

SECONDARY SCHOOL School center Krško-Sevnica, Gymnasium Krško AUTHORS Tanja Fabijan, Karmen Kukovičič, Katarina Pribožič

SUPERVISOR Veronika Gradišek

The Analysis of the Changes Regarding the Sava River and City of Krško



Satellite image data enable direct observation of the land surface at repetitive intervals and therefore allow mapping of the extent and monitoring of different processes at the surface. Our research paper focuses on the changes regarding Krško in the period from 1984 to 2011. Particular interest was placed upon urban sprawl, the changes in the bed of the Sava River and major construction developments conducted on the river.



Problem overview

• We were particularly interested in the changes in our town particulary the ones we have witnessed in the recent decade.

Methods of change detection

- Overview of historical sources.
- Visual interpretation of Landsat imagery and



- Krško has apparently been intensively developed, especially large investments have been made in the fields of traffic and energy infrastructure.
- We were also attracted and encouraged by the possibility of accessing high-quality images and learning new methods of remote sensing.

Data

- RGB orthophotos with 0.5 m resolution for 2003, 2006 and 2009.
- Landsat aerial imagery for 1984, 1991, 1994, 2003, 2007 and 2011.
- Spatial Planning Act of the Municipality Krško.
- Literature about Krško and the Sava River.

- orthophotos.
- Classification of NDVI (Normalized Difference Vegetation Index) image.
- RGB NDVI composite (feature image above).
- Image difference.
- Comparison between old and new Spatial Planning Acts.



Left: NDVI image for 1984. **Right**: NDVI image for 2011. Major differences are shown with red colour. NDVI is very useful when analysing anthropogenic based changes in a landscape.



Methods of change detection. From left to right: Image difference, NDVI image classification, visual interpretation. All of the used methods produced similar results.

• Urban areas have grown on the left and right bank of the Sava River in the southern, south-eastern and south-western direction. In the old town of Krško merely the density of built-up areas has increased due to the special features of relief. On the left bank (Videm) the built-up areas of housing facilities have increased while the building-up of industrial areas has levelled off or even decreased. On the right bank the town is continuously merging with the suburban residential as well as business and commercial areas of Leskovec.

• Due to intense construction works on the energy infrastructure (1981 – Nuclear Power Plant, 2010 – hydroelectric power plants Blanca and Krško) the settlement image has been radically changed.

• The bed of the Sava River moved and changed – in the past due to natural processes, recently mainly due to construction.







From left to right: Boundary stone between historic Štarejska and Kranjska regions which was once in the Sava river but today is far away from the river bed. Embankments in 2003 in 2011 on orthophoto image and construction work.

• Due to increased building material requirements, quarries and gravel pits have become considerably larger.



From left to right: Growth pattern of the quarry between 1984, 2003 and 2011, gravel pit in orthophoto for 2003 and gravel pit in orthophoto for 2011.

Conclusions

• The research paper has confirmed our predictions that the most apparent changes on the Sava River have occurred in terms of the river bed regulations because of **hydro-energy and traffic developments**, in the surrounding areas major changes comprise the increase in the debris, stone and gravel exploitation and the increased urbanisation.

• We have also established that for the final confirmation of the nature of changes field trips are an absolute necessity and Landsat images are less appropriate for establishing the more specific differences.



Visual interpretation of orthophoto imagery. **Left**: orthophoto for 2003. **Right**: Building of a hydroelectric power plant seen on an or-thophoto for 2009.



Small Satellites Systems and Services - The 4S Symposium 2012 Portorož, Slovenia, 4-8 June 2012

