



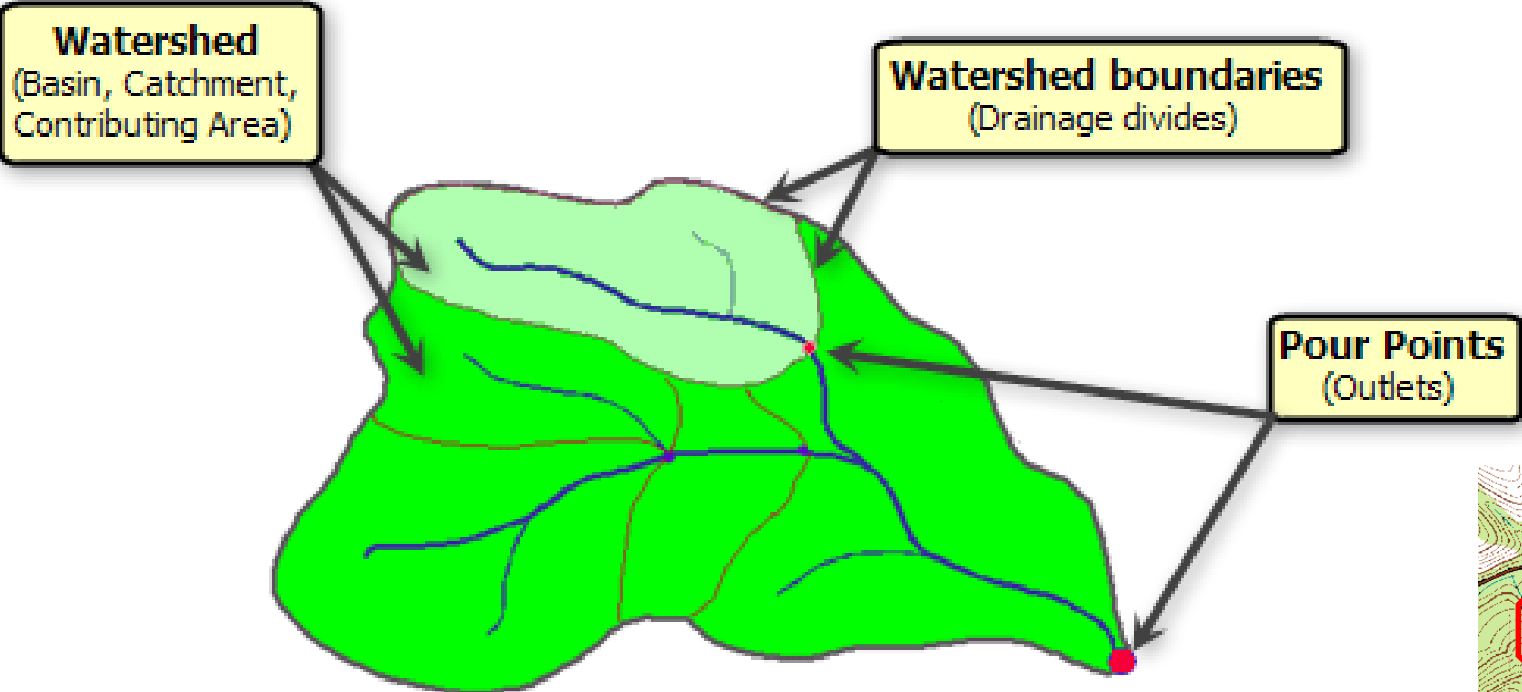
OpenTopography

TauDEM Processing Tools on OpenTopography and Visualization in QGIS

AGIC Short Course: Intro to Lidar, Data Access, and Processing with OpenTopography

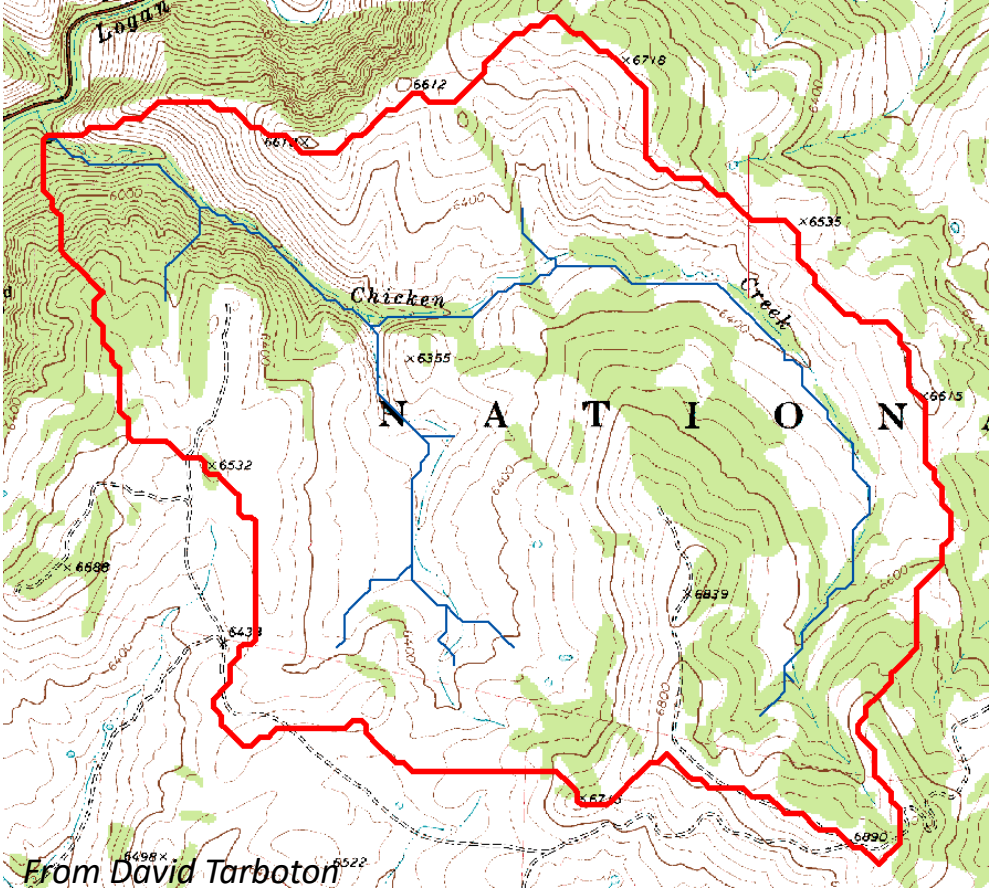
Wednesday, August 31, 2022

Watersheds



Credit: ArcMap

Topography defines the watershed, fundamental control on hydrology



Upper Granite Creek Watershed

You'll find other educational watershed panels at these locations in the Prescott area.

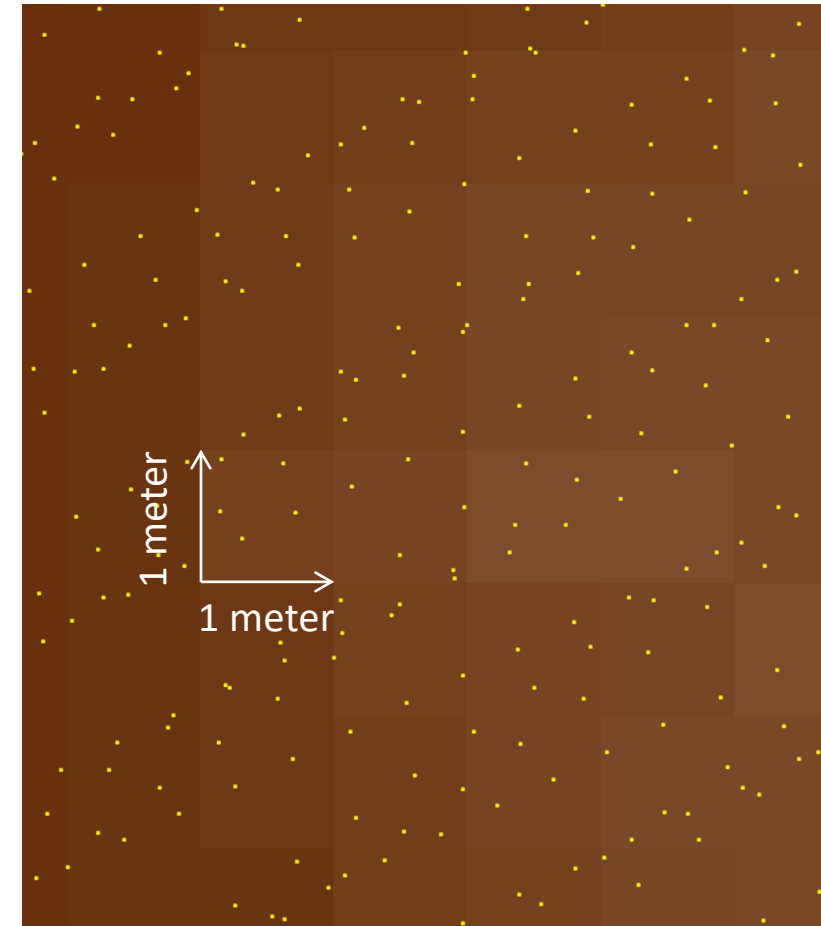


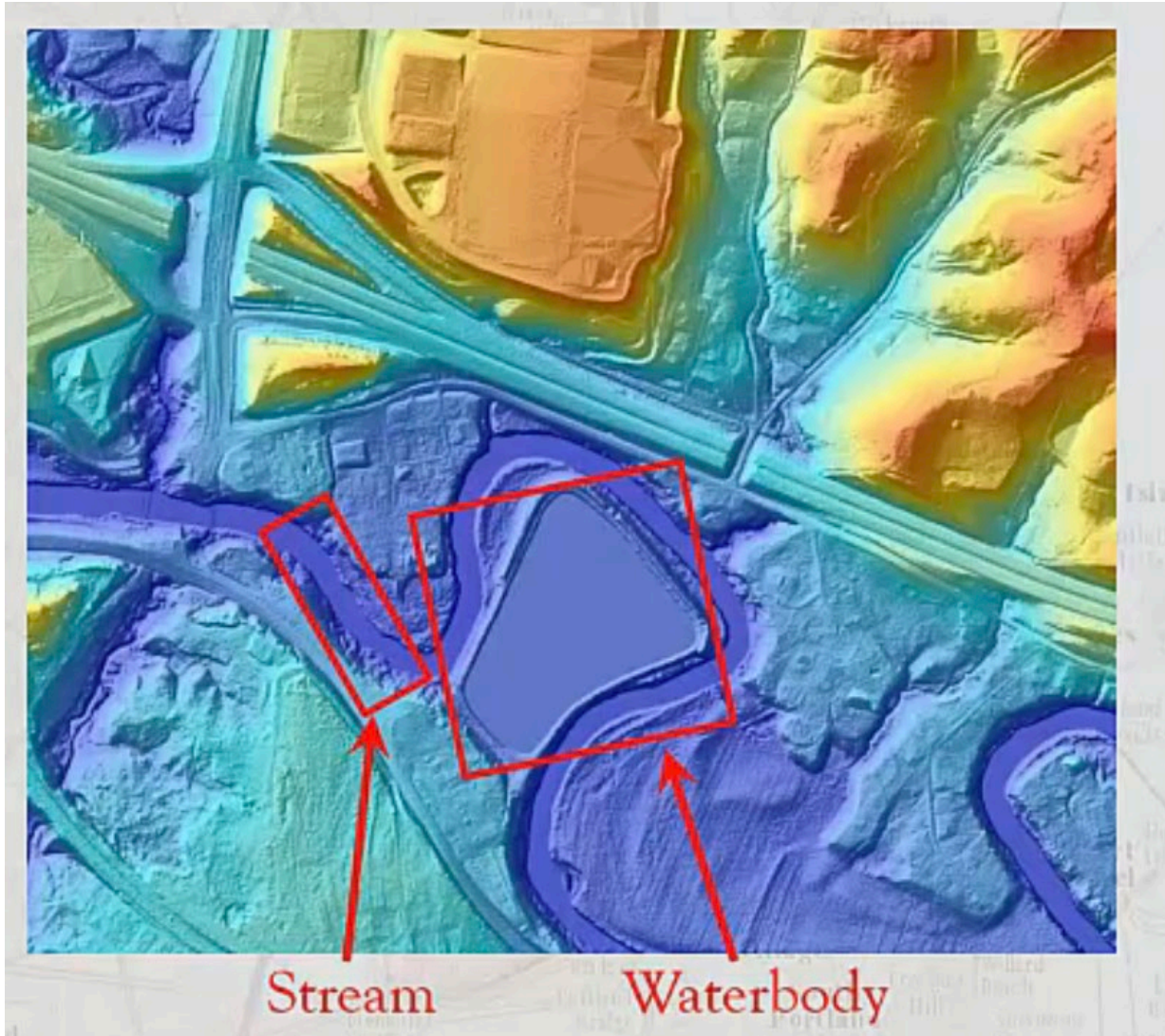
The entire Granite Creek Watershed and adjacent watersheds.



Rasters, Digital Elevation Model (DEM)

| | | | | | | | | | | | | | | | | |
|---|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 0 |
| 0 | 50 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 300 | 300 | 300 | 300 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 350 | 350 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 350 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 350 | 350 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 300 | 300 | 300 | 300 | 300 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 100 | 50 | 0 |
| 0 | 50 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 50 | 0 |
| 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



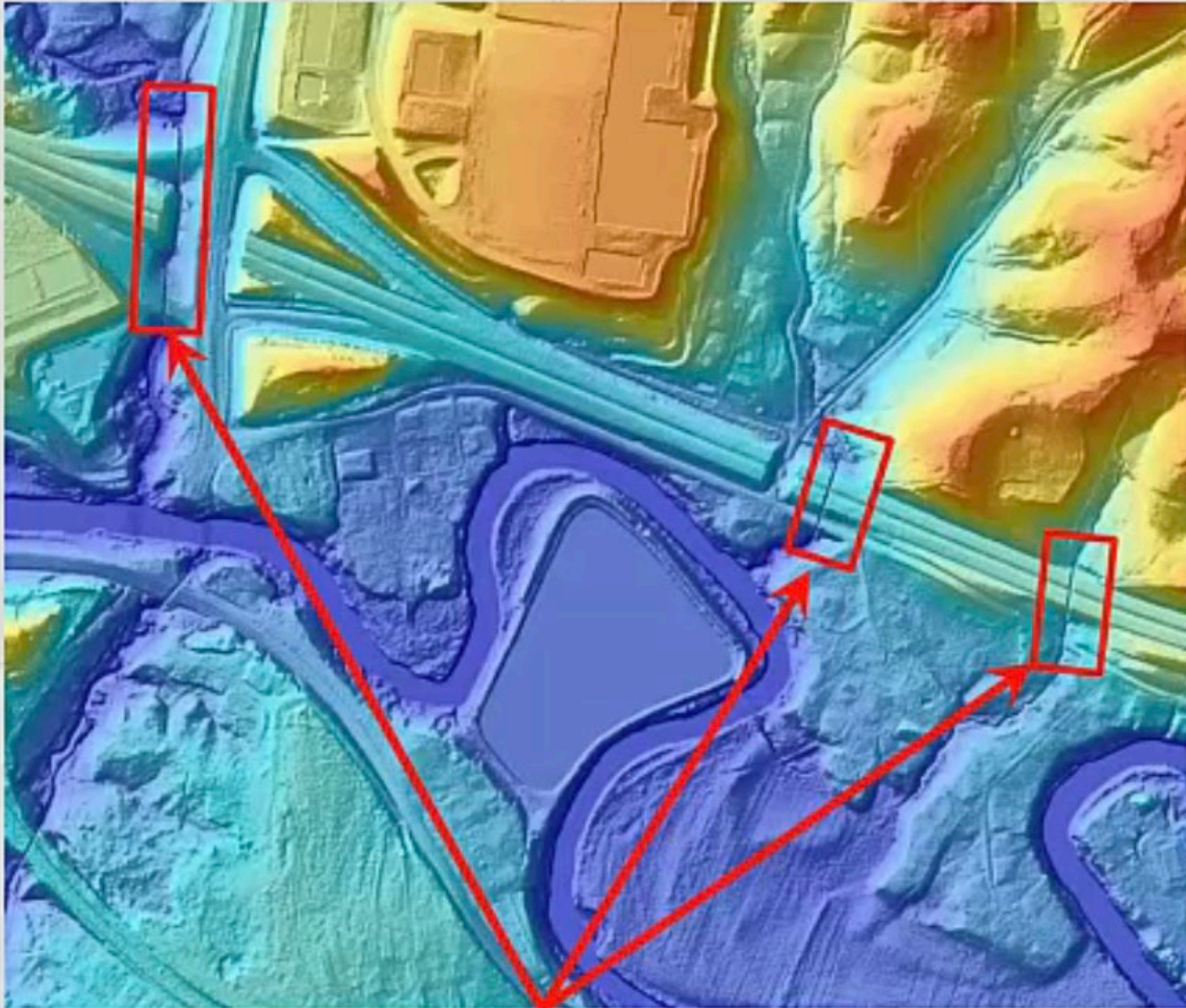


Hydro-flattened DEMs

- Cartographic enhancement, removes lidar artifacts
- Waterbodies are considered to have a single elevation
- Elevation is estimated from the adjacent terrain and is not representative of any measured water

Hydrologically Enforced DEMs

- Modified so waterbodies are level and streams flow downhill
- Contains surface modifications to allow water to flow across the surface, as it does in the real world
 - Road fills are cut through at drainage culverts



Culverts Cut Through Roads

TauDEM (Terrain Analysis Using Digital Elevation Models)

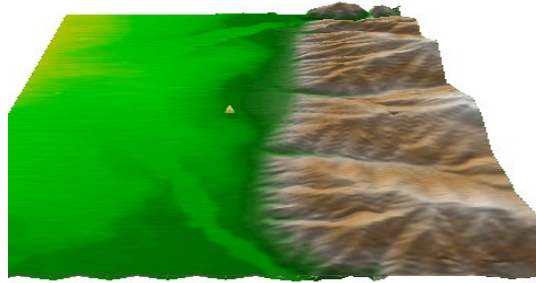
Suite of Digital Elevation Model (DEM) tools to extract and analyze hydrologic information from topography

Many of these tools are available on OpenTopography for high resolution and global topography datasets

OpenTopography's guided browser-based tools generate these TauDEM products in the cloud, which can be visualized in GIS software

TauDEM Workflow

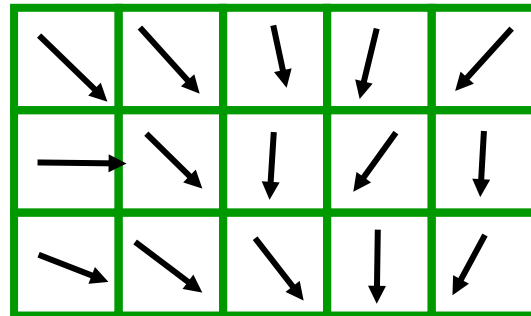
Raw DEM



Pit Removal (Filling)

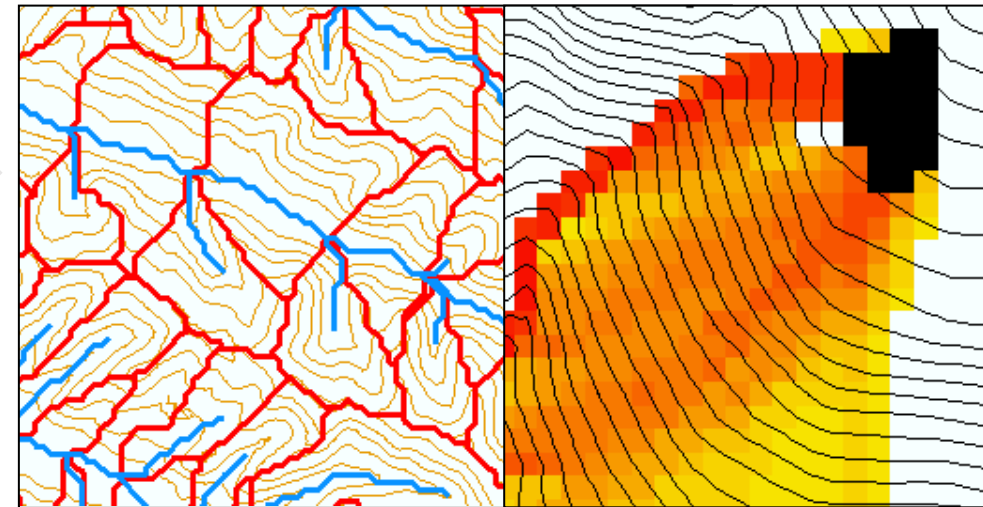


Flow Field



- D8
- D-Infinity

Channels, Watersheds, Flow Related Terrain Information





SDSC SAN DIEGO
SUPERCOMPUTER CENTER

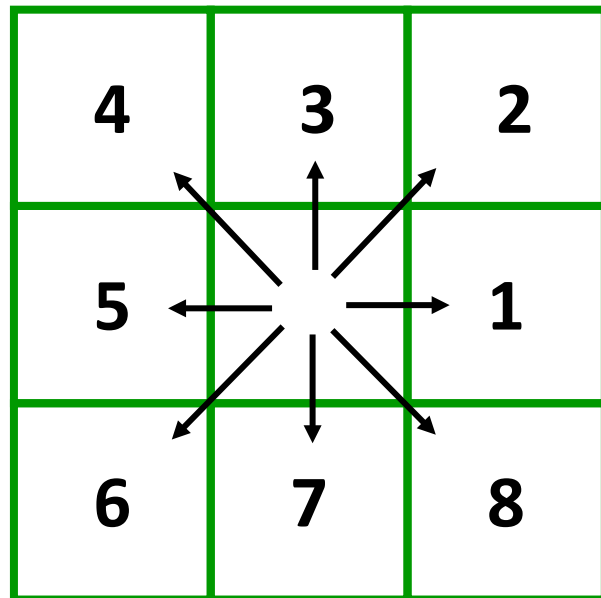


Supercomputer resources are available to all users via a user-friendly web browser interface

D8 Flow Direction

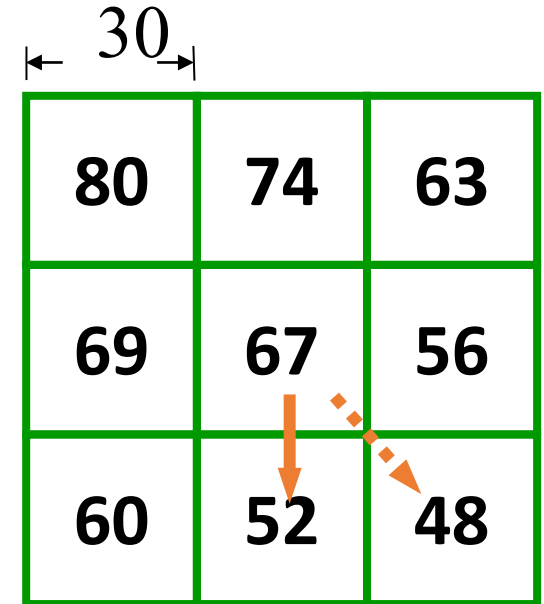
From David Tarboton

- Simplest model for water flow
- Models flow direction from each cell to its steepest downslope neighbor
- Encoded as a number 1 – 8



Flow Direction Coding:

