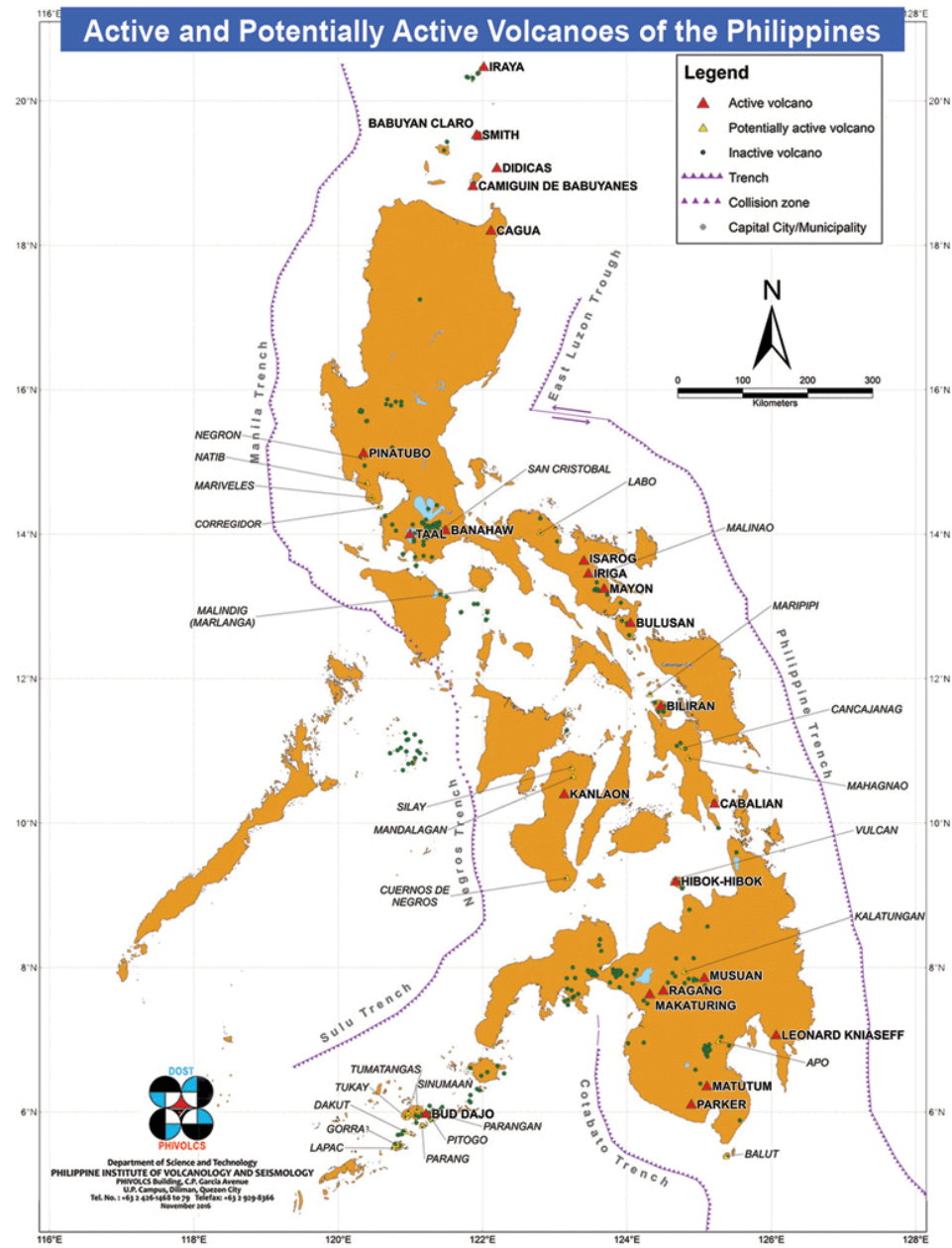
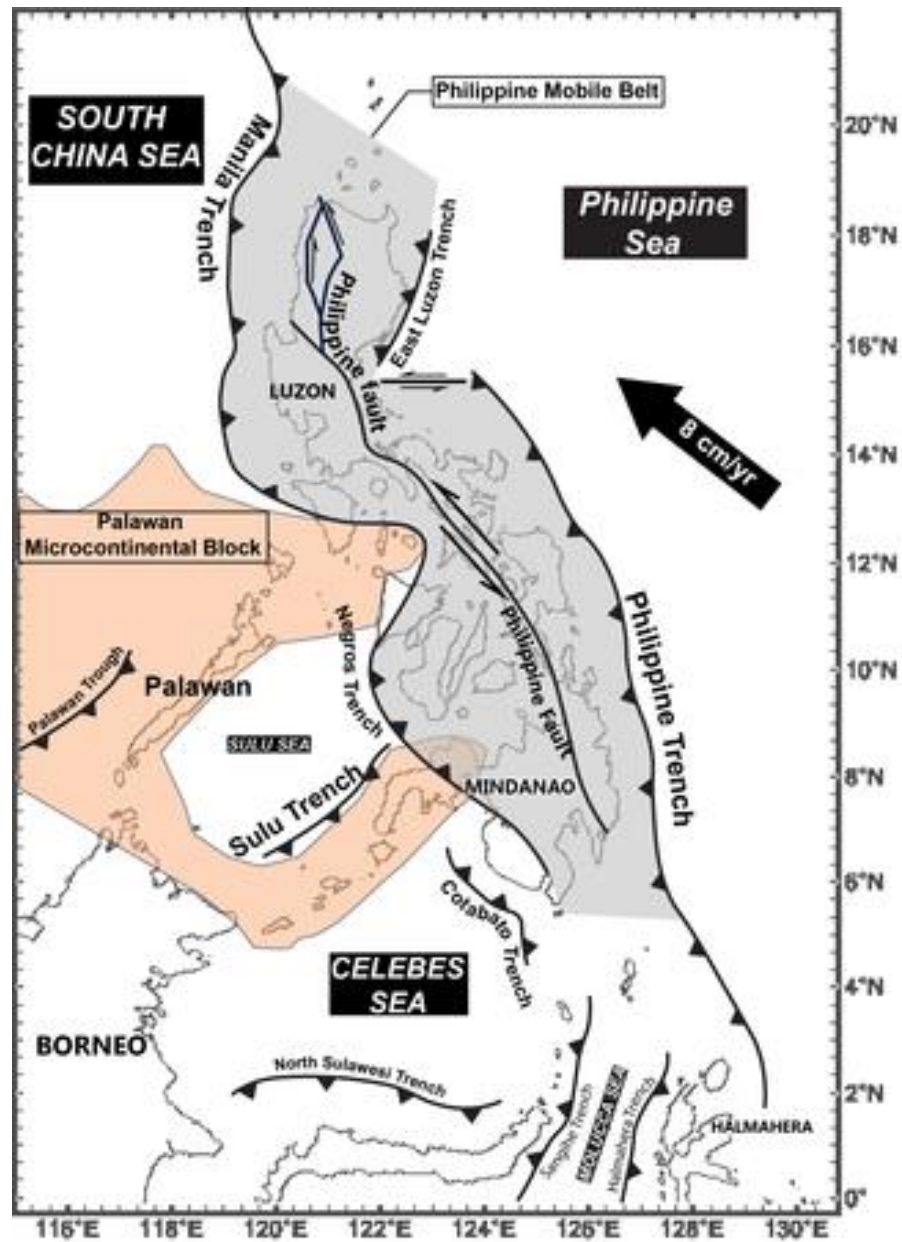


From Detection to Database: Standardized Seismic Processing Workflows in Philippine Volcano Observatories

