Technical Attachment

RAINFALL PATTERNS AND HURRICANE ANDREW

A Hydro-meteorological Survey
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INTRODUCTION

Hurricane Andrew moved ashore in south central Louisiana during the nighttime hours of August 26-27, 1992, as a category 3 hurricane on the Saffir-Simpson scale. The center of the storm progressed northward along the Mississippi River to Vicksburg, Mississippi, and then northeast passing between Columbus, Mississippi, and Tuscaloosa, Alabama during the night of August 27-28. This brief paper will serve to document the rainfall pattern associated with Hurricane Andrew, compare and contrast the rainfall pattern with two past hurricanes striking the Louisiana and Mississippi coasts, and briefly touch on the effect of such heavy rains on the rivers and streams of the Lower Mississippi Valley.

DESCRIPTION OF THE HURRICANE PRECIPITATION EVENT

Hurricane Andrew, as observed by WSFO New Orleans radar situated in Slidell, Louisiana, moved west-northwest along the marshy shoreline of Terrebonne Parish into Atchafalaya Bay before making final landfall in St. Mary Parish near Franklin about 3 AM on August 26. The storm then proceeded to move northward essentially along the Atchafalaya and Mississippi Rivers, passing very near Natchez and Vicksburg before moving northeast near Jackson and Columbus.

Due to the sparsely populated swamplands along the Louisiana coast, few storm total rainfall observations were routinely available near the center's path until after the storm had moved well inland. However, the cooperative program of the National Weather Service provided excellent coverage of rainfall for both Louisiana and Mississippi on a real-time basis at all other locations. The rainfall pattern (figs. 1, 2) was somewhat variable but showed an average near 5.5 inches of rain on the right side of the storm track, extending eastward about 120 miles from the center. Maximum rainfall in Louisiana was a little over 11 inches of rain reported at Hammond in Tangipahoa Parish, most of which fell as "feeder" rain bands repeatedly moved from south to north across the parish in a train echo effect as the center of Andrew moved north. The left side of the storm track was drier, with 1 to 3 inches extending westward about 40 miles from the center. This pattern, although somewhat more widespread than past hurricanes on the central Gulf coast, is still consistent as far as rainfall amounts and "wet" and "dry" sides are concerned, and compares favorably to classical expectations for hurricane rainfall as advanced by Cline [1] and Riehl (2].

As the storm lost its "eye", the rainfall pattern became more symmetric, but the largest storm totals were still to the east of the center on the "wet" side of the storm. From 1 to 6 inches of rain fell out to 60 miles west of the storm's path in north Louisiana, but from 3 to 8 inches of rain fell across nearly all of Mississippi except the extreme southeast and the northwest counties. Maximum rainfall in Mississippi was reported just northwest of Hattiesburg at Sumrall where 9.30 inches of rain fell and over 8 inches was measured at Pelahatchie, a small town about 30 miles east of Jackson.

COMPARISON AND CONTRAST WITH BETSY AND CAMILLE

Hurricane Andrew followed a path through the Atlantic, across extreme south Florida, and through the Gulf of Mexico to Louisiana that was very close to Hurricane Betsy, a category 3 storm which moved ashore in southeast Louisiana near Grand Isle in September, 1965. Betsy's rainfall pattern was similar, with the heaviest rains (from 2 to 6 inches) reported in a band from 40 miles west to 80 miles east of the center path (3]. Not as many reporting stations were available for analysis with Betsy as with Andrew, so it is possible that some large totals occurred unobserved (fig. 3).

Hurricane Camille, which was a category 5 storm that devastated the Mississippi Gulf coast in 1969, produced rainfall amounts strikingly similar to those associated with Andrew. Analysis by the U.S. Army Corps of Engineers, New Orleans District [4], showed average precipitation with Camille was about 5 inches within the area 20 miles west and 80 miles east of the hurricane path, which is similar to Betsy's but smaller than Andrew's pattern as described earlier. Maximum amounts were similar, with over 10 inches of rain reported at the Bay St. Louis NASA, MS, and Hattiesburg, MS, stations in Camille, compared with over 11 inches at Hammond, LA, in Andrew (fig. 4).

