



Anthropogenic hazards in the show caves in Italy

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In the last year, many caves are exploited for the touristic purpose, making underground karst environment suitable for a strong anthropogenic hazard. The caves represent a weak and complex ecosystem where it is important to preserve environmental integrity and quality. A large experience in sustainability management of many natural heritages and protect area used for touristic purpose are available and the impacts are well define with standard protocols both for physical and biological parameters. This conceptual approach cannot be applied in the caves and in the karst regions in general. A protocol for the monitoring the underground environment need a strong and appropriate theoretical basis linked to researches in different topics from geological to biological fields. The experience in the main show caves in Italy (Frasassi, Castellana and Corchia caves) and from candidate touristic cave (M.Cucco) indicate that the monitoring in not only restrict to a measure of several environmental variables. It involve a general concept of karst ecosystem and can be fully understood only through a multi-disciplinary approach. Direct observations in the underground landscape have an important role for to survey modifications related to the dust and other incoming pollution directly brought in the caves by the visitors.

The quantitative study of the air and water circulations in the karst are an important tool for evaluate the impacts in the cave and understand the limits of reversible changes in the system. The ways how external atmospheric perturbation flows in to the cave through the air and the water give indications for the inertia of the underground system.

The main processes that occur in the show caves are considered in term of energetic budget. The larger ammount of input energy, more than 80% come from to electricity and visitors; the output and the cooling is due to the air exchange for 70% and through the rock walls for 20%. The temporal evolution of these non stationary processes and variables are hard to predict because are controlled by chaotic dynamic processes.