## Assignment 1: Characteristics of raster data

This assignment is designed to question your understanding of the basic properties and characteristics of raster data as laid out in the lecture presentation. Remember to set your workspace to the P:// drive for saving your work. You may answer in this document, insert the maps and email it to me when it is done.

### Question 1

Open ASTGTMLUX.tif and look at the Properties:

a) What is the cell size of the data?
b) What is the bit-depth? What does this mean?
c) Would a 100m cell size be a more or less accurate resolution for this data and why?
d) How many pyramid layers does the raster have?

**a) Cell size (X,Y): 25.09731128, 25.09731128**

Cell size generally influences the accuracy of the information within the cell, therefore it is a trade between cell size and processing time.

**b) The "pixel" or "bit-depth" is 16 Bit**

Similar to computing, this represents the range of values stored in the raster pixels, in this case representing a fairly standard moderate range of colors that can be encoded (as opposed to a higher range 32bit). It determines the color richness accessible for display and visualization. We can determine the exact numerical value for this "color richness" with the formula $2^{n\ bits.}$

In the case of ASTGTMLUX.tif the individual pixel bith-depth is $2^{16}$ = 65536 available colors including pure Black for 0, but because the bit integer value is of the Signed type, the range covers negative values as well as positive, which by allocating half of the range to negative values yields -32768 to 32767.
Bit-depth depends on the file format (encoding and compression) output by the imaging instrument, where encoding determines whether it is Unsigned (positive values only, viz. 0 to 65535) or Signed (negative and positive values, viz. -32768 to 32767).

c**) A 100m cell size** would represent a lower resolution and be less accurate than the ~ 25 x ~ 25 cell

d**) The raster has 6 pyramid layers or "levels"**, which improves display performance by retrieving only the best suited display scale chosen. Each successive layer/level is a reduction in the dataset resolution (downsampling to a larger cell) at the scale of 2:1

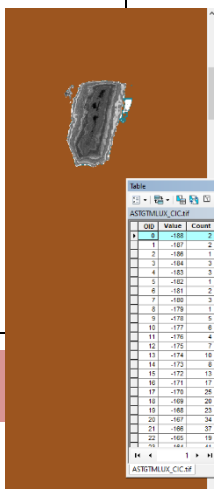
## Question 2

The TIFF raster format has no VAT (attribute table) calculated. In order to create one, export the raster, choosing the GRID format to save it to. Open the attribute table of your new raster.

a) What is the area of the DEM that has negative values?

b) Using a raster base map, can you see the reason for these negative values?

a) The entire ASTGTMLUX.tif DEM has about 529 km$^2$ Area of negative values (calculated by Sum of "Count" with negative "Values" and multiplied by DEM pixel size of 25m.



