Localization user guide

This application implements TRMLOC localization/relocalization software which performs efficiently the inversion of seismic (acoustic) first arrival time onsets for hypocenter location using the probabilistic inverse theory approach. The application estimates the maximum likelihood hypocenter location, enables other hypocenter location estimators to be calculated and it allows an advanced analysis of location (inversion) uncertainties, providing in addition, meta-characteristics of the data and solutions.

open in **IS-EPOS** PLATFORM

REFERENCES Document Repository

CATEGORY Source Parameter Estimation

KEYWORDS Source parameters, Source location

CITATION Please acknowledge use of this application in your work: IS-EPOS. (2015). *Localization* [Web application]. Retrieved from https://tcs. ah-epos.eu/

Step by Step

After the User adds the Application into his/her personal workspace, the window as shown in Figure 1 appears. The following files are necessary in order to perform the source location:

- *MiniSEED Waveform*
- *Network inverntory*
- *Catalog*
- *Velocity Model*

Figure 1. Inputs for the "Localization" application.

The User can upload files which are already available in his/her personal workspace (green filed in Figure 2) after clicking "SELECT FILES" (red filed in Figure 2). However, if User is not in possession of such files, he/she can obtain them from "Data Search" (green filed in Figure 3).
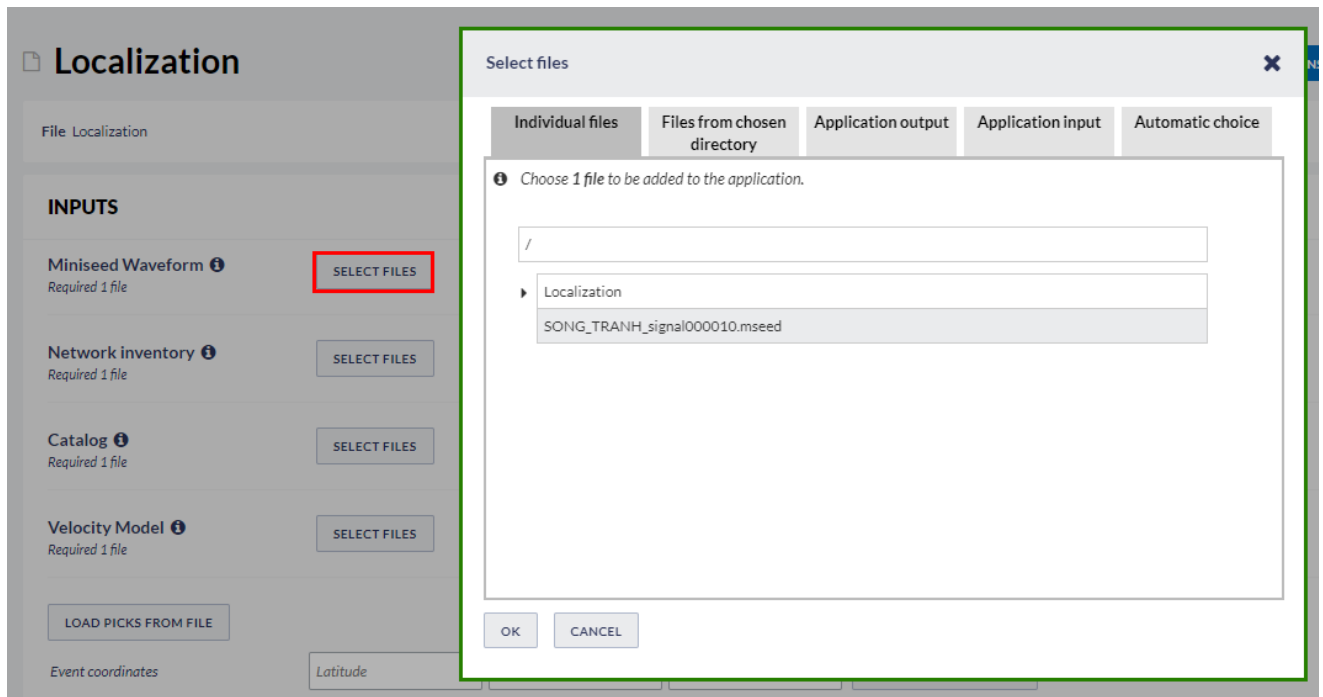
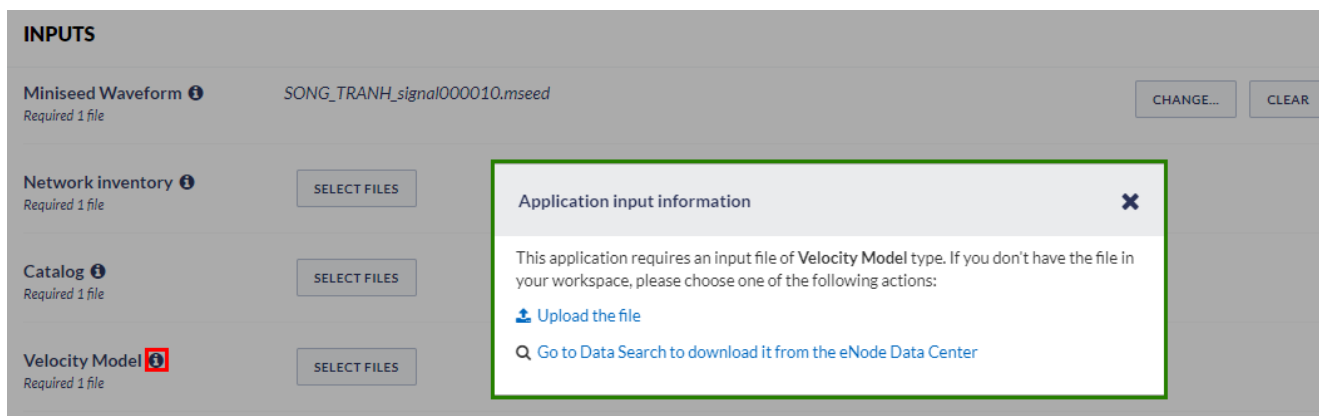**Figure 2. Input data uploading files for the application.**