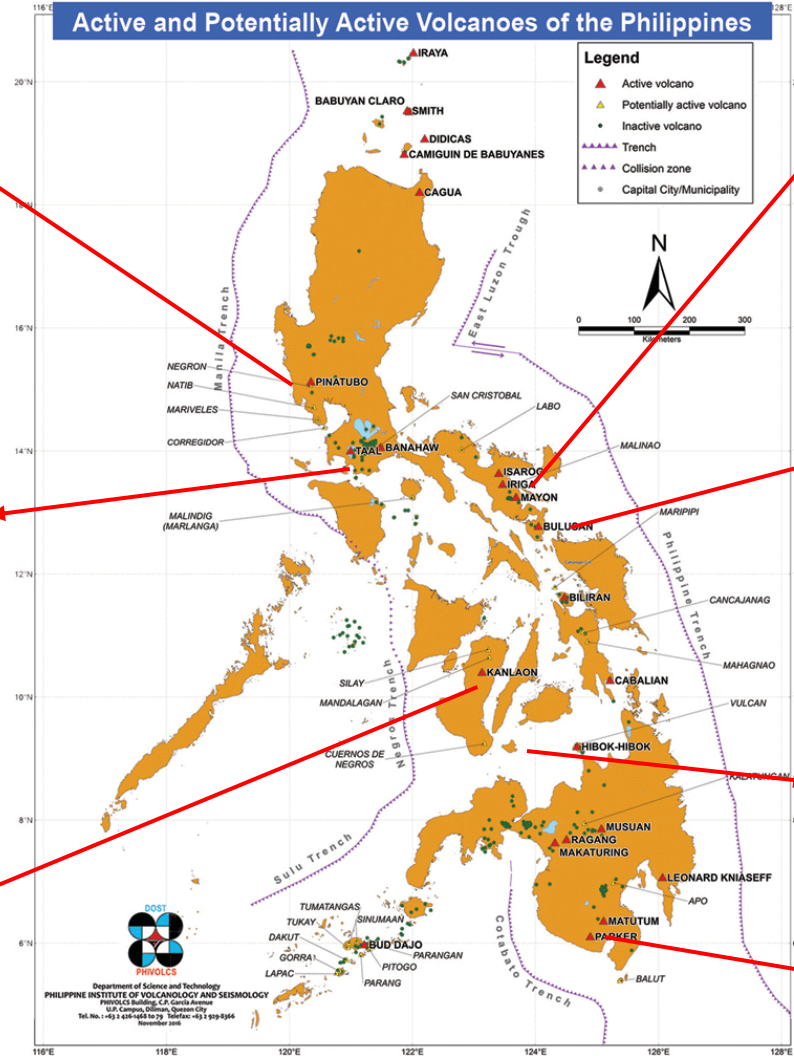
Lois Abigail Jumawan

Department of Science and Technology - Philippine Institute of Volcanology and Seismology
(PHIVOLCS)

