CLIMATE REPORT NO. G9

AUGUST 11th, 1940 HURRICANE

STATE OF SOUTH CAROLINA
WATER RESOURCES COMMISSION
STATE CLIMATOLOGY OFFICE

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August 11, 1940 Hurricane

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INTRODUCTION

The purpose of this study is to provide information on the impact of the August 1940 hurricane on the South Carolina coastal area.

In 1982, the South Carolina Coastal Council contracted with the National Hurricane Center, Miami, Florida, to develop hurricane statistics for the South Carolina coast, using the recently developed Sea, Lake and Overland Surge from Hurricanes (SLOSH) computer model. During the summer of 1983, the Federal Emergency Management Agency awarded a grant to the South Carolina Emergency Preparedness Division, who contracted with the South Carolina Water Resources Commission for assistance in analyzing the SLOSH computer printouts and preparing maps and tables depicting the results. Included in that contract was the statement that at least two historical storms would be studied using the SLOSH model to calculate the areas flooded. This study is in accord with that contract.

SUMMARY

The hurricane of August 1940 was the last hurricane to cause a large number of deaths in South Carolina.

This storm was first noticed on August 5, 1940 as an intensifying disturbance centered between St. Martin and St. Thomas Islands. Severe squalls of 44 miles an hour were recorded at 10:04 a.m. on the 5th at San Juan. At 6 p.m. on the 5th, the tropical cyclone was located a short distance north of Mona Passage, having moved rather rapidly in a west northwest direction during the preceding ten hours.

The Dutch motor vessel Pyomalion, near latitude 19°36' N and longitude 65°48' W, at 5 p.m. of August 5, reported easterly gales with a barometric pressure of 1,012.5 millibars.

Cloudy weather, high winds, and moderate to rough seas were encountered by ships in the vicinity of the path of the tropical disturbance as it continued to move in a northwest direction during the 6th. The center of the storm passed a short distance to the south of Turks Island at noon, August 6, with a barometer pressure of 1,003 millibars, accompanied by winds of 30 miles an hour.

During the next three days the disturbance showed little tendency to increase in intensity as it moved northward. On the 9th and 10th the storm slowed and turned westward. Late on the 10th the storm intensified to a hurricane and changed direction toward the northwest. During the 11th the hurricane initially continued to move toward the northwest, but gradually turned toward the west. At approximately 1630 EST on August 11, 1940, the eye of the hurricane made landfall near the Georgia-South Carolina border. The eye passed over the city of Savannah, Georgia at 1730 EST.

The track of the hurricane is shown in Figure 1.

Winds of hurricane force were experienced over a distance of ninety miles northward from the Savannah area to near Charleston (Charleston maximum velocity was 66 miles per hour for 5 minutes). Damaging gales extended north of Charleston to Georgetown and south of Savannah to Brunswick. Tides were very high north of the center.

In 1940 the property damage amounted to about $1,500,000 at Charleston and nearby beach resorts, nearly $1,000,000 in the Savannah area; and about $5,000,000 at Beaufort, South Carolina. Major crop damage also occurred, but is not included in these statistics. Reports are somewhat confused as to loss of life. The larger communities had very few casualties; none occurred at Charleston or Beaufort, and only two at Savannah, and one of these was by heart failure due to fright, rather than injury. In the coastal areas between Savannah and Charleston a considerable number of persons lost their lives, although the exact number may never be known. Early press reports indicated 35 dead but some missing individuals at first thought dead were later found safe.

The lower South Carolina coast is indented by many inlets, islands, and marshes. Some of these islands and inlets were inhabited by persons living in flimsy shanties or houseboats, without communication facilities as well as being difficult to access. The small number of deaths under these conditions was remarkable, and may have indicated the effectiveness of the Coast Guard and other agencies in reaching these remote people with the warnings and evacuation assistance. In addition to these rather inaccessible places along the lower South Carolina coast, a number of popular beach resorts are located in the area, ordinarily visited by thousands of people during early August weekends. A particular attraction during the hurricane's passage was a scheduled yacht race at Charleston, South Carolina. However, because of warnings, small craft were moved to safe anchorage, and the beaches cleared of people. Without the warnings, the loss of life and property would probably have been much greater. The hurricane weakened as it continued westward and the center passed near Macon, Georgia at 0730 on the 12th. The remaining depression moved in a slow clockwise direction until it dissipated in central North Carolina on the 15th. Its inland movement was accomplished by torrential rains and disastrous floods in many sections of Georgia, Tennessee, and the Carolinas. Press reports indicated an additional 30 deaths and property and crop damage of many millions of dollars occurred in the inland flood areas.

INTENSITY

Sparse information is available from ship observations while the hurricane was in the Atlantic Ocean. However, since the center passed directly over the city of Savannah, Ga., where a weather station was located, a good estimate of its landfall intensity was obtained. The lowest pressure recorded by the weather station was 975 millibars (mb) at 1730 EST on the 11th August. The hurricane weakened as it continued to move westward. At 0730 EST on the 12th August the center passed near Macon, Ga. and the weather station recorded a pressure of 1000 mb. Thus, the filling rate of 25 mb in 14 hours or 1.8 mb/hr was obtained.

Hourly observations of 10 minute average wind speeds were obtained for Savannah, Ga, Beaufort, SC, and Charleston, SC. Comparison of these values and SLOSH generated 10 minute wind speeds will be made in a subsequent section.

RADIUS OF MAXIMUM WINDS (RMW)

The radius of maximum winds (RMW) was determined using the time history data from the 3 stations mentioned above. At landfall the RMW was estimated to be 30 statute miles. After landfall the RMW was allowed to slowly increase.

SLOSH MODEL RESULTS

The track, intensity, and RMW data were tabulated at six hour intervals and used as input to initiate the National Weather Service Storm Surge model (SLOSH). The envelope of high water generated by the SLOSH model on a computer grid is shown in figure 2. The contours represent maximum storm surge relative to mean sea level (MSL). Two peak surges determined from tide gages located at Ft. Pulaski, GA and Charleston, SC are indicated by circles. Also four peak surges were estimated from high water marks at Hunting Island, Edisto Island, Folly Beach, and Isle of Palms. These values are indicated by diamonds.

The method to determine the storm surge marigram at Ft. Pulaski (i.e. Quarantine Station) and Charleston (i.e. Custom House) are shown in Figures 3 and 4. The hindcasted astronomical tide is subtracted from the observed storm tide to give the storm surge marigram. In both Figures 3 and 4 it will be noted that the resulting storm surge (i.e. short dashed line) still contains some component of the astronomical tide. This is due to the face that the hindcast astronomical equations are slightly different now than in 1940. (Note: Shifting of the hindcast astronomical tide did not improve the storm surge result).

