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Estimation of Seismic Hazard Parameters in the Northern Part of Algeria

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Abstract—In this study, the procedure of the earthquake hazard evaluation recently developed by KIJKO and SELLEVOLL (1992) is used to estimate seismic hazard parameters in the northern part of Algeria. The new method differs from the conventional one because it incorporates the uncertainty of earthquake magnitude, and accepts mixed data containing large historical events and recent complete catalogue. The importance of the method lies in its ability to estimate from incomplete and uncertain data files the parameter b of the Gutenberg-Richter relationship, the annual activity rate λ of event and the maximum possible magnitude $m_{\max}$. In this method, the earthquake process is considered to be of the Poisson type with an annual activity rate λ, and with a doubly truncated exponential distribution of earthquake magnitude with parameter β.

The northern part of Algeria is subdivided into three zones. For each zone, estimation of b-value, the annual activity rate λ and the expected maximum magnitude are obtained. The mean return period and the probability of non-exceedence of some magnitude during a time period $T = 50$ and 100 years are computed.

The results obtained in this study using this methodology, give a prior picture of seismic hazard in the northern part of Algeria. In some regions (Mitidja and Chelif basins) these results corroborate not only with the observation, but also with seismotectonic results.

Key words: Earthquake hazard, maximum magnitude, activity rate, b-value, earthquake catalogue, magnitude uncertainty, Poisson process.

Introduction

Our aim is to attempt an estimation of seismic hazard parameters in the northern part of Algeria and to analyse their regional variation. Particularly the analysis of the regional variation of b-values supplies information on the state of stress and the nature of faulting. The regional variation of the parameter λ (parameter of the Poisson process) presented here, gives information on the average regional seismic activity.

The Gutenberg-Richter relationship $\log N = a - b\,M$ has been empirically established between frequency occurrence of earthquakes N with magnitude higher than M, and the value of M. Experimental results have shown that it may vary with

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seismic region. Moreover, the b-value generally decreases with increasing focal depth. Laboratory experiments have revealed that the frequency-magnitude relation is also valid for microfractures during rock deformation (MOGI, 1962a,b), and that the b-value depends primarily on stress. The validity of this relationship, changing scale from microcracks to earthquakes, is not yet fully understood; however, an interesting consequence of this result is the possibility to infer regional or temporal variations of the state of stress from the variations of the b-value, decreasing values being related to increasing stress. A possible physical explanation of the b-value on stress invokes the occurring predominance of small earthquakes on pre-existing cracks, as a result of low stress, whereas, a result of increasing stress, new cracks may be generated, giving rise to earthquakes which are statistically larger. The b-value dependence to stress field may also reflect the competition for energy release between either a few faults (giving low b-values) or numerous small faults (giving larger b-values) (SCHOLZ, 1968). The geometrical properties of the fault system in relation to the fractal dimension of the faults may also be at the origin of the b-variations (AKI, 1981).

Description of the Model

This section presents a brief description of the model employed in this study to estimate the seismic hazard parameters in the northern part of Algeria. The details of the methodology can be found in KIJKO and SELLEVOLL (1989, 1992), KIJKO (1988).

The methodology developed by KIJKO and SELLEVOLL (1989, 1992) for seismic hazard evaluation is consistent with the available historical and instrumental data. The importance of the method lies in its ability to estimate from incomplete data files the parameter b of the Gutenberg-Richter relationship, the annual activity rate λ of the events (throughout the region) and the maximum possible magnitude $m_{\max}$. An illustration of the data which can be utilized by the procedure is presented in Figure 1. This approach permits a combination of the largest historical earthquake data (extreme value, e.g., GAN and TUNG, 1983; KIJKO and DESSOKEY, 1987) with the complete instrumental data of variable threshold magnitudes. The largest known historical events, from before the catalogue begins, can therefore be added into the data set used in the processing. It also accepts gaps, representing the time period when records were missed or seismic networks were not in operation.

The theoretical basis of the method is presented in KIJKO and SELLEVOLL (1989, 1992); the earthquake process is considered to be of the Poisson type with an annual activity rate λ, and with a doubly truncated exponential distribution of earthquake magnitude with parameter β (e.g., COSENTINO *et al.*, 1977). Following TINTI and MULARGIA (1985), the error in observation is taken into account by the procedure.

The input parameters required by the procedure are the extreme earthquake (e.g., GAN *et al.*, 1983) for the incomplete part of the catalogue, and the period, the number of events exceeding a threshold value for each complete data set.

The earthquake magnitude m can be substituted in the processing by the epicentral intensity I_0. In such a case, the β_I parameter, obtained from intensity data can be related to b_I parameter in the Gutenberg-Richter frequency-intensity relationship by $\beta_I = b_I$, Ln(10). Assuming a linear dependence between magnitude and epicentral intensity; $m = cI_0 + d$; the b parameter in the Gutenberg-Richter frequency-magnitude relationship takes the form $\beta_I = b.c.\text{Ln}(10)$.

