

# Working with Terrain Data

## QGIS Tutorials and Tips



Author

Ujaval Gandhi

<http://www.spatialthoughts.com>

# Working with Terrain Data

Terrain or elevation data is useful for many GIS Analysis and it is often used in maps. QGIS has good terrain processing capabilities built-in. In this tutorial, we will work through the steps to generate various products from elevation data such as contours, hillshade etc.

## Overview of the task

The task is to create contours and hillshade map for area around Mt. Everest.

### Other skills you will learn

- Searching and downloading freely available terrain data.
- Exporting a vector layer as KML and viewing it in Google Earth.

## Get the data

We will be working with GMTED2010 dataset from USGS. This data can be downloaded from the [USGS Earthexplorer](#) site. [GMTED \(Global Multi-resolution Terrain Elevation Data\)](#) is a global terrain dataset that is the newer version of GTOPO30 dataset.

Here is how to search and download the relevant data from USGS Earthexplorer.

1. Go to the [USGS Earthexplorer](#). In the Search Criteria tab, search for the place name *Mt. Everest*. Click on the result to select the location.

Home      Login   Register   Feedback   Help

**Search Criteria**      Data Sets   Additional Criteria   Results

1. Enter Search Criteria  
To narrow your search area: type in an address or place name, enter coordinates or click the map to define your search area (for advanced map tools, view the [help documentation](#)), and/or choose a date range.

Address/Place   Path/Row   Feature   Circle

mt. everest      Show   Clear

Click on an Address/Place to show the location on the map and add coordinates to the Area of Interest Control.

Num	Address/Place	Latitude	Longitude
1	Mount Everest	27.9858	86.9236

Coordinates   Predefined Area   Shapefile   KML  
Degree/Minute/Second   Decimal  
No coordinates selected.  
Use Map   Add Coordinate   Clear Coordinates

Date Range   Result Options



2. In the Data Sets tab, expand the Digital Elevation group, and check GMTED2010.

Home      Login   Register   Feedback   Help

Search Criteria   **Data Sets**   Additional Criteria   Results

## 2. Select Your Data Set(s)

Check the boxes for the data set(s) you want to search. When done selecting data set(s), click the *Additional Criteria* or *Results* buttons below. Click the plus sign next to the category name to show a list of data sets.

Use Data Set Prefilter ([What's This?](#))

Data Set Search:

- + Aerial Imagery
- + AVHRR
- + Cal/Val Reference Sites
- + Commercial
- + Declassified Data
- + Digital Elevation 
  - ASTER GLOBAL DEM
  - GMTED2010 **Selected**
  - GTOPO30
  - GTOPO30 HYDRO 1K
  - SRTM
  - SRTM Void Filled
  - SRTM Water Body Data
- + Digital Line Graphs

**Search Criteria Summary (Show)**   [Clear Criteria](#)

(28° 18' 02" N, 086° 44' 08" E)   Options   Overlays   Map   Satellite

3. You can now skip to the Results tab and see the part of the dataset intersecting your search criteria. Click the Download Options button. You will have to log in to the site at this point. You can create a free account if you do not have one.

**USGS** science for a changing world   [USGS Home](#)   [Contact USGS](#)   [Search USGS](#)

EarthExplorer      Home      Login   Register   Feedback   Help

Search Criteria   Data Sets   Additional Criteria   **Results**

## 4. Search Results

If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.

**Note:** You must be logged in to download and order scenes

Show Result Controls   [Click here to export your results »](#)

Data Set   **GMTED2010**

« First < Previous 1 Next > Last »   Displaying 1 - 1 of 1 **1**

Entity ID: GMTED2010N10E060	Acquisition Date: 11-NOV-10
	<a href="#"></a> <a href="#"></a> <a href="#"></a> <a href="#"></a>

« First < Previous 1 Next > Last »

**Search Criteria Summary (Show)**   [Clear Criteria](#)

(28° 12' 23" N, 086° 32' 21" E)   Options   Overlays   Map   Satellite

4. Select the 30 ARC SEC option and click Select Download Option.



You will now have a file named `GMTED2010N10E060_300.zip`. Elevation data is distributed in various raster formats such as ASC, BIL, GeoTiff etc. QGIS supports a wide variety of raster formats via the GDAL library. The GMTED data comes as GeoTiff files which are contained in this zip archive.

