THE 1930s DROUGHT IN THE U.S. GREAT PLAINS: NEW PERSPECTIVES AND A LOOK AT LAND SURFACE RESPONSES

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1. INTRODUCTION

The 1930s drought event in the North American Great Plains region—The Dust Bowl—is one of the best-studied historical and climatological events in U.S. history. We reexamine this drought episode using a recently compiled daily climate data set for the conterminous United States (Eischeid *et al.*, 2000) focusing on changes in the occurrences of daily weather patterns in comparison with the longer-term averages. We look at changes in a number of variables, such as the time interval between measurable rainfall events, the exceedance/non-exeedance of different threshold values for maximum daily temperature and precipitation in the Dust Bowl region, inferred synoptic weather patterns, and the cumulative impact of these climatic conditions on the regional landscape, using proxy climate records, such as the aeolian depositional histories in the western Sandhills region of Nebraska.

Recent results from a geomorphic study (Forman, unpublished) indicate local remobilization within the western Nebraska sandhills of 1 to 4 meters of material significantly impacted the land surface cover, local drainage patterns, and human occupants. Results from our analyses of the new daily climate data set have been used in the design of experiments to model the impact of vegetation cover changes on dune mobilization, and to assess the plausibility of climate as the primary forcing of dune reactivation during the 1930s Dust Bowl. *

2. RESULTS

We first had to define the spatial domain of the region most affected by the drought. Figure 1 illustrates the domain that we define as the core region of the 1930s drought. In general, this area experienced annual precipitation values during the decades of the 1930s in the lower tercile of the observed distribution. Mean precipitation over the 10-year period from 1930–39 averaged less than 90% of the long-term mean. In some years, precipitation was below normal and annual temperature was above normal for about 80% of the individual station records in the region shown in Fig. 1.

Previous studies (e.g., Skaggs, 1975; Diaz, 1983) have noted that the Dust Bowl drought was characterized by three successive episodes of dryness and above average temperatures, which was interrupted for about a year or so (in 1932 and 1935) with near normal precipitation. Figure 2 illustrates the time variability of normalized annual surface temperature and precipitation for the Great Plains region defined in Fig. 1 and highlights the highly anomalous nature of the Dust Bowl drought in this region.

We have examined the daily station precipitation records in this region to ascertain some of the salient characteristics of this drought event, in terms of such things as the mean interval between the occurrence of measurable precipitation, and changes in the distribution of quantiles during the decade of the 1930s compared to the long-term climatology. Some characteristics of the 1930s drought compared to the wet decade of the 1990s (see Fig. 2) are summarized in Table 1, below.

Table 1. Statistical summary for the 1930s and 1990s period in the northern Great Plains.

	PCDR	MDA	MAP	MAT
Climo	21.3	0.30	23.60	8.32
1930–39	19.5	0.28	20.56	8.93
1990–99	22.5	0.32	26.08	8.68

PCDR: percentage of days with rain; MDA: mean mount of days with rain; MAP: mean annual precipitation in region (inches) and MAT: mean annual temperature (˚C).

There were about 2% fewer days with measurable precipitation in the 1930s compared to climatology (a little over 1%

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more rainy days in the 1990s). The yield of the daily precipitation in the 1930s (rain per rain-day) is 0.28" versus 0.32" in the 1990s and mean precipitation in the 1930s was 87.1% of the long-term mean (20.56"/522 mm) compared to 110.5% of the LTM (26.06"/662 mm) for the 1990s. Interestingly, both decades were much warmer than normal with a mean temperature for the 1930s only about 0.5˚F/0.25˚C warmer than the 1990s.

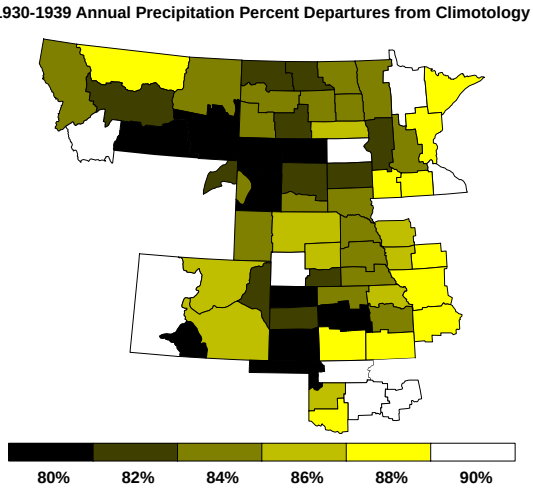

Fig. 1. Map of the northern Great Plains region where the core of the 1930s Dust Bowl drought was situated. The map highlights the climate divisions where the 10-year average was below 90% of the long-term average.

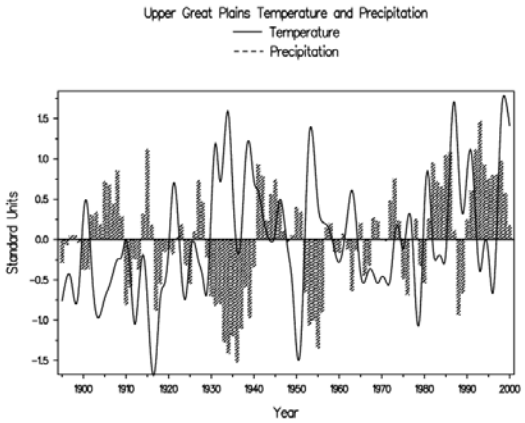

Figure 2. Time series of standardized temperature and precipitation anomalies for the Dust Bowl region illustrated in Fig. 1. Annual departures smoothed with a 1-2-1 moving filter.

An analysis of the daily amounts in the dry 1930s compared to the wet 1990s in this region, shows that the largest differences in the frequency of occurrence of daily amounts are found for daily totals in the range of about 0.2 to 0.5 inches (5.1 to 12.7 mm). These are amounts that are found within the interquartile range of the distribution of daily precipitation for this area.

Furthermore, assessments of the relationship between climate and dune activity in three different climatic zones that are progressively more arid (a cross-section from the western Great Plains through the Chihuahuan desert in southern New Mexico and the Mojave Desert in southeastern California, indicate that aridity, as defined be the ratio of precipitation to potential evapotranspiration is the more critical parameter in comparison with wind strength.

3. SUMMARY

The observational record of major decadal scale climate anomalies, such as the one that occurred in the U.S. Great Plains in the 1930s indicates that drought episodes with recurrence intervals of between 50 and 100 years are associated with a decrease in precipitation of about 15% to 20% over areas covering approximately 2 million square kilometers. Mean temperatures were about 0.6˚C warmer than the 100-year mean. Projections of greenhouse-gas induced climate change could result in permanent. shifts in the mean temperature and precipitation of regions of the U.S. of approximately the size of the Dust Bowl.

4. REFERENCES

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