“Geomorphological surveys and software simulations for rock fall hazard assessment: a case study in the Italian Alps”

Point by point response to Referee#1 comments

This file was prepared by Stefano Devoto and Chiara Boccali.

7331-23	OK, I am agree with Referee#1	Change “human facilities” with **buildings**
7335-3	OK, I am agree with Referee#1	Change (Fig. 2a) with **(Fig. 2c)**.
7336-16	OK, I am agree with Referee#1. It I better the new title of the paragraph.	**4.2 Seismicity**
7345-1-4.	OK, I am agree with Referee#1. Split the original sentences.	**Particular attention was devoted to the identification of a direct relationship between slope-failure activities and external triggering factors. In fact, the eastern sector of Italian Alps is located in a tectonically active zone and is characterised by annual rainfalls often exceeding 2000mm per year.**
7345-6	OK , the reference suggested by Referee#1 is important	**…evident, as recognised by Borgatti and Soldati (2010) in the central Dolomites.**
7345-15	OK	**…… with 8000 kJ energy……**
7345-19	OK, it is crucial to monitor the main joint	**Aperture variations of the main fracture, which isolates the background of the Block 1, can activate early warning devices connected directly to the Regional Geological Survey head offices or civil protection operators.**
7345-21	OK to add a sentence about relationships between triggering factors and rockfall	**Furthermore, the displacements of the fracture recorded by the fissurimeter can be correlate to daily rainfalls or earthquake accelerations, in order to investigate the role of external triggering factors on the variations of joint aperture, which is crucial for the stability of the larger block.**

I am agree to add at 7346-8 the reference suggested by Referee#1

Borgatti, L. and Soldati, M.: Landslides as a geomorphological proxy for climate change: a record from the Dolomites (northern Italy), Geomorphology, 120, 56-64, 2010.

TABLES

Table 1.

I am agree with the Referee#1 about need to change the title of Table 1.

I like the following title:

Table 1. Block parameters and related rock-fall susceptibilities classes.

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Block	Volume [m^3]	Direction	Rock-fall susceptibility
Block 1	420	Cimolais Village	Extremely high
Block 2	18	Cimolais Village	Extremely high
Block 3	9	Cimolais Village	Extremely high
Block 4	24	Cimolais Village	Extremely high
Block 5	6	Cimolais Village	Extremely high
Block 6	6	Fesena Valley	Low
Block 7	2	Fesena Valley	Fair
Block 8	12	Fesena Valley	Fair
Block 9	126	Fesena Valley	High
Block 10	1	Fesena Valley	High
Block 11	6	Fesena Valley	Fair
Block 12	5	Fesena Valley	Low
Block 13	1	Fesena Valley	Low

Table 2

As suggested by Referee#1 , I changed the title of the second column (see below) and the location list. Now I listed the Region hit by earthquakes

Table 2. Historical earthquakes within 250 km of Cimolais with M > 5.4. Source: Italian Seismological and parametric database, INGV (2010).

Date	**Earthquake Epicenter Region**	Magnitude
28 Jul 1700	Northern Friuli (Italy)	5.7
12 Jan 1721	Istra (Croatia)	6.0
10 Jul 1776	Western Friuli (Italy)	5.8
04 Apr 1781	Romagna (Italy)	5.8
20 Oct 1788	Northern Friuli (Italy)	5.8
22 Oct 1796	Eastern Emilia (Italy)	5.6
12 May 1802	Eastern Lombardia (Italy)	5.5
25 Oct 1812	Central Friuli (Italy)	5.5
13 Mar 1832	Central Emilia (Italy)	5.5
30 Oct 1870	Eastern Romagna (Italy)	5.4
29 Jun 1873	Northern Veneto (Italy)	6.3
17 Mar 1875	Eastern Romagna (Italy)	5.6
07 Jun 1891	Western Veneto (Italy)	5.6
14 Apr 1895	Central Slovenia	6.2
30 Oct 1901	Eastern Lombardia (Italy)	5.5
09 Jan 1917	Eastern Slovenia	5.7
01 Jan 1926	Central Slovenia	5.2
27 Mar 1928	Northern Friuli (Italy)	5.6
18 Oct 1936	Eastern Veneto (Italy)	5.8
15 Jul 1971	Western Emilia (Italy)	5.4
06 May 1976	Eastern Friuli (Italy)	6.4
11 Sept 1976	Eastern Friuli (Italy)	5.8
11 Sept 1976	Eastern Friuli (Italy)	5.6
15 Sept 1976	Eastern Friuli (Italy)	5.9
15 Sept 1976	Eastern Friuli (Italy)	6.0

12 Apr 1998	Western Slovenia	5.5
20 May 2012	Eastern Emilia (Italy)	5.8
29 May 2012	Eastern Emilia (Italy)	5.6

Table 3

I am agree with Referee#1 about need to change the title of Table 1 (see below). The last source in the table is **Piacentini and Soldati (2008)** and not Piacentini et al. (2008)

Table 3. Restitution coefficients used in the simulations according to the different types of slope materials and vegetation.

