Coursera's GIS Specialization
(4/5 course)

IMAGERY, AUTOMATION, ANDAPPLICATIONS FINAL ASSIGNMENT

PROJECT: Roermond flash flood Netherland July 2021

Mohamed Lamouchi -July 2022

Abstract

As a geospatial analyst, and as part of Cousera GIS geospecialisation, we have choose to analyze theepisode of flash flood that occurred in Roermond Netherland in July 2021 (https://earthobservatory.nasa.gov/images/148598/deadly-floods-surprise-europe).
extreme J rainfall swamped parts of Western Europe. Some of the worst-hit areas saw as much as two months of rain within 24 hours—enough to break precipitation records, push rivers to new heights, and trigger devastating flash floods.
The flood along the Meuse and Roer rivers was captured in 18 July by Landsat 8 Operational Land Imager (OLI), and was compared after transformation to a raster captured in 16 Juin and a layout of the limit of urban town of Roermond and to calculate the actual area in hectare under water.

Campsite in Roermond evacuated after flash floods swept through the area damaging caravans and campers. 15 July 2021

1. Image acquisition and classification

We first need to get satellite imagery for both the normal Meuse and Roe river and the flooding extent. Landsat 8 Collection 1 (C2) at 30-meter pixel resolution series (OLI-TIRS sensor) s. After creating an account with USGS, the two products were downloaded from the USGS Earth Explorer website (https://earthexplorer.usgs.gov/). Both images come with 7 bands covering different parts of the electromagnetic spectrum in the visible and infrared ranges. For the analysis, first we used band 4, band 3 and band 2 as respectively Red Green and blue to get “true color images but to get a beter view of the full flooding extent so we switched to “false color” images as the flood water was charged with eroded particles and was assimilated to earthy material(Figure 1and 2) so we set bands 2 (Blue), 5 (NIR) and 6 (SWIR1) were used as Red, Green and Blue filters respectively.

Figure 1: July 18, 2021, the Operational Land Imager (OLI) on Landsat 8
LANDSAT_PRODUCT_ID = "LC08_L2SP_198024_20210718_20210729_02_T1"
PROCESSING_LEVEL = "L2SP"
COLLECTION_NUMBER = 02
COLLECTION_CATEGORY = "T1

Figure 2 June 16, 2021 the Operational Land Imager (OLI) on Landsat 8
LANDSAT_PRODUCT_ID = "LC08_L2SP_198024_20210616_20210622_02_T1"
PROCESSING_LEVEL = "L2SP"
COLLECTION_NUMBER = 02
COLLECTION_CATEGORY = "T1"

To minimize processing time we choose to limit study area to 25Km around Roermond .
So we applied a buffer tool to get a buffer zone (figure 3 and 4) using a feature file containing a https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=5c2d44d457b44c8a973f73c8cd327405

T

Figure 3 before flood buffer zone

Figure 4 after flood buffer zone

2. Image Classification

To start with, we trained and finally created 40 training polygons on the July 18, 2021 image for the 4 different classes as shown in figure 5 and 6. These classes are Water, forest, Agriculture and Urban areas (figure 7 and 8). We used ArcGIS Image Classification Toolbar for this purpose

