

An Introduction to GIS Fundamentals

PART 7. RASTER TOOLS



Raster data in QGIS

QGIS uses the **GDAL library (Geospatial Data Abstraction Library)** to read and write raster data formats, including ArcInfo Binary Grid, ArcInfo ASCII Grid, GeoTIFF, ERDAS IMAGINE, and many more (>100!).

Not all of the listed formats may work in QGIS for various reasons. For example, some require external commercial libraries, or the GDAL installation of your OS may not have been built to support the format you want to use. Only those formats that have been well tested will appear in the list of file types when loading a raster into QGIS.

GDAL/OGR and PROJ.4

<http://www.gdal.org>

<http://proj.osgeo.org>

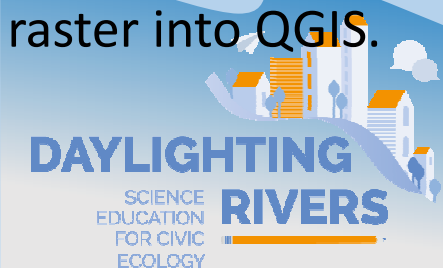


GDAL for Raster Data - The Geospatial Data Abstraction Library

Arc/Info ASCII Grid, **Arc/Info** Binary Grid (.adf), AIRSAR Polarimetric, Microsoft Windows Device Independent Bitmap (.bmp), BSB Nautical Chart Format (.kap), VTP Binary Terrain Format (.bt), CEOS (Spot for instance), First Generation USGS DOQ (.doq), DODS / OPeNDAP, New Labelled USGS DOQ (.doq), Military Elevation Data (.dt0, .dt1), **ERMapper** Compressed Wavelets (.ecw), **ESRI** .hdr Labelled, ENVI .hdr Labelled Raster, Envisat Image Product (.n1), EOSAT FAST Format, FITS (.fits), Graphics Interchange Format (.gif), GMT Compatible netCDF, **GRASS Rasters**, Golden Software ASCII Grid, Golden Software Binary Grid, Golden Software **Surfer** 7 Binary Grid, TIFF / **GeoTIFF** (.tif), GXF - Grid eXchange File, Hierarchical Data Format Release 4 (**HDF4**), Hierarchical Data Format Release 5 (HDF5), **Erdas Imagine** (.img), Vexcel MFF2, **Idrisi** Raster, Image Display and Analysis (WinDisp), ILWIS Raster Map (.mpr, .mpl), Japanese DEM (.mem), **JPEG** JFIF (.jpg), **JPEG2000** (JPEG2000, JP2KAK, JP2ECW, JP2MrSID), NOAA Polar Orbiter Level 1b Data Set (**AVHRR**), Erdas 7.x .LAN and .GIS, Daylon Leveller Heightfield, In Memory Raster, Vexcel MFF, Multi-resolution Seamless Image Database, Meteosat Second Generation, NDF, NITF, **NetCDF**, OGDI Bridge, PCI .aux Labelled, PCI Geomatics Database File, Portable Network Graphics (.png), PCRaster (.map), Netpbm (.ppm, .pgm), Swedish Grid RIK (.rik), RadarSat2 XML (product.xml), **ArcSDE** Raster, USGS SDTS DEM (*CATD.DDF), Raster Matrix Format (*.rsw, .mtw), SAR CEOS, **SGI** Image Format, USGS ASCII DEM (.dem), OGC Web Coverage Server, X11 Pixmap (.xpm)

OGR for Vector Data - Simple Feature Library

Arc/Info Binary Coverage, Comma Separated Value (.csv), DODS/OPeNDAP, DWG, **DXF**, ESRI Personal GeoDatabase, ESRI ArcSDE, **ESRI Shapefile**, FMEObjects Gateway, GML, **GMT Mapping**, **GRASS Vectors**, INTERLIS, **Google Earth KML**, Mapinfo File, Microstation DGN, Spatial **MySQL**, OGDI Vectors, ODBC generic database access layer, **Oracle** Spatial, PostgreSQL **PostGIS**, S-57 (ENC), SDTS, SQLite, UK .NTF, U.S. Census TIGER/Line, VRT - Virtual Datasource, Informix DataBlade



Training event (C1) of Daylighting rivers Florence Oct. 1st – 5th 2018

Raster data in QGIS

Raster data in GIS are **matrices of discrete cells** that represent features on, above or below the earth's surface. Each cell in the raster grid is the **same size**, and cells are usually **rectangular** (in QGIS they will always be rectangular). Typical raster datasets include remote sensing data, such as aerial photography, or satellite imagery and modelled data, such as an elevation matrix.

Unlike vector data, **raster data typically do not have an associated database record for each cell**. They are geocoded by **pixel resolution** and the **x/y coordinate of a corner pixel** of the raster layer. This allows QGIS to position the data correctly in the map canvas.

QGIS makes use of georeference information inside the raster layer (e.g., GeoTiff) or in an appropriate world file to properly display the data.

