Near Real-Time Applications of Earth Remote Sensing for Response to Meteorological Disasters

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Background

- Natural hazards become disasters when they affect life or property.
- Many natural disasters are meteorological in nature:
  - Tornadoes, hurricanes, typhoons, (lightning-induced) wildfires, drought, floods, blizzards, and others not listed.
- In responding to a natural or human-caused disaster, the weather related to the event is often *critical to response efforts:*
  - First responders can be threatened by other storms that follow.
  - Those impacted may find themselves without adequate shelter.
  - Weather affects dispersion in both water and air.
- Near real-time remote sensing offers several capabilities to support disaster assessment and response.
  - In addition, the broader availability of near real time Earth remote sensing provides continuity of weather observations to support response activities.

The SPoRT Disasters Team

- SPoRT has a 10+ year relationship supporting NOAA's National Weather Service, providing new satellite products, analysis techniques, appropriate training, and collaborative partnerships.
- SPoRT provided imagery to NWS offices following the April 27, 2011 "Super Outbreak" of tornadoes across the southeastern U.S.
  - ROSES 2011: Applied Sciences: Disasters "feasibility study" award
- Primary goals of the feasibility study:
  - Include near real-time Earth remote sensing within the NWS "Damage Assessment Toolkit", the smartphone app used in the tornado damage survey process.
  - Demonstrate that satellite data adds value to the survey process.
  - Explore additional techniques for supporting disaster response and assessment via use of near real-time NASA, NOAA, and other data.
