

# Applications of Earth Remote Sensing for Identifying Tornado and Severe Weather Damage

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# Background

- Following the April 27, 2011 severe weather outbreak across the southeastern U.S., the NASA SPoRT team provided MODIS and ASTER imagery to National Weather Service (NWS) forecast offices in Alabama
  - Imagery was used to refine and adjust some tornado tracks, particularly those that crossed CWA boundaries or were in areas with limited road access
- SPoRT was awarded a NASA Applied Science: Disasters “Feasibility” award to pursue inclusion of Earth remote sensing imagery and derived products within the NOAA/NWS Damage Assessment Toolkit

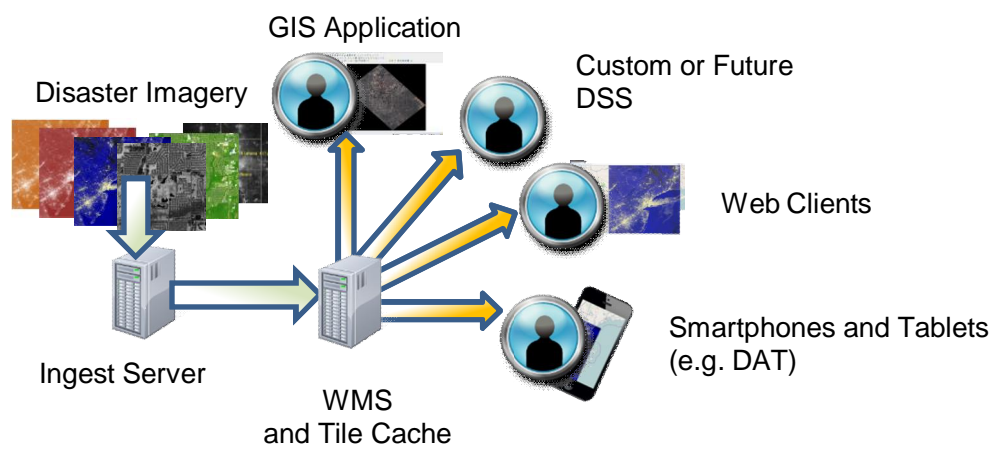
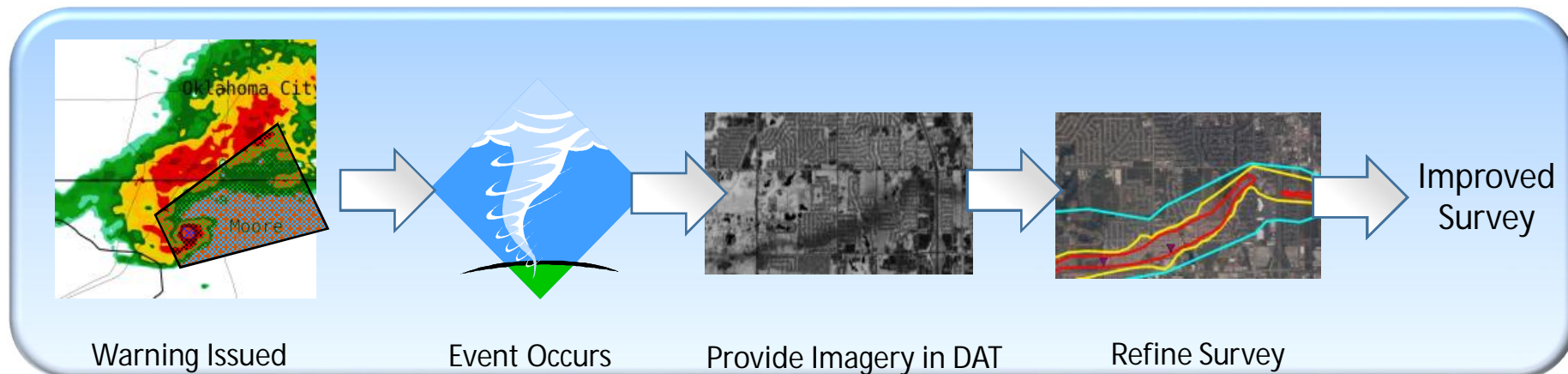


