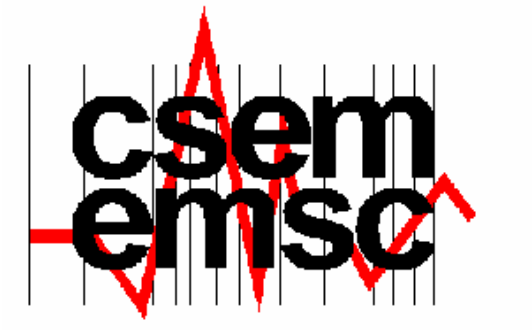


# *Report on EMSC Operational Activities*

## European-Mediterranean Seismological Centre

*http://www.emsc-csem.org*

Reporting period covered: **January 2004 – December 2004**

Actual reporting date: **23 February 2005**

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# Acknowledgments

EMSC would like to thank IGN and LDG for their constant support in operating the system and all the data providers for their efforts in providing timely and reliable information and especially the personal on duty at IGN and LDG for they constant and serious work.

Finally, we would greatly appreciate to receive your feedback to further improve our services and better answer your needs.

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# A. General Presentation

For many years, EMSC has been operating an **Earthquake Alert System** for potential damaging earthquakes mainly focused on the Euro-Mediterranean region, in collaboration with LDG and IGN (Madrid). This system is operational 24/7 thanks to the operational technical support of LDG and the collaboration with the IGN which runs back-up procedures and can take over the duty whenever it is required (e.g. maintenance activities).

The alert system is a component of the **Real Time Information system** which provides automatic real time locations of earthquakes through a web site.

This document first aims at presenting the operational activities of the EMSC and how both Real Time Information and Earthquake Alert Systems work and, in the second part, the status of these activities in 2004 will be presented.

- Special role of LDG and IGN in the operational activities

The Earthquake Alert System is operated by EMSC with the support of its host institute LDG (since 1992) for operational activities and is fully backed-up by IGN (Instituto Geografico Nacional, Madrid). This close collaboration has demonstrated its usefulness by having allowed the alert system to have remained operational 100% of the time in 2004.

## I. Introduction

The European Mediterranean Seismological Centre (EMSC) is a non-profit NGO created in 1975 whose members are mainly the seismological Institutes and observatories of the Euro.-Med. Region. With 65 members in 41 countries (see Appendix 2 for full list of members), it is well recognized by seismological community and plays a federative role at the European-Mediterranean level in close coordination with ORFEUS (Observatories and Research Facilities for EUropean Seismology).

## II. Data contributions

The Real Time Information and Alert systems are based on the reception, by email, of parametric data (source parameters, phase pickings, amplitudes) provided by 50 networks (see table 1) in the Euro-Med region.

- Type of messages

The messages can be either the result of automatic or manual data processing. Among the manual messages, some are sent very shortly after the earthquake by the person on duty for each network. In some other cases, the data are sent during working hours only.

- Type of data

The messages sent by the contributors can contain the following:

- Source parameters (origin time, epicenter location, depth, magnitude).
- Phase pickings (station, arrival times, phase type, amplitudes and period). Some messages only contain a group of phase pickings without any associated location.
- Moment tensors solutions.
- Additional information such as field observation, damage report, source studies, etc.

| CODE | INSTITUTE | TYPE | COUNTRY |
|---|---|---|---|
| BEO | Seismological Survey of Serbia, Beograd | OP | Serbia-Montenegro |
| BGR | Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover | OPA | Germany |
| BGS | British Geological Survey, Edinburgh | OPA | United-Kingdom |
| BRA | Seismology Division, Slovak Academy of Sciences, Bratislava | OPA | Slovakia |
| BUC | National Institute for Earth Physics, Bucharest | OP | Romania |
| CNRM | Centre National de la Recherche Scientifique et Technique, Geophysics Laboratory, Rabat | OP | Morocco |
| CRAA | Centre de Recherche en Astronomie, Astrophysique et Géophysique, Algiers | OP | Algeria |
| CYP | Geological Survey Department, Nicosia | OP | Cyprus |
| DDA | Earthquake Research Department, Ministry of Public Works and Settlement, Ankara | OP | Turkey |
| DJI | Observatoire Géophysique d'Arta | P | Djibouti |
| GFU | Geophysical Institute of Academy of Sciences, Prague | OP | Czech Republic |
| GFZ | GeoForschungsZentrum (GEOFON), Potsdam | OPA | Germany |
| GII | Seismology Division, Geophysical Institute of Israel, Tel Aviv | OP | Israel |
| GRAL | National Center for Geophysical Research, Beirut | OP | Lebanon |
| GSRC | Geophysical Survey. Russian Academy of Sciences, Obninsk | OP | Russia |
| ICC | Instituto Cartografico de Catalunya, Barcelona | P | Spain |
| IMO | Department of Geophysics, Icelandic Meteorological Office, Reykjavik | OP | Iceland |
| IMP | Instituto de Meteorologia, Seismologia, Lisbon | OPA | Portugal |
| INGV | Italian National Seismic Network, Roma | OPA | Italy |
| INMT | Institut National de la Météorologie, Tunis | P | Tunisia |
| IRSA | Romanian Institute for Applied Seismology, Bucharest | P | Romania |
| KAN | Kandilli Observatory and Earthquake Research Institute, Istanbul | OP | Turkey |
| LDG | Laboratoire de Détection et de Géophysique, Bruyères-le-Châtel | OPA | France |
| LED | Landsamt für Geologie, Rohstoffe und Bergbau, Baden Württemberg | OP | Germany |
| LJU | Environmental Agency of the Republic of Slovenia, Seismological Office, Ljubljana | OP | Slovenia |
| LVV | Carpathian Seismological Dept., Ukraine Academy of Science, Lviv | P | Ukraine |
| MAD | Instituto Geografico Nacional, Madrid | OPA | Spain |
| MCSM | Ukrainian NDC, Main Center of Special Monitoring, Kiev | P | Ukraine |
| MOLD | Institute of Geophysics and Geology, Chisinau | P | Moldova |
| MON | Direction de l'Environnement, de l'Urbanisme et de la Construction | P | Monaco |
| MSO | Montenegro Seismological Observatory, Podgorica | OPA | Serbia-Montenegro |
| NEIR | USGS/NEIC, Denver | OPA | USA |
| NEWS | Norwegian Seismic Array, Kjeller | OPA | Norway |
| NNC | Kazakhstan National Data Center, Institute of Geophysical Research, Almaty | P | Kazakhstan |
| NOA | National Observatory of Athens, Geodynamic Institute, Athens | OPA | Greece |
| NOR | Norwegian Seismic Array, Kjeller | OP | Norway |
| NRIA | National Research Institute of Astronomy and Geophysics, Cairo | OP | Egypt |
| ODC | Observatories and Research Facilities for EUropean Seismology, De Bilt | OP | The Netherlands |
| OGS | Osservatorio Geofisico Sperimentale, Trieste | OP | Italy |
| OMAN | Earthquake Monitoring Center, Sultan Qaboos University, Muscat | P | Sultanate of Oman |
| PDA | Instituto de Meteorologia, Azores University, Ponta Delgada, Azores | OP | Portugal |
| RNS | Réseau National de Surveillance Sismique, Strasbourg | OP | France |
| SED | Swiss Seismological Service, Zurich | OP | Switzerland |
| SOF | Bulgarian Academy of Science, Bulgarian Academy of Sciences, Sofia | P | Bulgaria |
| SPGM | Département de Physique du Globe, Rabat | OP | Morocco |
| THE | Department of Geophysics, University of Thessaloniki, Thessaloniki | OP | Greece |
| THR | International Institute of Earthquake Engineering and Seismology, Tehran | OP | Iran |
| TIR | Institute of Seismology, Academy of Sciences, Tirana | OP | Albania |
| ZAG | Seismological Survey, University of Zagreb, Zagreb | P | Croatia |
| ZAMG | ZentralAnstalt für Meteorologie und Geodynamik, Vienna | OP | Austria |

**Table 1: 50 networks have provided parametric data in the framework of the real time earthquake information and alert systems in 2004.**

**Legends:**

**Data type:**

- ***O: Source parameters (location and magnitude)***
- ***P: Phases pickings (arrival times)***
- ***A: Amplitudes readings***

**Network code:**

BRA**: new contribution in 2004.**

- Data Flow, Data process

The way the Real Time Information and Alert systems work are described on Figure 1.

- The parametric data of the seismological networks are collected by internet (email). The mailbox is checked **every minute** for new messages.

- All the collected data are included to the database. This database can then be requested by the users through autoDRM requests.

- A filter is applied which:
  - Identifies the network which provided the data.
  - Converts the data into GSE2.0 format.
  - Converts local station codes into international ones.
  - Only keeps events with magnitude greater than 2.0 for further processing (if a magnitude has been reported network).
  - Associates the message to the group of messages already received (e.g. from other networks) and that refer to the same event.

- From this point on, 2 parallel systems are applied:

  - Automatic locations:

  This system is fully automatic.

  **Each 5 minutes**, automatic locations are performed, by merging phase pickings provided by the individual networks, on the events that are reported by at least 2 networks and for which new messages arrived. On the other hand, each existing automatic location is updated if new data are available.

  Each automatic location is disseminated by email 90 minutes (lowered to 65 minutes on February, 1st, 2005) after the earthquake occurrence. This delay ensures that the vast majority of the data concerning the event has been received prior to disseminate this unchecked location. This service is restricted to seismologists and is notably used to trigger automatic data processing like Moment Tensor computation. These automatic locations have proved to be generally more reliable than individual automatic solutions.

  - Manual locations:

  This system is fully manual and based on the personal on duty. A manual location is computed for an event that either triggers the Earthquake Alert System or raises a particular interest because of it has been felt or has caused damage. Manual locations are performed by the seismologist on duty and disseminated to a list of end-users by fax, email and SMS (see part IV for more details).

- The results of automatic and manual locations along with the messages received from the individual networks are accessible through the web site on a page entitled “For seismologists only” (http://www.emsc-csem.org/cgi-bin/ALERT_all_messages.sh).

- Additional data (e.g. field report, source studies, etc.) that scientists provide to EMSC are also put on line on the web site.

This structure ensures data availability to the scientific community through specific requests (autoDRM), the public information (web site) and the dissemination of alert and information messages (fax, emails and SMS).