Figure 3. Application input information.

Once all these files are uploaded the waveforms are shown on the screen and are available for elaboration. As depicted in Figure 4, only the vertical channels are shown by default, since the methodology applied in this application uses only P-waves. Nevertheless, the User can make all the channels appear on the window, by ticking the "E" and "N" components, below the 'Show channels'.
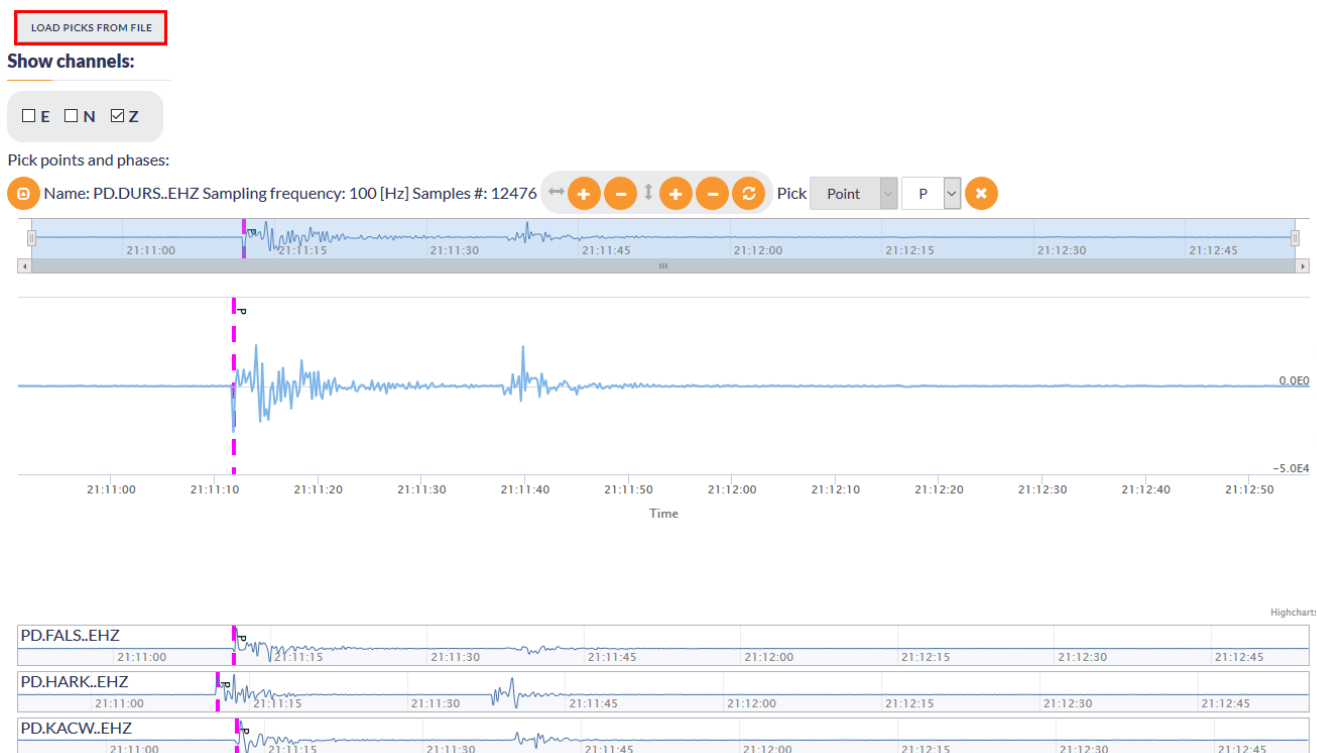
Figure 4. Picking p-wave arrival times on the waveforms

