



INTERNATIONAL CHARTER SPACE & MAJOR DISASTERS

SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

CEOS WGD 26 Workshop Innovation in the International Charter 'Space and Major Disasters'

Bonn, Germany
23 April 2024

Prepared by: ESA, ACRI-ST, PLES, Terradue



The International Charter

INTERNATIONAL CHARTER SPACE & MAJOR DISASTERS SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

An international agreement by Satellite Operators to provide priority access to satellite data in the event of Major Disasters.

- Disaster response
- Priority & fast access
- Satellite Tasking and Archive data
- Data processing possibilities



*Founded by Space Agencies in 1999 following UNISPACE III.
Declared operational November 1, 2000.*

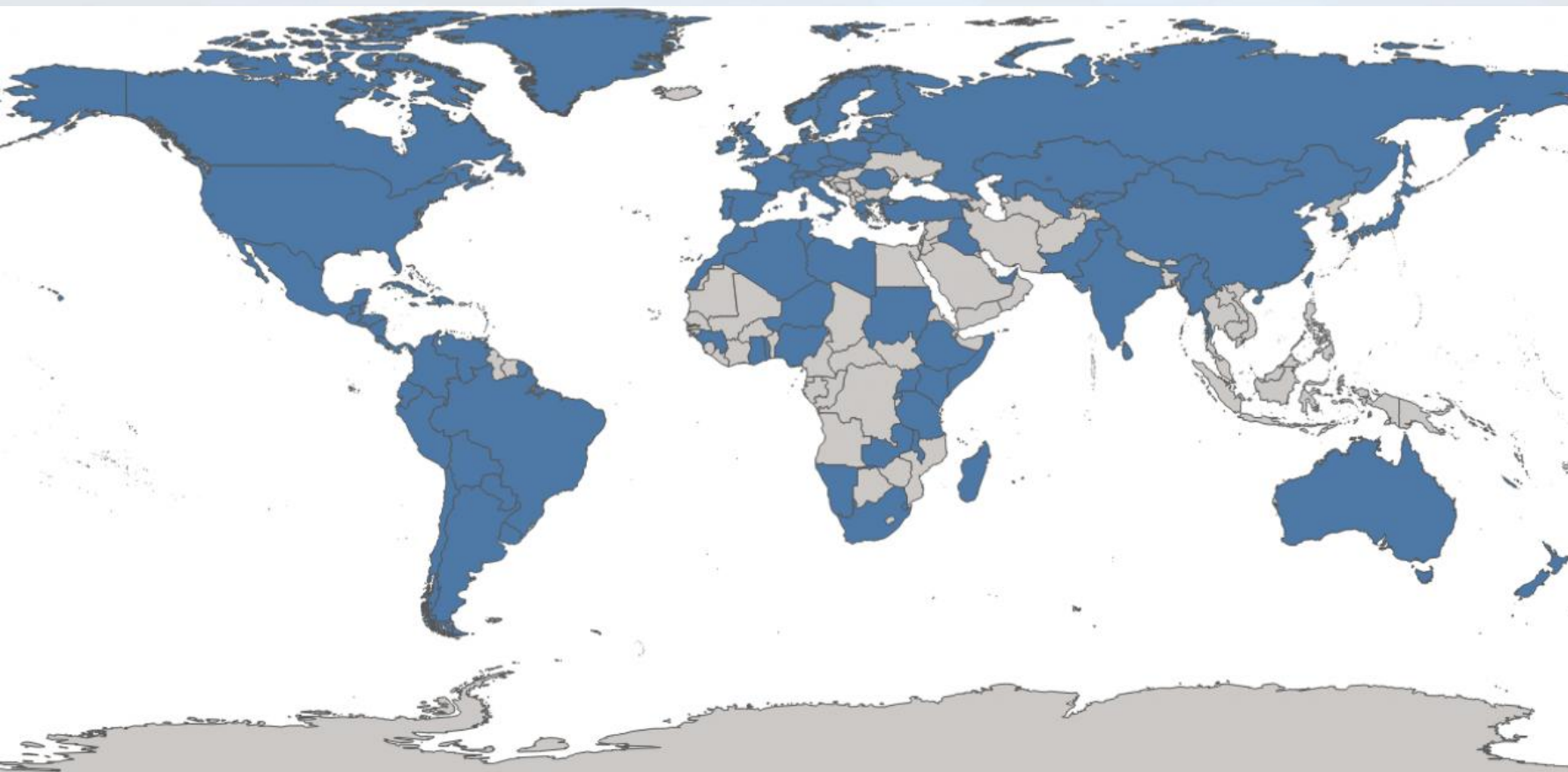
Member agencies of the Charter



Universal Access Initiative: Authorized User Map

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Map showing all countries (in blue) with direct access to the Charter as of September 2026



- A mandated disaster risk management entity from any country can apply to be an Authorized User
- There are currently 114 Authorized Users in 99 different countries, with 58 AUs coming through the Universal Access initiative.
- In 2026, 3 new AUs have been integrated into the Charter: Libya, Kyrgyzstan, and Morocco
- Additionally, The UN and Sentinel Asia can also activate the Charter



Example of Charter Activation: Earthquake in Myanmar

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28 March 2025

AU/EU: UNOSAT on behalf of United Nations Office for the Coordination of Humanitarian Affairs (OCHA) and International Federation of Red Cross and Red Crescent Societies (IFRC)

ECO: DLR

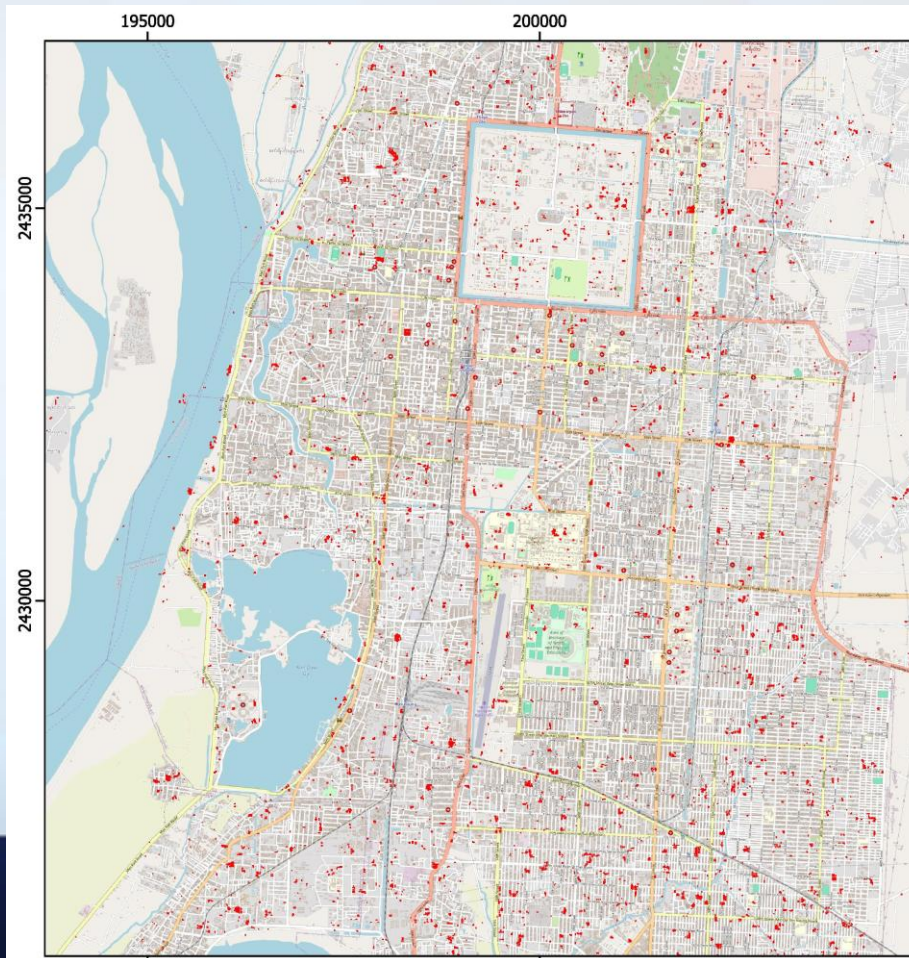
PM: UNITAR

VA: Copernicus EMS, SERTIT, LIST, INGV, AIT, UFRRI, EMERCOM, ISRO

Event Description: A 7.7-magnitude earthquake struck central Myanmar, with the epicentre located approximately 10 miles northwest of Sagaing. The quake caused extensive structural damage, leaving numerous buildings compromised

Data: Beijing-2, CAS500-1, CBERS4/4A, CartoSAT-2S/3, GF-1/2/3, EOS-04, FY3D, ICEYE, KOMPSAT-3/3A Kanopus-V, Landsat 8/9, Pleiades, JILIN-01A, RCM, Sentinel-1, TerraSAR-X, WorldView, Vision-1

VAP produced by INGV to generate a damage proxy map of Mandalay city using Sentinel-1 pre- and post-event images to calculate intensity correlation difference.



