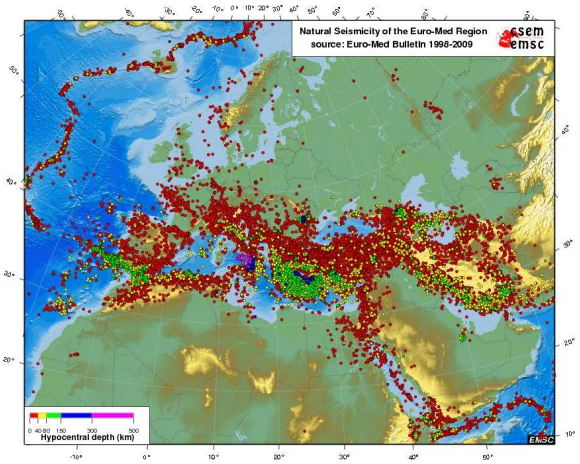
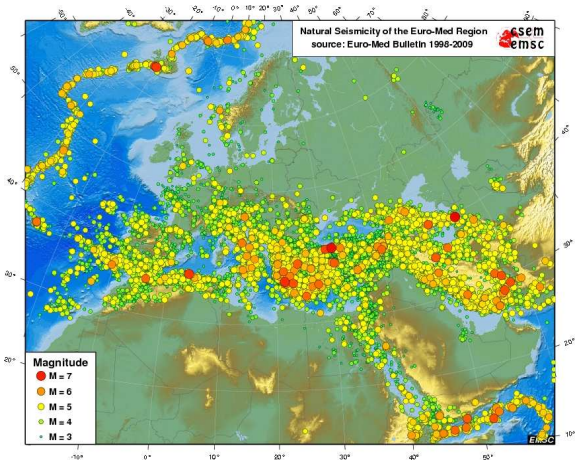
European-Mediterranean Seismological Centre
http://www.emsc-csem.org

Report on 2011 Bulletin Activities





Reporting period covered: **January 2011 – December 2011**
Reporting date: 31/01/2011

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EXECUTIVE SUMMARY

The EMSC is producing the Euro-Med Bulletin (EMB). Over the years, its content has greatly improved and increased in terms of data contributors. In 1998, 51 networks have provided data while for the year 2010, we have collected information from 71 institutes. Thanks to those efforts, the EMB is a reference catalogue of the seismicity for the Euro-Med region.

The available EMB now covers the period from January 1998 to July 2010, corresponding to more than 74,000 tectonic events of magnitude larger than 3. The amount data available for 2010 and 2011 is lower than in the previous years, in relation with political changes in several countries of the Mediterranean region. However, the number of locations collected continues to increase.

The back processing of the full EMB using ak135 has been completed in 2011. A special document describes the output of the relocation is available on line at: http://www.emsc-csem.org/Files/news/EMSC/AK135.pdf. The integration of low magnitude events in the EMB for the period 1998-2006 is under process.

Finally, the EMSC would like to thank all the operating networks that participate to the production of the Euro-Med Bulletin.

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I INTRODUCTION

The European Mediterranean Seismological Centre (EMSC), hosted by the LDG (*Laboratoire de Détection et de Géophysique*, Bruyères-le-Châtel, France), is a non-profit scientific international NGO which provides rapid earthquake information in coordination with the national seismological institutes in the Euro-Med region. Currently, 84 seismological institutes are members from 55 countries spanning over the whole Euro-Med region. The main scientific activities of the EMSC are the real time information services and the production of the Euro-Med Bulletin.

The Euro-Med Bulletin is a seismological product developed during the EPSI project (2002). It is based on the comprehensive collection of bulletins and arrivals provided by networks operating in the region. By merging data from 79 contributing networks and by computing locations in a homogeneous way, the EMB provides a reference catalogue of the seismicity since 1998.

This report presents the status of the 2011 bulletin activities in terms of data received, published bulletin and access.

II DATA CONTRIBUTION

We present in this paragraph the data contribution collected by the EMSC and the published events in the Euro-Med Bulletin.

II.1 Data collection

Since the beginning of the production of the Euro-Med Bulletin, the data provided by the operating networks of the region has steadily increased (Figure 1). The number of contributing networks is reaching a plateau as the data collection is now comprehensive. For the year 2010, data contributions from several networks of the Mediterranean region are missing (LDSN, JSO, KISR, see Table 1). The weekly content of the local bulletin database is available online http://www.emsc-csem.org/Bulletin/database.php?year=2010

Meanwhile, the content of the contribution has evolved. More networks compute and provide locations. In the last years, one third of the networks provide information on non tectonic events, against only one tenth in 1998.

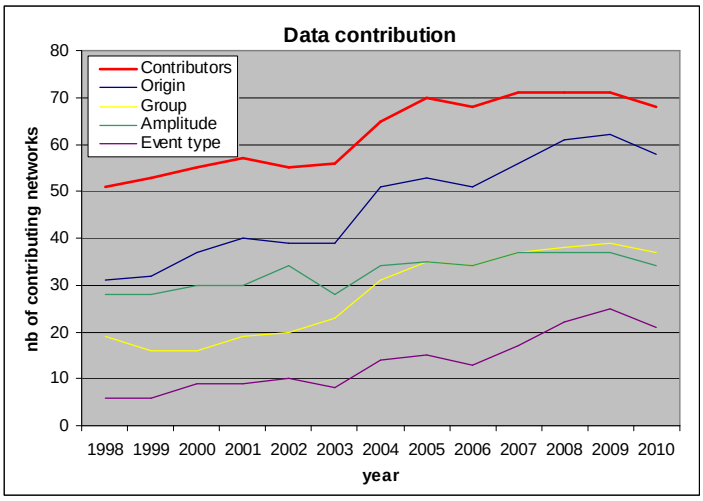


Figure 1: Evolution of the data contribution to the Euro-Med Bulletin

The steadily increasing number of contributors providing locations and the broader magnitude range of events collected is leading to a continuously growing number of origins in the EMSC database (Figure 2). While several contributions are missing for 2010, the number of origins provided still increases corresponding to extended data contributions from our providers for lower magnitude events. The Greek network UPSL has also started to provide locations instead of groups of arrivals.

