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Development of a Hydrological Model for Automation of Watershed Analysis

by

Hassan MUSA and Adamu BALA, Nigeria

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SMART SURVEYORS FOR LAND AND WATER MANAGEMENT**

PRESENTATION OUTLINE

- Introduction
- Materials and Methods
- Results And Discussion
- Conclusion

Introduction

- A watershed is a contributory area through which water flows across the land and drains into a major river, stream, etc.
- Watershed can be used for the analysis of Basin area, watershed slope, lag time, drainage pattern etc.
- Nowadays, with the user's digital elevation, coordinates of the spillway, watershed can be delineated with a few lines of codes in Jupyter-python.
- This paper aimed at the automation of the process of watershed delineation using pysheds and python.

Materials and Methods

Materials

Software used and the application

- i. Anaconda python 3.8 was utilized for coding
- ii. Pysheds library provided the required geospatial tools
- iii. Numerical python(numpy) was used for array analysis of values
- iv. Matplotlib was used for plotting the outcome of the geospatial analysis
- v. Geopandas was used for depicting the geospatial figures
- vi. Docker for deployment of the model
- vii. Notepad for creating a dockerfile

Data used

- i. SRTM Digital elevation
- ii. Coordinates of the pour-point or outlet
- iii. Threshold value

Materials and Methods

Methods

Design of model

- ✓ This analysis requires the digital elevation topography to be hydrologically corrected (i.e free from sinks and peaks) to enable water travel from upward to downward elevation (pour-point, spillway or outlets) with only the force of gravity as a driven force.
- ✓ the model was design to detect the depressions in the form of sinks ; detect the flats or peaks; resolve the flats or peaks; create the flow direction etc.

Materials and Methods

Methods

Modelling

- The coding started with the installation of relevant open source softwares :pysheds, geopandas, python etc.
- The python libraries required for the coding such numerical python, pysheds, geopandas and matplotlib were imported in to a Jupyter workspace.
- The modelling continues with the opening of the raster, detecting and filling or resolving raster depressions, creating the flow direction, delineating catchment and plotting the result after each process and #tag was used to indicate comment or explanation

Materials and Methods

Methods

Deployment

At the deployment stage docker file (which is the instruction given to the docker to create an image) was created with windows power shell with parameters such as python 3.8 as base image, python code, directory, python libraries used as parameters pysheds, matplotlib and numpy as dependencies and CMD as executables.

Model testing

The model was finally tested with the digital elevation of Jibia dam region and coordinate of the spill-way to analyse the watershed of the upstream of the dam.

Results and Discussion

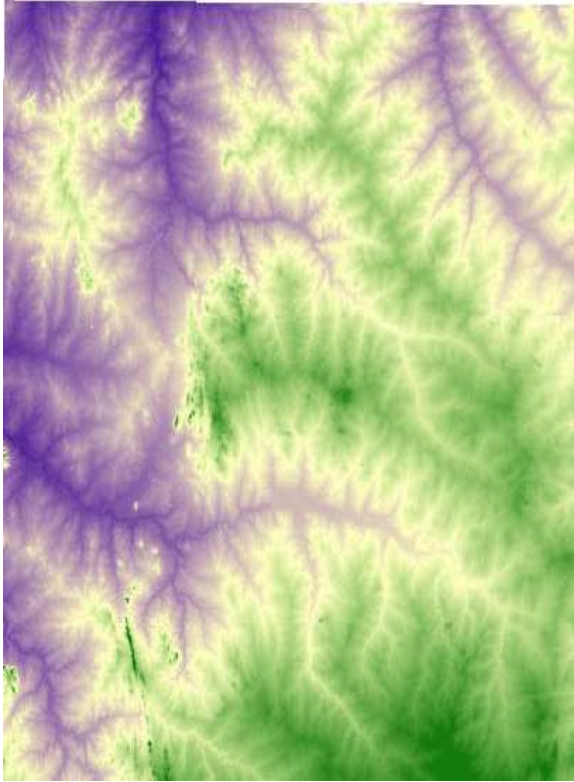


Figure 1: Raw digital elevation



Figure 2: Detected depressions(sinks)

