WATERSHED MAPPING AFFECTED BY WATER EROSION IN THE ARGENTINE REPUBLIC

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Abstracts

In this work is evaluated the accuracy watershed map secured by means computer graphics. Differents options of terrain modelling are tested in a very flat area afected by water erosion. The global accuracy of watershed maps areas ranges from 71,6% to 92,5%.

1 Introduction

The runoff and sediment yield in a watershed depends among others variables on the morphometrics caracteristics. With an adequate cartographics of thats variables allows interpret the hidraulic behavior watershed.

For watershed mapping the cartographics basic sources are the topographics maps and areal photograps (stereoscopics pairs). By means of the interpreting of these sources it is elaborated the preliminary map for cheking to the reality.

That work is difficult when the maps are out of date and stereoscopic vision is null because the relief is very flat. Moreover the interpretation and draw handling of linen (channel flow, boundary) is tedious and slow work [1].

At presente, there are digital techniques availables that offer new perspectives of work. Many authors have applicated automatics methods starting from Digital Elevation Models (DEM) to obtain watershed moarphometrics parameters. These methods are included in runoff/erosion simulating models [2].

Topographics caracteristics of the modelling terrain; the accuracy and pixel grid size of the DEM define the map quality achieved. Modelling flat relief usually generate "pits sporius" unreally [3]. It obligate the preprocess of DEM with filters or filling algorithm. The errors of DEM also spread in models derived like slope and aspect models [4], therefore they must be evaluated and corrected according to acciepted standar. Smaller pixel grid size of DEM produce teorics results best [5]. Vary algorithms for designer of watershed boundary and network drainage are available with different effectiveness [6].

The objective of this work is to evaluate the accuracy watershed map of an area severely affected by water erosion, automatically obtained by means of the GIS raster treatment. It formulates the hypothesis that the best map is obtained from the most exact and pixel size smaller DEM.

2 Materials and Methods

The area of study of 330 km^2, is situated in the province of Córdoba (Republic Argentine). Geographics coordinates are: 32°45'-32°55' south latitude and 53°40'-64°10' west longitude, at a height of 360 meters average above sea level. This area's caracteristics are: intensive rains in summer, very

flat relief (slope average: **0,68%**), soils of texture silty loam, agricultural land use and a design of roads in the manner of square reticle. This factors to cause severe sheet and gully water erosion. When sheet flows reach the roads, the energy increases and erode the bottom and are converted in the principal drainage network. This situation is not represented in the topographics maps because is newly made. When the runoff reach the General Cabrera city produce the flood of this [7].

From the digitize contour lines of Topogrphics Maps scale 1:50.000 (Military Geographics Institute of Argentine) were calculated the DEM (for contour line linear interpolation) in 100x100, 50x50 and 25x25 meters pixel grid size. The main drainage line (roads) were digitized with presents heights and rasterize in 25x25 meters pixel grid size generating drainage line layer.

The errors of the DEM is shown in table 1 and is considered acceptable (SME is smaller that middle verticals intervals of contuor lines -3,5 meters)

Table 1: Error of the DEM (meters)

DEM	E.Min	E.Max	Sd	A.M.E.*	S.M.E.**
100x100	0	4	1,00	0.70	1.00
50x50	0	3.66	0.91	0.65	0.90
25x25	0	3.50	0.91	0.64	0.90

* Absolute Mean Errors / ** Square Mean Errors

One DEM (pixel 25x25 m) was update in its heights by means of overlay operation with drainage line layer (roads). For all DEM were computed the Digital Aspects Models (DAM) whose circular parameters are shown in table 2.

Table 2: Circular parameters of the DAM

DAM	D.M.V.*	R**
100x100	112.63	0.88
50x50	113.14	0.81
25x25	113.96	0.86

*DMV: Mean direction vector (in degree azimutals)
**R: Module Sum Vector (1 = min. dispersion; 0 = max. dispersion)

Eventually with Watrshed command of Idrisi GIS were computed the watershed area maps for each DAM. This algorithm operates on aspect matrix including at the watershed overall pixels which drain in the direction of a target.

Two targets were indicated: General Cabrera city and a NE vector which overlap the railway line ending at that city; for DAM 100x100, 50x50, 25x25 and 25x25(update) and roads driver runoff (not update) generating one fifth alternative to test. As a mean of verification was used the maps ready made on terrain. The watershed real area is the 9.488 hectares.

