

Dual-Pol Experiences at WFO Phoenix

Doug Green, Gary Woodall and Ken Waters
WFO Phoenix Arizona

NEXRAD Technical Advisory Committee Meeting
1 March 2012



Dual-Pol Expectations at WFO Phoenix

- Hydrometeor classification algorithm might result in noticeably improved precipitation estimates
- CC should aid in determining melting layer and snow level, as well as confirming the existence of a damaging tornado
- ZDR should help identify stronger updrafts and hail-producing storms
- KDP will highlight areas of greatest liquid water content, and should identify areas experiencing locally heavy rainfall



Interesting Weather Cases where Dual Pol Data Added Value...

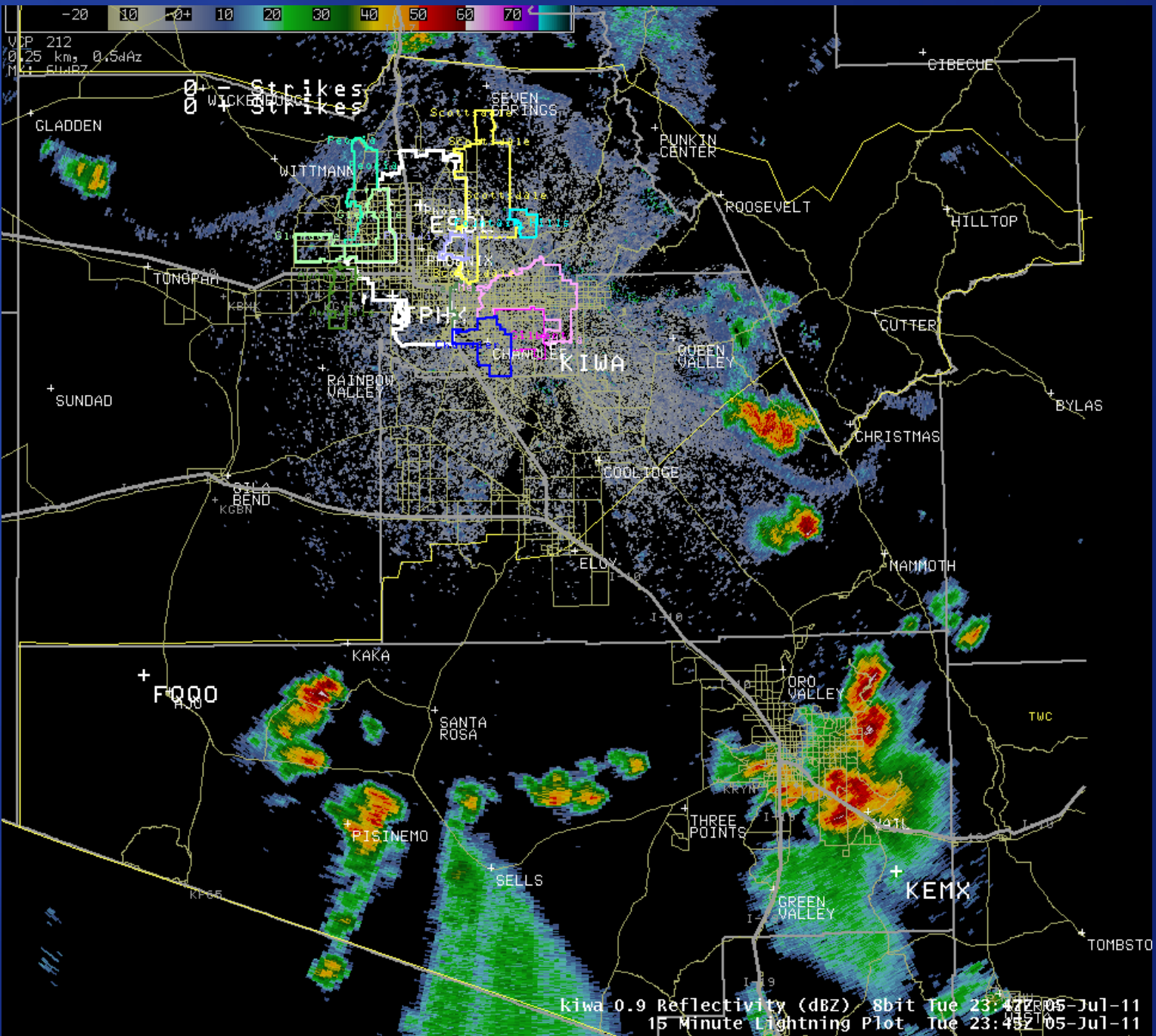
- 5 July intense dust storm over south-central Arizona
- 31 July microbursts over and near Phoenix
- 12 August microburst over southern Gila County
- 14 February snow over/near Globe in southern Gila County



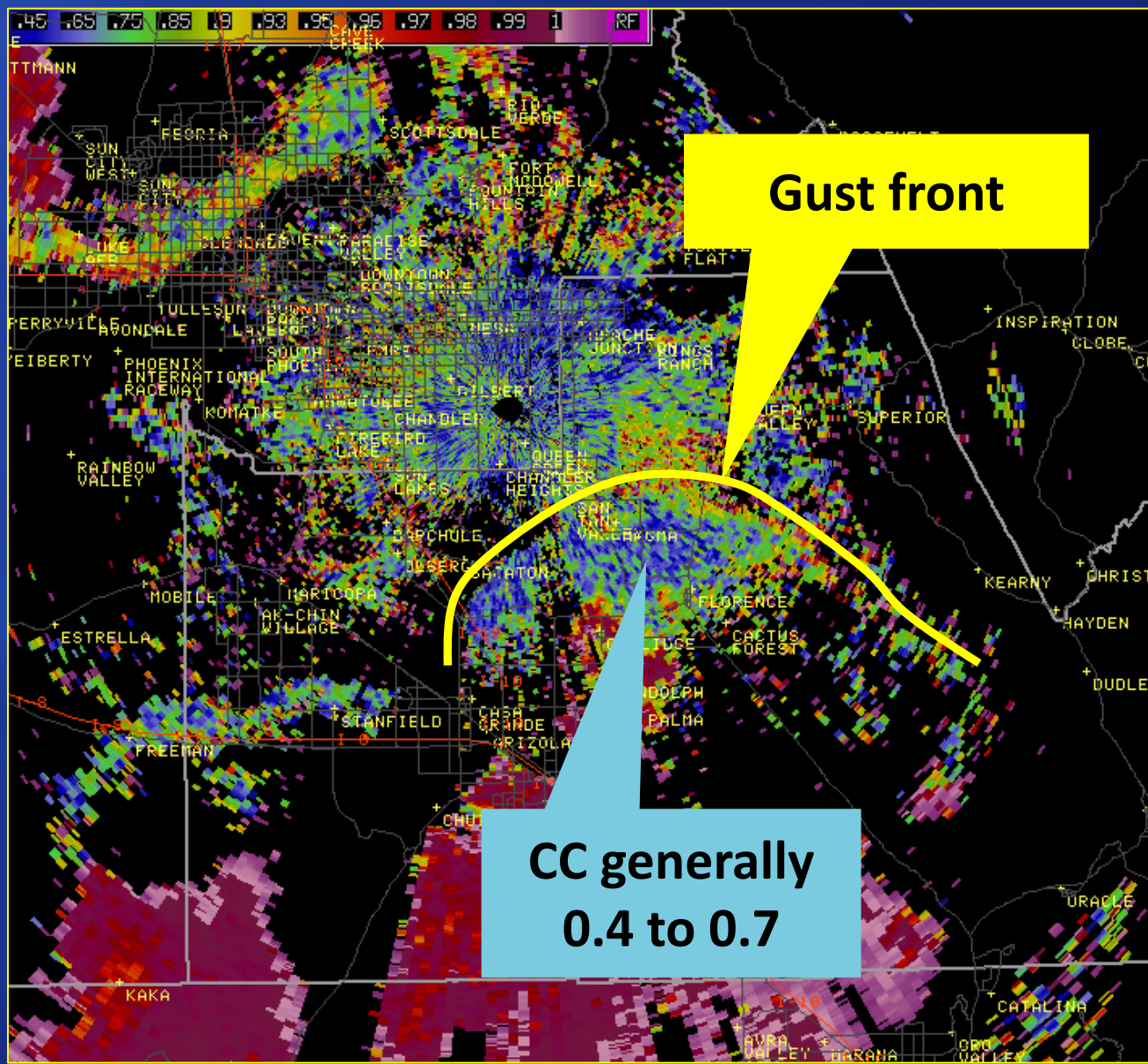
Dust Storms

- Initially, it wasn't intuitively obvious how dual pol information would help WFO Phoenix forecasters better identify the existence and intensity of dust storms
- Base velocity data, spotter reports, and pattern recognition techniques have served forecasters rather well for many years.
- Interestingly, Phoenix became the 'dust storm capital' of the country during summer 2011, due in part to a long-term drought over southeast Arizona
 - Intense dust storm...one of the worst ever observed... occurred on 5 July
 - At least 6 other significant dust events occurred between mid-July and early September, at least twice the long-term average
 - Let's take a look at the 5 July 2011 dust storm via reflectivity, velocity and CC fields...





