Vieneo Terrain Creation

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Info

Height range

Lowest elevation:	3753 m below MSL
Highest elevation:	8657 m above MSL
Range: 12410 m	

Original DEM in the Equirectangular Projection

- 8152 x 4076
- Cell size 0,044160942
- 2h50m для интерполяции из точек в исходной разрешение

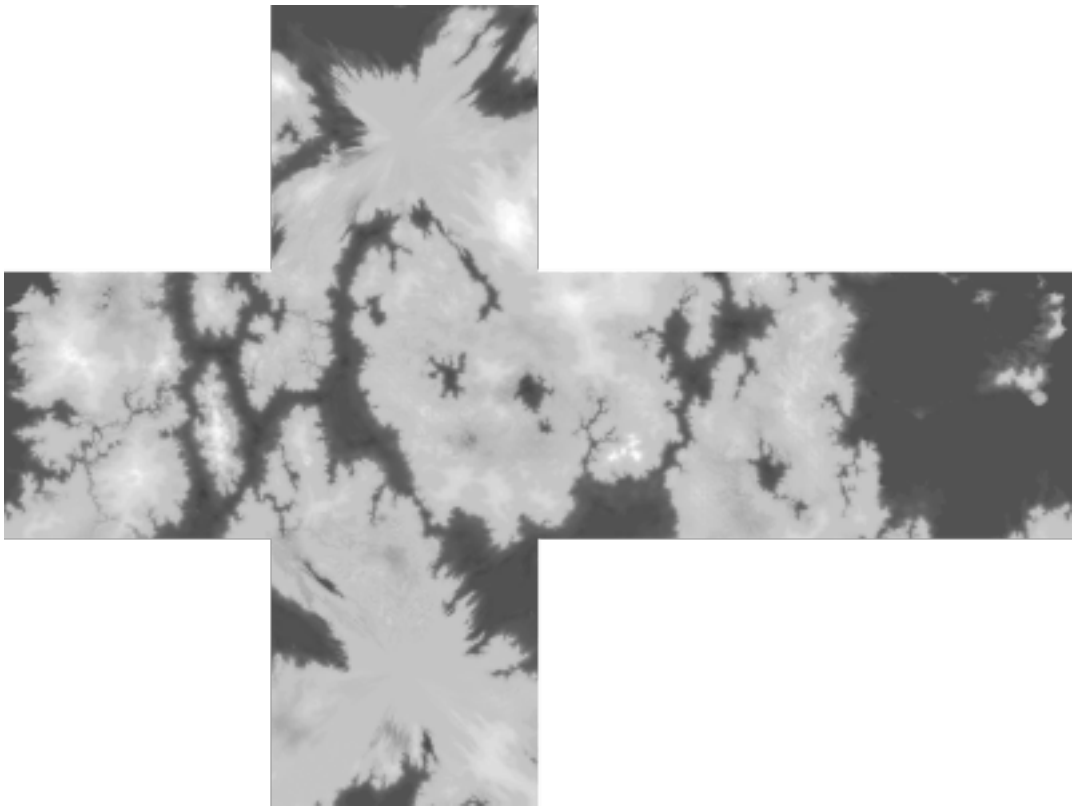
Target DEM in the Equirectangular Projection (x2 factor):

- 16304 x 8152
- Cell size 0,022080471
- 9h32m для интерполяции из точек в двойное разрешение