# Damage Assessment Toolkit

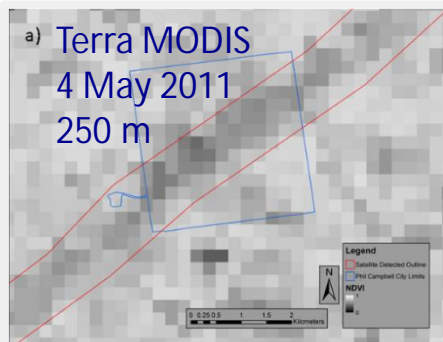
- NOAA/NWS Damage Assessment Toolkit (DAT)
  - The DAT is a smartphone, tablet, and web-based framework for acquiring, editing, and publishing storm survey information.
  - Users can acquire geotagged photos and other information, assess storm damage and intensity, and log for further review at their office. Information collected provides additional spatial data regarding tornado damage, extent, and intensity.
- Through the NASA Applied Science award, SPoRT and NOAA/NWS collaborate to establish a Web Mapping Service and data feeds that provide satellite imagery and products as viewable data layers.



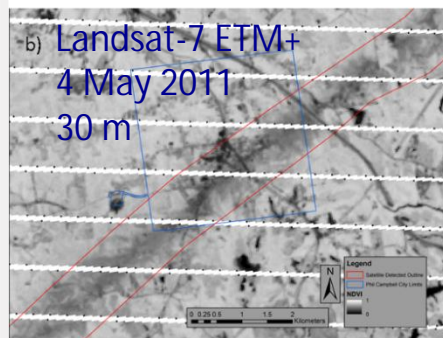
# Data Use Case And Dissemination



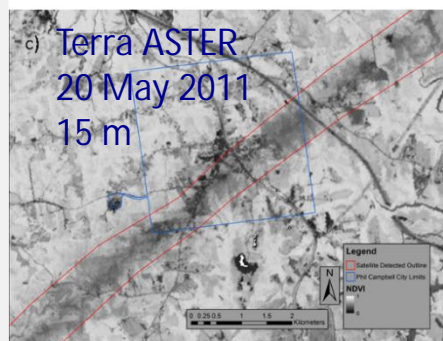
# Imagery Resolution



**Affects Detectability of Damage Indicators**



**Increases in Spatial Resolution Improves  
Detection Capabilities**



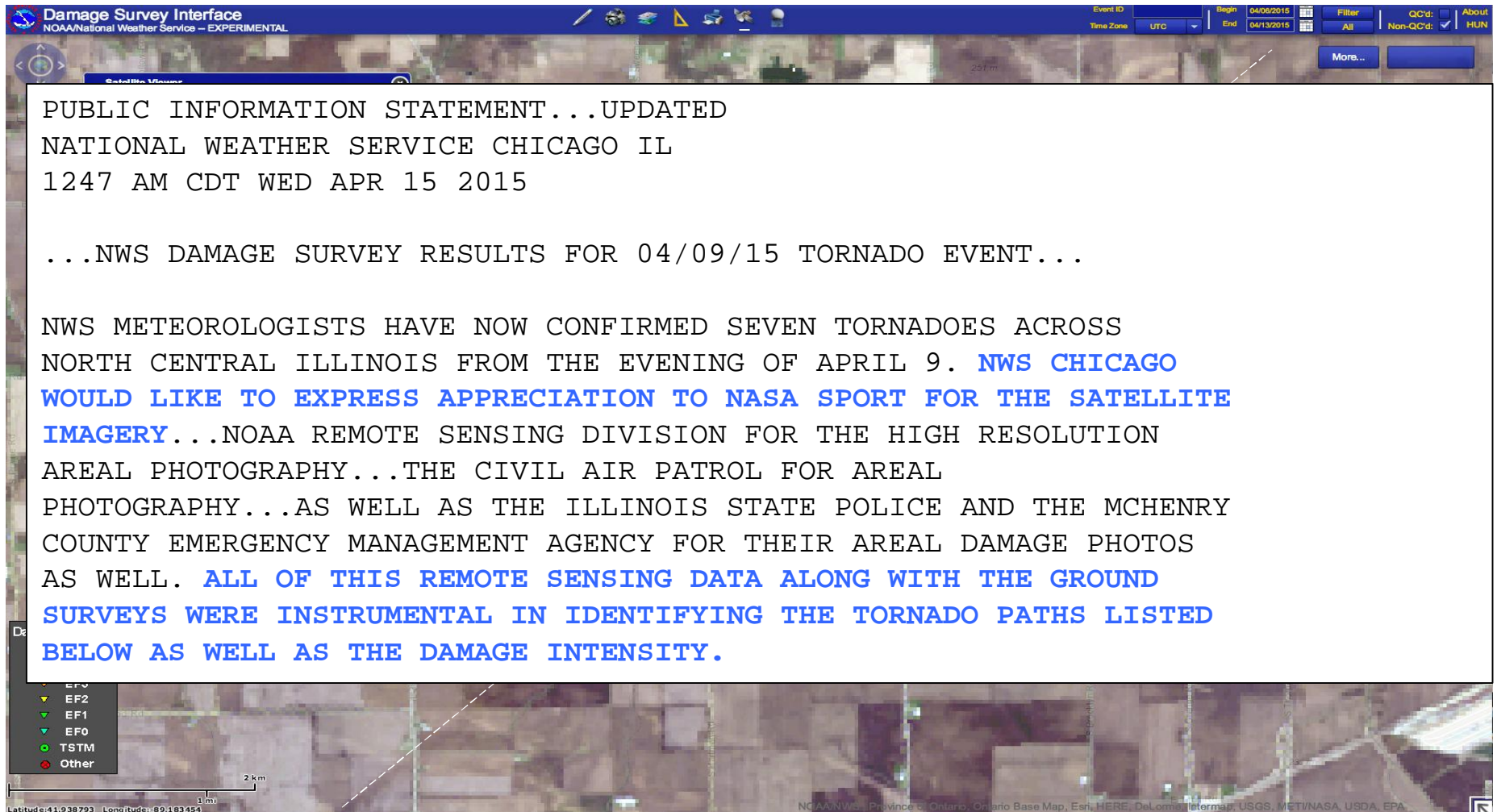
Reference: Molthan, A. L., J. R. Bell, T. A. Cole, and J. E. Burks, 2014: Satellite-based identification of tornado damage tracks from the 27 April 2011 severe weather outbreak. *J. Operational Meteor.*, 2 (16), 191–208.



