

Response to comments for "A Novel Approach to Assessing Nuisance Risk from Seismicity Induced by UK Shale Gas Development, with Implications for Future Policy Design", by Gemma Cremen and Maximilian J. Werner

NHESS-2020-95

We thank the reviewer for their thoughtful comments, which have improved the quality of the revised manuscript. The reviewer's comments have been numbered and listed below, followed by our responses in italics.

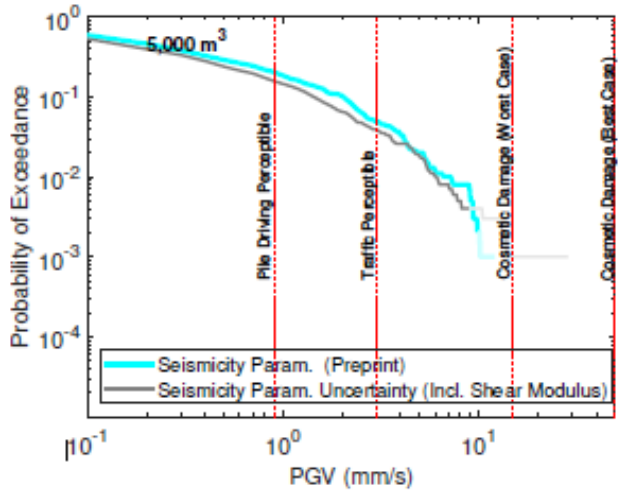
Reviewer 1:

1. The rupture behavior was found to be the most important source of uncertainty in the derived ground motion values. While in the volume-based model the authors explore the uncertainty in the b-values and SEFF in Section 5.1, it would also be interesting to explore the effect of using different shear modulus values for shales that are commonly reported in the literature.

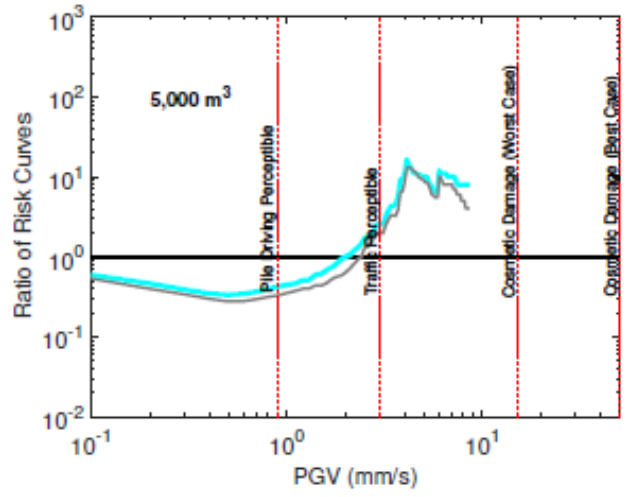
This is a good point. The authors have implemented this suggestion by also considering shear modulus uncertainty in the seismicity parameter uncertainty analysis of Section 5.1. Shear modulus is now treated as a uniform distribution between 10 and 20 GPa, based on the range of moduli values provided for Bowland Shale (i.e., the formation targeted at Preston New Road in the UK) in:

De Pater, C. and Baisch, S.: Geomechanical study of Bowland Shale seismicity, Synthesis report, 57, 2011.

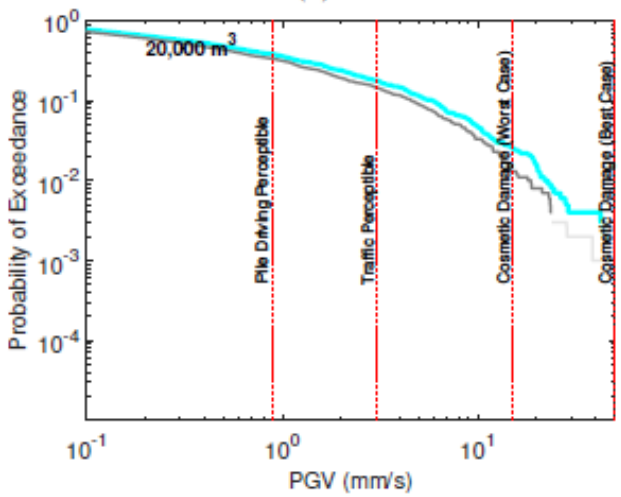
Figure 1 compares the exceedance and risk ratio curves (provided in Figure 9 of the paper) when the shear modulus uncertainty is (grey line) and is not (cyan line) accounted for in the seismicity parameter uncertainty analysis. It can be seen that there is no significant difference between the results of the two cases. Therefore, the conclusions about the effect of seismicity parameter uncertainty (discussed in Section 5.6) are unchanged, although the text in Section 5.1 has been updated to describe the additional uncertainty. The updated version of Figure 9 in the paper is provided in Figure 2 below.



