

Review of ‘Will landscape responses reduce glacier sensitivity to climate change in High Mountain Asia?’

General comments

The manuscript presents a detailed consideration of an alternative to the assumed evolution of climatic change in High Mountain Asia that is the focus of numerical modelling to date. The manuscript focuses on a more geomorphological approach of glacial landscape change in the coming century in the region, and contributes an important piece of work in an important area of glacial research.

The manuscript it written is a clear and accessible writing style. I have suggested some rewording of sentences to increase the applicability to a global audience and the general flow of the article. I think the figures, figure captions and references to figures would benefit from some editing, which I provide details of in the ‘Specific Comments’ section.

In conclusion, I think this manuscript is an important contribution to research in the area of glacial change in HMA, and is starting a key area of discussion that needs to be had in a field where regional scale numerical modelling has dominated over the past decade. I think this manuscript is publishable following minor to moderate corrections, detailed below.

Specific comments

1. The three figures included in the manuscript all contribute to the manuscript, but I think their placement does not support the text as fully as they could. Furthermore, the references to the figures in the text is brief and it is often not very clear how the figure supports the statement made. Suggestions to improve these points below:
 - a. For Figure 1, I suggest removing (a) and (c) – I do not feel these contribute to the figure, and I think they detract from the more important information in (b), (d) and (e).
 - b. When referred to in the text, the descriptions of figures about what needs to be taken from the figure is often vague. I suggest adding further words to explain fully what the reader needs to look for that helps them in understanding the argument made. It was difficult to confirm whether you were referring to the correct figures in a number of cases as it was unclear what was needed to be drawn from the figure.
2. Throughout the manuscript there are references to varying terminology for regions within HMA. I think it would be worth reviewing this terminology and either reducing the number of regions referred to or including them all in Figure 2 so the reader is aware of where you are referring to. I think it would also be worth placing, and referring to, this figure earlier in the manuscript so readers are aware of the regions you are referring to.
3. For Figure 3b, I think it would be worth considering whether this graph would be better placed in Figure 1, so all the graphs presented could be compared more easily. I also suggest labelling the (3) line on the graph along the lines of ‘Clean-debris transition glacier’, so all elements of the graph are clearly understood.
4. Please look at the placement of figures and the references to these figures throughout the text. Figure 3 was referred to before Figure 2.

5. A great effort has been made throughout to write short, concise sentences. However, there is frequent use of 'This' in the following sentence when this approach is taken. I suggest rereading the manuscript to make sure it is clear what 'this' is referring to and amending where necessary to make the focus of some sentences clearer – in some cases I have suggested additional words or rewording within the technical corrections.
6. The paragraph from Lines 135 to 144 does not fit where it is placed currently, and the information within it would be better suited earlier on in the section so when 'winter precipitation' is referred to on Line 119 this makes sense. I suggest removing the first sentence of this paragraph and placing the paragraph starting on Line 108 instead.

The final sentence (Lines 497-498) is key here, as it will help future researchers to show the rationale for geomorphological based fieldwork. I suggest some rewording by replacing 'This' with 'Such an approach' but also including a 'but' at the end of the sentence – something that makes a nod towards the difficulty of such data collection being undertaken.

Technical corrections

Line 67: Suggest including some examples of the 'number of reasons' referred to here.

Line 70: Include 'related' following 'glacial'.

Line 72: Suggest quantifying the 'hundreds of millions of people' referred to here to show the importance of the research.

Line 75: Suggest removal of 'Himalaya and other parts' to make the sentence more concise.

Line 77: Suggest moving 'by 2030' to the end of the sentence to make flow of sentence better.

Line 79: Remove extra bracket after citation.

Line 81 and 82: Suggest inclusion of citation after 'glacier lake outburst floods' and 'rock slides and falls' to provide evidence as you have for the other types of change mentioned in the sentence.

Line 87: A space is needed between 'e.g.' and 'Nie'.

Line 90: Suggest inclusion of 'the' before 'CMIP5'.

Line 99: I think a word such as 'direct' or 'simple' rather than 'linear', as I do not think this is always the case.

Line 102: Place '2019' in brackets.

Line 102: Suggest inclusion of 'outcome' between 'This' and 'arises'.

Line 108: Suggest moving 'however' to the start of the sentence.

