AGRICULTURAL EXTENSION SERVICE
Helping people put knowledge to work.

WEATHER WORDS

MONTHLY TOUCH TONE NEWSLETTER

NOVEMBER/OCTOBER 1989

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HUGO WAS THE WEATHER FOCUS OF SEPTEMBER

The weather story of September and perhaps for the year was Hurricane Hugo. This monster from the deep thrashed Puerto Rico and then aimed directly at Charleston, South Carolina. During the last two days of its life Hugo veered very little from its course as it headed straight for the South Carolina coast. Its forward speed increased from 10 to 15 mph to more than 20 mph as it neared the U.S. mainland. Even worse, its strength increased from a mere 90 to 100 mph after it had lost a bit of energy over Puerto Rico to around 135 mph as it hit the low country of South Carolina.

The accompanying map (figure 1) quite clearly illustrates the determination with which Hugo moved west-northwestward from the island of Guadeloupe to the Isle of Palms, SC. Hugo was ferocious over Guadeloupe, lost about one quarter of its strength as it moved over the extreme eastern tip of Puerto Rico, and then regained nearly all of the energy it had lost before striking Charleston. This rebuilding and acceleration the last 36 hours of the storm's life was not totally expected by the

Cooperative Extension Work in Agriculture and Home Economics,
A&T and N.C. State Universities,
100 Counties, and U.S. Department of Agriculture, Cooperating.

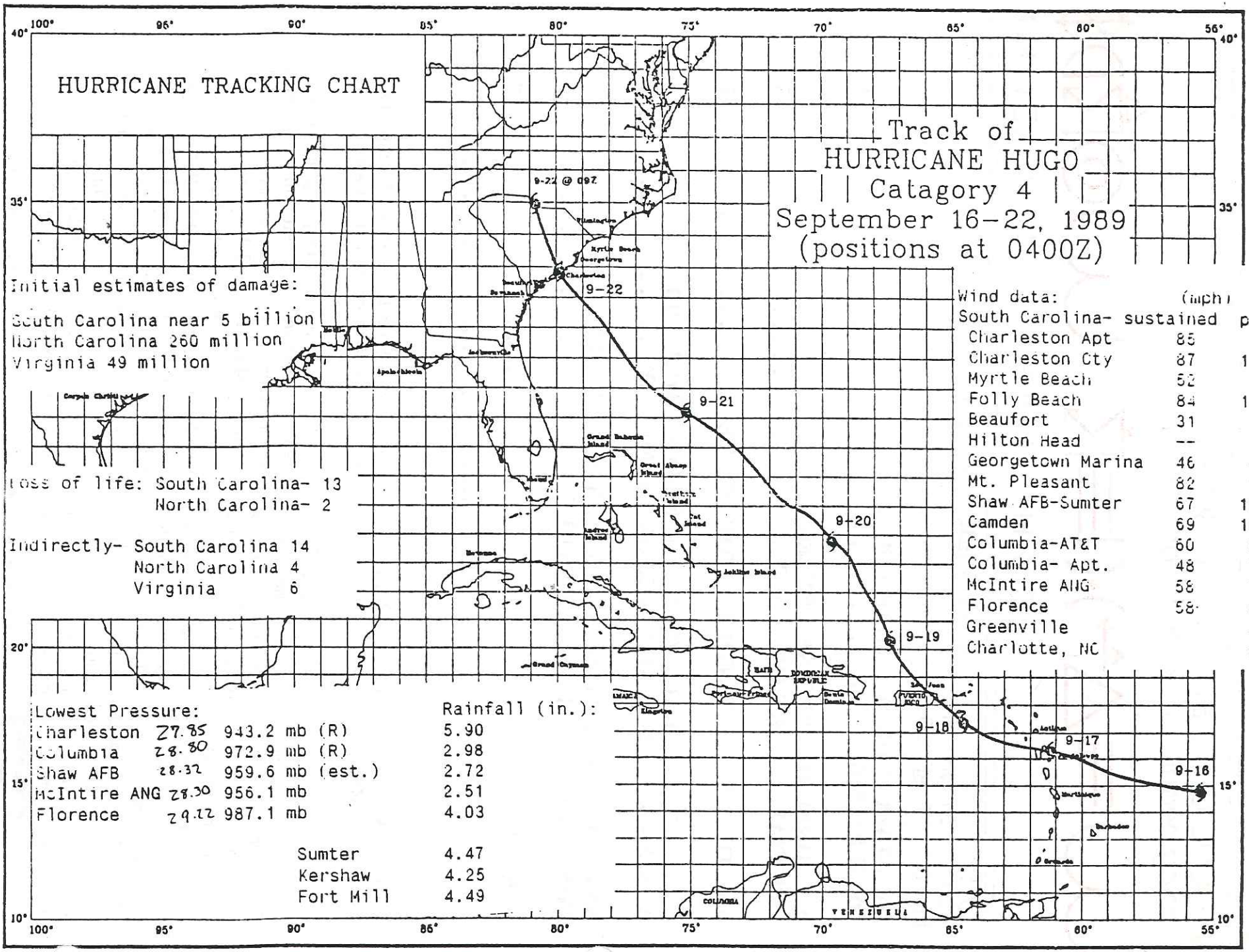

HURRICANE TRACKING CHART
Track of
HURRICANE HUGO
Catagory 4
September 16-22, 1989
(positions at 0400Z)
9-22 @ 09Z
9-22
9-21
9-20
9-19
9-18
9-17
9-16
Initial estimates of damage:
South Carolina near 5 billion
North Carolina 260 million
Virginia 49 million
Loss of life: South Carolina- 13
North Carolina- 2
Indirectly- South Carolina 14
North Carolina 4
Virginia 6
Wind data: (mph)
South Carolina- sustained pea
Charleston Apt 85 9
Charleston Cty 87 10
Myrtle Beach 52 7
Folly Beach 84 10
Beaufort 31 5
Hilton Head -- 4
Georgetown Marina 46 6
Mt. Pleasant 82 9
Shaw AFB-Sumter 67 10
Camden 69 10
Columbia-AT&T 60 9
Columbia- Apt. 48 7
McIntire ANG 58 7
Florence 58 6
Greenville 4
Charlotte, NC 9
Lowest Pressure:
Charleston 27.85 943.2 mb (R)
Columbia 28.80 972.9 mb (R)
Shaw AFB 28.32 959.6 mb (est.)
McIntire ANG 28.30 956.1 mb
Florence 29.12 987.1 mb
Rainfall (in.):
5.90
2.98
2.72
2.51
4.03
Sumter 4.47
Kershaw 4.25
Fort Mill 4.49

Figure 1.

models or the forecasters at the National Hurricane Center. The models did quite a good job of forecasting the storm track. At one point early Thursday, September 22 hurricane warnings were flying from Cape Hatteras to Jacksonville, Florida. Fortunately for coastal residents of North Carolina Hugo stayed south--something which hasn't happened for many years and one of the reasons why some old timers in South Carolina said "it couldn't happen here."