The flexibility and the abilities of the procedure to treat heterogeneous and uncertain data led to this method being used through different countries (e.g., PROCHAZKOVA *et al.*, 1990; MANTYNIEMI and KIJKO, 1991; KIJKO *et al.*, 1993).

Data Processing and Results

The northern part of Algeria is known as one of the most active seismogenic zones in the western Mediterranean basin. This activity is characterised by five major events which occurred during the last decade: El Asnam (10 October 1980, $M_s = 7.3$; e.g. DESCHAMPS *et al.*, 1982; RUEGG *et al.*, 1982; OUYED *et al.*, 1982; YIELDING *et al.*, 1989), Constantine (27 October 1985, $M_s = 5.9$; DESCHAMPS *et al.*, 1991), Mont Chenoua-Tipaza (29 October 1989, $M_s = 6.0$ e.g., BEZZEGHOUD *et al.*, 1990), Mascara (18 August 1994, $M_s = 5.6$) and recently in northwest Algiers (04 September 1996, $M_s = 5.7$).

Many others events have been reported by several workers (e.g., ROTHE, 1950; ROUSSEL, 1973a,b; BENHALLOU, 1985; AMBRASEYS and VOGT, 1988; BEZZEGHOUD *et al.*, 1995a). Some of these events are historical (before 1910) and

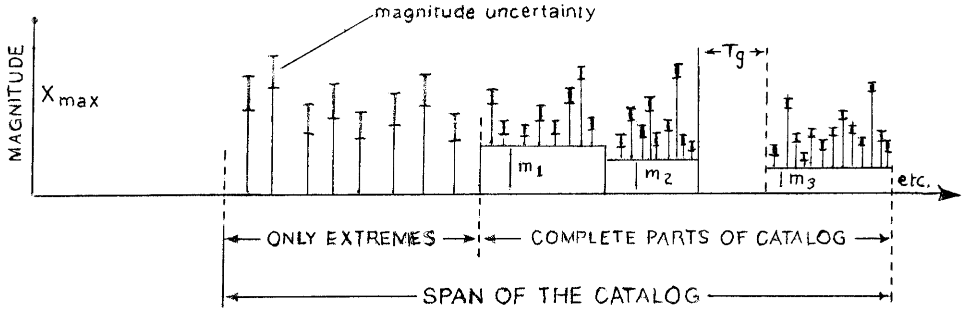


Figure 1

Illustration which can be used to obtain basic hazard parameters by the Kijko and Sellevoll procedure. The approach permits a combination of the largest historical earthquakes with the complete data of variable threshold magnitudes. It also accepts "gaps" (such as T_g), for example when records are missing or networks were not in operation. In addition it makes possible the use of the largest historical earthquakes which occurred before the beginning of the catalogue (from KIJKO and SELLEVOLL, 1992).

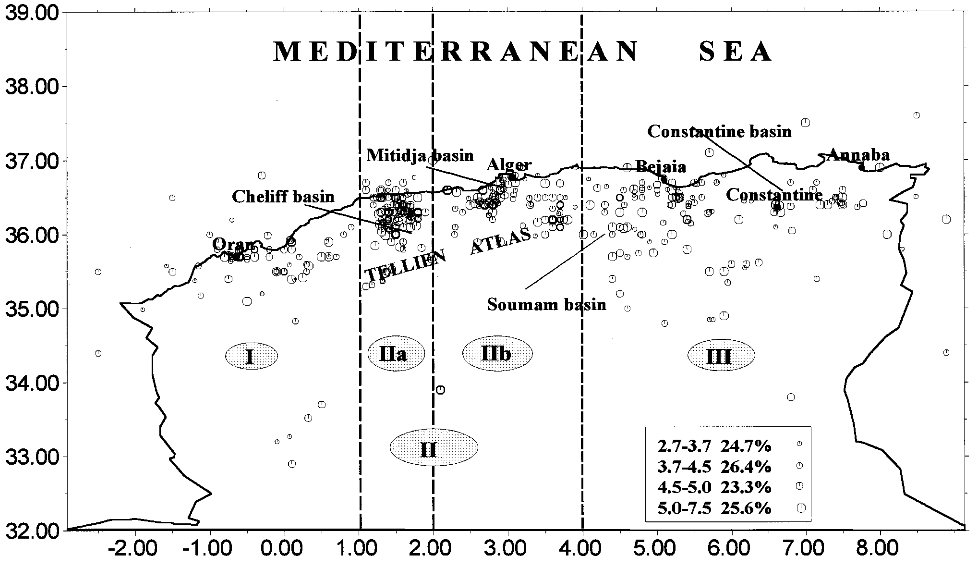


Figure 2
Spatial distribution of earthquake epicenters which occurred in the northern part of Algeria during the time period 1673 to 1992.

others are instrumental recent events that were recorded by teleseismic stations and by a few Algerian stations (e.g., Bezzeghoud *et al.*, 1992). It is also known that Algeria has experienced several strong earthquakes during the last century (e.g., Rothe, 1950; Roussel, 1973a,b; Benhallou, 1985; Ambraseys and Vogt, 1988; Bezzeghoud *et al.*, 1995a; Benouar, 1994).

