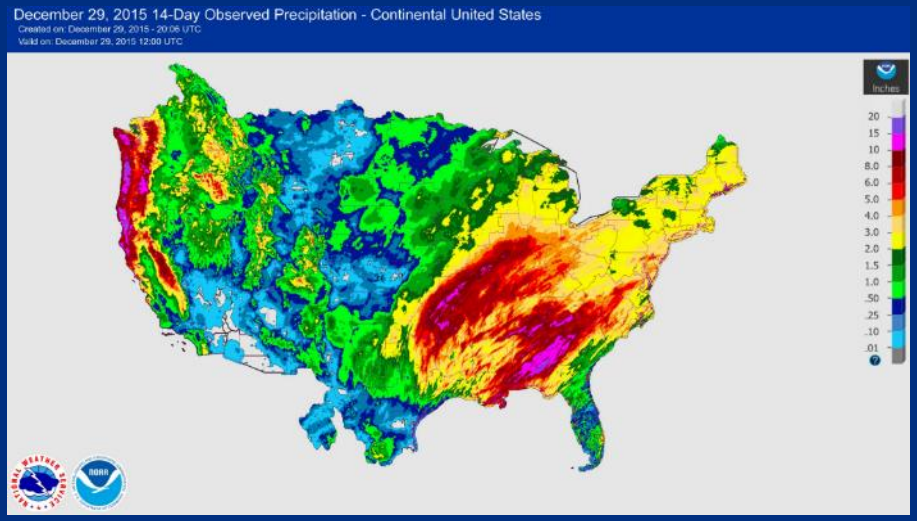
Roundtable Discussion

Lessons Learned from Midwest Floods

February 4, 2016

FEMA

Midwest Flood Event

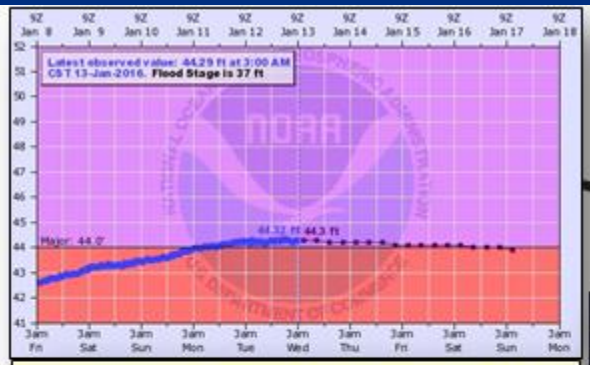


Source: (Missouri National Guard via Reuters)

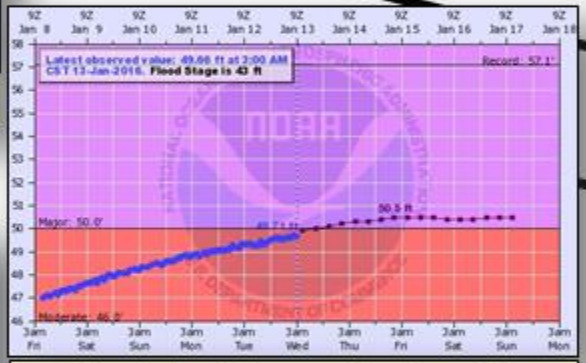
- Warm temperatures and tropical moisture created conditions for heavy rainfall
- Many areas experienced more than 12 inches of rain
- Resulted in massive floods in Illinois, Missouri, and Arkansas