Earthquake in Myanmar

Damage Proxy Map of Mandalay City
Charter Call 1095



Description

Damage Proxy Map obtained by calculating the Intensity Correlation Difference between pre-seismic and post-seismic image pairs, acquired by ESA Sentinel-1 SAR mission. Red features refer to likely destroyed or severely damaged buildings.

Data Sources

Pre-event images:
Sentinel-1 2025-03-10 & Sentinel-1 2025-03-22
Post-event image:
Sentinel-1 2025-04-03

Framework

Best effort product generation based on semi-automatic procedures.
No validation has been performed.

Cartographic Information

Coordinate reference system:
WGS 84 / UTM zone 47N
Basemap: Open Street Map Standard

0 1 2 3 km





Regional Training and Outreach

INTERNATIONAL CHARTER SPACE & MAJOR DISASTERS SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

PM/VA training in Pretoria, South Africa September 15-18, 2025

- Organized by ESA, UN-SPIDER, ZLF, and SANSA
- 25 participants from South Africa and Eswatini



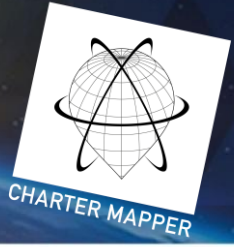
Space-Based Solutions for Disaster Management in Africa Training Nairobi, Kenya February 2026

- Three and a half day regional training
- Organized by ESA, UN-SPIDER, ZLF
- 59 participants from: Kenya, Mozambique, Uganda, Burundi, Rwanda, Somalia, Tanzania and Ethiopia.





The ESA Charter Mapper

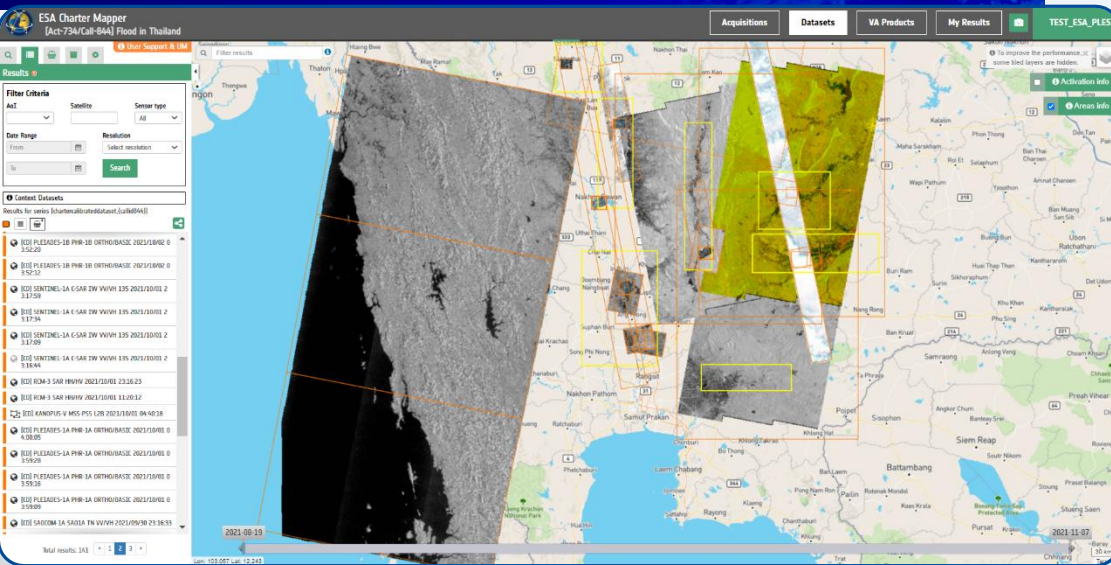


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ESA Charter Mapper

Welcome to the Charter Processing Environment implemented under the responsibility of the European Space Agency. It is built and integrated in COS-2 to support operations with on-line services to access and visualize EO data.



In operations since October 2021

To help the PM/VA work more efficiently, automated processing is executed in the background for all EO data delivered to an activation. The PM and VA are able to:

- Browse images in full resolution, filter and select those of interest;
- Analyse and process imagery using on-line EO services and tools;
- Create ad-hoc composites of different spectral bands and observe changes across time. The generation of information products (VA Products) requires experts' supervision and is under responsibility of VAs and PMs.

The ESA Charter Mapper currently supports a broad range of radar and optical products: **44 satellites (35 EO Missions) from 21 Space Agencies and data distributors.**



ESA Charter Mapper Service Portfolio

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ESA Charter Mapper On-demand Service portfolio after



New processing services

- HASARD Single Scene (RCM, SAOCOM-1, Sentinel-1, TanDEM-X, and TerraSAR-X data)
- SNAPPING DInSAR Stripmap with initial support of SAOCOM
- Map Composition Service for generating map layouts within the environment

New Optical index

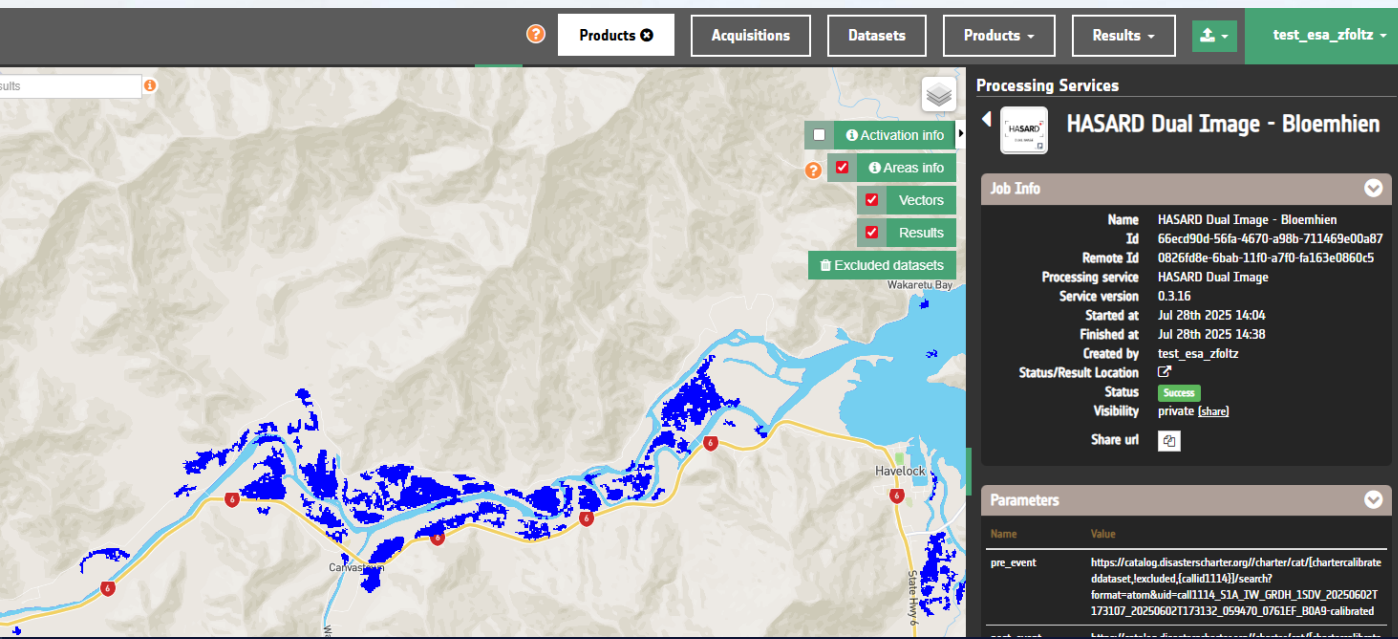
- BAP (Burnt Area Proxy) based on single product (Landsat 8/9 and Sentinel-2)



