

Cyclonic alert mechanisms: Know them and use them

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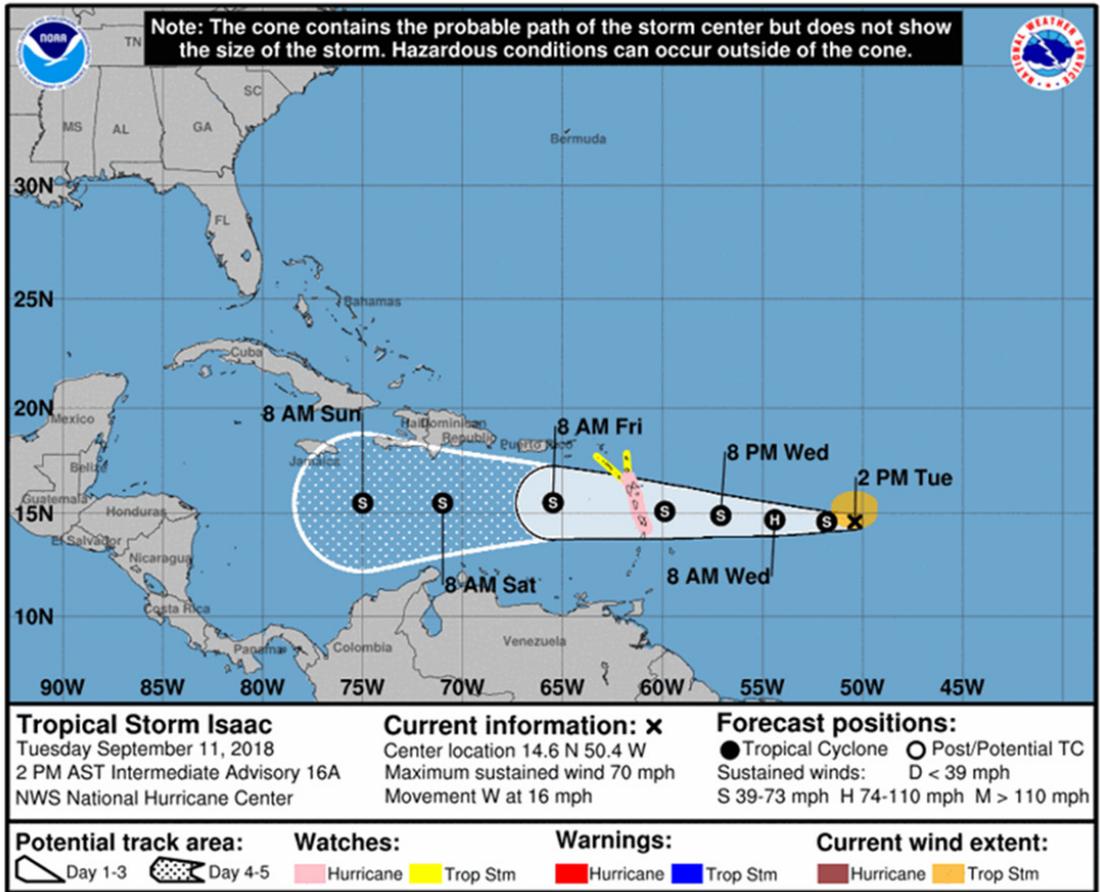
During each hurricane season, it is very common to see various concepts, graphics, and maps being used across social media and other means of communication. These ‘mechanisms’ or ‘products for cyclonic alerts’ have a goal to provide information about cyclonic systems that could threaten or impact an area or a region. In many instances, however, these products are misunderstood or poorly handled by the public. It is important that we know and understand these concepts and products because, without doubt, they help people prepare and make decisions regarding an approaching tropical depression, storm or hurricane. This publication provides information to make it easier to understand, interpret, and use these cyclonic alert products. We will begin by reviewing some of the concepts associated with these products.