The regional seismicity has been more or less, well known for the last decade. This activity is the strongest in the western Mediterranean region, as a result of the collision between the African and Eurasian plates. In this region, the contact between the African and Eurasian plates takes place along a wide zone of deformation from the region west of Gibraltar (Azores-Gibraltar fault) to Tunisia, including a semi-independent block of the Ibero peninsula, actually attached to the European plate. This situation is clearly described by Buforn *et al.* (1995).

Locally, many seismic events have occurred in many parts of the northern part of Algeria, especially in the Cheliff basin (around El Asnam city). The largest events during this century are those of 1954 ($M_s = 6.7$) and 1980 ($M_s = 7.3$) which caused extensive material damage and thousands of casualties. Also, in Figure 2 the spatial distribution of epicenters for the time period 1673–1992 is shown. The analysis of the distribution during the last two centuries leads to the conclusion that the recent earthquakes in Algeria occurred particularly in some Tellian Atlas zones (Bezzeghoud *et al.*, 1995b).

In this study, the northern part of Algeria is subdivided in three zones (see Fig. 2): western part or zone I (2.20W, 1.0E), central part or zone II (1.0E, 4.0E), and eastern part or zone III (4.0E, 8.5E). However, we have analysed especially the Algiers and El Asnam areas, respectively denoted zone II_b (2.0E, 4.0E) and zone II_a (1.0E, 2.0E).

The choice of these main seismic zones is based essentially on the observed mechanism faults. Effectively all the mechanisms of the events distribution in the western part of northern Algeria (zones I and II_a) dominated by thrust faulting show that the P axis is nearly normal to the African—Eurasian plate boundary with a NNW–SSE direction (LAMMALI *et al.*, 1997). Further east (zone III) the earthquake of Constantine (27 October 1985, $M = 5.9$) has a strike-slip mechanism and the pressure axis is approximately oriented in N–S direction. Moreover, the seismicity in this area (zone III) is fairly low in frequency and magnitude. On the other hand, the analysis of the distribution of epicenters in the northern part of Algeria seems to indicate that a significant seismic gap exists in the western part of Algeria, in particular in the vicinity of Oran (BEZZEGHOUD *et al.*, 1995a). The seismicity in zone II could be separated in two areas (see Fig. 2): the larger pattern of seismicity is associated with the large El Asnam earthquake (10 October 1980, $M = 7.3$) and the second pattern with Mont-Chenoua Tipaza earthquake (29 October 1989, $M = 6.0$). Although, the choice of these zones can be most speculative, since the subject of determining the seismogenic zones in the northern part of Algeria is currently under investigation, nevertheless, this subdivision of the northern part of Algeria is consistent with the map of maximum observed intensities (BEZZEGHOUD *et al.*, 1995a).

We used all the data available between 1673 and 1992 with magnitudes ranging from 2.4 to 7.5 contained in the catalogue of Algerian earthquakes, published by the CRAAG (1994). The catalogue includes both macroseismic and instrumental magnitudes. The macroseismic magnitude is computed from maximum observed intensity (I_0, Modified Mercali scale) with an empirical expression (e.g., CRAAG, 1994). The instrumental magnitude is generally m_b or M_s.

A simple analysis of the Algerian earthquake catalogue establishes that, it is heterogeneous, incomplete and includes data affected by uncertainties. These facts, make the methodology developed by KIJKO and SELLEVOLL (1989, 1992) more appropriate to the estimation of seismic hazard in the northern part of Algeria.

Estimation of seismic hazard parameters b, λ_x, $m_{\max}$, with their standard errors, is given in Table 2, where λ_x is the number of annually expected earthquakes with magnitude x or larger, $m_{\max}$ is the maximum expected magnitude during a time span equal to that of the catalogue, which is denoted by N.

Table 1 furnishes, for each studied zone, the threshold magnitude (TM), time period considered (TP), magnitude error (ME), and the relative contribution of each subcatalogue to the evaluation of b-value, and the activity rate, λ.

The completeness of an instrumental catalogue can differ according to the time period considered. It is directly related and is dependent on the consistency of the catalogue. The problem to determine the time period of completeness has been resolved by STEPP (1971), who has proposed a method, which is based on the selection of subinterval, in which the mean recurrence rate is stable for a particular magnitude range. BURTON *et al.* (1984) extend a simple modification of Stepp's method to resolve this problem.

