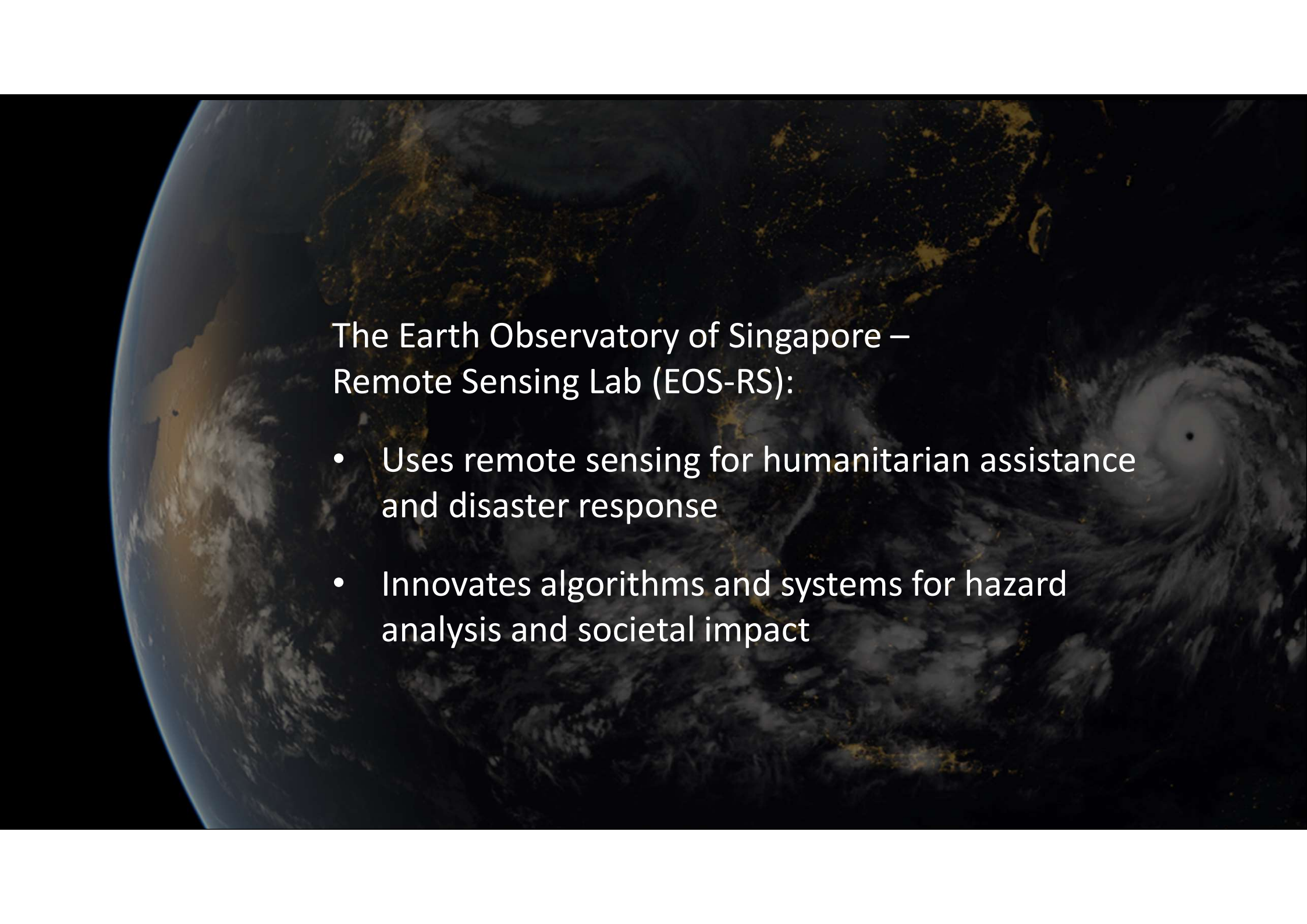Earth Observatory of Singapore

Remote Sensing Lab (EOS-RS)
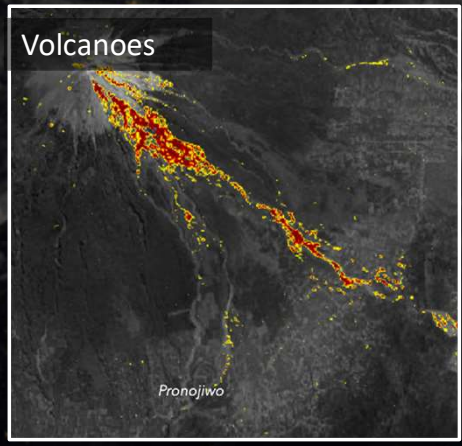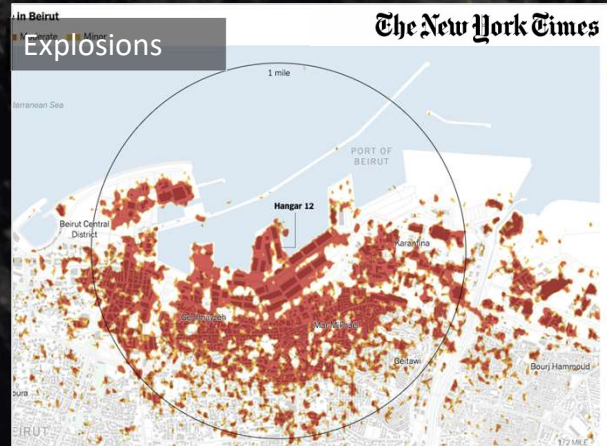
The Earth Observatory of Singapore –
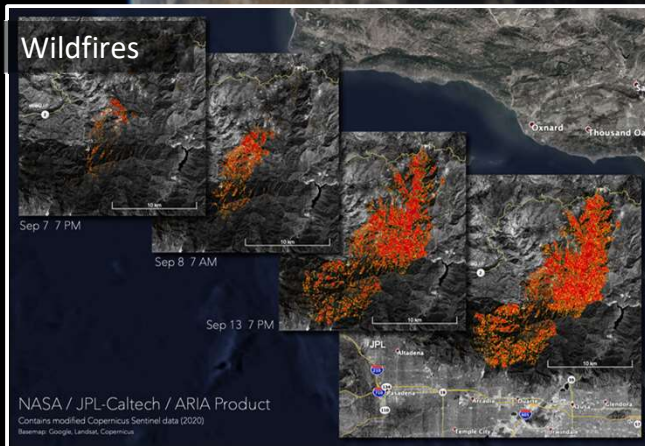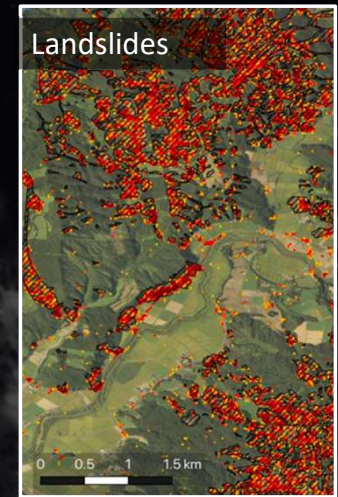Remote Sensing Lab (EOS-RS):

- Uses remote sensing for humanitarian assistance and disaster response

- Innovates algorithms and systems for hazard analysis and societal impact

Types of disasters we map

Floods

Ground Motion

Earthquake Damage

The Economist

Landslides

Wildfires

Explosions

Tropical Cyclones

Volcanoes

Impact to date

Twitter Maps

2022-02- Ukraine War

2022-06 Yellowstone National Park Floods

2020-10 Samos-Izmir Earthquake
2023-02 Turkiye-Syria Earthquake

2020-08 Lebanon Beirut Explosion

2019-09 Laos Storm Koguma
2020-05 Bangladesh Cyclone Amphan

2019-09 Nepal Landslides
2022-10 Nepal Avalanche
2022-06, 2023-03 Afghanistan Earthquake
2022-08 Pakistan Floods
2022-10, 2023-07 India Floods
2019-09 India Floods

2020-07, 2022-05 and 2022-06 India Assam Floods

2022-09 China Sichuan Earthquake

2019-10 Japan Typhoon Hagibis
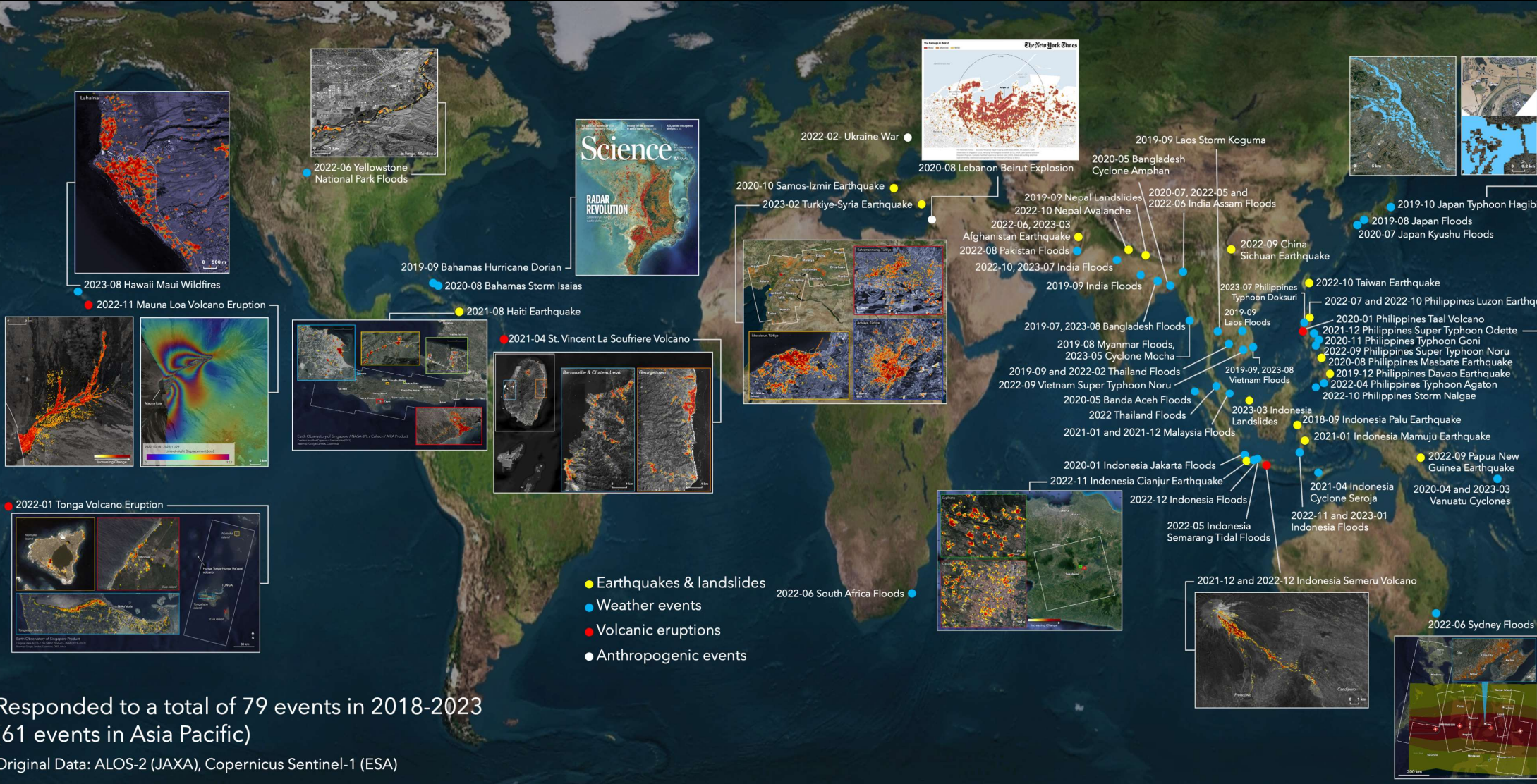2019-08 Japan Floods
2020-07 Japan Kyushu Floods

