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HYDROLOGIC INFORMATION EXTRACTION OF WATERSHED AND STREAM NETWORK DELINEATION BASED ON ARC HYDRO TOOL AND DEM OF MYNTDU RIVER BASIN, MEGHALAYA

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Abstract: The study is showing that automatically extracting watershed features based on Arc Hydro tools are achievable and effective. ArcHydro is a model developed for building hydrologic information systems to synthesize geospatial and temporal water resources data that support hydrologic modeling and analysis. This automation of running the model to obtain the delineated watersheds, just like ArcHydro Add-on, is much simpler. Using this tool, a user can obtain the desired result with three clicks. It has the option to set input data, output file names, and output folders of one's convenience. **Myntdu River** is one of the major water bodies in Jaintia Hills District of Meghalaya, has been taken as the study area. A Digital Elevation Model (DEM) is used to extract various watershed features of the Myntdu River basin to obtain hydrologic modeling and analysis.

Key Words: ArcHydro, hydrologic mdeling, Hydrologic analysis, DEM, Myntdu River, delineation.

Introduction:

Extracting watershed features using DEM (Digital Elevation Model) is a very useful function in Hydrologic study, and also it is the pre-process of hydrological simulation analysis. This paper introduces a very easy and useful method for Hydrological simulation analysis through extracting watershed features from DEM using Arc Hydro Tools. While performing hydrologic modelling the primary step involves delineating streams and watersheds, and getting some rudimentary watershed properties such as area, slope, flow length, stream network density, etc. Typically this is being done manually by using topographic/contour maps. With the availability of digital elevation models (DEM) and GIS tools, watershed properties can be extracted by using automated procedures. The processing of DEM to delineate watersheds is referred to as terrain pre-processing. There are several tools available online for terrain pre-processing. In this exercise, Arc Hydro tools are used to process a DEM to delineate watershed, stream network and some other watershed characteristics that collectively describe the drainage patterns of **Myntdu River** basin. The model is developed as an Add-on to ArcGIS software. It is used to extract topological variables from a digital elevation model raster (DEM) for building geometric networks for hydrologic analysis (Dost, 2005)

Study Area and Data used:

Myntdu River is one of the major water bodies in Jaintia Hills District, Meghalaya, locally known as 'ka Tawiar ka Takan' (Our Guardian Angel) in the Pnar dialect. It is a blessing to the residents of the town of Jowai and adjacent places. Its abundant water is used to irrigate the Myntdu Valley, located on the outskirts of Jowai Town. The River originating at 1420 meters (4660ft) above sea level.

Data Used -

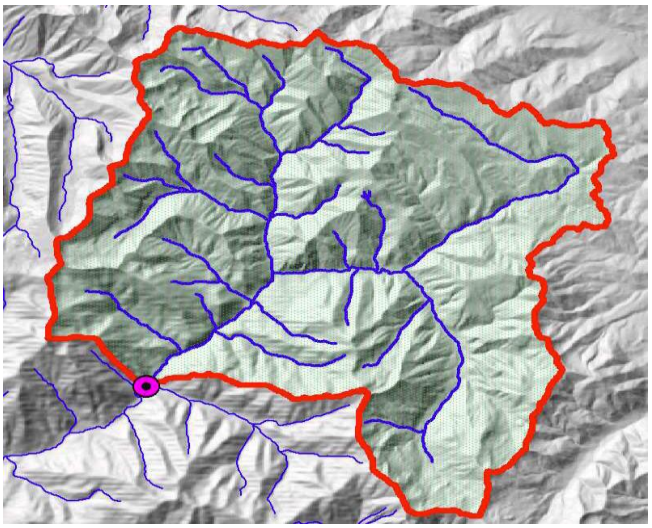
- CARTO DEM .
- SRTM DEM.
- CARTOSAT IMAGE 1m resolution.

