

Time dependent hazard in mining front surroundings user guide

i To estimate time-dependent values of seismic hazard parameters: the activity rate, the Gutenberg-Richter b-value, the return period and the exceedance probability for a space window surrounding an advancing mining front. The parameter values for the time moment t are estimated optionally either from events that occurred in dt time units preceding t , where dt is kept constant, or from n last events before t , where n is kept constant, or from a time period during which the front advanced by a constant length dx . For the magnitude distribution estimation methods please refer to the "Stationary Hazard" application.



REFERENCES [Document Repository](#)

CATEGORY Probabilistic Seismic Hazard Analysis

KEYWORDS Statistical analysis, Probabilistic seismic hazard analysis, Time-dependent hazard, Production-dependent hazard, Production - seismicity interaction

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Step by Step

Two input files needed for running this Application. The seismic events catalog and the mining front advance files, both available in the AH Episodes (See "AH Episodes" chapter). Once these files are uploaded to the personal workspace, the User may load them into the TDSH (mining front) application, by clicking on the 'Actions' tab and then select consecutively, 'USE IN APPLICATION' and 'Hazard in mining front surroundings', as shown in Figure 1.

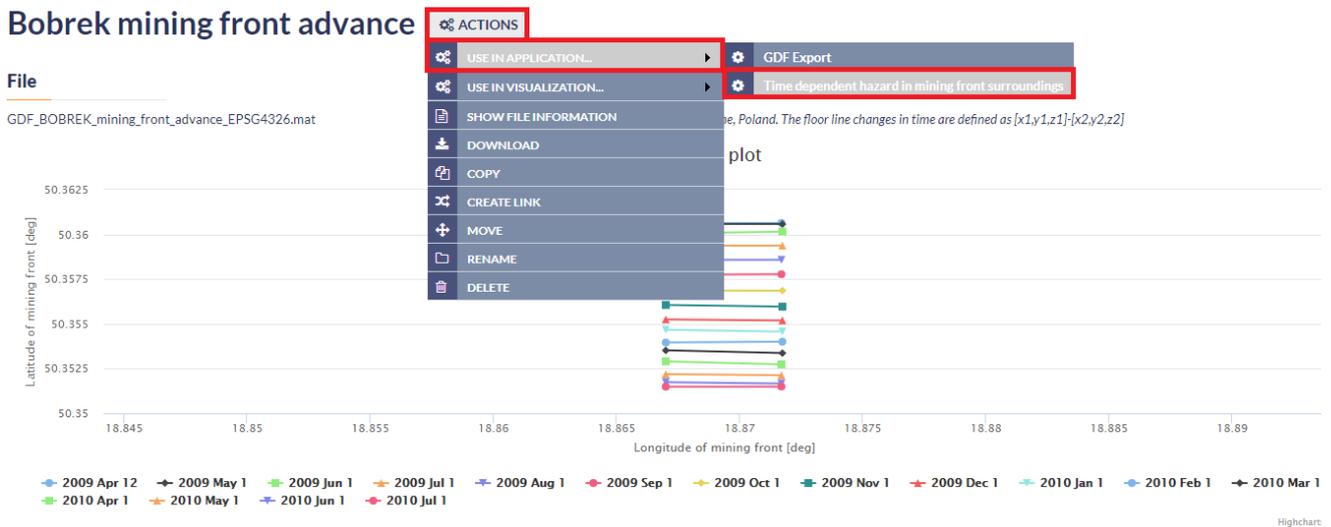


Figure 1. Selection of mining front advance for the application

After the application has been selected the User is requested to select options and fulfill some fields with parameter values needed for the TDSH analysis. First of all, he/she needs to select the proper seismicity catalog from the workspace, by clicking on the 'Change file' tab of the 'Using seismic Catalog' field, shown in the red box in Figure 2. The other parameters that have to be set are (also shown in Figure 2):

