Time dependent hazard in selected area user guide

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 prescribed area. 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. For the magnitude distribution estimation methods please refer to the “Stationary Hazard” application.

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REFERENCES Document Repository

CATEGORY Probabilistic Seismic Hazard Analysis

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

CITATION Please acknowledge use of this application in your work: IS-EPOS. (2017). *Time dependent hazard in selected area* [Web application/Source code]. Retrieved from https://tcs.ah-epos.eu/

Step by Step

The only data required for Time Dependent Seismic Hazard (TDSH - selected area mode), application is a 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 TDSH, the User shall click on the 'Actions' tab and then select consecutively, 'USE IN APPLICATION' and 'Hazard in selected area', as highlighted in Figure 1.

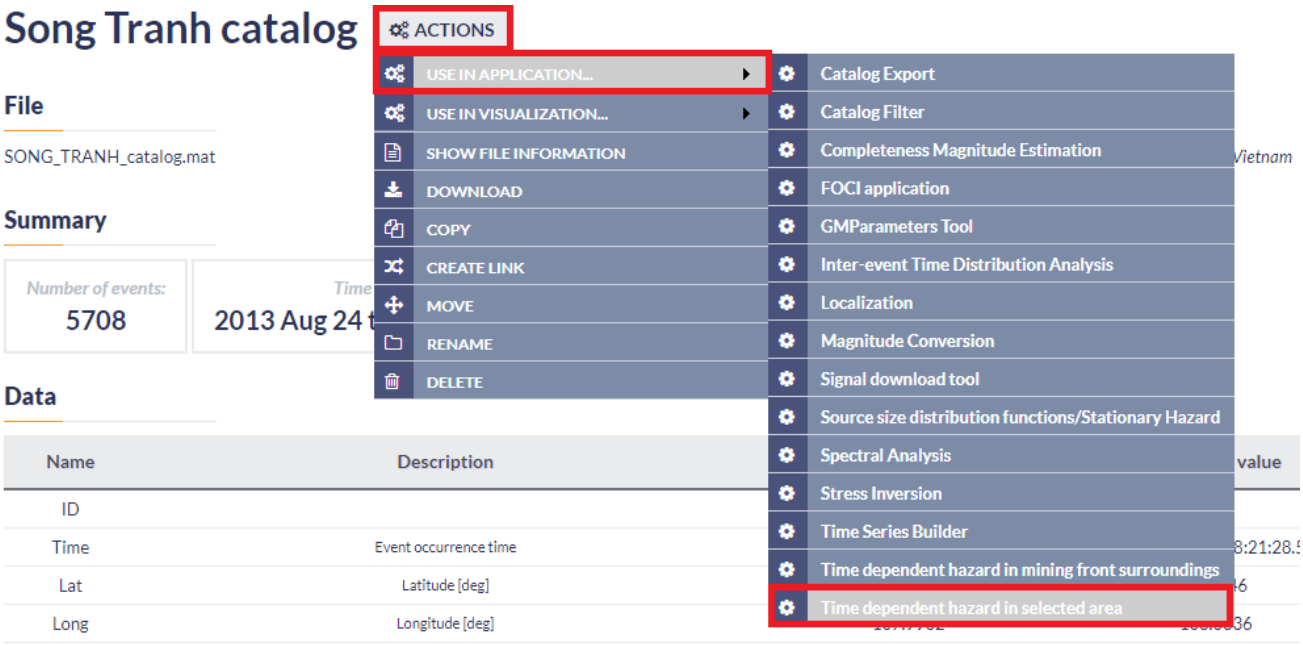


Figure 1. Selection of the application from the data uploaded in the workspace

Once the application has been selected the User is requested to select options and fulfill some fields with parameter values needed for the TDSH analysis (see the following Figures). 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.

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).

Select Area: This is an interactive option providing to the User the possibility to select data, spatially constrained by a predefined shape (indicated by numbers 1-5 in Figure 2):

1) No draw option.

2) Draw a polygon.The User may select data into a polygon drawn after clicking on different points of the map. To close the polygon, the User has to double click on the last point, such that this point will be connected with the first one.

3) Draw a rectangle. To select data into a rectangular the User has to click on a point of the map and move the cursor to any direction. A second left mouse button click will restrict the selected area at its current state.