In this study, the subintervals of time period are selected on the basis of existing data (instrumental and/or macroseismic) and the period, where the Algerian networks were in operation. The threshold magnitude (TM) for each subcatalog and for each zone is determined from cumulative frequency-magnitude relation. For example in the case of the eastern part (zone III), Figure 3 gives the plot of the cumulative law displayed for the two subcatalogues. The same procedure is used in the others zones to determine TM. The magnitude errors have been subjectively proposed.

Table 1

Subcatalogues for seismic hazard evaluation in the northern part of Algeria. Threshold magnitude (TM), time period (TP), magnitude errors (ME), and relative contribution of each subcatalogue to the evaluation of b-value (b%) and parameter λ *(*λ*%)*

Region	Type	*TP*	*TM*	*ME*	*b*(%)	λ(%)
Algeria	Extremes	1673–1895		0.5	38.3	7.7
	cpal1	1900–1949	4.1	0.5	15.5	17.2
	cpal2	1950–1959	4.1	0.4	17.6	30.4
	cpal3	1960–1970	4.0	0.3	10.6	16.7
	cpal4	1971–1992	4.0	0.2	17.9	27.9
West	Extremes	1790–1907		0.5	38.7	9.5
	cpw1	1910–1959	4.10	0.3	37.9	45.7
	cpw2	1960–1992	3.40	0.2	23.4	44.8
East	Extremes	1850–1908		0.5	25.5	7.7
	cpe1	1912–1959	4.1	0.4	31.4	38.1
	cpe2	1960–1992	4.0	0.3	43.1	54.2
Central	Extremes	1673–1909		0.5	46.0	12.5
	cpc1	1910–1950	4.1	0.5	10.3	12.3
	cpc2	1951–1959	4.1	0.4	19.8	36.2
	cpc3	1960–1980	4.0	0.3	13.5	21.9
	cpc4	1981–1992	4.0	0.2	10.4	17.1
Algiers	Extremes	1673–1909		0.5	43.8	12.7
	cpa1	1910–1959	4.1	0.5	37.7	58.1
	cpa2	1960–1992	4.1	0.3	18.5	29.2
El Asnam	Extremes	1891–1910		0.5	9.8	0.9
	cpch1	1910–1959	4.1	0.5	57.8	63.2
	cpch2	1960–1992	4.1	0.3	32.5	35.9

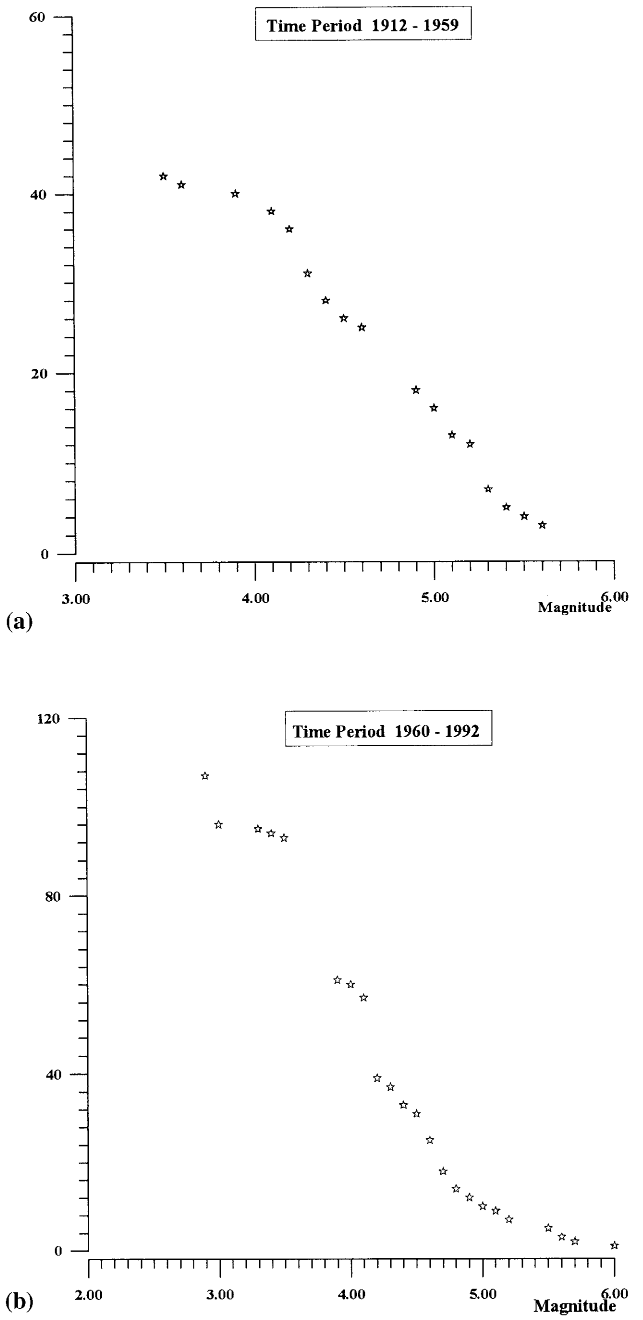


Figure 3
Determination of the threshold magnitude for each subcatalogue in the eastern part (zone III) by displaying the cumulative frequency: (a) for the time period 1912–1959. (b) for the time period 1960–1992.

