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The role of multicollinearity in landslide susceptibility assessment by means of Binary Logistic Regression: comparison between VIF and AIC stepwise selection

Mariaelena Cama (1), Ionuț Cristi Nicu (2,3), Christian Conoscenti (4), Geraldine Quénéhervé (1), Michael Maerker (1,5)

(1) Institut of Geography, University of Tübingen,Tübingen, Germany (mariaelenacama@gmail.com), (2) Interdisciplinary Research Department – Field Science, Arheoinvest Platform, "Alexandru Ioan Cuza" , (3) School of Humanities and Creative Arts, Faculty of Education, Humanities and Law, Flinders University,Adelaide SA, Australia, (4) Dipartimento di Scienze della Terra e del Mare, Universitá degli Studi di Palermo, (5) Dipartimento di Scienze della Terra, Universitá degli Studi di Firenze, Firenze, Italy

Landslide susceptibility can be defined as the likelihood of a landslide occurring in a given area on the basis of local terrain conditions. In the last decades many research focused on its evaluation by means of stochastic approaches under the assumption that 'the past is the key to the future' which means that if a model is able to reproduce a known landslide spatial distribution, it will be able to predict the future locations of new (i.e. unknown) slope failures. Among the various stochastic approaches, Binary Logistic Regression (BLR) is one of the most used because it calculates the susceptibility in probabilistic terms and its results are easily interpretable from a geomorphological point of view. However, very often not much importance is given to multicollinearity assessment whose effect is that the coefficient estimates are unstable, with opposite sign and therefore difficult to interpret. Therefore, it should be evaluated every time in order to make a model whose results are geomorphologically correct.
In this study the effects of multicollinearity in the predictive performance and robustness of landslide susceptibility models are analyzed. In particular, the multicollinearity is estimated by means of Variation Inflation Index (VIF) which is also used as selection criterion for the independent variables (VIF Stepwise Selection) and compared to the more commonly used AIC Stepwise Selection. The robustness of the results is evaluated through 100 replicates of the dataset.
The study area selected to perform this analysis is the Moldavian Plateau where landslides are among the most frequent geomorphological processes. This area has an increasing trend of urbanization and a very high potential regarding the cultural heritage, being the place of discovery of the largest settlement belonging to the Cucuteni Culture from Eastern Europe (that led to the development of the great complex Cucuteni-Tripyllia). Therefore, identifying the areas susceptible to landslides may lead to a better understanding and mitigation for government, local authorities and stakeholders to plan the economic activities, minimize the damages costs, environmental and cultural heritage protection.
The results show that although the VIF Stepwise selection allows a more stable selection of the controlling factors, the AIC Stepwise selection produces better predictive performance. Moreover, when working with replicates the effect of multicollinearity are statistically reduced by the application of the AIC stepwise selection and the results are easily interpretable in geomorphologic terms.