

Disaster Response from a NASA Perspective

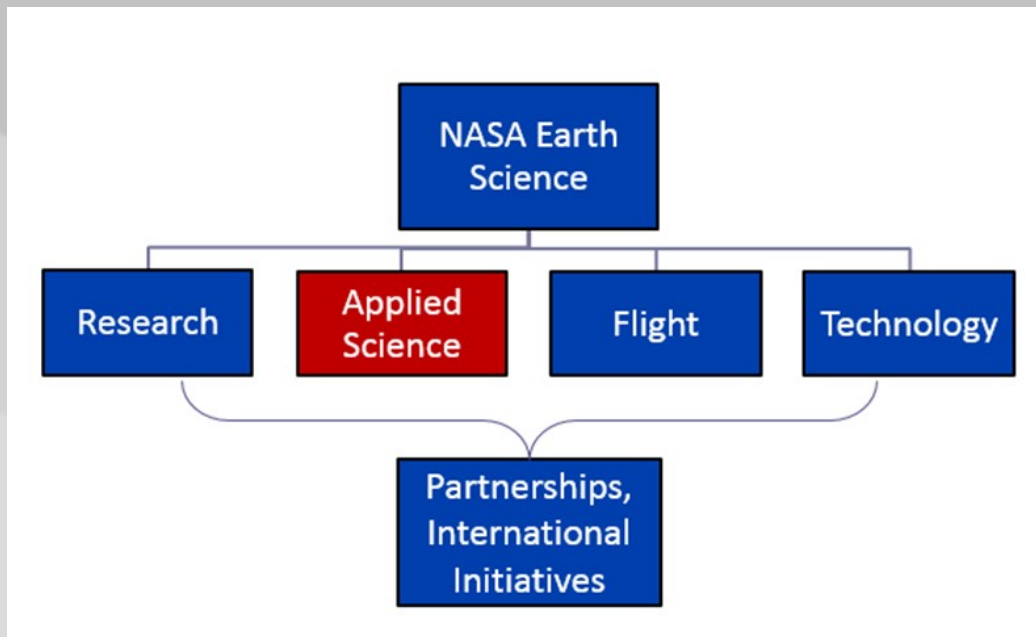
Dr. David Green
Disaster Program Manager
Science Mission Directorate
Earth Science Division



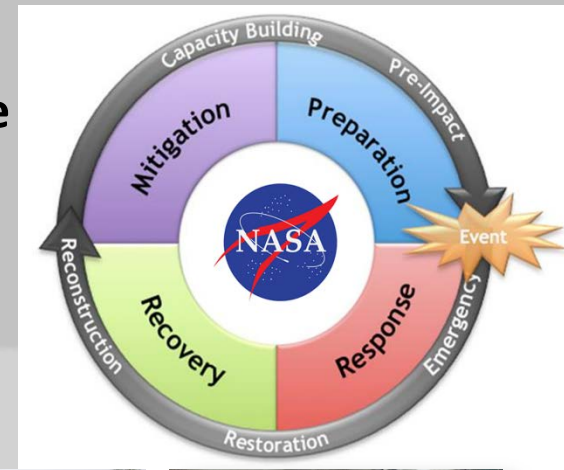
WH Subcommittee on Disaster Reduction

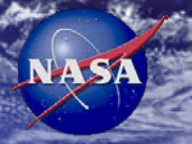
February 2, 2017

Science Mission Directorate Earth Science Division



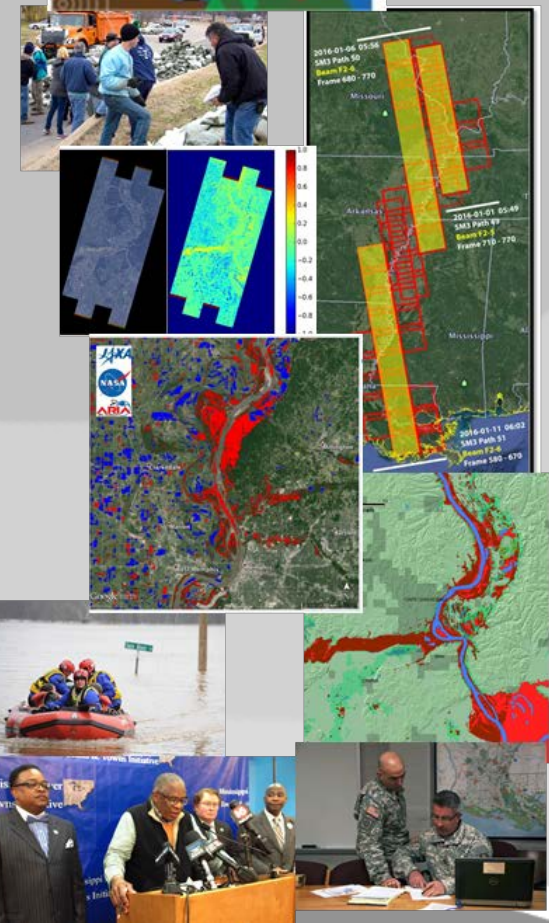
Disaster Response





Overview

- NASA Earth Science Disaster Response for Resilience
- Earth Observations and Partnerships
- Case Studies and Workflows
- Opportunities and Next Steps



Recent Disasters

- Hurricane Matthew 2016
- Typhoon Megi 2016
- Puerto Rico Blackout 2016
- Amatrice Italy Earthquake 2016
- Louisiana Flooding 2016
- California Wildfires 2016
- Alaska Pavlof Volcano 2016
- Eastern US Blizzard January 2016
- Mississippi Flooding January 2016
- Hurricane Patricia 2015

[View All](#)

About the NASA Disasters Program

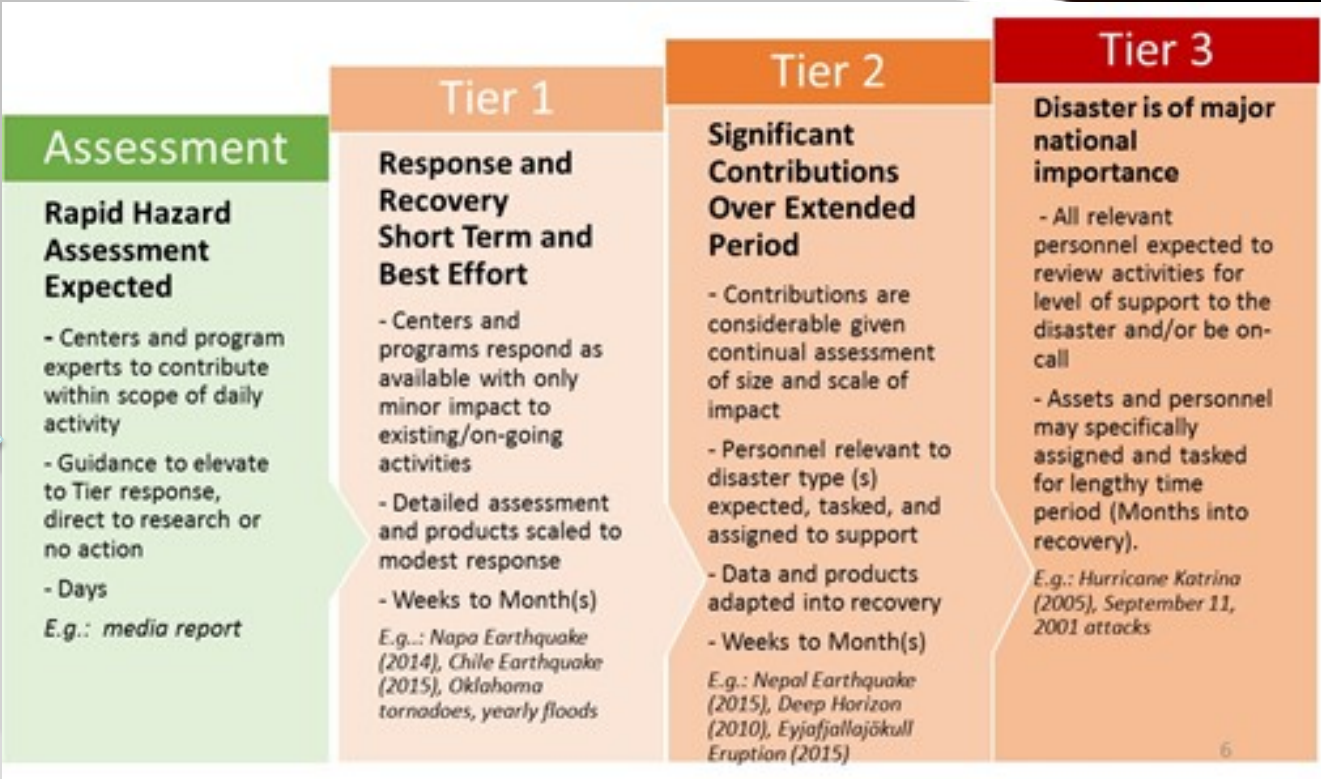
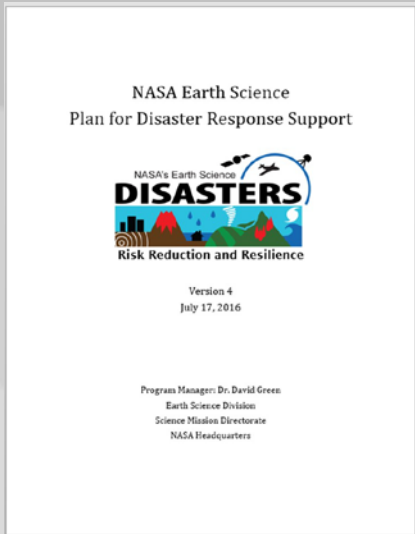
The Disasters Applications area promotes the use of Earth observations to improve prediction of, preparation for, response to, and recovery from natural and technological disasters. Disaster applications and applied research on natural hazards support emergency preparedness leaders in developing mitigation approaches, such as early warning systems and providing information and maps to disaster response and recovery teams.

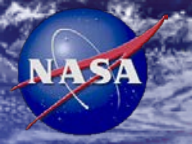
[Learn More](#)

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



NASA's Tiered Response





Deepwater Horizon Oil Spill

**Well Head Explosion
Uncontrolled Oil Spill**



**End of Active
Response**

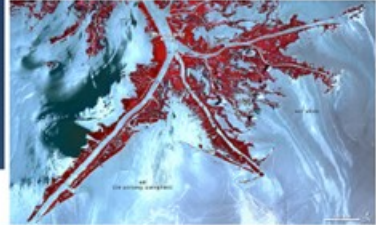
Terra & Aqua
MODIS images track
extent of spill



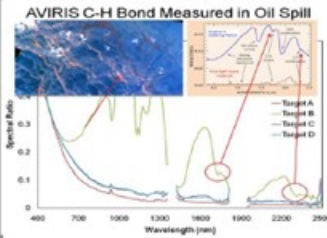
ER2/AVIRIS flights
6-25 May



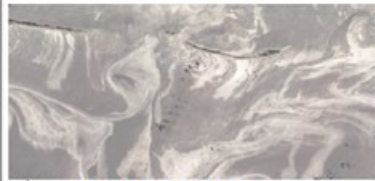
Terra/ASTER 24 May



G-III/ UAVSAR 22-24 Jun



EO-1/ALI 26 June



**B200/AVIRIS
flights
3-13 Jul**

**Well
Capped**

**B200/AVIRIS flights
2 Sep-4 Oct**



**Well
Sealed**

**Intl. Charter
Activated**

Day 0
20 Apr
2010

Day 3
23 Apr

Day 5
25 Apr

Day 15
6 May

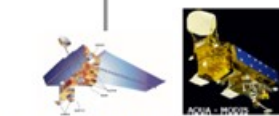
Day 33
24 May

Day 62
22 Jun

Day 73
3 Jul

Day 134
2 Sep

Day 166
4 Oct



Terra MODIS, Aqua
MISR, ASTER MODIS



Contents lists available at SciVerse ScienceDirect

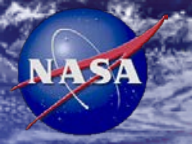
Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

Review

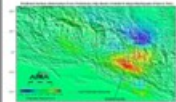
State of the art satellite and airborne marine oil spill remote sensing: Application to the BP Deepwater Horizon oil spill

Ira Lefler ^{a*}, William J. Lehr ^b, Debra Simecek-Beatty ^b, Eliza Bradley ^c, Roger Clark ^d, Philip Dennison ^e, Yongxiang Hu ^f, Scott Matheson ^g, Cathleen E. Jones ^h, Benjamin Holt ^h, Molly Reif ^h, Dar A. Roberts ^g, Jan Svejckovsky ⁱ, Gregg Swayze ^g, Jennifer Wozenraft ^h



Disaster Response for Nepal

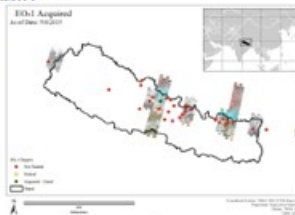
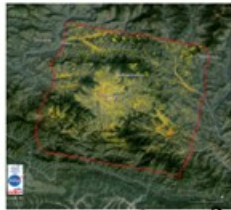
M7.8 Earthquake & 1st coordination call



Initial quake models
Interferograms
tilt maps

CSK Damage Proxy Map (DPM)

- Delivered to NGA, OFDA/USAID
- Publicly released



GPS Surface Deformation
- Delivered to USGS
- Publicly released

First Radar Surface
Deformation - S1A
- Publicly released

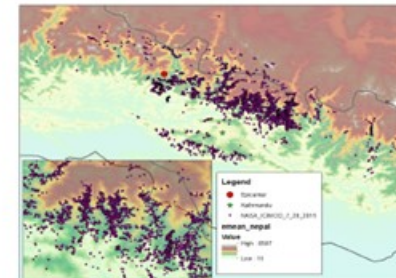
Products include: Surface deformation maps (interferograms),
Optical imagery
Damage Proxy Maps
Damage & Vulnerability Maps
Surface Deformation Models
Induced Hazards (i.e. Landslide/Flood susceptibility maps)

ALOS-2 DPM

- Delivered to NGA, OFDA,
DigitalGlobe, Esri
- Publicly released



Landslide mapping +
Susceptibility Maps
SERVIR/ICIMOD



Sub-Groups formed
& First optical images

Optical Imagery: Landsat,
ASTER, EO-1 Tasking

Landslide Identifications

Last telecon

Day 0
April 25

Day 1
April 26

Day 3
April 28

Day 4
April 29

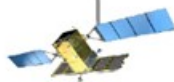
Day 7
May 1

Day 9
May 4

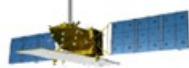
Day 10
May 5

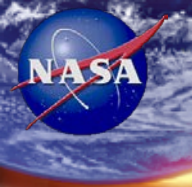
July

COSMO-SkyMed
images Nepal



ALOS-2 images
Nepal





Approach/Principles

■ Global to local reach on extreme events

- Tiered mobilization
- Best effort following hazard-based playbooks

■ Harvesting and exploiting data

- NASA and Non-NASA data and processing systems
- Infrastructure and natural resource impact maps and models
- Near real-time and direct readout data/product access and visualization systems
- Geospatial platform, GIS and web services