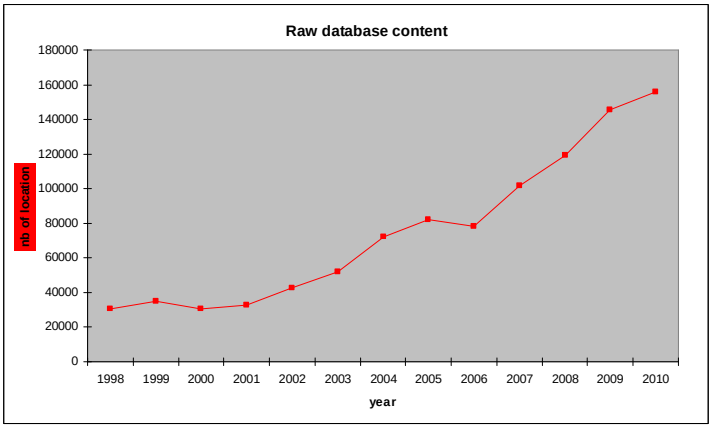


Figure 2: Evolution since 1998 of the number of locations in the Euro-Med region provided by the contributing networks

CODE	INSTITUTE	COUNTRY
ALG	Centre de Recherche en Astronomie, Astrophysique et Géophysique, Algiers	Algeria
ATH	National Observatory of Athens, Athens	Greece
AZER	Republic Center of Seismic Survey, Azerbaijan Academy of Science, Baku	Azerbajian
BARI	Osservatorio Sismologico Universita di Bari	Italy
BELR	Center for Geophysical Monitoring, Minsk	Belarus
BEO	Seismological Survey of Serbia, Beograd	Serbia-Montenegro
BER	University of Bergen, Bergen	Norway
BGR	Bundesanstalt fur Geowissenschaften und Rohstoffe, Hannover	Germany
BGS	British Geological Survey, Edinburgh	United-Kingdom
BRA	Seismology Division, Slovak Academy of Sciences, Bratislava	Slovakia
BUC	National Institute for Earth Physics, Bucharest	Romania
BUD	Hungarian Seismic Network, Budapest	Hungary
CNRM	Centre National de la Recherche Scientifique et Technique, Geophysics Laboratory, Rabat	Morocco
DBN	Observatories and Research Facilities for EUropean Seismology, De Bilt	The Netherlands
DHMR	National Seismological Observatory Center, Dhamar	Yemen
DIAS	Dublin Institute for Advanced Studies, Dublin	Ireland
DDA	Directorate of Disaster Affairs, Lodumlu, Ankara	Turkey
DSN	Dubai Municipality, Dubai	United Arab Emirates
DNK	Geological Survey of Denmark and Greenland, Copenhague	Denmark
DUSS	Damascus University Seismological Station, Damascus	Syria
GBZT	Earth Sciences Research Institute, Tubitak	Turkey
GEN	Rete Sismica Igg, Genova	Italy
GFU	Geophysical Institute of Academy of Sciences, Prague	Czech Republic
GII	Geophysical Institute of Israel, Tel Aviv	Israel
GRAL	National Center for Geophysical Research, Beirut	Lebanon
HEL	Institute of Seismology, Helsinki	Finland
HLW	National Research Institute of Astronomy and Geophysics, Cairo	Egypt
INMG	Instituto de Meteorologia, Seismologia, Lisbon	Portugal
IPEC	Institute of Physics of the Earth, Brno	Czech Republic
ISK	Kandilli Observatory and Earthquake Research Institute, Istanbul	Turkey
ISN	Iraqi Seismological Network, Bagdad	Iraq
JSO	Jordan Seismological Observatory, Amman	Jordan
KISR	Kuwait Institute for Scientific Research, Kuwait	Kuweit
LDG	Laboratoire de Détection et de Géophysique, Bruyères-le-Châtel	France
LDSN	Libyan Centre for Remote Sensing and Space Science, Tripoli	Lybia
LVSN	Latvian Seismic Network, Latvian Environment, Geology and Meteorology Agency	Latvia
LGS	Geological Survey of Lithuania, Vilnius	Lithuania
LJU	Environmental Agency of the Republic of Slovenia, Seismological Office, Ljubljana	Slovenia
MDD	Instituto Geografico Nacional, Madrid	Spain
MOLD	Institute of Geophysics and Geology, Chisinau	Moldova
MRB	Instituto Cartografico de Catalunya, Barcelona	Spain
NAO	Norwegian Seismic Array, Kjeller	Norway
NEIC	National Earthquake Information Center, USGS, Denver	USA
NIC	Geological Survey Department, Nicosia	Cyprus
NNC	Kazakhstan National Data Center, Almaty	Kazakhstan
NSSC	National Syrian Seismological Centre, Damascus	Syria
NSSP	National Survey of Seismic Protection, Yerevan	Armenia
OBN	Geophysical Survey. Russian Academy of Sciences, Obninsk	Russia
OMAN	Earthquake Monitoring Center, Sultan Qaboos University, Muscat	Sultanate of Oman
PAB	Observatorio de Toledo, Toledo	Spain
PDA	Instituto de Meteorologia, Azores University, Ponta Delgada, Azores	Portugal
PDG	Montenegro Seismological Observatory, Podgorica	Serbia-Montenegro
ROM	Italian National Seismic Network, Roma	Italy
REY	Department of Geophysics, Icelandic Meteorological Office	Iceland
RYD	King Saud University, Riyadh	Saudi-Arabia
SBS	Institut National de la Météorologie, Tunis	Tunisia
SFS	Real Instituto y Observatorio de la Armada, San Fernando	Spain
SIK	Seismological Institute of Kosovo/UNMIK	Kosovo/UNMIK

