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Research of water balance at hydrological micro-scale in the Aldeni Experimental Basin (Romania)

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Abstract

The paper presents a number of aspects regarding the Aldeni Experimental Basin (Romania). In order to experimentally investigate micro-scale (plot scale) hydrological impact of soil erosion, the National Institute of Hydrology and Water Management founded, in 1984, the Aldeni Experimental Basin (AEB). AEB is located in the Curvature Subcarpathians, a region characterized by a sharp erosion of soil.
Experimental investigations at a micro-scale are aimed towards: determining the parameters of the water balance equation, during natural and simulated rainfall; researching of runoff genetic and soil erosion processes on runoff plots; extrapolating relations involving runoff coefficients from a micro-scale to meso-scale.
Runoff plots have A = 80 sq m (20 x 4m), WNV-ESE aspect and an average slope of 5.6%; one runoff plot is maintained with grass, and the other "kept fallow" is devoid of grass by digging (processing) and the structure of the first horizon with a depth of 20 cm has been changed, which resulted in a greater development of infiltration than in the first runoff plot.
Complex measurements and sampling observations of the necessary elements for the quantitative estimation of the water balance equation are achieved with the help of specific equipment on standard climatologic and hydrological time (hourly and pentads) at hydrometric stations and meteorological platform, while at runoff plots scale per rainfall event.
Nowadays, the latest evolutions in data acquisition and transmission equipment are represented by sensors (such as sensors to measure the soil moisture). Exploitation and dissemination of hydrologic data is accomplished by: research themes/projects, yearbooks of basic data (Experimental Basins Yearbook) and scientific papers.

Keywords: *Aldeni Experimental Basin, runoff plots, water balance, micro-scale, experimental hydrology*

Rezumat. Cercetări hidrologice la microscară ale bilanţului apei în Bazinul Experimental Aldeni (România)

Articolul prezintă o serie de aspecte referitoare la Bazinul Experimental Aldeni (România). Pentru a cerceta experimental la microscară (scara parcelei) impacturile hidrologice ale eroziunii solului, Institutul Naţional de Hidrologie şi Gospodărire a Apelor a înfiinţat Bazinul Experimental Aldeni (BEA), în 1984. BEA este situat în Subcarpaţii de Curbură, regiune caracterizată printr-o accentuată eroziune a solului.
Cercetările experimentale la microscară sunt orientate către: determinarea parametrilor ecuaţiei bilanţului hidric, în condiţii naturale şi cu ploi artificiale; studiul factorilor genetici ai scurgerii lichide de suprafaţă şi a proceselor de eroziune a solului pe parcele de scurgere; extinderea relaţiilor privind coeficienţii de scurgere de la microscară la mezoscară.
Parcelele de scurgere au S=80mp (20x4m), orientare VNV-ESE şi o pantă medie de 5,6%; o parcelă este menţinută cu iarbă, iar cealaltă este lipsită de iarbă prin săpare (prelucrare) şi are modificată structura primului orizont de 20 cm, ceea ce a dus la o dezvoltare mai mare a infiltraţiei faţă de prima parcelă de scurgere.
Efectuarea complexului de observaţii, măsurători şi prelevări asupra elementelor necesare determinării cantitative a ecuaţiei bilanţului apei se face cu aparatura specifică la termene hidrologice şi climatologice standard (orare şi pentadale) la staţii hidrometrice şi platforma meteo, respectiv la evenimente ploioase la parcelele de scurgere.
In prezent, procesul de achiziţie şi transmisie a datelor se modernizează cu aparatură prevăzută cu senzori (de ex. senzori pentru măsurarea umidităţii solului). Exploatarea şi diseminarea datelor hidrologice se face prin: teme şi proiecte de cercetare, anuare (Anuarul Bazinelor Experimentale) şi articole ştiinţifice.

Cuvinte-cheie: *Bazinul Experimental Aldeni, parcele de scurgere, bilanţul apei, hidrologie experimentală*

Introduction

Experimentation and observations are central activities within the water sciences (Hopmans & Pasternack, 2006). From a hydrological point of view, experimental basins are typical natural laboratories, which play an important role in understanding the dynamics of genetic (natural or simulated rainfall) and conditional (soil, landuse, vegetation type, anthropogenic activities, etc.) factors that influence the overland flow and suspended sediment discharges. Also, plot-scale experimental studies are designed to help us better understand the relationships between processes involving hydrological, ecological and geomorphic factors (Linsley, 2009; Ferreira Moreira et al., 2011). Generally, water research investigations are based on the water balance equation (Eq. 1), (Lvovich, 1965):

$$P = S + U + N + T\,;\; W = P - S = U + E\,;$$
$$R = S + U\,; E = N + T\,; K_U = \frac{U}{W} \qquad (1)$$

where:

P - precipitation, S - surface runoff, U - underground flow, N - non-productive evaporation, T- Transpiration, W - gross moistening of territory (soil), E – evaporation of sweat, R - total runoff, K_u - coefficient of river feeding by underground waters.

