



NASA Response efforts for Harvey

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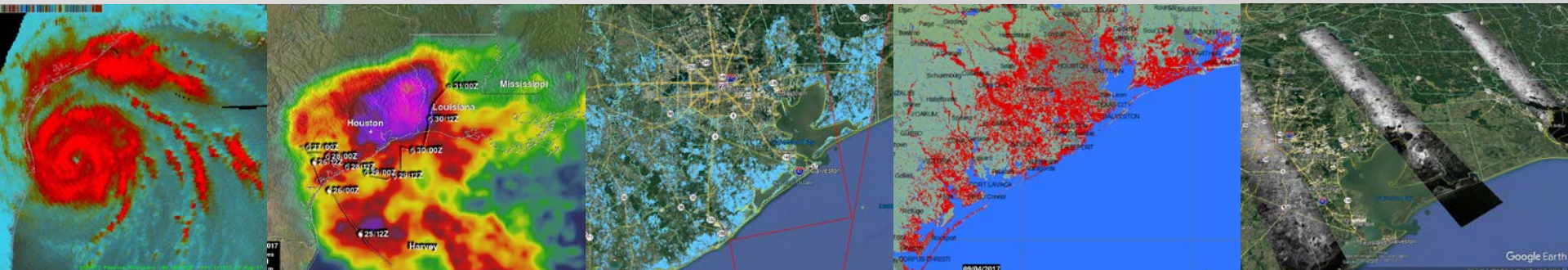
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Disaster Coordinator
NASA GSFC

Briefing for SDR Monthly Meeting
September 7th, 2017



Overview of response

- NASA's Disasters Program has been engaged with Hurricane Harvey assessment since a week before Harvey's landfall with images and models predicting an intensive risk, to support state agencies and other federal agencies.
- Disasters continues to collect data, and in combination with partners, generates targeted and complementary products for situational awareness and decision support, including: wind, precipitation models and maps flood maps based on satellite data, including Synthetic Aperture Radar (SAR), optical, and microwave data.
- Deployed the NASA UAVSAR airborne SAR instrument to Texas to acquire specific flood extent measurements and to monitor water levels and flood propagation throughout the TX/LA region – at the request of federal and state agencies.





Overview of response

■ Agencies/Organizations with which NASA is coordinating:

■ State:

- State of Texas agencies and the Governor's Office through a single POC at the Center for Space Research – U Texas/Austin (CSR/UTA)
- National Guard (Including NG DAART Team)

■ US Government:

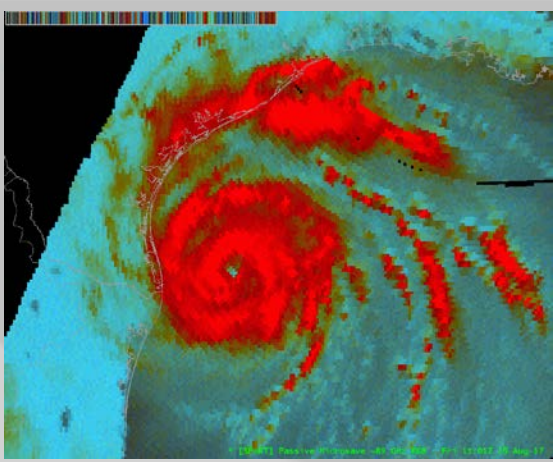
- DHS/FEMA National and Regional
- National Geographic Information Systems Team
- US Army Corps of Engineers (USACE), Flood Office and District
- NOAA/National Weather Service (Weather Forecast Offices and FEMA Liaison)
- EPA Water Quality Office
- USGS Office of Surface Water
- National Hazards Data Distribution System (chaired by USGS)

■ NGO:

