Use of NASA Near Real-Time and Archived Satellite Data to Support Disaster Assessment

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Introduction and Motivation

- NASA's Short-term Prediction Research and Transition (SPoRT) Center partners with the NWS to provide near real-time data in support of a variety of weather applications, including disaster.
- **Supports *NASA's Applied Sciences Program: Disasters* focus area by developing techniques to aid the disaster monitoring, response, and assessment communities.**
- SPoRT has explored a variety of techniques for utilizing archived and near real-time NASA satellite data.
- An increasing number of end-users – such as the NWS Damage Assessment Toolkit (DAT) – access geospatial data via a Web Mapping Service (WMS).
- **SPoRT has begun developing open-standard Geographic Information Systems (GIS) data sets via WMS in response to end-user needs.**

Data

- **SPoRT has investigated the use of a variety of NASA, NOAA, and commercial satellite resources.**
- LANCE (Land Atmosphere Near Real-time Capability for EOS) provides MODIS data
- Collaborating with the USGS to request data collection and data access via Earth Explorer and the Hazards Data Distribution System (HDDS), including ASTER
- VIIRS data from SNPP have been useful, particularly the day-night band for identifying power outages.
- High-resolution imagery from the recently available International Space Station SERVIR Environmental Research and Visualization System instrument (ISERV)
- The USGS Web-Enabled Landsat Data (WELD) Project provides 30-meter composites of Landsat 7 imagery at weekly, monthly, seasonal, and annual periods. These are used to compare pre- and post-disaster conditions and are more useful than single-pass imagery, which may suffer from cloud contamination.
- A summary of the NASA data sets explored to date is shown in Table 1.

Satellite	Sensor	Resolution	Products	Repeat Cycle
Terra	ASTER	15 m	NDVI, False Color, Natural Color	16 days
Landsat	ETM+	30 m	NDVI, True Color	16 days
Int'l Space Station	ISERV	5 m	True Color	1 day to 21 days
Aqua/Terra	MODIS	250 m - 1 km	NDVI, Vis. Diff.	12 hours
SNPP	VIIRS	750 m	DNB, Lights-Out	12 hours

Table 1: *NASA satellites utilized in SPoRT's disaster response activities*

18th Conference on Integrated Observing and Assimilation Systems for Atmosphere, Oceans, and Land Surface (IOAS-AOLS), 94th Annual AMS Meeting, Atlanta, GA, 2-6 February 2014

Severe Weather Applications: April 27, 2011

Sixty-two tornadoes occurred in AL that affected over 1% of the landmass and claimed 248 lives. Examples of tornado damage track detections from various sensors are shown in the Figs. 1-3. These were used extensively by the Huntsville WFO to guide their storm assessment teams.

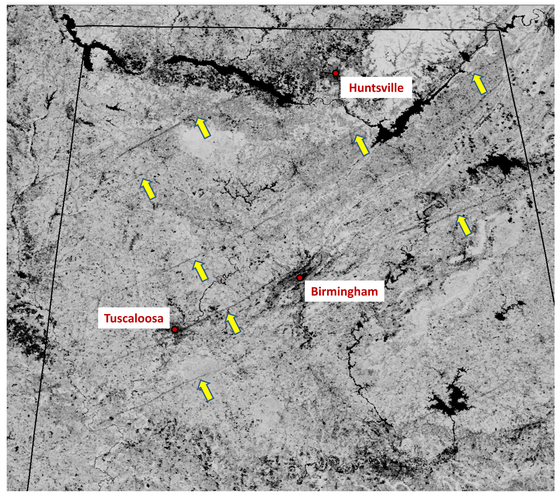

Figure 1: *MODIS Normalized Difference Vegetation Index image from 4 May 2011 showing multiple tornado damage tracks over North and Central Alabama. Tracks were also evident in before/after visible difference products.*

Figure 2: *ASTER natural color composite of Tuscaloosa, AL from 4 May 2011. This EF-4 tornado tracked 80 miles, claimed 65 lives, and injuring 1500 people.*

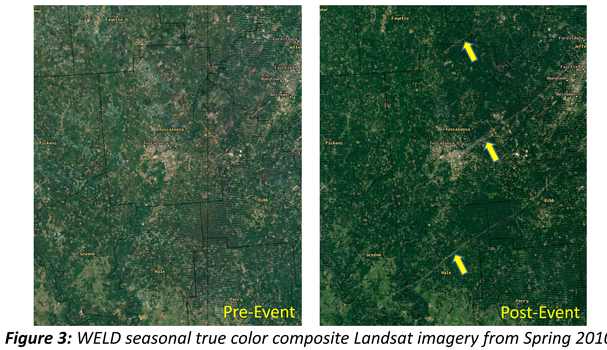

Figure 3: *WELD seasonal true color composite Landsat imagery from Spring 2010 (left; pre-event) and Spring 2011 (right; post-event). The 2011 true color image provides evidence of tornado damage scars.*

Severe Weather Applications: May 20, 2013

Multiple tornadoes occurred in central Oklahoma over a two-day period that claimed 26 lives and caused billions of dollars in damage. The most devastating tornado was an EF-5 that struck Moore, Oklahoma. Figs. 4-6 show additional applications of remote sensing data that could be used to support damage surveys and the monitoring of recovery efforts following such an event.

