

### **General comment to the handling editor**

We thank the handling editor for his additional insightful comments which are addressed below. In the track changes version of the manuscript, we show the differences between the last submission and our revisions. The comments of the handling editor are in bold, the replies in italics, and changed text in normal font.

Best wishes,  
Mirjam Schaller (corresponding author)

### **Comments to the author:**

Dear Authors,

First, please accept my apologies for the delay. This was related to my recent move to a new institution, which resulted in a delay due to ESurf emails not making it to the new address, and then a delay related to my own workload. I am sorry.

Thank you for your efforts in revision and replying to the reviewer comments and my own.

Having read through in detail these responses, I am satisfied that the major issues have been accounted for with revisions throughout the manuscript.

However, the new version has become a little more wordy, and there were some repeated clauses and tangential information. In addition, there was still one example of overreaching in the final section. I have edited the PDF and make suggestions for a final round of minor revisions to help address the first round of review comments.

Please let me know if any comments or suggested edits are unclear.

Best regards,  
Bob Hilton  
AE ESurf

## Response to comments of the associate editor Bob Hilton

Lines 46-49:

**I suggesting mentioning these concepts, but I wonder if the text to follow would be better linked to the discussion in the previous paragraph on what these terms mean for weathering, and also to seed that soil studies can be helpful. something like:**

**“Supply limited landscapes are those where increases in erosion can increase chemical weathering, while kinetically limited captures locations where other drivers (most commonly temperature, precipitation, fluid residence time) become important. While these concepts have proved useful, they may not well explain heterogeneties at the hillslope scale. In addition, complimentary to the previous work, other studies... etc.”**

*Text generally changed to the suggestion of the associate editor with minor changes. The text reads now like: “Supply-limited landscapes are those where increases in physical erosion can increase chemical weathering, while kinetically-limited landscapes capture settings where other drivers (most commonly temperature, precipitation, fluid residence time) become important. While these concepts have proved useful, they may not well explain heterogeneities at the hillslope and catchment scale. In addition, complimentary to the previous work, other studies...*

Line 74:

**New paragraph here**

*New paragraph inserted as recommended.*

Line 76:

**delete “taken together”, a repeat of previous sentence**

*“Taken together” has been deleted.*

Lines 101-102:

**~~This comparison is done to evaluate the similarity or dissimilarity in observations between areas.~~**

*Sentence deleted as suggested.*

Lines 104-108:

**To address the previous two aims, our efforts are focused on evaluating two hypotheses. These include: 1) soil production as well as chemical weathering rates increase with increasing MAP rates. This hypothesis stems from the model considerations of Norton et al. (2014) and a data compilation of Perron (2017) as well as White and Blum (1995); and 2) the contribution of chemical weathering to total denudation is constant over a climate gradient. Hypothesis 2 is supported by previous work of Riebe et al. (2004a) and Larsen et al. (2014).**

*The deletions as suggested have been accommodated. The section reads now like: “To address the previous two aims, our efforts are focused on evaluating two hypotheses: 1) soil production as well as chemical weathering rates increase with increasing MAP rates (e.g., Norton et al., 2014; Perron, 2017; White and Blum, 1995) and 2) the contribution of chemical weathering to total denudation is constant over a climate gradient (e.g., Riebe et al., 2004a; Larsen et al., 2014).”*

Lines 211-212:

**This was unclear as written.**

*Sentence changed to improve the understanding of the text:* “As a result, the SPRs reported here and the total denudation rates in Oeser et al, (2018) are the same expect for La Campana and Nahuelbuta where Oeser et al. (2018) reported rates based on cosmogenic production rates corrected for vegetation cover.”

Lines 215-217:

**To evaluate these hypotheses, we present an analysis for both the new Chilean transect data and also a global compilation of previously published data from similar granitoid sample locations as the Chilean data. More specifically, SPRs from the Chilean study...**

*Suggested deletions addressed. The sentence reads now as:* “To evaluate these hypotheses, SPRs from the Chilean study areas were compared to previously published SPRs derived from granitoid (Table 2 and S5) and non-granitoid (Table S6) soil-mantled hillslopes from around the world.”

Line 222:

**As per my review comment, please note (something like):**

**In addition, some studies have specifically sort out the highest SPRs to assess the potential limits to soil production (Heismath Nat Geo, Larsen Science)**

*The suggested sentence was added to the text:* “In addition, some studies have specifically sort out the highest SPRs to assess the potential limits to soil production (e.g., Heismath et al., 2012; Larsen et al., 2014).”

Lines 222-228:

**To avoid oversimplifying our comparison of the Chilean data to other globally distributed studies, we have carefully selected previous studies reporting data most akin to our sampling and analysis approach. For example, global sites we directly compare our results to were taken from soil-mantled 225 hillslope measurements rather than catchment average estimates from river load, and also locations with granitoid lithologies underlying the hillslopes to minimize lithologic variability effects. Although we include settings with non-granitoid hillslopes, we do this for completeness to highlight how lithologic variations might induce variability, but we avoid interpreting differences between these areas and our Chilean results.**

*Changes and deletions were addressed as suggested:* “To avoid oversimplifying our comparison of the Chilean data to other globally distributed studies, we have selected previous studies reporting data most akin to our sampling and analysis approach from soil-mantled hillslope measurements rather than catchment average estimates from river load, and also locations with granitoid lithologies underlying the hillslopes to minimize lithologic variability effects.”

