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Cover photo: *The soil water balance plots, Voinești Experimental Basin, 2016 (photo Gabriel MINEA)*

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A Special Issue: Hydrological Behaviour In Small Basins Under Changing Conditions

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CONFERENCE OVERVIEW

The ERB (The Euromediterranean Network of **E**xperimental and **R**epresentative **B**asins) is an open association of 23 European countries operating and managing well instrumented experimental and representative basins for hydrological and environmental research on a long-term basis.

The main objectives of the network are: i) to establish and maintain relationships between member countries and research teams by means of information exchange, mobility and regular conferences; ii) to initiate and enable co-operation between members and other organizations; iii) to maintain a database of small research and experimental basins (Holko and Miklánek, 2003).

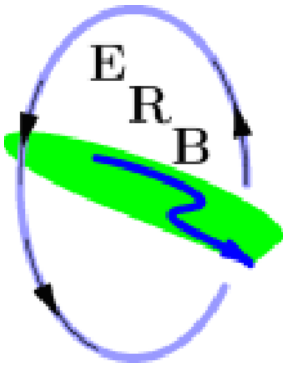

Fig. 1: Logo of the ERB - The Euromediterranean Network of Experimental and Representative Basins

In recent years, there has been an increasing interest in hydrological research in small catchments. Current evidence suggests that, only in well-defined small basins, where there are high-quality measurements, is it possible to investigate the complexities of combined physical, chemical, and biological processes (Holko et al., 2015). The scientific and practice importance of small catchments (hillslope, runoff plot), is recognized as a way (natural or simulated) to better understanding hydrological processes (e.g., runoff formation). According to previous source, Braunschweig Declaration (2009) showed that a strengthened network of hydrological research basins would help to facilitate the synthesis of research required to meet future challenges in water resources management in a changing environment.

Biennial Conference of ERB have a long tradition of 31 years. This special issue of the "Forum geografic. Studii de geografie şi protecţia mediului" (Geographical Phorum – Geographical Studies and Environment Protection Research), hosting the paper of *16th Biennial Conference ERB*.

The *16th Biennial Conference ERB* was held 5–8 September 2016 in Bucharest, Romania, and was hosted by National Institute of Hydrology and Water Management (NIHWM).

16th Biennial Conference ERB

The Conference was organized by National Institute of Hydrology and Water Management and the Romanian Association of Hydrological Sciences. Also, conference secured the support of National Administration "Romanian Waters"; International Association of Hydrological Sciences International Hydrological Program - UNESCO; Technical University of Civil Engineering - Bucharest; the University of Bucharest, Faculty of Geography.

The conference was opened by Daniela RĂDULESCU *Ph.D., Eng.* Director of the NIHWM, Romania and Gheorghe CONSTANTIN director of Department of Water Resources Management, Romanian Ministry of Environment, Water and Forests; Gianina NECULAU Ph.D. (NIHWM, Romania), organizer and actual national correspondent ERB; Marius MĂTREAŢĂ *Ph.D., Eng.*, president of the Romanian Association of Hydrological Sciences, and Hubert HOLZMANN, *Ph.D., Eng.*, ERB International Co-ordinator (2012-2016) co-chaired the Conference (Fig. 2).

The conference program focused on the theme "*Hydrological behaviour in small basins under changing conditions*". Eighty-four participants representing sixteen countries (Norway, Portugal, Italy, the Netherlands, Luxembourg, Germany, Austria, Poland, Czech Republic, Slovakia, Romania, Ukraine, Turkey, Iran, Lebanon and Brazil) attended the conference.

We have encouraged and sustained (free accommodation and reduced fee) for five PhD-students.

Over three days, sixty-one interesting presentations discussed a wide variety of topics: i) Assessing extreme natural events based on observed data from experimental and representative basins; Evapotranspiration and water circulation in small basin; ii) Water resources in small basins with changing land use; iii) Rainfall – runoff – relationship in small catchments under changing conditions; iv) Changes in water quality, aquatic ecology, sediment transport, and related issues. At the conference, *Prof.* João Pedroso de LIMA *Ph.D.*, *Eng.*, was welcomed as the new ERB International Coordinator (2016-2020).

