PRACTICAL AND THEORETICAL RESULTS OF THE EXPERIMENTAL METHOD FOR THE ASSESSMENT THE EROSION RISCK, USING THE IMERE INSTALLATION

REZULTATE PRACTICE ŞI TEORETICE ALE METODEI EXPERIMENTALE DE ESTIMARE A RISCULUI DE EROZIUNE FOLOSIND INSTALAŢIA IMERE

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Abstract. *The paper present the software which processes the experiment data obtained with IMERE installation, [1], [2], and the main results. Also, in the paper appear some analytical formulas which represent some assays to obtain others way for assess the soil erosion risk.*
Key words: soil, erosion, risk, assessment

Rezumat. *Articolul prezintă programul de prelucrare a datelor şi rezultatele obţinute prin prelucrarea datelor numerice brute achiziţionate în experienţele de estimare a riscului de eroziune efectuate cu ajutorul instalaţiei, IMERE, [1], [2]. Se prezintă interpretarea datelor şi unele încercari de obţinere a unor noi estimatori ai riscului de eroziune.*
Cuvinte cheie: sol, eroziune, risc, estimare

INTRODUCTION

This paper presents the method of processing the data from the experiences carried out with facility IMERE, [1], [2], in aim to determine the risk of erosion on slopes, caused by the water action. It also presents a number of top-level data, which clearly describe erosive rainfall event, was also the major source of improving theoretical models of the phenomenon.

MATERIAL AND METHOD

Method is based on algorithm testing with mobile plant for erosion risk estimation IMERE, [2], on its data and mathematical methods of classical statistical processing of experimental data. For computing and graphics, is using the MS Office software, Excel.

The experiences to estimating the risk of soil erosion situated on the slopes, caused by the water action, were made within ICDVV Valea Calugareasca, in 2008 year. To experience three locations were chosen within ICDVV experiences being carried out in April, June and September.

The software for experimental data processing - ALGIMERE

The experimental data processing program is called ALGIMERE, and is based on formulas given in Table 1. The first page of the program covers all ordinary calculations required to the final report and related schedules. Experimental data are inserted in specially marked areas: general information, current experimental data: the capacity of containers for collection of leakages, the initial time of filling of the containers, filling the final time of collection containers, total weight of dry soil obtained by drying the contents of each container . The program supports hundreds data collection, but, practically, the number of data not exceed a few tens.

Table 1

Formulas for calculating the parameters that appear in the program ALGIMERE *

The total quantity of water given:	$A=i_f-i_0$
The amount of water administered until flow:	$A_c=i_c-i_0$
Average flow of water supplied:	$Q=A/(t_f-t_0)$
The amount of water necessary to trigger specific unit surface flow	$a_c=A_c/S$
The amount of water specified unit area, given the entire period:	$a=A/S$
Specific flow unit area:	$q=Q/S$
The total mass of dry soil collected:	$M=\sum_{i=1}^{n} m_i$
Mass of soil collected from the emergence of flow by the end of water supply	$M_1=\sum_{i=1}^{n_f} m_i$
Overall loss of surface specific unit per event:	$P=M/S$
Overall loss per hectare per event:	$Pha=10\cdot P$
Overall loss of soil specific surface unit and flow unit pluviometric:	$\phi=P/Q$
Overall loss of soil specific surface unit and flow unit pluviometric specific unit area:	$\psi=P/q$
Coarse estimator of the annual soil loss per hectare, for a given system pluviometric, PL (in mm):	$Phaa=Pl\cdot Pha/(1000\cdot a)$
The total duration of watering	$T=t_f-t_0$
Watering duration to flow occurrence	$T_c=t_c-t_0$
Length of slope (plot watered)	L
Rain intensity	$I=A\cdot 1000/S$
Hourly intensity of rain	$i=A\cdot 3600/T$

*i_0, i_c and i_f = Flow meter index initially, when the flow and finally;
t_0, t_c and t_f = times at the same moments of experience

In the calculation, corrections arise because the replacement of a container filled with other goals, has duration of time and has loss of leaks. Leakage loss recorded in each time interval between the end of a container full time and during the initial filling of a new container was calculated as being equal to the amount of leakage specific unit of time multiplied by the half filled container during replacement container, plus the amount of leakage for specific unit of the container to be filled, multiplied by half the time of replacement container.