# Tornado Near Rochelle, IL April 9, 2015



# Tornado Near Rochelle, IL April 9, 2015



The screenshot shows the 'Damage Survey Interface' software. The title bar reads 'Damage Survey Interface NOAA National Weather Service - EXPERIMENTAL'. The interface includes a map of Rochelle, IL, with a legend on the left for damage types: EF0 (yellow triangle), EF2 (green inverted triangle), EF1 (green triangle), EF0 (green inverted triangle), TSTM (red circle), and Other (red circle). A text box in the center contains the following text:

PUBLIC INFORMATION STATEMENT...UPDATED  
NATIONAL WEATHER SERVICE CHICAGO IL  
1247 AM CDT WED APR 15 2015

...NWS DAMAGE SURVEY RESULTS FOR 04/09/15 TORNADO EVENT...

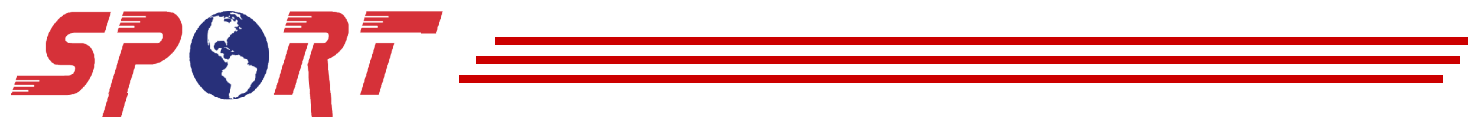
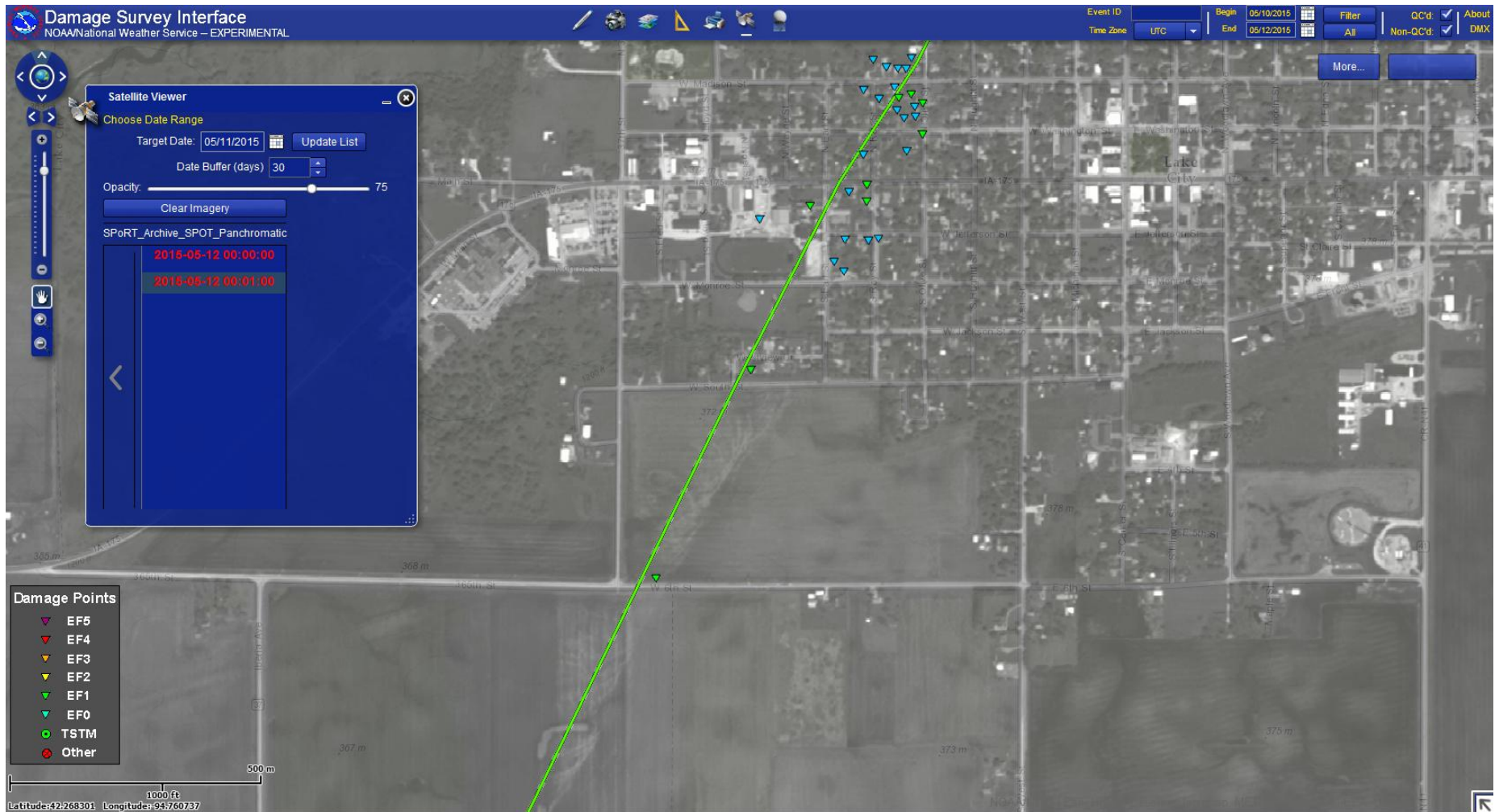
