

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

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IN32A-04

IN32A: Near Real Time Data for Earth Science and Space Weather Applications II



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

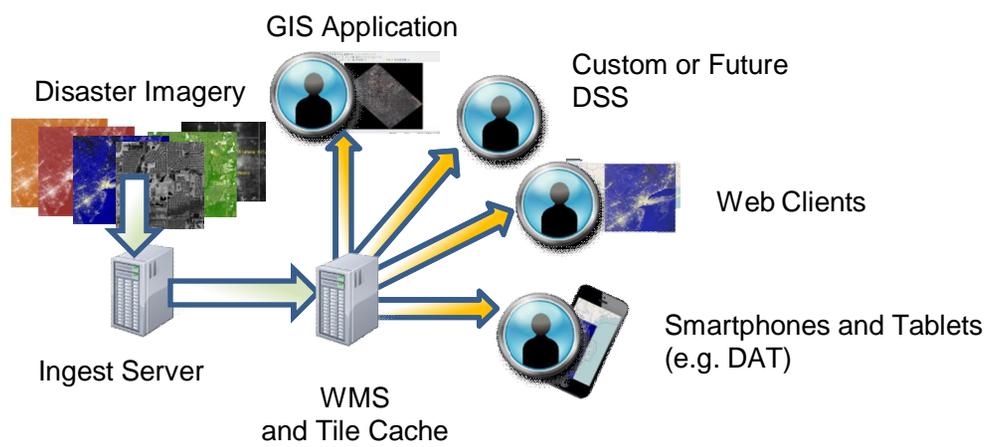
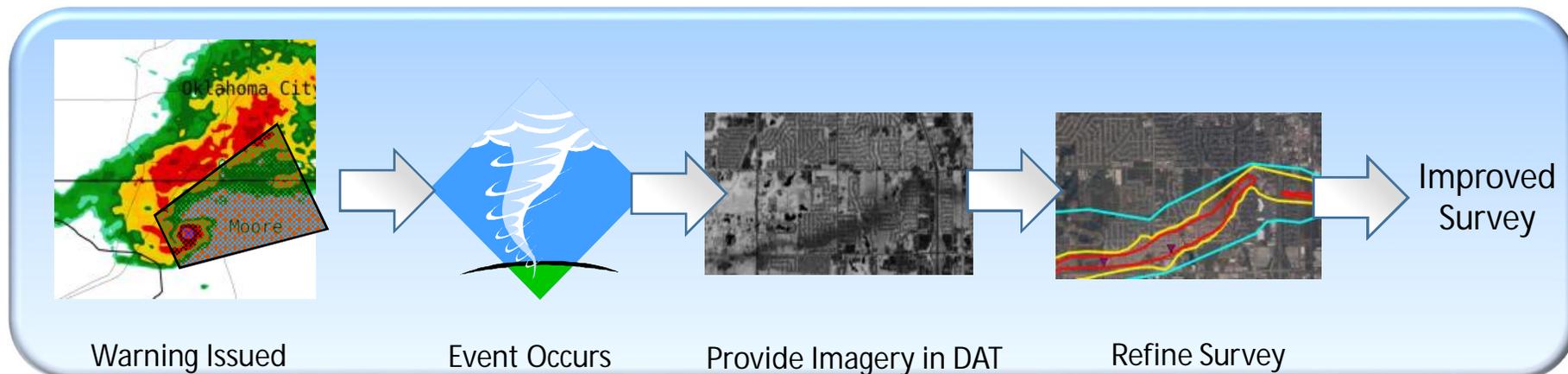


Damage Assessment Toolkit

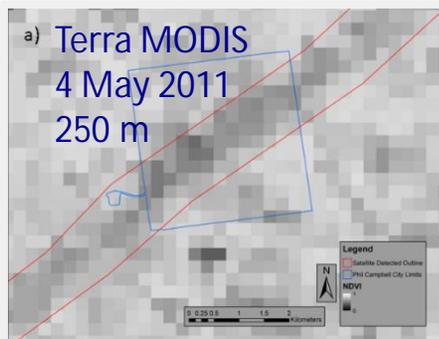
- NOAA/NWS Damage Assessment Toolkit (DAT)
 - The DAT is a smartphone, tablet, and web-based framework for acquiring, editing, and publishing storm survey information.
 - Users can acquire geotagged photos and other information, assess storm damage and intensity, and log for further review at their office. 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.