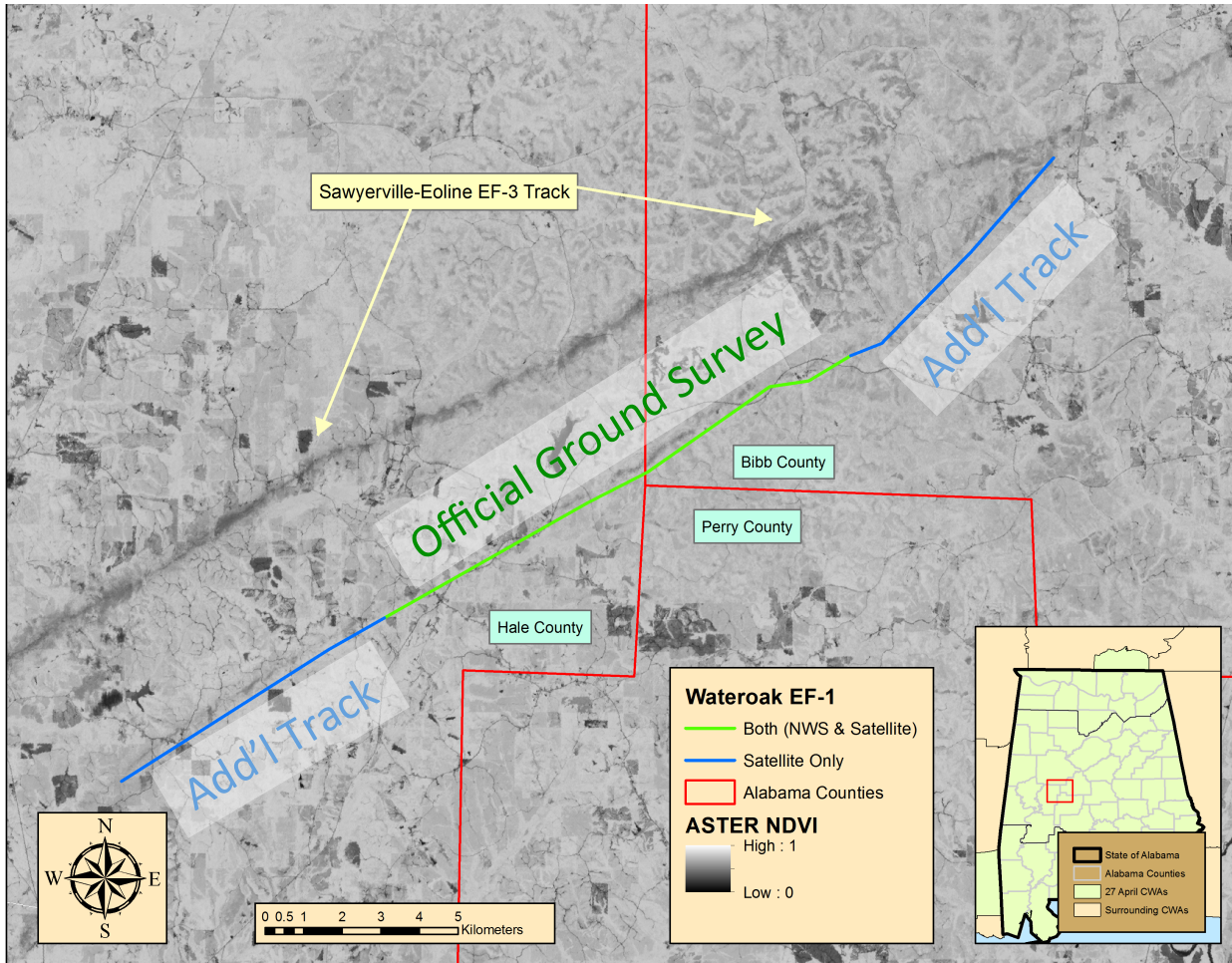
Case Study: April 27, 2011
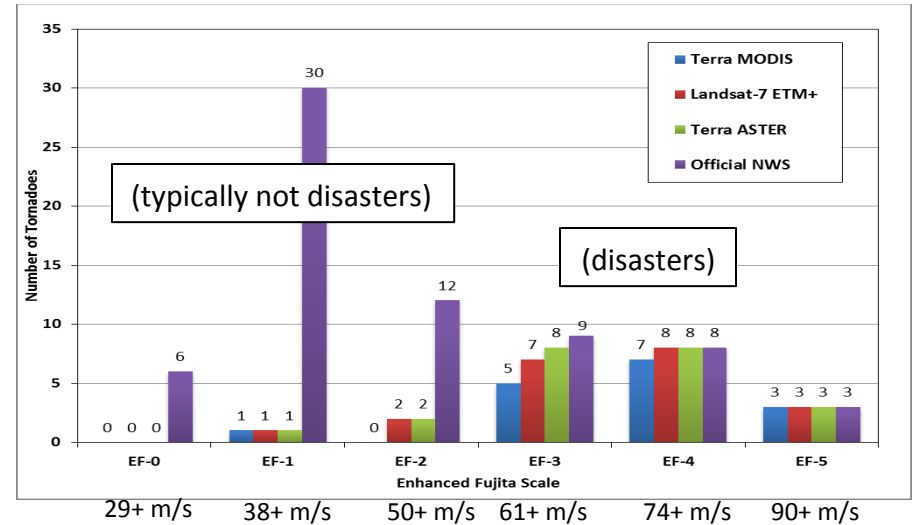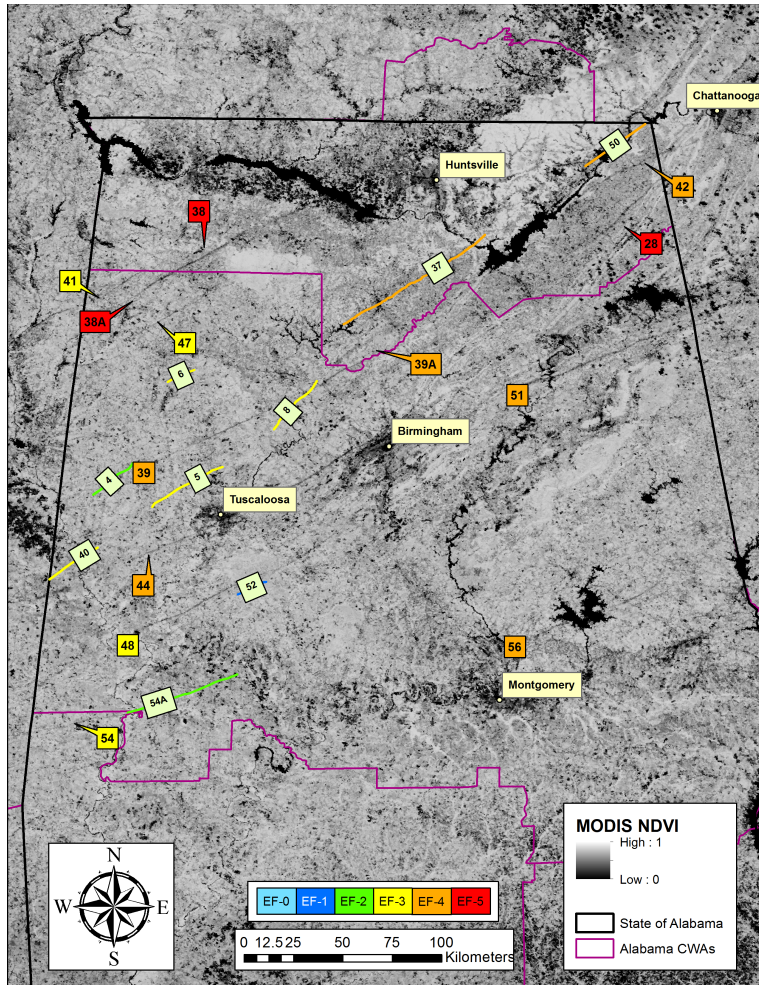
- We examined all Alabama tornadoes from April 27, 2011 and track detection from MODIS, Landsat-7, or ASTER.
  - Bell et al. (in review)
- Most tornadoes typically causing disasters (EF-2+) produce tracks visible in NDVI imagery during the primary severe weather season (March-August).
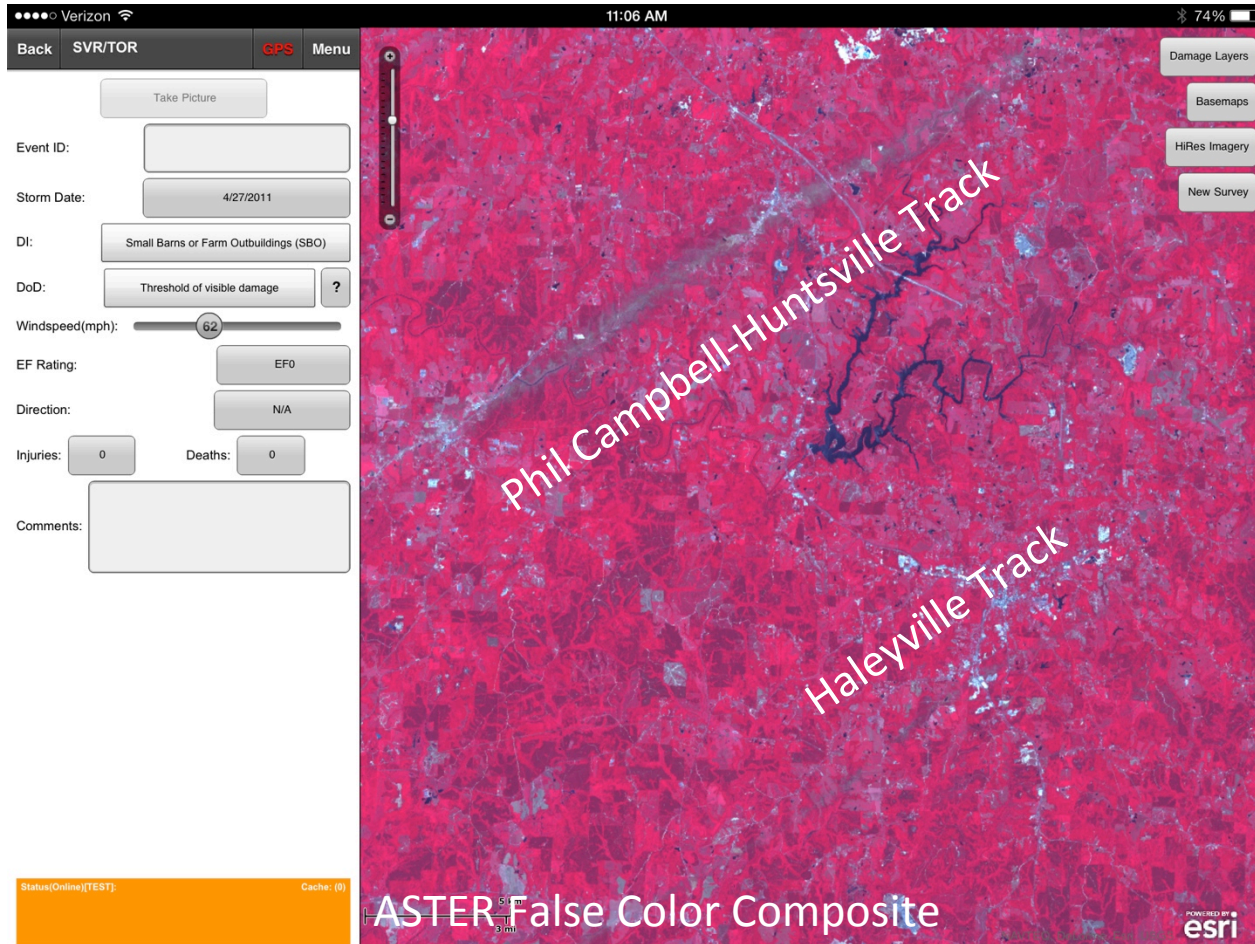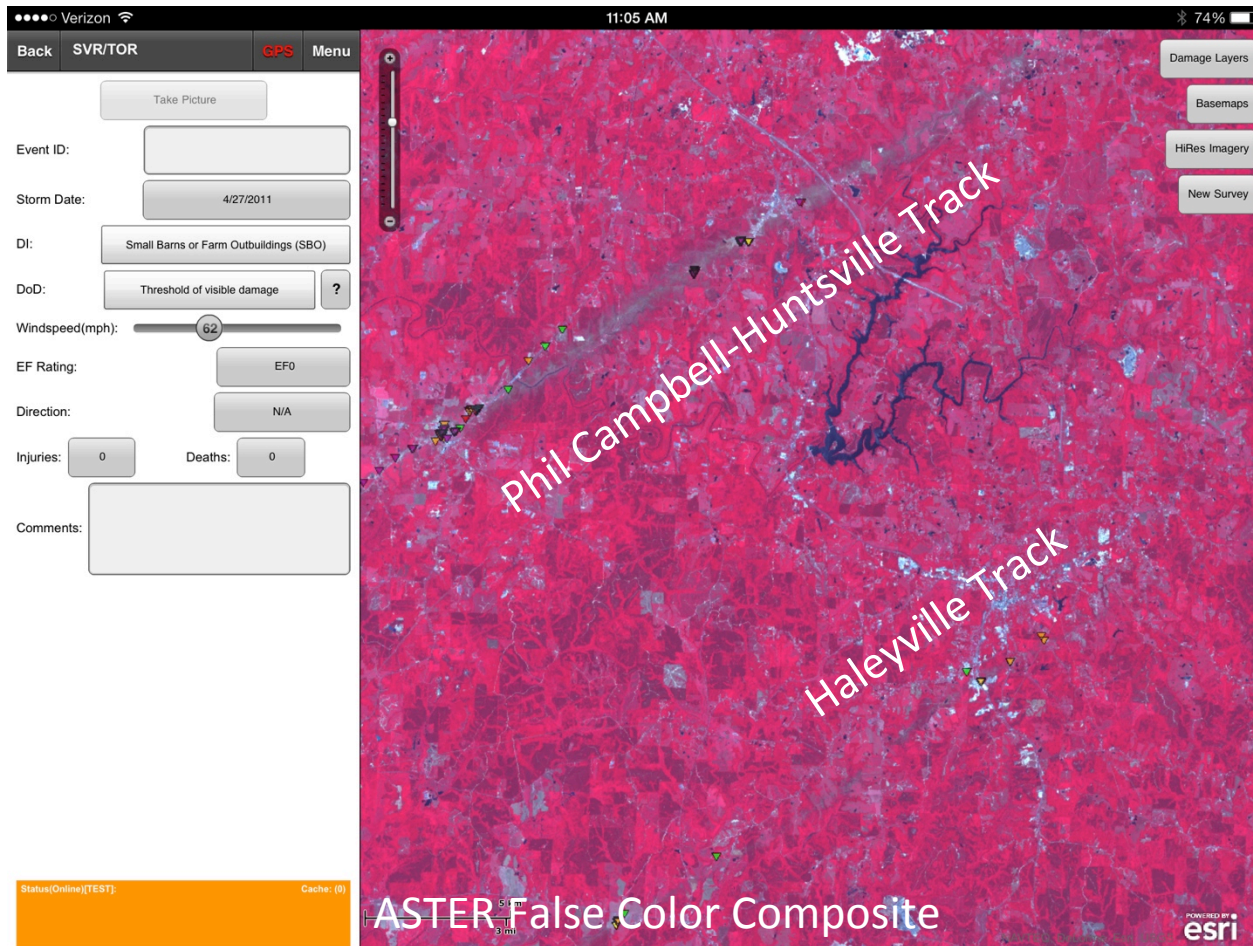
Case Study: April 27, 2011

