

**2008 Annual Report of Inter-Association (IAGA/IASPEI/IAVCEI)
Working Group of Electromagnetic Studies
on Earthquakes and Volcanoes (EMSEV)**

<http://www.emsev-iugg.org/emsev/>

By Jacques Zlotnicki, Malcolm Johnston, Seiya Uyeda, Toshiyasu Nagao, Yoichi Sasai, Jann-Yeng Liu, and T. Harinarayana

Contents:

- 1) Introduction
- 2) Membership
- 3) Web site
- 4) Activity in 2008
- 5) Financial Report 2008
- 6) Activity for 2009
- 7) Concluding Remarks

1) Introduction

The main objectives of EMSEV inter-association Working Group are:

- 1) To promote magnetic and electric studies of earthquakes, tsunamis and volcanoes from the source to the ionosphere, through national and international collaborations,
- 2) To integrate multi-disciplinary techniques in order to better analyze the physical mechanisms,
- 3) To organize international and regional meetings, and to disseminate relevant data and research results,
- 4) To contribute to develop EM studies in developing countries and to assist to develop integrated EM monitoring systems and data analyses.

During 2008, The EMSEV WG was - at least - involved in 7 international meetings (IWSEO2008, EGU, AOGS, URSI, IAVCEI, EMSEV-DEMETER and AGU). For several of these meetings EMSEV organized sessions: IWSEO2008, IAVCEI and AGU. In September 2008, EMSEV gathered the Electromagnetic (EM) community involved in active processes related to earthquakes and volcanic eruptions at the joint EMSEV-DEMETER meeting in Sinaia (Sept. 7-12, Romania).

EMSEV has also promoted international cooperative studies in developing countries like Indonesia (EM signals related to earthquakes, managed through Chiba University (Japan)) and Philippines (Understanding and monitoring Taal volcano based on a French-Japan-Philippines cooperation).

2) Membership

During the 11th business meeting held during the 2008 EMSEV-DEMETER meeting in Sinaia (Romania), members decided to elect new active EMSEV members and rotate off some others for keeping a strong and powerful organization.

The following were nominated as new members:

- **Dr. Renato Solidum, Jr. (PHILVOCS, Phillipines)** as national representative of Phillipines EM survey.
- **Prof. Zhao, Guoze (China Earthquakes Networks Center, CEA).** Chairman of geoelectric committee, Chinese Geophysical Society.
- **Prof. Lu, Jun (China Earthquakes Networks Center, CEA).** Leader of earthquake prediction efforts using geoelectric methods at CEA.
- **Prof. Du Xuebin** (China Earthquake Administration – Lanzhou). Leader of geoelectric data and processing.

It was also decided that the following would be rotated off the membership list:

Zeng Xiaoping, China Seismological Bureau, China
 Zhan Zhijia, China Seismological Bureau, China
 Shapiro, Vsevolod, Inst. of Geophysics, Urals Dept. of RAS, Russia

Thirty-eight members and more than 245 corresponding members are now enlisted in EMSEV mailing “<http://www.emsev-iugg.org/emsev/>”.

3) Web site

EMSEV secretary Toshiyasu Nagao maintains the EMSEV web site which includes objectives, mailing lists, EMSEV bureau and members, lists of meetings (past and future) and reports. Of particular importance is the fact that the EMSEV web site is linked to each of the association web sites. This allows easy dissemination, for example, of our annual reports, minutes of our meetings and summaries of our plans. The URL of this site is:

<http://www.emsev-iugg.org/emsev/>

At present, the EMSEV mailing list is limited to a message size of 50 Kb. Larger size email should be sent to T. Nagao: nagao@scc.u-tokai.ac.jp

It is expected that the storage capability will be increased to 40 Gb on October 1, 2008. This could allow exchanging of papers, data, and presentations. The number of EMSEV mailing list members is now 245.

