GIS and Spatial Data Network

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Introduction

The spatial databases are not only an important component of national information infrastructure. They are the source of our progress and development in many areas and together with the access to the world geography network they are considered as the attribute of a whole new level of importance. The Internet will provide a framework for future international data sharing and participating for public and private institutions. This is the vision of new access to the services and namely to the spatial data to spread and fulfil the idea of sustainable development on the background of running globalisation [1].

All these plans will consume a lot of money, the aimed effort and professional approach. We can help to accelerate the development of national geographical databases on the field of education, being able to generate the professionals in Geographic Information Systems (GIS) to support the process and make it more efficient.

Our world is much more closed. The successful regional policy and development can be made only with understanding and permanent comparing the local resources with global possibilities. GIS tools are very good equipped for this purposes. The large package of modelling functions is proposed to change our mind, to test new hypotheses and to increase our responsibility for the decisions.

The outstanding possibility to incorporate the temporal dimension of information data into all analytical aspect gives us the new facilities for the trend analysis and new reasons for sharing information [4], [5].

Objects, features and structures

The incorporation of GIS into state administrative, business, investment, networks and many others fields has allowed for wider use and access to a variety of spatial information and new efficient tools for spatial information analysis. Moreover, spatial data are collected and processed and during the last couple of decades the data flow in and between organisations has increased exponentially.

The ways of managing and distributing that data and namely the resolution of data sources have rapidly changed. In connection with these facts also the data management tools and techniques are continually changed. These include the automated recognition including knowledge acquiring, proper handling of large volumes of data, new accesses to data interpretation and effective exchange of information between and among various institutions.

Many users have theirs special requirements on the access to the data, on the content, the administrative units where the evaluation is provided, on the relations and contextual and temporal background for the processing of data. Even the desktop GIS - *ArcView 3.1* allows the users produce theirs own programmes using scripts in the Avenue language and spread the possibilities of large system.

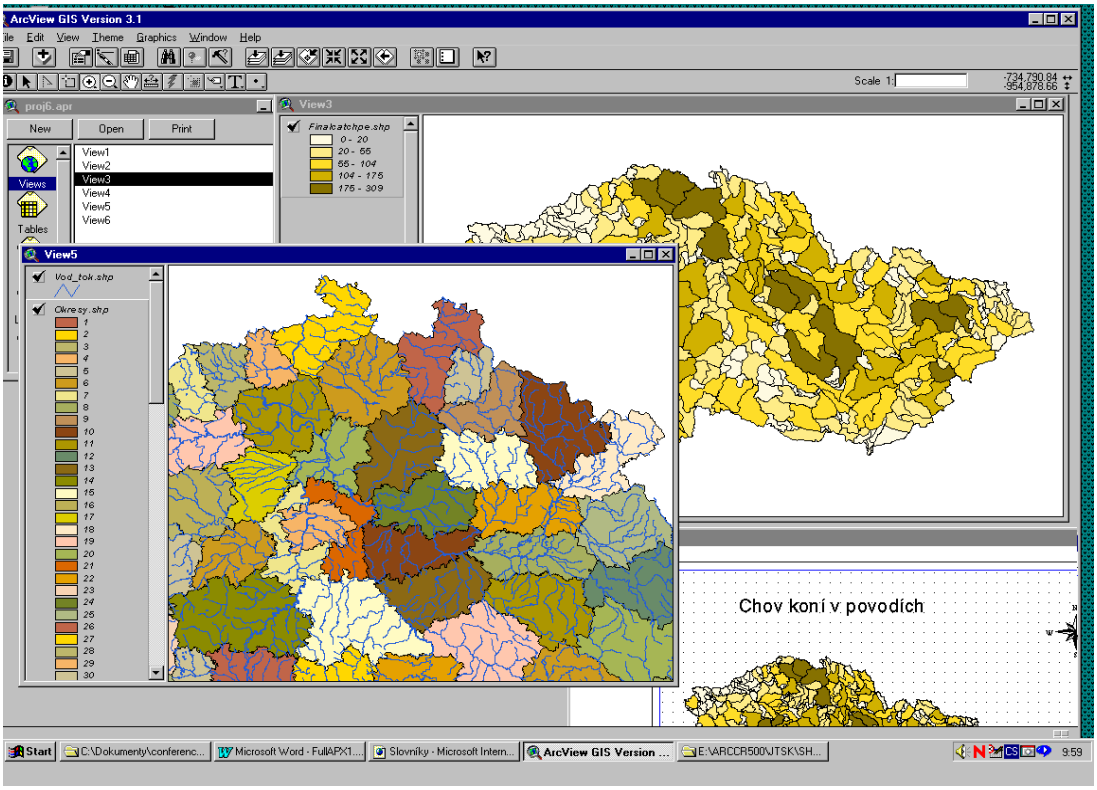


Fig. 1.: A comparison in the use of landscape districts and river basins in evaluation of horse breeding.