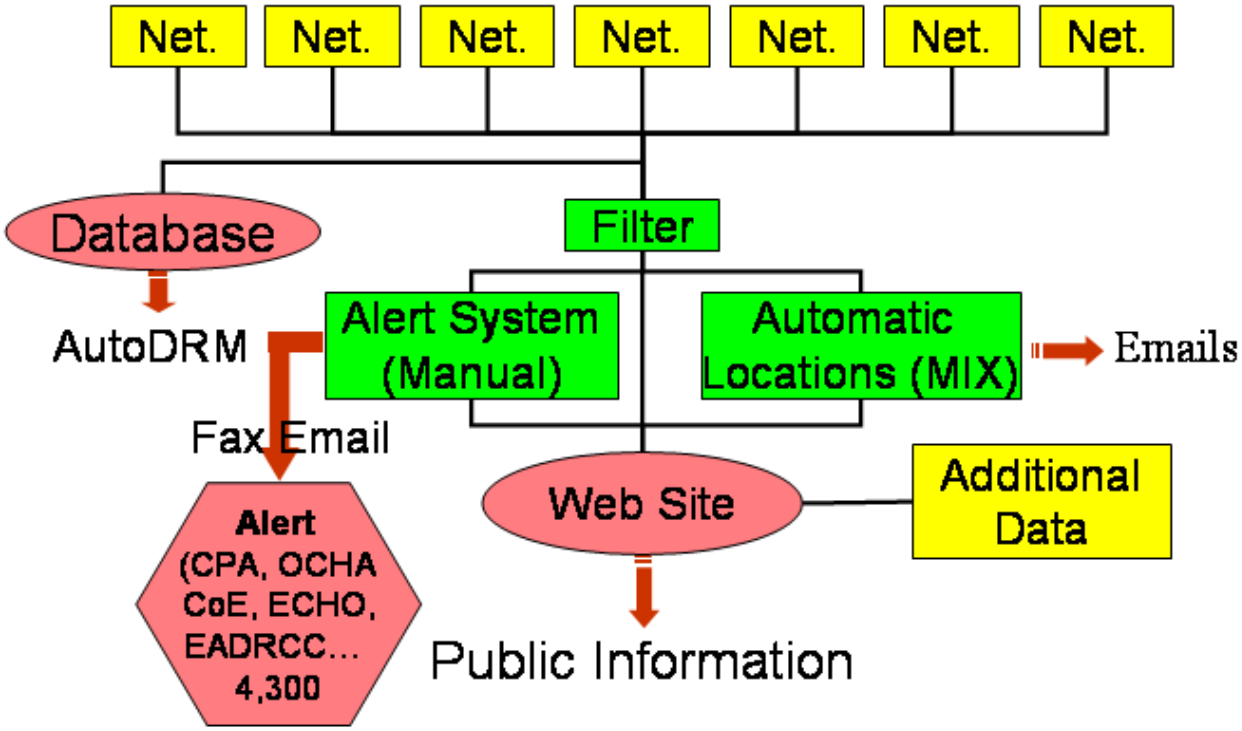


**Figure 1: Data flow for the Real Time Information and the Alert systems**

## III. Real Time Information page

The goal of the Real Time Information page is to provide a clear view of the current seismic activity including an up-to-date list of the last reported and/or located earthquakes and several maps.

- **Former and new Real Time Information page**

The first version of the Real Time Information page (mentioned previously) had been developed by and for seismologists. Nevertheless, in the last few years, EMSC web site has attracted an audience beyond the scientific community. As this page included all messages received and then often several sets of source parameters for each event (see Figure 2), it was the cause of misinterpretation by the public.

That is why, in 2004, a new Real Time Information page dedicated to the public has been developed on which a single set of source parameters is displayed by event (see Figure 3). This development has been partially funded by the MEDD (Ministère de l'Ecologie et du Développement Durable = French Ministry of Ecology and Sustainable Development).

The former page (Figure 2) remains public but more dedicated to the seismological community.

- **Description of the new Real Time Information page**

The new page is accessible through: http://www.emsc-csem.org/cgi-bin/QDM_all.sh. An extract is presented on Figure 3.

This page presents an up-to-date list of the last seismic events with their associated source parameters: origin time, epicenter coordinates, depth, magnitude type and value, region of occurrence and the time the location of each event have been updated.

For each event reported in this list, the following information are also accessible through hyperlinks:

- List of networks which provided data for the event.
- Links to the authoritative networks in the region (see next paragraph).
- Either the list of phase pickings used in the location (if the event has been located by EMSC) or the raw data message of the authoritative network.
- Three levels of maps that represent the epicenter on a global, regional and local scales (see Figure 4).

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2005/02/02 | 23:57:12.3 | 16.9N | 82.6E | 33 | mb5.2 | A | LDG | SOUTHERN INDIA |
| 2005/02/02 | 23:55:29.3 | 1.5N | 93.0E | 33 | mb5.0 | A | NOR | OFF W. CST OF NORTHERN SUMATERA |
| 2005/02/02 | 23:45:37.2 | 37.7N | 43.7E | 29 | MD3.1 | A | KAN | TURKEY |
| 2005/02/02 | 23:34:13.9 | 37.8N | 44.0E | 21 | MD3.2 | A | KAN | TURKEY-IRAN BORDER REGION |
| 2005/02/02 | 23:31:00.3 | 36.2N | 28.8E | 5 | MD3.2 | A | KAN | DODECANESE ISLANDS, GREECE |
| 2005/02/02 | 23:30 | | | | | M | MCSM | |
| 2005/02/02 | 23:28 | | | | | M | GRAL | |
| 2005/02/02 | 23:27:03.0 | 37.8N | 42.7E | | mb4.6 | A | BRA | TURKEY |
| 2005/02/02 | 23:27:01.0 | 38.5N | 43.7E | | mb4.4 | A | GFZ | TURKEY |
| 2005/02/02 | 23:26:58.0 | 38.0N | 43.3E | 10 | Ms3.2 | M | GSRC | TURKEY |
| 2005/02/02 | 23:26:53.4 | 37.8N | 43.6E | 8 | mb4.6 | M+ | INFO | TURKEY |
| 2005/02/02 | 23:26:51.6 | 37.7N | 43.6E | 5 | Ml4.5 | A | KAN | TURKEY |
| 2005/02/02 | 23:26:49.0 | 37.6N | 44.0E | 5 | Ml4.2 | M | NSSP | TURKEY-IRAN BORDER REGION |
| 2005/02/02 | 23:26:01.2 | 32.9N | 49.6E | 33 | mb4.7 | A | LDG | WESTERN IRAN |

**Figure 2: Extract of the former Real Time Information page (dedicated to seismologists): 1 line = 1 message. 1 group of messages = 1 event**

| | | | | | | |
|---|---|---|---|---|---|---|
| 2005/02/02 23:45:37.2 | 37.67 N | 43.74 E | 29 | MD3.1 | TURKEY | 2005/02/03 01:08 |
| 2005/02/02 23:34:13.9 | 37.77 N | 44.01 E | 21 | MD3.2 | TURKEY-IRAN BORDER REGION | 2005/02/03 00:49 |
| 2005/02/02 23:31:00.3 | 36.21 N | 28.82 E | 5 | MD3.2 | DODECANESE ISLANDS, GREECE | 2005/02/03 00:37 |
| 2005/02/02 23:26:53.4 | 37.75 N | 43.62 E | 8 | mb4.6 | TURKEY | 2005/02/03 06:20 |

**Figure 3: Extract of the new Real Time Information page (dedicated to the public): 1 line = 1 set of source parameters**

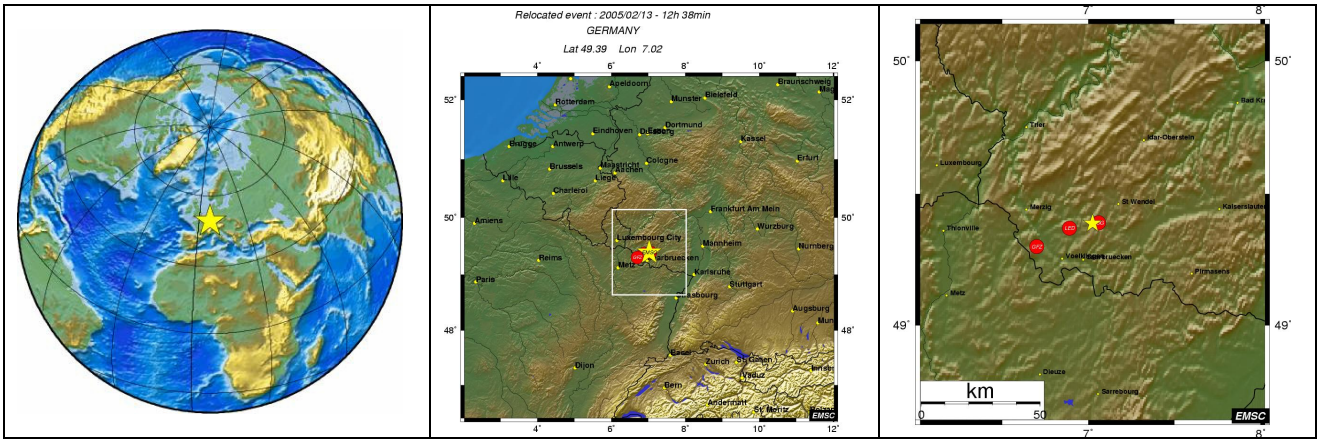


**Figure 4: Example of the maps produced for an event located by EMSC**

- **Notion of authoritative network**

The main goal of developing a Real Time Information page was to publish one set of source parameters per event and notably to avoid the publication of poorly constrained automatic locations (when the epicenter lies outside the network).

Here comes the notion of **authoritative network** on which this page is based: A region is associated to each network and an earthquake reported by this network and which location falls within this region is considered as reliable. One says the network is authoritative in this region.

In order to determine if a network is authoritative or not in a given region, a polygon has been associated to each network. For example, national network is associated to its respective country. Then, when a network reports an event, a software named QDM (Quake Data Merge) and developed at USGS by A. Jones and D. Oppenheimer allows us to tell if this network is authoritative in the region.

- **Strategy to publish an event**

If the event is reported by only one network: It is published on the web page only if the network is authoritative in the region. The location is not recomputed.

If the event is reported by several networks: An automatic location is computed and published on the web page.

When a manual location has been computed for an event, this replaces the automatic one in the Real Time Information page (see Part IV).

Each year, **between 6,000 and 10,000 events are reported** on the new Real Time Information page. This figures are extrapolation of the 3-4 months during which the new page has been on line.

- **A dynamic page**

This page is fully dynamic and its content is updated every minute. For example, after an earthquake, if the authoritative network sends a location computed automatically, it is immediately published on the Real Time Information page. Then, if the authoritative network provides a revision of the previous message, it will replace the former one.

As soon as the event is reported by 2 different networks, an automatic location is computed and published. Then, each time new data are available for an event already located by EMSC, the automatic location is updated.

Therefore the content of the Real Time Information page varies as new data are coming in.

- **Data redundancy**

Because of transnational data exchange and the development of virtual networks, the same station may be reported by several networks with different arrival times. Therefore, one has to select one pick among the whole bunch during the location process. For this, the following rules are applied:

- A manual pick replaces the automatic one (if reported by the same network, for the same station and phase type) as long as its residual is lower than the automatic pick.
- A pick to which an amplitude reading is associated replaces the one without amplitude (as it brings additional information) as long as its residual is lower than the one without amplitude.

In the dissemination of manual messages, most of this processing is done automatically to help the seismologist on duty to quickly refine its location. The remaining redundancies are processed by the seismologist himself.

## • Additional seismological information

Information such as Moment Tensors solutions, result of the location (phase pickings), and background of moment tensors for each reported event are also accessible on the web site.

### ➢ Moment Tensors solutions

The following institutes provide moment tensors solutions (MT) to the EMSC. They are included to the web site:

ETHZ: Swiss Federal Institute of Technology, Zurich, Switzerland
INGV: Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy
IGN: Instituto Geografico Nacional, Madrid, Spain
Harvard: Seismological group of Harvard University.
USGS: U.S. Geological Survey, Denver, USA
CPPT: Centre Polynésien de Prévention des Tsunamis, French Polynesia

| | ETH | INGV | IGN | Harvard | USGS | CPPT |
|---|---|---|---|---|---|---|
| **Region of interest** | Euro-Med | Euro-Med | Iberia Pen. West Med. | World | World | World |
| **Average dissemination time** | 90 min (1) | Few hours | 1-6 hours | 10-15 h | Few hours | Few hours |
| **Threshold magnitude** | 4.8-5.0 | 4.5 | 3.5 | 6.0 | 5.5 | 6.5 |

**Table 2: Criteria for MT dissemination by agency.**
**(1) : ETH launches automatic computation of MT upon reception of automatic or manual locations from EMSC.**

These MT provide reliable estimations of the moment magnitude (Mw) for moderate to large events while values of local magnitude (ML) and body wave magnitude (mb) can be saturated.

Mw values are often used in revision messages for large events

### ➢ Background of Moment Tensors

In order to plot each epicenter in its background of Moment Tensors, a database of Euro-Med earthquake mechanisms called EMMA (Earthquake Mechanisms of Mediterranean Area) and compiled by Vanucci & Gasperini in 2003, is used. This database compiles the MT of the Global CMT Catalog of Harvard and 2 regional CMT catalogs of ETH and INGV.

