NEW YORK STATE HURRICANE EVACUATION RESTUDY TECHNICAL DATA REPORT

for New York City, Nassau, Suffolk, and Westchester Counties

7 | HURREVAC / DECISION TOOLS

DECISION TOOLS

PURPOSE

This chapter describes the HURREVAC computer program. HURREVAC is a hurricane evacuation decision making tool that uses clearance times in conjunction with National Hurricane Center (NHC) advisories to help determine when and if evacuations should begin. More information on this program may be found at the HURREVAC web-site at www.hurrevac.com.

BACKGROUND

Hurricanes do not always approach land from a direction perpendicular to the coastline and, in fact, more frequently cross the coastline on an angular track. In that case, with a hurricane 24 hours from the coast, an error of 10 degrees in the predicted hurricane track can easily mean a 100-mile error in the point of eye landfall.

In the same way, forecast errors can affect the time of landfall. When a hurricane approaches a coastline at an acute angle, an error in forecast landfall position will cause an error in the forecast distance it must travel to reach the coast. This could possibly result in a significant error in forecast time of eye landfall. The forward motion of hurricanes can also accelerate and decelerate, causing the time of landfall to be even more unpredictable. Prior to mid-1980, hurricane evacuation decision making and mobilization was dependent upon forecast time and location of eye landfall. Because of the potential forecast errors (see Chapter 2, *Forecasting Inaccuracies*), a decision aid was needed that would help compensate for those errors by relating evacuation operations to the overall hurricane threat, rather than focusing on the

location of the eye. The Decision Arc Method was created for that purpose. Originally, a manual decision making tool, it is now incorporated into hurricane evacuation decision aid software.

Emergency management officials should review all available hurricane evacuation related software offered today. Some of these programs incorporate hurricane evacuation study data, including some form of the Decision Arc Method. Computer assistance is nearly indispensable for facilitating needed calculations and displaying important information and relationships. However, emergency management officials should be familiar with the concepts of sound evacuation decision making and timing.

HURREVAC

HISTORY

HURREVAC, an abbreviation for HURRicane EVACuation, is a computer program, designed to aid emergency managers in hurricane evacuation decision making. HURREVAC was originally developed for the State of South Carolina in late 1988 and was first used in South Carolina and Georgia during the 1989 season with Hurricane Hugo. Through 1996 the program was developed for locations in 13 additional states, the United States Virgin Islands, and Puerto Rico and included location-specific graphics and evacuation data. Between 1995 and 1997, a companion program, HURREVAC Inland Winds, was produced for use by the many inland counties who could be threatened by these storms after moving ashore. The Inland Winds used the National Hurricane Center (NHC) Wind Decay Model (DeMaria and Kaplan 1996). In early 1998, work started on a new Windows95/NT version of the program which would combine Coastal and Inland Winds versions of HURREVAC into one program.

The Win95/NTversion (then called HurWin95) was tested during the 1998 season at over 120 sites in FEMA, state and local emergency management offices, and National Weather Service (NWS) sites.

HURREVAC 2000

HURREVAC 2000 is an upgrade of the previous HURREVAC programs, which were written individually for particular states and/or regions. These programs were based on Hurricane Evacuation Studies (HES) for those areas. The study conclusions, in turn, are based for the most part on flooding scenarios created from the output of the National Weather Service SLOSH model.

Figure 7-1: *HURREVAC 2000*

HURREVAC 2000 adds the functionality of HURREVAC inland winds program to the coastal HURREVAC versions. Unlike the previous HURREVAC programs, the new version is an attempt to make HURREVAC as generic as possible, applicable to many areas in the least amount of time.

To further the aim of relatively quick deployment, the new HURREVAC no longer includes the Inundation Maps portion of the old HURREVAC program which took time to produce for each area. There is a separate

Inundation GIS effort in this area using ArcExplorer. Adobe Acrobat™ can also allow Inundation Maps to be easily displayed.

USING HURREVAC

HURREVAC displays hurricane tracks on computer plot maps using an automatic download of information from the NHC (National Weather Service (NWS), NOAA). Marine advisories on tropical storms are normally issued by the NHC every six hours: 0500EDT, 1100EDT, 1700EDT, and 2300EDT. At times, supplementary intermediate advisories are also issued. These advisories contain information on present and forecast position, intensity, size, and movement that is displayed by HURREVAC.

HURREVAC displays the local time when an evacuation decision must be made, using data from the federal hurricane evacuation study for the local area and NWS forecasts. The process is as follows:

