Applications of S-NPP Products for Disaster Response

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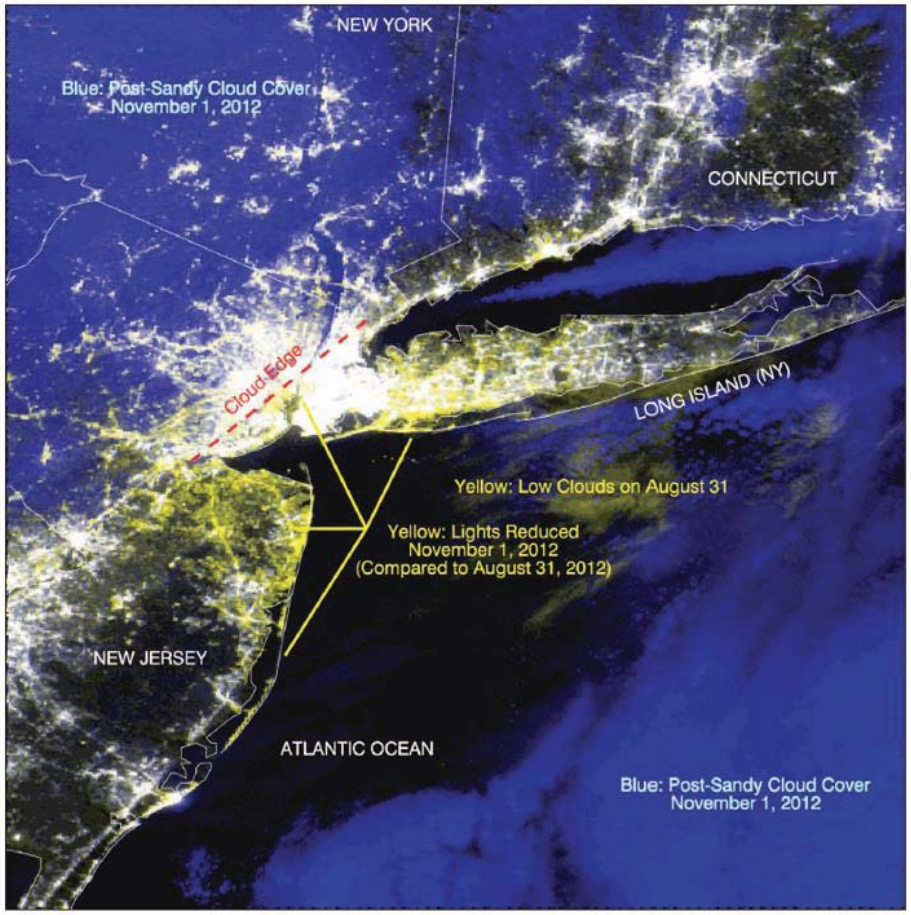
Background

- SPoRT has a well-established presence in supporting the NASA Applied Sciences: Disasters emphasis area, many incorporating observations from S-NPP / VIIRS, either extending MODIS capabilities or advantages of the DNB.
- Selected Examples:
  - Applications of the VIIRS DNB in response to Superstorm Sandy – data used by Department of Defense in civil response, acknowledged in 2012 annual report
  - Similar activities and applications for Super Typhoon Haiyan, referenced in 2013 annual report
  - Integration of S-NPP VIIRS observations for severe storm damage within the NOAA/NWS Damage Assessment Toolkit, as part of ongoing "Decisions" award from ROSES 2011: Disasters solicitation
  - Support to the SERVIR program (Applied Sciences: Capacity Building) through collaborations at Marshall Space Flight Center
- In 2014, our successes were acknowledged by an agency-wide *Group Achievement Award* to the SPoRT Disaster Response Team

