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CN-China: Revised runoff curve number by using rainfall-runoff events data in China

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ABSTRACT

The curve number (CN) method developed by the United States Department of Agriculture (USDA) in 1954 is the most common adopted method to estimate surface runoff. For years, applicability of the CN method is a conundrum when implementing to other countries. Specifically, countries with more complex natural environment may require more dedicated adjustments. Therefore, the current CN look-up table provided by USDA might not be appropriate and could be questionable to be applied directly to regions elsewhere. Some studies have been conducted to modify CN values according to specified natural characteristics in scattered regions of mainland China. However, an integral and representative work is still not available to address potential concerns in general matters. In this study, a large set of rainfall-runoff monitoring data were collected to adjust CN values in 55 study sites across China. The results showed that the revised CN values are largely different from CN look-up table provided by USDA, which would lead to huge errors in runoff estimation. In this study, the revised CN (dubbed CN-China) provides better reference guidelines that are suitable for most natural conditions in China. In addition, scientists and engineers from other parts of the world can take advantage of the proposed work to enhance the quality of future programs related to surface runoff estimation.

1. Introduction

The high-density construction of meteorological stations around the world makes it easy to acquire historical and real-time rainfall data, but there are few stations for runoff monitoring. Runoff monitoring is often carried out for short-term and limited area in order to accomplish specific research projects (Fauvel et al., 2016; Gwynne and Glover, 1961; Hvitvedjacobsen and Yousef, 1988; Kim and Sansalone, 2008). Surface runoff estimation serves as the most important role in hydrology related research (Hawkins, 1993; Jiang et al., 2012; Kim and Sansalone, 2008; Kirchner et al., 2000; Muche et al., 2019; Steenhuis et al., 1995; Tyagi et al., 2008; Wang and Wang, 2018). Fortunately, the relationship between runoff and rainfall allows us to use mathematical methods to estimate runoff based on readily available rainfall data (Clyde and Work, 1943; Guo et al., 2017). The Green-Ampt infiltration curve (Freyberg et al., 1980; Li et al., 2015; Stewart, 2018), the Philip infiltration curve (Triadis and Broadbridge, 2012), and the Horton infiltration curve methods are all for calculating runoff (Esen, 1987; Grimaldi et al., 2013). Applications of these methods are very limited because they require many parameters and detailed soil

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