Template-Matching based Detection Algorithm user guide

This application detects in a continuous seismic signal a window that is similar to a provided template window (i.e. a portion of the signal that correlates with a value higher than an imposed threshold). Several steps are required in order to adequately run the program.

open in IS-EPOS PLATFORM

REFERENCES Document Repository

CATEGORY Event Detection Algorithms

KEYWORDS Aftershocks, Earthquake Swarm, Data Selection

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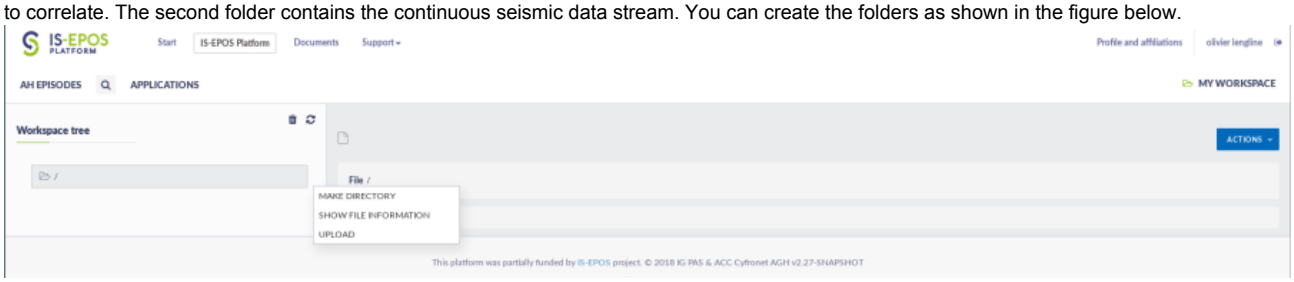
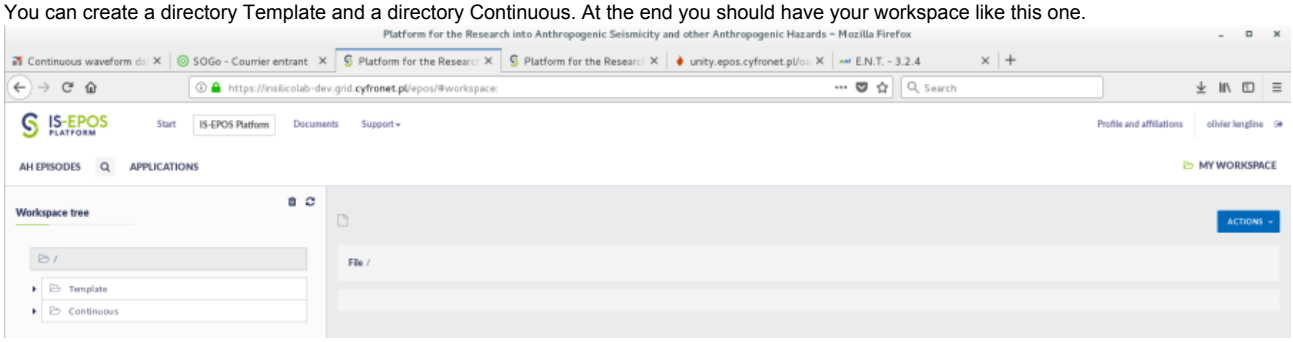
Step by Step

