D 6.2.3.

Identified and analysed historical floodplains into Danube GIS and Danube Floodplain GIS

WP:

WP6 Floodplain tools optimization, application and dissemination

Activity:

6.2 Optimization: Danube Floodplain GIS and Inventory

Activity-Leader:

SZTE – University of Szeged, Hungary

Involved partners
USZ, BOKU, TUM, NARW, NIHWM, SWME, MRBA, KÖTIVIZIG, CUEI, MEWF

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Table of Contents

1. Introduction

As part of WP3 of the Danube Floodplain project, the Danube Floodplain Geographic Information System (DFGIS) was developed. Activity 6.2 extended the content and functionality of the Danube Floodplain GIS (D3.1.2) and Inventory (D3.1.3) with the outputs of the activities in WP 4 (which were not planned in the original application form of the Danube Floodplain project) and WP 6. In the original version of the DFGIS, all FEM outputs related to the active and potential Danube floodplains and the selected tributaries were stored and published via a web interface. The extension consists of several parts. First, the results of the ecosystem services (ESS) and biodiversity analysis of the pilot areas of WP4 are integrated in the DFGIS and DFInv. Second, the extended parameters (water level dynamics and extended CBA) of the upgraded FEM-Tool (act 6.1) have been added. Third, the FEM evaluation results of the extended pilot areas will be incorporated. The extensions will make sure that all data of the Danube Floodplain project is stored and published on a uniform platform to support floodplain restoration and preservation. The last extension consists of addition of the historical floodplains along the Danube and Tisza. The updated data from the pilot areas will also be provided to Danube GIS.

2. Former floodplain delineation methodology

In the framework of the Danube floodplain project, former floodplains were delineated along the Danube and published in the DFGIS (Figure 1 and 2). In each country, the floodplain was outlined based on the available data. Therefore, the applied methodology differs per geography region. Former floodplains in countries that were not represented during the extension of the Danube Floodplain projects were delineated by the University of Szeged. In these cases, no manual improvements were conducted due to lack of local knowledge.