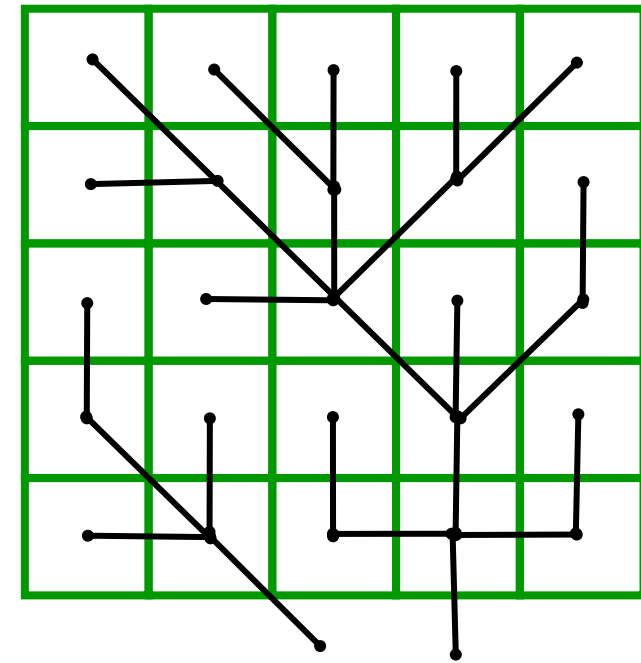
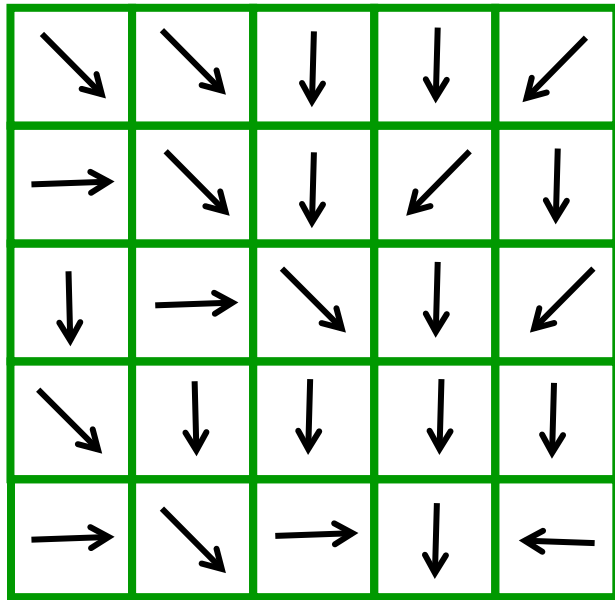
- 1 – East
- 2 – Northeast
- 3 – North
- 4 – Northwest
- 5 – West
- 6 – Southwest
- 7 – South
- 8 – Southeast



$$\frac{67 - 52}{30} = 0.50$$

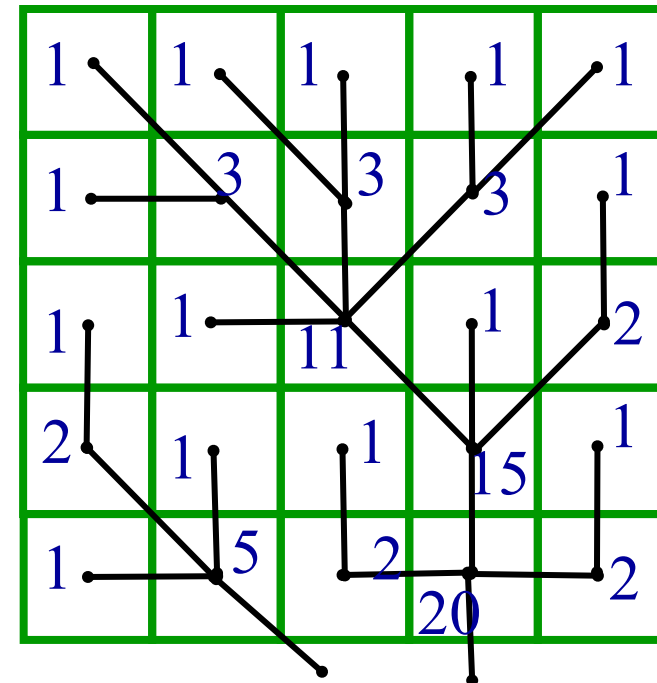
$$\frac{67 - 48}{30\sqrt{2}} = 0.45$$

Grid Network



Contributing Area
Area
(Flow Accumulation)

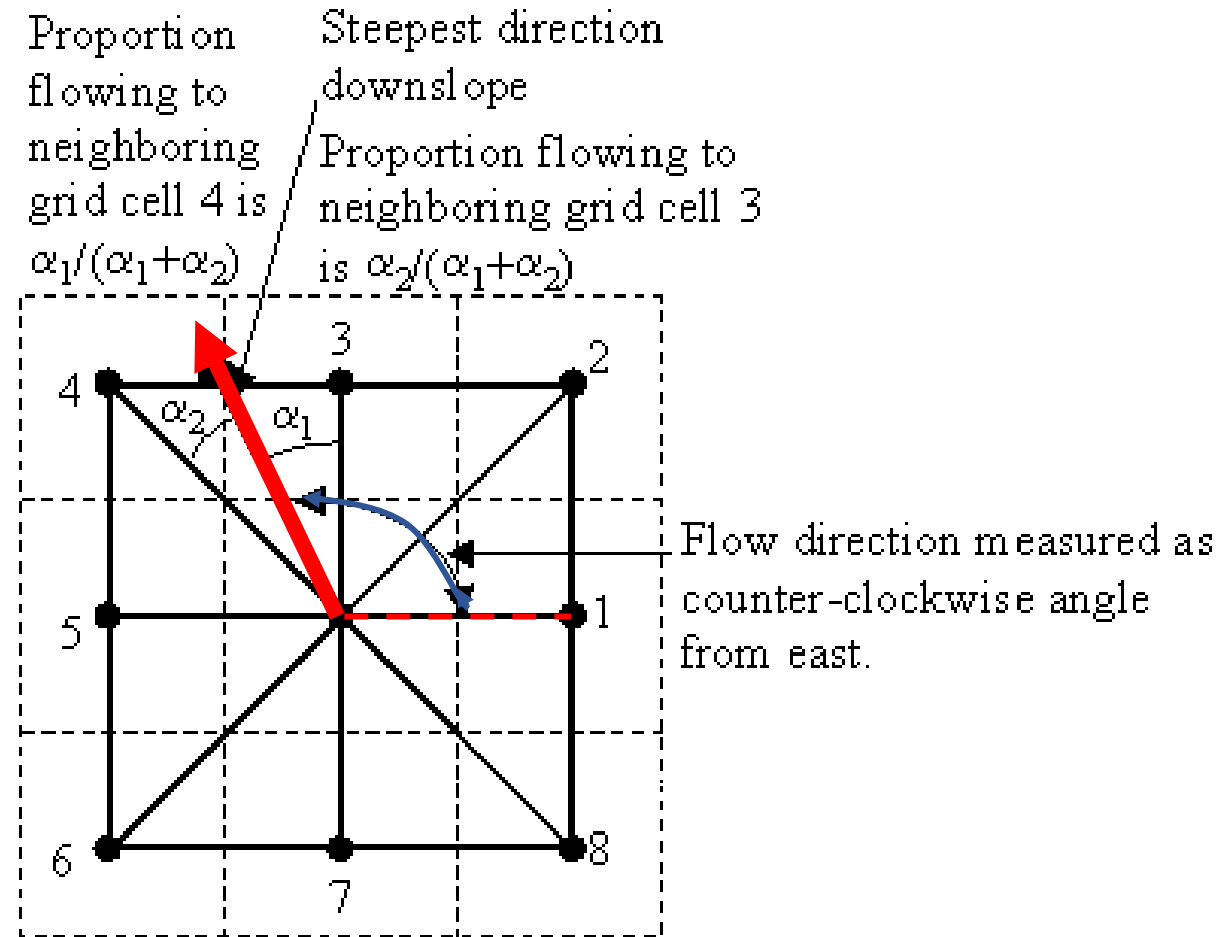
| | | | | |
|---|---|----|----|---|
| 1 | 1 | 1 | 1 | 1 |
| 1 | 3 | 3 | 3 | 1 |
| 1 | 1 | 11 | 1 | 2 |
| 2 | 1 | 1 | 15 | 1 |
| 1 | 5 | 2 | 20 | 2 |



From David Tarboton

D-Infinity Flow Direction

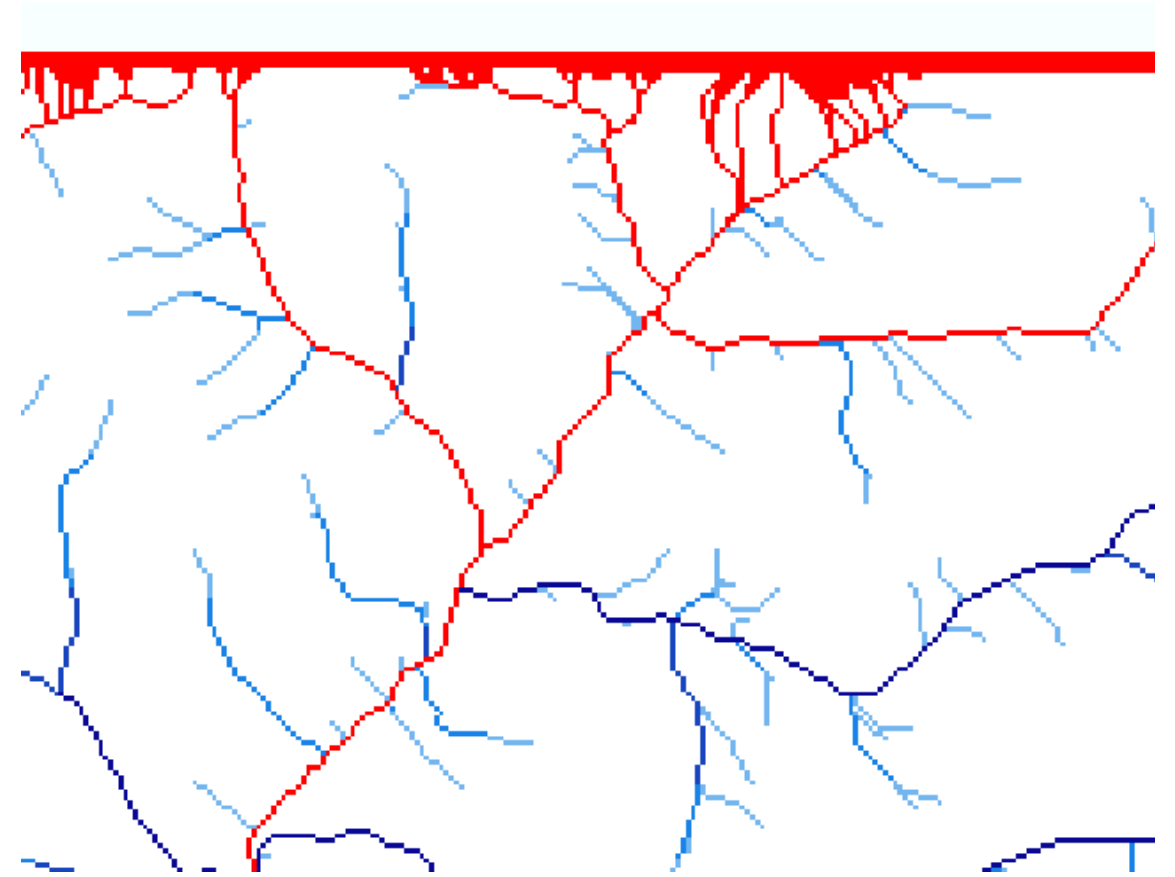
- Calculates steepest outward flow direction, distributes flow between neighboring grid cells based on flow direction angles
- Encoded as an angle in radians counter-clockwise from East between 0 and 2 pi



Numbers 1-8 represent grid cells, not direction like D8 method

Edge Contamination

- Occurs when the contributing area may be underestimated due to grid cells outside of the domain not being counted
- Ensure that DEM area selected includes all of headwater region, or trunk streams may result in “no data”



From David Tarboton

Mapping of San Gabriel Mountains, CA 2009 Fire

DOI: <https://doi.org/10.5069/G94M92N4>

OT Collection ID: OT.012019.26911.1

OT Collection Name: Mapping of San Gabriel Mountains, CA 2009 Fire

Short Name: CA09_Heimsath

Collection Platform: Airborne Lidar

Metadata Download:

- [ISO 19115 \(Data\)](#)
- [Plain Text](#)

Download and Access Products:

[Point Cloud Data](#)

[Bulk Download](#)

opentopoID: OTLAS.012019.26911.1

<https://doi.org/10.5069/G94M92N4>

[Raster Data](#)

[Bulk Download](#)

opentopoID: OTSDEM.012019.26911.1

Collection Overview: Survey conducted by NCALM for investigators Arjun Heimsath and Kelin Whipple, Arizona State University; Michael Lamb, California Institute of Technology; and Ken Hudnut, U.S. Geological Survey, through funding from their institutions to investigate tectonics and geomorphology of the San Gabriel Mountains, California.



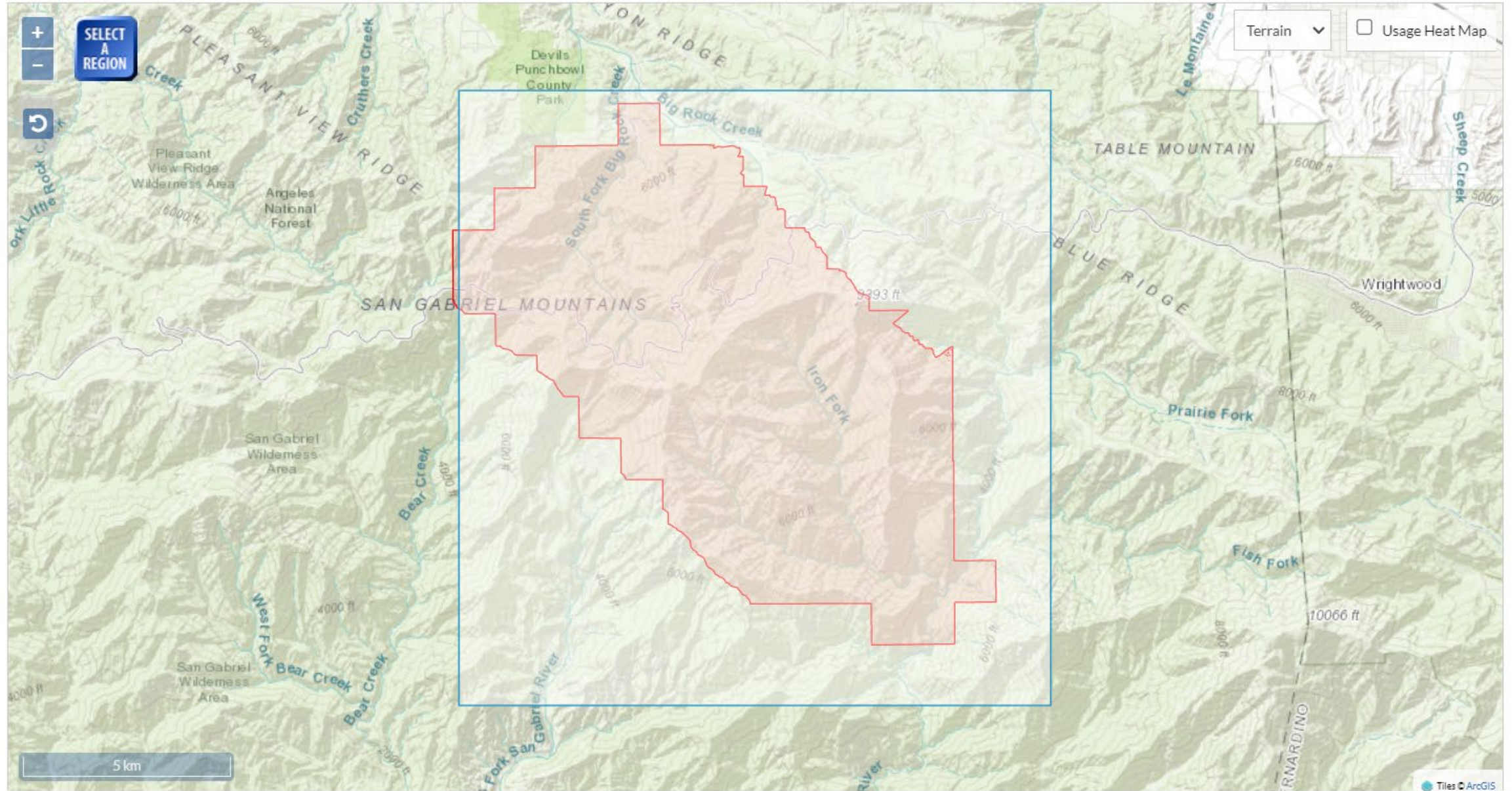
Caltech



Dataset Acknowledgement: Any use of this data should acknowledge lidar data acquisition and processing completed by the National Center for Airborne Laser Mapping (NCALM). NCALM funding provided by NSF's Division of Earth Sciences, Instrumentation and Facilities Program (EAR# 1830734).

Dataset Citation: Heimsath, A., Hudnut, K., Lamb, M., Whipple, K. (2019). Mapping of San Gabriel Mountains, CA 2009 Fire. National Center for Airborne Laser Mapping (NCALM), Distributed by OpenTopography. <https://doi.org/10.5069/G94M92N4>. Accessed: 2022-08-22

1a. Select area of data to download or process i



1. Coordinates & Classification

Horizontal Coordinates: NAD83 / UTM Zone 11N [EPSG: 26911]

Vertical Coordinates: NAVD88 [EPSG: 5703]

Units: meter

Data Selection Coordinates: Manually enter selection coordinates (in the horizontal coordinate system listed above)

$X_{\min} = 420173.053934$ $Y_{\min} = 3792626.445341$ $X_{\max} = 434302.602724$ $Y_{\max} = 3807234.659877$

The selection area contains 133,616,327 points.

Choose Return Classification Building Ground Unclassified

2. Point Cloud Data Download

Point cloud data in LAZ format

Point cloud data in LAS format

Point cloud data in ASCII format

3A. DEM Generation (TIN) ?

Gridding Method

Calculate TIN

Gridding Parameters

Grid Resolution (Default = 1 meter)

10

Max. triangle size (Default 50 units)

50

Grid Format

GeoTiff

7. Hydrologic Terrain Analysis Products (tauDEM) i

i Hydrologically correct DEM with pits filled

i D-Infinity Flow Direction
i D8 Flow Direction:

i D-Infinity Specific Catchment Area
i D8 Contributing Area

i Topographic Wetness Index



Dataset Citation: Heimsath, A., Hudnut, K., Lamb, M., Whipple, K. (2019). Mapping of San Gabriel Mountains, CA 2009 Fire. National Center for Airborne Laser Mapping (NCALM), Distributed by OpenTopography. <https://doi.org/10.5069/G94M92N4>. Accessed: 2022-08-22

Use License: CC BY 4.0

| Job Id | Dataset | Title | Submission | Completion | Duration | Num. Points | Final Status |
|-----------------|---------------|----------------|---------------------|---------------------|-----------|-------------|--------------|
| pc1661208983891 | CA09_Heimsath | SanGab 10m all | 2022-08-22 22:56:24 | 2022-08-22 23:14:19 | 1075 secs | 133,616,327 | Done ✓ |

18 min

Download Data

- Point Cloud Results
 - Download point cloud data in LAZ format [points.laz](#) (555.5 MB)
- DEM Results
 - Download DEM (TIN) [output.tin.tar.gz](#) (3.1 MB)
- TauDEM Products
 - Download PitRemove file [pitRemove.tar.gz](#) (3.1 MB)
 - Download D-Infinity: Flow Direction file [dinfFlowDirection.tar.gz](#) (3.3 MB)
 - Download D-Infinity: Slope file [dinfSlope.tar.gz](#) (3.6 MB)
 - Download D-Infinity Specific Catchment Area file [Dinfarea.tar.gz](#) (3.6 MB)
 - Download Topographic Wetness Index file [TWI.tar.gz](#) (3.5 MB)
 - Download D8 - Flow Direction file [d8FlowDirection.tar.gz](#) (343.7 KB)
 - Download D8: Slope file [d8Slope.tar.gz](#) (3.2 MB)
 - Download D8 Contributing Area file [D8area.tar.gz](#) (1.1 MB)

1. Coordinates

Horizontal Coordinates: NAD83 / UTM Zone 11N [EPSG: 26911]

Vertical Coordinates: NAVD88 [EPSG: 5703]

Units: meter

Data Selection Coordinates: Manually enter selection coordinates (in the horizontal coordinate system listed above)

2. Data Output Formats

i Select Data Output Format:

GeoTiff



3. Layer Types & Additional SRTM Data

i Digital Elevation Models (DEMs)

Digital Terrain Model (DTM)

Digital Surface Model (DSM)

i Include Global 30m SRTM Data

7. Hydrologic Terrain Analysis Products (tauDEM) **i**

i Hydrologically correct DEM with pits filled

i D-Infinity Flow Direction

i D8 Flow Direction:

i D-Infinity Specific Catchment

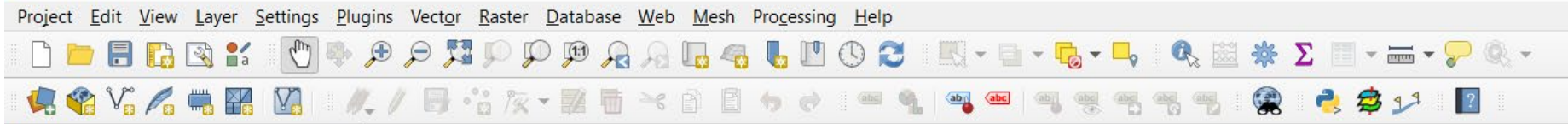
Area

i D8 Contributing Area

i Topographic Wetness Index

Download pre-generated data products

<https://opentopography.org/workshops/AGIC2022>

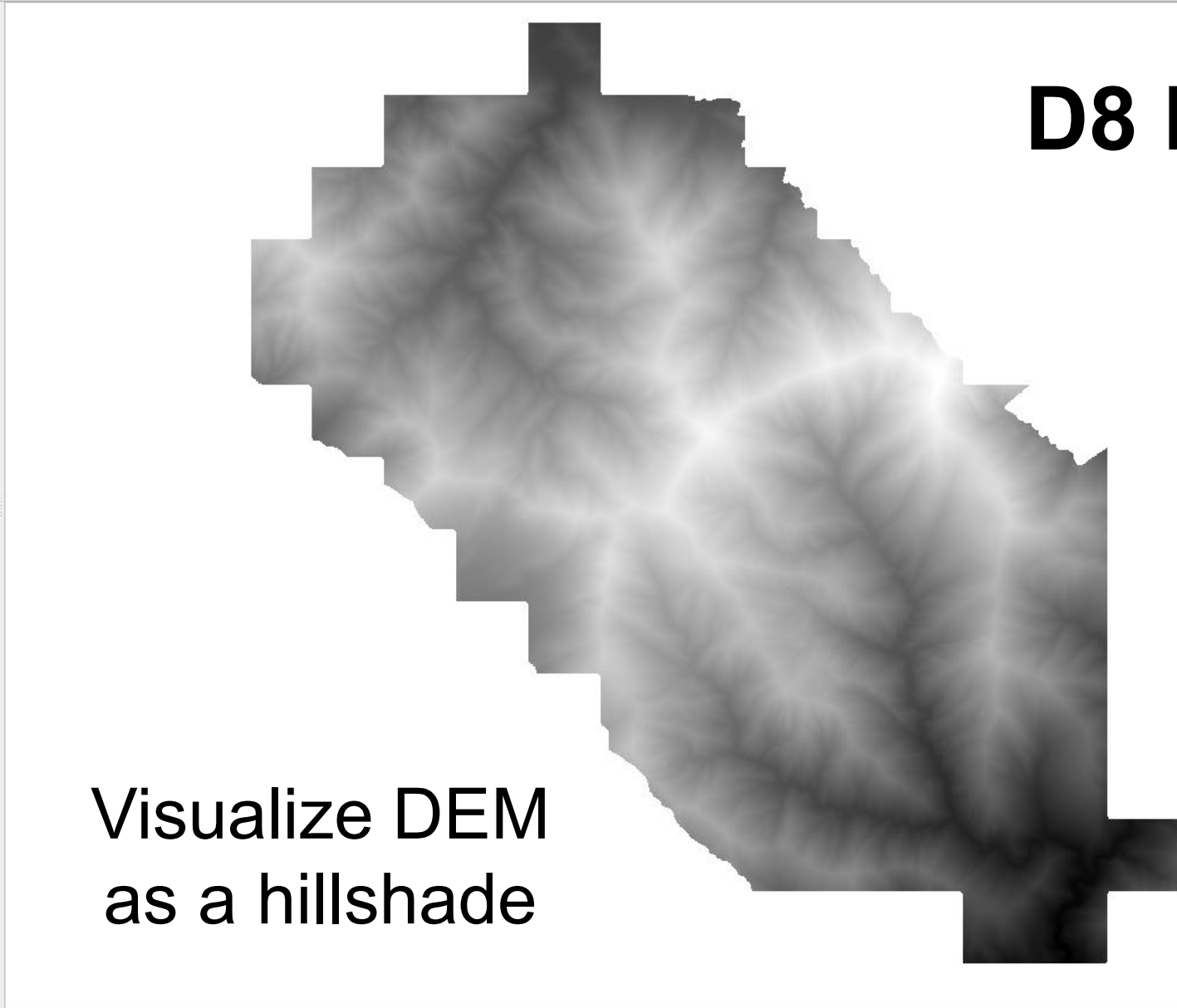


Layers

- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
8
- d8Slope**
Band 1 (Gray)
3.693929
- pitRemoveDEM**
Band 1 (Gray)
2,837.27002
849.22998

Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Project Home
- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage



D8 Products

Visualize DEM as a hillshade

Layers

- d8Contrib
Band 1 (Gray)
349,224
- d8FlowDi
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM
Band 1 (Gray)
2,837.27
849.23

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

- Zoom to Layer(s)
- Show in Overview
- Copy Layer
- Rename Layer
- Zoom to Native Resolution (100%)
- Stretch Using Current Extent
- Duplicate Layer
- Remove Layer...
- Move to Top
- Change Data Source...
- Set Layer Scale Visibility...
- Layer CRS
- Export
- Styles
- Add Layer Notes...
- Properties...