Time dependent hazard in mining front surroundings 

File

TDSHTimeVaryingGeom

Description

To estimate time-dependent values of seismic hazard parameters: the activity rate, the Gutenberg-Richter b-value, the return period and the exceedance probability a space window surrounding an advancing mining front. The parameter values for the time moment t are estimated optionally either from events that occurred in dt time units preceding t , where dt is kept constant, or from n last events before t , where n is kept constant. Four magnitude distribution estimation methods are supported: maximum likelihood using the unbounded Gutenberg-Richter relation based model, maximum likelihood using the upper-bounded Gutenberg-Richter relation based model, unbounded non-parametric kernel estimation, upper-bounded non-parametric kernel estimation. The upper limit of magnitude distribution is evaluated using Kijko-Sellevoi generic formula.

INPUTS

1 / 1	Catalog	<input type="text" value="Tetsing_Platform/InterEventTimeDist (1)/BOBREK_catalog.mat"/>	From Tree ▾	CHANGE FILE
1 / 1	Mining Front Advance	<input type="text" value="Tetsing_Platform/InterEventTimeDist (1)/GDF_BOBREK_mining_fron"/>	From Tree ▾	CHANGE FILE
Select Magnitude column		ML ▾		
Mmin M range (0.0, 3.7)		<input type="text" value="0.6"/>	HISTOGRAM	CUMULATIVE HISTOGRAM
Time range		Start <input type="text" value="2009 Apr 12 21:34:03.7"/>	End <input type="text" value="2010 Jul 07 22:47:39.0"/>	SEISMIC ACTIVITY PLOT
Margin along front strike [m]		<input type="text" value="50.0"/>		
Distance along the front advance [m]		<input type="text" value="100.0"/>		
Time unit		Day ▾		
Magnitude distribution estimation method		Unbounded Gutenberg-Richter model ▾		
Method of creating time windows		Constant time period ▾		
Window time step [days]		<input type="text" value="10"/>	Window size [days]	<input type="text" value="100"/>
Magnitude		<input type="text" value="3.5"/>		
Period length (for exceedance probability)		<input type="text" value="100.0"/>		

ABORT Status RUNNING

Figure 2. Input parameters and files for the application

Select Magnitude column: The user may click on the small arrow in the respective tab in order to choose among different magnitude scales, in the cases where they are available (e.g. ML, Mw, etc.).

The magnitude range (minimum and maximum magnitude assigned in the catalog) is shown on the screen (M range, Figure 2) for informative purposes.

Mmin: The User now is requested to choose the minimum magnitude (completeness level of the catalog). This can be done in two ways. The first is to type a single magnitude value in the empty box, possibly after he/she has performed an individual analysis (see "Completeness Magnitude Estimation", CME application). The second is to graphically select the minimum magnitude from the Normal or the Cumulative histograms, which are available after clicking on the respective tabs. In both cases there is an option to alter the step of the histogram's bars and to choose between linear and logarithmic scale of the Y-axis for the plotting.

Time range: The User may further filter the selected dataset by defining the starting and ending data of the period that he/she wishes to study. A calendar appears on the screen after clicking in the empty boxes next to 'Start' and 'End' fields (Figure 2). Note that this selection is optional. If no dates are entered, the entire dataset remains for the analysis.

Margin along front strike [m]: The distance (margin) along the front strike is requested in this field. This distance is equal for both directions of the front strike. Events will be spatially constrained by this margin together with the 'Distance along the front advance' (see field below).

Distance along the front advance [m]: The distance along the front advance is requested in this field. This distance is equal for both sides of the front (i.e. in front of and behind the front). Events will be spatially constrained by this margin together with the 'Margin along the front strike' (see field above).

Time unit: There are 3 options for this parameter, which are shown after clicking on the small arrow in the box: Day, Month, Year. The time unit will be stored and all the calculations hereinafter will be performed according to this unit.

Magnitude distribution estimation method: Four different methods are available in the EPISODES Platform: The Unbounded Gutenberg-Richter, the Upper-bounded Gutenberg-Richter, the unbounded non-parametric and the Upper-bounded non-parametric estimations. To select one of the aforementioned methods of analysis, the User has to click on the arrow in the respective box.