NWS METEOROLOGISTS HAVE NOW CONFIRMED SEVEN TORNADOES ACROSS NORTH CENTRAL ILLINOIS FROM THE EVENING OF APRIL 9. **NWS CHICAGO WOULD LIKE TO EXPRESS APPRECIATION TO NASA SPORT FOR THE SATELLITE IMAGERY**...NOAA REMOTE SENSING DIVISION FOR THE HIGH RESOLUTION AREAL PHOTOGRAPHY...THE CIVIL AIR PATROL FOR AREAL PHOTOGRAPHY...AS WELL AS THE ILLINOIS STATE POLICE AND THE MCHENRY COUNTY EMERGENCY MANAGEMENT AGENCY FOR THEIR AREAL DAMAGE PHOTOS AS WELL. **ALL OF THIS REMOTE SENSING DATA ALONG WITH THE GROUND SURVEYS WERE INSTRUMENTAL IN IDENTIFYING THE TORNADO PATHS LISTED BELOW AS WELL AS THE DAMAGE INTENSITY.**

The software interface also shows a top menu bar with 'Event ID', 'Begin' (04/09/2015), 'End' (04/13/2015), 'Filter' (All), 'QC'd' (Non-QC'd), and 'About' (HUN). A 'More...' button is visible on the right. The bottom status bar shows 'Latitude: 41.938793 Longitude: -89.183454' and 'NOAA NWS - Province of Ontario, Ontario Base Map, Esri, HERE, DeLorme, Intermap, USGS, MET/NASA, USDA, EPA'.



