Notes for ARPS/GDST Case 3: 4 May 1999 TLX Supercells

	POD	FAR	CSI
0-hr	0.586	0.000	0.586
1-hr	0.110	0.927	0.046
2-hr	0.000	1.000	0.000
3-hr	0.000	Undefined	0.000
4-hr	0.000	Undefined	0.000
5-hr	0.000	Undefined	0.000
6-hr	0.000	Undefined	0.000

Table 1: ARPS Scores for 4 May 1999
Composite Reflectivity Threshold: 41 dBZ
Fuzzy Validation Without Phase Shifting

	POD	FAR	CSI
0-hr	0.788	0.000	0.788
1-hr	0.281	0.634	0.189
2-hr	0.000	Undefined	0.000
3-hr	0.000	Undefined	0.000
4-hr	0.000	Undefined	0.000
5-hr	0.000	Undefined	0.000
6-hr	0.000	Undefined	0.000

Table 2: ARPS Scores for 4 May 1999
Composite Reflectivity Threshold: 41 dBZ
Fuzzy Validation With Phase Shifting

The radius of the verification kernel is 5nm (9.25 km). NIDS non-numeric data is set to 0 dBZ and the composite reflectivity is calculated using only grid points matched with observations

ARPS Initialization for 0000Z 4 May 1999:

- METAR and Oklahoma Mesonet Observations
- NIDS Reflectivity (AMA, DDC, DYX, FDR, FWS, ICT, LBB, MAF, SHV, SJT, SRX, TLX, VNX)
- IR Satellite
- 9-km ARPS background field initialized 1500Z 3 May 1999.

Note: SOP99 3-km forecast is interpolated to 133x133 3-km verification grid centered on TLX before scores are calculated.

	POD	FAR	CSI
0-hr	1.000	0.000	1.000
1-hr	0.656	0.262	0.532
2-hr	0.058	0.900	0.038
3-hr	0.024	0.784	0.022
4-hr	0.000	1.000	0.000
5-hr	0.000	1.000	0.000
6-hr	0.000	1.000	0.000

Table 3: GDST Scores for 4 May 1999
Composite Reflectivity Threshold: 41 dBZ

	POD	FAR	CSI
0-hr	1.000	0.000	1.000
1-hr	0.010	0.981	0.067
2-hr	0.000	1.000	0.000
3-hr	0.000	1.000	0.000
4-hr	0.000	1.000	0.000
5-hr	0.000	1.000	0.000
6-hr	0.000	1.000	0.000

Table 4: Persistence Forecast Scores for 4 May 1999
Composite Reflectivity Threshold: 41 dBZ

Summary

A 3-km ARPS and GDST Southern Plains forecast was run for the May 3-4, 1999 tornado outbreak over central and northern Oklahoma. Unlike the other ARPS forecasts evaluated, this forecast largely failed to simulate the convection that was observed, despite the use of NIDS reflectivity data in the initialization. The error types in the forecast can be classified as:

1. *Areal Coverage*. The extent of the model reflectivity field at initialization is too small due to (1) NIDS2ARPS only remapping radar data at points with both reflectivity and radial velocity values available, and (2) the ice, snow, and hail fields not being output by ADAS. The verification domain subsequently becomes devoid of significant reflectivity by the three-hour mark, in sharp contrast to the observations.

2. *Intensity*. The intensity of the initial model reflectivity field is too low due to the absence of ice, snow, and hail in the ADAS fields, reducing the probability of detection (POD) scores for that hour. Although the intensity briefly improves during the first two hours, it subsequently becomes far too low as the model fails to produce significant reflectivity.

3. *Phase Error*. ARPS propagates the storms far too quickly compared to NIDS observations, forecasting the storms to move into northeastern Oklahoma during the first two hours. This results in very low POD scores and very high false alarm rates (FARs). The model storms moves out of the verification domain by 03Z.

4. *Spurious Convection*. The model generates some significant reflectivity in eastern Oklahoma in the first two hours of the forecast, further contributing to high FAR scores. Late in the forecast, a north-south oriented band of light reflectivity develops in extreme eastern Oklahoma east of the observed radar echoes. Because of the low intensity of these echoes (< 35 dBZ), this activity is not reflected in the statistics.