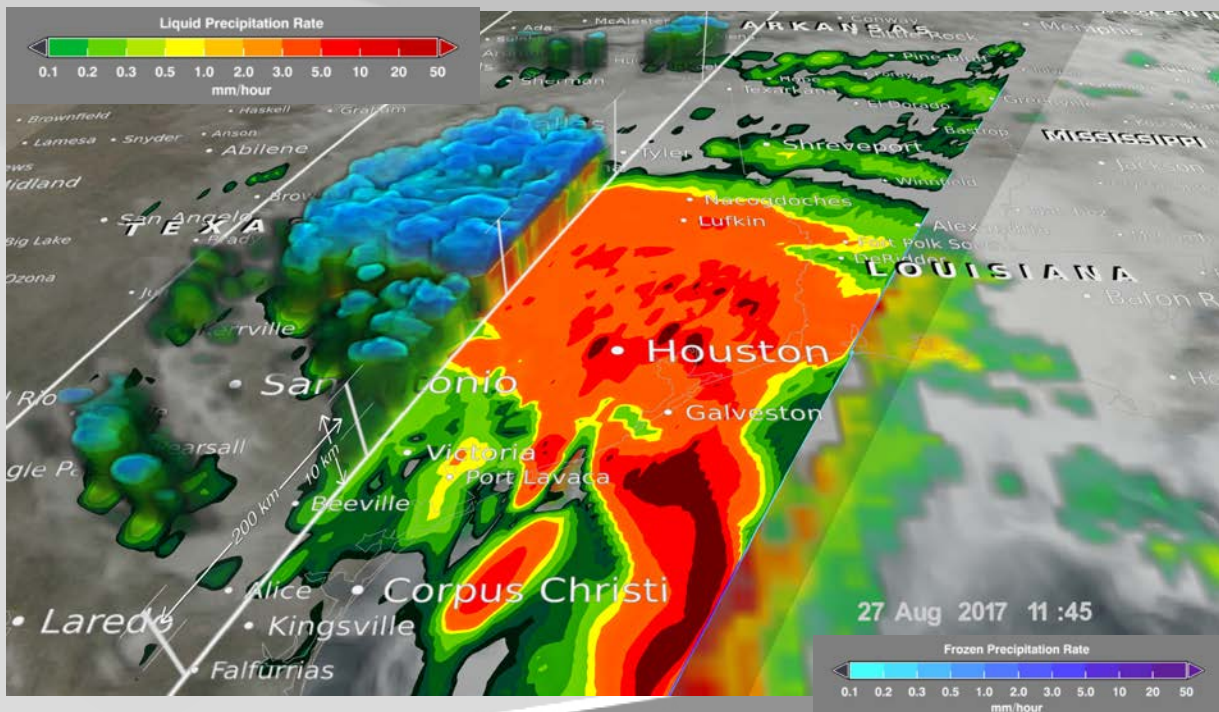
- Civil Air Patrol



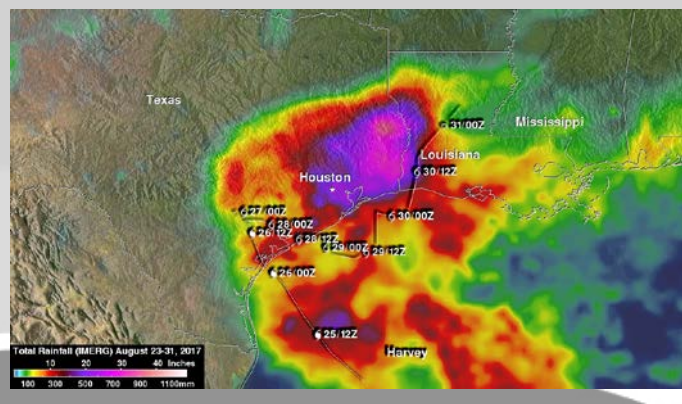
Precipitation



Global Precipitation Measurement (GPM) Microwave Imager (GMI) identified strong thunderstorms associated with Harvey on August 25 before it made landfall on the Texas coast. NASA SPoRT Center collaborates with the Naval Research Laboratory to integrate false color composites of passive microwave brightness temperatures that are helpful for identifying the center of circulation of storms. Images are shared with the National Weather Service and the National Hurricane Center to help integrate the use of unique NASA mission imagery and products within the weather forecasting process.

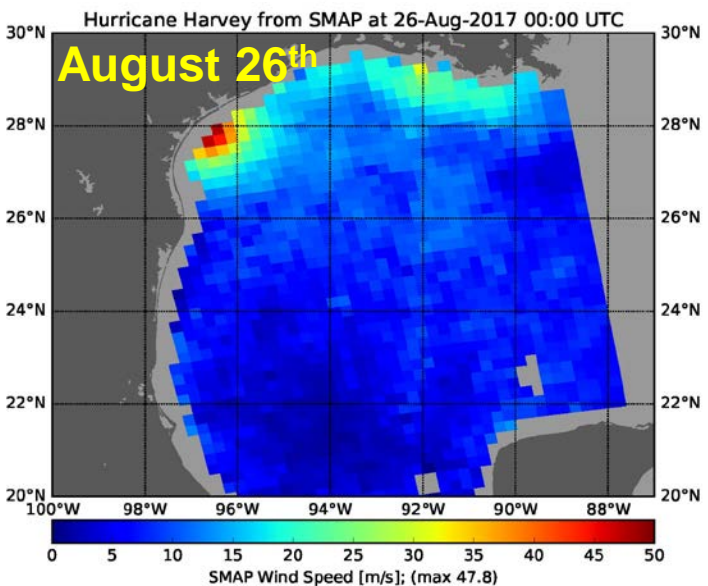
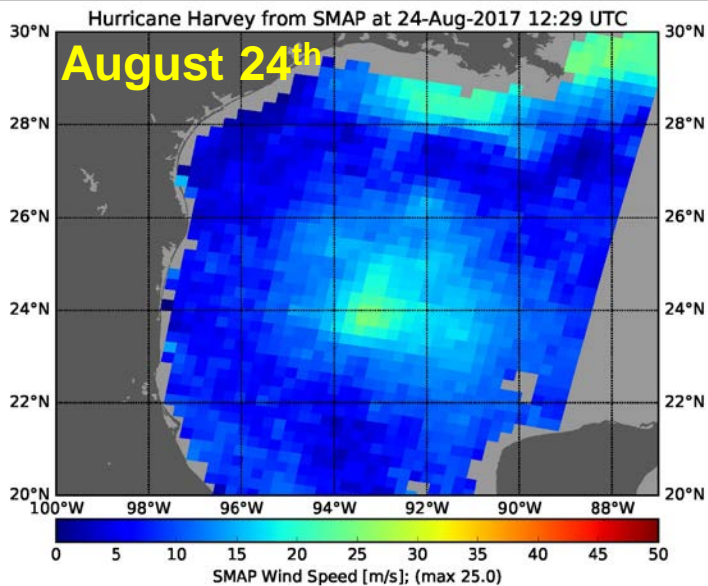


Subsequent overpasses by GPM revealed Tropical Storm Harvey's precipitation distribution and structure (in 2 and 3-D) as it affected Texas and Louisiana.