SKO	Seismological Observatory, Skopje	Macedonia
SNSN	Saudian National Seismological Network, Riyadh	Saudi-Arabia
SOF	Bulgarian Academy of Science, Bulgarian Academy of Sciences, Sofia	Bulgaria
SORS	Republic Hydrometeorological Institute, Banja Luka	Bosnia-Herzegovina
SPGM	Département de Physique du Globe, Rabat	Morocco
STR	Réseau National de Surveillance Sismique, Strasbourg	France
TEH	Institute of Geophysics, University of Tehran, Tehran	Iran
THE	Department of Geophysics, University of Thessaloniki, Thessaloniki	Greece
THR	International Institute of Earthquake Engineering and Seismology, Tehran	Iran
TIF	Georgian National Survey of Seismic Defence, Tbilissi	Georgia
TIR	Institute of Seismology, Academy of Sciences, Tirana	Albania
TRI	Osservatorio Geofisico Sperimentale, Trieste	Italy
UCC	Observatoire Royal de Belgique, Brussels	Belgium
UPP	Uppsala station, Uppsala	Sweden
UPSL	University of Patras Seismological Laboratory	Greece
UZBK	Institute of Seismology, Uzbekistan Academy of Sciences, Tashkent	Uzbekistan
WAR	Warsaw Seismic Network, Warsaw	Poland
ZAG	Seismological Survey, University of Zagreb, Zagreb	Croatia
ZAMG	ZentralAnstalt für Meteorologie und Geodynamik, Vienna	Austria
ZUR	Swiss Seismological Service, Zurich	Switzerland

Table 1: List of the 79 data contributors to the Euro-Med Bulletin.

II.2 Data verification

The routine search for duplicated events is applied before producing the Euro-Med Bulletin. This procedure allows us to identify possible problems and eases the following production step.

An additional review procedure allows the contributors to check and update their data before starting the Bulletin production by sending monthly bulletins by email. This procedure has proven to be useful:

- To ensure that a maximum of data is available for the computation of the Euro-Med bulletin
- To identify missing or erroneous data which helps to upgrade the data parsers
- To identify known explosions which were previously identified as earthquake
- To verify station information

This procedure has proven to be useful with 25 networks providing valuable updates particularly for event type modification.

AZER	DNK	LJU	TEH
BEO	GEN	LVSN	TIR
BGS	GRAL	MRB	UCC
BUC	HEL	NNC	ZAG
CNRM	IPEC	NSSP	
DDA	ISK	PDG	
DHMR	KISR	SFS	

II.3 Station status

The number of Euro-Med stations entering the calculation of the EMB has been constantly increasing, related to the joining contributors but also thanks to the installation of new instruments (Figures 3 and 4). Over the years, 2,743 stations were reported to the EMSC, but with variation in time, the maximum number of stations in a single year being 2,331 (in 2010).

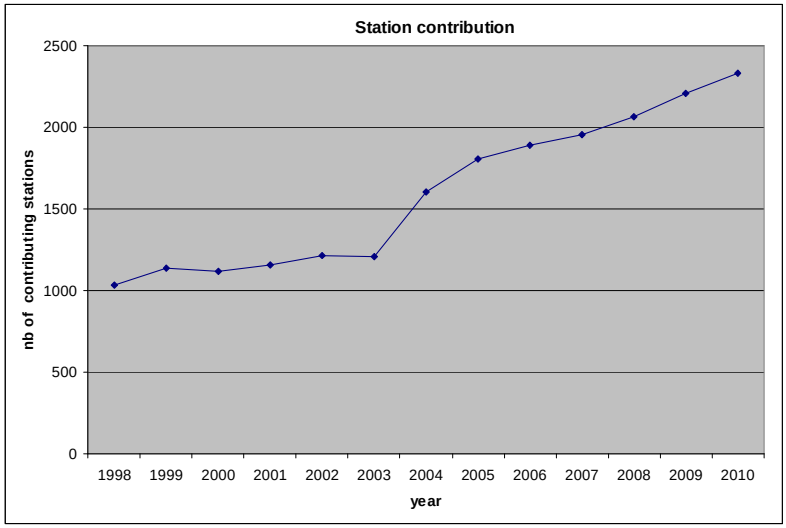


Figure 3: Evolution since 1998 of the number of stations in the Euro-Med region provided by the contributing networks

