Rucker Canyon Flash Flood WES Case

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Introduction

On July 21, 2002, a very localized but major flash flood occurred over the Rucker Canyon Basin of Cochise County, Arizona (figure 1). The canyon originates in the Chiricahua Mountains, which on average receives about half of its annual precipitation during the summer thunderstorm season from mid June through September. This storm was quite noteworthy given its very slow movement, isolated nature, and prolific rainfall. A storm spotter report of 4.7 inches in two hours was received from the area, although WSR-88D storm total estimates suggest up to 6 inches of rain may have fallen from the regenerative cell cluster (figure 2) with a basin average of over 2 inches. The resulting flash flood is documented in a companion Technical Attachment (WR-TA 04-07, Schaffner, 2004)

Synoptic and Mesoscale Situation

Conditions were quite favorable for strong and organized convection to develop over southeast Arizona. An upper level inverted trough over Sonora was clearly depicted on GOES water vapor imagery (figure 3) and was advancing west toward Arizona. Weak positive vorticity advection was underway on the northwest deformation flank of the low, with a subtropical high centered over northern Nevada and a much stronger upper low off the California coast (figure 4). The overall pattern nearly mimicked the classical "Type II" severe weather pattern in Arizona (McCollum, 1993) which is explained on the NWS Tucson website (http://www.wrh.noaa.gov/tucson/monsoon/severel.html). The 12Z KTUS sounding also showed several alarming features, including unusually high CAPE, a weak capping inversion at 450mb, and precipitable water near 1.5 inches. Mid level shear (in the 850-600mb layer) was around 20kts (figure 5), which according to a Technical Attachment by Mendoza (2004) falls into the "moderate" category for active severe thunderstorm and flash flood episodes in southeast Arizona.

Thunderstorms developed unusually early in the day on July 21, 2004, with a 50dBz cell over Rucker Canyon just before noon local time (figure 6). Aided by near surface west to northwest flow and coupled with northeast flow aloft, the storm regenerated several times over the canyon (figure 7). At that point, cloud-to-ground lightning strikes were occurring at the rate of 50-per-15 minutes with visible imagery showing a well-defined overshooting top over the flash flood area (figure 8). The storm cluster finally weakened after 2030Z as outflow moved away from the area and helped to choke off the persistent inflow (figure 9).

Discussion

This case was interesting from the standpoint that while the general situation was quite favorable for severe thunderstorms and flash flooding, only an isolated yet notable flash flood occurred. It appears that the weak capping inversion prevented widespread activity from developing. However, a combination of synoptic-scale forcing juxtaposed with the Chricahua Mountains helped to develop an isolated thunderstorm, which then regenerated over 2 to 3 hours thanks in large part to favorable low level inflow and moderate low

level shear. Other strong thunderstorms developed over the Gila and White Mountains (the initial development is visible in figure 8), organized into a loose line, and moved southwest into the Rucker Canyon area later in the afternoon. Normally, such a Type II pattern (referred to euphemistically as a "rim shot" pattern) would result in not only flash flooding, but also at least some damaging wind. However, as these storms crossed into Cochise County, the outflow from this initial flash flood-producing storm may have stabilized the atmosphere somewhat, kept the subsequent storms below severe limits, and prevented a renewal of flash flooding near Rucker Canyon later in the afternoon.

References

McCollum, D. M., 1993: Synoptic-scale patterns associated with severe thunderstorms in Arizona during the summer monsoon. M.S. thesis, School of Meteorology, University of Oklahoma, 166 pp.

Mendoza, J., 2004. NOAA*/NWS Western Region Technical Attachment,* **04-03.**

Schaffner, M., 2004: The Rucker Canyon Flash Flood of July 21, 2002: Estimating Discharge for an Ungaged Site. *NOAA/NWS Western Region Technical Attachment*, **04-07.**