The errors associated with this forecast are quite surprising given the widespread and intense severe weather that was observed. CAPS has been studying this case since shortly after the outbreak occurred, and will likely continue its investigations in the future.

GDST performed very well out to 1 hour before the forecast skill degraded due to additional convective development and decay. At 00Z on May 4, 1999, two distinct supercells are evident in central Oklahoma. Because of the mature, long-lived nature of these convective cells, the GDST is able to correctly advect these cells northeastward resulting in good skill scores at 1 hour with a POD of 0.66 and a false alarm rate of only 0.26. By 02Z, 2 hours into the forecast, additional supercellular development surrounding the previous convection is present. By this time, there is sufficient convective development and decay to preclude the GDST from providing skillful forecasts.

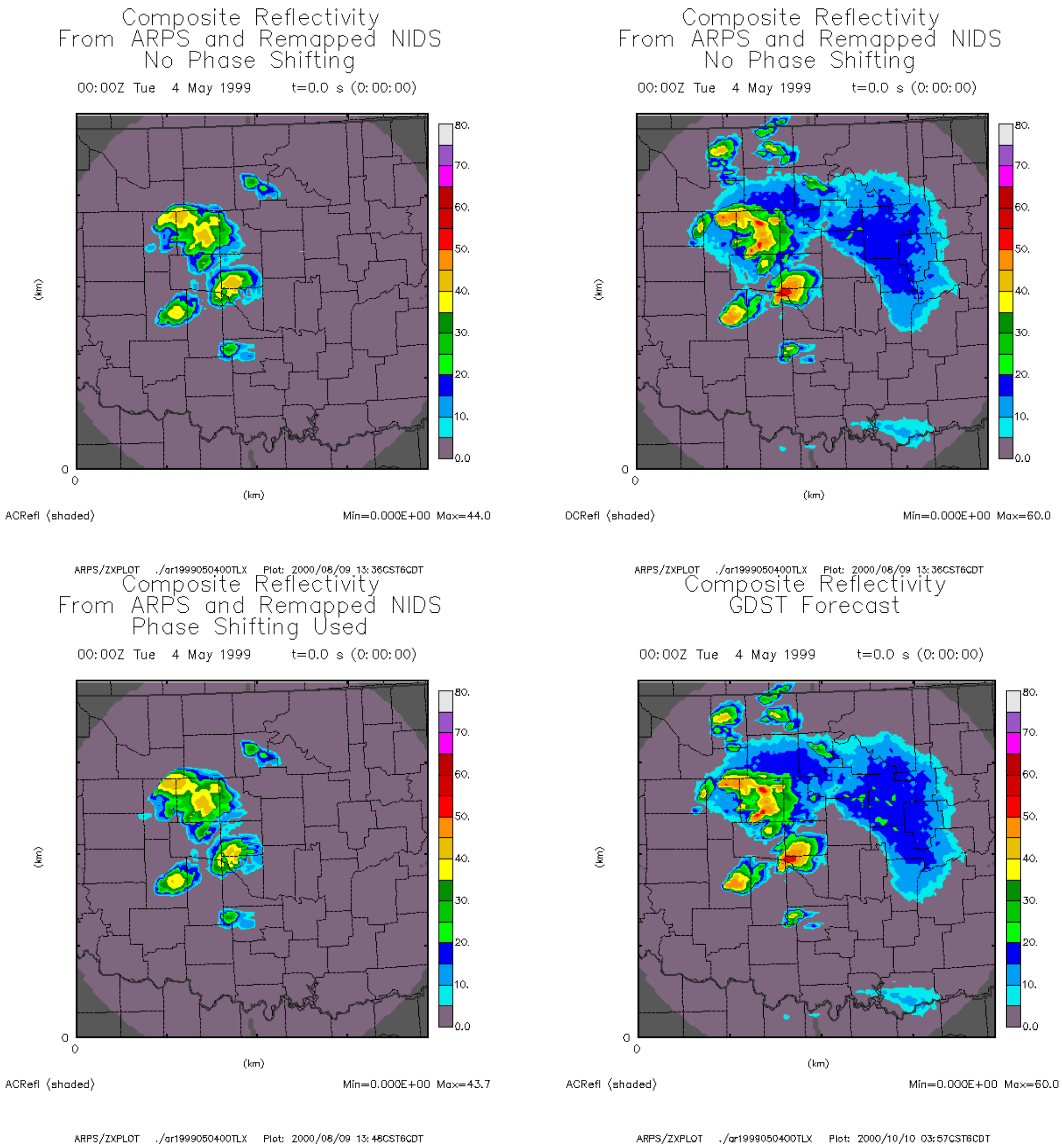

Figure 1: ARPS composite reflectivity forecast initialized 0000Z 4 May 1999 (upper-left), NIDS composite reflectivity (upper-right), ARPS phase-shifted forecast (lower-left), and GDST forecast (lower-right). All panels valid for 0000Z 4 May 1999.