3 Results and Discussion

The results for differents options are shown in table 3.

Table 3: Area (hectares)

DEM	A	B	C	D
100x100	12.189	8.251	3.938	462
50x50	9.557	7.582	1.975	1.905
25x25	8.531	7.021	1.510	2.468
25x25*	9.967	7.624	2.343	1.865
25x25**	9.916	7.889	2.027	1.600

*25x25 (update) / **25x25 (target roads not update)
A: Overall calculated area for algorithm; **B**: Correctly estimated area; C: Overestimate area;
D: Underestimate area.

It can be observed a resemblance for the different options in result B. But the oposite happens with results C and D. Circular parameters corresponding at correctly estimated, underestimated and overestimated area (table 4) showing that algorithm has incorpored pixels whose dispersion is smaller (mean direction vector has preferred orientation) while it has produced heterogeneous data in different pixel grid size where the data dispersion (module sum vector, R) increases.

Table 4: Circular paremeters for sector

Area	D.M.V	R
Agreement	114.3	0.93
Overestimated	72.8	0.85
Underestimated	86.0	0.85

The global accuracy maps obtained with different options was calculated wighted the porcentual relationships among overall calculated area, underestimated area and overestimated area and the real watershed area (9.488 h) showed in table 5.

Table 5: Maps Global Accuracy

DAM	100x100	50x50	25x25	25x25*	25x25**
Accuracy	**82.5**	**91.3**	**71.6**	**92.5**	**84.4**

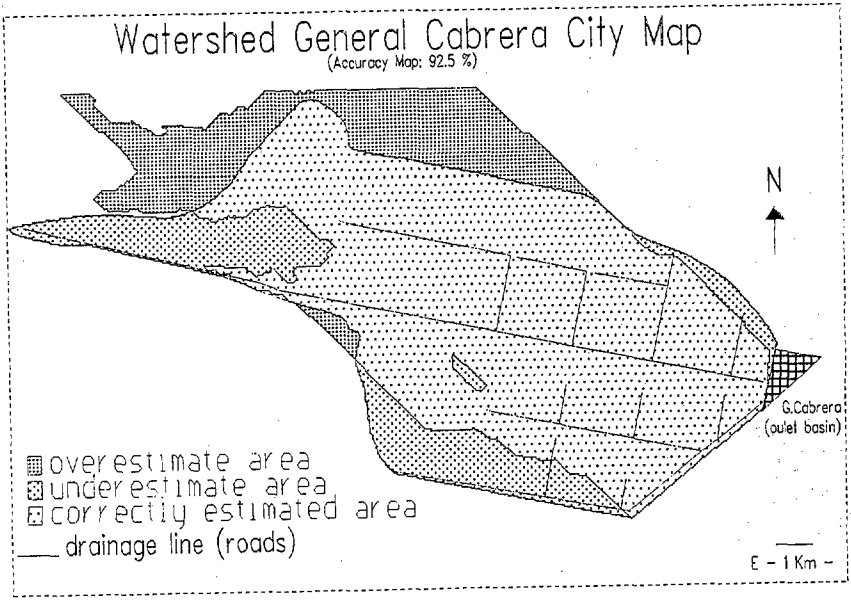
*DEM (update) / **DEM target roads not update

In relation with this results the most favorable option has been DAM pixel 25x25(update) -accuracy 92.5% (see Figura 1) confirmating the formulated hipothesis. However the results obtained with DAM

pixel 50x50 meters is similar to the anterior -accuracy 91.3 %, with additional advantage that is more simple the processing to obtain maps. The DAM pixel 25x25, homogeneity to much the data round the mean direction data underestimating in excess. This situation is reverted in DAM pixel 25x25 (update). The DAM pixel 100x100 homogeneity the data in sectors de higher dispersion overestimated in excess. Evidently the smaller pixel grid size yield teorics results better but as far a threshold since wich increase the information terrain detall (Topographics maps scale 1:25.000 or greater)

The conclusion is that the accuracy of watershed mappings obteined by means computers graphics, depends an the relations between terrain caracteristcs, the pixel grid size and quality of the DEM and informatics process used.

Figure 1.



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