

LiDAR: Setup

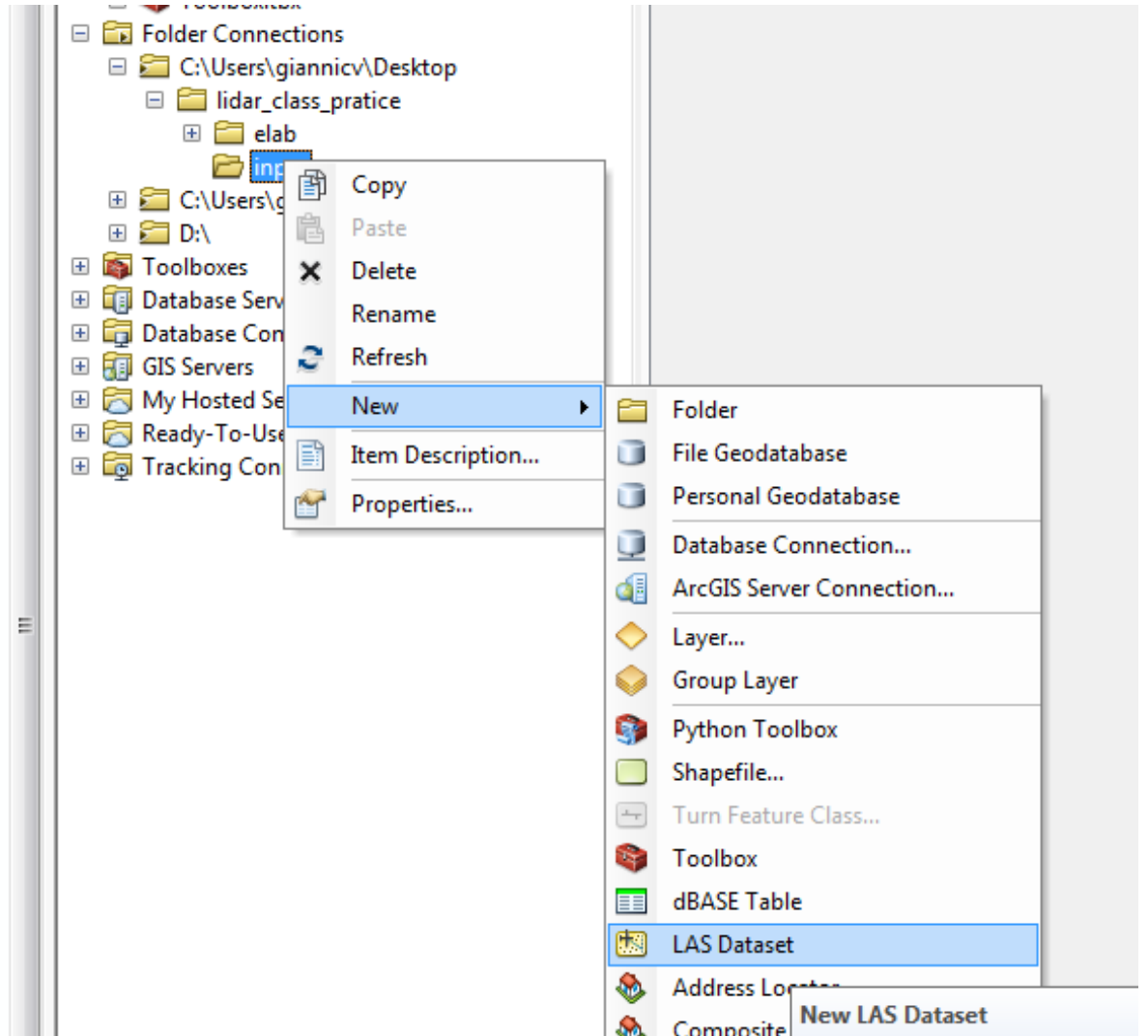
- Link to download LAStools:

<http://www.cs.unc.edu/~isenburg/lastools/download/LAStools.zip>

- In ArcMap open the ArcToolbox window, and add the LAStools toolbox

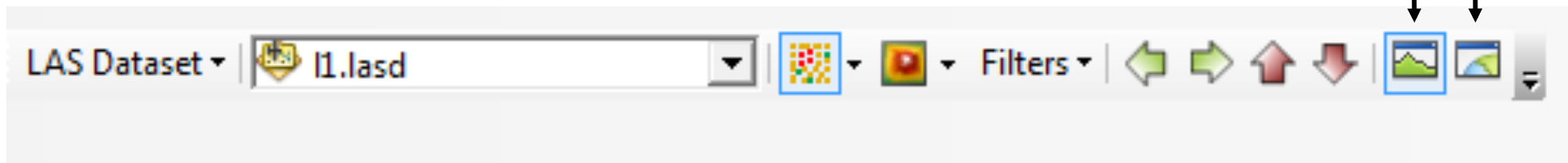
LiDAR: import data in ArcMap

- Create a new LAS dataset (catalog window)
- Double click on the created Las dataset
- On the “LAS files” tab click on “add files” and add “las_1.las”
- Look at the point spacing
- Point density = $1/(\text{Point spacing})^2$
- On the “Statistics” tab click on “Calculate”



LiDAR: Visualize data

- Load the las dataset to the table of contents
- Open LASdataset toolbar



- On the TOC right click on the LAS dataset and select properties
- On “Symbology” tab click on “Add...” on the right and add the “LAS attribute with unique symbol” render. This will allow to categorize each point on the base of various attributes (class, return number, ecc)

LiDAR: Detect and eliminate outliers

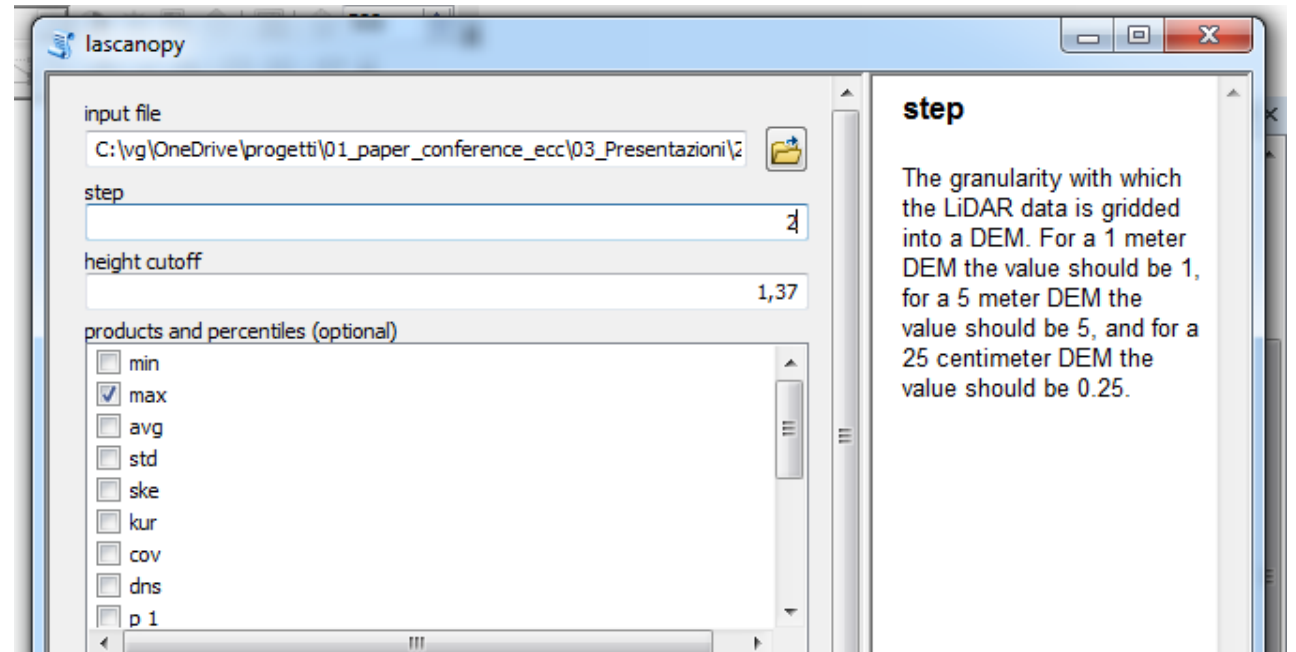
- Due to numerous reasons (multi-path reflection, moving objects and animals, snow, rain, dust etc.)
- Are present in the data Very often
- Removing outliers is essential to produce surface models (e.g. Canopy Height Model)



LiDAR: Detect and eliminate outliers

Step 1.

