OUTLOOK FOR PRECIPITATION IN GEORGIA

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ABSTRACT: Outlooks for climate changes in the next few decades must take into account all historic evidence for climatic changes in the past. Wet-dry periods are historic facts and evidence of cyclic periods is abundant. Thus, a century or more of historic patterns become precursors for patterns that project trends for several decades -- not precisely but generally.

Weather and climate in Georgia are governed primarily by two airmass systems: 1) the semi-permanent, Azores, high-pressure system affects Georgia's Coastal Plain area most directly, and 2) the continental polar airmasses affect the Southern Appalachian mountains. These airmasses cause droughts; they sometimes confront each other over Georgia as stationary frontal systems that cause much wet weather.

Dry weather statewide occurred periodically at intervals of 7-yr, 9-yr, 11-yr, and others. Each cyclic pattern overlays the others.

Possible outlooks for rainfall from the comparatively dry decade of the 1980's are: 1) an up-trend that brings more precipitation, 2) a down-trend into yet drier weather, and 3) an extension, or continuation, of the relatively dry weather of the 1980s. History indicates that an up-trend in precipitation from 1986 until 1990 to 1993 is a reasonable expectation; but that trend was modified in June 1988, perhaps temporarily. Another series of dry weather periodically is expected from about 1994 through 1999. Two major dry-weather periods, similar to the decades of the 1930s, '50s and '80s, are expected about 2010-2015 throughout southeastern U.S. The outlook is bleak for the kind of wet-weather periods that occurred in the 1940's, '60s, and early '70s.

(KEY TERMS: droughts, dry weather, climate, cycles, southeastern U.S., weather)

INTRODUCTION

Cyclic periods of wet-dry weather have long histories (Shaw, 1942). Abbe pointed out in 1901 that applications of cycles were frustrated by lack of knowledge and insufficient information. Yet, history reveals that dry weather and droughts were forecast in some of the very earliest records of mankind. Progress was made in drought forecasting prior to World War II (Walker, 1925; Brunt, 1927; Jones, 1944); but since that war, interest dwindled and droughts usually came without warnings. Recent droughts in the Southeast occurred periodically within a *dry-weather decade* -- a *climatic drought*; and that too happened several times in earlier years.

Dry-weather periods and droughts have long been associated with persistent fair weather; that is, high-pressure patterns -- *anticyclonic systems*. Sunspots have been associated also with some dry-weather conditions; but, the correlations have not been dependable. Recently, El Niño processes were claimed as prime causes for droughts in the 1980s (Canby, 1984), but El Niño factors have very few, if any, correlations with dry weather, historically. Also, increasing concentrations of carbon dioxide have been attributed to intense heat associated with the summer drought in 1988, but better historic evidence is needed for that also. Otherwise, various meteorological factors related to droughts were reviewed by Namias (1985).

This report presents precipitation data historically, interprets the patterns, and proposes trends. This report also emphasizes anticyclonic systems as timely factors responsible for drought. Further, the underlying causes are assumed to originate in various astrophysical processes.

DROUGHTS HISTORICALLY

"Seven years of plenty and seven years of famine" were part of Egyptian culture about 800-750 BC (Genesis 41:26,27; *et al.*) and at least two millennia before that (Lamb, 1988). Levels in the African Lake Victoria fluctuated in 11-year cycles also (Brooks, 1928). African droughts have other periodic attributes (Schove, 1983); such as an 18.6-yr lunar-nodal cycle, also in western America (Currie, 1984).

When water in the Great Salt Lake stood high in the 1980s, southeastern lakes ran low; that is, dry-wet phases alternated between east and west coasts.

From the time of settlement at Brisbane, Australia, drought patterns were developed by long-time residents (Jones, 1944).

Droughts were periodic in Europe (Brunt, 1927). A 35-year periodicity was found in variations of the Caspian Sea; then too, in the frequency of cold winters; and on dates of wine harvests in France, *et al.*; also, in river-ice in Europe, Siberia, and the American Hudson (Brückner, 1890).

Tree-rings in Arizona, observed as early as 1909, correlated with rainfall periodically (Douglass, 1936). Eventually wet-dry periods were identified backward some 8000 years. Also, bald cypress trees in southeastern U.S. have long dendrochronologic records of dry-weather periods (Stahle, *et al.*, 1988).