Objectives:

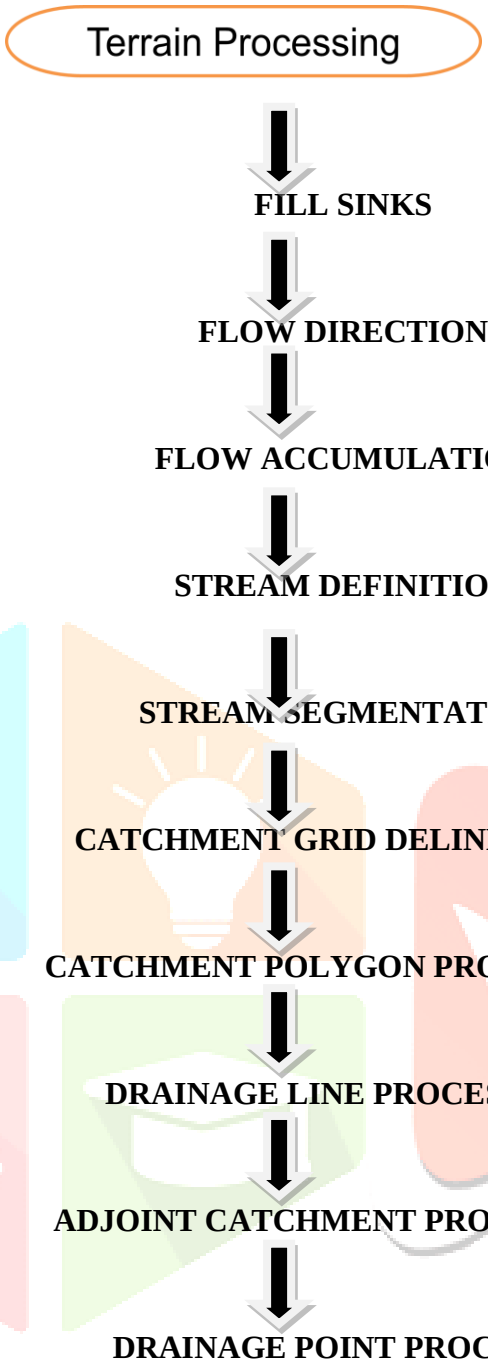
- To delineate the Myntdu River Basin using Arc GIS tools.
- To perform Automatic and Manual Delineation of stream networks.
- To compare stream networks obtained from Automatic and Manual Delineation.

Introduction to Delineation:

- Creating a boundary that represents the contributing area for a particular control point or outlet.
- Used to define boundaries of the study area, and/or to divide the study area into sub-areas.
- Delineated watersheds are required for HSPF modeling and for BASINS watershed characterization reports.
- So we can characterize and investigate what is going on in one portion of the study area versus another.
- Delineation is part of the process known as watershed segmentation, i.e., dividing the watershed into discrete land and channel segments to analyze watershed behavior.



Methods used in Delineation:



Drainage Point Processing:

The first step in doing any kind of hydrologic modelling involves delineating streams and watersheds, and getting some basic watershed properties such as area, slope, flow length, stream network density, etc.

- Using the availability of Digital Elevation Models (DEM) and GIS tools, watershed properties can be extricated by using automated procedures. The processing of DEM to outline watersheds is referred to as terrain pre-processing.
- Arc Hydro tools is used to process a DEM to delineate watershed, sub-watersheds, stream network and some other watershed characteristics that collectively draw the drainage patterns of a basin.

Delineation methods

• DEM Based (Automatic Delineation)

- Water flows downhill
- Grid cell based approach
- Boundaries created automatically by computer

• Manual Delineation

- Drawing watersheds by clicking on the map
- Requires underlying data for accuracy

Terrain Pre-processing:

- It is one of the most important steps in data preparation for water resources analyses using Arc Hydro tools.
- Arc Hydro Terrain Pre-processing should be performed in sequential order. All of the pre-processing must be completed before Watershed Processing functions can be used.

Fill sinks:

- This function fills the sinks in a grid.
- If cells with higher elevation surround a cell, the water is trapped in that cell and cannot flow. The Fill Sinks function modifies the elevation value to eliminate these problems.
-

Filling the DEM:

- After getting the DEM, there is need to fill the depressions if any in the DEM to get avoid false routings.
- Open the fill tool and give the DEM as the input files. It fills the sinks in the surface raster and removes small imperfections in the data.

