The Cone of Uncertainty

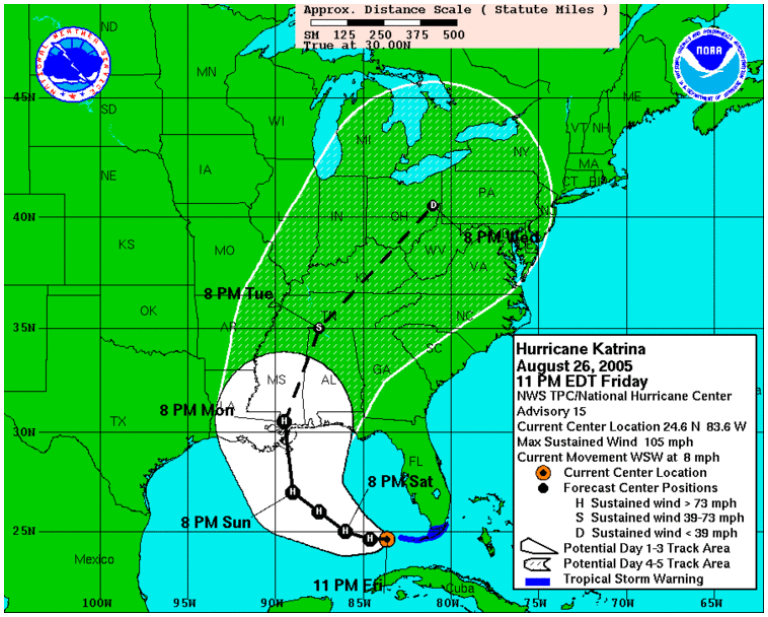
Student pages

A hurricane moves closer and closer to the southern shores of the U.S. Where will it hit? When will it hit?

People living in the hurricane path need time to prepare to weather the worst of it. It takes time to protect your home or your business, to gather and store everything that can act as a missile in high winds, and to get in enough food, water, and supplies to last through the power failures. It takes time for people to pack their cars with whatever they are trying to save and evacuate, if needed.

How can meteorologists predict where a hurricane might hit? How can they know if the hurricane will keep on a straight line course and not turn in a different direction? If their prediction is wrong, some people have evacuated for nothing and others are trapped in the hurricane's destructive path.

Meteorologists who work for the National Hurricane Center study past hurricane tracks in order to better predict the paths of hurricanes for a current season. Plotting the track or path of a hurricane is critical to predicting which locations may be hit by the hurricane.



In your Hurricane Alert! mission, you will make predictions about where a hurricane may hit by constructing a **cone of uncertainty**. You have probably seen these cone-shaped diagrams on weather maps during hurricane season. The cone is constructed by using a set of arc of varying sizes. The **radius** (a straight line extending from the center of a circle to the outer boundary of the circle) is determined by studying historical data and by calculating the radius from forecast errors using sophisticated computer models. The size of each circle is set so that two-thirds of historical forecast errors over a 5-year sample fall within the circle. The circles represent the area where the hurricane will most likely track. Lines are drawn connecting the outside border of the circles to form the cone.

The circles are different sizes because the chance for error is greater (and therefore a larger radius) as you make a prediction for more hours away. For example, the chance for error is much smaller if you are trying to predict where a hurricane may hit in 12 hours than if you are trying to predict where it may hit in 72 hours. In 72 hours, the hurricane may turn in a different direction, pushed by other wind systems.

Think about it. This is the same for the weather forecasts you listen to on TV. The forecasts for the next day are more accurate than forecasts for next week.

How to Construct a Cone of Uncertainty

For your mission work, you will construct a cone of uncertainty by using the distances for each number of hours given in the chart below for the radii of your circles.

