

Indiana County Flash Flood of 22 June 2017

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1. Overview

Slow moving thunderstorms brought 3 to 4 inches of rainfall to Indiana County, PA during the afternoon hours of 22 June 2017 (Fig. 1). The heavy rainfall produced flooding which caused one fatality when a man attempted to unclog a pond and got stuck in a drainage pipe ([WTAE](#)).

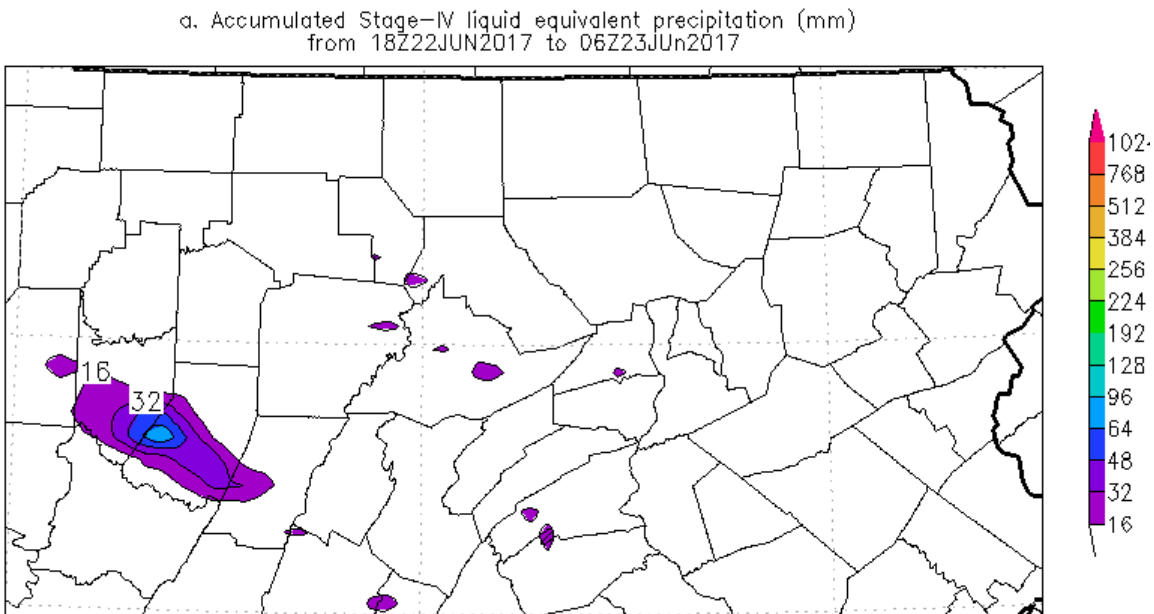


Figure 1. Stage-IV estimated rainfall 18 to 0600 UTC 22-23 June 2017. Rainfall values under 16mm have been filtered out. Values in mm.

Fast moving water knocked several rail cars off their tracks and damages numerous automobiles ([KDKA](#)). The heavy rainfall in Pennsylvania was very localized and focused over southern Indiana County and portions of western Armstrong County. Radar loops (not shown) indicated that southwest flow kept developing new cells on the western edges of the thunderstorms as the system tried to move to the southwest.

Most of the rain fell between 1800 UTC on 22 June and ended by 0000 UTC 23 June. During this period of time the 6-hour rainfall reached 25% of the 100 year 6-hour ARI values over a large swath of Armstrong and Indian Counties. A smaller area had over 50% of the 100 year 6-hour Average Recurrence Interval (**ARI**) values and there were small areas where the 6-hour rainfall exceeded 75% of the 100 year ARI value (Fig. 2).