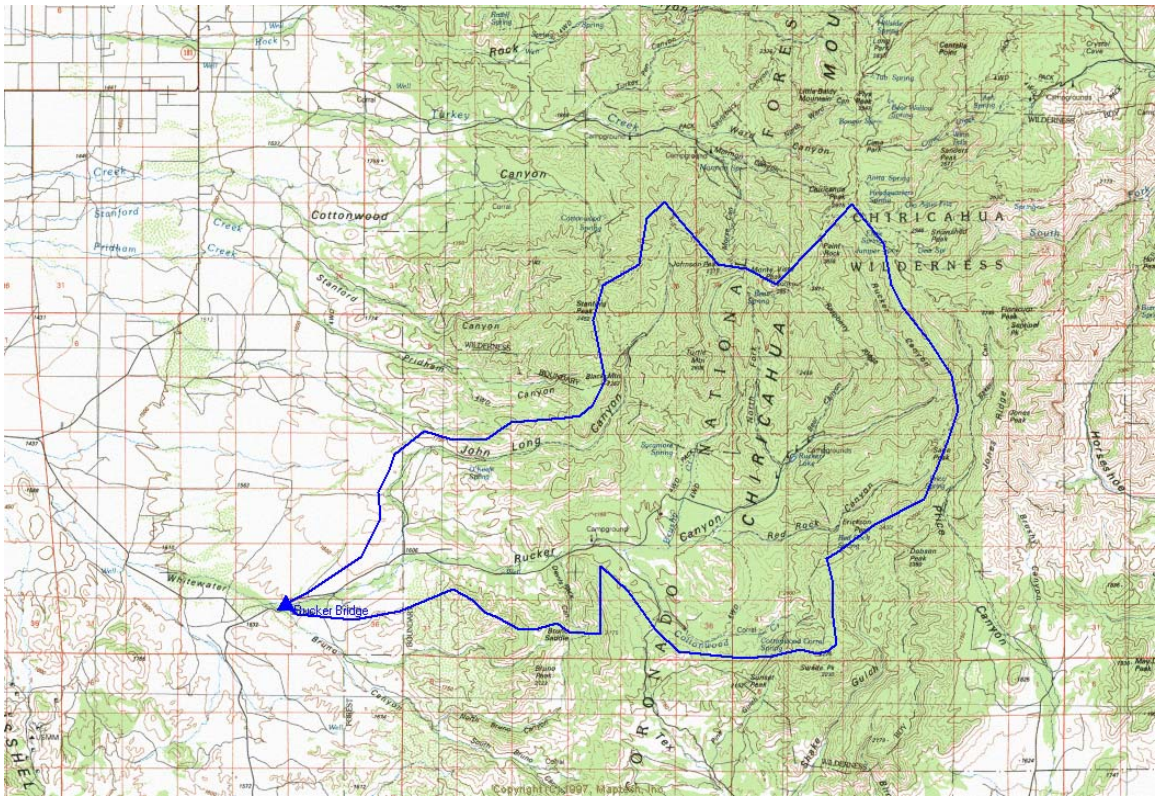

Figure 1: Watershed boundary for Rucker Canyon at Rucker Bridge overlaid over USGS 1:100000 topographic map.

