Appendix K

Conversion of local magnitude from foreign catalogs to SED local magnitude

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Introduction

In an effort to obtain an instrumental earthquake catalog with homogeneous moment magnitudes that includes data from different networks and institutions, we first convert the local magnitudes given in the foreign catalogs (Germany, Austria, France and Italy) to the equivalent Swiss local magnitude as computed by the SED. The analysis presented in this Appendix is restricted to the following catalogues:

Germany:	LED 1996-2007
Austria:	ZAMG 1975-2008
France:	BCSF 1975-2008
Italy:	INGV 1975-2007

The first step consisted in identifying events common to the foreign and Swiss catalogs. The chosen criteria are based on a coincidence in time (origin time difference < 0.1 min), epicentral location (difference < 10 km) and magnitude (difference < 0.5 for Germany and <1.0 for the other countries).

Procedure

To explore the robustness of the conversion relation for each country, we compute mean and standard deviation of the magnitude differences as well as linear regression coefficients between SED local magnitude and foreign local magnitude for the following data selections:

1. The complete data set of common events as defined above: this gives a general overview and quality assessment of the available data;
2. A selection restricted to a common border region: this restricts the data set to a region were both the Swiss and the foreign networks can be expected to deliver results that are of comparable quality, both in terms of locations and magnitudes;
3. Common border region and deviation from mean magnitude difference < 2 sigma: this selection is motivated by the fact that two of the data sets (France and Italy) show a skewed distribution of magnitude differences with some large outliers compared to Swiss values;
4. Common border region and location difference < 5km: this reduces the probability of location differences influencing the magnitude estimates;

5. Common border region, location difference < 5km and deviation from mean magnitude difference < 2 sigma: the data selected according to this combination of criteria satisfy simultaneously points 2, 3 and 4;
6. Selection same as 5, but only half the number of data points (odd indices): to check for dependence on sample size;
7. Selection same as 5, but only half the number of data points (even indices);
8. Selection same as 3, and first half of data: with this and the following point we explore possible temporal variations in the magnitude estimates between the different catalogs;
9. Selection same as 3, and second half of data: as above for point 8.

For the Italian data, we also test for temporal variations over additional time periods for which differences in data sources are known.

Regression coefficients for each of the nine cases listed above are calculated with a weighted least-squares algorithm that takes into account errors of both variables. Based on an evaluation of the magnitudes of all local events recorded by the Swiss digital broad-band network between 2002 and 2008 and on the results of a comparison between magnitudes calculated from short-period and broad-band stations for events recorded between 1999 and 2001, we assume a magnitude uncertainty (one standard deviation) of 0.13 units for the Swiss data. The results of a preliminary analysis (cases 1 and 2, listed above) show that the scatter of the German magnitudes are also in the range of 0.13 units; however, for the Austrian, French and Italian data, the scatter is considerably larger, so that for these we assume average uncertainties of 0.20, 0.22 and 0.27 respectively (see below for further details). Uncertainties of the regression coefficients are estimated from the standard deviations of 100 montecarlo simulations for each case based on these data uncertainties.

At the end of this document, for each country we show an epicenter map, a plot of the cumulative number of events with time as well as a histogram and two plots of location differences as a function of latitude and longitude for the whole data set. The latter two plots are helpful to define the common border region (point 2, above). The chosen border region is also marked on the epicenter map. The reference coordinates for all plots correspond to the epicentral locations of the SED. We also show histograms of the magnitude differences and plots of the regression fits for some of the cases listed above. The numerical results for all cases are summarized in a table following this text. Below we summarize the results of the comparison for each of the foreign catalogs.

Germany

Based on the analysis made for ECOS-02, German M_L values were treated as equivalent Swiss M_L. For the time period before 1996, the German data in ECOS-09 did not change, so there is no reason to revise the scaling for this time period. As of 1994, monitoring the seismicity of southern Germany has become the responsibility of the Landeserdbebendienst Baden-Württemberg (LED). Since the volume of data available from the LED has increased significantly since the compilation of ECOS-02, we have re-analyzed the magnitudes for the period 1996-2007.

Depending on the data selection, the mean magnitude difference (LED - SED) varies between 0.10 and 0.14. The distribution of the differences of the individual events about this mean is symmetric with a standard deviation of 0.16-0.20. For calculating the regression coefficients we have assumed an average magnitude error per event of 0.13 for both data sets over the whole magnitude range considered (about 1-5). This corresponds to the value one obtains for the mean error of the Swiss broad-band magnitudes above $M_L = 1$, assuming at least 4 amplitude measurements per event. An uncertainty of 0.13 for each data set corresponds also to a standard deviation of 0.18 for the differences between the two.

There is no evidence from an analysis of the two half-data sets for a time dependence in the scaling relations between the two data sets. For converting M_L (LED) to M_L (SED) we propose to use the regression results for case 5:

$$a = 0.964 \pm 0.015,\ b = -0.037 \pm 0.037,\ rms = 0.17$$

where M_L (converted) = a * M_L (LED) + b and rms is the root-mean-square of the differences M_L (SED) – M_L (converted).

For assigning uncertainties to the converted magnitude values, we assume that, as in the Swiss catalog, errors are larger for small events with fewer observations and smaller for larger events with more observations. Based on the good consistency observed between the two data sets, we assume the same magnitude dependence for the original LED magnitudes as for the SED magnitudes:

$M_L <= 1.0$:	+/-0.20
$1.0 < M_L < 2.0$:	+/-0.15
$M_L >= 2.0$:	+/-0.10

Taking into consideration the uncertainties of the regression coefficients gives the following estimates for the average magnitude-dependent errors of the converted German M_L values after 1996 (one standard deviation):

$M_L <= 1.0$:	+/-0.20
$1.0 < M_L < 2.0$:	+/-0.15
$M_L >= 2.0$:	+/-0.12

Austria

For ECOS-02, the data of common events was too small to derive a reliable conversion relation between the Austrian and the Swiss local magnitudes. However, for ECOS-09 the data obtained from the Zentralanstalt für Meteorologie und Geodynamik (ZAMG) provides a solid basis for a comparison between the two.

Depending on the data selection, the mean magnitude difference (ZAMG - SED) varies between -0.12 and -0.25. The distribution of the differences of the individual events about this mean is reasonably symmetric with standard deviation of 0.22-0.27. For calculating the regression coefficients we have assumed an average magnitude error per event of 0.13 for the Swiss data (see discussion on the German data), and, given an observed average standard deviation of 0.24 for the difference between the Austrian and Swiss magnitudes, we estimate an uncertainty of 0.20 for the Austrian data averaged over the whole magnitude range considered (about 1-5).

The analysis of the two separate half-data sets gives regression coefficients that differ somewhat from all other regressions calculated over the whole time period. However, the uncertainties of these regression coefficients are also significantly higher, so for converting M_L(ZAMG) to M_L (SED) we propose to use the regression results for case 5 calculated over the whole time period of the available data:

```
a = 0.967 +/- 0.021, b = -0.269 +/- 0.050, rms = 0.23
```

where M_L (converted) = a * M_L (ZAMG) + b and rms is the root-mean-square of the differences M_L (ZAMG) – M_L (converted).

For assigning uncertainties to the converted magnitude values, we assume that, as in the Swiss catalog, errors are larger for small events with fewer observations and smaller for larger events with more observations. Based on the ratio between the average uncertainties of two data sets, we obtain the following magnitude dependence for the errors of the original ZAMG magnitudes:

M_L <= 1.0:	+/-0.31
1.0 < M_L < 2.0:	+/-0.23
M_L >= 2.0:	+/-0.15

Taking into consideration the uncertainties of the regression coefficients gives the following estimates for the average magnitude-dependent errors of the converted Austrian M_L values (one standard deviation):

M_L <= 1.0:	+/-0.31
1.0 < M_L < 2.0:	+/-0.23
M_L >= 2.0:	+/-0.17

France

Depending on the data selection, the mean magnitude difference (BCFSF - SED) varies between 0.35 and 0.45. The distribution of the differences of the individual events about this mean is quite asymmetric with large negative outliers. The standard deviations vary between 0.22-0.29. For calculating the regression coefficients we have assumed an average magnitude error per event of 0.13 for the Swiss data (see discussion on the German data), and, given an observed average standard deviation of 0.26 for the difference between the French and Swiss magnitudes, we estimate an uncertainty of 0.22 for the French data averaged over the whole magnitude range considered (about 1-5).

The analysis of the half data sets suggest that there exist strong temporal heterogeneities in the French magnitudes. However, the regression over the second half of the data seems to be strongly dependent on a rather skewed distribution of small magnitudes and does not match the higher magnitudes at all. Therefore, for converting M_L (BCSF) to M_L (SED) we propose to use the regression results for case 5 calculated over the entire time period:

```
a = 1.136 +/- 0.015, b = -0.692 +/- 0.038, rms = 0.27
```

where M_L (converted) = a * M_L (BCSF) + b and rms is the root-mean-square of the differences M_L (BCSF) – M_L (converted).

For assigning uncertainties to the converted magnitude values, we assume that, as in the Swiss catalog, errors are larger for small events with fewer observations and smaller for larger events with more observations. Based on the ratio between the average uncertainties of the two data sets, we obtain the following magnitude dependence for the errors of the original BCSF magnitudes:

$M_L <= 1.0$:	+/-0.34
$1.0 < M_L < 2.0$:	+/-0.25
$M_L >= 2.0$:	+/-0.17

Taking into consideration the uncertainties of the regression coefficients gives the following estimates for the average magnitude-dependent errors of the converted French ML values (one standard deviation):

$M_L <= 1.0$:	+/-0.39
$1.0 < M_L < 2.0$:	+/-0.29
$M_L >= 2.0$:	+/-0.20

Italy

Depending on the data selection, the mean M_L magnitude difference (INGV - SED) varies between -0.17 and -0.28. The distribution of the differences of the individual events about this mean is quite asymmetric with large positive outliers. The standard deviations are large and vary between 0.22-0.37.

The analysis of the half data sets does not necessarily suggest that there exist strong temporal heterogeneities in the Italian magnitudes. However, from the data providers we know that a significant change in magnitude reporting took place in April of 2005, which is also visible in plots of event magnitudes as a function of time. Indeed, regressions over data sets before April 15th and after April 15th 2005 give significantly different scaling relations. Therefore, for converting M_L (INGV) to M_L (SED) we propose to use two different regression results:

```
a = 1.131 +/- 0.041, b = -0.041 +/- 0.096, rms = 0.33
a = 1.024 +/- 0.047, b =  0.127 +/- 0.094, rms = 0.23
```

where M_L (converted) = a * M_L (INGV) + b and rms is the root-mean-square of the differences M_L (INGV) – M_L (converted). The first relation is valid for the CSI and BOLLSI catalogs between 1975/01/11 and 2005/04/15 and the second for the ISIDE catalog between 2005/04/16 and 2007/12/22.

For calculating the regression coefficients we have assumed an average magnitude error per event of 0.13 for the Swiss data (see discussion on the German data), and, given an observed average standard deviation of 0.3 for the difference between the Italian and Swiss magnitudes, we estimate an uncertainty of 0.27 for the Italian data averaged over the whole magnitude range considered (about 1-5). For the ISIDE catalog alone, the standard deviation of the individual magnitude differences about the mean is only 0.22 and the corresponding uncertainty of the individual event magnitudes is then +/-0.18.

For assigning uncertainties to the converted magnitude values, we assume that, as in the Swiss catalog, errors are larger for small events with fewer observations and smaller for larger events with more observations. Based on the ratio between the average uncertainties of the Swiss magnitudes (+/- 0.13) and the two Italian data sets (+/-0.27 and +/- 0.18), we obtain the following magnitude dependence for the errors of the original magnitudes:

M_L <= 1.0:	+/-0.40	+/-0.28
1.0 < M_L < 2.0:	+/-0.30	+/-0.21
M_L >= 2.0:	+/-0.20	+/-0.14

Taking into consideration the uncertainties of the regression coefficients gives the following estimates for the average magnitude-dependent errors of the converted Italian M_L values (one standard deviation):

M_L <= 1.0:	+/-0.46	+/-0.29
1.0 < M_L < 2.0:	+/-0.36	+/-0.22
M_L >= 2.0:	+/-0.29	+/-0.19

In the INGV Bolletino (2003 until April 2005), there is a set of events, for which INGV provides an Md only. There is little overlap between events with Md(INGV) and the Swiss instrumental catalog -- Md(INGV): only 44 events with locations diverging not more than 0.2 degrees, and only 3 north of 45.45°N. Thus, a relation Md(INGV) to Ml(SED) seems inappropriate to reliably homogenize these events.

We have converted these Md(INGV) to Ml(INGV) first, using a linear regression over 1308 italian events between 2003 and April 2005 for which INGV provides Md and Ml, with Md ranging from 1.4 to 5.0. The observed relationship is described by

```
a = 0.896 +/- 0.019, b = -0.312 +/- 0.048, rms = 0.24
```

where M_L ("INGV" converted) = a * M_D (INGV) + b and rms is the root-mean-square of the differences M_L (INGV) – M_L (converted).

