WOVOdat' Classic Episodes of Unrest: Pinatubo 1991

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Background

Volcano Name: Mount Pinatubo
Location: Luzon, Philippines
Volcano Type: Stratovolcano
Major Rock Type: Dacite, Andesite/Basaltic Andesite
Tectonic Setting: Subduction Zone

Overview

The 1991 Pinatubo Eruption is one of the largest eruption to have occurred in human history. Multi parameter datasets are available on WOVOdat to analyse the chronological patterns which lead up to the climactic eruption. Hence, scientists are able to better understand the **precursory pattern** and the **development of volcanic unrest** which would allow better anticipation of eruption outcomes, and implementation of timely mitigation methods.

Sequence of events leading up to climactic eruption

mid-March through May 1991: Felt earthquakes first occurred on 15 March

2 April 1991: First phreatic eruption occurred.
- Numerous V-T earthquakes
- Series of small explosions issued from a 1.5-km-long line of vents along a northeast-trending fissure on the upper north flank of the volcano which occurred over a period of several hours.

7 May – 1 June: M<2.5 Earthquakes for all 1800 located earthquakes
- Clustered in a zone between 2 and 6 km deep, located about 5km NNW of the volcano's summit.
- SO2 readings of 500 t/d on 13 May ruled that this is volcanic, not tectonic.
- SO2 further increase to more than 5000 t/d on 28 May.

1 June to 7 June: Gas and ash explosions with migration of hypocenters

3 June: Small explosion at 1939 initiated an episode of increasing volcanic unrest characterized by intermittent minor emission of ash, increasing seismicity beneath the vents, episodes of harmonic tremor, and gradually increasing outward tilt at a tiltmeter high on the volcano's east flank.
5 June: Decrease in SO2 levels which could have been caused by plugging or sealing of magma and fractures through which gas was escaping.
7 June: Localisation of shallow earthquakes in a narrow pipe-like zone near volcano summit, culminated in a shallow intrusion that reached the surface. Increasing seismic energy release. Accelerated outward tilt and increased shallow seismicity suggested that a shallow conduit was developing for delivery of magma to the surface

- Tiltmeter detected about 50 microradians of cumulative tilt between June 4 and June 7 that ended when magma presumably reached the surface and a lava dome began to form.

7 June to 12 June: Continued lava dome growth, accompanied by increasing ash emission and seismic energy release, including significant episodes of volcanic tremor and increasing ash emissions.

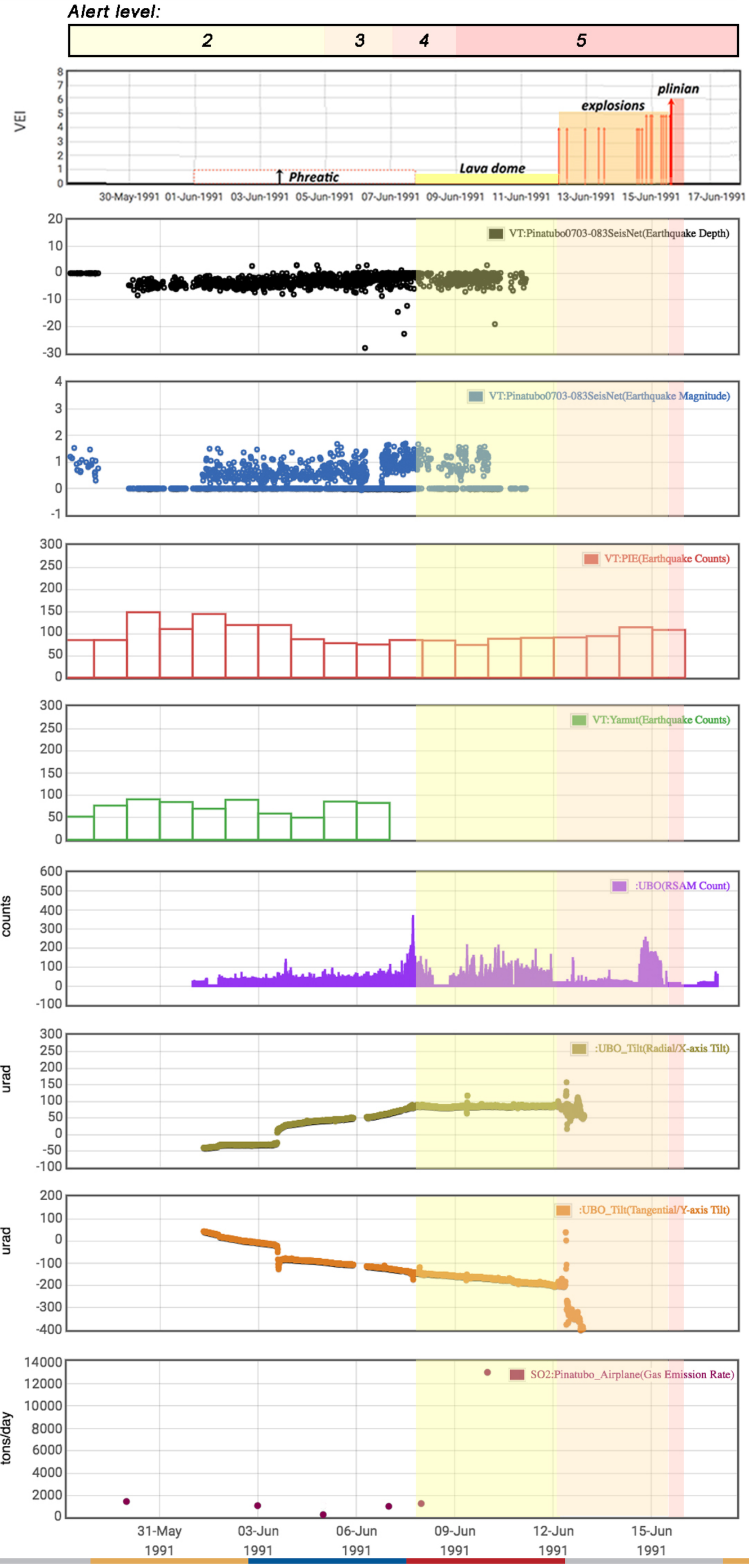
12 June to 14 June: Continued lava dome growth and series of 4 vertical eruptions preceded by 2-4hrs of long period earthquakes.