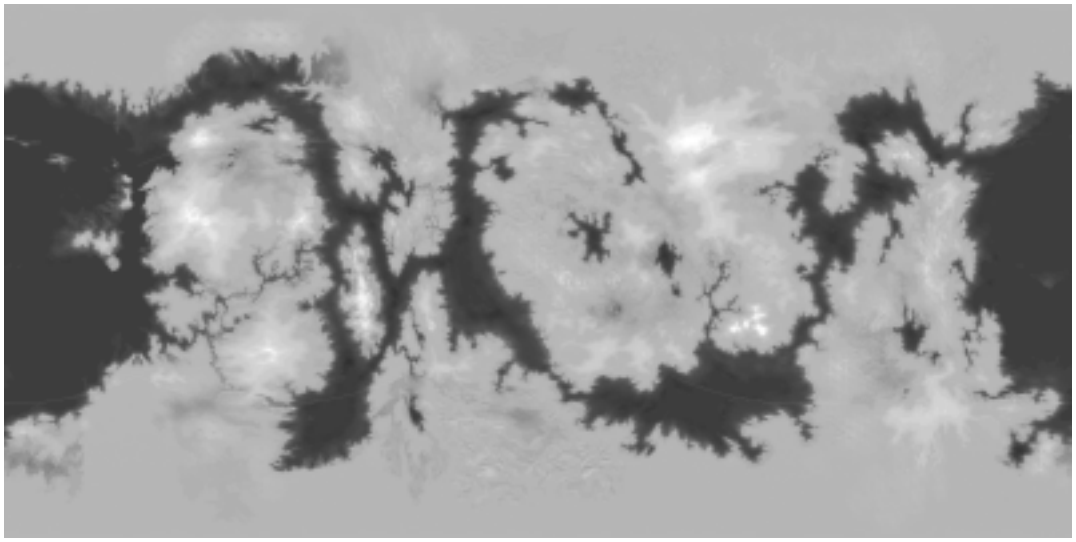
Processing

Step 1. Fill Gaps

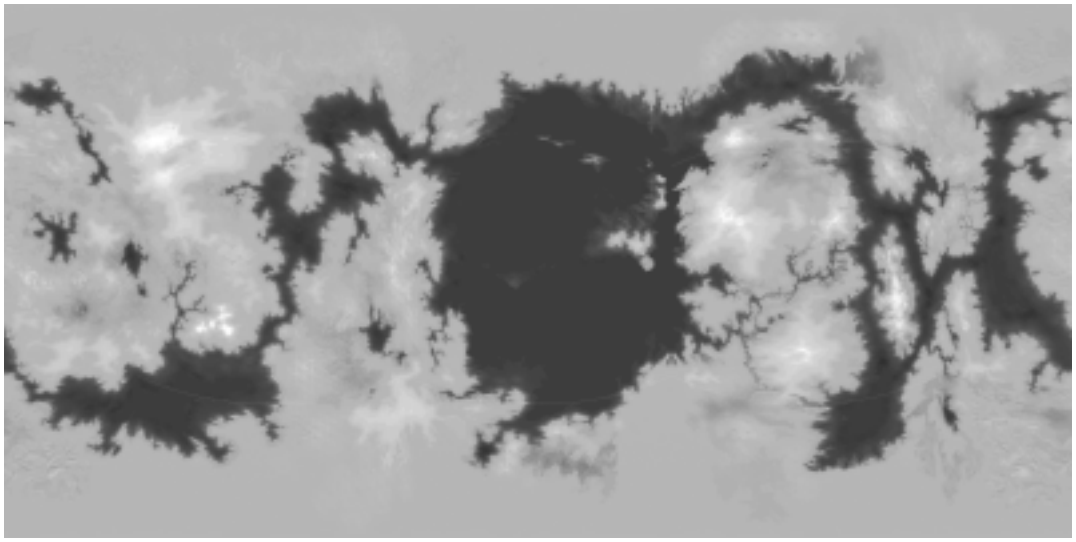
1. Use Pano2VR to reproject raster form original 'horizontal cross' projection to equirectangular, using '8152 x 4076' target resoltuion. Repeat this process to create the same image but with 180° eastern shift. Let's call the first one DEM0 and the second (shifted) - DEM1.



Original DEM in a 'horizontal cross' form



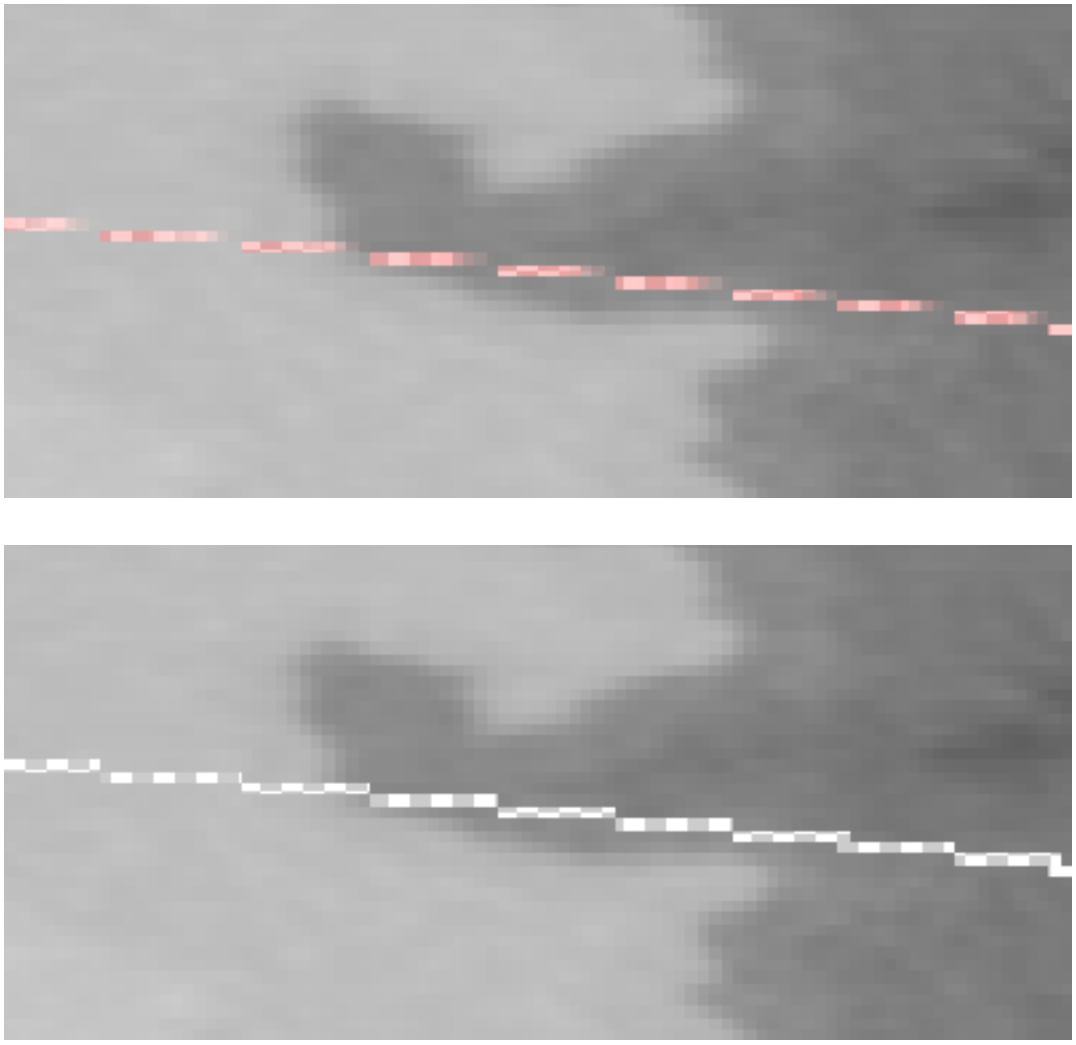
DEM in equirectangular projection (360°x180°)



