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Pour Point Description of Watershed Based on DEM of Bilaspur District

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Abstract

The purpose of this paper is to reveal the pour point description of watershed based on Digital Elevation Model (DEM) is the precondition of research on building distributed hydrological model and hydrological simulation. This paper explicates the method of revealing pour point of watershed based on DEM. With the support of GIS(Geographical Information System) technique, boundary of watershed and drainage areas of sewer pipeline discharge into a area where a pump station could be installed in Bilaspur district so as to provide the easily flow of sewerage into a treatment plant or a river basin. Using a hydrology module in ArcGIS environmental, watersheds for Bilaspur were delineated. The result of this experiment indicates that this method can effectively solve the problem of parallel waterways and main channel which departs its natural position. In flat area, mountain area and terrain area this method can reveal pour point using watershed analysis.

Keywords

DEM, Fill Direction, Fill Accumulation, Hydrology, Snap Pour Point, Spatial Analyst Hydrology Tools, Watershed.

1. Introduction

GIS stands for Geographic Information System. Geographic Information Science in new interdisciplinary field. GIS is a combination of geography, cartography, computer science, mathematics etc.

GIS can be defined as ' A system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data which are spatially referenced to the earth'.

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The purpose of this exercise is to demonstrate the steps involved in delineating a watershed analysis from a Digital Elevation model (DEM) using the spatial analyst hydrology tools in ArcGIS and to reveal the pour point so that we can install the pump station.

Figure 1: 3D Dem

DEM is a digital image of terrains surface-commonly for a planet, it can be either in 2D or 3D. There is no common usage of terms DEM, DTM and DSM in scientific literature. In most cases the term digital surface model represents the earth's surface and includes all objects on it. In contrast to a DSM, the digital terrain model represents the bare ground surface without any objects like plants & buildings.

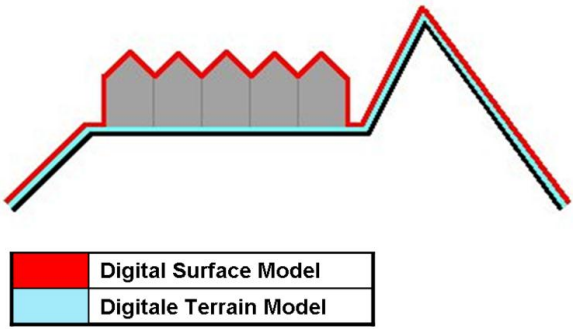

Figure 2: Surfaces represented by a Digital Surface Model include buildings and other objects. Digital Terrain Models represent the bare ground.

Most of the data providers (USGS, ERSDAC, CCGIAR, and SPOT IMAGE etc) use the term DEM as a generic term for DSM's & DTM's. there are also definitions which equalize the terms DEM & DSM on the web definitions can be found which define DEM as a regular GRID & DTM as TIN (Triangular Irregular Network).

TIN is a digital data structure used in a GIS for the representation of a surface. A TIN is a vector based representation of the physical land surface or sea bottom, made up of irregularly distributed nodes and lines with 3D coordinates that are arranged in a network of non overlapping triangles.

2. Materials and Methods

The materials which are required in this exercise are gathered into two main categories depending on its origin and later use.

2.1. Software

2.1.1. **ArcGIS 10 Desktop**: ArcGIS is software or we can say it is an application through which we can work with maps and geographic information. This software is used for: to analyze map information; to create map; to compile geographic data; and to manage geographic database.

2.1.2. **Spatial Analysis Tools**: the ArcGIS analysis tools provides a rich set of spatial analysis and modeling tools for both raster and vector data. The spatial analysis tools have rich amount of capabilities and are broken down into categories or groups of related functionality. Knowing the categories will help you identify which particular tool to use. The tools in spatial analyst extension are: density, distance, groundwater, hydrology, interpolation etc. Out of all these tools we will use hydrology tools for watershed delineation.

2.2. Spatial Information

2.2.1. **DEM Data**: DEM is a digital model or 3D representation of terrains surface-commonly for a planet. This can be fetch from data provider such as USGS, ERSDAC, CGIAR, SRTM etc.

The methods or tools which will be used for watershed delineation is Spatial Analyst. This is available in arc toolbox of ArcGIS. If arc toolbox is not activated within the map document, then right click on menu bar and select Spatial Analyst. If it is already activated (i.e. spatial analyst) then select spatial analyst tools in arc toolbox & then hydrology tools for watershed delineation.

Hydrology tools can be found by selecting spatial analyst tools →Hydrology within arc toolbox as shown below.

