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Comparative Study of Landsat and Aster Data by Morphometric Analysis

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Abstract

In this paper, a case-study is presented to differentiate between Landsat and Aster data by morphometric analysis. For this the Aster and Landsat digital elevation model (DEM) data of the same study area was taken and then both the data was delineated for the same (common) outlet. The major differences found in between Landsat and Aster data after delineation are in the number of first order stream, axial length of streams, average width and size of watershed. The case study presented will be useful in demonstrating the fact that Landsat DEM has better accuracy than Aster DEM for land cover areas when the DEM data characteristic are kept similar.

Keywords: ArcGIS 9.3, Aster; Digital Elevation Model, Landsat, Morphometric Analysis;

1. Introduction

Watersheds are natural hydrological entities that cover a specific aerial expanse of land surface from which the rainfall runoff flows to a defined drain, channel, stream or river at any particular point. The morphometric parameters of a watershed are reflective of its hydrological response to a considerable extent and are helpful in synthesizing its hydrological behavior because it enables us to understand the relationship among different aspects of the drainage pattern of the basin, and also to make a comparative evaluation of different drainage basins developed in various geologic and climatic regimes.

The basin morphometric characteristics of the various basins have been studied by many scientists using conventional (Horton, 1945; Smith, 1950; Strahler, 1957) and remote sensing and GIS methods (Krishnamurthy and Srinivas, 1995; Srivastava and Mitra, 1995; Agarwal, 1998; Biswas et al., 1999; Narendra and Nageswara Rao, 2006). The rapidly emerging Geoinformatics technology has effective tools to overcome most of the problems of land and water resources planning and management on the account of usage of conventional methods of data process. Morphometric analysis requires measurement of linear features, gradient of channel network and contributing ground slopes of the drainage basin.

In this study two DEM data (Landsat and Aster data, of same pixel resolution of 30 meter), was used to analysis an area of 4996.2 km^2 covering East Singhbhum. Both Landsat and Aster DEM data was downloaded from GLCF having the same latitude and longitude boundaries. Then both the data were processed in ArcGIS 9.3 and DEM based automatic delineation method was used to delineate the watershed at the same common outlet. This automation has made delineation very dependent on the quality of the digital elevation data.

2. Study area and Data

The region selected for proposed study is an area covering East Singhbhum which is situated at the southeast corner of Jharkhand in India showed in figure 1. The district is bounded on the east by Midnapore district, on the north by Purulia district, both of West Bengal, on the west by West Singhbhum district of Jharkhand state and on the south by

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Mayurbhanj district of Odisha. From the industrial growth and mining quarrying point of view this district has leading position in Jharkhand and this area is rich in minerals and is found abundantly. Iron Ore, Copper, Uranium, Gold Kyanite are the main minerals.