DEM in equirectangular projection, but shifted eastwards by 180° (required for working on ocean floor, to make seamless transition of elevation between -180° and

+180° meridians)

2. New equirectangular images have 'NoData' semi-transparent seams along top and bottom sides of the former cube. Use Photoshop to make all semi-transparent pixels be fully transparent (create a layer mask from transparency, then apply 255 Threshould to the mask). Save DEM0 and DEM1 as greyscale 8bit TIF, preserving transparency.



NoData semi-transparent pixels on the top (highlighted in red), and fully transparent after Photoshop processing on the bottom

3. Use the next worldfile to georeference rasters:

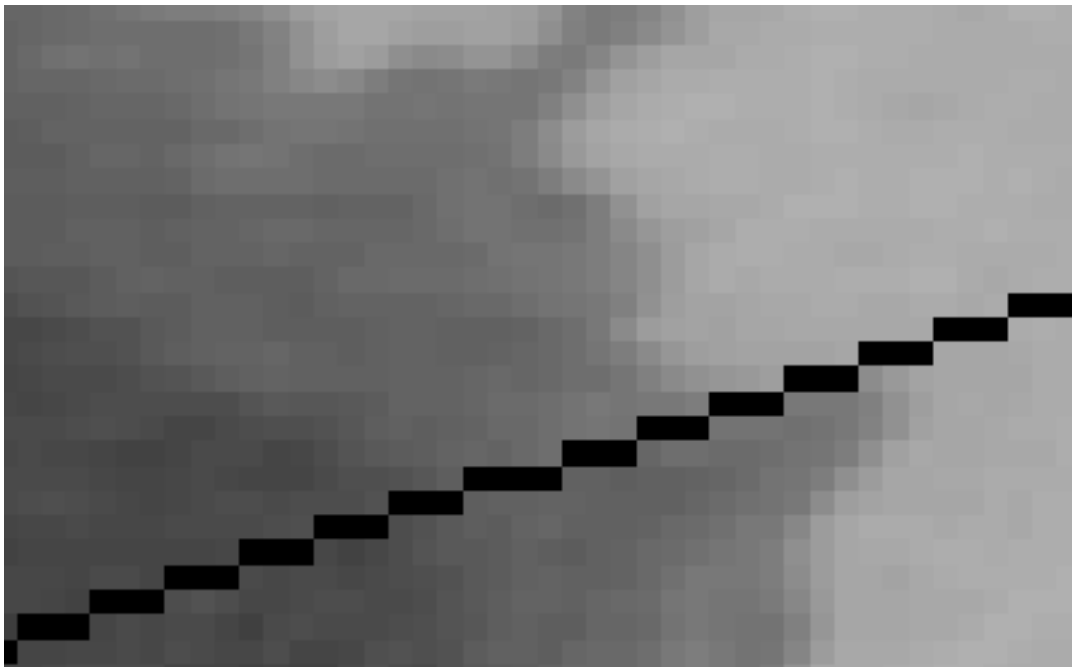
```
0.044160942100098135426889106967 62
0.0
0.0
-0.044160942100098135426889106967 62
-180
90
```

Put two prepared and georeferenced DEMs in an ArcGIS geodatabase.

