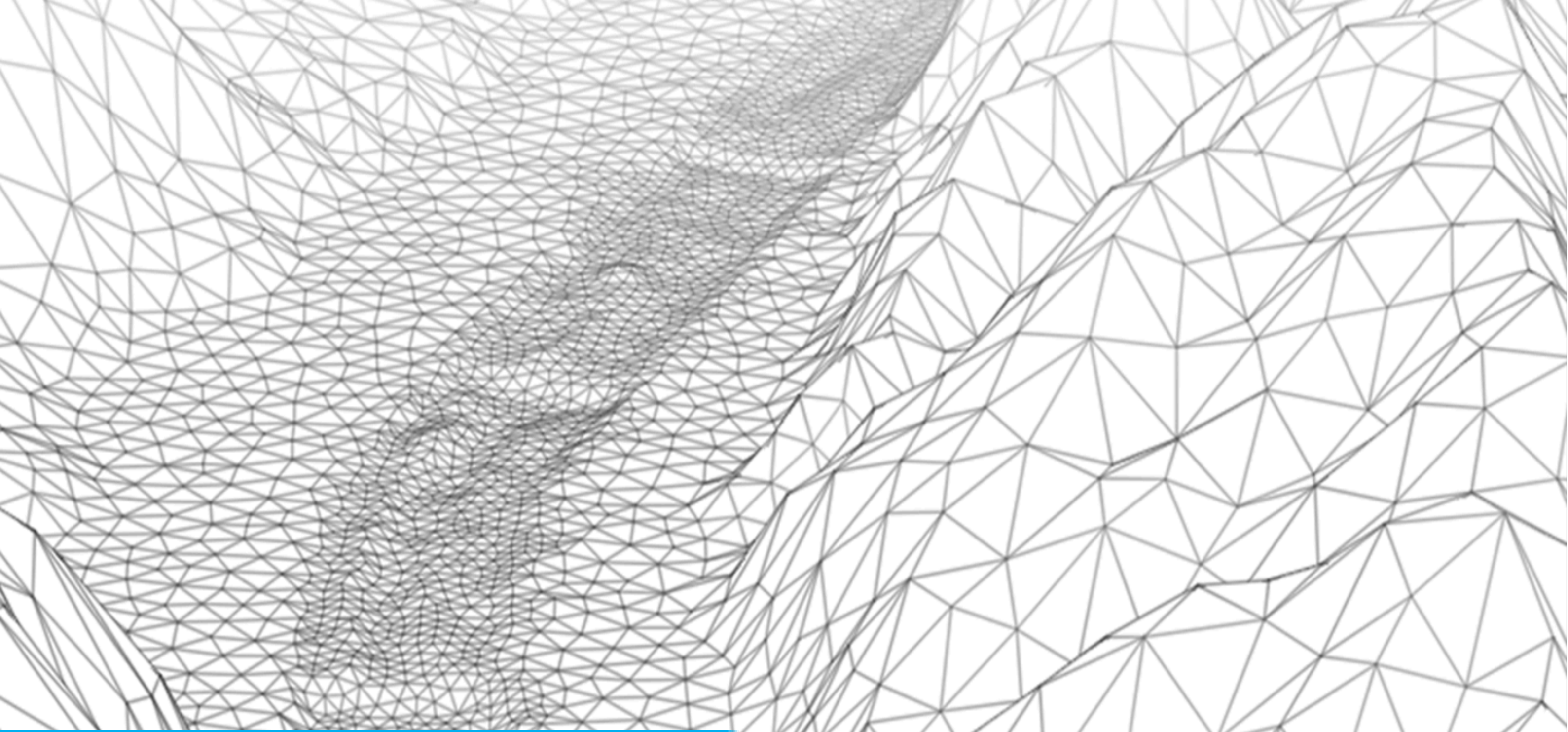

Team 10: Online Phase

HYDROEUROPE

Erasmus+ Programme Cooperation Partnerships
2022-1-FR01-KA220-HED-000089658
HydroEurope

WP2: Uncertainty in Advanced Hydrological and Hydraulic Modelling
WP3: Climate Change Impacts on Flash Floods
Case Study Tervuren Catchment (Belgium)

Team 10 - Report Online Phase: GIS Pre-Processing of Spatial Catchment Data

A.B. and C.D, Team 10
Version 2.1 - 18 février 2023

1. Introduction

Understanding the impacts of climate change on extreme rainfall events is crucial for effectively managing flood risks in urban areas. Particularly vulnerable to both river and extreme rainfall floods, Belgian localities such as Tervuren encounter significant challenges. Since urbanization increases the likelihood of severe disasters, it is essential to precisely predict probable flood scenarios by simulating extreme rainfall occurrences. This report focuses on the methodology used to model severe rainfall occurrences in the context of climate change in Tervuren, Belgium (figure 1). Our approach emphasizes the application of advanced modeling techniques to address the complexities of urban flood dynamics. Our goal is to have a better understanding of the dynamics of intense rainfall events and how they affect flood risk management in urban areas through focused application exercises. This paper describes our research methods and emphasizes how important our findings are for developing adaptable mitigation solutions against the effects of urban floods caused by climate change.