Main results of the experiment and its data processing occurs in the report of the first page of the program, as shown in the table in Fig. 1. In this table also appear in terms estimator for assessing the risk of erosion: loss of soil per m2 per event of soil loss per hectare per event, coarse estimator of annual soil loss per hectare and soil loss reported to measures of rain intensity: soil loss per hectare specific unit specific flow and soil loss rate per hectare unit, corresponding both rainfall event.

In page 2 of ALGIMERE program, is presented a chart containing the change in speed of deployment time (Fig. 2), calculated as the ratio between the amounts of material collected on each container and deployed during the collection - is therefore an average speed of deployment each collection period. It can be observed in the transitional area erosion rainfall event. The phenomenon is achieved only when both the material flows. On the same graph is presents the variation rate of leakage is corrected through the replacement of vessels breaks.

In the page 3 of the ALGIMERE program, is present the graph of the changes over time of dry material collected (Fig. 3), the uncorrected version and the corrected version. It is noted that the two curves meet the minimum requirement of monotonous growth.

From the program report, only the coarse estimator is annual soil loss per hectare. This estimator normally cannot be deduced from a single experiment with IMERE facility. The value of this estimator will be even better with how it is calculated as the average of several experiments, spread over an entire year, the key periods of development of vegetation, the conduct of agricultural operations and taking into account the natural distribution of average pluviometric regime.

The processing and interpretation of data, we tried to reach the classic estimators of the risk of erosion - the loss of soil per unit area and a coarse estimation of the annual soil loss per hectare - but we try to introduce also new possible estimators. These estimators appear in Table 1. The first proposed new estimator is *overall loss on the event specified unit area*, denoted *P*, which is equivalent locally (on the pluvial erosion event) of the estimator classic *annual soil loss per hectare*.

Raport experiment: A locatie: ICDVV Valea Calugareasca ALGIMERE
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FINAL PRIMARY RESULTS	
total amount of water administered, *A*, cm	0.423
quantity of water to flow sediment, *Ac*, cm	0.204
average flow of water distributed, *Q*, mc/s	0.000418
water quant. per unit area to sediment flow, *ac*, sup., m	0.002429
water quantity administered per unit of surface, *a*, m	0.005036
Specific flow unit area, *q*, m/s	4.97E-06
total mass of soil collected, *M*, kg	1.656782
mass flow and soil collected in the final watering, *M1*, kg	0.333381
Global soil loss per unit area and per eveniment, *P*, kg/sm	0.019724
Global soil loss per hectar and per eveniment, *Pha*, tons/ha	0.197236
Global soil loss per unit of average flow, *Φ*, kg s/m^5	47.24199
Global soil loss per unit of average flow and area, *ψ*, kg s/cm	3968.327
Coarse est. annual soil loss per hectar, *Phaa*, t/(ha*year)	21.54209
total duration of watering, *T*, s	1013.17
time before the flow appears, *Tc*, s:	480
rain intensity, *I*, mm	5.035714
intensity of rain per hour, i, mm/hour	17.89292

Fig. 1 The basic information in the report ALGIMERE program.

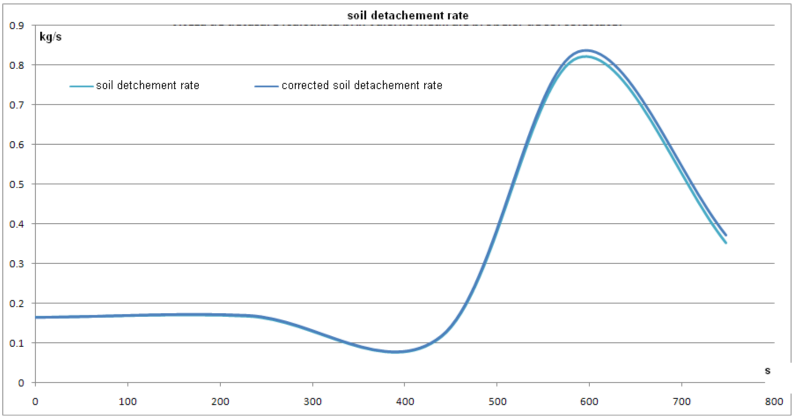

Fig. 2 Chart variation of soil detachment rate, resulting in the report ALGIMERE program.