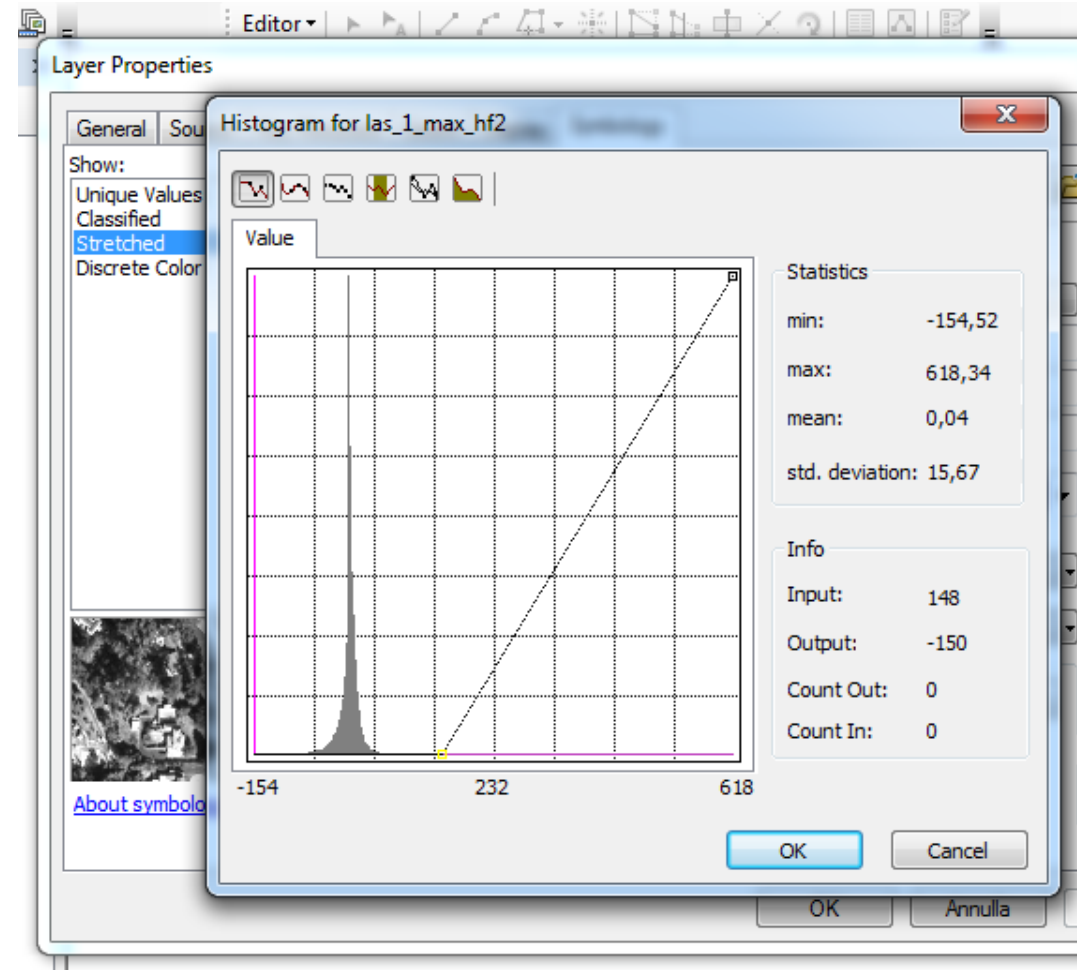
- Open lascanopy
- Use the .las file as input
- Set the step to 2
- Select “max”
- Insert the output location
- The tool will create a raster in which each cell has the value of the highest LiDAR point present (l1_max.tif)



LiDAR: Detect and eliminate outliers

Step 2.