Propagating the observed standard deviations into Ml (converted SED) results in the following standard deviation for Ml (SED scaled) derived from Md(INGV):

$M_L <= 1.0$:	+/-0.50
$1.0 < M_L < 2.0$:	+/-0.41
$M_L >= 2.0$:	+/-0.39

Table with the results of the means and regressions for each country (s. text for explanations)

Germany

```
 1. N =  447, mean =  0.12, std = 0.19, a = 0.993 +/- 0.013, b = -0.102 +/- 0.033, rms = 0.19
 2. N =  391, mean =  0.12, std = 0.20, a = 0.972 +/- 0.016, b = -0.057 +/- 0.036, rms = 0.19
 3. N =  377, mean =  0.11, std = 0.17, a = 0.959 +/- 0.014, b = -0.020 +/- 0.033, rms = 0.17
 4. N =  343, mean =  0.13, std = 0.19, a = 0.976 +/- 0.016, b = -0.076 +/- 0.038, rms = 0.19
 5. N =  331, mean =  0.12, std = 0.17, a = 0.964 +/- 0.015, b = -0.037 +/- 0.037, rms = 0.17
 6. N =  166, mean =  0.14, std = 0.17, a = 0.962 +/- 0.023, b = -0.050 +/- 0.053, rms = 0.17
 7. N =  165, mean =  0.10, std = 0.17, a = 0.965 +/- 0.021, b = -0.023 +/- 0.051, rms = 0.16
 8. N =  183, mean =  0.10, std = 0.16, a = 0.945 +/- 0.022, b =  0.034 +/- 0.058, rms = 0.16
 9. N =  190, mean =  0.12, std = 0.18, a = 0.970 +/- 0.020, b = -0.055 +/- 0.048, rms = 0.17
```

Austria

```
 1. N =  340, mean = -0.18, std = 0.27, a = 0.990 +/- 0.019, b =  0.203 +/- 0.043, rms = 0.27
 2. N =  281, mean = -0.17, std = 0.26, a = 0.998 +/- 0.021, b =  0.178 +/- 0.045, rms = 0.26
 3. N =  274, mean = -0.19, std = 0.24, a = 0.989 +/- 0.021, b =  0.210 +/- 0.046, rms = 0.24
 4. N =  180, mean = -0.19, std = 0.27, a = 0.982 +/- 0.024, b =  0.224 +/- 0.053, rms = 0.26
 5. N =  175, mean = -0.20, std = 0.24, a = 0.967 +/- 0.021, b =  0.269 +/- 0.050, rms = 0.23
 6. N =   87, mean = -0.18, std = 0.24, a = 0.994 +/- 0.034, b =  0.190 +/- 0.074, rms = 0.24
 7. N =   86, mean = -0.23, std = 0.22, a = 0.945 +/- 0.030, b =  0.347 +/- 0.065, rms = 0.21
 8. N =  137, mean = -0.12, std = 0.24, a = 1.013 +/- 0.033, b =  0.093 +/- 0.086, rms = 0.24
 9. N =  136, mean = -0.25, std = 0.22, a = 1.052 +/- 0.040, b =  0.163 +/- 0.073, rms = 0.23
```

France

```
 1. N = 1903, mean =  0.37, std = 0.29, a = 1.163 +/- 0.014, b = -0.775 +/- 0.035, rms = 0.31
 2. N = 1690, mean =  0.39, std = 0.28, a = 1.156 +/- 0.013, b = -0.763 +/- 0.033, rms = 0.30
 3. N = 1622, mean =  0.40, std = 0.24, a = 1.124 +/- 0.012, b = -0.702 +/- 0.031, rms = 0.26
 4. N =  986, mean =  0.36, std = 0.28, a = 1.144 +/- 0.019, b = -0.703 +/- 0.045, rms = 0.30
 5. N =  955, mean =  0.36, std = 0.25, a = 1.136 +/- 0.015, b = -0.692 +/- 0.038, rms = 0.27
 6. N =  478, mean =  0.37, std = 0.26, a = 1.137 +/- 0.029, b = -0.697 +/- 0.073, rms = 0.27
 7. N =  477, mean =  0.36, std = 0.25, a = 1.135 +/- 0.024, b = -0.688 +/- 0.059, rms = 0.26
 8. N =  810, mean =  0.45, std = 0.26, a = 1.093 +/- 0.024, b = -0.705 +/- 0.063, rms = 0.27
 9. N =  813, mean =  0.35, std = 0.22, a = 1.277 +/- 0.026, b = -0.952 +/- 0.057, rms = 0.22
```

Italy

```
 1. N =  932, mean = -0.18, std = 0.36, a = 1.147 +/- 0.023, b = -0.152 +/- 0.052, rms = 0.40
 2. N =  734, mean = -0.18, std = 0.37, a = 1.192 +/- 0.031, b = -0.237 +/- 0.068, rms = 0.41
 3. N =  691, mean = -0.23, std = 0.30, a = 1.128 +/- 0.026, b = -0.044 +/- 0.057, rms = 0.32
 4. N =  384, mean = -0.20, std = 0.34, a = 1.179 +/- 0.045, b = -0.184 +/- 0.096, rms = 0.38
 5. N =  356, mean = -0.23, std = 0.26, a = 1.096 +/- 0.040, b =  0.032 +/- 0.084, rms = 0.28
 6. N =  180, mean = -0.23, std = 0.26, a = 1.082 +/- 0.054, b =  0.058 +/- 0.117, rms = 0.27
 7. N =  182, mean = -0.23, std = 0.29, a = 1.156 +/- 0.063, b = -0.101 +/- 0.137, rms = 0.31
 8. N =  347, mean = -0.14, std = 0.37, a = 1.186 +/- 0.062, b = -0.288 +/- 0.146, rms = 0.42
 9. N =  347, mean = -0.28, std = 0.23, a = 1.139 +/- 0.032, b =  0.005 +/- 0.067, rms = 0.24
10. N =  490, mean = -0.22, std = 0.33, a = 1.147 +/- 0.041, b = -0.109 +/- 0.093, rms = 0.36
11. N =  536, mean = -0.25, std = 0.30, a = 1.131 +/- 0.041, b = -0.041 +/- 0.096, rms = 0.33
12. N =  203, mean = -0.23, std = 0.23, a = 1.109 +/- 0.043, b =  0.023 +/- 0.084, rms = 0.24
13. N =  147, mean = -0.17, std = 0.22, a = 1.024 +/- 0.047, b =  0.127 +/- 0.094, rms = 0.23
```

Dates of half datasets (cases 8 and 9 in the table above):

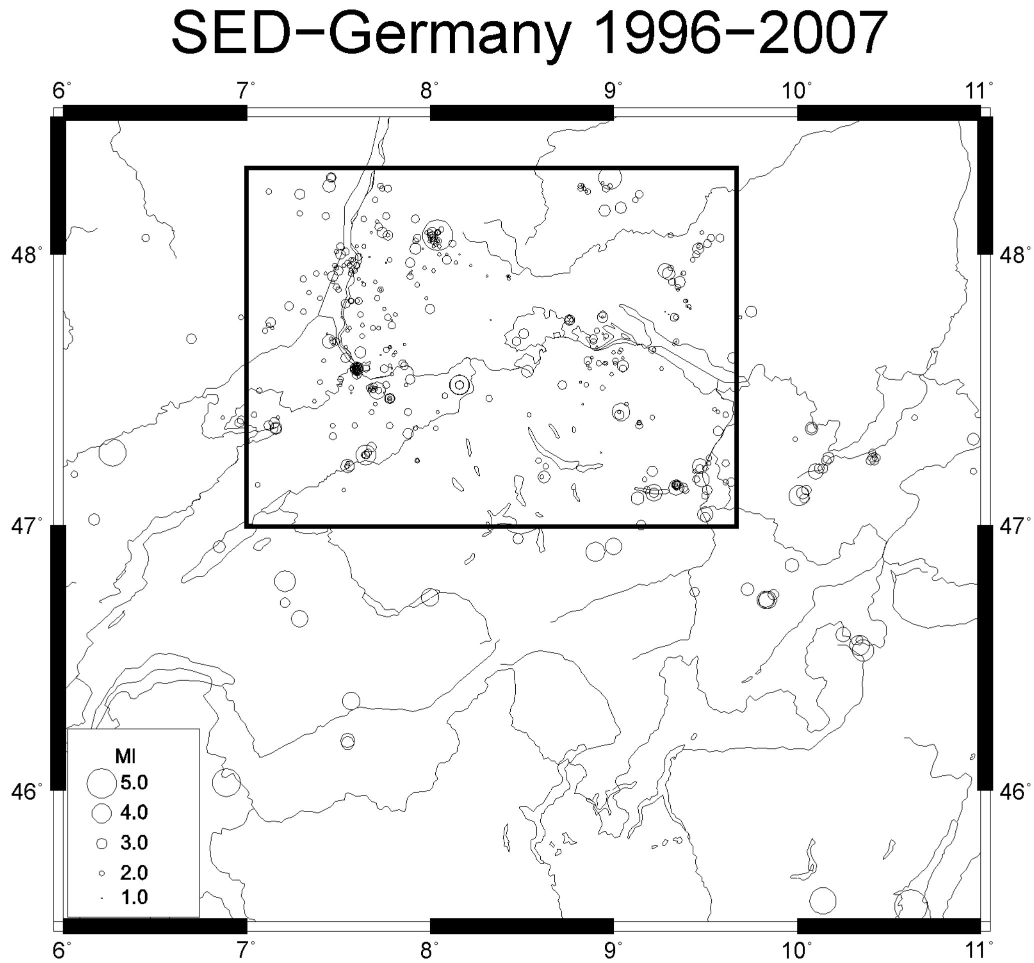
```
Germany: 1996/03/24 - 2003/05/27 - 2007/10/17
Austria: 1975/10/24 - 2003/01/29 - 2009/01/02
France:  1975/01/29 - 1999/11/21 - 2009/01/30
Italy:   1975/01/11 - 1995/10/30 - 2007/12/22
```

Different combinations of data sources of Italian catalog (cases 10–13) (selected area; magnitude difference < 2.0 * sigma):

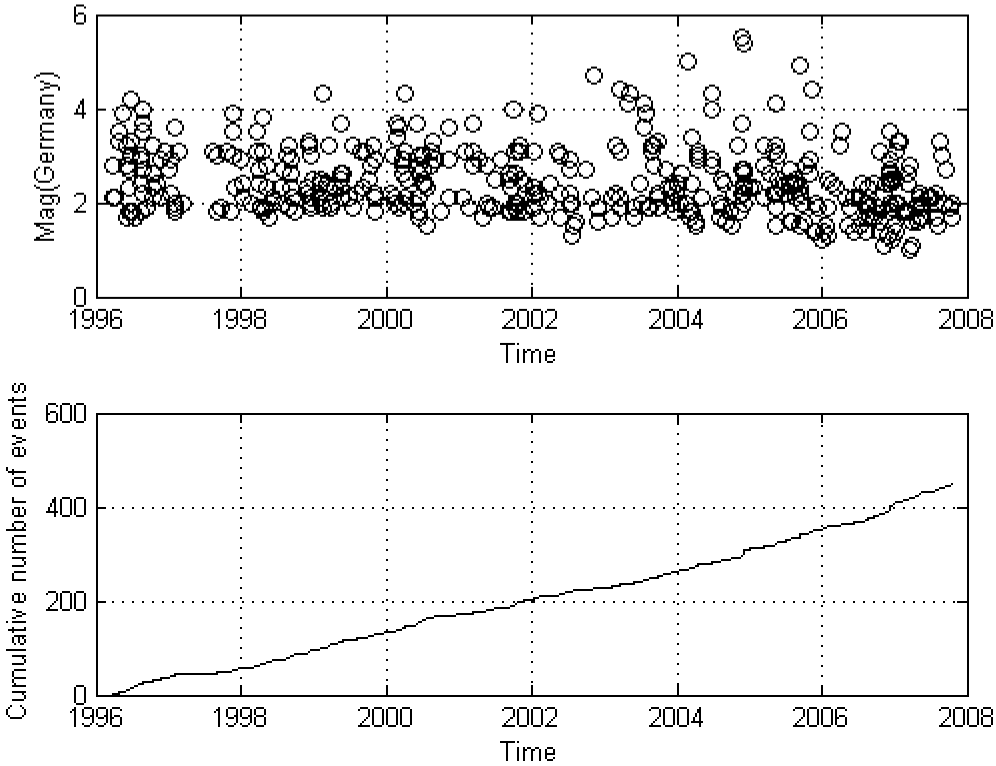
```
10. 1975/01/11 - 2002/12/31 (CSI)
11. 1975/01/11 - 2005/04/15 (CSI + BOLLSI)
12. 2003/01/01 - 2007/12/22 (BOLLSI + ISIDE)
13. 2005/04/16 - 2007/12/22 (ISIDE)
```

