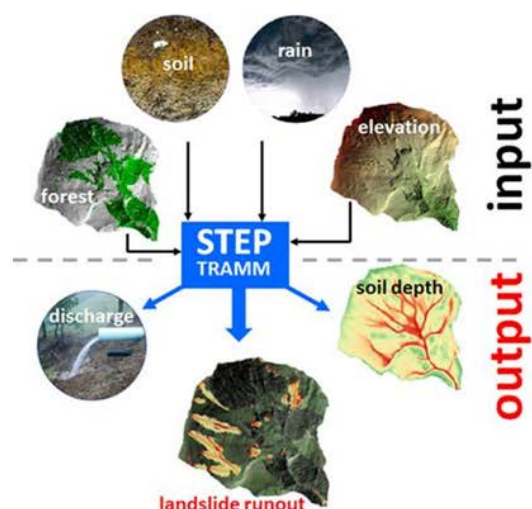




**Elevation  
maps  
DEM**

## STEP TRAMM

**Landslide and debris  
runout simulation**



**Download elevation model      page 2**

**Re-Project DEM coordinates      page 5**

**Cut region of interest      page 10**

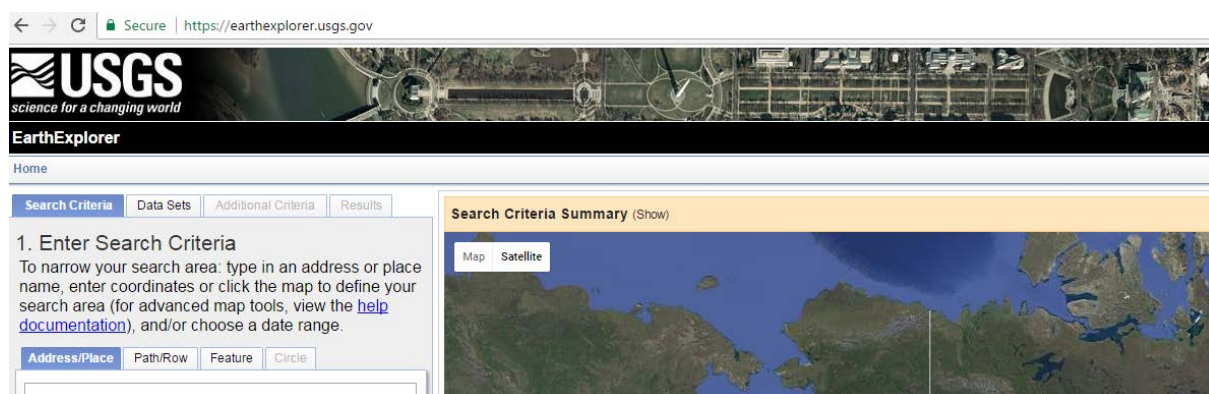
**Version June 2017, Dr. Jonas von Rütte, Dr. Peter Lehmann**

## Download elevation model for region of interest: STEP by STEP

As basic input for landslide simulations you need **elevation data** of your region of interest. This tutorial will guide you how to search and retrieve digital elevation model (DEM) and prepare the required input data files for the STEP TRAMM landslide modeling software. There are three main parts:

- (1) Downloading the elevation model (you can only download data that are much larger than your region of interest)
- (2) Re-projecting the coordinates of the DEM to the appropriate coordinate system (using QGIS)
- (3) Cutting the region of interest (using QGIS and GoogleEarth)

### PART 1: Download elevation data from USGS data repository: “EarthExplorer”



#### STEP 0: Register for free access (only for first application)

In order to access and download digital elevation models from the webpage <https://earthexplorer.usgs.gov/> you will have to create a user account. The USGS provides an entire catalog of remote sensed data from satellite imagery, land cover and elevation datasets SRTM and ASTER, which most of them are freely available. If you need help with the registration use the following link for guidance:

[https://lta.cr.usgs.gov/sites/default/files/ERS%20-%20Help%20Doc\\_clean.pdf](https://lta.cr.usgs.gov/sites/default/files/ERS%20-%20Help%20Doc_clean.pdf)

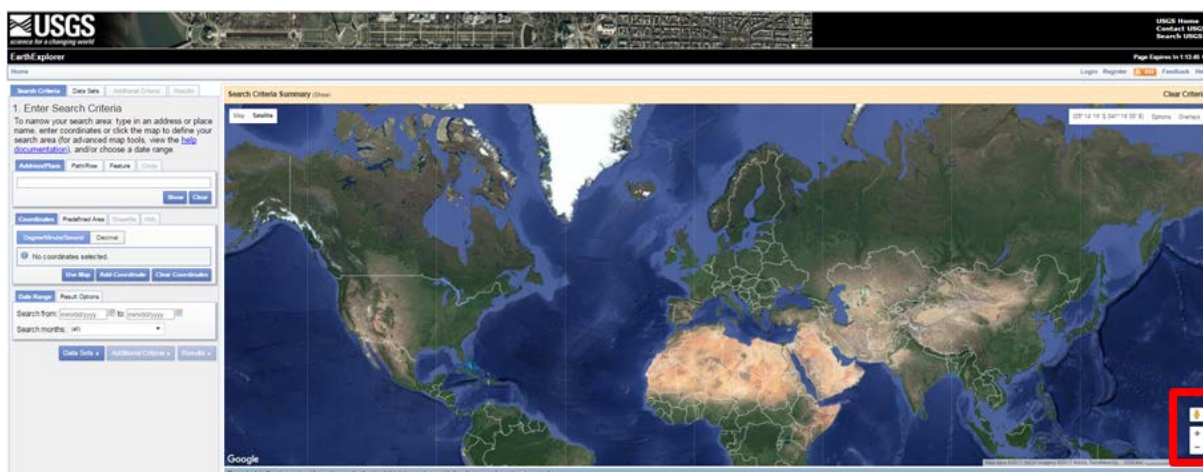
After registration you will be able to download the DEM of your study area. In a first step you will navigate with the map to your study area as explained next.

#### STEP 1: Find the correct DEM to download from USGS

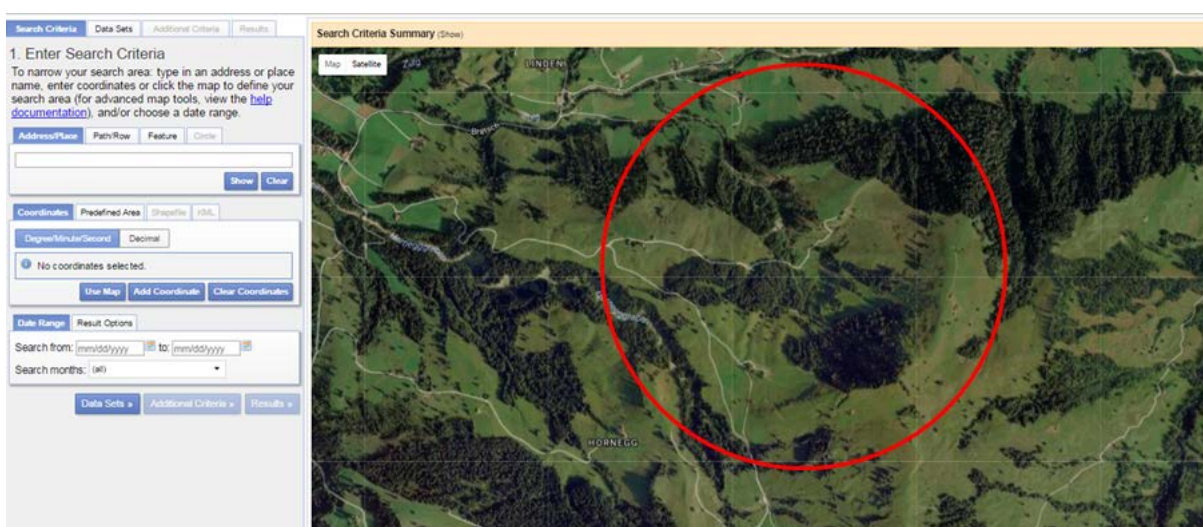
From “EarthExplorer” you can only download DEM’s of regions that are much larger than the region of interest. So you have to find out to which “piece” your region belongs to.

For this tutorial, we assume that we want to find a region in Switzerland called “Eriz” where landslide inventories were collected in 2007.