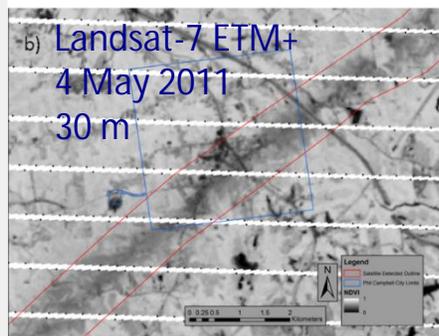
Data Use Case And Dissemination



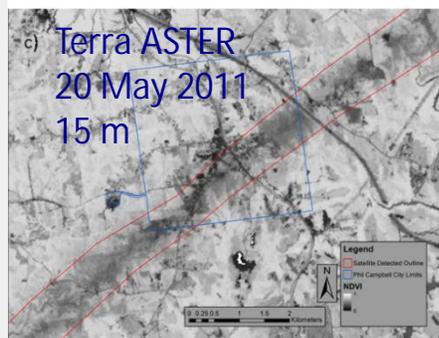
Imagery Resolution



Affects Detectability of Damage Indicators



**Increases in Spatial Resolution Improves
Detection Capabilities**

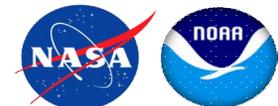


Reference: Molthan, A. L., J. R. Bell, T. A. Cole, and J. E. Burks, 2014: Satellite-based identification of tornado damage tracks from the 27 April 2011 severe weather outbreak. *J. Operational Meteor.*, 2 (16), 191–208.

