30 Hours from Acquisition to Online:

Surdex's Emergency Orthoimagery of the Meramec River Flood (2017)

From Emergency Responders to local authorities to insurance companies, those responding to the flooding of Missouri's Meramec River could access imagery within 30 hours of acquisition. Despite tremendous rains and poor atmospheric conditions, Surdex was able to capture critical imagery to help the community quickly respond to the disaster.

The Meramec River Flood Area

Missouri's Meramec River is one of the largest free-flowing waterways in the state. Its meandering 220 miles drains nearly 4,000 square miles in a watershed covering six Missouri counties. In late April 2017, the St. Louis region experienced exceptionally heavy rains. In Sullivan, Missouri, nearly 7 inches of rain fell from April 29 through May 1. Local authorities watched with concern as the rivers swelled beyond capacity. Being a St. Louis County-based company, Surdex monitored the flood waters and was able to conduct aerial imagery acquisition – despite the exceptionally cloudy and rainy conditions - to pull together a complete coverage of the flooded area for local communities and disaster recovery officials.

With the projection that the flood would crest early on Wednesday, May 3, Surdex acquired aerial imagery on May 2, processed the images, and provided web services containing the orthoimagery within 24 hours.

The Meramec crested on Wednesday, 3 May, at 36.52', breaking the over 100 year record by three feet. This was preceded by a crest of 31.48' on December 19, 2015 – essentially exhibiting two nearly "100-year" floods within a 16-month period. The Meramec Caverns attraction was again temporarily closed , along with several campgrounds, boat access areas, etc.

Surdex was able to capture the imagery at a timely point during the flooding and use our tested emergency response processes to ensure expedited products to the government and the public.

Flooding at the intersection of Missouri Highway 141 (top to bottom) and Interstate 44 (left to right) in Valley Park, Missouri.

Contact US
info@surdex.com
(636) 368-4400
www.surdex.com

30 Hours from Acquisition to Online:

Surdex's Emergency Orthoimagery of the Meramec River Flood (2017)

Aerial Image Acquisition

Platform and Sensors

For the Meramec River effort, one of Surdex's Leica ADS100 large-format pushbroom sensors was used to acquire the imagery. The 20,000 pixel width (at nadir) reduces the number of swaths required to acquire large areas, optimizing acquisition times to address narrow windows afforded by the weather. The Meramec imagery was acquired at approximately 12,500' AGL to achieve a resolution of 1' (~30cm). Precision ABGPS and IMU data was acquired to both reconstruct the pushbroom imagery and to provide absolute position and orientation.

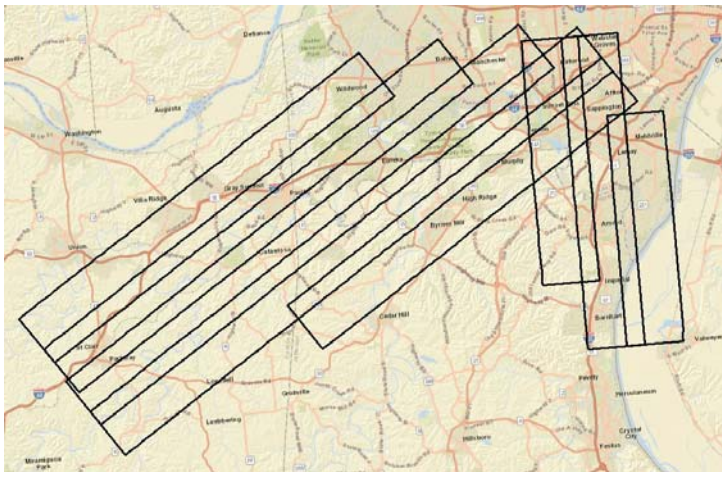
The ADS100 was hosted by one of Surdex's Cessna 441 (Conquest) aircraft. This twin-turbine aircraft is equipped to fly up to 37,000' and can cruise at speeds above 300 knots with an endurance of over 7 hours on a single tank of fuel.

Leica ADS100 installed in a Surdex Conquest aircraft.

One of Surdex's four Conquest aircraft.

Capture Area and Resolution

Surdex chose to acquire approximately 620 square miles of coverage based on local media coverage and previous flood trends. This final flight plan included eight flight lines at a resolution of 1'/30cm.



Flight plan covering the Meramec River from St. Clair, Missouri to confluence with the Mississippi River near Arnold, Missouri.

Contact US
info@surdex.com
(636) 368-4400
www.surdex.com

30 Hours from Acquisition to Online:

Surdex's Emergency Orthoimagery of the Meramec River Flood (2017)

Weather Challenges

With concerns that scattered cloud cover would interfere with successful acquisition, Surdex determined that at least two overflights of the flight plan would be executed, in hope that the combined acquisition would result in data largely free of clouds/cloud shadow. The first mission was flown from approximately 12:00 pm to 1:30 pm and the second mission from approximately 3:30 pm to 4:30 pm.

