The Italian Space Agency Contribution to CEOS WGDisasters for Disaster Monitoring and Response

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1. CONTEXT – CEOS WGDISASTERS

The Working Group on Disasters (WGDisasters, https://ceos.org/ourwork/workinggroups/disasters/) has been established since 2013 by the Committee on Earth Observation Satellites (CEOS, https://ceos.org) to ensure the sustained coordination of disaster-related activities undertaken by the CEOS Agencies as well as to act as an interface between CEOS and the community of stakeholders / users involved in risk management and disaster reduction. In this framework, CEOS WGDisasters has initiated, promoted and supported a series of concrete actions for Disaster Risk Management (DRM) and Disaster Risk reduction (DRR) oriented to disaster monitoring, preparedness and prevention. These actions have been translated in single-hazard Pilot and Demonstrator projects (e.g. fires, floods, landslide, volcanoes and seismic hazards) as well as multi-hazards projects as the Recovery Observatory (RO) and Supersites for Geohazard Supersites and Natural Laboratories (GSNL).
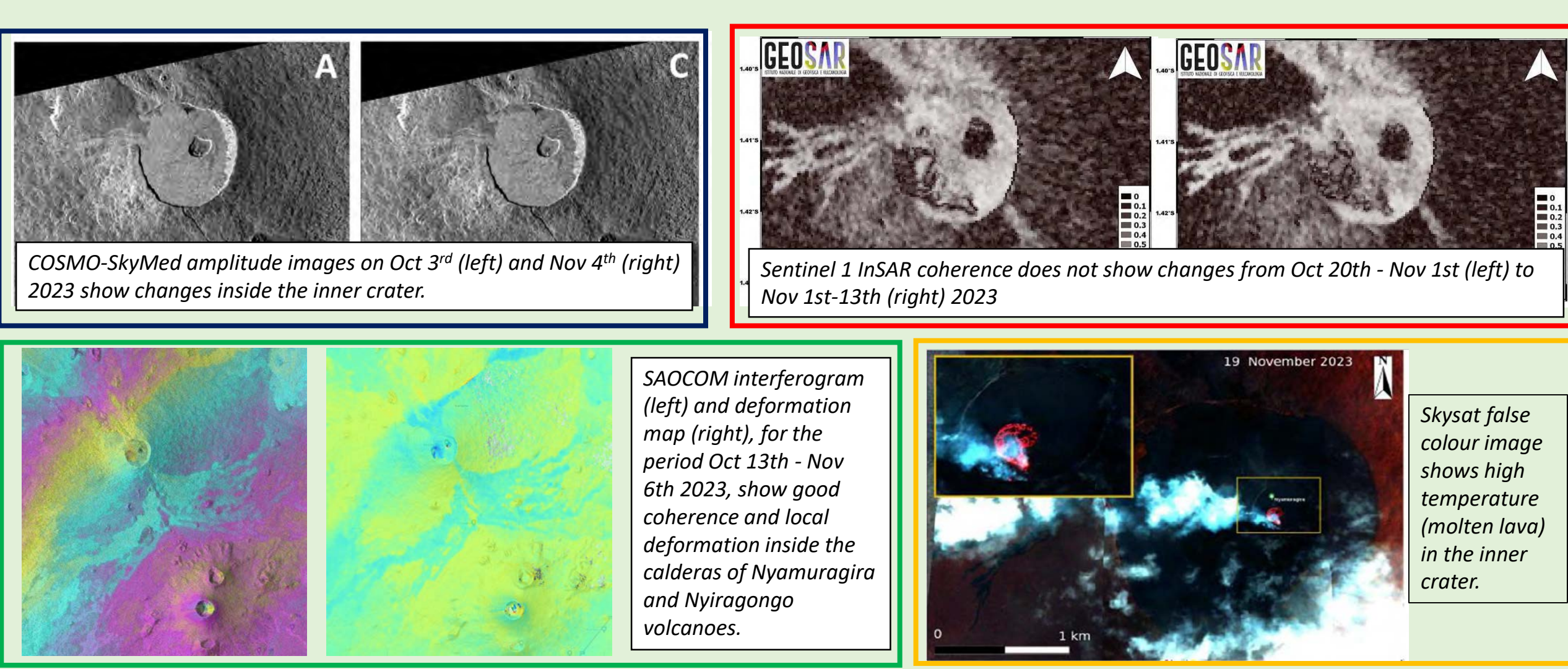
WILD-FIRE PILOT