In this example, the EF-3 tornado damage track is readily apparent.

An EF-1 track was also surveyed and is apparent from visual inspection, however, the ground survey limited the track extent. It may have been extended if satellite imagery were available.

Enabling Data Access
Integration into the Damage Assessment Toolkit

ASTER False Color Composite

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ASTER False Color Composite

Phil Campbell-Huntsville Track

Haleyville Track

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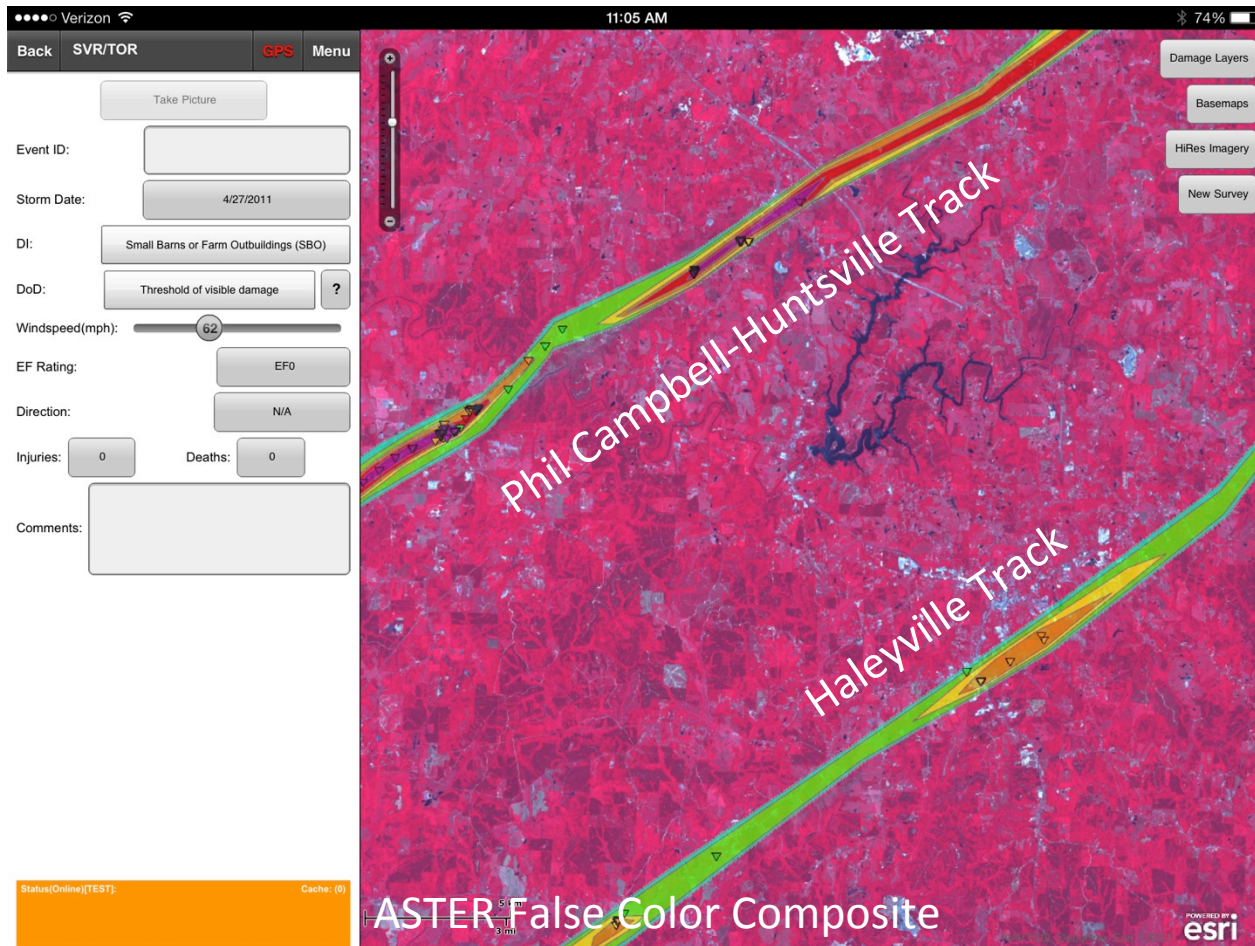
Enabling Data Access
Integration into the Damage Assessment Toolkit

