

The Art of Storm Surveying: Leveraging New Datasets to Document the 12 June 2013 Tornadoes



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Tornado #1

Rating: EF3 Time: 4:08 - 4:27pm Path Length: 6.20 Miles

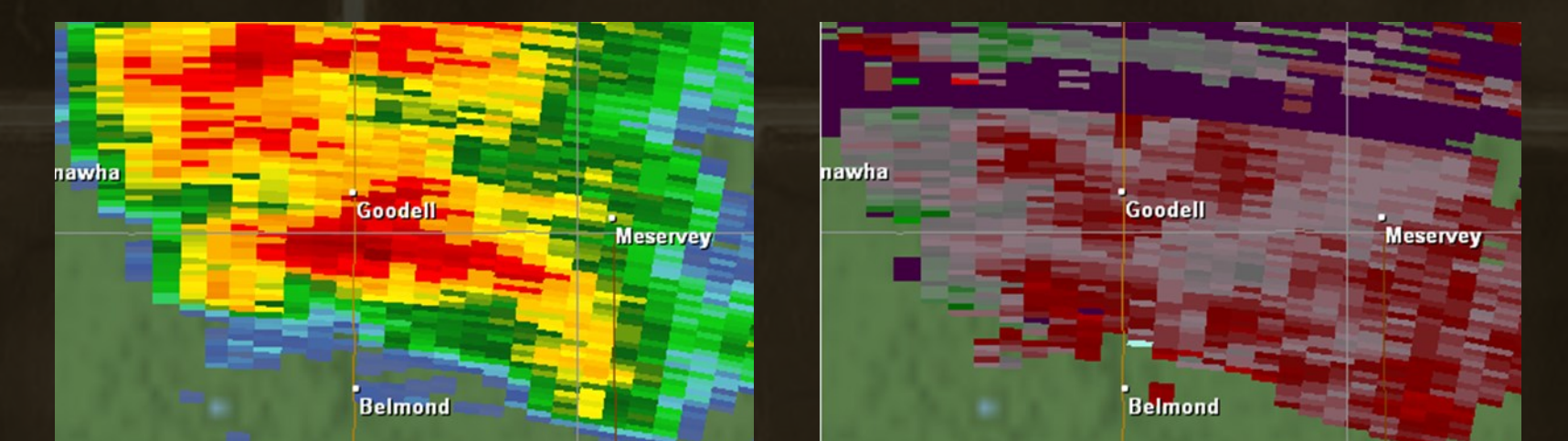
The central portion of this track was well analyzed by the ground survey team where it produced high-end EF3 damage in Belmond. The beginning of the track was originally based on a law enforcement report. The ground survey crew accidentally concluded that the tracks of tornadoes 1 and 2 were one continuous segment. A video posted to YouTube the day after the survey clearly showed that these were two separate entities. Furthermore, the satellite imagery revealed that the starting location of the track extended over two miles further to the northwest than originally thought. A pair of videos shared on Facebook that day confirmed the satellite findings. The tornado was well photographed as it travelled through Belmond.

Background

The last few years have witnessed an explosive growth in both the tools and resources available to NWS tornado damage surveyors. The advent of GPS-equipped digital cameras, the Damage Assessment Toolkit (DAT), and the ability to obtain high resolution satellite imagery shortly after an event, have greatly improved the accuracy and timeliness of a survey. The DAT has been of particularly high value to the NWS as it allows the surveyors to upload damage points via a mobile smartphone/tablet to a centralized GIS server, where a digital track of the tornado can then be constructed. Social media and other online sharing sites are proving to be a valuable asset for storm surveys, allowing the public to share photos and videos of tornadoes that may have previously been undocumented. The storm survey of the 12 June 2013 tornadoes leveraged a traditional ground survey, the DAT, satellite imagery, radar data, dozens of photos/videos shared on social media, and even a remote-controlled quadcopter, to produce an incredibly detailed and accurate set of tracks.

The Event

On the afternoon of 12 June 2013, a single storm cell produced multiple tornadoes along a 25 mile path through Wright and Franklin counties in north central Iowa. These tornadoes possessed many landspout characteristics and radar data from the KDMX WSR-88D was of limited use in determining the presence of any tornadoes. The radar beam, at an altitude of 7,000ft, only observed weak and intermittent rotation during the event.



Tornado #4

Rating: EF2 Time: 4:32 - 4:44pm Path Length: 5.20 Miles

The entire tornado track was thoroughly documented by the ground survey team and several sections were photographed by the quadcopter. Satellite imagery showed well-defined scouring for much of the tornado's life, though the last two miles of the track found in the ground survey did not show up in the imagery. There is only one known video of the tornado (in its dissipating stage) and relatively few photos.