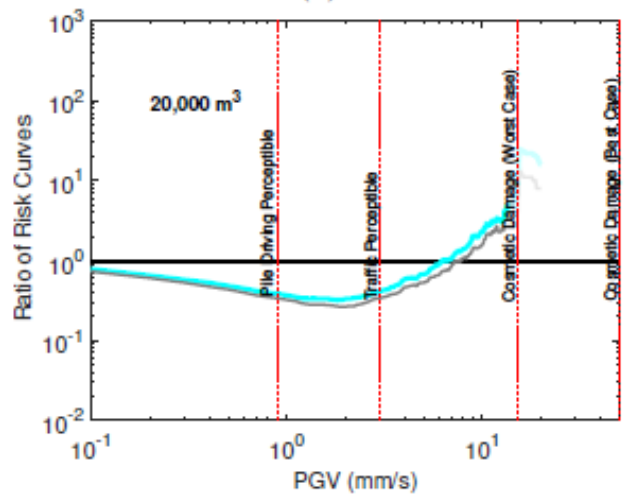
(a)



(b)



(c)



(d)

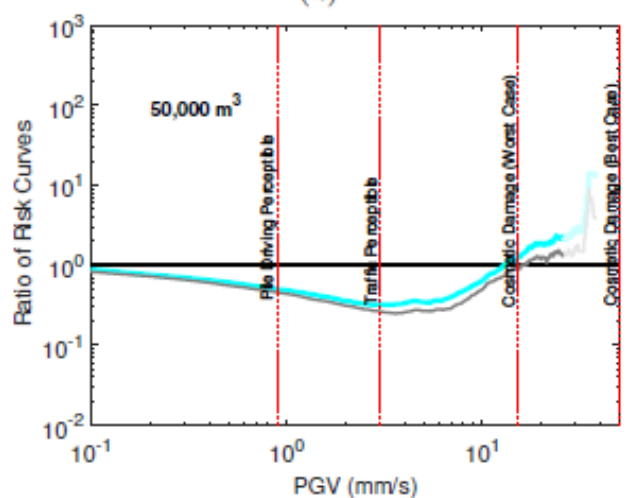
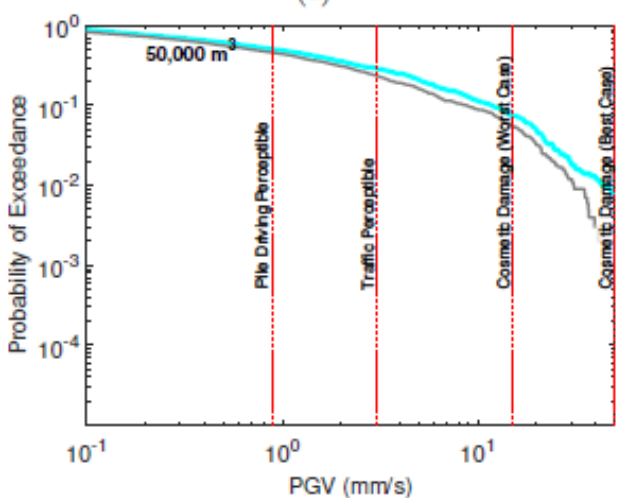


Figure 1: Comparing the impact of modelling assumptions when shear modulus uncertainty is (grey line) and is not (cyan line) in the seismicity parameter uncertainty analysis.