Inventory of Fire "hotspot" products from MODIS, VIIRS, & Landsat. Courtesy of FIRMS© system.
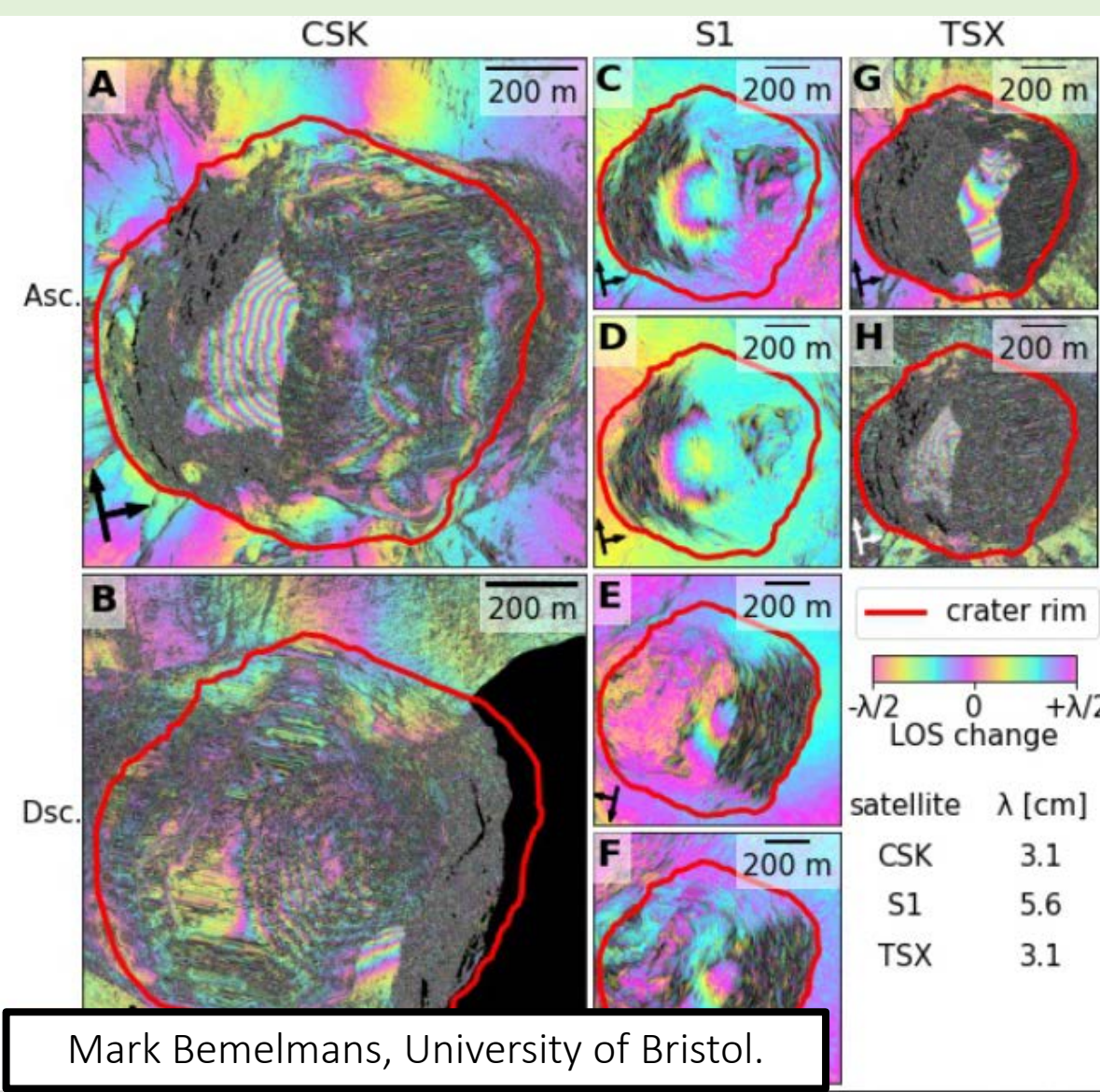
FLOOD PILOT
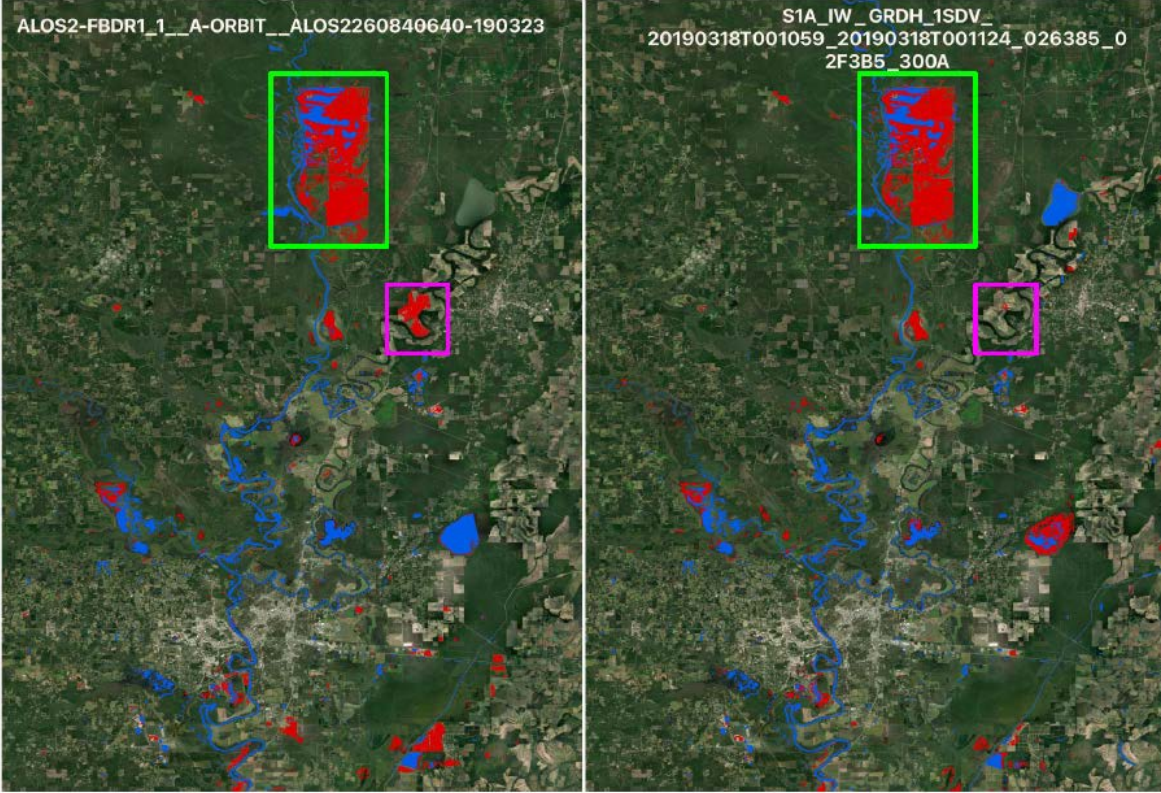
Submerged (red areas) and body waters (blue areas) detected in Australia (2021) by Adal-RAPID processing of Capella and Sentinel-1 SAR Data. Courtesy of Capella Open Dataset.