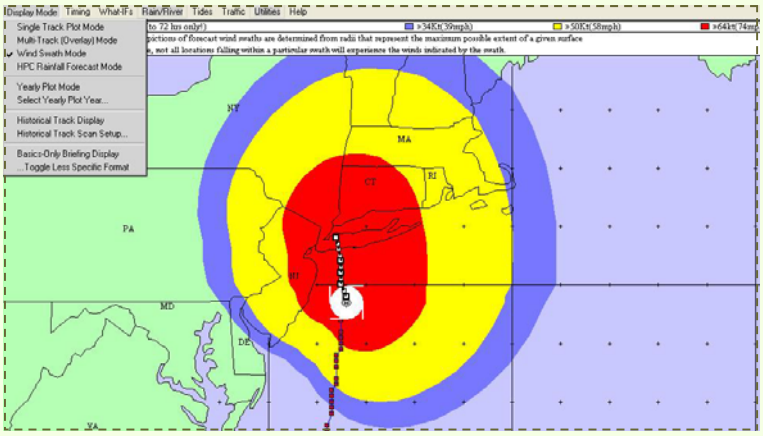

Figure 7-2: *Map created using HURREVAC's Exercise Track Wizard*

1. The time of arrival of sustained tropical storm winds (34 knots or 39 mph) in your area is computed using the NHC forecast adjusted to create a direct-hit on your community.
2. HURREVAC selects a clearance time based on the category of the storm according to the Saffir - Simpson scale, response of the public, and the level of tourist occupancy for the area. The clearance times are product of a Hurricane Evacuation Study conducted previously for the local area, usually performed by the U.S. Army Corps of Engineers (USACE), NHC and FEMA.
3. The HURREVAC program subtracts the hours required for the evacuation (clearance time) from the estimated point in time when the sustained tropical storm winds will arrive to reach a suggested evacuation decision time. This approach is based on the need to have all evacuees out of harms way before tropical storm force winds reach the coast.

USING HURREVAC—TRACKING THE STORM

There are many options available in HURREVAC for analyzing a storm and its progress. The suggested sequence for using the various options outlined in this chapter is organized according to the sequence normally followed during an event, that is from far out at sea to close and threatening.

Following this sequence, the first menu item used is the What-If along with the normal tracking functions, and later moving to the Timing Menu items for specifics as the storm nears.

WHEN THE STORM IS AT A DISTANCE

When the storm is far out at sea, the Single Plot Model of the program is used to track the storm. This mode is the default plotting mode that is displayed upon entry to the program.

AS THE STORM GETS CLOSER BUT NOT YET THREATENING

As the storm gets closer, (48 to 72 hours away), several other items programmed in HURREVAC will become useful. At this time, the What-IF Menu items from the Main Menu should be used. If extremely long lead times for the action are available, the Timing items from the Main Menu should be utilized at this time.

The Average Error Swath display and its list companion, the Average Error Affected List will show whether there should be concern about the storm coming to a particular area. At this point, there should never be sole focus on the NHC forecast track, but instead consider the forecast errors, which inevitably will occur (these increase with time). Emergency managers in counties that are in the Error Swath should be concerned and follow the storm closely. Those adjacent to or near counties in the Error Swath should monitor the situation closely.

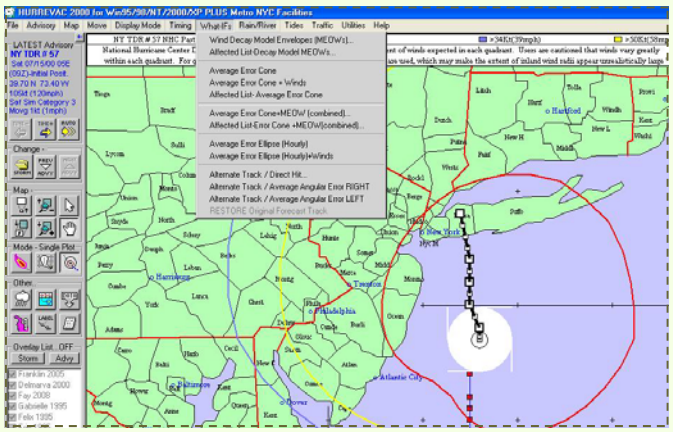

Figure 7-3: *Map created using HURREVAC's Exercise Track Wizard*

Emergency managers in or near the Error Swath noted above may want to examine the Decay Model Wind MEOW's relevant to the storm and attempt to assess possible risk. If the storm impacts the county, check the MEOW Affected List for the areas affected and to what extent each is affected. Inland counties can use this feature to tell about how much wind can be expected to penetrate inland, if the storm center comes very near or over the county.

Choosing the combined MEOW + Error Swath will show the MEOW winds only in the swath area. For a list of those affected, the companion MEOW + Error Affected List should be selected.

If a long lead time for evacuation is available, and the county is in or near the Average Error Swath, the Evacuation timing options and/or the Graphical Decision Arc may be displayed. Also, preliminary planning about the timing of actions should begin in case the storm threatens further in the ensuing hours.

The Overlay Mode feature is used to overlay on the map the previous NHC forecasts and see if there is a trend developing in the forecasts which may help in risk assessment; for example, being outside the Average Error Swath for early forecast, but closer to the Average Error Swath with each new forecast.

WHEN THE STORM IS CLOSE AND THREATENING

As the storm becomes more threatening (48 hours or less), the aforementioned features such as the Average Error Swath should be used to see the possible affected areas. But more importantly, the features that focus more on specifics of the NHC forecast need to be looked at. The closer the storm, the more accurate the NHC forecast becomes. There are still errors but they are usually smaller with each new advisory. It is at this time that the Timing Menu items should be used.