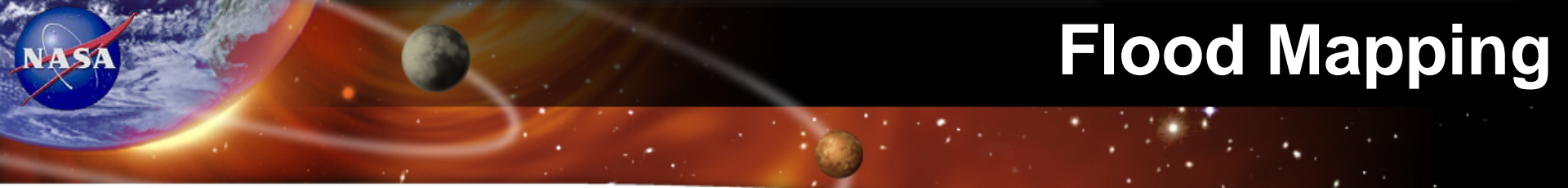


Soil Moisture

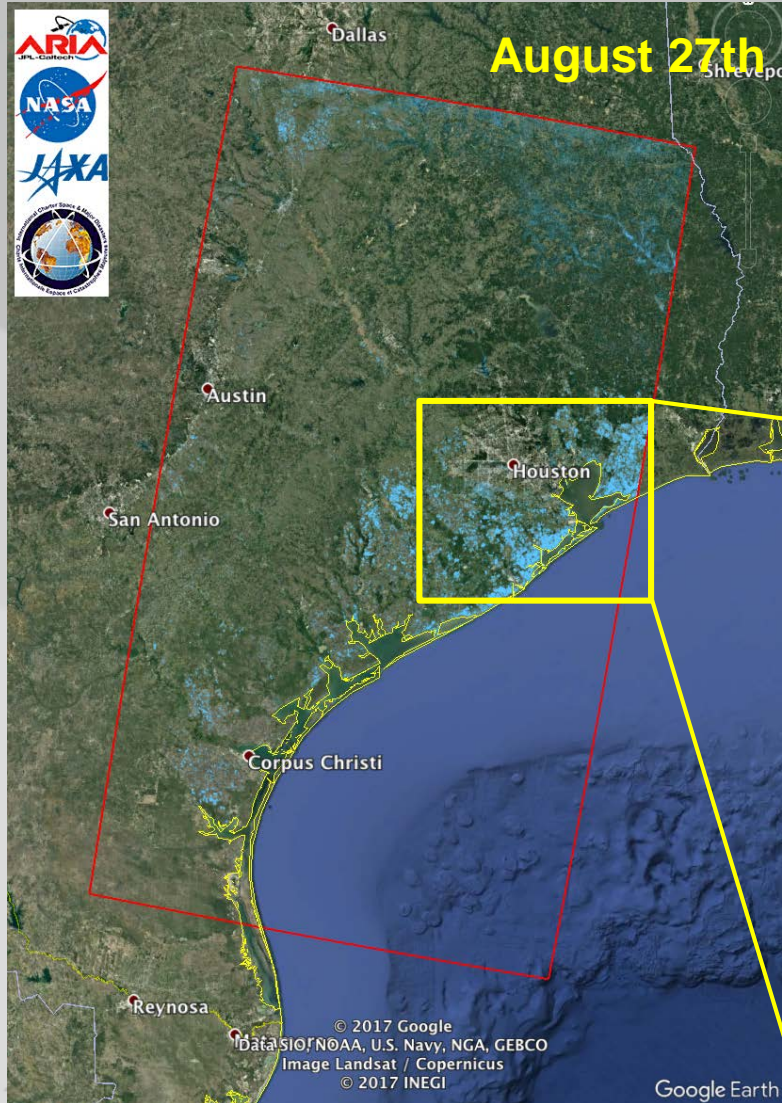


(left) Ocean surface wind speeds as observed by the radiometer instrument aboard NASA's Soil Moisture Active Passive (SMAP) satellite.
(below) SMAP soil moisture changes between Aug 19th and 27th in the area affected by Harvey

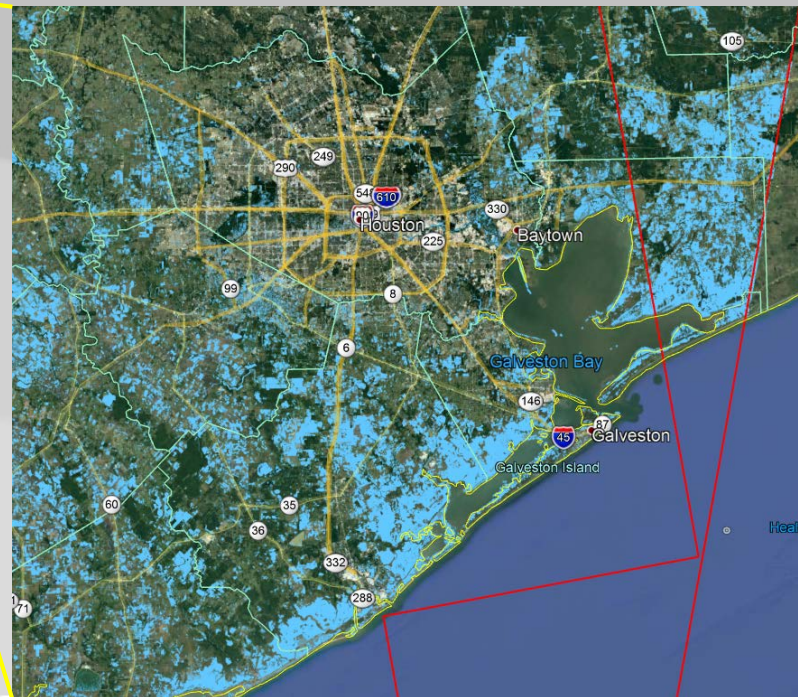


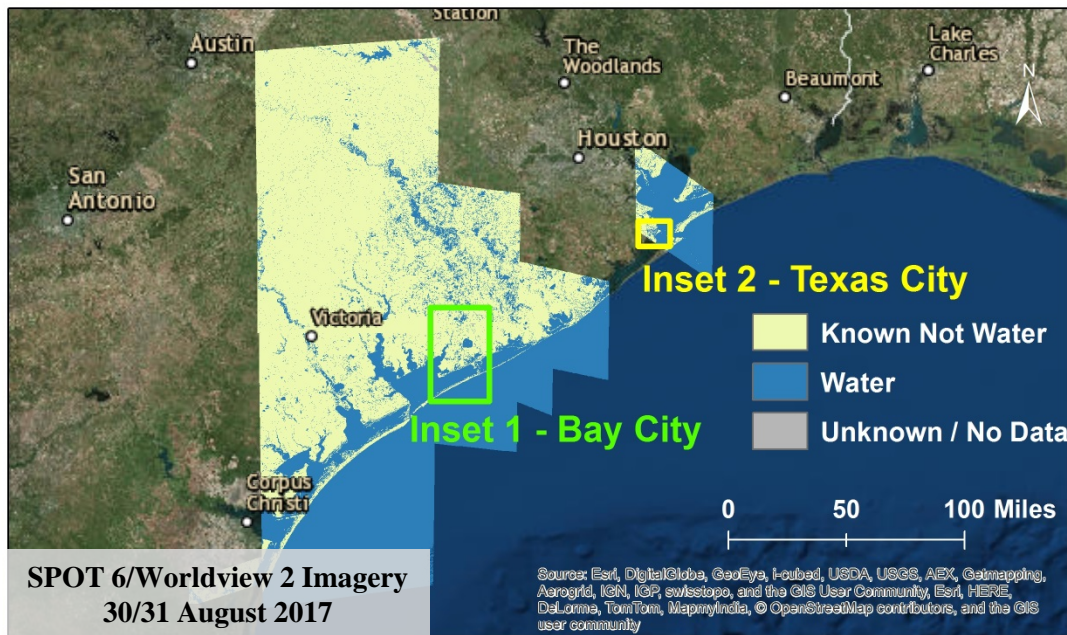


Flood Mapping



The Advanced Rapid Imaging and Analysis (ARIA) team at NASA JPL created a Flood Proxy Map depicting areas of Southeastern Texas that are likely flooded as a result of Hurricane Harvey, shown by light blue pixels. The map is derived from synthetic aperture radar amplitude images from the JAXA ALOS-2 PALSAR-2 satellite, taken before (July 30, 2017) and after (August 27, 2017) Hurricane Harvey made landfall. Additional maps were derived using Sentinel-1 data as the flooding evolved. **These products were provided to FEMA, USGS, International Charter and State of Texas.**

