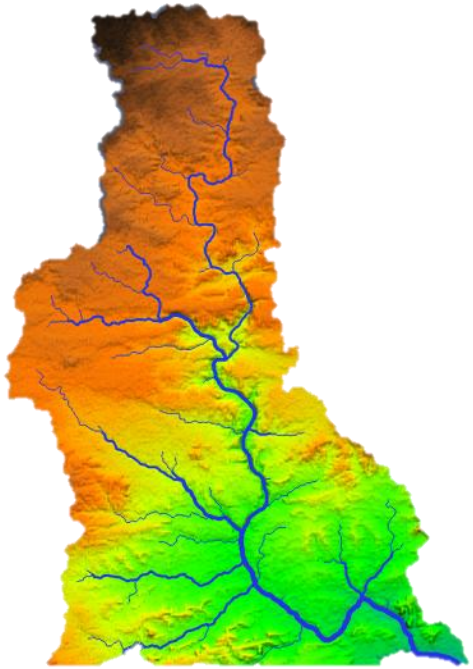
Advanced Modelling Technique for Water Resource Manage

AMTWRM WORKSHOP | MARCH-2021 | 22 | 23 | 24

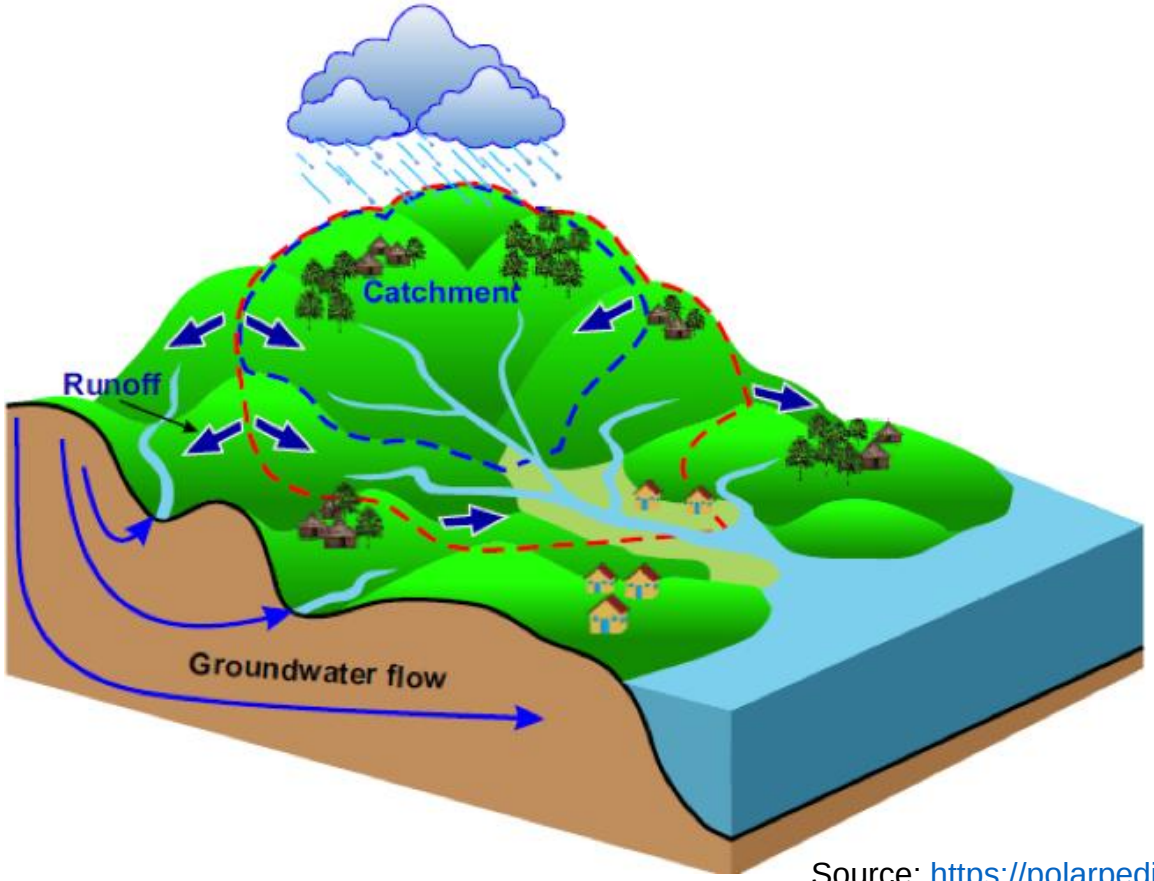
“Catchment Parameters Delineation Process”



Dr. Ankit Deshmukh
(Assistant Professor)
ankit.deshmukh@sot.pdpu.ac.in
CED SoT, PDEU, Gandhinagar

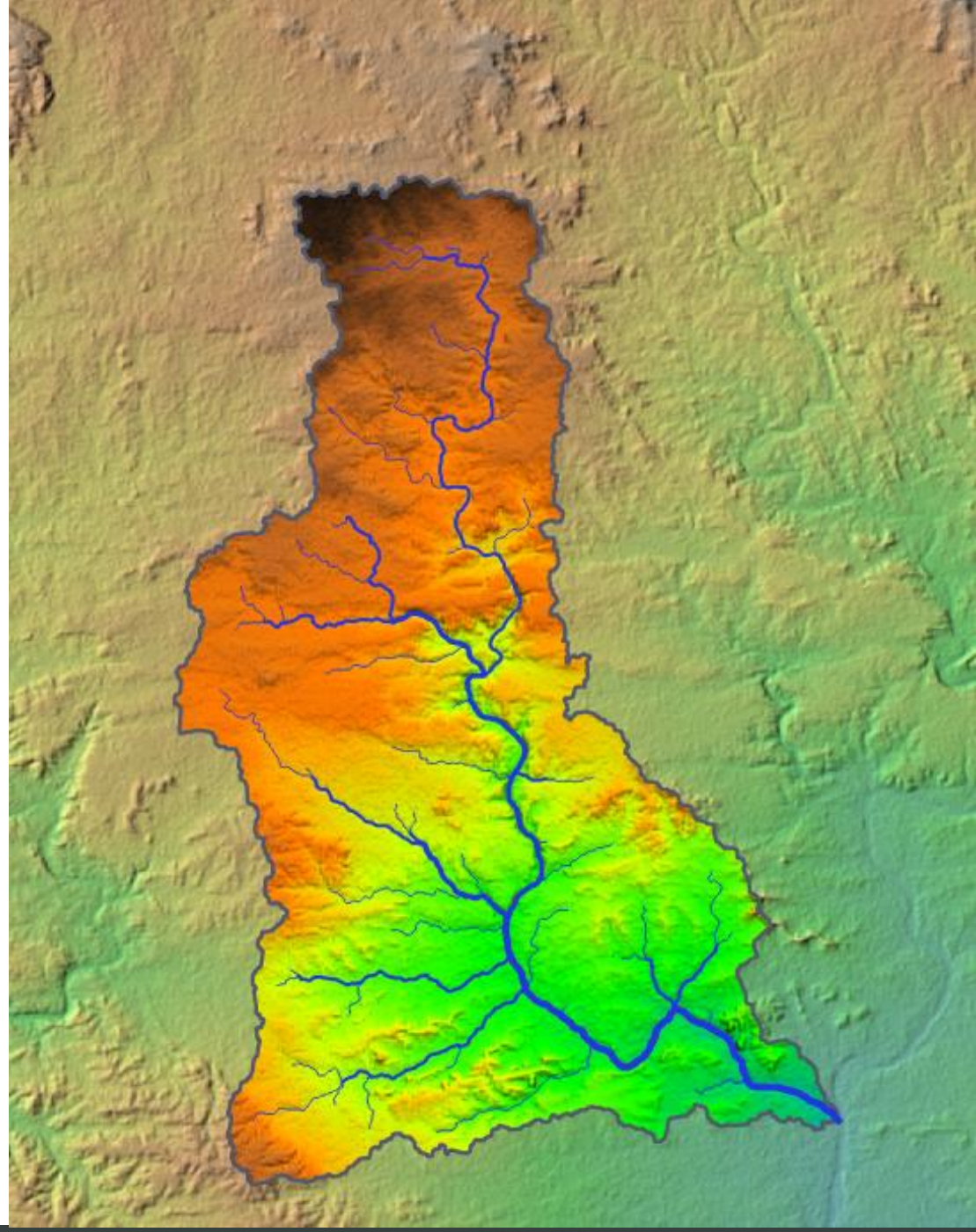
What is a catchment

Catchments are areas of land where runoff collects to a specific zone.

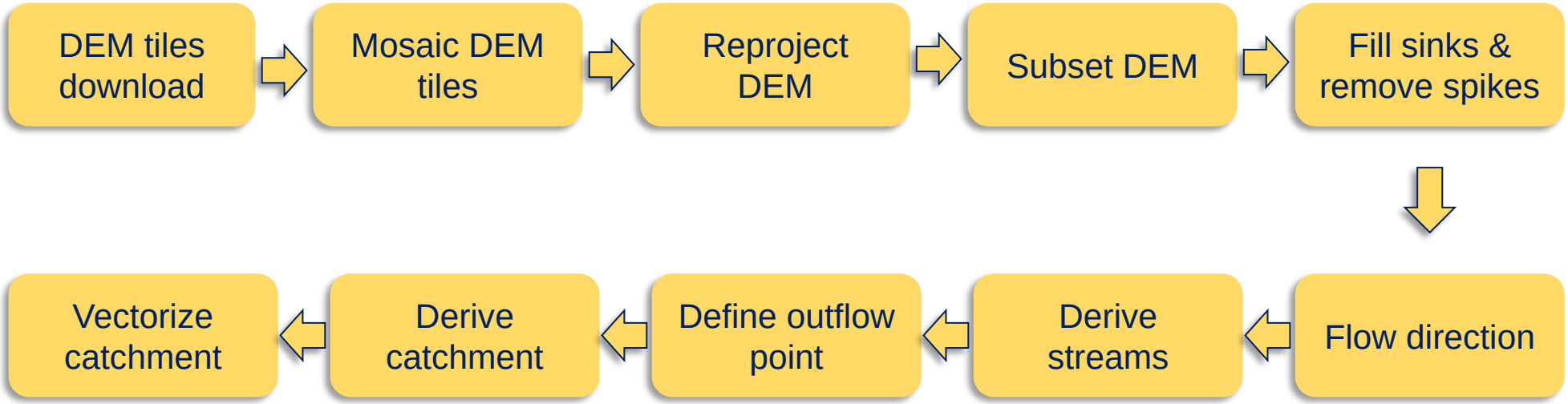


Source: https://polarpedia.eu/

A catchment is a basic hydrological unit in hydrological analysis.



The process of catchment delineation



Source: www.ocw.unesco-ihe.org

QGIS to catchment and stream delineation

Download QGIS

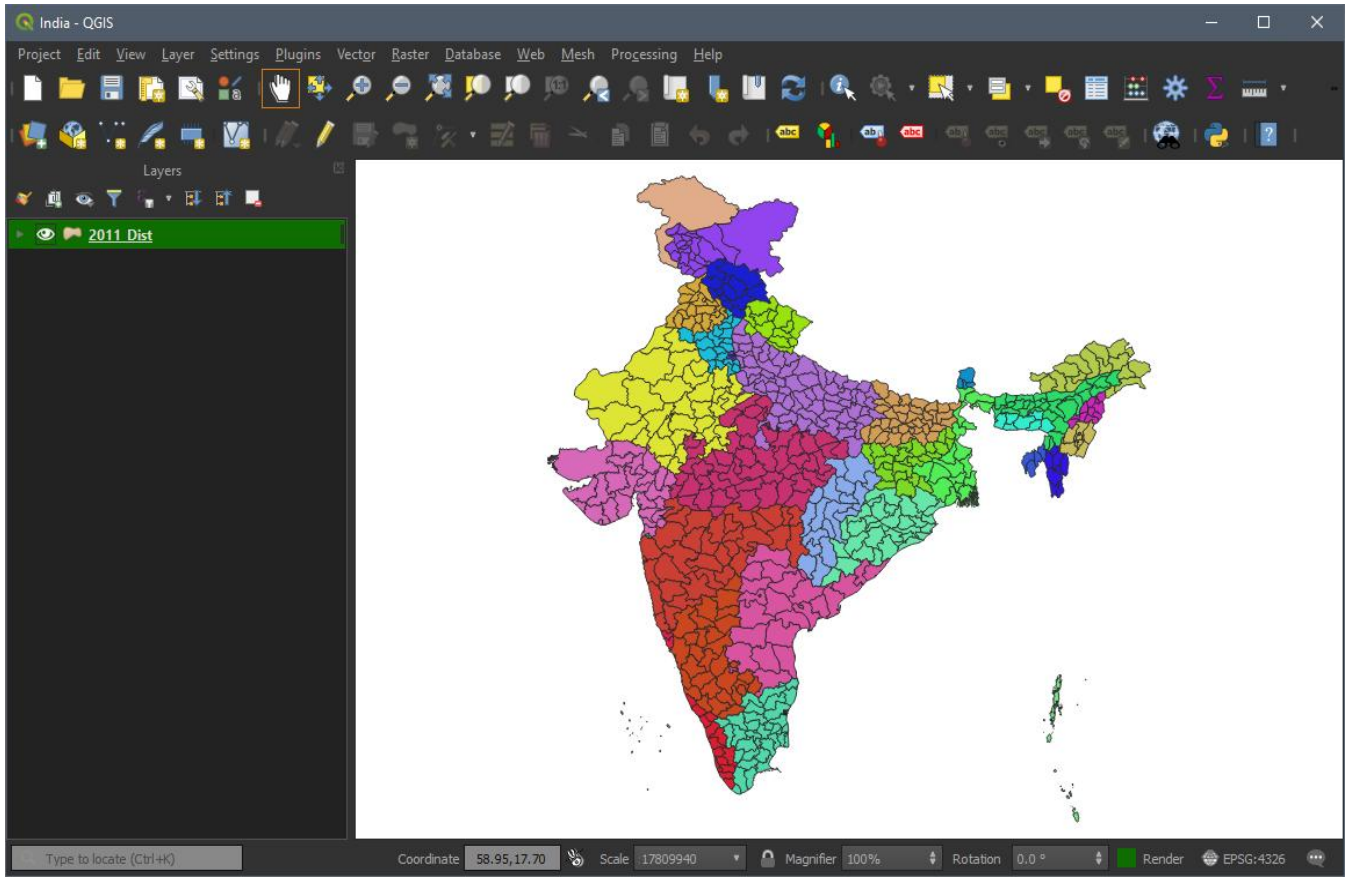
QGIS is a free and open-source cross-platform desktop geographic information system application that supports viewing, editing, and analysis of geospatial data.

Why I use QGIS

1. QGIS is Free and Open source (FOSS)
2. QGIS is cross platform
3. The use of open source GIS is growing
4. Plenty of QGIS support and Tutorials
5. Cartography, data visualization and styling
6. It's rapidly growing and evolving.

