Space for DRRM: The Philippine Perspective:

Utilizing Satellites in Monitoring Volcanic and Earthquake Disasters in the Philippines through Sentinel Asia

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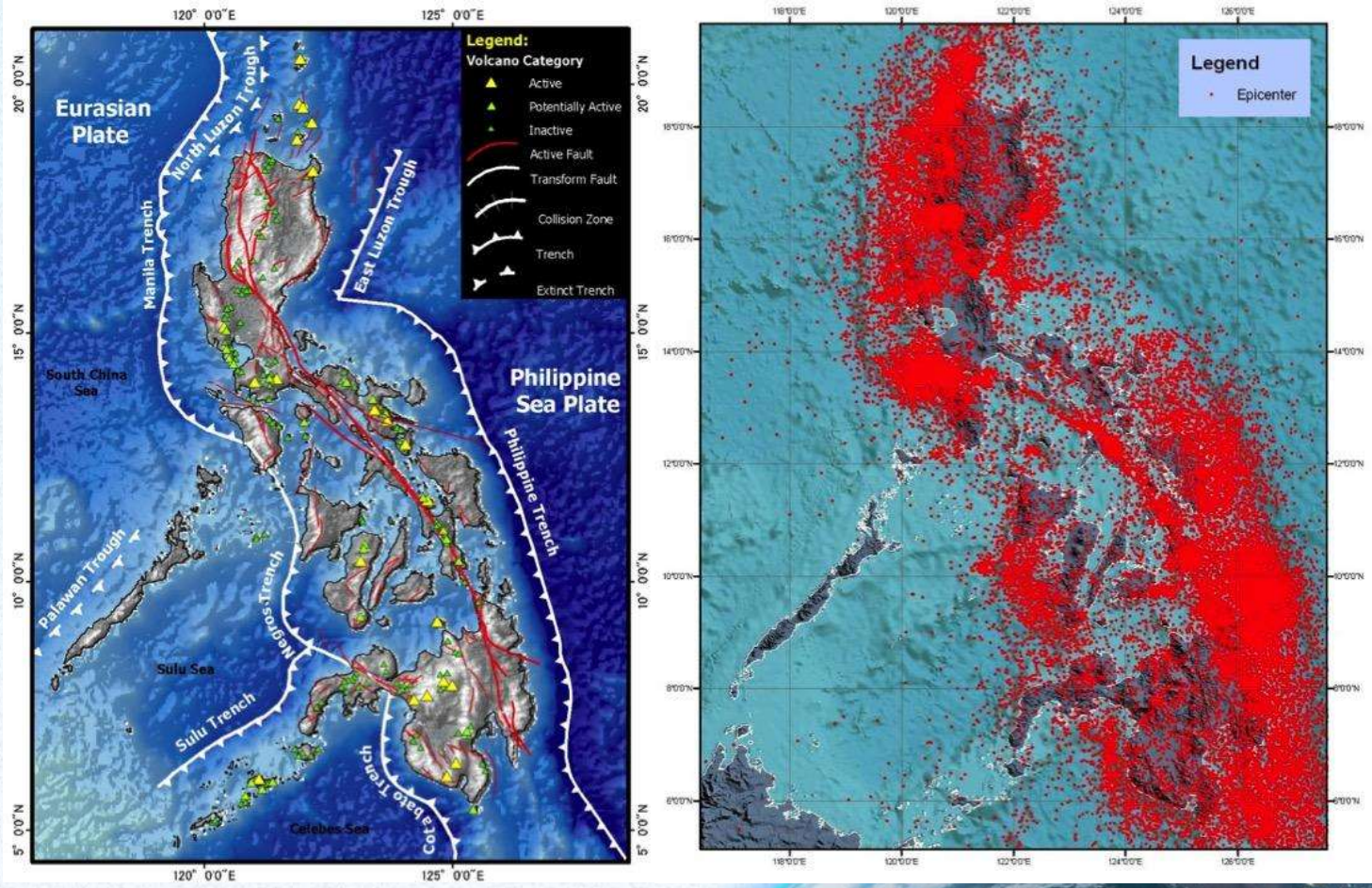
Introduction