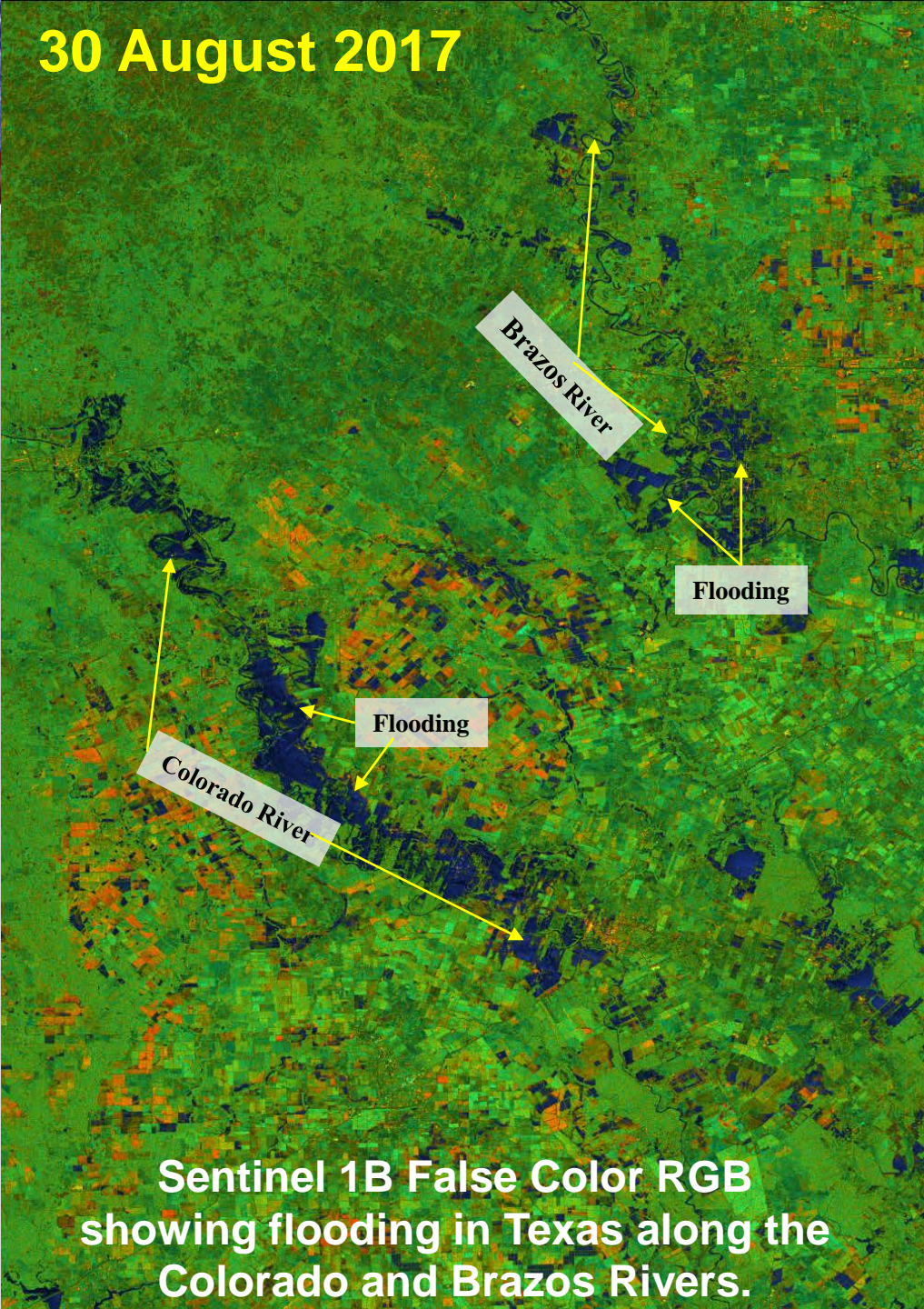




- NASA MSFC SERVIR and SPoRT exploited high resolution imagery to create products to help with mapping of flood waters
- Created both quantitative products (left) and qualitative RGBs (top)
- High resolution products were used to help validate other optical products, and SAR products

30 August 2017

SAR Flood Mapping



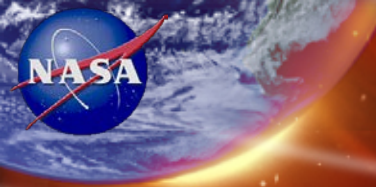
**Sentinel 1B False Color RGB
showing flooding in Texas along the
Colorado and Brazos Rivers.**

The use of false color RGBs (Red, Green, Blue) composites generated from the polarizations of SAR allows for a quick qualitative analysis of the area for large scale features.

- Water is quickly identified in shades of blue
- ESA's Sentinel 1 SAR instruments offer broad coverage over an area every 6-12 days, with increased coverage possible during threat events.