0.5 degree CC at 0154Z 6 July



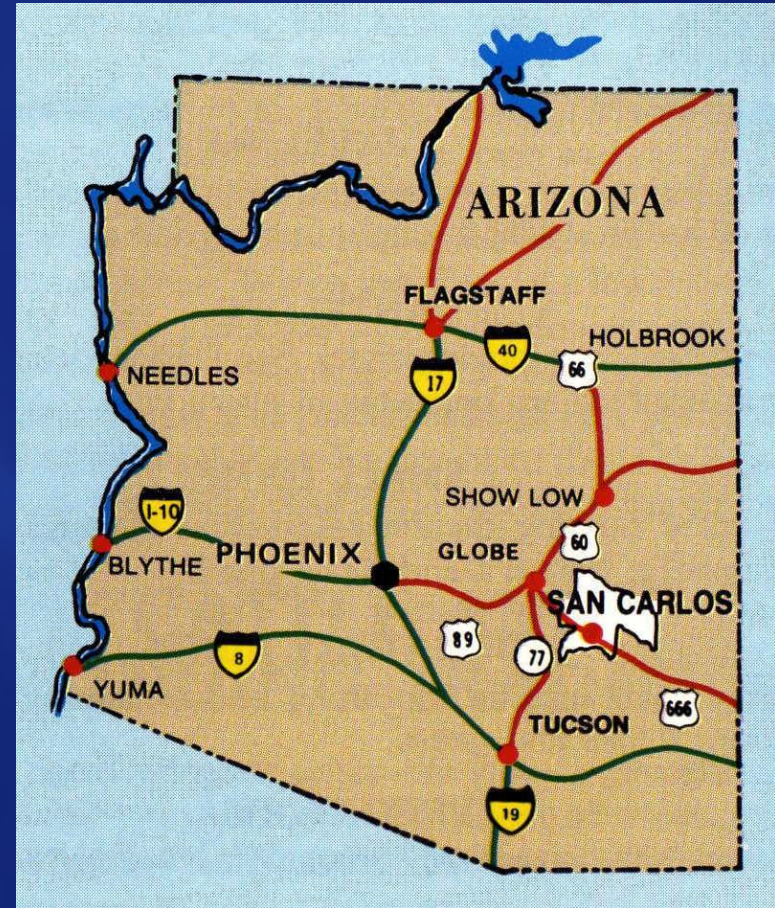
Microburst-producing storms

- Many summer severe weather events in the Phoenix CWA are downbursts/microbursts generated by evaporating or melting precipitation through a deep, dry sub-cloud layer
- Scharfenberg et al (2005) noted that ZDR, used in conjunction with Z, V and KDP, might help warning forecasters identify where microburst production is most likely by identifying areas of melting hail
- Let's look at a couple of microburst cases, one over the higher terrain and the other over/near Phoenix...

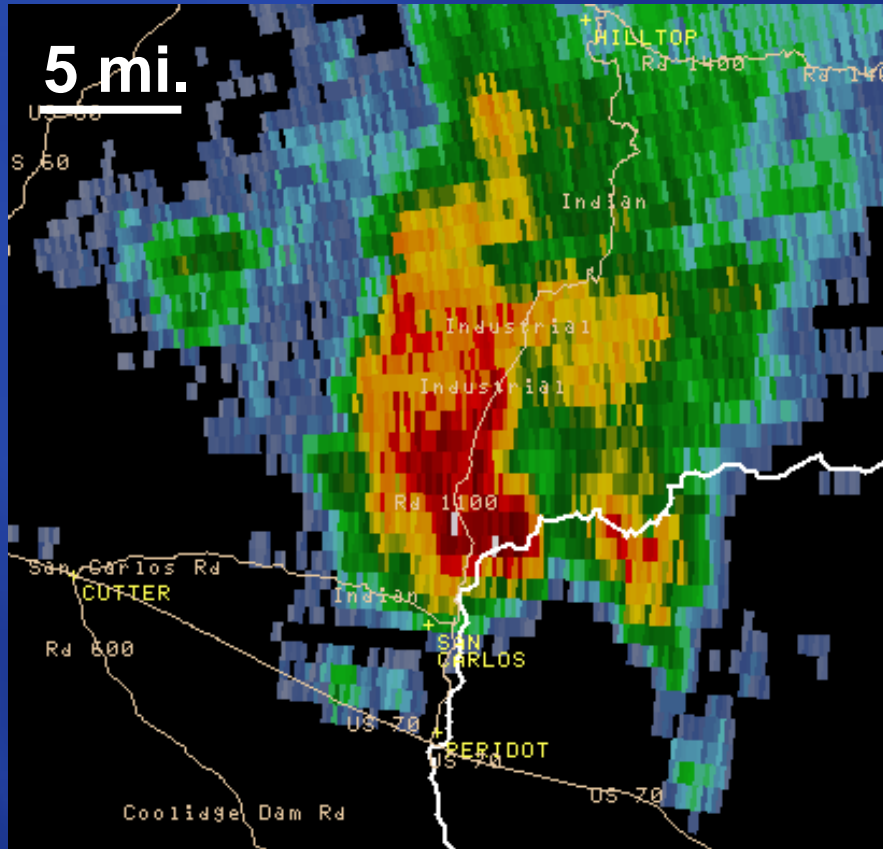


12 August 2011 Case

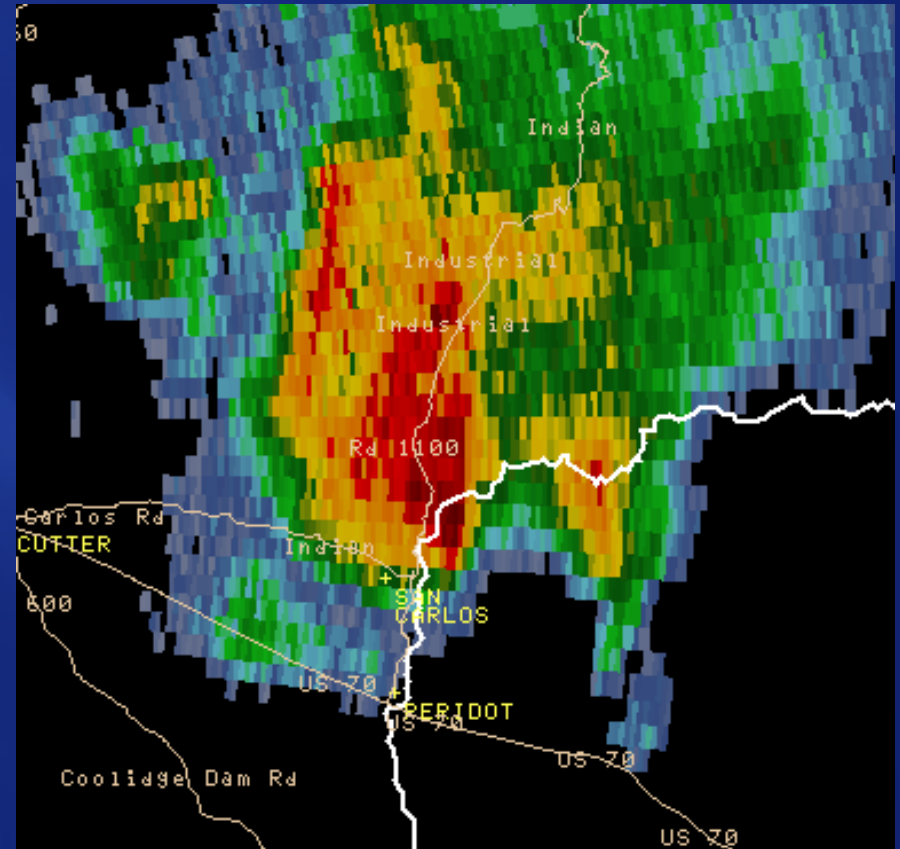
- Downburst affected San Carlos, AZ
- Approx. 70 miles east of KIWA 88D, 3000 foot elevation, partial 0.5 deg beam blockage
- Trees downed, numerous power poles broken
- Some roofs damaged by falling trees/poles
- Hail of unknown size reported in town