(the BOLLSI data with the chosen selection criteria comprises only about 50 events)

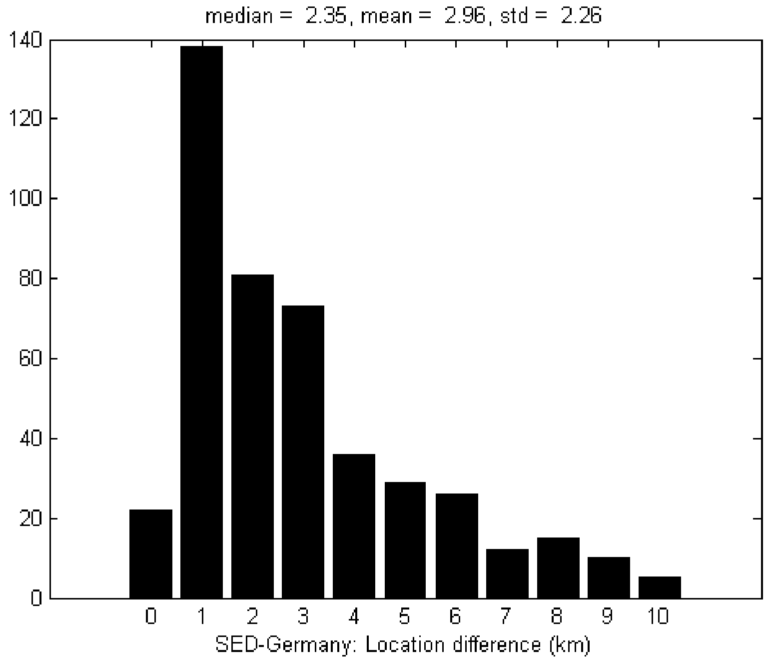
Germany



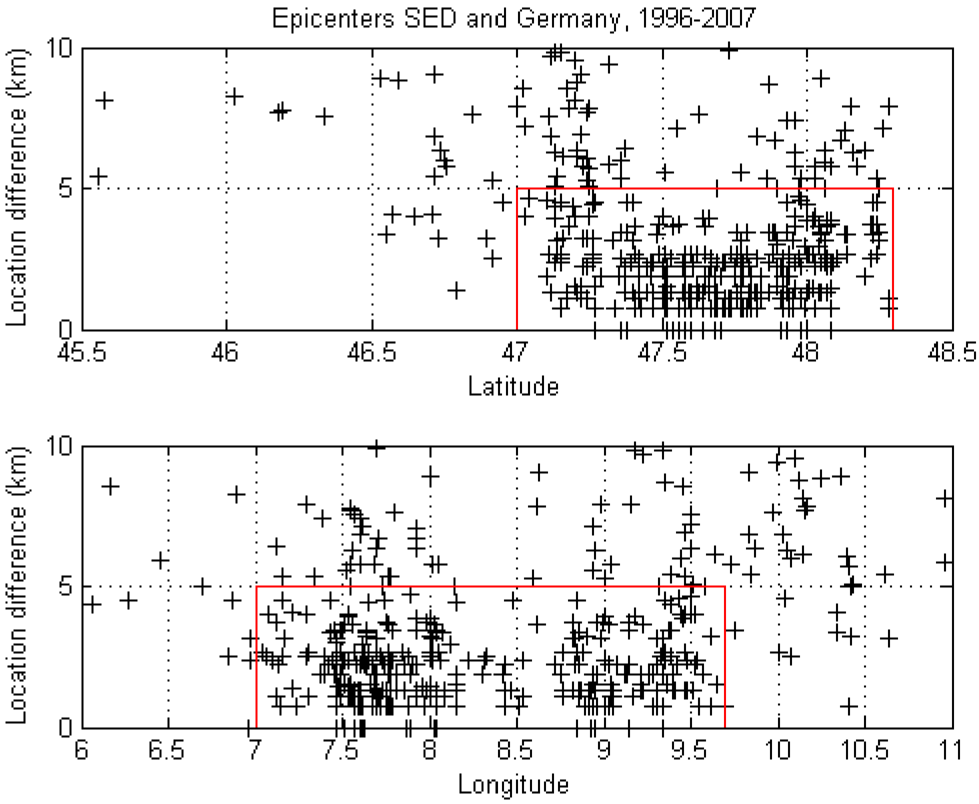
Epicenter map with all events recorded both by the Swiss and German networks over the time period 1996-2007. The rectangle delineates the selected area for the magnitude comparisons.



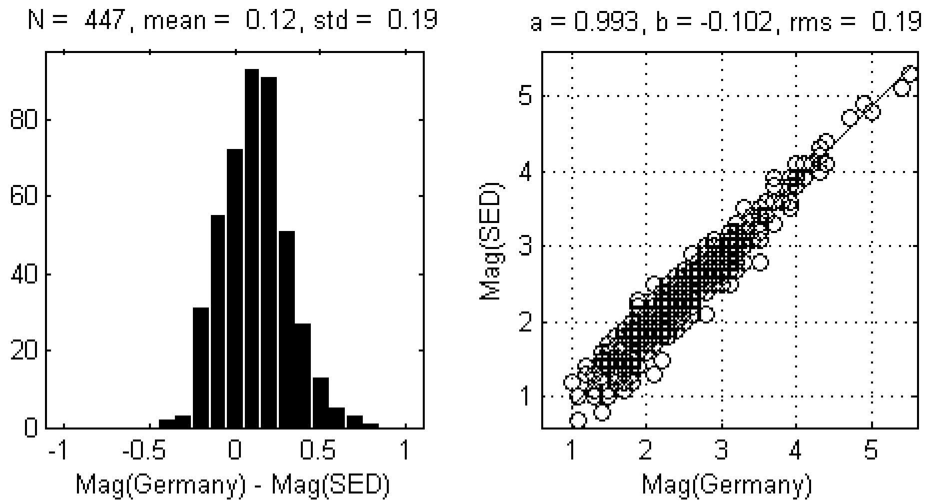
Magnitudes of all events and cumulative number of events recorded both by the Swiss and German networks over the time period 1996-2007.



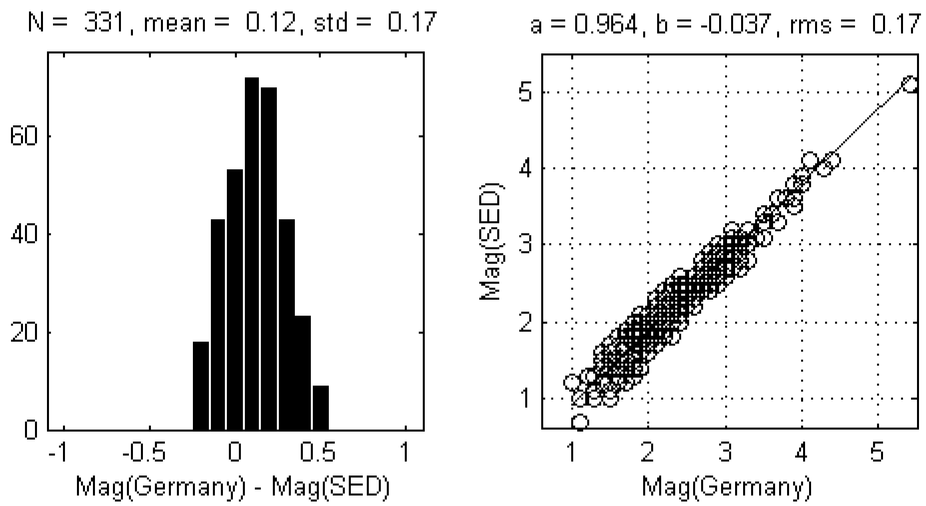
Histogram of location differences for all events recorded by both the Swiss and German networks over the time period 1996-2007.



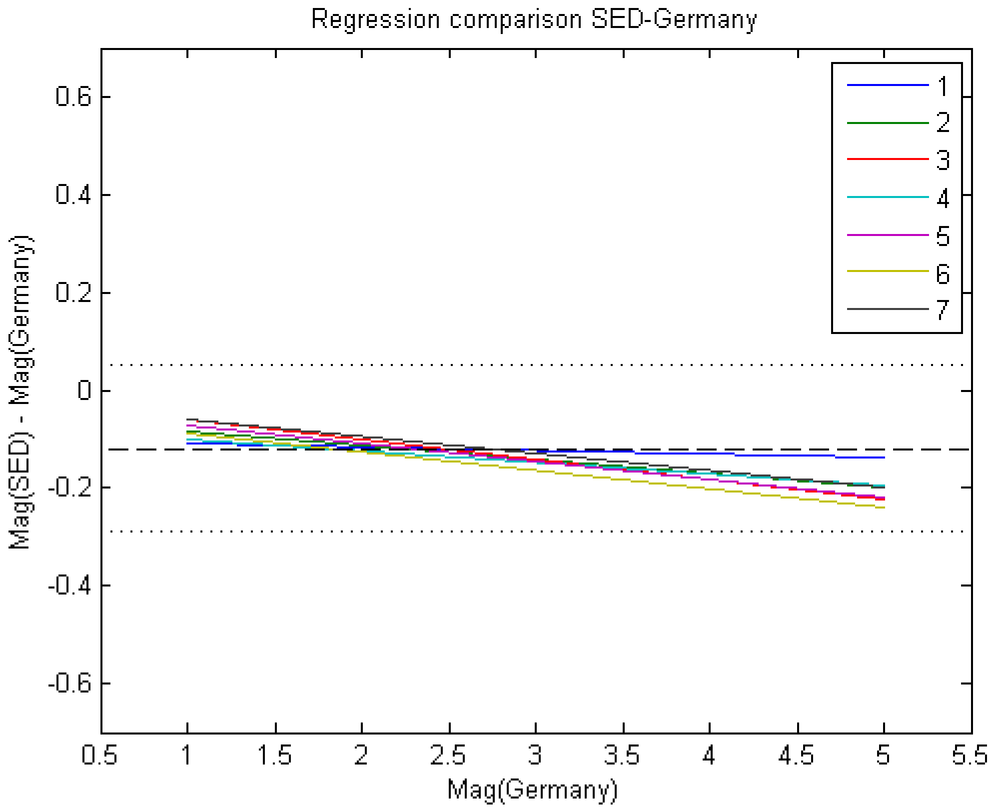
Location differences for all events recorded by both the Swiss and German networks over the time period 1996-2007 as a function of latitude (top) and longitude (bottom). The framed events are those inside the selected area with location differences < 5 km.



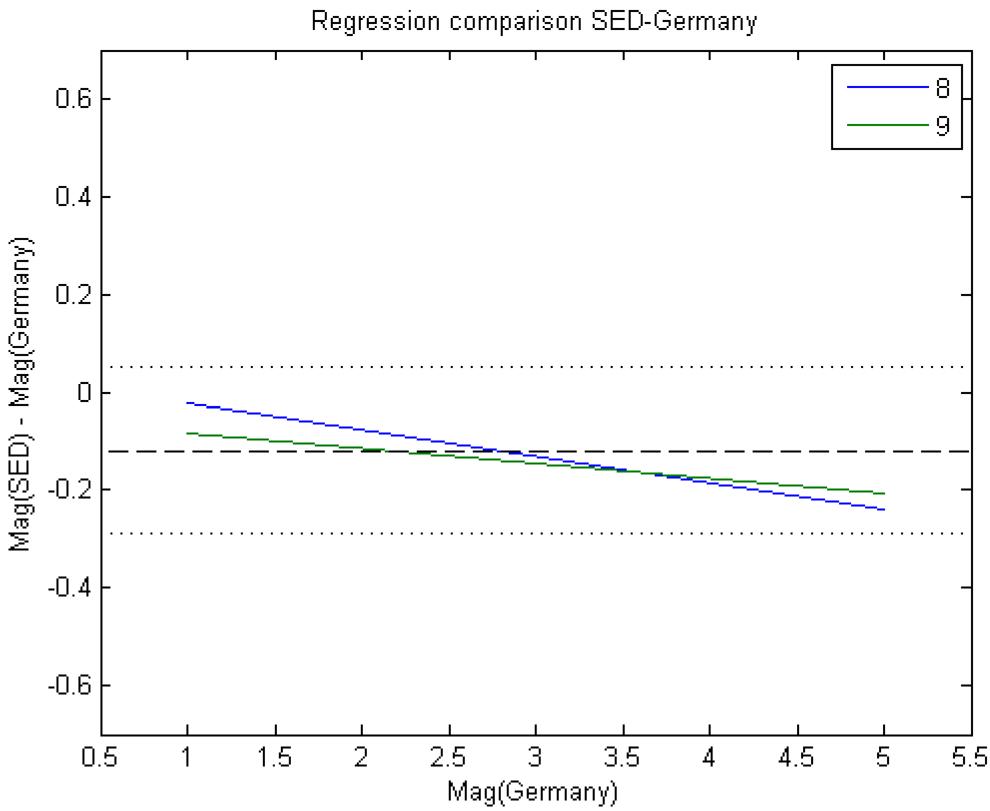
Histogram and regression for all available data (case 1).



