



National Transportation Safety Board

**Office of Aviation Safety
Washington, D.C. 20594-2000
October 24, 2016**

ATTACHMENT 2 to the WEATHER STUDY CEN16FA276

- Images from the Integrated Terminal Weather System (ITWS) Situation Display for 1103 and 1108 CDT.
- Radar imagery available from KLOT, KMKX, TORD and TMDW between about 1052 and 1112 CDT (these follow the convective cell coincident with the accident location and accident time). The following information presents the approximate altitudes above the accident site above msl that the radar beam would have “seen” for the various radars/tilts presented in the imagery.

KLOT ~0.5° tilt - between 700 and 1,300 feet
KLOT ~1.5° tilt - between 1,350 and 1,950 feet
KLOT ~2.5° tilt - between 1,950 and 2,600 feet
KLOT ~3.5° tilt - between 2,600 and 3,200 feet
KLOT ~4.4° tilt - between 3,200 and 3,800 feet
KLOT ~6.1° tilt - between 4,250 and 4,850 feet
KLOT ~10.0° tilt - between 6,700 and 7,300 feet
KLOT ~14.6° tilt - between 9,550 and 10,200 feet

KMKX ~0.5° tilt - between 6,100 and 14,750 feet
KMKX ~0.9° tilt - between 9,750 and 18,400 feet
KMKX ~1.3° tilt - between 13,400 and 22,050 feet
KMKX ~1.8° tilt - between 17,900 and 26,600 feet
KMKX ~2.4° tilt - between 23,400 and 32,050 feet
KMKX ~3.2° tilt - between 30,700 and 39,350 feet

TORD ~0.3° tilt - between 1,100 and 2,300 feet
TORD ~1.0° tilt - between 2,650 and 3,900 feet

TORD ~1.9° tilt - between 4,650 and 5,900 feet

TMDW ~0.3° tilt - between 1,150 and 2,450 feet

TMDW ~1.0° tilt - between 2,750 and 4,050 feet

TMDW ~2.6° tilt - between 6,500 and 7,800 feet

According to the FAA the dBZ thresholds for the color scale (levels) presented in the ITWS Situation Display are as follows:

Level 1: 18 < 30 dBZ

Level 2: 30 < 41 dBZ

Level 3: 41 < 46 dBZ

Level 4: 46 < 50 dBZ

Level 5: 50 < 57 dBZ

Level 6: 57+ dBZ

With regard to the ITWS screenshots, the FAA provided the following information:

100 nm window

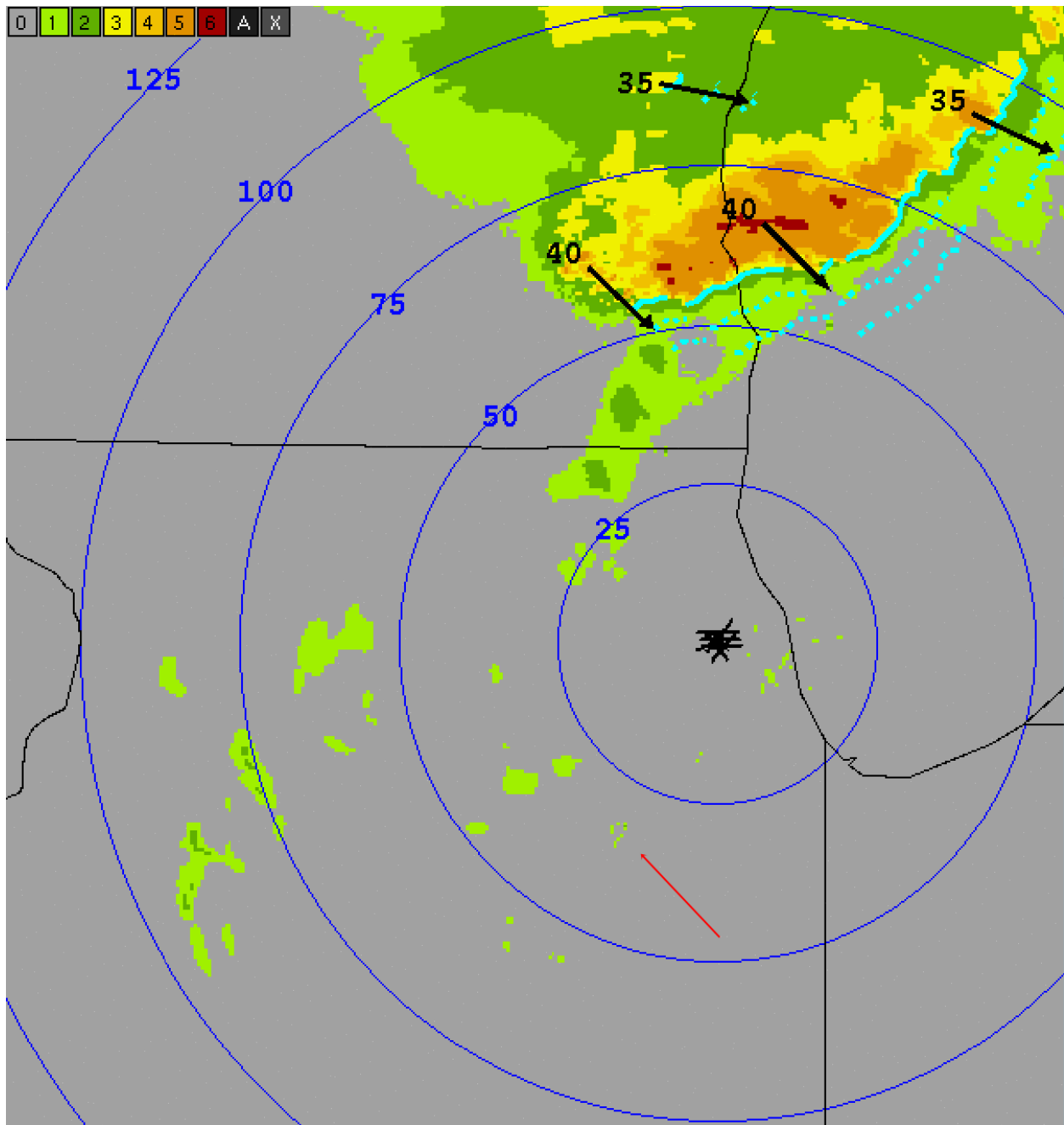
- Mosaic of the following 5 radars: NEXRADs, Chicago (KLOT), and Milwaukee (KMKX), and TDWRs, ORD, MDW, and MKE; update rate 1/5 min. These data are mosaicked by the ITWS processor to create one precipitation map for display in the 100 and 200nm windows on the Situation Display: (1) The NEXRAD data is a VIL¹ product received directly from each NEXRAD, (2) The TDWR data is a composite reflectivity map of all tilts which is created by the ITWS processor. The ITWS processor combines the 2 NEXRAD VIL maps and 3 TDWR composite maps to create one precipitation map for display on the SD.

ORD TRACON window

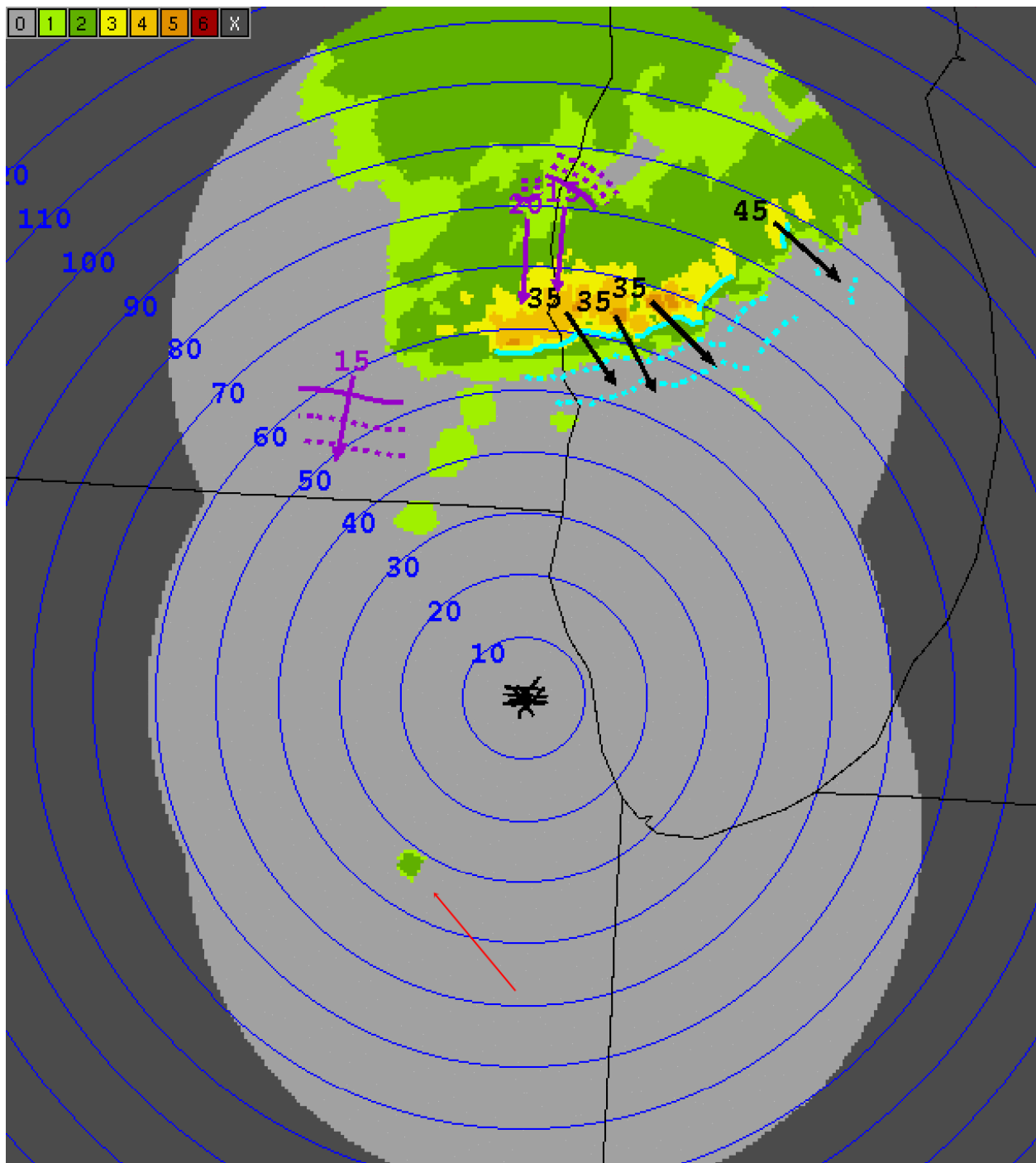
- Mosaic of the following 4 ASR-9s, Chicago (ORD), Oak Forrest (QXM), Milwaukee (MKE), and Chicago North (ORN); update rate 1/30 sec. The TRACON window precipitation is a mosaic of all 4 ASRs. Precipitation data from each ASR is edited for Anomalous Propagation (AP), and then the AP edited data is combined into a single ASR mosaic image to be displayed on the SD. A set of rules is used to combine the ASR data into one mosaic image; the rules depend on how many ASRs are overlapping in a particular region.

*Submitted by: Mike Richards
NTSB, AS-30*

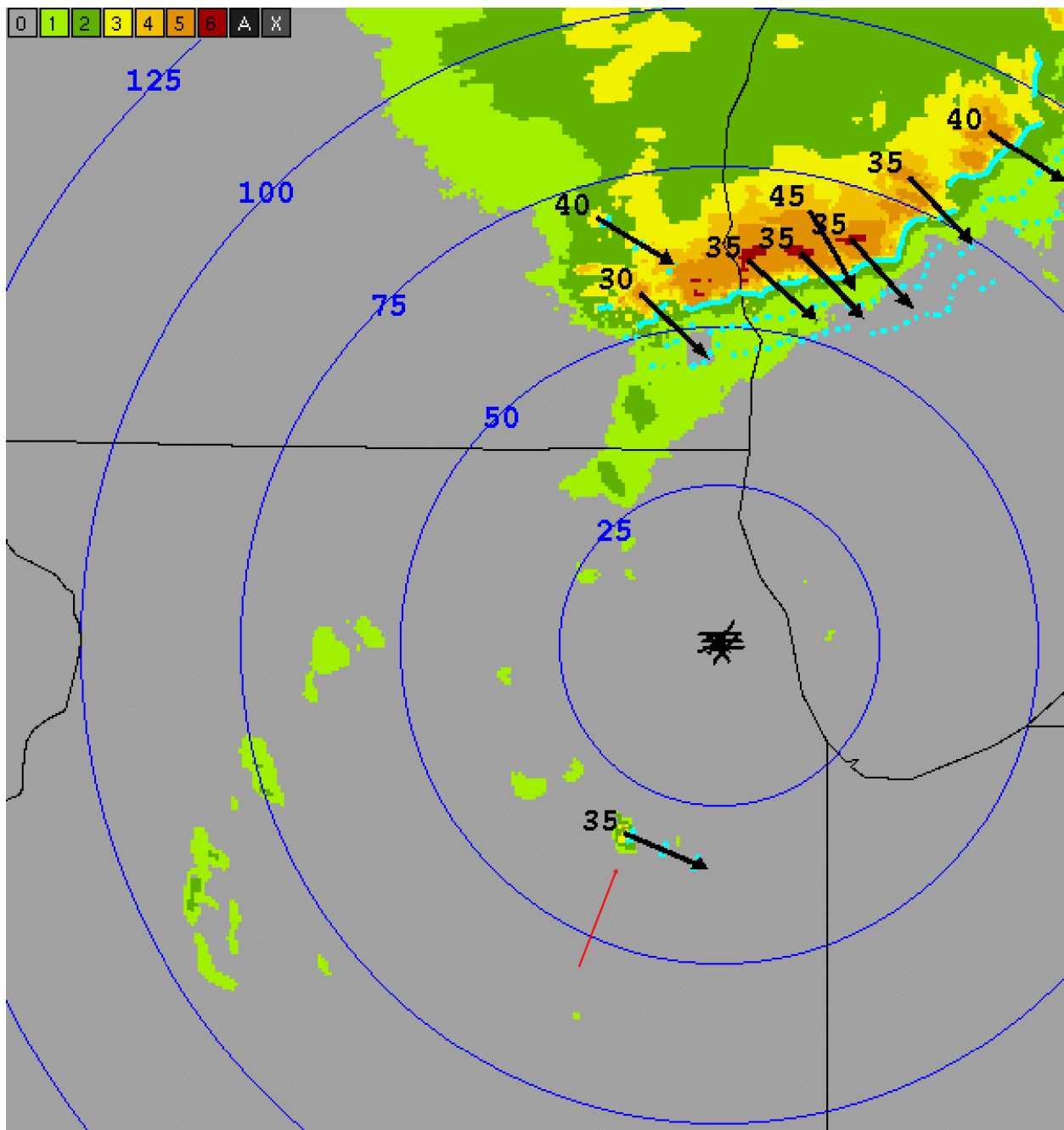
¹ Vertically integrated liquid (VIL) is an estimate of the total mass of precipitation in the clouds, and can be obtained by weather radar observation.



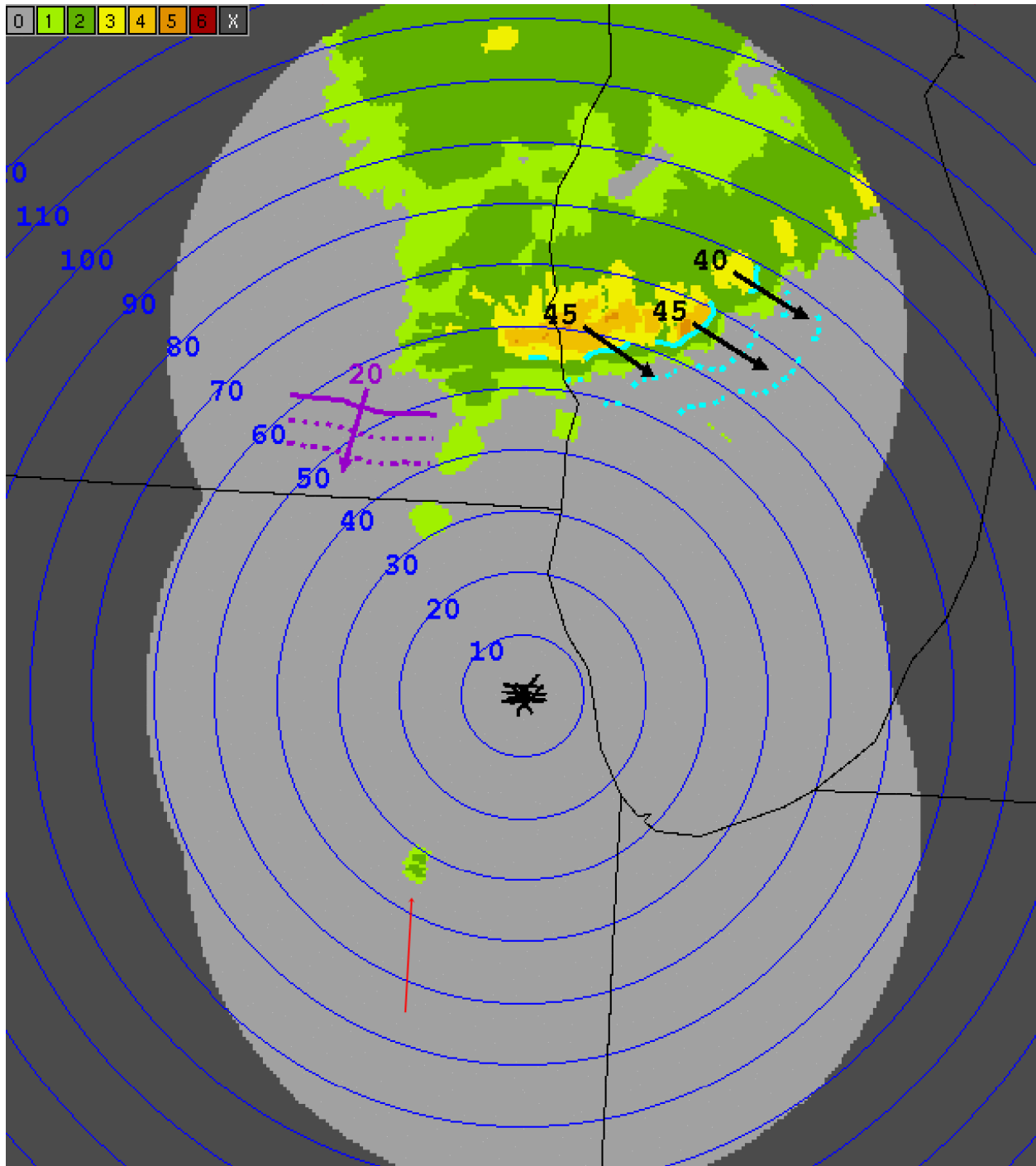
Chicago area ITWS “100 nm” weather radar display for 1103:00 CDT. Red arrow identifies convective cell coincident with the accident location at the accident time.



Chicago area ITWS “ORD TRACON” weather radar display for 1103:00 CDT. Red arrow identifies convective cell coincident with the accident location at the accident time.



Chicago area ITWS “100 nm” weather radar display for 1108:00 CDT. Red arrow identifies convective cell coincident with the accident location at the accident time.



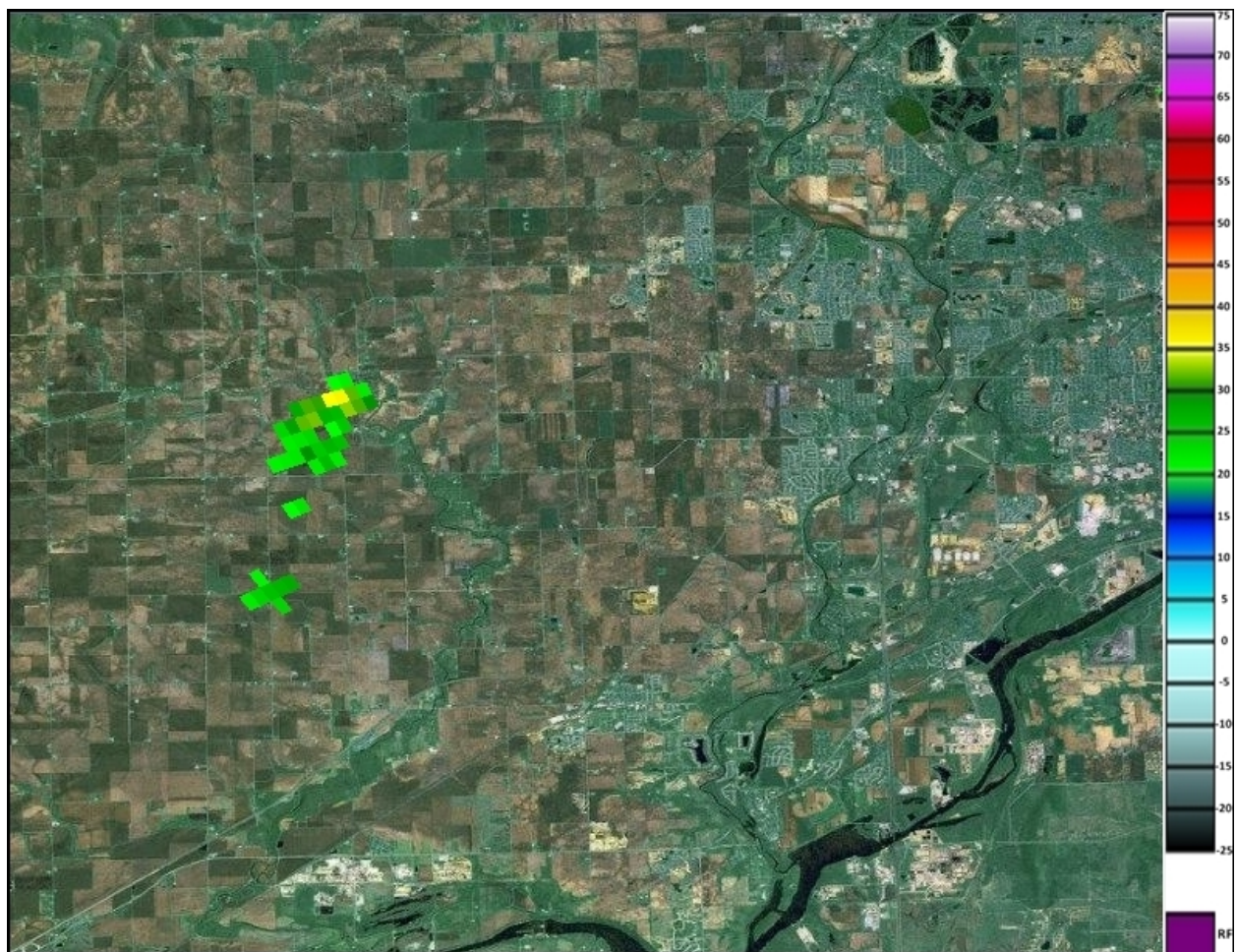
Chicago area ITWS “ORD TRACON” weather radar display for 1108:00 CDT. Red arrow identifies convective cell coincident with the accident location at the accident time.



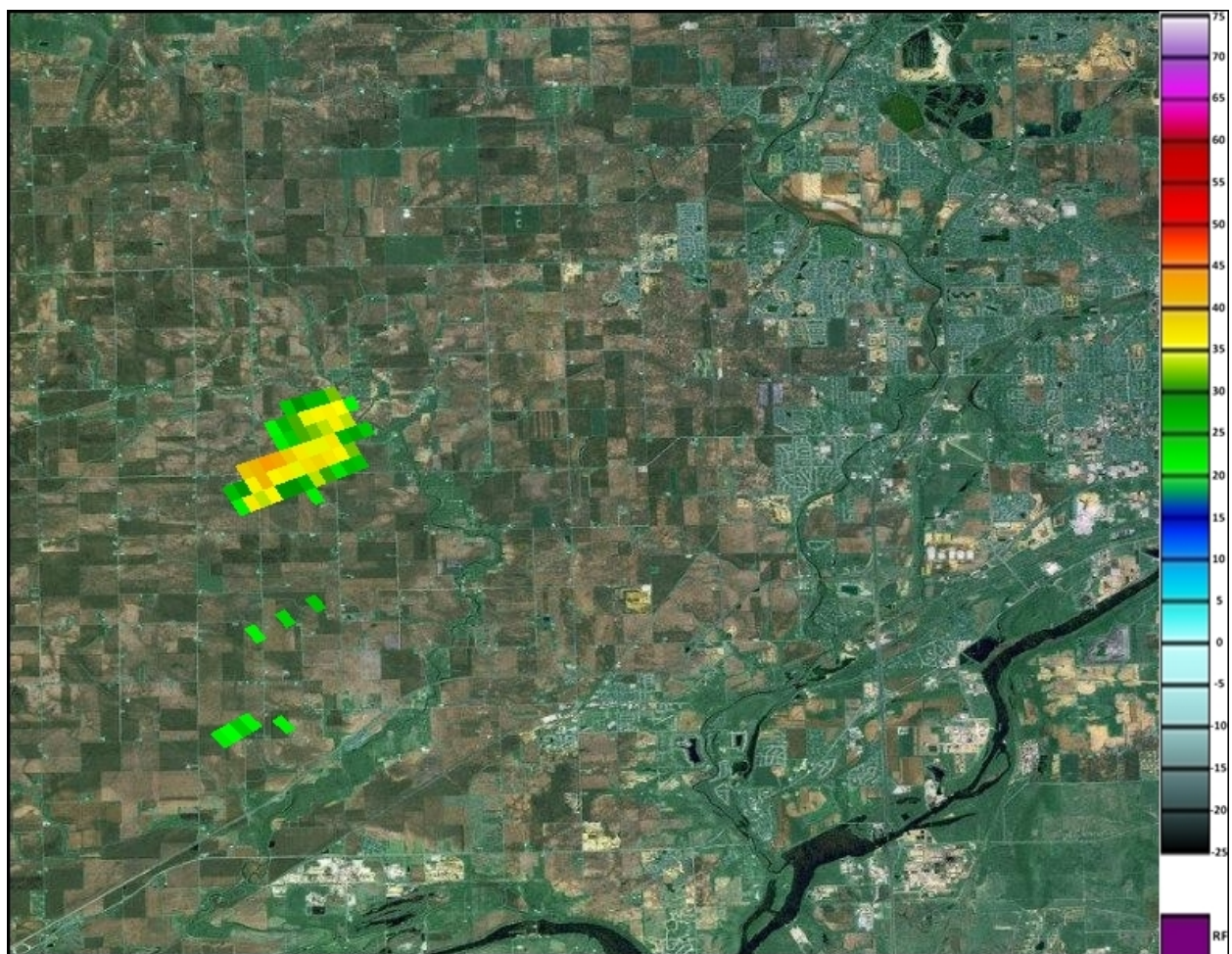
KLOT WSR-88D Level-II ~3.5° radar sweep beginning about 1051:50 CDT.



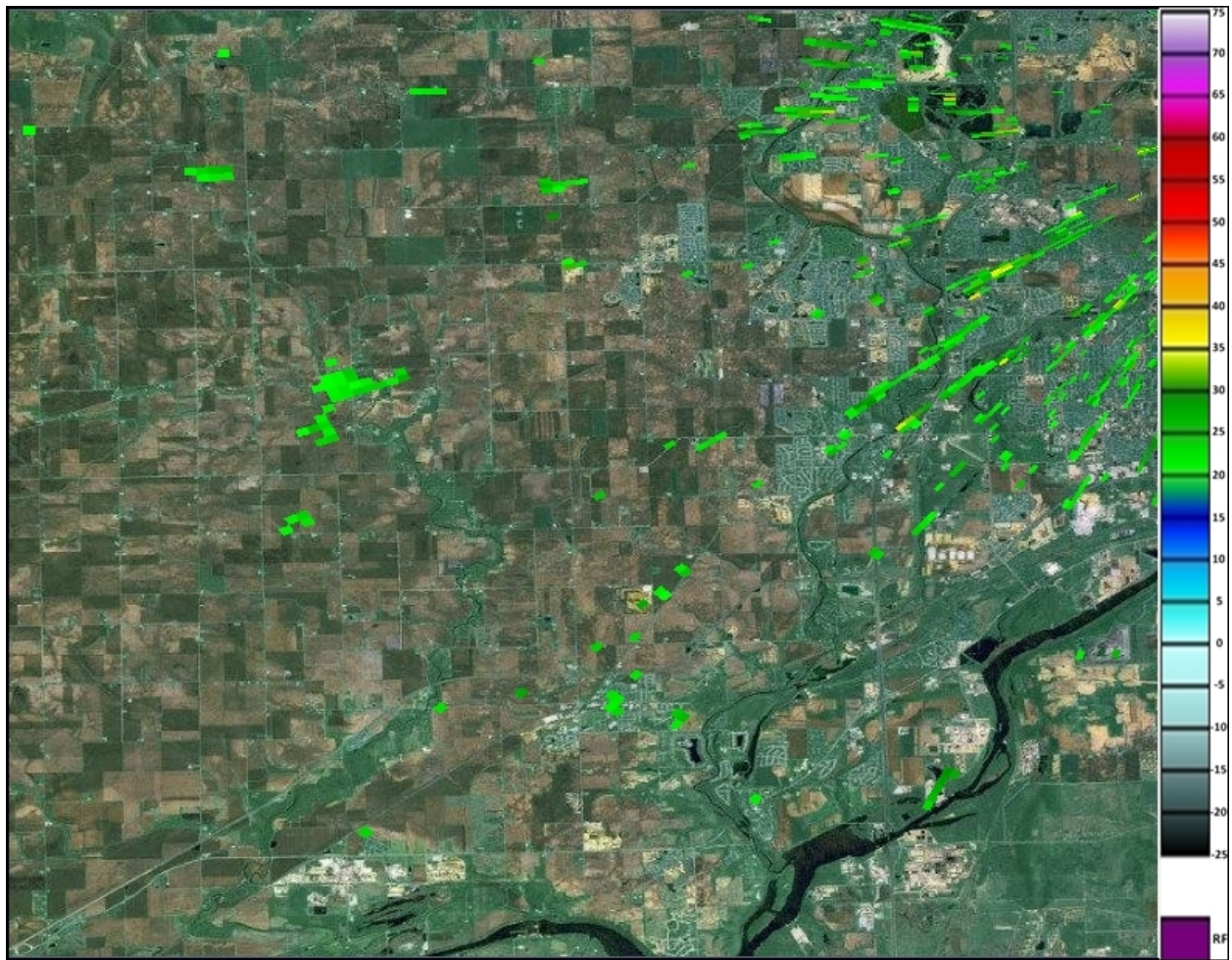
KLOT WSR-88D Level-II ~4.4° radar sweep beginning about 1052:24 CDT.



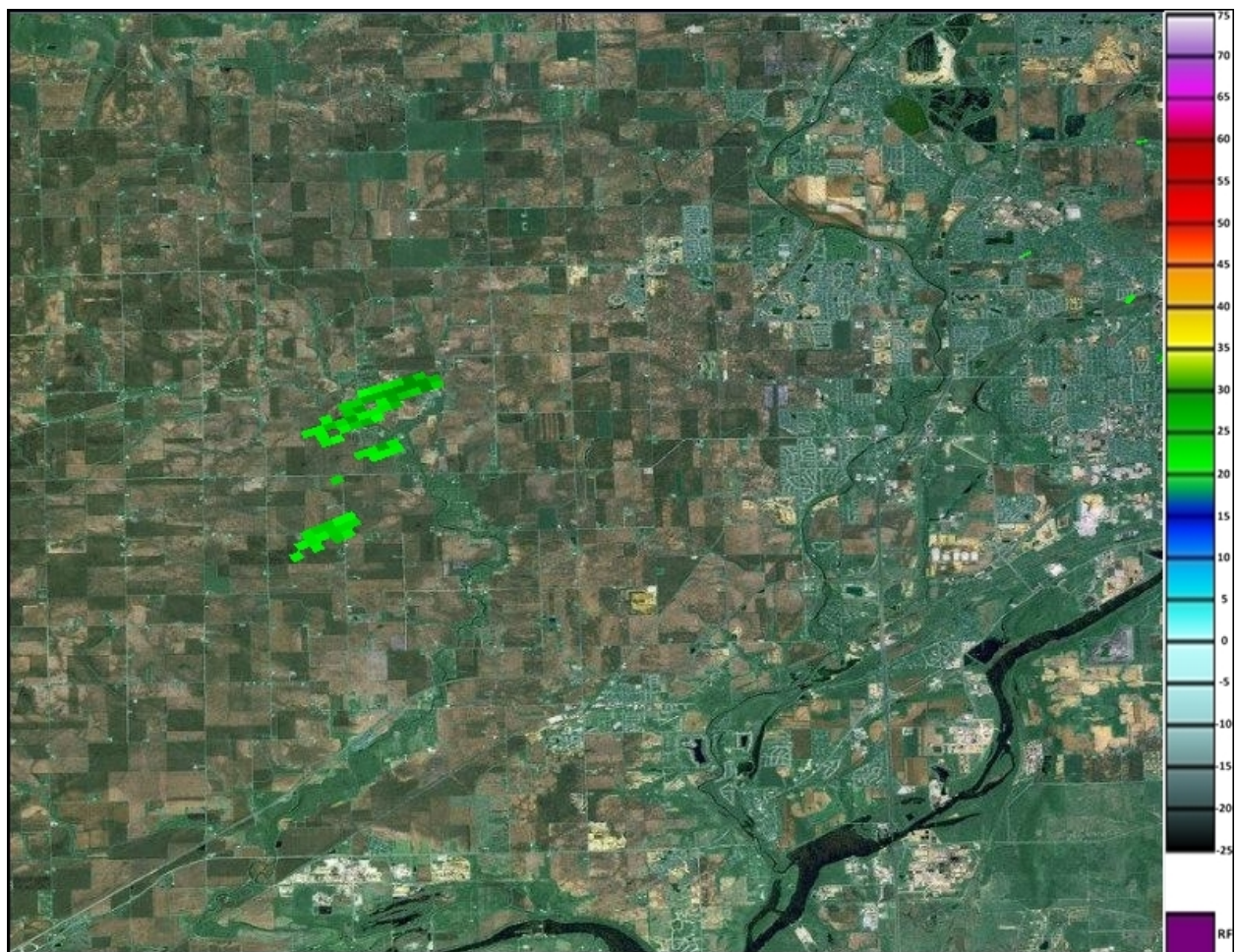
KLOT WSR-88D Level-II $\sim 6.1^\circ$ radar sweep beginning about 1052:57 CDT.



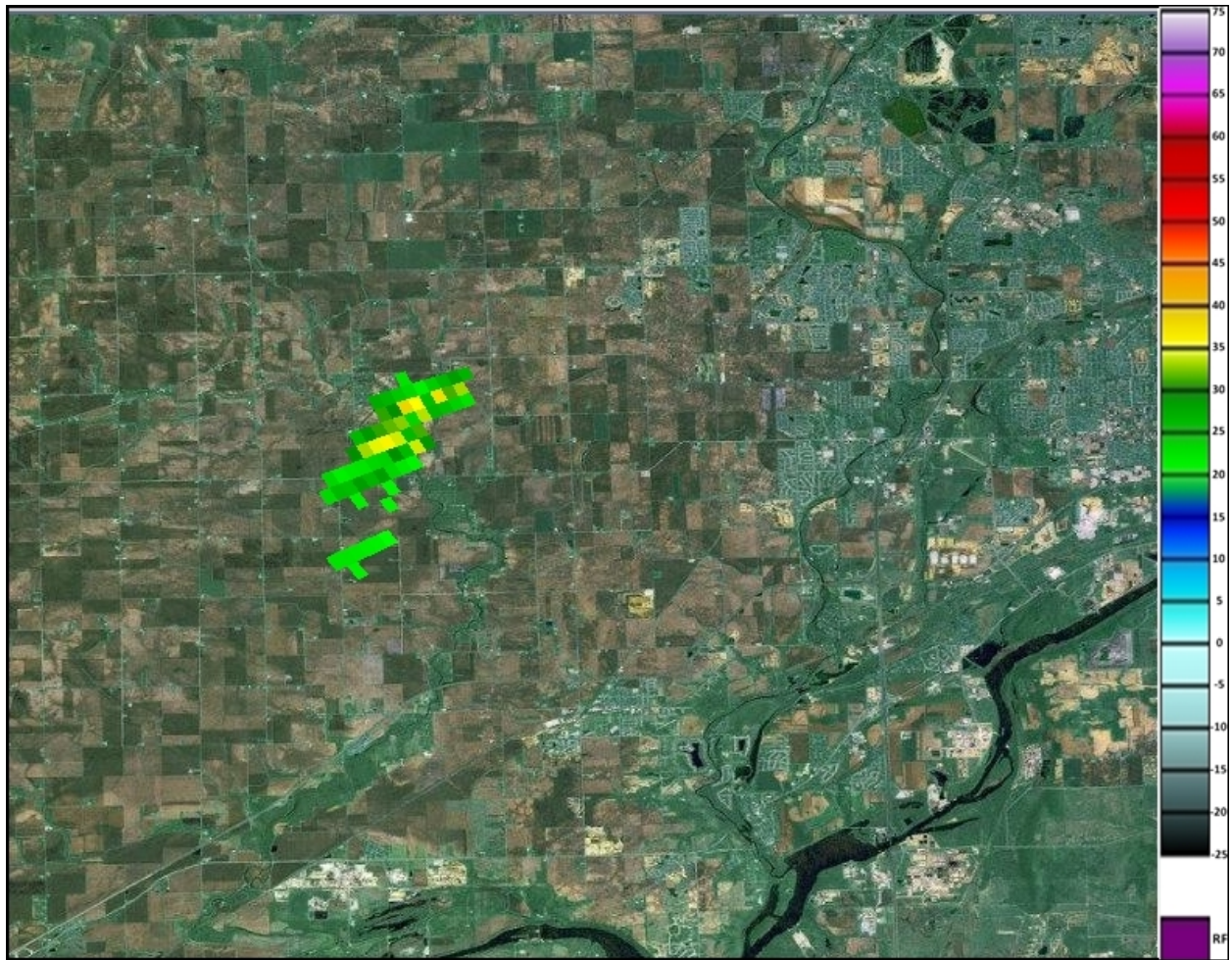
KLOT WSR-88D Level-II $\sim 10.0^\circ$ radar sweep beginning about 1053:30 CDT.



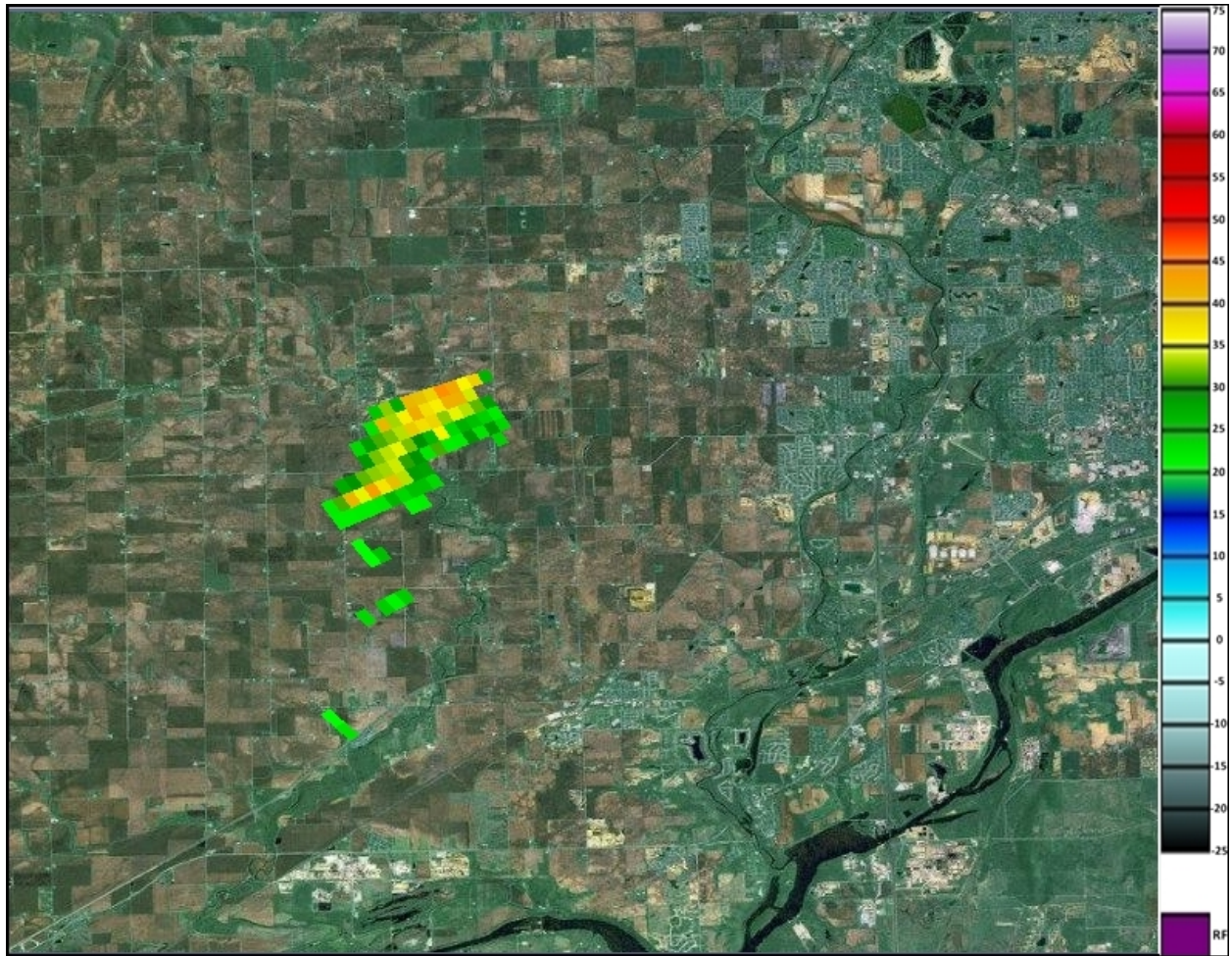
KLOT WSR-88D Level-II ~0.5° radar sweep beginning about 1054:04 CDT.



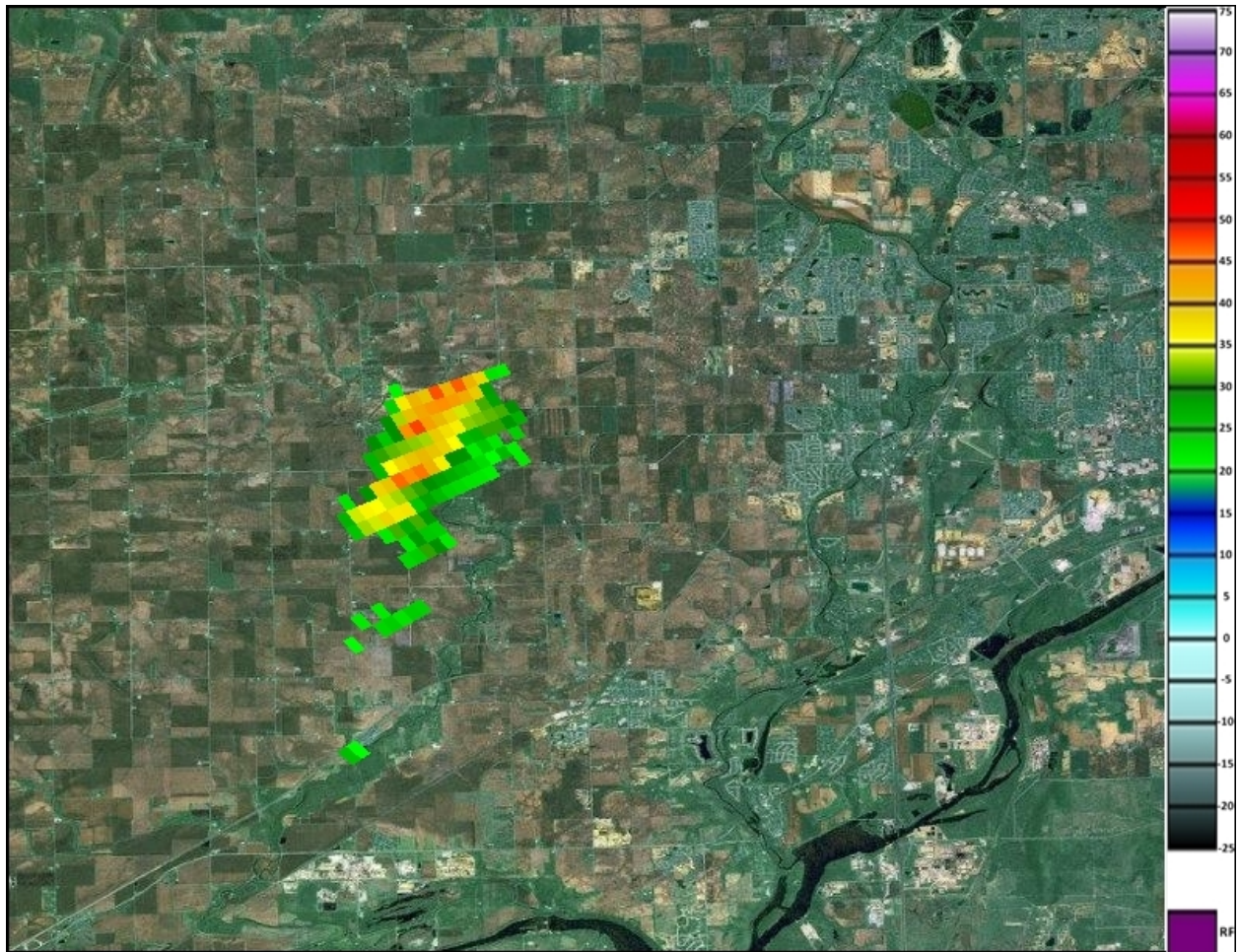
KLOT WSR-88D Level-II $\sim 1.5^\circ$ radar sweep beginning about 1055:08 CDT.



