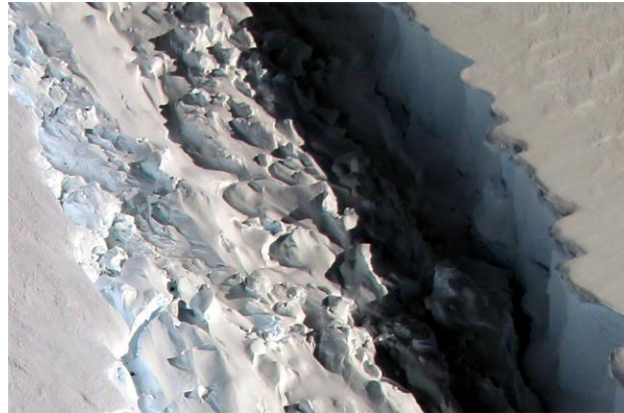


SCIENCE

National Aeronautics and
Space Administration



TROPICS Applications Workshop February 2020 in Miami

Overview of NASA's Disasters Program Support for Recent Hurricane Responses

Andrew Molthan and NASA Disasters Team

NASA Marshall Space Flight Center / Earth Science Branch¹

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February 19, 2020

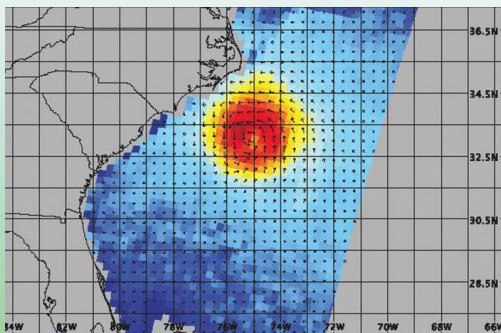
Contributions from NASA Earth Science Elements

- Applied Sciences
 - Earth Science Disasters Program brought together NASA and sponsored investigators to support analysis of pre-landfall and recovery efforts.
 - Brings forward ***NASA's Earth Science Disaster Response Team***, which includes multi-Center and institutional efforts to map damage and flooding – for Florence, in-person support at FEMA HQ to better understand their immediate and longer-term remote sensing needs.
- Research and Analysis (R&A)
 - Ongoing research regarding tropical cyclones, intensification, modeling, and use of NASA tools to map cyclone impacts, and sharing of data with the weather community via SPoRT Project
- Satellite and Airborne Science
 - With R&A and Applied, deployed G-III aircraft and UAVSAR instrument to the Carolinas to support immediate flood mapping, response activities, and collect data for longer-term science
- Earth Science Technology Office (ESTO)
 - Developed UAVSAR instrument, supports investment in NASA remote sensing and data systems technologies to support rapid acquisitions and sharing of information

NASA Mission Insights: Structure and Evolution

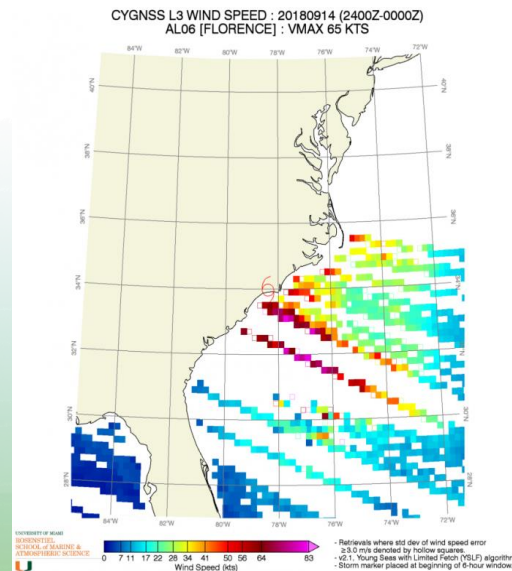
Ocean Surface Winds from SMAP

- SMAP observations are being used to estimate cyclone wind speeds, helpful for diagnosing and documenting the intensity and extent of impacts



