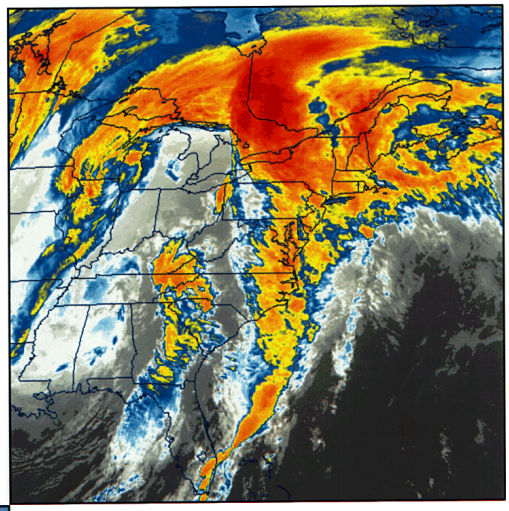
Technical Report 98-02

April 1998

NATIONAL CLIMATIC DATA CENTER

The El Nino Winter of '97-'98



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National Climatic Data Center Technical Report No. 98-02

The El Nino Winter of ’97 - ’98

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April 1998

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INTRODUCTION

The winter of 1997-1998 was marked by a record breaking El Nino event and unusual extremes in parts of the country. Overall, the winter (December 1997- February 1998) was the second warmest and seventh wettest since 1895. Severe weather events included flooding in the southeast, an ice storm in the northeast, flooding in California, and tornadoes in Florida. The winter was dominated by an El Niño-influenced weather pattern, with wetter than normal conditions across much of the southern third of the country and warmer than normal conditions across much of the northern two-thirds of the country.

Prior to the winter of 1997-1998, strong warm-episode (El Niño) conditions had persisted in the tropical Pacific since June 1997. Sea surface temperatures throughout the equatorial east-central Pacific increased to near 29 degrees C during February and March 1998. At the same time, departures from normal were near +4 degrees C along the west coast of South America. During 1997 the National Center for Environmental Prediction (NCEP) statistical and coupled model predictions were consistent in indicating the development and persistence of strong warm-episode conditions. As of April 1998, the latest NCEP forecasts indicate that warm episode oceanic conditions, comparable to those observed during 1982-83, will continue through June 1998. Thereafter, both the statistical model and the NCEP coupled model indicate a return toward normal. This report will focus on highlights and unusual events covering the December 1997-February 1998 period.

WINTER SUMMARY

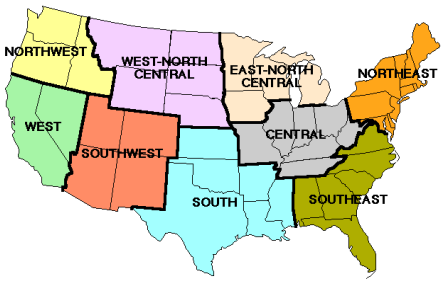
The first two months of 1998 were the warmest and wettest in the 104-year record of temperatures and precipitation measurements for the contiguous 48 states. During the period January - February, the national average temperature was 37.5 degrees F compared with a normal of 32.1 degrees F. The previous record was 37.0 degrees F in 1990. For precipitation, 6.01 inches fell, compared with a normal of 4.05 inches. The previous record was 5.7 inches in 1979.

For the winter (December through February) as a whole, however, temperatures and precipitation were not as extreme, due to December being somewhat cooler and drier (as a national average) than January and February. The winter of '97-'98 was the second warmest on record and the seventh wettest. The normal national average temperature for the winter months of December, January, and February is 32.3 degrees F. This winter's figure was 36.4 degrees F. The record was 36.6 degrees F set in 1991-1992. For the three-month period, the normal precipitation value for the country is 6.35 inches. This winter's figure was 7.96 inches, compared with the record 8.5 inches in 1932-1933.

California and North Dakota had their wettest February on record. Florida, Maryland, Nevada, Rhode Island, and Virginia had their second wettest February since records began in 1895. The warmest February on record took place in much of the upper midwest and parts of the east

including Minnesota, Wisconsin, Illinois, Michigan, Ohio, Pennsylvania, and Connecticut. Nationwide energy savings were estimated at 10% (i.e., 10% lower heating costs as compared to normal winter).

"These are the patterns one would typically expect during a strong El Nino event," said Ants Leetma, director of NOAA's Climate Prediction Center in Camp Springs, MD. "This year, the strong El Nino on top of the continuing gradual increase of temperature and precipitation set the stage for many all-time state records." "With the newest figures, the long-term trend of increasing temperatures and precipitation in the United States continues," said Tom Karl, Director at NOAA's National Climatic Data Center in Asheville, NC.



Tables 1 and 2 are winter season's rankings of temperature and precipitation for the contiguous 48 states broken down by geographic region.

Figure 2 Regional U.S. Map

Table 1. Winter Temperature/Precipitation Ranks

TEMPERATURE AND PRECIPITATION RANKINGS FOR
DECEMBER 1997-FEBRUARY 1998, BASED ON THE PERIOD
1895-96 TO 1997-98.
1 = DRIEST/COLDEST, 103 = WETTEST/HOTTEST.

REGION	PRECIPITATION	TEMPERATURE
NORTHEAST	63	102
EAST NORTH CENTRAL	42	103
CENTRAL	35	102
SOUTHEAST	103	72
WEST NORTH CENTRAL	79	99
SOUTH	99	81
SOUTHWEST	61	63
NORTHWEST	36	92
WEST	99	70
NATIONAL	97	102

Table 2. Winter Extremes/Normals

WINTER EXTREMES, 1961-90 NORMALS, AND 1997-98 VALUES
FOR WINTER, DECEMBER-FEBRUARY

PRECIPITATION (INCHES)

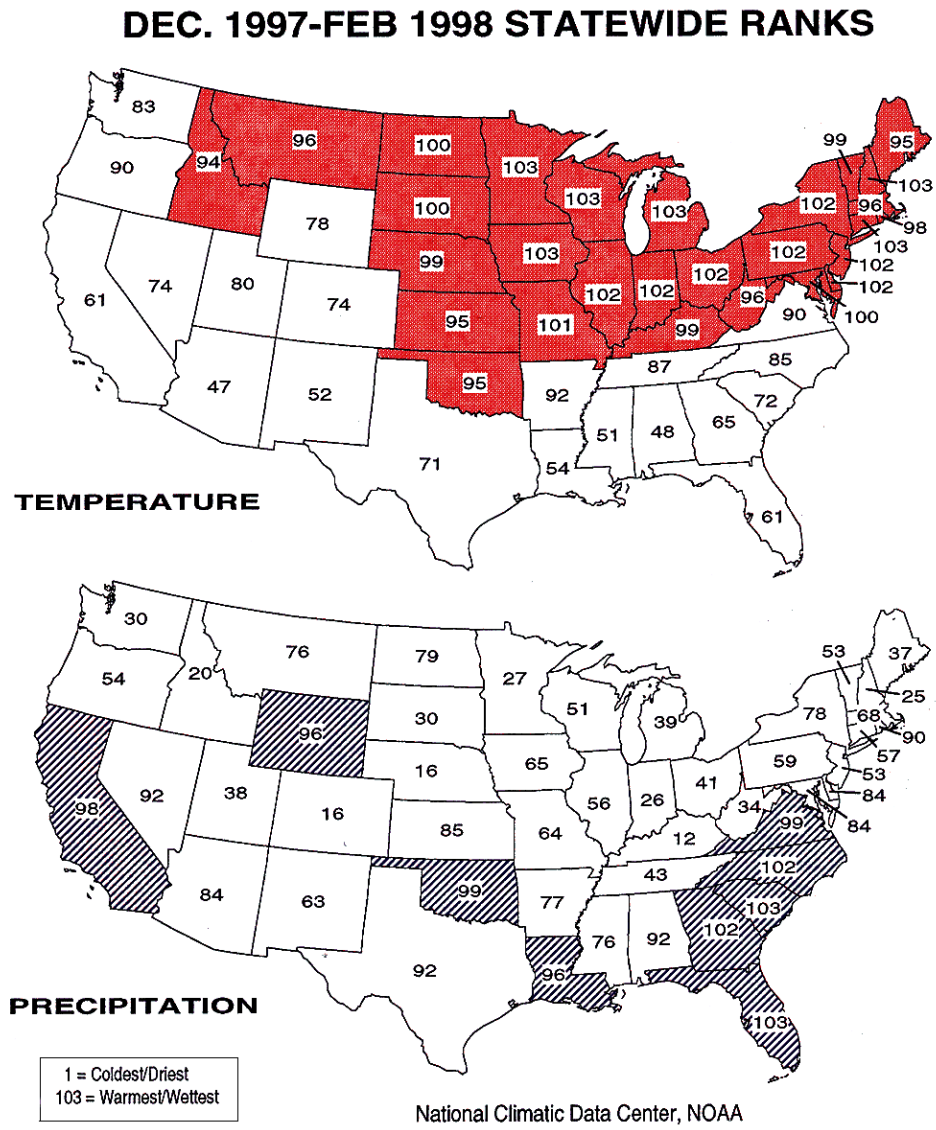
REGION	DRIEST VALUE	DRIEST YEAR	WETTEST VALUE	WETTEST YEAR	NORMAL PCPN	1998 PCPN
NORTHEAST	4.56	1980	13.97	1979	8.94	9.27
EAST NORTH CENTRAL	1.61	1931	5.55	1969	3.50	3.27
CENTRAL	4.24	1963	17.30	1950	8.60	7.95
SOUTHEAST	5.77	1938	17.81	1998	12.15	17.81
WEST NORTH CENTRAL	.84	1931	2.90	1969	1.81	2.07
SOUTH	3.57	1918	13.12	1932	6.88	9.67
SOUTHWEST	.93	1904	6.53	1993	2.58	2.78
NORTHWEST	3.86	1977	15.73	1965	10.69	9.65
WEST	2.52	1977	15.87	1969	7.18	14.02
NATIONAL	4.08	1977	8.50	1932	6.35	7.96*

* PRELIMINARY VALUE, CONFIDENCE INTERVAL + OR - .47 INCHES

TEMPERATURE (DEGREES F)

REGION	COLDEST VALUE	COLDEST YEAR	WARMEST VALUE	WARMEST YEAR	NORMAL TEMP	1998 TEMP
NORTHEAST	16.6	1918	30.7	1932	23.7	29.8
EAST NORTH CENTRAL	8.4	1936	26.6	1998	16.4	26.6
CENTRAL	23.9	1978	40.8	1932	31.1	37.4
SOUTHEAST	41.2	1978	55.5	1932	46.2	48.4
WEST NORTH CENTRAL	9.5	1979	27.6	1992	19.4	25.8
SOUTH	38.0	1905	48.6	1952	43.1	45.7
SOUTHWEST	27.3	1933	38.4	1981	33.2	34.2
NORTHWEST	21.7	1949	37.2	1934	30.5	33.4
WEST	31.7	1949	43.9	1981	39.9	40.9
NATIONAL	27.1	1979	36.6	1992	32.3	36.4*

* PRELIMINARY VALUE, CONFIDENCE INTERVAL + OR - .2 DEG. F.



Temperature and Precipitation Ranks for the contiguous United States. Each state is ranked based on its data from 1895-1998. States having a rank of top ten coldest or driest (rank 1-10) or top ten warmest or wettest (rank 94-103) are shaded.

Figure 3 Individual State Rankings

Maps shown in Figure 2 are the December 1997-February 1998 statewide ranks of temperature and precipitation. Shaded areas show greatest departures. Additional maps in the Appendix (Figures 12-14) show individual state divisional winter precipitation amounts for California and the southeast, along with nationwide maps of divisional precipitation for the winter (Figures 15-18). Figures 19-20 show the snow cover and streamflow as compared to normal in mid-March.