Slope materials	Rn	Rt	Source
Clean hard bedrock	0.53 ± 0.04	0.99 ± 0.04	Rocfall user's guide (1998)
Talus with vegetation	0.32 ± 0.04	0.80 ± 0.04	Rocfall user's guide (1998)
Asphalt/urban areas	0.40 ± 0.04	0.90 ± 0.04	Rocfall user's guide (1998)
Lawn	0.25	0.55	Bruschi (2004)
Forest	0.3	0.8	**Piacentini and Soldati (2008)**

Table 4

I am agree with Referee#1 to change Notes with **Unit** (third column).

Table 4. Input parameters selected for computer simulations.

Parameter	Value	**Unit**
Horizontal velocity	1.5	m sec^{-1}
Vertical velocity	0	m sec^{-1}
Block mass	1134	t
Angular velocity	0	rad sec^{-1}
Number of rocks to throw	1000	
Minimum velocity cut off	0.1	m sec^{-1}

FIGURES

Regarding the figures, we have changed the figure 1, figure 2, figure 3, figure 4, figure 6 and figure 11.

The new caption for Figure 1 is:

Figure 1. Study area: (a) Northern Italy and location of rain gauges (the red arrow indicates the study area); (b) Geological map. The legend symbols are accompanied to numbers which indicate: 1, Alluvial deposits; 2, Talus; 3, Anthropic reshaped area; 4, Scaglia Rossa Friulana Fm. (marls and reddish limestone); 5, Successione condensate Fm. (cherty limestone); 6, Vajont Limestone Fm.; 7, Igne Fm. (marls and red nodular limestone); 8, Soverzene Fm. (cherty dolostone); 9, Dolomia Principale Fm. (grey massive dolostone); 10, Attitude of the strata; 11, Reversed strata; 12, Vertical strata; 13A, Fault; 13B, Buried fault; 14A, Overthrust; 14B, Buried overthrust; 15, Trace of the geological section; 16, Edge of fluvial erosion; 17, Edge of terrace; 18, Stream; 19A, Crep Savath; 19B, Cimolais steeple; (c) Geological section.

The figure 1 has been deeply modified.

As suggested by Referee#1, we modified portion A (all North Italy) and B. We added a shaded relief as base for B. Now we think the geomorphological features listed in figure 1 are clear.

As suggested, old 2-3-4 features were incorporated in talus (2). Conversely, we prefer to leave three different types of strata, in order to show the tectonic activity.

FIGURE 1.

The new figure 1.

