NEtwork of Research Infrastructures for European Seismology

Deliverable D10
NA4 European Earthquake Catalogue
1000-1963, M > 5.8

(June 2010)

Activity:	Distributed Archive of Historical Earthquake Data
Activity number:	NA4
Deliverable:	European Earthquake Catalogue (1000-1963), M>5.8
Deliverable number:	D10
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Abstract. The NA4 European Earthquake Catalogue (EEC) 1000-1963, M > 5.8, includes 933 events covering an area approximately comprised between 13°W to 30°E (lon), 35°N to 65°N (lat). For the time-window 1000-1899 the earthquake list has been obtained from the "preferred" entries, coded with "p", of the NA4 inventory (Delivarables D1 and D6). These entries represent the selection of the most significant datasets among the inventoried ones, supporting each of the 640 earthquakes classified as "large". For the time window 1900-1963 the procedure is similar, with the addition that for this time-window also the instrumental datasets have been considered (see Deliverable D8); the number of earthquakes is 293.
622 events out of the 933 have macroseismic data points (MDPs); the parameters of about 610 events have been determined with three methods based on the use of MDPs: i) Boxer (Gasperini et al., 1999); ii) MEEP, developed within NA4 (see Deliverable D3); iii) BW, proposed by Bakun and Wentworth (1997). The MEEP software has been improved in 2010 with the addition of a "boostrap" procedure, that now allows supplying a measure of uncertainty. The coefficients of each method were first calibrated in the five NA4 regions (Deliverable D5 – part 1): Aegean, Iberia, Italy (Alpine belt), Great Britain, Switzerland; in 2010 they were totally revised (see App. 1). Then, an attempt has been performed to calibrate the three methods in the Stable Continental Region, including France, Germany, Scandinavia, Poland, Slovakia, Hungary, Czech Republic and Lower Austria. For Vrancea, only, data did not allow a calibration.
For the remaining 311 events the parameters were assessed by expert judgment, on the basis of the information provided by the root, if any, or from the available parametric catalogues.
The availability of multiple determinations for the same event, and the lack of criteria for assessing the "best" one, gives the users a catalogue with all the available information. In other words, NA4 EEC does not indicate a preferred value of the parameters, does not propose weights and does not average the values. Although traditional users would prefer a catalogue with one "default" set of parameter values, only, such values usually neglect the epistemic uncertainty in the data. Just as practice in seismic hazard has had to come to terms with uncertainty in strong ground motion prediction, so now it is beginning to come to terms with uncertainty regarding seismicity. Thus, NA4 EEC prefers to show the inherent variability of the parameters, allowing users the ability to include this in models.
NA4 EEC is available at http://emidius.mi.ingv.it/neries_NA4/catalogue/; the parameters are found on the map obtainable by clicking on the corresponding symbol in the EEC column.

1. Introduction.

One of the most popular tool for seismic hazard assessment is the parametric earthquake catalogue, that is, a list of earthquake parameters - such as time of occurrence, location, magnitude, depth, etc. - that can be used as input for current computer codes. While in the case of instrumentally recorded events the parameters are determined from waveforms, in the case of historical events such parameters are determined either from intensity data points or from the effects accounts; in the latter case it is performed according to mostly unreported procedures. Each national or regional earthquake catalogue adopts individual procedures; the NA4 European Earthquake Catalogue has been compiled re-assessing the earthquake parameters according to uniform procedures from the best possible supporting datasets.
The NA4 European Earthquake Catalogue 1000-1963, M > 5.8 covers an area approximately comprised between 13°W to 30°E (lon), 35°N to 65°N (lat) (Fig. 1). The selection with respect to M ≥ 5.8 is not final. As the scope of NA4 was to re-assess the earthquake parameters, including Mw, a preliminary selection was made on the basis of the M values supplied by the current catalogues. It may follow that some of the earthquakes included in this catalogue will have M ≤ 5.8, while a few with Mw slightly > 5.8 (after re-assessment) may be missing.

For the time-window 1000-1899 the earthquake list has been obtained from the "preferred" entries of the NA4 inventory (Deliverables D1 and D6). These entries represent the selection of the most significant datasets supporting the 640 earthquakes classified as "large".
The NA4 inventory classifies the datasets (roots) according to their level (type and quality, see Deliverable D8). The distribution of the entries per root level RL is given in Tab. 1 and Fig. 1.

Table 1. Amount and percentage (over the total) of the entries according to their root level in the time-window 1000-1899 (NA4 regions are: Aegean, Iberia, Italy (Alpine belt), Great Britain, Switzerland).

Type		RL	Number of earthquakes with M > 5.8		%	N. of eq. in the NA4 reg.	% in the NA4 reg.	N. of eq. outside NA4 reg.	% outside NA4 reg.
Eq with MDPs		11	183	516	80.6	495	77.3	21	3.3
		12	27						
		13	306						
		14	0						
Eq. without MDPs	**with a report, only**	21	12	45	7.0	12	1.9	33	5.2
		22	33						
	known from a parametric catalogue	31	75	79	12.3	21	3.3	58	9.1
		32	4						
		Total	**640**	**640**	**100**	**528**	**82.5**	**112**	**17.5**

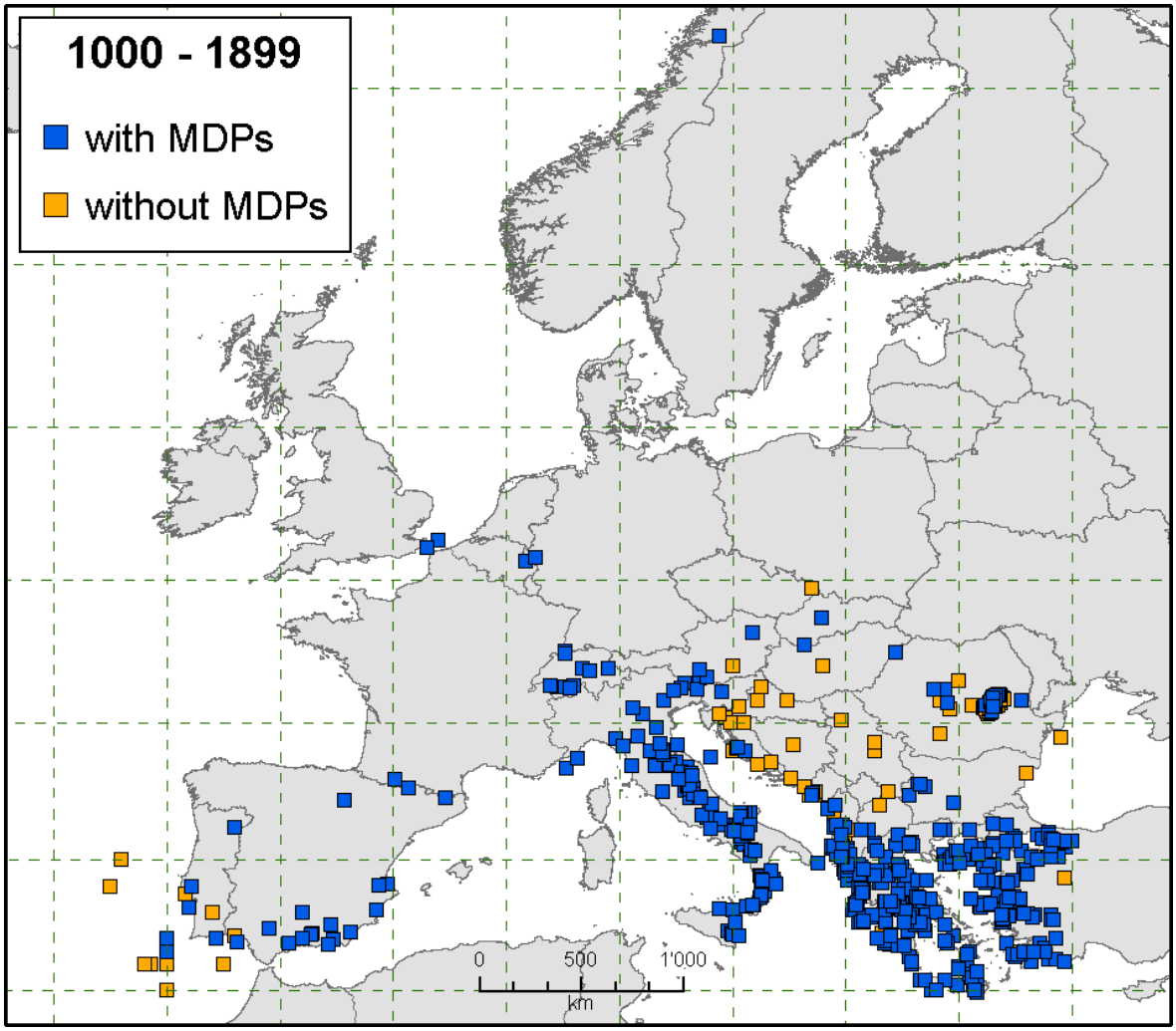


Figure 1. Geographical distribution of the earthquakes in the NA4 catalogue, according to their root level in the time-window 1000-1899.

For the time window 1900-1963 the procedure has been similar, with the addition that for this time-window also the instrumental datasets have been considered (see Deliverable D8). The number of earthquakes is 293. The relevant figures and data distribution are proposed in Tab. 2 and Fig. 2.

Table 2. Amount and percentage (over the total) of the entries according to their root level in the time-window 1900-1963.

Type		RL	Number of earthquakes with M> 5.8		%	N. of eq in the NA4 reg.	% in the NA4 reg.	N. of eq. outside NA4 reg.	% outside NA4 reg.
Eq with MDPs		11	21	106	36.2	104	35.5	2	0.7
		12	5						
		13	80						
		14	0						
Eq. without MDPs	**with a report, only**	21	0	0	0	0	0	0	0
		22	0						
	known from a parametric catalogue	30	103	187	63.8	126	43.0	61	20.8
		31	60						
		32	24						
		Total	**293**	**293**	**100**	**230**	**78.5**	**63**	**21.5**

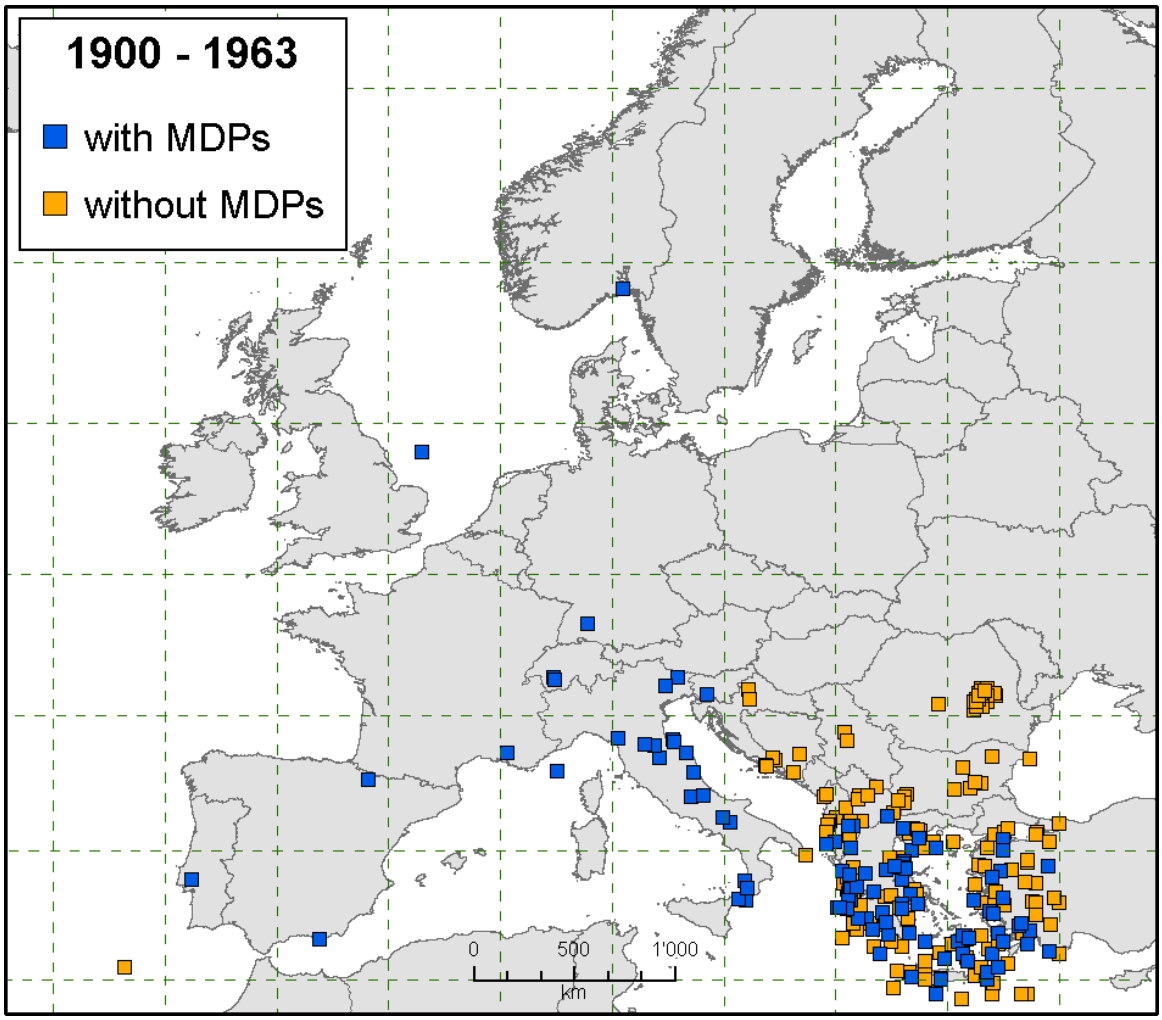


Figure 2. Geographical distribution of the earthquakes in the NA4 catalogue, according to their root level in the time-window 1900-1963.