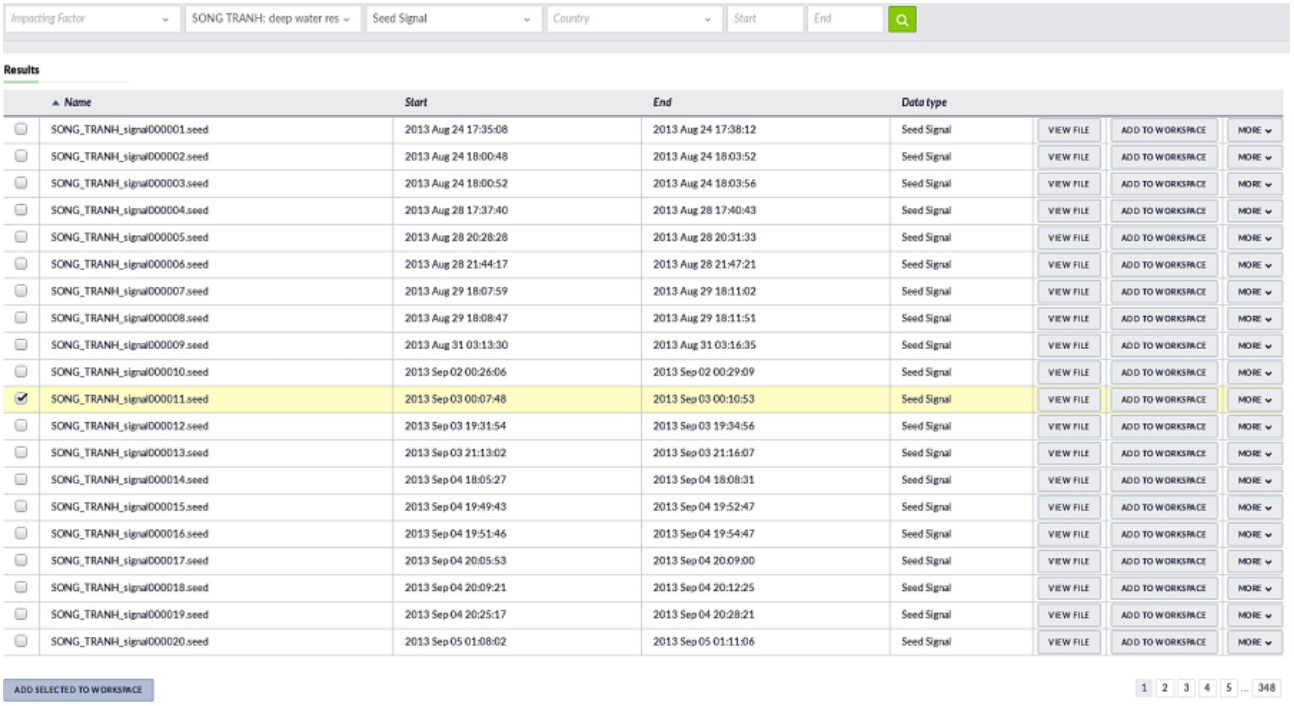
The first thing that needs to be done in order to organize the data is to create two folders. The first one contains the template signal that we want to correlate. The second folder contains the continuous seismic data stream. You can create the folders as shown in the figure below.