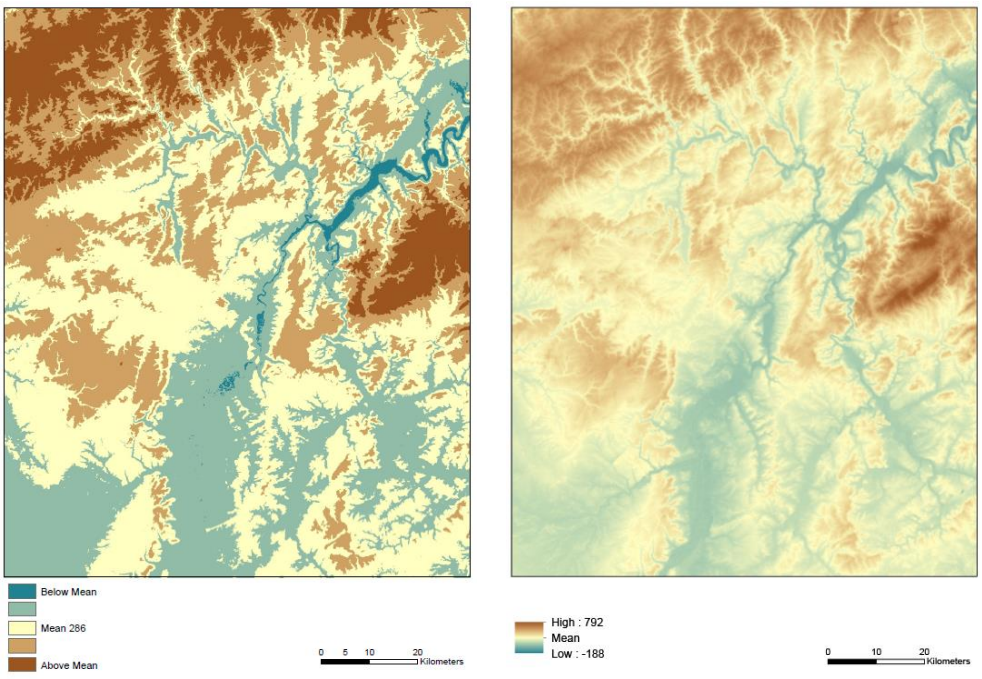
b) The negative values of the TIFF represent the below-sea level (negative) elevations of the terrain. It is interesting that nearly all of the negative area represents the area of the Tagebau Hambach, two large open-pit (lignite) coal mines in Niederzier and Elsdorf, in the North Rhine-Westphalia region of Germany, which is both the deepest open pit mine with respect to sea-level, and the deepest artificially made topographic depression in the region.

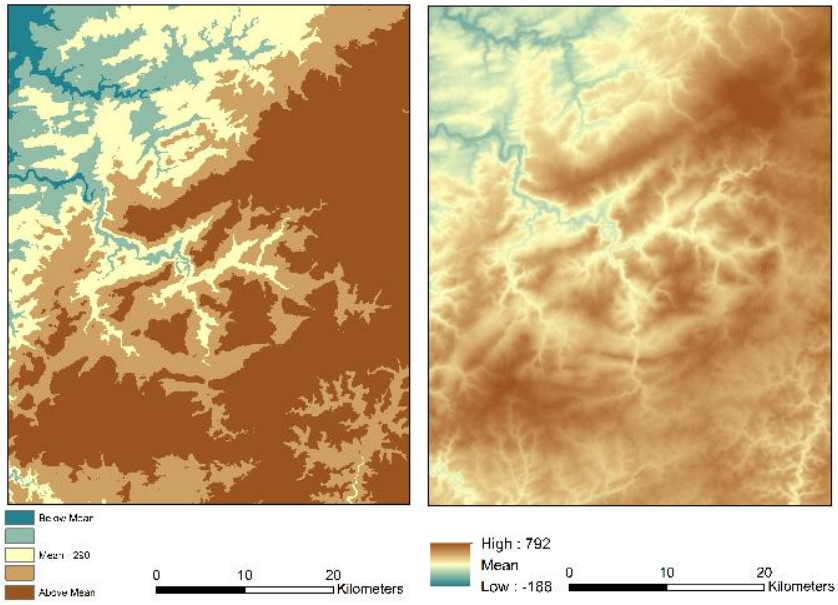
## Question 3

Go to the Symbology and change the rendering from Stretched to Classified. Select the brown to blue colour ramp and invert it.

a) Create a quick, simple map with legends showing the two classification methods side by side, zooming in to a region that emphasises the differences, as shown in the example.
   I. What are the min, mean and max values?
   II. Change the labels to Below Mean, Mean, and Above Mean, using 5 classes.
   III. Copy the layer and paste it into a new data frame. Use the Stretched method of rendering, with the same colour ramp. Visually, what is the main difference between the two rendering methods?

Answers: I. **Min = -188 Mean = 286 Max = 792** **III. Classified** value groupings **are sharply delineated** while **Stretched values smooth over across the color ramp** (different Stretch types available)






## Question 4

Converting vector to raster: Take the Luxembourg.shp layer and using the conversion tool, convert to raster (ArcToolbox→ To Raster→ Polygon to Raster). Select the value field as the field on which the conversion will be based (in this case, it is ObjectID). The cell assignment, in this case, can be any of the options and the cell size should be the same as the DEM (i.e. 25m).