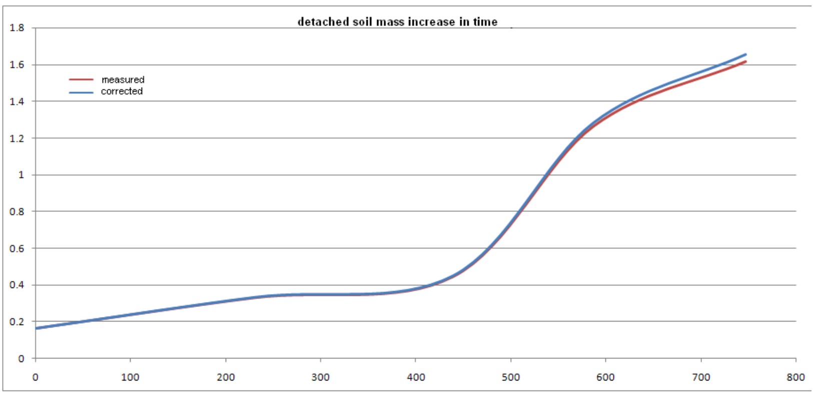

Fig. 3 Chart variation while the mass of soil detached graphics ALGIMERE program appears in the report.

Overall loss per hectare per event, noted P_{ha}, is derived from the parameter, P, so we approach the language commonly used in agriculture - the reference to the hectare as a measure of area. *Overall loss of soil specific surface unit and flow unit pluviometric*, noted Φ, is another possible measure of erosion risk. This measure introduces the link between the amount of land lost and the amount of water fell during the pluvial event. The final measure of the risk of soil erosion is *the overall loss of soil specific surface unit and flow unit pluviometric specific unit area*, noted ψ. This is a refinement of previous, as the ratio of two unit sizes specific surface.

The news soil erosion risk parameters introduced, bind the parameters of the pluviometric system with the parameters which describing soil loss. We believe that these parameters are intermediate steps to achieve a satisfactory estimator of soil erosion, possibly dimensionless interpreted as degree of erosion. One such parameter measured or estimated the likelihood or intensity of erosion, would allow comparison pluviometric erosion events, independent of the chosen geo climatic zone.

Data processing algorithm and the new estimators of the risk of erosion is the authors' original contributions.

RESULTS AND DISCUSSIONS

Main results in the paper are: program and method of processing experimental data, the new estimators of the risk of erosion introduced and results obtained for the particular locality ICDVV of Calugareasca Valley. The experiments carried out have led to estimates of annual soil loss per hectare from 0.9 - 1.9 t, for slopes of about 7%, respectively, about 5 t / ha on slopes of 15%, on a plantation hill - valley. These results are consistent with the reports and maps of erosion in Europe, [5]. This according was the main test of the method of estimation and data processing proposed by the authors. The authors of [4] give a map that characterized the area that includes soil erosion in Valea Calugareasca having negligible on most surfaces. The authors of [3] estimate for the plantations of vine in Romania, according to anti-erosion works, soil loss between 1.45 and 70.60 t / ha per year.

CONCLUSIONS

Experiences of risk assessment due to the action of water erosion on slopes produce results consistent with known data on soil erosion throughout Europe, [5]. In terms of the size of results, the estimation method (part experimental and data processing), are confident.

The experimental data are consistent with limits from 0 to 2 t / ha per year, typical of large areas of Romania, which includes territory I.C.D.V.V. Valea Călugărească, where they held their experiences.

Higher data processing, lead to results realized in the attempt to obtain some models (possibly hydraulic or mixed solid-fluid), the soil erosion under the action of water.

Experimental method of processing and interpretation of data is presented in this article, is an alternative to the methods used to estimate erosion risk: method USLE and its derivatives (RUSLE with variants), methods based on hydraulic models (WEPP, EUROS, etc.), mixed methods using GIS techniques and one of the methods above, finally, experimental methods. The alternative presented is different to the experimental methods so far by the mobility of plant IMERE by choice pluviometric arrangements according with the wishes of users, the independence of natural pluviometric regime, and also by the new erosion risk estimators have entered. The method can express the risk of erosion in classical terms also. Through the characteristics of the method for estimating the risk of erosion, this method can receive the attribute of the accelerated method for estimating the erosion because it may give a measure of erosion risk in a shorter time than the actual experiments carried out for at least a year.

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