4. Set NoData in rasters to '0' Value. Now ArcGIS interprets NoData correctly.

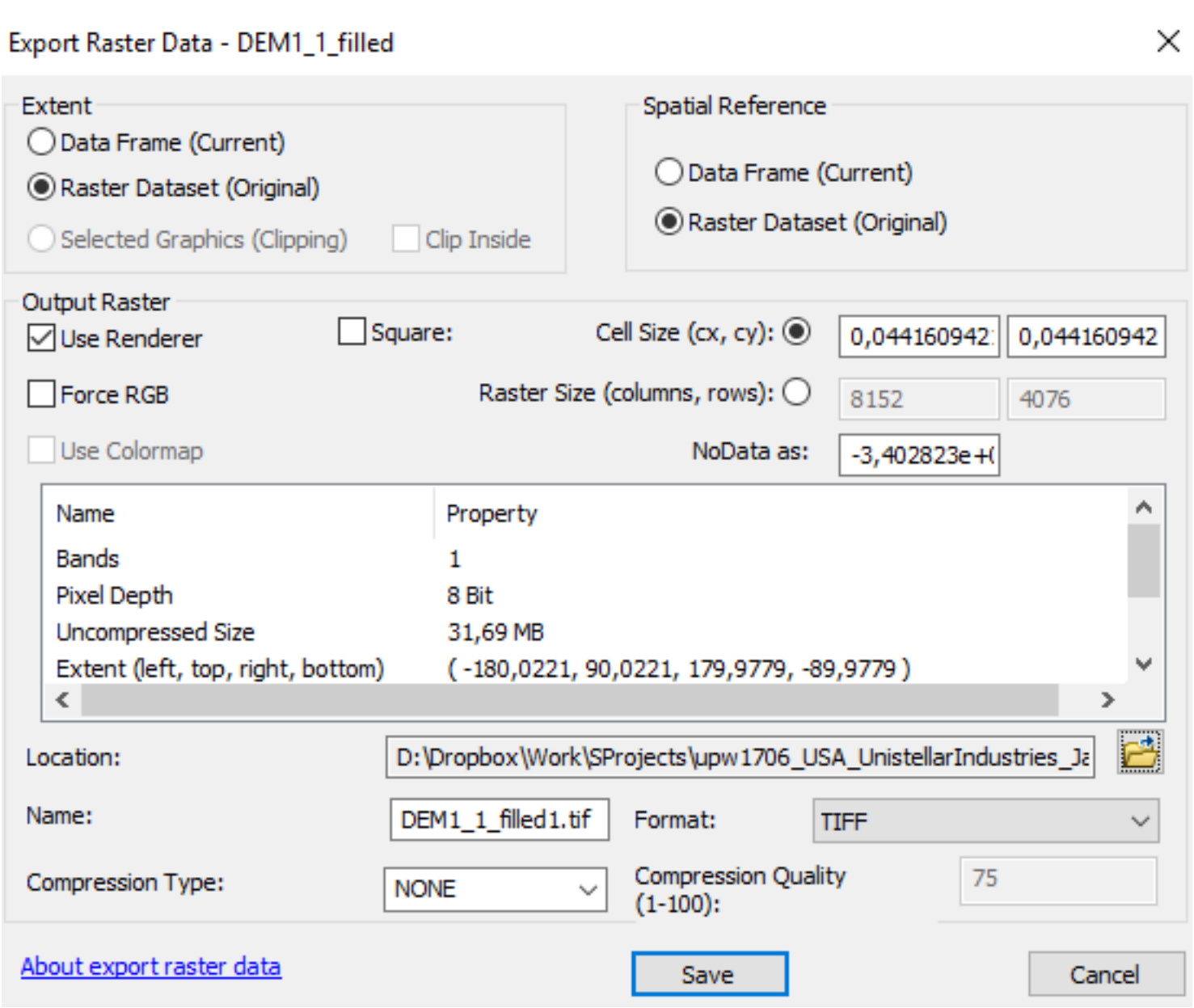
5. Apply a Raster Calculator formula to fill only transparent pixels:

```
Con(IsNull("%Input DEM%"), FocalStatistics("%Input DEM%", NbrCircle
(5,"CELL"), "MEAN"), "%Input DEM%")
```



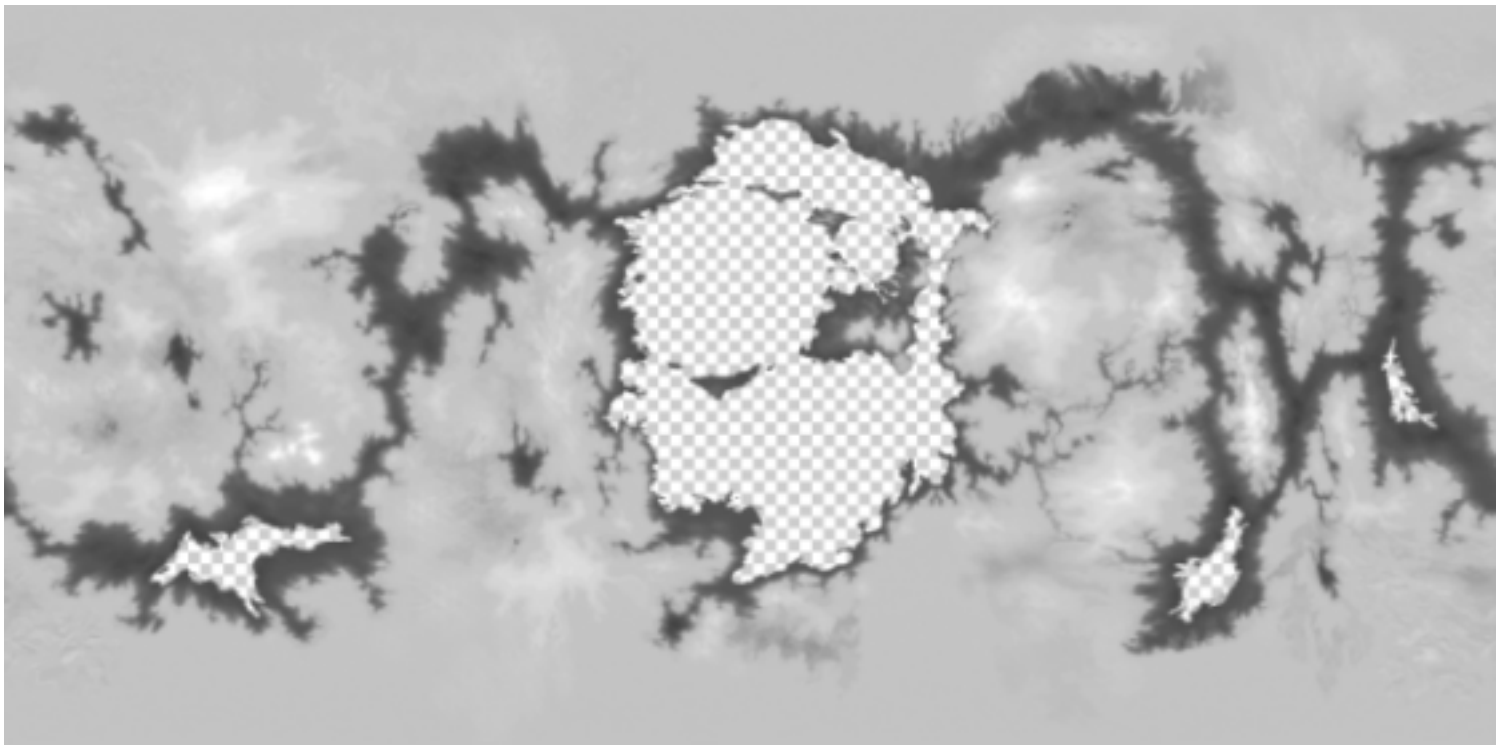
After using FocalStatistics function we filled all NoData values with reasonable elevation values.