QGIS resource

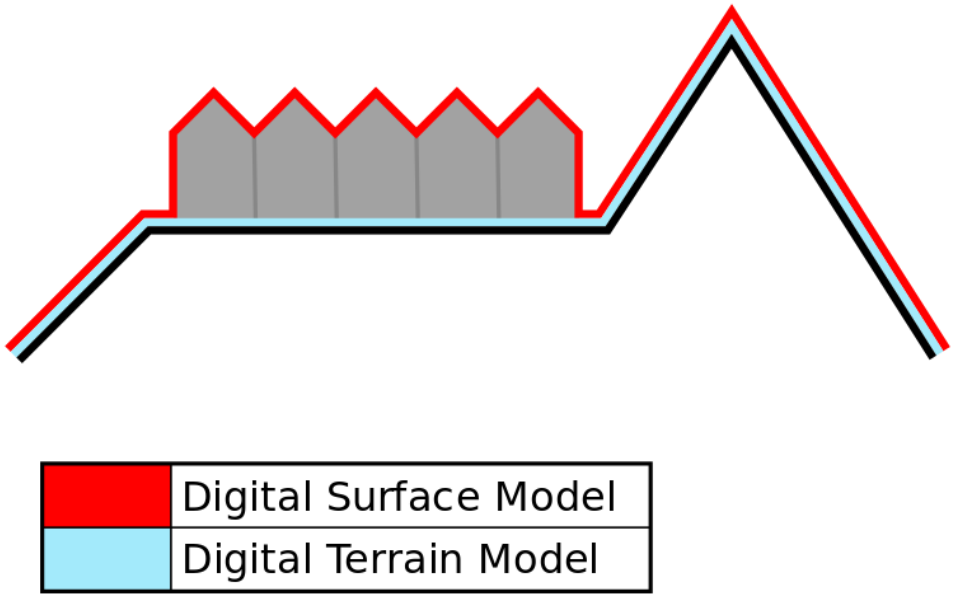
1. Documentation (qgis.org)
2. QGIS Python API documentation
3. QGIS Learning Resources
4. Geographic Information Systems Stack Exchange



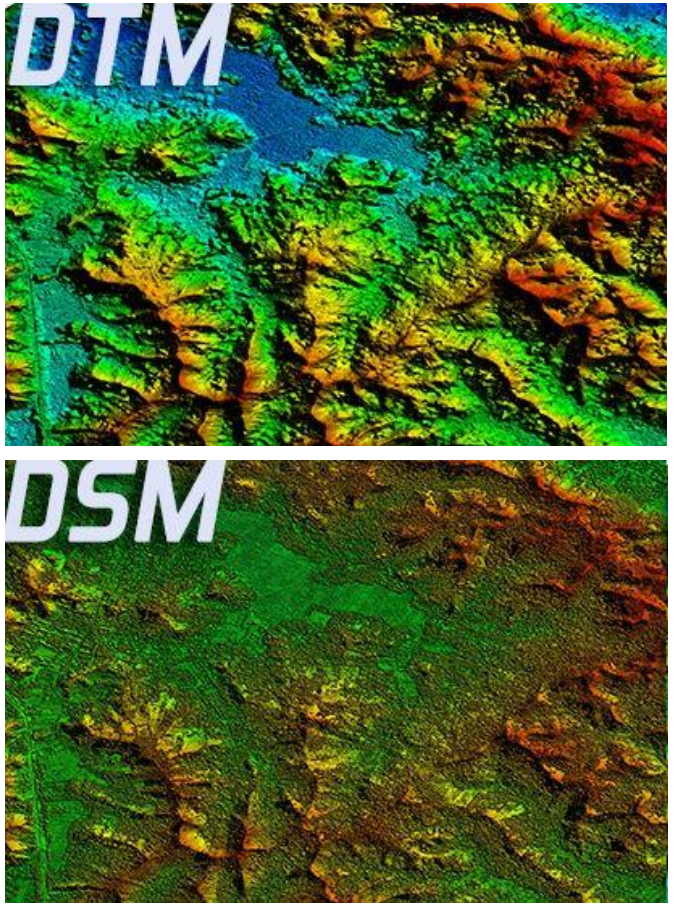
Digital Elevation Models

Digital Terrain Model (DTM): A quantitative model of a part of the Earth's surface in digital form (Burrough & McDonnel, 1998)

Digital Surface Model (DSM): DTM + all natural or human-made features.



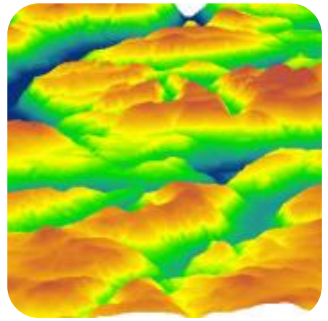
Source: https://en.wikipedia.org/wiki/Digital_elevation_model



Source: www.geopranata.co.id

Open access DEM source

Space Shuttle Radar Topography Mission (SRTM)
NASA crated 30-meter digital elevation model back in February 2000 with the Space Shuttle Endeavour launched with the SRTM payload.

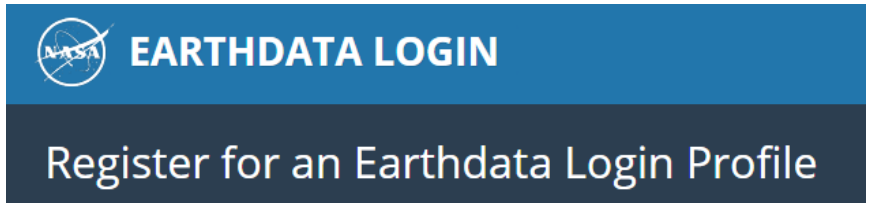


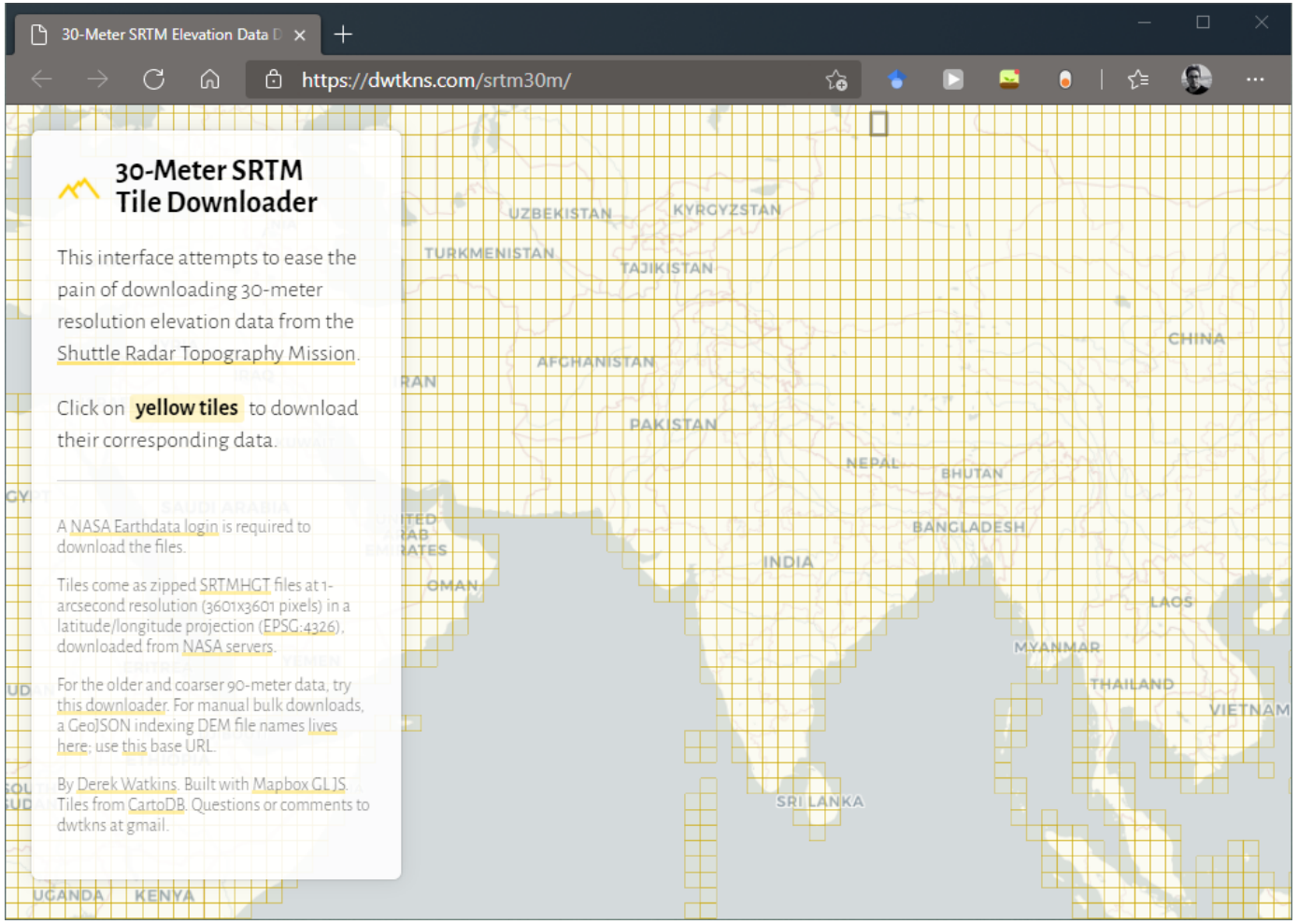
Global Digital Elevation Model
ASTER GDEM boasted a global resolution of 90 meters with a resolution of 30 meters in the United States.

JAXA's Global ALOS 3D World
ALOS World 3D is a 30-meter resolution digital surface model (DSM) captured by the Japan Aerospace Exploration Agency's (JAXA).

A 30-meter SRTM elevation data downloader

Step 01: Open link https://dwtkns.com/srtm30m/
Step 02: Choose tile of you choice
Step03: Login with your EARTHDATA account to download DEM tiles

