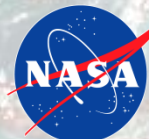


Introduction: DAT Project with NASA Applied Sciences

Science Advisory Committee Meeting

26 – 28 August, 2014

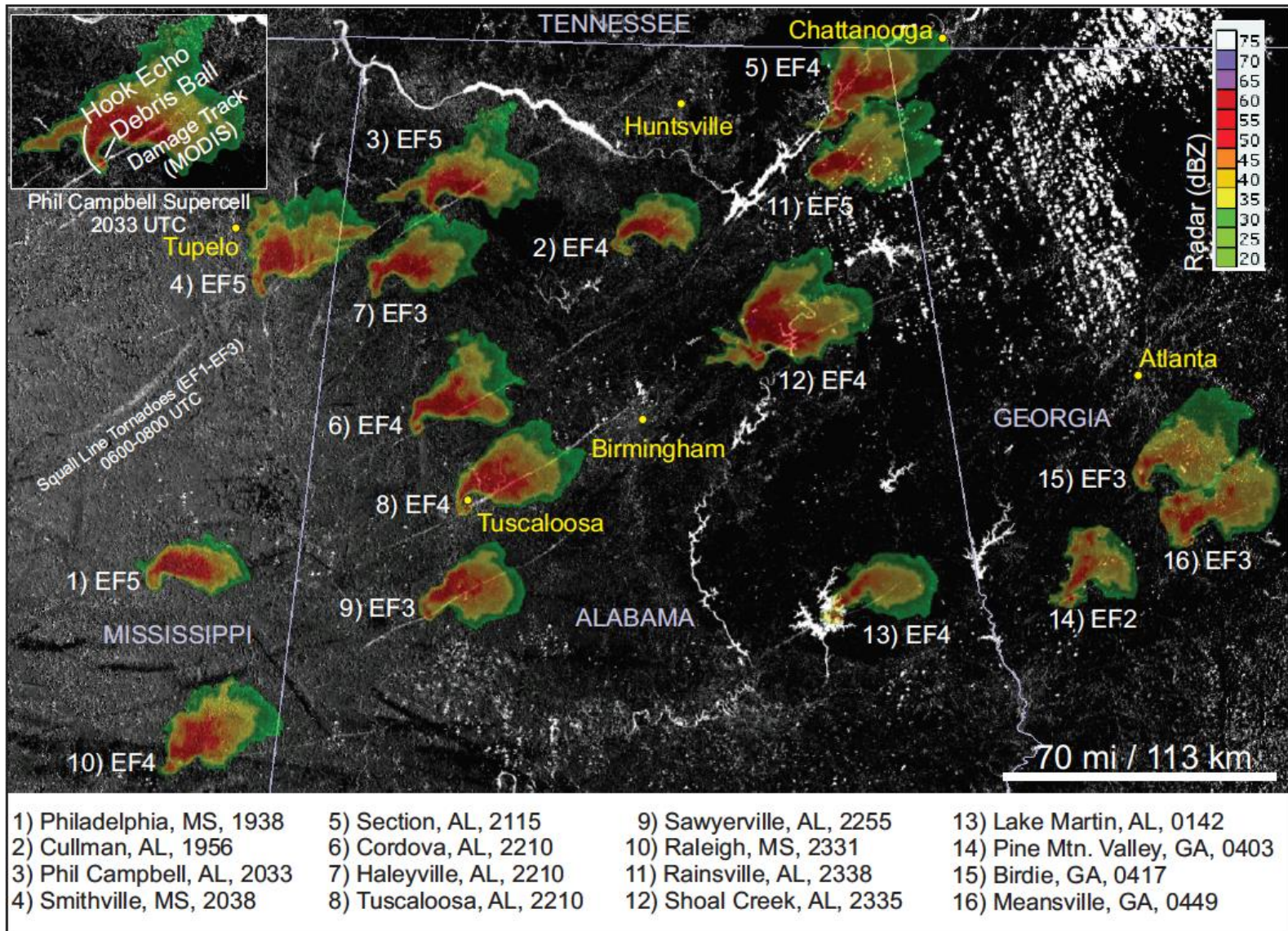
National Space Science and Technology Center, Huntsville, AL