Fig. 2: Collage of the photographs taken at the 16th Biennial Conference ERB, 2016

A total of 74 abstracts were compiled in the Book of Abstracts: "HYDROLOGICAL BEHAVIOUR IN SMALL BASINS UNDER CHANGING CONDITIONS", of which 38 corresponded to oral and 23 to poster contributions. The Book of Abstracts also included General information on ERB, Organization the 16th Biennial Conference ERB 2016, Technical visit and Abstracts, and is available here[1].

Stimulating discussions abounded and the interest of the contributors for hydrology (small basins) was obvious. The conference was completed by a notable fieldwork day at the Voinești Experimental Basin - 7 September 2016. Fifty-four delegates participated in this fieldwork. Film footage of the conference and snapshot picture can be viewed or downloaded from web site conference[2].

Papers presented

In 2015, Holko et al. published a paper in which they described previous ERB conference (http://www.ci.uc.pt/imar/erb2014/), and summarizing paper contributions submitted to the Journal of Hydrology and Hydromechanics. Continuing this precious initiative we found a journal *"Geographical Phorum - Geographical studies and environment protection research"*, for includes contributions presented at the ERB 2016 conference.

Therefore, this special issue contains papers presented at the conference and submitted for inclusion in the Special Issue: *"HYDROLOGICAL BEHAVIOUR IN SMALL BASINS UNDER CHANGING CONDITIONS"*. Each manuscript submitted was assigned to one of the ERB Editorial Advisory and Review Board. The Editor's decision regarding publication is based on the assessments and reports of independent referees. The thirteen papers contained a variety of hydrology subjects. A short statement on each paper is as follows:

i) in their contribution, **Abrantes et al.** evaluate the applicability of an infrared thermography technique relying on cooling the soil surface with cold water for assessing soil water repellency (SWR) severity under field conditions; results of this study

[1] - http://media.wix.com/ugd/aaa9d1_e330d6c4066845618223dcc6af6e0c77.pdf
[2] - http://www.erb2016.com/conference-snashots

suggest that is worthwhile to explore this technique; only extensive testing can, in fact, validate the technique and reveal its suitability under different field conditions (e.g., surface roughness, surface cover, spatial scale);

ii) **Budzisz and Cieśliński** estimated the effect of changes in groundwater level on selected plant communities in wetland areas (Piaśnickie Łąki); the paper provides a detailed hydrographic analysis of wetland areas including information on water migration pathways, water recharge systems and sources of water loss;

iii) **Osypov et al.** presents results for the analysis conducted on nutrient loads to the river from the non-point sources in the small agricultural Holovesnya River Catchment (Ukraine), by means of hydrological process-based SWAT model; acceptable results were achieved for nitrogen and phosphorus loads;

iv) in their contribution, **Neculau and Stan** provide a valuable information about evaporation and evapotranspiration rates in Romania; their work can be used for determining indirectly evaporation and evapotranspiration rates at the micro-scale: on a multi-year period, evaporation ranged from 300 mm - 800 mm/year, with the highest values recorded in the south east of the country and the Danube Floodplain (over 1,000 mm/year), western part (over 800 mm/year) and the lowest values registered in the mountain areas (less than 400 mm/year); evapotranspiration vary between 300 mm/year and 625 mm/year, with a maximum of over 650 mm/year in the plains and a minimum of less than 300 mm/year in the mountains;

v) the paper by **Mătreaţă et al.** presents an integrated approach for preparation of flash flood hazard maps using different threshold values and indices methods; the methods are based on the influence of the main physical-geographical factors on the rainfall-runoff processes; authors conclude that the methodology, is a robust approach suitable for the first general assessment of flash flood hazard determination in small basins and it can be applied to large areas;

vi) **Caloiero et al.** evaluate experimental the role of forests in the hydrological processes which occur in a headwater basin draining a Calabrian pine forest (*Pinus laricio* Poiret); results of this work evidenced the effect of a silvicultural practice on the runoff response thus showing that an appropriate forest management can have a key role in water management at basin scale;