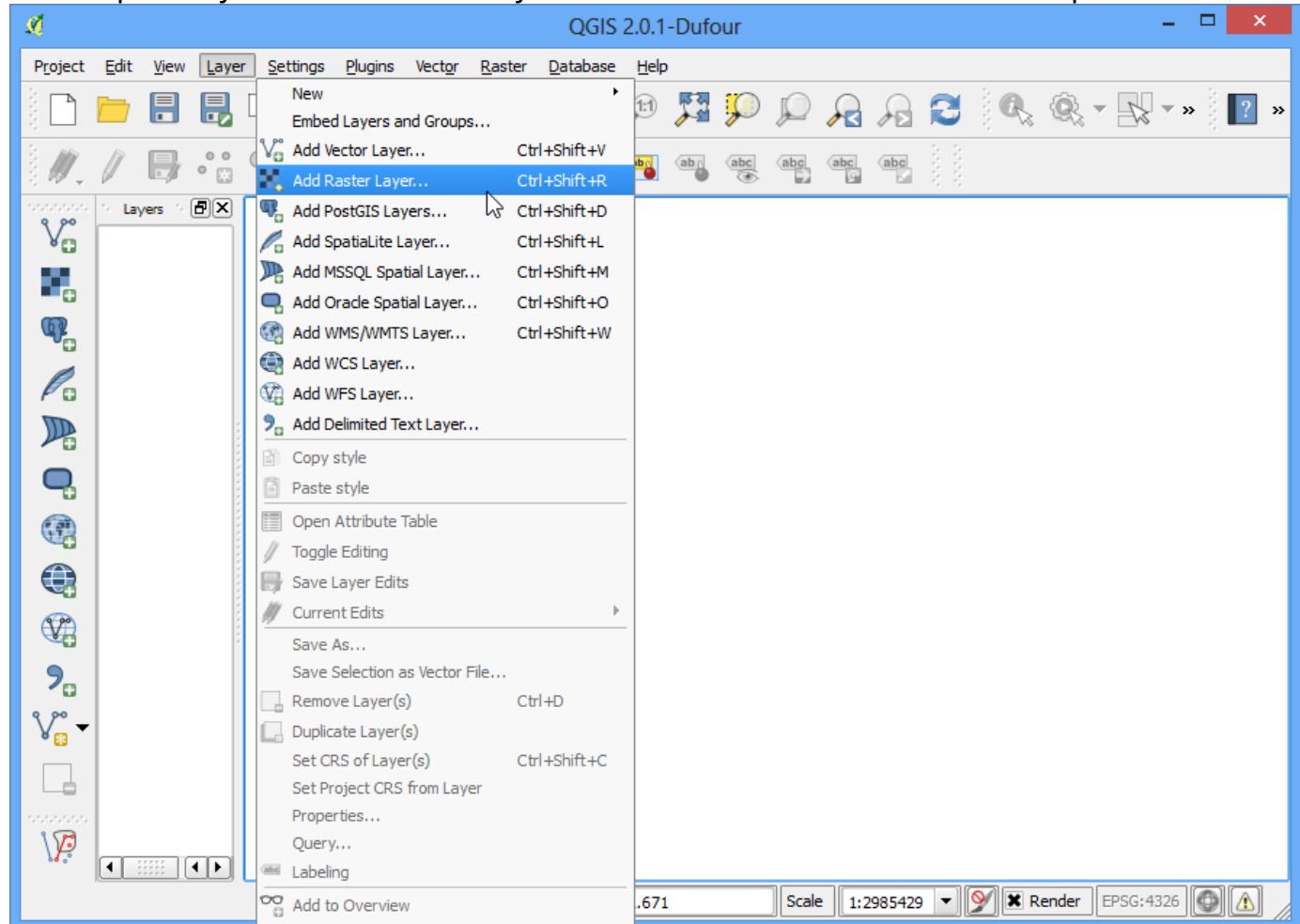
For convenience, you can download a copy of the data directly from below.