4) Draw a circle (option demonstrated in Figure 2). To select data into a circular the User has to click on a point of the map and move the cursor to any direction. A second left mouse button click will restrict the selected area at its current state. Note that the first click on the map corresponds to the circle's center.

5) Select all data. All available data included in the uploaded dataset is used for TDSH analysis

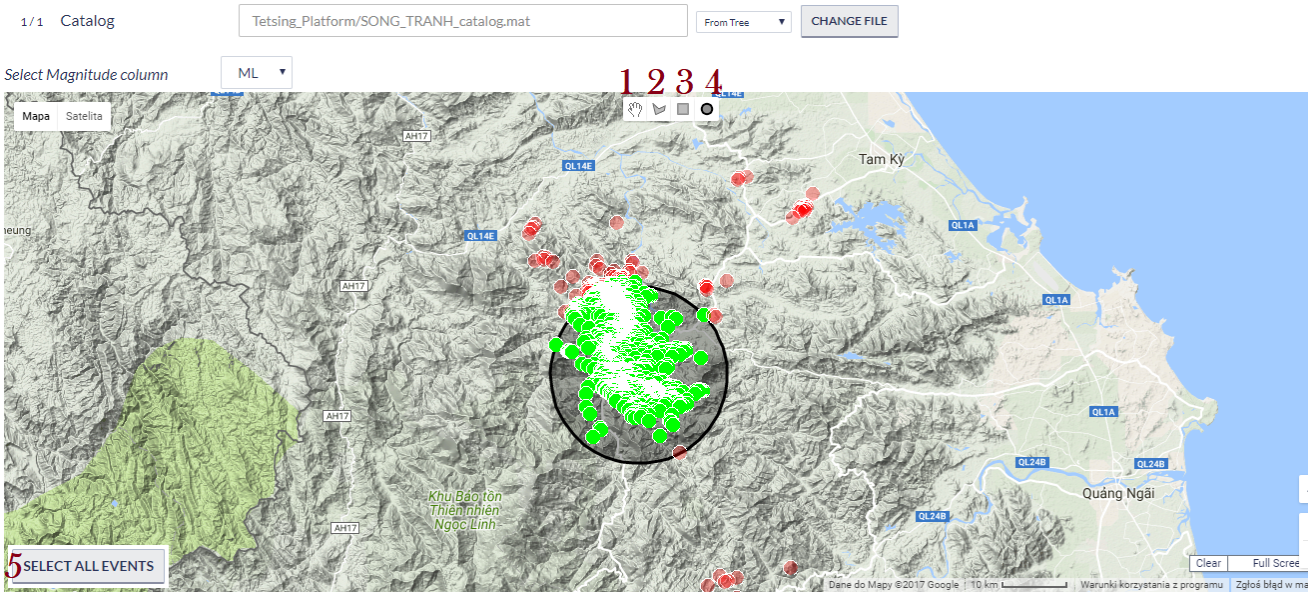


Figure 2. Interactive data selection

The magnitude range (minimum and maximum magnitude assigned in the catalog) is shown in the screen (M range, Figure 3) for informative purposes. The rest of the input parameters are demonstrated in Figure 3:

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 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 3). Note that this selection is optional. If no dates are entered, the entire dataset remains for the analysis.

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.