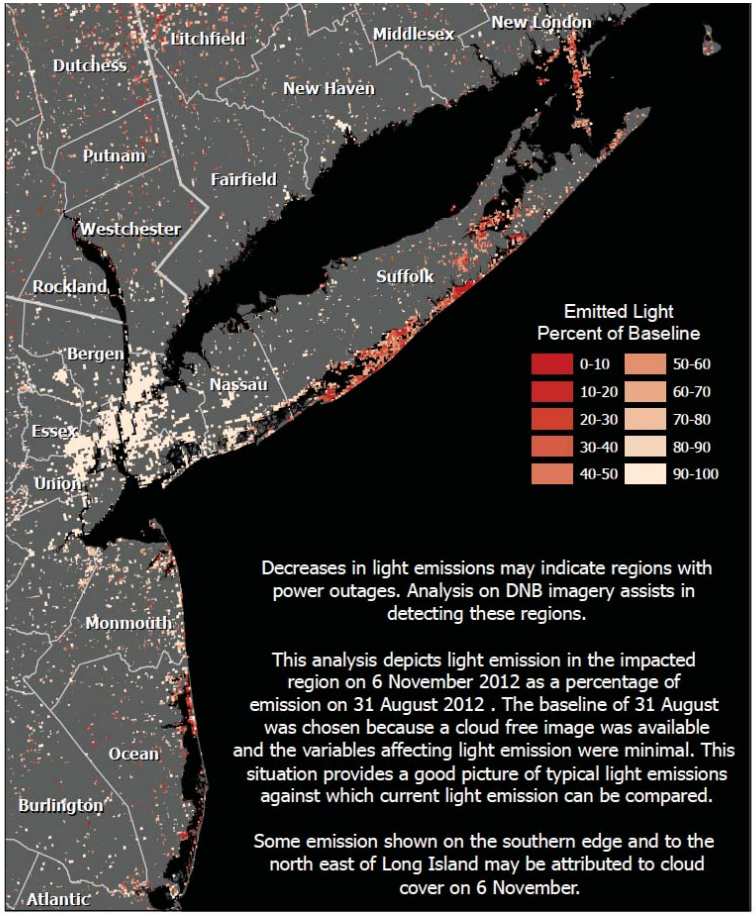
Use of the VIIRS DNB

- Since the VIIRS DNB observes light emitted from human activities, we focus on the loss or change in pre-event light in order to identify affected areas and recovery
- Two concepts have been explored to date:
  - False color RGB compositing to highlight changes in light
    - Using a composite where R and G are pre-event, and B as post-event, missing lights are highlighted in shades of yellow.
  - Differencing pre- and post-event to produce a "percent of normal light"
    - In a more quantitative approach, dividing current emissions by a reasonable pre-event baseline allows for monitoring current light conditions and trends toward normal during recovery efforts
- Disaster response can be further supported by identifying populations and infrastructure located within outage areas.