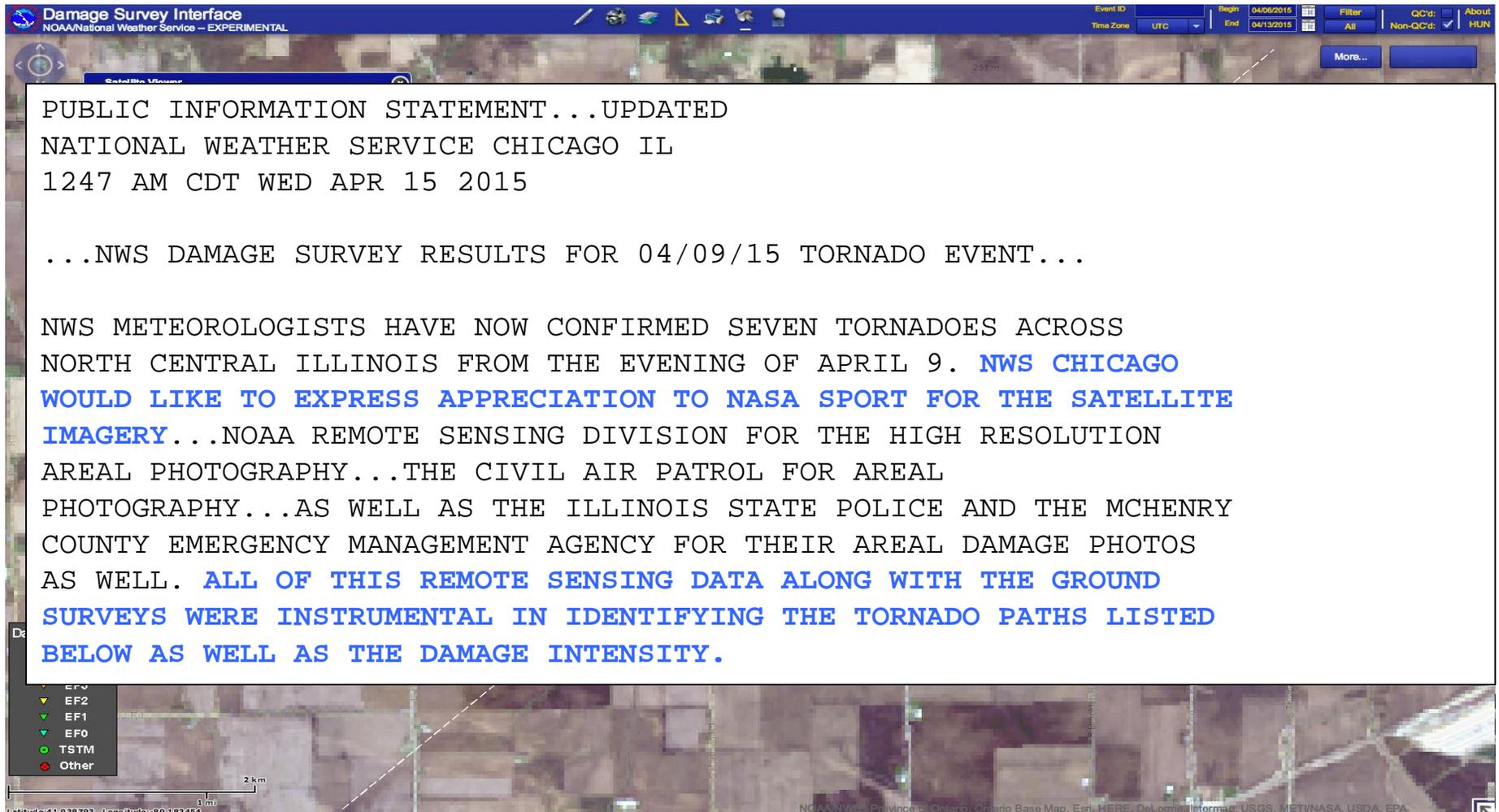
Tornado Near Rochelle, IL April 9, 2015



Meteorologists at NWS WFO in Chicago, IL analyze Landsat 8 imagery within the NOAA/NWS Damage Assessment Toolkit, and are “very excited and impressed” by this capability.



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 toolbar with various icons, a search bar, and a filter menu. The main content area displays a public information statement. The statement is dated 1247 AM CDT WED APR 15 2015 and discusses damage survey results for a tornado event on 04/09/15. It mentions that NWS meteorologists have confirmed seven tornadoes across North Central Illinois and expresses appreciation to NASA Sport for satellite imagery. The statement also lists other agencies involved in the damage assessment, including the Civil Air Patrol, Illinois State Police, and the McHenry County Emergency Management Agency.

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...

