

Stationary Hazard user guide



Source size distribution functions

To estimate the probability density function and cumulative distribution function of magnitude. 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 the Kijko-Sellevol generic formula.

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CATEGORY Earthquake Interactions

KEYWORDS Geo-resource production impact, Statistical properties of seismicity, Mainshock, Aftershock

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Step by Step

Source size distribution functions

The only data required for Stationary Seismic Hazard (SSH) application is the catalog containing seismic events ('_catalog.mat' is appended in the filenames contain such catalogs). The User enters his/hers personal workspace and clicks on a seismic events catalog, that is already uploaded (see "AH Episodes" chapter).

For using a selected catalog for SSH, the User shall click on the 'Actions' tab and then select consecutively, 'USE IN APPLICATION' and 'Source size distribution function', as highlighted in Figure 1.

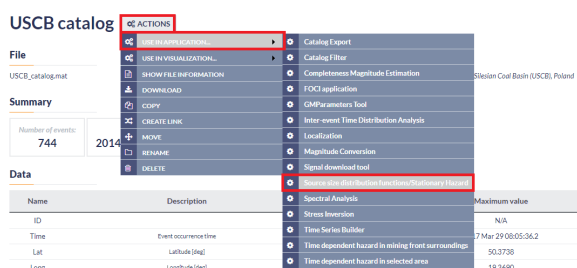


Figure 1. Selection of the application from the data uploaded in the workspace

Once the application has been selected the User is requested to fulfill some fields with parameter values needed for the SSH analysis (Figure 2). These parameters are:

Catalog: A catalog has been already uploaded since the previous step, however, the User has the chance to select a different dataset, either from another episode or the any dataset after performing some processing/ filtering (see "AH Episode" and "Data Handling Applications" chapters).

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

In any case the magnitude range (minimum and maximum magnitude assigned in the catalog) is shown in the screen (M range)

Mmin: The User now is requested to chose 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 option to alter the step of the histogram's bars and to select between linear and logarithmic scale of the Y-axis for the plotting.

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.

Magnitude: Here the User is requested to enter minimum ('Start' tab), maximum ('End' tab) and step ('Step' tab) values of the magnitude. After that, the platform will evaluate the distribution parameters as a function of magnitude.

Once all the parameters have been selected, the User may click on the "Run" button (blue button, Figure 2), for the calculation process to be initiated.

INPUTS

1 / 1 Catalog

USCB_catalog.mat

From Tree

CHANGE FILE

Select Magnitude column

ML

Mmin M range (2.3, 4.1)

2.5

HISTOGRAM

CUMULATIVE HISTOGRAM

Time unit

Day

Magnitude distribution estimation method

Unbounded Gutenberg-Richter model

Magnitude

Start 1.5

End 4.0

Step 0.1

RUN

Status CREATED

Figure 2. Input parameters for the application

The results of the process include a report with parameters values selected by the user and estimated by the system and two figures, one plotting the PDF (Probability Density Function) of the distribution as a function of magnitude and another one plotting the CDF (Cumulative Distribution Function) of the distribution as a function of magnitude (Figure 3 and Figure 4):

The SSH parameters calculated and shown are depended on the Magnitude distribution estimation method selected. They are summarized in Table 1.

Gutenberg Richter (GR)		Non-Parametric	
Unbounded	Upper-Bounded	Unbounded	Upper-Bounded
Magnitude Round-off Interval			
Mean Activity Rate above Completeness Magnitude			
Mean Activity Rate for all Events			
b-value		Kernel Smoothing Factor	
	Mmax	Synthetic Sample for Non-Parametric Estimators (<i>plotting option</i>)	
		Weighing Factors for Adaptive Kernel (<i>plotting option</i>)	
			Mmax