Concepts Applied to Superstorm Sandy

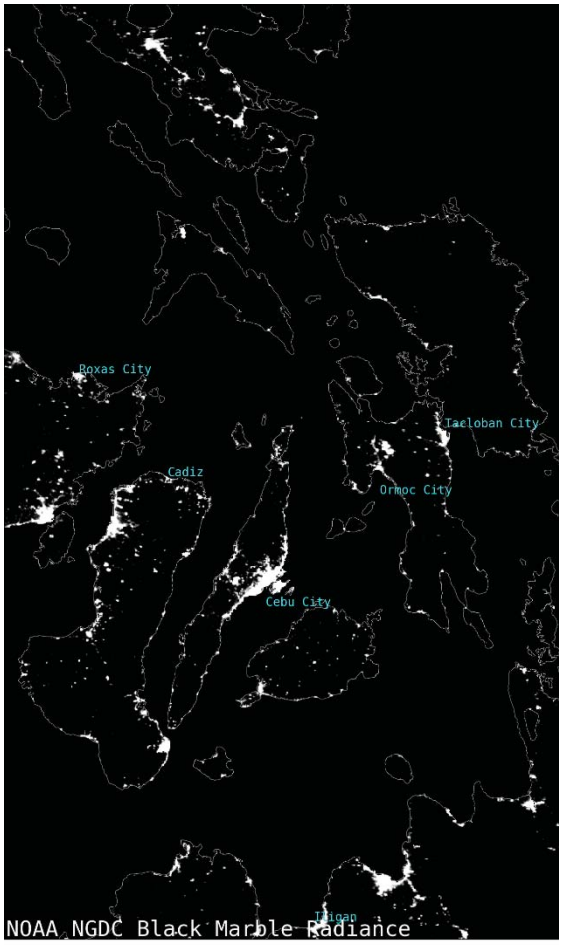


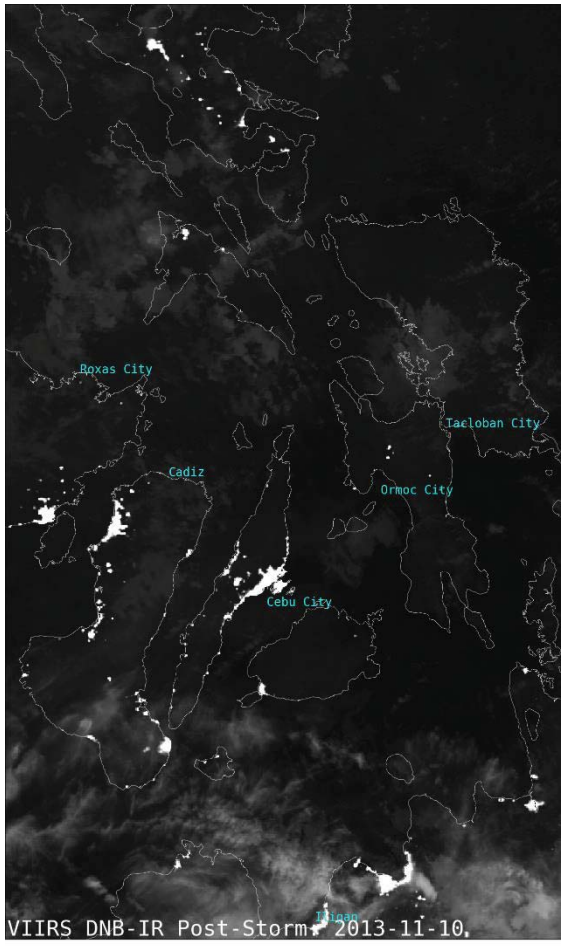
False color composite of pre- and post-storm VIIRS DNB imagery over New York and New Jersey following Superstorm Sandy (reproduced from Molthan et al. 2013)

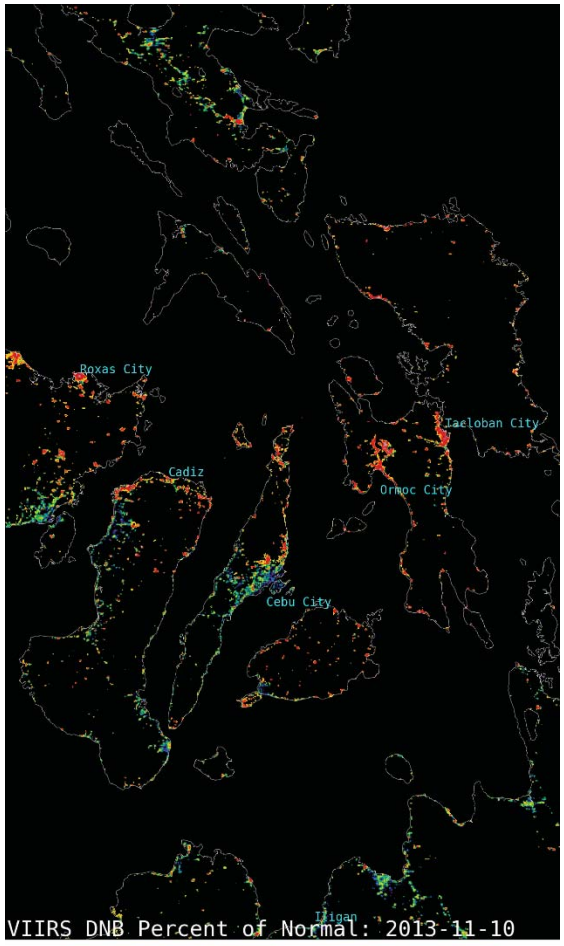


SPoRT provided U.S. Northern Command with daily VIIRS DNB and guidance on deriving "percent of baseline" light emissions used by DoD in recovery efforts.