According to Toebes & Ouryvaev (1970), the general equation for the water balance from an experimental basin (Eq. 2), is calculated as mean values and expressed in depths (mm):

$$P = Q + E \pm \Delta M_S \pm \Delta G \pm \Delta V + e \qquad (2)$$

where, over a specified period:
P = total precipitation; E = total evaporation of sweat; Q = total stream flow; ΔM_S = change in soil-moisture storage; ΔG = change in ground-water storage; ΔV = change in storage of liquid and solid precipitation in endoreic depressions; e = an error term which includes not only deep percolation (Qdp) but also errors associated with other elements of the water balance.

Regarding water balance investigations, experimental studies at hydrological micro-scale (1 sq cm → 1 sq km), allow simulations of elementary hydrological processes by means of runoff plots (Garcia et al., 1963; Toebes & Ouryvaev, 1970; Becker & Nemec, 1987). The sizes of runoff plots are: a) microplots "*one or two square meter*"; b) small-scale ~ 100 sq m and c) field plots ~ 1 ha (Hudson, 1993). The results thus obtained are representative for a region or a certain conditional factor, and, by means of extrapolation, these results can be used on the slopes of the catchment. Several types of studies can be used such as: modeling data; assessing socio-economic impact aspects of the water resource; detection of trends and changes in runoff regimes and ecosystem responses due to anthropogenic activities and climate variability (Schumann et al., 2010).

In 1986, UNESCO, through its International Hydrological Program - IHP, has created the Euro-Mediterranean Network of Experimental and Representative Basins (ERB), and Romania is affiliated with this organization since 1993, through the National Institute of Hydrology and Water Management (NIHWM). Within NIHWM, field experimental hydrological research at plot scale, in correlation with complex programs of observations and measurements, is conducted at 3 research units.

The content of its activity concerns the establishment of quantitatively defined relationships between discharge and genetic and conditional factors. These basins are situated in the Curvature Carpathians and Subcarpathians (Fig. 1).

