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Evaluation of interpolation methods in tillage surface area

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Most of DEM evaluations were done in continuous surfaces, either in artificial or natural surface. There are little attempts of DEM evaluation in such disturbed or discontinuous surface (e.g., in tillage surface area). Present study aims to evaluate common interpolation methods (triangulation, nearest neighbor, natural neighbor, minimum curvature, multiquadratic radial basis function (MRBF), ordinary kriging, and inverse distance weight) in representing detail topography of two different tillage types, namely bench terrace and modified furrow. Evaluation procedure was conducted through stepwise analysis using combination between accuracy level (mean error (ME) and standard deviation error (S)) and shape similarity analysis. This study also gives additional application of break-line function during interpolation process and the usage of drainage sink area as another step in evaluating DEM quality.

To achieve the aim of this study, two field-size area in dry-land agriculture (tegalan) were observed through a set of total station Nikon DTM 322 with 3" angle accuration. These plots, namely Tieng (1940 m^2) and Buntu (673 m^2), are situated in the upper part of Wonosobo Perfecture, Central Java Province, Indonesia. These plot area were initially prepared for measuring and modeling the soil loss rate in both different land use and soil conservation methods. Tieng has terrace risers supported with rocks structure and smooth ground surface on it. On the other side, Buntu has smooth terraces with stripping ridges and furrows along the terraces ground which lays perpendicularly to the contour lines. In Tieng plot, the sampling position was conducted along the edge of terrace both on upper and lower part with 3 to 4 meters distance interval. There were 299 point observations and 30 of them were used as validation data set. Regarding the repeated dimension of the ridges and furrow in Buntu area, the survey was initiated from the end part each of the furrow and ridge; continued with the ditch area and some additional points for validation purpose. There were 1752 point observations from the field survey - 235 point were excluded as validation points. The output grid cell size for Tieng and Buntu were 10 cm and 5 cm, respectively.

The stepwise evaluation was simply carried out by giving a rank to each performance of interpolation method throughout every test. In terms of R^2, ME and S, there were slightly different in results between each method except the MRBF which was failed to generate terrace form in Tieng. The ordinary kriging could not present the abrupt change of the terrace risers. Therefore, the break-line function was applied here. In Tieng area, three methods were considerably performing satisfactory results, i.e. triangulation, natural neighbor and ordinary kriging. Triangulation generated the best DEM with 0.11 of intercept value, perfect gradient of the R^2 slope, zero mean error, and 0.001 of error standard deviation. Based on the cross and longitudinal profile, both of minimum curvature and nearest neighbor failed to represent the spatial forms of the bench terrace. Natural neighbor, ordinary kriging, minimum curvature, and MRBF showed reliable DEM results in Buntu area. Ordinary kriging was the best fit for Buntu area with 15.45 of intercept value, nearly perfect gradient (1.01) of the R^2 slope, 0.02 mean error, and 0.1 of error standard deviation. Triangulation and nearest neighbor were failed to represent the edge of furrows and ridges which were too sharp in shape. The ordinary kriging with break-line function may result the best fit DEM for combination of topography between bench terraces and furrows.