Figures 5 and 6 compare the SLOSH model generated storm surge and the observed storm surge at Ft. Pulaski and Charleston respectively. The point in the SLOSH model used for Ft. Pulaski has an average elevation of 3 feet above MSL. Therefore, until the surge rises above 3 feet and inundates this square a constant 3 feet is indicated. At both locations the SLOSH computed and observed storm surges are in phase, but the Charleston SLOSH computed surge is approximately three quarters of a foot too high and the Ft. Pulaski SLOSH computed surge is 2 feet too high. Also the peak storm surge at Charleston occurs at approximately 1500 LST or near high tide. At Ft. Pulaski the peak storm surge occurs 4 hours later at 1900 LST or near mean tide.

Figures 7, 8, and 9 compare the SLOSH model generated 10-minute winds with the observed 10-minute winds at Savannah, Charleston, and Beaufort respectively. Also plotted on the Savannah and Charleston figures are the observed gust values. The observed gust values are generally between 10 to 20 per cent greater than the observed 10-minute wind. The one exception is the comparison after the peak wind speed occurs at Charleston. This difference may be a result of our inability to correctly determine the position, intensity, or RMW of the storm during this time period.

DESCRIPTION OF FIGURES 10-17

The envelope of maximum storm surge height was also plotted on sectional hurricane evacuation maps (scale 1:62,500).

Figures 10-17 describe the envelope of high water for each of the sectional maps from Conway southward through Savannah Beach. For example, the sectional map for Fripp Island, Figure 7, shows storm surge heights in mean sea level ranging form nine feet at the mouth of Trenchards Inlet upwards to more than ten feet at the confluence of the Morgan River and the Coosaw River. The areas not inundated are bounded by solid lines on the various charts. The mean sea level depth of the storm surge is shown as dashed lines. In order to obtain actual depth at any location, the user should subtract actual elevation from the storm surge elevation given. It should be remembered that the storm surge heights are in reference to mean sea level, whereas the usual reports of tide height are often in terms of mean low water. Another very important consideration is that these storm surge calculations do not include tidal influence or wave heights.

NEWSPAPER REPORTS OF AUGUST 1940 HURRICANE

Listed below are reports extracted from newspapers published before, during or after the passage of the August 1940 hurricane across South Carolina. No effort has been made to edit these accounts of the storm.

FROM: The Charleston News and Courier - August, 1940

August 6 - "A disturbance was reported moving through the West Indies toward Puerto Rico. Squalls have been reported along with this".

August 7 - "A tropical storm passed over Turks island in the British West Indies yesterday. It was moving to the WNW with winds of 30 mph and a barometric reading of 29.63 inches as it passed through the island".

August 8th - "On yesterday, the tropical storm was reported moving NNW through the Atlantic at 7:00 p.m. It had winds of 30 mph. It was located about 220 miles east of Nassau, Bahamas".

August 9th - "Yesterday it began moving NNE at 10-12 mph. The storm was about 500 miles ESE of Jacksonville, Fla. The storm is expected to increase in intensity tonight".

August 10th - "Yesterday, all craft from Cape Hatteras to Miami, were asked to stay in port, because of the stationary or slowly drifting tropical storm. The storm was about 325 miles ESE of Jacksonville, Florida at 7 p.m."

August 11th - "Gales and high tides are expected in Charleston today. At 10:35 p.m. last night, the storm was still erratic but it was possible that it could change its course again before reaching Charleston. At 7 p.m. it was about 250 miles ENE of Jacksonville, Fla., moving slowly to the north. At 1:30 a.m. this morning, winds at the airport were from the NE at 15 mph. Winds yesterday afternoon reached 27 mph but it was said to be associated with a high pressure area. Light rain began to fall last evening."

August 12 - "Hurricane hit the coast yesterday. It caused tremendous property damage, but no loss of life was reported. The hardest hit areas were Savannah, Beaufort, Charleston, and Georgetown. The storm was moving north at 15 mph."

August 12 - "The town of Beaufort and the Marine Base lost all communications. Walterboro lost power. The Hurricane was said to have struck the coast between Savannah and Charleston. Folly Beach was also wrecked by the storm. In St. Matthews, some buildings were unroofed. Power lines in Charleston were mostly down by 8:30 a.m. yesterday and by 2:30 p.m., reached hurricane force and carried a tide of 12.7 ft. into low-lying sections. Winds were reported to have gusted up to 80 mph. The wind direction changed from east northeast, during the peak of the storm, to southeast shortly after sunset. The lower half of the Charleston area was more severely struck than in other areas."

"For a 5 minute period, at 1:55 p.m., the wind reached 75 mph and the barometer was at 29.64 inches. On Saturday, about midnight, winds blew at 27 mph. By 6 a.m., it was reported to be blowing at 32 mph. By noon, the wind blew at 54 mph. The 1 p.m. wind speed was reported at 60 mph, and by 2 p.m. between 57 and 75 mph. The wind blew steadily at 50-70 mph from 2 p.m. until 6 p.m.

"By 3:05 p.m., yesterday, it was believed that the storm had passed its peak. The wind at that time was at 65 mph and barometer began to rise slowly. At 7:00 a.m., yesterday, the storm was located about 120 miles SE of Charleston and it was moving to the NW. The wind in Charleston was from the east at 76 mph at 2:30 p.m. It was also believed that the storm was centered at 50 miles ENE of Savannah. Rainfall in Charleston totaled 7.68 inches during the storm. Several houses were damaged in Summerville."

August 13 - "The Beaufort area took the worst blow with a loss of 33 lives. In Edisto, 50% of the buildings were down. On Folly Beach and the Isle of Palms, the storm also destroyed 50% of the houses."

"Rainfall in the state for the period 8 a.m. - 8 p.m. averaged 4.20 inches in Orangeburg, .71 in Camden, and .95 inches in Sumter. The power in Berkeley county was cut. Georgetown escaped with little damage."

August 14 - "In Beaufort, estimated winds reached 85-90 mph. The town had property loss in the millions, and left hundreds homeless. By 2:30 p.m. a barometer reading of 28.80 inches was reported. Fall crops on the coast were almost completely ruined."

From The Charleston Evening Post (August 10-14, 1940)

August 10, 1984 - "Tropical Storm edge Florida east coast. A small craft advisory was issued from Cape Hatteras to Miami. At 7 a.m., the storm was centered 250 miles east of Daytona Beach. At 9:30 a.m., the advisory said that the storm was moving west or south westward. An earlier advisory placed the storm about 325 miles ESE of Jacksonville."

August 12th - "Charleston Emerges from Hurricane - Widespread damage caused, in city and nearby places, no fatalities were reported." " 76 Miles an hour wind moves up coast". "Charleston was lashed for 24 hours by winds that reached hurricane force and tides and floods reached many streets. As far as could be seen - no loss of life. Savannah and Georgetown were shipped by furious winds like that of Charleston."

"The storm hit S.C. between Charleston and Savannah. The center of the storm was believed to have been moving up the coast at 15 mph. The Charleston Weather Bureau recorded 4 a.m. yesterday wind speeds of 32 mph. At 6:00 a.m. - 29 mph, and then after that increased. At noon, the wind velocity reached 60 mph and at 2:00 p.m. it was 72 mph. The maximum speed was reached at 2:30 p.m. with 76 mph recorded for a 5 minute period with wind gusts reaching 90 mph.