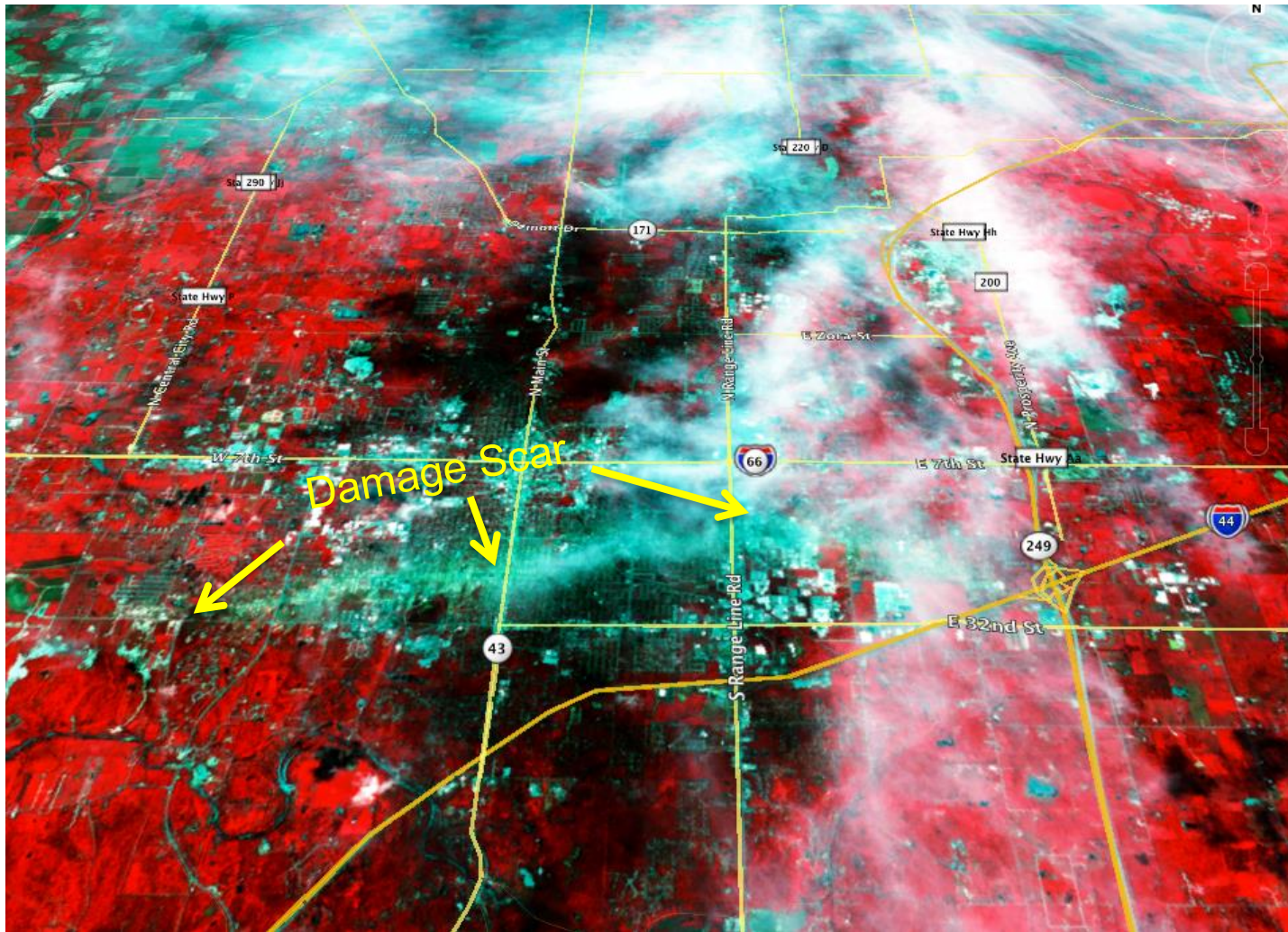
Disaster Response Activities

- SPoRT has increased involvement in disaster response:
 - Support for imagery to WFOs or the broader community following April 27, 2011 and other significant weather events
 - Extended previous work by Jedlovec et al. (2006) by providing MODIS short-term land surface change (scars) and higher-resolution ASTER to aid with April 27 track refinements and post-storm surveys
 - Developed false color composites and other products for other tornadoes in 2011 and the years that followed
 - Use of VIIRS DNB for power outage detection
 - Expanded use of the DNB, beyond WFO applications to also support non-NWS interests in disaster assessment and response.
 - Developed techniques for identifying power outages that result from severe storms and tropical cyclones by using the VIIRS day-night band
 - Applied use of the VIIRS DNB to support civil response efforts of DoD/Northern Command during Superstorm Sandy – accolades from NASA Administrator, Headquarters, and recent Agency Group Achievement Award
 - Use of commercial, higher-resolution imagery
 - Examined higher-resolution commercial imagery via USGS to develop preliminary damage identification and classification techniques





Reproduced from Molthan et al. (2012), this difference image from Terra and Aqua MODIS identifies tornado damage scars (white to gray) along the path of various supercells observed by radar during the afternoon and evening of April 27, 2011.



False color image combination from Terra ASTER, acquired on May 30, 2011, identifying the tornado damage scar across the community of Joplin, Missouri. Imagery viewed through Google Earth on a tilted plane at reduced resolution. Full resolution ASTER imagery is available at 15 m.