Comments: The ARPS model is initialized with the placement of the convection agreeing well with the observed reflectivity (including the tornadic supercell moving into Oklahoma City). However, there are differences in the magnitudes of the composite reflectivity due to an error in one of the input files used in this forecast (hail, snow, and cloud ice were not included in the initial history dump produced by ADAS).

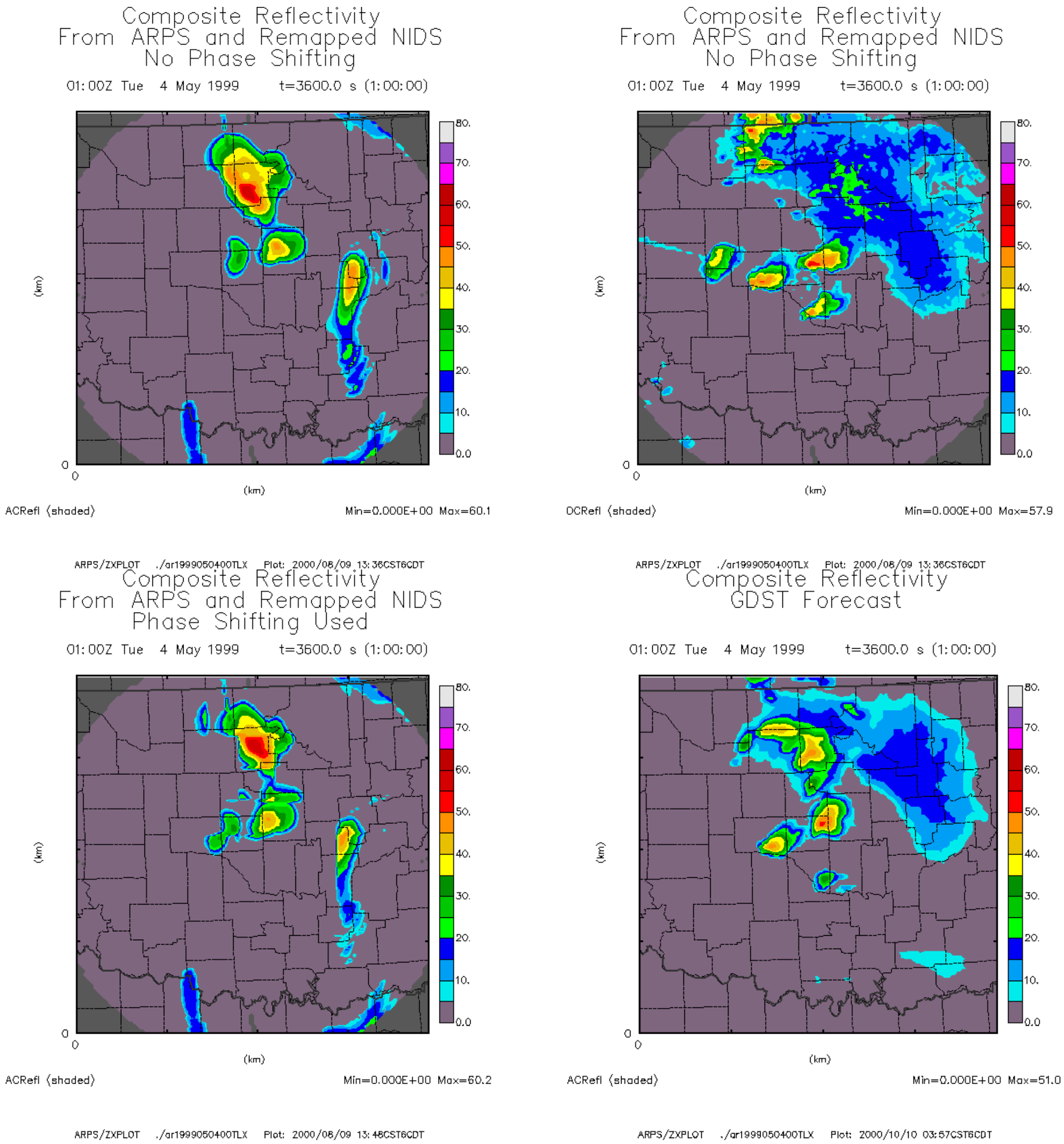

Figure 2: As in Figure 1, but valid 0100Z 4 May 1999.