2022-10 Taiwan Earthquake

2023-07 Philippines Typhoon Doksuri
2019-09 Laos Floods

2022-07 and 2022-10 Philippines Luzon Earthquake
2020-01 Philippines Taal Volcano
2021-12 Philippines Super Typhoon Odette
2020-11 Philippines Typhoon Goni
2022-09 Philippines Super Typhoon Noru
2020-08 Philippines Masbate Earthquake
2019-12 Philippines Davao Earthquake
2022-04 Philippines Typhoon Agaton
2022-10 Philippines Storm Nalgae

2019-07, 2023-08 Bangladesh Floods
2019-08 Myanmar Floods, 2023-05 Cyclone Mocha
2019-09 and 2022-02 Thailand Floods
2022-09 Vietnam Super Typhoon Noru
2020-05 Banda Aceh Floods
2022 Thailand Floods
2021-01 and 2021-12 Malaysia Floods

2019-09, 2023-08 Vietnam Floods

2023-03 Indonesia Landslides

2018-09 Indonesia Palu Earthquake
2021-01 Indonesia Mamuju Earthquake

2022-09 Papua New Guinea Earthquake
2020-04 and 2023-03 Vanuatu Cyclones

2020-01 Indonesia Jakarta Floods
2022-11 Indonesia Cianjur Earthquake
2022-12 Indonesia Floods

2021-04 Indonesia Cyclone Seroja
2022-11 and 2023-01 Indonesia Floods

2022-05 Indonesia Semarang Tidal Floods

2023-08 Hawaii Maui Wildfires
2022-11 Mauna Loa Volcano Eruption

2022-01 Tonga Volcano Eruption

2019-09 Bahamas Hurricane Dorian
2020-08 Bahamas Storm Isaias
2021-08 Haiti Earthquake

2021-04 St. Vincent La Soufriere Volcano

2021-12 and 2022-12 Indonesia Semeru Volcano

2022-06 Sydney Floods

- Earthquakes & landslides
- Weather events
- Volcanic eruptions
- Anthropogenic events

2022-06 South Africa Floods

Responded to a total of 79 events in 2018-2023
(61 events in Asia Pacific)
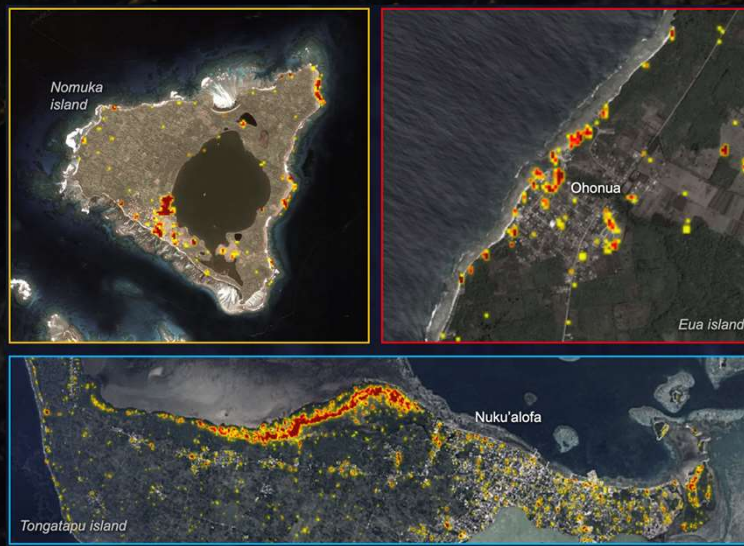
Original Data: ALOS-2 (JAXA), Copernicus Sentinel-1 (ESA)

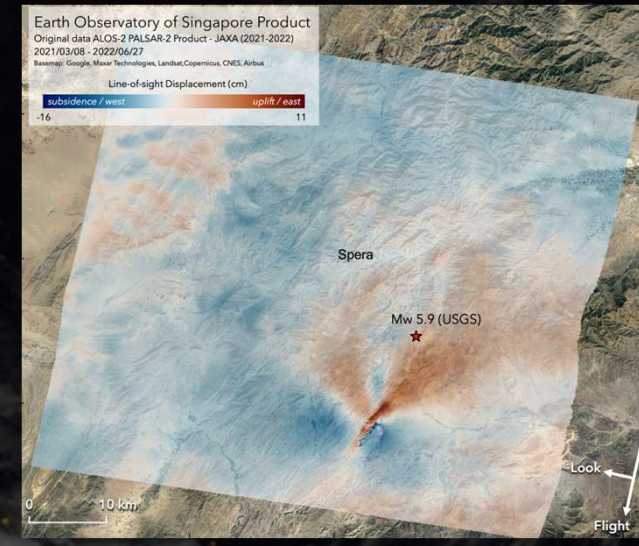# 3 Main Products

Flood Proxy Maps

Damage Proxy Maps

Surface displacement maps

Flood extent

Building damage

Deformation

Using cloud-based and High Performance Computing systems for rapid response

Feb 2023
M7.8 Türkiye-Syria Earthquake Response Support

To date, this event has caused an estimated of
more than **150,000** of *damaged or collapsed buildings*
and close to *60,000 recorded fatalities*.

M 7.5
2023-02-06
10:24:48 UTC

M7.8
2023-02-06
01:17:34 UTC

Collapsed buildings in Hatay, Türkiye.
https://www.bloomberg.com/news/photo-essays/2023-02-06/in-pictures-major-earthquake-collapses-buildings-in-turkey-syria?leadSource=uverify%20wall

Collapsed buildings in Kahramanmaras, Türkiye.
https://www.livemint.com/science/news/how-the-turkey-syria-earthquake-occurred-behind-the-science-of-the-catastrophe-1167575042838.html

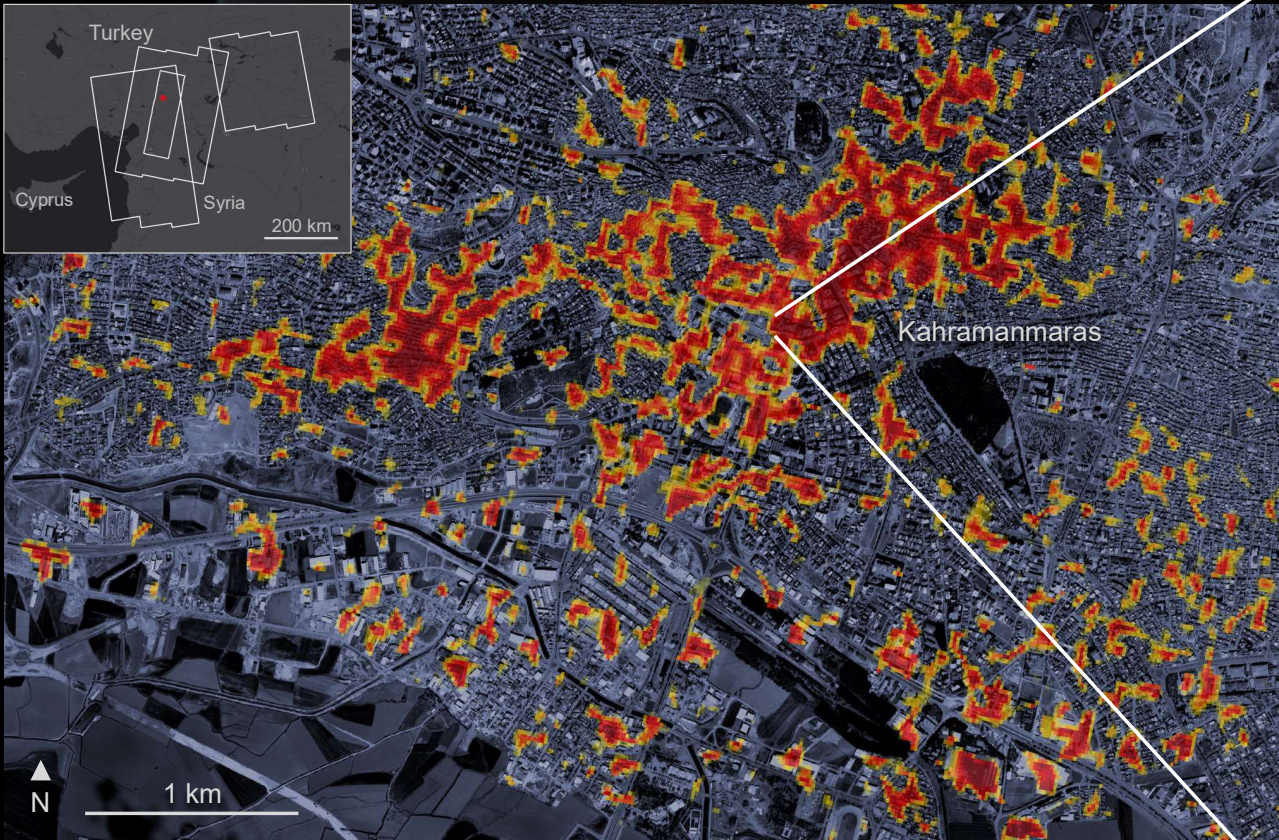# M7.8 Türkiye-Syria Earthquake Response Support

Timeline

- 6 Feb 2023 (M7.8 and M7.5 Earthquakes)
  EOS-RS reached out to JAXA (Japanese Space Agency).

- 8 Feb 2023
  JAXA acquired the first satellite radar data.

- 8 Feb 2023
  EOS-RS produced and disseminated the first Damage Proxy Map (DPM).

- 9 Feb 2023
  ESA (European Space Agency) acquired their first satellite radar data.