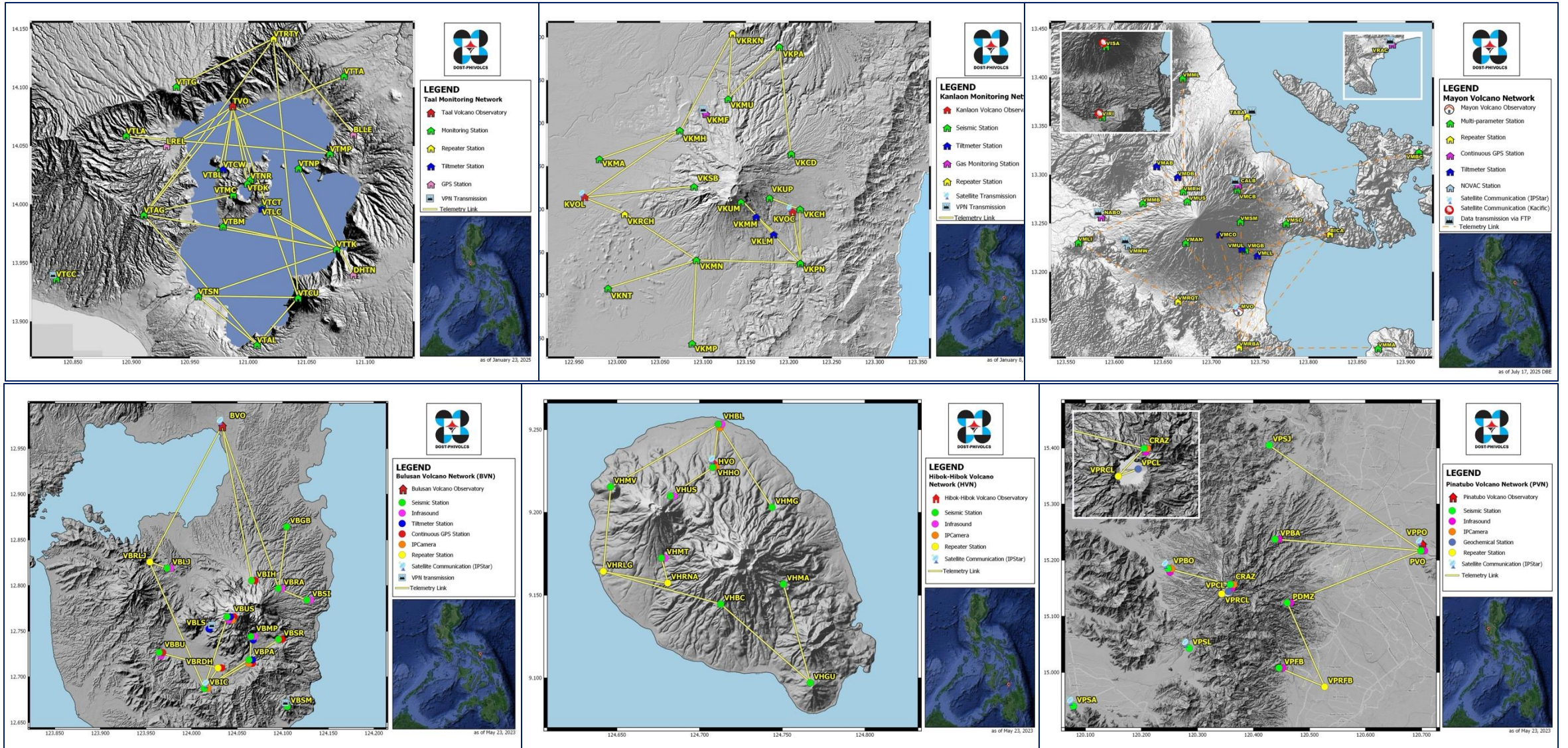


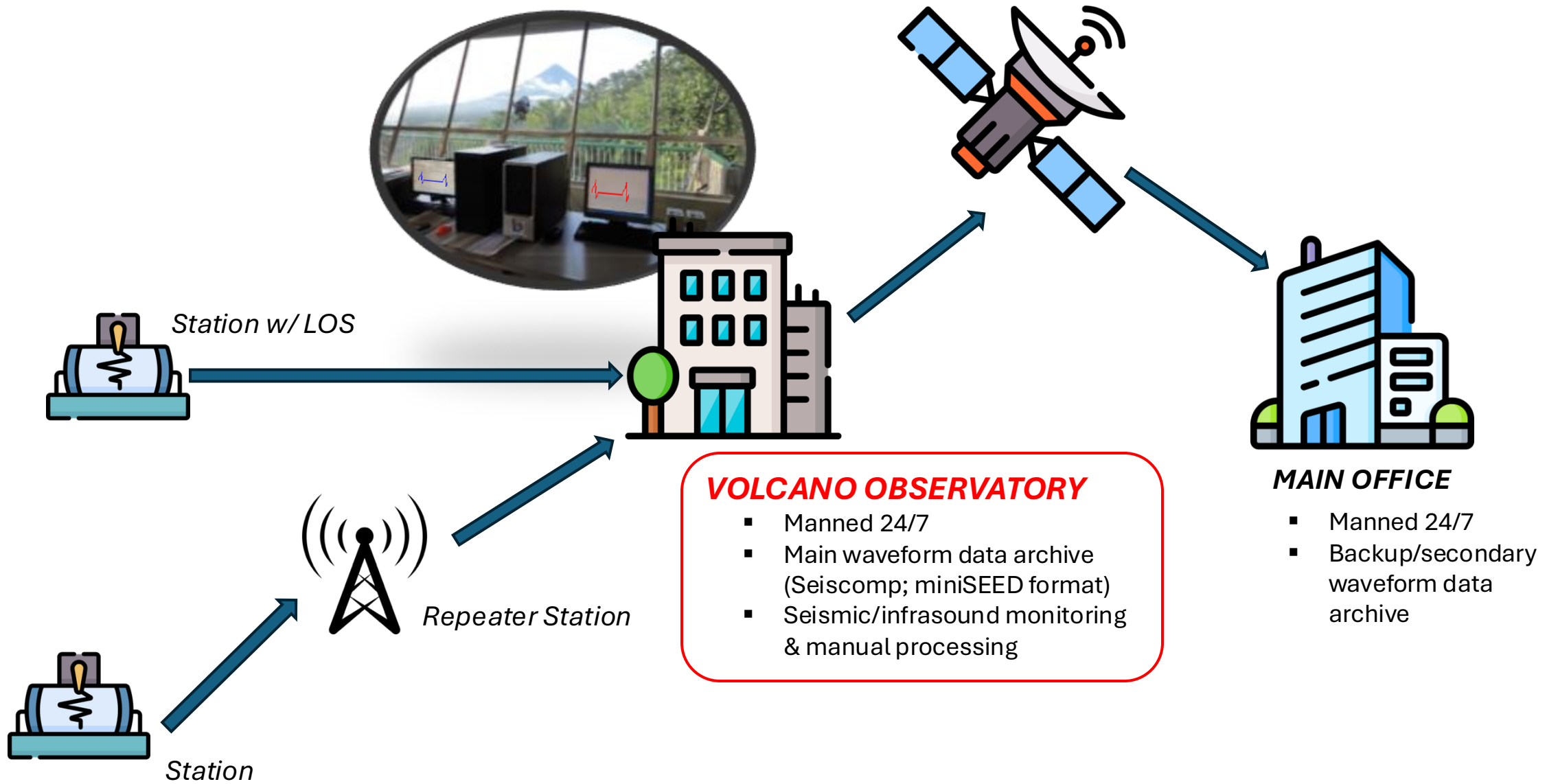


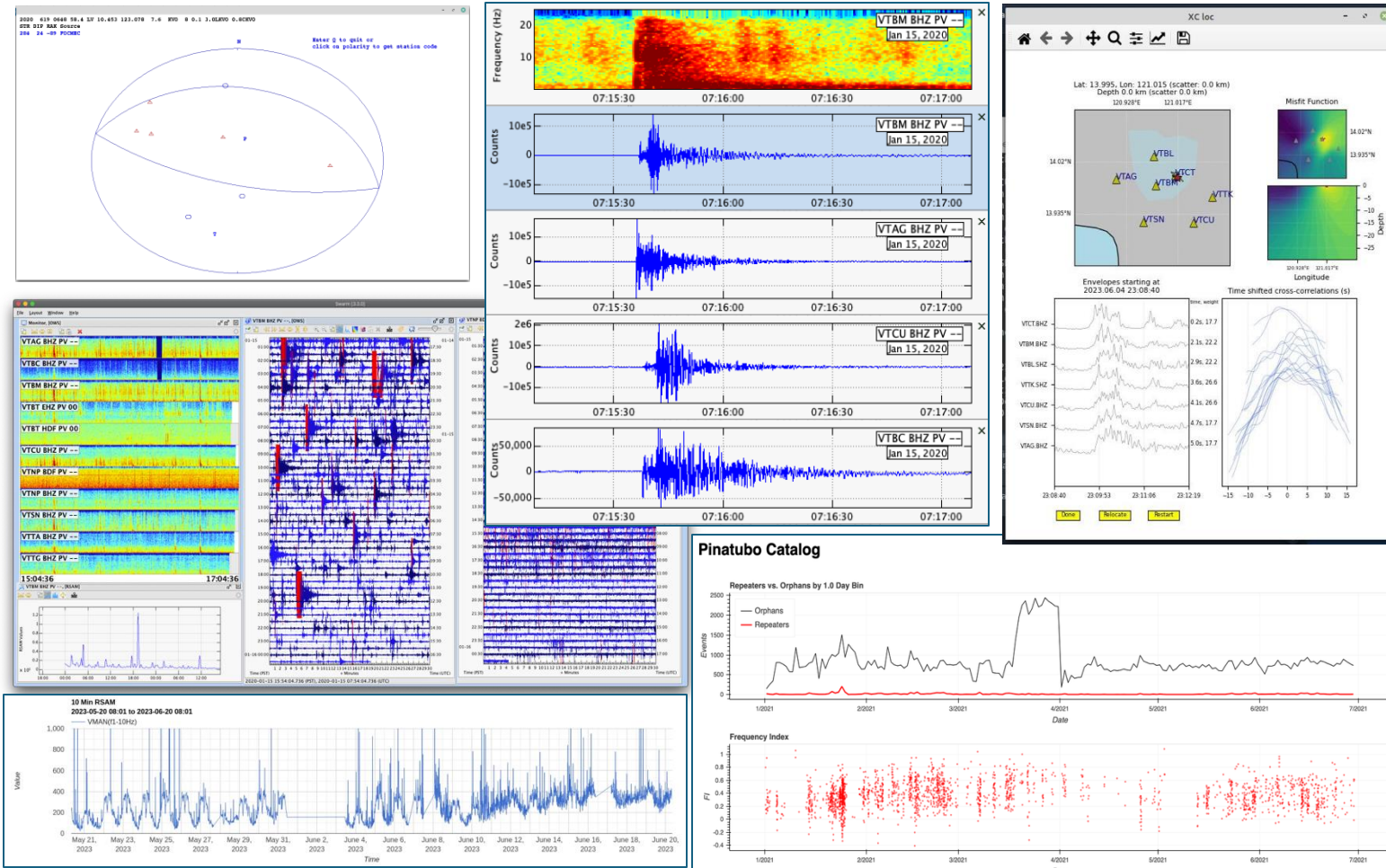
7 Volcano Observatories to monitor 12 active volcanoes



Volcano Monitoring Networks





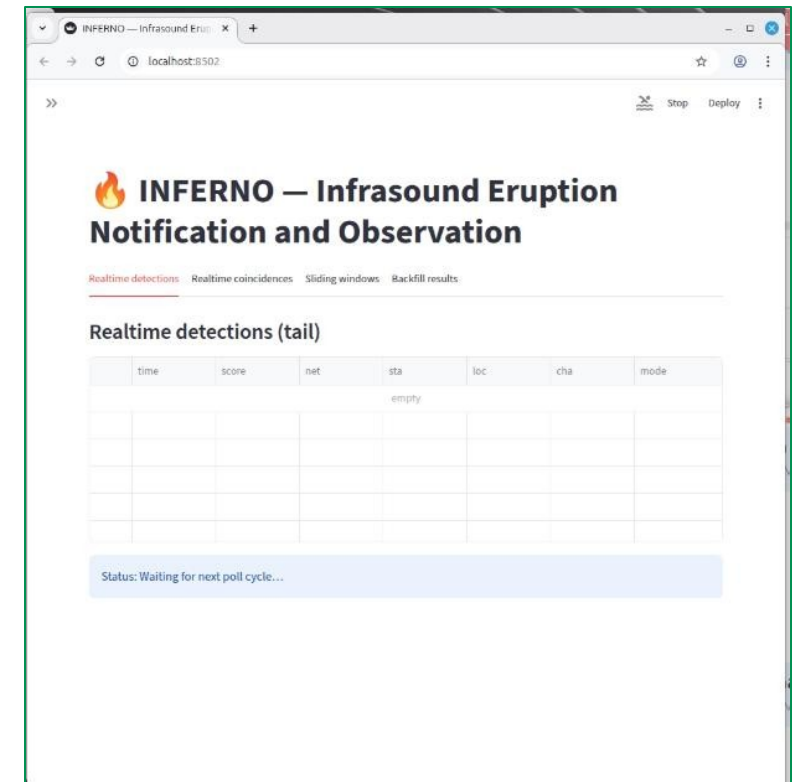
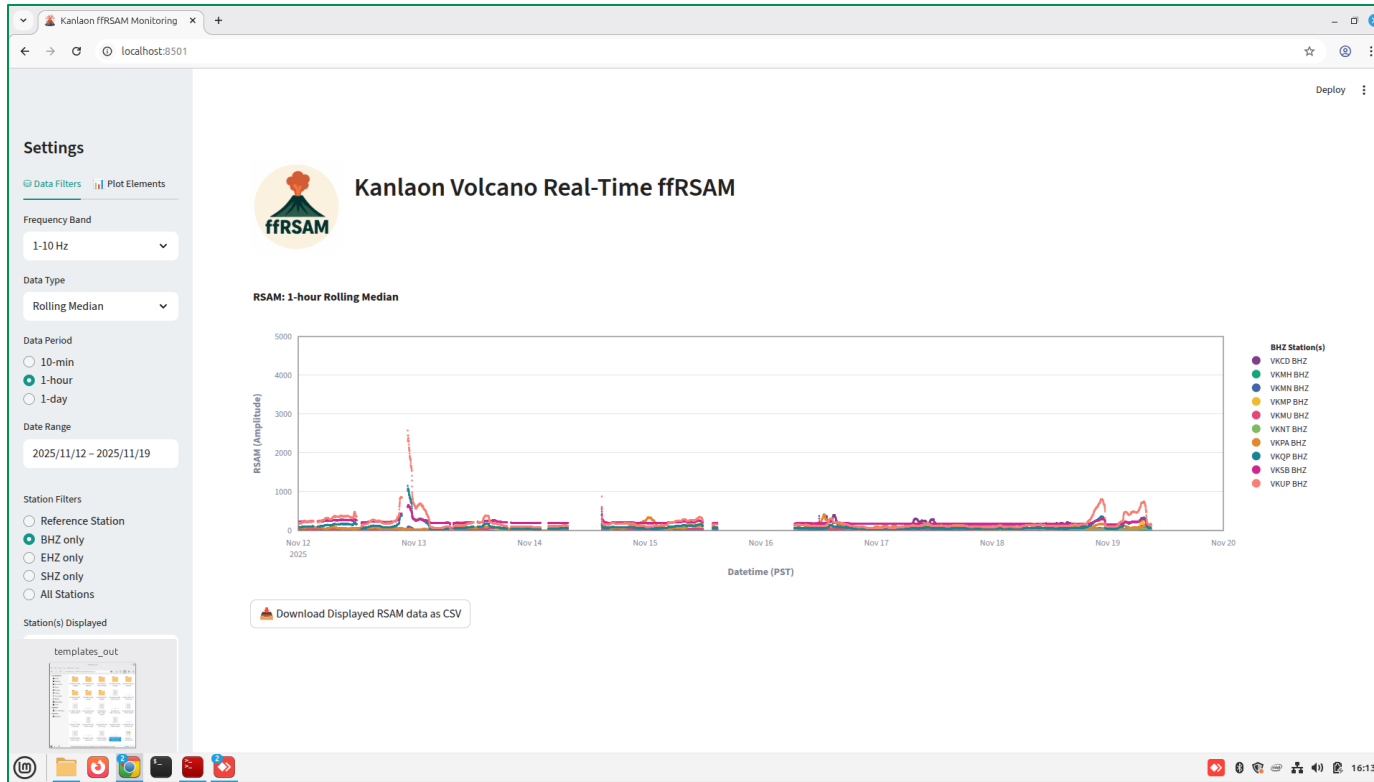