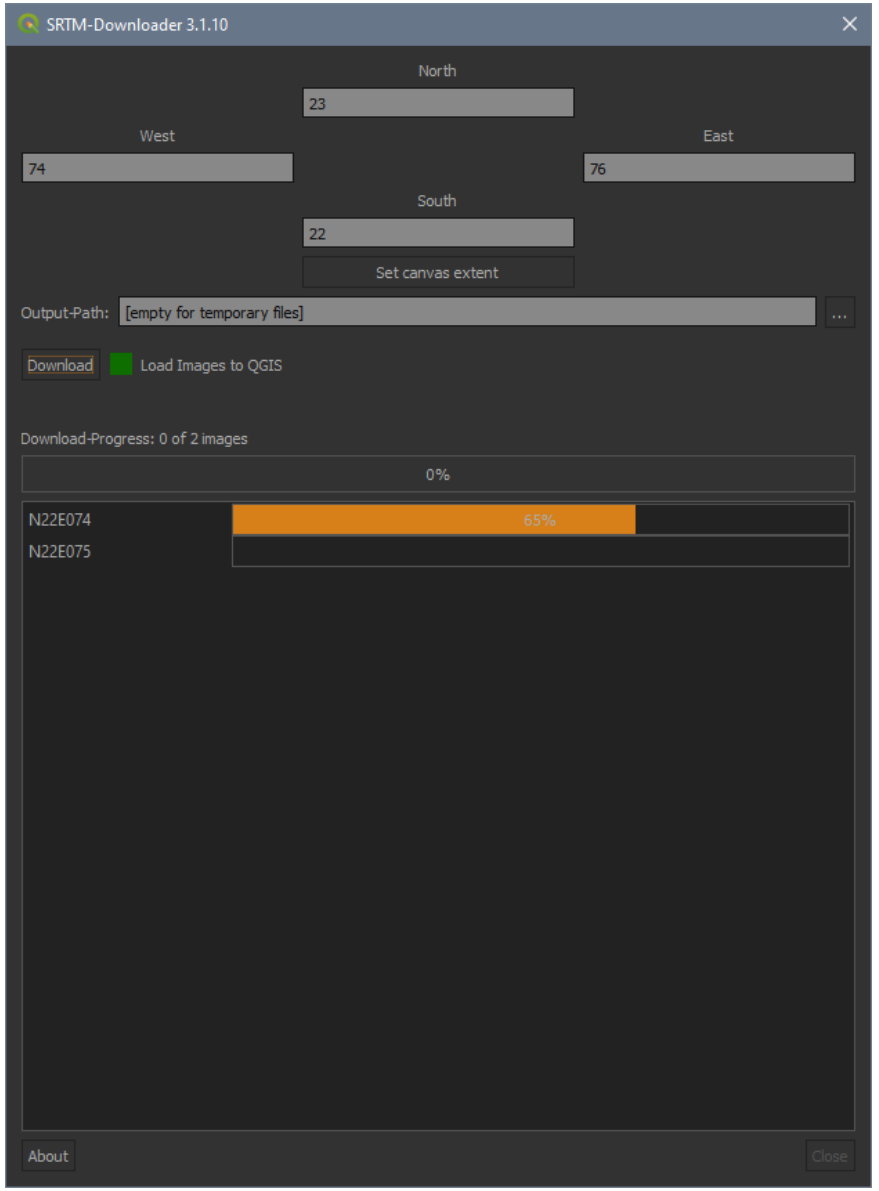




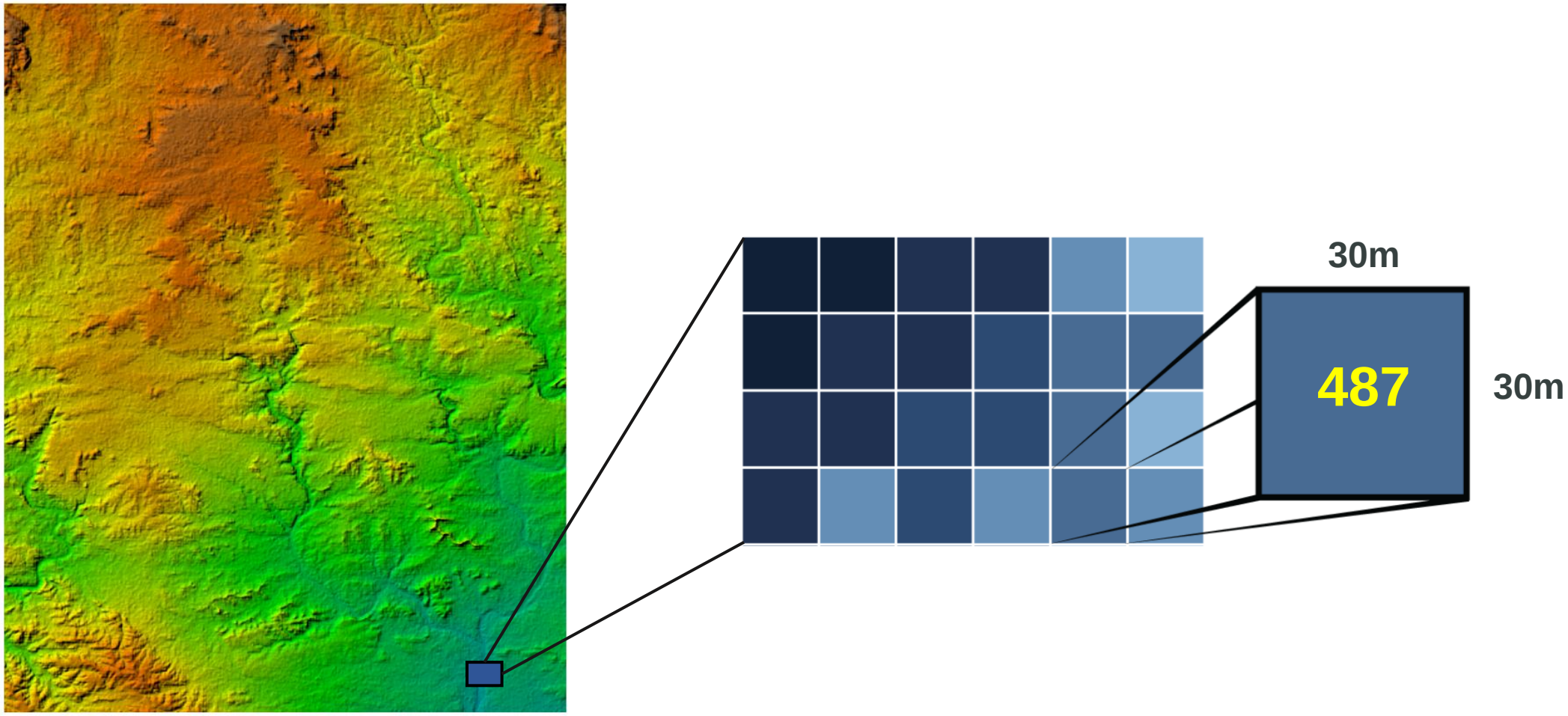
Download SRTM tiles using a plugin

SRTM-Downloader plugin:: Plugin → SRTM-Downloader

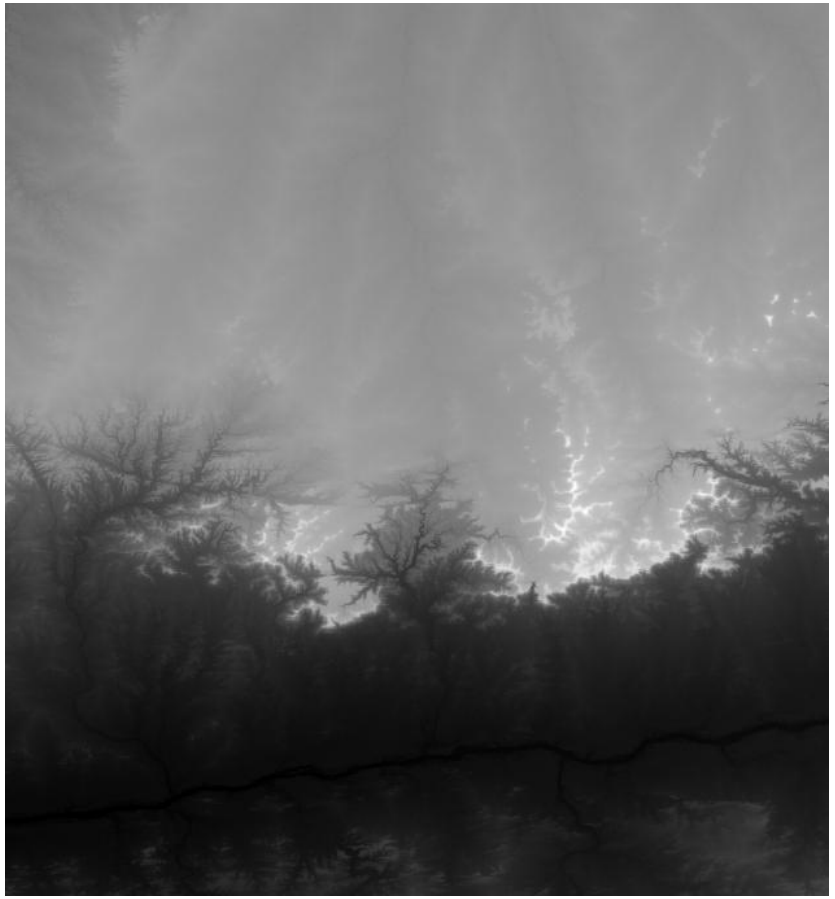
* NASA Earthexplorar account required



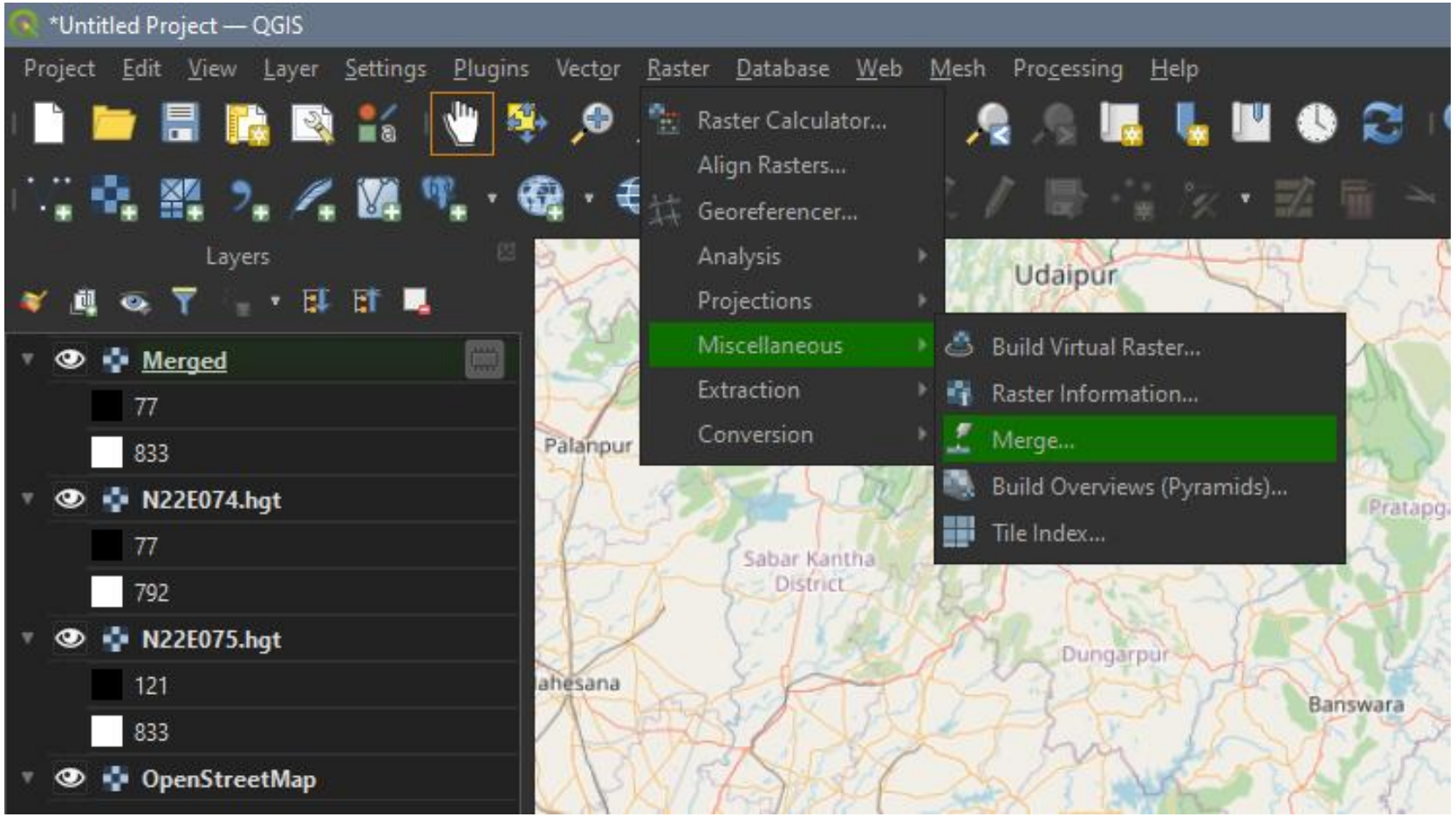
A 30m DEM: A raster made of 30m x 30m pixel size



Merge or mosaic DEM



Merge:: Raster→ Miscellaneous → Merge

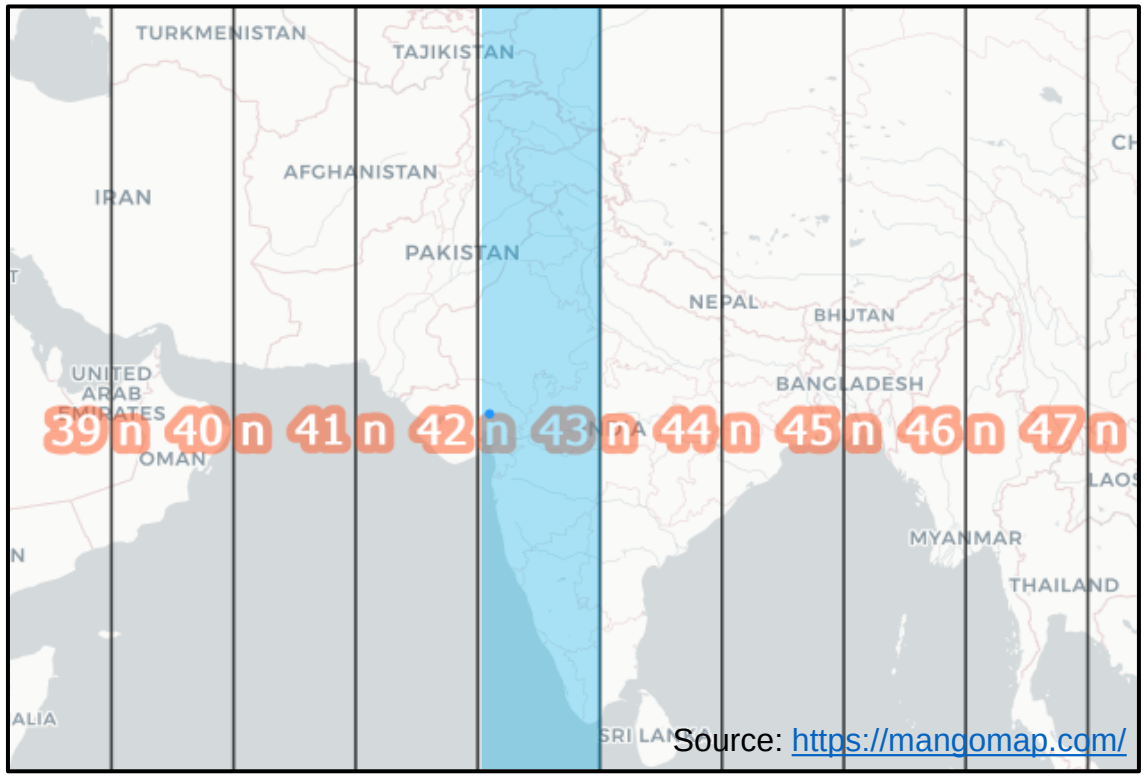


Reproject DEM for computation

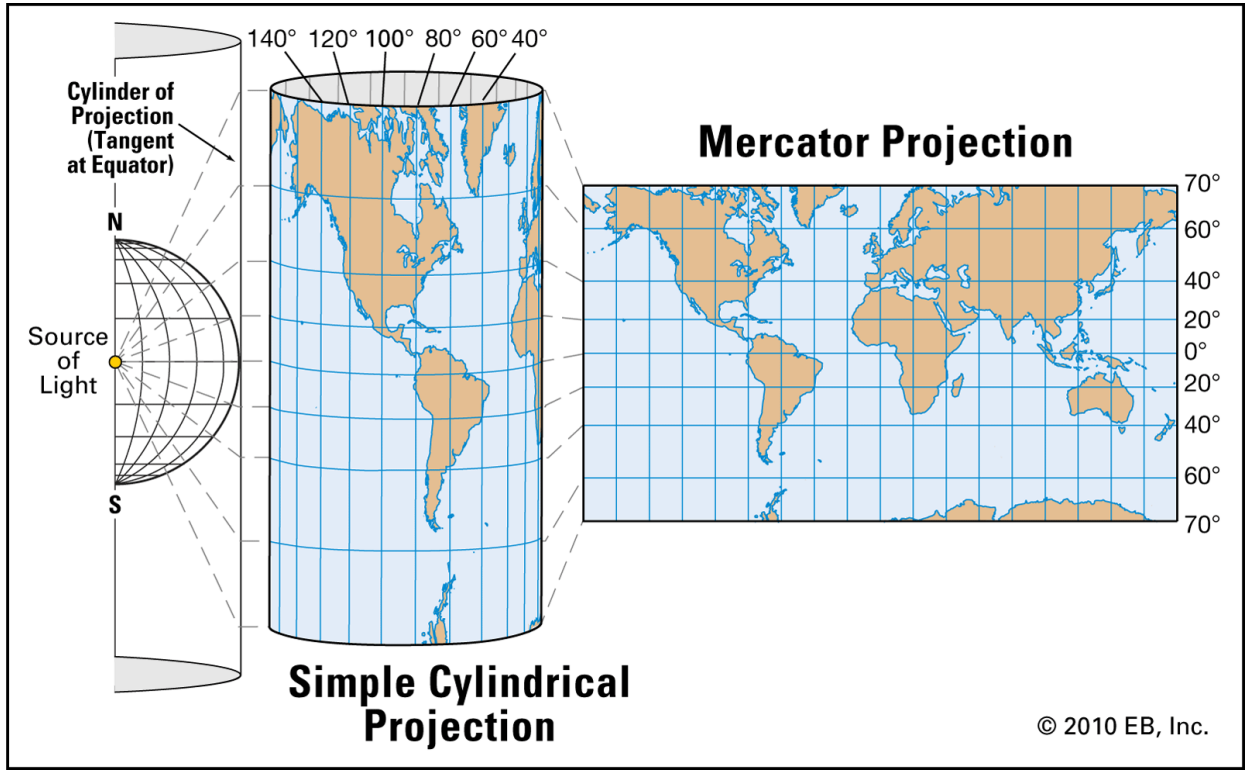
Global datasets are usually in EPSG:4326 (Geographic Coordinate System, Lat/Lon)

For correct calculation of DEM derivatives, the DEM should be reprojected to a Coordinate Reference System

