Contribution of Heliborne Electro-Magnetic survey for landslide recognition and modelling: application to La Martinique (West Indies, France)

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Landslide hazard and risk assessment (LHA & LRA) in French West Indies is a big challenge, because of several factors contributing to high sensitivity of slopes to landslide (complex weathered volcanic grounds, hurricane seasons, heavy land pressure, [1]).The initial step is to assess the spatial probability (and sometimes temporal) of failure (i.e. landslide susceptibility assessment; LSA) for a given area. LSA can be evaluated by several approaches (i.e. knowledge approach, data-driven approach, physically based approach). Physically based approaches are used to calculate a slope stability factor taking into account mechanical, geotechnical, hydrological and hydrogeological parameters.

However, in many cases the parametrization of these models is difficult because of a lack of information (i.e. soil depths, precipitations chronicles…) or because of ground data acquisition complexity. Thus, HEM (Heliborne Electro-Magnetic Survey) can be an alternative to obtain specific information quickly and over large areas. Since 2000, the HEM method is increasingly used for environmental studies: geomorphological and hydrogeological studies [2, 3, 4; 5]. In 2010, The French Geological Survey conducted an HEM survey over La Martinique (West Indies). Resistivity contrasts has been imaged up to depths of 250-300 meters with a horizontal resolution around 30 m and a vertical resolution between 3 and 8 m [6]. Even if the resistivity has not a straightforward relationship with soil mechanical properties (which are key parameters for LHA) it provides relevant information on both the thickness and the extension of formations.

The aim of this study is to design and assess a methodology which will be used for modeling and mapping of landslide hazard on areas with such HEM coverage. The study is split in two steps: in the first step a qualitative analysis of the contribution of HEM data for hazard mapping is performed by comparison and correlation with field data and drilling in order to identify potential landslide prone areas; in the second step HEM results are integrated in a physically based model called ALICE® to assess and to map the landslide susceptibility of slopes for selected areas. A phase of exchanges between field observations, drilling and results, allows calibrating and validating the model. The contributions and weaknesses of the method are also discussed, as well as proposals to improve the latters.

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