

Raster modeling of surface runoff accumulation by incorporating artificially constructed water handling structures

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Abstract

This study presents a new algorithm to calculate surface runoff accumulation from Digital Elevation Model (DEM) with a coarse grid resolution by incorporating artificially constructed water handling structures. The algorithm can consider various scales of water handling structures such as diversion ditches, haul roads, culverts, underground pipelines, pumping facilities and temporary storage ponds which can significantly influence the overland flow patterns and the amount of incoming surface drainage at each cell. During raster modeling processes, the effects of diversion structures can be represented by modifying the flow paths derived from DEM according to known flow directions within the artificial water handling system. The gain and loss of incoming water at each cell due to underground pipelines and pumping facilities can be also assessed to reasonably determine the surface runoff accumulation. An application to the Pasir open-pit coal mine, Indonesia, showed that the algorithm developed in this study can provide a more accurate modeling of surface runoff accumulation than other conventional algorithms and that the modeling result is less sensitive to the resolution of DEM.