An investigation into remote sensing techniques and field observations for modeling of dynamic hydraulic roughness from riparian vegetation

Smriti Chaulagain[1], Mark Stone[1], Daniel Dombroski[2], Tyler Gillihan[1], Li Chen[3], and Su Zhang[1]

[1]The University of New Mexico
[2]US Bureau of Reclamation Denver Federal Center
[3]Nanjing University of Information Science and Technology

November 23, 2021

Abstract

Riparian vegetation provides many noteworthy functions in river and floodplain systems including its influence on hydrodynamic processes. Traditional methods for predicting hydrodynamic characteristics in the presence of vegetation involve the application of static roughness (n_s) values, which neglect changes in roughness due to local flow characteristics. The objectives of this study were to: (1) implement numerical routines for simulating dynamic hydraulic roughness (n_d) in a two-dimensional (2D) hydrodynamic model; (2) evaluate the performance of two dynamic roughness approaches; and (3) compare vegetation parameters and hydrodynamic model results based on field-based and remote sensing acquisition methods. A coupled vegetation-hydraulic solver was developed for a 2D hydraulics model using two dynamic approaches, which required vegetation parameters to calculate spatially distributed, dynamic roughness coefficients. Vegetation parameters were determined by field survey and using airborne LiDAR data. Water surface elevations modeled using conventional and the proposed dynamic approaches produced similar profiles. The method demonstrates the suitability in modeling the system where there is no calibration data. Substantial spatial variations in both n and hydraulic parameters were observed when comparing the static and dynamic approaches. Thus, the method proposed here is beneficial for describing the hydraulic conditions for the area having huge variation of vegetation. The proposed methods have the potential to improve our ability to simulate the spatial and temporal heterogeneity of vegetated floodplain surfaces with an approach that is more physically-based and reproducible than conventional "look up" approaches. However, additional research is needed to quantify model performance with respect to spatially distributed flow properties and parameterization of vegetation characteristics.

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