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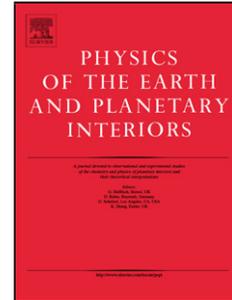
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1 **European-Mediterranean Regional Centroid Moment Tensor Catalog: solu-**
2 **tions for 2005–2008**

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15 **Abstract**

16 Since 1997 we maintain and systematically update the European–Mediterranean Regional Centroid Moment
17 Tensor (RCMT) Catalog, which contains seismic-moment tensors for earthquakes with moderate magnitude
18 ($4.5 < M < 5.5$) in the Mediterranean and European regions. We present 354 new solutions for the period
19 2005–2008. The Catalog now spans 12 years and contains more than 1000 definitive RCMT solutions.
20 In addition to definitive solutions, we maintain and update a dataset of recent ‘quick’ solutions that are
21 computed soon after an earthquake occurs using the more limited set of data available in quasi-real time.
22 We investigate the reliability of the moment tensor results in the RCMT catalog. Comparison with Global
23 CMT results, which is possible for the larger events ($M > 5.0$) in the RCMT catalog, shows that for 75% of
24 the events, the Kagan angle measure of the similarity of two moment tensors is smaller than 20° , reflecting
25 good agreement of the results. We describe improvements and enhancements in the dissemination of the
26 RCMT results through our web site.

27 **Keywords:** Seismic moment tensors, focal mechanisms, seismicity, European–Mediterranean region

28 **1 Introduction**

29 The centroid-moment-tensor (CMT) approach (Dziewonski et al., 1981; Dziewonski and Woodhouse, 1983)
30 to the description and quantification of earthquake sources has become a well-established method for routine
31 analysis of seismicity. On a global scale, the Global CMT Project (Ekström et al., 2005; www.globalcmt.org)
32 systematically analyzes and publishes moment tensors for earthquakes larger than $M = 5.0$. Starting in
33 1997, we perform a similar comprehensive CMT analysis of earthquakes in Europe and the Mediterranean
34 region. By considering intermediate-period surface waves recorded at regional distances, we are routinely
35 able to analyze earthquakes as small as $M = 4.5$, thereby extending the capabilities of the CMT approach
36 to a larger number of events than can be studied by using exclusively the global data set. Our Regional CMT
37 (RCMT) effort has resulted in a comprehensive catalog of earthquakes which is systematically extended
38 and updated (Pondrelli et al., 2002, 2004, 2007; www.bo.ingv.it/RCMT). Complementing the definitive
39 moment-tensor results, preliminary ‘quick RCMT’ solutions are routinely calculated immediately following
40 the occurrence of significant earthquakes in the region.

41 The availability of moment tensors for intermediate-magnitude events contributes to a better charac-
42 terization of individual seismic sequences (e.g., Pondrelli and Morelli, 2008), and to investigations of the
43 complex large-scale tectonics connected to the Africa-Eurasia collision (e.g., Vannucci et al., 2004). Seis-
44 micity is widespread in the Mediterranean region and, while strong earthquakes are rare, more frequent
45 moderate-size events often cause significant damage. Systematic study of smaller events therefore also has
46 the potential to contribute to the development of a better understanding of seismic hazard of this populated
47 area.

48 In this paper, we describe RCMT results for the period 2005–2008. In the analyses described here,
49 we have slightly modified our procedures compared to those employed in earlier reports (Pondrelli et al.,
50 2002, 2004, 2007). Specifically, we now fit not only long-period surface waves in the inversion, but also
51 include long-period body waves in the set of observations to be matched. We determined 354 moment-
52 tensor solutions for the four-year period, and describe results for several noteworthy earthquake sequences.
53 With the addition of the new solutions, the RCMT catalog now spans a time period of 12 years and contains
54 results for more than 1000 earthquakes. We investigate the robustness of the solutions by comparing our
55 results with those obtained in the GCMT Project using a global data set. Finally, we discuss new technical
56 aspects of the maintenance and dissemination of the RCMT catalog.

57 **2 Seismic moment tensors for the years 2005–2008**

58 The routine RCMT analysis relies on the fitting of surface waves in the period band 35–150 seconds,
59 recorded at regional distance and modeled using global phase-velocity maps (Arvidsson and Ekström, 1998;
60 Ekström et al., 1998). Recently, we have started including body waves in the analysis, modeled in the same
61 manner as in the Global CMT Project by summation of the normal modes of the Earth corrected for large-
62 scale three-dimensional mantle structure (Woodhouse and Dziewonski, 1984). Body waves are now included
63 in the RCMT inversion when the epicentral distance is large enough to separate their arrivals from the sur-
64 face wave packet, and when the signal-to-noise ratio is sufficiently high. Figure 1 shows the body-wave
65 and surface-wave windows included in the inversion for one example seismogram recorded at a distance of
66 31.89° from a $M_W = 5.5$ earthquake. We find that the use of the two different wave types has a stabilizing
67 effect on the centroid location. This is particularly useful for events occurring near the border of our study
68 region since for these events the azimuthal station coverage is often poor.

69 Figure 2 shows a regional map with the 354 new seismic moment-tensor solutions that we determined for
70 the period 2005–2008. The earthquake source parameters are listed in Tables 1–12 (added as Supplementary
71 Material), including the reported magnitude M and the computed moment magnitude M_W . Centroid shifts
72 δlat_0 , δlon_0 and δdep_0 are given with respect to the initial hypocentral coordinates, which we obtain from
73 the European–Mediterranean Seismological Center (EMSC/CSEM, www.emsc-csem.org). Our criteria for
74 selecting earthquakes for analysis are based on the reported magnitude M and the earthquake location.
75 Generally we do not select for analysis earthquakes with $M > 5.5$ since these events will be analyzed as
76 part of the Global CMT Project. However, we occasionally choose to analyze earthquakes of particular
77 interest or significance with $M > 5.5$, and also include the results in the RCMT catalog. At the low-
78 magnitude end, we use $M \geq 4.5$ as the general selection criterion, but often attempt analysis for smaller
79 earthquakes, especially for those located in Italy and nearby areas where the station distribution is favorable
80 for the RCMT analysis. For earthquakes with a reported magnitude $M < 4.5$, a successful analysis is
81 contingent on a favorable station distribution and a high signal-to-noise ratio at close-in stations.

82 For approximately 30% of the events presented here we were able to augment the surface-wave data set
83 with body-wave data. Solutions determined using both types of data are identified in Tables 1, 4, 7 and 10
84 (see Supplementary Material) by event codes that start with a ‘C’ (for ‘combined’) rather than an ‘S’ (for
85 ‘surface waves’).

86 Following the method developed to describe the relative reliability of RCMT results for earthquakes in
87 Italy (Pondrelli et al., 2006), we now provide a quality flag for each event (A/B/C/D, see Tables 3, 6, 9, and

12 in Supplementary Material) that we believe reflects the robustness of the RCMT solution. The ‘A’ flag (assigned to 80% of the earthquakes) indicates the best-quality solution. For these events the distance of the centroid epicenter from the reported epicenter is smaller than 0.3° , the residual normalized misfit between seismograms and synthetics is lower than 0.4, and the resulting non-double couple component is smaller than 0.33. The ‘B’ flag (9% of the earthquakes) is assigned to solutions with a centroid–epicenter shift between 0.3° and 0.5° . Such shifts generally occur when the station distribution is not very homogenous azimuthally. We assign the ‘C’ flag (11%) to earthquakes for which we fixed the epicentral location, usually because of a very limited number of recording stations. The ‘D’ flag is assigned to earthquakes with a large non-double couple component (larger than 0.33), but none of the new solutions presented here fall in this category.

