

Comments on "Rainfall and Climate Variation over a Sloping New Mexico Plateau during the North American Monsoon"

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In a recent paper, Bowen (1996) examined rainfall patterns in northern New Mexico. In this study, hourly rainfall data were available for three stations for the years 1981–89. Rainfall frequencies at all stations had two maxima in their diurnal curves during July and August. As pointed out by Bowen, these months are during the summer monsoon and have by far more thunderstorms and precipitation than other months of the year. Although Bowen also presented data on precipitation amounts, they will not be discussed here because the small number of years used for this analysis could cause it to be biased by one or two events of unusually large amounts. For two of the stations, one maximum was at 1300 or 1400 local time and another at 2100 or 2200 local time. One station had a maximum at 1800 and 2300 local time in July and 1400 and 2100 local time in August. Although no statistical verification was presented, it seems reasonable from their magnitudes that both maxima are important and need to be explained. Bowen suggested that these precipitation patterns could be accounted for by convergence due to katabatic and anabatic winds. Certainly, the midday maxima could be accounted for in this manner, because the upslope flow could initiate convective activity. The late evening maxima appear to be more difficult to explain by this mechanism because the area is bounded by mountains on only one side and there is no opposing flow to create the necessary convergence.

Similar precipitation patterns have been observed in southern New Mexico (Tucker 1993). Tucker showed that for the stations with two diurnal maxima, both maxima were statistically significant for the majority of stations in the study. The major difference in the patterns is that the nighttime maximum in southern New Mexico is later, between 2300 and 0200 local time. Tucker proposed that the

precipitation maximum that occurred near midnight could be explained by diurnal precipitation patterns forced by the plateau circulation system. Reiter and Tang (1985) showed that the 850-mb level (representing the planetary boundary layer) is dominated by low pressure during the daytime due to strong heating by the elevated terrain. This low pressure region had three major centers, one in southern Colorado–Utah, one in central Nevada, and one near the Idaho–Wyoming border. These low pressure areas moved outward from these centers during the evening as the daytime circulation transitioned to a nighttime one. Reiter and Tang (1985) noted that the farther areas were from one of the daytime centers of the plateau circulation system, the later the time of maximum precipitation. For southern New Mexico, this maximum would fall at the time the nighttime maxima are observed at area stations.

Northern New Mexico is closer to one of the daytime centers of the plateau circulation system and, therefore, one would anticipate that precipitation maxima forced by this mechanism would be earlier in the evening than for southern New Mexico. This expectation is consistent with the observations presented by Bowen (1996). Therefore, the diurnal variations in precipitation forced by the plateau circulation system would appear to be a likely explanation for the late evening (2100–2300 local time) precipitation maxima in this region.

Bowen (1996) also presents data to show that this region has a south to southwesterly wind maximum at 92 m above the earth's surface during the night. Tucker (1993) also showed high-speed low-level winds that are consistent with the plateau circulation system. The wind profiles presented by Tucker have maximum speeds at about 2000 m above the earth's surface. Unfortunately, it does not appear as though wind measurements above 92 m are available at the northern New Mexico site to use for comparison.

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REFERENCES

- Bowen, B. M., 1996: Rainfall and climate variation over a sloping New Mexico plateau during the North American Monsoon. *J. Climate*, **9**, 3432–3442.
- Reiter, E. R., and M. Tang, 1984: Plateau effects on diurnal circulation patterns. *Mon. Wea. Rev.*, **112**, 638–651.
- Tucker, D. F., 1993: Diurnal precipitation variations in south-central New Mexico. *Mon. Wea. Rev.*, **121**, 1979–1991.