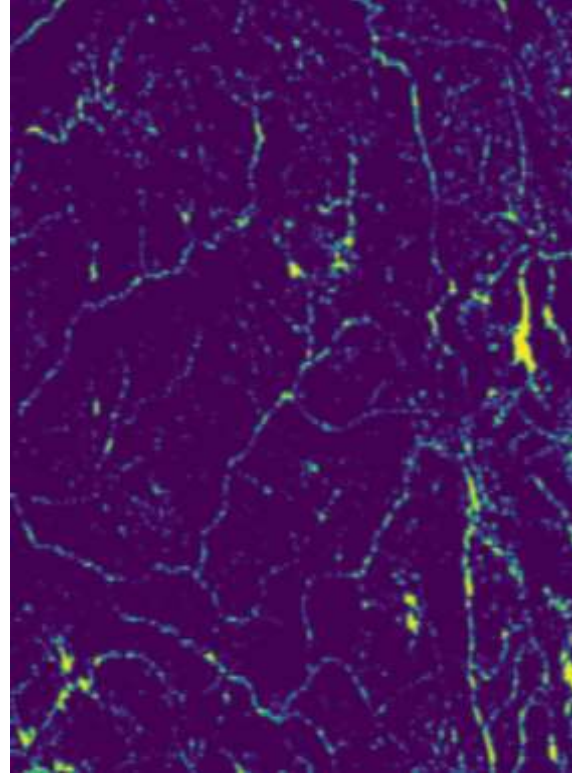


Figure 3: Detected flats(peaks)