Table 3. States/Regions Which Set Precipitation and Temperature Records

Record High December - February Precipitation Totals

State/Rgn	Total	Normal	Pct. Of Normal	(Previous) Rec'd	Year
FL	19.28	8.69	222	15.14	1963-64
SC	19.54	11.21	174	17.38	1981-82
Southeast	*18.57*	*11.60*	*160*	*16.55*	*1935-36*

Record Warm December - February Temperature Averages

State/Rgn	Avg. T	Normal	Dep. From Normal	(Previous) Rec'd	Year
CT	33.2	27.5	+5.7	33.0	1931-32
IA	29.2	21.3	+7.9	29.0	1991-92
MI	29.1	21.2	+7.8	28.7	1931-32
MN	23.4	11.6	+11.8	21.7	1986-87
NH	26.4	20.5	+5.9	26.2	1932-33
WI	26.4	16.6	+9.8	23.8	1930-31
E. N. Central	*26.6*	*17.0*	*+9.6*	*24.5*	*1986-87*

These data and tables were compiled based on U.S. climate divisional data, which in turn are based on preliminary data from over 5000 reporting stations across the country. NCDC's *Climate Variations Bulletin* (CVB) contains additional information, analyses, and individual monthly reports. The publication is available via the WWW at the following address: http://www.ncdc.noaa.gov/ol/documentlibrary/cvb.html. The NOAA press release relating to the above figures can be found at http://www.ncdc.noaa.gov/ol/climate/warmest.html.

MONTHLY HIGHLIGHTS

December 1997

December's weather pattern featured a typical El-Nino configuration. A northern branch jet stream confined cold air to central Canada, and a strong southern branch of the jet stream brought cool wet weather across portions of the deep south. Due to the lack of arctic air, the northern plains averaged from 5 to 15 degree F above normal for the month. For the first time on record, Glasgow, MT had no sub-zero temperatures and was 10.9 degrees above normal for the month. In contrast, temperatures across the south were generally 1-3 degrees F below normal. The biggest departures of 6 to 9 degrees F below normal were recorded in parts of the southwest.

Record rainfall drenched parts of central and northeast Florida with Tampa receiving 15.57 inches, Orlando 12.63 inches, and Jacksonville 9.77 inches. The strong southern jet stream was also associated with near record rains across other sections of the southeast. Areas farther to the north, while not receiving abundant precipitation, didn't get much sunshine. St. Louis recorded less than 80 hours of sunshine during the month (27% of possible). Des Moines recorded an 11 day cloudy streak running from December 1-11, and Albuquerque, NM had no sunshine on four consecutive days from December 20-23.

The procession of storms northeastward from the southwest was also responsible for above normal snowfall across portions of the plains and midwest. Monthly snowfall totals reached 14.9 inches at Dodge City, KS, 10.9 inches at Kansas City, MO, and 15.2 inches in Moline, IL. Across the northern tier of states, monthly precipitation only reached 0.34 inches at Houghton Lake, MI, and Helena, MT recorded only a trace of precipitation.

January 1998

Weather patterns only occasionally deviated from the classic El Nino structure, as Arctic air edged into the northern plains and Pacific storms hit parts of the Pacific Northwest. Frequent storminess continued across the south and east, including a powerful storm that produced flooding in the southeast and one of the worst ice storms on record in parts of New England (see below for details). In terms of temperatures, arctic air was held at bay, although it occasionally reached the northern plains. Though the temperature fell to -40 F at Jordan, MT on the 12th, the only areas of the U.S. where monthly mean temperatures averaged below normal were across portions of Montana and southern California. Monthly mean temperatures were ten degrees above normal across portions of the Great Basin, northern plains, Ohio Valley, and the Middle Atlantic region.

The persistent storminess lead to record breaking monthly precipitation totals at the following locations: New Orleans, LA (19.28 inches), Mobile, AL (16.92 inches), Baton Rouge, LA (14.94 inches), Asheville, NC (9.96 inches), Roanoke, VA (7.97 inches), Blacksburg, VA (7.39 inches), and Burlington, VT (5.15 inches). Late in the month, an east coast storm caused beach erosion and dumped record snowfall across the central and southern Appalachians, with Flat Top, WV accumulating 35.0 inches of snow in a 24-hour period on January 27-28. Elsewhere in West Virginia, 24-hour snowfall records were established at Bluefield (21.9 inches) and Beckley (31.0 inches). Storm total snowfall reached 42 inches in Ghent, WV and 40 inches at Beech Mountain, NC. A GOES-8 visible image of this particular storm on January 27, 1998 is displayed in Figure 6.

Flooding Rains and Ice Storm

During the week of January 5-9, 1998, the eastern U.S. and eastern Canada were severely affected by a storm system with a very deep southerly flow and abundant moisture. This resulted in flooding rains from the lower Mississippi valley through the southeast and into the northeast, accompanied by several tornadoes, and a severe ice storm in parts of the northeast/New England and into Canada. The death toll from this system included:

Flood-related:
Tennessee--7
North Carolina--2
South Carolina--1
Kentucky--1
Alabama--1
Ice storm-related:
Canada--28
New York--9
Maine--5
New Hampshire--2
U.S./Canada total--56

The heaviest rains and most severe flooding occurred in the mountains of North Carolina and northeast Tennessee, where up to 16 inches of rain fell in a two day period in Jackson County, NC. See Table 4 for some of the two-day rainfall totals for January 7-8. Estimates indicated over 500 homes either destroyed or with severe damage in North Carolina, and over 200 homes severely damaged or destroyed in Tennessee. Tornado touchdowns produced some damage in Dublin, GA and Easley, SC. Flooding also was a problem in parts of the lower Mississippi valley and upstate New York.

The severe ice storm mainly affected upstate New York, northern New Hampshire and Vermont, much of Maine, and southeast Canada. Some locations received over 3 inches of rain (in the form of freezing rain). Canada reported over 3 million utility customers without power immediately after the storm, while the northeast U.S. reported over 500,000 customers without power. In Maine, four out of five residents lost electrical service at some point during or after the storm, and nearly 3 million feet of power lines were destroyed. Overall damages were well over $2 billion for Canada and over $300 million for the U.S. See Figures 3-5 for satellite/radar images of this storm system.

The last U.S. ice storm to strike with this (or greater) intensity was during February 1994 in the southeast U.S. The NCDC report, 1994 Weather in the Southeast: February Ice Storm and July Flooding includes details about that storm, which caused approximately $3 billion in total damages in the southeast.

Table 4

The following are rainfall totals (> 3.0 inches), for January 7-8, 1998 in northeast Georgia, northwest South Carolina, and western North Carolina. Note numerous amounts exceeding 7 inches. Amounts were provided by the National Weather Service's Greenville-Spartanburg office:

NORTHEAST GEORGIA COUNTIES:

COUNTY	LOCATION	RAINFALL (INCHES)
RABUN	MOUNTAIN CITY	5.90

HABERSHAM	CLARKESVILLE	5.06
	CORNELIA	4.68
STEPHENS	TOCCOA	4.71

UPSTATE SOUTH CAROLINA COUNTIES:

OCONEE	SALEM	6.10
	KEOWEE	5.37
	JOCASSEE	5.25
	CLEMSON	3.67
PICKENS	TABLE ROCK	6.50-7.00
	PICKENS/EASLEY	5.00-6.00
	CEDAR ROCK	4.00
	3 MI SE EASLEY	3.03
GREENVILLE	US 25 NEAR NC BORDER	5.25
	HUNTS BRIDGE	3.79
	GOWENSVILLE	3.65
	TRAVELERS REST	3.40
	CAESARS HEAD	3.16
SPARTANBURG	CAMPOBELLO	3.90
	20 MI N GREER	3.60

WESTERN NORTH CAROLINA COUNTIES:

SWAIN	TROUT FARM	4.84
	BRYSON CITY	3.45
	PIN OAK GAP	3.32
MACON	HIGHLANDS	9.63
	OTTO	5.47
	FRANKLIN	4.67
JACKSON	HOGBACK MTN	16.12
	ROBINSON CREEK	15.33
	COLD CREEK	13.36
	TANASEE CREEK	12.96
	WOLF CREEK	11.64
	CHARLEY RIDGE	10.91
	CEDAR CLIFF	9.00
	TUCKASEGEE	7.40
	PUMPKINTOWN	6.72
	SYLVA KINGS MTN	5.20
HAYWOOD	MT HARDY	12.20
	DANIEL RIDGE	8.16
	WAYNESVILLE	3.47
TRANSYLVANIA	5 MI NW CEDAR MTN	14.50
	CONNESTEE FALLS	12.38
	LAKE TOXAWAY	10.63
	ROSMAN	9.02
	BREVARD	8.92
	PISGAH FOREST	7.92
	BALSAM GROVE	7.80
	RICH MTN	7.24
HENDERSON	SUGARLOAF MTN	9.17
	BEARWALLOW CREEK	7.81
	HORSEPEN MTN	6.84
	ETOWAH	7.67
	HENDERSONVILLE	6.09
	MILLS RIVER	5.54

	DANA	5.08
BUNCOMBE	BEAVERDAM CREEK	7.96
	MT PISGAH	5.92
	FLAT TOP MTN	5.07
	ASHEVILLE AIRPORT	4.70
	BARNARDSVILLE	4.36
	CANDLER	3.82
	ASHEVILLE DOWNTOWN	3.35
	NEWFOUND CREEK	3.08
MADISON	DUCKETT TOP & IVY GAP	3.36
	LITTLE PINE CREEK	3.16
YANCEY	BLUE ROCK	7.64
	MT MITCHELL	7.50
	BLACK MTN	4.86
MITCHELL	SPRUCE PINE	9.64
	HAWK	4.85
AVERY	GRANDFATHER MTN	5.15
	BEECH MTN	3.56
ASHE	JEFFERSON	4.32
BURKE	JONAS RIDGE	7.71
MCDOWELL	OLD FORT	6.29
POLK	TRYON	4.38

February 1998

February was again very warm across most of the continental U.S. due to the strong El Nino signal. Mean monthly temperatures were as much at 6-16 degrees F above normal across portions of the northern plains. These warm temperature resulted in many record temperatures including an average temperature of 29.1 degrees F at Sault Ste. Marie, MI, which was 15.1 degrees F above normal. The only below normal areas in the contiguous U.S. were across portion of the southwest and west coast. Especially impressive was the lack of night-time cold, as temperatures remained above the 20 degree F mark for the entire month in Topeka, KS.-- the first occurrence since records began 102 years ago. At Madison, WI, the month's extreme lowest daily temperature was only 11 degrees F, which is equal to their normal daily average February minimum. Unusually cloudy weather continued across a large portion of the eastern half of the country, which acted as a night-time blanket and kept temperatures well above normal. At month's end, the water temperature of Lake Erie at Buffalo was 36 degrees F, the highest on record for the end of the month. The only other seasons that the lake remained unfrozen were 1952-1953 and 1982-1983.

In terms of precipitation, across California and the southwest, four weeks of nearly continuous storminess resulted in widespread flooding, mudslides, and agriculture disruptions. Late in the month a shift in the weather pattern brought some of that storminess out of the southwest and into the northern plains. February precipitation records were set at nearly a dozen locations in the east and at least 19 stations in California. Santa Barbara, CA received an incredible monthly total of 21.74 inches, breaking the old record of 17.33 set in 1962 and establishing a record for any month. Records for that location date back to 1867.

