Using NASA's LANCE Near Real-time Products for Disaster Risk Reduction

EXPLORE EARTH

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Other partners: USGS/Hazards Data Distribution System, Int'l Charter on Space and Major Disasters, end user collaborators within FEMA, IFRC, U.S. National Guard, University of Maryland, Global Flood Partnership, others.	

Outline

NASA's Land, Atmosphere Near real-time Capability for EOS (LANCE)

NASA's Earth Applied Science Disasters Program

Disasters Application

Data Latency Terminology

- **Latency is defined as the time between satellite observation and the time data are available to users.**

- In 2016, **a workshop titled "Time Sensitive Applications of NASA Data" was held at NASA**, and the terms for latency were defined and agreed to by participants across NASA for all data managed by EOSDIS on behalf of NASA's Earth Science Division. The table below summarizes these terms.

- **The European Space Agency (ESA)** uses the same definition for Near Real-Time (NRT) which refers to data products delivered less than 3 hours after data acquisition.

Term	Latency	Purpose
Real-time	Less than 1 hour	These terms are often used to refer to data that are made available quicker than routine processing allows. They are used for a range of applied sciences, decision and tactical support, monitoring and early warning of events.
Near real-time (NRT)	1-3 hours	
Low latency	3-24 hours	
Expedited	1-4 days	
Standard routine processing	Generally, 8 – 40 hours but up to 2 months for some higher-level products	Standard products provide an internally consistent, well-calibrated record of the Earth's geophysical properties to support science.

(Source: What is Data Latency? | Earthdata (nasa.gov) https://earthdata.nasa.gov/learn/backgrounders/data-latency)

NASA's Land, Atmosphere Near Real-time Capability for Earth Observing Systems (LANCE)

- The goal of LANCE (https://earthdata.nasa.gov/lance) is to provide **Near Real-time (NRT) data products within 3 hours** from satellite observations to meet the timely needs of applications users including disasters.

- LANCE NRT imagery is generally available within 3-5 hours after observation from **NASA's Global Imagery Browse Services (GIBS) and Worldview**.

- LANCE provides NRT data and imagery from **10 instruments** much quicker than routine processing allows including AIRS, AMSR2, LIS, MISR, MLS, MODIS, MOPITT, OMI, OMPS, and VIIRS. NRT data and imagery from **SMAP (Soil Moisture Active Passive) are coming soon.**

- LANCE provides access to **more than 110** NRT products.

- Fire Information for Resource Management System (**FIRMS**) is a part of LANCE.

- Karen Michael is the LANCE manager. Diane Davies is the LANCE Operations Manager.

LANCE User Working Group (UWG)

- LANCE is managed by NASA's Earth Science Data and Information System (ESDIS) but steered by a User Working Group (UWG) responsible for providing guidance and recommendations concerning a broad range of topics related to the LANCE system, capabilities, and services.

- **The UWG meets twice a year to ensure that LANCE capabilities are aligned with the NRT community needs**.

- UWG recommendations are made to ESDIS, which in turn engages NASA Headquarters concerning the feasibility and cost of implementation.

- **The UWG is chaired by Dr. Miguel Roman (Earth from Space Institute, USRA).**

LANCE UWG members

Name	Affiliation
Miguel Roman	Universities Space Research Association Earth from Space Institite (EfSI)
Robert Brakenridge	Colorado/Dartmouth Flood Observatory
Arlindo da Silva	NASA/Goddard
Vanessa Escobar	NOAA/NESDIS
Mike Fromm	NRL/Washington DC
Sean Helfrich	NOAA/NESDIS/OSPO
Steve Miller	Colorado State University
Maggi Glasscoe	JPL/UAH/MSFC
Brad Quayle	USFS
Josh Cossuth	NRL/Monterey/Washington DC
Mark Trice	MD DNR
Mike Budde	USGS
Patrick Duran	NASA/MSFC/SPoRT

LANCE Users

(Picture is adapted from Diane Davies's presentation.)

How to Browse and Download LANCE NRT Data Products and Imagery

Visualize LANCE NRT data via **Worldview/GIBS/FIRMS**:

https://earthdata.nasa.gov/earth-observation-data/visualize-data

Register with **Earthdata** Login to start downloading LANCE NRT data:
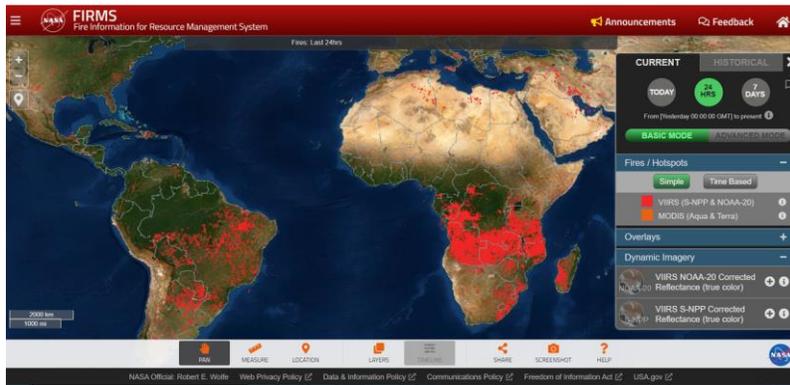https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data