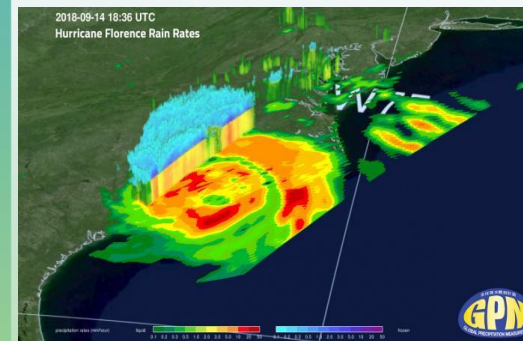
CYGNSS Wind Speed Measurement

- CYGNSS wind speeds capture higher spatial and temporal details of cyclone intensity



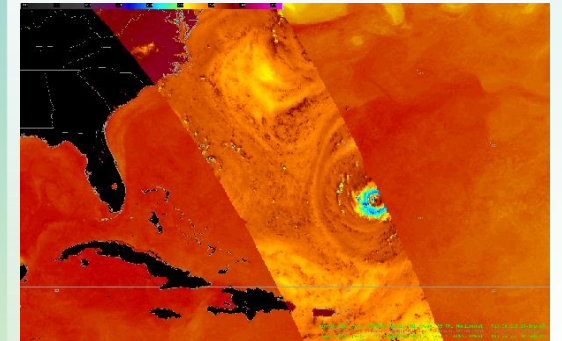
Monitoring Precipitation with GPM

- GPM Core and supported constellation provide routine mapping of torrential rains and storm structure, particularly valuable in offshore and radar-sparse locations



Supporting Operational Weather Forecasting

- Imagery from GPM, including views of storm structure and rainfall, provided along with other NASA mission data to the weather community through the SPORT Center



NASA Mission Insights: Land Surface and Hydrology

Imaging the Earth to Capture Flooding

- Routine imaging by Landsat 8 and comparisons to historical record provide visual confirmation of flood extent and potential impacts



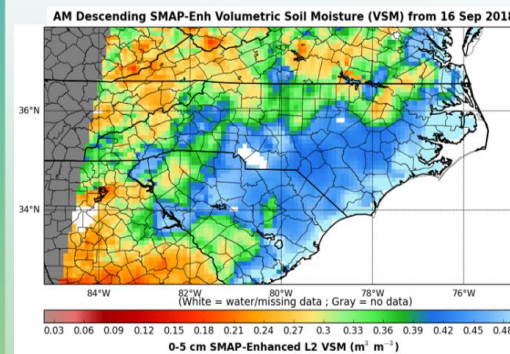
Coastal Impacts from Flood and Runoff

- Imaging captures sediment plumes and coastal pollution from inland runoff



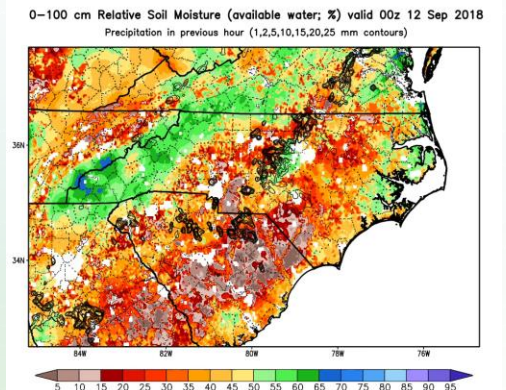
Mapping Soil Moisture and Flood Risk

- Observations from the SMAP instrument capture wet soils, increased runoff, and longer-term impacts to agriculture and flood risk in the Carolinas



Soil Moisture Modeling and Climatology

- Inclusion of SMAP, rainfall, and other information helps real-time predictions for understanding flood risk and improving streamflow models