Layer Properties — pitRemoveDEM — Symbology

Band Rendering

- Render type: Multiband color
- Gray band: Paletted/Unique values
- Color gradient: Singleband gray
- Color gradient: Singleband pseudocolor
- Color gradient: Hillshade
- Color gradient: Contours

Min / Max Value Settings

Min: 849.23 Max: 2837.27

Contrast enhancement: Stretch to MinMax

Layer Rendering

Blending mode: Normal

Brightness: 0 Contrast: 0

Gamma: 1.00 Saturation: 0

Invert colors: Grayscale: Off

Hue: Colorize Strength: 100%

Resampling

Zoomed: in Nearest Neighbour out Nearest Neighbour Oversampling: 2.00 Early resampling:

Style

OK Cancel Apply Help

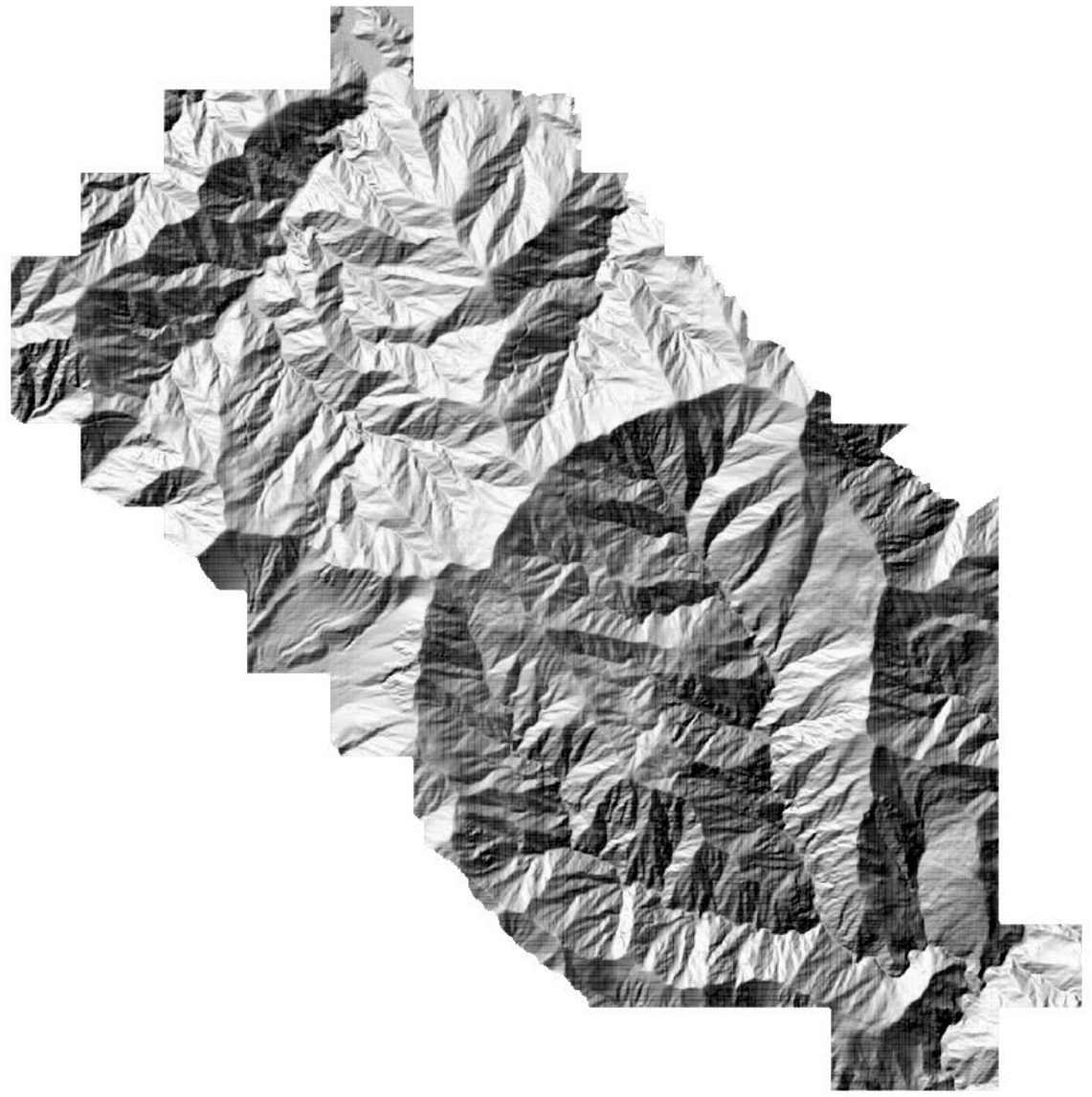


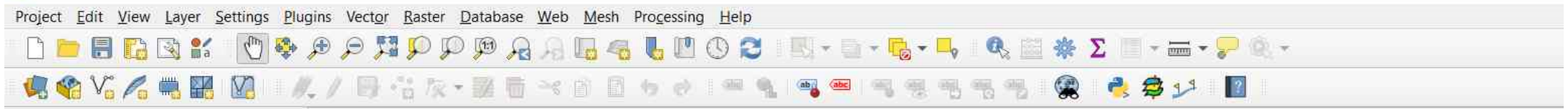
Layers

- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
8
- d8Slope**
Band 1 (Gray)
3.69393
- pitRemoveDEM**

Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Project Home
- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage



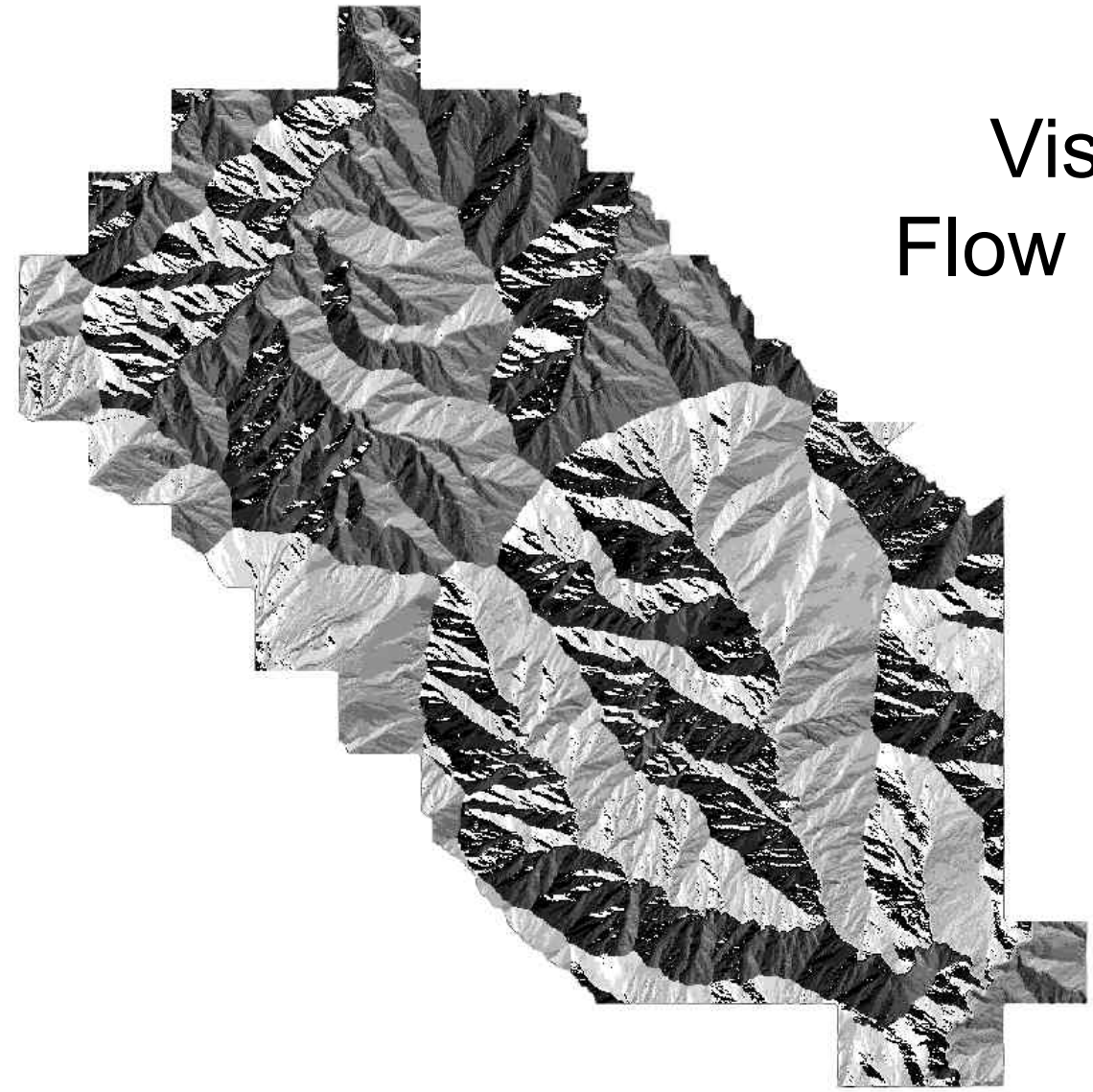


Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM

Browser

- ★ Favorites
- ▶ Spatial Bookmarks
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- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage



Visualize Flow Direction



Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM

- Zoom to Layer(s)
- Show in Overview
- Copy Layer
- Rename Layer
- Zoom to Native Resolution (100%)
- Stretch Using Current Extent
- Duplicate Layer
- Remove Layer...
- Move to Top
- Move to Bottom
- Change Data Source...
- Set Layer Scale Visibility...
- Layer CRS
- Export
- Styles
- Add Layer Notes...
- Properties...**

"Paletted/Unique values"

Layer Properties — d8FlowDirection — Symbology

- Information
- Source
- Symbology**
- Transparency
- Histogram
- Rendering
- Temporal
- Pyramids
- Metadata
- Legend
- QGIS Server

Band Rendering

- Multiband color
- Paletted/Unique values**
- Singleband gray
- Singleband pseudocolor
- Hillshade
- Contours

Render type: [Dropdown]
Gray band: [Dropdown]
Color gradient: [Dropdown]
Min: 1 Max: 8
Contrast enhancement: Stretch to MinMax

Min / Max Value Settings

Legend Settings...

Layer Rendering

Blending mode: Normal [Reset]
Brightness: [Slider] 0
Gamma: [Slider] 1.00
Contrast: [Slider] 0
Saturation: [Slider] 0
 Invert colors
Grayscale: Off
Hue: Colorize [Dropdown] Strength: [Slider] 100%

Resampling

Zoomed: in Nearest Neighbour out Nearest Neighbour Oversampling 2.00 Early resampling

Style [Dropdown] [OK] [Cancel] [Apply] [Help]

Browser

- Favorites
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- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
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Band 1 (Gray)
8
- d8Slope
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3.693929
- pitRemoveDEM

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- GeoPackage

Layer Properties — d8FlowDirection — Symbology

Information
Source
Symbology
Transparency
Histogram
Rendering
Temporal
Pyramids
Metadata
Legend
QGIS Server

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: Random colors

| Value | Color | Label |
|-------|-------|-------|
|-------|-------|-------|

Classify Delete All

Adds all missing unique values from the raster

Layer Rendering

Blending mode: Normal

Brightness: 0 Contrast: 0

Gamma: 1.00 Saturation: 0

Invert colors Grayscale: Off

Style

Select
"Classify"

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layer Properties — d8FlowDirection — Symbology

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: Random colors

| Value | Color | Label |
|-------|-------|-------|
| 1 | | 1 |
| 2 | | 2 |
| 3 | | 3 |
| 4 | | 4 |
| 5 | | 5 |

Layer Rendering

Blending mode: Normal

Brightness: 0

Gamma: 1.00

Contrast: 0

Saturation: 0

Grayscale: Off

Buttons: Classify, Add, Delete All, OK, Cancel, Apply, Help

Random color will be assigned 1-8

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM

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Layer Properties — d8FlowDirection — Symbology

Information
Source
Symbology
Transparency
Histogram
Rendering
Temporal
Pyramids
Metadata
Legend
QGIS Server

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: Random colors

| Value | Color Ramp |
|-------|---|
| 1 | Invert Color Ramp |
| 1 | <input checked="" type="checkbox"/> Random Color Ramp |
| | Shuffle Random Colors |
| 2 | Blues |
| | Cividis |
| 3 | Greens |
| | Greys |
| | Magma |
| 4 | Mako |
| | RdGy |
| | Reds |
| | Rocket |
| | Spectral |
| | Turbo |
| | Viridis |

Layer Rendering

Blending mode: Normal

Brightness: 0

Gamma: 1

Invert colors

Contrast: 0

Saturation: 0

Grayscale: Off

Reset

OK Cancel Apply Help

Choose a color ramp, here using "Spectral"

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layer Properties — d8FlowDirection — Symbology

Information
Source
Symbology
Transparency
Histogram
Rendering
Temporal
Pyramids
Metadata
Legend
QGIS Server

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: [Color Ramp]

| Value | Color | Label |
|-------|----------------|-------|
| 1 | [Red] | 1 |
| 2 | [Orange] | 2 |
| 3 | [Light Orange] | 3 |
| 4 | [Yellow] | 4 |

Classify [Add] [Remove] Delete All [More]

Layer Rendering

Blending mode: Normal [Reset]

Brightness: [Slider] 0 [Spin]

Gamma: [Slider] 1.00 [Spin]

Contrast: [Slider] 0 [Spin]

Saturation: [Slider] 0 [Spin]

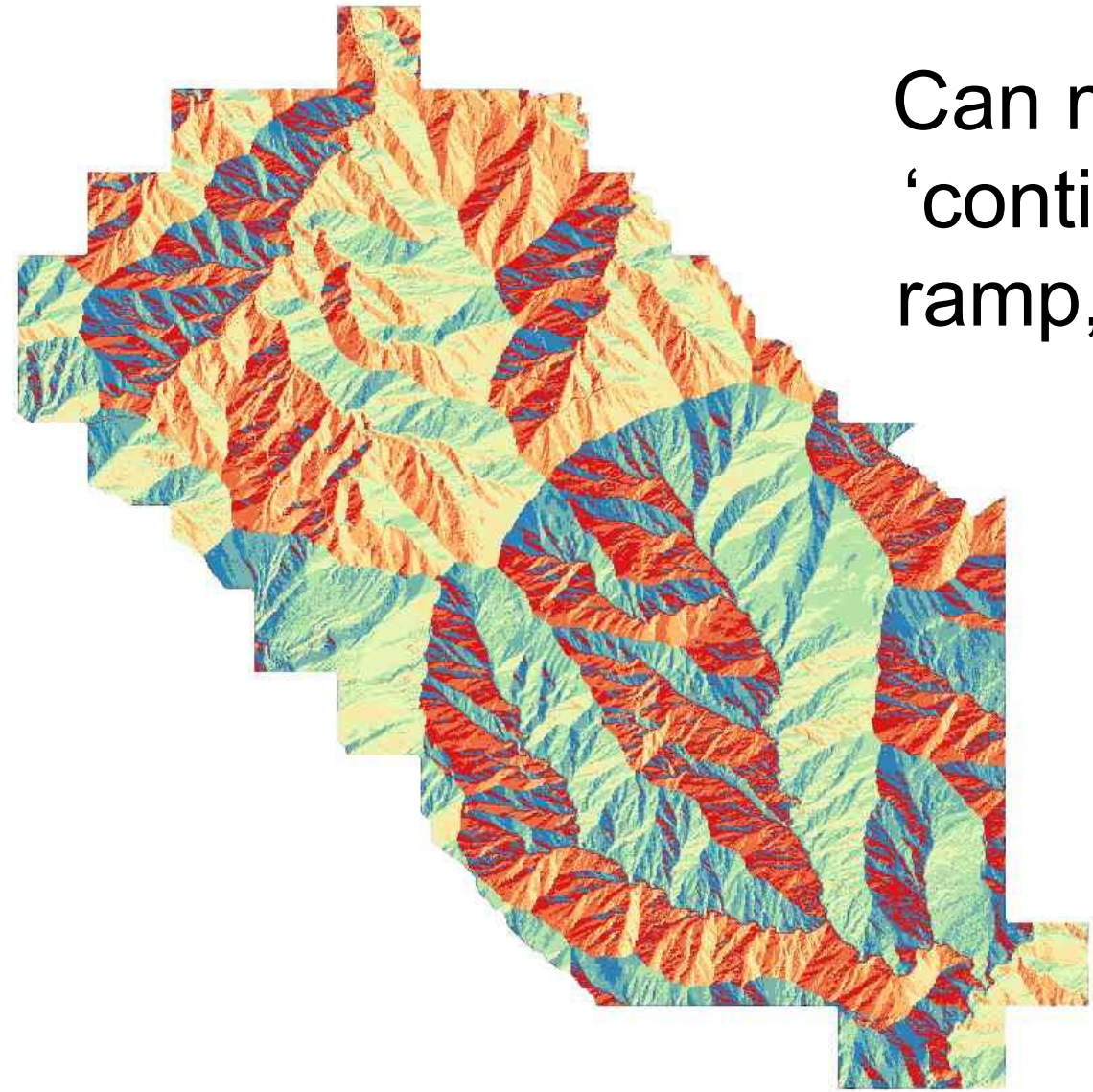
Invert colors

Grayscale: Off

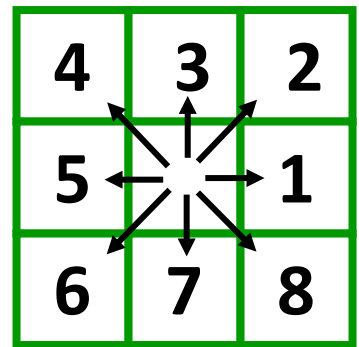
Style [OK] [Cancel] [Apply] [Help]

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
1
2
3
4
5
6
7
8
- d8Slope
Band 1 (Gray)
3.693929
0
- pitRemoveDEM



Can make a more 'continuous' color ramp, as 1 = East



Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
1 2 3 4 5 6 7 8
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM

Layer Properties — d8FlowDirection — Symbology

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: [Color Ramp]

Value

- Invert Color Ramp
- Random Color Ramp
- 1 Blues
- 2 Cividis
- 3 Greens
- 4 Greys
- Magma
- Mako
- RdGy
- Reds
- Rocket
- Spectral
- Turbo
- Viridis

All Color Ramps

Create New Color Ramp...

Edit Color Ramp...

Save Color Ramp...

Layer Rendering

Blending mode: [Dropdown]

Brightness: [Slider]

Gamma: [Slider]

Invert colors

Contrast: [Slider] 0

Saturation: [Slider] 0

Grayscale: Off

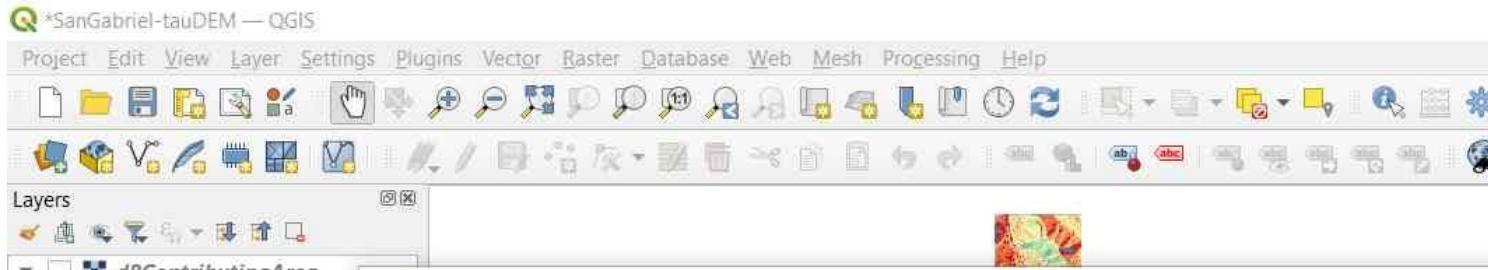
Reset

OK Cancel Apply Help

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Edit the color ramp



Click on color droppers
and adjust the color

Layer Properties — d8FlowDirection — Symbology

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: [Color Ramp]

| Value | Color | Label |
|-------|----------------|-------|
| 1 | [Red] | 1 |
| 2 | [Orange] | 2 |
| 3 | [Light Orange] | 3 |
| 4 | [Yellow] | 4 |

Layer Rendering

Blending mode: Normal

Brightness: 0

Gamma: 1.00

Invert colors

Style

Select Color Ramp

Color 1: [Red] Color 2: [Blue] Type: Continuous

Color ramp: [Color Ramp]

Gradient Stop

Relative position: 0.0 % [Delete Stop]

Sample average radius: 1 px

Sample color: [Color Picker]

Press space to sample a color from under the mouse cursor

H: 359°

S: 88%

V: 84%

R: 215

G: 25

B: 28

Opacity: 100%

HTML notation: #d7191c

Current: [Red]

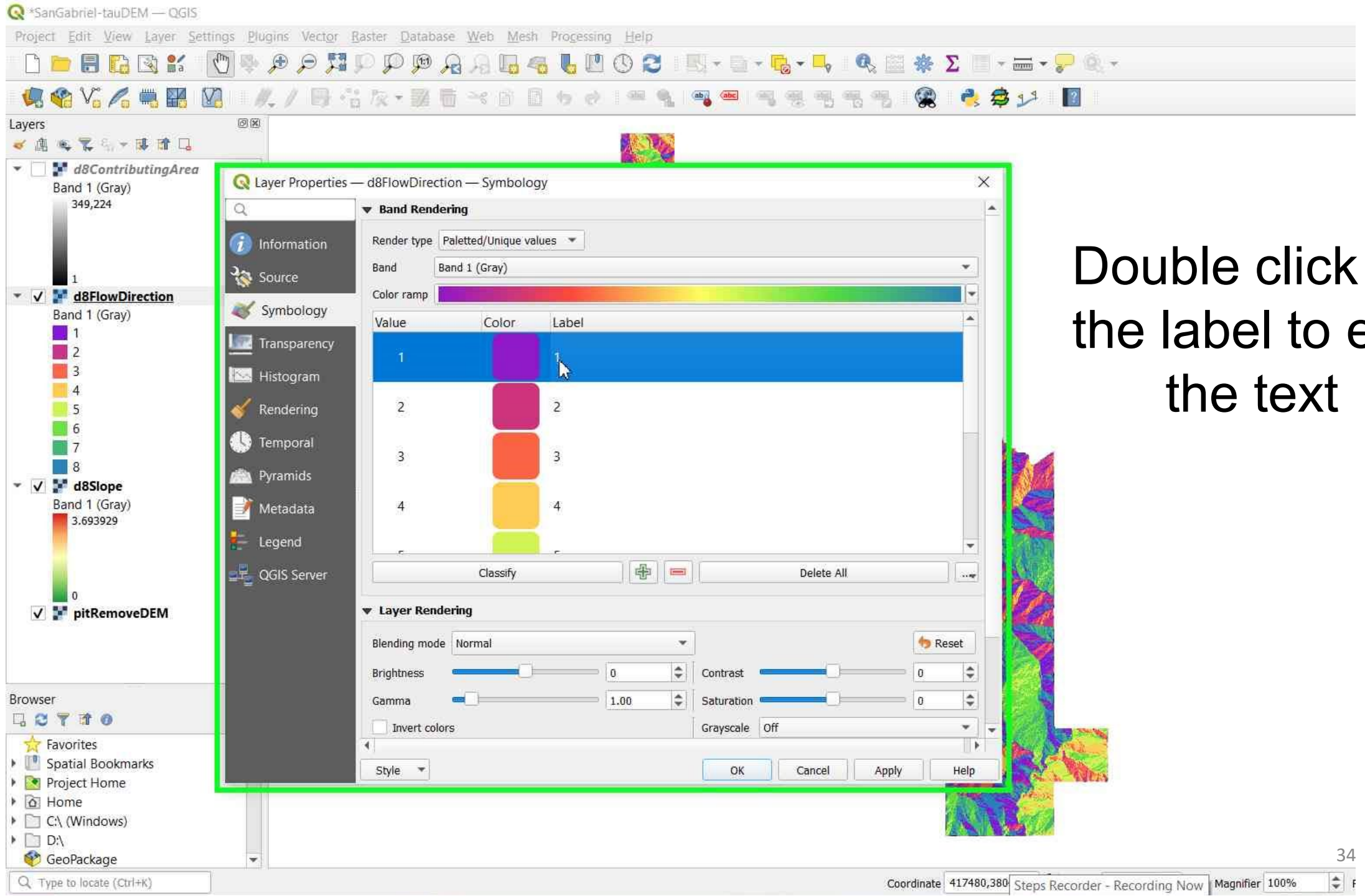
Information

OK Cancel Help

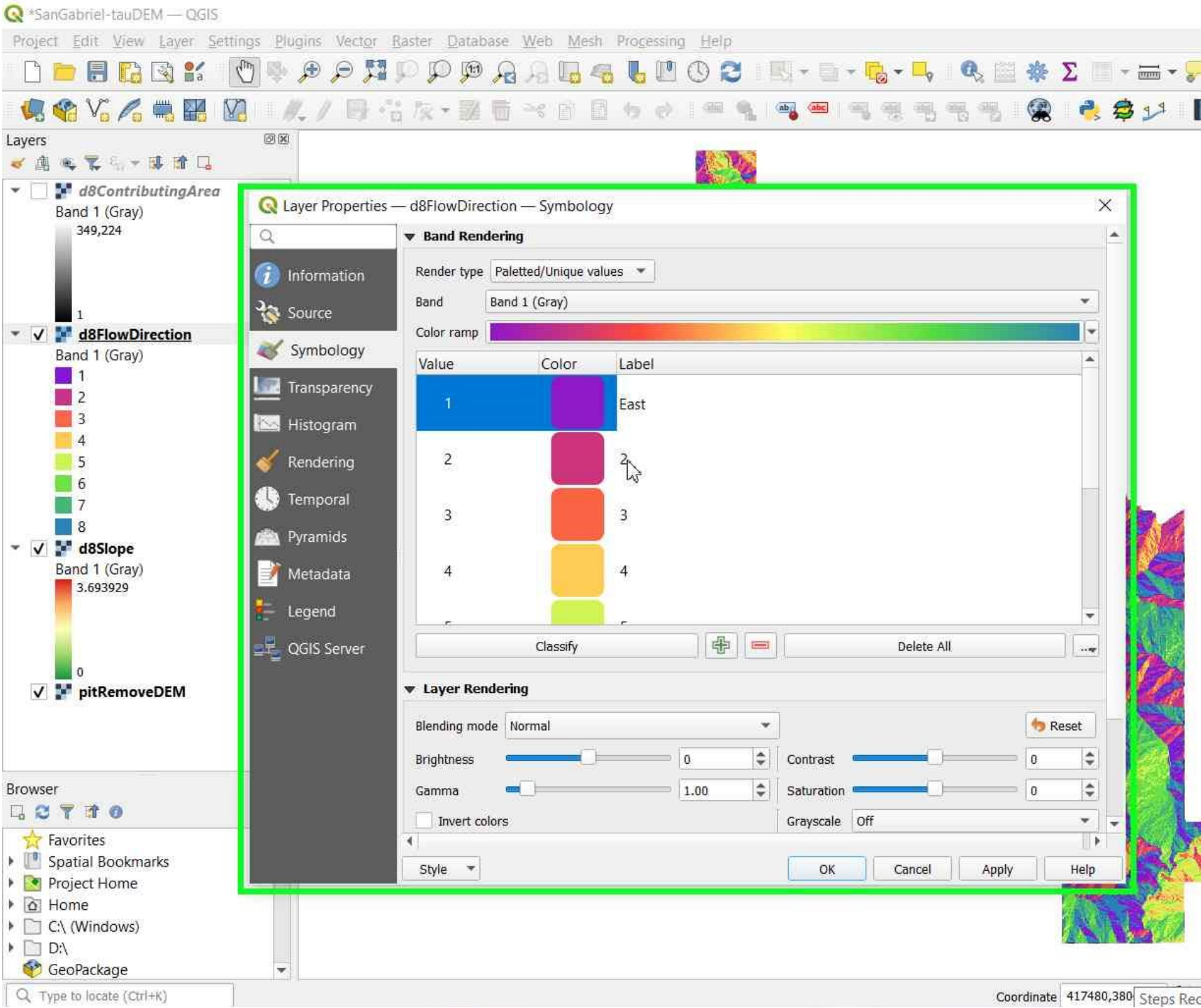
I've made a rainbow scheme that will be more continuous from 8 to 1

The image shows a QGIS interface with several panels. The 'Layers' panel on the left shows three layers: 'd8ContributingArea', 'd8FlowDirection', and 'd8Slope'. The 'd8FlowDirection' layer is selected and its properties are shown in the 'Layer Properties' dialog. The 'Symbology' tab is active, showing a 'Paletted/Unique values' render type. A table lists values 1 through 4 with corresponding colors (red, orange, yellow, light green). The 'Layer Rendering' section shows 'Blending mode' set to 'Normal', 'Brightness' at 0, and 'Gamma' at 1.00. The 'Select Color Ramp' dialog box is open, showing a 'Continuous' color ramp with a rainbow gradient. The 'Gradient Stop' section shows a stop at 75.0% relative position. The 'Sample color' section has a 'Sample average radius' of 1 px. The 'Color' section shows HSB values: H=112°, S=64%, V=80%. The 'HTML notation' is #5bcd4a. The 'OK' button is highlighted with a mouse cursor.