- Integration within the DAT is provided through WMS capabilities, which download appropriate data sets, resolution, and tiles, including access when cellular data is not available.

- Latency of data is an issue, but surveyors make use of data as it becomes available, even well after the event.

  - Minor track corrections, reassessment, identifying damage that can't be easily accessed, checking for consistency between offices performing surveys, and other activities.

Significant Events in 2013

- The feasibility study resulted in an evaluation version of the DAT application, suitable for testing the integration of satellite data sets.

- The SPoRT Disasters Team has examined use of NRT data within the DAT for:
  - The May 20, 2013 EF-5 tornado in Moore, OK
  - The November 17, 2013 EF-4 tornado in Washington, IL

Moore, Oklahoma Tornado
May 20, 2013

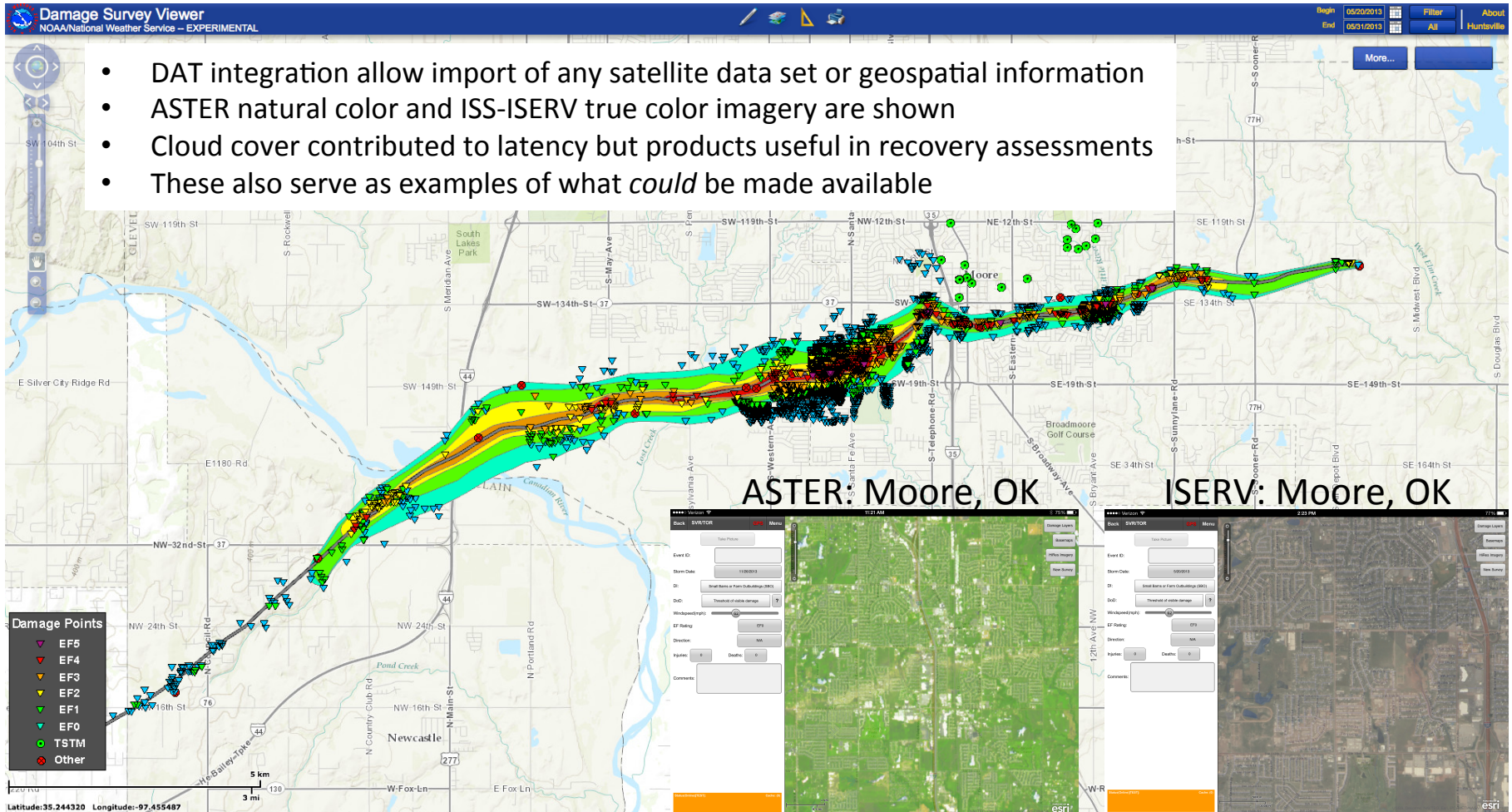Placeholder for Jordan's damage analysis

Moore, Oklahoma Tornado

May 20, 2013

- DAT integration allow import of any satellite data set or geospatial information
- ASTER natural color and ISS-ISERV true color imagery are shown
- Cloud cover contributed to latency but products useful in recovery assessments
- These also serve as examples of what *could* be made available

ASTER: Moore, OK   ISERV: Moore, OK

Damage Points
- ▽ EF5
- ▽ EF4
- ▽ EF3
- ▽ EF2
- ▽ EF1
- ▽ EF0
- ○ TSTM
- ⊗ Other

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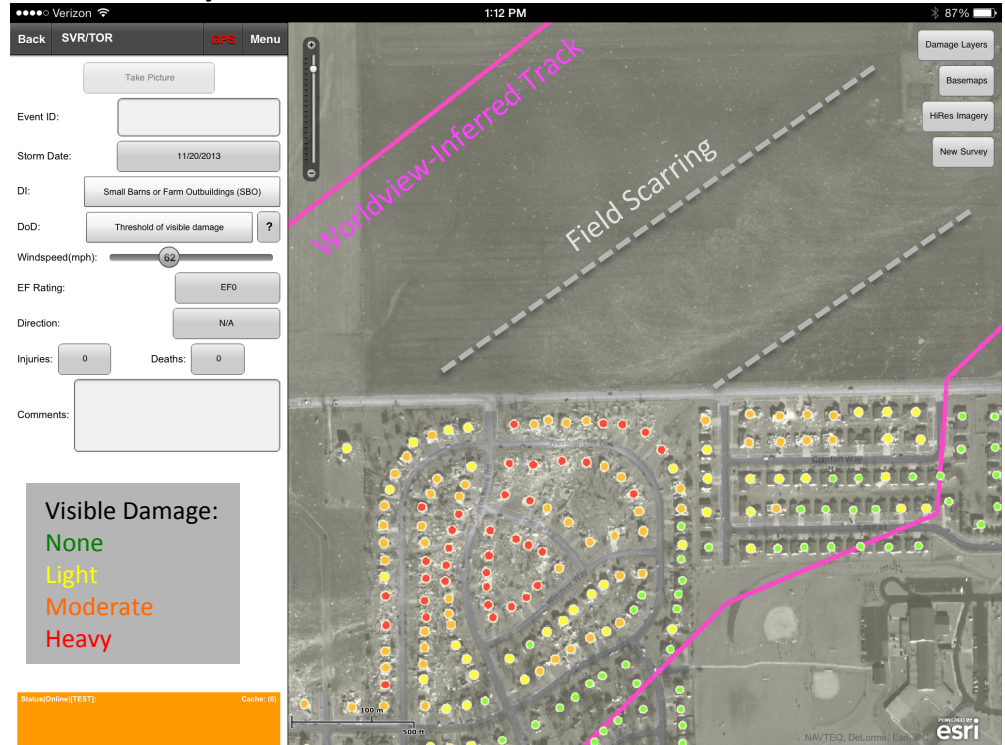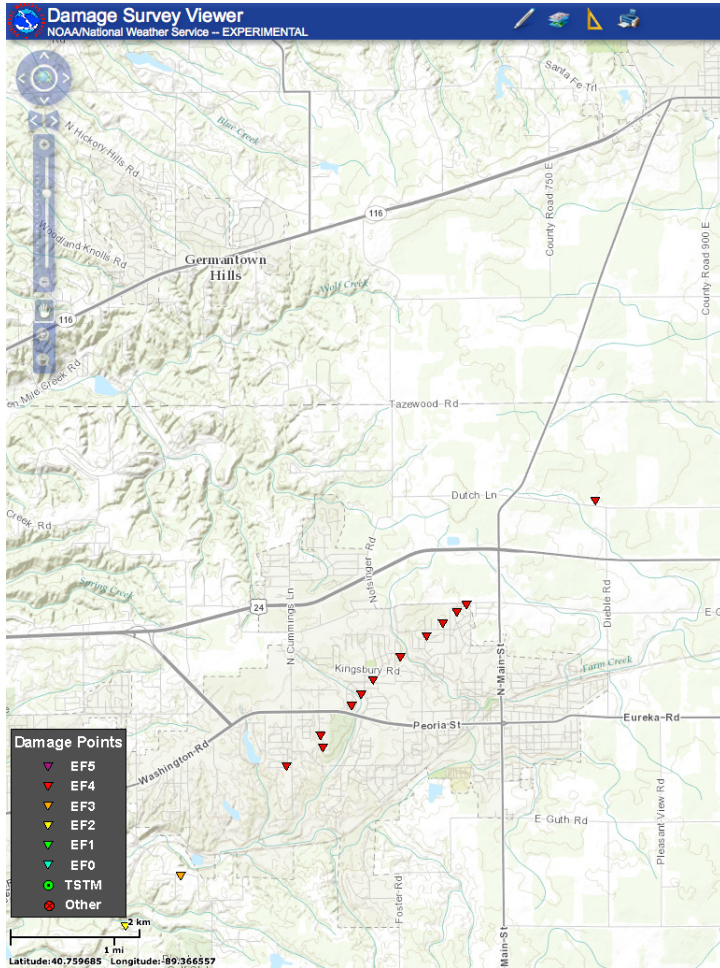
Peoria/Washington, Illinois Tornado