- 16 Feb 2023
  EOS-RS generated 8 DPMs using European and Japanese satellite radar data, covering the entire region (every 30 m x 30 m) impacted by the earthquake and the following aftershocks.
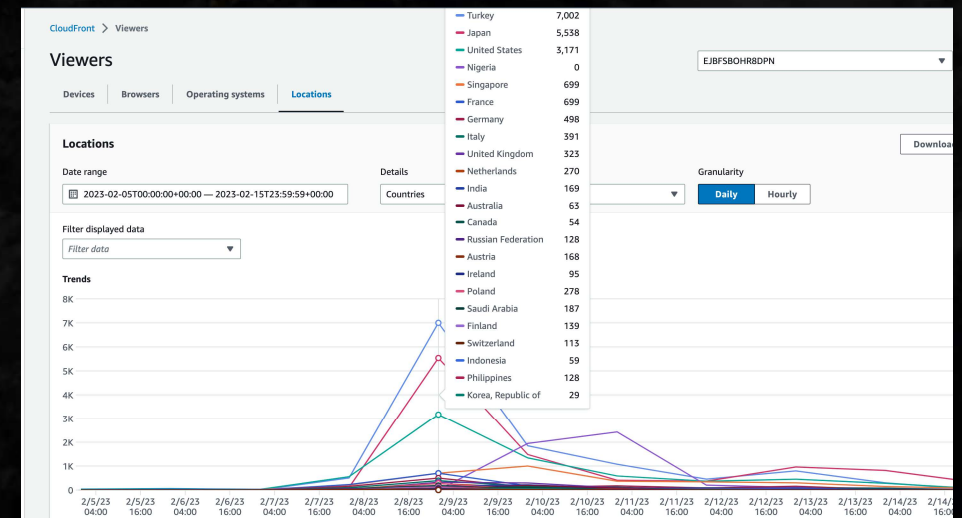
Feb 2023
M7.8 Türkiye-Syria Earthquake Response Support

Turkey
Cyprus
Syria
200 km

Kahramanmaras

N
1 km

Before

After
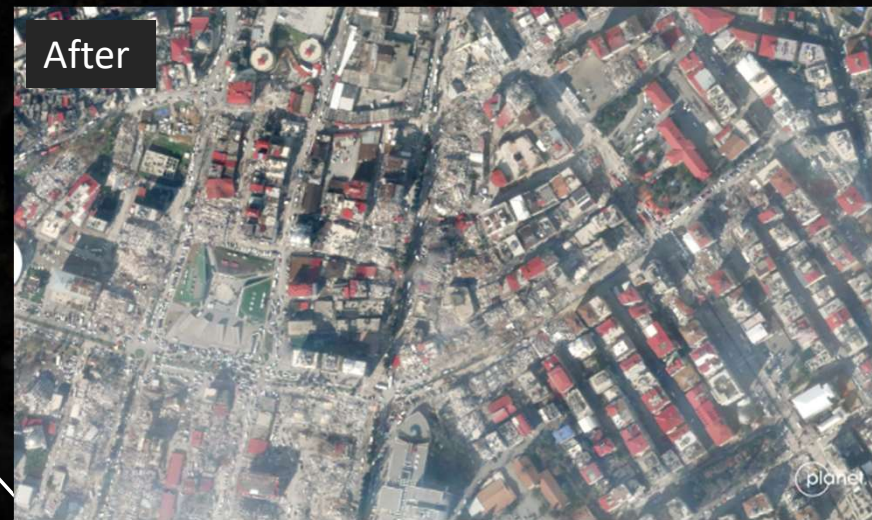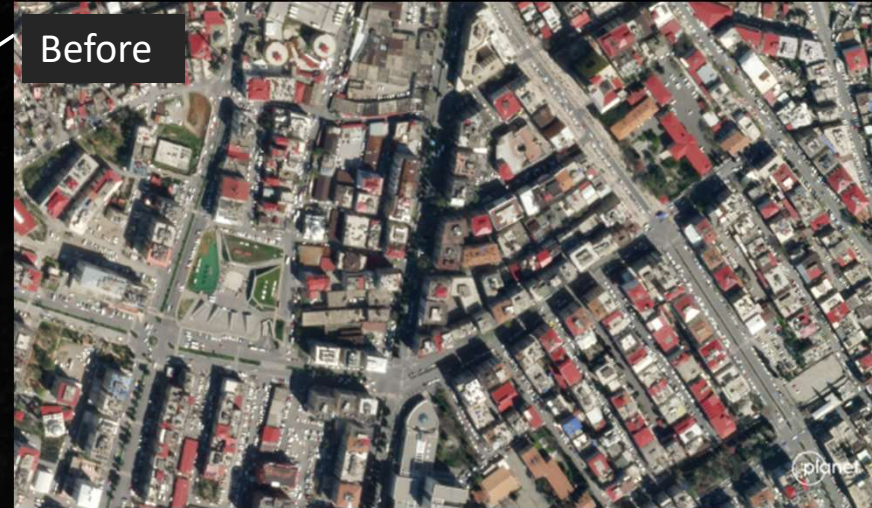
204,000 km² (280 times SG) covered within 10 days

Planet optical imagery.
https://www.abc.net.au/news/2023-02-08/before-and-after-satellite-images-turkiye-syria-earthquake/101944474
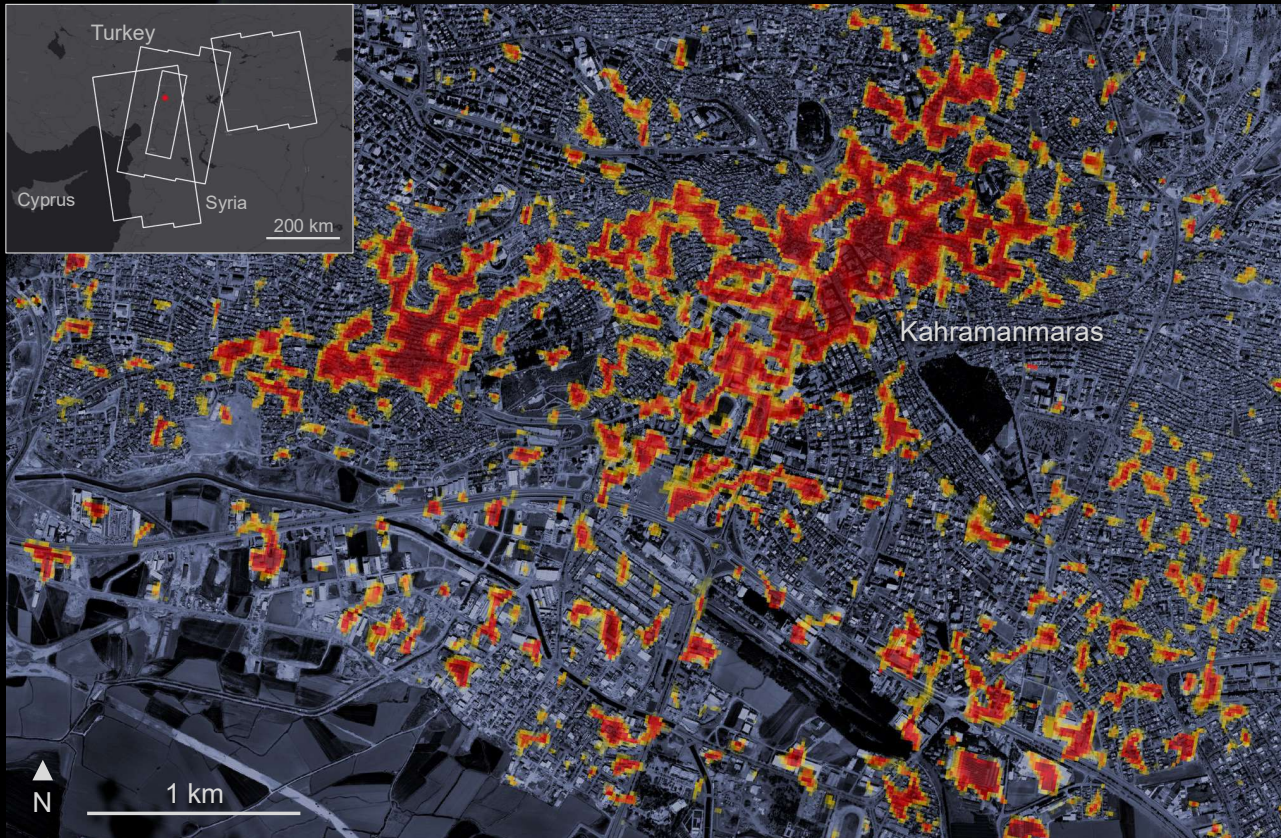
The First Damage Proxy Map
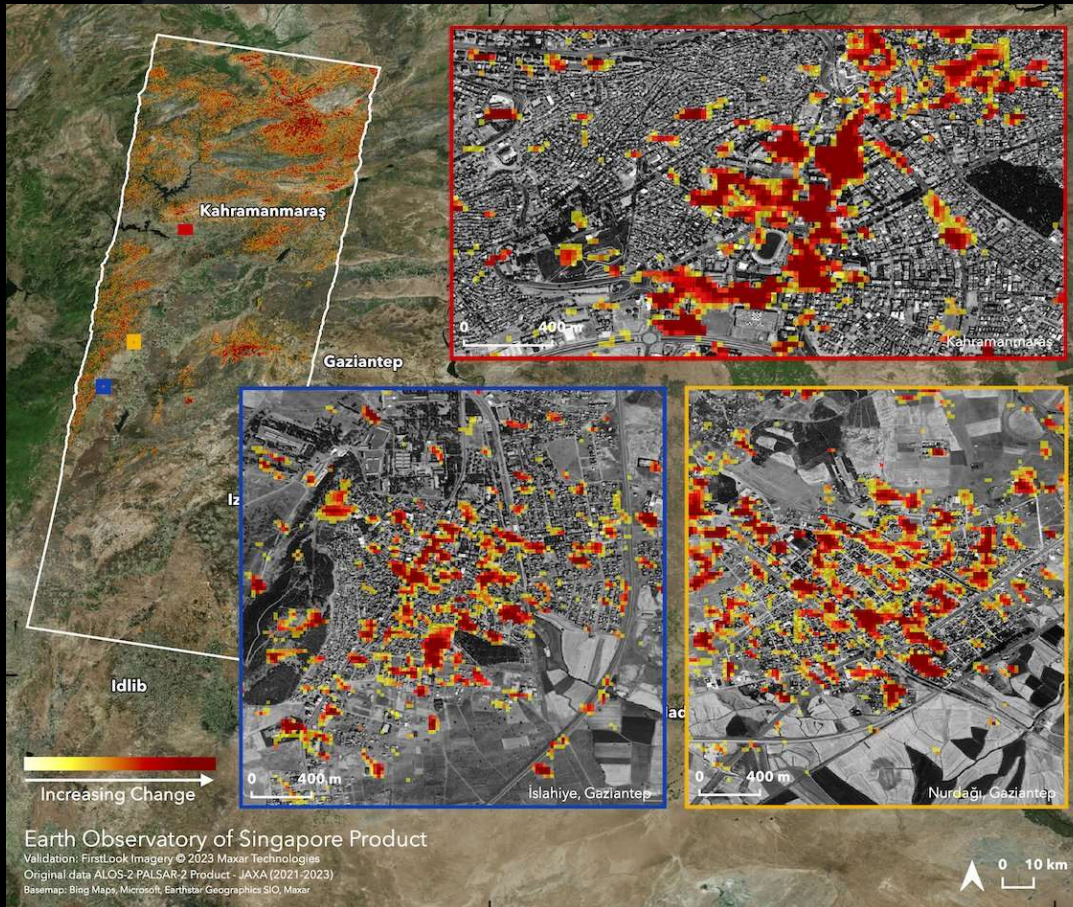
- Disseminated to the United Nations World Food Programme and other response agencies via Sentinel Asia.
- Tweet viewed by 180,000 within 24 hrs.
- Map accessed 7,000+ times from Türkiye, 5,000+ times from Japan, 3,000+ times from United States within 24 hrs of release.