vii) **Roel and Lisette** investigate with field experiments hydrologic parameters in the small basaltic aquifers and modelling water transport on Skaftafellsheiði (Iceland); the authors detect that: quick discharge response on rainfall events, but also rather constant base flow during dryer periods when discharge observations in streams are combined with groundwater head observations, it is possible to calibrate a rather simple groundwater flow model and obtain reasonable hydraulic conductivity values for the basalt layers; the model layers do not reflect single basalt layers of sub-aquifers, but represent multiple flows and thus resemble representative elementary units;

viii) **Mocanu et al.** analyse some of the decision factors when you are faced with decisions related to how to construct a water-management Information and Communication Technologies (ICT) support tool; Mocanu et al. suggest that that data processing related research directions that need strong ICT support are very demanding in our days, considering the variety and complexity of the research field, and the necessity of targeted, specialized research teams, able to deal with different perspectives, but with deep expertise in one of them;

ix) a contribution by **Osadcha et al.** deals with field experiments about peculiarities and establish quantitative parameters of leaching of organic matter of humic nature and iron from the wetlands, as well as to evaluate the role of certain processes influencing the migration of iron with the river runoff; the research was conducted at the experimental base (small runoff plot) of the Ukrainian Hydro-Meteorological Institute, located in the forest-steppe zone of Ukraine (Boguslavka River); during the snowmelt, exclusively a subsurface runoff was formed; the values of distribution characteristics of two main fractions of humic substances - humic and fulvic acids - between the solid phase of peat and water runoff were obtained; a methodology has been proposed to predict emission of humic substances and iron into water runoff of the Pripyat River;

x) **Kulasova et al.** paper discusses the influence of extreme rainfall on flow, soil moisture, nutrients, and tracer pathways in two agricultural experimental sites: Královský and Smržovský (Jizera Mountains, Czech Republic); the authors use several field experiments both on a meadow and in forest with sprinkling and runoff plots; the results correspond to results from rainfall-runoff events, when extreme rainfall causes the wash off of the soil into the stream; the change in Olsen P on the pasture slope was less than 1 mg/kg of dry matter of soil while on the catchment used for crops it was larger than 10 mg/kg;

xi) **Krammer** et al. evaluate performance of the HYDROBOD - obtaining a GIS - based hydrological soil database and a runoff coefficient calculator for Lower Austria; in the State of Lower Austria, it is an acknowledged method to use rainfall-runoff models when estimating flood peak discharges for small catchments where there are no direct gauging observations; the project HYDROBOD intends to provide a solid and homogeneous database of some

basic soil hydraulic parameters over the whole state area (over 19,000 km²) and contains a hydrological model for estimation of these runoff coefficients which takes into account some relevant input variables; in a first step (HYDROBOD I), hydraulic soil parameters are calculated by regionalization methods and assembled for the whole area of Lower Austria, using a GIS-database (50 x 50 m^2) and in a second step (HYDROBOD II), a vertical one-dimensional event model was set up which allows to calculate storm event runoff coefficients on a cell-by-cell basis for any given area in Lower Austria.

xii) **Cieśliński et al.** present results from quantity of wastewater entering the Gulf of Gdańsk - which is part of the Baltic Sea and identify main determinants potentially affecting water quality in rivers flowing across the city of Sopot; investigation has shown that none of the 6 studied rivers experienced concentrations of total nitrogen above the norm accepted in Poland for Class 1 water quality (5 $mg \cdot dm^{-3}$); the 6 small rivers discussed in this paper contribute 0.002% of the biogenic load supplied to the Baltic Sea by Poland as a whole; the annual load supplied by all 6 rivers in the Sopot city area during the study period was ~4,300 kg for total nitrogen and ~370 kg for total phosphorus;

xiii) **Minea et al.** examine the temporal rainfall properties at events scale in the Curvature Subcarpathians at Voinești Experimental Basin (Romania), during in the warm semester (the period between 1 April and 30 September; 1980-2010); rainfall events was characterized by small depth (up to 15.7 mm; up to 90^{th} percentile) ~ 93%, and they were concentrated (34.4%) in May; almost half of rainfall events (48.2%), had short duration (up to one hour) and the smallest depth (95% confidence interval, 3.85–4.56 mm), while those with durations longer than 5 hours (10.5%) were specific the September (22.5%); regarding maximum intensities of rainfall events just 16 events exceeding 1 mm/min (0.86%), which denote insignificant occurrence - encountered phenomenon in all months, especially in August - and mild torrential character.

