

Interactive comment on “The Geodynamic World Builder: a solution for complex initial conditions in numerical modelling” by Menno Fraters et al.

Anonymous Referee #2

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This paper presents a tool, the Geodynamic World Builder, allowing the simulation of more realistic tectonic features, e.g., a continental, an oceanic or a subducting plate. The paper explains the philosophy of the tool and the definition of different tectonic settings. The second part focusses on 2D/3D cartesian and spherical examples of mid-ocean ridges and subduction zones models. I appreciate the effort made to simulate different tectonic context. I have no doubt this tool will be very beneficial and readily usable by the community. The GitHub documentation is also abundant, including a documentation section and a manual.

General comments:

- Basics information, which could benefit potential users, are missing. The models' parameters are not specified, such as the name of the codes used to generate the

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figures. - The methodology to define complex geometries/polygons could be more explained. For example, figure E1 is useful and could be included in the main text. - The authors didn't discuss the impact of more realistic geometries on the computational time of the models. Indeed, rapid temperature variation between different materials can induce longer calculation times.

Specific comments:

P1, I15: "...constrained by boundary conditions, which can be time-dependent, and by initial conditions..." you should briefly explain these conditions here and consider adding the parameters of all the models you present in the paper.

P2, I12: "that implicitly define volumes to which temperature and composition can be assigned." Rough variations of temperature, so viscosity, are hard to solve: Could you add a function to avoid this issue?

P3, I3-4: "but it can be achieved through a sticky air approach, where air is a composition...". Yes for small models, but such an approach is difficult to implement in 3D spherical models because it drastically increases the calculation time.

P3, I12-14: "This allows for defining a upper and lower mantle and to insert specific volumetric structures such as Large Low Shear wave Velocity Provinces (LLSVPs) at the core-mantle boundary. In the present version these mantle features can be assigned a radially uniform, linear or adiabatic temperature profile." Could you give an example, it is not clear how you can generate such structures?

P3, I26-30: "Dip angles are linearly interpolated along a segment. The overall direction of slab dip can be to either side of the trench and is selected... varying 3D slab morphology." A figure, like figure E1, could help the reader to understand the method.

P5, paragraph 3: I encourage the authors to focus on open source software such as CitcomS, CitcomCU, Underworld,....

P5, I17: "The slab temperature is computed using the McKenzie model for a particular

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slab history.” I understand this paper is not on geodynamic interpretations, but it could help the reader to add the model parameters.

P9, I1-2/Fig. 5: “One sided subduction is obtained in a self-consistent way by the presence of a weak crustal layer of uniform viscosity 10^{21} Pa·s on top of the subducting lithosphere.” Is it a self-consistent slab?

P8-9, Paragraph 3.2 to 3.4: the same comment than before: In order to foster the development of open source tools, it could be relevant to add open source software such as CitcomS, CitcomCU, Underworld,..

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