FEMA

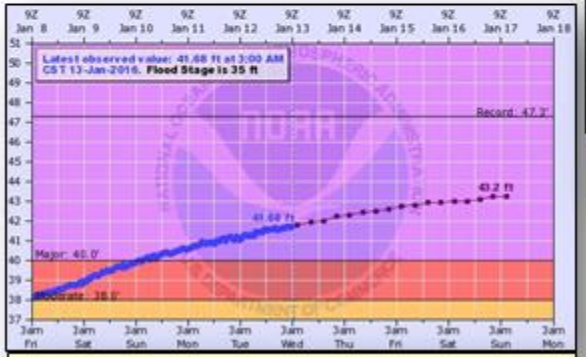
Midwest Flood Event



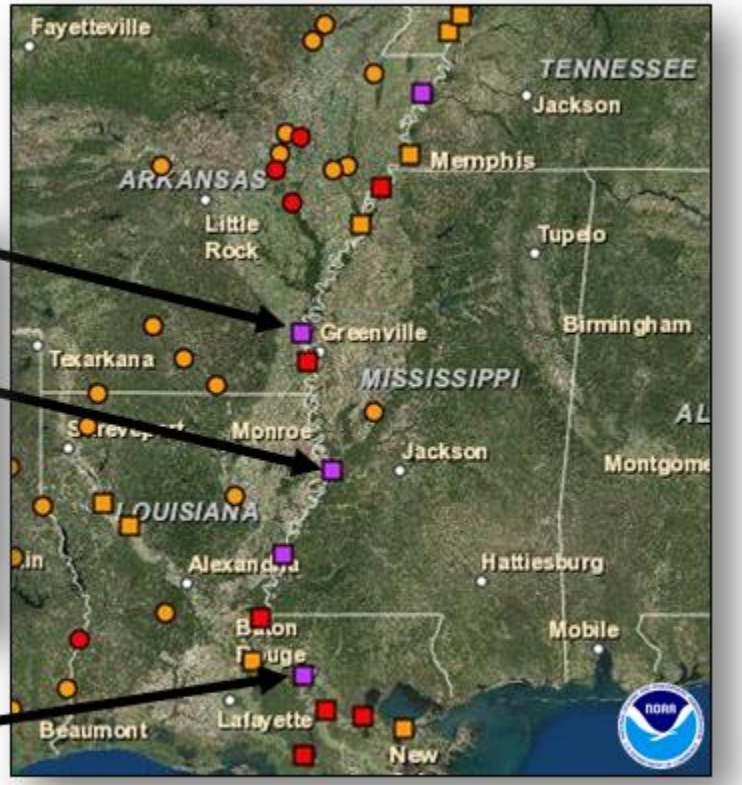
Mississippi River at Greenville, MS



Mississippi River at Natchez, MS



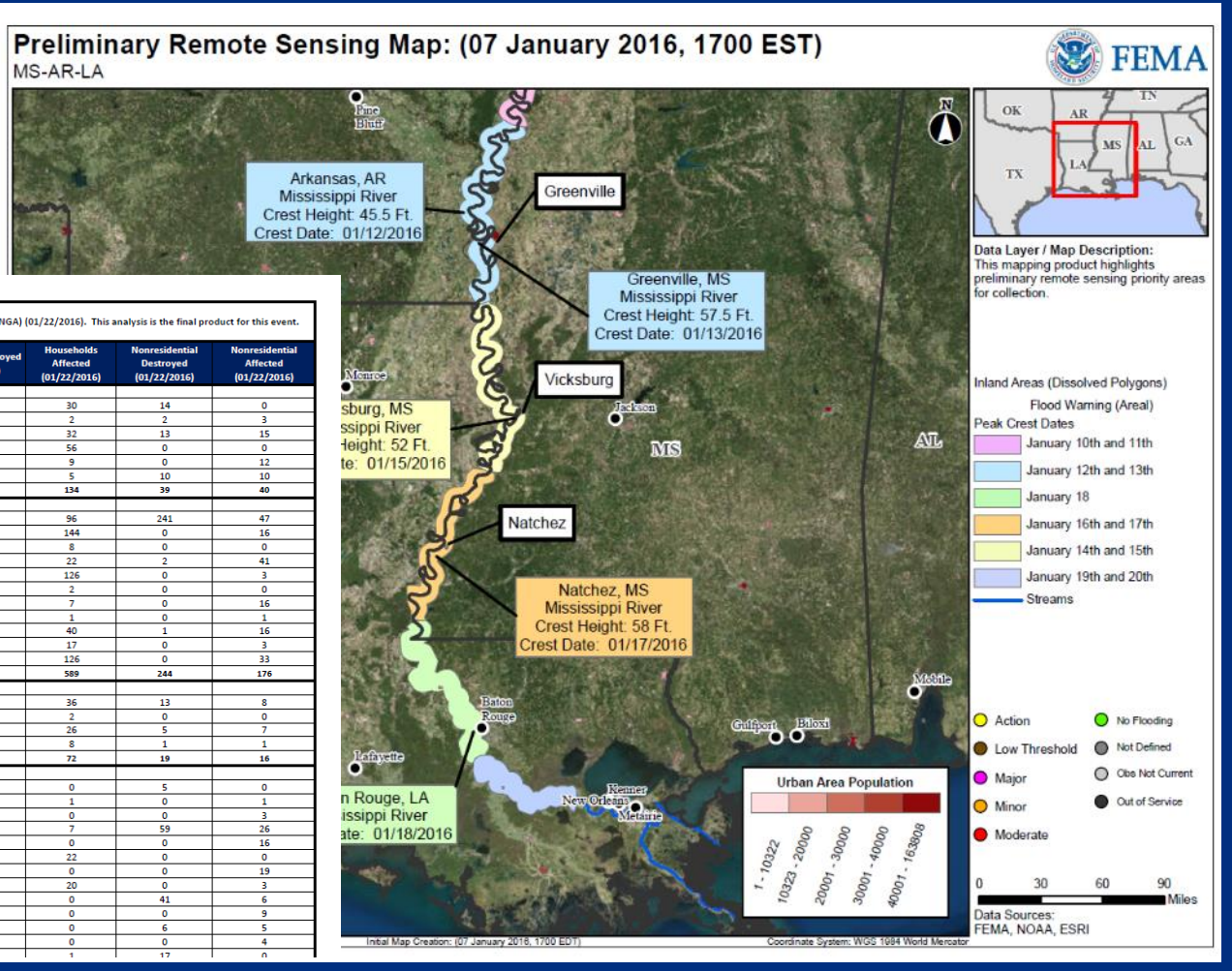
Mississippi River at Baton Rouge, LA



Midwest Flood Event

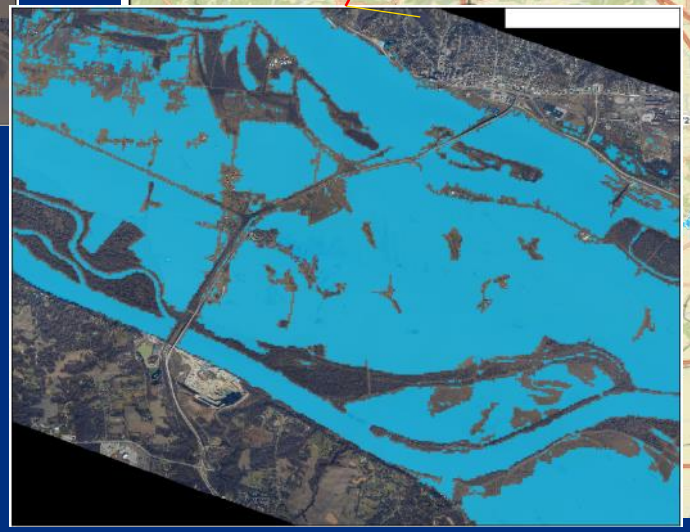
The following table represents geospatial damage assessments taken from FEMA and the National Geospatial Intelligence Agency (NGA) (01/22/2016). This analysis is the final product for this event.

County Name/State Name	All Structures Affected and Destroyed (01/22/2016)	Total Damaged Households (01/22/2016)	Total Damaged Nonresidential (01/22/2016)	Households Destroyed (01/22/2016)	Households Affected (01/22/2016)	Nonresidential Destroyed (01/22/2016)	Nonresidential Affected (01/22/2016)
Arkansas							
Chicot	69	55	14	25	30	14	0
Crittenden	12	7	5	5	2	2	3
Desha	81	53	28	21	32	13	15
Lee	56	56	0	0	56	0	0
Mississippi	21	9	12	0	9	0	12
Phillips	71	51	20	46	5	10	10
Totals	**310**	**231**	**79**	**97**	**134**	**39**	**40**
Illinois							
Alexander	563	275	288	179	96	241	47
Calhoun	160	144	16	0	144	0	16
Greene	8	8	0	0	8	0	0
Jackson	65	22	43	0	22	2	41
Jersey	129	126	3	0	126	0	3
Johnson	2	2	0	0	2	0	0
Madison	23	7	16	0	7	0	16
Monroe	2	1	1	0	1	0	1
Pulaski	59	42	17	2	40	1	16
Randolph	20	17	3	0	17	0	3
Union	160	127	33	1	126	0	33
Totals	**1191**	**771**	**420**	**182**	**589**	**244**	**176**
Kentucky							
Ballard	97	76	21	40	36	13	8
Carlisle	2	2	0	0	2	0	0
Fulton	38	26	12	0	26	5	7
Hickman	10	8	2	0	8	1	1
Totals	**147**	**112**	**35**	**40**	**72**	**19**	**16**
Louisiana							
Ascension	5	0	5	0	0	5	0
Avoyelles	6	5	1	4	1	0	1
Catahoula	3	0	3	0	0	0	3
Concordia	402	317	85	310	7	59	26
East Baton Rouge	16	0	16	0	0	0	16
East Carroll	22	22	0	0	22	0	0
Jefferson	19	0	19	0	0	0	19
Madison	23	20	3	0	20	0	3
Pointe Coupee	283	236	47	236	0	41	6
St. Charles	9	0	9	0	0	0	9
St. James	13	2	11	2	0	6	5
St. John the Baptist	4	0	4	0	0	0	4
Tangipahoa	55	38	17	37	1	17	0