■ Convergent and integrated research

- Basic and applied, technology and flight

■ Human Capital

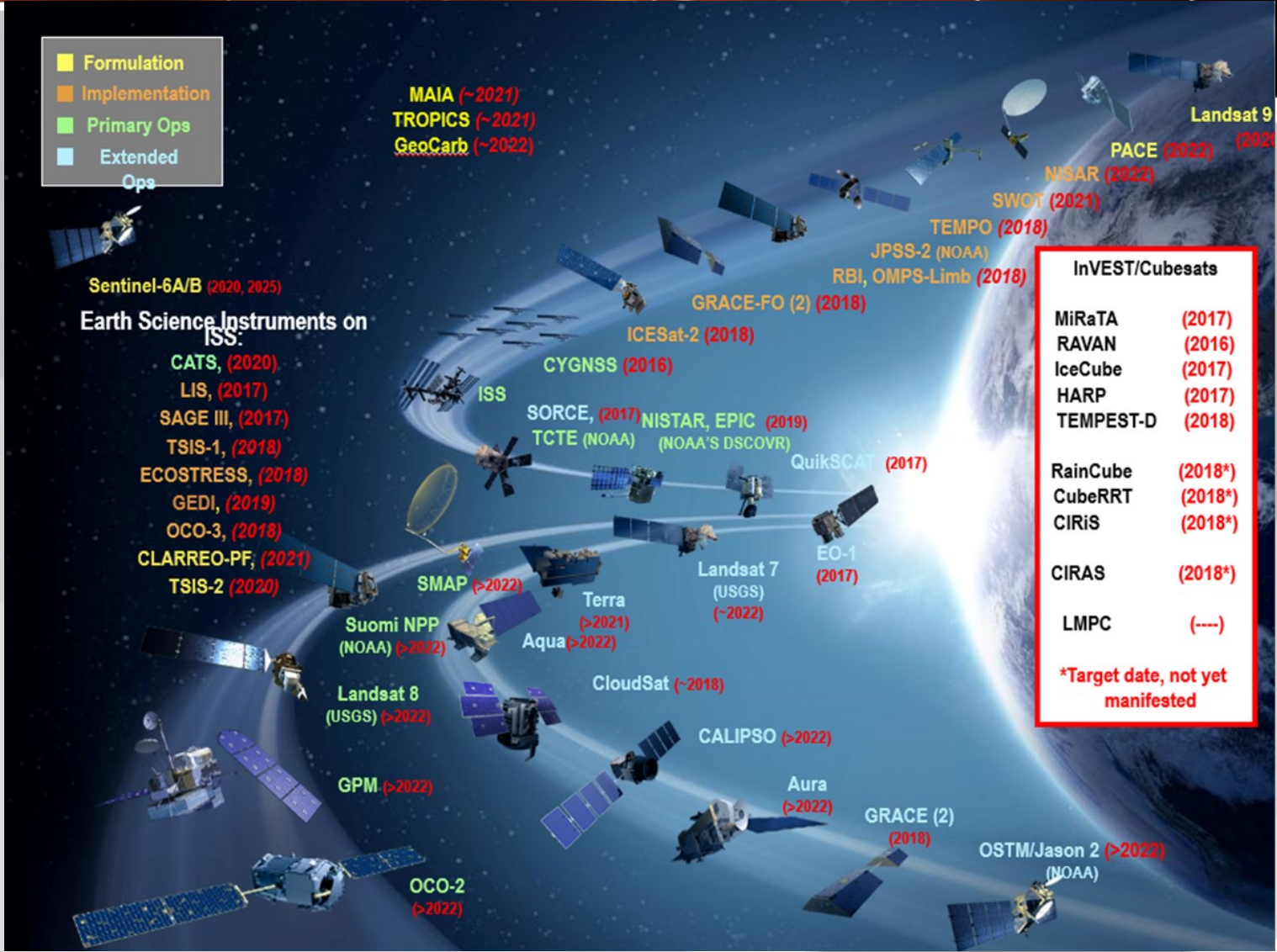
- Center Coordinators, Event Leads and Engagement
- Integrated workforce of scientists, technologists, communication and emergency management specialists
- Principal Investigators, Users, and Volunteer Networks
- Partnerships

- Formulation
- Implementation
- Primary Ops
- Extended Ops

Earth Science Instruments on ISS:

- CATS, (2020)
- LIS, (2017)
- SAGE III, (2017)
- TSIS-1, (2018)
- ECOSTRESS, (2018)
- GEDI, (2019)
- OCO-3, (2018)
- CLAREO-PF, (2021)
- TSIS-2 (2020)

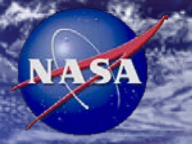
- MAIA (~2021)
- TROPICS (~2021)
- GeoCarb (~2022)



InVEST/Cubesats	
MiRaTA	(2017)
RAVAN	(2016)
IceCube	(2017)
HARP	(2017)
TEMPEST-D	(2018)
RainCube	(2018*)
CubeRRT	(2018*)
CIRiS	(2018*)
CIRAS	(2018*)
LMPC	(---)

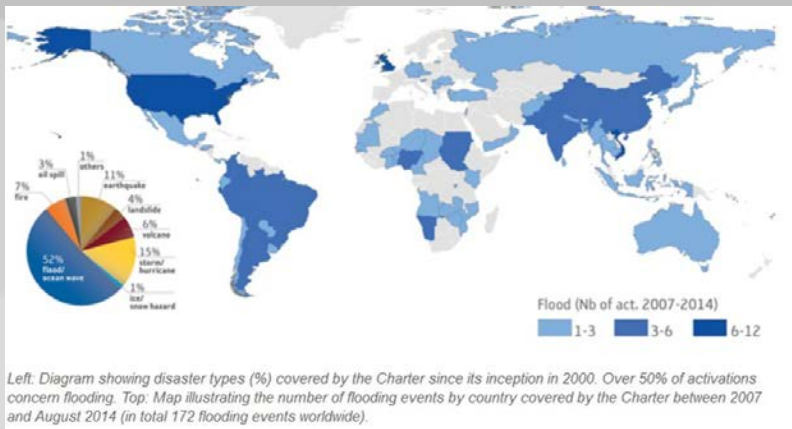
*Target date, not yet manifested



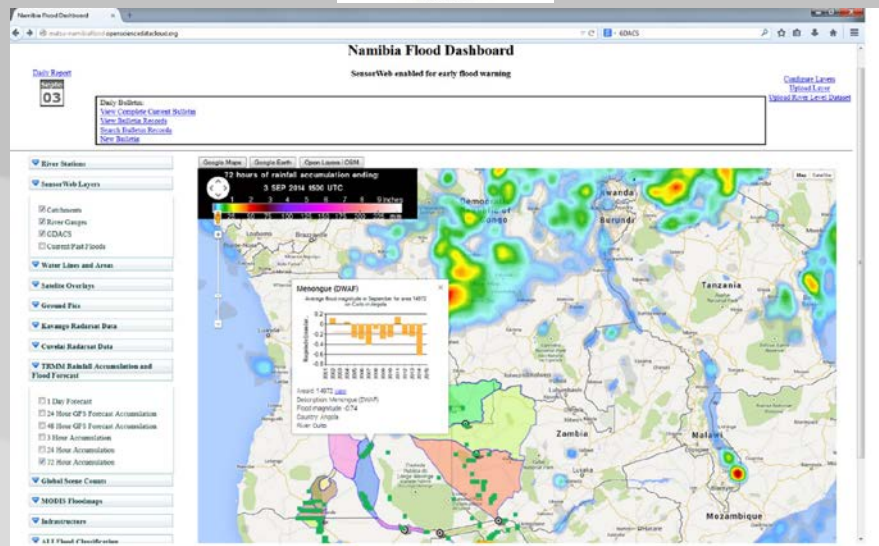


International Coordination and Data Sharing

Group on Earth Observations
Committee of Earth Observing Satellites
International Charter

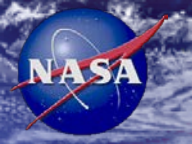


Left: Diagram showing disaster types (%) covered by the Charter since its inception in 2000. Over 50% of activations concern flooding. Top: Map illustrating the number of flooding events by country covered by the Charter between 2007 and August 2014 (in total 172 flooding events worldwide).

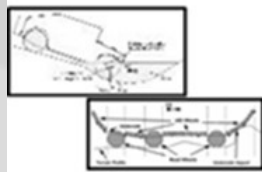
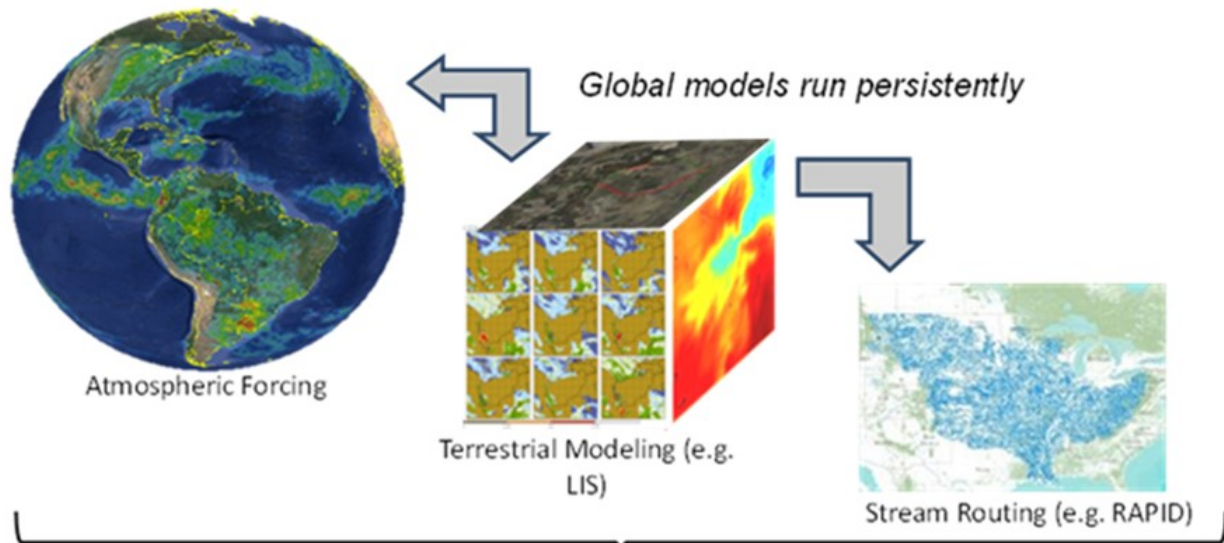


GEO Flood Task: Supporting access to a unified system of space data acquisition and delivery, models and mapping to support those affected by natural or man-made disasters

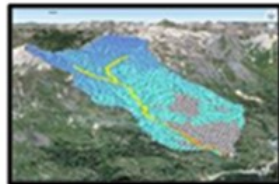
CEOS Flood Dashboard



From Data to Modeling to Mapping Tools for Decision Support



Mobility Analyses



Snow Assessments



Humanitarian Assistance



Drought Vulnerability



Navigation



Social Issues



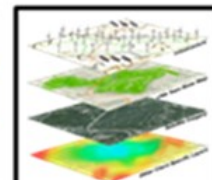
Economic Issues



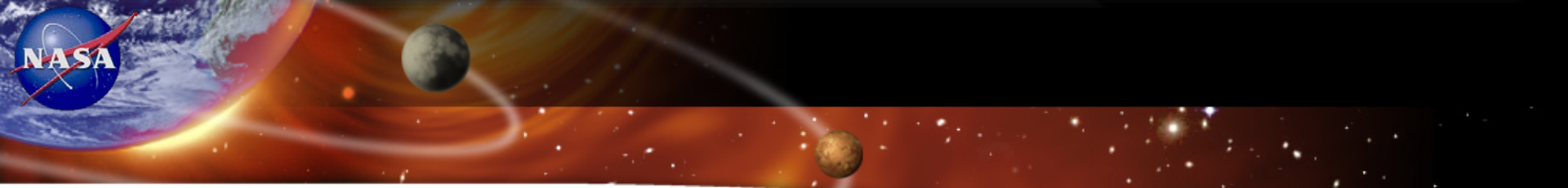
Chemical/Biological/Radiation Hazards



Transportation Networks

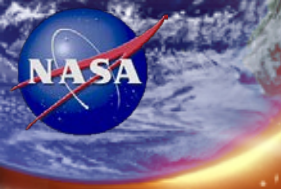


Other Layers



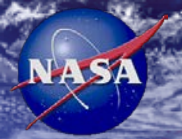
Flood Response

<https://www.youtube.com/watch?v=wqLghXCMxBI>



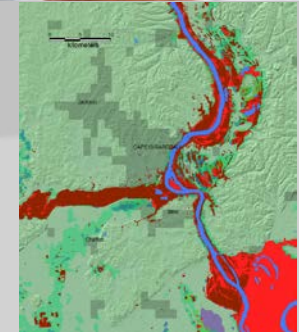
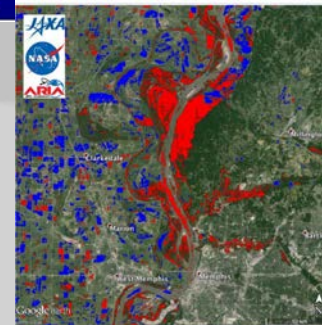
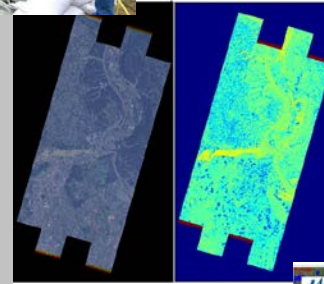
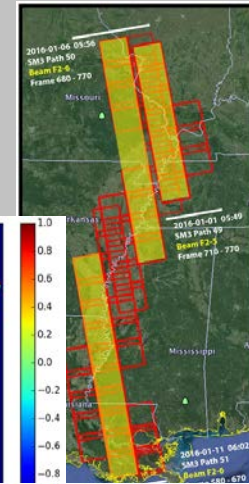
Flood Response



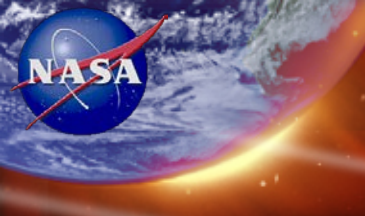


NASA Tier 1 Response to Record Flooding Mapping a Disaster from Illinois to Mississippi

December 29, 2015 – January 15, 2016

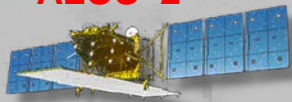


- Consolidated flood and water-index maps
- GIS-capable web-mapping, visualization and decision tools
- Inundation and Damage proxy maps/assessments
- Imagery and interpretive support
- Prioritized, shared, ingested and processed SAR and optical data over areas of interest and disseminated products to stakeholders

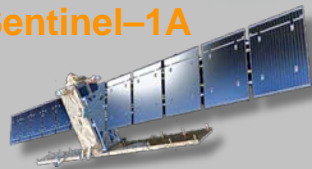


NASA Coordinates Synchronized Space-Air-Ground Observations for Louisiana Floods

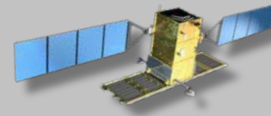
ALOS-2



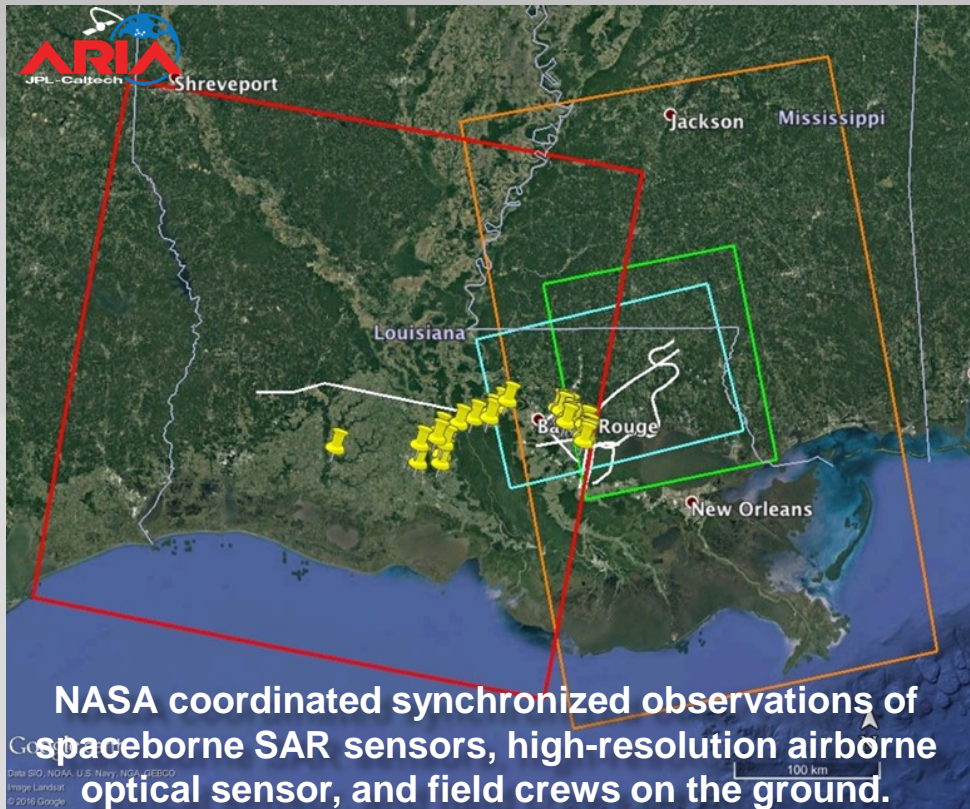
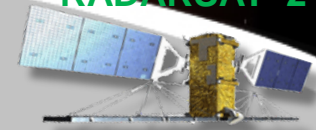
Sentinel-1A