- DOST-PHIVOLCS has mandates to Predict the occurrence of volcanic eruptions and earthquakes and their related geo-tectonic phenomena
- The Philippines is a tectonically active region.
- 300 volcanoes: 23 ACTIVE and 26 POTENTIALLY ACTIVE
- Six (6) converging tectonic plates or trenches (source of near-field tsunami), 87 ACTIVE FAULTS, and several unmapped active faults (buried/hidden)



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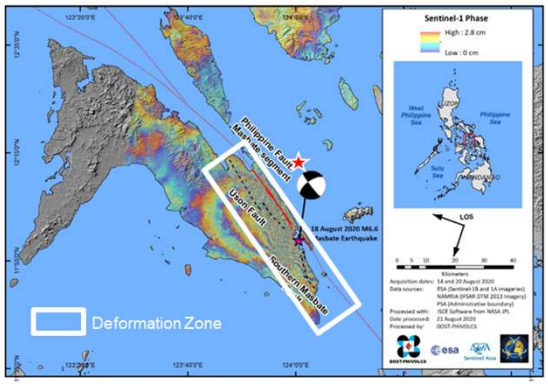
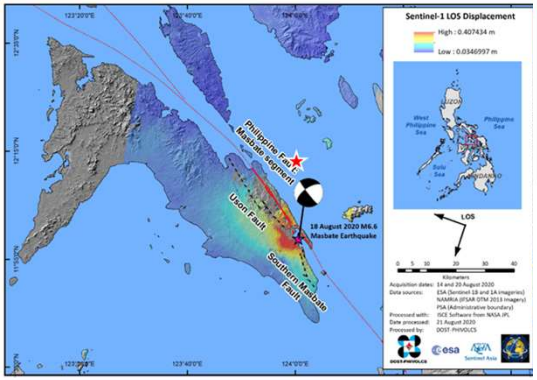
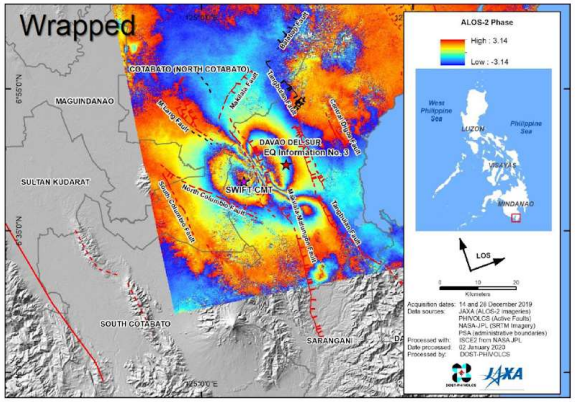
Deformation Mapping of Ground Rupture and Blind Fault. 18 August 2020 M6.6 Masbate EQ (40cm ground rupture) and 15 December 2019 M6.9 Davao del Sur Earthquake (Blind Fault)

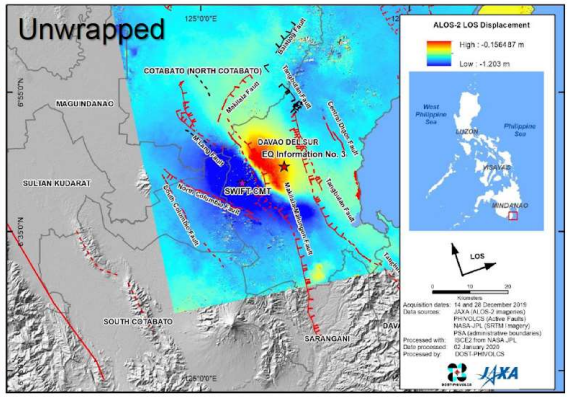
18 August 2020 M6.6 Masbate Earthquake

Through DInSAR analysis, DOST-PHIVOLCS identified the **zone of deformation** (left image) caused by the movement of the Philippine Fault: Masbate Segment last August 2020. DInSAR deformation results manifested on the ground as ground rupture, liquefaction, landslides etc.. Damages to man-made structures were also observed in these sites. DInSAR analysis also **estimated that the ground deformation was ~30cm** (right image). This measurement came close with ground observations, which measured at ~40cm.









- The wrapped phase image shows a pattern of fringes consistent with the deformation cause by the earthquake.
- The unwrapped LOS image shows movement towards the satellite (indicated by the red areas) with a max. value of approx. 15.6 cm and movement away from the satellite (indicated by the blue areas) with a max. value of approx. 120 cm.