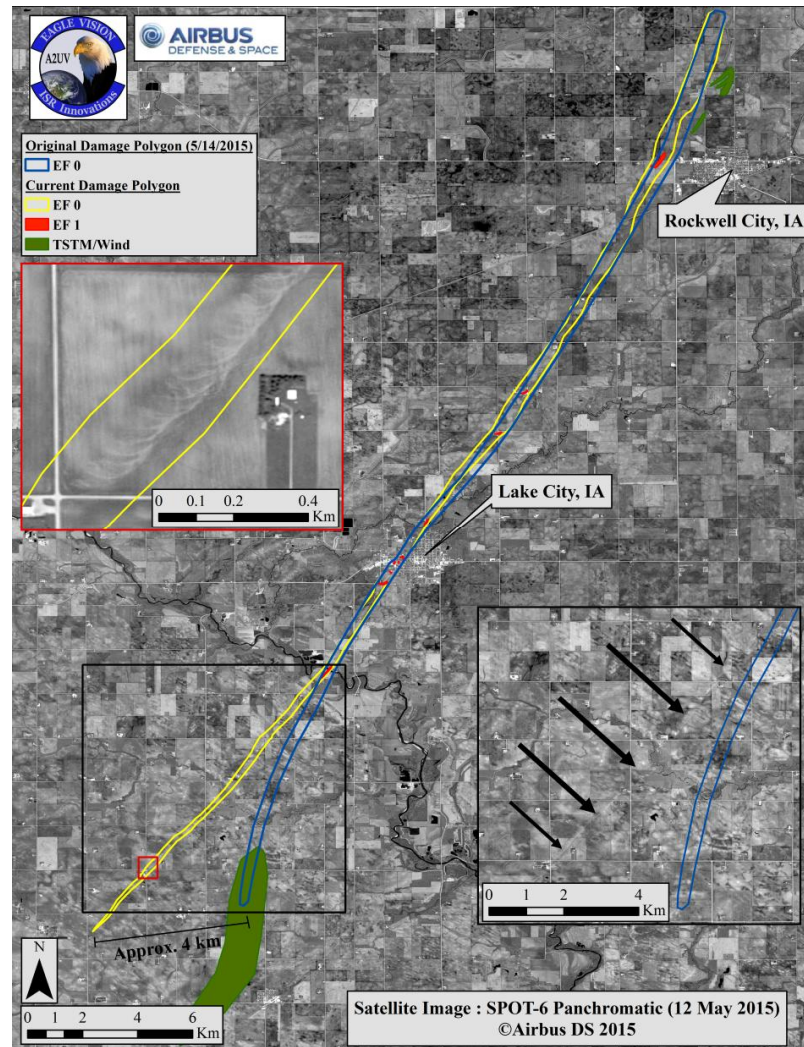


# Tornado Near Lake City, IA May 10, 2015



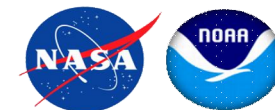


# Track updated based on imagery



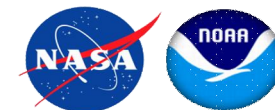
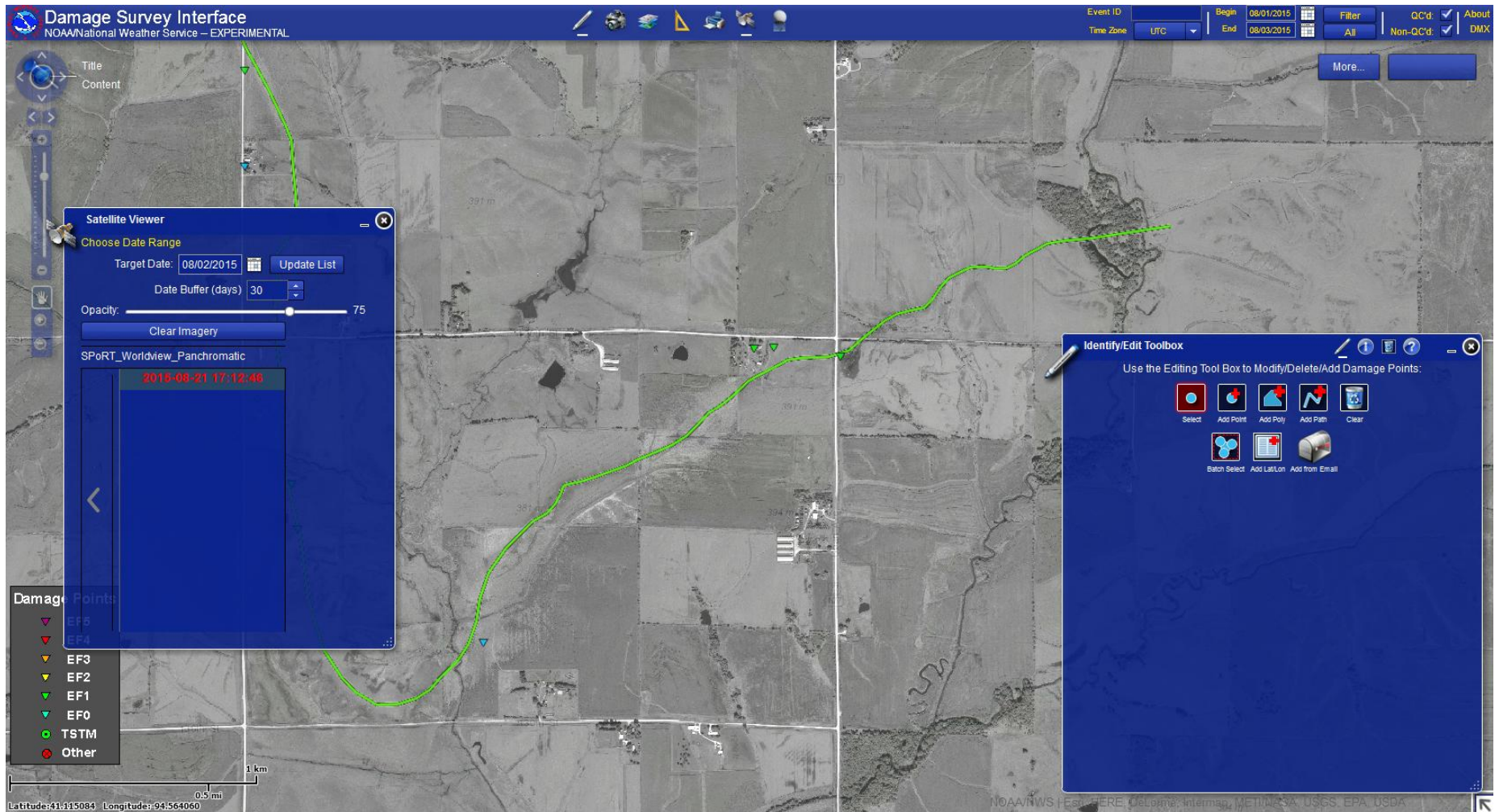
# Tornado Near Williamson, IA August 2, 2015

The screenshot displays the Damage Survey Interface (DSI) software. The main window shows a satellite view of a rural area with several damage points marked. The interface includes a top navigation bar with fields for Event ID, Time Zone, Begin, End, Filter, QC'd, and About. A left sidebar contains a legend for Damage Points, with categories: EF6 (red inverted triangle), EF4 (red triangle), EF3 (orange inverted triangle), EF2 (orange triangle), EF1 (green inverted triangle), EF0 (green triangle), TSTM (green circle), and Other (red circle). Two toolboxes are open: 'Satellite Viewer' on the left and 'Identify/Edit Toolbox' on the right. The 'Satellite Viewer' toolbox includes a 'Choose Date Range' section with a 'Target Date' of 08/02/2015 and a 'Date Buffer (days)' of 30. The 'Identify/Edit Toolbox' includes buttons for Select, Add Point, Add Poly, Add Path, Clear, Batch Select, Add Lat/Long, and Add from Email. The bottom of the interface shows a scale bar (0.5 km, 1 km) and coordinates: Latitude: 41.111980, Longitude: -94.560970.





# Tornado Near Williamson, IA August 2, 2015



# Tornado Near Williamson, IA August 2, 2015

The screenshot displays the Damage Survey Interface (DSI) software, a NOAA National Weather Service experimental tool. The main window shows a satellite map of a rural area with a green dashed line indicating a tornado path. Several toolboxes are overlaid on the map:

- Satellite Viewer:** Allows users to choose a date range (Target Date: 08/02/2015, Date Buffer: 30 days) and adjust the opacity of the satellite imagery. It also shows a list of available imagery, including one from 2015-08-21 17:12:46.
- Damage Point:** A window that displays a photograph of a damage site, with a "Zoom to" button.
- Identify/Edit Toolbox:** A central panel for adding, editing, or deleting damage points. It includes fields for Office (DMX), Event ID (150802\_01), Storm Date (8/2/2015), and Survey Date (8/3/2015). It also features a Damage Indicator (Trees: Hardwood (TH)), Degree of Damage (Trunks snapped), Wind Speed (93 mph), EF Rating (EF1), and Damage Direction (N/A). Buttons for "Submit Edit", "Delete Point", and "Move Point" are at the bottom.