Lines 232-234:

**~~The global data sets used here for LAI and climate therefore benefit from having the same, consistent, processing of data, but suffer from having a coarser resolution than local to regional based studies~~**

*Sentence was deleted as suggested.*

Line 238:

**spell out why this is a potential issue - something like:  
which means chemical weathering may not be as responsive to changes in climatic and biotic drivers.**

*Sentence adjusted to suggestion: "The potential bias introduced by this is that these areas may be supply-limited which means that chemical weathering may not be as responsive to changes in climatic and biotic drivers."*

Lines 241-243:

**~~Thus, the compilation presented here of 'pruned' global observations aims at the fairest comparison possible between different areas, but does so at the risk of excluding some readers 'favorite' study areas that don't meet the objective application of criteria described here.~~**

*Sentence deleted as suggested.*

Line 244-250:

**This paragraph contains some repeated info, and I wonder if the tables can be mentioned in the previous paragraph and the methods briefly too, thus this paragraph deleted.**

*The paragraph was shortened and coupled to the next paragraph. We hope that this change is acceptable. The new paragraph reads now like: "For the Chilean and global data sets our analyses were conducted in two ways. First, the SPRs and the compiled topographic, climate, and vegetation parameters for granitoid sample locations were analyzed with a Pearson linear correlation analysis (Table S7). Also, the compiled chemical weathering and physical erosion rates determined in granitoid soil-mantled hillslopes around the world (Tables 2 and S8) were compared to climate and vegetation parameters based on a Pearson correlation analysis (Table S9). In addition (second), we compare....".*

Lines 264-273:

**~~In this section, results for soil production, chemical weathering, and physical erosion rates are presented for the new and previously published cosmogenic nuclide concentrations from the Chilean study areas (Fig. 2; Tables S1, S3, and S4). Results are given for each study area starting in the arid north and progressing to the south. The total denudation rates ( $D_{total}$ ) presented below are the composite of the total chemical weathering rate ( $W_{total}$ ) and the physical erosion rate ( $E_{soil}$ ) and based on the calculated SPRs and the Zr concentrations in rock, saprolite, and soil (Table S2). The previously published total denudation rates (Oeser et al., 2018) were recalculated to account for chemical weathering of saprolite (see methods). Because the observations presented in our global compilation were previously published (see references in Table 2), we do not present the compilation in this section but rather in section 5 (Discussion) where~~**

~~it is integrated and discussed in the context of our Chilean observations. In addition, correlations of SPRs as well as chemical weathering and physical erosion rates with parameters are also shown in section 5.~~

*Paragraph deleted as suggested.*

Line 364:

**This is where you need to mention what the reviewer flags - the highest SPRs at 3000 mm/yr may have higher precipitations.**

**You can say what you want about model vs measurements, but I'm sorry, it rains a lot in the western Southern alps, and a lot more than 3000 mm/yr.**

**So your text needs to be fair to that, rather than just saying there is an up and down again. Because if you put those samples at higher precipitation, clearly it doesn't support your claim.**

*We have modified the text to add this caveat as you suggest. The text now says:*

*“The maximum SPRs in these settings are not only higher than in granitoid lithologies but also reached at a higher MAP (~3,000 mm/yr). However, we note that the SPRs coming from these high MAP settings are located on the western flank of the Southern Alps, New Zealand where other studies (e.g., Larsen et al., 2014), using different climate data, have suggested higher precipitation rates (>3,000 mm/yr). We caution that if MAP is higher than 3,000 mm/yr in this location, then the functional relationship between SPR and MAP in granitoid vs. non-granitoid hillslopes is not the same as suggested here.”*

Lines 487-489:

**repeated information from a few lines previous?.**

*Sentence in question deleted.*

Lines 552-555:

**this discussion seems out of scope of the manuscript**

*Two sentences in question deleted.*

Lines 552-555:

**This paragraph contains too much hyperbole as highlighted in the review process. The Chilean sites are 4, and have complex patterns. Therefore to start the whole discussion with “it is astonishing that the global dataset shows a similar picture...” is too much. Also the important discussion has already been made in the two previous sections.**

*We have deleted text at the start and end of the paragraph that could be considered ‘hyperbole’ (including the sentence mentioned above). We also restate that four Chilean study areas were investigated. The rest of the paragraph was kept because it makes a comparison of our work to previous published work which sticks to observations presented in those study. The remaining text and numbers cited are not covered elsewhere in the manuscript and we think it is important to reference related, previous studies (most journals request a section with ‘comparison to previous work’). Hopefully you find this acceptable.*

*Please note – we modified the paragraph to be more cautiously worded and use expressions like “if this similarity in limited observations is not coincidence, then ...” and “If true, then these observations [previous work we cite] suggest ...”. Thus, we try to make it abundantly clear to readers what the assumptions are in our and others work and that the ideas presented warrant additional observational investigations.*