As a whole, the NA4 catalogue 1000-1963, M > 5.8, contains 933 earthquakes; the distribution of the entries per root level is presented in Tab. 3 and Fig. 3.

Table 3. Total amount and percentage (over the total) of the entries according to their root level in the time-window 1000-1963.

Type		RL	Number of earthquakes with M> 5.8		%	N. of eq in the NA4 reg.	% in the NA4 reg.	N. of eq. outside NA4 reg.	% outside NA4 reg.
Eq with MDPs		11	204	622	66.8	599	64.2	23	2.5
		12	32						
		13	386						
		14	0						
Eq. without MDPs	**with a report, only**	21	12	45	4.8	12	1.3	33	3.5
		22	33						
	known from a parametric catalogue	30	103	266	28.4	147	15.8	119	12.8
		31	135						
		32	28						
		Total	**933**	**933**	**100**	**758**	**81.2**	**175**	**18.8**

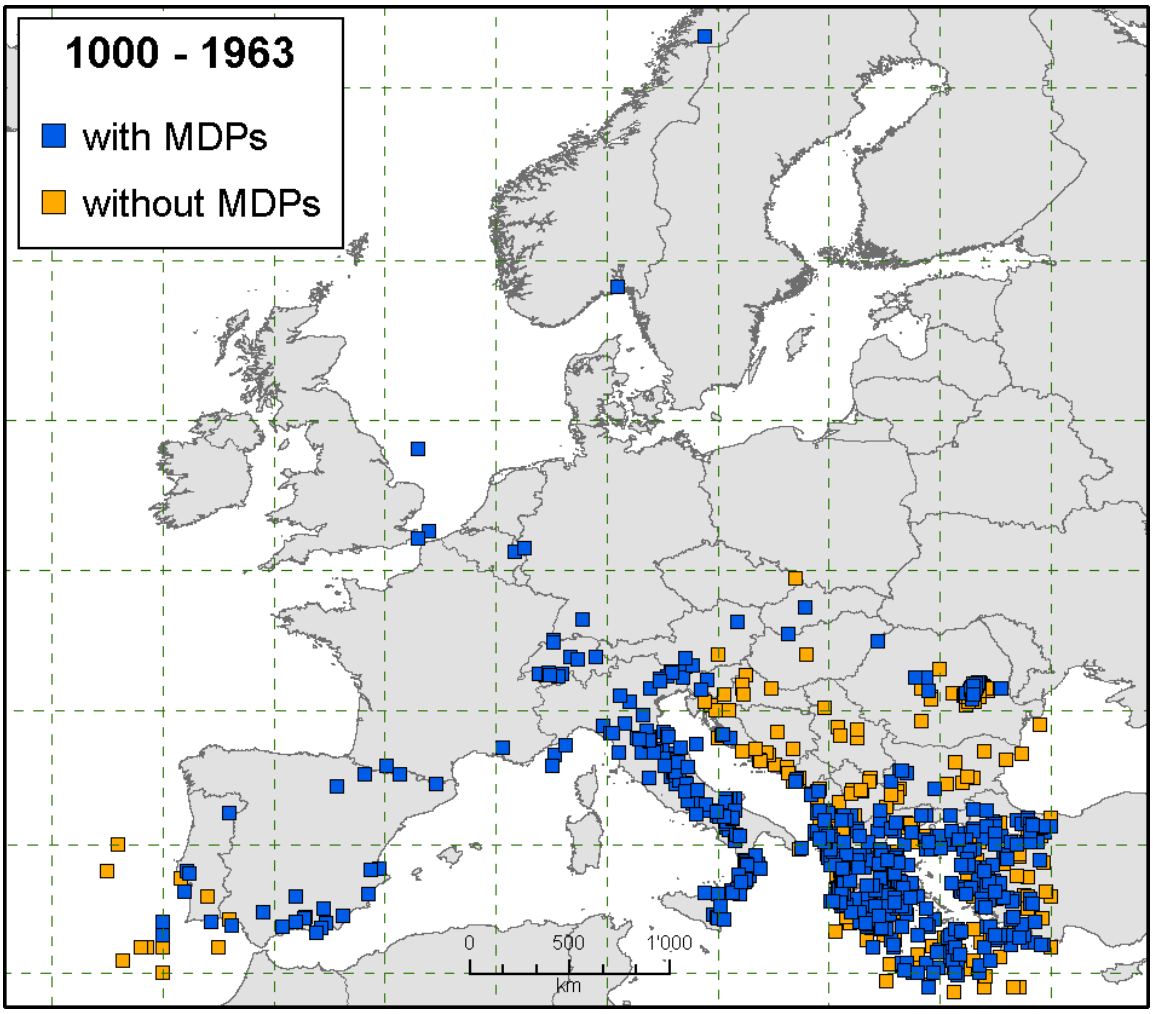


Figure 3. Geographical distribution of the earthquakes in the NA4 catalogue, according to their root level in the time-window 1000-1963.

In the following we describe the criteria adopted for assessing the parameters, with reference to the type of root.

2. Events with MDPs

The parameters of the 622 earthquakes whose roots have MDPs have been determined with three methods based on the use of macroseismic data points: i) Boxer (Gasperini et al., 1999); ii) MEEP, developed within NA4 (see Deliverable D3); iii) BW, proposed by Bakun and Wentworth (1997). The MEEP software has been improved in 2010 with the addition of a "boostrap" procedure, now allowing to supply a measure of uncertainty.

2a. NA4 Regions. The coefficients of each method have been first calibrated in the five NA4 regions (Deliverable D5 – part 1): Aegean, Iberia, Italy (Alpine belt), Great Britain, Switzerland. The input consists of several events with good instrumental parameters and good MDPs, collected and validated in a homogeneous format.
The calibration and validation procedures described in Deliverable D5 have been revised in 2010, after the first phase of application to the historical earthquakes. Special attention has been devoted to: i) adopting the most suitable conversion of the "inappropriate" intensity assessments (F, D, etc.); ii) comparing different calibration coefficients for each method and selecting the most reliable one; iii) ensure the consistency among the results of the three methods in the case of events with one MDP, only; etc. The new coefficients are reported in App. 1.

The coefficients were then applied to 599 earthquakes in the five regions, that is, to about 67% of the events (Fig. 4). Special attention has been devoted to earthquakes with one or few MDPs, only.

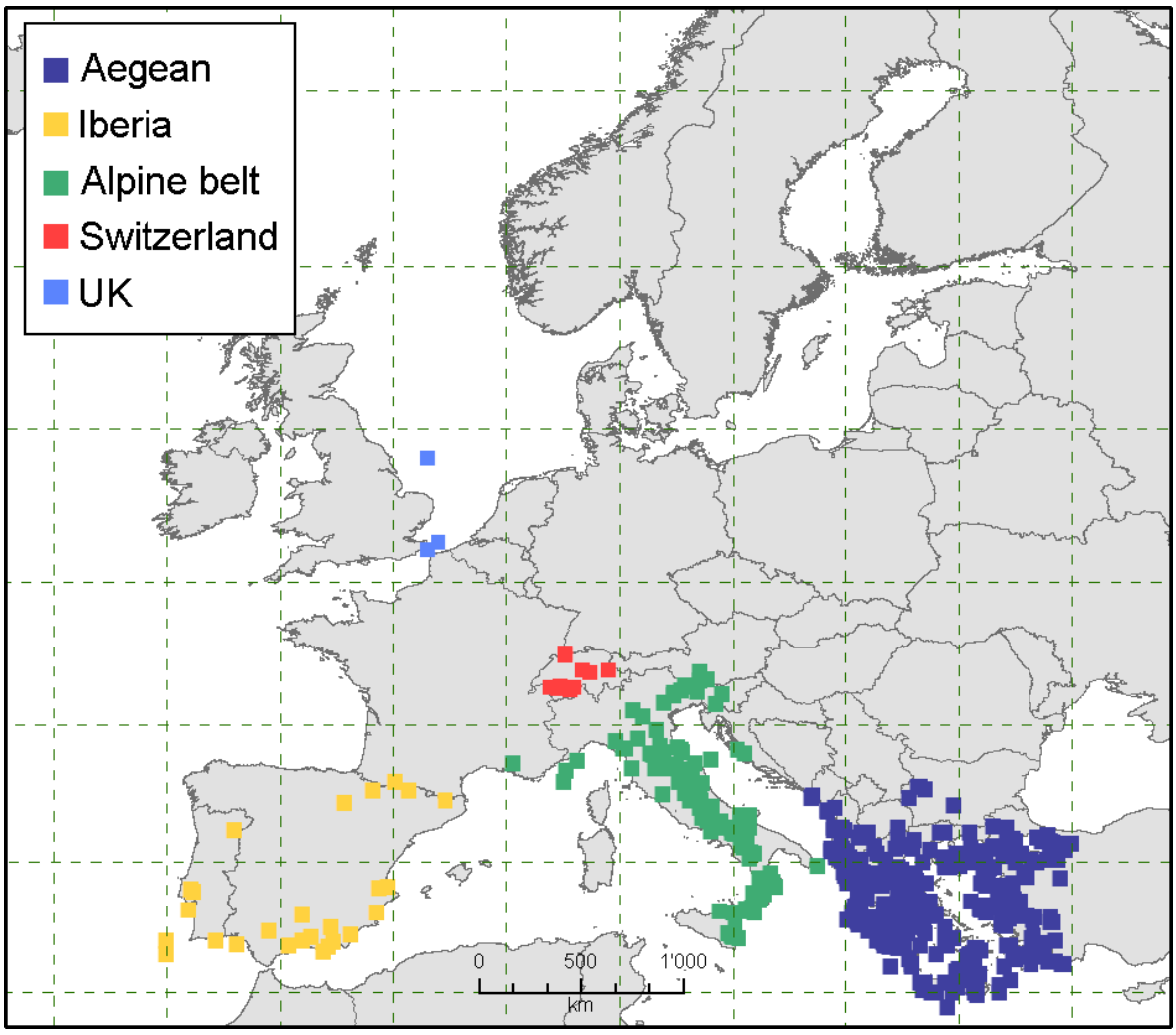


Figure 4. Geographical distribution of the earthquakes processed using to the coefficients of the five NA4 regions.

The Boxer method determines Mw with the Sibol model when the number and the distribution of MDPs is sufficiently good; in the other cases it supplies Mw determined from Io according to a Mw(Io) relation the coefficients of which, shown in App. 1, also come from the calibration procedure. Boxer determines Io for all the events: therefore, we have decided to compute Mw(Io) for all events, in addition to the three Mw values from the three methods and with the exception of the clearly offshore events.

Some results are presented in Figures 5 and 6. Although the dispersion looks high in some cases and some improvements in the calibration might be needed, such dispersion seems to represent, in a way clearer than ever, the epistemic uncertainty connected with the process.
Results are also compared with the Mw values provided by the current parametric catalogues or derived from them. It can be seen that in most cases the current values seem higher then the average values obtained within this initiative.

The complete set of results is available at http://emidius.mi.ingv.it/neries_NA4/.

