Review of paper by Colleoni et al.: *PALEOSTRIPv1.0 – a user-friendly 3D backtracking software to reconstruct paleo-bathymetries;* **submitted to GMD (MS No. gmd-2021-78)**

General comments:

This paper presents the rationale, methodology, physical/geophysical background and parameterization of new open-source software to calculate paleo-water depths in a 1D, 2D and 3D backtracking/backstripping procedure. The development of a relatively user-friendly open-source software for paleobathymetry is timely as the relevance for improved paleo-water depths for different time slices of the past geological history of ocean basins and continental margins is largely increased for urgently needed improved paleo-ice sheet and paleo-climate modelling results. Previously available software solutions have been lacking various aspects, such as full 3D flexural response, implementation of mantle-driven dynamic topography, sensitivity testing, open-access/open-source, and user-friendliness. All aspects are absolutely necessary to a research community-wide acceptance and usage of this software. The paper is well structured and written, and it contains the necessary and informative tables and figures. The methods and mathematical background are absolutely sound, and previously developed procedures are correctly cited. I recommend the paper to be accepted for publication after the following minor issues are addressed.

Specific comments and suggestions (numbers refer to line numbers of manuscript):

1) In general: Difference between backtracking and backstripping? I think that this is rather a semantic difference. In both approaches, the same fundamental principles and equation systems are used. It's only a matter which of the variables should be solved or kept constant first: Either assuming a fixed paleo-water depth and then solve for decompaction and subsidence, or implying an assumed subsidence and decompaction for obtaining a paleo-water depth. I suggest to generally use the term backstripping for either approach as this term is widely known and recognised in the geoscience community.

3) Introduction: I suggest to add the following two references as previous examples of 3D backstripping cases from the SW African and Brazilian margins to the Introduction: Dressel et al. (Marine & Petroleum Geology, 2015) and Dressel et al. (Tectonophysics, 2017).

2) Chapter 3: The authors describe with great clarity all necessary steps for backtracking/backstripping (decompaction, isostatic correction, thermal subsidence, sea-level, dynamic topography), but one important aspect is missing which is in particular important for polar continental shelves. That is the reconstruction of sediments that were eroded/truncated by grounded ice-sheet advances. Of course, reconstructing such eroded sediments above truncational unconformities or the seafloor (in case where dipping sequences pinch out) requires assumptions on pre-erosional sedimentation rates, but it would be useful if the authors could include a short paragraph on how this issue could be handled with their software.

4) Chapter 3.4 Sea level correction: The first paragraph has some repetition regarding the short timescale, glacial/interglacial cycle driven sea-level changes. Should be partly rewritten.

5) Chapter 4: The description of input data formats for 2D and 3D is not always very clear. For instance, is with 'regular array' a constant spacing of nodes meant? And can the x,y coordinates be different from horizon to horizon, or must x,y be the same for all horizons? Please clarify.

6) Chapter 6: I think it would be very useful to potential users of the software if the authors could make the input files of their two cases accessible, either as Supplementary Material or by providing URLs. Most new users to a software prefer to start with well tested working example files to become more familiar with the parameterization before preparing and

loading their own data files. This would add to the acceptance and encouragement for a wider usage of PALEOSTRIP.

Corrections of phrasing and spelling, and other minor issues:

7: 'to allow user<u>s</u> to'

12: '(e.g. the Shared Socio-economical Pathways <u>by</u> Riahi et al, 2017)'

15: '…, <u>although</u> …'

37: '…, and <u>thus</u> the paleo-water depth …'

45: 'trend<u>s</u>'

50-51: '… of <u>the</u> geodynamical open-source software GPlates (https://www.gplates.org/). <u>It benefits</u> from geodynamical corrections related to <u>kinematic</u>, …'

55: '…areas to <u>constrain</u> climate …'

71: '<u>operating</u> system'

81: '<u>operating</u> system' and 'provide <u>the</u> PALEOSTRIP code'

84: 'Coordinat<u>e</u> system'

101: I suggest to add '… on the thermal subsidence <u>as well as erosion</u> …'

Equation (1): Shouldn't it be $\rho_m+\rho_w$ in the last term?

111: Add abbreviation '… sea level <u>(SL)</u> variations …' to refer to term in equation.

123+125: '<u>right</u>-hand side'

128: '… are explain<u>ed</u> following …'

187: '… grid point result<u>s</u> <u>are</u> independent from each othe<u>r</u>.'

206: Remove the <u>a</u> before '2d and 3D …'

210: 'by mean<u>s</u> of'

211: Remove one of the two <u>in</u>.

212: 'also allo<u>w</u> to use' (remove s)

222: 'the stretched lithosphere <u>thins</u> due to cooling'

247: 'larger time el<u>apsed</u> since'

258: Add '<u>On a long time scale,</u> sea level …'

259: '… and <u>on shorter time scales</u>, due to …'

258-267: There are some repetitions in this paragraph. Please rewrite.

290: '… dynamic topography<u> occurs</u> at long wavelength …'

308: 'PALEOSTRIP'

324: It says 90% in Fig. 4a. Please be consistent.

330: Please clarify if *dx* and *dy* must be identical for all horizons polygons.

331: It is not clear what is meant with scattered data as opposed gridded data. Do you mean data on an irregular grid as opposed to data on a regularly spaced grid?

345: Add sentence: 'Depths are related to present regional sea level.'

349: Add '… is the age of horizons <u>at the base of the layers</u> and …'

368: '<u>The m</u>atch between …'

377: Why are results better than with Flex-Decomp? Do you have a short explanation?

381: 'The match between …'

385: '… also extract 2D transects or 1D wells from 3D …'

386: 'we provide two case studies'

389: 'Both cases are taken …'

392: '… Ross Sea paleo-bathymetry …'

396-397: Shouldn't it be 'DSDP Site 273' on the western Ross Sea shelf?

414: '… depth of the mid-Miocene unconformity …'

419-424: According to Fig. 4 in De Santis et al. (1999), the unconformity RSU4 and other unconformities pinch out to the seafloor due to glacial erosion. How have the eroded sediments been taken into account? See also my comment above.

436: Add 'It can process paleobathymetries for …'

439: 'allow users to insert'

440: Remove a before 'minor work'

Figures:

Fig. 4a & caption: The text (line 324) says 80%. Please correct.

Fig. 4b & caption: It is not clear if the squared grid is absolutely required. How about a rectangular grid, e.g. in cases of long but narrow continental shelves?

Fig. 8 caption: Change to 'DSDP Site 273'.

Fig. 9 caption: What are the references for the RSU-4 and basement grids?