COSMO-SkyMed



RADARSAT-2

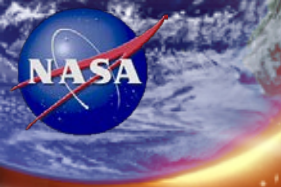


NOAA

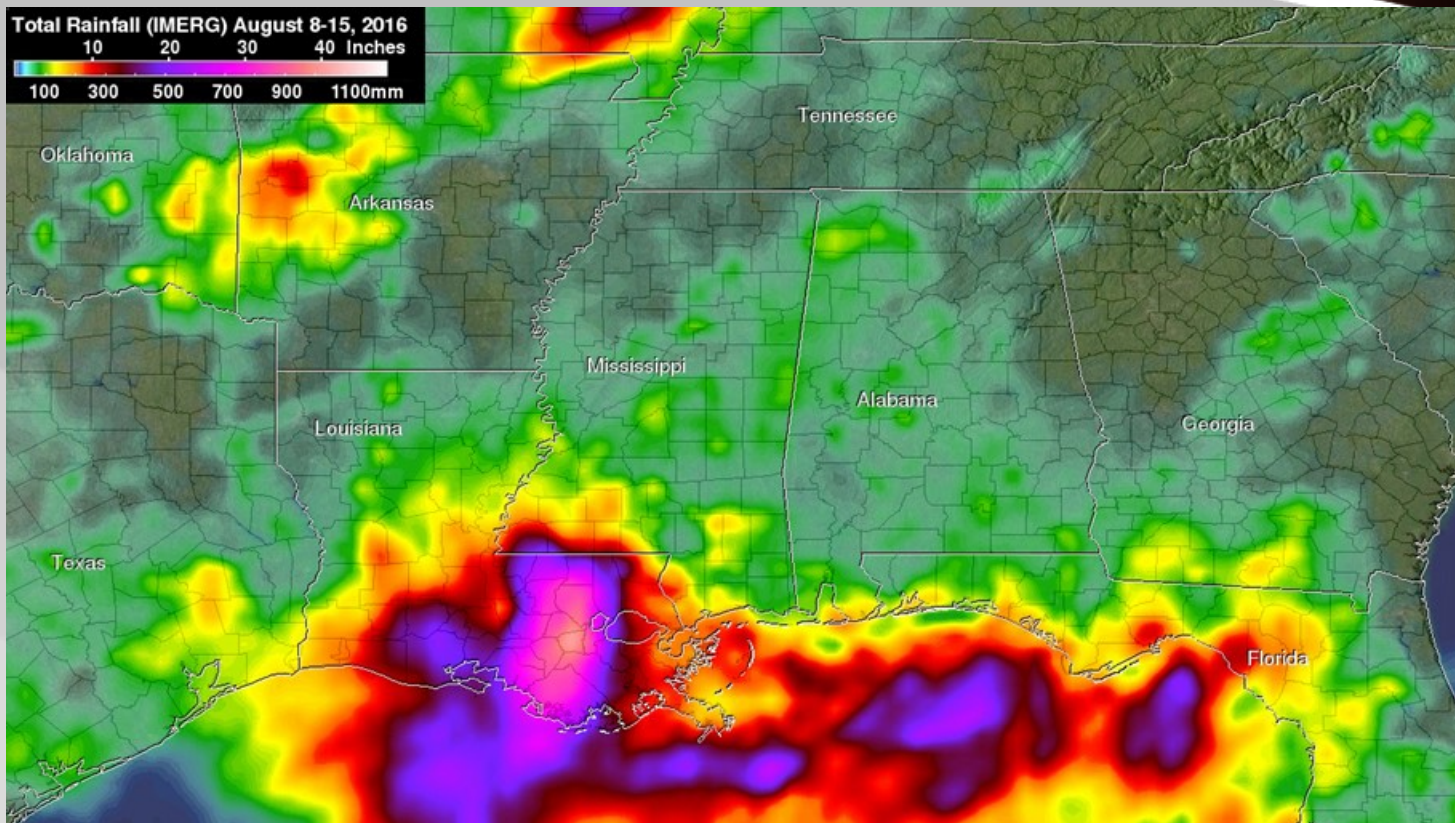


FEMA



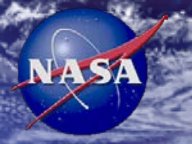


NASA Global Precipitation Mission – GPM IMERG

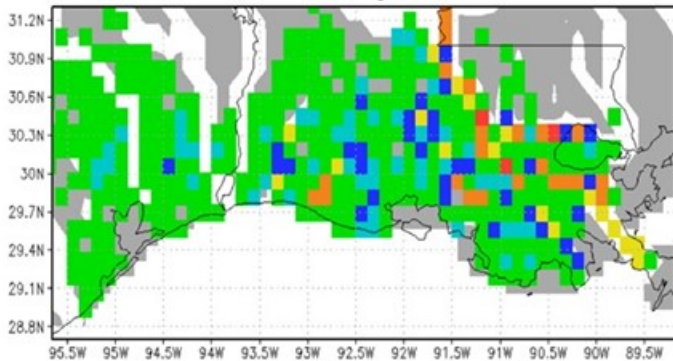


NASA's IMERG data from Aug. 8 to Aug. 15, 2016 showed over 20 inches (508 mm) of rainfall was estimated in large areas of southeastern Louisiana and extreme southern Mississippi. Even greater rainfall totals of 30 inches (762 mm) were indicated in a small area of Louisiana west of Lake Pontchartrain.

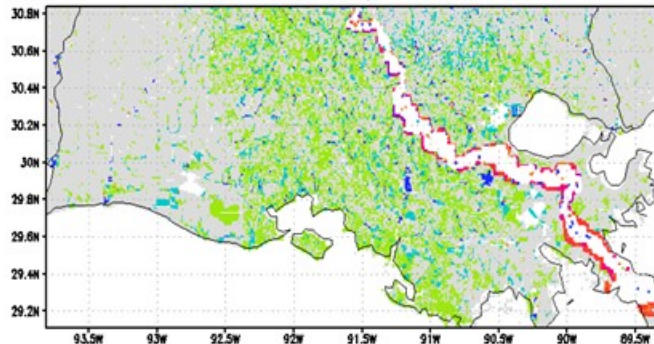
Credits: NASA/JAXA, Hal Pierce



Global Flood Mapping System – GFMS

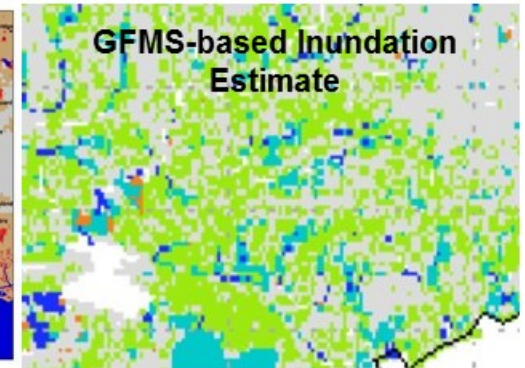
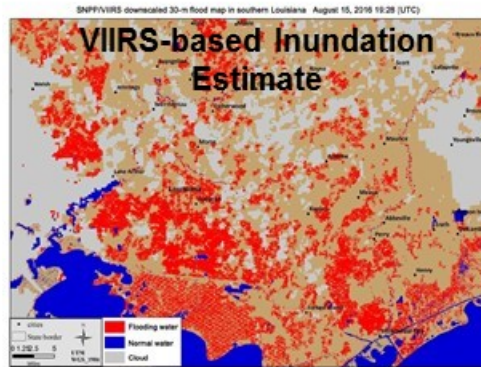


Global Flood Monitoring System (GFMS)
Adler/Wu University of Maryland

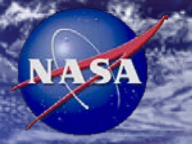


Credit: Bob Adler and Huan WU, UMD

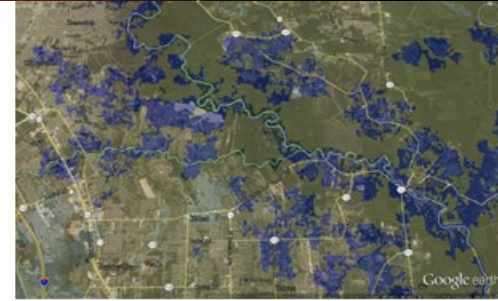
Satellite precipitation estimates merged via the GPM product are utilized as a key Input into the Global Flood Monitoring System (GFMS) utilizing land surface and routing models at 12 and 1 km resolution to estimate the occurrence and intensity of floods. The hydrological calculations are extended into the future (out to five days) using GEOS-5 rainfall predictions.



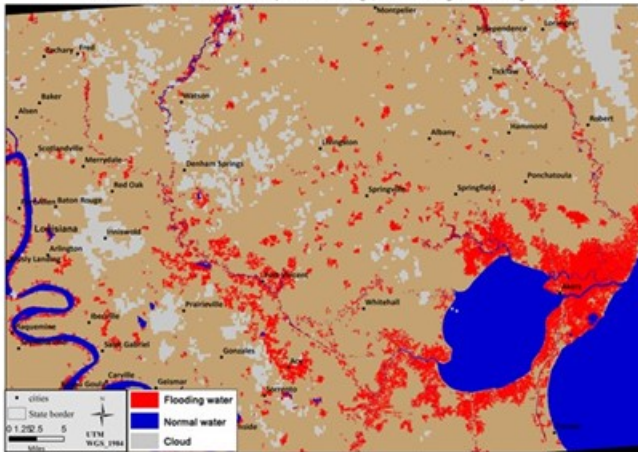
GFMS showing current conditions and forecasts (3-hr resolution) provided to help plan their response to estimate number of structures and homes impacted.



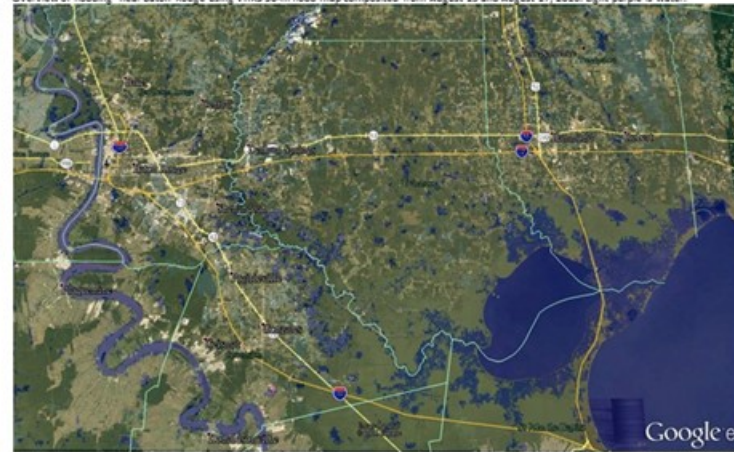
NPP Suomi VIIRS Flood Maps



SNPP/VIIRS downscaled 30-m flood map near Baton Rouge, Louisiana August 15 and August 17, 2016

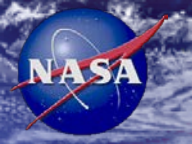


Overview of flooding near Baton Rouge using VIIRS 30-m flood map composited from August 15 and August 17, 2016. Light purple is water.



August 15-17,
2016 VIIRS
Flood maps
courtesy of
Sanmei Li,
GMU. 20

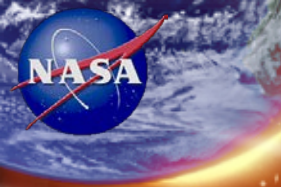




International Space Stations (ISS) Handheld Digital Camera Photography



- ISS USOS crew acquired imagery of flooding area on Aug 16, 17, 23 in response to target requests from JSC Crew Earth Observations ops team
- Downlinked imagery reviewed and manually georeferenced prior to delivery to USGS HDDS team
- Data potentially useful for validation of SAR and flood extent model products



Suomi NPP VIIRS Day-Night Band Detects Power Outages

NASA Coordinates Synchronized Space-Air-Ground Observations for Historic Floods in Louisiana

VIIRS DNB Image During Flood Event, August 15th, 2016

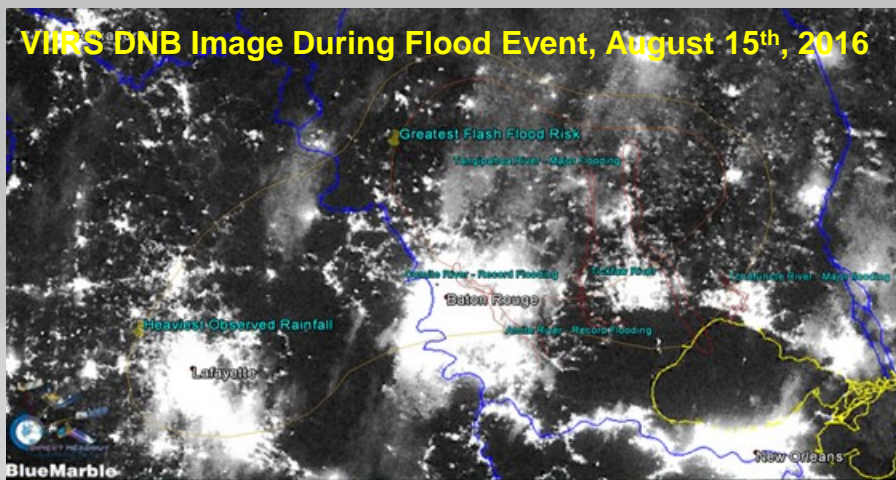
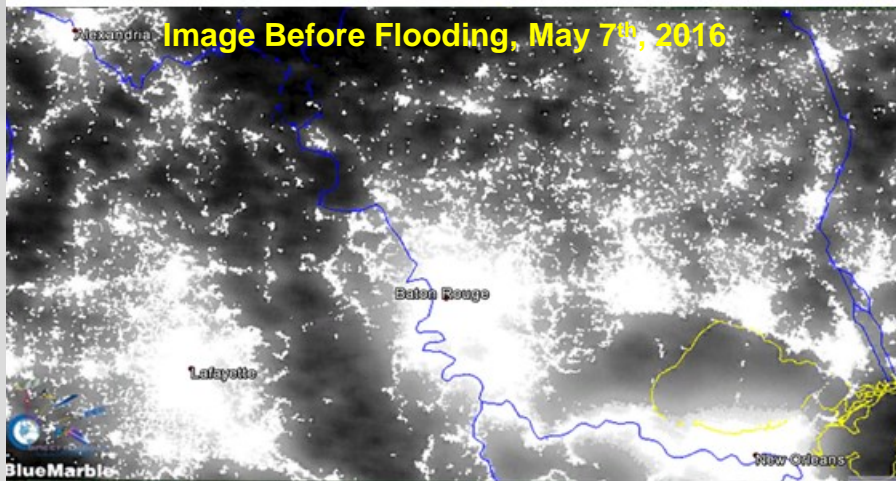


Image Before Flooding, May 7th, 2016



NASA utilized a new algorithm for producing night time optical data, which was used as one of the assets for assessing impact of the Louisiana floods at the request of FEMA.

