Western Region Technical Attachment
No. 89-14
May 9, 1989

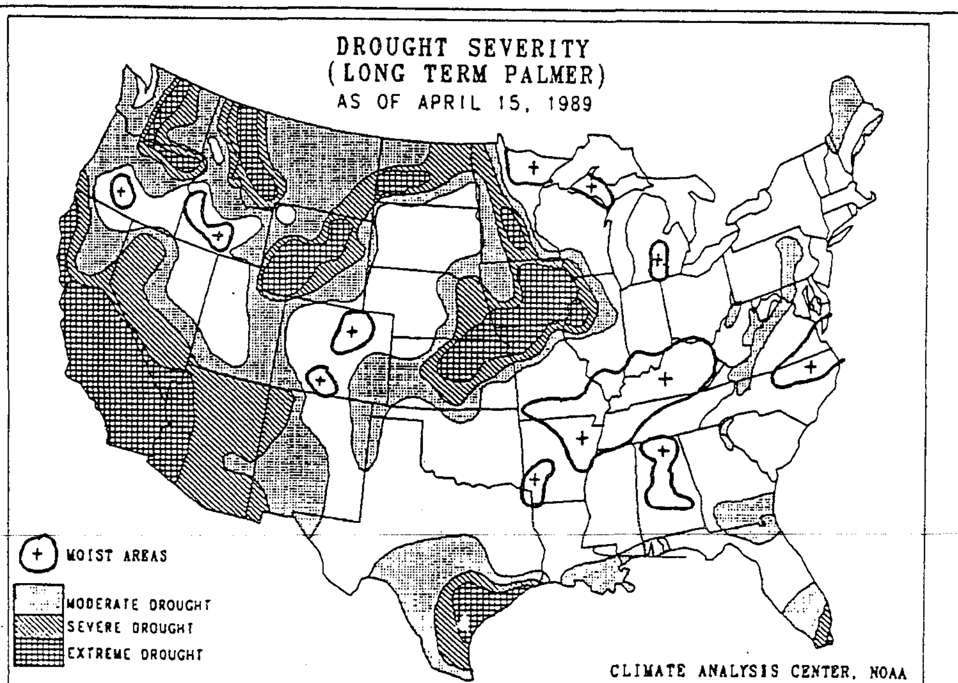
The Current State of Drought Severity in the Western Region

As many forecasters probably realize, 1988 was the most significant and active fire weather season in the western U.S. ever. A record number of fire weather forecaster deployments covered a record number of days on fires, utilizing a record number of ATMU field deployments (Brown, 1988). Since this record fire season was due, in large part, to the severity of the drought conditions in the Western woodlands, it is instructive for us to briefly examine where we are at this time with respect to the holdover drought conditions in the West as we enter another fire weather season.

The weekly Climate Bulletin dated April 15, 1989 displayed a map of the Long-Term Palmer Drought Severity Index (Figure 1) through the date of the publication. (Note that a description of the Palmer Drought Severity Index is included on the following pages of this Technical Attachment). This map shows that while the extreme drought across a good portion of the midwestern U.S. has abated, the dryness throughout much of the West remains. Moderate drought (or worse) covers approximately 75% of the NWS Western Region. Some areas, including portions of the Washington Cascades, Montana Rockies, and the California coastal ranges and southern and central Sierras are still under extreme drought conditions. Therefore, forecasters should remain alert for potentially dangerous "dry lightning" episodes throughout much of the region as the convective season begins. Likewise, all responsible offices should ensure that they are able to support field fire weather forecasters with products upon request. Given the right (or, perhaps, the wrong) circumstances, this could be another active fire weather season in the Western Region.

Reference:

Brown, S.W., 1988: The 1988 Fire Season: A Fire Weather Perspective. Interagency Fire Weather Report (Available from WSFO Boise).



The long-term Palmer Drought Index as analyzed by category (see above table) for the week ending April 15, 1989. Severe or extreme long-term drought still existed in parts of the western Corn Belt, central Great Plains, northern Rockies, and Far West, while unusually moist conditions prevailed in the Ohio and Tennessee Valleys, western Great Lakes, central Rockies, and Carolinas.

The Drought Severity (Long-Term, Palmer) Index

[This information was taken, with only minor changes, from the Weekly Climate Bulletin, April 15, 1989.]

