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Discussions

Interactive comment on "Water limitation may restrict the positive effect of higher temperatures on weathering rates in forest soils" *by* Salim Belyazid et al.

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The paper by Salim Belyazid and coauthors reports the results of modelling of the effects of predicted future climate change, with respects specially to changes in soil temperatures and soil moisture, on future chemical weathering rates in forest soils. They use an 'integrated forest ecosystem model' known as ForSAFE to model chemical weathering on 544 managed forest sites distruted through Sweden. They derive their future climate predictions from two general circulation models. From their modeling, they conclude that soil moisture will decrease in summer under predicted future warming, which could limit expected future increases in weathering rates attributable

to higher temperatures.

I write this review from the perspective of someone who is not a modeler but rather is a geomorphologist with knowledge of weathering. I thought the paper was really disappointing, given that this is an interesting topic and that the paper started reasonably well. The Abstract was clear and concise, the Introduction set the problem up, and the Methods were explained. However, from there the manuscript deteriorates with some fairly uninspiring results, a discussion that reads as esoteric and largely irrelevant to the results, and no Conclusions. The authors discuss various shortcomings with weathering models but offer no interpretation of their Results. There also seems to be almost no connection between the model and the physical environment, depite using 544 forest soil sites (boreal forest, soils developed on glacial diamicts, temperate to Arctic climatic range, mineral derived nutrients, podzols, etc, are all terms reflective of the physical environment that I was looking for but which were missing). Also, the important effects of soil erosion on chemical weathering rates are completely overlooked and there is no consideration of the temporal evolution of these soils derived from glacial sediments, which may be largely unrelated to climate. For example, what happens over time as easily available mineral nutrients in the sediments are depleted? Is there any bedrock weathering and how might that change in the future? The soils on which many of these forests are located are frequently thin and clastic. What about the effects of fire under a future warmer climate on these managed forests, in terms of nutrient uptake, nutrient cycling, effects on surface runoff, and vegetation assemblages, which might also be important enough to at least warrant a mention? The thread of their narrative is difficult to follow and I missed having a Conclusion section. The paper simply finishes with this sentence: "To reduce the uncertainties connected to those regressions, a revision of the regression is required, where the newest technology can be used". It really says nothing, which in a way sums up this paper. It's a pity because I think the modelling exercise that the authors have completed has merit and it could be worthy of publication, but certainly is not, in my view, in its present form.

In addition to this general impression, I list the following specific points: I have enormous sympathy for non-native English speakers having to write scientific English. It's not easy. However, the manuscript does suffer from it being difficult to read and from numerous grammatical errors, especially through the Results and Discussion sections. A revised version would benefit from more detailed proof reading.

15: Previous estimates of weathering rates? And what about temperature controls on reaction kinetics? 20: For those from a different field, it could be worthwhile explaining 'productive'. We can guess what it probably means but it would be good to have it defined. Also, what is modeled? 25: Elevated air temperatures should appear earlier 30: This could be shortened 35: It is unclear what exceedance of planetary boundaries means, its connection with climate change, and its relevance for this paper. 40: Why is an increase in biomass production needed to meet the stated goals? 50: Grammatical error with the references. Be specific and substitute tree harvesting for forestry!? 55: Compensation potential – with respect to acidity? The reader can often guess what you mean but the writing should be much clearer. 60: Losses of what? 65: Accelerated is preferable to higher because the latter might mean larger trees. 70: Could be worth explaining radicals or being more specific with respect to listing those. Also the number and intensity of wetting and drying cycles might be important. "Net effect is positive or negative" be explicit: "on chemical weathering of soils". Also weathering encompasses physical and chemical processes, and physical processes related to freeze-thaw/frost cracking will change in a different way to chemical processes, under a warmer climate. 80: Are you explicitly modelling all of the unsaturated zone? What about in locations where it extends below the maximum rooting depth? What is the maximum rooting depth? 90: "and" organic cations. And "H2O" with the 2 as subscript. 95: What are the different layers of the simulated soil? 125: Hydrology-related fluxes of what? 130: No previous mention of the listed atmospheric pollutants. Explain their importance to this study and do this earlier in the paper. 150: Explain why you use these two particular models: ECHAM5 GCM and CCSM3 GCM. Is "story line" the correct term?

RESULTS: In general, I found this section to be hard to follow. 175: Temporal or spatial 'variability'? 175-180: These two sentences read as being in conflict with each other. 190: Is it really both climate models? In the CCSM result in Figure 4 it appears that variance increases with soil temperature increase. 195: There really is no correlation between annual weathering rate and predicted moisture change. Is the correlation really significant? You are explaining 5% of the variance. The regression line very weakly indicates that annual weathering will increase with reduced soil moisture. Why would this be so and if you consider this result to be significant then why isn't is further explored in the Discussion?

DISCUSSION: There is essentially no exploration of the results but lots of esoteric model details. The sentence below 230 is essentially a repeat of 230. Part of the disparity in what? 235: Geophysical properties – what about geochemical properties? Soil coarse material – this is the first mention of grain sizes and their importance to the study needs to be introduced near the start of the paper. "Fine earth" – is that silt + clay? "Estimation method" – what is being estimated? 240: "User defined possible materials" sounds like something out of a robotic University HR department. It is incomprehensible here. Also a concluding sentence is needed for this paragraph. What is the key point for the reader? 250: It is unclear what this sentence means 265: It is entirely unclear what the concluding sentence to this paragraph means. 275: Exposed mineral surface – is this reactive surface area?

CONCLUSIONS: Where are they?

TABLES AND FIGURES Table 1: Might be better in a plot!? Define "future climate" in the footnotes. It is not a constant, but rather is evolving. 370: What is "increment of weathering"? 385: Define BC in the caption. 390: Figure 4: only the bottom left hand figure shows a correlation, and it is weak. 400: Figure 6: Is it even worth showing these? The highest R2 of the 4 plots is 0.1. 410: Figure 8. Here you have something but you make no attempt in the Discussion to explain it. This result may reflect an expected chemical weathering threshold around zero degrees. Increases in win-

ter temperatures, such that the soil is unfrozen for longer, is likely to be important in Swedish forest soils and your results support this.

In general, with respect to the figures explain how you calculated your statistics. The equations are all expressed in terms of X and Y but the parameters vary between plots, so should be individually defined for each plot. R2 should be R^2 (superscript).

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