Raster data in QGIS

Loading raster data in QGIS

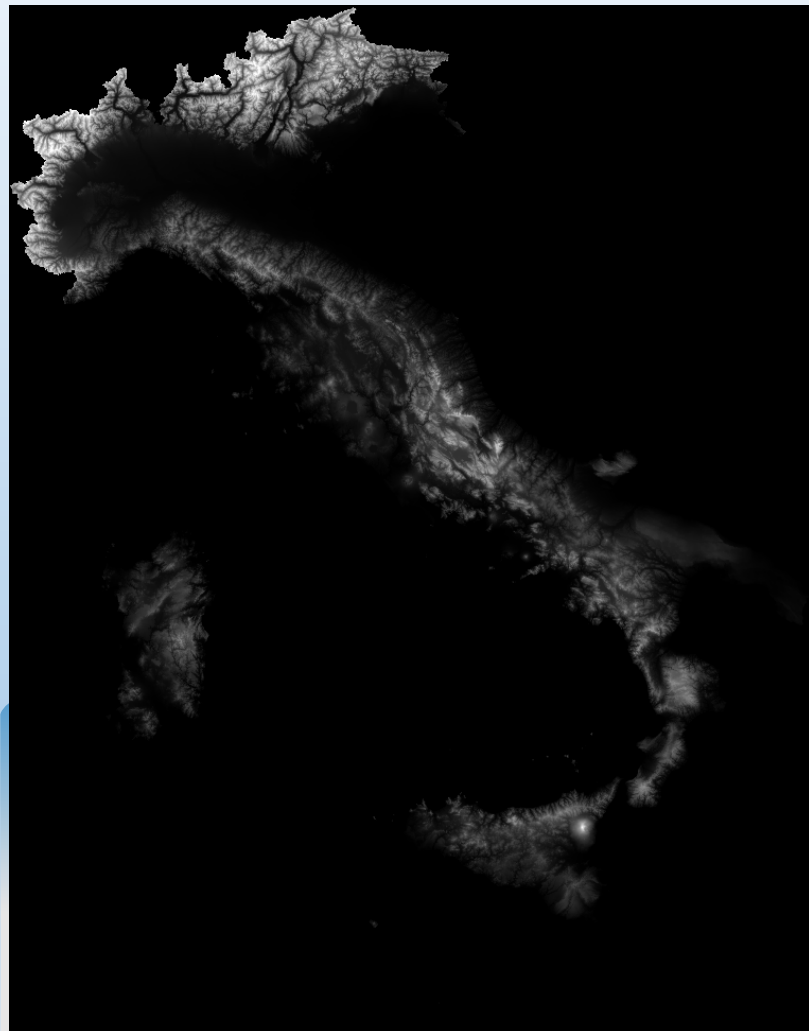
Raster layers are loaded either by clicking on the Add Raster Layer icon or by selecting the Layer>AddRasterLayer>Add from the Raster Layer menu option.

More than one layer can be loaded at the same time by holding down the Ctrl or Shift key and clicking on multiple items in the Open a GDAL Supported Raster Data Source dialog.

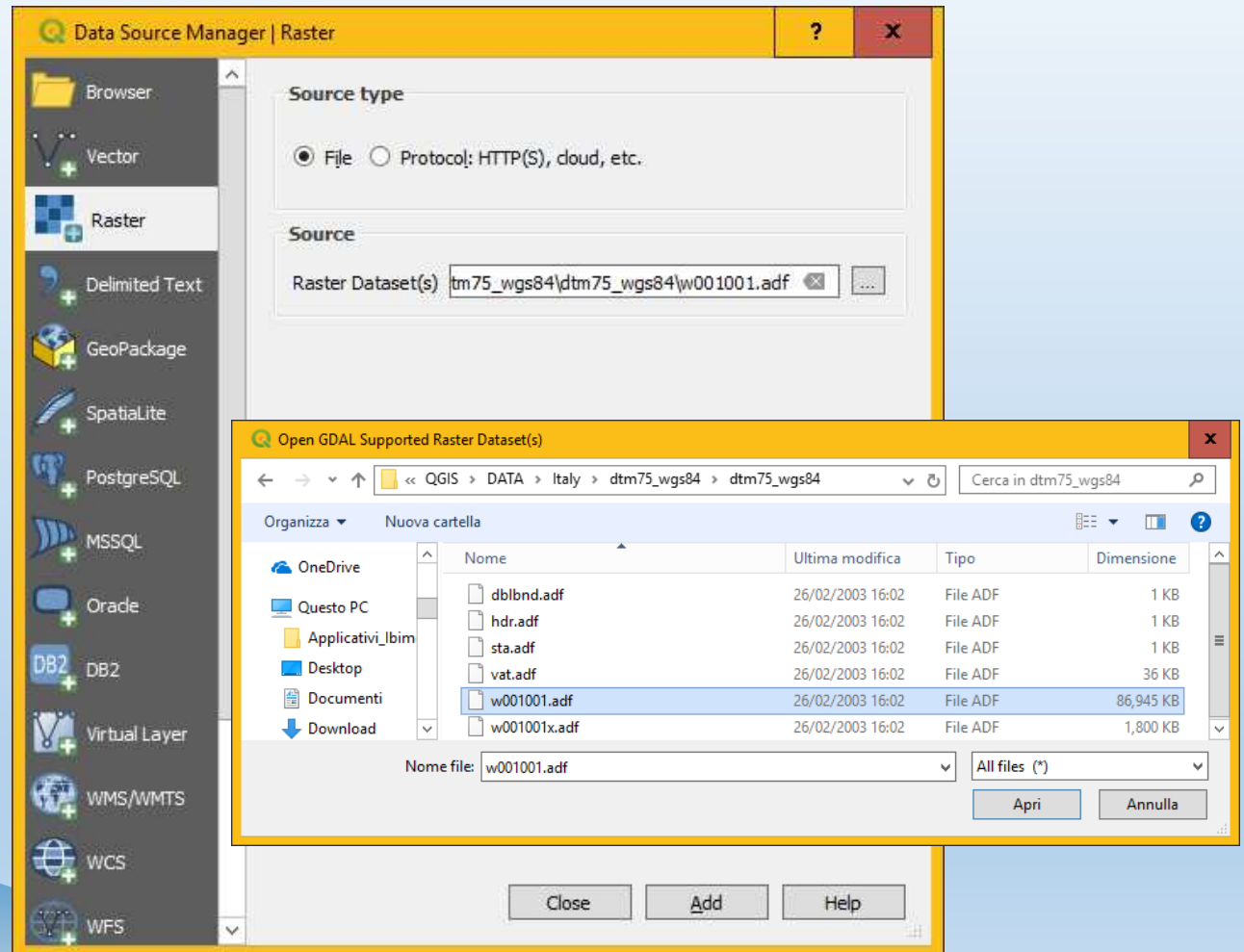
Once a raster layer is loaded in the map legend, you can click on the layer name with the right mouse button to select and activate layer-specific features or to open a dialog to set **raster properties** for the layer.