Geospatial Analysis - SAR

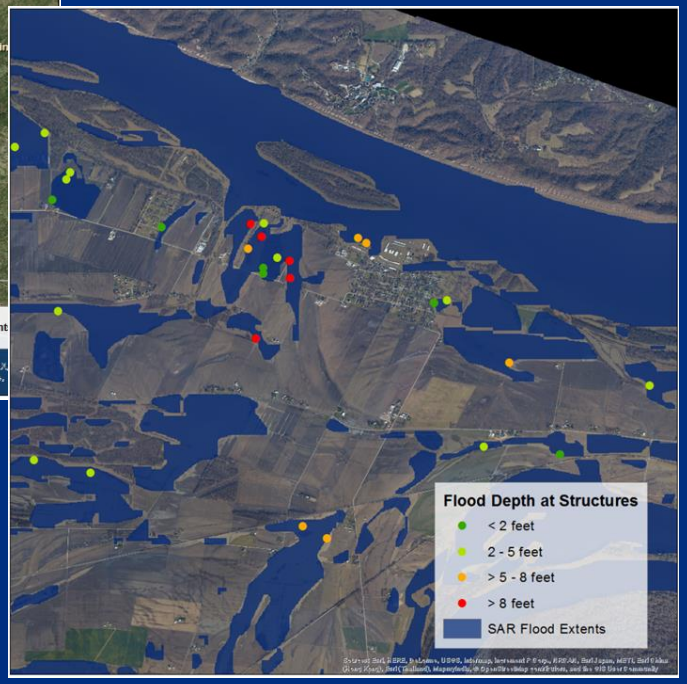
NOAA imagery



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



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Estimated Impact Analysis: (03 February 2016, 1400 EST)

Mississippi River (St. Louis - Cape Girardeau), Missouri

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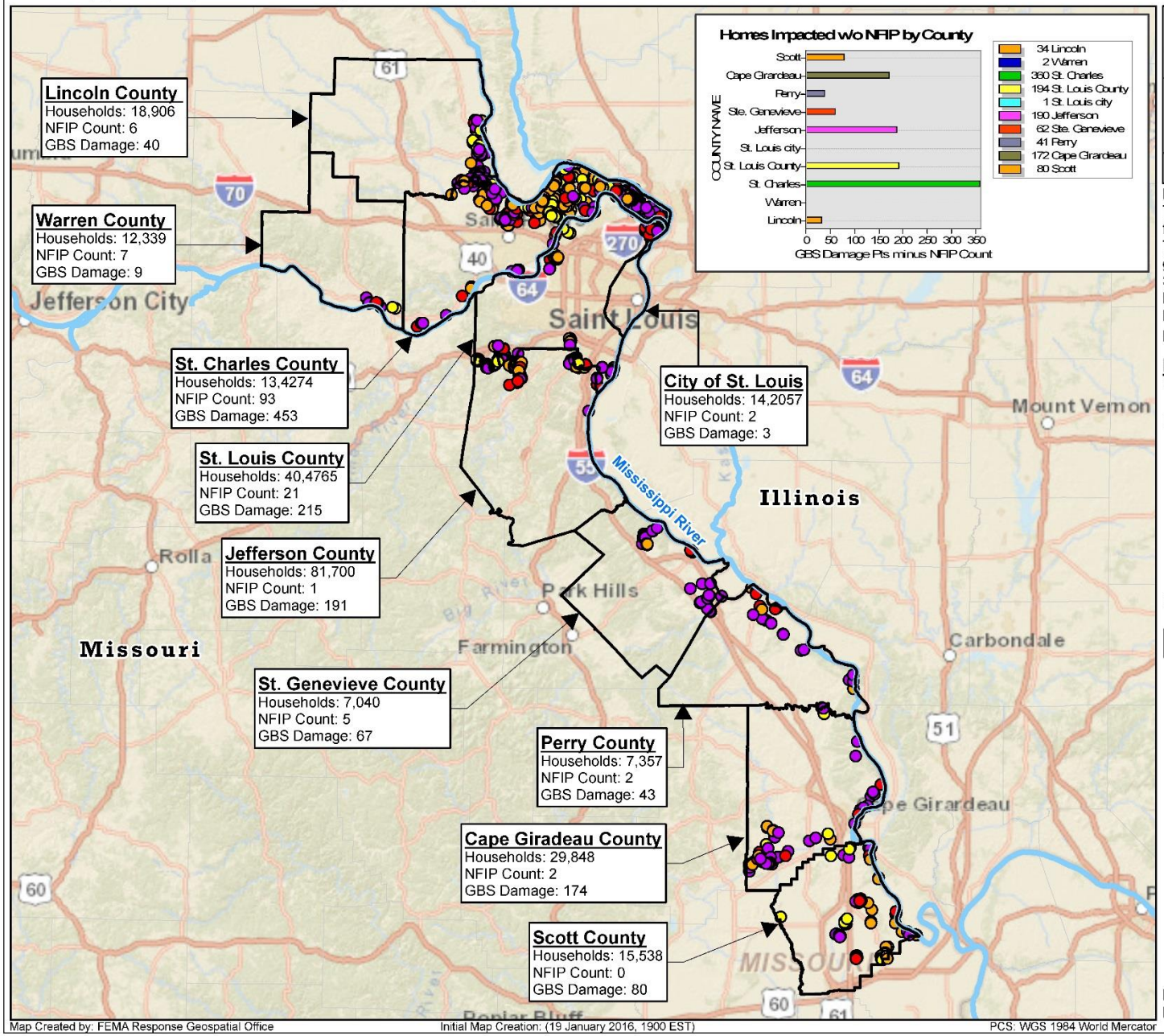


Data Layer / Map Description:
This map displays initial estimated impacts from riverine flooding event.
This experimental analysis includes geospatial intersect of Global Building Stock (GBS) with Synthetic Aperture Radar (SAR inundation area, and National Flood Insurance Program (NFIP) polices identification.

Missouri Total Impact:
1500 Structures

Building Damage Assessment

- Destroyed Total: 542
- Major Total: 243
- Minor Total: 251
- Affected Total: 150

County of Interest

County with Impacted Buildings

N

0 10 20 30 40 Miles

Data Sources:
FEMA, HSIP 2015, USACE, Esri, NGA

Map Created by: FEMA Response Geospatial Office
Initial Map Creation: (19 January 2016, 1900 EST)
PCS: WGS 1984 World Mercator

