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Geoscientific Model Development Discussions

Interactive comment on "SiSeRHMap v1.0: a simulator for mapped seismic response using a hybrid model" *by* G. Grelle et al.

Anonymous Referee #1

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This paper presents an interesting and original approach to provide prediction maps of seismic site response, by means of metamodels trained by simplified physics based models. The code comprises of 5 interdependent modules for: 1) lithologic parametrization; 2) GIS Cubic Model frame; 3) stratigraphic site response analysis; 4) training "Spectra", the metamodel for the acceleration response spectra; 5) Map generation. The modular approach makes this model easy to update/maintain, and being able to quickly obtain the maps of response spectra sounds quite tempting.

The authors have done a good job incorporating the current simplified approaches for quantifying the stratigraphic and topographic site response into their metamodel. However, the modules for computing the site response suffer from the limitations of the employed simplifying assumptions. I would suggest that the authors consider and

discuss the following points.

General comments

- The proposed model brings improved computational efficiency thanks to its metamodels. However, often the preparation of the model (i.e. characterization of wave velocities, thickness of lithological units, etc) is much more time consuming than the actual computation. This issue is essentially the same for the proposed model. If the characterization of geological units is complete, the reduced computation is obviously a clear advantage, but if it is not readily available, what are the clear advantages of the proposed method over the conventional methods?

- In my opinion, the equivalent linear approach is no better than the linear elastic approach, unless it's very carefully performed. I think it's not suitable for being run automatically (as in this code). The iterations in the equivalent linear approach is not guaranteed to converge. It is only valid for a limited range of strain; for a very high level of strain, it tends to underestimate the ground response (non-conservative). A simple non-linear dynamic analysis requires no more parameters than the equivalent linear approaches, and the computation time is not an issue either. A linear elastic approach would be at least conservative, although it still may not be accurate for large strains.

- In this study, it appears that the metamodel for the topographic amplification is calibrated using simplified numerical models, assuming homogeneous materials. However, previous studies suggested that often the topography effects are coupled with stratigraphy (see Asimaki and Jeong [2013] or Burjanek et al. [2014]), and not easily separable. I therefore think it would be useful if you discuss when your model assumption may and may not be valid. Also, I only see the comparison of the the prediction with 2D SH wave simulations. How about the P-SV wave simulations? Or 3D effects?

Specific comments

P 4495: I think Equation (1) deserves a justification. It's is customary to model the

velocities of granular materials with a power law equation. Is there a specific reason for choosing a logarithmic function of depth? Similarly, why a linear function for Equation (2)?

P 4499: Equation (10): It's customary to take the time-averaged shear wave velocity. Is there a specific reason why you chose to use the arithmetic mean of Vs(top) and Vs(bottom)?

P 4508: How to you justify the model equations (17) and (18)? Can you please discuss why you chose these specific functional forms?

P 4509: Line 3 5: The simplifying assumption is probably ok, but this statement is not necessarily true.

P 4510: Line 6 9: Where is this shown?

Editorial comments

P 4502: Using the name "Spectra" for the metamodel of acceleration response spectra is actually quite confusing. Also the symbol S is usually reserved for the summation.

P 4509: Line 9: (Fig. 11) → (Fig. 10)

P 4510: Line 20: (Fig.13) → (Fig. 12) ?

P4512: Line 14: (Fig.14) → (Fig. 13)

P 4513: Line 25 28: This was not discussed in the body of the article, but only in the conclusion.

Interactive comment on Geosci. Model Dev. Discuss., 8, 4487, 2015.