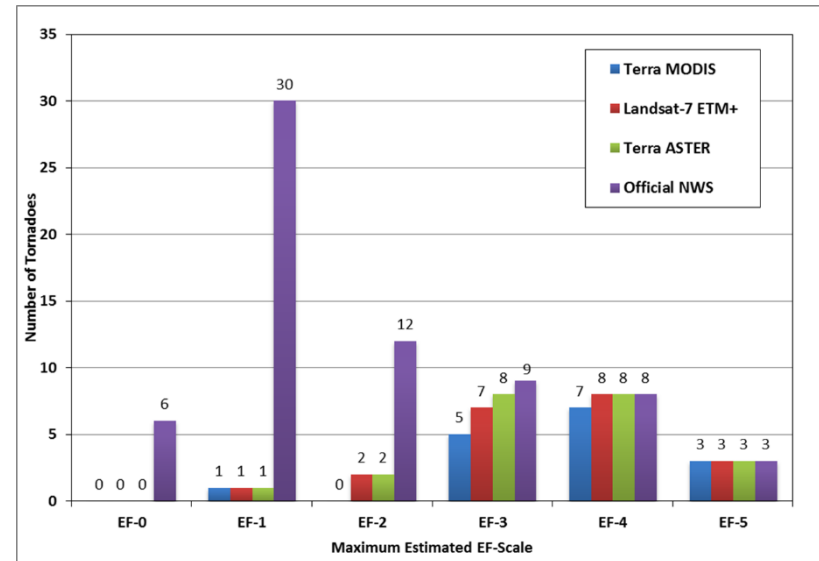
Applied Science Feasibility Study

- Efforts to support tornado damage detection techniques were continued through a ROSES Applied Sciences: Disasters proposal as a *feasibility study* in partnership with NOAA/NWS.
 - Feasibility study ran through 2012-2013
 - In the “feasibility study” phase, our goal was to demonstrate the ability to integrate Earth remote sensing within the DAT, and show potential value in a longer-term collaboration.



Applied Science Feasibility Study

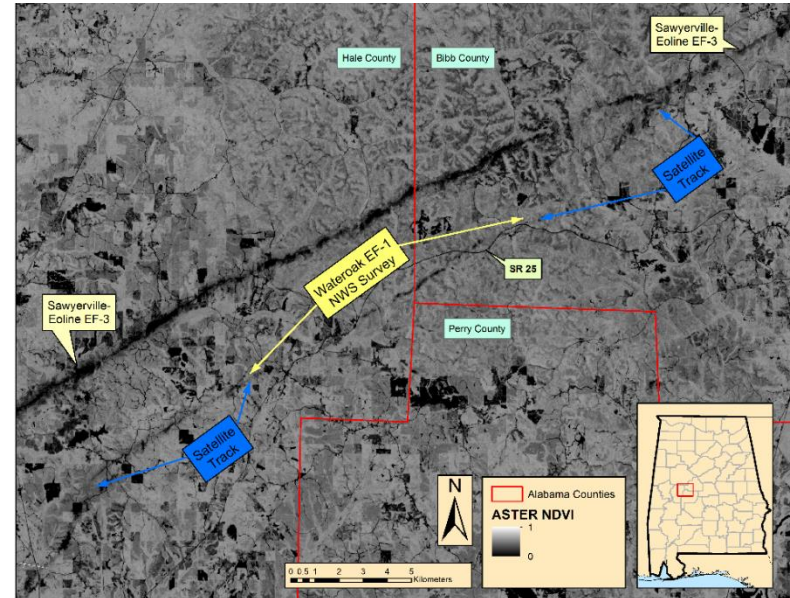
- As part of the feasibility study phase, the team evaluated tornado track detections across Alabama following the April 27, 2011 events.
- General conclusions:
 - Analysts could frequently identify damage tracks from single-day NDVI imagery using sensors such as ASTER (15 m), Landsat-7 (30 m), and MODIS (250 m).
 - Tracks were most frequently identified for tornadoes with maximum intensity of EF-3 and greater.
 - Less intense tornadoes were harder to identify due to limited path width and vegetation damage, though in some cases, higher resolution imagery was valuable for filling in track details.



Reproduced from Molthan et al. (2014), counts of identified NDVI scars (damage tracks) identified by various satellite sensors, based upon observations of tracks resulting from the April 27, 2011 event.