Interagency Briefs

NASA

NGA

NOAA

USACE / CAP

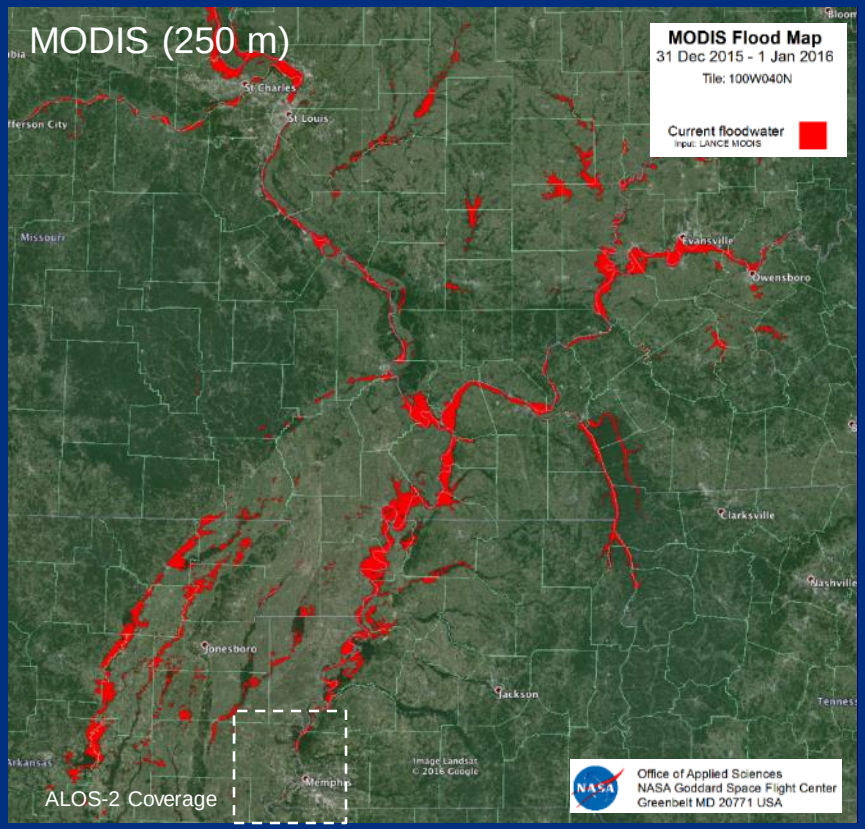
USDA

USGS - International Charter

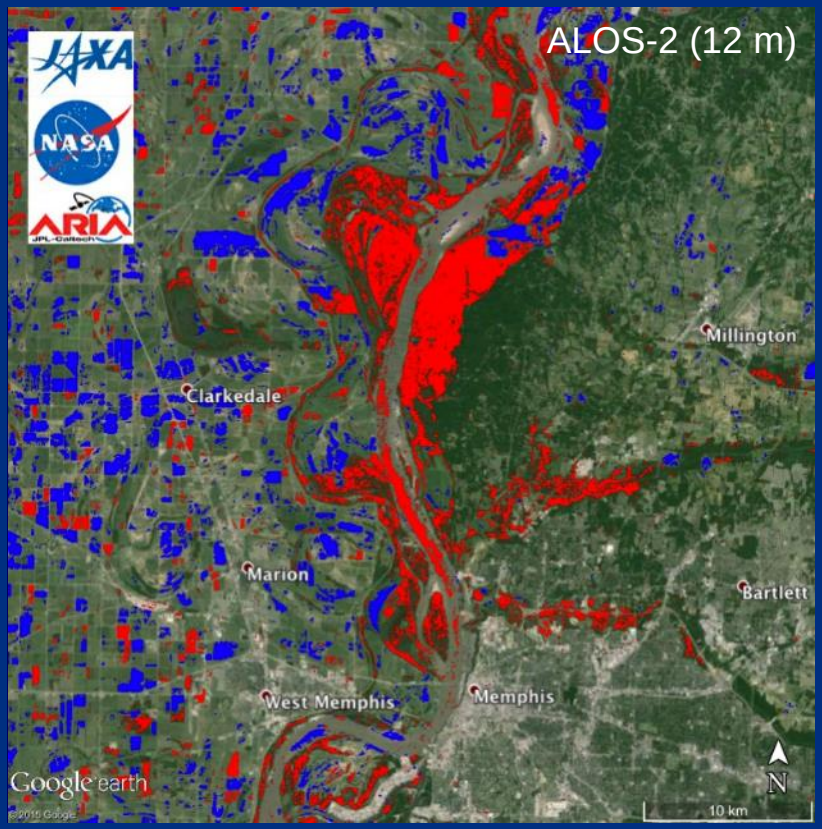
FEMA

NASA – Remote Sensing of Flood

NASA MODIS Detections and JAXA ALOS-2 Synthetic Aperture Radar



Flood detections (red) from NASA Near Real-Time Global Flood Mapping with flood extent on January 1, 2016, courtesy of Goddard Space Flight Center.



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.

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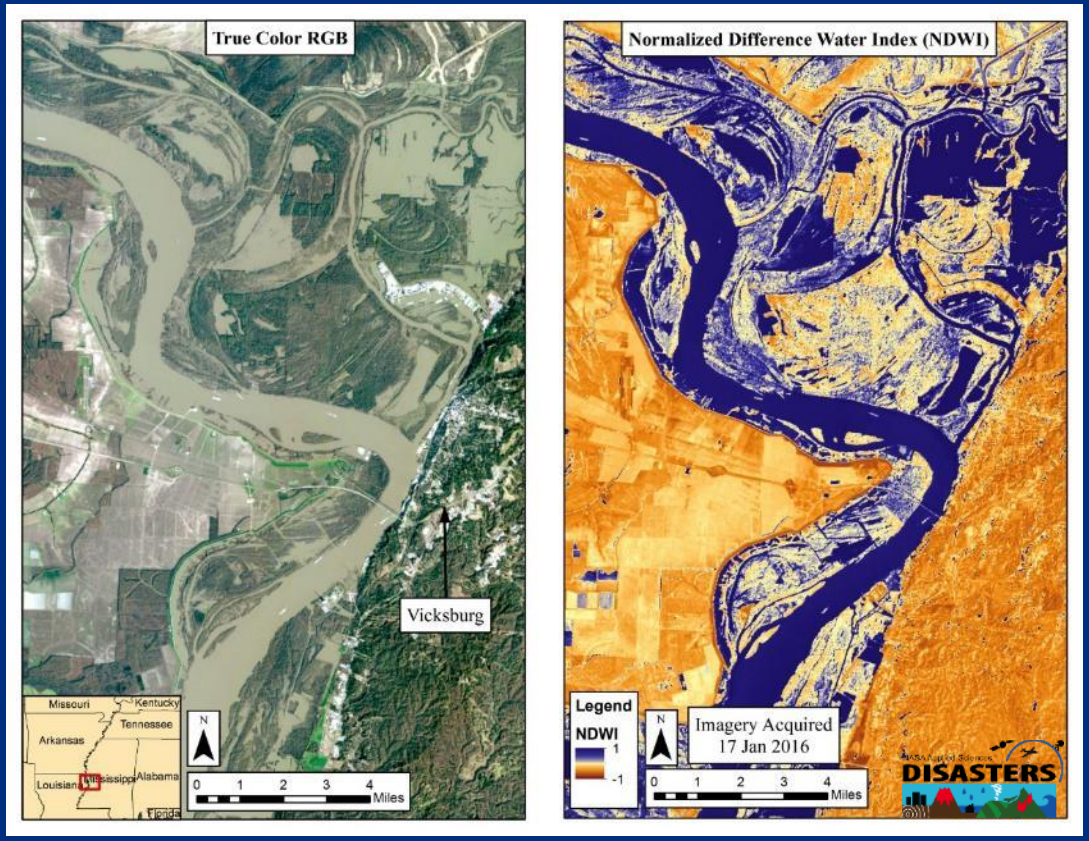
NASA - Remote Sensing of Flood

Multispectral Views from NASA's Earth Observing-1 Mission



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.