Window time step (days): In this field the User selects the time window step, i.e. the number of days between the starting dates of subsequent datasets (see Figure 3 caption for details).

Magnitude: Magnitude for which the TDSH parameters will be calculated.

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Method of creating time windows: Three options are available in this field after clicking on the small arrow of the tab: 'constant time period', 'constant event number' and 'constant front advance size' (see "'Time window size' field below for details).

Window size: Size (span) of the windows containing data for the analysis. If time-mode is selected, the given value corresponds to the duration of each dataset, in days. If events-mode is selected instead, the given value corresponds to the number of events that each dataset contains (see Figure 3 caption for details). Finally, if the front-mode mode is selected, the given value corresponds to the meters of front advance, i.e. a subsequent time window start at the time when the front advance is moved as much (in meters) as this value indicates from the position it was in the beginning of the previous time window. Therefore, in this case, nor the number of events neither the time range will be equal in the datasets.

Period length (for exceedance probability): Duration of time period for which exceedance probability will be estimated for the magnitude specified above.

Time window details <i>Method "Time", Window Size "100"</i>			Time window details <i>Method "Events", Window Size "75"</i>		
No.	Number of events	Time range	No.	Number of events	Time range
1	17	2013 Aug 24 18:01:24.1 - 2013 Sep 23 18:01:24.1	1	75	2013 Aug 24 18:01:24.1 - 2013 Oct 24 09:26:48.6
2	17	2013 Aug 29 18:01:24.1 - 2013 Sep 28 18:01:24.1	2	75	2013 Aug 29 18:01:24.1 - 2013 Oct 28 02:18:48.7
3	21	2013 Sep 3 18:01:24.1 - 2013 Oct 3 18:01:24.1	3	75	2013 Sep 3 18:01:24.1 - 2013 Oct 31 01:24:36.1
4	17	2013 Sep 8 18:01:24.1 - 2013 Oct 8 18:01:24.1	4	75	2013 Sep 8 18:01:24.1 - 2013 Nov 9 13:58:34.5
5	26	2013 Sep 13 18:01:24.1 - 2013 Oct 13 18:01:24.1	5	75	2013 Sep 13 18:01:24.1 - 2013 Nov 15 02:09:54.2
6	42	2013 Sep 18 18:01:24.1 - 2013 Oct 18 18:01:24.1	6	75	2013 Sep 18 18:01:24.1 - 2013 Nov 18 17:47:38.1
7	40	2013 Sep 23 18:01:24.1 - 2013 Oct 23 18:01:24.1	7	75	2013 Sep 23 18:01:24.1 - 2013 Nov 22 05:23:09.3
8	40	2013 Sep 28 18:01:24.1 - 2013 Oct 28 18:01:24.1	8	75	2013 Sep 28 18:01:24.1 - 2013 Nov 24 00:37:55.5
9	34	2013 Oct 3 18:01:24.1 - 2013 Nov 2 18:01:24.1	9	75	2013 Oct 3 18:01:24.1 - 2013 Nov 28 02:43:51.0
10	34	2013 Oct 8 18:01:24.1 - 2013 Nov 7 18:01:24.1	10	75	2013 Oct 8 18:01:24.1 - 2013 Nov 28 16:24:20.2
11	25	2013 Oct 13 18:01:24.1 - 2013 Nov 12 18:01:24.1	11	75	2013 Oct 13 18:01:24.1 - 2013 Dec 7 03:10:18.2
12	11	2013 Oct 18 18:01:24.1 - 2013 Nov 17 18:01:24.1	12	75	2013 Oct 18 18:01:24.1 - 2013 Dec 15 11:04:52.4
13	12	2013 Oct 23 18:01:24.1 - 2013 Nov 22 18:01:24.1	13	75	2013 Oct 23 18:01:24.1 - 2013 Dec 17 20:30:43.3
14	13	2013 Oct 28 18:01:24.1 - 2013 Nov 27 18:01:24.1	14	75	2013 Oct 28 18:01:24.1 - 2013 Dec 18 02:43:50.2
15	14	2013 Nov 2 18:01:24.1 - 2013 Dec 2 18:01:24.1	15	75	2013 Nov 2 18:01:24.1 - 2013 Dec 19 01:46:53.7
16	19	2013 Nov 7 18:01:24.1 - 2013 Dec 7 18:01:24.1	16	75	2013 Nov 7 18:01:24.1 - 2013 Dec 19 09:33:15.5
17	16	2013 Nov 12 18:01:24.1 - 2013 Dec 12 18:01:24.1	17	75	2013 Nov 12 18:01:24.1 - 2013 Dec 25 02:22:05.1
18	14	2013 Nov 17 18:01:24.1 - 2013 Dec 17 18:01:24.1	18	75	2013 Nov 17 18:01:24.1 - 2013 Dec 28 09:30:41.4
19	24	2013 Nov 22 18:01:24.1 - 2013 Dec 22 18:01:24.1	19	75	2013 Nov 22 18:01:24.1 - 2013 Dec 30 01:34:37.6