Circle radii for Cones of Uncertainty for Forecast Periods

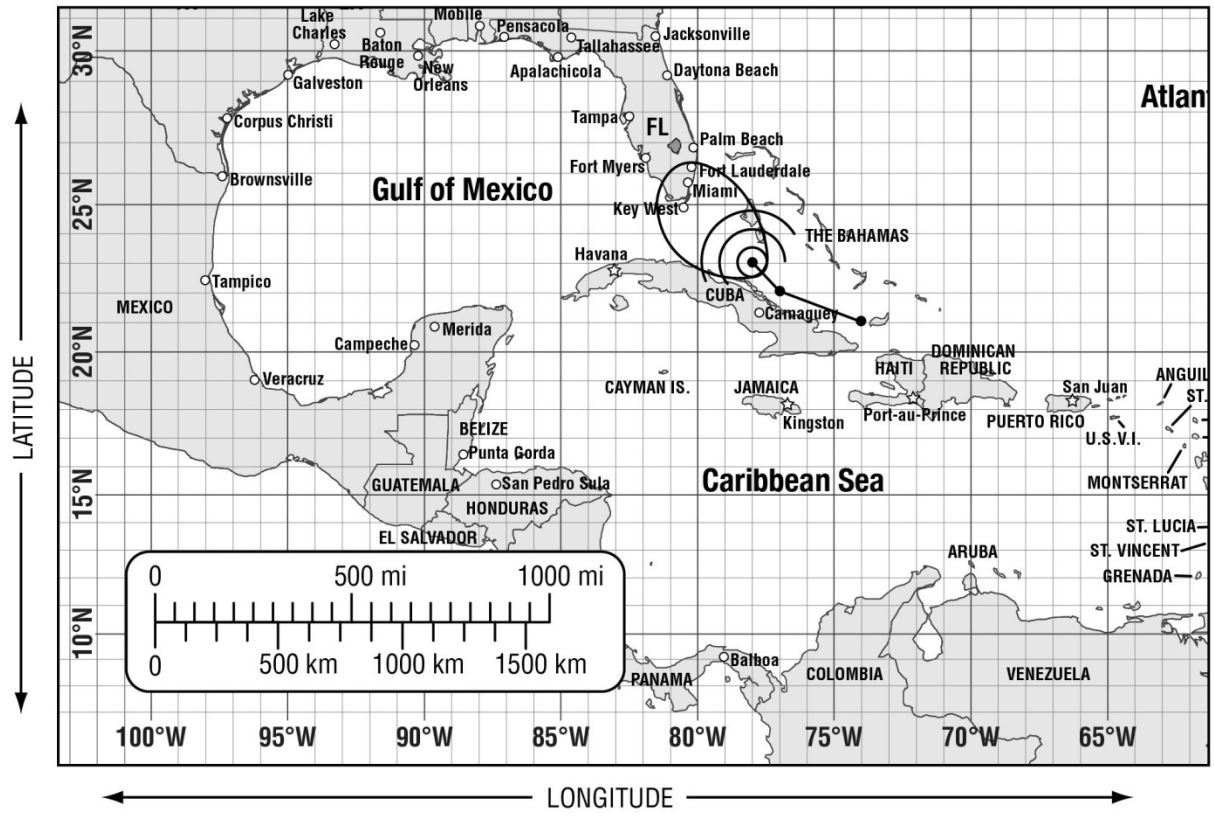
Forecast Period (hours)	2/3 Probability Circle, Atlantic Basin (miles)
12	45
24	77
36	106
48	136
72	196

For example:

Look at the map below. You can see the track of a hurricane in the Caribbean Sea. To construct the cone of uncertainty shown, a compass was used to set a distance of **45 miles**, the number of miles for the cone at a 12 hour forecast period. An arc was drawn on the map in the general direction the hurricane was tracking by putting the compass point on the last hurricane latitude/longitude location and drawing the arc. This is the first arc shown.

The procedure was repeated using the same data point for the distance of 77 miles (24 hours), 106 miles (36 hours), and 136 miles (48 hours).

The outer borders of the arcs were then connected to form a rough cone shape.