The relative contribution of each subcatalogue to the evaluation of the b-value and the activity rate parameter λ for each zone is given in Table 1. The results obtained in some regions can be explained as follows: in the western region (zone I), the extreme part and the two completed subcatalogues contribute approximately the same to the evaluation of the parameter b. However, the second subcatalogue (cpw2 in Table 1) contributes higher to the evaluation of the parameter λ.

We note that in the central region (zone II), the relative contribution to the extreme part is equal to the sum of the complete subcatalogues (cpc1, cpc2, cpc3, cpc4 in Table 1). Nevertheless, the recent period (1981–1992) denoted cpc4 in Table 1, shows a relative weak contribution to the evaluation of b-value. Concerning the activity rate parameter λ, the higher values are obtained by the two completed subcatalogues cpc2 and cpc4 (time period 1951–1980 and 1981–1992). These results agree with the 1954 and 1980 seismic crises, which occurred in the El Asnam region (zone II_a). The same remark can be made in the eastern region (zone III), where the 1985 seismic crisis (Constantine earthquake, 27 October 1985, $M = 5.9$) affected the relative contribution of the second complete subcatalogue (cpe2, 1960–1992) to the evaluation of the λ parameter. This result could be explained by the 1960 installation of the seismological networks through the world, as the WWSSN network.

In view of Figure 2, the Algerian seismic activity is concentrated in the central region with two patterns distributed around El Asnam (zone II_a) and Algiers area (zone II_b).

Table 1 shows that the historical data of the Algiers area more highly contributes to the evaluation of b-value than the El Asnam area. However, both the relative contribution to the evaluation of b-value and activity rate or the two others subcatalogues (cpch1 and cpch2) are most important in the El Asnam area (Cheliff basin). This could be interpreted as follows: during this century (from 1910), the number of moderate earthquakes which affected the region of El Asnam (zone II_b) is more important, than those of the Algier's area (zone II_b Mitidja basin). On the other hand, the seismic activity of the Algiers region for anterior centuries was more important, particularly because this region was affected by earthquakes which more than once caused the destruction of Algiers and its surroundings (e.g. 03/01/1365; 10/03/1673; 03/02/1716, $I_0 = X$).

The results of entire Algeria, presented in Table 1, are very similar to those obtained for the central region (zone II). The analysis of the distribution of epicenters in space during the last centuries (BEZZEGHOUD *et al.*, 1995a) leads to the conclusion that the earthquakes in Algeria occurred particularly in some Tellian Atlas zones; Cheliff, Mitidja and Constantine basins (see Fig. 2). Our results (Table 1) corroborate this observation, particularly for the Cheliff and Mitidja basin.

The seismic hazard parameters (b-value, λ, $m_{\max}$) obtained in this study for each zone are presented in Table 2. It is known that it is possible to use the b-value as an indicator for the mechanical properties in the seismogenic material, such as stress concentration, crack density and degrees of heterogeneity. The results in

Table 2 can attest to this fact. The b-value obtained in the Algiers and El Asnam areas reflects as explained presently the seismicity of these regions. The b-value obtained for the El Asnam area ($b = 0.61 \pm 0.06$) reflects the energy released by the presence of different faults of different types as explained by MEGHRAOUI (1988). VILLA (1980) provides a representation of the faults existing in the eastern region (zone III) which confirms the result of the b-value obtained in this zone (low b-value).

This model proposed by KIJKO and SELLEVOLL (1989, 1992) and described in the previous section, is also applied to the proposed main seismogenic regions of the northern part of Algeria in order to compute the return period, the annual seismic activity rate and the probabilities of a non-exceedence during time periods of one year and 50 years. Tables 3 and 4 set forth respectively the probabilities of non-exceedence, and the return period for the magnitude ranging between 4.5 and 7.5 Figure 4 displays the return period for each magnitude treated in this study and for each zone. It is important to note that the mean annual activity rate obtained in the northern part of Algeria is approximately three earthquakes with magnitudes ranging between 4.0 and 4.5.

Conclusions

This study is an attempt using probabilistic assessment to estimate the seismic hazard parameters in the northern part of Algeria. The procedure used permits the combination of both historical and instrumental data. The obtained results yield significant information about seismic hazard analysis (b-value, $m_{\max}$ expected, return period, annual activity rate,...).