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.

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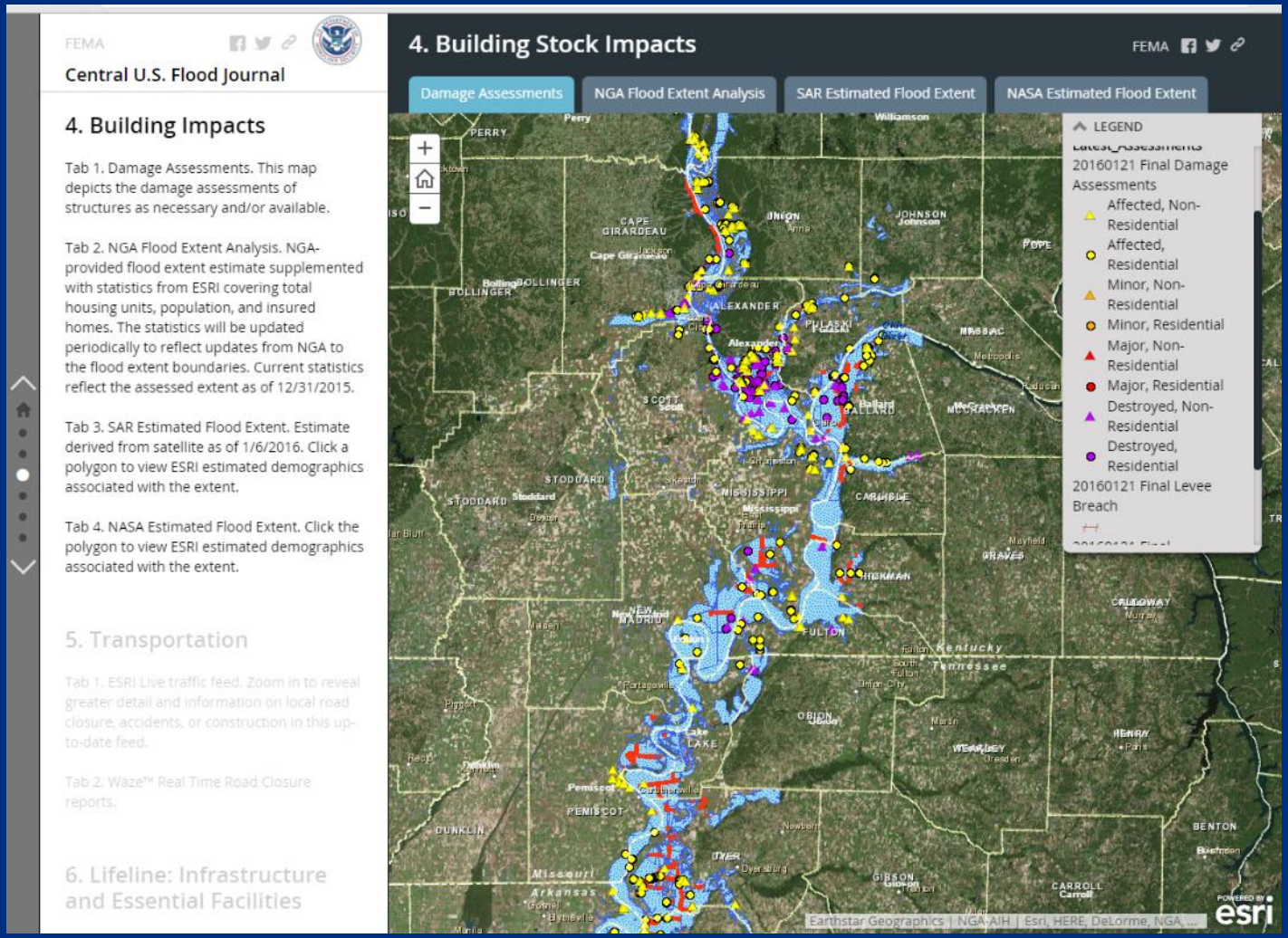
NGA – Structure Assessments



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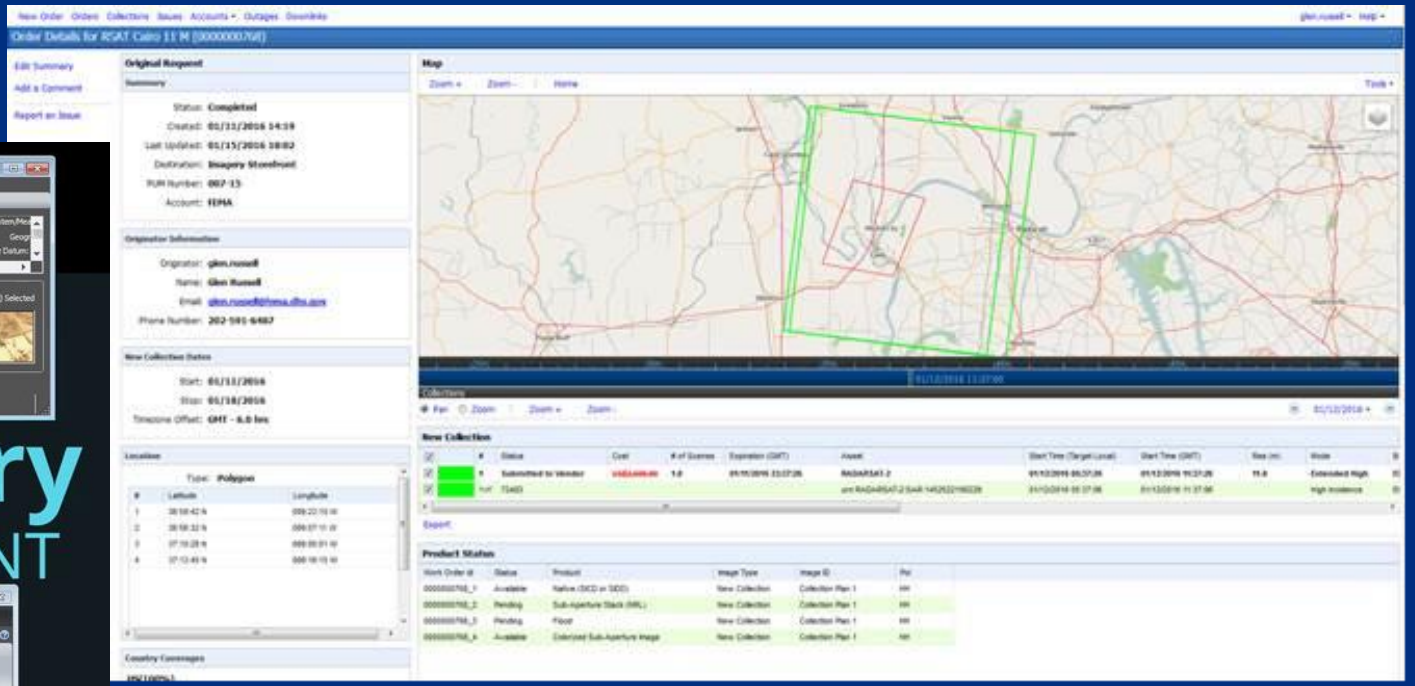
NGA – Observera / iView