Histogram and regression for all data in selected area, with outliers (magnitude difference > 2 sigma) and with location differences > 5 km removed (case 5).

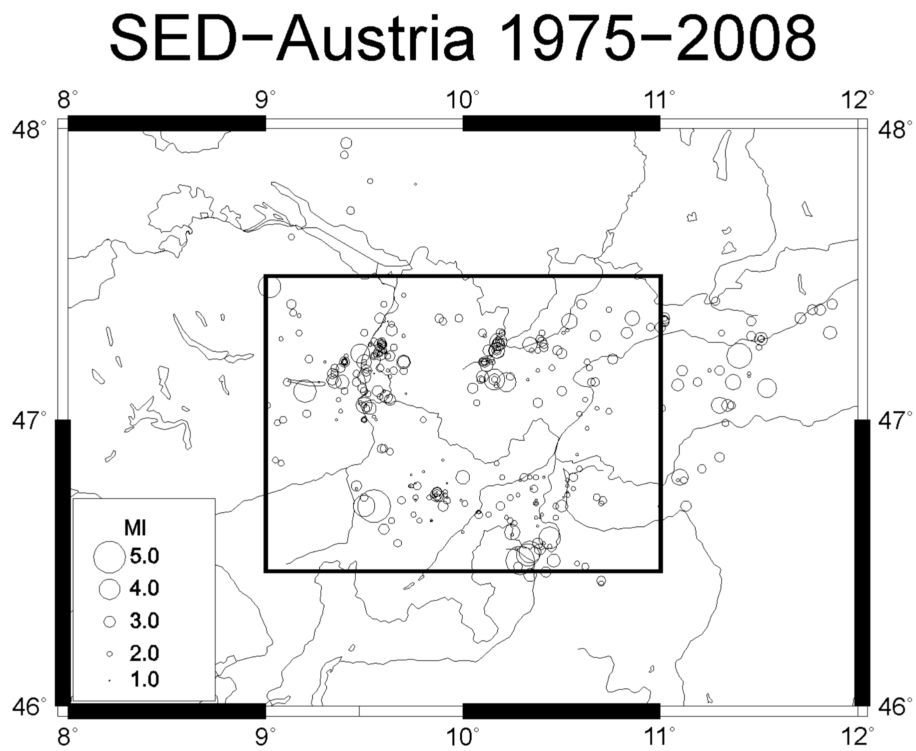


Regression results over the whole time period (cases 1-7).

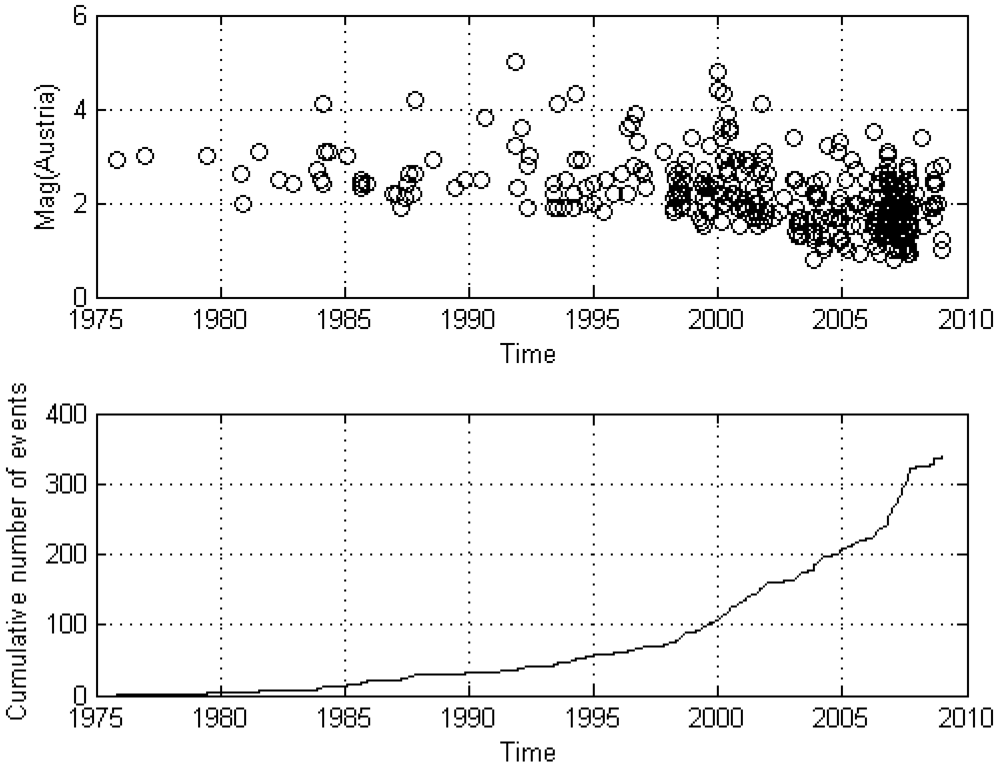


Regression results over the first half (case 8) and the second half of the data set (case 9) for the selected area and with outliers removed (magnitude difference < 2 sigma).

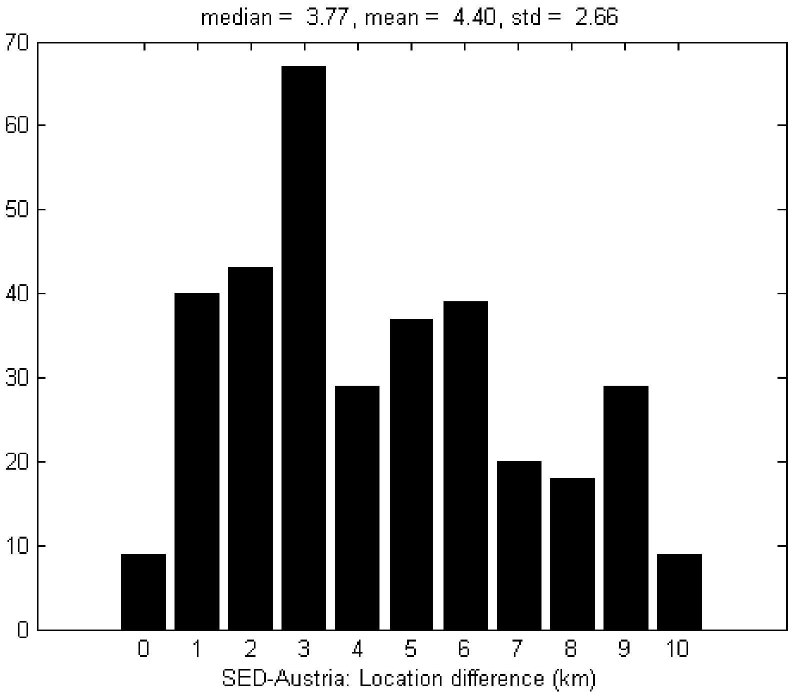
Austria



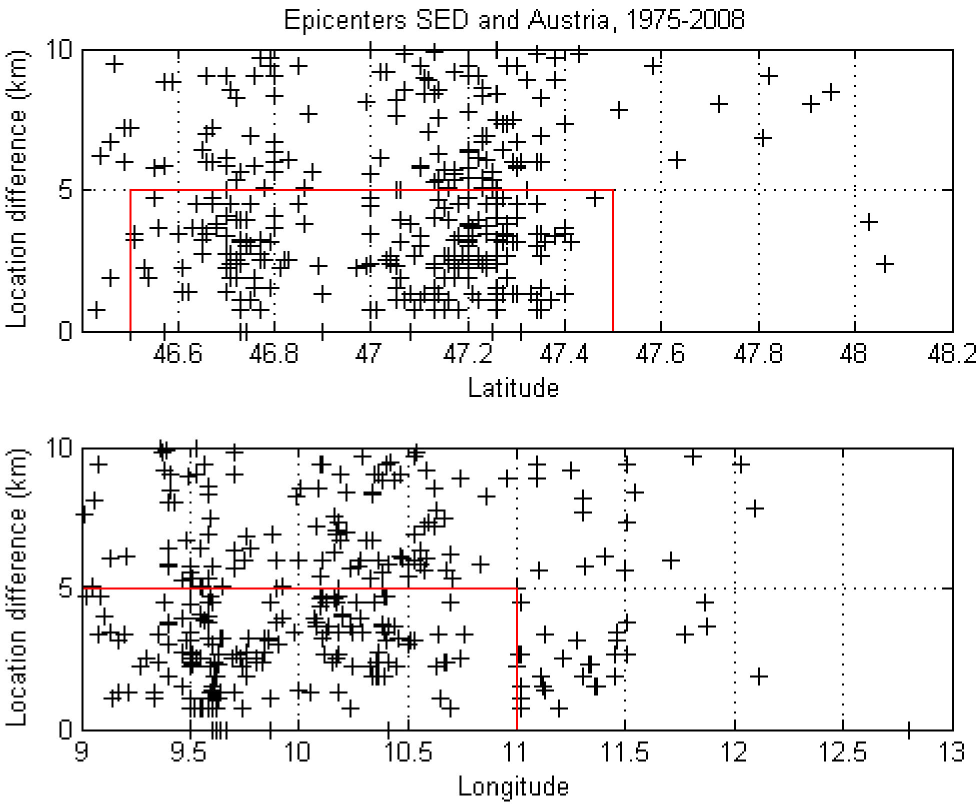
Epicenter map with all events recorded both by the Swiss and Austrian networks over the time period 1975-2008. The rectangle delineates the selected area for the magnitude comparisons.



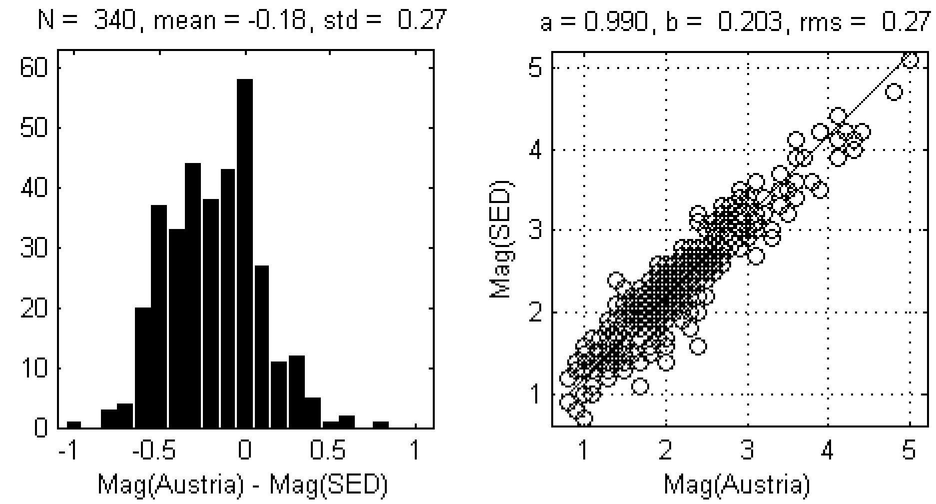
Magnitudes of all events and cumulative number of events recorded both by the Swiss and Austrian networks over the time period 1975-2008.



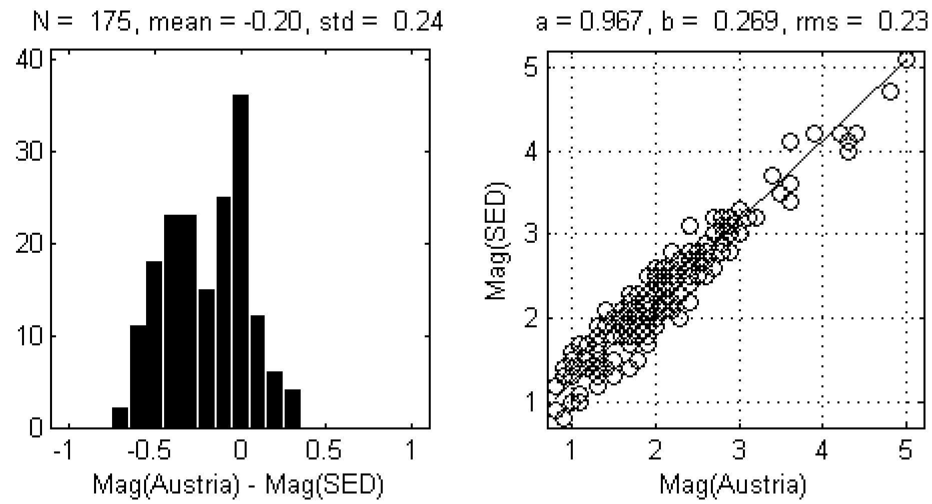
Histogram of location differences for all events recorded by both the Swiss and Austrian networks over the time period 1975-2008.