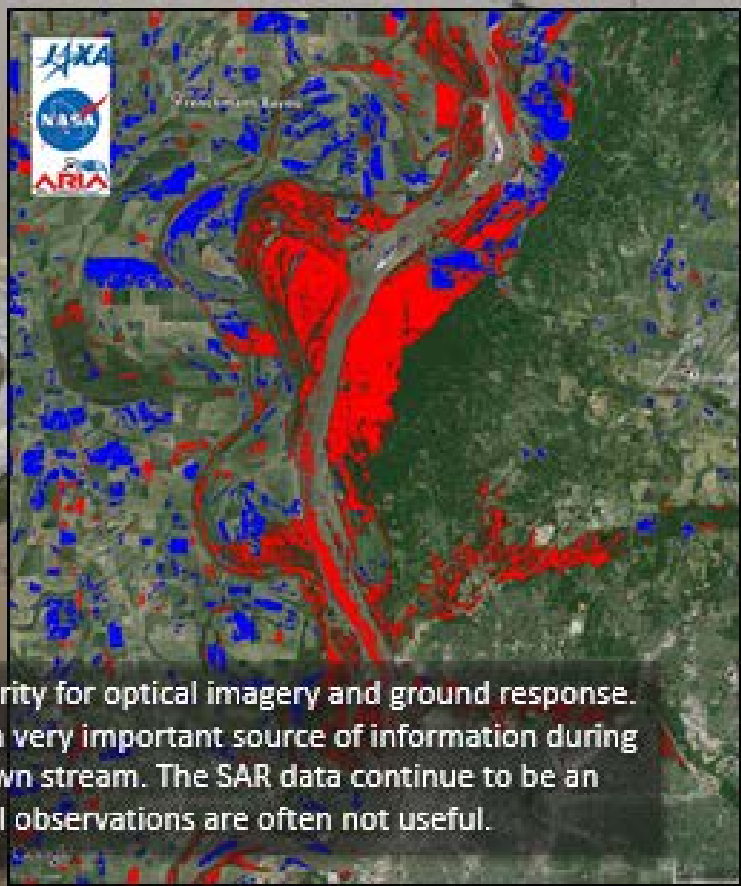
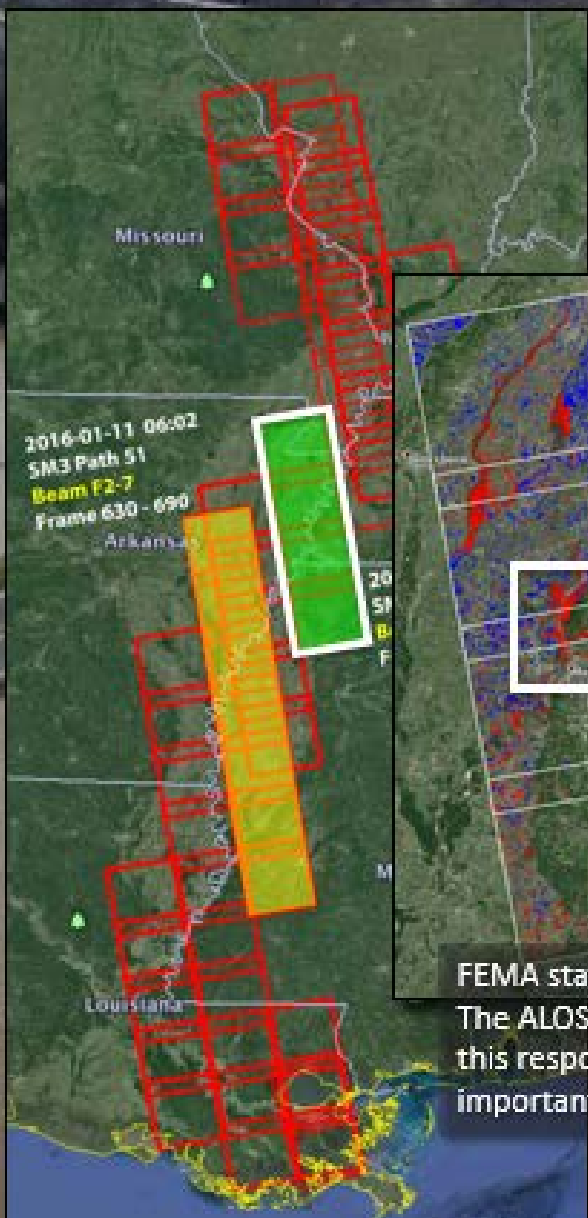
Data was used for determining power outages as a means of mapping impact zones. (NASA Direct Readout Lab).

Top-L: During flood event, Aug 15th, 2016; Bottom-L: Before event, May 7th, 2016. A similar product developed by NASA MSFC to difference images such as these was first provided by NASA Disasters to DHS/FEMA to support efforts to restore power after Hurricane Sandy.

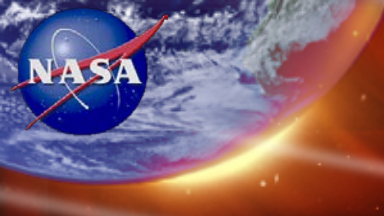


2016 Midwest Floods

Sensor: ALOS-2 SAR (JAXA)
Coverage: 70km x (240km + 420km)
Resolution: ~12m
Blue pixels: Open Land Floods
Red pixels: Vegetation Floods
Available online at
<http://aria-share.jpl.nasa.gov/events/>



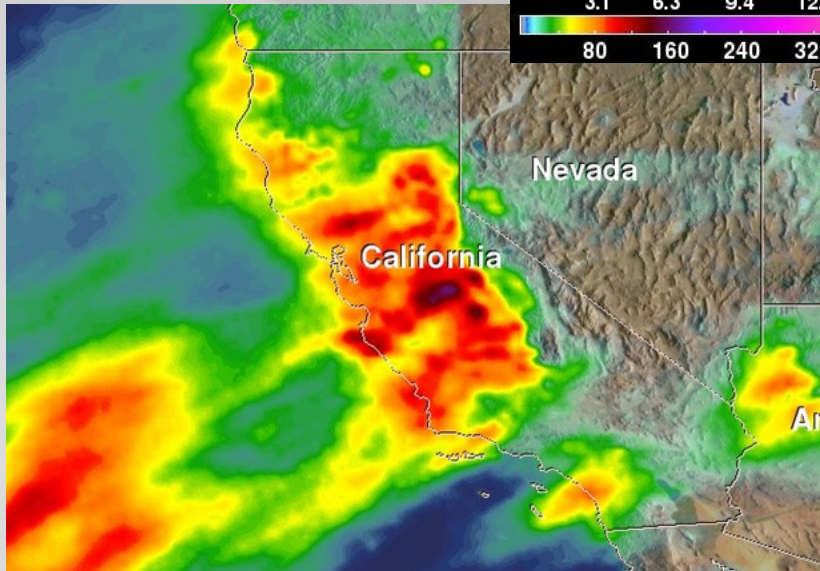
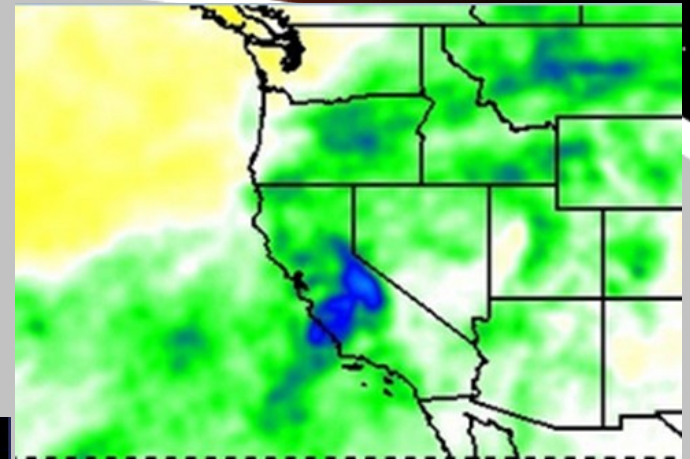
FEMA stated that SAR provides inspection priority for optical imagery and ground response. The ALOS-2 data and the products have been a very important source of information during this response as the flood crest has moved down stream. The SAR data continue to be an important resources during times when optical observations are often not useful.



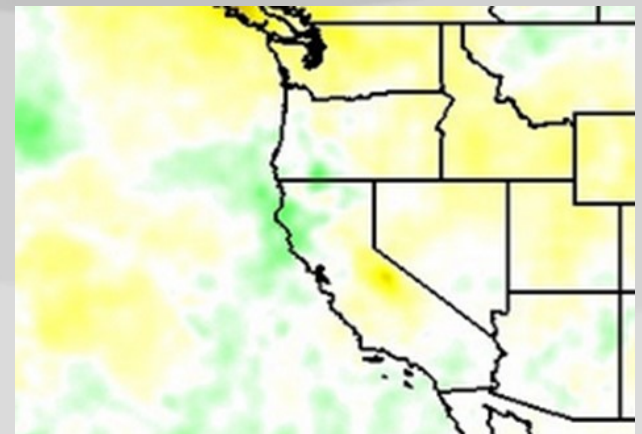
GPM Observes Pineapple Express rainfall, causing flooding in California January 2017

Rainfall anomalies, Jan 10th, 2017

An atmospheric river (“Pineapple Express”) delivered over 5 inches of rainfall in parts of California in early January, 2017 (bottom) as viewed by GPM’s IMERG data. The 30-day rainfall anomalies ending Jan. 10th show TRMM Multi-satellite Precipitation Analysis from 2017 (top right) and 2016 (bottom, right).

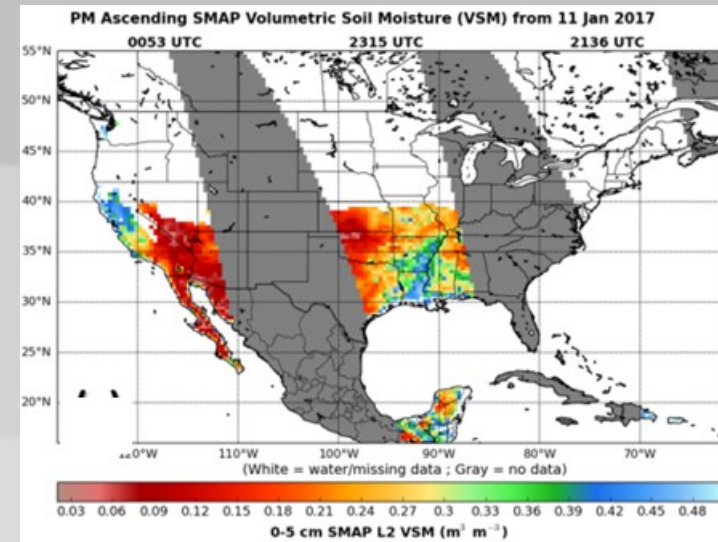
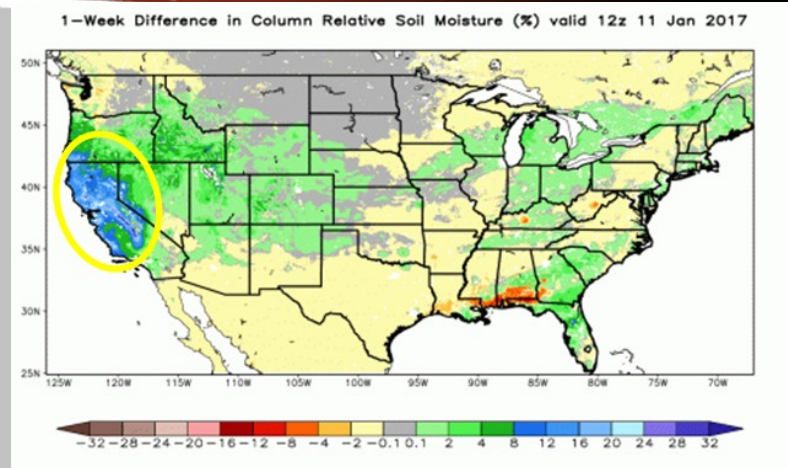


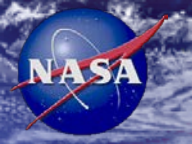
Rainfall anomalies, Jan 10th, 2016



SPoRT Soil Moisture Products Highlight California Flood Potential January 2017

- MSFC/SPoRT runs a real-time version of the NASA Land Information System (LIS) to output soil moisture products used in identifying areal flood potential during CA floods in January
- Surface soil moisture one-week change product from LIS (upper right) shows >35% change in some areas meaning higher runoff/flood potential, consistent with other high-profile flood events
- Select NOAA/National Weather Service offices have been using these products for identifying flood potential since early 2014
- Level 2 SMAP soil moisture products (lower right) from the same day show very high soil moisture values in CA
- SPoRT has completed assimilation of the L2 SMAP soil moisture into the real-time LIS and is currently validating this offline run
- Working with to bring SMAP data 1) into the National Water Model and 2) to evaluate impacts on regional numerical weather prediction forecasts

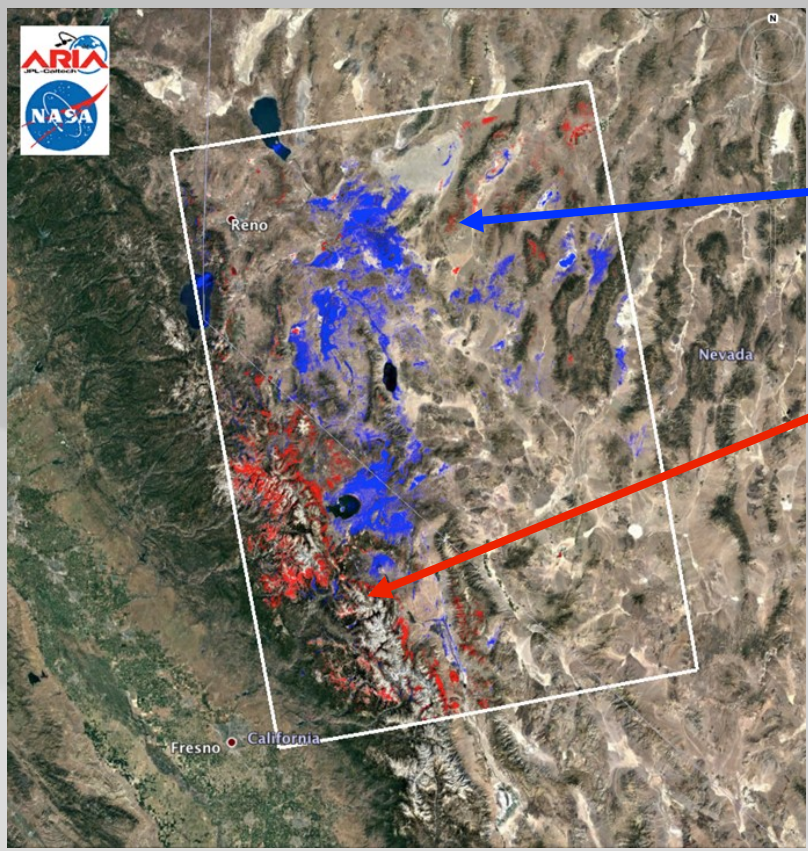




Synthetic Aperture Radar UnCOVERS Flooding in NV

Radar image difference pre-event (12/15/16) and during event (1/8/17)

Flood Proxy Map (FPM) covering an area of 155-by-224 miles (250-by-360 km), derived from Sentinel-1's pre- (2016-12-15 6 PM PST) and during-the-event (2017-01-08 6 PM PST) Synthetic Aperture Radar (SAR) amplitude images. The colored pixels represent areas of potential flood (Red: flooded vegetation, Blue: open water flood). Different irrigation conditions on the two data acquisition dates can produce errors on agricultural lands. This FPM should be used as guidance to identify potential areas of flooding, and may be less reliable over urban areas or snow cover.