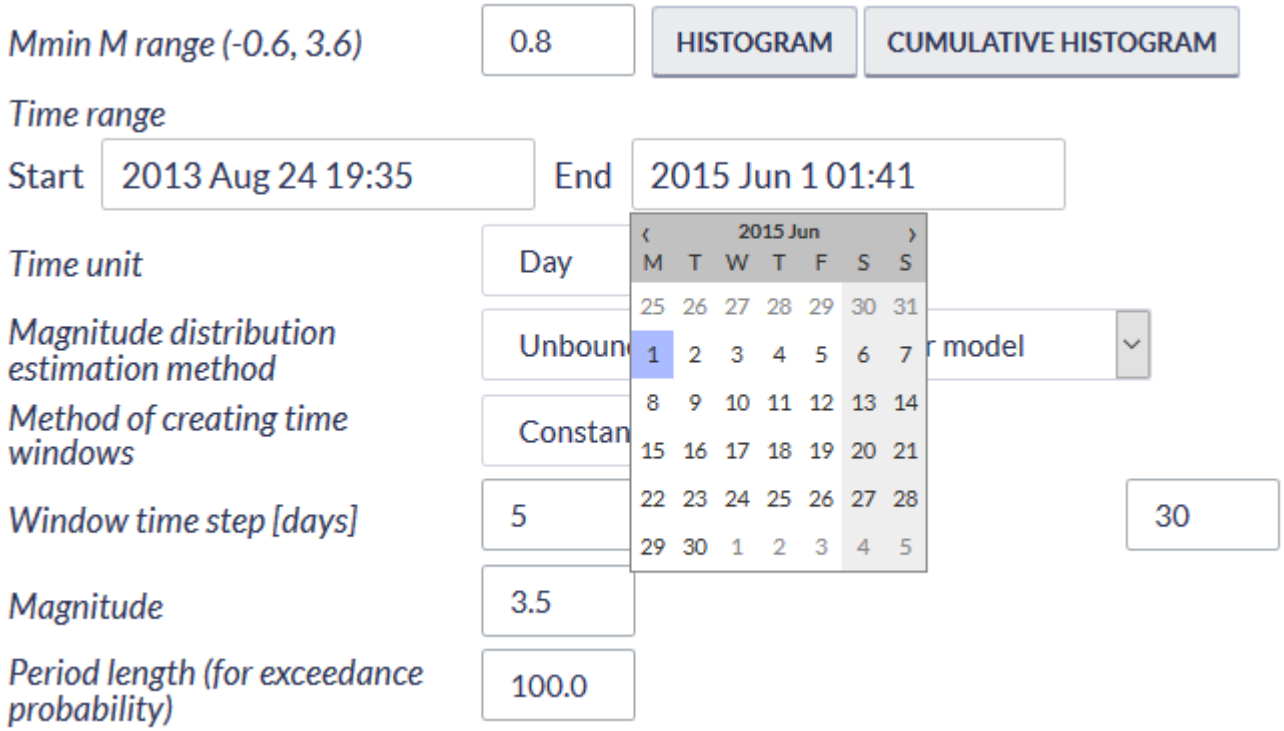


Figure 3. Input parameters selection

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 4 for details).

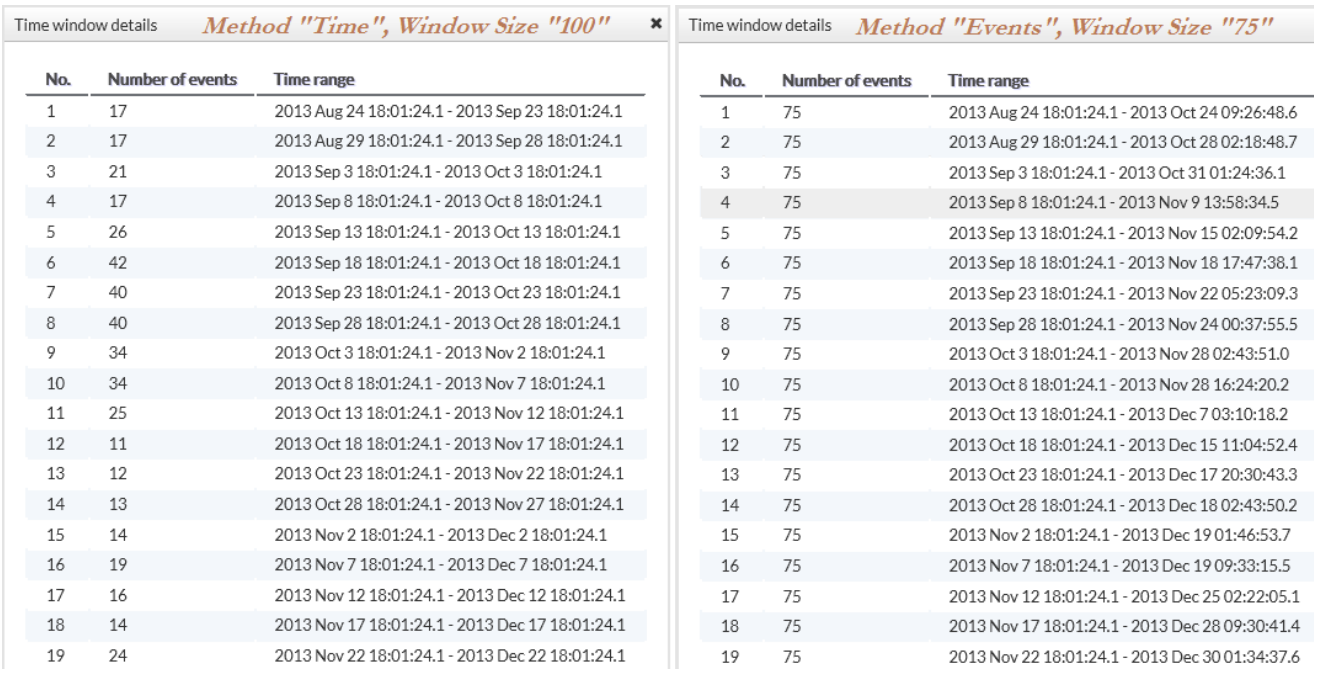
Magnitude: Magnitude for which the TDSH parameters will be calculated.

