VEGMIX: INFLUENCE OF VEGETATION ON FLOW AND MIXING IN SMALL OPEN CHANNELS – FROM LAB TO REAL WORLD

Vegetation is commonly found in rivers and channels. It significantly affects the flow of water, the mixing of dissolved substances, as well as the shape of rivers, the water quality, ecology, agriculture, urban development and many other aspects of our lives. The public awareness of the crucial role of aquatic and riparian vegetation in healthy river ecosystems is increasing. Historically, however, vegetation in watercourses has been treated primarily as an "obstacle" and has been frequently removed to meet flood protection needs. Extensive vegetation removal is still widely practised. However, the protection of water resources and water quality is becoming more and more important, also in Poland, which is one of the countries with the largest water deficit in Europe. Especially in the context of the changing climate, the vegetation in channels is beginning to be perceived not only as something undesirable but also as a way to increase retention and natural trap and filter for suspending sediment and pollution. Balancing the risk of flooding and drought and protecting water quality is extremely important. However, they require knowledge of the physical processes occurring in surface waters. These processes, initially complex in themselves, become even more complicated with the presence of vegetation. However, their understanding is crucial in making the right decisions, both in the context of subsequent research steps on flow-vegetation hydrodynamics and in the water management strategy (including accidental catastrophes when toxic substances reach the water bodies).

The main goal of the project is to elucidate the influence of vegetation on the flow and mixing in small open channels. The project will engage a range of activities: field studies, including tracer tests, with the use of a special, environmentally safe dye, remote sensing, laboratory measurements, data analysis and interpretation, as well as numerical computations and simulations to determine the impact of vegetation coverage on the processes taking place in the channel. **The influence of vegetation will be assessed for various possible flow values and different vegetation coverage conditions** (Fig. 1) by determination of several parameters representing both the flow and the mixing processes. **Determination of the coefficients of the so-called longitudinal dispersion and their dependence on the vegetation coverage seems to be the crucial task.** These coefficients are the most important and at the same time, the most difficult to determine factors characterising the processes of mixing and spreading the dissolved substance in water. The tracer experiments planned in the project are the best source of information for estimating their value. Additionally, the project aims to capture the impact of seasonal changes in the vegetation occurring along the channel reach and different vegetation management scenarios. Accordingly, an essential part of the project will be to analyse the large amount of data obtained from a series of tracer experiments conducted for a wide range of hydrological and vegetation conditions. Contrary to most of the available research, which so far has been conducted mainly in laboratory conditions, usually with artificial elements imitating natural vegetation, in specific, selected configurations, the proposed study will concern vegetation in complex natural conditions. **This is the first time when the project field campaigns are planned for such a large scale for naturally vegetated channels. The innovative aspect of these field campaigns lies in their transition "from the lab to the real world. It's a significant step forward in bridging the gap between controlled laboratory settings and the complexities of natural environments.**

Fig. 1. Examples of the results of the vegetation photo monitoring carried out within the BRITEC project (https://britec.igf.edu.pl/) and preliminary project research in the Warszawicki Canal. Selected photos (from the left): winter conditions (before the beginning of vegetation), intermediate conditions - vegetation in the initial growing season, developed vegetation just before the periodic canal cleaning.

The determined parameters can be used, among others, in computer models that allow for the simulation of the spread of contaminants, reaching the water bodies, either accidentally, or in a controlled manner, as in the case of cooling waters or industrial wastewater. The project's findings will be disseminated to enable their use by other researchers. **The analysis of the influence of vegetation on the flow can be useful in preparing water strategies under changing climatic conditions**, especially for the maintenance of vegetation in agricultural channels. Analyses of different channel maintenance scenarios may help to formulate new maintenance guidelines with the compromises balancing the flood protection needs with the pro-retention activities and protection of water quality.