- **Tropical cyclone:** A low-pressure atmospheric system or disturbance, with sustained winds exceeding 34 miles per hour (mph) [55 km/h] and which has a defined, closed circulation, and thunderstorms. Its formation begins in tropical latitudes (between 23.5° N and 23.5° S), and it is characterized by having an organized cloud structure while being accompanied with copious rain and strong winds. It is classified according to wind intensity:
 - **Tropical depression:** A cyclone with maximum winds between 34 and 38 mph (55 and 62 km/h). It is the first phase of a tropical cyclone, and it is identified with a number.
 - **Tropical storm:** A cyclone with maximum winds between 39 and 73 mph (63 and 118 km/h). At this point, the storm is officially named.
 - **Hurricane:** a cyclone with maximum winds exceeding 74 mph (>119 km/h). It is characterized by having a very well-defined center of circulation, also known as the eye.
 - **Major hurricane:** A hurricane reaching a category of 3, 4, or 5 on the Saffir-Simpson scale; in other words, a hurricane with winds beyond 111 mph (178 km/h).

- ④ **Sustained winds:** Winds remaining at the same intensity of at least a minute.
- ④ **Wind gusts:** These are winds that are stronger than the sustained winds, but with a duration shorter than a minute. Usually, wind gusts have a magnitude 1.3 times stronger (or 30% more) than 1-minute sustained winds.
- ④ **Wind field:** This area represents the possible extension of sustained winds from a cyclone.
- ④ **Translation movement:** The direction towards which the cyclone moves.
- ④ **Translation speed:** The speed in which the cyclone moves.
- ④ **Eye wall replacement:** A process in which a hurricane's eyewall collapses and reforms. This process usually occurs in intense hurricanes and can result in the phenomenon's weakening, whether temporary or progressive.
- ④ **Rapid intensification:** When a cyclone registers an increase of 35 mph (56 km/h) or more in its sustained wind speeds within a 24-hour period or less.
- ④ **Invest:** The name given to a low-pressure system for which data has started to be gathered in order to develop forecasts for its intensity and path. It is given a number between 90 to 99, along with the letter 'L' for 'Low'; for example, *Invest 90L*. An invest will not necessarily become a tropical cyclone.
- ④ **Meteorological models:** Mathematical guides which, through equations and formulas, provide forecasts about the atmosphere's status and chemistry.
- ④ **Spaghetti models:** Grouped models that represent an intensity or route forecast for an atmospheric system in development or already formed. These models are presented as lines on graphs or maps. Each model is represented by a single line.
- ④ **Radar:** A tool which detects rain and thunder activity as well as intensity and movement.
- ④ **Satellites:** Tools that orbit space and which, through laser emission or photography, detect cloud, water vapor and other gases and weather conditions.
- ④ **Potential Tropical Cyclone (PTC):** The classification given to a system or disturbance with great chances of becoming a tropical cyclone. The PTC, despite not having all the characteristics of a cyclone, may generate storm or hurricane conditions on a territory within 48 hours, or may even become a tropical cyclone very near a territory.
- ④ **Cyclone advisories:**
 - **Warning:** Implies that storm or hurricane conditions are imminent in the area under the alert during a 36-hour period.
 - **Watch:** Implies that storm or hurricane conditions are possible in the area under the alert during a 48-hour period.
- ④ **Storm surge:** High and dangerous surf conditions, above normal values, product of the strong winds and low air pressure that come along with the cyclone. This surge can cause inland flooding, a reason why watch and warning alerts refer to the imminence or the possibility of it happening.

Here are some of the more commonly used cyclonic advisory products...

Track forecast cone map



Source: NOAA.

A [track cone map](#) shows the possible route of the center of the cyclone will take, as well as the projected time of arrival. The cone is made up of an area inside which the cyclone center is expected to move; however, the cyclone can move to any location within the cone's extension. The cone's end is always much wider, given that the margin of error increases as the time period forecasted increases. The map uses letters to indicate the system's classification at different points in its development: D (tropical depression), S (tropical storm), H (category 1 and 2 hurricanes) or M (major hurricanes, from category 3 to 5). More information about the weather system is presented in the lower parts of the map, such as: the cyclone's number or its name (according to its classification), the date and time at which the forecast was produced, and the advisory number. It also provides the location for the system's center at the moment in which the forecast was produced, its strength and movement, and the territories under threat of impact and their respective alert within the next 5 days: the red color means 'hurricane warning', while the blue areas are under 'tropical storm warning'. The other important advisory, the 'Watch' alert, is represented here by the colors pink (for hurricane conditions) and yellow (for storm conditions). The 'Current wind extent' portion of the data represents the sustained wind speeds as orange for tropical storm strength winds, while hurricane strength winds are signaled with a darker, terracotta-like color. In the map provided here, the sustained wind extent shown corresponds to tropical storm strength winds.