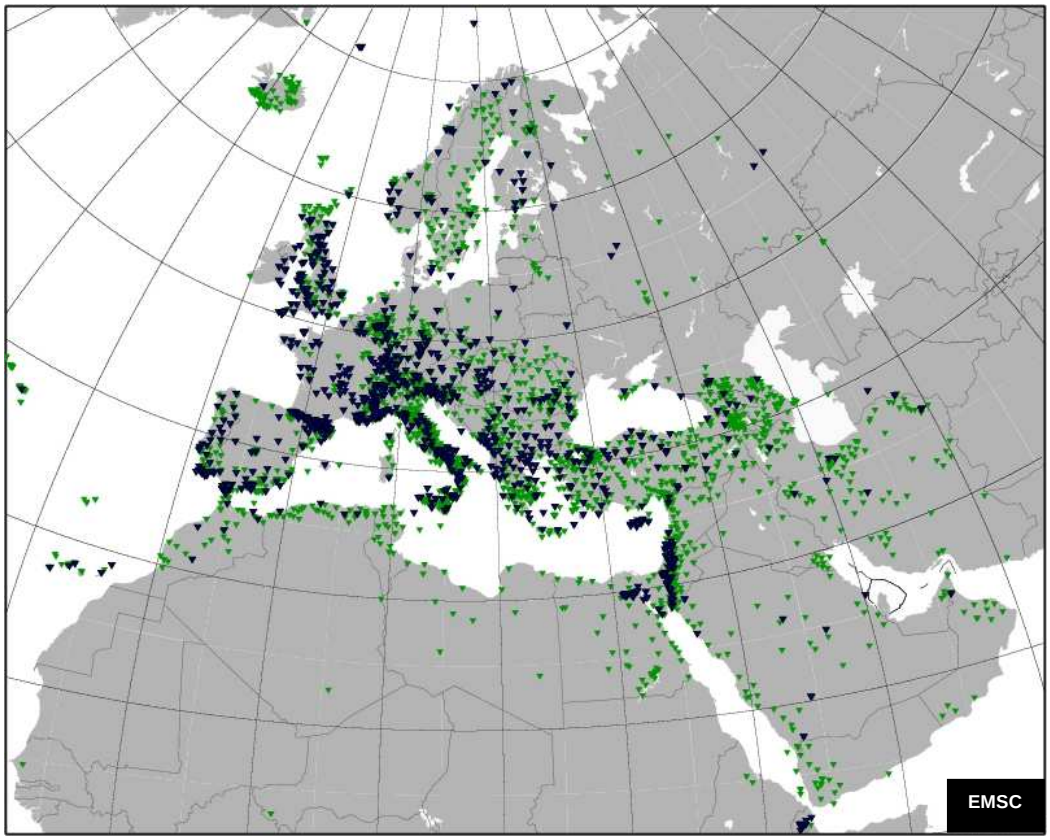


Figure 4: Distribution of the stations contributing to the Euro-Med Bulletin. Stations in blue were available in 1998. Stations in green joined the contribution pool later on.

III EURO-MED BULLETIN 1998-2009

III.1 General information

Details on the procedure to compute the Euro-Med Bulletin are now available in a specific document available at: http://www.emsc-csem.org/Doc/emb/emb_production.pdf

The Euro-Med bulletin is currently available and covers the period from January, 1998 to July, 2010. In this report, we display the information for the period 1998-2009 (Figure 5). The EMB for the year 2010 is under production and should be available early 2012.

Three classes of events are defined for the Euro-Med Bulletin according to the type of location related to them.
- *Associated event*: when an event is recorded by several networks and an EMSC location is computed.
- *Reported event*: when and event is recorded by a single local network. In this case, the network location is preferred.
- *Deprecated or doubtful event*: if the event is recorded by a distant network or if the number of recording stations is lower than 4. In this case, the network location is reported and the bulletin is not disseminated online but is available only upon request.

Since 1998, the number of events has regularly increased (Figure 6). For 2007 onward all magnitude events are included which has multiplied by three the total number of events. 274,428 events are currently available in the EMB, among which 40% are associated. For the year 2009, a large amount of events is related to the earthquake sequences in L'Aquila on April 6th, and Crete on July 1st.

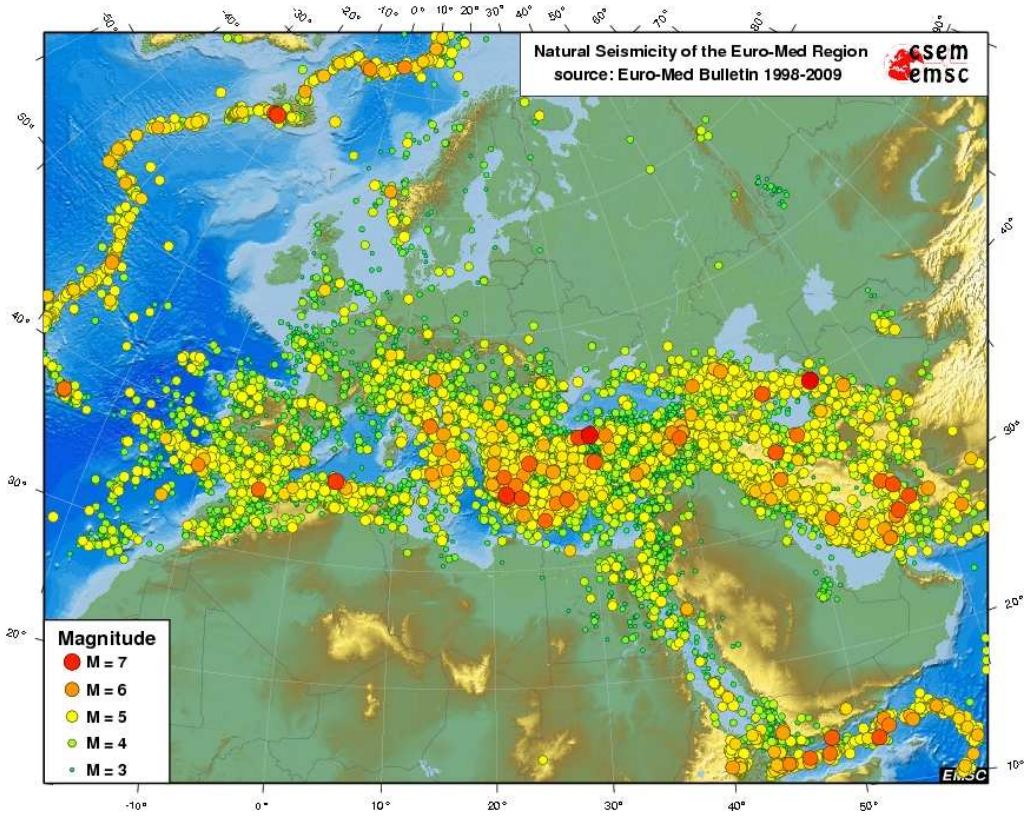


Figure 5: Natural seismicity in the Euro-Med region for the period 1998-2009 as computed in the EMB for events of magnitude larger than 3.

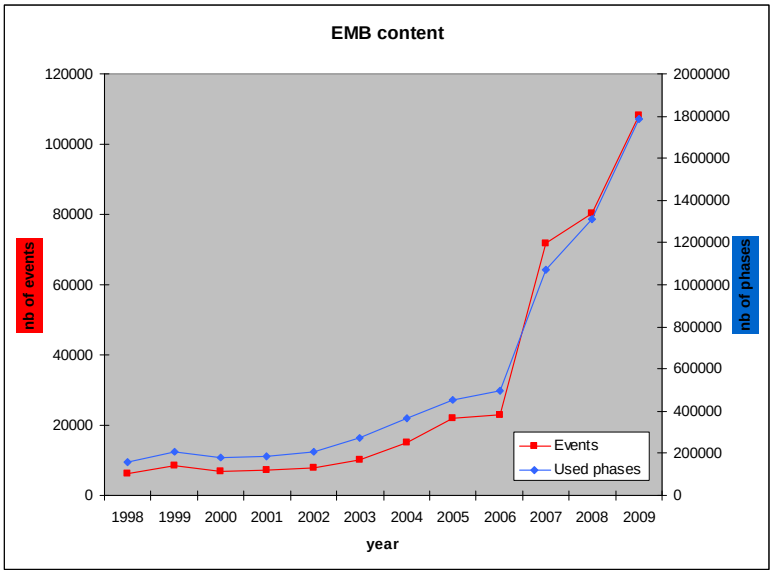


Figure 6: Content of the EMB since 1998.