Projections used by governmental planning agencies were estimating that the hurricane would move northward once reaching land, moving from roughly Georgetown SC to Raleigh and then north to Washington, DC. Instead, Hugo maintained the same northwestern path that it had for days as it tore across central South Carolina and took direct aim at Charlotte. The Queen City had winds up to 90 mph, with some stronger gusts in some areas. Destruction was incredible over much of the southwestern Piedmont of North Carolina, with Union, Mecklenburg, Gaston, Lincoln, Cabarrus, Catawba, Alexander, Wilkes and Alleghany counties taking the brunt of the problems. In Wilkes county alone one apple grower lost 4000 trees (not just apples!) as the high winds ripped them up tumbled them down hillsides in a scene reminiscent of a dusty western movie.

The "what could have been" talk was rampant for several days after Hugo as people assessed the potential for disaster, especially in eastern North Carolina. As late as Thursday afternoon before the storm hit there were indications that a northward turn in the hurricane was occurring and that it could hit Myrtle Beach and move directly over the prime agricultural area of the Tar Heel state. Fortunately for these farmers, the storm stayed west. Unfortunately for growers in the western Piedmont, the storm stayed the course and hit their area. Had Hugo hit the Brunswick county area of North Carolina it could have equalled or surpassed the destruction from Hazel. One must also remember that there has been significant development along the coast in the 35 years since Hazel.

Hopefully the lessons of Hugo will serve to remind us of the power of hurricanes and that planning for the future will include building codes and land-use laws which will minimize the destruction that will certainly come from the next hurricane to hit the Carolinas.

NATIONAL HURRICANE CENTER OFFICIAL REPORT ON HUGO

Hurricane Hugo Preliminary Report
Miles Lawrence
National Hurricane Center, NOAA
Coral Gables, Florida
October 27, 1989

Hugo was a classical Cape Verde hurricane that left a path of devastation across the Leeward Islands, the Virgin Islands, Puerto Rico and South and North Carolina.

1. Synoptic history

The origin of Hugo was detected on satellite imagery on 9 September when a cluster of thunderstorms moved off the coast of Africa and the official best track begins on the 10th when a tropical depression formed to the southeast of the Cape Verde Islands. Hugo moved westward at 18 knots across the tropical Atlantic Ocean, becoming a tropical storm on the 11th and a hurricane on the 13th while located about 1100 nautical miles east of the Leeward Islands.

Hugo gradually turned toward the west northwest and showed its forward speed as

it headed for the Leeward Islands in response to low pressure to the north of Puerto Rico which represented a weakness in the westward extension of the subtropical high pressure ridge. Hugo's eye was over Guadeloupe at 0500 UTC on the 17th. Continuing to decelerate and turning toward the northwest, the eye moved over St Croix at 0600 UTC on the 18th with a forward speed of eight knots. The hurricane then began to accelerate its forward speed and the eye moved over the island of Vieques, Puerto Rico, at 1200 UTC and then over the extreme eastern tip of mainland Puerto Rico at 1300 UTC on the 18th.

Early on the 19th, the hurricane was north of Puerto rico and moving toward the north northwest at 12 knots. By this time, the weakness in the subtropical high pressure ridge had diminished and the hurricane's motion was under the influence of the ridge and of an upper-level low pressure system centered over Georgia. Hugo's track curved gently to the northwest over the next few days as the low pressure center moved southwestward and altered the steering flow pattern. By the 21st, Hugo was centered a few hundred miles east of Florida and began a gradual turn and acceleration toward the north in response to the steering flow associated with a major extratropical low that was advancing eastward across the central U.S.

The final landfall was made on the South Carolina coast near Charleston at Sullivans Island at 0400 UTC on the 22nd with the eye moving northwestward at 23 knots. Moving inland and weakening, the center passed between Columbia and Shaw Air Force Base around 0800 UTC. By 1200 UTC, Hugo had weakened to a tropical storm and passed just west of Charlotte, North Carolina, to near Hickory.

The storm moved northward across extreme western virginia, West Virginia, eastern Ohio and to near Erie, Pennsylvania by 0000 UTC on the 23rd and transformed into an extratropical storm. The storm was tracked for two more days as it moved northeastward across eastern Canada and into the far north Atlantic Ocean.

2. Meteorological statistics

Figures 2 and 3 show the curves of maximum one-minute wind speed and minimum central pressure, respectively, versus time, along with the plot of the satellite, aircraft reconnaissance and surface data used to construct these curves. Table 1 lists a selection of the relevant surface observations.

Both Air Force and NOAA aircraft participated in the reconnaissance of this hurricane. The first aircraft reached the hurricane on 15th, several hundred miles east of the Leeward Islands and reported a central pressure of 918 millibars, a wind speed of 165 knots at an altitude of 1500 feet and a surface wind speed of 140 knots. This turned out to be Hugo's maximum intensity. During the following seven days, there were 76 aircraft penetrations of the eye of the hurricane, for an average of one center fix every 2 hours.

On the 17th, just before Hugo's eye passed over Guadeloupe, an aircraft reported 135 knots at 700 millibars. A surface pressure of 941.4 millibars has since been reported from Guadeloupe. It is estimated that the hurricane's maximum one-minute surface wind had decreased to 120 knots at this time. A report of 40 knots with a gust to 68 knots has been received from St. Maarten and the center passed about 75 nautical miles to the southwest of this island. The maximum surface wind was again estimated at 120 knots when the eye passed over St Croix at 0600 UTC on the 18th.