0.9 Deg Reflectivity



2323 UTC

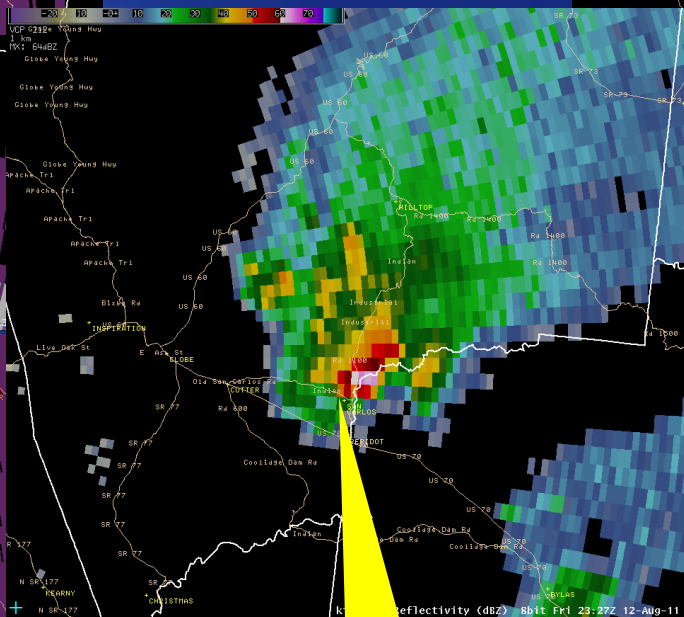
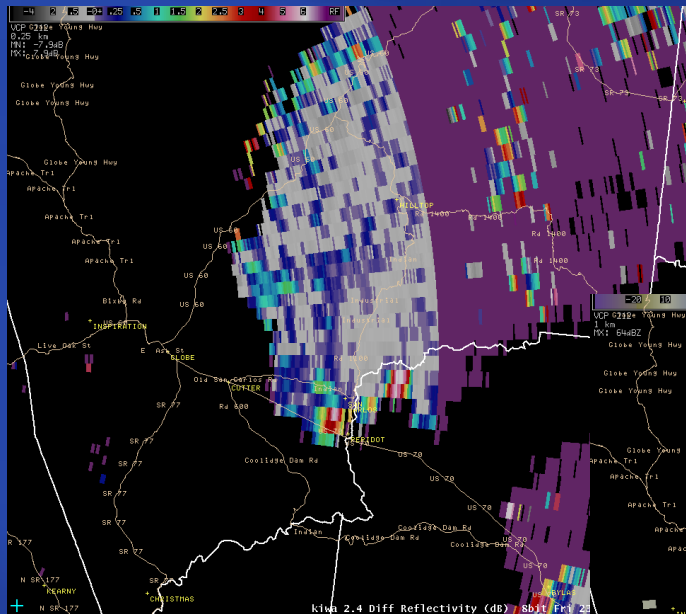


2327 UTC

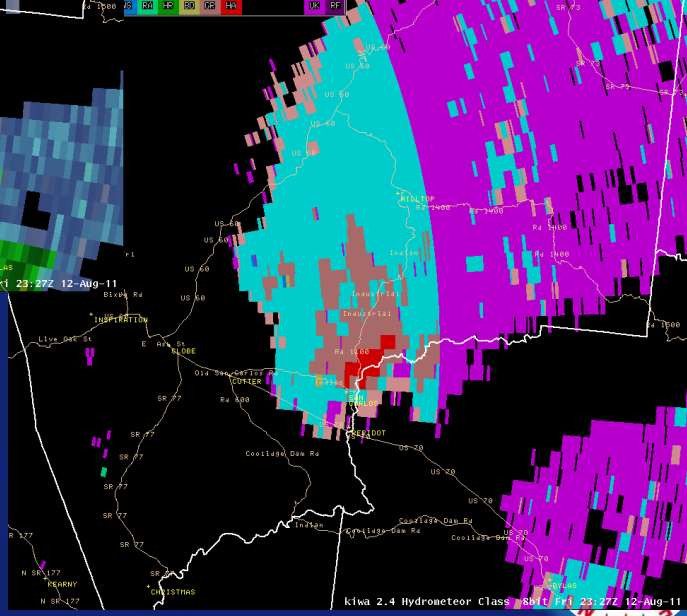
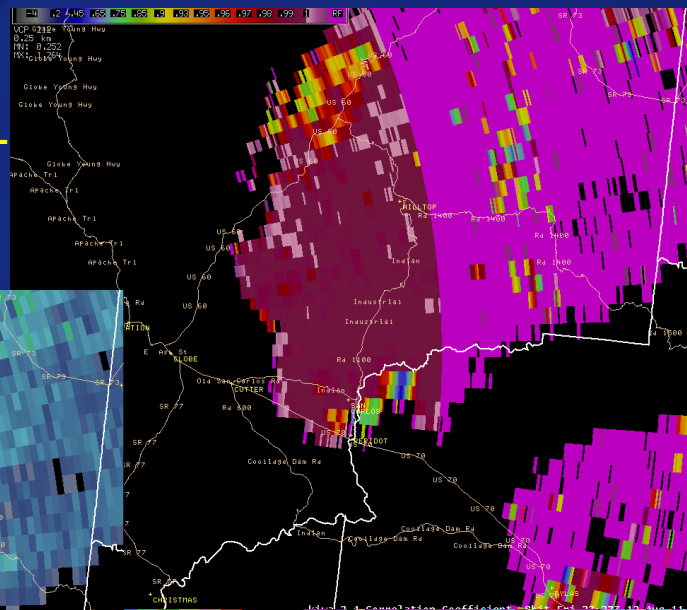
Approx. 9500 ft. MSL, 6500 ft. AGL