Raster data in QGIS

Loading raster data in QGIS



Open the raster layer DATA/Italy/dtm75_wgs84/.../w001001.adf»

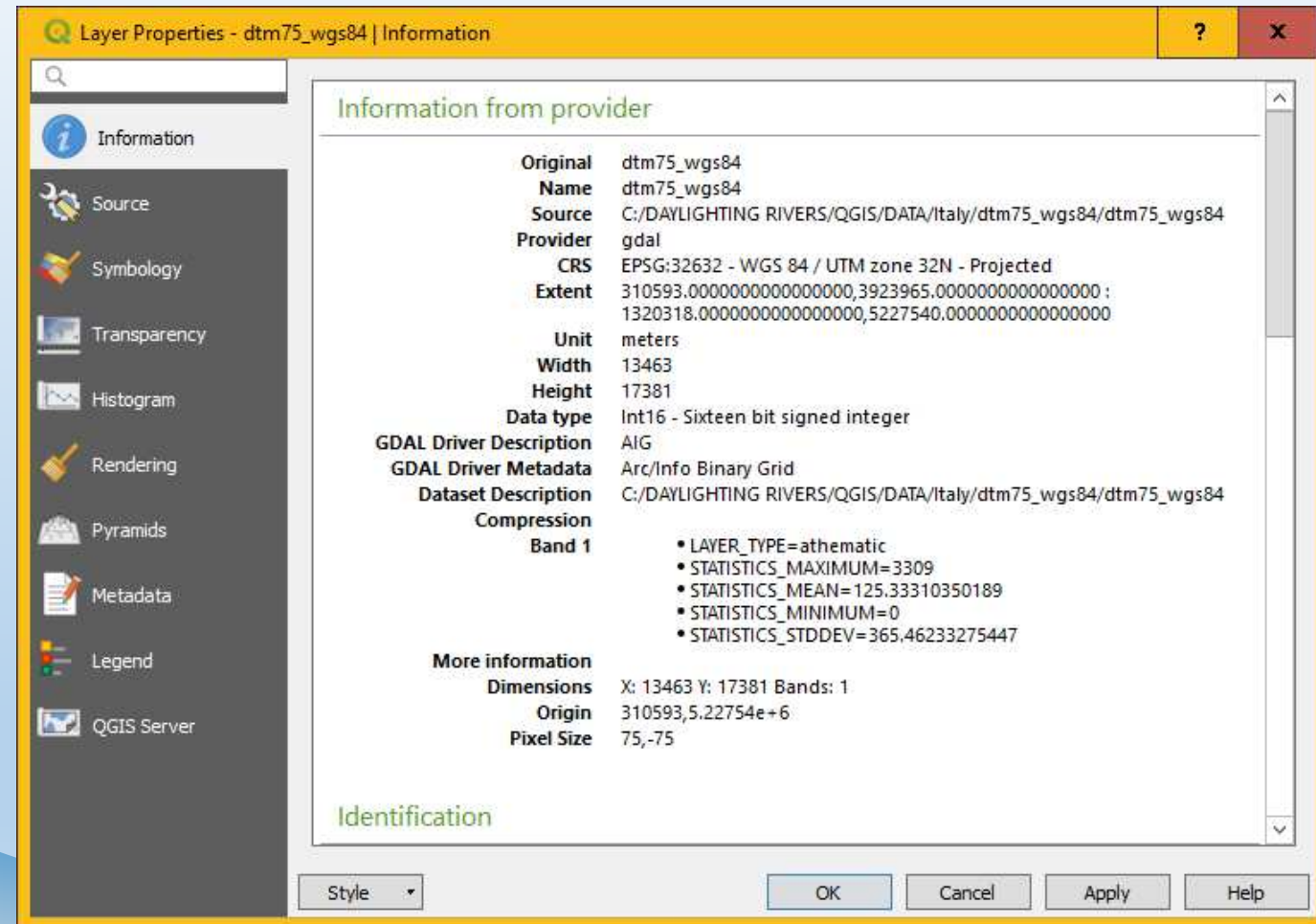
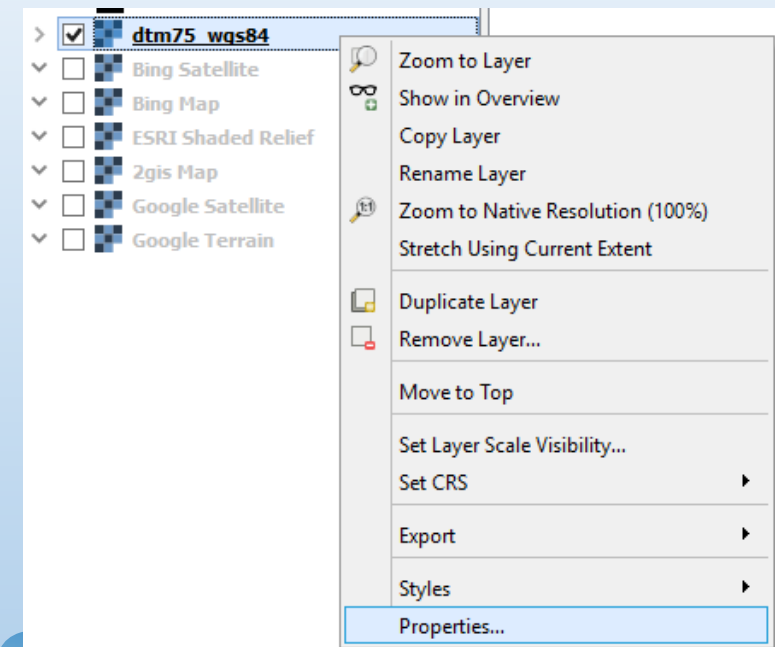