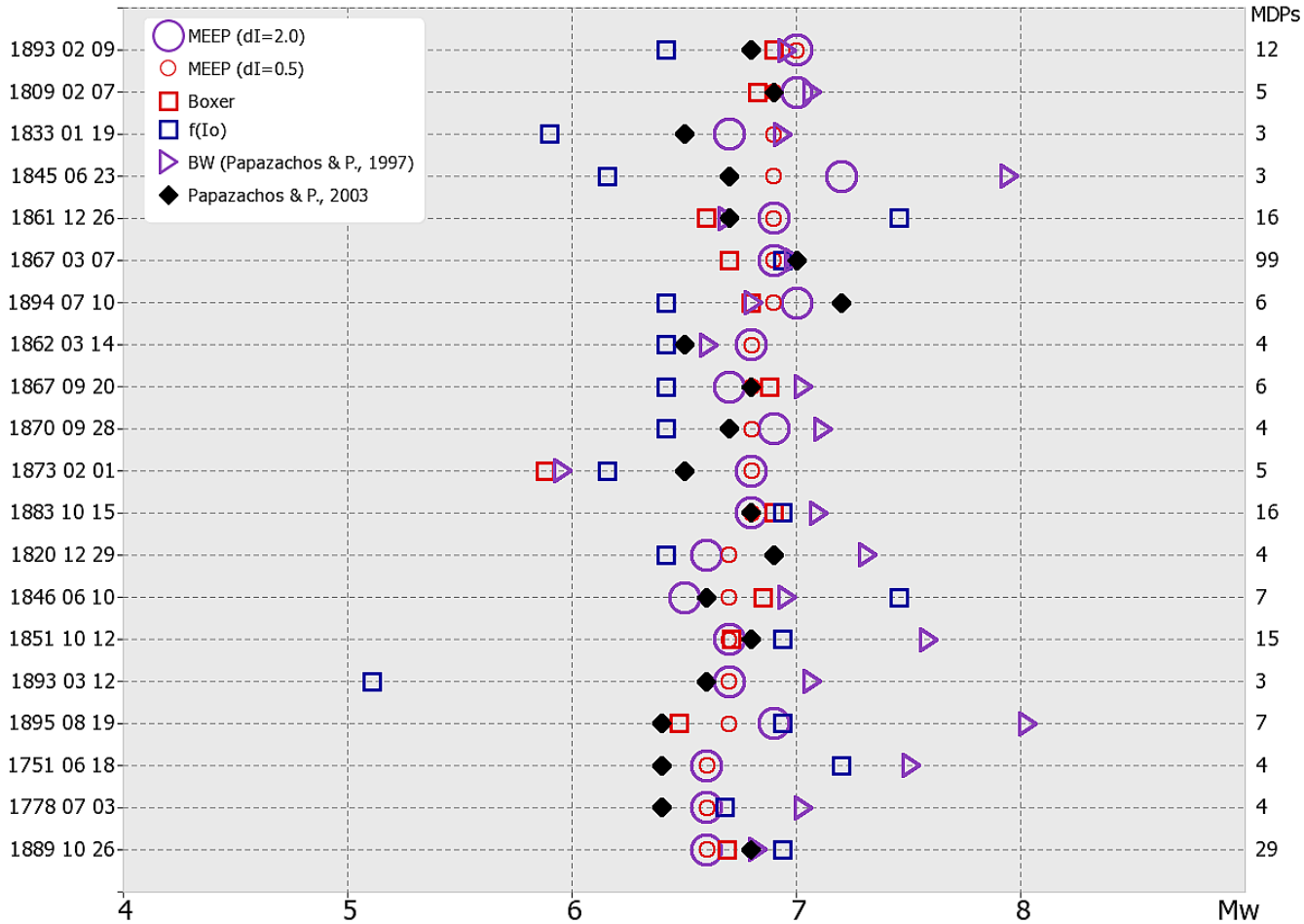


Figure 5a - Aegean area: plot of Mw values determined from MDPs compared with those from Papazachos & P., 2003.

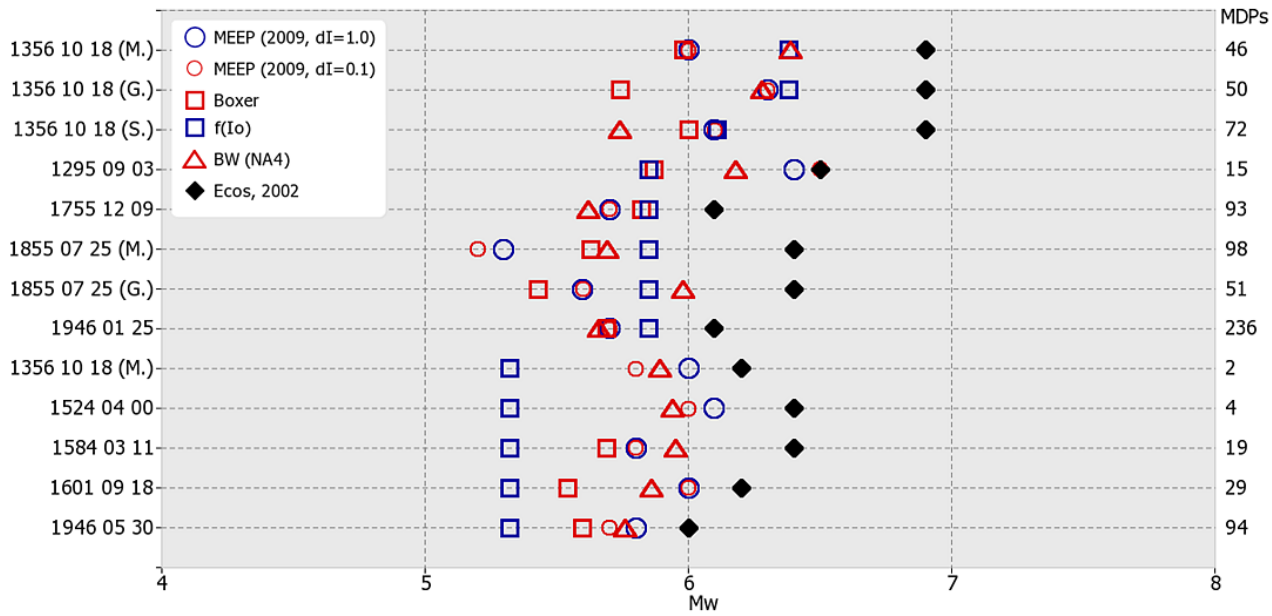


Figure 5b - Swiss area: plot of Mw values determined from MDPs compared with those from ECOS, 2002

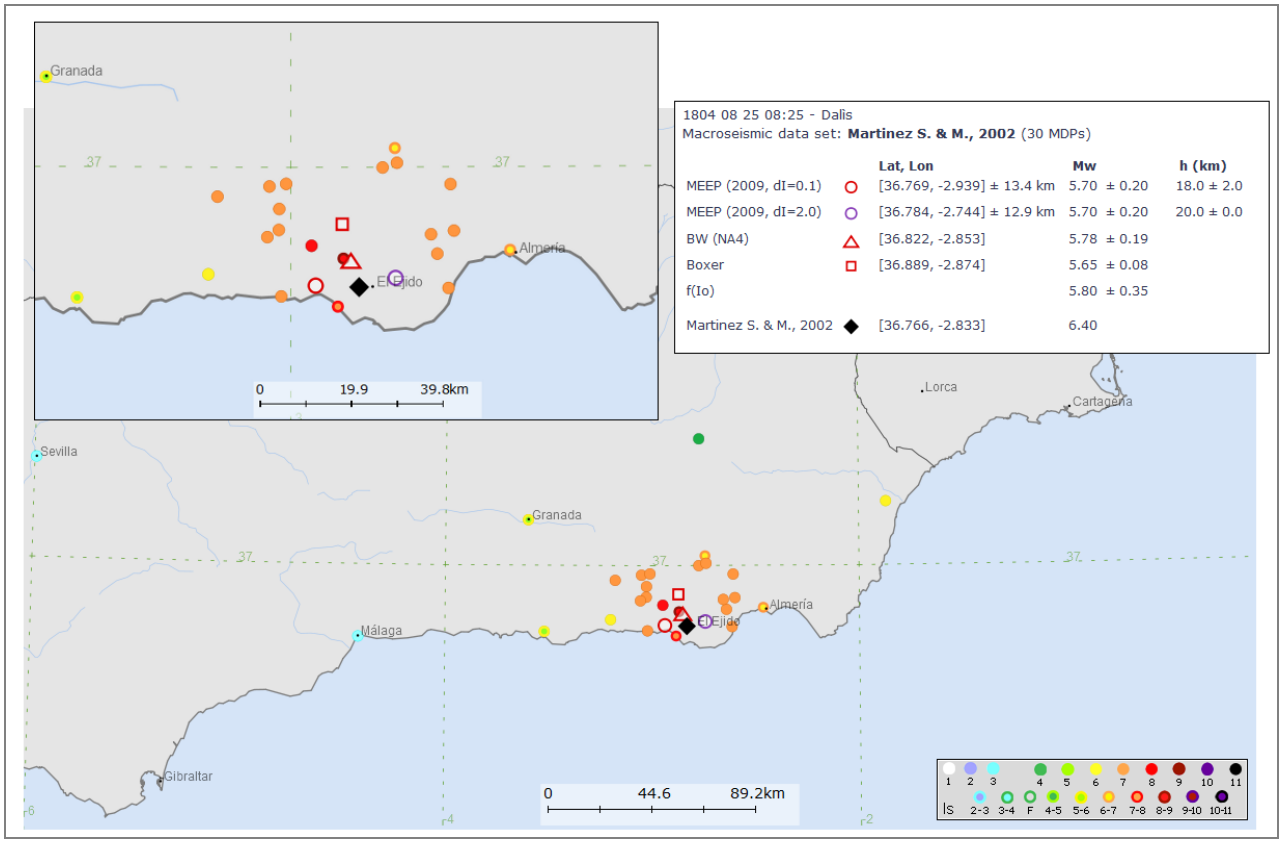


Figure 6a. Earthquake of 1804.08.25 (Iberian area). Full set of parameters.

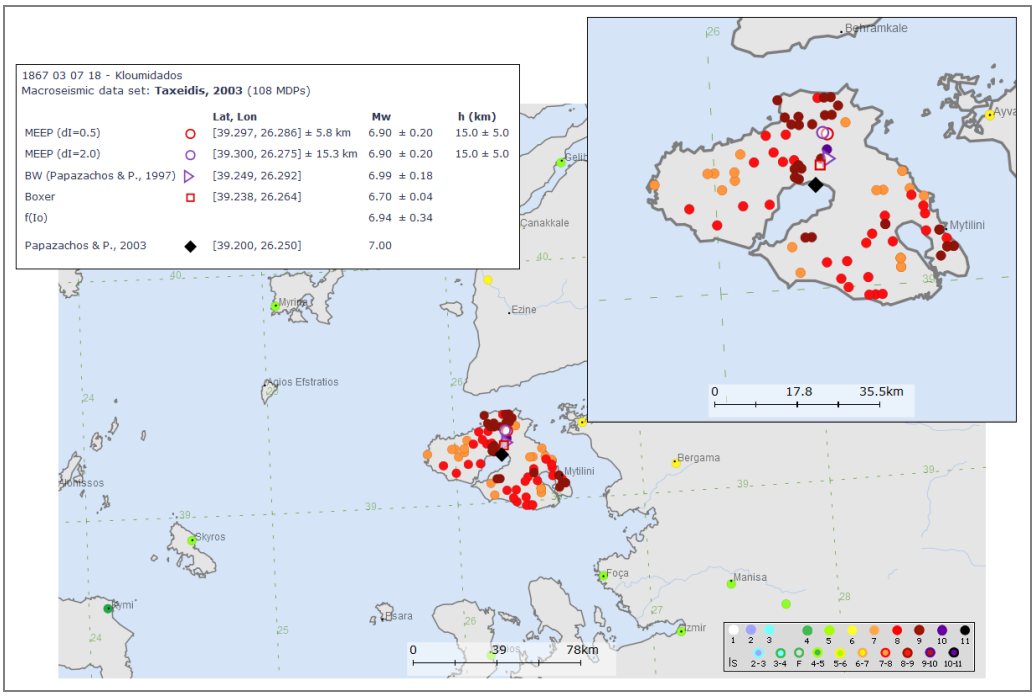


Figure 6b. Aegean earthquake of 1867.03.07. Full set of parameters.

2b. Earthquakes outside the NA4 regions. An attempt has been performed to calibrate the three methods in the Stable Continental Region, including France, Germany, Scandinavia, Poland, Slovakia, Hungary, Czech Republic and Lower Austria. The epicentres of the earthquakes used for calibration (including some from the NA4 UK area) are presented in Fig. 7. Results in terms of Mw are presented in Fig. 8.