The return periods we have estimated evidence that the El Asnam (zone II_a) is the most concerned, with a return period ranging between 70 and 230 years for magnitudes 7.0 and 7.5. Paleoseismic studies suggest (MEGHRAOUI, 1986, 1988; SWAN, 1988) that the three most recent surface faulting events were separated by

Table 2

Estimated seismic hazard parameters and their standard errors. b-value, activity rate λ_x, expected maximum magnitude $m_{\max}$, and N the time span of the catalogue

Region	b-value	λ_x	$m_{\max}$	N
West	0.71 ± 0.06	$\lambda_{3.4} = 1.78 \pm 0.19$	6.81 ± 0.79	142
Central	0.65 ± 0.01	$\lambda_{4.0} = 2.00 \pm 0.02$	7.72 ± 0.68	319
East	0.69 ± 0.07	$\lambda_{4.0} = 1.33 \pm 0.13$	6.80 ± 0.69	140
Algeria	0.73 ± 0.03	$\lambda_{4.0} = 3.53 \pm 0.70$	7.72 ± 0.70	319
Algiers	0.75 ± 0.07	$\lambda_{4.0} = 1.05 \pm 0.11$	7.30 ± 0.80	319
El Asnam	0.60 ± 0.06	$\lambda_{4.1} = 1.29 \pm 0.12$	7.90 ± 0.61	101

Table 3

Probabilities of non-exceedence in the studied region, during the time period $T = 50$ and 100 years for magnitude range 4.5 to 7.5.

	Region											
	West		Central		East		Algeria		Algiers		El-Asnam	
Mag.	50y	100y	50y	100y	50y	100y	50y	100y	50y	100y	50y	100y
4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
4.5	0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	0.0028	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0002	0.0002	0.0	0.0
5.5	0.0919	0.0084	0.0001	0.0	0.0063	0.0	0.0	0.0	0.0353	0.0353	0.0002	0.0
6.0	0.4209	0.1771	0.0131	0.0002	0.1562	0.0244	0.0087	0.0	0.3230	0.3230	0.0178	0.0003
6.5	0.8149	0.6640	0.1597	0.0255	0.6469	0.4185	0.1622	0.0149	0.8689	0.8689	0.1607	0.0258
7.0			0.5101	0.2602			0.5374	0.2366			0.4724	0.2231
7.5			0.8746	0.7650			0.8779	0.7630			0.8016	0.6426

Table 4

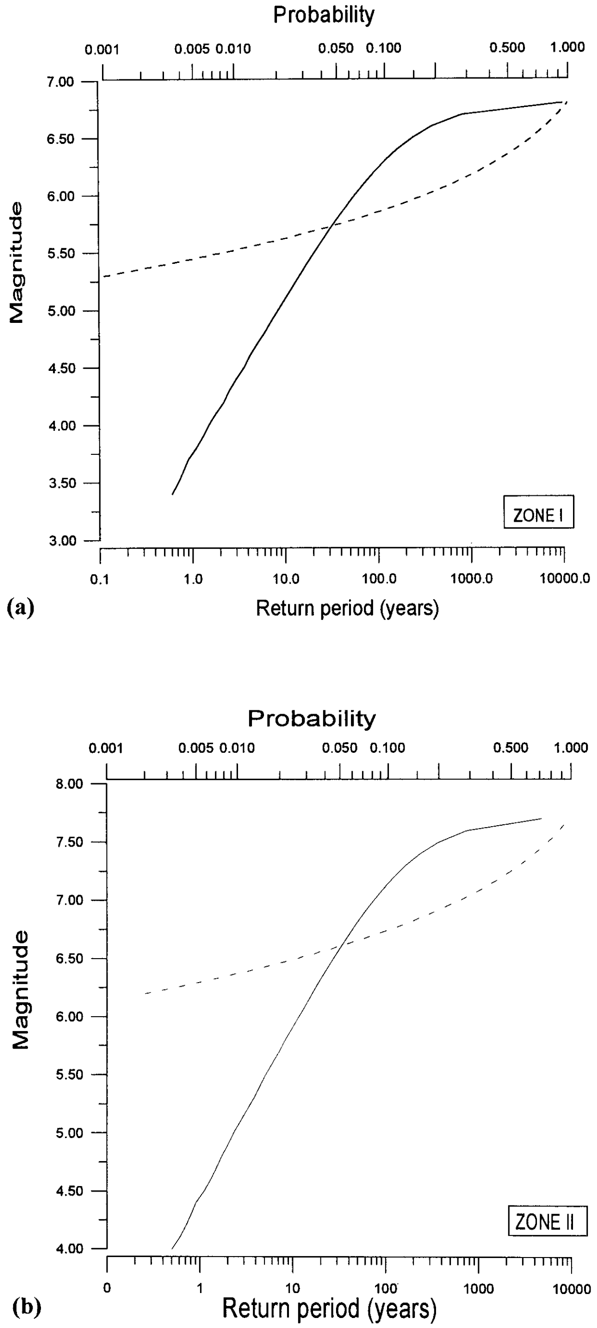
Mean return period in the studied region, for magnitude range 4.5 to 7.5