For the largest earthquakes of those we have analyzed (marked by a star in Tables 1-12 in the Supplementary Material), both a global GCMT and a regional RCMT are available. We compared the scalar moments and the moment tensors, and found a very close similarity (Figure 3). For each pair of solutions we computed the Kagan angle (Kagan, 1991, 2007) between their double-couple representations. This angle can vary from 0° , reflecting complete agreement, to a maximum of 120° , for complete disagreement. For 75% of the events, the Kagan angle is smaller than 20° , considered to correspond to very good qualitative geometrical agreement (Kagan, 1991, 2007). Figure 3 shows that for nearly all events the Kagan angle is less than 60° , an empirical threshold indicating general agreement. The rotations of the P, T and N axes needed to overlap each pair of moment tensors is also reported in Figure 3. The largest Kagan angles occur for those events for which a relatively large non-double-couple component exists in at least one of the two moment tensors, as for the examples shown in Figure 4. In such cases, the double-couple representation is not appropriate, and the actual radiation patterns may show substantial similarity in spite of the large Kagan angle.

3 Significant earthquakes in 2005 – 2008

Most of the earthquakes in the study region occur in the eastern Mediterranean (Figure 2), in particular in Greece, along the Hellenic Trench, in the Aegean Sea and in Turkey. Each year more than one earthquake with magnitude greater than 5.5 has occurred in this area. Figure 5 shows an enlarged view of part of this region, with structural features indicated and individual earthquake sequences identified in panels A, B, and C.

Panel A is centered on the Ionian Islands, an area in which different tectonic styles of deformation are

118 active, as reflected by the diversity of RCMT and GCMT focal mechanisms. A seismic sequence, with the
119 larger events occurring in October 2005 and in April 2006 (Tables 1 and 4 of the Supplementary Material),
120 occurred immediately south of Zakyhnthos, the southernmost island of the Ionian archipelago. All moment
121 tensors in the sequence reflect thrust motion, in agreement with the tectonics expected along a subduction
122 trench. Four strike-slip events, mapped in panel A of Figure 5, occurred north of this sequence, close to
123 Kefhalonia, on the strike-slip Kefhalinia fault, in March 2007. A third sequence of earthquakes in this
124 area occurred north of the Gulf of Patras in April 2007 (Table 7 of Supplementary Material) for which all
125 moment tensor show normal faulting.

126 Panel B shows RCMT and GCMT solutions for events in the seismic sequence associated with the M_W
127 6.6 and 6.2 earthquakes of February 2008 located along the Hellenic Trench (Roumelioti et al., 2009; Sokos
128 et al., 2009). This sequence lasted for more than four months and we determined source parameters for
129 25 earthquakes with $M \geq 4.5$ (Table 10 of Supplementary Material). Most of the events have a thrust
130 mechanism, with a smaller number of strike-slip earthquakes located in the northernmost part of the area hit
131 by the sequence.

132 Panel C shows RCMT and GCMT solutions for the earthquakes that occurred in October 2005 in the
133 northernmost part of the Aegean Sea, in eastern Turkey (Table 1 in the Supplementary Material). The focal
134 mechanisms reflect the strike-slip motion expected in this area, related to the propagation of faults associated
135 with the Northern Anatolian fault in the Aegean Sea.

136 Outside of the regions where most of seismicity occurs, we note several earthquakes on the Iberian
137 peninsula. Two events occurred in 2005, January 29 and February 3 (Table 1 of Supplementary Material,
138 events 4-05 and 7-05; Figure 6), both mostly strike-slip, similar to previous solution for the Murcia region.
139 Our RCMT solutions are similar to moment tensors determined for the same events at IAG (Stich et al.,
140 2003; www.ugr.es/iag/tensor/mtc.html). Other earthquakes located on the Iberian peninsula are two events
141 of 2006, April 23 and June 10 (Table 4 of Supplementary Material, events 35-06 and 47-06) located in
142 northern Spain, the 2006, March 10, M_W 4.8 extensional earthquake located between Valencia and Madrid,
143 and the two thrust earthquakes with M_W 4.5 and 4.8, that occurred in 2007, June 30 and 2008, October 2
144 (Tables 7 and 10 of Supplementary Material) north of Gibraltar.

145 Several events with moderate magnitude took place in northern Africa, including two earthquakes with
146 M_W 4.8 and 5.1 located along the coast of Tunisia in February 2005 (Table 1 of Supplementary Material,
147 events 8-05 and 9-05), and the M_W 5.2 earthquake on March 20, 2006; the M_W 5.1 earthquake on April 4,
148 2006; the M_W 4.8 earthquake on August 7, 2006 (Table 4 of Supplementary Material, events 13-06, 16-06

149 and 56-06); and the M_W 5.5 earthquake on June 6, 2008, in Algeria (Table 10 of Supplementary Material;
150 Figure 6, event 55-08). These events show different styles of deformation, primarily thrust faulting, but also
151 strike-slip faulting, mainly in eastern Algeria toward Tunisia. This heterogeneity can be attributed to the
152 effects on the present-day kinematics of the complex evolution of the Alboran Sea-Gibraltar arc (Facenna et
153 al, 2004; Serpelloni et al., 2007).

154 In the easternmost part of the Mediterranean, two small earthquakes in the Dead Sea region in 2007
155 (Table 7 of Supplementary Material, events 10-07 and 78-07; Figure 2) appear consistent with the left-lateral
156 strike-slip motion of of the Dead Sea fault. In Italy, a seismic sequence hit the Italian northern Apennines,
157 with two main events on December 23, 2008 (Table 10 of Supplementary Material, events 95-08 with M_W
158 5.5 and 96-08 with M_W 4.9; Figure 7; Ercolani et al., 2009). Several deep earthquakes occurred along
159 the southern Tyrrhenian slab (Figure 7, gray background focal mechanisms) and a shallow earthquake, on
160 February 27, 2006, M_W 4.4, in the Messina Straits, occurred near the the location of the strongest Italian
161 earthquake of modern times, on December 28, 1908, I_{max} XI, M_W 7.1 (Pino et al., 2000).

162 Two noteworthy earthquakes are the $M_W = 4.6$, United Kingdom event on February 27, 2008 (Table 10
163 of Supplementary Material, event 21-08 and Figure 2), and the earthquake on the French Atlantic coast on
164 April 18, 2005 ($M_W = 3.9$, event 16-05 in Table 1 of Supplementary Material; Figure 2). These two events
165 occurred in areas where seismic activity reaching these magnitudes is rare. The first, the Market Rasen (UK)
166 earthquake, has been the subject of a detailed study (Heyburn and Fox, 2010) to determine source parameters
167 using body and regional surface waves at higher frequencies than those employed in our analysis. The source
168 parameters determined in the two studies are very similar for the location, depth, magnitude and the focal
169 mechanism (Heyburn and Fox, 2010). The second event is located along the Atlantic coast. It is isolated and
170 provides an additional example of a moderate event with a preliminary reported magnitude 5.2 m_b (Table 1
171 of Supplementary Material), significantly greater than the M_W 3.9 obtained here.