Always remember . . .



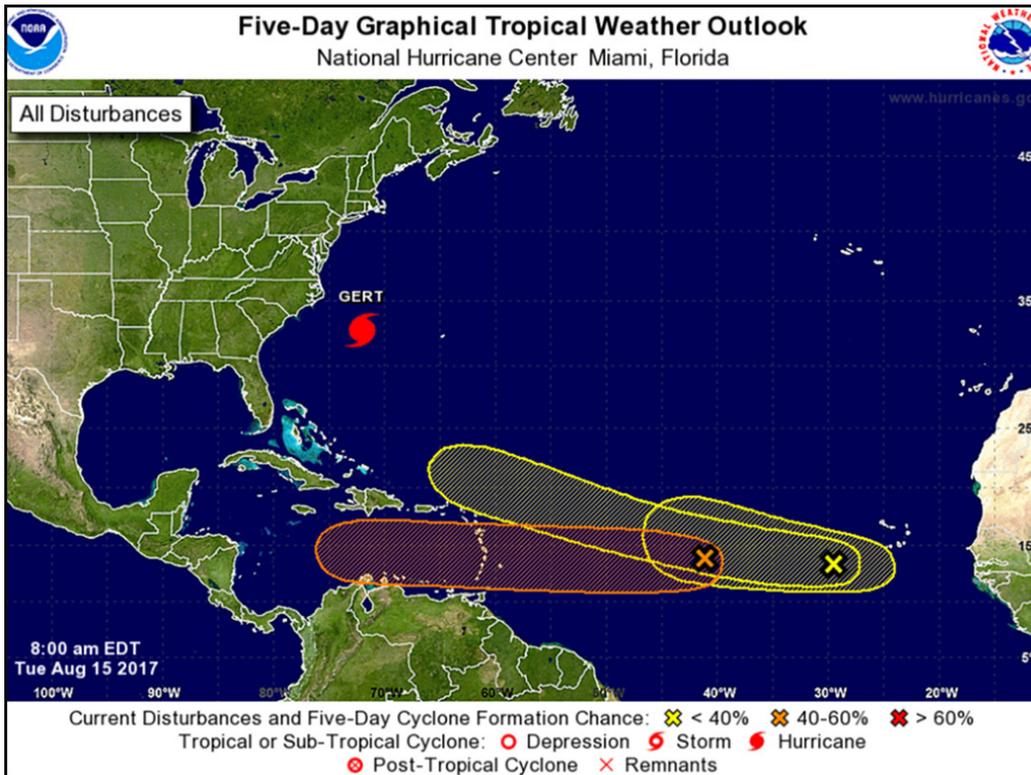
The cone doesn't consider the disturbance's size and therefore, doesn't mean you can ignore possible hazards and impacts from wind and rain far from its center.

The cone shows the possible trajectory of a storm's center, but the wind field can extend much further from the cone. Therefore, territories outside the cone can still be indirectly impacted by strong winds. A weather system is much more than a specific point in a map!

Thinner, smaller cones do not necessarily mean a greater degree of certainty; it can also indicate a faster speed of movement for the system.

Statistically, one of every three cyclonic systems can stray outside the projected cone; in other words, its center (eye) can move outside the projected path.

