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Introduction of the inundated area as a parameter for evaluation of river dryness

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Up-to-date climate models predict extreme weather events in the Mediterranean climate zone as a consequence of the effect of the global warming [1]. The monitoring of the hydrological cycle in Bulgaria has also proved a tendency of extremely long draughty period: the run-off of the rivers in Bulgaria has decreased with 40 % during the period 1985 - 1995 [2]. The negative impact of climate changes on the water availability and quality demands new modelling tools to be developed for description of river behaviour under these conditions.

Run-off has been used traditionally for evaluation of the river hydrology and is a key parameter in the mass balances equations of the water quality. However, the alternation of drying and rewetting of the river banks due to the climate changes, gives rise to new scientific questions, in particular which processes take place in the sediment during the dry period and what is their impact on the river water quality during the rewetting period. The sediment reactions and microbial activities depend on the soil moisture and hence on the total active area. This prompts that the inundated area is an important parameter for spatial characterisation of the drying and rewetting processes. The relation between this parameter and the river dryness has been investigated in the framework of the TempQsim project [3]. The achieved results are reported here.

River Iskar in Bulgaria was chosen as one of eight test sites. It is situated in the western part of the country and is the longest Bulgarian river (368 km). The river is representative for moderate climate zone having typical seasonal flow variations. It plays important role, through the Iskar reservoir, for the drinking water supply of Sofia - the capital of Bulgaria. Detailed hydrological and water quality investigations were carried out at reach scale. The selected reach is 400 m long and is situated about 1 km above the Iskar reservoir.

The seasonal dynamics of the run off for the period 2000 - 2004 (without 2003) was studied, being the first important criterion for evaluation of the river dryness. Based on the data for the long term average annual run-off, year 2000 could be characterised as a year with normal climate behaviour with average run off 7.7 m3/s, year 2001 as dry one with average run off 4.1 m3/s and year 2002 as wet one with average run off 9.1 m3/s. For year 2004 the average run off is 8.9 m3/s. The minimum run off for the four years varies between 3 and 15% of the corresponding average annual run off. There are between 226 and 286 days per year with run off less than the average one.

The river dryness was evaluated further using the inundated area dynamics. It was mapped 2 times per season within one year for the selected reach. The vertical, horizontal angles and distances to the observed points were recorded by total surveying station SOKIA [4]. The coordinates and the elevations of the observed points were calculated using TPLAN software, developed at the University of Architecture, Civil Engineering and Geodezy, Sofia. Based on these data a digital map of the investigated reach was created and the area, lengths, distances and gradients were further calculated. The analysis shows that during low summer run off the inundated area is 75% of the average annual inundated area and 59% from the maximum inundated area in spring.

Since the mapping of the inundated area is a time and labour consuming process, in order to facilitate the analysis in future, two equations (Eq. 1and Eq.2) were worked out using the experimental data. They give the relation between the water discharge (D) and the shoreline length (SL). Considering that the shoreline length might be expressed both in relation to inundated perimeter in m/ha or in relation to the river midstream in m/m [5], these two equations will allow determining of the inundated area if the discharge (run off) is known. When SL is expressed in m/ha, SL = 1763, 9.Dˆ(-0.2699), R2 = 0.89 (1). When SL is expressed in m/m, SL=3,2346.Dˆ(-0.0755), R2 = 0.87 (2).

The following general conclusions of the research could be made: i) The minimum run off is only 3 to 15% of the average run off, however the minimum inundated area is 75% of the average. This result should be explained with the nature of the river bed, mostly narrow, with steep banks in about half of the investigated section. This phenomenon allows existence of sustainable aquatic ecosystem throughout the year; ii) Two equations were developed, which could be used as a tool for easy evaluation of the inundated area, using the run off only; iii) The maximum inundated area (flood plain) for the selected reach was determined; iv) It is important to continue the investigations having in mind that for more than 60% of the days in a year the run off is below the average one. This study is a step forward towards the understanding of the drying and rewetting processes. The results will be used to quantify the effect of sediment related processes on the river water quality at different flow conditions.

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References 1. http://unfccc.int/essential_background/feeling_the_heat/items/2918.php, United Nations Framework Convention on Climate Change 2. http://www.moew.government.bg, Program concerning the necessary measures in the circumstances of trend to drought 3. http://www.tempqsim.net. 5th Framework EU project: “Evaluation and improvement of water quality models for application to temporally waters in Southern European catchment” 4. K. Kukurin, I. Ribarova, P. Kalinkov, Pl. Ninov, J. Topalova, J. Froebrich (2004). Winter low flow spatial dynamics for selected reach of Iskar river upstream, XIII International Symposium in Ecology, 7-10 June, Sunny Beach, Bulgaria, pp.296-306 5. Nat D., A. Schmidt, Kl. Tockner, P. Edwards, J. Ward. (2002). Inundation dynamics in braided floodplains: Tagliamento river, Northeast Italy, Ecosystems, 5, 636-647