172 **4 1997-2008: 12 years of RCMT solutions**

173 Efforts leading to the European–Mediterranean RCMT Catalog were initiated following the study of the
174 1997-1998 Umbria-Marche earthquake sequence (Ekström et al., 1998; Amato and Cocco, 2000; Morelli
175 et al., 2000). In that investigation (Ekström et al., 1998), we were able, for the first time, to compute reli-
176 able seismic moment tensors immediately following a significant earthquake sequence in Italy. The anal-
177 ysis provided important data for the assessment of the ongoing sequence, and for further tectonic studies
178 (e.g., Pondrelli and Morelli, 2008). We then applied the same methods to analyze routinely moderate-

179 magnitude seismicity in Europe and the Mediterranean, and to building and updating a regional moment-
180 tensor catalog (Pondrelli et al., 2002, 2004, 2007). In addition, we established a routine procedure for
181 determining quick RCMT solutions immediately following the occurrence of an earthquake (see med-
182 net.rm.ingv.it/quick_rcmt.php; earthquake.rm.ingv.it/qrcmt.php or the individual event pages at www.emsc-
183 csem.org). In the real-time analyses we rely mainly on data from the MEDNET (Mazza et al., 2008) and
184 GEOFON (Hanka and Kind, 1994) networks.

185 Systematic moment-tensor investigations similar to the RCMT effort are conducted, or have recently
186 been conducted, by other research groups in Europe. The ETHZ moment tensor catalog (Braunmiller et al.,
187 2002; www.seismo.ethz.chprod/tensors/index_EN) is not maintained beyond 2006, but automated solutions
188 for recent earthquakes are still provided. The IAG catalog (Stich et al. 2003; www.ugr.es/iag/tensor/mtc.html)
189 is updated through the end of 2005, and the IGN (Rueda and Mezcua, 2005; www.ign.es/ign/en/IGN/SisCalculo.jsp)
190 real-time catalog is up to date, but both of these catalogs are limited to the Spanish region and parts of north-
191 ern Africa. These independent studies, some of which have a more limited regional scope than the RCMT
192 effort, but also a lower magnitude threshold, offer opportunities for comparisons of results for the few events
193 that are in common.

194 The RCMT catalog now contains more than 1000 solutions. Figure 8 shows the growth with time of the
195 number of solutions available for the whole Mediterranean area in the RCMT catalog (in green), compared to
196 the global GCMT, and ETHZ (red) catalogs. The RCMT solutions for the period 1977-1996 are exclusively
197 for the Italian region (Pondrelli et al., 2006), and the European-Mediterranean scope of the catalog starts
198 in 1997. For Europe and the Mediterranean, the RCMT catalog roughly doubles the number of seismic
199 moment tensors available.

200 Figure 9 shows a frequency-magnitude distribution for the RCMT catalog and the appropriate Gutenberg-
201 Richter line (Gutenberg and Richter, 1944). The b -value has been determined on the basis of the distribution
202 of the events with a M_W greater than the completeness magnitude M_c , using the Maximum Likelihood
203 method (Aki, 1965; Bender 1983; for the uncertainties, see Shi and Bolt, 1982). The M_c , that corresponds
204 to 4.7, has been computed using the maximum curvature method (Wiemer and Wyss, 2000). The complete-
205 ness falls off rapidly for magnitude smaller than 4.5 earthquakes, reflecting the lack of close-in stations with
206 high signal-to-noise ratio seismograms for most small earthquakes, and the practical limits of the RCMT
207 method of analysis.

208 Each year we add nearly one hundred new RCMT solutions to the catalog (Figure 10). The number
209 of successful analyses, with respect to those attempted, has grown from approximately 60% in 1997 to

210 86% in 2008 (Figure 10). There are several possible reasons for failure to compute a reliable solution.
211 The most frequent is a high preliminary magnitude for a too-small event. As an example, event 16-05 was
212 initially reported with $m_b = 5.2$ but turned out to have a much smaller moment magnitude, $M_W = 3.9$. In
213 other instances, such situations do not lead to a stable RCMT solution, such as for the November 17, 2006,
214 earthquake in France, which was initially reported with $M_L = 5.0$, but later described with $M_W = 4.4$
215 (Sylvander et al., 2008). A second significant cause for failure is the overlap of seismic signals from two
216 earthquakes that occur close in time. This situation is not uncommon, since in many cases we analyze events
217 belonging to the same seismic sequence. The gradual improvement in the success rate seen in Figure 10 is
218 likely due to more consistent preliminary magnitudes and the expansion of seismographic networks in the
219 Mediterranean region.

220 Figure 11 shows epicentral locations for all earthquakes (1997–2008) for which we have attempted
221 analysis. Yellow symbols correspond to successful analyses and red symbols show locations of events for
222 we did not obtain a robust result. In some regions, for example in Poland, we have so far been unable
223 to obtain a single acceptable moment-tensor result even though the reported magnitudes for several events
224 have suggested that successful RCMT analysis would be possible. A potential explanation is that some of
225 the events in Poland are associated with mining activity, and thus may have unusual frequency characteristics
226 with low excitation of the long-period surface waves used in the RCMT analysis.

227 Figure 12 shows the geographical distribution of the recently added quality parameter (A, B, C, D)
228 described above. The inset diagram, displaying the number of events of A, B, or C quality at different
229 magnitudes, shows that there is no clear correlation between quality and magnitude. There also does not
230 appear to be a geographical correlation once the relative level of seismicity of different regions is taken into
231 account.

232 In addition to providing standard earthquake parameters for individual events of interest, the com-
233 prehensive character of the RCMT catalog makes it a valuable source of information for investigations of
234 the character of seismic deformation in Europe and the Mediterranean region. The data set has been used,
235 for example, for the compilation of stress maps (e.g., Montone et al., 2004; Sperner et al., 2003) and strain
236 maps (e.g., Kreemer et al., 2003; Serpelloni et al., 2007; Vannucci et al., 2004; Hollenstein et al., 2008), for
237 seismotectonic studies (e.g., Stich et al., 2007; Mauffret, 2007), and for the assessment of seismicity and
238 seismic sequences (e.g., Grunthal et al., 2009; Pondrelli et al., 2010).

239 Distribution of moment-tensor information occurs mainly through the worldwide web. In response
240 the increasing size of the RCMT data base, as well the variety of user requirements, we have added

241 new functionalities to the RCMT web site. Earthquake data are available in yearly files and in several
242 possible formats, such as those required to plot seismic moment tensors with the GMT map tool (Wes-
243 sel and Smith, 1998) and in Google Earth. An advanced web interface (Postpischl et al., 2010) pro-
244 vides full search capabilities of the entire dataset by location, time, magnitude and quality parameters
245 (www.bo.ingv.it/RCMT/searchRCMT.html). The searchable database includes all reviewed solutions for
246 the period 1997-2008 and all quick solutions up to the present. Solutions can be further filtered to distin-
247 guish between quick and definitive results.