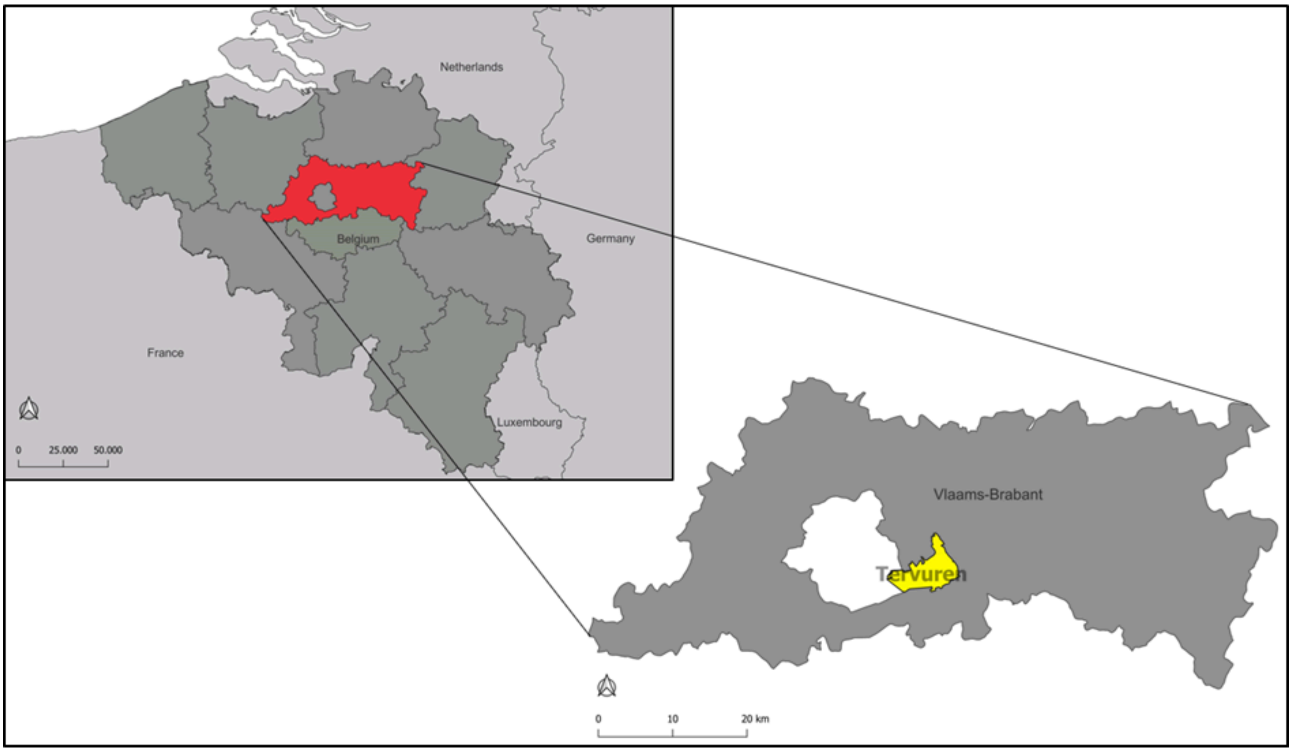

Figure 1. Tervuren municipality in Belgium

2. Methodology

Flood Modelling LISFLOOD

LISFLOOD modeling programme in the VISUAL STUDIO environment was used to simulate intense rainfall events in Tervuren Municipality, Belgium, and evaluate flood hazards in light of climate change. The hydrological rainfall-runoff-routing model LISFLOOD is based on GIS and can simulate all of the events that occur in a watershed. Producing a tool that can be utilized in large and trans-national catchments for a range of applications, such as flood forecasting and evaluating the consequences of river management measures, land-use change, and climate change, was the particular development target (Van Der Knijff et al., 2010). To properly assemble the model, LISFLOOD was built up within the VISUAL STUDIO environment, and the required parameters were modified. After calibrating LISFLOOD, simulated scenarios were run by supplying the necessary input data, which included boundary conditions (water inflow) and the raster Digital Elevation Model. The input data has to be copied to the "out" LISFLOOD output folder for the simulation to run. Once the simulations were finished, the outcomes were examined to determine the dynamics of flooding and the level of flood danger in Tervuren. Key data from the simulation, such as the depths of the water and the amount of flooding, were tabulated to provide a full picture of flood scenarios under different situations.

Preprocessing of Flood Model Data Input

The purpose of the study is to prepare input data for LISFLOOD modeling through a series of tasks. Preprocessing tasks are included in the first phase which includes creating a floodplain friction coefficient file (.n.asc), defining the stream network, and preparing a digital elevation model file (.dem.asc). The stream network delineation is essential because it is the basis for determining the river widths (.width.asc), river bed elevations (.bed.asc), and boundary condition file (.bci) points that are spatially changeable. To achieve this, we utilized two approaches that use the DTM extent (.tif) acquired from earlier steps: GRASS and the PCRaster Tool Plugin, which is a GIS tool. The output from the PCRaster Tool Plugin includes a stream order (.tif), whereas GRASS generates the stream network as a shapefile (.shp).

The second activity in the LISFLOOD input data preparation series focuses on creating maps of river geometry and regionally distributed floodplain infiltration. To precisely define hydraulic conductivity for floodplain infiltration and estimate the river geometry parameters required by LISFLOOD, the process consists of many crucial phases. First, we created a map of the infiltration of floodplains, identifying regions with different hydraulic conductivity levels throughout the research region. We calculated the average infiltration rate from this map and then added it to the parameter file (.par) so that LISFLOOD simulations may utilize it. Furthermore, we used a higher-resolution (1m) elevation model to refine the river geometry parameters, particularly river bed elevation (.bed.asc) and river width (.width.asc). To effectively simulate flood dynamics inside the LISFLOOD model, a more accurate assessment of river features is made possible by the finer-grained elevation data.

The generation of the rainfall data file (.rain) using a carefully designed design storm based on the corrected Intensity-Duration-Frequency (IDF) Curve from Ukkle Station is the primary focus of this last part of the LISFLOOD input data preparation series. The basic resource for creating the design storm is the Corrected IDF Curve.xlsx worksheet, which makes changes for different return periods easier. We used estimated cumulative precipitation data for periods of 5, 10, 15, 30, 60, 120, 180, and 360 minutes, expressed in millimeters, to create the design storm. The 'Tervuren Rainfall Input.xlsx' spreadsheet contains this data, which is necessary to calculate the rainfall intensities that correspond to various periods. Refinement of rainfall predictions was made possible by the improved IDF curve, which improves the accuracy of the design storm used as input data for LISFLOOD simulations. We made sure that the design storm appropriately depicts the strength and duration of extreme rainfall occurrences in Tervuren by including corrected rainfall data based on historical records and statistical assessments.

The development of boundary conditions, particularly the river discharge time series, is the subject of this fourth and final installment of the LISFLOOD input data preparation series. These boundary conditions are necessary for simulating time-varying boundary conditions within LISFLOOD. Using specialized tools, WETSPRO and ECQ, we applied hydrological sub-flow filtering and extreme value analysis methodologies to analyze the flood with a 100-year return period. Willems (2008) created WETSPRO, a time-series tool that divides rainfall-runoff discharge into components related to baseflow, interflow, and overland flow. WETSPRO makes use of the linear reservoir modeling idea to make it easier to extract hydrological sub-flows that are crucial for describing the dynamics of river discharge. Furthermore, extreme value analysis makes use of ECQ, which Willems et al. (2007) created and which offers insights into the likelihood of extreme occurrences occurring. ECQ makes it possible to estimate the 100-year design discharge, a crucial metric for evaluating flood hazards connected to uncommon but high-impact occurrences, by examining historical data and using statistical techniques.

We got the river discharge time series required for modeling boundary conditions in LISFLOOD by integrating the ECQ and WETSPRO approaches. Realistic simulations of flood dynamics under various situations are made possible by this technique, which guarantees that the produced boundary conditions appropriately reflect the hydrological parameters of the studied region.