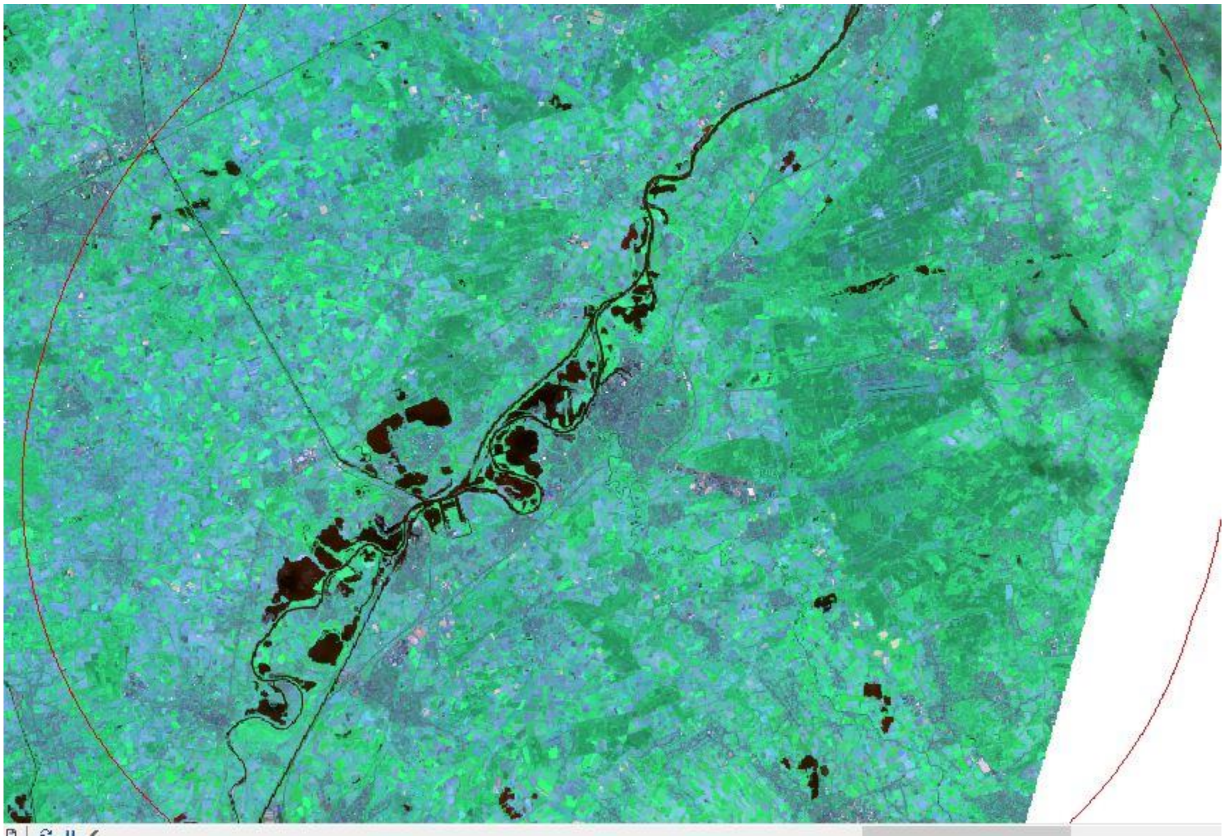


figure 5 the normal extent of Meuse rivern notice that we barely see here the southern est part the Roer