	Region					
Mag.	West	Central	East	Algeria	Algiers	El Asnam
4.0	1.5	0.5	0.8	0.3	1.0	
4.5	3.6	1.1	1.7	0.7	2.0	1.4
5.0	8.5	2.3	4.0	1.6	4.8	2.8
5.5	20.9	5.1	9.9	3.8	11.9	5.9
6.0	57.8	11.5	26.9	9.3	30.9	12.4
6.5	244.2	27.3	114.8	23.8	89.3	27.3
6.8	9827.8	48.3	>1000	44.0	196.2	45.8
7.0		74.3		69.4	398.9	66.7
7.2		122.8		117.6	1444.4	101.5
7.5		373.3		383.9		226.1
7.7		4810.4		4858.1		526.8
7.8						1134.3

300 to 500 years. Considering error interval linked with paleoseismic measurement and our model used in this study, the obtained values of the return periods ($T \geq 230$ years) are significant, in particular for a magnitude greater than 7.0. For magnitude $M = 6.5$ the return period is 30 years. This fact reflects the earthquakes recorded in this region during this century. Recently, LAMMALI *et al.* (1997) show clearly from seismotectonic analysis, that the thrusting and uplift observed near the El Asnam area are most significant in the western part of Algeria.

In the central region (zone II), the return periods estimated for earthquakes of magnitudes greater than $M = 7.0$ are 1000 years and more. Effectively, the spectacular topographic features in this region, particularly the Kabylias region (Djurdjura, 2302 m high), present significant geomorphologic features which indicate past seismic activity. The small earthquake ($M \leq 5.5$) recorded in this area during these last three centuries (BENOUAR, 1994; CRAAG, 1994) could not explain the tectonic deformations observed in this area. It seems rather that this geomorphologic evidence is associated with strong thousand year old earthquakes ($M > 7.0$). From digital elevation models and remote analysis (Landsat image aerial photos) associated with the tectonic analysis, BOUDIAF and PHILIP (1996) demonstrate that the quaternary deformations in the northern side of the Soumam basin (scarp of 10 m) are probably generated by strong earthquakes whose return period will be 1000 years and more. Our results in this region corroborate these tectonic deformations.

In the Algiers region (zone II_b), the return period estimated is 100 years for magnitude $M = 6.5$, reflects the record earthquake in the region (BEZZEGHOUD *et al.*, 1995a). The lack of data greater than $M = 7.0$ does not permit estimation of the return period for a magnitude greater than $M = 7.5$.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0.050 0.100
0.500 1.000
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
Magnitude
ZONE I
0.1
1.0
10.0
100.0
1000.0
10000.0
Return period (years)
(a)
Probability
0.001
0.005 0.010
0.050 0.100
0.500 1.000
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
Magnitude
ZONE II
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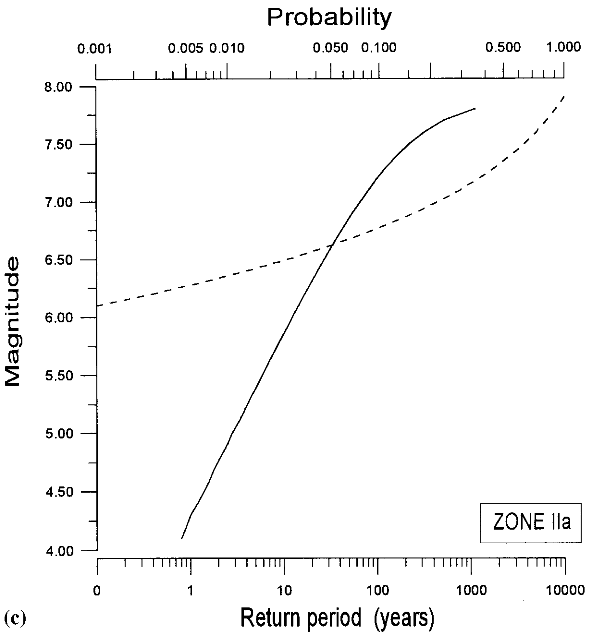
1
10
100
1000
10000
Return period (years)
(b)

Figure 4 (a,b)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0.050 0.100
0.500 1.000
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7.00
6.50
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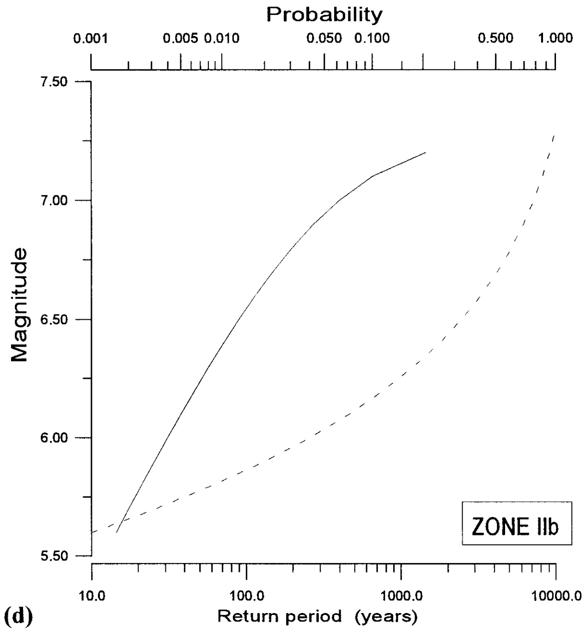
1
10
100
1000
10000
(c)
Return period (years)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(d)
Return period (years)