LANCE NRT data products have been integrated into **Disasters Mapping Portal** for viewing, analyzing and downloading disaster response datasets:
https://disasters-nasa.hub.arcgis.com/
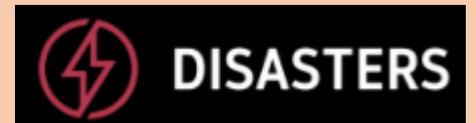
The Fire Information for Resource Management System (FIRMS)

- The Fire Information for Resource Management System (**FIRMS**) (https://firms.modaps.eosdis.nasa.gov/) distributes **Near Real-Time (NRT) active fire/thermal anomaly data** within 3 hours of satellite observation from the Moderate Resolution Imaging Spectroradiometer (**MODIS**) aboard the Aqua and Terra satellites, and the Visible Infrared Imaging Radiometer Suite (**VIIRS**) aboard S-NPP and NOAA 20.

- FIRMS was transitioned to NASA LANCE in 2012.

- Users can download active fire products from the MODIS and VIIRS **for the last 24, 48 hours and 7 days in shapefile, KML or text file formats.**

FIRMS US/Canada

- **In February 2021, FIRMS US/Canada** (https://firms.modaps.eosdis.nasa.gov/usfs/), a new and expanded version of FIRMS was released as the result of an agreement between the **USDA Forest Service's** Geospatial Technology and Applications Center (**GTAC**) and NASA.

- FIRMS US/Canada provides enhanced capabilities for visualization and access of NRT satellite active fire/thermal anomaly data and other relevant remote sensing data products for the United States and Canada. FIRMS US/Canada is currently available for use and **additional capabilities will continue to be added to FIRMS US/Canada.**

Disaster Response Support: Visualizing LANCE NRT Data Products in NASA Disasters Mapping Portal

- **Following a disaster event**, NASA HQ team evaluates to determine an appropriate degree of response. When activated, disasters coordinators in each NASA Center will help providing information and products requested by partners and stakeholders.

- **NASA Disasters Mapping Portal** (https://disasters-nasa.hub.arcgis.com/**), the **NASA's Open Data Portal hosted by the NASA Earth Applied Sciences Disasters Program,** is an ArcGIS-based online interface for viewing, analyzing and downloading disaster response datasets **including LANCE NRT products on disasters events.**

NASA Disasters Program

Program Manager: Dr. David Green.

Global models run persistently

Atmospheric Forcing

Terrestrial Modeling (e.g. LIS)

Stream Routing (e.g. RAPID)