Tornado #5

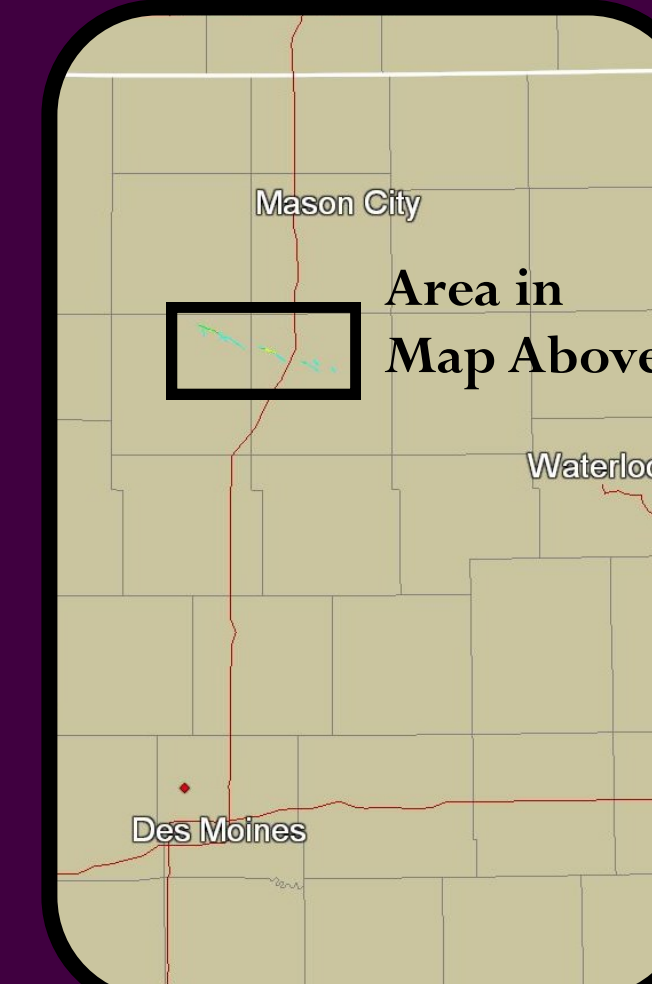
Rating: EF1 Time: 4:46 - 4:55pm Path Length: 3.48 Miles

This tornado was located by the ground survey team and the final track still heavily relies on their findings. The satellite footprint is generally weak but encompasses much of the track and most photos/videos of the tornado were taken near the end of its life.

#4

Alexander

Legend



Tornado #3

Rating: EF0 Time: 4:21 - 4:24pm Path Length: 1.14 Miles

Three photos found in a Facebook album in early February 2014 led to the documentation of this previously unknown tornado. After determining the approximate location of the tornado through the photos, satellite imagery confirmed the narrow track. The field scouring orientation, track shape, and location in the storm strongly indicate that this tornado rotated anticyclonically. The timing was based on the location of tornado #1, seen in the background of the photos.