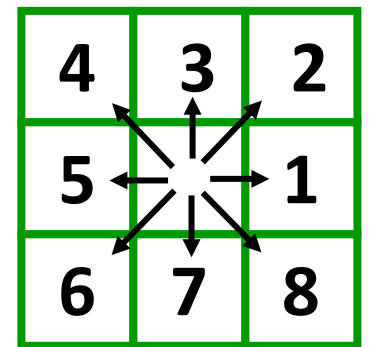
| Value | Color | Label |
|-------|-------------|-------|
| 1 | Red | 1 |
| 2 | Orange | 2 |
| 3 | Yellow | 3 |
| 4 | Light Green | 4 |



Double click on the label to edit the text



Assign labels accordingly



- 1 – East
- 2 – Northeast
- 3 – North
- 4 – Northwest
- 5 – West
- 6 – Southwest
- 7 – South
- 8 - Southeast

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
1
2
3
4
5
6
7
8
- d8Slope
Band 1 (Gray)
3.693929
0
- pitRemoveDEM

Layer Properties — d8FlowDirection — Symbology

Band Rendering

Render type: Paletted/Unique values

Band: Band 1 (Gray)

Color ramp: [Color Ramp]

| Value | Color | Label |
|-------|---------------|-----------|
| 5 | [Light Green] | West |
| 6 | [Green] | Southwest |
| 7 | [Dark Green] | South |
| 8 | [Blue] | Southeast |

Layer Rendering

Blending mode: Normal

Brightness: 0

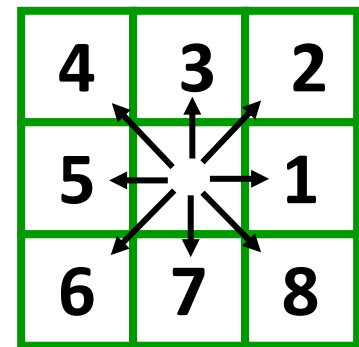
Gamma: 1.00

Contrast: 0

Saturation: 0

Grayscale: Off

Buttons: Classify, Add, Remove, Delete All, OK, Cancel, Apply, Help



- 1 – East
- 2 – Northeast
- 3 – North
- 4 – Northwest
- 5 – West
- 6 – Southwest
- 7 – South
- 8 - Southeast

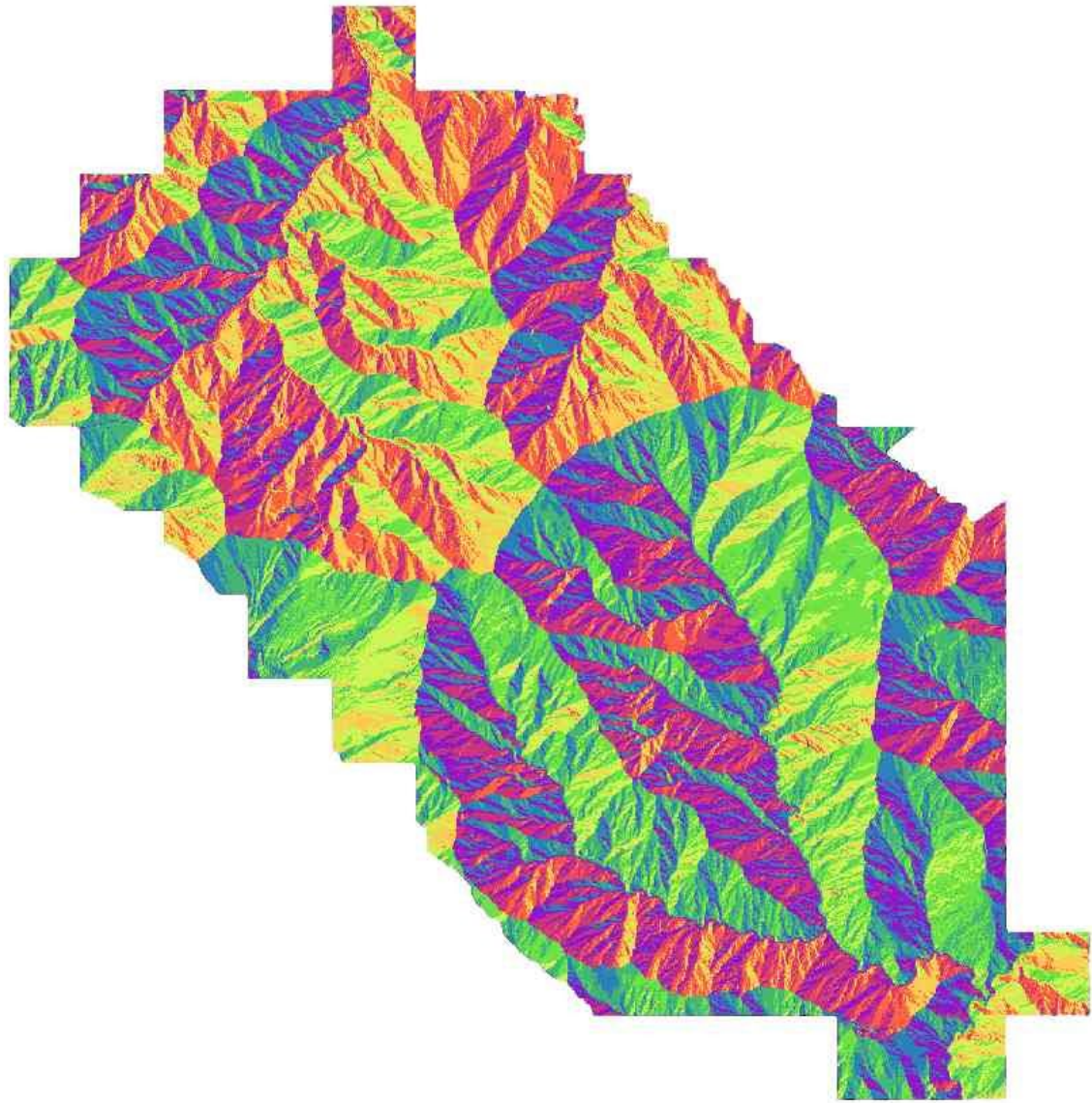
Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage



Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
East
Northeast
North
Northwest
West
Southwest
South
Southeast
- d8Slope
Band 1 (Gray)
3.693929
- pitRemoveDEM



Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layers

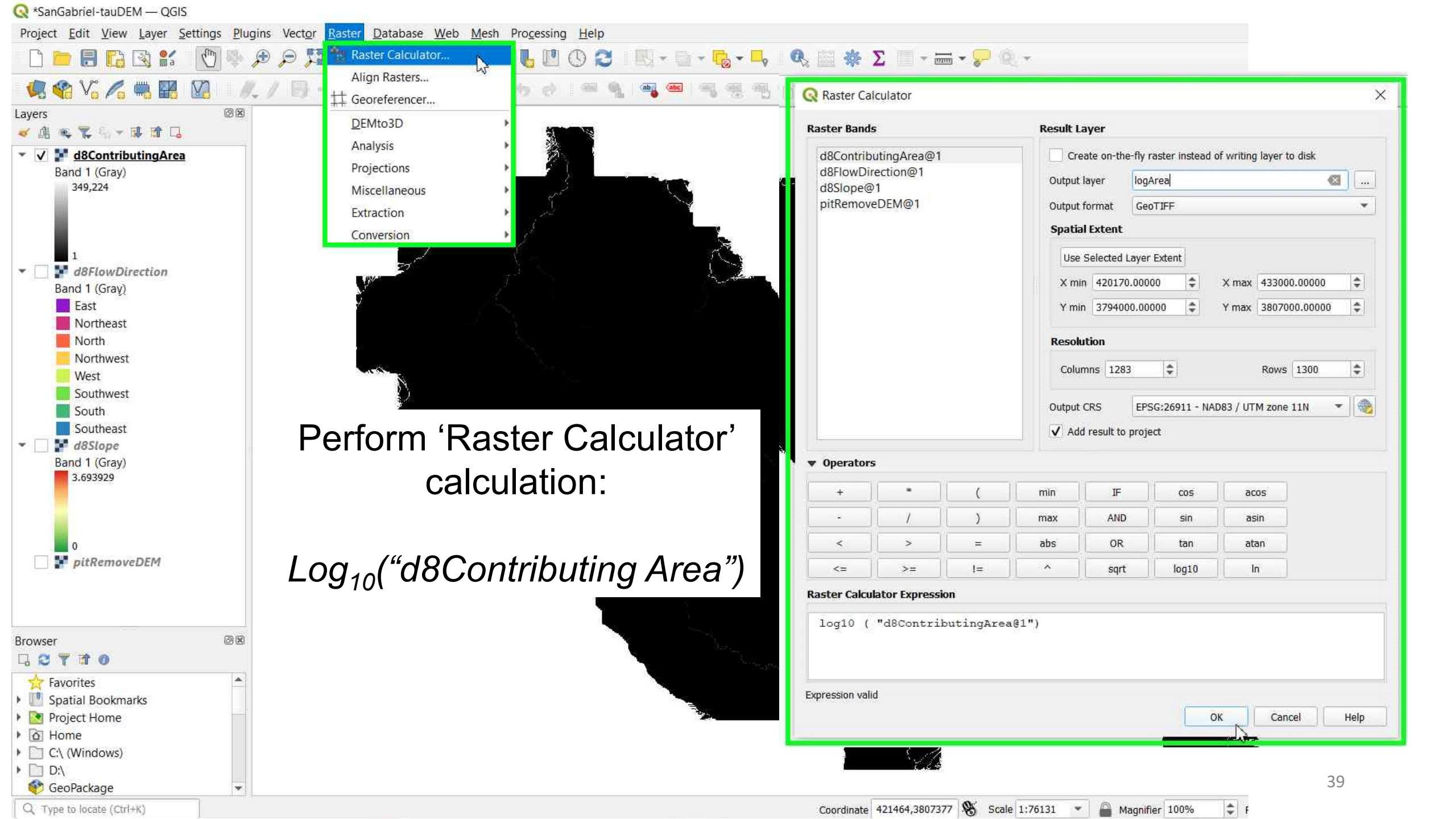
- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
East
Northeast
North
Northwest
West
Southwest
South
Southeast
- d8Slope**
Band 1 (Gray)
3.693929
0
- pitRemoveDEM**

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage



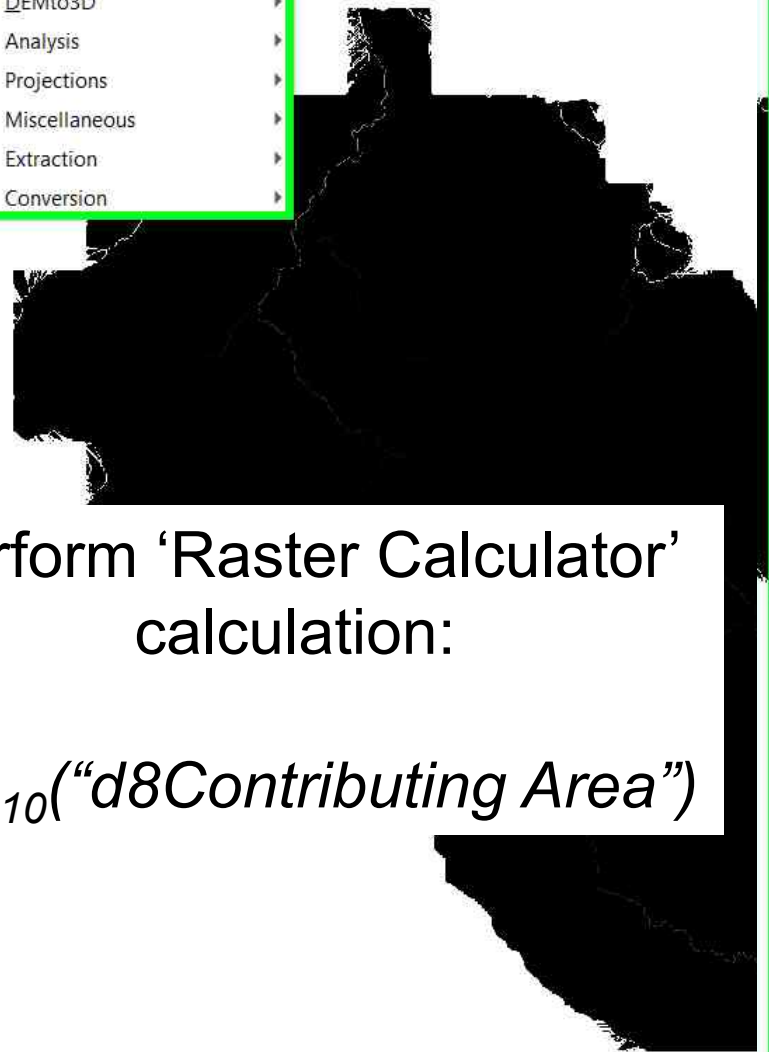
Visualize the contributing area



Layers

- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
East
Northeast
North
Northwest
West
Southwest
South
Southeast
- d8Slope**
Band 1 (Gray)
3.693929
- pitRemoveDEM**

- Raster Calculator...
- Align Rasters...
- Georeferencer...
- DEMto3D
- Analysis
- Projections
- Miscellaneous
- Extraction
- Conversion



Perform 'Raster Calculator'
calculation:
 $Log_{10}(\text{"d8Contributing Area"})$

Raster Calculator

Create on-the-fly raster instead of writing layer to disk

Output layer:

Output format:

Spatial Extent

X min: X max:

Y min: Y max:

Resolution

Columns: Rows:

Output CRS:

Add result to project

Operators

| | | | | | | |
|----|----|----|-----|------|-------|------|
| + | * | (| min | IF | cos | acos |
| - | / |) | max | AND | sin | asin |
| < | > | = | abs | OR | tan | atan |
| <= | >= | != | ^ | sqrt | log10 | ln |

Raster Calculator Expression

Expression valid

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layers

- logArea**
- d8ContributingArea**
 - Band 1 (Gray)
349,224
 - 1
- d8FlowDirection**
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West
 - Southwest
 - South
 - Southeast
- d8Slope**
 - Band 1 (Gray)
 - 3.693929
 - 0
- pitRemoveDEM**

✓ Raster calculator: Calculation complete.



Adjust the symbology

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layers

- logArea
 - Band 1 (Gray) 5.543104
- d8Contrib
 - Band 1 (Gray) 349,224
- d8FlowDir
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West
 - Southwest
 - South
 - Southeast
- d8Slope
 - Band 1 (Gray) 3.693929

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

- Zoom to Layer(s)
- Show in Overview
- Copy Layer
- Rename Layer
- Zoom to Native Resolution (100%)
- Stretch Using Current Extent
- Duplicate Layer
- Remove Layer...
- Move to Bottom
- Change Data Source...
- Set Layer Scale Visibility...
- Layer CRS
- Export
- Styles
- Add Layer Notes...
- Properties...

Layer Properties — logArea — Symbology

Band Rendering

- Render type: Singleband gray
- Gray band: Singleband pseudocolor
- Color gradient: Hillshade
- Contrast enhancement: Stretch to MinMax

Min / Max Value Settings

Min: 0 Max: 5.5431

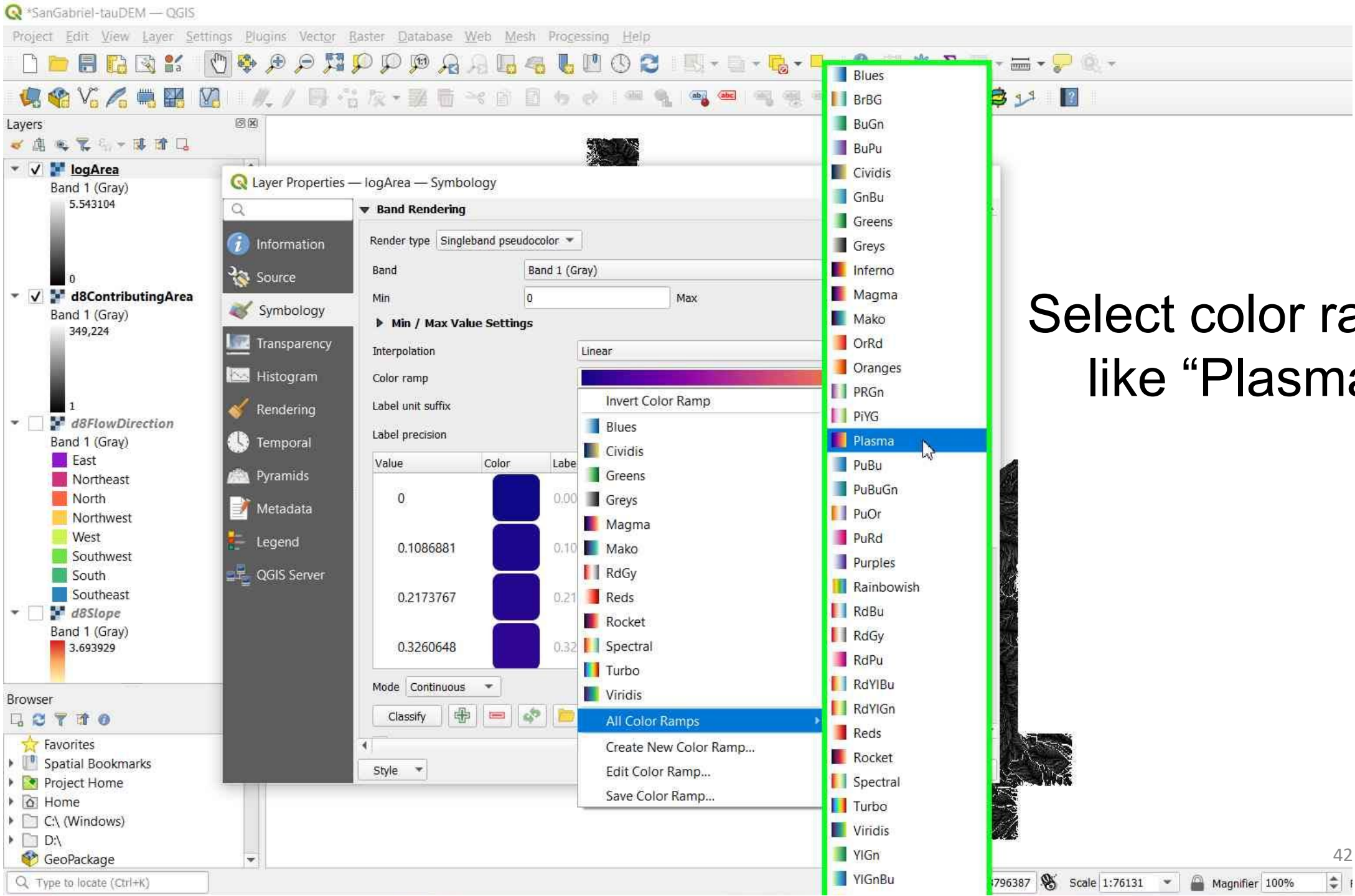
Layer Rendering

- Blending mode: Normal
- Brightness: 0
- Gamma: 1.00
- Contrast: 0
- Saturation: 0
- Grayscale: Off
- Hue: Colorize (Strength: 100%)

Resampling

- Zoomed in: Nearest Neighbour
- Zoomed out: Nearest Neighbour
- Oversampling: 2.00
- Early resampling: Off

OK Cancel Apply Help



Select color ramp,
like "Plasma"

Layer Properties — logArea — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0 Max: Max

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color Ramp]

Invert Color Ramp

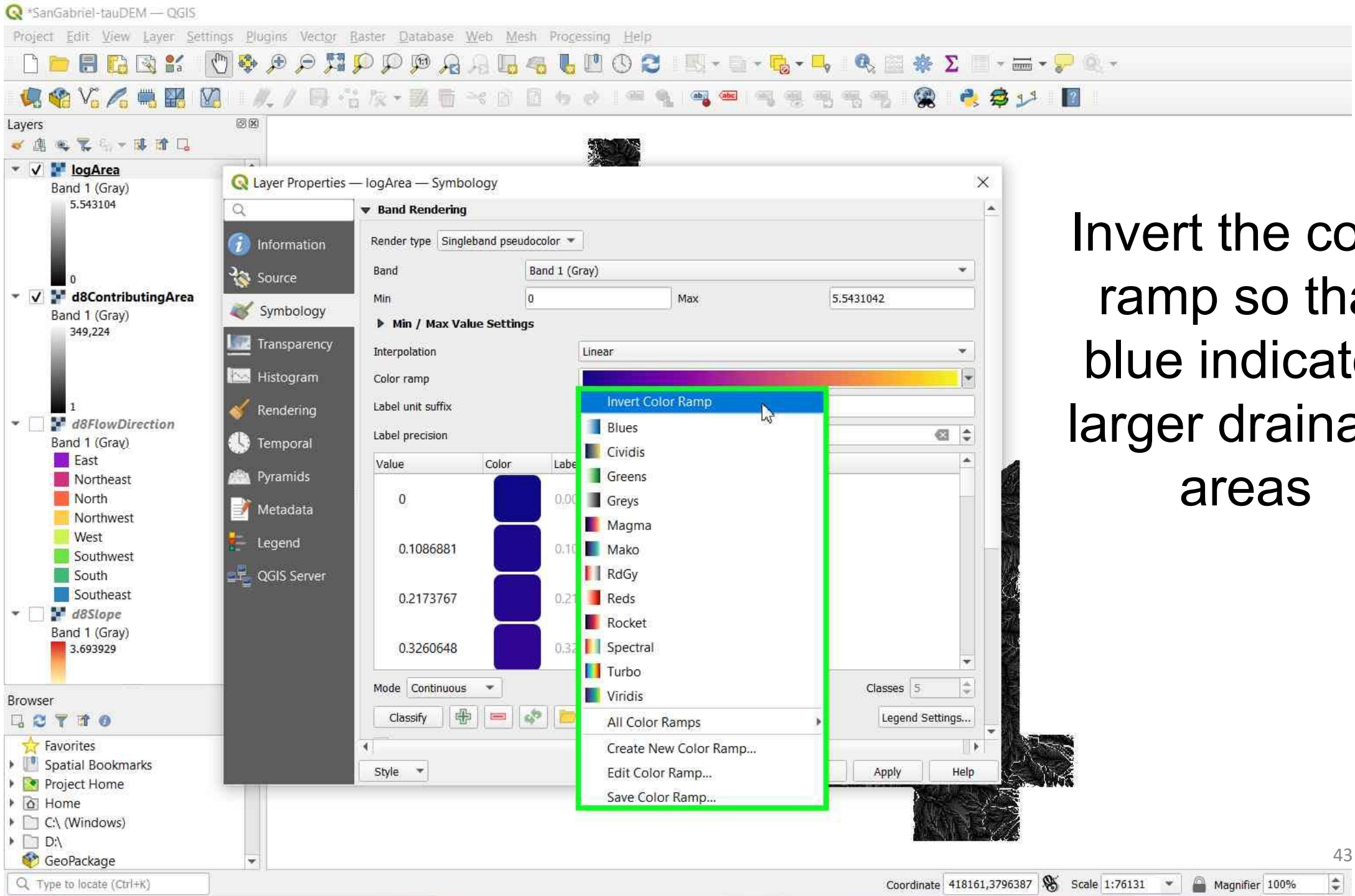
| Value | Color | Label |
|-----------|---------|-------|
| 0 | [Color] | 0.00 |
| 0.1086881 | [Color] | 0.10 |
| 0.2173767 | [Color] | 0.21 |
| 0.3260648 | [Color] | 0.32 |

Mode: Continuous

Classify [Buttons]

Style [Dropdown]

- Blues
- BrBG
- BuGn
- BuPu
- Cividis
- GnBu
- Greens
- Greys
- Inferno
- Magma
- Mako
- OrRd
- Oranges
- PRGn
- PiYG
- Plasma**
- PuBu
- PuBuGn
- PuOr
- PuRd
- Purples
- Rainbowish
- RdBu
- RdGy
- RdPu
- RdYBu
- RdYIGn
- Reds
- Rocket
- Spectral
- Turbo
- Viridis
- YIGn
- YlGnBu



Invert the color ramp so that blue indicates larger drainage areas

Layers

- logArea
 - Band 1 (Gray) 5.543104
- d8ContributingArea
 - Band 1 (Gray) 349,224
- d8FlowDirection
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West
 - Southwest
 - South
 - Southeast
- d8Slope
 - Band 1 (Gray) 3.693929

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layer Properties — logArea — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0 Max: 5.5431042

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color ramp]

Label unit suffix: [Label unit suffix]

Label precision: 4

| Value | Color | Label |
|-----------|----------|--------|
| 0 | [Yellow] | 0.0000 |
| 0.1086881 | [Yellow] | 0.1087 |
| 0.2173767 | [Yellow] | 0.2174 |
| 0.3260648 | [Yellow] | 0.3261 |

Mode: Continuous Classes: 5

Buttons: Classify, Legend Settings...