3. Result and Discussion

Simulation run on LISFLOOD

Numerous hydrological characteristics throughout time, such as area, volume, Qin (inflow), and Qout (outflow), were provided by the LISFLOOD simulation. These simulation findings at various time stages are presented in the following figure:

Time	Tstep	MinTstep	NumTsteps	Area	Vol	Qin	Hds	Qout	Qerror	Verror	Rain-(Inf+Evap)
1.000	1.0000	1.0000	1	2.1750e+05	2.6389e+05	73.000	0.000	6.142	1.4015e-04	1.4015e-02	0.0000e+00
100.000	1.0000	1.0000	100	4.2500e+05	2.6748e+05	73.000	0.000	43.543	3.0762e-04	3.0762e-02	0.0000e+00
200.000	1.0000	1.0000	200	4.6500e+05	2.7179e+05	73.000	0.000	23.498	-1.7578e-04	-1.7578e-02	0.0000e+00
300.000	1.0000	1.0000	300	4.8000e+05	2.7675e+05	73.000	0.000	21.772	-3.2227e-04	-3.2227e-02	0.0000e+00
400.000	1.0000	1.0000	400	4.9750e+05	2.8205e+05	73.000	0.000	16.886	4.1992e-04	4.1992e-02	0.0000e+00
500.000	1.0000	1.0000	500	5.0750e+05	2.8777e+05	73.000	0.000	14.716	-3.5156e-04	-3.5156e-02	0.0000e+00
600.000	1.0000	1.0000	600	5.2250e+05	2.9363e+05	73.000	0.000	14.148	3.0273e-04	3.0273e-02	0.0000e+00
700.000	1.0000	1.0000	700	5.2250e+05	2.9954e+05	73.000	0.000	13.379	1.4648e-05	1.4648e-03	0.0000e+00
800.000	1.0000	1.0000	800	5.3000e+05	3.0552e+05	73.000	0.000	13.010	-1.7578e-04	-1.7578e-02	0.0000e+00
900.000	1.0000	1.0000	900	5.3000e+05	3.1152e+05	73.000	0.000	12.922	-3.4668e-04	-3.4668e-02	0.0000e+00
1000.000	1.0000	1.0000	1000	5.3750e+05	3.1753e+05	73.000	0.000	12.796	3.0273e-04	3.0273e-02	0.0000e+00
1100.000	1.0000	1.0000	1100	5.4500e+05	3.2356e+05	73.000	0.000	12.714	1.8066e-04	1.8066e-02	0.0000e+00
1200.000	1.0000	1.0000	1200	5.5250e+05	3.2959e+05	73.000	0.000	12.671	-2.3437e-04	-2.3438e-02	0.0000e+00
1300.000	1.0000	1.0000	1300	5.6000e+05	3.3562e+05	73.000	0.000	12.672	-8.3008e-05	-8.3008e-03	0.0000e+00
1400.000	1.0000	1.0000	1400	5.7000e+05	3.4165e+05	73.000	0.000	12.718	-1.5625e-04	-1.5625e-02	0.0000e+00
1500.000	1.0000	1.0000	1500	5.8250e+05	3.4768e+05	73.000	0.000	12.800	-7.8125e-05	-7.8125e-03	0.0000e+00
1600.000	1.0000	1.0000	1600	6.0000e+05	3.5369e+05	73.000	0.000	12.895	1.0254e-04	1.0254e-02	0.0000e+00
1700.000	1.0000	1.0000	1700	6.1250e+05	3.5970e+05	73.000	0.000	12.995	-1.2695e-04	-1.2695e-02	0.0000e+00
1800.000	1.0000	1.0000	1800	6.2500e+05	3.6569e+05	73.000	0.000	13.106	-2.5391e-04	-2.5391e-02	0.0000e+00
1900.000	1.0000	1.0000	1900	6.3500e+05	3.7168e+05	73.000	0.000	13.224	2.4414e-04	2.4414e-02	0.0000e+00
2000.000	1.0000	1.0000	2000	6.4750e+05	3.7765e+05	73.000	0.000	13.341	-1.2207e-04	-1.2207e-02	0.0000e+00
2100.000	1.0000	1.0000	2100	6.6000e+05	3.8361e+05	73.000	0.000	13.457	-3.0762e-04	-3.0762e-02	0.0000e+00
2200.000	1.0000	1.0000	2200	6.6750e+05	3.8956e+05	73.000	0.000	13.572	8.9355e-04	8.9355e-02	0.0000e+00
2300.000	1.0000	1.0000	2300	6.8000e+05	3.9549e+05	73.000	0.000	13.685	-5.8594e-04	-5.8594e-02	0.0000e+00
2400.000	1.0000	1.0000	2400	6.9000e+05	4.0142e+05	73.000	0.000	13.797	3.3691e-04	3.3691e-02	0.0000e+00
2500.000	1.0000	1.0000	2500	7.0250e+05	4.0733e+05	73.000	0.000	13.908	-1.7090e-04	-1.7090e-02	0.0000e+00
2600.000	1.0000	1.0000	2600	7.1250e+05	4.1324e+05	73.000	0.000	14.019	-6.3477e-04	-6.3477e-02	0.0000e+00
2700.000	1.0000	1.0000	2700	7.1750e+05	4.1913e+05	73.000	0.000	14.131	5.7617e-04	5.7617e-02	0.0000e+00
2800.000	1.0000	1.0000	2800	7.3250e+05	4.2501e+05	73.000	0.000	14.243	-3.2227e-04	-3.2227e-02	0.0000e+00
2900.000	1.0000	1.0000	2900	7.5000e+05	4.3088e+05	73.000	0.000	14.355	3.4180e-04	3.4180e-02	0.0000e+00
3000.000	1.0000	1.0000	3000	7.6750e+05	4.3674e+05	73.000	0.000	14.469	9.2773e-05	9.2773e-03	0.0000e+00
3100.000	1.0000	1.0000	3100	7.7750e+05	4.4259e+05	73.000	0.000	14.585	2.9297e-05	2.9297e-03	0.0000e+00
3200.000	1.0000	1.0000	3200	7.8250e+05	4.4842e+05	73.000	0.000	14.705	5.7129e-04	5.7129e-02	0.0000e+00

Figure 2. Simulation run results

The area and volume of the flooding are shown in the table as they progressively increase throughout the experiment. Furthermore, the inflow (Qin) and outflow (Qout) values provide insight into the dynamics of water transport in the studied area. With a steady input of 73 m^3/s and an area flooded of 2.17 m^2 at the first time step, the volume is 2.64 m^3. Area and volume rise gradually as the simulation progresses, and shows corresponding changes in outflow rates.

Preprocessing of Input Data

4. Conclusion

A summary of the project

Simulating extreme rainfall events on Tervuren, Belgium

Context: Simulating extreme rainfall events in Tervuren Municipality, Belgium, in a large area at risk of urban fluvial and pluvial floods under the climate change context which influences the situation.