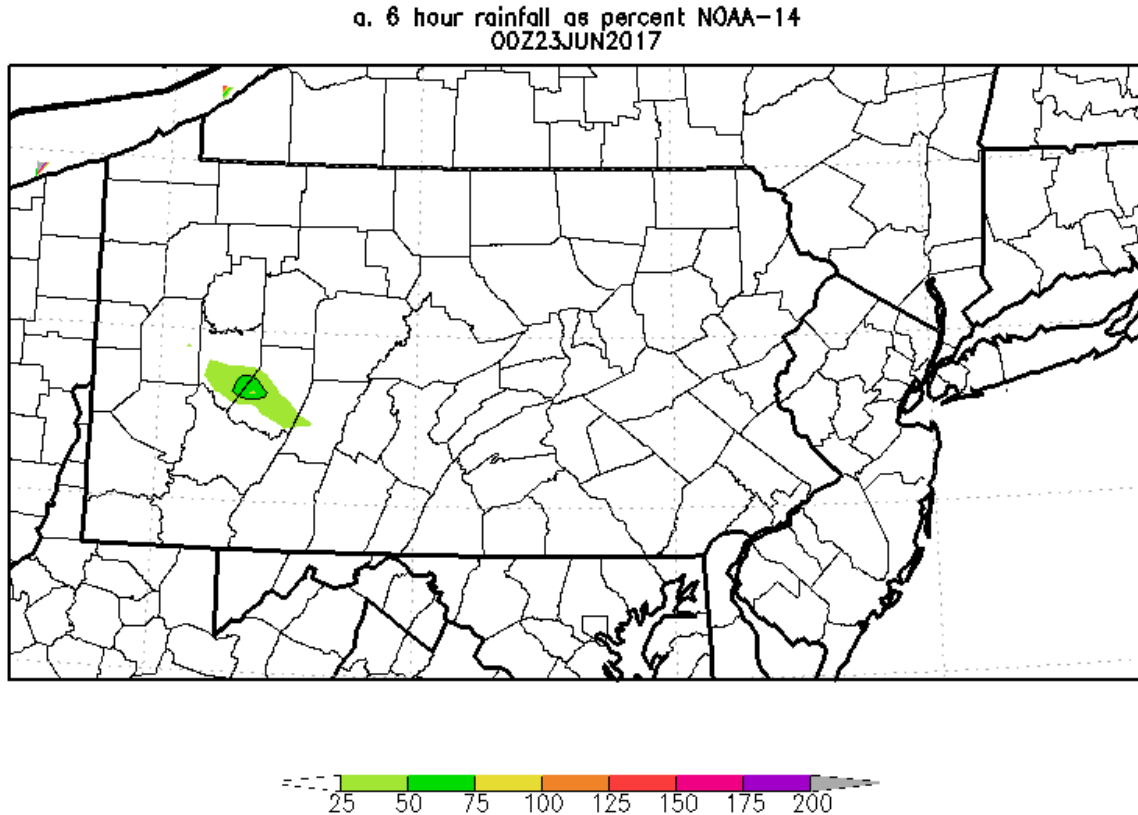


Figure 2. The total rainfall over 3 inches (black contour) and the ratio of the 6-hour rainfall relative to the 6-hour 100 year rainfall average recurrence interval (ARI). Rainfall was accumulated for the 6-hour ending at 0000 UTC 23 June 2017

The large scale 500 hPa pattern over the eastern United States (Fig. 3) showed the evolution of a ridge over the eastern United States from 1200 UTC 21 to 1800 UTC 22 June 2017. The circulation associated with tropical storm Cindy was well south of the affected area.

The pattern at 1800 UTC (Fig. 4) showed the strong ridge (Fig. 4a) over the southeastern United States and the strong low-level southerly flow over the Gulf States into the Ohio Valley (Fig. 4b). The surge of deep moisture from the south as shown by the PW field had not reached Pennsylvania (Fig. 4c). However, there was a surge of high PW air independent of the southern surge coming over the ridge in the implied northwesterly 500 hPa flow (Fig. 4a&4c). The surface pattern showed the anticyclone off the southeastern United States and the deep cyclone over the Gulf Coast associated with “Cindy”.

This was clearly a slow moving convective event not directly associated with the tropical system. It had some of the key ingredients for a heavy rainfall event with westerly flow in western Pennsylvania with deep moisture moving in from the northwest (Fig. 4).