Now we need to use this new raster as a mask for the DEM, as we are only interested in the area covering Luxembourg.

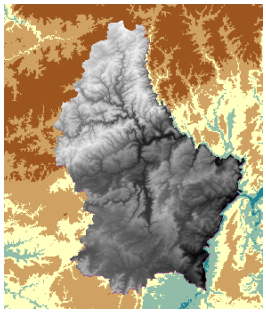
We create a new DEM raster using "Extract by Mask" (ArcToolbox→ Spatial Analyst→ Extraction→ Extract by Mask).

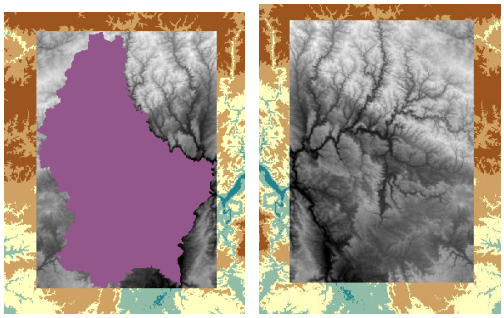
a) What is the new min, mean, and max of the extracted DEM?
b) What is the difference if you use the Raster Clipping tool (ArcToolbox→ Data Management Tools→ Raster→ Raster Processing→ Clip)? If you see no difference, why do you think this is?

a) new min = 115m

new max = 562 m

b) Raster clipping yields a bounding square, while Raster masking enables us to use the shp contours

**Extract raster Mask:** 

**Clip Tool:** 

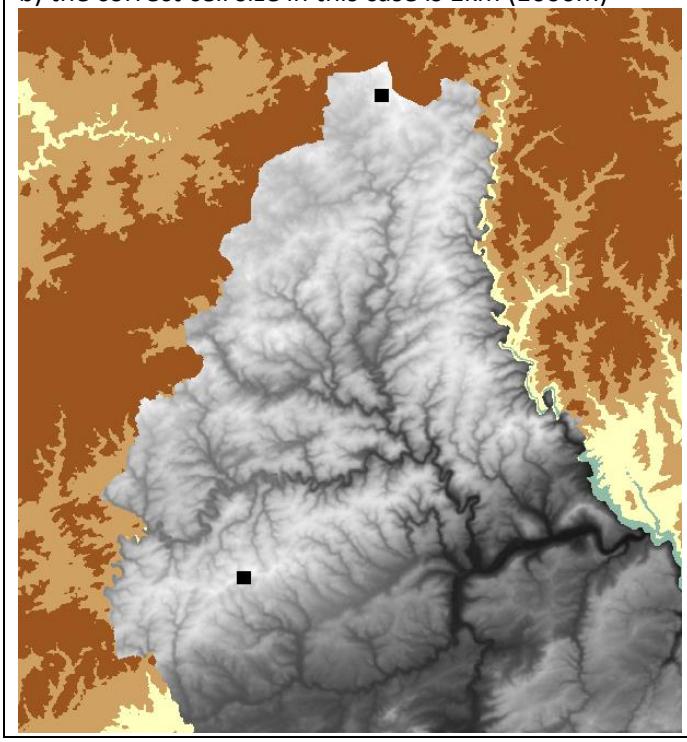
## Question 5

Using the point elevation vector layer, convert this to raster, using MEAN as the cell assignment, and the **default** cell size.

a) What is wrong with your result?
b) What is the correct cell size to use and why?

a) To begin with there is a different elevation VALUE range in the min/max values of the ASTGTMLUX masked to Luxembourg (115 m – 562 m) and the elevation_points1km vector layer (126 m – 550m), but implementing the MEAN as cell assignment returns exactly the pixels with centroid values at 529m.

b) the correct cell size in this case is 1km (1000m)