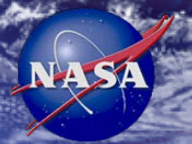
Blue: open water flood

Red: flooded vegetation

Map covers FEMA Primary AOI



Overlap of Sentinel ground tracks and FEMA AOIs



Real Time Flood Impact System Detects Recent Flooding in Southern Thailand

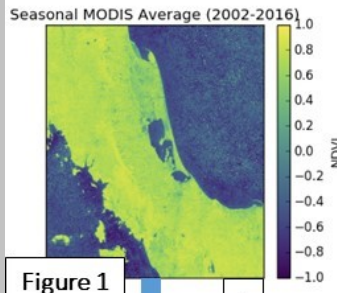
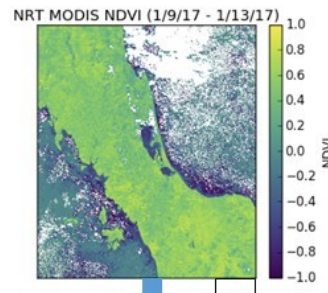
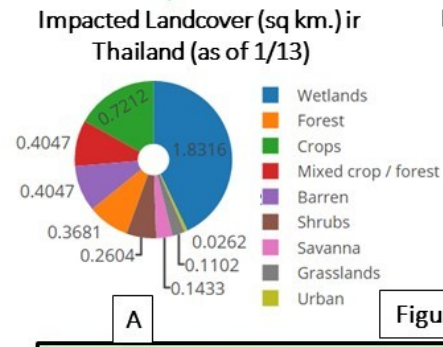


Figure 1



Spectral Training and Image Classification

Incorporate Socioeconomic Data



A

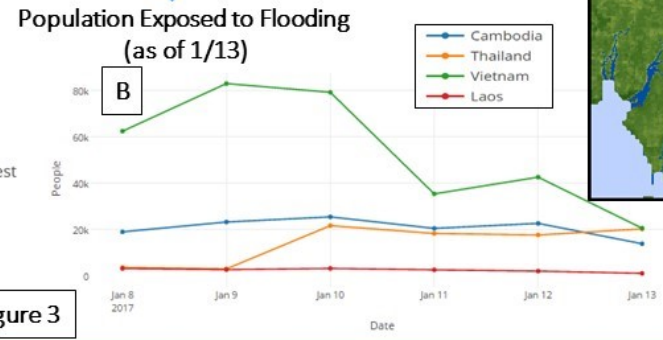
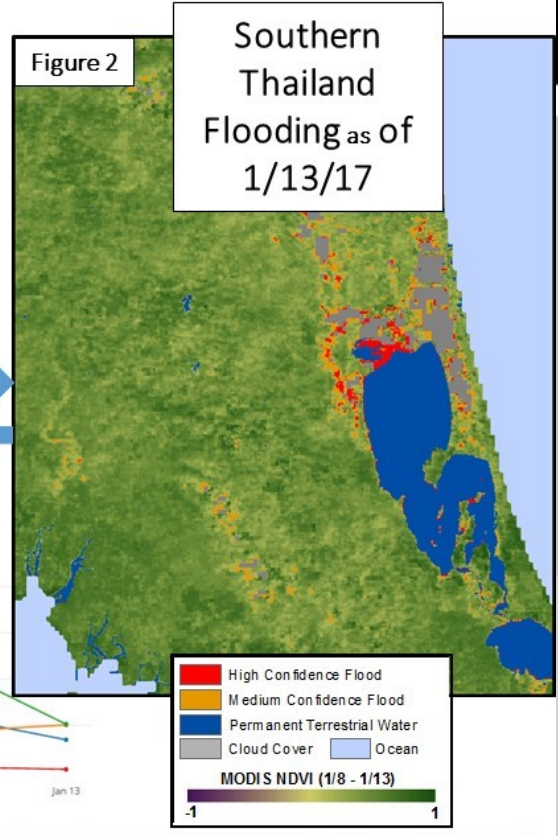
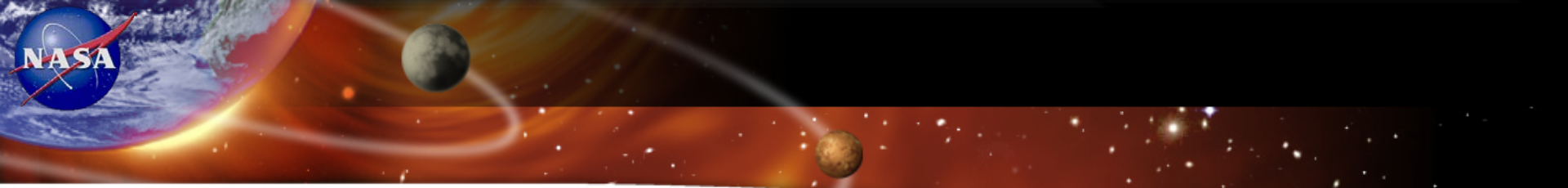


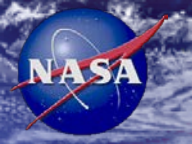
Figure 3



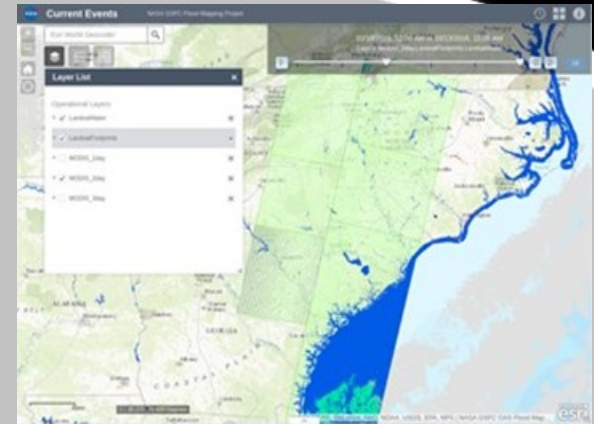
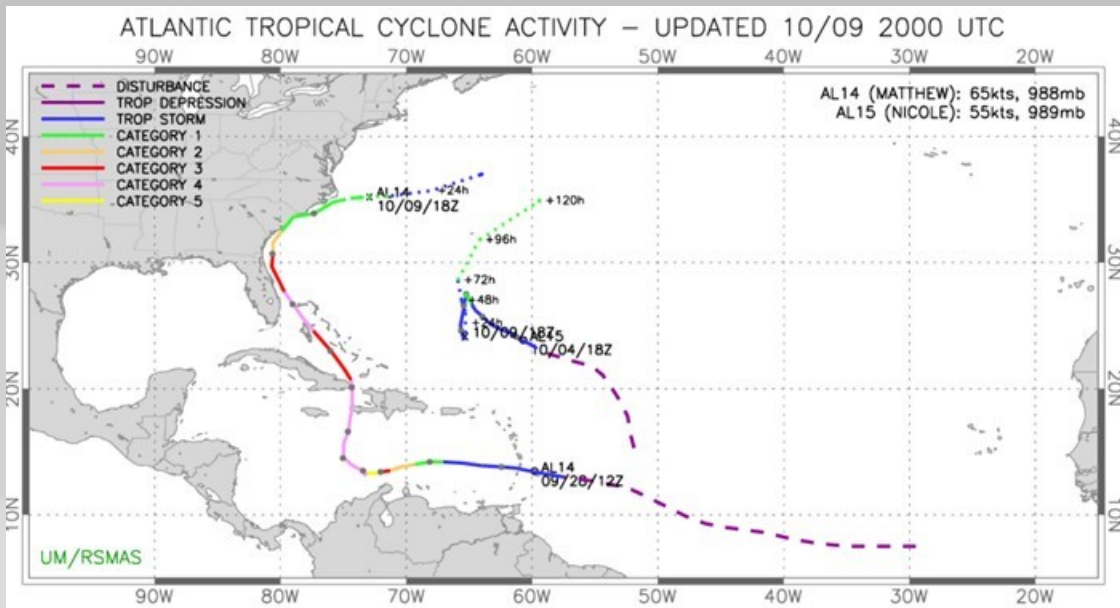
MODIS satellite observations and derived information products (e.g. flooded areas and socioeconomic impacts) are being used by regional NGO's like the Asian Disaster Preparedness center to identify floods and associated impacts to people and infrastructure in near real-time.

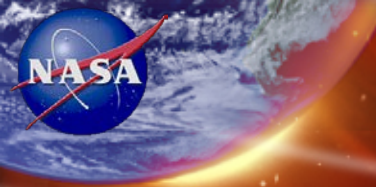


Hurricane Response



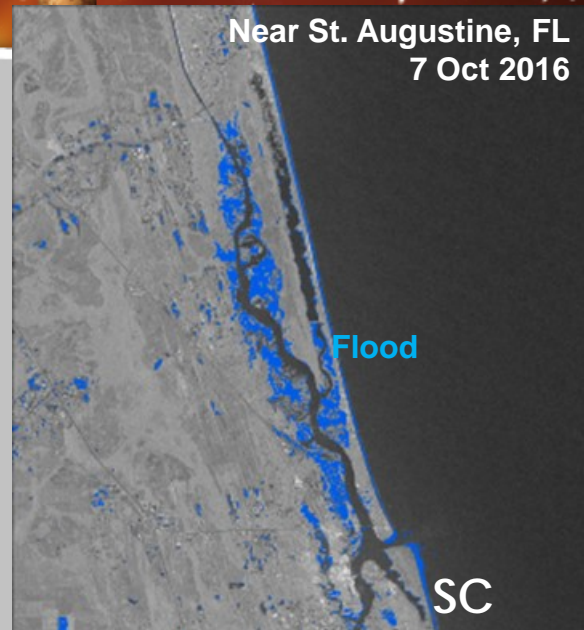
Hurricane Matthew October 2016



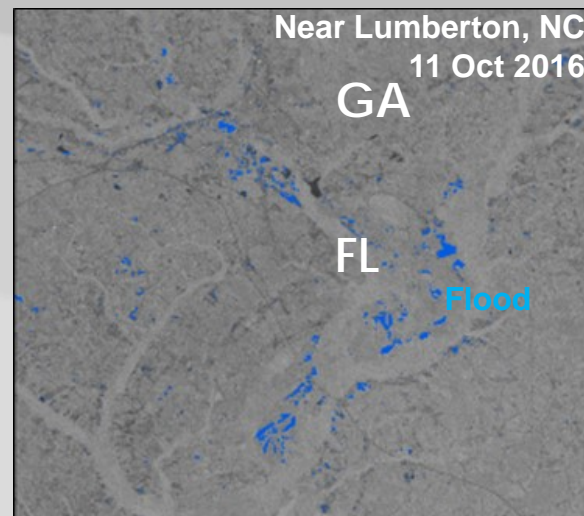


Flood Mapping SAR Applications

- In preparation for NISAR's launch, Disasters Team collaborators are working with a variety of platforms to develop products in support of disaster response efforts.
- Through the International Charter activation assets, the team obtained data through the CEOS Flood Pilot, and through Sentinel 1A/1B acquisitions from ESA. Team members contributed flood maps to USGS/HDDS and FEMA partners, including:
 - SAR Imaging of Haiti, the Dominican Republic and eastern Cuba
 - Products for the U.S. coastline including the eastern coast of Florida (via Charter/Radarsat-2) and the Carolinas (via Sentinel)
- Collaborations among team members are ongoing to share and explore best practices, improve products, their validation, and automation to provide service to FEMA and international partner disaster response efforts, and to build a user community in preparation for the launch of NISAR.



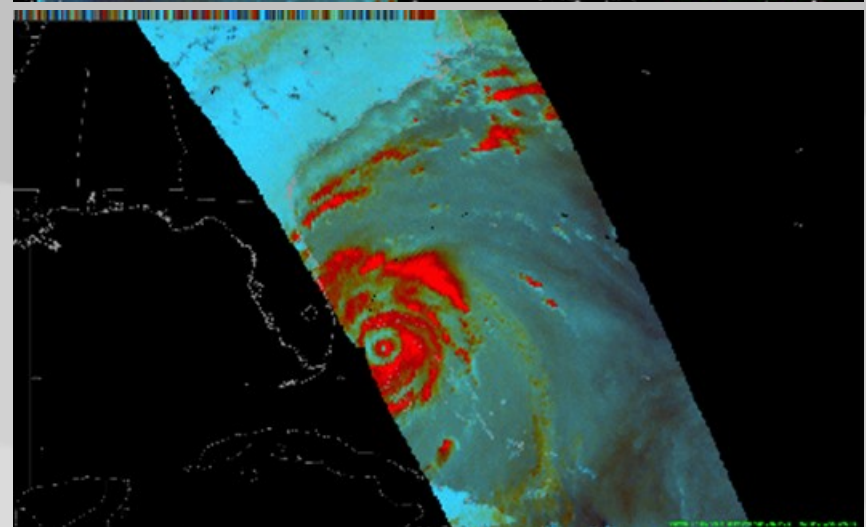
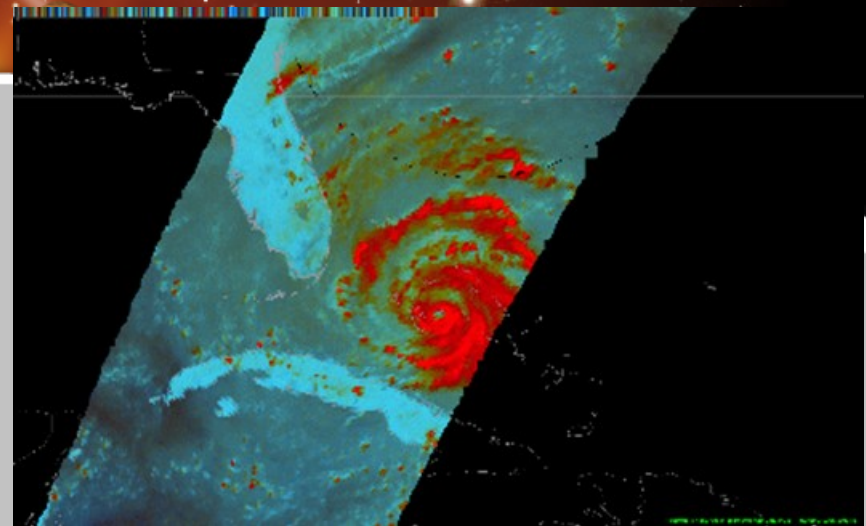
Imagery was acquired by RADARSAT-2 on 7 October 2016
RADARSAT-2



Sentinel 1A/1B imagery collected in partnership with ESA and delivered through the Alaska Satellite Facility / UAF.

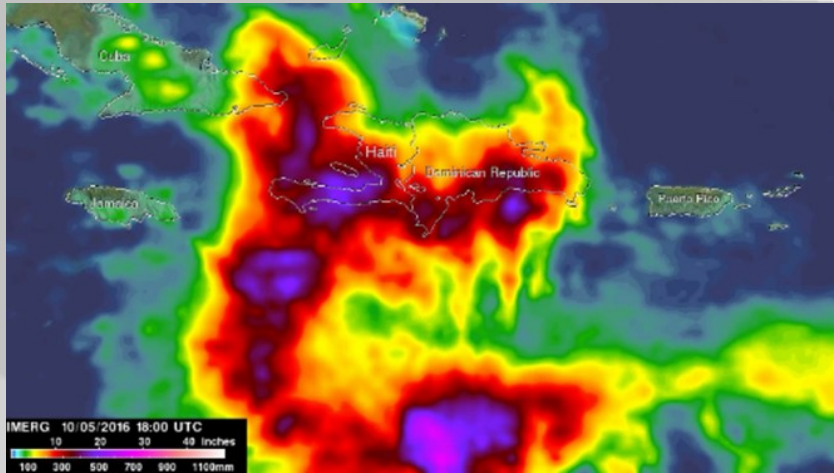
Imaging Matthew's Circulation with GPM

- Collaborative effort between the GPM science team and NASA SPoRT provided brightness temperature and IMERG products to NOAA's National Weather Service and the National Hurricane Center.
- Images on the right capture snapshots of Matthew using NASA's Global Precipitation Measurement mission Microwave Imager (GPM GMI) data, as displayed within the AWIPS decision support system used by NOAA/National Weather Service partners.
- NASA's GPM GMI provides passive microwave brightness temperatures useful for displaying cyclone structure, particularly when able to see through overlying cirrus to the center of circulation and spiraling rain bands.
- In addition, cross-calibration of other passive microwave brightness temperatures are made available from the Precipitation Processing System, along with estimates of rainfall from the Integrated Multi-satellitE Retrievals for GPM (IMERG) product.