Digital Elevation Model, resolution 75 m EPSG

Raster data in QGIS

Raster properties

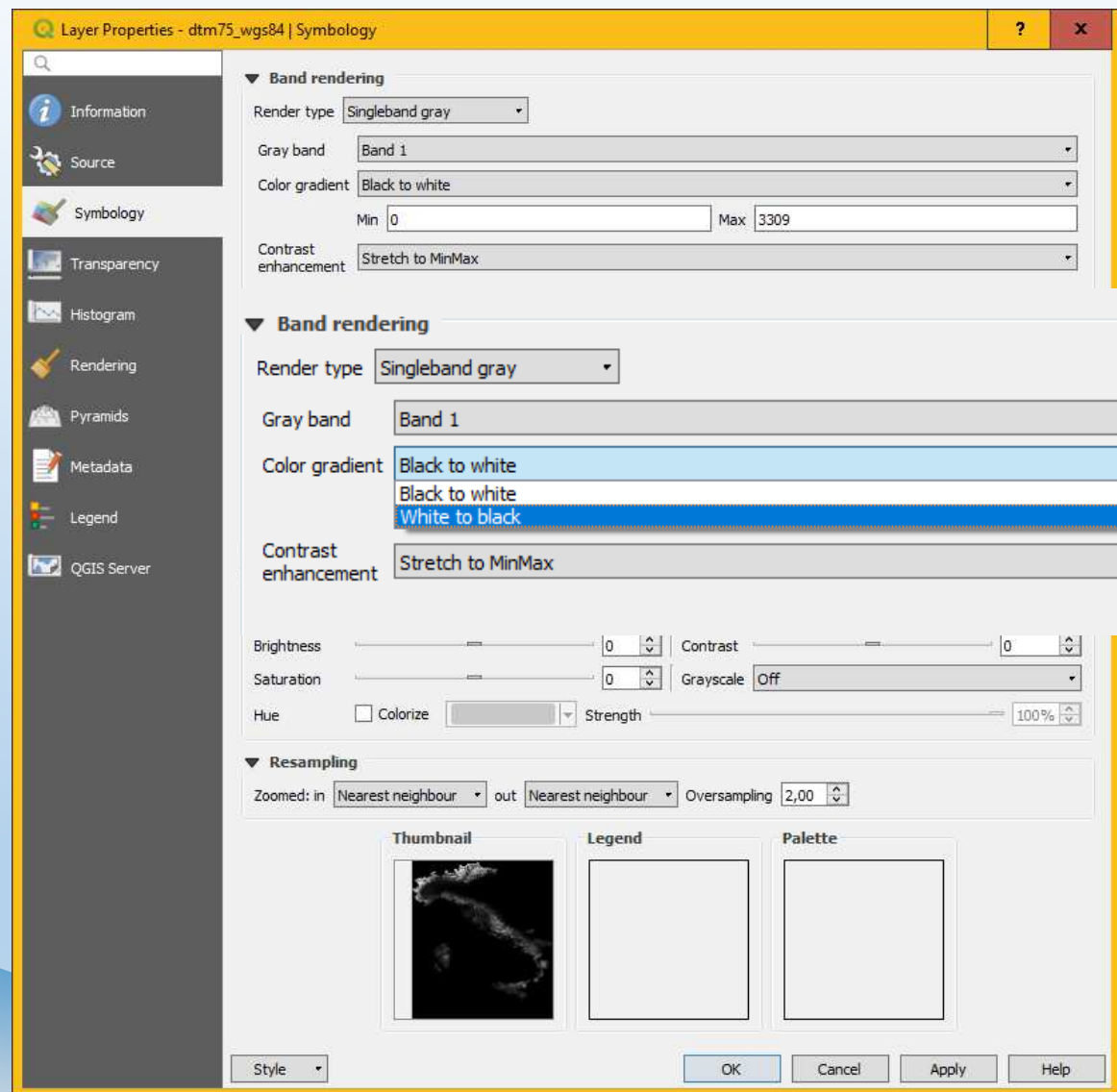
Right click on the raster layer



Digital Elevation Model, resolution 75 m EPSG

Raster data in QGIS

Raster Layer symbology



Raster data in QGIS

Raster Layer symbology

QGIS Raster Information dialog box showing parameters for the raster file:

```
C:\DAYLIGHTING RIVERS\QGIS\DATA\Italy\dtm75_wgs84\dtm75_wgs84\w001001x.adf
```

Size is 13463, 17381

Coordinate System is ...

Origin = (310593.0000000000000000, 5227540.0000000000000000)

Pixel Size = (75.0000000000000000, -75.0000000000000000)

Corner Coordinates:

Upper Left (310593.000, 5227540.000)

Lower Left (310593.000, 3923965.000)

Upper Right (1320318.000, 5227540.000)

Lower Right (1320318.000, 3923965.000)

Center (815455.500, 4575752.500)

and 1 Block=256x4 Type=Int16, ColorInterp=Undefined

Description = dtm75_wgs84

Min=0.000 Max=4780.000

Minimum=0.000, Maximum=3309.000, Mean=125.333, StdDev=365.462

NoData Value=-32768

Metadata:

LAYER_TYPE=athematic

STATISTICS_MAXIMUM=3309

Buttons: Run as Batch Process..., Run in Background, Close, Help

QGIS Layer Properties - dtm75_wgs84 | Symbology

Band rendering

Render type: Singleband pseudocolor

Band: [0] Max: 4780

Min / max values settings

Interpolation: Linear

Color ramp: [Color ramp]

Label unit suffix:

Value Color Label

Value	Color	Label
1		1
11		11
29		29
56		56
88		88
124		124
169		169
214		214
260		260
310		310
369		369
432		432
504		504
595		595
704		704
835		835
1026		1026
1311		1311
1805		1805

Render type: Singleband pseudocolor

Band: [Band]