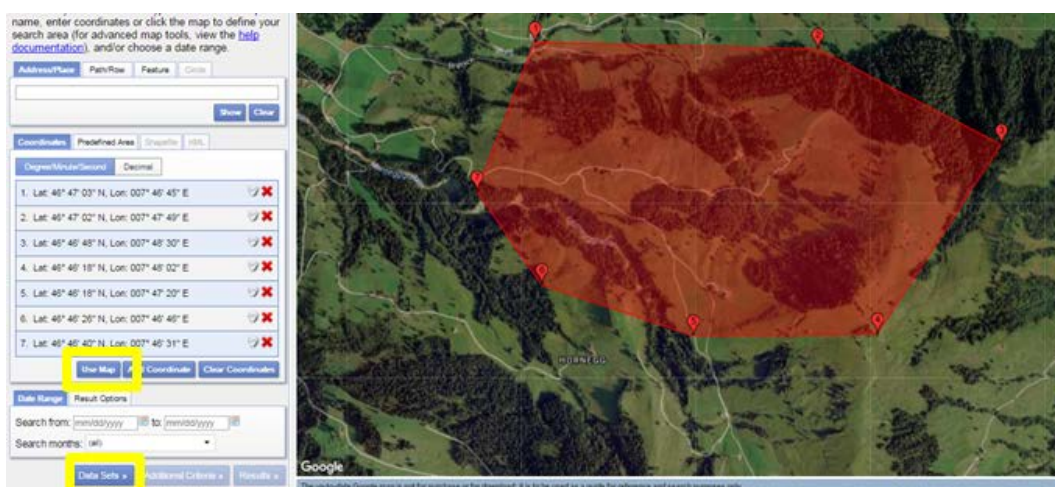
Open <https://earthexplorer.usgs.gov/> (don’t use “Internet Explorer”). To find your “piece” that contains the region of interest: (i) shift the world map by moving the cursor on the map while pressing on the left of your mouse and (ii) enlarge the region using the “+” button in the corner highlighted in the following figure in red.



Shift and enlarge until you see your region of interest (shown below with red circle)



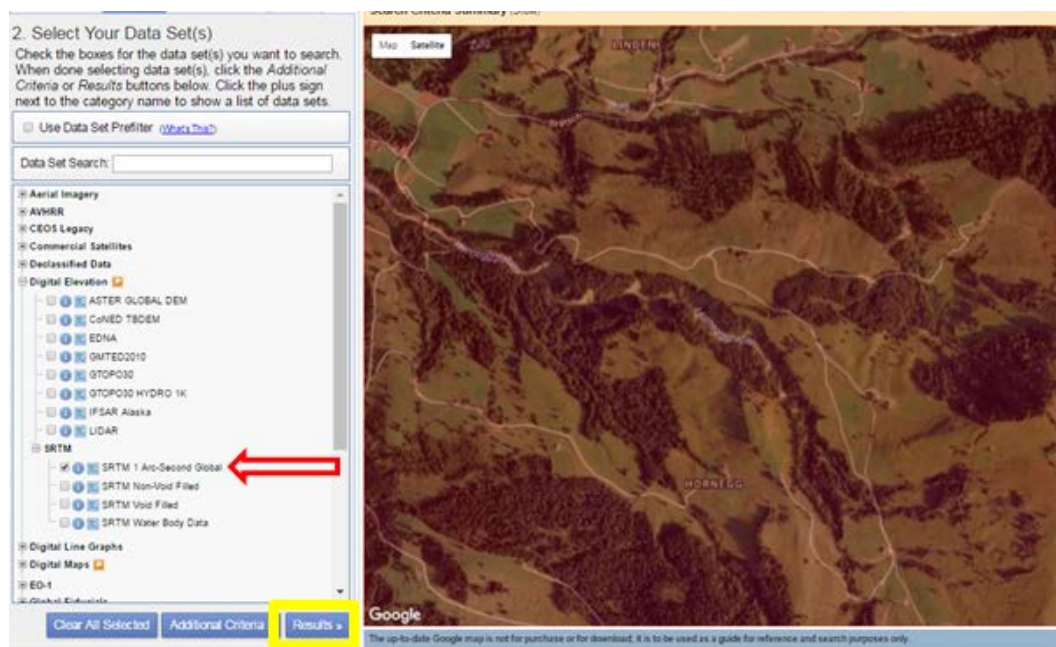
Mark a polygon around your region by clicking in the map point by point (the coordinates of each click are written down on the left); click on "Use Map" and then "Data sets" (yellow rectangles in Figure below)



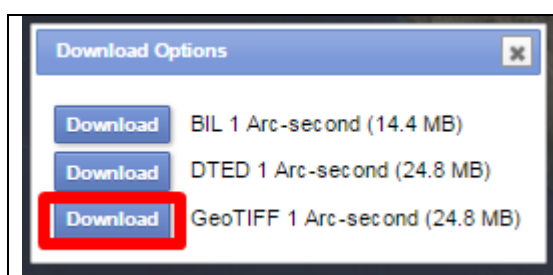
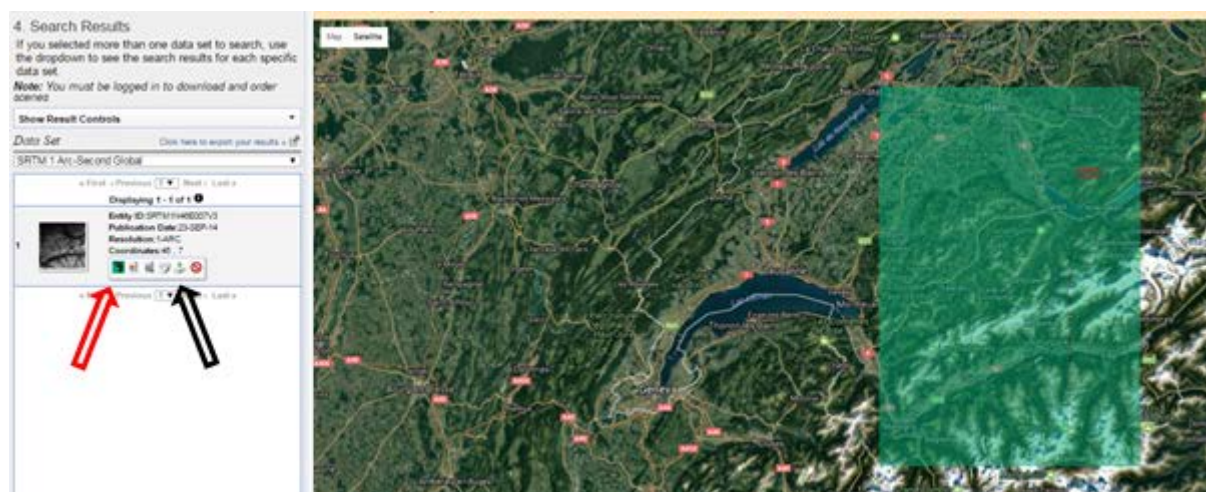


## STEP 2: Download the DEM

On the left a new menu appears (see figure below). Open the “Digital Elevation” (by clicking on “+” next to it). Click in the box “SRTM 1 Arc-Second Global” (highlighted with red arrow; corresponds to a spatial resolution of about 30 m) and then click “Results” (yellow box in Figure below). Note that an alternative source of DEM is the “ASTER GLOBAL DEM”.



On the left new menu appear. Click on the “Show footprint” icon with the little foot (highlighted below with red arrow) and in green the “large piece” to be downloaded that contains your region of interest is shown. Click on “Download Options” icon (highlighted with black arrow)



A window pops up and asks you to specify data format. Click on “GeoTIFF” (marked here in red). The DEM will be downloaded and be put in the “Downloads” folder of your computer. Move it (and rename it; here “testEriz.tif”) into a new folder of your choice (here called “GetDEM”) to work with the file.

## PART 2: Project the DEM to appropriate coordinate system with QGIS

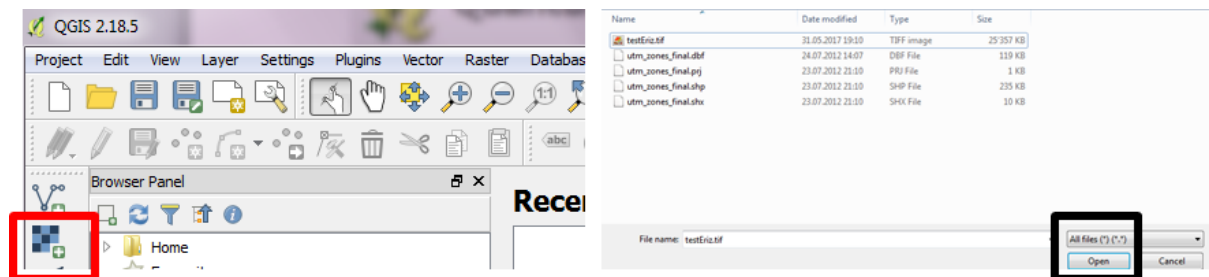


In this section we will guide you to re-project the elevation data in appropriate coordinate system using the open source GIS software QGIS which can be downloaded from their webpage:

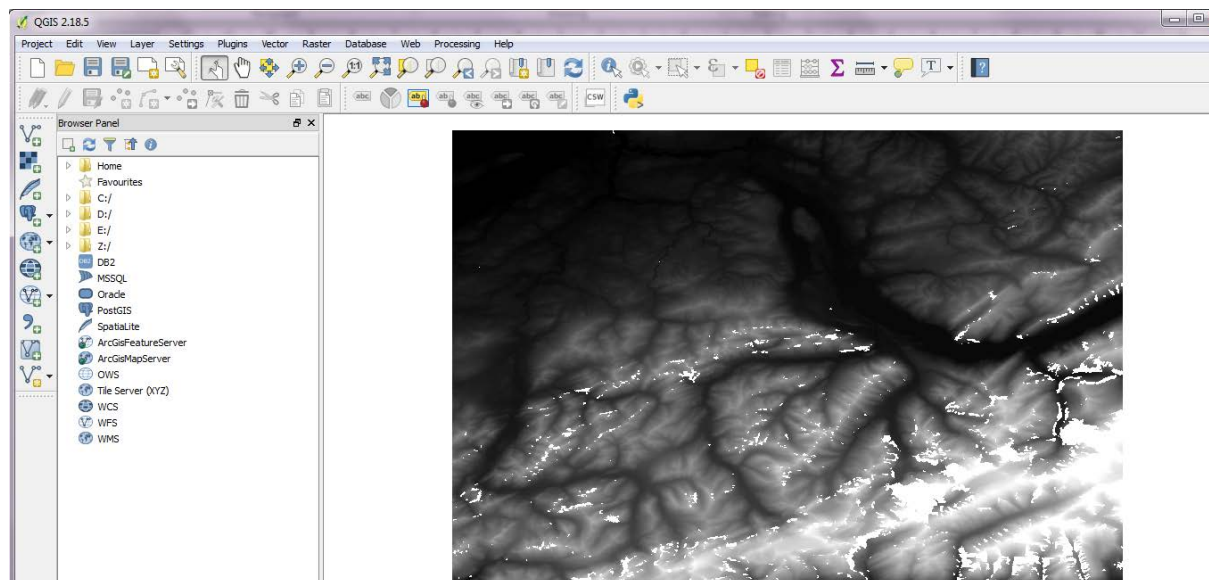
<http://www.qgis.org/en/site/>

### STEP 3: Load GeoTIFF file downloaded from EarthExplorer

After completing “Part 1” using “EarthExplorer” we generated a file called “testEriz.tif” and put it in a folder called “GetDEM”. Now Open QGIS and load the GeoTIFF file by clicking on the button “Add Raster Layer” (see red rectangle at the left in figure below); in the new window choose your GeoTIFF file and click “Open” (black rectangle).

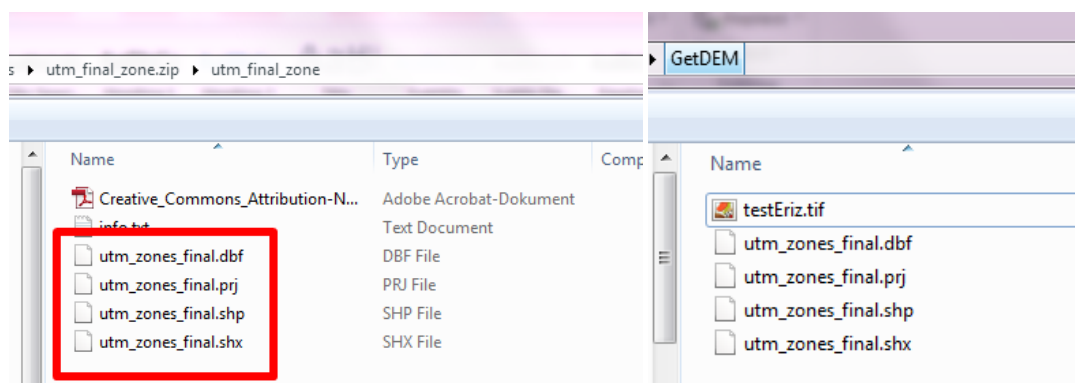


In a new large window the downloaded DEM is shown (see below)

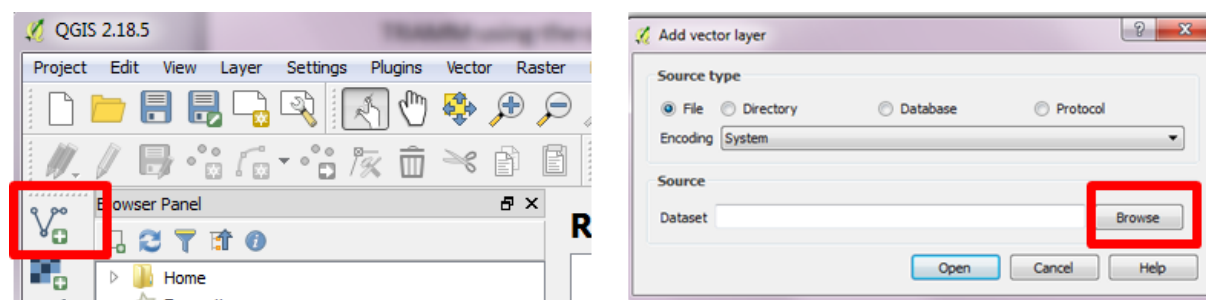


#### STEP 4: Determine the zone of your region of interest within the geographic coordinate system WGS 84 UTM

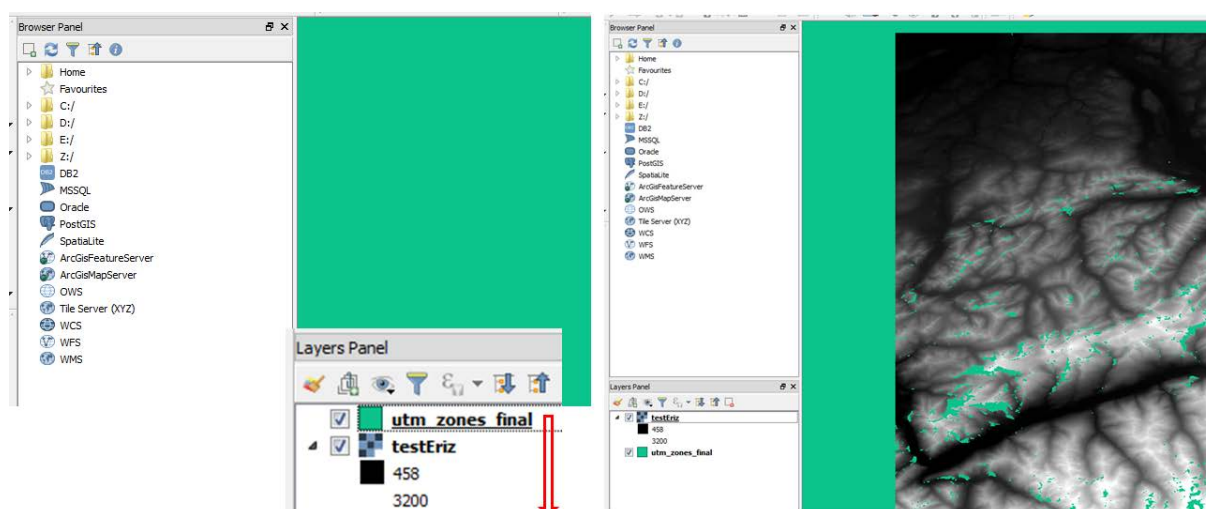
You need to know in which zone of the WGS 84 UTM coordinate system your study area is located. This can be done by searching in the internet (UTM zones map, <https://upload.wikimedia.org/wikipedia/commons/e/ed/Utm-zones.jpg>). Another option is to copy the four files located in the tutorial folder we sent you (marked below in red) and put them in the same folder where you have the GeoTIFF file from the last step (here the folder is denoted GetDEM and the GeoTIFF file is named “testEriz.tif”).



In QGIS click on the icon “Add Vector layer” (red rectangle on left figure below) and “Browse” for the file “utm\_zones\_final.shp” in the new window.

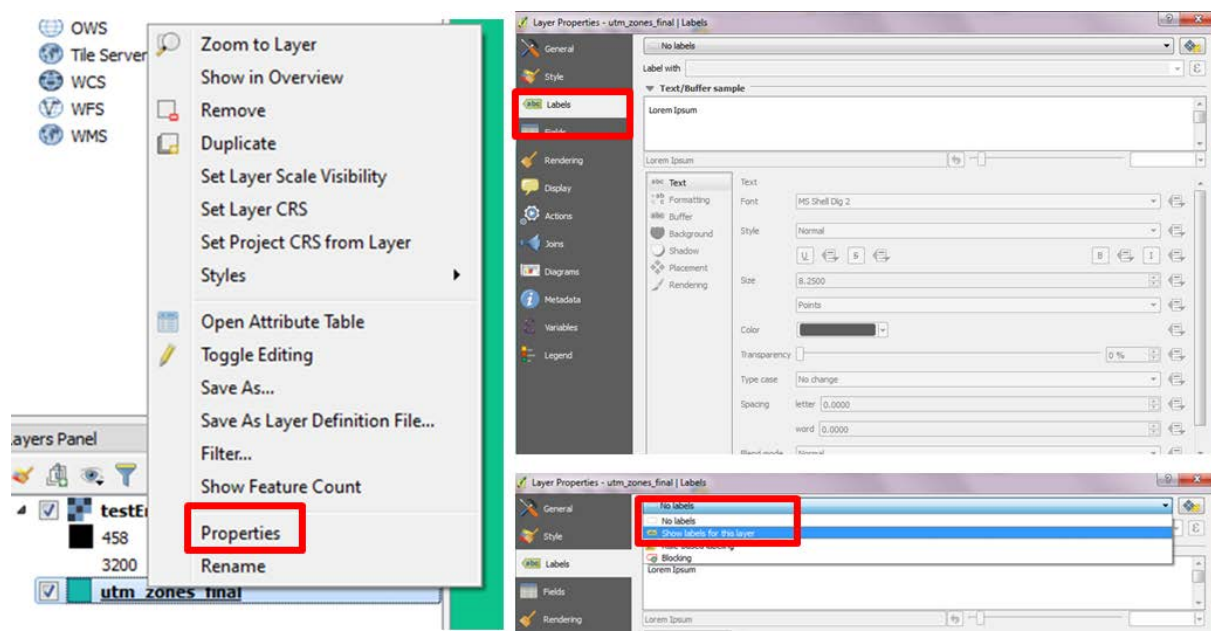


Then you will see a colored area in the main window (here shown in green); by moving the “utm\_zones\_final” layer below the DEM layer (here denoted as “testEriz”) the green area is shown in the back (see right figure below)