Prior to World War II climatic periodology (Walker, 1925) began to spread into other scientific disciplines, especially palenology; all of which attempted to formulate post-Pleistocene climatic history throughout the Late-Wisconsin glacial till (Potzger, 1956).

"Drought remains an unconquered ill. Meteorological science has not yet come to grips with drought and has not even described the phenomenon adequately," according to H. E. Landsberg in his foreword to Palmer's research paper (1965) that introduced the Drought Index.

Although droughts have been a scourge of mankind for millennia, the optimisms, the unfulfillments, the problems and difficulties were characterized by Griffiths and Driscoll in their climatology (1982): "There is common belief that droughts occur in a cyclic, and thus forecastable, pattern ..., 22 years being a common one. If this were the case, meteorologists would have been able for many years to give warnings of droughts."

Table 1. Georgia rainfall.
Running summations monthly. Data represent 12-months FOLLOWING.
Bold italics indicate periods of drought.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DRY-PERIOD INTERVAL			
1892	51.1	46.1	48.6	46.0	45.5	45.9	44.5	***41.2***	***41.6***	***40.9***	42.4	***40.5***			11	
1893	***40.2***	***40.9***	***41.6***	42.0	42.0	***41.9***	***40.1***	45.2	43.8	44.6	46.6	46.5				
1894	47.7	52.4	48.7	50.0	53.0	54.7	55.9	53.1	55.4	53.2	50.3	50.5				
1895	49.5	45.6	48.3	46.9	43.2	***41.6***	***41.2***	44.5	***39.8***	***40.7***	***40.9***	44.9	7	9		Pair
1896	45.1	43.6	46.0	50.9	52.9	51.9	51.9	49.4	51.5	52.0	53.1	48.9				
1897	49.2	49.0	42.1	***36.6***	***37.3***	***36.9***	***36.6***	***39.0***	44.1	46.0	49.3	53.0				
1898	53.1	55.5	61.9	63.9	62.2	62.8	62.1	58.5	53.0	49.6	47.5	44.5				
1899	44.2	42.1	42.6	43.2	46.2	46.9	53.3	53.9	51.9	53.5	53.7	55.1				
1900	57.3	59.2	55.5	56.3	54.8	58.0	54.3	53.3	60.7	62.8	59.8	57.4				
1901	57.5	54.5	57.7	59.4	57.0	53.7	52.0	52.3	46.3	45.8	48.5	51.2				
1902	49.9	51.4	52.5	51.4	52.6	55.7	58.2	57.6	59.3	59.0	57.3	56.1				
1903	53.8	54.4	49.9	45.9	44.5	***41.2***	***38.2***	***38.0***	***39.8***	***36.8***	***35.2***	***35.8***	7			Pair
1904	***37.1***	***36.4***	***39.5***	***39.8***	***41.5***	44.3	45.1	45.8	43.5	44.9	47.4	46.0		9	11	82
1905	51.0	53.8	48.7	51.9	49.8	49.1	51.7	55.5	56.4	58.7	59.6	59.6				
1906	54.6	49.8	51.2	46.9	51.4	51.3	49.3	45.9	44.2	45.1	42.3	45.8				
1907	48.7	51.9	54.1	56.9	58.2	56.6	55.7	55.9	57.8	54.7	56.6	52.7				
1908	50.0	47.4	47.7	50.7	47.5	49.3	51.4	51.4	49.9	49.9	48.7	48.4				
1909	48.3	49.4	48.3	42.2	***41.8***	***40.9***	42.6	43.0	42.4	***41.7***	43.5	44.3				
1910	43.7	43.1	***41.3***	42.8	44.0	42.6	***38.2***	***37.9***	***40.3***	***40.7***	42.4	44.4	7			
1911	48.2	51.6	54.2	59.4	62.2	64.1	68.2	68.4	67.2	69.9	67.7	66.2				
1912	63.0	60.5	59.8	60.5	54.8	53.0	51.0	50.9	50.0	48.4	48.0	46.6				