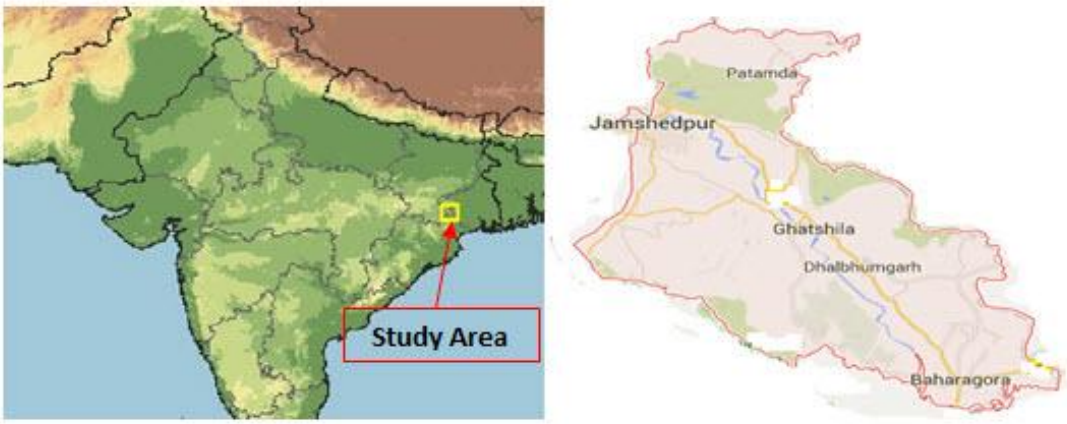

Figure 1. Index map of study

The input data for the proposed study are Landsat DEM and Aster DEM having 30m resolution and have same latitude and longitude (Data source characteristic shown in table 1). Landsat imagery is available since 1972 from six satellites in the Landsat series with three primary sensors evolving over thirty years: MSS (Multispectral Scanner), TM (Thematic Mapper) and ETM+ (Enhanced Thematic Mapper Plus). The Aster sensor is an imaging instrument flown on the Terra satellite which was launched in December 1999. It covers a wide spectral region with 14 bands from the visible to the thermal infrared with high spatial, spectral and radiometric resolution. The spatial resolution varies with Wavelength: 15 m in the visible and near-infrared (VNIR), 30 m in the short wave infrared (SWIR), and 90 m in the thermal Infrared (TIR). Data source characteristic of the DEM data is shown in table 1:

Table 1. Data source characteristic

	LANDSAT	**ASTER**
DATA SOURCE	GLCF	GLCF
SENSOR	TM	SWIR
PIXEL RESOLUTION	30 meter	30 meter
LATITUDE	22^0 12’ - 23^0 01’N	22^0 12’ - 23^0 01’N
LONGITUDE	86^0 04’- 86^0 54’E	86^0 04’- 86^0 54’E

3. Methodology

There are two methods used to delineate the watershed, DEM based automatic delineation and manual delineation. In automatic delineation, DEM used as an input and boundary created automatically by computer while in manual delineation, manually draw the watersheds by clicking on map. Automatic delineation method used in the present study the details of which are shown in flowchart below.