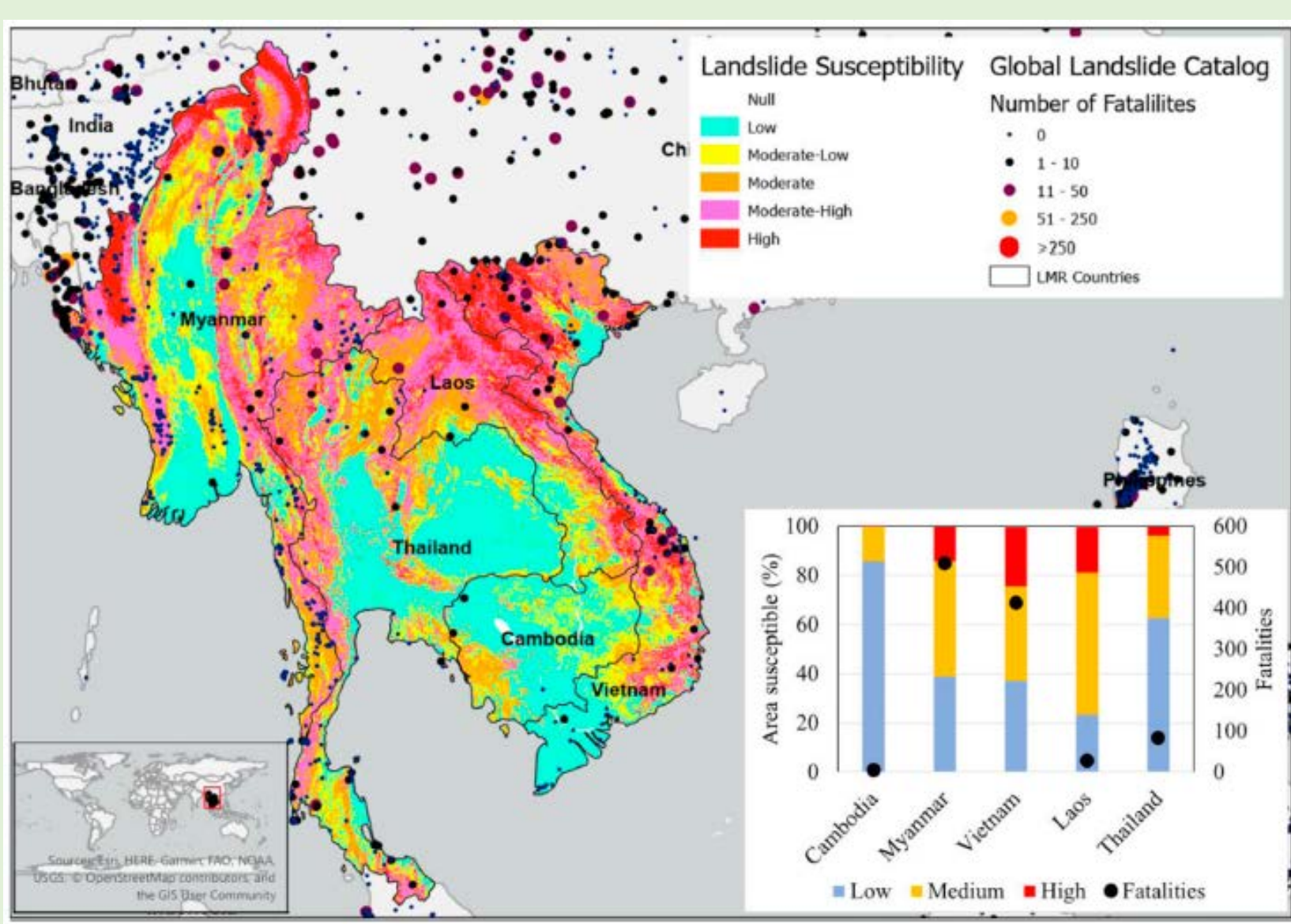### GEOHAZARDS SUPERSITES AND NATURAL LABORATORIES

COSMO-SkyMed amplitude images on Oct 3rd (left) and Nov 4th (right) 2023 show changes inside the inner crater.

Sentinel 1 InSAR coherence does not show changes from Oct 20th - Nov 1st (left) to Nov 1st-13th (right) 2023

SAOCOM interferogram (left) and deformation map (right), for the period Oct 13th - Nov 6th 2023, show good coherence and local deformation inside the calderas of Nyamuragira and Nyiragongo volcanoes.

Skysat false colour image shows high temperature (molten lava) in the inner crater.

Multi-missions EO results gathered for Nyamulagira Eruption in 2023 for Virunga Supersites

VOLCANO DEMONSTRATOR

satellite	λ [cm]
CSK	3.1
S1	5.6
TSX	3.1

Mark Bemelmans, University of Bristol.

Interferograms retrieved by COSMO-SkyMed, TerraSAR-X and Sentinel-1 pairs, showing deformation on the crater floor of Mount Agung (Indonesia) prior to its 2017 eruption.

LANDSLIDE DEMONSTRATOR

Distribution of reported landslide fatalities across the Lower Mekong Region based on NASA's Global Landslide Catalog (Kirschbaum et al., 2015), with NASA's global landslide susceptibility map (Stanley and Kirschbaum, 2017).

SEISMIC DEMONSTRATOR
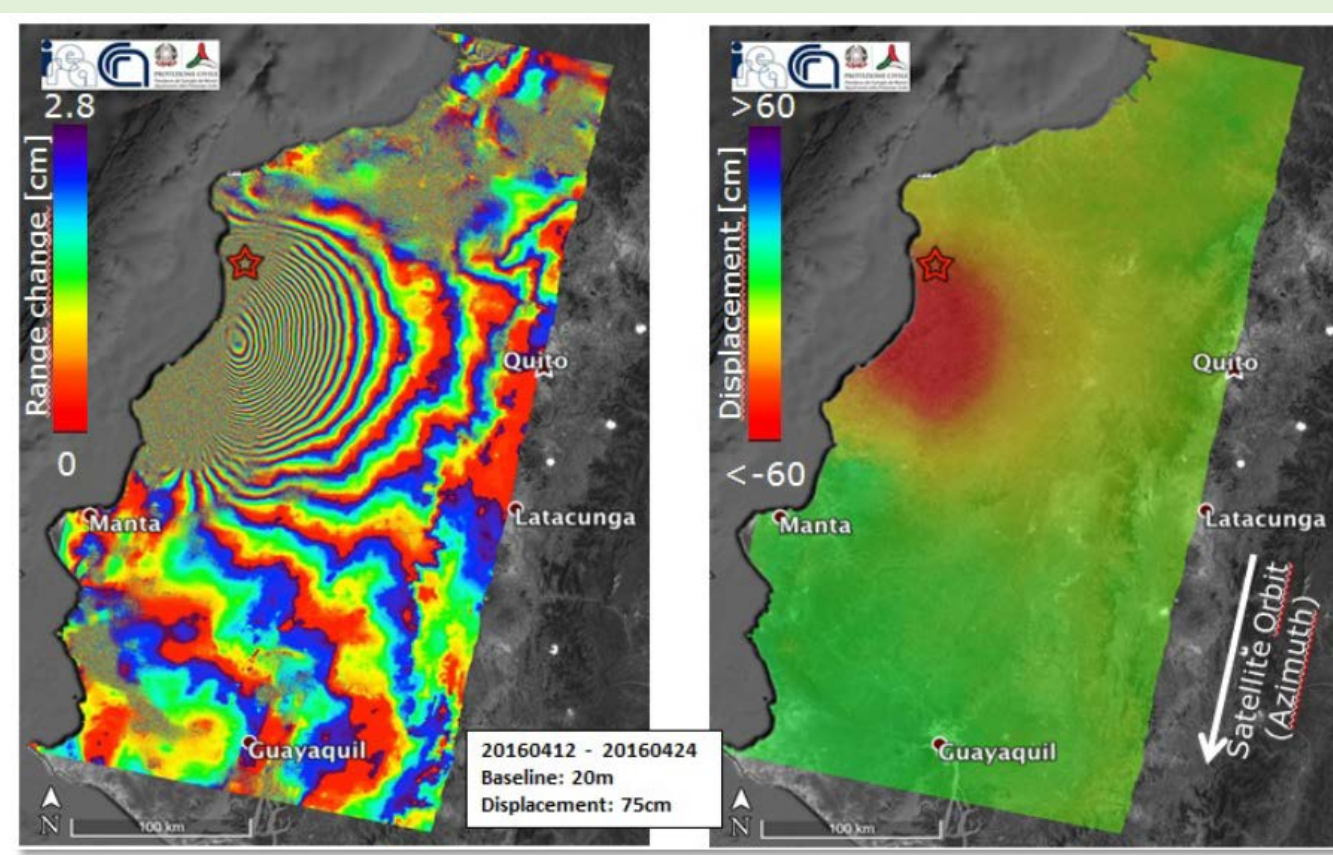
Interferogram generated by CNR-IREA, exploiting two Sentinel-1© 2016 images acquired from descending orbits (Track 40) before (12 April) and after (24 April) the Mw 7.8 event in Ecuador.

