

10 years of International Scientific Cooperation for understanding and monitoring Taal volcano (The Philippines)

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Since 2004, the IUGG Working Group EMSEV (Electromagnetic Studies of Earthquakes and Volcanoes', <http://www.emsev-iugg.org/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.

The first target was to image the hydrothermal system, the geological and tectonic discontinuities with combined magnetic, electric, ground temperature and soil degassing surveys (see reports at <http://www.emsev-iugg.org/emsev/>). EMSEV and PHIVOLCS EM teams have implemented audiomagnetotellurics and resistivity soundings, magnetic and bathymetric mappings of the inner acidic lake, and bottom lake temperature. Results 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 hydrothermal system. This area 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

The second target was to monitor the activity. 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 is possible to regularly process data and to detect anomalous signals as 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/>). In 2013, new stations has been added to the 3 existing real-time multi-parametric stations.

In addition to these land observations, satellite Aster thermal imagery and Robust Satellite Techniques are being carried out.