BASEmeso: a tool for the automatic delineation of fluvial mesoscale patches

Erik van Rooijen, David F. Vetsch, Robert M. Boes, Davide Vanzo

Laboratory of Hydraulics, Hydrology and Glaciology (VAW) - ETH Zürich

Zürich, Switzerland

Annunziato Siviglia

Department of Civil, Environmental and Mechanical Engineering, University of Trento (IT)

Trento, Italy

The relatively recent spread of two-dimensional numerical hydrodynamic tools for ecohydraulic applications called for the development of automatic habitat detection methods, adopted as prediction tools for river habitat analysis. Previous research has shown promising results in the automatic identification of mesoscale habitat patches by using clustering algorithms together with numerical hydrodynamic model results. These algorithms attempt to implement and simulate some of the expert-based requirements adopted in the field to delineate habitat patches. Spatial contiguity is one of such expert-based requirements that has not been enforced and exploited in automatic mesohabitat identification so far.

Here we propose a novel tool (BASEmeso) based on an agglomerative hierarchical clustering algorithm where we enforced a spatial contiguity constraint. This algorithm can better capture a patch's extent, can better distinguish different patches, and creates patches with smoother characteristics than algorithms without such a constraint. BASEmeso comes as free QGIS plugin and interfaces directly with BASEMENT (freeware tool for river processes) simulation outputs. We compare the patch delineation of BASEmeso with a conventional expert-based mesohabitat method and evaluate similarities and differences. We also investigated which (hydraulic) parameter is more relevant in the delineation of mesoscale patches. By introducing parameter weighing into the BASEmeso approach, we are able to identify how experts (subconsciously) weigh different parameters while delineating patches. The used weights can impact a habitat assessment and are therefore important to be considered. Adding weights can be used to make expert-based approaches more objective and algorithm-based approaches for ecohydraulic investigations more relevant in the future.

We further exemplarily discuss an application of the tool, where we quantify mesohabitat changes due to multiple subsequent flood events in an Alpine river stretch. Such an analysis is especially interesting in view of the expected increase in flood-frequency due to climate change. BASEmeso allows for a fast and robust delineation of mesoscale habitat patches in the fluvial environment in a variety of hydro-morphological conditions, thus being a useful tool for many ecohydraulic applications.