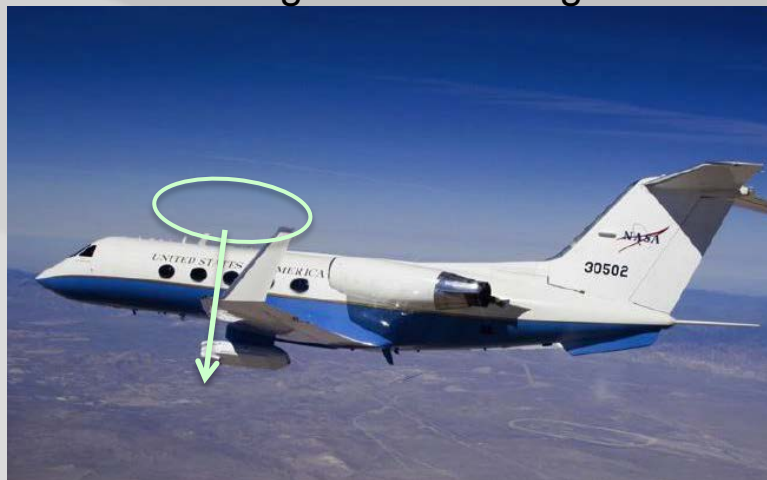
Partnership with the Alaska Satellite Facility and the University of Alaska Fairbanks has facilitated the availability in near real time products to quickly respond to end users using their automated system, Hybrid Pluggable Processing Pipeline or HYP3 (<https://www.asf.alaska.edu/>).

Credit: NASA/MSFC, ASF

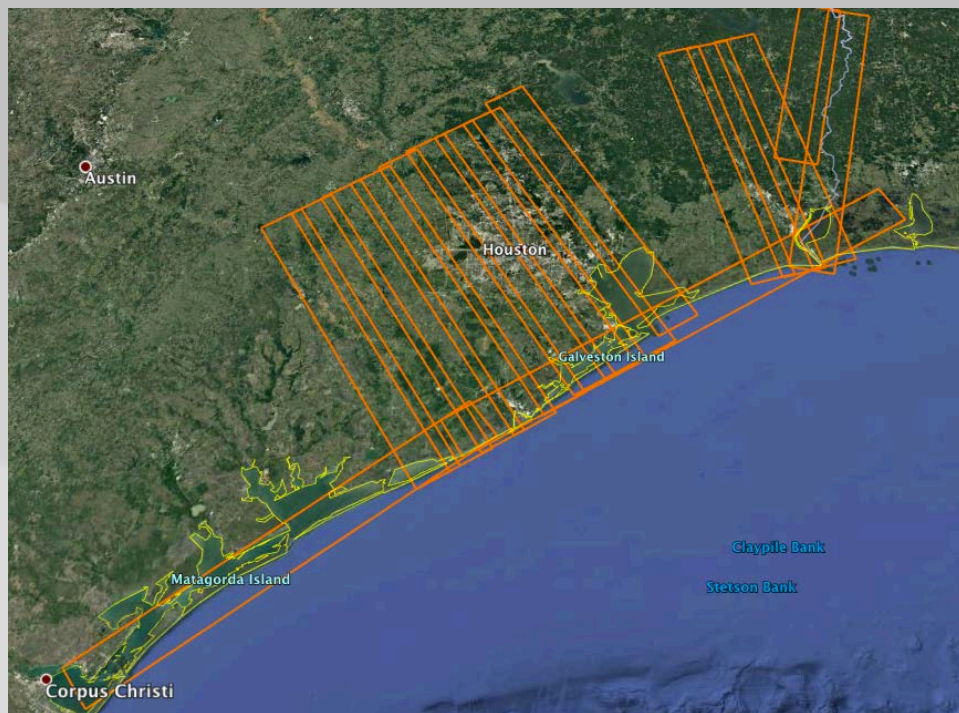


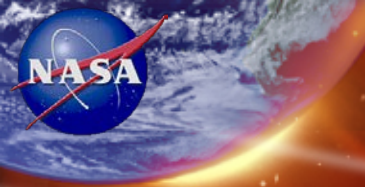
UAVSAR Instrument and Coverage

- Platform: NASA G-IIIs based at AFRC and JSC
- Nominal altitude: 12.5 km (41,000 ft)
- Nominal flight duration: 5.5 hours
- Platform precision autopilot: < 10 m tube
- Left-looking all weather L-band radar
- Repeat-pass polarimetric interferometry for monitoring surface change
- Spatial posting: 6 m
- Typical flight lines (orange rectangles in map) in Houston were 22 km wide by 190 km long (programmable)
- Quick-look processing with short latency (3-6 hours) post-landing



L-band radar pod



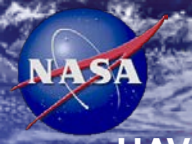


UAVSAR Deployment Timeline

- Base of Operation: Austin, TX
- Four local flights: Thu, Fri, Sat, Sun
- Takeoff time/Flight Duration: ~ 10 am CDT / 5.4 – 6.1 hours
- Generated single channel quick-look products during flight and post-flight