2327 UTC 2.4 Deg Dual-Pol

Beam ~19,000 ft MSL
FZL ~ 15,700 ft MSL

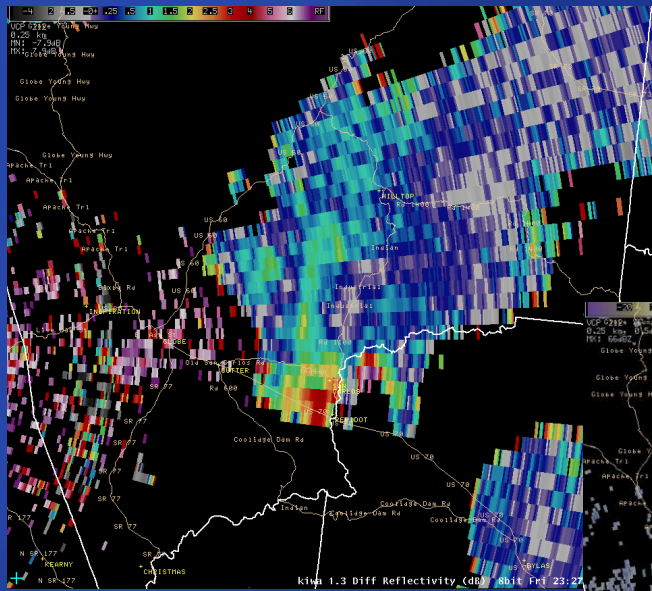


San Carlos

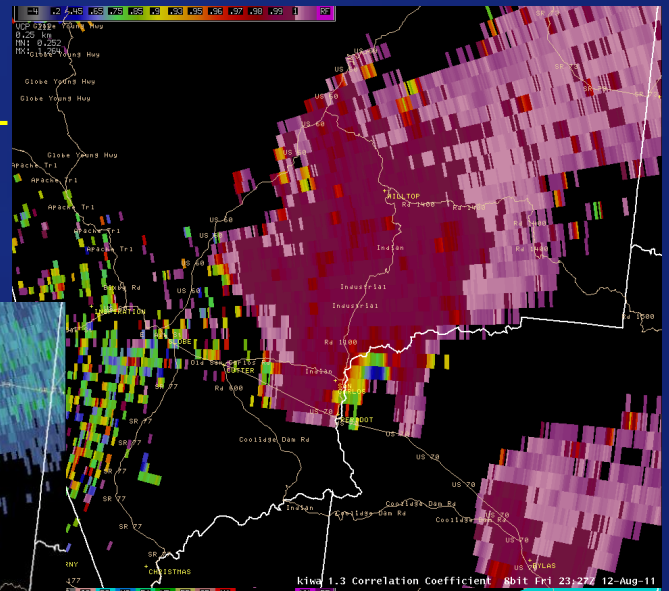


2327 UTC 1.3 Deg Dual-Pol

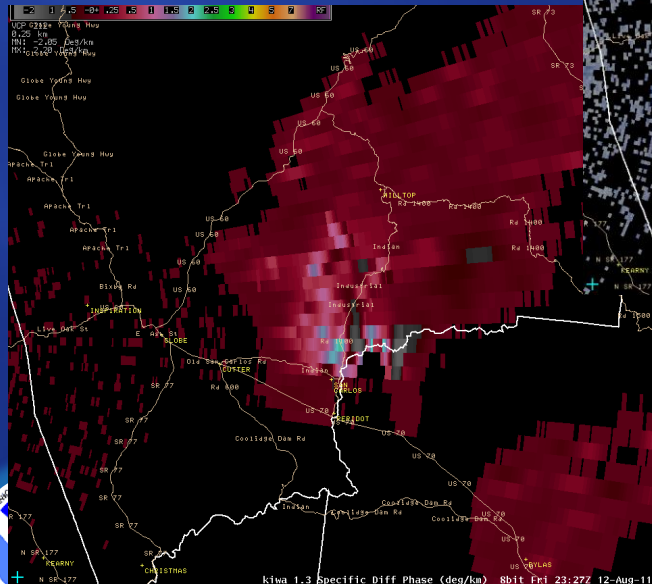
Beam ~12,000 ft MSL
FZL ~ 15,700 ft MSL



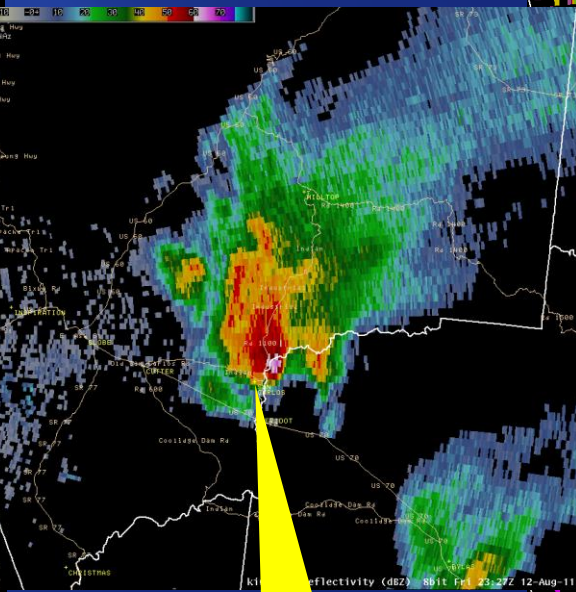
kiwa 1.3 Diff Reflectivity (dBZ) 8bit Frl 23:27



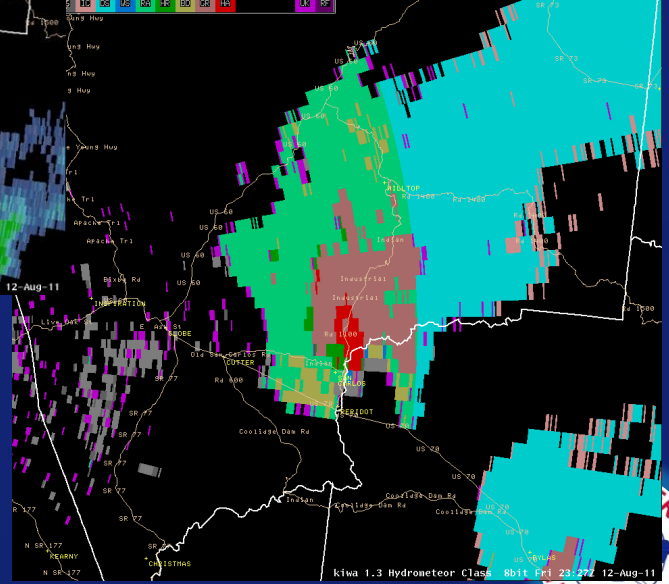
kiwa 1.3 Correlation Coefficient 8bit Frl 23:27 12-Aug-11



kiwa 1.3 specific Diff Phase (deg/ka) 8bit Frl 23:27 12-Aug-11

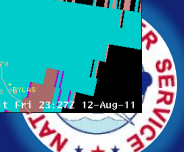


kiwa 1.3 Reflectivity (dBZ) 8bit Frl 23:27 12-Aug-11



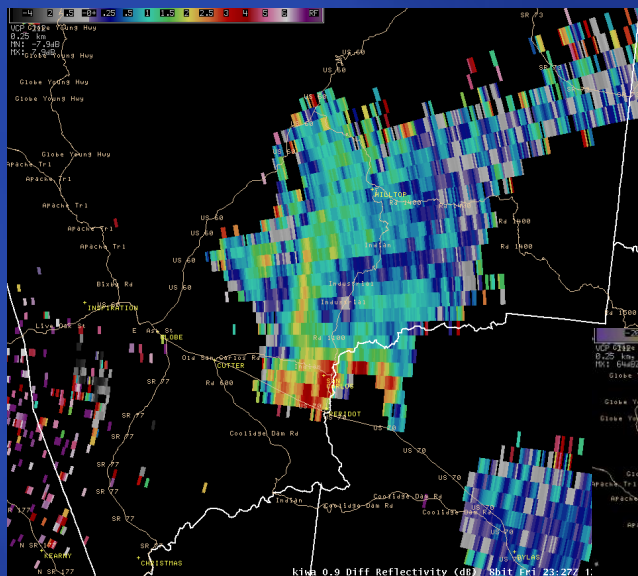
kiwa 1.3 Hydrometeor Class 8bit Frl 23:27 12-Aug-11

San Carlos

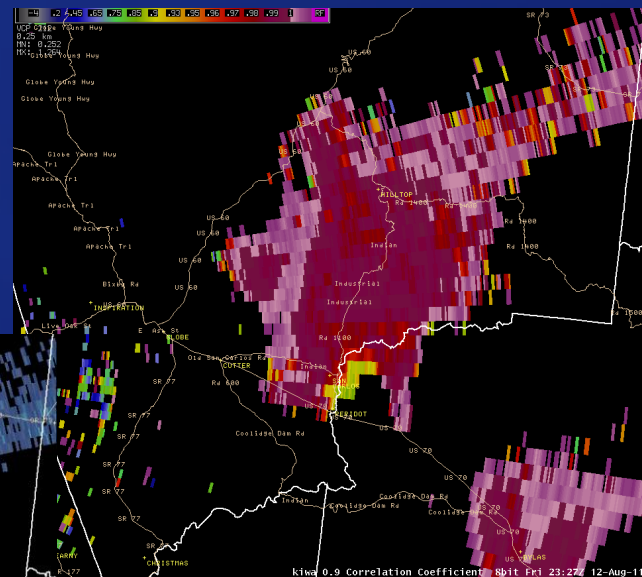


2327 UTC 0.9 Deg Dual-Pol

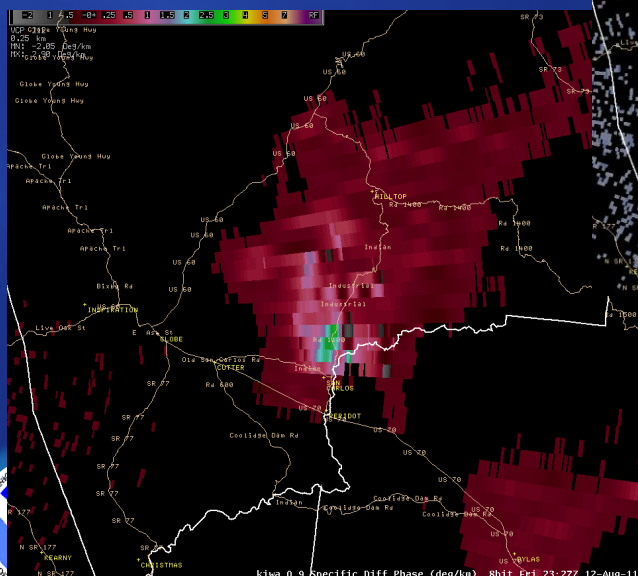
Beam ~9,500 ft MSL
FZL ~ 15,700 ft MSL



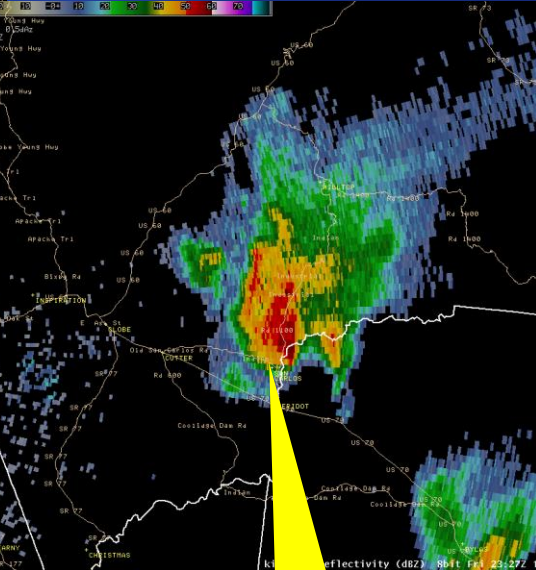
kiwa 0.9 Diff Reflectivity (dB) 8bit Fri 23:27Z 12-Aug-11