4) Organizational Activity in 2008

Meetings:

4.1 IWSEO2008 International Workshop on Seismo-Electromagnetic Observation Satellite, JAPAN on Feb. 29-March 1, 2008 (Secretary: Tetsuya Kodama, Chair and Co-chair: Kiyohumi Yumoto and Katsumi Hattori).

Cosponsored by EMSEV/IUGG an International Workshop on Seismo-Electromagnetic Observation Satellite, Japan on March 1, 2008 (Chair and Co-chair: Kiyohumi Yumoto and Katsumi Hattori)

At this session there were 5-6 speakers.

4.2 EGU, Vienna, 13-18 April, 2008

Session NH5.1

Seismic hazard evaluation, precursory phenomena and reliability of prediction

(Co-listed in SM & TS); Convener: Contadakis, M. Co-Convener: Biagi, P.; Zschau, J.

Session NH5.2

Electric, magnetic and electromagnetic phenomena related to earthquakes (co-listed in SM & TS); Convener: Biagi, P., Co-Convener: Hayakawa, M.; Molchanov, O.; Vallianatos, F.

4.3 AOGS 2008 Meeting, Busan, Korea (July 16-20, 2008).

A number of papers on EM related to earthquakes were presented at this meeting. J.Y Liu represented EMSEV.

4.4 URSI GA 2008 Chicago (9-16 August 2008), Seismo-electromagnetics, Conveners: M. Parrot, S. Pulinets, O. Molchanov.

4.5 IAVCEI 2008 Reykjavik, Iceland

Session: New insights from Electromagnetic (EM) Investigations of Active Volcanoes and Hydrothermal/Geothermal Fields. Conveners: J. Zlotnicki, M. Johnston and R. Karlsdottir.

Talks and posters were presented in three different sessions:

2-f: Advances in electromagnetic investigations of active volcanoes and hydrothermal fields

2-b: Integrated monitoring and modelling of volcanic activity

3-e: Volcanic and geothermal systems at the Earth's surface: From fumaroles and mudpools to volcanic lakes.

J. Zlotnicki and M. Johnston attended a meeting with the IAVCEI executive committee headed by Joan Marti who expressed support for our efforts, particularly in under developed countries.

4.6 EMSEV-DEMETER 2008 Sinaia, Romania; Dates: September 7-12, 2008, LOC-chair: Dimitru Stanica.

The Workshop was organized in six sessions:

1. Seismicity and seismotectonics of Vrancea zone. Inter-correlation with other seismogenic zones; 2. Electric, magnetic, and electromagnetic methods related to earthquakes, tsunamis, volcanic eruptions, landslides and geothermal activities;

3. Integration of multi-technique monitoring. Cross-correlation between ground and satellite observations;

4. Generation and propagation mechanism of EM signals, and related laboratory experiments;

5. Study of ionospheric perturbations, GPS based measurements;

6. Imaging active faults, volcanoes, landslides and geothermal fields by EM methods.

Integration of other methods: geophysical, geochemical, geological, etc.

The Workshop sessions included 48-scientific presentations and stimulating discussion.

The papers were presented by scientists from 13 countries – China, Czech Republic, France, Greece, India, Iran, Italy, Japan, Poland, Romania, Russia, USA and Taiwan.

The Workshop provided an excellent opportunity to establish close contacts with Romanian colleagues.

4.7 AGU 2008

The session of interest is “Search for Large Earthquake Precursors from Space and Ground Observations”, convened by: Dimitar Ouzounov, Patrick Taylor, Sergey Pulinets, J.Y. Liu, Katsumi Hattori, and Michel Parrot. In order to provide wider exposure, a number of invited papers are planned including one from Kelis Borok. About 30 papers are expected.

Inter-Association Initiative activities:

- Volcano Taal investigation (Philippines):

Under PHIVOLCS (Philippine Institute of Volcanology and Seismology)-EMSEV 2004 agreement, a Japan-French team is pioneering efforts to understand the slow unrest of Taal volcano. The activities

include implementation of EM monitoring systems, and education of PHIVOLCS teams on electromagnetic methods etc.