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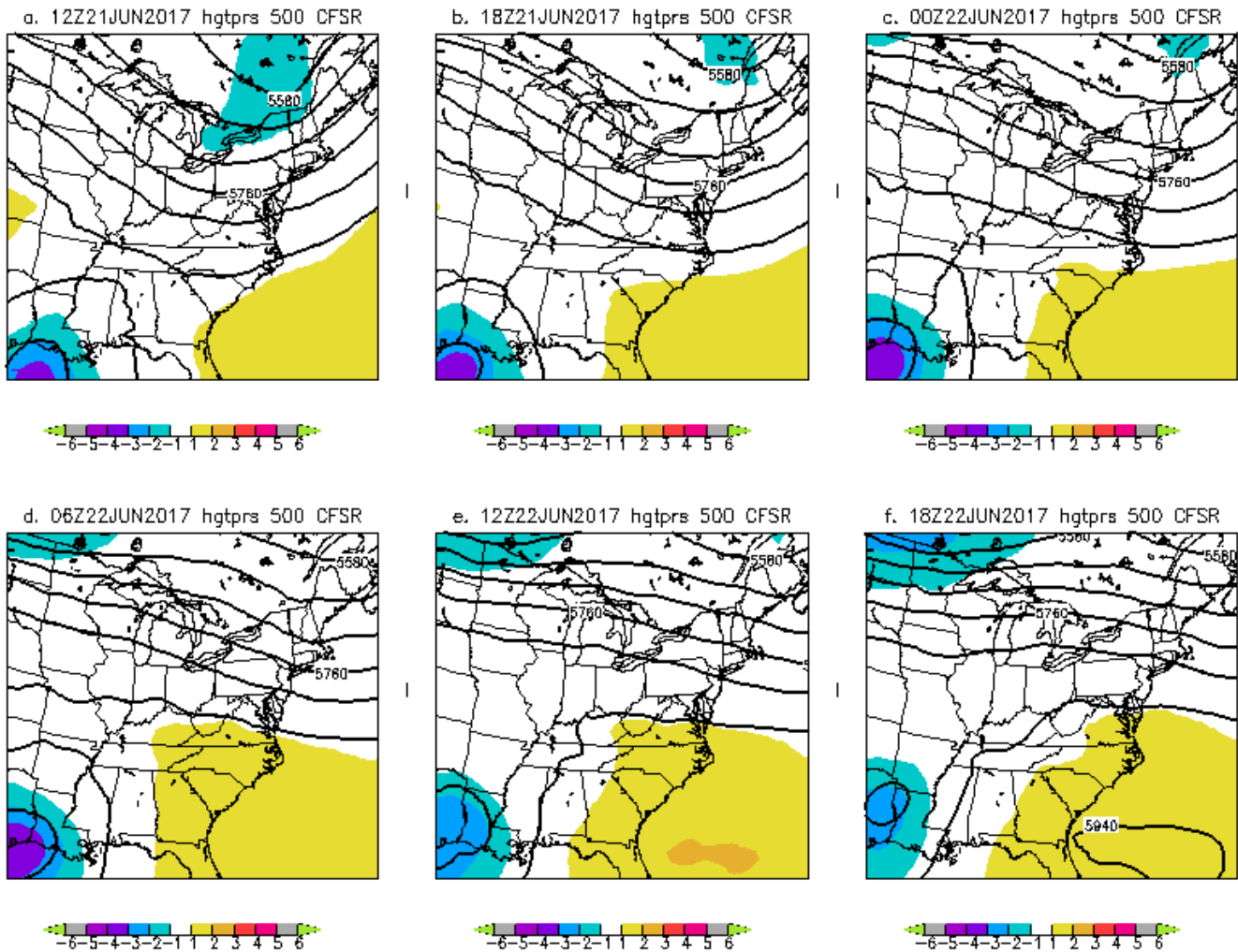


Figure 3. The CFSR 500 hPa heights over the eastern United States in 6-hour increments from a) 1200 UTC 21 June through f) 1800 UTC 22 June 2017.

The forecast models indicated the potential for rain across Pennsylvania. But few models focused the rainfall over Indiana County. However, once the convection developed, then 3km HRRR was able to simulate the potential for a region of 1-2 inches of rainfall over Indiana County and the potential for areas of 2-4 inches of rainfall (Fig. 5).

The 1900 UTC HRRR provided good very short-term guidance for Indiana County. However the forecasts to the north and east were too robust relative to verification.