Feb 2023
M7.8 Türkiye-Syria Earthquake Response Support

"We have dispatched 10 teams to the field for ground observations after downloading your maps on their mobile devices."

-- Emergency Management Center in Ankara, Türkiye

"Your maps produced an estimate of the number of affected people that is the closest to the ground observation-based Turkish government's number, compared to any other remote sensing-based products."

-- Geospatial Support Unit at the UN World Food Programme

M7.8 Türkiye-Syria Earthquake Response Support

THE STRAITS TIMES — SINGAPORE

NTU scientists create proxy maps of damage from Turkey-Syria quake to guide rescue work

The damage proxy maps can be used to guide local governments and first responders in identifying the areas most in need of rescue and aid. PHOTO: NTU'S EARTH OBSERVATORY OF SINGAPORE

MONEYFM 89.3
Associate Professor Yun Sang-Ho, NTU Singapore

BREAKFAST WITH LYNLEE & RYAN
FRIDAY | 03 MAR | 7:15AM
ASSOCIATE PROFESSOR YUN SANG-HO
Director, Earth Observatory of Singapore & Remote Sensing Lab, NTU Singapore

The team from NTU's EOS-Remote Sensing Lab. (Back row, from left) PhD student Bryan Marfito, research assistant Jay Wong, student assistant Ricky Winarko, research fellows Eleanor Ainscoe, Rino Salman and Noel Ivan Ulloa (inset). (Front row, from left) PhD student Cheryl Tay, EOS-RS director Yun Sang-Ho, research associate Shi Tong Chin and research assistant Lin Way. PHOTO: NTU'S EARTH OBSERVATORY OF SINGAPORE

NASA earth observatory

Earthquake Damage in Türkiye

February 8, 2023

July 2023
Typhoon Doksuri
Philippines

The casualties are reported as 26 deceased individuals, 52 injured persons and 13 missing in the Philippines

Imagery from any Himawari satellite, credit the Cooperative Institute for Research in the Atmosphere at Colorado State, the Japan Meteorological Agency, and the Japan Aerospace Exploration Agency **(CSU/CIRA & JMA/JAXA)**
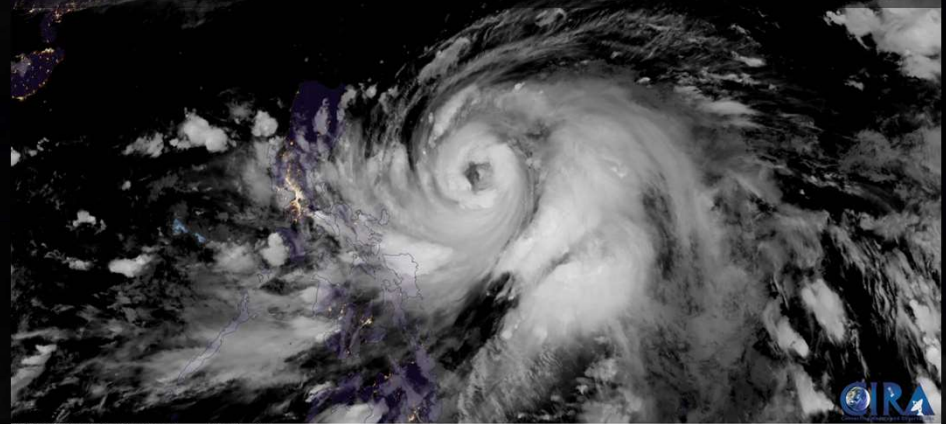
07-23-2023 | 13:10:00 UTC | Himawari-9 | GeoColor

Chico River in Bontoc, Mountain Province
(Photo by Handout / Mountain Province Disaster Risk Reduction Management Office / AFP)

Capsized Ferry in Binangonan, Rizal province, Philippines
Sharma, S. (2023, July 28). *At least 26 dead after overloaded ferry capsizes in Philippines amid strong winds.* The Independent. https://www.independent.co.uk/asia/southeast-asia/philippines-ferry-capsize-doksuri-china-b2383512.html

Typhoon Doksuri

- Third typhoon of the 2023 Pacific typhoon season

- Doksuri meaning "Eagle" in Korean, known as "Super Typhoon Egay (eh-guy)" in the Philippines

- Highest winds of 185 km/h reached

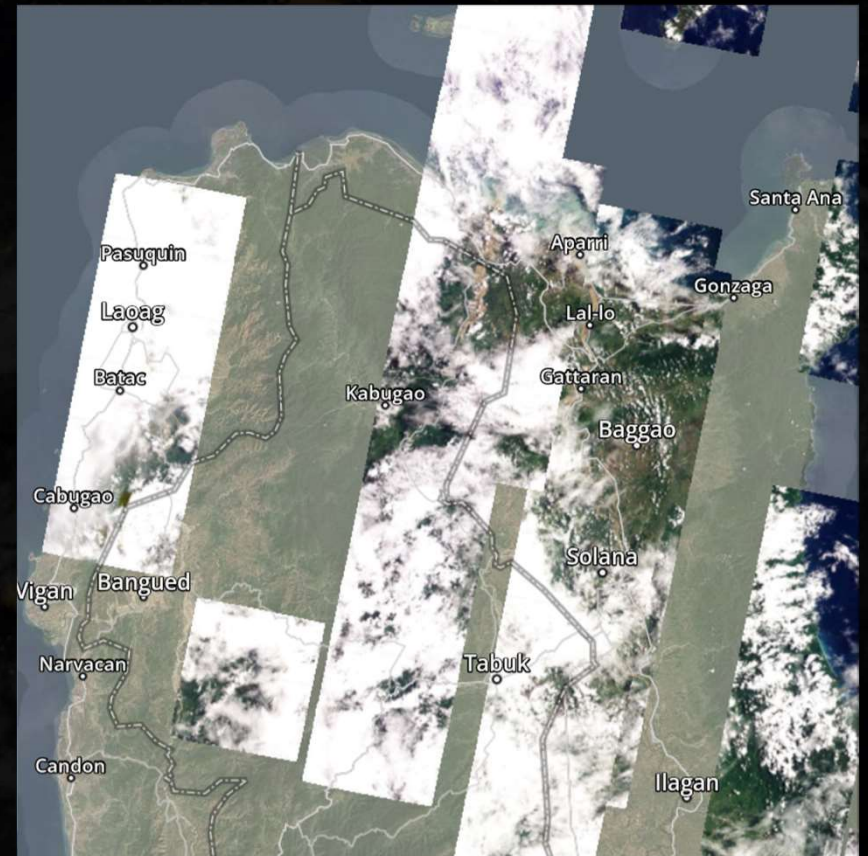07-23-2023 | 13:10:00 UTC | Himawari-9 | GeoColor
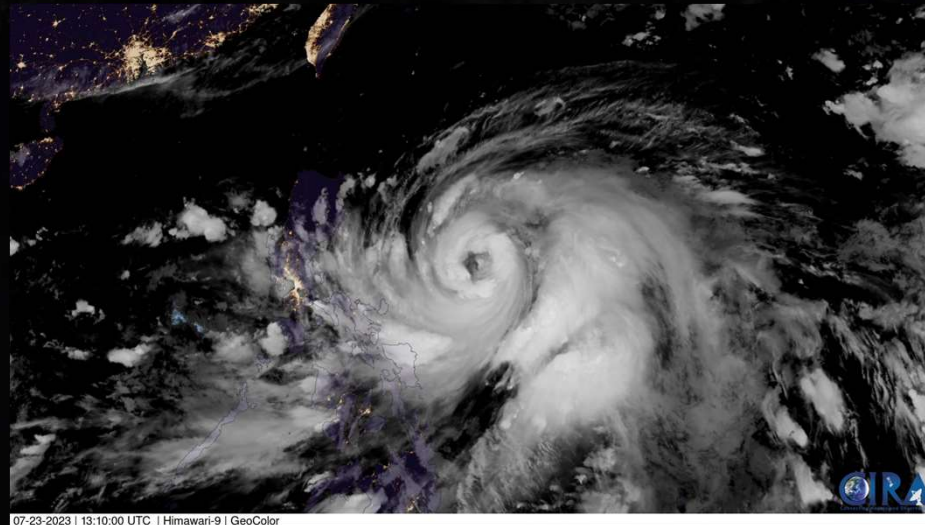
Response Support

Timeline

- 25 July 2023
  Typhoon Doksuri made landfall in the Philippines

- 28 July 2023
  Request for Data Analysis Node from Asian Disaster Reduction Center, through Sentinel Asia

- 2 Aug 2023
  EOS-RS produced and disseminated the first Flood Proxy Map (FPM).