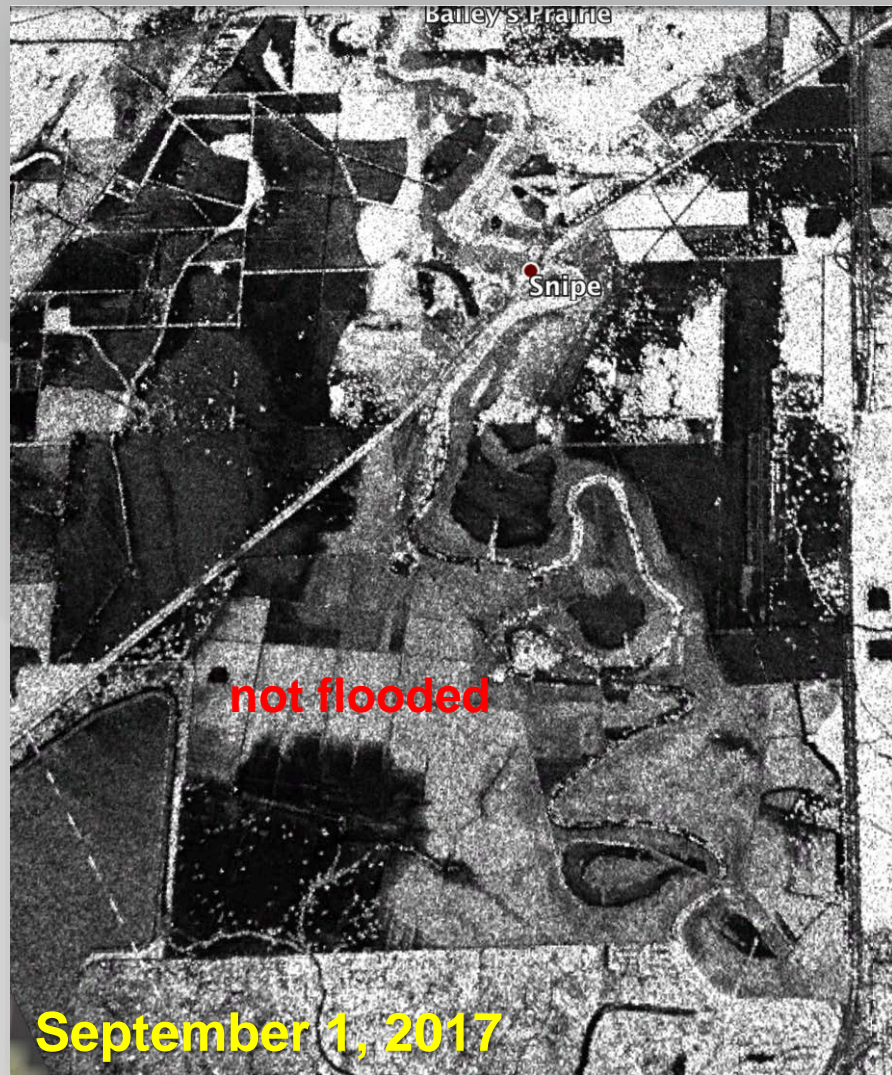
Date	Target Areas	Flight Lines Delivered Upon Landing	Flight Lines Delivered 3-5 hours Post Flight
8/31	Greater Houston area along the Colorado, San Bernard, Brazos, San Jacinto, and Trinity Rivers	6	6
9/1	Areas along the Brazos (Rosenberg, Sugar Land, Addicks Reservoir), San Jacinto, Neches (Beaumont), and Sabine Rivers	7	5
9/2	Areas along the lower Brazos, San Jacinto, Neches (Beaumont), and Sabine Rivers, Texas coast (Galveston, Port Arthur)	9	3
9/3	Lower Brazos, San Bernard, and Colorado Rivers, Trinity River, Neches, and Sabine Rivers, Barrier Islands	8	3

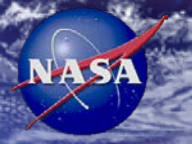
“UAVSAR gave us such a good view of where the flood waves were impacting, and allowed us to anticipate where things would be hit next.” Gordon Wells (UT Austin Center for Space Research)



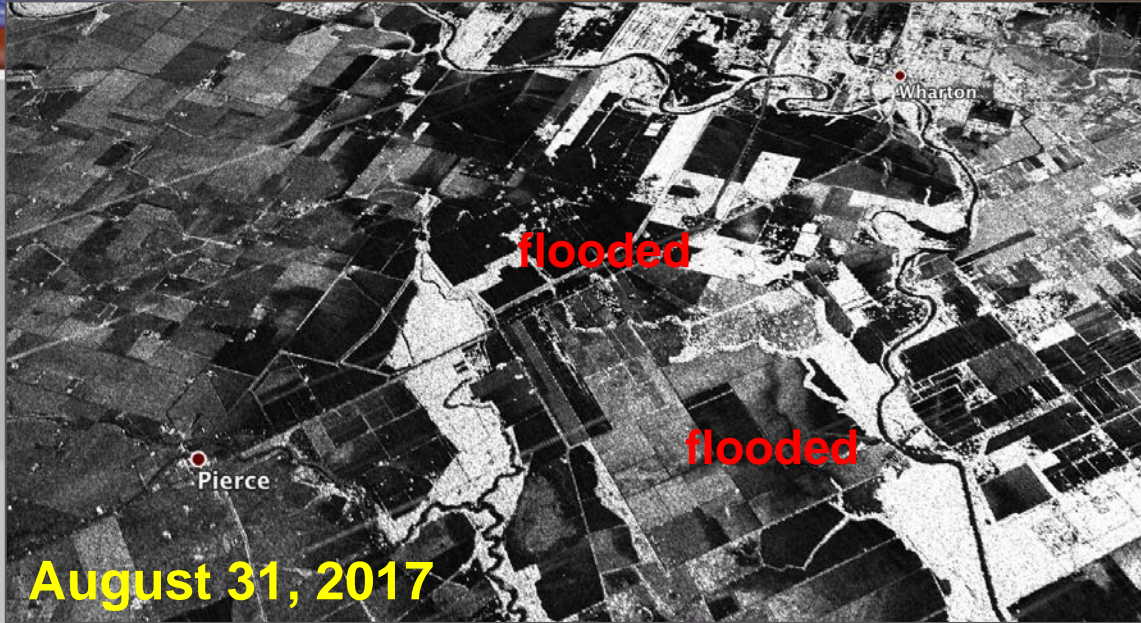
UAVSAR: Flooding in Lower Brazos River

UAVSAR HH-polarized quick-look images acquired one day apart showing increased flooding in lower Brazos River basin due to floodwater flowing south into the Gulf of Mexico





UAVSAR: Flood retreating along the Colorado



August 31, 2017

UAVSAR HH-polarized quick-look images acquired 3 days apart showing fields near Wharton, along the Colorado River, no longer flooded



