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A slope units based landslide susceptibility analyses using Weight of Evidence and Random Forest

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As identified by previous work, landslides present a significant hazard in the Umbria Region, Central Italy. We present a Weight of Evidence (WoE) and Random Forest (RF) approach for deriving landslide susceptibility maps (LSMs) for the defined slope units (SU) cartographic unit. Used input data in this study includes a layer containing 7360 SU with 26 landslide conditioning factors (LCFs) and two landslide presence flags. Namely, „presence1“ (P1) and „presence2“ (P2) describe 3594 and 2271 SU as unstable, respectively. LCFs were reclassified using Natural Breaks into 10 classes, followed by testing collinearity which resulted in selecting 11 for the further analyses. Unstable SU were randomly split in two equal sets, one for deriving LSMs, and the other for validation. Using only unstable SU for WoE, the landslide dataset applied in RF included additionally an equal amount of stable SU. Stable SU were randomly selected from the area which had excluded only the previously selected unstable SU, simulating a temporal inventory for landslide validation. The latter ensured application of the model to unseen data, as well as unbiased landslide dataset for training the model. Model evaluation and LSM validation included determining Area Under the Curve (AUC) for the LSM area defined with Cumulative percentage of study area in susceptibility classes and the Cumulative percentage of landslide area in susceptibility classes. For model evaluation, 50% of unstable SU were examined, whereas to validate it, the remaining 50% of unstable SU were used. For model classification parameters, all SU were used to define Overall Accuracy (OA) and a Hit Rate and False Alarm Rate curve for which AUC was calculated. RF model performed excellent, having 86.16 and 90.00 AUC values for P1 and P2 scenarios, respectively. Significantly worse, the WoE P1 and P2 scenarios have 62.09 and 69.41 AUC values, respectively. LSM validation on unseen data goes in favor of WoE with 60.46 (P1) and 66.17 (P2) AUC values, compared to 45.06 (P1) and 56.68 (P2) AUC values for RF, indicating a random guess prediction. Considering OA and AUC as classification parameters, OA values for P1 and P2 scenarios in RF are 74.36 and 77.60 whereas AUC values are 81.65 and 84.61. Significantly less, WoE method has 66.03 and 69.14 OA values for P1 and P2 scenario, respectively. Similarly, WoE AUC values for P1 is 74.09 whereas for P2 it is 77.07. Showing better results in all four studied parameters in both methods, we point out the P2 scenario as a better option for defining landslide datasets concerning the amount of unstable and stable SU. Due to having a relatively big portion of unstable SU in the input data we argue that classification parameters should be prioritized when choosing the optimal method and scenario, as they take to consideration both unstable and stable SU for the entire study area. Based on the conducted research, we suggest using RF due to better classification performance as an approach for landslide susceptibility analyses and future

zonation in the study area.