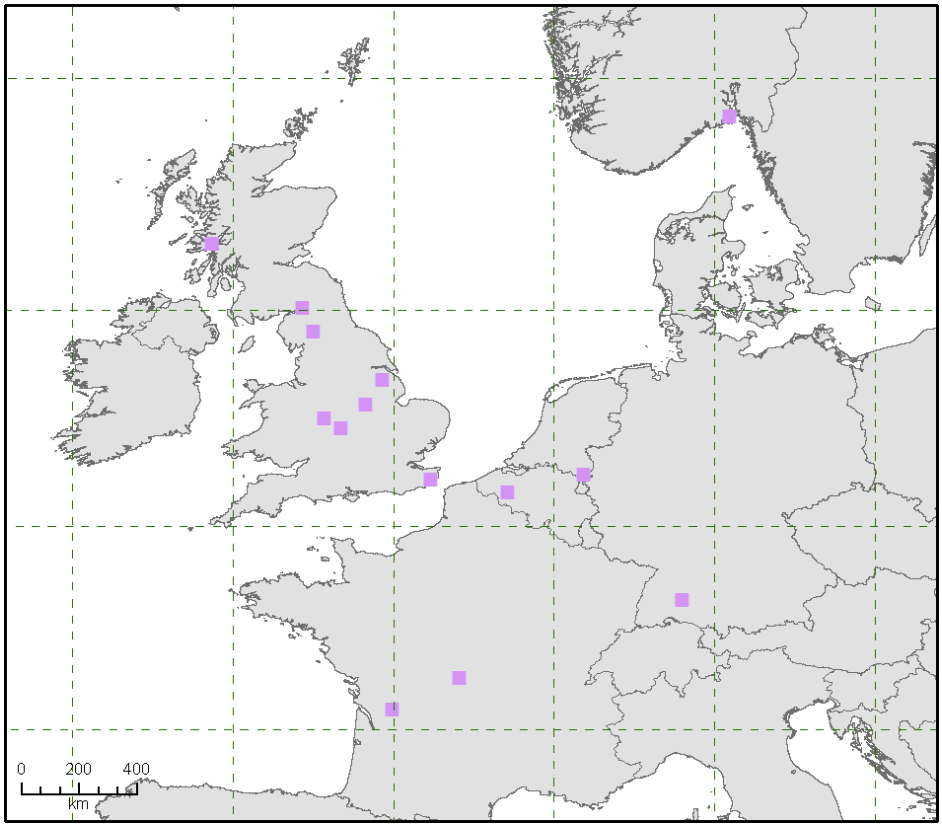


Figure 7 – Stable Continental Region: distribution of the events used for the calibration.

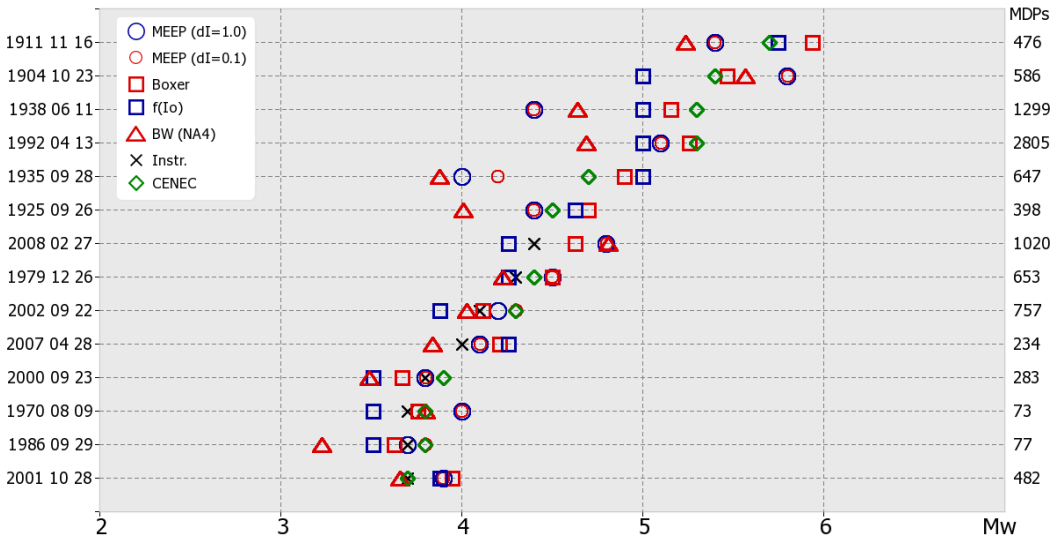


*Figure 8 – Stable Continental Region: plot of Mw values determined from MDPs for the events of Figure 7, compared with the instrumental ones and those taken from CENEC (*Grünthal *et al., 2009).*

The relevant coefficients have then been used for processing the earthquakes in Fig. 9. Some results are shown in Fig. 10. and Fig. 11.
As the definition of the attenuation regions is far from being precise, events which may belong to two bordering regions have been processed according to two calibrations.
For the Vrancea earthquakes no calibration is so far available, owing to a lack of sufficient events with both macroseismic and instrumental data.

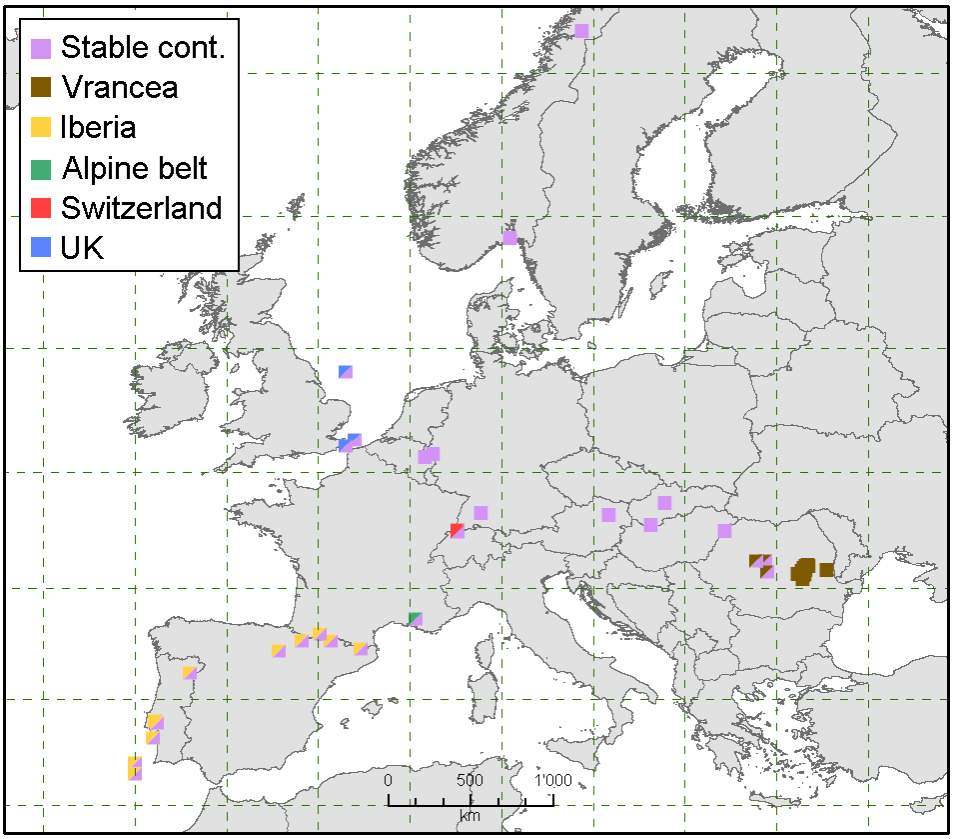


Figure 9. Earthquakes possibly belonging to Stable Continental Region and to Vrancea. Squares with two colors indicate events processed according to two calibrations.

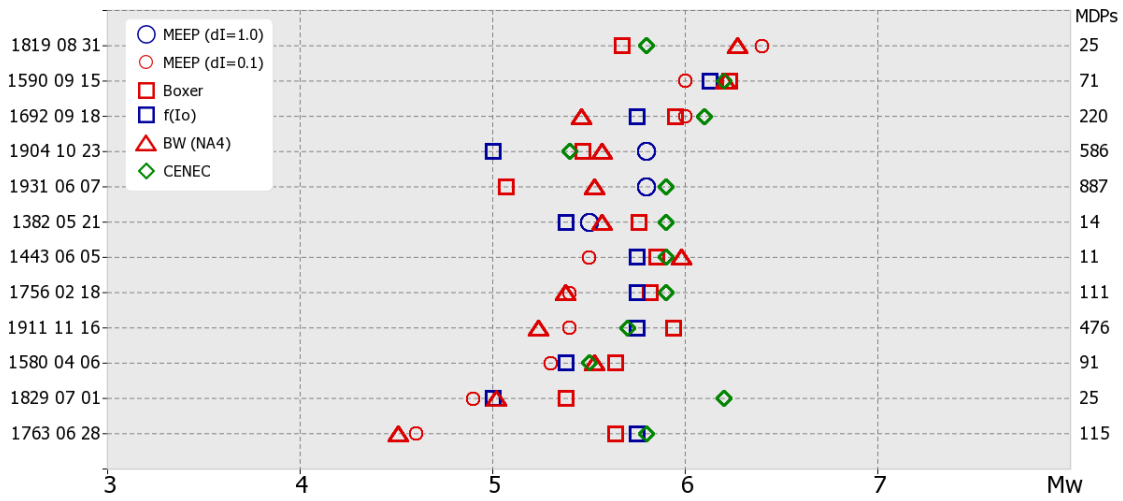


Figure 10 – Stable Continental Region: plot of Mw values determined from MDPs for some of the relevant events of Fig. 9, compared with those taken from CENEC (Grünthal *et al., 2009).*

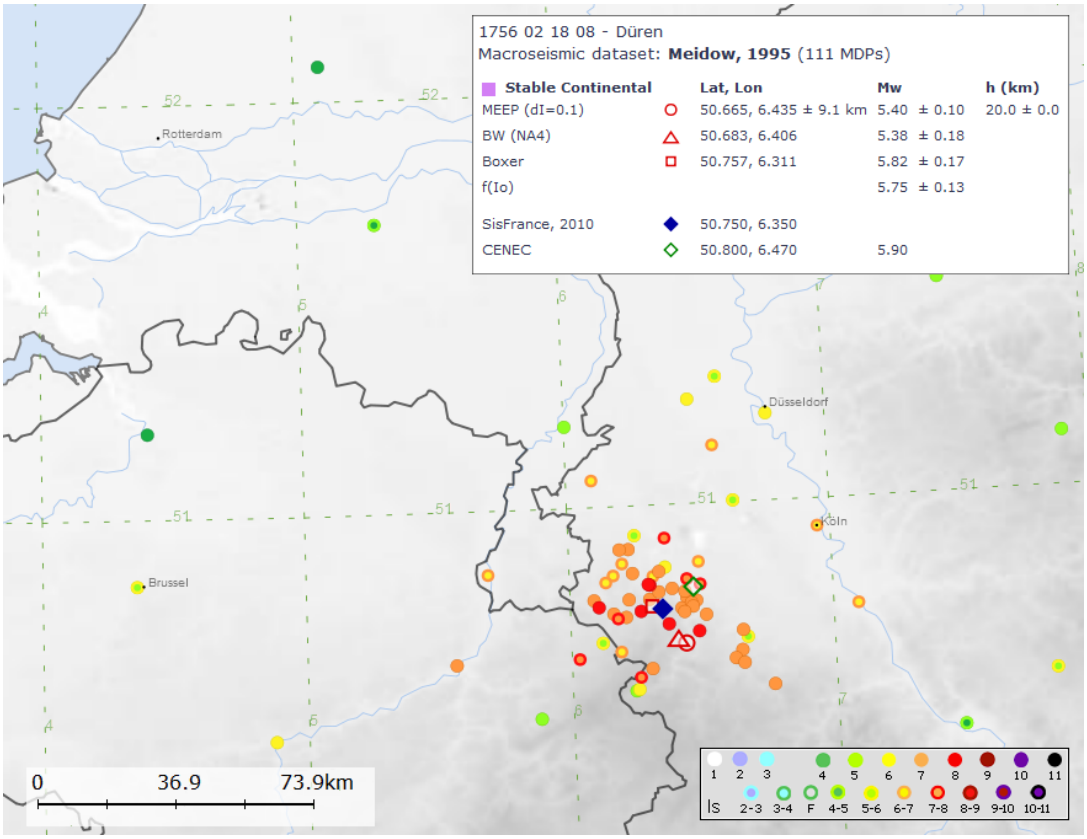


Figure 11 – Earthquake of 1756.02.18 (Düren area); complete set of parameters.