The Drought Severity, or Palmer, Index is an index of meteorological drought (or moisture excess) and indicates prolonged abnormal conditions affecting water sensitive economics. The index usually ranges from about -6 to +6, with negative values denoting dry spells and positive values denoting wet spells of weather (categories of values are given on the accompanying map. The equations for the index were derived from monthly average data and based on the concept of a balance between moisture supply and demand (Palmer, 1965). The equations have been modified to compute the index on a weekly bases for publication in the Weekly Climate Bulletin. Input data consists of weekly temperature averages and precipitation totals for 350 climate divisions in the United States and Puerto Rico.

The index is a sum of the current moisture anomaly and a portion of the previous index to include the effect of the duration of the drought or wet spell. The moisture anomaly is the product of a climate weighting factor and the moisture departure. The weighting factor allows the index to have a reasonably comparable significance for different locations and times of the year. An index value for a division in Florida would have the same local implication as a similar value in a more arid division in western Kansas. The moisture departure is the difference between water supply and demand. Supply is precipitation and stored soil moisture, and demand is the potential evapotranspiration, the amount needed to recharge the soil, and runoff needed to keep the rivers, lakes and reservoirs at a normal level. The runoff and soil recharge and loss are computed by keeping a hydrologic accounting of moisture storage in two soil layers. The surface layer can store one inch of water, while the available capacity in the underlying layer depends on the soil characteristics of the division being measured. Potential evapotranspiration is derived from Thornthwaite's method (1948).

The index is measured from the start of a wet or dry spell and is sometimes ambiguous until a weather spell is established. A week of normal or better rainfall is welcome in an area that has experienced a long drought, but may be only a brief respite and not the end of the drought. Once the weather spell is established (by computing a 100% "probability" that an opposite spell has ended), the final value is assigned. To make the program have a real-time significance, a value is assigned based on a greater than 50% "probability" that the opposite spell has ended. This is not entirely satisfactory, but it does allow the index to have a value when there is a doubt that it should be positive or negative.

One aspect that should be noted is that the demand part of the computations includes three parameters: potential evapotranspiration, recharge of soil moisture, and runoff. Any one of these three parameters may produce negative values. If only enough rain fell to satisfy the expected evapotranspiration, but not enough to supply the recharge and runoff (considering the soil characteristics), then a negative index would result. If such an odd situation continued, agriculture would continue at a normal pace, but a worsening drought would be indicated. Similarly, enough rain could fall to keep fuel moisture at a high enough level to diminish the threat of wide-spread fires, yet a worsening drought could still occur. Shallow wells and springs would dry and the levels of rivers, lakes, and reservoirs would fall. Serious economic stress to the livestock trade, industries, and cities would eventually result. Then, if rainfall fell below the minimum needed for agriculture, crops would suffer dramatic and rapid decline because there would be no reserve water in the soil. Such a situation, to some extent, occurred in the Northeast drought in the mid-

1960's when New York City almost ran out of water.

A detailed explanation and examination of the index is given by Alley (1984). Both Alley and Karl (1983) address the sensitivity of the index and list some limitations.

References:

Alley, W., 1984: The Palmer Drought Severity Index: Limitations and Assumptions. *J. Clim. and Appl. Meteor.,* **23,** 1100-1109.

Karl, T.R., 1983: Some Spatial Characteristics of Drought Duration in the United States. *J. Clim. and Appl. Meteor.,* **22,** 1356-1366.

Palmer, W.C., 1965: *Meteorological Drought.* Weather Bureau Research Paper No. 45, U.S. Dept. of Commerce, Washington, D.C., 58 pp.

Thornthwaite, C.W., 1948: An Approach Toward a Rational Classification of Climate. *Geog. Rev.,* **38,** 55-94.

General Categories of the Palmer Drought Index

> +4.0	Extreme Moist Spell
+3.0 to +3.9	Very Moist Spell
+2.0 to +2.9	Unusual Moist Spell
+1.0 to +1.9	Moist Spell
+0.5 to +0.9	Incipient Moist Spell
+0.4 to -0.4	Near Normal
-0.4 to -0.9	Incipient Drought
-1.0 to -1.9	Mild Drought
-2.0 to -2.9	Moderate Drought
-3.0 to -3.9	Severe Drought
< -4.0	Extreme Drought