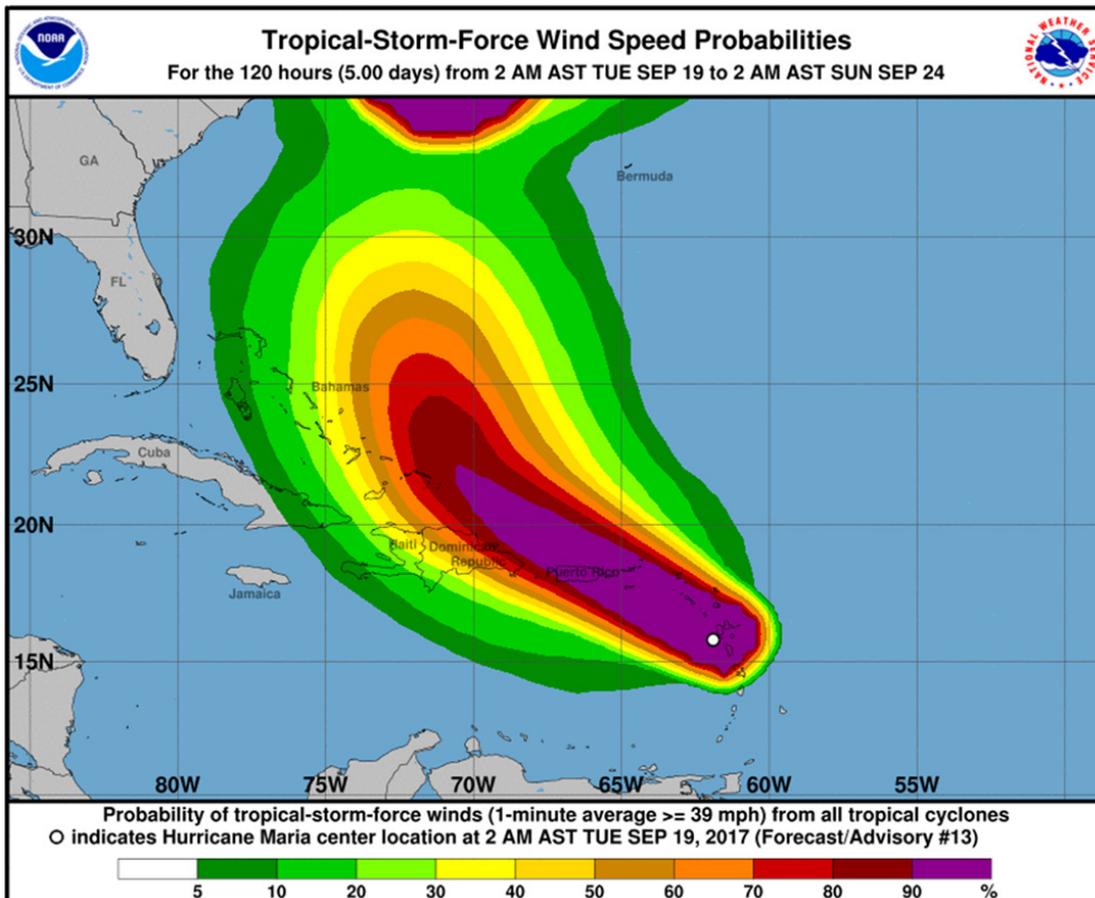
Tropical Weather Outlook



The [tropical weather outlook](#) identifies disturbances with current cyclonic potential or disturbances with a potential for further development, whether on a 2 or a 5-day period. The systems with a potential for development are identified with an X and with an area shaded with a color corresponding with the development potential: yellow (potential for cyclonic development up to 40%; in other words, low chances of development), orange (potential for development greater than 40%, but lower than 60%; middling chances of development) or red (potential for development higher than 60%; a high chance for further development). If the X is accompanied with an arrow, this means that the disturbance will have cyclonic potential once it reaches the colored area (towards where the arrow points). On the other hand, if the map identifies a disturbance with potential development but does not include the X, it indicates that when the product was published, the disturbance was not within the area covered in the map, but that within 2 to 5 days, a system with that potential might reach that area.

If more than one system with chances of cyclonic development at the moment the alert is made are registered, they will be assigned a number to use as a reference in other alert mechanisms associated with the system. If a cyclone has lost its characteristics or strength, it will be identified by a crossed-out circle and a thin 'X'. When already-developed disturbances, it will be identified with the corresponding symbology. For example, the map provided in the previous page identifies Hurricane Gert, as well as three disturbances with potential development.