Response and Engagement Timeline: Hurricane Florence



Integrated Sharing of Data via Esri Services

NASA Disasters Mapping Portal

TOOLS TRAINING NEWS

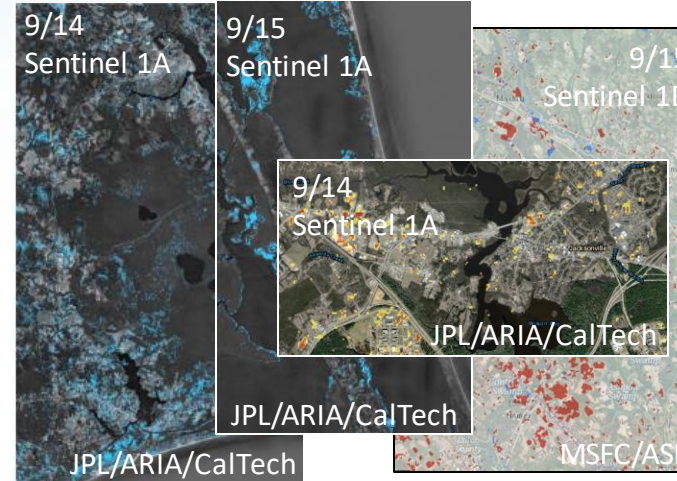
Sharing of imagery, products, and training through uniform services to improve integration



9/12: Int'l Space Station

Photos from the ISS demonstrate the storm's intimidating size and intensity, capturing the attention of the public and media

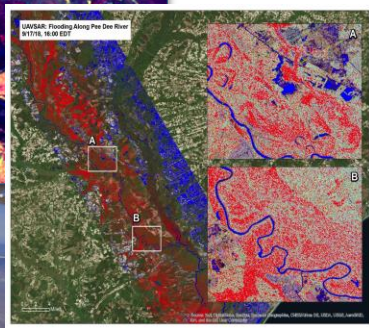
Flood Mapping: Team members generate flood and damage proxy maps via ESA and International Charter contributions to SAR imaging



UAVSAR Flights Support Research and Response Efforts



Imaging provides immediate mapping and new data to advance SAR application (NISAR) and hydrologic research studies



NASA Response Tier **0** **Tier 1: 9/10** **Tier 2: 9/14** **Tier 1: 9/24** **0**
 Day 1: Sept 9 Day 20: Sept 28

9/13 – NASA Team Member Supports at FEMA HQ – 9/20

9/14 – UAVSAR and Team Receive FEMA Mission Assignment

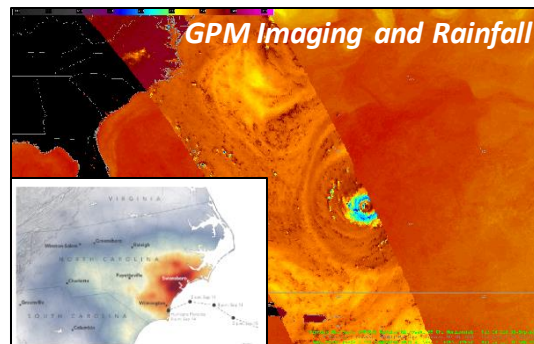
9/17 – NASA UAVSAR Flights to Support Science and Response – 9/24

Team Coordination:
 Daily calls begin to coordinate NASA team:

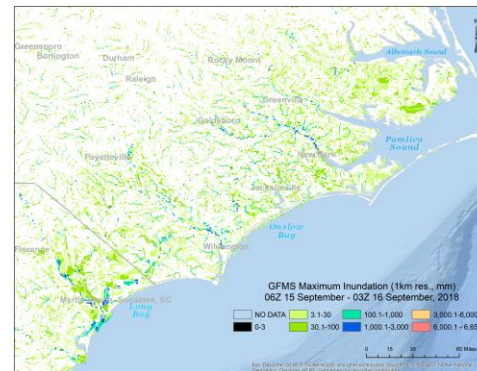
- Flood Mapping
- Other Products
- UAVSAR