When the eye passed over the island of Vieques, Puerto Rico, it is estimated that the maximum one-minute wind speed had decreased to 110 knots. On the island of

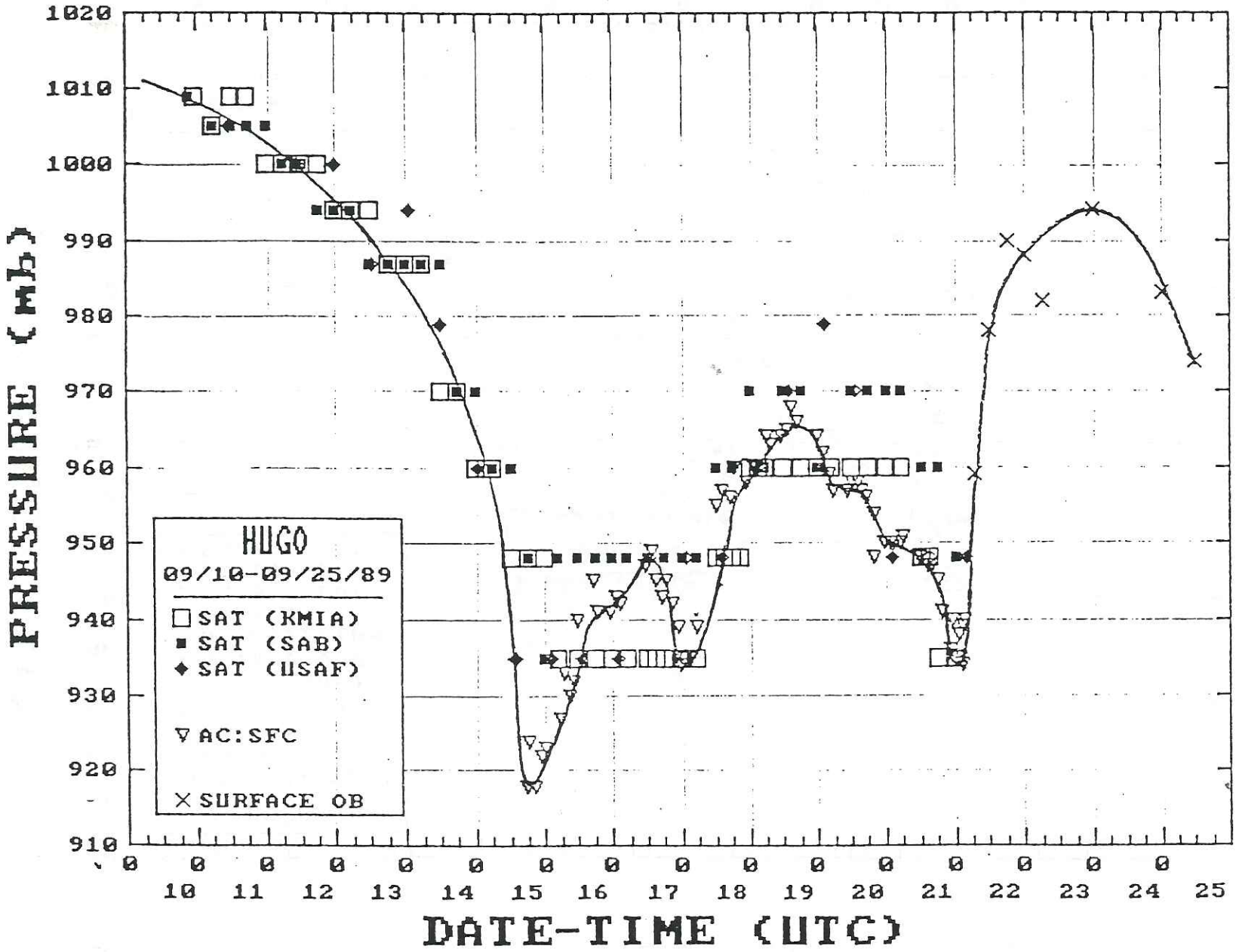
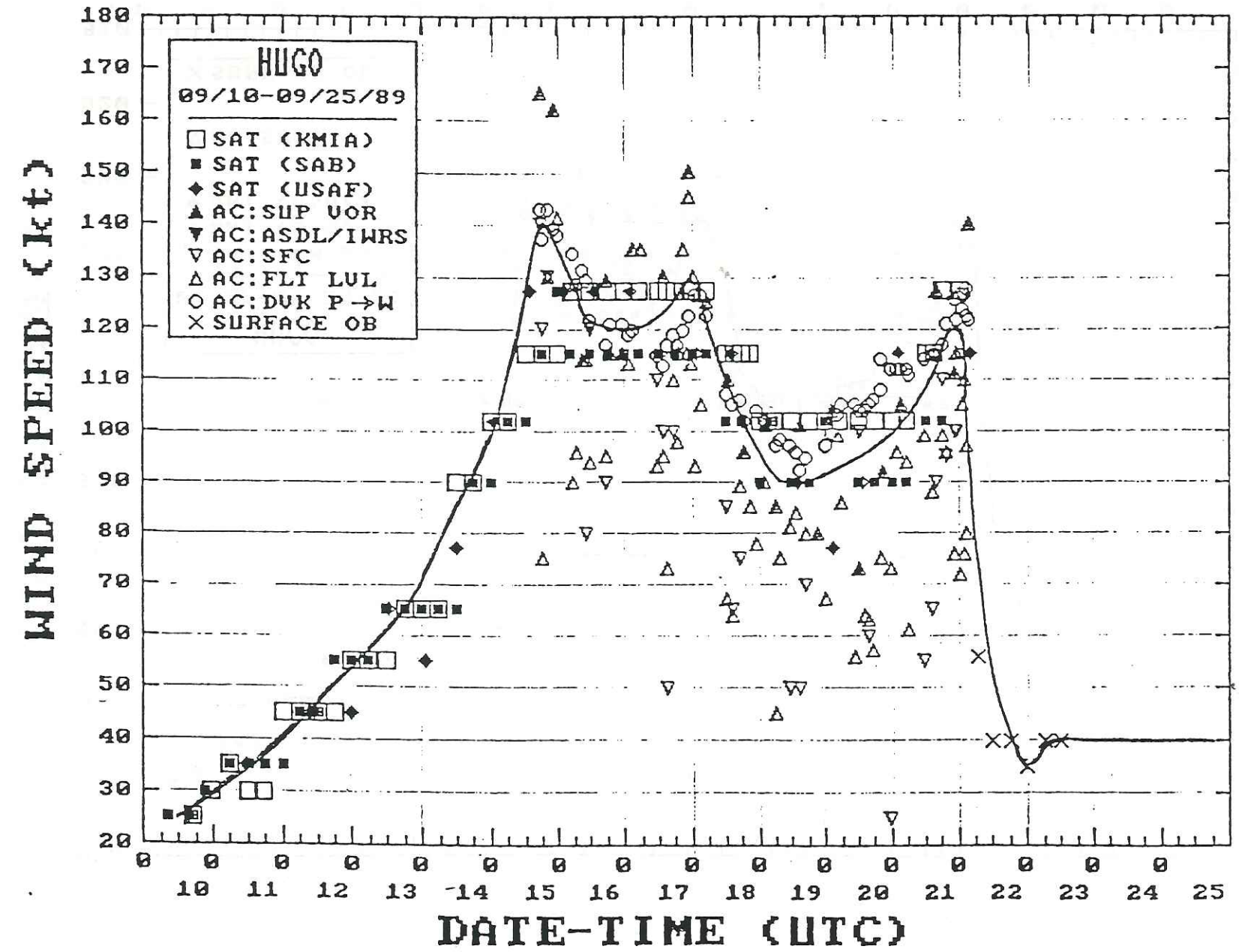