Comments: Serious problems with the ARPS forecast are present by this hour. Although an apparent supercell is simulated only one county NE of the OKC supercell, there are also spurious storms developing in northern and eastern OK. In contrast, the NIDS reflectivity field indicates four isolated cells in central OK, with other storms along the OK/KS border. The GDST forecast correctly advects two supercells northeastward across central Oklahoma.

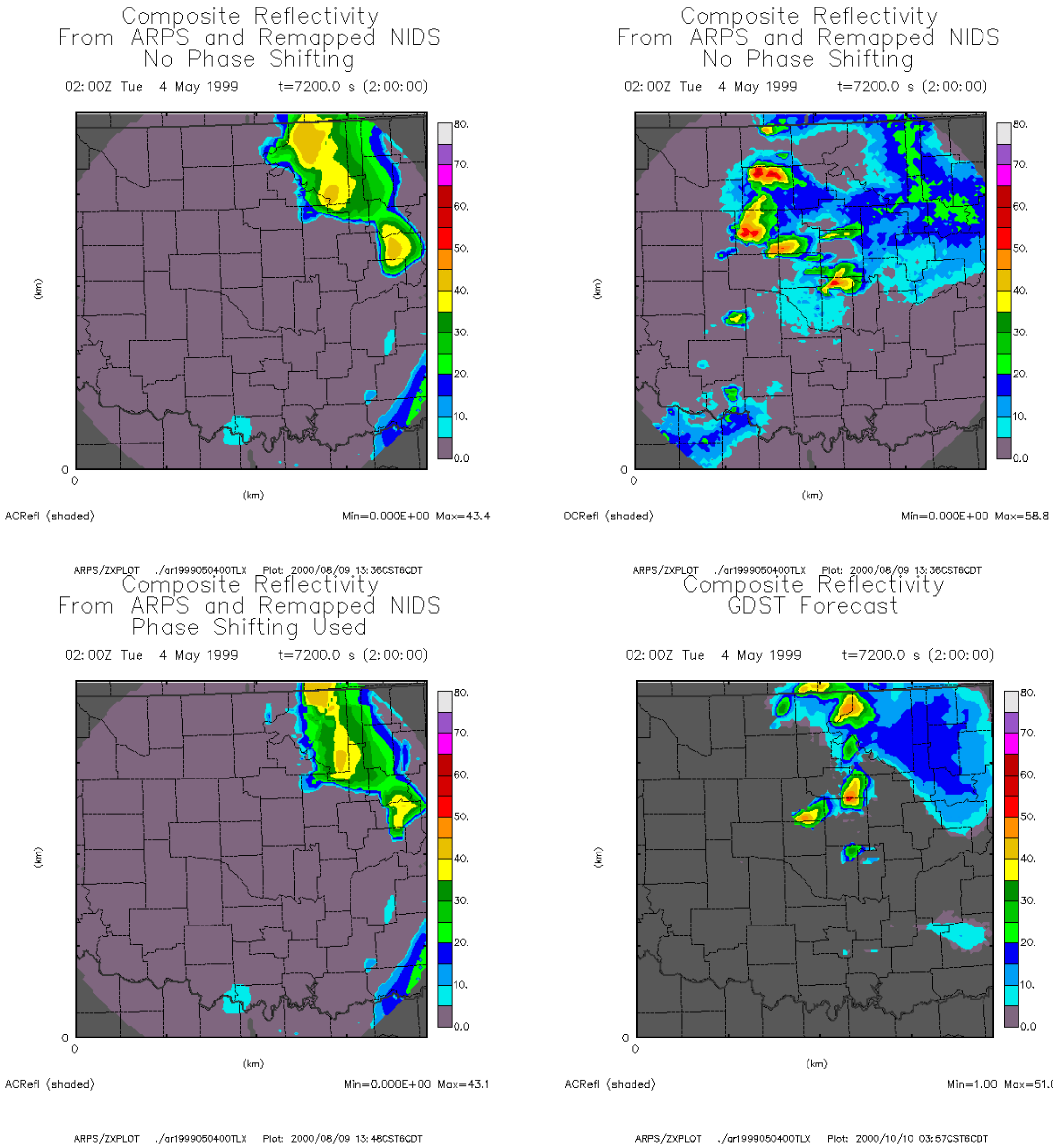

Figure 3: As in Figure 1, but valid 0200Z 4 May 1999.

Comments: At this point the model storms are weakening and are entirely located in NE OK. The observed storms are in central and northern OK. By comparing the upper-right and lower-right figures, additional convective development is seen by 02Z that the GDST forecast cannot forecast. The GDST quickly degrades at this time.

