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 disasters.
- SPoRT supports *NASA's Applied Sciences Program: Disasters* focus area by developing techniques that will 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 to respond to end-user needs.

Data

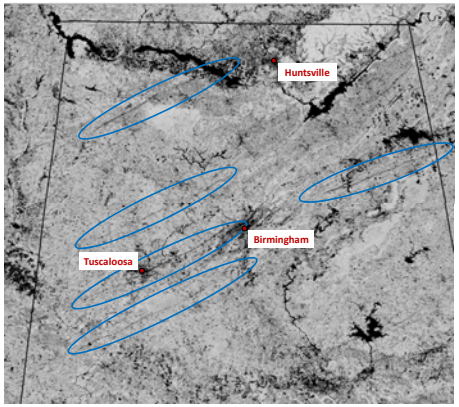
- SPoRT has investigated the use of a variety of NASA, NOAA, and commercial satellite resources .
- LANCE (Land Atmosphere Near Real-time Capability for EOS) provides **MODIS** data
- Collaborating with the USGS to request data collection and data access via Earth Explorer and the Hazards Data Distribution 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.

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

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

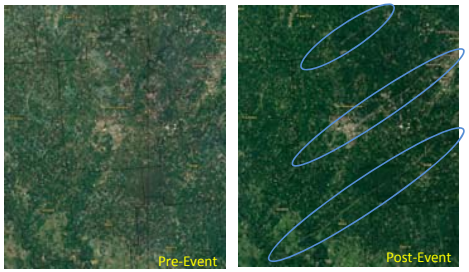
Severe Weather Applications: April 27, 2011

Sixty-two tornadoes occurred in AL that affected over 1% of the landmass. Examples of tornado damage track detection from various sensors are shown in the figures below. These were used extensively by the Huntsville WFO to guide their storm assessment teams.



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

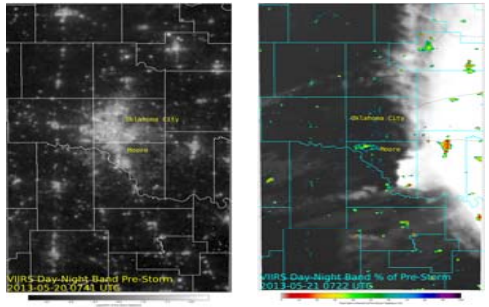
ASTER natural color composite of Tuscaloosa, AL (4 May 2011)



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

Analysis of the Moore, OK EF-5 tornado was incorporated into the NWS DAT and supported the damage survey process.



The VIIRS day-night band pre-event (left) and post-event (right) percent of normal light product identifies areas affected by power outages.

An ASTER false color composite shows where vegetation and urban infrastructure have been disturbed in Moore, OK (2 June 2013)

Imagery from the ISERV instrument aboard the ISS has sufficient resolution (5 m) to show damage to individual structures (27 June 2013)

Data Dissemination Strategy: WMTS

Early WMS prototypes included a Web Mapping Tile Service (WMTS), in which the input imagery was pre-sliced, -tiled, and -scaled to various zoom levels; served from a normal webserver.

Benefits:

- High-performance serving of data
- Tiles are pre-generated

Issues:

- Requires significant computing power to process images
- Large amounts of disk space to store the images

Data Dissemination Strategy: WMS

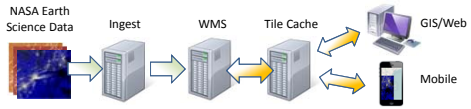
SPoRT began developing a WMS during the summer of 2013 based on Geoserver.

Benefits:

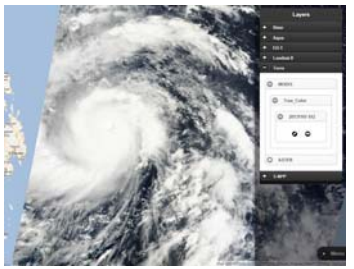
- Flexibility; less labor-intensive solution
- Expeditious delivery (no delays associated with pre-tiling)

Issues:

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



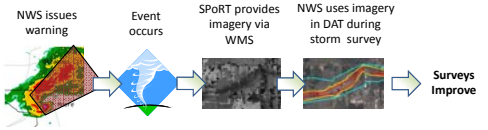
WMS data flow



WMS web interface showing Super Typhoon Haiyan as it approached the Philippines (Terra MODIS True Color, 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 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



NWS storm survey process using the DAT and supplemental SPoRT imagery

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