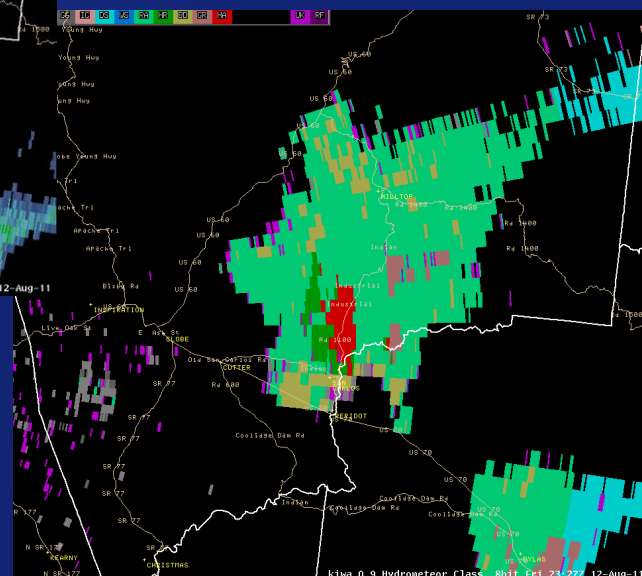
kiwa 0.9 Correlation Coefficient 8bit Fri 23:27Z 12-Aug-11



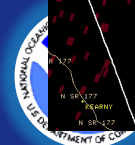
kiwa 0.9 Specific Diff Phase (deg/km) 8bit Fri 23:27Z 12-Aug-11



San Carlos



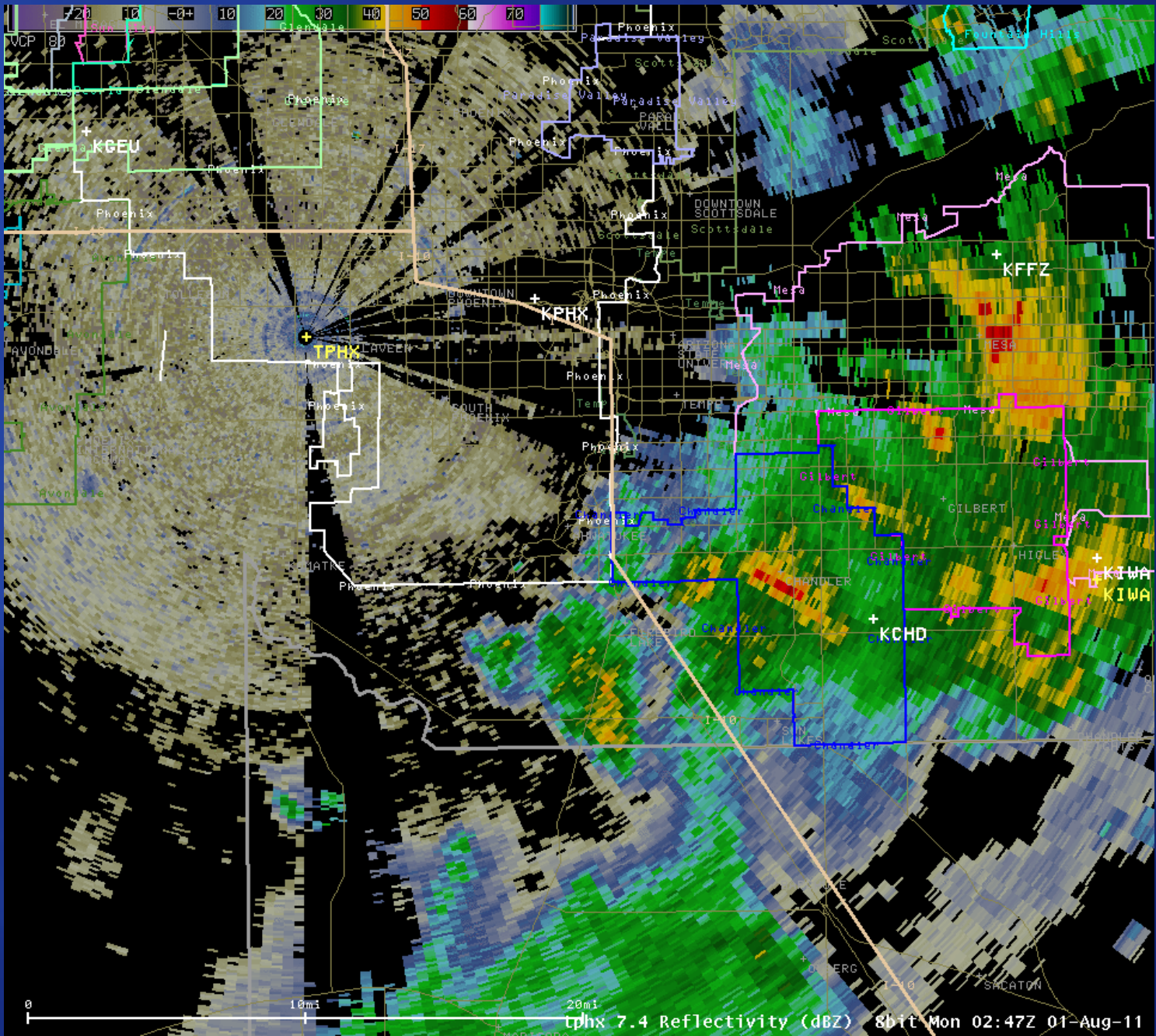
kiwa 0.9 Hydrometeor Class 8bit Fri 23:27Z 12-Aug-11

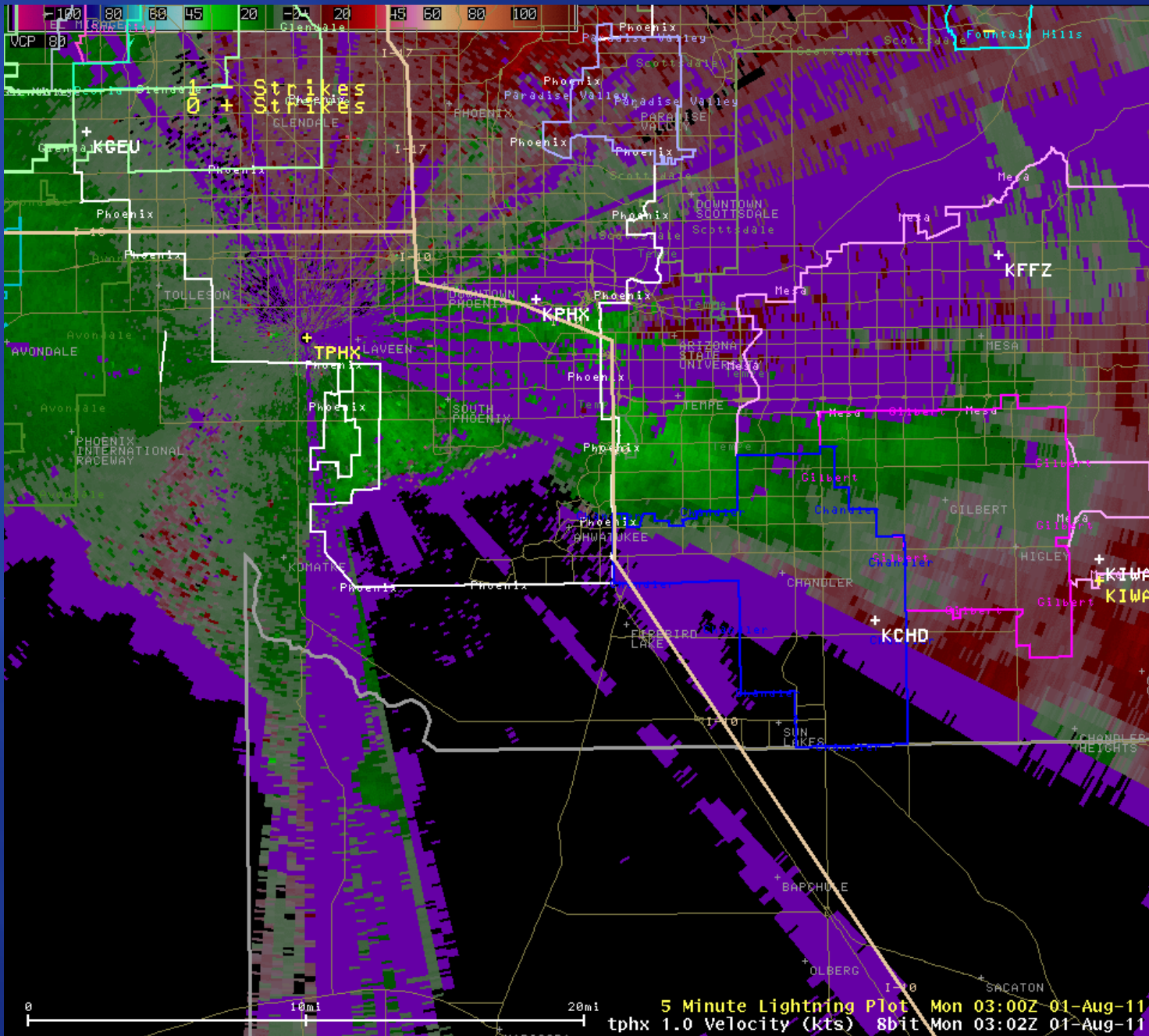


31 July 2011 case

- TPHX radar really helped us identify degree of threat posed by isolated thunderstorms over the west and central portions of the Greater Phoenix area
 - Two (or three) damaging microburst-producing storms, triggered by outflows from previous storms, occurred between 8 and 915 pm MST. Low level winds were best observed via the TPHX radar.
 - Dust storm was in progress over much of the Phoenix area