Table 1. Output parameters of the application according to the selected approach

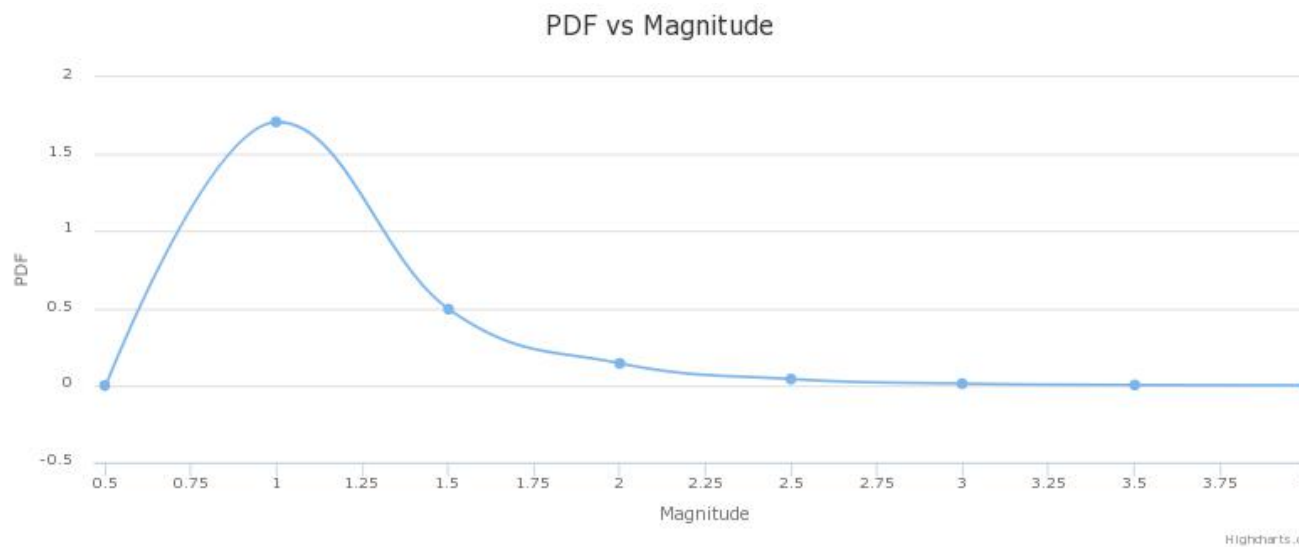


Figure 3. Output graph (PDF)

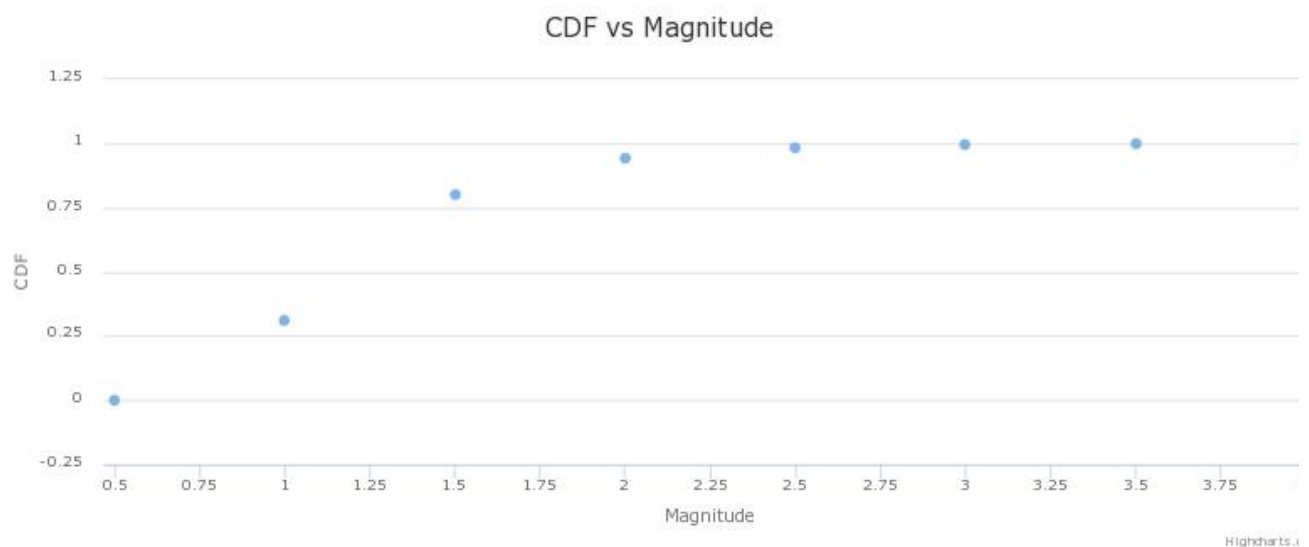


Figure 4. Output graph (CDF)