III.2 Azimuthal coverage

Thanks to extensive data contributions, the seismicity in the EMB is well constrained over the whole region. Figure 7 shows the azimuthal coverage for associated events of magnitude larger than 3. Low azimuthal gap is observed for most of the Euro-Med region although poorer resolution is obtained at the outskirt of the area and at the coasts (e.g. West of Gibraltar and Off the Coast of Portugal). In the North of the Red Sea, lower resolution is also obtained.

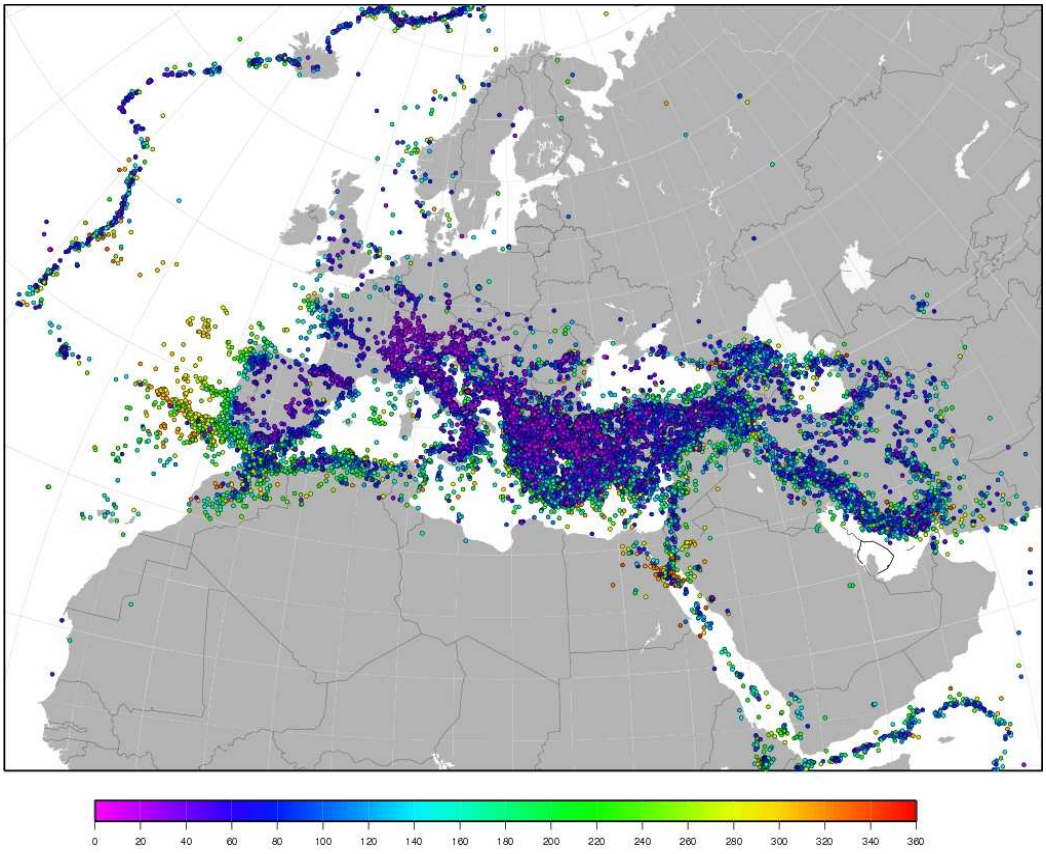


Figure 7: Azimuthal gap of associated events with magnitude larger than 3.

For the full period 1998-2009, 70% of the events of magnitude larger than 3 were located with an azimuthal gap lower than 140° (Red line on Figure 8) and 40% of the events display a gap lower than 80°. Since 1998, the overall azimuthal gap has steadily improved, the best distribution being obtained in 2009 (Black line on Figure 8).

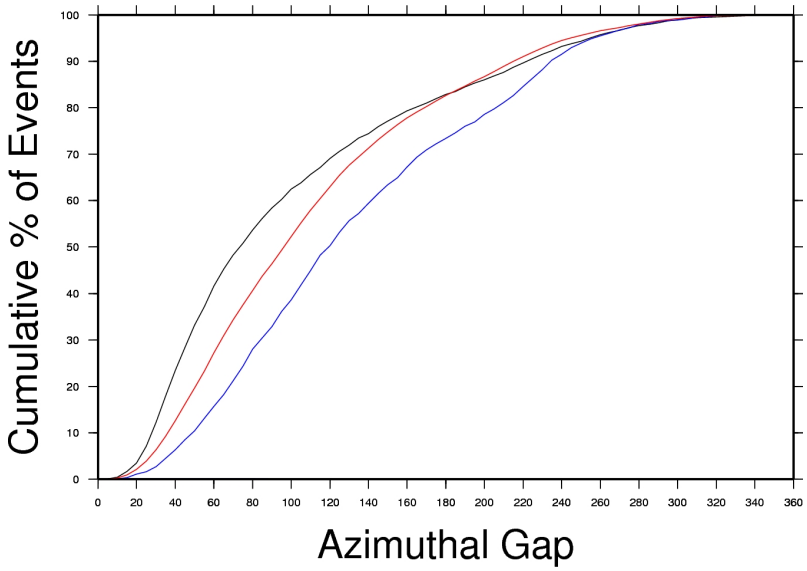


Figure 8: Evolution of the azimuthal gap since 1998 for associated events of magnitude larger than 3. In red is shown the average value over 11 years, In blue in 1998 and in black 2009.