Method of creating windows: Two options are available at this field after clicking on the small arrow of the tab (see 'Time window Size' below for details).

Window size: Size (span) of the windows containing data for the analysis. "constant time period" and 'constant event number'. 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 4 for details).

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

After selecting all the parameters needed the User may click on the run button (blue tab - figure 3), for the calculation process to be initiated.



Time window details — *Method "Time", Window Size "100"*

No.	Number of events	Time range
1	17	2013 Aug 24 18:01:24.1 - 2013 Sep 23 18:01:24.1
2	17	2013 Aug 29 18:01:24.1 - 2013 Sep 28 18:01:24.1
3	21	2013 Sep 3 18:01:24.1 - 2013 Oct 3 18:01:24.1
4	17	2013 Sep 8 18:01:24.1 - 2013 Oct 8 18:01:24.1
5	26	2013 Sep 13 18:01:24.1 - 2013 Oct 13 18:01:24.1
6	42	2013 Sep 18 18:01:24.1 - 2013 Oct 18 18:01:24.1
7	40	2013 Sep 23 18:01:24.1 - 2013 Oct 23 18:01:24.1
8	40	2013 Sep 28 18:01:24.1 - 2013 Oct 28 18:01:24.1
9	34	2013 Oct 3 18:01:24.1 - 2013 Nov 2 18:01:24.1
10	34	2013 Oct 8 18:01:24.1 - 2013 Nov 7 18:01:24.1
11	25	2013 Oct 13 18:01:24.1 - 2013 Nov 12 18:01:24.1
12	11	2013 Oct 18 18:01:24.1 - 2013 Nov 17 18:01:24.1
13	12	2013 Oct 23 18:01:24.1 - 2013 Nov 22 18:01:24.1
14	13	2013 Oct 28 18:01:24.1 - 2013 Nov 27 18:01:24.1
15	14	2013 Nov 2 18:01:24.1 - 2013 Dec 2 18:01:24.1
16	19	2013 Nov 7 18:01:24.1 - 2013 Dec 7 18:01:24.1
17	16	2013 Nov 12 18:01:24.1 - 2013 Dec 12 18:01:24.1
18	14	2013 Nov 17 18:01:24.1 - 2013 Dec 17 18:01:24.1
19	24	2013 Nov 22 18:01:24.1 - 2013 Dec 22 18:01:24.1

Time window details — *Method "Events", Window Size "75"*

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

Figure 4. 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 the same in all dataset and equal to 100, but the time range (difference between ending and starting dates) is different for each dataset.

The results of the process include:

- Information on the time windows created (Figure 4), shown after clicking on the 'Show details' tab.
- Numerical parameters resulted by the process, stored in the system, in the current folder (Figure 5). These outputs are available for the User for demonstration and plotting (when available).
- b-value and mean activity rate (Figure 6).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 7).
- Exceedance probability vs time (Figure 8).