## • Special web pages

When an event raises a particular interest (Russia (Kaliningrad) 21/09) and/or produces significant damage (Morocco (Al Hoceima) 24/02, Indonesia (Sumatra) 26/12, etc.), EMSC opens a special web page gathering additional information such as field observations, damage report, moment tensors, etc.

The popularity of Special web pages and of the new Real Time Information page had a clear impact on the web traffic in 2004. In order to illustrate this, the annual evolutions of web traffic as well as the variations of web traffic just after some significant earthquakes will be shown in the following paragraph.

- **Web site connections**

In 2004, the number of visitors of the web site has increased dramatically. This is due to the implementation of the new page and the popularity of the special pages and also to the number of significant events: Morocco (Al Hoceima) 24/02; Slovenia 12/07; Russia (Kaliningrad) 21/09; Romania 27/10; North Italy 24/11; Indonesia (Sumatra) 26/12. To each significant event corresponds a peak in the web traffic as shown on Figure 5.

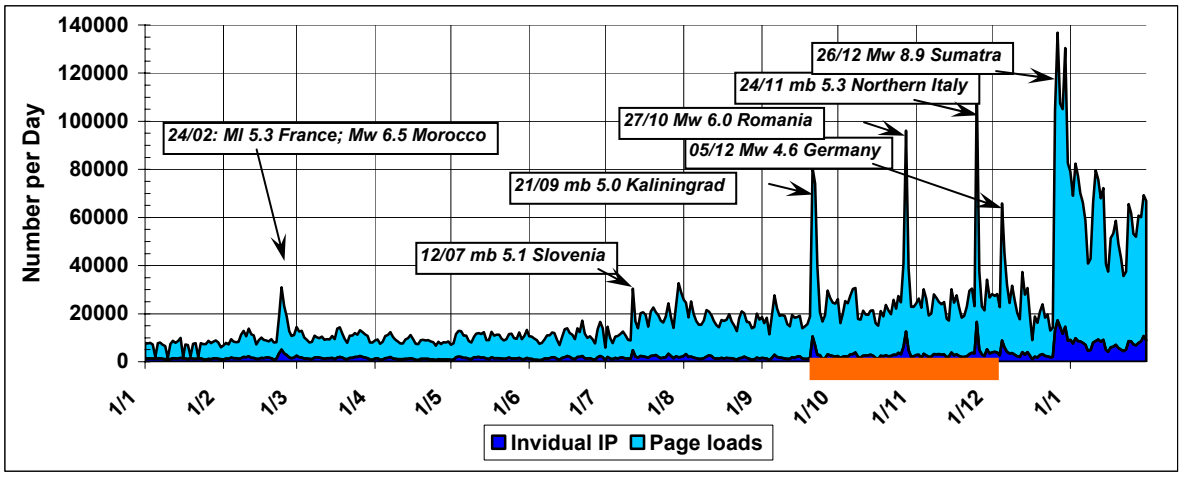


**Figure 5: Evolution of page loads and web visitors in 2004**
**The orange part corresponds to the period the new real time page has been put on line.**

The implementation period of the new page is represented by the orange part on Figure 5. Today, the new page represents more than 30% of the page loads.

In 2004, the following traffic has been observed:

- An average of 2,200 daily individual visitors (about 1000 in 2003). This average reaches 4,300 over November and December 2004.
- An average of 15,000 daily page loads (9,000 in 2003). 30,000 on average over November and December 2004.

Most of the visitors come from the Euro-Med region and from the U.S. More than 70 countries are represented among the visitors each day.

➢ **Hourly variations after significant earthquakes**

We have studied the hourly variations of web traffic in term of **additional visitors compared to the average traffic** just after 4 significant events in the Euro-Med region: mb 5.1 in Slovenia 12/07; mb 5.0 in Russia (Kaliningrad) 21/09; Mw 6.0 in Romania 27/10; mb 5.3 in Italy 24/11. For each event, we have removed the hourly average traffic for the same period (see example Figure 6) from the hourly variations of number of visitors observed after the earthquakes in order to track the additional traffic just after the earthquakes (see Figure 7).

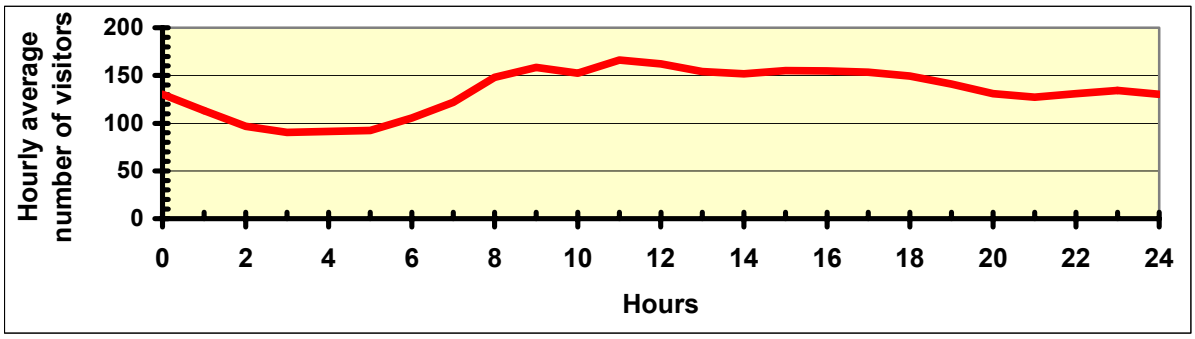


**Figure 6: Average over October 2004 of hourly number of visitors**

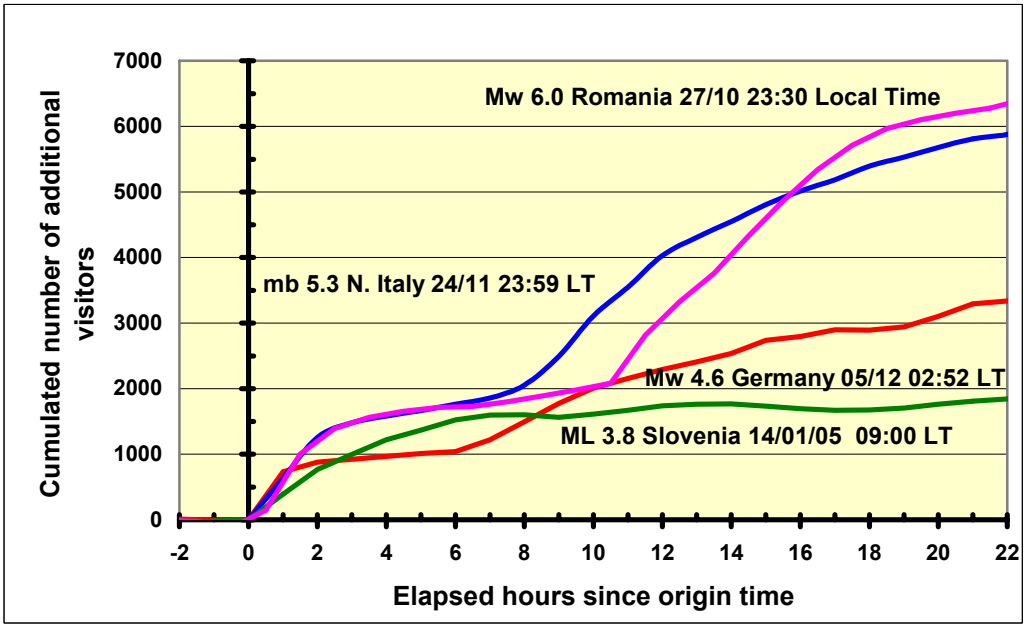


**Figure 7: Variation of number of visistors after significant events in the Euro-Med region**

As shown on Figure 7, for the 3 events that occurred during the night, there are 3 steps in the evolution of the number of visitors.

1. In the first hour following the events, approximately 1,000 to 2,000 additional visitors are recorded. (first positive slope in the first hours after the earthquake on Figure 7). As these visitors connect to EMSC in the very first hours following the earthquake (besides during night time), this probably means that these visitors may have felt the earthquake.
2. The number of hourly visitors goes back to the average (flat part in the 3 curves). There are few additional visitors compared to the average.
3. At 7-8 am, the number of additional visitors exceeds again the average (second positive slope). These probably correspond to people who have heard about the earthquake at the news and are willing to retrieve more information about it.

Today, most of the significant earthquakes in the Euro-Med have an immediate impact of the web traffic. For example, **more than 1,000 additional visitors connected to EMSC web page in the 2 first hours** after the Mw 6.0 in Romania (27/10/04) and the mb 5.3 in Northern Italy (24/11/04) (see Figure 7). Even the M3.8 that occurred in Slovenia on 14/01/05 has drawn **more than 1,000 additional visitors in the 5 following hours.**

# IV. Earthquake Alert System

In the framework of the Real Time Information service, EMSC operates an Earthquake Alert System, operational 24/7, for potentially damaging earthquakes in the European-Mediterranean region, and for large events worldwide. The main difference between Real Time Information and Alert Systems is that the latter is fully manual and based on the personal on duty.

## • Objectives

The objectives are:
- To give redundancy to alerts systems operated by national institutes.
- To ensure the information outside the affected country(ies).
- To provide reliable locations in border regions and off shore.
- To inform European authorities.

## • Procedure

The alert system is triggered when 2 different networks report a magnitude that reaches the local threshold (see Figure 8) for the same event. Then, the seismologist on duty is automatically called on his mobile. He connects to EMSC through an internet connection and manually computes the location and magnitude by merging all the phase pickings provided by the contributing networks. Finally, he disseminates the alert message to the end-users. Among them: ECHO (*Humanitarian Aid Agency of the EU*), OCHA (*Humanitarian Aid Agency of the UN),* Council of Europe, European Civil Protection Unit, EADRCC (*Euro-Atlantic Disaster Reaction and Coordination Centre*), NATO, a dozen of rescue teams and a about 4,500 individuals (on 20/02/2005).

EMSC commits itself to disseminate each alert within an hour after the earthquake occurrence.

## • Alert, Information and Revision messages.

Many events raise a particular interest because they have been felt and/or caused damage although they do not trigger the Earthquake Alert System because their respective magnitude is lower than the local threshold. For such events, EMSC sends **Information messages**. Information messages are also used for events which triggered the Alert System but for which the magnitude computed by EMSC is finally lower than the local threshold.

Eventually, manual locations may be disseminated in 3 types of messages:

i. **Alert messages**: If the magnitude of the event is higher than the local threshold. Alert messages are sent within an hour following the earthquake occurrence. See example of Alert message in Appendix 3.

ii. **Information messages**: If the event raised a particular interest because and/or its magnitude is lower than the local threshold. Information messages are sent without any time constraint.

iii. **Revision messages**: These are sent as revisions of the preliminary messages (may be Alert or Information message). These messages are often used for large events for which the magnitude is generally difficult to estimate within the first hour. For minor revisions, no message is sent, the only information published on the web site are revised.

