

## **Addressing Forecast Uncertainty in Hurricane Response Plans**

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Every type of business has its own hurricane response plan, and each of these plans has specific actions that must be taken at certain times before impact. The problem is that it is often difficult to determine when to escalate (or de-escalate) a hurricane response plan. This is particularly true in the case of hurricanes when the track may shift a little left or right with each advisory update. We know from past hurricane seasons what the forecast track and intensity errors with time are. These data, along with data of the cyclone's structure (wind radii), can help us create useful information in developing objective guidance for a hurricane response plan.

The first step in any hurricane response plan is to identify the risk. If one waits until a disturbance becomes a tropical depression to begin the response plan, it could be too late to complete preparations. Consider that once every 2.3 years (1982-2011) a tropical depression forms in the Gulf of Mexico and goes on to become a hurricane. Fortunately, hurricanes do not form out of thin air; they require a pre-existence weather system for initiation. The initial disturbances may form thousands of miles away only to develop later. Alternatively, formation could occur close-in along an old frontal boundary pushing just offshore. We can identify those disturbances that have the potential to develop and estimate when development may occur by close examination of the model guidance. By identifying the potential for development early on we can give our clients "a tap on the shoulder," which may warrant some early actions to be made in the hurricane response plan.

Another tool that can be used is what will be referred to as a Worst Case Scenario (WCS). The WCS assumes a more direct path toward a client's location and at a slightly faster forward speed. The speed and intensity increases for the WCS are based on running averages from previous hurricane seasons. This scenario suggests an earliest possible arrival time of the storm center or any critical wind radii, such as the 39-mph and 58-mph radii. The main drawback to the WCS is that, under certain circumstances, it can be unfeasible. For example, it would not be practical to use WCS for a location in North Carolina when the hurricane is travelling westward in the Gulf of Mexico. The WCS is most useful for locations that have a tropical cyclone heading in their general direction.

Another tool used in creating a hurricane response plan is the Probability of Wind Impact (PWI). This feature gives a probabilistic occurrence of sustained winds meeting or exceeding a specific threshold. Most often, we employ the PWI of the 58-mph wind when creating a hurricane response plan. That threshold is used because it roughly coincides with the start of significant wind damage. The PWI of the 58-mph wind can be used as objective guidance in gauging the risk of potentially damaging winds. It avoids the issues that arise when too much focus is placed on the forecast track line alone. The PWI is sensitive to the size of the hurricane wind field, whereas the forecast track and cone are not.

On its own the PWI can be used as objective guidance when escalating or de-escalating a hurricane response plan. The combination of the PWI of the 58-mph wind and the WCS arrival time of the 39-mph wind can be used to create an even more useful set of objective guidance for a hurricane response plan. By plotting the hours until the WCS arrival of the 39-mph wind vs. the PWI of the 58-mph wind for many locations and many hurricanes some patterns are revealed. There is a distinct pattern for locations where the hurricane moves toward the location and strikes. Another pattern exists in the situation where the hurricane moves toward the location and then moves away. By comparing these two scenarios, we can discover a range of values for the WCS arrival of the 39-mph wind and the PWI of the 58-mph that can be used to develop objective guidance to escalate or de-escalate a hurricane response plan. Incorporation of objective guidance into a hurricane response plan can help to assure that a business will take the proper actions at the proper times when a hurricane threatens.