Financial support from the IUGG and Associations is used to facilitate PHIVOLCS teams to field campaigns. The foreign teams provide equipment and other materials. Several papers have been published (Harada et al., 2005, 2008; Zlotnicki et al., 2008) and another one is in press (Zlotnicki et al., 2009). Two other papers are in preparation.

Campaign [March 26 – April 4, 2008]

This joined campaign was led by EMSEV and PHIVOLCS. About 10 persons from PHIVOLCS participated to the field work while 5 foreign researchers brought their own research expertise. In such a way, magnetic, electric, geochemical and thermal studies could have been carried out:

- Resurvey of several SP-GTE-CO₂ and magnetic benchmarks were re-surveyed,
- A first magnetic and bathymetric survey of the Main Crater lake was operated,
- CO₂ fluxes, ground temperature and gradients were sampled in the crater and outside, and on the Main Crater lake as well,
- Telemetry system of the two continuous SP-CO₂ stations was improved up to the local BUCO observatory and a daily routine updated,
- A Rn sensor was implemented on the two continuous SP-CO₂ stations,
- The two continuous magnetic stations were installed and checked,
- A continuous multi-parameter station including the record of the three components of the magnetic field, the two horizontal components of the electric field and the vertical seismicity was installed in the Main Crater. Data are sampled at 20 Hz.
- A continuous water level and temperature gauge was installed in the Main Crater lake.

Two months short campaigns

PHIVOLCS is now able to conduct short term field campaigns.

Every two months, the ‘magnetic’ and ‘electric’ teams come to the field. They check the continuous stations, collected the data and recover them.

During summer 2008, the ‘magnetic’ team resurveyed the magnetic benchmarks while the ‘electric’ team made measurements of the self-potential and ground temperature along a profile used as reference.

Memorandum of Agreement on the Use of Geomagnetic Data

In July, EMSEV and PHIVOLCS signed a memorandum ‘Memorandum of Agreement on the Use of Geomagnetic Data from Muntinlupa Magnetic Observatory (Philippines)’ between the National Mapping and Resource Information Authority (NAMRIA), the Ocean Hemisphere Research Center, Earthquake Research Institute (OHRC-ERI), the Philippine Institute of Volcanology and Seismology (PHIVOLCS), the IUGG Inter-Associations Working Group on Electro-magnetic Study of Earthquakes and Volcanoes (IUGG-EMSEV).

- International Workshop on Seismo-Electromagnetic Phenomena, Recent Progress: IWSEP 2007, Bandung, Indonesia, November 2007.

State of research

Indonesia consists of more than 17,000 islands and severe natural disasters in this country are frequent. These include destructive earthquakes, tsunamis, and volcanic eruptions. As an example, casualties of the 2004 Sumatra-Andaman Earthquake reached several hundred thousand. Mitigation of these disasters is obviously of essential importance. Identification of electromagnetic phenomena associated with crustal activity and the detection of these phenomena should be included in the methods for monitoring seismic and volcanic activities. To develop the methodology and to

improve scientific knowledge for the seismo-electromagnetics, measurements with sensitive sensors, sophisticated signal processing, and theoretical consideration should be performed.

Even if this activity is well supported by LIPI, LAPAN, and BMG, further implementations of EM methods and the use of installed stations/equipment are crucial for improving the effectiveness of current global investigations.

Workshop on seismo-electromagnetic precursors (IWSEP 2007)

The workshop was held at the Conference Hall of the Indonesia's National Institute of Aeronautic and Space, Bandung, Indonesia, 6~7 November 2007. This workshop was supported by the Japan Society for the Promotion of Science (JSPS) through JSPS Bilateral Program between Chiba University (Dr. Katsumi Hattori, Principle Investigator) and Research Center for Geotechnology-LIPI (Dr. Djedi S. Widarto, Principle Investigator), and co-sponsored by LAPAN, Indonesian Association of Geophysicists (HAGI), Chiba University, EMSEV-IUGG, and SERC-Kyushu University, and supported by Science Council of Asia and IEEJ (Institute of Electronic Engineers of Japan).