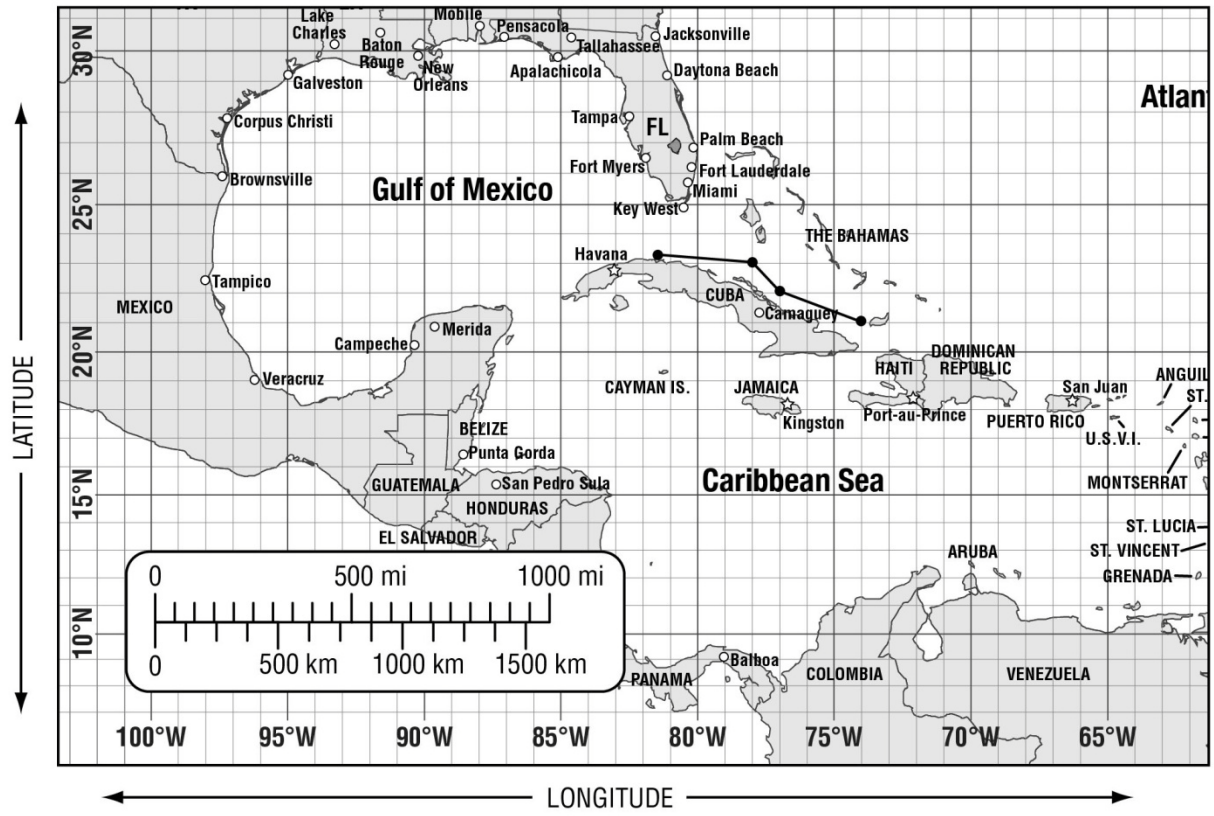


What would be your prediction for the hurricane track? For which cities would you issue warnings?

Now, construct your own cone of uncertainty using the same procedure as above for the next data point for the hurricane .

Procedure

1. Using the scale on the map, set your compass to represent 45 miles—the distance for the forecast period of 12 hours.
2. Put your compass point on the last latitude/longitude location (westward) and draw an arc.
3. Repeat the procedure for the 24 hour forecast.
4. Repeat the procedure for the 36 hour and 48 hour predictions.
5. Draw lines connecting the outer boundary of each circle and form a cone shape.



Which areas should be now warned about a possible hurricane strike?