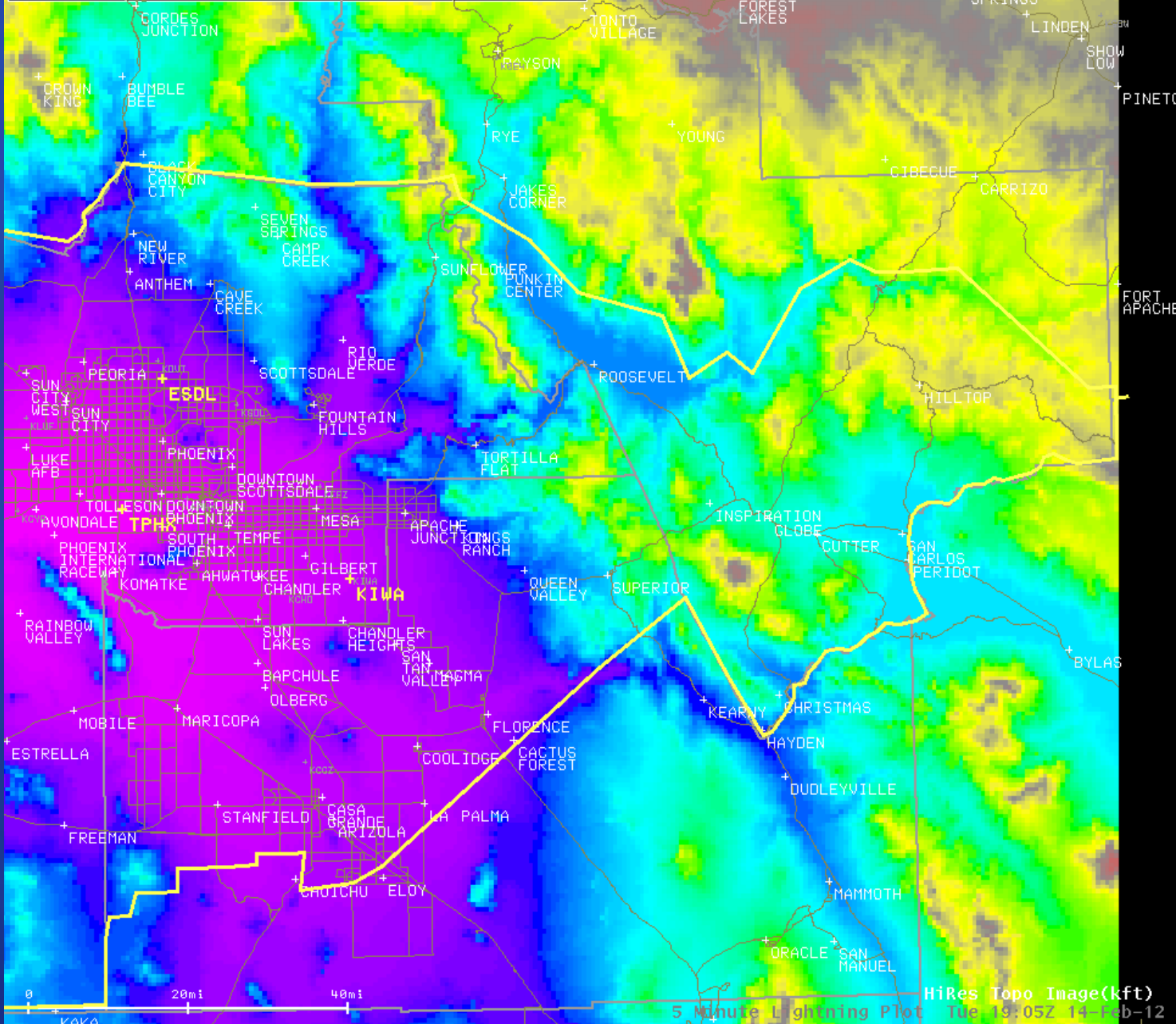




Snow Event

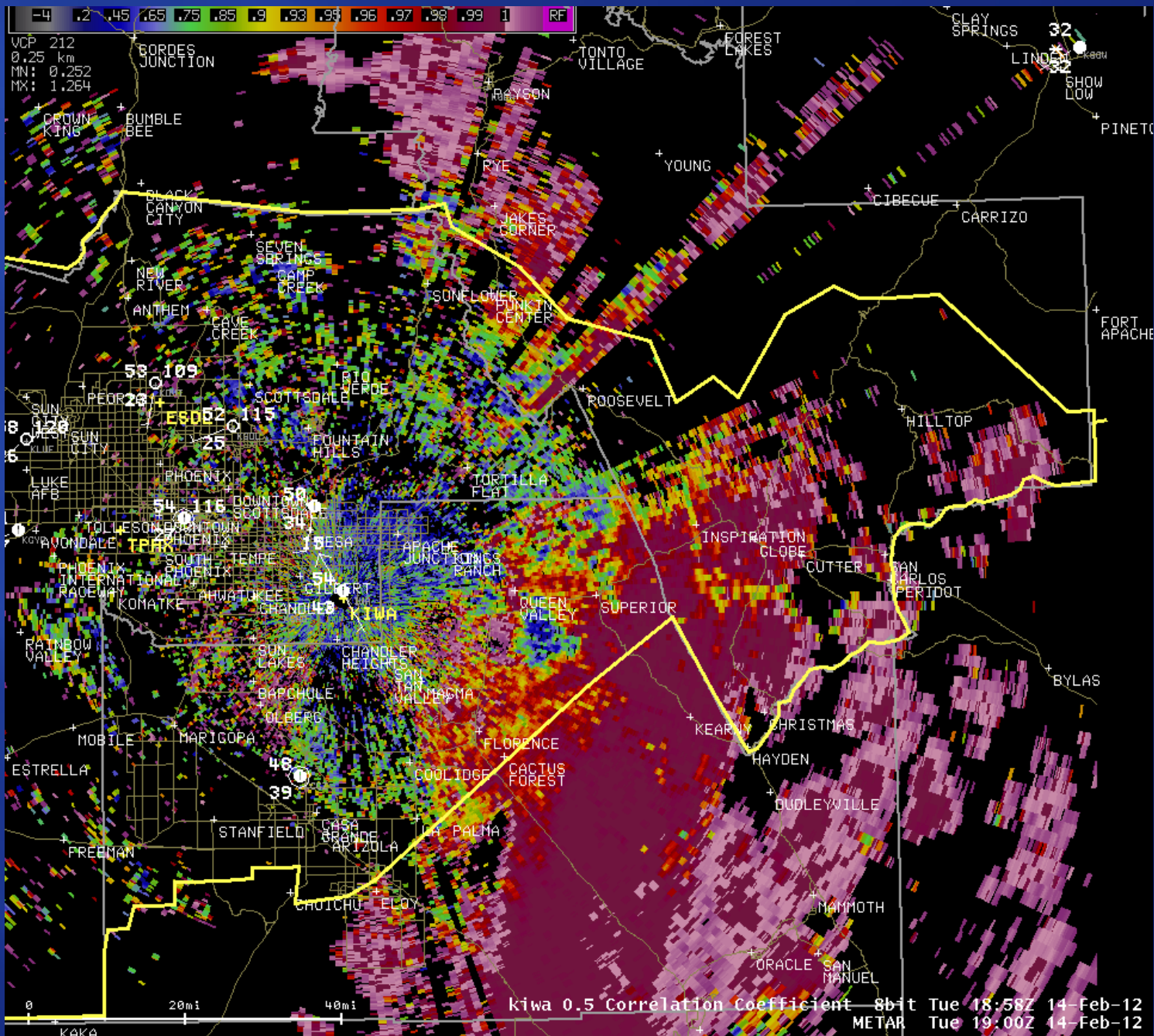
- Melting layer algorithm and CC should help forecasters determine the snow level
- Snow level can be a very high-impact weather variable. Higher precipitation rate and a drier subcloud layer can combine to dramatically lower snow level...sometimes by a couple thousand feet.
- Let's briefly examine a modest event...the 14 February snow over and near Globe, AZ [several inches of wet snow accumulated between 1800Z and 2100Z (11 am to 2 pm MST)]