The 2019 M6.9 Davao del Sur Earthquake
DOST-PHIVOLCS Quick Response Team

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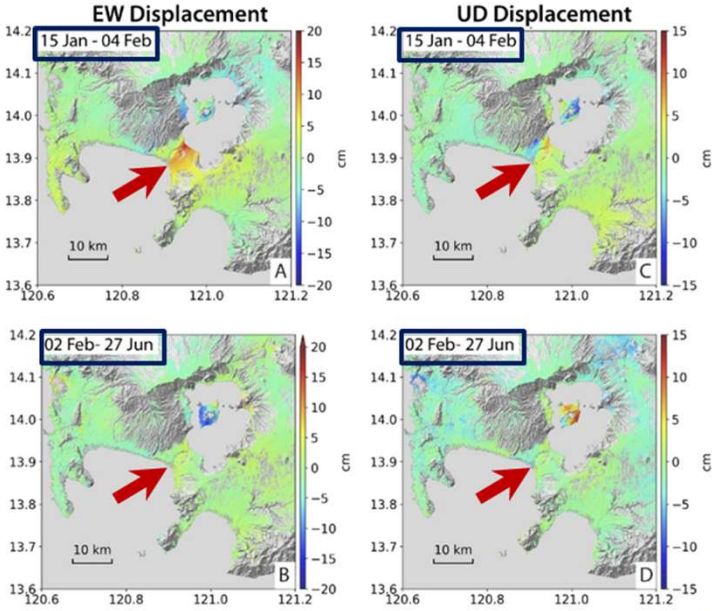
Volcano deformation monitoring using Differential Interferometry (DInSAR

DInSAR Analysis of Taal Volcano Ground Deformation



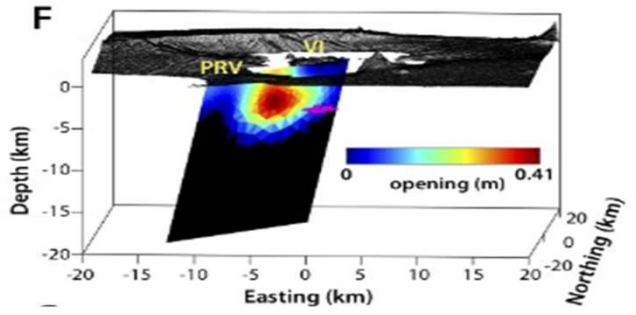
Horizontal (A-B) and vertical displacement
(C-D) maps derived from the descending and ascending cumulative displacements covering two periods:
(A,C) 15 January-04 February and
(B,D) 02 February to 27 June 2020.

(A-B) Red means that the ground moved eastward, blue signifies that the ground moved westward.
(C-D)Red means that the ground moved upward and blue represents downward movement.

Source: https://www.essoar.org/pdfjs/10.1002/essoar.10504404.2

Bato et al., The 2020 eruption and the large lateral dike1emplacement at Taal volcano, Philippines: Insights2 from radar satellite data

3D view of the post-eruptive model covering 15 January-04 February 2020



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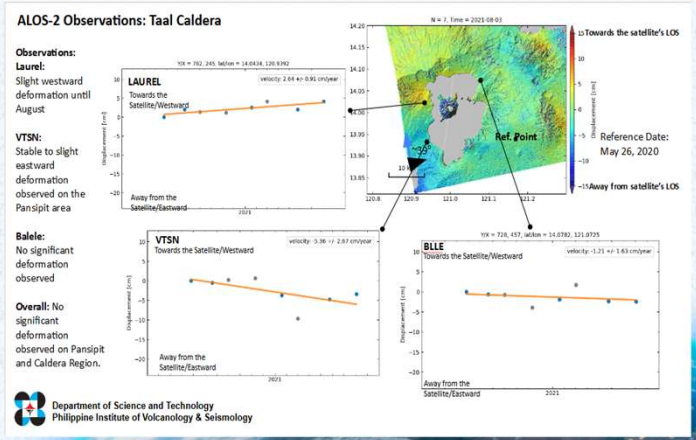

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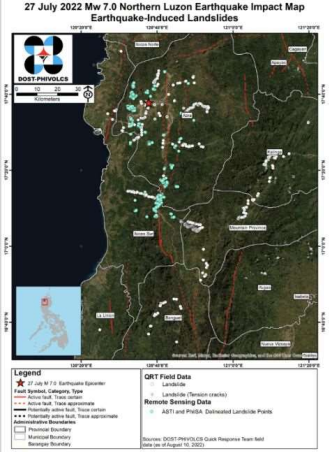
Use of optical satellite images on impact assessment on volcanoes and earthquakes.

