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Development of a statistical model for the determination of the probability of riverbank erosion in a Mediterranean river basin

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Riverbank erosion affects the river morphology and the local habitat and results in riparian land loss, damage to property and infrastructures, ultimately weakening flood defences. An important issue concerning riverbank erosion is the identification of the areas vulnerable to erosion, as it allows for predicting changes and assists with stream management and restoration. One way to predict the vulnerable to erosion areas is to determine the erosion probability by identifying the underlying relations between riverbank erosion and the geomorphological and/or hydrological variables that prevent or stimulate erosion. A statistical model for evaluating the probability of erosion based on a series of independent local variables and by using logistic regression is developed in this work. The main variables affecting erosion are vegetation index (stability), the presence or absence of meanders, bank material (classification), stream power, bank height, river bank slope, riverbed slope, cross section width and water velocities (Luppi et al. 2009).

In statistics, logistic regression is a type of regression analysis used for predicting the outcome of a categorical dependent variable, e.g. binary response, based on one or more predictor variables (continuous or categorical). The probabilities of the possible outcomes are modelled as a function of independent variables using a logistic function. Logistic regression measures the relationship between a categorical dependent variable and, usually, one or several continuous independent variables by converting the dependent variable to probability scores. Then, a logistic regression is formed, which predicts success or failure of a given binary variable (e.g. 1 = "presence of erosion" and 0 = "no erosion") for any value of the independent variables. The regression coefficients are estimated by using maximum likelihood estimation. The erosion occurrence probability can be calculated in conjunction with the model deviance regarding the independent variables tested (Atkinson et al. 2003).

The developed statistical model is applied to the Koiliaris River Basin in the island of Crete, Greece. The aim is to determine the probability of erosion along the Koiliaris' riverbanks considering a series of independent geomorphological and/or hydrological variables. Data for the river bank slope and for the river cross section width are available at ten locations along the river. The riverbank has indications of erosion at six of the ten locations while four has remained stable. Based on a recent work, measurements for the two independent variables and data regarding bank stability are available at eight different locations along the river. These locations were used as validation points for the proposed statistical model. The results show a very close agreement between the observed erosion indications and the statistical model as the probability of erosion was accurately predicted at seven out of the eight locations. The next step is to apply the model at more locations along the riverbanks. In November 2013, stakes were inserted at selected locations in order to be able to identify the presence or absence of erosion after the winter period. In April 2014 the presence or absence of erosion will be identified and the model results will be compared to the field data. Our intent is to extend the model by increasing the number of independent variables in order to indentify the key factors favouring erosion along the Koiliaris River. We aim at developing an easy to use statistical tool that will provide a quantified measure of the erosion probability along the riverbanks, which could consequently be used to prevent erosion and flooding events.

Atkinson, P. M., German, S. E., Sear, D. A. and Clark, M. J. 2003. Exploring the relations between riverbank erosion and geomorphological controls using geographically weighted logistic regression. Geographical Analysis, 35 (1), 58-82.

Luppi, L., Rinaldi, M., Teruggi, L. B., Darby, S. E. and Nardi, L. 2009. Monitoring and numerical modelling of riverbank erosion processes: A case study along the Cecina River (central Italy). Earth Surface Processes and Landforms, 34 (4), 530-546.

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