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Flow resistance in small streams and agricultural drainage ditches: potential high sensitivity to climate change?

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Abstract

Surface water channels serve many purposes. Arguably, primary amongst these are (i) transporting (flood) waters and sediment to the sea, and (ii) supporting biodiversity and ecological health. These tend to counteract each other, since increased biomass within channels will tend to increase resistance to flow conveyance, and sediment trapping. Moreover, both are sensitive to the impacts of climate change. Where the optimum balance lies between maximizing conveyance capacity and ensuring that these channels are resilient supporters of biodiversity is a prominent issue, and is particularly problematic in the smallest of drainage channels – agricultural ditches and streams – where vegetation and other obstacles can block the flow of water and trap sediments very effectively. The work described here sets out to understand how vegetative and other flow resistance in small drainage channels can be parameterised and predicted, given that standard methods used in larger channels may not be accurate in this context. A first approach attempted to separate out variations in flow resistance at seasonal timescales due to the effects of vegetation growth from variations in flow resistance at daily timescales due to changes in flow rate. This was of limited success due to insufficient data across the range of flow rates for each stage in the growing season. Subsequently, we attempted to investigate whether differences in flow resistance between channels with different amounts of vegetation were discernible against a backdrop of varying flow rates and seasonal growth patterns. This was found to be the case. A third experiment investigated the way in which spatial distribution of obstacles affected flow resistance, using arrays of sandbags. Clear differences in energy partitioning in the flow, and thus flow resistance due to changing their spatial patterning were found. The implications of this work in the context of climate change effects will be discussed.