Mode: Quantile

Classes: 20

Color rendering

Blending mode: Normal

Brightness: 0 Contrast: 0

Saturation: 0 Grayscale: Off

Hue: [Hue] Strength: 100%

Resampling

Zoomed in: Nearest neighbour out: Nearest neighbour Oversampling: 2,00

Thumbnail Legend Palette

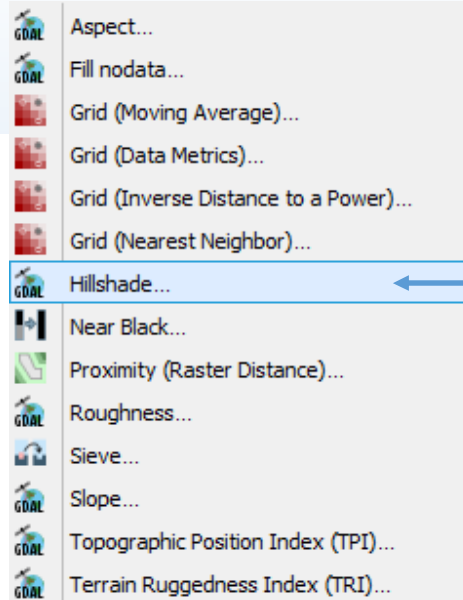
Style

OK Cancel Apply Help

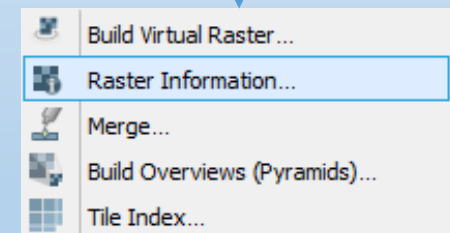
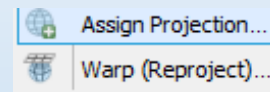
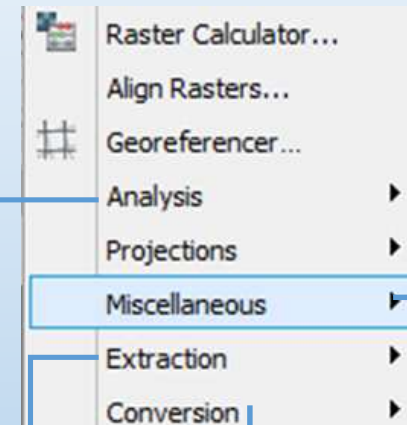
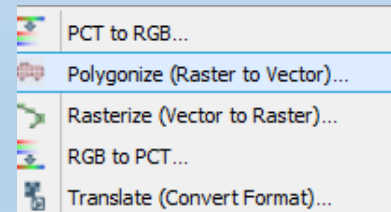
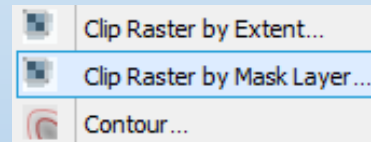


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Raster data in QGIS

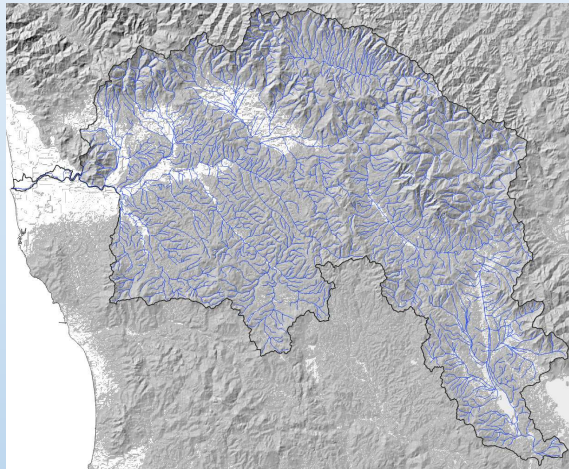


Raster Processing Tools



Raster data in QGIS

Analysis: Hillshade



Hillshade

Parameters Log

Input layer
dtm75_wgs84 [EPSG:32632]

Band number
Band 1

Z factor (vertical exaggeration)
1,000000

Scale (ratio of vertical units to horizontal)
1,000000

Azimuth of the light
315,000000

Altitude of the light
45,000000

☐ Compute edges

☐ Use Zevenbergen/Thorne formula instead of the Horn's one

☐ Combined shading

☐ Multidirectional shading

☒ Advanced parameters

Hillshade
[Save to temporary file]

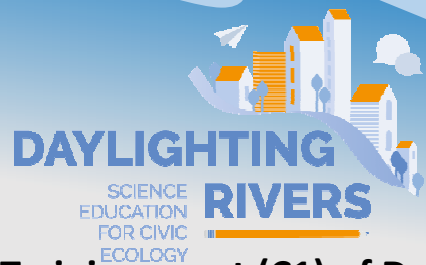
☒ Open output file after running algorithm

GDAL/OGR console call

```
gdaldem hillshade "C:/DAYLIGHTING RIVERS/QGIS/DATA/Italy/dtm75_wgs84/dtm75_wgs84" C:/Users/Fa/AppData/Local/Temp/processing_d079b61ce9414f14a3c7dbec17d29b87/1fef64a1998f42eb8f18aca102b77785/OUTPUT.tif -of GTiff -b 1 -z 1.0 -s 1.0 -az 315.0 -alt 45.0
```

0% Cancel

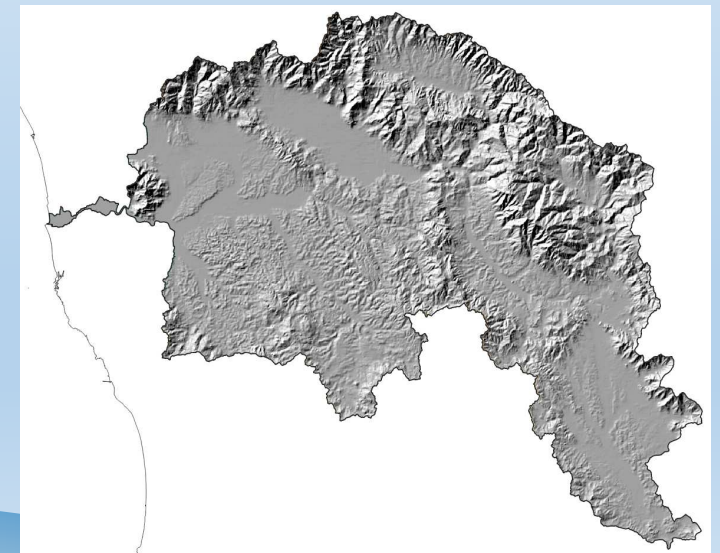
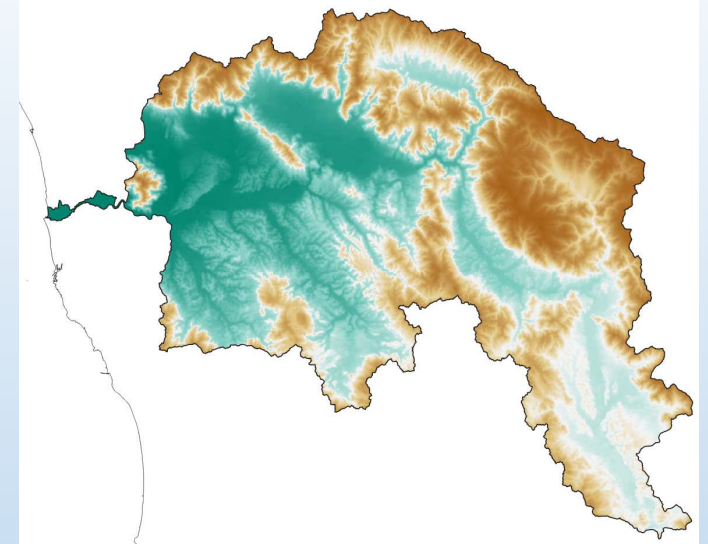
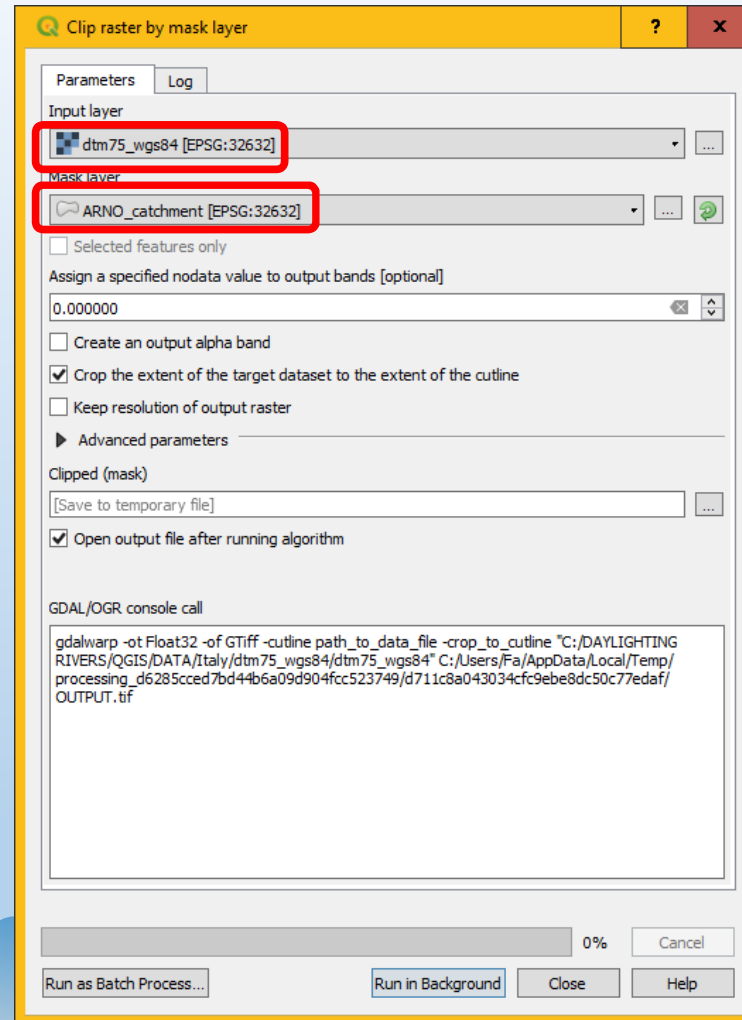
Run as Batch Process... Run in Background Close Help