1913	46.4	45.3	45.7	***39.5***	***40.6***	***39.1***	***37.8***	***36.9***	***38.9***	***38.3***	***40.3***	44.4		9		
1914	45.5	49.2	47.9	47.7	45.7	51.7	52.0	51.5	50.6	49.7	52.0	49.2				
1915	49.6	45.5	45.3	44.7	45.8	***41.9***	42.3	52.2	50.2	49.7	45.2	44.8			11	
1916	43.5	46.7	48.1	54.0	55.4	55.3	54.1	45.0	47.4	50.9	49.9	49.3				
1917	47.4	47.9	44.9	***38.5***	***38.9***	***38.0***	***39.0***	***38.7***	***37.6***	***35.1***	***38.5***	42.0	7			
1918	46.7	45.9	50.7	53.5	52.1	55.0	56.9	60.8	62.2	60.5	58.7	56.1				
1919	54.9	54.8	52.4	55.7	60.7	60.6	58.0	55.2	57.2	59.3	57.4	59.3				
1920	59.7	57.7	57.6	51.8	47.8	47.4	46.7	47.6	44.4	43.1	44.3	44.4				
1921	***40.9***	42.6	44.5	51.1	51.4	54.4	56.9	54.9	53.8	53.2	54.8	51.8		9		
1922	55.3	54.6	53.1	50.8	51.2	52.8	52.9	52.4	54.5	54.9	52.1	54.2				
1923	52.7	54.1	53.2	50.7	52.7	47.7	47.0	48.3	45.1	53.8	54.2	52.0				
1924	54.2	59.7	57.8	56.4	52.2	50.2	48.5	46.4	45.7	***36.6***	***39.8***	43.4	7			P
1925	***41.0***	***37.8***	***40.2***	43.9	44.4	44.3	45.5	48.7	52.0	54.0	51.1	50.4				
1926	50.4	43.6	43.6	***41.0***	***40.7***	***40.6***	42.2	42.0	***40.8***	***38.5***	***38.7***	***36.6***				
1927	***40.6***	***41.2***	***41.8***	45.1	51.1	53.5	53.8	54.2	60.3	66.1	66.5	65.8			11	
1928	59.9	63.4	66.9	70.6	66.6	68.1	67.4	65.2	58.4	61.0	64.0	68.0				
1929	69.8	69.8	62.8	58.4	57.7	54.5	53.1	54.3	52.9	49.3	45.7	46.5				
1930	46.2	44.1	45.4	42.8	42.6	43.5	***41.6***	***40.8***	44.0	***39.2***	***38.6***	***33.6***	7	9		P
1931	***37.6***	***40.5***	***41.7***	43.1	***41.8***	42.5	47.2	47.4	48.3	51.1	55.6	59.5				
1932	59.3	56.9	58.8	57.8	60.1	59.1	55.7	56.0	54.4	54.2	50.9	47.1				
1933	42.0	***41.4***	***39.6***	***41.3***	***40.9***	43.3	45.5	44.7	45.6	44.4	46.5	47.3				
1934	48.0	47.8	47.3	46.2	47.0	44.7	***42.0***	44.7	45.0	46.7	43.5	44.8				
1935	45.0	51.3	54.1	54.0	57.3	55.5	56.0	53.5	54.3	54.4	57.3	55.5				
1936	58.9	56.6	55.5	55.0	54.0	55.2	56.5	56.8	56.9	55.1	56.6	57.4				
1937	53.1	48.4	44.3	44.4	44.0	45.3	46.5	49.0	45.6	45.9	***41.3***	***41.9***				
1938	42.6	44.3	52.1	52.6	49.8	50.4	49.3	46.6	50.5	50.4	50.0	48.1	7			
1939	48.7	49.2	45.6	45.4	44.6	42.5	42.7	44.2	44.7	42.9	43.5	46.4			11	
1940	47.1	44.7	***41.4***	***42.0***	***41.0***	***39.7***	***41.3***	42.5	***39.2***	***40.1***	***41.7***	***39.6***		9		
1941	42.8	45.4	47.9	51.3	50.8	54.2	52.9	50.3	51.9	54.5	54.0	54.0				
1942	53.2	54.4	51.6	51.0	53.6	53.3	52.6	53.0	51.2	49.9	48.6	48.9				
1943	46.4	44.7	49.5	52.7	55.6	53.6	51.9	51.3	52.4	53.6	55.6	56.0				
1944	54.3	53.6	52.5	44.4	44.3	44.9	45.4	47.9	47.6	48.5	48.6	48.5				
1945	54.2	57.0	55.8	59.3	56.3	60.0	61.0	58.8	57.7	56.0	56.9	57.0	7			
1946	50.5	51.6	48.9	49.7	51.4	49.0	49.8	47.7	49.1	49.1	50.1	55.6				
1947	59.8	56.6	59.9	62.2	61.5	61.6	59.5	64.0	63.5	63.9	61.7	63.9				
1948	63.6	62.7	63.5	57.5	58.5	57.9	60.0	58.2	60.6	59.8	60.6	51.7				
1949	49.2	47.9	44.5	47.4	43.8	44.7	43.1	44.5	***41.7***	43.2	43.8	43.7				