Results

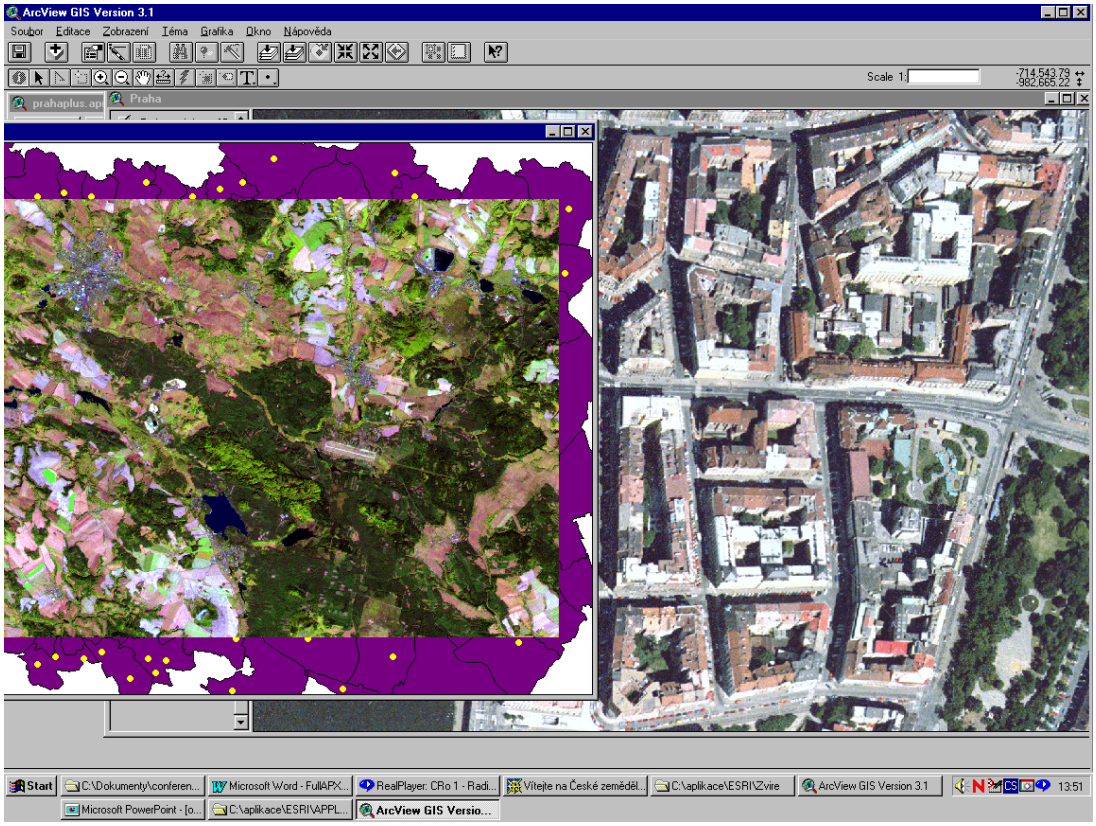
For example, in case of the horse or dairy cattle breeding evaluation it is more suitable use as the unit *the river basin* instead of traditional district or another administrative units. *The river catchment area* respective *the groundwater drainage basin* has direct environmental connection with animal keeping than the administrative department units, see fig. 1.

The plans of world spatial network building open outstanding possibilities for the co-operation and for the use of contextual understanding of phenomena and human activities [6], [7], [18].

The information power continually increase. The satellite data with the resolution 1m are in disposal for many applications and namely for the map creation and updating, see figures 2 and 3. The fine resolution of data

ask for new technology of processing and evaluation. On one hand, the proper edge detection techniques can help us to detect and interpret the objects much more exactly. A new convolution masks have been developed to simplify the process of the vectorization.