Figure 2. Best track minimum-central-pressure-versus-time curve for Hugo, September 1989.

Figure 3. Best track maximum-sustained-wind-versus-time curve for Hugo, September 1989



Culebra, just north of Vieques, an anemometer reading of a gust to 148 knots was reported from the ship Night Cap located in the harbor there. Maximum wind speeds were also estimated at 110 knots one hour later when the eye passed over the eastern tip of Puerto Rico. However, the highest recorded wind speed over land was 90- knots with a gust to 104 knots at Roosevelt Roads. The highest winds reported at San Juan International Airport were 67 knots with a gust to 80 knots. Rainfall totals ranged up to a maximum of 9.20 inches at Gurabo in the eastern interior of Puerto Rico. The lowest surface pressure reading from Puerto Rico was 946.1 millibars at Roosevelt Roads.

There are no storm surge observations available from the Caribbean at this time. However, the SLOSH storm surge model calculations, based on Hugo's track, indicate that water levels of three to four feet above normal tide levels occurred during the period of onshore winds at St Croix and along the eastern end of Puerto Rico and water levels of two to three feet above normal occurred along the north coast of Puerto Rico.

As Hugo moved away from Puerto Rico and headed for the southeastern U.S., its central pressure rose to 966 millibars on the 19th and the maximum winds decreased to 90 knots. Then, during the final 30 hours before landfall near Charleston, Hugo began to reintensify. Just before landfall, a reconnaissance measurement of 934 millibars and 140-knot winds at an altitude of 12000 feet are the basis of the estimate of the highest one-minute wind speed of 120 knots at landfall.

A report of 76 knots with a gust to 94 knots was received from downtown Charleston. The National Weather Service office at the Charleston airport measured 689 knots with a gust to 85 knots. A report of 74 knots with a gust to 93 knots was received from Folly Beach. A hurricane-chaser from Miami, Jim Leonard, measured 936.5 millibars with a portable barometer on the Savannah Highway just west of Charleston. A report of 933 millibars from Mt. Pleasant is unofficial. No wind observations are available from near Bulls Bay where the maximum one-minute winds of 120 knots are estimated to have occurred. The ship Snow Goose was anchored in the Sampit river five miles west of Georgetown and measured a pressure of 984.5 millibars and sustained winds of 104 knots from a three-cup Tradewind anemometer located on the ship's mast at 61-feet elevation.

Hugo was still estimated to be of hurricane strength when its center passed just west of Shaw Air Force Base where 58 knots with gusts to 61 knots. In North Carolina, 60-knots winds with gusts to 86 knots were reported from Charlotte as the center went by and Hickory had a gust to 70 knots. Sustained wind speeds in the 30 to 40 knot range were reported along and east of the weakening storm's path as it moved northward to Canada.

Few direct tide gage measurements of the storm surge water levels have been received. The tide station in Charleston near the Custom House measured a water level of 12.9 feet above mean lower low water which converts to a storm tide of 10.4 feet above mean sea level or a storm surge of 8.0 feet above the predicted normal astronomical tide height. As far north as Hatteras, North Carolina, the storm surge was reported at 4 feet above the predicted tide. In addition, a considerable number of high water marks gathered by survey teams indicate that the storm tide was 10 to 12 feet above mean sea level at Folly Beach and ranged to near 20 feet at Bulls Bay...13 to 16 feet at McClellanville...13 feet at Myrtle Beach...and to 8 to 10 feet at Holden Beach, North Carolina.

Rainfall totals along the southeast U.S. coast ranged from a trace at Jacksonville to 6.10 inches at Savannah to a maximum of 8.10 inches at Mt. Pleasant near Charleston to 2.30 inches at Myrtle Beach to 0.58 inches at Hatteras. A 150-mile wide swath of three to eight inches of rain spread inland across South Carolina. The swath continued over western North Carolina with a maximum of 6.91 inches reported at Boone. Rainfall totals were in the two- to four-inch range across western Virginia, West Virginia, western Pennsylvania, eastern Ohio and western New York.

3. Casualty and damage statistics

The total number of deaths associated with Hugo is currently estimated at 82 as follows:

South Carolina	27
North Carolina	7
Virginia	6
New York	1
Puerto Rico	12
U.S. Virgin Islands	6
Antigua and Barbuda	1
Guadeloupe	11
Montserrat	10
St. Kitts and Nevis	1

The South Carolina death figures were provided by the State Climatologist of South Carolina and the remainder of the death figures were taken from the October 1st issue of "The State" newspaper, Columbia, South Carolina.