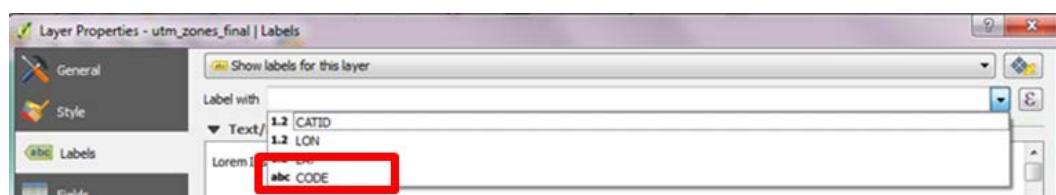




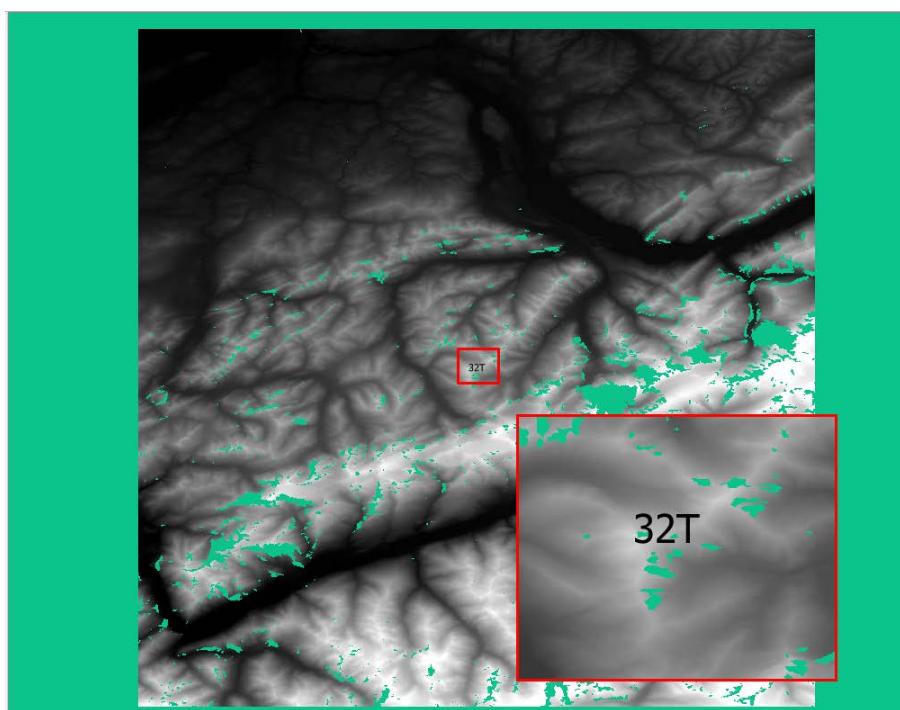
After loading the shapefile “utm\_zones\_final” make a right-click on its name (see below) and select “Properties”; in the new window (see figure below) select “Labels” and then select “Show labels for this layer” on the drop down list at the top of the window (see red rectangle in Figure below).



In the field “Label with” select the variable “CODE” and click “Open” at the bottom.

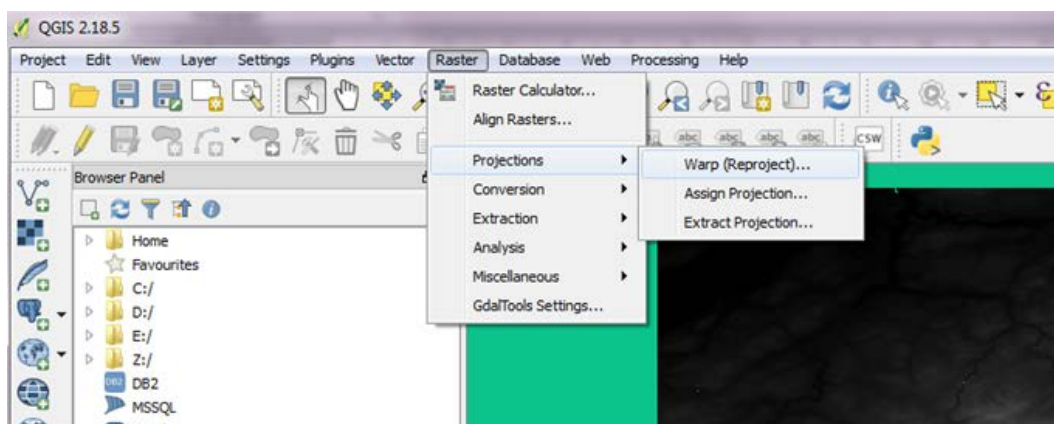


Now, within the main window, the number of the UTM zone (here 32T) is written. So it is known that the region belongs to the WGS 84 UTM 32 zone (the letter after the number is not relevant).



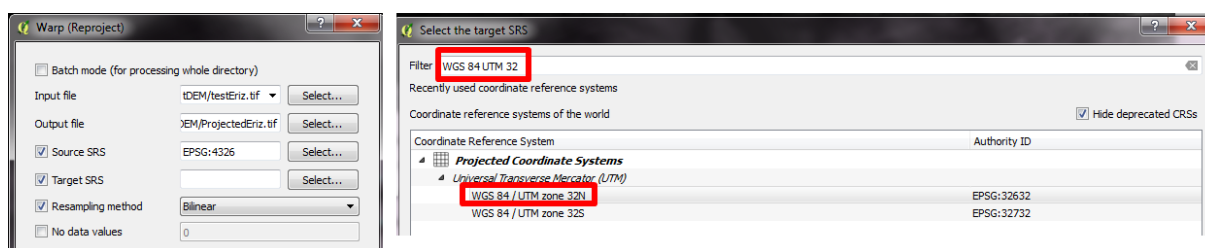
## STEP 5: Re-project the DEM to coordinate system WGS 84 UTM

To re-project the DEM coordinates to a convenient coordinate system, you need to use the tool “Warp (Re-project)” in the menu path “Raster” → “Projections” → “Warp” (see Figure below).



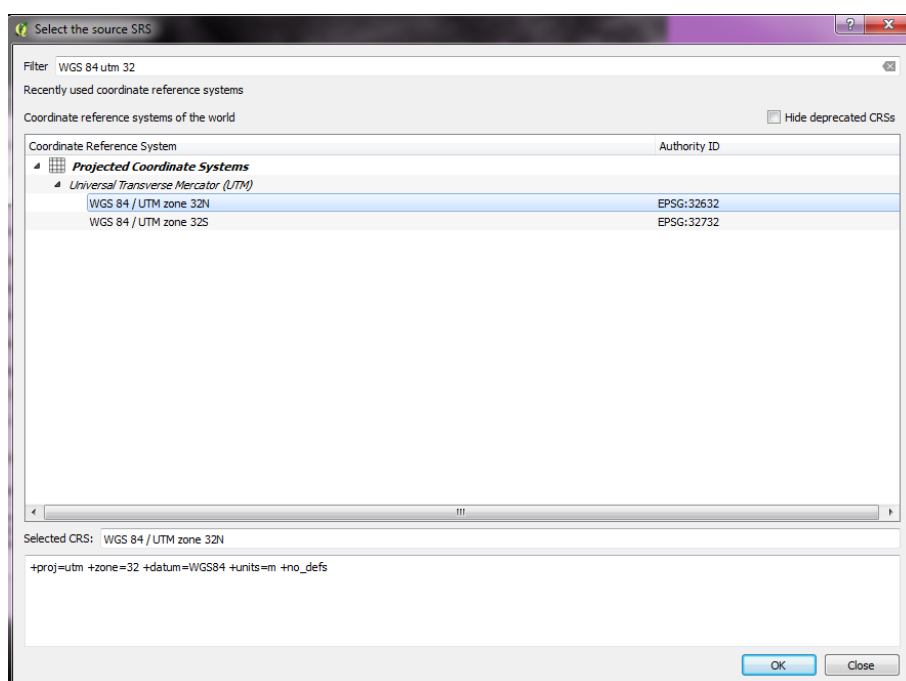
A new window “Warp (Reproject)” appears (see left figure below). Proceed as follows:

- Select the correct “Input file” (here called “testEriz.tif”)
- for the “Output file” select the same path as the input file (here “ProjectedEriz.tif”);
- for “Resampling method” choose “Bilinear”.
- specify the coordinate system you want to choose:
  - Click in the box “Target SRS” and click “Select” button next to it and a new window opens (see figure at the right)
  - In the “Filter” field write the coordinate system you want (determined as 32T in the previous step), here it is “WGS 84 UTM 32”
  - In the field “Coordinate Reference System” two options are shown (32N and 32S) and you must click on one of those (here 32N is chosen; as stated above, the letter (N or S) is not relevant).