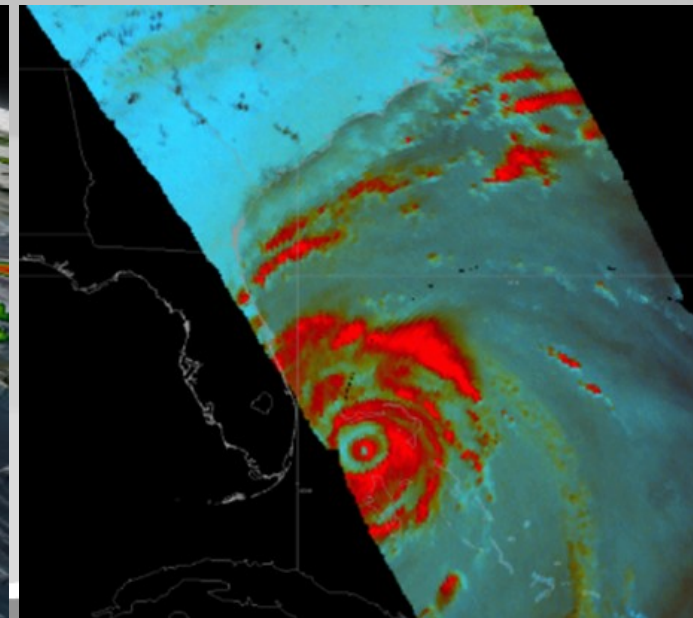
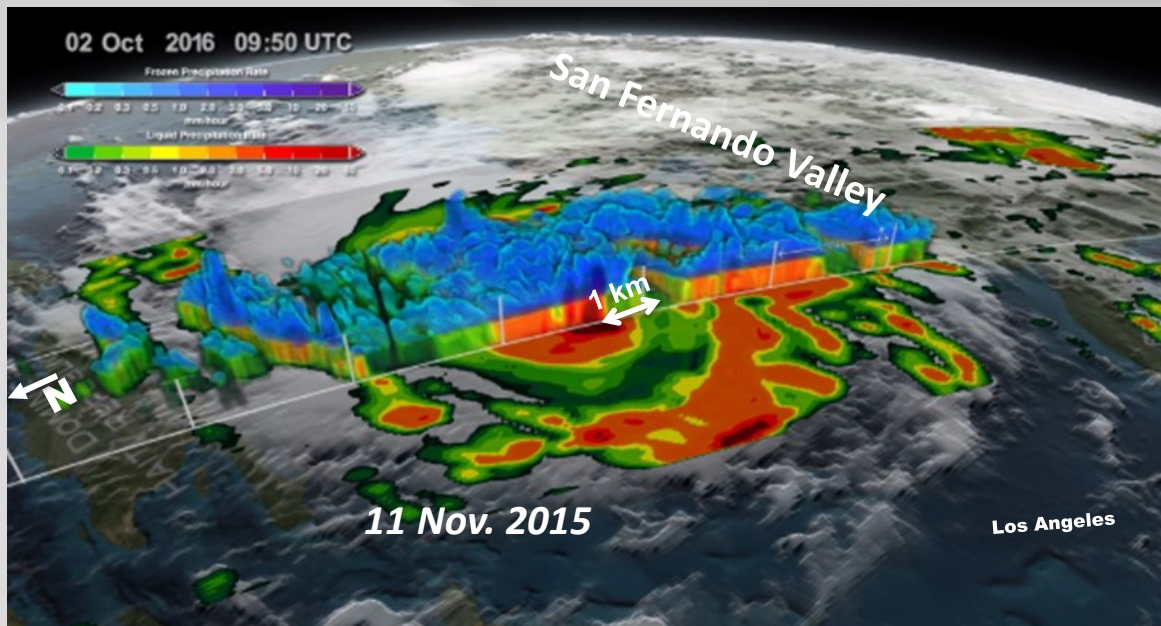


Hurricane Matthew approaches Florida on at (top) 9 and (bottom) 19 UTC on October 6, with passive microwave brightness temperatures observed from the GPM GMI; data provided to NOAA/NWS/National Hurricane Center

GPM observes Hurricane Matthew's rapid intensification and eyewall replacement



- GPM observed intense rainfall (left) as Matthew battered Hispaniola and Cuba
- On Oct. 2 (bottom left) GPM Core Observatory viewed a newly intensified Cat 4 storm south of Haiti, showing strong convection and heavy rainfall in the eye wall and rain bands
- GPM's Microwave Imager (bottom right) observed the storm going through eye wall replacement before impacting Florida as a Cat. 3. This data was provided to FEMA and NWS Offices for situational awareness

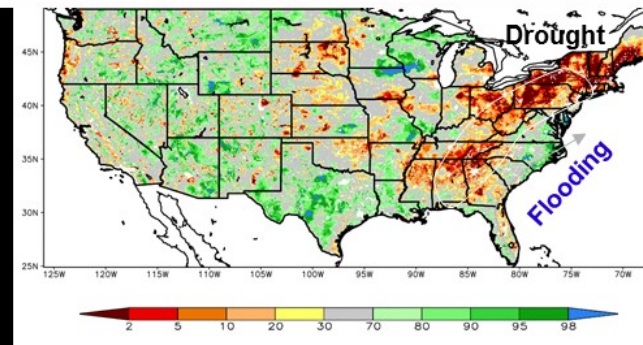
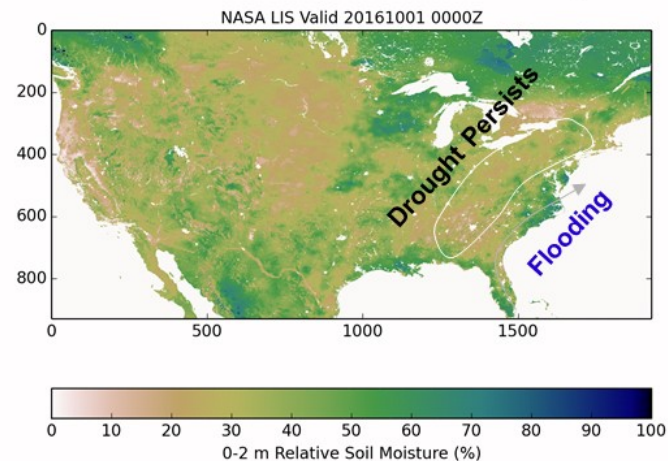


NASA Soil Moisture Mapping of Matthew

- NASA's Land Information System (LIS) assisted NOAA/NWS partners with:
 - Mapping high soil moisture content prior to Matthew and heavy rainfall events where flooding is likely
 - Mapping dry soils to understand the extent of and change in drought, used by NWS partners to inform updates to the U.S. Drought Monitor
 - Understanding how current conditions relate to 30-year climatology
- LIS outputs were shared with NOAA/NWS and USGS/HDDS during their Hurricane Matthew response.
- New application partners identified (U.S. Forest Service); other spinoffs to follow, including power-outage prediction when combined with predicted wind speeds, duration, and extent.

(Top) (0-2 m) soil moisture (0-100%) pre- and post-Matthew. (Bottom) Soil moisture compared to 30-year climatology (percentiles). Pre-Matthew soils were saturated in the eastern Carolinas and drier in eastern Florida; high soil moisture remains.

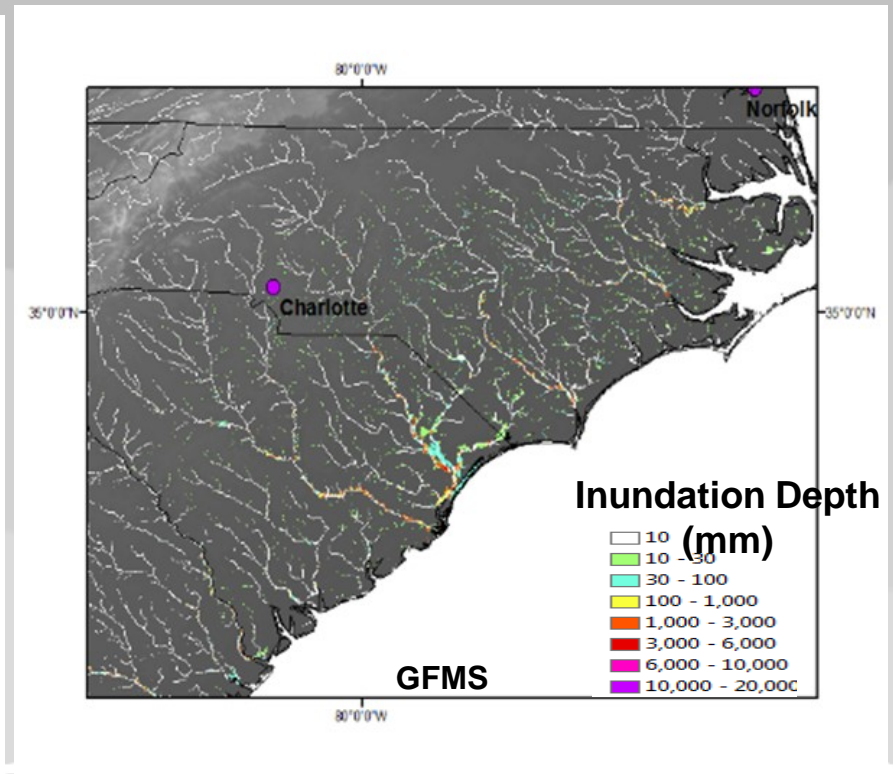
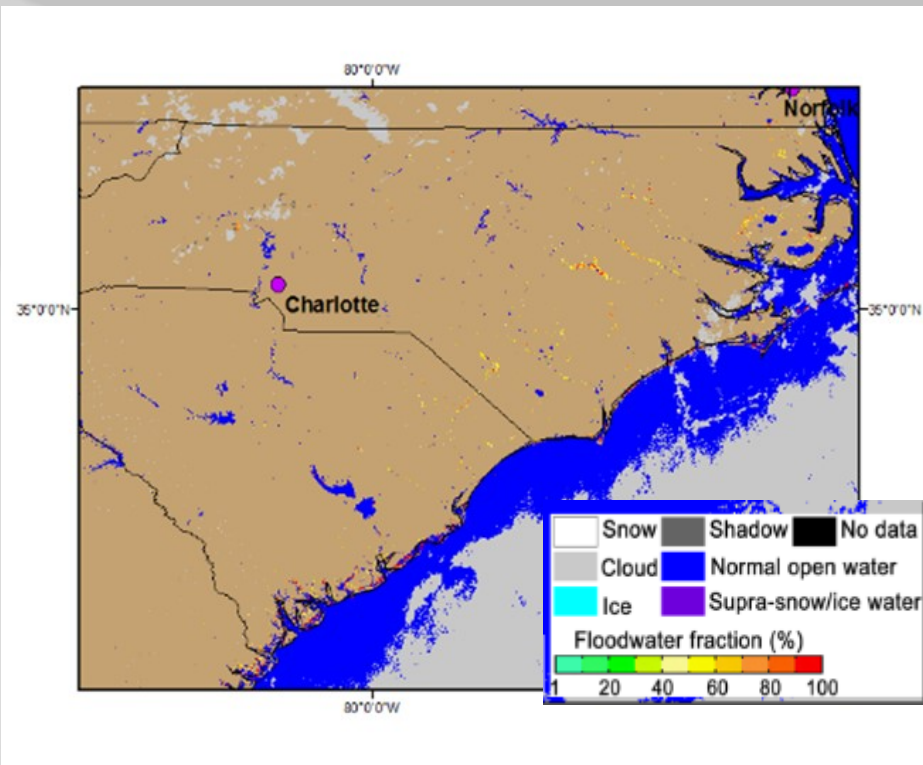
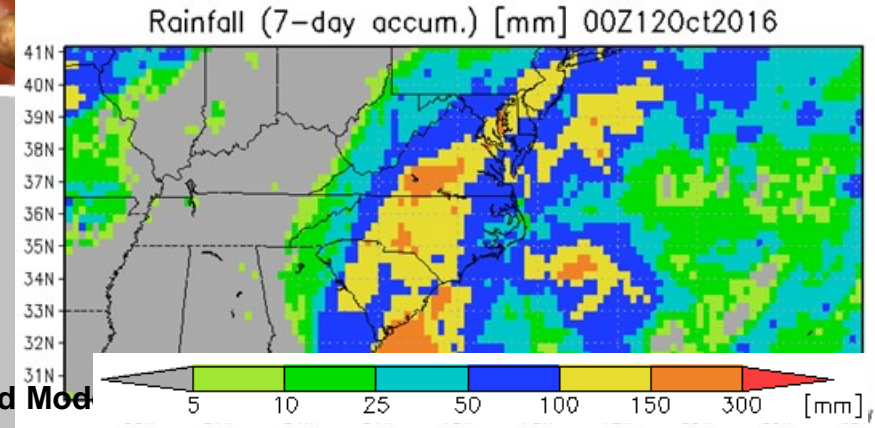
NASA SPoRT/GSFC LIS: October 1-12, 2016



NASA Flood products provided for Hurricane Matthew Response

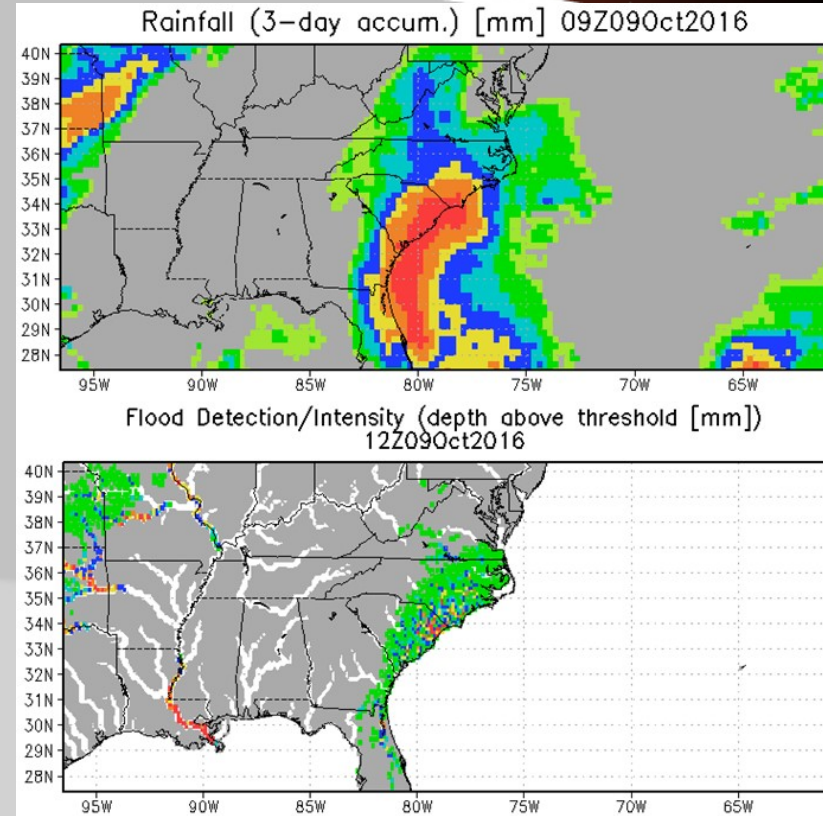
- The Global Flood Monitoring System provided inundation estimates, flood intensity/detection, and forecasts for Matthew (bottom right)
- GMU used VIIRS to map estimated inundation area follow Matthew's passage (bottom left)

Inundation on same time: Oct. UTC 18:00: Global Flood Model



NASA Heavy Rainfall and Flood Prediction

- Extensive inland flooding was widely predicted as a result of extremely heavy rains inland of Matthew's trajectory up the eastern seaboard.
- The Global Flood Monitoring project used NASA GEOS-5 model simulations of precipitation, combined with streamflow and flood predictions to map areas of likely flooding in eastern North Carolina, South Carolina, coastal Georgia, and northeastern Florida.
- These areas experienced record rainfall with Matthew, resulting in several days of near or record flooding in the areas highlighted by the Global Flood Monitoring project's flood predictions.

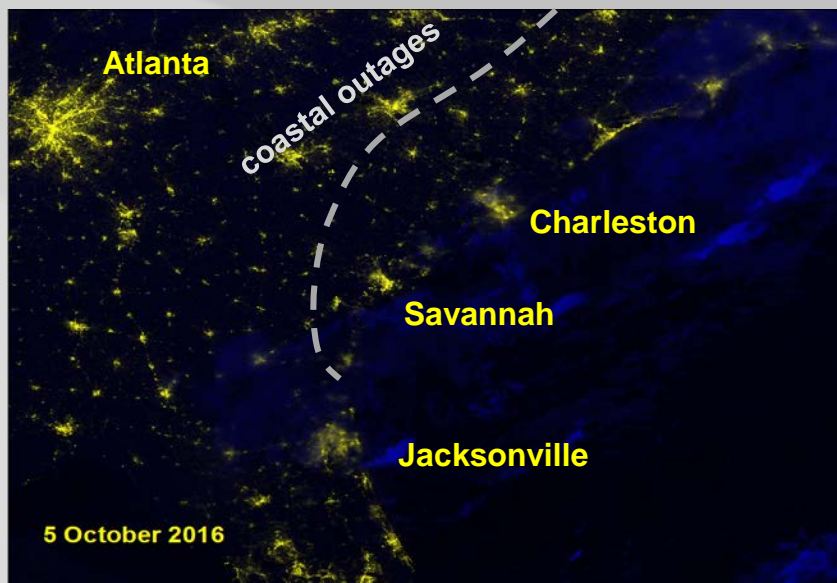


NASA GEOS-5 48-hour rainfall prediction (top) and associated prediction of streamflow and resulting flooding associated with Matthew's coastal impacts on the Carolinas and coastal Georgia.

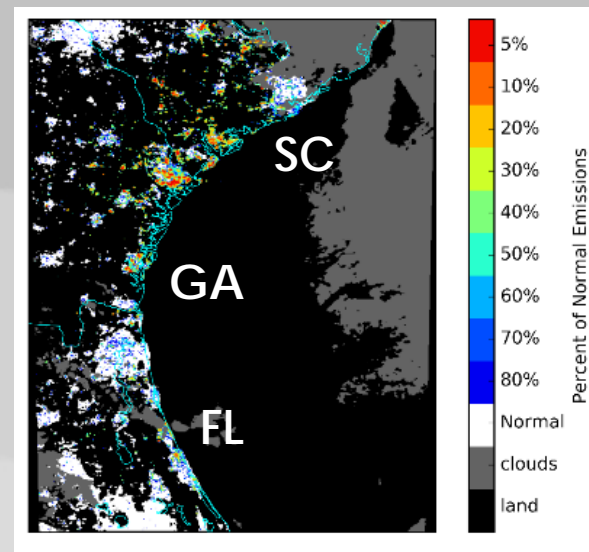
NASA Power Outages with S-NPP VIIRS

■ Collaborations between NASA Goddard, their Direct Readout Laboratory, and MSFC/SPoRT have contributed pre- and post-event light comparisons using VIIRS Day-Night Band emissions and gridded products that incorporate corrections for moonlight.