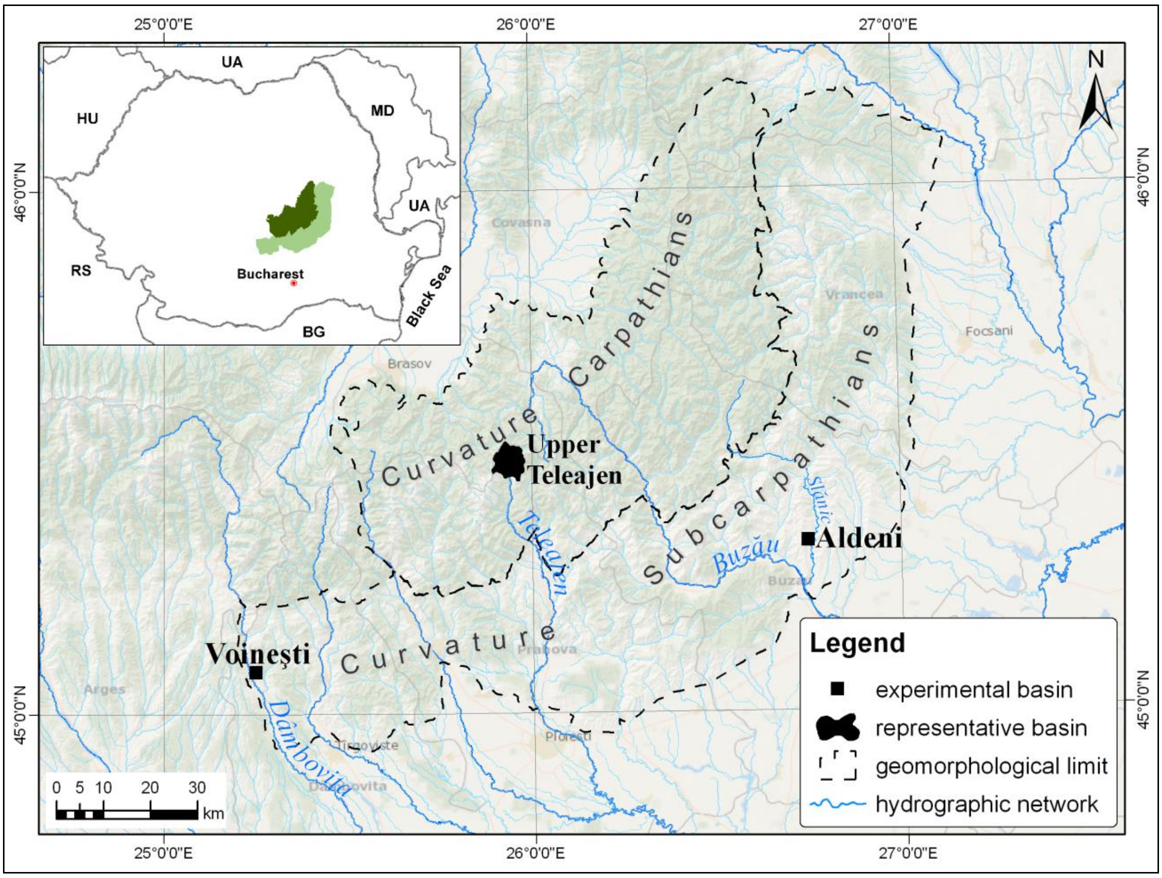

Fig. 1. Geographical location of ALDENI and VOINEŞTI Experimental Basin, respectively Upper Teleajen "CHEIA" Representative Basin (This figure was produced using ArcGIS 9.3)

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The research started around 1964, with the founding of the Station for Experimental Hydrology Voineşti, now called Voineşti Experimental Basin. Subsequently, in 1975, the research concerning the mechanism for the formation of slope discharge was extended to "Upper Teleajen" in the hydrographic basin of the Telejean River, and since 1984 to Aldeni (Mustaţă, 1980; Miţă, 1996). On the basis data obtained from these research units, especially those related to deterministic models numerous studies were published: Blidaru (1970); Diaconu & Crăciun (1973); Petrescu (1974); Blidaru et al. (1980); Mustaţă (1980), Stanciu & Zlate (1988); Zlate (2000), Stanciu (2002).

ALDENI EXPERIMENTAL BASIN

Within the Aldeni Experimental Basin, the micro-scale study of hydrological elements of the water balance is conducted with equipment of observation that allows an estimation of the physiographic influences in the region (geomorphic, climatic, soil and anthropic intervention: anti-erosion landscaping with terraces and orchard plantations).

Historical and Geographical background

In order to experimentally research at micro-scale the hydrological impacts of soil erosion, the National Institute of Hydrology and Water Management (NIHWM), has founded in 1984 the Aldeni Experimental Basin (AEB). Studies in the AEB are part of the hydrologic comprehensive research initiated since 1980.

In 1980, the first field explorations were conducted, and between 1981 and 1984, in collaboration with the present-day University of Agronomic Sciences and Veterinary Medicine of Bucharest, soil improvement activities were initiated (terracing, artificial rill and orchard planting), in order to assess, finalize and certify the basin. Anthropic interventions conducted by AEB in the area allowed the determination of the values of liquid and solid discharge in a modified anthropic regime.

In terms of geomorphology, AEB is situated within the Curvature Subcarpathians (45°19'30"N latitude and meridian 26°44'43"E longitude); a region characterized by accentuated erosion of the soil - especially in the eastern part (Mociorniţă & Birtu, 1987; Zaharia et al., 2011; Costache et al., 2014), and the catchment covers a surface of 0.6 sq km.

The altitude of the basin varies between 238 m a.s.l. and 411 m a.s.l., with an average of 331 m. Hydrographically, it is part of the Slănic River Catchment, a left-side tributary of the Buzău River. The landscape presents torrential formations of different stages: rills, ephemeral gullies, gullies. The main drained erosion formation created by rain water from the basin is the "Valea cu Drum" gully (partially channelized), which flows towards the Slănic River. The closure hydrometric station (hs) "Sondă" (Fig. 2; Tab. 1) is situated on this gully channel (up to 2 m deep).

