Effects of depth-varying vegetation roughness in two-dimensional hydrodynamic modelling

ABSTRACT

For detailed hydrodynamic modelling of vegetated floodplains, the ability to quantify vegetation is advantageous as vegetation significantly influences the flow mechanism. Although it is widely known that roughness changes with depths, many two-dimensional (2D) models assign constant or generic roughness and the values are typically adjusted for calibration. This practice is likely to lead to the misinterpretation of the flow mechanism. This paper assesses the effects of depth-varying vegetation roughness in 2D hydrodynamic modelling based on vegetation density derived from a remotely sensed regression analysis. The simulated flood extents, depths and velocities of a historical flood event were compared between the constant and depth-varying vegetation roughness coefficients and verified against historical data and literature. A minimum value of 0.03 was found for vegetation with the lowest density of 0.01 m^{-1} at 0.2 m depth and a maximum value of 0.20 for vegetation with the highest density of 0.20 m^{-1} at 2 m flow depth, resulting in the maximum differences in flood depths and velocities of 0.40 m and 0.25 m/s, respectively. This study presented a bridge between the theoretical and practical applications which can potentially be used for evaluating vegetation restoration and removal.

Keyword: Vegetation roughness; Manning's n; Depth-varying; Density; Regression; 2D hydrodynamic modelling