Hydraulic modelling of brown trout habitat in a hydropower-impacted Alpine braided stream

Yufang Ni\textsuperscript{1,2} and Stuart N. Lane\textsuperscript{2}
\textsuperscript{1}State Key Laboratory of Water Resources and Hydropower Engineering Science, Wuhan University, Wuhan, China (yufangni@whu.edu.cn)
\textsuperscript{2}Institute of Earth Surface Dynamics, Faculté des géosciences et de l'environnement, Université de Lausanne, Lausanne, Switzerland (stuart.lane@unil.ch; yufang.ni@unil.ch)

Braided rivers have complex and dynamic bed morphologies. In Alpine streams, they may be impacted upon by natural flow variability (e.g. snow and ice melt) that can lead to the lateral displacement of suitable habitat. To date, this process has been investigated in two-dimensional models due to the difficulty of applying fully three-dimensional computational fluid dynamics at the scale of river reaches. This is problematic because lateral and vertical variations in kinetic energy and vorticity and their change through time are crucial determinants of where good habitat is found and where it migrates to as river discharge changes. Here we attempt a reach-scale three-dimensional model of stream habitat using the open-source toolbox OpenFoam, with turbulence resolved by Delayed Detached Eddy Simulation (DDES), to model the flow structures in a braided reach of the Turtmanna, a tributary of the Rhône river, Switzerland. The results show that locations deemed suitable in a 2D solution are not when looked at in 3D, and vice versa. This result has important implications for the use of hydraulic habitat modelling for the design of environmental flows in human impacted Alpine streams.