III.3 Ground Truth events

Using the criteria of Bondar and McLaughlin (2009), we have extracted the GT5 events available in the EMB for the period 1998-2009. 10,919 events fulfil the GT5 criteria, with 75% of them recorded in 2009.

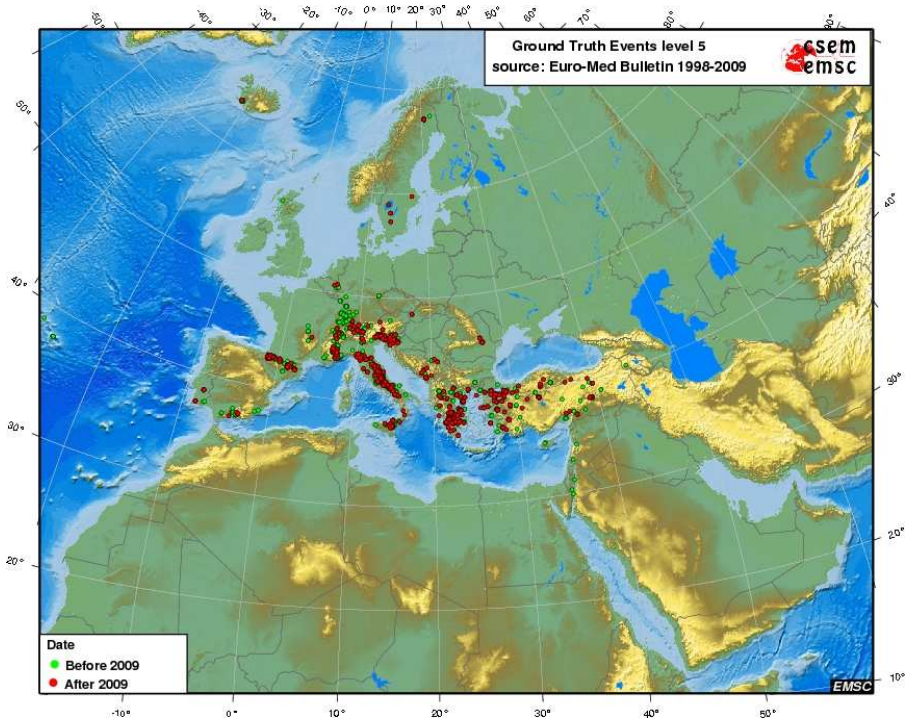


Figure 9: Distribution of GT5 events in the EMB

III.4 Non tectonic activity

Event type identification relies on the information provided by the local networks. Figure 9 shows that the amount of non tectonic events increases over the years, reflecting a better identification and reporting of these information by the operating networks. The large values since 2007 are due to the integration of low magnitude events.

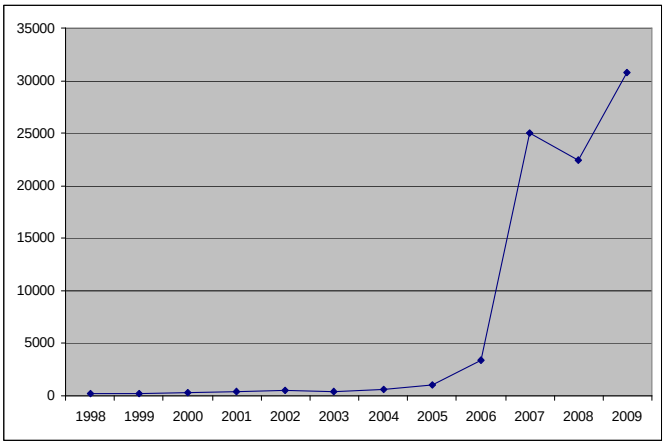


Figure 9: Evolution of the number of non tectonic events in the EMB since 1998.

Figure 10 shows the distribution of non tectonic events in the EMB. Patches of non tectonic activity are observed, with clusters in Poland and Czech Republic, Scandinavia, Spain, the Red Sea and Kazakhstan. This regional discrepancy shows the importance of collecting accurate event type information. The Turkish networks now provide event type information which is clearly reflected on Figure 10. It is a challenge to harmonize event type information distribution among the Euro-Med seismological networks and this process will continue in the coming years.

