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3D rockfall modelling in the Choirokoitia UNESCO World Heritage site

Andrea Valagussa (1), Paolo Frattini (1), Giovanni Crosta (1), Kyriacos Themistocleous (2), Claudio Margottini (3), Daniele Spizzichino (3), Emma Bee (4), and Jose Antonio Fernandez-Merodo (5)

(1) University of Milano - Bicocca, Italy (andrea.valagussa@unimib.it), (2) Department of Civil Engineering and Geomatics, Cyprus University of Technology, Cyprus, (3) ISPRA, Italian National Institute for Environmental Protection and Research, Rome, Italy, (4) British Geological Survey, Keyworth, Nottinghamshire. NG12 5HP, United Kingdom, (5) Instituto Geológico y Minero de España (IGME), Madrid, Spain

Located in the District of Larnaka, about 6 km from the southern coast of Cyprus, the Neolithic settlement of Choirokoitia lies on a hill partly enclosed in a loop of the Maroni River. Occupied from the 7th to the 5th millennium B.C., the village covers an area of approximately 3 ha and is one of the most important prehistoric sites in the eastern Mediterranean. Since only part of the site has been excavated, it forms an exceptional archaeological reserve for future studies. This site has been selected as a case study for the PROTHEGO (PROTection of European Cultural HEritage from GeO-hazards) research project.
The rockfall runout simulation in the World Heritage site was performed by using the 3D model Hy-STONE (Agliardi and Crosta, 2003; Crosta et al., 2004), which is able to simulate block motion along a 3D topography by including lateral dispersion of trajectories due to large and small scale morphological complexity. The results are spatially distributed over the entire study area, without need for any interpolation of data computing along specific trajectories or imposing predetermined fall direction. Hy-STONE incorporates both kinematic and hybrid algorithms, allowing to model free fall, impact, and rolling. Different damping relationships are available to simulate energy loss at impact or by rolling. The stochastic nature of rockfall processes is introduced as a function of model spatial resolution and by random sampling most parameters from different PDF (e.g. uniform, normal, lognormal, exponential).
The results show that potential fragmental rockfalls do not damage the archaeological excavations of the site located on the southwest side of the hillslope. However, potential events could affect the north and northeast areas of the hillslope. This can impact the path for the tourists, and cause serious injury or possible loss of live. For these reasons, safety measures have been simulated to protect the area and prevent possible injuries.