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ORIGINAL ARTICLE

The application of the Water Erosion Prediction Project (WEPP) model for the estimation of runoff and sediment on a monthly time resolution

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Abstract The Water Erosion Prediction Project (WEPP) model is utilized to simulate the sediment and runoff processes. According to previous studies, WEPP model provides impressive results in watersheds of diverse climates and scales. It is also capable of modeling the sediment transportation processes and consequently predicting subsequent deposition sites. In this study, the geo-spatial interface for WEPP (GeoWEPP) was employed as a GIS framework to extract the data required from the ASTER Global Digital Elevation Model (ASTER-GDEM) dataset which was subsequently used as the model input. The case study was based on monthly data consisting of average sediment and runoff estimation from the Emameh subbasin, in northern Iran. The model estimations were validated through field measurements. Two statistical measures of co-efficiency including the Nash–Sutcliffe Efficiency (NSE), and the coefficient of determination (R^2) were considered to evaluate how well the model predictions could explain the variability of observations in the field. The model performed favorably as corroborated by a reasonably high NSE of 0.99 and an R^2 value of 0.92 for sediment. In the case of runoff, the results were slightly inferior, but still acceptable with an NSE of 0.76 and R^2 value of 0.62.

Keywords ASTER-GDEM · Emameh · Runoff · Sediment · WEPP

Introduction

From a hydrological perspective, erosion is the process whereby particles are detached from the soil surface in one place, transported by surface runoff, and deposited in another distinct location (Julien 2010). The driving forces in sediment transportation are predominantly wind, water or ice. For this motive, erosion is often classified into three corresponding categories: wind, water and ice erosion (Refahi 1996). Investigation on erosion was notably conducted by Ellison (1944) with a preliminary study of the mechanical effects of rain drops on soil particles. He demonstrated that rain drops can give rise to extensive soil erosion, which in turn can be further augmented due to lack of kinetic energy absorbing vegetation. Another noteworthy study is by Wischmeier et al. (1971), who conducted analytical studies in the United States to seek a relationship focused on erosion of farmland and construction sites. In the same year many further studies were carried out but at a regional level and the results were not applicable for large areas. Ella (2005) used the WEPP model to simulate erosion and sediment on hill slope environments located in small upland watersheds. His investigation was orientated towards establishing a relationship between vegetation cover and erosion in this specific terrain. He demonstrated that vegetation cover gives rise to the reduction of runoff and soil erosion. Flanagan and Nearing (1995) undertook a research on the Piracicaba River, Brazil, and evaluated the

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