The First Flood Proxy Map

Challenges

- Validation Data

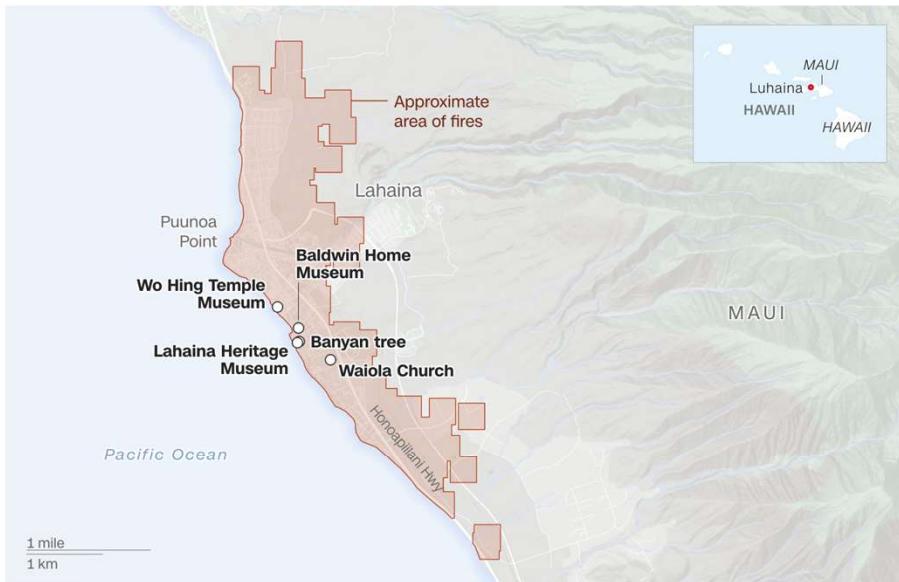- Clouds

- Ground Truth

August 2023
Maui, Hawaii Wildfires

LIEUTENANT GOVERNOR SYLVIA LUKE VIA FACEBOOK/VIA REUTERS

This video has no sound
Credit: Javier Cantellops
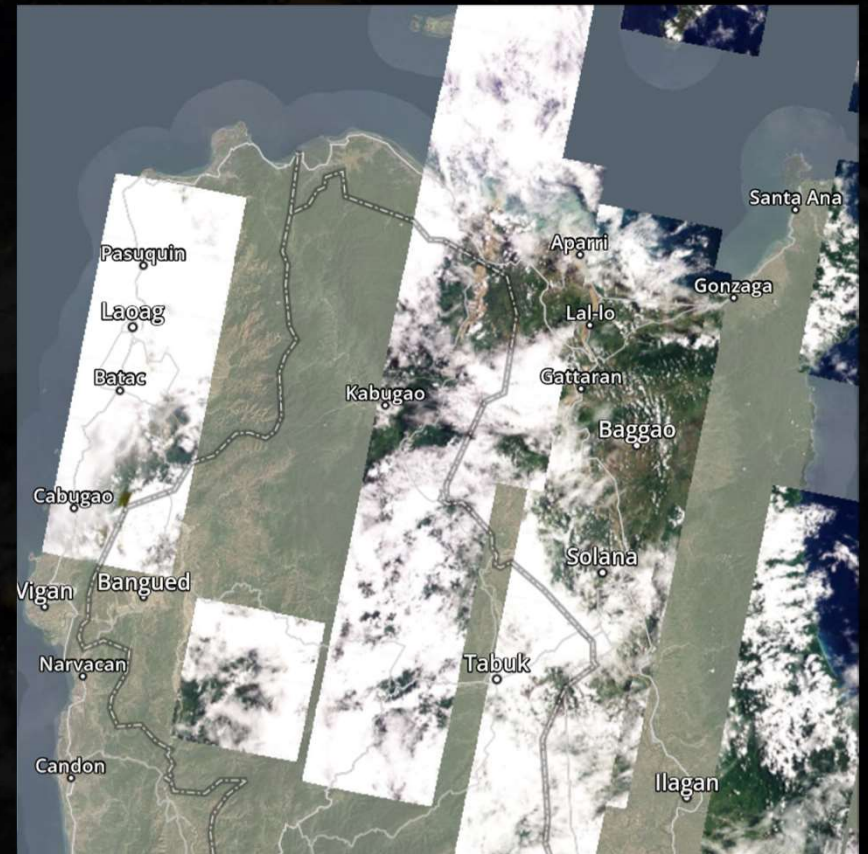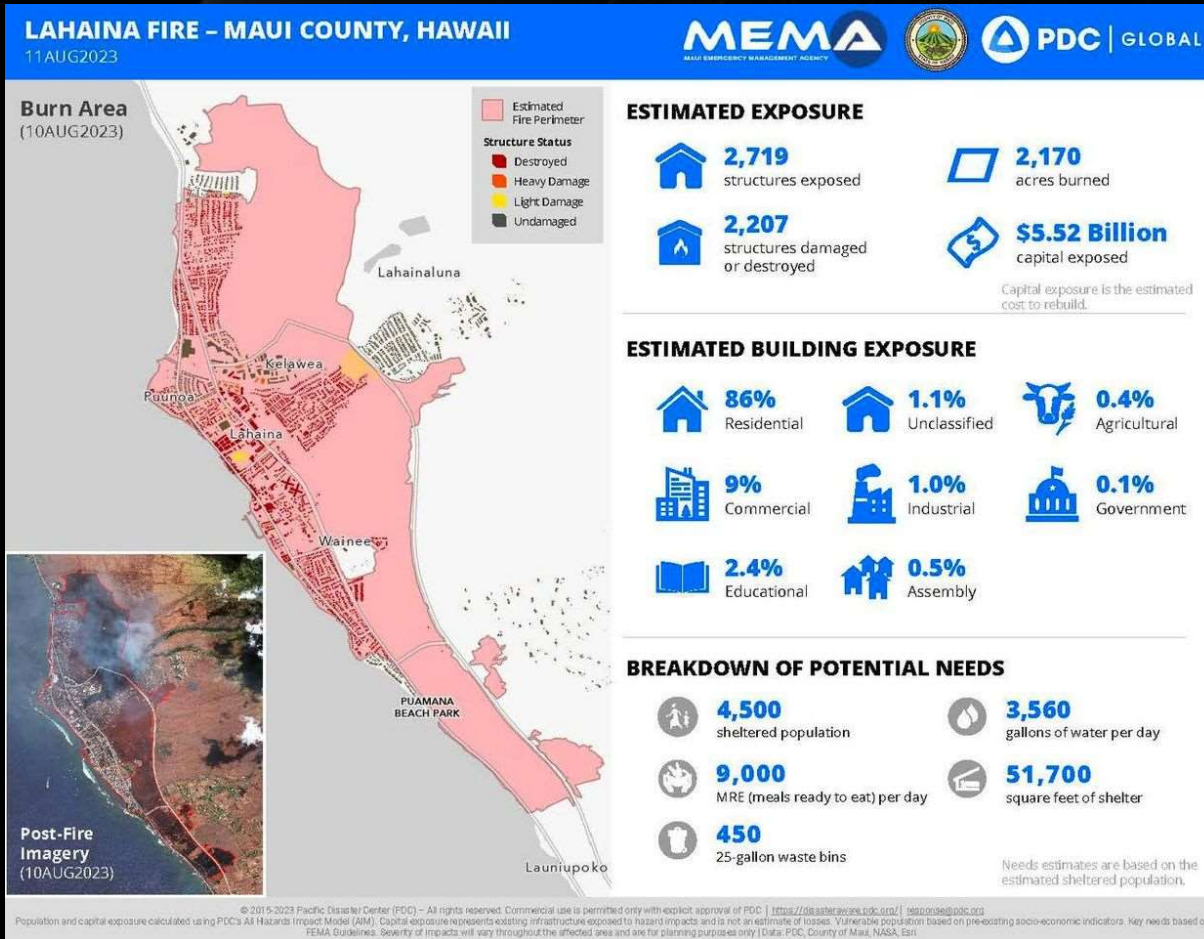
August 2023
Maui, Hawaii Wildfires

CNN travel | Destinations Food & Drink News Stay Video

Hawaiians fear for historic landmarks amid Maui fires

Note: VIIRS sensors detect thermal anomalies in 375 sq. meter areas, which was used to approximate the total fire perimeter. Data collected at 3:00 p.m. ET Aug. 10, 2023.

The Washington Post
Democracy Dies in Darkness

When did the fires start in Maui?

The fires began just after midnight Tuesday, Maui County Fire Chief Brad Ventura said at a Thursday news conference, and were "compounded by extreme winds that we're all aware of," he said. The first fire around upper Makawao burned about 675 acres, he said.

[*Maui fires not just due to climate change but a 'compound disaster'*]

By 11 a.m., the Lahaina fire had begun ravaging the historical town, fueled by wind gusts up to 60 mph. The deadly blaze would go on to essentially burn Lahaina to the ground, multiple officials have said.

Around noon Tuesday, another fire started in Kula, spurring evacuations of nearby residential areas. Then, about 6 p.m., a fourth fire began on Pulehu Road in the central valley "that burned several hundred acres."
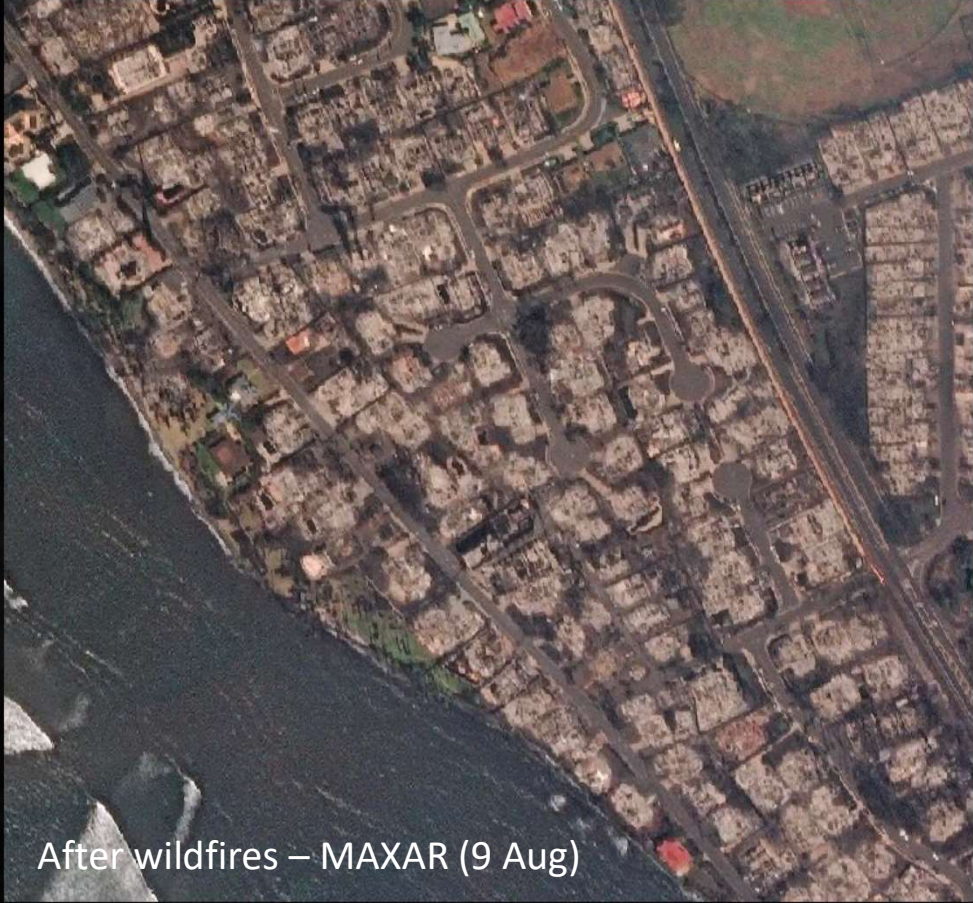
August 2023
Maui, Hawaii Wildfires