Notations illustrating cloud/cloud shadow cover for the first (red) and second (green) flight missions.

Expedited Data Processing

For quick response situations, a revised process is utilized to expedite data production:

- Ground control is not introduced into the aerotriangulation unless it is readily available.
- Only existing elevation model data is utilized with no update/edit.
- Automated seamlines are only edited as needed to reduce the presence of clouds and cloud shadows.
- Radiometric balancing is performed to a large degree, but without localized modifications.
- All technicians work under emergency response conditions, supplying a steady work force with a target completion of 24 hours or less.

Final orthoimagery product in color (left) and color infrared (right) renditions. Some residual cloud/cloud shadow cover is present, but exhibiting very little occlusion in flooded areas.

Contact US

info@surdex.com

(636) 368-4400

www.surdex.com

Data Dissemination

Image Services

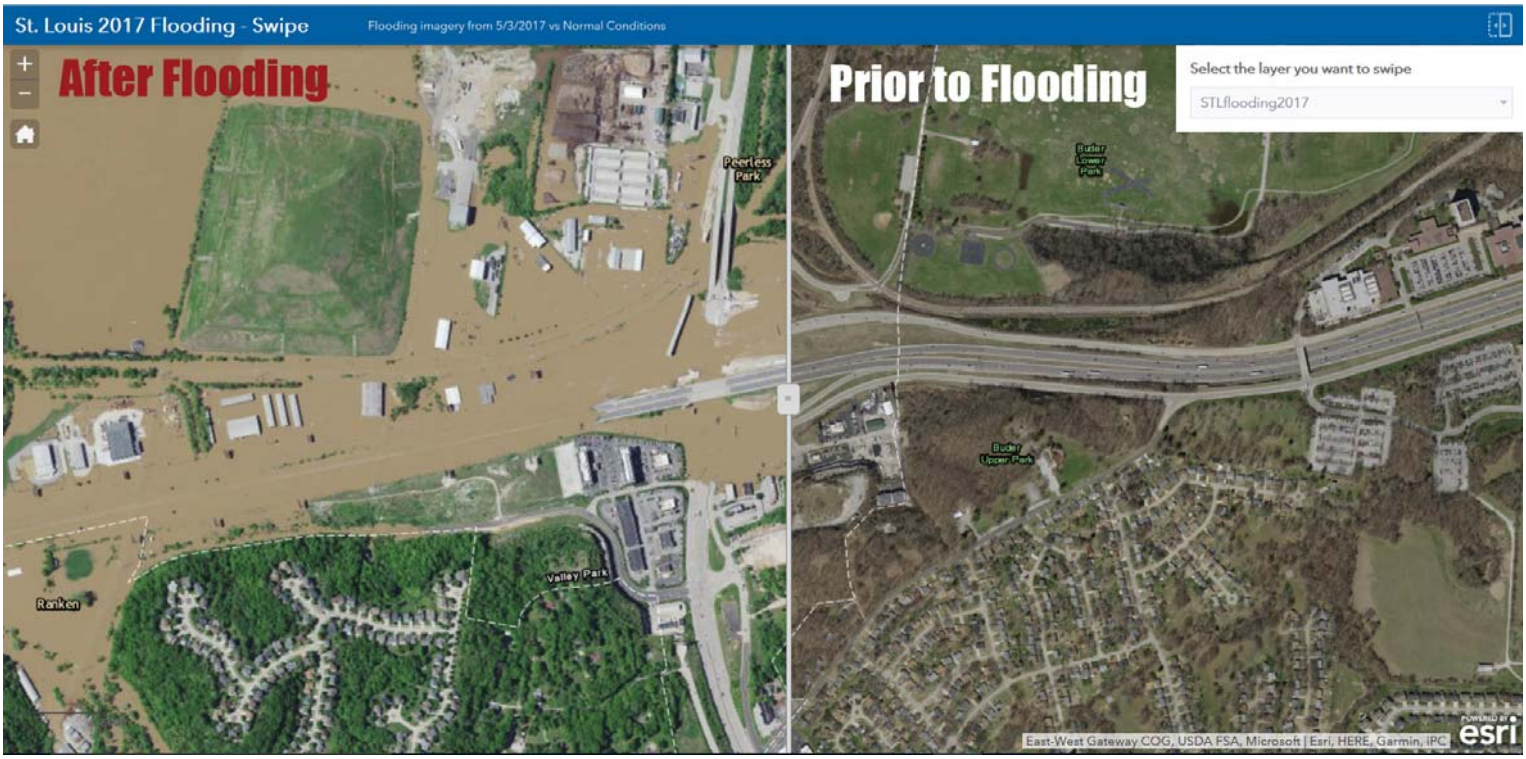
Historically, dissemination of emergency response data has relied on delivery of hard drives to the users. Fortunately, recent proliferation of high bandwidth internet connectivity and standards for web hosting of geospatial data has simplified and expedited the delivery process:

- As soon as data is ready, it is hosted out as an imagery service under REST (REpresentational State Transfer) protocols that make it accessible by virtually any off-the-shelf GIS system as well as Java viewing for desktops, PCs, smart phones, smart tablets, etc.
- For users requiring "hard pixels," projects the size of the Meramec River response can be delivered using FTP protocol.
- For larger response efforts, the hard drives are hand-delivered or shipped by commercial carrier/courier.

By adhering to protocols such as WMS (Web Map Service) and OGC (Open GIS Consortium) for image services, a number of exploitation uses are accommodated for users with varying levels of geospatial awareness and tools. Imagery can be viewed through a simple Java viewer, within a GIS software suite (i.e. Esri's ArcGIS), and in Google Earth.

Of particular benefit is the use of previous imagery and/or geospatial data to present a before-and-after view of the flood. For example, other image layers can be "swiped" against the disaster imagery using a slider to expose imagery prior to the flood to examine the extent of damage. This presentation of the data is a simple yet powerful means for characterizing the situation.

Surdex published an image service that was used by Esri to add to their ArcGIS Online service and also employed two additional web services that were distributed to anticipated users and news media outlets.



30 Hours from Acquisition to Online:

Surdex's Emergency Orthoimagery of the Meramec River Flood (2017)

Final Timeline

The timeline achieved by Surdex was exemplary, as exhibited in the summary table. The projected flood crest was the early morning hours of Wednesday, May 3.

Key Steps in the Emergency Response Timeline

Event / Task	Time / Date	Elasped Time (Hours)
Decision To acquire imagery	9am, Tuesday, May 2	0
Mission planning and preparation	10am - 11:30am, May 2	2.5
First flight	12:07pm - 1:31pm, May 2	4.5
Second flight	3:20pm - 4:36pm, May 2	7.5
Production	5pm, May 2 - 4pm May 3	31.0
Image Service startup	5pm, May 3	32.0

This was accomplished through careful yet quick planning and a workforce willing to work the extra hours to achieve the 24-hour timeline from completion of acquisition.

Experience with Usage to Date

The distribution of links to the imagery included the following users:

- Missouri GIS Advisory Council (MGISAC) listserv mechanism, reaching many state and local entities.
- Direct contact with MSD, SEMA and many public works departments in affected cities and towns.
- Various local media outlets, most notably KMOV-TV.
- The US Army Corps of Engineers, St. Louis District.

The initial use of the imagery was primarily assessment of the extent of the flooding and comparisons to flood model projections. Paul H. Rydlund of the US Geological Survey, Data Chief for the Surface Water Program stated, "Our benefit from this was an active flood inundation mapping project that was underway. The imagery provided peak verification (via flood extent) at a couple of reaches of the Meramec River for us during our modeling and mapping efforts."

Abraham Cook of the Franklin County Emergency Management Agency (EMA) noted that the agency's GIS department digitized a shapefile representing the impact using Surdex's imagery. From this, impacted structures were defined – some of which were unreachable by vehicle. EMA also used data extracted from the imagery during participation in the FEMA (Federal Emergency Management Agency) Preliminary Damage Assessment, and there are plans to compare the flood extent against the flood models by the mitigation groups.

The Missouri Department of Transportation (MoDOT) also utilized the imagery. According to a Professional Engineer at the department, "It was great to see the amount of near-immediate imagery available for the Meramec River flood impact area provided by Surdex. This imagery service assisted us in managing the impact to our transportation system. In the future, we will use these tools to do an even better job of incorporating the imagery into our Emergency Operations Center (EOC) processes."

Local KMOV-TV featured the imagery with the before-and-after scenario using the swipe slider bar to update St. Louis area viewers and to assist in raising donations to various charity funds addressing those affected by the flooding.

Summary

Surdex was excited to provide this community service for the Meramec River flood of 2017. With previous similar experiences behind us, we were able to capture the imagery at a timely point during the flooding and use our tested emergency response processes to ensure expedited products to the government and the public. It is clear that disseminating time-critical data is becoming easier because of web mapping services and expansion of broad-band internet availability. It is also clear that the GIS professionals within state and federal agencies are essential to ensuring such data is provided to the appropriate responders and decision-makers.