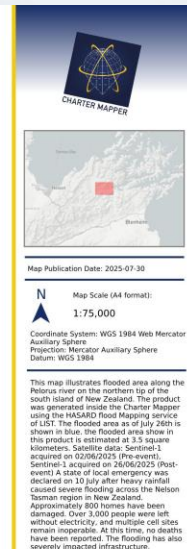
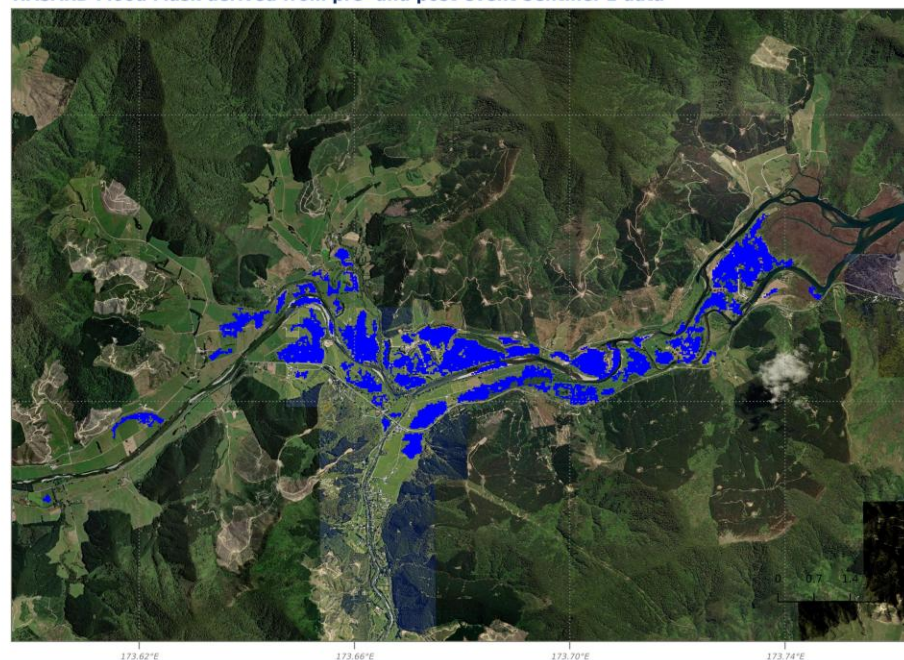
Act-973: Flood in New Zealand

INTERNATIONAL CHARTER SPACE & MAJOR DISASTERS SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

- HASARD Flood mapping Service used with Sentinel-1 data
- Service result transferred to Map composition
- Flooded area: 3.5km²
- ESRI basemap used



Flooded area along the Pelorus River as of June 26th 2025
HASARD Flood Mask derived from pre- and post-event Sentinel-1 data



[Act-973/Call-1114]
Flood in New Zealand



This product contains modified Copernicus Sentinel data, Base map: ESA World Imagery. Source: Esri, Maxar, Earthstar Geographics, and the GIS user community.



[Act-777/Call-895] Flood in Nigeria

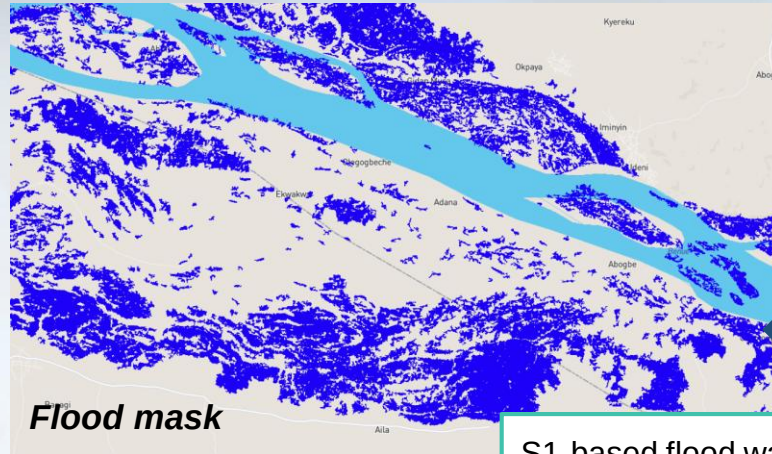
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STACK

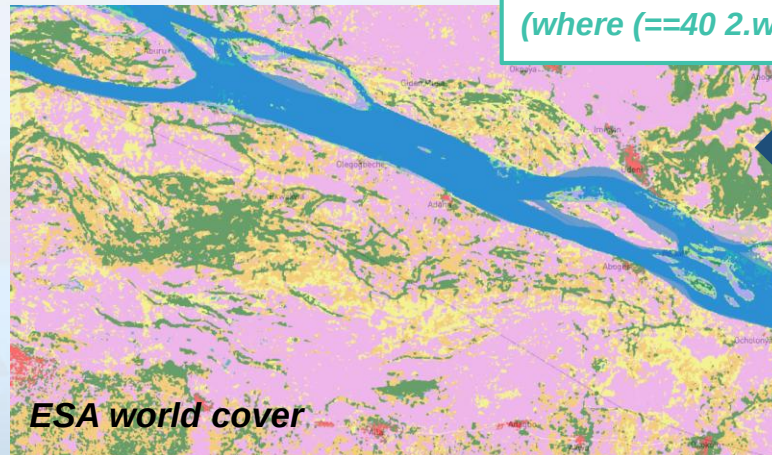


HASARD

ESA
World
Cover



Flood mask

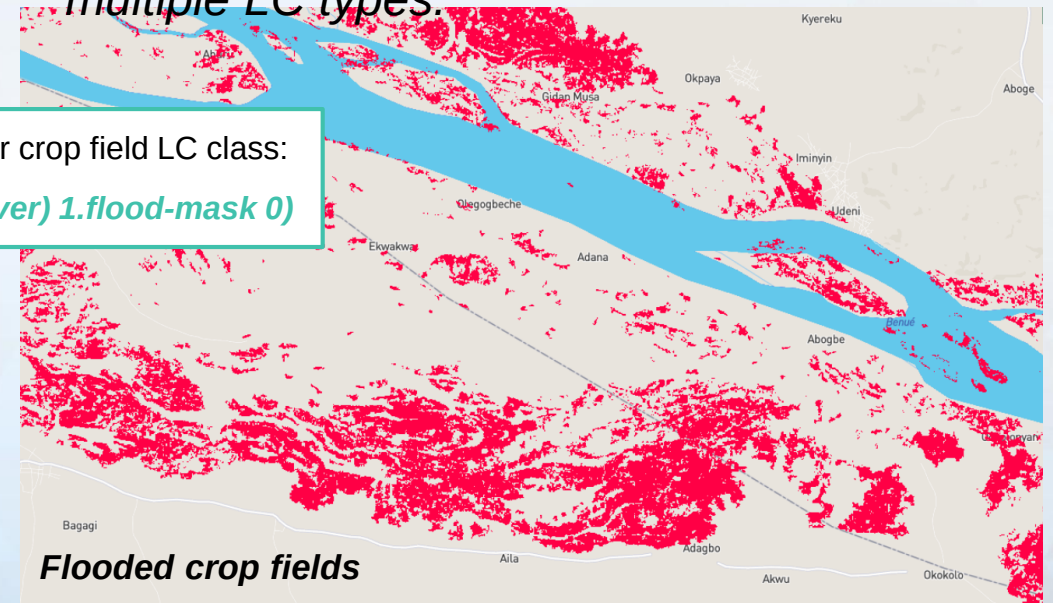


ESA world cover

S1-based flood water over crop field LC class:

(where $((=40 \ 2.worldcover) \ 1.flood-mask \ 0)$)

Result from co-locating a binary flood map derived from the HASARD service with the ESA World cover auxiliary dataset. Band Arithmetic functions of the STACK service allow to discriminate flooded areas over multiple LC types.