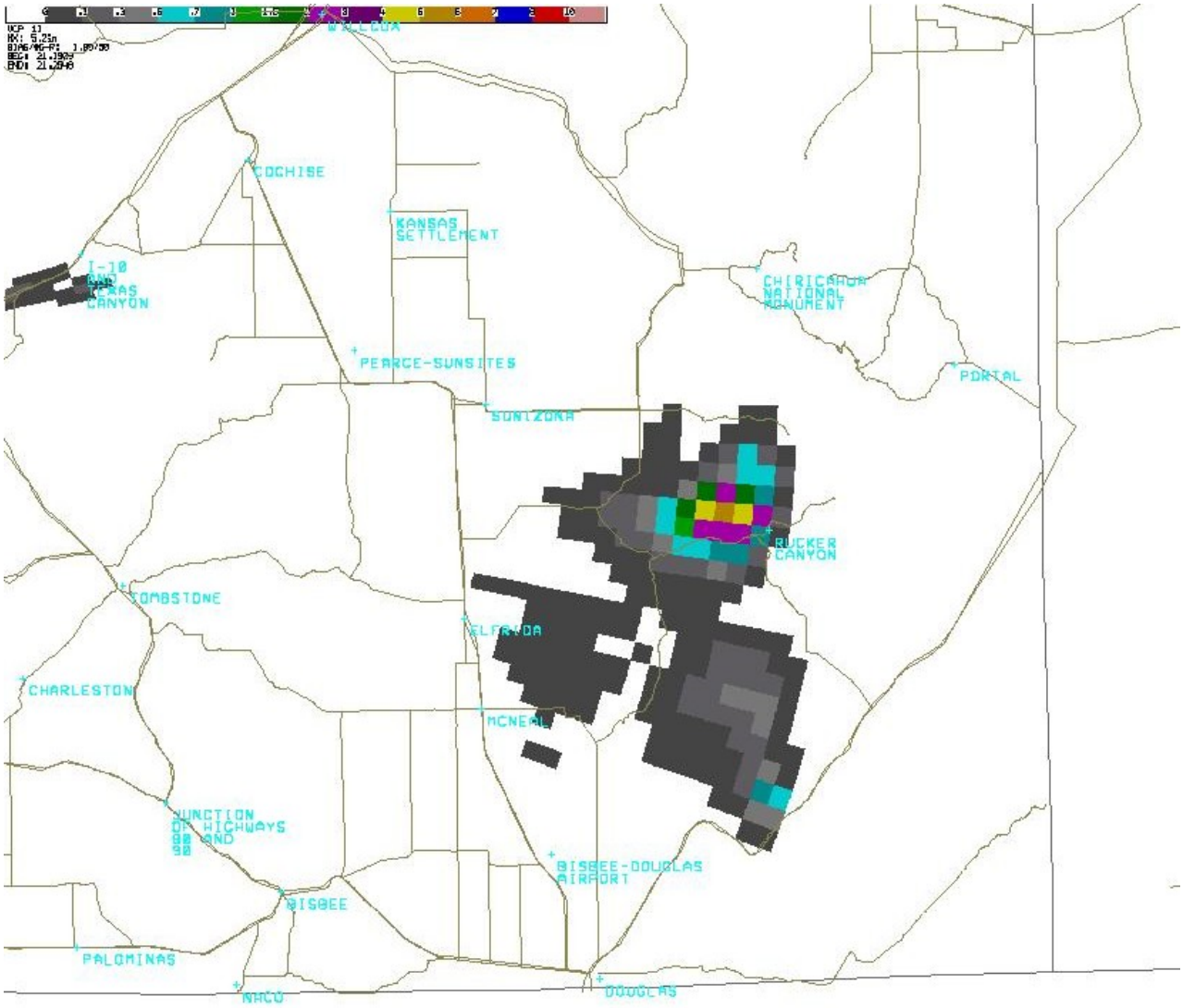

Figure 2: KEMX Storm Total Precipitation, valid 2046Z July 21, 2002. Note that the depicted precipitation fell in a 2.5 hour period.

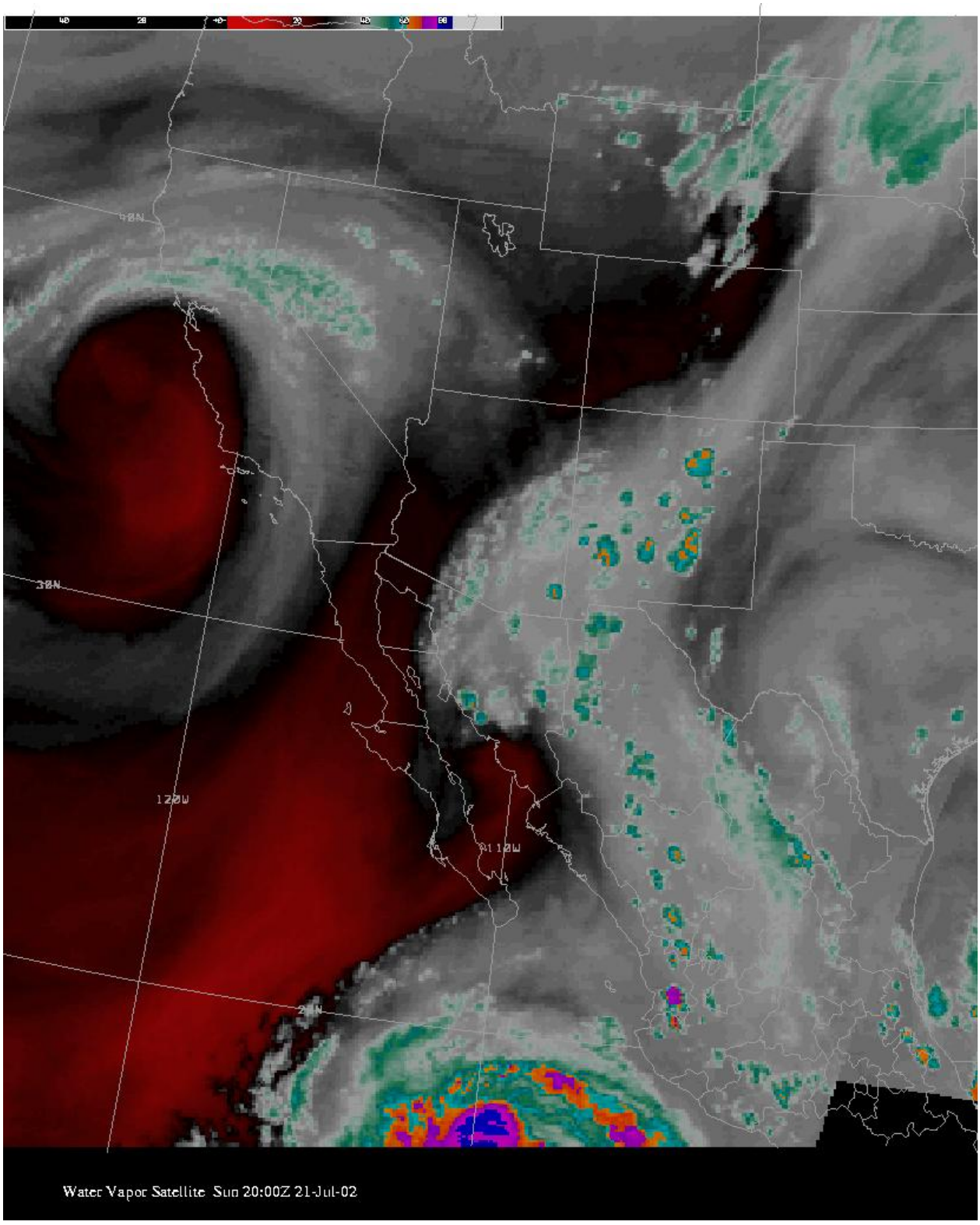

Figure 3: GOES-10 water vapor imagery, 2000Z.

