Sediment quantity modelling in a climate change context

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Introduction: The rate of the sediment transport and its continuity in catchment-river-sea systems have been severely altered in many places through implementation of anthropogenic measures. As recently concluded, results of these interventions will be additionally amplified by the climate change through e.g., alterations of water cycle, precipitation, distribution, and its intensification over land areas [1]. Since, shifts in water quantity can disturb natural processes like: weathering, erosion, denudation, and surface runoff, therefore we shall assume that climate change will also modify sediment quantity. Taking into consideration existing shortages in the sediment quantity monitoring data the modelling tools should be considered to assess this problem [2].

Methods: To study this issue the sediment quantity modelling tool has been proposed for the Raba River catchment (Southern Poland). This tool combines the Macromodel DNS/SWAT [3], successfully used in the past to assess impact of land use changes on the water quality [4], and sediment quality information. The Raba flowing to the Vistula River (134.7 km) has a typical mountain character (Carpathian Foothills), and supplies a drinking water reservoir. The base model consists a series of modules containing detailed data on catchment hydrology, meteorology, soil types, elevation, and land use. The sediment quality module based on the fingerprinting study [5], and the state monitoring data.

Results: The data collected so far (Fig. 1) clearly indicate that the Raba River catchment is suitable for the pilot study. Research conducted in the past in this area suggests that there are significant suspended sediment loads, which will additionally vary depending on the location of the calculation profile. The data with use of the proposed analytical tool allows for the first time to assess not only the amount of suspended sediment (including its separation into individual fractions), but also quality of suspended sediment throughout the catchment, including the reservoir. The final result of the research will be the results of variant scenarios regarding climate change and their impact on suspended sediment.

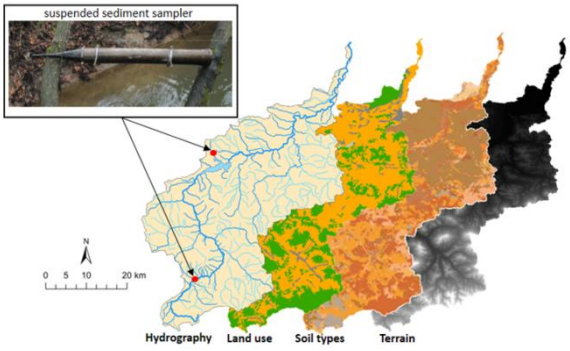

Fig. 1: The Raba River model scheme with localization of the suspended sediment samplers.

Discussion: The proposed modelling tool is able to precisely determine soil erosion from the landscape and in-stream depositional and degrading processes during sediment routing. Based on monitoring data, the model will be able to simulate results for all computational profiles in the catchment. The model is also able to simulate the movement of suspended particles, even is a dam reservoir is located along the way. It will also help to answer the key question "what effects on the quantity and quality of suspended sediment will be imposed by the expected climate changes (temperature and precipitation) and whether it is possible to limit this impact through alterations in the land use of the catchment.

Acknowledgements: This research has been supported by the Ministry of Science and Higher Education within the statutory research AGH WGGiOŚ No. 11.11.140.017

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