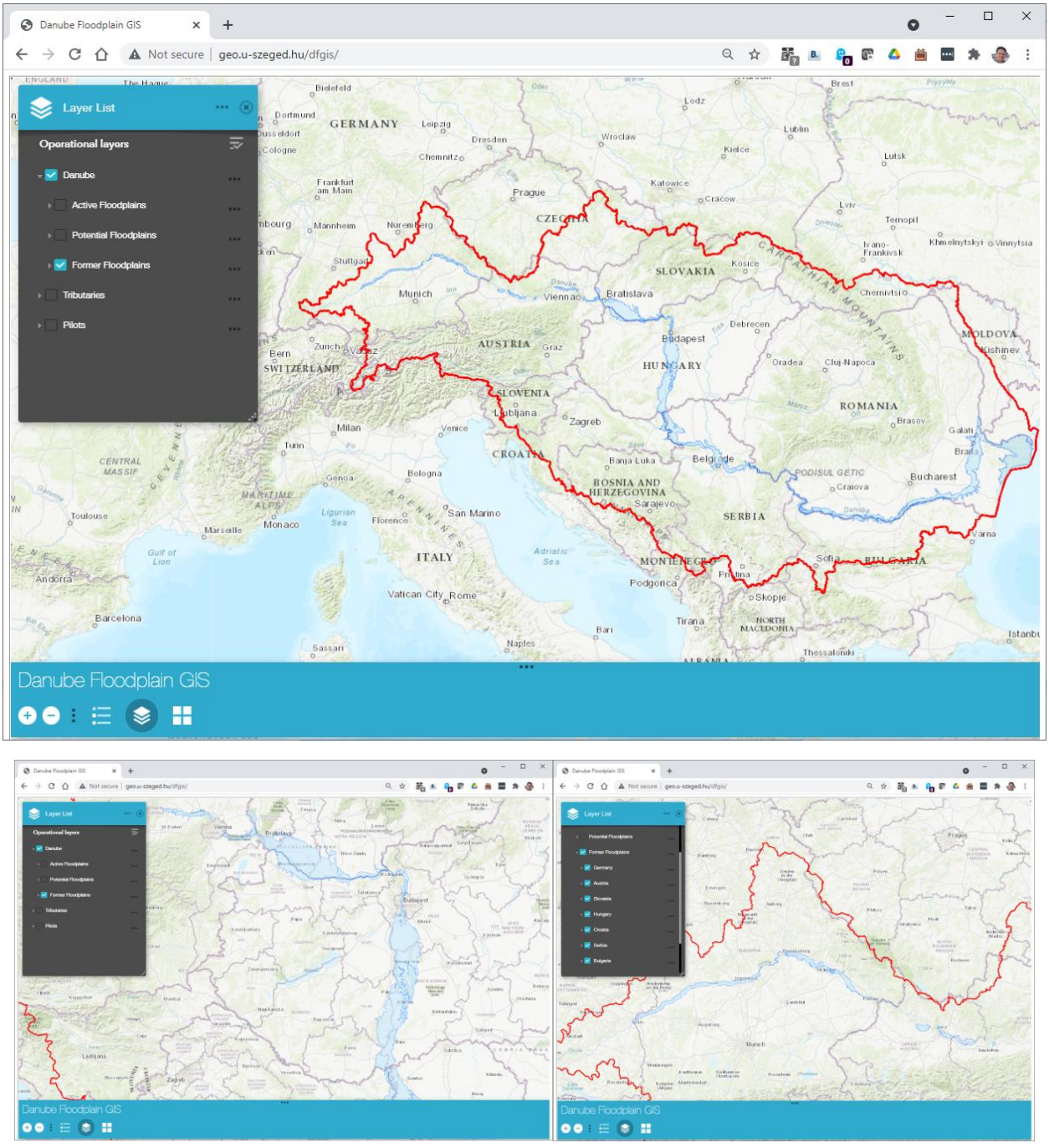

Figure 1. An overview (top) and two subsections (centre and bottom) of the former floodplains in the DFGIS

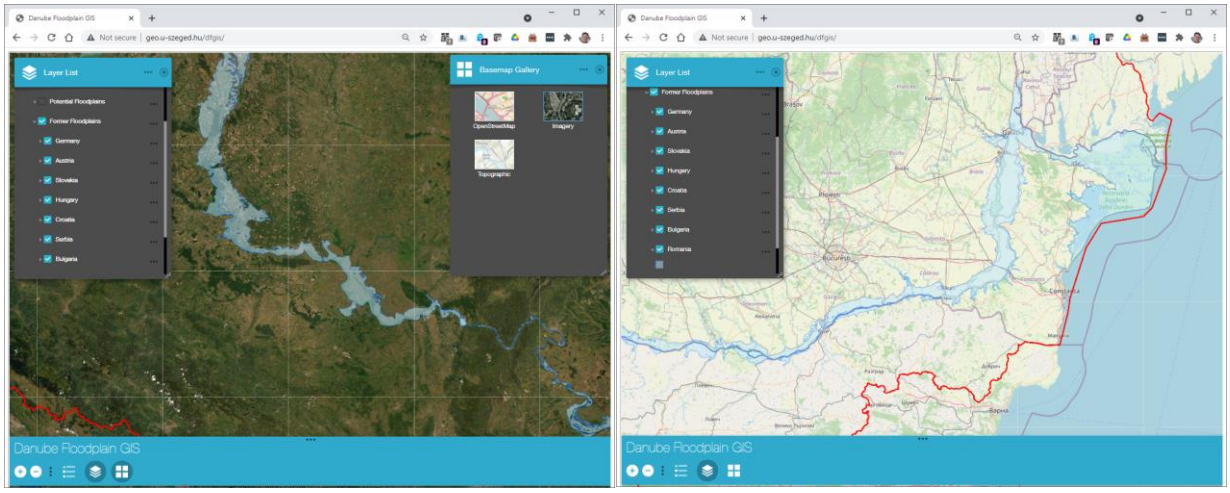

Figure 2. Two subsections of the former floodplains in the DFGIS

A detail description of the methodology per country is given in the following section.

Germany

The Technical University of Munich (TUM) has delineated former floodplains for the Bavarian section of the Danube; the Baden-Württemberg region was not considered in the analysis, due to data availability. A complex methodology was developed that resulted in 12 different floodplain scenarios. The methodology is an adjusted version of the methodology published in *Locating Spatial Opportunities for Nature-Based Solutions: A River Landscape Application (Guerrero et al. 2018)*. Several types of input data were used:

- OpenStreetMap for waterways and rivers
- water depthsof the HQextreme map (0 - >4m)
- ground unit map (soil or sediment conditions):
  - digital pedological map of Bavaria for the digital overview soil map
  - digital geological map of Bavaria for the sedimentological conditions
- Digital terrain model for the topological conditions such as slope, hillshade, etc.

Twelve different floodplain scenarios were created based on combinations of parameters applied to the variables (e.g. a threshold of slope of 3% or 5%). To each scenario, the following post-

processing steps were performed: Gaps smaller than 0,2 km^2 were filled; edges were smoothed; and tributaries were left out.