...bility Analyses

Snow Assessments

Humanitarian Assistance

Drought Vulnerability

Navigation

Economic Issues

Chemical/Biological/Radiation Hazards

Transportation Networks

Other Layers
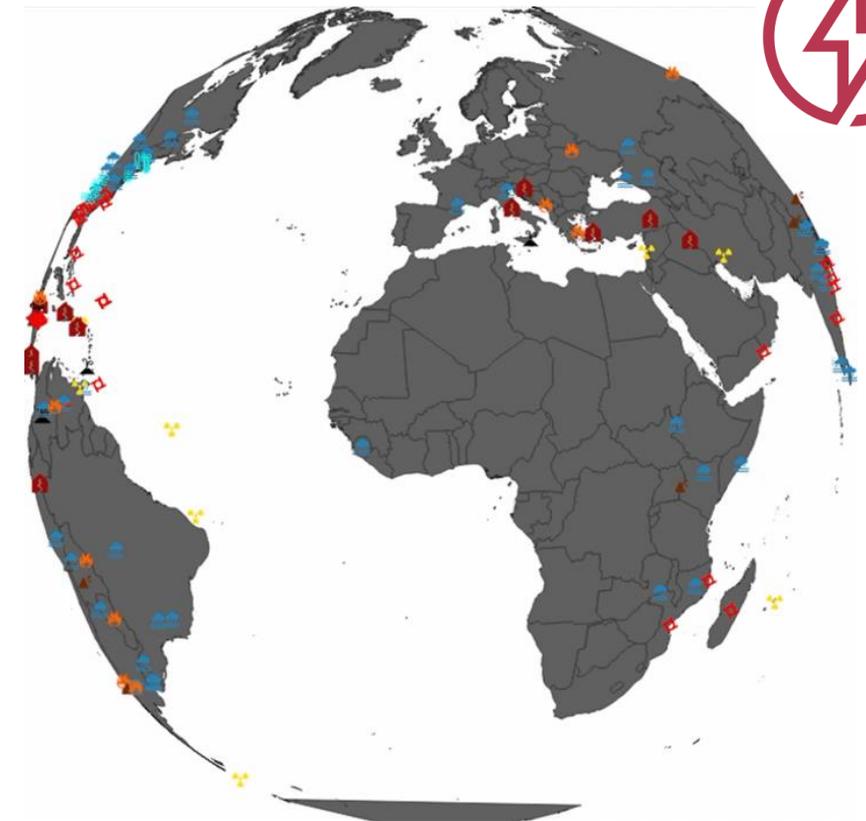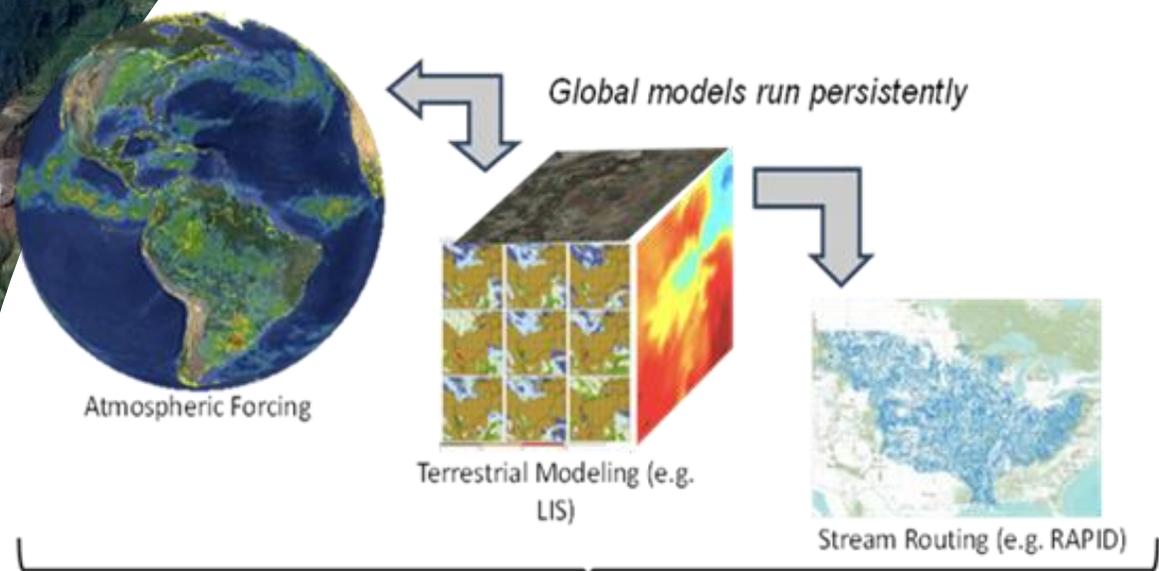
NASA Disasters Program Activation Tier Structure	
Tier 0	Evaluation tier in which the Disasters program conducts a rapid assessment.
Tier 1	Activation occurs when end users are identified, and useful products are developed.
Tier 2	Potential contributions are worth some impact to the ongoing activities in NASA.
Tier 3	Activation occurs when the disaster event directly affects national safety, security, or interests.

261 Activations since 2017

(This slide is adapted from presentation by Dr. Batuhan Osmanoglu in IGARSS 2021)
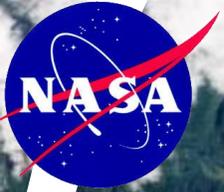
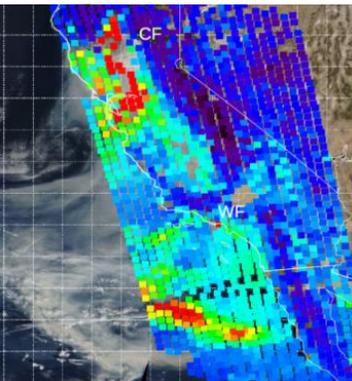# Disasters Application of LANCE NRT Data Products
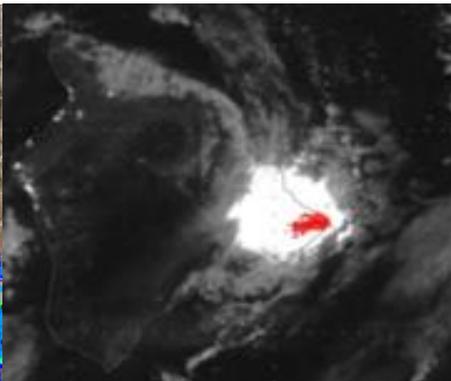