This heavy rainfall event was an isolated convective rainfall event. It involved training echoes and redevelopment of new cells over several hours. *These events are not well forecast by NWP with significant lead time.* The sequence of images in Figure 6 shows the initial convection entering Indiana County at 1837 UTC. The 0.5 degree reflectivity (Z) and base velocity (V) are shown. These data show that at low-levels (yellow arrows) the individual storms that developed

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had low-level rotation. And the red arrows attempt to show the region of new cell generation which allowed for the training of multiple echoes and heavy rain cores over the region.

Short-term convective events like this still require human forecasters to observe and interpret the data to effectively warn for potential high impact weather. In this case a flash flood event which produced 1 fatality and toppled rail cars.

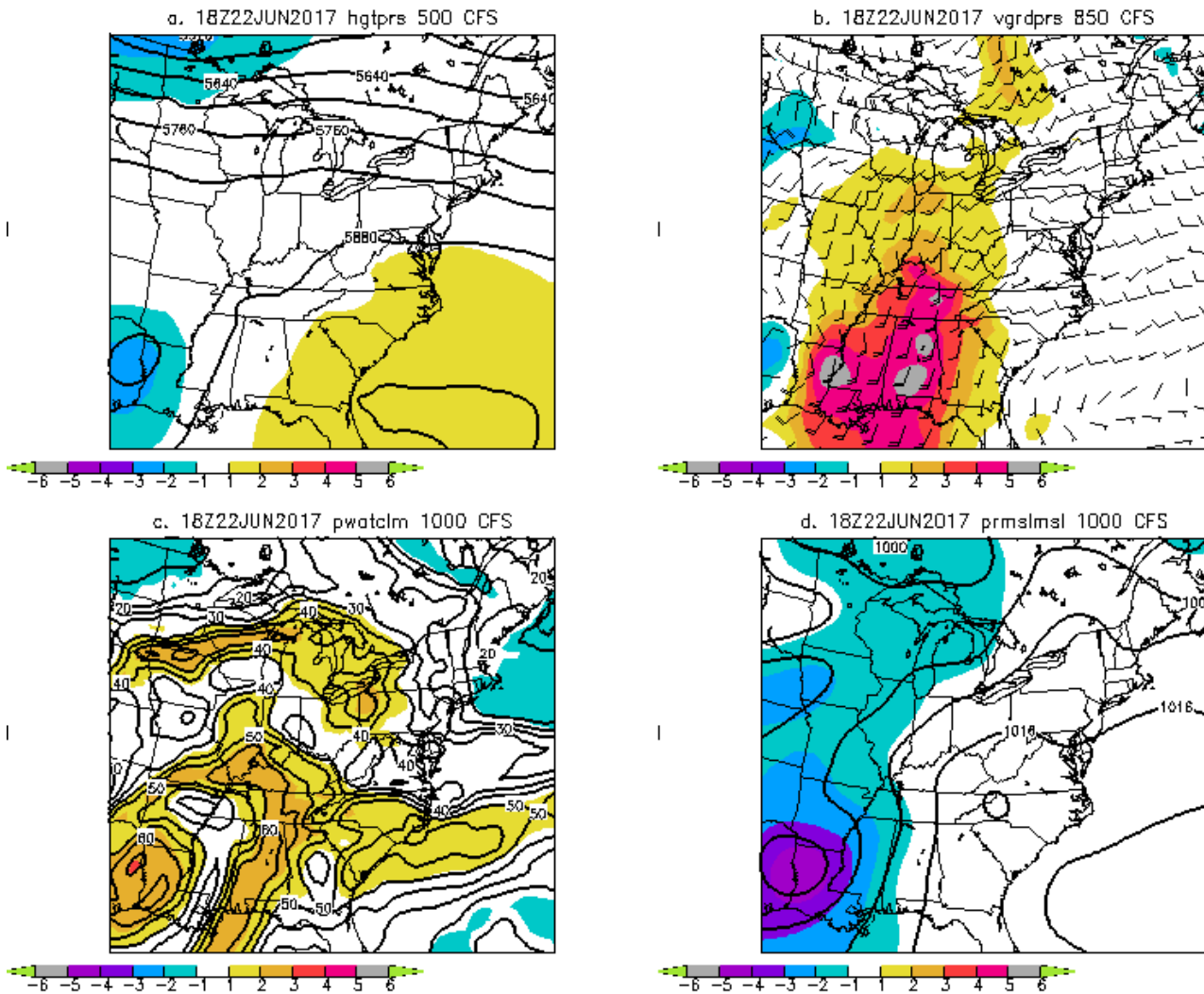
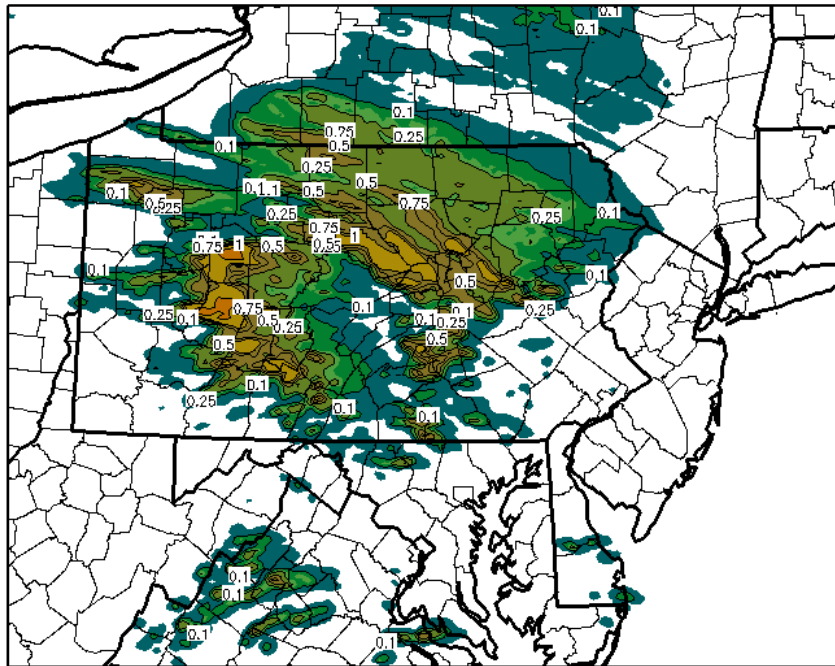