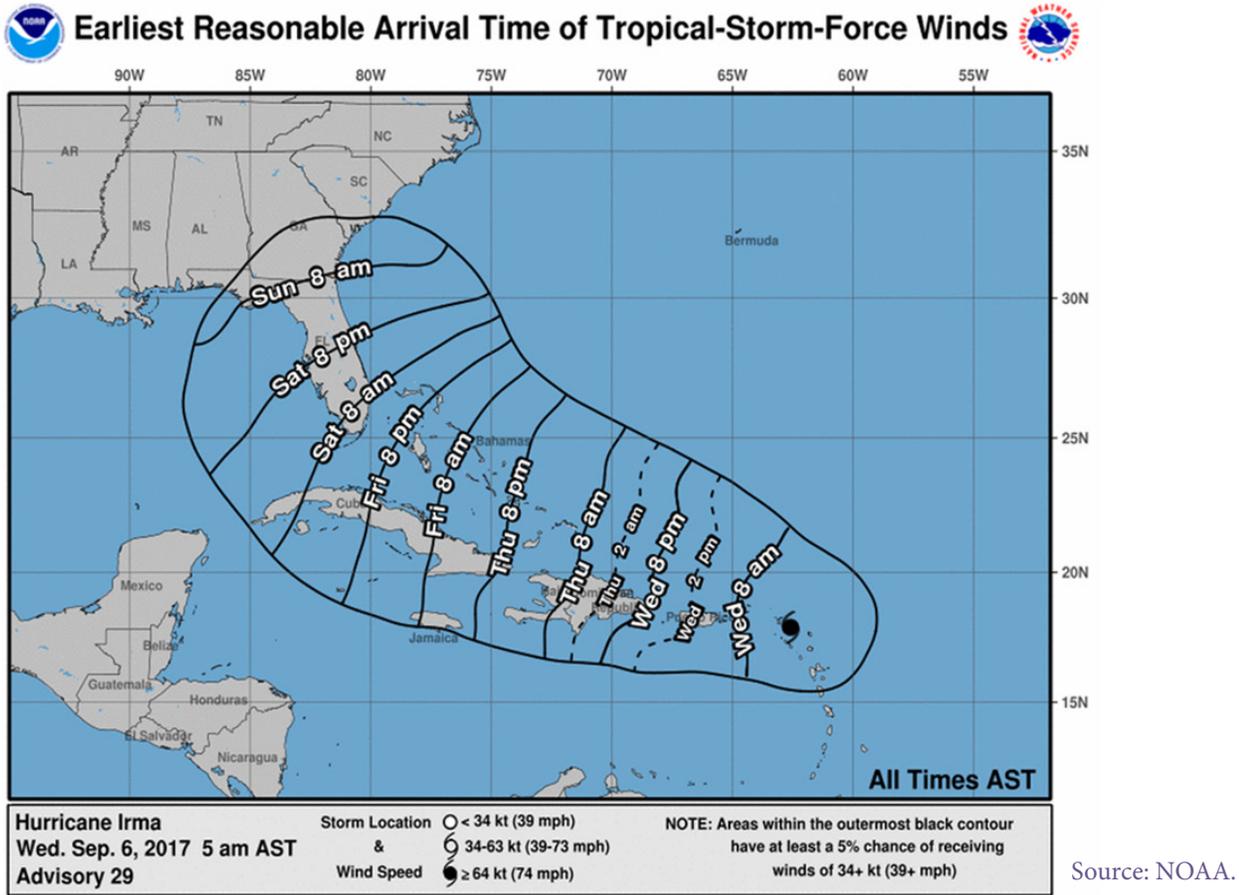
Surface Wind Speed Probability Map



Source: NOAA.

The [surface wind speed probability map](#) offers a general outlook of what is expected in terms of sustained winds. It is made up of an area with different colors that each represent the probability (>5% to 100%) that the sustained winds in the cyclone will manifest in the colored areas. The areas under the purple or red areas have a great chance of being impacted by sustained winds, while the areas within the green areas have less of a chance. The uncolored areas do not have any potential for impact.