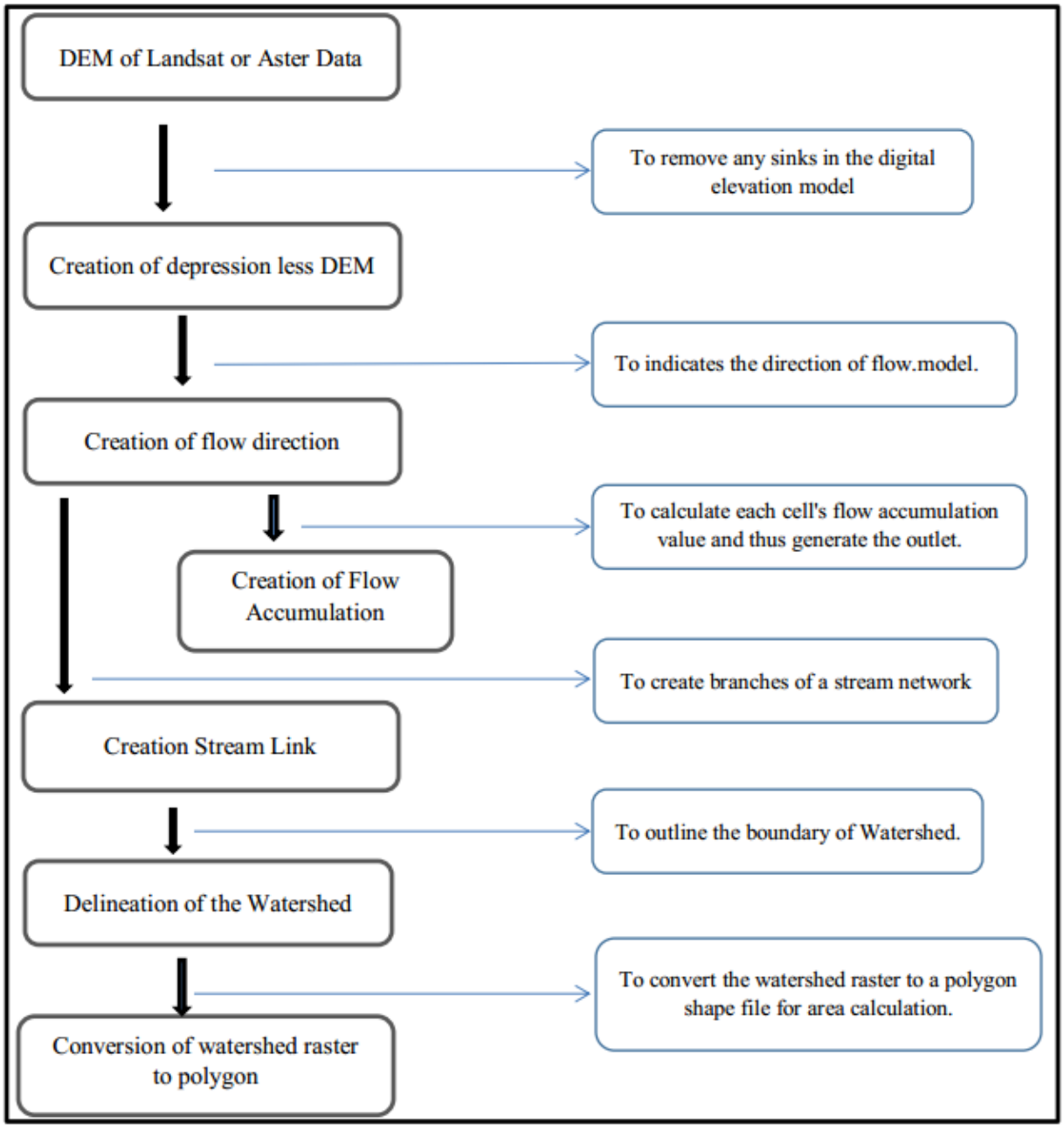

Figure 2. Outline of automatic Watershed Delineation method by ArcGIS 9.3

4. Results and Discussions

The Aster and Landsat DEM data downloaded and processed in ArcGIS 9.3. The Study area (East Singhbhum) watershed map, stream network map and sub-watershed boundaries map have been prepared using ArcGIS 9.3. Basins delineation algorithm provides similar distribution of sub basins However, the outlet of sub-basin boundaries is at same point. Figure 3 and 4 shows delineated watershed of both of the Aster and Landsat DEM data.

The above figures show some comparative results:

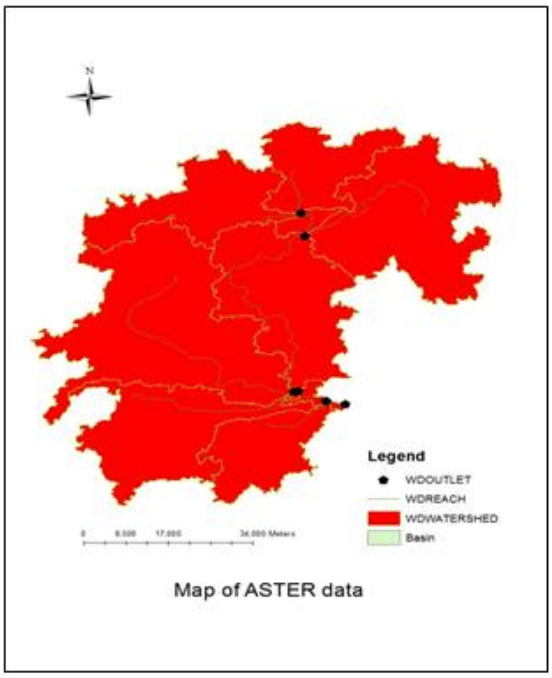

Figure 3. Delineated watershed of Aster

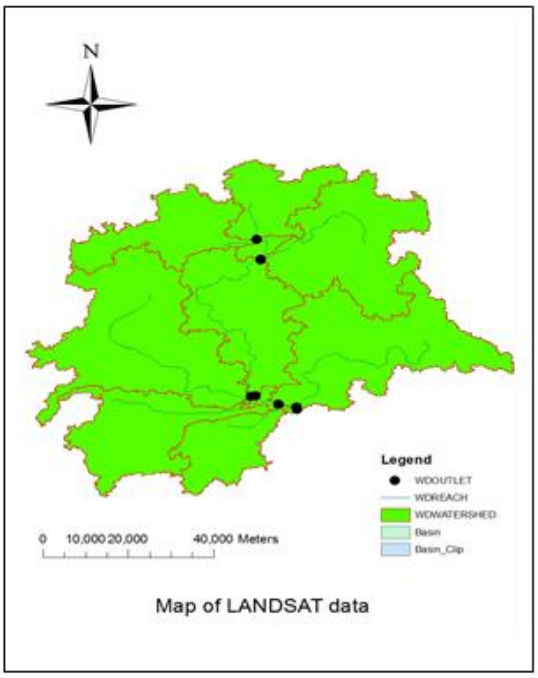

Figure 4. Delineated watershed of Landsat

The above figures show some comparative results:

- Axial length and Average width provided by both of the delineations are relatively different to each other. Axial length is more in the case of Aster data delineation and Average width is more in the case of Landsat data delineation

- Stream number is different for first order stream but same for higher order stream. Aster DEM based delineated watershed have 7 number of 1st order streams while in Landsat DEM based delineated watershed have 6 number of 1st order streams.

- Area of watershed is found to be comparatively different for both watersheds. Area of Aster data based delineated watershed = 4231.637 km^2 and Area of Landsat data based delineated watershed= 5560.327 km^2 while actual area of watershed is 4996.2km^2.

5. Summary and Conclusions

The utility of satellite remote sensing for morphometric analysis is emphasized in the present study. ArcGIS software was used. There is a valuable difference found in delineated watershed of Landsat and Aster database having same outlet point. As most of the area is land cover therefore it can be concluded that Landsat DEM has better accuracy than Aster DEM for land cover areas. As a result, it is concluded that field surveys should be considered in conjunction with digital manipulation for the accurate classification of stream orders, watershed area, average width, axial length and all other morphometric variables.

6. References

[1] Agarwal, C. S. "Study of drainage pattern through aerial data in Naugarh area of Varanasi district, UP." Journal of the Indian Society of Remote Sensing 26, no. 4 (1998): 169-175.

[2] Biswas, Sujata, S. Sudhakar, and V. R. Desai. "Prioritisation of subwatersheds based on morphometric analysis of drainage basin: A remote sensing and GIS approach." Journal of the Indian society of remote sensing 27, no. 3 (1999): 155-166.

[3] Bose, AS Chandra, P. Sridhar, M. V. S. S. Giridhar, and G. K. Viswanadh. "Watershed delineation and stream network analysis uisng gis."

[4] Hendriks, J. P. M., and P. Pellikka. "Semi-automatic glacier delineation from Landsat imagery over Hintereisferner in the Austrian Alps." Zeitschrift fur Gletscherkunde und Glazialgeologie 41 (2007): 55.

[5] Horton, Robert E. "Drainage basin characteristics." Eos, Transactions American Geophysical Union 13, no. 1 (1932): 350-361.

[6] Krishnamurthy, J., and G. Srinivas. "Role of geological and geomorphological factors in ground water exploration: a study using IRS LISS data." International Journal of Remote Sensing 16, no. 14 (1995): 2595-2618.

[7] Narendra, K., and K. Nageswara Rao. "Morphometry of the Meghadrigedda watershed, Visakhapatnam district, Andhra Pradesh using GIS and Resourcesat data." Journal of the Indian Society of Remote Sensing 34, no. 2 (2006): 101-110.

[8] Singh, B., and J. Dowerah. "ASTER DEM based studies for geological investigation around Singhbhum Shear Zone (SSZ) in Jharkhand, India." Journal of Geographic Information System 2, no. 01 (2010): 11.

[9] Smith, Kenneth Grant. "Standards for grading texture of erosional topography." American Journal of Science 248, no. 9 (1950): 655-668.

[10] Srtvastava, V. K., and D. Mitra. "Study of drainage pattern of Raniganj Coalfield (Burdwan District) as observed on Landsat-TM/IRS LISS II imagery." Journal of the Indian Society of Remote Sensing 23, no. 4 (1995): 225-235.

[11] Strahler, Arthur N. "Quantitative analysis of watershed geomorphology." Civ. Eng 101 (1957): 1258-1262.