6. Export DEM0 and DEM1 back to tiff, making 8bit pixel depth and resolution (on the previous step it was automatically converted to 32 Bit).

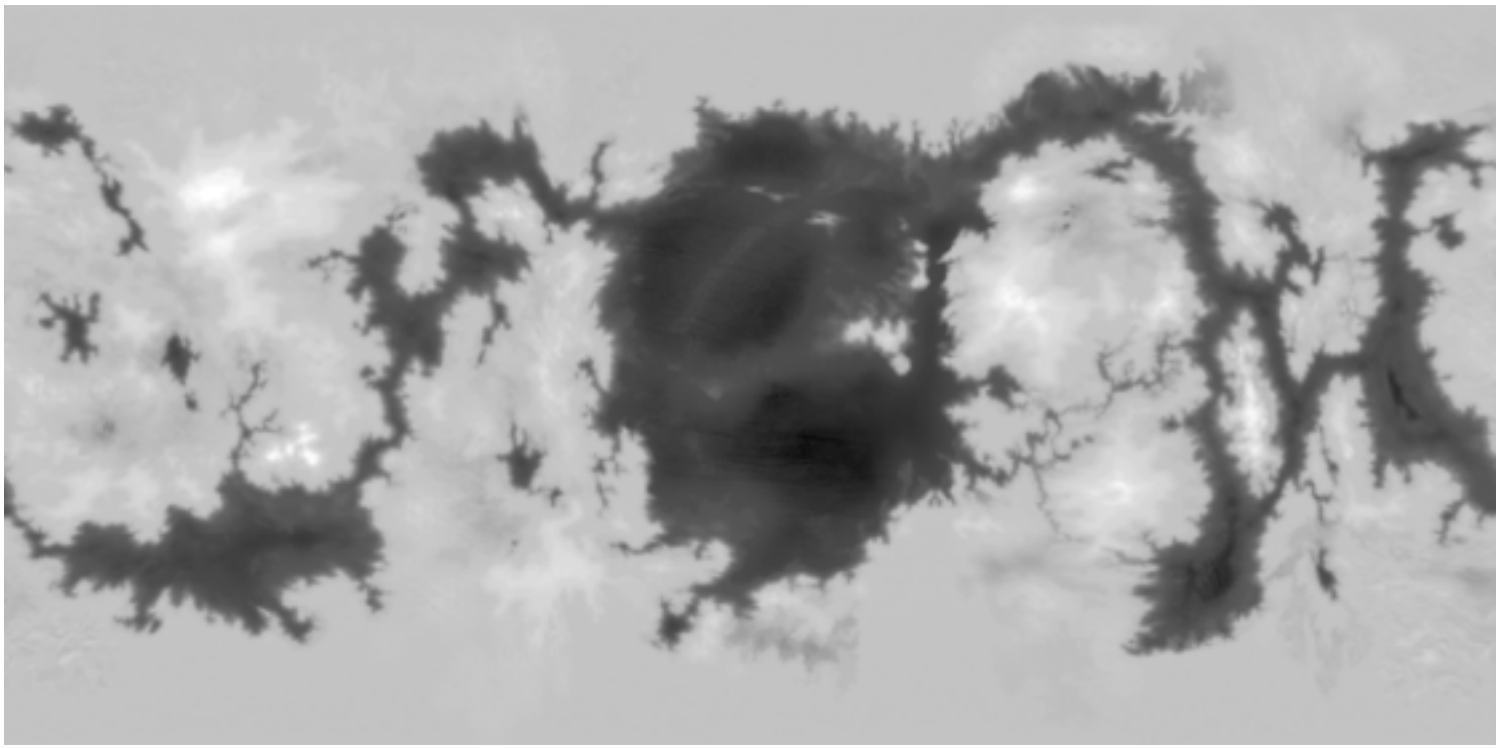


Step 2. Underwater elevation

1. In Photoshop, using real world bathymetry, add underwater relief to DEM1. It is necessary to adjust hystogram in the bathymetry raster, so that its highest values (except 255) will not prevail lowest values in DEM1.