(source: UNSDR)

LANCE provides **Near Real-time (NRT) products** within 3 hours of observation to meet the timely needs of **disaster risk reduction** activities before, during and after a disaster including volcano eruptions, wildfires, floods, landslides, hurricanes and earthquakes.
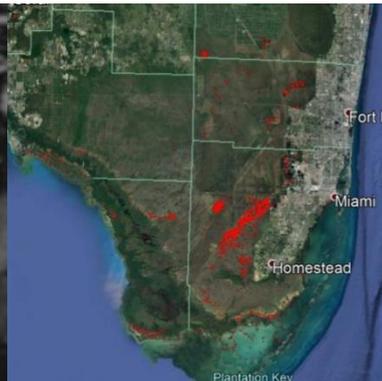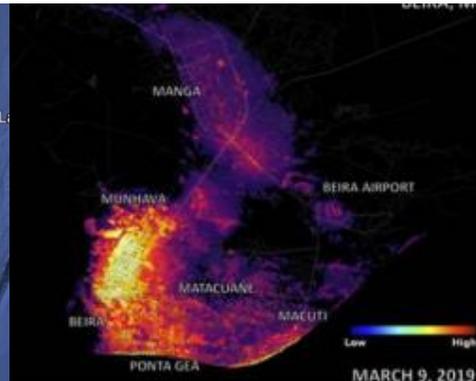
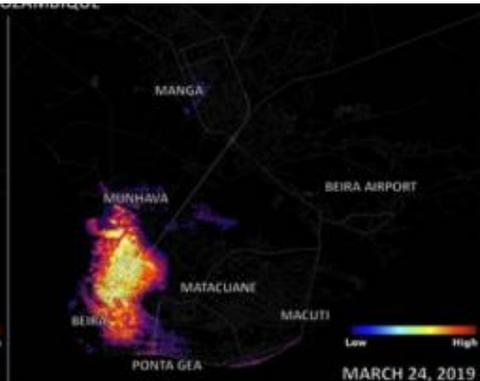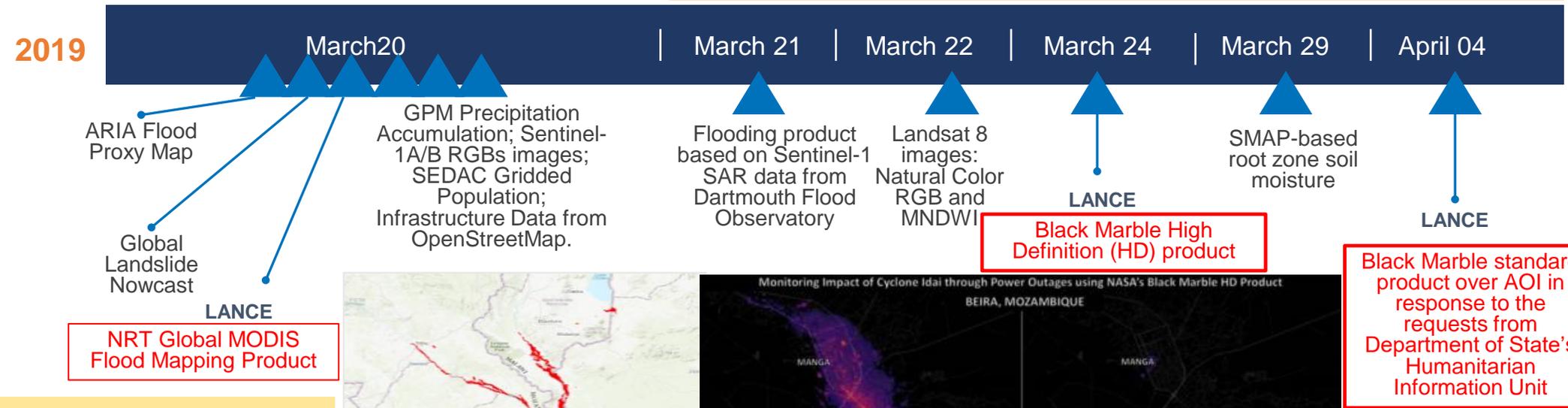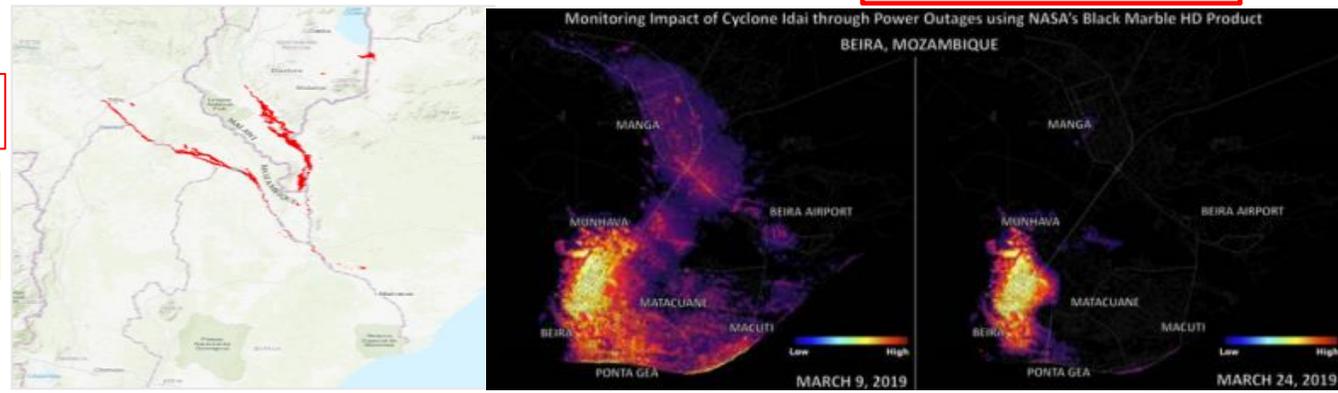| AMSR2 Surface Precipitation Rates product	MOPITT CO product	VIIRS Fire product	MODIS NRT Flood Mapping product	NASA's Black Marble Nighttime Light product