One very interesting precipitation non-event was the almost complete lack of heavy rains in the Appalachian and eastern seaboard states as Andrew moved through after landfall. In spite of history (Camille and Agnes) as well as dire predictions of heavy rain and flooding from NWS offices, Andrew was not a torrential rainfall producer in the east.

HYDROLOGIC CONSIDERATIONS

The Lower Mississippi Valley was fairly dry before Andrew's landfall, and in spite of the large amounts of rain, flooding was minimal. Above bankfull stages were observed on the Tangipahoa, Bogue Chitto, Tickfaw, Tchefuncta, and middle and lower Pearl rivers in Mississippi and Louisiana; however, flooding was minor to moderate.

From calculations done at LMRFC comparing volume of rainfall and actual runoff passing forecast points in Mississippi and Louisiana, only 25 percent or less of the volume of rain that fell actually made it into rivers, with the remaining 75 percent or more absorbed by the soil or plants or evaporated.

Some of the rainfall-runoff calculations performed are listed below:

RIVER AND FORECAST POINT	MEAN AREA PCPN THIESSEN (IN)	RUNOFF CALCULATED (IN)	PERCENT RUNOFF
Bogue Chitto R near Tylertown MS	6.85 in	1.72 in	25.1 %
Leaf R near Collins MS	5.85 in	1.08 in	18.5 %
Bowie Creek near Hattiesburg MS	7.64 in	1.23 in	16.1 %
Tallahala Creek near Waldrup MS	3.24 in	0.25 in	7.7 %
Tickfaw River near Liverpool LA	7.32 in	1.31 in	17.9 %

CONCLUSIONS

Hurricane Andrew closely fulfilled classical expectations of central Gulf coast hurricanes as far as rainfall amounts and distribution are concerned, but contrary to expectations did not become the forecast heavy rain producer in the Appalachians and east. In spite of rainfall amounts exceeding 10 inches in some areas, flooding from Andrew's rains was minimal due to the very dry soil conditions in the Lower Mississippi Valley.

REFERENCES

[1] Cline, Isaac M., Tropical Cyclones, MacMillan & Co., New York, N.Y., 1926, pp. 185-186.