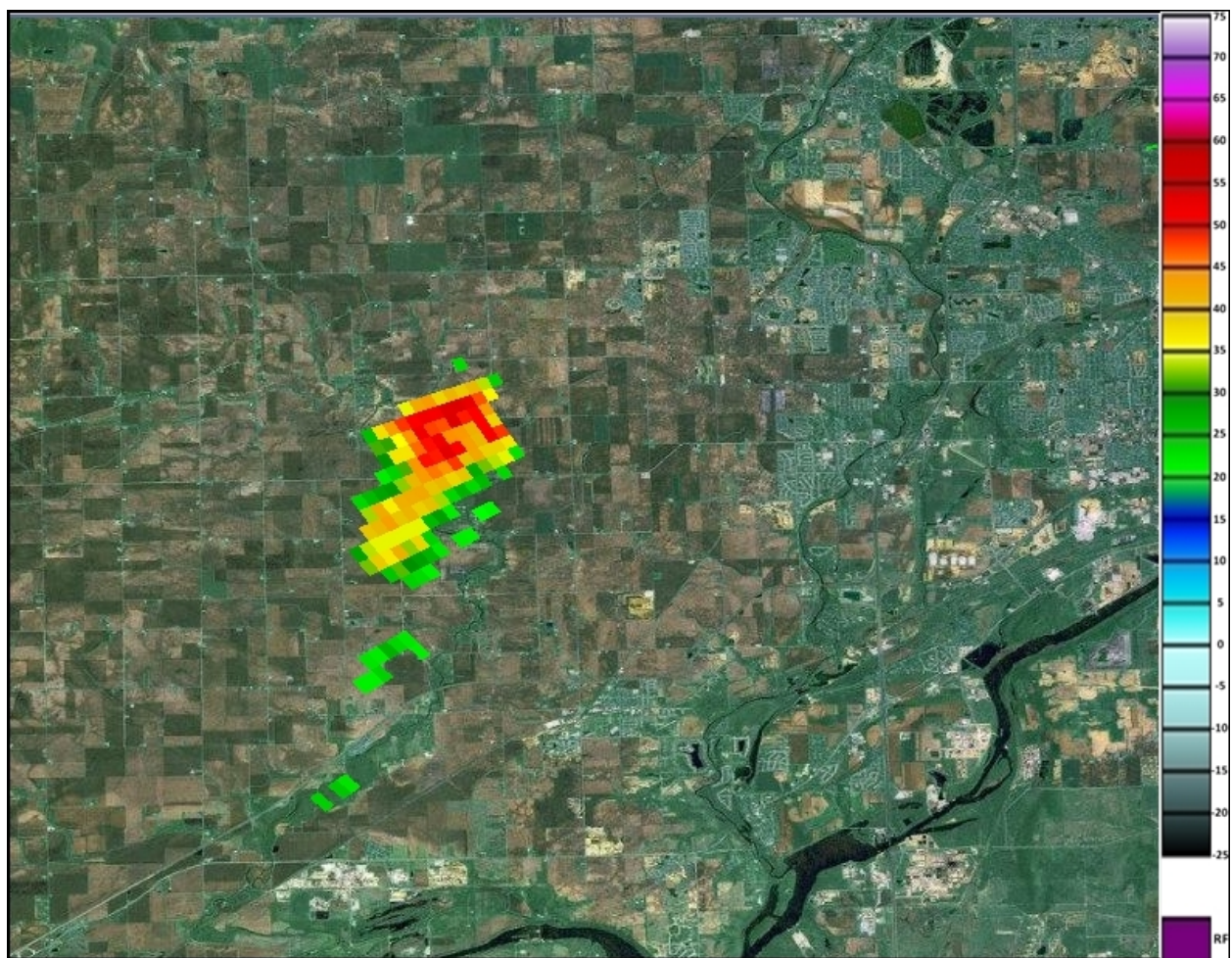
KLOT WSR-88D Level-II $\sim 2.5^\circ$ radar sweep beginning about 1056:13 CDT.



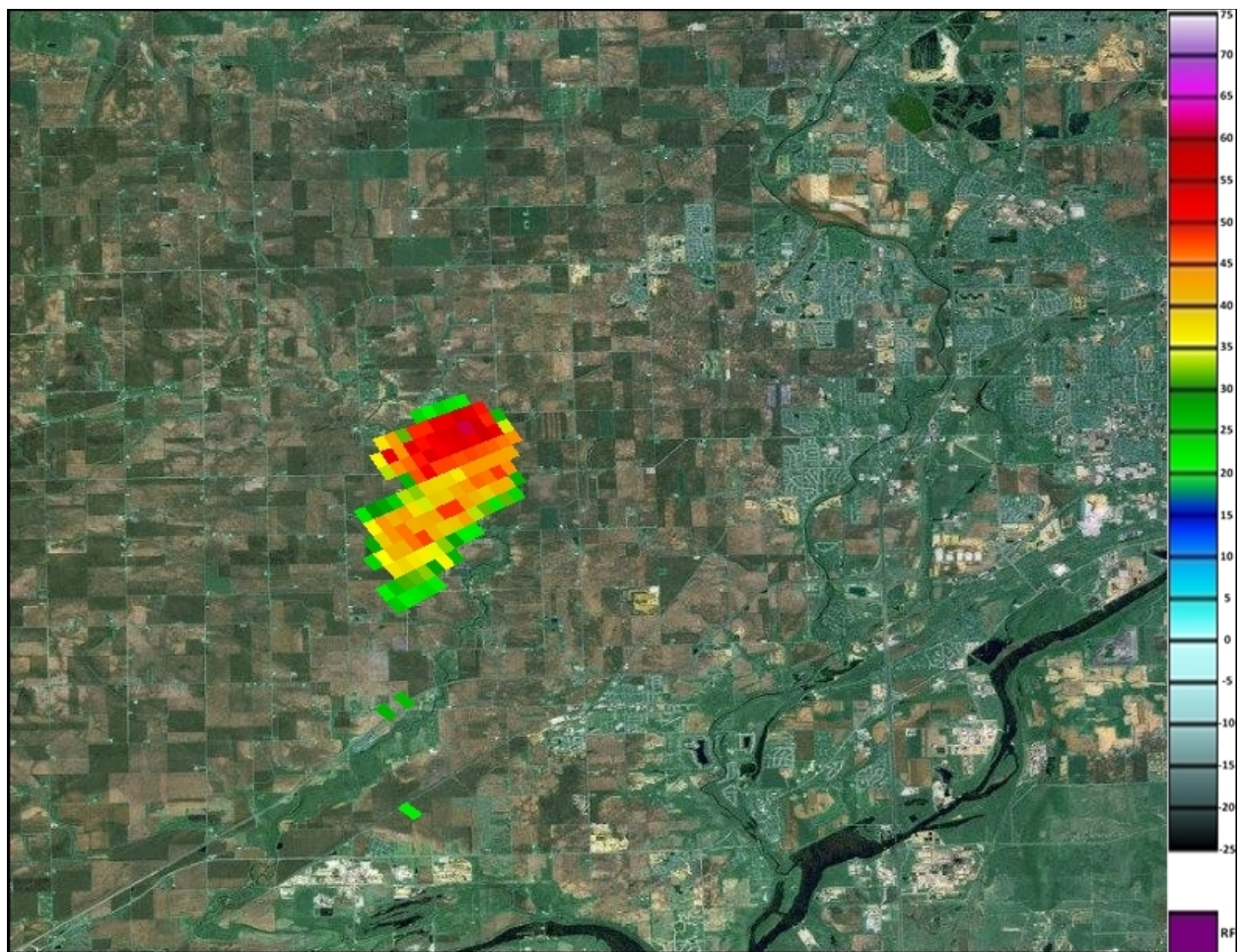
KLOT WSR-88D Level-II ~3.5° radar sweep beginning about 1056:46 CDT.



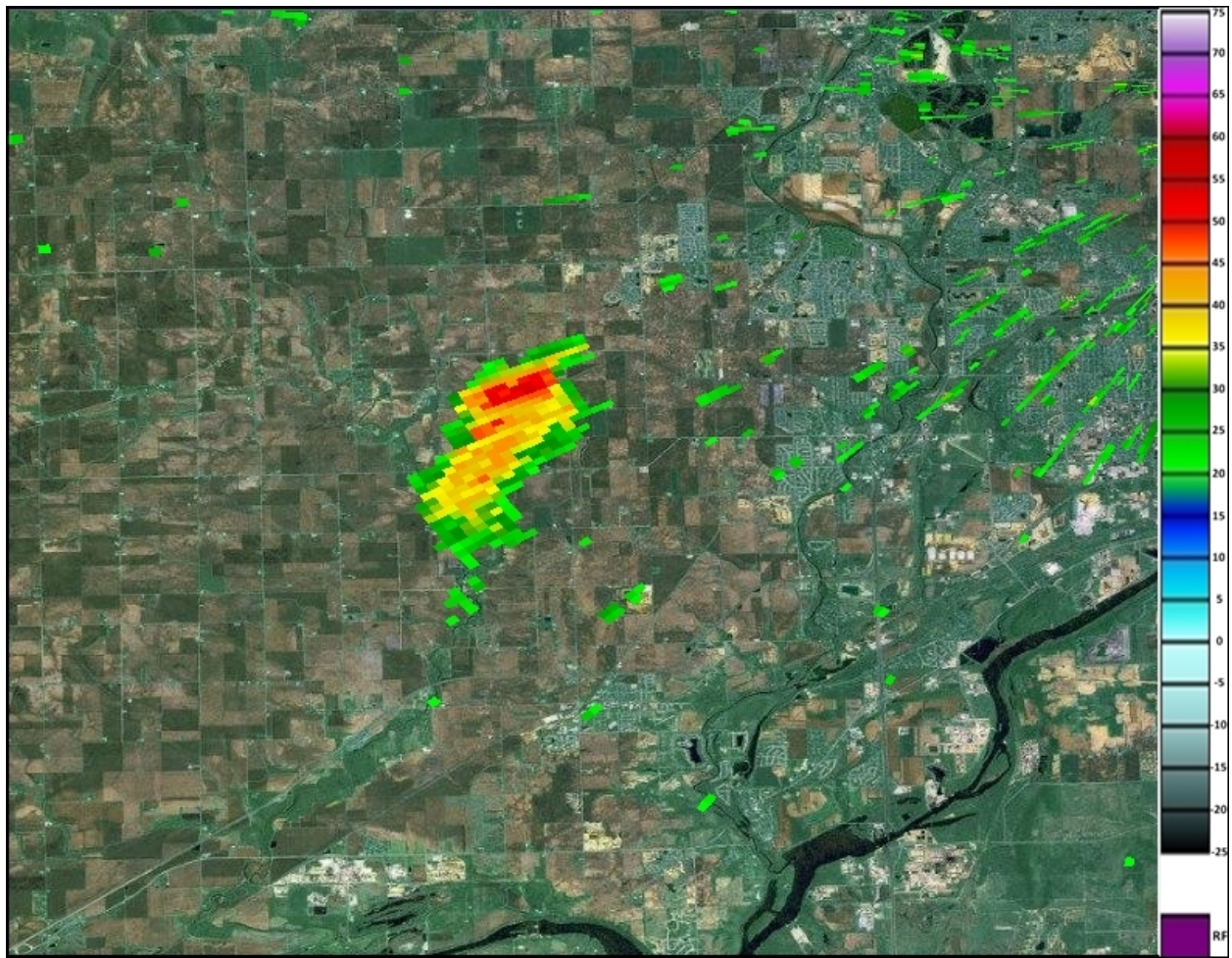
KLOT WSR-88D Level-II $\sim 4.4^\circ$ radar sweep beginning about 1057:19 CDT.



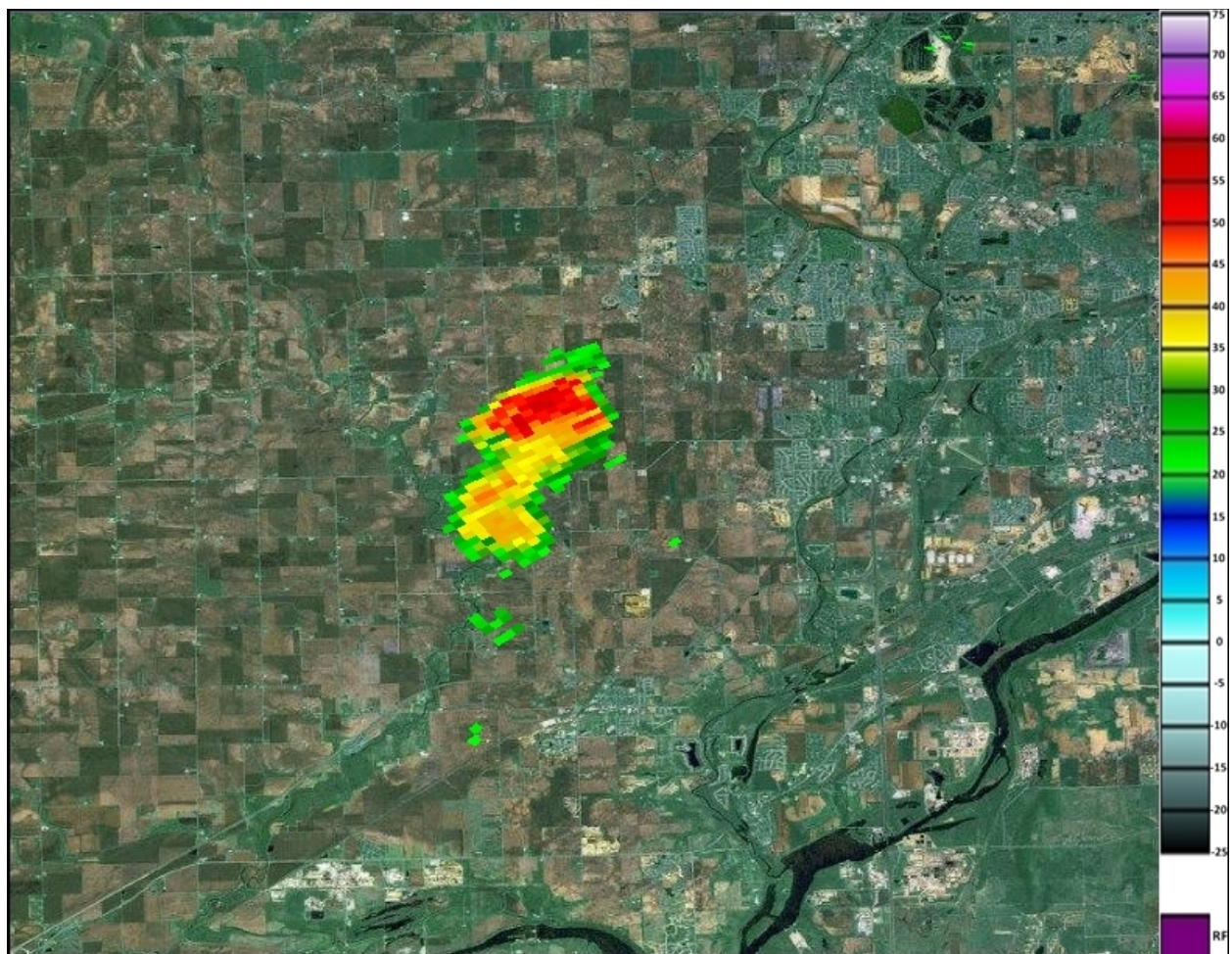
KLOT WSR-88D Level-II $\sim 6.1^\circ$ radar sweep beginning about 1057:52 CDT.



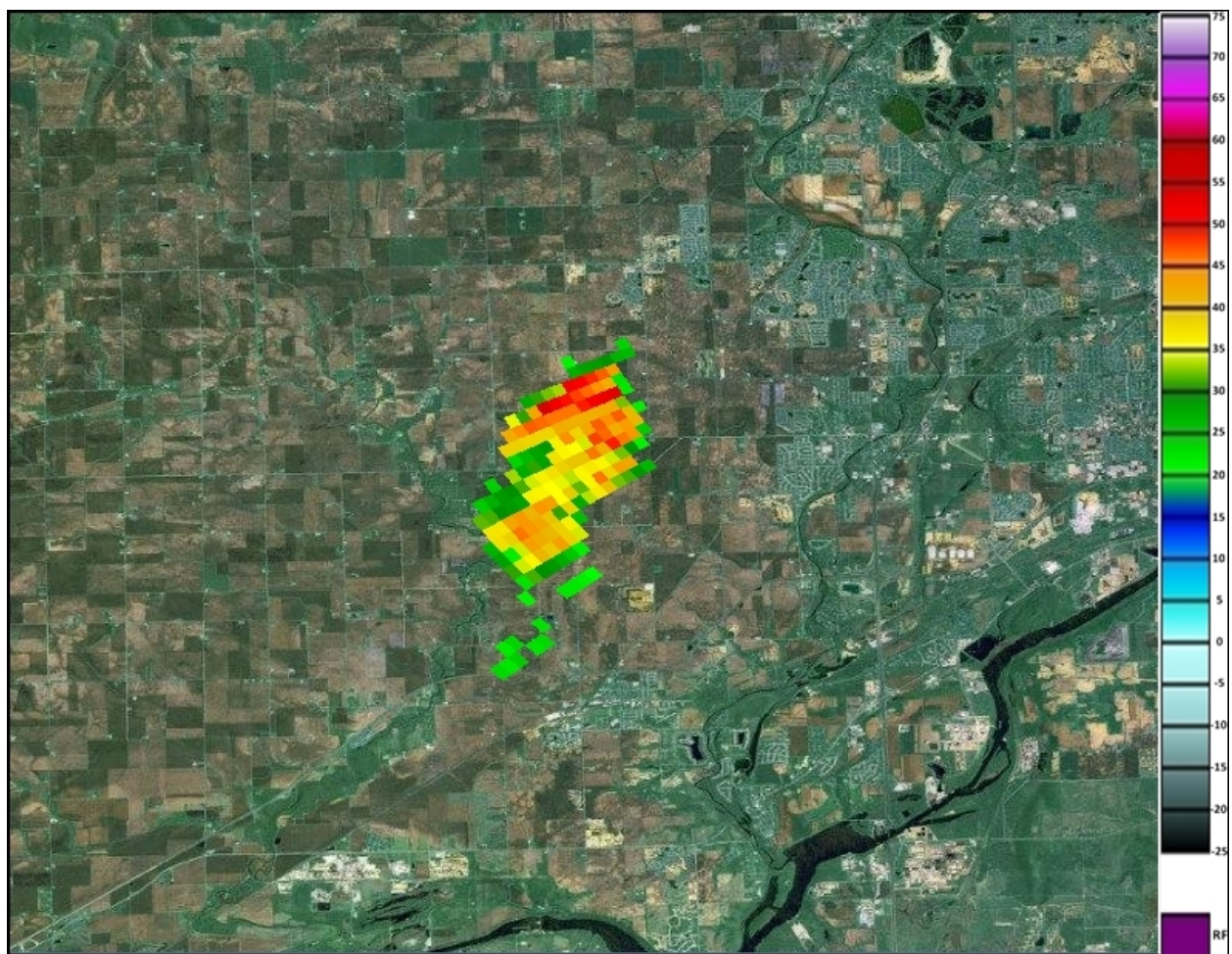
KLOT WSR-88D Level-II $\sim 10.0^\circ$ radar sweep beginning about 1058.25 CDT.



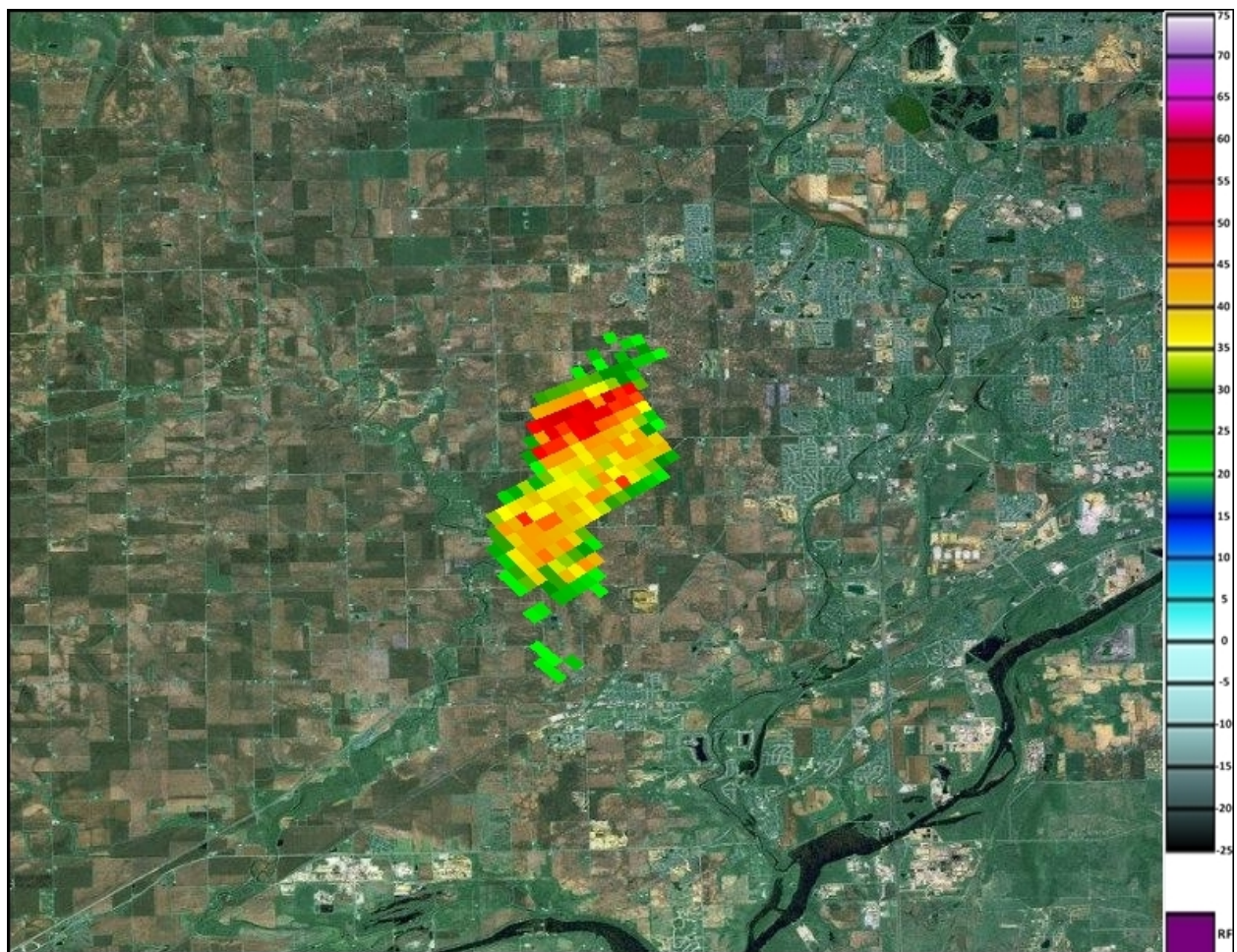
KLOT WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1101:01 CDT.



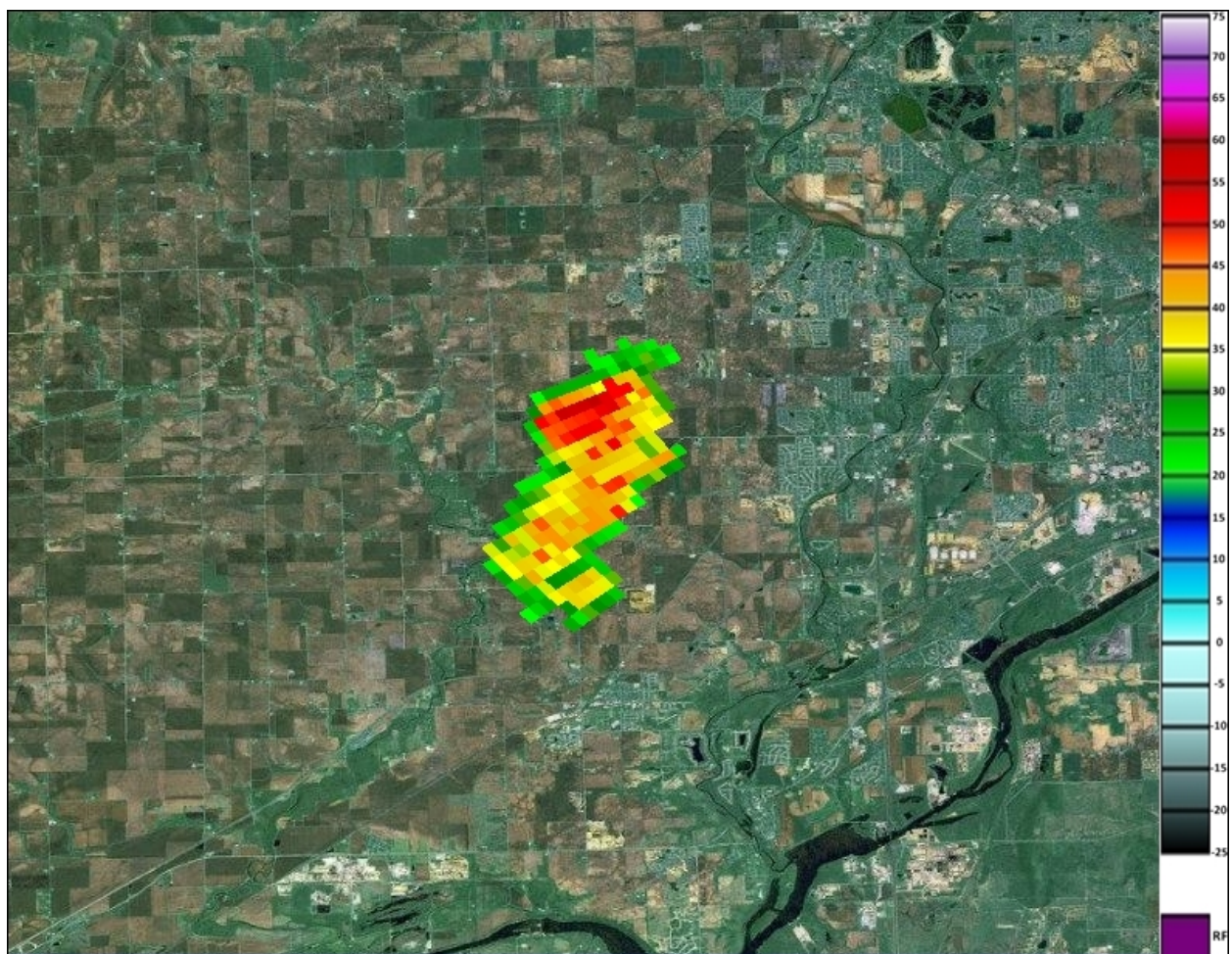
KLOT WSR-88D Level-II $\sim 1.5^\circ$ radar sweep beginning about 1102:04 CDT.



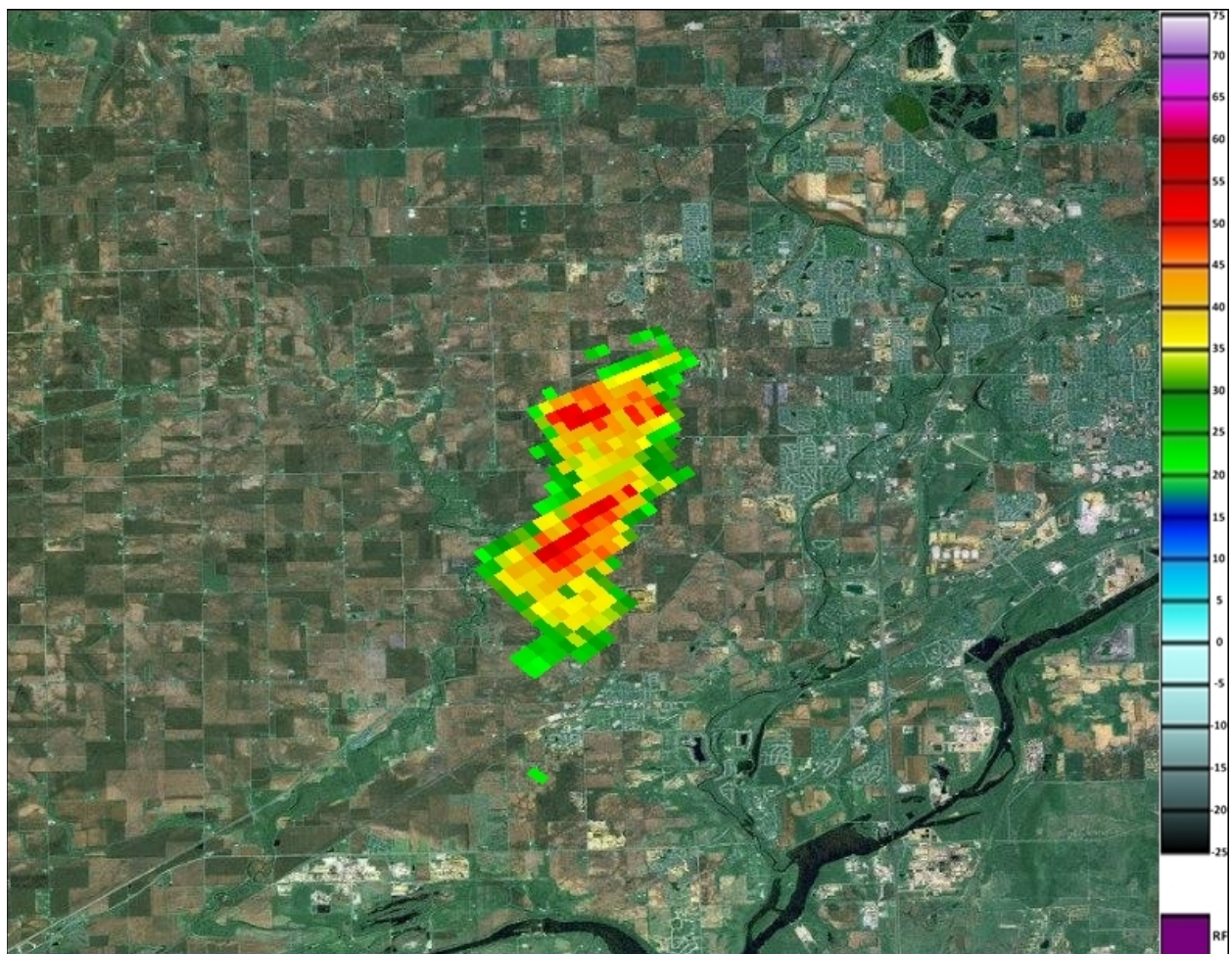
KLOT WSR-88D Level-II $\sim 2.5^\circ$ radar sweep beginning about 1103:08 CDT.



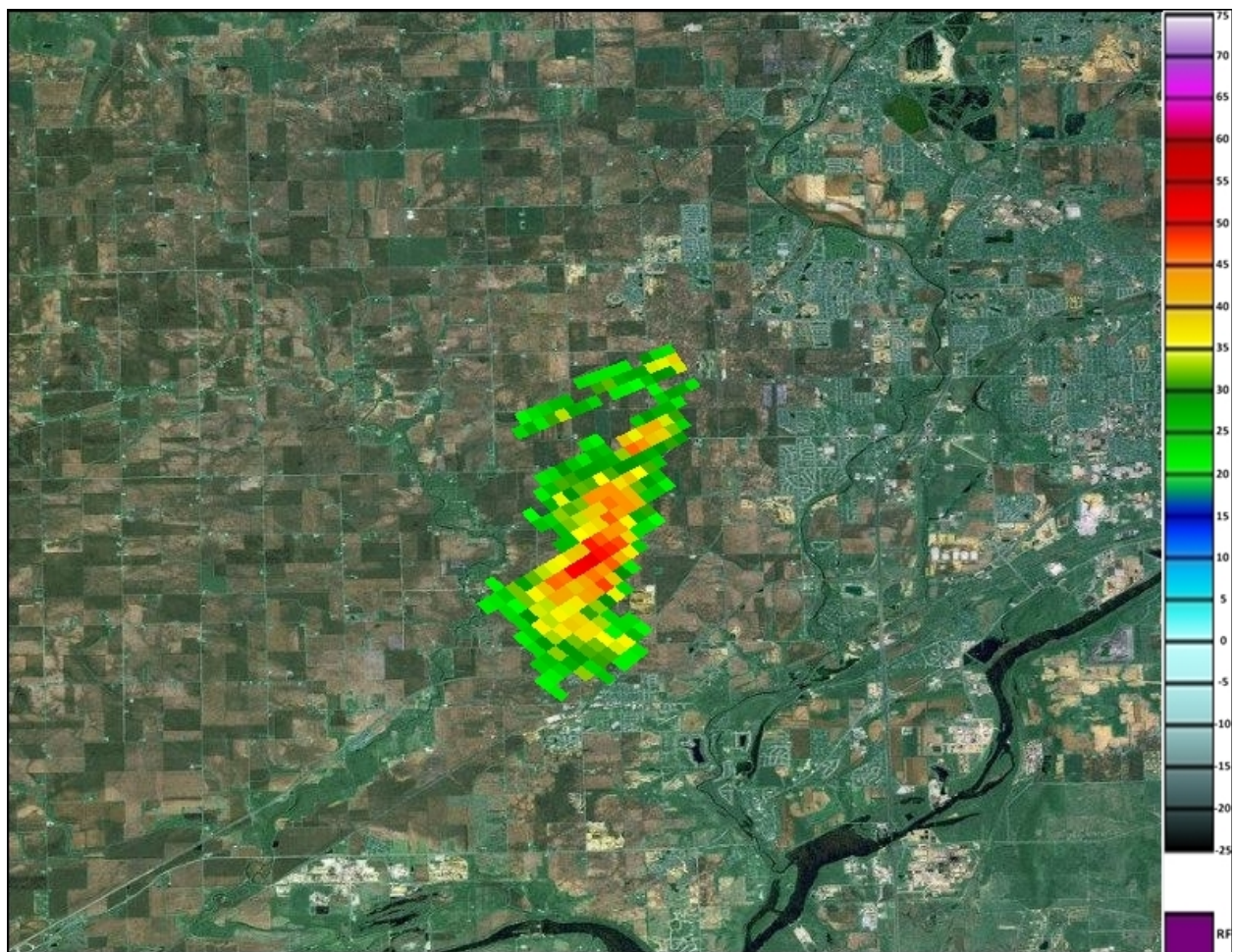
KLOT WSR-88D Level-II $\sim 3.5^\circ$ radar sweep beginning about 1103:41 CDT.



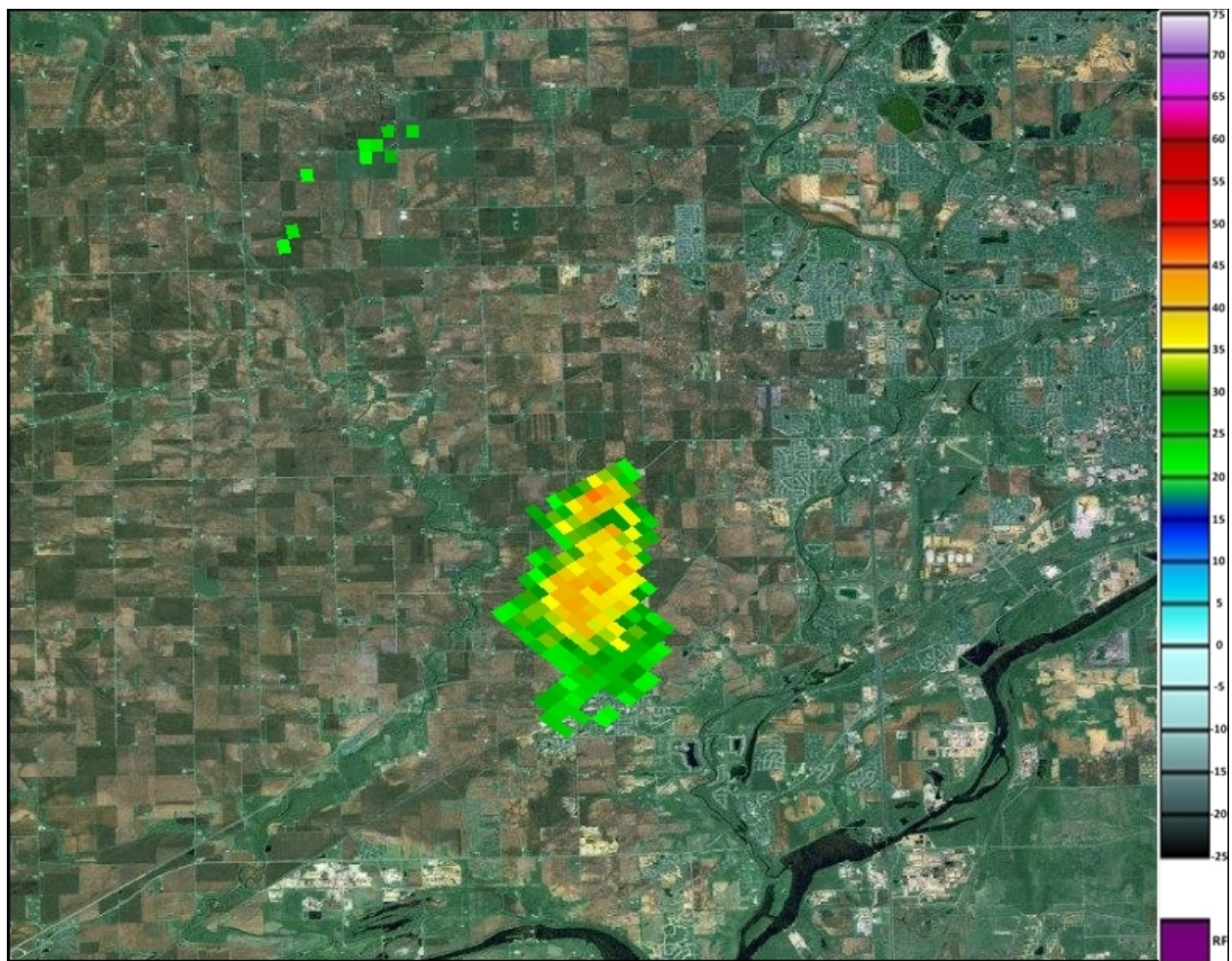
KLOT WSR-88D Level-II $\sim 4.4^\circ$ radar sweep beginning about 1104:15 CDT.



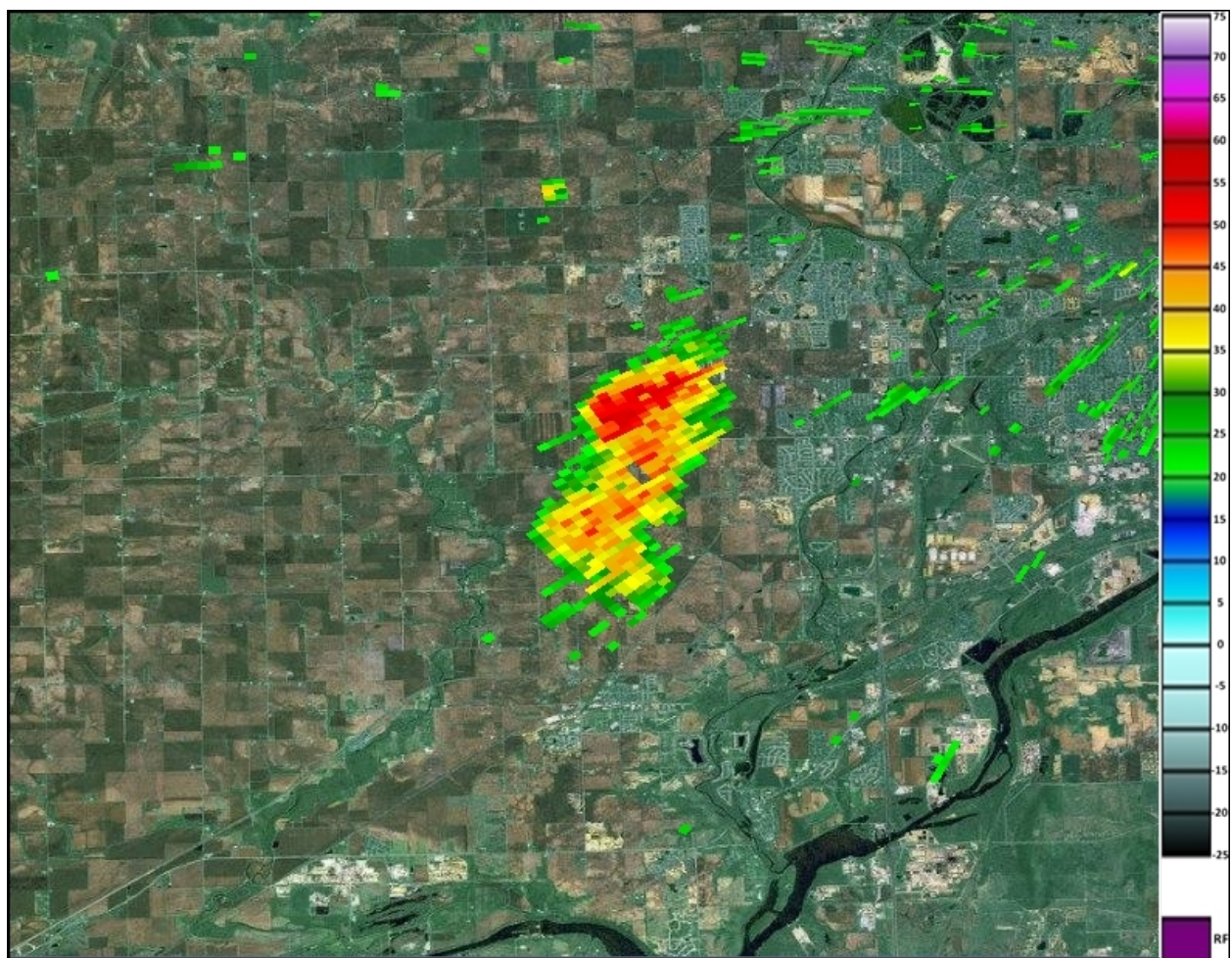
KLOT WSR-88D Level-II $\sim 6.1^\circ$ radar sweep beginning about 1104:48 CDT.



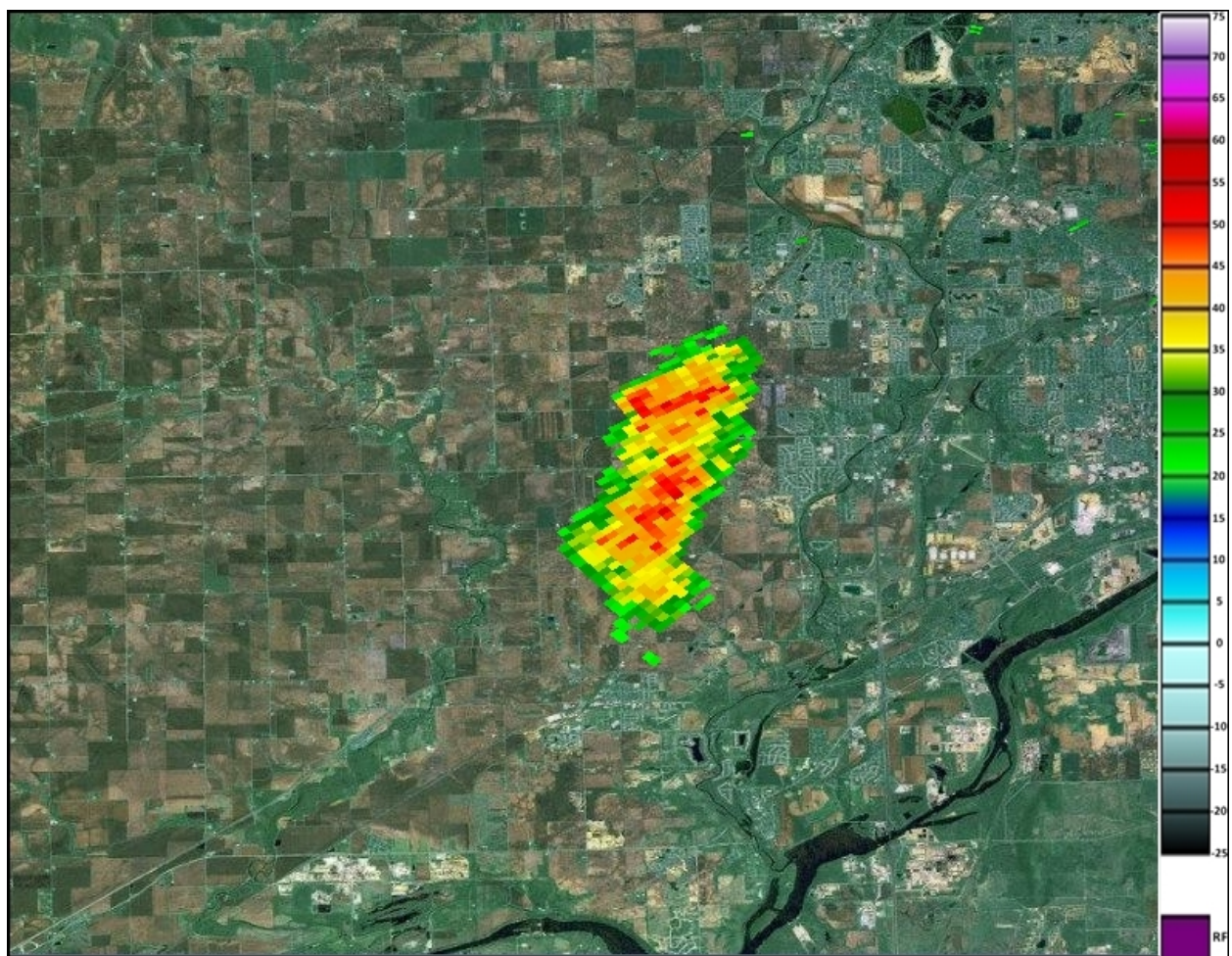
KLOT WSR-88D Level-II ~10.0° radar sweep beginning about 1105:21 CDT.