Outages from Typhoon Haiyan



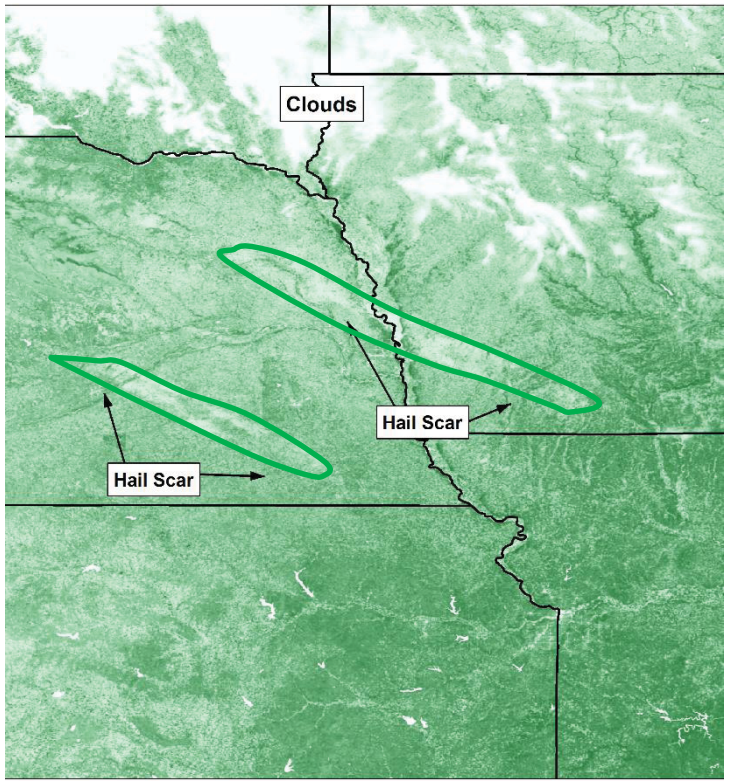




NOAA/NGDC Black Marble global lights, post-typhoon lights and cloud cover, and difference imagery over the Philippines following Super Typhoon Haiyan. The Black Marble serves as pre-event "normal" light.

Applications to Severe Weather

- As with tornado track detection, hail causes significant damage to vegetation
- Damage can be identified as changes in vegetation index (e.g. NDVI) and land surface temperature, but manual analysis is too time consuming
- Develop algorithm to identify damage areas
  - Incorporate NDVI and land surface temperature to *objectively* identify scars
  - Extract as geospatial features



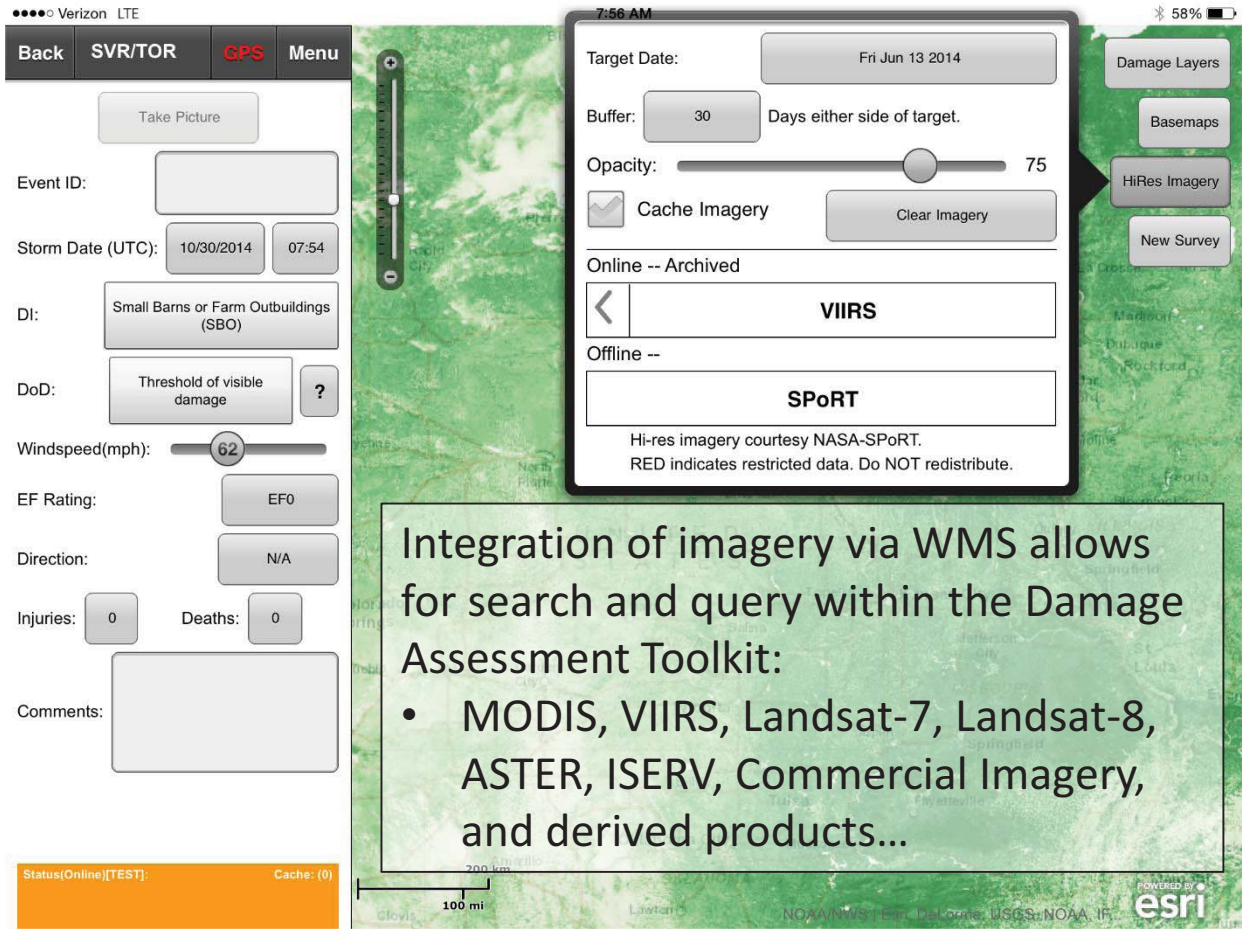
Hail damage scars across Nebraska and Iowa from a mid-June severe weather event in 2014