Using LANCE NRT Data Products in NASA Response for Tropical Cyclone Idai

"I've heard from our field teams that the maps that we are making with NASA data are also being used **by the Mozambique government for initial assessments and decision-making**, so that's great news. The data you're providing is very useful for us as we work with partners to respond to the flooding." **Lauren Bateman, IFRC**

" In terms of any direct asks we have relating to data needs for our current production on Tropical Cyclone Idai, there is one item of interest that stands out.
1.   Black Marble Power Outages – We see this is available for the city of Beira. Is it possible to get this on the scale of the entire province of Sofala in Mozambique? Access to electric is key for proper hygiene, especially this long after the onset of the disaster and, combined with flood extent and displacement, can be really helpful in showing the scale of potential Cholera/disease outbreaks." **Ryan Latgis, Humanitarian Information Unit, U.S. Department of State**

2019 Timeline

March20	March 21	March 22	March 24	March 29	April 04

ARIA Flood Proxy Map

Global Landslide Nowcast

GPM Precipitation Accumulation; Sentinel-1A/B RGBs images; SEDAC Gridded Population; Infrastructure Data from OpenStreetMap.

Flooding product based on Sentinel-1 SAR data from Dartmouth Flood Observatory

Landsat 8 images: Natural Color RGB and MNDWI

SMAP-based root zone soil moisture

LANCE
NRT Global MODIS Flood Mapping Product

LANCE
Black Marble High Definition (HD) product

LANCE
Black Marble standard product over AOI in response to the requests from Department of State's Humanitarian Information Unit

NASA Response and Engagement Timeline for Tropical Cyclone Idai (March-April 2019)

Monitoring Impact of Cyclone Idai through Power Outages using NASA's Black Marble HD Product
BEIRA, MOZAMBIQUE
MARCH 9, 2019
MARCH 24, 2019

Using LANCE NRT Data Products in NASA Response for Volcano Eruptions

- Satellite images on the right-side show that in Hawaii's Big Island, **lava flows from Kilauea volcano eruption** are located by LANCE VIIRS NRT thermal anomalies product, with the base map of VIIRS nighttime imagery in NASA Worldview website **in June 2018**. The lower-right photo was taken by Dr. Jean-Paul Vernier in NASA Disasters Program.

- The Volcano Dashboard in **NASA Disasters Mapping Portal shows Hawaii's Kilauea volcano activity of the last 24 hours** with LANCE VIIRS NRT thermal anomalies products **on 09/30/2021**.

