

Response to Reviewers

We sincerely thank the reviewers and the editor for their thorough evaluations and insightful comments. We have revised the manuscript according to the suggestions provided. Below, we address each point raised by the reviewers and indicate how we have incorporated the corresponding changes into the revised manuscript.

Reviewer 1

“In the theoretical model test, both the root-mean-squared error and standard deviation of the inversion results obtained based on Lip-MALA algorithm are smaller than that obtained based on HMC algorithm. However, in the two-dimensional real data test, the inversion results obtained based on HMC algorithm are better. According to Figure 1, the inversion results obtained according to HMC algorithm should have smaller error. What is the reason for the smaller error in the inversion results obtained using Lip-MALA algorithm?”

Response:

We appreciate this observation and have clarified the reasoning in the revised manuscript (Discussion section). The apparent contradiction arises mainly from (i) the **evaluation metric** and (ii) the **dimensionality of the problem**:

- In **1D tests (synthetic and real)** we emphasized RMSE along seismic traces. Lip-MALA, by applying a locally Lipschitz adaptive step size, stabilizes local sampling and reduces pointwise RMSE.
- In the **2D real case**, we emphasized posterior standard deviation. HMC, with its long Hamiltonian trajectories, explores multimodal posterior structures more effectively, reducing global uncertainty.

To make this distinction more transparent, we have added explicit text explaining the role of the metrics and dimensionality, and we have also included a supplementary table reporting **2D RMSE values** for a direct comparison. This addition demonstrates that HMC indeed minimizes uncertainty globally, while Lip-MALA achieves competitive local RMSE at lower computational cost.

Reviewer 2

“The manuscript undoubtedly presents an interesting work related to different seismic inversion algorithms. However, it should be structured differently and the entire text carefully reviewed. In its current state, it is not easy to follow. I suggest major revisions in this regard because, as I indicated, the topic is very interesting and the results are important and deserve to be published.”

Response:

Thank you for highlighting the importance of clarity and readability. Following your advice, we have substantially revised the manuscript to improve its structure and flow:

- Restructuring: The methodology is now divided into shorter subsections for each algorithm (MH, HMC, MALA, Lip-MALA), with concise descriptions and a comparative summary table (Table 1).
- Results section: The analysis is now presented in three clear stages — synthetic 1D test, real 1D case, and real 2D case — with transition sentences added to guide the reader.

- Figures and tables: Descriptions of figures have been shortened to focus on key findings, avoiding redundant text.
- Readability: Long paragraphs were split into shorter units; connectors such as “*In contrast*”, “*Moreover*”, and “*Therefore*” were added to ensure smoother transitions. We also used AI-based language tools to refine grammar and clarity.