Damage figures are astronomical and Hugo is the costliest hurricane in U.S. history. The American Insurance Association reports 3.042 billion dollars as the preliminary estimate of insured property damage for the U.S. mainland, and 1.881 billion dollars for Puerto Rico and the U.S. Virgin Islands and these numbers are subject to upward revision. The Federal Emergency Management Agency estimate of money outlay is currently at .208 billion dollars for the U.S. mainland and .731 billion dollars for Puerto rico and the U.S. Virgin Islands and is also subject to upward revision. "The State" newspaper mentioned above reports a dollar damage estimate totalling 7.071 billion dollars for the U.S. mainland, 1.600 billion dollars for other islands in the Caribbean, including Antigua and Barbuda, the British Virgin Islands, Guadeloupe, Montserrat and St. Kitts and Nevis. Hurricane damage estimates for past storms have often been two to three times the insured property damage and it is possible that Hugo's international damage total will exceed ten billion dollars.

Meanwhile, for those requiring a number, the damage estimate is temporarily placed at seven billion dollars for the U.S. mainland and two billion dollars for Puerto Rico and the Virgin Islands and one half billion dollars for the other island countries in the Caribbean. These estimates are believed to be accurate within about plus or minus 40 percent.

4. Forecast and warning critique

Table 2 lists the average official track forecast errors along with the errors of several guidance models. The official errors are quite small for Hurricane Hugo. For example, the 24-hour average forecast error of 65 nautical miles during Hugo compares with the previous ten-year average official error of 111 nautical miles and the 72-hour Hugo error of 154 nautical miles compares with the previous ten-year average of 342 nautical miles. It is also noted that some of the guidance models also had very small errors.

There was a left bias to the official forecasts for the period when Hugo was turning from west northwestward to northwestward. This was as Hugo was moving across the islands of the Caribbean

TABLE 1. Hurricane Hugo selected surface observations September 1989.

Location	Minimum sea-level pressure		Maximum surface wind speed (knots)			Storm surge (tide height above normal) (ft)	Rain (storm total) (in)
	Pressure (mb)	Date/time (UTC)	1-minute average	Peak gust	Date/time (UTC)*		
Guadeloupe	941.1						
St. Maarten							
Juliana Airport			40	68	18/0200		
Puerto Rico							
Gurabo							9.20
Isla de Culebra				148			
Isla Verde	970.3	18/1415					
Luquillo	956	18/1300					
Roosevelt Roads	946.1	18/1250	90	104	18/1158		
San Juan	970.3	18/1444	67	80	18/1350		3
Florida							
Jacksonville	1003.5	22/0200	18	22	21/2035		T
St. Augustine			14	26	21/1900		
Georgia							
Fort Pulaski						1.4	
St. Simons Island			20	40	22/0100		
Savannah Light Tower	989.6	22/0300	50	59	22/0400		
Savannah WSO	993.5	22/0353	30	47	22/0553		6.10
South Carolina							
Beaufort	984	22/0455	27	44	22/0700		5.94
Charleston AFB	943.2	22/0423					
Cahrleston city			76	94	22/0340	8.0	6.37
Charleston Pier P	942						
Charleston WSO	942.1	22/04??	68	85	22/0503		5.90

TABLE 1.(cont.) Hurricane Hugo selected surface observations September 1989.

Location	Minimum sea-level pressure		Maximum surface wind speed (knots)			Storm surge (tide height above normal) (ft)	Rain (storm total) (in)
	Pressure (mb)	Date/time (UTC)	1-minute average	Peak gust	Date/time (UTC)*		
South Carolina							
Charleston							
Savannah hwy	936.5	22/0405					
Columbia AT&T	971.7	22/0800		86	22/0654		
Columbia WSFO			46	61	22/0609		
Florence	989.1	22/0750	39	54	22/0547		
Folly Beach C-MAN	940	22/0400	74	93	22/0400		
Georgetown EOC			69		22/0300		3.74
Mt. Pleasant	933	22/0405	71	83	22/0345		8.10
Myrtle Beach AFB	993.5	22/0455	45	66	22/0555		2.30
Sampit River	984.5	22/0442	104				
Shaw AFB	959.6	22/0655	58	95	22/0655		
Summerville							5.98
North Carolina							
Asheville	989.9	22/1150	20	32	22/1050		1.93
Boone							6.91
Cape Fear River				61	22/0545		
Carolina Beach						3(est.)	
Charlotte	978.0	22/0945	60	86	22/1003		3.16
Greensboro	998.1	22/1153	37	47	22/1108		1.43
Hatteras	1013.1	22/0730	23	30	22/0050	4	0.60
Hickory	980.5		30	70	22/1046		
Holden Beach				51	22/0555	6(est.)	
Ocean Isle						7(est.)	
Raleigh	1004.6	22/0930	25	40	22/1050		0.45
Wilmington	1004.5	22/0500	26	46	22/0452		0.79
Virginia							
Norfolk	1008.8	22/1950	23	32	22/2050	0.2	0.21

*Time of 1-minute wind speed unless only gust is given.

Table 2. Hurricane Hugo average track forecast errors (nautical miles), non-homogeneous sample.

	forecast period (hours)					
model	0	12	24	36	48	72
Official	10	33	65	98	122	154
(no. of cases)	(43)	(43)	(41)	(39)	(37)	(33)
BAM	51	50	84	123	154	268
	(17)	(17)	(16)	(15)	(14)	(13)
CLIPER	10	37	73	119	161	216
	(43)	(43)	(41)	(39)	(37)	(33)
NHC83	12	38	61	88	106	178
	(42)	(42)	(40)	(38)	(36)	(32)
QLM	7	81	90	119	172	268
	(19)	(19)	(18)	(17)	(16)	(14)
SANBAR	8	28	55	92	141	302
	(15)	(15)	(15)	(14)	(13)	(11)

and for the following two days and this is a normal bias for National Hurricane Center track forecasts in this area during recurvature situations. Also, there was a slight right bias for two forecasts on the 21st just before landfall, indicating that the track would be across eastern North Carolina and requiring a last-minute northward extension to the hurricane warning which, using hindsight, turned out to be unnecessary.