Flooded crop fields

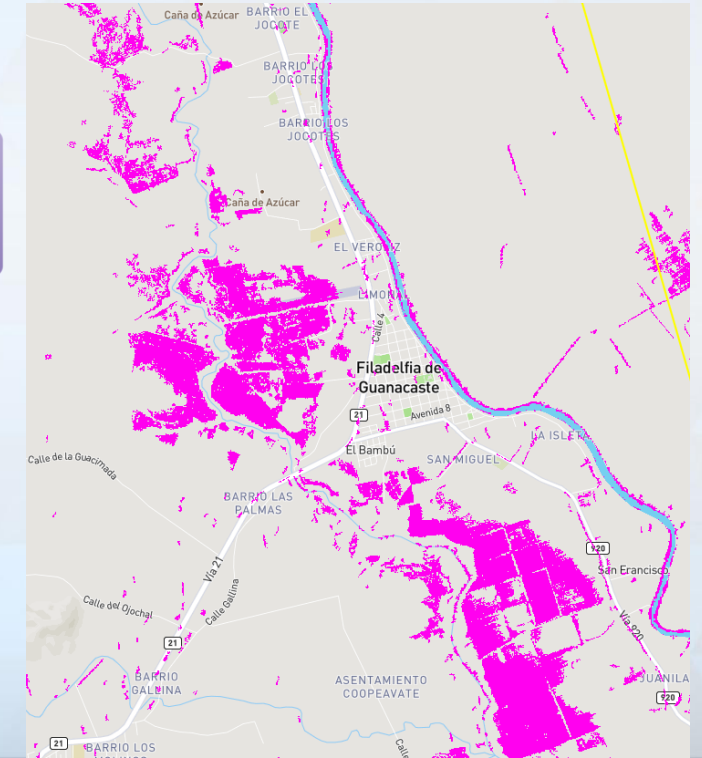
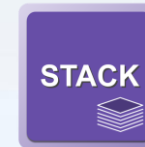
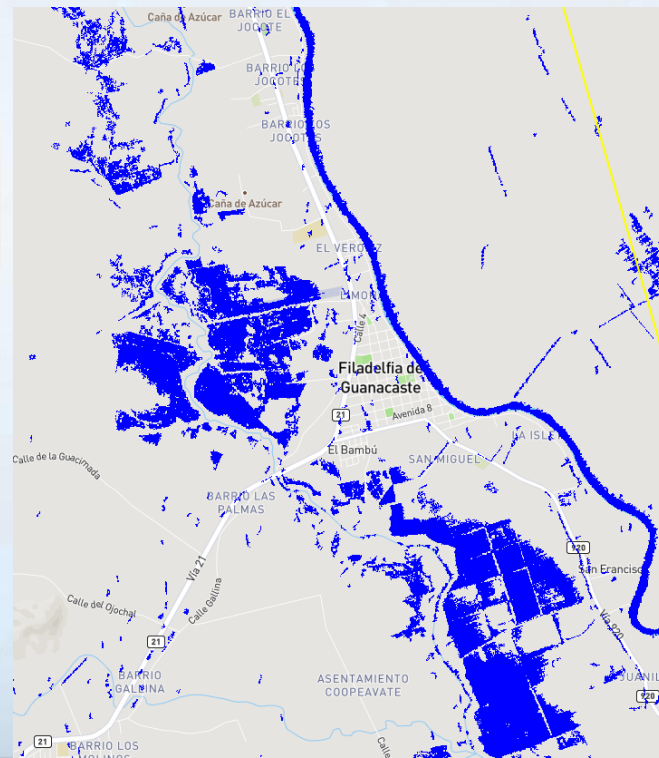
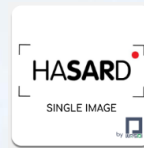
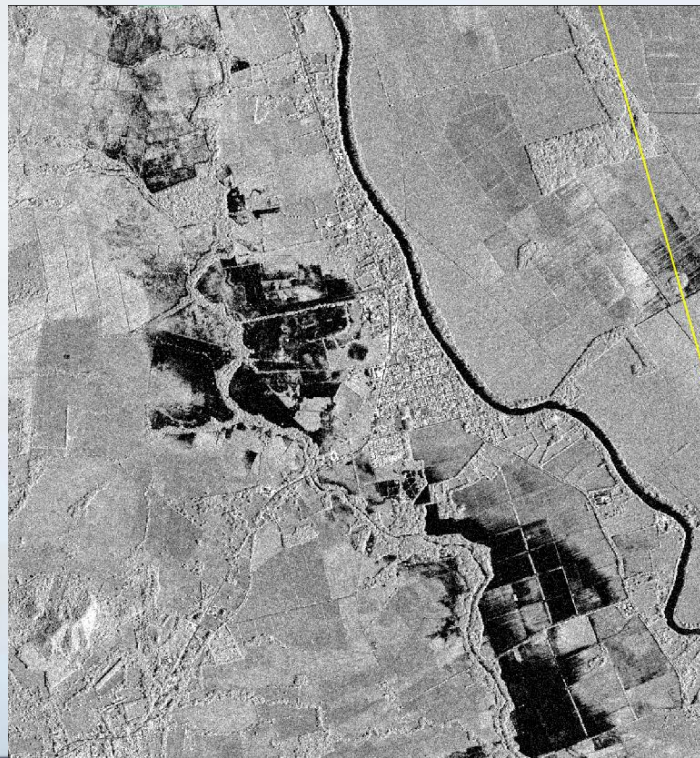
Image credits (ESA, Copernicus)



Deriving a flood map from a single post-event radar image HASARD Single Image - Activation 929: Flood in Costa Rica

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- By combining the ESA World Cover land cover map and the standing water mask (HASARD Single Image output) using the STACK service, we can assess only the estimated flooded areas.
- Standing water (blue) compared with the estimated flooded areas (pink).



TSX Image: 11-17-2024

HASARD Single Image Service Result

*STACK Service Result
(Permanent Water Bodies Removed)*



Charter Mapper Processing and Visualization: Co-Registration

Co-Register



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WoldView pre-event image
10/04/22

- Here we would like to take advantage of a post-event image from BlackSky Global, however the only Pre-event VHR image over this area is from WorldView-3
- Slight difference in viewing angle
- Pre event: Oct 4th, 2022
- Post-event: March 11th, 2023



Charter Mapper Processing and Visualization: Co-Registration

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Original WorldView pre-event image

- Using the Co-Registered stacking service of the Charter Mapper, we can quickly align the images to aid visualization
- The compare layers slider can be employed to easily spot collapsed buildings



Charter Mapper Visualization and Processing: Dam Break on the Syria-Türkiye border