Figure 4. As in Figure 3 except valid at 1800 UTC 22 June showing a) 500 hPa heights and height anomalies, b) 850 hPa winds and v-wind anomalies, c) precipitable water and anomalies, and d) mean sea-level pressure and anomalies. Return to text.

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Accumulated Precipitation(in)
valid 23Z22JUN2017 (Thu) (initialized 18Z22JUN2017)



Accumulated Precipitation(in)
valid 22Z22JUN2017 (Thu) (initialized 19Z22JUN2017)

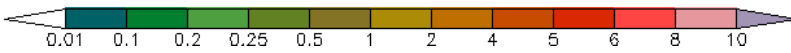
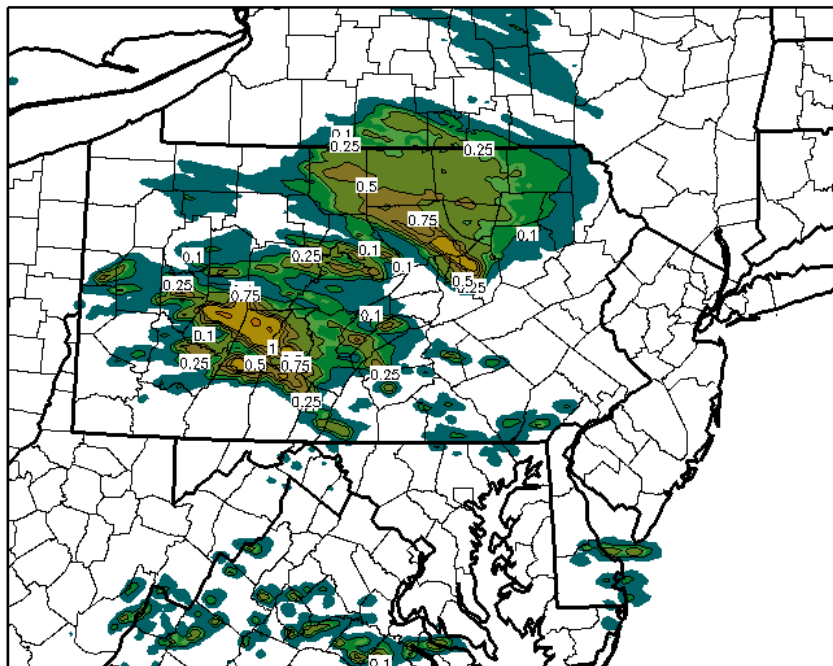


Figure 5. Accumulated QPF in the 3km HRRR showing the maximum rainfall period in or near Indiana County from the NCEP HRRR initialized at 1800 and 1900 UTC 22 June 2017.