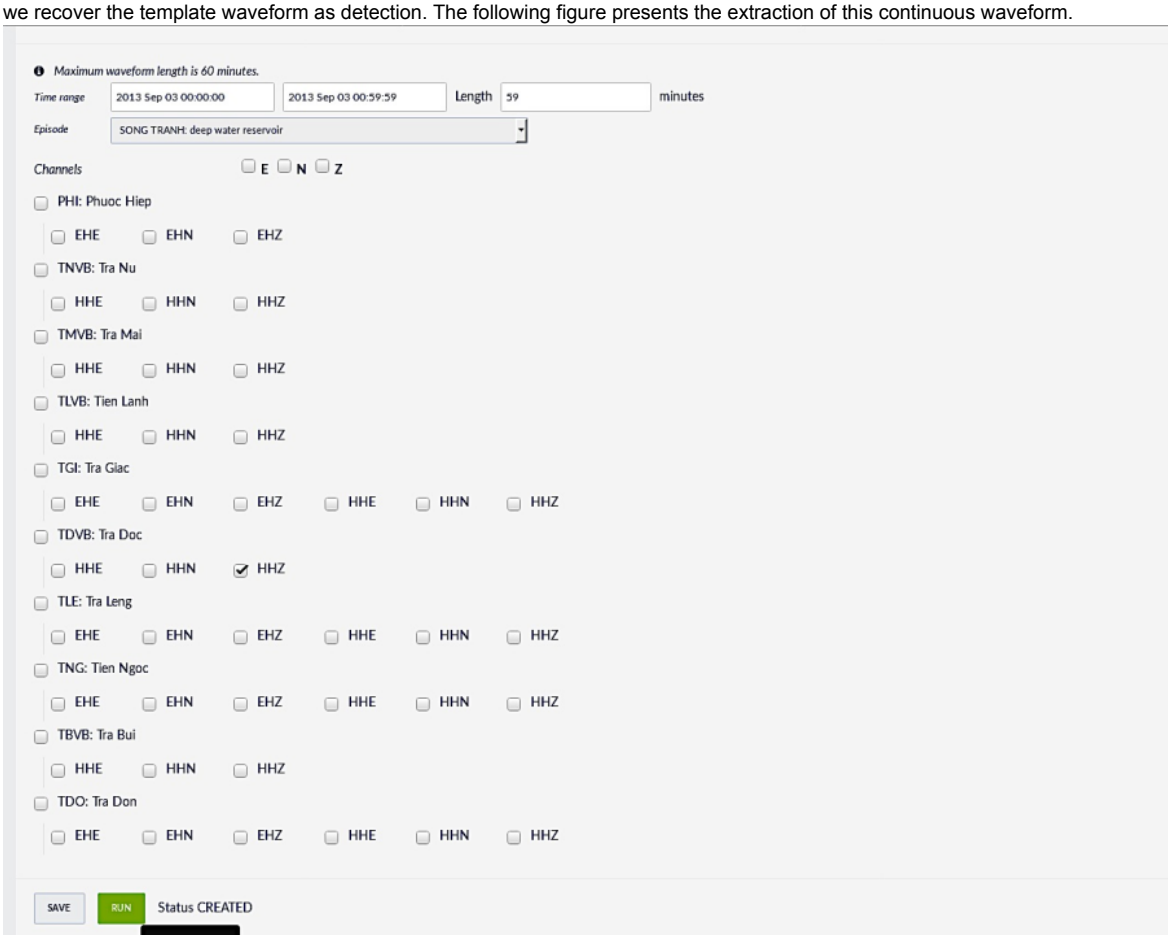
You can create a directory Template and a directory Continuous. At the end you should have your workspace like this one.