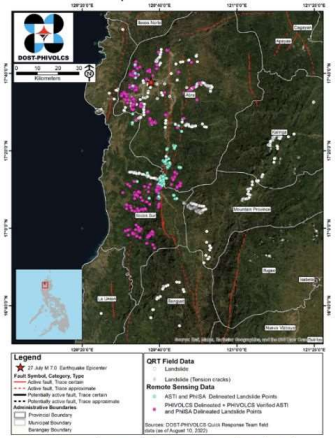
EIL: Landslide Distribution (LSI) using remote sensing and QRT Data

27 July 2022 Mw 7.0 Northern Luzon Earthquake Impact Map
Earthquake-Induced Landslides



Sample interpretation of polygon feature LSI (delineated from RS images in QRT)

27 July 2022 Mw 7.0 Northern Luzon Earthquake Impact Map
Earthquake-Induced Landslides



Comparison of LSI using the DOST- PHIVOLCS **QRT** field data and ASTI & PhilSA **RS** using Planet and Kompsat

LSI-QRT and RS validation using the Pleaides and Worldview

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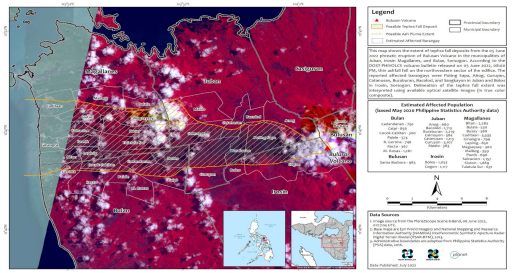
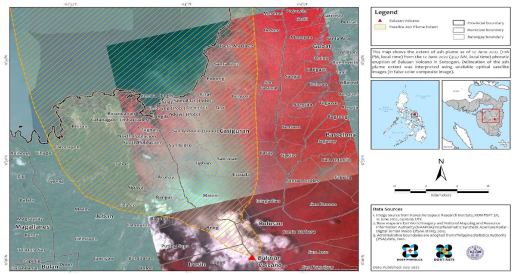
The 27 July 2022 Magnitude 7.0 Northwestern Luzon Earthquake

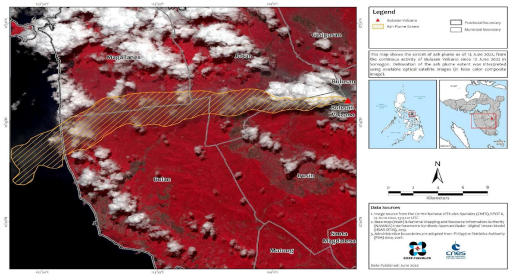
RS-based Delineated Tephra Fall Deposits from 05 June 2022 Phreatic Eruption of Bulusan Volcano in the Province of Sorsogon



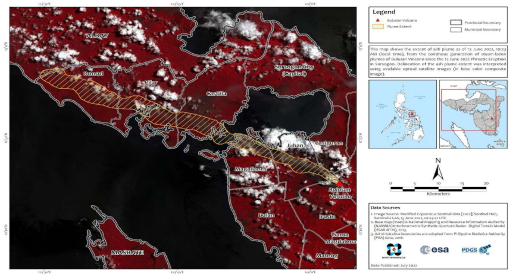
RS-based Delineated Extent of Ash Plume from the 12 June 2022 Phreatic Eruption of Bulusan Volcano in the Province of Sorsogon



RS-based Delineated Extent of Ash Plume from the 14 June 2022 Bulusan Volcano Activity in the Province of Sorsogon



RS-based Delineated Extent of Ash Plume from the 13 June 2022 Bulusan Volcano Activity in the Province of Sorsogon



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Additional Notes

- **Benefits:**
  - Satellite data are free in the event of disaster using established protocols using Sentinel Asia and can be elevated to The International Charter Space and Major Disasters
  - Rapid disaster assessment over wide area

- **Challenges:**
  - Optical satellite images may have significant cloud cover in tropical regions like Philippines especially after typhoon.

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