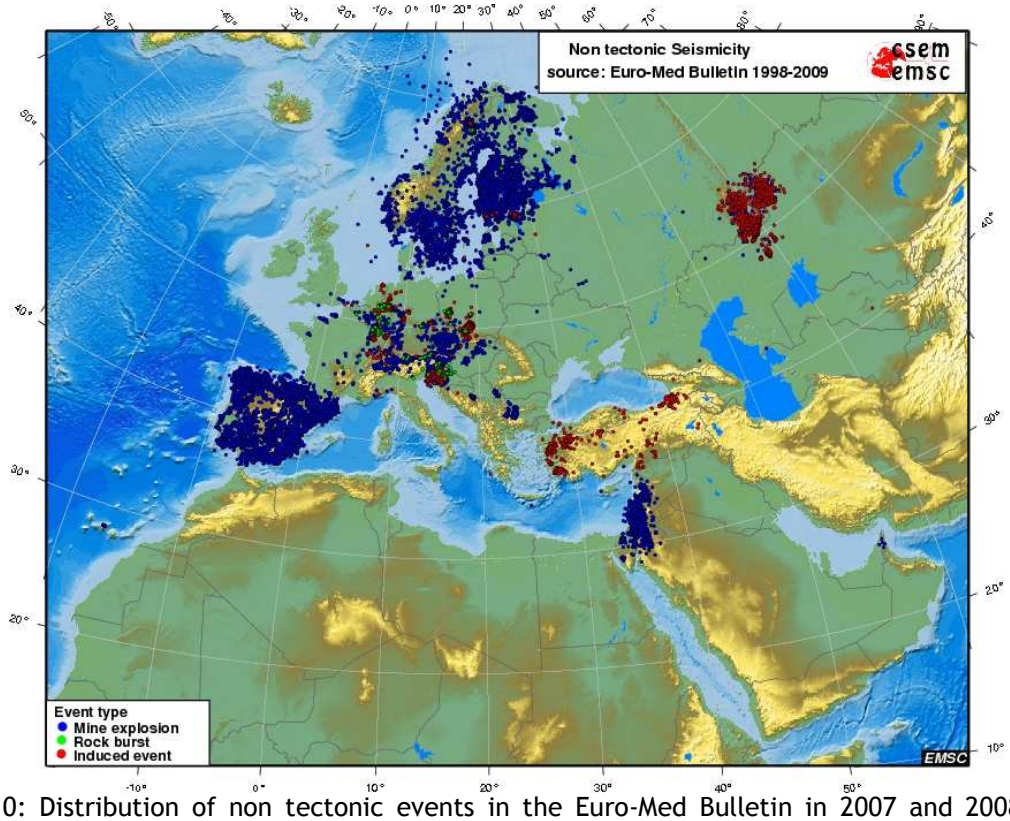


Figure 10: Distribution of non tectonic events in the Euro-Med Bulletin in 2007 and 2008 for all magnitude.

An alternative solution to improve the discrimination in the EMB is to use an a posteriori simple approach based on the known quarry location and the time distribution of the events occurring in the vicinity.

This method allows searching for event type identification error by

- Scanning the database on a grid or for a set of known quarry locations
- Gathering events 20km around the grid point available in the database
- Representing the event time occurrence of the gathered events

Figure 11 represents the results for two specific quarries in France and Turkey. On the plot, 360° represents 24 hours; the radius of the circle represents the distance from the center point (with a maximum radius of 20km). In Luzenac, France, a clear blast signature appears at 12am UTC with the majority of the events properly labeled. The second example corresponds to the quarry of Eskihisar, Turkey. In this case, less than half of the events are labelled as non tectonic while their occurrence time is clearly linked to a human activity. We can also see that there are at least two distinct sources of events.
Those examples show the potential of this simple approach and we will investigate, if time allows, how to apply it to the full EMB. Of course, the contributors are welcomed to contribute to this effort.

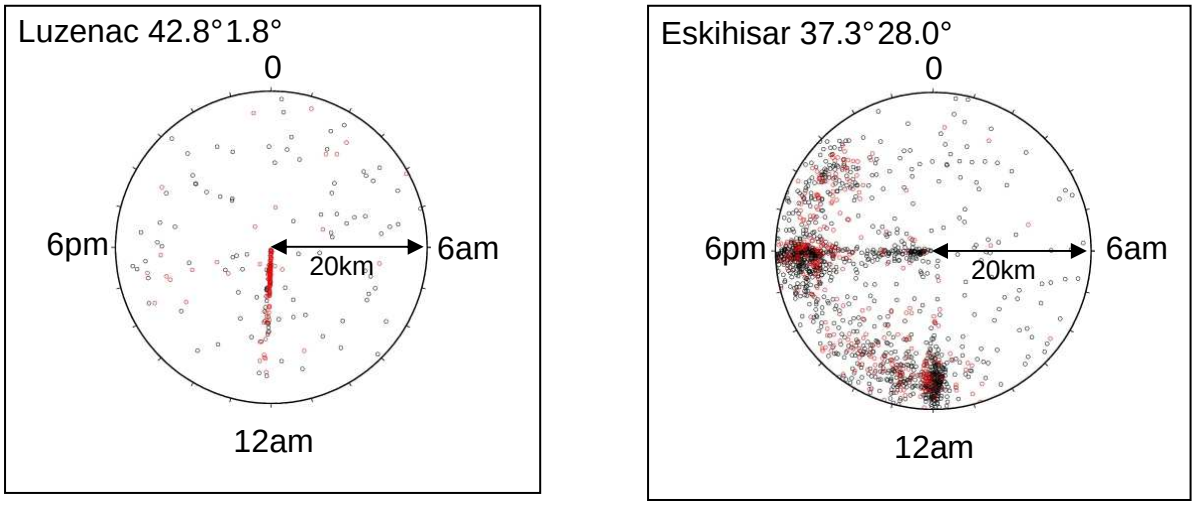


Figure 11: Time distribution of non tectonic events in the Euro-Med Bulletin for two specific quarries in France and Turkey. Red circles represent events labeled as non tectonic, black circles represent events labeled as known earthquakes.

III.5 Influence of ak135

Comparison between the JB and ak135 locations for M>2.5 events recorded by several networks from January, 1998, to December, 2007 (42 760 events) shows that no significant discrepancy is observed between the two models for the Euro-Med region. For 78% of events, differences of less than 10 km are observed between the JB and ak135 solutions.

Furthermore, in order to assess the relative performance of the JB and ak135 models, hypocenter solutions from the two models are compared with the authoritative locations when possible. Among our set of 42,760 events, 7,769 have an authoritative location (7%). By comparing JB and AK135 to authoritative locations, we found slightly better performance in the epicenter location from 4.3 km to 4.0 km and an improvement in the depth estimate from 6.0 to 5.8 km when ak135 is used (Table 2). No systematic bias is then expected for locations in the Euro-Med region with the introduction of the ak135 velocity model.

A specific report describes in detail the output of the relocation: http://www.emsc-csem.org/Files/news/EMSC/AK135.pdf

- JB/authoritative location

	Dloc [km]	Depth [km]
Average	4.3	6.0
95%	11.8	20

- Ak/authoritative location

	Dloc [km]	Depth [km]
Average	4.0	5.8
95%	10.9	18.6

Table 2: Statistics on location differences between JB (top) and ak135 hypocenters (bottom) and authoritative location.

IV WEB AND DATA ACCESS

IV.1 The EMB web page

Only the natural seismicity in the Euro-Med region is available online. Non tectonic events are discarded on the web and can be requested to the EMSC directly. Deprecated events are also discarded as their occurrence is doubtful.

