Roundtable Discussion
Lessons Learned from Midwest Floods

February 4, 2016
Midwest Flood Event

- Warm temperatures and tropical moisture created conditions for heavy rainfall
- Many areas experienced more than 12 inches of rain
- Resulted in massive floods in Illinois, Missouri, and Arkansas

Source: (Missouri National Guard via Reuters)
Midwest Flood Event

Mississippi River at Greenville, MS

Mississippi River at Natchez, MS

Mississippi River at Baton Rouge, LA
Midwest Flood Event

Preliminary Remote Sensing Map: (07 January 2016, 1700 EST)

The following table represents geospatial damage assessments taken from FEMA and the National Geospatial-Intelligence Agency (NGA) (01/22/2016). This analysis is the final product for this event.

<table>
<thead>
<tr>
<th>County Name</th>
<th>All Structures Affected and Destroyed (01/22/2016)</th>
<th>Total Damaged Households (01/22/2016)</th>
<th>Total Damaged Non-Households (01/22/2016)</th>
<th>Households Affected (01/22/2016)</th>
<th>Households Destroyed (01/22/2016)</th>
<th>Non-Households Affected (01/22/2016)</th>
<th>Non-Households Destroyed (01/22/2016)</th>
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Data Layer / Map Description:
This mapping product highlights preliminary remote sensing priority areas for collection.

Inland Areas (Dissolved Polygons): Flood Warning Areas
- Peak Crest Dates:
  - January 10th and 11th
  - January 12th and 13th
  - January 14th
  - January 15th and 16th
  - January 17th

Streams

Urban Area Population

Initial Map Creation: 07 January 2016, 1700 EST

Coastal System: WGS 1984 World Mercator

FEMA

Christopher Vaughn
February 4, 2016
Geospatial Analysis - SAR

NOAA imagery

SAR derived flood extents
Geospatial Analysis - SAR

- Three SAR providers:
  - Cosmo-SkyMed, RadarSat-2, TerraSAR-X

- Each scene had different:
  - Resolutions, look angles, acquisition dates
Interagency Briefs

NASA
NGA
NOAA
USACE / CAP
USDA
USGS - International Charter
NASA – Remote Sensing of Flood

NASA MODIS Detections and JAXA ALOS-2 Synthetic Aperture Radar


Standing water (blue) and water-inundated vegetation (red) detected by ALOS-2 and the Synthetic Aperture Radar (SAR) at the Jet Propulsion Laboratory, January 6. Coverage area shown as dashed inset of MODIS image.
NASA - Remote Sensing of Flood
Multispectral Views from NASA’s Earth Observing-1 Mission

NASA staff at Goddard Space Flight Center and Marshall Space Flight Center targeted collections of imagery by NASA’s Earth Observing-1 (EO-1) mission.

Multispectral imaging by EO-1 provides true color imagery (left) and capabilities for derived products (right), and can also be applied to Landsat-7 and Landsat-8 missions, Aqua and Terra MODIS, Suomi-NPP VIIRS, and other imagery provided by federal agency partners, International Charter, and commercial vendors.

Here, true color imagery near Vicksburg, Mississippi highlights flood water (left) along the Mississippi in a visual sense, while the Normalized Difference Water Index helps to draw attention to standing water (right) in shades of blue.

True color (left) and Normalized Difference Water Index (right) imagery derived from NASA’s Earth Observing-1 mission, observed near Vicksburg, Mississippi on 17 January 2016.
NGA – Structure Assessments

4. Building Impacts

Tab 1. Damage Assessments. This map depicts the damage assessments of structures as necessary and/or available.

Tab 2. NGA Flood Extent Analysis. NGA-provided flood extent estimate supplemented with statistics from ESRI covering total housing units, population, and insured homes. The statistics will be updated periodically to reflect updates from NGA to the flood extent boundaries. Current statistics reflect the assessed extent as of 12/31/2015.

Tab 3. SAR Estimated Flood Extent. Estimate derived from satellite as of 1/6/2016. Click a polygon to view ESRI estimated demographics associated with the extent.

Tab 4. NASA Estimated Flood Extent. Click the polygon to view ESRI estimated demographics associated with the extent.

5. Transportation

Tab 1. ESRI Live traffic feed. Zoom in to reveal greater detail and information on local road closure, accidents, or construction in this up-to-date feed.

Tab 2. Waze™ Real Time Road Closure reports.

6. Lifeline: Infrastructure and Essential Facilities
NGA – Observera / iView
NOAA – Decision Support

- The NOAA Liaison to FEMA translated hydrologic forecasts into KMZ files to depict location and timing of peak crests along the Mississippi River.

- The liaison also provided cloud cover forecasts to help prioritize remote sensing / aerial imagery collection opportunities.

- Forecast information was briefed to FEMA and interagency partners on a daily basis.
NOAA – Flood Response Imagery

Georeferenced airborne imagery acquisition: January 1–18, 2016

- 68 total hours flown (two aircraft)
- Data published to the web within hours of landing
  - 9 million web “hits” / 1 TB of data downloaded
- Primary users FEMA and NGA
  - Available to other users and public
- Imaged ~7,475 sq. miles
  - 10,067 frame images acquired – including 4,710 Red/Green/Blue, 2,713 Near Infrared and 2,644 Oblique (side looking)
Central U.S. Flood Journal

This journal presents the FEMA GeoFramework web map collection for floods. At any time, this journal can be used for demonstration purposes and to serve as a template for future events. During an actual event, maps presented in this journal depend on the availability and quality of data.

1. Hazard Map

Tab 1: Precipitation and Gauge Data. National overview of precipitation and stream gauge information to indicate flood events and threats.

Tab 2: National Flood Hazard Layer by FEMA.

Tab 3: Some selected areas of interest.

Tab 4: Civil Air Patrol Imagery. Click a point on the map, then click "More Info" in the Image/Info field to view the image.

2. Declaration

Tab 1: Filter by state or declaration number.
Daily emails listing geospatial information and remotely sensed imagery products
<table>
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<th>Scenes</th>
<th>New Acquired or Archived</th>
<th>Sensor type</th>
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<td>Radar</td>
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</table>
USGS – International Charter

Charter Products:
- ROSCOSMOS: 1
- DLR: 1
- JAXA: 3
Lessons Learned

SAR flood extents
SAR Interagency calls
International Charter
Local interagency coordination for products
Lessons Learned

Need for more interagency collaboration to produce products in support of response and recovery efforts

Ensure existing protocols are continued to obtain SAR data quickly

Outreach to FEMA leadership

Have an after-action focused on scientific / analytical / modeling efforts