1950	45.0	44.8	44.8	45.1	46.8	43.7	44.8	42.8	***41.7***	42.4	***40.4***	43.4		9	11	P
1951	45.8	46.9	49.4	51.3	50.3	53.5	51.7	49.4	52.8	50.6	49.8	47.9				
1952	45.7	47.7	49.3	45.1	47.1	47.2	49.0	52.9	49.8	54.4	53.9	53.3	7			
1953	57.7	56.2	51.9	51.5	49.3	47.6	45.7	42.4	42.1	***35.9***	***36.0***	***37.5***				P
1954	***32.2***	***33.4***	***35.1***	***33.7***	***35.9***	***37.5***	***37.7***	***41.1***	***41.3***	43.0	44.6	43.9				
1955	***41.5***	***39.4***	42.5	45.2	44.6	43.2	43.8	42.7	42.6	45.2	45.6	44.4				
1956	47.2	48.2	44.6	44.4	44.8	47.8	49.5	48.1	48.2	50.1	50.5	56.3				
1957	55.6	55.7	57.1	57.6	58.8	55.9	55.2	58.0	58.4	52.7	50.9	45.4				
1958	45.1	45.8	47.0	49.1	46.2	49.7	48.7	47.2	47.6	50.2	56.3	56.4				
1959	56.3	58.0	58.2	56.0	57.3	53.0	53.4	53.1	54.0	54.2	48.7	48.1	7	9		
1960	47.5	45.0	46.8	47.0	49.5	51.5	52.9	51.6	53.9	50.8	49.2	50.5				
1961	55.8	57.9	54.3	54.9	53.7	50.8	51.0	51.3	48.2	50.5	52.5	54.4				
1962	49.8	49.9	49.5	48.7	47.6	50.3	53.0	54.1	52.7	53.4	51.1	50.4			11	
1963	51.8	54.6	56.9	59.3	62.6	62.1	57.7	61.2	64.2	62.7	69.5	68.3				
1964	70.5	64.7	64.5	64.3	60.0	58.0	61.1	57.0	55.2	55.9	52.1	51.7				
1965	47.7	51.4	52.5	50.2	50.2	55.7	52.4	51.8	53.0	52.6	53.5	54.2				
1966	55.7	54.7	51.7	48.8	47.9	45.7	48.0	50.9	53.1	51.3	49.3	50.3	7			
1967	52.0	50.5	48.0	49.2	50.1	50.0	47.7	45.6	***42.0***	42.7	43.1	43.7				
1968	43.0	42.1	44.2	45.8	45.9	46.8	47.1	46.8	50.7	53.5	52.4	50.4		9		
1969	50.2	50.5	50.1	52.5	51.6	50.5	50.5	51.1	49.9	46.6	50.4	49.6				
1970	48.9	50.3	52.8	52.9	54.0	53.2	54.0	56.2	56.6	57.5	55.3	56.9				
1971	58.4	60.9	59.7	56.9	54.5	55.7	58.2	54.5	51.5	50.3	49.9	50.9				
1972	52.2	51.0	51.3	54.2	59.7	61.0	60.1	60.0	60.8	63.0	61.9	60.2				
1973	58.7	58.9	59.7	55.3	52.7	51.1	49.2	50.3	52.4	52.3	51.6	52.0	7		11	
1974	51.6	51.5	52.3	56.5	57.5	58.4	59.0	60.6	57.9	59.4	62.7	62.6				
1975	61.9	60.3	55.7	55.1	51.3	55.2	55.5	52.7	53.0	51.7	53.0	55.2				
1976	56.1	55.8	56.4	57.9	59.0	51.8	49.5	49.3	50.4	51.6	49.8	50.1		9		
1977	49.4	52.6	52.1	47.9	48.7	51.7	52.1	52.5	52.9	49.0	45.9	43.9				
1978	43.2	42.1	47.1	46.7	51.0	50.4	50.1	52.4	51.0	56.1	57.2	58.5				
1979	57.2	56.0	51.5	60.0	56.4	56.6	57.4	53.1	51.4	49.7	51.2	49.0				
1980	47.8	43.9	47.3	***39.4***	***38.0***	***36.1***	***36.4***	***38.0***	***40.6***	***37.4***	***37.4***	***37.0***	7			
1981	42.8	46.9	46.8	45.3	49.0	49.0	50.2	52.5	51.2	52.7	52.2	54.1				P
1982	53.4	52.7	52.7	57.2	56.3	55.7	55.4	52.1	51.6	53.0	52.3	54.9				
1983	56.2	56.4	55.3	54.3	53.2	55.8	54.3	59.9	60.5	56.9	57.1	53.2				
1984	47.8	46.3	45.0	***40.7***	***38.2***	***37.3***	***37.9***	***36.2***	***38.5***	***38.6***	***41.3***	44.2				
1985	45.2	44.1	45.2	46.6	45.3	43.7	42.6	***38.5***	***38.7***	***40.5***	***39.8***	***40.7***		9	11	P
1986	42.7	47.8	49.3	51.4	51.7	51.8	55.1	55.9	53.3	53.5	52.2	48.9				82
1987	47.1	44.9	43.1	***40.9***	44.9	43.8	***37.5***	***37.8***	***38.8***	***41.9***	44.5	44.7				
1988	43.3	.	.	.	.	.	.	.	.	.	.	.				