In this application the User has to pick a single point in each waveform (Figure 4), instead of a phase (i.e. two points, starting and ending). For the waveform processing details see also "FOCI" and "Spectral Analysis" chapters.

NOTE: Although it is not necessary to pick P-wave arrivals in all of the waveforms to run the application, a minimum of 3 picks is required for the application to proceed to the calculations (stated also at the top of Figure 5). The number of the seismograms and P-wave phases picked, are updated, each time the User selects makes a new picking. The User may also load picks from XML file (red filed in Figure 4) rather than processing the waveforms manually.

Parameters selected for the source localization

'Event Coordinates' and 'Event description' can be taken from the catalog ('LOAD VALUE FROM FILE' tab, Figure 5), however the User has here the chance to modify the given values, or retry the process with different e.g. depths.

The additional input parameters required to execute the application are shown in Figure 5. Some of those parameters take numerical arguments, entered by the User, others take values selected from a list. In any case default values are provided. Advanced options are also available, however the application runs properly even if they are discarded. For detailed description of all application parameters please see at the TRMLOC manual at the document repository.

Picked seismograms: 2 . Required at least: 3

Picked phases: -

Picked points: P: 2

CLEAR ALL PICKS

| Event coordinates | Latitude | Longitude | Depth | LOAD VALUE FROM FILE |

Event description

A priori variance of X/Y ⓘ — 500

A priori variance of Z ⓘ — 500

Prior distribution Norm ⓘ — g ⌄

A posteriori pdf norm ⓘ — g ⌄

Likelihood variance ⓘ — 0.1

Minimum Z value ⓘ — 0

Maximum Z value ⓘ — 5000

X value step ⓘ — 200

Y value step ⓘ — 200

Z value step ⓘ — 100

▶ *Advanced options*

CLEAR   SAVE   RUN   ☐ Enable autorun

Figure 5. Input parameters for the application

Once the point picking in the waveforms and the parameter selection is over, the User shall click on 'RUN' (green button) to initiate the Source Localization process.