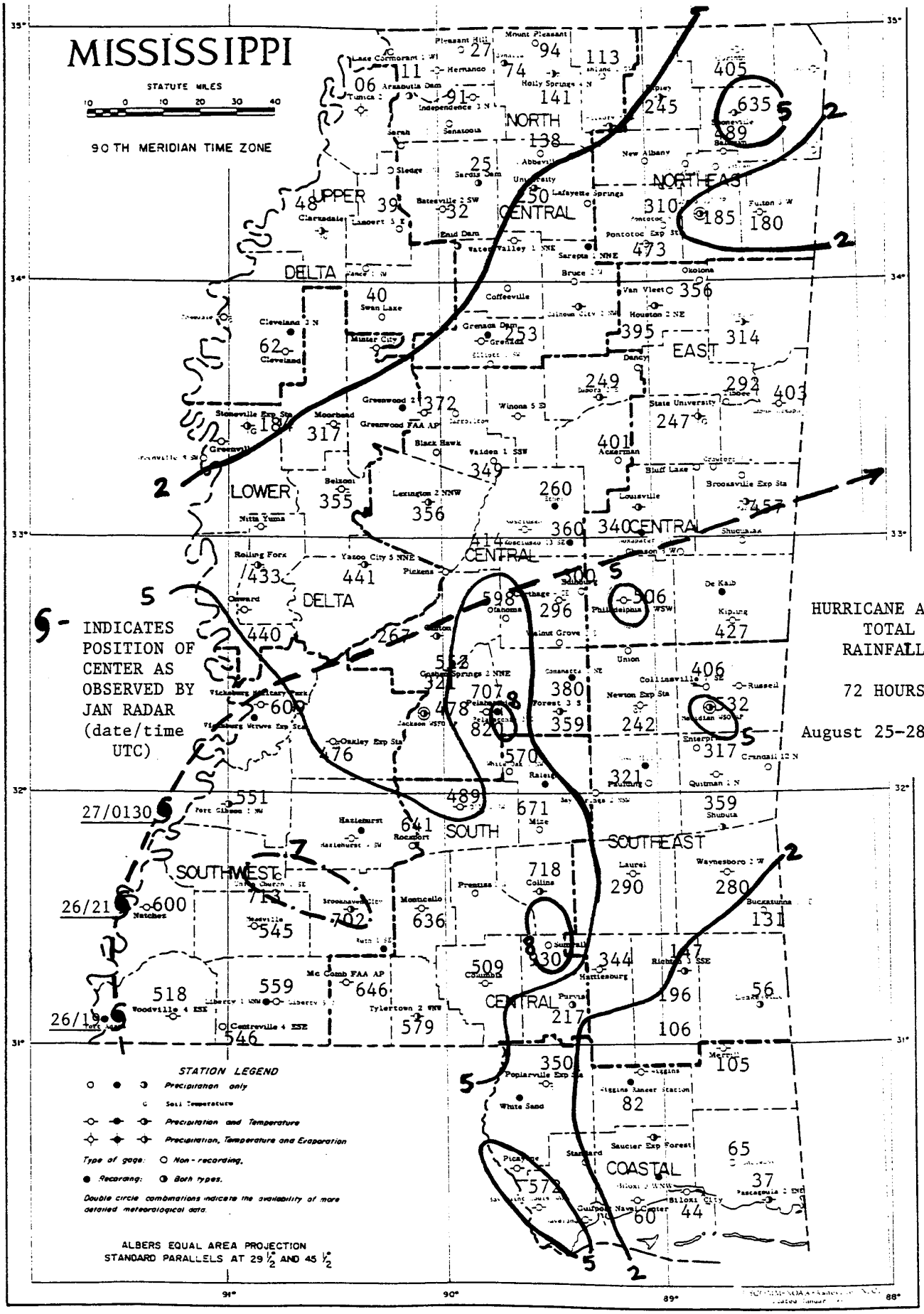
[2] Riehl, Herbert, Tropical Meteorology, McGraw-Hill, New York, N.Y., 1954, pp. 294-295.