RECENT DRY-WEATHER PATTERNS

Average precipitation in Georgia approximates 50 inches for any 12-months period. For a century of data, rainfall ranges from 42 to 58 inches in about 68 percent of the years.

When monthly rainfall data are summed into 12-mo periods consecutively (Table 1), -- RunSuMo -- dry/wet patterns stand out clearly. Dry weather occured when rainfall during any 12-mo period was less than 42 inches; severe droughts came with less than 34 inches. Dry-weather periods in Georgia (Plummer, 1987) were similar to those in the Southeast (Plummer, 1989). Agricultural droughts, hydrologic droughts, meteorologic droughts, climatic droughts, and others, all have technicalities that relate each one to time-and-amount of rainfall.

Dry-period intervals of 7-years, 9-yr, 11-yr, and others are shown in Table 1. These are subject to further adjustments and are not fitted firmly. One outstanding feature in Table 1 is the paired drought-periods; that is, 1986 and 1981, 1954 and 1951, 1931 and 1925, 1904 and 1897. Another pair occurred just after the Civil War, and yet another in 1839 and 1845, according to history.

Figure 1 presents patterns of precipitation typical in the Southeast, except Florida. It shows subnormal rainfall came frequently prior to 1940. Abnormal rainfall came during the 1940s, '60s and '70s in distinct periods. Since 1975, the Southeast has been in a dry-weather decade -- with some wet periods.

In Georgia, the ten-year average ranged from 90 to 95 percent of the long-term mean. The outstanding dry-periods -- *drought troughs* lasted from seven to eleven years. Beginning in May 1984, persistent dry weather with severe droughts came to North Georgia for five years; rainfall averaged 60 to 70 percent.

Between August 1987 and the end of July 1988 in Athens, rainfall totalled 50 percent -- 25.86 in -- the driest 12-mo period on record since 1845. Much of Northeast Georgia was as dry or drier.

Two, two-year dry periods led to *hydrologic* droughts when some first-order streams dried in summer 1981 and in July 1986. Streams did not dry so readily in July 1988 because ground-water was restored between October '86 and April '87. One municipal water-well (in the North Georgia town, Kingston) produced 40 gallon of water per minute until it ran dry on February 19, 1989 -- indicative of low rainfall since March 1987; and perhaps for five years overall. Numerous dug-wells dried in early 1986; also, drilled-wells 350 feet deep dried in some North Georgia counties, especially Hall.