RECOVERY OBSERVATORY
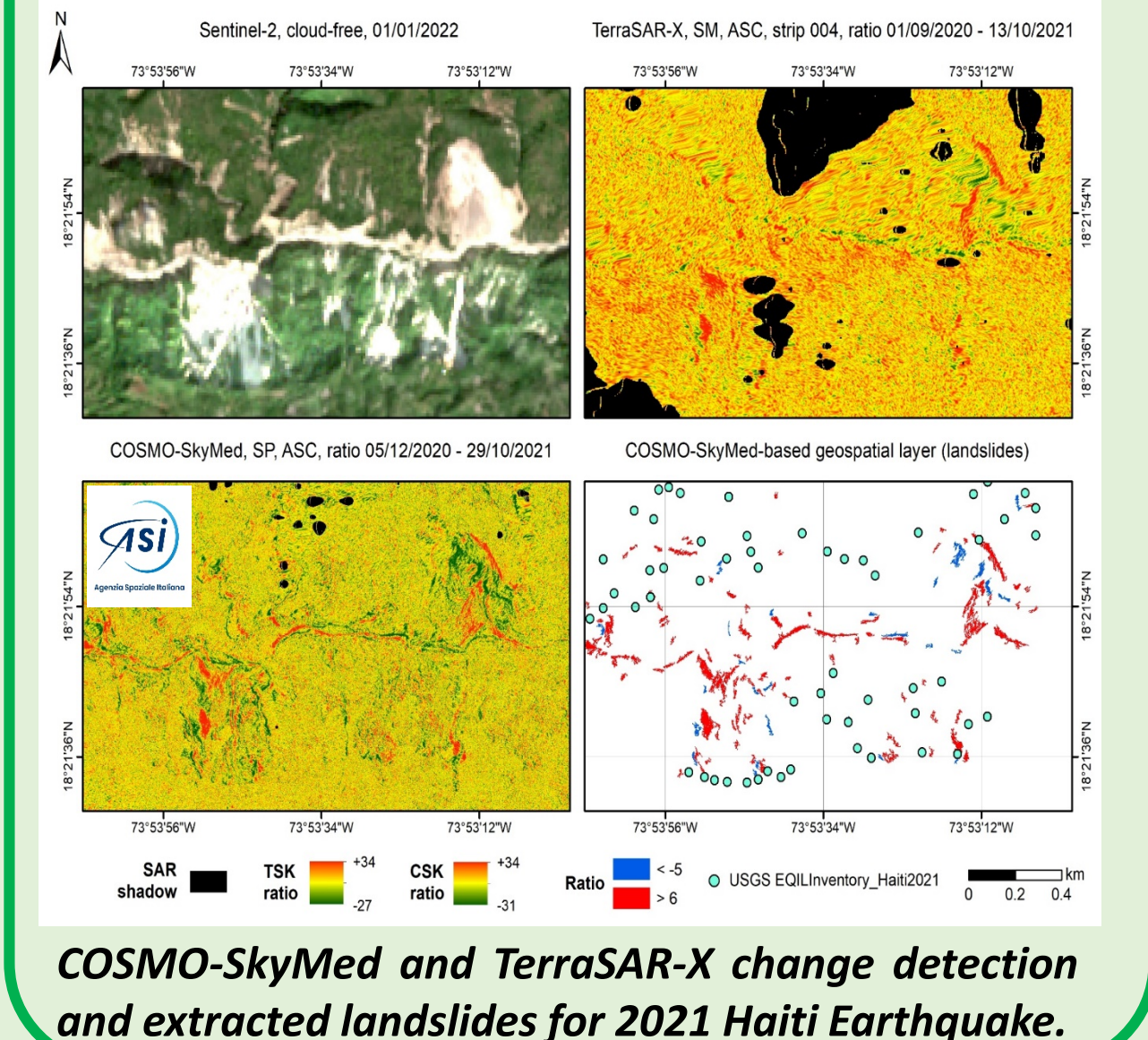
COSMO-SkyMed and TerraSAR-X change detection and extracted landslides for 2021 Haiti Earthquake.

## 2. ASI CONTRIBUTION TO CEOS WGDISASTERS

Since 2012 ASI participates and contributes to the above-mentioned initiatives in terms of project selection and evaluation (as part of Data Coordination Team); data provision of COSMO-SkyMed (delivered via conventional ASI FTP and further made available through a dedicated ASI server https://192.106.234.150/cgi-bin/), SAOCOM (only within the ASI Zone of Exclusivity defined in agreement with CONAE within SIASGE program, https://www.asi.it/en/2021/07/asi-starts-the-exploitation-phase-of-data-acquired-in-europe-by-the-l-band-sar-sensors-of-the-argentinean-saocom-constellation/) and PRISMA images (https://prisma.asi.it/); scientific activities in DRM and RO projects. In coordination with WG members and CEOS Agencies, ASI has delivered more than 20.000 EO products until now and is actively involved in demonstrating novel scientific products based on a tailored exploitation of COSMO-SkyMed radar images. Several showcases are here presented dealing with volcano monitoring (e.g. St. Vincent in Caribbean), seismic activities (e.g. 2023 Turkey-Syria earthquake), GSNL projects (e.g. Reykjanes Peninsula, Kilauea and Mauna Loa volcanoes in Hawaii, Nyamuragira and Nyiragongo volcanoes in Africa, Campi Flegrei and Vesuvius in Italy) and RO initiative (e.g. 2016 Hurricane Matthew and Eta-Iota activation in Honduras). To further promote COSMO-SkyMed data exploitation (1st and 2nd generation of satellites), ASI has activated an "Open Call for Science" initiative: https://www.asi.it/bandi_e_concorsi/open-call-for-science-data-utilization-of-the-cosmo-skymed-mission-first-and-second-generation-english-version/.