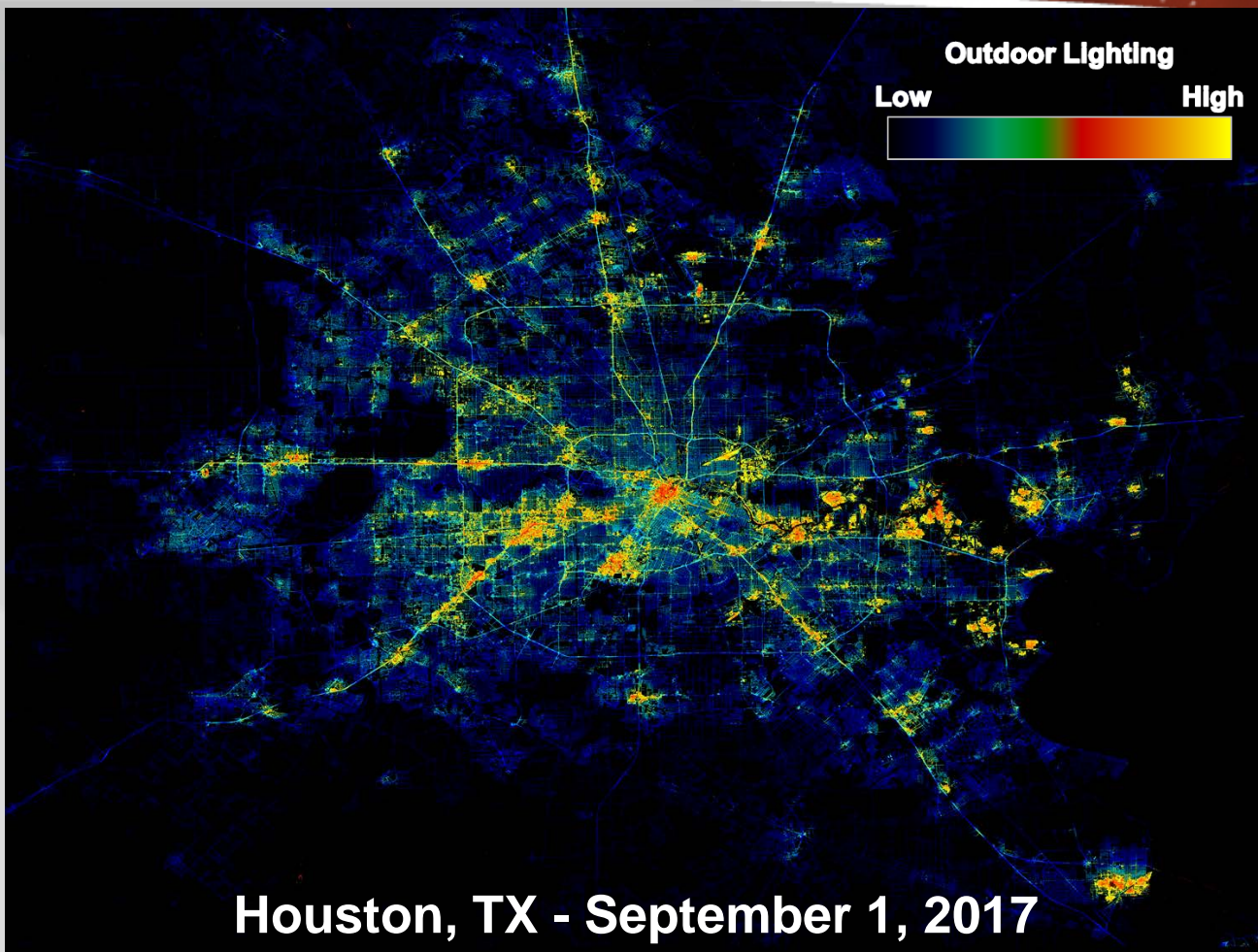
September 3, 2017

UAVSAR data were used by emergency response staff at the Texas State Operations Center in Austin to:

- **Identify levee breaches** and levee over tops around small towns and neighborhoods to direct evacuation and rescue efforts
- **Identify flooding in refineries**, especially containment breaches and over tops around the oil tank batteries to direct chemical spill response efforts
- **Identify where the “dry spots” are for disaster relief agencies** to stage relief centers near flooded towns

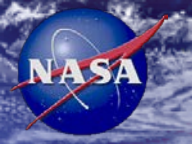


Nighttime Satellite Data

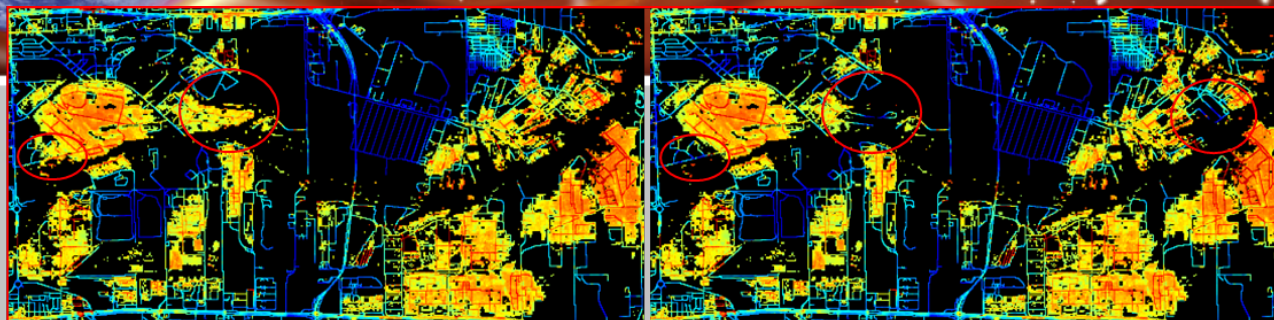


- **Project Goal:** To improve the timing, decision making, and effectiveness of large-scale search and rescue operations.
- **Unique Features:** High resolution nighttime maps combine data from six satellites (Suomi-NPP, Landsat-8, Sentinel 2A & 2B, TerraSAR-X/TanDEM-X) to enable first-ever daily monitoring of affected areas at neighborhood scales (< 30 meters).

During search and rescue operations, knowledge of outdoor lighting conditions is an important aspect of situational awareness.

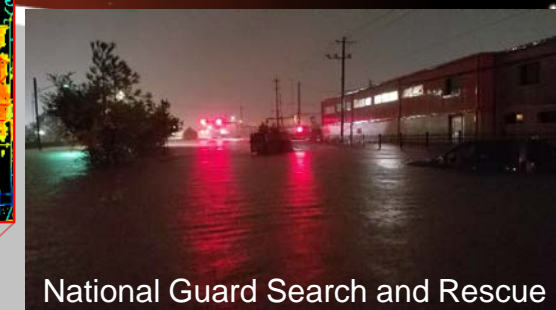


Nighttime Satellite Data (East Houston)