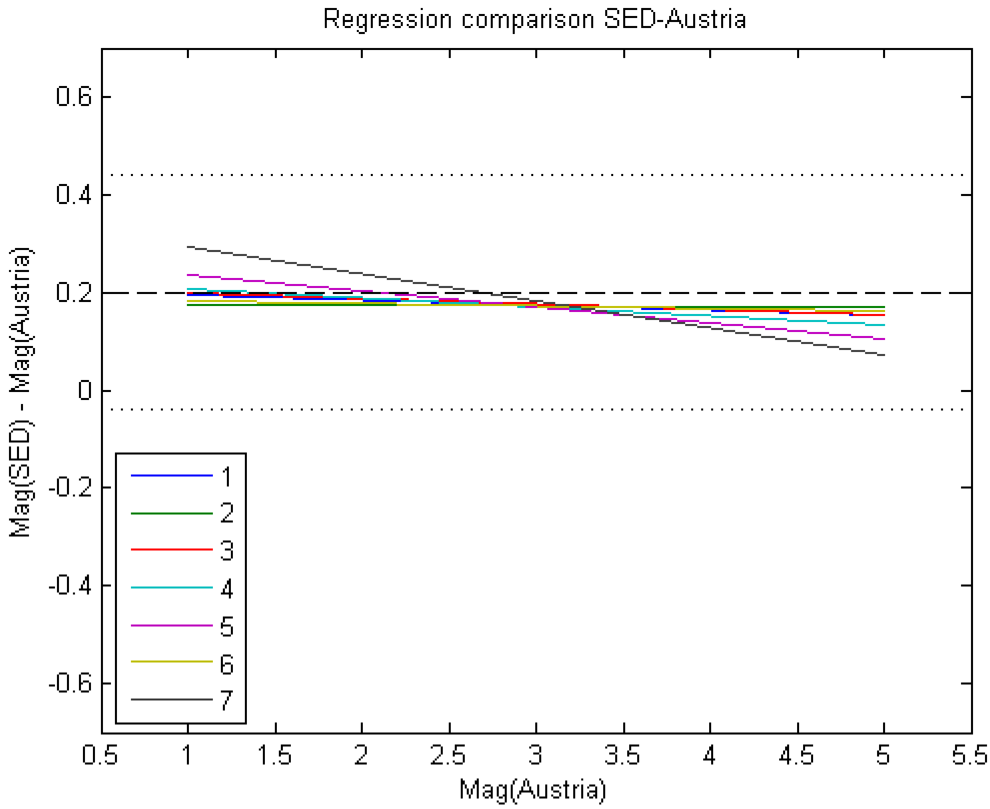
Location differences for all events recorded by both the Swiss and Austrian networks over the time period 1975-2008 as a function of latitude (top) and longitude (bottom). The framed events are those inside the selected area with location differences < 5 km.



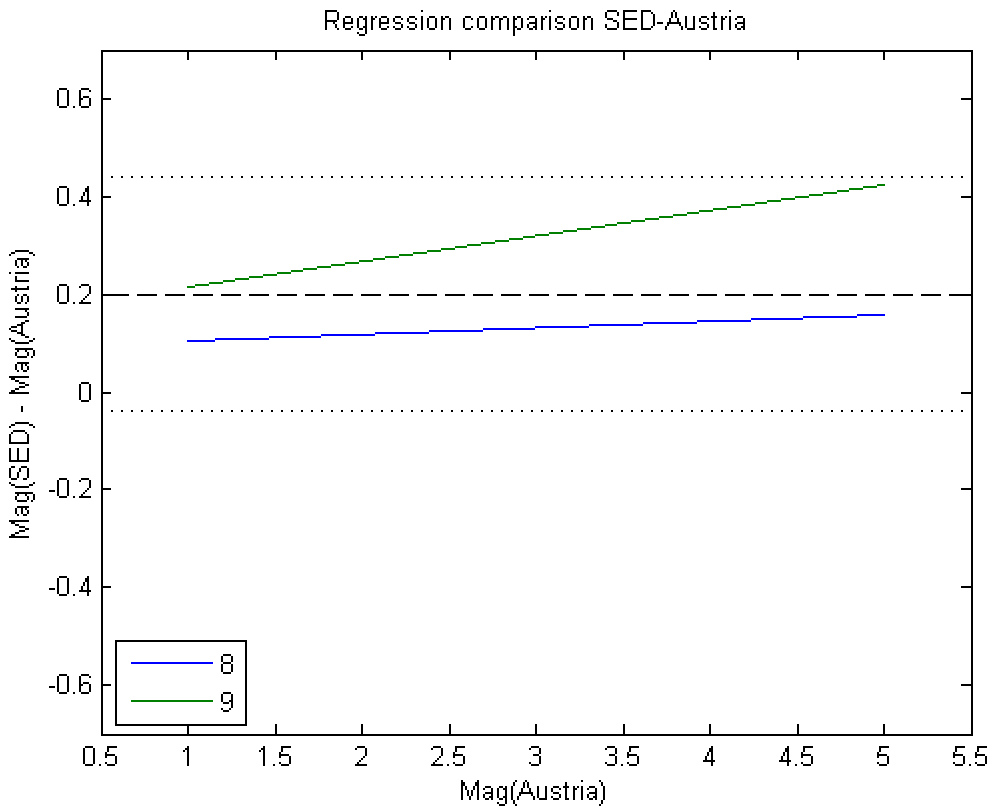
Histogram and regression for all available data (case 1).



Histogram and regression for all data in selected area, with outliers (magnitude difference > 2 sigma) and with location differences > 5 km removed (case 5).

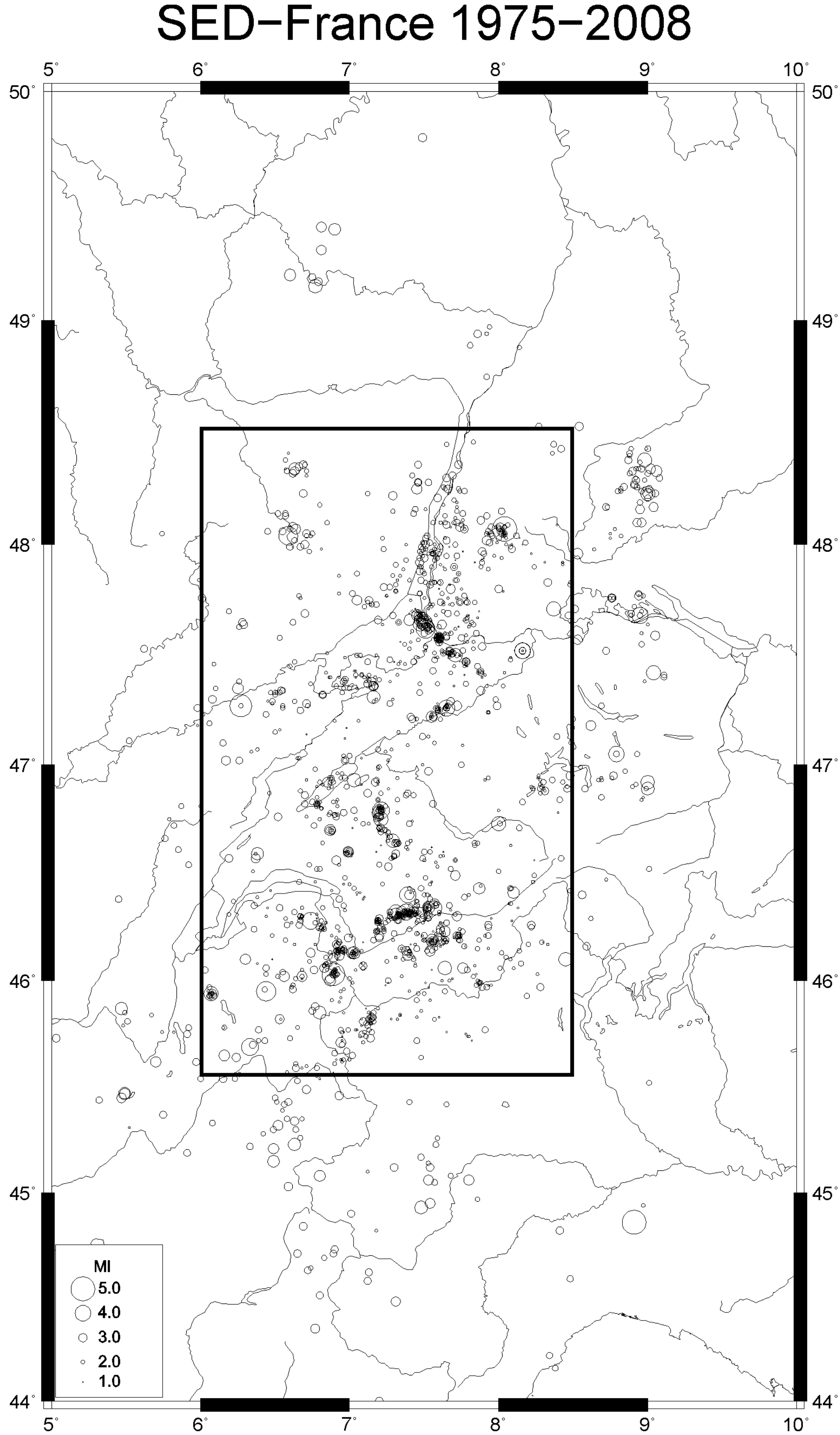


Regression results over the whole time period (cases 1-7).

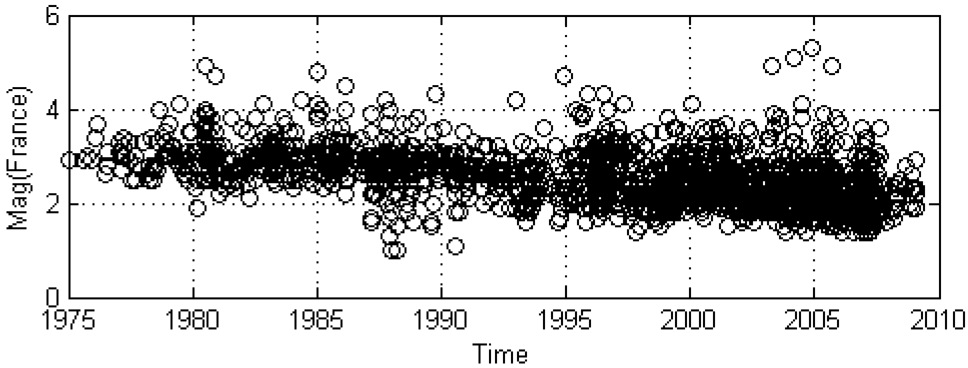


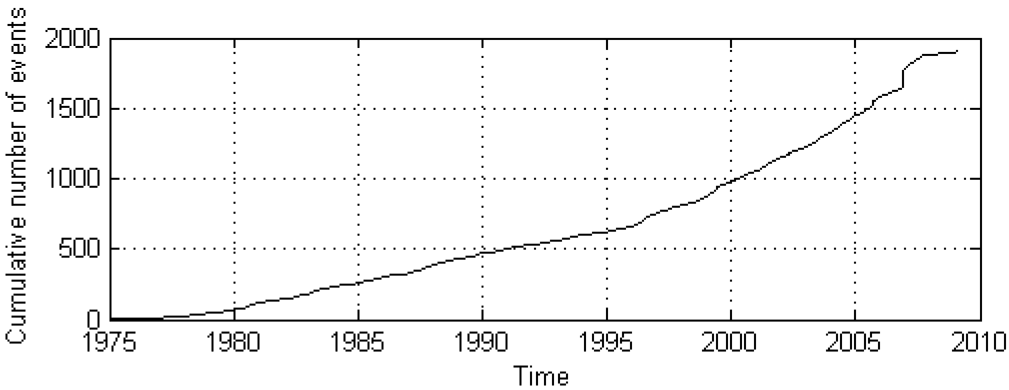
Regression results over the first half (case 8) and the second half of the data set (case 9) for the selected area and with outliers removed (magnitude difference < 2 sigma).