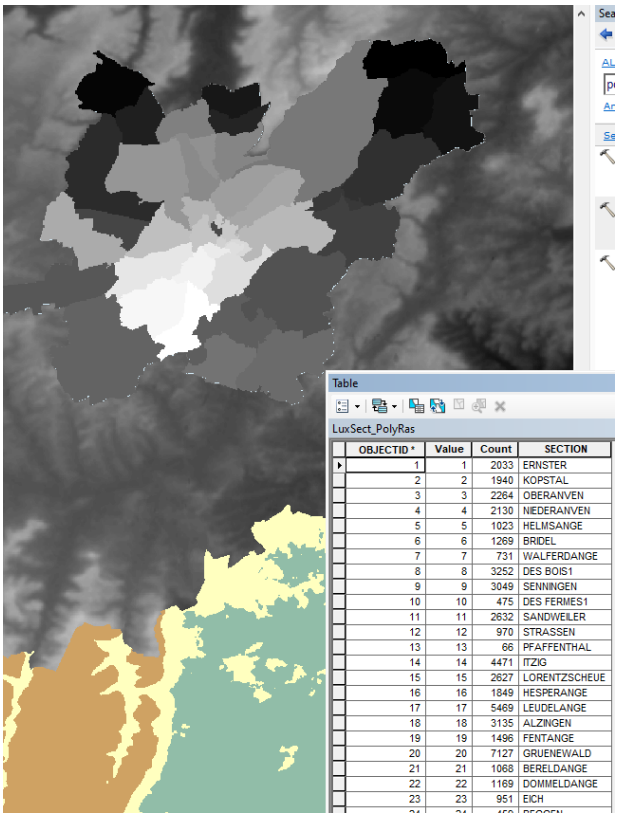
## Question 6

Create a GRID from the LuxSectors.shp layer, selecting a cell size that will retain sufficient detail (i.e. the border details) (ArcToolbox→ Conversion→ To Raster→ Polygon to Raster).

a) Note the cell size, file size and bit-depth of the resultant raster.
b) Convert the GRID to JPG, firstly at 75% and then at 100%. What do you notice about the results and the differences between these two?
c) Finally, convert the GRID to PNG and create a simple map showing the difference in results between the 3 methods.

a) resulting Raster: cell size = 50 (acceptable for proof of concept), file size = 124.52 KB, 8Bit

**note: the default cell size is the shortest of the width or height of the extent of the input feature dataset, in the output spatial reference, divided by 250.



Table

LuxSect_PolyRas

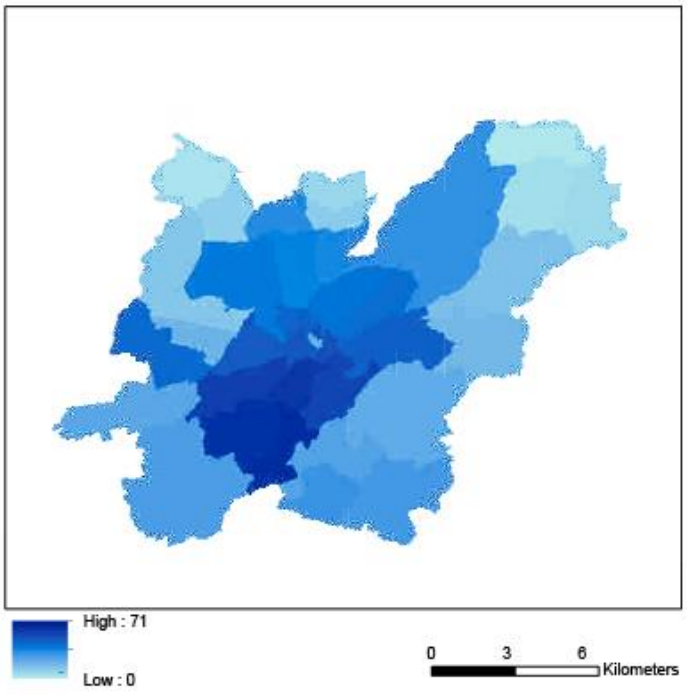
| OBJECTID * | Value | Count | SECTION |
|---|---|---|---|
| 1 | 1 | 2033 | ERNSTER |
| 2 | 2 | 1940 | KOPSTAL |
| 3 | 3 | 2264 | OBERANVEN |
| 4 | 4 | 2130 | NIEDERANVEN |
| 5 | 5 | 1023 | HELMSANGE |
| 6 | 6 | 1269 | BRIDEL |
| 7 | 7 | 731 | WALFERDANGE |
| 8 | 8 | 3252 | DES BOIS1 |
| 9 | 9 | 3049 | SENNINGEN |
| 10 | 10 | 475 | DES FERMES1 |
| 11 | 11 | 2632 | SANDWEILER |
| 12 | 12 | 970 | STRASSEN |
| 13 | 13 | 66 | PFAFFENTHAL |
| 14 | 14 | 4471 | ITZIG |
| 15 | 15 | 2627 | LORENTZSCHEUE |
| 16 | 16 | 1849 | HESPERANGE |
| 17 | 17 | 5469 | LEUDELANGE |
| 18 | 18 | 3135 | ALZINGEN |
| 19 | 19 | 1496 | FENTANGE |
| 20 | 20 | 7127 | GRUENEWALD |
| 21 | 21 | 1068 | BERELDANGE |
| 22 | 22 | 1169 | DOMMELDANGE |
| 23 | 23 | 951 | EICH |