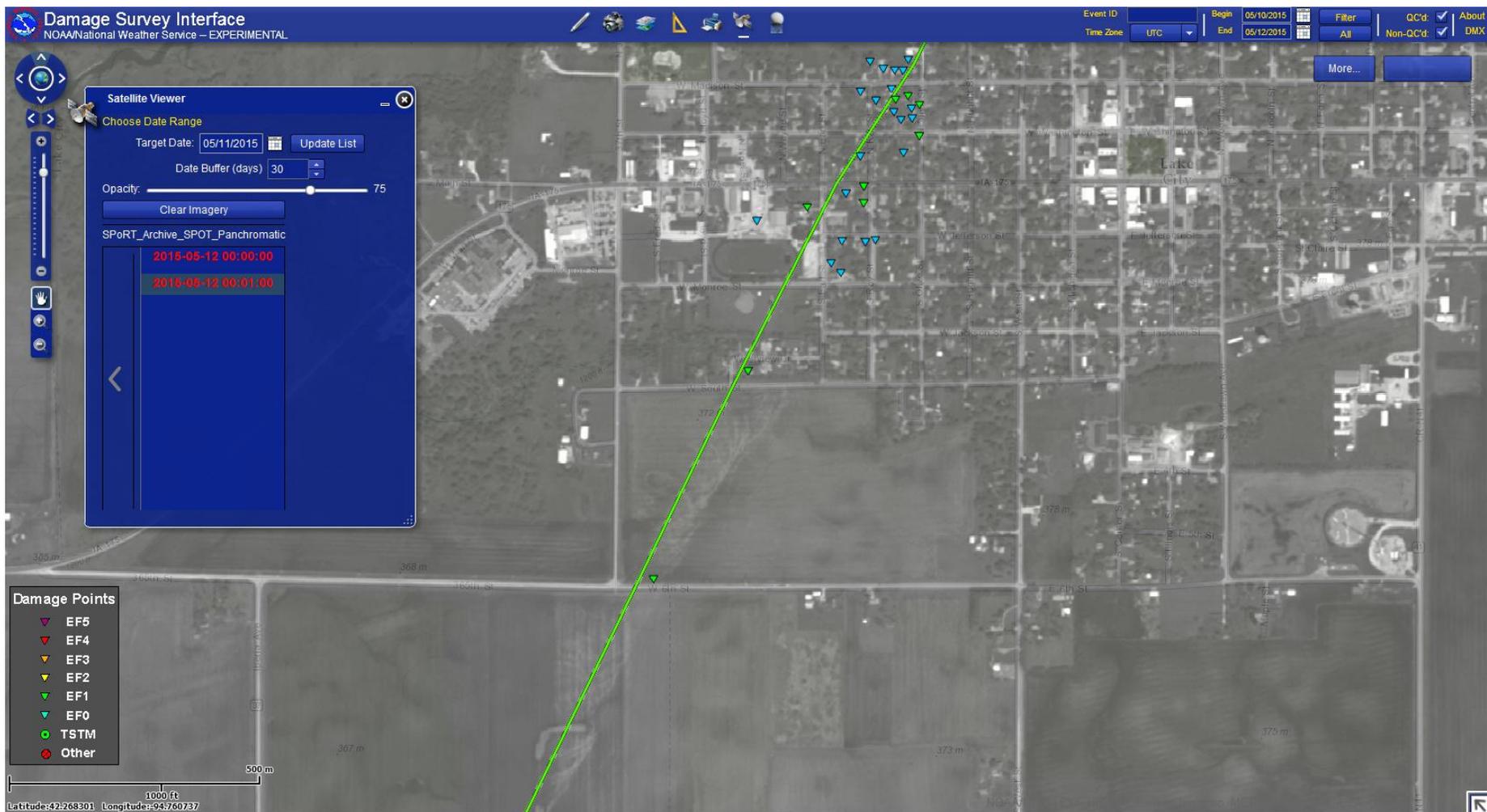
NWS METEOROLOGISTS HAVE NOW CONFIRMED SEVEN TORNADOES ACROSS NORTH CENTRAL ILLINOIS FROM THE EVENING OF APRIL 9. **NWS CHICAGO WOULD LIKE TO EXPRESS APPRECIATION TO NASA SPORT FOR THE SATELLITE IMAGERY**...NOAA REMOTE SENSING DIVISION FOR THE HIGH RESOLUTION AREAL PHOTOGRAPHY...THE CIVIL AIR PATROL FOR 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.**