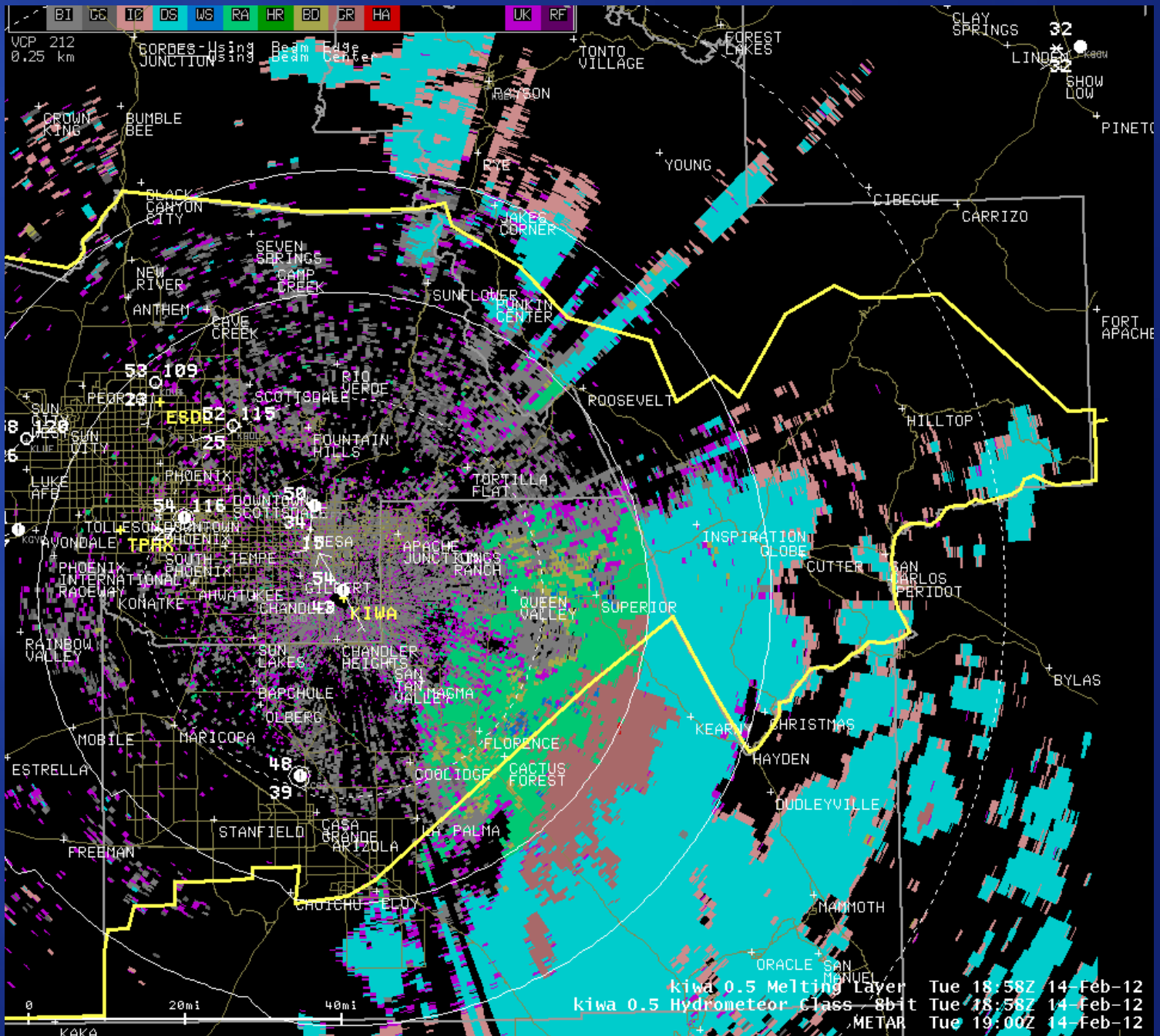




HiRes Topo Image(kft)
5 Minute Lightning Plot Tue 19:05Z 14-Feb-12



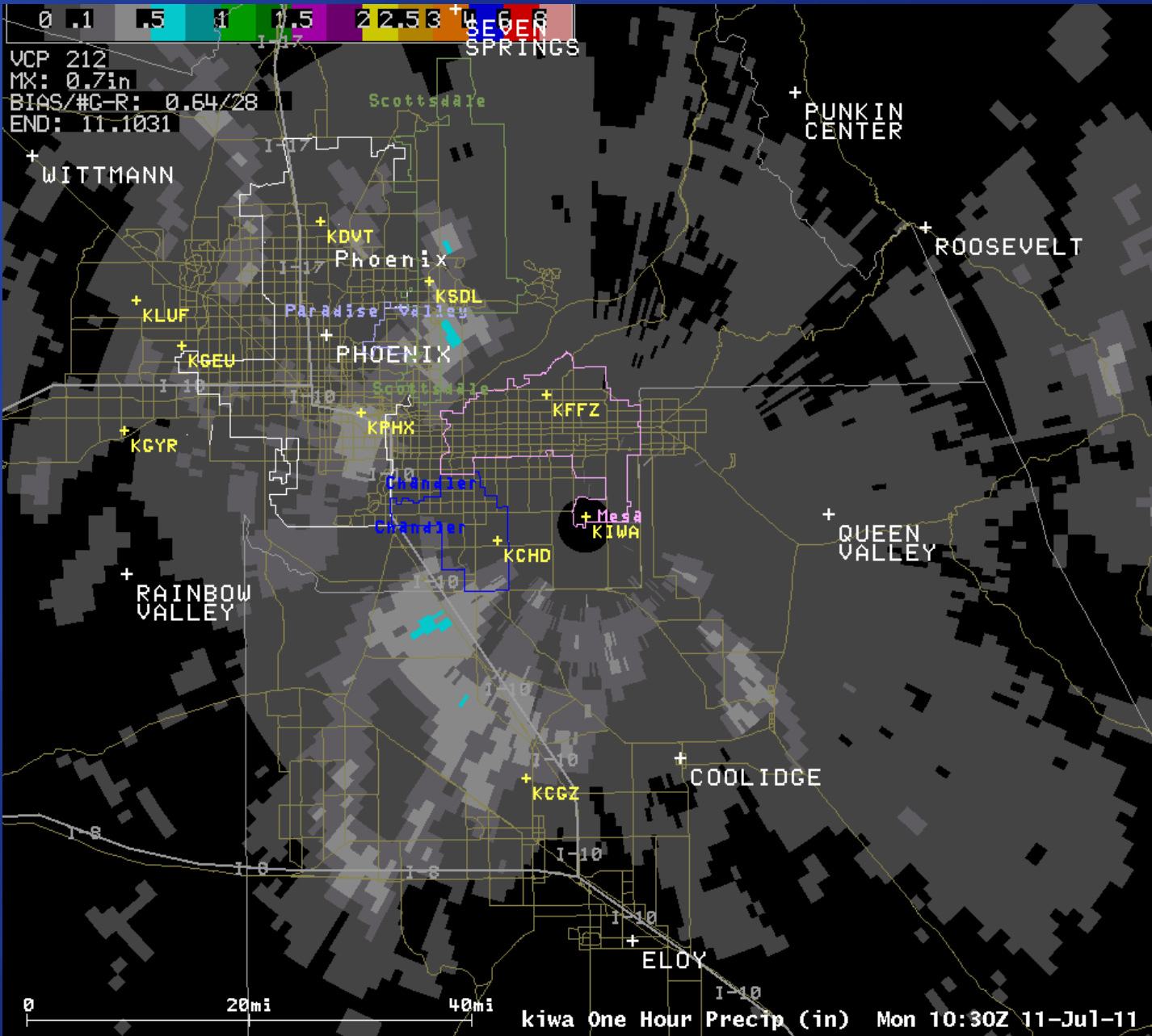


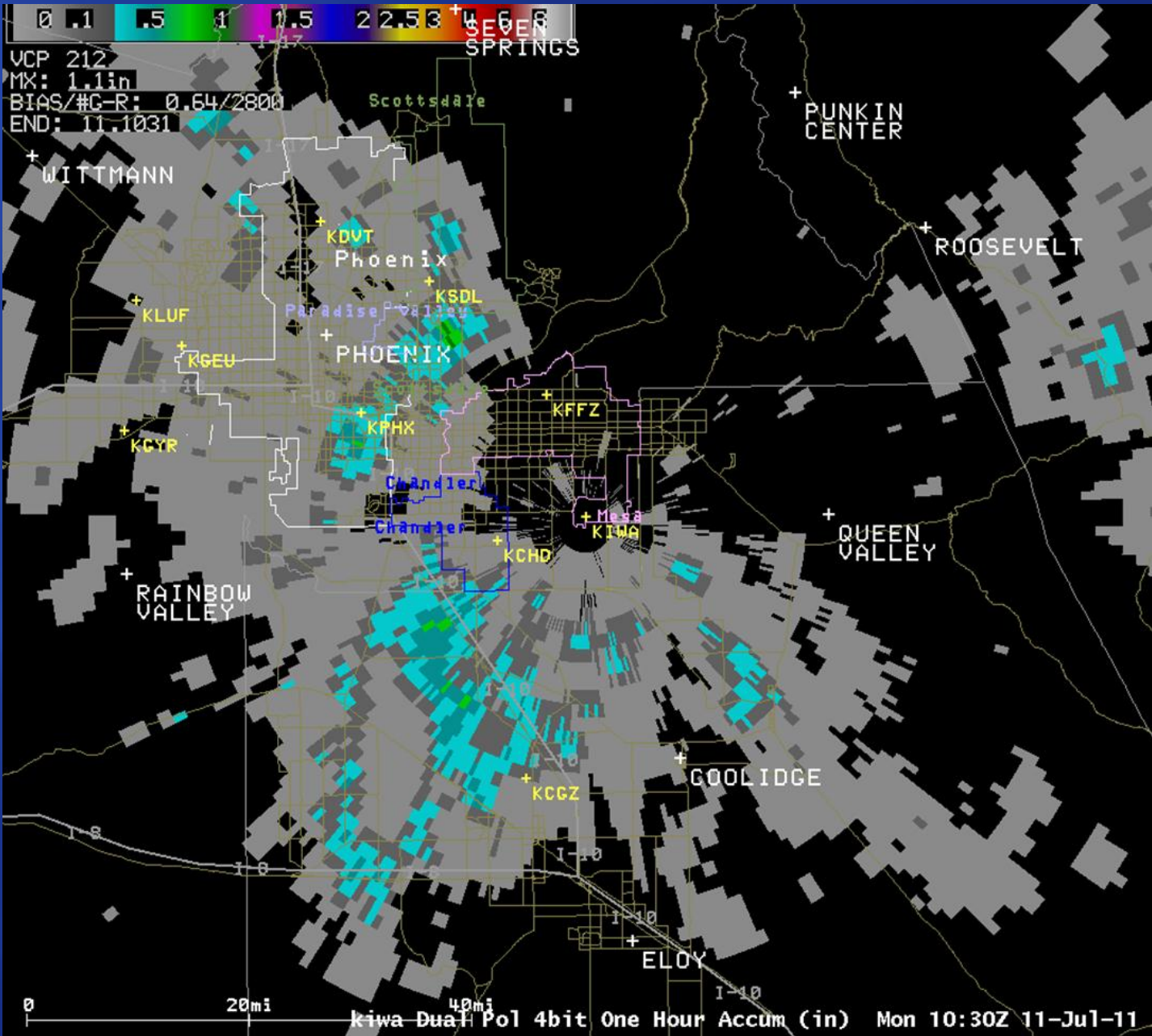


Precipitation Estimation

- Hydrometeor classification algorithm provides a best-guess regarding the makeup of particles in each sample volume
- Improved precipitation estimates should be obtainable.
- Let's compare and contrast legacy and dual pol precipitation estimates for one of the most widespread rain events over Phoenix during summer 2011, which occurred during the predawn hours on 11 July.



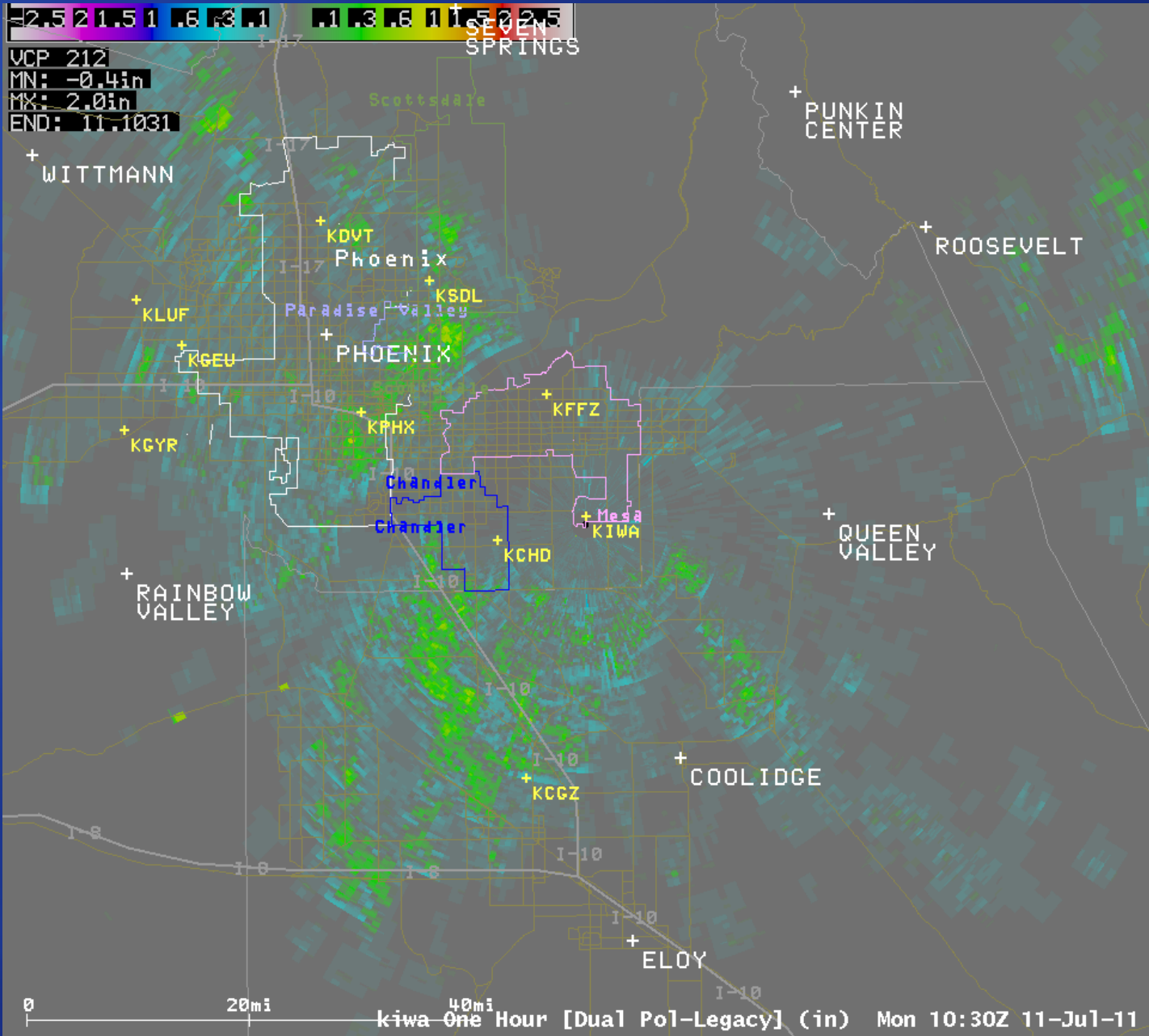




kiwa Dual Pol 4bit One Hour Accum (in) Mon 10:30Z 11-Jul-11



-2.5 2 1.5 1 .6 3 1 .1 3 .6 1 1.5 2 2.5
 VCP 212
 MN: -0.4in
 MX: 2.0in
 END: 11.1031



kiwa One Hour [Dual Pol-Legacy] (in) Mon 10:30Z 11-Jul-11



Summary

- ❑ CC may be useful to help confirm the presence of various sizes/types of airborne targets due to strong/severe wind (e.g., the 5 July 2011 dust storm)
- ❑ CC and melting layer algorithm can definitely help forecasters determine how the snow level is evolving
- ❑ Some thunderstorm warning decision-making support is provided by dual pol variables during weak shear, low CAPE environments
 - Warning lead times for pulse severe storms can be increased by a few minutes, if proper interrogation techniques are employed
- ❑ Dual Pol precipitation estimates may or may not be more accurate than legacy precipitation estimates. Haven't had too many decent rain events...need to examine more cases.

