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Observed changes in the block size ditribution as consequence of the rockfall fragmentation

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The fragmentation of the rock mass during a rockfall is a complex phenomenon which is poorly understood. A fragmental rockfall is defined by the separation of a mass into several smaller pieces upon the first impact(s) with the ground surface, leading to individual trajectories of the resultant blocks, affecting the redistribution of the initial mass and energy. This should be considered in the quantitative assessment of the rockfall hazard.
A rock mass detached from the slope face at a rockfall event is composed of intact rock (blocks) and discontinuities and its volume can be characterized by an In situ Block Size Distribution (IBSD). After the first impact(s), both the disaggregation of the rock mass along preexisting discontinuities and the block breakage modify the original distribution of the block volumes resulting in a new one, the Rockfall Block Size Distribution (RBSD).
The scope of this work is the study of the fragmentation process by comparing the changes between the IBSD and the RBSD, with the ultimate goal of obtaining the latter from the former based on a fractal fragmentation model.
We have analyzed the RBSD generated in a large fragmental rockfall in the Cadí Sierra (Eastern Pyrenees) over 10000 m3 of rock mass and compared it to the ISBD derived from the scar.The RBSD was obtained by measuring more than 1500 blocks in the field and the biggest ones were also georeferenced. To obtain the IBSD, a digital surface model (DSM) of the cliff has been generated by means of digital photogrammetry. The main joint sets have been identified from the DSM, which has been also used to reconstruct the detached rockfall volume. The difference in volumes is less than 20%.
The detached volume has been cut by all the observed joint sets, preserving their spatial location and assuming infinite persistence. Thus, the volume distribution of the in-situ rock blocks has been generated. The IBSD and the RBSD can be well fitted with an exponential and power law, respectively. By comparing them in terms of cumulative number of blocks it is observed a significant reduction of blocks bigger than one cubic meter, and a sharp increase of blocks with volumes smaller than a cubic meter. The difference between the area defined by the IBSD and the RBSD is typically attributed to the fragmentation energy in blastability studies. Even though rock fall blocks can be generated by disaggregation of the originally detached rock mass, in the Cadí case we interpret that block breakage is the predominant mechanism.