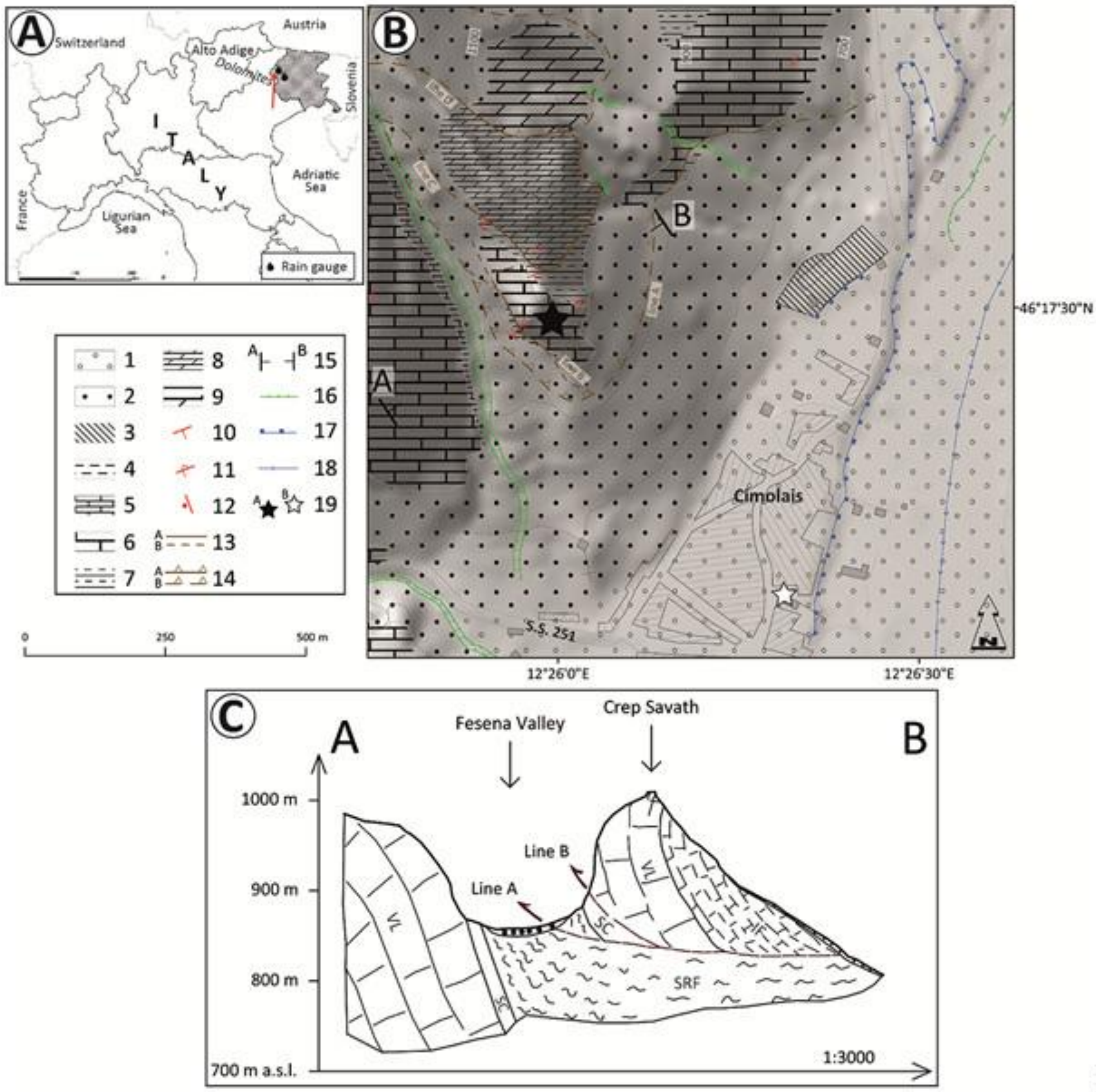

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FIGURE 2.

The new figure 2 below. We incorporated the suggestions indicated by the Referee#1 regarding figure C.

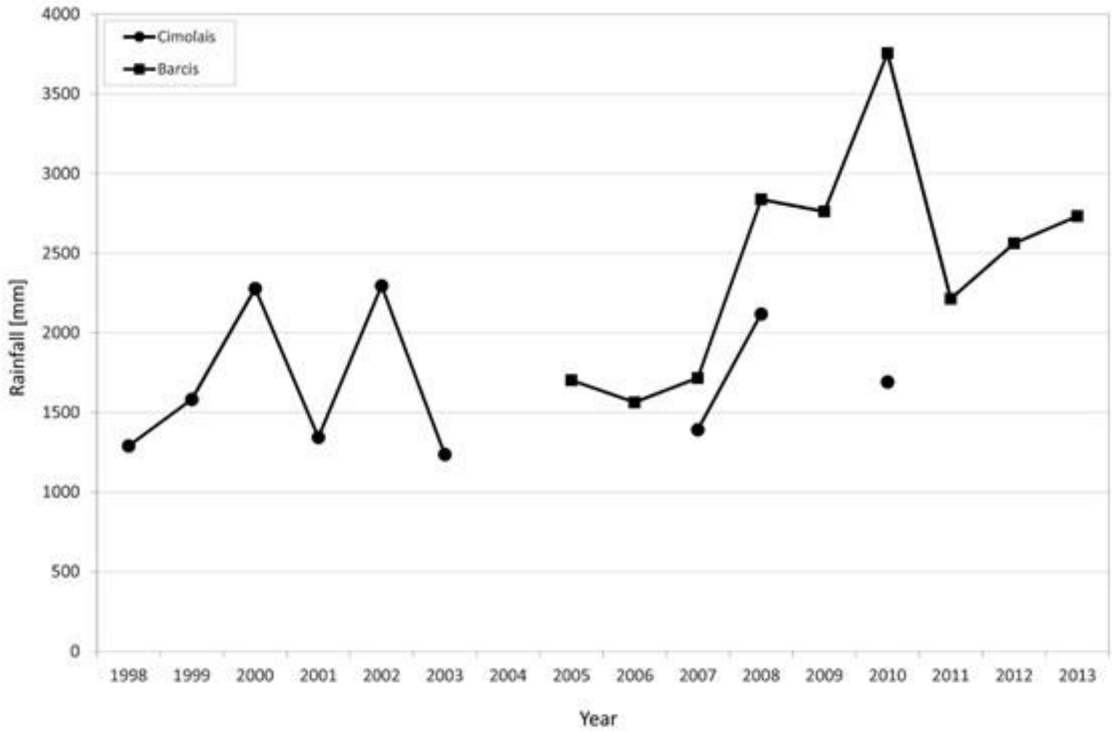
We accepted the modifications of caption regarding Figure 2.