Pre-Existing Partners

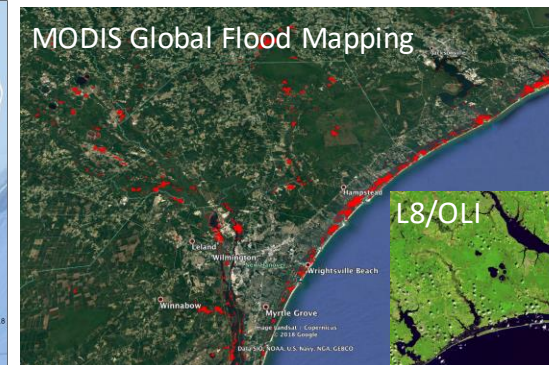
- FEMA, USFS, NOAA/NWS and NWC, USGS, National Guard,
- Research/Academia



Monitoring the Storm: NASA's SPoRT Center, via R&A, ensures mission data support operational forecasting



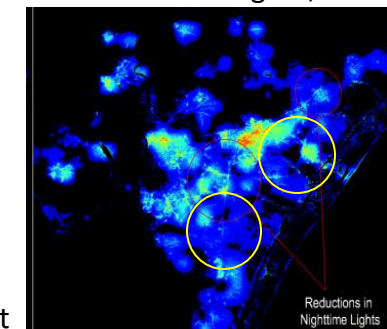
Global Flood Monitoring System estimates extent of inundation



Mapping Floods as Skies Clear: Clear skies and views from MODIS/Landsat

NASA Black Marble HD

Black Marble HD: Captures lights missing in coastal Wilmington, NC

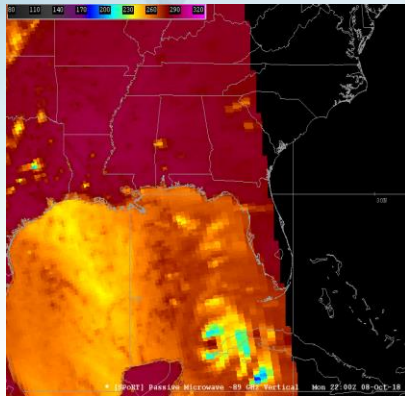


Decreased illumination compared to pre-event composite

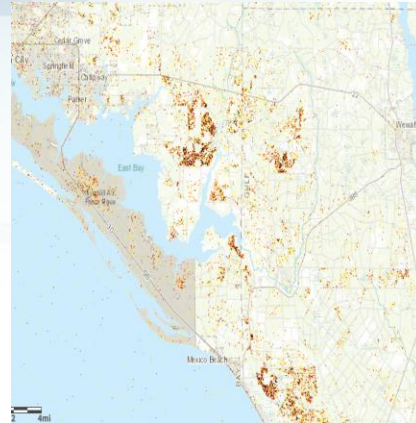
Response and Engagement Timeline: Hurricane Michael



Team coordination began prior to 10/10 and continued daily throughout the event
Partners/Stakeholders engaged prior to and throughout storm's impact
FEMA, NGB, NOAA, USFS, USGS, US Army Geospatial Center, Department of Interior



Monitoring the Storm:
GPM data provided to support operational forecasting



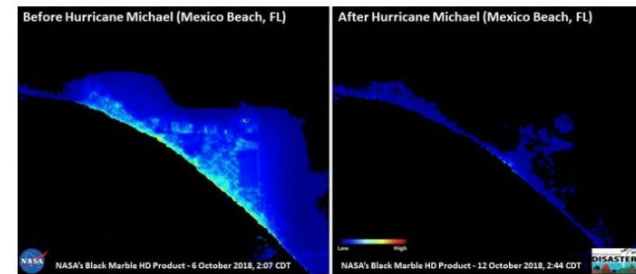
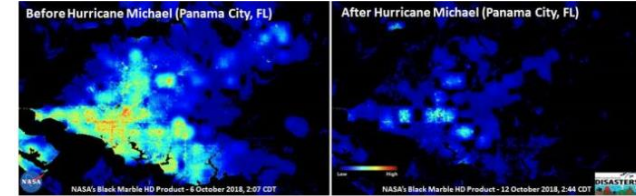
Damage Mapping: Damage proxy maps capture structure damage on immediate coastline