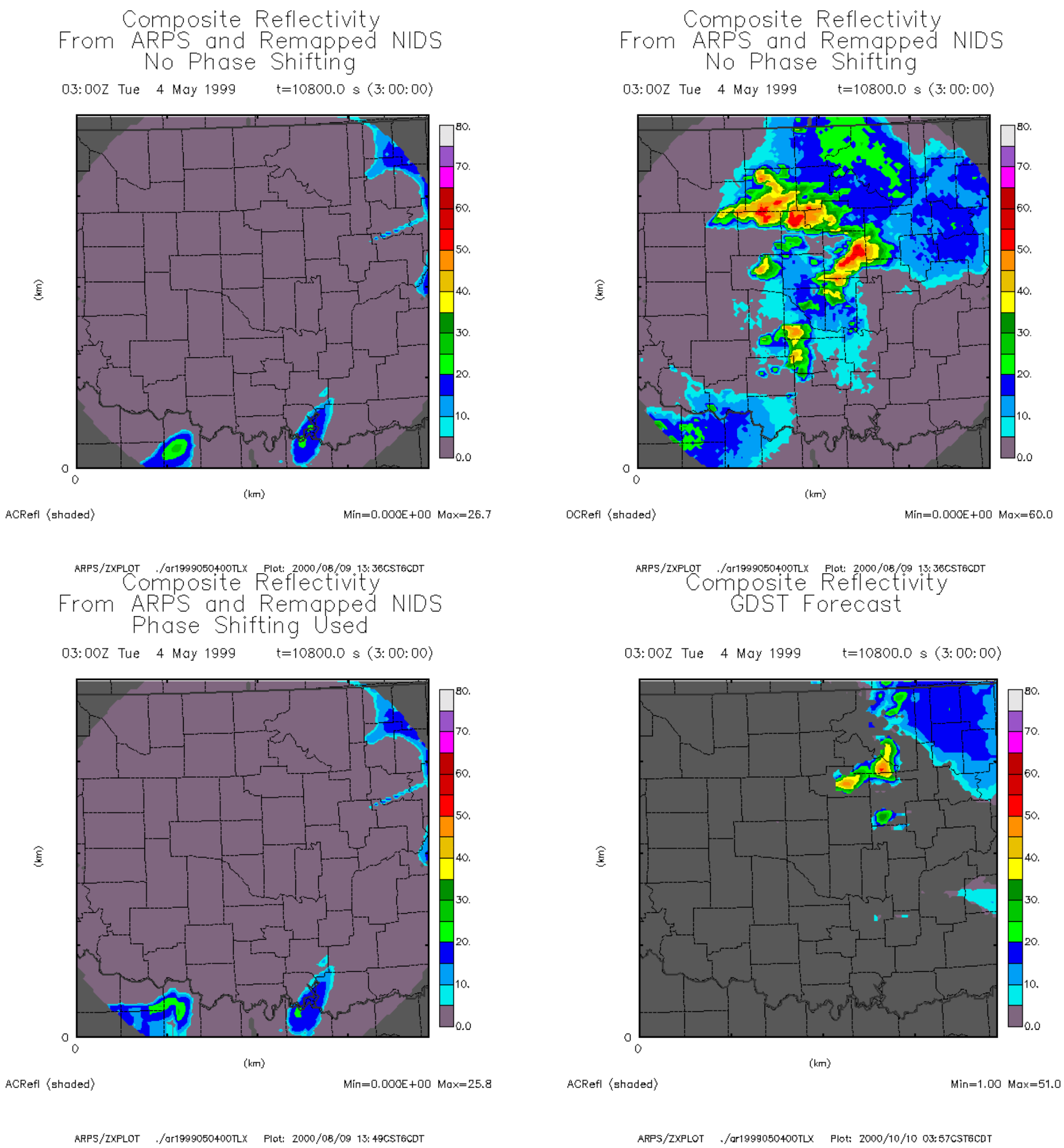

Figure 4: As in Figure 1, but valid 0300Z 4 May 1999.

Comments: From this point on the ARPS fails to produce any significant reflectivity. In contrast, a