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Natural hazards in the karst areas of the Viñales National Park, Cuba

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Cuban karst is subject to several natural hazards, the great majority of which is hydro-meteorological in character: intense rainstorms, tropical cyclones, seawater inundation, etc. A further, serious problem is represented by droughts, that have become very severe during the recent years, due to longer persistence of the dry season. Beside these hazards, seismic shocks in the eastern part of the country, and mass movements in the mountain areas have also to be mentioned. In general, it has to be noted that both casualties and economic losses from natural disasters have slowly decreased during the last decades at Cuba. Viñales National Park, as many other natural landforms in the Cuban karst, has a great potential for development and exploitation in several different fields, from agriculture, to tourism and recreational activities. At these aims, it is necessary to preserve the natural landscape, its beauty and resources, and, at the same time, improve the quality of people living in these environments. In particular, to face the social changes at present occurring in the area is one of the most difficult task for those people that are in charge of land management and development. It has also to be remembered that "Valle de Viñales" has been included by UNESCO in the World Cultural Heritage List.

The main scenarios of natural hazards in the Viñales National Park are described in this contribution, and analyzed by means of different methodologies. Flooded areas have been mapped in the field soon after the occurrence of an extreme event as the hurricane Ike, characterized by rainfall higher than 300 mm/day, and preceded only ten days before by hurricane Gustav, that discharged in the area an amount of 120 mm/day of rain. As a consequence of the temporal vicinity of the two events, the terranes were already highly saturated at the time of occurrence of hurricane Ike, which thus resulted to be one of the most extreme floods ever recorded in the area. Electrostatic discharges have been mapped on the basis of the outcomes from inquiries carried out in the villages of the area, and of the documentation recorded in the Viñales National Park archives since the time of its foundation in year 2000. Slope movements in karst are quite difficult to map and survey, given the wilderness of the area. Thus, different methodologies were applied at this aim. Mass movements were mapped by using the PNUMA-FAO method, that allows to map the erosional features based upon a matrix analysis, and the results were checked in the field, and processed by means of GIS. As before mentioned, natural hazards from meteorological events are the most dangerous, even because of the peculiar characters of karst landforms, and the hydrologic recharge of karst territories. For instance, arrival of waters from allochtonous, non karst, territories has a great influence on the overall amount of water that is present in karst, both at the surface and underground, and the discharge from karst springs or rivers is strongly dependant upon such waters. Many caves are also conditioned by the presence of water, and periodically may become flooded, especially when located at the mountain or mogote foothills, well within the areas morelikely to be inundated. At the same time, flood occurrence greatly affects the anthropogenic activities, and is often at the origin of the main damage recorded to man and the human society. The other cited natural hazards are by far less disruptive to man, and cause minor damage when compared to floods. This because the great majority of mass movements and erosional phenomena have to be registered in sectors where the presence of man and his activities is much lower, so that economic activities are less affected; lightnings, on the other hand, are at the origin of wildfires generally limited to the highest peaks and mogotes (residual hills and ridges in Cuban tropical karst), once again rarely affecting man's activities.