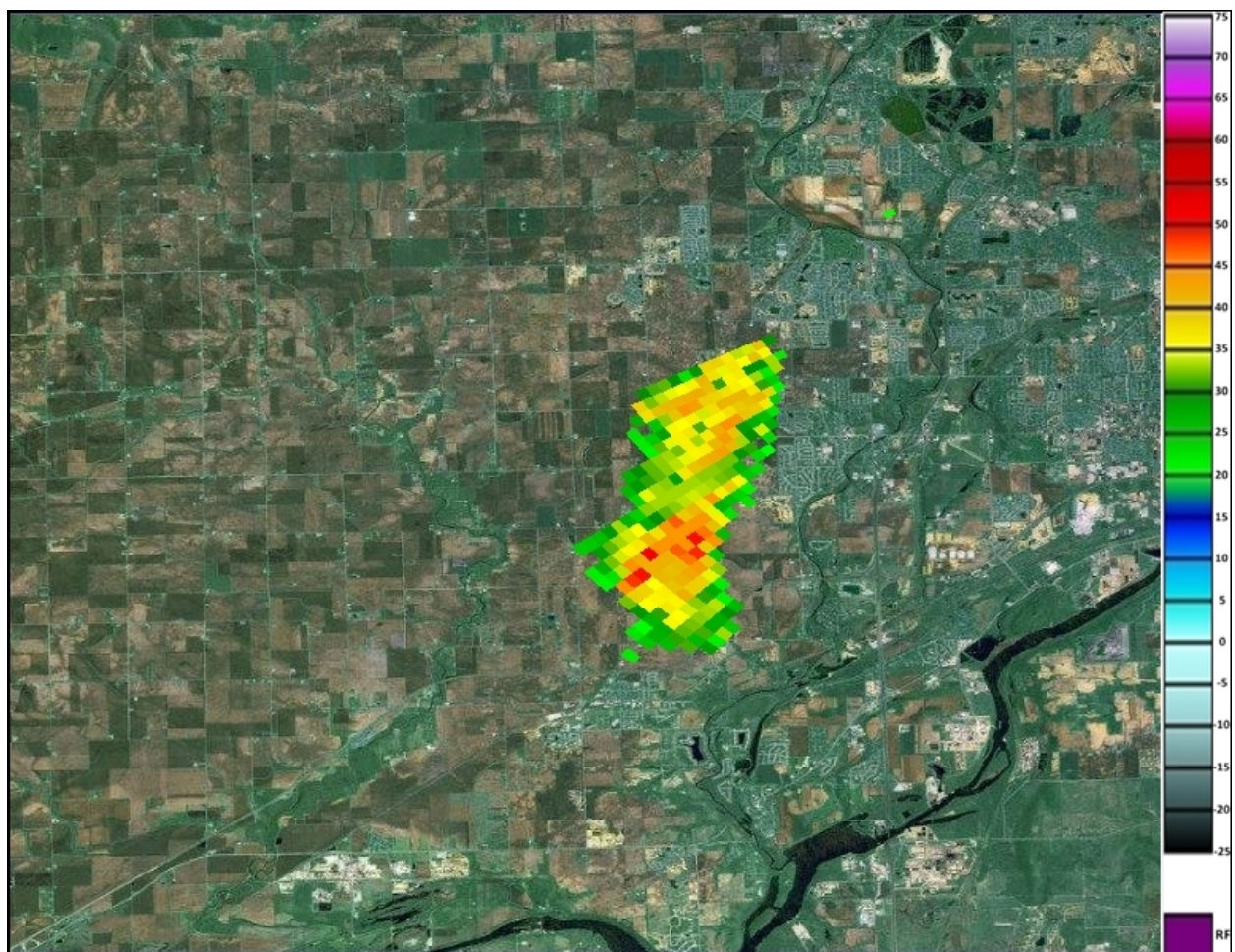
KLOT WSR-88D Level-II $\sim 14.6^\circ$ radar sweep beginning about 1105:48 CDT.



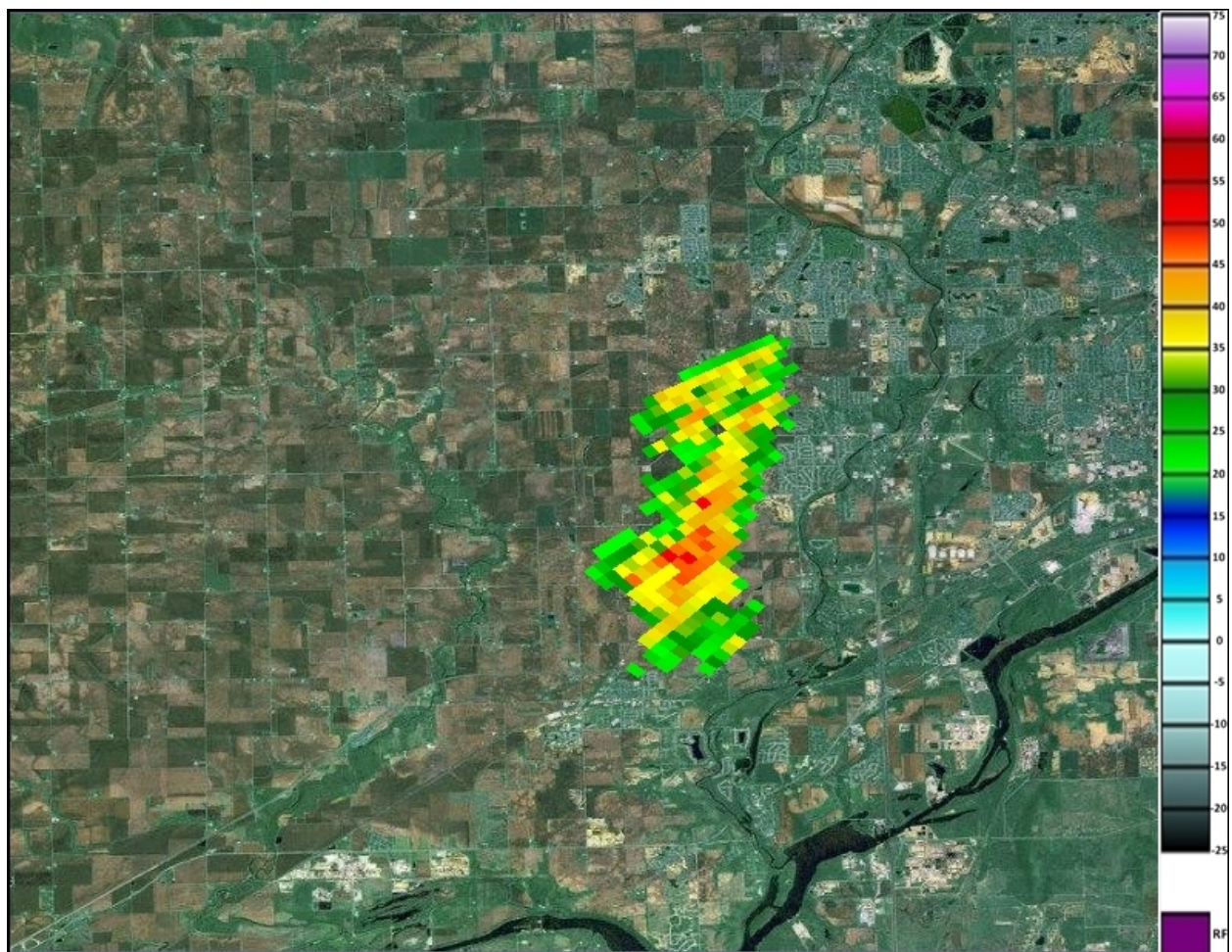
KLOT WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1106:22 CDT.



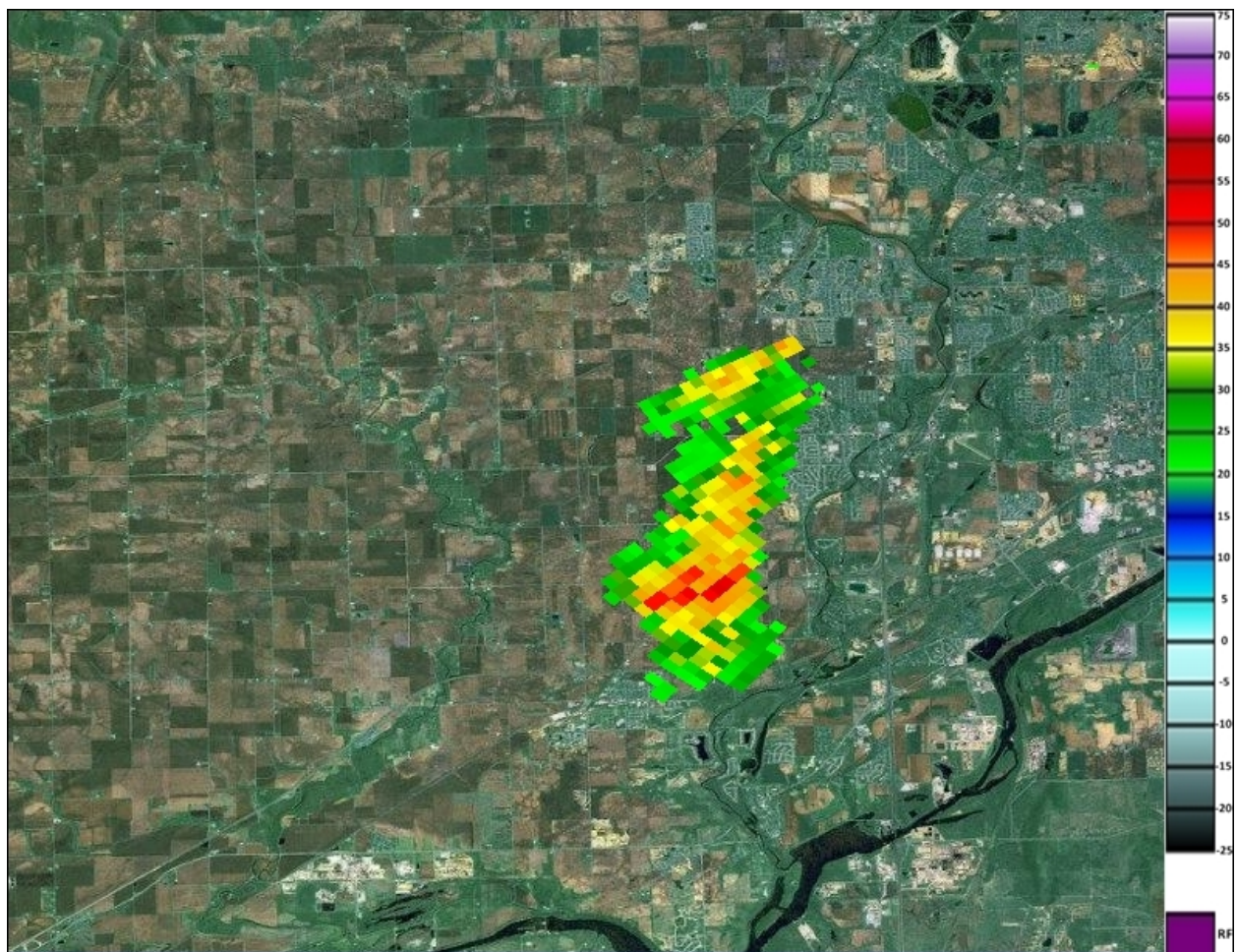
KLOT WSR-88D Level-II $\sim 1.5^\circ$ radar sweep beginning about 1107:26 CDT.



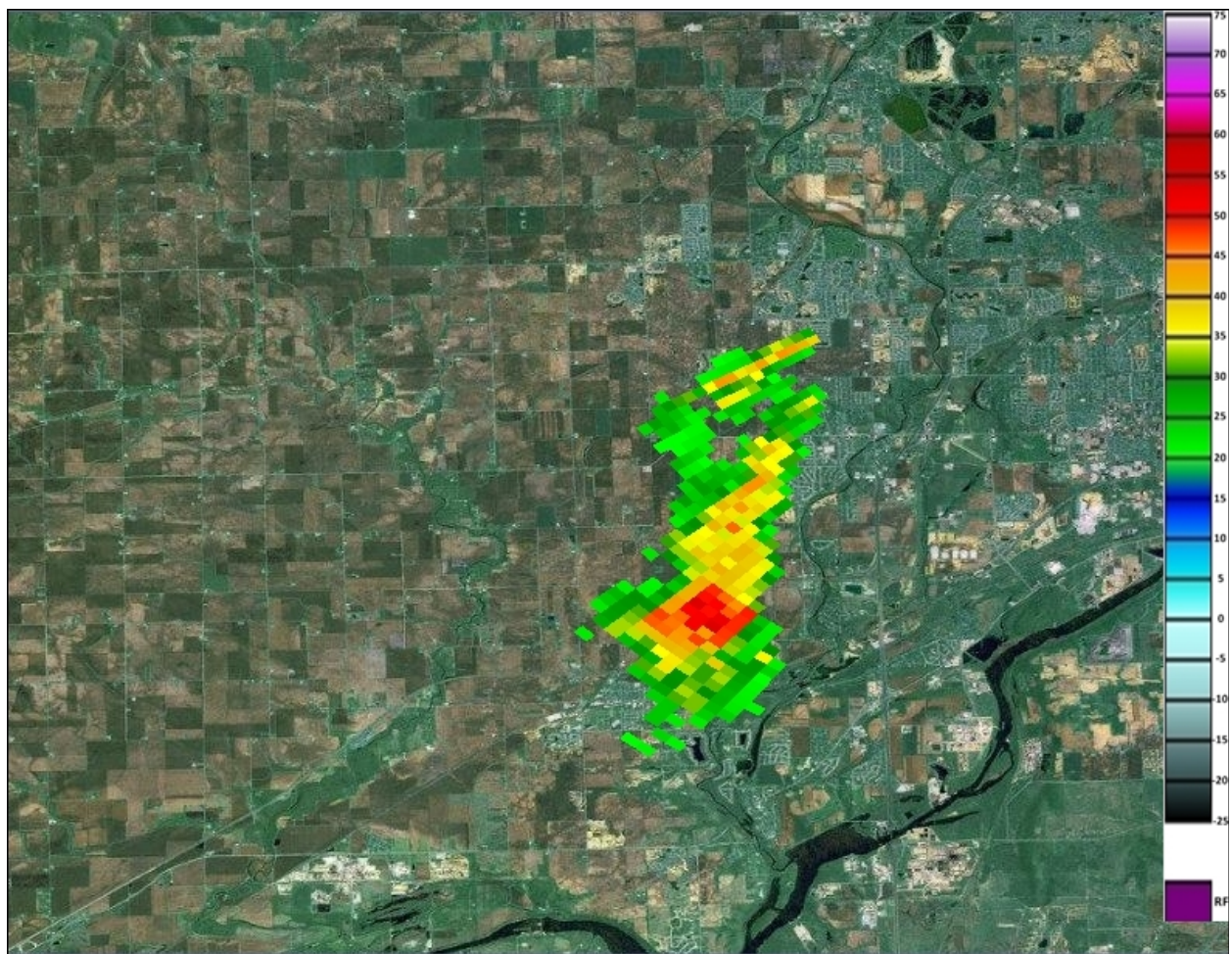
KLOT WSR-88D Level-II $\sim 2.5^\circ$ radar sweep beginning about 1108:30 CDT.



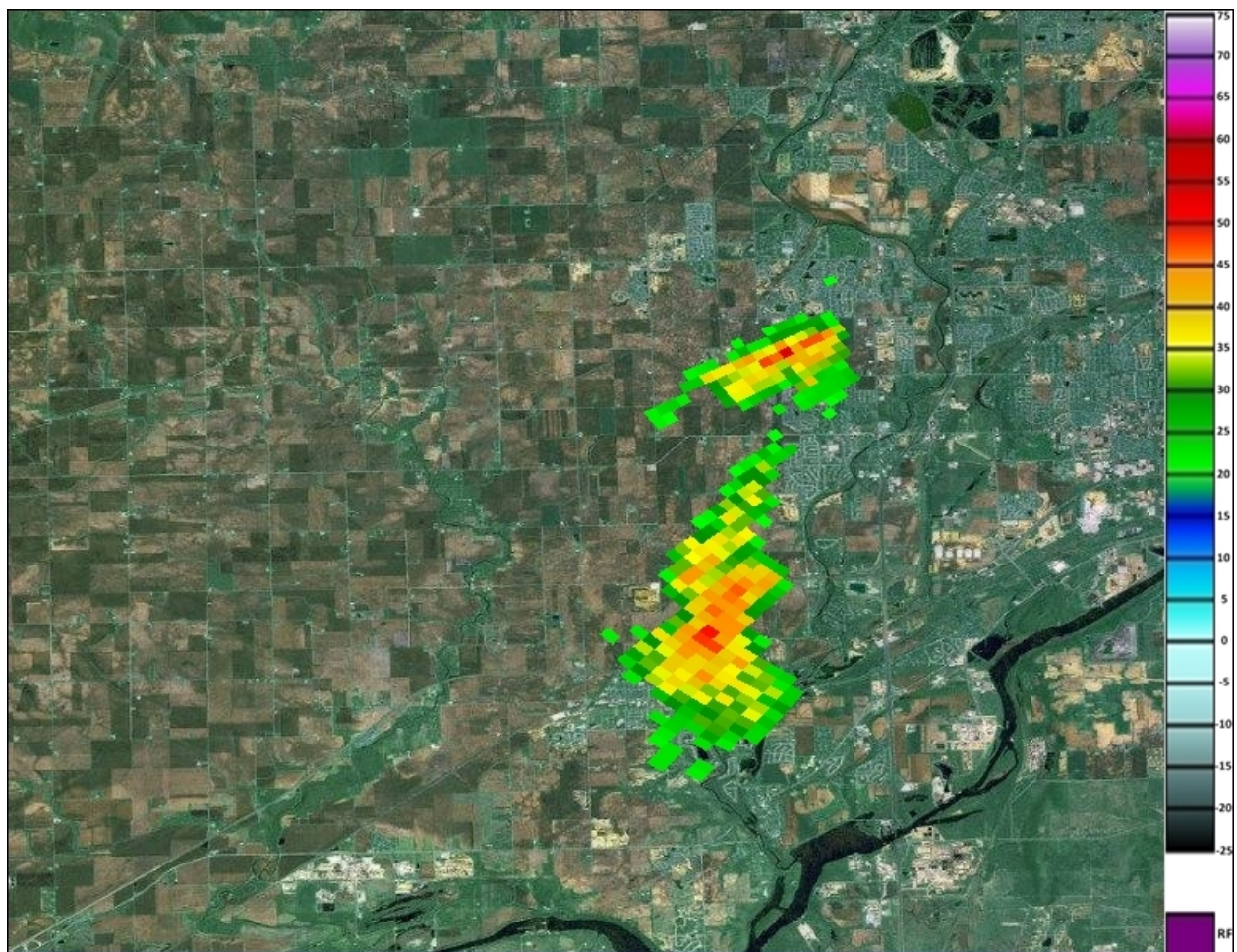
KLOT WSR-88D Level-II $\sim 3.5^\circ$ radar sweep beginning about 1109:03 CDT.



KLOT WSR-88D Level-II $\sim 4.4^\circ$ radar sweep beginning about 1109:36 CDT.



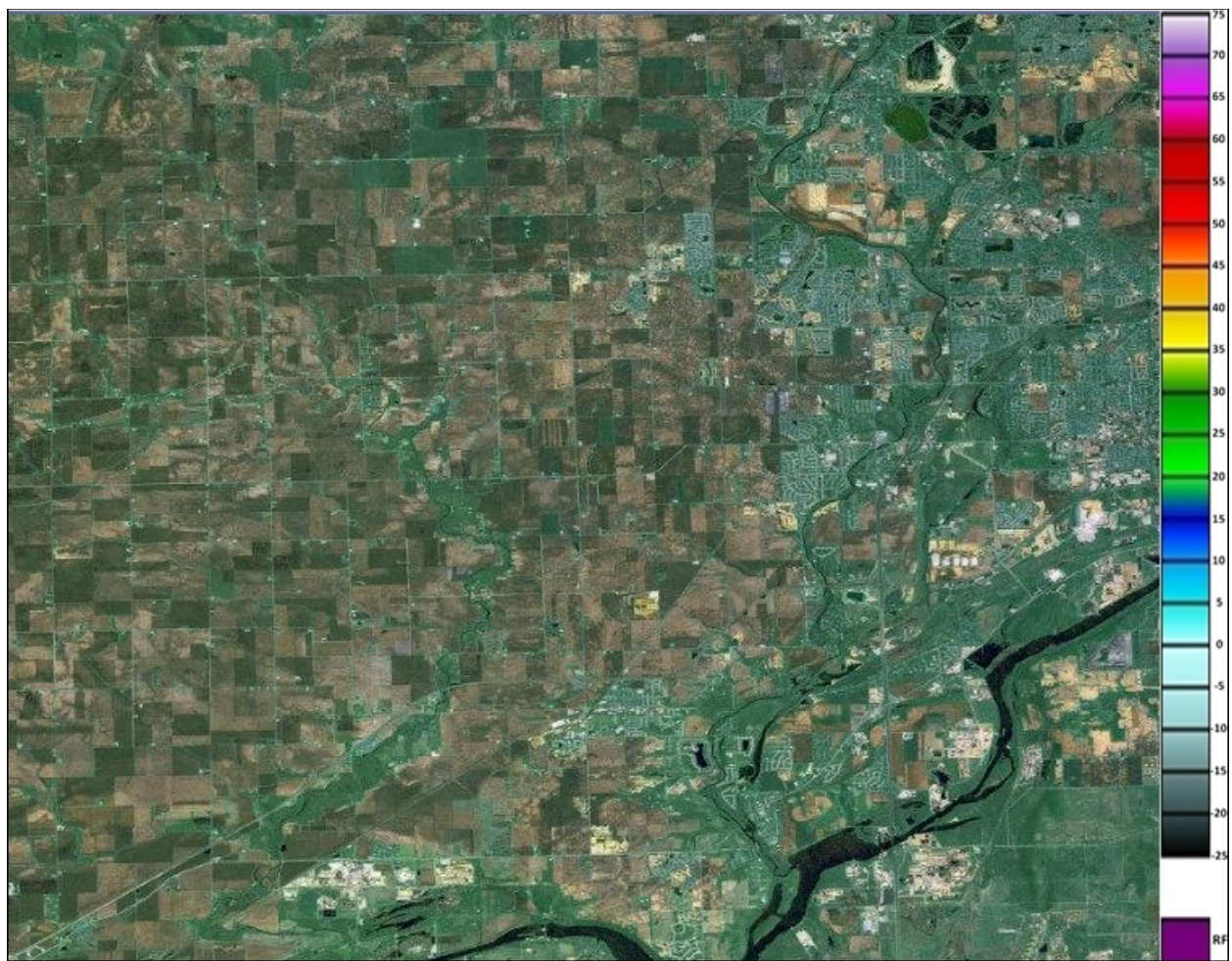
KLOT WSR-88D Level-II $\sim 6.1^\circ$ radar sweep beginning about 1110:09 CDT.



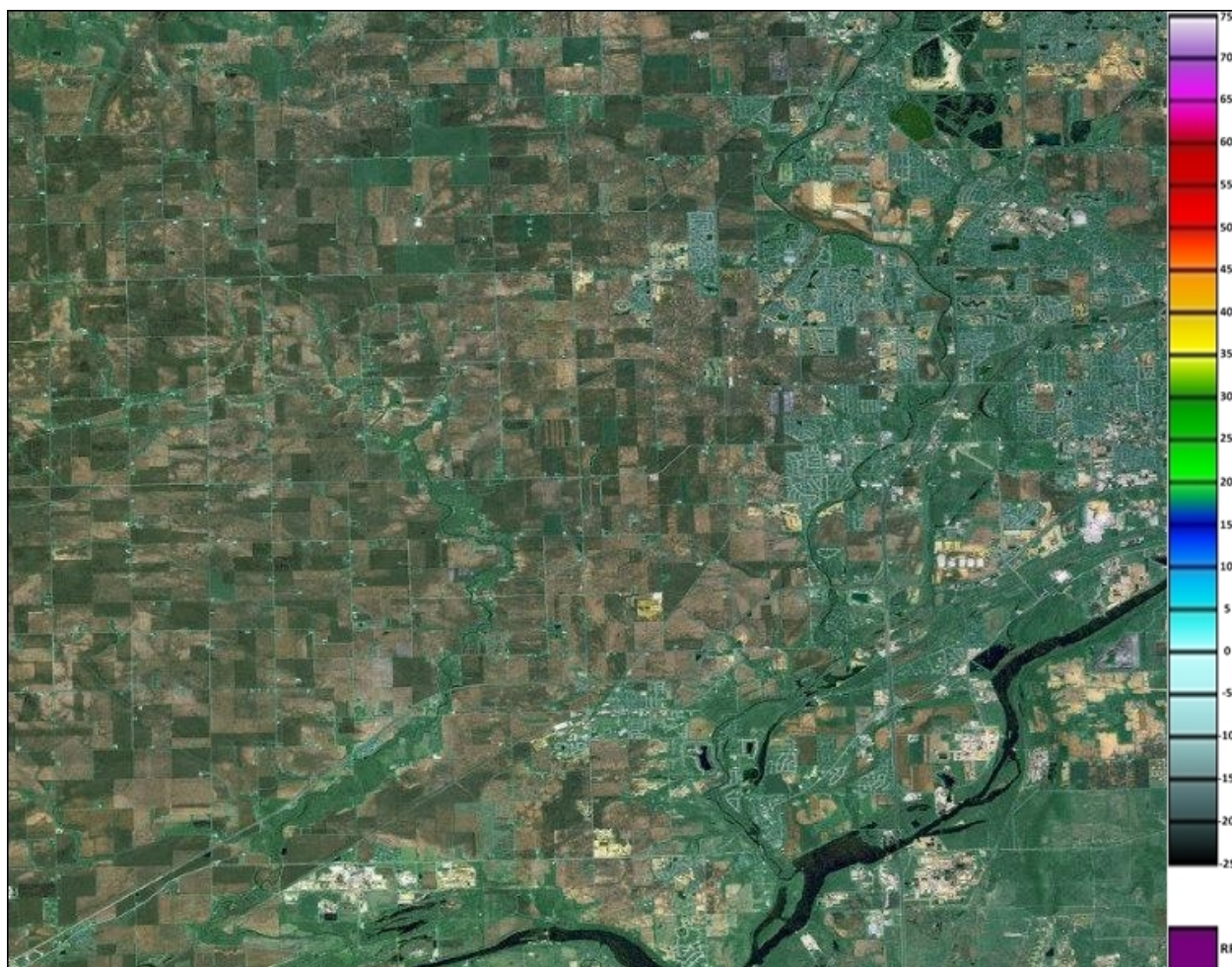
KLOT WSR-88D Level-II $\sim 10.0^\circ$ radar sweep beginning about 1110:42 CDT.



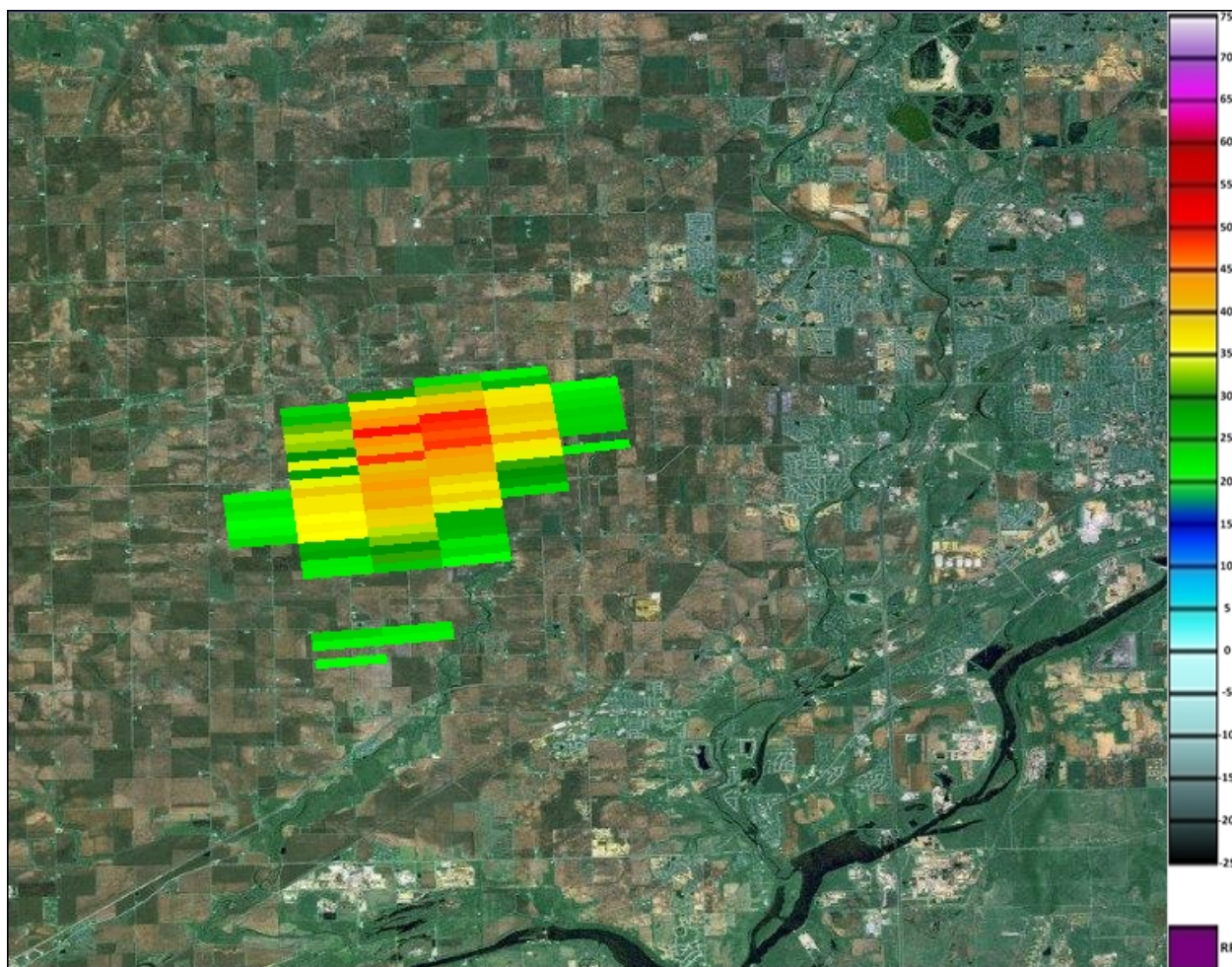
KMKX WSR-88D Level-II $\sim 1.8^\circ$ radar sweep beginning about 1052:28 CDT.



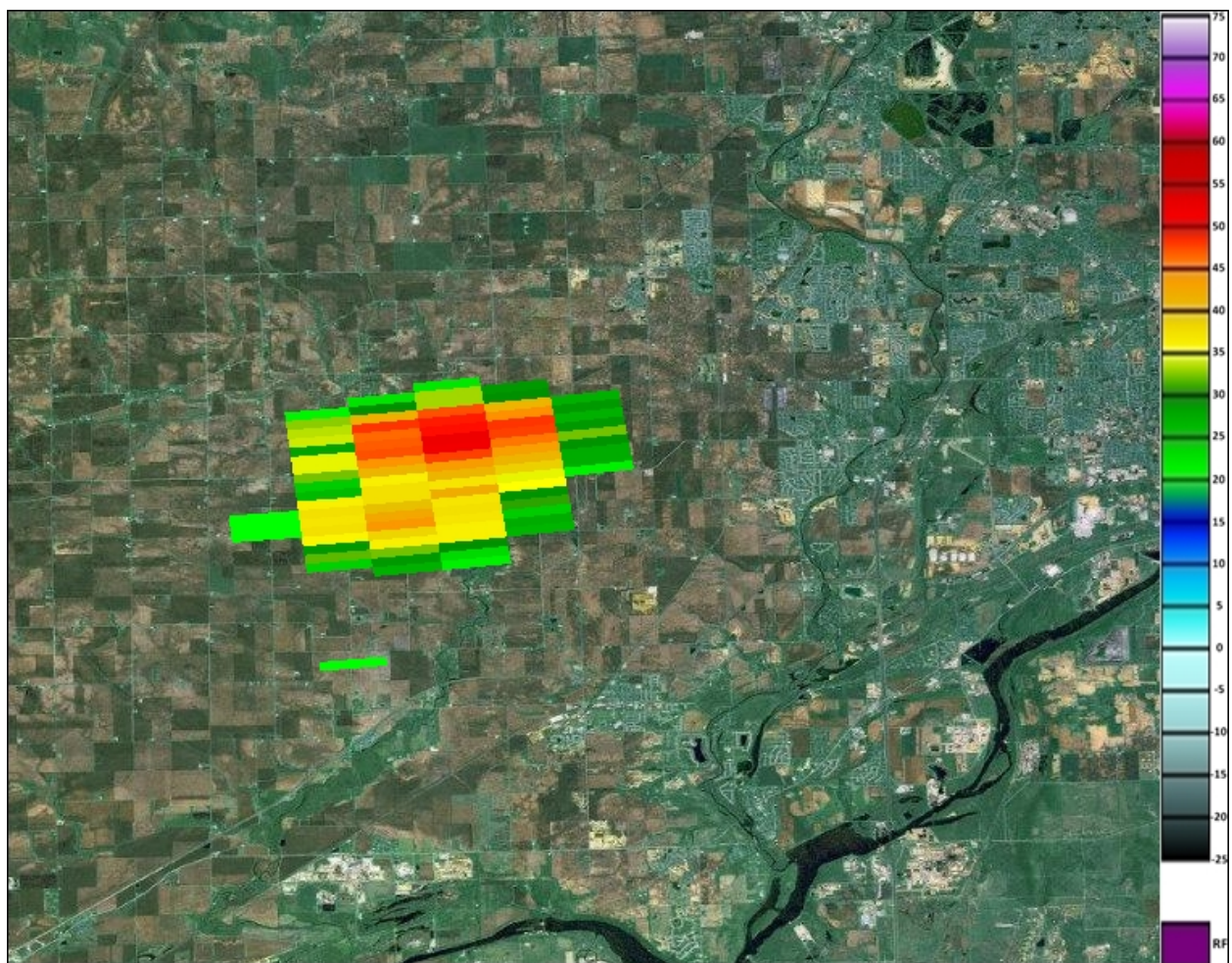
KMKX WSR-88D Level-II ~2.4° radar sweep beginning about 1052:43 CDT.



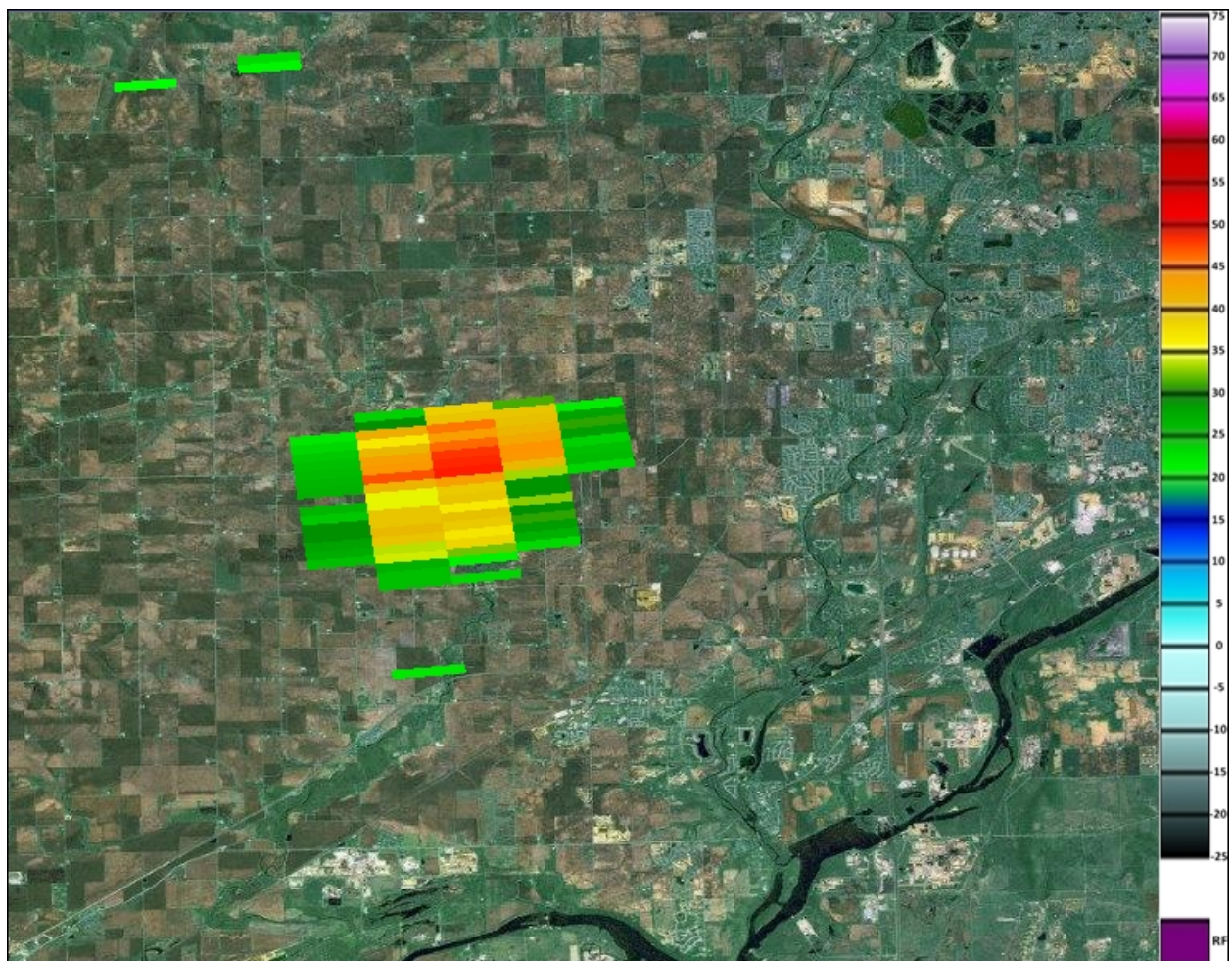
KMKX WSR-88D Level-II $\sim 3.2^\circ$ radar sweep beginning about 1052:57 CDT.



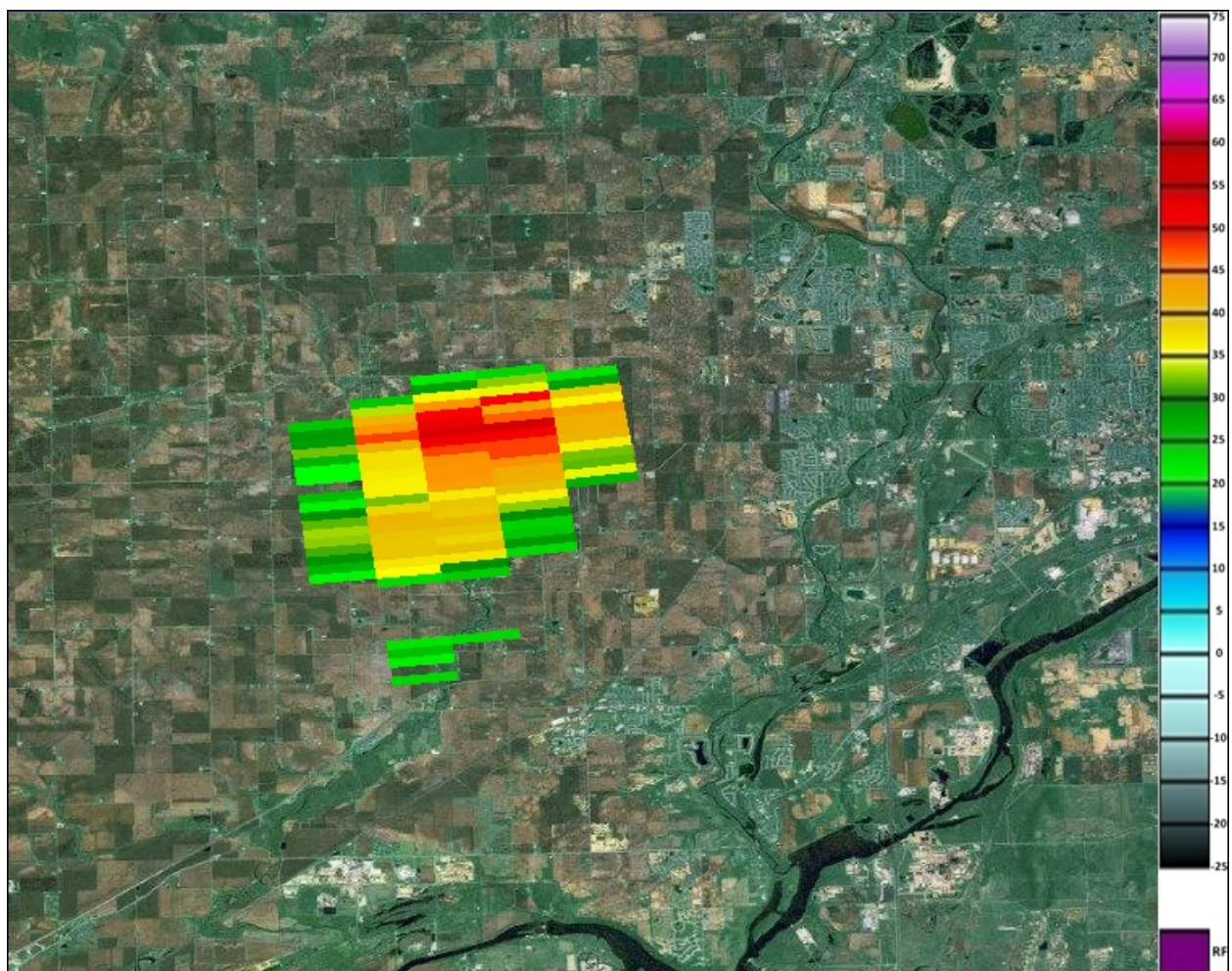
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1056:25 CDT.



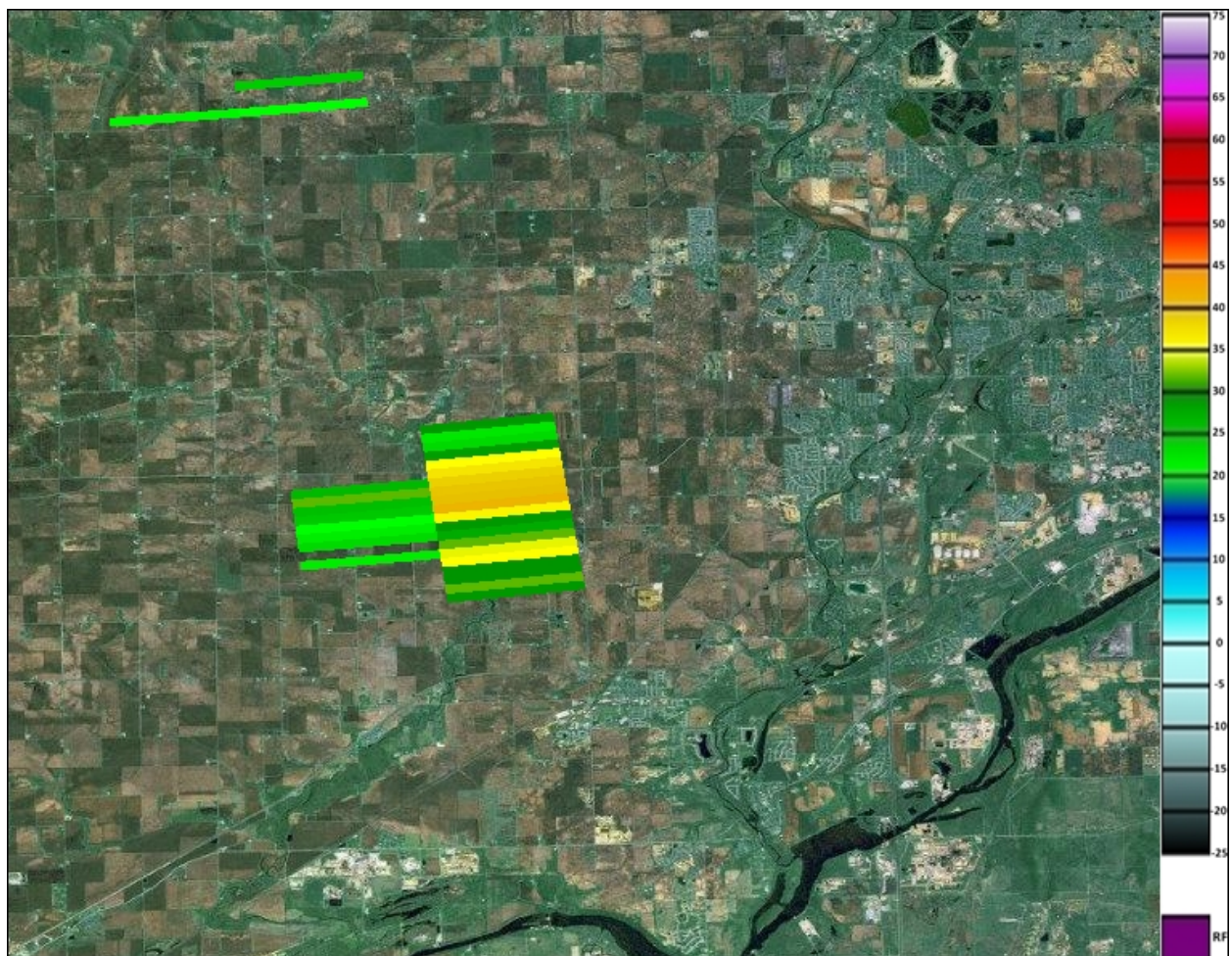
KMKX WSR-88D Level-II $\sim 0.9^\circ$ radar sweep beginning about 1057:03 CDT.



KMKX WSR-88D Level-II $\sim 1.3^\circ$ radar sweep beginning about 1057:41 CDT.