widespread outbreak of severe convection developed across much of northern, central, and eastern OK.

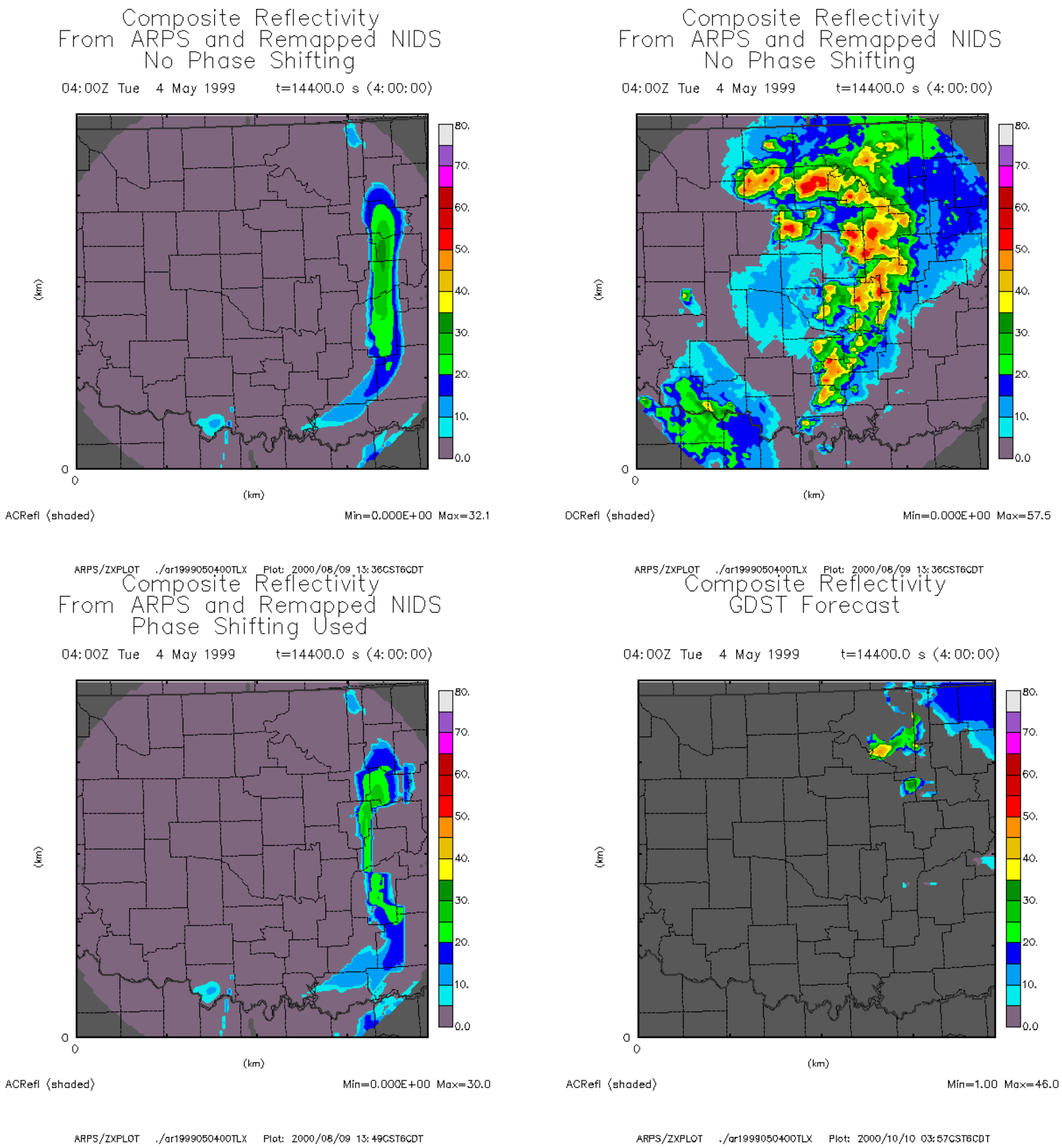

Figure 5: As in Figure 1, but valid 0400Z 4 May 1999.

