Dear Editor Dr. Daniele Giordan and Dr. Haruyuki Hashimoto

Thank you for your comments, we addressed them in our resubmitted version of this paper. In this document, we put the point-by-point responses to your comments.

With all the best

Dr. Marcelo Somos-Valenzuela

Comment R2 (CR2) Dr. Haruyuki Hashimoto

CR2_1: Pages 2 to 20: There are various technical terms expressing 'sediment-related disaster', such as rockslide, landslide, avalanche, hyper-concentrated flow, hyperconcentrated sediment flow, mudflow, debris flow, debris and mud flow, detritus flow, avalanche flow, mass flow, two-phase flow, non-Newtonian flow, and water-sediment mixture. These similar technical terms make us confused. In order to avoid the confusion, the authors should unify these similar words and then describe the definition of each term.

Response to CR2_1:

Thank you for this comment. We appoligize for being sloopy in the used of the terminology and finally used "landslide" to refer to the collapse of the wall that started the event. And mudflow when we refer to the event when water was added.

For the other terms,

- Hyper-concentrated sediment flows, mudflows and non-Newtonian flow are terms used in the Flo2D description Therefore, we provided in the text the references to consult the meaning (O'Brien and Zhao, 2004).
- For debris flow and avalanche flow, mass flow, two-phase flow, and water-sediment mixture in the description of R.Avaflow, we included the refence (Mergili, M., Pudasaini, 2019)
- Mud flow, Detritus flow Water-sediment mixture are not longer part of the document

References:

FLO-2D: Reference Manual, Nutrioso, AZ., 2018.

Mergili, M., Pudasaini, S. P.: r.avaflow - The mass flow simulation tool. r.avaflow 2.0 Software 2014-2019, http://r.avaflow.org/software.php, 2019.

CR2_2: Pages 7 to 10: Slope of land along the flow trajectory is one of important factors for the mechanism of the landslide and debris flow. The more detailed information of the slope is needed. Therefore, the cross sectional profile of the land along the flow is helpful for the discussion. Using the figure of the cross sectional profile, the authors should discuss the landslide and debris flow event.

Response to CR2_2:

We added a slope profile in Figure 1, which now looks as follow

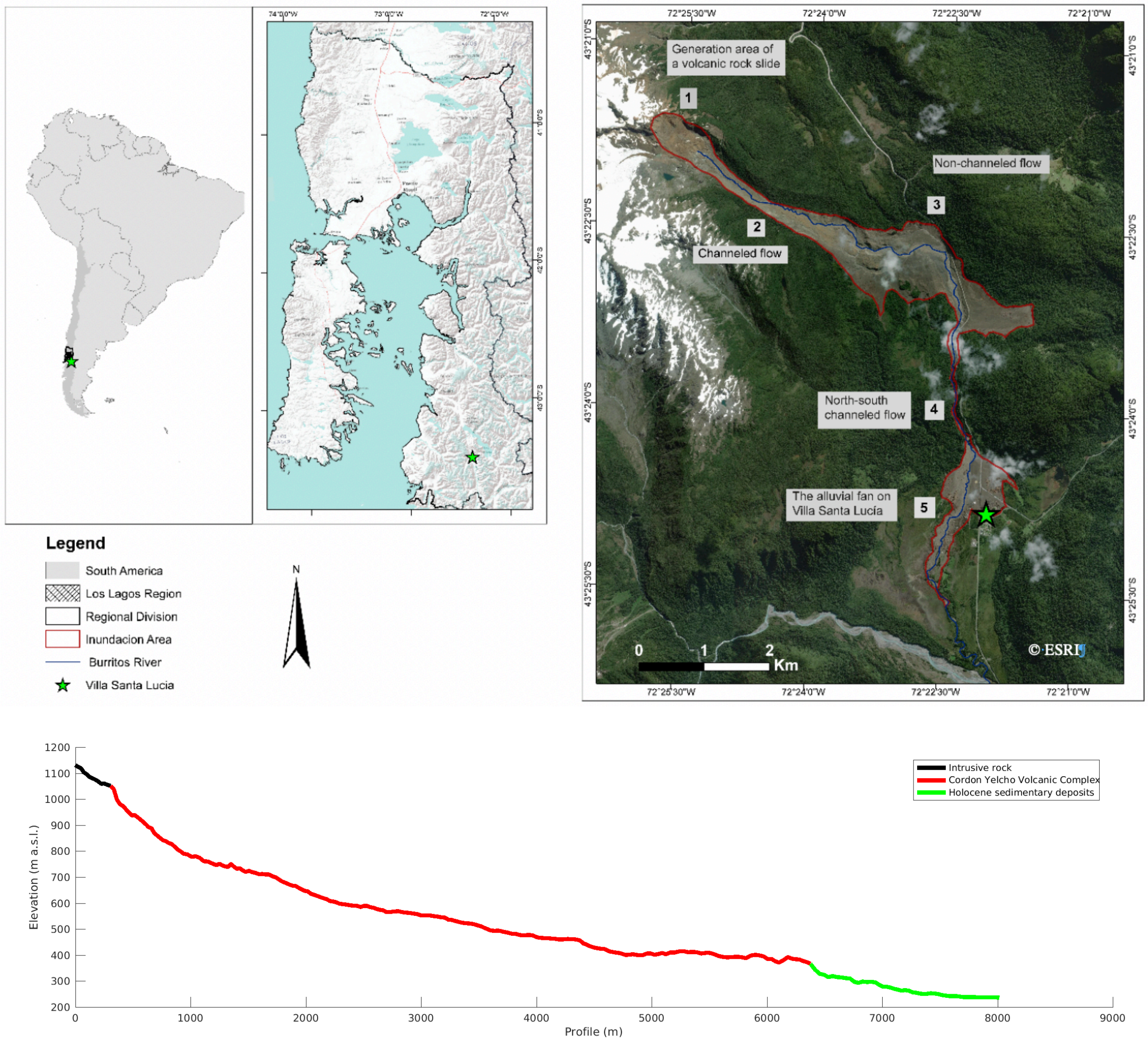

Figure 1: Top left: Study area and extension of the inundation (South America and Los Lagos Region layer from https://tapiquen-sig.jimdo.com,.Top right: Burritos River blue line layer from http://datos.cedeus.cl/, background © ESRI). Bottom: Elevation profile and geological formation along the mudflow path.

CR2_3: Pages 10 and 19 The budget of sediment and water during this event is important for understanding the process of the landslide and debris flow. A schematic figure of this budget is helpful for the discussion.

Response to CR2_3: We appreciate your observation. After reviewing in detail our manuscript, we noted that figure 13 needs to be explained correctly. Now, we inserted the following sentence in the results section of r.avaflow

“We varied the percentage of water between 20% and 70%. The error for the heights, speeds calculated in each model are in Figure 9. Therefore, we propose that a mudflow with a 30% water volume could reproduce best the VSL event (Figure 10).”

We renumber Figure 13 as Figure 9, according to the figure prioritization suggested by reviewers.

CR2_4: Line 217, Page 10 Sernageomin (2018 c) found flow velocity 20 m/s at the Burritos River canyon. The authors should explain the method of estimating the velocity.

Response to CR2_4:

Sernageomin (2018) used Equation 1 from Johnson (1970) that empirically estimated the flow's velocity in a curve.

$$V = \sqrt{\left(g * R * cos \propto * \frac{\Delta h}{\Delta x}\right)}$$

Equation 1

Where:

V= mean velocity (m/s)
g=gravity (m/s2)
R=curve radius (m)
α=channel slope (°)

The curves used for the calculationa re shown in the figure below:

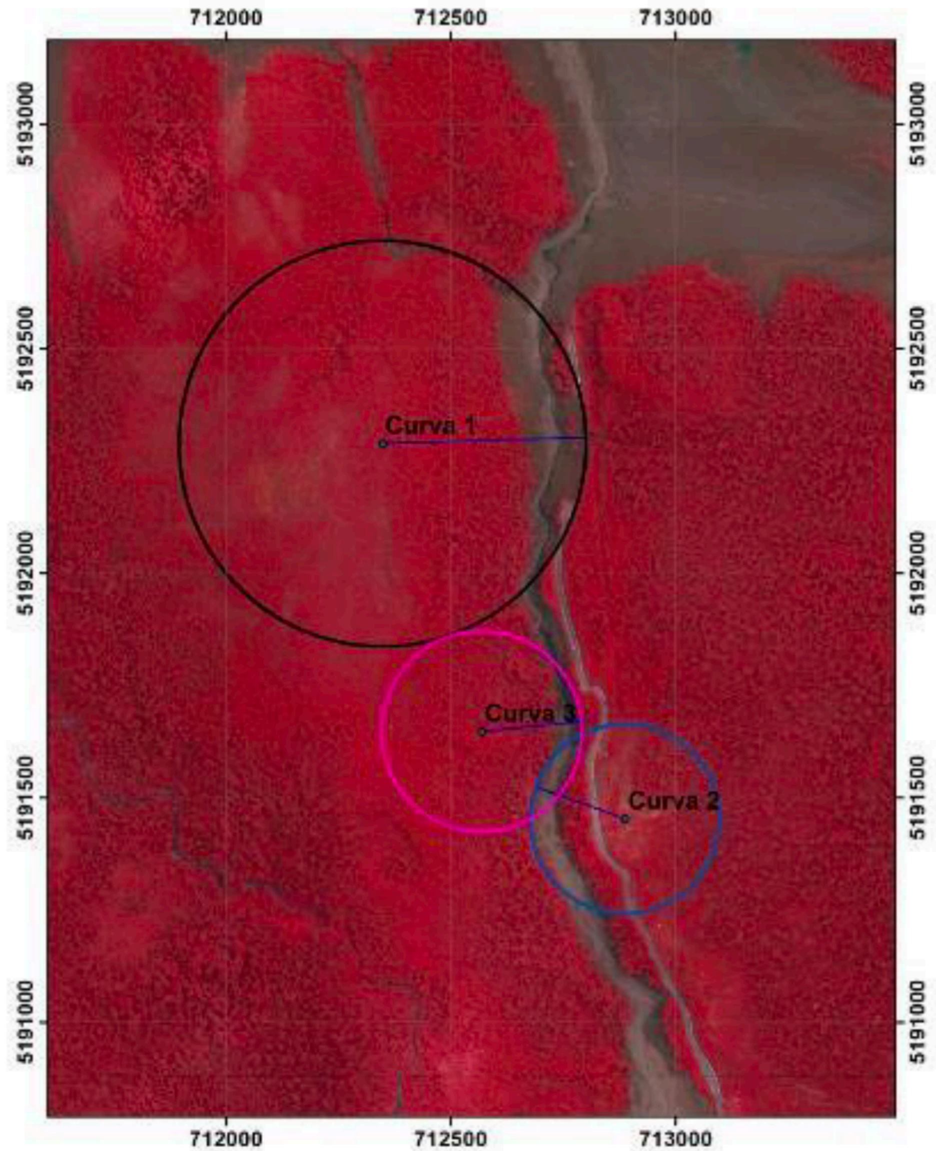

Figure: Curves used by Sernageomin (2018) to estimate the velocity of the flow in that section of the Burritos River.

Table: Summary of the result from Sernageomin (2018)

Curve		C1	C2	C3	
R		460	210	225	
$\propto$		2.121	1.626	10	
Camber	Δx	145	55	57.4	
	Δh	12	11	11	
$\frac{\Delta h}{\Delta x}$		0,08275862	0,2	0,19163763	
$cos \propto$		0,9993149	0,99959734	0,98480775	
V^2		372,820266	411,434266	416,141325	
V (m/s)		19,3085542	20,2838425	20,3995423	Average
V (Km/hr.)		69,5107952	73,0218329	73,4383522	71,9903268

References:
Sernageomin: Origen y efectos de la remoción en masa del 16.12.2017 que afectó la localidad de Villa Santa Lucía, comuna de Chaitén, Región de los Lagos, , 60, 2018.

Sernagoemin (2018) used: Johnson, A. M. (1970). Physical Processes in Geology: a Method for Interpretation of Natural Phenomena—Intrusions in Igneous Rocks, Fractures and Folds, Flow of Debris and Ice, Freeman, Cooper, and Co., San Francisco, California, 577 .

Since we did not do these calculations, we consider that we should not include them in our document and just cited the reference unless the editor thinks we should do so.

CR2_5: Line 331, pages 15 There are various factors in the basic equations describing the numerical simulation of the event, such as drag coefficient, basal friction angle, environmental resistant coefficient and fluid friction coefficient. Because the definition of these factors is not clear, it should be described in this paper.
Response to CR2_5:
We corrected the terms in the document that were poorly translated (see Response to SCR1_17) and we added the reference from r.avaflow. Therefore the descripton of the section where those terms were indicated reads as follow:

"To simplify the calibration, we divided the process into two. First, we set the sediment concentration by volume of the mudflow in 50% and change the entrainment coefficient, basal friction angle, ambient drag coefficient and fluid friction coefficient. For the description of the parameters in r.avaflow see Mergili et al. (2017)."

Mergili, M., Fischer, J. T., Krenn, J. and Pudasaini, S. P.: R.avaflow v1, an advanced open-source computational framework for the propagation and interaction of two-phase mass flows, Geosci. Model Dev., 10(2), 553–569, doi:10.5194/gmd-10-553-2017, 2017.

CR2_6: ‘pressures’, line 342, page 16 and line 357, page 17 Generally speaking, the word ‘pressure’ is not used for open-channel flow but for pipe flow. Therefore, this word is incorrect.

Response to CR2_6:

One of the outputs from r.avaflow is flow pressure (see Table 1 from Mergili, M., Fischer, J. T., Krenn, J. and Pudasaini, S. P.: R.avaflow v1, an advanced open-source computational framework for the propagation and interaction of two-phase mass flows, Geosci. Model Dev., 10(2), 553–569, doi:10.5194/gmd-10-553-2017, 2017.)

However, we did not use pressure for the validation of the model and incorrectly used it here. So we deleted the word “pressure” from line 342 and 357.

CR2_7: ‘a mudflow with a volume of water of 30%’, line 346, Page 17 Does this mean the mudflow with sediment concentration of 70 %.?

Response to CR2_7:

Yes, it means that the sediment concentration is 70%