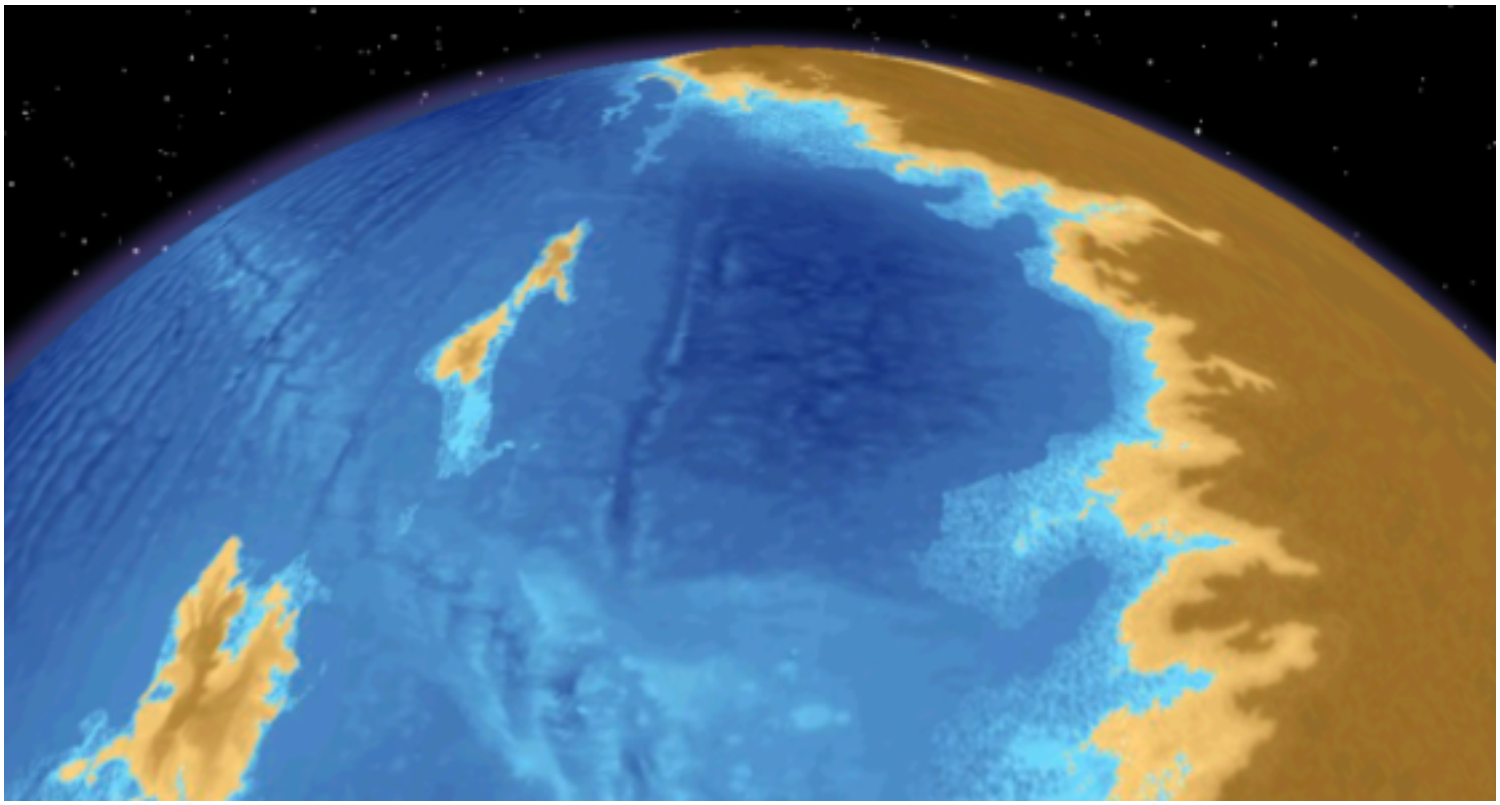


Clear water surface



Underwater surface

2. Run ArcMap model "Step 2 - Restore Real Elevation" - it will convert DEM to 16 bit unsigned pixel type, and recalculate pixel values (from 0 to 12410)



Step 3. Create new surface

File name convention:
• elev0 - 16bit true elevation DEM
•

1. Convert pixel centers to vector points:
elev0 -> elev0_point
2. Downsample DEM by 100 times and convert resulted pixel centers to vector points:
elev0 -> elev0_small
elev0_small -> elev0_small_point
3. Remove ladder-effect areas in elev0_small_point and replace them by points from elev0_small_point
4. "Topo to Raster" interpolation.

Step 4. Extract waterbodies

Initially we had these features of the moon:
• Lowest elevation 3753 m below MSL
• Highest elevation 8657 m above MSL
• Total range 12410 m

After I generated the new surface, that satisfied both of us, setting elevation to absolute zero level I got range from 0 to 12361 m (about 100 m loss). But it's okay.

Now I'm extracting water bodies trying to preserve their original shapes and not flooding cities. I got these depths for major seas:
• Ennaretraidem Sea - 3000 m above 0
• Kalesrab Sea - 2900 m above 0
• Ederar Sea - 2700 m above 0

