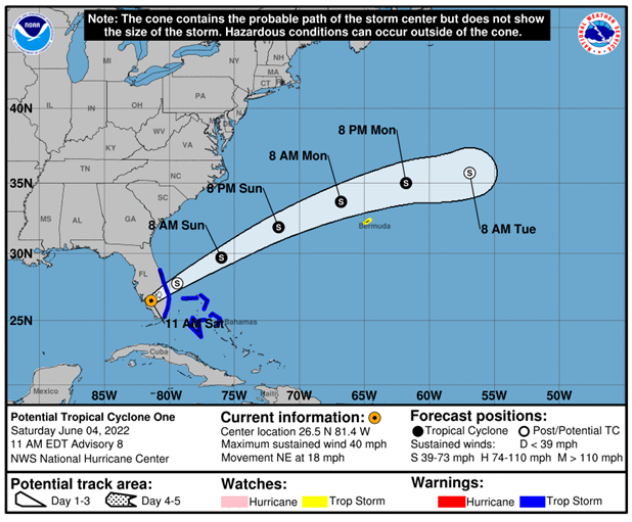

Figure 6 *- Advisory 8 for Potential Tropical Cyclone One (2022), which eventually became Tropical Storm Alex (Source: NHC Archives).*

Similarly, tropical depressions, upon origination, are not named but numbered much like potential tropical cyclones. While tropical depressions do not usually result in notably windy conditions (generally sustained winds less than 39 MPH), they can result in significant rainfall. Interestingly, if a storm gains strength and becomes a tropical storm (therefore receiving a name), then weakens back to a tropical depression, the name remains attached to the tropical depression. Therefore, a tropical depression does not originate with a name, but keeps a name if it is the result of a downgraded tropical storm.

On occasion, the National Hurricane Center will fail to name a storm, even when it should have been named. This strange occurrence happens upon reanalysis of the event post-storm. In rare cases, the National Hurricane Center will forensically determine whether a storm reached tropical storm strength despite its strength having been unknown at the time of original forecasts. If the storm was not named in real-time, it remains unnamed after the event. Therefore, a tropical storm that "should have" received a name may have made landfall resulting in high winds, heavy rain, and storm surge, but was never a "named storm."

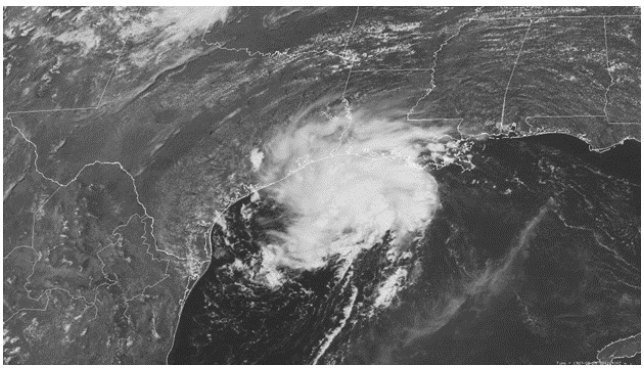

Figure 7 *- Satellite image over the Gulf of Mexico on August 9, 1987, of an "unnamed tropical storm" (Source: National Weather Service).*

Regardless of the nuances in naming conventions, the insurance industry worldwide should be aware of the risk factors associated with tropical cyclones, most notably flooding and high winds, especially in low-lying and coastal areas. An often-misunderstood notion about tropical cyclones is that the storm is confined to the forecast cone in graphics such as those presented by the National Hurricane Center. In fact, the cone represents statistically probable paths for the forecasted track of the center of the storm, and the impacts of the storm

will extend far beyond the cone, notably and most often on the right-hand side. More on the forecast cone can be found in an article written on the Association of Certified Meteorologists webpage here.

After the storm, insurance professionals should be cautious in their choice of weather reporting information. For example, a Category 3 hurricane will not result in Category 3 sustained winds everywhere within its reach (there is almost a certain chance that all land-based estimations and recordings will be less). However, when using nearby land-based measurements, electrical power and communications outages may not have allowed the strongest surface winds to be publicly disseminated by nearby weather stations, while others may be at non-standard heights above the ground (such as on top of tall buildings).

Additionally, proprietary algorithms used to estimate wind speeds in tropical cyclones contain undisclosed methodology, leading to significant uncertainty as to the applicability, reliability, and results of their data. It is suspected that some proprietary methods are radar-based algorithms, which can be difficult to accurately resolve by automation due to the rotation associated with tropical cyclones combined with wide variations in reported wind speeds from surface weather stations.

***Figure 8** - Aerial imagery of Mexico Beach, Florida, following Hurricane Michael in 2018 (Source: NHC tropical cyclone report on Hurricane Michael).*

TROPICAL CYCLONE PREPARATION AND SAFETY CONSIDERATIONS

Tropical cyclones can be dangerous events and are not only known for their wind speeds. In fact, it has been noted that about 90% of tropical cyclone deaths are related to stormwater, not winds (For more information see previously published article on what not to do ahead of and during tropical cyclones).

Tropical cyclones can most often result in the following weather hazards:

- Prolonged, strong winds.
- Storm surge.
- Heavy rainfall.
- Water body and flash flooding (even in areas of little rainfall).
- Tornadoes.
- Lightning.

Tropical cyclones can also result in hazardous driving conditions, as well as downed trees and power lines and flying debris. It is important to remember not to run portable generators indoors in the event of a power outage, a peril that statistically results in about 5% of indirect fatalities (from carbon monoxide poisoning) resultant of tropical cyclones.

While community preparation for tropical cyclones may differ due to many variables across storm-prone areas, there are some common good practices to implement:

- Identify storm- and flood-prone areas and create evacuation zones and routes accordingly.
- Create a public information strategy to communicate clearly and regularly with residents and community stakeholders about the emergency plan.
- Prepare a relief shelter in a safe area with provisions and back-up power.
- Remain in contact with local, state, and federal partner agencies, especially the National Weather Service.
- Prepare a list of additional resources that may be needed for response and recovery operations, and request/secure those resources ahead of time.

In the United States, your local National Weather Service office can assist you and your community with hurricane preparation education and planning tips through the *StormReady* program and Weather Ready Nation initiative.

In addition to National Weather Service training, FEMA's National Hurricane Program (NHP) assists emergency managers by providing additional tools and training needed to prepare for and respond to hurricanes in their area. Some of the toolkits and products available through this program include the HURREVAC product to assist in hurricane evacuation planning and decision support, and Post-Storm Assessment guidance.

CONCLUSION & HOW EXPERT METEOROLOGY CONSULTING SERVICES CAN HELP

Tropical cyclones are dynamic, complicated meteorological features, and each is unique in many ways. If you or your organization have concerns about preparing for or responding to storm related crises, it is advisable to enlist the help of hurricane experts who can assist in properly investigating the magnitude of named storms (wind, rain, surge, etc.) at defined locations. When paired with building consultants, forensic engineers, forensic accountants, and environmental health and safety professionals, expert meteorologists help form a "complete package" of quality catastrophic loss investigation for the insurance industry.

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