The peak passed, and at 4:00 p.m. had decreased to 56 mph. Shortly before 4 p.m. the barometer began rising. It was the worst storm since 1911 (81 mph)."

"Accompanying the wind were heavy downpours of rain, and tides which flooded a large portion of the city. The rainfall amount between midnight Saturday, and 7:30 a.m. this morning was 8.61 inches. Tides were estimated at 10.3 ft. because the tide gauge broke and it could not be accurately measured. Electrical power went out as early as 9:30 a.m. and by noon, all circuits were out. Waters reached up to car rims and one Citadel barrack had water up the the walls. Property damage was mostly minor. North of the city, the damage was similar to that of Charleston, trees being blown down and highways being blocked. Downed trees extended inland as far as Cameron. Damage to crops was noticeable".

"Folly Beach badly damaged. Light damage reported on Sullivans Island."

August 13, 1940 - "Death toll from Sunday's storm reached 35 persons. Storm hit hardest on the islands of South Carolina and Georgia. Twenty-five persons died on St. Helena Island. Eight persons died on Ladies Island".

"The storm traveled inland and lost its intensity. Between midnight on Saturday until noon today, Charleston received 9.88 inches of rain. The Airport Weather Station had reported 10.16 inches through the same period. The wind maximum at the airport was considerably less at 55 mph. In downtown Charleston, highest wind 66 mph for a 5 minute period. The highest was 73 mph. The gusts, however, reached over 80 mph. The highways in our state suffered from flooding."

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_____, 1940, Climatological Data for South Carolina: National Oceanic and Atmospheric Administration, Environmental Data and Information Service, Asheville, N.C., 8 p.

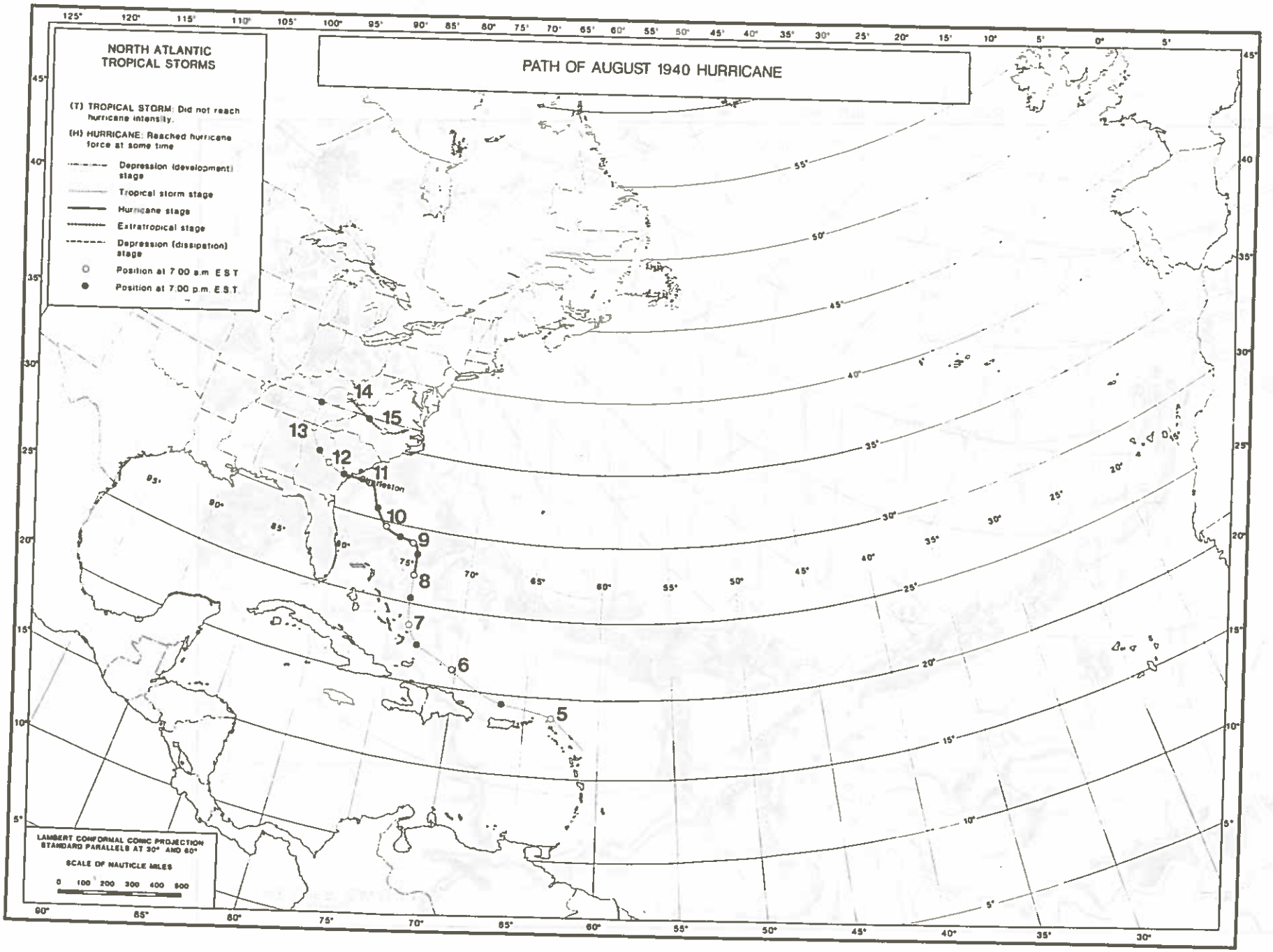
NORTH ATLANTIC
TROPICAL STORMS
(T) TROPICAL STORM: Did not reach hurricane intensity.
(H) HURRICANE: Reached hurricane force at some time
Depression (development) stage
Tropical storm stage
Hurricane stage
Extratropical stage
Depression (dissipation) stage
Position at 7:00 a.m. E.S.T.
Position at 7:00 p.m. E.S.T.
PATH OF AUGUST 1940 HURRICANE
LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30° AND 60°
SCALE OF NAUTICLE MILES
0 100 200 300 400 500
Depression
14
15
13
12
11
10
9
8
7
6
5