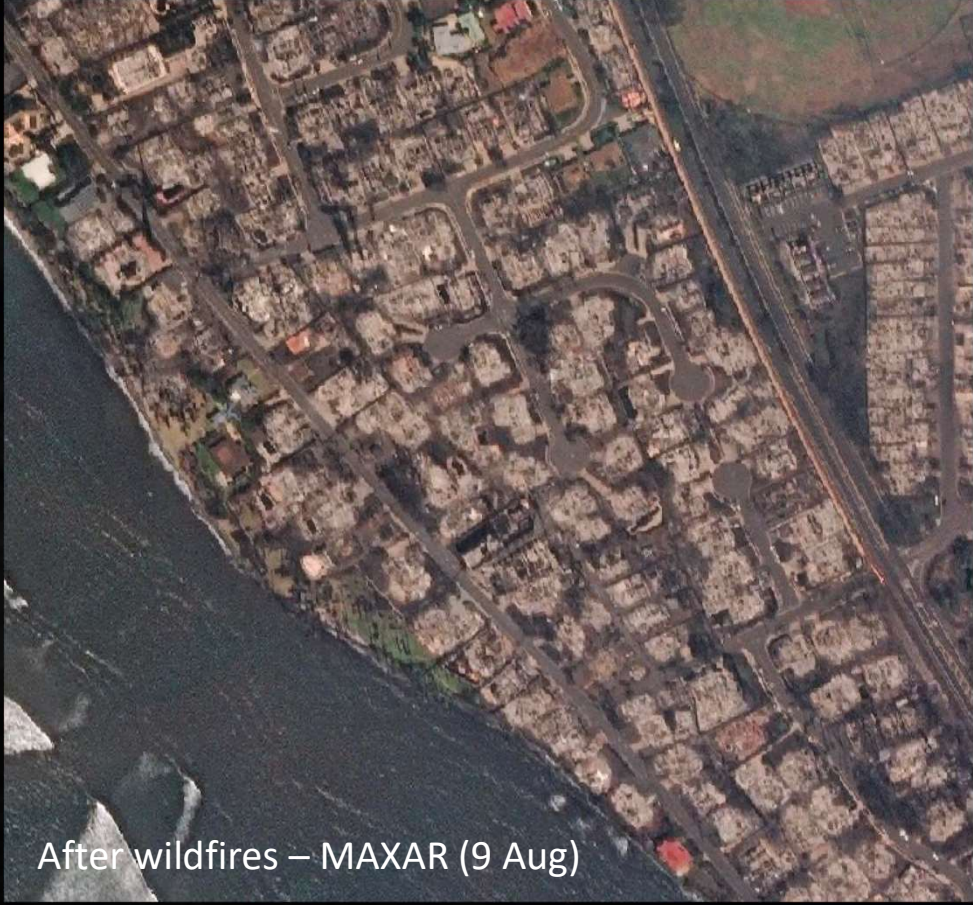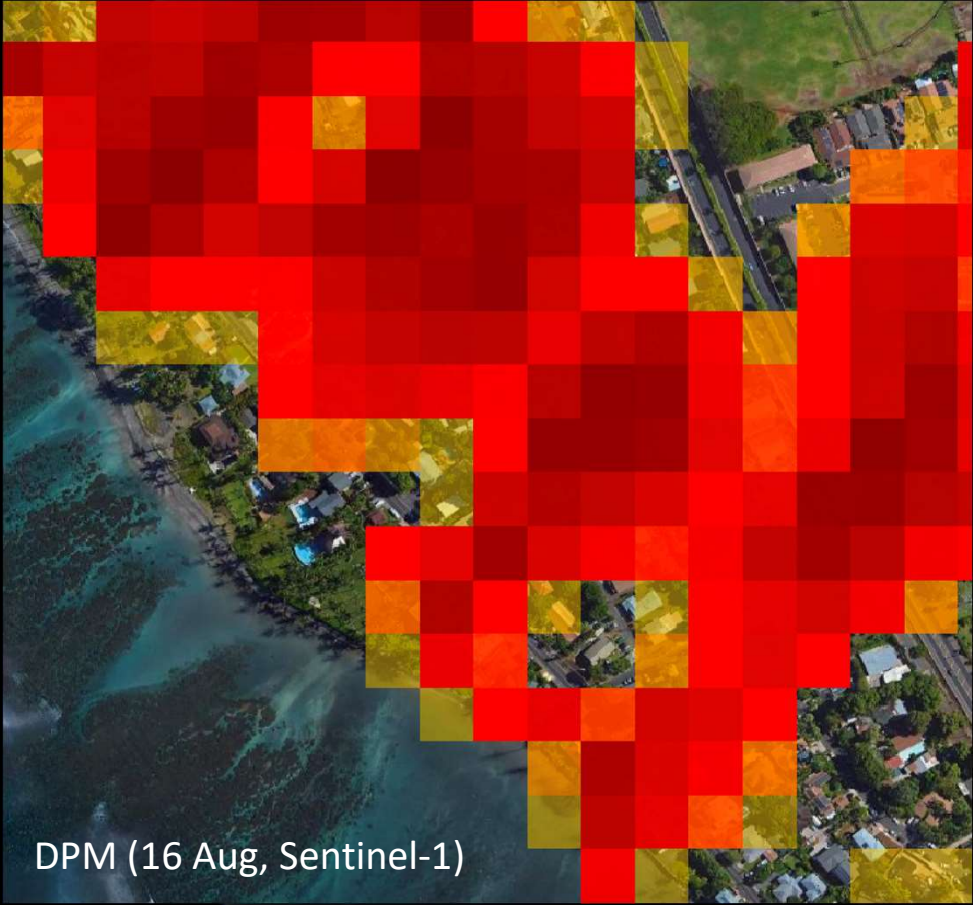Lahaina, Maui County

Before wildfires – Google Earth

After wildfires – MAXAR (9 Aug)

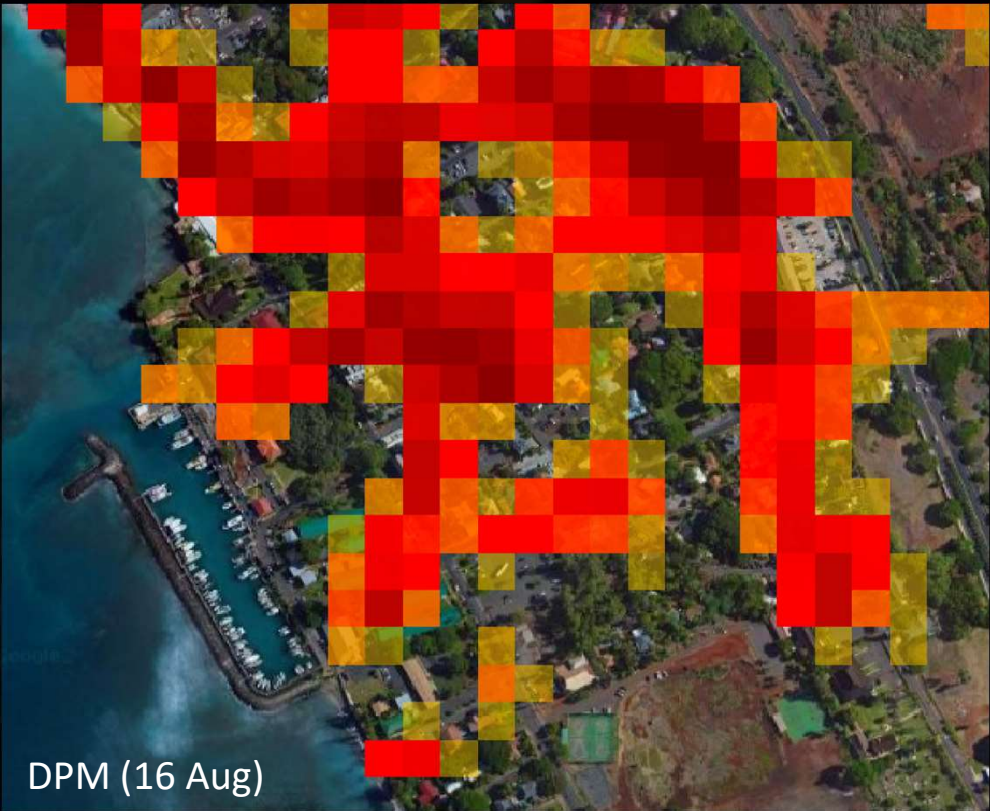August 2023
Maui, Hawaii Wildfires

Lahaina, Maui County

DPM (16 Aug, Sentinel-1)

After wildfires – MAXAR (9 Aug)
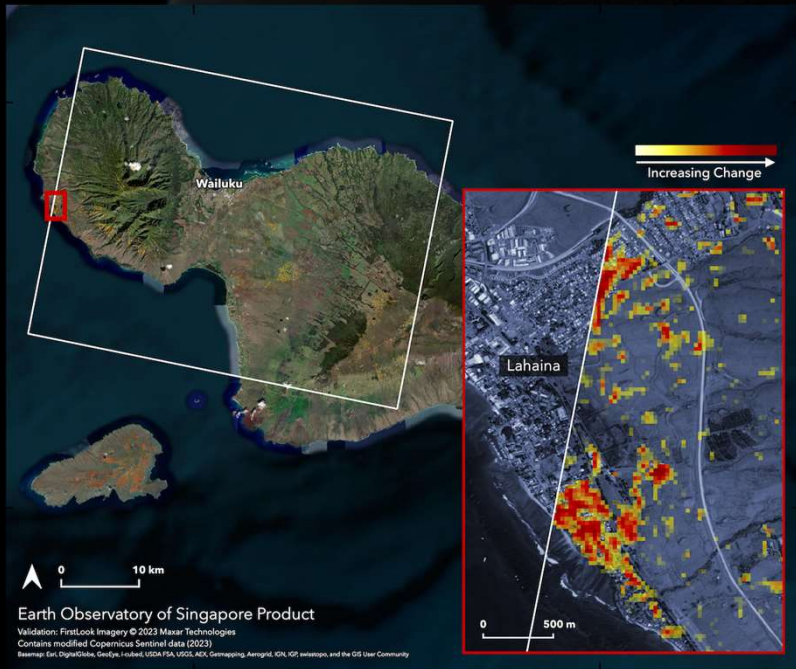
August 2023
Maui, Hawaii Wildfires
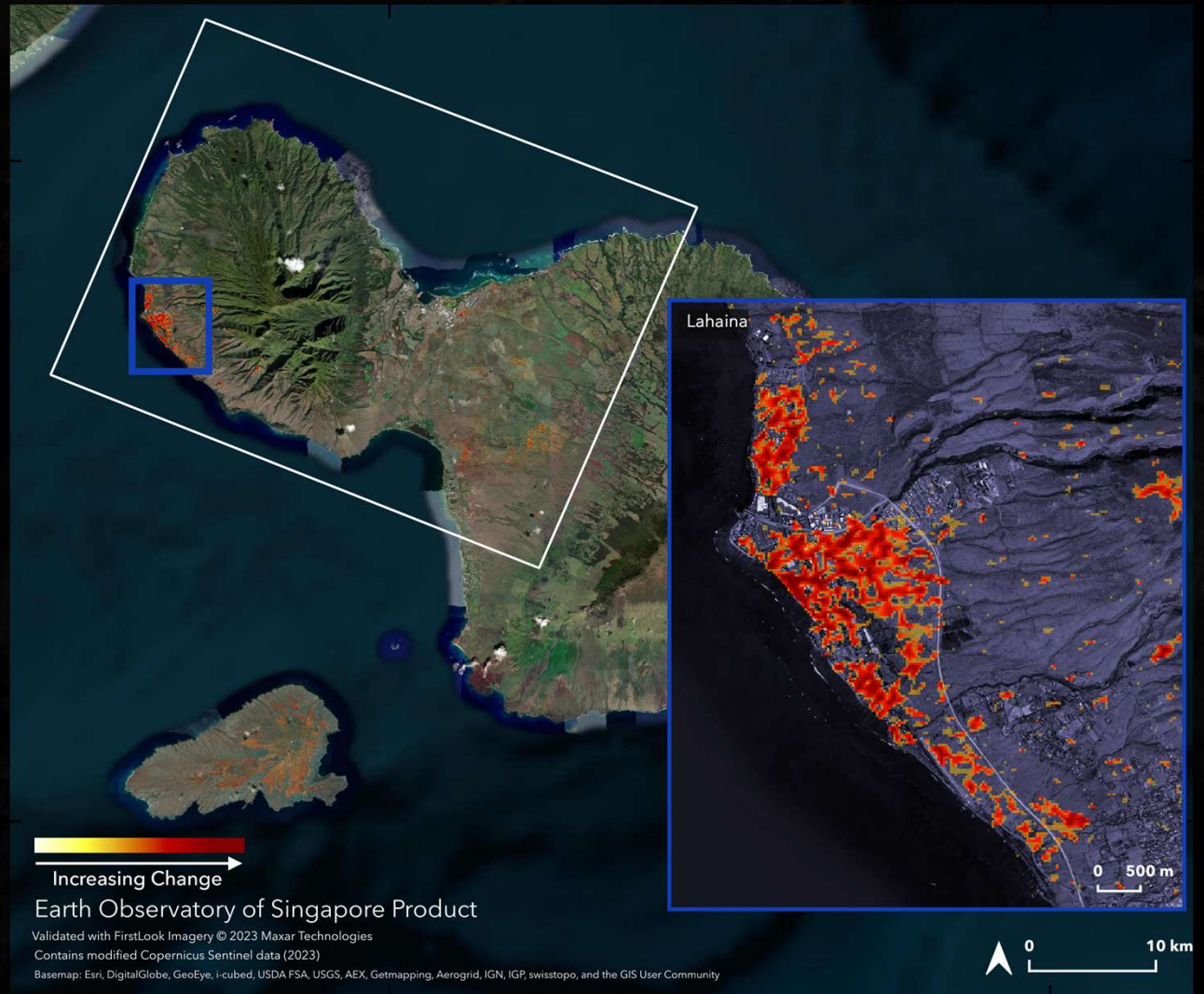

