



Influence of complex slope hydrogeology on landslide susceptibility assessment: the case of the Pays d'Auge (Normandy, France)

Arthur Cance, Yannick Thiery, Mathieu Fressard, Rosalie Vandromme, Olivier Maquaire, Mark E. Reid, Martin Mergili

► To cite this version:

Arthur Cance, Yannick Thiery, Mathieu Fressard, Rosalie Vandromme, Olivier Maquaire, et al.. Influence of complex slope hydrogeology on landslide susceptibility assessment: the case of the Pays d'Auge (Normandy, France). Journées Aléas Gravitaires, Oct 2017, Besançon, France. , JAG Proceedings 2017. hal-01586144

HAL Id: hal-01586144

<https://brgm.hal.science/hal-01586144>

Submitted on 12 Sep 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

TITLE:

Influence of complex slope hydrogeology on landslide susceptibility assessment: the case of the Pays d'Auge (Normandy, France)

Authors:

- Cance Arthur (*BRGM, Direction Risques et Prévention, Unité Risques, Instabilités gravitaires et érosion des sols et des versants, France*)
- Thiery Yannick (*BRGM, Direction Risques et Prévention, Unité Risques, Instabilités gravitaires et érosion des sol et des versants, France*)
- Fressard Mathieu (*Environnement, ville et société-UMR 5600 - CNRS, Université Lyon 3, France*)
- Vandromme Rosalie (*BRGM, Direction Risques et Prévention, Unité Risques, Instabilités gravitaires et érosion des sol et des versants, France*)
- Maquaire Olivier (*LETG-UMR 6554 – CNRS, Université de Caen, France*)
- Reid Mark E. (*USGS, Menlo Park, California, USA*)
- Mergili Martin (*Geomorphological Systems and Risk Research, Department of Geography and Regional Research, University of Vienna*)

The role of water as a landslide triggering factor is one of the challenges in landslide risk and susceptibility assessment. Indeed, hydrogeologic conditions can greatly influence slope stability conditions.

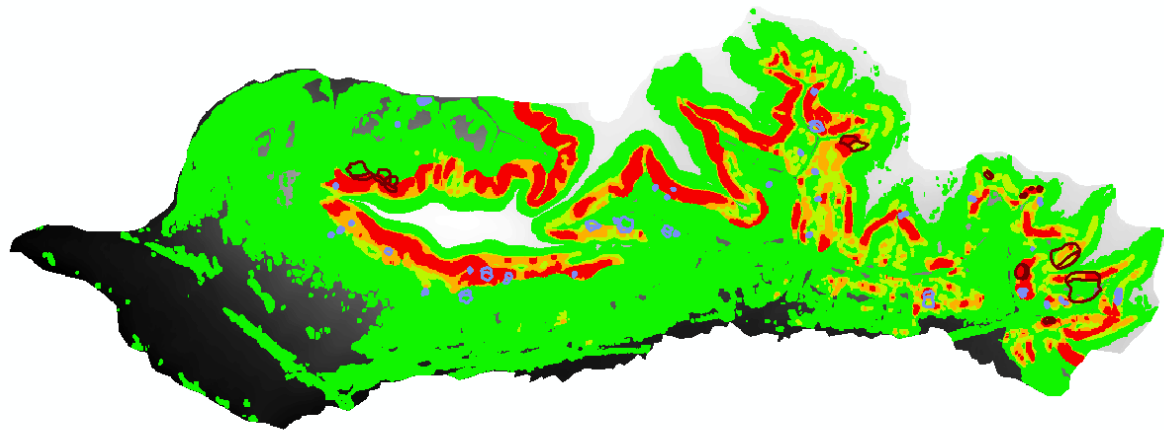
This is particularly true in the case of the slopes of Normandy that are covered by different types of surficial materials with thickness varying from 1 to 4 meters. One solution to assess water influence on slope stability is to simulate a groundwater level (GWL) in the materials and introduced it into a slope stability model. (Fressard et al., 2016).

Recently, we performed some research based on this approach to analyse slope stability and map landslide susceptibility in the Pays d'Auge (Cance, 2017). Several spatially distributed, physically based models, that account for various levels of GWL in an empirical way and use different slope stability calculation methods, have been tested (Cance, 2017; Mergili et al., 2014; Reid et al., 2015).

Each of the spatialized models shows that the influence of groundwater, as integrated empirically, does not produce the observed instabilities: some areas suffering from slope instabilities appear to be not identified or miss-simulated. Examination of the these poorly simulated areas reveals that, despite a high GWL and very susceptible materials, these areas are subject to a more complex hydrogeology than the one used in the models.

Hence, we decided to build a hydrogeological model to (i) reflect this complexity and (ii) account for several water levels in (1) deeper calcareous materials and (2) shallow surficial materials closer to the ground surface. This conceptual model will be integrated in a hydrogeological model to simulate a more realistic hydrogeology. Using simulation runs with 2D hillslope profiles, we will compare the slope stability under various scenarios with differing hydrogeological models (simple/complex). Finally, we will performed a reflection to regionalize the hydrogeological model and thus map in a more precise way the landslide susceptibility of the slopes.

This research is supported by the ANR RICOCHET project led by the University of Caen (LETG-UMR 6554 CNRS); the objective of this work is to estimate the volumes of material produced on the slope by landslide activity.



FoS (Factor of Safety)

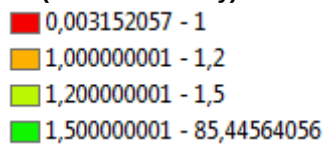


Figure 1. Susceptibility map obtained with ALICE® for shallow landslides (GWL = 0.9) for 'Pont L'Evêque' area (Pays d'Auge, Normandie, France)

Bibliography:

Cance, A. 2017. Transfert de sédiments par mouvement de masse : analyse quantitative par modèles à base physique : le cas du Pays d'Auge. Mémoire de Master II. EPF Sceaux. 50p.

Fressard, M. 2013. Les glissements de terrain du Pays d'Auge continental (Normandie, France) Caractérisation, cartographie, analyse spatiale et modélisation. University of Caen Normandie. 331 p.

Fressard, M., Maquaire, O., Thiery, Y., Davidson, D., Lissak, C. 2016. Multi-method characterisation of an active landslide: Case study in the Pays d'Auge plateau (Normandy, France). *Geomorphology*, 270, 22-39.

Mergili, M., Marchesini, I., Rossi, M., Guzzetti, F., Fellin, W. 2014. Spatially distributed three-dimensional slope stability modelling in a raster GIS. *Geomorphology*, 206. 178-195.

Reid, M.E. Christian, S.B., Brien, D.L., and Henderson, S.T. 2015. Soops3D: software to analyze 3D slope stability throughout a digital landscape. USGS Report, Techniques and Method 14-A1, Report XIV. Section A: Modeling methods in Book 14 *Landslide and Debris-Flow Assessment* 218 p.