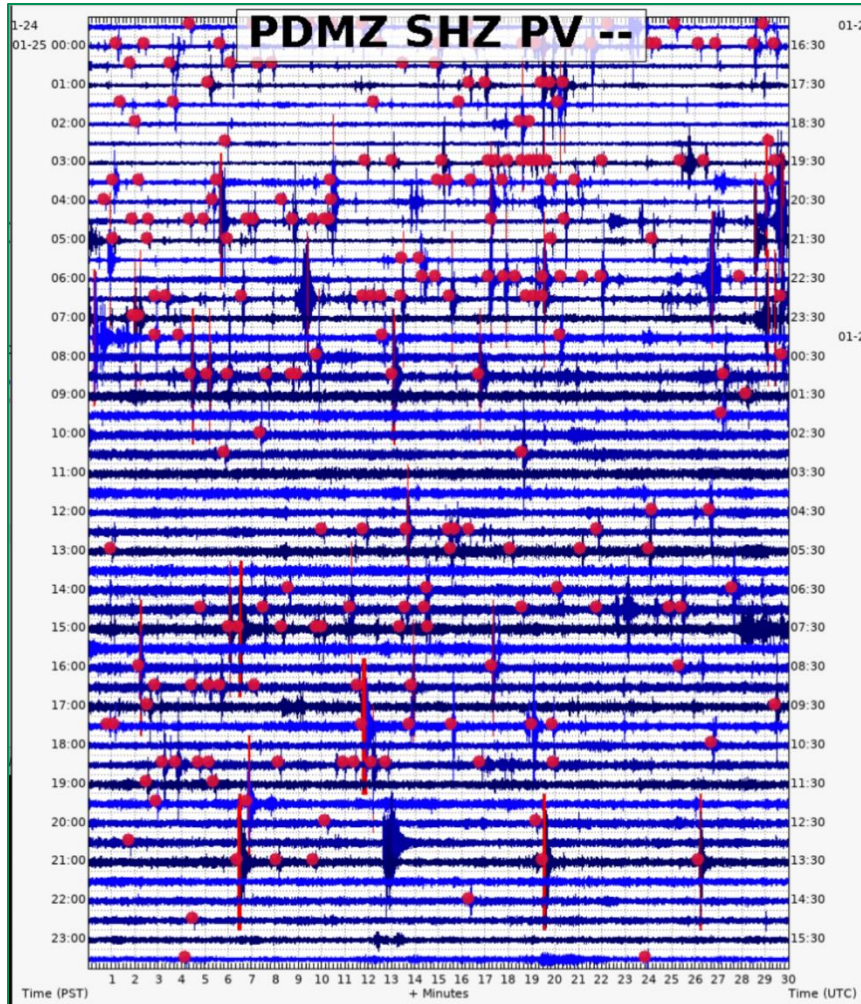
Seismic Monitoring Tools

- Swarm
- SeisAn
- Enveloc
- HypoDD
- iPensive
- ffRSAM
- RedPy

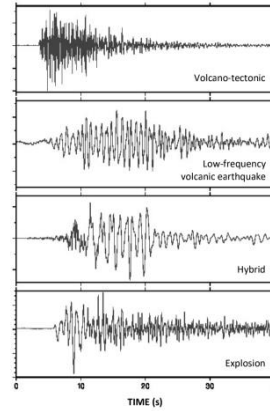
- And more...

Display + Alarms





Volcanic seismic signal classification



Volcano-tectonic (VT) earthquakes are high-frequency waveforms with broad spectra ($> 5\text{ Hz}$) and can have either impulsive or emergent onset. These are caused by shear failure mechanism from excess heat and pressure from magmatic processes.

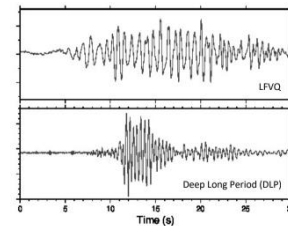
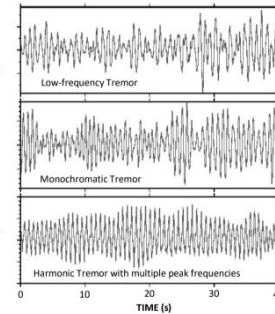
Low-frequency volcanic earthquakes (LFVQ) are short duration waveforms with peak frequencies of $< 5\text{ Hz}$. These are mostly attributed to gas and/or fluid movement at shallow depths (ie. Hydrothermal activity or ash emission events).

Hybrid earthquakes are a combination of high- and low-frequency waveforms with no clear S-wave, but peak frequencies are $< 5\text{ Hz}$. These signals can signify brittle failure that intersect a fluid-filled crack, and can also be related to dome growth.

Explosion (E-type) earthquakes accompany eruption processes such as lava fountaining or explosive eruption. This signal has a distinct, low-frequency "airwave" onset and followed by either broadband or low-frequency tremor.

Tremor is a continuous seismic signal with a duration of several minutes to days. It can be caused by several different processes, including fluid resonance, continuous occurrence of VT or LFVQs, and explosions.

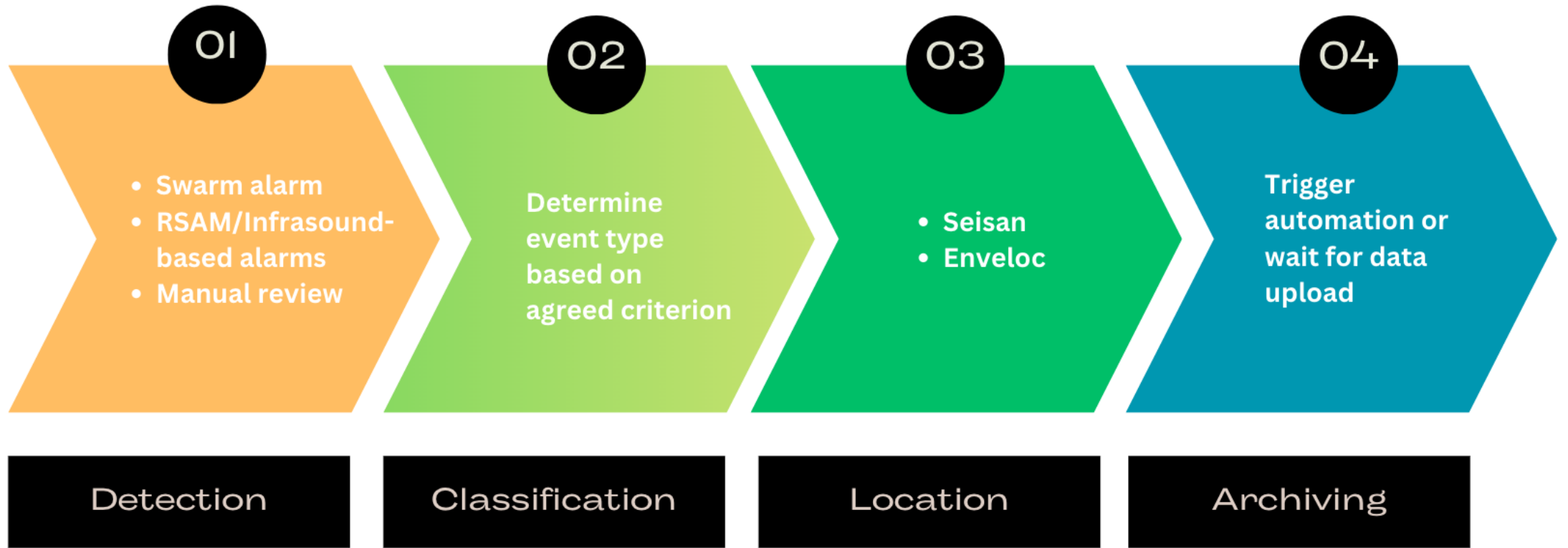
Harmonic Tremor are rhythmic, low-frequency tremors with peak frequencies at $< 3\text{ Hz}$ and are associated with fluid oscillation. Each individual signal last up to several minutes, but these can also occur in hours-long sequences with overlapping codas. These can occur either as **Monochromatic tremors** (single-peak frequency) or contain **2 or more** harmonic peaks. These signals can be attributed to gas streaming and/or ash and steam emission events.