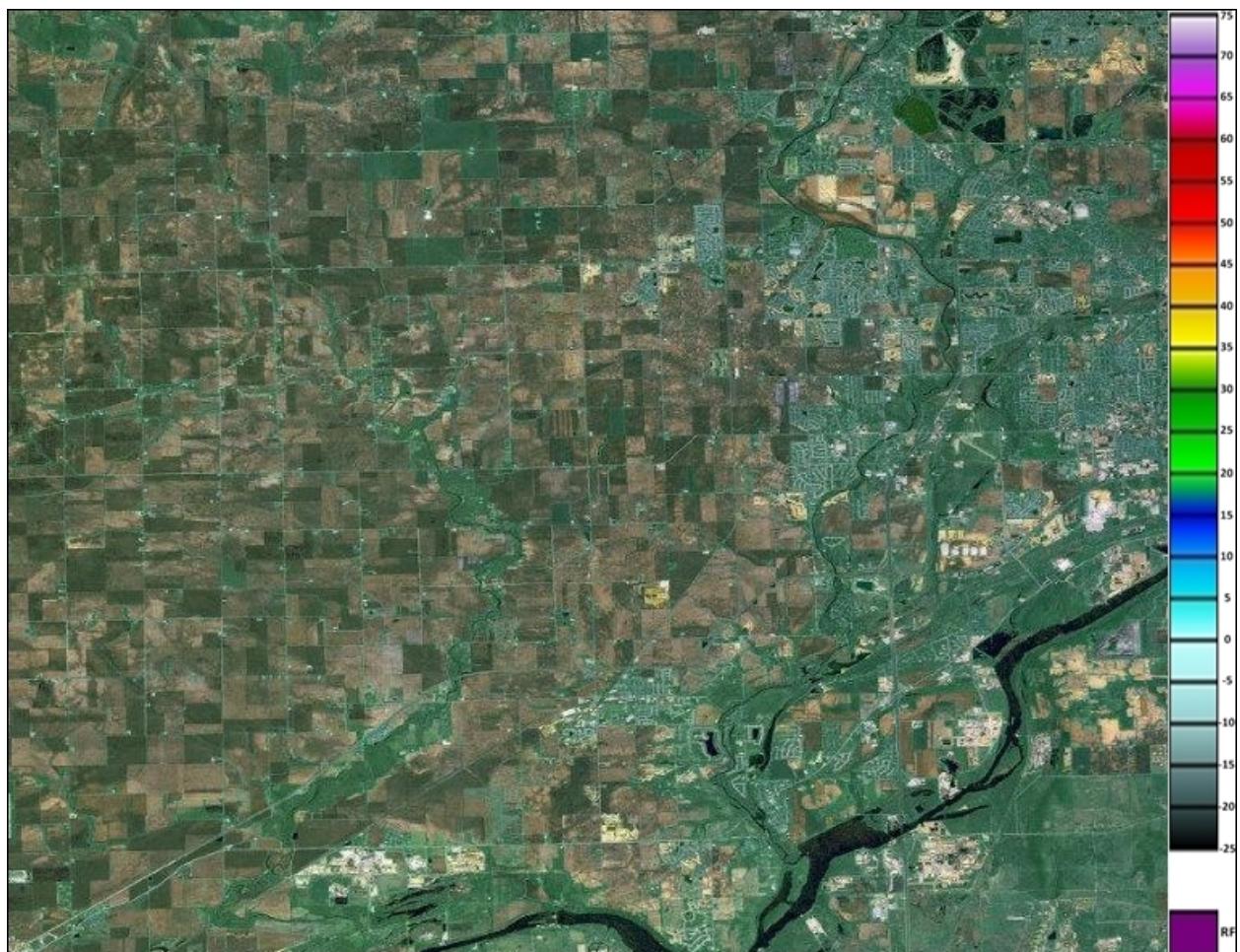
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1058:22 CDT.



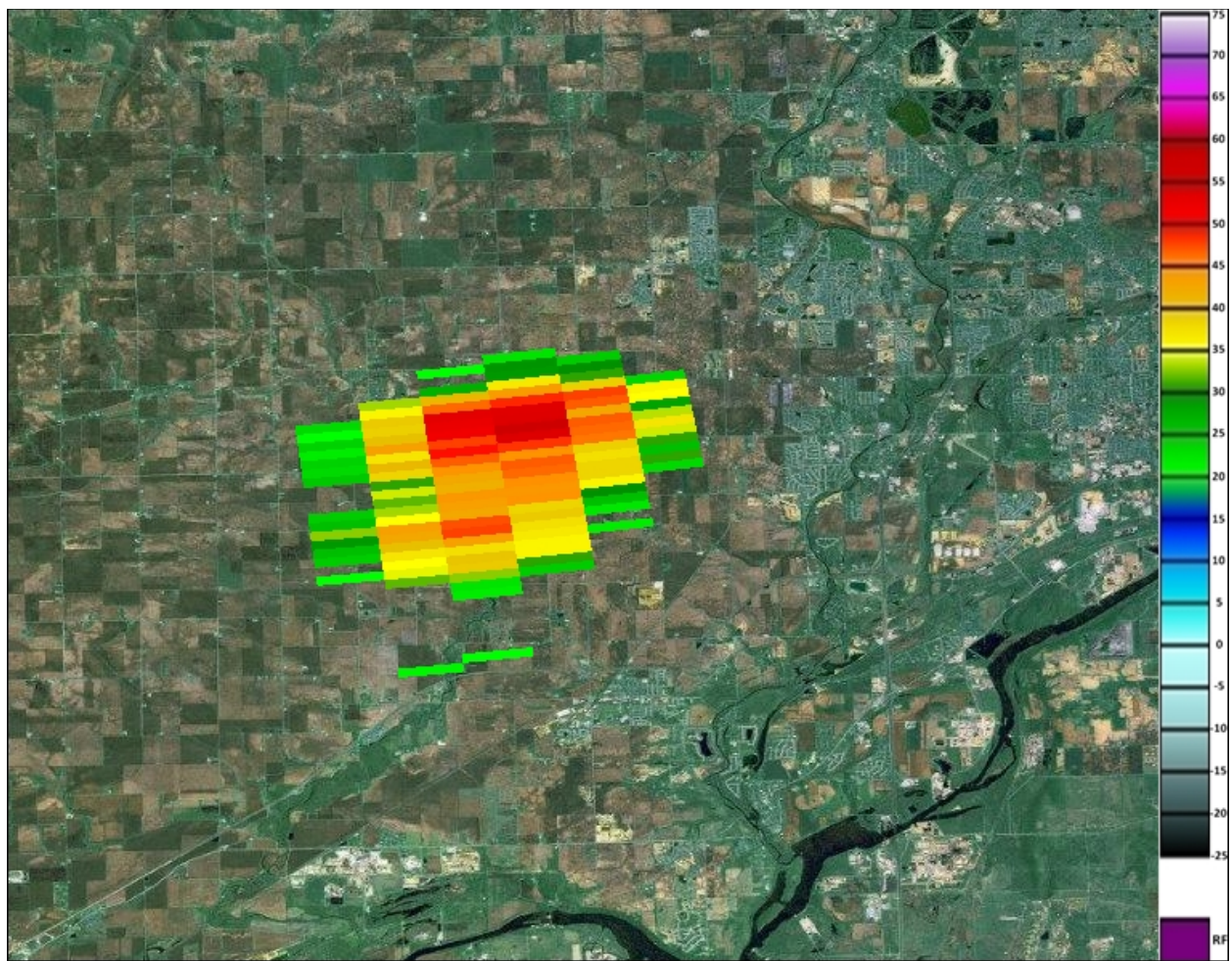
KMKX WSR-88D Level-II $\sim 1.8^\circ$ radar sweep beginning about 1058:56 CDT.



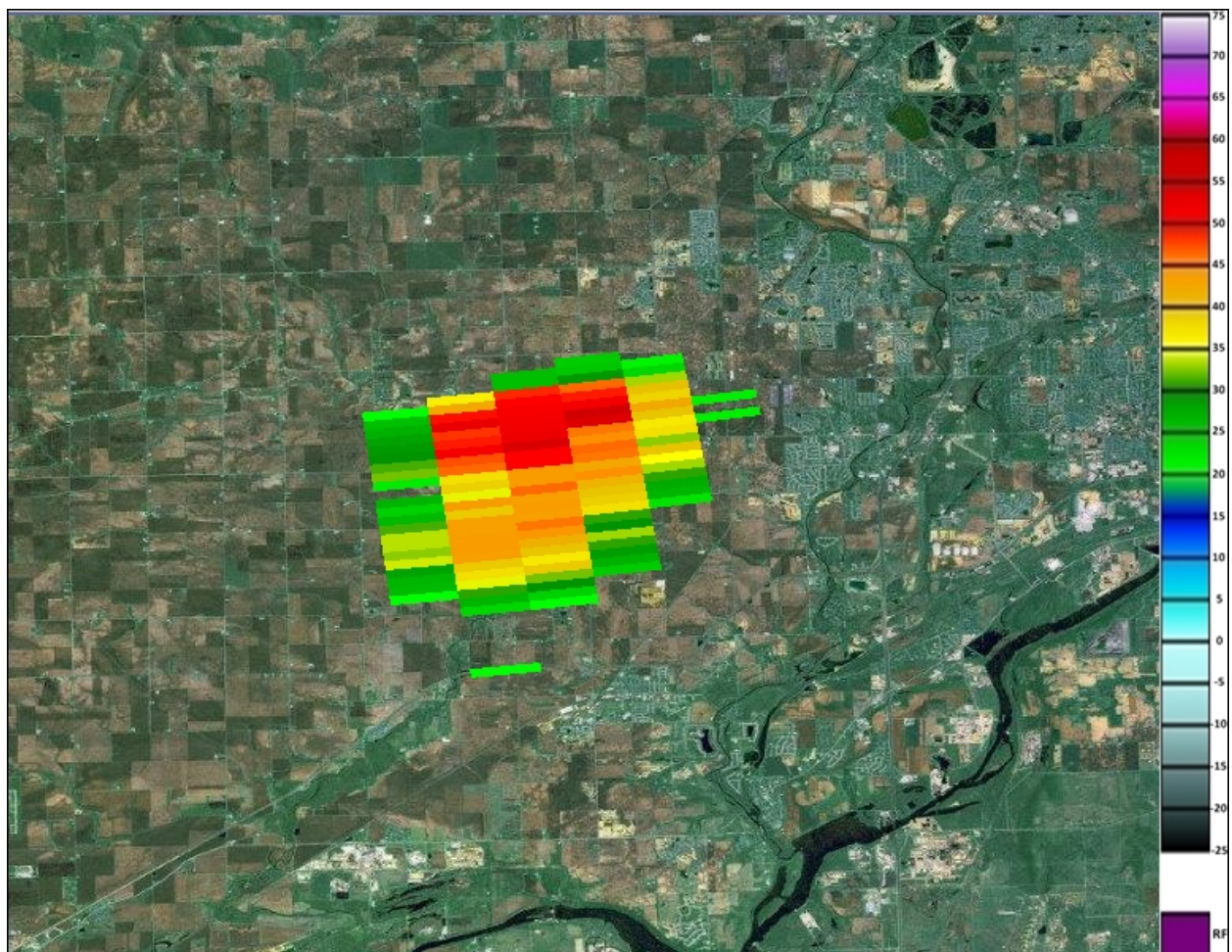
KMKX WSR-88D Level-II $\sim 2.4^\circ$ radar sweep beginning about 1059:11 CDT.



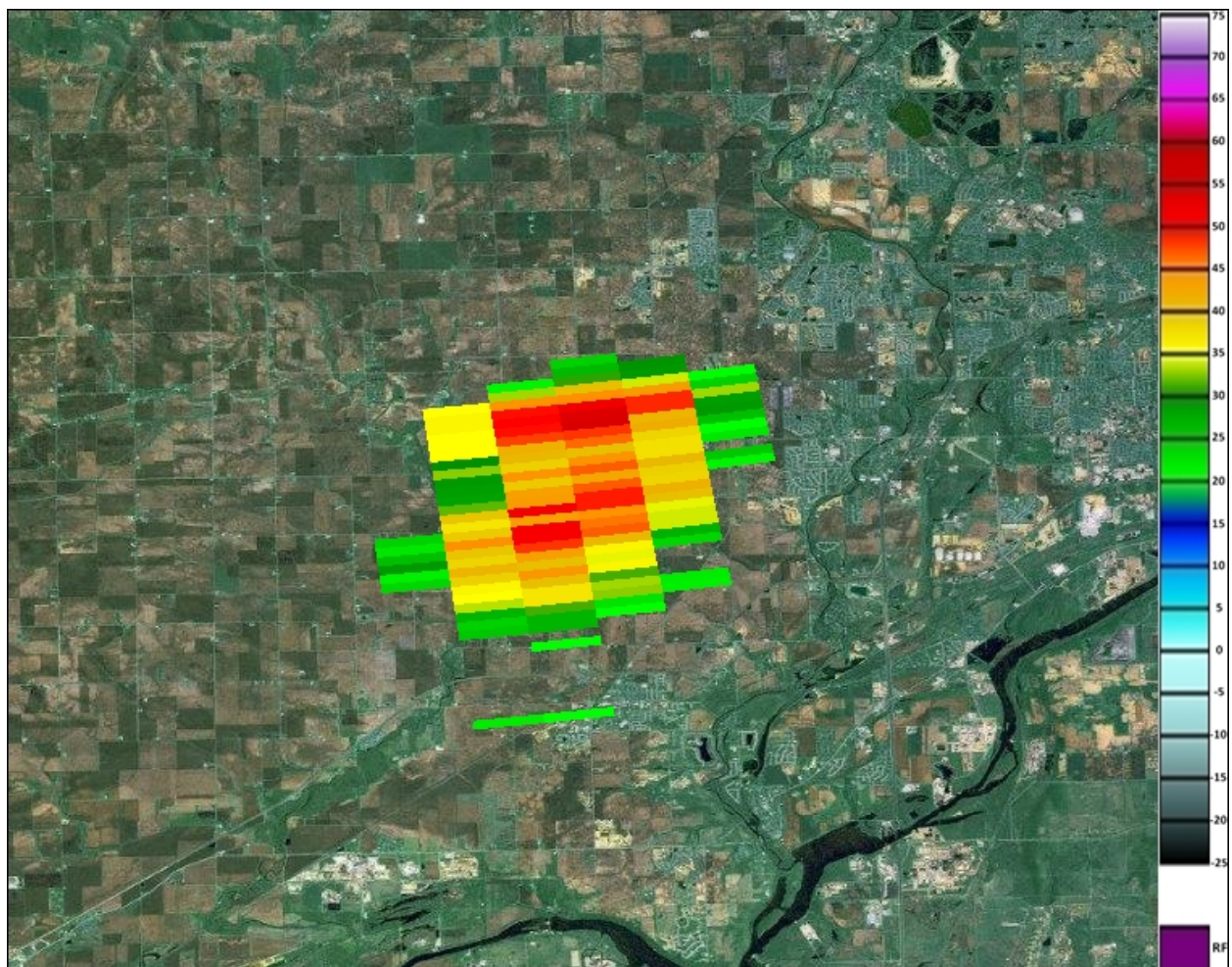
KMKX WSR-88D Level-II $\sim 3.2^\circ$ radar sweep beginning about 1059:25 CDT.



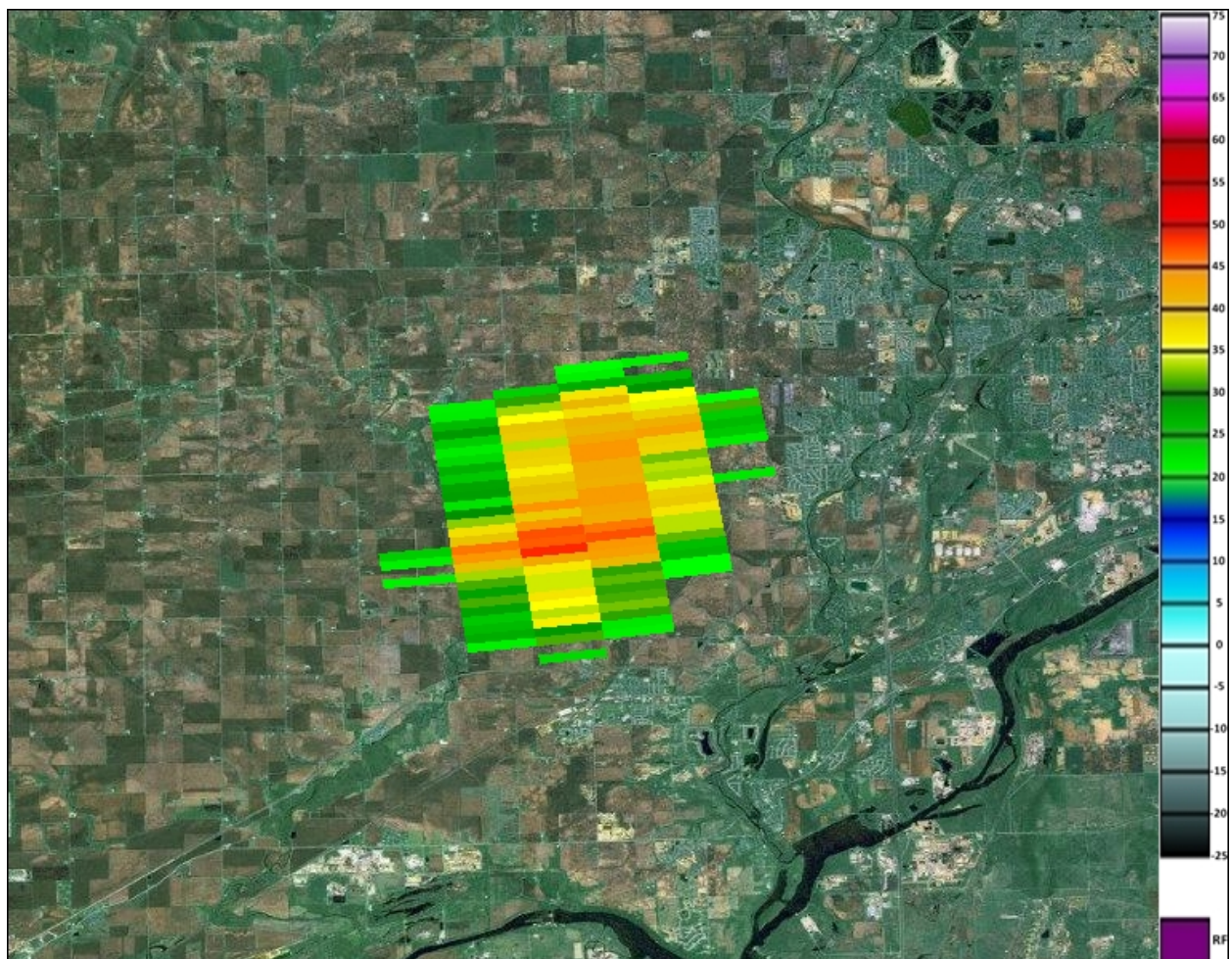
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1059:44 CDT.



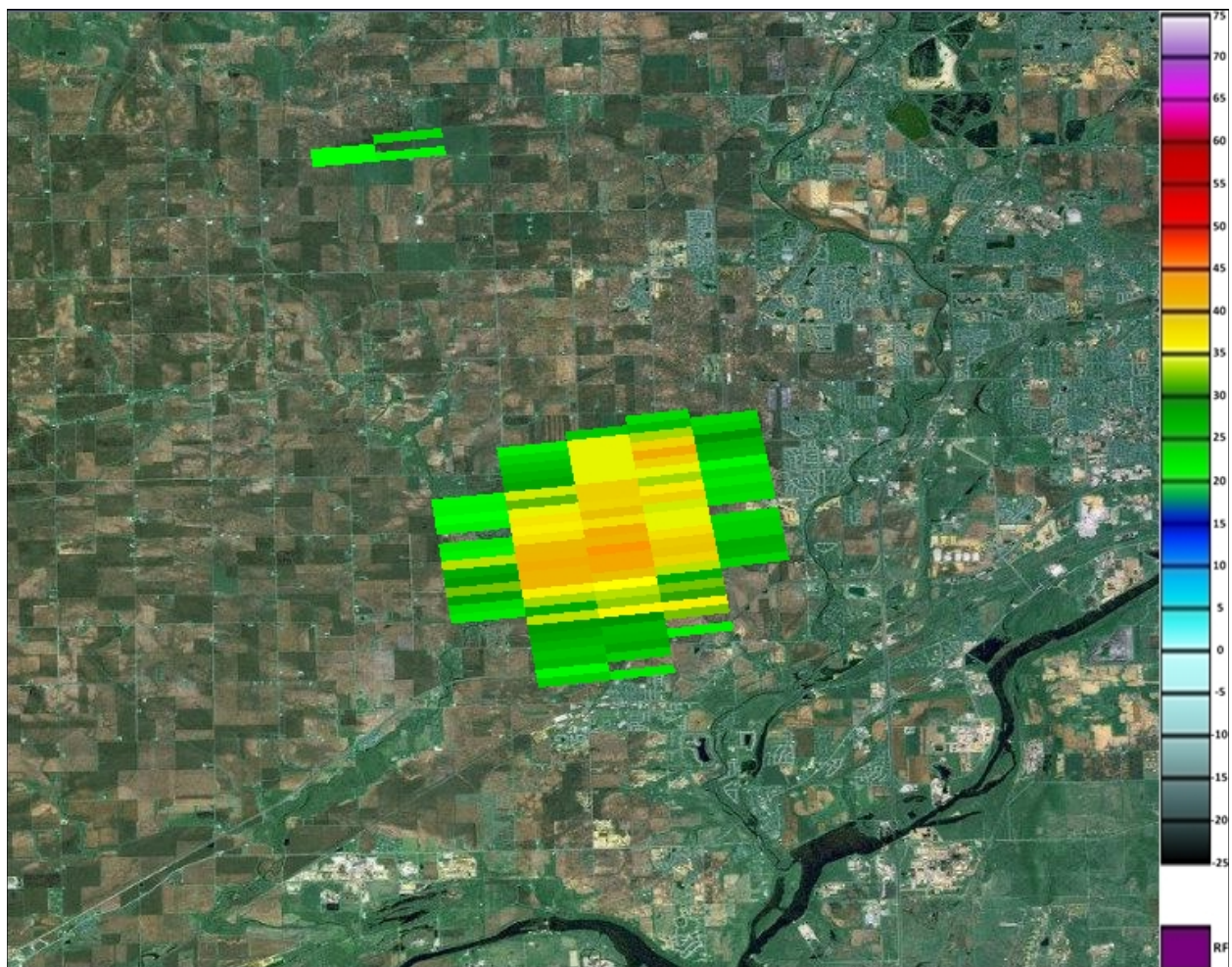
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1101:20 CDT.



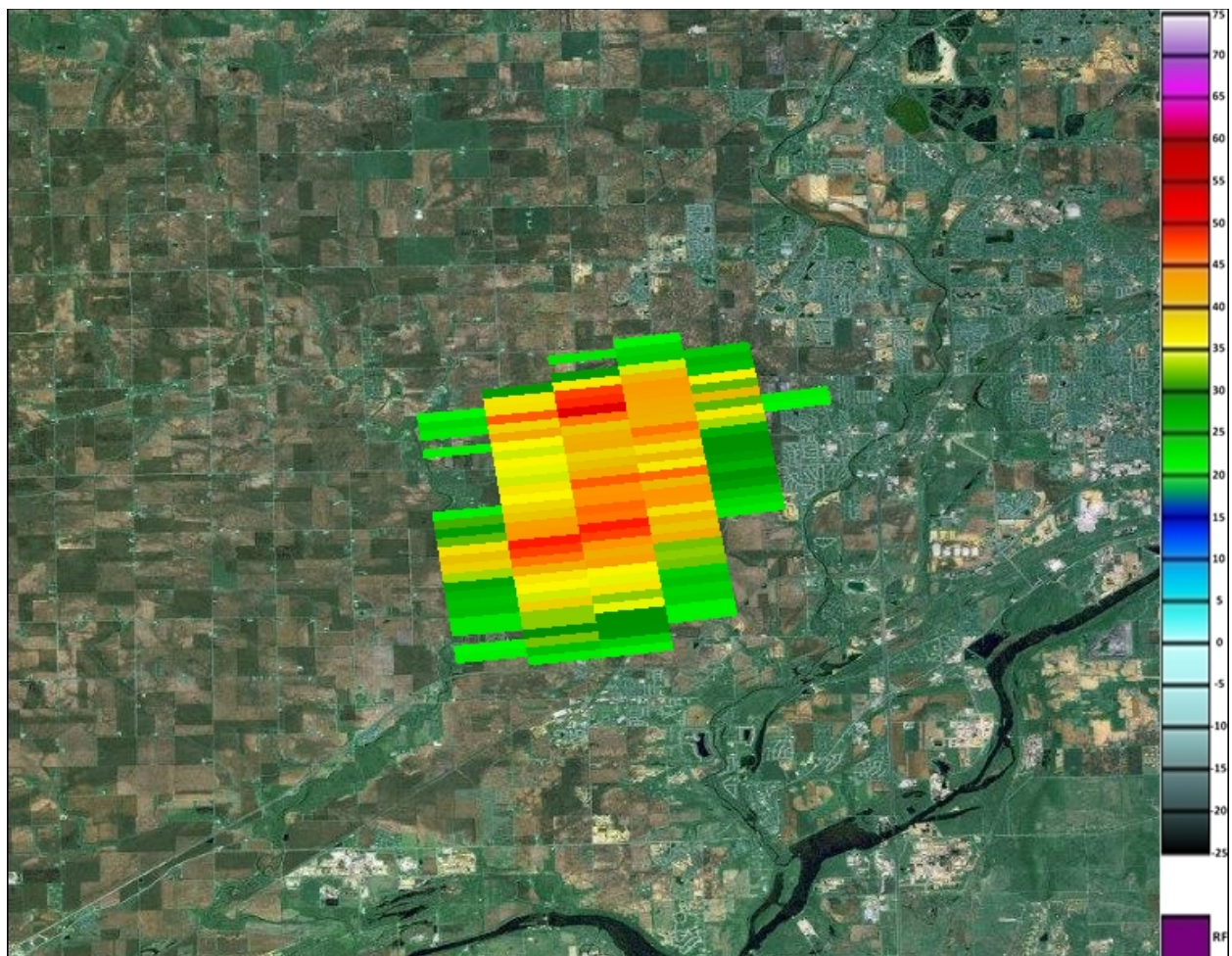
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1102:56 CDT.



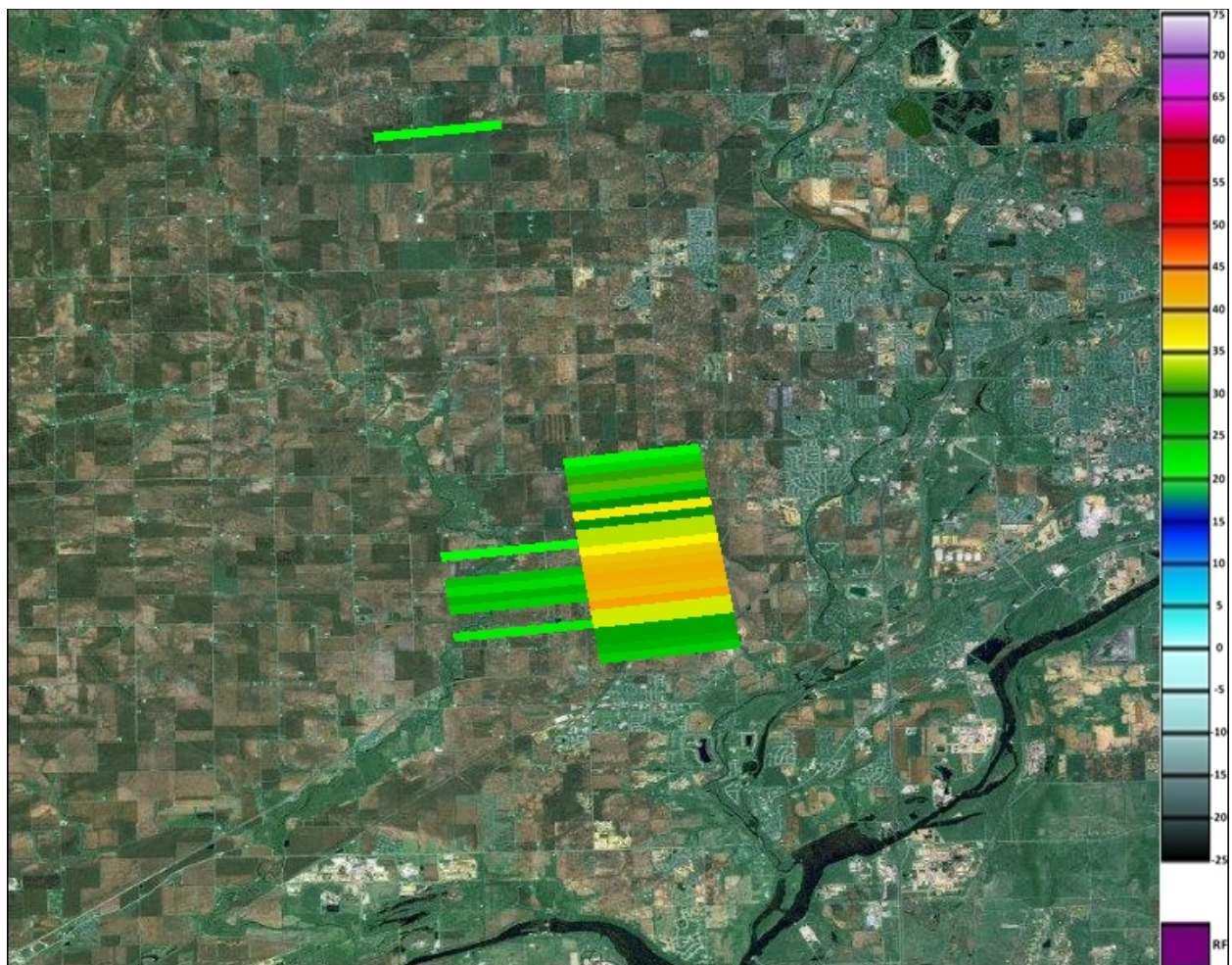
KMKX WSR-88D Level-II $\sim 0.9^\circ$ radar sweep beginning about 1103:32 CDT.



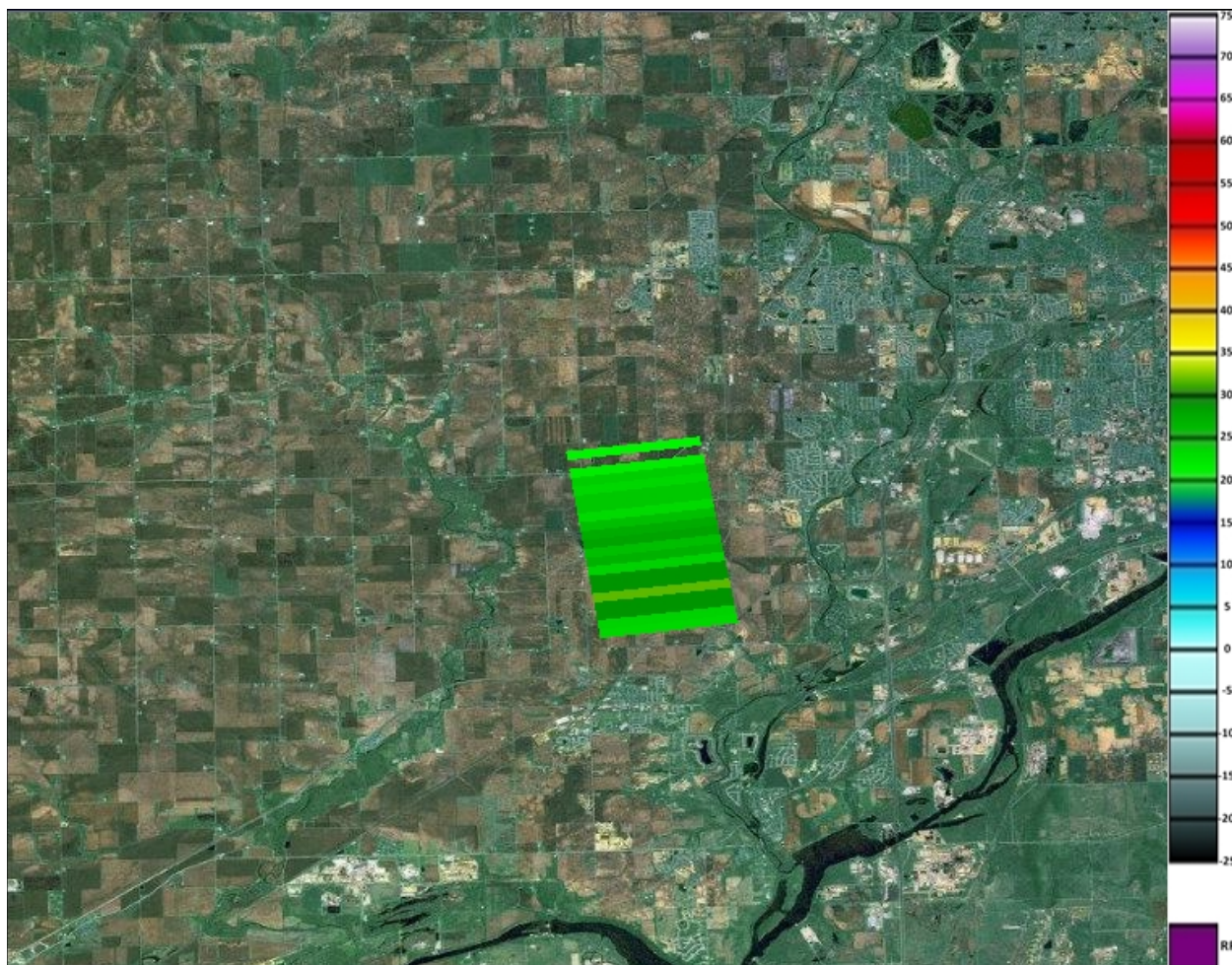
KMKX WSR-88D Level-II $\sim 1.3^\circ$ radar sweep beginning about 1104:08 CDT.



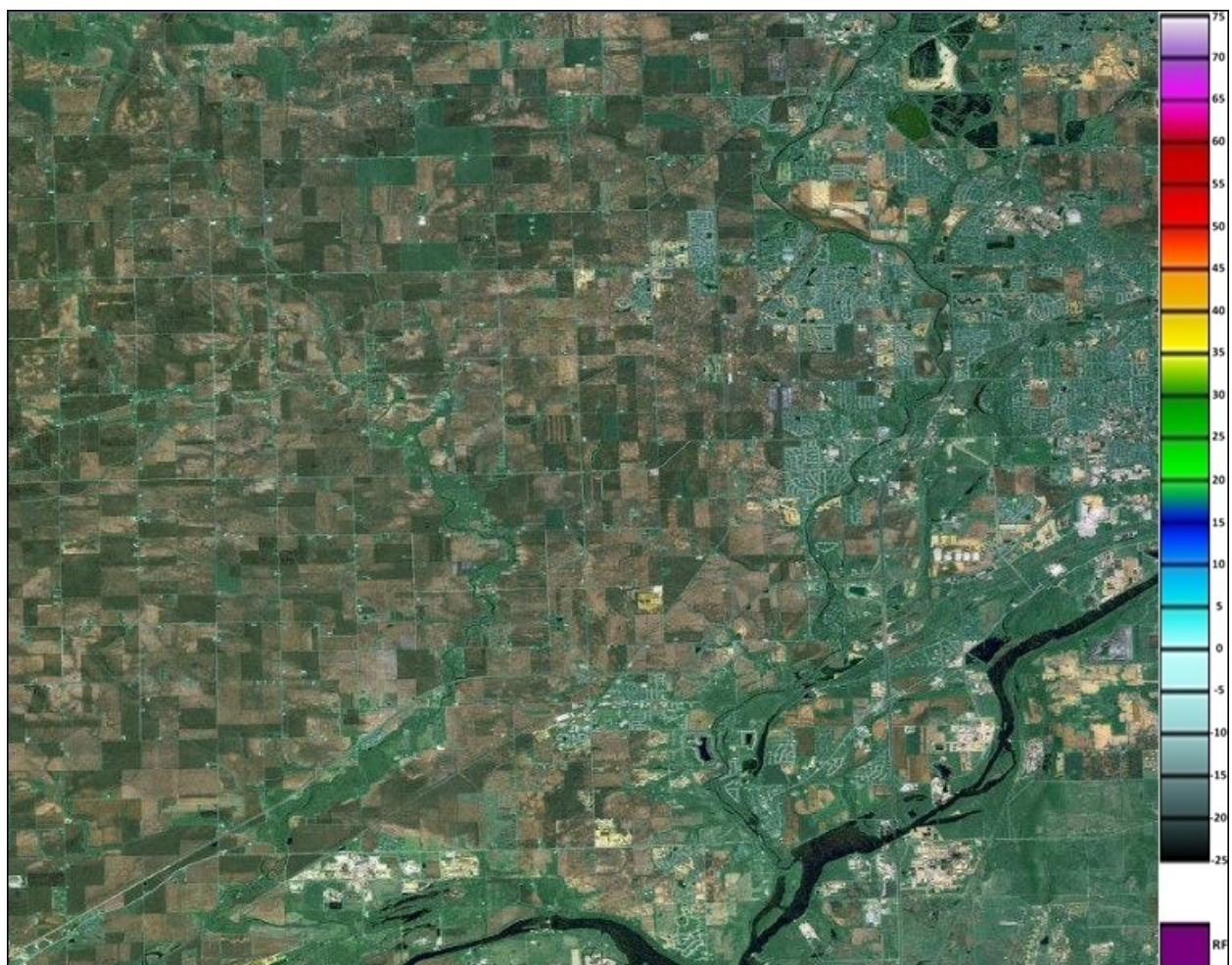
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1104:49 CDT.



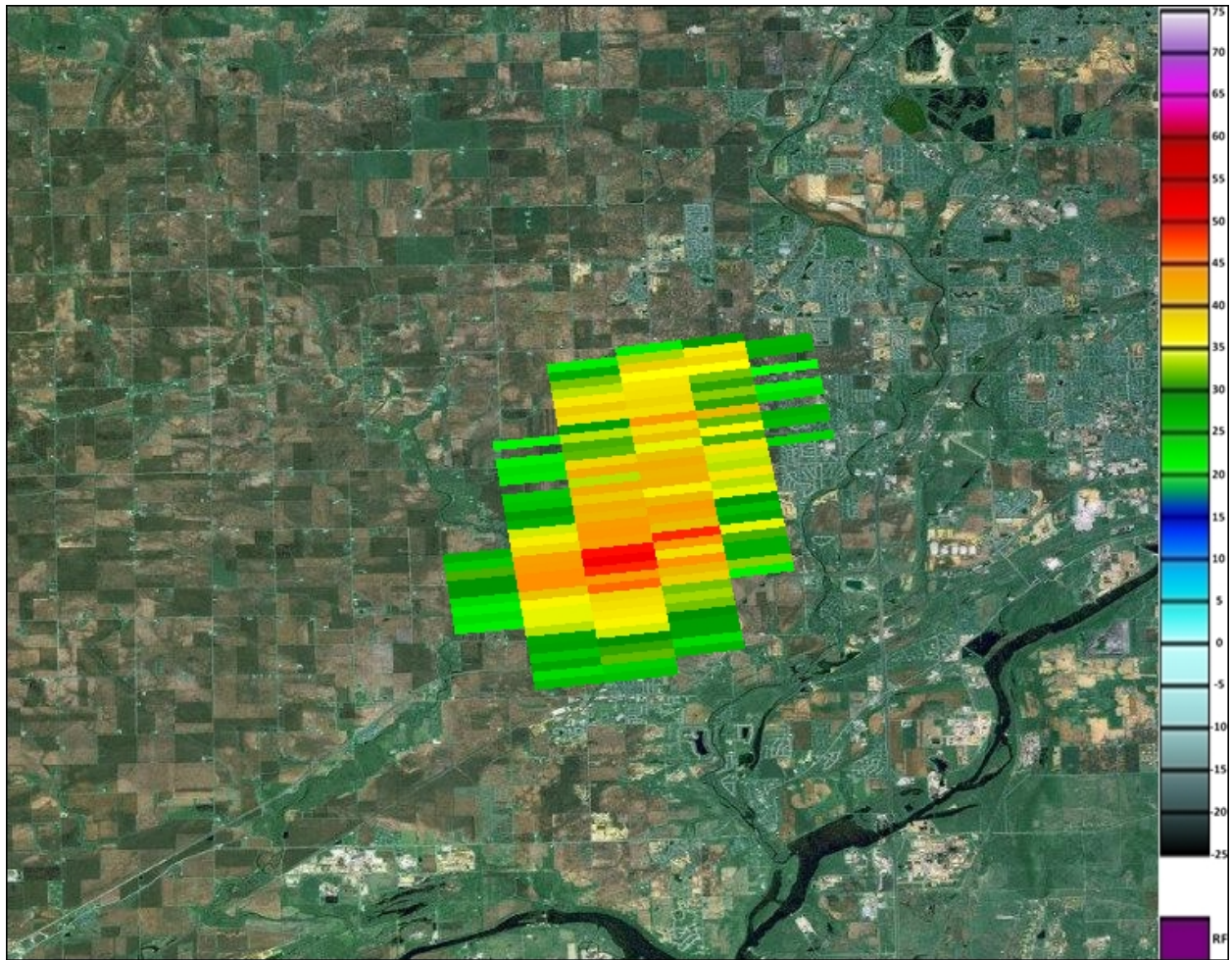
KMKX WSR-88D Level-II $\sim 1.8^\circ$ radar sweep beginning about 1105:21 CDT.



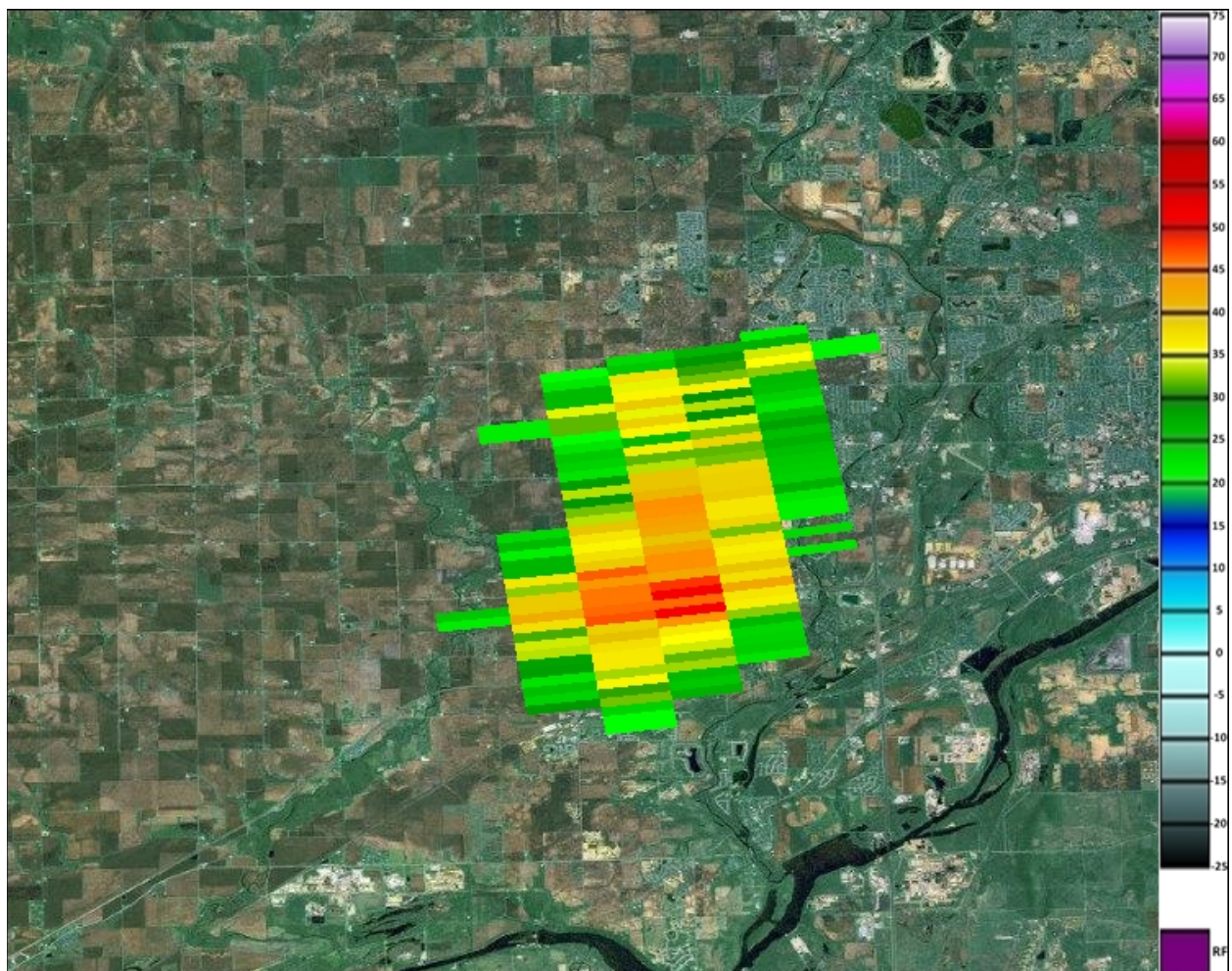
KMKX WSR-88D Level-II $\sim 2.4^\circ$ radar sweep beginning about 1105:36 CDT.