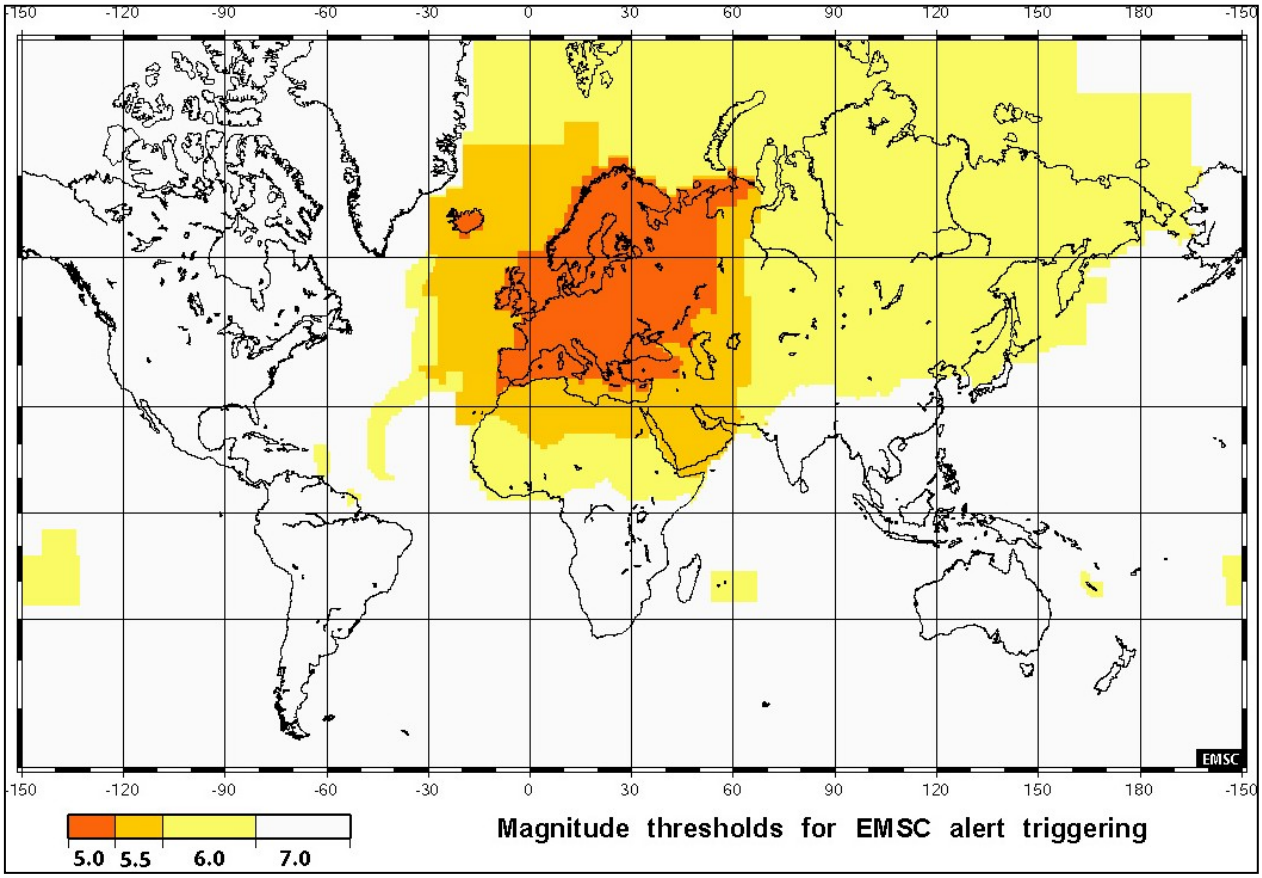


**Figure 8: Local magnitude thresholds of earthquake alert triggering**

- EUR-OPA alerts

EMSC provides a specific alert system for the Council of Europe for events with magnitude greater than 6.0 in one of the countries which have signed the EUR-OPA (Open Partial Agreement on Major Hazards) agreement: Albania, Algeria, Armenia, Azerbaijan, Belgium, Bulgaria, Cyprus, Spain, France, Georgia, Greece, Italy, Lebanon, Luxembourg, Macedonia, Malta, Moldavia, Morocco, Monaco, Portugal, San-Marino, Romania, Russia, Turkey, Ukraine.

# B. Status in 2004

This part aims at presenting the status and the evolution of the data contribution and of the Real Time Information and Alert Systems in 2004.

## I. Data contributions

This part shows the status of data contributions in 2004.

- Today **50 networks** are providing real time parametric data to EMSC (see table 1)**. 7 new networks** have started to send real time data to EMSC in 2004. This represents about **80 new stations** to the total number of contributing stations (1,100 on 01/01/2005) (see Figure 9).

  The density of stations in Europe and around the Mediterranean Sea (except Libya) is quite high whereas the Arabia Peninsula and Iran are poorly covered (Figure 9), though the latter is a very active seismic region.

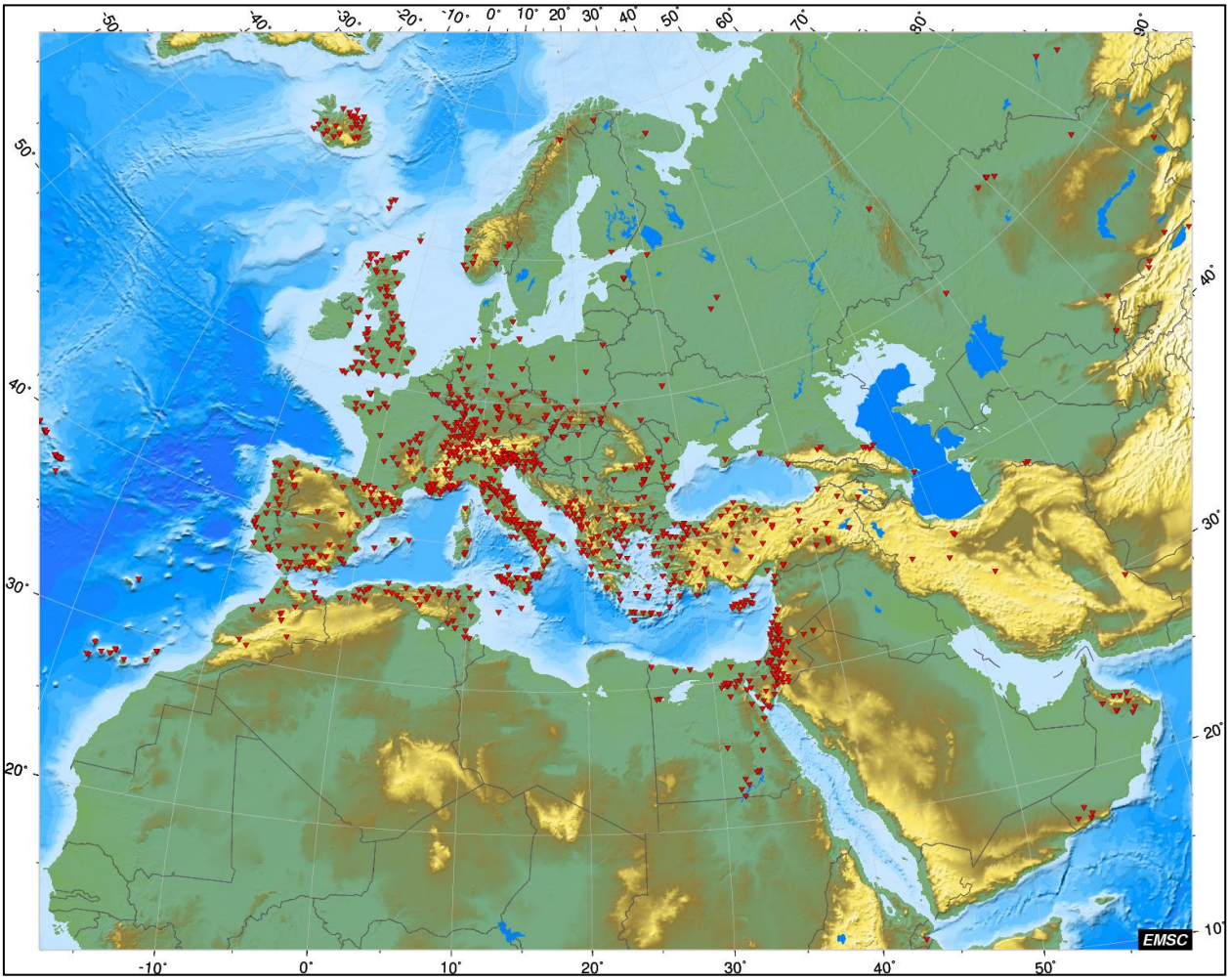


**Figure 9: About 1,100 Euro-Med stations have provided data in 2004**

- In 2004, EMSC has received **38,486 messages** from the contributing networks, representing **447,552 phase pickings**.

- In 2004, EMSC has received **1,026 Moment Tensors** solutions from the six institutes mentioned in the part A. These MT concerned **562 events** in the world (**56 located in the Euro-Med region**).

| | ETH | INGV | IGN | Harvard | USGS | CPPT | Total |
|---|---|---|---|---|---|---|---|
| **Euro-Med** | 35 | 32 | 21 | 24 | 16 | 5 | 133 |
| **World** | 43 | 32 | 21 | 510 | 387 | 33 | 1,026 |

**Table 3: Number of moment tensors received by institute in 2004**

# II. Real time information

This part presents all the work done by EMSC in term of Real Time Information in 2004.

- In 2004, **1,934 automatic locations** have been computed. On February 2005, the dissemination delay for automatic locations has been lowered from **90 to 65 minutes**.

- In 2004, **15 special web pages** have been opened:

  - Mw 8.9 Indonesia (Northern Sumatra) 26/12/2004
  - Mw 4.6 Germany 05/12/2004
  - ML 4.7 Polish-Slovak border 30/11/2004
  - mb 5.3 Northern Italy 24/11/2004
  - mb 5.2 Greece-Albania 23/11/2004
  - Mw 7.0 West coast of Colombia 15/11/2004
  - Mw 6.0 Romania 27/10/2004
  - Mw 6.8 Japan 23/10/2004
  - The anticipated Parkfield earthquake (US)
  - mb 5.0 and mb 4.4 in Russia (Kaliningrad) 21/09/2004
  - Earthquake Activity in the Gokova Gulf (Dodecanese Island, Greece) in august 2004
  - mb 5.1 Slovenia 12/07/2004
  - mb 5.1 Eastern Turkey 01/07/2004
  - Mw 6.5 Morocco (Al Hoceima) 24/02/2004
  - mb 5.1 Israel-Jordan border region 11/02/2004

The special pages have proved to be popular. More and more spontaneous contributions to the special pages are now received. EMSC strongly encourages scientists to contribute to these pages in order to easily share their information and documents.

- More than **25,000 autoDRM requests** have been done on EMSC real time database.

# III. Earthquake Alert System

This part presents the status of the Earthquake Alert System in 2004.

- IGN back-up

In 2004, IGN has been on duty for a total of **57 hours** (177 hours in 2003) mainly for maintenance reasons and for an unexpected internet connections interruption at EMSC.

During its duty, IGN ensured the continuity of our alert service by processing and disseminating **2 alert messages**. Therefore, the collaboration with IGN remains crucial for the alert system to remain operational 24/7.

- Disseminated manual messages

In 2004, **185 manual messages** (168 in 2003) have been disseminated for events located worldwide (see Figure 10). These messages concerned **164 events worldwide** (91 in the Euro-Med region) (see Figure 11). These 185 manual messages are:

- **55 Alert messages**: including 36 events located in the Euro-Med region (see Figure 11 and Appendix 1). Two of these events were processed and disseminated by the **IGN** (because of maintenance activities or technical problems at EMSC).
- **109 Information messages** (65 in the Euro-Med region). Most of the Information messages are sent for events located in the Euro-Med region because this is the region most of our data come from.
- **21 Revision messages** (9 in the Euro-Med region).