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251 earthquakes in 2005 and 2006. Maps and focal mechanisms were plotted with GMT (Wessel and Smith,
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352 **Figure captions**

353 Figure 1: Recorded (blue) and synthetic seismograms (red) used to compute the RCMT solutions for
354 an event that occurred in the Mediterranean Sea, on February 3, 2007, with $M_W = 5.5$. Epicentral
355 distance is 31.89° . In this case, body (a) and surface (b) waves were simultaneously used in the
356 inversion.

357 Figure 2: Map of RCMT solutions for the time span of 2005-2008 (in red). The focal mechanisms
358 with gray extensional quadrants are for earthquakes with hypocentral depth greater than 50 km. Small
359 black mechanisms shown in the background correspond to earlier RCMT solutions from the catalog.

360 Figure 3: Upper left: Frequency plot of Kagan angles for the 2005-2008 RCMT and GCMT compared
361 solutions. Upper right: Frequency plot of P, T and N axes rotations. Lower: Plot of the logarithm of
362 the scalar moment for compared RCMT and GCMT solutions.

363 Figure 4: Examples of pairs of RCMT (grey) and GCMT (black) solutions for earthquakes that show
364 Kagan angles greater than 60° . Each pair is coded by the ID number used in the Tables of Supple-
365 mentary Material.

366 Figure 5: Map of significant events and seismic sequences in the eastern Mediterranean region. In
367 the principal image are reported in red all RCMT solutions determined in the present study. The fo-
368 cal mechanisms with gray extensional quadrants correspond to earthquakes with hypocentral depth
369 greater than 50 km. Small black focal mechanisms show earlier RCMT solutions. Insets A, B
370 and C show the main seismic sequences of 2005-2008 respectively in Southern Greece (close to the
371 Kephalinia fault), along the Hellenic trench and in the eastern Aegean Sea and Turkey. Black focal
372 mechanisms show GCMT solutions for the main shocks.

373 Figure 6: Map of significant events in the westernmost part of our study region, for which RCMT
374 solutions are determined in the present study. Small black focal mechanisms show earlier RCMT
375 solutions. For larger events, the date of occurrence is given.

376 Figure 7: Map of significant events in Italy and surrounding regions, for which RCMT solutions
377 are determined in the present study. The focal mechanisms with gray extensional quadrants refer
378 to earthquakes with hypocentral depth greater than 50 km. In the background — small black focal
379 mechanisms — all previous RCMT solutions are also shown. The two main events of the sequence
380 that hit the northern Apennines in December 2008 are highlighted.

381 Figure 8: Growth with time of the number of centroid-moment tensors for the Euro-Mediterranean
382 region in different catalogs: Global CMT (blue); ETHZ data (red); our RCMT data (green).

383 Figure 9: Frequency-magnitude distribution of the RCMT catalog earthquakes (squares, cumulative;
384 triangles, not-cumulative) and relative Gutenberg Richter line (red line) for the events of magnitude
385 M_W larger than the completeness magnitude (M_c).

386 Figure 10: Number of events attempted (white columns) and number of obtained RCMT solutions
387 (black columns) for each year from 1997 to 2008.

388 Figure 11: Map of attempted (red circles) and successful solutions (yellow squares) for RCMT solu-
389 tions in the 12-year period of the catalog.

390 Figure 12: Map of whole catalog solutions, distinguished by quality flag, represented by different
391 colors: flag A (best quality), red; flag B, orange; flag C, yellow; flag D, white. Upper right: histogram
392 of the number of events with respect to M_W and quality flags: flag A, white; flag B, dark gray; flag
393 C, light gray.

2007/02/03 13:43:23.1, $\vartheta = 35.81$, $\varphi = 22.43$, $h = 59.0$
KURK-II $\Delta = 42.51$, $\alpha = 51.42$, $\beta = 271.80$