Study approach : Our approach is to begin with application exercises that will enable us to tackle our main subject.

Steps : necessary steps to obtain the required data input of flood modelling

- Exercise 1: Introduction to LISFLOOD FP
- Exercise 2: establish DEM file, Friction map file, stream network delineation
- Exercise 3: Floodplain infiltration and river geometry files
- Exercise 4: discharge (boundary condition and time-varying boundary files)
- Exercise 5: rainfall

Exercise 1: Introduction to Flood Modelling: LISFLOOD

We began by getting to grips with the LISFLOOD modeling tool via VISUAL STUDIO. LISFLOOD-FP is a raster-based flood inundation model that includes several numerical schemes (solvers) that simulate the propagation of flood waves along channels and across floodplains. The model uses a simple storage cell algorithm based on hydraulic continuity principles to calculate water routing through the floodplain and water depth in each raster grid cell. The primary input required by LISFLOOD to simulate inundation dynamics is the raster Digital Elevation Model and boundary condition (water inflow).

- Step1: Downloading and installing the software

- Step2: Set up and compile LISFLOOD from VISUAL STUDIO

- Step 3: Simulate by copying the input data to the LISFLOOD output folder "out".

Data input
Digital Elevation Model
Root for naming of results files
Floodplain boundary condition types
Channel widths for the sub-grid channel model
Channel bank heights file for the sub-grid channel model

Channel bed elevations
Initial water depth condition

.- Step 4: Result, the table below shows the simulation results in tabular form.

res_SGC.mass

Time	Tstep	MinTstep	NumTsteps	Area	Vol	Qin	Hds	Qout	Qerror	Verror	Rain-(Inf+Evap)
1.000	1.0000	1.0000	1	2.1750e+05	2.6209e+05	73.000	0.000	6.142	1.4015e-04	1.4015e-02	0.0000e+00
100.000	1.0000	1.0000	100	4.2500e+05	2.6748e+05	73.000	0.000	43.543	3.0762e-04	3.0762e-02	0.0000e+00
200.000	1.0000	1.0000	200	4.6500e+05	2.7179e+05	73.000	0.000	23.498	-1.7578e-04	-1.7578e-02	0.0000e+00
300.000	1.0000	1.0000	300	4.8800e+05	2.7675e+05	73.000	0.000	21.772	-3.2227e-04	-3.2227e-02	0.0000e+00
400.000	1.0000	1.0000	400	4.9750e+05	2.8205e+05	73.000	0.000	16.986	4.1992e-04	4.1992e-02	0.0000e+00
500.000	1.0000	1.0000	500	5.0750e+05	2.8777e+05	73.000	0.000	14.716	-3.5156e-04	-3.5156e-02	0.0000e+00
600.000	1.0000	1.0000	600	5.2250e+05	2.9363e+05	73.000	0.000	14.148	3.0273e-04	3.0273e-02	0.0000e+00
700.000	1.0000	1.0000	700	5.2250e+05	2.9954e+05	73.000	0.000	13.379	1.4648e-05	1.4648e-03	0.0000e+00
800.000	1.0000	1.0000	800	5.3800e+05	3.0552e+05	73.000	0.000	13.010	-1.7578e-04	-1.7578e-02	0.0000e+00
900.000	1.0000	1.0000	900	5.3800e+05	3.1152e+05	73.000	0.000	12.922	-3.4668e-04	-3.4668e-02	0.0000e+00
1000.000	1.0000	1.0000	1000	5.3750e+05	3.1753e+05	73.000	0.000	12.796	3.0273e-04	3.0273e-02	0.0000e+00
1100.000	1.0000	1.0000	1100	5.4500e+05	3.2356e+05	73.000	0.000	12.714	1.8066e-04	1.8066e-02	0.0000e+00
1200.000	1.0000	1.0000	1200	5.5250e+05	3.2959e+05	73.000	0.000	12.671	-2.3437e-04	-2.3438e-02	0.0000e+00
1300.000	1.0000	1.0000	1300	5.6800e+05	3.3562e+05	73.000	0.000	12.673	-8.3008e-05	-8.3008e-03	0.0000e+00
1400.000	1.0000	1.0000	1400	5.7800e+05	3.4165e+05	73.000	0.000	12.718	-1.5625e-04	-1.5625e-02	0.0000e+00
1500.000	1.0000	1.0000	1500	5.8250e+05	3.4768e+05	73.000	0.000	12.800	-7.8125e-05	-7.8125e-03	0.0000e+00
1600.000	1.0000	1.0000	1600	6.0000e+05	3.5369e+05	73.000	0.000	12.895	1.0254e-04	1.0254e-02	0.0000e+00
1700.000	1.0000	1.0000	1700	6.1250e+05	3.5970e+05	73.000	0.000	12.985	-1.2695e-04	-1.2695e-02	0.0000e+00
1800.000	1.0000	1.0000	1800	6.2500e+05	3.6569e+05	73.000	0.000	13.106	-2.5391e-04	-2.5391e-02	0.0000e+00
1900.000	1.0000	1.0000	1900	6.3500e+05	3.7168e+05	73.000	0.000	13.224	2.4414e-04	2.4414e-02	0.0000e+00
2000.000	1.0000	1.0000	2000	6.4750e+05	3.7765e+05	73.000	0.000	13.341	-1.2207e-04	-1.2207e-02	0.0000e+00
2100.000	1.0000	1.0000	2100	6.6000e+05	3.8361e+05	73.000	0.000	13.457	-3.0762e-04	-3.0762e-02	0.0000e+00
2200.000	1.0000	1.0000	2200	6.6750e+05	3.8956e+05	73.000	0.000	13.572	8.9355e-04	8.9355e-02	0.0000e+00
2300.000	1.0000	1.0000	2300	6.8000e+05	3.9549e+05	73.000	0.000	13.685	-5.8594e-04	-5.8594e-02	0.0000e+00
2400.000	1.0000	1.0000	2400	6.9800e+05	4.0142e+05	73.000	0.000	13.797	3.3691e-04	3.3691e-02	0.0000e+00
2500.000	1.0000	1.0000	2500	7.0250e+05	4.0733e+05	73.000	0.000	13.908	-1.7090e-04	-1.7090e-02	0.0000e+00
2600.000	1.0000	1.0000	2600	7.1250e+05	4.1324e+05	73.000	0.000	14.019	-6.3477e-04	-6.3477e-02	0.0000e+00
2700.000	1.0000	1.0000	2700	7.1750e+05	4.1913e+05	73.000	0.000	14.131	5.7617e-04	5.7617e-02	0.0000e+00
2800.000	1.0000	1.0000	2800	7.3250e+05	4.2501e+05	73.000	0.000	14.243	-3.2227e-04	-3.2227e-02	0.0000e+00
2900.000	1.0000	1.0000	2900	7.5000e+05	4.3088e+05	73.000	0.000	14.355	3.4180e-04	3.4180e-02	0.0000e+00
3000.000	1.0000	1.0000	3000	7.6750e+05	4.3674e+05	73.000	0.000	14.469	9.2773e-05	9.2773e-03	0.0000e+00
3100.000	1.0000	1.0000	3100	7.7750e+05	4.4259e+05	73.000	0.000	14.585	2.9297e-05	2.9297e-03	0.0000e+00
3200.000	1.0000	1.0000	3200	7.8250e+05	4.4842e+05	73.000	0.000	14.705	5.7129e-04	5.7129e-02	0.0000e+00
3300.000	1.0000	1.0000	3300	7.9500e+05	4.5425e+05	73.000	0.000	14.827	-1.2061e-03	-1.2061e-01	0.0000e+00
3400.000	1.0000	1.0000	3400	8.0250e+05	4.6006e+05	73.000	0.000	14.954	-6.7383e-04	-6.7383e-02	0.0000e+00
3500.000	1.0000	1.0000	3500	8.0500e+05	4.6585e+05	73.000	0.000	15.086	6.1523e-04	6.1523e-02	0.0000e+00
3600.000	1.0000	1.0000	3600	8.1250e+05	4.7164e+05	73.000	0.000	15.223	9.5703e-04	9.5703e-02	0.0000e+00
3700.000	1.0000	1.0000	3700	8.2000e+05	4.7741e+05	73.000	0.000	15.365	-5.9570e-04	-5.9570e-02	0.0000e+00
3800.000	1.0000	1.0000	3800	8.2250e+05	4.8317e+05	73.000	0.000	15.513	2.9297e-05	2.9297e-03	0.0000e+00
3900.000	1.0000	1.0000	3900	8.2750e+05	4.8891e+05	73.000	0.000	15.665	-6.6406e-04	-6.6406e-02	0.0000e+00
4000.000	1.0000	1.0000	4000	8.3250e+05	4.9463e+05	73.000	0.000	15.821	1.5430e-03	1.5430e-01	0.0000e+00