The interface also includes a legend for damage points (EF5, EF4, EF3, EF2, EF1, EF0, TSTM, Other) and a scale bar (500m, 1000ft). The bottom status bar shows the coordinates: Latitude: 41.123481, Longitude: -94.548621.





# Tornado Near Williamson, IA August 2, 2015

The screenshot displays the Damage Survey Interface (DSI) software, a NOAA National Weather Service experimental tool. The interface is divided into several panels:

- Top Panel:** Contains the title "Damage Survey Interface" and "NOAA National Weather Service - EXPERIMENTAL". It also features a toolbar with various icons and a header area with fields for "Event ID", "Begin" (08/01/2015), "End" (08/03/2015), "Filter" (All), "QC'd" (checked), and "About" (DMX).
- Main Map Area:** Shows a satellite view of a rural landscape with a road and fields. A "Damage Point" is marked with a green triangle. A "Zoom to" button is visible below the damage point.
- Satellite Viewer Panel (Left):** Allows users to "Choose Date Range" with a "Target Date" field (08/02/2015) and an "Update List" button. It includes a "Date Buffer (days)" slider set to 30 and an "Opacity" slider set to 75. A "Clear Imagery" button is also present. The panel shows "SPoRT\_Worldview\_Panchromatic" imagery with a timestamp of "2015-08-21 17:12:46".
- Damage Point Panel (Center):** Displays a close-up image of a narrow, intense crop damage path in a field. A "Zoom to" button is located below the image.
- Identify/Edit Toolbox Panel (Right):** Provides detailed information for the selected damage point:
  - Office ID: DMX | Event ID: 150802\_01
  - Latitude: 41.13023000 | Longitude: -94.56450000
  - EF-Rating: EF1 | Wind Speed: 90
  - Damage Date: Sun Aug 2 23:33:00 2015 UTC
  - Survey Date: Thu Aug 13 15:29:00 2015 UTC
  - Damage Indicator: Other (O)
  - Degree of Damage: Other damage
  - Damage Direction: N/A
  - Comments: Narrow intense crop damage. Aerial photo by private UAV.
  - QC Flag Checked: Y
- Bottom Left Panel:** A legend for "Damage Points" with color-coded symbols for EF6 (red), EF4 (orange), EF3 (yellow), EF2 (light green), EF1 (green), EF0 (light blue), TSTM (dark blue), and Other (red circle).
- Bottom Status Bar:** Shows coordinates: "Latitude: 41.125381 Longitude: -94.574734" and a scale bar for "1000 ft" and "500 m".



# Tornado Near Williamson, IA August 2, 2015

**Damage Survey Interface**  
NOAA National Weather Service – EXPERIMENTAL

Event ID: [ ] Begin: 08/01/2015 Filter: QC'd: [x] About: [x]  
Time Zone: UTC End: 08/03/2015 All Non-QC'd: [x] DMX

Title: [ ] Content: [ ] More...

**Satellite Viewer**  
Choose Date Range  
Target Date: 08/02/2015 Update List  
Date Buffer (days): 30  
Opacity: [ ] 75  
Clear Imagery  
SPoRT\_WorldView\_Panchromatic  
2015-08-21 17:12:46

**Damage Points:**  
EF5  
EF4  
EF3  
EF2  
EF1  
EF0  
TSTM  
Other

**Identify/Edit Toolbox**  
**Damage Point**  
Office ID: DMX Event ID: 150802\_01  
Latitude: 41.13023000 Longitude: -94.56450000  
EF-Rating: EF1 Wind Speed: 90  
Damage Date: Sun Aug 2 23:39:00 2015 UTC  
Survey Date: Thu Aug 13 15:29:00 2015 UTC  
Damage Indicator: Other (O)  
Degree of Damage: Other damage  
Damage Direction: NA  
Comments: Narrow intense crop damage. Aerial photo by private UAV.  
QC Flag Checked: Y