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The Evacuation Timing options and/or the Graphical Decision Arc display (both found under the Timing item in the Main Menu) should be utilized now, to time the beginning of actions, should the decision be made to evacuate. Keep in mind that these timing computations assume a direct hit by the storm for the purposes of timing only. They say nothing about whether actions should be taken, but rather only the time they should be taken.

As the storm approaches and more specifics are needed as to possible affected areas, highest wind speeds expected, etc., the Wind Timing options and the Wind Swath plot should be used to show the specific NHC forecast of areas affected and wind speeds expected.

Also, possible rainfall effects (use the HPC Rain option) should be monitored to see whether an area appears vulnerable to effects other than wind and storm surge such as flooding. Rain can be far more devastating than the wind and storm tide. The National River Flood Outlook is available in the Rain / River menu option.

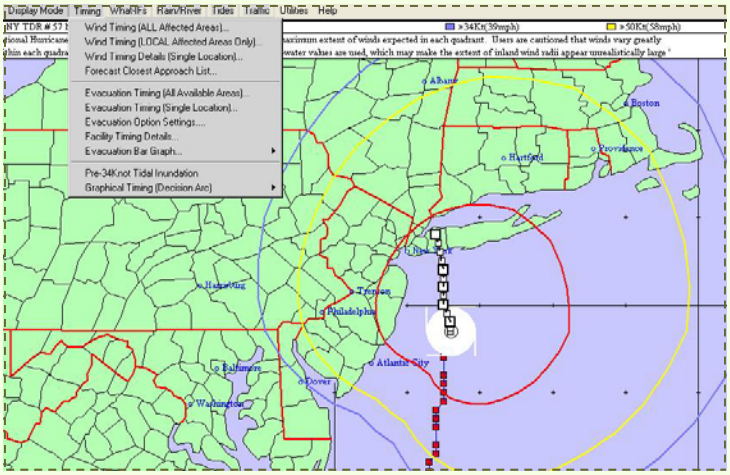

Figure 7-4: *Map created using HURREVAC's Exercise Track Wizard*

Inland areas that only need a short lead time for actions, should wait until the last advisory or two before landfall to help ensure a greater level of forecast accuracy.

OTHER FEATURES OF HURREVAC

Other HURREVAC features include the Evacuation Transportation Information System (ETIS). ETIS includes a traffic model that estimates the evacuation traffic on routes in the southeast United States during a Category 3 or higher storm impacting multiple states. The Wind Tags option allows you to view the wind at any location around the storm as the storm moves forward in time. The Strike Probabilities displays the chances of a storm passing within 65 miles of the local area, as assessed by a NHC strike probability program. An added feature in HURREVAC shows whether such probabilities are relatively high or low for the distance the storm is from the area. And the Warnings and Watches will display those if issued by the NHC.

THE NEXT GENERATION OF HURREVAC

HURREVAC is developing the next generation using vb.net that will allow for the ability to monitor real-time evacuations. This new visual basic version will import and integrate the regional transportation models showing traffic patterns, movements, slowdowns, and obstructions diminishing the evacuation. Real time storm information from the National Weather Service and NHC will allow users to more effectively manage the evacuation.

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HURREVAC's developers also have HurricaneMapping.com a subscription-based service that delivers live hurricane, tropical storm, and typhoon tracking data quickly and efficiently to subscribers. HurricaneMapping.com offers live data feeds and historical storm archives in a versatile Shapefile and KML formats for display in ESRI's ArcGIS and Google Earth. HurricaneMapping's datasets contain many advanced map layers to help analyze storm threats. HurricaneMapping's advisory datasets may contain as many as 12 different map layers depending on the conditions of the storm:

- Storm Location - Current location of the eye of the storm at the time of advisory issuance
- Wind Ranges - Extent of tropical storm force, 50kt, and hurricane force winds surrounding the storm center
- Forecast Track - Where the center of the storm in projected to track within a 3 to 5 day period
- Forecast Positions - Storm center locations and forecasted intensity at 12, 24, 36, 48, 72, 96, and 120-hour intervals
- Forecast Wind Swath - A composite of wind ranges throughout a 72-hour forecast period
- Forecast Error Swath - The area in which the storm is most likely to track given forecasting uncertainties
- Past Track - Actual path the storm has taken
- Advisory Positions - Storm center locations and observed intensity at the time of each old advisory
- Past Wind Swath - A composite of observed wind ranges from all advisories
- Watches and Warnings - Hurricane and tropical storm watches and warnings issued for coastlines
- Rainfall Isopleths - Amount of rain expected to fall within a 3-day period
- Flooding Outlook - Areas where flooding is possible or likely to occur
- Wind Probabilities - 0 to 120 hour probabilities of tropical storm force and hurricane force winds.

OBTAINING HURREVAC

HURREVAC may be downloaded from the www.hurrevac.com web-site. This program is a U.S. Government program produced by FEMA and the USACE for the emergency management community, and is not for public distribution.

Maintenance and support for this program is mainly via the Internet. Although there is no charge for use of the program for qualified users, registration is mandatory. Registration allows emergency managers to receive support, notice of updates, new versions, and other information on the program.