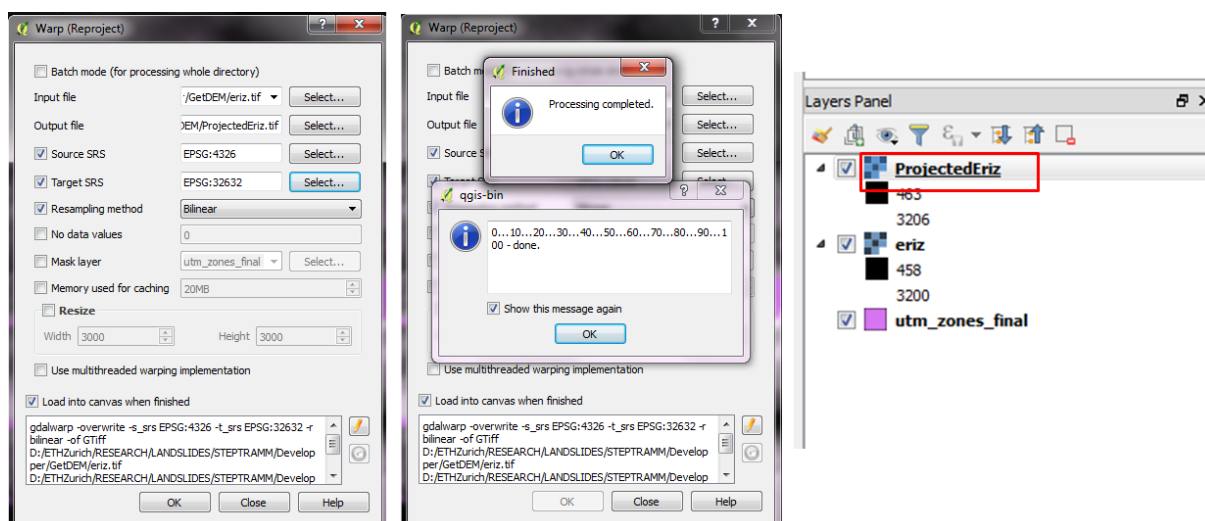




Then click “Ok” at the bottom.



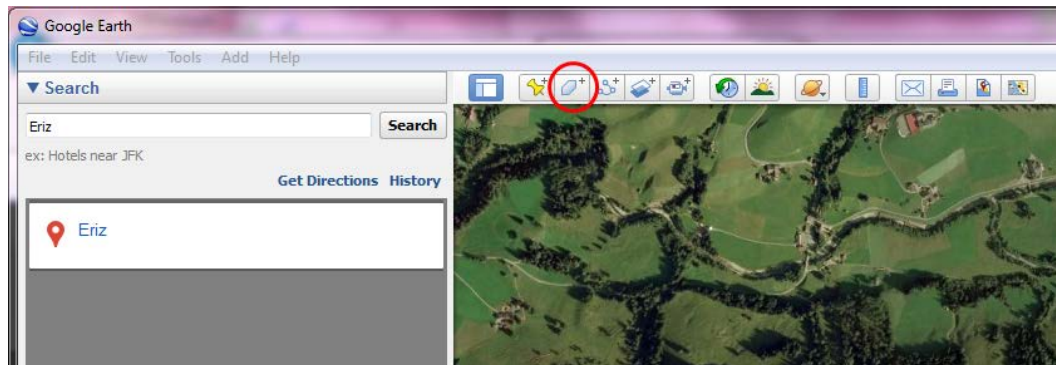
Now click “Ok” in the “Wrap” window (see below), click again “Ok” in the two new windows and then “Close” the “Wrap” window. In the main window the new layer “ProjectedEriz” is now shown as well.



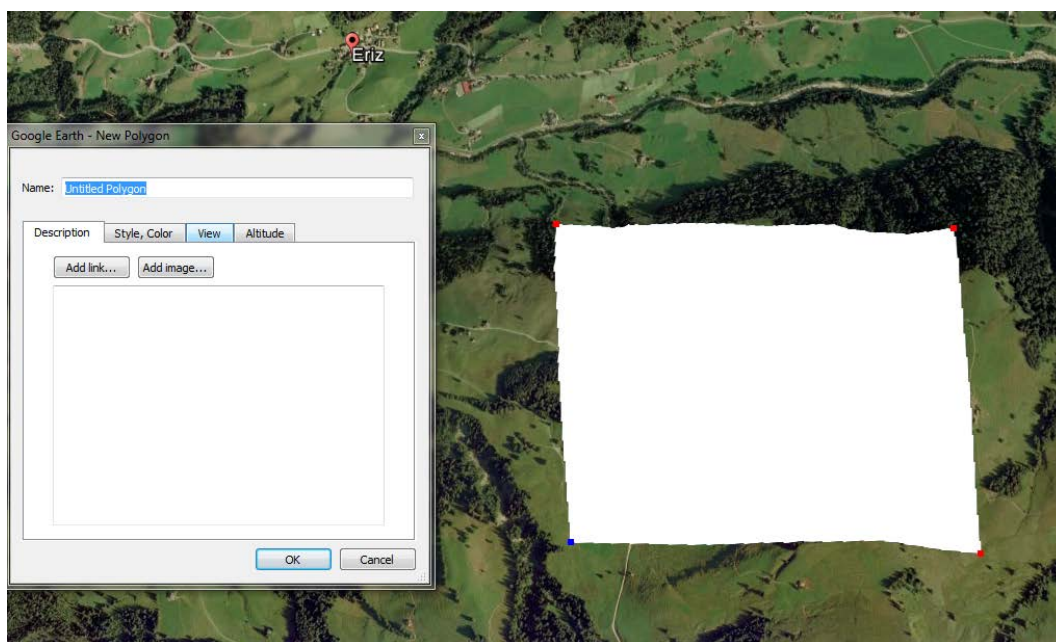
## PART 3: Cut the DEM using QGIS

### STEP 6: Mark study area in Google Earth

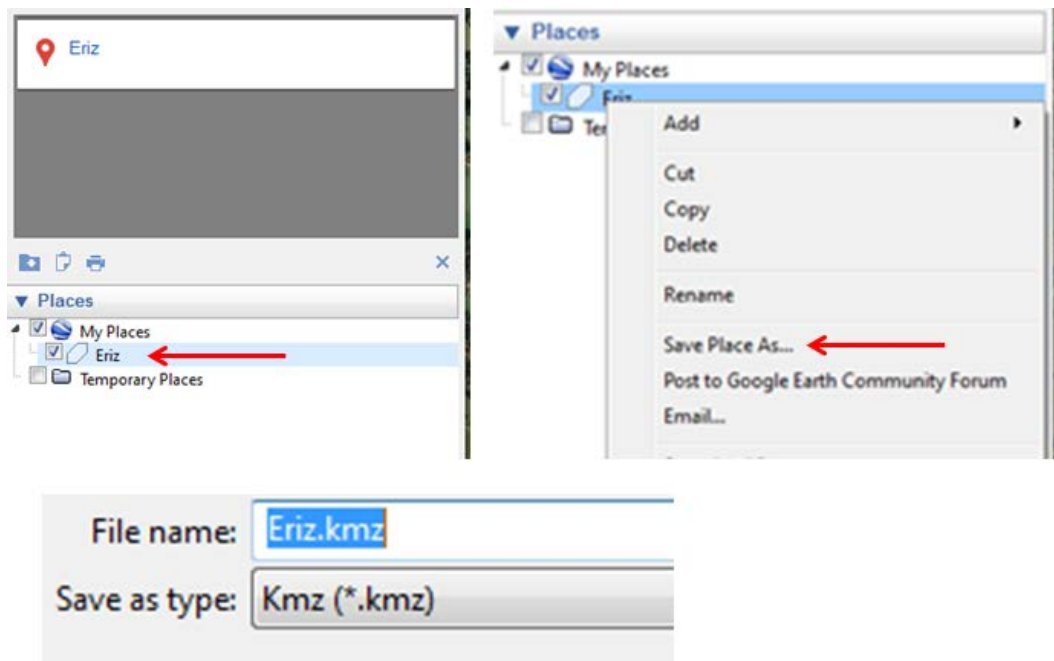
To choose the region of interest (here it is “Eriz”), open “Google Earth”, zoom into the study area, and click on “Add polygon” icon (see red circle below)



A new window (“New Polygon”) opens. Mark four edges of a polygon that contains the region of interest (the polygon becomes white) and click “Ok”.