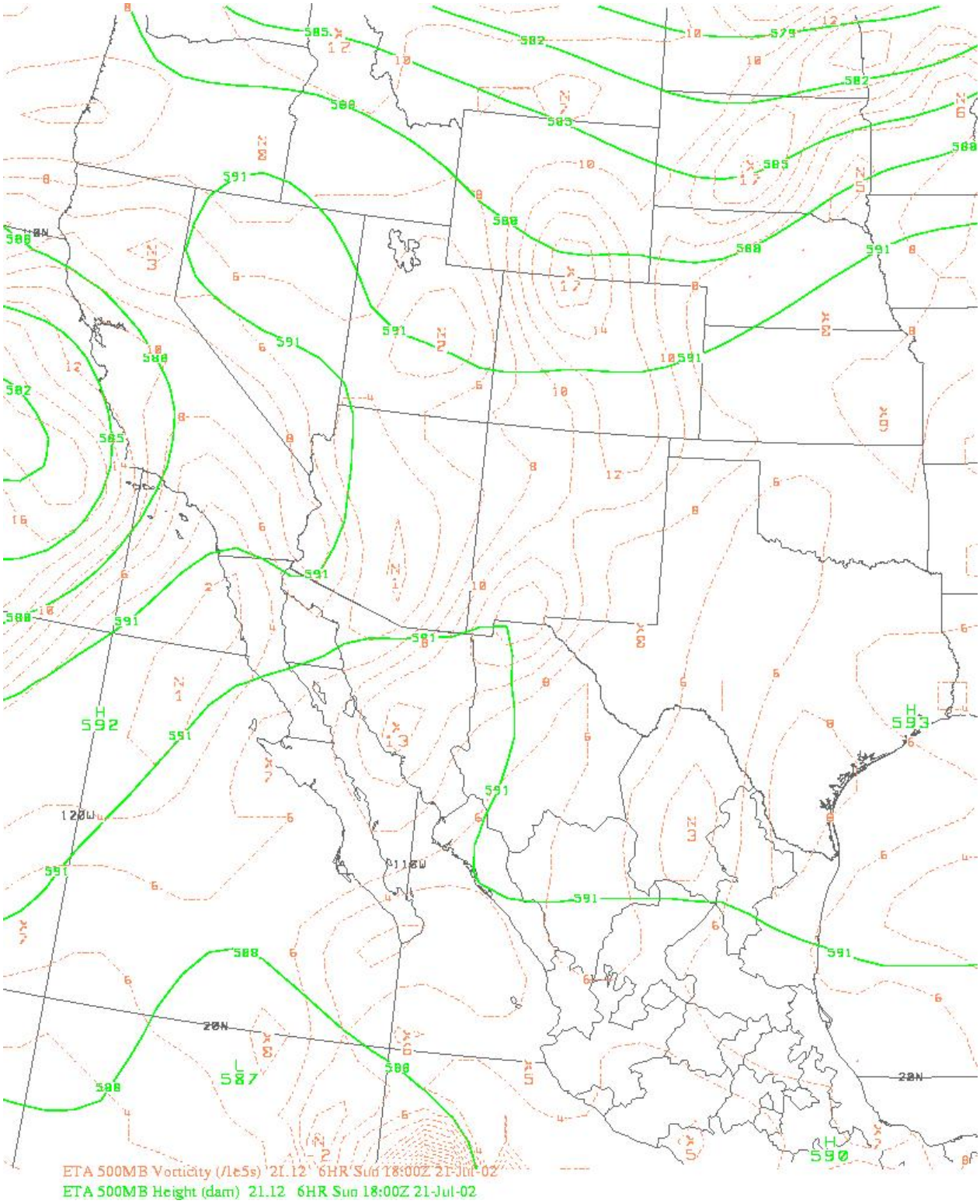

Figure 4: 1800Z forecast of 500mb forecast of height and vorticity, from the 12Z Eta model run. Note weak mid level inverted trough extending from central New Mexico, through extreme southeast Arizona, into Sonora.