End-User Decision Support

- Products generated by the SPoRT Disasters Team are integrated into a web mapping service and provided to the NOAA/NWS Damage Assessment Toolkit (DAT)
- The DAT is a handheld smartphone, tablet, and web-based application that NWS meteorologists use to identify and catalog damage from severe storms

Integration with NOAA/NWS

Damage Assessment Toolkit



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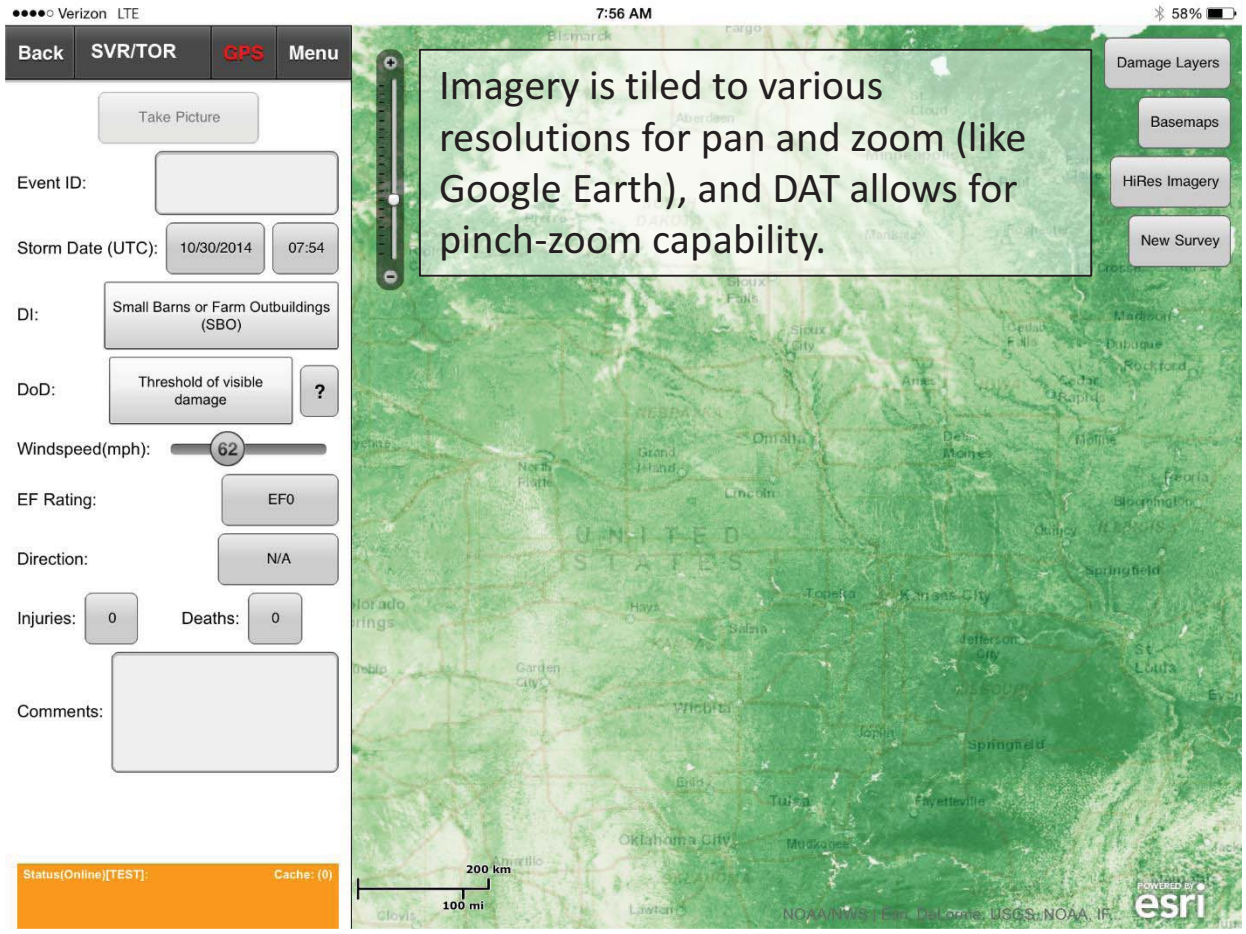