The results obtained after the process terminates include a variety of output values, files and figures. Numerical outputs are the hypocenter coordinates obtained by different methods, their uncertainties and the original coordinates from the catalog, for comparison (Figure 6, top). These values are also plotted in charts, one showing the epicentral location (longitude-latitude) of the original and obtained solutions together with the stations positions (Figure 6, bottom), and one more showing the vertical (depth) distribution of the aforementioned solutions. Four ASCII files are also created ('res.txt', 'out.txt', 'log.txt', and 'xcp.txt'), which contained detailed and specialized information on the process, the results and their uncertainties. These files can be either displayed in the screen or downloaded by the User. Two JSON files ('trmloc_result.json' and 'app_form_snapshot.json') are created as well.
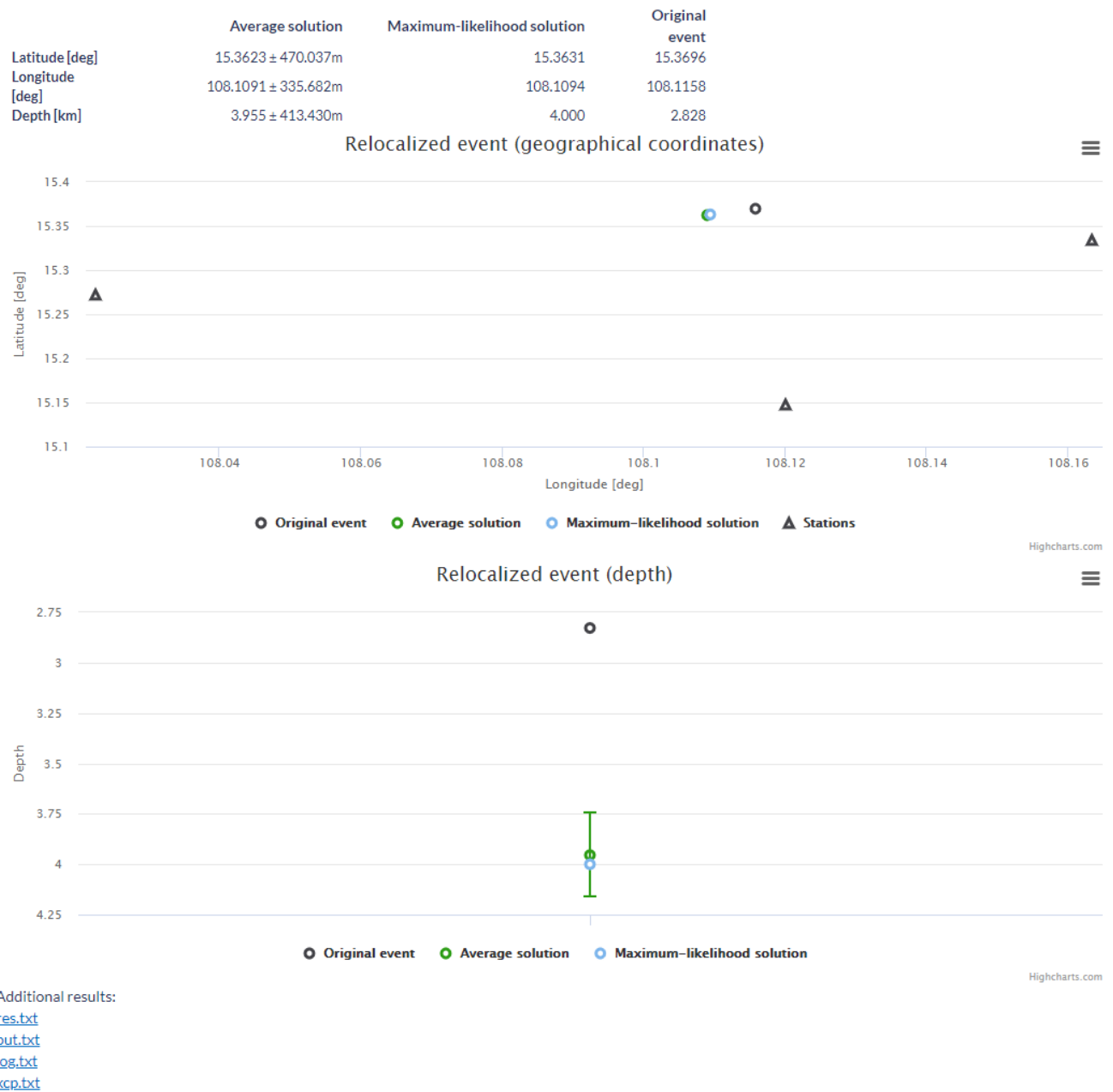
OUTPUTS

	Average solution	Maximum-likelihood solution	Original event
Latitude [deg]	15.3623 ± 470.037m	15.3631	15.3696
Longitude [deg]	108.1091 ± 335.682m	108.1094	108.1158
Depth [km]	3.955 ± 413.430m	4.000	2.828

Relocalized event (geographical coordinates)

Relocalized event (depth)

Additional results:
res.txt
out.txt
log.txt
xcp.txt

Figure 6. Outputs of the application

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