Line 108: Suggest replacing 'and this' with 'which'.

Line 109: Remove superscripted 0 after citation.

Line 115: Suggest replacing 'with' with 'to'.

Line 118: Include 'anomaly' between 'This' and 'is'.

Line 123: Replace 'et_al.(2017)' with 'et al. (2017)'.

Line 145: Suggest including a comma after 'research'.

Lines 149-151: Suggest remove of semi colons in this sentence and replacing with a comma.

Line 151: Make the closing bracket normal text – it is currently in bold.

Line 159: GLOF needs to be referred to in full here, as Glacial Lake Outburst Floods have not been referred to before this point.

Line 158-163: Please include reference to (e) in the figure caption.

Line 165: Remove space before comma.

Lines 166-167: Suggest removing the opening bracket with a comma on this line and placing the opening bracket before 'e.g.' instead.

Line 175: Suggest inclusion of 'that' after 'instance,'.

Line 178: Suggest inclusion of 'more generalised' before 'approach'.

Line 182: Suggest removal of 'As we discussed,'.

Lines 183-184: Suggest the removal of 'the Himalaya and the wider' here to make references to the region in question clearer.

Line 185: Suggest replacement of 'This is' with 'The conclusions are'.

Line 186: Remove second opening bracket.

Line 187: Check 'glacierMIP3' does not need a citation.

Line 190: Define 'RGI' as this is the first time it is referred to.

Line 191: Suggest replacing hyphen with a comma.

Lines 192-193: Suggest replacing ': for example,' with 'with'.

Line 196: Suggest including 'However,' before 'the consensus'.

Line 198: Suggest naming the three HMA RGI regions here to link clearly with the figure.

Lines 199-200: The figure caption for Figure 1 does not explicitly say it is for HMA glaciers. I suggest either rewording this sentence (maybe including 'which applies to' or similar) or including HMA in the figure caption. It is then clear whether Figure 1 is specific to HMA glaciers or whether it applies to glacier globally and is being using to make a point about HMA glaciers here.

Line 206: Add space between 'e.g.' and 'Richardson'.

Line 207: Suggest defining GLOF here, as it is the first use of it outside a figure caption.

Line 208: Add space between 'e.g.' and 'Song'.

Line 220: Suggest changing 'will have been' to 'is to projected to have been'.

Line 221: Suggest replacing 'leading up to this result' with 'up to this point, there'.

Line 222: Suggest replacing 'became' with 'were'.

Line 222; Suggest replacing 'perhaps,' with 'potentially'.

Line 225: Suggest including 'approach' before 'misrepresents'.

Line 227: Suggest adding 'geomorphologically' after 'responded'.

Line 228: Capitalise Last Glacial Maximum.

Line 233: Suggest removing 'amongst others' and include 'processes such as' between 'by' and 'increased'.

Line 235: Suggest removal of 'by'.

Line 238: Suggest replacement of 'and' with 'with'.

Line 244: Suggest inclusion of 'rock' before debris.

Line 244: Suggest replacing 'This' with 'Rock'.

Line 247: Suggest replacing 'that presently is' with 'which, at present;.

Lines 247-248: Suggest removing 'extreme cold conditions' and 's' from 'enters' and adding 'due to extreme conditions at the end of the sentence.

Line 248: Suggest replacing 'This' with 'If these conditions persist'.

Line 253: Suggest replacing 'the' with 'a'.

Line 255: Suggest adding 'in the PT scenario' at the end of the sentence.

Line 258: Suggest moving 'historically' to be after 'Himalaya'.

Line 259: Suggest replacing 'much' with more so' and including examples of this point in the form of citations.

Line 263: Suggest including a comma after 'widely'.

Line 265: Suggest replacing 'perhaps' with 'potentially'.

Line 269: Suggest inclusion of 'parity' or similar word between 'this' and 'appears'.

Line 271: Replace 'RG' with 'RGI'.

Line 275: Suggest replacing 'This paraglacial pathway' with 'The PT scenario/pathway'.

Line 276: Suggest including 'is anticipated' at the end of the sentence.

Lines 277-278: Suggest more explanation of the statement 'given the armoured nature of the rock dam' in this context.

Lines 278-280: Suggest this sentence goes last in the paragraph as it makes an important conclusionary point.