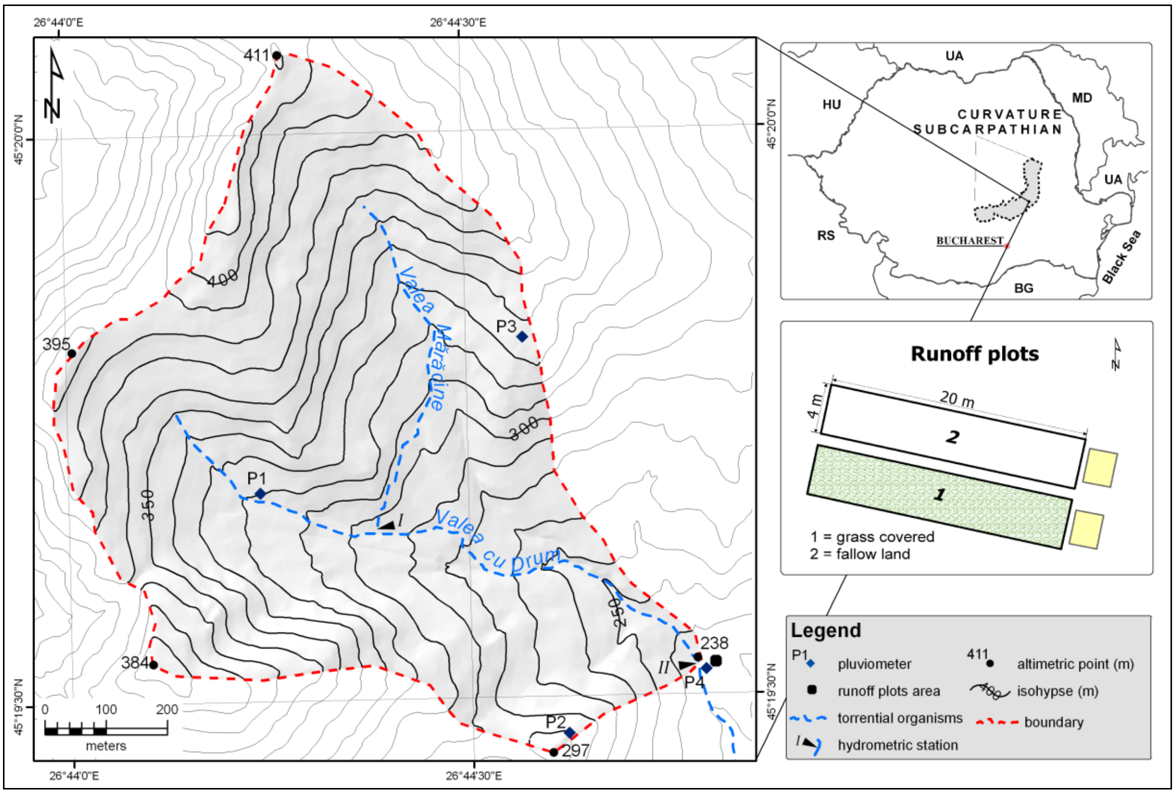

Fig 2. The Aldeni Experimental Basin and its location in Romania and runoff plots scheme (This figure was produced using ArcGIS 9.3)

The climate of the region is moderate temperate-continental and is characterized by foehnal influences with a mean annual precipitation of 565 mm, respectively mean annual temperature of 10.5 °C (for the period 1984-2013).

On runoff plots, the soils "aluviosol coluvic", generally have clay content (33%) into humus (3.28%), the phosphorus (24%) and ph=7.2 - a neutral reaction - mildly alkaline (Muşat, 2006; Radu et al., 2010). Actual landuse is in decline (typical perennial grass), due to partial abandonment and/or unproductive land; the land use influences the genetic processes of overland flow, as the degradation of the soil improvement activities (such as: abandoned agricultural terraces; gullies clogging) determines the appearance of diffused (lamellar) discharge of water currents through rills, ephemeral gullies and gullies.

MONITORING THE ELEMENTS OF THE WATER BALANCE

Hydrological monitoring and experimental investigations at micro-scale in AEB's are oriented towards: (a) determining parameters of water balance equation, during natural and simulated rainfall, (b) research of runoff genetic and soil erosion processes and (c) transfer relation of runoff coefficients form a small scale to medium scale. The AEB hydrological observations program includes: observations and measurements involving 2 observers (a Hydrometer and a Hydrological Technician) and a continuous recording of data related to major elements in the water balance (such as water level, rain etc.), by using both classic measurement instruments (e.g. limnigraphs, pluviograph, thermograph), as well as modern sensor technology.

Equipment used in observations

Hydrometric equipment is meant for measuring the principal elements of water balance equation and consists of calibrated flumes, runoff plots, pluviometric networks and a rainfall portable simulator with nozzles. The instruments are distributed as follows:

(i.) on torrential formations (gullies) 2 hydrometric stations „Mărăcine" and „Sondă" were established (Tab. 1) with calibrated flumes, which allow the determination of water discharges on the basis of limnimetric keys; from a hydrological standpoint, the hydrologic regime through the drainage system containing erosion formation - rills and gullies – is temporary; the process of formation and transit of water resources and suspended sediment load reflects: the pluvial regime (frequency, depth, duration and intensity) and the actual landuse (degraded terracing, storm drains/ditches clogged and filled with hay and pasture land);

Table 1. Data on the hydrometric stations from the AEB

Hydrometric station	A (sq km)	H (m)	I (%)	FR (%)
Mărăcine	0.14	356	25.8	9
Sondă	0.60	331	23.3	12.2

A = area; H = average altitude; I = average catchment slope; FR = forest ratio.