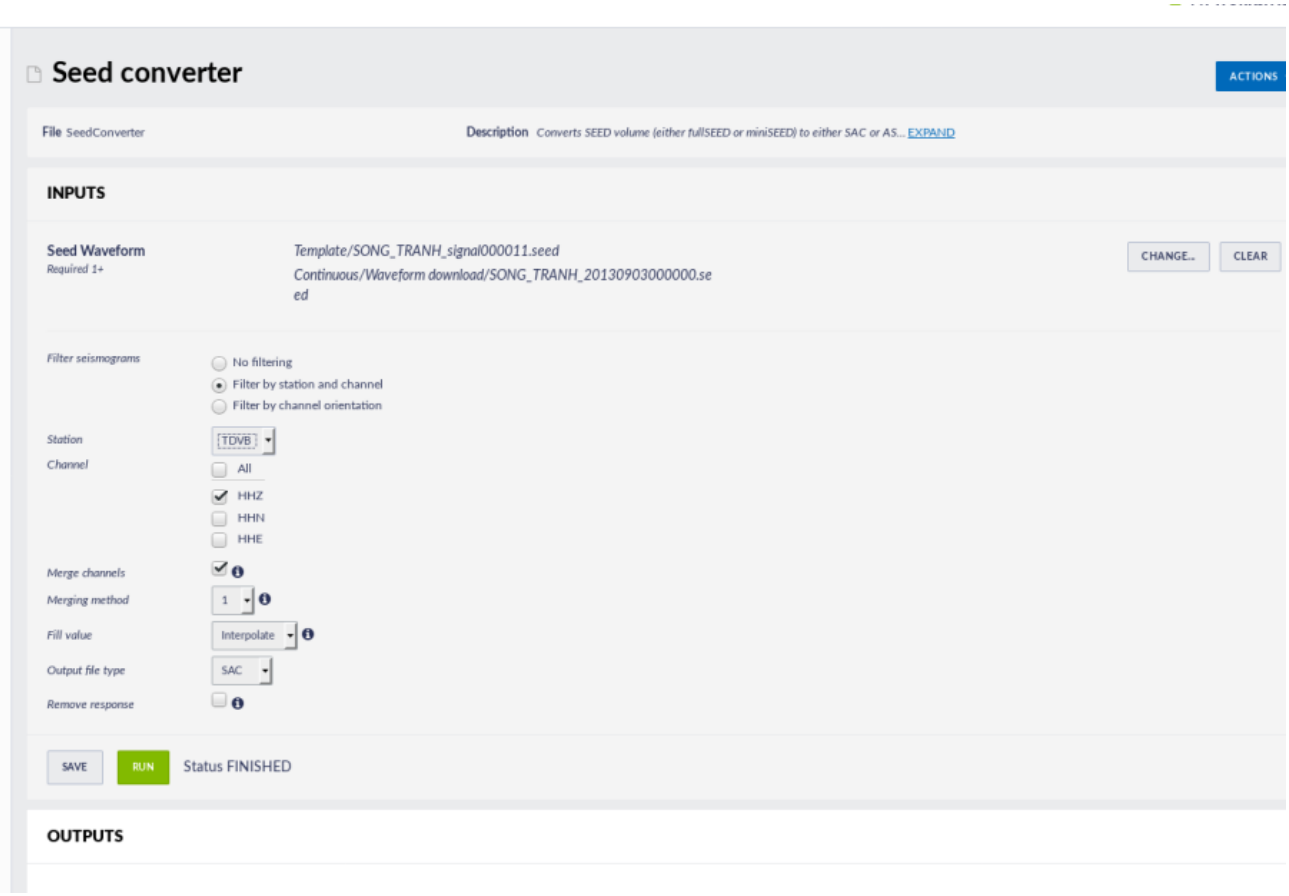
We will first add a template signal. In order to do this we will work with an example from SONG TRANH dataset. Select AH episodes and then SONG TRANH and click on **Events related waveforms**. We will add to the workspace the event 11. Just click on the event and add it to the workspace in the directory Template as shown in the figure below.