12 June (0851): First vertical eruption which lasted 38 minutes
12 June (2252): Second vertical eruption which lasted 14 minutes
13 June (0841): Third vertical eruption which lasted 5 minutes
14 June (1309): Fourth vertical eruption which lasted 2 minutes

14 June - 15 June: Pyroclastic-surge-producing eruptions
- 13 brief surge producing eruptions which became progressively more closely spaced.
- Seismic energy release increased as system evolved toward climactic eruption.
- Large pyroclastic density currents sweep down volcano flanks.

15 June (1342): Climactic eruption
- Lasted 9 hours
- Recorded 20,000,000 t/d of SO2 emissions.
- Ash plume reached 35km
- Summit collapsed to form a caldera with ~2.5km diameter.

June- late July: Decline and termination of continuous emission of a tephra plume from vents within caldera and steady decline of V-T earthquakes that began during the climactic eruption, intermittent small ash eruptions until early Sept.



WOVOdat actively solicit relevant data contributions from volcano observatories, other institutions, and individual researchers. We also welcomes interactive tools (i.e. pattern recognition, automation data input, etc.) and scripts that will optimize the data search engine and display.

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Metadata Information

Various deformation, gas, hydrologic, seismic, thermal, meteorological and field stations were deployed to monitor the conditions of the volcano, for the Pinatubo 1991 unrest.