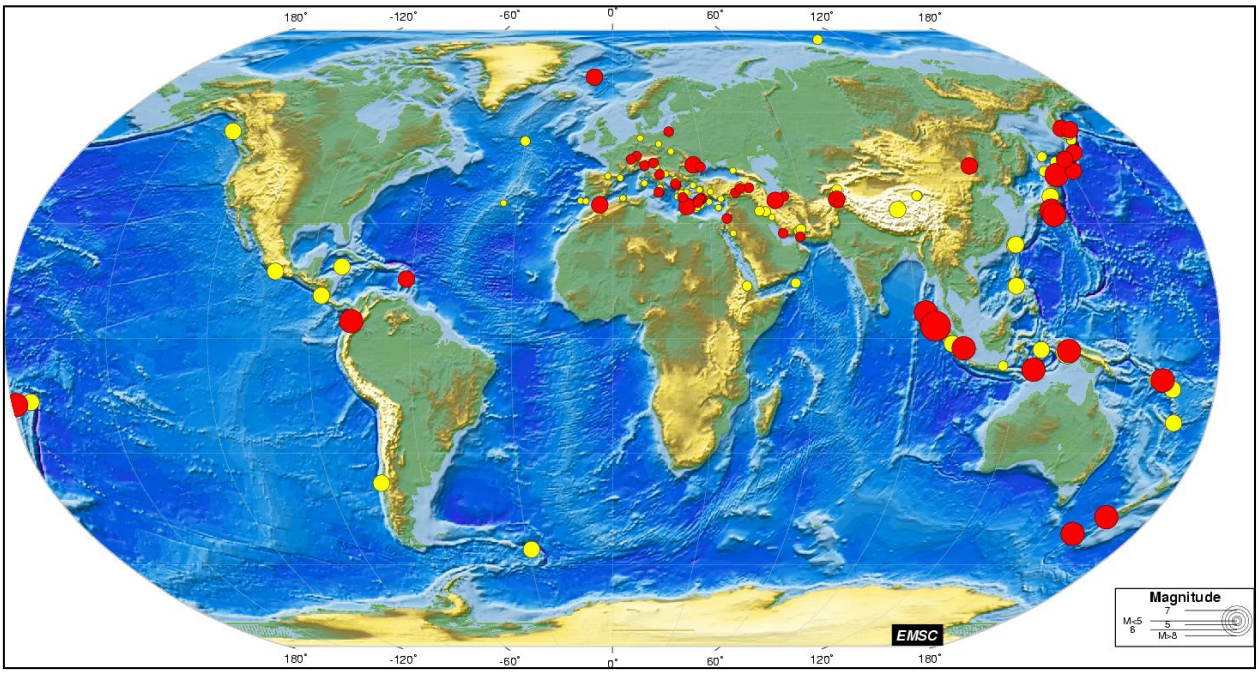


**Figure 10: Disseminated manual locations in the world in 2004 (red=alert messages; yellow=information messages) For events for which a revision message has been sent, the revised location is plotted on this map.**

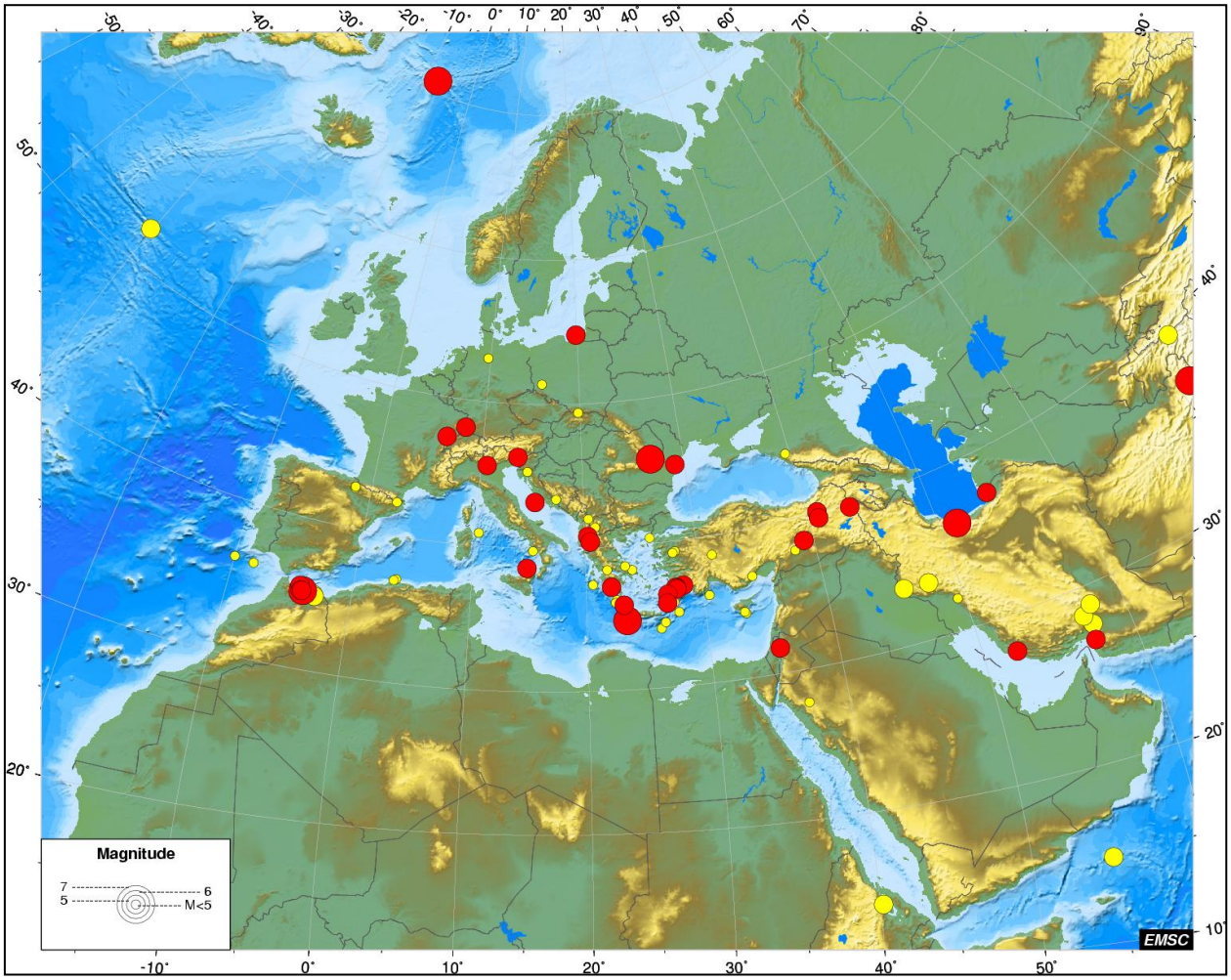


**Figure 11: Disseminated manual locations in 2004 in the Euro-Med region (red=alert messages; yellow=information messages) For events for which a revision message has been sent, the revised location is plotted on this map.**

- Availability of Moment Tensors

Figure 12 shows the 91 Euro-Med events for which EMSC sent a manual message in 2004 and their respective number of moment tensors solutions received from the agencies mentioned in Table 3.

Among the 55 alerts messages, **128 Moment Tensors** solutions have been received (79 for the 36 alerts located in the Euro-Med region):

- **Five** out of the 36 Euro-Med events for which EMSC sent an alert message had no MT solution available. These concern 2 events located in Europe, 1 in Eastern Turkey and 2 in Iran.
- For most M>5 events located in Europe, Moment Tensors are available. For some events, EMSC received up to 5 different MT.

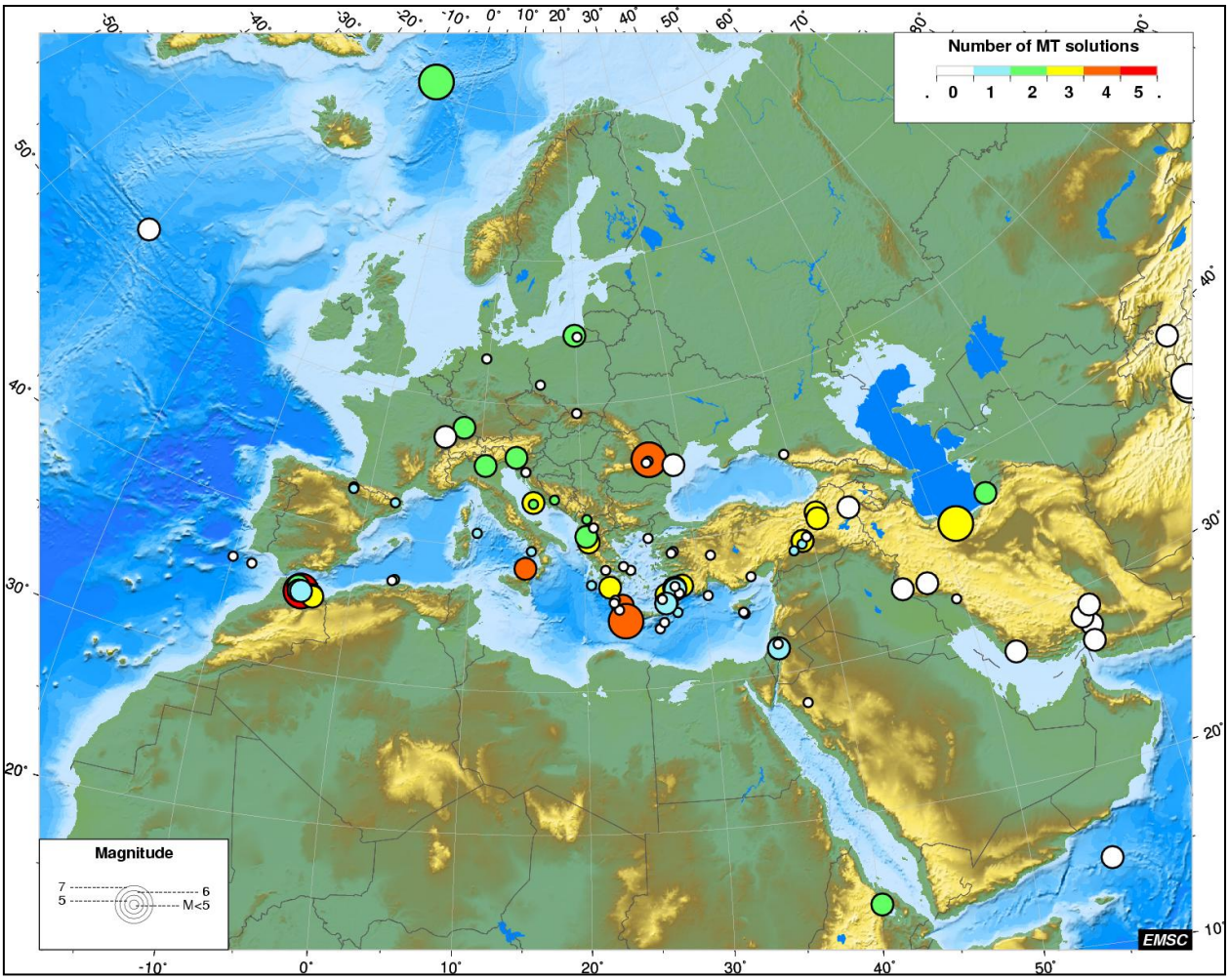


**Figure 12: Disseminated Manual locations in the Euro-Med region in 2004 and reception of associated Moment Tensors solutions**

- Modifications in the alert thresholds

The local alert threshold of the North Atlantic Ocean, between the ridge and the British, French and Spanish coasts has been lowered from 7.0 to 5.5 in order to give a more continuous pattern of the distribution of local thresholds in the Euro-Med region and to avoid problem in trigger timing due potential mislocations (see Figure 13).

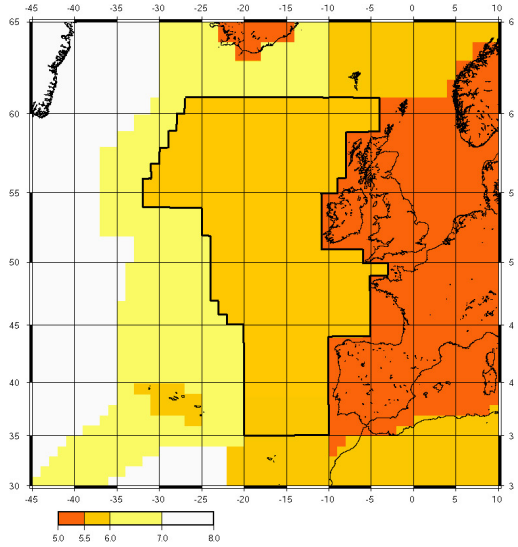

**Figure 13: Modifications (thick line polygon) in the repartition local alert threshold**

- Azimuthal gap of manual locations

Most manual locations in Western Europe for which EMSC sent an alert message have a nice station coverage. This shows that within an hour, EMSC is able to locate all events that trigger the alert system with a reliable accuracy.