Relatively wet weather came sometimes during the dry-'80s -- in 1982 and '83, as well as October 1986 through March 1987. During other dry periods, rather wet summers statewide came in the 1890s, around 1905, in the '20s, '40s, '60s, and in 1984 and 1985.

From 1984 into 1989, strong polar airmasses from the Northwest pushed numerous frontal systems with low-pressure troughs through Georgia; but, little rain fell -- from clouds off the warm Pacific also. When continental anticyclonic systems prevailed over the Midwest, in Julys and Decembers, dry weather came regularly.

DROUGHTS AND HIGH-PRESSURE SYSTEMS

To many weather observers, dry weather comes when *"fronts are blocked by a ridge"* of high pressure. Those anticyclonic "ridges" originate from "subsiding air", according to meteorologic textbooks. Atmospheric literature does not explain why those anticyclonic systems recur persistently in some places and not others. Further, the fundamental causes of anticyclones, their fair-weather electric field and geomagnetic properties are not well-known.

Also, autumnal dry weather in October is ordinarily associated with anticyclonic systems over the Midwest.

The role of anticyclonic systems in the Southeast has been noticeable since about 1975. A single massive anticyclone, 1024-

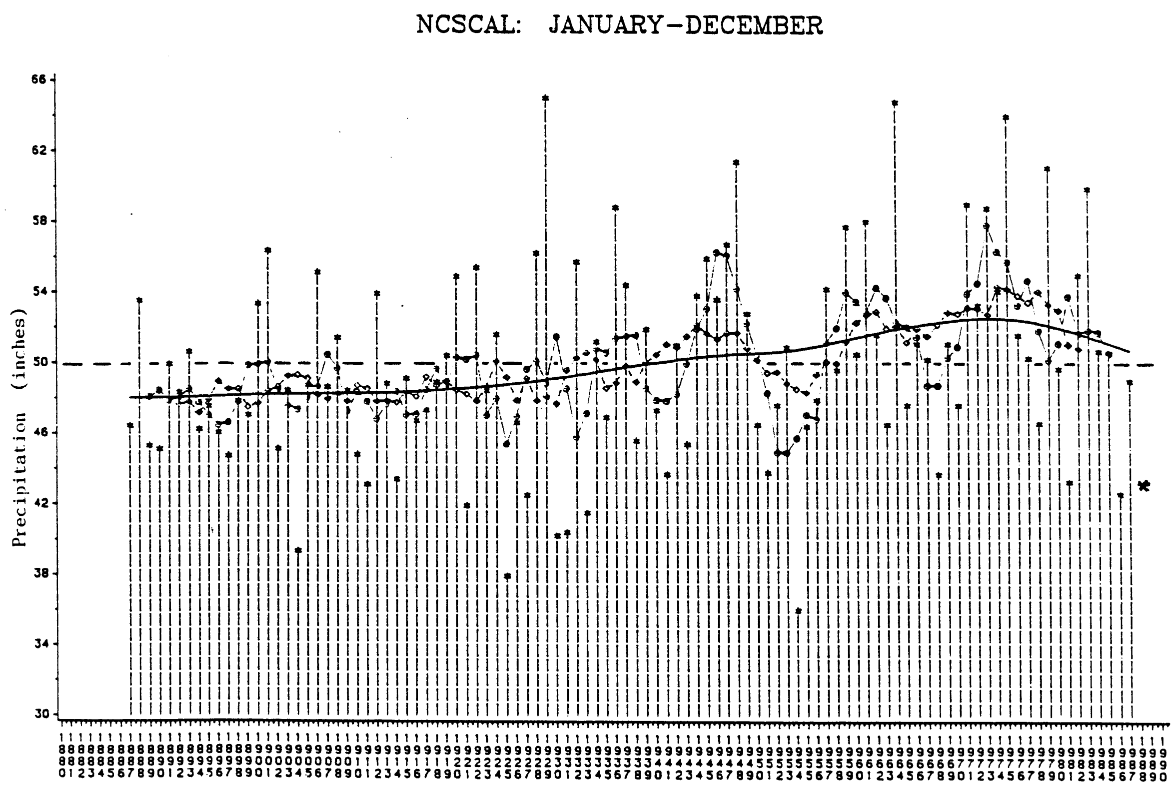

Figure 1. Precip-data for NC SC AL averaged. Overall mean = 49.9 in. annually.
Moving averages: 5-yrs = DOTS; 10-yrs = DIAMONDS. Trend line = SPLINE interpolation.