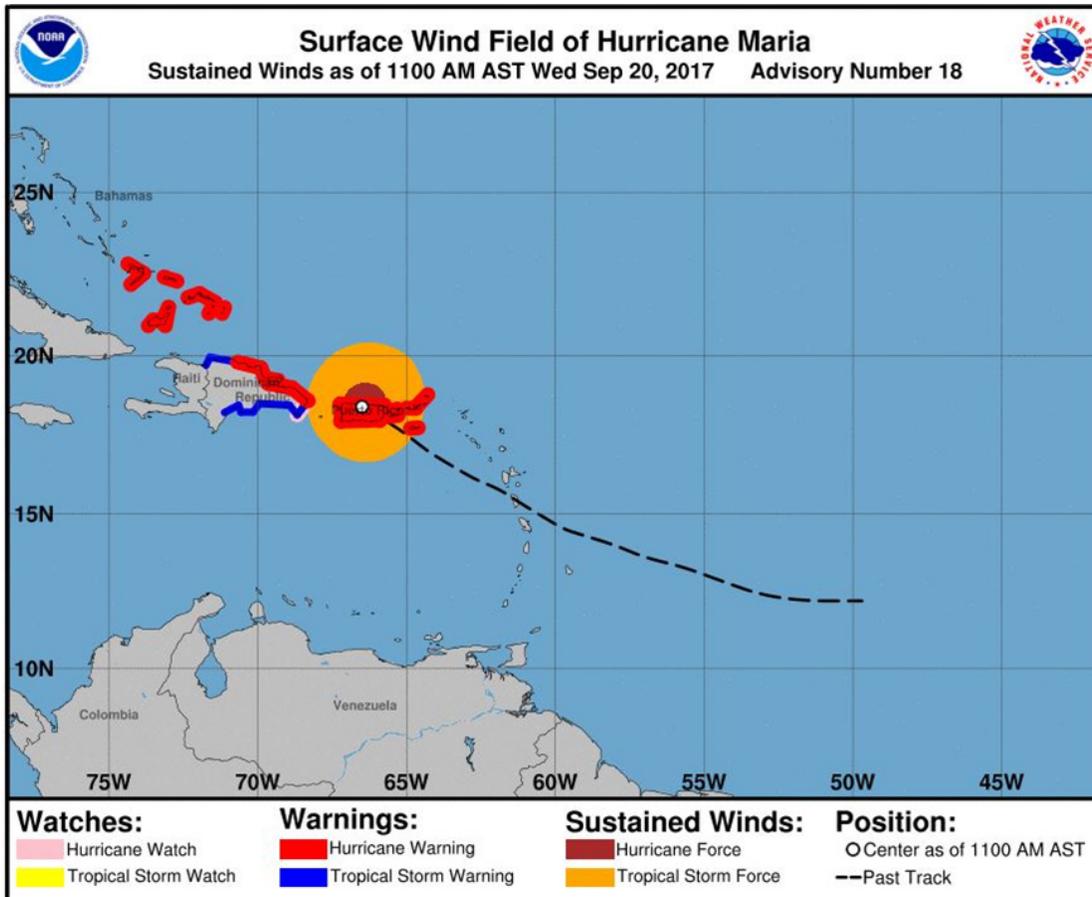
Arrival Time of Winds Map



The [arrival time of sustained winds map](#) has a similar format to the wind speed probability map, and, in fact, it is meant as a complement to that alert mechanism. The difference is that the arrival time of sustained winds map does not project the probabilities of experiencing the winds but rather the approximate time at which these winds will be manifesting. This map helps people establish a time limit for their preparation efforts, the acquisition of supplies and equipment, and, in some cases, evacuating their communities.

The map also indicates the system’s center at the moment of emitting the alert and its classification (and corresponding symbology) according to wind intensity.

Surface Wind Field Map



Source: NOAA.

The [surface wind field map](#) indicates the areas which are possibly experiencing, or could experience, winds at a tropical storm intensity (in orange) or hurricane-force winds (in terracotta). As this only refers to possibility, not all of the colored area equates to reported, sustained cyclone-strength winds. It also presents the route that the cyclone has been on for the previous hours (dotted line) and the location of the cyclone center (white circle) at the time the product was published. It also indicates any alert (watches or warnings) active in nearby regions: the color red means 'hurricane warning' while blue means 'tropical storm warning'. On the other hand, watches are represented by the colors pink (hurricane) and yellow (storm).



A product associated to the surface wind field map is the **cumulative winds map**. This map shows the wind field history experienced by the territories or geographical areas along the cyclone's path until the product's publication. This map is useful when evaluating the changes in the cyclone's size, since it shows the wind field's extension as it moves across an area.