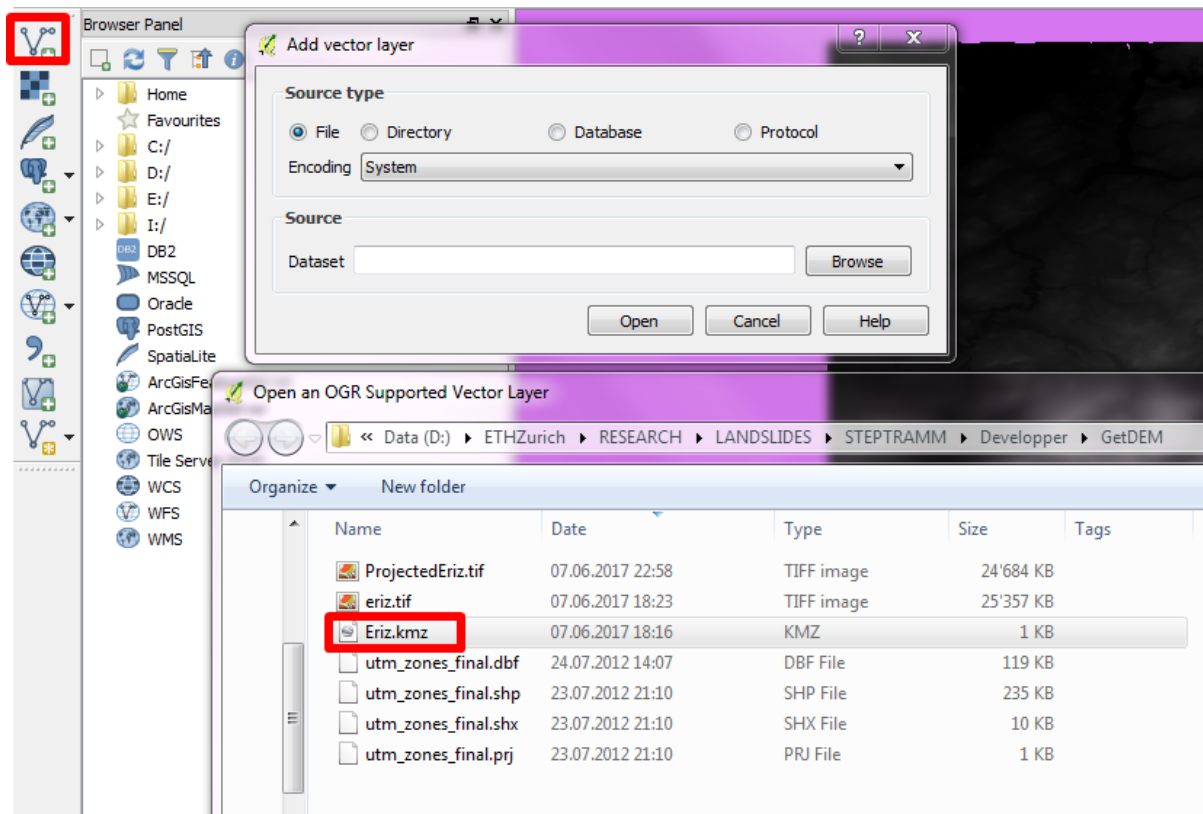


Now the polygon icon (“Eriz”) appears on the left side (see left figure below); right-click on that polygon (a new window appears) and save it in the same folder with the tif files (here in the folder “GetDEM” containing the file “eriz.tif”); here we chose filename “eriz.kmz”.



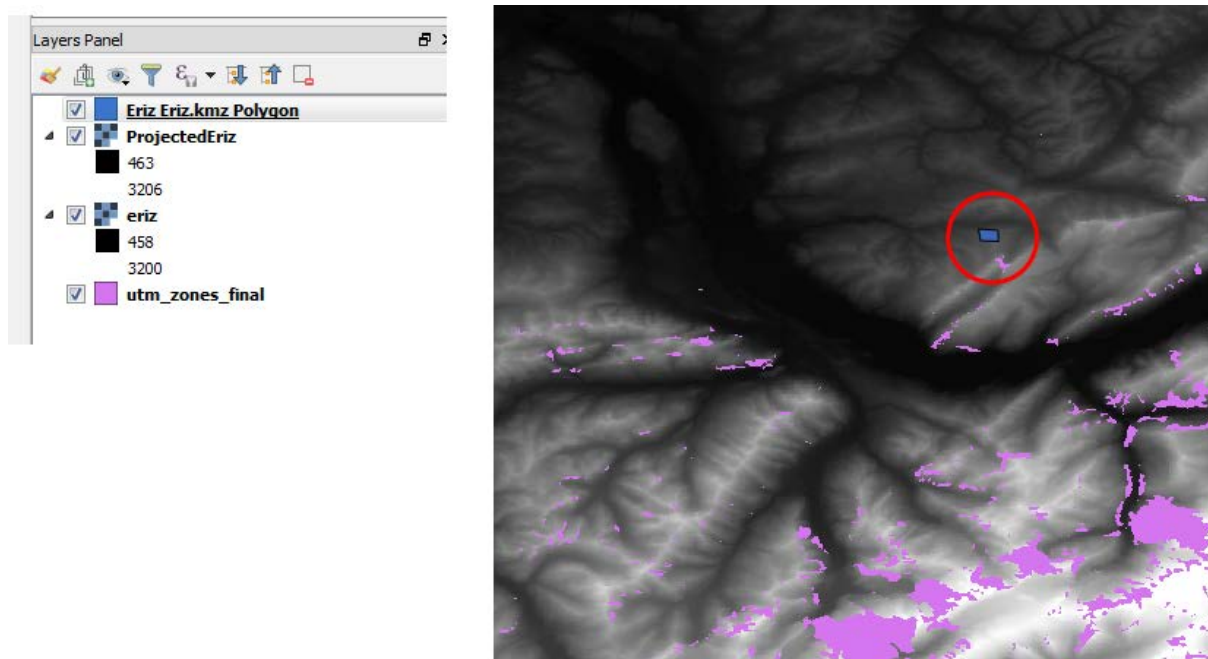
### STEP 7: Implement study area into QGIS project

To implement the polygon from Google Earth into QGIS, click on “Add vector layer” icon (see red rectangle below), “Browse” the “kmz” file and click open.



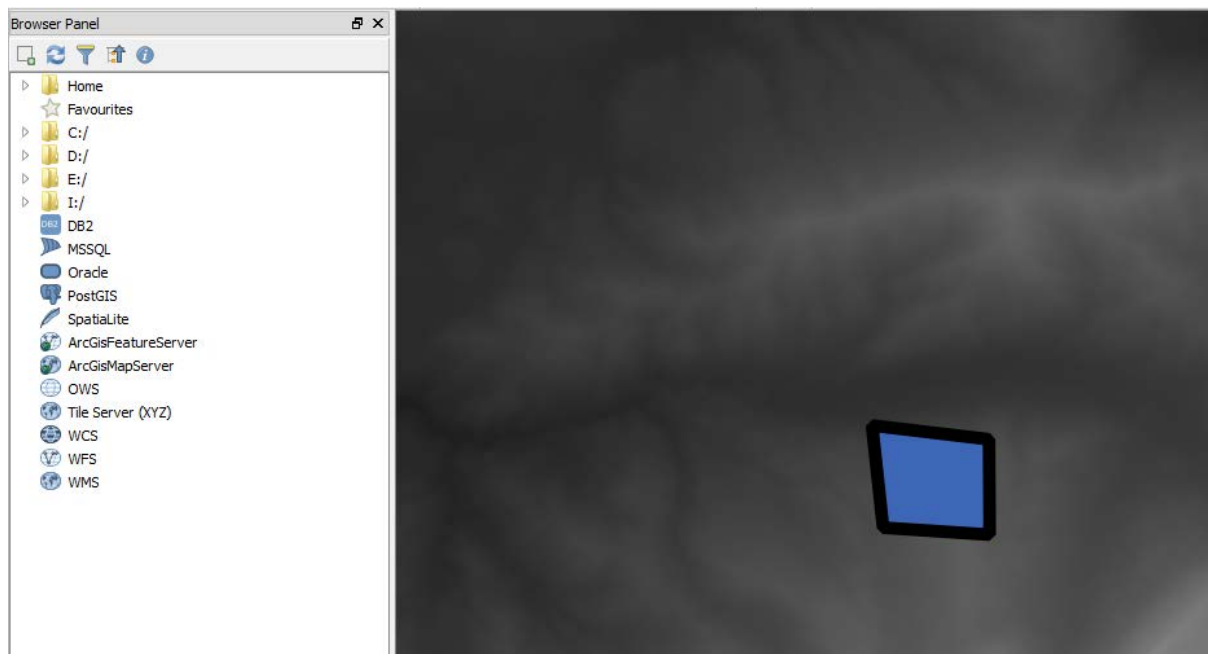


The “kmz” layer appears in the Layer Panel; make sure that it is on top of the other layers. The polygon is now shown (here highlighted with red circle)