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

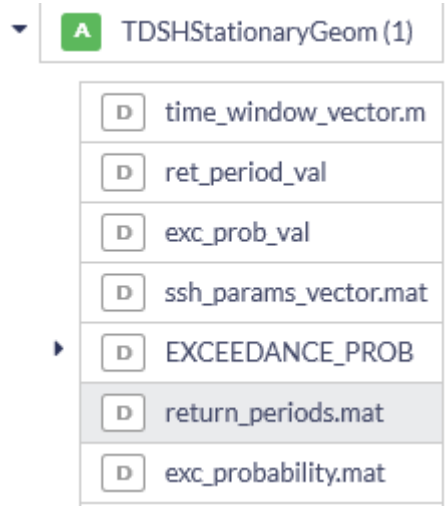


Figure 5. Outputs of the application

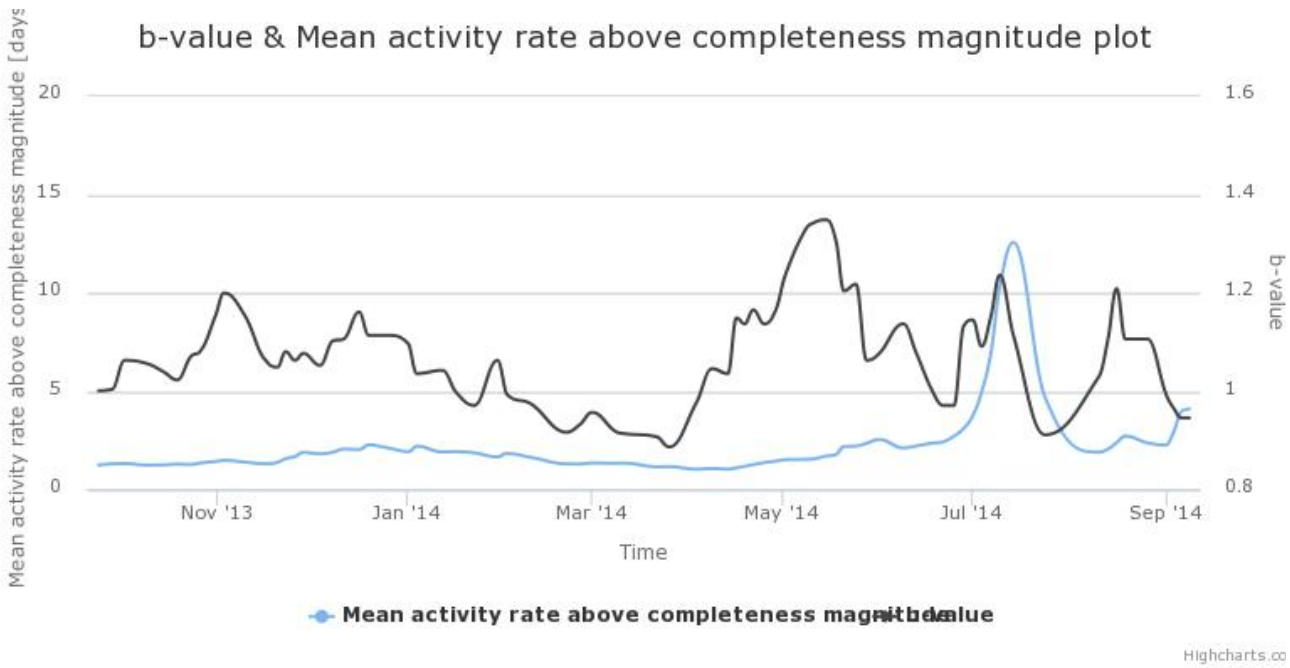


Figure 6. Output graph Mean Activity Rate

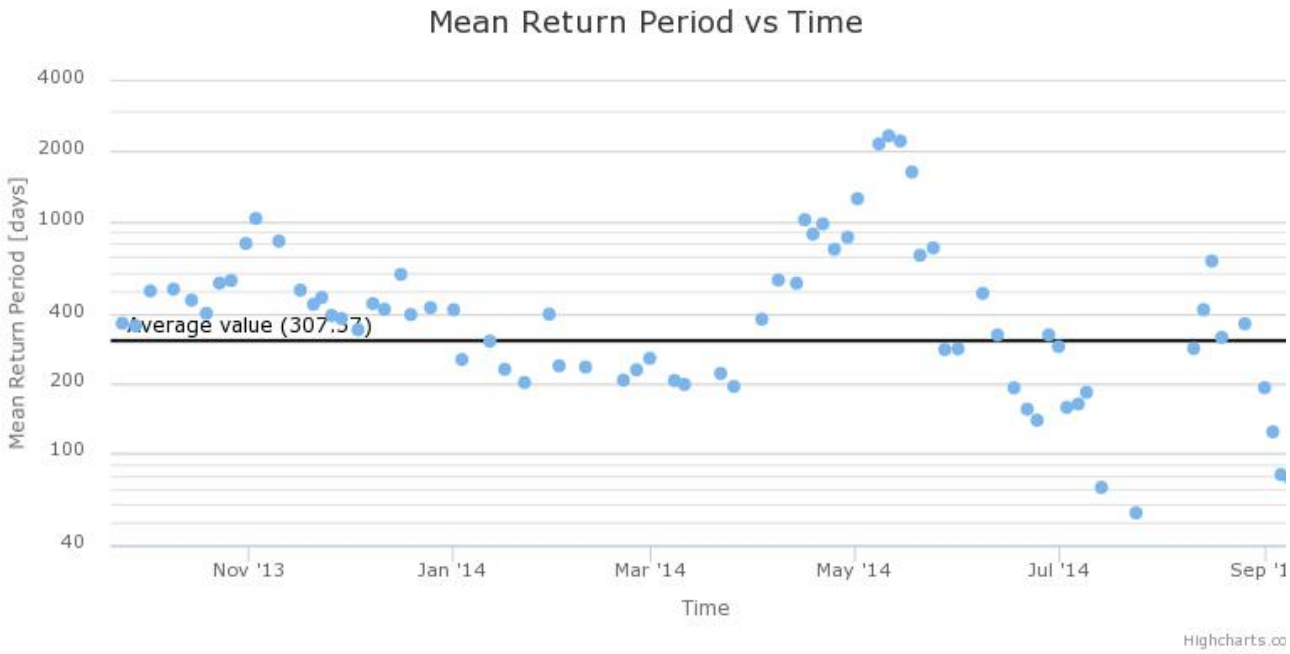


