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An integrated management tool for rockfall evaluation along transportation corridors: the ParaChute research project

Catherine Cloutier (1), Jacques Locat (1), Mélanie Mayers (1), François Noël (1), Dominique Turmel (1), Chantal Jacob (2), Pierre Dorval (2), François Bossé (2), Pierre Gionet (3), and Michel Jaboyedoff (4)

(1) Département de géologie et de génie géologique, Université Laval, Québec, Québec, Canada, (2) Ministère des transports du Québec, Québec, Québec, Canada , (3) ArcelorMittal-Infrastructure Canada, Port-Cartier, Québec, Canada , (4) Risk-group, ISTE, Institute of Earth Sciences, Faculté des Géosciences et de l'Environnement, Université de Lausanne, Lausanne, Switzerland

Rockfall is a significant hazard along linear infrastructures due to the presence of natural and man-made rock slopes. Knowing where the problematic rockfalls source areas are is of primary importance to properly manage and mitigate the risk associated to rockfall along linear infrastructures. The aim of the ParaChute research project is to integrate various technologies into a workflow for rockfall characterization for such infrastructures, using a 220 km-long railroad as the study site which is located on Québec's North Shore, Canada. The objectives of this 3-year project which started in 2014 are: (1) to optimize the use of terrestrial, mobile and airborne laser scanners data into terrain analysis, structural geology analysis and rockfall susceptibility rating, (2) to further develop the use of unmanned aerial vehicles (UAV) for photogrammetry applied to rock cliff characterization, and (3) to integrate rockfall simulation studies into a rock slope classification system similar to the Rockfall Hazard Rating System. Firstly, based on laser scanner data and aerial photographs, the morpho-structural features of the terrain (genetic material, landform, drainage, etc.) are mapped. The result can be used to assess all types of mass movements. Secondly, to guide field work and decrease uncertainty of various parameters, systematic rockfall simulations and a first structural analysis are made from point clouds acquired by mobile and airborne laser scanner. The simulation results are used to recognize the rock slopes that have potentially problematic rockfall paths, meaning they could reach the linear infrastructure. Other rock slopes are not included in the inventory. Field work is carried out to validate and complete the rock slopes characterization previously made from remote sensing technique. Because some or parts of cliffs are not visible or accessible from the railroad, we are currently developing the use of photogrammetry by UAV in order to complete the characterization of these rock slopes. At a cliff scale, joint sets orientation and spacing were quantified to identify failure mechanisms and evaluate the most active rockfall areas in order to define susceptibility criteria at that scale. Finally, using all these information, a system will be developed offering, in graphical form, a way to systematically assess rockfall sources and support the development of a dynamic mitigation strategy.