November 17, 2013

Worldview image of tornado damage in Washington, IL. Damage categories assessed by J. Bell of SPoRT Disasters Team. Underlying Worldview panchromatic image (~0.5m) copyright DigitalGlobe, provided via USGS for disaster response efforts.

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Early Praise for NASA/NOAA DAT Collaborations

"*Using this (high resolution) imagery, we can revolutionize the way we conduct surveys* ... If we had this imagery much sooner (*even within a month*), there's no telling how dead-on we could be with our surveys...and there would be little to no mistaking what actually happened (tornado vs. straight line winds)."

        -- NWS Collaborator, Nashville, TN

"[The proposal team] got us images for the Moore, OK Tornado and the [Norman NWS] ... working with Parks Camp (proposal collaborator, NWS Tallahassee) and NASA ... re-defined the polygon as we were able to make the images available in Damage Assessment Toolkit. The imagery is very useful and has come in very handy for these types of events. Fortunately these also worked for the River Flooding in NWS Central Region's area. *I think we should support this and the images have already been used in operations*."

        -- NWS Collaborator, NWS Southern Region HQ

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Summary and Future Work

- The SPoRT Disasters Team has successfully performed a feasibility study demonstrating integration of NRT Earth remote sensing within the NWS Damage Assessment Toolkit
  - Demonstrated benefits from April 27, 2011 case study in addition to high impact events of 2013.
  - Significant, early praise and excitement already received from NOAA/NWS partners.
- The team plans to continue supporting NOAA/NWS partners as part of a three-year Applied Sciences: Decisions award, if received in FY2014.

Questions?

- Contact: andrew.molthan@nasa.gov

- Interested in learning more?
  - Visit our Hyperwall presentation at the NASA Exhibit Booth (#325) in Moscone North Hall.
  - Tuesday, December 10 from 10:00-10:15 am.
  - Additional information about tornado applications, plus extension to wildfires and tropical cyclones.