

Controls over debris flow initiation in glacio-volcanic environments in the Southern Andes

Response of authors

We thank you very much for the detailed and thoughtful review. We truly appreciate the time and care you dedicated to carefully assessing the manuscript, considering these dates. We appreciate the positive feedback. Following, we indicate the modifications introduced to the document in this second round.

The authors have conducted a comprehensive revision and provided careful responses to all the comments. The manuscript is now better structured, and the representation of the hazard model, where volcanic material overlies glacial deposits has been improved by the inclusion of figure 1. Nevertheless, some technical revisions are still needed.

A: Thank you for the detailed review of the document.

1. L50: It is unnecessary to abbreviate 'rainfall-induced landslides', as the term is mentioned only a few times throughout the manuscript and is not lengthy.

A: Thanks for your comment. We have now removed the abbreviation from the abstract. Moreover, the manuscript was modified from RIL to mass wasting in the context that these events are triggered by rainfall.

2. L444: The term 'localized pressurization' introduced in the newly added paragraph has not been discussed previously. Could the authors please elaborate on this in more detail?

A: Our apologies for the modification. We now continue the sequence of the document, changing from “soil pore pressure” used in the introduction and study zone sections.

Original text:

Our conceptual model promotes water retention and localized pressurization, especially during extreme rainfall events such as 2021

Modified text:

Our conceptual model promotes water retention and changes in soil pore pressure, especially during extreme rainfall events such as 2021

3. The authors mention that the Osorno volcano area frequently experiences debris flows and refer to the Petrohue event as an analogue to the Nisoleufu debris flow. It would be interesting, if possible, to include all such analogues in figure 1D.

A: The analogue situation are related to the climatic features and conditioning factors related to volcanic environment. Figure 1 illustrates a spatial description of mass wasting in the southern Andes and its correlation with the Last Glacial Maximum. We think that the current form could introduce bias and misunderstanding of the information provided. Therefore, we rewrite the sentence of the discussion in 5.3

Original text:

The Ñisoleufu debris flow showed a characteristic pattern of mass wasting processes in the Southern Andes, becoming analogues to Petrohue event (Fustos-et al., 2021) in Osorno Volcano (Figure 1D).

Modified text:

The Ñisoleufu debris flow exhibited a characteristic pattern of mass-wasting processes in the Southern Andes, similar to the Petrohué event (Fustos et al., 2021) at Osorno Volcano (Figure 1D), which can be attributed to comparable climatic and volcanic conditions.

4. L493: Please remove the word ‘worldwide’ from the sentence beginning with ‘on a regional scale’.

A: Now, we removed the word “worldwide” in line 500.

Additional comment:

Mr Ebel: Your Table 2 contains coloured cells. Please note that this will not be possible in the final revised version of the paper due to HTML conversion of the paper. When revising the final version, you can use footnotes or italic/bold font. For now, the process will continue, but please note that the final version cannot be published by using coloured tables.

A: Now, we modified Table 2

Original table:

Soil type/Property	Normative	S-2	S-3	S-4	S-7
Moisture [w] (%)	NCh-1515	17.8	56.2	119.3	111.6
Density [ρ] (g/cm ³)	UNE-103-301-94	2.07	1.52	<1	1.06
Specific Gravity [G_s]	ASTM-D854-14	2.76	2.49	2.5	2.34
Liquid Limit [W_L] (%)	AS 1289.3.9.1	27.48	123.93	-	149.83
Plastic Limit [W_p] (%)	Nch 1517/2	16.07	91.3	-	114.13
Plasticity Index [PL]	NCh1517/2	11	33	-	36
Hydraulic Conductivity [k_u] (m/s)	Porchet and LaFerrere (1935)	-	-	-	3.13E-4

Modified table:

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