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65th Anniversary of the Institute of Hydrology, Slovak Academy of Sciences

The Institute of Hydrology, Slovak Academy of Sciences is one of the Journal of Hydrology and Hydromechanics co-publishers and in this year celebrates its 65th anniversary. For this reason I afford, as the Director of the Institute of Hydrology, to write some words about the history of our institution and the history of the journal, as well.

The necessity to understand basic laws of water cycle as a precondition to improve water management of Slovakia was the reason of establishing the Institute of Hydrology, Slovak Academy of Sciences (SAS), 65 years ago. The resolution of the Presidium of the Slovak Academy of Sciences in 1953 established the institute as the Water Management Laboratory of SAS. Founder of the Institute – and its first director – was Prof. Dr. Oto Dub. Since then eight people have held the position of director of the Institute. There are: Prof. E. Mäsiar (1963–1974), Prof. M. Dzubák (1974–1981), Prof. J. Benetin (1981–1990), Dr. K. Kosorin (1990–1991), Dr. J. Šútor (1991–2004), Dr. V. Štekauerová (2004–2012), Dr. P. Pekárová (2012–2016) and me (2016-up to now).

The aim of the Water Management Laboratory of SAS was to develop theoretical hydrology and solution of actual problems related to surface and subsurface water. In 1959 the Water Management Laboratory was renamed (again by the resolution of the Presidium of SAS) to the Institute of Hydrology and Hydrotechnics SAS. The relatively good equipment for the theoretical and experimental studies was reflected in many research activities. Since 1963 Presidium of SAS decided to change the name of the institution again according to its new tasks. Its new name – Institute of Hydrology and Hydraulics SAS – better represented its research topics. It is necessary to mention the year 1989, after which significant changes of the Institute were performed. The number of employees decreased from 108 to 50 and funding of the Institute was changed from budgetary to those which activity are covered from the state budget only partially (since 1993). To characterize contemporary institute's activity focused to hydrology, its name has been changed to the Institute of Hydrology SAS since 1993.

Institute of Hydrology SAS is now a scientific research institution which conducts a comprehensive research and teaching in the field of environmental science and water management to improve and disseminate knowledge on the circulation and quality of water in the nature. The activity of the Institute is focused on:

– water balance components and their changes in catchments;
– transport processes of water and dissolved matters in the atmosphere–plant canopy–soil water–groundwater system with special focus on the subsurface water formation and its quality;
– flow of surface water, groundwater and transported substances;
– impact of human activities on hydrological processes, including processes of surface and subsurface water pollution;
– changes in hydrological regime of surface and subsurface waters caused by expected climatic changes;
– solving problems connected with environmental management, ecology, utilization and protection of environment, hydrogeology, pedology
– solving problems connected with water constructions and their impact on the environment, hydromelioracy, hydrotechnical applications, water modifications, flood protection, water morphology, integrated water management, water planning and water resources protection;
– solving problems connected with landscape engineering, plants and soil protection and with securing water supply during drought seasons.

The Institute provides consultancy and expertise services related to its main activity and also performs PhD study in accordance to valid legal regulations.

Since its establishment, the mission of the Institute of Hydrology SAS is the acquirement and transfer of new scientific knowledge in the fields of hydrology, hydrodynamics and water hydraulics to water management practise, mainly in Slovakia. The Institute elaborates methodologies and manuals to provide the society with powerful tools to solve urgent and perspective water-related problems using the contemporary scientific knowledge. Simulation models are designed and used in analyses and predictions of water dynamics and quality. Special attention is paid to building databases of input data characterizing the regions of Slovakia.

Different sub-disciplines of hydrology are using specific methodological approaches and equipment; this is reflected even in structure of the Institute. Institute is divided into two departments:

– Department of Surface Water Hydrology,
– Department of Subsurface Water Hydrology.

Territory of Slovakia is morphologically diversified and research under different natural conditions also needs specific methodology and equipment. There was one of reasons to establish remoted workplaces for particular regions, which are focused on research in the field conditions:

– Research Base of Mountain Hydrology, Liptovský Mikuláš, (research of water movement and runoff formation in condition of mountainous catchments),
– Research Base of Lowland Hydrology, Michalovce (soil hydrology of lowlands, with accent to East Slovakia Lowland).

The aim of research conducted by the Institute of Hydrology SAS is to acquire new knowledge about quantitative and qualitative characteristics of water movement in ecosystems influenced by human activity and global changes (climate change is one of many global changes).

Those goals can be reached by the combined laboratory and field activities; field research is the source of primary information about the system and allows designing mathematical and simulation models and its results also can be used for their validation.