- Dr. Jean-Paul Vernier in NASA Disasters Program received the **feedback** from users indicated that LANCE VIIRS NRT thermal anomalies products were able to detect the first sign of volcano eruption and were **critical for decision making**.
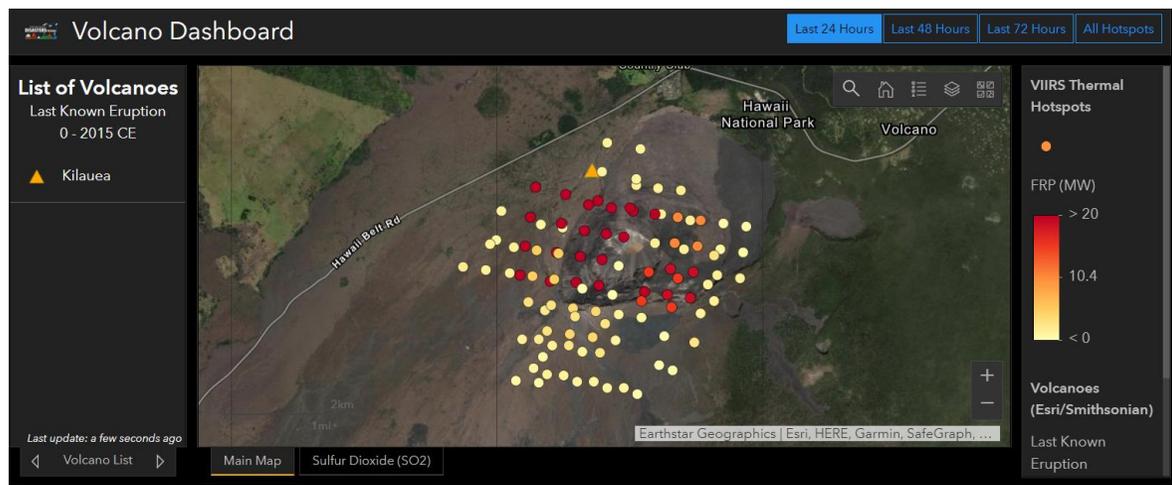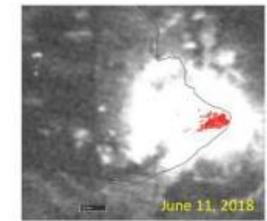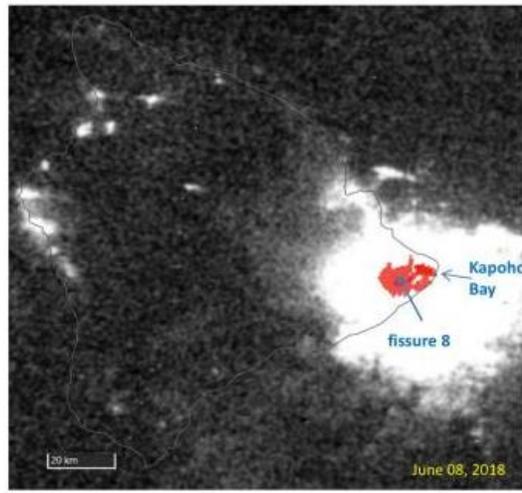
Using LANCE NRT Data Products in NASA Response for Floods due to Hurricanes, Tropical Cyclones and Earthquakes

- **NASA GSFC MODIS NRT Flood Mapping Products** (https://floodmap.modaps.eosdis.nasa.gov/) have been widely used to support Floods disaster responses for a few years, which are available in LANCE (https://earthdata.nasa.gov/earth-observation-data/near-real-time/mcdwd-nrt) since April 2021.