3. Events without MDPs

The events of this type are 311 (Tab. 3 and Fig. 3). For these events the parameters are to be assessed by expert judgment, on the basis of the information provided by the root, if any.

Events with some background information. There are 45 events with a root of type 2, that is, with some explicit background information. In such cases the parameters from the current catalogues have been considered and a comment has been added to assess whether the background information supports the current parameters or whether it suggests some changes.
Fig. 12 supplies an example of an earthquake at the border between today Poland and Slovakia, the location of which is coherent with the source, while Mw shows some uncertainty.

Year Mo Da	Ax	Root	RL
1786 02 27	Silesia	Pagaczewski, 1972	22

61. 1786 February 27; 04h. Epicenter: φ = 49.7°N, λ = 18.5°E, I_0 = 7½°. M_I = 6.6, h = 40 ± 5 km. The earthquake was felt on wide areas of Czechoslovakia and even up to Vienna, on Polish territory in almost all of Silesia up to Głogów, and in the southern and central part of Poland up to Sandomierz and Piotrków. The isoseismical lines of this quake are in Fig. 3. Damages occurred on the whole area up to Cieszyn and Opava. At Cieszyn damages to brick- and stone-built houses, panic; at adjoining Cierlicko disintegration of a church roof, at Mysłów was damaged a church tower; at Bytom - ringing of the church bells; at Polanica - increased yield of a mineral water source.

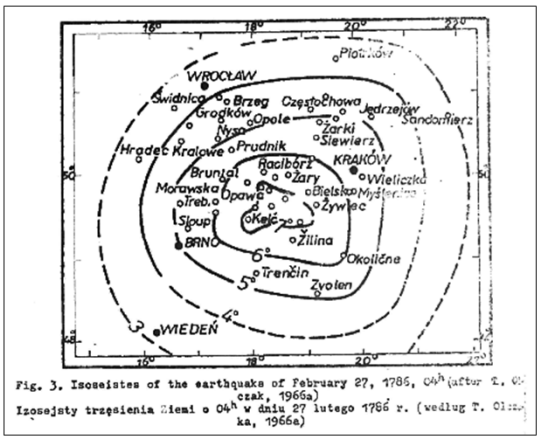


Fig. 3. Isoseistes of the earthquake of February 27, 1786, 04h (after Z. Ol[illegible]czak, 1966a)
Izosejsty trzęsienia ziemi o 04h w dniu 27 lutego 1786 r. (według T. Ol[illegible]ka, 1966a)

Figure 12 – Text and map provided by Pagaczewski (1972) for the earthquake of 1786 in Silesia.

In this case the comment is:

> *"The epicentre provided by Pagaczewski (1972) seems reliable. As for magnitude, the compiler assessed Io = 7-8 and h = 40 km, based on the area over which the earthquake was felt; on the basis of this CENEC provides Mw 5.7. Considering the highest intensity data points from the map (I = 7), Boxer would assess Io = 7. With the Mw(Io) relationship for Stable Continental Region we obtain Mw 5.00 ± 0.13; this value has to be considered as the lowest Mw limit."*

Events taken from other parametric catalogues. There are further 266 events known from a parametric catalogue, only. Out of them, 135 come from catalogues supplying references and, therefore, can be investigated further, in principle at least; 28 come from catalogues that do not supply references. Additionally, 103 entries in the time-window 1900-1963 come from instrumental catalogues (mostly Makropoulos et al., 1992).
For such events there are two alternatives only; a) to search for some background information; b) to select the most reliable set of parameters, according to some rule.
Figure 13 and 14 provide two examples of case a). In the case of the 1571, Romania event (Fig. 13), the only available information comes from Transylvania, although it is far from being exhaustive. Three compilers propose varied solutions for location and magnitude. In this case the comment is:

> *"Contradictory location and size. This is a typical case of an event that in principle could have been originated either in Transylvania or in the Vrancea area. As all the data come from Transylvania the epicentre by Shebalin et al. (1974) seem more reliable. With Io = 8, we obtain: Mw = 5.62 ± 0.34 (Alp. belt) Mw = 5.75 ± 0.13 (Stable cont.)"*

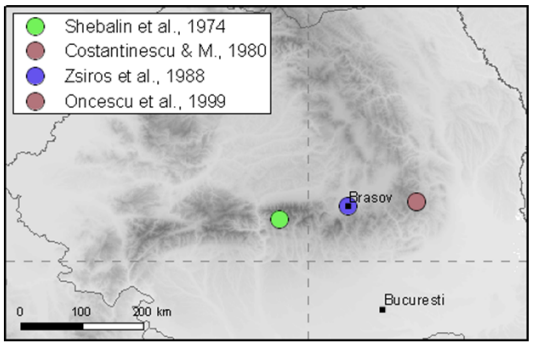
Year Mo Da	Ax	Root	RL
1571 05 10	[Romania]	Shebalin et al., 1974	31

Year	Mo	Da	Ho	Mi	Se	Ct	Et	Ax	Nmdp	Ix	Root	RL	En	Rn	P	Com	Map	CP	Io	Lat	Lon	M	TM
1571	05	10						[Vrancea]			Florinesco, 1958	22	23540.020					COMA980	8	45.700	26.600		
1571	05	10						BRASSO			Réthly, 1952	22	23540.010					ZIAL988	6	45.650	25.600	4.40	M
1571	05	10						[Romania]			Shebalin et al., 1974	31	23540.030		pl			SHAL974	8	45.500	24.600		
1571	05	10									Costantin. & M., 1980	31	23540.035					ONAL999	8	45.700	26.600	7.10	W

Oncescu et al., 1999
Io = 8, Mw = 7.1, h = 150 km

Costantinescu & Marza, 1980
Io = 8

Florinesco, 1958



1571 mai Io
Grand tremblement de terre en Transylvanie, spécialement fort dans la courbure des Carpathes - le pays de Bîrsa et le pays des Séklers. Dégâts à l'Eglise Noire /Braşov/.

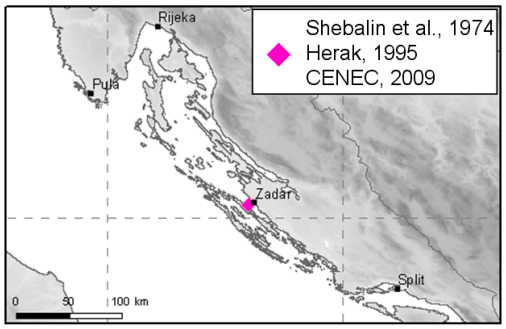
Fig. 13 – Contradictory locations and magnitude for the 1571 earthquake in Romania, and background information retrieved.

In the case of the 1280, Zadar (Dalmatia) earthquake a quick investigation showed that the effects were probably overestimated (Fig. 14).

Year Mo Da	Ax	Root	RL
1280 06 06	Dalmatia	Shebalin et al., 1974	31

Herak, 1995
Io = 9

Shebalin et al., 1974
Io = 9



Year	Mo	Da	Ho	Mi	Se	Ct	Et	Ax	Nmdp	Ix	Root	RL	En	Rn	P	Com	Map	CP	Io	Lat	Lon	M	TM
1280	06	06						[Dalmatia]			Shebalin et al., 1974	31	12220.010		pl			SHAL974	9	44.100	15.200		
1280	06	06						[Dalmatia]			Shebalin et al., 1974	31	12220.020					HERA995	9	44.100	15.200		
1280	06	06									Herak, 1995	31	12220.050					GRUAL009	9	44.100	15.200	6.50	W

Kispatic, 1891 Wrongly interpreted Bianchi	Bianchi, 1888 Used local, perhaps contemporary sources
1280 On the 5th of April soon after midnight a strong earthquake was felt at Zadar, for some seconds. It repeated the following morning causing the destruction of many buildings.	1280, 5 April After midnight a strong earthquake was felt at Zadar, and again the following morning. This same year the old "loggia" of Zadar was restored.

Fig. 14 – Parameters of the 1280 earthquake at Zadar and background information retrieved.

In this case the comment is:

"For this earthquake a change of date to 1280 April 05 is proposed. The source tells nothing more than that an earthquake strongly felt in Zadar (I = 5 EMS98 at Zadar ?). The event is either to be located offshore (Mw ≤ 6) or near Zadar (Mw ≤ 4.5)".

4. Structure of NA4 EEC

The availability of multiple determinations for the same event, and the lack of criteria for assessing the "best" one, prompted the building of a catalogue containing all the available parameters.

Actually, as for lat, lon, depth, Mw, Io and related uncertainties, most traditional and current earthquake catalogues supply only one set of such parameters for each event, with little or no reference to the background data and to the methods according to which they have been processed.
In contrast, the NA4 catalogue supplies several values of such parameters, derived from:

a) the three methods described above (BW, Boxer, MEEP), using the adopted calibration coefficients;
b) Io, in the case of Mw(Io);
c) from expert judgment (case of events of type 2 and 3);
d) from selected set of instrumental parameters (for 80 events, in addition to the 103 ones for which instrumental parameters only are available).

In addition, the parameters taken from the most reliable parametric catalogue(s) of the relevant area are also compiled, as a reference. The synthetic format of NA4 EEC is given in Table 1. The complete format is given in App. 2, with the parameters of three events as examples.

Table 1 – Synthetic format of NA4 EEC.

Parameter	***Description***	***From***
Time	Year, month, day, etc.	NA4 inventory
Macroseismic data	Area of Imax, data source, Nr of MDPs, Imax	NA4 inventory
From MDPs: Boxer	Lat, Lon, Io, Mw, unc.	Boxer, relev. calibr.
From MDPs: Bakun & W.	Lat, Lon, Mw, unc.	Bakun & W., relev. calibr.
From MDPs: MEEP	Lat, Lon, depth, Mw, unc.	MEEP, relev. calibr.
From Io	Mw = f(Io), unc.	Io, relev. Mw(Io) relat.
From studies w/o MDPs	Lat, Lon, depth, Io, Mw, unc.,	Expert judgement
Instrumental	Source, Lat, Lon, depth, Mw, type of Mw	Instrum. catalogues
Current eq. par. (1)	Source cat. 1, Lat, Lon, Io, Mw, unc., type of Mw	Parametric catalogue 1
Current eq. par. (2, opt.)	Source cat. 2, Lat, Lon, Io, Mw, unc., type of Mw	Parametric catalogue 2
Comment	Overall comment	EEC contributors

NA4 EEC is available at http://emidius.mi.ingv.it/neries_NA4/catalogue/ where the basic data are shown (Fig. 15) and the parameters are found on the map obtainable by clicking on the corresponding symbol in the EEC column (Fig 16).

Year Mo Da Ho Mi Se	Ct	Ax	ComAx	Nmdp	EMD	Ix	Root	RL	En	Rn	P	Com	Reg	EEC
1361 07 17 17 15		Ascoli Satriano		2	@	10	Guidoboni et al., 2007	12	14250	060	pl			
1366 04 30		Rhodos		1	@	9	Thess. Macro DB, 2010	13	14410	020	pl			
1366 06 01		Athos		1	@	7	Thess. Macro DB, 2010	13	14430	050	pl			
1373 03 03 02		Ribagorça		23	@	8-9	Olivera et al., 2006	11	14590	080	pl			
1380		Elbasan		1	@	7	Thess. Macro DB, 2010	13	14870	070	pl			
1382 05 21		DOVER STRAITS		15	@	7-8	Musson, 2008	11	14940	070	pl			
1384 08 06		Mytilene		1	@	9	Guidoboni & Com., 2005	11	15020	060	pl			
1386		Bosnia					Cvijanovic, 1981	32	15090	020	pl			
1389 03 20 12 30		Chios		4	@	9-10	Guidoboni & Com., 2005	11	15150	060	pl			
1389 10 18		BOCCA SERRIOLA		9	@	9	Castelli et al., 1996	11	15180	020	pl			
1395 10		Edessa		3	@	8	Thess. Macro DB, 2010	13	15350	040	pl			
1395 11 30		Thessaloniki		2	@	8-9	Guidoboni & Com., 2005	11	15360	010	pl			
1396 12 18 12		Tavernes de la Valldigna		12	@	8-9	Inst. Geog. Nac., 2010	13	15455	040	pl			
1399 11 06 15		Zadar		1	@	5-6	Guidoboni & Com., 2005	11	15570	070	pl			
1400 01		Bursa		1	@	8-9	Guidoboni & Com., 2005	11	15590	010	pl			
1402 06		Xylokastro		8	@	9	Thess. Macro DB, 2010	13	15620	060	pl			
1402 07 28		Istanbul		1	@	8	Thess. Macro DB, 2010	13	15630	050	pl			
1418 03 07		Vrana		1	@	8	Guidoboni & Com., 2005	11	16120	040	pl			
1419 03 15		Bursa		1	@	9	Thess. Macro DB, 2010	13	16130	040	pl			
1419 05 25		Istanbul		1	@	6	Thess. Macro DB, 2010	13	16140	040	pl			
1420 07		Thessaloniki		1	@	9	Guidoboni & Com., 2005	11	16170	030	pl			
1421 01 21		Artokosta		2	@	G4	Guidoboni & Com., 2005	11	16190	040	pl	1		
1422 04 13 00 10		W. Peloponnese		5	@	9	Guidoboni & Com., 2005	11	16210	010	pl			
1428 02 02 08		Camprodon		136	@	9	Olivera et al., 2006	11	16580	090	pl			
1428 05		Koroni		2	@	8-9	Guidoboni & Com., 2005	11	16600	010	pl			
1430 03 26	@	Thessaloniki		1	@	5-6	Guidoboni & Com., 2005	11	16670	060	pl			
1431 04 24 14		Granada		8	@	8-9	Inst. Geog. Nac., 2010	13	16700	050	pl			
1431 07		Atarfe					Inst. And.Geof., 2003	21	16710	010	pl	1		
1437 09 04		Chersonisos		2	@	6	Thess. Macro DB, 2010	13	16820	040	pl			
1443 06 05		Central Slovakia		11	@	8-9	Labak, 1996	11	16940	030	pl			
1444 08 25		Ulcinj		1	@	8-9	Guidoboni & Com., 2005	11	16980	070	pl			
1444 11		Eastern Bulgaria					Stalkoff, 1930	22	16990	010	pl	1		

Fig. 15 – Layout of the NA4 European Earthquake Catalogue (EEC). Clicking on the globes of column EEC the map with the parameters appears (Fig. 16).