Deformation Gas Hydrologic Seismic Thermal Meteo Field

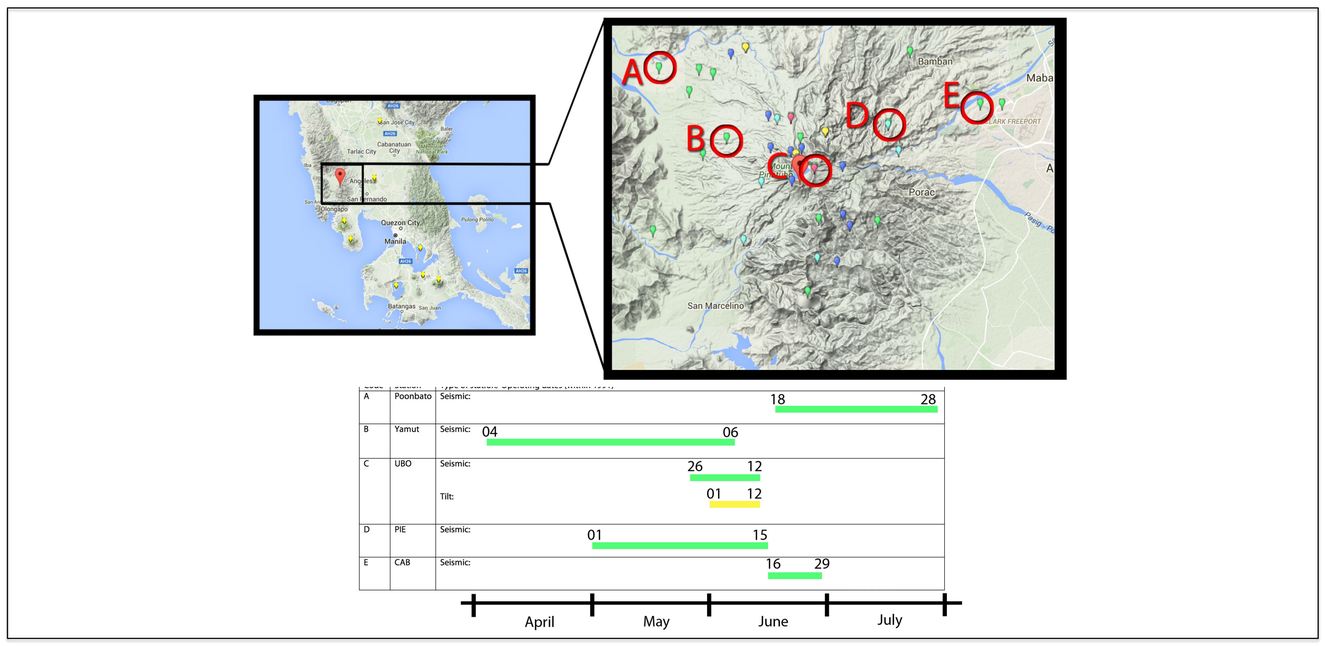
Some of the notable measuring stations are