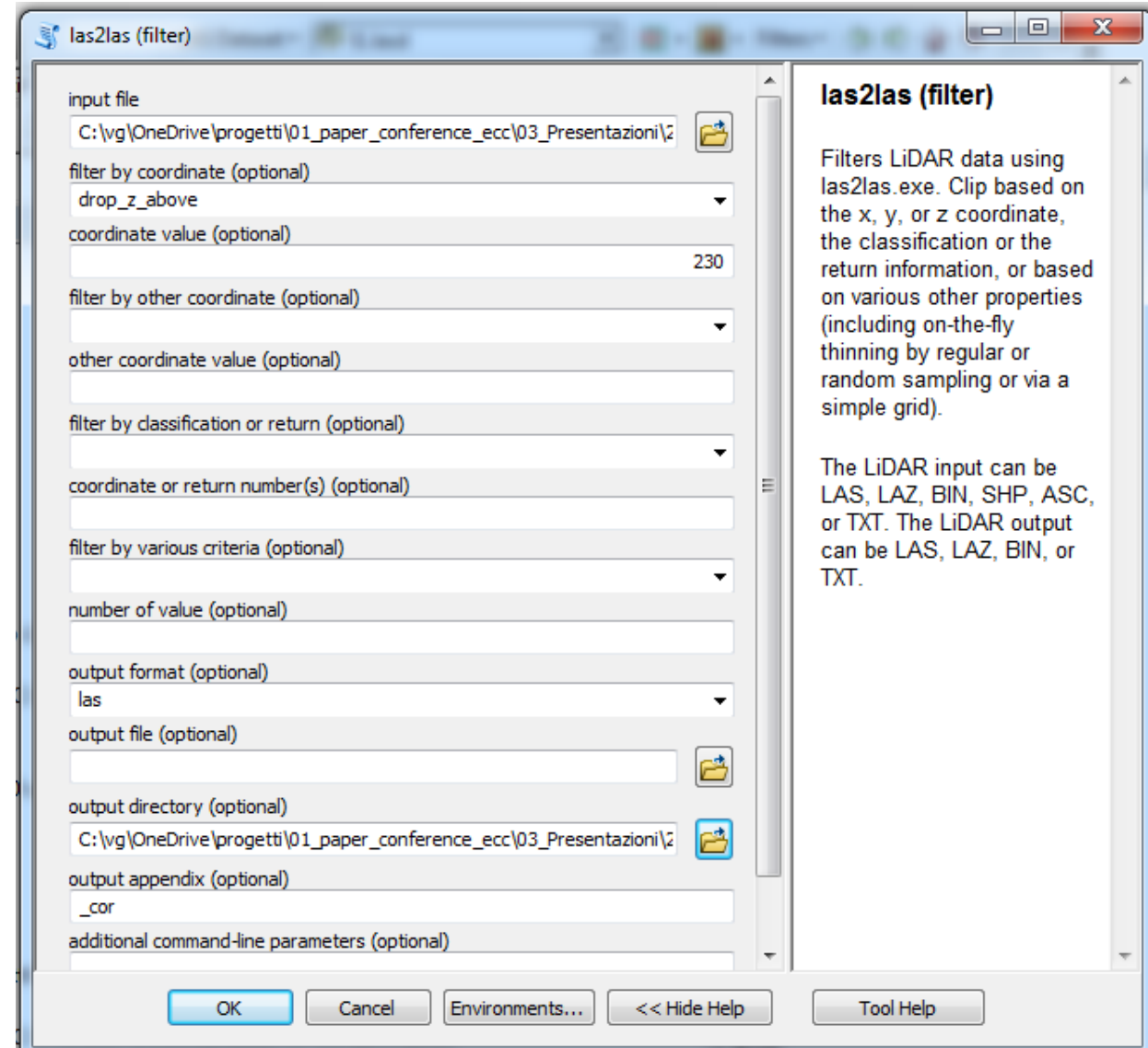
- Apply a high pass filter (Spatial Analyst Tools\Neighborhood \Filter) to the raster just created
- Through histogram stretch (Layer Properties > Stretched > Histograms) individuate the outliers range of values (right tail of the raster histogram) ≈ 150



LiDAR: Detect and eliminate outliers

Step 3.