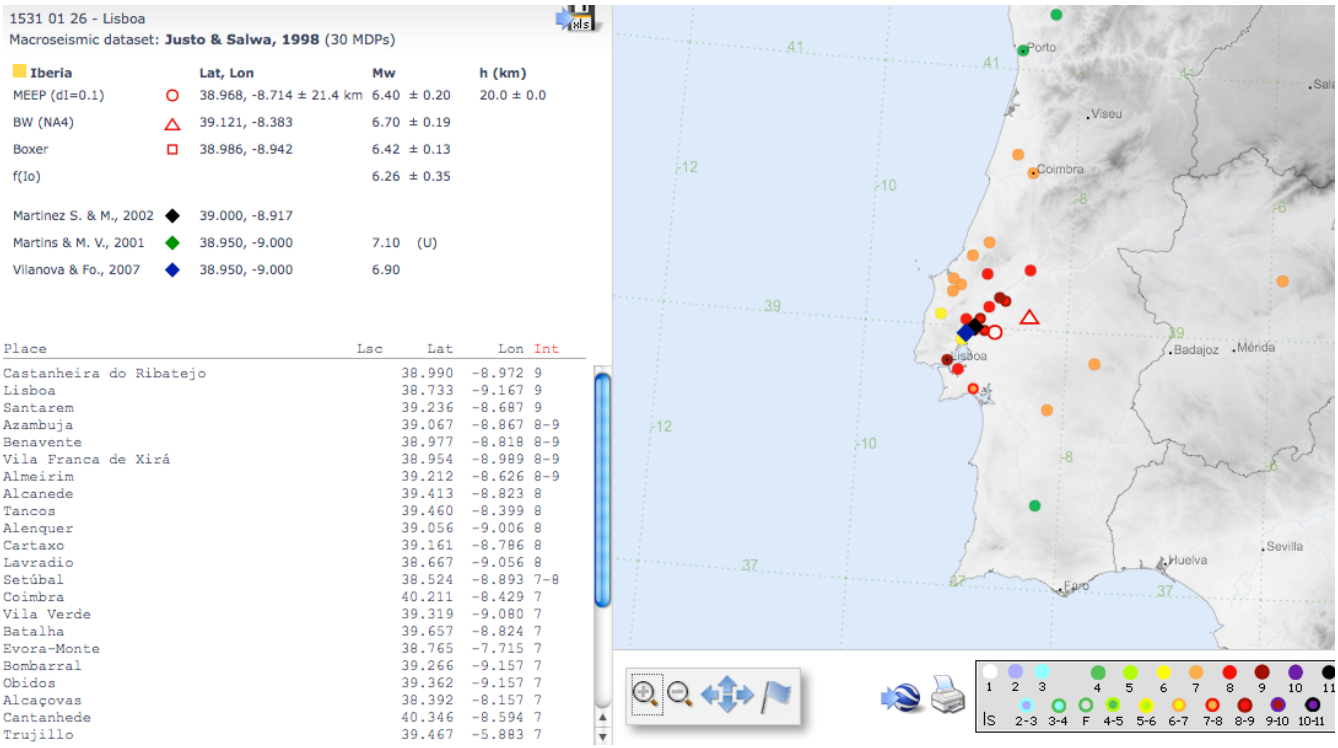


Fig. 16 – Layout of data and parameters for the earthquake of 1531 near Lisbon.

5. Hints for the users

As mentioned above, NA4 EEC does not indicate a preferred value of the parameters, does not propose weights and does not average the values. Although traditional users would prefer a catalogue with one "default" set of parameter values, only, such values usually neglect the epistemic uncertainty in the data. Just as practice in seismic hazard has had to come to terms with uncertainty in strong ground motion prediction, so now it is beginning to come to terms with uncertainty regarding seismicity. Thus, NA4 EEC prefers to show the inherent variability of the parameters, allowing users the ability to include this in models.

It is true, however, that the results to date show a large variability of cases, with reference to either the parameters determined by the three methods or their match, or mismatch, with the available catalogues. This is an inevitable issue with parameter determination from macroseismic data; where data sets are irregular (e.g. from offshore or coastal earthquakes) or simply poor, different procedures will react to the distribution of MDPs in different ways.

To help the users, a first hand classification in term of a matrix based on the match of parameters determined by the three methods and their correlation with the ones from the available catalogues can be suggested (Tab. 2).

Table 2. - Definition of the EEC parameters class.

Parameters from MDPs		good match	some not reliable	all different	mostly unreliable	not determined
match with the avail. catalogues		A	B	C	D	E
good for all	1					
good for some	2					
not good for all	3					
impossible (being determined by exp. judgment)	4					

In the following some examples are illustrated (Fig. 17).

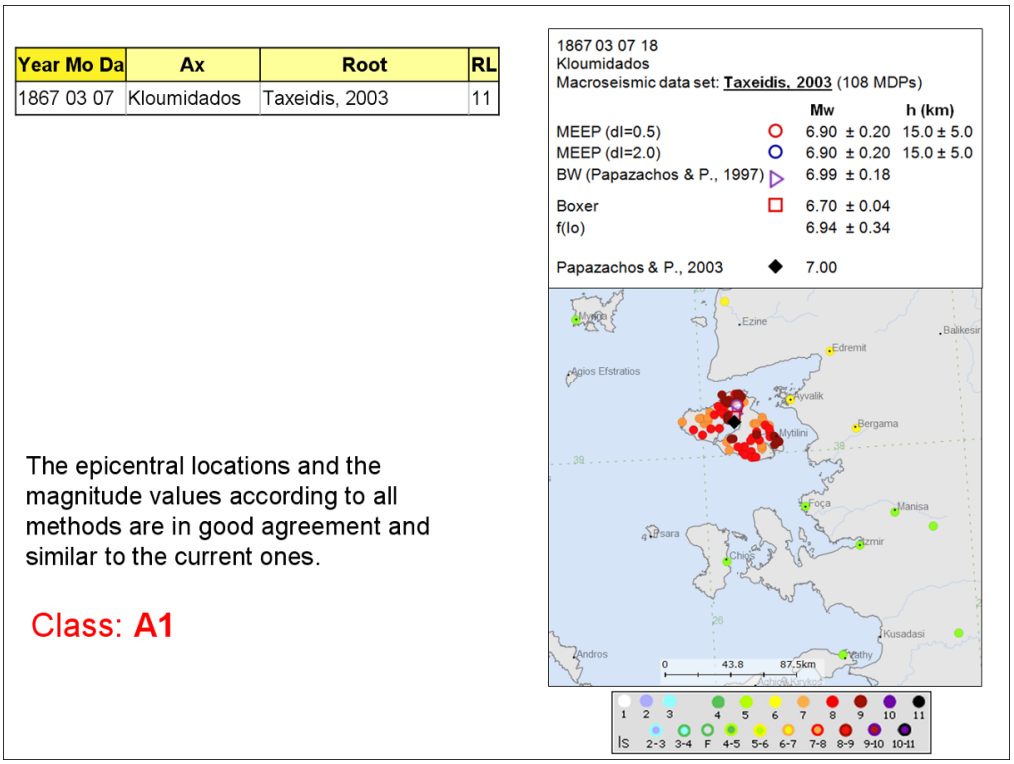
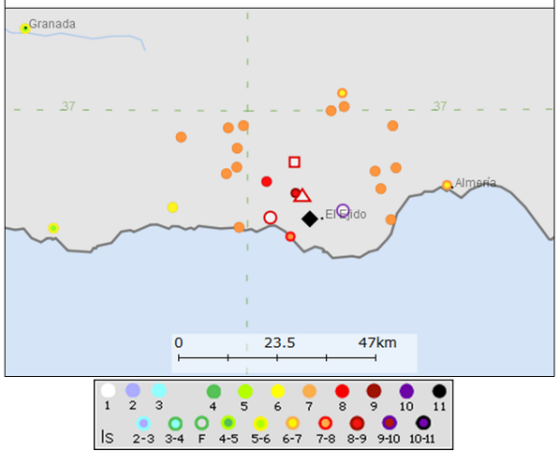


Figure 17a. – Example of parameters class A1.

Year Mo Da	Ax	Root	RL
1804 08 25	Dalías.AL	Inst. Geog. Nac., 2010	13

1804 08 25 08:25
Macroseismic data set: **Inst. Geog. Nac., 2010** (30 MDPs)

		Mw	h (km)
MEEP (2009, dI=0.1)	○	5.70 ± 0.20	18.0 ± 2.0
MEEP (2009, dI=2.0)	○	5.70 ± 0.20	20.0 ± 0.0
BW (NA4)	△	5.78 ± 0.19	
Boxer	□	5.65 ± 0.08	
f(Io)		5.80 ± 0.35	
Martinez S. & M., 2002	◆	6.40	



The epicentral locations and the magnitude values according to all methods are in good agreement. Magnitudes are lower than the current one.

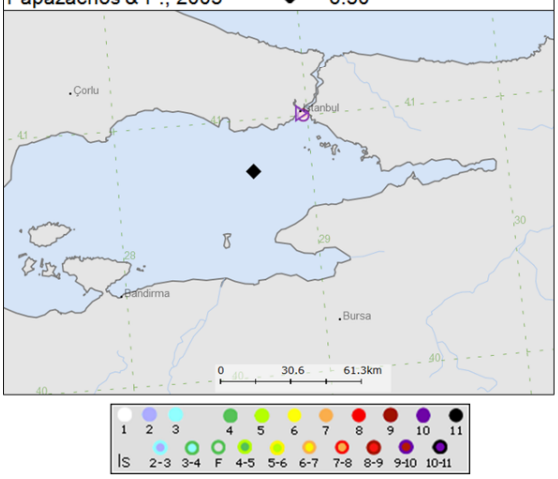
Class: **A2**

Figure 17b. – Example of parameters class A2.

Year Mo Da	Ax	Root	RL
1656 01 24	Istanbul	Thess. Macro DB, 2010	13

1656 01 24
Constantinople
Macroseismic data set: **Thess. Macro DB, 2010** (1 MDPs)

		Mw	h (km)
MEEP (dI=0.5)	○	5.90	
MEEP (dI=2.0)	○	5.90	
BW (Papazachos & P., 1997)	▷	6.24 ± 0.44	
f(Io)		6.42 ± 0.34	
Papazachos & P., 2003	◆	6.30	



All epicentral locations coincide with the only macroseismic datapoint; Mws are different. The current epicentre is located far from the datapoint probably according to expert judgement.

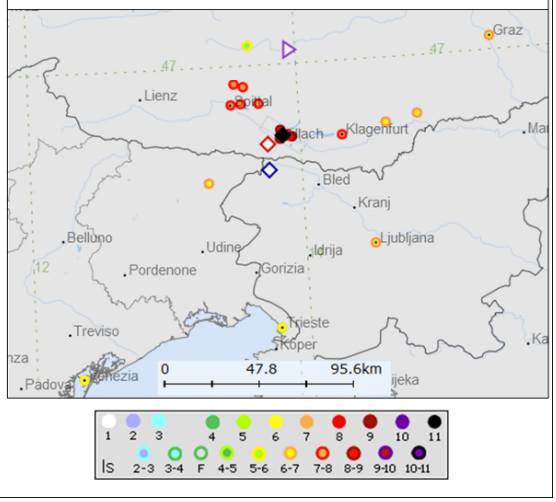
Class: **B4**

Figure 17c. – Example of parameters class B4.

