EQvis

European Natural Hazard Visualisation and Management Platform

This work is based on the open-source-platform MAEviz developed by the Mid-America Earthquake (MAE) Center and the National Center for Supercomputing Applications (NCSA), extended and further applied to European conditions by Vienna Consulting Engineers (VCE).

VCE Vienna Consulting Engineers ZT GmbH   Mid-America Earthquake Center

Ergo consortium

Rooted and designed in the complex system of earthquake impact assessments finds place the open source software EQvis. It is defined as an analytical impact assessment software package that estimates impacts to numerous types of infrastructure, comprehending the effects on society and economy. EQVIS is originally based on MAEviz, developed by the Mid-America Earthquake (MAE) Centre, an open-source project built upon extensible software which makes use of the Eclipse Rich Client Platform (MAEviz, 2013).

EQvis has an open-source framework which employs the advanced workflow tools to provide a flexible and modular path. It can run over 50 analyses ranging from direct seismic impact assessment to the modelling of socioeconomic implications. It provides 2D and 3D mapped visualizations of source and result data and it provides tables, charts, graphs and printable reports for result data. It is designed to be quickly and easily extensible. When new science, source data or methodologies are discovered, these can be added to the system by developers or end users via a plug-in system. Furthermore, the extensibility allows EQvis to be used for other future scenarios, such as other hazardous events like hurricanes, fires, landslides, etc.

IT details

EQvis is an open source software. It is written in Java Language and using Eclipse RCP. Eclipse RCP is a platform for building and deploying rich client applications. It includes Equinox, a component framework based on the OSGi standard, the ability to deploy native GUI applications to a variety of desktop operating systems, such as Windows, Linux and Mac OSX and an integrated update mechanism for deploying desktop applications from a central server. RCP made it possible to make EQvis modular and extensible. In fact, EQvis provides a framework to add new data and algorithms or update existing ones.

It also uses NCSA GIS Baseline that is a rich client application. This latter is composed by three main functions: data management (typing, ingestion, access, provenance tracking), visualization (support for 2D and 3D views, zoom, selection, highlighting), analysis execution (support for local multithreaded execution, visual dataflow system in development).

EQvis can easily integrate spatial information, data and visual information to perform seismic ri

sk and analysis. It supports *.shp file that is really useful to visualize immediately input and output data. For what concerns output data it provides different formats of results such as *.dbf table, .shp file and *pdf file.

The level of resolution depends on the size of the geounit that can be defined by the user. The geographical unit could be a regional unit, a provincial unit, a local unit and it could be an arbitrary polygon (regular or irregular).

Finally, EQvis has a user-friendly GUI that guides the user through the analyses. In the catalog box, in the lower left corner, the databases are stored and the user can utilize this box to select default data or their own data that are saved herein. In the scenario box, in the upper left corner, the analyses that have been run can be selected and can be visualized on the right box of the GUI.

Software description

EQVIS is an advanced seismic loss assessment, and risk management software which stands on the Consequence-based Risk Management (CRM) methodology. The software allows deterministic analysis; probabilistic one is under development. Hazard, inventory and fragility models are the required inputs.

Hazard

Earthquake hazard defines ground shaking and ground deformation, and also includes ground failure, surface faulting, landslides, etc.

For a deterministic ground motion event, the user specifies the location (e.g., epicentre), magnitude of the scenario earthquake, attenuation relationship (Ground Motion Prediction Equation) and the soil map to account of the local site conditions.

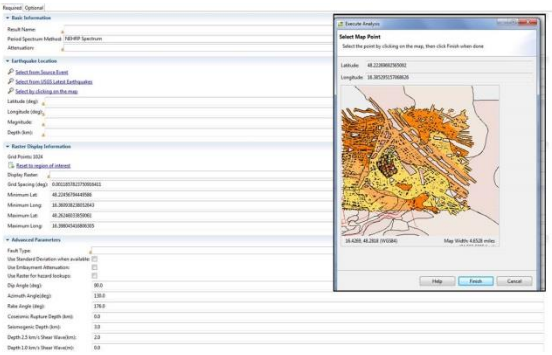

Figure 1. Hazard: earthquake parameters input.

In case of ground deformation, three types of ground failure can occur: liquefaction, landslides, and surface fault rupture. Based on the age, depositional environment, and possibly the material characteristics of each location a liquefaction susceptibility map is constructed with susceptibility levels ranging from 'None' to 'Very High'. These susceptibility levels are utilized in the program to determine permanent ground deformation resulting from both spreading and settlement.

Inventory

Inventory, or assets, consists of two major groups:

- ❖ population (i.e. demographic data, specifically classifications regarding age, income, gender, etc.)
- ❖ infrastructures i.e. buildings, transportation, utilities, and other critical infrastructure. Information like structural type, construction materials, and age are extremely important when assessing the level of damage resulting from an earthquake event. Also, additional factors such as replacement values are necessary to predict economic losses.

Fragility models

Structural fragility functions relate the severity of shaking to the probability of reaching or exceeding pre-determined damage limit states.

SYNER-G FP7 fragility functions are implemented in the current version of EQvis. The software automatically maps each structure with the most appropriate function (according to structural characteristics). However, the user has the possibility to select another function or even to input his own fragility function.

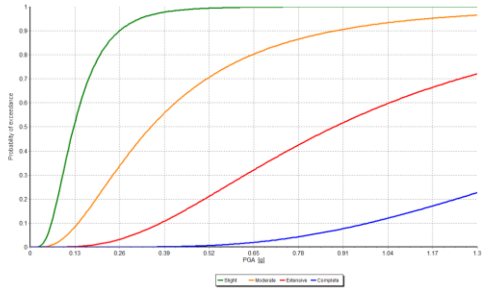

Figure 2. Example of fragility function

Output

The results of any type of computation are directly displayed on the map.

Concerning the damage assessment, four damage states are considered: insignificant, moderate, heavy and complete damage. The user can visualize immediately on the browser the structural or non-structural damage for these damage states. He/she can choose to visualize the insignificant, the moderate, the heavy, the complete state or the mean damage state.

Moreover the user can choose, for each analysis, to display the attributes tables. The output tables can be exported in excel tables or *.dbf tables.

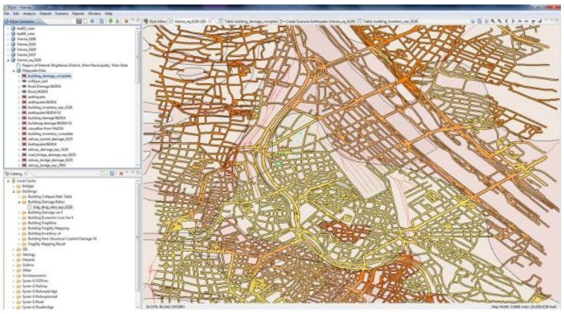

Figure 3. Mean damage plot on the road network (yellow is for lower damage lever, dark orange for higher one).

Conclusions

A powerful software tool consisting of an open source management platform is available. Nevertheless through the complexity of the subject and its features it still needs engineering knowledge for proper application.

Further development is directed into risk analysis and the computation of scenarios with resilience background. It shall be considered that the data necessary to run major models are of large volume and might require high computation power. The platform satisfies current demand on disaster management but offers considerable opportunities for further research and development.

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