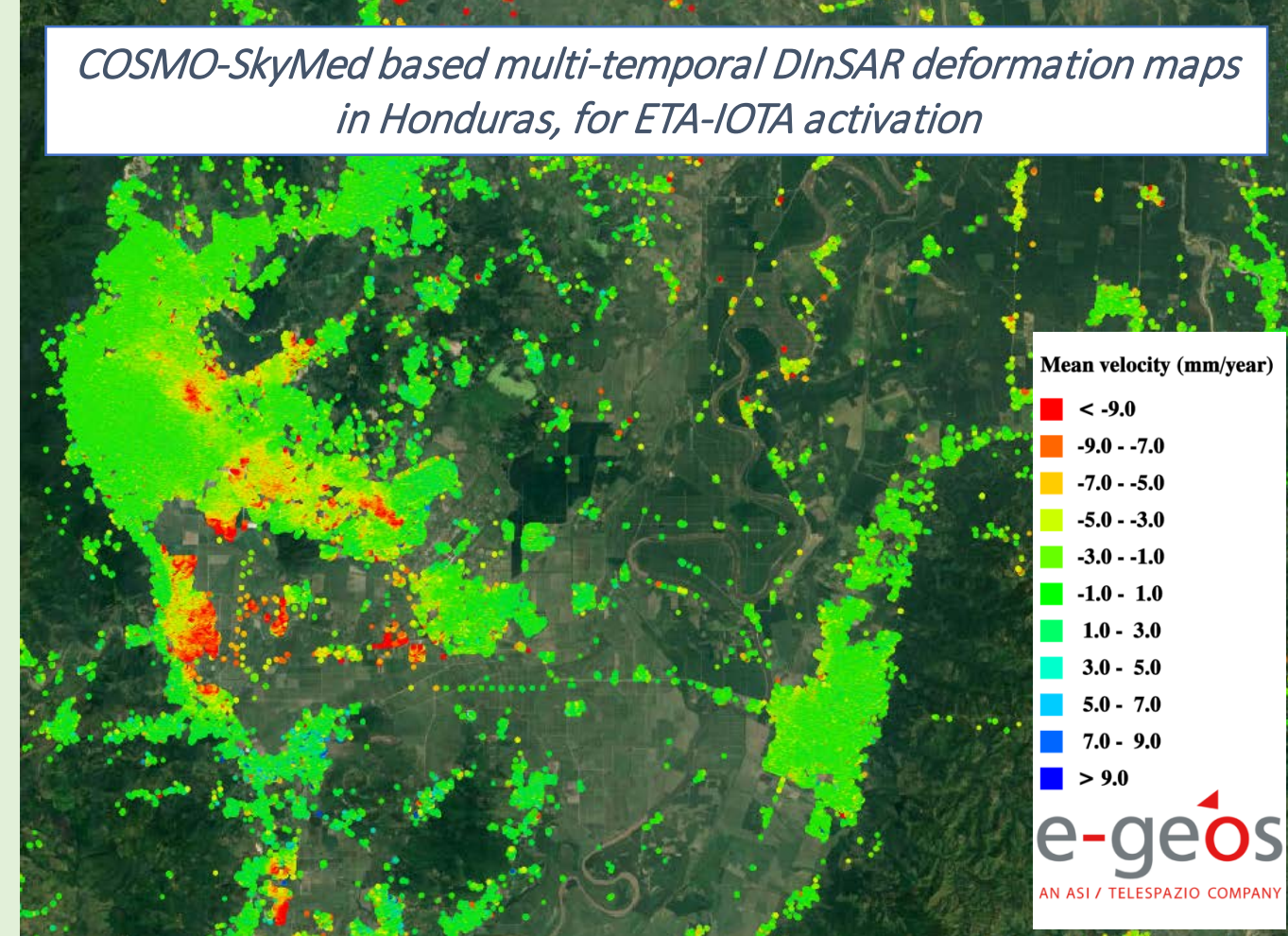27 July to 4 August 2022 — Processed by Michelle Parks (IMO)
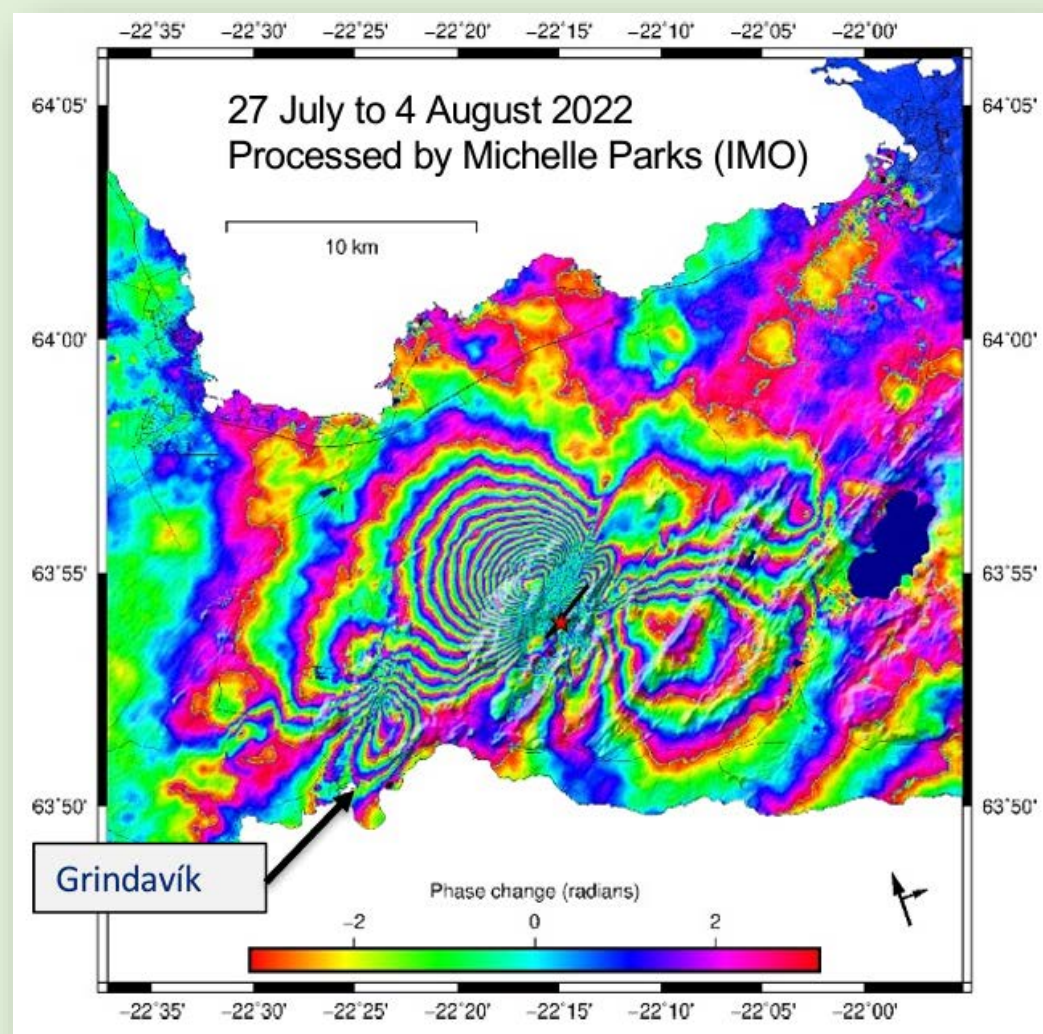
Iceland Supersite: COSMO-SkyMed interferogram showing deformation related to the dike intrusion on the Reykjanes Peninsula started on the 21st December 2021.

