EGUsphere, author comment AC2
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Reply on RC2

Moritz Liebl et al.

Author comment on "Modeling large□scale landform evolution with a stream power law for glacial erosion (OpenLEM v37): benchmarking experiments against a more process-based description of ice flow (iSOSIA v3.4.3)" by Moritz Liebl et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-352-AC2, 2022

Dear Eric Deal,

we thank you for thoroughly reviewing our manuscript and for providing constructive comments. Before we prepare a detailed revised version, we will briefly address the main points you raised. Most comments are very useful to the reader's understanding and we are happy to include them.

As also pointed out by the first reviewer, the manuscript is rather long. We will shorten the description of the benchmark experiments by first summarizing the main findings of each experiment and then explaining how we arrived at these findings in a shortened version. In this way the advantages and disadvantage of each model should be addressed more clearly. Then the scope of the study should be clear: benchmarking and evaluating of existing models.

We agree that additional figures/diagrams would help the reader to understand more clearly how the two models function. We are trying to create a figure that compares both models along a small section of the glacier showing the direction of the ice flow and how the flow lines come together.

Although including the last experiment makes the manuscript longer, we think it is reasonable to keep it as it shows exactly the field of application OpenLEM is intended for. We have structured the study in a way that the first set of benchmark experiments is conducted in settings intended for a process-based model such as iSOSIA to show how a topography based model such as OpenLEM performs in these settings. This helps to make the shortcomings of OpenLEM even more visible. Unfortunately, benchmarking the two models on scales of the last experiment is not possible due to the high computational cost of iSOSIA. This highlights the weaknesses of process-based models and strengthens the request to develop and test simpler models such as OpenLEM.

The major criticisms you made (in particular in the second half of your review) are more about the theoretical description of one model (OpenLEM), and not about the results of the benchmark experiments. We would like to emphasize that this study is not about the further development of one of the two models but only about the comparison of published, existing codes. In order to achieve a balanced benchmarking, we have asked the "masterminds" behind iSOSIA (David Egholm) and OpenLEM (Stefan Hergarten) to

conduct this study together with us.

Several ad-hoc assumption, in particular the the finite valley width, were ultimately the reasons we undertook this benchmark study in the first place, prior to adopting this new approach to describing glacial erosion. With this study, we show quantitatively how the very simple implementation of finite valley width in OpenLEM affects erosion rates and landscape patterns, which can than be discussed on a solid scientific basis instead of a gut feeling that it may not work properly. We also came to the conclusion that the treatment of OpenLEM in respect to the evolution of the glacial cross-valley geometry is a major shortcoming describing the evolution of glacial landforms but not necessarily describing the topographic evolution of entire mountain ranges.

We address this limitation along with its ad-hoc assumptions as a starting point for describing the models. However, we feel that going into the basic implementations of the models and modifying them as suggested is beyond the scope of a benchmark study. The limitations we identified in our benchmark study, which were also addressed in the review, provide a good basis for further model improvements, which the main developers of the codes will be happy to address in future releases. Again, our work aims to help potential users to decide which model is suitable for the particular problem that they would like to solve.

Best regards,
Moritz Liebl on behalf of all co-Authors