France

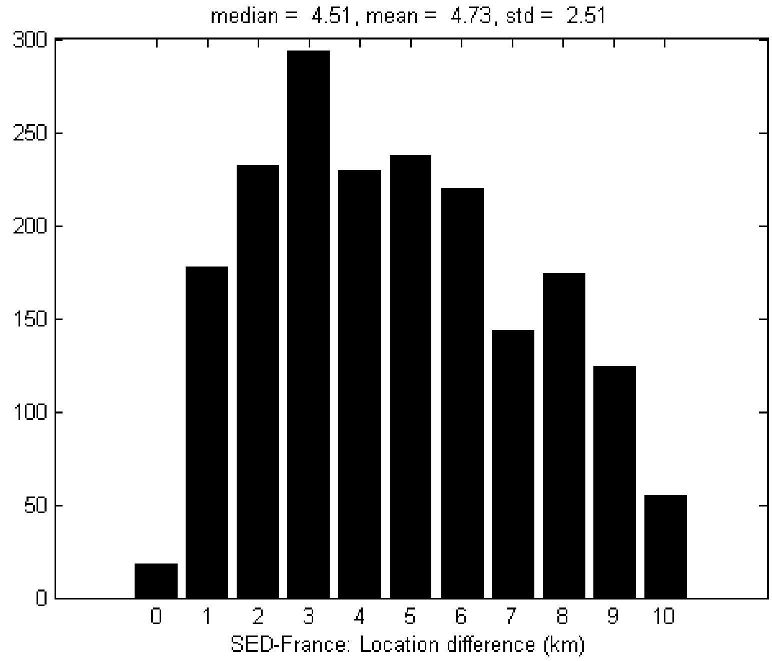


Epicenter map with all events recorded both by the Swiss and French networks over the time period 1975-2008. The rectangle delineates the selected area for the magnitude comparisons.

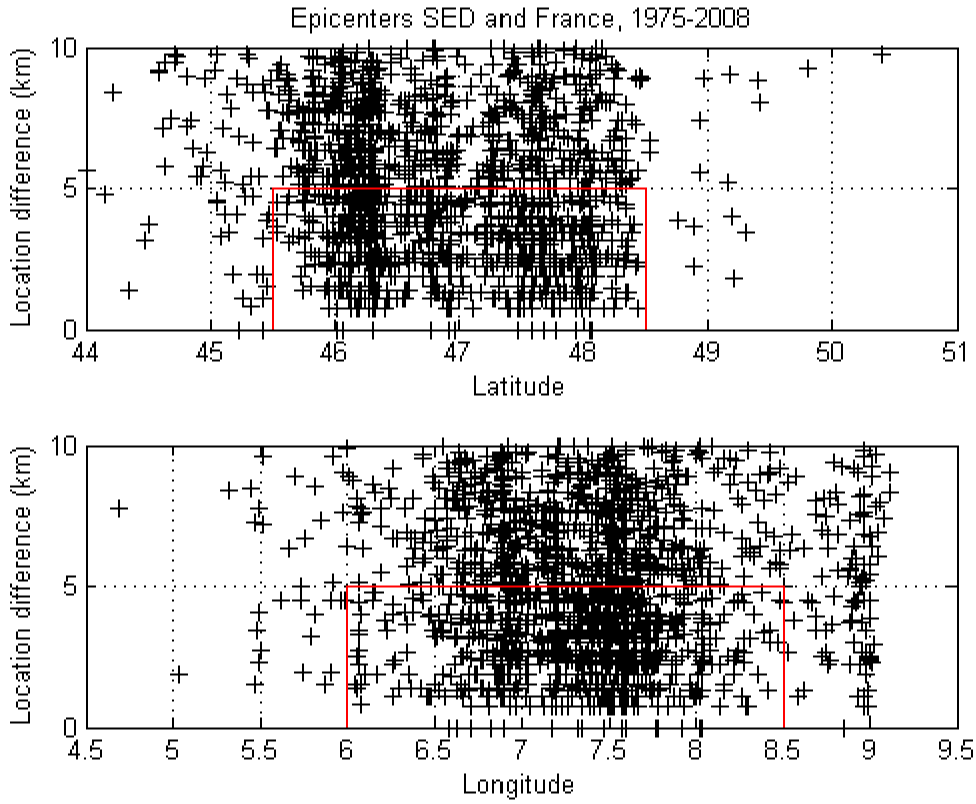




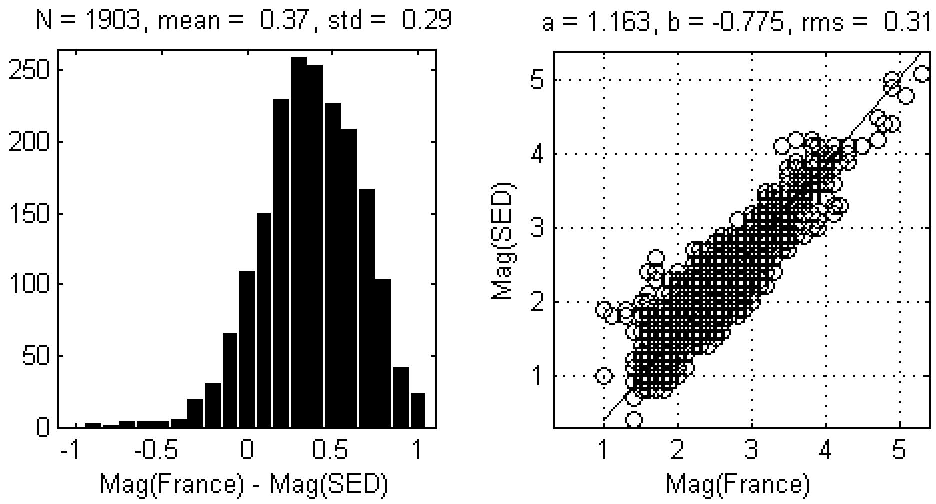
Magnitudes of all events and cumulative number of events recorded both by the Swiss and French networks over the time period 1975-2008.



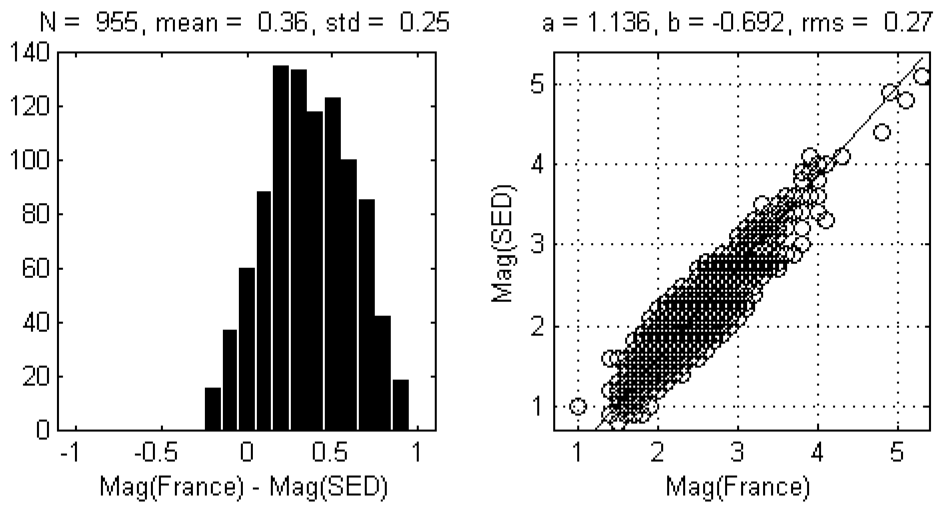
Histogram of location differences for all events recorded by both the Swiss and French networks over the time period 1975-2008.



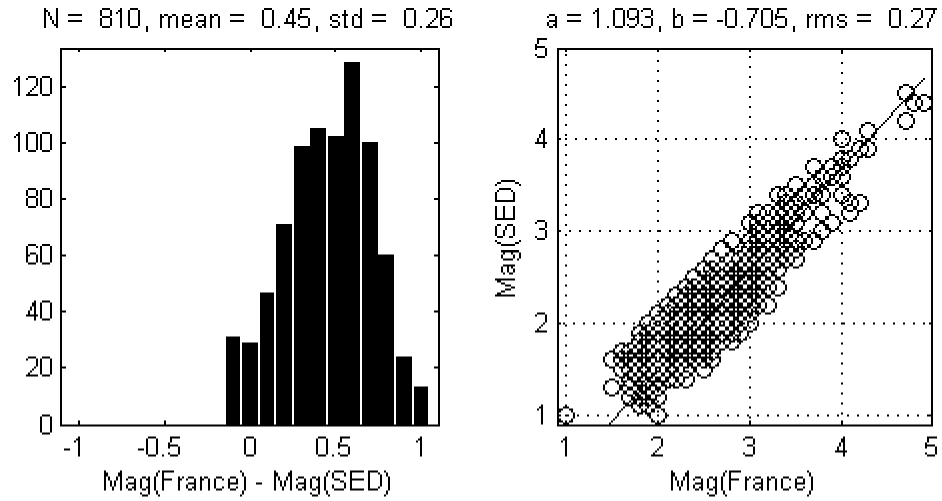
Location differences for all events recorded by both the Swiss and French networks over the time period 1975-2008 as a function of latitude (top) and longitude (bottom). The framed events are those inside the selected area with location differences < 5 km.



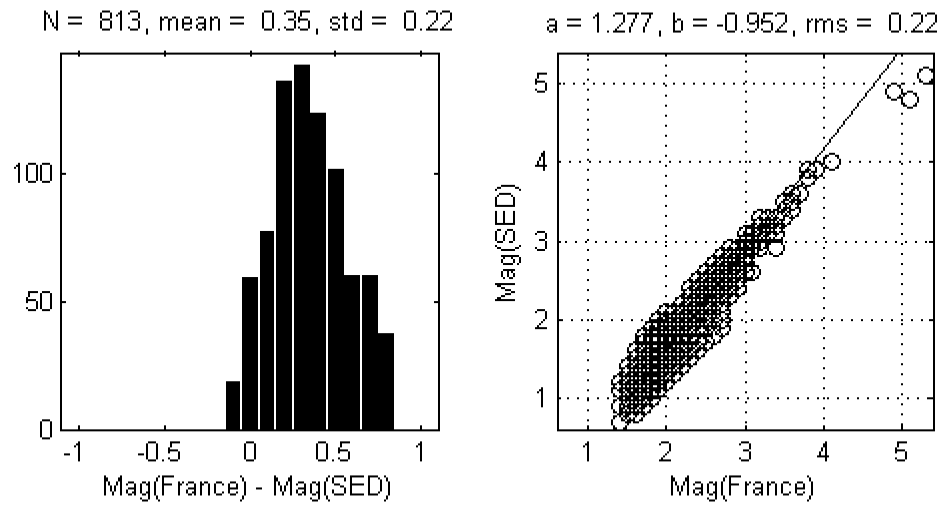
Histogram and regression for all available data (case 1).



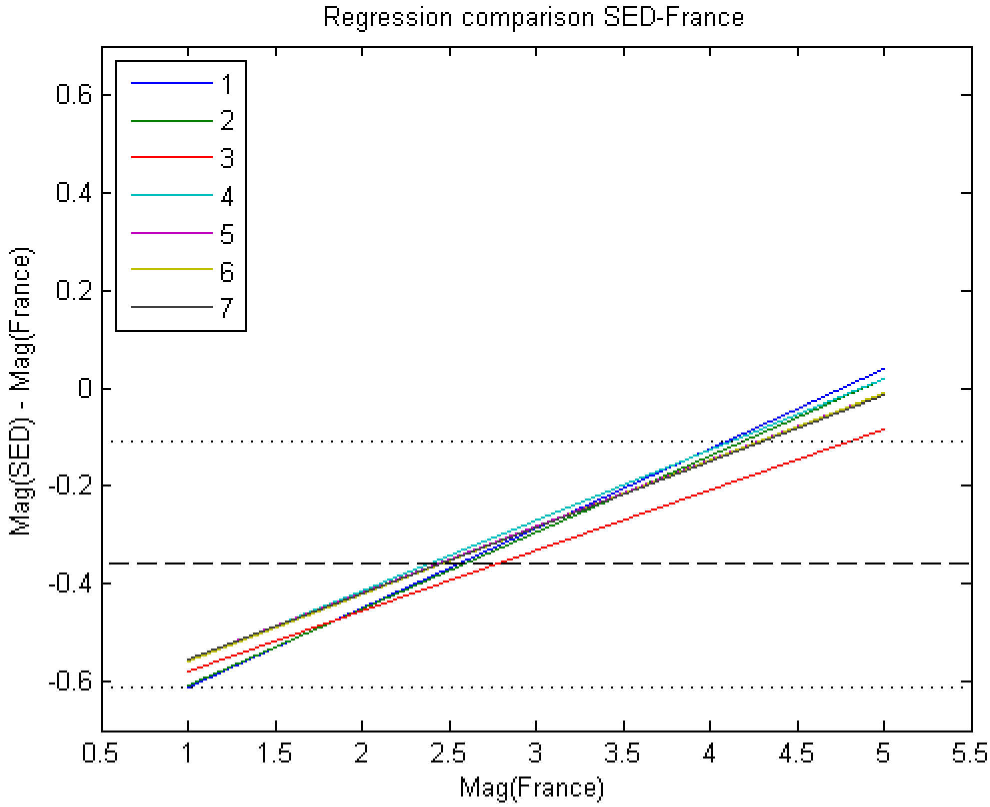
Histogram and regression for all data in selected area, with outliers (magnitude difference > 2 sigma) and with location differences > 5 km removed (case 5).