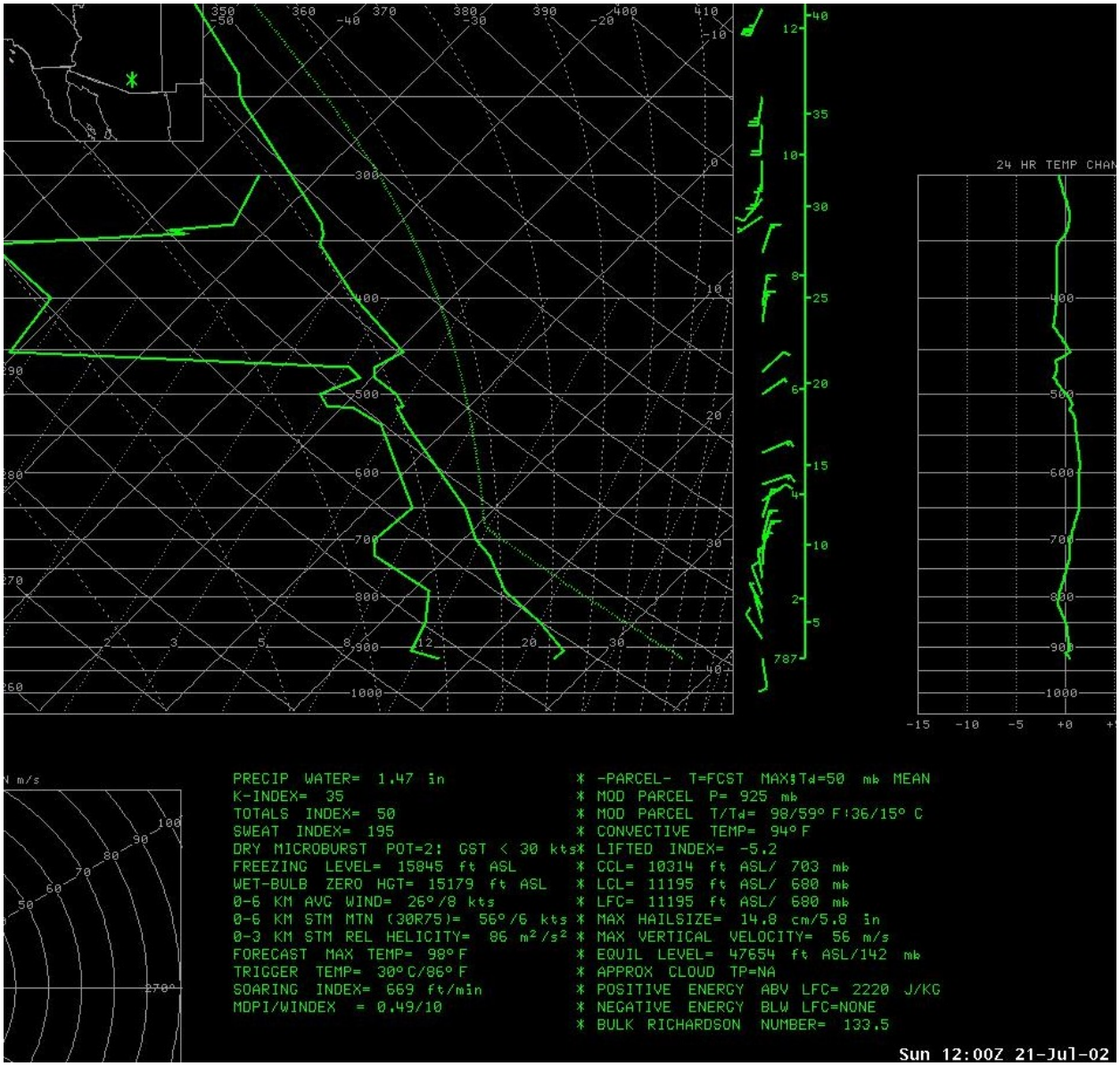

Figure 5 1200Z KTUS sounding, July 21, 2002. Note the modest 850-500mb shear, high CAPE, and high precipitable water.