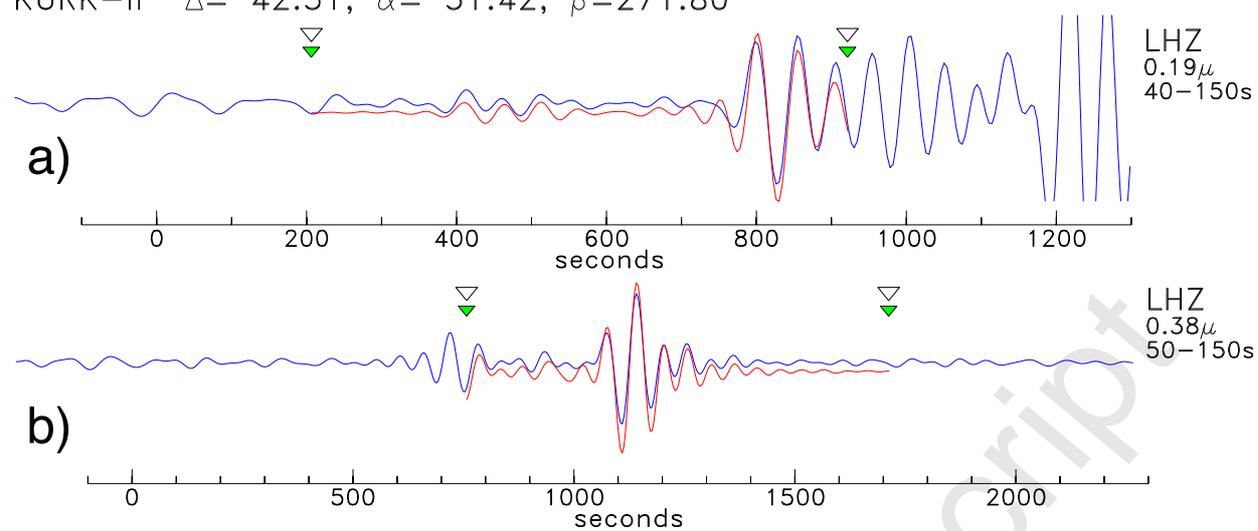


Figure 1

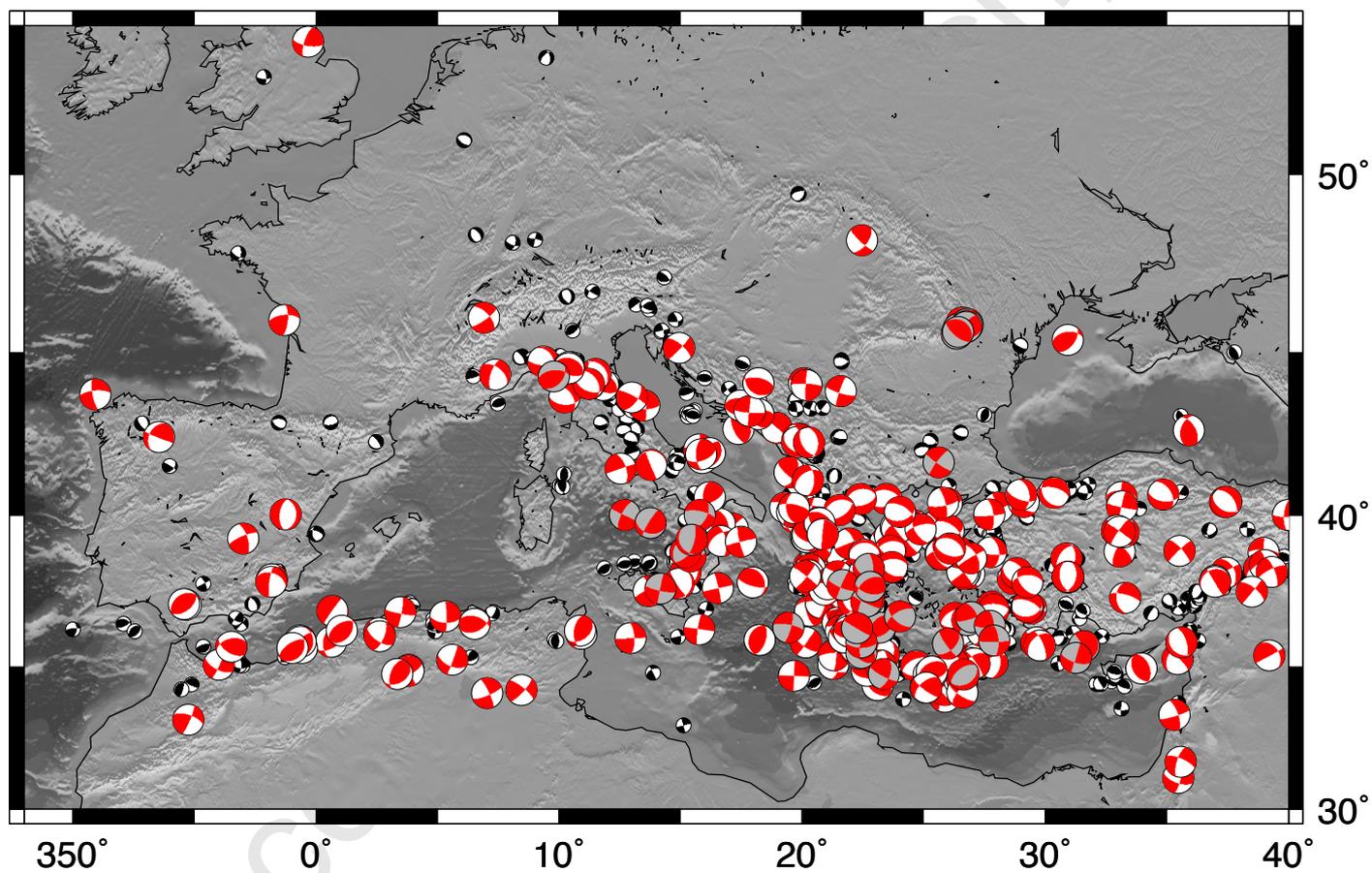


Figure 2

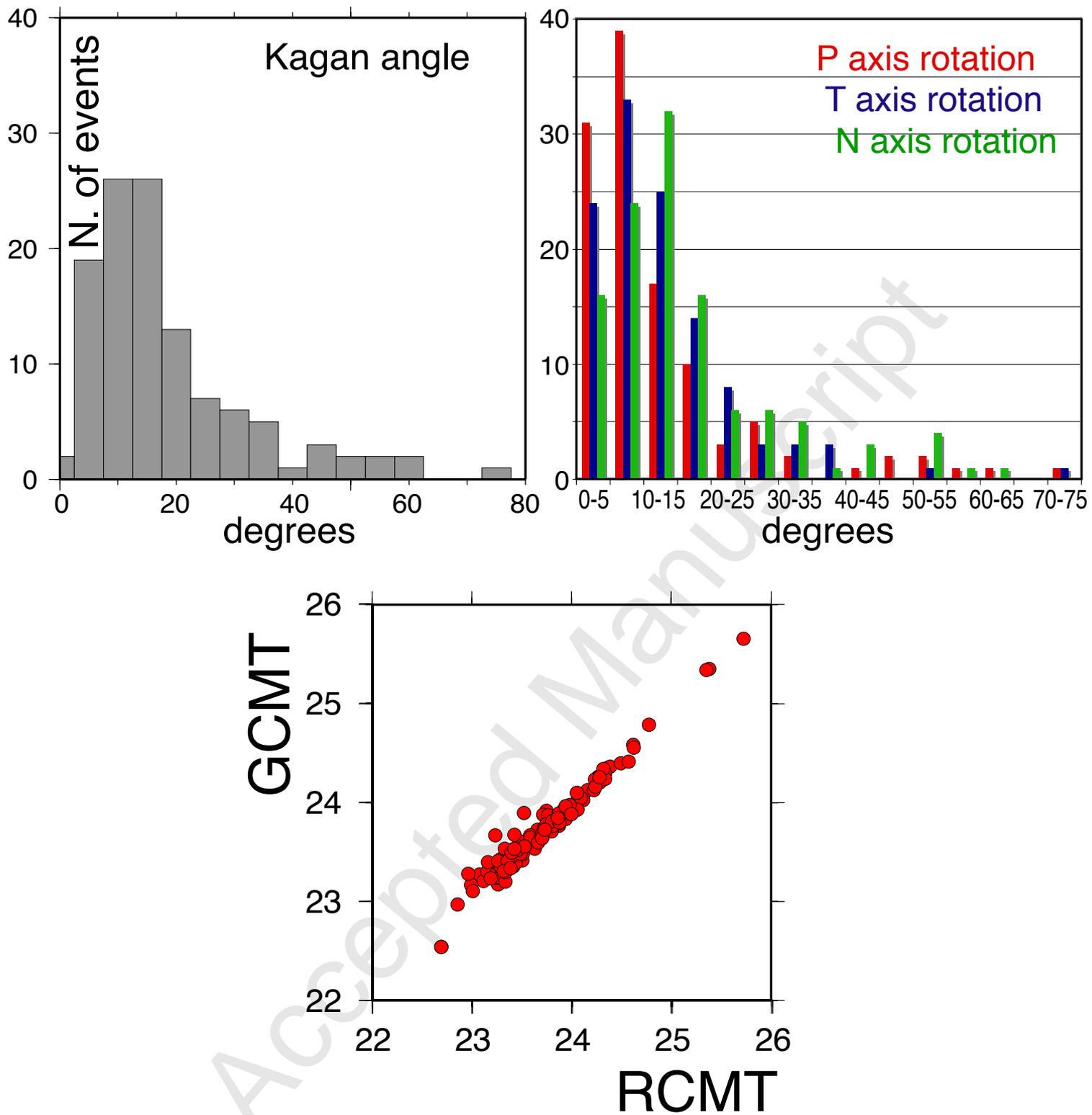
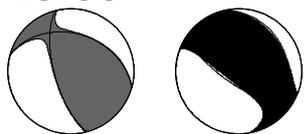
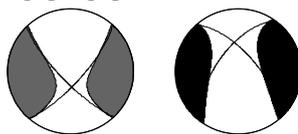


Figure 3

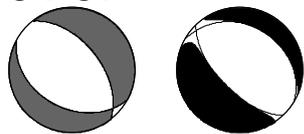
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60-05