In Eastern Turkey, Iran and Northern Africa, the station coverage still need to be improved (see Figure 14). Border effects are observed in Western Iran, Northern Africa and Icelandic region because the majority of the data we receive come from Euro-Med stations.

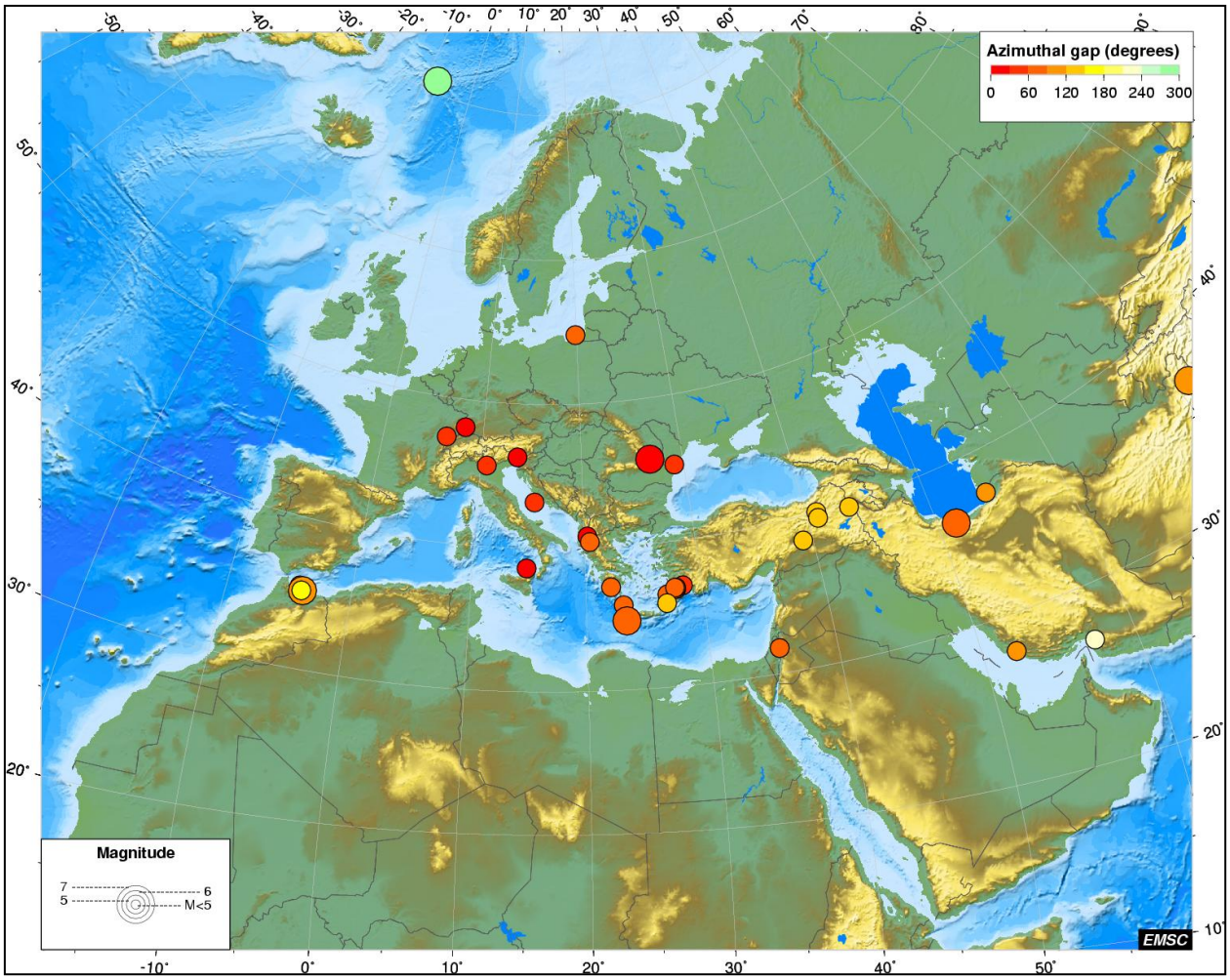


**Figure 14: Azimuthal gap of manual locations of Euro-Med events for which an alert message has been disseminated in 2004**

As shown on Figure 15, 90% of the locations disseminated in the alert messages for events in the Euro-Med region have been located with an azimuthal gap lower than 180 degrees.

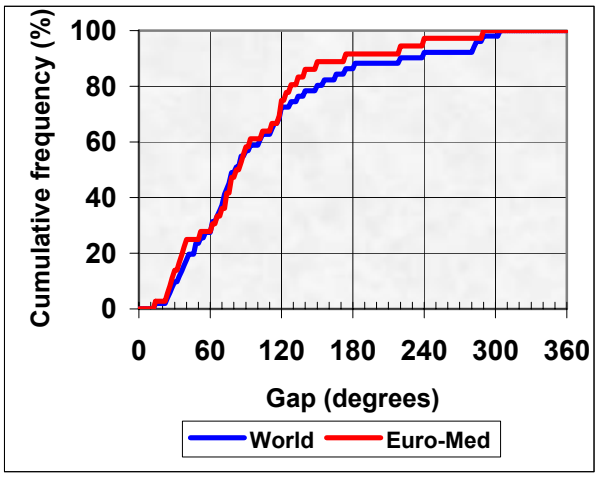


**Figure 15: Cumulated distribution of azimuthal gap of Euro-Med events for which an alert message has been disseminated in 2004**

- EUR-OPA alerts

EUR-OPA alert has been triggered for 8 events in 2004. They concern events with magnitude greater than 6.0 in one of the country mentioned in part A. This represents:

- 1 event in Greece
- 1 event in Northern Morocco (Al Hoceima)
- 1 event in Romania
- 5 events in Russia (2 in Kamtchatka and 3 in Kurils Islands)

- Alert triggering time statistics

The graph plotted on Figure 16 shows the cumulative distribution of the alert triggering time (the time elapsed between the earthquake occurrence and the triggering of the alert system) for Euro-Med events.

In 2004, all alerts for Euro-Med events have been triggered within 25 minutes after the event occurrence.

The median triggering time is about 13 minutes (14 minutes in 2003). This result is rather stable since 2003 and we do not think there is a possibility to improve it significantly with the current system.

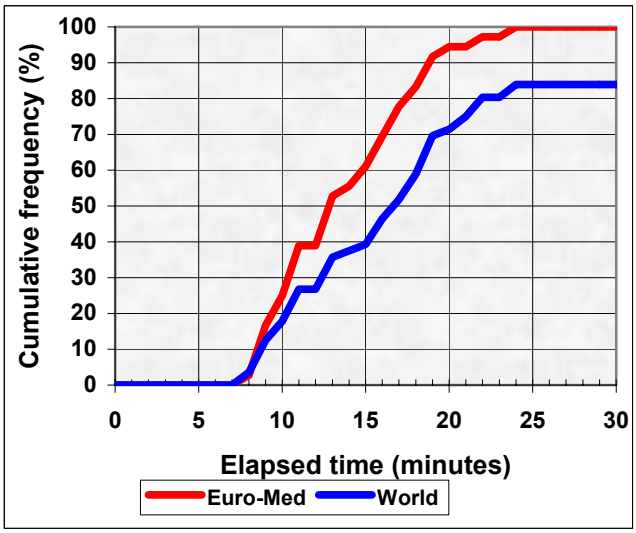


**Figure 16: Cumulated distribution of alert triggering time in 2004**

- Dissemination time statistics

Ninety five per cent of the alert messages for events located in the Euro-Med region have been disseminated in less than 1 hour by the seismologist on duty (100% in less than 75 minutes).

The two cases for which the time dissemination exceeded 60 minutes concern:

- A mb 5.2 in Greece disseminated in 65 minutes for which the processing time has been longer than usual.
- A mb 5.0 in Northern Morocco for which the initial magnitude was 4.7 and the information message has been sent after 37 minutes. The magnitude was reevaluated to 5.0 and sent after 73 minutes.

Among the worldwide 55 alerts, 80% of them have been processed in less than 1 hour (see figure 17). The remaining 20% corresponds to events for which the alert has been triggered late. This generally happens for the large events (M>7) in region where the local threshold is 7.0 because for large events the magnitude estimation requires more time to be computed.

The median dissemination time for the Euro-Med region is about 40 minutes (42 minutes in 2003) (see Figure 17). As for the median alert triggering time (see here above paragraph), there is no possibility to improve this performance significantly.

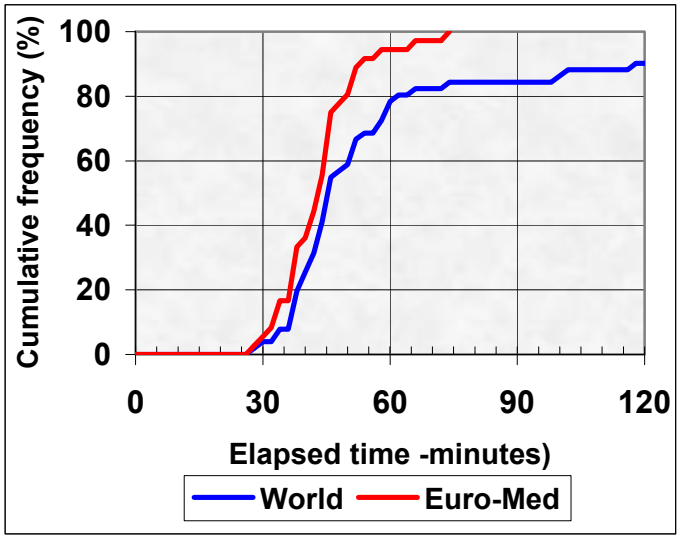


**Figure 17: Cumulated distribution of dissemination time (elapsed time between the earthquake occurrence and the dissemination of the alert message)**

- Alert dissemination lists

The email dissemination list of EMSC alerts contains more than 4,500 addresses on February, 20th 2005 (1,000 addresses on January 1st, 2004). It continues to expand with an average amount of 200 new subscriptions a month. There can be more than 100 new requests in the days following an earthquake which has been largely felt in the Euro-Med region.

The recipients are mainly from Euro-Med countries (~ 75%) but also from North America (~15%) (see Figure 18).

Countries with high seismic hazard are well represented like Greece, Italy and Turkey (Figure 19). Note that Romania represents a quarter of the total number of Euro-Med recipients; many of them have been registered following the Mw 6.0 that hit Romania on October 27th, 2004.

The countries that are not represented on Figure 19 have less than 50 recipients each and are the following (in decreasing order): Finland, Cyprus, Israel, Morocco, Sweden, Hungary, Norway, Iceland,

Malta, Egypt, Slovakia, Ukraine, Belgium, Lebanon, Jordan, Moldova, Denmark, Czech Republic, Syria, Luxembourg, Monaco, Saudi Arabia, UAE, Azerbaijan, Andorra, Liechtenstein, Armenia, Georgia.

