Natural Hazards and Earth System Sciences : Interactive comment on "Study of the seismicity temporal variation for the current seismic hazard evaluation in Val d'Agri, Italy" by I. Baskoutas et al.

Anonymous Referee #2

Ref Comment: From P. 4422 onward
The authors should specify the magnitude scale at which the value is related.
ANSWER:
The magnitude refers to Ml. The suggestion was adapted.

Ref Comment: P. 4423, lines7-10
This comment seems to me questionable, but it is certainly not necessary.
ANSWER:
This work as its title states, is examining the seismic temporal variation, in Val d Agri area, by using new tool of the seismic analysis, which are suited to monitor seismic changes. With the proposed methodology can be evaluated the level of the seismic activity, by monitoring the monthly temporal evolution of the lower and higher probability periods sequence, which can be seen in the seismic parameters temporal variation curves.
Given that the abstract summarizes (among others) the major results and the author's interpretations, this sentence states for the interpretation of the obtained curves and is closely related to our results.

Ref Comment: P. 4423. line 20
On the basis of what is said in the paragraph "Method" this parameter should threshold, that occurs in the unit of time. and
P. 4423. line 22
It would be more correct to say seismic energy released per unit of time by earthquakes with magnitude greater than the magnitude of completeness.,
ANSWER:
The referee is right, information is added although the same appears later: "*The number of earthquakes per unit time, log N, is obtained by the means of the follow formula*:"
All parameters occur in the unit of time but also all of them refer to a fixed lower magnitude threshold. This threshold is not always the magnitude of completeness.
The magnitude of completeness guarantees the homogeneity of the catalog which is used, especially in the case of the examination of quite long time periods.

Ref Comment: Eq. 1
The first parameter used to monitor the time evolution of the seismicity of the investigated area is the logarithm of the number of unit time should be estimated, earthquakes per unit time.
The number of earthquakes per in fact, by the argument of the logarithm in equation 1; I think that this formula is written incorrectly *i* is used as the index of summation, it is therefore be an integer, its minimum value is set equal to *t-w*; it would be appropriate to explain how the time has been measured to meet this condition.
I believe that even the upper limit of the summation should be a time, not a number of earthquakes in a time interval. It seems to me, also, that the argument of the summation should not be the same index *i*
ANSWER:
The equation and its terms explanation text were revised in order to be clearer, as follow:

$$\log N(t) = \log\left(\sum_{i=n(t-w)}^{n(t)} i\right)$$

where i- is the serial number of an earthquake wi1th magnitude Ml ≥ Mmin, Mmin- is the completeness magnitude for sampling data, t- is the time (in months), w- is a temporary window smoothing (in months), and n (t – w)- is the initial number of earthquake in the window smoothing, n(t) is the finite number of earthquakes in the window smoothing

Ref Comment: Eq. 1 P. 4425. line 12
Authors should say whether the magnitude values listed in the catalog are directly related to the moment magnitude scale, or whether they were transformed by an empirical correlation law.

The magnitude used in this study is Ml and not Mw. Mistyping is corrected.

Ref Comment: P. 4425. line 13
The meaning of the times *t* and *w* should be explained more clearly. As mentioned in the next paragraph it seems that *w* indicates the length of the estimation time window and *t* the advancement step of this window.

ANSWER:

t- is the time (in months)
w- is a temporary window smoothing (in months),

Ref Comment: P. 4425. line 16
Justify the formula used to estimate the standard deviation of log N.

ANSWER:

Taking into account the fact that the time distribution of earthquakes obeys Poisson's law and that the root mean square (rms) error of calculation of *N* is

$$\sigma_N = \sqrt{N}$$

we can estimate the rms error of the logarithmic number of earthquakes, which is equal to the differential of this function :

$$\sigma_{\lg N} = 0.4343/\sqrt{N}$$

Ref Comment: Eq. 2
Also this equation should be corrected as can be seen comparing it with the equation 1 in Papadopulos and Baskoutas (2009) or with the equation 3 in Zavyalov (2005).

ANSWER:

The equation 2, which appears in Papadopulos and Baskoutas (2009), was revised later in Popandopulos and Baskoutas (2011).

Ref Comments:
P. 4425. line 12.
P. 4425. line 13,
P. 4425. line 16 and
P. 4426, lines 19 Fig. 4.
P. 4426, lines 21 For normally distributed errors the confidence level of the interval +/- sigma is about 68 %.
P. 4426, lines 23 Vertical lines.
P. 4427, lines 1 Averaging window.