Figure 1

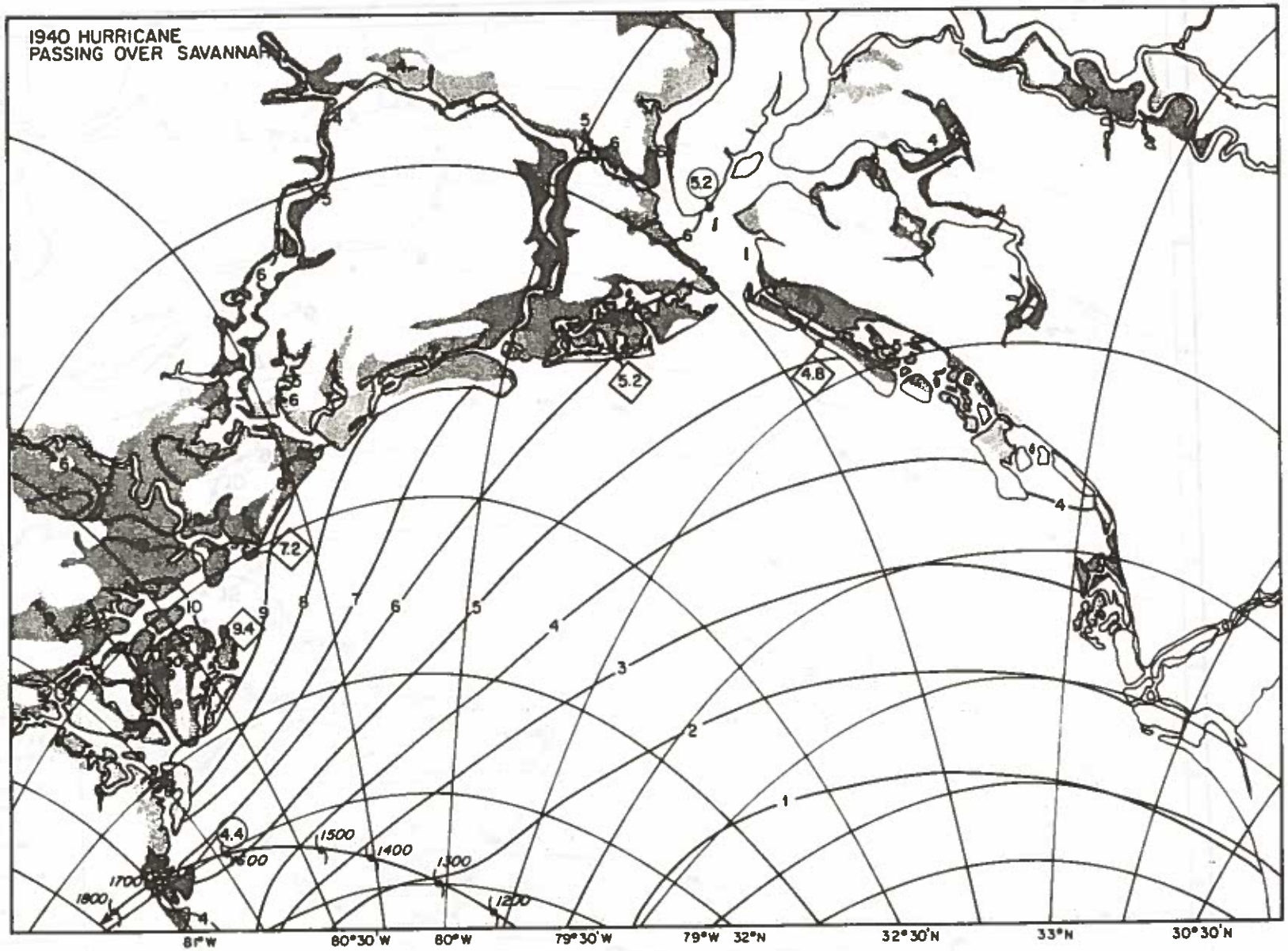
1940 HURRICANE
PASSING OVER SAVANNAH
5.2
5.2
4.8
7.2
9.4
4.4
1500
1400
1300
1200
1700
1800
81°W
80°30'W
80°W
79°30'W
79°W
32°N
32°30'N
33°N
30°30'N

Figure 2

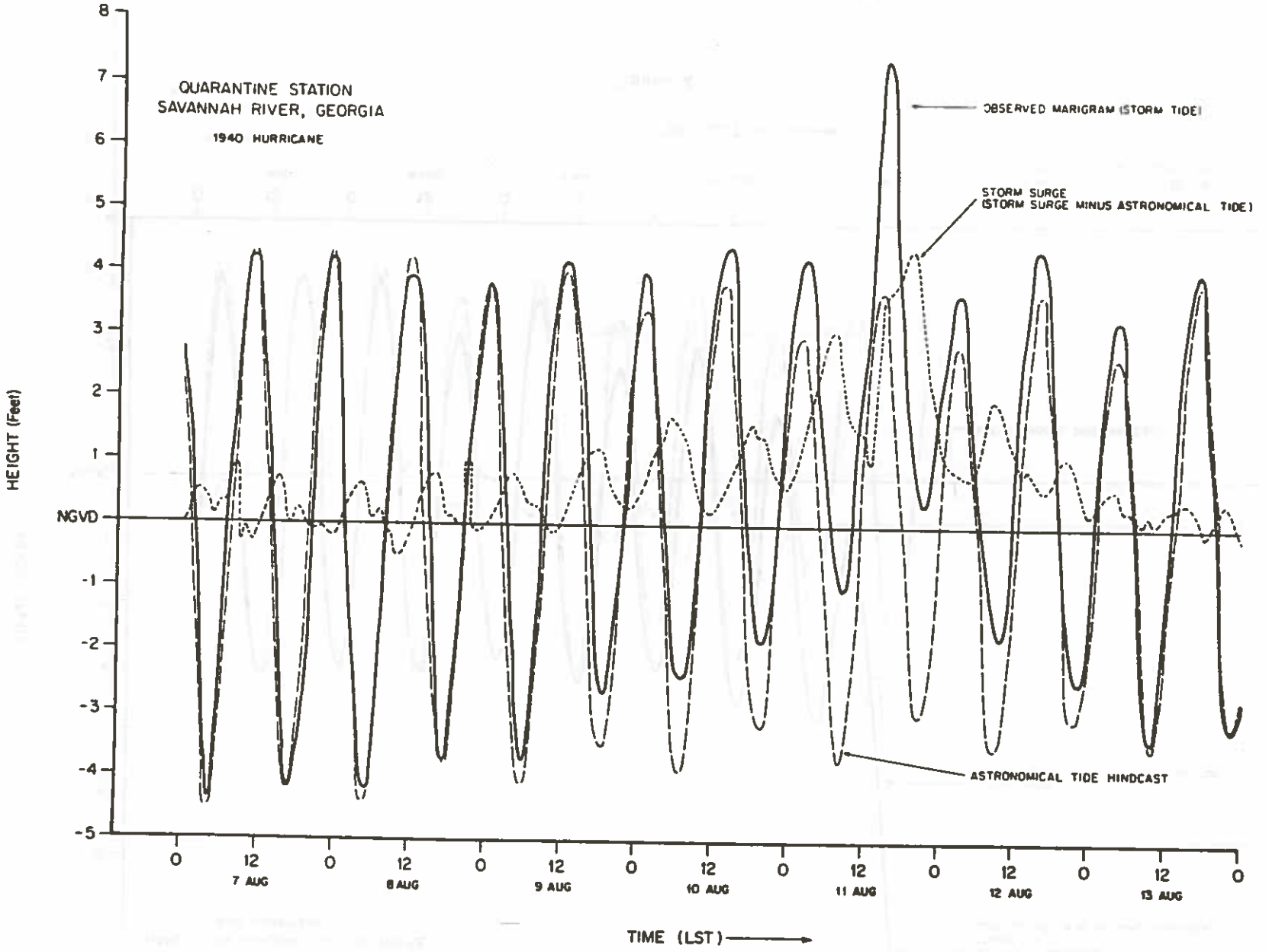
QUARANTINE STATION
SAVANNAH RIVER, GEORGIA
1940 HURRICANE
OBSERVED MARIGRAM (STORM TIDE)
STORM SURGE
(STORM SURGE MINUS ASTRONOMICAL TIDE)
ASTRONOMICAL TIDE HINDCAST
HEIGHT (Feet)
NGVD
8
7
6
5
4
3
2
1
-1
-2
-3
-4
-5
0
12
7 AUG
8 AUG
9 AUG
10 AUG
11 AUG
12 AUG
13 AUG
TIME (LST)