By all manners of means, one of the significant activities of the Institute of Hydrology SAS consists in the issue of the Journal of Hydrology and Hydromechanics. History of this journal reached or is linked with the establishment of the Institute. The first volume of the journal antecedent, which name at that time was the Vodohospodársky časopis, was published in 1953, when the Institute was founded, and contained one double issue. Since 1955 the journal was issued quarterly and since 1969 in 6 issues per year. Since 1961, the journal is issued by the Institute of Hydrology SAS (Slovakia) in co-operation with the Institute of Hydrodynamics AS CR (Czech Republic). During the years the quality of journal has increased, from relatively modest beginnings with small group of authors and subscribers up to the significant international journal. In 1993 the Journal changed its name to the todays form: Journal of Hydrology and Hydromechanics. Nowadays, the journal is an international open access journal for the basic disciplines of water sciences. The scope of hydrology is limited to biohydrology, catchment hydrology and vadose zone hydrology, primarily of temperate zone. The hydromechanics covers theoretical, experimental and computational hydraulics and fluid mechanics in various fields, two- and multiphase flows, including non-Newtonian flow, and new frontiers in hydraulics. The Journal publishes original research papers, short communications/technical notes, and reviews that have been thoroughly peer reviewed. Hundreds of papers published in the journal prove that, within the mentioned scientific disciplines, it has become an important mediator of research results from all over the world.

This thematic issue summarizes and presents latest results of cooperation among researchers from the Institute of Hydrology SAS and from other research institutions. This issue includes papers from more than 50 authors from 11 European countries. It was designed to communicate contributions on the current state of catchment hydrology, vadose zone hydrology and also hydromechanics.

Iovino et al. (this issue) analyse the extent (determined by the repellency indices RI and RIc) and persistence (determined by the water drop penetration time, WDPT) of soil water repellency (SWR) induced by pines in different geographic regions - in clay loam soil at Ciavolo, Italy (CiF), sandy soil at Culbin, United Kingdom (CuF), silty clay soil at Javea, Spain (JaF), and sandy soil at Sekule, Slovakia (SeF). For Culbin soil, the potential SWR characteristics were also determined after oven-drying at 60°C (CuD). They found out that RI and RIc increased in the order: JaF < CuF < CiF < CuD < SeF, reflecting nearly the same order of WDPT increase. RI correlated closely with WDPT, which was used to develop a classification of RI that showed a robust statistical agreement with WDPT classification according to three different versions of Kappa coefficient.

Bebej et al. (this issue) study of flow type dynamics at pedon scale via morphometric parameter analysis of dye-pattern profile. The application of Brilliant Blue FCF tracer enables to identify flow types in multi-domain porous systems of soils. They analysed the vertical dye pattern profiles exposed for different time lengths, and revealed temporal evolution of dye solution redistribution leading to changes in flow types. The analyses of the dyed patterns profiles allowed to specify three stages of dye solution redistribution history: (i) a stage of preferential macropore flow, (ii) a stage of strong interaction between macropore-domain and soil matrix leading to the generation of heterogeneous matrix flow and fingering flow types, and (iii) a final stage of dye redistribution within the soil body connected with leaching of BB caused by meteoric water.

Soil compaction leads to the decrease in infiltration rates, in saturated hydraulic conductivity and in porosity, as well as causes an increase in soil bulk density. Detailed determination of soil compaction and the investigation of a compaction impact on water content, water penetration depth and potential change in water storage in sandy loam soil under sunflower was carried out by Nagy et al. (this issue) at 3 plots (K1, K2 and K3) within an experimental site (field) near Kalinkovo village (Slovakia). The vertical bulk density distribution was similar to the vertical soil penetration resistance distribution, i.e. the highest values were estimated at the plot K1 in 15–20 cm depths and the lowest values at the plot K2. Soil water storage measured at the plot K2 (in the ridge) was 1.17-times higher than the soil water storage measured at the plot K3 (in the furrow) and 4.2-times higher than the soil water storage measured at the most compacted plot K1 on the edge of the field.

During the last decade, biochar has captured the attention of agriculturalists worldwide due to its positive effect on the environment. To verify the biochar effects on organic carbon content, soil sorption and soil physical properties under the mild climate of Central Europe, Igaz et al. (this issue) established a set of field experiments. Applied biochar increased total and available soil water content in all fertilized treatments. Based on the results from the spring soil sampling (porosity and water retention curves), they found a statistically significant increase in the soil water content for all fertilized treatments. Furthermore, biochar (with or without N fertilization) significantly decreased hydrolytic acidity and increased total organic carbon.