Year Mo Da	Ax	Root	RL
1690 12 04	Carinzia	Guidoboni et al., 2007	11

1690 12 04 14
Macroseismic data set: Guidoboni et al., 2007 (60 MDPs)

	Mw	h (km)
MEEP (2010, dI=0.5)	8.30 ± 0.20	20.0 ± 0.0
MEEP (2010, dI=1.5)	8.50 ± 0.00	20.0 ± 0.0
BW (Pasolini et al., 2008)	7.39 ± 0.18	
Boxer	6.56 ± 0.24	
f(Io)	5.84 ± 0.34	
CENEC	6.30	



Both the epicentral locations from MEEP and Boxer are similar to the current one; the epicentre from BW is out of the area of maximum intensities.
Magnitudes from both MEEP and BW are very high, not reliable.

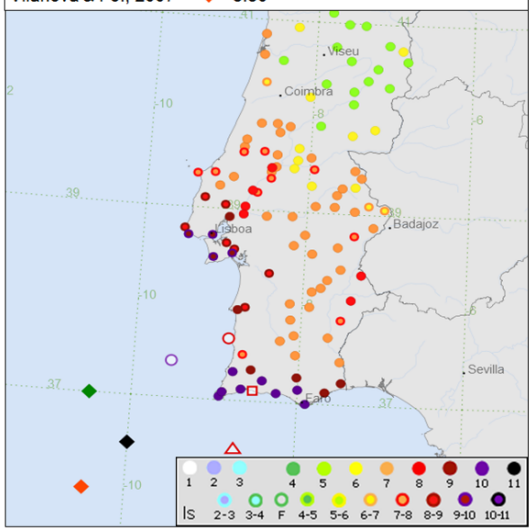
Class: **C3**

Figure 17d. – Example of parameters class C3.

Year Mo Da	Ax	Root	RL
1755 11 01	Lisboa	Sousa Moreira, 1984	11

1755 11 01 09:30
Macroseismic data set: Sousa Moreira, 1984 (128 MDPs)

	Mw	h (km)
MEEP (2009, dI=0.1)	7.60 ± 0.10	20.0 ± 0.0
MEEP (2009, dI=2.0)	7.80 ± 0.10	20.0 ± 0.0
BW (NA4)	7.86 ± 0.18	
Boxer	7.59 ± 0.19	
f(Io)	6.73 ± 0.35	
Martinez S. & M., 2002	8.50	
Martins & M. V., 2001	8.50 (M)	
Vilanova & Fo., 2007	8.50	



The obtained epicentres are quite different and, although off-shore (except Boxer), far from the different current locations. The obtained magnitudes are in good agreement but none of them is as high as the current one.

Class: **D4**

Figure 17e. – Example of parameters class D4.

6. Conclusion

The NA4 European Earthquake Catalogue 1000-1963, M > 5.8, contains 933 events; for more than 600 of them the earthquake parameters have been determined with three methods based on the use of MDPs: i) Boxer (Gasperini et al., 1999); ii) MEEP, developed within NA4 (see Deliverable D3); iii) BW, proposed by Bakun and Wentworth (1997). The coefficients of these methods have been calibrated in six European regions according to homogeneous procedures.
The corresponding dataset represents the result of the largest initiative ever performed, at European scale, to determine earthquake parameters according to homogeneous procedures.

Following the choice of supplying all determinations instead of indicating a preferred value, or averaging the values according to some weights, the catalogue has an innovative structure.
The work can be continued as calibrations can be improved. In addition, earthquakes with M < 5.8, also inventoried in the frame of NA4, can be processed.

Part of this work will be performed in the frame of the EU project “SHARE” (Seismic Hazard Harmonization in Europe).

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App. 1 - Relations and coefficients obtained from the calibration process or selected from the literature (*in yellow those adopted*)

a. Aegean

BW

Reg	Code	Source	Relation [I = I (Mw, D)]	st. dev.	Relation [Mw = Mw (I, D)]	h (km)
AE	BWLit	Papazachos and Papaioannou (1997)		0.48	Mw = 0.621*I +2.035logR+0.002R-0.78	10

MEEP

	Q	C	alpha	K	Date	Comment
AE	320	2.50	0.004	3.00	April 2009	Report NA4, April 2009
AE	410	2.54	0.009	2.70	March 2010	Gomez Capera

Note: dI to be used in the application: 0.5 and 2.0

Boxer: Sibol Coefficients

	Intensity	Coeff. a	Coeff. B	Coeff. C	st. dev. of regr.	weight norm. factor	deg. of freedom of regr.	Date	Comment
AE	2.0	1.37392	0.18275	0.00000	0.2195	16.2000	3	April 2009	Report NA4, April 2009
	3.0	3.16855	0.08826	0.01938	0.2584	51.1250	13		
	4.0	4.02939	0.06906	0.01615	0.2939	105.4706	14		
	5.0	5.08576	0.07371	0.00000	0.2345	53.3158	17		
	6.0	5.83892	0.04663	0.00000	0.2357	26.2308	11		
	7.0	6.10379	0.04030	0.00000	0.3406	19.1429	5		
	8.0	6.57308	0.00791	0.00000	0.4240	7.8000	3		
AE	2.0	5.50000	0.00000	0.00000	0.0000	11.0000	0	March 2010	Gomez Capera
	3.0	2.61421	0.15072	0.00000	0.2971	33.2857	12		
	4.0	2.98181	0.15889	0.00000	0.3528	72.7059	15		
	5.0	5.04675	0.07599	0.00000	0.2454	48.2500	14		
	6.0	5.77298	0.05020	0.00000	0.2157	30.8182	9		
	7.0	5.86321	0.05767	0.00000	0.3084	20.5000	4		
	8.0	7.39472	-0.07137	0.00000	0.3545	9.0000	2		
	9.0	6.70000	0.00000	0.00000	0.0000	0.0000	0		

Boxer: Mw(Io)

	Relation	St. dev.	Date	Comment
AE	Mw = 4.517 + 0.242 Io		April 2009	Report NA4, April 2009
AE	Mw = 2.243 + 0.522 Io	0.34	March 2010	Gomez Capera

b. Iberia

BW

Reg	Code	Source	Relation [I = I (Mw, D)]	st. dev.	Relation [Mw = Mw (I, D)]	h (km)	Date	Comment
IB	BW(MI)	NA4	I=2.419+1.184*Mw-0.0003*R-2.564*log(R)	0.60	Mw=(I-2.419+0.0003*R+2.564*log(R))/1.184	10	April 2009	Report NA4, April 2009
IB	BW(MI)	NA4	I=-0.544+1.98*Mw-0.0036*R-2.793*log(R)	0.72	Mw=(I+0.544+0.0036*R+2.793*log(R))/1.98	10	March 2010	Gomez Capera

MEEP

	Q	C	alpha	K	Date	Comment
IB	950	2.38	0.003	3.30	April 2009	Report NA4, April 2009
IB	700	2.32	0.009	1.90	Sept. 2009	Batllo
IB	600	2.62	0.005	7.80	March 2010	Tatevossian
IB	850	2.33	0.004	2.10	March 2010	Batllo/Alves
IB	620	2.33	0.004	3.70	April 2010	Batllo/Alves

Note: dI to be used in the application: 0.1 and 2.0

Boxer: Sibol Coefficients

	Intensity	Coeff. a	Coeff. B	Coeff. C	st. dev. of regr.	weight norm. factor	deg. of freedom of regr.	Date	Comment
IB	2.0	2.90825	0.07783	0.00000	0.2412	22.5000	16	April 2009	Report NA4, April 2009
	3.0	3.38110	0.07073	0.00000	0.2512	20.4211	17		
	4.0	2.89200	0.04926	0.04067	0.1813	24.0833	9		
	5.0	4.97347	0.06432	-0.01335	0.0000	18.6667	0		
IB	2.0	2.85938	0.06310	0.01302	0.2187	19.5882	14	April 2010	Gomez Capera
	3.0	3.07089	0.07889	0.00759	0.2185	18.8889	15		
	4.0	3.29328	0.10437	0.00000	0.1680	59.3333	13		
	5.0	4.02975	0.08854	0.00000	0.1466	42.2857	5		
	6.0	4.20781	0.13788	-0.00967	0.0000	46.6667	0		
	7.0	4.19353	0.12244	0.00000	0.0000	26.5000	0		
	8.0	4.66038	0.08430	0.01049	0.1749	40.1500	17		
	9.0	5.63151	0.14275	0.00000	0.2246	22.6250	6		

Boxer: Mw(Io)

	Relation	St. dev.	Date	Comment
IB	Mw = 7.950 - 0.450 Io		April 2009	Report NA4, April 2009
IB	Mw = 2.080 + 0.465 Io	0.35	Sept. 2009	Gomez Capera
IB	Mw = 2.826 + 0.349 Io	0.25	March 2010	Gomez Capera

C. Italy

BW								
Reg	**Code**	**Source**	**Relation [I = I (Mw, D)]**	**st. dev.**	**Relation [Mw = Mw (I, D)]**	**h (km)**	**Date**	**Comment**
IT	**BW(Lit)**	Pasolini et al.,2008	I=-5.862+2.460*Mw-0.0086*(R-h)-1.037*[ln(R)-ln(h)]	0.87	Mw=(I+5.862+0.0086*(R-h)+1.037*[ln(R)-ln(h)])/2.460	3.91	April 2009	Report NA4, April 2009
IT	**BW(Lit)**	Gomez Capera	I=2.343+1.346*Mw-2.865*logx	0.72	Mw=(I-2.343+2.865-log(x))/1.346	-	August 2008	Used only for offshore events
IT	**BW(MI)**	NA4	I=2.181+1.654*Mw-0.011*R-3.252*log(R)	0.64	Mw=(I-2.181+0.011*R+3.252*log(R))/1.654	10	April 2009	Report NA4, April 2009

MEEP						
	Q	**C**	**alpha**	**K**	**Date**	**Comment**
IT	300	1.50	0.009	2.10	April 2009	Report NA4, April 2009
IT	375	2.09	0.006	3.90	March. 2010	Tatevossian

Note: dI to be used in the application: 0.1 and 2.0

Boxer: Sibol Coefficients									
	Intensity	**Coeff. a**	**Coeff. B**	**Coeff. C**	**st. dev. of regr.**	**weight norm. factor**	**deg. of freedom of regr.**	**Date**	**Comment**
IT	2.0	2.72168	0.06502	0.02294	0.2543	18.5385	10	April 2009	Report NA4, April 2009
	3.0	2.91254	0.05820	0.02368	0.2919	55.7222	15		
	3.9	25.81147	-0.86902	0.00000	0.0000	7.0000	0		
	4.0	2.66605	0.15810	0.00000	0.2011	88.8889	16		
	5.0	3.72208	0.03952	0.02307	0.2298	73.8125	13		
	6.0	4.29467	0.00505	0.02452	0.1619	120.7143	4		
	7.0	4.45819	0.15915	0.00000	0.2482	117.0000	4		
	8.0	3.66031	0.19864	0.00884	0.0000	86.6667	0		
	9.0	5.14999	0.23878	0.00000	0.0000	16.5000	0		
IT	2.00	3.14332	0.0680	0.01442	0.2739	11.4946	90	March 2010	CPTI04
	2.50	3.35407	0.0549	0.01611	0.2460	11.9048	60		
	3.00	3.36459	0.0541	0.01698	0.2753	20.7390	246		
	3.50	3.44765	0.0491	0.01776	0.2852	18.4626	144		
	4.00	3.32285	0.0597	0.01816	0.2633	25.2230	284		
	4.50	3.40390	0.0529	0.02044	0.2876	25.7730	138		

Boxer: Sibol Coefficients

Intensity	Coeff. a	Coeff. B	Coeff. C	st. dev. of regr.	weight norm. factor	deg. of freedom of regr.	Date	Comment
4.60	3.31972	0.0597	0.01877	0.2713	10.4848	30		
5.00	3.44807	0.0703	0.01695	0.2754	27.6503	180		
5.50	3.83897	0.0679	0.01340	0.3201	20.4179	64		
6.00	4.02290	0.0437	0.01714	0.3620	30.4457	89		
6.50	3.89861	0.0614	0.01664	0.3428	25.8333	51		
7.00	3.96195	0.0506	0.01904	0.3144	42.1273	52		
7.50	4.50698	0.0816	0.01049	0.2558	30.8077	23		
8.00	4.66038	0.0843	0.01049	0.1749	40.1500	17		
8.50	5.92602	0.0912	0.00000	0.1973	29.8750	6		
9.00	5.63151	0.1427	0.00000	0.2246	22.6250	6		