Kahramanmaraş Event Supersite 2023

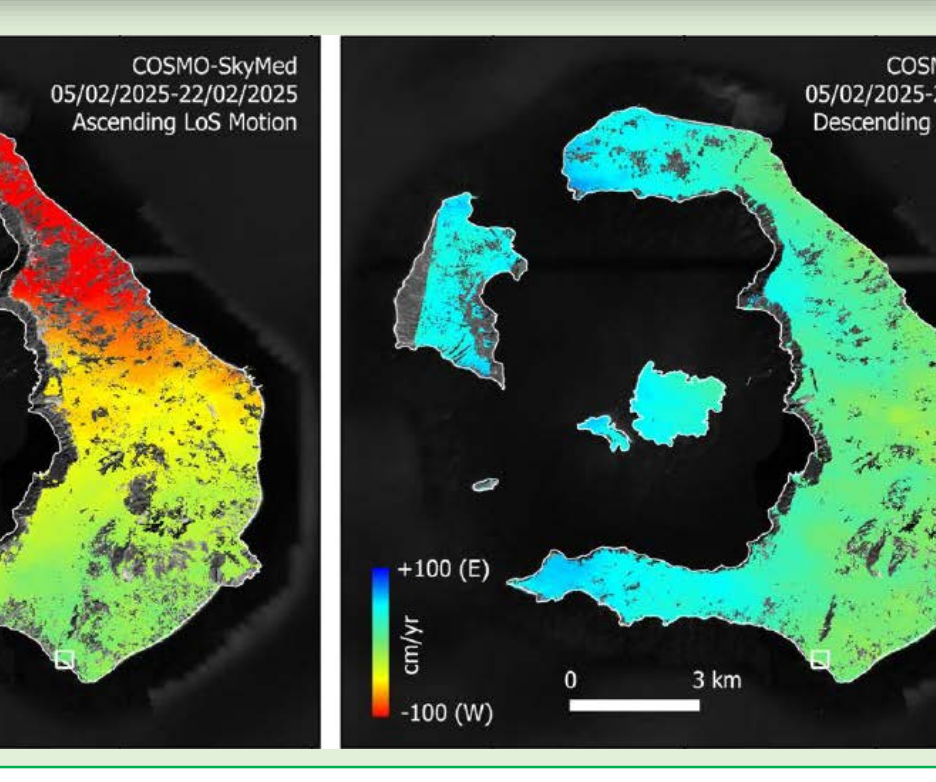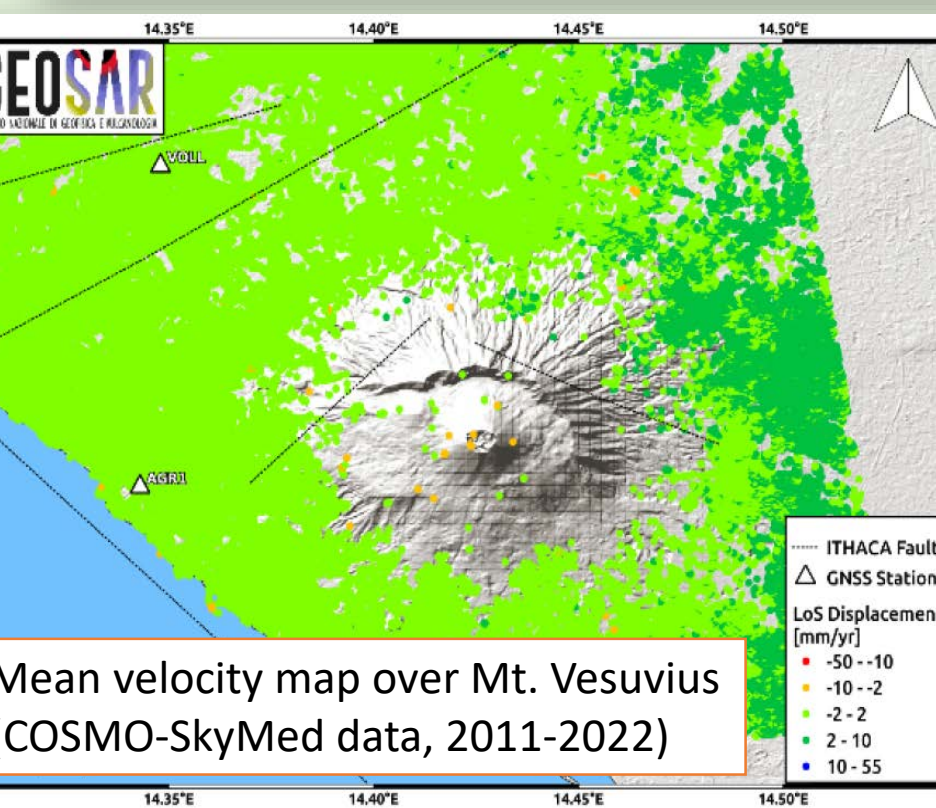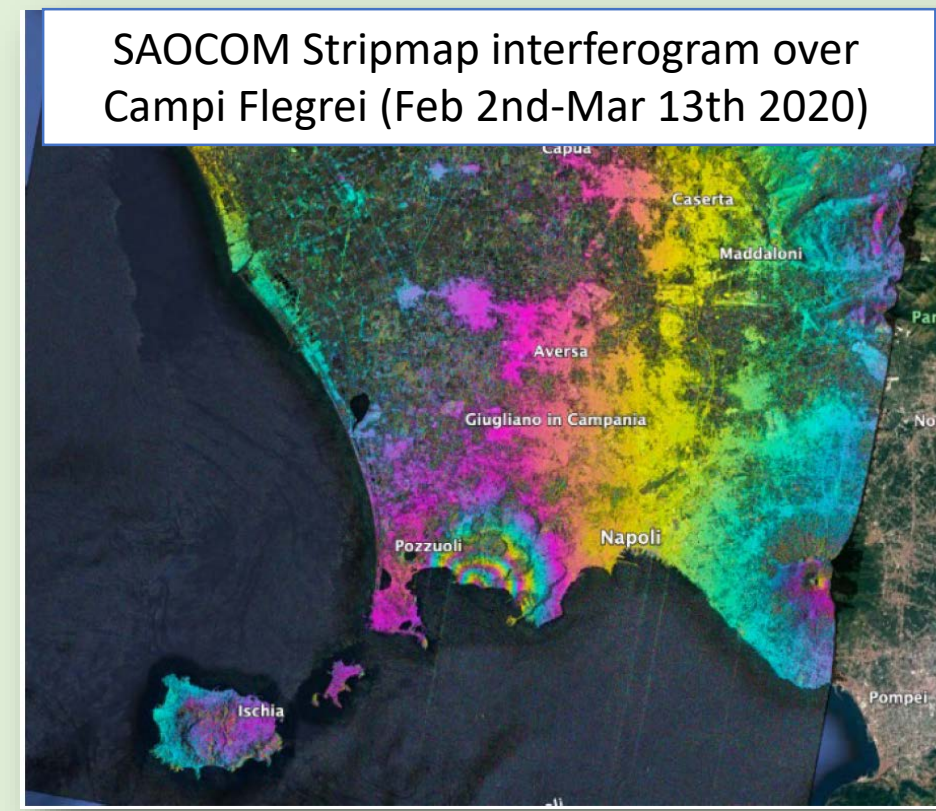*Severe damages detected from COSMO-SkyMed data*
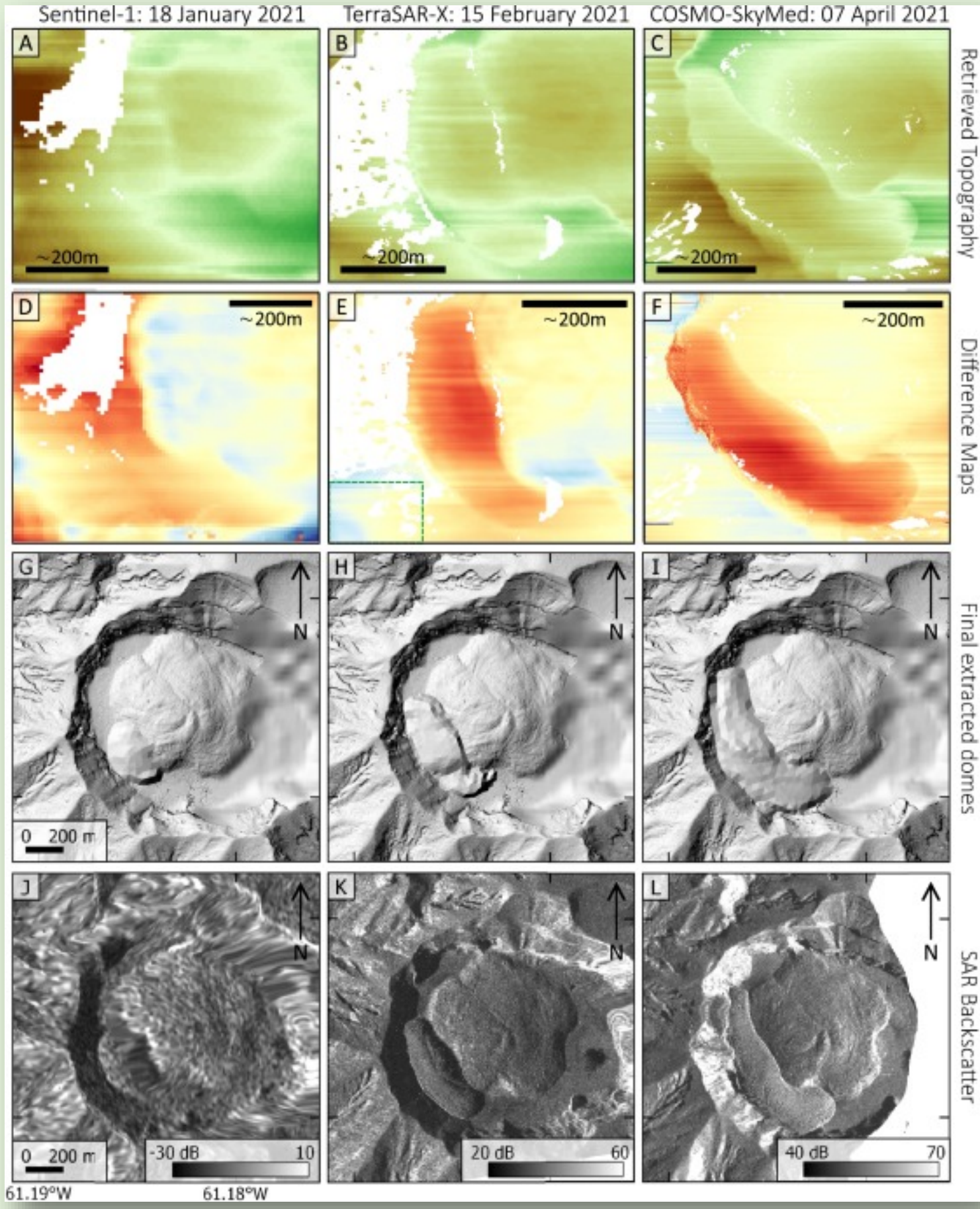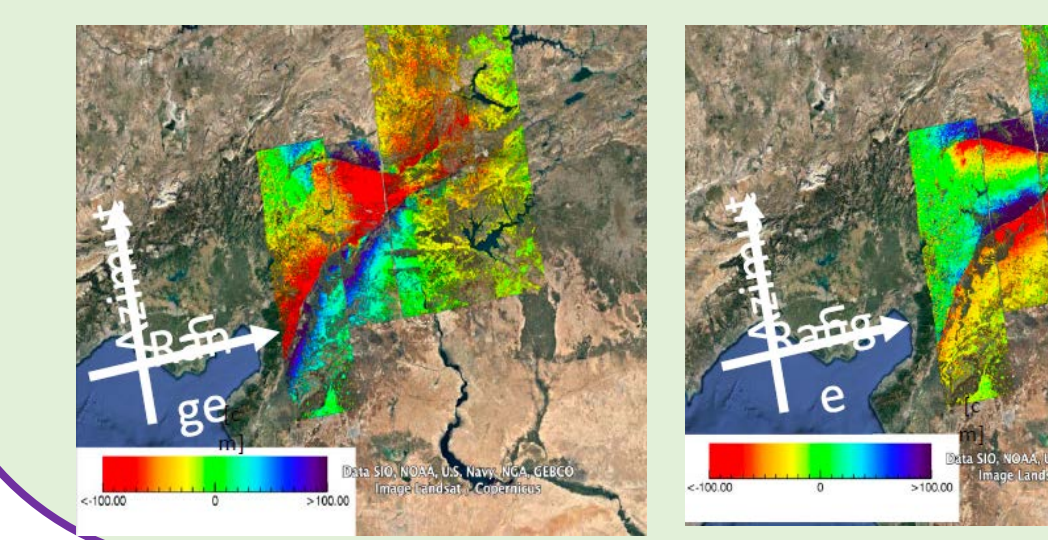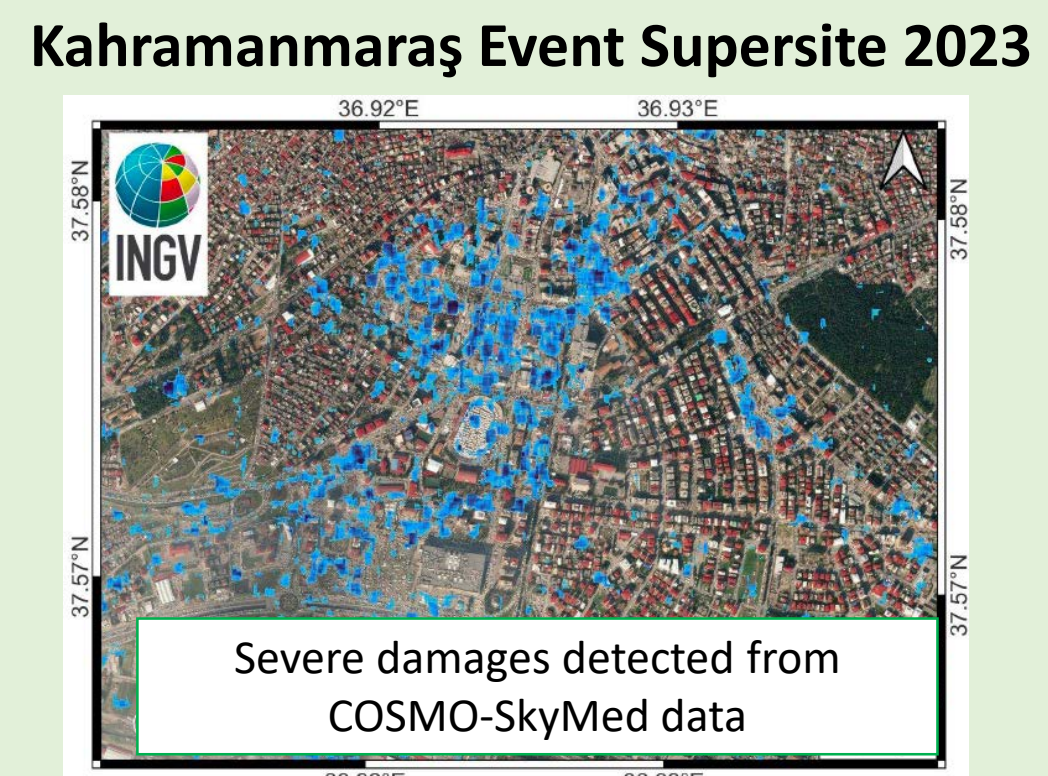
SAR-based products over St. Vincent volcano. (A-B-C) Range line retrieval of topography. (D-F) difference between the extracted height from SAR and the pre-eruption DEM. (G-I) final dome shapes. (J-L) original SAR backscatter images.
