



**Centre for Disaster Management
and Risk Reduction Technology**

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Open source Procedure for Assessment of
Loss using Global Earthquake Modelling
(OPAL-GEM Project)

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Includes my work done at IUSS and
University of Pavia for my MEEES Thesis



ABSTRACT

This report incorporates my Masters Thesis as part of the MEEES course at EUCENTRE - ROSE School – IUSS Pavia – University of Pavia collaboration, Italy supervised by Dr. Rui Pinho and Dr. Helen Crowley entitled “A comparison and production of open source earthquake loss assessment software packages” and additional work done at CEDIM, Karlsruhe, Germany.

The aim of this research report is to provide a comparative in-depth view of current Earthquake Loss Estimation (ELE) and other earthquake software packages using an “*Open source Procedure for Assessment of Loss using Global Earthquake Modelling software*” (OPAL-GEM1) with the view of creating a truly “*Open source Program for Assessment of Loss for Global Earthquake Modelling*” (OPAL-GEM2).

The OPAL procedure has been developed to provide a framework for selection of optimal components:

- 1) Overview of current and new components of earthquake loss assessment (vulnerability, hazard, exposure, specific cost and technology) was made, identifying the disadvantages and advantages of methods used;
- 2) Preliminary research, acquisition and familiarisation with all available ELE software packages was carried out;
- 3) Assessment of these software packages was undertaken in order to identify the ELE methods used; and
- 4) Loss analysis was undertaken for a deterministic earthquake (Mw7.2) for the Zeytinburnu district, Istanbul, Turkey, by production and use of 2 software packages: displacement-based MDBELA (Matlab-based DBELA); and CSM-based MHAZUS (Matlab-based HAZUS). Also SELINA was adapted for use in order to gain an understanding of the different processes needed for the production of damage, economic and social loss estimates. MDBELA was found to be more computationally expensive. Other mediums and optimisation techniques have also been presented.

Optimisation of the software and ELE components needed for OPAL-GEM2 were identified through a multi-criteria analysis applied to all ELE software packages using the knowledge gained through the OPAL-GEM1 process. Future improvements to the step 4 in the OPAL procedure have been recognised and will be undertaken in future work, including conversion to Octave and Python.

OPAL-GEM2 will be a dynamic, open-source, multi-tier, Python-based (Java-compatible) ELE Software Package integrated with an open source GIS package, and it will be produced to provide a solution for both forecasting and rapid loss estimation with special insights into the improvement of socio-economic software practice, use of remote sensing in exposure data and systems planning.

Keywords: OPAL, displacement-based, DBELA, earthquake loss estimation, earthquake loss assessment, GEM, OPAL-GEM, open source, HAZUS

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