Applied Science Feasibility Study

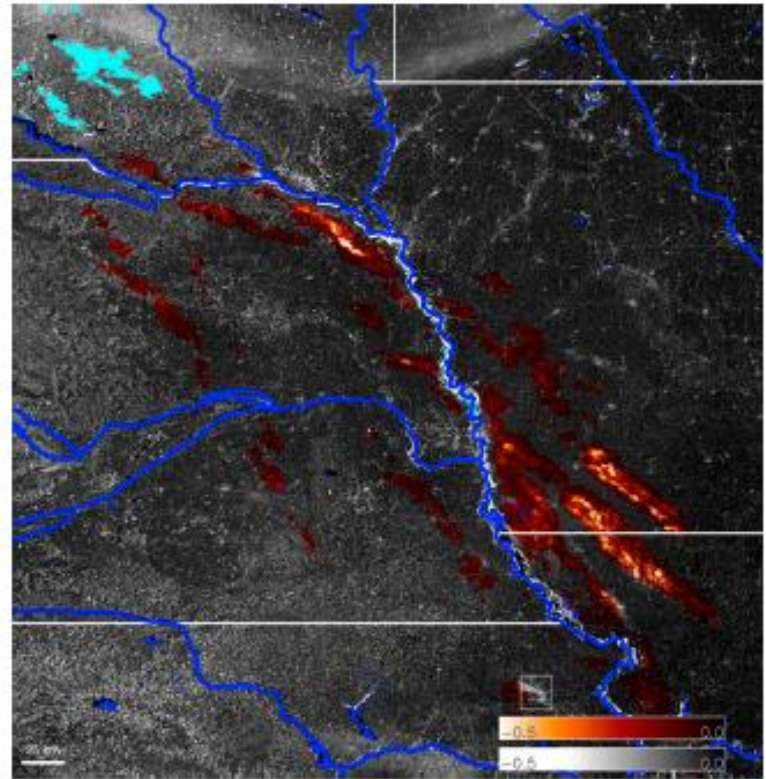
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Reproduced from Molthan et al. (2014), an example of ASTER NDVI imagery helping to identify and extend the likely path of an EF-1 maximum intensity tornado near Wateroak, AL.

Applied Science Feasibility Study

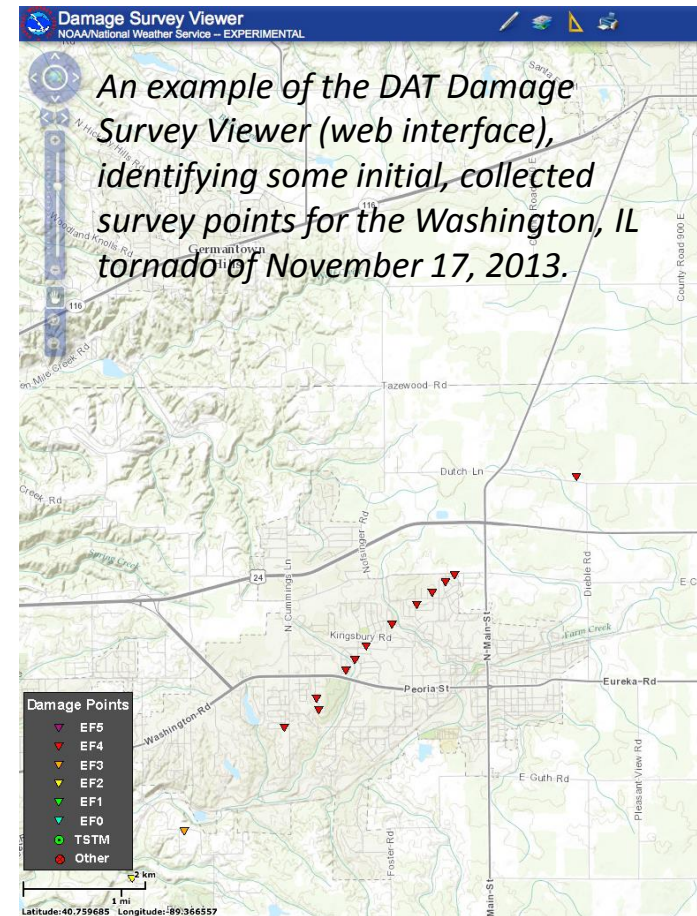
- In addition to tornado damage track detection, the team explored the use of imagery and short-term changes to identify hail damage to agriculture.
- In a case study for an event on August 18, 2011, the team concluded:
 - Combinations of short-term NDVI change and reasonable proxy for hail fall (e.g. radar products) could be used to help map damage swath areas.
 - Large swaths identified by relatively coarse MODIS imagery could be refined in more detail via higher resolution (e.g. ASTER, Landsat) imagery, which can identify individual fields and other features.
- The initial case study concept of hail damage detection is explored further as an M.S. research area by Jordan Bell (UAH/SPoRT)



Reproduced from Molthan et al. (2013), a short-term NDVI differencing technique from MODIS, identifying red areas as vegetation change (loss) coinciding with radar-detected severe hail.