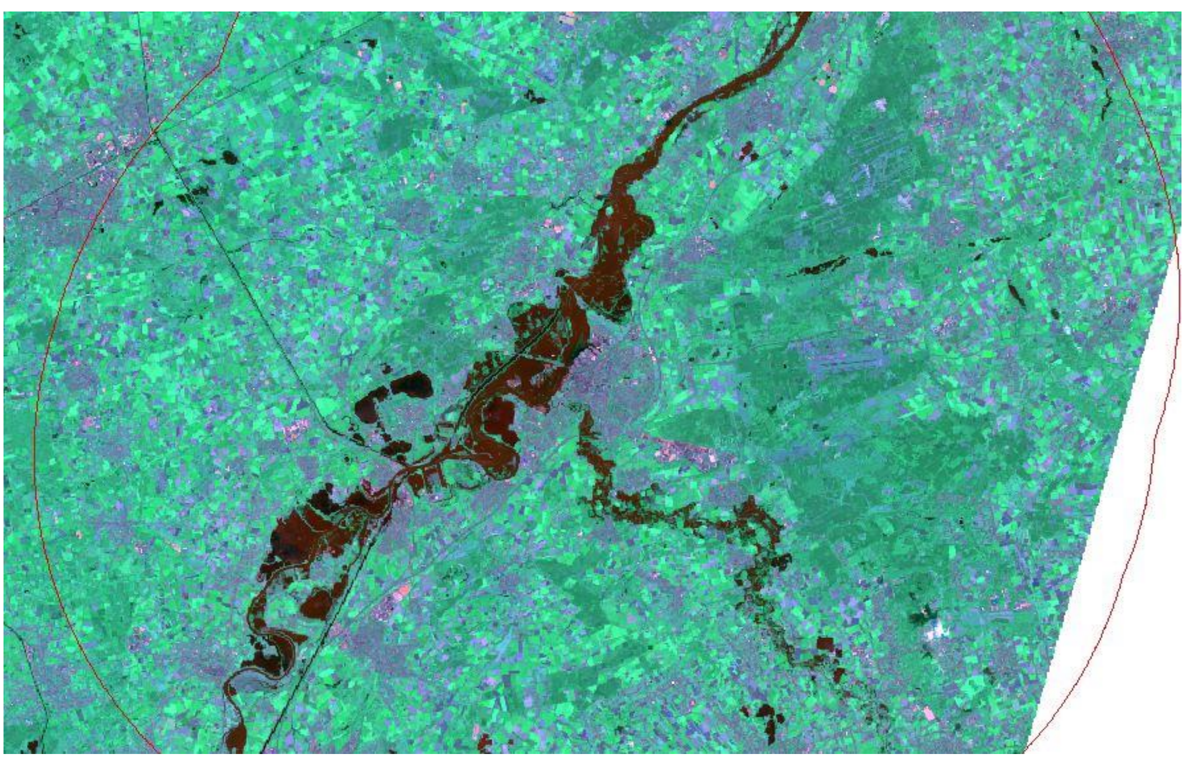