Florida wasn't immune to wild weather either, as a strong southern jet stream brought storminess to the "Sunshine State." Severe thunderstorms produced winds gusts to 104 mph in Miami, 90 mph in Hollywood, and 66 mph in Homestead on the 2nd and 3rd of the month. Over 220,000 Florida Power and Light customers were left without power, as the company said damage to its system was the worst since the "Storm of the Century" in March 1993. Another batch of severe thunderstorms spawned deadly tornadoes across central Florida on February 22-23, killing 42 people. See below for further details on the flooding in California and tornadoes in Florida.

California Flooding

During the month of February 1998, California was struck by a series of storms due in part to the affects of El Nino. The current estimates indicate over $550 million in damages for the state, with that total expected to climb. The state also reported 17 storm-related deaths for the winter, and 35 counties were declared federal disaster areas. Clear Lake in northern California reached its highest level since 1909, flooding portions of Lakeport, about 90 miles north of San Francisco. See Table 5 for the monthly rainfall records broken during February, and Figures 7-8 for satellite images of the storm system which struck the state on February 3.

The west coast has dealt with severe flooding for each of the last four winters (including this year). However, the previous three winters were not significantly influenced by El Nino, thus showing that (as climatologists have pointed out in prior years) severe flooding can occur on the west coast during non-El Nino years. These NCDC reports describe the previous three winters' flooding:

Technical Report 97-01, Winter of '96-'97 - West Coast Flooding
Technical Report 96-02, The Winter of '95-'96 - A Season of Extremes
Technical Report 95-01, January and March 1995: A California Cloudburst

These and other reports are available via the NCDC World Wide Web (WWW) site:
http://www.ncdc.noaa.gov/ol/reports/weather-events.html

Table 5. February 1998 Record Rainfall Amounts (inches)

Location	Total	Former Record/Year
Ukiah	22.33	19.49 in 1958
Santa Barbara	21.74	*17.33 in 1962
UCLA	20.51	*18.37 in 1918
Chatsworth	20.11	*17.71 in 1962
Oxnard	17.80	15.58 in 1962
Simi Valley	17.20	*11.15 in 1992
Northridge	15.75	*14.23 in 1962
Monterey	15.00	11.68 in 1978
San Francisco	14.89	12.52 in 1878
L.A. Cvc Ctr	13.68	13.37 in 1884

L.A. Airport	13.30	11.07 in 1962
Lompoc	12.86	11.54 in 1918
Redwood City	12.46	10.06 in 1986
Santa Maria	11.59	9.69 in 1962
Long Beach	11.22	9.66 in 1937
San Jose	10.23	7.02 in 1915
Riverside	9.49	* 6.97 in 1969
Stockton	8.01	7.34 in 1936
Bakersfield	5.36	* 4.68 in 1978

* Denotes an all-time-record February monthly total.

Florida Tornadoes

During the late evening of February 22 and early morning of February 23, 1998, a series of tornadoes ripped across central Florida. At least one of the tornadoes reached an estimated F4 intensity. Forty-two fatalities occurred, over 800 residences were destroyed, another 700 were left uninhabitable, over 3500 were damaged to some extent, and 135,000 utility customers lost power at the height of the storms. Damages from the tornado outbreak exceeded $60 million, and Florida's overall storm damage total since last fall is approximately $500 million. Hardest hit locations in the tornado outbreak were Winter Garden, Altamonte Springs, Sanford, and Campbell. See Figures 9-11 for NEXRAD images of the storms. Overall, 54 of Florida's 67 counties were declared federal disaster areas due to storms over the past few months.

ACKNOWLEDGMENTS AND ADDITIONAL INFORMATION

The photograph of the landslide on the front cover is courtesy of the Federal Emergency Management Agency (FEMA). Figures 9-11 are from the Melbourne, FL NEXRAD site. Figures 15-18 were provided by the Western Regional Climate Center, and Figures 19-20 were provided by the National Weather Service Hydrologic Information Center. The Climate Prediction Center, the *Weekly Weather and Crop Bulletin* (NOAA / US Department of Agriculture publication), and the *Climate Variations Bulletin* (NCDC publication) provided some of the information for this report.

In looking for general information and impacts related to El Nino and this past winter, the following resources are good places to start.

- NOAA El Niño Forecasts, Observations and Research (http://www.elnino.noaa.gov/): This site is quite inclusive and covers current El Niño status and U.S. forecasts, threat assessment for the U.S., state by state assessment, hurricane forecasts, preparing for El Nino, El Niño loss reduction center, overview of NOAA's role in forecasting, NOAA and NOAA supported El Niño forecasts, comprehensive list of El Niño forecasts, and much more.

- NOAA/CIRES Climate Diagnostic Center (http://www.cdc.noaa.gov/~mz/currentclimob.html): This page allows the user to plot current or historical climate anomalies and compare those to the trends associated with El Niño.

- *Weekly Weather and Crop Bulletin*, a joint publication prepared by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of Agriculture (USDA): A good source for narrative information and National Weather Service (NWS) office records.

- National Climatic Data Center WWW site (http://www.ncdc.noaa.gov): Numerous datasets, reports, and satellite images which provide additional details and data for further research.

APPENDIX - FIGURES/IMAGES

January 1998 Satellite and Radar Images:

February 1998 Satellite and Radar Images:

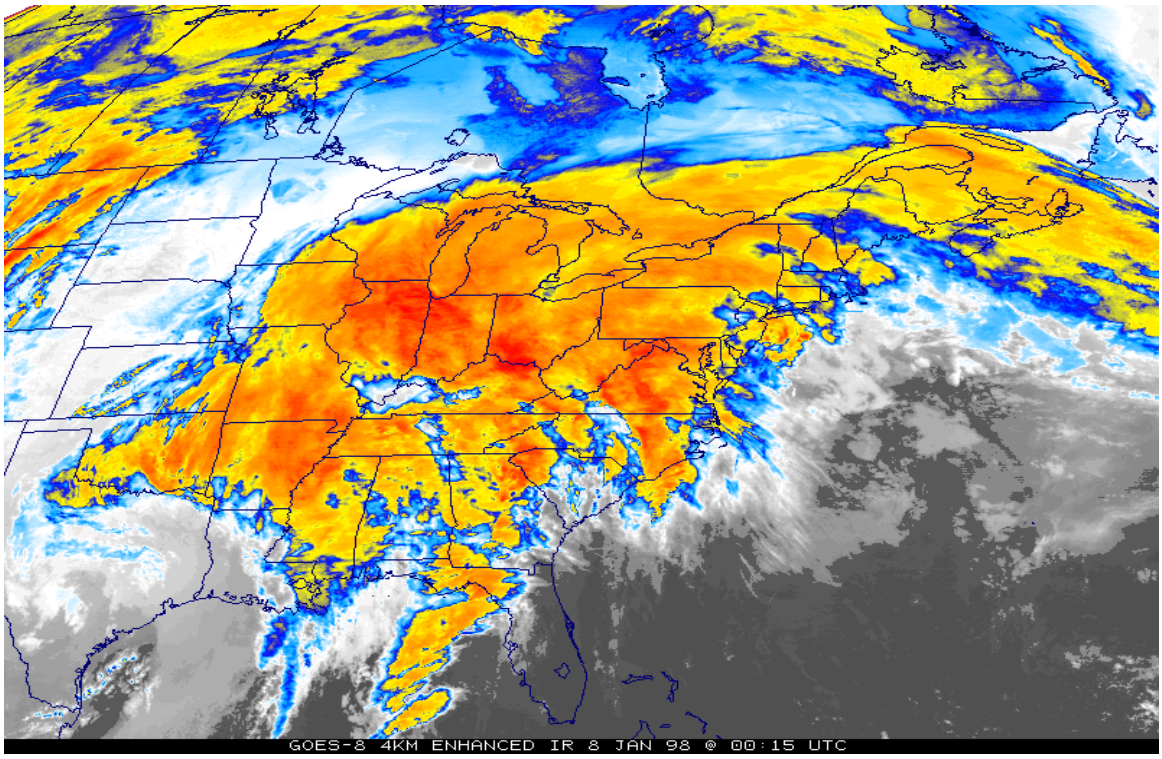


Figure 3. GOES- 8 Infrared Image, 08 Jan 98 at 00:15 Z

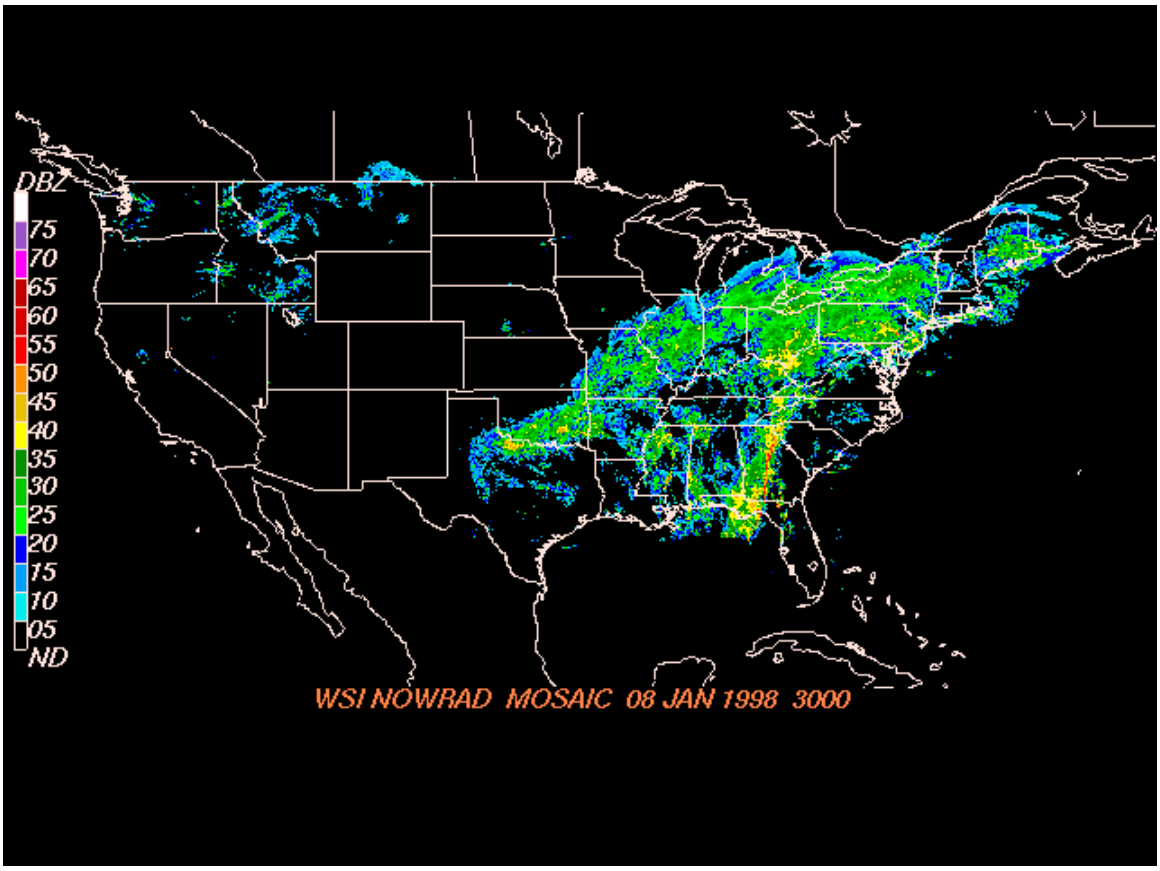


Figure 4. NEXRAD National Composite, 08 Jan 98 at 00:00Z

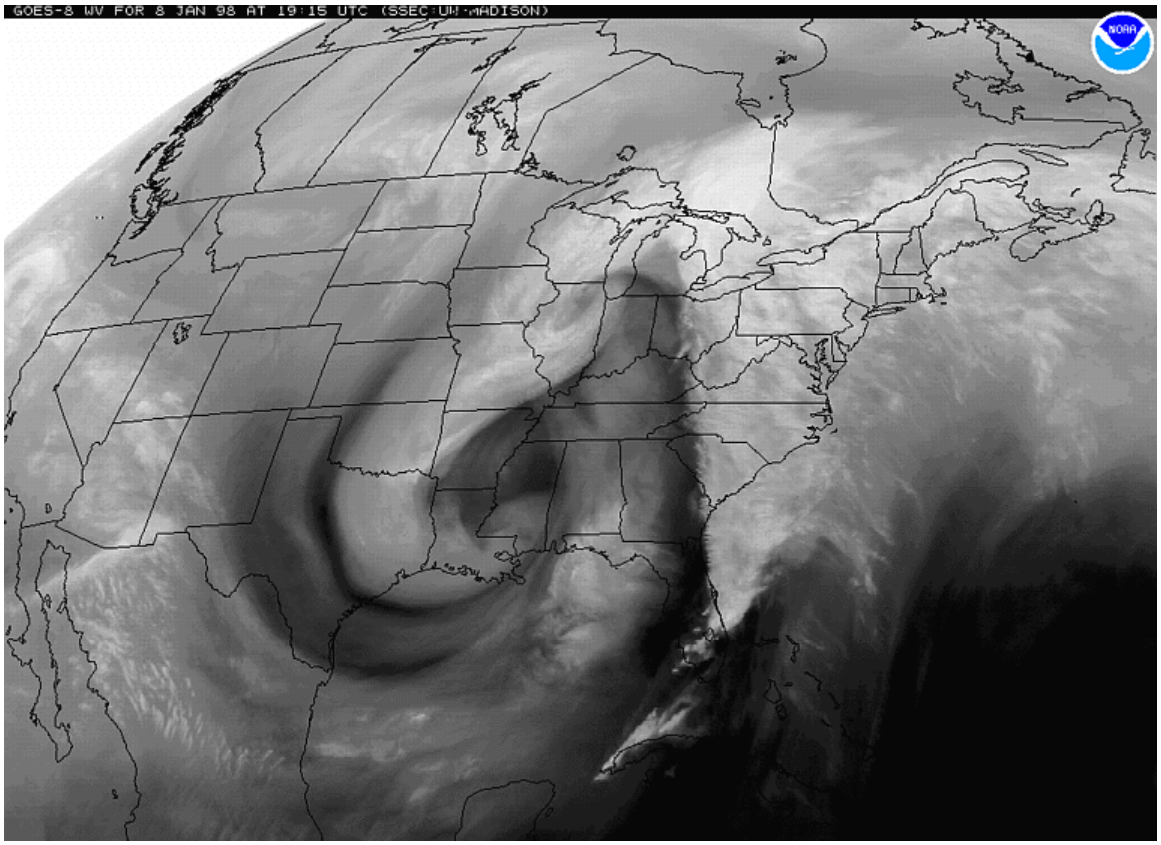


Figure 5. GOES-8 Water Vapor Image, 08 Jan 98 at 19:15Z

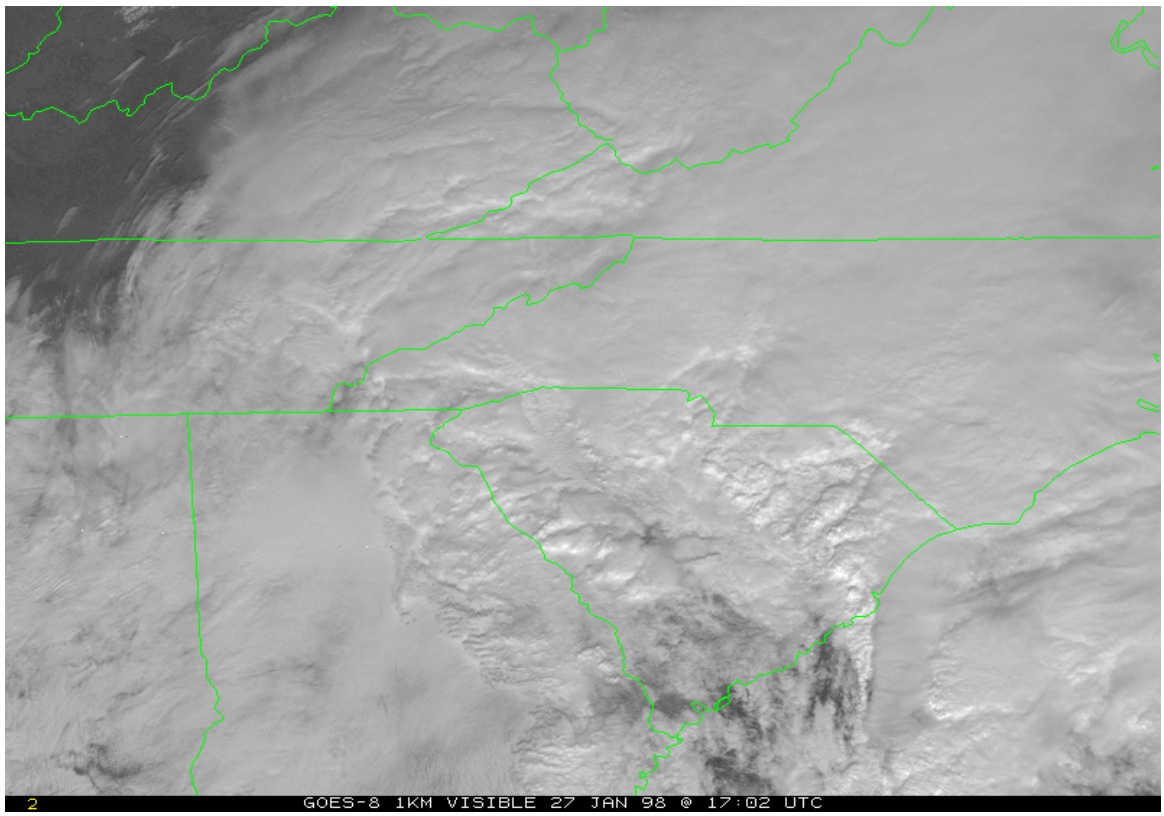


Figure 6. GOES-8 1KM Visible Image, 27 Jan 98 at 17:02 Z

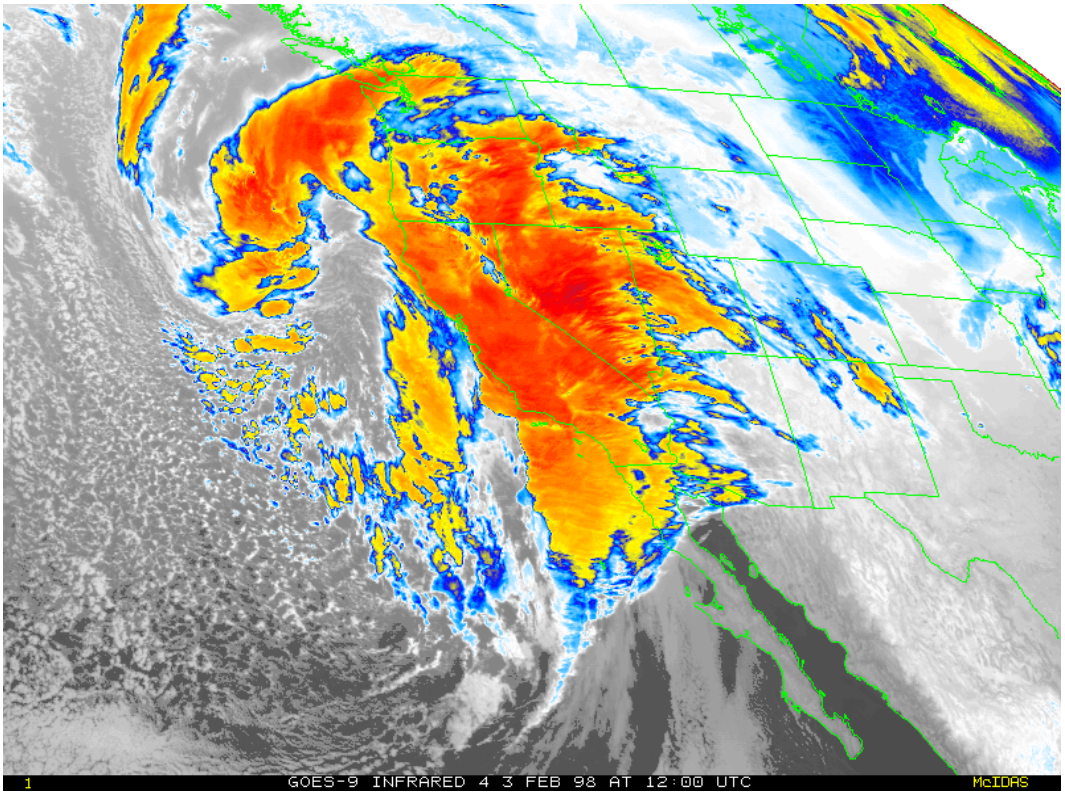