Applied Science Feasibility Study

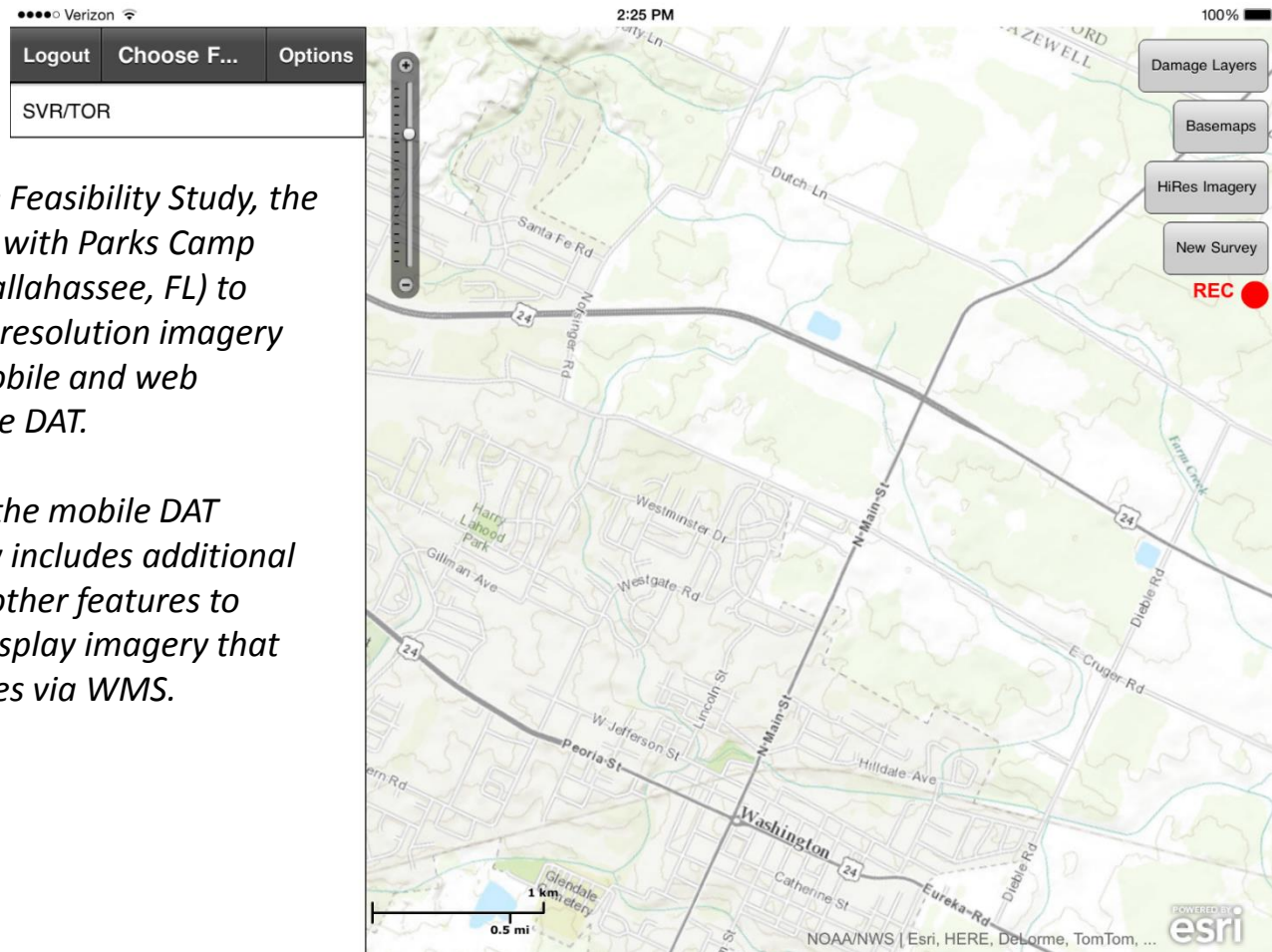
- In addition to tornado and hail damage analysis, the feasibility study focused on inclusion of Earth remote sensing within the NOAA/NWS Damage Assessment Toolkit, or DAT.
- The DAT is a smartphone, tablet, and web-based framework for acquiring tornado damage locations and assigning estimated intensity.
- Once acquired, the various data points are then used to characterize the damage path and assign overall intensity or intensity at various points along the path.



Applied Science Feasibility Study

As part of the Feasibility Study, the team worked with Parks Camp (NWS WFO Tallahassee, FL) to integrate full resolution imagery within the mobile and web versions of the DAT.

Shown here, the mobile DAT interface now includes additional buttons and other features to search and display imagery that SPoRT provides via WMS.



Applied Science Feasibility Study

An additional toggle button creates a menu to search for available imagery based upon the viewing location and time of year.

Caching of imagery allows users to download data before they go out to the field, ensuring availability despite a loss of cellular data.

Verizon 2:26 PM 100%

Logout Choose F... Options

SVR/TOR

Target Date: Fri Nov 15 2013

Buffer: 30 Days either side of target.