INTERNATIONAL CHARTER SPACE & MAJOR DISASTERS SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

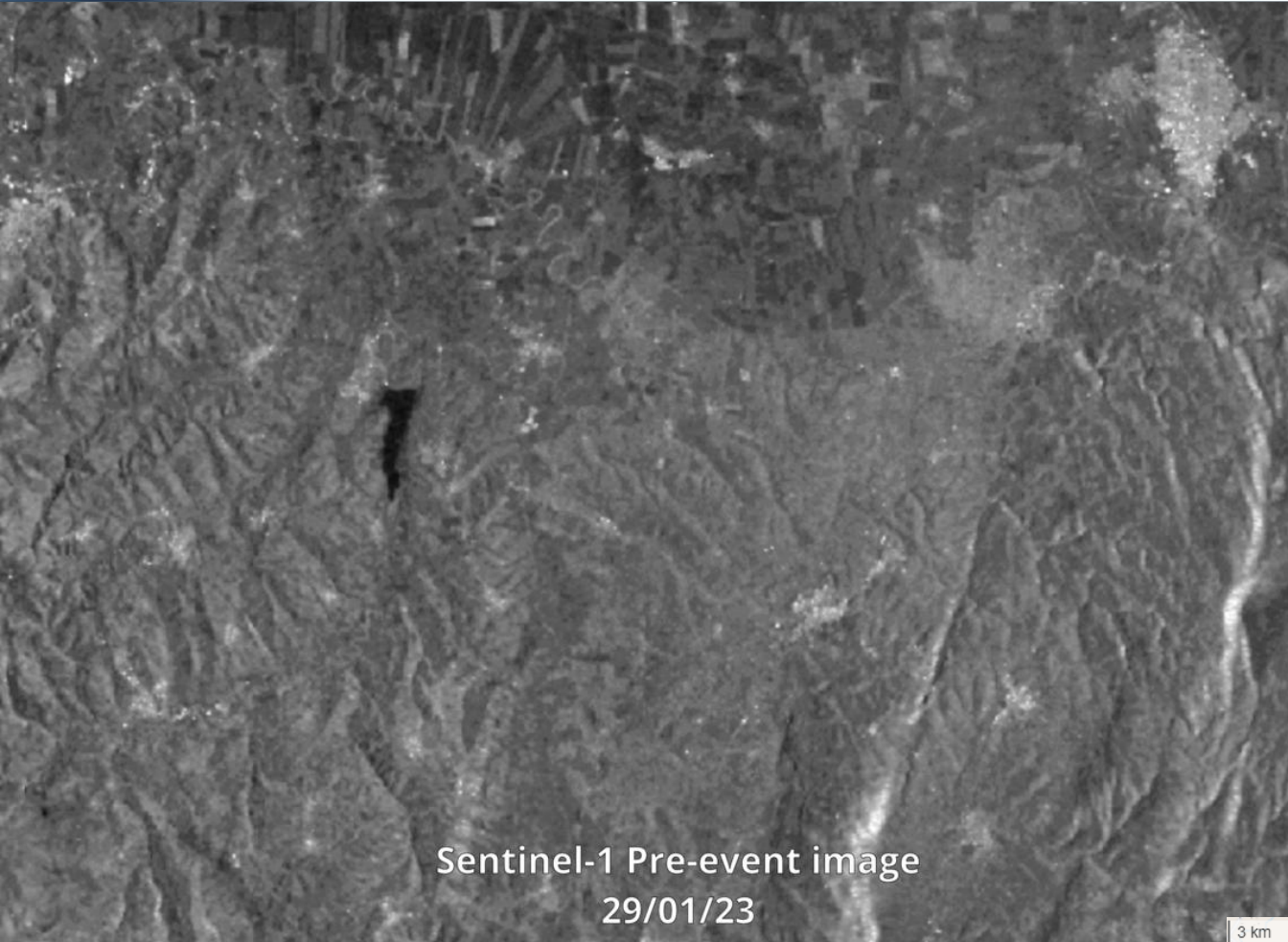


- Adding to the devastating aftermaths of the earthquake, the collapse of packwall dam in the village of Al-Tloul forced more people to leave their homes.
- Dam collapse: Feb 9th
- Post event S2 image: Feb 9th



Charter Mapper Visualization and Processing: Dam Break on the Syria-Türkiye border

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- Sentinel-1 images can be used as input for the HASARD flood extent mapping service, to create a raster bitmask of flooded area
- Dam collapse: Feb 9th
- Pre-event S1 image: Jan 29th
- Post event S1 image: Feb 10th

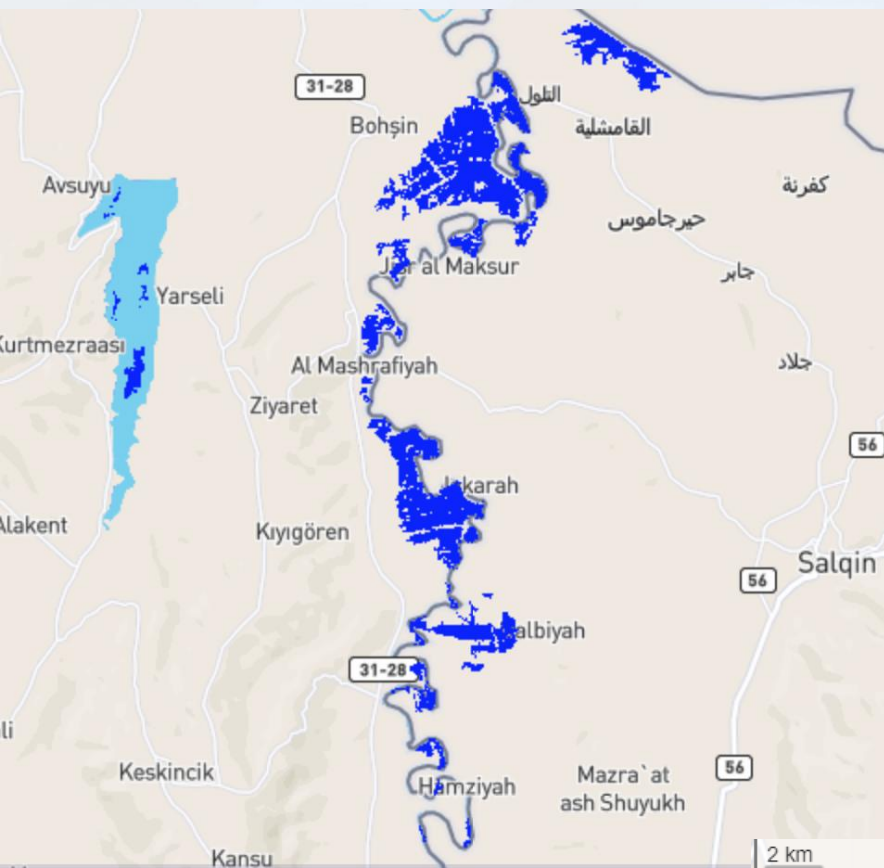


Charter Mapper Visualization and Processing: Dam Break on the Syria-Türkiye border

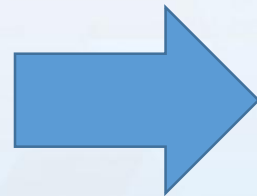
INTERNATIONAL CHARTER SPACE & MAJOR DISASTERS SATELLITE DATA TO SUPPORT DISASTER RESPONSE WORLDWIDE

- The result of the HASARD flood extent mapping service can be used as input for the Filter Vectorize service, to create a vector representing flooded area