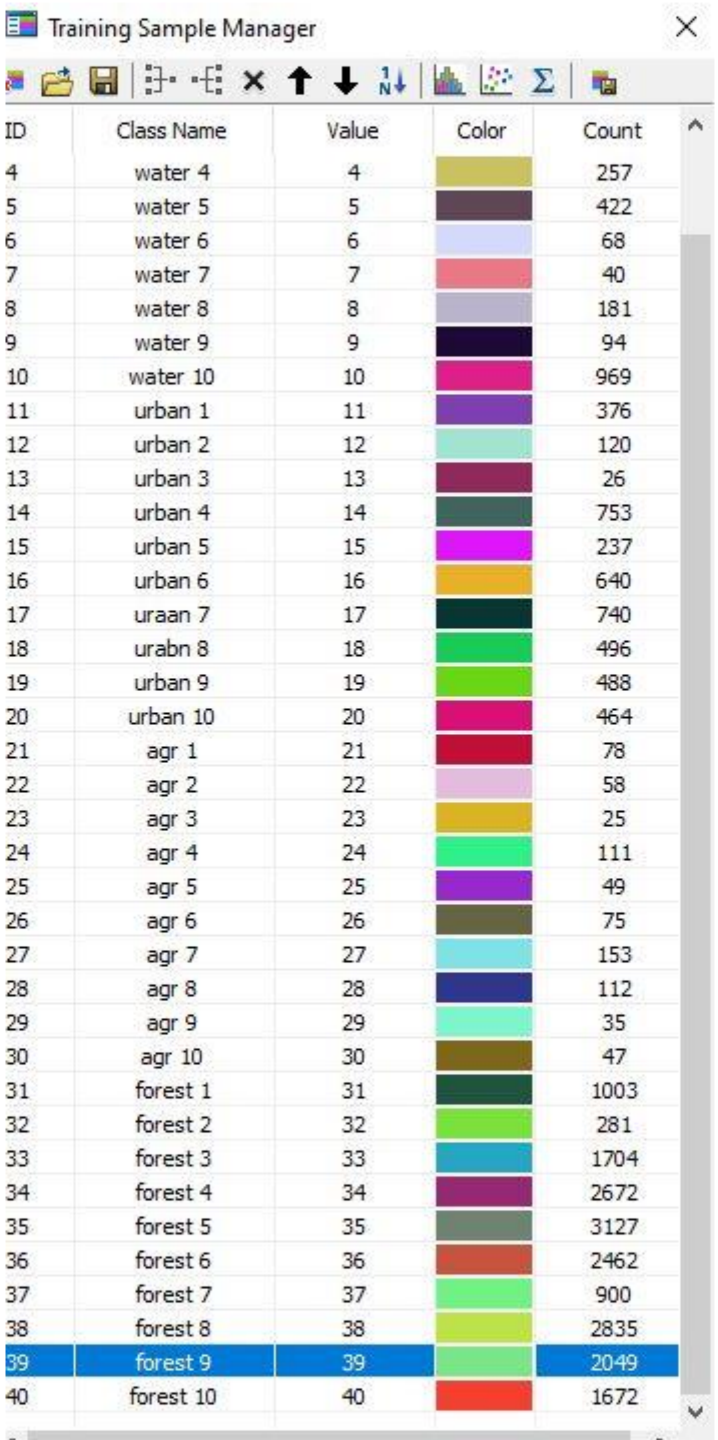