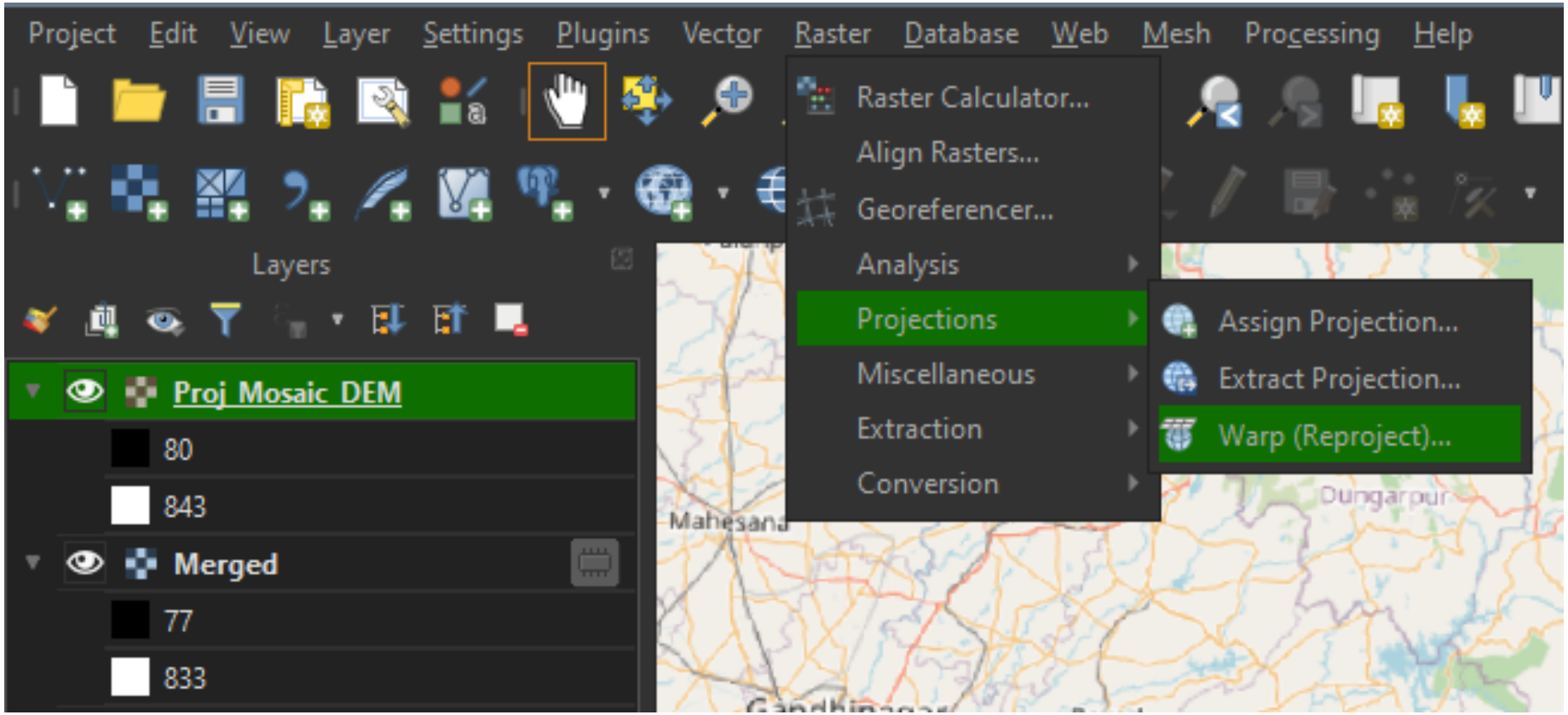
Projection: WGS 84 / UTM zone 43N
Proj4 : +proj=utm +zone=43 +datum=WGS84 +units=m
Extent : 72.00, 0.00, 78.00, 84.00



Source: https://mangomap.com/



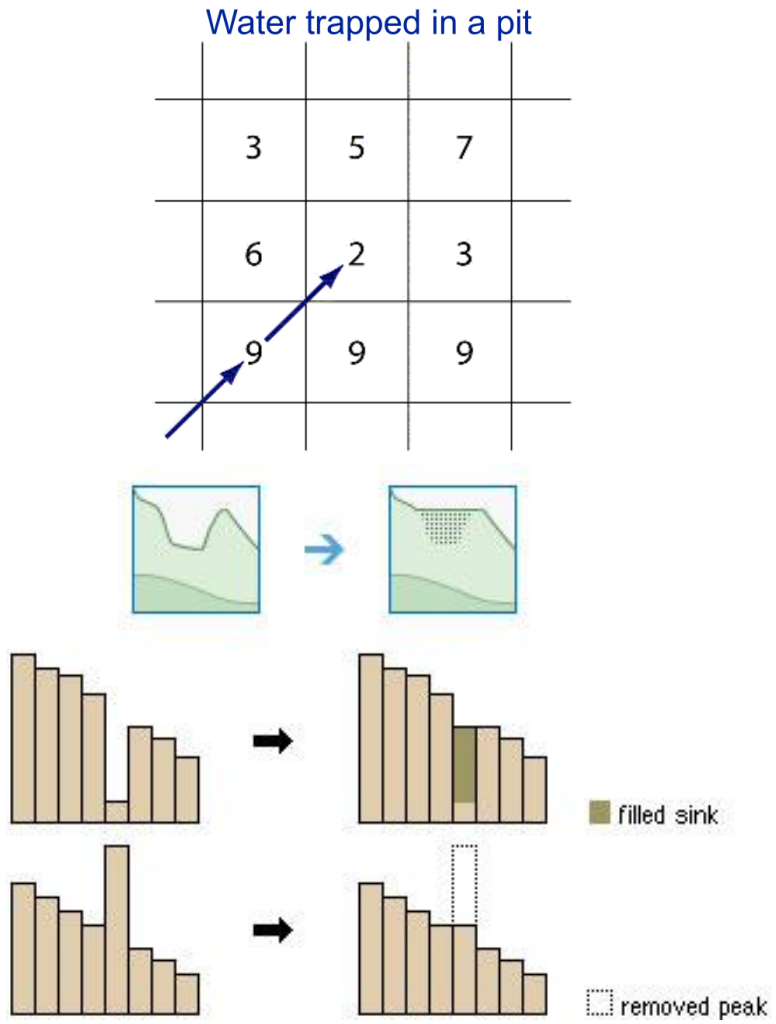
Reproject:: Raster → Projections → Warp

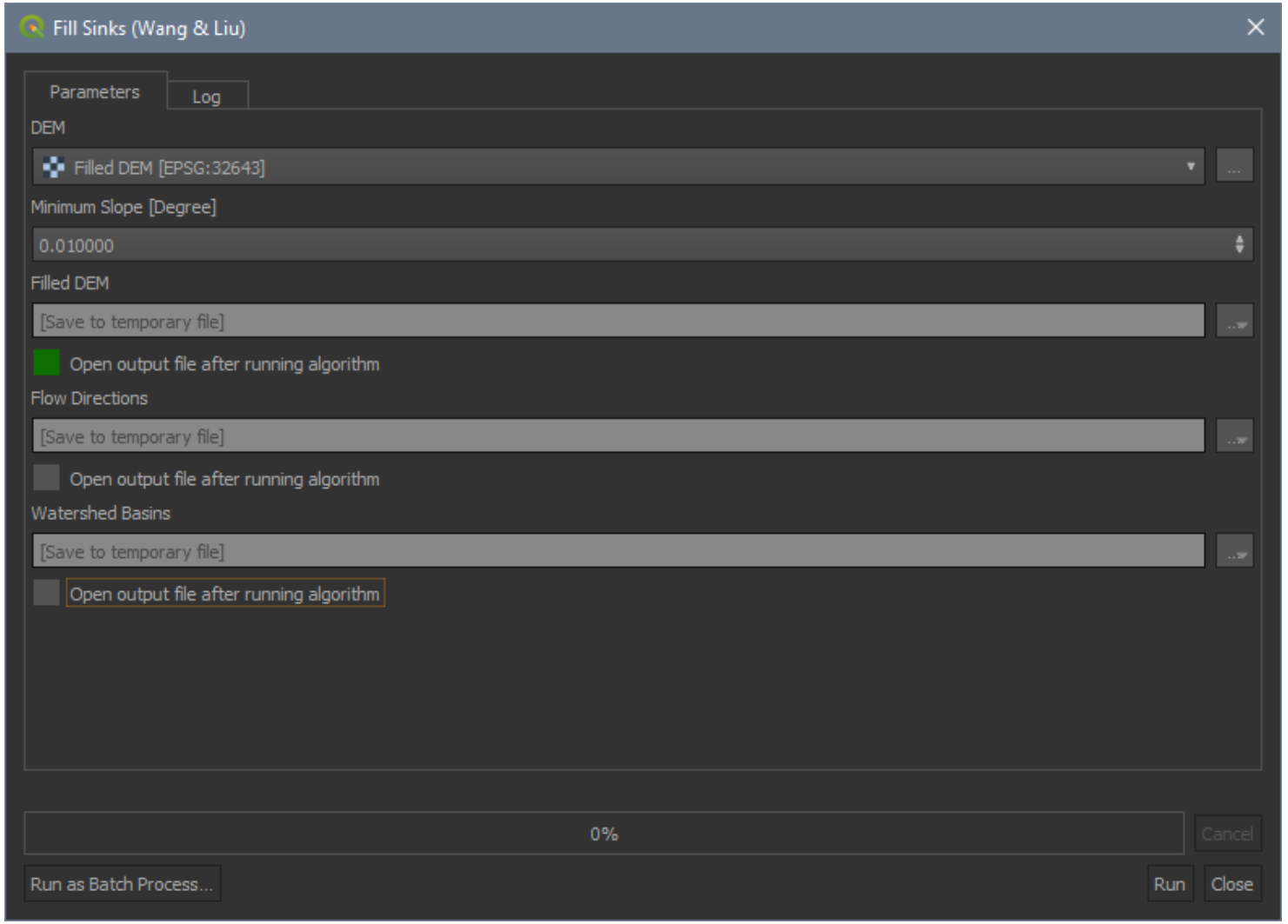


Fill sinks/ pits removal

Processing→ Toolbox → SAGA→ Terrain analysis → Fill

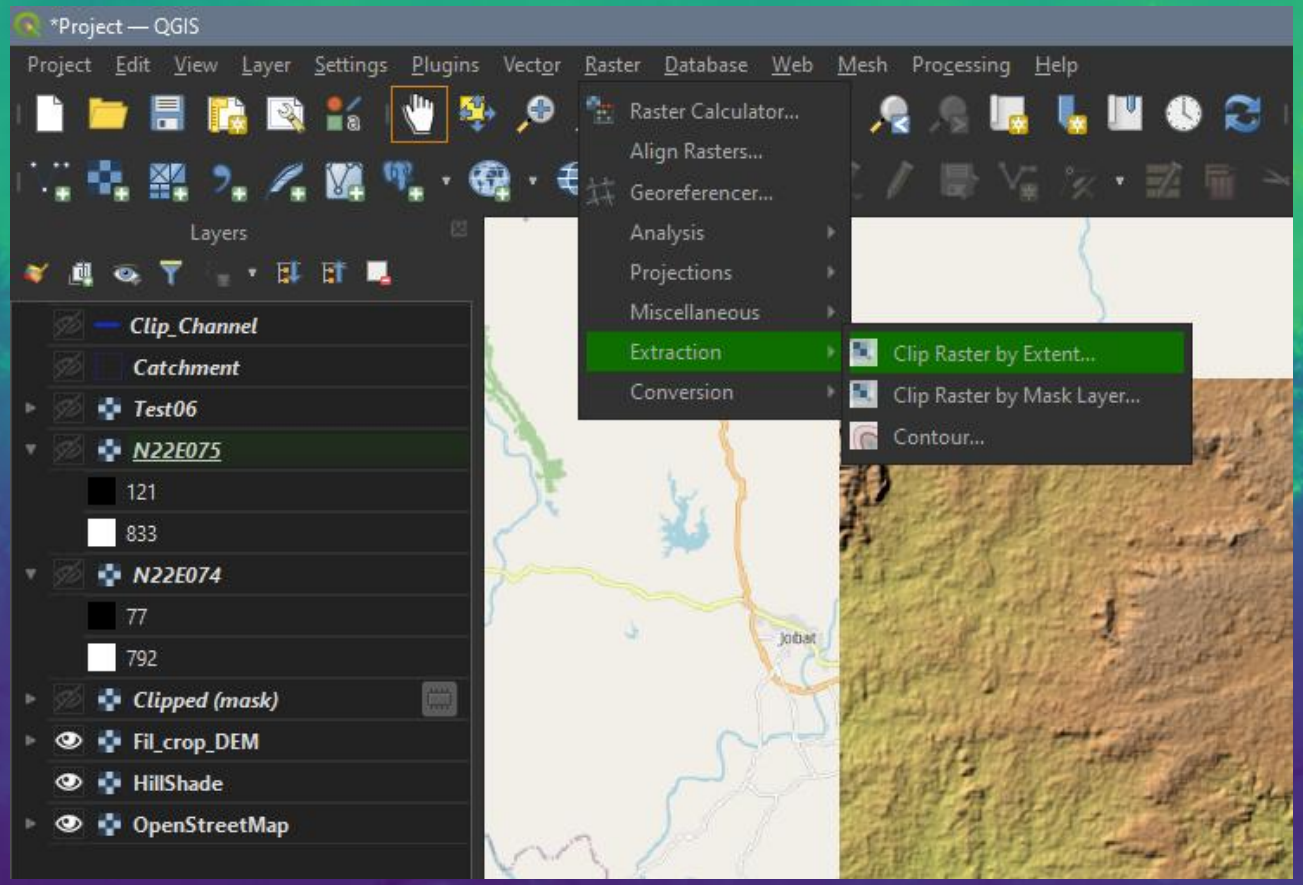
Create a hydrologically correct DEM



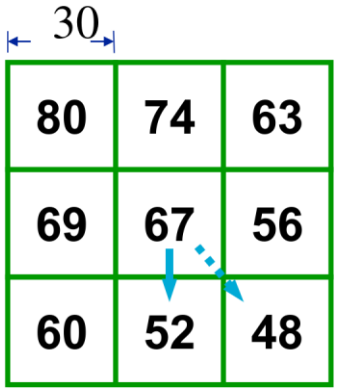


Source: http://girps.net/

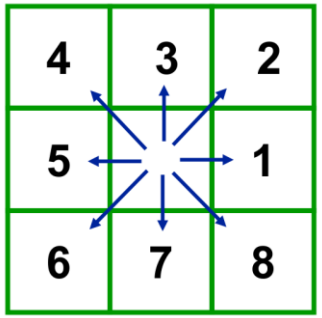
Subset a DEM


*Project — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
Raster Calculator...
Align Rasters...
Georeferencer...
Analysis
Projections
Miscellaneous
Extraction
Conversion
Clip Raster by Extent...
Clip Raster by Mask Layer...
Contour...
Layers
Clip_Channel
Catchment
Test06
N22E075
121
833
N22E074
77
792
Clipped (mask)
Fil_crop_DEM
HillShade
OpenStreetMap