Figure 7. GOES-9 Infrared Image, 3 Feb 98 at 12:00Z

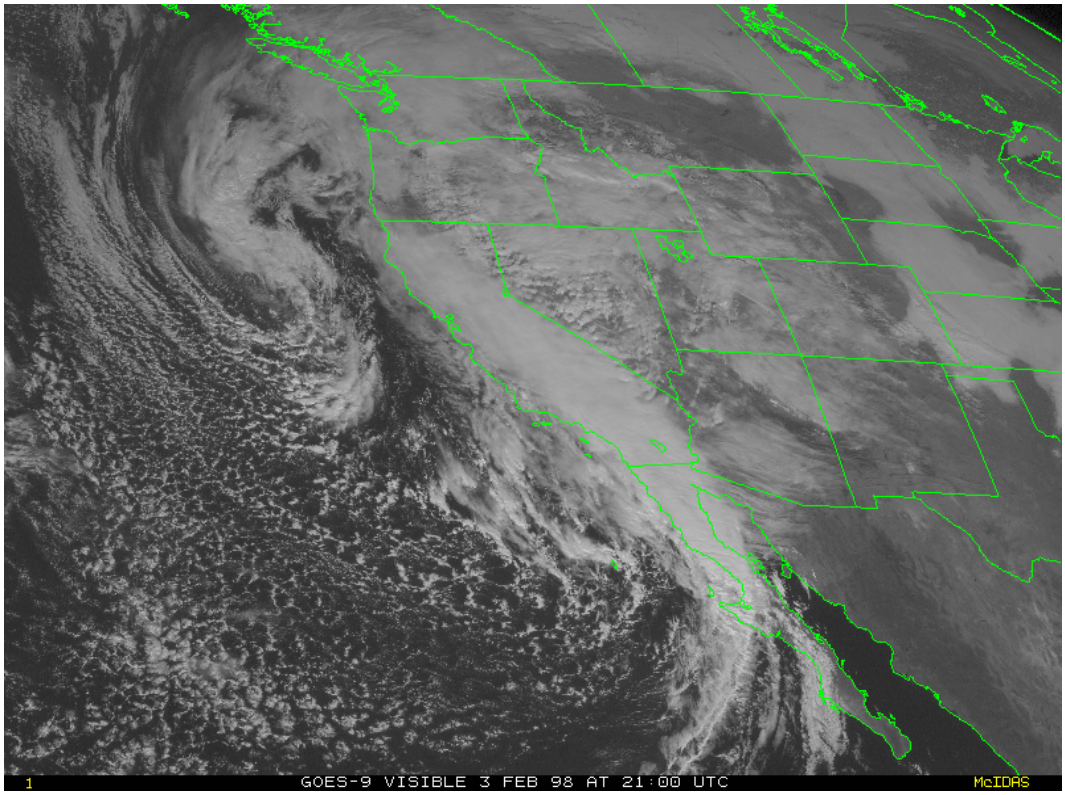


Figure 8. GOES-9 Visible Image, 3 Feb 98 at 21:00Z

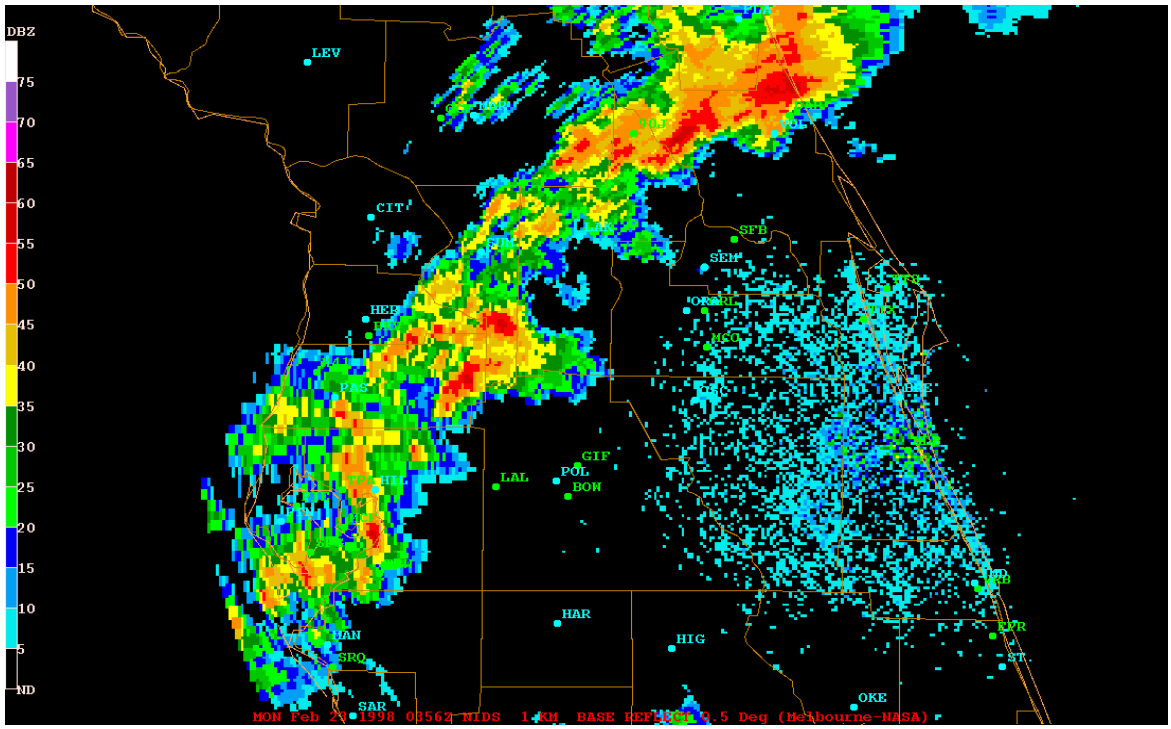


Figure 9. NEXRAD Radar Reflectivity 23 Feb 98 at 03:56Z

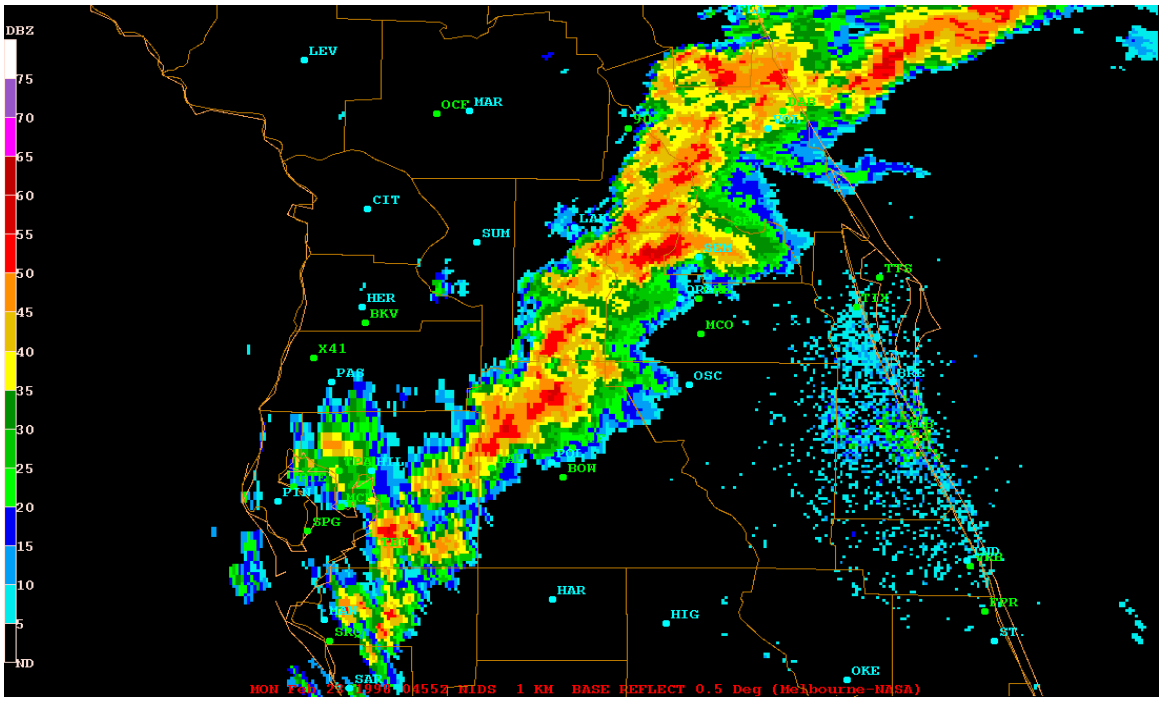


Figure 10. NEXRAD Radar Reflectivity 23 Feb 98 at 04:55Z

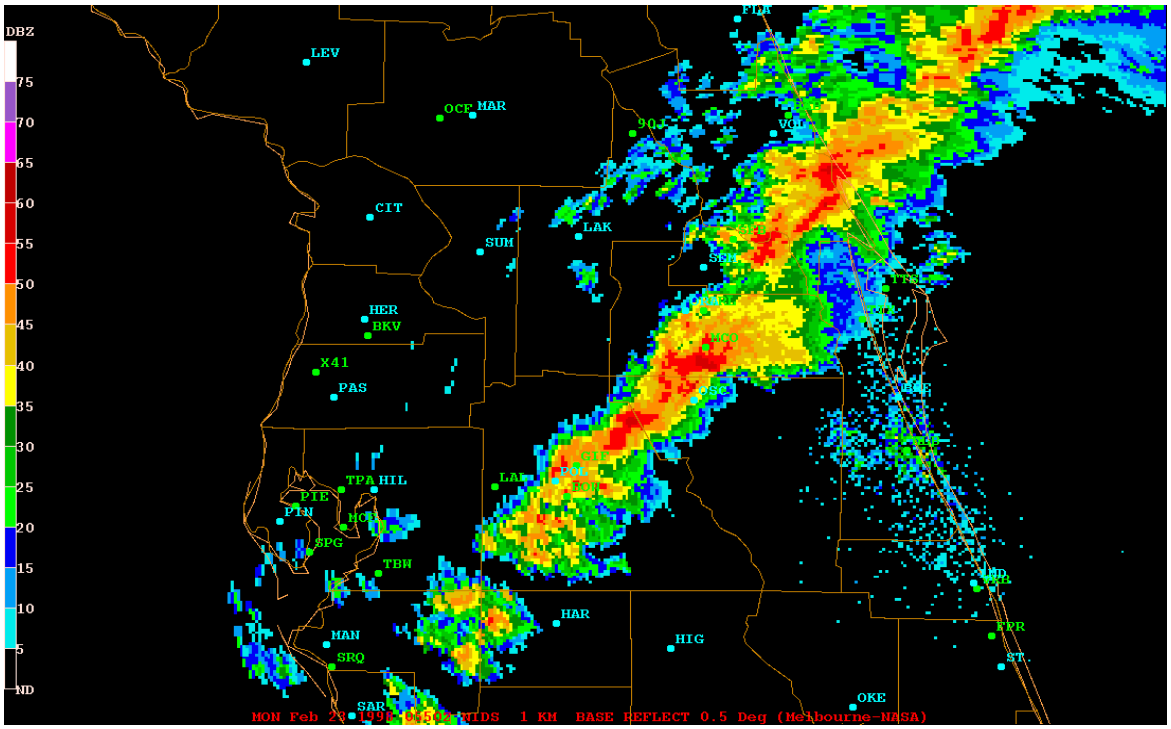
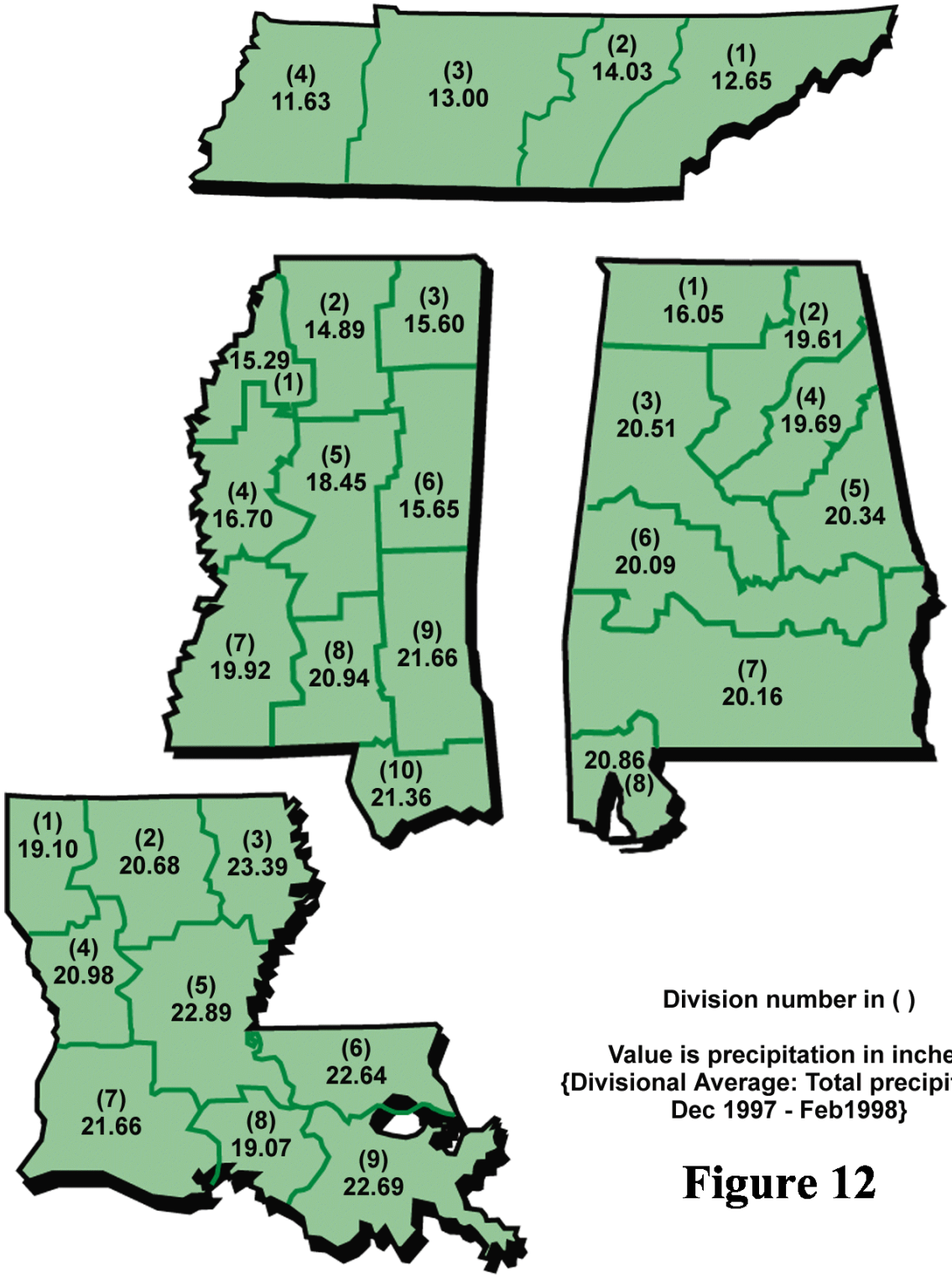