Figure 3

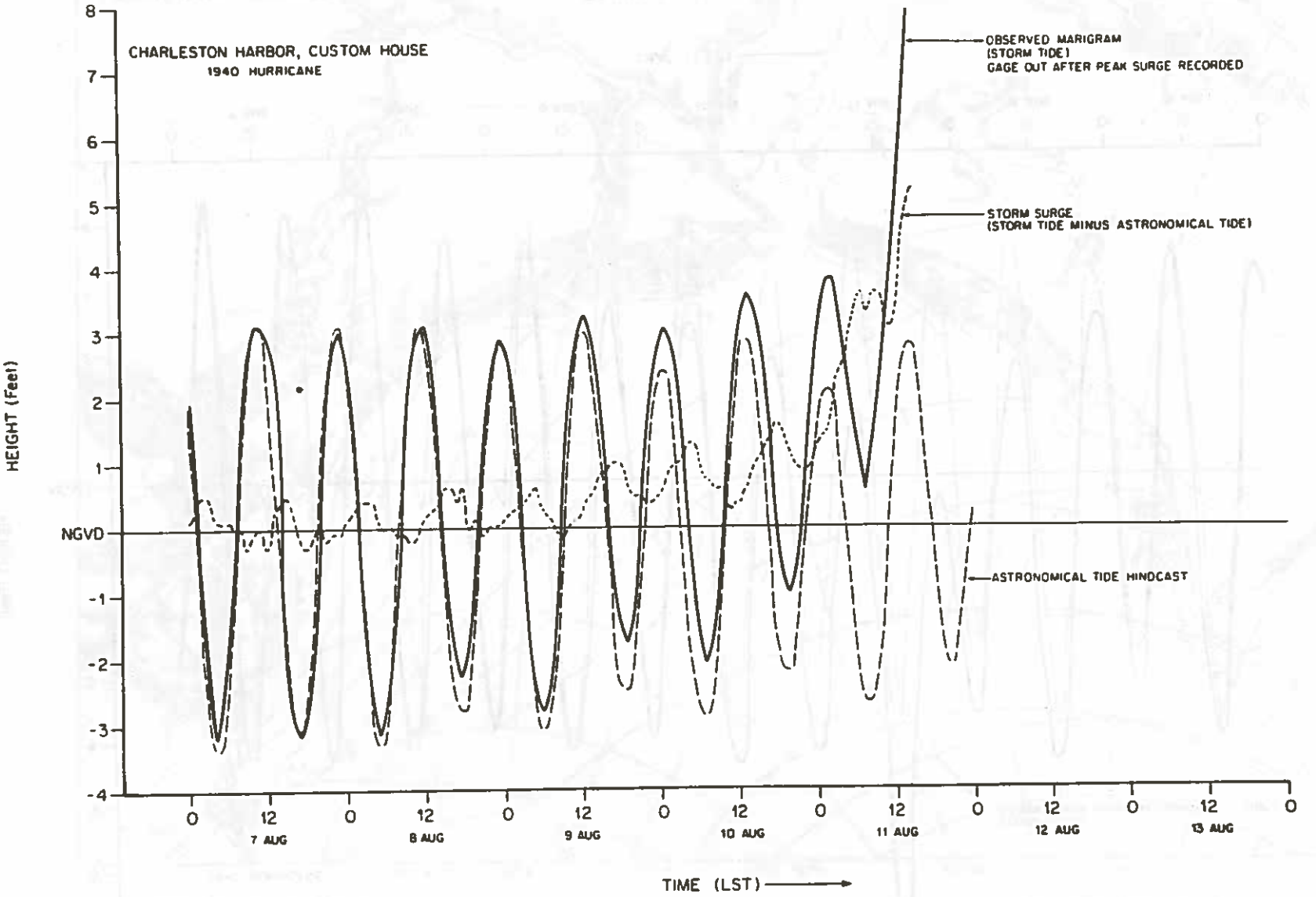
CHARLESTON HARBOR, CUSTOM HOUSE
1940 HURRICANE
OBSERVED MARIGRAM
(STORM TIDE)
GAGE OUT AFTER PEAK SURGE RECORDED
STORM SURGE
(STORM TIDE MINUS ASTRONOMICAL TIDE)
ASTRONOMICAL TIDE HINDCAST
HEIGHT (Feet)
NGVD
8
7
6
5
4
3
2
1
-1
-2
-3
-4
0
12
7 AUG
8 AUG
9 AUG
10 AUG
11 AUG
12 AUG
13 AUG
TIME (LST)