To measure the traffic on the Euro-Med Bulletin page, we use the statistics provided by Google Analytics. The traffic on this specific page is, of course, much lower than on the real time information pages. On average, 22 unique visitors reach this page per day (Figure 12). Some picks are observed on the traffic and are related to large events. The highest picks are observed on the days of the Tohoku event on March 11th 2011 and of the Van event on October 23rd 2011. People interested by this event search additional information on the EMSC web site and look around the data available on our web site.

Overall, users from 59 countries have visited the EMB web page (Figure 13). About 50% of our visitors are coming from Serbia, France, Italy, Bulgaria and Romania.

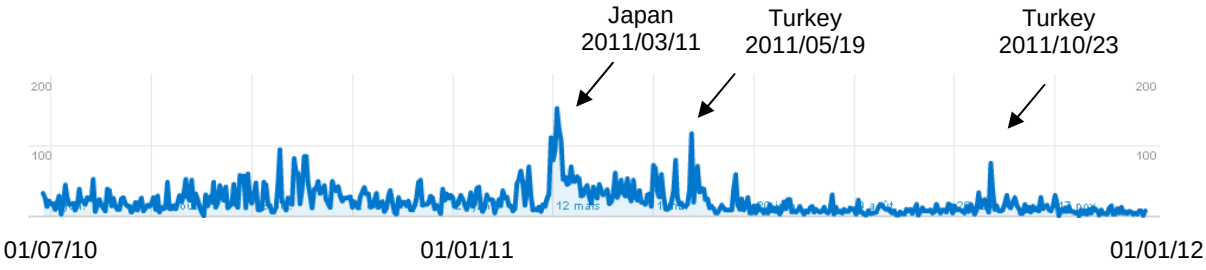
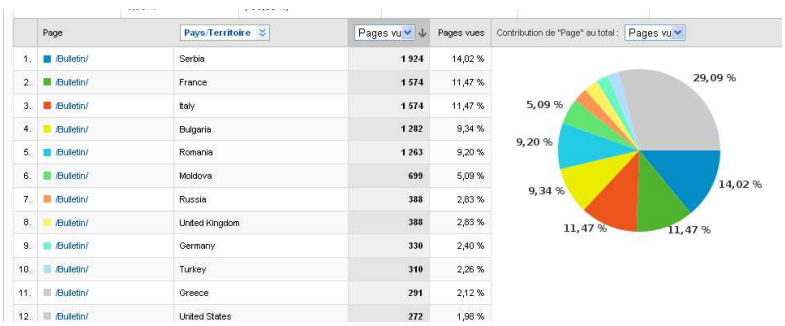


Figure 12: Daily number of visits on the Euro-Med Bulletin web page since July 2010.



	Page	Pays/Territoire	Pages vu	Pages vues	Contribution de "Page" au total : Pages vu
1.	/Bulletin/	Serbia	1 924	14,02 %	
2.	/Bulletin/	France	1 574	11,47 %	
3.	/Bulletin/	Italy	1 574	11,47 %	
4.	/Bulletin/	Bulgaria	1 282	9,34 %	
5.	/Bulletin/	Romania	1 263	9,20 %	
6.	/Bulletin/	Moldova	699	5,09 %	
7.	/Bulletin/	Russia	388	2,83 %	
8.	/Bulletin/	United Kingdom	388	2,83 %	
9.	/Bulletin/	Germany	330	2,40 %	
10.	/Bulletin/	Turkey	310	2,26 %	
11.	/Bulletin/	Greece	291	2,12 %	
12.	/Bulletin/	United States	272	1,98 %	

Figure 13: Origin of the EMB web page users over a period since July 2010.

IV.2 Data distribution and request

The Euro-Med bulletin is automatically provided to the ISC (International Seismological Centre) as soon as a monthly period is available. In addition, all the data are available online, i.e. collected local data and published Euro-Med Bulletin, both in GSE format. Redistribution or uses for commercial purposes are prohibited. Furthermore and full access to the data is now given to all users upon simple registration.

35 new users have registered to collect local bulletins in 2011 while 31 new users have registered to collect the EMB. 1,353 requests were performed on the web or by email from 237 users (registered or not) for the year 2011. This is the highest number recorded so far and is related to the increasing use of the EMB web page.

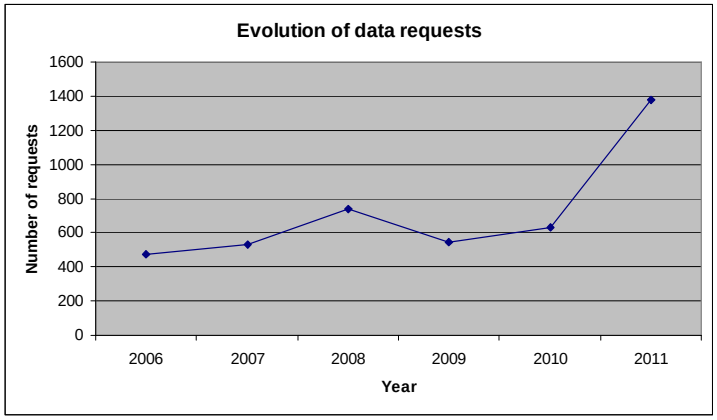


Figure 14: Data requests since 2006 by email or via the internet.

V CONCLUSIONS AND PERSPECTIVES

The Euro-Med Bulletin includes a steadily increasing number of data contributions and provides the most comprehensive picture of the seismicity in the region.

In 2012, our goals are:

- **Faster production**
  It is important to decrease the delay of production. To achieve this goal, the data collection has to be improved, by collecting more rapidly the contributions. This will only be possible in collaboration with the operating networks and by setting up reliable and automatic data exchange.

- **Low magnitude events**
  Enriching the EMB with low magnitude events for the full period is a significant work, which will be done along the years.

- **Continue the work!**
  The amount of data available continues to increase every year. The production of the EMB has then to tackle new issues and to adapt the procedures to keep on providing as soon as possible the EMB.

VI REFERENCES AND CITATIONS

References

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