Geophysical Research Abstracts
Vol. 13, EGU2011-11559-2, 2011
EGU General Assembly 2011

Water flow model for the Harrier Basin, Kurdistan of Iraq

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The study includes computer topographic and morphologic simulation of water flow produced using a watershed modeling system that uses hydrologic and physical data from the study area. The DEM module, TIN module, Map module, and Hydro module were used in this study. A land use map, a soil map, and rainfall data were used to produce a curve that illustrates quantity of water flow water versus time of water flow across the Harrier Basin. The calculated water loss rate can be attributed to a number of factors such as joints, faults, bedding, and land use (agriculture and forest). Land use and soil characteristics are both important factors affecting water flow rates. The climate in the Harrier Basin is semi-arid. Simulated flow data indicate that the top flow rate is 32 m3 per second and that water can be reach to the basin out let in 3 hours and 10 minutes.
An important question associated with this method is what support area threshold to use? A basin's hydrology depends on its geomorphic form as well as hill slope. The aim of this paper is to focus on creating a hydrologic module and digital elevation models (DEMs) in a GIS environment as well as to learn how this data can be used in conjunction with a WMS to run lumped-parameter hydrologic models.
Methods
GIS programs and elevation data in a grid format can be used to delineate drainage basins, create stream networks, and compute drainage basin data. Once computed, several important variables, such as area, slope, and runoff distances, can be determined for hydrological analysis. A DEM can be used to determine the hydrologic parameters of a watershed such as slope, flow accumulation, flow direction, drainage area delineation, and stream network. TINs were derived from a contour map. Then, the (DEM) and Map Module were used to produce a digital map of the Harrier Basin. The digital map of the basin is three-dimensional.
The TIN and Hydrologic Module were used to produce a water flow curve for the study area and to calculate flow time. The curve requires the integration of four layers: 1) digitized 3-D contour map, 2) digitized land use map five groups (table 2) , 3) digitized soil coverages map (three groups A, B and C(Table 3), 4) daily local rainfall data. Land use and soil classes were also used in the computation of runoff via the use of the SCS Curve Number Method to calculate water loss. Supplemental data were collected on-site during the winter season.

Results
Water flow is concentrated in channels, hence the drainage area contributing to each point in a
channel may be quantified, while on hill slopes, flow is dispersed. The "area" draining to a given point is zero because the width of a flow path to a point disappears (Fagherazzi, 2004). In Table 1, the watershed modeling program used physical characteristics such as maximum flow slope (0.3578 m/m) and total length (20425.8 m). The time of concentration for the study area was calculated by the modeling program as 3.5 hours and five minutes. A long storm period produces significant flooding at the basin outlet, which increases erosion (a form of sediment transport) throughout all three hours. Figure 3 shows water flow versus time, starting from the Harrier Mountains to the point of confluence with Bata Stream (basin outlet). The quantity of water flow changes from the axial area of the Harrier Mountains, as it is fed back to the sub stream. The water flow rate starts at 5 m3/s in the Harrier Mountains at one hour and a half, and increases in the middle section of the basin to 32 m3/s at two hours and a half. This is because more sub streams affect Harrier Stream. The rate of water loss during a storm is 47.05%. This is due to four factors – joints and faults in the Harrier anticline as well as soil type and land use in the middle and southern parts of the basin. In the middle and southern parts of the basin, agriculture plays a role and the soil type is represented by two crops (A and B). All of the above factors lead to water loss in two areas – the first is the ground and second is the basin surface, which is used by agriculture.