Legend:
EF0
EF2
EF1
EF0
TSTM
Other

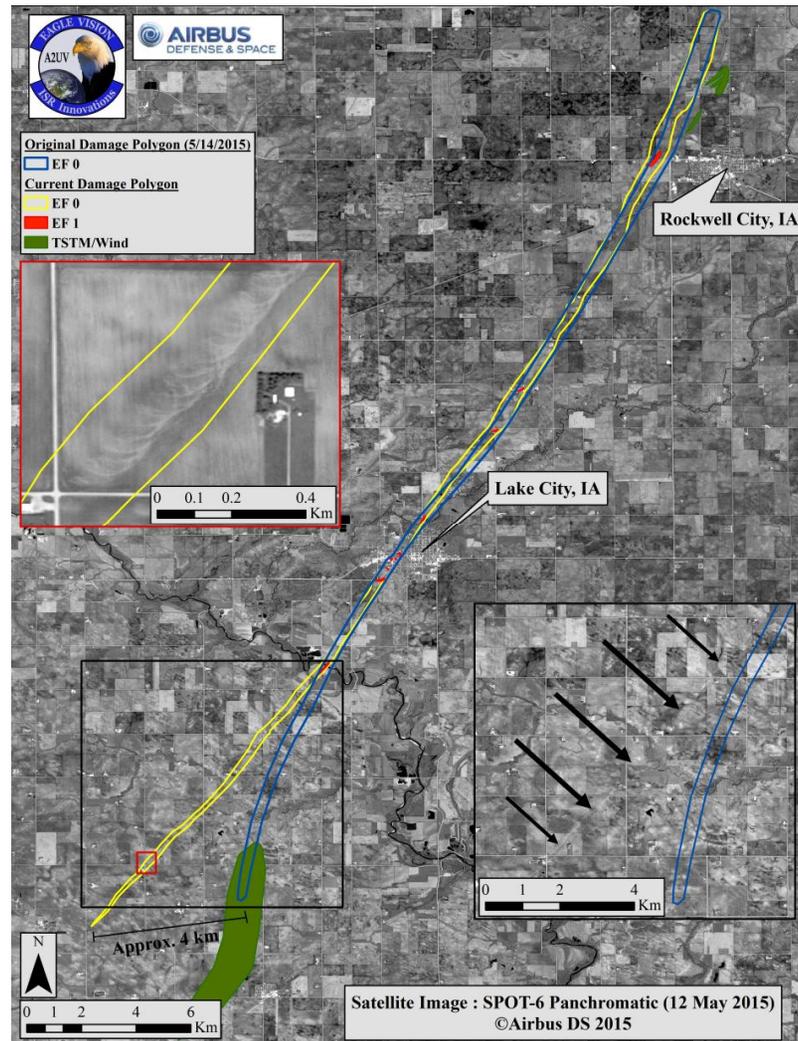
Latitude: 41.938793 Longitude: -89.183454



Tornado Near Lake City, IA May 10, 2015



Track updated based on imagery



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: []
Time Zone: UTC End: 08/03/2015 All Non-QC'd: [x] DMX

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

Identify/Edit Toolbox
Use the Editing Tool Box to Modify/Delete/Add Damage Points:
Select [] Add Point [] Add Poly [] Add Path [] Clear []
Batch Select [] Add Lat/Long [] Add from Email []