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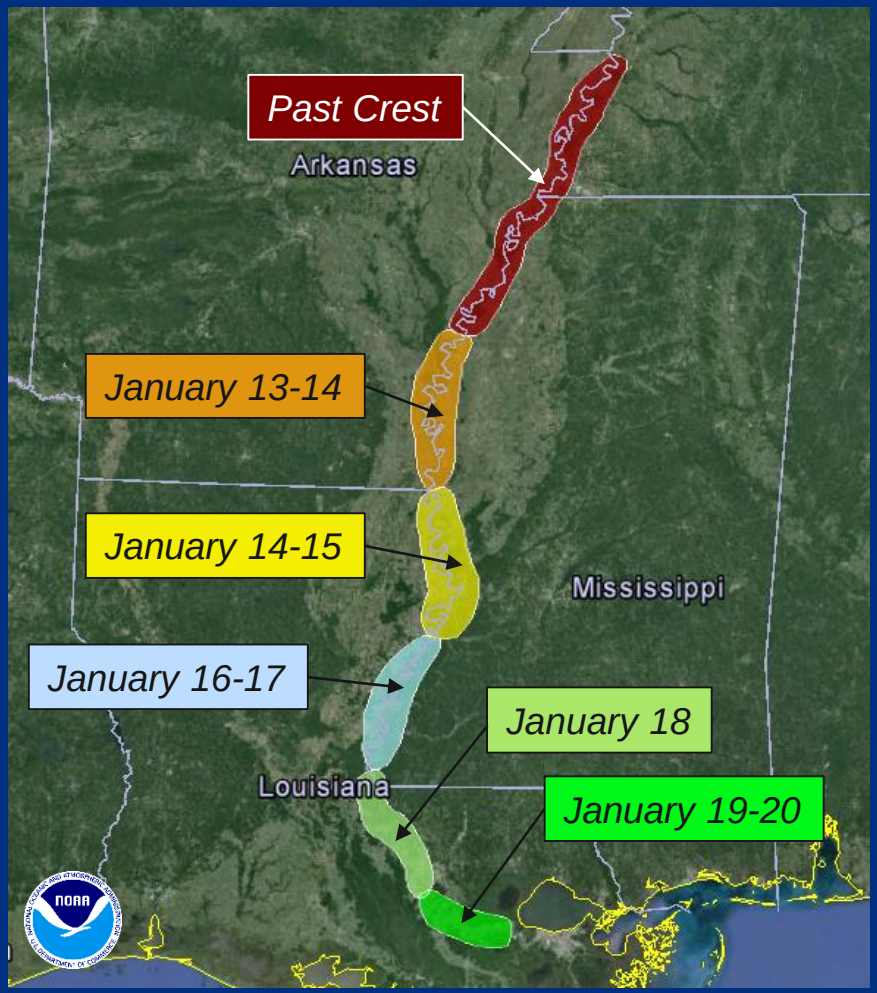
NOAA – Decision Support



- 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

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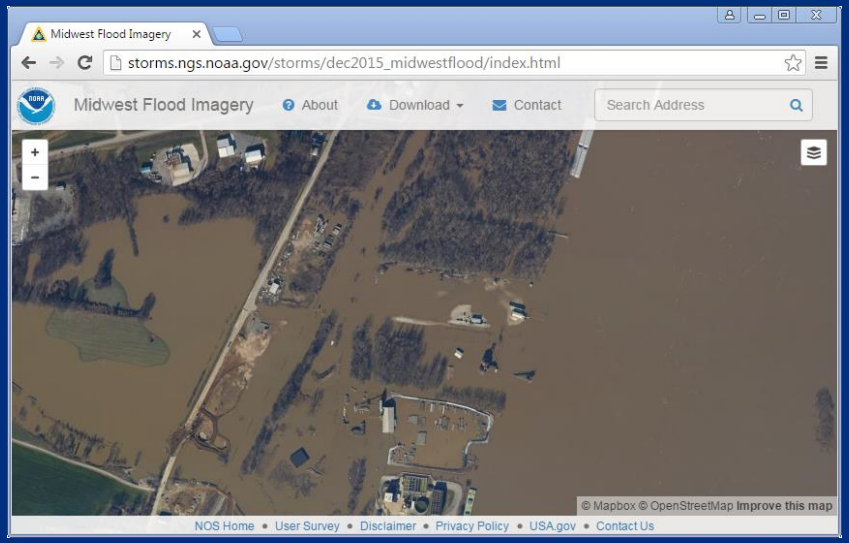
NOAA – Flood Response Imagery

Georeferenced airborne imagery acquisition: January 1–18, 2016



NOAA King Air Aircraft

Aerial Digital Camera

- 68 total hours flown (two aircraft)
- Data published to the web within hours of landing
  - 9 million web “hits” / 1 TB of data downloaded
  - http://storms.ngs.noaa.gov/storms/dec2015_midwestflood/index.html
- 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)

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USACE/CAP

FEMA

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.