Figure 4

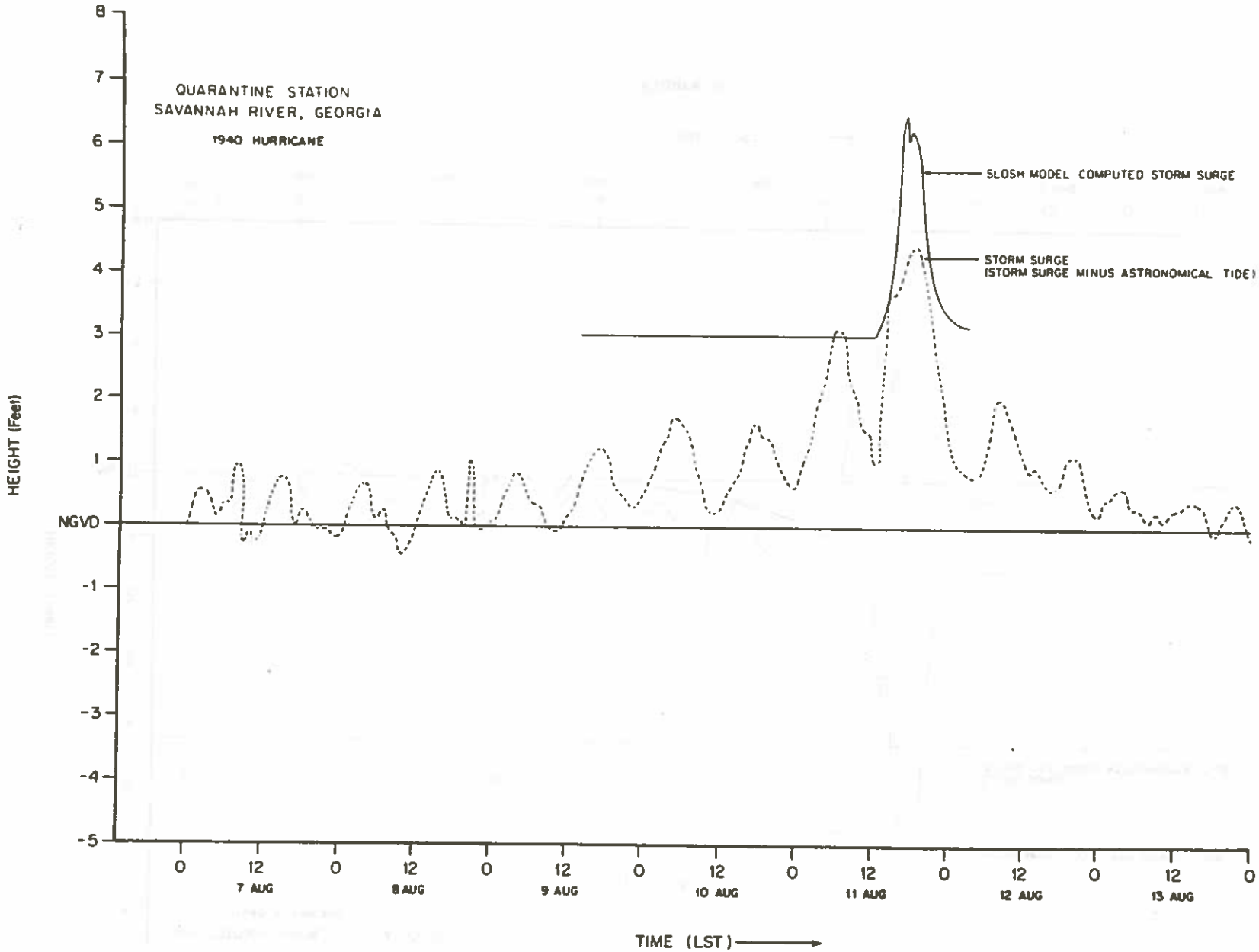
QUARANTINE STATION
SAVANNAH RIVER, GEORGIA
1940 HURRICANE
SLOSH MODEL COMPUTED STORM SURGE
STORM SURGE
(STORM SURGE MINUS ASTRONOMICAL TIDE)
HEIGHT (Feet)
NGVD
8
7
6
5
4
3
2
1
-1
-2
-3
-4
-5
0
12
7 AUG
8 AUG
9 AUG
10 AUG
11 AUG
12 AUG
13 AUG
TIME (LST)

Figure 5

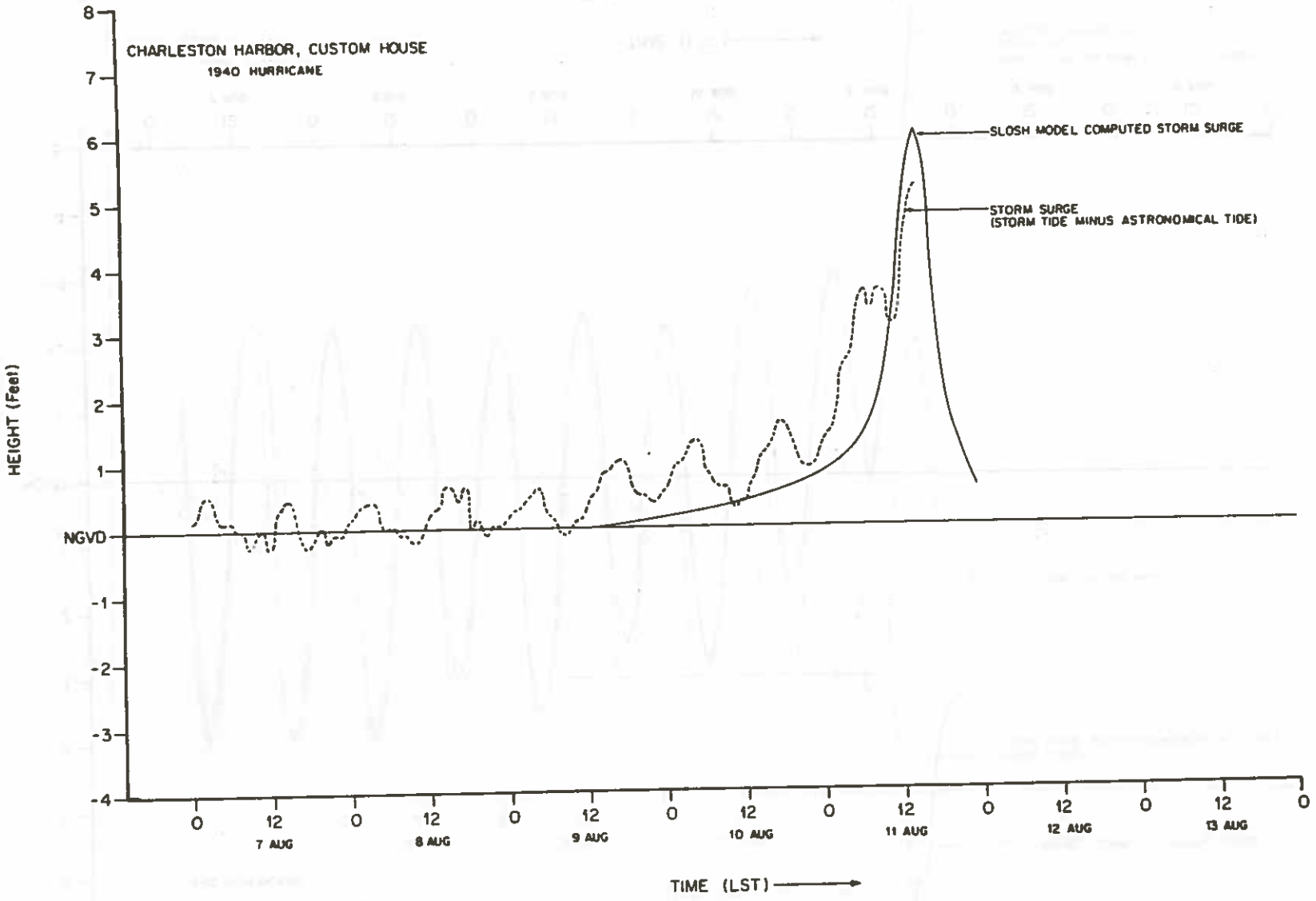
CHARLESTON HARBOR, CUSTOM HOUSE
1940 HURRICANE
SLOSH MODEL COMPUTED STORM SURGE
STORM SURGE
(STORM TIDE MINUS ASTRONOMICAL TIDE)
HEIGHT (Feet)
NGVD
8
7
6
5
4
3
2
1
-1
-2
-3
-4
0
12
7 AUG
8 AUG
9 AUG
10 AUG
11 AUG
12 AUG
13 AUG
TIME (LST)