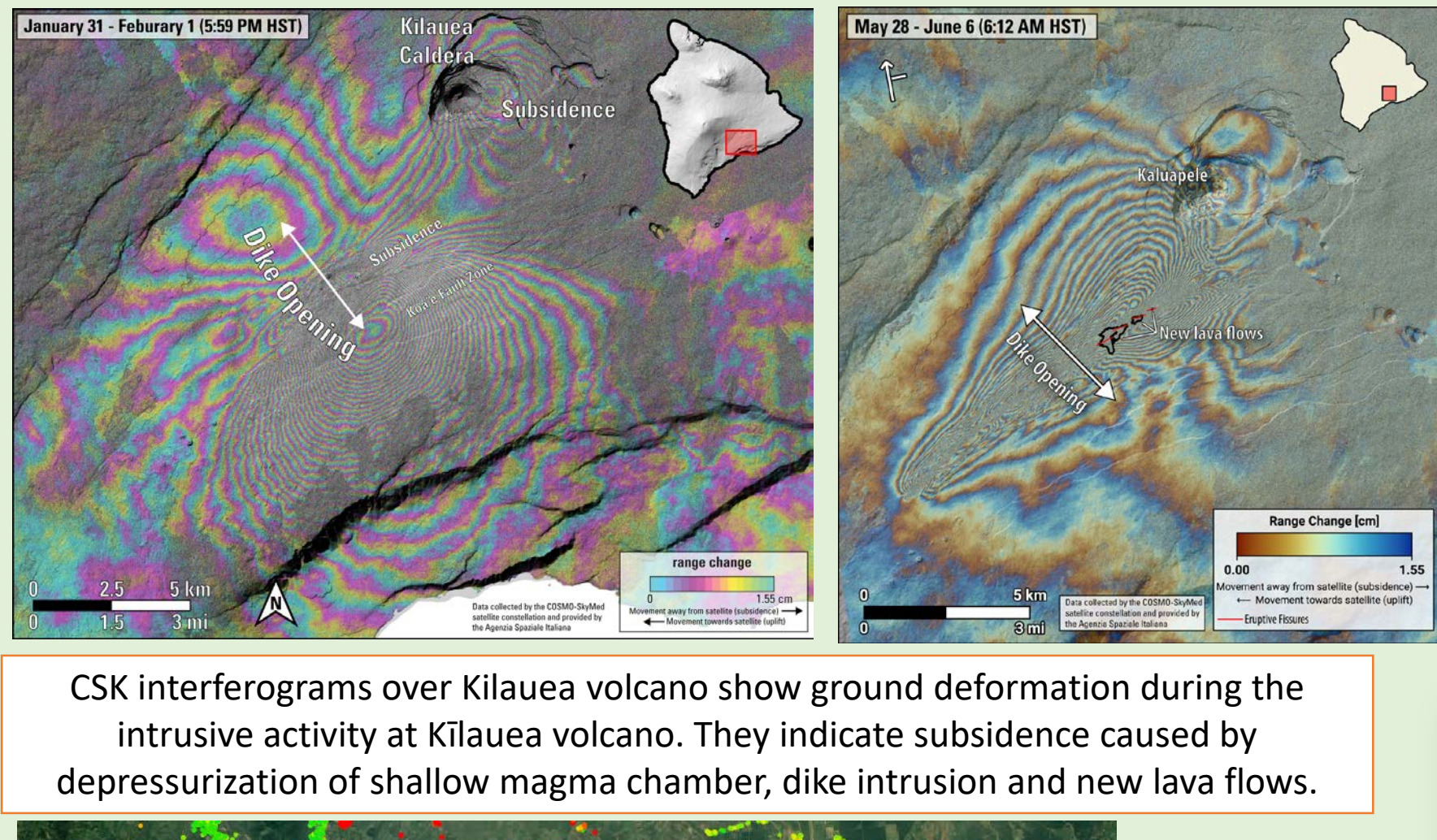
CSK interferograms over Kilauea volcano show ground deformation during the intrusive activity at Kīlauea volcano. They indicate subsidence caused by depressurization of shallow magma chamber, dike intrusion and new lava flows.
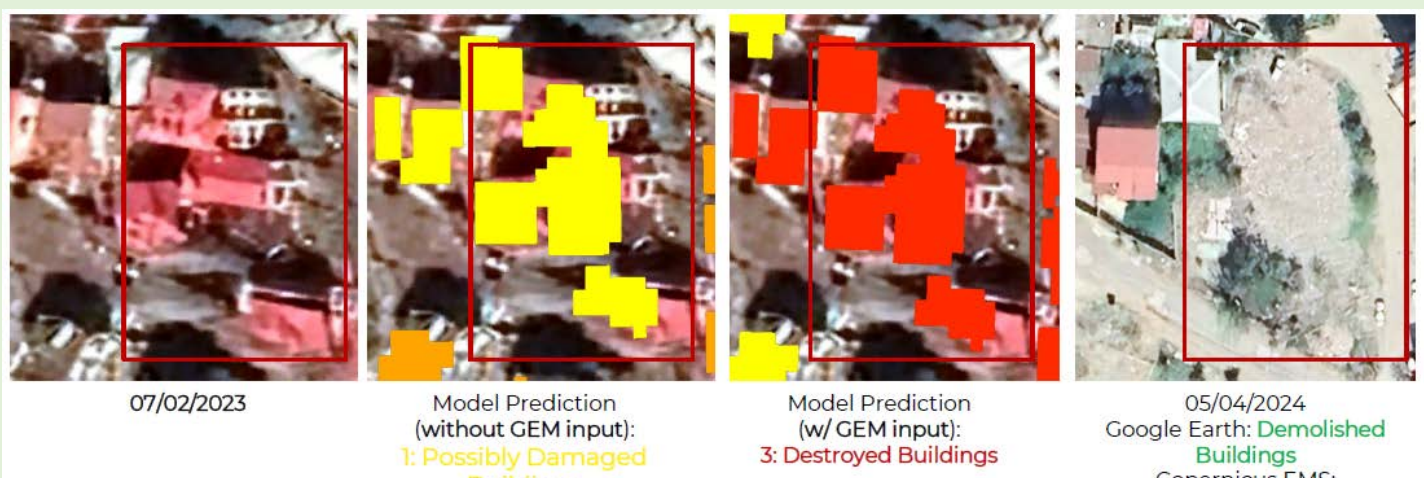

COSMO-SkyMed based multi-temporal DInSAR deformation maps in Honduras, for ETA-IOTA activation

SAOCOM Stripmap interferogram over Campi Flegrei (Feb 2nd-Mar 13th 2020)

Mean velocity map over Mt. Vesuvius (COSMO-SkyMed data, 2011-2022)

A dislocation model (left) using displacement fields from SAOCOM (right), Sentinel1 and ALOS2 (middle).

Earthquake induced damages retrieved through GEM and DL methods applied to COSMO-SkyMed SAR data for Syria-Turkey Earthquake 2023.

Constraining the Anydros Feb. 2025 unrest and its effect on Santorini Island with COSMO-SkyMed data processing. Image courtesy of AUTh in cooperation with ASI.