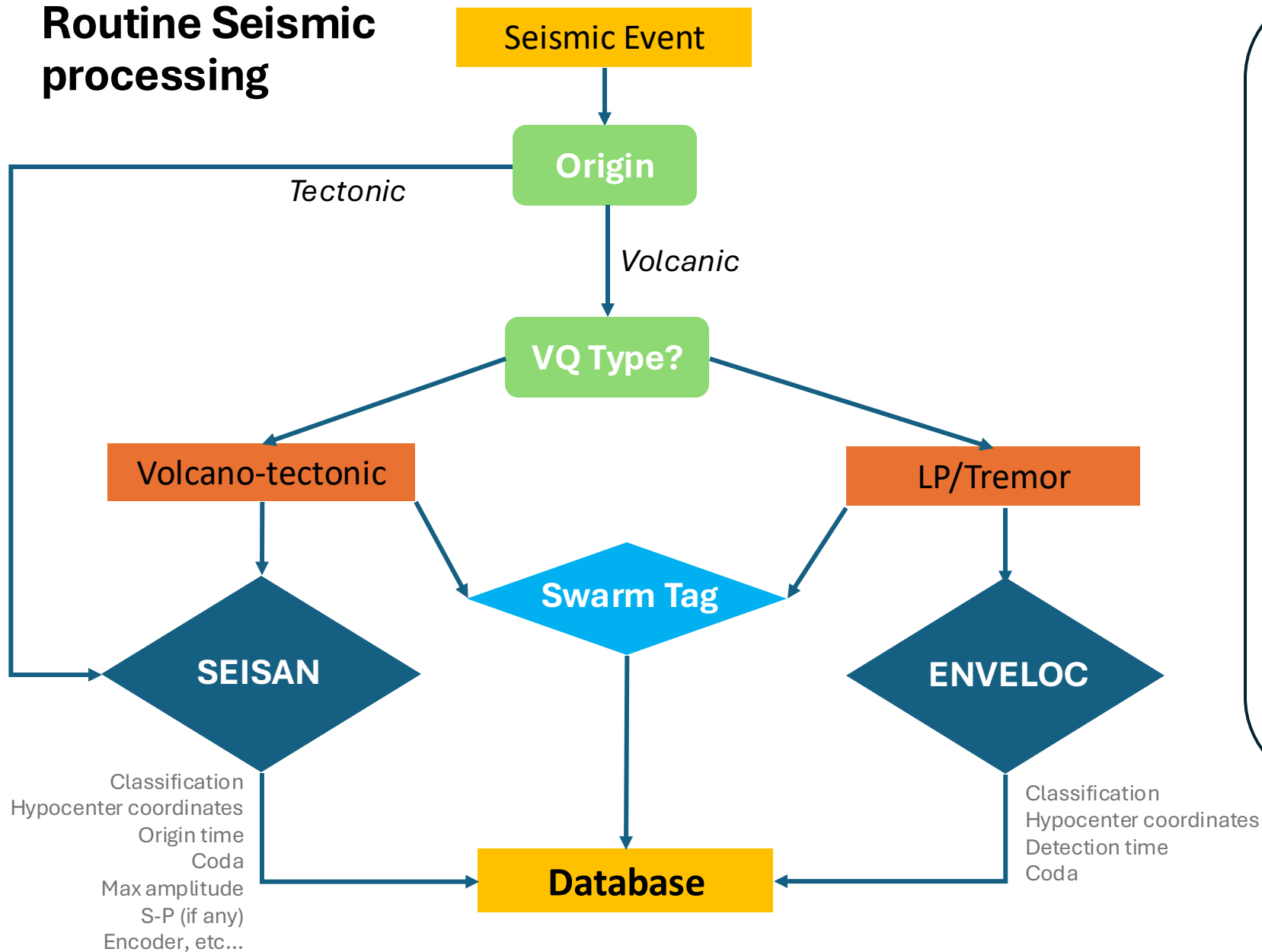
Deep Long-Period (DLP) earthquakes are a type of LF seismicity ($< 5\text{ Hz}$) with emergent onset, S-wave arrival, and extended codas. DLP hypocenters are located at mid- to lower crust and upper mantle regions. These are attributed to fluid movement at those depths, occurring either as background seismicity or precursors to a volcanic eruption.

VQ Classes

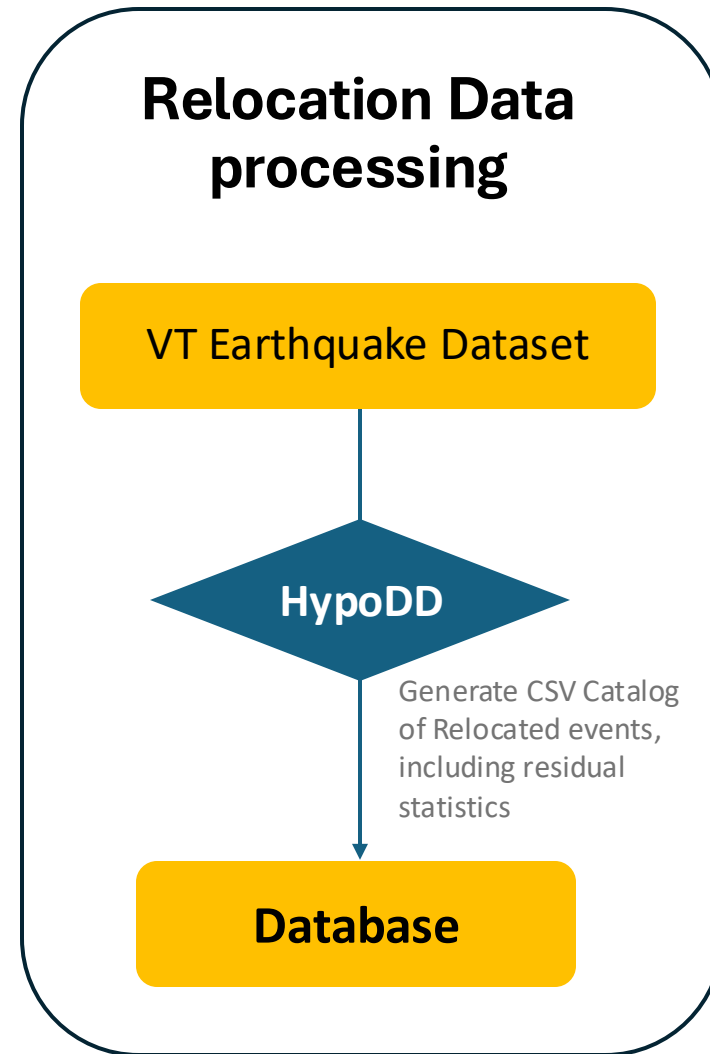
- VT – Volcano-tectonic
- LFVQ – “Low-frequency volcanic earthquake”
- DLP – Deep Long-period
- Hybrid
- Tremor
- Harmonic Tremor
- Tornillo
- E-type