The new caption for Figure 2 is:

Figure 2: Panoramic view of Cimolais Village and the overlying Crep Savath peak (a). The red circle indicated the overlying slab, source of possible rock falls. The oblique view from Fesena Valley (b) and the frontal view (c) highlight the hazardous position and the large dimensions of Block 1.

FIGURE 3

The new Figure 3 is below. The text axis are more clear and visible now.



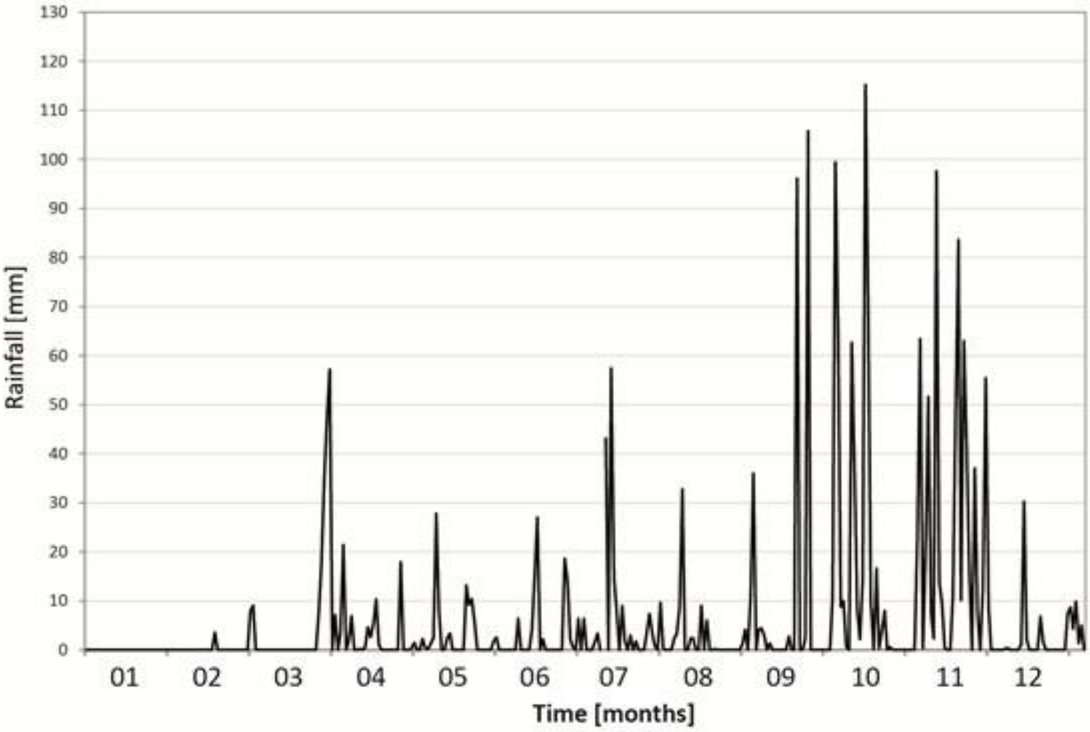
We accepted the modifications of caption regarding Figure3.

The new caption for Figure 3 is:

Figure 3: Trend of annual rainfall from 1998 to 2013. Data of 2004 are missing (source: Cimolais and Barcis rain gauges).

FIGURE 4.