Looking over the public advisories, it is noted that from 2200 UTC on the 20th to 2200 UTC on the 21st, the highest sustained winds increased from 105 mph to 135 mph. During this same period, the wind forecast contained in all of the public advisories was "little significant change in strength is likely". It is important for users of National Hurricane Center products to appreciate the limitations in tropical cyclone intensity forecasting, as here is a situation where a tropical cyclone goes from a category two to 30 hours prior to landfall. Fortunately, in this case, the response of state and local officials and of the general public of South Carolina was excellent. A massive evacuation of the coastal barrier islands was 90 percent complete several hours before landfall and this allowed a margin of safety which accommodated the increase in strength described above.

ANOTHER WET MONTH FOR THE STATE

by Jeff Vukovich

The month of October brought above average rainfall to most areas of the Tarheel state. Farmers received generous amounts of rain in the first week of the month with about every station reporting over an inch of precipitation. In a two day span, some parts of the southern mountains reported up to 6 inches of rain. Indeed, too much water was a problem for the coastal areas where 3 to 5 inches of precipitation caused some sweet potato damage.

Growers had plenty of time to resume harvesting activities the next week beginning Oct. 7. The week was generally dry, except for the southeast where some parts reported up to a half inch of rain. With the fair weather, most farmers were able to continue harvesting corn, cotton, and other crops. It was also an excellent week to prepare land for small grain seeding.

A strong upper level low just to the east of the Carolinas brought more wet weather to the state for three straight days. In the period of October 17-19, the coastal plain and mountains received two to five inches of precipitation. Very humid and warm air remained over the state with high temperatures climbing into the 80s. However, temperatures fell quickly with the passage of a cold front on October 19 as low temperatures dropped into the 20s in the mountains and 30s elsewhere. Frost was not a problem for growers except in the mountains and some areas in the northern foothills.

Slightly above normal temperatures and above average rainfall were the common at stations for the month. North Carolina farmers had an average of 19 days suitable for fieldwork during the month. At the end of the month, 72% of the sweet potatoes, 95% of the peanuts, and 10% of the soybeans had been harvested.

Some of the other highlights of the month included two inches of snow at Grandfather Mountain on October 20 where the high temperature on that day was 21 degrees! The highest temperature reading of the month was 88 at Wilmington and Laurinburg. The coldest spot was Mount Mitchell at 15 degrees! In the southern

mountains, Highlands reported over 10 inches of rain for the month, including 6 inches in one week. The Coastal Plain had 3 to 8 inches of precipitation and the Piedmont 3 to 6 inches.

The extended outlook for November calls for slightly above normal rainfall and near normal temperatures.

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NC Agricultural Extension Service
Weather Analysis System
Main Report Summary

October 1-31, 1989

Station Name (# reports)	Month Pcpn	Depart from Normal	Month Pcpn	Hi Soil	Low Soil	Evap.	Avg Temp	Max Temp	Min Temp	GDD Base1	GDD Base2	GDD Base1	GDD Base2
** ASHEVILLE	4.37	1.64	4.37	31			56	82	27	209		209	
** AURORA	3.11		3.11	30		2.7	64	85	37	427	127	427	127
** BLACK MTN.	2.00	-0.87	2.00	23			56	82	29	159		159	
** BOONE	2.40	-1.50	2.40	25			55	76	28	144		144	
* BREVARD	4.85	1.05	4.85	24			57	83	29	173		173	
** BRYSON CITY	1.36		1.36	24			55	83		128		128	
** BURGAW	1.24		1.24	23			66	87	42	378	148	378	148
** BURLINGTON	1.37	-1.07	1.37	24			60	87	25	247	7	247	7
** BURNSVILLE	1.64		1.64	23			55	81	27	122		122	
** CANTON	1.99	-0.55	1.99	31			53	79		111		111	
** CAPE HATTERAS	8.28	3.32	8.28	31			66	83	48	524	214	524	214
** CARTHAGE	0.67	-2.00	0.67	27			65	88	34	420	150	420	150
** CASTLE HAYNE	2.01		2.01	25			64	84	41	349	99	349	99
** CHAPEL HILL	1.10	-1.27	1.10	24		2.7	59	86	32	229		229	
** CHARLOTTE	4.13	1.40	4.13	31			63	86	34	429	119	429	119
** CHERRY POINT	2.12		2.12	26			68	88	42	470	210	470	210
** CLINTON	2.89		2.89	30			61	87	31	349	49	349	49

Station Name (# reports)	Month Pcpn	Depart from Normal	Month Pcpn	Hi Soil	Low Soil	Evap.	Avg Temp	Max Temp	Min Temp	GDD Base1	GDD Base2	GDD Base1	GDD Base2
** CONCORD AG (25)	5.23	2.45	5.23				58	88	27	208		208	
** CORE POINT (28)	3.68		3.68				65	83	41	431	151	431	151
** CULLOWHEE (24)	1.50	-0.90	1.50				59	80	31	216		216	
** EDENTON (24)	0.88	-1.78	0.88				63	85	39	323	83	323	83
** ELIZABETH CITY AG (31)	4.01	0.10	4.01				62	84	35	389	79	389	79
** ELIZABETHTOWN (30)	5.23	2.44	5.23				63	85	35	389	89	389	89
** ELLERBE (24)	0.55		0.55	76	63		64	86	30	337	97	337	97
** ERWIN (23)	0.07		0.07				62	85	36	280	50	280	50
** FAYETTEVILLE (31)	2.41	-0.34	2.41				60	87		327	17	327	17
** FLATTOP (11)	3.21		3.21	55	50		56	71	34	74		74	
** FOREST CITY (23)	3.58		3.58	65	62		63	85	33	300	70	300	70
** FRANKLIN (31)	2.69	-0.59	2.69				57	81	25	244		244	
** GATESVILLE (20)	1.78		1.78				60	80	32	202	2	202	2
** GOLDSBORO (26)	1.48	-0.91	1.48				63	84		344	84	344	84
** GOLDSBORO AG (23)	0.73		0.73				62	86	34	282	52	282	52
** GRANDFATHER MTN (25)	2.32		2.32				51	70	28	44		44	
** GREENSBORO (31)	5.02	1.85	5.02				59	84	33	307		307	
** GREENVILLE (24)	1.20	-1.08	1.20				62	86	36	301	61	301	61
** GUM NECK (23)	3.29		3.29	72	59		65	86	40	348	118	348	118
** HALIFAX (25)	0.10		0.10				61	86	32	288	38	288	38
** HAYESVILLE (23)	0.98		0.98	68	56		60	86	30	232	2	232	2
** HENDERSONVILLE (25)	3.90	0.52	3.90				59	84	33	227		227	
** HENDERSONVILLE AG (18)	0.00		0.00				56	84	30	118		118	
** HICKORY (30)	5.06	1.76	5.06				60	85	34	322	22	322	22