Flood Mapping: Identifying coastal and inland flooding from SAR imagery

NASA Black Marble HD:

Black Marble HD: Captures lights missing in Florida's Energy Sector



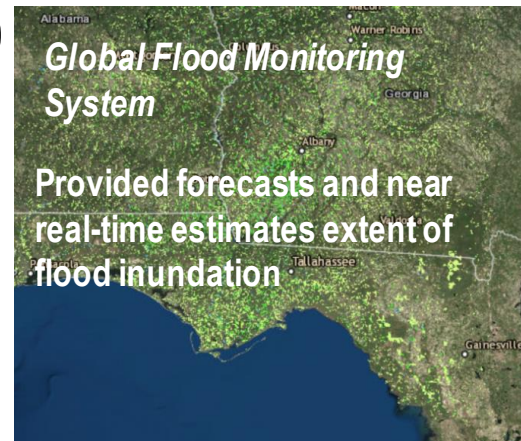
10/8



NASA Data/Product portal available via Esri Services
<http://maps.disasters.nasa.gov>

10/9

10/10

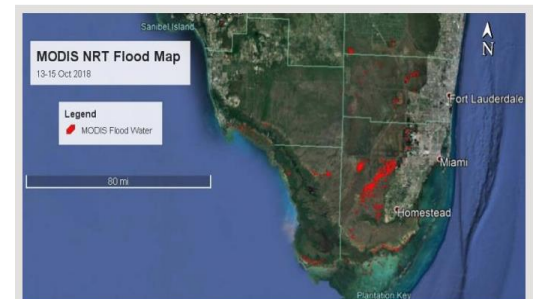


10/11

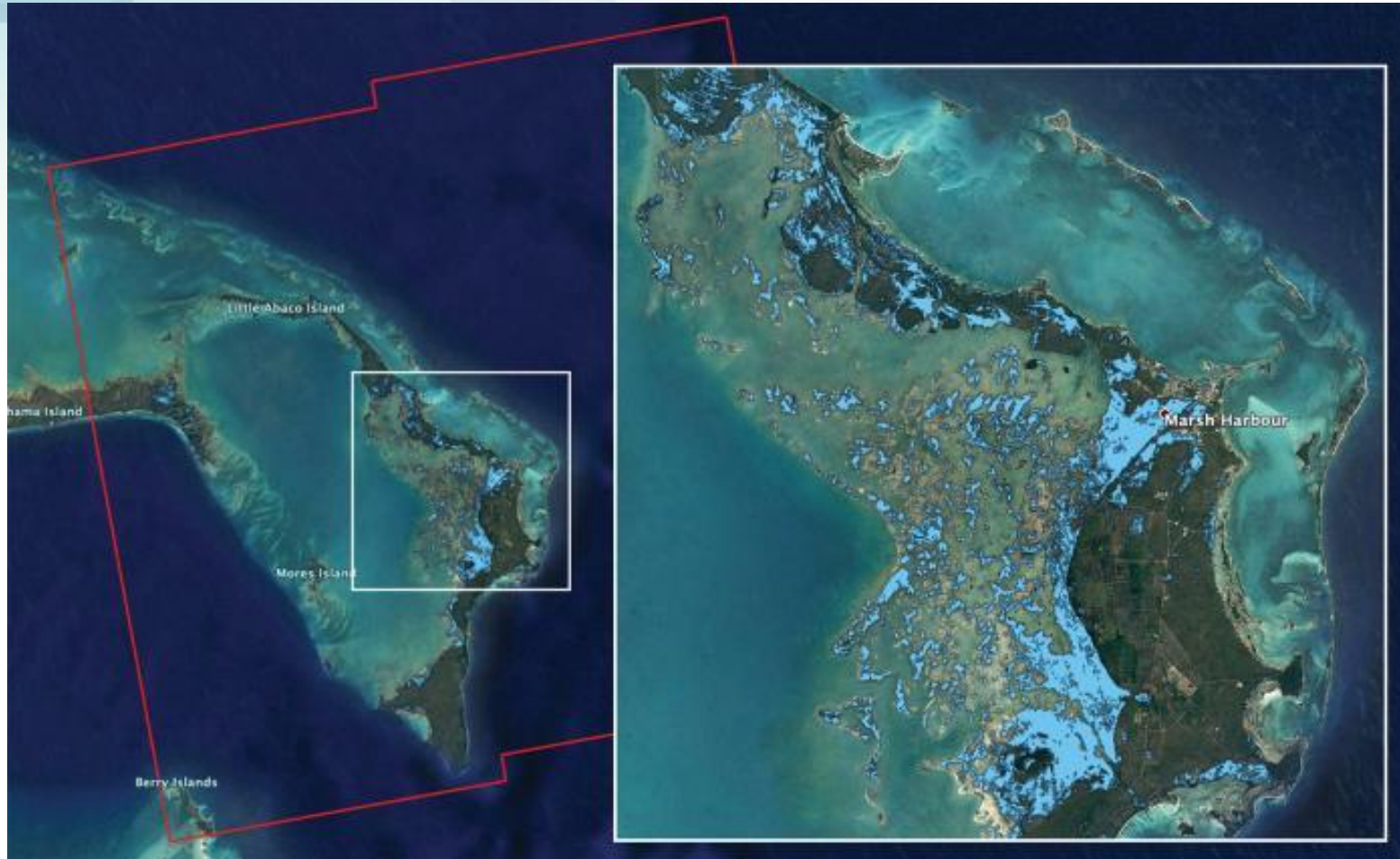
10/12

10/16

Mapping Floods as Skies Clear:
MODIS & Landsat-derived flood maps in affected regions