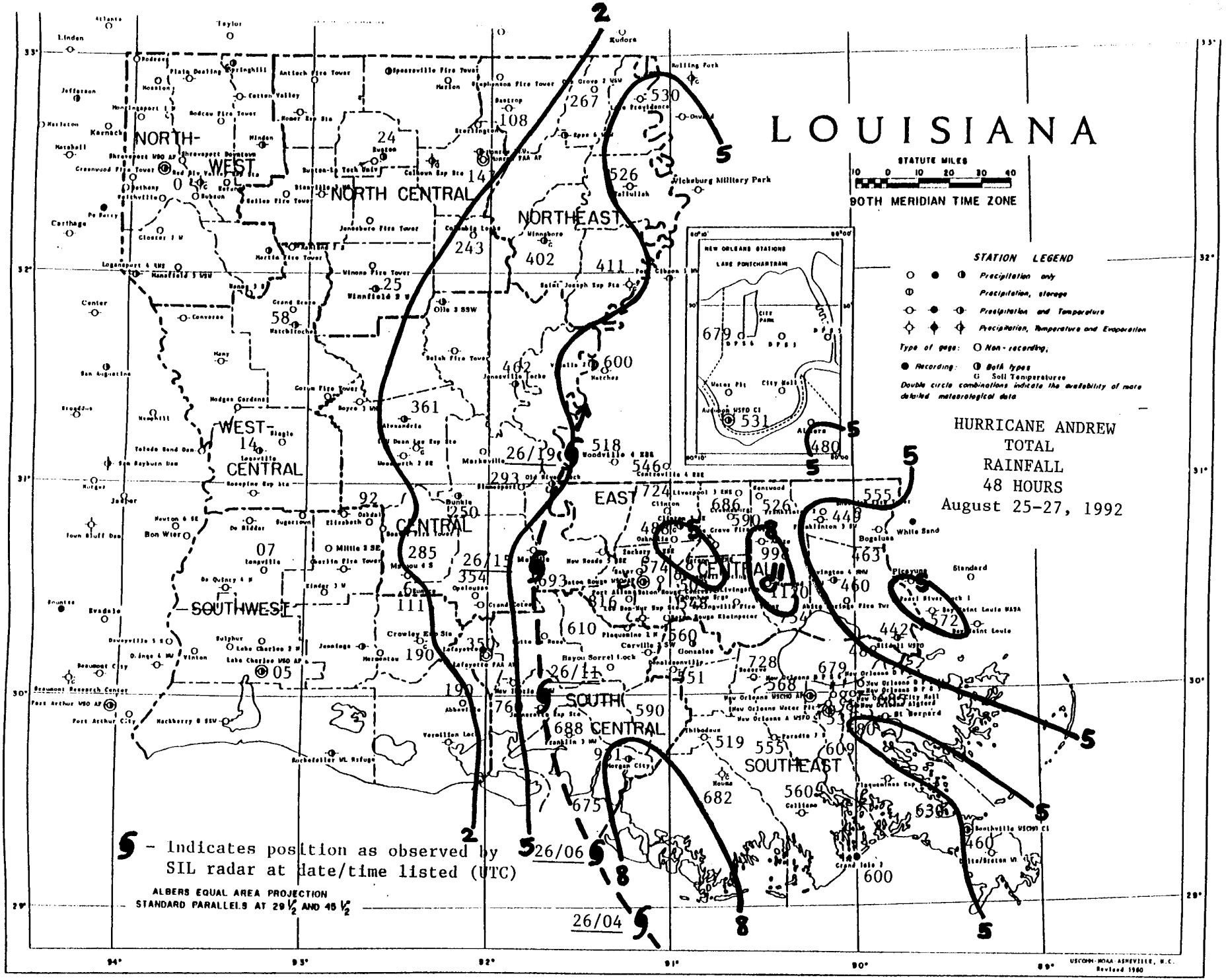
[3] U.S. Army Corps of Engineers, New Orleans District, Report on Hurricane Betsy, November, 1965, pp. 19-20.