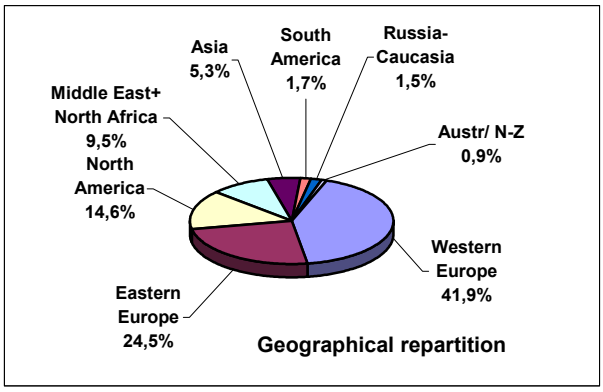


**Figure 18: Geographical repartition of end-users in 2004**

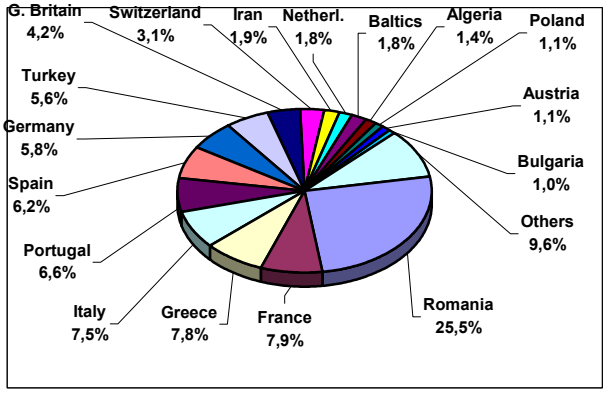


**Figure 19: Geographical repartition of Euro-Med end-users in 2004**

While subscribing to the email notification service, the users fill a form with compulsory fields that allow to know what are their respective interest in subscribing to this service. Rescue teams, the Medias and the Civil Protection Services are represented with 100 to 200 recipients each. The scientific community represents about 14%. The rest (76%) corresponds to individuals who subscribed for personal interest (Figure 20).

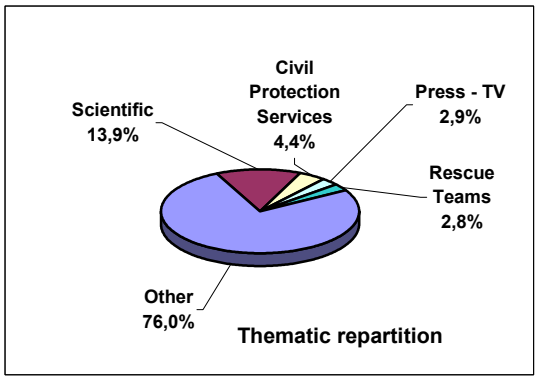


**Figure 20: Thematic repartition of end-users in 2004**

# C. Concluding remarks

- The Earthquake Alert System has remained fully operational in 2004 thanks to the technical support of LDG and the efficient collaboration with the IGN which has always fulfilled its role by taking over the duty when EMSC needed it.

- The Real Time Information and Alert System could not run without the contributions of the network operators who keep on providing quick and reliable data to EMSC. In 2004, new contributions have started and many other have become more regular.

- Moment Tensors contributions are much appreciated. Those really help to estimate the magnitude of moderate and large events.

- The implementation of the New Information page with its dynamic content has appealed a broader audience. The former page remains of interest for the seismological community.

- The use of the EMMA database allows to plot the epicenters in their tectonic context.

- The web traffic has increased dramatically. In 2004, an average of 2,200 individual persons per day have visited EMSC web site. This average exceeds 6,000 in January-February 2005 !

- More spontaneous contributions to the special web pages and to the News page are received. EMSC is always keen on helping the scientific community to share information.

- More than 4,500 emails are registered to the alert system. The median dissemination time of alert messages is about 40 minutes in 2004.

# D. Projects and potential evolutions for 2005

- To maintain operational alert activities (24 hours/day, 7 days/week) and the current level of performances.

- Improve the reliability of exchange procedures in specific regions, notably Northern Africa and the Middle East in order to lower the local thresholds to 5.0 in these regions.

- Increase the number of contributors for calibrated amplitudes data (required for magnitude computation).

- Getting more Moment Tensors in order to better estimate the magnitude of moderate to large events.

- Development of a specific current seismicity page to be displayed on cellular phones.

- Alert dissemination by SMS.

- Development of a RSS feed of the Real Time Information page.

- Improvement in the dissemination of automatic locations to fulfill specific needs of end-users (possibility to restrict to an area of interest, a magnitude range, etc…)

- Systematic and rapid computation of Mw magnitude for all manual locations.

- Availability of high graphical resolutions maps for all reported events.

- Multi-criteria dissemination system in order to answer the need of EMSC members and data contributors.

# Appendix

| DATE | TIME | MAG | LAT | LON | DEPTH (km) | DT (min) | RMS (sec) | SMAJ (km) | SMIN (km) | AZIM (°) | NSTA | GAP (°) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26/12/2004 | 04:21 | Ms 7.3 | 7.07 N | 92.99 E | 33 | 218 | 0.95 | 8.9 | 6.8 | 179.0 | 190 | 67 |
| 26/12/2004 | 00:58 | Mw 8.9 | 3.50 N | 95.72 E | 10 | 100 | 1.02 | 11.6 | 8.0 | 179.0 | 265 | 61 |
| 23/12/2004 | 14:59 | Mw 7.8 | 51.14 S | 158.25 E | 33 | 124 | 2.17 | 42.2 | 19.6 | 81.0 | 181 | 86 |
| 20/12/2004 | 23:02 | mb 5.2 | 36.93 N | 28.41 E | 30 | 46 | 1.01 | 3.1 | 2.1 | 19.0 | 298 | 39 |
| 18/12/2004[2] | 06:46 | Ms 6.5 | 48.95 N | 156.45 E | 30 | 101 | 0.89 | 10.3 | 3.8 | 0.0 | 273 | 182 |
| 05/12/2004 | 01:52 | ML 5.1 | 48.11 N | 8.08 E | 10 | 44 | 1.06 | 2.9 | 2.1 | 173.0 | 157 | 23 |
| 28/11/2004 | 18:32 | Mw 7.0 | 43.06 N | 145.15 E | 40 | 60 | 0.75 | 6.1 | 2.6 | 0.0 | 507 | 42 |
| 26/11/2004 | 02:25 | Mw 7.1 | 3.03 S | 135.23 E | 33 | 167 | 2.26 | 23.7 | 17.3 | 0.0 | 179 | 77 |
| 25/11/2004 | 06:21 | mb 5.2 | 43.17 N | 15.38 E | 2 | 38 | 1.07 | 2.3 | 1.7 | 77.0 | 275 | 37 |
| 24/11/2004 | 22:59 | mb 5.3 | 45.62 N | 10.62 E | 25 | 41 | 0.96 | 2.1 | 1.4 | 46.0 | 279 | 35 |
| 23/11/2004 | 02:26 | mb 5.2 | 40.39 N | 20.49 E | 20 | 65 | 1.13 | 3.1 | 2.5 | 14.0 | 256 | 61 |
| 22/11/2004 | 20:26 | Mw 7.1 | 46.56 S | 164.68 E | 33 | 131 | 1.23 | 10.0 | 8.5 | 78.0 | 157 | 47 |
| 21/11/2004 | 11:41 | mb 6.3 | 15.78 N | 61.65 W | 33 | 52 | 1.08 | 8.9 | 3.3 | 4.0 | 342 | 56 |
| 15/11/2004 | 09:06 | Mw 7.0 | 4.85 N | 77.52 W | 40 | 59 | 1.18 | 10.0 | 4.5 | 21.0 | 397 | 101 |
| 11/11/2004 | 21:26 | Ms 7.2 | 7.94 S | 124.96 E | 33 | 117 | 1.13 | 13.3 | 9.2 | 5.0 | 118 | 48 |
| 04/11/2004 | 06:22 | mb 5.2 | 35.86 N | 23.19 E | 80 | 52 | 1.35 | 4.0 | 2.5 | 13.0 | 357 | 90 |
| 27/10/2004[2] | 20:34 | Mw 6.0 | 45.83 N | 26.77 E | 76 | 46 | 1.00 | 3.5 | 1.6 | 28.0 | 347 | 27 |
| 07/10/2004 | 21:46 | mb 5.6 | 37.37 N | 54.37 E | 30 | 37 | 1.02 | 8.5 | 4.4 | 161.0 | 283 | 103 |
| 07/10/2004 | 01:05 | mb 5.8 | 36.36 N | 26.95 E | 132 | 45 | 1.21 | 5.8 | 2.9 | 172.0 | 316 | 65 |
| 03/10/2004 | 09:027 | mb 5.0 | 45.16 N | 29.09 E | 2 | 43 | 1.02 | 4.8 | 2.7 | 53.0 | 144 | 51 |
| 21/09/2004 | 13:32 | mb 5.0 | 54.77 N | 19.94 E | 10 | 33 | 1.09 | 5.5 | 4.0 | 107.0 | 78 | 78 |
| 13/09/2004[2] | 03:00 | mb 6.0 | 44.14 N | 151.50 E | 10 | 38 | 0.82 | 10.4 | 4.6 | 2.0 | 282 | 114 |
| 05/09/2004 | 10:07 | Mw 7.2 | 32.63 N | 137.36 E | 33 | 40 | 0.63 | 40.5 | 15.2 | 138.0 | 237 | 284 |
| 11/08/2004 | 15:48 | Mw 5.6 | 38.37 N | 39.20 E | 10 | 33 | 0.83 | 4.7 | 4.2 | 51.0 | 246 | 123 |
| 04/08/2004 | 14:18 | mb 5.0 | 36.73 N | 27.79 E | 25 | 38 | 0.98 | 5.8 | 3.3 | 30 | 150 | 87 |
| 04/08/2004 | 04:19 | mb 5.2 | 36.81 N | 27.79 E | 30 | 31 | 0.95 | 4.5 | 2.7 | 176 | 250 | 78 |
| 04/08/2004 | 03:01 | mb 5.2 | 36.84 N | 27.71 E | 30 | 46 | 0.98 | 4.9 | 4.2 | 177 | 137 | 74 |
| 25/07/2004 | 14:34 | Mw 7.1 | 2.84 S | 104.25 E | 133 | 45 | 0.86 | 25.9 | 9.4 | 177.0 | 319 | 166 |
| 15/07/2004 | 04:27 | Mw 7.0 | 17.22 S | 178.89 W | 500 | 140 | 1.42 | 26.6 | 17.3 | 18.0 | 167 | 156 |
| 12/07/2004 | 13:04 | mb 5.1 | 46.26 N | 13.65 E | 5 | 30 | 0.99 | 2.3 | 1.8 | 31.0 | 260 | 13 |
| 08/07/2004[2] | 10:30 | mb 6.0 | 47.20 N | 151.35 E | 126 | 40 | 0.77 | 6.6 | 3.2 | 3.0 | 376 | 71 |
| 01/07/2004 | 22:30 | mb 5.1 | 39.67 N | 43.69 E | 40 | 46 | 0.98 | 9.9 | 6.1 | 171.0 | 154 | 127 |
| 10/06/2004[2] | 15:19 | mb 6.5 | 55.46 N | 160.28 E | 28 | 61 | 0.85 | 33.9 | 14.7 | 159.0 | 272 | 304 |
| 28/05/2004 | 12:38 | mb 6.3 | 36.41 N | 51.41 E | 23 | 42 | 0.98 | 9.0 | 4.1 | 169.0 | 362 | 85 |
| 05/05/2004 | 13:39 | mb 5.3 | 38.57 N | 14.81 E | 243 | 44 | 1.08 | 2.6 | 1.8 | 19.0 | 414 | 25 |
| 14/04/2004 | 23:07 | Mw 6.2 | 71.01 N | 7.89 W | 10 | 44 | 0.73 | 12.4 | 4.5 | 148.0 | 269 | 281 |
| 14/04/2004[2] | 01:54 | mb 6.2 | 55.35 N | 162.64 E | 21 | 57 | 0.74 | 8.5 | 3.4 | 10.0 | 369 | 72 |
| 07/04/2004 | 01:32 | mb 5.0 | 40.77 N | 20.31 E | 50 | 41 | 1.21 | 3.9 | 3.6 | 15.0 | 212 | 29 |
| 05/04/2004 | 21:24 | mb 6.8 | 36.67 N | 70.88 E | 200 | 52 | 1.21 | 12.4 | 5.1 | 170.0 | 341 | 94 |
| 28/03/2004[1] | 03:51 | mb 5.4 | 39.95 N | 40.91 E | 30 | 52 | 1.15 | 19.6 | 5.7 | 174.7 | 156 | 150 |
| 27/03/2004[1] | 18:45 | Mw 6.2 | 33.96 N | 89.17 E | 33 | 45 | 0.71 | 64.1 | 39.2 | 155.1 | 49 | 290 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25/03/2004 | 19:30 | mb 5.1 | 39.63 N | 40.89 E | 40 | 47 | 1.44 | 16.0 | 13.5 | 167.0 | 126 | 133 |
| 24/03/2004 | 01:53 | mb 6.0 | 45.53 N | 118.25 E | 21 | 60 | 0.82 | 9.3 | 3.9 | 179.0 | 244 | 76 |
| 17/03/2004[2] | 05:21 | mb 6.0 | 34.79 N | 23.36 E | 29 | 50 | 1.48 | 6.0 | 3.2 | 2.0 | 392 | 74 |
| 12/03/2004 | 22:44 | mb 6.3 | 36.36 N | 71.13 E | 33 | 46 | 1.03 | 15.8 | 5.6 | 171.0 | 236 | 111 |
| 12/03/2004 | 17:22 | mb 5.0 | 35.55 N | 4.32 W | 73 | 27 | 0.91 | 30.0 | 8.7 | 178.0 | 39 | 219 |
| 01/03/2004 | 00:35 | mb 5.0 | 37.22 N | 22.22 E | 10 | 58 | 1.71 | 6.0 | 3.2 | 8.0 | 288 | 82 |
| 26/02/2004 | 12:07 | mb 5.0 | 35.21 N | 4.16 W | 10 | 38 | 1.53 | 11.1 | 6.0 | 159.0 | 123 | 118 |
| 25/02/2004 | 12:44 | mb 5.0 | 35.21 N | 4.10 W | 10 | 73 | 1.96 | 26.8 | 8.4 | 149.0 | 122 | 174 |
| 24/02/2004[2] | 02:27 | Mw 6.5 | 35.23 N | 4.02 W | 2 | 37 | 1.06 | 4.8 | 2.7 | 163.0 | 382 | 120 |
| 23/02/2004 | 17:31 | ML 5.3 | 47.35 N | 6.29 E | 2 | 34 | 1.62 | 3.8 | 3.1 | 157.0 | 127 | 34 |
| 11/02/2004 | 08:15 | mb 5.6 | 31.64 N | 35.24 E | 10 | 38 | 1.04 | 7.1 | 6.0 | 122.0 | 154 | 69 |
| 07/02/2004 | 21:17 | mb 5.2 | 35.84 N | 26.92 E | 17 | 54 | 1.04 | 4.0 | 2.2 | 13.0 | 286 | 139 |
| 28/01/2004 | 09:06 | mb 5.5 | 26.86 N | 57.44 E | 60 | 43 | 1.05 | 25.9 | 7.6 | 7.0 | 86 | 239 |
| 14/01/2004 | 16:58 | mb 5.5 | 27.78 N | 52.35 E | 33 | 39 | 0.99 | 13.3 | 6.7 | 2.0 | 112 | 119 |