1026 mb, situated over lower-Louisiana produced the hot-drought of July 1980 (Plummer, 1981); another happened again in July 1986 (Plummer, 1986); and yet another in June 1988.

Then relative humidities less than 30 percent occurred frequently. Relative humidities in December 1988 went to 15 percent during the strong, midwestern, anticyclonic weather. That aridity increased both evaporation of soil water and biotic dehydration.

Freeze-drying weather during wintertime is as dehydrating as heat-drying in summer. Occasionally in winter, massive anticyclonic systems with frigid, continental, polar air -- so-called "arctic expresses" -- brought freeze-drying weather into the deep South.

Freeze-drying conditions occurred on December 25, 1983 and again on January 21, 1985. These originated in Montana with massive anticyclonic systems, 1058+mb. Consequently, several "arctic expresses" reached into South America when the Azores high-pressure system weakened markedly, allowing that to happen.

ATMOSPHERIC PRESSURE PATTERNS

The very highest pressure over North America, 1078.4 mb, occurred on January 31, 1989 in mid-Alaska with -75 to -80 deg F. That massive anticyclonic system spread freeze-drying temperatures throughout North America, except Florida. At the same time, the Azores-high, 1038 to 1044 mb, -- and a Caribbean-high, 1029 mb -- were sufficiently widespread to dominate the atmosphere over Georgia also. That frigid continental airmass was stopped by the intensely warm Caribbean-high -- a unique occasion.

In this case, a difference of 3 or 4 mb between the confrontation of the Caribbean-high with the continental-high caused drought in Georgia and deluges of rain with devastating floods in Texas and Kentucky -- *i.e.*, February 14-16, 1989 -- and cyclones elsewhere.

Southeastern weather is under the primary influence of the Azores-high. For 400 years and more, sailors navigated the Atlantic Ocean on the clockwise winds of that huge anticyclonic system. Numerous sub-systems of the Azores-high occur in the Caribbean, especially the Bermuda-high in summertime. During the 1940s, '60s and '70s, the Bermuda-high brought warm-moist maritime-air to the Southeast, resulting in abundant precipitation. On the other hand, during the recent dry summers, the Bermuda-high was scarce; it was embedded in the abnormal Azores-high.

The shortage of rainfall since 1976 can be related to abnormal sea-level pressures (SLP) in the Caribbean and over Georgia. Sea-level pressures globally average 1012 millibars of mercury (29.9 inches), but variations are great. For many years, the Azores-high averaged 1023 mb in January and 1026 mb in July; and SLP on Georgia averaged 1020 mb and 1018 mb respectively. Though warm Gulf-waters reached 90 F at times, high-SLP retarded evaporation.

OUTLOOK AND EXPECTATIONS

Four scenarios are possible for precipitation in the near future:

... 1) precipitation may continue at the 1976-to-1989 amounts;

... 2) precipitation may range upward from recent conditions to a new mean between that of the wet-'70s and the dry-'80s;

... 3) precipitation can get worse than in the 1980s;

... 4) rainfall may return to the 1970s-level and trend upward or downward from there.

Case-1 is a reasonable possibility.

History and other technicalities indicate that case-2 may be expected in the long run.

Wisdom suggests that case-3 should be taken into account promptly for planning purposes, especially public services.

Overall..., shortages should be expected generally ... in rainfall, ... in ground-water reserves, and ... in high-quality surface water.

Until about 1990 to 1993, more wet weather is expected each year than in the 5-year period from mid-1984 through 1989. Another series of dry-weather periods is expected from about 1994 through 1999. Two major dry-weather periods, similar to the decades of the 1930s, '50s and '80s, are expected about 2010-2015 throughout southeastern U.S. Periods of wet-dry weather developed from synergistic cycles; so, droughts are expected aperiodically as one cycle concurs out-of-phase with its neighboring cycles.

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