

## ***Interactive comment on “Rockfall hazard assessment along a road on Peloritani Mounts (northeastern Sicily, Italy)” by G. Pappalardo et al.***

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First of all, we would like to thank the Anonymous Referee#3 for his deep interest in our paper. However, we do not agree with his objections: 1) Referee#3 says that data set is not available in this paper. Actually, in the first version of the manuscript we had provided detailed data, tables and figures, but, during the reviewing phase, Anonymous Referee#1 said: "The authors should give more emphasis in presenting the hazard and thus it is proposed to reduce the geostructural survey paragraph. It is proposed to remove Table 1 or report not with all the detail. Additionally, Fig 4 could be removed and only Fig 5 presented". So, since the manuscript was considered suitable for publication in NHESS following minor revisions, we have reduced the geostruc-

C2885

tural survey paragraph and removed Table 1 and Fig. 4, so the dataset. 2) Although RMR and SMR, CRSP and RHRS have been routinely applied for more than 20 years, the modified RHRS (Budetta, 2004) has been applied for a shorter time. Referee#3 says that "the analysis of the Peloritani Mounts in Sicily does not bring any new insight that could benefit those interested in the rockfall hazard assessment". This assertion is purely subjective. Maybe Referee#3 does not find our topic interesting; this is absolutely rightful. But, Peloritani Mounts have a wide rockfall/landslide history; just think, for example, to the recent events of Giampilieri (2009) which caused several victims. This is a very interesting area for the study of these phenomena, even because Peloritani Mounts represent a portion of one of the main geodynamic complexes of Italy (the Calabrian Peloritani Orogen). We believe that the provided case study is very interesting because it takes into account an important Italian tourist location, a strategic communication route, a complex area from the geological point of view, natural slopes with different grade of quality, and so on. Furthermore we provide the application of one of the international hazard rating systems. Such a paper is considered of scientific interest, just think of the IAEG XII international congress, which will take place in Torino (Italy) next September, holding an entire conference session titled "ROCKFALL RISK ASSESSMENT AND MANAGEMENT - CURRENT PRACTICE AND DEVELOPMENTS". 3) The fact that there are slopes belonging to Romana's II class (good-quality) cannot discredit the validity of our data. As the Reviewer#3 will have noticed, the better quality of the 3 stations is confirmed by Markland Test. In fact we have only a possible wedge failure at L-St-2, which can be considered as an "occasional failure" corresponding to the II class of SMR, while at S-St-2 and S-St-3 no unstable mechanism resulted from Markland Test. Furthermore, Referee#3 says: "Despite the area is rated as high hazard (in Figure 7) the obtained SMR values are higher than the RMRbasic values (Table 1)". SMR is required for hazard computation, according to Budetta's modified RHRS, but this is not the only parameter to take into account. So the resulting high hazard does not depend only on SMR, thus we cannot make a direct balance between SMR and the final hazard. Furthermore, we have

C2886

detected different hazard grades, reflecting also the different quality of slopes, as well as several factors related to the road. 4) With respect to the trajectory of the blocks, we are not interested in the end point of blocks which cross the downstream segment of the road and keep rolling along an uninhabited valley (out of the profile in Fig. 6). We are interested only in those blocks impacting on the road. We do not agree with Referee#3 when he says that "results do not look reliable". Kinetic energy of a falling blocks depends not only from the size of the block, but also on the seismic acceleration, on the coefficients of restitution, on the type of movement (rolling or rebounding) and it is not constant in time. We don't believe that 20 kJ is an abnormally high value for a block of 50 kg, since rockfall with kinetic energy lower than 30 kJ are considered of "low intensity" and 30 kJ corresponds to the maximum energy that oak-wood stiff barriers can resist (Raetzo et al. 2002). 5) Referee#3 asks: "In some road sections (Figure 7), the outside lane shows a higher value (higher hazard) of the RHRS than the inner lane (next to the excavated slope). How is it possible?" Well, it is possible. In the modified RHRS (Budetta, 2004), the Decision Sight Distance (DSD) is the parameter with the largest influence on the final score. As the Referee#3 knows, this is calculated in both directions of travel, so there can be 2 different values at the same measurement station. There are several local conditions in a road (especially in mountainous roads) which make this parameter changing. However, even if the inner portion has a lower hazard class, the final value is really close to the upper class (see histogram in Fig.7). 6) The aim of our paper is to assess the rockfall hazard along a road, by applying an international rating system. This research is not focused on the relation between the geological history, the seismicity and the occurrence of the rockfalls, which have however been discussed in the paper. Finally, it is true that the possibility that "shrubs could be used as protection measure against blocks traveling with a kinetic energy of 20KJ, has not been demonstrated", but a) falling blocks do not have a constant kinetic energy of 20 kJ along the slopes; b) we stated in the text that "the presence of several boulders lying along the vegetated slopes testifies to how shrubs and trees may decelerate their rolling. Thus, planting shrubs along the slopes would be a suitable additional remedial

C2887

work, in conjunction with barriers and wire meshes". This is only a final consideration, which can be removed if Referee#3 believes that it is off topic, since the paper does not deal with the remedial works to perform.

References Budetta, P.: Assessment of rockfall risk along roads, *Nat. Hazards Earth Syst. Sci.*, 4, 71–81,10 doi:10.5194/nhess-4-71-2004, 2004. Raetzo, H., Lateltin, O., Bollinger, D., Tripet, J.P.: Hazard assessment in Switzerland Codes of Practice for mass movements, *Bull. Eng. Geol. Env.*, 61, 263-268, 2002.

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C2888