Response to Reviewer 1

We thank the reviewer for the careful assessment of our manuscript against the GMD model-description requirements, which we found very useful in restructuring the paper. Here we briefly summarize below how the revised manuscript responds to your concerns.

We agree that the software is a plugin/extension of LaMEM that enables coupling to FastScape, and not a separate model. We will revise the title and the text no longer presents LaScape as an independent code. We also agree that, method-wise, the coupling concept follows established practice, and the new Discussion says so openly, citing in particular the ASPECT-FastScape coupling (Neuharth et al., 2022) that the reviewer pointed out, which is conceptually the closest existing implementation and which we had indeed used for comparison runs. While the overall coupling concept aligns with established practices (i. e., ASPECT-FastScape coupling (Neuharth et al., 2022)), we wish to highlight specific methodological innovations in our implementation. First, this represents the first detailed documentation of an open-source, finite-difference-based coupling framework. We present a verified, documented, and openly available implementation of this capability within LaMEM, together with an explicit description of its limitations. Second, our work shows different coupling choices. For geodynamics-to-surface coupling, we demonstrate that interpolating velocities (rather than topography) from the coarser geodynamic grid to the finer erosional grid yields higher stability due to the inherent smoothness of velocity fields. The combination of different solution algorithms and mesh processing methods can result in varying levels of accuracy in geomorphic evolution across specific scenarios. Our model introduces a new open-source coupling approach, and we believe that these methodological differences position our work within the scope of GMD manuscript types.

A more detailed user with associated codes (including LaMEM, FastScape, PETSc and so on) will be archived together in an updated Zenodo release.

We agree that the original manuscript gave too much space to the component models and too little to the coupling itself. Our methodology section has been rewritten and substantially expanded, and Figure 1 has been completely redrawn (Fig. A1).

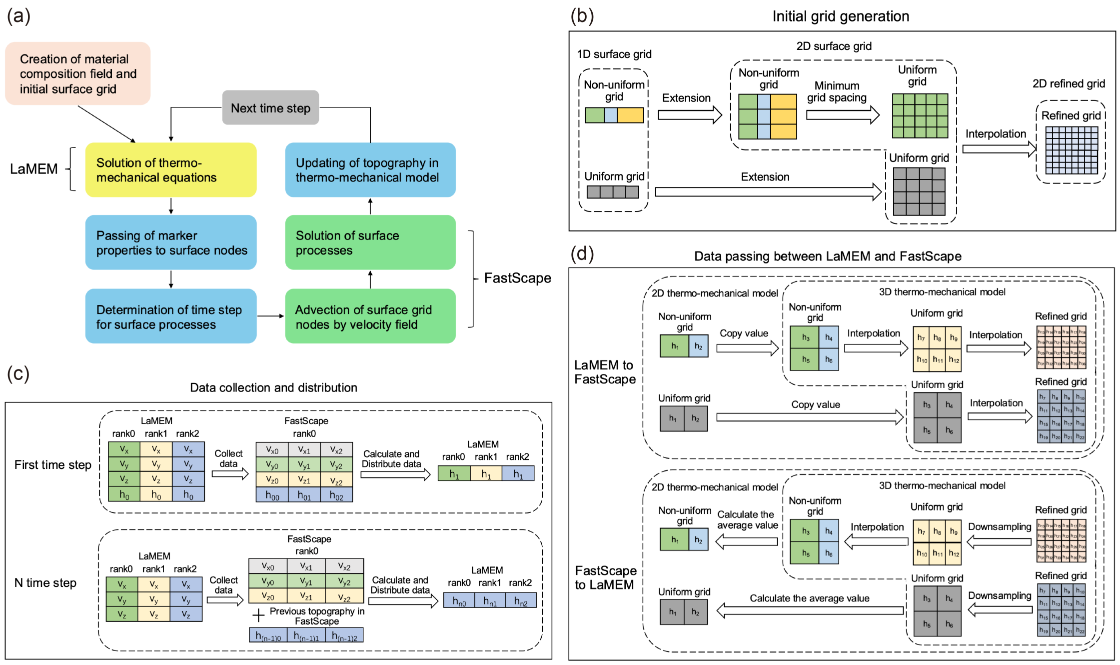

Figure A1. The redrawn workflow figure of the coupling module (new Fig. 1 of the revised manuscript). (a) Flow chart of the coupled computation. (b) Initial grid generation for the four grid configurations. (c) Data collection and distribution between the parallel LaMEM ranks and the serial FastScape process, distinguishing the first timestep (velocities and topography collected) from all subsequent timesteps (only velocities collected, FastScape reuses its stored topography). (d) Data transfer between the grids in both directions.