Tornado #2

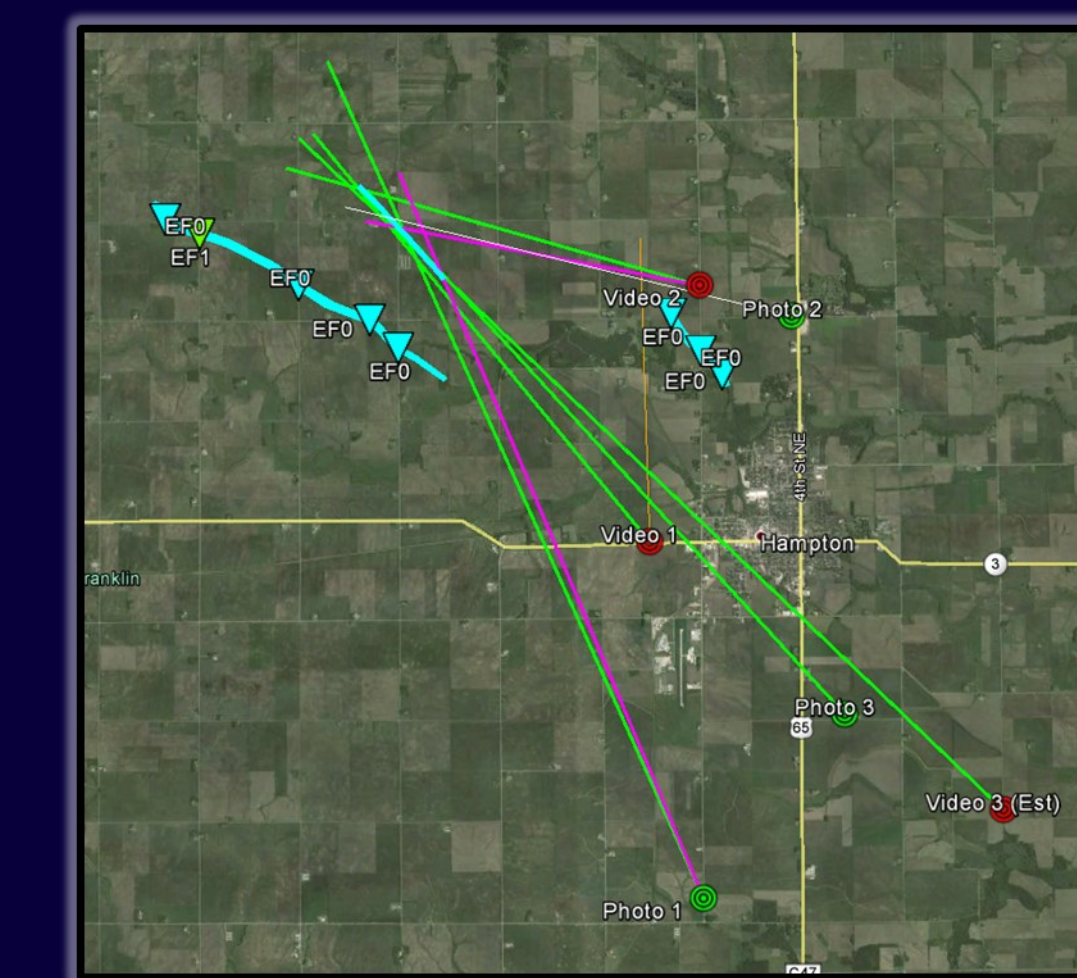
Rating: EF1 Time: 4:19 - 4:32pm Path Length: 5.00 Miles

This track was originally thought to be an extension of tornado #1 by the ground survey. However, a YouTube video uploaded on June 14 dispelled this notion and a separate track was created with start location 1.5 miles ESE of Belmond. However, satellite imagery acquired on June 20 revealed a faint but traceable circulation in the farm fields that extended westward from this start location all the way to the east side of town. This track perfectly matches three damage reports/photos located along a line through central Belmond (trees snapped and a mesonet station blown off the elementary school roof). Because the damage track was so intermittent through town, it was decided to start the tornado path at the destroyed mesonet/field scouring on the east side of town. The tornado was well photographed once the condensation funnel formed a mile east of town.

Tornado #6

Rating: EF0 Time: 4:53 - 4:56pm Path Length: 1.28 Miles

This tornado was added in January 2014 after a review of over a dozen photos/videos which were originally thought to be of tornado #4. The ground team did not survey this area and there was no track in the satellite data. The track of the tornado was triangulated using the aforementioned photos and videos and an estimated track determined (below). The timing of this tornado was based on tornado #5, which was occurring at the same time just to the south.



Tornado #7

Rating: EF0 Time: 4:56 - 4:59pm Path Length: 1.10 Miles

This tornado was located by the ground survey team and the track is based solely on the team's findings. Satellite imagery confirms a possible track, but it is very weak. No photos are known to exist of the tornado. An eyewitness stated that the tornado had no condensation funnel during its brief life.

#7

Hampton

The Ground Survey

The NWS in Des Moines (DMX) sent a team to conduct a ground survey of the affected area on June 13. This was the third survey conducted by DMX using the DAT and the second using an iPad to input and upload the findings. The EF-scale ratings for five of the tornadoes were determined by the ground survey. The two tornadoes added posthumously in early 2014 caused no known damage and were rated EF-0.

Unmanned Aerial Vehicle

A local television meteorologist allowed the ground survey team to use his remote controlled quadcopter, with a camera attached to its underside, to survey portions of the damage tracks. This camera revealed details in the tracks that could not be seen from the ground and were too fine to be resolved by satellite.



Satellite Imagery

Through a newly implemented NWS/USGS partnership program, satellite imagery was captured by the Worldview-2 satellite on June 17 and made available to the NWS the next day. Panchromatic jpeg images with a resolution of 0.46 meters were used to study and map the tracks. Multispectral imagery was available, but the resolution was too coarse to use.

Conclusion

The 12 June 2013 tornado damage survey demonstrated a successful application of various cutting edge tools and a wide range of data sources to construct very accurate tornado tracks. A single data source (e.g. ground survey, satellite, photos, etc.) alone was not sufficient for this process; each one possessed certain strengths and weaknesses and using multiple data sources lessened their individual shortcomings.