ISSN: 2688-8653

Extraction of Catchment Basins from Digital Elevation Model Data based on Arc-Hydrology

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Abstract

For instance objects based on the HeiHe river basin and its water system, based on the space shuttle radar topography production of 90m high-resolution SRTM-DEM data, using the Hydrology ArcGIS10.2 hydrological analysis module of HeiHe river basin drainage network extraction and related analysis, verified the SRTM-DEM data application in hydrological analysis, also objectively shows the SRTM-DEM data the prospect of application in hydrological aspects is very objective.

Keywords

SRTM-DEM Data; Flow Accumulation; Hydrology; River Basin Characteristics; River Network.

1. Introduction

Geographic information system (GIS) in the mass data storage and management, spatial analysis and visual display and drawing the excellence of the respect such as function, especially its spatial analysis function is played a crucial role in all fields.Watershed information is the necessary information for hydrological simulation, and the extraction of watershed information is the premise of constructing a modern distributed hydrological model, hydrological simulation and other related research.With the wide application of GIS technology and the convenient acquisition of different precision DEM data, from DEM.

The data extracted from the water system network and the watershed boundary are of great concern and become the focus of GIS application in hydrology and environmental research.

This article is the GIS space analysis function in the application of hydrological analysis, the focus in the study of hydrological models from watershed hydrological statistical model to GIS combined with hydrological mechanism model of distributed hydrological model.In traditional hydrologic analysis applied research, the extraction of river basin is an important aspect, but there are two traditional methods of extracted basin, one is obtained through the field measurement river water system;The second is to measure and analyze the topographic map to obtain the river system.However, these two methods are difficult in practice, and many dangerous places cannot be measured in the field. In addition, the investment and expenditure of human resources resources are huge.

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2. Introduction to the Research Area and the Introduction of SRTM-DEM Data

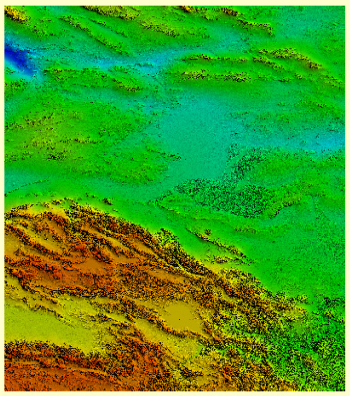

Figure 1. The four scene SRTM-DEM data in Globe Mapper

Figure 2. The four scene SRTM-DEM data in ArcGIS

Heihe river basin in northwest China is the second largest inland, from north of qilian mountains was interrupted, basin is bounded in qilian mountain south, north and bordering the Mongolian People's Republic of China, the shiyang river basin, east and adjacent, west into the shule river basin, basin range between east longitude 98 ° ~ 102 °, latitude 37 ° 50 '~ 42 ° 40', in qinghai, gansu, Inner Mongolia autonomous region three provinces (autonomous regions), the total area of 14.29 square kilometers, including 6.18 square kilometers, gansu province, qinghai province, 1.04 square kilometers, the Inner Mongolia autonomous region is about 7.07 square kilometers.The heihe river basin has 35 small tributaries.With the increasing use of water, some tributaries gradually lose the surface hydraulic connection with the dry flow, forming three independent sub-water systems in the east, middle and west.Among them, the western sub-water system includes the lai river and the hongshui river, which flows into the jintan basin, covering an area of 21,000 square kilometers.Central river water system including horse camp, feng river, was a tower of salt pond, a bright flowers basin area of 0.6 square kilometers, east son drainage the heihe river water system, including the heihe river, liyuan river, and more than 20 small tributaries along the mountain, covers an area of 11.6 square kilometers.

SRTM DEM - (Shuttle Radar Topography Mission) Shuttle Radar Topography measurement is in Germany and Italy's Space Agency, by NASA (National Aeronautics and Space Administration, NASA), National spatial information Intelligence (National Geospatial Intelligence Agency, NGA) work together to finish [10],In February 2000, by loading interference radar in the space shuttle endeavour in space flight 11 days, for the earth between latitude 60 DHS and 56 DHS (about 80% of the world's land surface, area of more than 119 million km2 of radar image data, the production of commonly used SRTM DEM data product a resolution of 1 arc arc seconds (about 30 m) and 3 seconds (90 m), covering China's area is 90 m resolution data (standard absolute elevation accuracy + 16 m, absolute precision plane + 20 m), these data are available for free public release [5-7]. The srtm-dem production map is one of the most valuable and globally beneficial data ever created by a scientific mission, which can be widely used in scientific

ISSN: 2688-8653

research, military, civil and other fields.Srtm-dem has two versions: srtm-dem version 1.0 (V1.0) data and srtm-dem version 2.0 (V2.0) data, also known as "Finished" version data;SRTM DEM version 2.0 (V2.0) data is NGA for V1.0 data post-processing, including the definition of editing, peak clipping to fill hollow, water body and the coastline of operation such as, although V2.0 data in data quality had greatly improved, but only for less than 16 consecutive data points to fill the missing area of, still have a lack of data in a large area of the zone without processing.