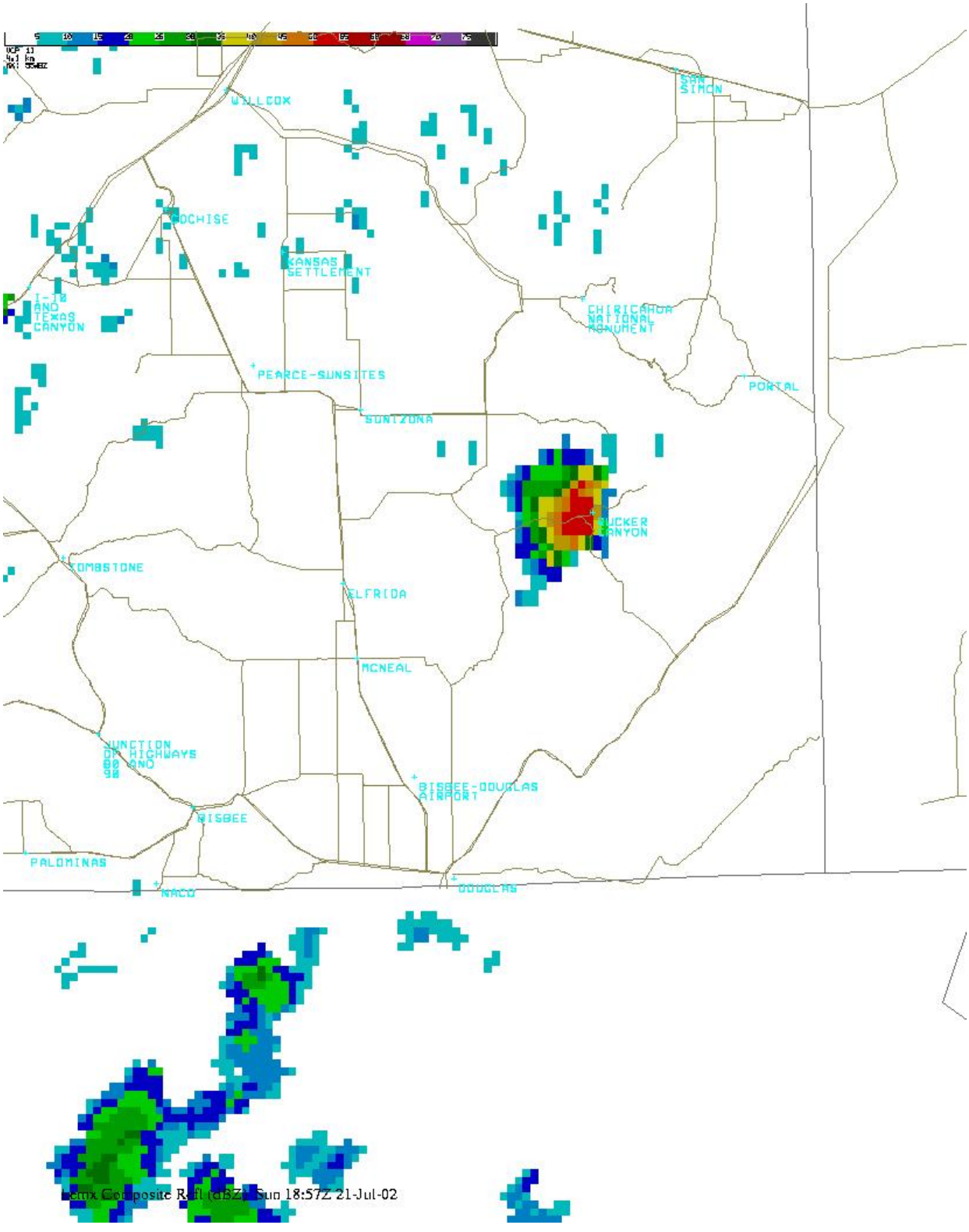

Figure 6: KEMX WSR-88D composite reflectivity, 1857Z.