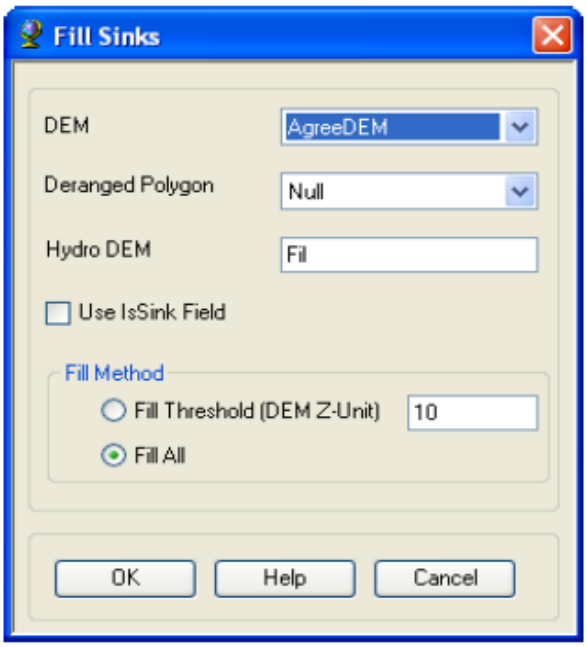
Fill Sinks in ArcGIS :

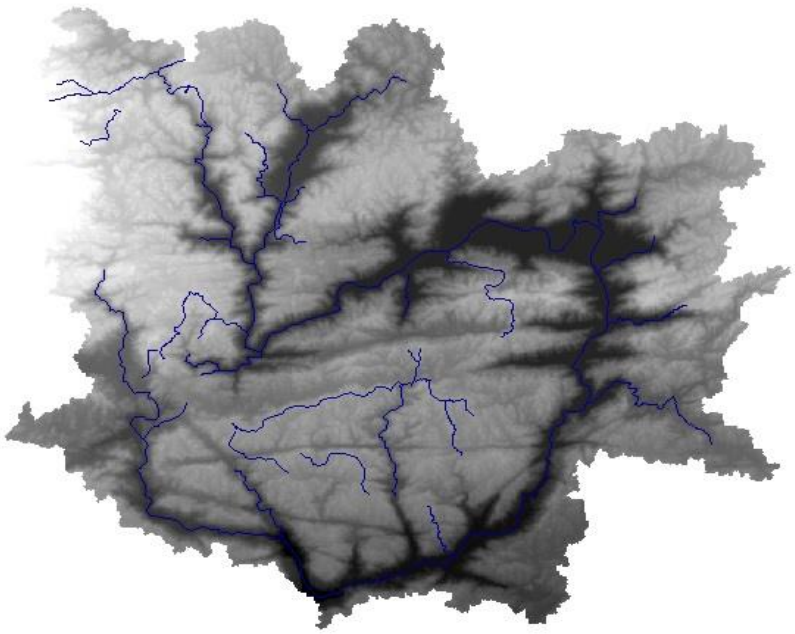
On the **ArcHydro Toolbar** ;

Select: ***Terrain Preprocessing >Data Manipulation > Fill Sinks****;*

Confirm that the input for DEM is ***AgreeDEM*** (or your original DEM if Reconditioning was not implemented). The output is the Hydro DEM layer, named by default ***Fil***. This default name can be overwritten. Leave the other options unchanged

Press ***OK***. Upon successful completion of the process, the ***Fil*** layer is added to the map.

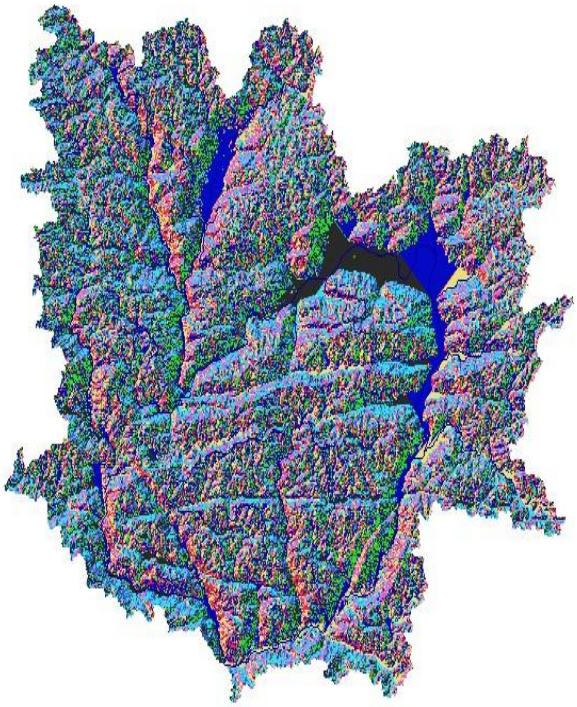




Flow Direction:

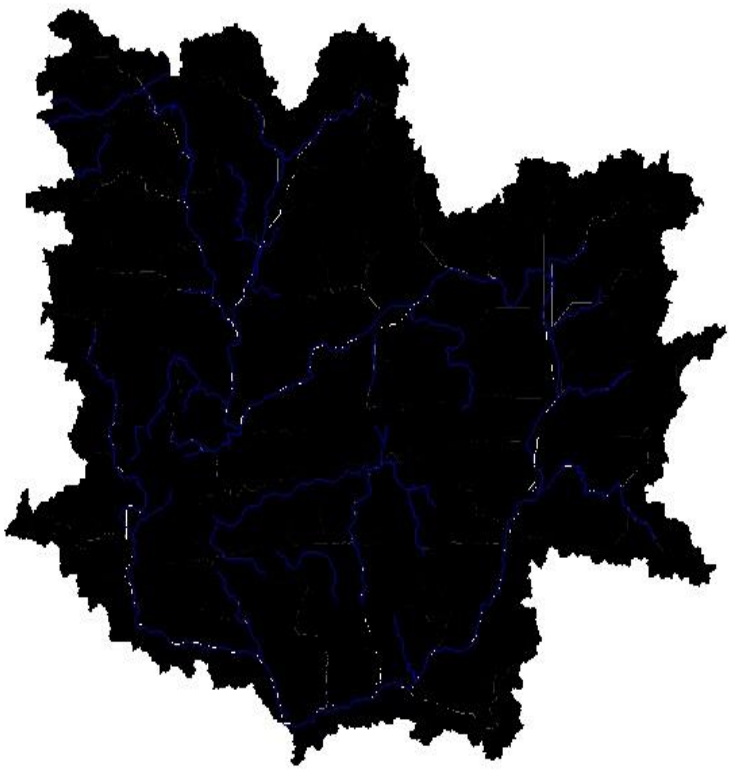
- This function computes the flow direction for a given grid.
- The values in the cells of the flow direction grid indicate the direction of the steepest descent from that cell.


Flow Direction
Hydro DEM
Fil
Outer Wall Polygon
Null
Flow Direction Grid
Fdr
OK
Help
Cancel



Flow Accumulation:

- This function computes the flow accumulation grid that contains the accumulated number of cells upstream of a cell, for each cell in the input grid.



Stream Segmentation:

- This function creates a grid of stream segments that have a unique identification. Either a segment may be a head segment, or it may be defined as a segment between two segment junctions.
- All the cells in a particular segment have the same grid code that is specific to that segment.

Catchment Grid Delineation:

- This function creates a grid in which each cell carries a value (grid code) indicating to which catchment the cell belongs.
- The value corresponds to the value carried by the stream segment that drains that area, defined in the stream segment link grid.

Catchment Polygon Processing :

- This function converts a catchment grid into a catchment polygon feature.

Drainage Line Processing :

- This function converts the input Stream Link grid into a Drainage Line feature class. Each line in the feature class carries the identifier of the catchment in which it resides.

Adjoin Catchment Processing :

- This function generates the aggregated upstream catchments from the Catchment feature class. For each catchment that is not a head catchment, a polygon representing the whole upstream area draining to its inlet point is constructed and stored in a feature class that has an Adjoint Catchment tag.
- This feature class is used to speed up the point delineation process.

Drainage Point Processing :

- This function allows generating the drainage point associated to the catchments.

Conclusion:

Here the great importance of using the D.E.M. in hydrographic studies has been realised. Instead of studying the contour lines for many topographic maps which take long time to understand the topo- surface, then delineated the watershed of each stream or river, here the **Archydro** extension has been used that uses the D.E.M. as a base for analyse and delineate the watershed in few hours and find its area directly. One of the great advantages of using GIS for hydrologic studies is to suggest the best location for construction of dams or to locate monitoring (gauge) points.

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