Figure 4 (c,d)

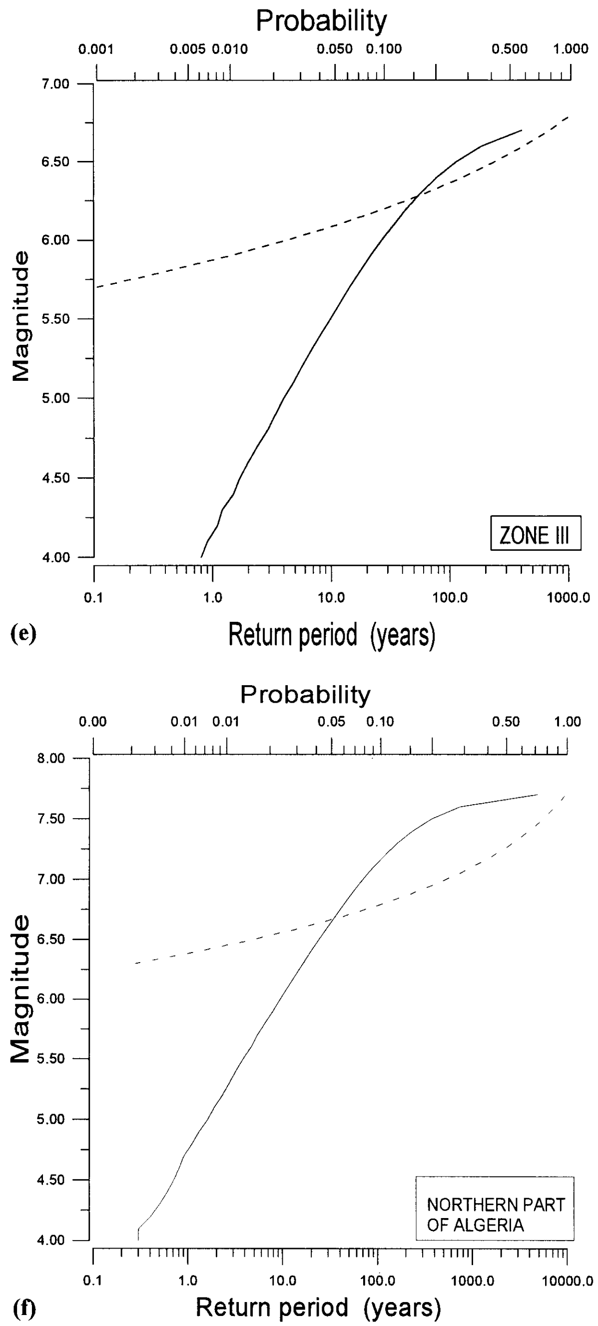

Figure 4 (e,f)

Mean return period (solid line) and probability of non-exceedence (dashed line) during the time period $T = 100$ years, for the proposed main zone and for the northern part of Algeria: (a) zone I, (b) zone II, (c) zone III, (d) zone II_a, (e) for the northern part of Algeria, (f) zone II_b.

In the western part of Algeria (zone I) a paradox is observed. Although the return periods are 1000 years for earthquakes of magnitudes $M > 7.0$, none of the geomorphologic evidence has been observed. This is due to a lack of seismicity and insufficient topographic or seismotectonic works in this region, as in the others (Cheliff basins, Mitidja basins,...) where many studies have been made, e.g., ROUSSEL (1973a,b), BENHALLOU (1985), AMBRASEYS and VOGT (1988), PHILIP and MEGHRAOUI (1983), MEGHRAOUI (1986, 1988) and OUYED *et al.* (1980).

Knowledge of the return period is of great importance in studying and analysing seismic hazard and/or seismic risk. It contributes with great importance to the determination the national seismic code, according to which building of different categories (normal, strategic, monumental) must be constructed, and it conditions the priority of interventions on existing buildings. The methodology used in the present work for seismic hazard evaluation provides a convenient tool for obtaining estimates of the frequencies of earthquake occurrence. The most interesting aspect of the method is the possibility of combining the strongest historical events with complete instrumental records. The results obtained in this study, using probabilistic assessment present a prior picture on seismic hazard in the northern part of Algeria. In some regions of Algeria these results corroborate with seismotectonic results and in others, particularly in the western part of Algeria (Oranie), they must be followed by more studies.

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