Figure 7. Output graph of hazard parameter: Mean Return Period

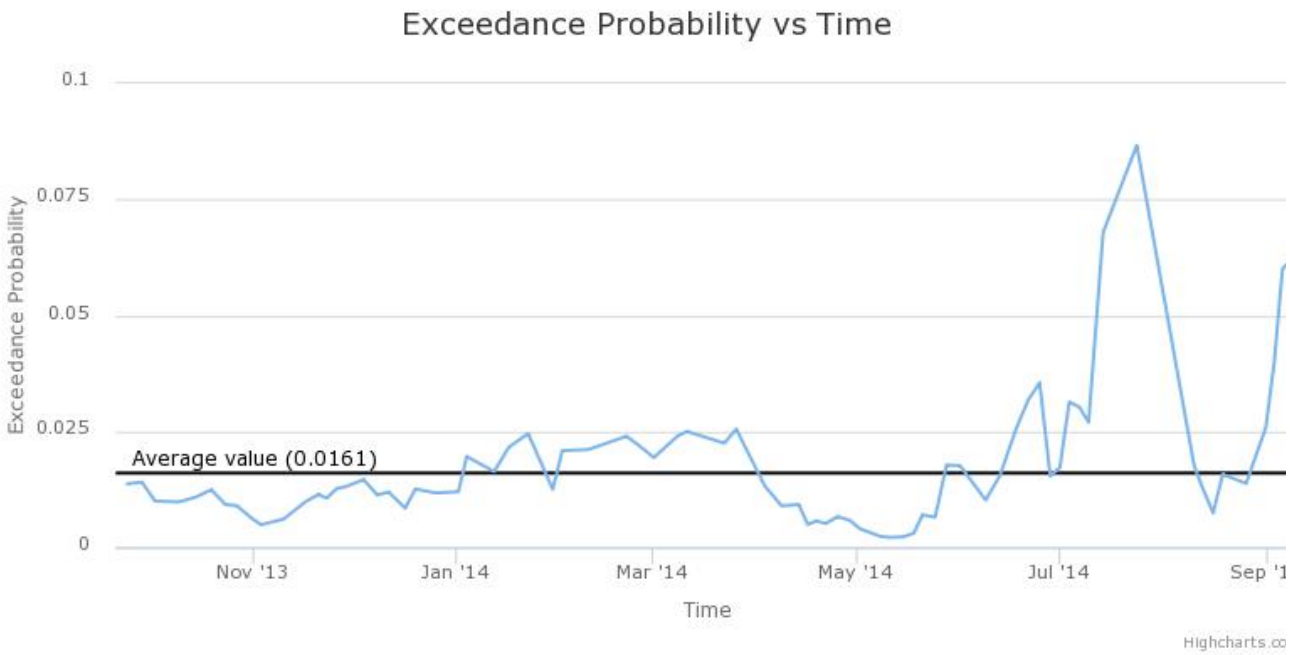


Figure 8. Output graph of hazard parameter: Exceedance Probability

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