Figure 6 we can see here the full extent of the flooding event, notice here the rise of water level in Roer river .



Training Sample Manager

ID	Class Name	Value	Color	Count
4	water 4	4		257
5	water 5	5		422
6	water 6	6		68
7	water 7	7		40
8	water 8	8		181
9	water 9	9		94
10	water 10	10		969
11	urban 1	11		376
12	urban 2	12		120
13	urban 3	13		26
14	urban 4	14		753
15	urban 5	15		237
16	urban 6	16		640
17	uraan 7	17		740
18	urabn 8	18		496
19	urban 9	19		488
20	urban 10	20		464
21	agr 1	21		78
22	agr 2	22		58
23	agr 3	23		25
24	agr 4	24		111
25	agr 5	25		49
26	agr 6	26		75
27	agr 7	27		153
28	agr 8	28		112
29	agr 9	29		35
30	agr 10	30		47
31	forest 1	31		1003
32	forest 2	32		281
33	forest 3	33		1704
34	forest 4	34		2672
35	forest 5	35		3127
36	forest 6	36		2462
37	forest 7	37		900
38	forest 8	38		2835
39	forest 9	39		2049
40	forest 10	40		1672

Figure 7 unsupervised classification

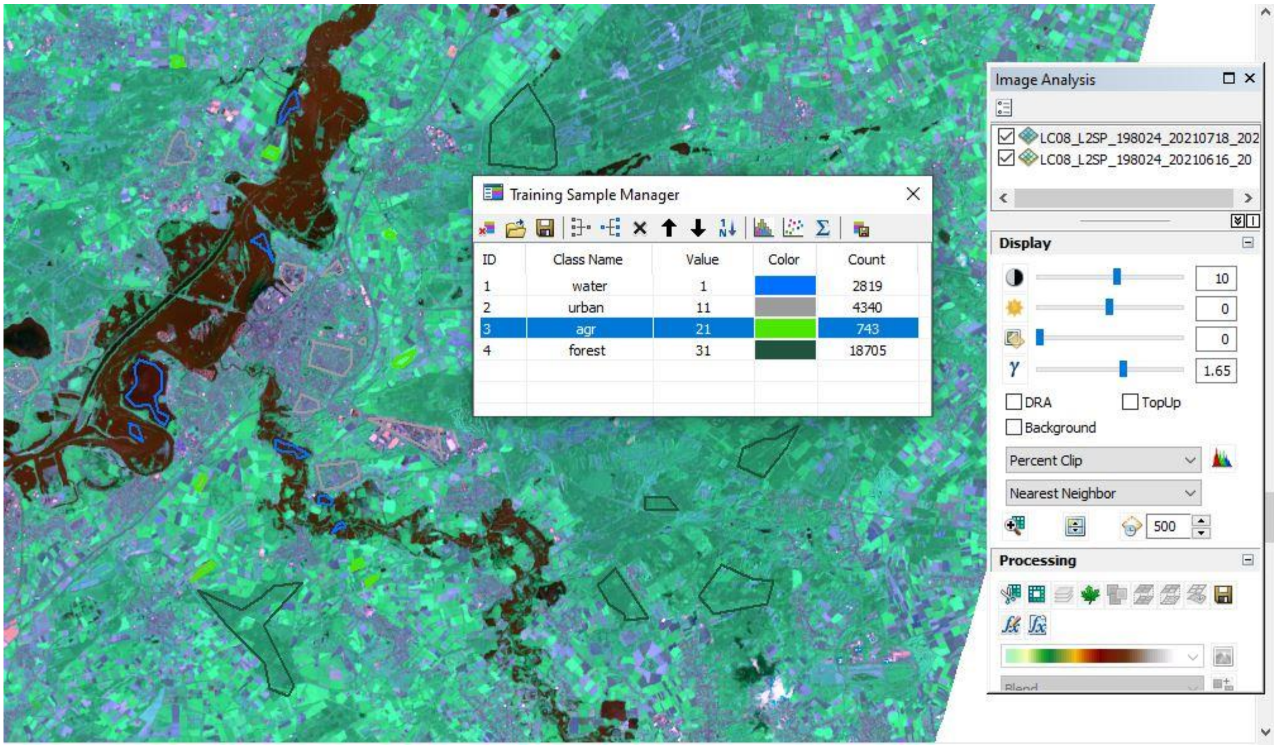


Figure 8’ 4 supervised class

Then, we ran a Maximum Likelihood supervised Classification that yielded the result shown in Figure 9, after the 40 polygons were merged into 4 classes and these were assigned a more natural color. Though it overall seems like a good match to the satellite image, the . water charged with sediment particle were era were mixed with agricultural parcel but we estimate that The water extent (rivers, streams, dams and ponds) seems also reasonably well presented and thus, we extracted just that class for using it in our subsequent analysis) for images in June and July and run the minus tool the get difference between before and after flood and by using the Extract by Attributes Tool we determine were the river run over their bed.

After thئ by adding the town layout and running the extract by mask we get the urban area flooded.

