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Intercomparison of DEM-based approaches for the identification of flood-prone areas in different geomorphologic and climatic conditions

Caterina Samela (1), Fernando Nardi (2), Salvatore Grimaldi (3), Francesco De Paola (4), Aurelia Sole (1), and Salvatore Manfreda (1)

(1) Università degli Studi della Basilicata, Potenza, Italy (caterina.samela@unibas.it), (2) Università per Stranieri di Perugia, Perugia, Italy, (3) Università degli Studi della Tuscia, Viterbo, Italy, (4) Università degli Studi di Napoli Federico II, Napoli, Italy

Floods represent the most critical natural hazard for many countries and their frequency appears to be increasing in recent times. The legal constraints of public administrators and the growing interest of private companies (e.g., insurance companies) in identifying the areas exposed to the flood risk, is determining the necessity of developing new tools for the risk classification over large areas. Nowadays, among the numerous hydrologic and hydraulic methods regularly used for practical applications, 2-D hydraulic modeling represents the most accurate approach for deriving detailed inundation maps. Nevertheless, data requirement for these modeling approaches is certainly onerous, limiting their applicability over large areas.

On this issue, the terrain morphology may provide an extraordinary amount of information useful to detect areas that are particularly prone to serious flooding. In the present work, we compare the reliability of different DEM-derived quantitative morphologic descriptors in characterizing the relationships between geomorphic attributes and flood exposure. The tests are carried out using techniques of pattern classification, such as linear binary classifiers (Degiorgis et al., 2012), whose ability is evaluated through performance measures. Simple and composed morphologic features are taken into account. The morphological features are: the upslope contributing area (A), the local slope (S), the length of the path that hydrologically connects the location under exam to the nearest element of the drainage network (D), the difference in elevation between the cell under exam and the final point of the same path (H), the curvature (∇^2H). In addition to the mentioned features, the study takes into consideration a number of composed indices, such as: the modified topographic index (Manfreda et al., 2011), the downslope index (DI) proposed by Hjerdt et al. (2004), the ratio between the elevation difference H and the distance to the network D, and other indices. Each binary classifier is applied in several catchments in order to verify the reproducibility of the procedures in different geomorphologic, climatic and hydrologic conditions. The study explores the use of these procedures in gauged river basins located in Italy and in an ungauged basin located in Africa.

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