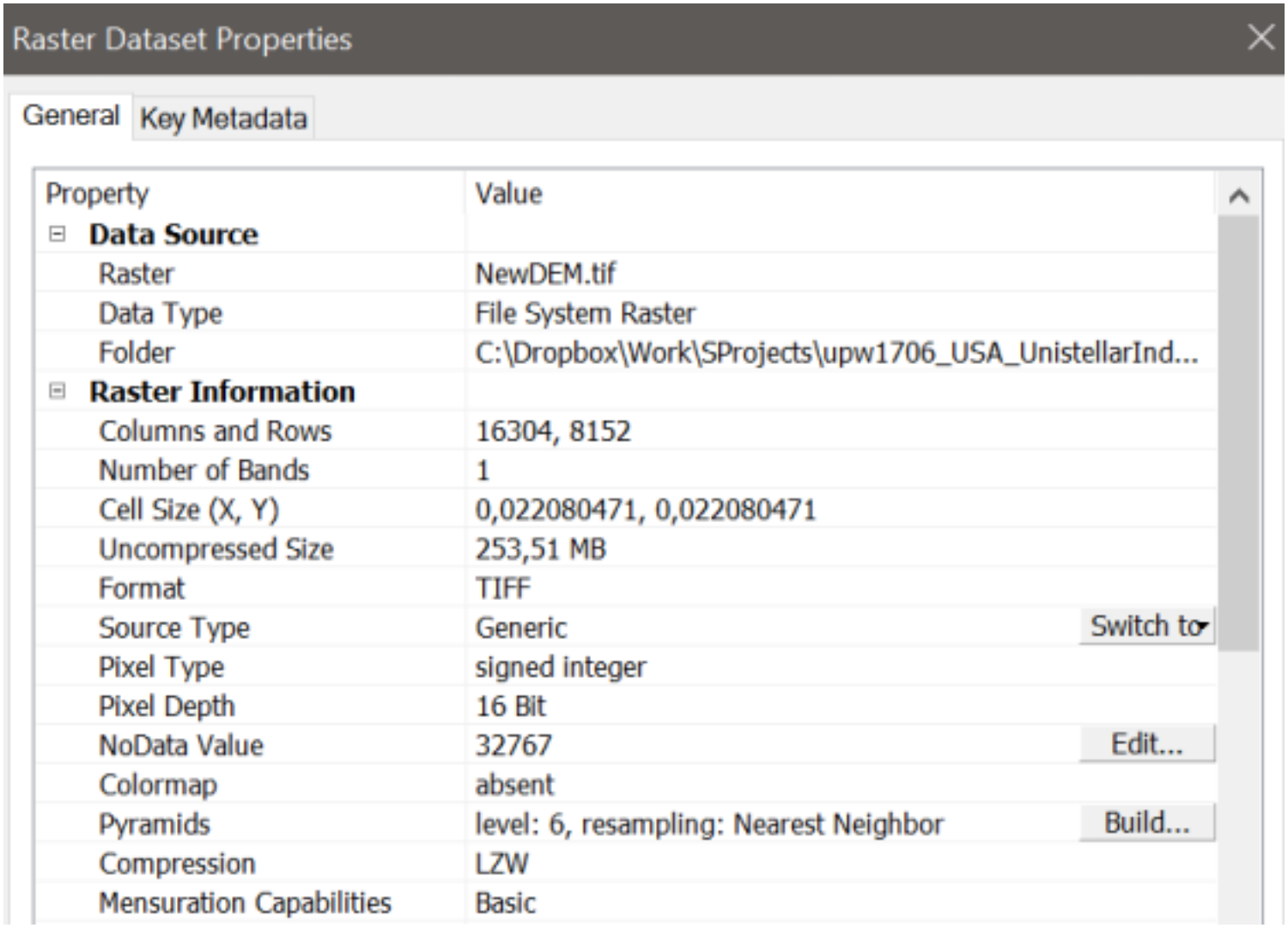
• Apstrian Sea - 2700 m above 0

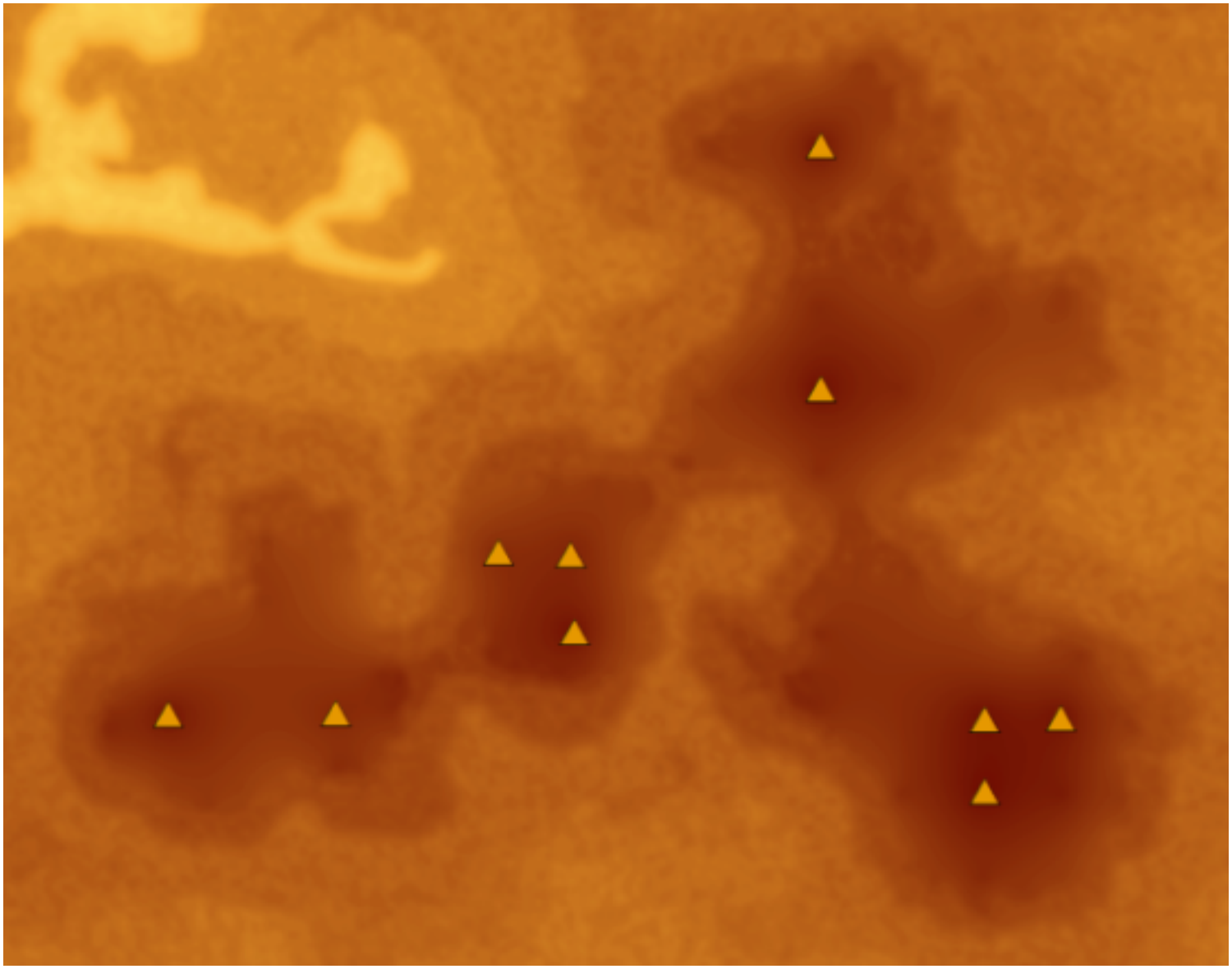
Average sea level will be: 11300/4 = 2825 m
So final range will be:
-2825 m (lowes elevation)
0 (MSL)
+9536 m (highest elevation)