Station Name (# reports)	Month Pcpn	Depart from Normal	Month Pcpn	Hi Soil	Low Soil	Evap.	Avg Temp	Max Temp	Min Temp	GDD Base1	GDD Base2	GDD Base1	GDD Base2
** HIGHLANDS (31)	10.15	4.60	10.15				52	80	22	70		70	
** JACKSON SPRINGS (31)	5.16	1.93	5.16				60	86	32	337	27	337	27
** JACKSONVILLE (25)	1.70		1.70				65	87	38	396	146	396	146
** KERR SCOTT (31)	4.01		4.01				58	88	32	259		259	
** KING (16)	1.72		1.72				58	85	31	143		143	
** LAURINBURG (30)	3.61	0.73	3.61				62	88	31	375	75	375	75
** LENOIR (25)	3.50	0.45	3.50				60	87	33	262	12	262	12
** LEXINGTON (14)	0.02	-1.40	0.02				60	88	32	143	3	143	3
** LINCOLNTON (13)	2.41	1.13	2.41										
** LINCOLNTON AG (21)	0.26	-1.79	0.26				60	83		210		210	
** LOUISBURG (22)	0.92	-1.39	0.92				52	84	21	55		55	
** LUMBERTON (18)	3.16	1.48	3.16			2.7	60	87	29	192	12	192	12
** MARION (23)	4.14	0.66	4.14				61	87	32	266	36	266	36
** MARSHALL (24)	0.84	-1.00	0.84				45	79					
** MARTINSVILLE VA (25)	2.22		2.22				58	87	30	216		216	
** MCLEANSVILLE (23)	1.58		1.58				64	86	35	254	74	254	74
** MILWAUKEE (25)	1.95		1.95				60	80	36	254	4	254	4
** MOCKSVILLE (23)	1.65		1.65				61	86	33	272	42	272	42
** MORGANTON (23)	1.61	-1.21	1.61				58	84		195		195	
** MORGANTON AG (22)	2.49	-0.21	2.49				60	92	31	222	2	222	2
** MOUNT AIRY (31)	4.41	1.06	4.41				58	85	30	276		276	
** MT. LECONTE (20)	0.70		0.70				47	67	28				
** MT. MITCHELL (24)	5.25		5.25				40	67					
** MT. PISGAH (24)	3.57		3.57				48	65	25				

Station Name (# reports)	Month Pcpn	Depart from Normal	Month Pcpn	Hi Soil	Low Soil	Evap.	Avg Temp	Max Temp	Min Temp	GDD Base1	GDD Base2	GDD Base1	GDD Base2
** MURPHY				31									
	3.46	0.60	3.46				57	83	25	234		234	
** NASHVILLE AG				11									
	1.75	0.70	1.75	66	60		58	86	33	92		92	
** NEW BERN				31									
	5.89	2.51	5.89				65	86	35	469	159	469	159
** NEWFOUND GAP				22									
	1.10		1.10				54	73	28	92		92	
** OCONALUFTEE				22									
	0.30		0.30				51	83		27		27	
** PITTSBORO				8									
	0.84		0.84				56	80	28	52		52	
** PROSPECT HILL				20									
	2.44		2.44				56	83	30	135		135	
** RAEFORD				26									
	3.57		3.57				64	86	34	370	110	370	110
** RALEIGH-DURHAM				31									
	3.87	0.98	3.87				61	86	33	360	50	360	50
** RANDLEMAN				21									
	4.08	2.08	4.08				59	83	31	189		189	
** REIDSVILLE				29									
	5.14	1.80	5.14				59	84	34	261		261	
** ROANOKE RAPIDS				31									
	4.00		4.00				59	85	36	307		307	
** ROBBINSVILLE				23									
	1.29		1.29				57	80	30	161		161	
** ROSMAN(DOD)				25									
	5.80	1.00	5.80				55	80	26	139		139	
** ROXBORO				31									
	4.69	1.46	4.69				58	86	31	254		254	
** SHALLOTTE				31									
	3.99		3.99				65	85	35	492	172	492	172
** SHELBY				25									
	4.51	1.81	4.51				61	84	37	297	47	297	47
** SILER CITY				31									
	5.71	2.36	5.71				59	84	32	281		281	
** SMITHFIELD				30									
	5.87	2.81	5.87				59	85	32	289		289	
** SNOW CAMP				25									
	2.97		2.97				62	88	32	323	73	323	73
** SPARTA				7									
	0.00	-0.93	0.00				54	75	26	32		32	
** SPRUCE PINE				23									
	3.14		3.14				56	79	32	145		145	
** STATESVILLE				31									
	6.04	2.87	6.04				58	86		257		257	
** TARBORO				22									
	0.76	-1.46	0.76				61	86	33	256	36	256	36