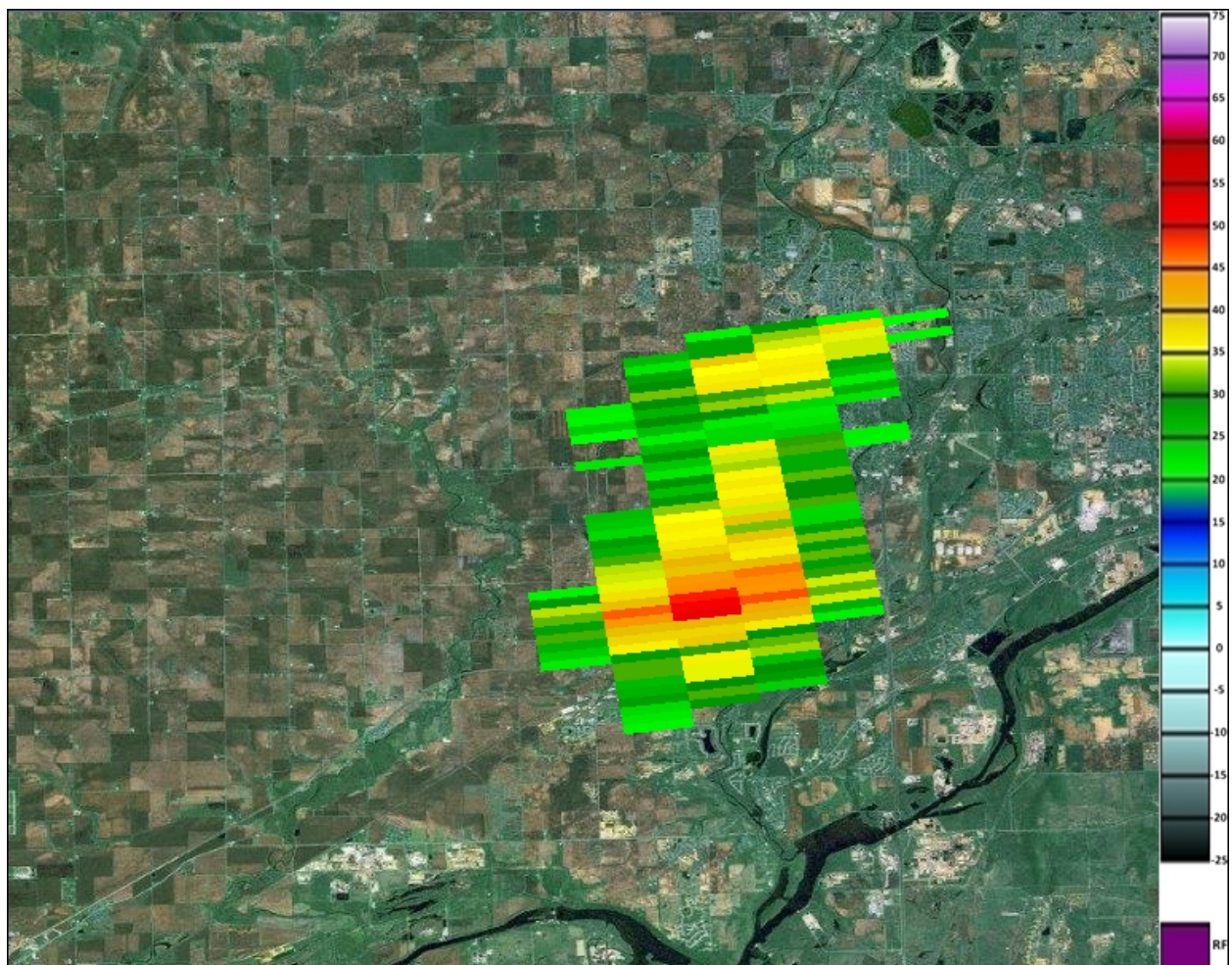
KMKX WSR-88D Level-II $\sim 3.2^\circ$ radar sweep beginning about 1105:50 CDT.



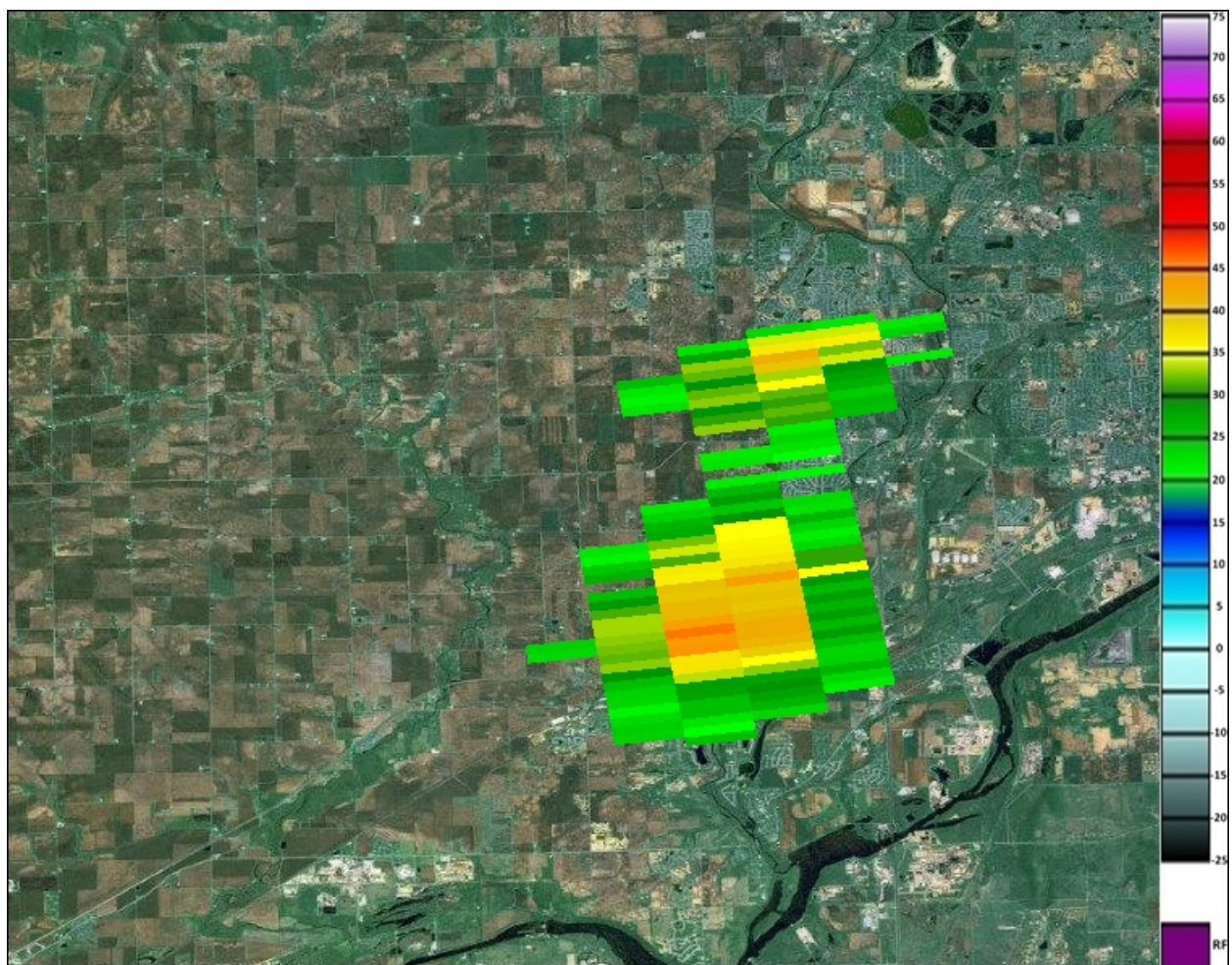
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1106:09 CDT.



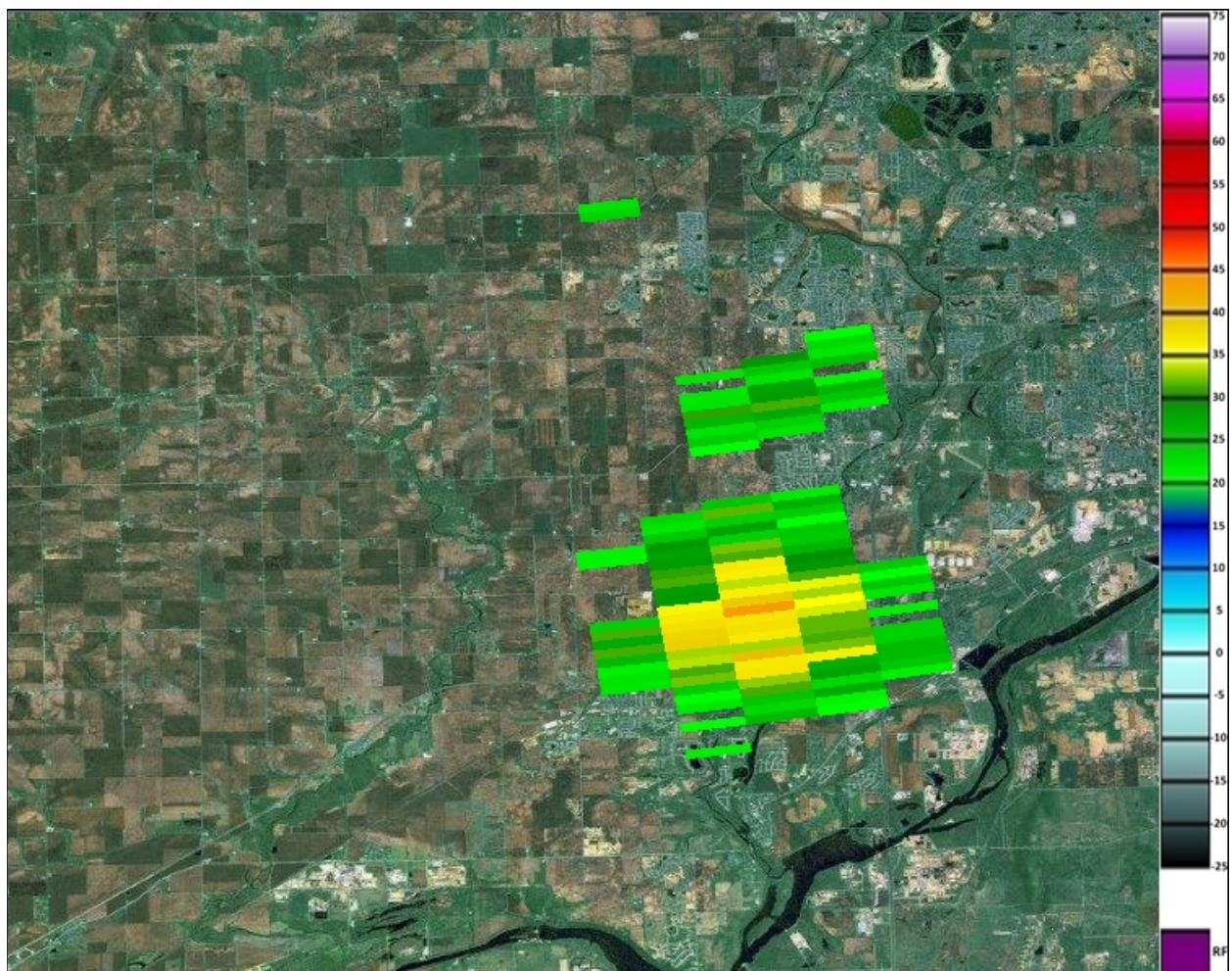
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1107:43 CDT.



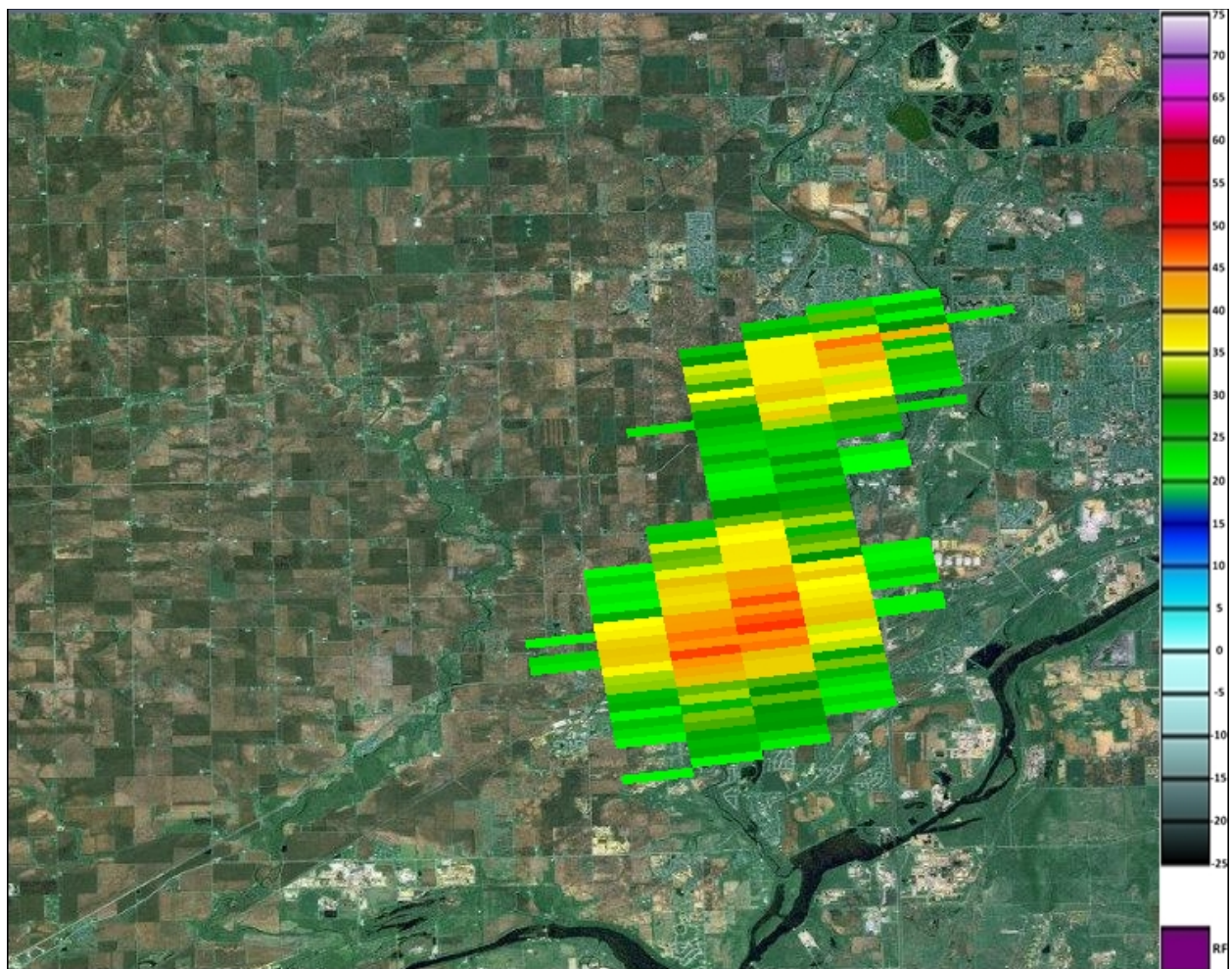
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1109:24 CDT.



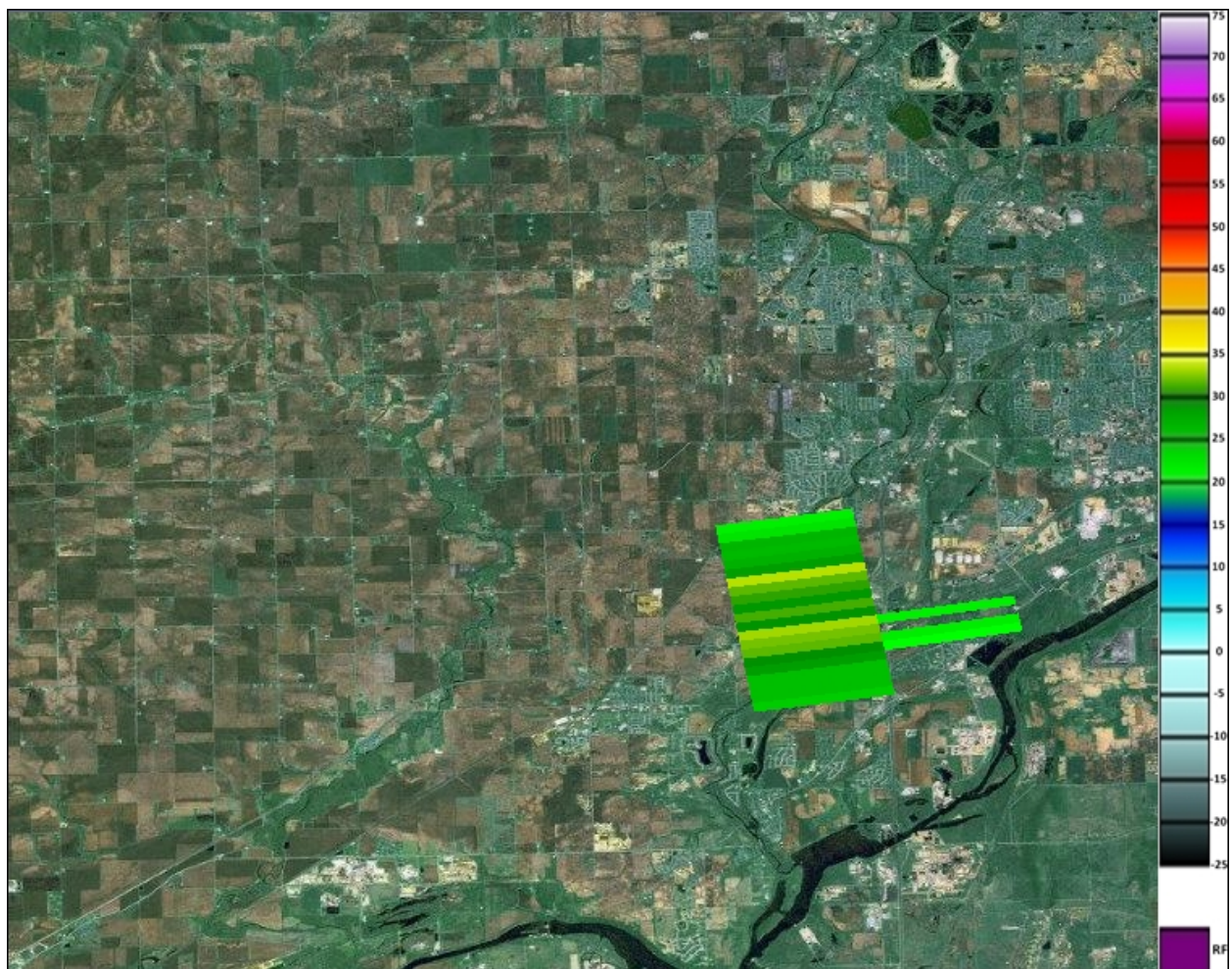
KMKX WSR-88D Level-II $\sim 0.9^\circ$ radar sweep beginning about 1110:00 CDT.



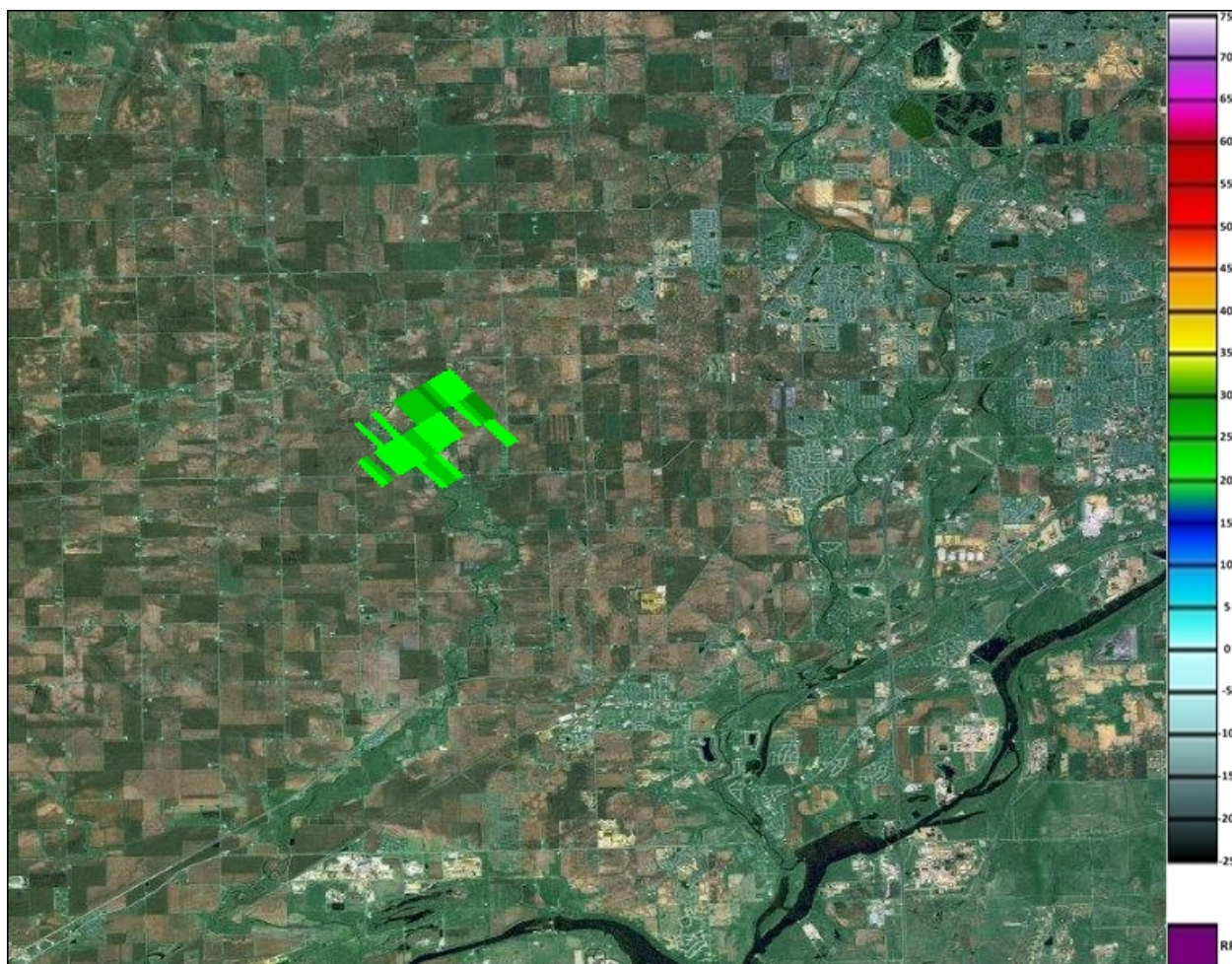
KMKX WSR-88D Level-II $\sim 1.3^\circ$ radar sweep beginning about 1110:36 CDT.



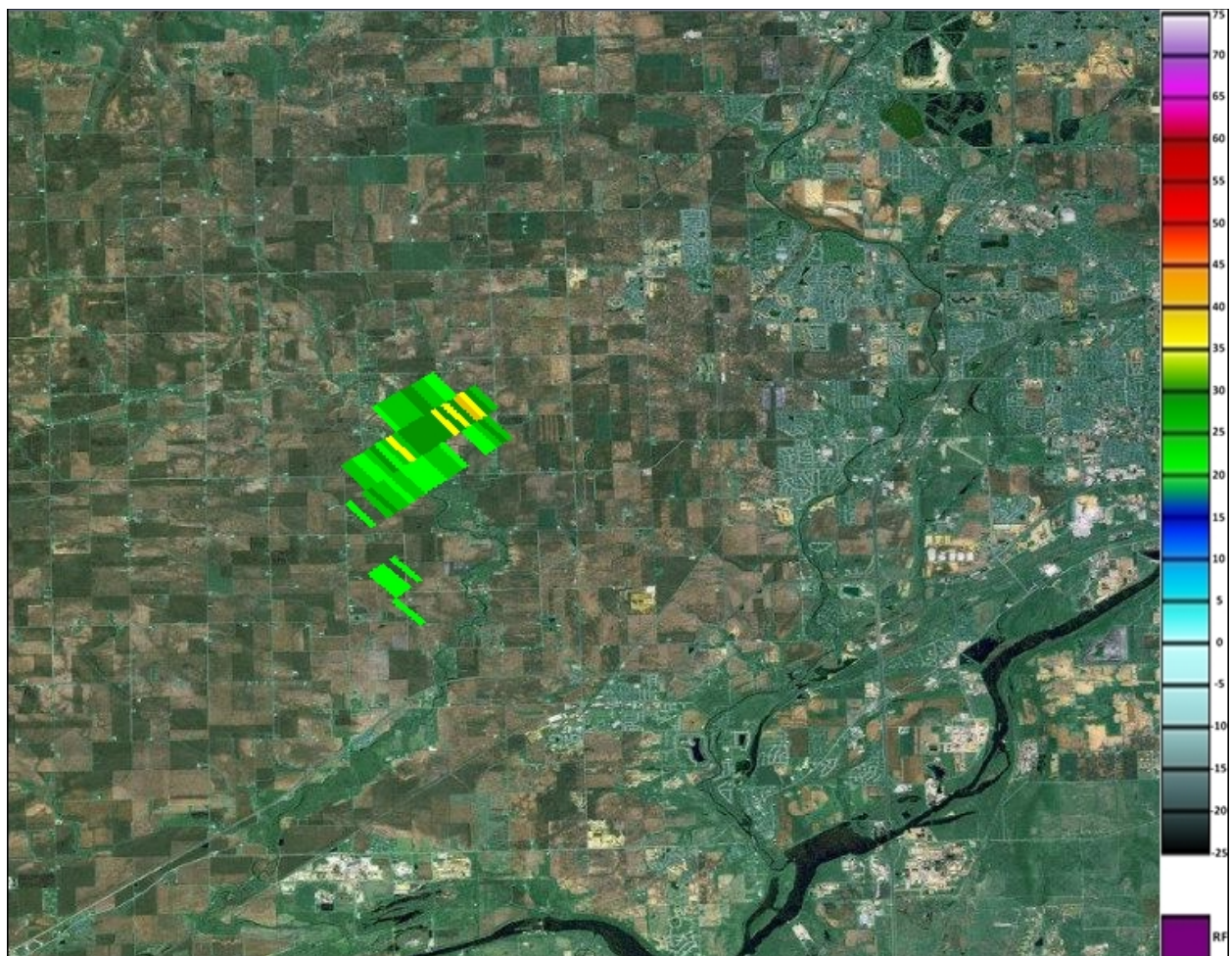
KMKX WSR-88D Level-II $\sim 0.5^\circ$ radar sweep beginning about 1111:12 CDT.



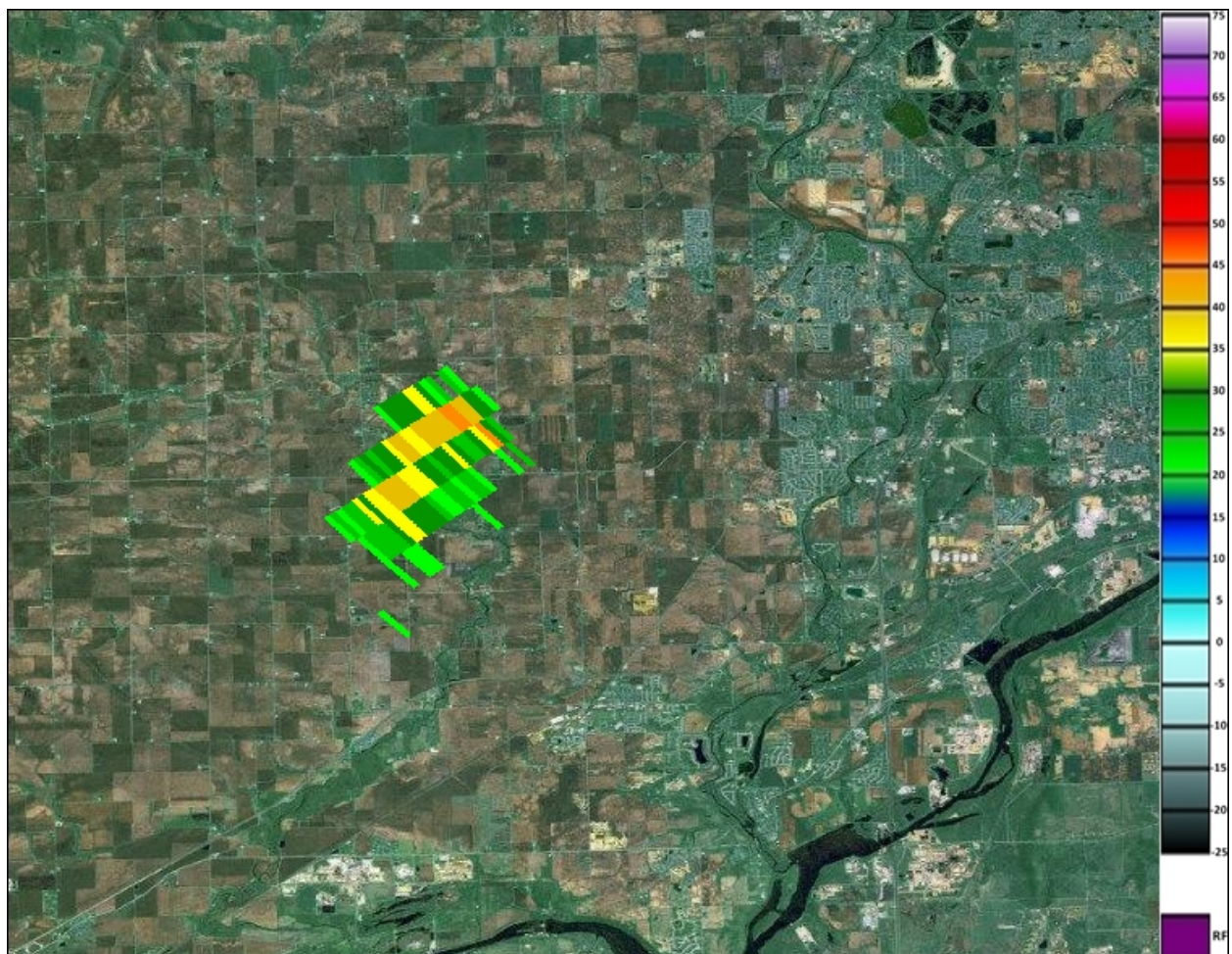
KMKX WSR-88D Level-II $\sim 1.8^\circ$ radar sweep beginning about 1111:51 CDT.



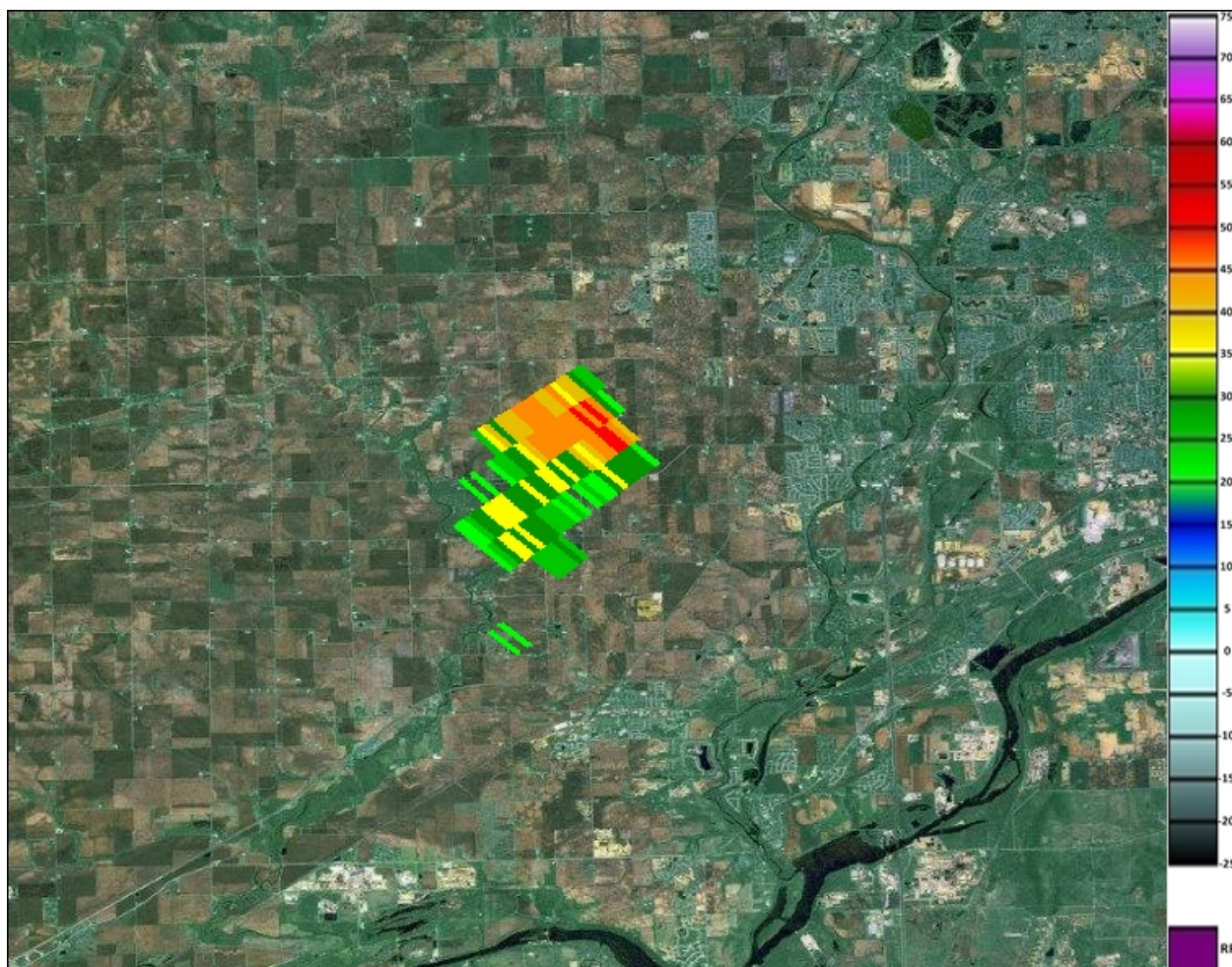
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1055 CDT.



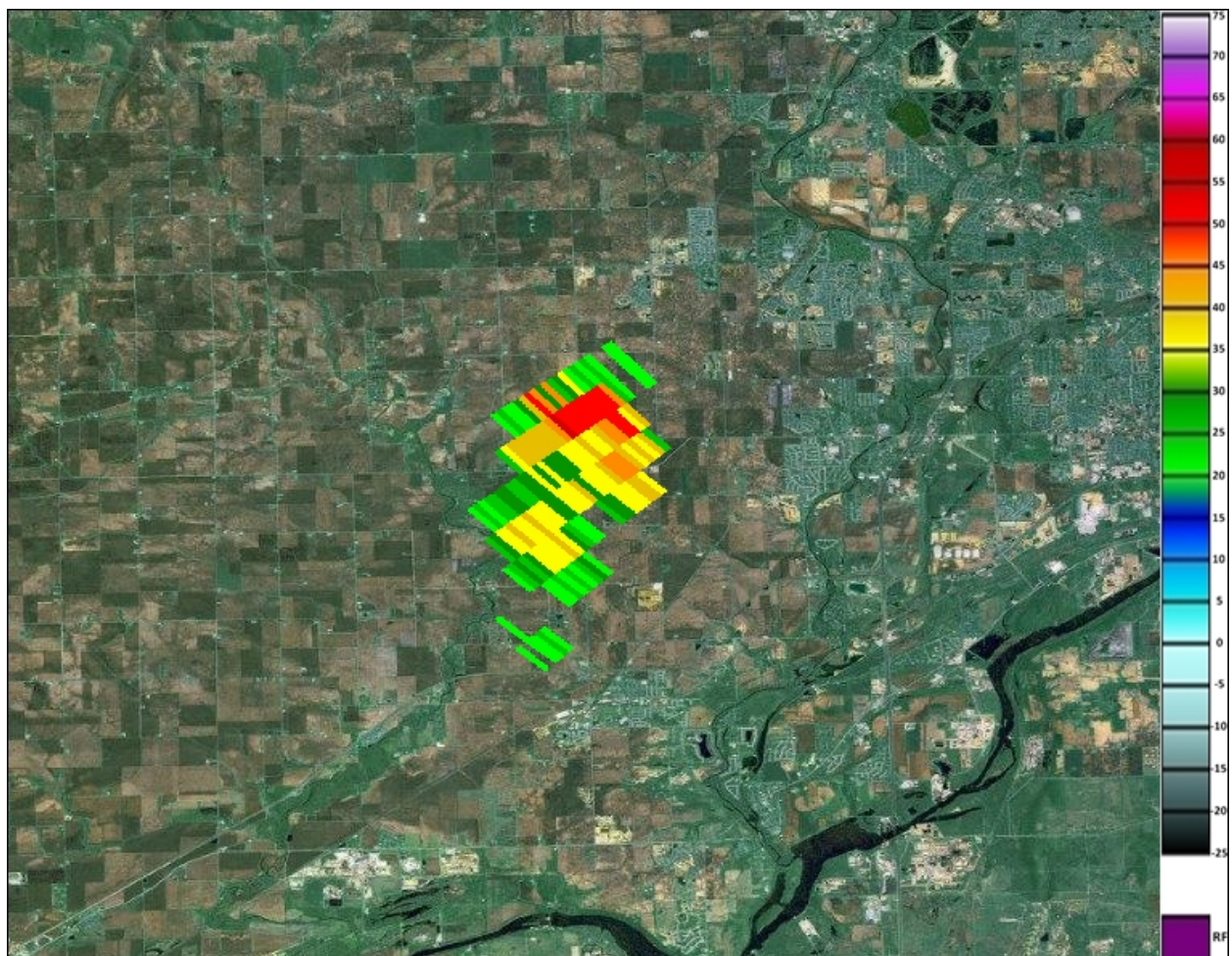
TORD TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mints after 1055 CDT.



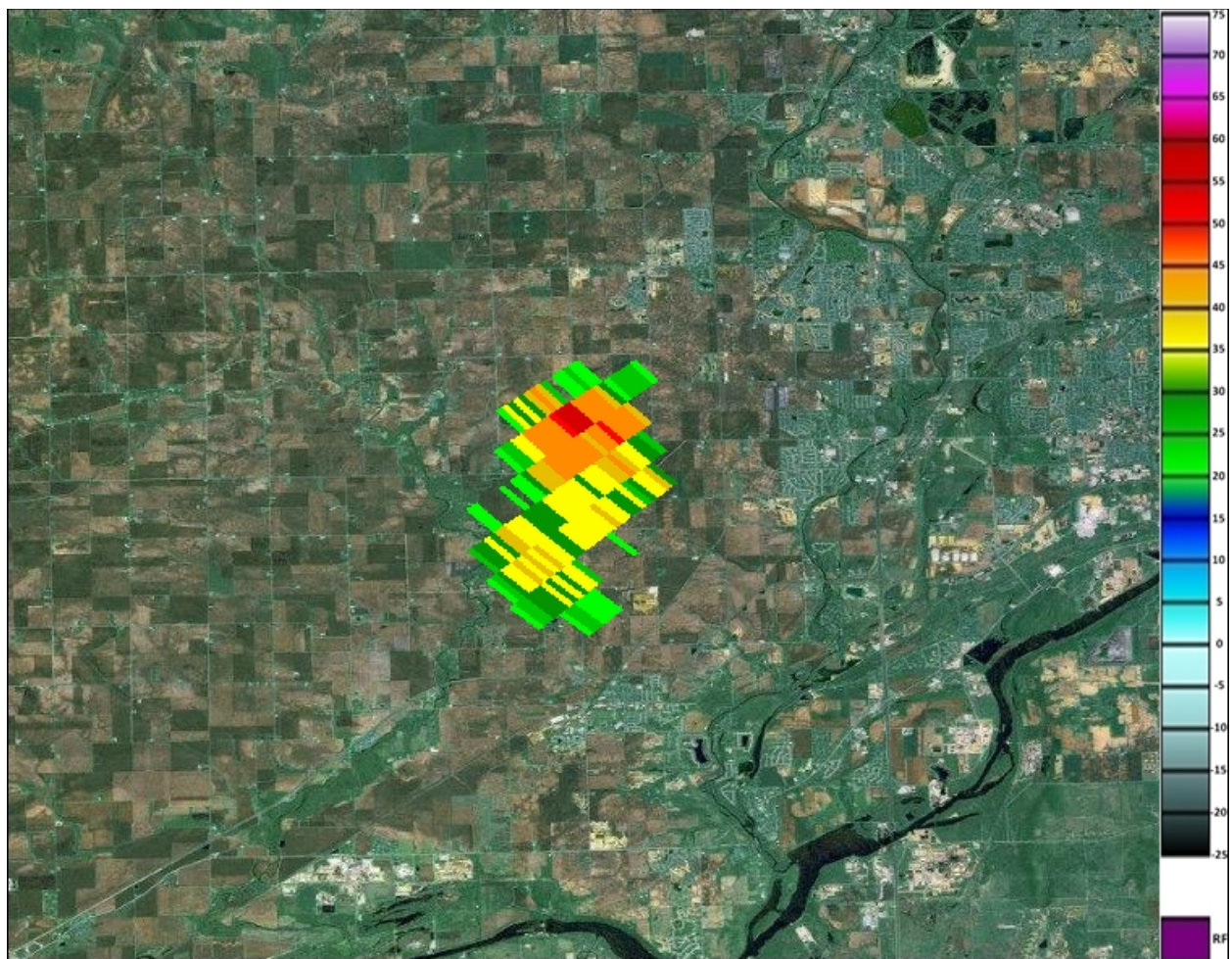
TORD TDWR $\sim 1.9^\circ$ radar sweep beginning at or within a few mints after 1055 CDT.



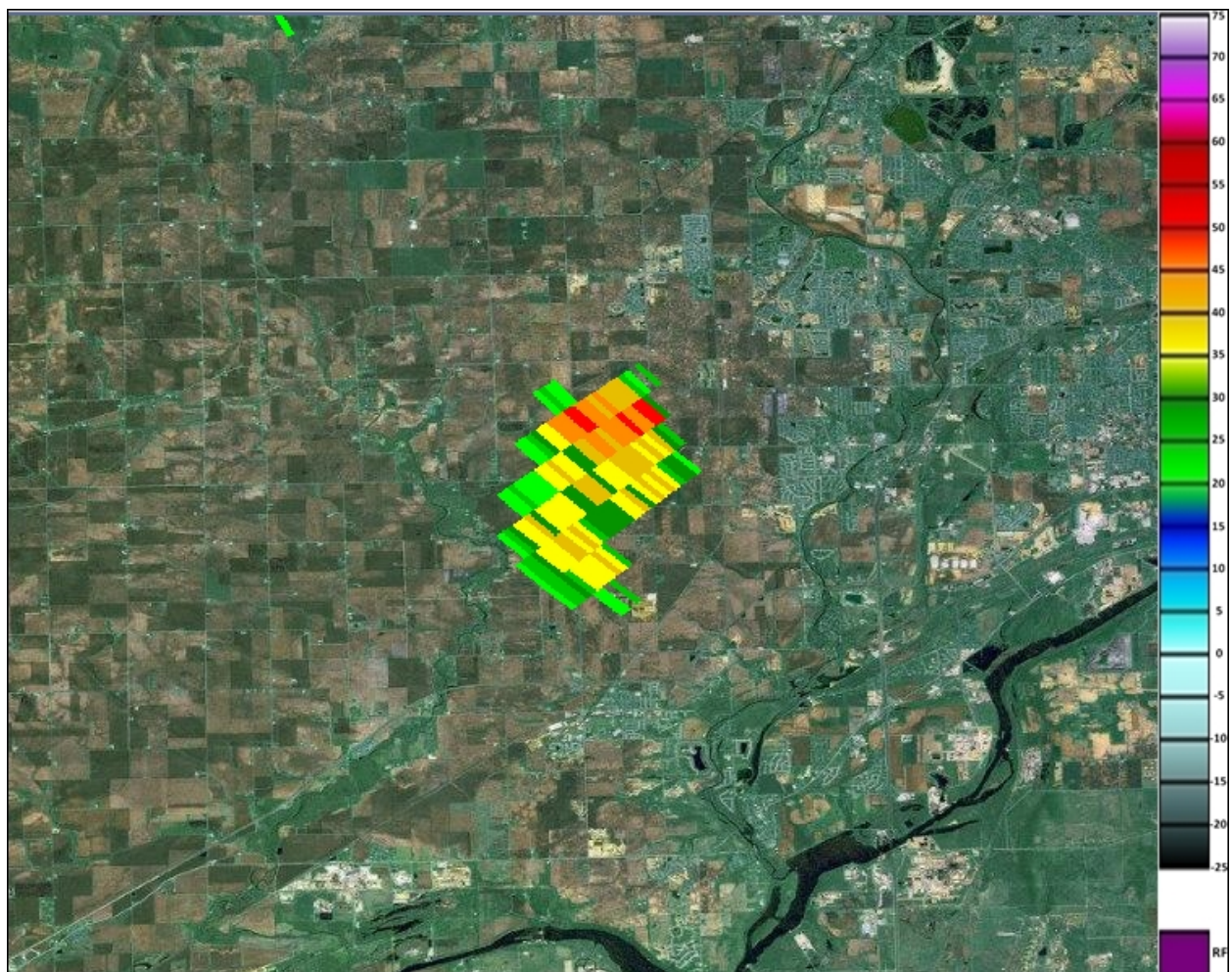
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1101 CDT.