The Figures provide the options of choosing among linear, spline and scatter plot, linear logarithmic scale, zooming and saving as .pdf, .svg, .jpeg or .png formats.

The necessary parameters for SSH analysis are now estimated ('ssh_params.mat' in Figure 5) and they are ready to be used in Hazard parameters estimation. This can be achieved by clicking on the 'Actions' tab and then selecting 'USE IN APPLICATIONS' field. Three such parameters are available in the EPISODES Platform: Exceedance Probability, Maximum Credible Magnitude and Mean Return Period (top right corner of Figure 5).

Workspace tree

- Signal download
- TEST_FOCI
- CatalogFilter (1)
 - USCB_GMcatalog.mat
 - USCB_catalog.mat
- SSHParameters
 - m.mat
 - CDF.mat
 - PDF.mat
 - ssh_params.mat

Magnitude distribution parameters

File		
ssh_params.mat		
Mmin	2.5	
Magnitude distribution estimation method	Unbounded Gutenberg-Richter model	
b-value	2.080	
Magnitude round-off interval	0.1	
Mean activity rate above completeness magnitude [events per day]	0.624	
Mean activity rate for all events [events per day]	0.630	

ACTIONS

- USE IN APPLICATIONS
- SHOW FILE INFORMATION
- DOWNLOAD
- COPY
- CREATE LINK
- MOVE
- RENAME
- DELETE

Stationary Hazard: Exceedance Probability

Stationary Hazard: Maximum Credible Magnitude

Stationary Hazard: Mean Return Period

Figure 5. Use of magnitude distribution for further processing (Hazard parameters estimation)

Stationary Hazard: Exceedance Probability

Exceedance Probability: In addition to the Magnitude Distribution parameters already imported, the User is requested to select the following parameters (Figure 6):

- **Choose mode:** Two options are available by clicking on the arrow in the respective field: "Fixed magnitude" and "Fixed time period length"
- **Magnitude/ Period length:** Parameter is requested according to the selected mode (Magnitude or Period length, for Fixed magnitude or Fixed time period length, respectively)
- **Time period length / magnitude :** Parameter minimum value ('start' tab), maximum value ('end' tab) and step value ('step' tab) are requested according to the selected mode (Time period length of magnitude, for Fixed magnitude or Fixed time period length, respectively).

INPUTS

Magnitude distribution

1 / 1 parameters

Tetsing_Platform/SSHParameters/ssh_params.mat

From Tree

CHANGE FILE

Choose mode: Fixed magnitude

Magnitude3.5

Time period length [days]

Start100

End500

Step25

Figure 6. Inputs for the application

The User now has to click on the "Run" button in order to start the calculation process. The results are available in both vector format (red frame of Figure 7), or by a x-y plot shown in Figure 7.