There is about 800 m shift between sea/land absolute level.

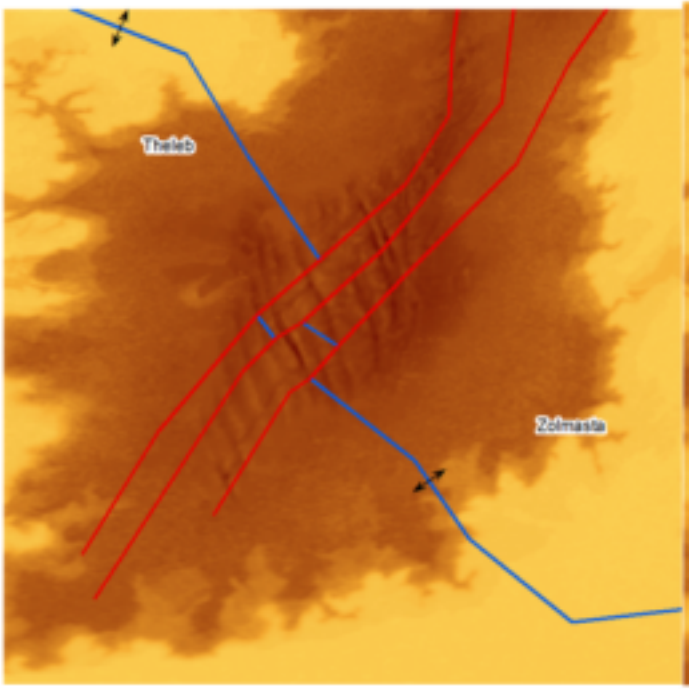
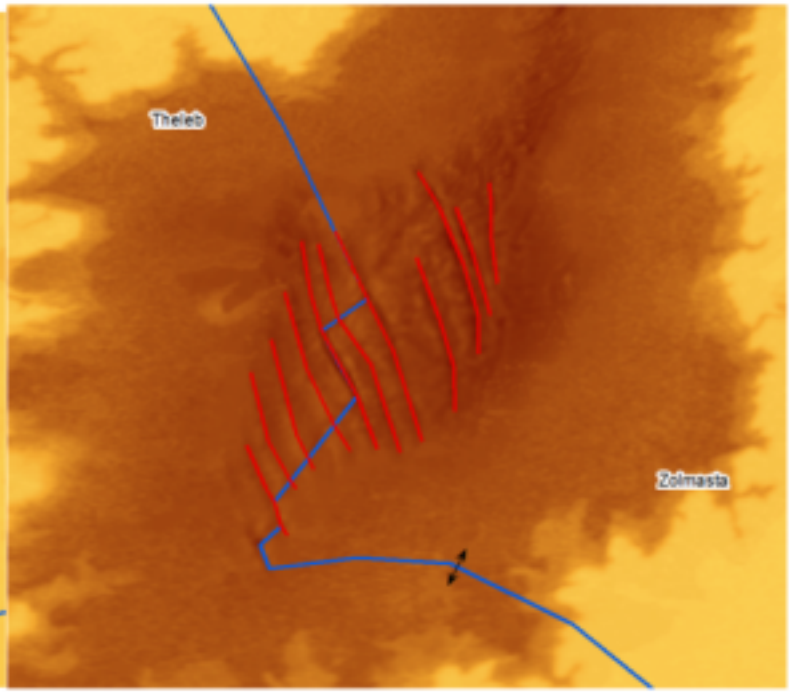
Result

• GeoTiff format (can be opened in ArcGIS, QGIS etc.)
• Pixel type is signed 16 bit float (from -32768.0 to +32767.0)
• Raster size: 16304x8152 pixels (input was 8152x4076)
• Cell size: 0.022080471° (input was 0.044160942°)
• All cities near waterbodies are above water level (I also checked a user's S 1.124 W 179.494 point)
• Four major sea coastlines are extracted from this new DEM. They have different absolute elevation:
  ◇ Ennaretraidem Sea 3000m above 0
  ◇ Kalesrab Sea 2900m above 0
  ◇ Ederar Sea 2700m above 0
  ◇ Apstrian Sea 2700m above 0
• Real elevation range from -2826m to +9536m; 0 is the Mean Sea Level.
• Tectonic boundaries and volcanoes were corrected to fit the new terrain





BEFORE



AFTER