Before

Lahaina Harbor

After

DPM (16 Aug)

August 2023
Maui, Hawaii Wildfires

Post-event: 13 August, Sentinel-1

Post-event: 16 August , Sentinel-1

Choice of Colors for Color Vision Deficiency (CVD)
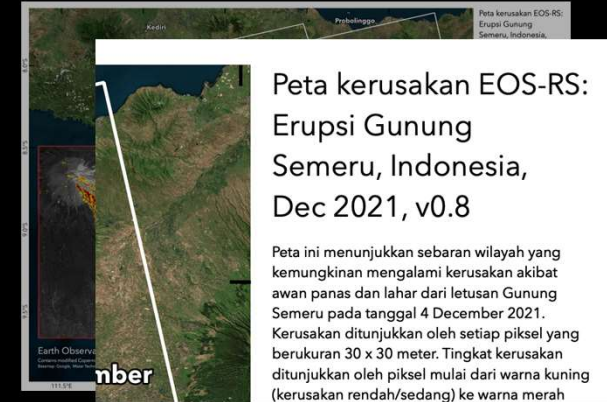
2021 Semeru Volcano Eruption

Data: ALOS-2

Original color

CVD friendly color

CVD Filter

Original color

CVD friendly color
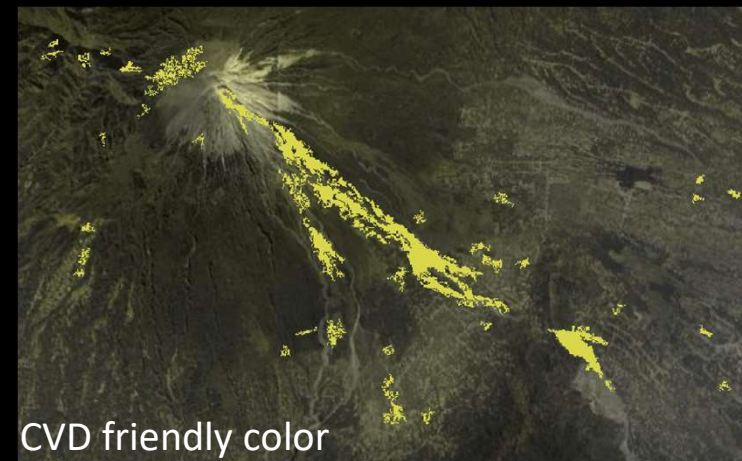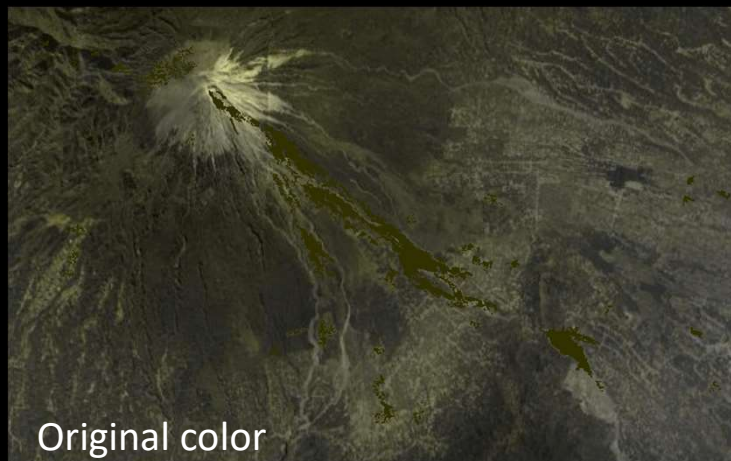
Local Language Versions

Semeru Volcano Eruption

East Java, Indonesia

EOS-RS Damage Proxy Map: Indonesia, Semeru volcano, Dec 2021, v0.8

The Earth Observatory of Singapore - Remote Sensing Lab (EOS-RS) created this Damage Proxy Map (DPM) depicting areas that are likely damaged by pyroclastic flows and lahars in Eastern Java, Indonesia due to the eruption of Semeru volcano starting on

English

Peta kerusakan EOS-RS: Erupsi Gunung Semeru, Indonesia, Dec 2021, v0.8

Peta ini menunjukkan sebaran wilayah yang kemungkinan mengalami kerusakan akibat awan panas dan lahar dari letusan Gunung Semeru pada tanggal 4 December 2021. Kerusakan ditunjukkan oleh setiap piksel yang berukuran 30 x 30 meter. Tingkat kerusakan ditunjukkan oleh piksel mulai dari warna kuning (kerusakan rendah/sedang) ke warna merah

Bahasa

Tropical Cyclone Agaton

Leyte, Philippines
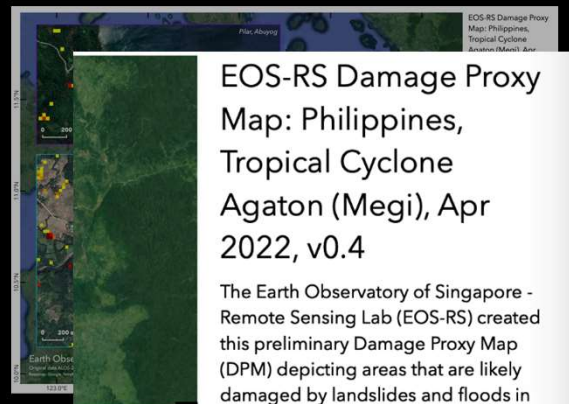
EOS-RS Damage Proxy Map: Philippines, Tropical Cyclone Agaton (Megi), Apr 2022, v0.4
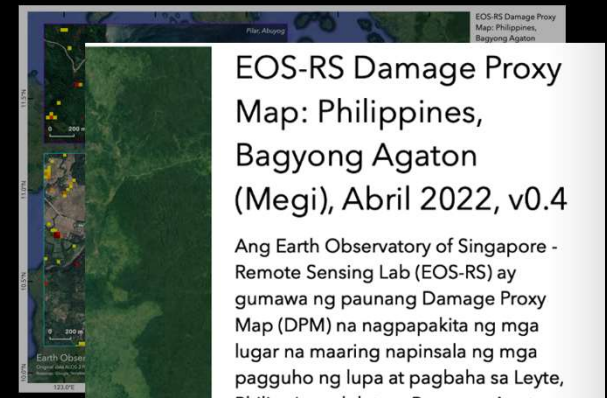
The Earth Observatory of Singapore - Remote Sensing Lab (EOS-RS) created this preliminary Damage Proxy Map (DPM) depicting areas that are likely damaged by landslides and floods in

English

EOS-RS Damage Proxy Map: Philippines, Bagyong Agaton (Megi), Abril 2022, v0.4

Ang Earth Observatory of Singapore - Remote Sensing Lab (EOS-RS) ay gumawa ng paunang Damage Proxy Map (DPM) na nagpapakita ng mga lugar na maaring napinsala ng mga pagguho ng lupa at pagbaha sa Leyte,