The new Figure 4. The text axis are more clear and visible now.



We accepted the modifications of caption regarding figure4.

The new caption for Figure 4 is:

Figure 4: Daily precipitation occurred in 2000 (source: Cimolais rain gauge).

FIGURE 5

We suggest only variations to the caption for figure 5.

Figure 5: Different types of block motions related to variations of dip slope (modified from Dorren, 2003).

FIGURE 6.

We inserted the north symbol in figure 6 (below).

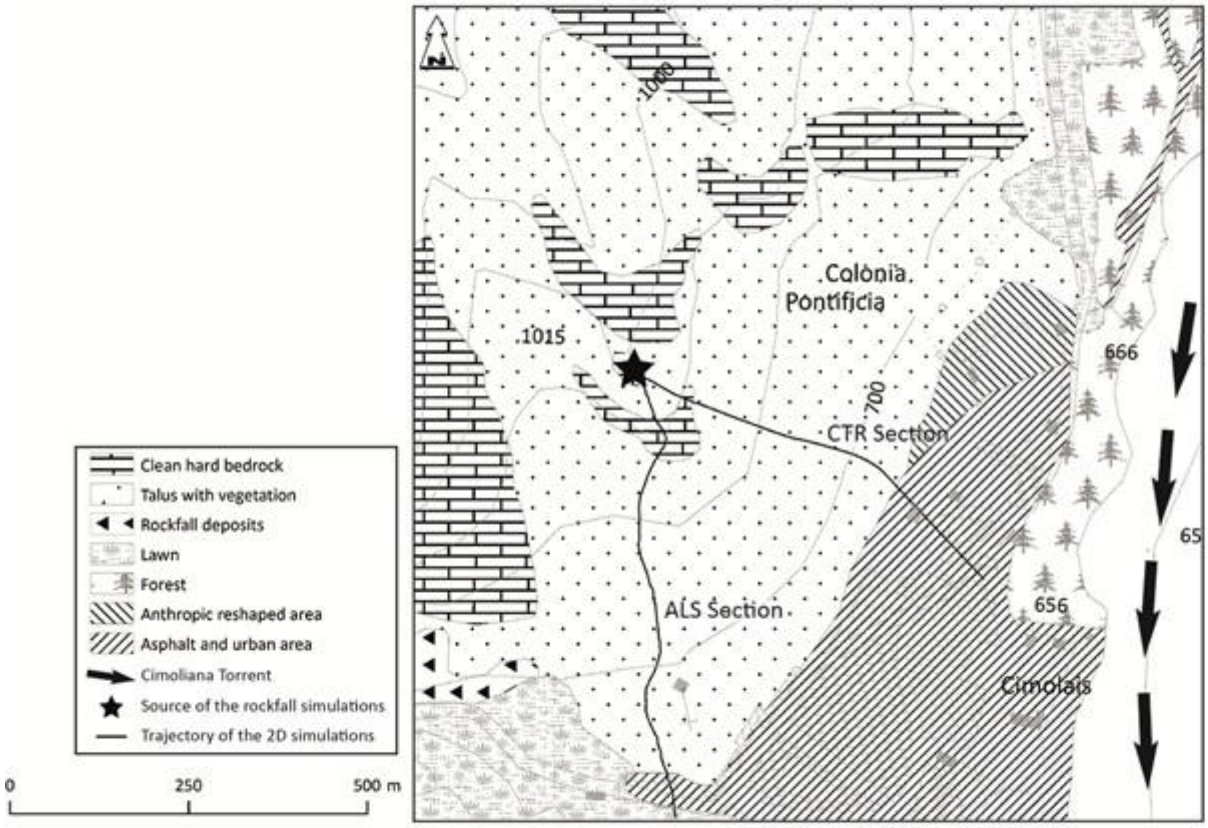


FIGURE 9 (the number of figure does not consider a new figure, see last page).

Figure 9 was not modified, as indicated by referee1. The figure is an output of Rocfall software, for this reason we cannot change the text of axis.

Only variations to the caption text.

We suggest for the caption for Figure 9:

Figure 9: Run-out distances of simulated blocks (a), bounce heights and kinetic energy variations (b) along the CTR-derived profile.

FIGURE 10 (the number of figure does not consider a new figure, see last page).