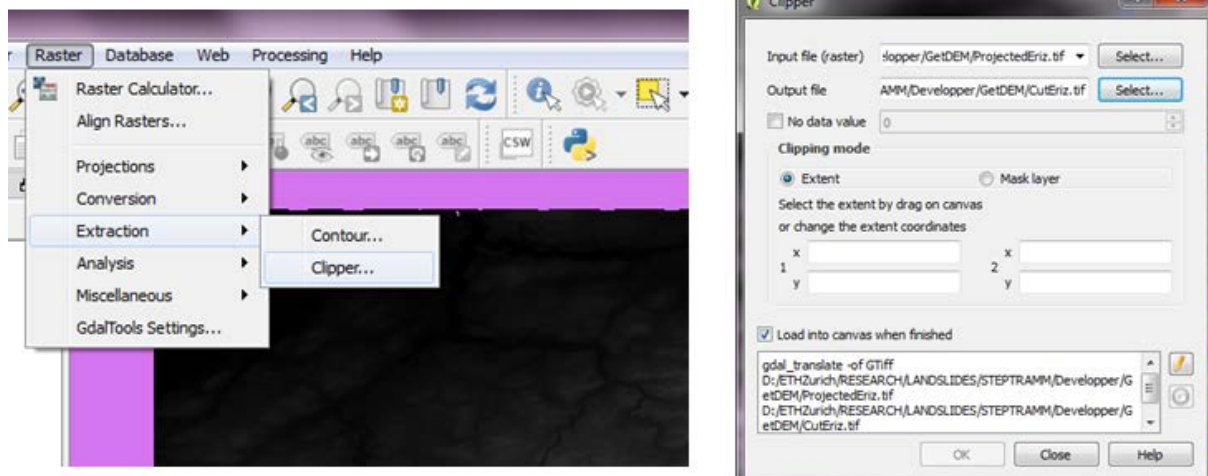


### STEP 8: Cut your region of interest

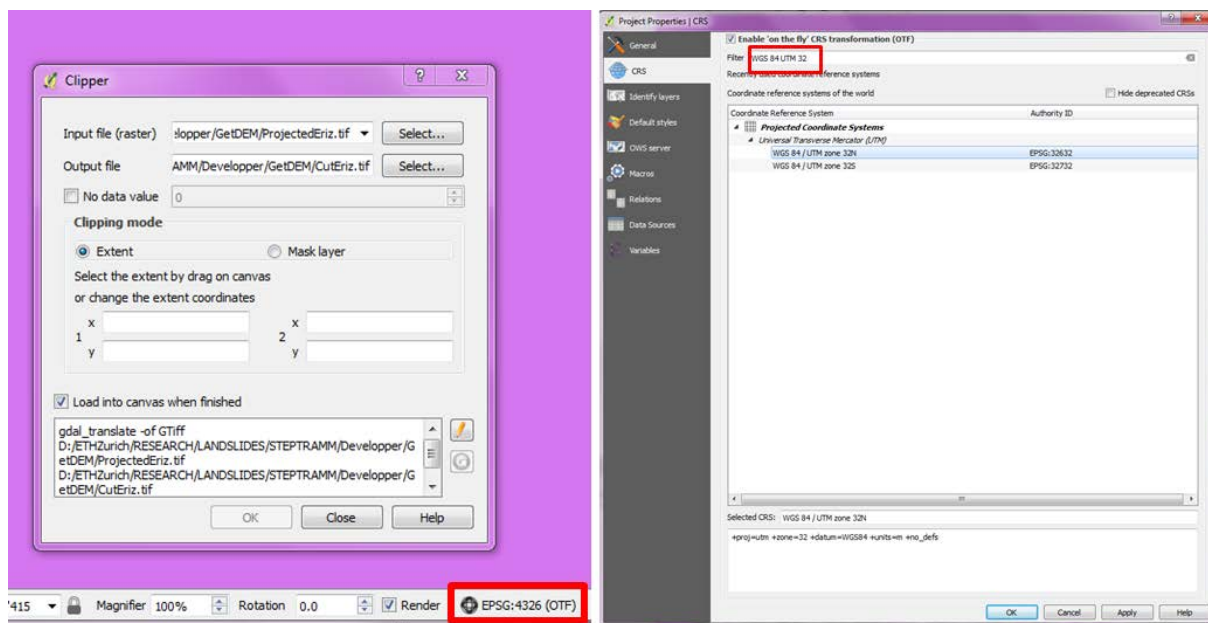
Increase the resolution of the main window (click in “Magnifier” menu shown at the bottom and change from 100% to 1000%) so that your region of interest is in the middle of main window



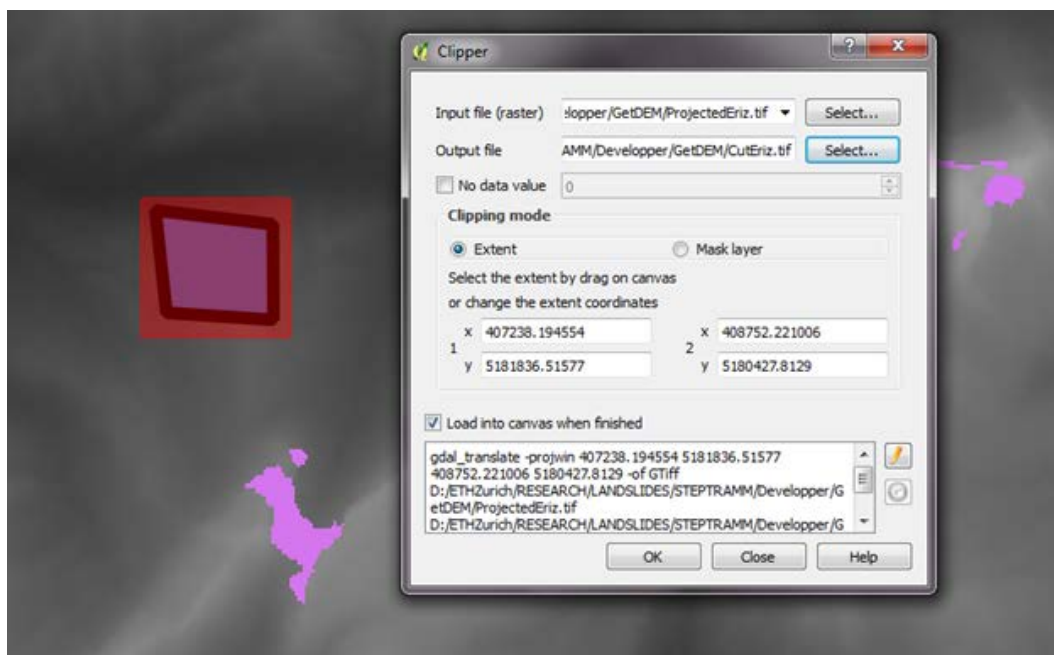
To cut the region of interest, go to menu “Raster”, choose “Extraction” and then “Clipper” (see figure on next page). A new window appears. “Select” the Input file you generated before (“ProjectedEriz.tif”) and “Select” the same folder and assign an “Output file” name (here “CutEriz.tif”).



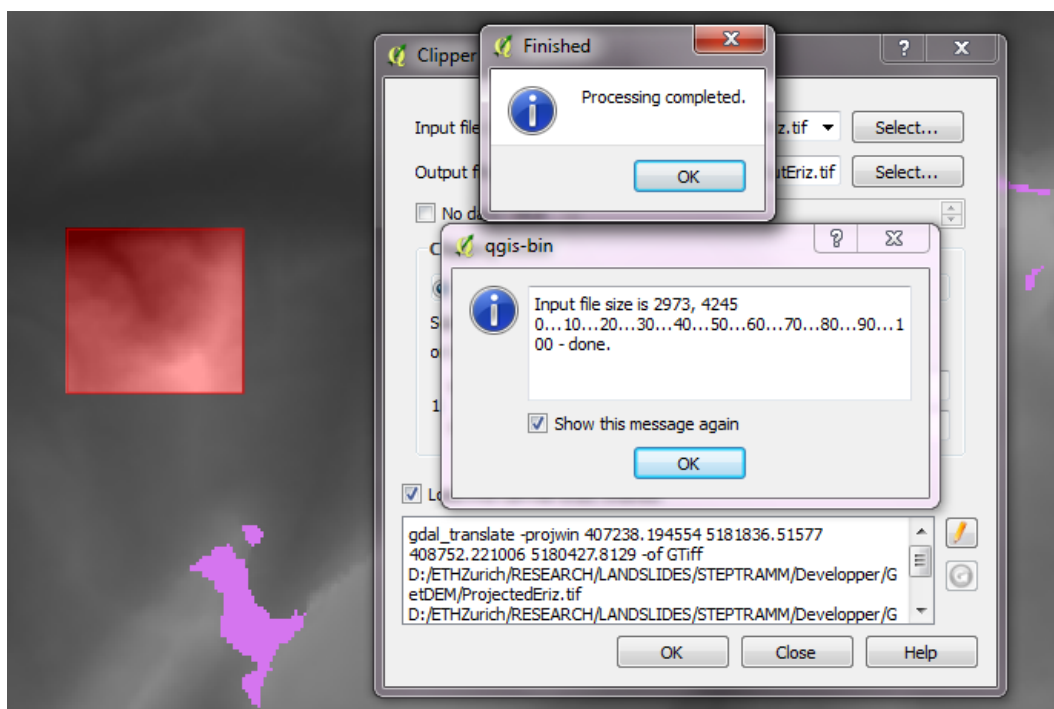
Next we have to ensure that we are in the correct coordinate system. Click on the field in the low right corner of the main window (highlighted by red rectangle in left figure below) so that a window “Project Properties” appears. As before write the name of your coordinate system in the field “Filter” (here it is WGS 84 UTM 32”), choose the correct system (here 32N or 32S) and click “OK”.