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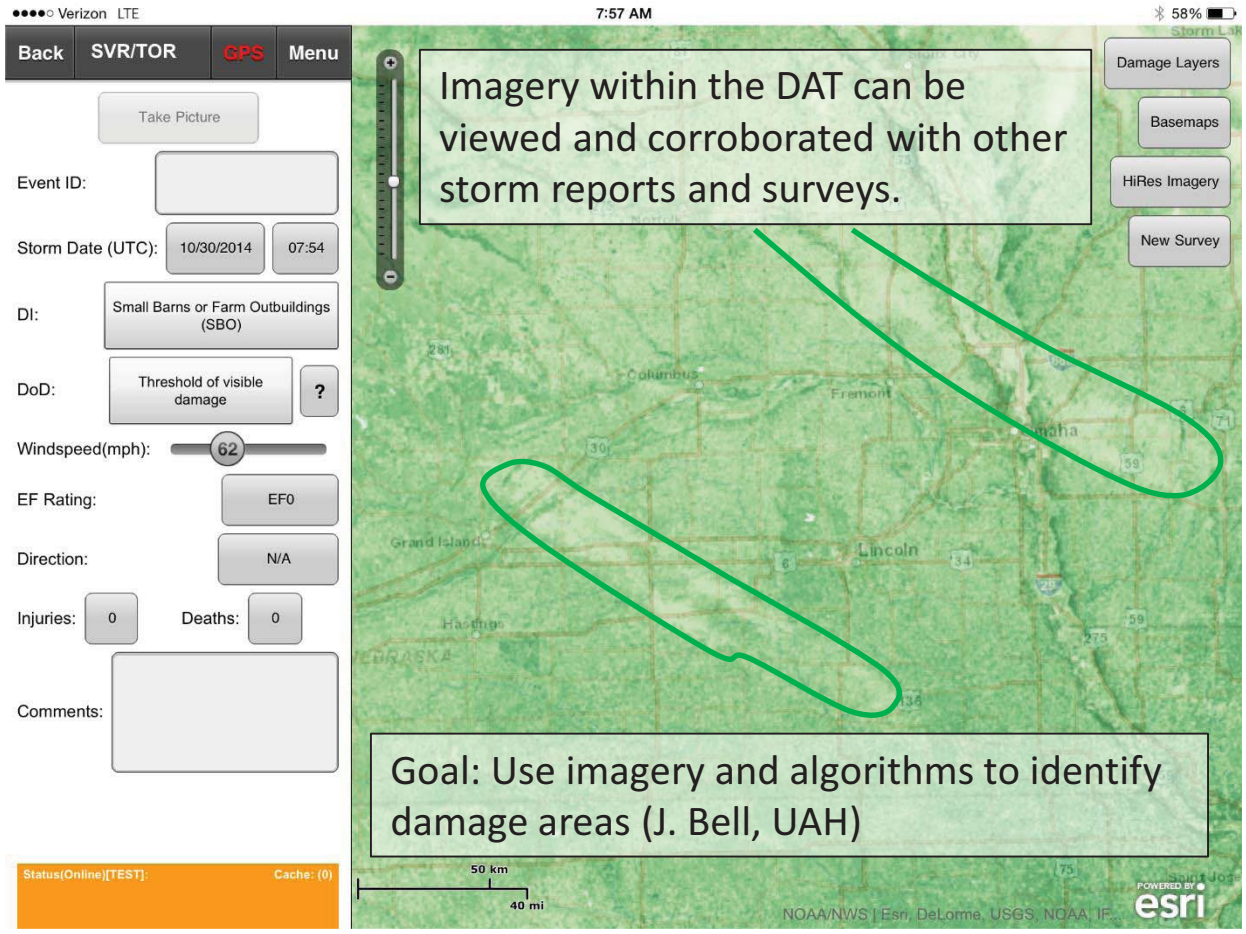
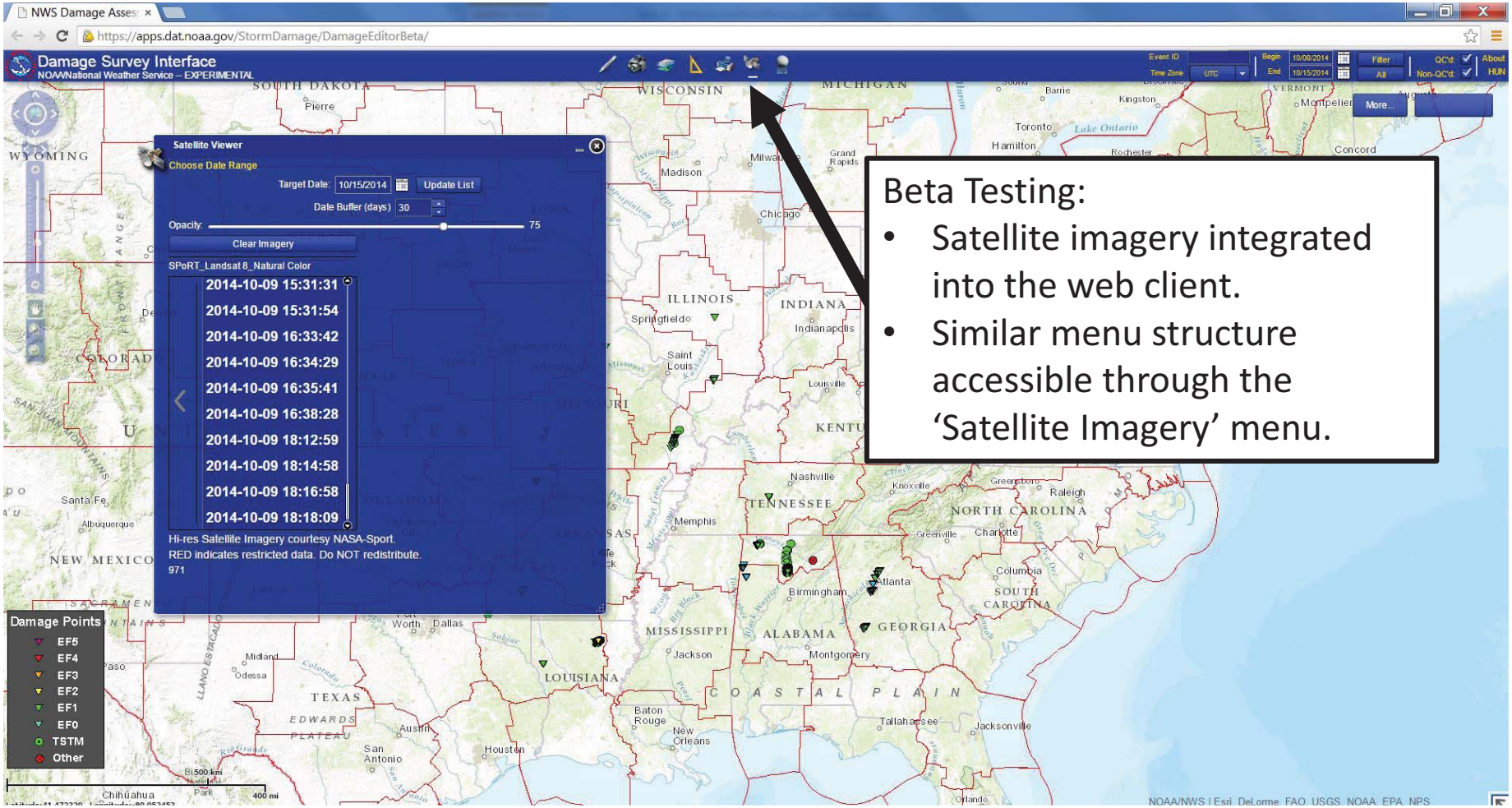