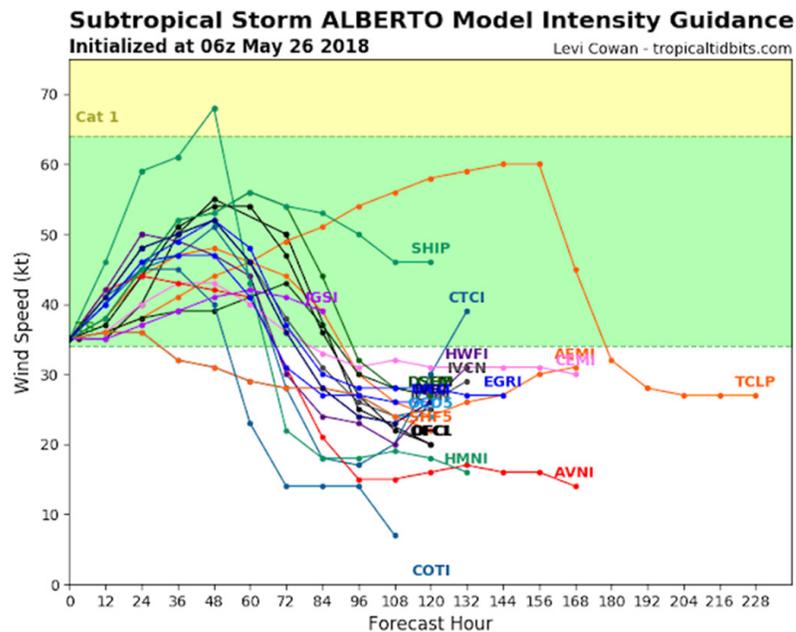
Source: NOAA.

Spaghetti Model Graphs and Maps

The spaghetti models graphs and maps show, through different-colored lines, the forecasts produced by different weather-predicting models regarding one weather system, whether it is a storm with cyclonic potential or an actual cyclone. A single spaghetti strand (a single line on the graph or map) indicates an average made up of several forecasts that resulted in the same model based on different variables such as humidity, temperature, winds, cyclonic history, and other parameters. The graph or the map shows the results of different forecasts according to different models, each represented by the different colors and symbols used.

Storm intensity spaghetti models

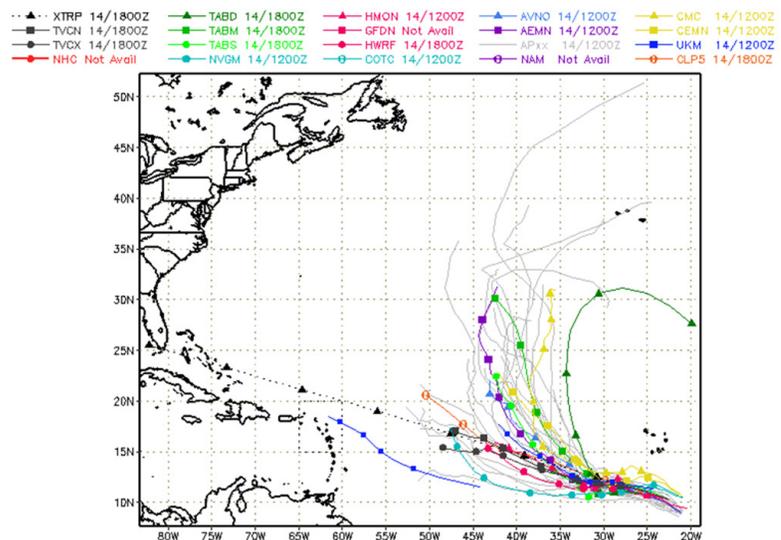
The models are presented in a graph in which the 'X' axis is the period of hours in the forecast and the 'Y' axis refers to the intensity of the forecasted winds. The intervals in 'Y' will depend on the forecasts for the shown system. For instance, if it is a tropical storm and the models visualize a maximum intensification up until a category 1 hurricane, the 'Y' axis will only extend until such an intensity. Each model will have a characteristic color and be labeled with their abbreviated names (for instance, HWRF stands for *Hurricane Weather Research and Forecasting*). Each dot represents the interval in hours, whether in 6, 12, or 24-hour periods.



Source: Weather Underground.

Track spaghetti models

The models are illustrated in a map, represented by lines. Each model will have its characteristic color and symbols (triangles, squares and circles, among others). Similar to the intensity models, it includes the abbreviated name of each model.



Source: University of Wisconsin-Milwaukee.