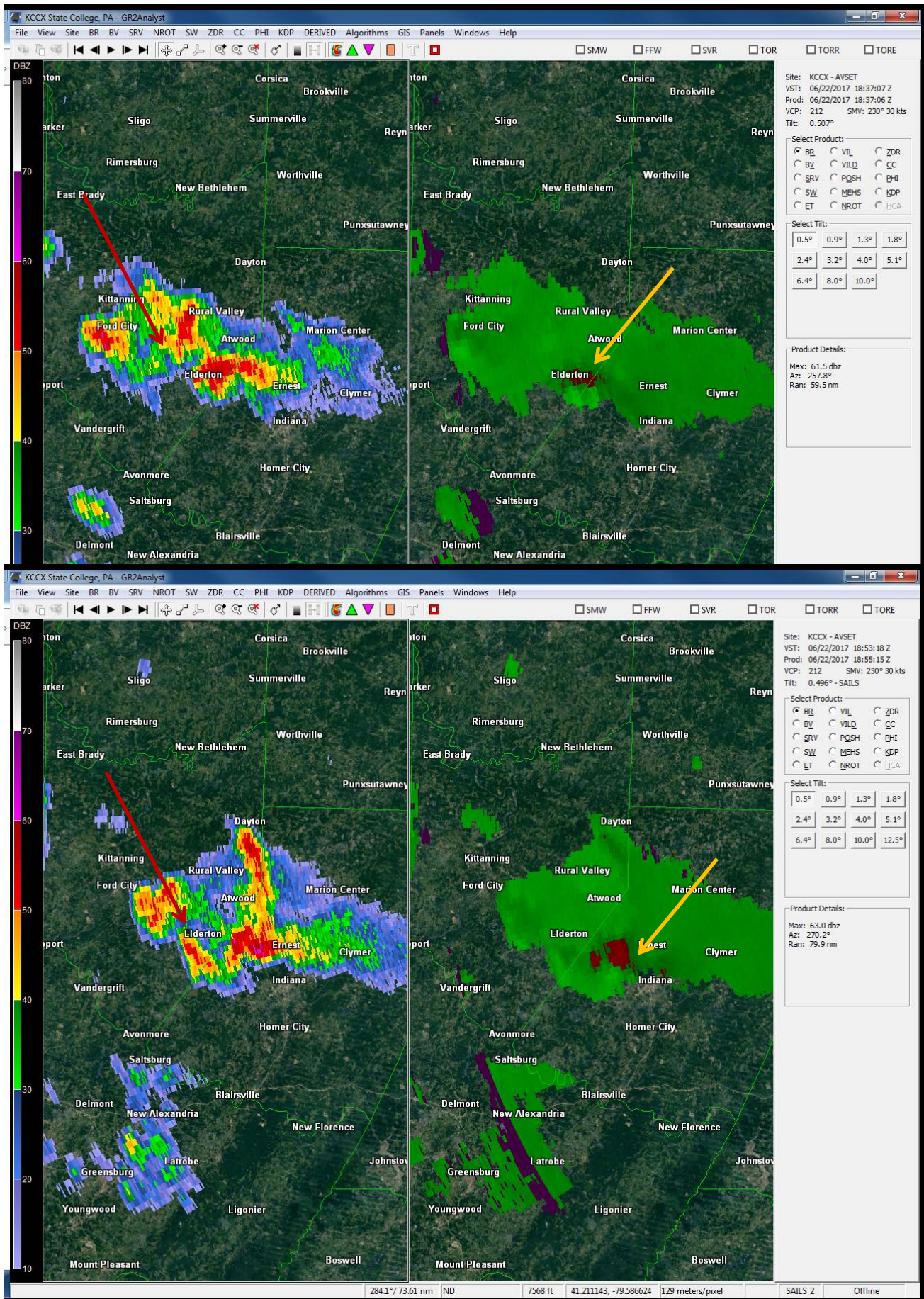


Figure 6. KCCX 0.5 degree reflectivity and velocity valid at 1837 and 1853 UTC 22 June showing the echoes over Indiana County, PA. The yellow arrows show the low-level rotation and the red arrows show the general area of new cell generation on the western flank of the main cell(s).