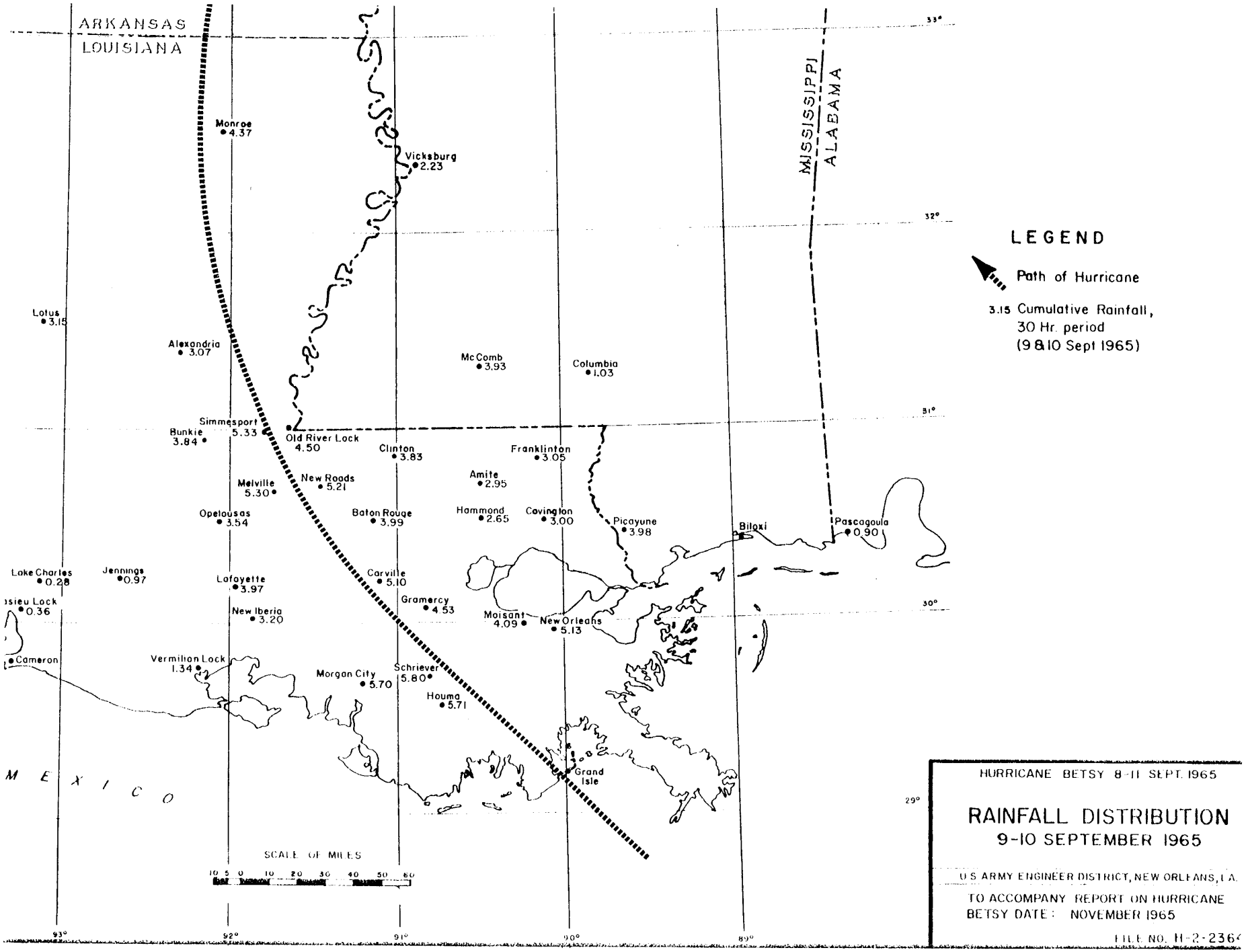
[4] U.S. Army Corps of Engineers, New Orleans District, Report on Hurricane Camille, May, 1970, pp. 52 ff.