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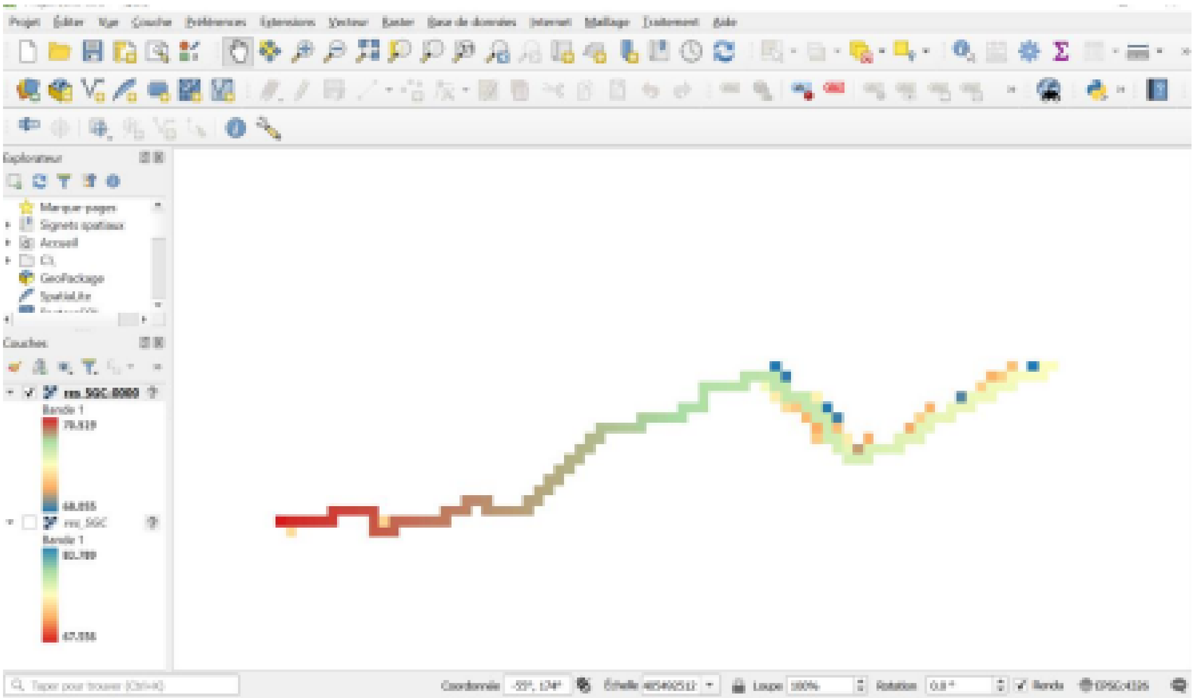
Other datasets can be visualized in raster form. The following figure shows the riverbed elevation map.

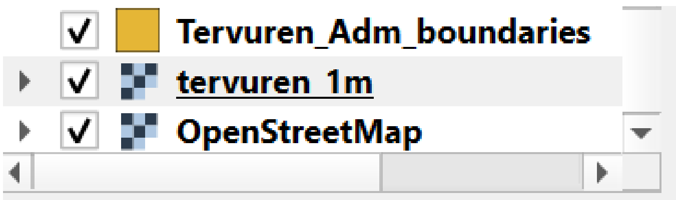


Exercise 2: establish DEM file, Friction map file, stream network delineation

This is the first part of a series of exercises on preparing LISFLOOD input data. We will start the preprocessing by preparing a digital elevation model file (.dem.asc), delineating the stream network, and preparing a floodplain friction coefficient file (.n.asc). The result of the stream network delineation process will be used to define spatially variable river bed elevation(.bed.asc), spatially variable river width (.width.asc), as well as, the points on boundary condition file (.bci).