Participants of the workshop were scientists and/or researchers, as well as students, interested in this field. They came from overseas (25 participants) and no less than 100 participants from many institutions in Indonesia (LAPAN, LIPI, BMG, ITB, Mataram University, Geological Survey Center, Chevron Energy, Local Government Agency, Indonesian Hotels Association, etc.). Many young scientists (researchers and university graduate students) both from Japan and Indonesia were actively involved in this workshop.

Outputs

Effective promotion of seismo-electromagnetic studies and the usage of electromagnetic stations are important to improve the effectiveness of the further investigations in Indonesia. International cooperation between developed countries in the EM field with Indonesian's institutions, particularly BMG, LAPAN and LIPI, should be encouraged. EMSEV could largely contribute to this demand when it will be formalized by Indonesian counterparts.

There are 3 main subjects that should be implemented in the future:

1. Observation on the ground and satellite for crustal activity-related phenomena
2. Data integration
3. Human resource development

5) Financial Report 2008

2007 Funds Received:

Remaining from (IUGG-2007; Perugia): \$3500

2007 Funds Outgoing - Nov. 2007 (Taal field work; PHIVOLCS): -\$1200

Remaining 2007 Funds: \$2,300

2008 incoming support:

- IUGG, EMSEV general activity: received 1380 Euros (\$2000)
- IAGA, International cooperation: received 710 Euros (\$1,000)
- IASPEI, EMSEV 2008 meeting: received \$1,000
- IAVCEI, IAVCEI meeting (Iceland): promoted IUGG 2008-10 grant
- *Specific action:*

IUGG Taal volcano proposal; Received \$9300 grant for 2 years (Sept. 2008-Aug. 2010).

2008 outgoing:

- EMSEV 2008: IUGG support to participants: 320 Euros
- IASPEI support for Capetown IASPEI GM: \$500
- IASPEI support to developing countries: \$500

Remaining budget on September 12, 2008 for EMSEV general activities:

- \$2,300
- 1,770 Euros

Remark: Several grants delivered to applicants to different meetings were recovered, because these applicants did not get any enough additional support by their own. EMSEV will take care of this increasing number of cases in the next future.

Proposed expenditures at EMSEV meeting (October)

- Philippines workshop: preparation, support to PHIVOLC, invitation for developing countries [about 2000 Euros]
- IASPEI support to developing countries: seismometer and tiltmeters (participation) [about \$500]
- Support to Second International Seminar on Prediction of Earthquakes; Lisbon, Portugal, 2009, 23-24 April [about 750 Euros]
- Cities on Volcanoes (preparation to EMSEV session) [about 500 Euros]

EMSEV would like to promote more deeply case studies through international cooperation in countries including China, Greece, Indonesia, USA, Japan, Kyrgyz, Mexico, etc.

6) Activities for 2009-2010**2008 activities**

During 2008, The EMSEV WG was - at least - involved in 7 international meetings (IWSEO2008, EGU, AOGS, URSI, IAVCEI, EMSEV-DEMETER and AGU). For several of these meetings EMSEV organized sessions: IWSEO2008, IAVCEI and AGU. In September 2008, EMSEV gathered the Electromagnetic (EM) community involved in active processes related to earthquakes and volcanic eruptions at the joint EMSEV-DEMETER meeting in Sinaia (Sept. 7-12, Romania).

EMSEV has also promoted international cooperative studies in developing countries like Indonesia (EM signals related to earthquakes, managed through Chiba University (Japan)) and Philippines (Understanding and monitoring Taal volcano based on a French-Japan-Philippines cooperation).

Organization of 2009 meetings

In 2009, EMSEV continues to promote and sponsored more successfully international meetings, and regional and specific meetings.