HASARD result

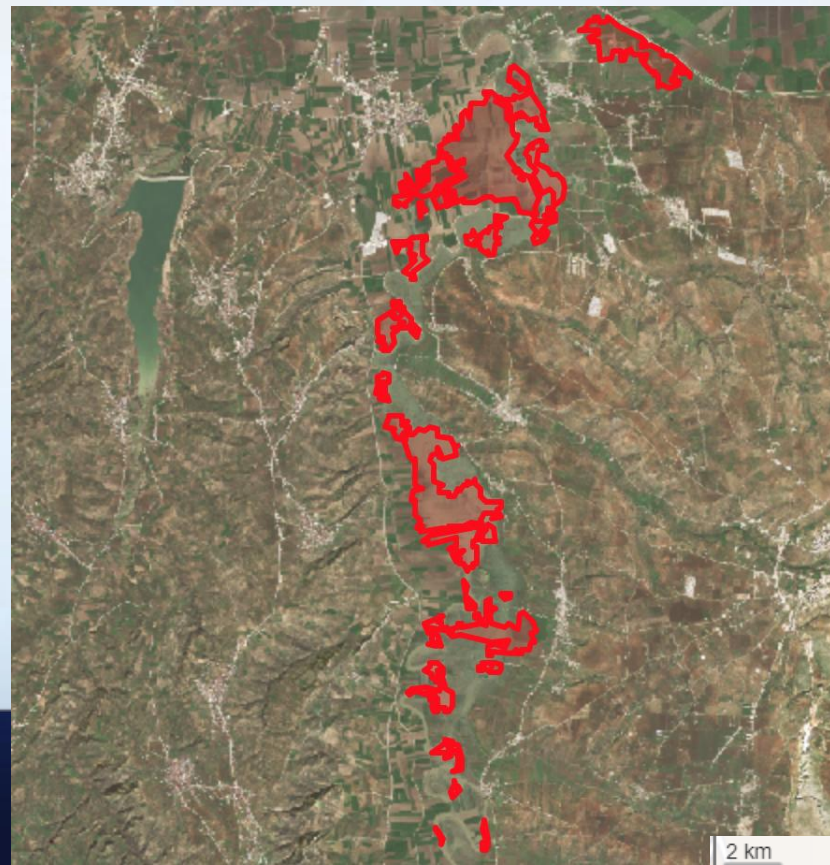


HASARD



Filter
Vectorize

Generated vector



Spatial info ✓

Geometry type
multipolygon

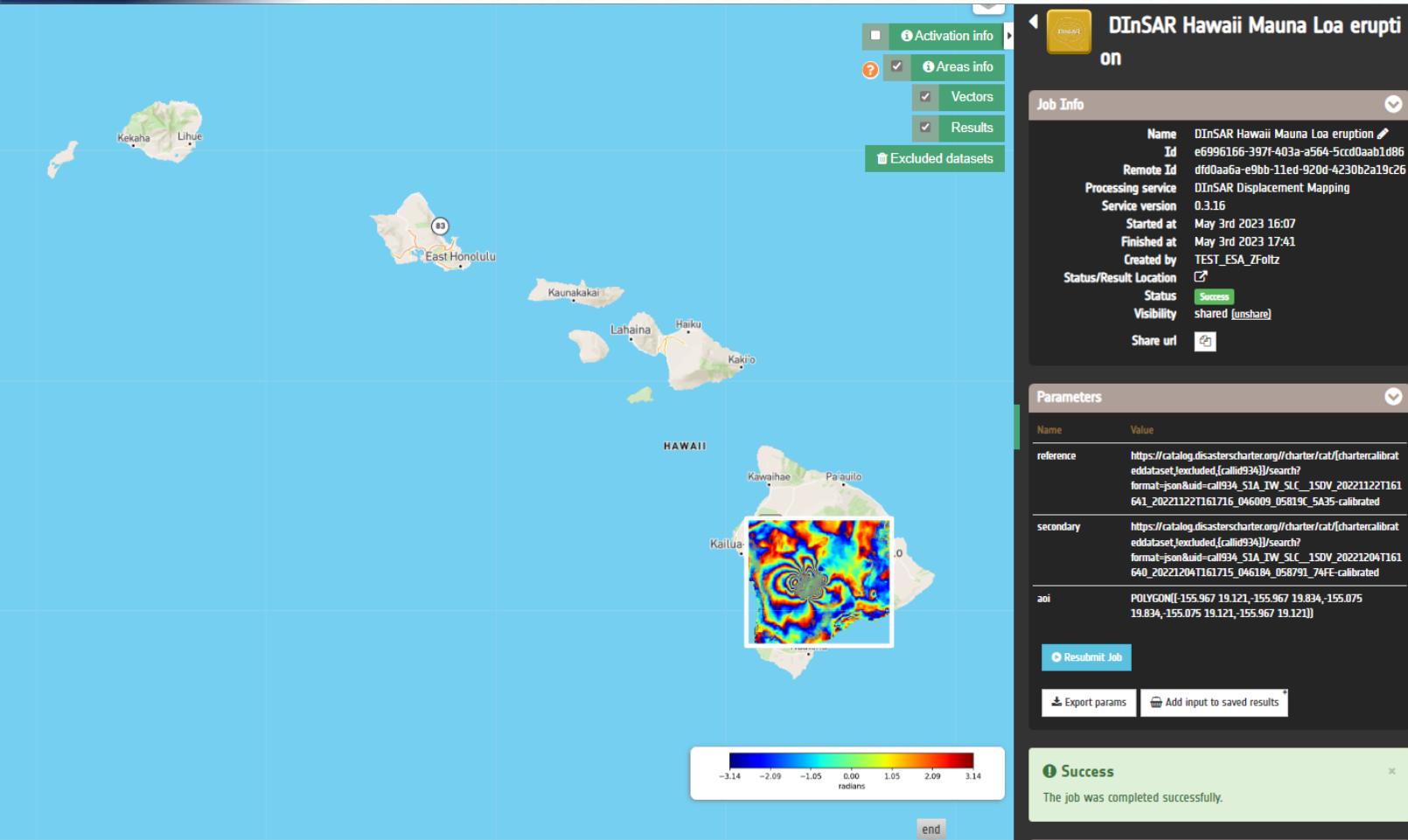
Perimeter
110.846 Km

Area
6.6122 Km²
661.2237 h



Mauna Loa Volcanic Eruption – Hawaii, USA

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- DInSAR Displacement Mapping service
- Sentinel-1 SLC pre- and post-event images:

Pre-Event: 11/22/2022

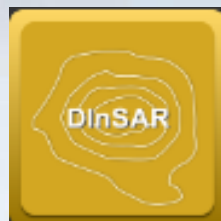
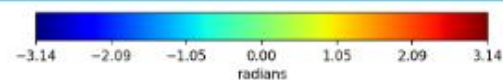
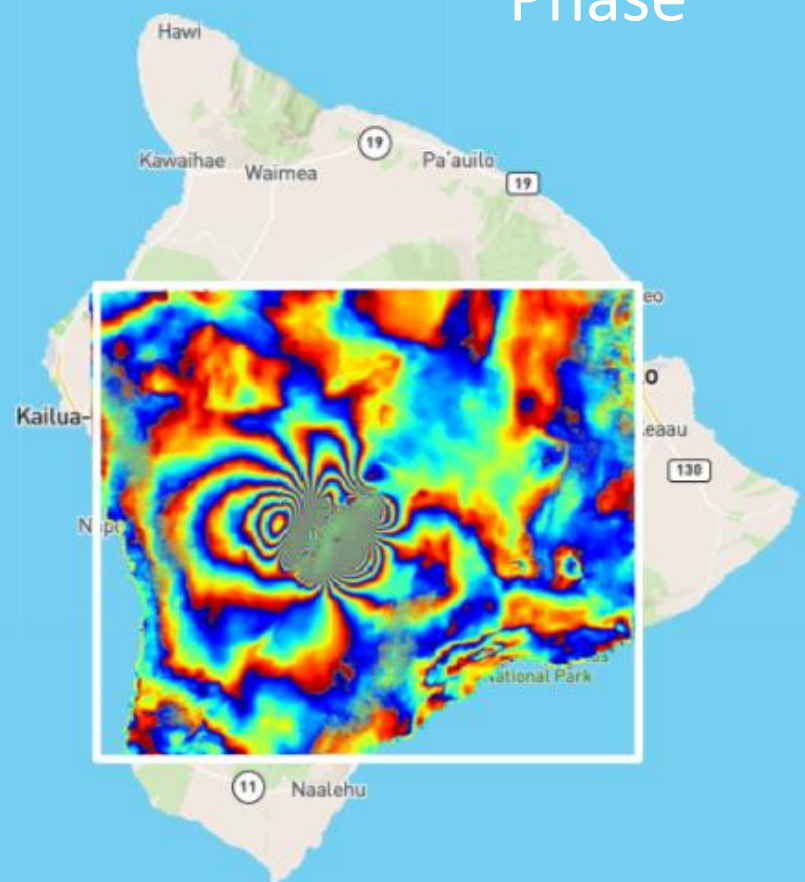
Post-Event: 12/04/2022



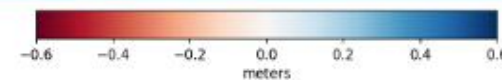
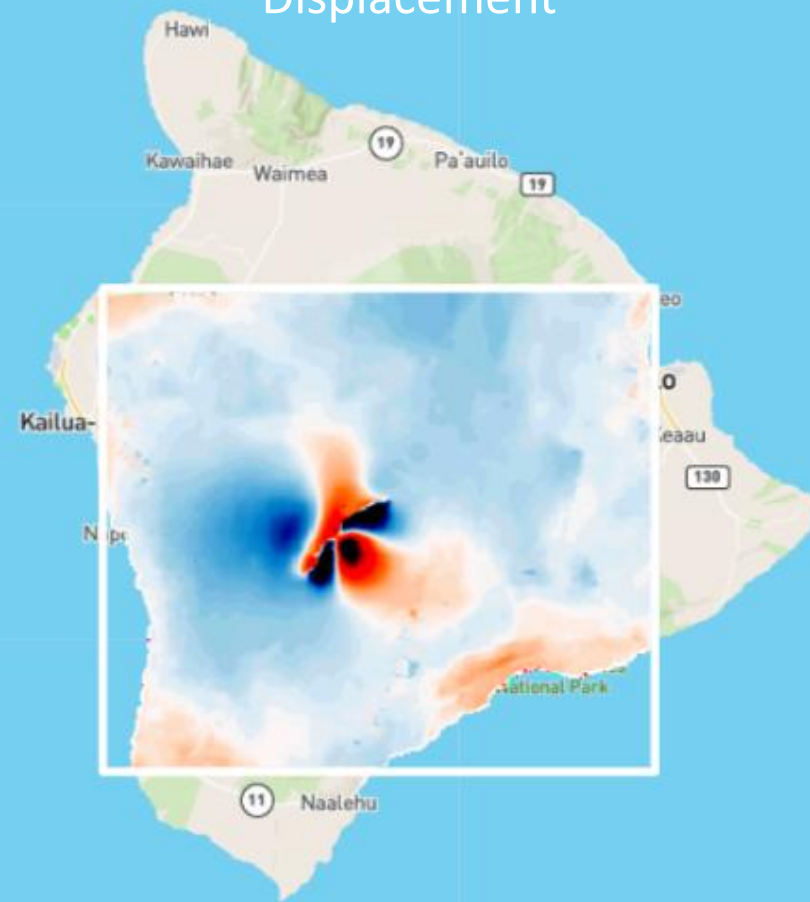
DInSAR Service - Phase and Displacement