Routine Seismic processing

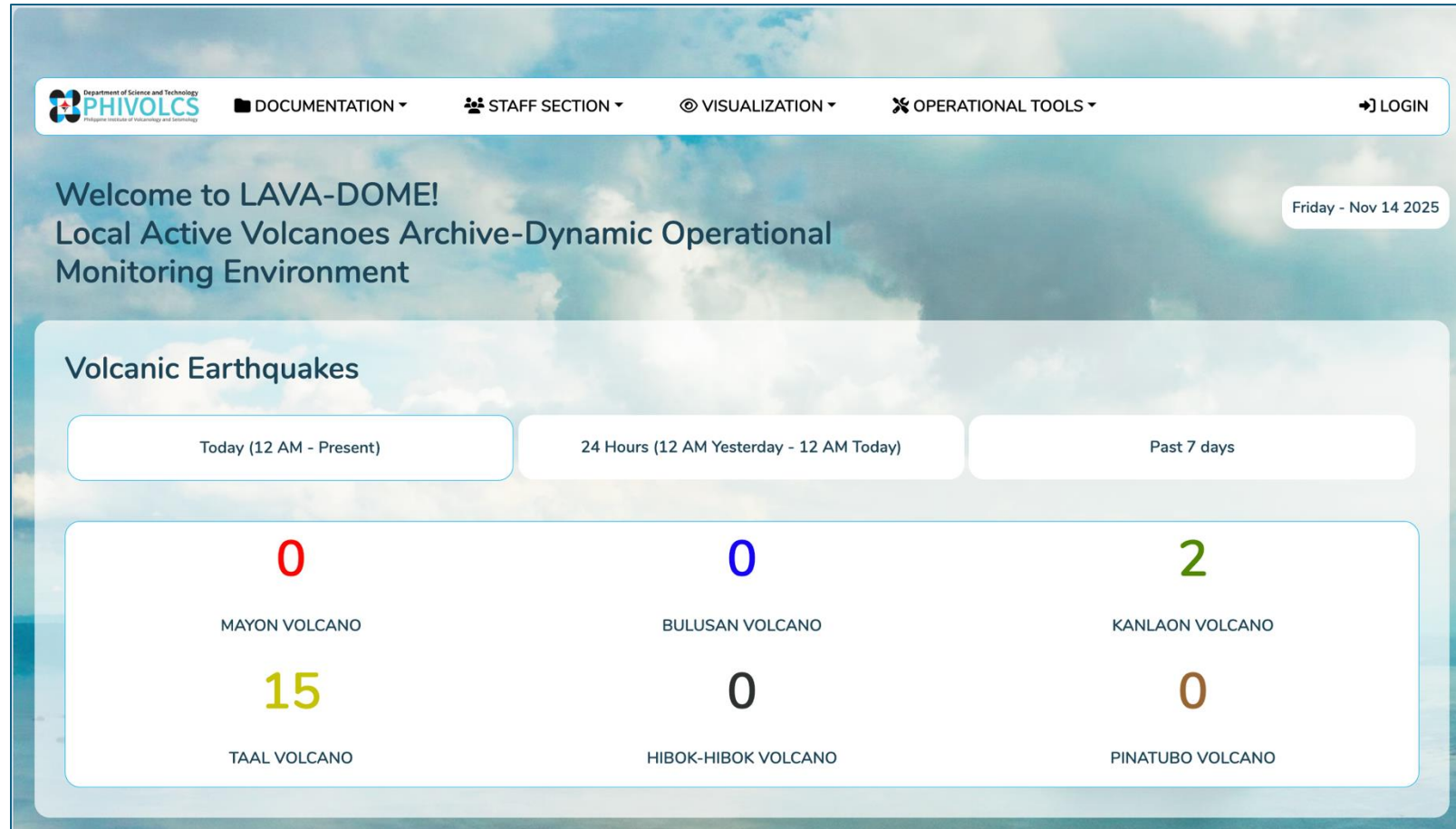


Relocation Data processing



LAVA-DOME

(Local Active Volcanoes Archive – Dynamic Operational Monitoring Environment)



- Archive of processed monitoring data (seismic, infrasound, deformation, geochemical, visual)
- Bulletin infographics creation tool
- Philippine Volcanoes information resource
- Accessible to all volcano monitoring personnel in PHIVOLCS
- Fully integrated to SOP
- Seismic data uploading is fully automated (one-click trigger or cron)

PHIVOLCS Department of Science and Technology

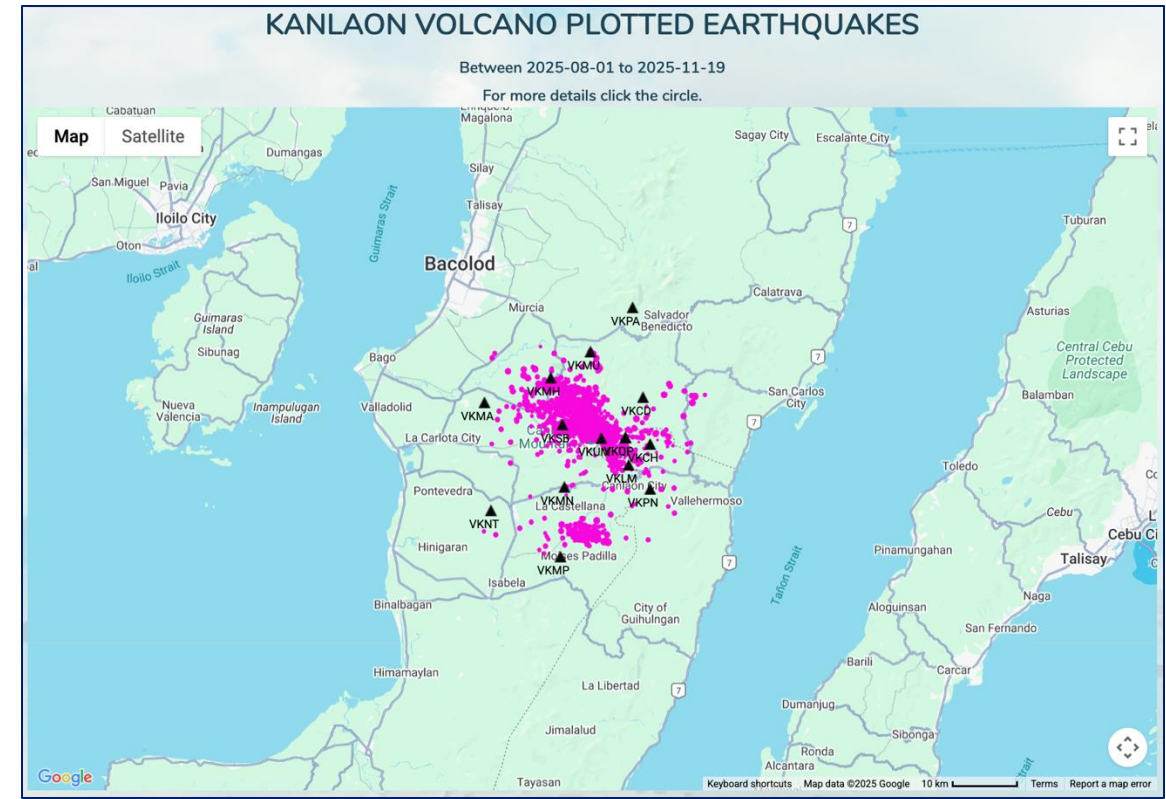
DOCUMENTATION STAFF SECTION VISUALIZATION OPERATIONAL TOOLS Logout [Icjumawan]

Show Latest Data

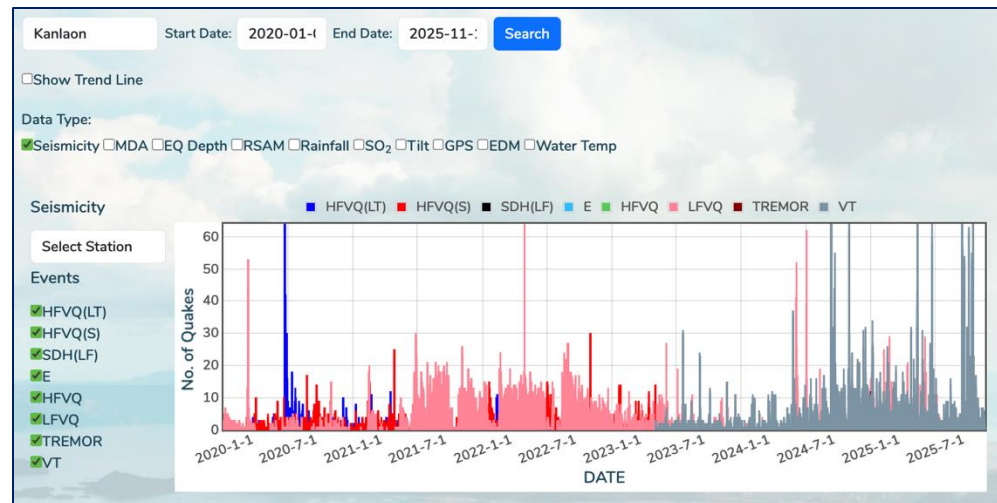
The latest records will be displayed if no dates are entered.

Volcano: Start Date: End Date: Or Select eqtype:

<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Delete"/>	Id	volcano	Code	Ss_id	EventTime	Msec	P-Method	S-P	Duration	Amplitude	S-Rate	Classification
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Delete"/>	5012902	565	0702-02=VKMU20251116192006727	140	2025-11-16 19:20:06	0.73	H	1.46	9	15	50	VT
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Delete"/>	5012900	565	0702-02=VKCD20251116192005417	119	2025-11-16 19:20:05	0.42	H	1.56	7	395.1	50	VT
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Delete"/>	5012901	565	0702-02=VKPN20251116192005777	145	2025-11-16 19:20:05	0.78	H	0.82	7	1.5	50	VT
<input type="checkbox"/>	<input type="button" value="Edit"/>	<input type="button" value="Delete"/>	5012899	565	0702-02=VKUP20251116192004891	81	2025-11-16 19:20:04	0.89	H	1.07	7	13.8	50	VT