6.1 Second International Seminar on Prediction of Earthquakes; Lisbon, Portugal, 2009, 23-24 April

The First International Seminar on Prediction of Earthquakes was organized in Lisbon in 1988 under the sponsorship of UN and the EC (ECE at the time). The second Seminar is included in the framework of the Year of the Earth. The objectives are:

- To provide a platform for meetings, discussions and exchange of views between specialists in earthquake forecasting;

- To review the state-of-the-art concerning the existing possibilities of predicting major seismic movements and their intensities;
 - To identify the most promising lines of research;
 - To examine the improvement of international co-operation in the field of earthquake prediction.
- Some EMSEV members will participate to this seminar which will gather scientists of any discipline (seismology, geodesy, etc).

6.2 EMSEV business meeting during the China meeting on the Wenchuan May 2008 earthquake.

Dimitar Ouzounov initiated the organization of an EM session for the first anniversary of the M7.9 May 12 2008 Wenchuan earthquake (China). This important meeting is organized by the Centre of Earthquake Administration and the Institute of Earthquake Science in China. All observations made before, during and after the Wenchuan earthquake will be discussed and compare to Sumatra December 2004 earthquake. This meeting could be held in Chengdu next June or July.

Both Chinese and EMSEV parties agreed to integrate a specific session to land and satellite EM observations related to earthquakes. Demeter observations will also be discussed during the meeting as well as new satellite cooperation (Chinese colleagues have scheduled to launch an EM satellite, similar to DEMETER, in 2011). Moreover some EMSEV members have already bilateral cooperation with Chinese Institutes which could be widened. Therefore this meeting, during which an EMSEV business meeting will be held, will be of prime importance for developing large international cooperation.

6.3 IAGA General Assembly, Sopron, Hungary (23-30 August, 2009)

I06. Crustal tectonic processes constrained by electromagnetic observations

One large session will be devoted to EM observations: "Crustal tectonic processes constrained by electromagnetic observations; Study of the crustal processes helps to delineate the natural resources, seismically active zones, geothermal regions etc".

The session is focused on research contribution of electromagnetic studies in resolving structural features of crust ranging from Achaean to Recent in age. Recent review paper on EM investigations of the lithosphere in Europe provided an overview of the large-scale EM surveys on a regional scale. We particularly invite such large-scale studies. The session is also addressed the role of EM in monitoring crustal processes. EM monitoring of seismic and volcanic processes have examined the correlation of electrical resistivity models with crustal melting, seismicity, and fault zones. (Conveners: T. Harinarayana and Yasuo Ogawa).

6.4 Cities on Volcanoes 6 (COV6) Tenerife, Canary Islands 16-19 November, 2009

For many years, EMSEV WG has made great efforts to promote EM techniques, observations, data processing and interpretation during volcanic unrest and eruptive episodes. EM studies are now commonly used to study volcanic structures and to monitor volcanic activity within these structures.

In 2009, one important volcanological event will be the International Cities on Volcanoes (COV6) meeting which will be held in November 2009 in Tenerife, Canary Island. An EM session organized by EMSEV has been accepted by the local organizing committee. Our WG would like to build a full session on imaging and monitoring volcanoes from land to satellites observations, emphasizing some cases study (Etna, Taal, etc), and to make efforts to invite key speakers from other fields (geochemistry for instance). Some hundreds participants are expected.

6.5 EMSEV Business meeting for Asian countries

This second event is under the responsibility of EMSEV and the Philippines Institute of Volcanology and Seismology (PHIVOLCS, Philippines). In the frame of the EMSEV-PHIVOLCS cooperation on Taal

volcano, supported by IUGG, an international workshop on EM phenomena induced by volcanic activity is scheduled for the end of 2009 or early 2010. Depending on the budget we will gather, we will invite researchers from Asian countries (Indonesia, India, Vietnam, and China) to participate to this meeting. Peer discussions will be managed on Taal volcano as well as on volcanoes monitored by participants. About 50 persons could attend this workshop.

6.6 AGU Fall Meeting, 2009

As for the preceding years, EMSEV members will propose EM sessions related to EM phenomena related to earthquakes and Natural Hazards.