ANSWER:

Taking into account the above comments the old (strikethrough text) :

~~Figure 3 show, from the top to at the bottom, the temporal variation of the seismic parameters *logN, b-value and logE*$^{2/3}$ and their rms scatter *(1σ)* of the data, corresponding~~

~~to a 70% confidence interval. These errors are reported in this graph as horizontal lines, on either side of the average value in the case of the parameters *logN* and $logE^{2/3}$. The standard error of the *b-value* estimate refers at each step of averaging.~~

was revised as:

Fig. 4 show, from the top to at the bottom, the temporal variation of the seismic parameters log *N*, *b* value and log$E^{2/3}$. Their rms scatter corresponding to a 70% confidence interval can be seen as horizontal lines on either side of the average value of the parameters log *N* and log *E*2/3. The standard error of the *b* value, which is shown by vertical lines, refers to the monthly estimates.

Ref Comment: Eq. 3
also equation 3 should be revised and properly discussed. It is not clear if the authors want to determine the average energy of the earthquakes occurred in a given time interval (about one year in this application) or the energy released per unit of time (one month in this application).

ANSWER:

The algorithm of constructing the time series for all examined parameters is presented widely in previous works (Papadopoulos and Baskoutas, 2009, Popandopoulos and Baskoutas, 2011)

Briefly this procedure is as follow:
The temporal variation for each parameter is obtained with a constant time step of one month. These monthly cumulative values allow the statistical evaluation of any time interval greater than a month, by the means of recursive formulas.
The obtained monthly values of the time series are then smoothed with running overlapping time windows shifted by one month.
The time duration of the smoothing window depends on the available seismic data.
The series are filtered by a triangular filter (to avoid side distortion).
Practically this last filter acts as a low pass filter that allows passing without distortion signals with periods longer than the half a the window length.
This consideration suggests that two or more successive strong events, which their origin time distances about the filter width, can be associated to the same anomaly

Ref Comment: Authors should also indicate the empirical correlation law by which they have calculated the energy of the seismic events.

ANSWER:

Actually the FastBEE algorithm uses the formula proposed by Papazachos and Papazachos (2000). This formula was not changed in the present study since doesn't affect the temporal characteristics of the obtained curves.

Ref Comment: The general suggestion that I would give to the authors, aimed at redrafting the description of the three parameters is to split, initially, the whole analysis period in a number of indexed contiguous elementary time windows, with amplitude equal to the advancing step. It should also be easy to specify the size of the calculation window in terms of this index.

ANSWER:

It is interesting suggestion which we will examine properly in another work.

Ref Comment: P. 4426, line12 The authors state that in the studied area, there are two major seismogenic volumes. Assuming independence between the seismogenic processes taking place in each be appropriate that the authors also analyze, separately, the seismic activity of the two seismogenic volumes.

ANSWER:

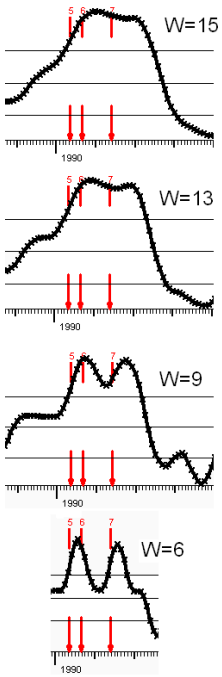
In fact the available data for the examined area comes from two major seismogenic volumes. Unfortunately due to low seismicity each area can't be examined separately, besides the aim is to study is examined Val d' Agri area.

P. 4427, line 2
How have been optimized the analysis window width and the advancement step?.
Optimization of the analysis window is obtained through iterative trials and depends on the seismicity characteristics of each examined area.

Ref Comment: What is effect of the variation of these parameters on the final curves?
How the minimum magnitude for which there is a significant correlation between estimated high probability intervals and actual occurrence of earthquakes depends on the width of the analysis window,?
Would be interesting that the authors show the results obtained using, at least, another smoothing window of different length.

ANSWER:

The overall temporal variation character of the obtained curves and described by the proposed precursory pattern doesn't change. The shorter the filter of the analysis is the better the resolution, depending on the available data. Bellow is an example of the temporal variation of $\log E^{2/3}$, for events 5, 6, 7 by using filter of 15, 13, 9 and 6 months.



Ref Comment: P. 4427, lines 5-10 It is not clear the meaning of this sentence.

ANSWER:

This argument already was reported in the earlier "Method" part. Probably here the way this magnitude definition, which is described in earlier publication, is better to omit here

Ref Comment: Better express the concepts. In particular, it is not clear because the curve relative to the first parameter is not considered reliable, since it is clearly correlated with curve 3, as we expected because of the narrow range of variability of the energy of the earthquakes considered.