- This approach allows for analyzing changes between pre- and post-event scenes and identifying missing or reduced lights due to power outages and other impacts from Hurricane Matthew.
- Products provided to FEMA, with future goals of reduced latency and automation.



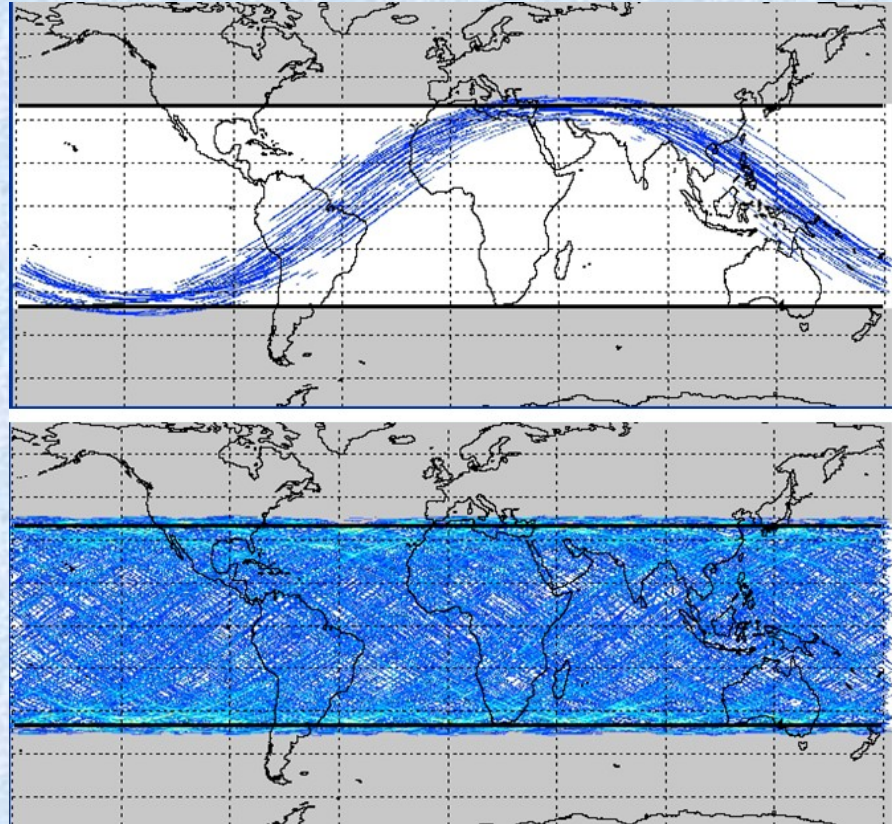
Animation of change in lights pre- and post-event; lights here are shown in yellow, and pre- or post-event cloud cover in blue.



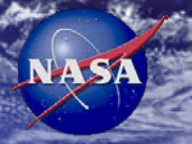
Comparison of pre- ("normal") and post-event light emission along the southeastern coast following Hurricane Matthew, on October 9.

CYGNSS Launched December 2016

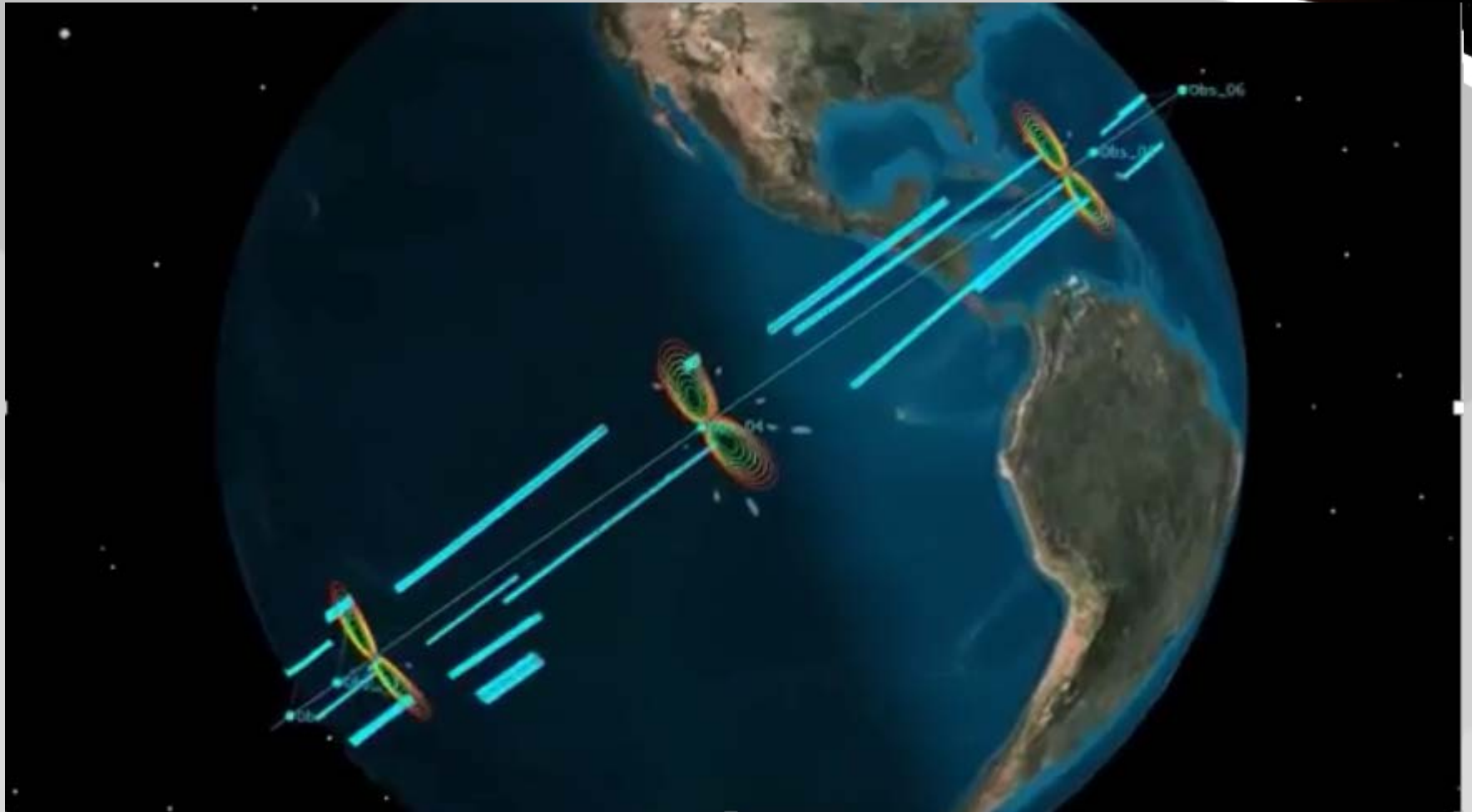
- CYGNSS is a constellation of 8 microsattellites that will use direct and reflected GPS signals to measure ocean surface wind speed during most precipitation events, with a special focus on tropical cyclones.
- Median revisit time = 2.8 hr
- Mean revisit time = 5.9 hr

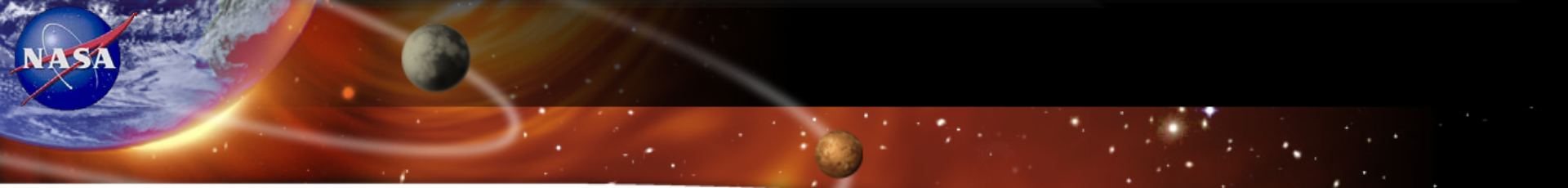


Target launch date: 2016



CYGNSS



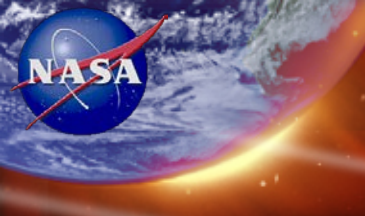


Earthquake Response

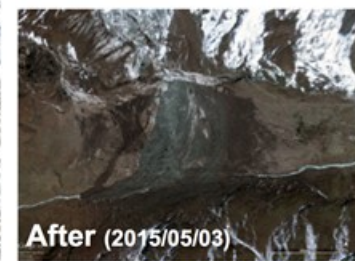
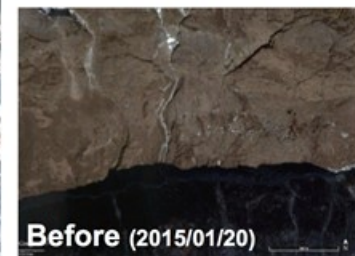
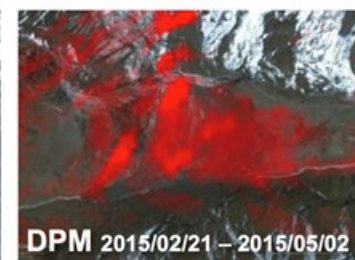
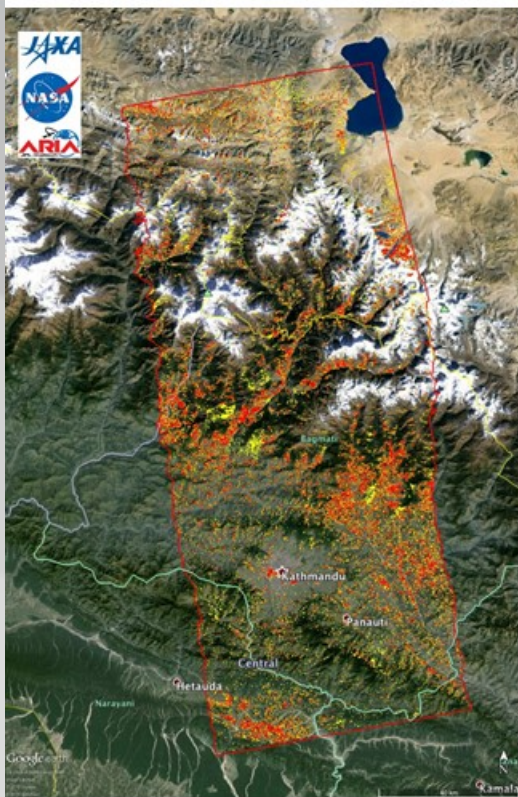


 NASA's Response to the magnitude 7.8
Gorkha Earthquake in Nepal – April 25, 2015



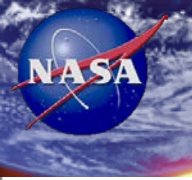


Damage Proxy Map from ALOS-2



For more information about ARIA, visit: <http://aria.jpl.nasa.gov>

- Highlights **areas of potential damage** caused by M7.8 Nepal earthquake (70 km x 180 km)
- Used by **World Bank, USGS, OFDA/USAID, ICIMOD, and GEER** for damage assessment, **NGA** for analysis priority, **DigitalGlobe** for WorldView image acquisition planning
- **657 downloads** worldwide in May 2015
- Derived from SAR data from **JAXA ALOS-2 (L-band)**



Gorkha Earthquake Volunteers Image Analysis Group



Flags indicate nation of volunteers home institution(s)

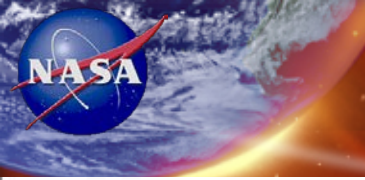
➤ Volunteer global campaign to assist with earthquake disaster, coordinated by the University of Arizona

➤ Six areas of interest were defined according to river valley. Expert researchers from 9 nations contributed to the satellite image analysis.

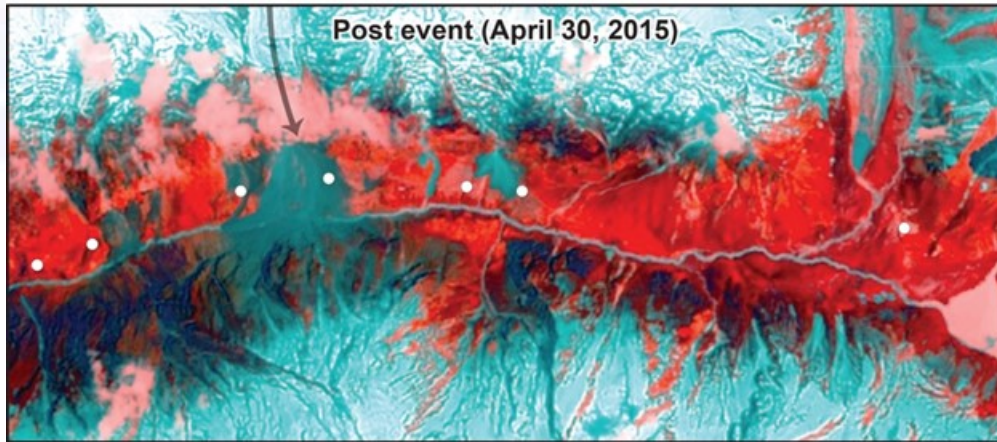
➤ NASA data: Landsat, ASTER, EO-1 ALI, SRTM data; (+ DigitalGlobe, WorldView images through commercial partnership).

➤ Aided NASA, USGS and NGA in the targeting of satellite imaging

➤ Results reported to NASA, SERVIR Applied Science Team, and authorities in Nepal



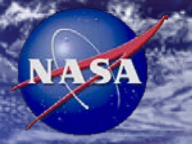
Gorkha Earthquake: Langtang Valley landslides, Nepal



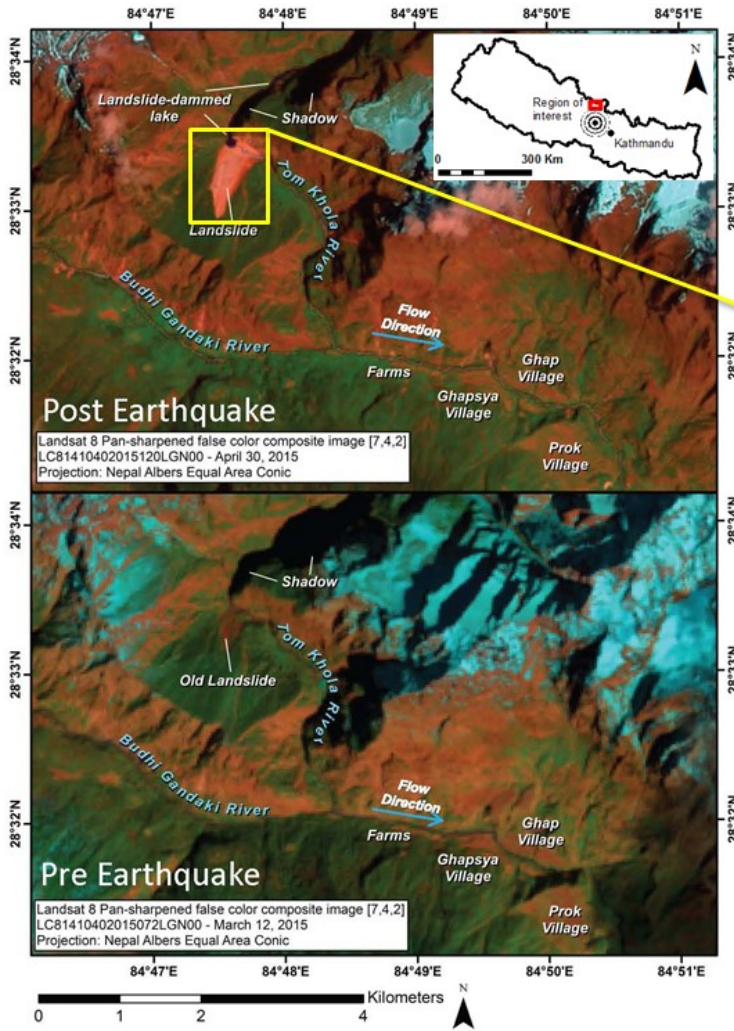
0 0.5 1 2 km

- Langtang Valley was severely affected by the main earthquake and aftershocks.
- Image analysis by volunteer group validated and qualified effects of the disaster.
- Several villages destroyed or damaged, more than 200 people killed, dozens missing.
- Information relayed to authorities resulted in relief helicopter missions to the valley
- Recurrent landsliding resulted in complete evacuation and public closure of the valley.