Data source: data obtained by processing topographical plans (scale 1:2000) corroborate with the orthophotos (scale 1:5000).

(ii.) on the premises of the station, 2 runoff plots were set up, according to the requirements and design described by Mutchler (1963), Toebes & Ouryvaev (1970); these have an area of 80 sq m, 5.6% average slope, WNV-ESE aspect; one of them is covered with grass (nr. 1), while the other is „fallow land" (nr. 2) and devoid of grass through digging and grass removal and the structure of the first soil horizon measuring 20 cm is modified from that of the first runoff plots, which led to a higher degree of infiltration compared to the first (Fig. 3.A); the runoff plots are provided with boundaries (concrete walls), collection channels composed of gutters, underground pipes, and at their lower part there are shelters containing metal tanks water removal installations; flow rates from runoff plots are measured with the help of the mechanic limnigraph and automatic flow measurement device; automatic and continuous recordings of the water drained from the parcels into tanks is done by means of a limnigraph (Valdai model), with daily change of diagram (limnigrama), which permits the recording of any change (volumetric method and variation in spillway) of the water level collected in the tank (that has a capacity of 0.46 m^3); the limnigraphs record the variation in water levels both inside the tank with the help of a floater and also at the spillway; tanks have a spillway with an opening at 45° (Fig. 3.B); the water discharge calculation is done through the partial volumetric method (through division), the relationship being Q=f(H); also, water level measurements are conducted with the help of sensors (pressure sensors); soil temperature and soil moisture are measured (Fig. 3.A);

(iii.) the portable rainfall simulator with nozzles is used for the studies concerning runoff; this tool generates artificial rains with a controlled depth, intensity and duration;

(iv.) in the basin, one can find a pluviometric network consisting of 4 pluviometers, while on the premises of the stations there are: one combined pluviometric - pluviograph and 2 sensor pluviometers (Fig. 3.A).

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Fig. 3. Runoff plots "kept fallow" (A) with pluviometer (up) and sensors for determining soil temperature and soil moisture (down), and shelter house (B) provided with tanks, limnigraph and level sensor

Hydrological Monitoring

The observation and measurement program at AEB is carried out following the instructions and standard guidance of the NIHWM, e.g. A guide for the activity in the representative and experimental basins, Volume IV (Adler & Minea, 2014). The instructions and guidebooks are made in accordance with the recommendations of Toebes & Ouryvaev (1970), Technical regulations, Volume III (WMO, 2006) and Guide to Hydrological Practices, Volume I (WMO, 2008). According to WMO (2006), this falls in the "*hydrological stations for specific purposes*" category, and the observation program is typical for a hydrometric station and for *„climatological stations and precipitation stations for hydrological purposes"*. The complex observations, measurements and samplings are conducted at hydrological and climatologic terms (Tab. 2), thus:

a) at the hydrometric station, observations (evaluated subjectively) follow river stage at staff gauge and water turbidity (depending on rainfall and runoff magnitude); concerning the measurement of water turbidity (ρ), this is done through the "filtering method"; the procedure consists of collecting water samples (500 ml) from tanks - for runoff plots, their filtering and their oven drying, followed by the calculation of associated sediment losses, after one rainfall;
b) at the runoff plot scale, observations during natural and simulated rainfall events and following water depth and water turbidity at 2 runoff plots; soil temperature and soil moisture are also measured on runoff plots by using radiological waves (Fig. 3.A);
c) at the meteorological platform, the observed parameters are: precipitations (amount, time of occurrence, intensity at pluviometers and pluviograph); air temperature (thermograph); air humidity (hygrograph); wind; snow cover (movable snow stake and weighing snow sampler); soil temperature (with liquid-in-glass thermometer at 0.20 m) and soil moisture (in the top layer 0.02 m down to 0.40 m depth), directly (gravimetric).

Hydrological Data Acquisition and Transmission

The current modernization of the process of observation, collection and recording of the elements necessary for a quantitative estimation of the water balance equation, involves the renewal and replacement of out-dated equipment and instruments with modern equipment. The newest pieces of equipment acquired are: (1) an automatic weather station (temperature sensor, wind vane, cup anemometer); (2) for measuring height, quantity and the intensity of the rainfall, we are currently using sensor pluviometers with tilting cups, connected to a data-logger and powered by the 220V network; (3) temperature sensor; (4) sensors for the measurement of soil humidity (Fig. 3.A), which directly measure the apparent dielectric permittivity and indirectly measure this parameter with the Topp equation for determining volumetric humidity.