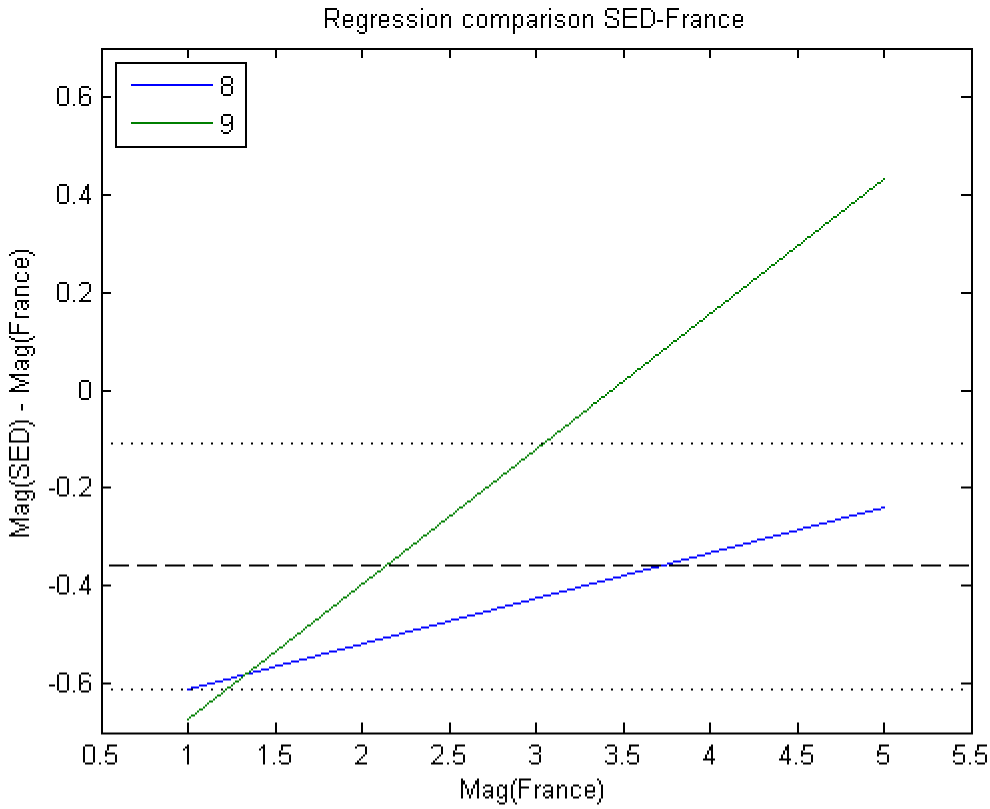
Histogram and regression for first half of data in selected area and with outliers (magnitude difference > 2 sigma) removed (case 8).



Histogram and regression for second half of data in selected area and with outliers (magnitude difference > 2 sigma) removed (case 9).

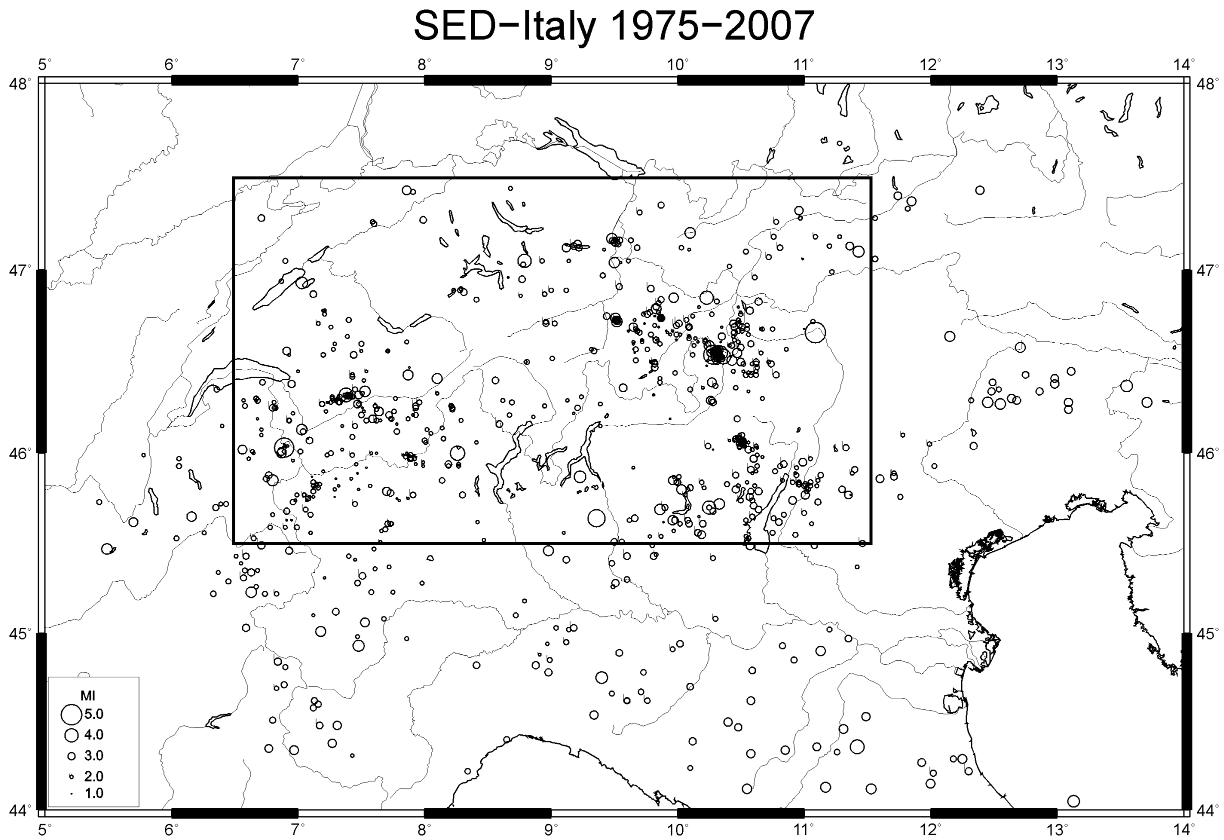


Regression results over the whole time period (cases 1-7).

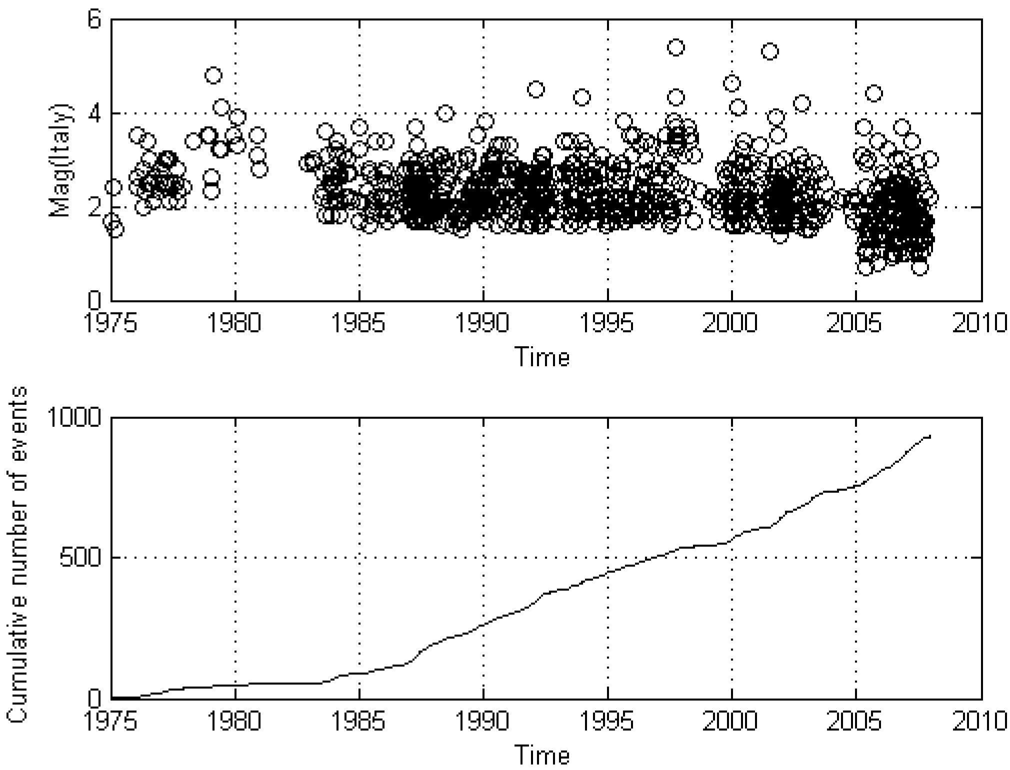


Regression results over the first half (case 8) and the second half of the data set (case 9) for the selected area and with outliers removed (magnitude difference < 2 sigma).

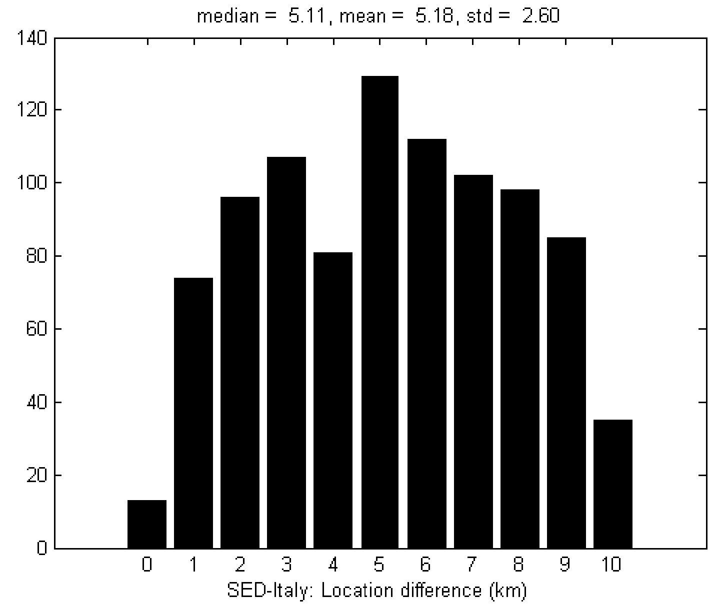
Italy



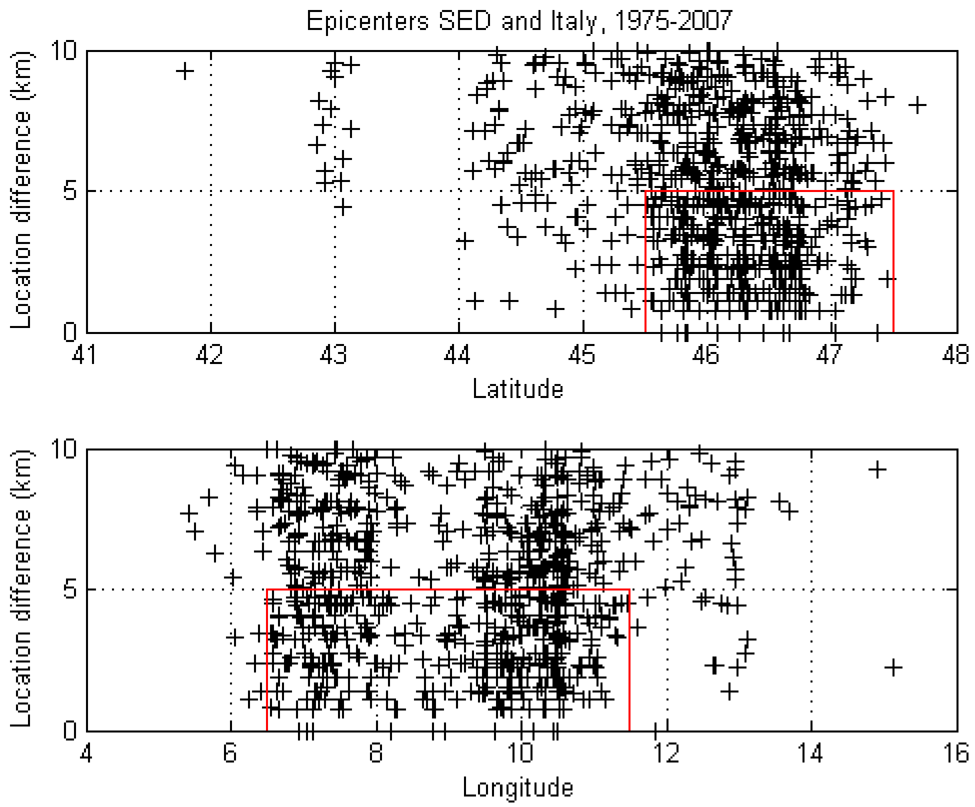
Epicenter map with all events recorded both by the Swiss and Italian networks over the time period 1975-2007. The rectangle delineates the selected area for the magnitude comparisons.