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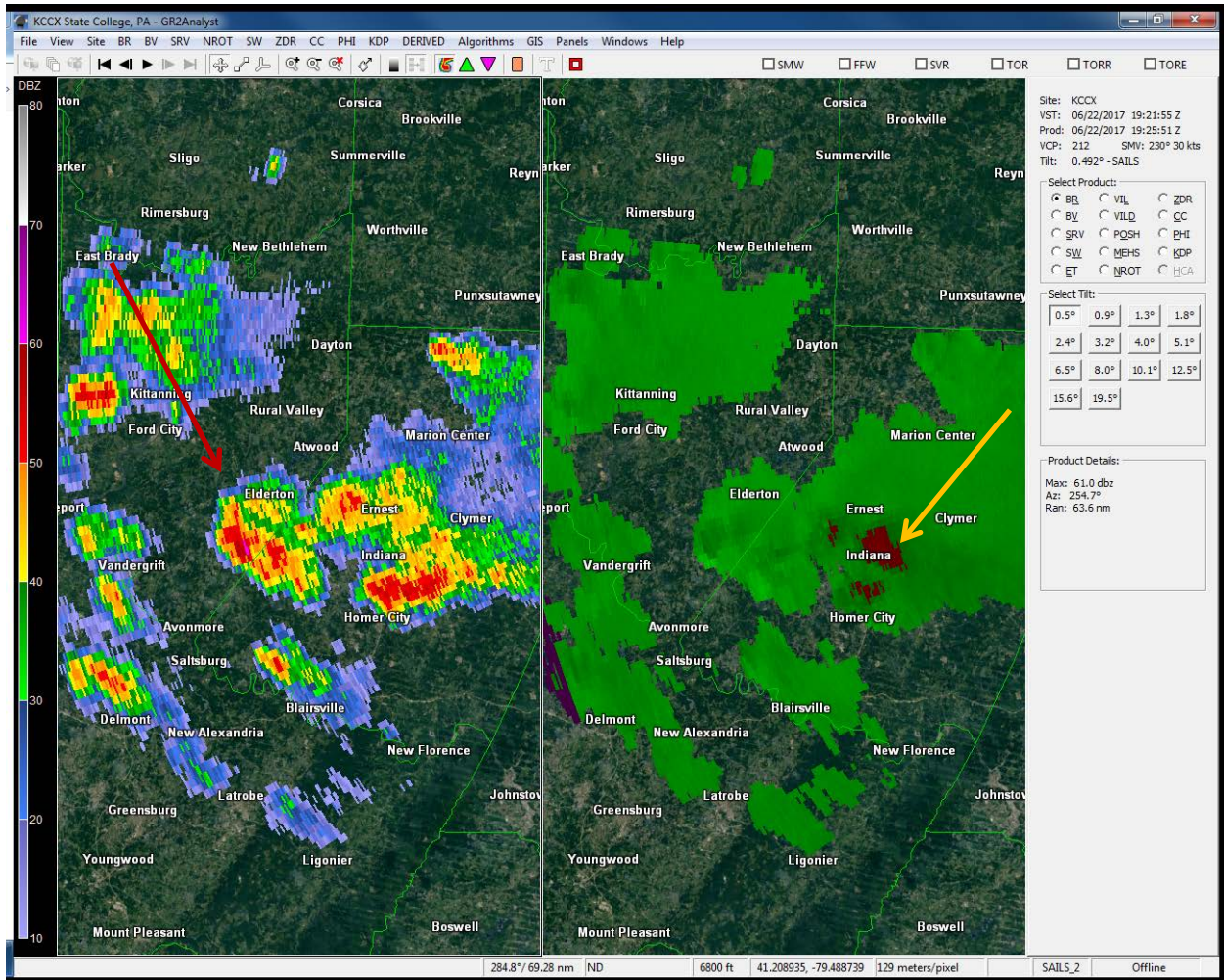


Figure 6 continued showing the 1925 UTC image.

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