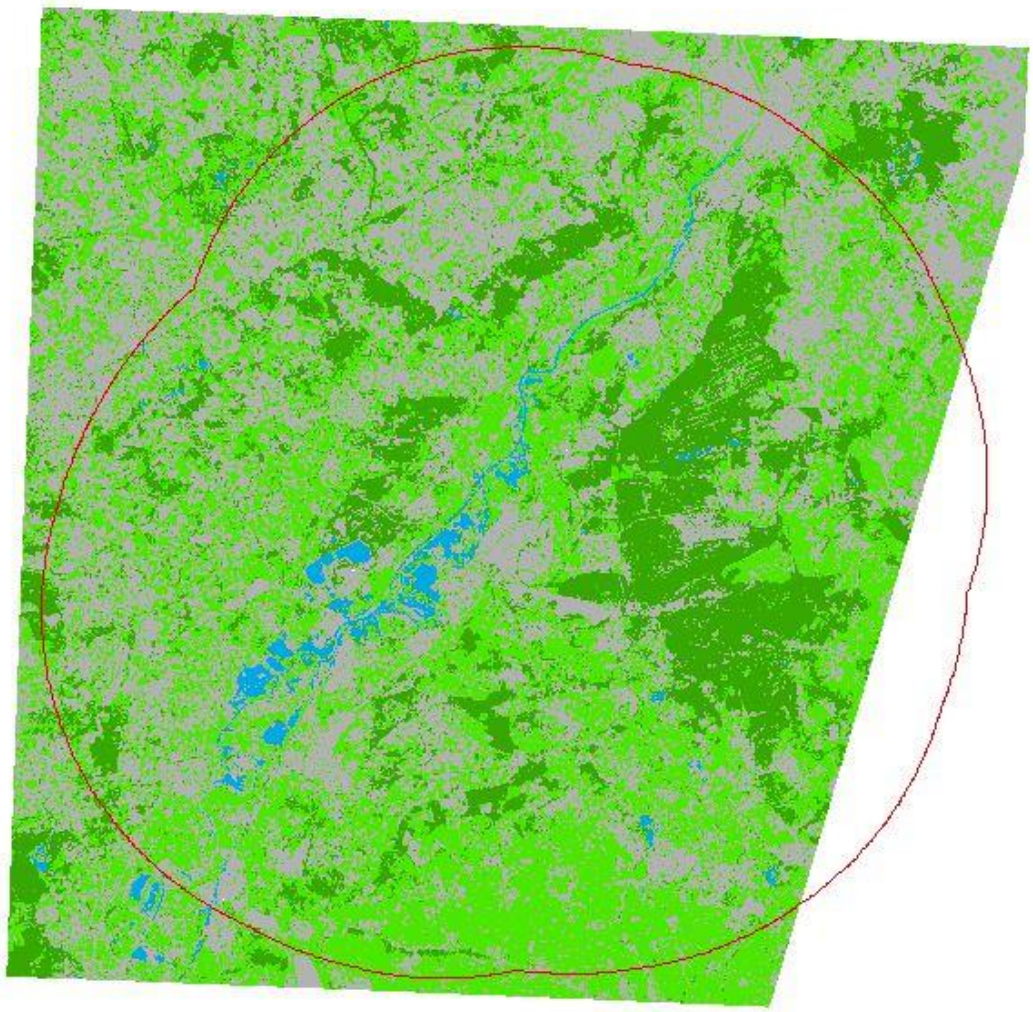


Figure 9 The difference between before and after flood

3. Model Builder

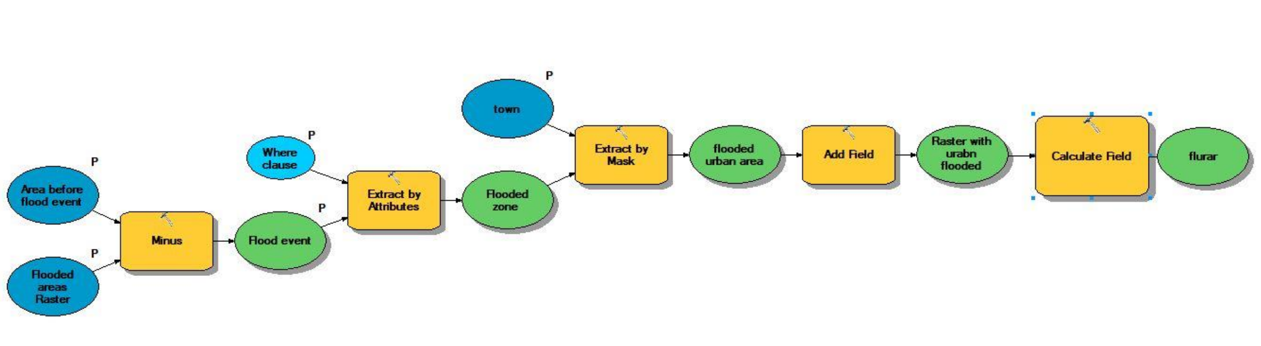


Figure 10 Model builder

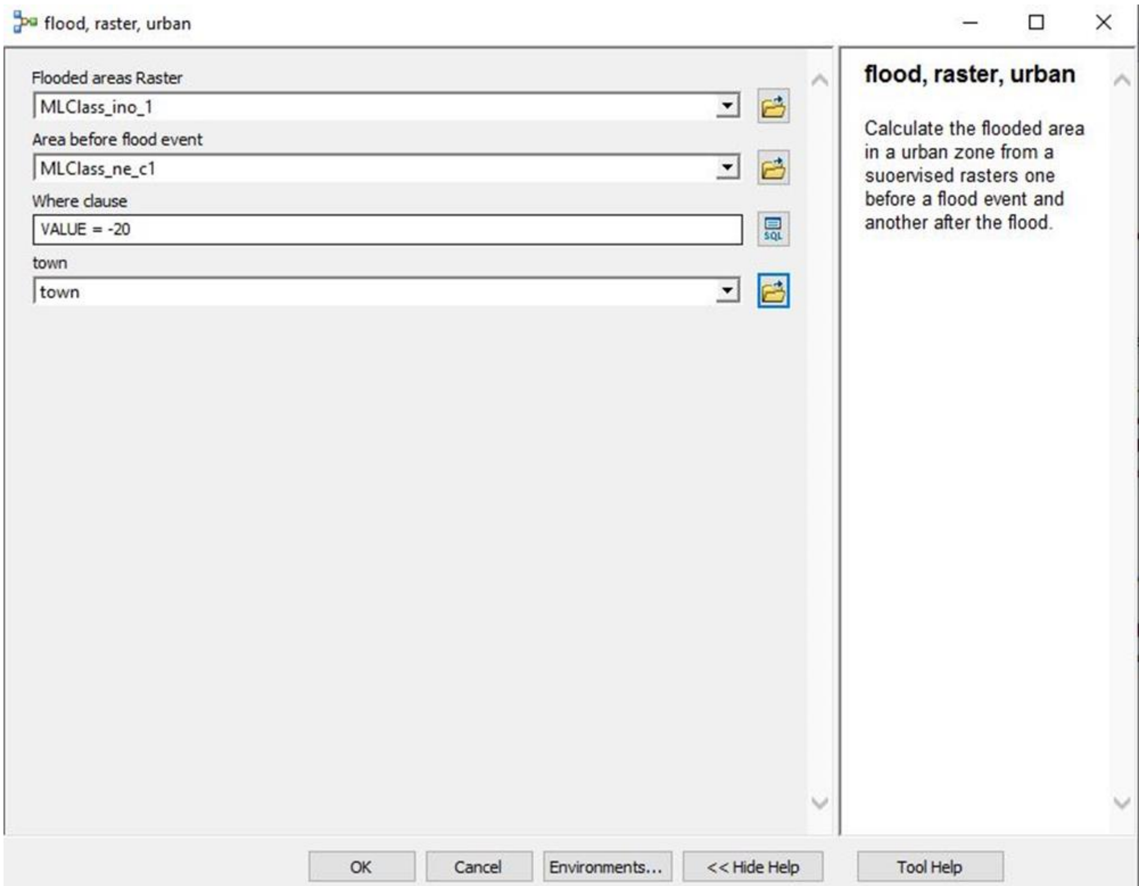


Figure 11 Model interface

The Model goes through five different tools to cover the following algorithm:

1) Calculate the difference between input rasters. This was achieved by using the Minus tool. The output raster's cells have 6 possible values, we notice that ther value -20 corespond to the flooded area
2) Get the actual flooded extent from previous raster. This was achieved by using the Extract by Attributes tool with expression 'value = -20' to effectively get the pixels that are in the flooded raster but not in the base comparison raster.
3) Get the pixels that overlap the given polygon area. This was achieved by using the Extract by Mask tool, so when, for instance, the Downtown feature class is passed on as parameter, the output raster contains just the cells of flooding in that area.
4) Finally, to automatically calculate the surfaced covered by water, we added a field to the previous raster's table (Add Field tool) and populated it (Calculate Field tool) with expression ('[COUNT] x%Analysis cell size% x %Analysis cell size%'/10000 to get a surface in hectare so the toltal uraban floded area is **461 hecatre.**

Rowid	VALUE	COUNT	AREA_HA
0	-20	5124	461