Figure 11. NEXRAD Radar Reflectivity 23 Feb 98 at 05:50Z



Division number in ( )

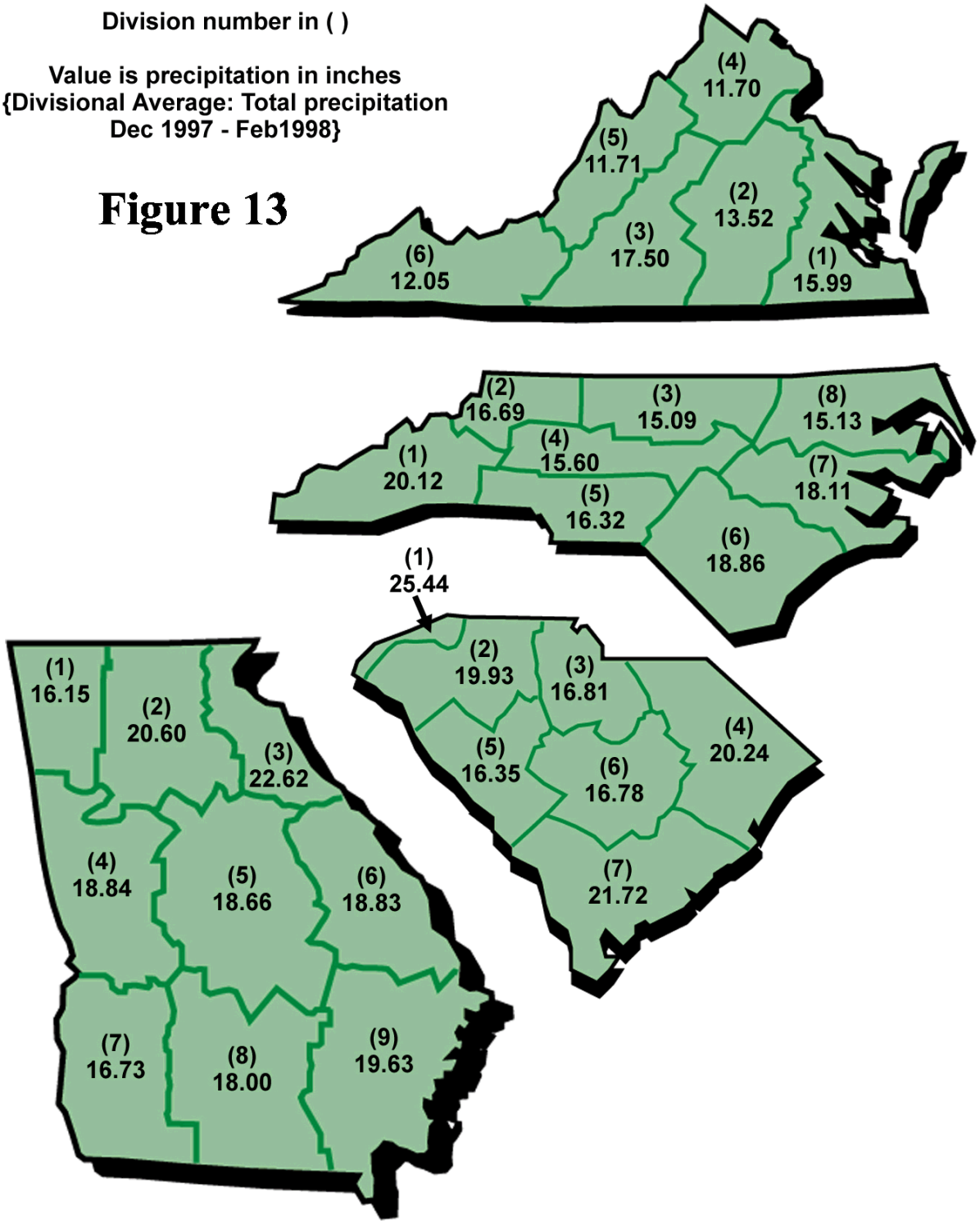
Value is precipitation in inches
{Divisional Average: Total precipitation
Dec 1997 - Feb1998}

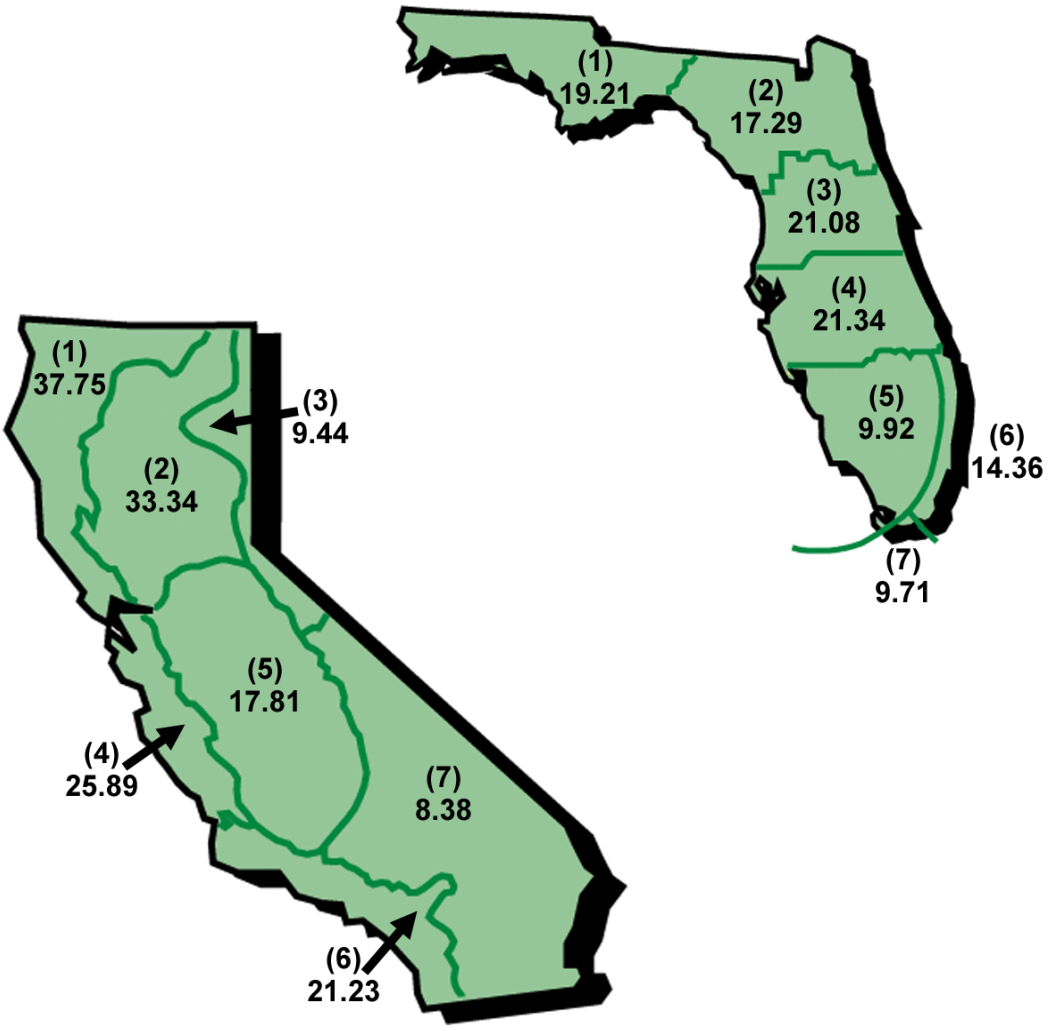
Figure 12

Division number in ( )

Value is precipitation in inches
{Divisional Average: Total precipitation
Dec 1997 - Feb1998}

Figure 13





Division number in ( )

Value is precipitation in inches
{Divisional Average: Total precipitation
Dec 1997 - Feb1998}