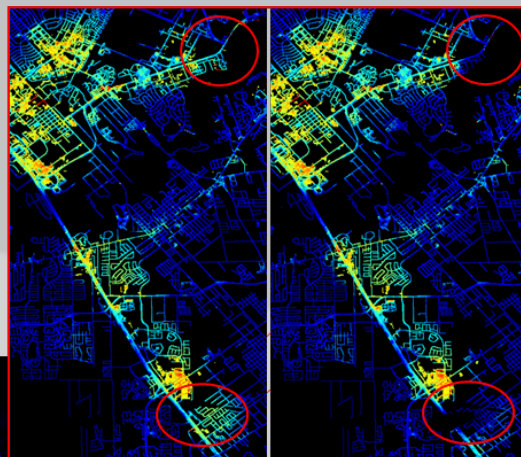


Pre-Event

Post-Event



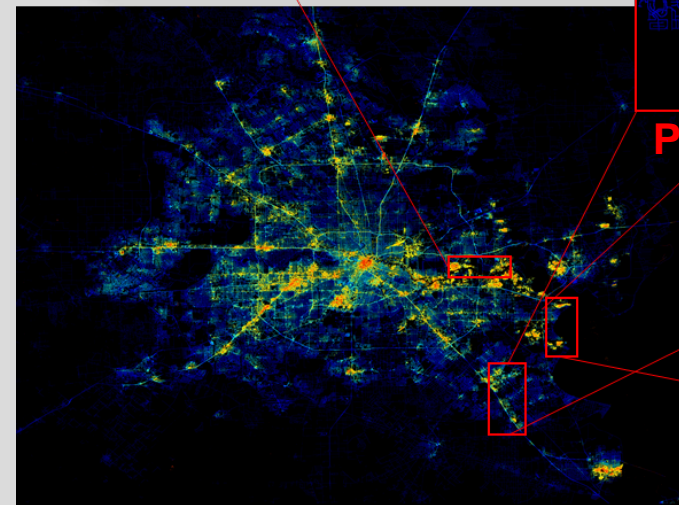
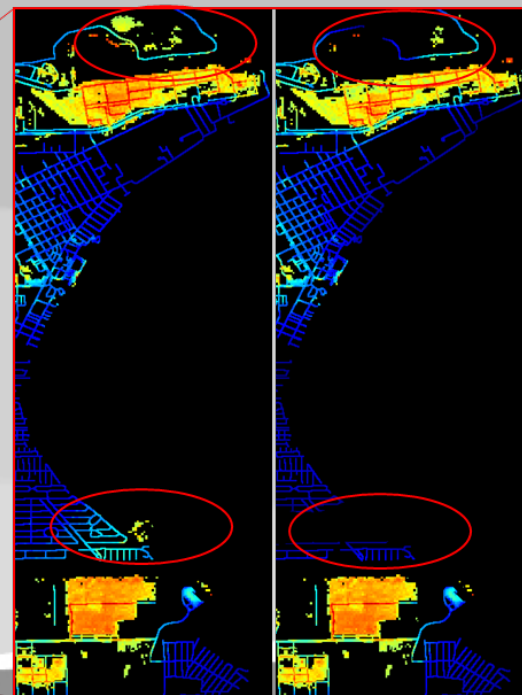
National Guard Search and Rescue

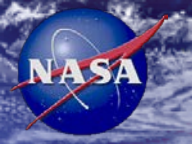


Pre-Event

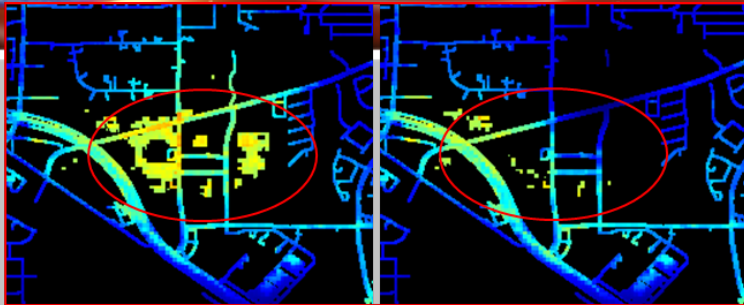
Post-Event

Pre-Event Post-Event





Nighttime Satellite Data (NW & SW Houston)



Pre-Event

Post-Event



Residents ride in the bed of an emergency vehicle following flooding.

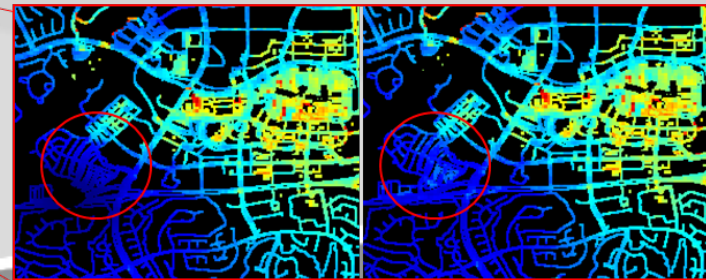
Pre-Event



Post-Event

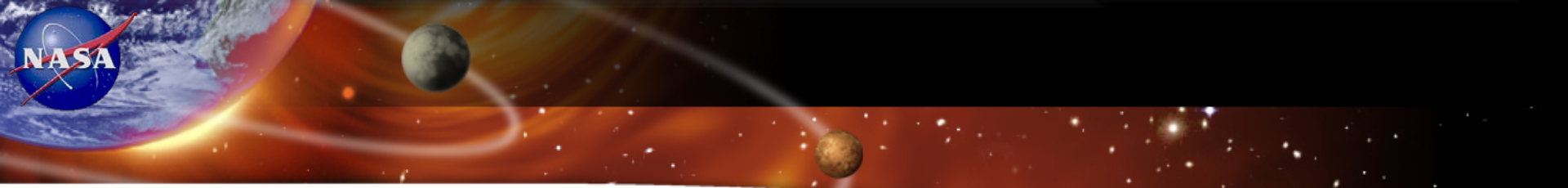




Credit: Miguel Roman/GSFC, Sumoi-NPP VIIRS



Pre-Event

Post-Event



NASA Earth Science  NASA Applied Sciences Program | www.nasa.gov 


DISASTERS PROGRAM

Search

ORGANIZATION DISASTERS PRODUCTS RESOURCES

September 1, 2017

MODIS Sees Sediment Runoff from Harvey



Colorado River — — Brazos River — Galveston Bay

— Lavaca River Sediment

NASA has activated Tier 2 response for Hurricane Harvey and is providing significant response over an extended period. [Learn more](#)

Upcoming Meeting Sept. 3-8, 2017: Strengthening Disaster Risk Reduction across the Americas: A Regional Summit on the Contribution of Earth Observations [📄](#)

Recent Disasters

<https://disasters.nasa.gov/>

Program: <http://appliedsciences.nasa.gov/programs/disasters-program>