Now mark a region that is slightly larger than the region of interest by marking left upper corner and moving the cursor to right lower corner (see figure).



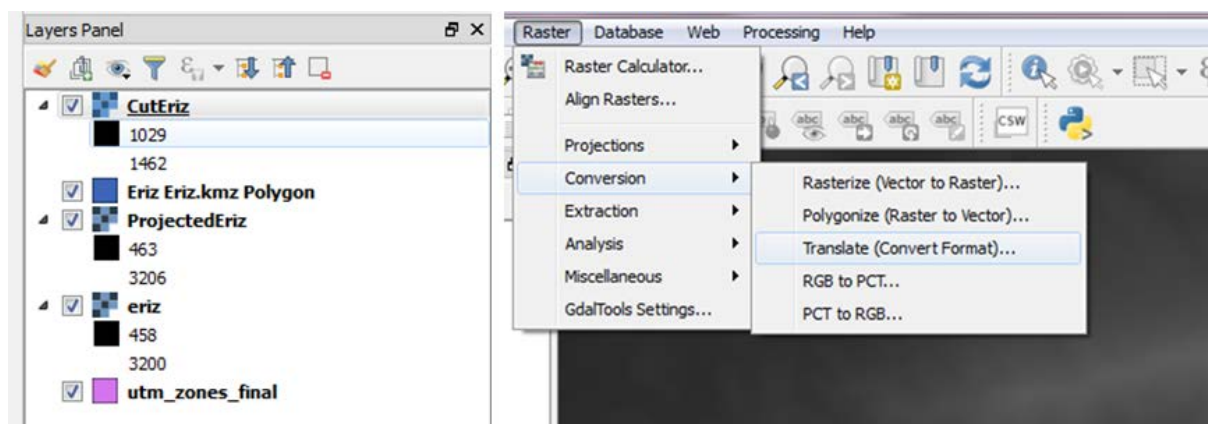
Now click “Ok” and then confirm “Ok” in the two new windows, then click “Close”.



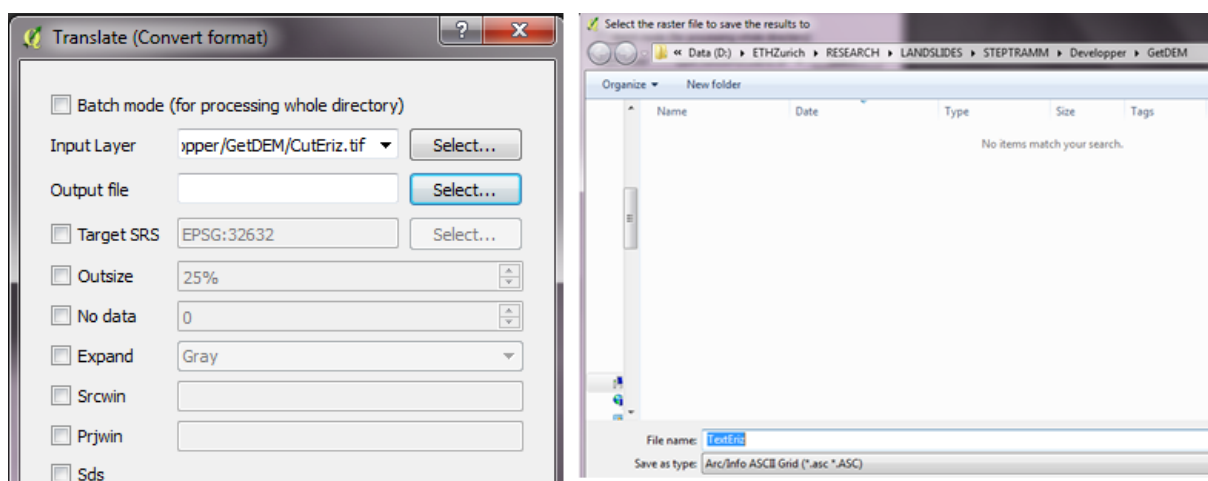


### STEP 9: Transfer from GeoTIFF to text format

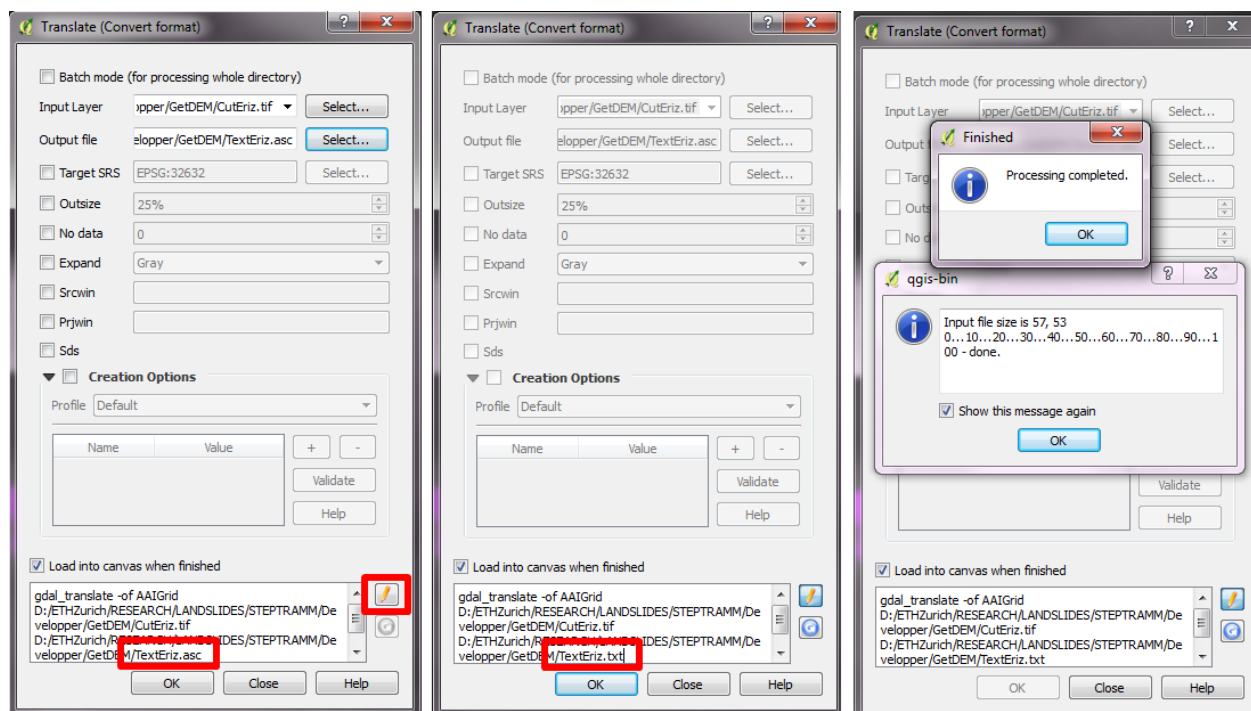
The new file ("CutEriz") is now shown in the "Layers panel". Now go to menu "Raster", choose "Conversion" and then "Translate (Convert Format)"



As "Input Layer" "Select" the cut file ("CutEriz.tif"), for "Output File" click "Select" and choose the same folder as Input Layer, specify a name (here "TextEriz") and choose option "Arc/Info ASCII Grid" for "Save as Type" and click "Save".



Next, back in the “Translate” window, you must click on the “Pencil” icon (red rectangle in the figure below on the left) and change file type from “asc” to “txt”. Then click “Ok” and confirm by clicking “Ok” in the two new windows, next click on “Close”. Now the asci file was generated.



Now a text file was generated as shown below that can be used as input file in STEP TRAMM.

```
ncols      57
nrows      53
xllcorner  407226.081141438100
yllcorner  5180434.400208327900
cellsize   26.527465386301
NODATA_value -32767
994 994 994 997 999 999 1000 1004 1008 1013 1016 1015 1015 1017 1017
1014 1018 1025 1028 1030 1036 1044 1050 1049 1060 1060 1060 1061 1063
1065 1069 1075 1081 1083 1085 1085 1083 1082 1083 1084 1086 1089 1092
1096 1104 1111 1113 1118 1128 1136 1142 1150 1154 1155 1155 1153 1148
1001 998 998 1000 1002 1002 1002 1004 1010 1016 1020 1021 1021 1023 1028
1029 1032 1038 1040 1040 1052 1061 1064 1064 1068 1068 1072 1077 1078
1082 1085 1090 1096 1099 1100 1099 1098 1096 1096 1098 1100 1101 1103
1110 1121 1128 1132 1140 1147 1155 1160 1166 1168 1168 1168 1168 1165
1006 1003 1003 1006 1009 1010 1009 1011 1019 1026 1029 1028 1029 1031
1036 1041 1048 1053 1058 1058 1070 1074 1077 1079 1083 1086 1090 1095
1096 1100 1104 1106 1111 1113 1113 1114 1114 1116 1117 1115 1115 1115
```