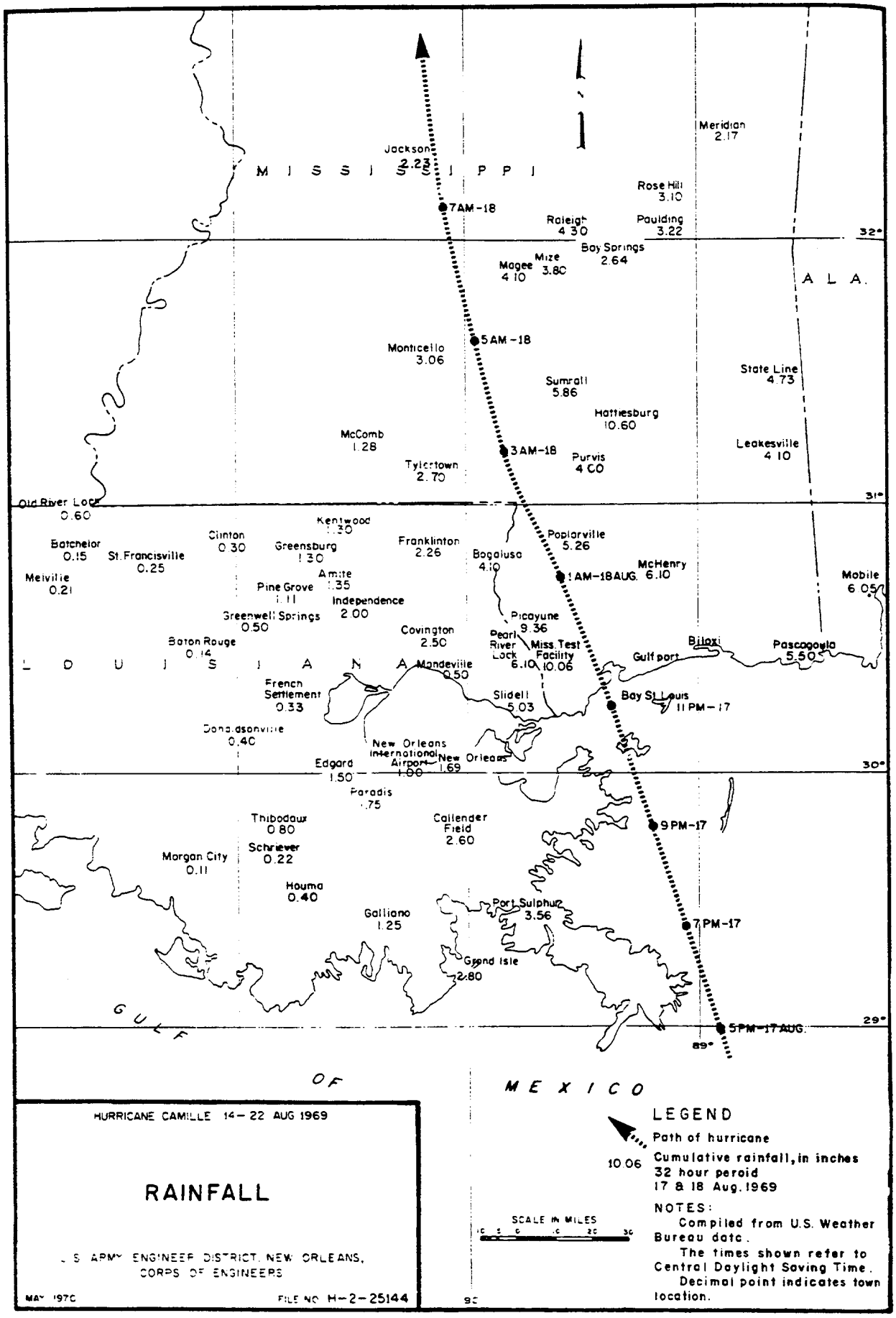
[5] U.S. Dept. of Commerce, NOAA, National Weather Service Forecast Office, New Orleans Area, personal communication on rainfall and radar data, August, 1992.

[6] U.S. Dept. of Commerce, NOAA, National Weather Service Forecast Office, Jackson, MS, personal communication on rainfall and radar data, August, 1992.


MISSISSIPPI
STATUTE MILES
10 0 10 20 30 40
90 TH MERIDIAN TIME ZONE
NORTH
NORTHEAST
UPPER
CENTRAL
DELTA
EAST
LOWER
CENTRAL
CENTRAL
DELTA
SOUTH
SOUTHEAST
SOUTHWEST
CENTRAL
COASTAL
5- INDICATES POSITION OF CENTER AS OBSERVED BY JAN RADAR (date/time UTC)
27/0130
26/21
26/1
HURRICANE ANDREW
TOTAL
RAINFALL
72 HOURS
August 25-28, 1992
STATION LEGEND
Precipitation only
Soil Temperature
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording,
Recording: Both types.
Double circle combinations indicate the availability of more detailed meteorological data.
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29 1/2 AND 45 1/2


LOUISIANA
NORTH-WEST
NORTH CENTRAL
NORTHEAST
WEST-CENTRAL
CENTRAL
EAST
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
STATUTE MILES
10 0 10 20 30 40
90TH MERIDIAN TIME ZONE
STATION LEGEND
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: O Non-recording,
Recording: Both types
G Soil Temperature
Double circle combinations indicate the availability of more detailed meteorological data
HURRICANE ANDREW
TOTAL
RAINFALL
48 HOURS
August 25-27, 1992
5 - Indicates position as observed by SIL radar at date/time listed (UTC)
26/06
26/04
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29 1/2 AND 45 1/2
USCOMM-NOAA-ASHEVILLE, N.C.
Revised 1980