Boxer: Mw(Io)

	Relation	St. dev.	Date	Comment
IT	Mw = 1.831 + 0.500 Io	0.34	April 2009	Report NA4, April 2009
IT	Mw = 2.18 + 0.430 Io	0.34	March 2010	CPTI04

d. Switzerland

BW

Reg	Code	Source	Relation [I = I (Mw, D)]	st. dev.	Relation [Mw = Mw (I, D)]	h (km)	Date	Comment
CH	BW(MI)	NA4	I=0.094+1.93*Mw-0.0007*R-3.057*log(R)	0.78	Mw=(I-0.094+0.0007*R+3.057*log(R))/1.93	10	April 2009	Report NA4, April 2009

MEEP

	Q	C	alpha	K	Date	Comment
CH	1800	2.58	0.001	2.80	April 2009	Report NA4, April 2009
CH	2280	2.61	0.002	1.7	March 2010	Tatevossian

Note: dI to be used in the application: 0.1 and 1.0

Boxer: Sibol Coefficients

	Intensity	Coeff. a	Coeff. B	Coeff. C	st. dev. of regr.	weight norm. factor	deg. of freedom of regr.	Date	Comment
CH	2.0	3.78845	0.04826	0.00000	0.3610	21.8000	8	April 2009	Report NA4, April 2009
	3.0	3.78522	0.06349	0.00000	0.2764	42.2308	11		
	4.0	3.68597	0.08364	0.00000	0.3413	57.5882	15		
	5.0	4.44374	0.06161	0.00000	0.2007	73.1000	8		
	6.0	4.97757	0.04223	0.00000	0.2751	33.0000	2		
	7.0	3.33181	0.25350	0.00000	0.0000	29.0000	0	March 2010	Gomez Capera

Mw(Io)

	Relation	St. dev.	Date	Comment
CH	Mw = 3.835 + 0.190*Io		April 2009	Report NA4, April 2009
CH	Mw = 1.600 + 0.531*Io	0.23	January 2010	Gomez Capera

e. Great Britain

BW								
Reg	**Code**	**Source**	**Relation [I = I (Mw, D)]**	**st. dev.**	**Relation [Mw = Mw (I, D)]**	**h (km)**	**Date**	**Comment**
UK	**BW(Ic3)**	NA4_Ic3			Mw=0.874*I+0.497*ln(R)+0.00034*R-1.453	1.34	April 2009	Report NA4, April 2009
UK	**BWLit**	Musson, 2005		0.45	ML=(1-3.31+1.22*ln(R))/1.28 Grunthal & Wahl.2003) Mw=0.67+0.56*ML+0.046*ML^2		April 2009	Report NA4, April 2009
UK	**BW(Ic3)**	NA4_Ic3	I=0.17+1.54*Mw-0.016*R-0.585*log(R)	0.66	Mw = (I-0.17+0.016*R+0.585*log(R))/1.54	3.5	March 2010	Gomez Capera

MEEP						
	Q	**C**	**alpha**	**K**	**Date**	**Comment**
UK	720	1.57	0.003	7.20	April 2009	Report NA4, April 2009
UK	665	1.37	0.003	2.70	March 2010	MEEP 2.0 User Guide

Note: dI to be used in the application: 0.1 and 1.0

Boxer: Sibol Coefficients									
	Intensity	**Coeff. a**	**Coeff. B**	**Coeff. C**	**st. dev. of regr.**	**weight norm. factor**	**deg. of freedom of regr.**	**Date**	**Comment**
UK									
	2.0	1.78417	0.06393	0.02404	0.0068	6.2500	1	April 2009	Report NA4, April 2009
	3.0	2.11746	0.09871	0.00000	0.1167	52.8462	11		
	4.0	2.41146	0.10227	0.00000	0.1411	87.6000	13		
	5.0	3.57644	0.06216	0.00000	0.2052	121.6000	3		
	6.0	4.40412	0.00005	0.00000	0.1426	30.3333	1	March 2010	Gomez Capera

	Relation	**St. dev.**	**Date**	**Comment**
UK	Mw = 0.330 + 0.667 Io		April 2009	Report NA4, April 2009
UK	Mw = 0.135 + 0.649 Io	0.41	March 2010	Gomez Capera

f. Stable continental regions

BW

Reg	Code	Source	Relation [I = I (Mw, D)]	st. dev.	Relation [Mw = Mw (I, D)]	h (km)	Date	Comment
SCR	BW(MI)	NA4	I=3.414+1.287*Mw-0.0020*R-2.363*log(R)	0.58	Mw=(I-3.414+0.0020*R+2.363*log(R))/1.287	10	June 2010	Gomez Capera

MEEP

	Q	C	alpha	K	Date	Comment
SCR	625	1.36	0.008	2.00	June 2010	Gomez Capera

Note: dI to be used in the application: 0.1 and 1.0

Boxer: Sibol Coefficients

	Intensity	Coeff. a	Coeff. B	Coeff. C	st. dev. of regr.	weight norm. factor	deg. of freedom of regr.	Date	Comment
SCR	2.0	1.40683	0.04015	0.05451	0.0866	22.1250	5	June 2010	Gomez Capera
	3.0	1.80441	0.03537	0.05129	0.1388	164.0769	10		
	4.0	1.89580	0.04726	0.04477	0.1911	313.3571	11		
	5.0	2.41148	0.04509	0.03898	0.1803	191.5455	8		
	6.0	4.67049	0.04426	0.00000	0.1660	69.4000	3		
	7.0	5.70000	0.00000	0.00000	0.0000	8.0000	0		

Mw(Io)

	Relation	St. dev.	Date	Comment
SCR	Mw = -0.239 + 0.749*Io	0.13	June 2010	Gomez Capera

App. 2 - Format of the NA4 European Earthquake Catalogue

Parameter	Description	From	Example 1	Example 2	Example 3
Time					
Year	Year	dataset, as compiled in AHEAD	1382	1786	1909
Mo	Month	dataset, as compiled in AHEAD	05	02	04
Da	Day	dataset, as compiled in AHEAD	21	27	23
Ho	Hour	dataset, as compiled in AHEAD		04	
Mi	Minutes	dataset, as compiled in AHEAD			
Macroseismic data					
Ax	Area of max. effects (rev. denom.)	AHEAD compilers	DOVER STRAITS	Silesia	Benavente
Root	Macroseism. dataset short citation	AHEAD compilers	Musson, 2008	Pagaczewski, 1972	Choffat & Bens., 1912
RL	Root level	AHEAD compilers	11	22	11
Nmdp	Number of MDPs	AHEAD compilers	15		543
Ix	Maximum MDP intensity	AHEAD compilers	7-8		10
Macroseismic location					
Lat_Bo	Boxer epicentral latitude	Boxer, adopted calibration	51.263		38.928
Lat_BW	BW epicentral latitude	BW, adopted calibration	51.413		39.000
Lat_ME	MEEP epicentral latitude	MEEP, adopted calibration	51.247		39.003
Lon_Bo	Boxer epicentral longitude	Boxer, adopted calibration	0.750		-8.806
Lon_BW	BW epicentral longitude	BW, adopted calibration	0.874		-8.734
Lon_ME	MEEP epicentral longitude	MEEP, adopted calibration	0.914		-8.869
Uep_ME	Uncertainty of MEEP ep. loc.	MEEP, adopted calibration	14.1		24.3
De_ME	MEEP Depth	MEEP, adopted calibration	20.0		18.0
UDe_ME	Uncertainty of MEEP depth	MEEP, adopted calibration	0.0		2.0
Macroseismic size					
Mw_Bo	Boxer Moment magnitude	Boxer, adopted calibration	5.30		6.01
UMw_Bo	Uncertainty of Mw_Bo	Boxer, adopted calibration	0.52		0.22
Mw_BW	BW moment magnitude	BW, adopted calibration	5.58		5.99
UMw_BW	Uncertainty of Mw_BW	BW, adopted calibration	0.21		0.18

Parameter	Description	From	Example 1	Example 2	Example 3
Mw_ME	MEEP moment magnitude	MEEP, adopted calibration	5.80		6.20
UMw_ME	Uncertainty of Mw_ME	MEEP, adopted calibration	0.10		0.00
Io_Bo	Boxer epicentral intensity	Boxer, adopted calibration	7-8		10
Mw_Io	Mw from Io_Bo	Io_Bo, adopted Mw(Io) relation	5.00		6.31
UMw_Io	Uncertainty of Mw_Io	Adopted Mw(Io) relation	0.41		0.25
Param. of roots with RL=2 or 3					
Lat_EJ	Lat. assigned by exp. judg.	NA4 catalogue compilers		49.700	
Lon_EJ	Long. assigned by exp. judg.	NA4 catalogue compilers		18.500	
De_EJ	Depth assigned by exp. judg.	NA4 catalogue compilers		40.0	
Io_EJ	Io assigned by exp. judg.	NA4 catalogue compilers		7	
Mw_EJ	Mw assign. by exp. judg.	NA4 catalogue compilers		5.40	
UMw_EJ	Uncertainty of Mw_EJ	NA4 catalogue compilers		0.13	
Instr. parameters					
Source_Is	Source of instrumental hypoc.	Instrumental dataset			Stich et al., 2005
Lat_Is	Instrumental latitude	Instrumental dataset			38.900
Lon_Is	Instrumental longitude	Instrumental dataset			-8.800
De_Is	Instrumental depth	Instrumental dataset			10
SourceMw_Is	Source of Mw_Is	Instrumental dataset			Stich et al., 2005
Mw_Is	Instrumental Mw	Instrumental dataset			6.00
DMw_Is	Uncertainty of Mw_Is	Instrumental dataset			0.10
TMw_Is	Type of Mw_Is	Instrumental dataset			N
Current eq. param. (1)					
Code_C1	Code of the selected cat. (1)	AHEAD compilers	Musson, 1994	Pagaczewski, 1972	Martins & M. V., 2001
Lat_C1	Epicentral latitude, cat. (1)	catalogue (1)	51.100	49.700	38.900
Lon_C1	Epicentral longitude, cat. (1)	catalogue (1)	1.600	18.500	-8.800
Io_C1	Epicentral intensity, cat. (1)	catalogue (1)		7-8	
De_C1	Depth, cat. (1)	catalogue (1)		40.0	
M_C1	Magnitude, cat (1)	catalogue (1)	5.80		7.60
TM_C1	Type of M_C1	catalogue (1)	L		U
Current eq. param. (2)					
Code_C2	Code of the selected cat. (2)	AHEAD compilers	Grünthal et al., 2009	Grünthal et al., 2009	Vilanova & Fon., 2007
Lat_C2	Epicentral latitude, cat (2)	catalogue (2)	51.300	49.700	38.950

Parameter	Description	From	Example 1	Example 2	Example 3
Lon_C2	Epicentral longitude, cat (2)	catalogue (2)	2.000	18.500	-8.820
Io_C2	Epicentral intensity, cat (2)	catalogue (2)	8	7-8	
De_C2	Depth, cat (2)	catalogue (2)		40.0	
M_C2	Magnitude, cat (2)	catalogue (2)	5.90	5.80	6.27
TM_C2	Type of M_C2	catalogue (2)	W	W	W
Map and comment					
Map	link to map and digital MDPs	AHEAD compilers	@	@	@
Class	Parameters class	AHEAD compilers	B3	E2	A1
Com	Overall comment	AHEAD and NA4 catalogue compil.	The calculated epicentres are compatible, but none of them matches the current locations. The magnitudes are similar to the current ones, except that from Boxer, which is lower.	The epicentre provided by Pagaczewski (1972) seems reliable. As for magnitude, the compiler assessed Io = 7-8 and h = 40 km, based on the area over which the earthquake was felt; on the basis of this CENEC provides Mw 5.7. Considering the highest intensity data points from the map (I = 7), Boxer would assess Io = 7. With the Mw(Io) relationship for Stable Continental Region we obtain Mw 5.00 ± 0.13; this value has to be considered as the lowest Mw limit.	The calculated epicentres are similar, the location from Boxer is very close to the instrumental one. The magnitudes are compatible with both the current instrumental Mw and that provided by Vilanova & Fo. (2007). The M value provided by Martins & M. V. (2001) appears overestimated.
AHEAD eq. id.					
EN	Event number	AHEAD compilers	14940	80566	1938600