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# Investigations on debris sheets for the analysis of slope instability conditions in the Machu Picchu area

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Since 1997 the Machu Picchu area has been in the spotlight for its slope instability, when Carreno & Bonnard described the general geological and geomorphological condition, and the further studies of Sassa et alii (2001, 2002) contributed to define the interpretation of the structures, as the result of the existence of a main deep slow slide involving the archaeological area. However, the attention of these studies focused on the condition of the entire slope, with a lesser consideration for the shallow rainfall induced landslides, even if debris flows often occur and cause damages (like in 1995-1996, along the access road to the site) and real catastrophes (such as the one in 2004, when the day after Easter a channelized debris flow produced eleven casualties in Machu Picchu Pueblo, the close tourist town). A more general approach to the instability conditions of the site was undertaken in 2002, with the start of an international project, coordinated by K. Sassa and carried out in the framework of the activity of the International Consortium on Landslides. As constituent of this project, an integrate study of the instability condition of the debris was established: in this work the results of the field survey and the geotechnical investigation and of a slope stability analysis are shown. In particular, starting from the field data of the Carretera Hiram Bingham slope, two aspects has been handled: the interpretation of the distribution of debris thickness and the assessment of the working order of the runoff drainage system. Both the topics and the potentiality of their integration were approached in this work: the data deriving from these studies, combined with the results of the geotechnical tests, allowed the realisation of a slope stability analysis with a distributed model. The results constitute the first step for an exhaustive debris flow hazard assessment in this area, where the interactions between slope instability and land use can produce some very critical conditions.