

Interactive comment on “Devito (v3.1.0): an embedded domain-specific language for finite differences and geophysical exploration” by Mathias Louboutin et al.

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We thank you for your review time and very useful review to make this paper impactful. We answered all the reviewer requests and discuss our choices on revision changes. Please find attached below response to the review and attached the revised manuscript with the updates in blue.

In their paper “Devito (v3.1.0): an embedded domain-specific language for finite differences and geophysical exploration” the authors present a software that introduces a high level representation for partial differential equations discretized with finite difference. The paper presents how this software can be used to solve wave equations and

C1

apply it to Full wave inversion problems. These problems are typical for geophysical exploration and thematically fits the GMD. The authors does a thorough verification of the full wave inversion implementation, which raises the quality of the paper. However, I would advise the authors to revise section 3.2 and 4, as it lacks references to previously published results. Also, I advice the authors to show the applicability of the software by presenting multiple examples with different partial differential equations.

Major issues:

Section 3.2 and Section 4 explain how the domain specific language Devito is structured. However, these sections do not refer to [1-3], which are tutorials published in The Leading Edge that presents the Devito implementation of the problem. I suggest the authors include these references, as well as revise these chapters, as some of the details in this section can be excluded.

- We do understand why these section may seem a bit lengthy for someone who already read the TLE tutorials, we think that TLE is a very domain specific journal and that a lot of GMD readers will not have read these. We therefore think it is better to keep this section detailed and self contained rather than shorten it and refer to a journal people may not know.

The paper present Marmousi-ii model. This is a very interesting example, which is very relevant for showing the applicability of the software. However, their description of the optimization setup is insufficient. I suggest the authors add information about the number of iterations needed, the stopping criterion and the initial and final functional values.

- A convergence plot and details about the experimental set-up have been added to the manuscript.

C2

As mentioned in the conclusion, Devito can be applied to other equations, as CFD problems. I would like the authors to present one or two CFD examples to emphasize the ease of use and generality of Devito.

- Added 3 CFD examples that highlight the flexibility of Devito. More examples are available in the repository and this is now mentioned in the manuscript. The domain decomposition (MPI) and half-node FD are discussed.

Minor Issues:

Page 7, Figure 2: Missing period after figure caption

- Fixed

Page 7, Line 9: This formula does not make sense for me. For $k=2$, this is a sum from 1 to 1, which excludes the midpoint and conflicts with the first equation on Page 8. Also $k=3$ would make it a sum from 1 to 1.5.

- The sum runs from $k=0$ to $\text{floor}(k/2)$ (0 to 1 for $k=2,3$) and fixed accordingly. Odd orders do not exist except first order so order $k=5$ would be the same as order $k=4$. changed accordingly

Page 8, Figure 3: The text in between the code and equivalent output makes this look like a part of the text. Please add borders around figure to clarify that this is one figure. Especially unfortunate since this is mid sentence from the previous page.

- Added borders

Page 11, Line 1: δd missing subscript s.

C3

- Fixed

Page 11, Line 7: Three sentences in a row starts with "We have".

- Fixed

Page 12, Figure 4: The variable "src" is not defined explicitly in this paper. However, it is defined in [1].

- Added reference and brief note on it.

Page 16, Line 1: "...convergence results is yo" should be "is to"

- Fixed

Page 17, Line 12: Replace comma after equation (11) with a period

- Fixed

Page 21, Line 16: Reference not properly formatted

- Fixed

Page 22, Figures 16-18: have too small fontsize. I also think all these figures can be combined

- Combined

C4

References: [1] Louboutin, Mathias, et al. "Full-waveform inversion, Part 1: Forward modeling." *The Leading Edge* 36.12 (2017): 1033-1036. <https://library.seg.org/doi/pdfplus/10.1190/tle36121033.1> [2] Louboutin, Mathias, et al. "Full-waveform inversion, Part 2: Adjoint modeling." *The Leading Edge* 37.1 (2018): 69-72. <https://library.seg.org/doi/pdf/10.1190/tle37010069.1> [3] Witte, Philipp, et al. "Full-waveform inversion, Part 3: Optimization." *The Leading Edge* 37.2 (2018): 142-145. <https://library.seg.org/doi/pdfplus/10.1190/tle37020142.1>

Please also note the supplement to this comment:

<https://www.geosci-model-dev-discuss.net/gmd-2018-189/gmd-2018-189-AC2-supplement.pdf>

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2018-189>, 2018.