04-07



22-07

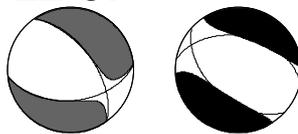


Figure 4

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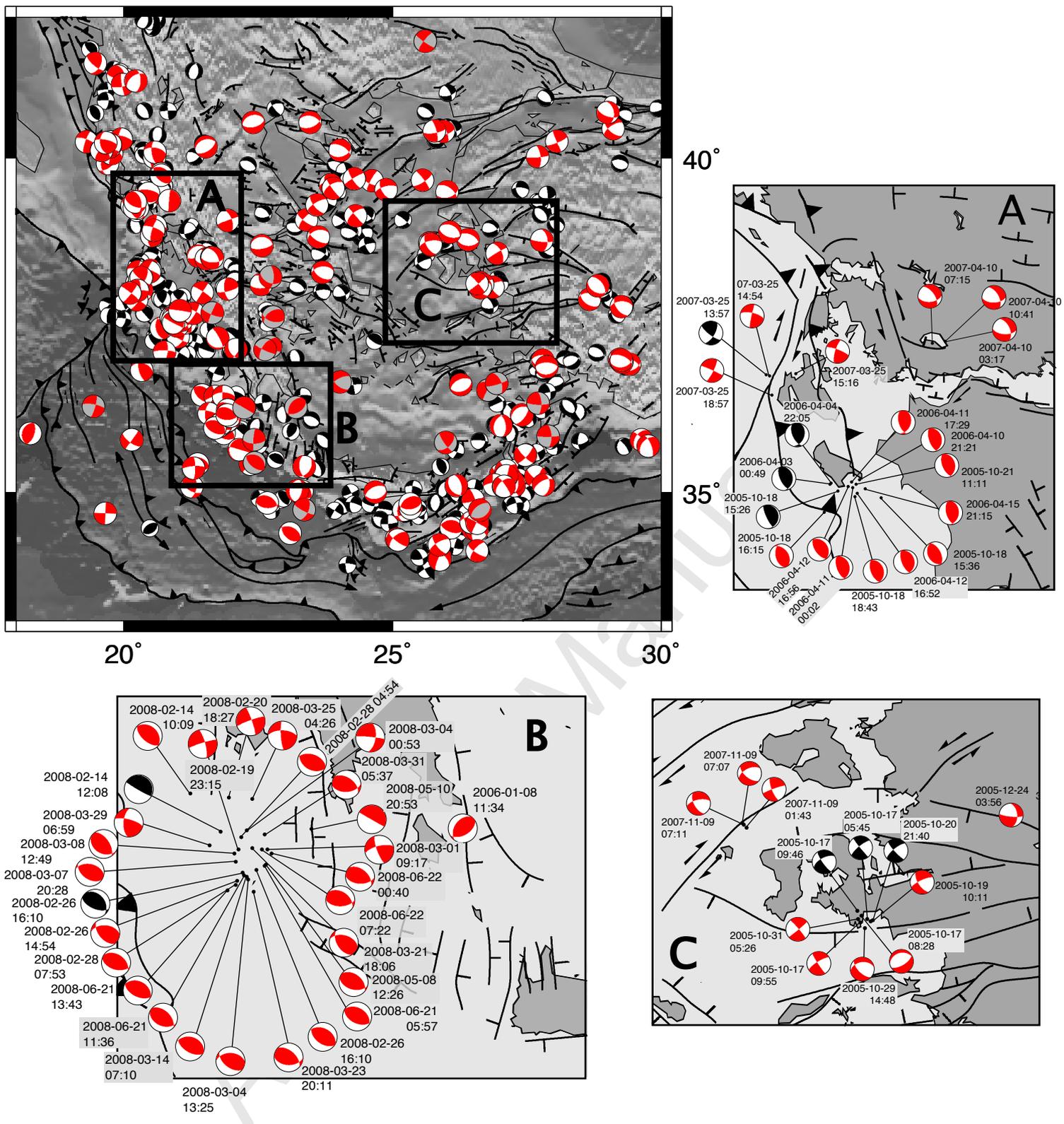