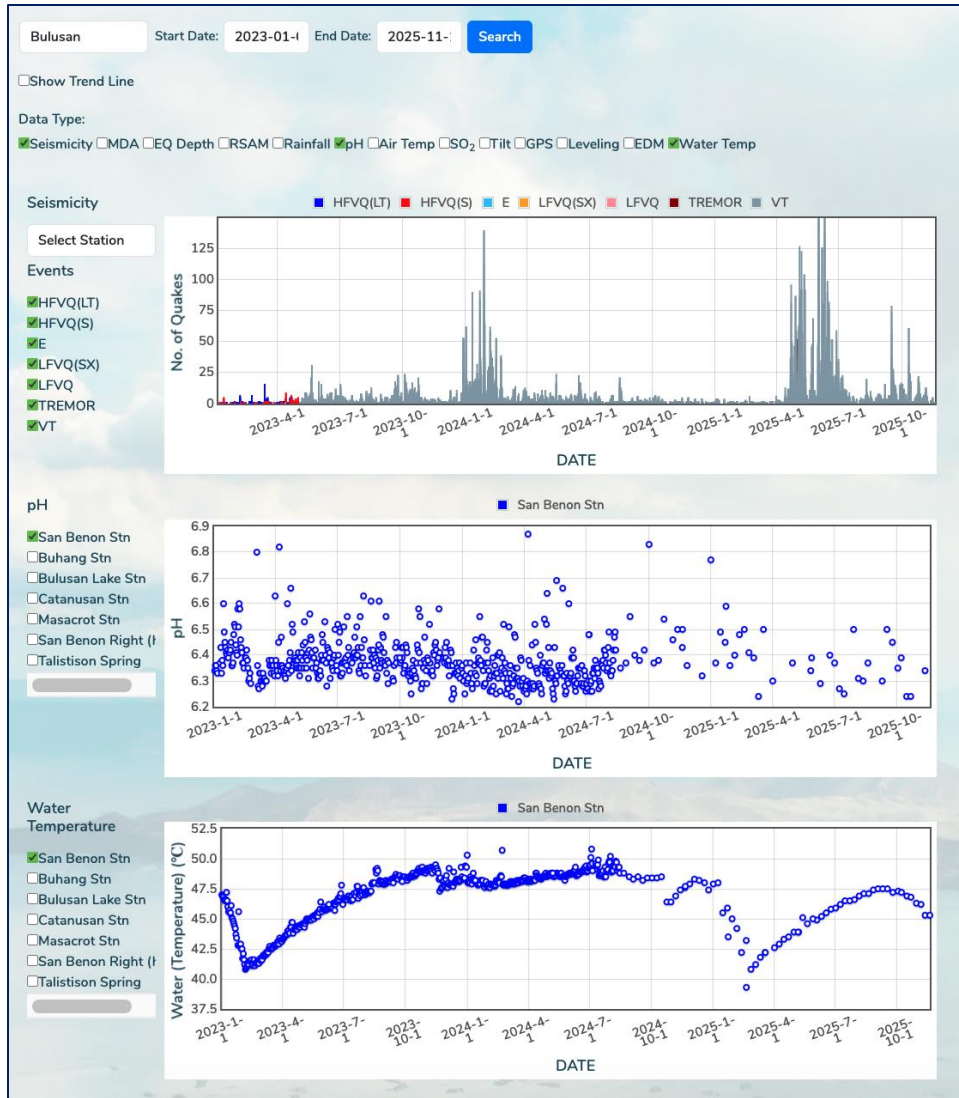
Phase Reading



Earthquake counts

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	sd_ews_id	sd_ews_code	ss_id	sd_ews_time	sd_ews_time	sd_ews_time	sd_ews_time	sd_ews_time	sd_ews_picks	sd_ews_spint	sd_ews_dur	sd_ews_dur	sd_ews_dist	sd_ews_maxa	sd_ews_samp	sd_ews_eqtyr
2	5013905	0702-02=VKMN20251119011953451	80	19/11/2025 01:19		0.45		H	1.59	14				163.9	50	VT
3	5013906	0702-02=VKMH20251119011951393	77	19/11/2025 01:19		0.39		H		14				331.7	50	VT
4	5013907	0702-02=VKSB2025111901195152	78	19/11/2025 01:19		0.52		H	1.29	14				3376.1	50	VT
5	5013902	0702-02=VKNT2025111900404936	167	19/11/2025 00:40		0.36		H		14				9.4	50	VT
6	5013903	0702-02=VKSB2025111900404953	78	19/11/2025 00:40		0.53		H	2.39	12				517.6	50	VT
7	5013904	0702-02=VKQP2025111900404947	190	19/11/2025 00:40		0.47		H	1.84	18				80.6	50	VT
8	5013901	0702-02=VKMN2025111900404803	80	19/11/2025 00:40		0.03		H	1.78	10				240.2	50	VT
9	5013782	0702-02=VKNT2025111818515624	167	18/11/2025 18:51		0.24		H	18.45	49				18.2	50	TQ
10	5013781	0702-02=VKMP2025111818515572	181	18/11/2025 18:51		0.72		H	16.94	49				173.1	50	TQ
11	5013780	0702-02=VKMN2025111818515498	80	18/11/2025 18:51		0.98		H	14.64	47				119	50	TQ
12	5013779	0702-02=VKMH202511181851535	77	18/11/2025 18:51		0.5		H	13.9	42				97.1	50	TQ
13	5013778	0702-02=VKQP2025111818515246	190	18/11/2025 18:51		0.46		H	14.53	44				360.7	50	TQ

Downloaded data format



Multi-parameter plots

Latest volcano bulletins, advisories, updates & other issuances, or archived issuances.

[New Content Alerts](#) [Posting Template](#) [Relocated EQ](#)
[search for archived issuances](#)

BULKANG BULUSAN
 Buod ng 24 oras na pagmamaman (simula 12AM kahapon hanggang 12AM ngayong araw)

Petsa: 20 Nobyembre 2025

ANTAS NG ALERTO 1

BULUSAN VOLCANO
 Summary of 24Hr Observation (from 12AM yesterday to 12AM today)

Date: 20 November 2025

ALERT LEVEL 1
 (Low-level unrest)

[BULKANG Bulusan Buod ng 24 oras na pagmamaman 20 Nobyembre 2025 alas-12 ng umaga Bulletin \(Filipino\)](#) [Bulusan Volcano Summary of 24Hr Observation 20 November 2025 12:00 AM Bulletin \(English\)](#)

BULKANG MAYON
 Buod ng 24 oras na pagmamaman (simula 12AM kahapon hanggang 12AM ngayong araw)

Petsa: 20 Nobyembre 2025

ANTAS NG ALERTO 1

MAYON VOLCANO
 Summary of 24Hr Observation (from 12AM yesterday to 12AM today)

Date: 20 November 2025

ALERT LEVEL 1
 (Low-level unrest)

Bulletin creation tool

List of EN / VONA

Taal

Start Date: YYYY-MM-DI End Date: YYYY-MM-DI

[Search](#)

	ID	Created	Volcano	Notice No.	Type	Event Date	Start Time	End Time	Edit	Chat Format
Delete	595	2024-09-26 13:42:26	Taal	1	VONA Actual	2024-09-26	12:39:30	12:42:30	Edit	View
Delete	594	2024-09-25 04:01:54	Taal	1	VONA Actual	2024-09-25	01:59:21	02:03:41	Edit	View
Delete	593	2024-09-25 03:02:23	Taal	1	VONA Actual	2024-09-25	01:59:21	02:03:41	Edit	View
Delete	592	2024-09-22 09:25:40	Taal	3	VONA Actual	2024-09-22	09:14:21	09:17:22	Edit	View
Delete	591	2024-09-22 09:16:16	Taal	2	VONA Actual	2024-09-22	09:10:44	09:11:10	Edit	View

VONA creation and archiving tool

PHIVOLCS-LAVA

Public website for legacy data and near-realtime data from select stations

Department of Science and Technology
PHIVOLCS
Volcano Monitoring and Eruption Prediction Division

WELCOME TO
PHIVOLCS-LAVA
Philippine Institute of Volcanology and Seismology
Local Active Volcanoes Archive

VOLCAN (Live)

Volcano Status
View or download the latest volcano bulletins, advisories, updates & other issuances, or archived issuances.

Volcanic Earthquake
Check out the latest locatable volcanic earthquake in monitored Philippine volcanoes.

Volcano Catalog
Browse & learn about volcanoes of the Philippines interactively.

Monitoring Data
Search, view or download monitoring data on volcanic seismicity, ground deformation, gas, visual and other parameters.

Visualize Data
Visualize time-series volcano monitoring data interactively.

Image Gallery
View or download volcano photos & scanned selected legacy monitoring records.

WOVodat in PHIVOLCS
The backend database and core scripts of WOVodat were programmed by the Earth Observatory of Singapore (EOS) in Open Source MySQL and PHP, respectively, and were completed in 2012.

PHIVOLCS Volcano Database History
From the early 1990's, PHIVOLCS had been using spreadsheets of simple to more complex functionalities for storing, analysis and visual output of processed volcano observation data...