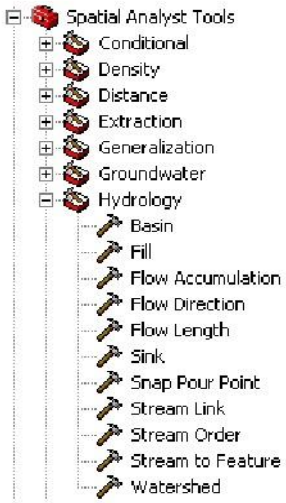

Figure 3: Hydrology Tools

There are following steps involved for using hydrology tools. The steps are:-

- Filling Sinks
- Flow Direction
- Flow Accumulation
- Snap Pour Point
- Watershed

These methods can be explained by flow diagram which is made in ArcGIS Model Builder:-

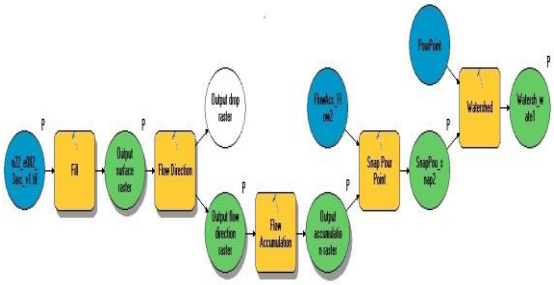

Figure 4: Flow diagram of methods involved for watershed delineation.

To add Latitude and Longitude columns to the attribute table for any point layer has the following steps:

- ➔ Right-click on the layer (here we will select Pour Point layer), select open attribute table.
- ➔ Use option → add field…. To add two fields, one for Lat and Long, setting the type to "double".
- ➔ Right click on the field lat and select calculate geometry.
- ➔ A pop-up window will appear and select property box and add Y coordinate to this box.
- ➔ Same step will be follow for long field.

3. Result and Discussion

The result of my experiment after following the above method is pour point description of watershed based on DEM. The output of my experiment which is performed in ArcGIS is given below.

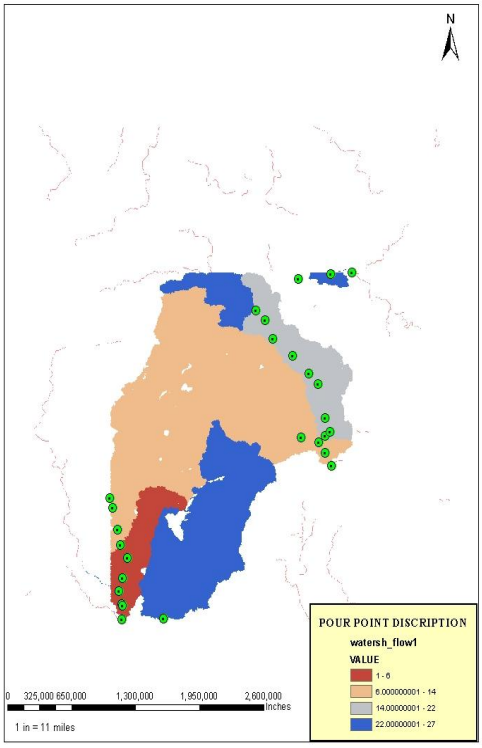

Figure 5: Result of watershed delineation of Bilaspur District having a Pour Point on it

The latitude and longitude of each pour point is described below:

Table 1: Pour Point describing Latitude and Longitude

FID	Shape	Id	Lat	Long
0	Point	1	22.057256	82.21871
1	Point	2	22.084013	82.22621
2	Point	3	22.031843	82.22454
3	Point	4	21.999447	82.2246
4	Point	5	22.02718	82.22728
5	Point	6	22.123893	82.23789
6	Point	7	22.181286	82.21542
7	Point	8	22.150391	82.22118
8	Point	9	22.22543	82.20371
9	Point	10	22.245418	82.19788
10	Point	11	22.368698	82.642
11	Point	12	22.358633	82.68183
12	Point	13	22.337931	82.69768
13	Point	14	22.311377	82.71117
14	Point	15	22.371482	82.69696
15	Point	16	22.379334	82.70803
16	Point	17	22.407816	82.69718
17	Point	18	22.476559	82.68033
18	Point	19	22.497831	82.65977
19	Point	20	22.534737	82.62094
20	Point	21	22.568644	82.57504
21	Point	22	22.606335	82.55805
22	Point	23	22.62568	82.53714
23	Point	24	22.689826	82.63534
24	Point	25	22.700248	82.71058
25	Point	26	22.70296	82.75855
26	Point	27	22.000894	82.32105

So from the above table we can select latitude and longitude of each pour point. And can install the pump station on these coordinates.

4. Conclusion

The DEM is representation of continuous elevation values over a topographic surface of z-values, referenced to a common datum. DEM's are typically used to represent terrain in a digitalized manner. The conclusion of my experiment is that after performing all the methods for watershed delineation of Bilaspur DEM data we will get the pour point where pump station could be installed in Bilaspur district so as to provide the easily flow of sewerage into a treatment plant or a river basin. In my experiment I have also

calculated longitude and latitude by using calculating geometry in lat and long field of pour point attribute table so that we can easily install our pump in these coordinate. These coordinate that we have get in our table because our DEM file is geo referenced in ArcGIS software.

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