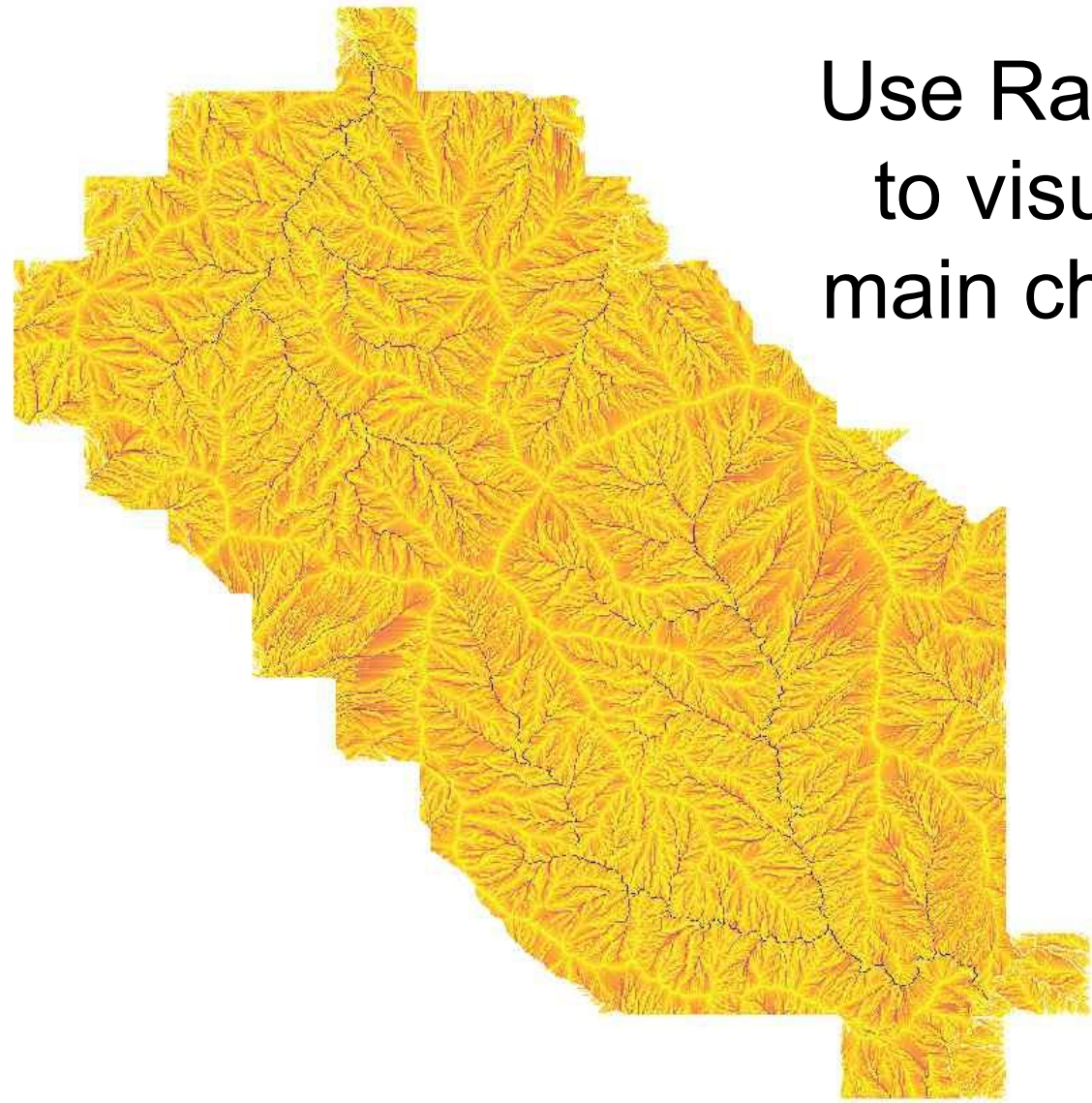
Buttons: OK, Cancel, Apply, Help

Layers

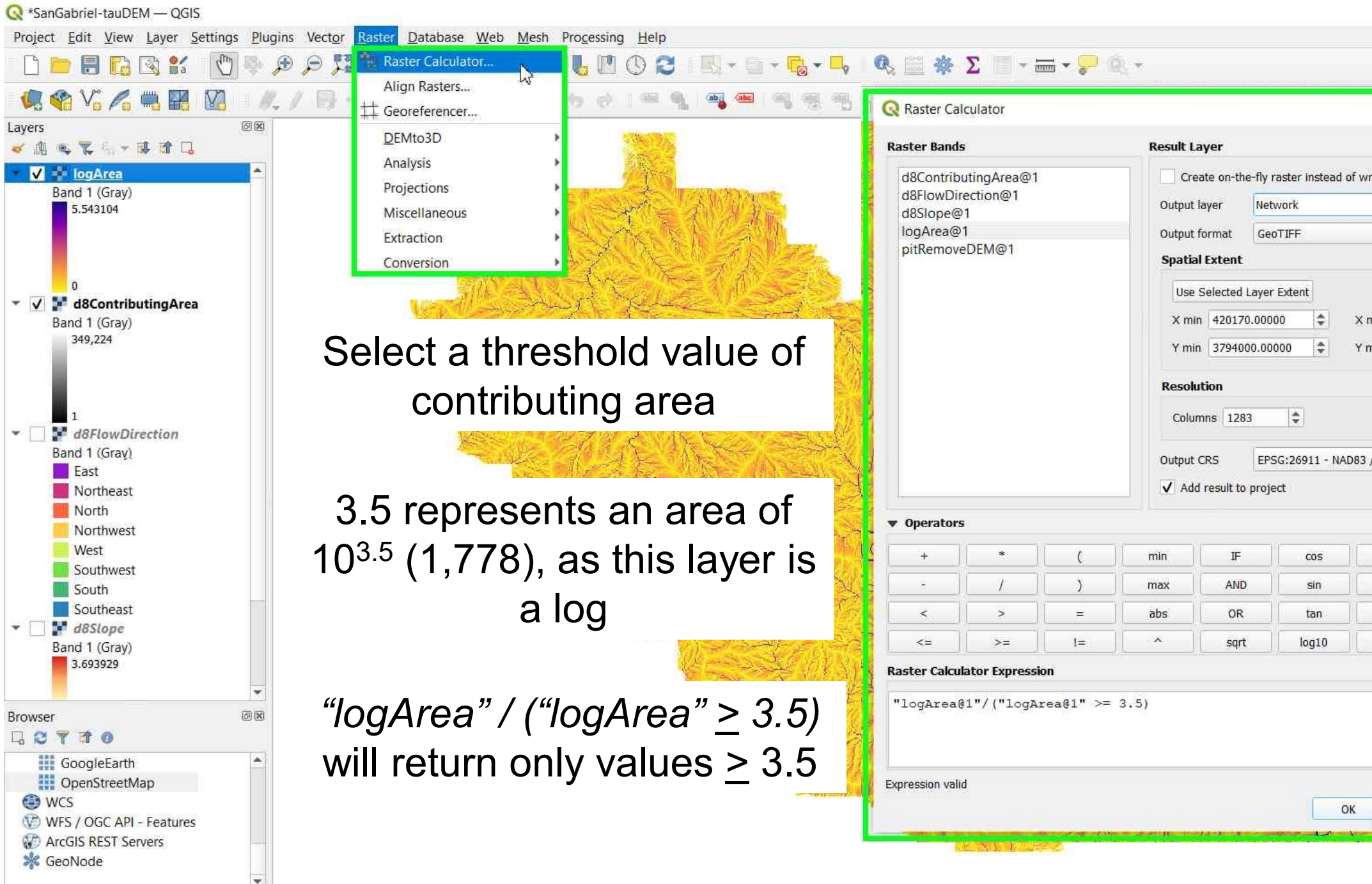
- logArea
Band 1 (Gray)
5.543104
- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
East
Northeast
North
Northwest
West
Southwest
South
Southeast
- d8Slope
Band 1 (Gray)
3.693929

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage



Use Raster Calculator
to visualize just the
main channel network



Select a threshold value of contributing area

3.5 represents an area of $10^{3.5}$ (1,778), as this layer is a log

"logArea" / (*"logArea"* \geq 3.5) will return only values \geq 3.5

Layers

- Network
Band 1 (Gray)
5,543,104
Network (EPSG:26911)
Network.tif
- logArea
Band 1 (Gray)
5,543,104
- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
East
Northeast
North
Northwest
West



Add same color scheme to river network

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layers

- Network
 - Band 1 (Gray) 5.543104
- logArea
 - Band 1 (Gray) 5.543104
- d8Contributi
 - Band 1 (Gray) 349,224
- d8FlowDirect
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

- Zoom to Layer(s)
- Show in Overview
- Copy Layer
- Rename Layer
- Zoom to Native Resolution (100%)
- Stretch Using Current Extent
- Duplicate Layer
- Remove Layer...
- Move to Bottom
- Change Data Source...
- Set Layer Scale Visibility...
- Layer CRS
- Export
- Styles
- Add Layer Notes...
- Properties...

Layer Properties — Network — Symbology

Band Rendering

- Multiband color
- Paletted/Unique values
- Singleband gray
- Singleband pseudocolor
- Hillshade
- Contours

Render type: Singleband gray

Gray band: Singleband pseudocolor

Color gradient: Hillshade

Contours: []

Min: 3.50406 Max: 5.5431

Contrast enhancement: Stretch to MinMax

Min / Max Value Settings

Layer Rendering

Blending mode: Normal

Brightness: 0

Gamma: 1.00

Contrast: 0

Saturation: 0

Invert colors:

Grayscale: Off

Hue: Colorize Strength: 100%

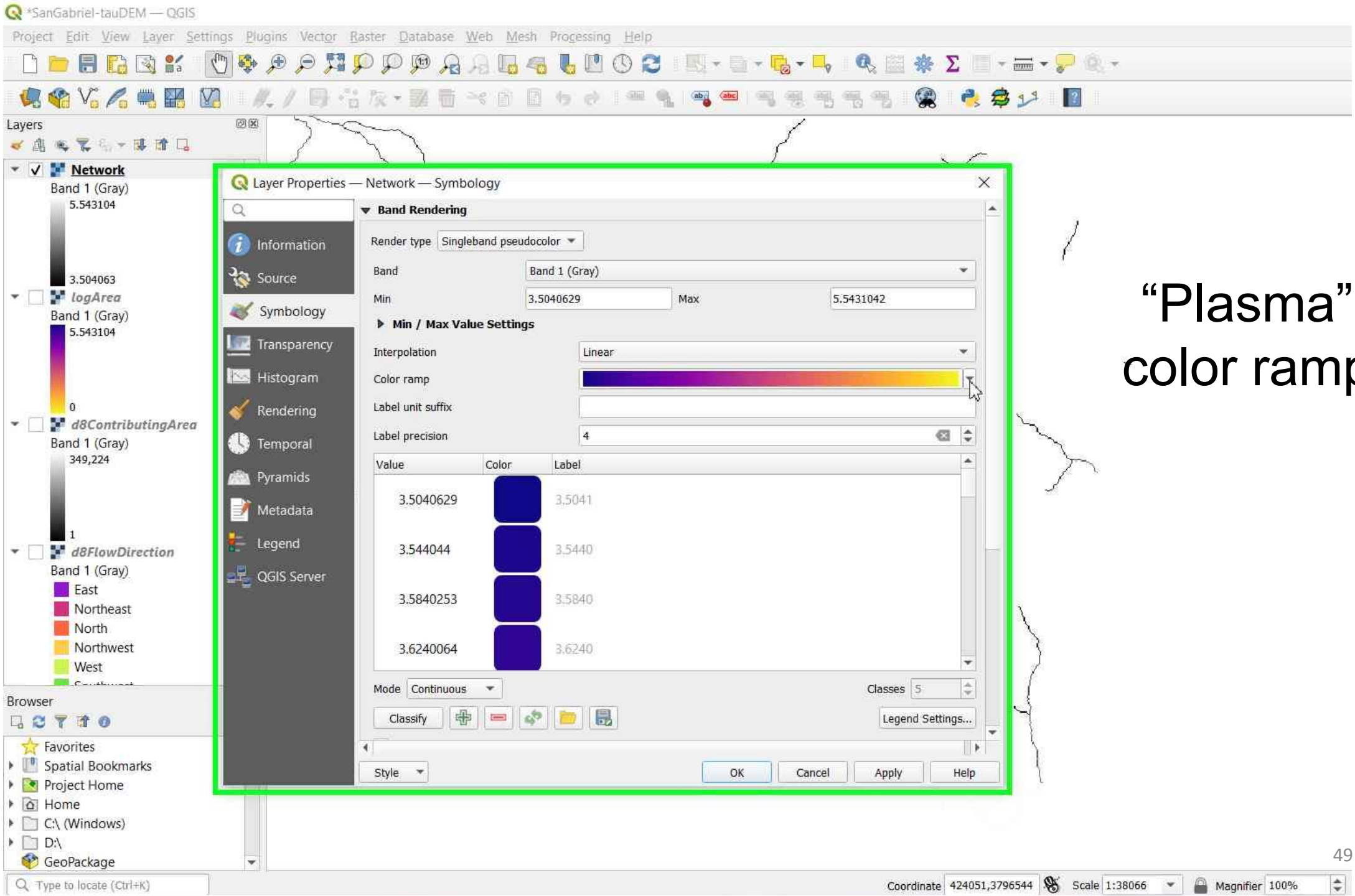
Resampling

Zoomed: in Nearest Neighbour out Nearest Neighbour Oversampling 2.00

Early resampling:

Style: []

OK Cancel Apply Help



“Plasma”
color ramp

Layers

- Network
 - Band 1 (Gray) 5.543104
- logArea
 - Band 1 (Gray) 5.543104
- d8ContributingArea
 - Band 1 (Gray) 349,224
- d8FlowDirection
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West
 - Southwest

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layer Properties — Network — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 3.5040629 Max: 5.5431042

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color Ramp]

Label unit suffix: []

Label precision: []

| Value | Color | Label |
|-----------|-------------|-------|
| 3.5040629 | [Dark Blue] | 3.50 |
| 3.544044 | [Dark Blue] | 3.54 |
| 3.5840253 | [Dark Blue] | 3.58 |
| 3.6240064 | [Dark Blue] | 3.62 |

Mode: Continuous

Buttons: Classify, +, -, Refresh, Save, Style

Color Ramp Menu:

- Invert Color Ramp
- Blues
- Cividis
- Greens
- Greys
- Magma
- Mako
- RdGy
- Reds
- Rocket
- Spectral
- Turbo
- Viridis
- All Color Ramps
- Create New Color Ramp...
- Edit Color Ramp...
- Save Color Ramp...

Classes: 5

Buttons: Legend Settings..., Apply, Help

Invert color ramp

Layers

- Network
 - Band 1 (Gray) 5.543104
- logArea
 - Band 1 (Gray) 5.543104
- d8ContributingArea
 - Band 1 (Gray) 349,224
- d8FlowDirection
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West
 - Southwest

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layer Properties — Network — Symbology

Information
Source
Symbology
Transparency
Histogram
Rendering
Temporal
Pyramids
Metadata
Legend
QGIS Server

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 3.5040629 Max: 5.5431042

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color Ramp]

Label unit suffix: [Empty]

Label precision: 4

| Value | Color | Label |
|-----------|----------|--------|
| 3.5040629 | [Yellow] | 3.5041 |
| 3.544044 | [Yellow] | 3.5440 |
| 3.5840253 | [Yellow] | 3.5840 |
| 3.6240064 | [Yellow] | 3.6240 |

Mode: Continuous Classes: 5

Classify [Add] [Remove] [Refresh] [Apply] [Save]

Legend Settings...

Style [Dropdown] OK Cancel Apply Help

Layers

- Network
- logArea
- d8ContributingArea
- d8FlowDirection

Band 1 (Gray) 5.543104

Band 1 (Gray) 5.543104

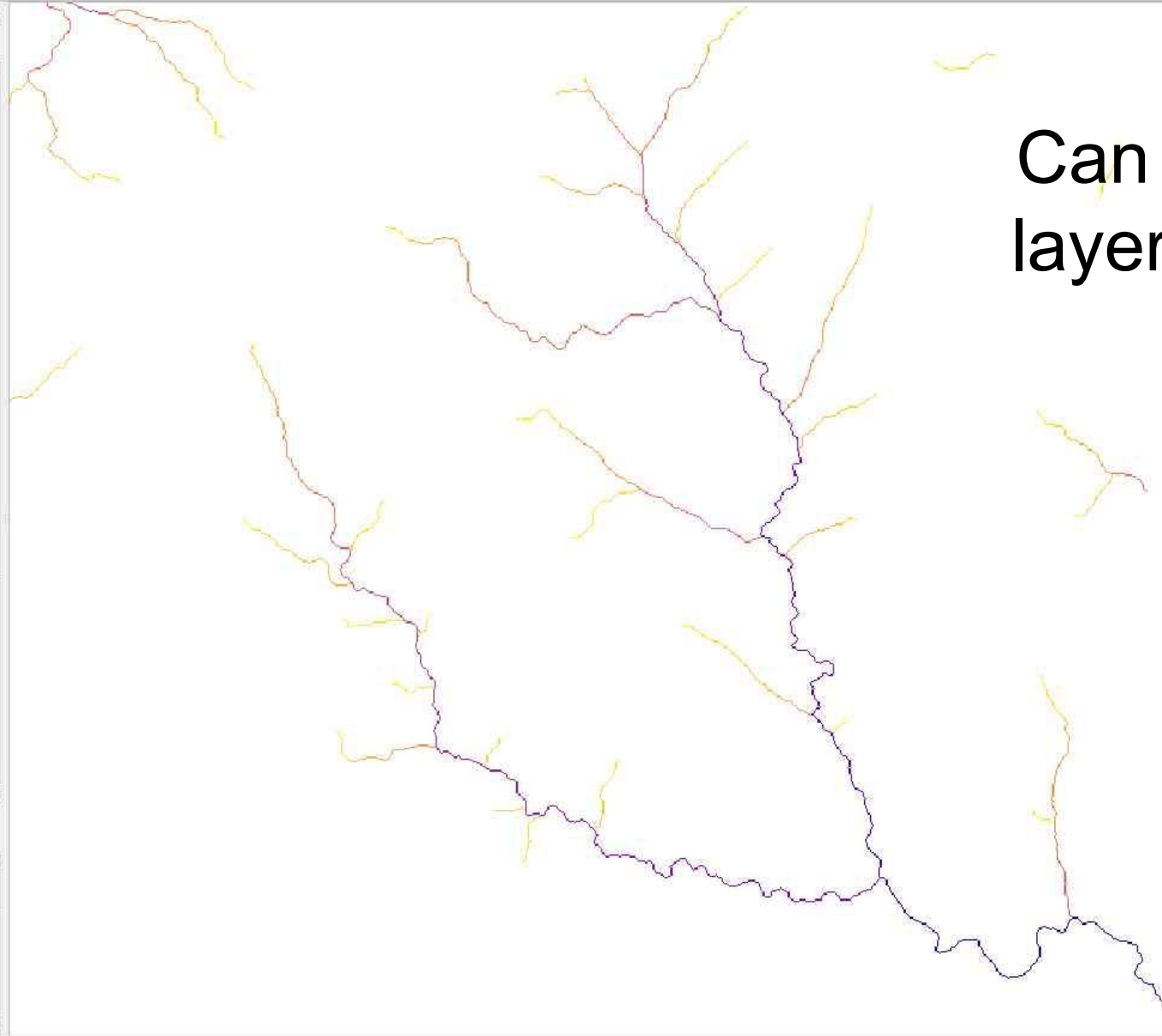
0

1

East
Northeast
North
Northwest
West
Southwest

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage



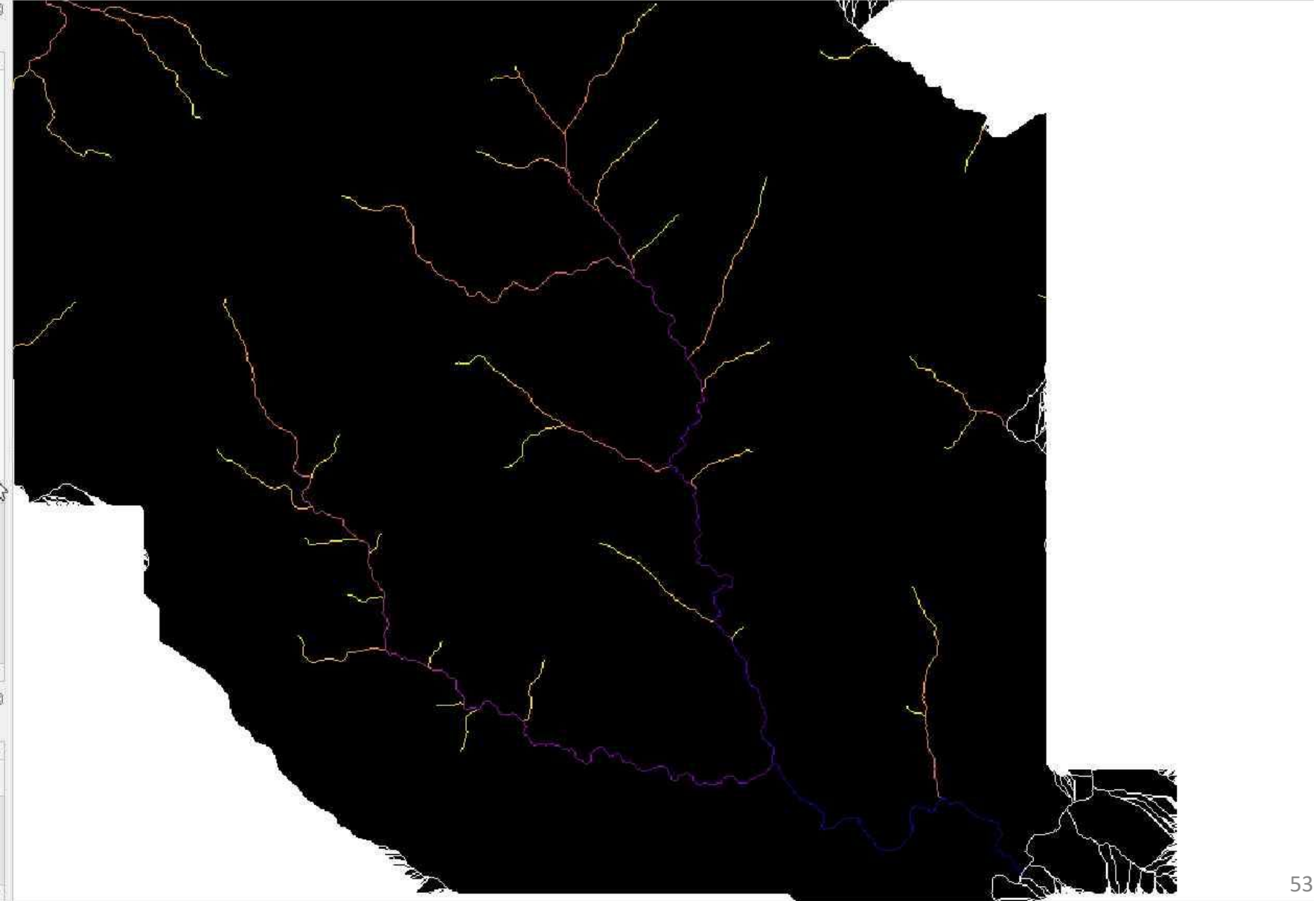
Can turn on other layers to visualize context