ARKANSAS
LOUISIANA
MISSISSIPPI
ALABAMA
MEXICO
Monroe 4.37
Vicksburg 2.23
Lotus 3.15
Alexandria 3.07
McComb 3.93
Columbia 1.03
Simmesport 5.33
Bunkie 3.84
Old River Lock 4.50
Clinton 3.83
Franklinton 3.05
Amite 2.95
Melville 5.30
New Roads 5.21
Opelousas 3.54
Baton Rouge 3.99
Hammond 2.65
Covington 3.00
Picayune 3.98
Biloxi
Pascagoula 0.90
Lake Charles 0.28
Jennings 0.97
Lafayette 3.97
Carville 5.10
Gramercy 4.53
New Iberia 3.20
Morgan City 5.70
Schriever 5.80
Houma 5.71
Vermilion Lock 1.34
Cameron
Grand Isle
Moisant 4.09
New Orleans 5.13
SCALE OF MILES
10 5 0 10 20 30 40 50 60
93°
92°
91°
90°
89°
33°
32°
31°
30°
29°
LEGEND
Path of Hurricane
3.15 Cumulative Rainfall, 30 Hr. period (9 & 10 Sept 1965)
HURRICANE BETSY 8-11 SEPT. 1965
RAINFALL DISTRIBUTION
9-10 SEPTEMBER 1965
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
TO ACCOMPANY REPORT ON HURRICANE BETSY DATE: NOVEMBER 1965
FILE NO. H-2-2364


M I S S I S S I P P I
A L A.
L O U I S I A N A
G U L F O F M E X I C O
Jackson 2.23
Meridian 2.17
Rose Hill 3.10
Raleigh 4.30
Paulding 3.22
Bay Springs 2.64
Magee 4.10
Mize 3.80
Monticello 3.06
Sumrall 5.86
Hattiesburg 10.60
State Line 4.73
Leakesville 4.10
McComb 1.28
Tylertown 2.70
Purvis 4.00
Old River Lock 0.60
Batchelor 0.15
St. Francisville 0.25
Melville 0.21
Clinton 0.30
Kentwood 1.30
Greensburg 1.30
Franklinton 2.26
Amite 1.35
Pine Grove 1.11
Independence 2.00
Greenwell Springs 0.50
Baton Rouge 0.14
Covington 2.50
Bogalusa 4.10
Poplarville 5.26
McHenry 6.10
Picayune 9.36
Pearl River Lock 6.10
Miss. Test Facility 10.06
Mobile 6.05
Biloxi
Pascagoula 5.50
Gulfport
Mandeville 0.50
French Settlement 0.33
Slidell 5.03
Bay St. Louis
Donaldsonville 0.40
New Orleans International Airport 1.69
New Orleans
Edgard 1.50
Paradis 1.75
Thibodaux 0.80
Callender Field 2.60
Morgan City 0.11
Schriever 0.22
Houma 0.40
Galliano 1.25
Port Sulphur 3.56
Grand Isle 2.80
7AM-18
5AM-18
3AM-18
1AM-18AUG.
11PM-17
9PM-17
7PM-17
5PM-17AUG.
32°
31°
30°
29°
89°
HURRICANE CAMILLE 14-22 AUG 1969
RAINFALL
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, CORPS OF ENGINEERS
MAY 1970
FILE NO H-2-25144
LEGEND
Path of hurricane
10.06 Cumulative rainfall, in inches 32 hour period 17 & 18 Aug. 1969
SCALE IN MILES
NOTES:
Compiled from U.S. Weather Bureau data.
The times shown refer to Central Daylight Saving Time.
Decimal point indicates town location.