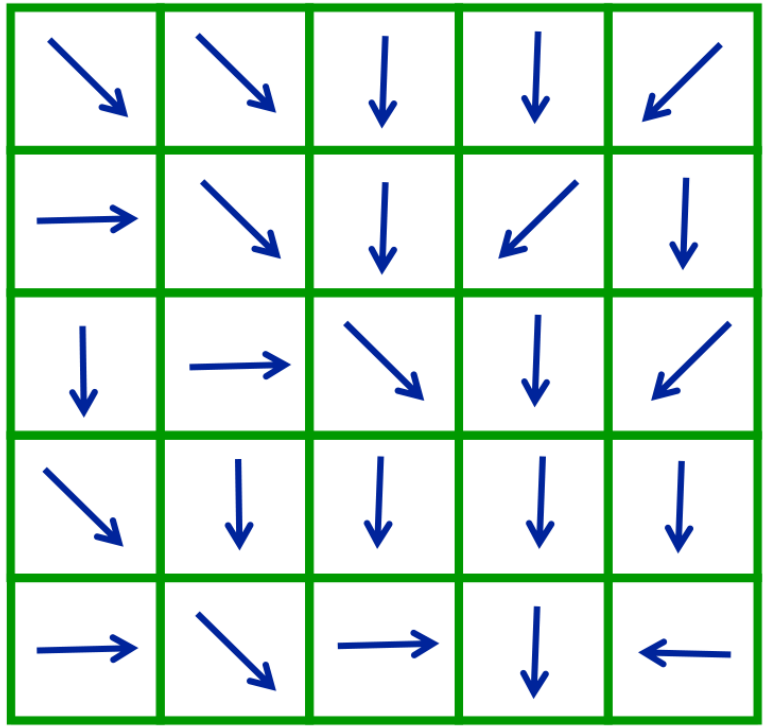
Calculate flow directions: D8



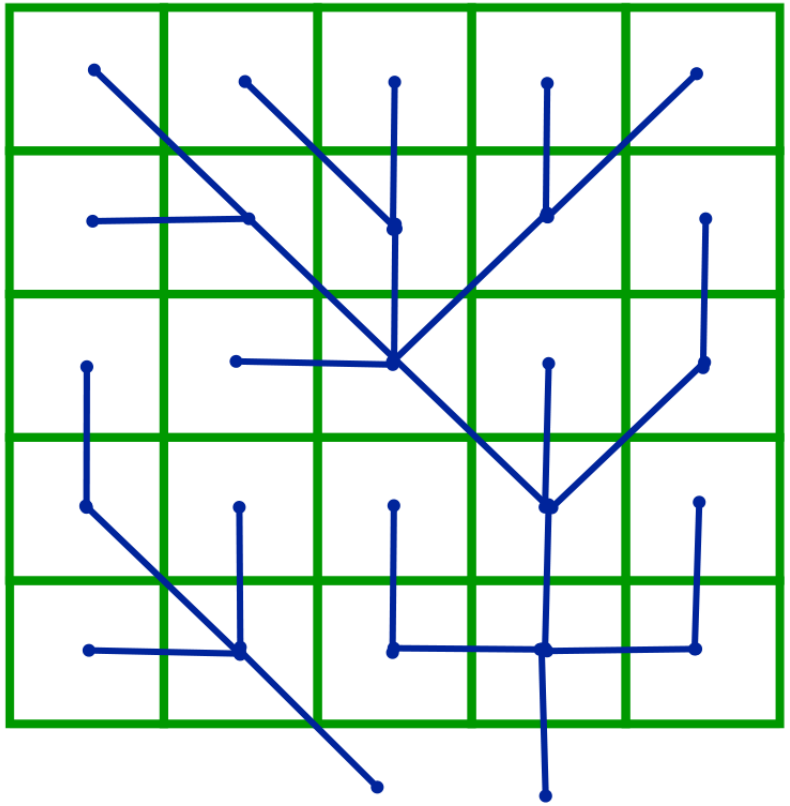
$$\frac{67-52}{30}=0.50 \qquad \frac{67-48}{30\sqrt{2}}=0.45$$



Slope = Drop/Distance
Steepest down slope direction



D8 for each cell

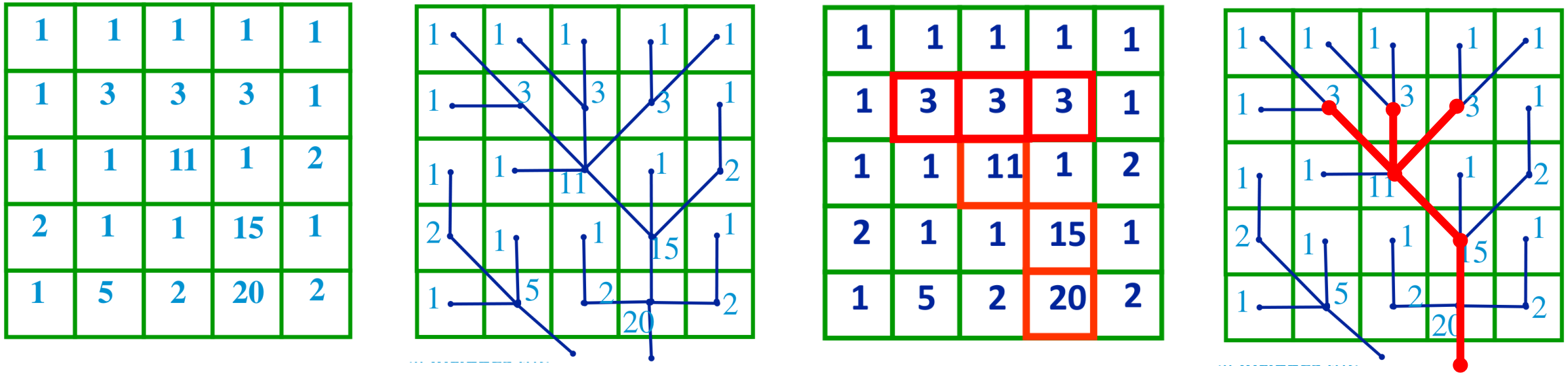


Stream link

Adopted from : Hans van der Kwast

Derive streams: Flow accumulation

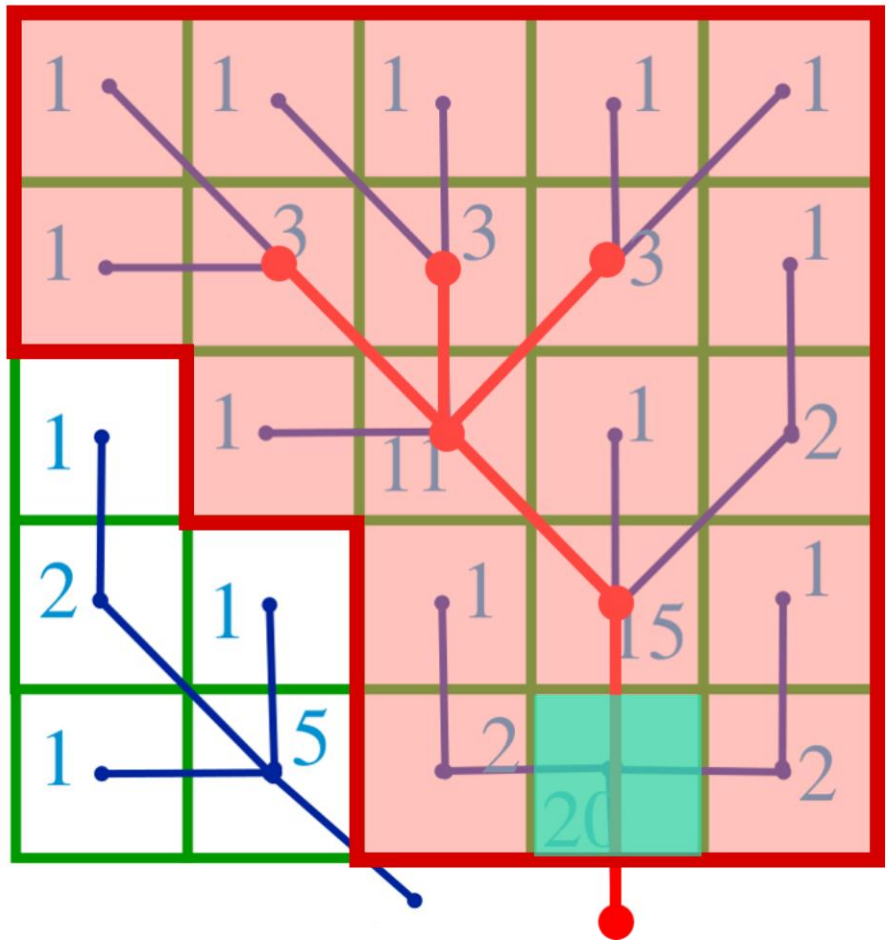
Flow Accumulation > 3 Cell Threshold



Adopted from Hans van der Kwast

Define outflow point and compute upslope area

Outlet needs to be defined in a delineated river that corresponds with the flow directions that have been calculated



Catchment

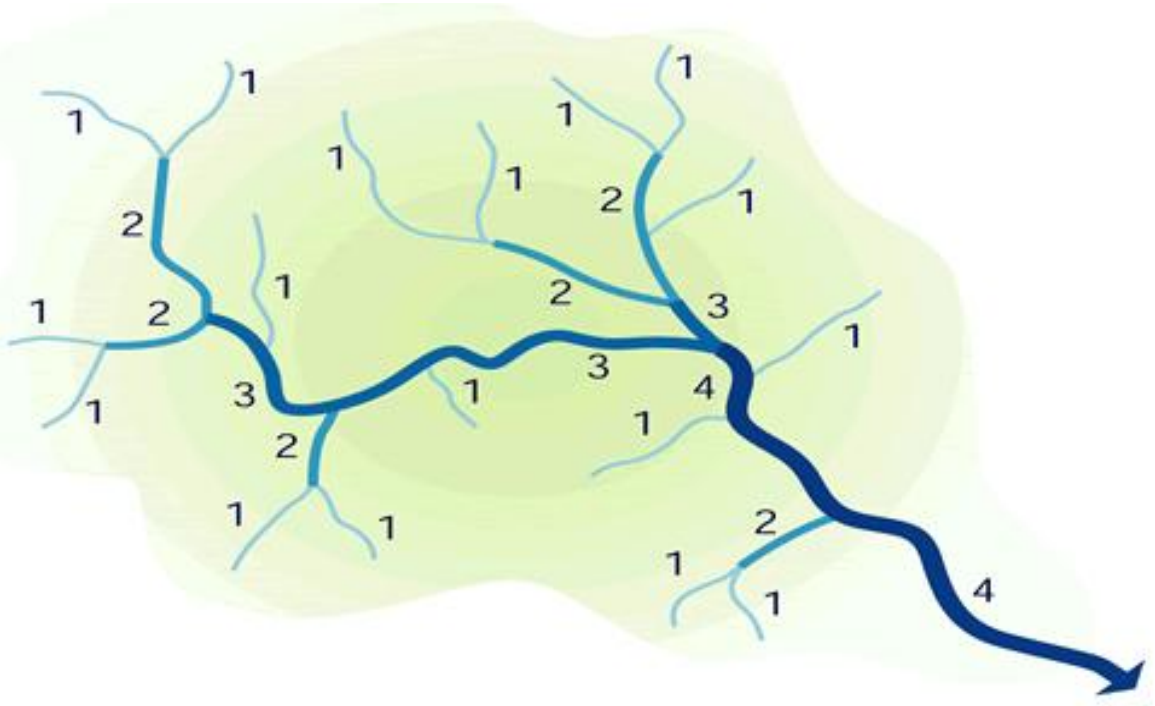
Outflow point

Adopted from Hans van der Kwast

Strahler stream order

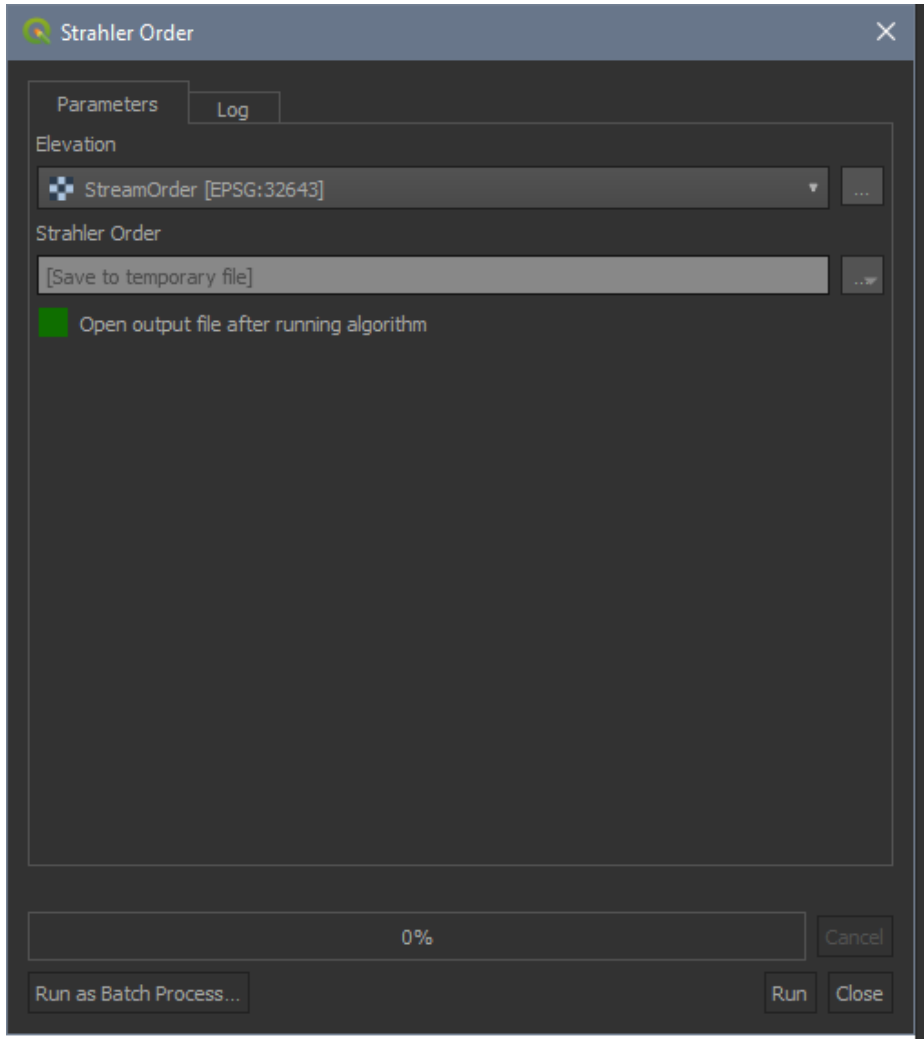
Stream order in hydrography deals with the hierarchy of streams from the source downstream [Horton, R. E. (1945)].