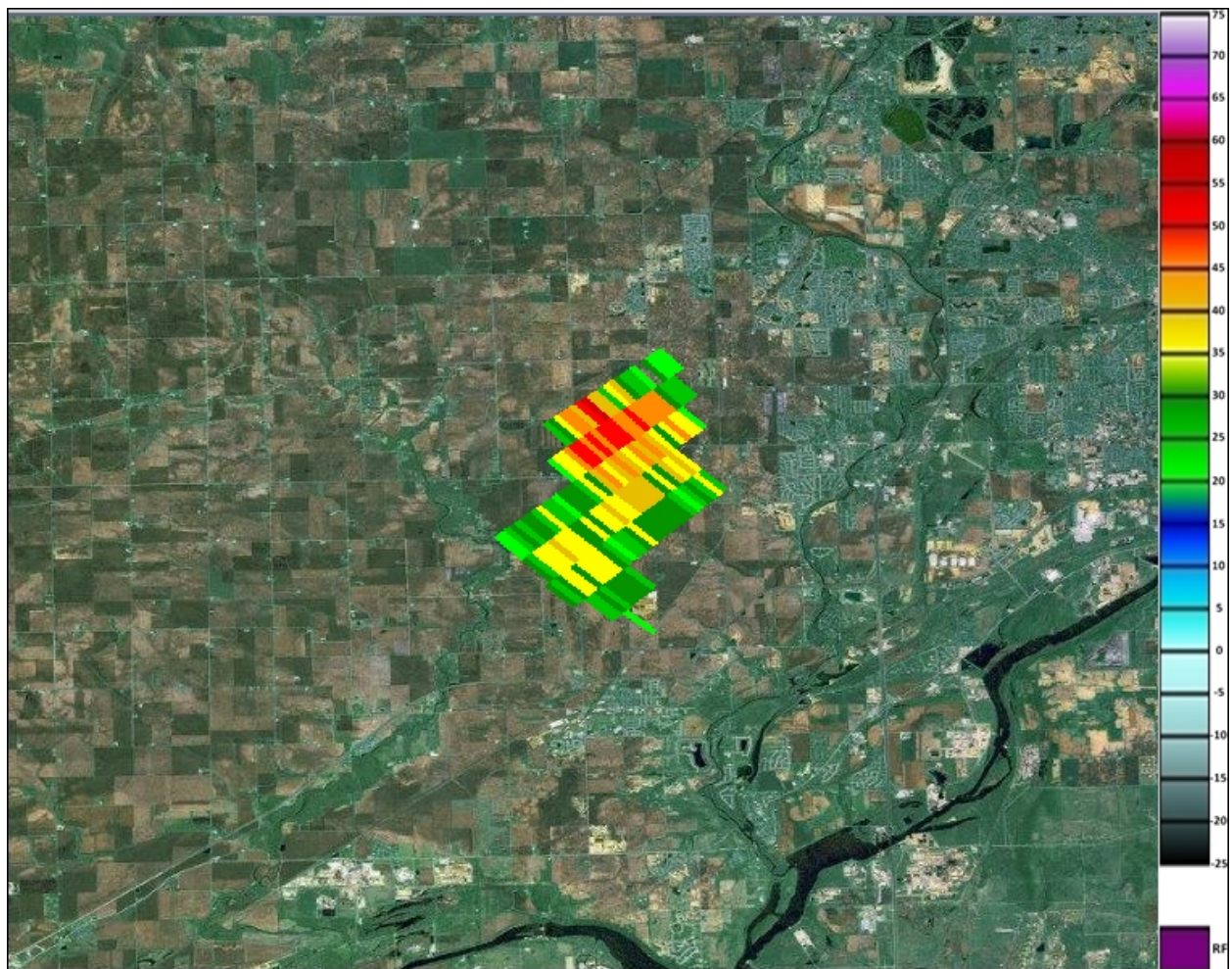
TORD TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mints after 1101 CDT.



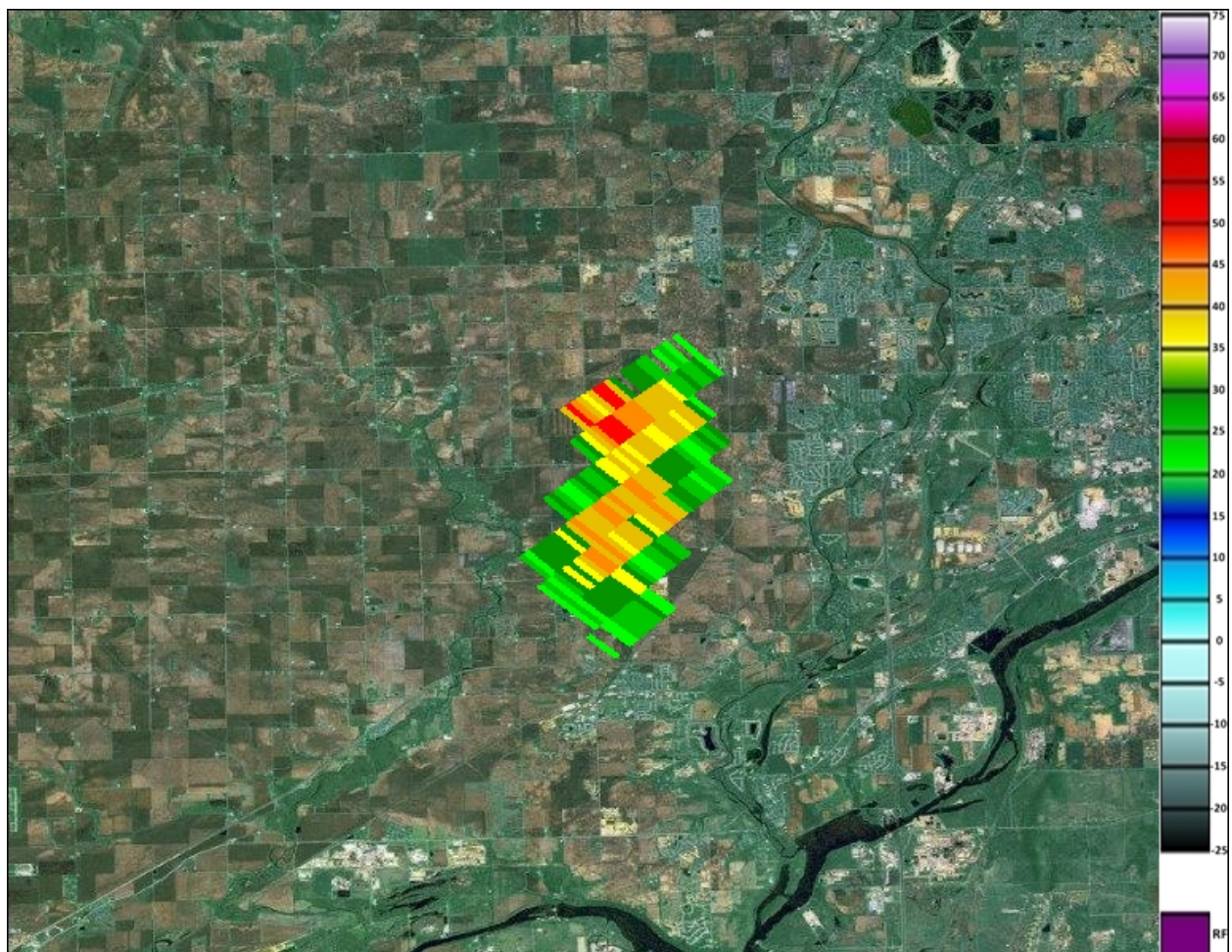
TORD TDWR $\sim 1.9^\circ$ radar sweep beginning at or within a few mints after 1101 CDT.



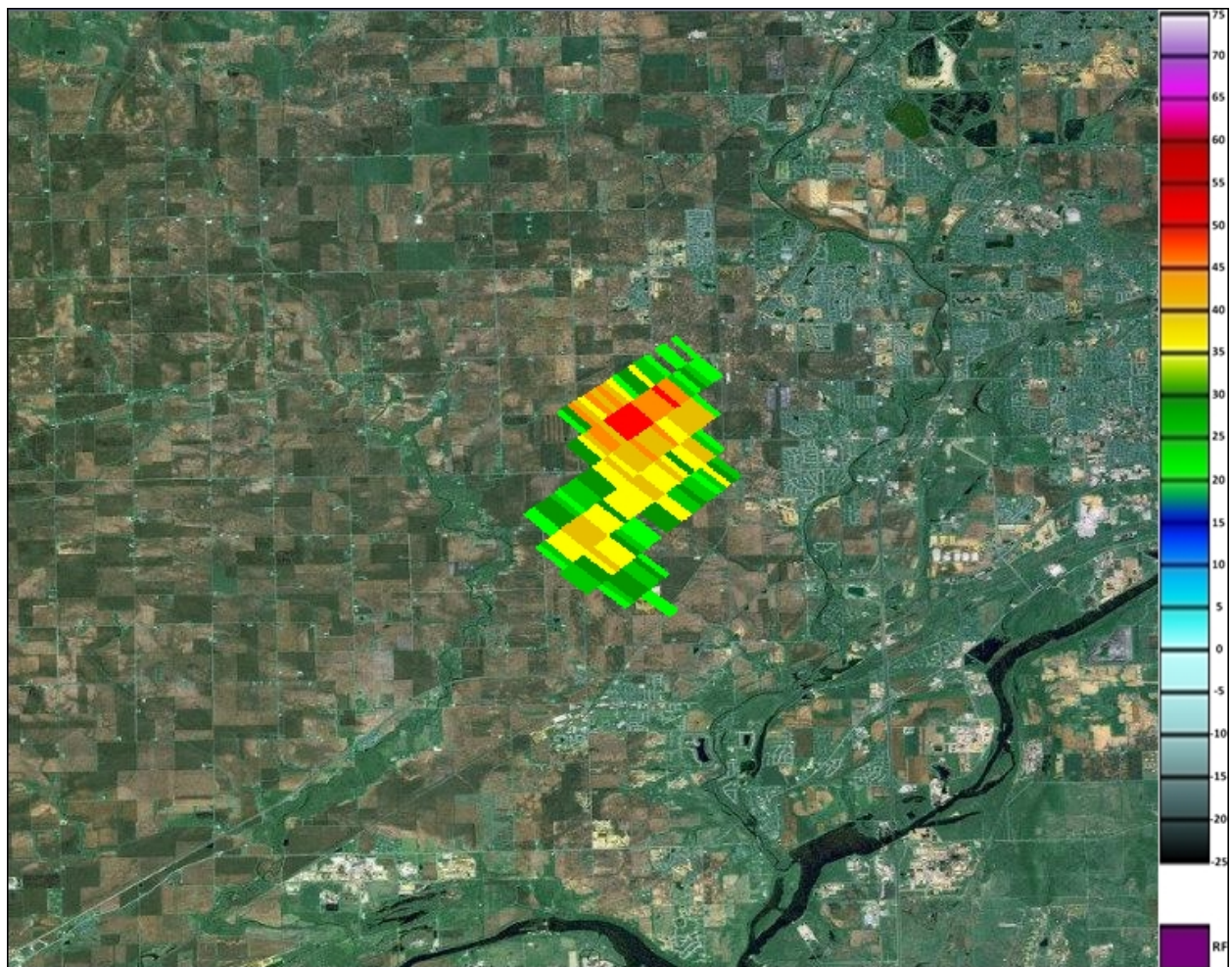
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few minutes after 1104 CDT.



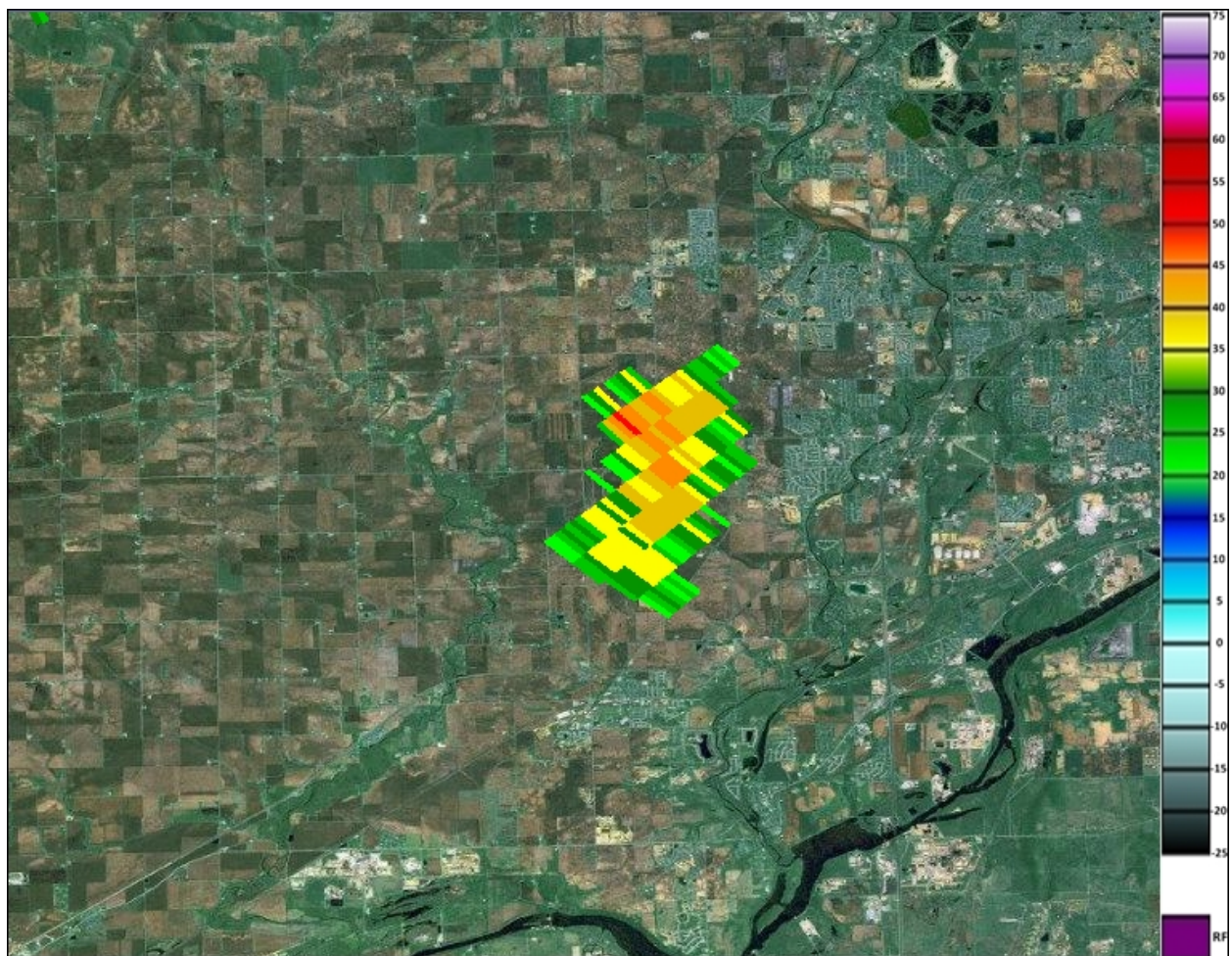
TORD TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mints after 1104 CDT.



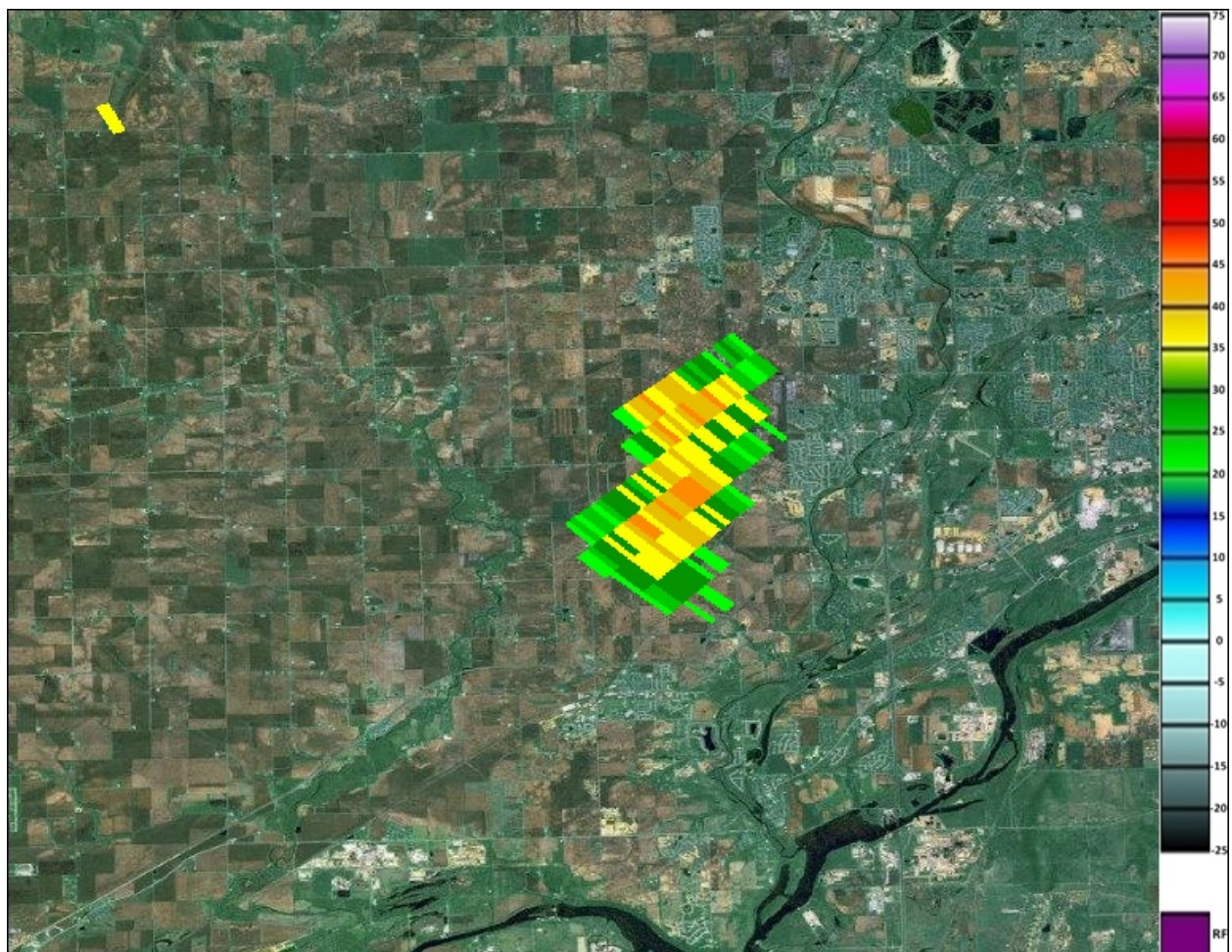
TORD TDWR $\sim 1.9^\circ$ radar sweep beginning at or within a few mints after 1104 CDT.



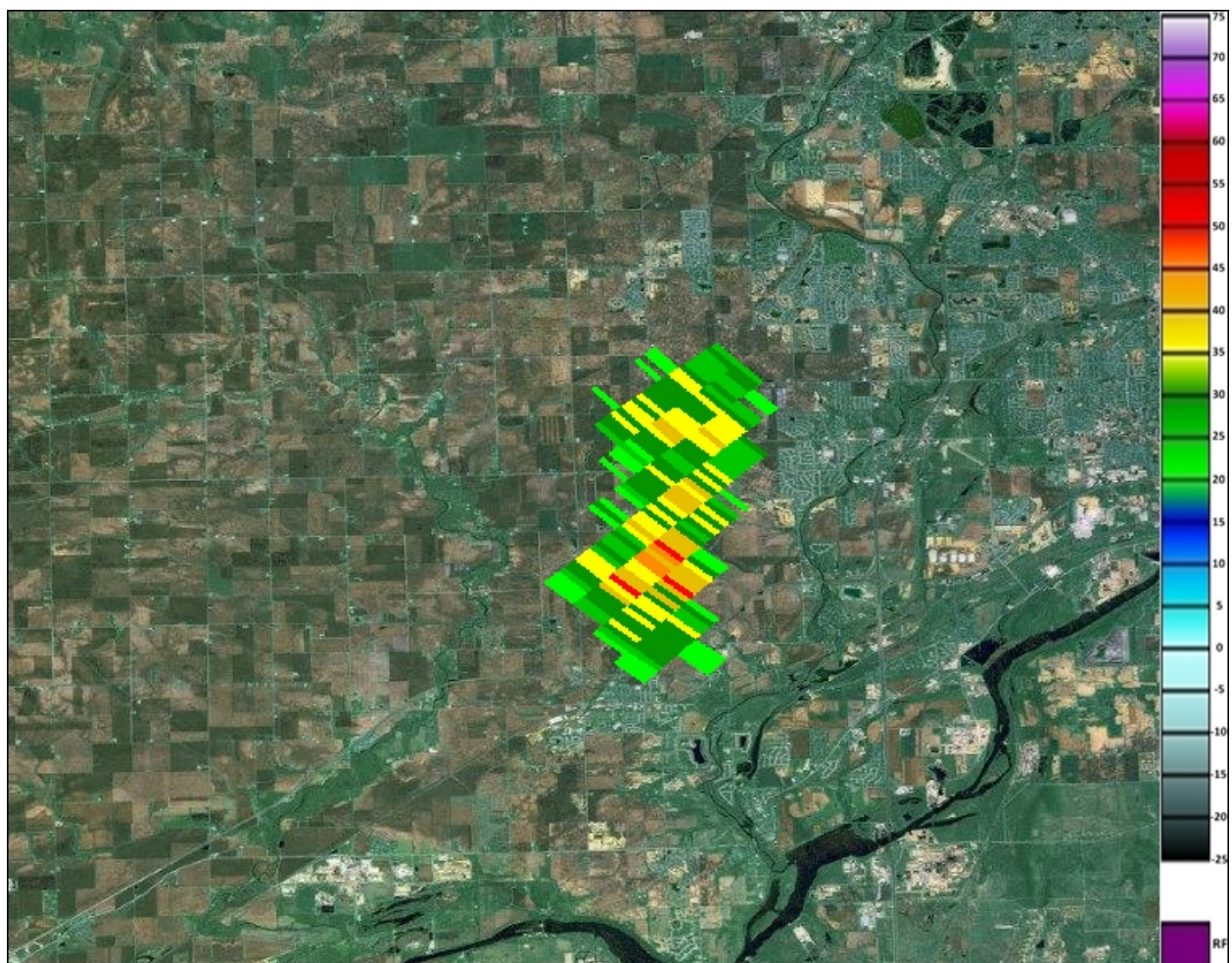
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1105 CDT.



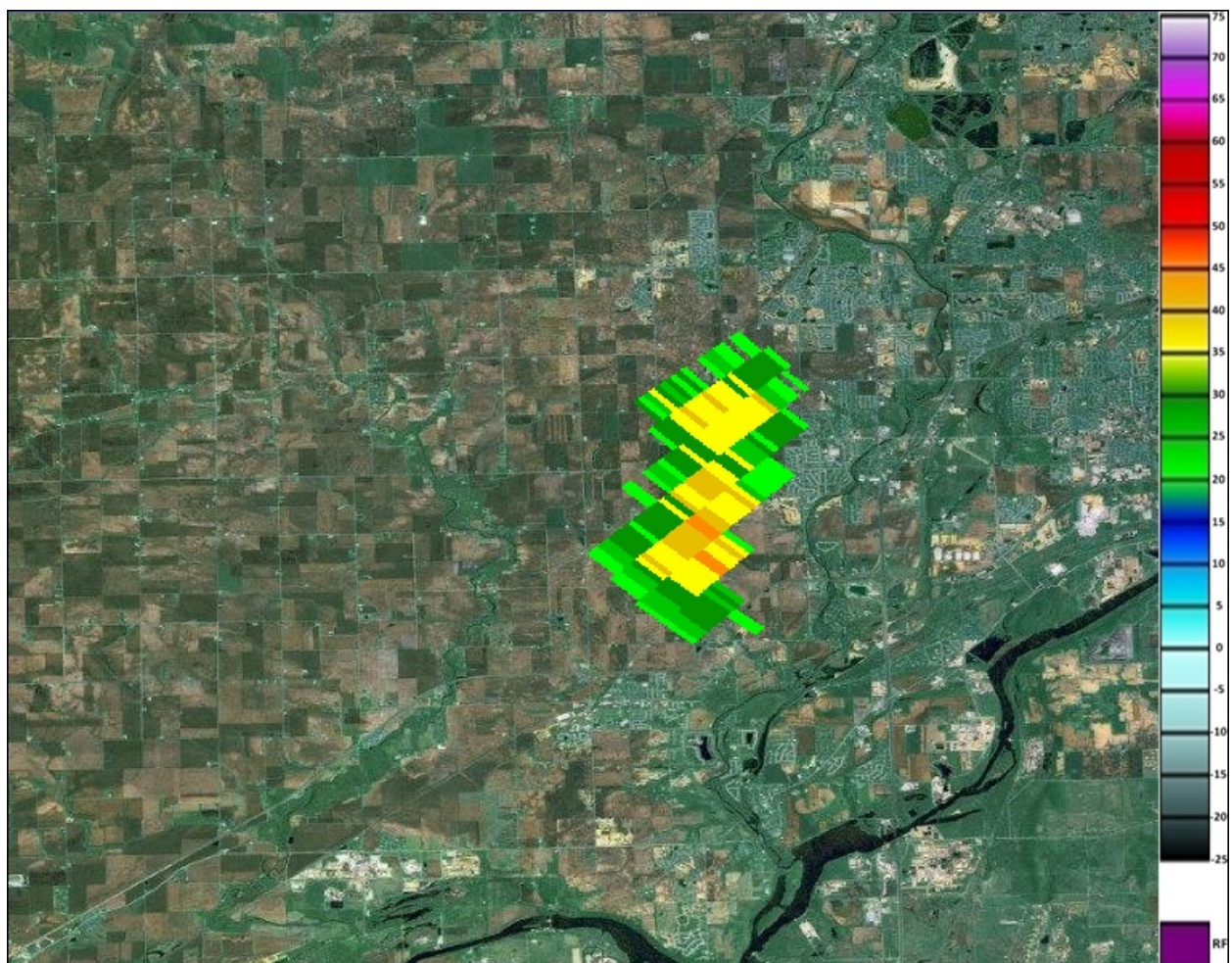
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1106 CDT.



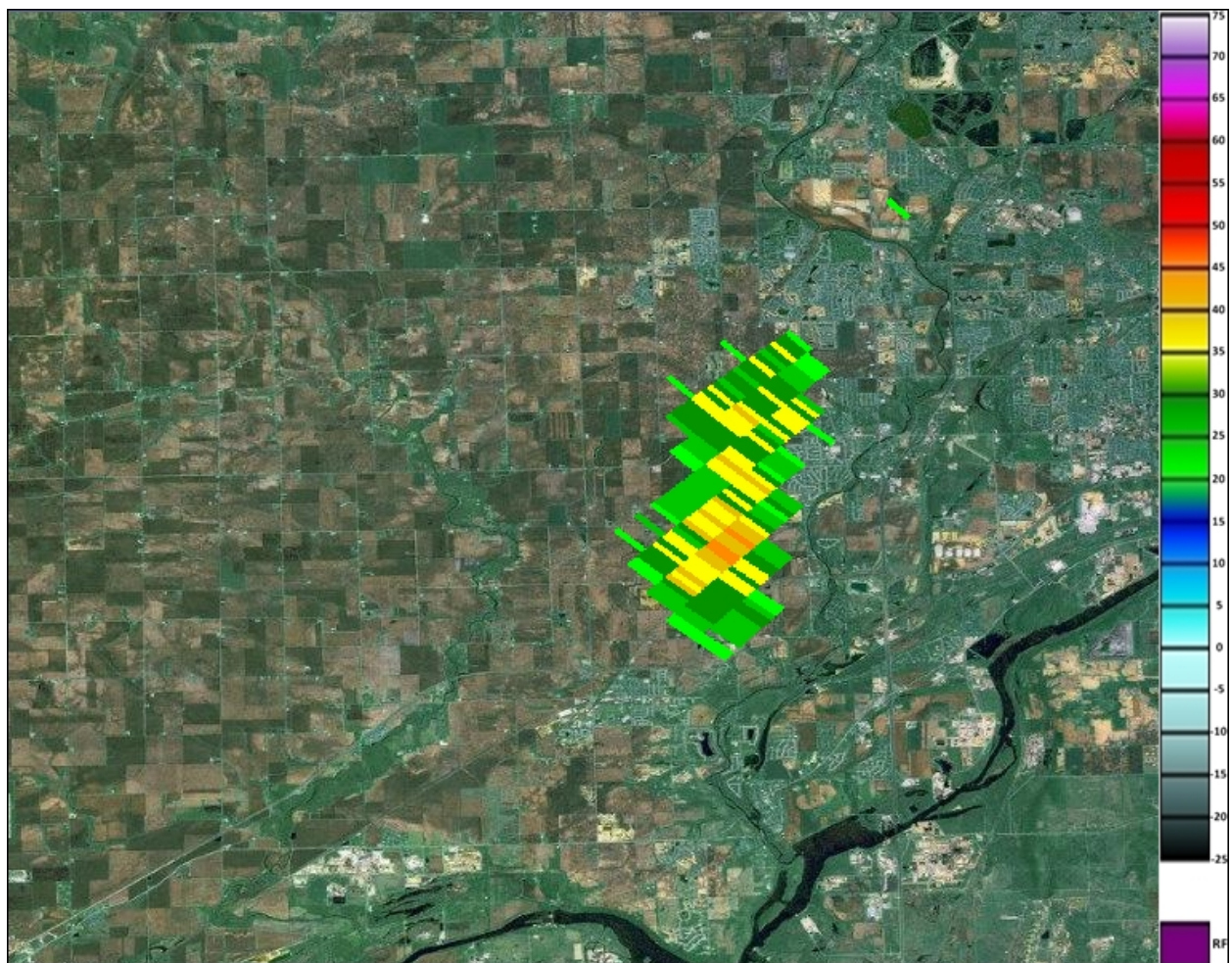
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1107 CDT.



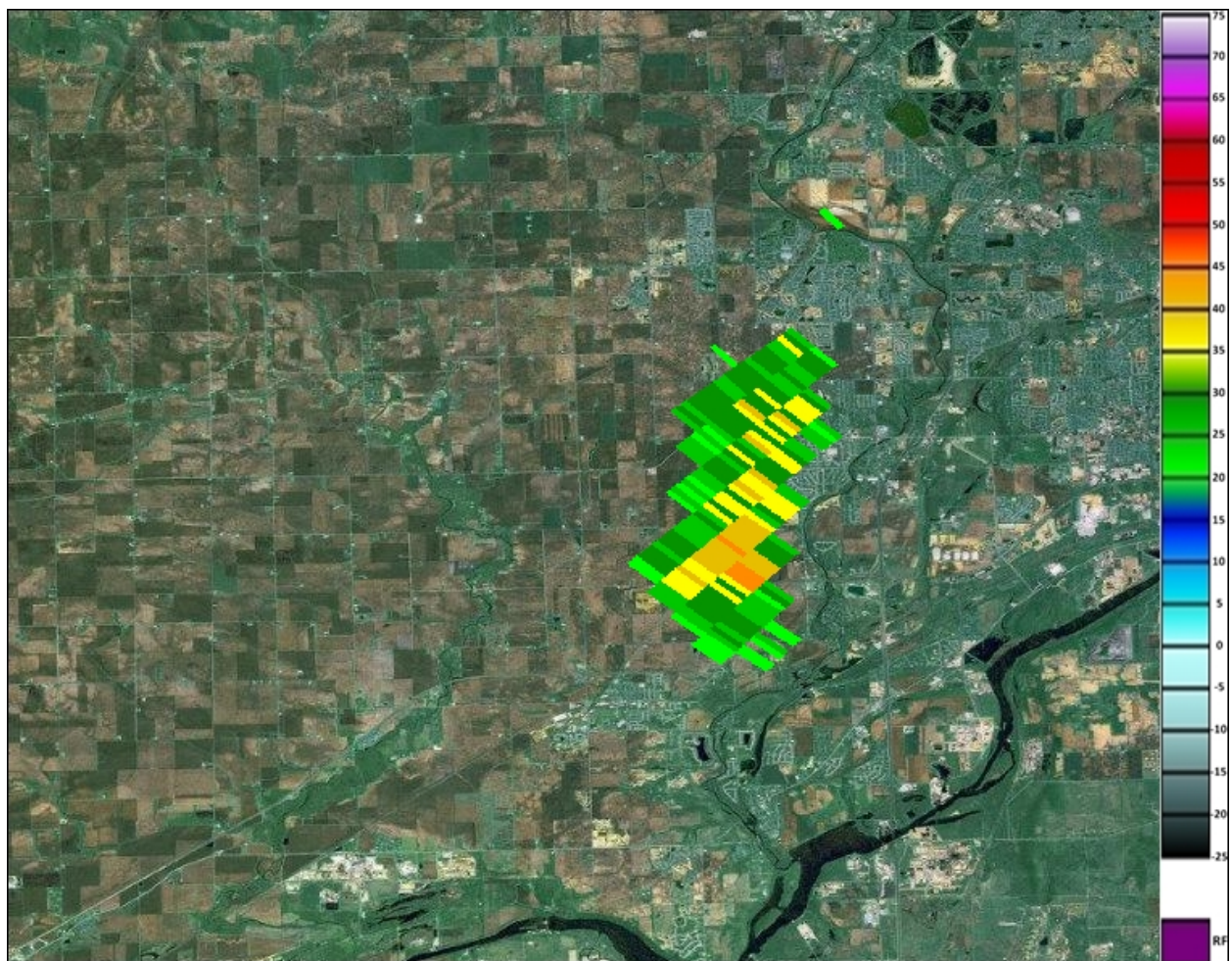
TORD TDWR $\sim 1.9^\circ$ radar sweep beginning at or within a few mints after 1107 CDT.



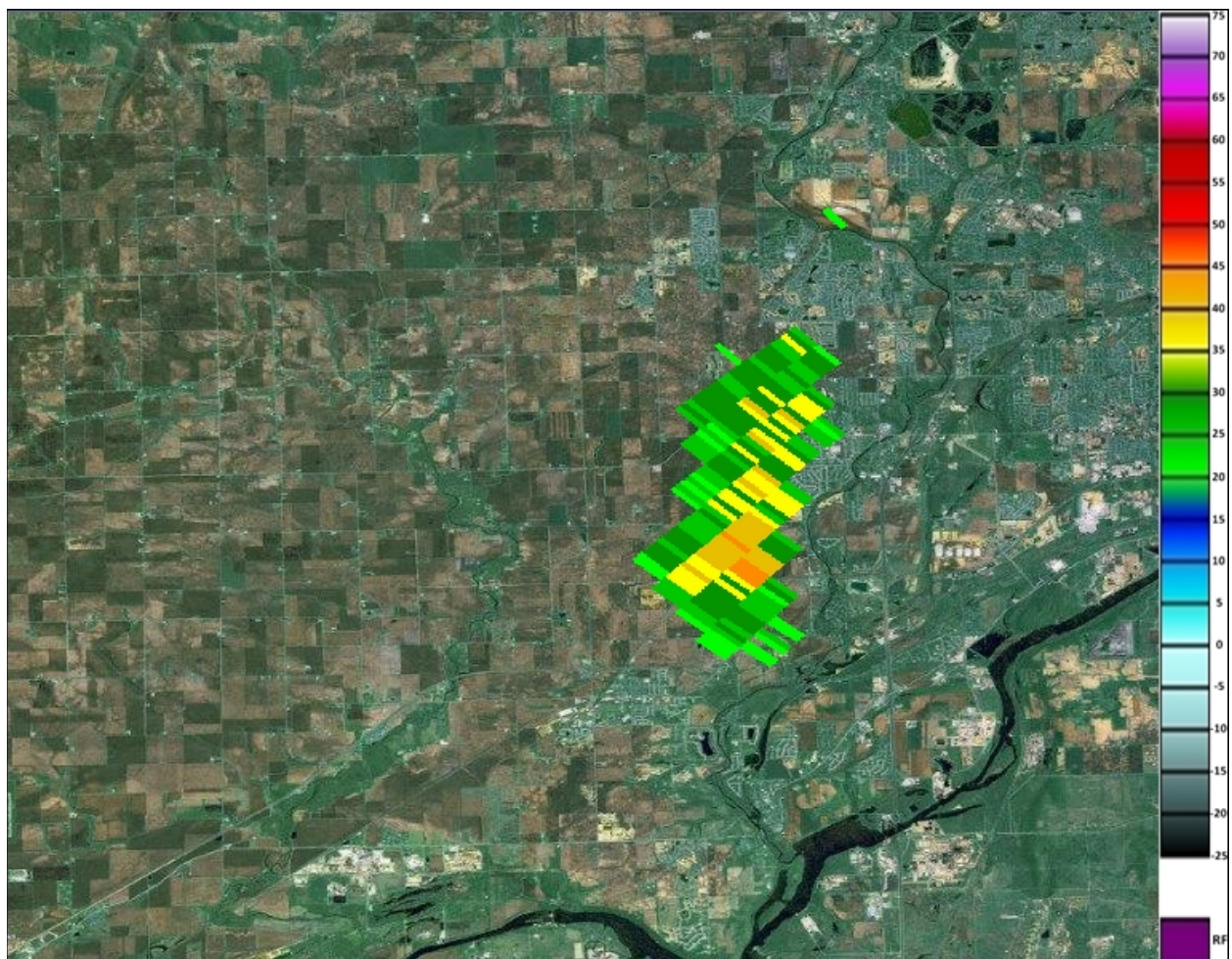
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1108 CDT.



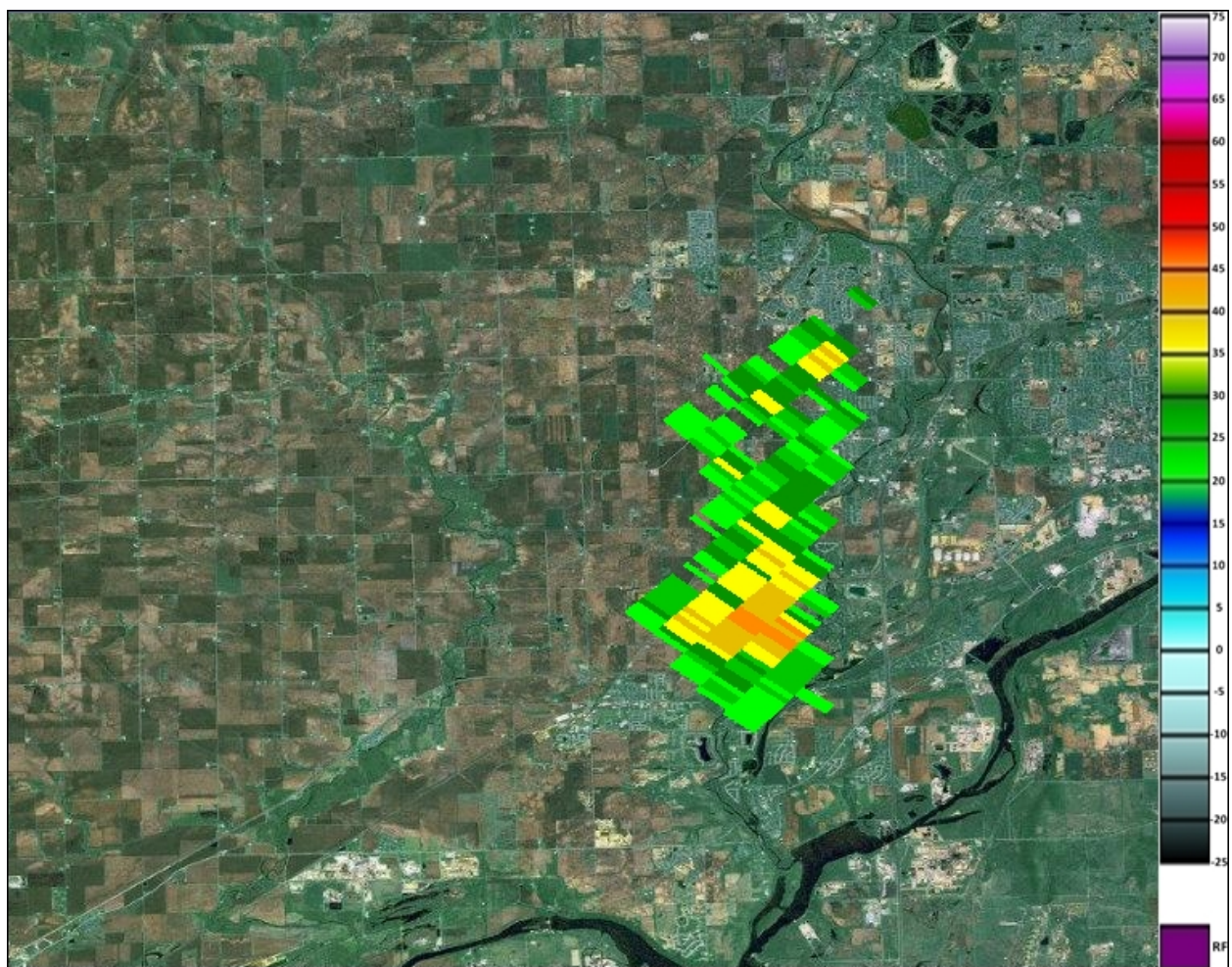
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1109 CDT.



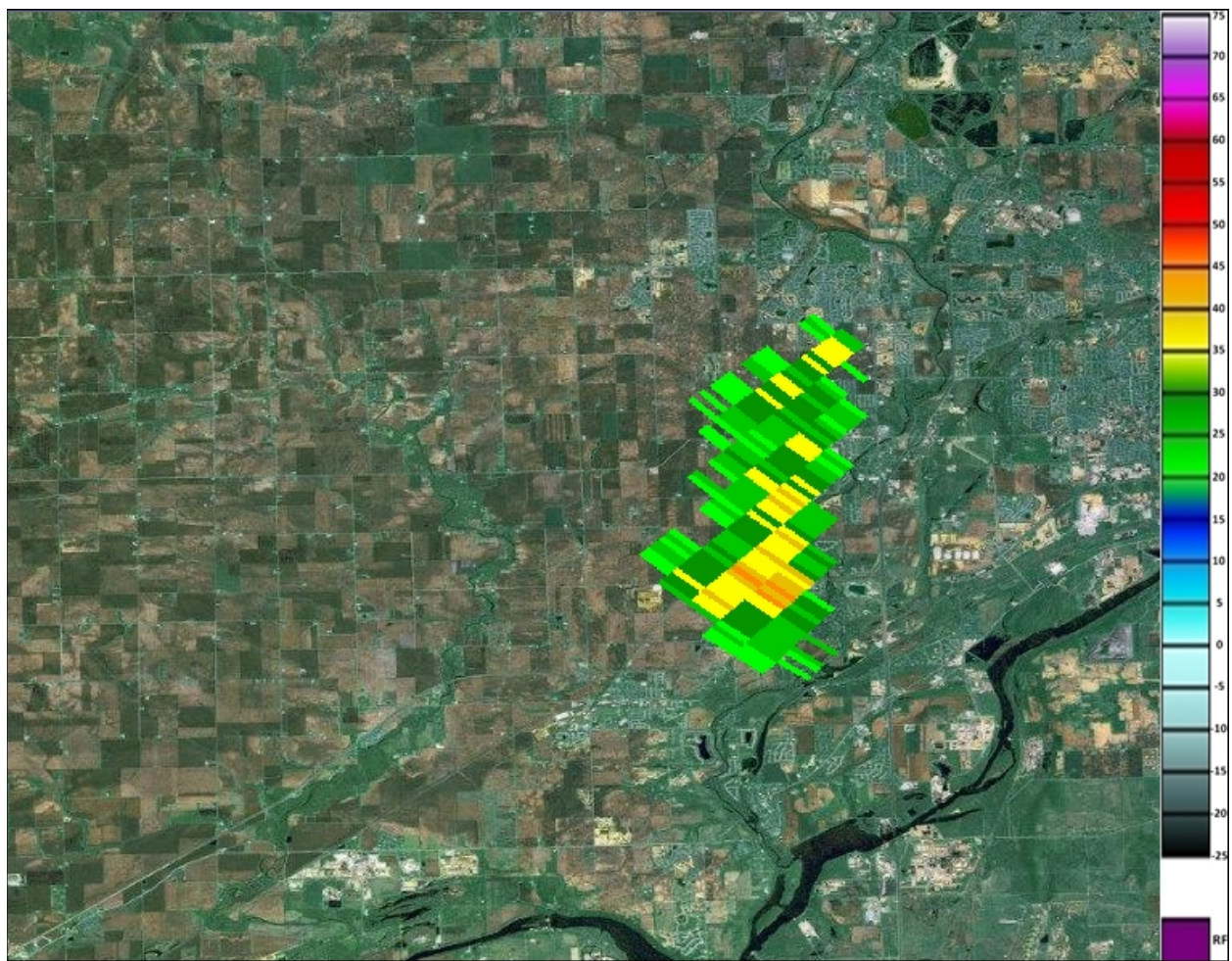
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1110 CDT.



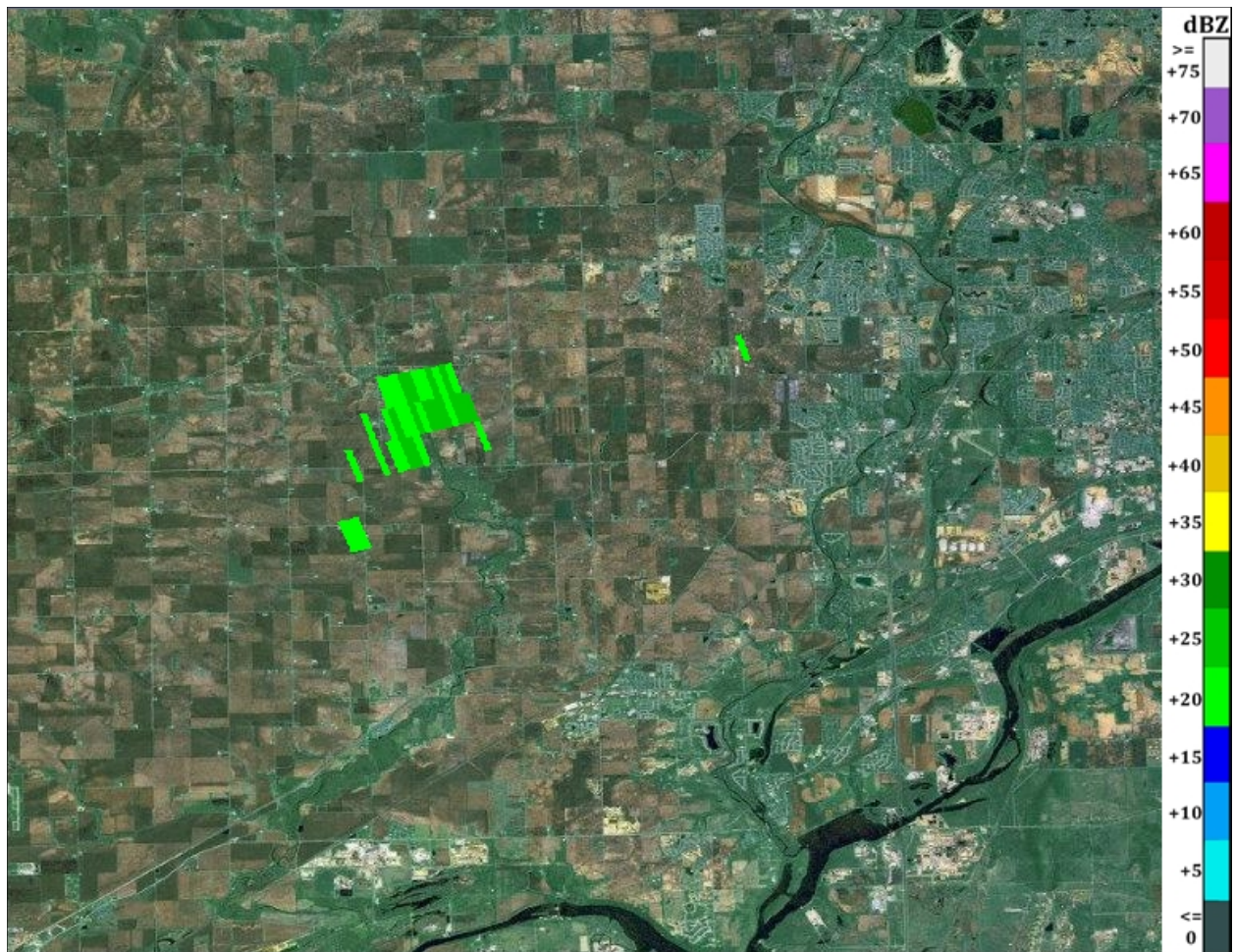
TORD TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mints after 1110 CDT.