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We hope you enjoy this Special Issue.

References

Abrantes, J.R.C.B., de Lima, J.L.M.P., Prats, S.A., & Keizer, J.J., Field assessment of soil water repellency using infrared thermography. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Budzisz, M. & Cieśliński R., Effect of changes in groundwater levels on selected wetland plant communities. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Osypov, V., Osadcha, N. & Osadchyi, V., SWAT model application for simulating nutrients emission from an agricultural catchment in Ukraine. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Necualu, G. & Stan, F.I., Evaporation and evapotranspiration in Romania. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Mătreaţă, M., Mătreaţă, S., Costache, R.D., Mihalcea, A., & Manolache A.V., Assessment of flash flood hazard maps using different threshold values and indices methods. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Tommaso, C., Corrado, B., Giovanni, C., Alessio, C., Raffaele, F., Mauro, M., GIORGIO, M., Gaetano, P., & Antonella V., Results of a long-term study on an experimental watershed in southern Italy. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i i

Roel, D., & Lisette, A., Measuring and modeling water transport on Skaftafellsheiði, Iceland.

Forum geografic, XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Mocanu, M., Cristea, V., Dobre, C., & Pop, F., Smart Data for ICT-based Water Management. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Osadchyi, V., Guzienko, I., Nabyvanets, Y., & Artemenko, V., Field Experimental Studies of the Leaching of Humic Substances from the Peat Soils and Estimation of their Role in Dissolved Iron Transportation. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Kulasova, A., Blazkova, S.D., & Parma, P., The Influence of Extreme Rainfall on Flow, Soil Moisture, Nutrients and Tracer Pathways. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Krammer, C., Klebinder, K., Eder, A., Sotier, B., Strauss, P., & Bauer, T., HYDROBOD: obtaining a GIS-based hydrological soil database and a runoff coefficient calculator for Lower Austria. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Cieśliński, R., Pietruszyński, Ł., Budzisz, M., Ossowska, A., & Olszewska, A., Pollution load released into the Bay of Gdańsk by small river catchments in the coastal city of Sopot in northern Poland. *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Minea, G., Iliescu, M., & Dedu F., Temporal rainfall properties at events scale in the Curvature Subcarpathians (Romania). *Forum geografic,* XV(Suppl. 1), 2016 (in press), DOI: 10.5775/fg.2016.070.i

Holko, L., Holzmann, H., Lima, M.I.P., & de Lima, J.L. (2015). Hydrological research in small catchments–an approach to improve knowledge on hydrological processes and global change impacts. *Journal of Hydrology and Hydromechanics, 63*(3), 181-182.

Holko, L., & Miklánek, P. (2003). *Interdisciplinary approaches in small catchment hydrology: Monitoring and research.* Proceedings. IHP-VI, Technical Documents in Hydrology, No. 67 UNESCO, Paris.

Minea, G., Pătru G., & Neculau G. (Eds), Book of Abstracts - HYDROLOGICAL BEHAVIOUR IN SMALL BASINS UNDER CHANGING CONDITIONS, (2016), Editura Didactică şi Pedagogică, Bucureşti, ISBN: 978-606-31-0297-4. http://media.wix.com/ugd/aaa9d1_e330d6c4066845618223dcc6af6e0c77.pdf

ERB website: http://erb-network.simdif.com/

The 15th Biennial Conference ERB2014, website conference: http://www.ci.uc.pt/imar/erb2014/

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Field Assessment of Soil Water Repellency Using Infrared Thermography