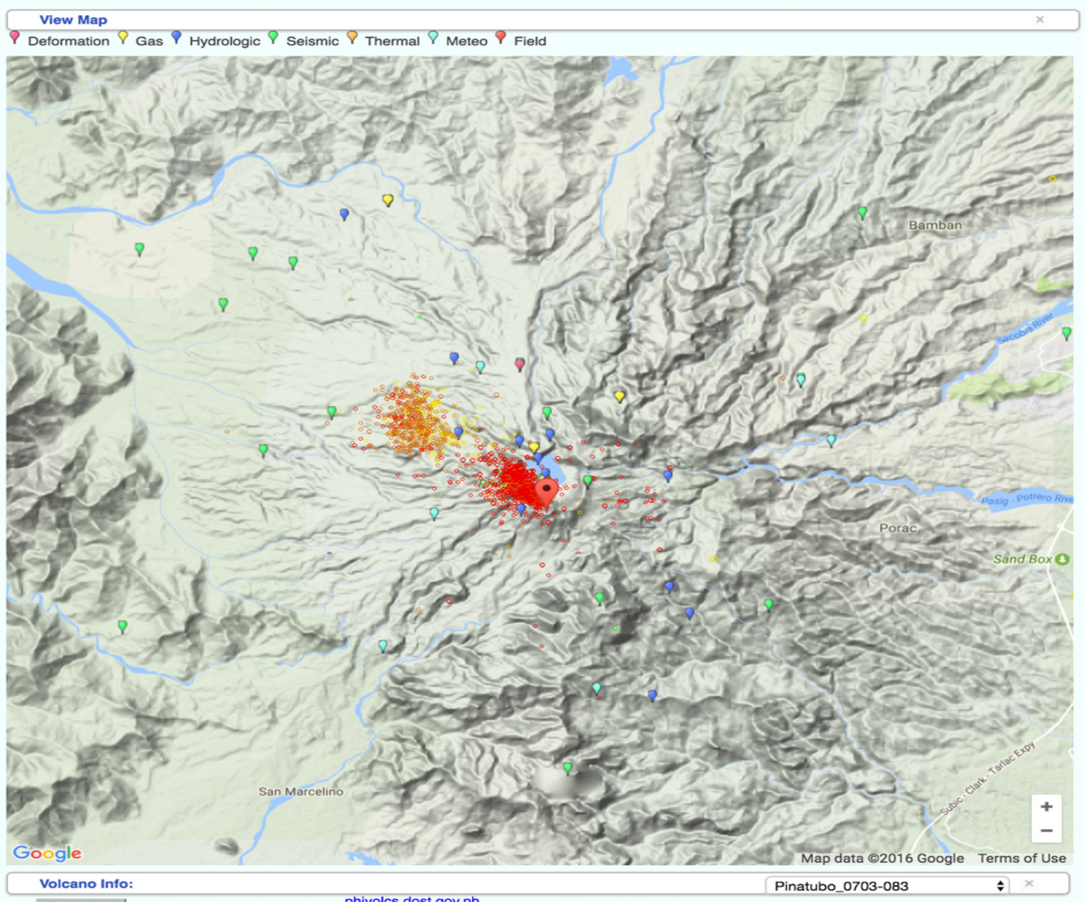
Deformation : UBO

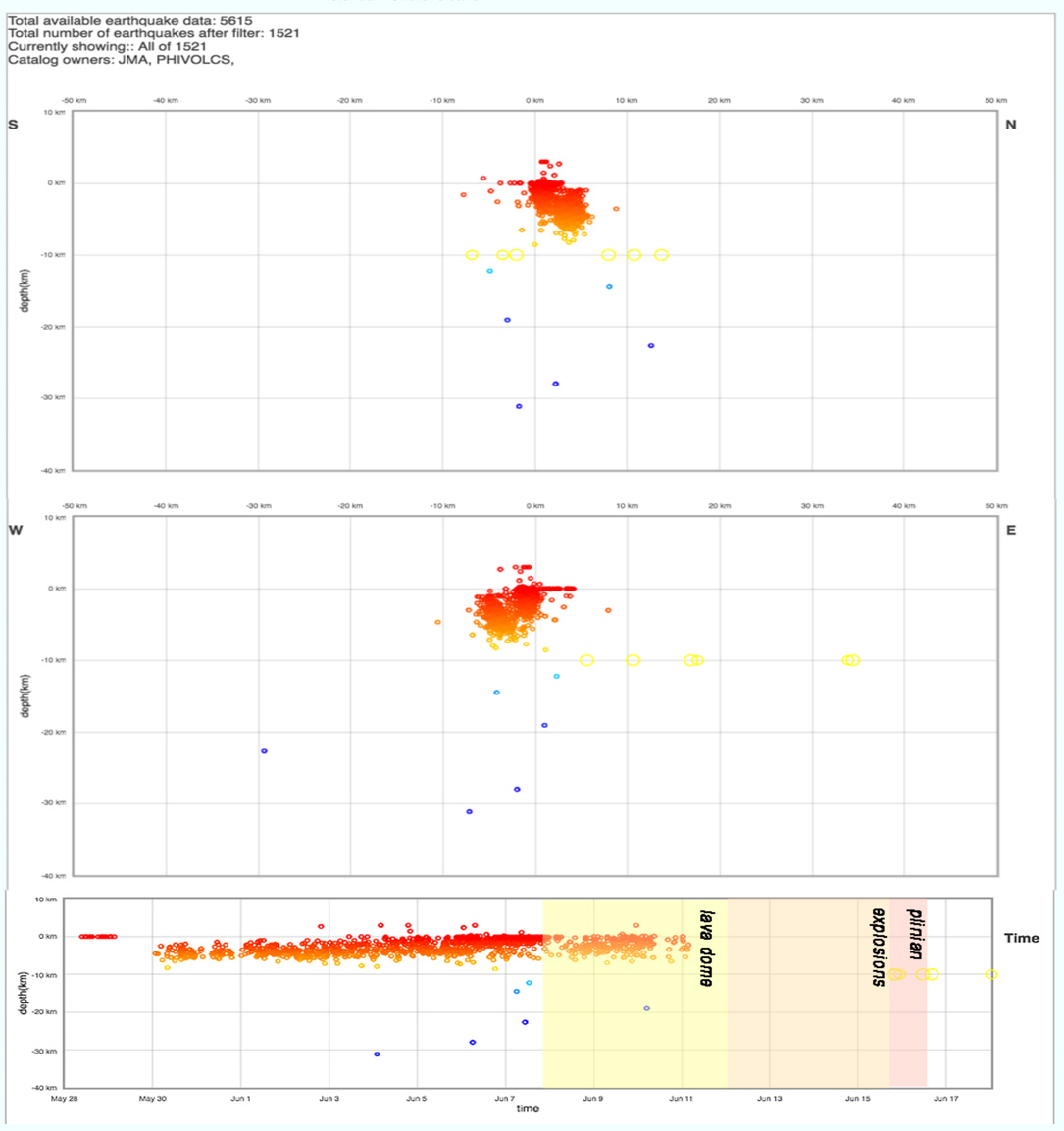
Gas : Mainly mobile aircraft carriers with correlation spectrometers

Seismic : Poonbato, Yamut, UBO, PIE, CAB

Different stations have different operating dates. This a result of different installation dates, as well as, destruction of measuring stations due to the ongoing eruption.







Using the visualisation function of WOVOdat, hypocenters could also be plotted against time. From this diagram, we can also observe the migration of earthquake hypocenters. This is also congruent to the fact that there were localisation of shallow earthquakes in a narrow pipe-like zone near volcano summit, culminated in a shallow intrusion that reached the surface on 7 June.

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