[GMTED2010N10E060\\_300.zip](#)

Data Source: [GMTED2010]

## Procedure

5. Open Layer ▶ Add Raster Layer and browse to the downloaded zip file.



6. There are many different files generated from different algorithms. For this tutorial, we will use the file named `10n060e_20101117_gmted_me300.tif`.



7. You will see the terrain data rendered in the QGIS Canvas. Each pixel in the terrain raster represents the average elevation in meters at that location. The dark pixels represent areas with low altitude and lighter pixels represent areas with high altitude.



8. Let's find our area of interest. From [Wikipedia](#), we find that the coordinates for our area of interest - Mt. Everest - is located at the coordinates  $27.9881^{\circ}$  N,  $86.9253^{\circ}$  E. Note that QGIS uses the coordinates in (X,Y) format, so you must use the coordinates as (Longitude, Latitude). Paste  $86.9253, 27.9881$  these at the bottom of QGIS window where it says Coordinate and press Enter. The viewport will be centered at this coordinate. To zoom in, Enter  $1:1000000$  in the

Scale field and press Enter. You will see the viewport zoom to the area around the Himalayas.



9. We will now crop the raster to this area of interest. Select the Clipper tool from Raster > Extraction > Clipper.

### Note

The Raster menu in QGIS comes from a core plugin called GdalTools. If you do not see the Raster menu, enable the GdalTools plugin from Plugins > Manage and install plugins > Installed. See [Using Plugins](#) for more details.



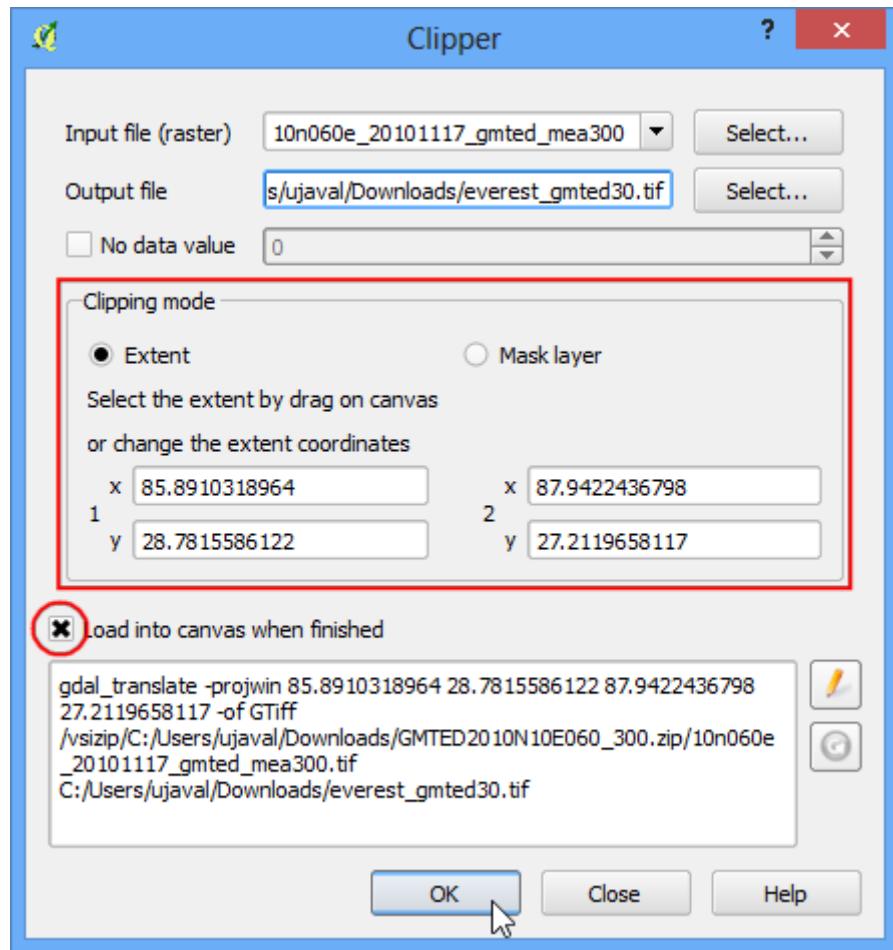
10. In the Clipper window, name your output file as `everest_gmted30.tif`. Select the Clipping mode as Extent.