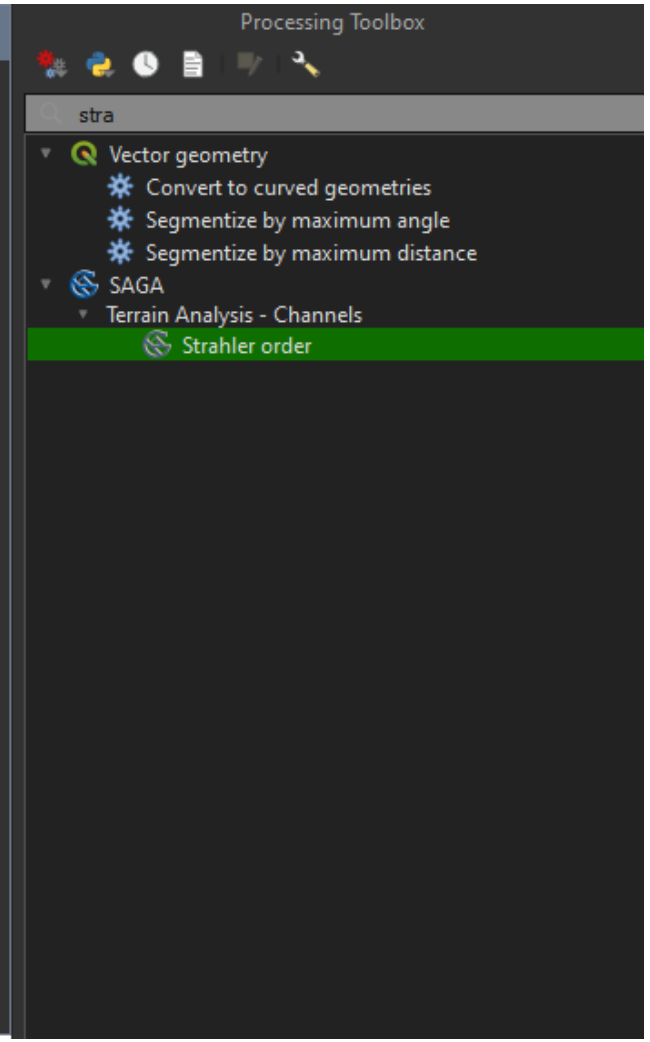
Source: https://www.thoughtco.com/

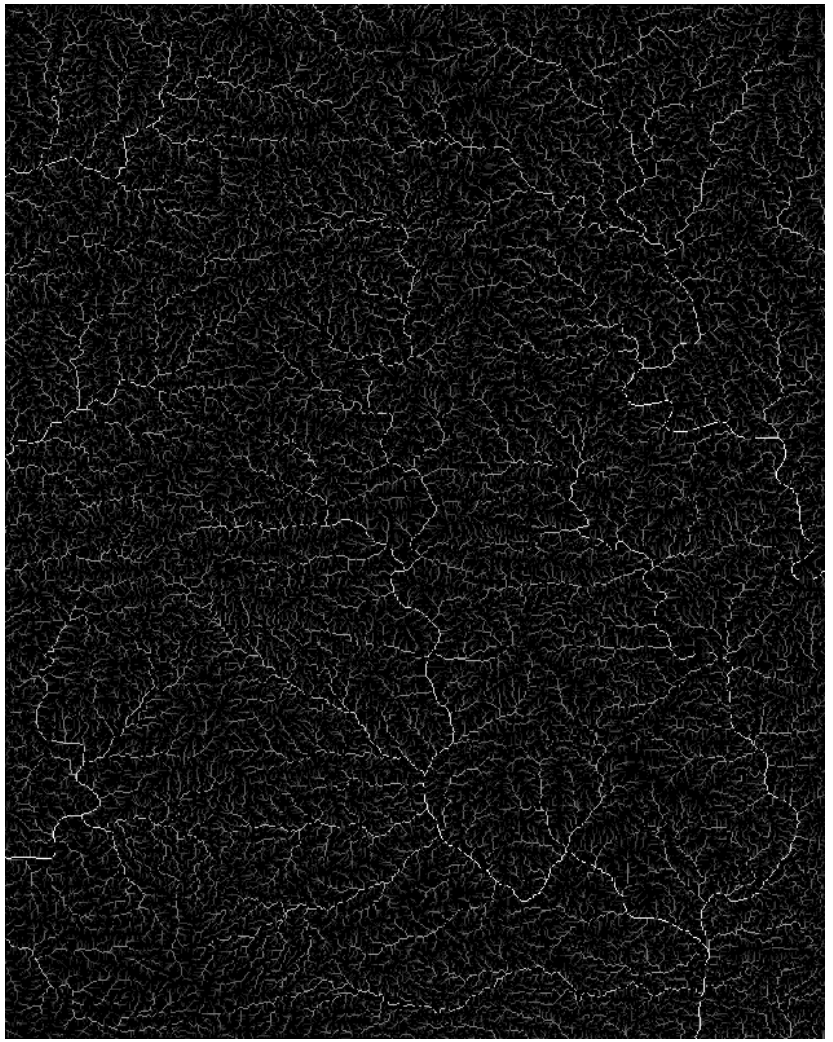


Source: http://bookofmormonresources.blogspot.com/

Strahler stream order

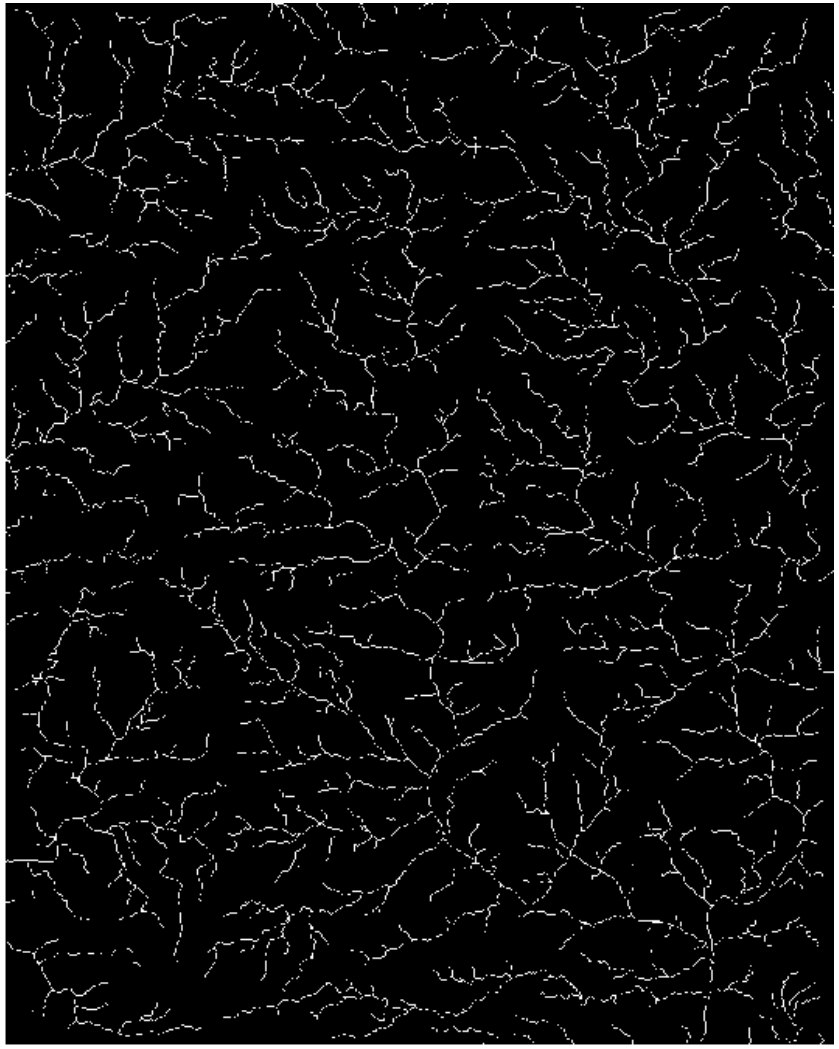




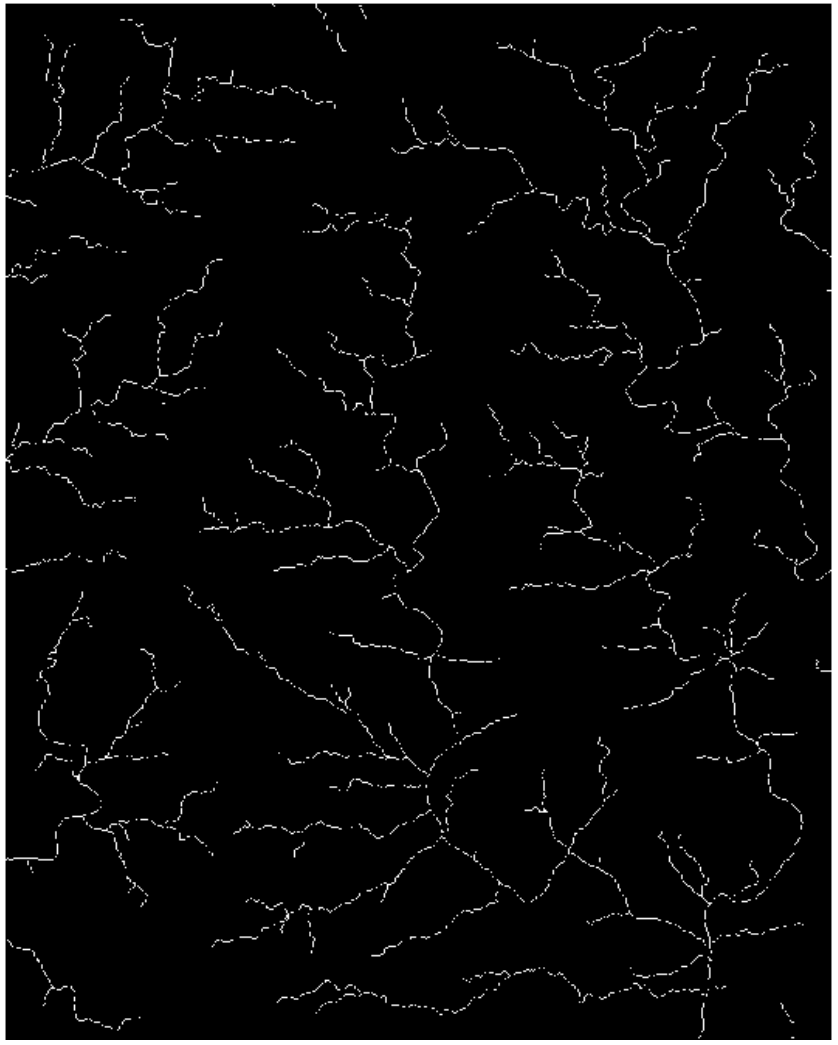


Calibration of Stream Order threshold with Raster Calculator

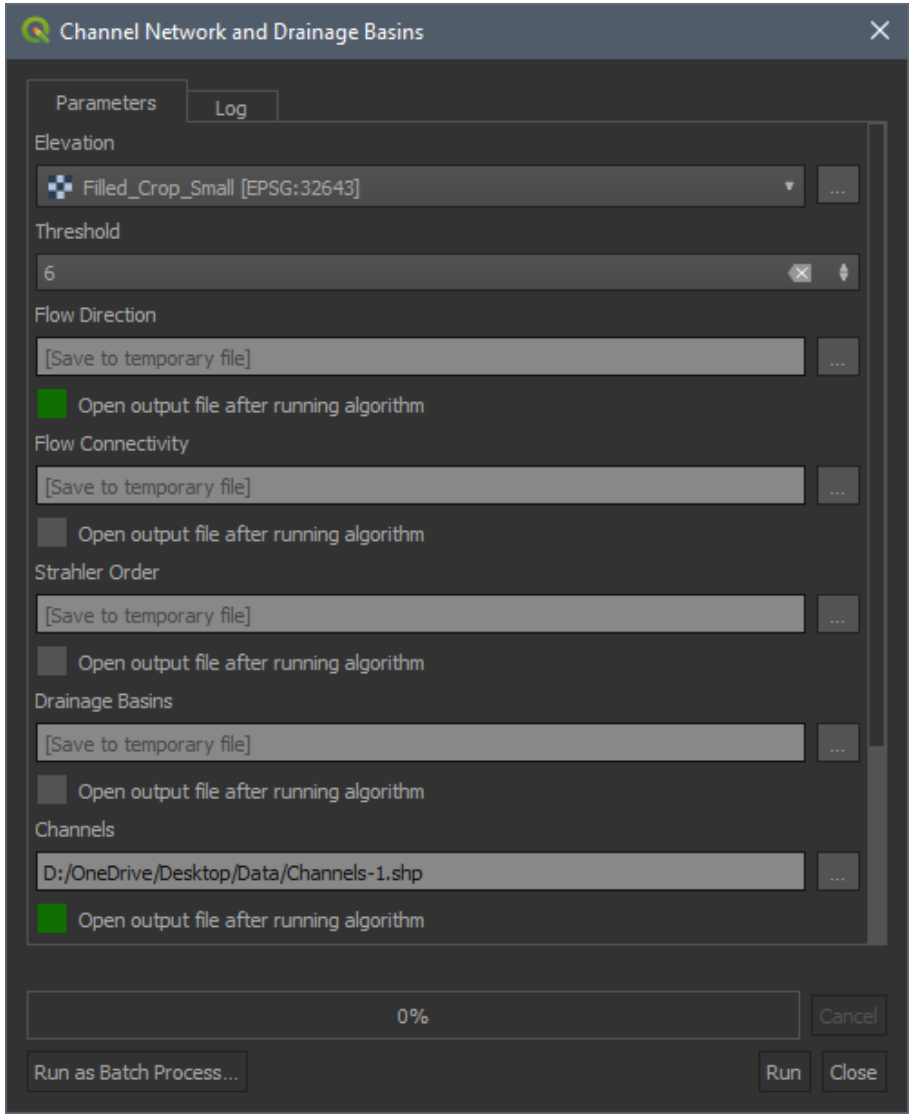
Threshold : SO ≥ 5