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Abstract

This study aimed to evaluate the applicability of an infrared thermography technique relying on cooling the soil surface with cold water for assessing soil water repellency (SWR) severity under field conditions.
This study is a follow-up of earlier exploratory small-scale laboratory tests, where SWR spatial variability was mapped and repellent areas could be clearly detected on the thermal imaging due to their higher temperatures, thus distinguishing them from the remaining wettable areas.
Field tests were carried out, where both natural and artificial SWR were mapped through thermal imaging, using a portable infrared video camera. Cold water was used to create a temperature gradient on the soil surface in order to assess SWR.
Naturally repellent soils were found in a pine and eucalyptus forest and artificial SWR was induced with a waterproofing spray.
The molarity of an ethanol droplet (MED) test was used to measure both natural and artificial SWR severity.
The technique was, in overall terms, successful in mapping SWR spatial variability, distinguishing repellent from wettable areas as well as distinguishing different levels of SWR severity.
Only extensive testing can, ultimately, validate the technique and reveal its suitability in different field conditions (e.g., surface roughness, surface cover, spatial scale).

Keywords: *soil water repellency, infrared thermography, field tests*

Rezumat. Evaluarea în teren a impermeabilităţii apei în sol utilizând termografia în infraroşu

Acest studiu a avut drept scop evaluarea utilizării unei tehnici de termografie în infraroşu, bazându-se pe răcirea suprafeţei solului cu apă rece, pentru a evalua impermeabilitate hidrică a solului (SWR) în condiţii severe de teren. Acest studiu este o continuare a testelor de laborator anterioare de explorare la scară mică, în care variabilitatea spaţială a SWR a fost cartata, iar zonele de respingere a putut fi detectate în mod clar pe imagini termice datorită temperaturilor lor mai mari, ceea ce a permis distingerea de perimetrele umectate. Testele de teren SWR au fost efectuate, în regim natural cat şi artificial, iar cartografierea s-a efectuat prin imagistică termică, cu o camera video portabila în infraroşu. Apa rece a fost folosit pentru a crea un gradient termic pe suprafaţa solului, în scopul de a evalua SWR. În mod natural, soluri hidrofuge au fost găsite într-o pădure de pin şi eucalipt şi SWR artificiala a fost indusă cu un spray pentru impermeabilizare. Molaritatea unui test de etanol a picăturii (MED) a fost utilizata pentru a măsura severitatea SWR atât natural şi artificiala. În termeni generali, tehnica a fost un succes si a permis cartarea variabilităţii spaţiale a SWR, diferenţierea perimetrelor hidrofuge de cele zone hidrofile precum şi niveluri distinctive de severitate diferită a SWR. Numai testare extinsă poate, în cele din urmă, să valideze tehnica şi sa dezvăluie caracterul adecvat în condiţii diferite de teren (de exemplu, rugozitate de suprafaţă, acoperirea terenului, scară spaţială).

Cuvinte-cheie: *impermeabilitate hidrică a solului, termografiere în infraroşu, testele de teren*

Introduction

Soil water repellency (SWR) is recognized as a key hydrological and geomorphological process since the earlier part of the 20th century. However, first observations of this phenomenon were reported in the later part of the 18th century (DeBano, 2000, Doerr et al., 2000). SWR is a major concern to hydrogeologists and land managers since it can alter infiltration and solute transport into the soil, enhancing surface runoff and associated erosion and affecting seed germination and plant growth, triggering land degradation processes (Keizer et al., 2005a; Leighton-Boyce et al. 2007; Ritsema and Dekker, 1994; Shakesby et al., 1993).

SWR is originated by the coating of soil particles with hydrophobic organic substances usually released by plants or decomposing plant material (Dekker and Ritsema, 1994; Keizer et al., 2005b). Repellent soils have been found in fire affected forest lands (Badía-Villas et al., 2014; Keizer et al., 2008; Mataix-Solera and Doerr, 2004), but also in pine and eucalypt forest lands not affected by fires and in agricultural lands with high soil organic matter content (Doerr et al., 2000, Keizer et al., 2007, Santos et al., 2013).

One of the most commonly used technique to measure SWR is the Molarity of an Ethanol Droplet (MED) test (Letey, 1969), which measures the surface tension between an ethanol solution and the soil surface to indirectly determine how strongly the water is repelled. It provides quantitative data, but the subsequent classification or characterization of