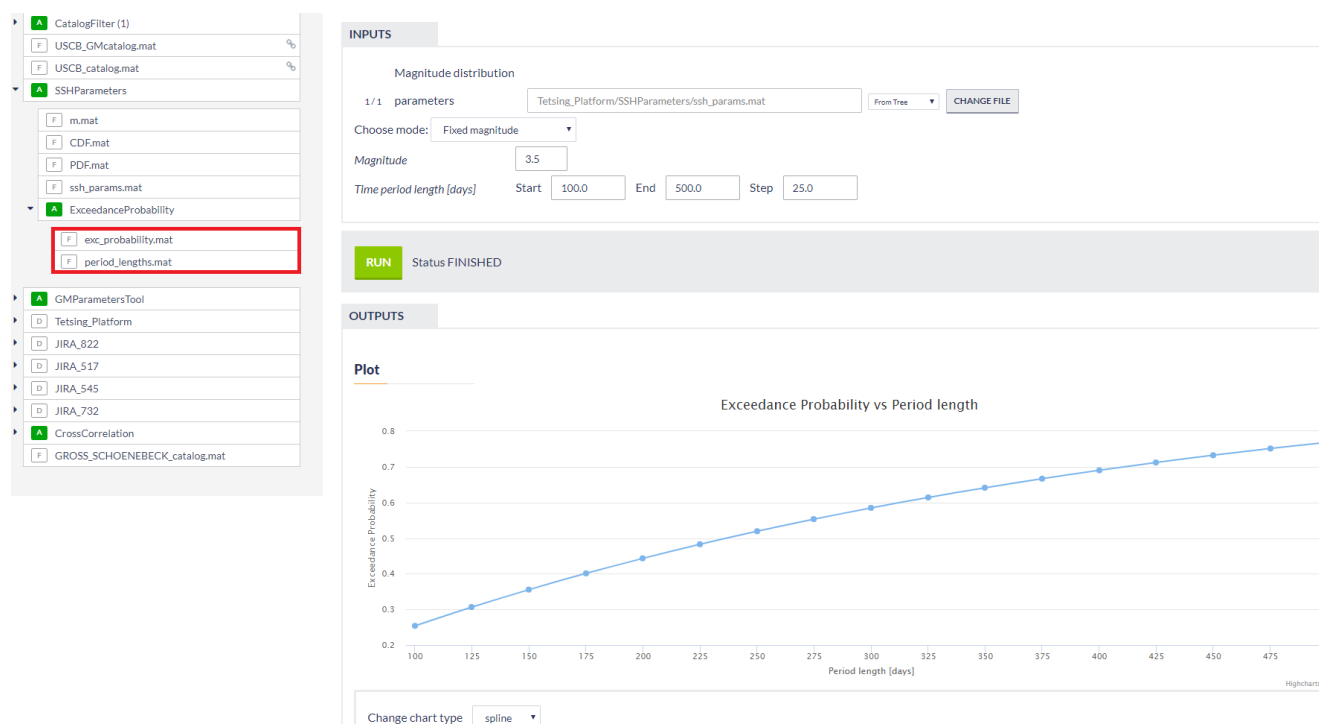


Figure 7. Snapshot of the platform after the results calculation

Stationary Hazard: Maximum Credible Magnitude

- ☐ Maximum Credible Magnitude: In this case the User has only to enter a minimum value ('start' tab), a maximum value ('end' tab) and a step value ('step' tab) for the time period length iteration. After running the process, the results are also available in both vector format (see example above and Figure 8)