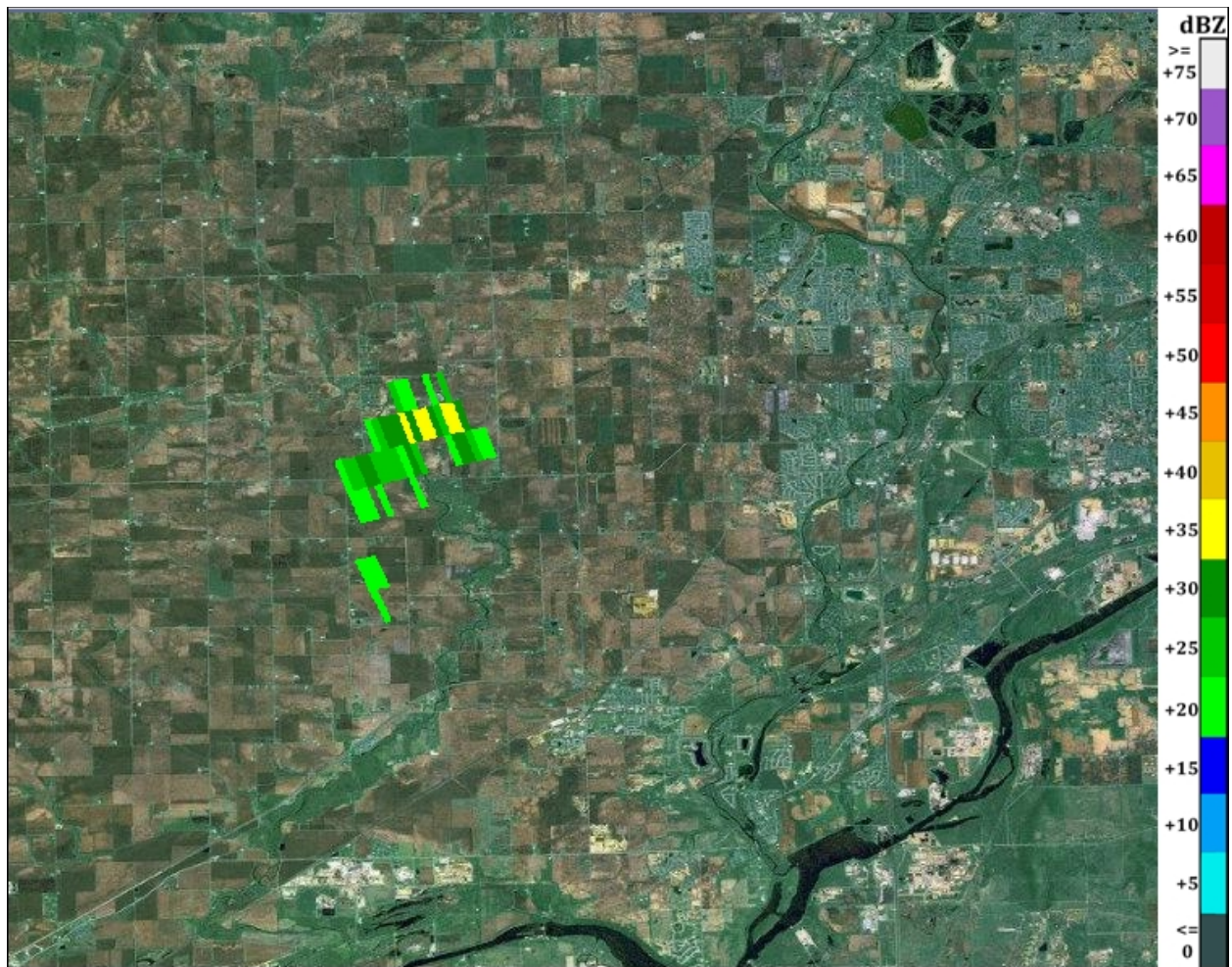
TORD TDWR $\sim 1.9^\circ$ radar sweep beginning at or within a few mints after 1110 CDT.



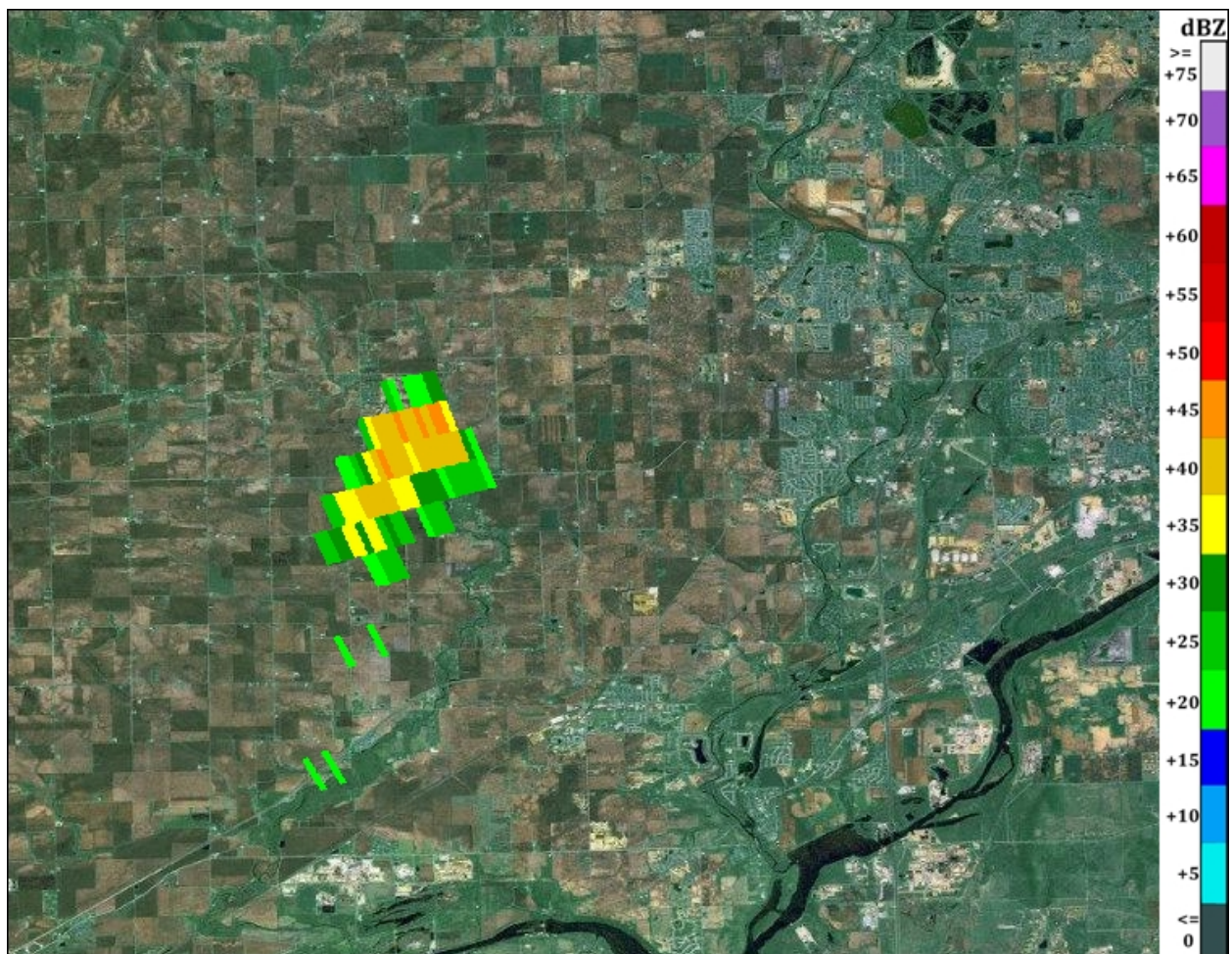
TORD TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1111 CDT.



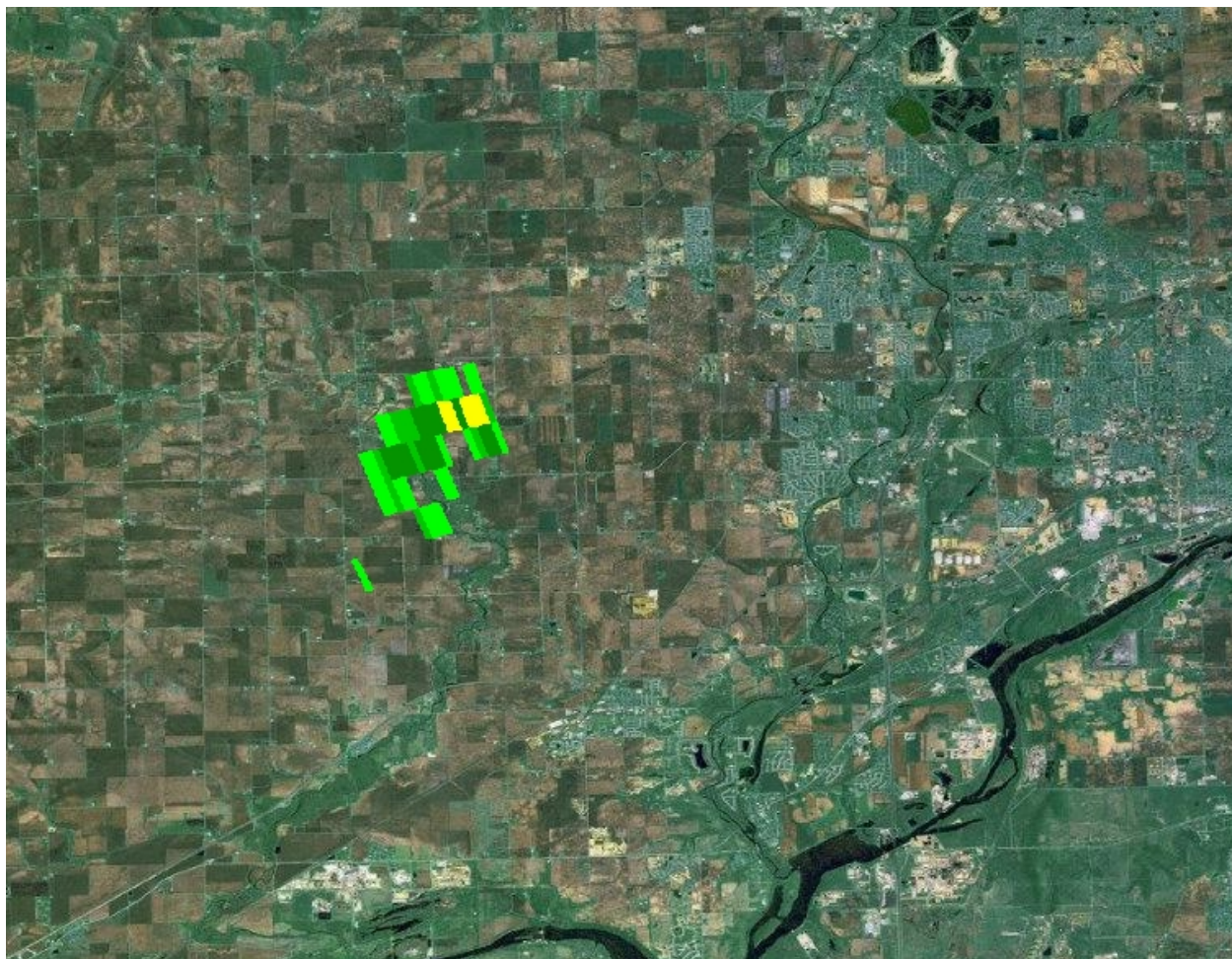
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1055 CDT.



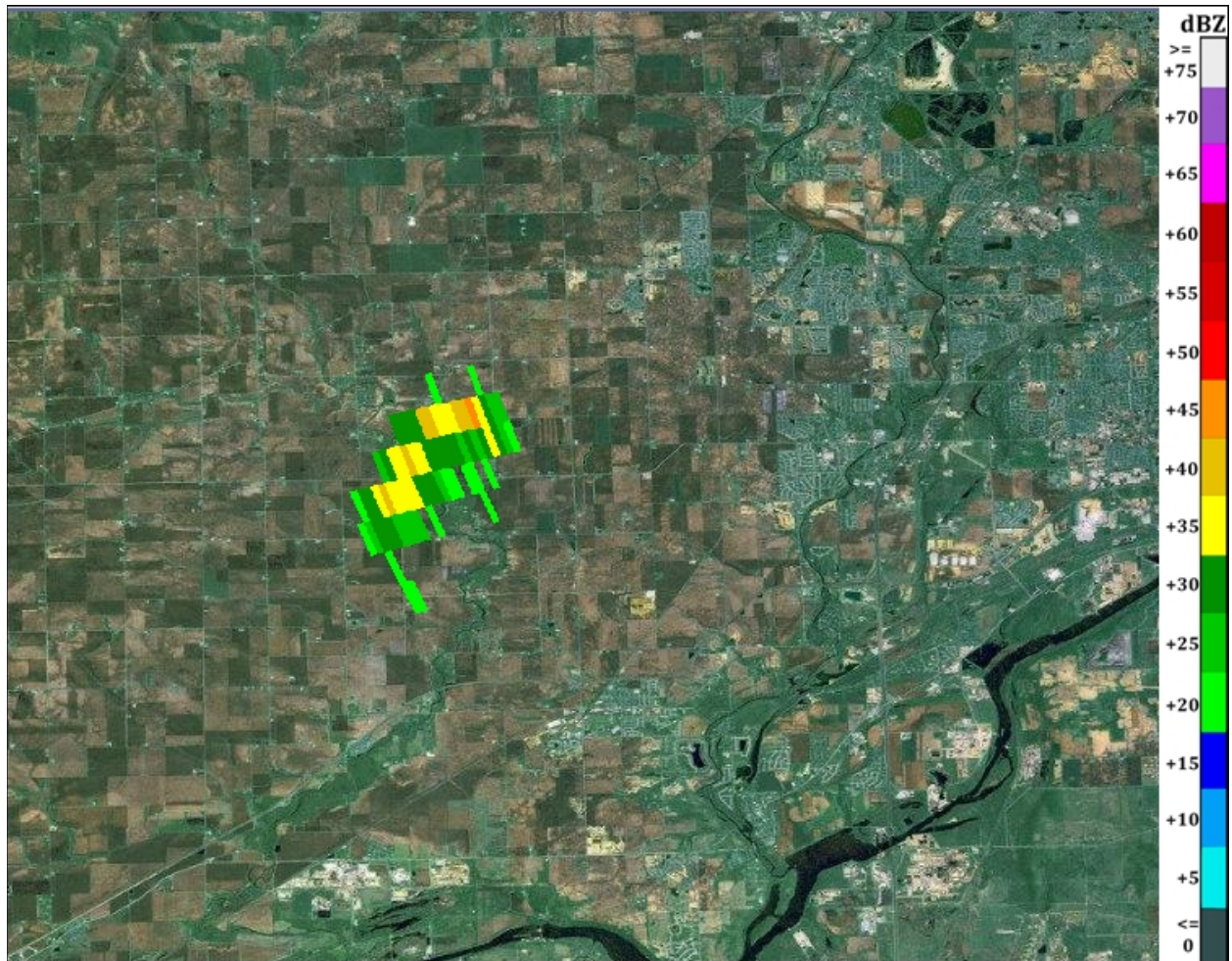
TMDW TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mins after 1055 CDT.



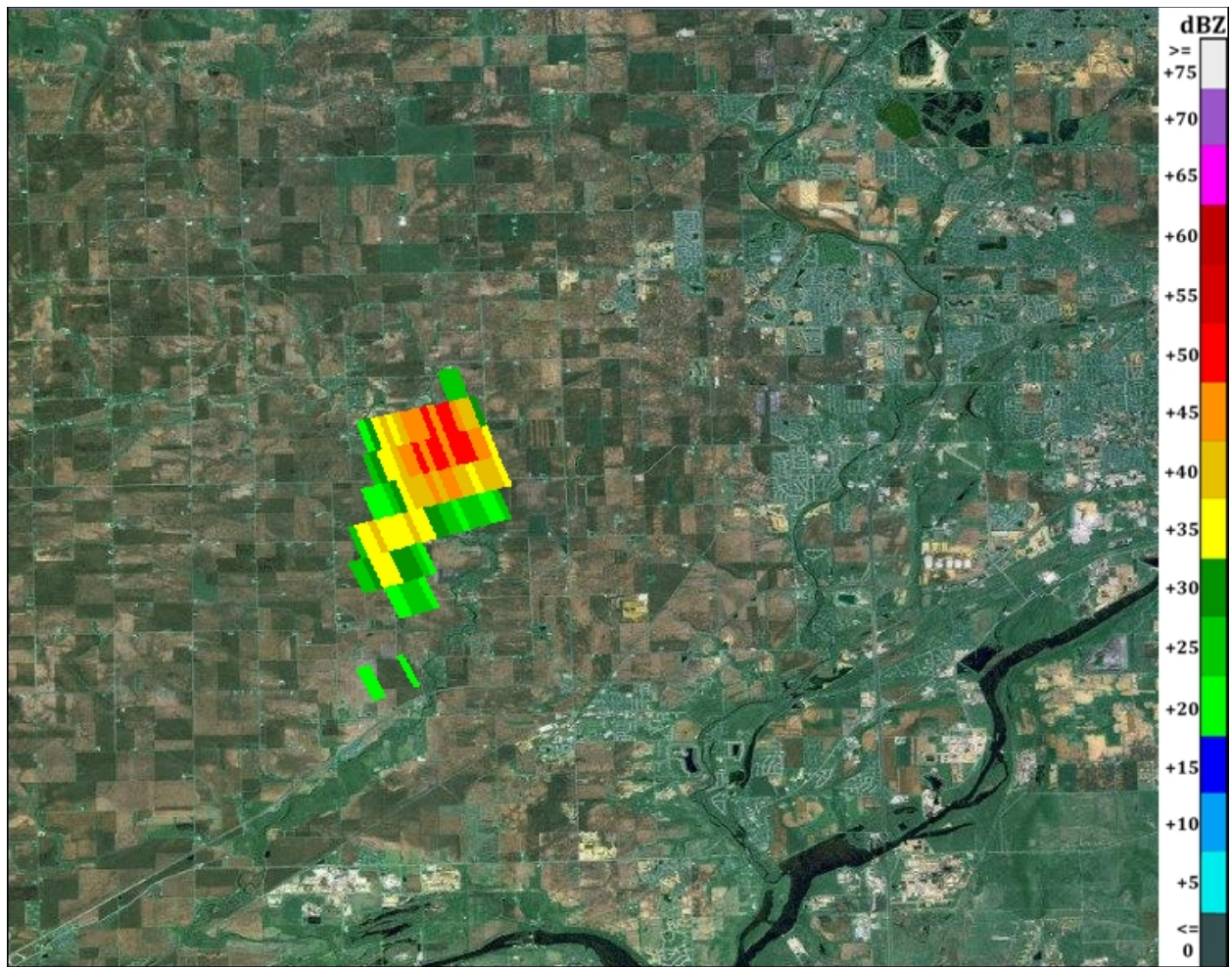
TMDW TDWR $\sim 2.6^\circ$ radar sweep beginning at or within a few mins after 1055 CDT.



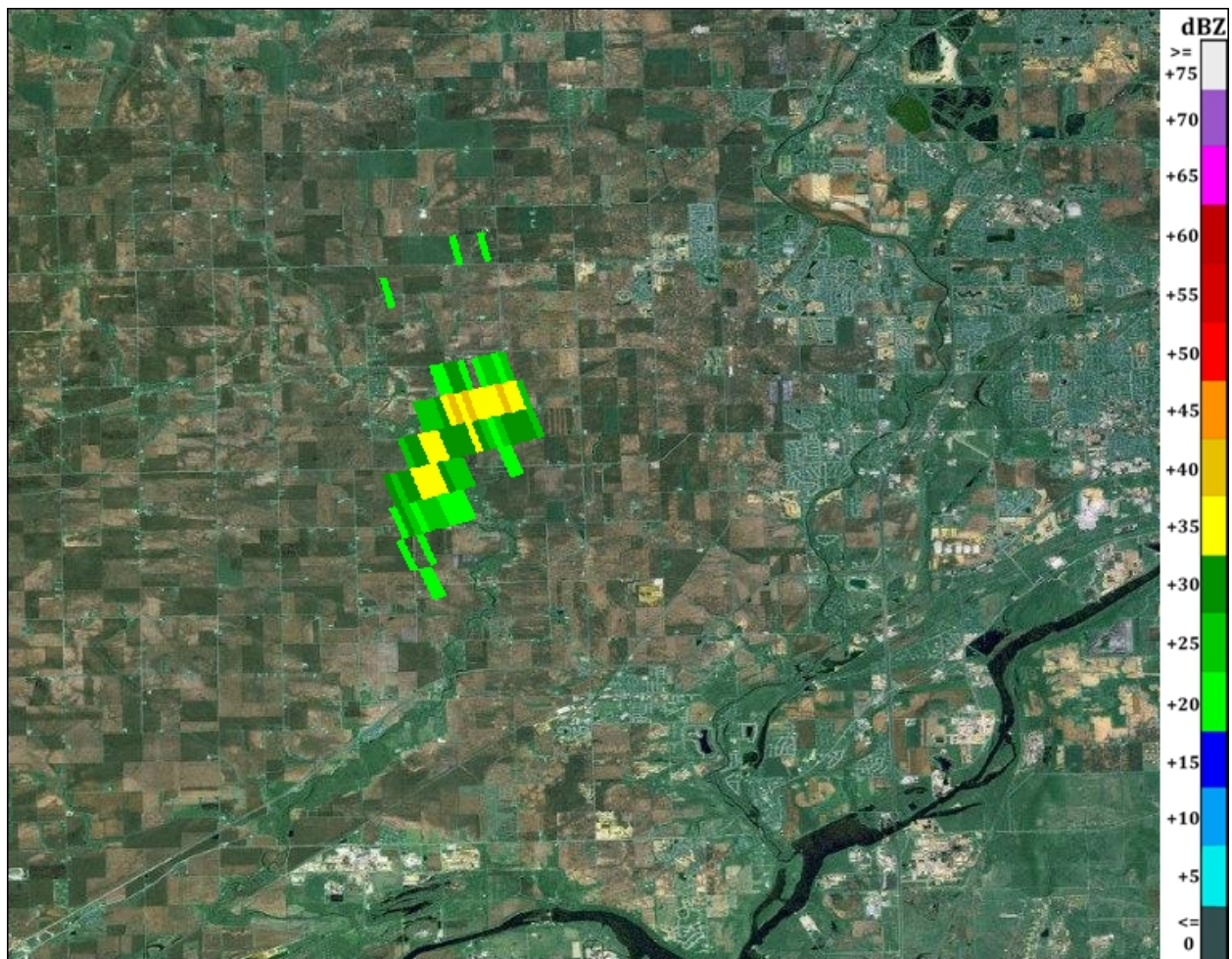
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1057 CDT.



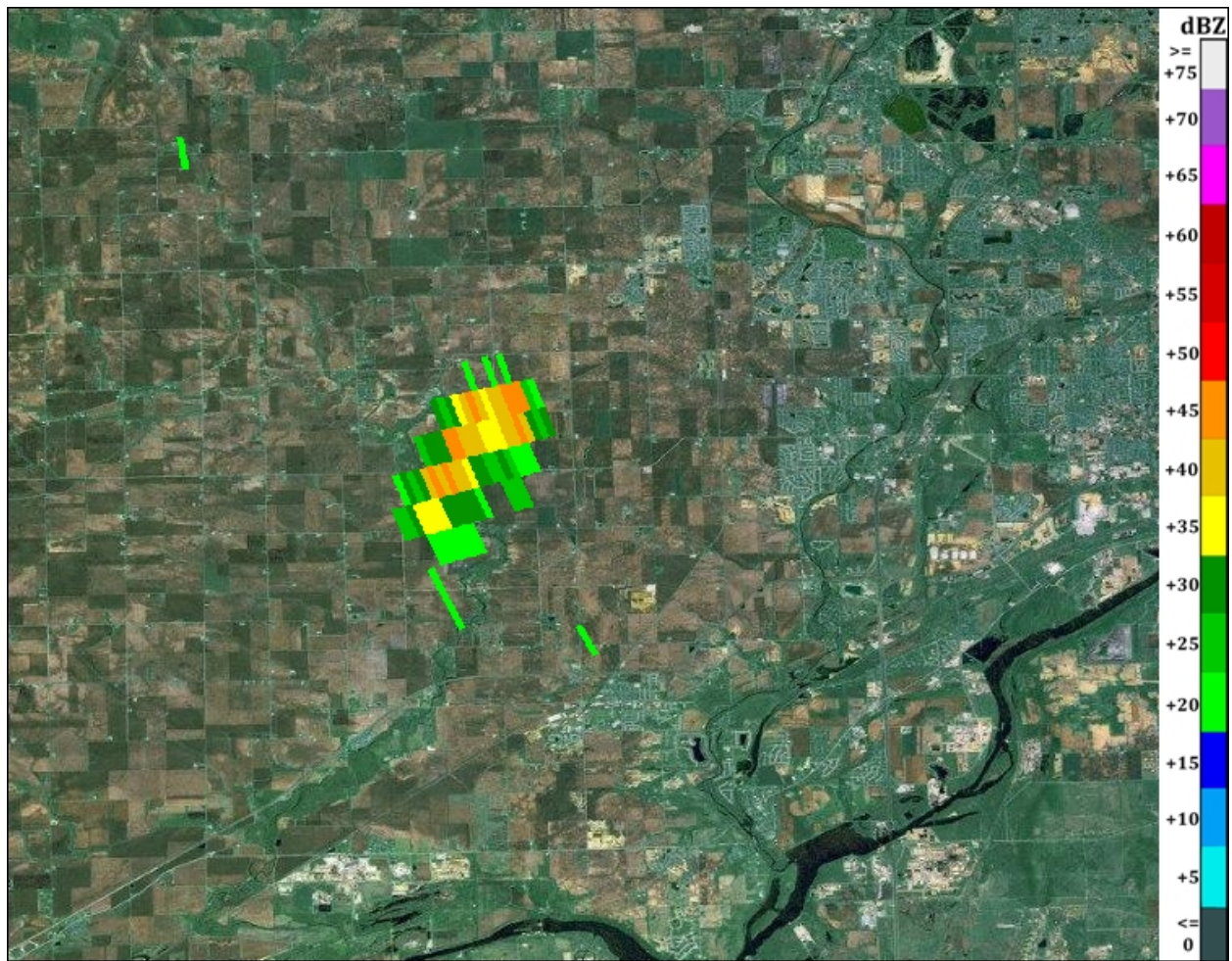
TMDW TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mins after 1057 CDT.



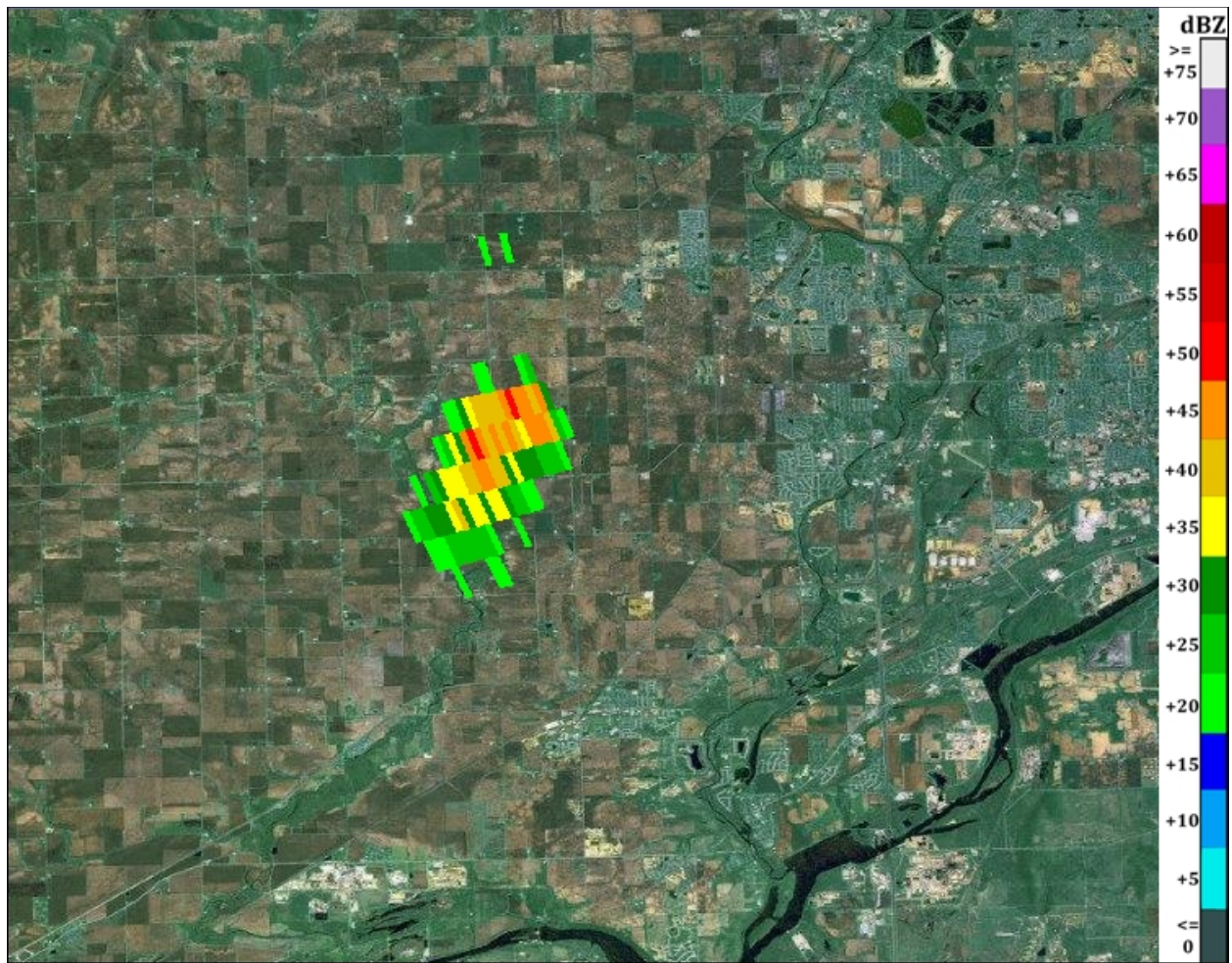
TMDW TDWR $\sim 2.6^\circ$ radar sweep beginning at or within a few mints after 1057 CDT.



TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1058 CDT.



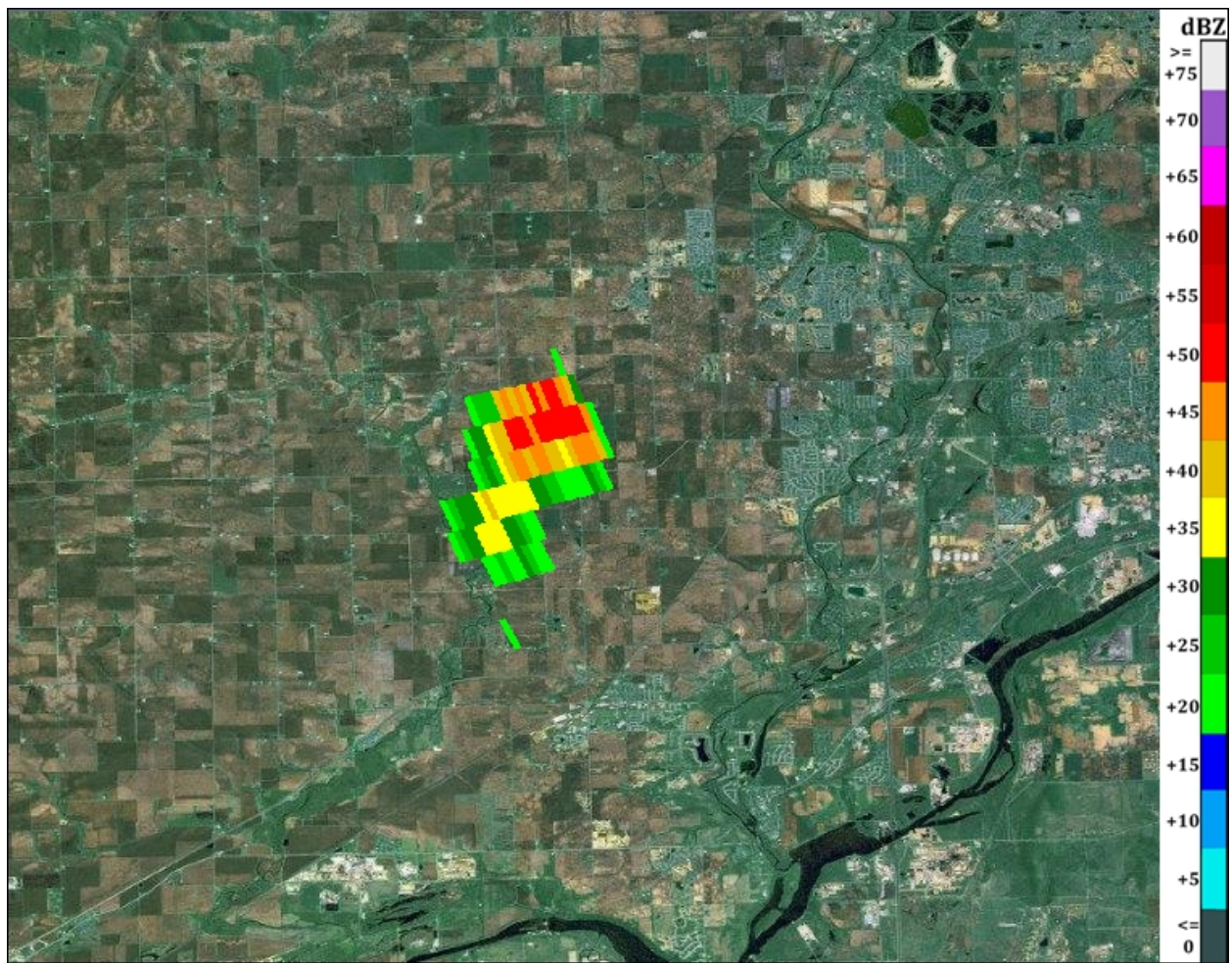
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1059 CDT.



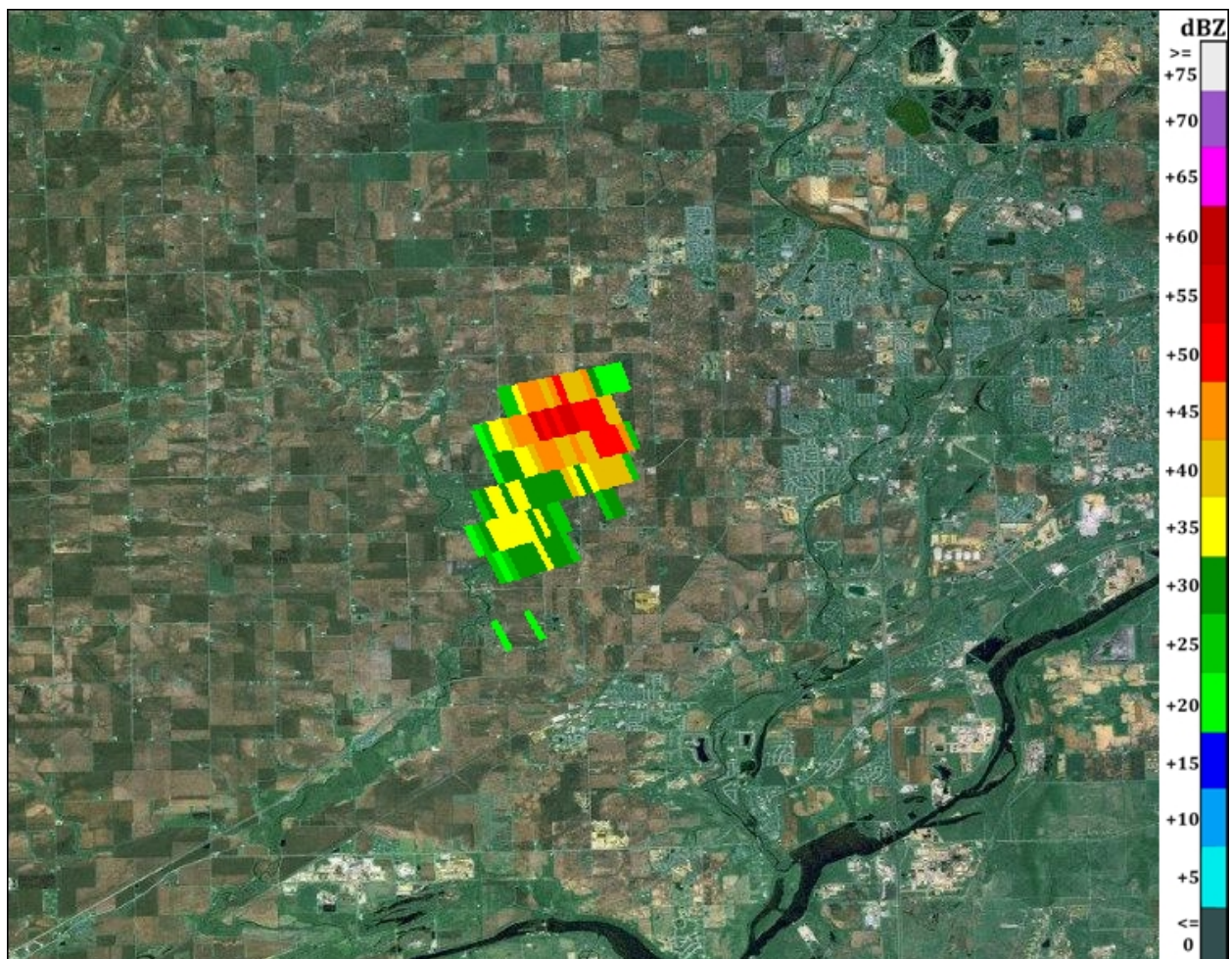
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1100 CDT.



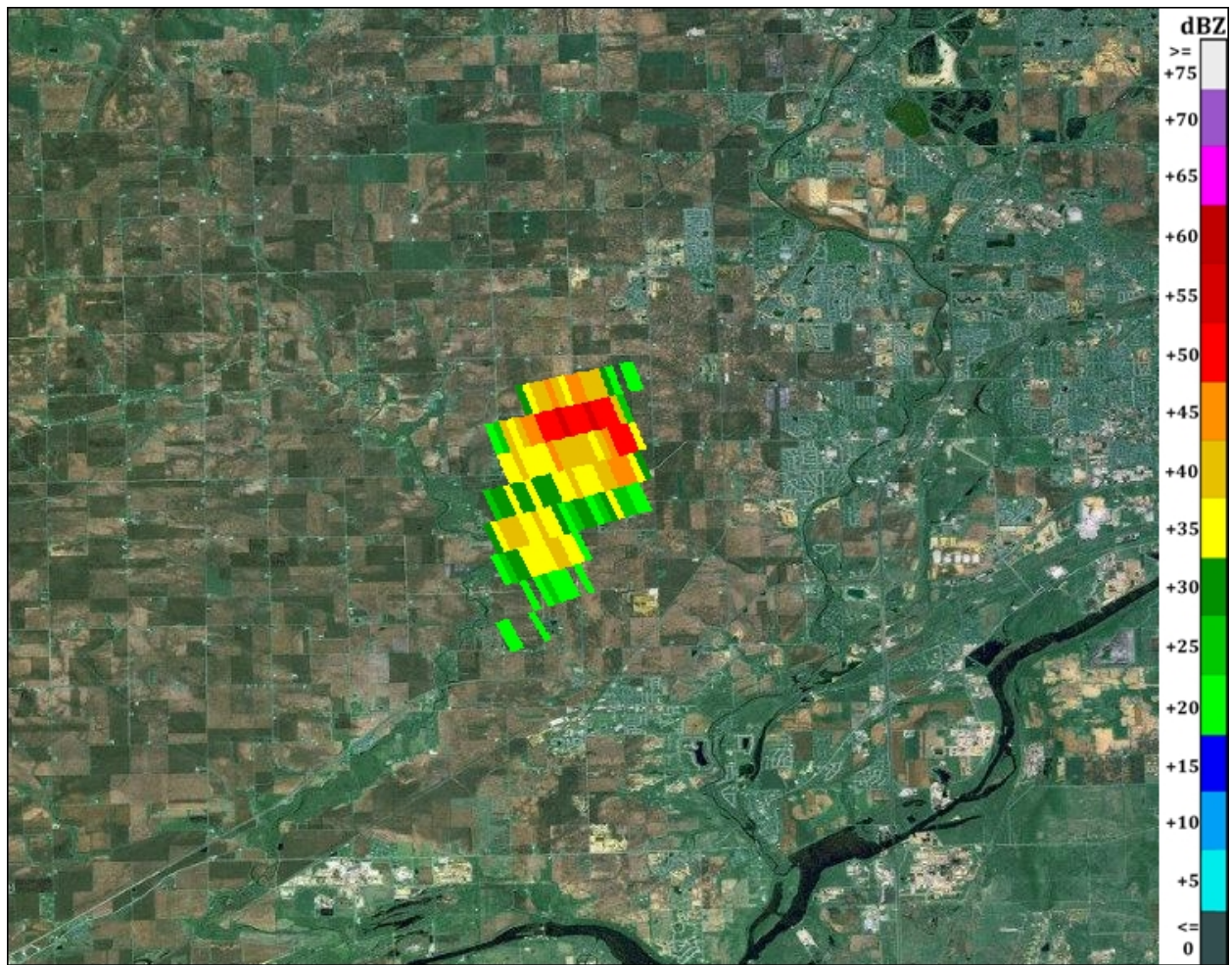
TMDW TDWR $\sim 2.6^\circ$ radar sweep beginning at or within a few mins after 1100 CDT.



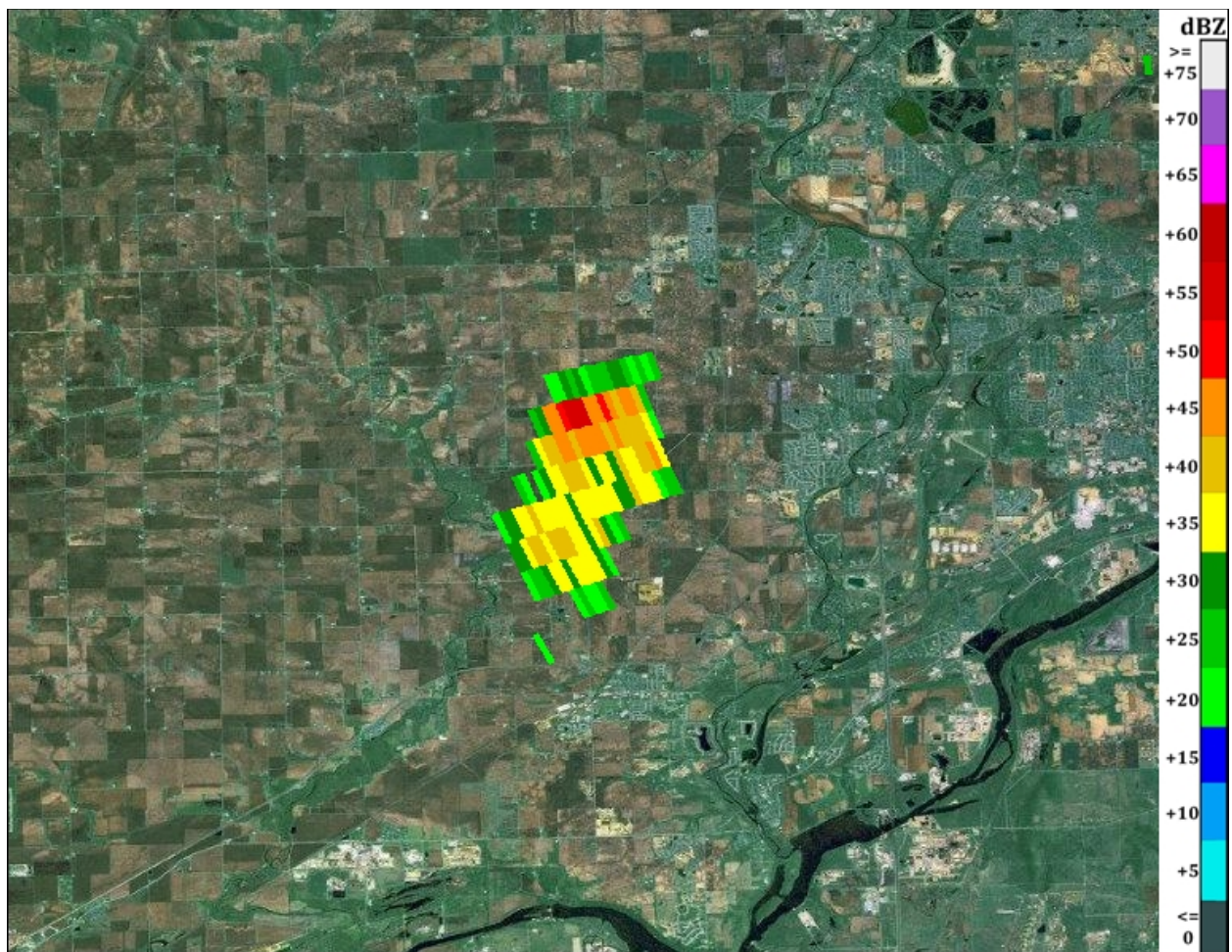
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1101 CDT.