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Raster data in QGIS

Extraction: Clip



Raster data in QGIS Raster calculator



Raster Calculator

Raster bands

- Hillshade@1
- dtm75_wgs84@1
- dtm75_wgs84@1
- hillshade_dtm75_EPSG32632@1

Result layer

Output layer: TA\Italy\dtm75_wgs84\DEM_3_classes

Output format: GeoTIFF

Selected layer extent

X min: 310593,00000 X Max: 1320318,00000

Y min: 3923965,00000 Y max: 5227540,00000

Columns: 13463 Rows: 17381

Output CRS: EPSG:32632 - WGS 84 / UTM zone 32N

☒ Add result to project

Operators

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

Raster calculator expression

("dtm75_wgs84@1" <=300) *1 + ("dtm75_wgs84@1" >300 AND "dtm75_wgs84@1" <=600) *2 + ("dtm75_wgs84@1" >600) *3

Expression valid

OK Cancel Help

Raster data in QGIS Raster calculator



Raster Calculator

Raster bands

- DEM_3_classes@1
- DEM_3_classes_no_zero@1
- Hillshade@1
- dtm75_wgs84@1
- dtm75_wgs84@1
- hillshade_dtm75_EPSG32632@1

Result layer

Output layer: n75_wgs84\DEM_3_classes_no_zero.tif

Output format: GeoTIFF

Selected layer extent

X min: 310593,00000 X Max: 1320318,00000

Y min: 3923965,00000 Y max: 5227540,00000

Columns: 13463 Rows: 17381

Output CRS: EPSG:32632 - WGS 84 / UTM zone 32N

☒ Add result to project

Operators

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

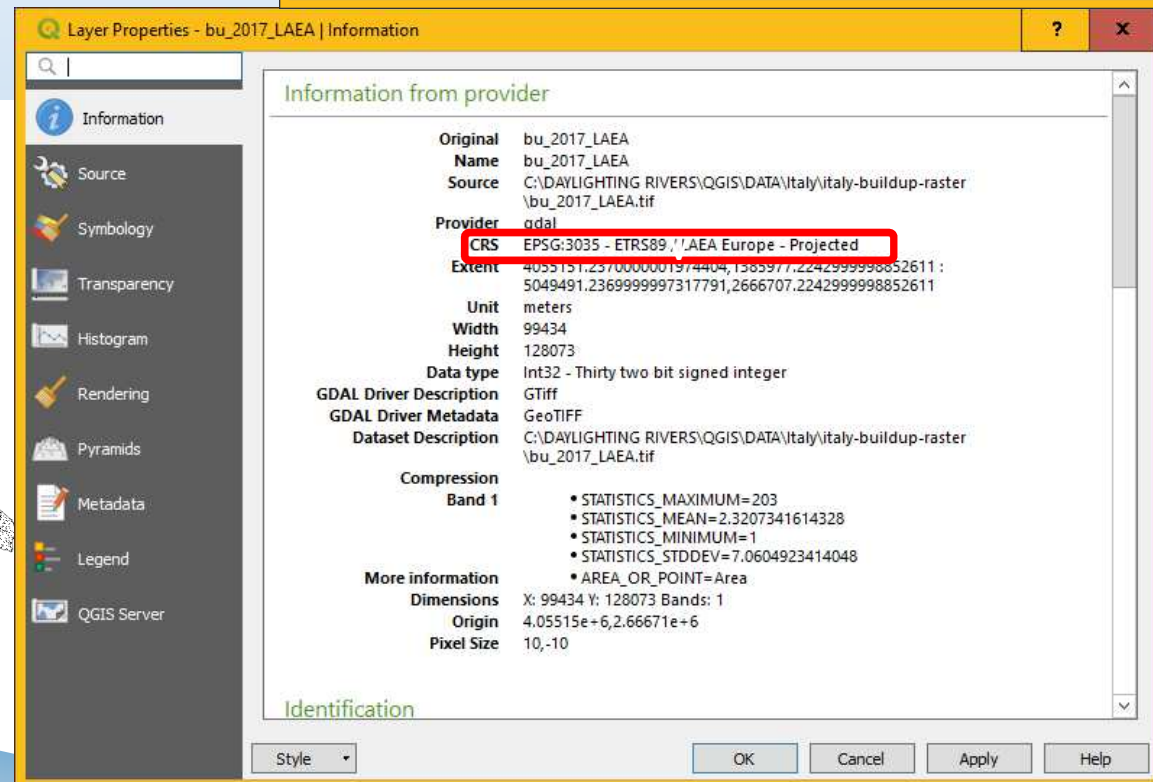
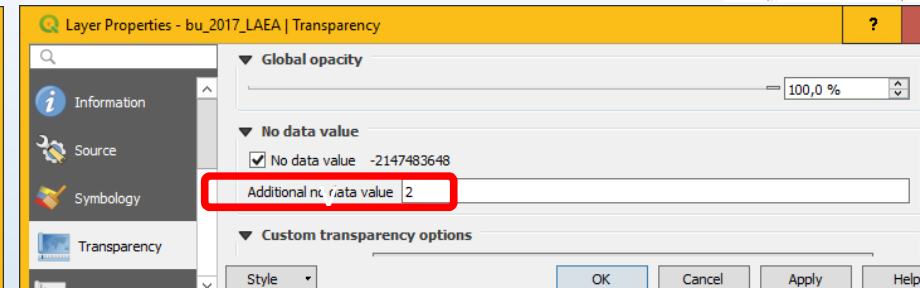
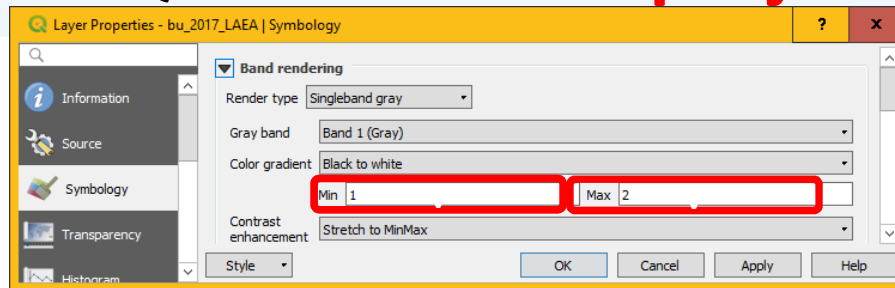
Raster calculator expression

("dtm75_wgs84@1" > 0 AND "dtm75_wgs84@1" <=300)*1 + ("dtm75_wgs84@1" > 300 AND "dtm75_wgs84@1" <=700)*1) *2 + ("dtm75_wgs84@1" > 700)*3

Expression invalid

OK Cancel Help

Raster data in QGIS Raster reprojection

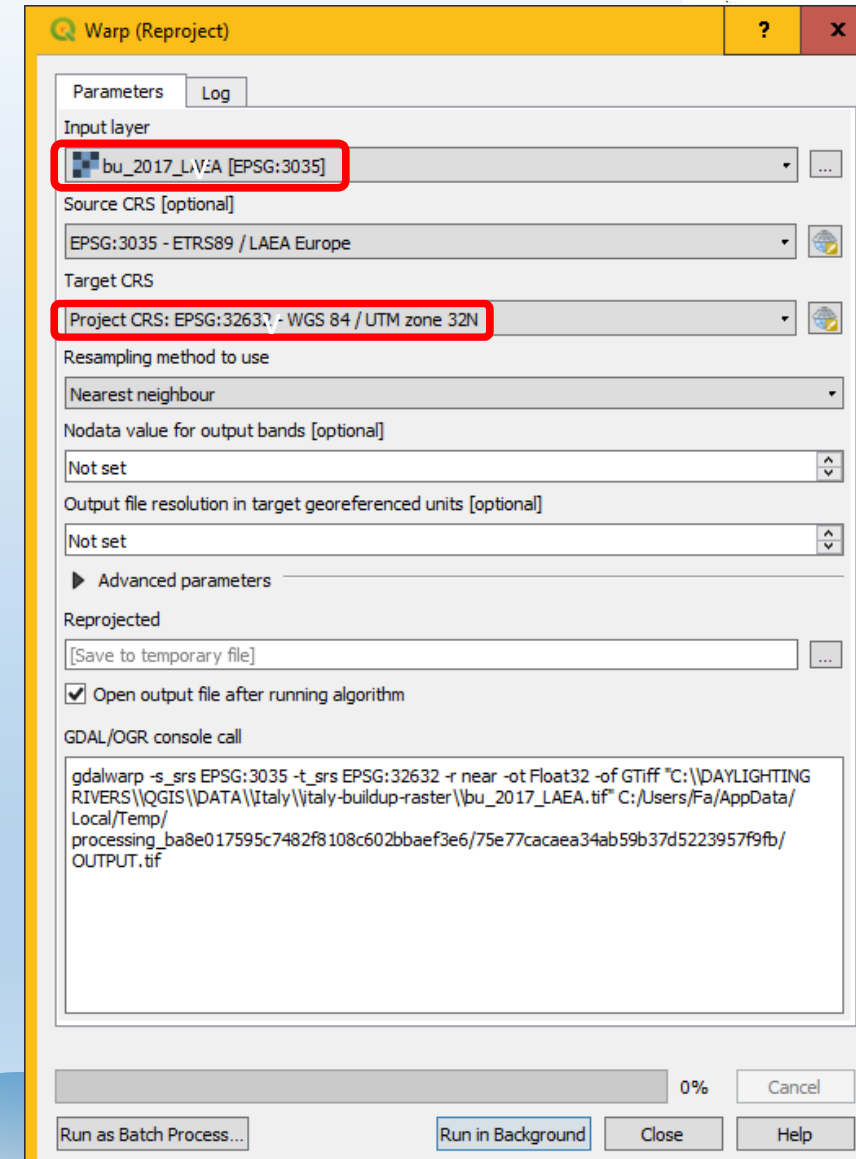
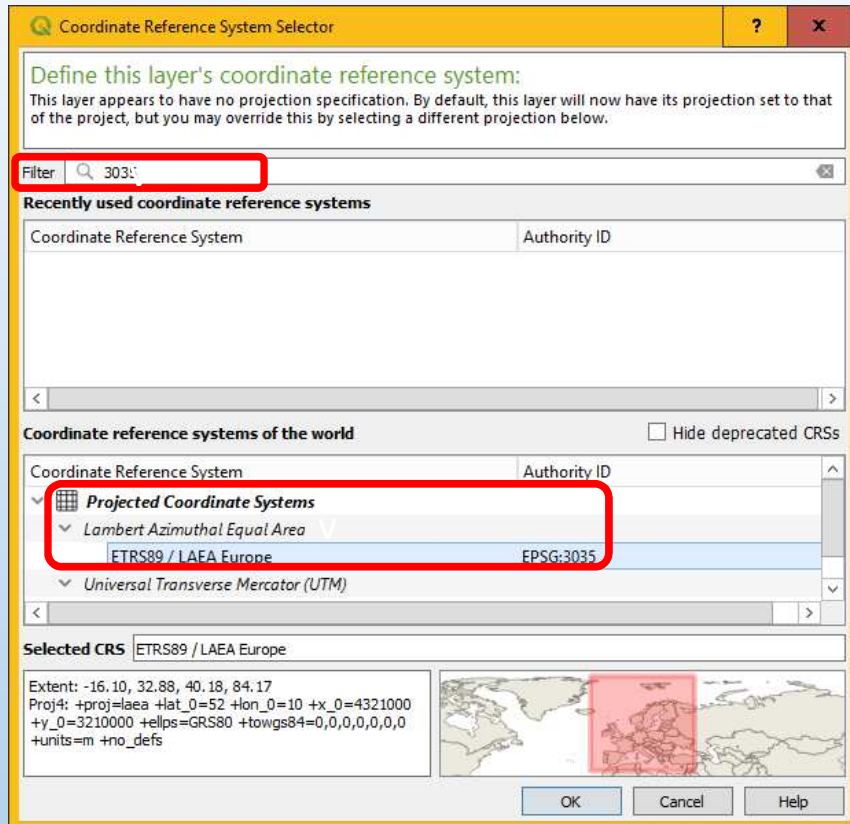