Layers

Layers panel showing a list of layers:

- Network
 - Band 1 (Gray) 5.543104
- logArea
 - Band 1 (Gray) 5.543104
- d8ContributingArea
 - Band 1 (Gray) 349,224
- d8FlowDirection
 - Band 1 (Gray)
 - East
 - Northeast
 - North
 - Northwest
 - West
 - Southwest

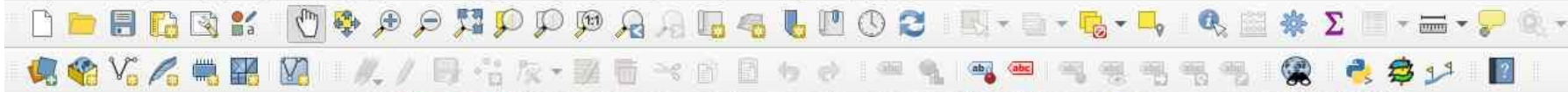


Browser

Browser panel showing a file tree:

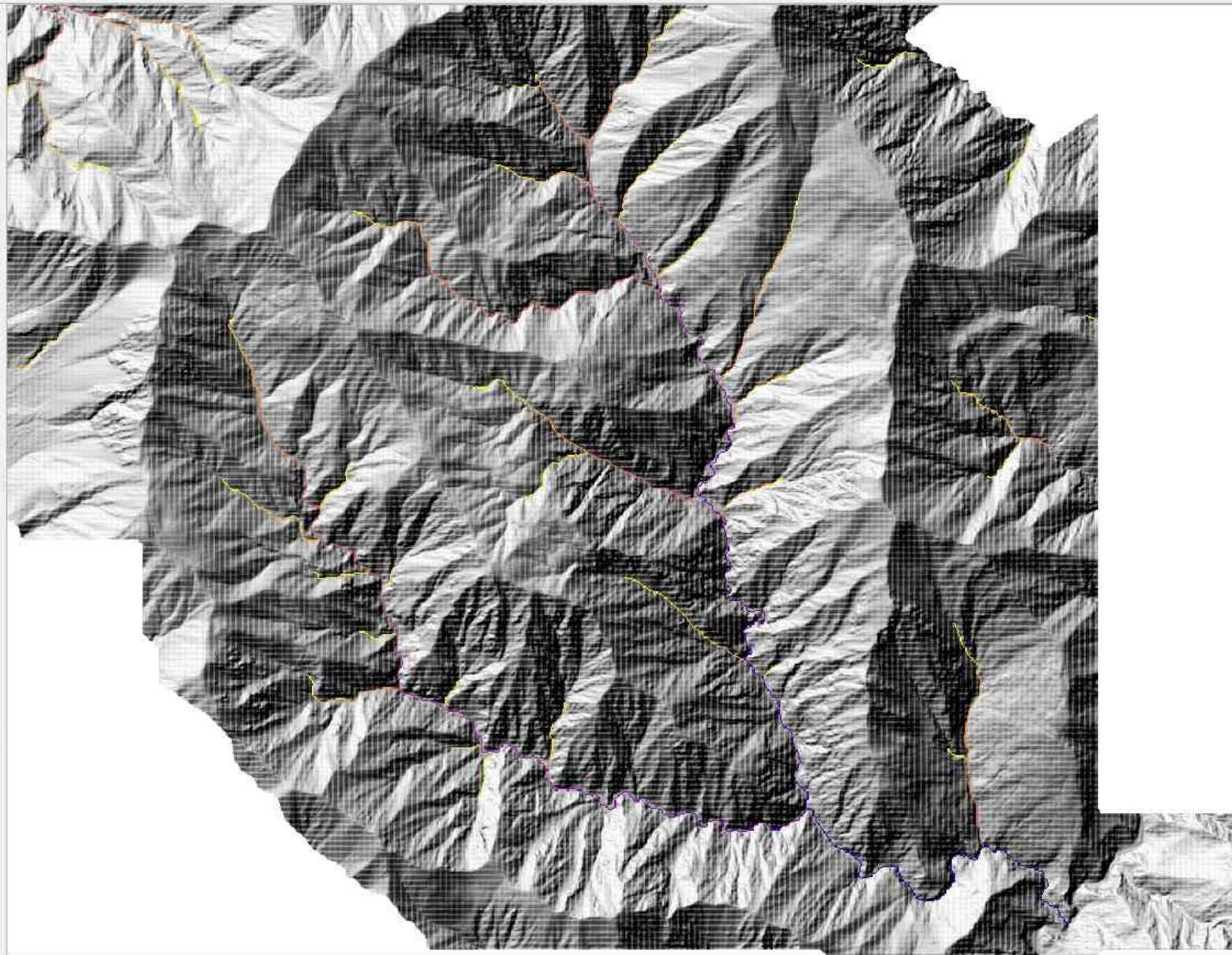
- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Project Home
- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage

Type to locate (Ctrl+K)



Layers

- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
East
Northeast
North
Northwest
West
Southwest
South
Southeast
- d8Slope**
Band 1 (Gray)
3.693929
- pitRemoveDEM**



Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Project Home
- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage

Q Type to locate (Ctrl+K)



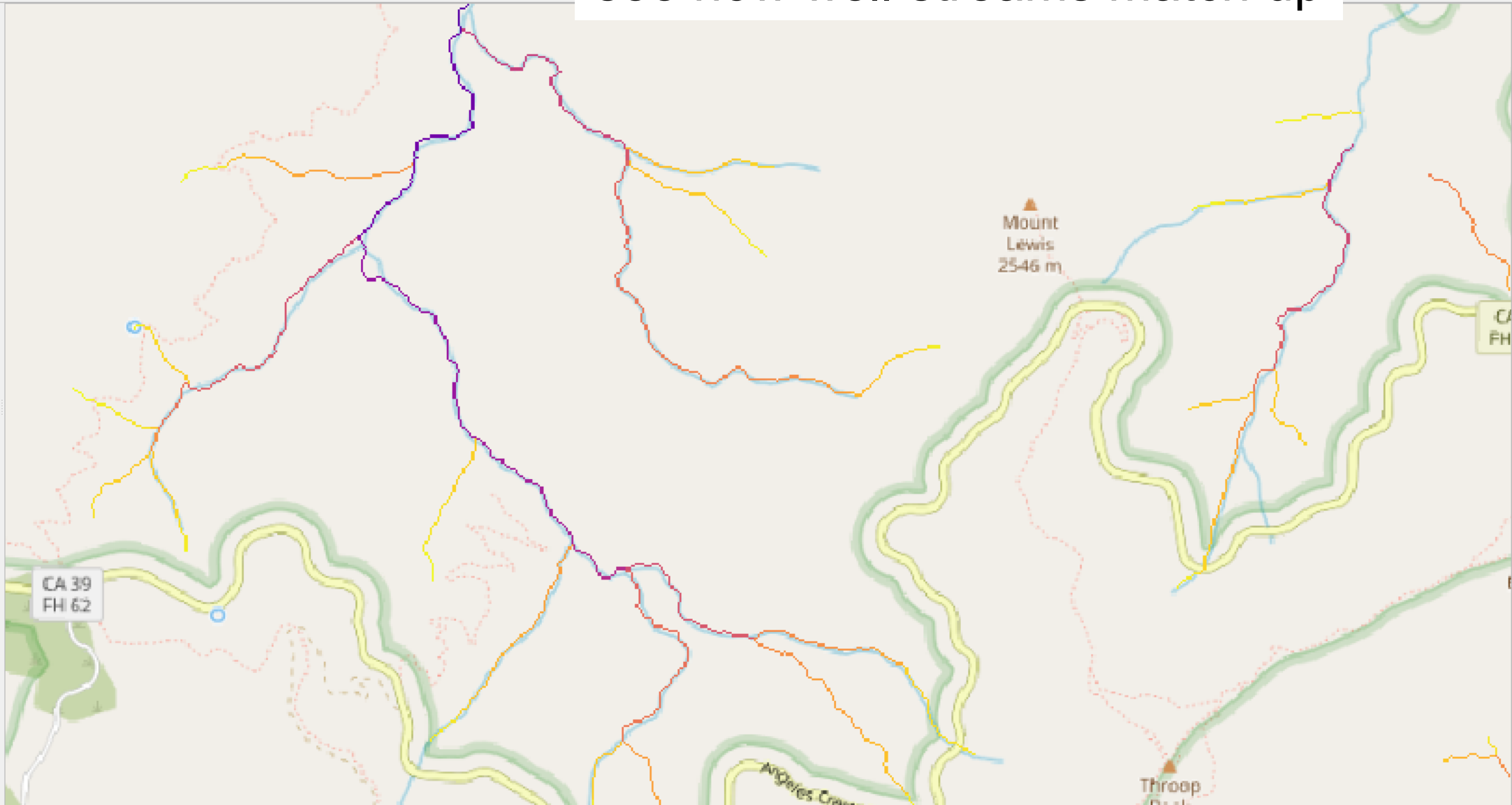
Layers

- Network
Band 1 (Gray)
5.543104
- logArea
Band 1 (Gray)
5.543104
- OpenStreetMap
- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
East
Northeast
North
Northwest

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

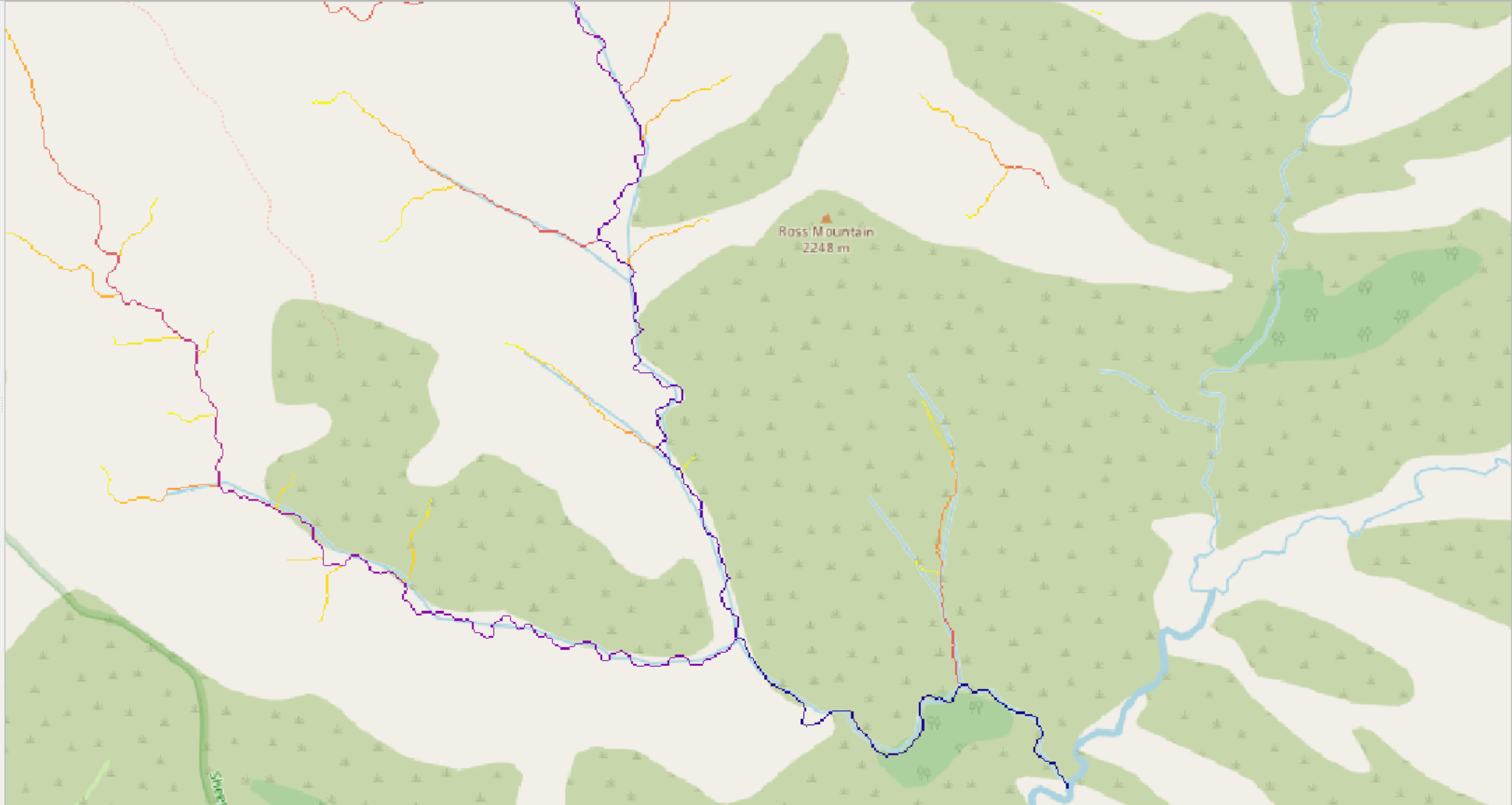
Add OpenStreetMap layer to see how well streams match up





Layers

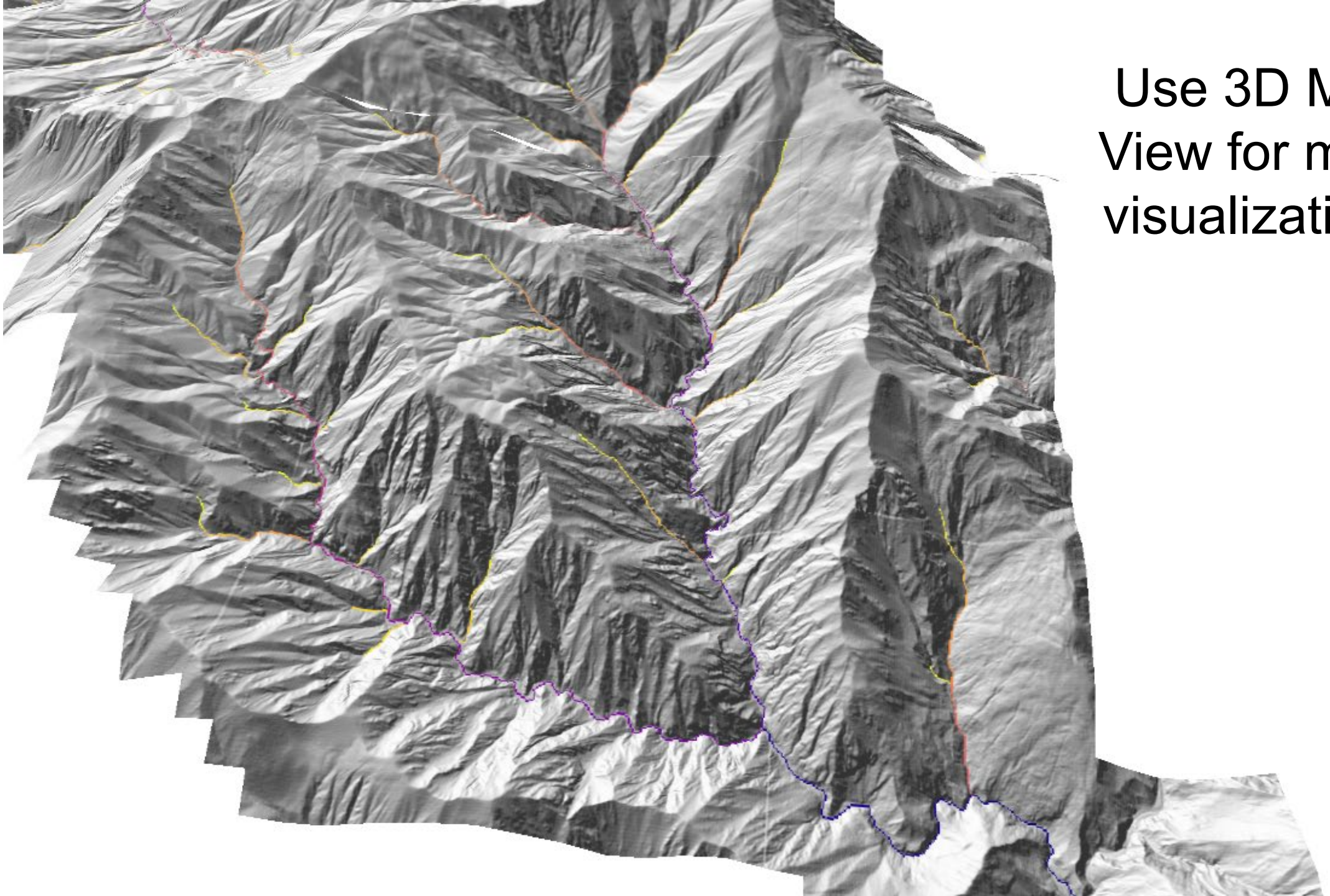
- Network**
Band 1 (Gray)
5.543104
3.504063
- logArea**
Band 1 (Gray)
5.543104
0
- OpenStreetMap**
- d8ContributingArea**
Band 1 (Gray)
349,224
1
- d8FlowDirection**
Band 1 (Gray)
East
Northeast
North
Northwest



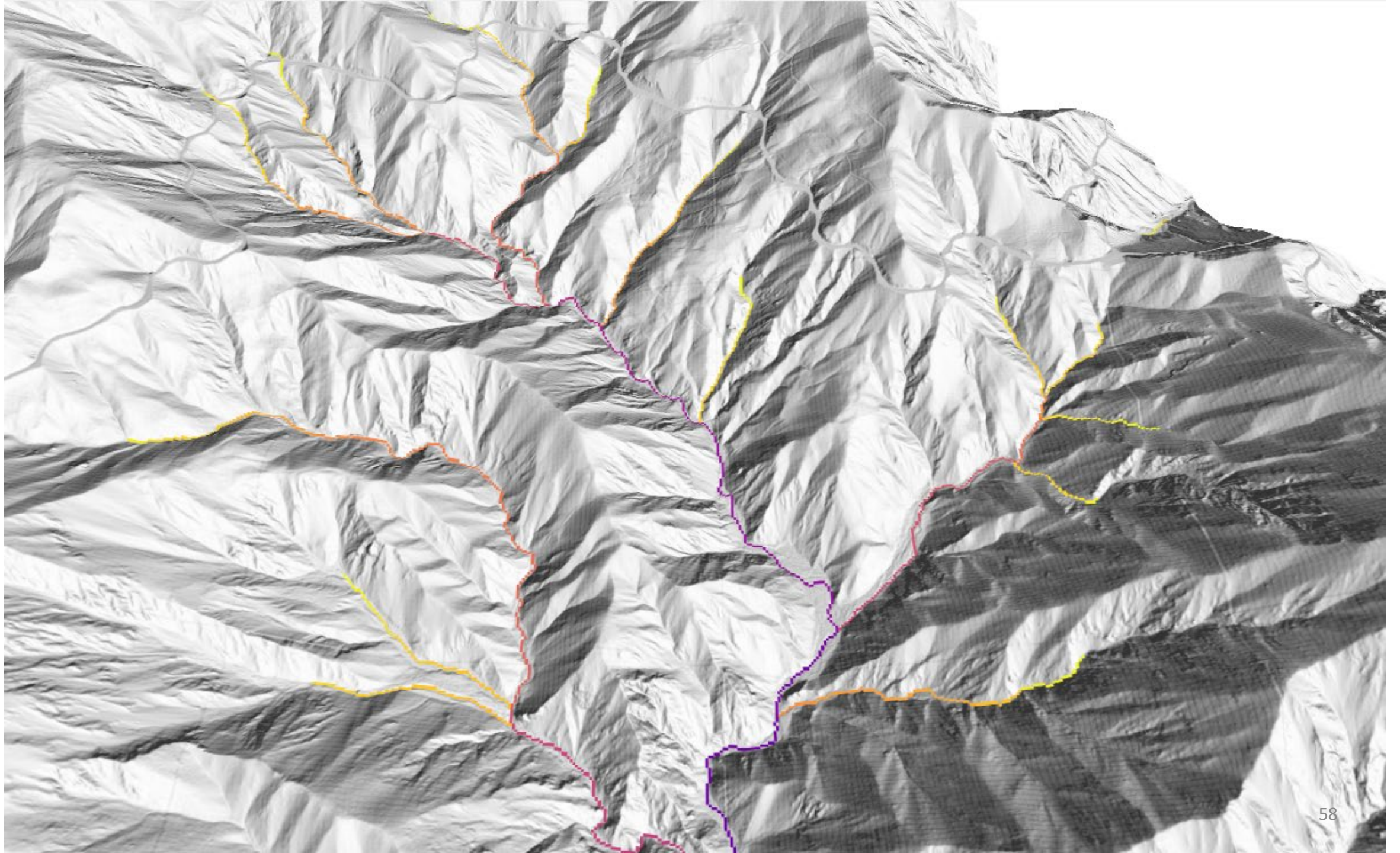
Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

Type to locate (Ctrl+K)



Use 3D Map
View for more
visualizations



Layers

- dInfinityCatchmentArea
Band 1 (Gray)
3,126,359.25
- dInfinityFlowDirection
Band 1 (Gray)
6.281362
- dInfinitySlope
Band 1 (Gray)
3.964565
- pitRemoveDEM
- SG_1mDEM

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

Layer Properties — dInfinityFlowDirection — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0 Max: 6.281362

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color ramp bar]

Label unit suffix: [Empty field]

Label precision: 4

| Value | Color | Label |
|-----------|----------|--------|
| 0 | [Red] | 0.0000 |
| 1.5703405 | [Orange] | 1.5703 |
| 3.140681 | [Yellow] | 3.1407 |
| 4.7110215 | [Green] | 4.7110 |

Mode: Continuous

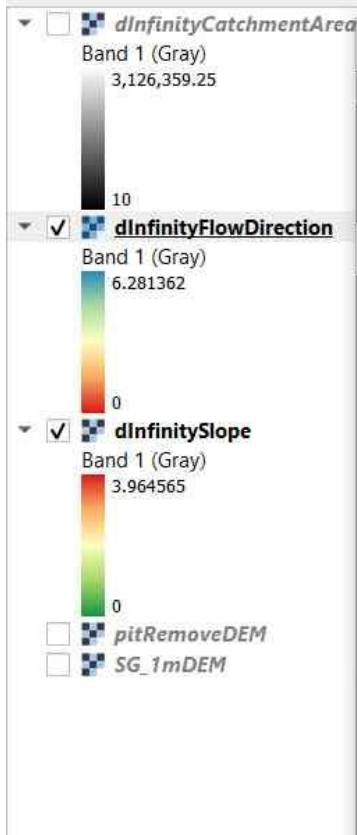
Classes: 5

Buttons: Classify, Legend Settings...

