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Computing LS factor by runoff paths on TIN

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The article shows results of topographic factor (the LS factor in USLE) derivation enhancement focused on detailed Airborne Laser Scanning (ALS) based DEMs. It describes a flow paths generation technique using triangulated irregular network (TIN) for terrain morphology description, which is not yet established in soil loss computations. This technique was compared with other procedures of flow direction and flow paths generation based on commonly used raster model (DEM). These overland flow characteristics together with therefrom derived flow accumulation are significant inputs for many scientific models. Particularly they are used in all USLE-based soil erosion models, from which USLE2D, RUSLE3D, Watem/Sedem or USPED can be named as the most acknowledged. Flow routing characteristics are also essential parameters in physically based hydrological and soil erosion models like HEC-HMS, Wepp, Erosion3D, LISEM, SMODERP, etc.
Mentioned models are based on regular raster grids, where the identification of runoff direction is problematic. The most common method is Steepest descent (one directional flow), which corresponds well with the concentration of surface runoff into concentrated flow.
The Steepest descent algorithm for the flow routing doesn't provide satisfying results, it often creates parallel and narrow flow lines while not respecting real morphological conditions. To overcome this problem, other methods (such as Flux Decomposition, Multiple flow, Deterministic Infinity algorithm etc.) separate the outflow into several components.
This approach leads to unrealistic diffusion propagation of the runoff and makes it impossible to be used for simulation of dominant morphological features, such as artificial rills, hedges, sediment traps etc.
The modern methods of mapping ground elevations, especially ALS, provide very detailed models even for large river basins, including morphological details. New algorithms for derivation a runoff direction have been developed as a part of the Atlas DMT software package. Starting points for the flow direction generation remain in regular grid (allowing easy contributing area assessment) while realistic direction paths are generated directly at TIN. It turns out that this procedure allows predicting actual runoff paths while ensuring the continuity of the potential runoff by sophisticated filling of sinks and flats. The algorithm is being implemented in a new USLE based erosion model ATLAS EROSION aiming to enhance designing of technical (morphological) soil erosion measures using detailed DEMs.
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