Digital Elevation Model (DEM):

Step 1: Load DTM and catchment boundary shapefile



Step 2: Reprojection to **Belgian Lambert 72**
Step 3: Clipping and Aggregation by: **Clip Raster by Mask Layer**

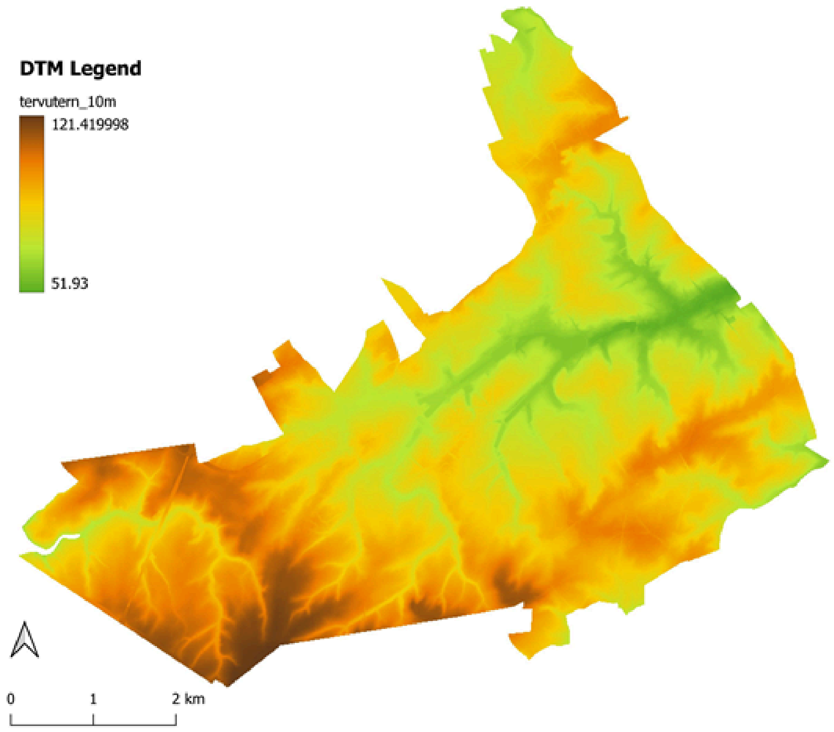
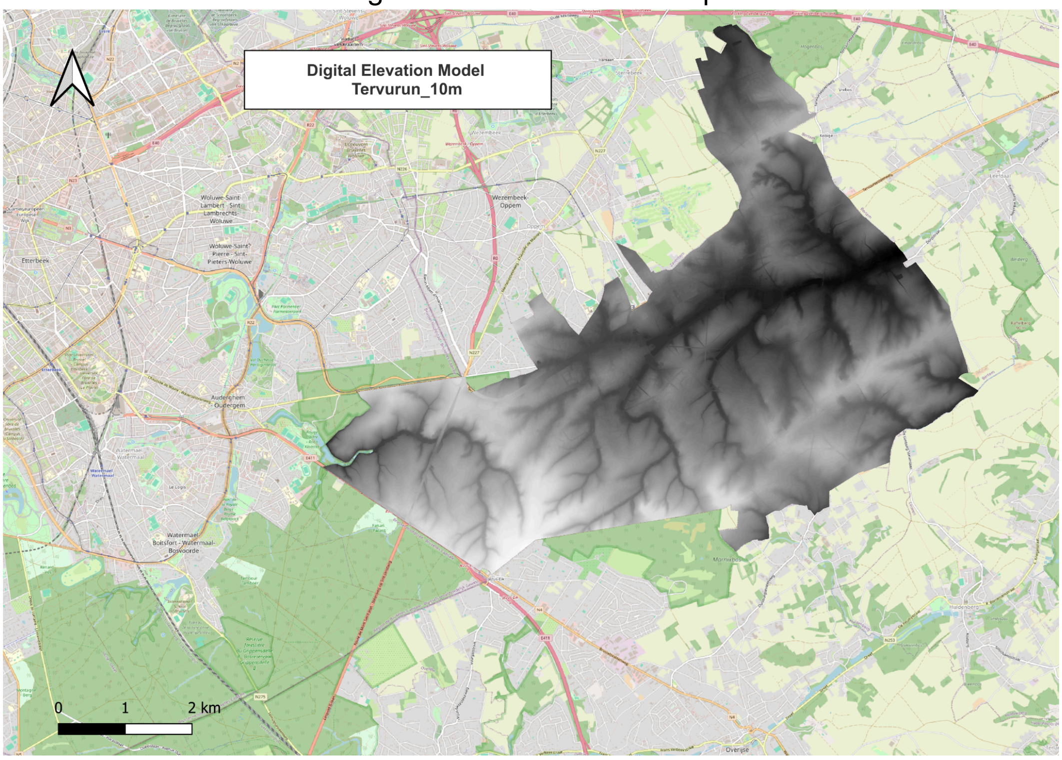


Figure 2. Tervuren DTM map



-DTM layer-10m-

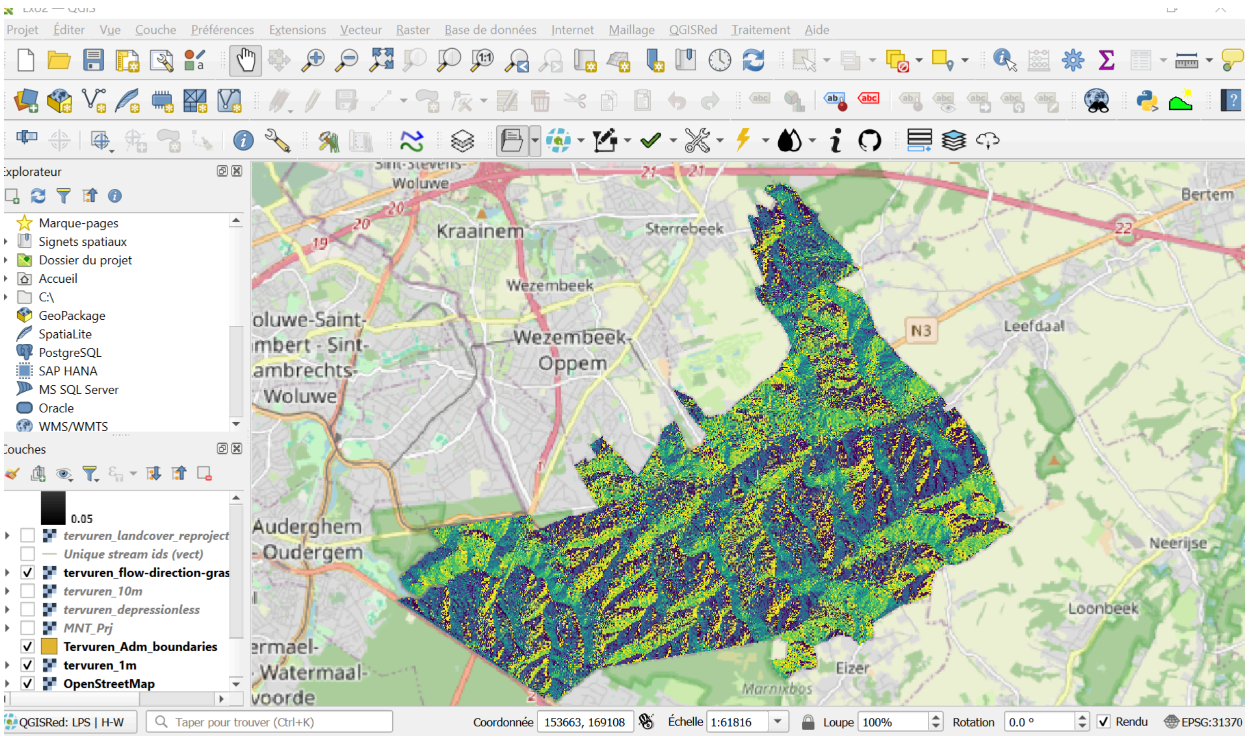
Step 4: Convert/Translate to.ASC format

tervuren_10m.dem..asc	20/12/2023 10:15	Fichier ASC	927 083 Ko

River Network Delineation :