b) 75% JPEG unacceptable quality, too pixelated and noisy around the edges
100% JPEG yields nearly the same visual quality, with slightly flattening of color range

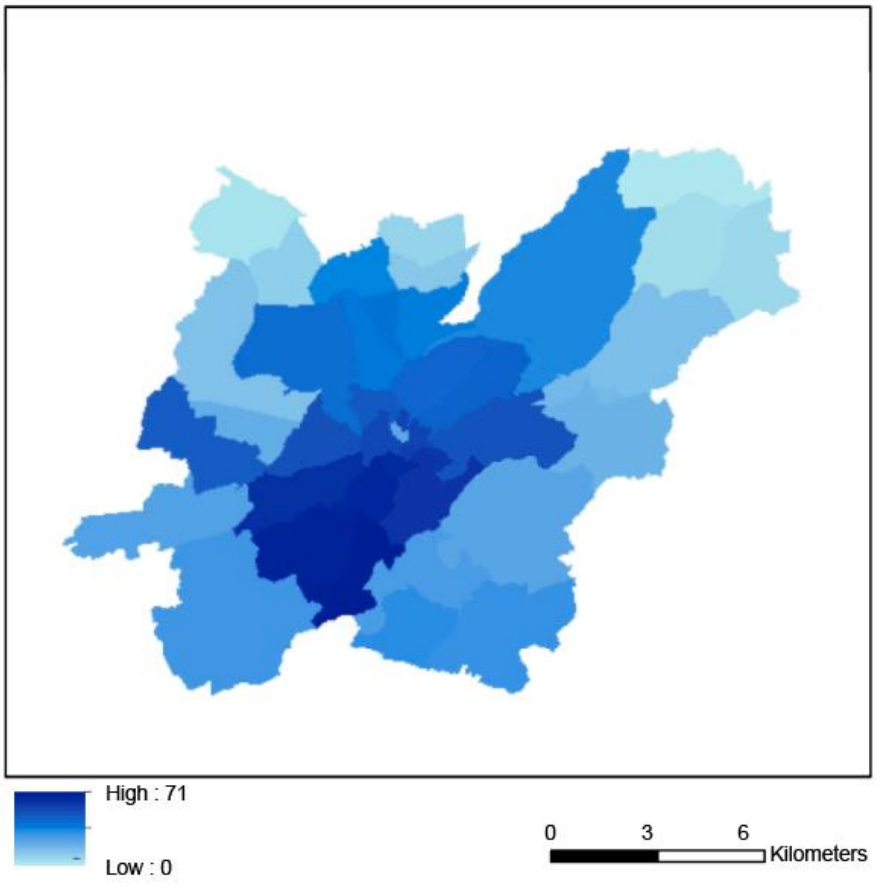
with the PNG having a lossless display quality, same as raster

c)

JPG 75%



JPEG 100%




PNG