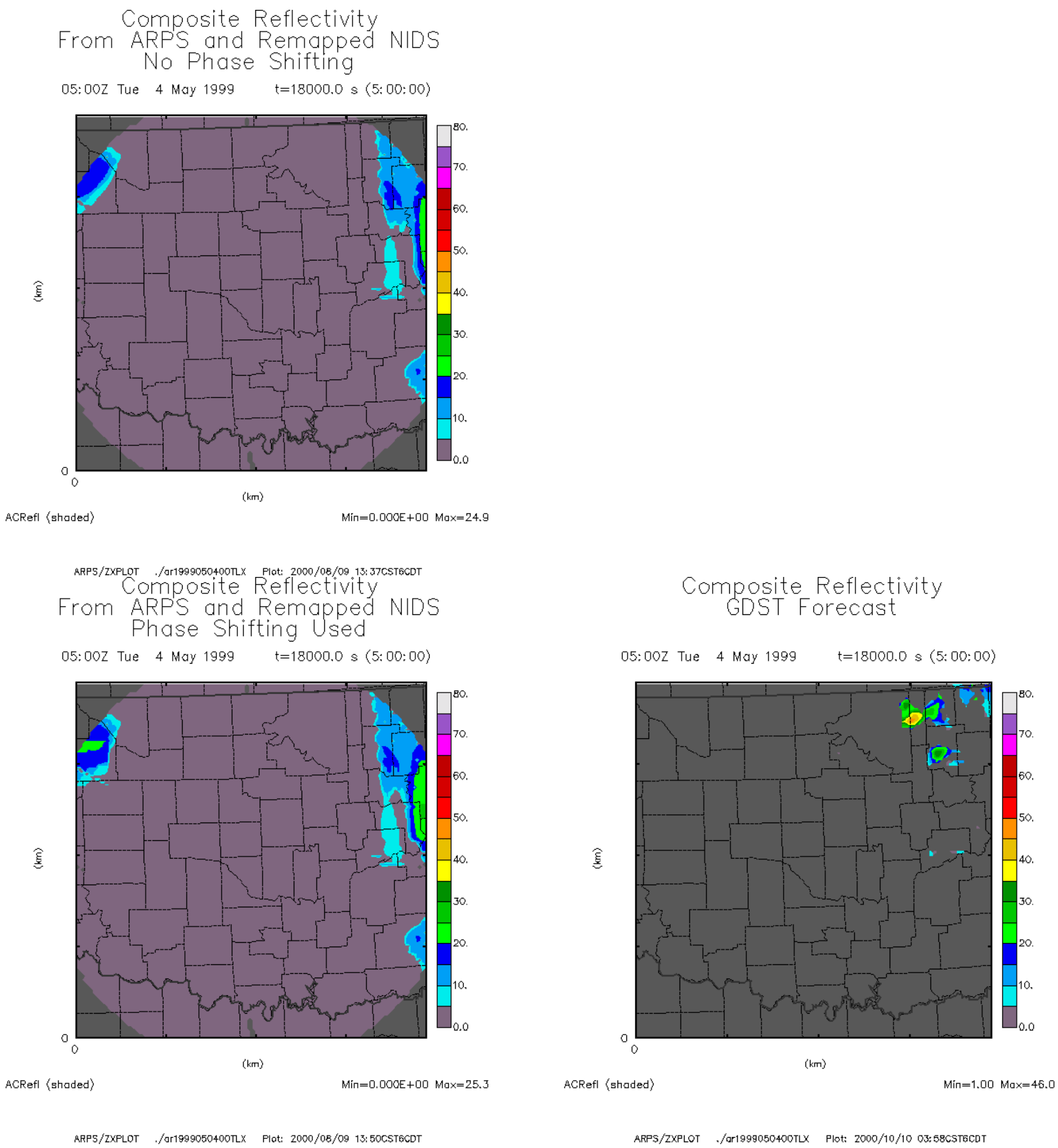

Figure 6: As in Figure 1, but valid 0500Z 4 May 1999. (NIDS composite reflectivity image unavailable.)