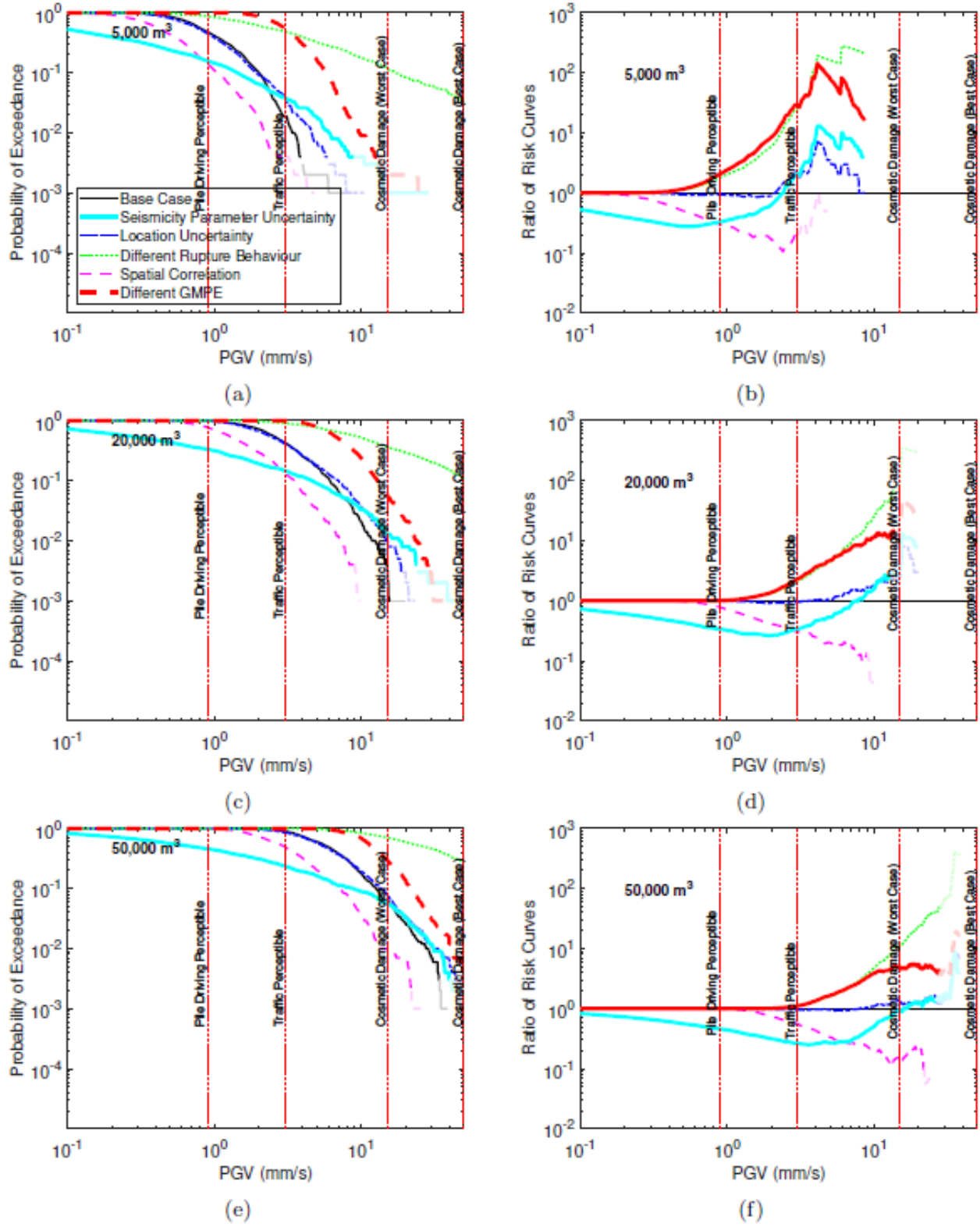


Figure 2: Updated Figure 9 of the paper, to reflect the shear modulus uncertainty that is now considered for the seismicity parameter uncertainty case.

2. Page 13, Line 277 “b-values values”. Remove repetition.

Thank you for pointing this out. This error has been fixed in the updated version of the paper.

3. In Fig.10a the authors plot the probabilities of exceeding prescribed PGV values according to the GMPE and its equivalent for the maximum expected amplitude, as magenta and blue color lines, while in Line 459 refer to black lines. Please clarify.

Thank you for pointing this out. The “black” description of Line 459 was an error; it has been changed to the correct “magenta” description in the updated version of the paper.