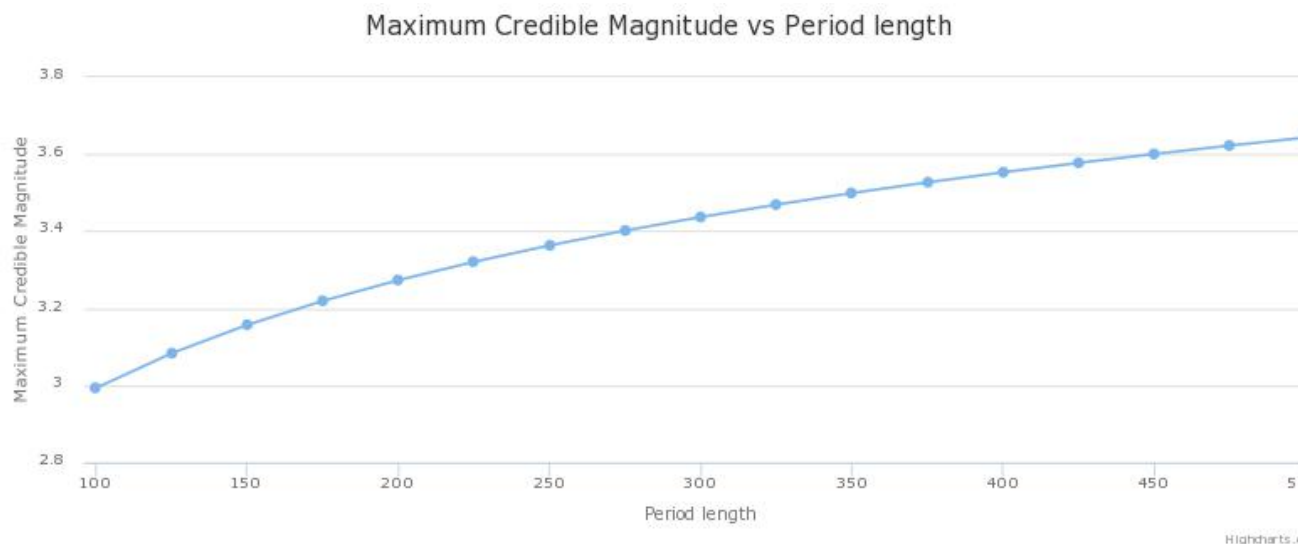


Figure 8. Output graph of hazard parameter: Maximum Credible Magnitude

Stationary Hazard: Mean Return Period

- ☐ Mean Return Period: In this case the User has only to enter a minimum value ('start' tab), a maximum value ('end' tab) and a step value ('step' tab) for the magnitude iteration. After Running the process, the results are also available in both vector format (see examples above Figure 9)

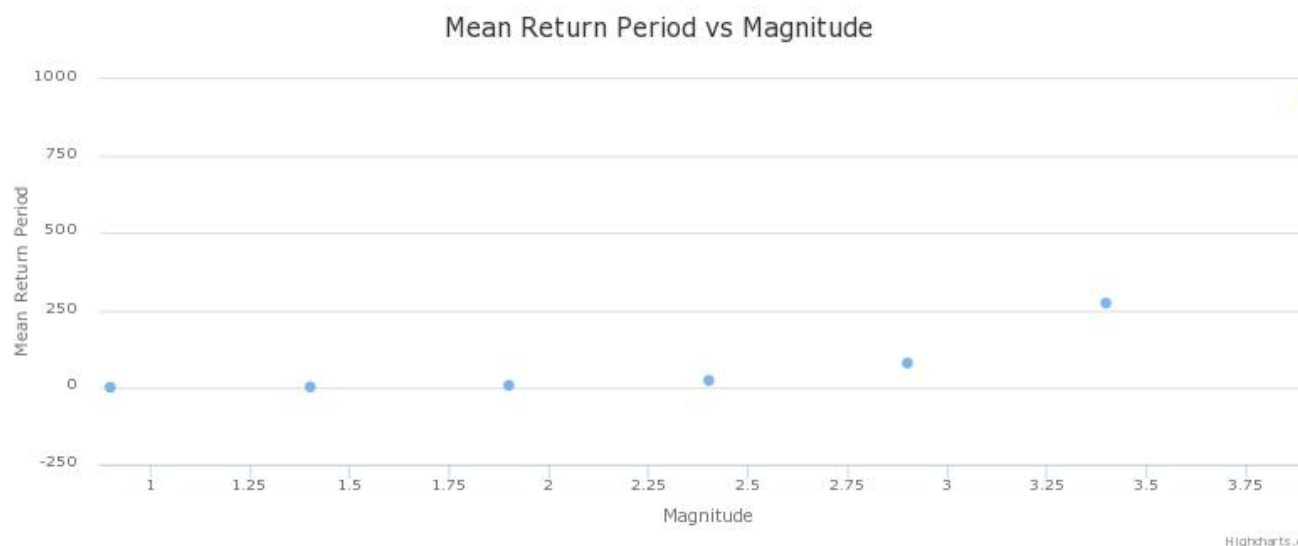


Figure 9. Output graph of hazard parameter: Mean Return Period

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Related Documents

- [Time dependent hazard in selected area user guide](#)
- [Time dependent hazard in mining front surroundings user guide](#)
- [Stationary Hazard user guide](#)
- [MERGER: Dynamic risk analysis using a bow-tie approach](#)
- [Ground Motion Prediction Equations user guide](#)

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