Figure 5

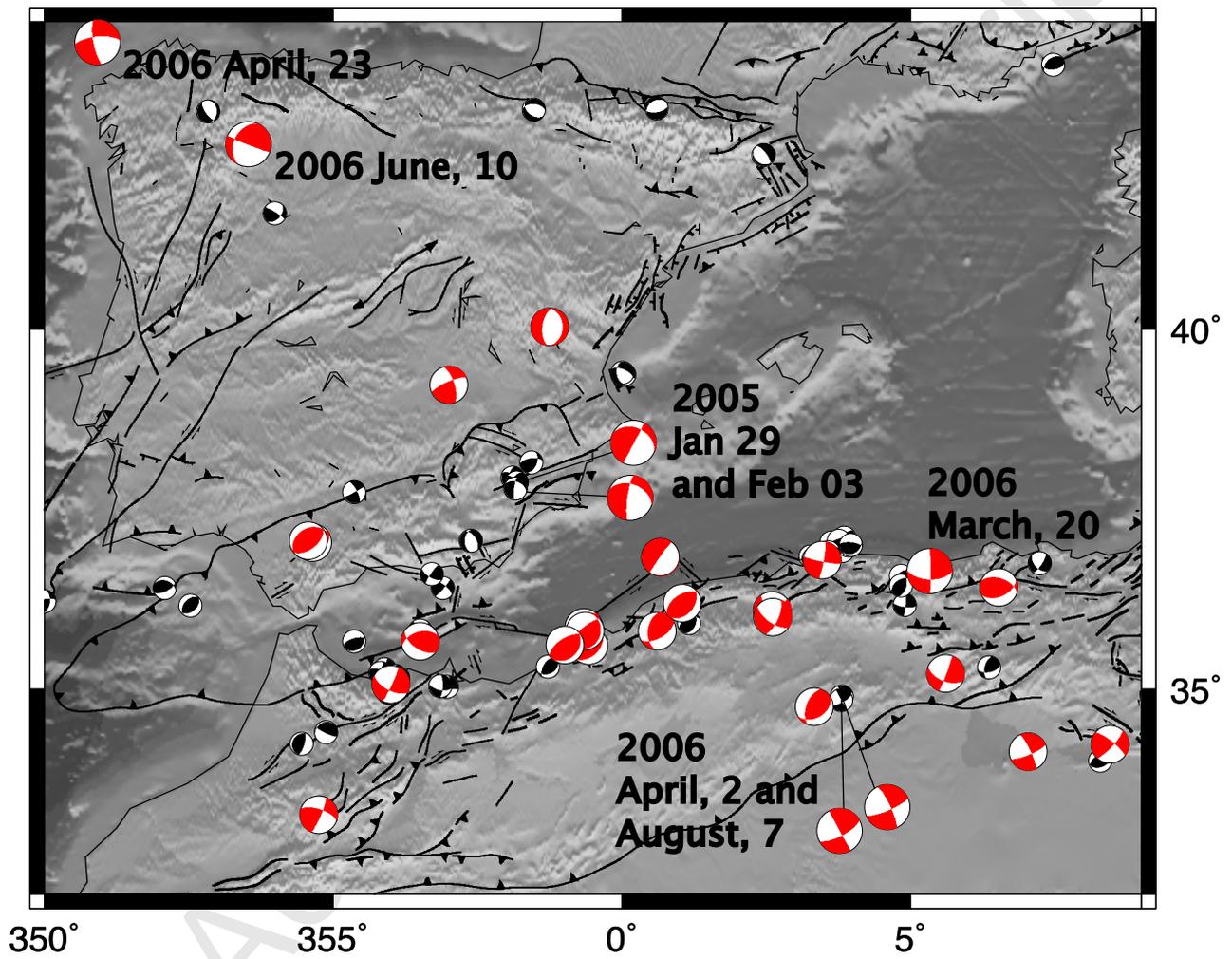


Figure 6

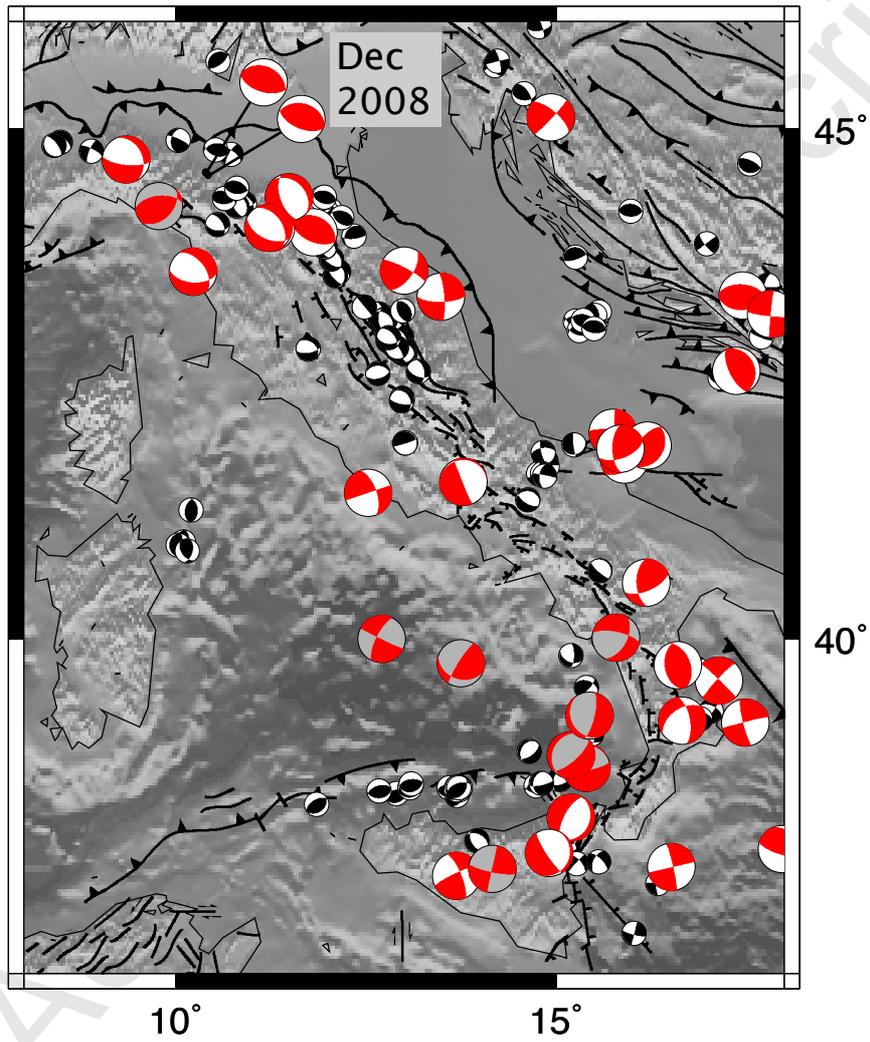
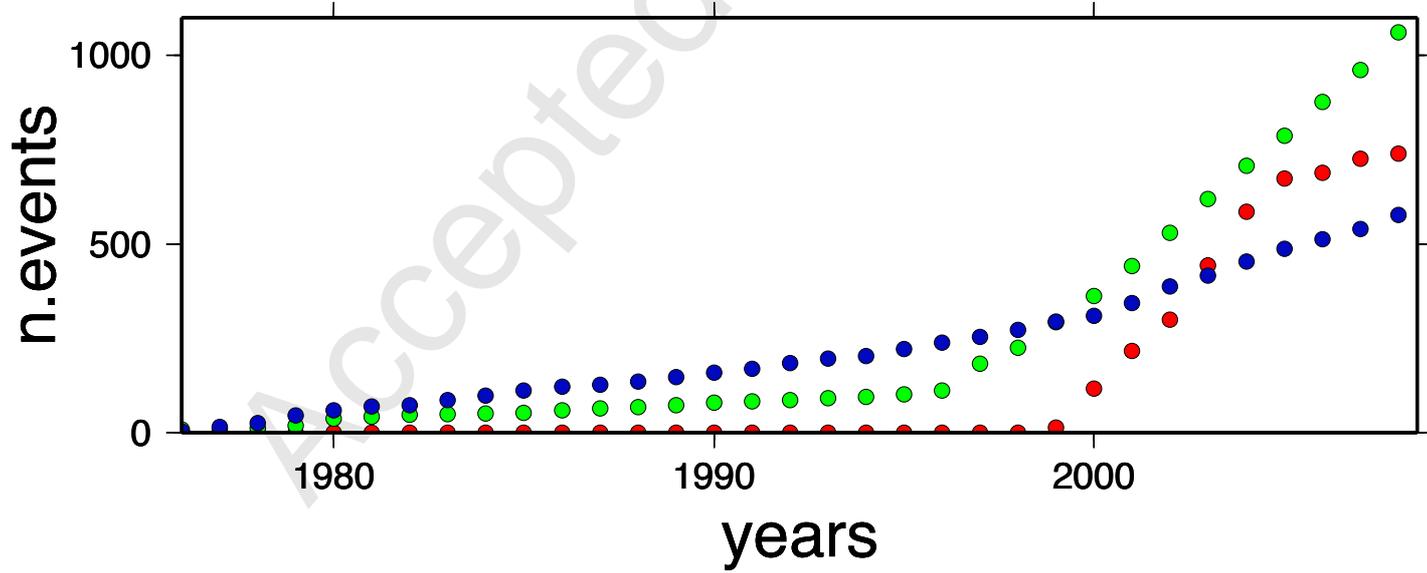