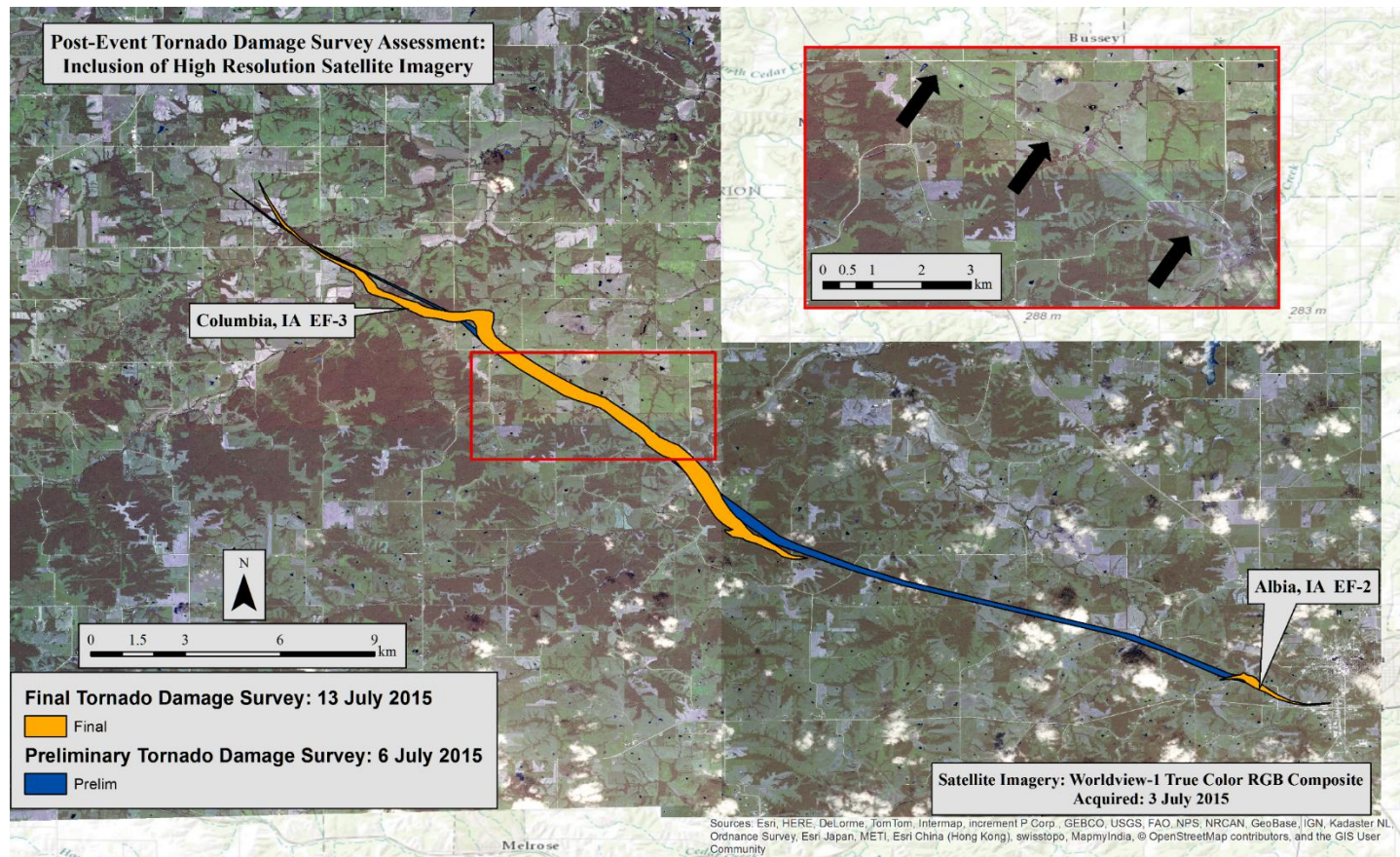
Latitude: 41.133058 Longitude: -94.577008

NOAA/NWS Esri HERE DeLorme IPC Intermap USGS METI/NASA EPA/SD





# Track updated based on imagery



Imagery from Worldview-1 (in collaboration with USGS) was delivered to the NWS Damage Assessment Toolkit and used to refine a tornado track, shifting from a single, long track to two separate tracks. Final tracks (orange) were noted for an EF-2 and EF-3 maximum intensity tornado.



Questions?  
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