Table 1. The metadata information of SRTM-DEM

Data attribute parameter	value
UPPER LEFT X	79.7836538462
UPPER LEFT Y	46.5143171806
LOWER RIGHT X	113.9086538462
LOWER RIGHT Y	33.4856828194
WEST LONGITUDE	79° 47' 1.1538" E
NORTH LATITUDE	46° 30' 51.5419" N
EAST LONGITUDE	113° 54' 31.1538" E
SOUTH LATITUDE	33° 29' 8.4581" N
PIXEL SIZE X	0.0250551 arc degrees / pixel
PIXEL SIZE Y	0.0250551 arc degrees / pixel
SCALE	1:10541500
ENCLOSED AREA	4213937 km2
VIEW PIXEL SIZE	1362 x 520
Geographic Coordinate System	GCS_WGS_1984
Datum	D_WGS_1984
Columns and rows	(6000,6000)
Cell Sizes(X,Y)	(0.00083333333, 0.00083333333)

3. Example Operation and Result Analysis

3.1. Preprocessing of Data

The Mosaic data of the four - shot srtm-dem data is treated as the area of the instance operation.

3.2. Generation of DEM Data Without Depression

Figure 3. In the direction of flow to extract

Figure 4. The extraction of depression

According to the D8 algorithms to extract the flow direction, and calculate the lowland areas, according to the prescribed threshold to determine the extraction of depression area, the contribution of the calculation of the contribution to the regional minimum height and the

ISSN: 2688-8653

outlet of the lowest elevation, calculating the poor in the raster calculator is worth to the height of the depression. Hollow and its depth is calculated by means of this way, and then to fill depressions are numerous depressions of DEM data, in this illustration, depressions fill is an iterative process, the result is reached the ideal situation when depression have been filled, because of large amount of data, in this case only adopt a filling.

The calculation of the depression:

3.3. The Calculation of Confluence Cumulants

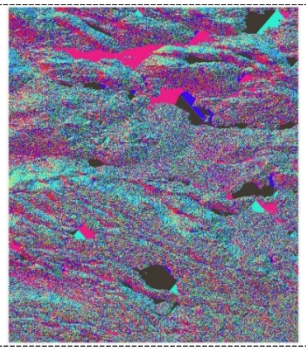

Figure 5. No depression extract DEM in the direction of flow

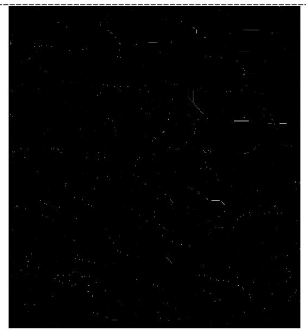

Figure 6. Cumulant Data

Due to the large amount of data, it is easy to display, so the enlarged image and the pixel color of Invert image in the image are displayed to get a clearer image.

3.4. Calculation of Current Length

Figure 7. Parallel computing

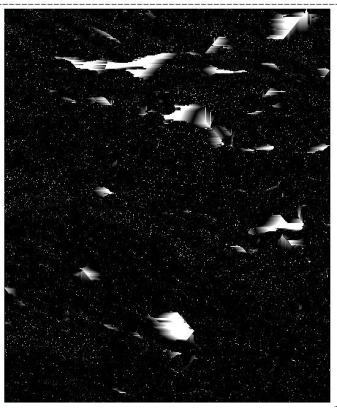

Figure 8. Go to calculate

3.5. Extraction of River Network

Figure 9. Raster river network to extract

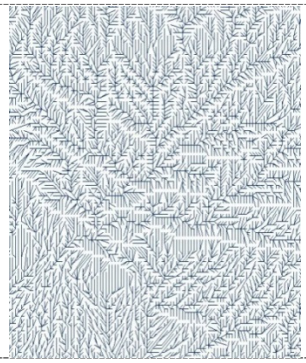

Figure 10. Lattice vector river water system

ISSN: 2688-8653

River network convergence of extraction process is mainly based on the cumulative amount of data, set the appropriate threshold, because of the different levels of valleys correspond to different threshold, the valleys of the same level in different regions of the corresponding threshold value are also different.Therefore, in this experiment, 500, 300,800 thresholds were used to extract the grid river network, and the effect was compared, and the threshold value of 500 threshold was selected as the river network extraction.

4. Interpretation of Result

Based on the srtm-dem 90m data of heihe river basin, this study USES ArcGIS Hydrology Tools function module to carry out data processing, and carries out hydrological simulation analysis of river basin with the download of heihe river basin.Analysis results show that SRTM DEM - 90 MB of data extraction on the basis of the digital river network spatial distribution and the actual situation is roughly, and the digital hydrological data can be directly as a hydrologic model parameters, can greatly improve the efficiency of the hydrological models, decrease the cost of data acquisition.

The accuracy of srtm-dem data is high, and ArcGIS software is powerful, and the combination of the two can easily and quickly accomplish the tasks such as terrain features and water system extraction.Gradient, slope direction and other information is the foundation of terrain analysis and application, and can be directly as a parameter, using SRTM DEM data - extraction of terrain factors can greatly improve efficiency, and it is concluded that based on SRTM DEM data extraction in the process of the river basin, water directly affects the whole river basin feature extraction threshold value results.According to the analysis, the river network in the river basin based on 90 m srtm-dem data was extracted, and when the threshold was 500, the generated river network could better reflect the river network in the region.

SRTM-DEM digital terrain data is the best, highest resolution, best precision global digital terrain data so far.Good to solve the data exists in the problem of "empty", make its application more widely in the whole world, is bound to make it in many fields of digital terrain analysis, hydrological simulation analysis in particular has a very broad application prospects.

Acknowledgments

The project was supported by Soil moisture inversion study of the Loess Plateau dry plateau based on SAR radar data (DJNY2022-23).

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