DAT Integration: Web Client



Training

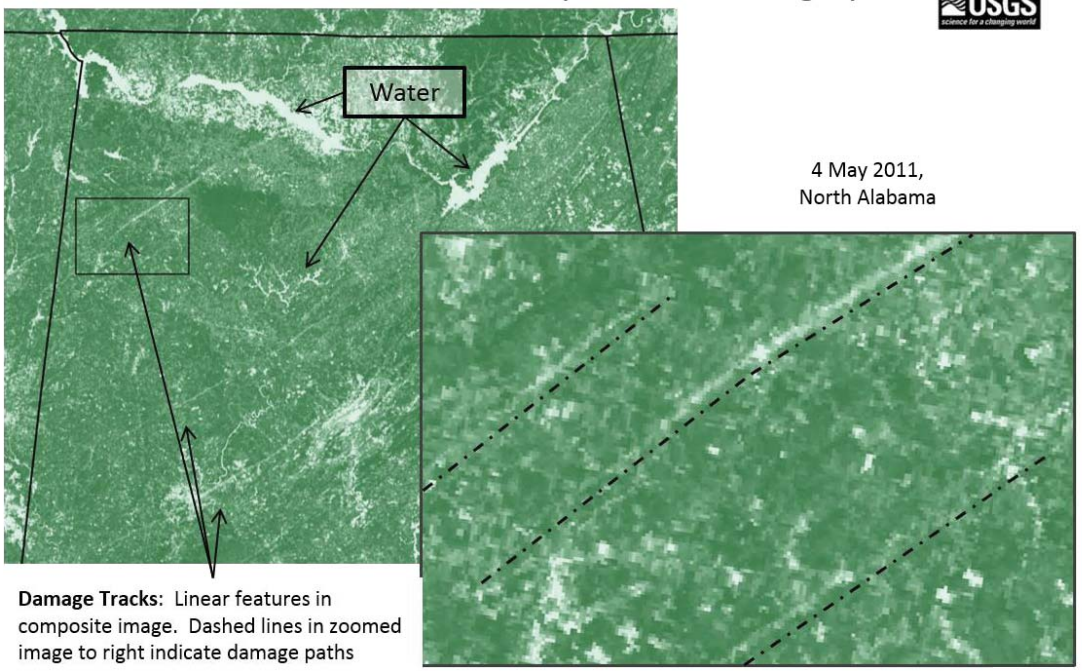
- To support the use of imagery within the DAT, the proposal team has developed multiple forms of training:
  - Teletraining completed with partnering Southern Region WFOs during the Fall 2014 season, rollout to Central Region planned for Spring 2015
  - Quick Guides, or one-page highlights of products available and examples of their usage
  - Narrated slide presentations (e.g. Articulate) will eventually be developed for viewing within the mobile client or web viewer

Quick Guide Example

- Quick guides have been provided for each product disseminated in near real-time to the DAT.
- Short-term goal to work with NWS developer to integrated training directly within the DAT.
- Other future opportunities for derived products (NDVI change) or automated techniques (damage detection)

NOAA/NWS DAT: Satellite Imagery Quick Guide

VIIRS/MODIS NDVI Daily Maximum Imagery



Damage Tracks: Linear features in composite image. Dashed lines in zoomed image to right indicate damage paths

Access	SPoRT > VIIRS > Daily NDVI Max SPoRT > MODIS > Daily NDVI Max
Restriction	None
Resolution	375m VIIRS 250m MODIS
Latency	Daily
Provider	UW CIMSS / NASA SPoRT NASA LANCE / NASA SPoRT
Spectral Bands	NDVI uses red and near infrared. Both cloud and water masks have been applied.
Application	Identify short term decreases in NDVI to identify possible severe weather damage.

How is this image generated?

- Maximum daily values from each VIIRS/MODIS pass across the CONUS domain are composited.

What should I be looking for in this product?

- The maximum daily value of NDVI will highlight areas where the vegetation is not as green as the surrounding area. This will naturally occur where water ways or urban areas are present. More linear type features may indicate damage tracks through vegetative areas. Corroboration with other datasets required.

What are the product limitations?

- Tracks may not always be distinguishable near or around urban areas, or whenever vegetation values are low, such as when fields have died off for the season.
- Damaged vegetation may not immediately cause a change in the NDVI values. Multiple passes may be necessary to see damage track information.
- Damage caused by weaker tornadoes may not cause enough damage to be detectable at the resolutions of the VIIRS or MODIS instruments

Questions?