11. Keep the Clipper window open and switch to the main QGIS window. Hold your left mouse button and draw a rectangle covering the full canvas.



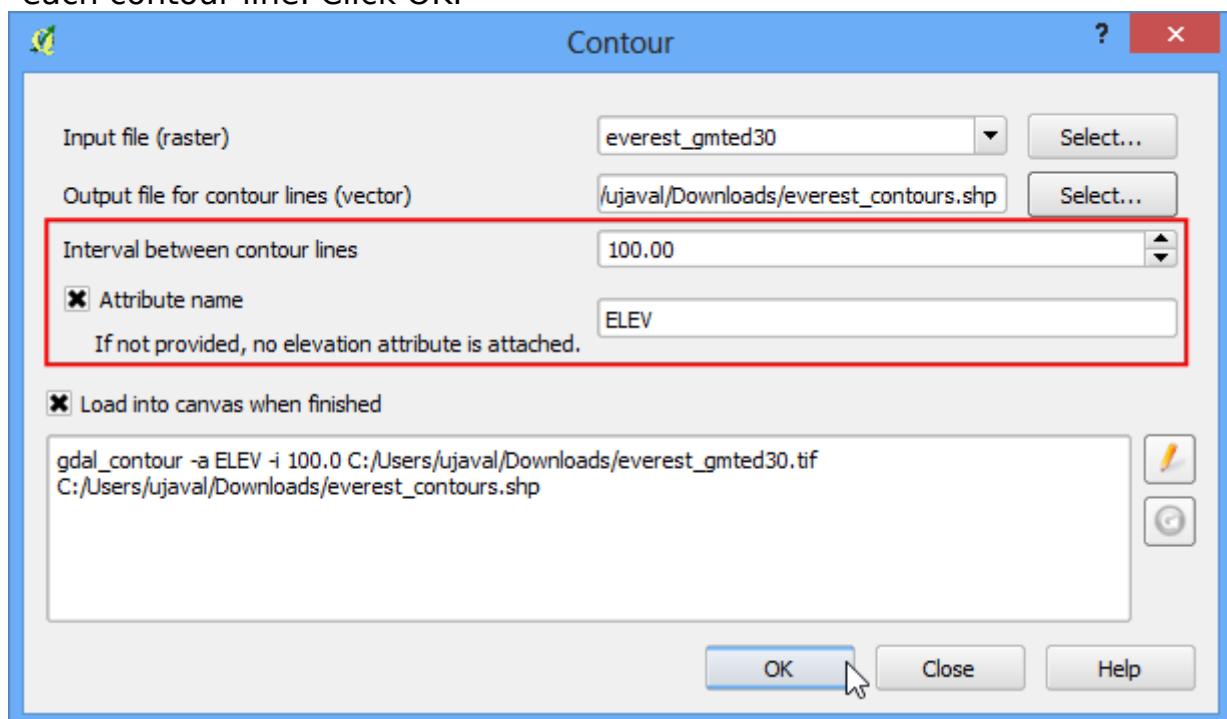
12. Now back in the Clipper window, you will see the coordinates auto-populated from your selection. Make sure the Load into canvas when finished option is checked, and click OK.



