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Approximate Convection-Diffusion Wave Application to Compute Discharge Using only Stage Data

Muthiah Perumal¹ and Kirtan Adhikari²

¹Indian Institute of Technology Roorkee, Hydrology, India (muthiahperumal30@gmail.com)

²College of Science and Technology, Royal University of Bhutan, Bhutan

Measuring discharge in a river system involves tedious procedures. Over the last few decades, innovations in technology has improved discharge estimation methods in rivers due to the use of improved velocity measurement equipment, such as the ADCP and thereby easing and improving the discharge estimation at the river sites. However, adopting these technologies prove to be expensive for its use in very many sites. To overcome this expensive approach of river discharge estimation, a new approach of discharge estimation based on the use of hydrodynamic principle to estimate discharge using only the observed stage data at a river site is proposed in this study. This method is derived in this study using the Approximate Convection-Diffusion equation combined with the Diffusive Wave model. This method can be considered as a more generalized approach ideally suited for field applications. Due to its simplicity, easy applicability, versatility and accuracy of estimating discharge for a wide range of roughness and channel bed slope conditions, this method can be considered ideal for field applications. Moreover, the method can be applied to estimate discharge in a channel characterized by varying cross-section or the roughness parameter along the river reach. The proposed method has been tested for a number of hypothetical flood scenarios in hypothetical channels. Further its accuracy, and its applicability has been evaluated using the well-established evaluation criteria. After its evaluation using hypothetical flood scenarios in hypothetical channels, the field applicability of the method is evaluated by applying the method for the real data to estimate discharge using only the observed stage data at the desired site. The limitation of the method arises due to uncertainty of the used Manning's roughness coefficient(s) at the desired station and, therefore, to avoid this problem it may be prudent to carry out the sporadic velocity measurements at the desired river site during the passage of a flood wave, for the confident use of the proposed model or formula for estimating discharge using only the stage data.