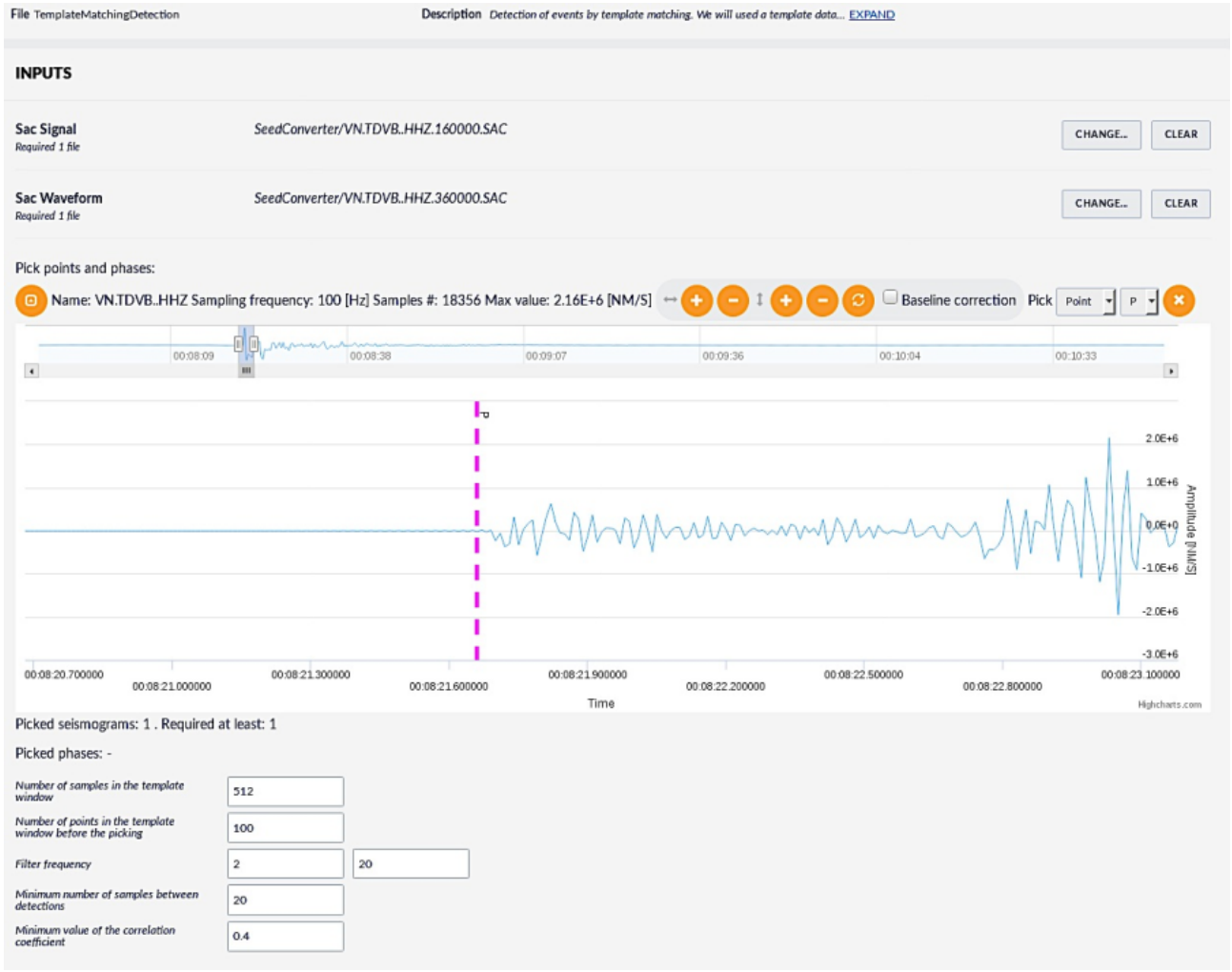
We will now add the continuous dataset to the workspace. We need first to add to the workspace the **waveform download tool**. Add the tool to you workspace in the Continuous folder.
We will just extract the signal at 1 station and one channel (here in this example the channel HHZ of station TDVB). The continuous signal we want to analyse is from 2013 September 03 00:00:00 up to 2013 September 03 at 00:59:59. This is the maximum duration allowed to be processed by the waveform download tool program (60 minutes). This time period covers the time of the template itself so we can test to see if we recover the template waveform as detection. The following figure presents the extraction of this continuous waveform.