Figure 7

Figure 8



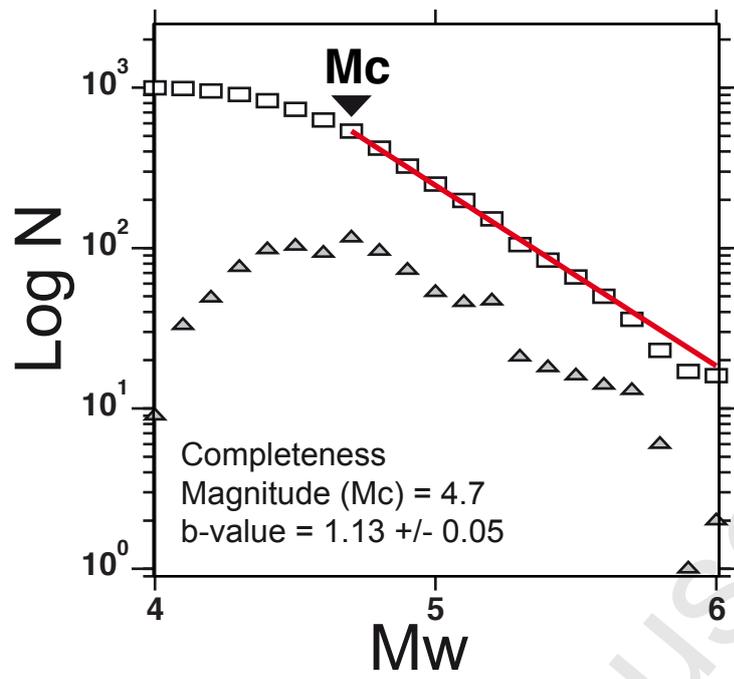


Figure 9

Figure 10

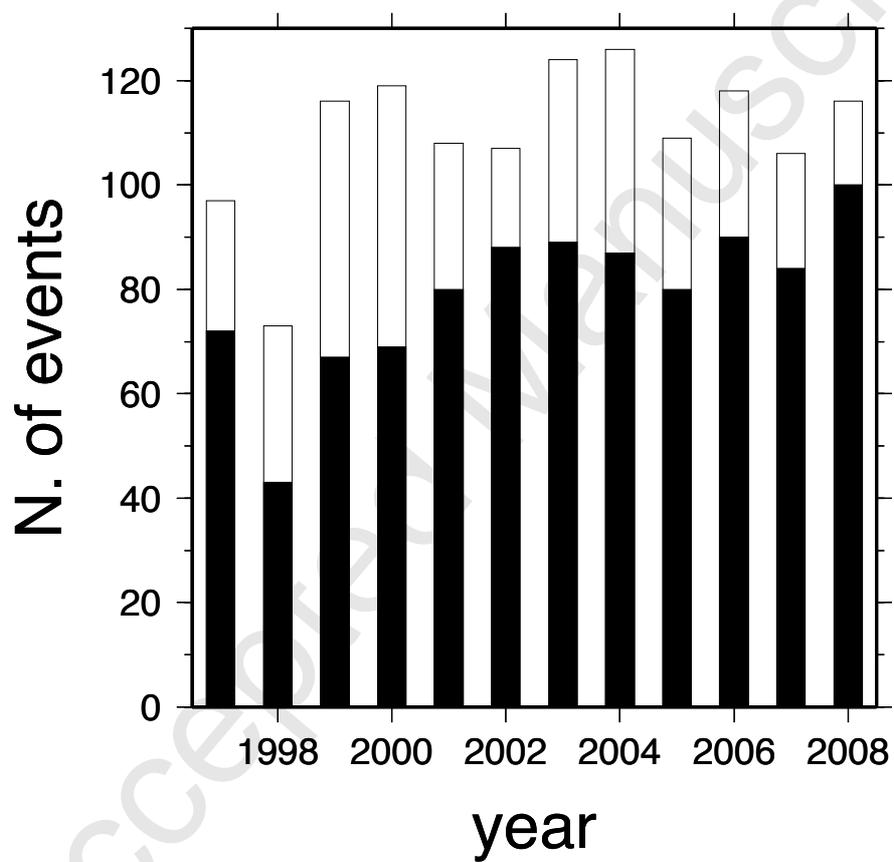


Figure 11

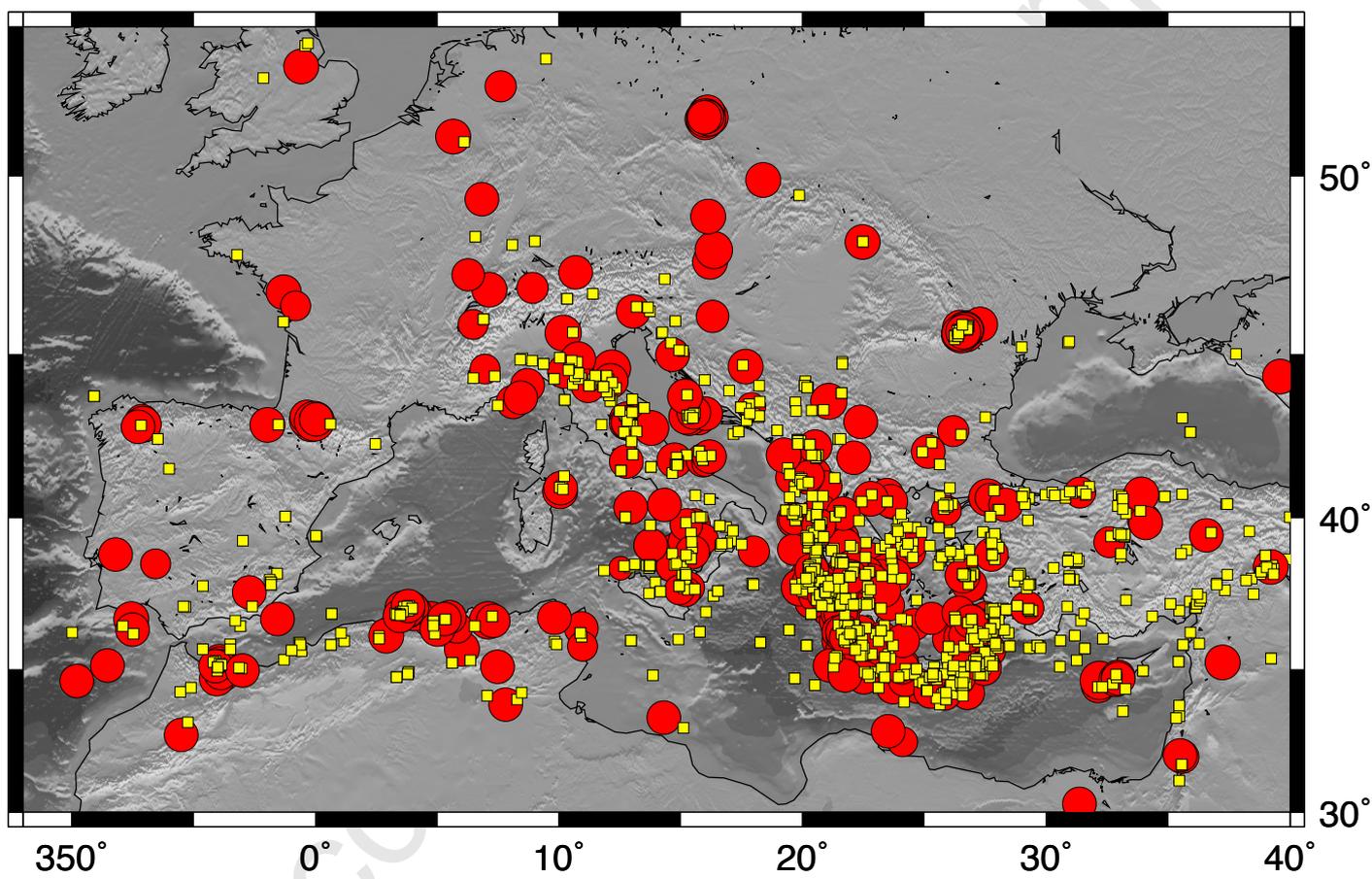


Figure 12