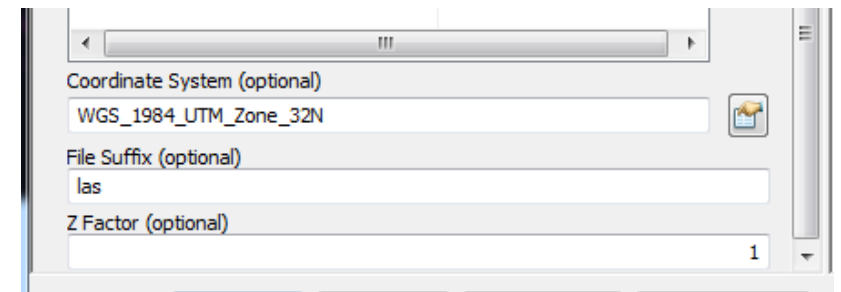
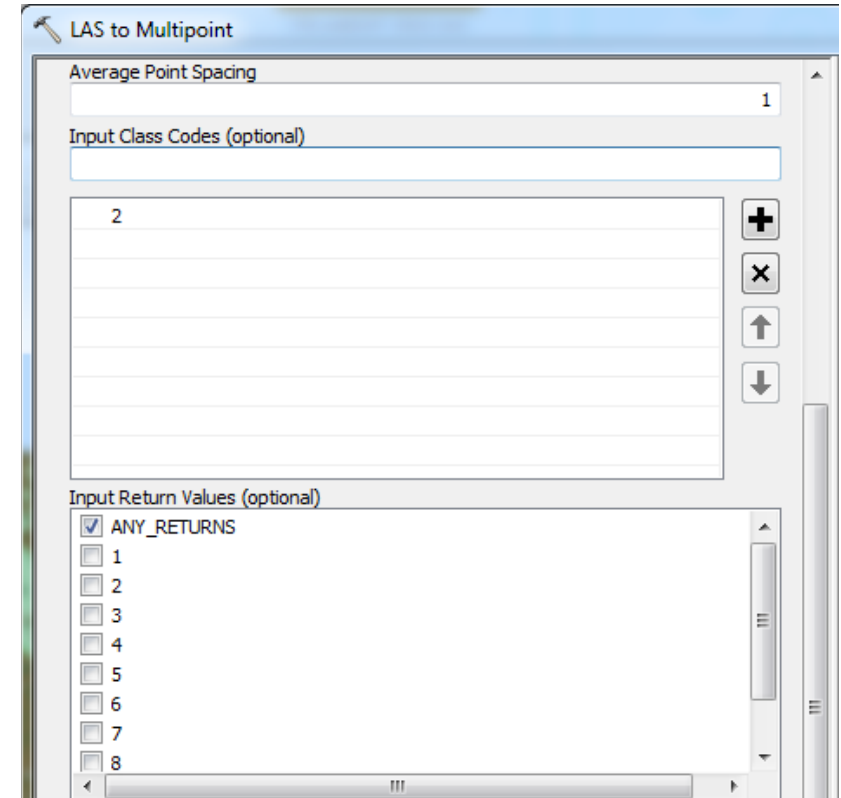
- Create a mask in which the range of values of outliers is 1 (Spatial Analyst Tools\Conditional\Con)
- Apply the mask to the file l1_max.tif (Spatial Analyst Tools\Extraction\Extract by Mask)
- Once known the range of outliers (≈ 230 m) we can eliminate these using “las2las (filter)” tool in LAStools.