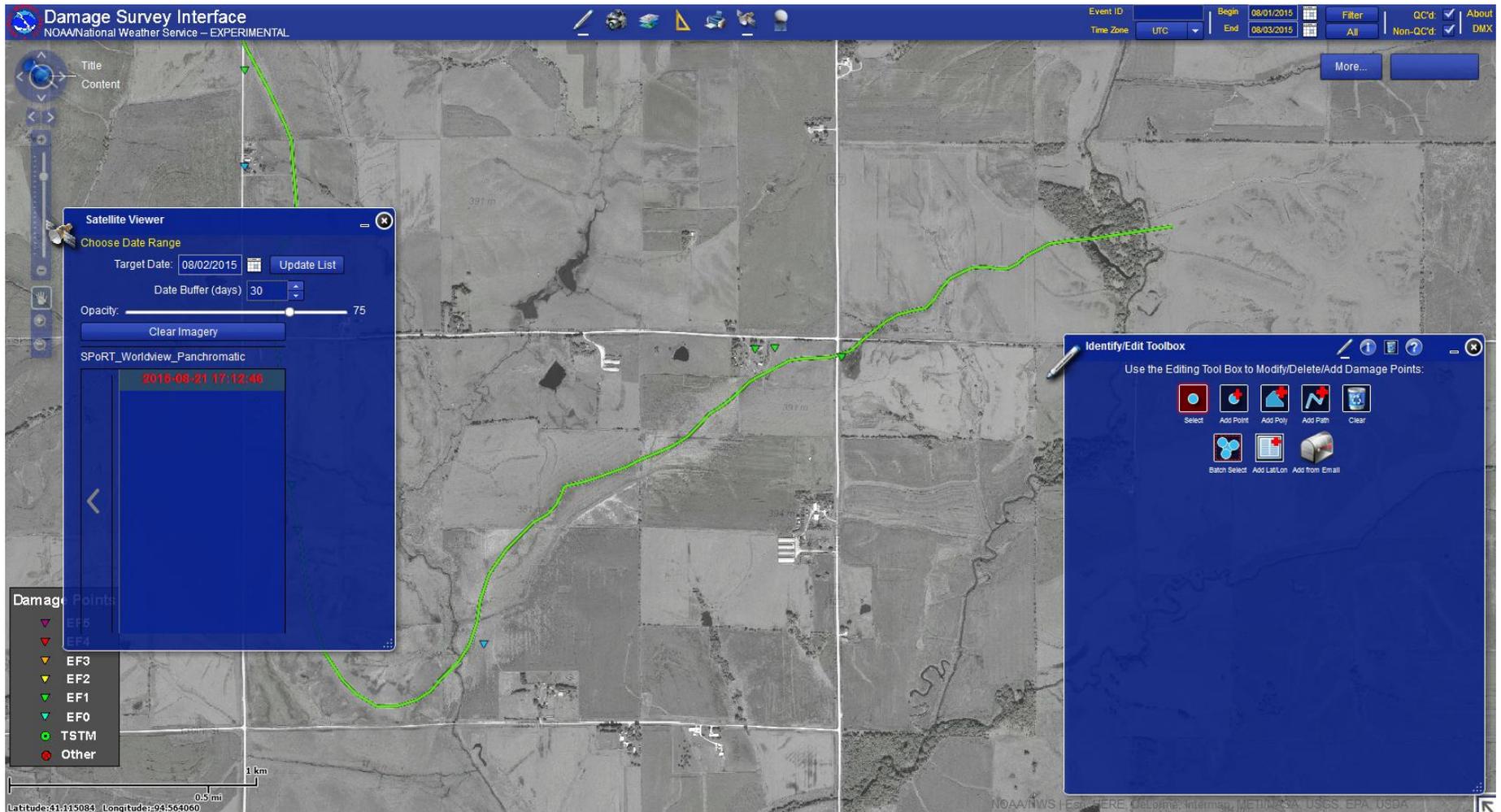
Damage Points
EF6 []
EF4 []
EF3 []
EF2 []
EF1 []
EF0 []
TSTM []
Other []

Latitude: 41.111980 Longitude: -94.560970

NOAA/NWS Features HERE, O&P, Inmap, MET, NWS, USGS, EPA, USDA



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 shows a list of available imagery with a timestamp of 2015-08-21 17:12:46.
- Damage Point:** A pop-up window showing a photograph of a damaged area, with a "Zoom to" button.
- Identify/Edit Toolbox:** A comprehensive data entry and editing interface for a damage point. 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 visible.

The interface also includes a legend for Damage Points (EF5, EF4, EF3, EF2, EF1, EF0, TSTM, Other) and a scale bar (0 to 1000 ft). The status bar at the bottom 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 control area with "Event ID", "Begin" (08/01/2015), "End" (08/03/2015), "Filter", "QC'd", and "About" options.
- Main Map Area:** Shows a satellite view of a rural landscape with fields and a road. 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 Points Legend (Bottom Left):** A list of damage point types with corresponding symbols: EF6 (red inverted triangle), EF4 (orange inverted triangle), EF3 (yellow inverted triangle), EF2 (green inverted triangle), EF1 (light green inverted triangle), EF0 (dark green inverted triangle), TSTM (green circle), and Other (red circle).
- Identify/Edit Toolbox (Right):** Provides detailed information for the selected "Damage Point". The data includes: 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, and QC Flag Checked: Y. A small thumbnail image of the damage point is also shown.

At the bottom of the interface, there is a scale bar (1000 ft / 500 m) and coordinates: Latitude: 41.125381, Longitude: -94.574734. The footer text reads: "NOAA/NWS | Esri, HERE, DeLorme, iPC, Intermap, USGS, METI/NASA, EPA, USDA".