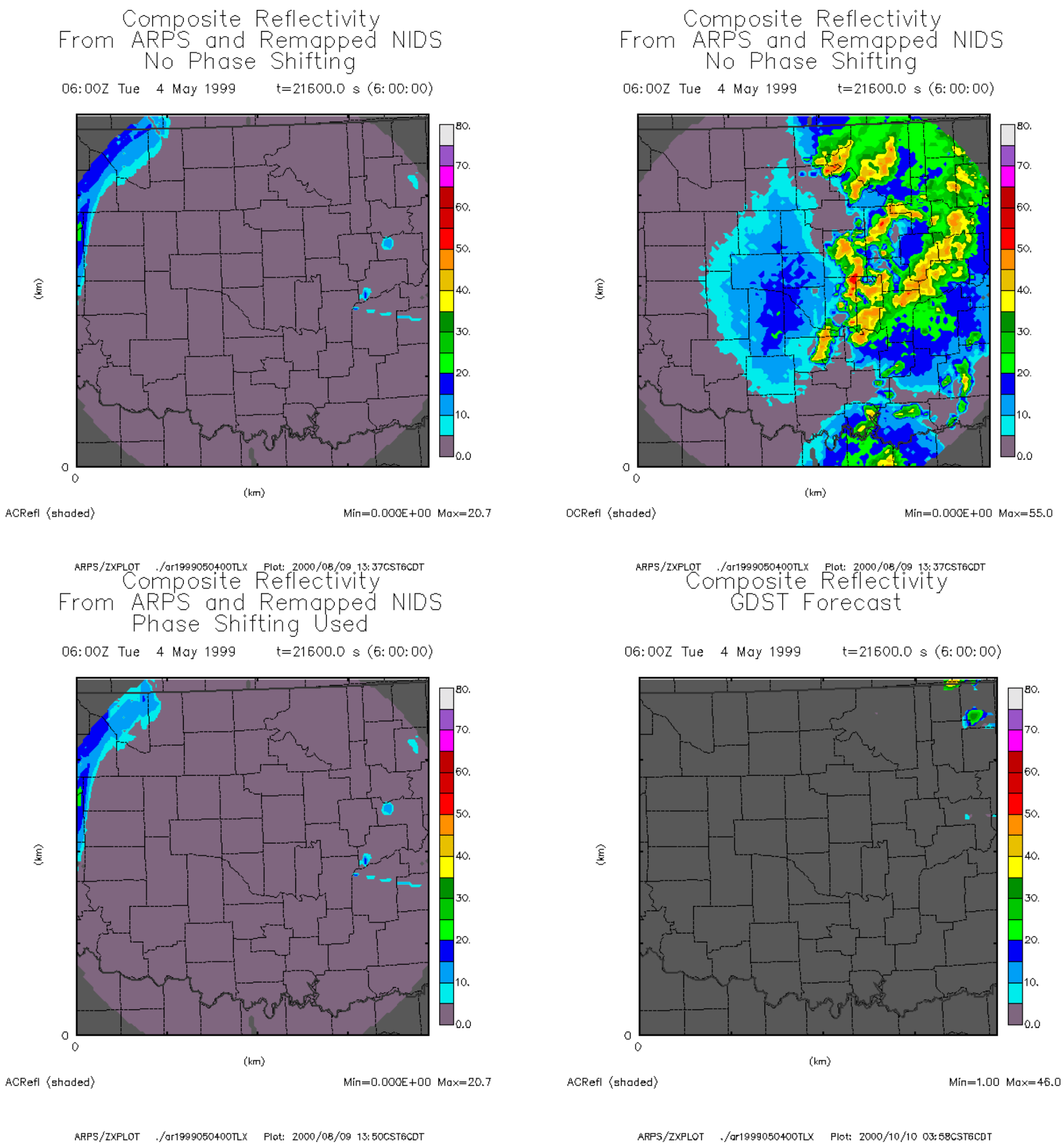

Figure 7: As in Figure 1, but valid 0600Z 4 May 1999.