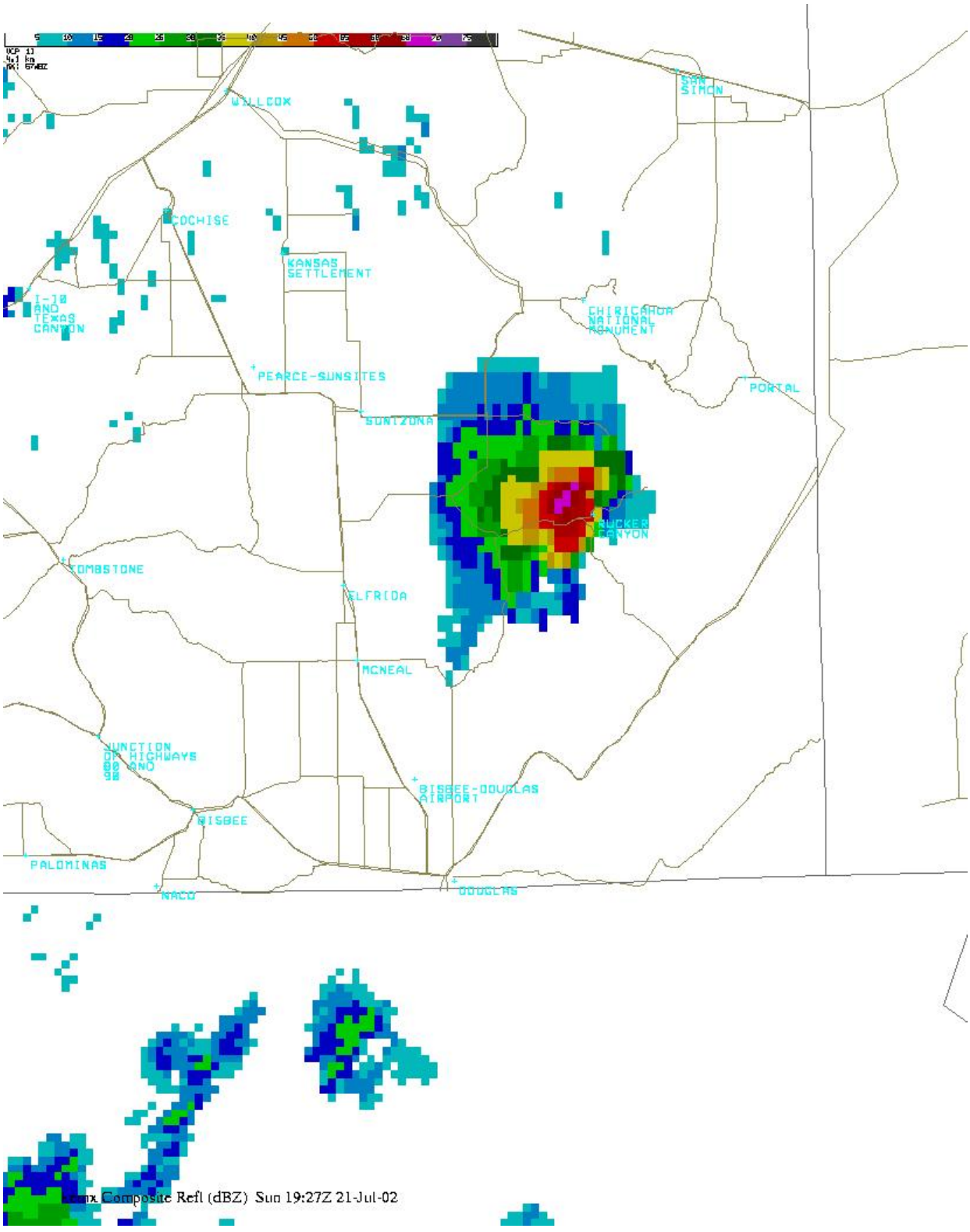

Figure 7: KEMX WSR-88D composite reflectivity, 1927Z.

