Response to Referee #1

We express our gratitude to Referee #1 for his/her useful comments. Our response to the reviewer's comments and the corresponding revision are described in detail and separately below. The numbers of pages, lines, equations, tables and figures are those in the revised manuscript unless otherwise described.

Comment 1:
"Similar models have been implemented since about 30 years. I think that the authors forgot a few references. For examples, ref to the SAFE and PROFILE box-models should appear in the text, because these are the first to apply laboratory kinetic laws to the field. The WITCH model has been also developped to simulate weathering reactions mechanistically, and a version of it includes the CO2 diffusion (check Goddéris et al., 2006, in GCA; Roland et al., 2013 in Biogeosciences; Beaulieu et al. 2012 in Nature Climate Change; Goddéris et al., 2013 in Biogeosciences). Although not dealing with enhanced weathering, these simpler box-models demonstrate their ability to simulate weathering processes in the field based on a more mechanistic formulation."

Response:
We recognized the significance/importance of developments and successful applications of the already published models including the SAFE, PROFILE, and WITCH models, for a better understanding of ongoing natural weathering and predicting the future weathering in a process-based manner. We did not refer to them because we focused on simulations of enhanced rock weathering, i.e., application of crushed rocks and reactive transport of them at the soil surface, which most of the models were not specifically designed for. Nonetheless we agree with the reviewer that it is important to mention these models as they and our model have a shared goal of a better understanding of weathering processes in general.

Changes in manuscript (Page numbers/Line numbers):
We added a sentence to refer to the previous models (P2/L48-53).

Comment 2:
"I found a bit strange to talk about uplift. Is the model really accounting for uplift ? If I understand it correctly, it seems to me that the model is using a referential in which fresh primary minerals are going upwards as weathering proceeds. In the real world, it is the regolith which progressively penetrates the bedrock and thus goes downward. This has nothing to do with uplift ?"

Response:

We utilized a spatially fixed frame for the model's calculation domain and solid phases can be supplied from the bottom via uplift from a deeper depth and can be lost via erosion at the surface after the reaction and transport within the model domain. This is a common assumption taken in many 1D reactive-transport models and consistent with the dynamics of rocks in the real world (e.g., Bolton et al., 2006; Li et al., 2014). We believe that the reviewer referred to the propagation of reaction front, which can be related to the interface between soil/regolith and parent/bed rocks, as they deepen with time as inferred from the reviewer's comment. Our model can indeed simulate deepening of reaction front with time (e.g., Figs. 1-3) within our calculation domain. Please also note that steady state for solid phases (and thus reaction fronts and/or bedrock/regolith interfaces) can be achieved within a spatially fixed frame only when considering the solid phase supply from the depth (uplift); otherwise, there is no source to balance the loss via dissolution/erosion, assuming no external supply (e.g., dust). The effect of including uplift and erosion may not be significant if we consider reaction/transport only on anthropogenic timescales (e.g., < 100 years), but we enabled solid phase erosion as well as uplift to make the model comprehensive and applicable for tuning at different and flexible timescales, which can be longer than the anthropogenic timescale (e.g., Fig. 13). Enabling erosion can also be justifiable or even desirable, given the enhancement of soil erosion at croplands (e.g., Pimentel, 2006, Environ. Dev. Sustain, 8, 119).

Changes in manuscript (Page numbers/Line numbers):
Because we have already described uplift/erosion with references in lines 88-90, we did not make any changes regarding explanations of uplift/erosion. However, we added a sentence in order to more clearly define our calculation domain (P3/L92-P4/L94).