Figure 3. Data windows determination: The time window step is set to 5 days in both cases. Notice that the each starting date has 5 days difference from the previous one. Left frame: Parameters set are 'Time window size' equal to 100 days and 'Method of creating windows' selected to be 'TIME'. In this case the number of events differs in each dataset, but the time range (difference between ending and starting dates) is 100 days for all the datasets. Right frame: Parameters set are 'Time window size' equal to 75 (events) and 'Method of creating windows' selected to be 'EVENTS'. In this case the number of events is the same in all dataset and equal to 100, but the time range (difference between ending and starting dates) is different for each dataset. However, when 'FRONT' is selected (not shown here), nor the number of events neither the time range will be equal in the datasets.

After selecting all the parameters needed the User may click on the run button (blue tab - Figure 2), for the calculation process to be initiated. The results of the process include:

- Information on the time windows created (Figure 3), shown after clicking on the 'Show details' tab.
- Numerical parameters resulted by the process, stored in the system, in the current folder (Figure 4). These outputs are available for demonstration and plotting (when possible).
- b-value and mean activity rate (Figure 5). Note that b-value is not plotted (and not estimated all) if a non-parametric approach is selected as 'Magnitude distribution estimation method'.
- Mean return period vs time (Figure 6).
- Exceedance probability vs time (Figure 7).

NOTE that figure have enabled the zoom option, the scatter/line.spline chart type and linear/logarithmic scale of the Y-axis option.

▼ **A** TDSHTimeVaryingGeom (2)

- D exc_prob_val
- D time_window_vector.mat
- D ret_period_val
- D ssh_params_vector.mat
- D exc_probability.mat
- D return_periods.mat