The measurements of the hydro-meteorological elements in automatic system, using the sensors, are nowadays used to compare the results with those from the classical systems for instruments' calibration.

The modernization process concerns: data acquisition (at hourly intervals), storage, data transfer; terminal emulation, numeric output and export functions. Transmission of hydro meteorological data is conducted though the Global System for Mobile Communications (GSM) to the NIHWM server or is downloaded from a data-logger directly on a portable PC. Data transmitted through GSM from AEB is consulted for the required time interval (*time taken and finish time*) and can be viewed online in table form (such as: browser grid/data table/plain/fancy; spreadsheet .xls/zip) and downloaded (Fig. 4).

Table 2. Observational and measured aspects of principal hydrological elements

Nr. crt	Hydrological elements	Observing station[1]	Determined characteristics
1	air temperature	meteorological platform[2]	daily reading of maximum and minimum value of ordinary thermometer, at hourly climatologic terms 7, 13 and 19h; deciphering thermograms with hourly and extreme values;
2	air humidity		deciphering hygrograms concerning hourly and extreme values
3	rain	- collected in 4 pluviometers (3 distributed in the basin and one at the weather platform afferent to the station* - measured and recorded with 1 the pluviograph (no. 4) and 2 sensor pluviometers situated on the weather platform	measurement of collected quantity/water strata (7 and 19h) and the computation of quantity/24h collected depth; deciphering pluviograms and the calculation of depth, duration and intensity
4	snow cover	triangular plot (10 m) snow-gauge profiles (860 m and 560 m)	snow thickness and snow density (on the 5th, 10th, 15th, 20th, 25th and last day of month) and water equivalent snow depth;
5	soil moisture	adjacent to the pluviometer no. 4	sampling, oven method and calculations for samples taken from depths 2, 10, 20, 30 and 40 cm (on the 5th, 10th, 15th, 20th, 25th and last day of month);
6	wind	meteorological platform	daily observations at hourly climatologic terms (7, 13 and 19h), concerning speed and direction of wind;
7	water	*„Mărăcine”* (I)** and *„Sondă”* (II)** hydrometric stations	daily reading (6 and 18h) of water level at the staff gauge; supplementary reading during floods;
		runoff plots	limnigraph deciphering and calculation of water depth and volume;
8	water turbidity	„Sondă” hydrometric station and at runoff plots	sampling, oven drying and calculations for samples taken during the water discharge;

[1] - place for measurement/collection/sampling; [2] - climatological station for specific purposes; * - See location on map - *Fig. 2* **- to be seen *Fig. 2.*

DateCurenteAldeni :: FDB_BHExperimental :: Sep 5, 2014 1:34:05 PM

Data inceput interval:2014-08-23 13:33
Data sfarsit interval:2014-08-25 13:33

IDMAS	IDMESAJ	DATA ↓	TAER	TSUPRSOL	TSOL20CM	PRECIPITATIE	UMIDITATE	VITVANT	DIRVANT	SENZORH1	SENZORH2
34903	34903	2014-08-23 14:00:06.875	23.3	0	0	0	102.7	0.8	124	232	122
34904	34904	2014-08-23 15:00:28.468	24.1	0	0	0	102.7	0.2	6	234	122
34905	34905	2014-08-23 16:00:20.109	25	0	0	0	102.7	2.9	141	229	122
34906	34906	2014-08-23 17:00:11.375	25.3	0	0	0	102.7	0.4	118	229	124
34907	34907	2014-08-23 18:00:02.718	24.9	0	0	0	102.7	1.2	124	230	124
34908	34908	2014-08-23 19:00:24.484	24.1	0	0	0	102.7	0	17	229	124
34909	34909	2014-08-23 20:00:15.765	22.3	0	0	0	102.7	0	96	229	124
34910	34910	2014-08-23 21:00:07.64	20.6	0	0	0	102.7	0	39	229	123
34911	34911	2014-08-23 22:00:28.656	20	0	0	2.4	102.7	0	23	235	123
34912	34912	2014-08-23 23:00:20.437	19.8	0	0	2.4	102.7	0	28	230	123
34913	34913	2014-08-24 00:00:12.015	19.9	0	0	1.2	102.7	0	39	230	122
34914	34914	2014-08-24 01:00:03.609	19.8	0	0	4.8	102.7	0	68	240	122
34916	34916	2014-08-24 02:00:25.625	19.6	0	0	2.4	102.7	0	45	249	430
34915	34915	2014-08-24 02:00:25.625	19.6	0	0	2.4	102.7	0	45	249	430
34917	34917	2014-08-24 03:00:17.171	19.1	0	0	0	102.7	0	68	256	716
34918	34918	2014-08-24 04:00:08.687	19.2	0	0	0	102.7	0	23	256	722
34919	34919	2014-08-24 05:00:30.468	19.4	0	0	0	102.7	0	62	256	762
34920	34920	2014-08-24 06:00:21.515	19.3	0	0	0	102.7	2.6	129	256	718
34921	34921	2014-08-24 07:00:13.703	16.5	0	0	33.6	102.7	0	73	288	718
34922	34922	2014-08-24 08:00:05.078	15.8	0	0	2.4	102.7	0.3	28	305	230
34923	34923	2014-08-24 09:00:26.484	16.3	0	0	1.2	102.7	0	45	303	183
34924	34924	2014-08-24 10:00:17.953	19.3	0	0	0	102.7	0.9	56	304	184
34925	34925	2014-08-24 11:00:09.078	22.1	0	0	0	102.7	0.4	113	305	186
34926	34926	2014-08-24 12:00:30.718	22.1	0	0	0	102.7	0.6	51	305	187
34927	34927	2014-08-24 13:00:22.64	24.3	0	0	0	102.7	0	135	306	188
34928	34928	2014-08-24 14:00:14.187	25.8	0	0	0	102.7	0.4	248	307	189