Floods in Indonesia
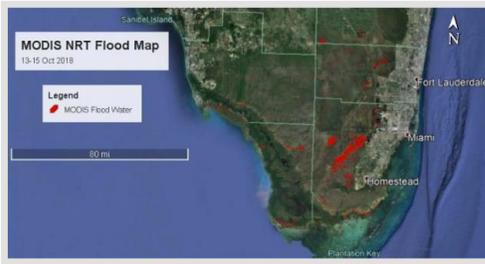
Hurricane Michael

Hurricane Florence

Cyclone Idai

Australia Floods 2021

Hurricane Elsa

Using LANCE NRT Data Products in NASA Response for Monitoring Power Outages

- **NASA's Black Marble Nighttime Lights product suite** (https://blackmarble.gsfc.nasa.gov) allows users to observe changes in nighttime lights that may be due to power outages. The Black Marble dataset is available in **NRT in LANCE (**https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data/viirs-nrt**)** and as a standard product from NASA's LAADS DAAC.
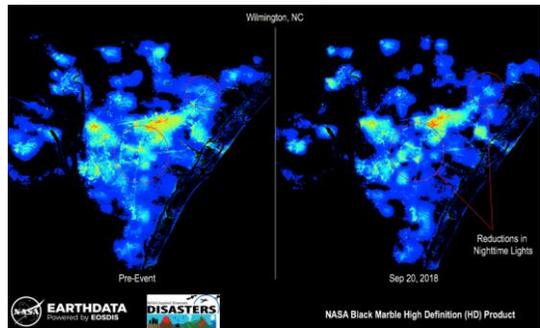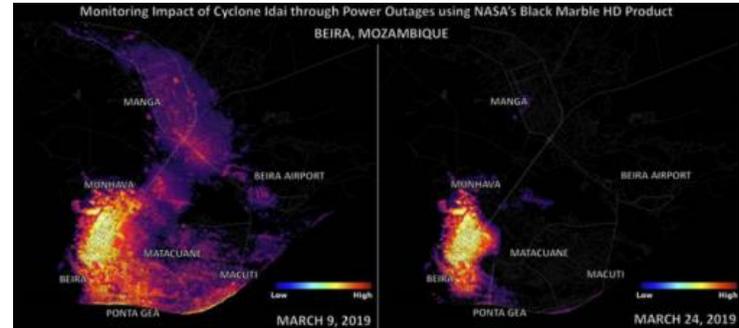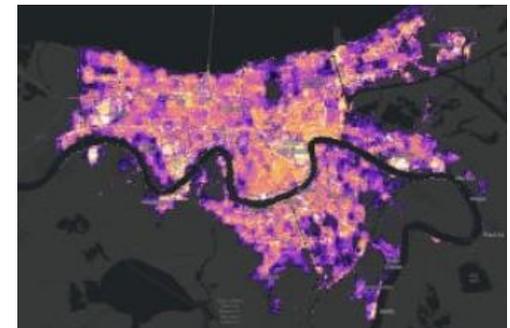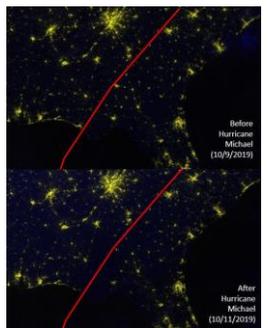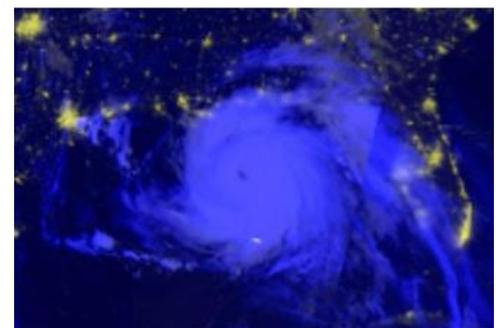

Hurricane Florence	Cyclone Idai	Hurricane Ida

- **The Black Marble Nighttime Blue/Yellow Composite Product** is available in NASA Disasters Mapping Portal and NASA Worldview website since June 2021.
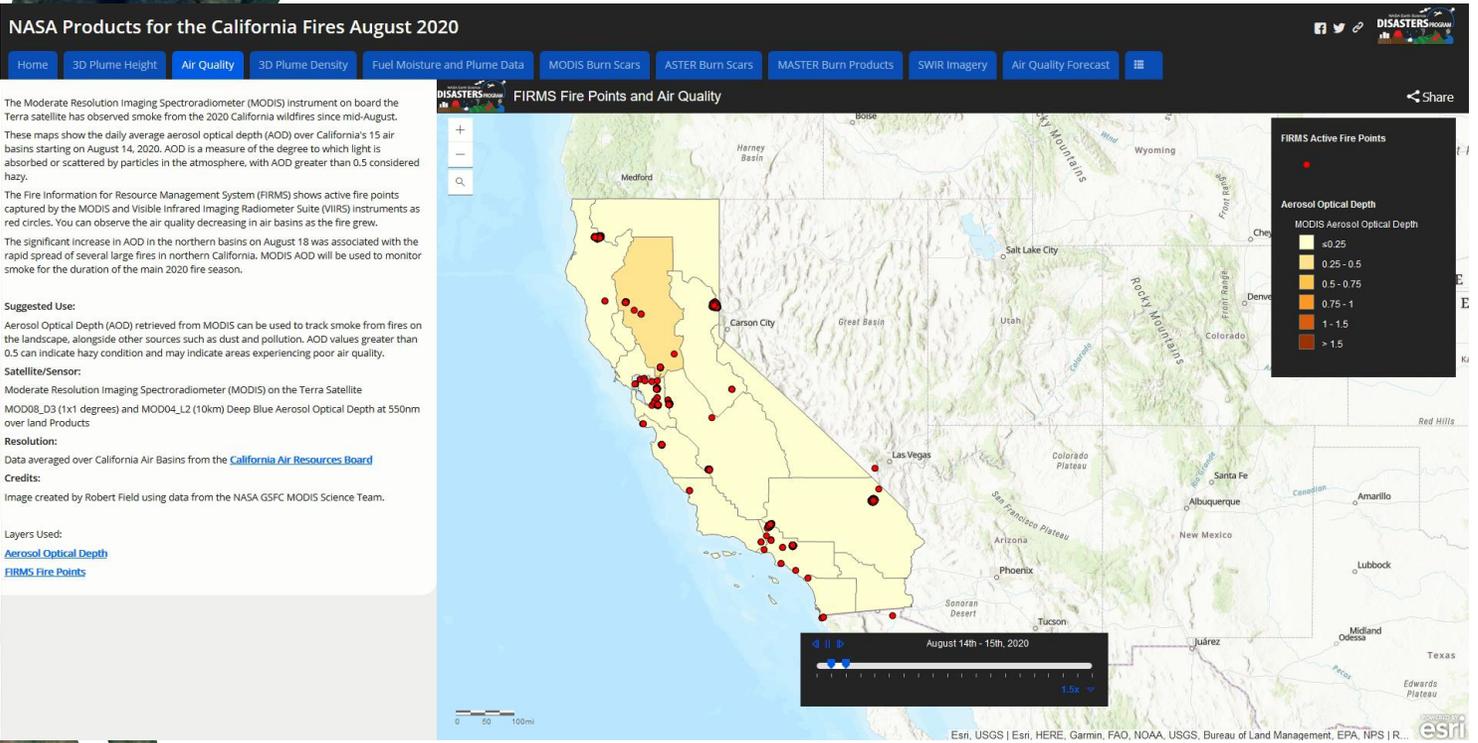