6.7 PHIVOLCS-EMSEV meeting 2009-2010:

In the frame of “Monitoring Taal volcano unrest in Philippines based on a joint Electromagnetic and multi-disciplinary educational EMSEV-PHIVOLCS program”, a specific workshop will be held between December 2009 and the beginning of 2010 at PHIVOLCS headquarter, Manila.

Scheduled International cooperation

- Understanding and monitoring Taal volcano.

The Philippines Institute of Volcanology and Seismology is worried about the intermittent seismic and surface activities at Taal volcano. Again, volcanic seismic swarms were recorded after May 2008, and a level 1 on a 5-levels alert scale was set. Since 2005, EMSEV teams made considerable efforts to understand the hydrothermal activity on Taal and install monitoring systems. Up to now, it appears that there was no global change in the hydrothermal activity prior to 2008, in spite of intense seismic crises. But, EM and associated geochemical studies show that some rapid burst of activity could occur. Four papers are now published.

PHIVOLCS Institute relies on EMSEV capabilities to contribute to understanding of the volcano structure, the behavior of the hydrothermal system, and to monitor the sporadic but continuous unrest. Therefore, EMSEV will increase its cooperation with PHIVOLCS. EMSEV is helped by the IUGG two years grant. Several campaigns will be scheduled during 2009, one in January, one in October-November, and one for the Asian International workshop organized by EMSEV and PHIVOLCS in December or January 2010. Note that EMSEV support is allocated only for Philippines field work costs, while foreign teams contribute their own travel support, equipment costs and time to set up these experiments.

EMSEV submitted one proposal to IUGG based on the on-going cooperation with PHIVOLCS on volcanoes “Monitoring Taal volcano unrest in Philippines based on a joint Electromagnetic and multi-disciplinary educational EMSEV-PHIVOLCS program”. The IAGA and IAVCEI Associations supported the project. IUGG Executive Committee, at its meeting in Karlsruhe in August 2008, reviewed the recommendation of the IUGG Bureau regarding the project and decided to award the project. The amount of the IUGG grant is US\$9,300 for the 2 years project. In addition to the research and training program, EMSEV will organize a workshop devoted to Asian countries.

- Possible new EMSEV contribution to developing country: Indonesia.

At IWSEP-2007 meeting in Bandung (see above), the general discussion led by LIPI, LAPAN, and BMG pointed out that EM studies should be enlarged in Indonesia, first in the earthquakes mitigation and second in volcanic eruption forecast. A recommendation letter was drawn up and sent to Indonesia Authorities for highlighting the necessity to increase international cooperation in these domains.

The Indonesians colleagues have asked EMSEV to strengthen their EM studies. EMSEV will carefully consider any more formal request. We will propose to contribute to one or several areas of study in which EMSEV teams could participate for several years.

7) Concluding Remarks

The Inter-Association Working Group of Electromagnetic Studies on Earthquakes and Volcanoes was created by IUGG in 2001. During the past seven years, EMSEV has continuously acted for the improvement of the quality of observations and interpretations of EM phenomena related to earthquakes and volcanic eruptions. The power of EMSEV comes from the considerable expertise of members in the three associations. EMSEV will attempt to keep a good balance between the three associations and related topics. The EMSEV WG stays strongly focused on promotion of the highest quality research in advanced countries (Japan, France, USA, Greece, Italy...) and extends its activities in developing countries as well.

EM studies are now performed more and more accurately with sophisticated tools and data processing that include integration of other geophysical and remote sensing methods, such as the Demeter micro-satellite. Results become clearer and more convincing as more the number of multi-parameter observations accumulates (EMSEV-DEMETER 2008 meeting). The outstanding point of all EMSEV activities results in a very high level of researches done on anomalies observed during earthquakes preparation, as well as on volcanic unrests. Physical mechanisms, based on cross-correlated observations (on land and on board of satellites) are more and more solidly based.