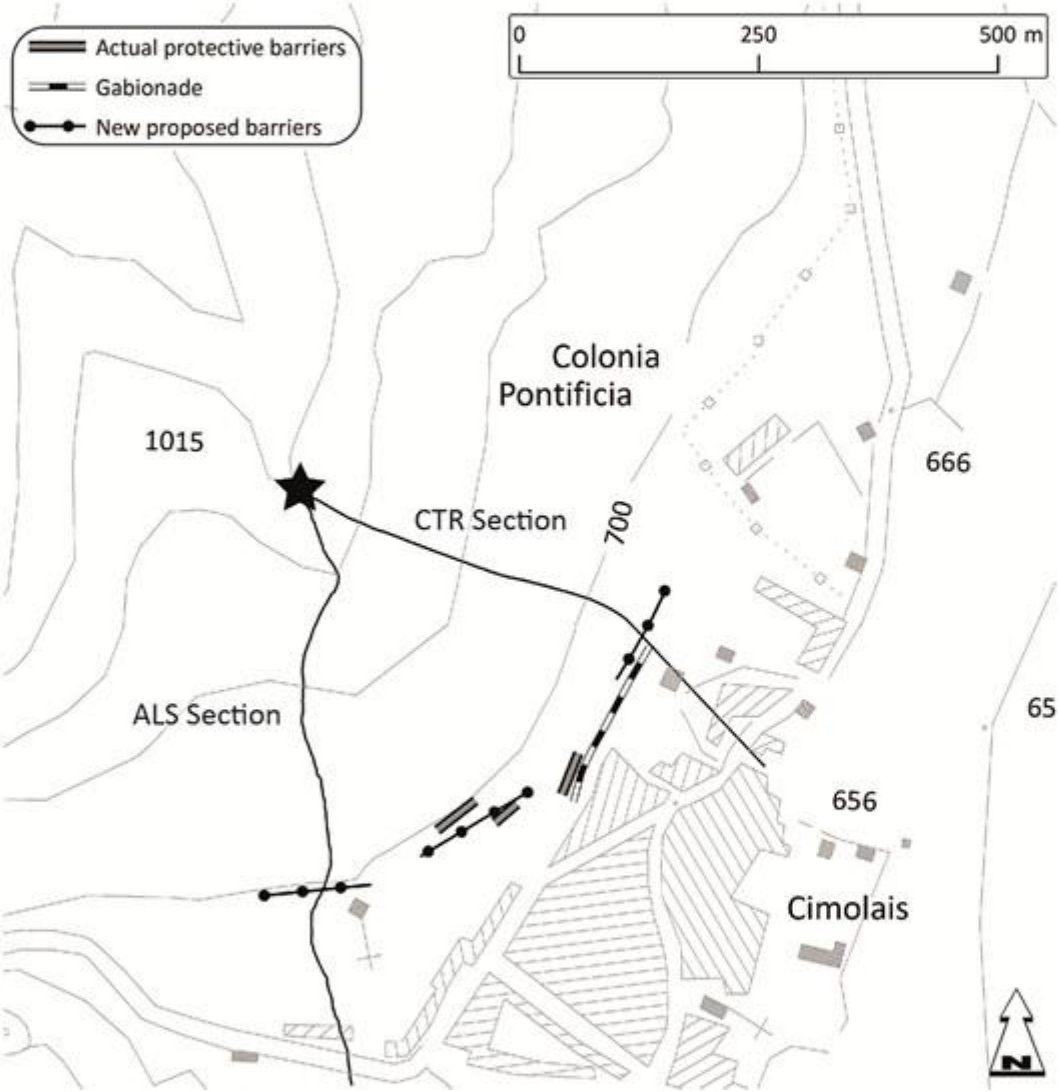
Figure 10 was not modified (same reason of figure 9)

The new caption for Figure 10 is:

Figure 10: Run-out distances of simulated blocks (a), bounce heights and kinetic energy variations (b) along the ALS-derived profile.

FIGURE 11 (the number of figure does not consider a new figure, see last page)

We inserted the north in Figure 11 (below).



The new caption for Figure 11 is:

Figure 11: Actual positions of mitigation works and possible locations of new rock-fall barriers.

LAST BUT NOT LEAST, I AM AGREE TO INSERT A NEW FIGURE, as suggested by referee1.

It could be inserted as new FIGURE 7 (pp.7340, 26, after the end of the word *peek*).

Caption of possible new figure 7: **View from Cimolais Village of the steep talus located at the base of limestone cliff. The photo was taken during the summer period, for this reason the slope vegetation is lush.**