Tagalog

Our Compute Infrastructure

Use of Cloud-based and High Performance Computing systems for rapid response

https://registry.opendata.aws/sentinel1-slc-seasia-pds/
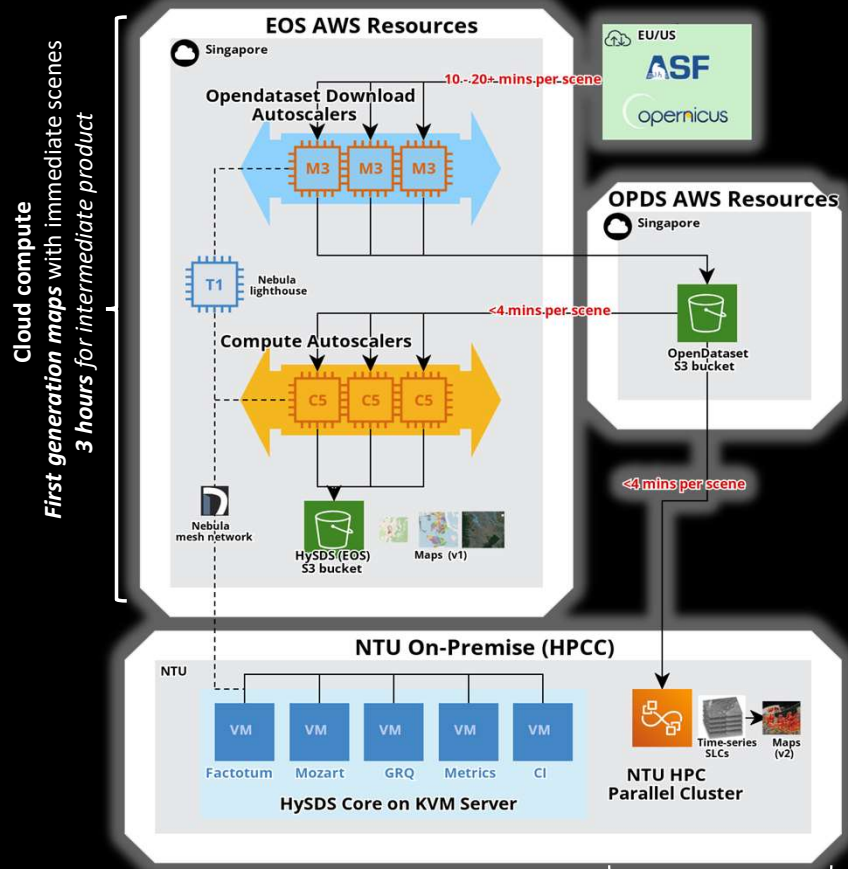
EOS-RS initiative in AWS Open Data program to host Sentinel-1 data in Asia-Pacific endpoint
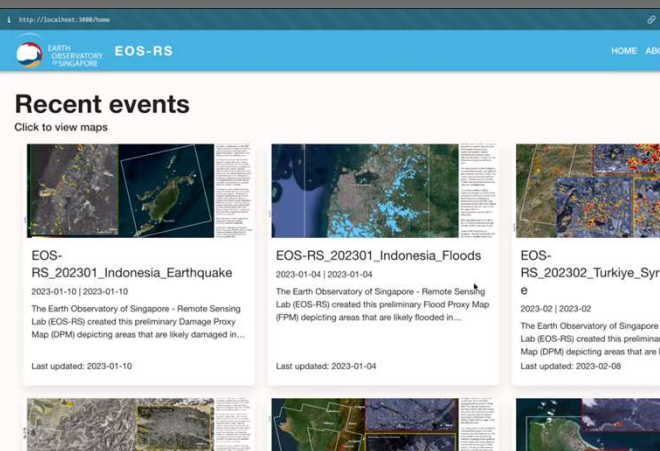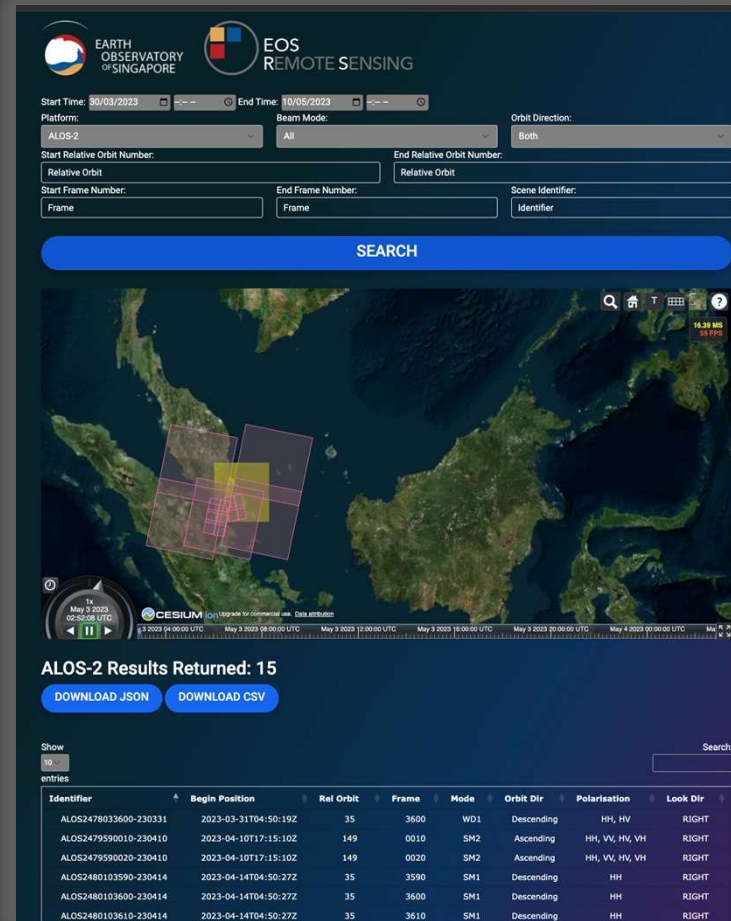Improve download speeds by **8 to10 times**.

Our Compute Infrastructure

Current live products page, a static site hosted by S3 and Cloudfront.

eos-rs-products.earthobservatory.sg

Interactive products page, planned serverless site to be rolled out.

SAR finder: Application to quickly search for SAR data.

EOS-RS Members

Rino Salman
Research Fellow
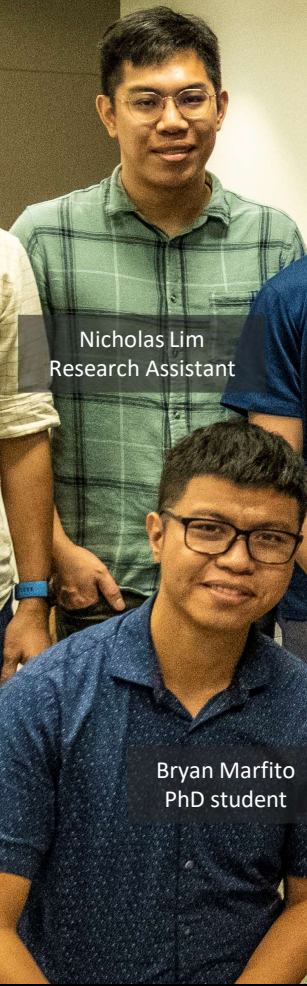
Nicholas Lim
Research Assistant
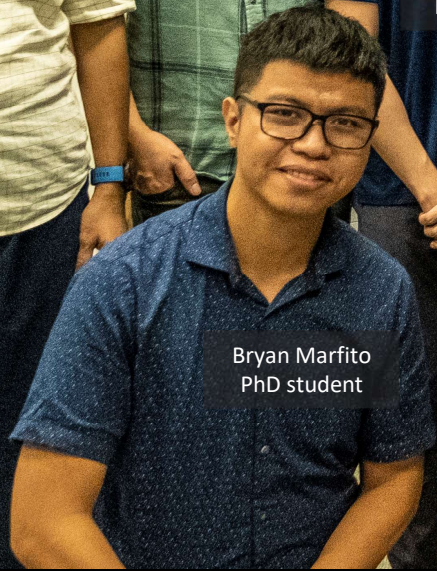
Denny Chee
ASE Student
Researcher

**Sang-Ho Yun
EOS-RS Director**

Noel Ulloa
Research Fellow
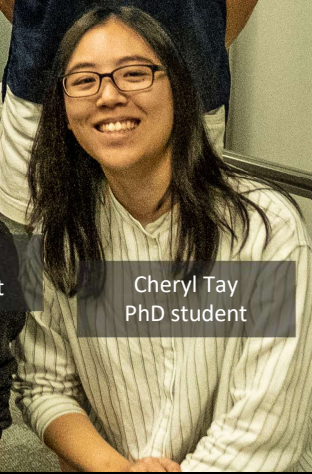
Eleanor Ainscoe
Research Fellow

Ricky Winarko
Student Assistant

Bryan Marfito
PhD student

Shi Tong Chin
Research Associate

Lin Way
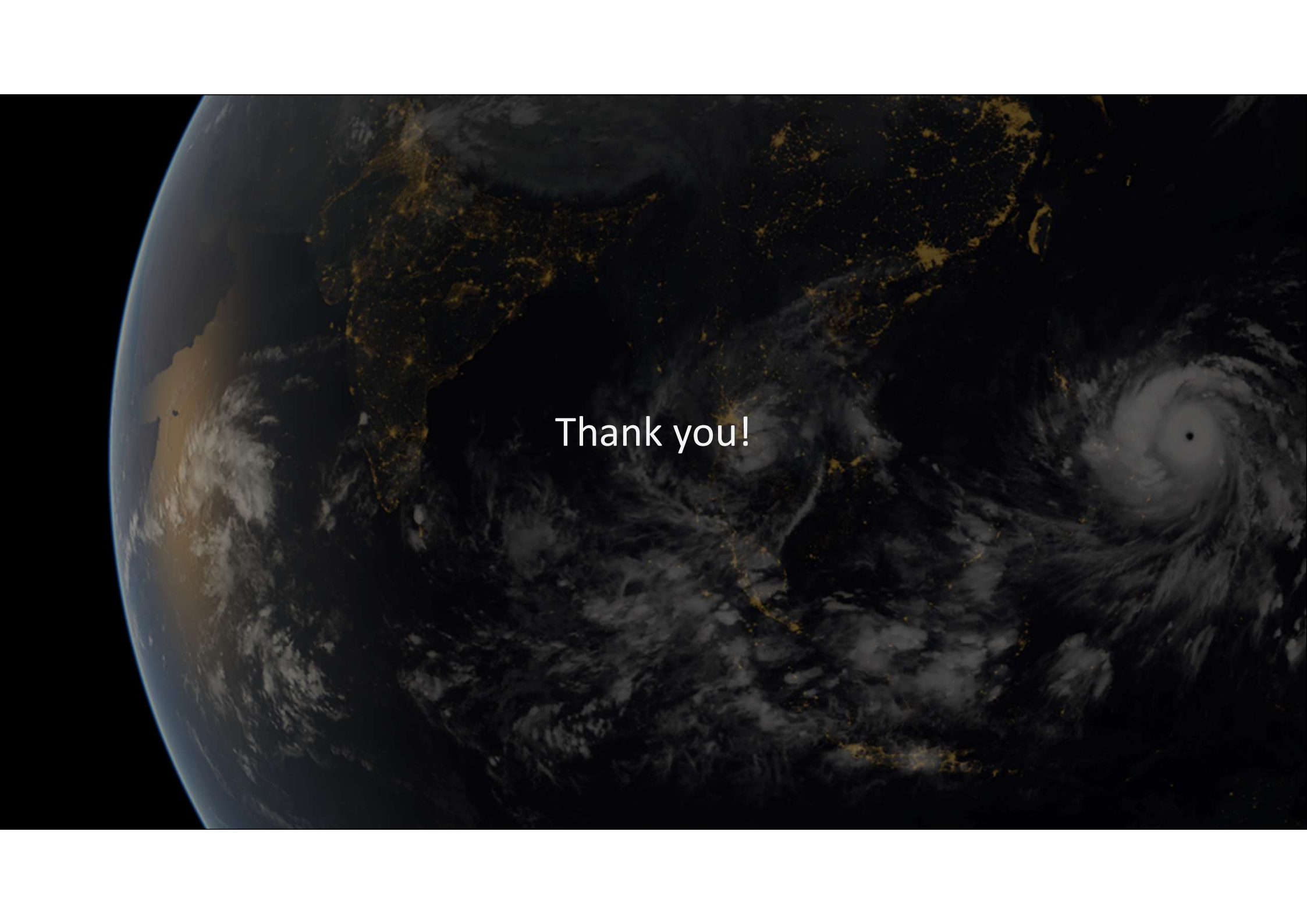Research Assistant

Cheryl Tay
PhD student

Jay Wong
Project Officer
(Science Communications)

Thank you!