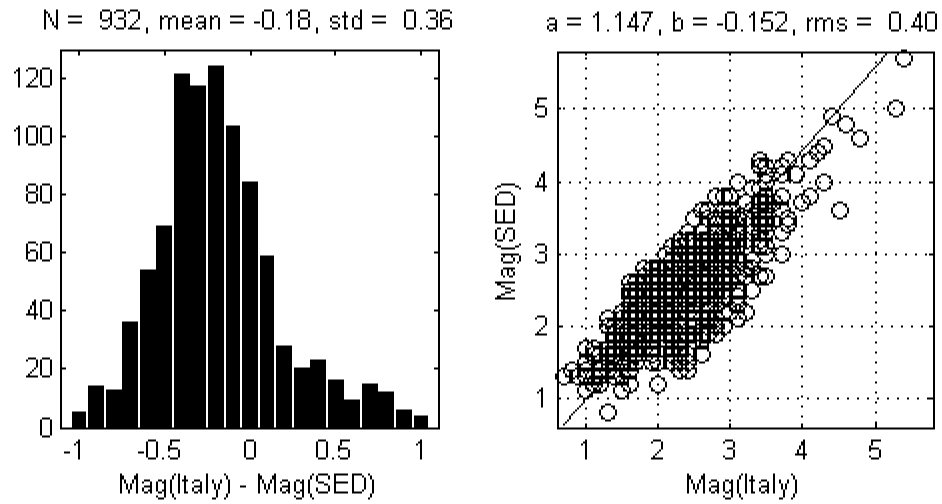
Magnitudes of all events and cumulative number of events recorded both by the Swiss and Italian networks over the time period 1975-2007.



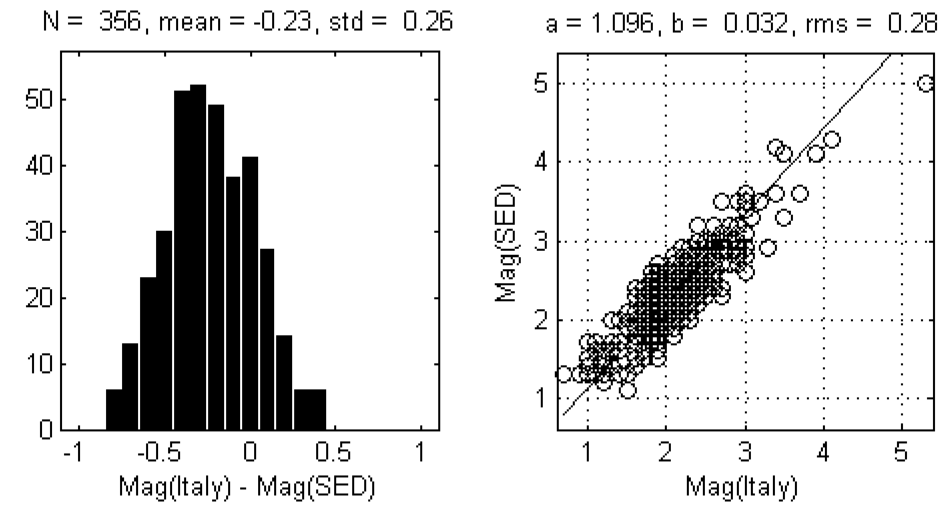
Histogram of location differences for all events recorded by both the Swiss and Italian networks over the time period 1975-2007.



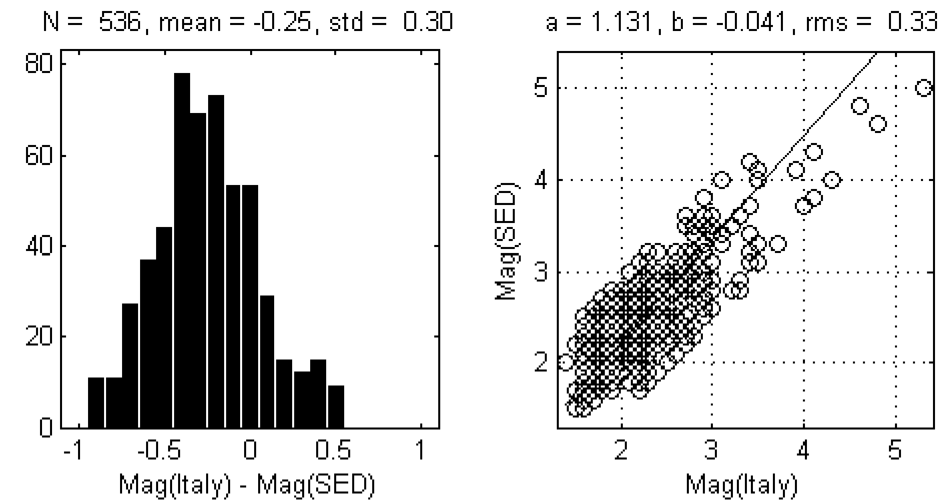
Location differences for all events recorded by both the Swiss and Italian networks over the time period 1975-2007 as a function of latitude (top) and longitude (bottom). The framed events are those inside the selected area with location differences < 5 km.



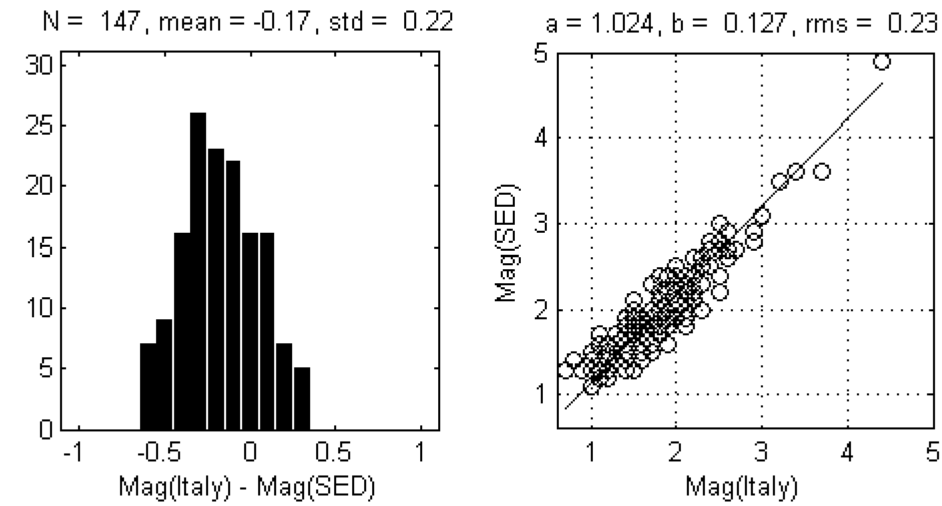
Histogram and regression for all available data (case 1).



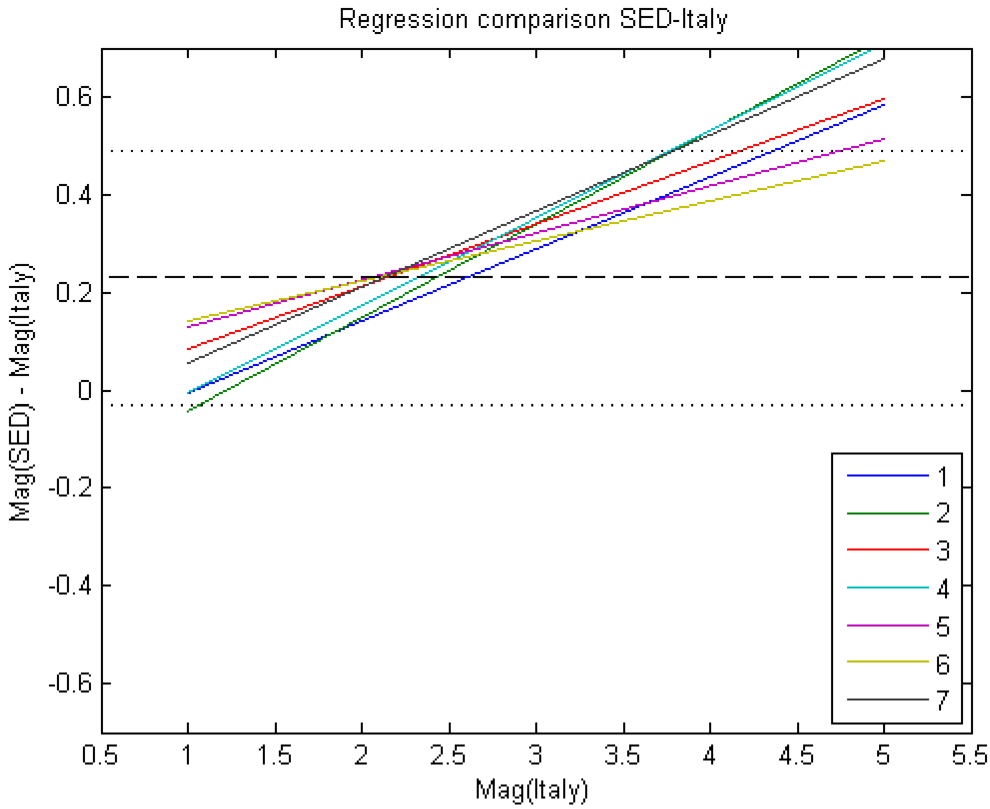
Histogram and regression for all data in selected area, with outliers (magnitude difference > 2 sigma) and with location differences > 5 km removed (case 5).



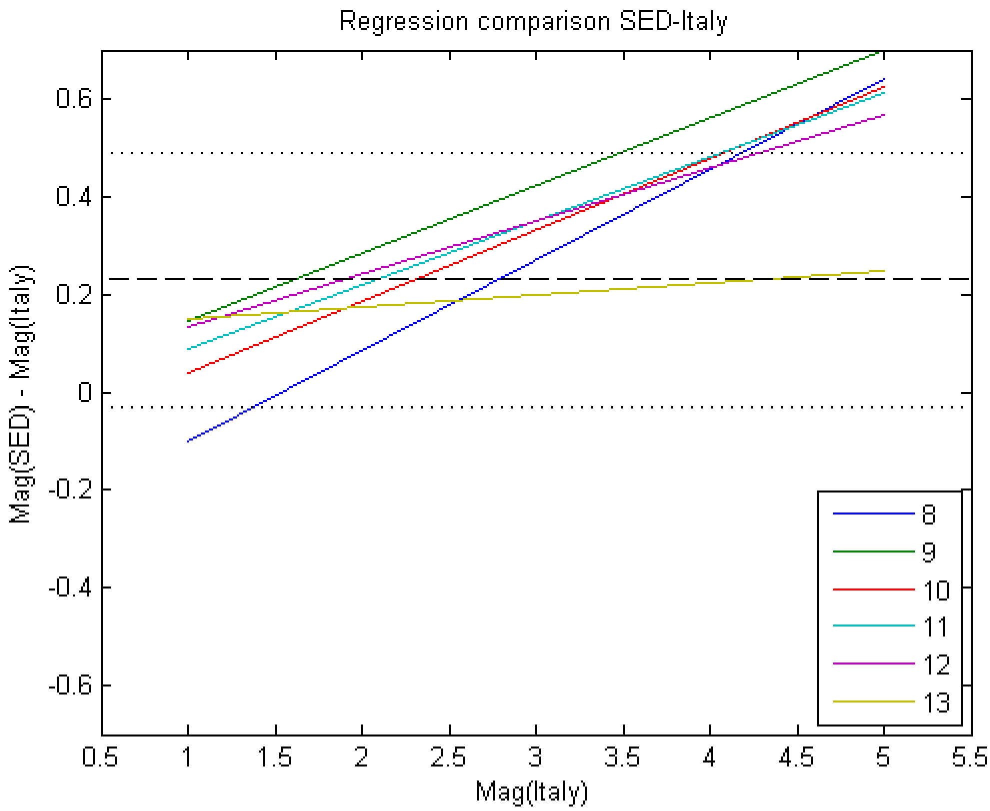
Histogram and regression for data in selected area and with outliers (magnitude difference > 2 sigma) removed over the time period 1975/01/11 - 2005/04/15 (case 11).



Histogram and regression for data in selected area and with outliers (magnitude difference > 2 sigma) removed over the time period 2005/04/16 – 2007/12/22 (case 13).



Regression results over the whole time period (cases 1-7).



Regression results for events in the selected area and with outliers removed (magnitude difference < 2 sigma) over the first half (case 8) and the second half of the data set (case 9) and for the following time periods: 1975/01/11 – 2002/12/31 (10), 1975/01/11 – 2005/04/15 (11), 2003/01/01 – 2007/12/22 (12), 2005/04/16 - 2007/12/22 (13).