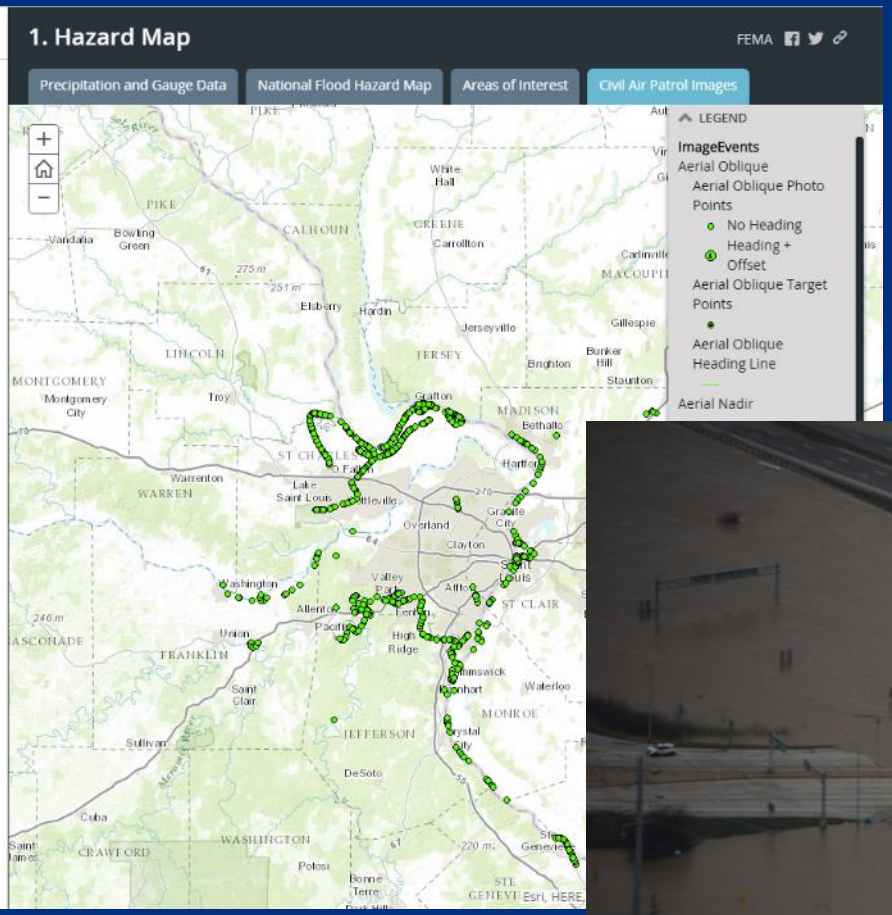
Tab 2. National Flood Hazard Layer by FEMA.

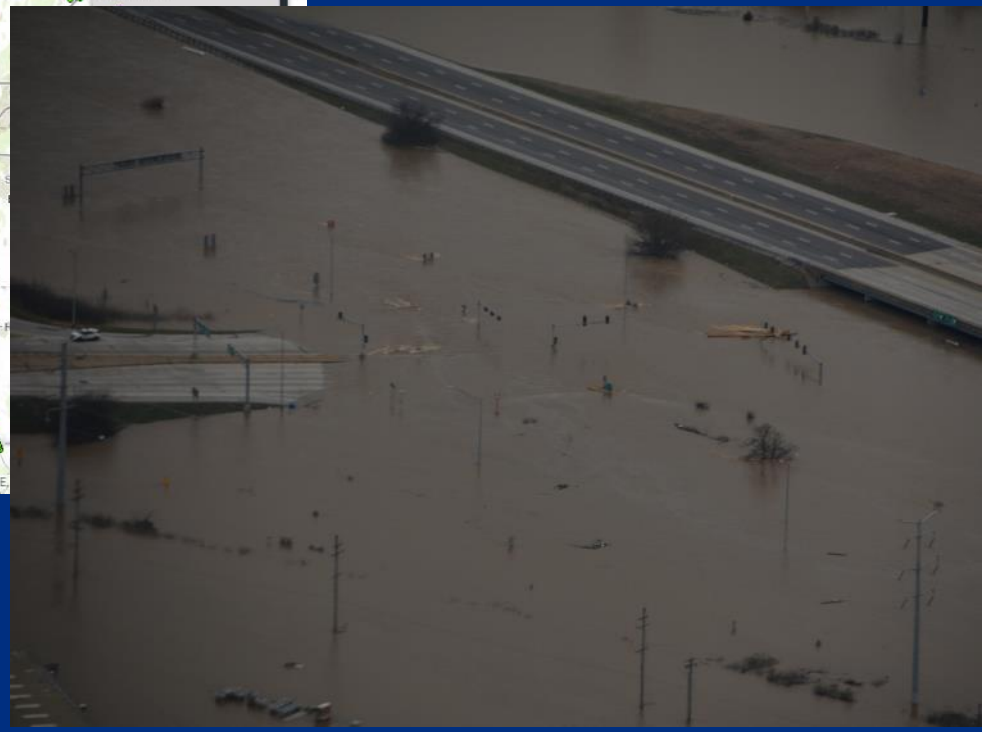
Tab 3. Some selected areas of interest.

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

2. Declaration

Tab 1. Filter by state or declaration number.





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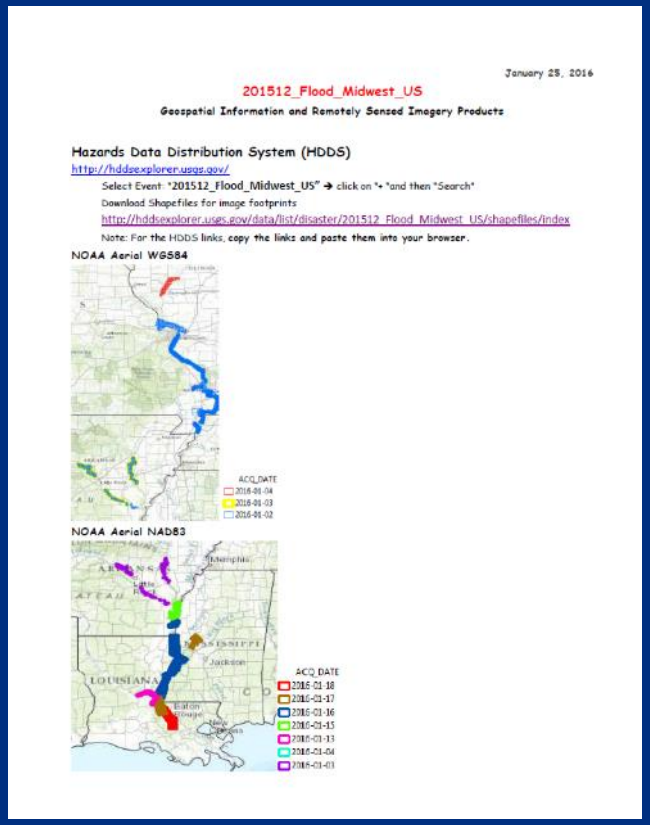
USDA

Daily emails listing geospatial information and remotely sensed imagery products



January 25, 2016

201512_Flood_Midwest_US

Geospatial Information and Remotely Sensed Imagery Products

Hazards Data Distribution System (HDDS)

http://hddsexplorer.usgs.gov/

Select Event: "201512_Flood_Midwest_US" → click on "+ "and then "Search"

Download Shapefiles for image footprints

http://hddsexplorer.usgs.gov/data/list/disaster/201512_Flood_Midwest_US/shapefiles/index

Note: For the HDDS links, copy the links and paste them into your browser.