Figure 14

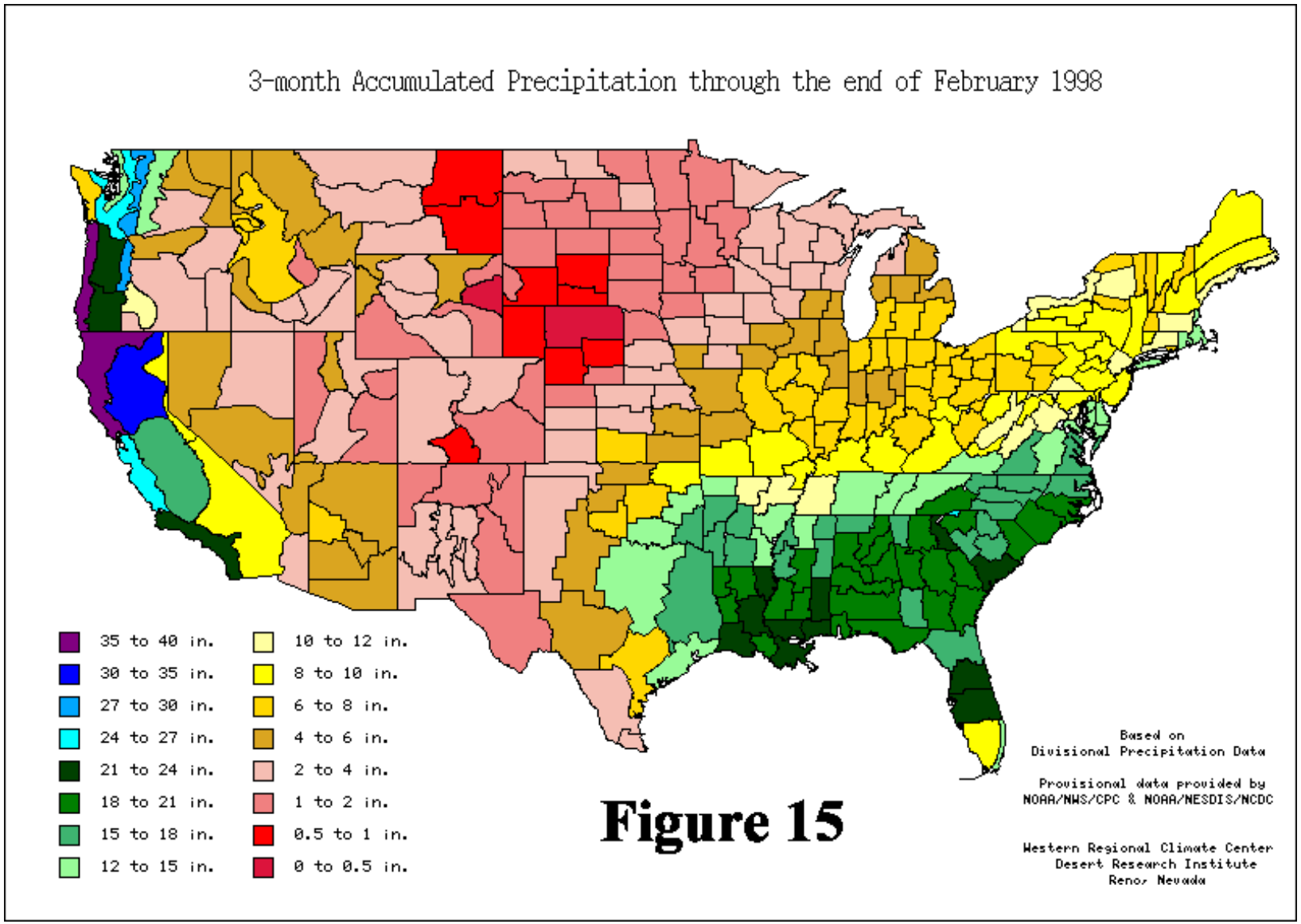

3-month Accumulated Precipitation through the end of February 1998
35 to 40 in.
30 to 35 in.
27 to 30 in.
24 to 27 in.
21 to 24 in.
18 to 21 in.
15 to 18 in.
12 to 15 in.
10 to 12 in.
8 to 10 in.
6 to 8 in.
4 to 6 in.
2 to 4 in.
1 to 2 in.
0.5 to 1 in.
0 to 0.5 in.
Based on
Divisional Precipitation Data
Provisional data provided by
NOAA/NWS/CPC & NOAA/NESDIS/NCDC
Western Regional Climate Center
Desert Research Institute
Reno, Nevada

Figure 15

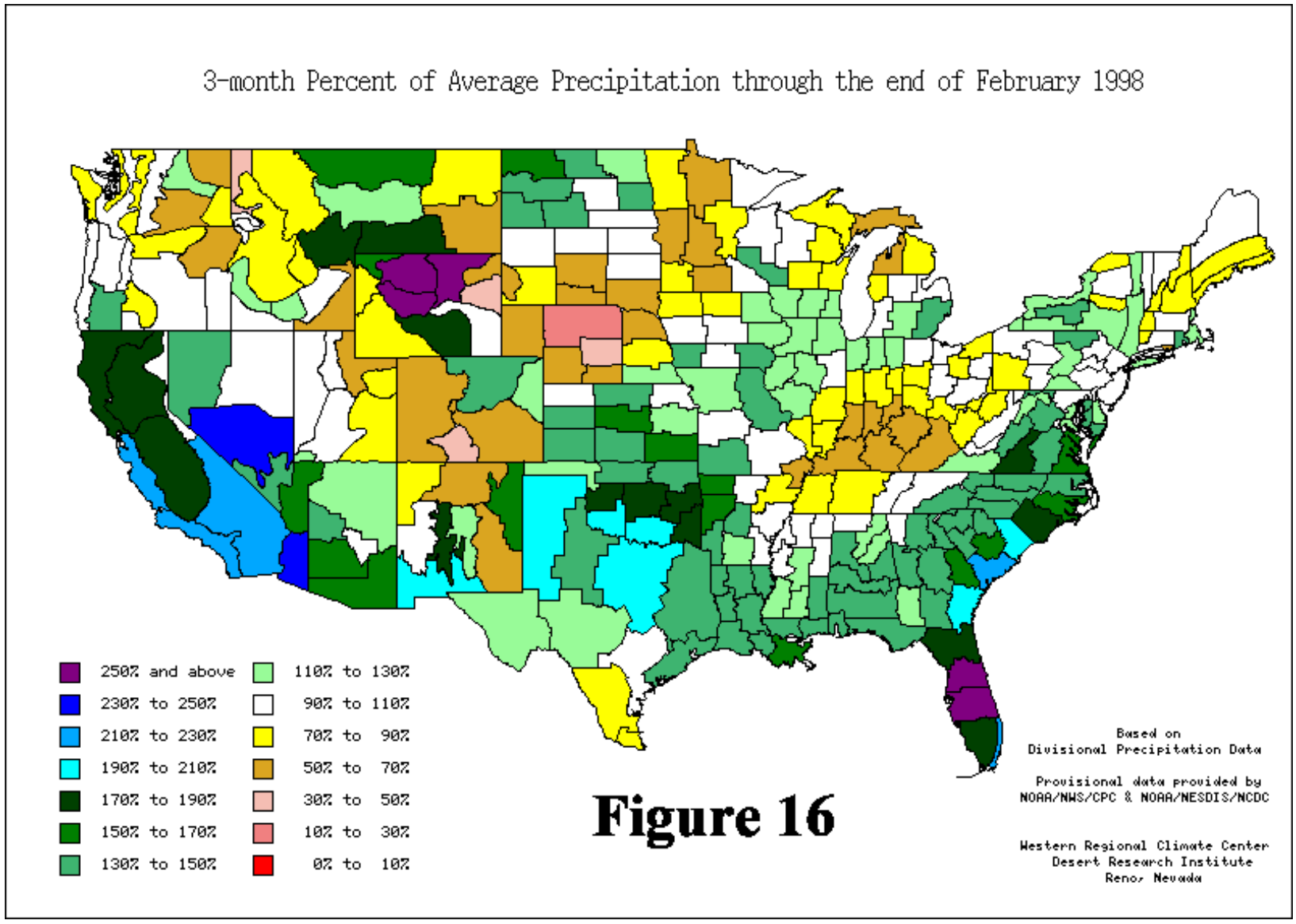

3-month Percent of Average Precipitation through the end of February 1998
250% and above
230% to 250%
210% to 230%
190% to 210%
170% to 190%
150% to 170%
130% to 150%
110% to 130%
90% to 110%
70% to 90%
50% to 70%
30% to 50%
10% to 30%
0% to 10%
Based on
Divisional Precipitation Data
Provisional data provided by
NOAA/NWS/CPC & NOAA/NESDIS/NCDC
Western Regional Climate Center
Desert Research Institute
Reno, Nevada

Figure 16

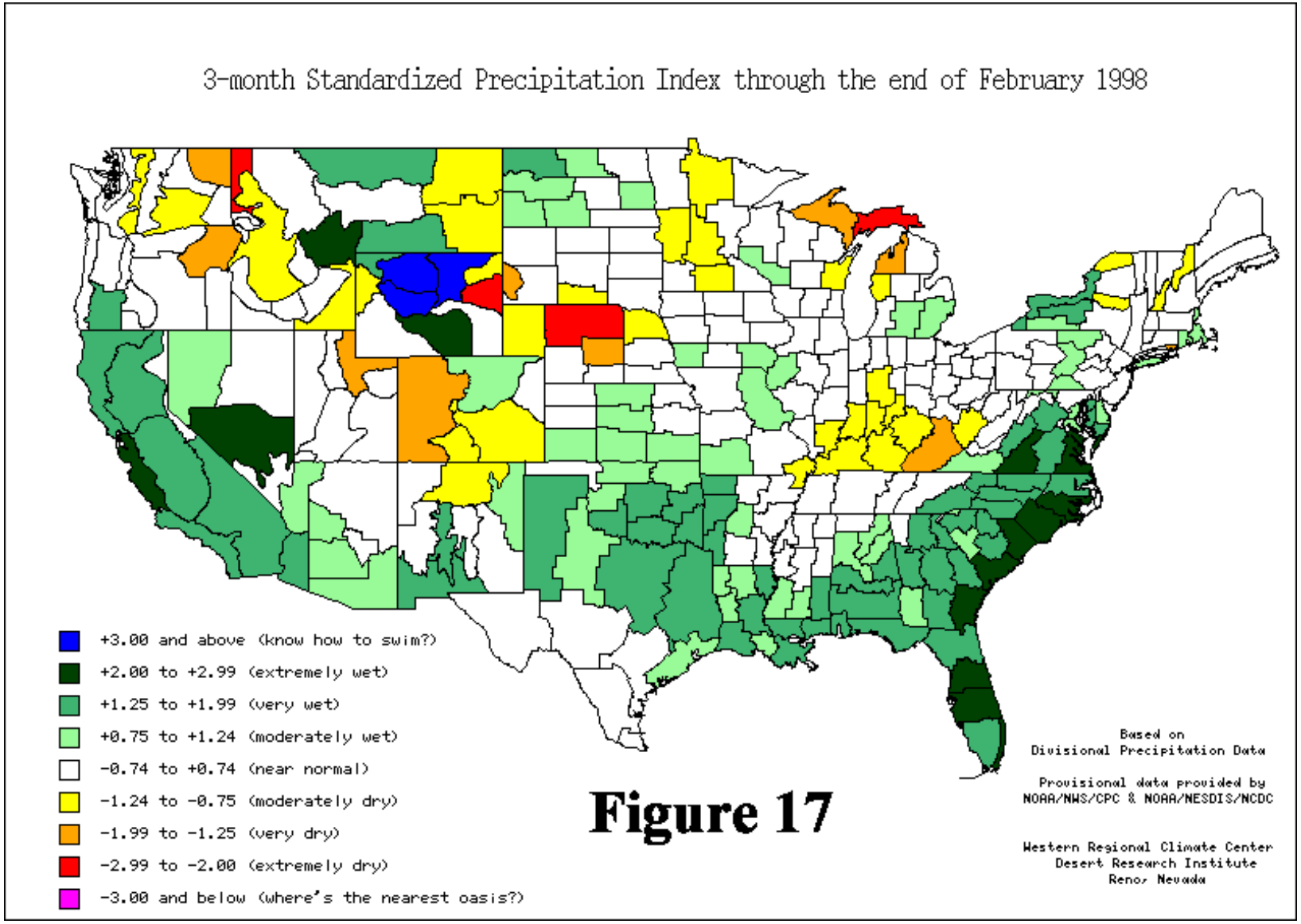

3-month Standardized Precipitation Index through the end of February 1998
+3.00 and above (know how to swim?)
+2.00 to +2.99 (extremely wet)
+1.25 to +1.99 (very wet)
+0.75 to +1.24 (moderately wet)
-0.74 to +0.74 (near normal)
-1.24 to -0.75 (moderately dry)
-1.99 to -1.25 (very dry)
-2.99 to -2.00 (extremely dry)
-3.00 and below (where's the nearest oasis?)
Based on
Divisional Precipitation Data
Provisional data provided by
NOAA/NWS/CPC & NOAA/NESDIS/NCDC
Western Regional Climate Center
Desert Research Institute
Reno, Nevada