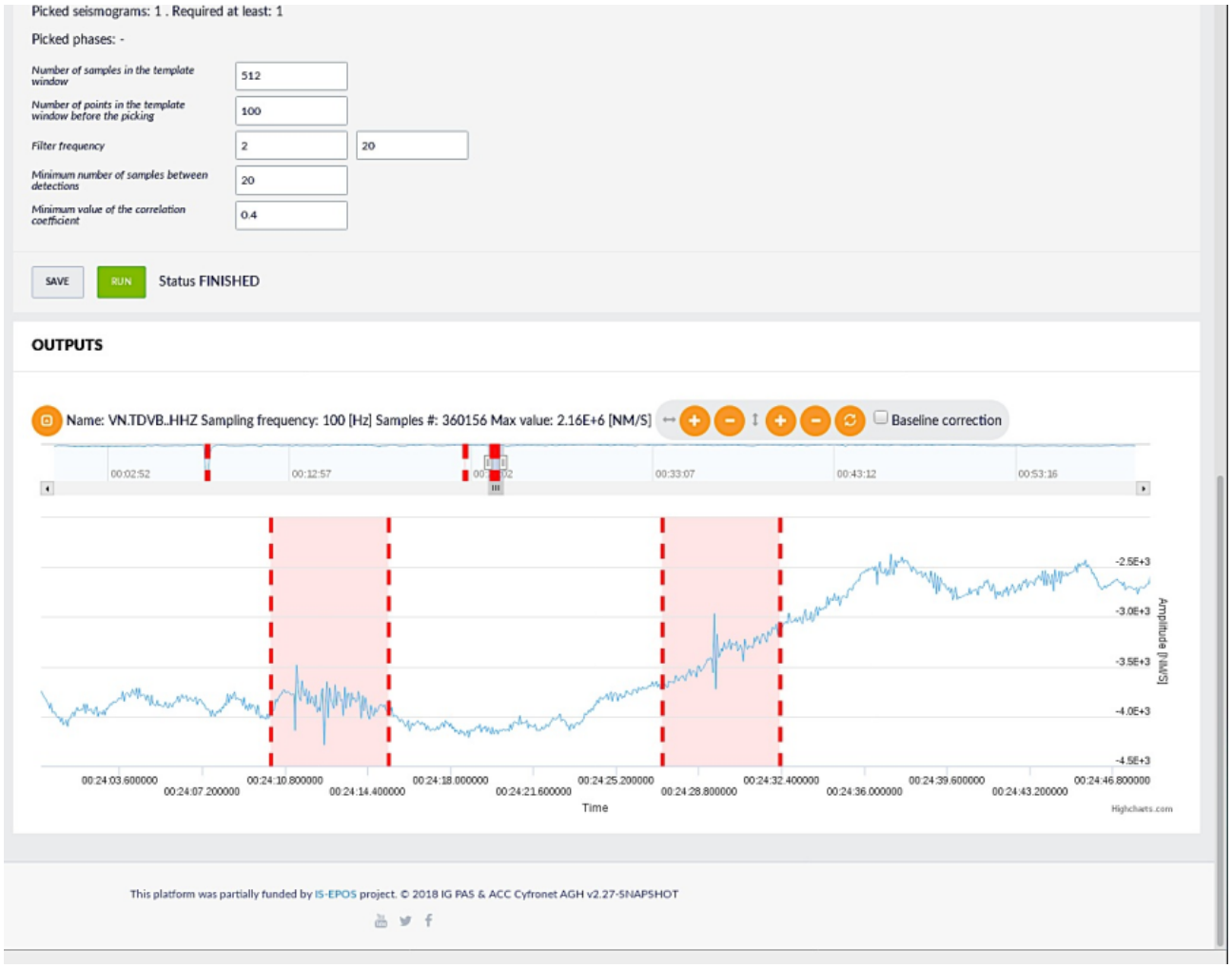
We now need to convert the waveforms (template and continuous) in the SAC format in order to then run the Template matching code. In order perform this conversion simply add the **seed converter** program to the workspace.
In this application you can select the two seed files (templates and continuous). We will precise that we only want to convert the signal of station TDVB and channel HHZ into SAC waveforms. It will then produce two SAC files. The figure below shows the settings of the seed converter.



The two SAC files produced by the application are in this example VN.TDVB_HHZ.160000.SAC and VN.TDVB_HHZ.360000.SAC. The first one is the template file and the second one the continuous sac waveform. If you click on one of the waveform you can see the duration of the signal just to check which one is the template waveform and which one is the continuous data stream.
You need now to import to the workspace **the Template Matching Detection** application.
You need first to select the waveforms you want to use. Once you have selected your template waveform (called sac signal in the application) you will see it appearing in a window. You need to pick the P-wave arrival on this window; it will be used to define the portion of the template signal to correlate with the continuous signal.
This window will start at some fixed number of points before the P-wave pick and be of a given duration (both parameters can be set in the application). You also need to set the frequency range in which you want to filter both signals.
You also have to set the threshold correlation coefficient (between 0 and 1) such that only parts of the signal with correlation higher than this threshold will be considered as detections.
The last parameter that needs to be set is the minimum possible time between 2 detections. If two detections are less than this time, only the one with the highest correlation coefficient is kept. The figure below shows an example of setting the parameters for the signals we selected.



As an output the application will indicate the portion of the continuous signal that correlates with the windowed template signal with a correlation coefficient higher than the threshold. A file is also produced that gives the time of these correlations. In the example below we see that the program is able to recover two close events in time that were not previously detected (see last figure).



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