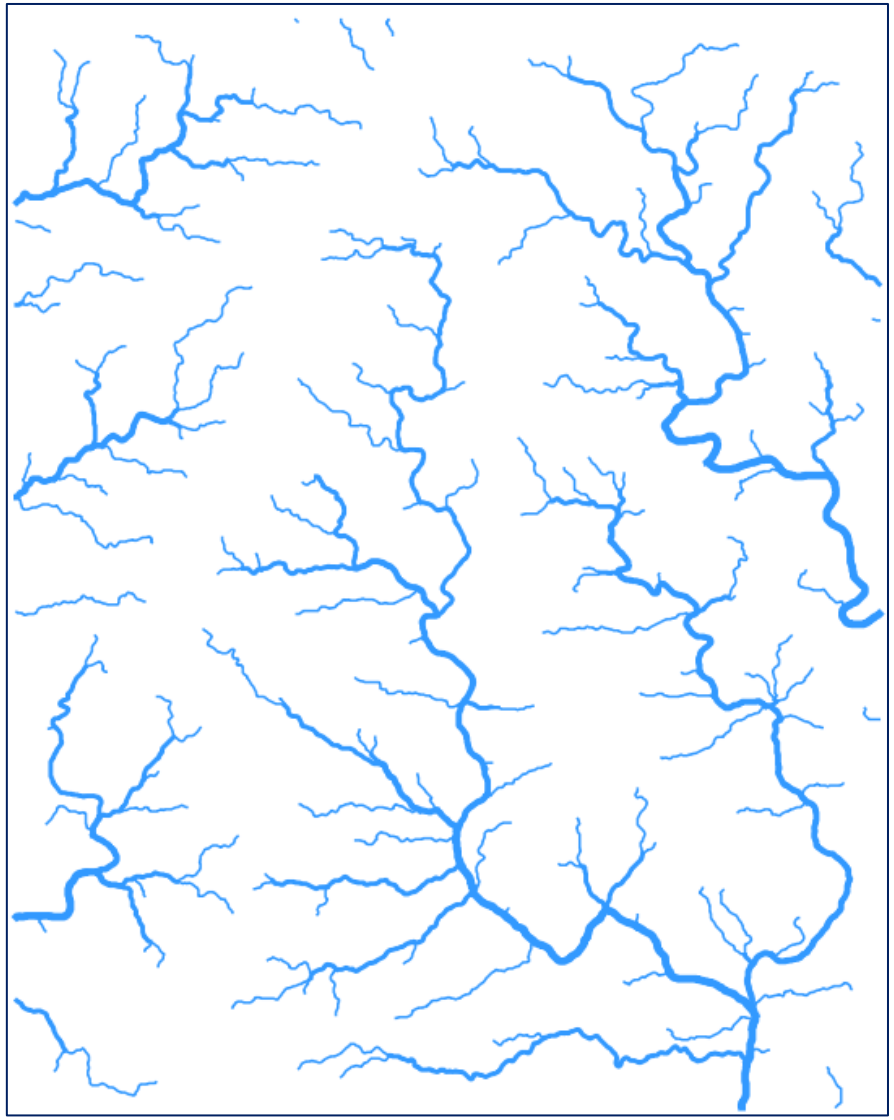


Threshold : SO ≥ 6

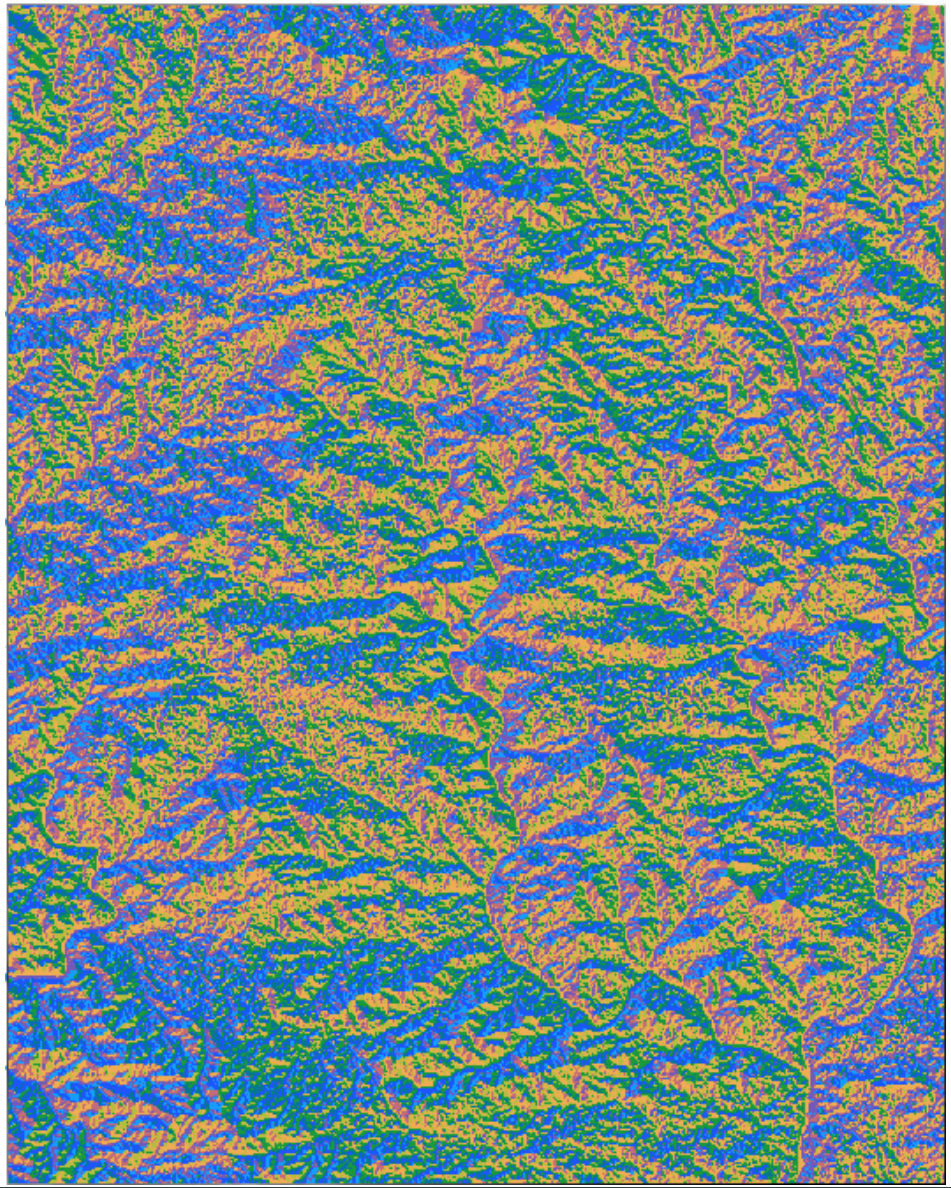


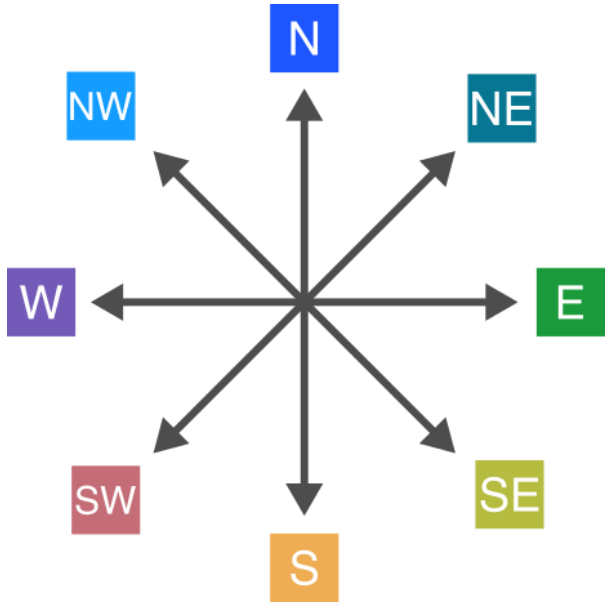
Delineate channel networks



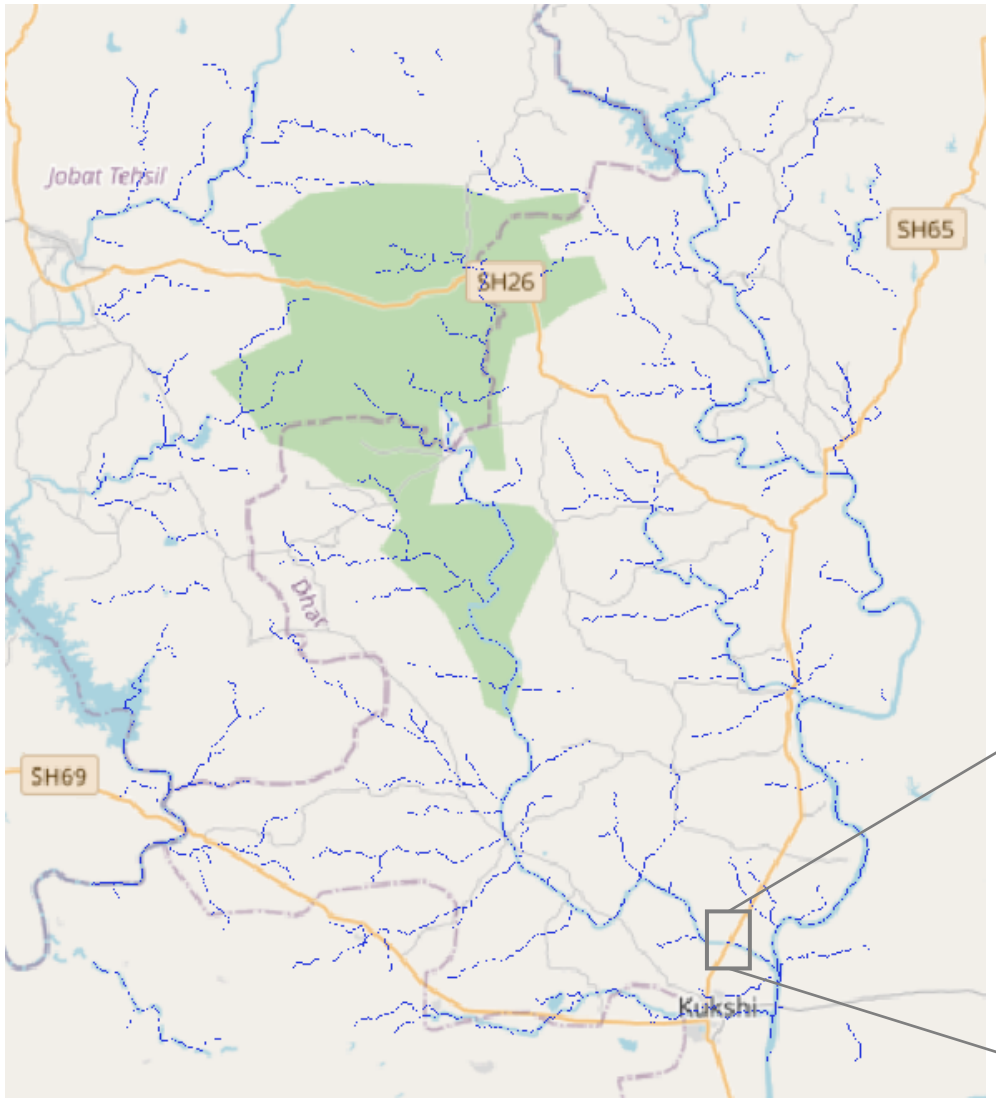


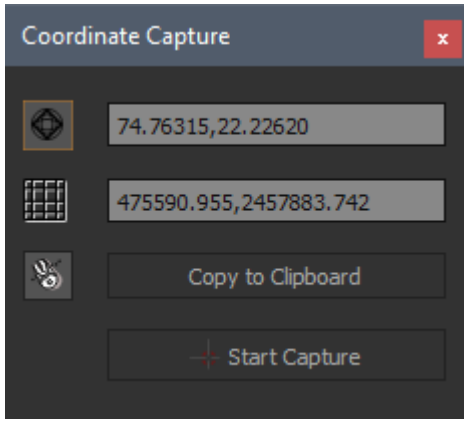
Stylize the flow direction map

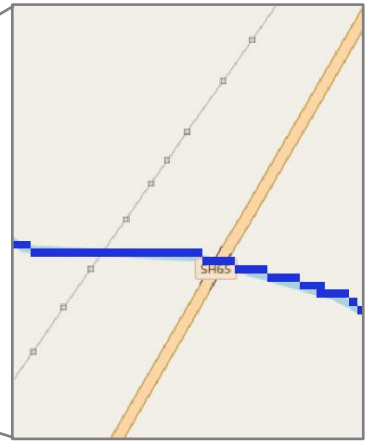


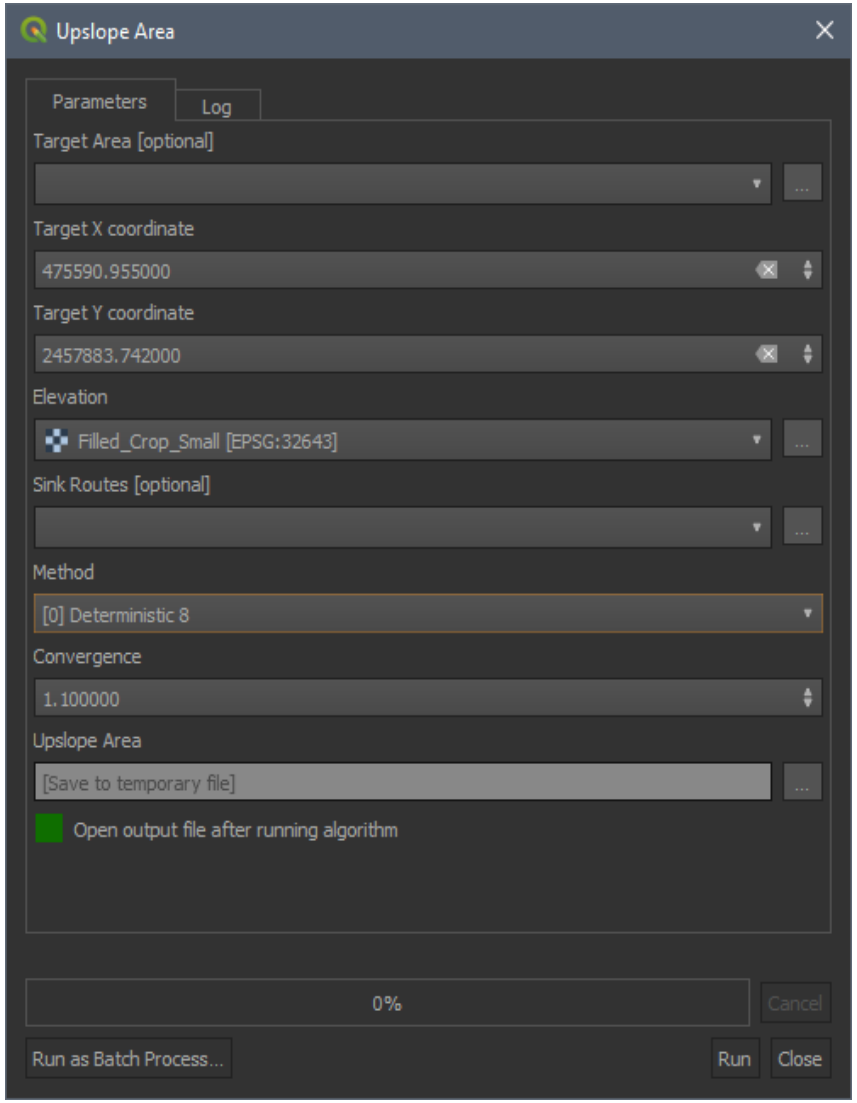


Delineate the upslope area

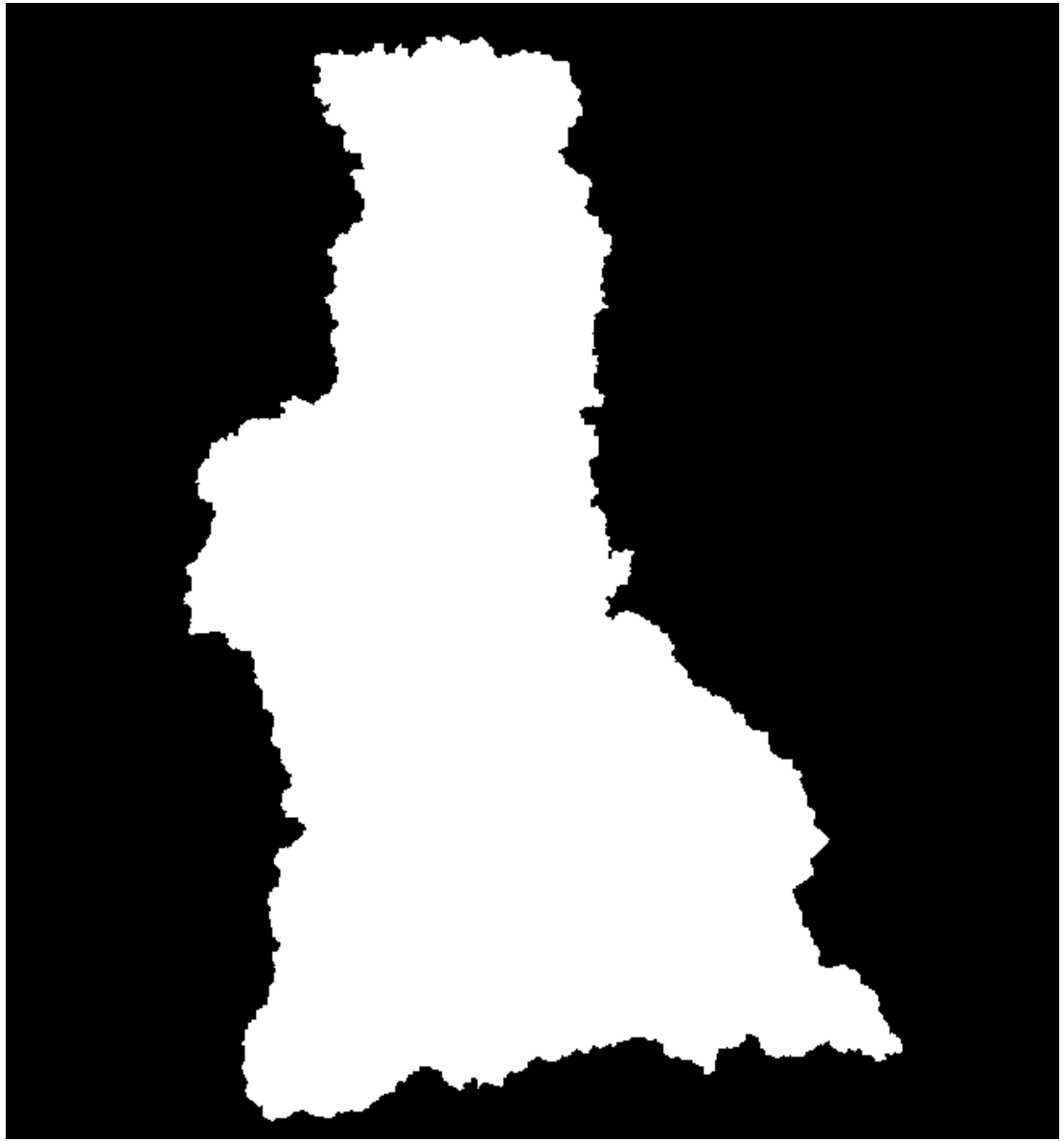