Fig. 4. Interface capture image of hydrological elements registered between 14:00, 23.08.2014 and 14:00, 24.08.2014

Data processing, quality control and storage

Periodically (at the end of each month and year), after data collection – usually checked by a Hydrological Technician - in printed work format and electronic format (Excel format), the data are used for the hydrologic process of verification and expertise (data quality control). Afterwards, following positive solutions (validations), the data are stored in the database. Data are used and disseminated through: relations updates (e.g. rainfall-runoff); multiple correlations to reflect the role of various factors, research themes/projects; yearbooks of basic data (Experimental Basins Yearbook) and scientific papers.

CONCLUSIONS AND PERSPECTIVES

Aldeni Experimental Basin is a research unit equipped with hydrometric instruments for the conduct of experimental hydrological studies. Hydrological monitoring is currently undergoing a process of modernization due to the appearance of new tools based on sensor and electronic data transfer technologies.

The valorization of data acquired allows the realization of studies, at micro-scale concerning the determination of the elements that make up the equation for water balance, in order to expand the application of the relation between runoff coefficients form a small scale to a medium scale.

The future plans involve implementing research projects on subjects related to rainfall, runoff and sediment transport modeling, in order to substantiate the relationship between drainage and genetic and conditional factors.

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References

Adler, M-J & Minea, G. (2014). Îndrumar pentru activitatea bazinelor reprezentative şi experimentale, Volume IV, Institutul Naţional de Hidrologie şi Gospodărire a Apelor, Bucureşti, ISBN-978-606-93776-3-5, pp. 34.

Becker, A., & Nemec, J. (1987). Macroscale hydrologic models in support to climate research. The Influence of Climate Change and Climatic Variability on the Hydrologie Regime and Water Resources, pp. 431-445.

Blidaru, S. (1970). Prime rezultate privind formarea scurgerii din ploi pe baza activităţii staţiei Hidrologice Experimentale Voineşti, *Studii de hidrologie, XXVIII*, Extras, Institutul de Meteorologie şi Hidrologie, Bucureşti.

Blidaru, S., Drăgoi, E. & Stanciu, P. (1980). Mathematical modelling of overland runoff under various physiographical conditions and for certain agricultural uses. *The influence of man on the hydrological regime with special reference to representative and experimental basins. Proceedings of the Helsinki Symposium,* IAHS-AISH Publ. no. 130.

Costache, R., Fontanine, I. & Corodescu, E. (2014). Assessment of surface runoff depth changes in Sărăţel River basin, Romania using GIS techniques. *Central European Journal of Geosciences*, 6(3), 363-372.

Diaconu, C. & Crăciun, S. (1973). Rezultate obținute în studiul formării scurgerii cu ajutorul trasorilor radioactivi, Studii de hidrologie, XXXV, Institutul de Meteorologie şi Hidrologie, Bucureşti.

Ferreira Moreira, L.F., de Oliveira Silva, F., Chen, S., de Almeida Andrade, H.T., Tavares da Silva, J.H., Marozzi Righetto, A., 2011, Plot-Scale Experimental Studies. *In Soil Eros Stud*, 7, 151-166.

Garcia, G., Hickey, W.C., & Dortignac, E.J. (1963). An inexpensive runoff plot (Vol. 12). *Rocky Mountain Forest and Range Experiment Station,* Forest Service, US Dept. of Agriculture.