Figure 6

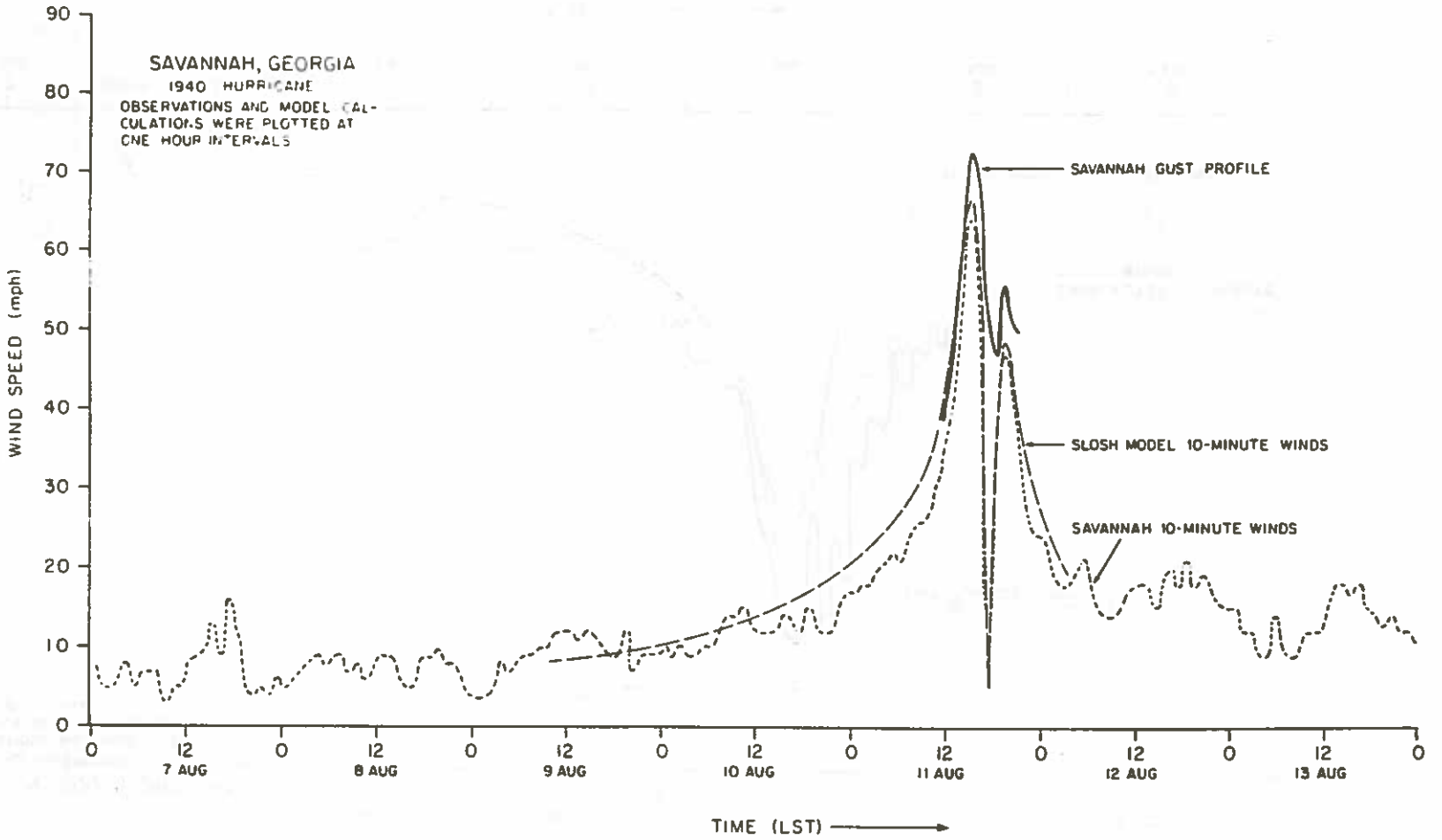
SAVANNAH, GEORGIA
1940 HURRICANE
OBSERVATIONS AND MODEL CALCULATIONS WERE PLOTTED AT ONE HOUR INTERVALS
SAVANNAH GUST PROFILE
SLOSH MODEL 10-MINUTE WINDS
SAVANNAH 10-MINUTE WINDS
WIND SPEED (mph)
TIME (LST)
0
10
20
30
40
50
60
70
80
90
0 12 0 12 0 12 0 12 0 12 0 12 0 12 0 12 0
7 AUG
8 AUG
9 AUG
10 AUG
11 AUG
12 AUG
13 AUG