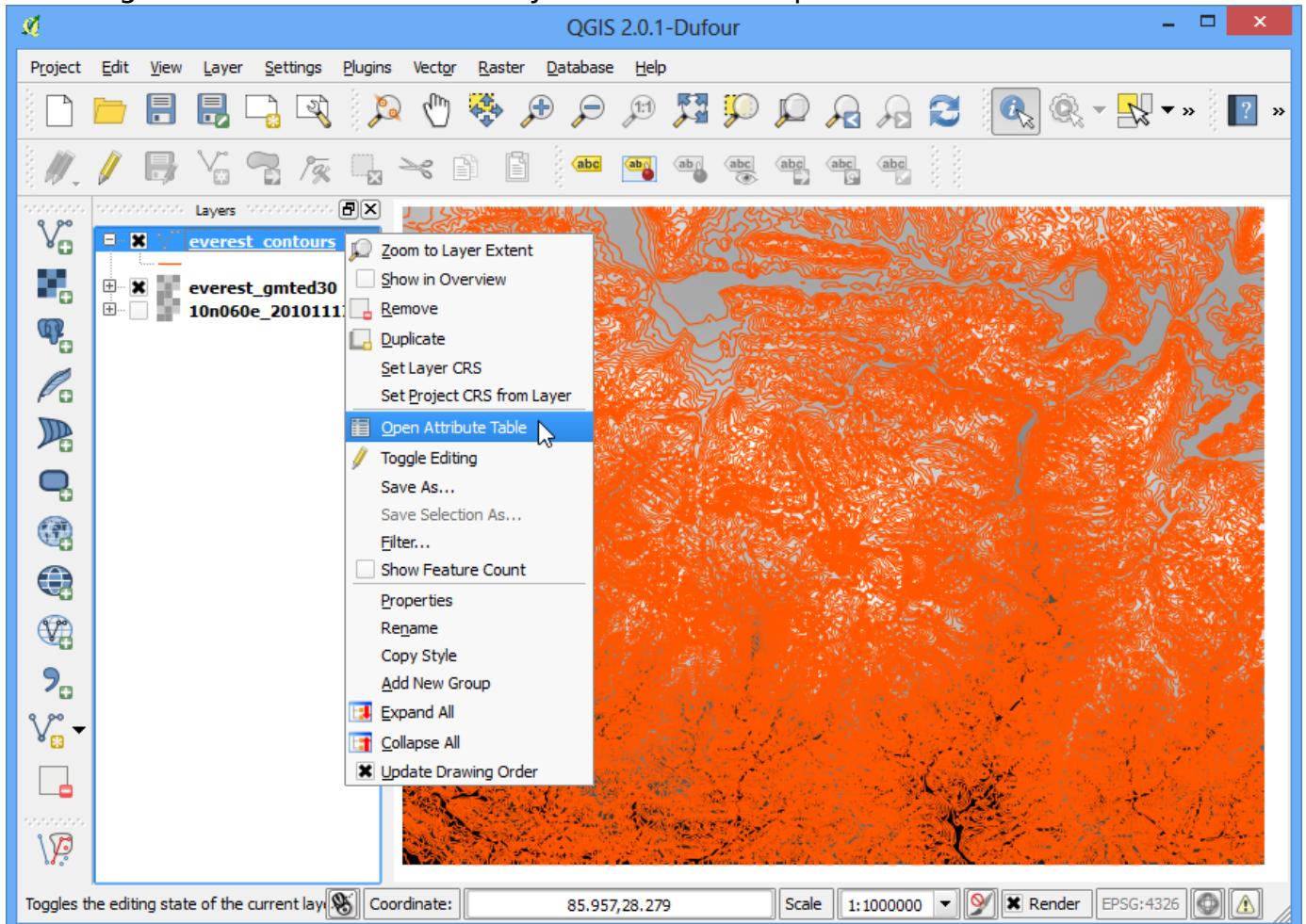
13. Once the process finishes, you will see a new layer loaded in QGIS. This layer covers only the area around Mt. Everest. Now we are ready to generate contours. Select the contour tool from Raster > Extraction > Contour.