Hopmans, J. W. & Pasternack, G. (2006). Experimental hydrology: A bright future, *Advances in Water Resources,* 29(2), 117-120.

Hudson, N.W. (1993). Field measurement of soil erosion and runoff, FAO Soils Bulentin, Vol. 68, Roma.

Linsley, R.K. (2009), Representative and experimental basins where next, *In Hydrological sciences bulletin,* 21:4, 517-529.

Lvovich, M.I. (1965). Experimental soil-hydrologic water-balance investigations, International Association of Hydrogeologists, International Association of Hydrological Sciences, FAO.

Muşat, M. (2006), Studiul solurilor afectate de eroziune din zona colinară a bazinului hidrografic Slănic - Buzău în vederea stabilirii măsurilor de ameliorare şi stăvilire a procesului de eroziune, Teză de doctorat, Universitatea de Ştiinţe Agronomice şi Medicină Veterinară Bucureşti, Facultatea de Agricultură, Bucureşti.

Miţă, P. (1996), Representative Basins in Romania, National Institute of Meteorology and Hydrology, Bucharest.

Mociorniţă, C. & Birtu, E. (1987). Unele aspecte privind scurgerea de aluviuni în suspensie în România, Hidrotehnica, Vol. 32, No. 7, pp. 241-245.

Mustaţă, L. (1980). Prime rezultate de la staţiile hidrologice experimentale şi din bazine reprezentative, Studii şi cercetări, Hidrologie, XLIX, Institutul de Meteorologie şi Hidrologie, Bucureşti.

Mutchler, C.K. (1963). Runoff plot design and installation for soil erosion studies. ARS 41-79, Agricultural Research Service, U.S. Department of Agriculture, National Agricultural Librar.

Petrescu, M. (1974). Stabilirea de relaţii între ploaie-infiltraţie, scurgerea lichidă şi solidă pe suprafeţe reduse de versant, *Studii de hidrologie, XLII (Extras).* Institutul de Meteorologie şi Hidrologie. Bucuresti.

Radu, A., Muşat, M., Parvan, L., Urzică, C., & Sevastel, M. (2010). Assessment, by Soil Survey, of Condition of Soil Fertility And Identification of its Natural And Human Limiting Factors in The Cernăteşti-Manasia Interbasinal Area, Buzău County. Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series, 40(1), 547-552.

Schumann, S., Schmalz, B., Meesenburg, H. & Schröder, U. (2010). Status and Perspectives of Hydrology in Small Basins. Results of the International Workshop in Goslar-Hahnenklee, 2009 and Inventory of Small Hydrological Research Basins., IHP/HWRP-Berichte 10, Koblenz.

Stanciu, P. (2002). Mişcarea apei pe versanţi permeabili, Editura HGA, Bucureşti.

Stanciu, P. & Zlate, I. (1988). Modelarea matematică a proceselor scurgerii în bazine experimentale şi reprezentative, Studii şi cercetări, Hidrologie 2, Institutul de Meteorologie şi Hidrologie, p. 17-32, Bucureşti.

Toebes, C., & Ouryvaev, V. (1970). Representative and experimental basins, An international guide for research and practice, A contribution to the International Hydrological Decade, United Nations Educational, Scientific and Cultural Organization, Paris.

WMO (2006). Technical regulations, Volume III, Hydrology, *2006 Edition*, *Basic Documents No. 2*, Suppl. No. 1 (I.2008), WMO-No. 49, Secretariat of the World Meteorological Organization, Geneva.

WMO (2008). Guide to Hydrological Practices, Volume I, Hydrology – From Measurement to Hydrological Information, No. 168, Sixth edition, Geneva.

Zaharia, L., Grecu, F., Ioana-Toroimac, G. & Neculau, G. (2011). Sediment transport and river channel dynamics in Romania–variability and control factors. *Sediment Transport in Aquatic Environments,* Eds. Andrew J. Manning, pp. 293-316.

Zlate, I. (2000). Distributed runoff modelling in small catchment. Catchment hydrological and biochemical processes in the changing environment Seventh Conference of the European Network of Experimental and Representative Basins (ERB), Liblice (Czech Republic), 22 - 24 September 1998, UNESCO, Paris.

*** (1964), Plan topografic, scara 1:5000, Consiliul Superior al Agriculturii, Secţia Fondului Funciar şi Organizarea Teritoriului, Bucureşti.

*** (2012), *Ortofotoplan, scara 1:5.000*, Agenţia Naţională de Cadastru şi Publicitate Imobiliară, Bucureşti.