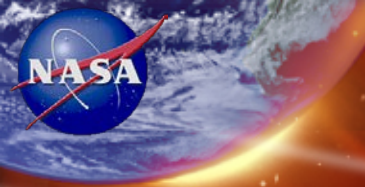




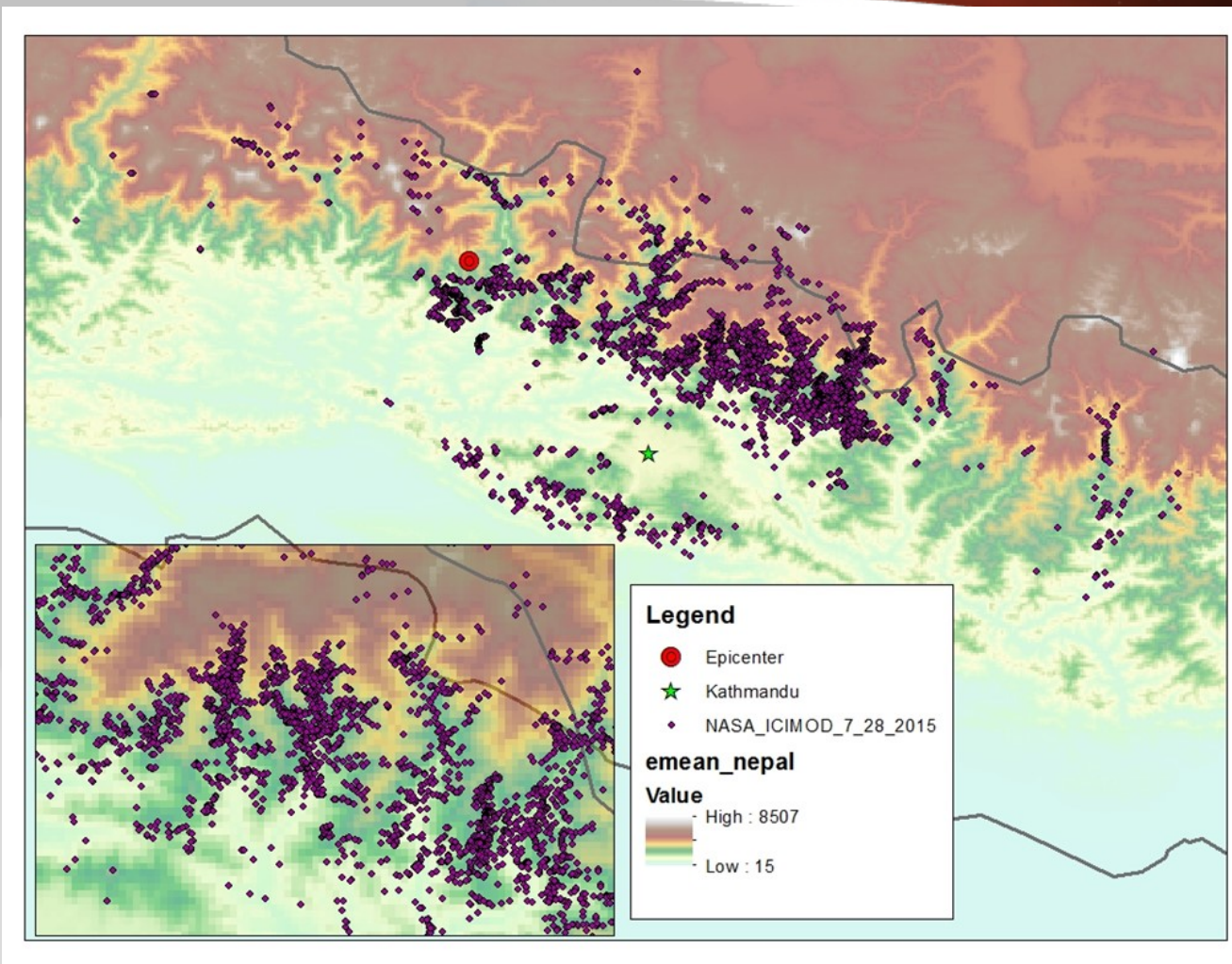
Ghap landslide-dammed lake, Manaslu region

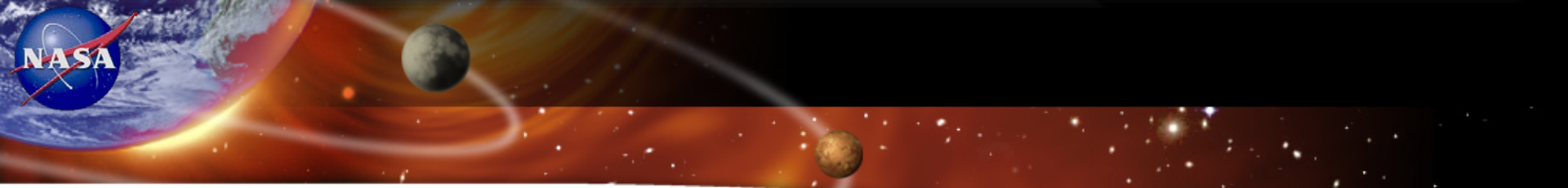


- ~450 m wide landslide at its base at river level and originated from a point ~1 km up slope.
- ~150 m wide and 1.4 km long dammed lake
- Lake still exists and rose slightly as of May 17 Landsat coverage



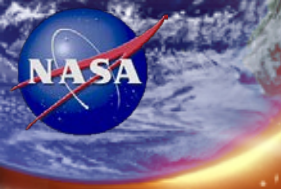
Regional landslide mapping





Volcano Response

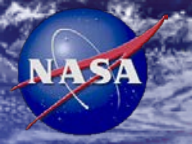




NASA Volcano Response



Fire, Ice, and Safer Skies
NASA SATELLITES TRACK VOLCANIC CLOUDS

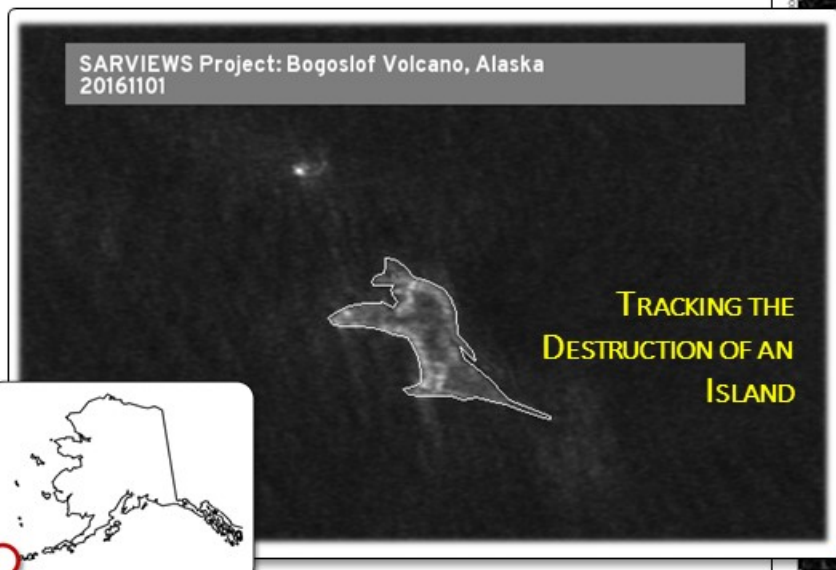


NASA SAR-VIEWS: Bogoslof – Tracking the Destruction of an Island January 2017

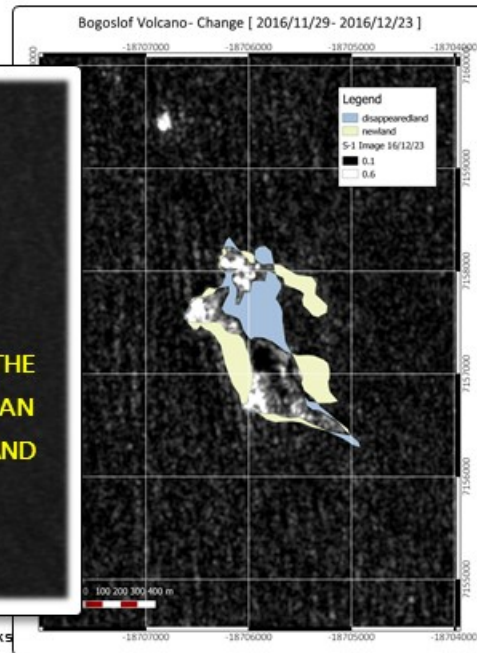
- SAR-VIEWS: SAR Volcano Integrated Early Warning System
- Bogoslof event started on Dec 16, 2016 and is ongoing
- SARVIEWS assisting USGS Alaska Volcano Observatory with image time series and change detection information

As of:
1/13/17

NASA ASP DISASTERS MOST RECENT VOLCANO HAZARD SUPPORT
Bogoslof Eruption Dec'16 – Jan'17



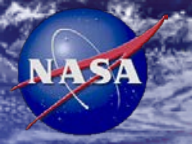
NASA Disasters PI: Franz J. Meyer, University of Alaska Fairbanks



END-USER TESTIMONY

D. Schneider (AVO) via email on 1/12/17:

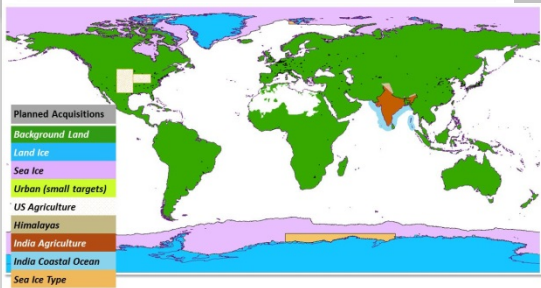
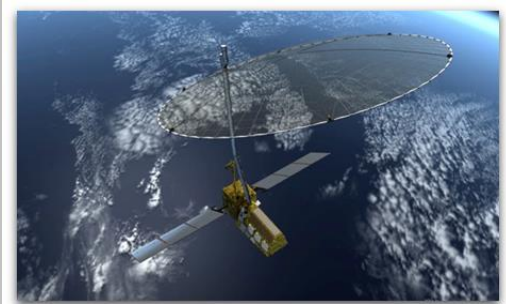
"This has been a fascinating eruption for many of us and it is remarkable how much information you have provided for such a remote volcano. I appreciate your help and the support of NASA"



NASA and Mission Partnerships NISAR* and Resilience

Among the many existing, new and planned missions NISAR is one of many examples where NASA partnerships opportunities would improved resilience and response

NISAR will change the way the world shares data and provide advanced radar imaging that it will capture uniquely the Earth in motion



Earthquakes



Volcanoes



Landslides



Floods

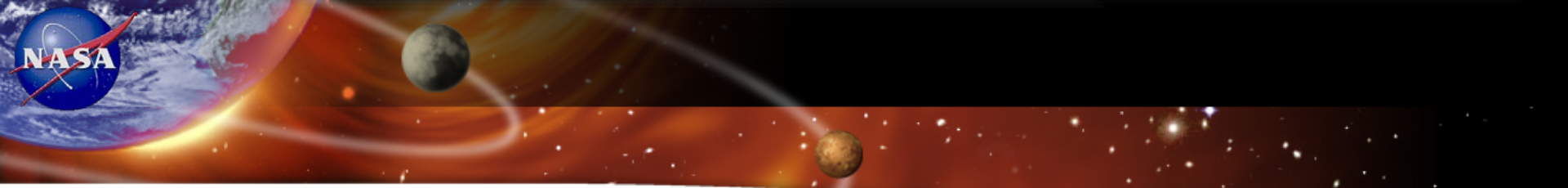


Fires

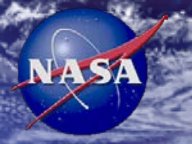


Land Subsidence

*** NASA and ISRO (the Indian Space Research Organisation)
Synthetic Aperture Radar *Mission Concept to Launch in 2020***



Oil Spill Response

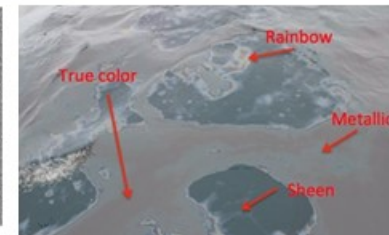
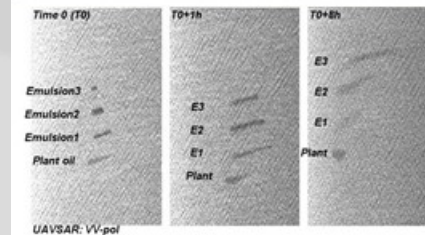
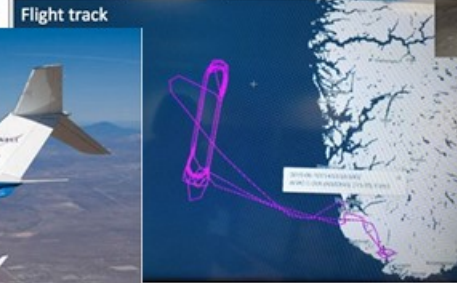


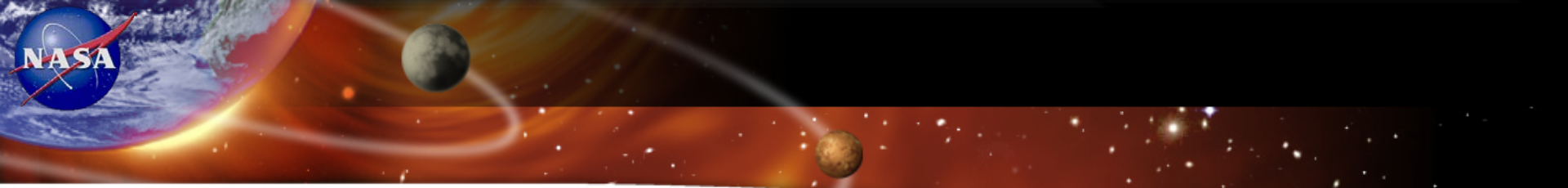
NASA Application Science and Technology Deployed in Norway's Annual Oil Spill Cleanup Exercise

- NASA/UAWSAR deployed for the first time in the annual Norwegian "Oil on Water" spill exercise June 8-11, 2015 in simulation of a large spill (10s of kl) in the North Sea
- Objective to advance application science, calibrate and validate technology and test oil characterization models, demonstrate L-band SAR-based capacity, and inform NISAR Mission applications science
 - Concurrent sea truth and optical, IR, and satellite SAR imagery all obtained at no cost to NASA.
- Norwegian collaboration expected to lead to oil-in-ice spill response capability – important for Arctic oil exploration



UAWSAR
2 days, 3 flights,
33 flight lines acquired over Frigg Field





ORGANIZATION DISASTERS PRODUCTS RESOURCES

January 11, 2017

ARIA Flood Proxy Map for Floods in Northern California and Nevada

ARIA Flood Proxy Map for the floods in Northern California and Nevada on January 8th, 2017.

Flood Proxy Map (FPM) covering an area of 155-by-224 miles (250-by-360 km), derived from Sentinel-1's pre- (2016-12-15 6 PM PST) and during-the-event (2017-01-08 6 PM PST)...

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Recent Disasters

- California Flooding 2017
- Alaska's Bogoslof Volcano Eruption
- Thailand Flooding 2017
- Argentina Wildfires 2016/17
- Hurricane Matthew 2016
- Typhoon Megi 2016
- Puerto Rico Blackout 2016
- Amatrice Italy Earthquake 2016
- Louisiana Flooding 2016
- California Wildfires 2016

[View All](#)

About the NASA Disasters Program

The Disasters Applications area promotes the use of Earth observations to improve prediction of, preparation for, response to, and recovery from natural and technological disasters. Disaster applications and applied research on natural hazards support emergency preparedness leaders in developing mitigation approaches, such as early warning systems, and providing information and maps to disaster response and recovery teams.

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Community

- FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)
- PACIFIC DISASTER CENTER
- USAID FROM THE AMERICAN PEOPLE

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Organization

The Team

- Org Chart
- Disaster Response Coordination Team
- Monthly Status Reports (MSR)
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Response: <https://disasters.nasa.gov/>

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