To calibrate and validate the parameters of the variables and choose the best scenario, historical military map tiles were also used. The Schmitt'sche Karte (Heinrich von Schmitt 1797; Gábor Molnár et al. 2014) is an old military map depicting the rivers in their natural courses, prior to anthropogenic influence. The map drawing started in 1797 by Heinrich von Schmitt on behalf of the German Emperor Franz II. Floodplains were drawn as polygons that cover the typical floodplain-colours on the map and the water course of Danube river. The historical Bavarian floodplain in Skublics' article (Skublics and Rutschmann 2014) was derived from the historical map of Adrian von Riedl (Adrian von Riedl 1808), it was also used to calibrate and validate the modelled former floodplains.

According to the calibration and validation method, the best scenario resulted from the use of the pedological map, a slope threshold of 3%, and a buffer distance from the river network of 4km (*pedological floodplain of 3% 4 km*). Validation with the Schmitt'sche and Skublics' floodplains reveals an accuracy of nearly 70%. Detailed information of the applied methodology can be found in. (Melkisetian, 2021, Identification of Historical Floodplains along the Bavarian Danube, Technical University Munich, Munich).

For more information on the German former floodplains please contact Francesca Perosa (francesca.perosa(at)tum.de).

Austria

Austria's former Danube floodplain has been delineated by the Universität für Bodenkultur (BOKU). The former floodplain was visually interpreted and edited using available digital datasets and historical military maps:

- Polygons of HQ1000 (1000 year flood area, produced in the framework of the Danube Floodrisk project) model were the basis dataset of the analysis
- I. and II. Military Survey map

The I. Military Survey maps were created between 1773 and 1781, which were divided into two regions: Österreich unter der Enns and Oberösterreich. This map illustrates rivers in their natural courses, prior to anthropogenic influence.

The II. Military Survey maps were created in Lower and Upper Austria between 1819 and 1869. This map illustrates the topographical conditions in a more detailed way than the I. Military Survey.

HQ1000 was converted from raster to vector dataset and it was reshaped based on the military survey maps by visual interpretation.

Some post-processing was applied after editing (visual interpretation), such as filling small gaps, eliminating donut polygons, and smoothing sharp edges of the vector layer.

For more information on the Austrian former floodplains, please contact Markus Eder (markus.eder(at)boku.ac.at).

Hungary

The University of Szeged (USZ) has delineated Hungary's former Danube floodplain. The former floodplains were visually interpreted and edited using available digital datasets and historical military maps:

- The HQ1000 model polygons served as the analysis's base dataset.
- II. Military Survey Map tiles

The II. Military Survey maps were created in Hungary between 1819 and 1869. This map depicts the topographical conditions relatively well. Because the colours and styles of the map tiles differ significantly, automated classification or delineation of the former flood plains is not possible. HQ1000 was converted from raster to vector dataset and it was reshaped based on the military survey maps by visual interpretation.

The military survey maps tiles were projected based on the work of *Tímár, G. (2004) GIS integration of the second military survey sections – a solution valid on the territory of Slovakia and Hungary*:

- Higher (southern) tower of the Vienese Stephansdom was the projection center 16º 22’ 29” (from Greenwich)
- Based on Cassini projection
- Central meridian: 16,37º
- Latitude of origin: 48,21º

Some post-processing was applied after editing (visual interpretation), such as filling small gaps, eliminating donut polygons, and smoothing sharp edges of the vector layer.

For more information on the Hungarian former floodplains, please contact Nándor Csikós (csikos(at)geo.u-szeged.hu).

Romania

The National Administration Romanian Waters (NARW) has delineated the Danube's former floodplain in Romania. The former floodplains were visually interpreted and edited using available digital datasets and historical military maps:

- The HQ1000 model polygons served as the analysis's base dataset.
- Georeferenced historical maps

HQ1000 was converted from raster to vector dataset and it was reshaped based on the historical maps by visual interpretation. Some post-processing was applied after editing (visual interpretation), such as filling small gaps and smoothing sharp edges of the vector layer.

For more information on the Romanian former floodplains, please contact Razvan Bogzianu (razvan.bogzianu(at)rowater.ro).

Slovakia, Croatia, Serbia, Bulgaria

The University of Szeged (USZ) has delineated the Danube's former floodplain in Slovakia, Croatia, Serbia, and Bulgaria. Only the HQ1000 dataset was used, because historical maps or other relevant databases to perform a more complex analysis were not available.

HQ1000 was converted from a raster to a vector dataset, and several post-processing steps were taken. The sliver polygons have been removed, and small donut polygons have been filled. Anthropogenic linear elements were removed, and sharp edges have been smoothed.

For more information on the Slovakian, Croatian, Serbian or Bulgarian former floodplains, please contact Nándor Csikós (csikos(at)geo.u-szeged.hu).