Solid Earth Discussions

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Comment on se-2021-156

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Referee comment on "An efficient probabilistic workflow for estimating induced earthquake parameters in 3D heterogeneous media" by La Ode Marzujriban Masfara et al., Solid Earth Discuss., https://doi.org/10.5194/se-2021-156-RC1, 2022

This manuscript presents a new algorithm for probabilistic earthquake source inversion based on Hamiltonian Monte Carlo (HMC) sampling of the posterior distribution. The algorithm's efficiency rests on problem-specific adaptations to the base version of HMC, and in particular an iterative linearisation scheme that accelerates the forward problem solution while reducing dependence on the prior.

The manuscript is a please to read and clearly a scientific advancement. Most of my comments are contained in the annotated manuscript. A few more significant, but still minor, ones are listed below:

1) Given that this is a purely synthetic study that could in principle be translated to a broad range of applications, the introduction seems unnecessarily focused on Groningen. This may confuse some readers, and it artificially limits the scope of this work. It may make more sense to centre the introduction around induced seismicity and earthquake moment tensor inversion in general.

2) The reasons for stronger nonlinearity and weaker priors given on page 3 are not so obvious and need more substance. In general, arguing in terms of frequency may have limited meaning because what ultimately counts is the number of wavelengths between source and receiver.

3) While the derivation of the representation theorem for moment tensor sources has educational value, I doubt that this well-known result needs to be repeated in a research paper. My suggestion would be to leave this out and thereby shorten this already rather long manuscript.

4) The conclusion that the proposed algorithm works may be a bit too strong, given that it is only run in a synthetic scenario. So, what is actually shown is that the algorithm satisfies some sort of minimum requirement, which is the delivery of reasonable results under idealised conditions. This is still am important achievement!

Please also note the supplement to this comment:
https://se.copernicus.org/preprints/se-2021-156/se-2021-156-RC1-supplement.pdf