Šimanský et al. (this issue) also present how biochar improves physical properties of soils and contributes to the carbon sequestration. In their study the effects of biochar alone and in a combination with N-fertilizer (i) on the content of water-stable aggregates (WSA) as well as soil structure parameters; and (ii) on the contents of soil organic carbon (SOC) and labile carbon (CL) in water-stable aggregates was investigated. The results indicate that the biochar significantly decreased the structure vulnerability by 25%. The content of SOC in WSA in all size classes and the content of CL in WSA 3–1 mm significantly increased after applying 20 t ha^{-1} of biochar. Their results showed that biochar might have beneficial effects on soil structure parameters.

Sleziak et al. (this issue) focus on quantification of the factors that control change in the hydrological model efficiency over time by using the TUW rainfall-runoff model over the whole territory of Austria. The effect of the temporal change of at-site climatic conditions is expressed by the mean catchment precipitation and the air temperature in two large groups of catchments representing diverse physiographic/climatic zones. The results indicate that the main controlling factor of changes in simulated runoff volumes is the magnitude of the change in precipitation for both groups of catchments.

The research of Fendeková et al. (this issue) was oriented on droughts occurrence in discharge time series in twelve Slovak river basins within the period 1981–2015. Results showed that drought parameters in evaluated river basins of Slovakia differed in respective years, most of the basins suffered more by 2003 and 2012 drought than by the 2015 one. Water balance components analysis for the entire period 1931–2016 showed that because of continuously increasing air temperature and balance evapotranspiration there is a decrease of runoff in the Slovak territory.

The erosion, transport and deposition of sediments in small valley reservoirs represent a significant impact on their operations, mainly with regard to reducing the volume of their accumulation. The aim of the study by Hlavčová et al. (this issue) is a comparison and uncertainty analysis of two modelling concepts for assessment of soil loss and sediment transport in a small agricultural catchment, with an emphasis on estimating the off-site effects of soil erosion resulted in sedimentation of a small water reservoir. The small water reservoir (polder) of Svacenicky Creek which was built in 2012, is a part of the flood protection measures in Turá Lúka and is located in the western part of Slovakia, close to the town of Myjava. The town of Myjava in recent years has been threatened by frequent floods, which have caused heavy material losses and significantly limited the quality of life of the local residents. To estimate the amount of soil loss and sediments transported from the basin, there were applied two modelling concepts and the results were validated with the actual bathymetry of the polder.

The results show that in the given area, there has been a gradual clogging of the bottom of the polder caused by water erosion. It was estimated that within the four years of the acceptance run, 10,494 m^3 of bottom sediments on the Svacenicky Creek polder have accumulated. It therefore follows that repeated surveying of the sedimentation is very important for the management of the water reservoir.

Next paper, by Sokáč et al. (this issue), presents a new approximate method for 1-D simulation of pollution transport in streams with "dead zones". Analytical solutions describing the 1D substance transport in streams have many limitations and factors, which determine their accuracy. One of the very important factors is the presence of the transient storage ("dead zones") that deform the concentration distribution of the transported substance. For better adaptation to such real conditions, a simple 1D approximation method, based on the asymmetric probability distribution (Gumbel's distribution), was proposed and verified on three streams in southern Slovakia. Tracer experiments on these streams confirmed the presence of dead zones to various extents, depending mainly on the vegetation extent in each stream. Statistical evaluation confirms that the proposed method approximates the measured concentrations significantly better than methods based upon the Gaussian distribution.

Velísková et al. (this issue) deal with studying of two topics – measuring of velocity profile deformation behind an over-flooded construction and modelling of this velocity profile deformation by computational fluid dynamics (CFD). Numerical simulations with an unsteady RANS models - Standard k-ε, Realizable k-ε, Standard k-ω and Reynolds stress models (ANSYS Fluent v.18) and experimental measurements in a laboratory flume (using ADV) were performed. Results of both approaches showed and affirmed presence of velocity profile deformation behind the obstacle, but some discrepancies between the measured and simulated values were also observed. With increasing distance from the obstacle, the differences between the simulation and the measured data increase and the results of the numerical models are no longer usable.

Mentioned collection of original articles represents latest dissemination outcomes of mainly international cooperation activities of the Institute of Hydrology SAS. I would like to thank all authors for their contributions and I wish the readers of Journal of Hydrology and Hydromechanics a procuration of next knowledge and a lot of new inspiration not only from this issue, but from all next ones.

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