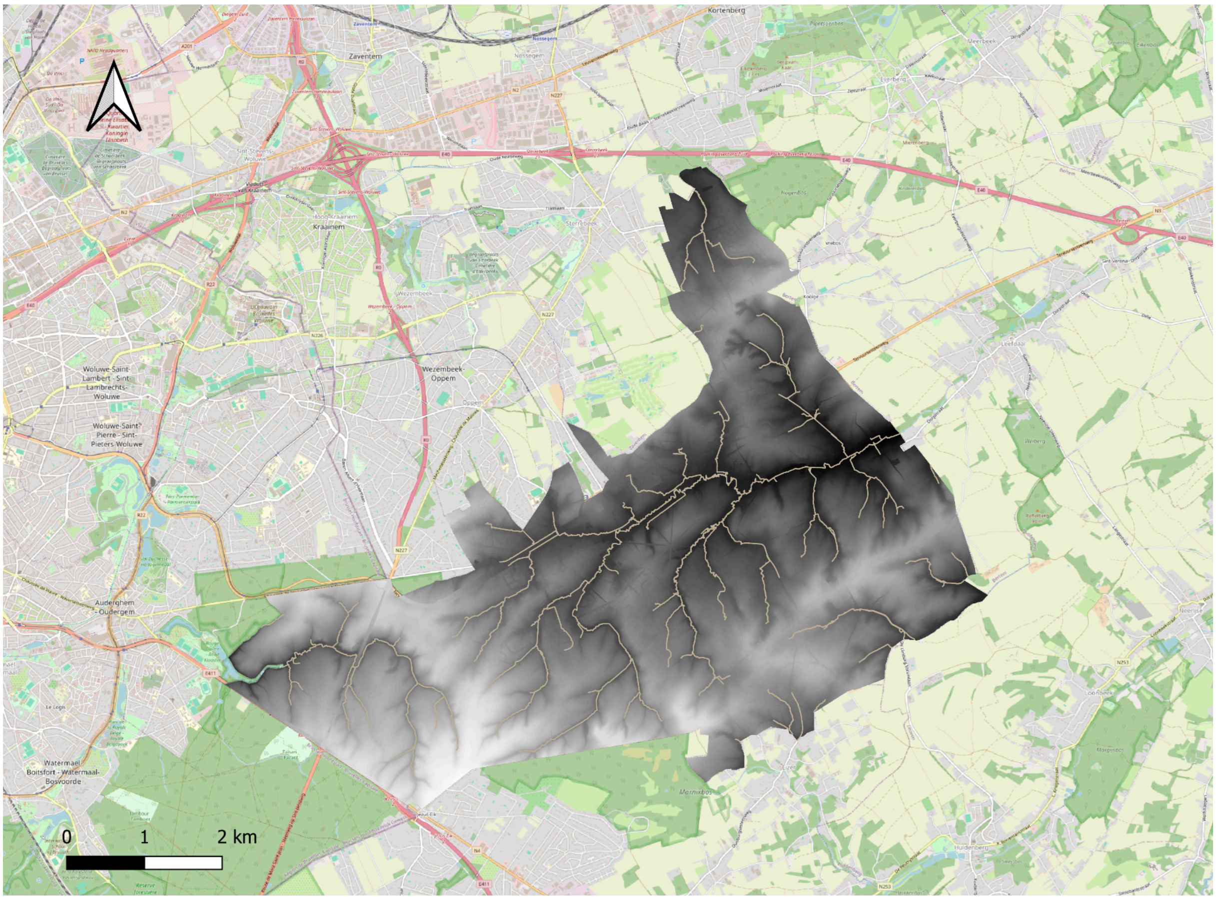
Method 2 : GRASS

Step 1: Depression-less Elevation and Flow Direction



- depression-less elevation map -

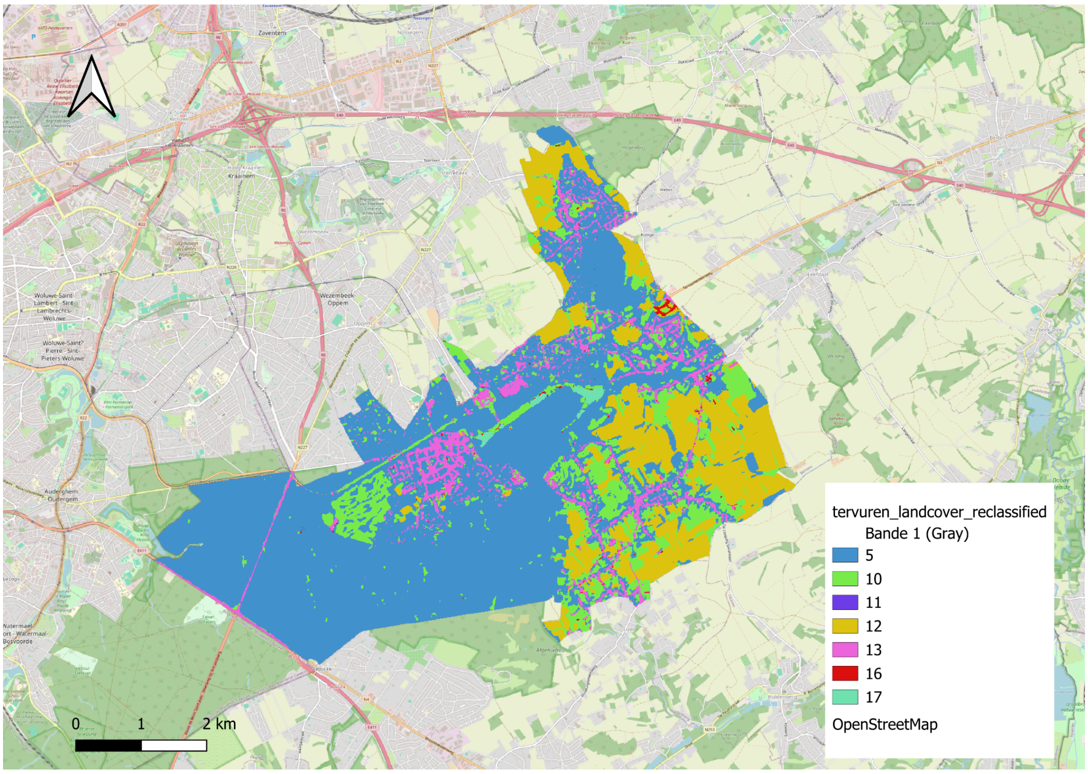
Step 2: Stream Extraction



-Unique stream-

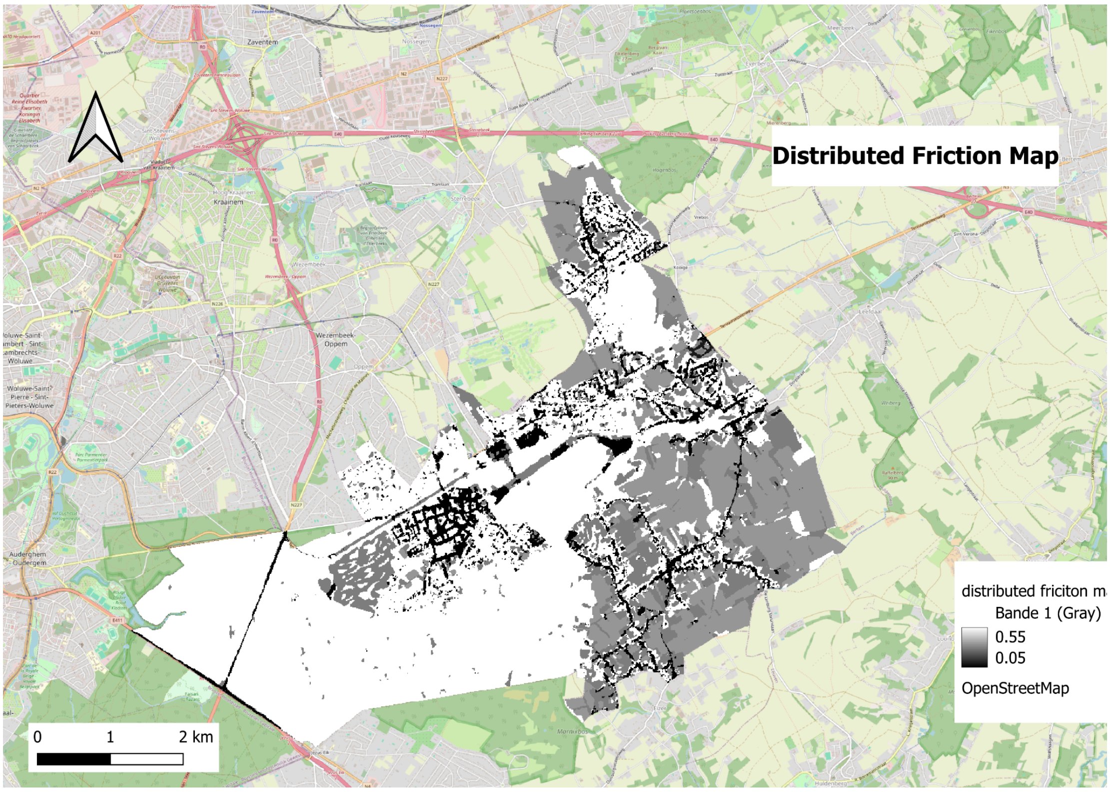
Friction Map

Step 1: Reclassify Land Use Map



-Land Use Map-

Step 2: Distributed Friction Map



Step 3: Clipping and Aggregation by Clip Raster by Mask Layer
Step 4: Convert/Translate

Exercise 3: Floodplain infiltration and river geometry files

This exercise is the second part of the LISFLOOD input data preparation series which will present the workflow to prepare spatially distributed floodplain infiltration and river geometry maps. Based on the floodplain infiltration (hydraulic conductivity) map, the average infiltration rate will be defined and set in the parameter file (.par). Meanwhile, river bed elevation (.bed.asc) and river width (.width.asc), which are the river geometry parameters required by LISFLOOD, will be estimated based on a finer resolution (1m) elevation model.

Step 1 : Floodplain Infiltration

Table B.2: Default parameters characterizing soil textural classes.

Code	Texture classes	Hydraulic conductivity (mm/h)	Hydraulic conductivity (m/s)
1	Sand	208.80	0.000058
2	Loamy sand	61.20	0.000017
3	Sandy loam	25.92	0.0000072
4	Silt loam	13.32	0.0000037
5	Silt	6.84	0.0000019
6	Loam	5.58	0.0000016
7	Sandy clay loam	4.32	0.0000012