Figure 4. Outputs of the application

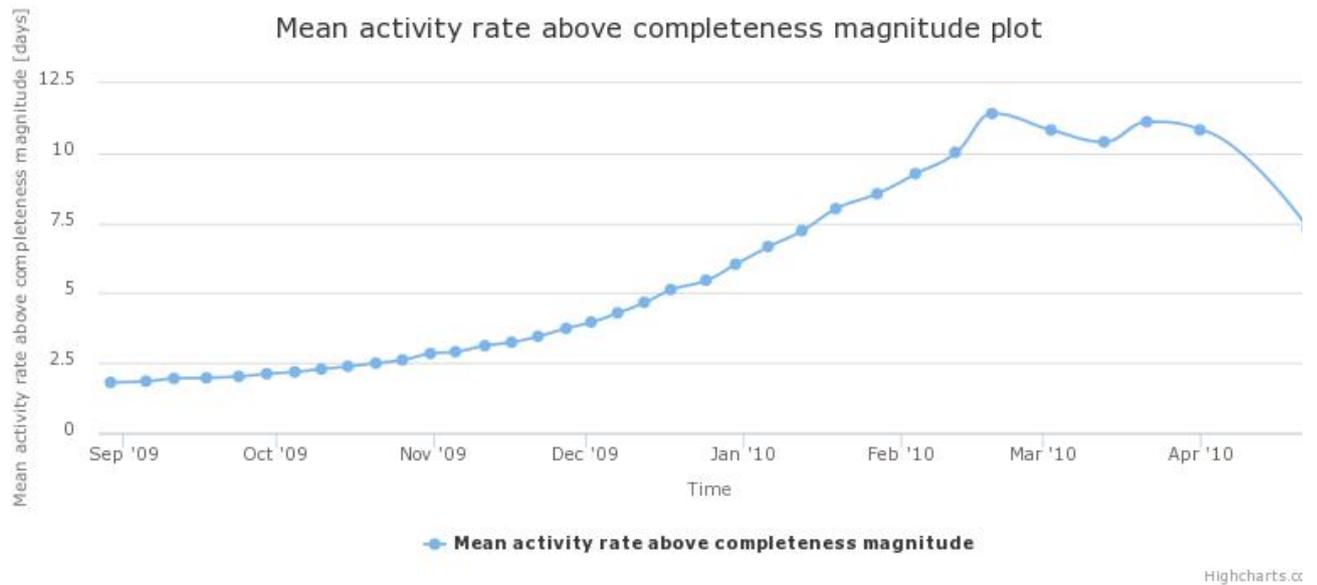
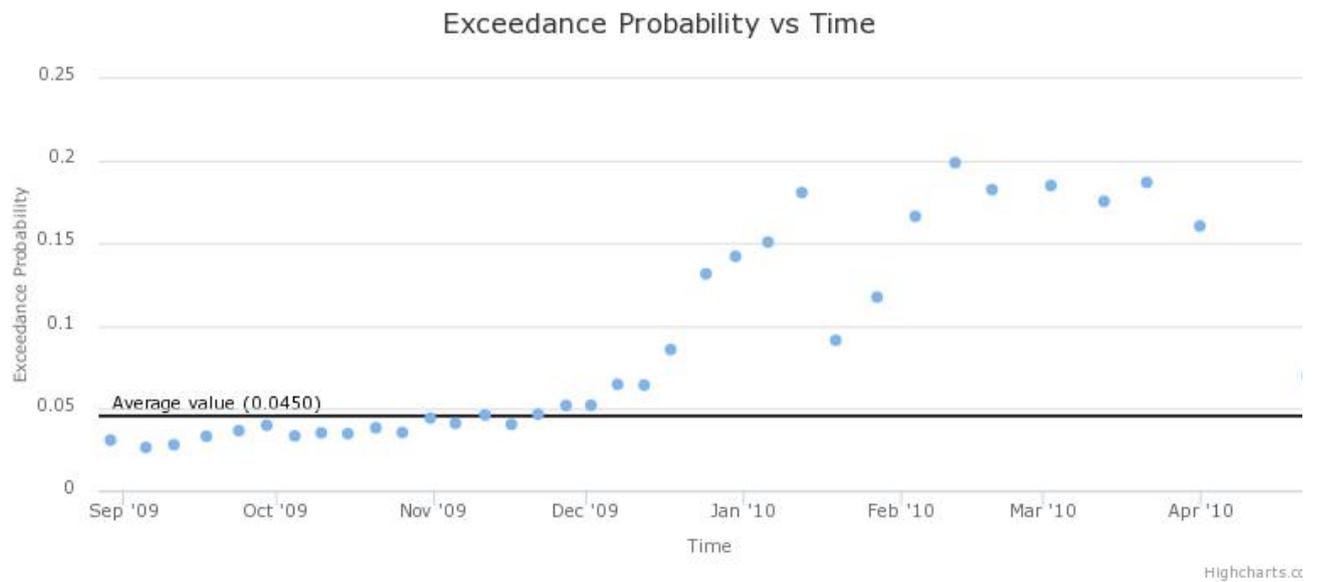


Figure 5. Output graph of Mean Activity Rate



Figure 6. Output graph of hazard parameter: Mean Return Period



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Figure 7. Output graph of hazard parameter: Exceedance Probability

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