Hurricane Dorian Activities

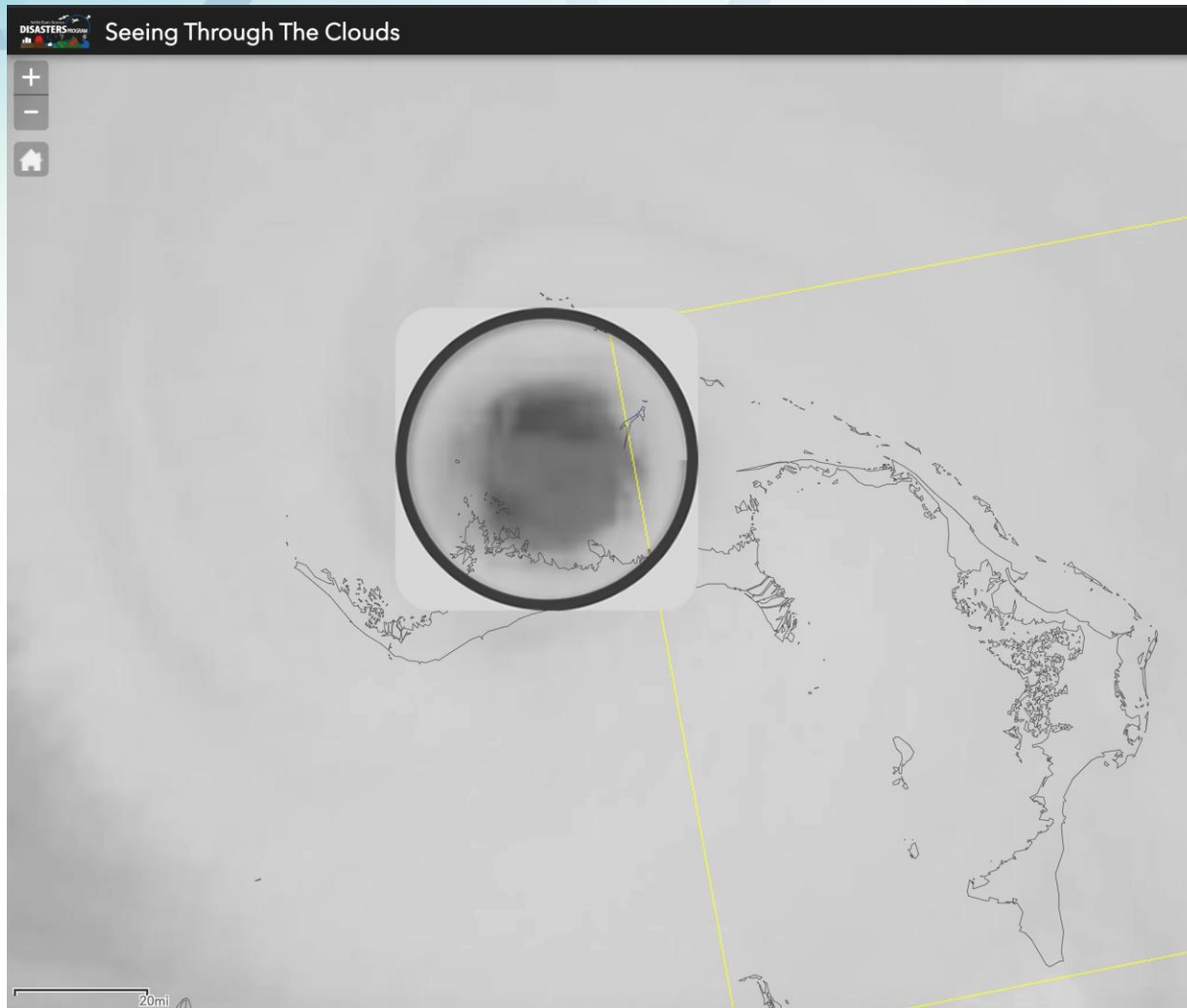


JPL/ARIA production of Sentinel-1 based Flood Proxy Map for impacts to the Bahamas following Dorian.

Also produced: Damage Proxy Map (not shown), helps to identify areas of significant structural damage and land surface change attributable to the storm.

Credits: NASA/JPL-CalTech, ESA

Collaborative Activities: Demonstrating SAR



A growing set of capabilities in GIS, and cross-team collaborations foster novel ways of helping communicate the benefits of remote sensing.