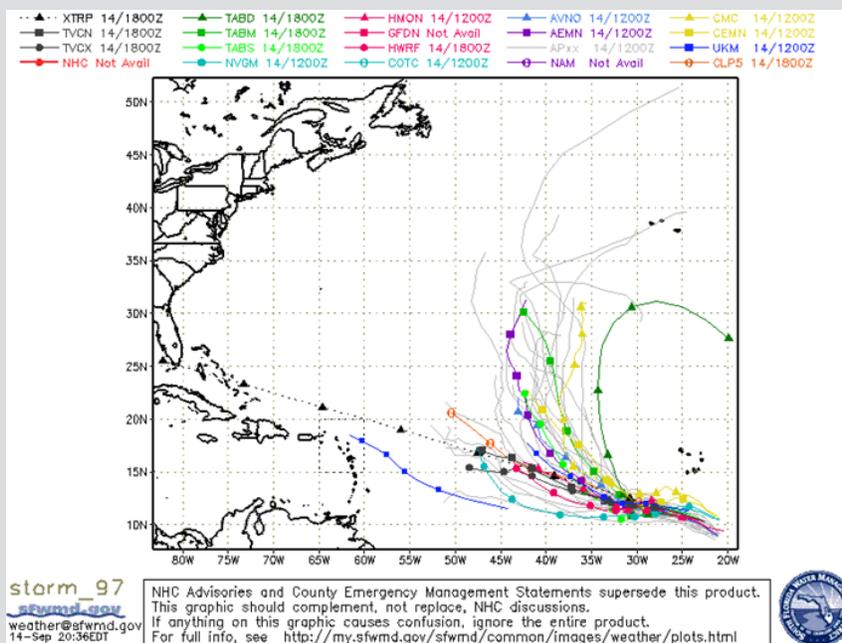
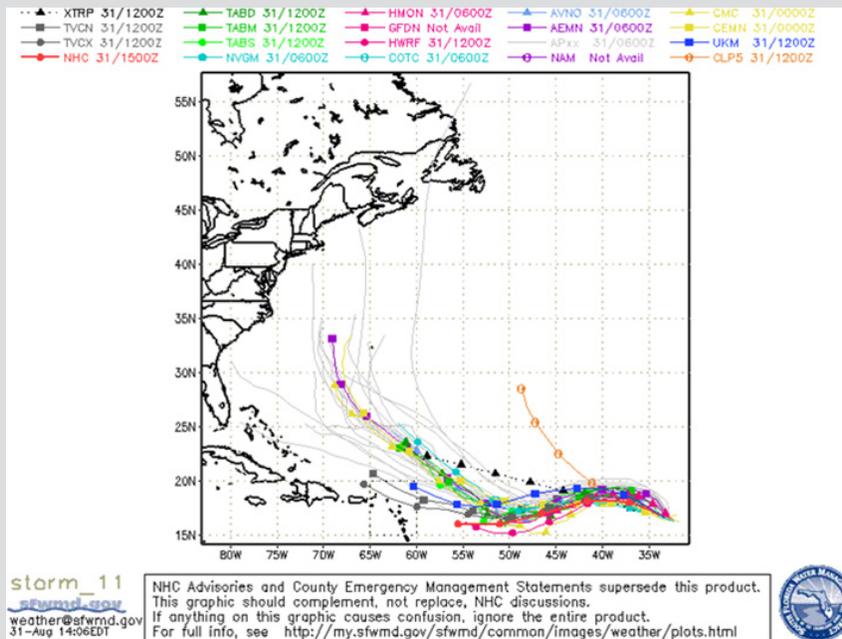
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NHC Advisories and County Emergency Management Statements supersede this product. This graphic should complement, not replace, NHC discussions. If anything on this graphic causes confusion, ignore the entire product. For full info, see <http://my.sfwmd.gov/sfwmd/common/images/weather/plots.html>





In each case, whether it's the intensity or track spaghetti models, these maps or graphs can help users deduce the most likely scenario for the forecast. Visually, the models' forecasts will be in general consensus when the lines tend to group closely together, or when they trace a generalized pattern of behavior (for instance, when the majority points towards an intensification on the 'Y' axis, or when the majority suggests a similar trajectory).



Source: University of Wisconsin-Milwaukee.

In the first map, for example, there is a greater consensus or tendency towards the initial movement to the west, with a slightly more northwest component later on. The second map, on the other hand, has its lines further apart, which indicates less certainty in forecasting the system's track when past the 30° W latitude.

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