Line 295: Remove comma,

Line 294: This is the first reference of Figure 3, so I would expect the figure to be placed at the end of the paragraph. Also, Figure 2 has not yet been referred to.

Line 301: Check Westerlies are referred to in the overview of meteorological/climate conditions in the HMA, so the reference to it here makes sense.

Line 302: Suggest replacing 'although see' with 'with the exception of'.

Line 304: Suggest including 'already' before 'most'.

Line 305: Suggest inclusion of 'conditions that enable' before freeze-thaw.

Line 306: Suggest replacing 'conditions' with 'to occur'.

Line 307: Suggest replacing 'places' with 'conditions'.

Line 308: Include Karakoram on Figure 2.

Line 310: Suggest replacing 'not seen' with 'greater than those seen'.

Line 311: Suggest including 'these' before 'rock glaciers'.

Line 312: Suggest replacing 'grow' with 'develop'.

Line 312: Suggest replacing 'hampered' with 'restricted'.

Lines 315-316: Suggest placing 'A first order understanding of which of the MIL and PT scenarios are more likely and their future spatial distributions' at the start of the sentence and removing the sentence question completely.

Line 320: Suggest including 'in question' after 'glaciers'.

Lines 320-321 and Lines 323: For the statements made about the MIL and PT scenarios here, I think further explanation of these statements would be of benefit here.

Line 328: Suggest replacing 'Therefore,' with 'To achieve this' or 'Consequently'.

Line 336: Suggest replacing 'far behind' with 'much further than'.

Line 336: Suggest replacing 'over' with 'from'.

Line 340: Suggest replacing 'these' with 'the investigated'.

Line 340: Suggest replacing ‘;this’ with ‘. This spatial disparity’.

Line 365: Suggest replacing ‘;’ with ‘, whilst’.

Lines 366 and 367: Suggest combing the two bracketed pieces of information in both cases for clearer reading.

Line 368: Suggest replacing ‘Source:’ with ‘Adapted from’.

Line 372: Suggest replacing ‘few’ with ‘that’, following ‘moraines’.

Line 372: Suggest including ‘are limited,’ after HMA.

Line 373: Include comma between ‘Rowan’ and ‘2017’.

Line 380: Capitalise Equilibrium Line Altitude.

Line 382: Include comma after Himalaya.

Line 386: It would be beneficial to include explanation of the statement of about the weakened monsoon and include its effect on accumulation explicitly.

Line 391: Suggest replacing ‘this’ with ‘the’.

Lines 397-298: Suggest moving ‘at Ama Dablam and Lhotse in the Khumbu region’ to the end of the sentence and replacing ‘at’ with ‘for’.

Line 403: Include comma in citation.

Line 403: Suggest including ‘predicted’ before ‘future’ and replacing ‘ will dominantly involve’ with ‘must have been dominated by’.

Line 409: Suggest replacing ‘this’ with ‘the’.

Line 409: Suggest including ‘presented here, despite being limited and incomplete,’ after ‘data set’ and removing ‘(albeit limited and incomplete)’.

Line 411: Suggest replacing ‘and this’ with ‘which’.

Lines 409-412; Suggest combing the paragraph with the following paragraph.

Line 420: Suggest replacing ‘ regional ELA’ with ‘regionally averaged or ‘more regional’.

Line 421: Include commas in citations.

Line 422: Include commas in citations.

Line 430: Suggest swapping ‘therefore will’ around.

Line 454: Suggest replacing ‘that’ with ‘which’.

Line 460: Suggest replacing 'climate' with 'numerical' and including 'results' after modelling.

Line 462: Suggest including 'climate' before 'warming'.

Line 463: Suggest replacing 'produced' with 'presented'.

Line 464: Suggest including 'as climate change progresses' at the end of the sentence.

Line 470: Suggest removing 'also'.

Line 473: Suggest replacing 'viewpoint' with 'scenario' or 'suggested scenario'.

Line 478: Suggest replacing 'hampered' with 'made challenging' or similar.

Line 483: Suggest replacing 'hardly known' with 'poorly understood',

Line 483: Suggest including ', particularly' before 'given'.

Line 493: Suggest replacing 'on' with 'for'.

Line 496: Suggest replacing 'enough' with 'sufficiently detailed' and placing it before 'resolutions'.