| Hurricane Michael	Hurricane Dorian	Hurricane Ida

Data integration for LANCE NRT data in NASA Disasters Mapping Portal

The above map shows the Aerosol Optical Depth averaged of CA Air Basins, where FIRMS NRT active fire points product provides context of location of fires.

LANCE FIRMS NRT Fire Products were used during the Disasters Program's response to the Western US Fires in 2020.
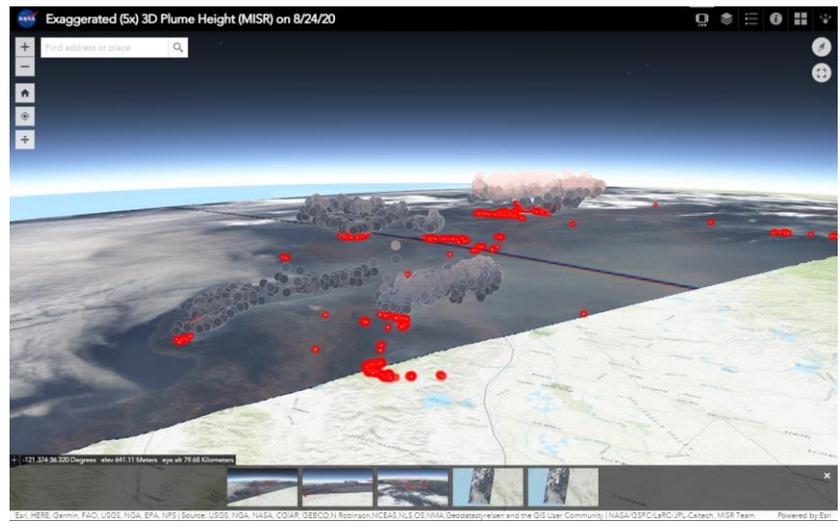
The image above shows that FIRMS active fire points provides context of origin of the smoke plumes shown in 3D from MISR Smoke Plumes Height on 8/24/20.

(This slide is provided by Garrett Layne from NASA Disasters Program)

Data integration for LANCE NRT data in NASA Disasters Mapping Portal

LANCE NRT Ozone Mapping and Profiler Suite (OMPS) Aerosol and Sulfur Dioxide products have been integrated into NASA Disasters Mapping Portal, which allow users to see how the plume was transported in different levels of the atmosphere throughout the eruptive period of Volcano La Soufrière from 4/7/2021-4/21/2021.

(This slide is provided by Garrett Layne from NASA Disasters Program)

Open and Free Data Products from Upcoming NASA Missions

With the free and open data policy, upcoming NASA missions will increase our capabilities to cover the gaps in Disaster Risk Reduction between scientific capability and users' needs:

✔ *NISAR (Launch in 2023 Q1)* will provide low latency high-resolution SAR observations which can penetrate cloud cover to support disaster response.

✔ *TROPICS (Constellation launch in 2022 Q1)* will provide near real-time high resolution sounding within hurricane eyes. *The TROPICS Pathfinder launched in July 2021 and first light images have been released:* https://www.nasa.gov/feature/esnt/goddard/2021/nasa-s-tropics-pathfinder-satellite-produces-global-first-light-images-and-captures

✔ *PACE (Launch in 2024)* will provide low latency data products in the application of detecting and mapping disasters including wildfires, floods and oil spills.

Thank you!

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NASA Earth Applied Sciences Disasters Program
https://appliedsciences.nasa.gov/what-we-do/disasters

NASA Disasters Mapping Portal:
https://disasters-nasa.hub.arcgis.com/

NASA's Land, Atmosphere Near Real-time Capability for Earth Observing Systems (LANCE):
https://earthdata.nasa.gov/lance

Many thanks to my co-authors!
Dr. David Green, Karen Michael and Diane Davies.