VOLCAN
Volcano Observation Live Capture Net

KANLAON

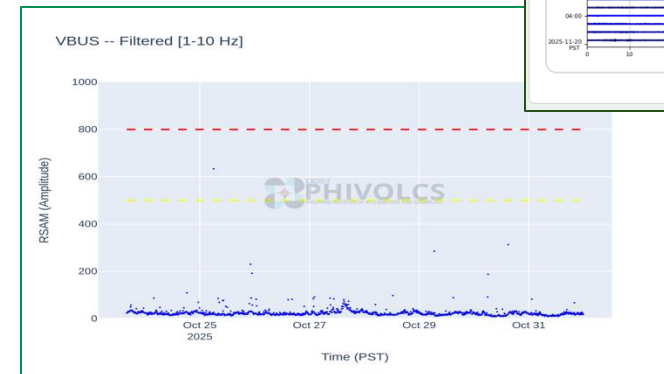
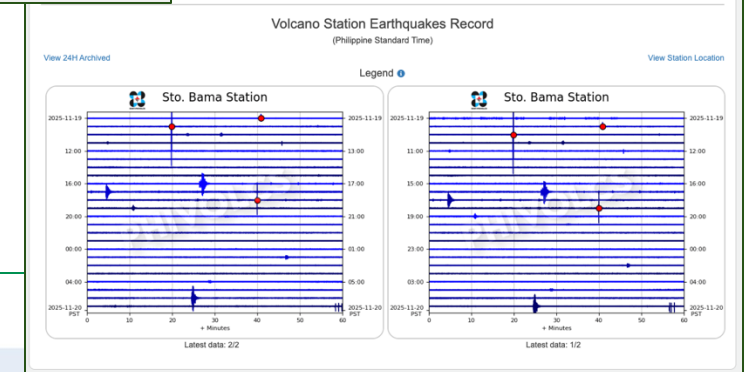
Camera Snapshots Mansalanao
(Philippine Standard Time)

View 24H Archived | View Station Location

Latest data: 2/2 | Latest data: 1/2

Reference station deploy

Select station images



Reference station RSAM

PHIVOLCS-LAVA

WELCOME TO PHIVOLCS-LAVA
Philippine Institute of Volcanology and Seismology
Local Active Volcanoes Archive

Volcano Status
View or download the latest volcano bulletins, advisories, updates & other issuances, or archived issuances.

Volcanic Earthquake
Check out the latest locatable volcanic earthquake in monitored Philippine volcanoes.

Volcano Catalog
Browse & learn about volcanoes of the Philippines interactively.

Monitoring Data
Search, view or download monitoring data on volcanic seismicity, ground deformation, gas, visual and other parameters.

Visualize Data
Visualize time-series volcano monitoring data interactively.

Image Gallery
View or download volcano photos & scanned selected legacy monitoring records.

PHIVOLCS-LAVA is the database of multi-parameter monitoring data acquired through the years by instrumental and visual observation of the Philippines active volcanoes.

WOVOdat in PHIVOLCS
The backend database and core scripts of WOVOdat were programmed by the Earth Observatory of Singapore (EOS) in Open Source MySQL and PHP, respectively, and were completed in 2012.

PHIVOLCS Volcano Database History
From the early 1990's, PHIVOLCS had been using spreadsheets of simple to more complex functionalities for storing, analysis and visual output of processed volcano observation data...



Interactive Data Plots

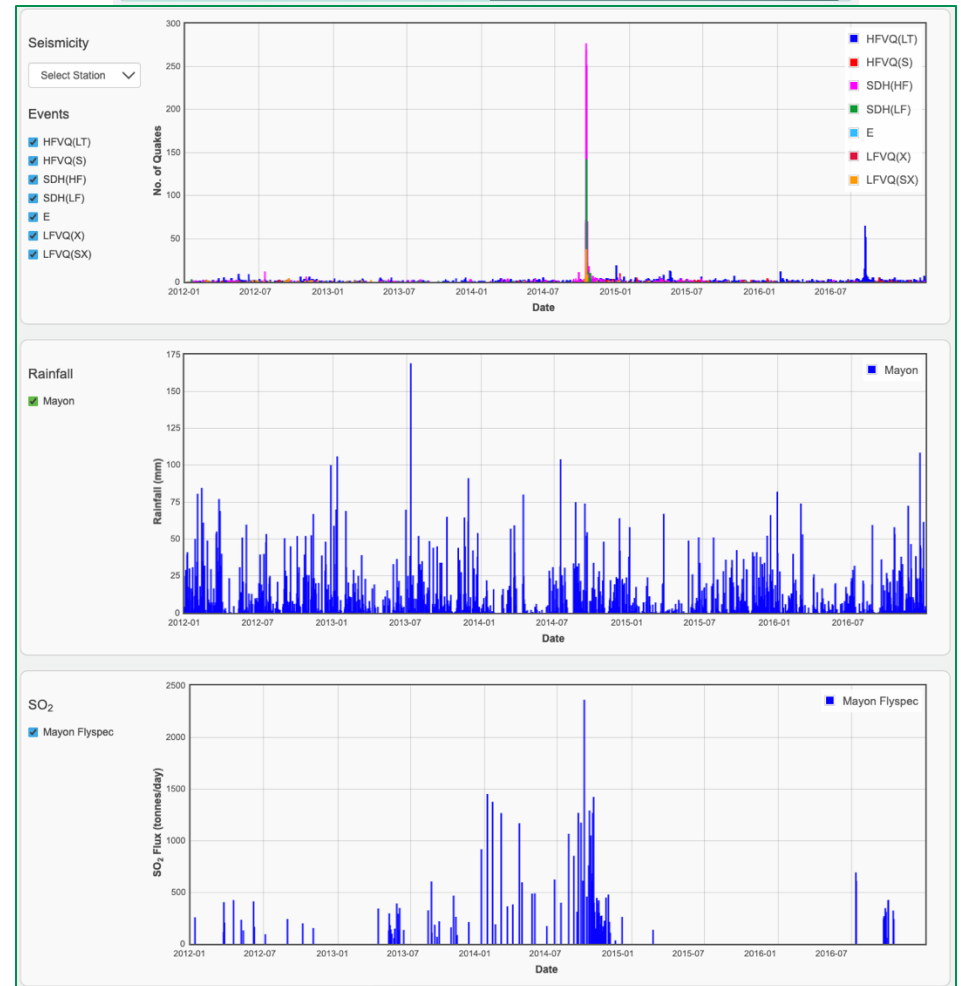
Visualize time-series volcano monitoring data interactively.

Mayon Start: 2012-01-01 End: 2016-12-31 Search

Check the box to show the plots.

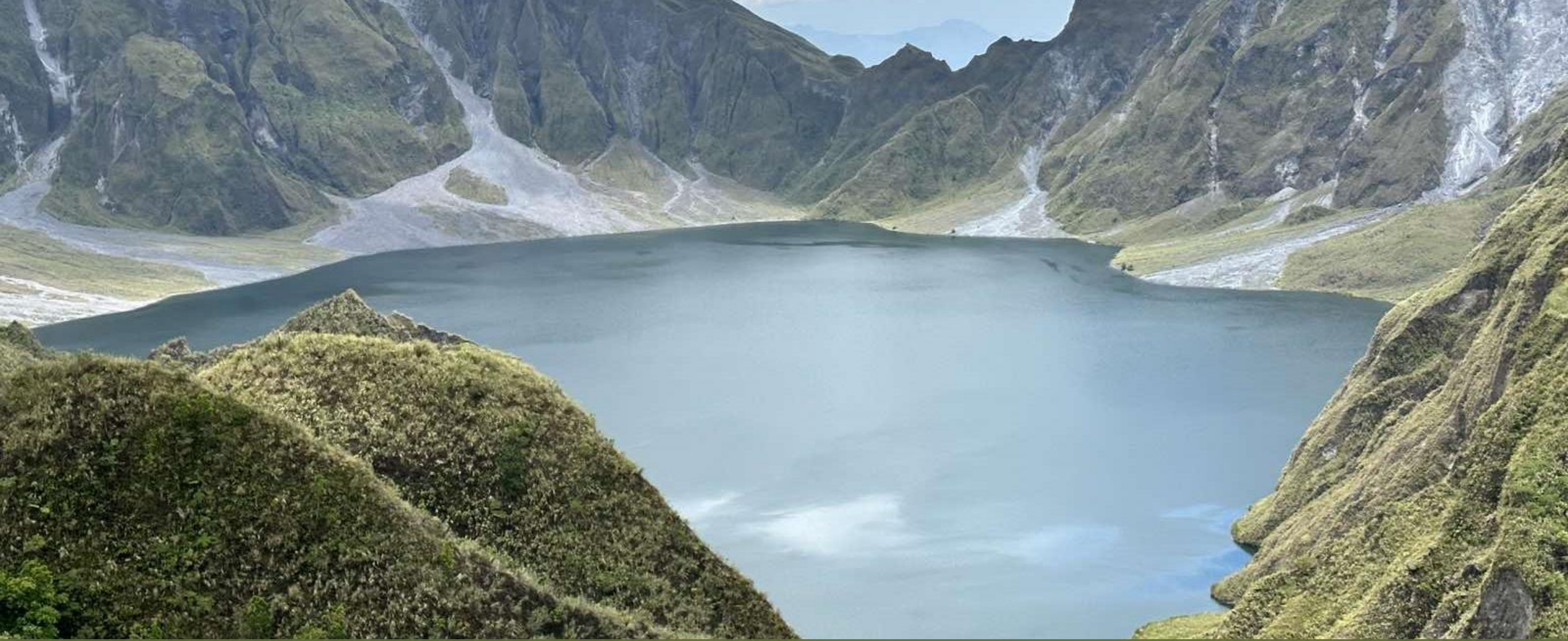
Seismicity MDA Rainfall SO₂

EARTHQUAKES 2D/3D CHARTS



Challenges/Future Work

1. Enhance data in database(s) without compromising operations
2. Implement AI or Machine Learning in workflows
3. Adapt new technologies into seismic processing procedures and address compromises made due to limited infrastructure



Thank you