Opacity: 70

Cache Imagery Clear Imagery

Online --

SPoRT

Offline --

SPoRT

Hi-res imagery courtesy NASA-SPoRT.
RED indicates restricted data. Do NOT redistribute.

Damage Layers

Basemaps

HiRes Imagery

New Survey

REC

NOAA/NWS | Esri, HERE, DeLorme, TomTom, ...

POWERED BY esri

Applied Science Feasibility Study

In this example, the WMS has two types of imagery available for Washington, IL in the period of interest:

MODIS true color imagery provided via SPoRT, and higher resolution Worldview (commercial) imagery provided via the USGS.

The screenshot displays a mobile application interface for a Web Map Service (WMS). The interface includes a top navigation bar with 'Logout', 'Choose F...', and 'Options' buttons. Below this is a search bar containing 'SVR/TOR'. The main area shows a map of Washington, IL, with a control panel overlay. The control panel is titled '2:26 PM' and '100%' battery. It features a 'Target Date' field set to 'Fri Nov 15 2013', a 'Buffer' field set to '30 Days either side of target', and an 'Opacity' slider set to '70'. There is a 'Cache Imagery' checkbox checked and a 'Clear Imagery' button. Below these are sections for 'Online -- SPoRT' and 'Offline --'. The 'Online -- SPoRT' section lists 'MODIS' and 'Worldview; Panchromatic'. The 'Offline --' section lists 'SPoRT'. A red 'REC' indicator is visible on the right side of the control panel. The map shows streets like Santa Fe Rd, Harry Lahood Park, Gillman Ave, Westgate Rd, Lincoln St, N Main St, Hilldale Ave, Peoria St, W Jefferson St, Catherine St, Eureka Rd, and Diabie Rd. A scale bar indicates 0.5 mi and 1 km. The map is powered by Esri, with data from NOAA/NWS, Esri, HERE, DeLorme, and TomTom.

Applied Science Feasibility Study

By drilling down through the data menus, an image can be loaded for this specific event and then displayed within the DAT application.

The screenshot displays the SPoRT application interface. At the top left, there is a menu with options: "Logout", "Choose F...", and "Options". Below this menu, the text "SVR/TOR" is visible. The main area shows a map of a residential area with streets like Santa Fe Rd, Harry Lahood Park, Gillman Ave, Westgate Rd, Lincoln St, N Main St, Hilldale Ave, Peoria St, W Jefferson St, Washington, Catherine St, Eureka Rd, and Diabie Rd. A scale bar indicates 0.5 miles and 1 kilometer. A central dialog box is open, showing settings for a target date of "Fri Nov 15 2013" and a buffer of "30 Days either side of target". The opacity is set to "70". There is a checked "Cache Imagery" option and a "Clear Imagery" button. The dialog also lists "Online -- SPoRT_Worldview;Panchromatic" and "Offline -- SPoRT". A red "REC" indicator is visible on the right side of the map. The bottom right corner of the map area says "POWERED BY esri" and "NOAA/NWS | Esri, HERE, DeLorme, TomTom, ...".

Applied Science Feasibility Study

Verizon

Logout Choose F... Options

SVR/TOR

2:26 PM 100%

Target Date: Fri Nov 15 2013

Buffer: 30 Days either side of target.

Opacity: 70

Cache Imagery Clear Imagery

Online -- SPoRT_Worldview;Panchromatic_Nov_17_2013Tornadoes

2013-11-18 18:30:00

Offline --

SPoRT

Hi-res imagery courtesy NASA-SPoRT.
RED indicates restricted data. Do NOT redistribute.

NOAA/NWS | Esri, HERE, DeLorme, TomTom, ...

POWERED BY esri

Date and time for the Worldview image is shown, and here, a red text view is a reminder that this imagery is restricted for NOAA/NWS use only, and not available for public release.