14. In the Contour dialog, select `everest_gmted30` as the Input file. Name the Output file for contour lines as `everest_countours.shp`. We will generate contour lines for 100m intervals, so put 100 as the Interval between contour lines. Also check the Attribute name option so elevation value will be recorded as attribute of each contour line. Click OK.



15. Once the processing is complete, you will see contour lines loaded into the canvas. Each line in this layer represents a particular elevation. All points along a contour line in the underlying raster would be at the same elevation. The closer the lines, the steeper the slope. Let's inspect the contours a bit more. Right click on the contours layer and choose Open Attribute Table.



16. You will see that each line feature has an attribute named ELEV. This is the height in metres that each line represents. Click on the column header a couple of times to sort the values in descending order. Here you will find the line representing the highest elevation in our data, i.e. Mt. Everest.

Attribute table - everest\_contours :: Features total: 2988, filtered: 2988, selected: 1

The screenshot shows a QGIS attribute table window titled "Attribute table - everest\_contours". The status bar at the top indicates "Features total: 2988, filtered: 2988, selected: 1". The table has two columns: "ID" and "ELEV". The first row, which contains the values "1200" and "8600.000", is highlighted with a green background. A red circle highlights the "ELEV" column header. A cursor arrow is positioned near the bottom center of the table area. At the bottom left, there is a button labeled "Show All Features". On the right side of the table, there are vertical scroll bars. The bottom right corner of the window contains three small icons.

	ID	ELEV
1200	1200	8600.000
1199	1199	8500.000
1227	1227	8400.000
1462	1462	8400.000
1226	1226	8300.000
1461	1461	8300.000
1225	1225	8200.000
1460	1460	8200.000
1249	1249	8100.000
1459	1459	8100.000
1248	1248	8000.000
1458	1458	8000.000
1273	1273	7900.000
1487	1487	7900.000
960	960	7800.000
1272	1272	7800.000
1486	1486	7800.000
959	959	7700.000
1271	1271	7700.000
1485	1485	7700.000
958	958	7600.000
1270	1270	7600.000
...	...	...

17. Select the top row, and click on the Zoom to selection button.

Attribute table - everest\_contours :: Features total: 2988, filtered: 2988, selected: 1

The screenshot shows the QGIS Attribute Table window. The title bar indicates "Attribute table - everest\_contours :: Features total: 2988, filtered: 2988, selected: 1". The toolbar at the top includes various icons for editing, selection, and analysis. A red circle highlights the selection tool icon (a hand cursor) in the toolbar. The main area is a table with two columns: "ID" and "ELEV". The "ID" column lists feature identifiers, and the "ELEV" column lists their elevations. The first row, with ID 1200 and elevation 8600.000, is highlighted with a green background, indicating it is the currently selected feature.

	ID	ELEV
1200	1200	8600.000
1199	1199	8500.000
1227	1227	8400.000
1462	1462	8400.000
1226	1226	8300.000
1461	1461	8300.000
1225	1225	8200.000
1460	1460	8200.000
1249	1249	8100.000
1459	1459	8100.000
1248	1248	8000.000
1458	1458	8000.000
1273	1273	7900.000
1487	1487	7900.000
960	960	7800.000
1272	1272	7800.000
1486	1486	7800.000
959	959	7700.000
1271	1271	7700.000
1485	1485	7700.000
958	958	7600.000
1270	1270	7600.000
...	...	...

Show All Features

18. Switch to the main QGIS window. You will see the selected contour line highlighted in yellow. This is the area of the highest elevation in our dataset.