NOAA Aerial WGS84

NOAA Aerial NAD83

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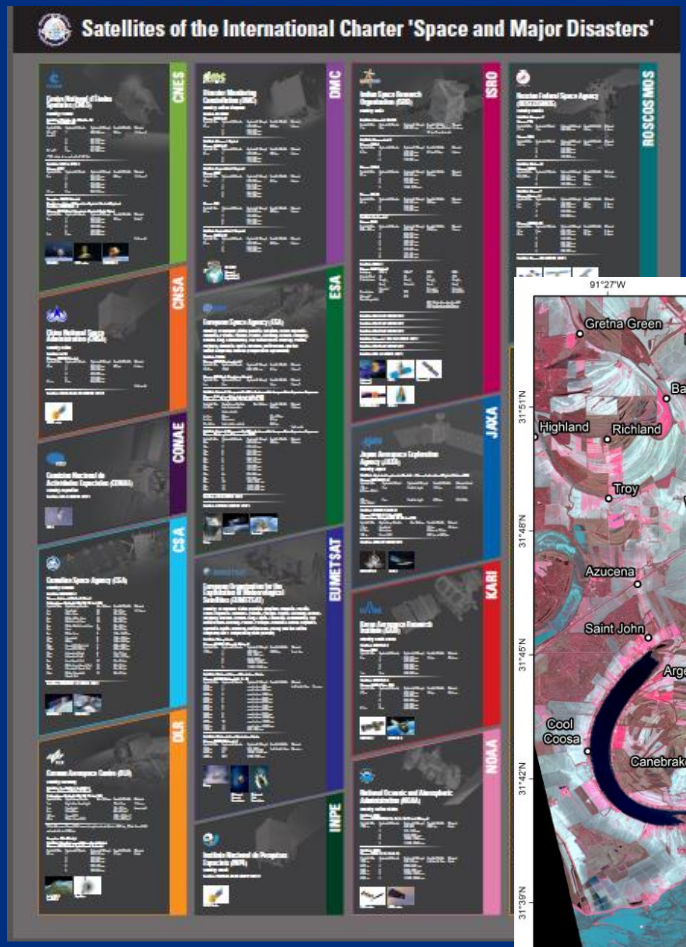
USGS – International Charter

Agency	Sensor	Scenes	New Acquired or Archived	Sensor type
DLR	TerraSAR-X	8	New Acquired	Radar
	RapidEye	19	New Acquired	Optical
DMCii	UK-DMC2	5	New Acquired	Optical
		2	Archived	Optical
ISRO	RISAT-1	8	New Acquired	Radar
	Resourcesat-2	4	New Acquired	Optical
MDA (via DoD Eagle Vision)	RadarSAT	6	New Acquired	Radar
JAXA	ALOS-2 PALSAR-2	14	New Acquired	Radar
		11	Archived	
ROSCOSMOS	RESURS-P	15	New Acquired	Optical
	KANOPUS-V	1	New Acquired	
USGS	Worldview 2&3	3664	New Acquired	Optical
	Landsat-7	24	New Acquired	Optical
	Landsat-8	67	New Acquired	Optical

USGS – International Charter

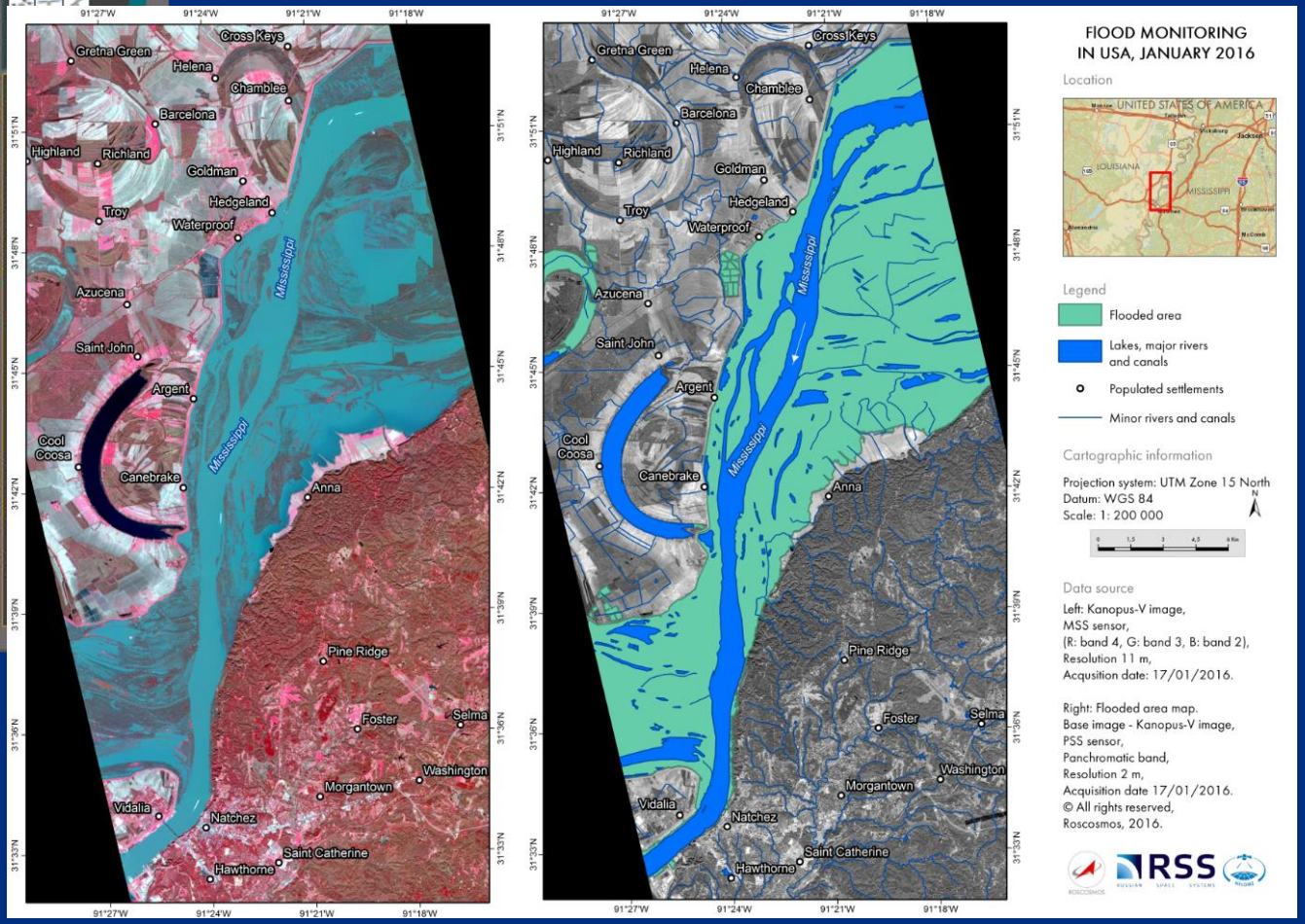


Charter Products:

ROSCOSMOS: 1

DLR: 1

JAXA: 3



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Lessons Learned

SAR flood extents

SAR Interagency calls

International Charter

Local interagency coordination for products

FEMA

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

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FEMA