ASSOCIATION OF FIELD OBSERVATIONS AND GIS TOOLS FOR GROUND MOVEMENT HAZARD MAPPING (ROCKFALLS, LANDSLIDES AND CAVITIES COLLAPSE)

EXAMPLE OF MENDE AND VALDONNEZ BASINS (LOZÈRE, FRANCE)

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INTRODUCTION

Under the French policy of natural risks prevention, the "Laboratoire Régional des Ponts et Chaussées d'Aix-en-Provence" is in charge of ground movement mapping in its territory action including the French region of "Languedoc-Roussillon". The example presented here is somewhat different from the other cases usually treated for 3 main reasons :

- the area to be covered is important (251km^2 for 8 municipalities) and expected results are maps across of 1/10 000 that will be used for urbanization planning ;
- this is a multi-risk study which integrates several types of ground movement hazards (rockfalls, landslides and cavities collapses) ;

For these reasons, development of a methodology based on both field observations and the use of GIS is necessary.

CONTEXT OF MENDE AND VALDONNEZ BASINS (LOZERE, FRANCE)

The studied area covers 8 municipalities of Lozère French department (48), located in the northern part of the "Causses". The "Causses" are constituted by sedimentary rocks (affected by folds of large radius of curvature oriented WE) in discordant contact with granites and micaschists of the basement (figure 1). The studied area is crossed by the Lot river in the northern part and by the Nize and the Bramont rivers in the southern part.

The top of the "Causses" borders, constituted by limestones and dolomite rocks, constitutes the main start zones for rockfalls but diffuse micaschists cliffs can also liberate some blocks.

The basis of the"Causses", constituted by marls, is the main location of landslides which are also present in a minor part in the superficial deposits. Natural cavities are present in the "Causses" plateaus and also in the geomorphological area of the "Avant-Causses".

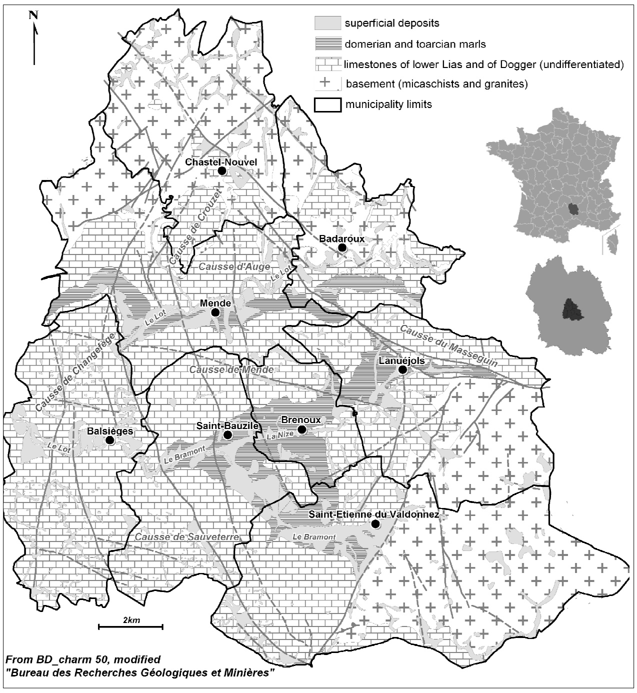

Fig. 1 Structural map of the studied area.

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HAZARD MAPPING METHODOLOGY

The applied methodology respects the main principles of the guidebook edited by the “Laboratoire Central des Ponts et Chaussées” and the Ministry of ecology. The hazard is the result of crossing between occurrence probability (within 100 years) and intensity of the expected phenomenon.

The first step of this study is based on bibliographic synthesis (Departmental and Municipal Archives), interviewing local actors, photo-interpretation and field observations which leads to an observations map including : identified start zones and their characterization, geomorphology of slopes, localization of liberated blocks, evidences of landslides, karstic potential of the different sedimentary layers, faults and fracturation.

The second step consists of defining crossing grids in order to qualify the occurrence probability of each phenomenon. These crossing grids use both local field observations described above and GIS data : DEM, lithological and structural data from BDcharm50 edited by the “Bureau des Recherches Géologiques et Minières”, GIS tools which permit to apply the Energy Line model to define rockfall run-out envelops. Indeed, association of this two types of data permits to :

- complete lithological data, especially for superficial deposits, from our field observations ;
- qualify start zones hazard from naturalist criteria (fracturation orientation and density, schistosity orientation, karstification degree, vegetation state, hydrogeological conditions, etc.) ;
- define slope values from which start zones of rockfall are present in the field ;
- use these slope values to define potential start zones of rockfall, non-observed in the field (due to vegetation density for example) ;
- define slope values from which landslides indexes are present in the field ;
- use these slope values and lithological data to define potential landslides zones ;
- calibrate the angle used in the Energy Line model from local examples of rockfall, representative of the local geomorphological context ;
- correct this calculated rockfall run-out envelops from our field observations.

The third step consists to define intensity level for each identified occurrence zone respecting the principle related in table 1. Hazard map for each phenomenon results from crossing between occurrence probability and intensity and constitute a real tool for urbanization planning.

Tab. 1 Definition of intensity level

Intensity level	Prevention measures
Low intensity	Individual prevention measures are possible
Medium intensity	Collective prevention measures are possible
High intensity	No prevention measure is possible

CONCLUSION

In this context of large studied area (261 km^2) and needed precise scale (1/10 000), both field observations and GIS tools are necessary and complementary for ground movement hazard mapping. Indeed, GIS tools permit to accelerate, automate and homogenize hazard mapping whereas field observations permit to calibrate used parameters and to correct some mistakes due to a too much expeditive method.

Keywords: ground movements (rockfalls, landslides and cavities collapses), hazard mapping, field observations and GIS.