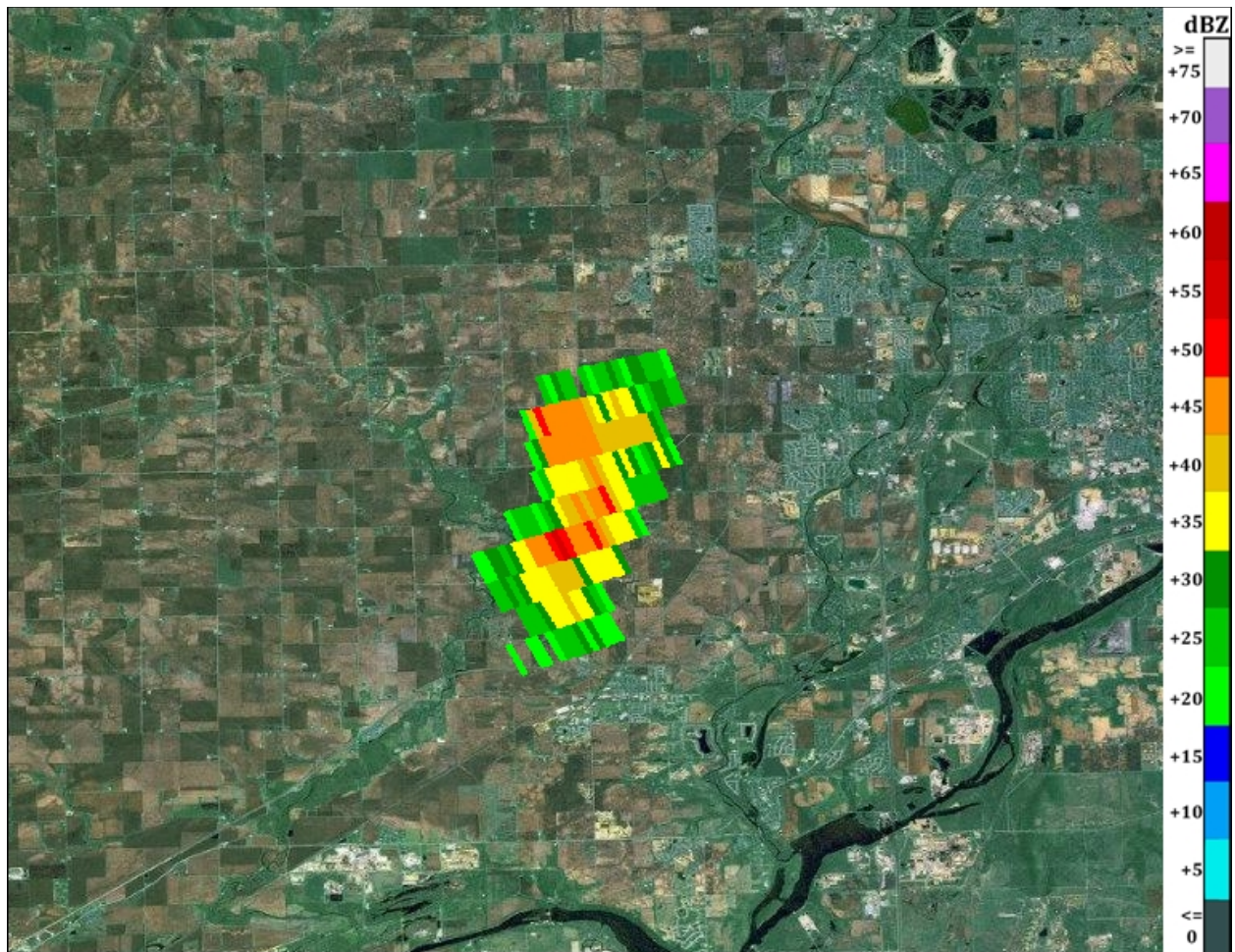
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1102 CDT.



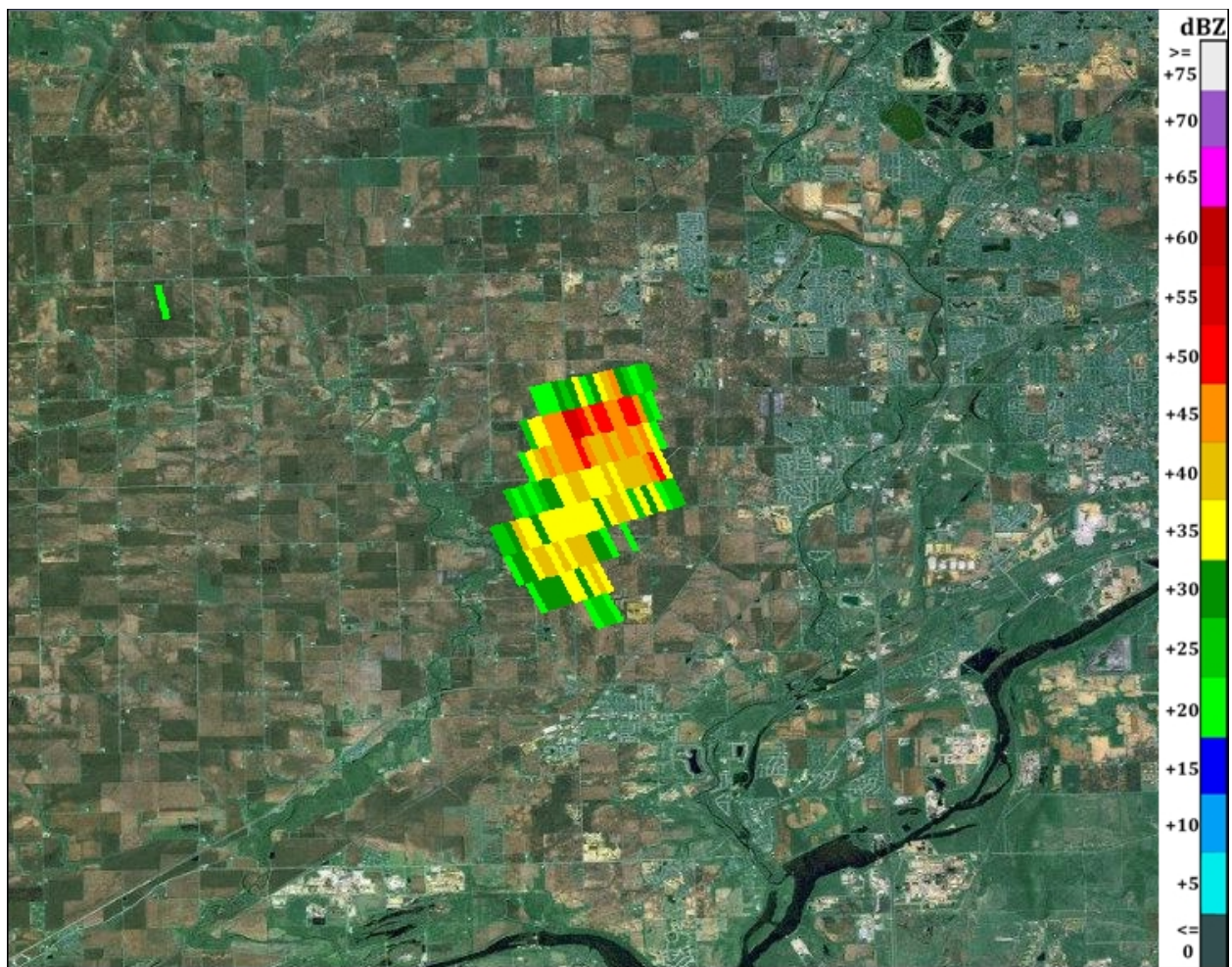
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few minutes after 1103 CDT.



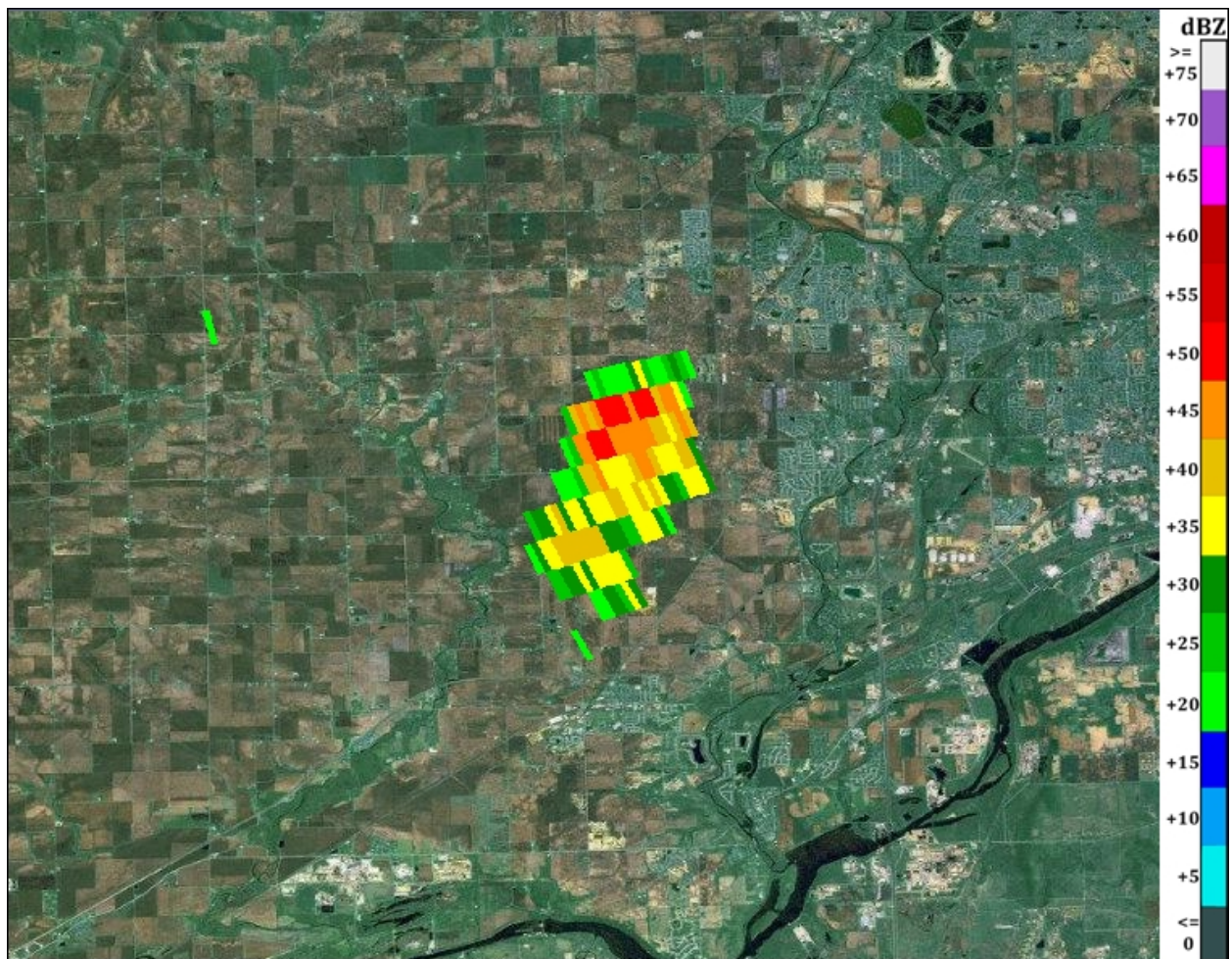
TMDW TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mints after 1103 CDT.



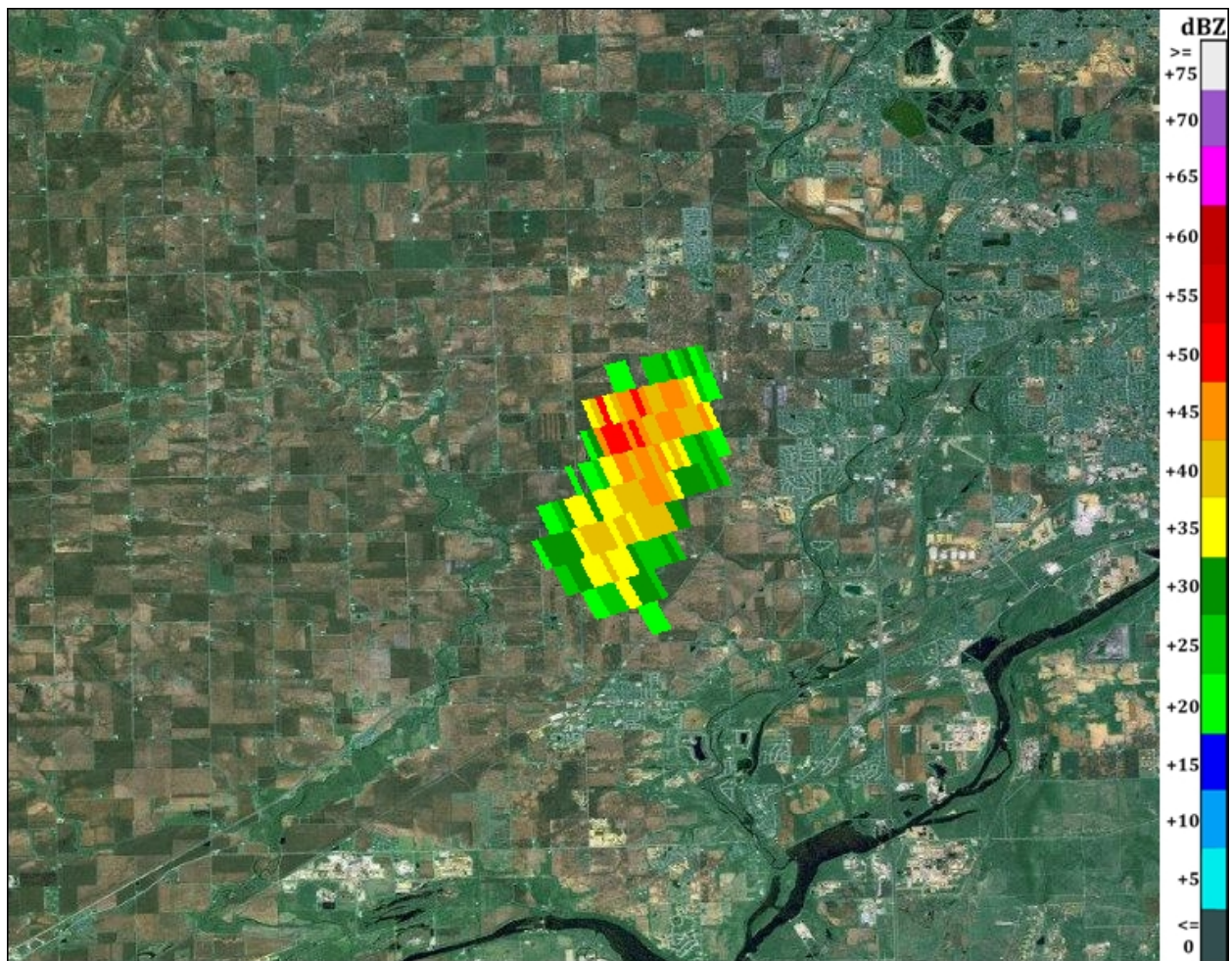
TMDW TDWR $\sim 2.6^\circ$ radar sweep beginning at or within a few mins after 1103 CDT.



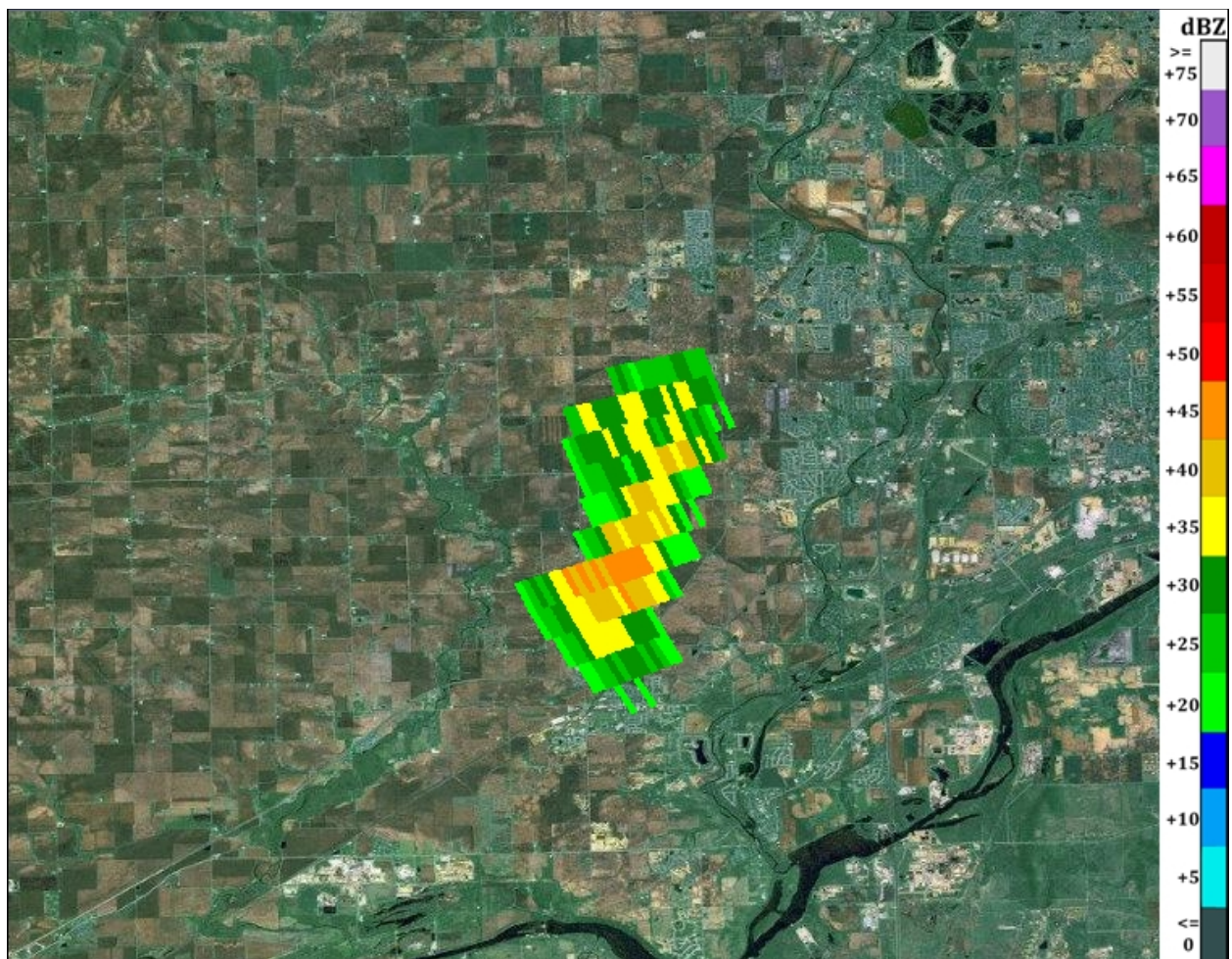
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1104 CDT.



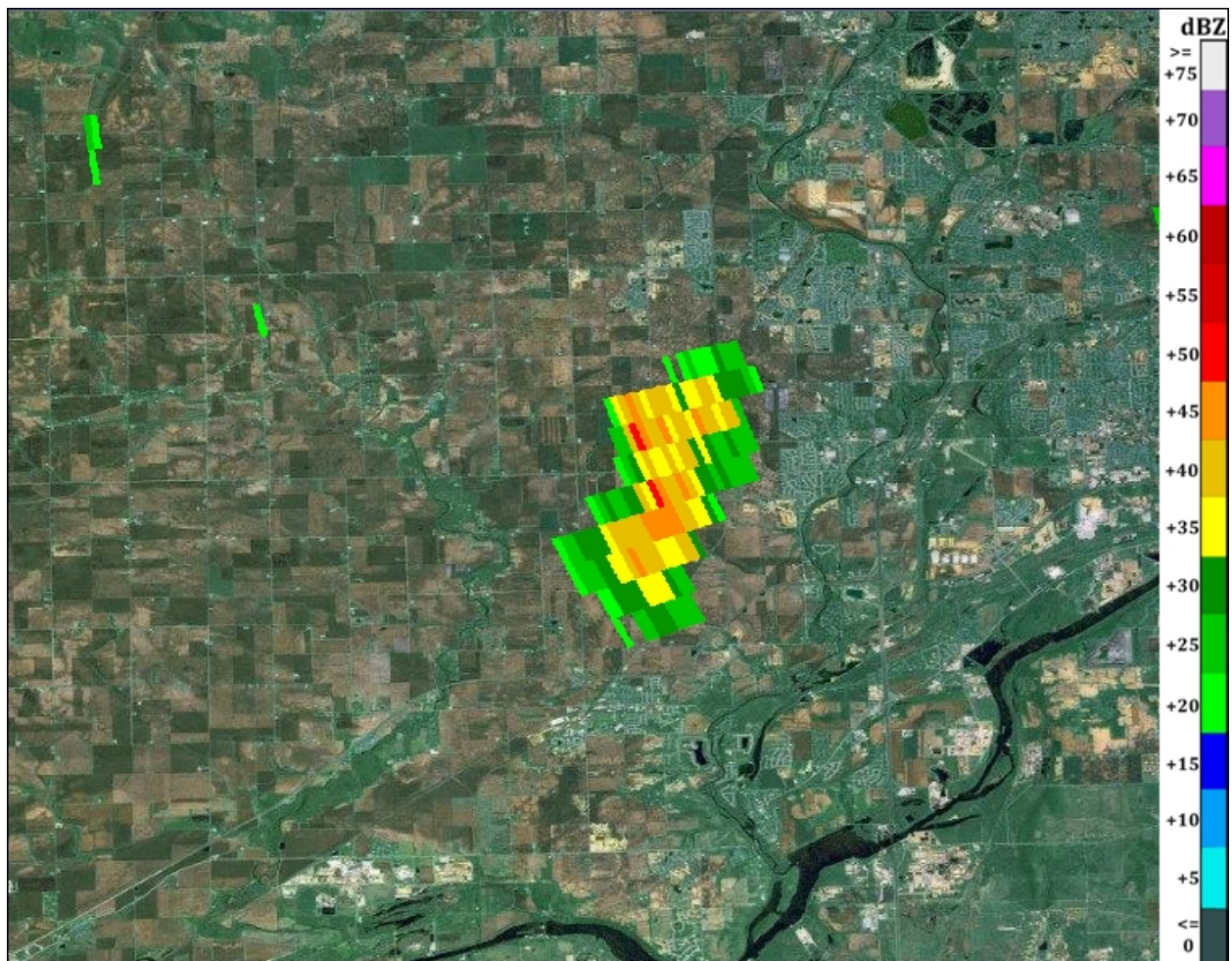
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1105 CDT.



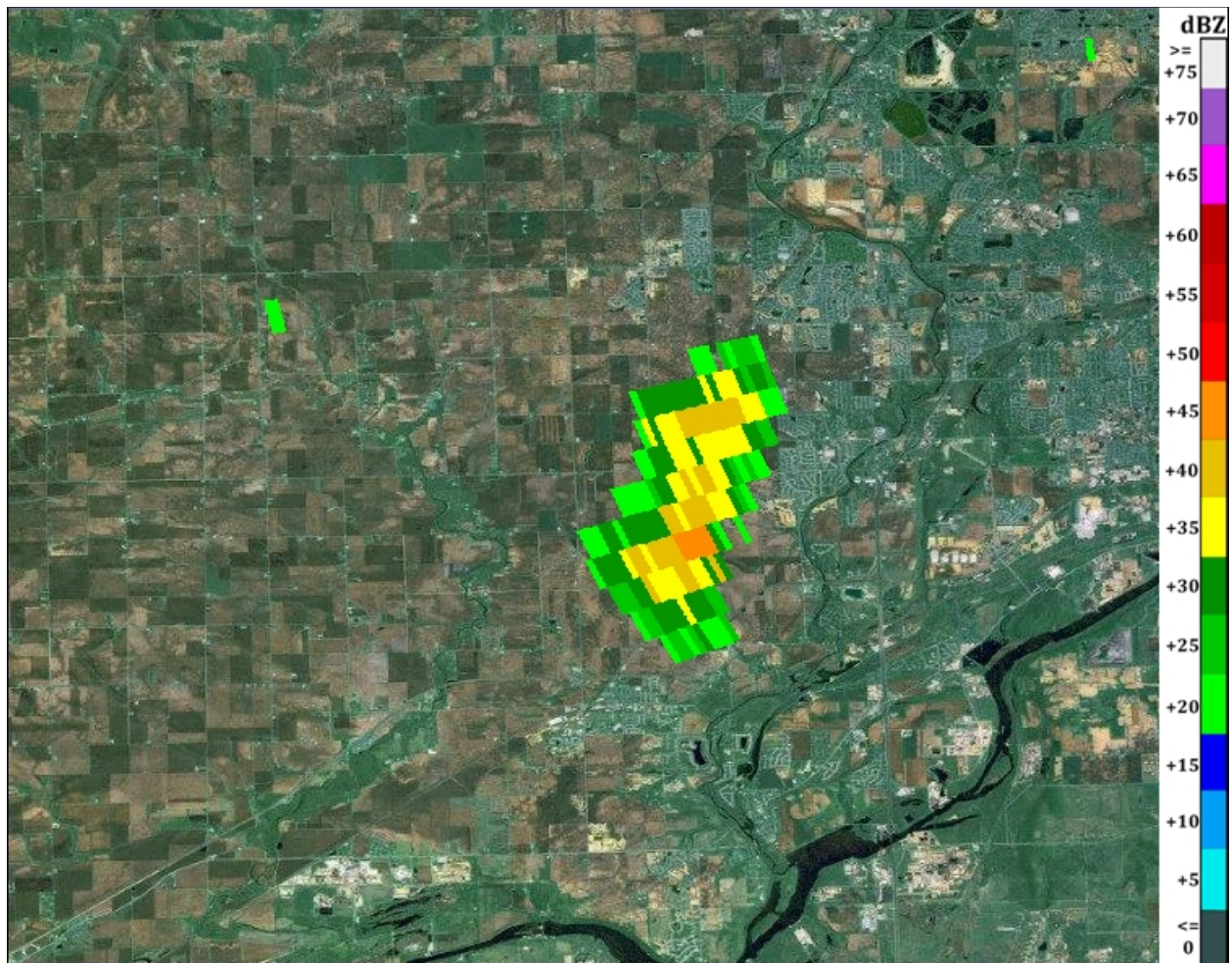
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1106 CDT.



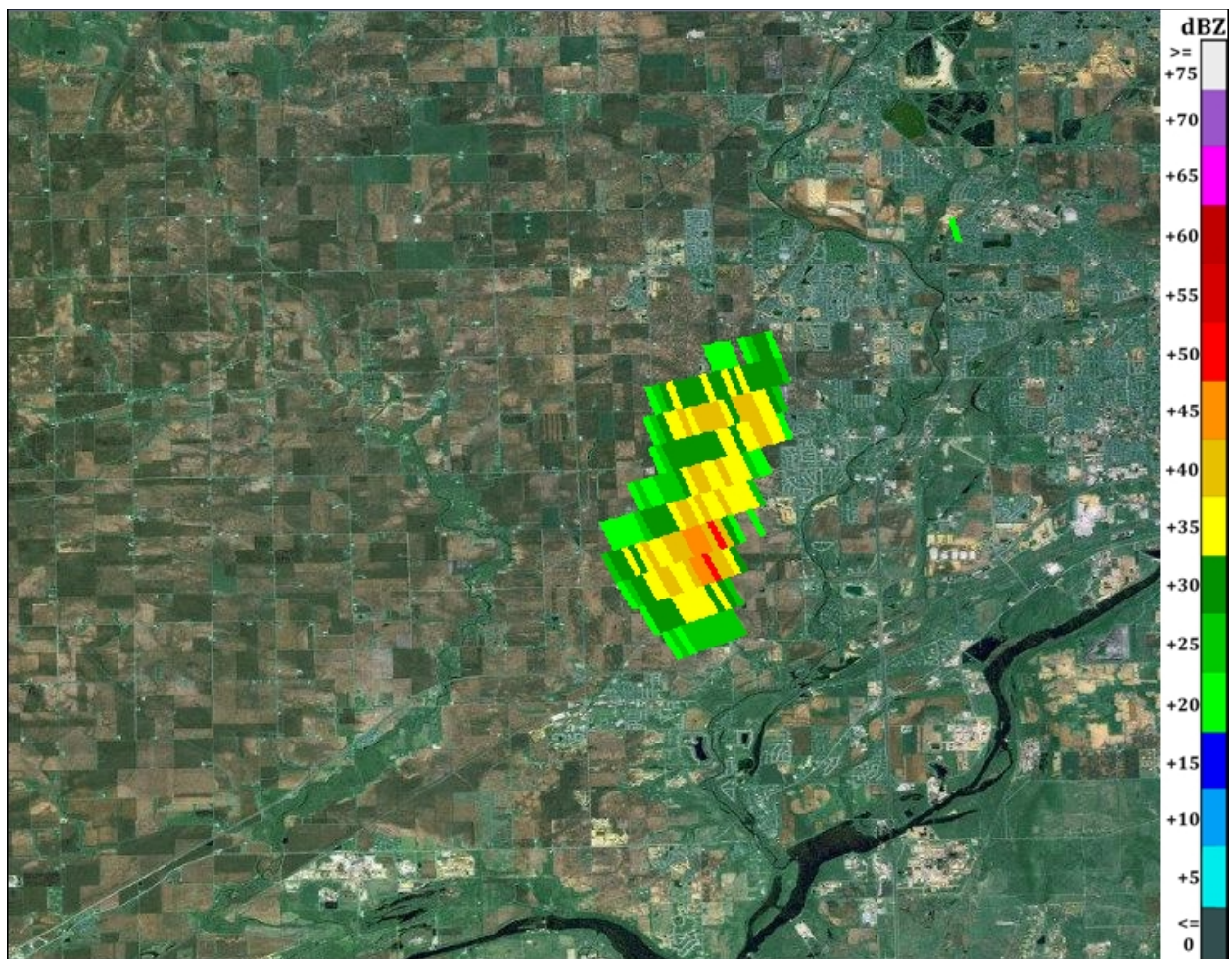
TMDW TDWR $\sim 2.6^\circ$ radar sweep beginning at or within a few mins after 1106 CDT.



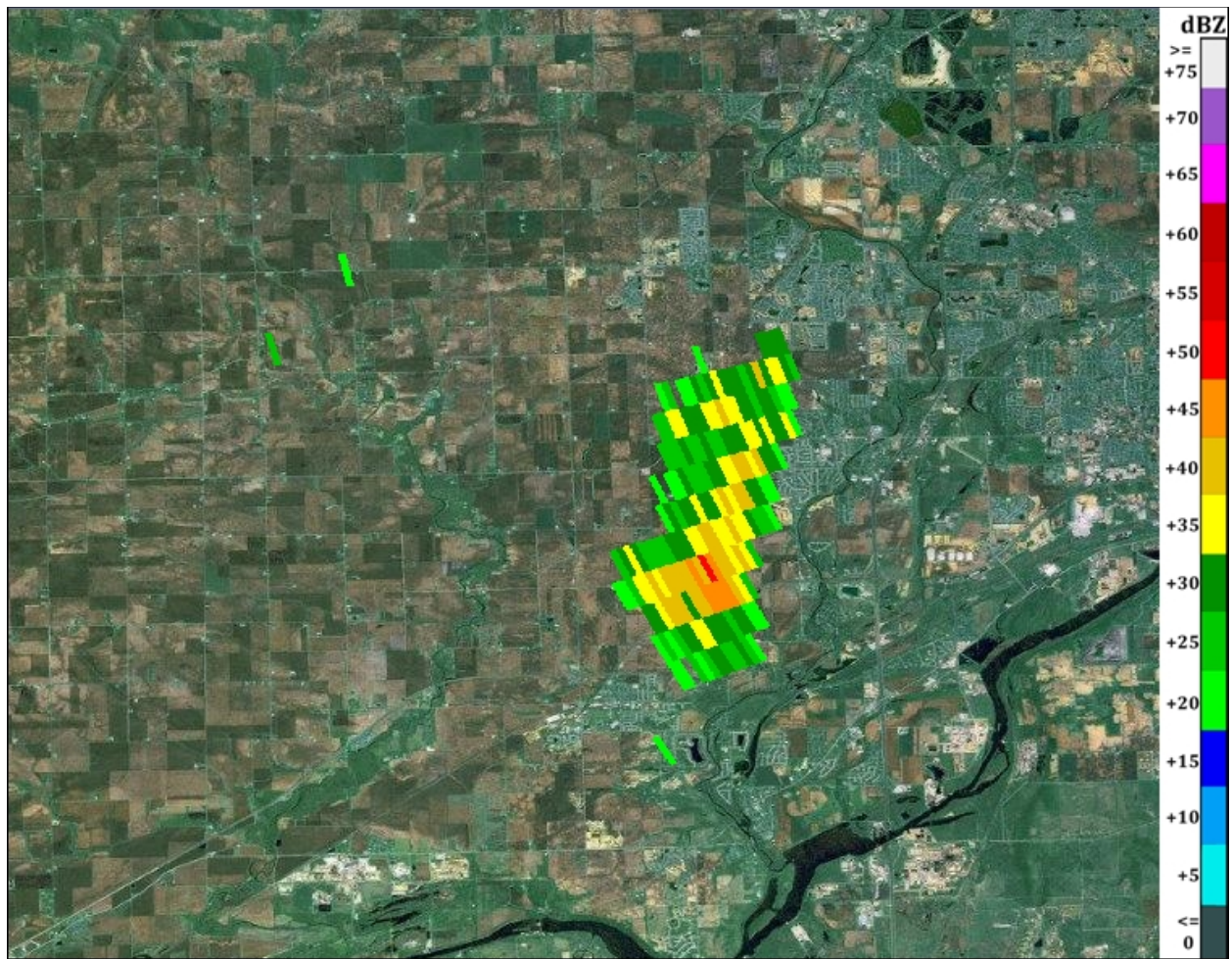
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1107 CDT.



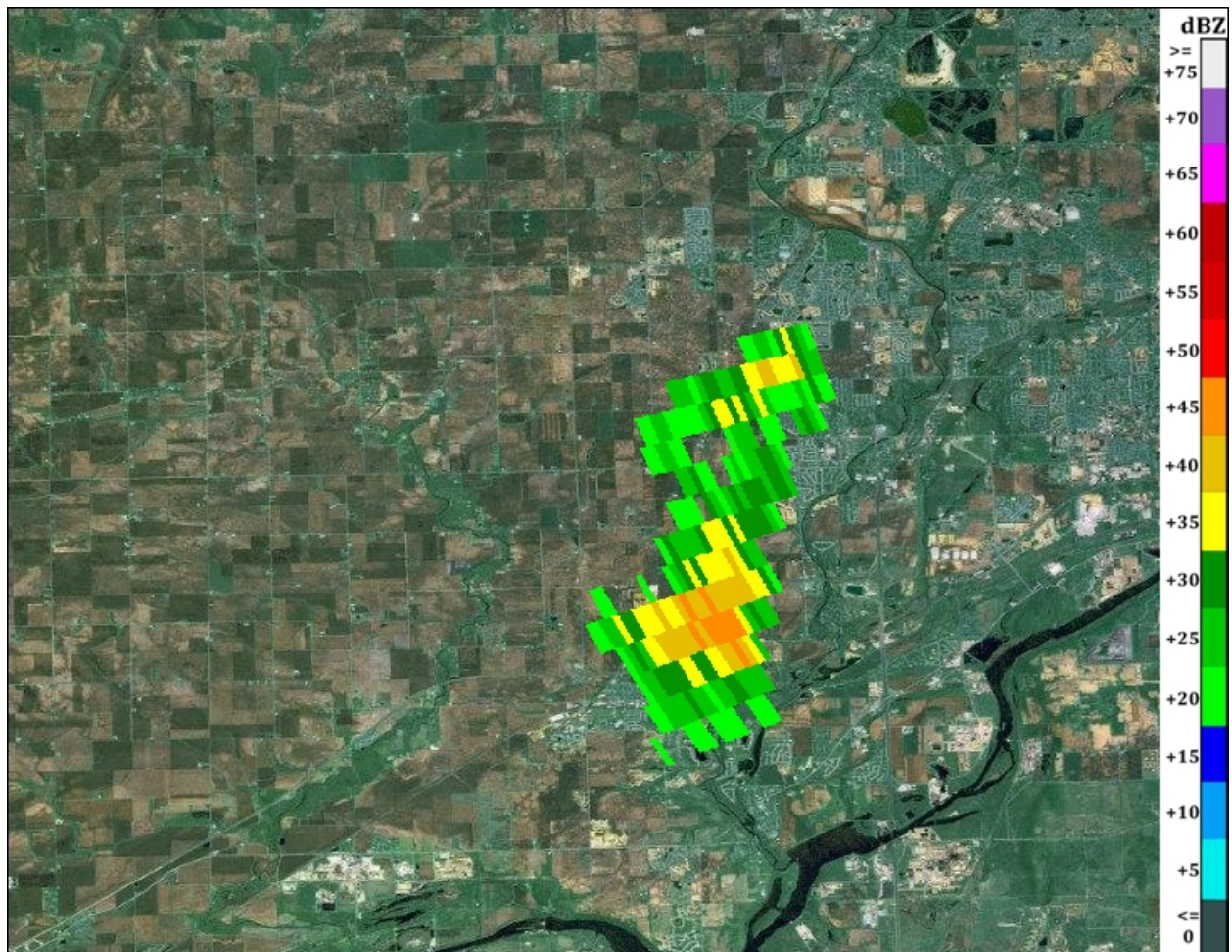
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1108 CDT.



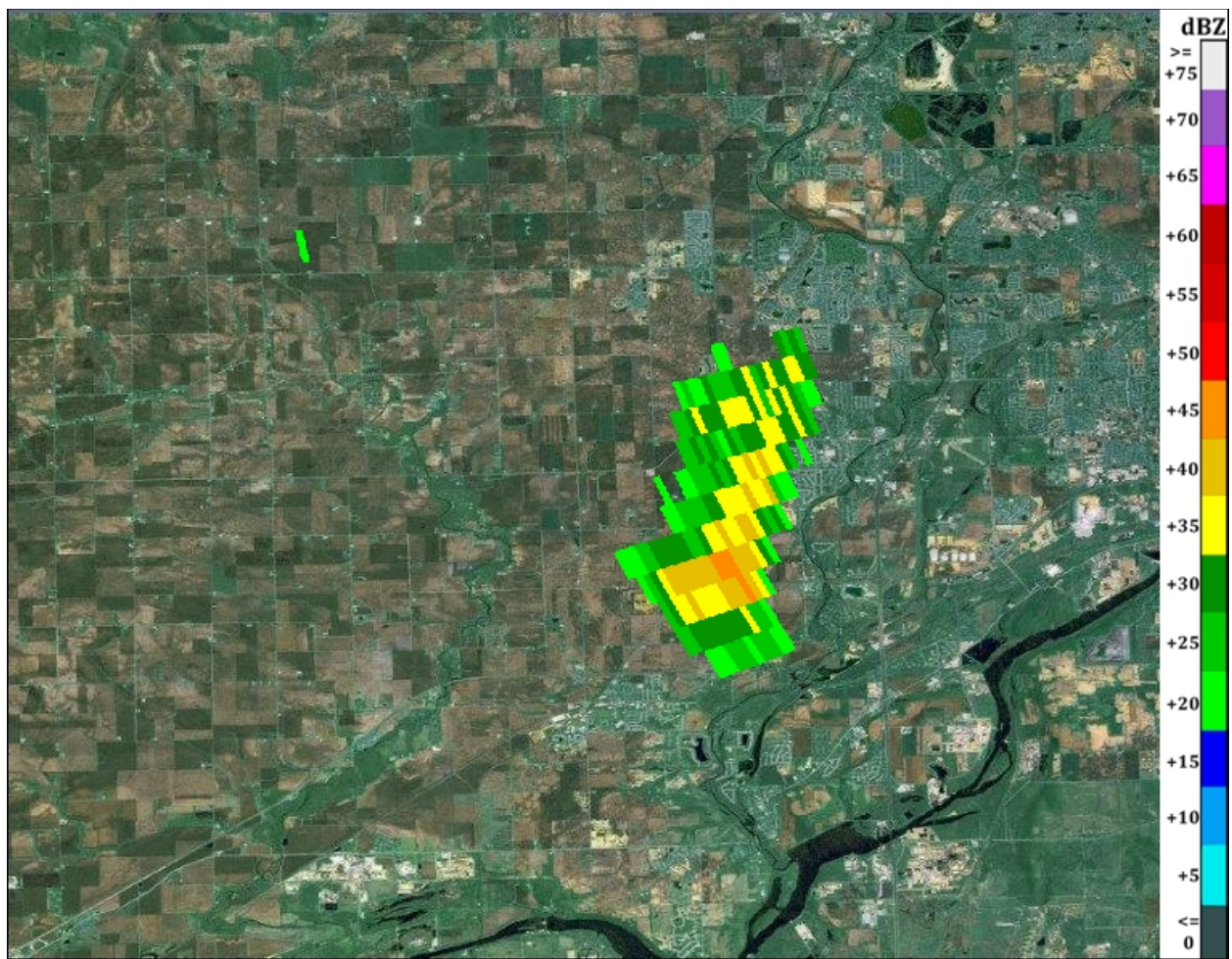
TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1109 CDT.



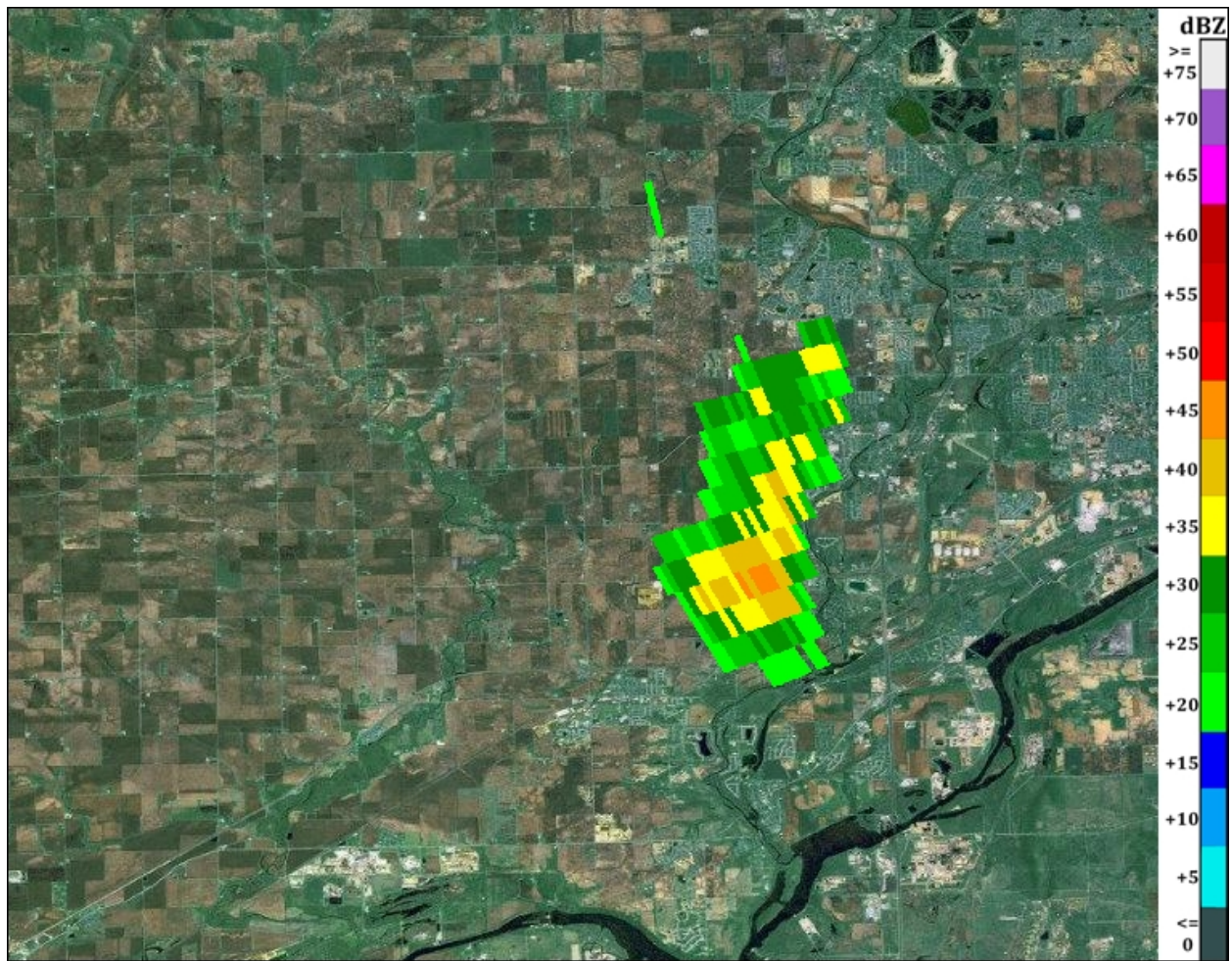
TMDW TDWR $\sim 1.0^\circ$ radar sweep beginning at or within a few mins after 1109 CDT.



TMDW TDWR $\sim 2.6^\circ$ radar sweep beginning at or within a few mints after 1109 CDT.



TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mints after 1110 CDT.



TMDW TDWR $\sim 0.3^\circ$ radar sweep beginning at or within a few mins after 1111 CDT.