19. Now let us create a hillshade map from the raster. Select Raster ▶ Analysis ▶ DEM (Terrain Models).



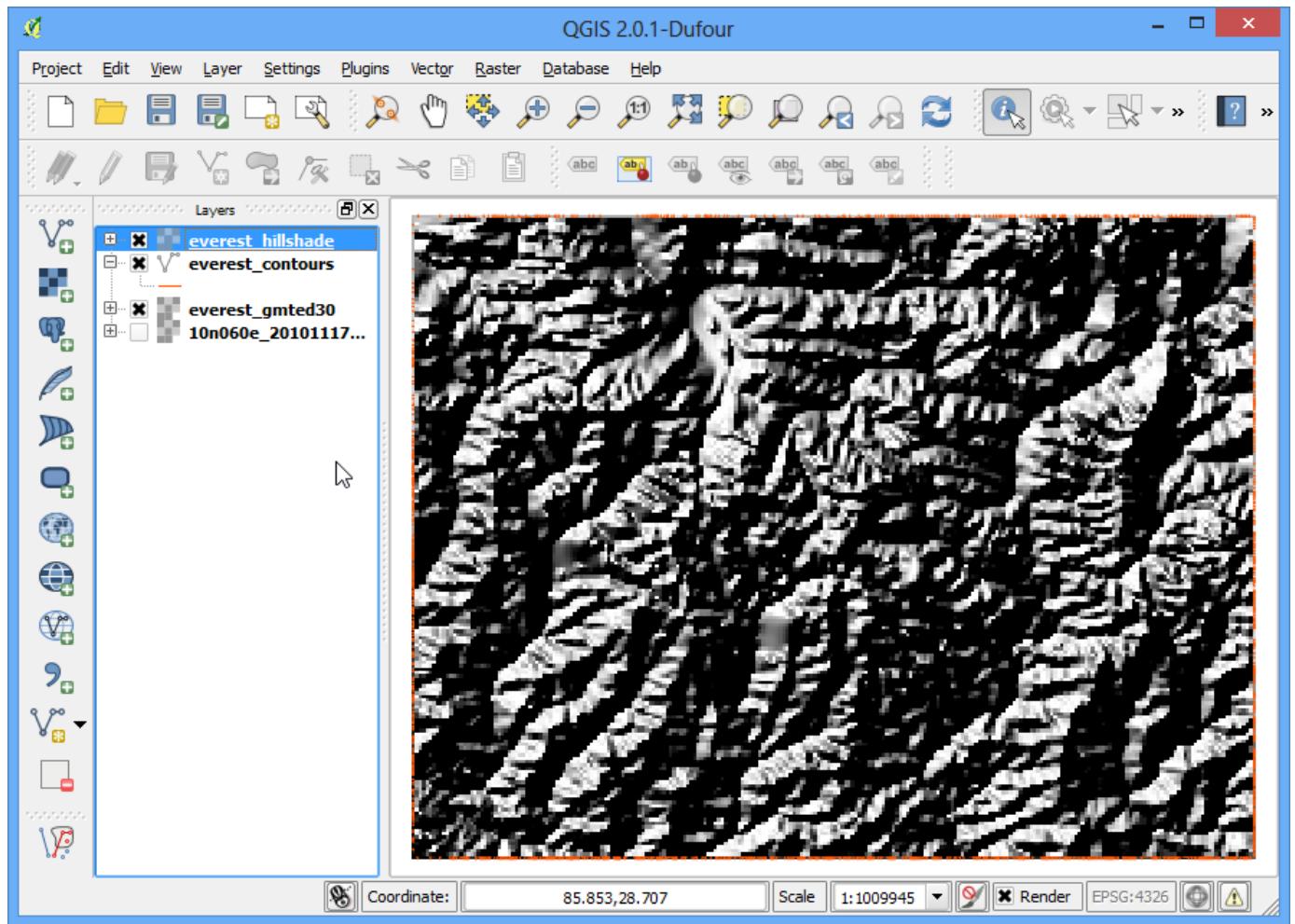
20. In the DEM (Terrain Models) dialog, choose `everest_gmted30` as the Input file. Name the Output file as `everest_hillshade.tif`. Choose Hillshade as the Mode. Leave all other options as is. Make sure the Load into canvas when finished option is checked, and click OK.