Figure 7

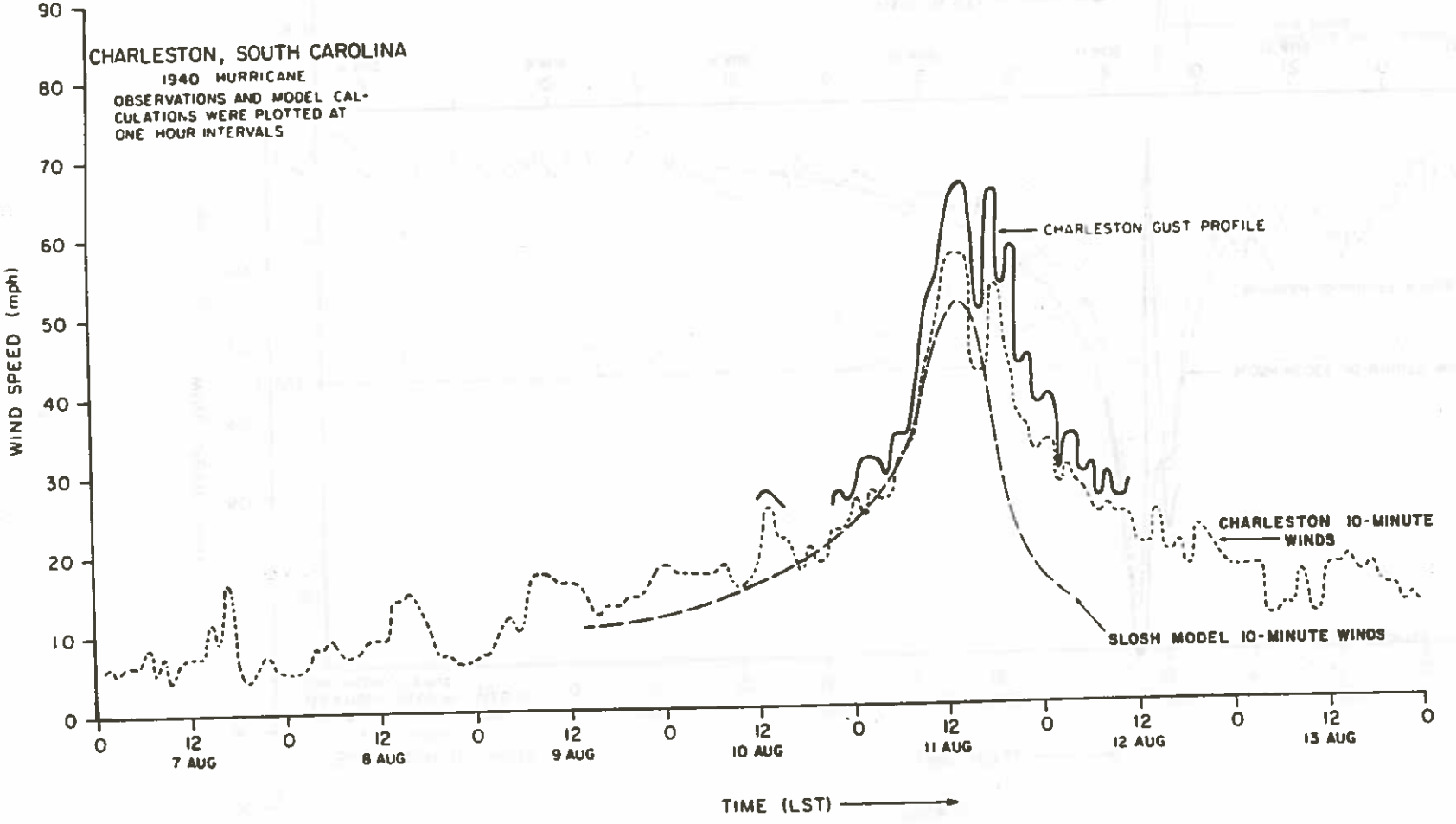
CHARLESTON, SOUTH CAROLINA
1940 HURRICANE
OBSERVATIONS AND MODEL CALCULATIONS WERE PLOTTED AT ONE HOUR INTERVALS
WIND SPEED (mph)
90
80
70
60
50
40
30
20
10
0
CHARLESTON GUST PROFILE
CHARLESTON 10-MINUTE WINDS
SLOSH MODEL 10-MINUTE WINDS
0
12
7 AUG
8 AUG
9 AUG
10 AUG
11 AUG
12 AUG
13 AUG
TIME (LST)

Figure 8

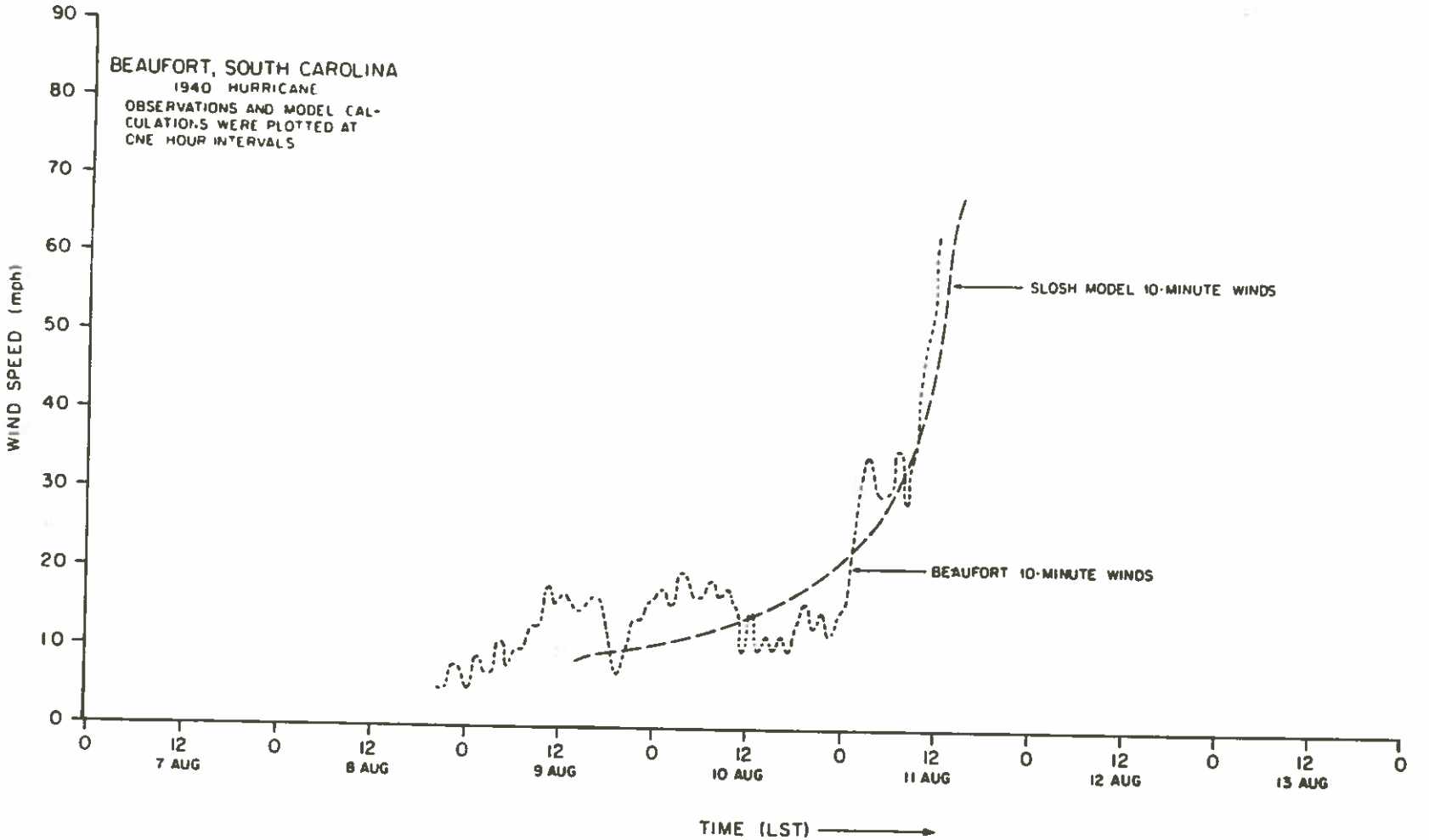
BEAUFORT, SOUTH CAROLINA
1940 HURRICANE
OBSERVATIONS AND MODEL CALCULATIONS WERE PLOTTED AT ONE HOUR INTERVALS
WIND SPEED (mph)
90
80
70
60
50
40
30
20
10
0
SLOSH MODEL 10-MINUTE WINDS
BEAUFORT 10-MINUTE WINDS
0
12
7 AUG
0
12
8 AUG
0
12
9 AUG
0
12
10 AUG
0
12
11 AUG
0
12
12 AUG
0
12
13 AUG
0
TIME (LST)

Figure 9