



Python designed toolboxes for automatic data mining, pre-processing and download, and time domain moment inversion

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The scientists need both software and observed data to test and develop their theories.

As in other sciences, seismologists use analysis software written in a wide variety of languages (i.e.: fortran, C++, Perl, Matlab, shell script, ...) and tested for one or more operating systems and platforms. Seismic data and meta-data are also available in a wide variety of format (i.e.: SAC binary/alpha, seed, GSE, xml, ...). Generally, seismic analysis software accept only one specific file format and often organize meta-data input and output files with a unique structure and syntax.

In this work we present two complementary toolboxes for data mining, acquisition and pre-processing (*wavesdownloader*), and for moment tensor inversion (*pytdmt*). Both toolboxes have similar and compatible syntax, deal with all most seismological data and meta-data formats, and are platform independent. The two toolboxes are python based codes and they use extensively the seismological observation library *obspy* (Beyreuther et al. 2010, Megies et al. 2011).

The *wavesdownloader* (*wd*) access continuous data via web-services to various data-centers and to the user local hard-drive using a unique syntax regardless to the data-access entry point, i.e.: LOCAL (user HD), EIDA, IRIS, WEBDC-(Orfoeus) data repositories; *wd* is designed to easily integrate new data repository. Features of *wd* are for example geographical, time window, channel and network data selection; filtering, deconvolution, rotation to GCP; the downloaded and pre-processed waveforms may be plotted with different options and stored into the most used seismological file formats (SEED, SAC, SAC-ASCII, GSE2, ..). The *wd* is also designed to compute peak ground motion parameters and store these values into ShakeMaps like file format.

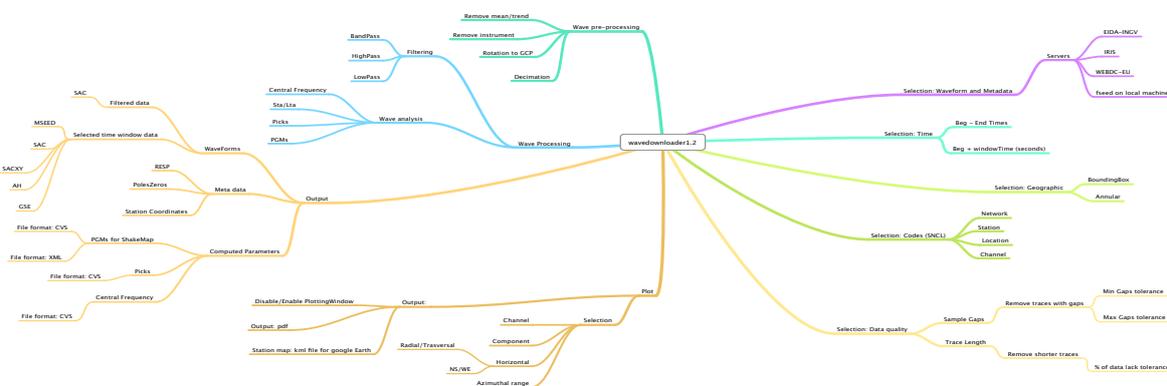


Figure 1. General schema of *wavesdownloader* options.

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The *pytdmt* is a package for Time Domain Moment Tensor inversion. The inversion, from data load to data pre-processing and plot, is performed and controlled by a syntax compatible with *wd* and does not require to run sequence of scripts. The inversion is performed using only python modules with exception of the greens computation (fortran). The inversion can be performed manually step-by-step or fully automatic. In order to improve the reliability of the MT solutions computed with the automatic mode, the *pytdmt* also includes data signal-to-noise analysis (which do not require pre-event signal) and waveform spikes inspection in order to automatically clean the dataset. The *pytdmt* is tested to produce reliable solution using 1D Earth model synthetics for small to large earthquakes. In this work we present the results obtained using the full automatic mode for earthquakes occurred into the European-Mediterranea since begin of 2000 with moment magnitude larger than 5. Goal of this test is to inspect the efficiency of the code with respect to the MT solutions and speed. The results show that the code is robust and produce reliable results for such earthquake and could be applied into automatic real-time seismologic analysis procedures.

REFERENCES

- Beyreuther M., Barsch R., Krischer L., Megies T., Behr Y. and Wassermann J. (2010), ObsPy: A Python Toolbox for Seismology, *Seismological Research Letters*, 81(3), 530-533.
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