

Notification: Study on the cumulative propagation effect of Groningen risk model component uncertainties on hazard and risk predictions

Organisation: State Supervision of Mines

Purpose of the notification

The Procurement Office of the Ministry of Economic Affairs and Climate Policy (MEA) is publishing this notification on behalf of the State Supervision of Mines (SSM). The purpose of this notification is to determine whether there are parties interested to perform the abovementioned assessment.

Background information

It is the objective to verify and quantify the cumulative effect on predicted hazards and risks caused by Groningen-seismic-hazard-and-risk-model-train components: (1) input data, (2) model choices and assumptions. Quantify their uncertainty propagation in the model train etc. and their relative contribution to overall uncertainty. It is the objective to especially review the scientific and probabilistic soundness of the assumptions and choices with respect to the state-of-the-art knowledge about performance-based seismic risk assessment. It is the objective to rank model parameters, assumptions, model choice uncertainties in terms of contributions on resulting impact uncertainty in calculated hazard and risks. It is the objective to formulate recommendations to validate the probabilistic framework and to possibly reduce the uncertainties with respect to the working assumptions of the Groningen-seismicity-hazard-and-risk-model-train.

The current risk approach consists of the well-known seismic risk approach decomposing the problem in steps from source to hazard, fragility and exposure (consequences/loss) models: production level/seismicity, attenuation/site response, fragility/territorial exposure and consequences/impacts. In each component stochastic modelling is required to quantify uncertainty. These uncertainties propagate in the whole risk assessment model. The obtained quantified hazard and risk results are compared to building code and personnel safety norms. Based on the outcomes and the inherent uncertainties, strengthening program measures are designed to ensure that buildings meet the safety norm. Both conservative and unconservative assumptions, as well as, - not state-of-the-art - stochastic modelling, model choices and inappropriate uncertainty ranges may result in biased estimates leading to wrong risk-based decisions.

The source code for the model will be made available after this study has been awarded. Signing a non-disclosure agreement is mandatory.

Central research questions:

1. How do the model assumptions, model choices and uncertainty ranges influence the hazard and risk calculated?
2. Which modelling assumptions, model choices and model parameters contribute most to the hazard and risk calculated? How can the uncertainty bandwidth be reduced? Are there missing parameters? How can currently missing parameters be included?
3. What is needed in terms of research, if any, to render the risk estimate unbiased?

Deliverables expected

1. Report on the influence of model assumptions, model choices and uncertainties on hazard or risk. Clear explanation about safety factors (if any) used in the models. Conclusion about the validity of the approach followed.
2. Report how model train assumptions, model choices and model parameters impact on the predicted risk output (risk figures disaggregation). Conclusions on the risk components which are not state of the art (if any) in terms of modelling and stochastic modelling (uncertainty treatment and quantification).

3. Recommendation for improving modelling and stochastic model of each model component, ranked by the anticipated effect and recommendations to integrate the model components in the integrated risk assessment framework.

Expected use

The result will be used to plan for improving a (public) version of the Groningen seismic hazard and risk model. The improved model train will produce better predictions enabling SSM and MEA to better inform citizens and to better shape the strengthening program.

All deliverables are open access, publication of results is explicitly encouraged.

Timeline

A nine month duration of the project is expected.

Required skills / experience / capacity

The company or companies (in case of a consortium) should:

- Have knowledge on probabilistic hazard and risk modelling, from seismology to nonlinear structural dynamics, eminent statistical expertise and monitoring techniques;
- Have the capability to execute the calculations using the Python/MATLAB source code that will be made available:
 - Python HRA Code: just under 4,000 lines of Python code + 1,500 lines of comments
 - Common Code (incl. postprocessing): about 8,000 lines of Python code + 2,600 lines comments
 - Storage: Each risk run consumes some 50Gbyte disk space (full logic tree).
 - Hardware: For best performance the number of cores needs to exceed the number of logic tree branches (504 branches).
 - Post-processing: requires some 80 Gbyte of main memory.
 - A 500,000 catalogue risk run in the above compute environment takes some 55 hours (Python)
 - All libraries are open source and available for free. The following libraries are used (placed in requirements.txt, as per the Python coding conventions):
 - numpy==1.9.1
 - h5py==2.6.0
 - scipy==0.14.1
 - matplotlib==1.5.3
- Have all further technical and economic knowledge required to perform this study.

Application

Interested companies / consultants, fitting the above mentioned requirements, are invited to respond to the Procurement Office of the Ministry of Economic Affairs and Climate Policy, to the attention of Ms. Marjolein Switzar by e-mail IUCEZteam5@rvo.nl.

You do not have to send documents, only an e-mail if you are interested.

Interested parties will receive the request for the tender by e-mail, as soon as possible after the deadline for responding to this Notification.

The deadline for responding to this Notification is set at 19 February 2019.