Delineation of catchment

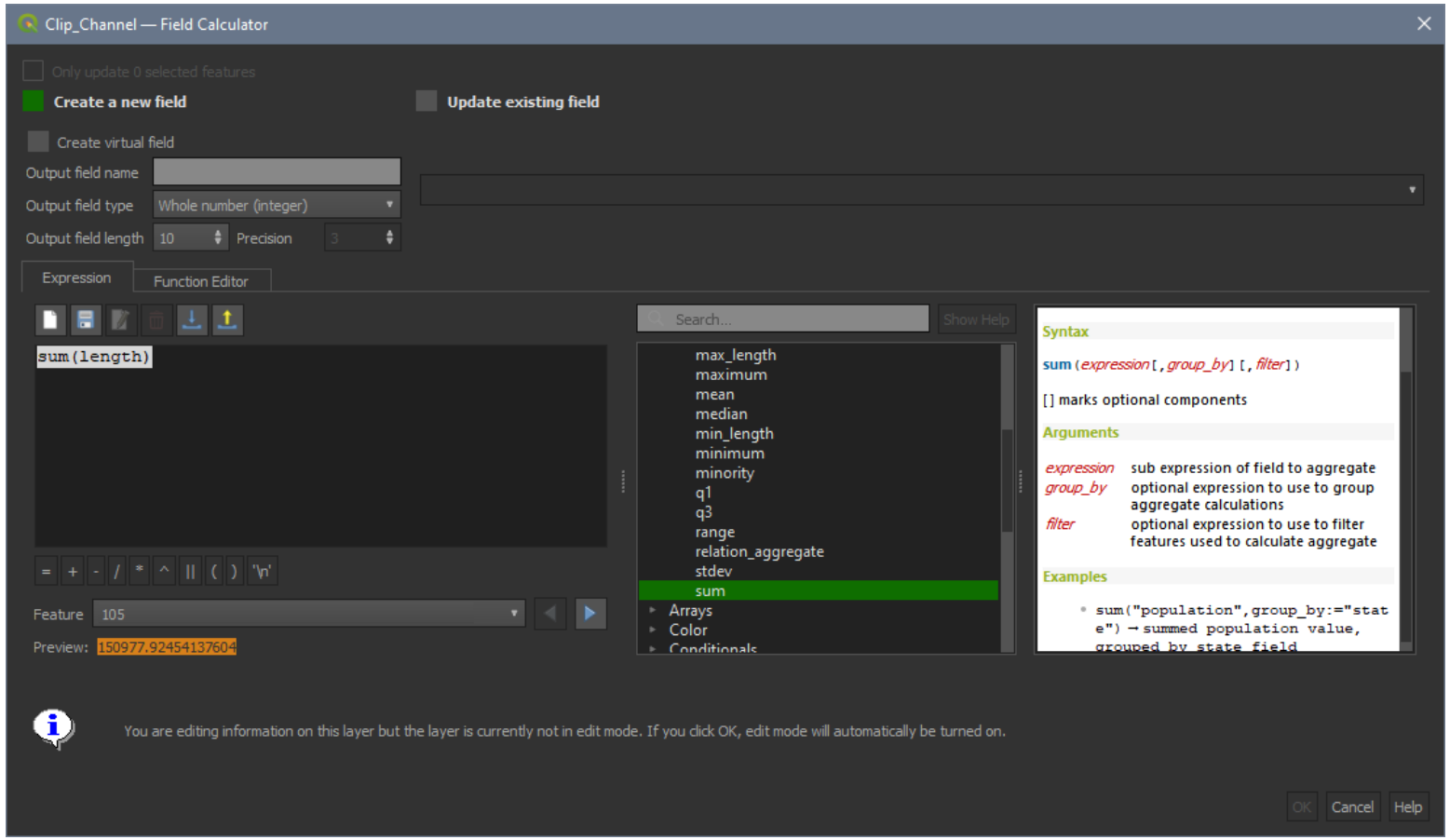


Use *field calculator* for field operation

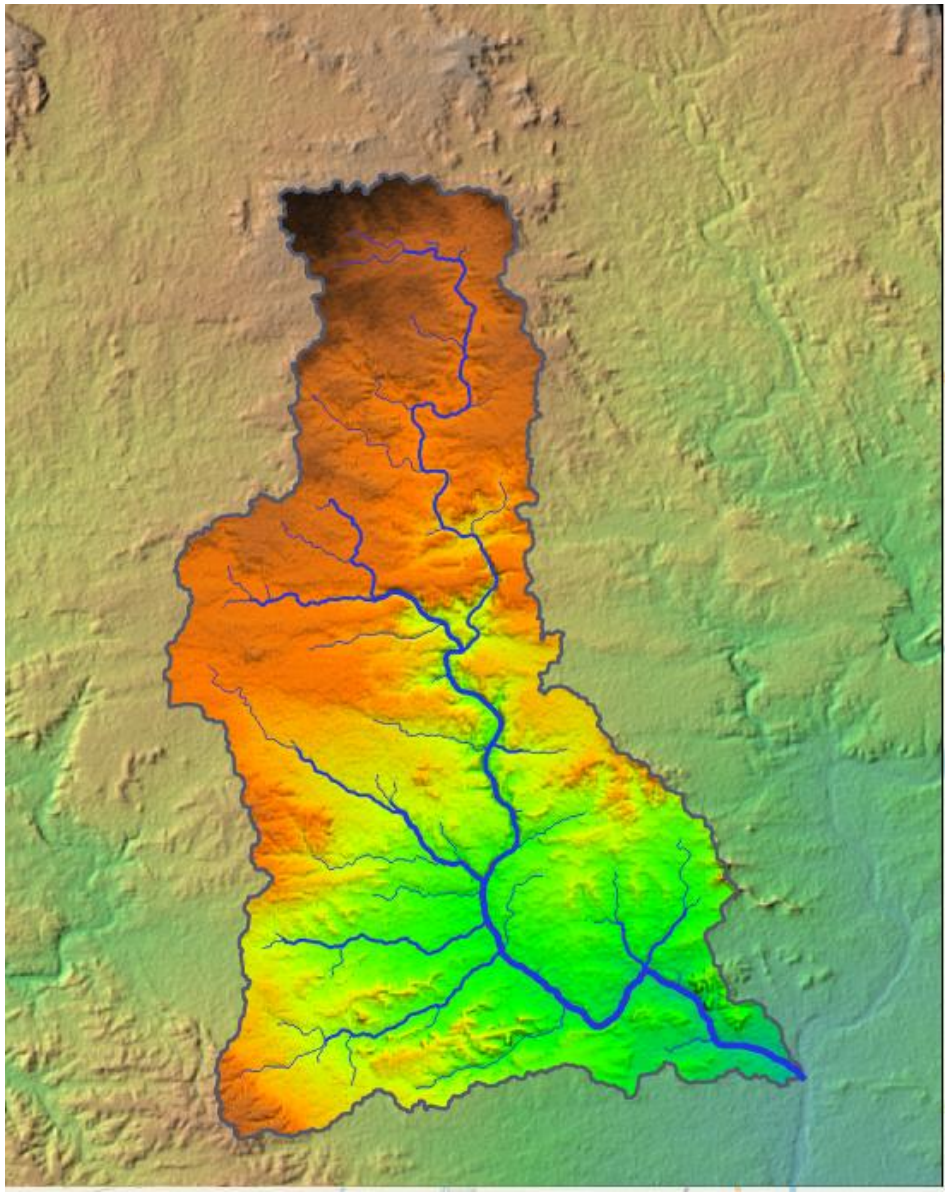
Area = 218325577.17 m^2

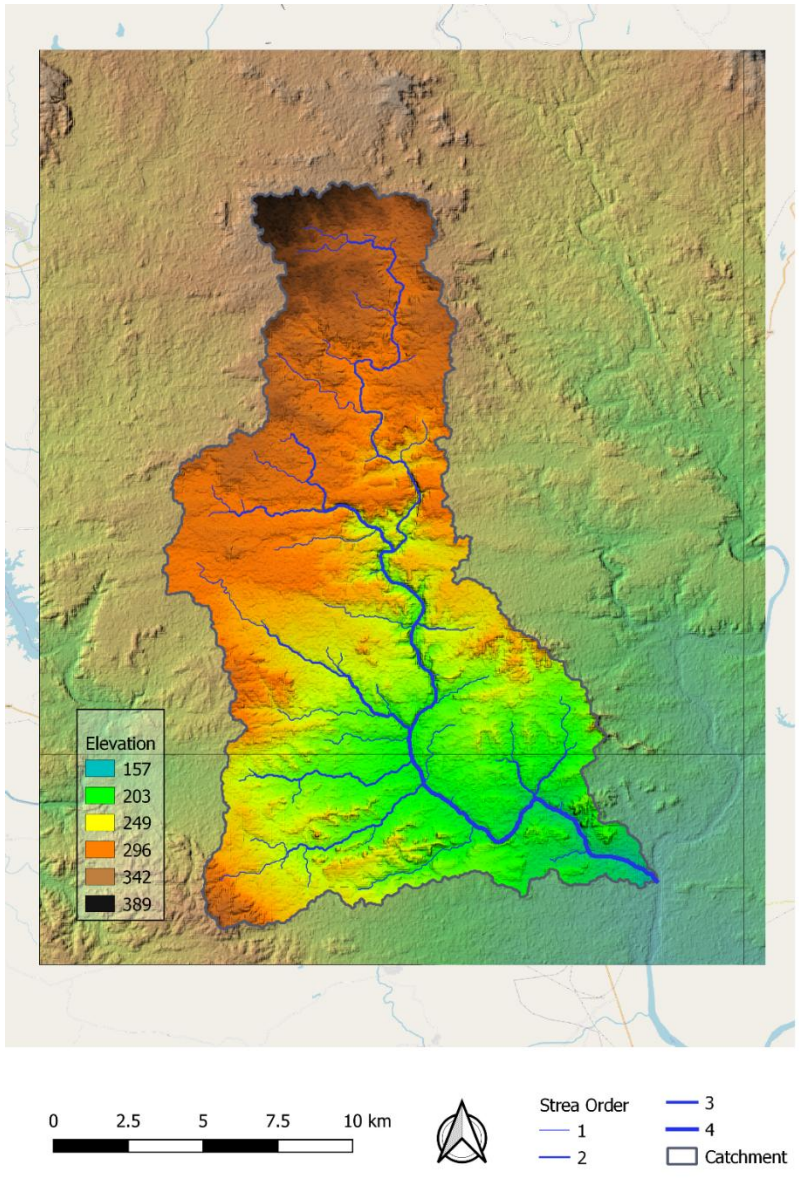
Perimeter = 122047.79 m

Stream length = sum(length) = 150977.93 m



Stylize and create a map





Thank You!

Contact
Ankit Deshmukh
www.ankitdeshmukh.com
ankit.deshmukh@sot.pdpu.ac.in