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Artificialized land characteristics and sediment connectivity explain muddy flood hazard in Wallonia

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Muddy flood occurrence is an off-site erosion problem of growing interest in Europe and in particular in the loess belt and Condroz regions of Wallonia (Belgium). In order to assess the probability of occurrence of muddy floods in specific places, a muddy flood hazard prediction model has been built. It was used to test 11 different explanatory variables in simple and multiple logistic regressions approaches. A database of 442 muddy flood-affected sites and an equal number of homologous non flooded sites was used. For each site, relief, land use, sediment production and sediment connectivity of the contributing area were extracted. To assess the prediction quality of the model, we proceeded to a validation using 48 new pairs of homologous sites.
Based on Akaïke Information Criterion (AIC), we determined that the best muddy flood hazard assessment model requires a total of 6 explanatory variable as inputs: the spatial aggregation of the artificialized land, the sediment connectivity, the artificialized land proximity to the outlet, the proportion of artificialized land, the mean slope and the Gravelius index of compactness of the contributive area.
The artificialized land properties listed above showed to improve substantially the model quality (p-values from 10e-10 to 10e-4). All of the 3 properties showed negative correlation with the muddy flood hazard. These results highlight the importance of considering the artificialized land characteristics in the sediment transport assessment models. Indeed, artificialized land such as roads may dramatically deviate flows and influence the connectivity in the landscape.
Besides the artificialized land properties, the sediment connectivity showed significant explanatory power (p-value of 10e-11). A positive correlation between the sediment connectivity and the muddy flood hazard was found, ranging from 0.3 to 0.45 depending on the sediment connectivity index. Several studies already have highlighted the importance of this parameter in the sediment transport characterization in the landscape.
Using the best muddy flood probability of occurrence threshold value of 0.49, the validation of the best multiple logistic regression resulted in a prediction quality of 75.6% (original dataset) and 81.2% (secondary dataset). The developed statistical model could be used as a reliable tool to target muddy floods mitigation measures in sites resulting with the highest muddy floods hazard.