

Eight years of cooperation between PHIVOLCS and EMSEV for understanding and monitoring Taal volcano (Philippines)

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Since 2004, EMSEV has developed a scientific cooperation with the Philippines Institute of Volcanology and Seismology (PHIVOLCS, <http://www.phivolcs.dost.gov.ph/>) on Taal volcano titled “Monitoring Taal volcano unrest in the Philippines with a joint multi-disciplinary EMSEV-PHIVOLCS program (Electromagnetic ‘EM’, Seismic, Deformation, Geochemical together with local educational programs)”.

Taal volcano is considered as a threat to surrounding population from its eruptions from pyroclastic flows, base surges, and violent phreatic explosions. Since the last long eruptive episode during 1965-1977, Taal volcano has undergone continuously sporadic and intense seismic activities, ground deformation, and surface activities. At present, about 600,000 inhabitants are living in a radius of 15 to 20 km from the center of volcano.

Late in 2004, a newly formed PHIVOLCS EM team and an EMSEV team started to image the hydrothermal system, the geological and tectonic discontinuities with combined magnetic, electric,

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ground temperature and soil degassing surveys (see reports at <http://www.emsev-iugg.org/emsev/>). Progressively, the international EMSEV community enlarged with researchers from Greece, Italy, USA, and Belgium.

EMSEV, together with the PHIVOLCS EM team, have implemented new research methods such as audiomagnetotellurics and resistivity soundings, magnetic and bathymetric mappings of the inner acidic lake, and bottom lake temperature ([1] - [6]). From these bi-annual field campaigns, new important results were obtained. These are now used in information planning by both the local inhabitants and the Civil Authorities. One outcome is that the northern part of the volcano is undergoing strong thermal transfers, degassing, and mineralization. The activity takes place along active E-W fissures possibly linked to the root of the northern border of the Crater at a depth of some hundreds of meters, and connected to the hydrothermal/volcanic source of the volcano. This thermal source could be the primary focus of the next eruptive activity. In such a case, strong activity could induce a collapse of a part of the northern crater rim into the Crater Lake, due to mechanical weakening by the active 1992-1994 fissures.

Simultaneously with repeated surveys, EMSEV and PHIVOLCS have built a real-time monitoring network based on EM and other geophysical parameters as magnetic and electric fields, ground temperature and gradients, seismicity, and tilt. Data are automatically transferred to Taal volcano observatory, PHIVOLCS headquarter and EMSEV servers. Thanks to the real-time multi-parametric network, it was possible to regularly process data and to detect anomalous signals before and during the April to June 2010 strong seismic/volcanic crisis. During this crisis, PHIVOLCS raised the alert level from 1 to 2 requiring a partial evacuation of the Volcano Island (see reports on <http://www.emsev-iugg.org/emsev/>, [7]). In 2011, one new real time EM station has been added to the 2 existing multi-parametric stations. In the future, a fourth station including a permanent current system is being planned that will help to access changes with time of the electrical resistivity at the 3 other stations. A second borehole tiltmeter will be integrated in one of the real time stations.

In addition to these land observations, satellite Aster thermal imagery [8], and atmospheric trace gases using NASA satellites [9], and Robust Satellite Techniques [10] are being carried out to study volcanic activities and changes observed in atmospheric and meteorological parameters using satellite data.

As a result of EMSEV guidance, PHIVOLCS is now a major contributor to the development of geophysical studies on Taal volcano and to the analysis of its ongoing activity as it was stated during the February 2010 EMSEV-PHIVOLCS international workshop on 'Monitoring active volcanoes by electromagnetic and other geophysical methods; Application to Asian volcanoes'. The new Memorandum of Agreement for the coming 5-years is the confirmation of long term and successful cooperation between PHIVOLCS and the Inter-Association working group EMSEV.



Further information can be found on EMSEV and PHIVOLCS web-sites (<http://www.emsev-iugg.org/emsev/> and <http://www.phivolcs.dost.gov.ph>). This cooperation was supported by an IUGG 2009-2010 grant.

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