Buttons: OK, Cancel, Apply, Help

D-Infinity Products

Flow Direction, Singleband pseudocolor, values are an angle in radians counter-clockwise from east between 0 and 2 pi



Layer Properties — dInfinityFlowDirection — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0

► Min / Max Value Settings

Interpolation: Linear

Color ramp: [Red to Green]

Label unit suffix: [Empty]

Label precision: 4

| Value | Color | Label |
|-----------|----------|--------|
| 0 | [Red] | 0,0000 |
| 1.5703405 | [Orange] | 1.5703 |
| 3.140681 | [Yellow] | 3.1407 |
| 4.7110215 | [Green] | 4.7110 |

Mode: Continuous

Buttons: Classify, Add, Remove, Refresh, Save, Style

Adjust color ramp to make it more continuous

Select Color Ramp

Color 1: [Purple] Color 2: [Blue] Type: Continuous

▼ Gradient Stop

Relative position: 75.0 % [Delete Stop]

Sample average radius: 1 px

Sample color

Press space to sample a color from under the mouse cursor

H: 112° S: 64% V: 82% R: 93 G: 210 B: 75

Opacity: 100%

HTML notation: #5dd24b

Current: [Green]

Buttons: OK, Cancel, Help

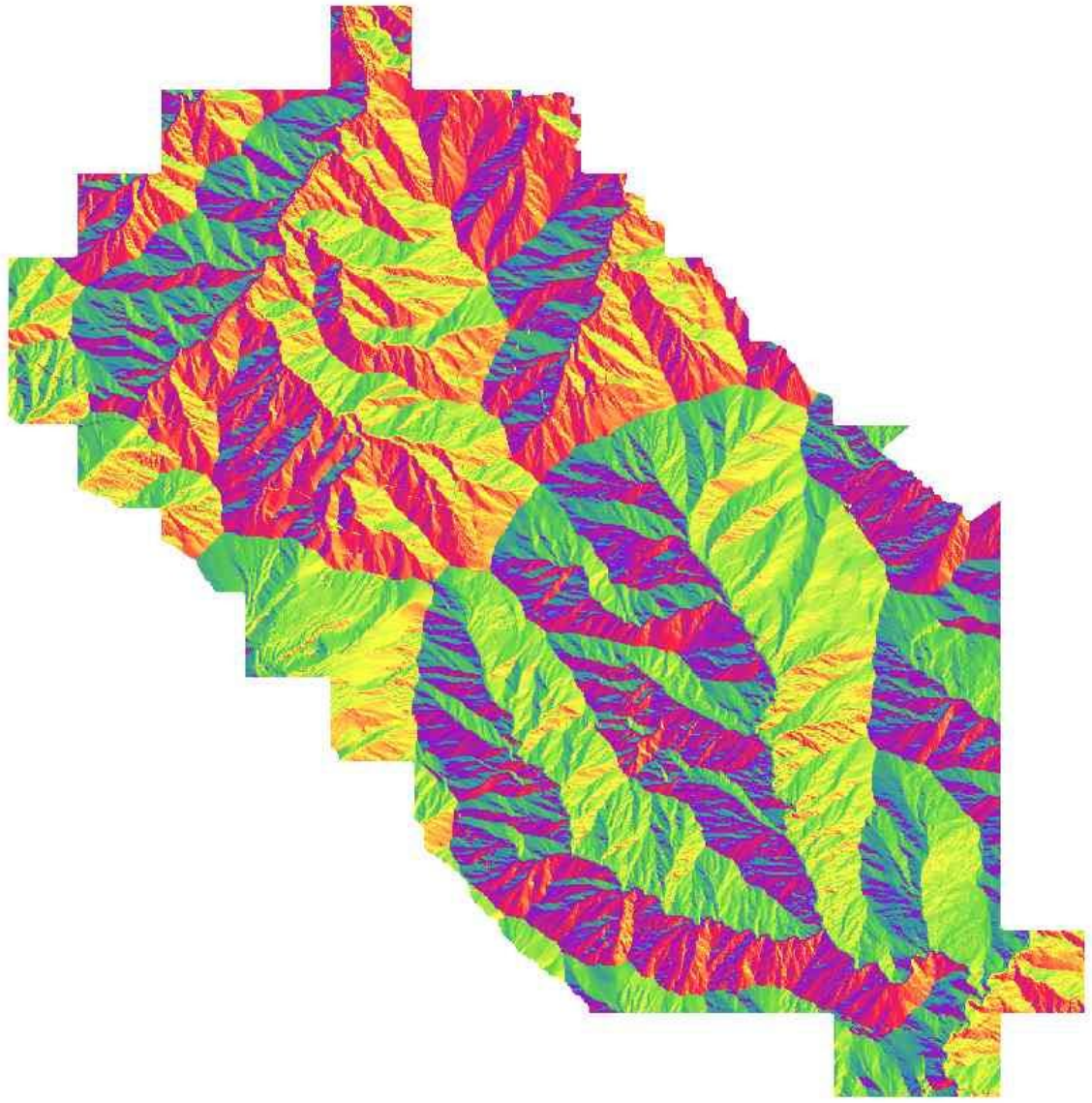


Layers

- dlInfinityCatchmentArea
Band 1 (Gray)
3,126,359.25
- dlInfinityFlowDirection
Band 1 (Gray)
6.281362
- dlInfinitySlope
Band 1 (Gray)
3.964565
- pitRemoveDEM
- SG_1mDEM

Browser

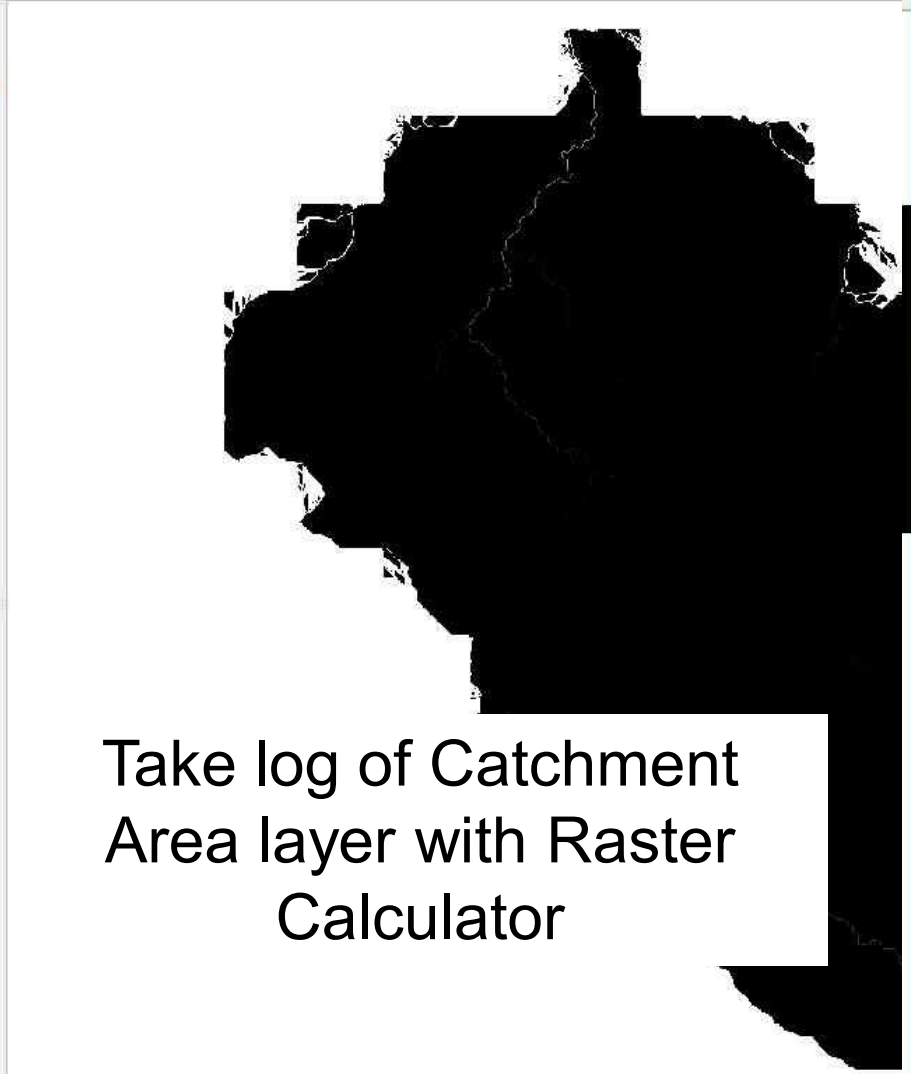
- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode





Layers

- dInfinityCatchmentArea
 - Band 1 (Gray)
3,126,359.25
- dInfinityFlowDirection
 - Band 1 (Gray)
6.281362
- dInfinitySlope
 - Band 1 (Gray)
3.964565
- pitRemoveDEM
- SG_1mDEM



Take log of Catchment Area layer with Raster Calculator

Raster Calculator

Raster Bands

- SG_1mDEM@1
- dInfinityCatchmentArea@1
- dInfinityFlowDirection@1
- dInfinitySlope@1
- pitRemoveDEM@1

Result Layer

Create on-the-fly raster instead of writing layer to disk

Output layer: logDinif

Output format: GeoTIFF

Spatial Extent

X min: 420170.00000 X max: 433000.00000

Y min: 3794000.00000 Y max: 3807000.00000

Resolution

Columns: 1283 Rows: 1300

Output CRS: EPSG:26911 - NAD83 / UTM zone 11N

Add result to project

Operators

| | | | | | | |
|----|----|----|-----|------|-------|------|
| + | * | (| min | IF | cos | acos |
| - | / |) | max | AND | sin | asin |
| < | > | = | abs | OR | tan | atan |
| <= | >= | != | ^ | sqrt | log10 | ln |

Raster Calculator Expression

```
log10 ( "dInfinityCatchmentArea@1" )
```

Expression valid

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

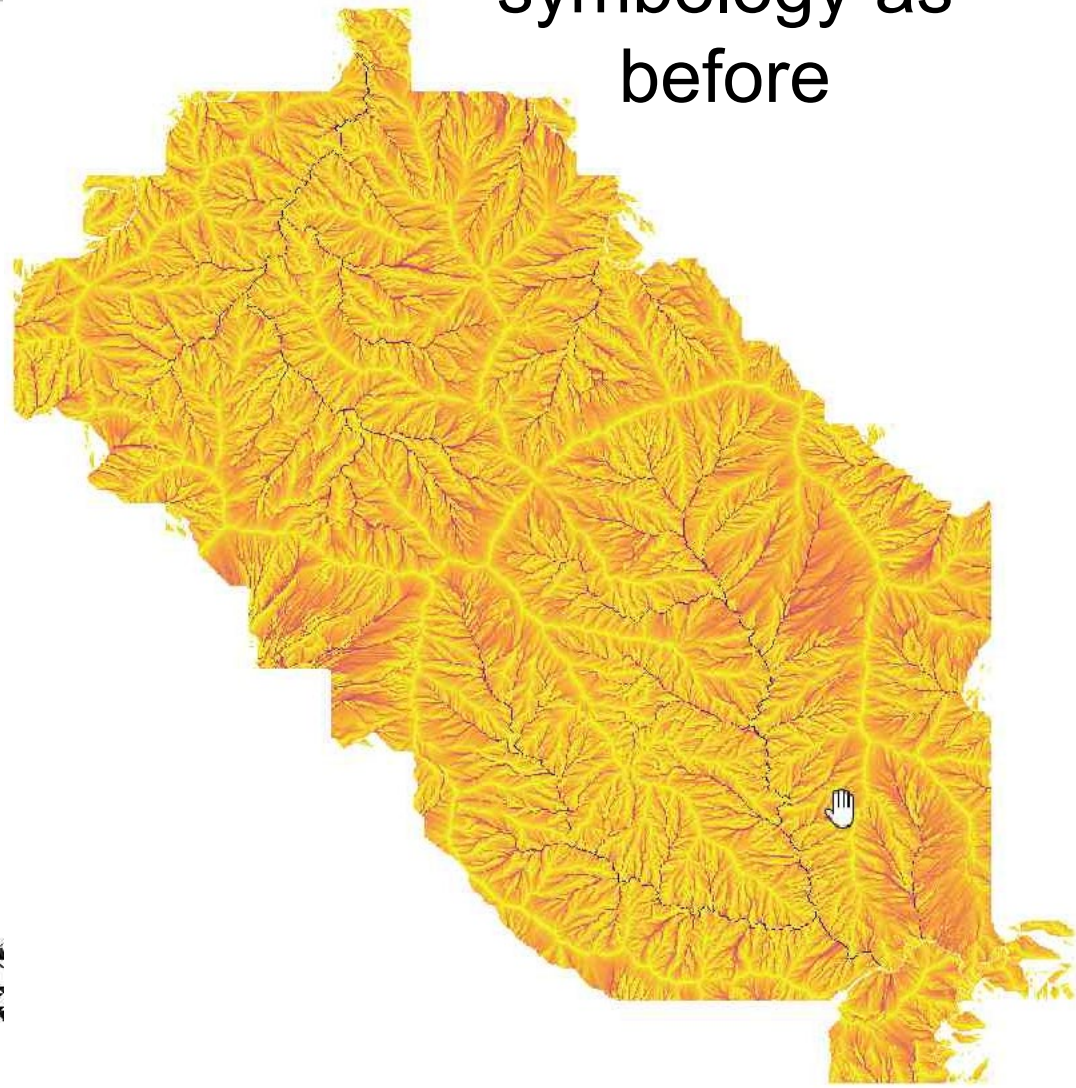


Layers

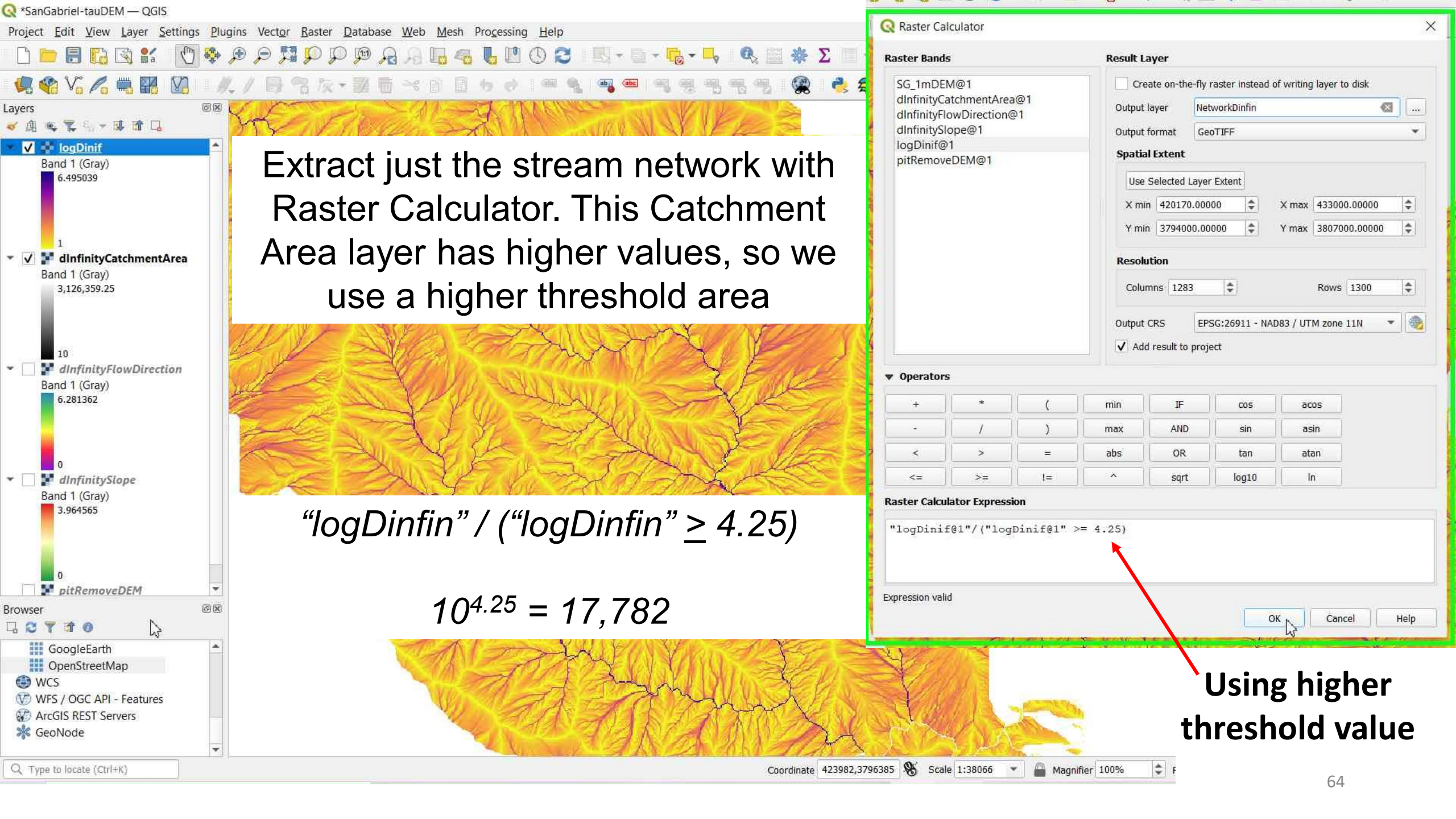
- logD.tif
Band 1 (Gray)
6.495039
- dInfinityCatchmentArea
Band 1 (Gray)
3,126,359.25
- dInfinityFlowDirection
Band 1 (Gray)
6.281362
- dInfinitySlope
Band 1 (Gray)
3.964565
- pitRemoveDEM

Base

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode



Change layer symbology as before



Extract just the stream network with Raster Calculator. This Catchment Area layer has higher values, so we use a higher threshold area

$$"logDinif" / ("logDinif" \geq 4.25)$$

$$10^{4.25} = 17,782$$

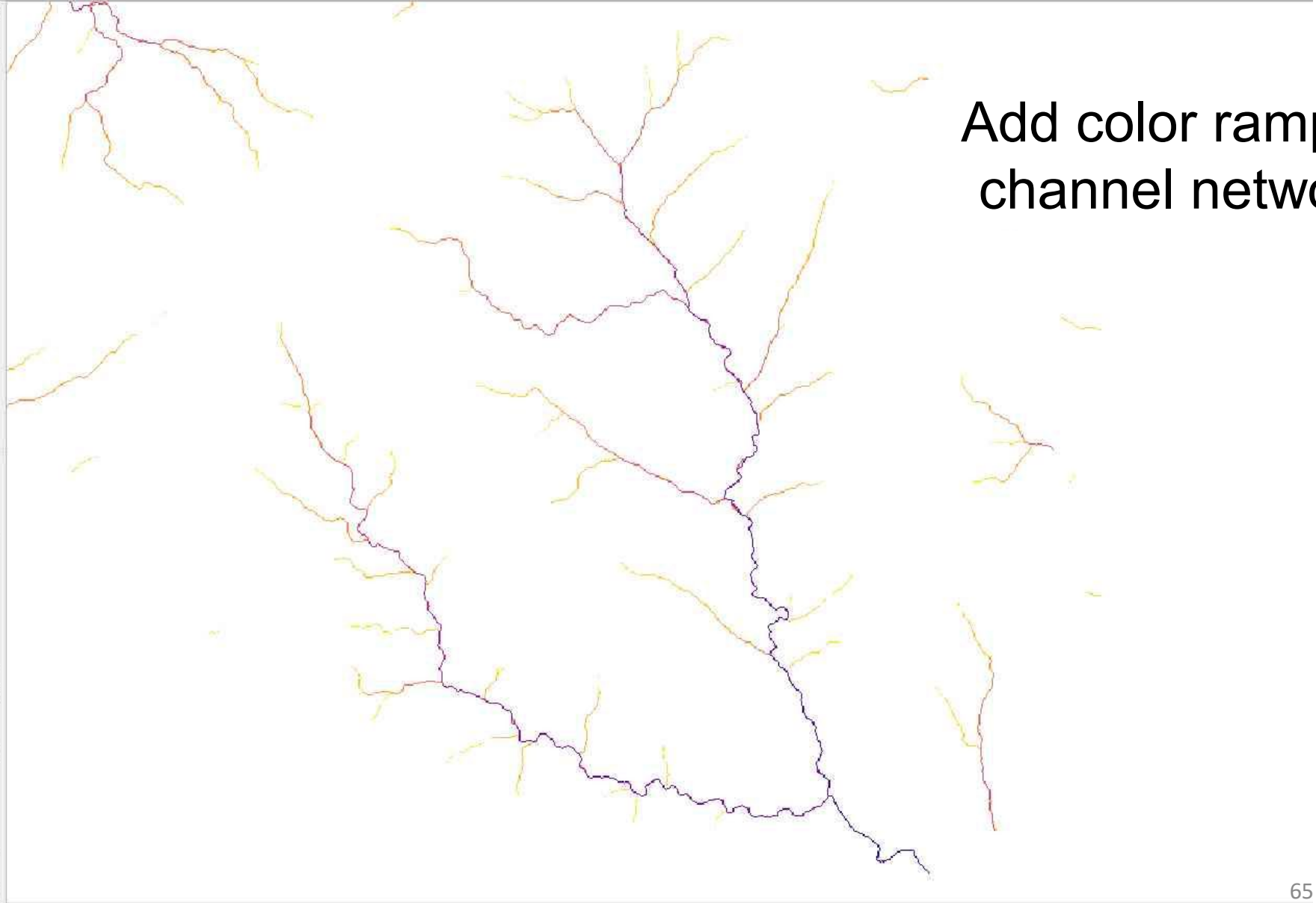
Using higher threshold value

Layers

- NetworkDinfin**
Band 1 (Gray)
6.495039
4.250453
- logDinif**
Band 1 (Gray)
6.495039
1
- dInfinityCatchmentArea**
Band 1 (Gray)
3,126,359.25
10
- dInfinityFlowDirection**
Band 1 (Gray)
6.281362
0
- dInfinitySlope**

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode



Add color ramp to channel network



Layers

- TopographicWetnessIndex**
 - Band 1 (Gray)
18.1006
 - 1.10483
- NetworkDinfin
- logDinif
- dInfinityCatchmentArea
- dInfinityFlowDirection
- dInfinitySlope
- pitRemoveDEM
- SG_1mDEM

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

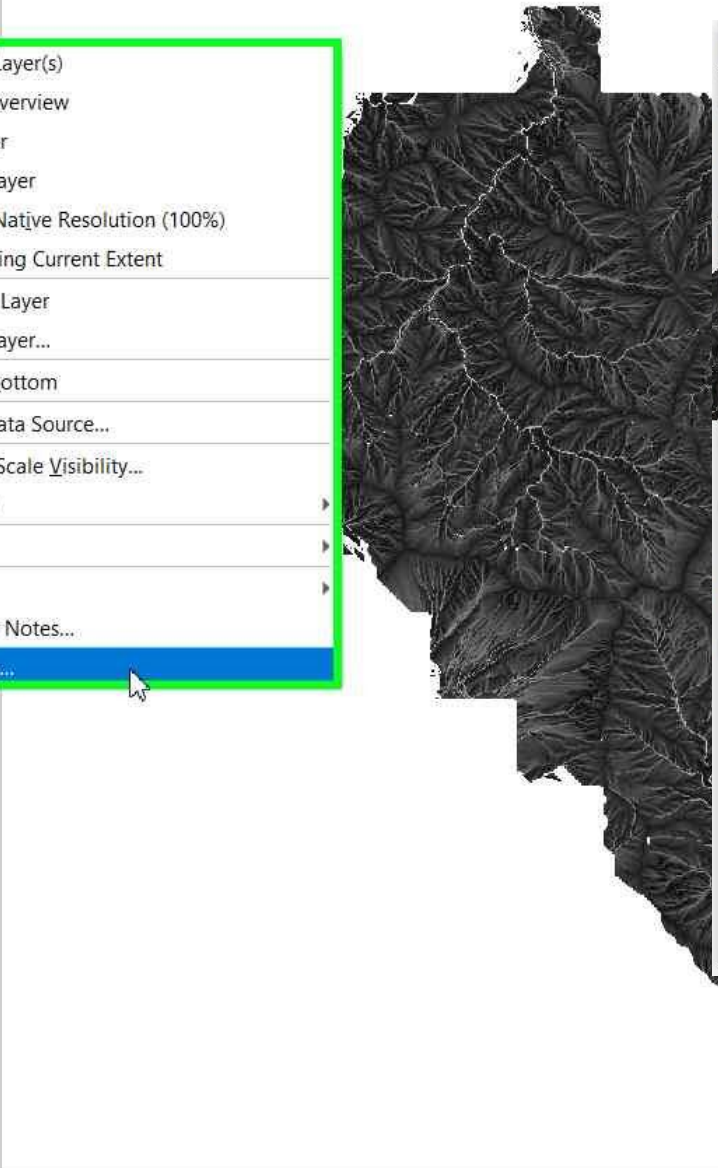


Visualize Topographic Wetness Index



Layers

The Layers panel on the left lists several layers: 'Band 1 (Gray)' with a value range of 18.1006 to 1.10483, 'NetworkDinfin', 'logDinif', 'dInfinityCatchm', 'dInfinityFlowDir', 'dInfinitySlope', 'pitRemoveDEM', and 'SG_1mDEM'. A context menu is open for the 'TopographicWetnessIndex' layer, listing actions such as 'Zoom to Layer(s)', 'Show in Overview', 'Copy Layer', 'Rename Layer', 'Zoom to Native Resolution (100%)', 'Stretch Using Current Extent', 'Duplicate Layer', 'Remove Layer...', 'Move to Bottom', 'Change Data Source...', 'Set Layer Scale Visibility...', 'Layer CRS', 'Export', 'Styles', 'Add Layer Notes...', and 'Properties...'. The 'Properties...' option is highlighted in blue.



The 'Layer Properties' dialog for 'TopographicWetnessIndex' is open, showing the 'Symbology' tab. A dropdown menu is open for 'Band Rendering', with 'Singleband pseudocolor' selected. The 'Band Rendering' section includes 'Render type' (Singleband gray), 'Gray band' (Singleband pseudocolor), 'Color gradient' (Hillshade), and 'Contours'. Below these are 'Min' (1.10483) and 'Max' (18.1006) value fields, and a 'Contrast enhancement' dropdown set to 'Stretch to MinMax'. The 'Layer Rendering' section has 'Blending mode' set to 'Normal', 'Brightness' at 0, 'Gamma' at 1.00, 'Contrast' at 0, 'Saturation' at 0, 'Grayscale' set to 'Off', and 'Hue' set to 'Colorize' with 'Strength' at 100%. The 'Resampling' section shows 'Zoomed: in' and 'out' both set to 'Nearest Neighbour' and 'Oversampling' at 2.00. Buttons for 'OK', 'Cancel', 'Apply', and 'Help' are at the bottom.

The Browser panel at the bottom left shows various data sources: 'GoogleEarth', 'OpenStreetMap', 'WCS', 'WFS / OGC API - Features', 'ArcGIS REST Servers', and 'GeoNode'. A search bar at the bottom of the panel says 'Type to locate (Ctrl+K)'.