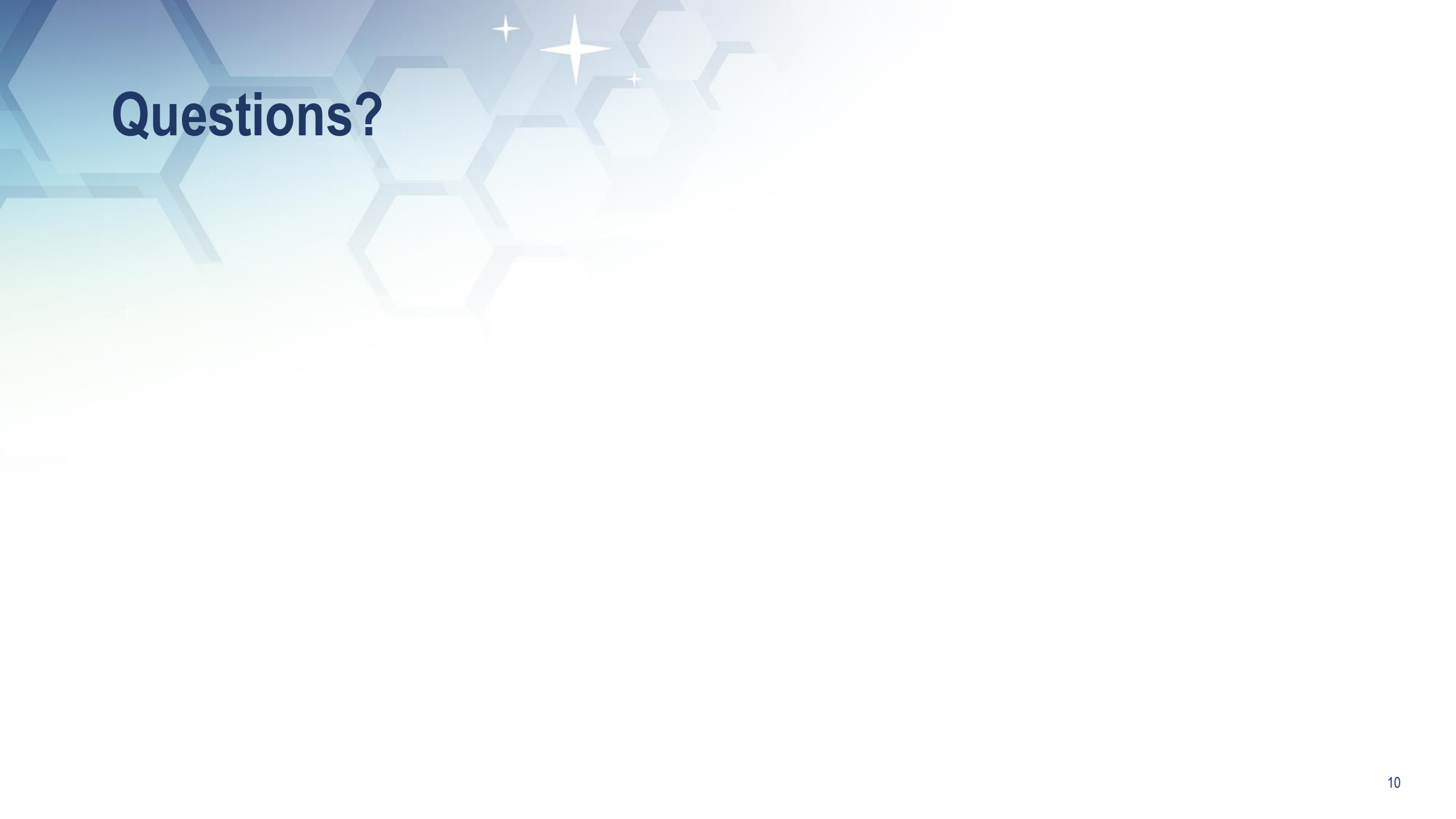
Here, the team assembled GOES imagery of Hurricane Dorian (then, Category 5) at approximately the same time that Sentinel-1A visited parts of the Bahamas.

GIS-based storytelling:

Here, we can show how SAR “sees through” dense clouds and rainfall to image flooding beneath (JPL/ARIA Flood Proxy Map), showing benefits of SAR imaging, team development of products, and helping end users understand the unique benefits of active sensors.

Supporting Activities

- GIS Portal Efforts
 - Sustained sharing and use of products through a GIS-capable data portal: maps.disasters.nasa.gov
- Activities with the Community on Earth Observing Satellites (CEOS)
 - NASA serves in the chair role for the CEOS Working Group on Disasters, working with international partners on improved data access, utilization, and integration in response to all phases of the disaster cycle. Subcommittee on Disaster Reduction (SDR)
- UN-SPIDER / IWG-SEM
 - UN Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER) and their International Working Group on Satellite Emergency Mapping (IWG-SEM)
 - Working group to understand UN-SPIDER activities and how NASA can effectively participate in broader international efforts to apply remote sensing to emergency response



Questions?