LiDAR: Digital terrain model

Step 1. Create a Multipoint file from the Las data (3D Analyst Tools \Conversion\From File\LAS to Multipoint) with the following parameters:

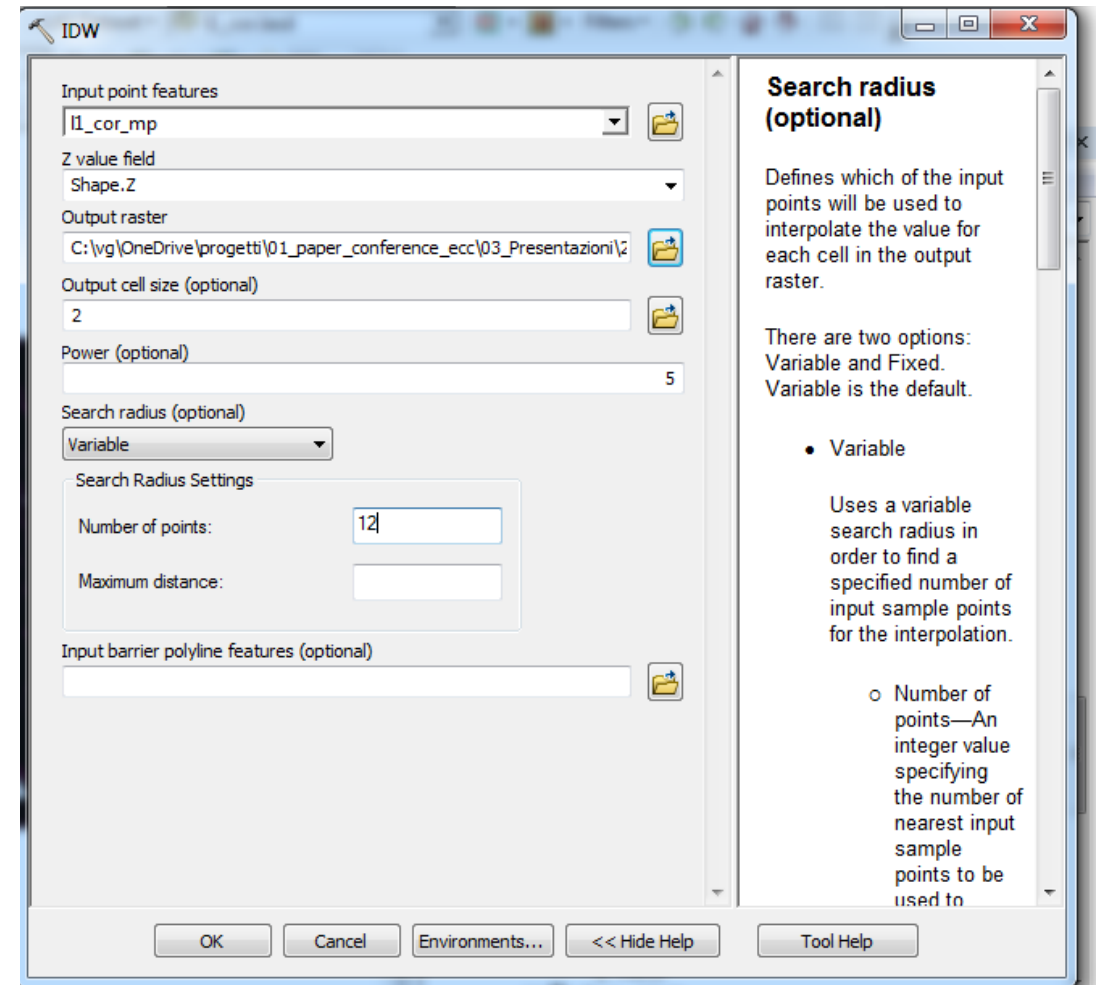
- Average point space = 1
- Input class code = 2 (ground)
- Coordinate system = WGS_1984_UTM_Zone_32N



LiDAR: Digital terrain model

Step 2. From the multipoint create the DTM using the IDW (inverse distance weighted) interpolation technique (3D Analyst Tools\Raster Interpolation\IDW)

- Z value field = Shape.z
- Cell size = 2
- Power = 0.5



LiDAR: Digital Surface model (DSM) and Canopy Height Model (CHM)

Step 3. Create a DSM using the same tool and the same parameters used in the first step of the outliers removal procedure. (This time using the LAS corrected from outliers l1_cor.las)

Step 4. Create a CHM subtracting the DTM from the DSM

The CHM thus created presents also has buildings in it. It is possible to create a CHM without buildings using the lasfilter tool (LASTOOL) in order to eliminate points belonging to the building class (class 6) and repeat the step 3 and 4 with the new las.