Layers

- TopographicWetnessIndex
 - Band 1 (Gray)
 - 18.1006
 - 1.10483
 - NetworkDinfin
 - logDinif
 - dInfinityCatchmentArea
 - dInfinityFlowDirection
 - dInfinitySlope
 - pitRemoveDEM
 - SG_1mDEM

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

Layer Properties — TopographicWetnessIndex — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 1.1048282 Max: 18.1005783

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color ramp]

Label unit suffix: [Label unit suffix]

Label precision: 4

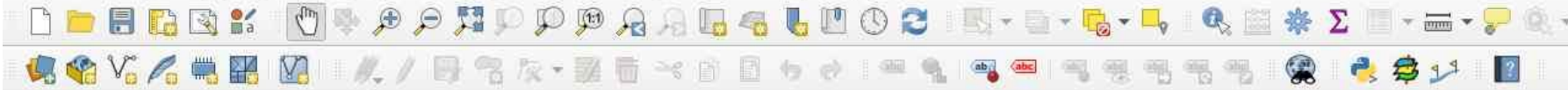
| Value | Color | Label |
|-----------|-------|--------|
| 1.1048282 | [Red] | 1.1048 |
| 1.1712187 | [Red] | 1.1712 |
| 1.2376075 | [Red] | 1.2376 |
| 1.303998 | [Red] | 1.3040 |

Mode: Continuous Classes: 5

Buttons: Classify, Legend Settings...

Buttons: OK, Cancel, Apply, Help

Add color symbology



Layers

TopographicWetnessIndex

Band 1 (Gray)

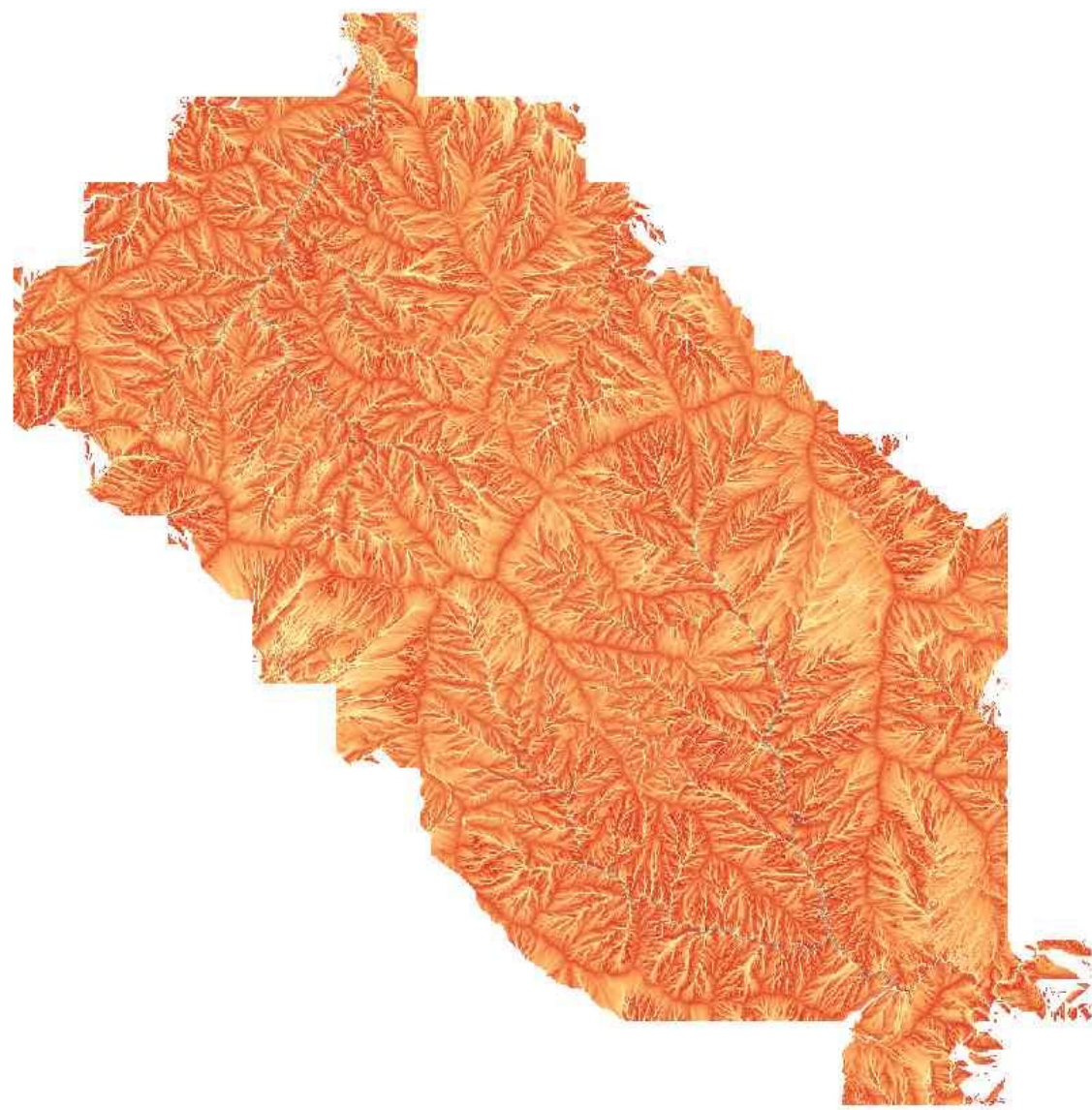
18.100578

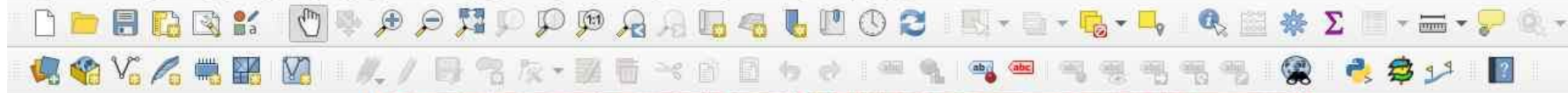
1.104828

- NetworkDinfin
- logDinif
- dInfinityCatchmentArea
- dInfinityFlowDirection
- dInfinitySlope
- pitRemoveDEM
- SG_1mDEM

Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode





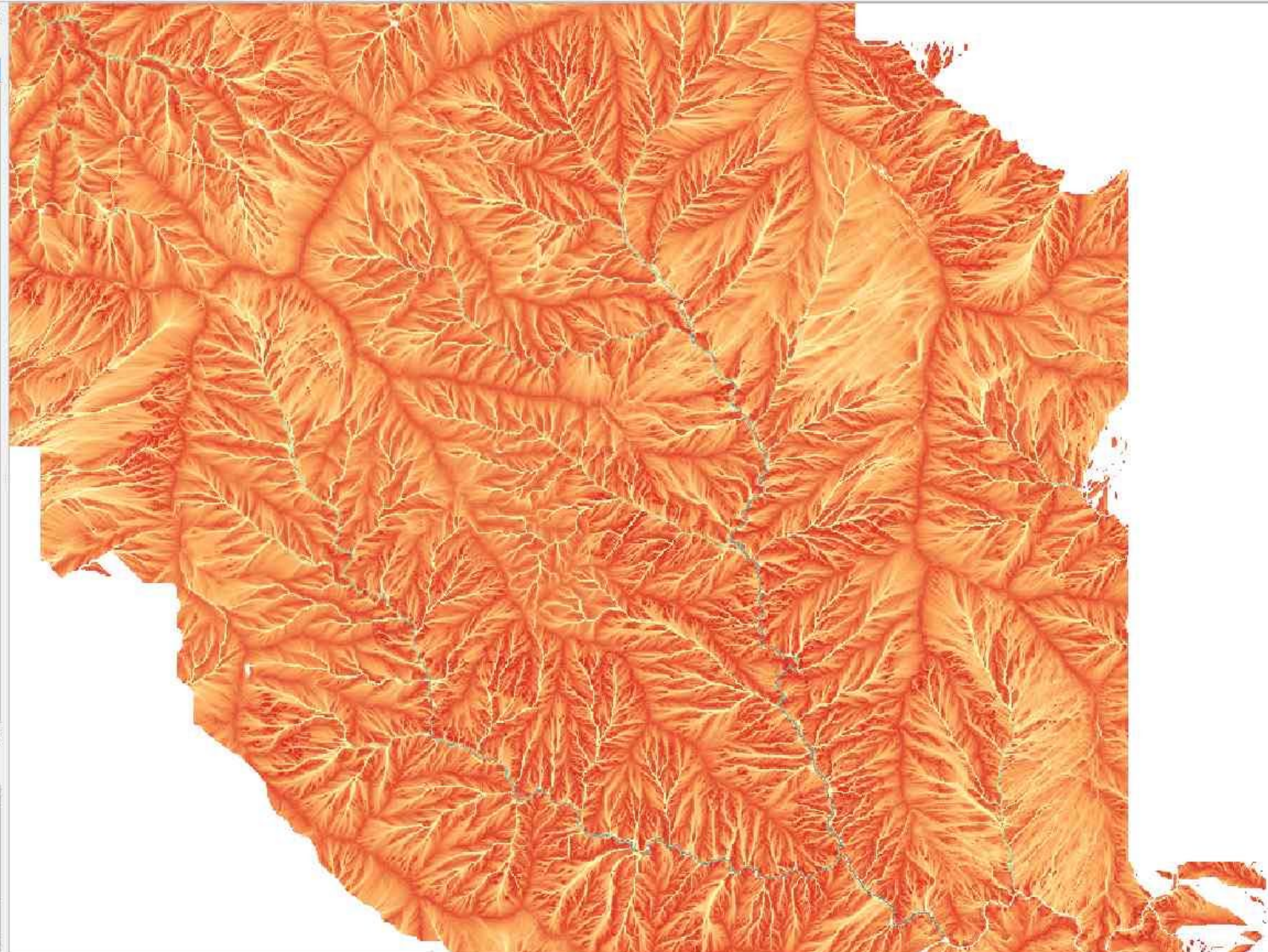
Layers

TopographicWetnessIndex

Band 1 (Gray)
18.100578

1.104828

- NetworkDinfin
- logDinif
- dInfinityCatchmentArea
- dInfinityFlowDirection
- dInfinitySlope
- pitRemoveDEM
- SG_1mDEM



Browser

- GoogleEarth
- OpenStreetMap
- WCS
- WFS / OGC API - Features
- ArcGIS REST Servers
- GeoNode

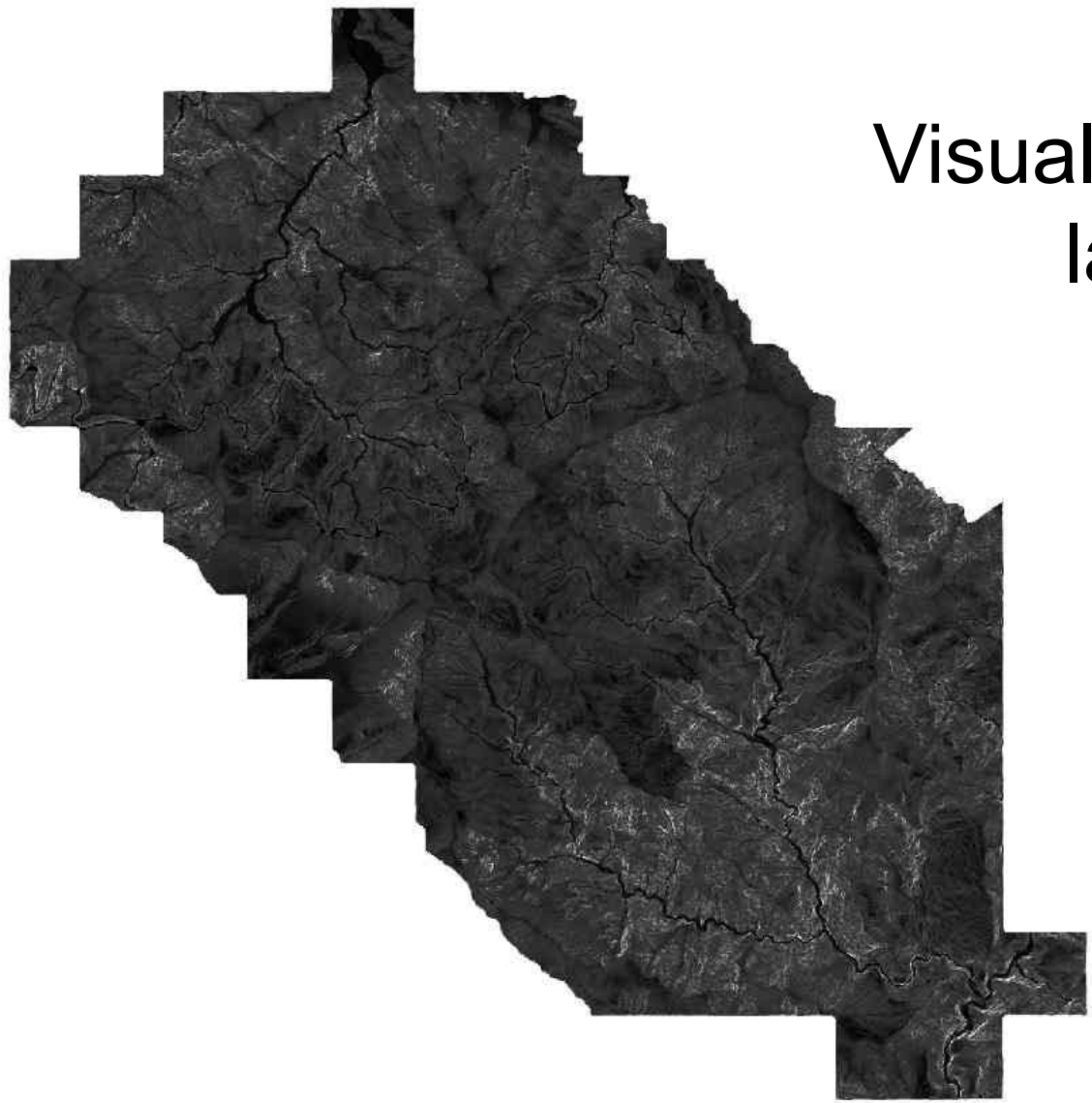
Type to locate (Ctrl+K)

Layers

- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
8
- d8Slope**
Band 1 (Gray)
3.69393
- pitRemoveDEM**

Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Project Home
- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage



Visualize Slope layer

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.69393
- pitRemove

- Zoom to Layer(s)
- Show in Overview
- Copy Layer
- Rename Layer
- Zoom to Native Resolution (100%)
- Stretch Using Current Extent
- Duplicate Layer
- Remove Layer...
- Move to Top
- Move to Bottom
- Change Data Source...
- Set Layer Scale Visibility...
- Layer CRS
- Export
- Styles
- Add Layer Notes...
- Properties...

Layer Properties — d8Slope — Symbology

Band Rendering

Render type: Singleband pseudocolor

Gray band: [dropdown]

Color gradient: [dropdown]

Min: 0 Max: 3.69393

Contrast enhancement: Stretch to MinMax

Min / Max Value Settings

Legend Settings...

Layer Rendering

Blending mode: Normal

Brightness: [slider] 0 Contrast: [slider] 0

Gamma: [slider] 1.00 Saturation: [slider] 0

Invert colors: Grayscale: Off

Hue: Colorize [color] Strength: [slider] 100%

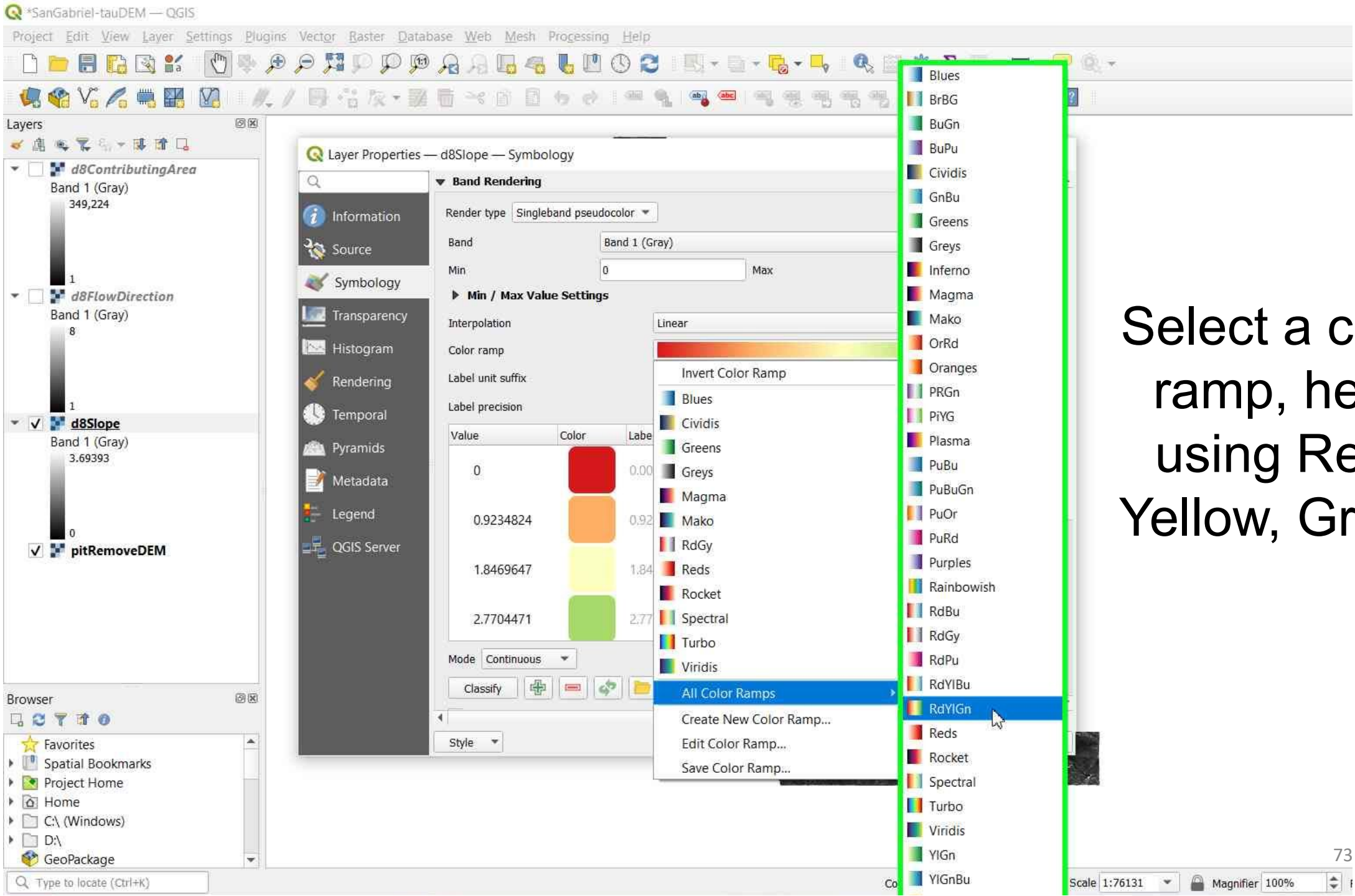
Resampling

Zoomed: in Nearest Neighbour out Nearest Neighbour Oversampling 2.00 Early resampling

Style [dropdown] OK Cancel Apply Help

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage



Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope
Band 1 (Gray)
3.69393
- pitRemoveDEM

Layer Properties — d8Slope — Symbology

Information
Source
Symbology
Transparency
Histogram
Rendering
Temporal
Pyramids
Metadata
Legend
QGIS Server

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0 Max

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color Ramp]

Invert Color Ramp

| Value | Color | Label |
|-----------|----------|-------|
| 0 | [Red] | 0.00 |
| 0.9234824 | [Orange] | 0.92 |
| 1.8469647 | [Yellow] | 1.84 |
| 2.7704471 | [Green] | 2.77 |

Label unit suffix

Label precision

Mode: Continuous

Classify

Style

- Blues
- BrBG
- BuGn
- BuPu
- Cividis
- GnBu
- Greens
- Greys
- Inferno
- Magma
- Mako
- OrRd
- Oranges
- PRGn
- PiYG
- Plasma
- PuBu
- PuBuGn
- PuOr
- PuRd
- Purples
- Rainbowish
- RdBu
- RdGy
- RdPu
- RdYlBu
- RdYlGn**
- Reds
- Rocket
- Spectral
- Turbo
- Viridis
- YlGn
- YlGnBu

Select a color ramp, here using Red, Yellow, Green

Layers

- d8ContributingArea
Band 1 (Gray)
349,224
- d8FlowDirection
Band 1 (Gray)
8
- d8Slope**
Band 1 (Gray)
3.69393
- pitRemoveDEM

Browser

- Favorites
- Spatial Bookmarks
- Project Home
- Home
- C:\ (Windows)
- D:\
- GeoPackage

Layer Properties — d8Slope — Symbology

Band Rendering

Render type: Singleband pseudocolor

Band: Band 1 (Gray)

Min: 0 Max: 3.6939294

Min / Max Value Settings

Interpolation: Linear

Color ramp: [Color Ramp]

Label unit suffix: [Field]

Label precision: [Field]

| Value | Color | Label |
|-----------|----------|-------|
| 0 | [Red] | 0.00 |
| 0.9234824 | [Orange] | 0.92 |
| 1.8469647 | [Yellow] | 1.84 |
| 2.7704471 | [Green] | 2.77 |

Mode: Continuous

Buttons: Classify, Style, Legend Settings...

Buttons: Apply, Help

Color Ramp Menu

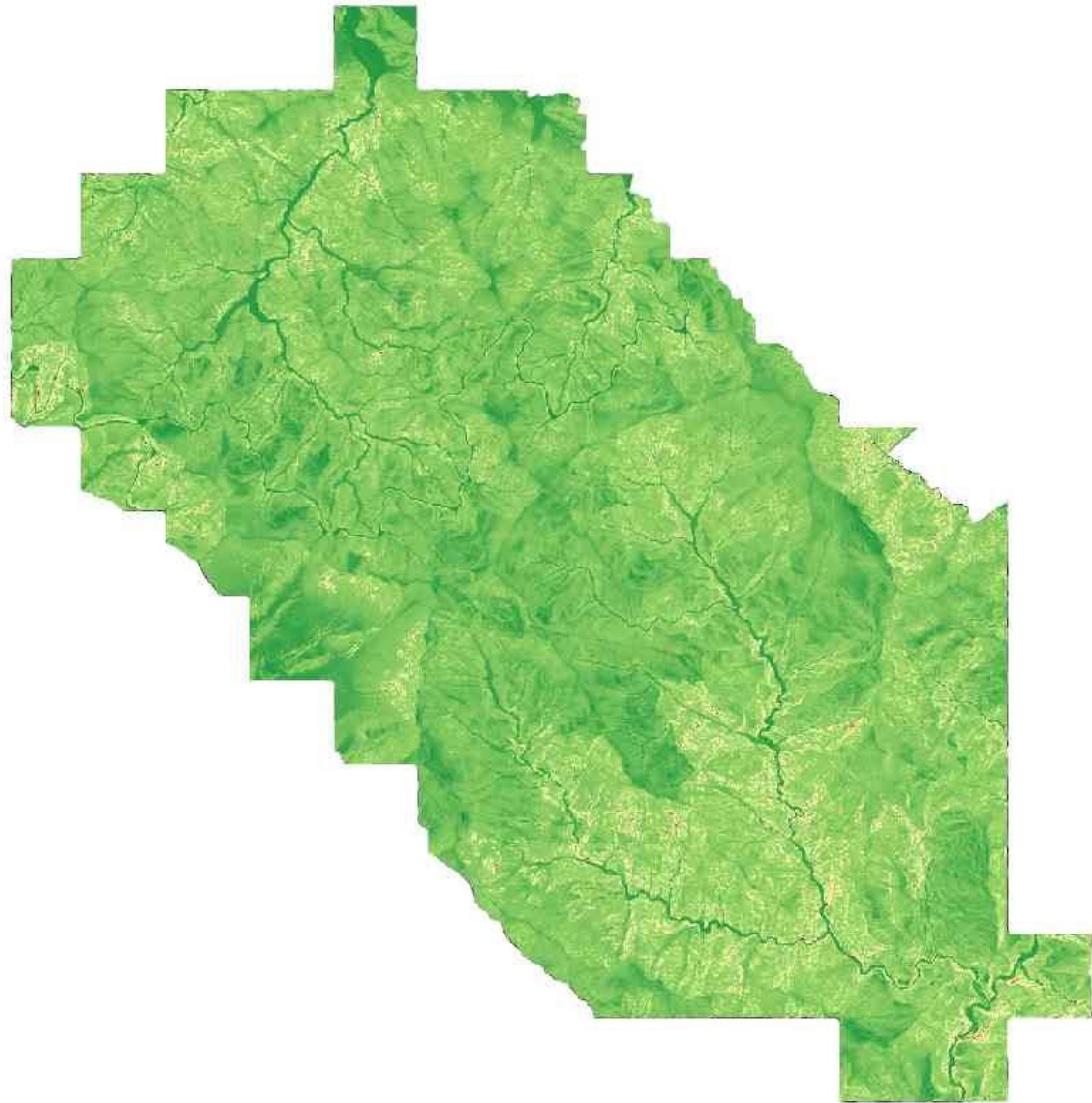
- Invert Color Ramp
- Blues
- Cividis
- Greens
- Greys
- Magma
- Mako
- RdGy
- Reds
- Rocket
- Spectral
- Turbo
- Viridis
- All Color Ramps
- Create New Color Ramp...
- Edit Color Ramp...
- Save Color Ramp...

Invert the color ramp so that red is the steepest slopes



Layers

- d8ContributingArea**
Band 1 (Gray)
349,224
- d8FlowDirection**
Band 1 (Gray)
8
- d8Slope**
Band 1 (Gray)
3.693929
- pitRemoveDEM**



Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Project Home
- ▶ Home
- ▶ C:\ (Windows)
- ▶ D:\
- ▶ GeoPackage