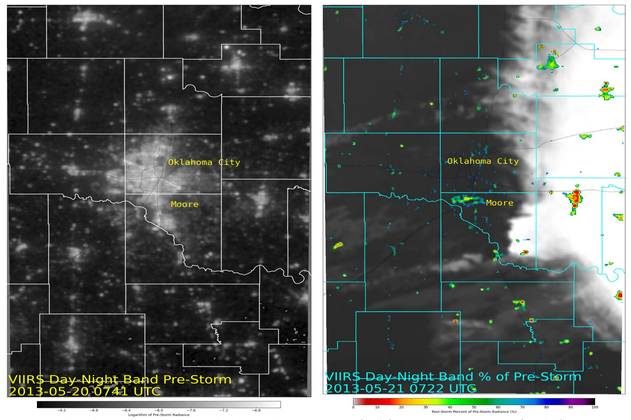

Figure 4: *The VIIRS day-night band pre-event (left) and post-event (right) percent of normal light product identifies areas affected by power outages. The post-event image incorporates long-wave IR imagery to identify where lights were obscured by clouds.*

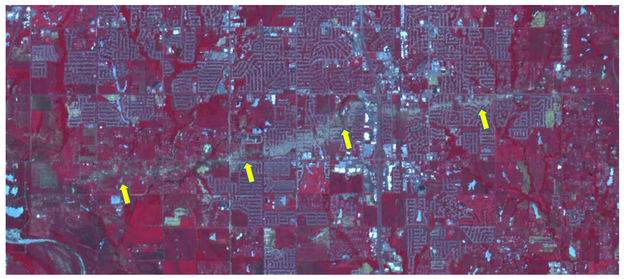

Figure 5: *An ASTER false color composite from 2 June 2013 shows where vegetation and urban infrastructure have been disturbed in Moore, OK. Changes in tornado path and width can also be seen.*

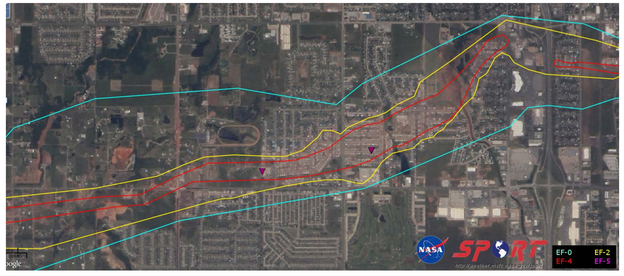

Figure 6: *Imagery from 27 June 2013 captured by the ISERV instrument aboard the International Space Station has sufficient resolution (5 m) to show damage to individual structures. The colored polygons depict tornado intensity ratings based upon NWS damage assessments.*

Data Dissemination Strategy

A Web Mapping Tile Service (WMTS) was used as an early prototype though abandoned due to the extensive time required to pre-slice and -tile the imagery. **SPoRT instead began developing a WMS based on Geoserver**. Figs. 7-8 depict the WMS dataflow and web interface.

Benefits:

- Flexibility; less labor-intensive solution
- Expeditious delivery (no delays associated with pre-tiling)
- Easy integration into common GIS apps; querying capability

Issues:

- Delays associated with re-projecting
- Performance requirements can be less predictable

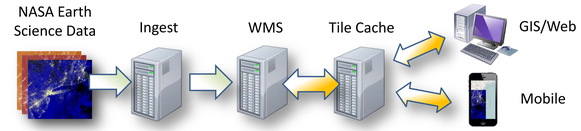

Figure 7: *WMS data flow depicting ingest, processing, tile generation, and delivery to end users*

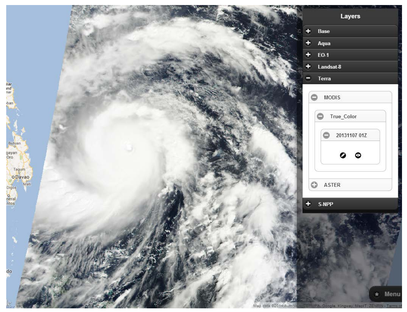

Figure 8: *The WMS web interface showing Terra MODIS True Color imagery of Super Typhoon Haiyan as it approached the Philippines on 7 November 2013.*

Integration into the NWS Damage Assessment Toolkit

- The NWS DAT is a GIS-based iOS/Android app to better organize storm damage surveys.
- Allows users to log location and intensity of damage
- **SPoRT examined the feasibility of integrating NASA imagery and datasets into the DAT to help with storm surveys** and developed:
  - Imagery to help identify damaged areas
  - WMS infrastructure to deliver the data to the DAT
  - Collaborated with the DAT team to provide offline access to the data in a cached mode

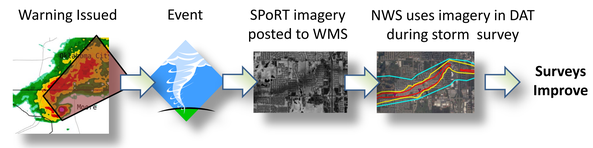

Figure 9: *NWS storm survey process using the DAT and SPoRT imagery*