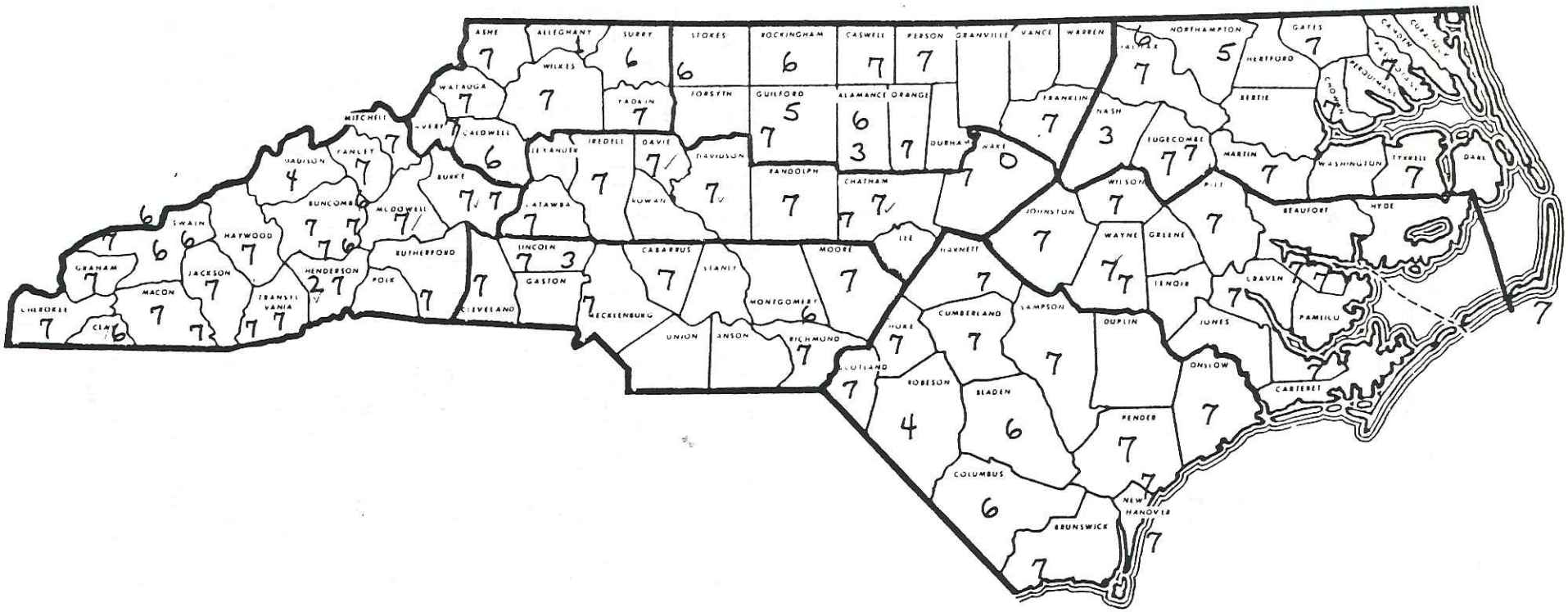
Station Name (# reports)	Month Pcpn	Depart from Normal	Month Pcpn	Hi Soil	Low Soil	Evap.	Avg Temp	Max Temp	Min Temp	GDD Base1	GDD Base2	GDD Base1	GDD Base2
** TARBORO AG (17)	3.06	1.34	3.06				62	88	35	218	48	218	48
** VOLENS VA (23)	1.58		1.58										
** WAKE FOREST (10)	1.04		1.04				62	85	37	127	27	127	27
** WAYNESVILLE (24)	1.25	-0.91	1.25				57	80	30	180		180	
** WEST JEFFERSON (31)	3.97	0.15	3.97				50	77	22	21		21	
** WHITEVILLE (26)	0.13		0.13				62	86	33	315	55	315	55
** WILLIAMSTON (22)	0.58	-1.84	0.58				61	85	41	261	41	261	41
** WILMINGTON (31)	4.49	1.51	4.49				66	88	38	510	200	510	200
** WILSON (31)	5.16	2.49	5.16				60	87	28	319	9	319	9
** YADKINVILLE (25)	3.12		3.12	72	56		61	86	32	281	31	281	31

NOTE: Short term and seasonal precipitation and growing degree days are equal here because starting and ending dates are the same (10/1 and 10/31). Growing degree days are at base 50 (base 1) and base 60 (base 2). Evaporation is total for the period, in inches. Soil temperatures are measured at four inches under bare cover (data was available but calculations were in error for the Elizabeth City and Shallotte stations). Ag. suffix after some station names is used for distinguishing touch tone location from a nearby Weather Service station with the same city name. The number following the station name is the number of reports in the computer out of a total possible of 31 for October. Many stations were less than this due to a failure of the computer in the Ag. Weather Office during the third week of October. For this reason, most rainfall totals are short by 1 to 1.5 inches if less than 31 reports are shown. The touch tone computer at the Weather Service office at Raleigh-Durham has functioned with no significant downtime in the past two months.

NEW DATABASE WORKING WELL; TOUCH TONE CONTINUES TO FLOW SMOOTHLY

The table above was prepared using our new weather analysis system, which is being fine-tuned by our capable programmer John Smith. As you can see, the ability to extract limitless summaries of weather data is here. In addition to the typical temperature and rainfall data there are evaporation, soil temperature and growing degree day data. In the next few months programming will be completed on soil moisture and chilling hour models.

There have been almost no problems with touch tone since it was started nearly one year ago. The present network of stations covers the entire state and includes nearly all counties. The accompanying map shows the number of reports received during the period from September 24 to 30. Note that most observers got all 7 reports in. Those who got in less than 7 may have called in the missing days after this summary was run on the computer.



Number of reports received during week of September 24-30, 1989 (7 possible)

Agricultural Weather Program/National Weather Service Cooperative Program

Observers will receive new reporting forms with this issue. If for some reason we missed you please contact us at the Agricultural Weather Program, Box 7609, NCSU, Raleigh, NC 27695-7609.

SEE YOU IN MAY!

As many of you are probably already aware I am going on a five month study leave starting December 1. I will be using the time to do research for my PhD dissertation. Under the supervision of Dr. Jerry Davis of Marine, Earth and Atmospheric Sciences I will be examining the effect of urbanization on the global temperature record. We have received funding from NASA over a three year period to determine if, in fact, the earth has already shown any appreciable warming due to "greenhouse gases" or if the measured warming is due principally to the buildup of the urban heat island in the vicinity of many of the climatological observing sites around the globe. I will be in Raleigh in the new National Resources building, but I leave no forwarding number!

Actually, I leave in you very capable hands. For routine ag. meteorology questions please direct them to Katie. While I am gone many of our agricultural weather advisories will be written by Jeff Vukovich, a senior in meteorology here at NCSU. Jeff will also author a somewhat-condensed version of Weather Words each month. He will provide a summary of weather data, similar to what you see in this issue, along with a written summary of the previous month. Jeff can be reached at our regular number, 919-737-3537. If you have trouble with equipment or the touch tone system contact Katie or Jeff.

Since I won't be writing to you for the next several months let me say happy holidays and happy New Year now. Think of this as your first Christmas card!

Meteorologically yours,

Greg Johnson

Greg Johnson
Extension Specialist
Agricultural Meteorology

AGRICULTURAL EXTENSION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
NORTH CAROLINA STATE UNIVERSITY
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