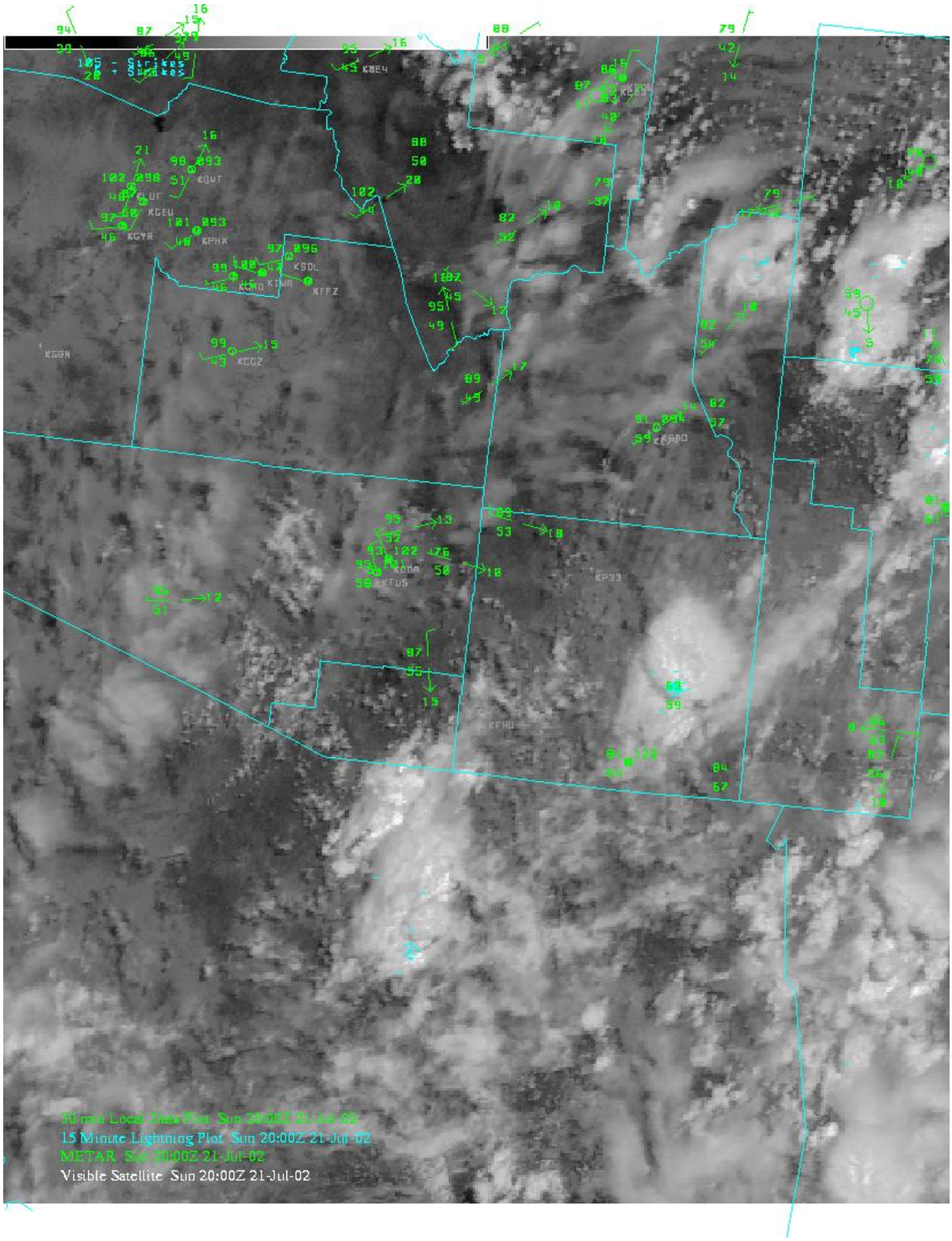

Figure 8: GOES-10 visible satellite imagery, 15 minute lightning data, and surface observations, 2000Z. Note the persistent cluster still near Rucker Canyon, along with new development over the mountains northeast of KSAD.

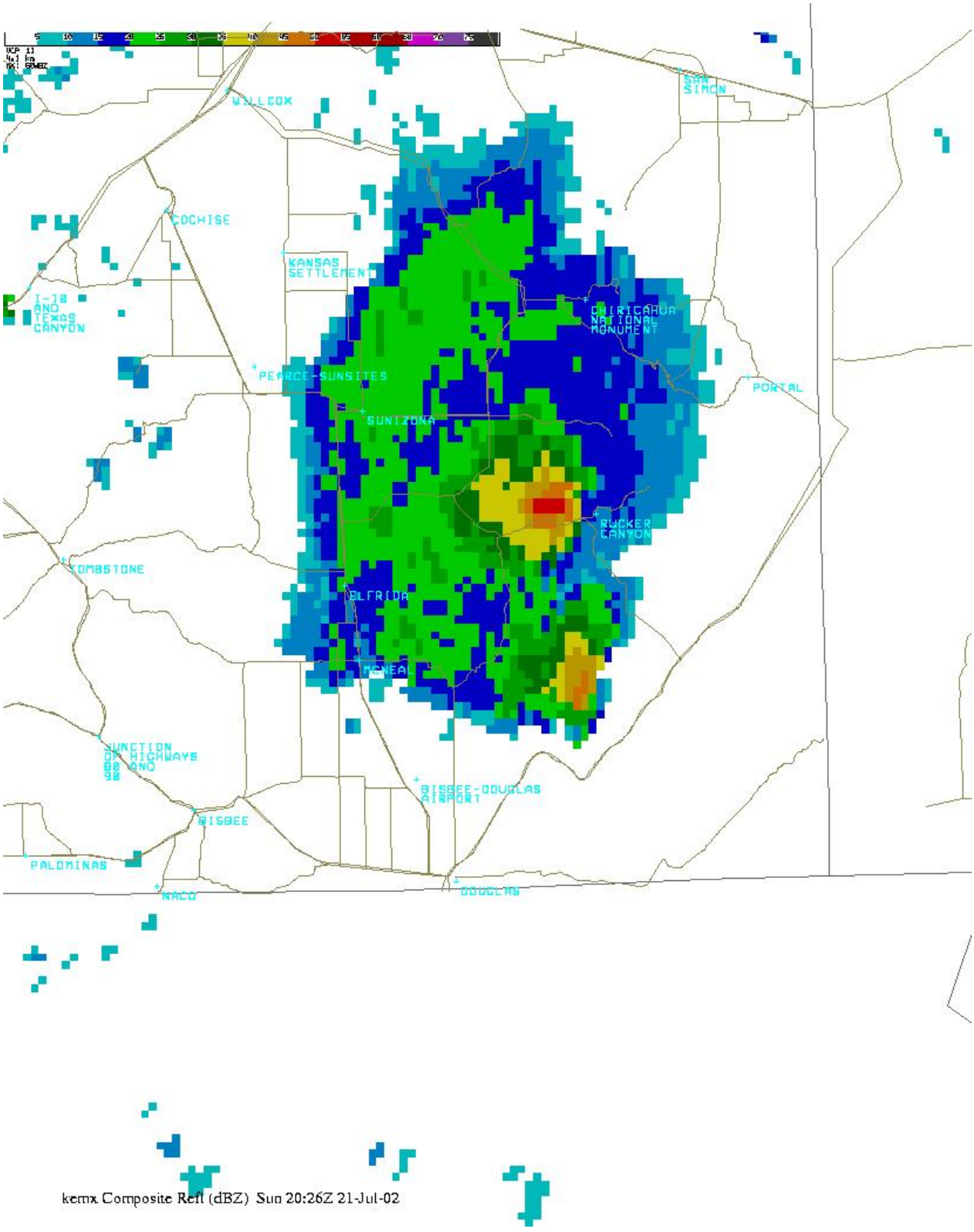

Figure 9: KEMX WSR-88D composite reflectivity, 2026Z.