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

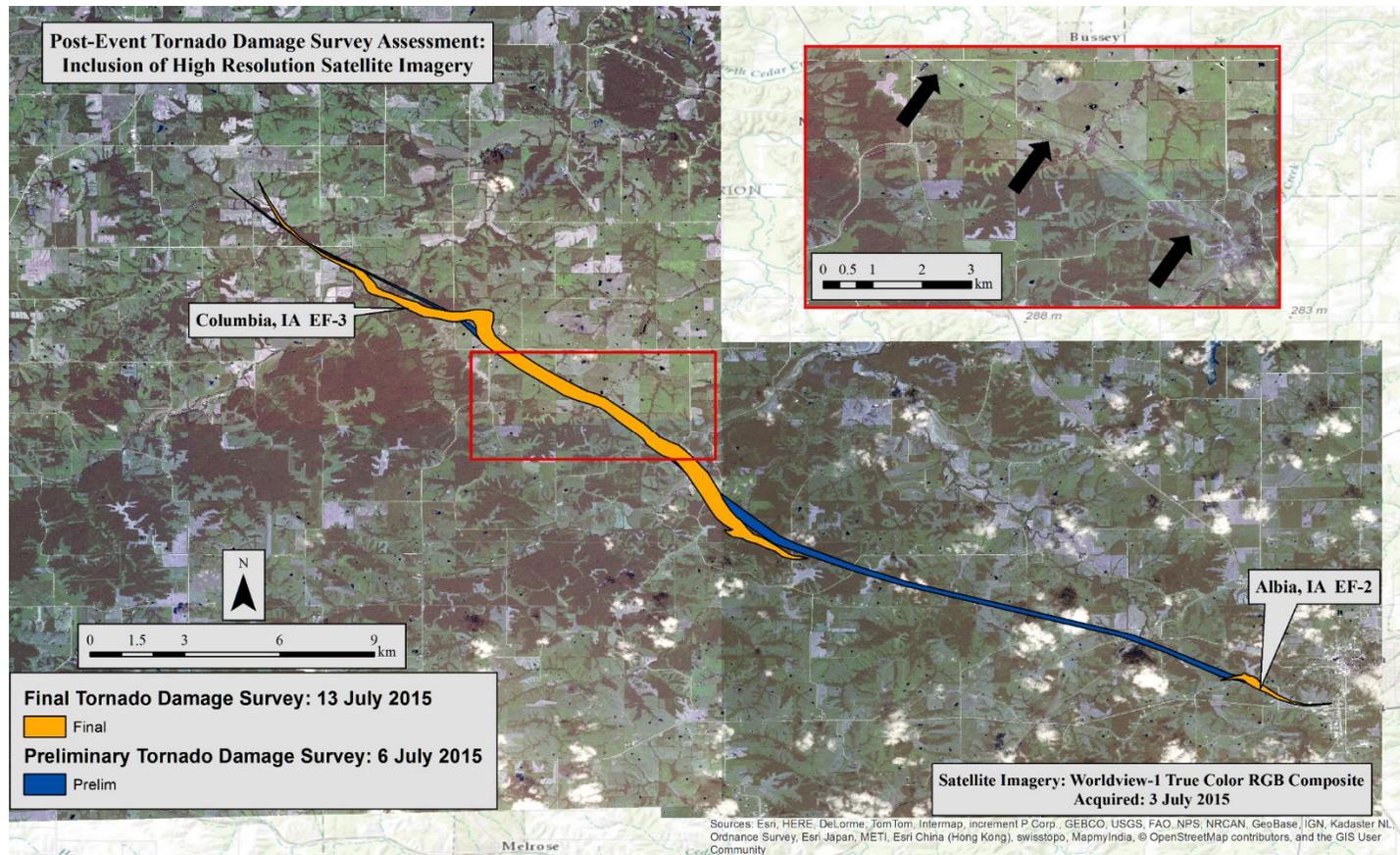
Identify/Edit Toolbox
Damage Point
Office ID: DMX Event ID: 150802_01
Latitude: 41.13023000 Longitude: -94.56450000
EF-Rating: EF1 Wind Speed: 90
Damage Date: Sun Aug 2 23:39:00 2015 UTC
Survey Date: Thu Aug 13 15:29:00 2015 UTC
Damage Indicator: Other (O)
Degree of Damage: Other damage
Damage Direction: 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?
Jason.E.Burks@nasa.gov

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