QGIS\DATA\Italy\italy-buildup-raster\bu_2017_LAEA.tif



Training event (C1) of Daylighting rivers Florence Oct. 1st – 5th 2018

Raster data in QGIS Raster reprojection



Raster data in QGIS Raster reprojection

Layer Properties - Reprojected | Information

Information

Source

Symbology

Transparency

Histogram

Rendering

Pyramids

Metadata

Legend

QGIS Server

Information from provider

Original Name	Reprojected
Source	C:/Users/Fa/AppData/Local/Temp/processing_ba8e017595c7482f8108c602bbaef3e6/bb27c6d4e9924c68b9d439ba926fd43d/OUTPUT.tif
Provider	gdal
CRS	EPSG:32632 - WGS 84 / UTM zone 32N - Projected
Extent	310315.3406003601849079; 129015.5225133.5215731579810381
Unit	meters
Width	99874
Height	129015
Data type	Float32 - Thirty two bit floating point
GDAL Driver Description	GTiff
GDAL Driver Metadata	GeoTIFF
Dataset Description	C:/Users/Fa/AppData/Local/Temp/processing_ba8e017595c7482f8108c602bbaef3e6/bb27c6d4e9924c68b9d439ba926fd43d/OUTPUT.tif
Compression	
Band 1	<ul style="list-style-type: none"> • STATISTICS_MAXIMUM=203 • STATISTICS_MEAN=2.3021538035986 • STATISTICS_MINIMUM=1 • STATISTICS_STDDEV=6.8059384385234 • AREA_OR_POINT=Area
More information	
Dimensions	X: 99874 Y: 129015 Bands: 1
Origin	310315.522513e+6
Pixel Size	10.0513, -10.0513

OK Cancel Apply Help

Warp (Reproject)

Parameters Log

Processing algorithm...

Algorithm 'Warp (reproject)' starting...

Input parameters:

```
{ 'DATA_TYPE' : 5, 'INPUT' : 'C:/DAYLIGHTING RIVERS/QGIS/DATA/Italy/italy-buildup-raster/bu_2017_LAEA.tif', 'MULTITHREADING' : False, 'NODATA' : None, 'OPTIONS' : '', 'OUTPUT' : 'C:/Users/Fa/AppData/Local/Temp/processing_ba8e017595c7482f8108c602bbaef3e6/processing_ba8e017595c7482f8108c602bbaef3e6.tif', 'SOURCE_CRS' : 'EPSG:3035', 'TARGET_CRS' : 'EPSG:32632', 'TARGET_EXTENT' : None, 'TARGET_RESOLUTION' : None }
```

GDAL command:

```
gdalwarp -s_srs EPSG:3035 -t_srs EPSG:32632 -r near -ot Float32 -of GTiff "C:/DAYLIGHTING RIVERS/QGIS/DATA/Italy/italy-buildup-raster/bu_2017_LAEA.tif" C:/Users/Fa/AppData/Local/Temp/processing_ba8e017595c7482f8108c602bbaef3e6/bb27c6d4e9924c68b9d439ba926fd43d/OUTPUT.tif
```

GDAL command output:

```
0...10...20...30...40...50...60...70...80...90...100 - done.
```

Execution completed in 9602.75 seconds

Results:

```
{ 'OUTPUT' : <QgsProcessingOutputLayerDefinition {'sink':C:/Users/Fa/AppData/Local/Temp/processing_ba8e017595c7482f8108c602bbaef3e6/bb27c6d4e9924c68b9d439ba926fd43d/OUTPUT.tif} }
```

Save Raster Layer as...

Output mode ☒ Raw data ☐ Rendered image

Format GeoTIFF ☐ Create VRT

File name C:/DAYLIGHTING RIVERS/QGIS/DATA/Italy/italy-buildup-raster/bu_2017_EPSG_32632.tif

CRS EPSG:32632 - WGS 84 / UTM zone 32N

☒ Add saved file to map

Extent (current: layer)

North 5225133.5216

West 310315.3406 East 1314175.7661

South 3928369.0704

Current layer extent Calculate from layer Map view extent

Resolution (current: layer)

☒ Horizontal 10.0513 Vertical 10.0513 Layer resolution

☐ Columns 99874 Rows 129015 Layer size

OK Cancel Help