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Phase



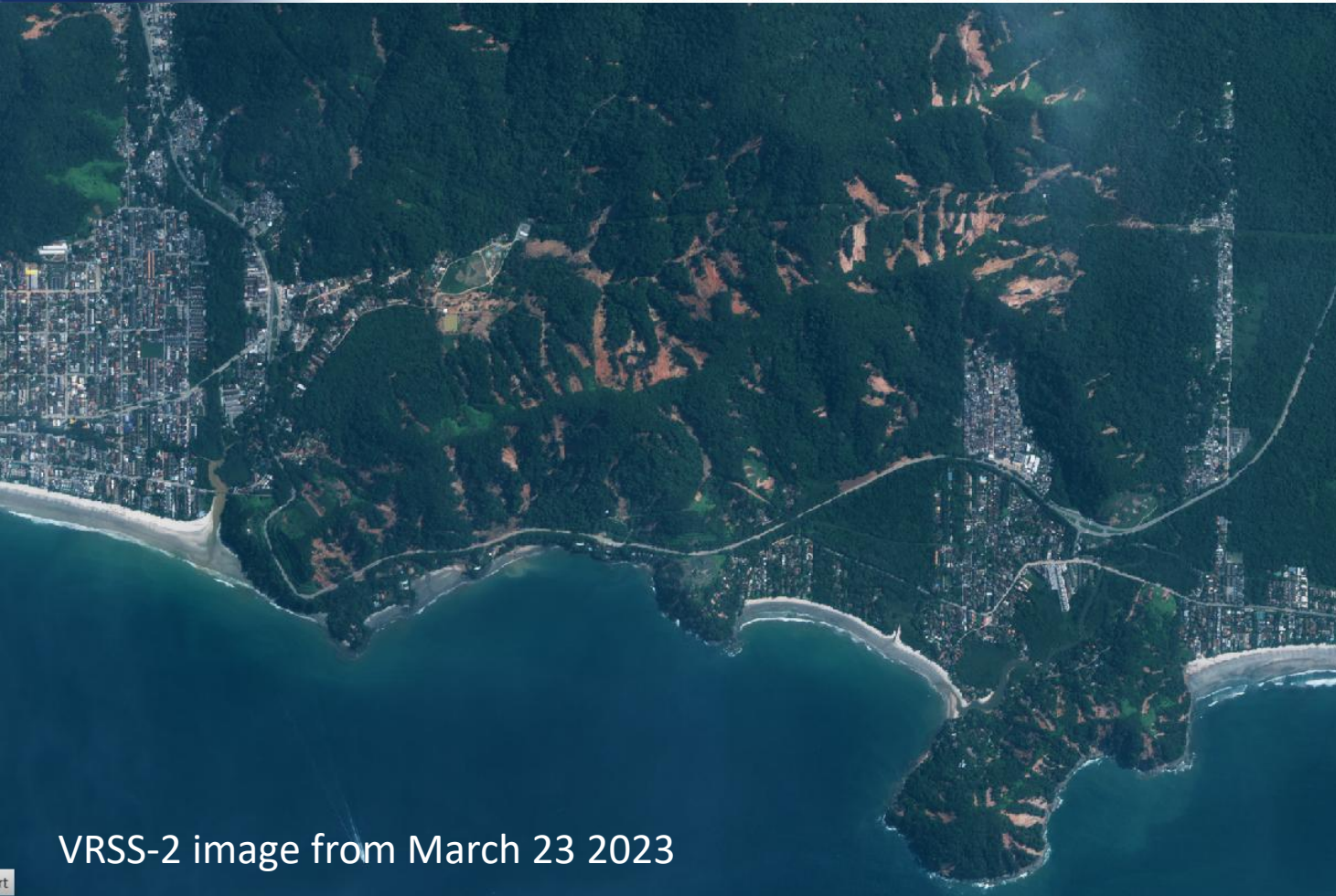
Displacement





Activation 866: Landslides and Flooding in Brazil

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VRSS-2 image from March 23 2023

Landslides and Flooding in Brazil: February 20th 2023

Requestor:

- CENAD

Project Manager:

- CENAD

Value-Adding providers:

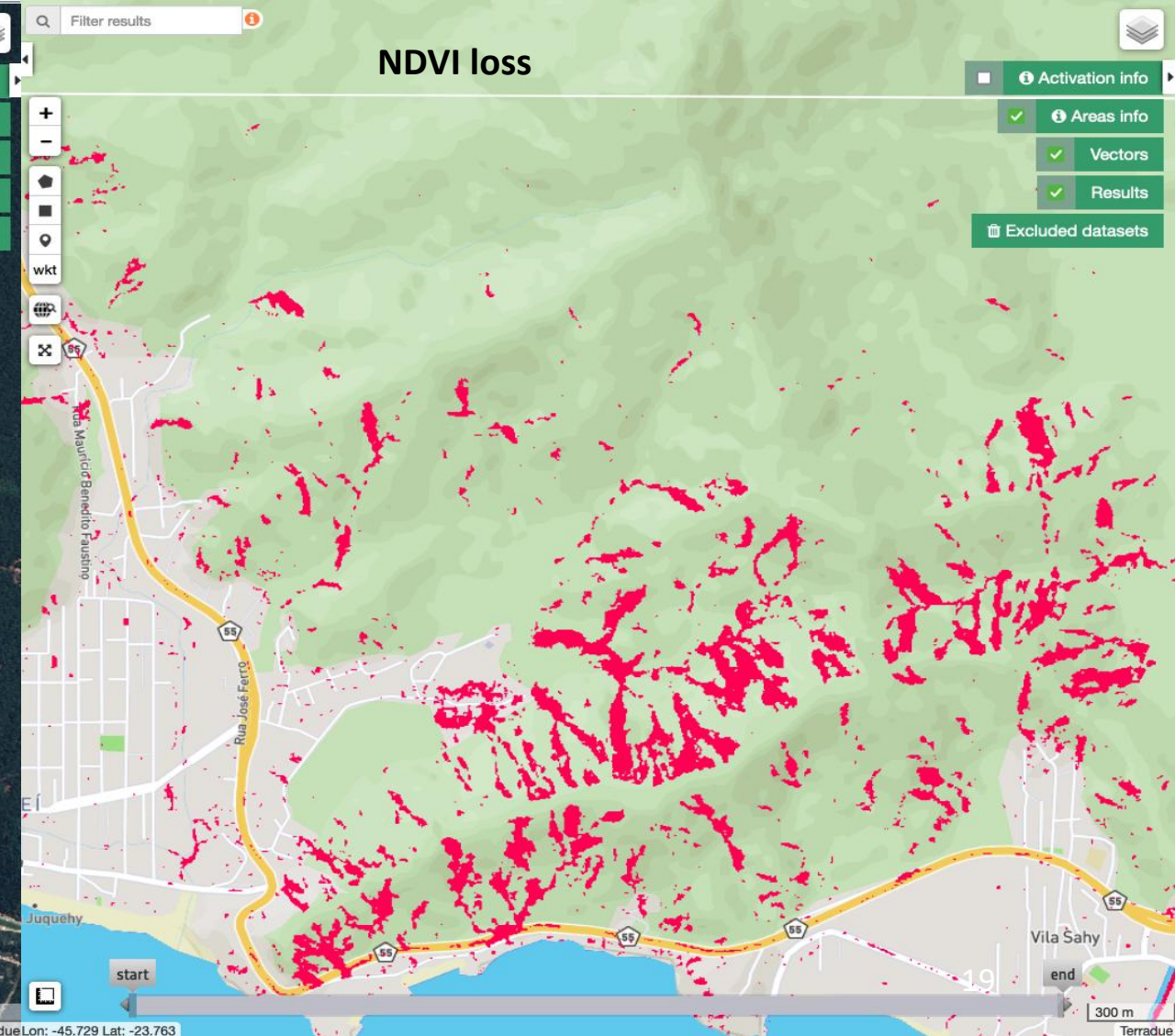
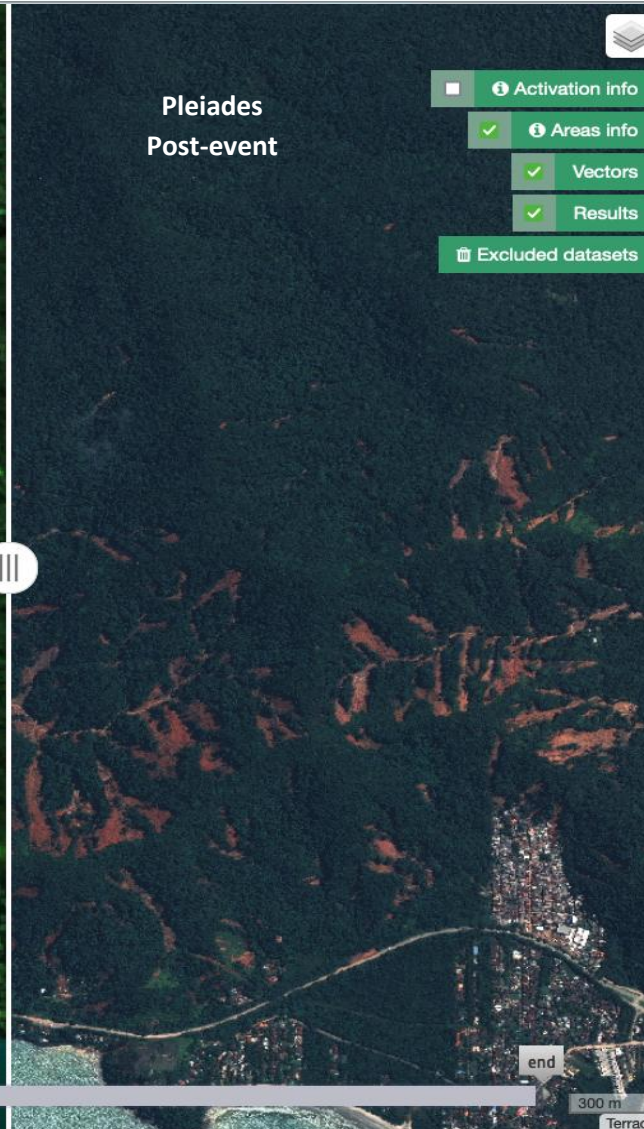
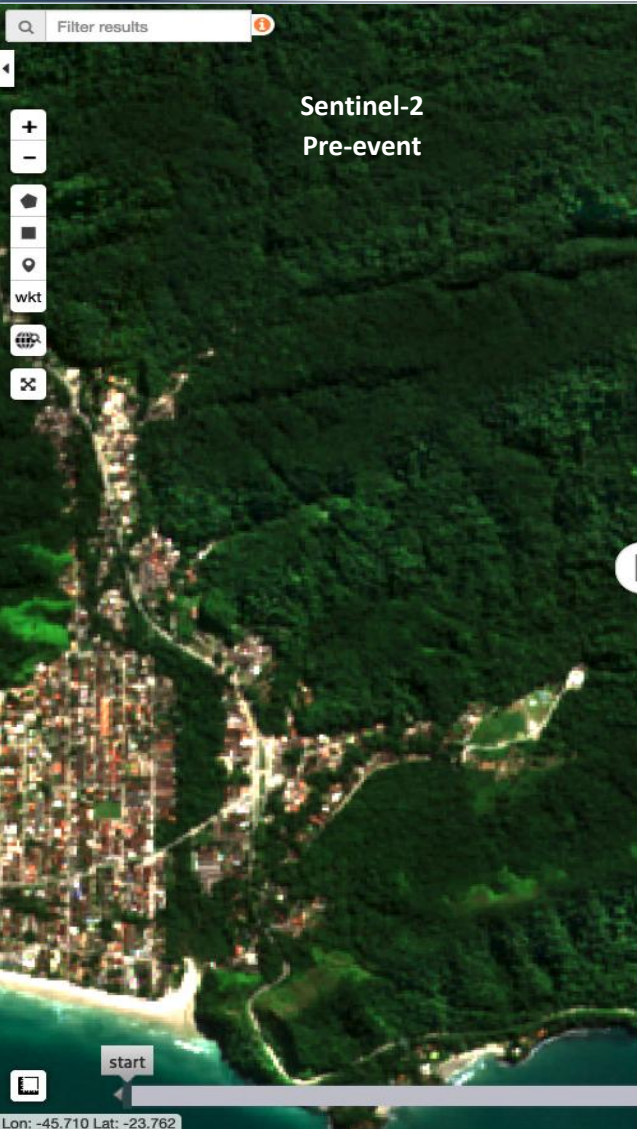
- INPE, SGB, CEMADEN
- Heavy rains triggered floods and landslides in Brazil, killing at least 36 people.
- The hardest-hit regions have been Sao Sebastiao, Ubatuba, Ilhabela and Bertioga



NDVI Change Detection Service



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AI4EO Challenge

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The **AI Model Challenge for Disaster Response** was organized by the Charter in collaboration with ESA's Φ -lab. From July to September 2025, teams from around the world competed to design AI models capable of automatically detecting building-level earthquake damage from high resolution satellite imagery furnished by the Charter archive.

The Dataset:

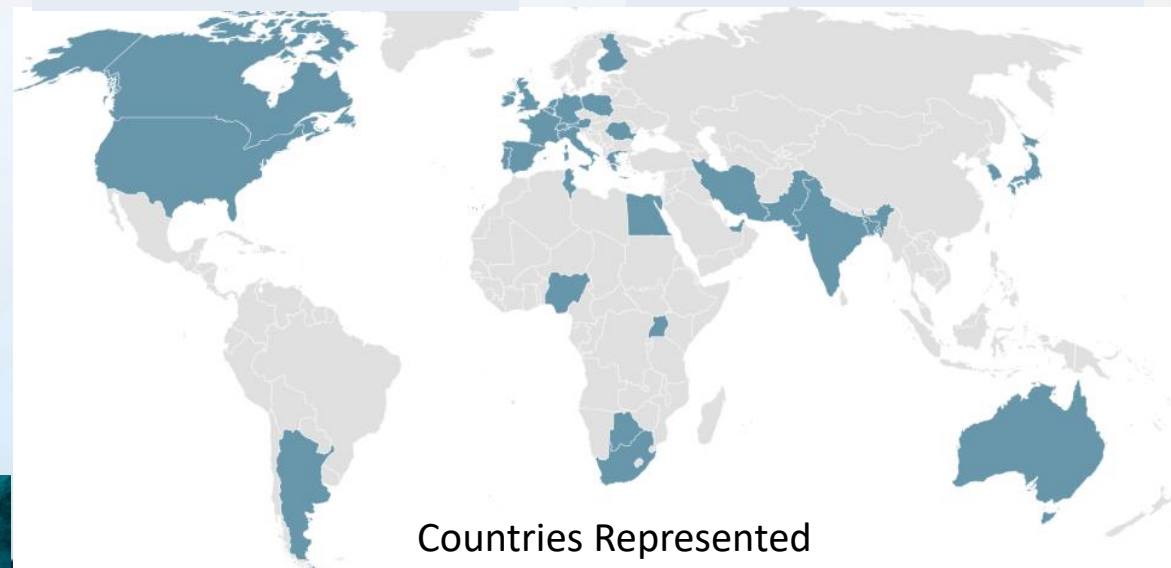
- Built from Charter archive: 5 events, ~200+ images (with pan assets), 14 sites. 475 GB
- Contributions from KARI, USGS/Maxar, CNES/Airbus, CNSA.
- Data curation issues included:
 - Multi-sensor harmonization (Pleiades + WorldView/GeoEye).
 - Pan-sharpening & co-registration.
 - Class imbalance (few damaged vs. many undamaged).
- This dataset is arguably the most operationally realistic earthquake training dataset available in the world. 10+ times larger than precursor xBD of xView2 (US Defense Innovation Unit).

Number of Participants

143

Countries

40





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www.disasterscharter.org

Emergency enquiries from users requiring direct access to Charter resources should be addressed to:

ExecutiveSecretariat@disasterscharter.org

General requests for information should be addressed to

helpdesk@disasterscharter.org