Figure 17

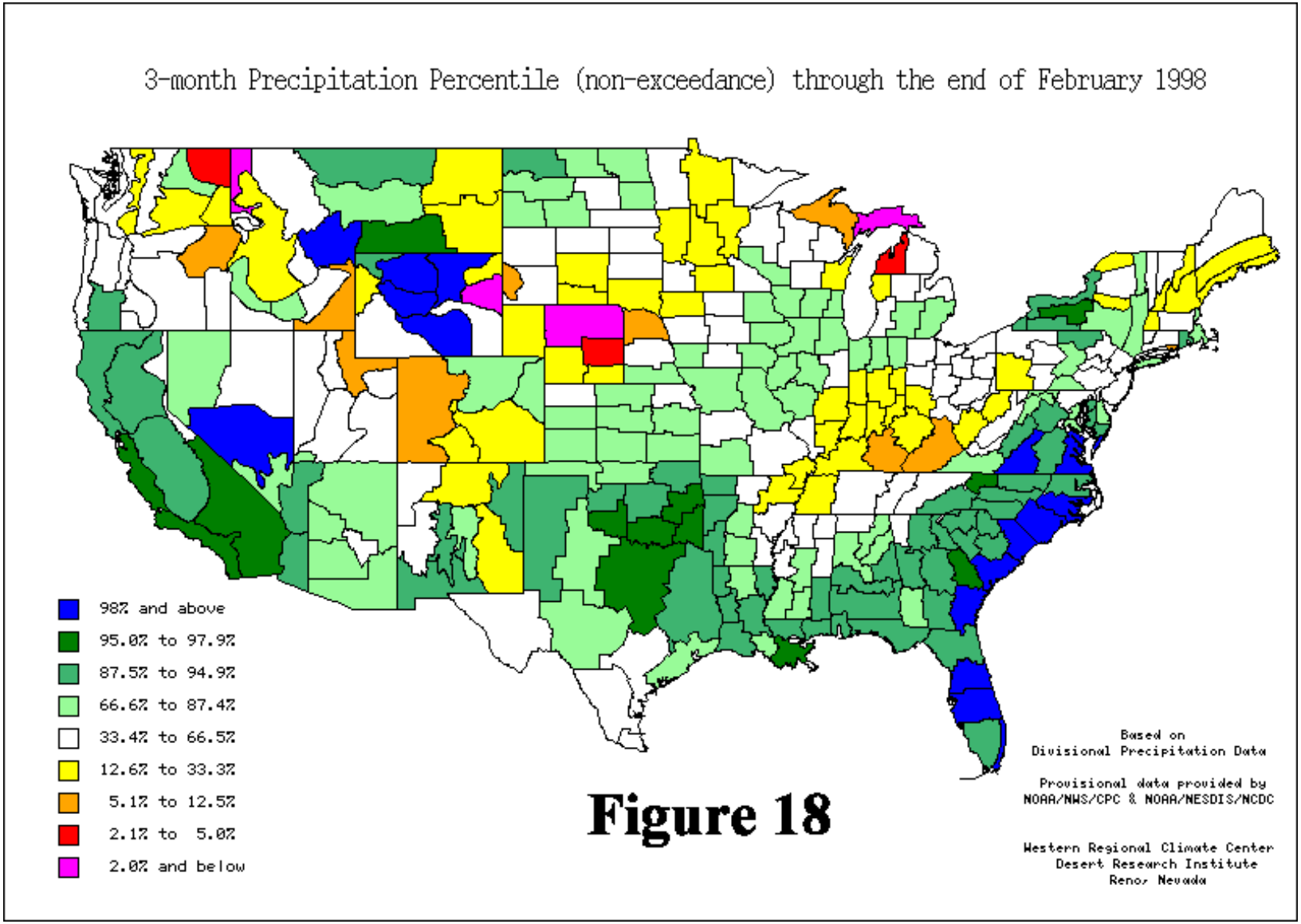
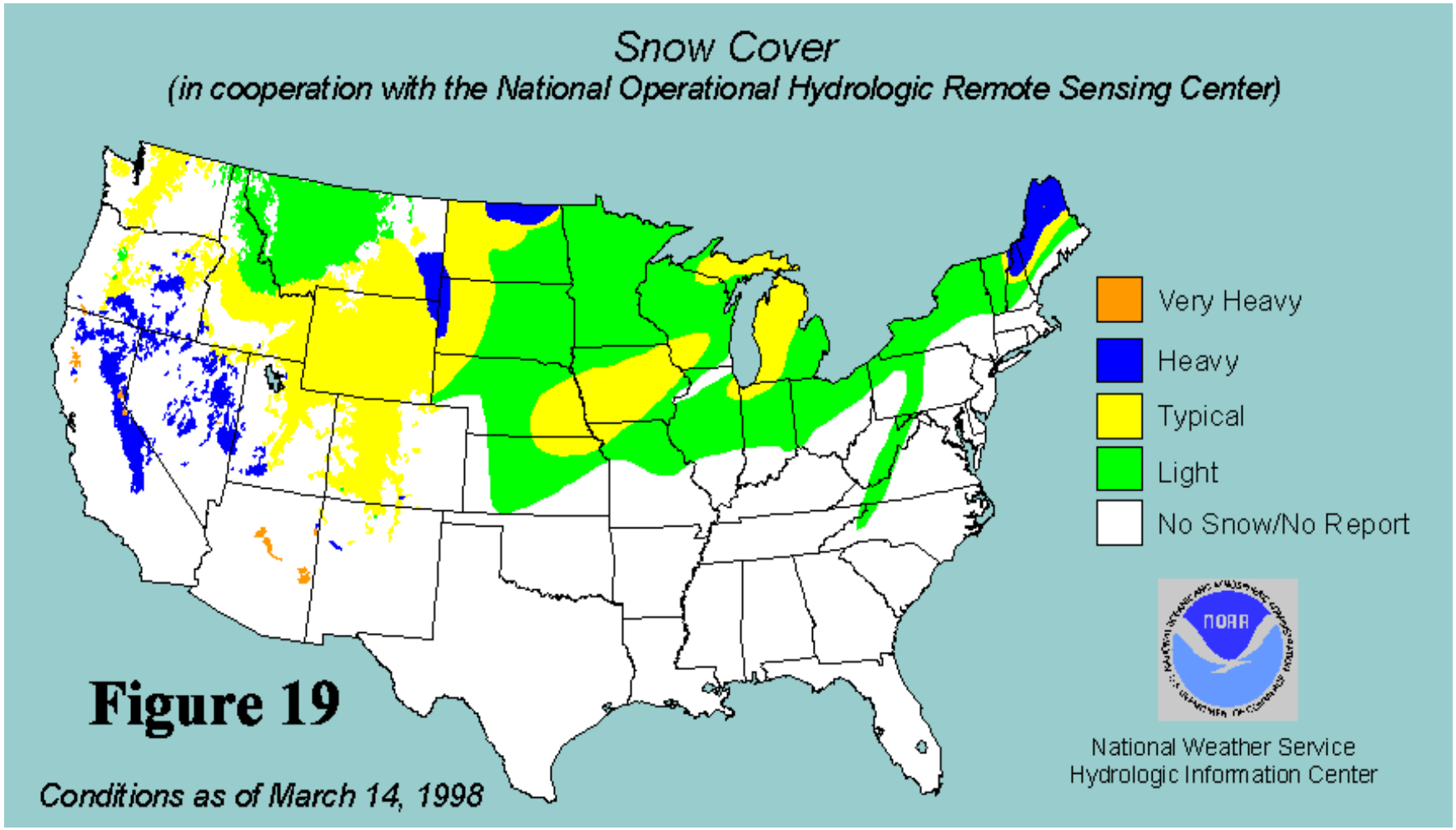
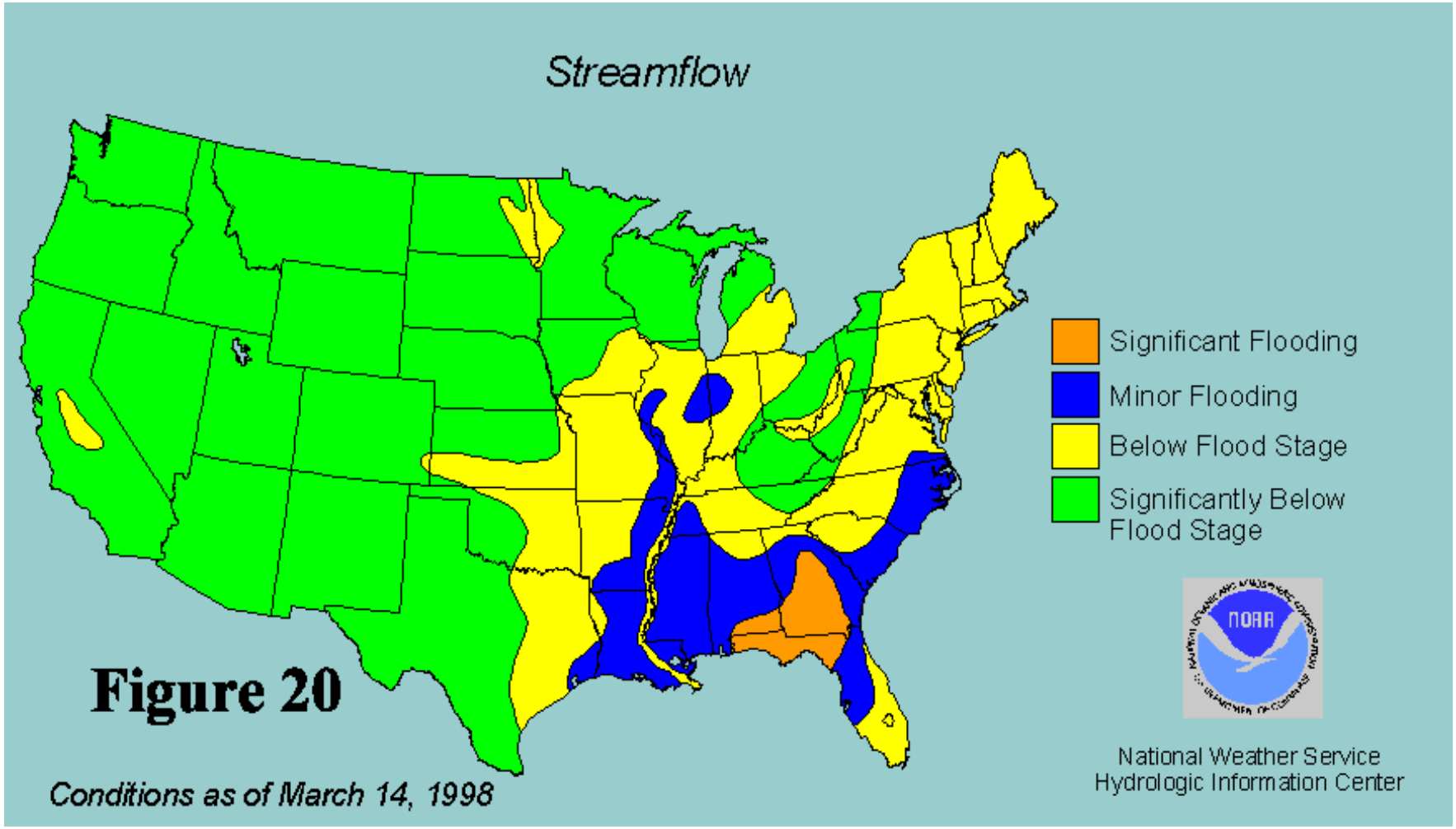

3-month Precipitation Percentile (non-exceedance) through the end of February 1998
98% and above
95.0% to 97.9%
87.5% to 94.9%
66.6% to 87.4%
33.4% to 66.5%
12.6% to 33.3%
5.1% to 12.5%
2.1% to 5.0%
2.0% and below
Based on
Divisional Precipitation Data
Provisional data provided by
NOAA/NWS/CPC & NOAA/NESDIS/NCDC
Western Regional Climate Center
Desert Research Institute
Reno, Nevada

Figure 18


Snow Cover
(in cooperation with the National Operational Hydrologic Remote Sensing Center)
Very Heavy
Heavy
Typical
Light
No Snow/No Report
NOAA
National Weather Service
Hydrologic Information Center
Figure 19
Conditions as of March 14, 1998


Streamflow
Significant Flooding
Minor Flooding
Below Flood Stage
Significantly Below Flood Stage
NOAA
National Weather Service
Hydrologic Information Center
Figure 20
Conditions as of March 14, 1998