21. Once the process finishes, you will see yet another raster loaded into QGIS canvas. Since you maybe zoomed-in near the Mt.Everest region, right click on the *everest\_hillshade* layer and choose Zoom to Layer Extent.



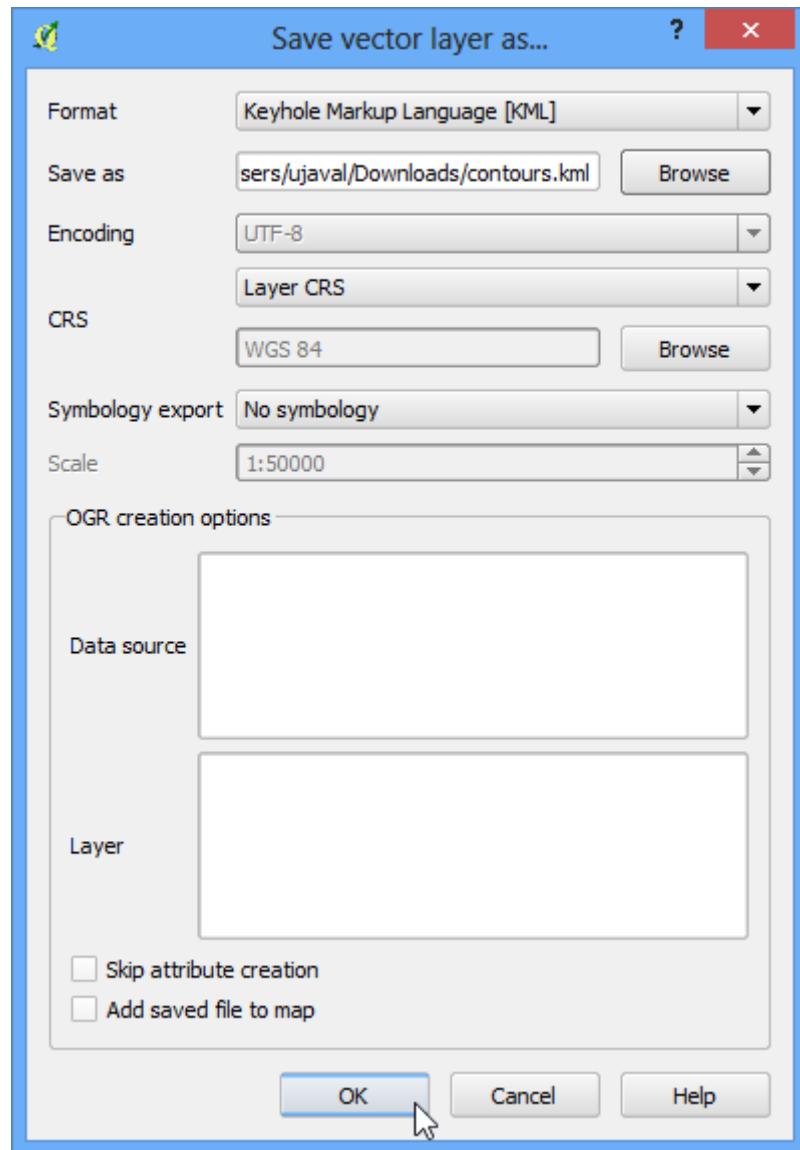
22. Now you will see the full extent of the hillshade raster.



23. You can also visualize your contour layer and verify your analysis by exporting the contours layer as KML and viewing it in Google Earth. Right click on the contours layer, select Save as...



24. Select Keyhole Markup Language [KML] as the Format. Name your output as *contours.kml* and click OK.



25. Browse to the output file on your disk and double-click on it to open Google Earth.