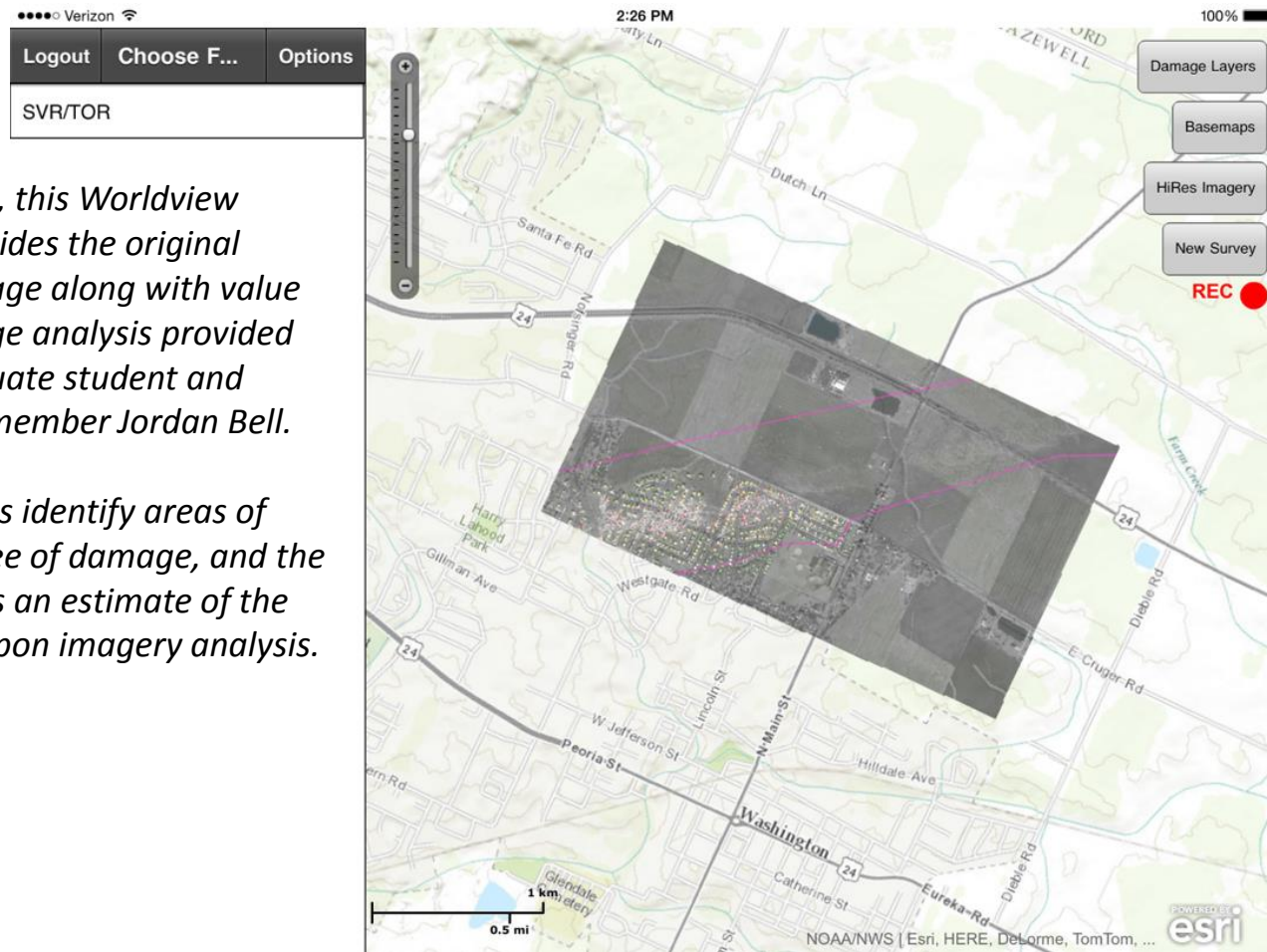
Certain data sets are restricted to use by governmental agencies (not released to the public) due to their licensing requirements.



Applied Science Feasibility Study

When loaded, this Worldview example provides the original grayscale image along with value added damage analysis provided by UAH graduate student and SPoRT team member Jordan Bell.

Colored points identify areas of varying degree of damage, and the pink outline is an estimate of the path based upon imagery analysis.