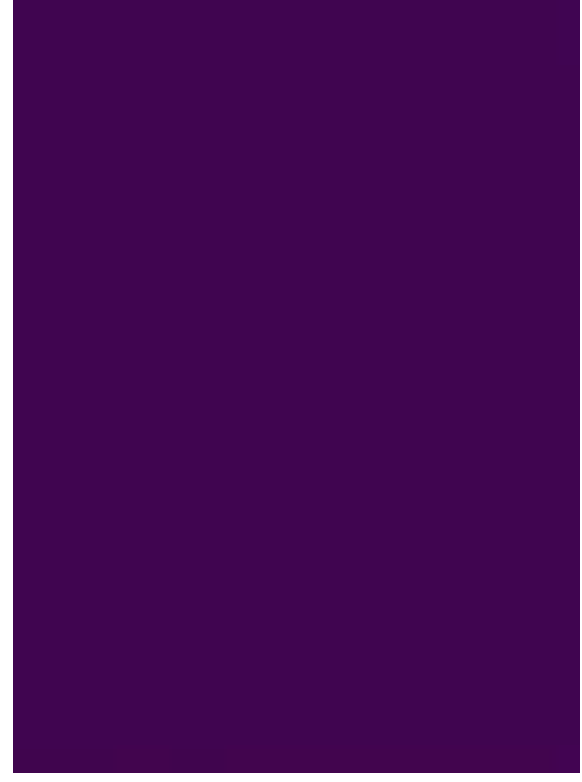


Figure 4: Corrected digital elevation

Results and Discussion

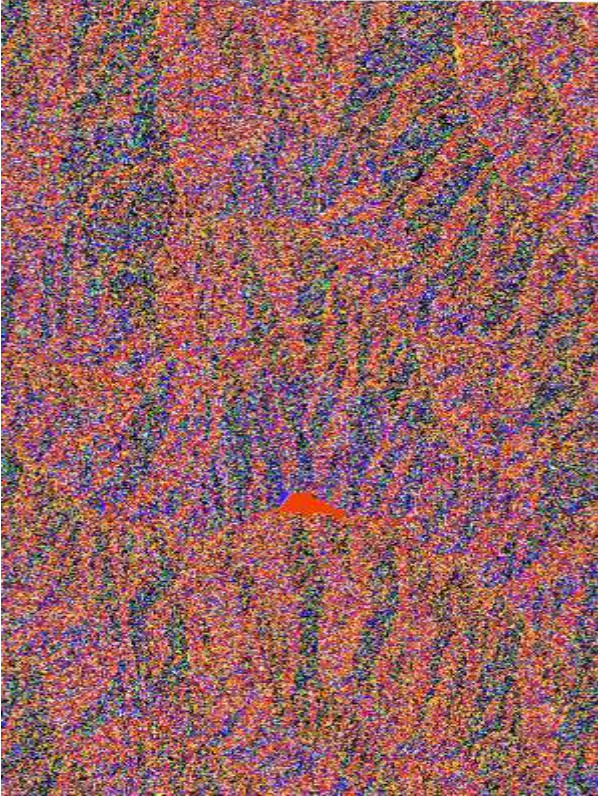


Figure 5 Flow direction

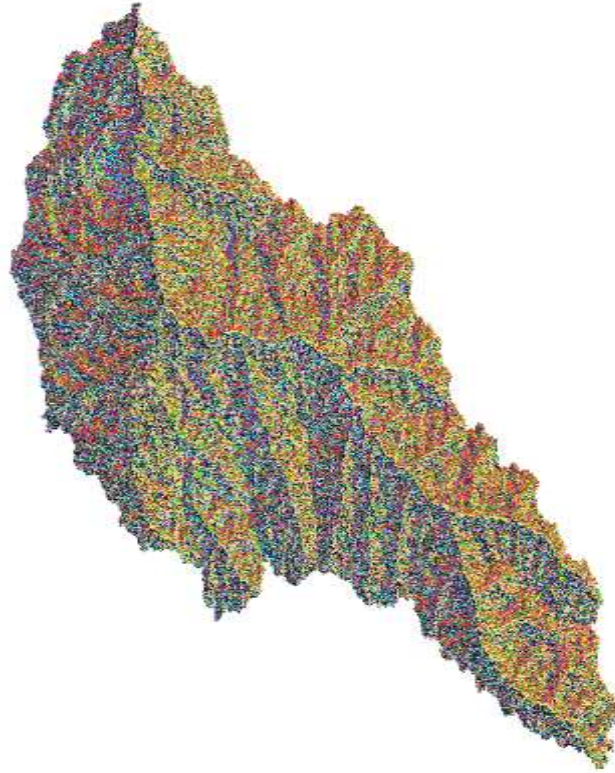


Figure 6: Watershed(catchment)



Figure 7: Stream network

Results and Discussion

- ❖ Figure 1-7 is the results of the reading raster data, detection of sinks and peaks, the result of resolving raster depressions, flow-direction, catchment delineation and the stream-network extraction using pysheds in anaconda and python libraries.
- ❖ Python and pysheds has the ability to carry out analysis perform by ArcGIS (commercial) with additional capabilities such as detection, filling and resolving sinks and peaks respectively.
- ❖ This model is now containerized by docker technology for sharing with everyone.
- ❖ The model can process digital elevation raster with high speed and accuracy as revealed by this research.
- ❖ The result of this analysis can be opened and read in both ArcGIS, QGIS etc.

Conclusion

- ✓ This study automated the processes of watershed delineation and stream network extraction through design of model, coding, deployment and testing of the model.
- ✓ The data utilized for testing of the model were the digital elevation of some parts of Jibia, Katsina State
- ✓ The outcome of the study were the catchment area of the dam and stream network of the upstream basin.
- ✓ Testing of the model shows the model can recognize all type of digital elevation data with any coordinate reference system and extract flow direction and stream network in 10 and 15 seconds.
- ✓ The study laid the foundation for continuous development of model for combination of watershed, elevation and land-use land-cover data.
- ✓ It is therefore recommended that, this model should be package as software plugins.

Thank you for
listening