**Appendix 1: List of events for which an alert message has been sent in 2004**

**When the source parameters of the preliminary message have been revised, the source parameters of the Revision Message appear in this table.**

**DT: Dissemination time**
**SMAJ: Semi-major axis of 95% confidence ellipse**
**SMIN: Semi-minor axis of 95% confidence ellipse**
**AZIM: Azimuth of the 95% confidence ellipse**
**NSTA: Number of station used to compute the location**
**GAP: Largest azimuthal angle not covered by any station**
**[1]: Event processed by IGN**
**[2]: Event that triggered EUR-OPA alert**

| Key Nodal Members | Country | Contact |
|---|---|---|
| Laboratoire de Détection et de Géophysique (LDG) | France | Dr. B. FEIGNIER |
| GeoForschungsZentrum (GFZ) | Germany | Dr. W. HANKA |
| Istituto Nazionale di Geofisica e Vulcanologia (INGV) | Italy, Roma | Dr. M. OLIVIERI |
| Istituto Nazionale di Geofisica e Vulcanologia (INGV) | Italy, Milano | Dr. M. STUCCHI |
| Center of Geophysical Computer Data Studies (CGDS) | Russia | Dr. A. GVISHIANI |
| Instituto Geografico Nacional (IGN) | Spain | Dr. E. CARRENO HERRERO |
| **Active Members** | | |
| Seismological Institute (ASN) | Albania | Dr. E. DUSHI |
| Centre de Recherche en Astronomie, Astrophysique et Géophysique (CRAAG) | Algeria | Dr. A. K. Y. CHAOUCHE |
| National Seismological Center (NSC) | Armenia | Dr. S. MAGARYAN |
| Central Institute for Meteorolgy and Geodynamics (ZAMG) | Austria | Dr. E. FIEGWEIL |
| Center of Geophysical Monitoring | Belarus | Dr. A. G. ARONOV |
| Observatoire Royal de Belgique (ORB) | Belgium | Dr. R. VERBEIREN |
| Republic Hydrometeorological Institute (RHI) | Bosnia-Herzegovina | Prof. D. TRKULJA |
| Federal Meteorological Institute (FMI) | Bosnia-Herzegovina | Dr. Ivan BRLEK |
| Bulgarian Academy of Sciences | Bulgaria | Dr. E. BOTEV |
| A. Mohorovicic Geophysical Institute and Croatian Seismological Survey (AMGI & CSS) | Croatia | Dr. M. HERAK |
| Geological Survey Departement (GSD) | Cyprus | Dr. G. PETRIDES |
| Institute of Physics of the Earth, Brno (IPE) | Czech Republic | Dr. J. SVANCARA |
| Geophysical Institute of the Academy of Sciences (GFU) | Czech Republic | Dr. J. ZEDNIK |
| National Survey and Cadastre | Denmark | Dr. S. GREGERSEN |
| National Research Institute of Astronomy and Geophysics (NRIAG) | Egypt | Prof. A. TEALEB |
| Institute of Seismology (ISF) | Finland | Dr. P. HEIKKINEN |
| Bureau Central de Sismologie Français (BCSF) | France | Dr. M. CARA |
| Bureau de Recherches Géologiques et Minières (BRGM) | France | Dr. P. DOMINIQUE |
| Laboratoire Central des Ponts et Chaussées (LCPC) | France | Dr. P-Y. BARD |
| Bureau of Seismic Risk Evaluation for the Safety of Nuclear Facilities (BERSSIN) | France | Dr. C. BERGE-THIERRY |
| Institute of Geophysics (TIF) | Georgia | Prof. T. CHELIDZE |
| BGR Seismological Observatory Graefenberg (BGR) | Germany | Dr. K. KLINGE |
| National Observatory of Athens (NOA) | Greece | Dr. G. STAVRAKAKIS |
| University of Thessaloniki (AUTH) | Greece | Dr. E. SCORDILIS |
| Institute of Engineering Seismology and Earthquake Engineering (ITSAK) | Greece | Dr. C. PAPAIOANNOU |
| Icelandic Meteorological Office (IMO) | Iceland | Dr. S. JACOBSDOTTIR |
| Dublin Institute for Advanced Studies (DIAS) | Ireland | Prof. P. READMAN |
| Geophysical Institute of Israel (GII) | Israel | Dr. Y. GITTERMAN |
| Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS) | Italy | Dr. M. RUSSI |
| Storia Geofisica Ambiente srl (SGA) | Italy | Dr. E. GUIDOBONI |
| Geophysics Centre at Bhannes (SGB) | Lebanon | Dr. A. SURSOCK |
| Seismological Observatory | Macedonia | Dr. L. PEKEVSKI |
| Academy of Sciences of Republic of Moldova | Moldova | Dr. V. ALCAZ |
| Direction Environnement Urbanisme et Construction (DEUC) | Monaco | M. P. MONDIELLI |
| Centre National de la Recherche (CNR) | Morocco | Prof. J. NACER |
| University of Bergen (BER) | Norway | Dr. J. HAVSKOV |
| Norwegian Seismic Array (NORSAR) | Norway | Dr. J. FYEN |
| Instituto de Meteorologia (IMP) | Portugal | Dr. M.-L. SENOS |
| Instituto Superior Tecnico (IST) | Portugal | Dr. J. FONSECA |
| Universidade de Evora | Portugal | Dr. M. BEZZEGHOUD |
| National Institute for Earth Physics (NIEP) | Romania | Dr. G. MARMUREANU |
| Bucharest Seismic Alert Centre (BSAC) | Romania | M. A. AILENEI |
| King Abdulaziz City for Sciences and Technology (KACST) | Saudi Arabia | Dr. T. AL-KHALIFAH |

| | | |
|---|---|---|
| Geophysical Institute, Department of Seismology | Slovakia | Dr. P. LABAK |
| Geophysical Survey of Slovenia (ARSO) | Slovenia | Dr. I. CECIC |
| Institut Cartografic de Catalunya (ICC) | Spain | Dr. A. ROCA |
| Universidad Politecnica de Madrid (UPM) | Spain | Dr. B. BENITO |
| Schweizerischer Erdbebendienst (ETH) | Switzerland | Dr. M. BAER |
| Royal Netherlands Meteorological Institute (KNMI) | The Netherlands | Dr. R. SLEEMAN |
| Earthquake Research Department (ERD) | Turkey | Dr. R. DEMIRTAS |
| Kandilli Observatory and Earthquake Research Institute (KOERI) | Turkey | Prof. G. BARBAROSOGLU |
| British Geological Survey (BGS) | United Kingdom | M. B. BAPTIE |
| Montenegro Seismological Observatory (MSO) | Serbia-Montenegro | Dr. B. GLAVATOVIC |
| Seismological Survey of Serbia (SSS) | Serbia-Montenegro | Dr. S. RADOVANOVIC |
| U.S. Geological Survey (USGS) | United States | Dr. S. SIPKIN |
| **Corporate Members** | | |
| Mediterranean Re | Ireland | Ms. K. CRAWFORD |
| **Members by Right** | | |
| European Seismological Commission (ESC) | | Ms. A. WALKER |
| Observatories and Research Facilities for EUropean Seismology (ORFEUS) | | Dr. B. DOST |
| International Seismological center (ISC) | | Dr. A. SHAPIRA |

## Appendix 2: List of 2004 EMSC members

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                Centre Sismologique Euro-Mediterraneen
              European-Mediterranean Seismological Centre

                Rapid Determination of Source Parameters
               operated at LDG (Paris) and IGN (Madrid)

**********************************************************************
**********************  ALERT  MESSAGE  **************************
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WARNING : These parameters are preliminary and subject to revision.
Location and magnitude estimations may be revised if necessary in
an INFORMATION message.
_____________________________________________________________________



EARTHQUAKE on 31/01/2005 at 01:05 (UTC)
IONIAN SEA                          57 km W  Katastarion

MAGNITUDE: mb 5.2

Data provided by: GFZ  INGV LDG  LED  LJU  LVV  MCSM NEIC NEWS NOA
                  OGS

Latitude    =  37.65 N
Longitude   =  20.10 E
Origin Time =  01:05:32.0 (UTC)
Depth       =  25 Km
RMS         =   0.87 sec
Gap         =  83 degrees
95% confidence ellipse: - Semi major = 4.7 Km
                        - Semi minor = 2.9 Km
                        - Azimuth of major axis =  17 degrees

Number of data used = 147

Preliminary location computed on Mon Jan 31 01:40:19 2005 (UTC)
Done by Pascal Roudil

Comments :

Message number: 447

All magnitudes estimations :
ML5.3 (INGV)  mb4.9 (LDG)   mb5.2 (NEIC)
mb5.2 (NEWS)  ML5.2 (NOA)

P.S.: For additional information, please contact EMSC at:
             - Email: mazet@emsc-csem.org
             - Web  : http://www.emsc-csem.org (maps available)
             - Fax  : 33 1 69 26 70 00
```

**Appendix 3: Example of Alert message**