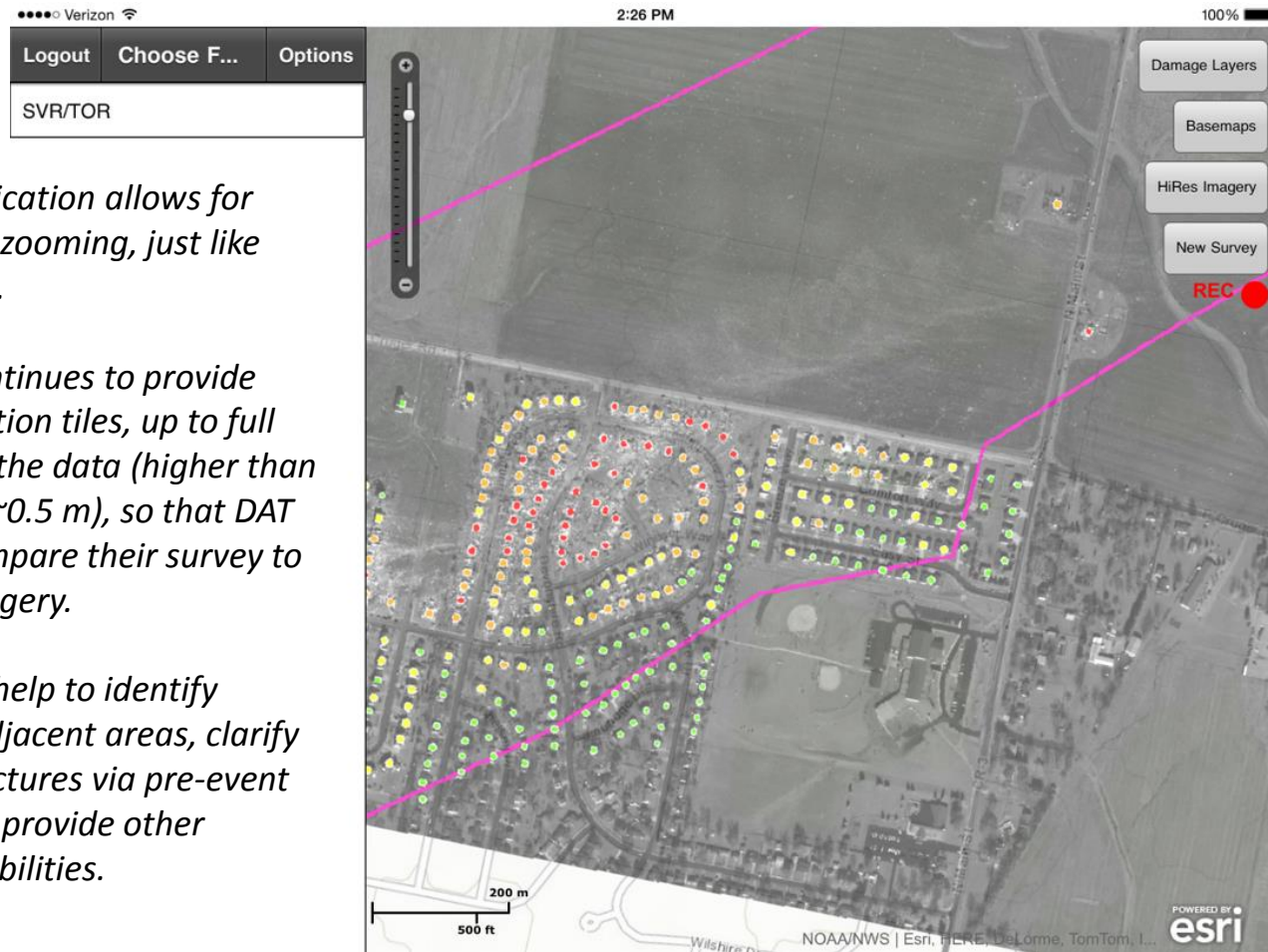


Applied Science Feasibility Study

The DAT application allows for pinching and zooming, just like Google Maps.

The WMS continues to provide higher resolution tiles, up to full resolution of the data (higher than shown here, ~0.5 m), so that DAT users can compare their survey to available imagery.

Imagery can help to identify damage in adjacent areas, clarify previous structures via pre-event imagery, and provide other analysis capabilities.



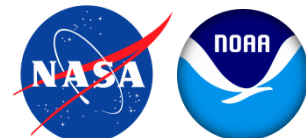
Applied Science Decisions Award

- Following our successful “feasibility study” award, the team was awarded a three-year follow-on “Decisions” award
 - Goals of the Decisions phase require a transition of track detection capabilities to NOAA/NWS operations
 - During this transition phase, the proposal team will provide support and guidance to NOAA/NWS on the use and integration of satellite products for the DAT



Applied Science Decisions Award

- Goals of the Decisions award include:
 - Near real-time products to the DAT, derived from MODIS and VIIRS. Likely products include vegetation index (NDVI) and short-term change detection.
 - The team will develop additional tools to aid NOAA/NWS in the integration and processing of imagery from ASTER, Landsat-7, and Landsat-8
 - New tools and capabilities for the processing and display of highest resolution commercial imagery
 - Support to end users with relevant training, end-user surveys and improvements via end user feedback
- Recently, the team met in July 2014 to carve out an initial, but comprehensive plan to transition capabilities to NOAA/NWS implementation



Applied Science Decisions Award

- 2014-2015 Collaborations:
 - The team will provide teletraining to NWS Southern Region partnering offices to prep for the fall severe weather season.
 - Near real-time products available via the WMS/DAT, and additional support for commercial imagery.
 - Learn from experiences in Southern Region and prepare for additional office partnerships in Central Region for Spring 2015.
 - Use experiences gained in the first year to refine a transition plan executed in years two and three.



Applied Science Decisions Award

- After the first year, the team will partner with NOAA/NWS staff to identify means of:
 - Migrating WMS capabilities and DAT-specific techniques for data integration to NOAA-managed resources
 - Transitioning open-source code and scripting (e.g. Python) to NWS partners for execution following severe weather events
 - Refining end-user training and modifying products or delivery, as necessary, to improve use in disaster response



Upcoming Presentations

- Applications of Web Mapping Services (Burks)
- New Techniques for Damage Detection (Bell)
- VIIRS DNB for Disaster Response (Molthan)
- Future Disaster Activities (Molthan)