8	Silt clay loam	2.30	0.00000064
9	Clay loam	1.51	0.00000042
10	Sandy clay	1.19	0.00000033
11	Silt clay	0.90	0.00000025
12	Clay	0.60	0.00000017

Source: Liu, 2004

Cheking the STATISTICAL_MEAN :

Information du fournisseur

Emprise	155530.0000000000000000,164820.0000000000000000 : 165350.0000000000000000,173060.0000000000000000
Largeur	982
Hauteur	824
Type de Donnée	Float32 - nombre à virgule flottante de 32 bits
Description du Driver GDAL	GTiff
Métadonnées du Driver GDAL	GeoTIFF
Description du jeu de données	C:\Users\youss\OneDrive - Polytech Nice\Desktop\HydroEurope\Week_3\Tervuren_soil_infilvalue.tif
Compression :	
Bande 1	• STATISTICS_APPROXIMATE=YES • STATISTICS_MAXIMUM=5.800000144518e-05 • STATISTICS_MEAN=1.440187155746e-06 • STATISTICS_MINIMUM=1.5499999506119e-07 • STATISTICS_STDDEV=8.3988036460262e-06 • STATISTICS_VALID_PERCENT=40.62 • Échelle : 1 • Décalage : 0
Plus d'information	• AREA_OR_POINT=Area

step 2: River Geometry

River Width

1. Prepare Data Input :

2. Plot Terrain Profile :
3. Calculate River Width :
4. Rasterize River Width :
5. River Width Map Revision :
6. Convert/Translate :

Riverbed Elevation

1. Prepare Data Input
2. Extract Vertice
3. Sample Bed Elevation
4. Rasterize Bed Elevation
5. Convert/Translate

Rain data pre processing

https://docs.google.com/document/d/191mzsDFJMkqPRMwrkbsVjRCoNCsi0tKZA2jfvTEEzeA/edit?usp=sharing

here is the rain fall data that we found