A dedicated subsection now describes what kinds of models can and cannot be run and under which conditions the solution becomes inaccurate.

Since no standard benchmark exists for this class of coupled models, we constructed two decoupled end-member tests that verify the coupling at the interface level against the standalone component codes. A coupled run with a negligible erosion rate reproduces the standalone LaMEM solution to within 1 m of topography, and a coupled run with disabled data transfer and prescribed uplift reproduces the standalone FastScape solution to within 1 cm of topography and 10^{-3} km^2 of drainage area. The revised Results explicitly separates these verification tests from the subsequent evaluation and demonstration models. The figures are provided in the response letter to the Editor.

We will also add the one-to-one comparison the reviewer requested (Fig. A2). The same buoyant-block (plume) setup is run in a 2D-coupled configuration (2D LaMEM with the surface grid extended in the second horizontal direction, the T-coupled model) and in a fully 3D coupled configuration, with identical surface-process parameters.

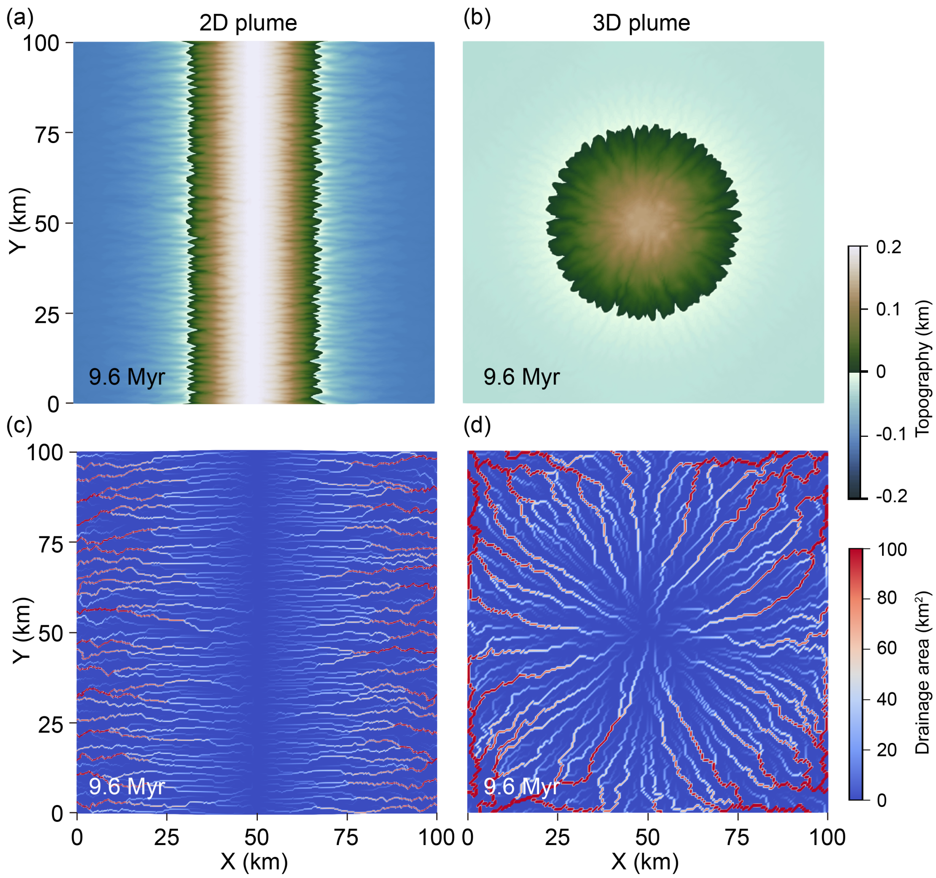

Figure A2. Comparison of the T-coupled (a, c) and fully 3D (b, d) plume configurations. Topography (top) and drainage area (bottom) after 9.6 Myr.

We thank the reviewer again for the constructive critique, which has substantially improved both the software documentation and the manuscript.