ANSWER:

the old (strikethrough text - P. 4427, lines 5-10) :

~~*In fact the overall temporal variation of logN follow the same behaviour, but as it was found in previous works this parameter is less informative, nevertheless it contains*~~

~~*information which help in the interpretation of the behaviour of the curves of the other two other parameters.*~~

Was revised as:
These events, as was pointed out earlier, report the lower magnitude earthquakes threshold that fit better with the observed significant temporal variation changes occurred in the area. They were determined in an error and trial iterative procedure, considering the longest available seismic data set.
Because of the low seismicity, the available number of data and their magnitude variance as well, which in many cases is less than 2.5, do not allow reliable calculation of b value, (as illustrated in Fig. 3) and hence ….

Ref Comment: P. 4427, lines 17-20 It would be interesting to analyze the trend of the parameter log E2/3 in the absence of the earthquakes reported in Tab. 1 and Fig 5.
ANSWER:
The absence of earthquakes as it is obvious doesn't contribute to the parameters fluctuation, therefore the appearance of the curves is flat, until the addition of new data, which can change this behavior.

Ref Comment: P. 4428, lines 5-8
It seems that there is not an exact match between the data of Table 2 and the abscissas of the relative maxima and minima identified in Figure 5. Why?
The description of the trend of the signals should highlight the most significant aspects of it; for example, the regularity of the distances between consecutive relative minima and maxima, the range of variability of the parameter, etc. The association of intervals where the curve has decreasing trend with periods characterized by low probability of occurrence of events of great magnitude should be supported by further theoretical considerations (possibly) and referring to other applications reported in the literature.
ANSWER:
In reality the relative minima are not measured directly from the figures (Fig 5). The numerical estimates can be taken from a file, which is reporting them. Of course the visual inspection of the figures helps to monitor these changes immediately.

Ref Comment: P. 4428, line 20Three parameters were calculated, but the trends are probably significant only for two of them.
ANSWER:
Actually we consider and we discuss the significant temporal changes in all three parameter, according to the suggested precursory pattern, despite the final result (in this case due to low number of data) were based in the analysis of just one parameter.

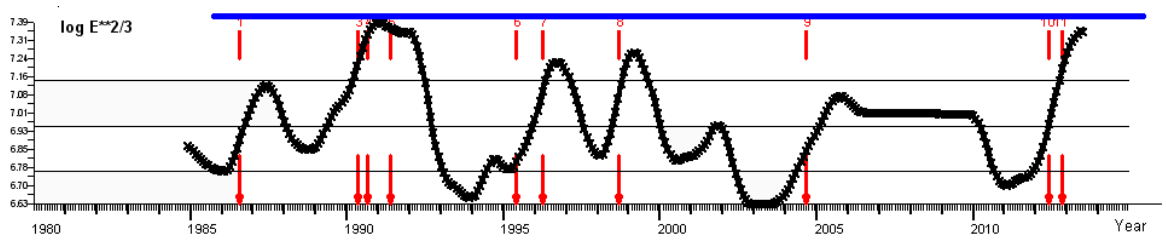
Ref Comment: P. 4428, lines 23-25
I believe that the authors should specify the process of preparing an earthquake with a magnitude greater than a given threshold. It is not clear the meaning of the statement of lines 25-27; reformulate or remove.
ANSWER:
The reference (Popandopoulos and Baskoutas, 2011), which is added contains all details. We believe that is meaning less to report this information again, especially in this part, moreover, this information, is beyond of the scope of this paper..

Ref Comment: P. 4429, lines 5-7 Authors should also provide estimates of the variability of the two periods of which provide the average value.
ANSWER:
The variability can be added, but do not add significant information. The crucial point in this approach is the capability to monitor clearly the beginning and the end of the successive low and the high probability periods.

Ref Comment: P. 4429, lines 8-11 It does not seem that there is clear evidence that at the end of 2013 we can place the beginning of a period of low probability of occurrence of events with M> 4.

ANSWER:

Probably we should write "next to the year 2013 probably will start… ", but it is certain that during 2013 can be observed a trend to change the curve behavior. If not it mean that amplitude of $\log E^{2/3}$ estimates will grow abnormally further exceeding the upper limit. Nevertheless the analysis by adding new data can give a clearer image of the future temporal behavior of this curve. This is exactly the importance of the proposed methodology.



Ref Comment: P. 4429, lines 11-14 This work is useful for the assessment of the method FastBEE but certainly not enough to declare that this method allows the evaluation of the seismic hazard at a given time in a specific place.

Of course FastBEE is has nothing to do with the Seismic Hazard Assessment, which is connected with a very precise methodology to asses the strong ground motion in a given place. In fact FastBEE, as was stated in all previous published or not works, is a tool suited to obtain temporal variation of a set of selected seismicity parameters with the aim to estimate quickly changes that can be interpreted as a signal for impending strong earthquake in a given place.