On the other hand the high resolution spreads and accomplishes the object structure and hierarchy.



The discrete convolution on the image f_m with the masks g can be expressed as follows:

$$h_m(i,j) = \sum_{k=d}^{h} \sum_{l=d}^{h} f_m(k,l)\, g(i+k, j+l)$$

, where

$d = -(s-1)/2, \quad h = s/2, \quad s$ is the size of the masks.

The figure 5 shows the result of convolution of the original image (fig.4), where 3-level Robinson edge detector in the form of mask of size **5x5** has been used.

It corresponds to the mask:

MASK 1 1 1 0 -1 -1 1 1 0 -1 -1 1
1 0 -1 -1 1 1 0 -1 -1 1 1 0
-1 -1 with the rotation in requested direction.

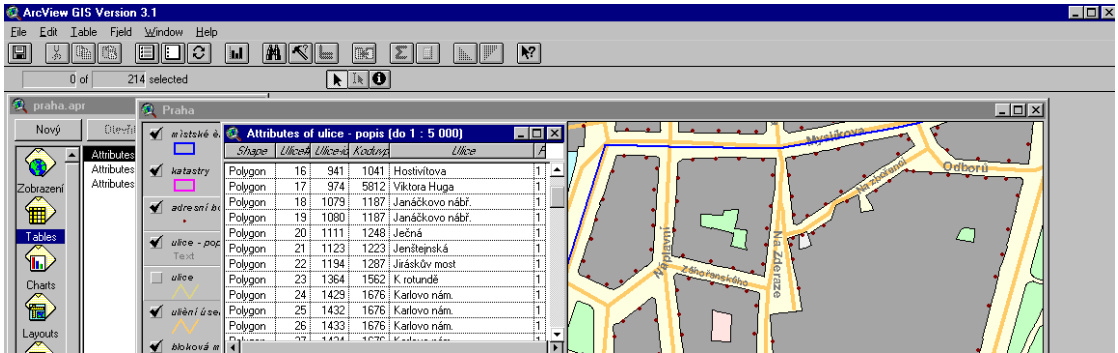


Fig. 3.: The map strip of Prague, the map interpretation, compare with image data in fig. 2, on the right side.

MASK 2						MASK 3					
1	1	1	1	1	0	1	1	1	1	1	1
1	1	1	0	-1	1	1	1	1	1	1	0
1	0	-1	-1	1	0	0	0	0	0	-1	-1
-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1
-1	-1					-1	-1				

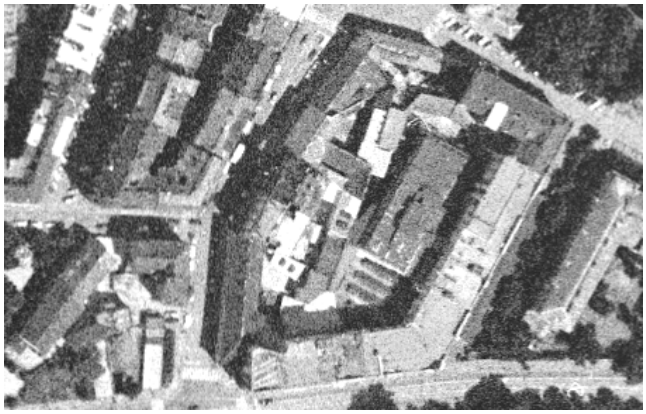


Fig. 4.: Original image, 1m resolution.

Fig. 5.: The result of the convolution with 3level maxabs mask for edge detection.

The object oriented knowledge based DB works with all objects we can recognise and interpret on the image. In connection with increasing resolution of the sources we obtain the increasing number of objects of course and moreover the complexity of object structuring hierarchy is rapidly growing too.We can consider *the house* as well as *the block of houses* , or the type of *the site*. Very similar it is in case of trees: *scattered trees* can create one object and *dense standing trees* another one and what about the *forest*?

The huge amount of data ask for automation of the recognition and interpretation process of spatial data. But this procedures are usually applied without taking context into consideration [2], [6], [8], [16] and even spatial character of data. The cognitive ability of the last mentioned property is rapid and with spatial data network the access would be very simple. The task is to prepare efficient techniques and effective context sensitive methods.

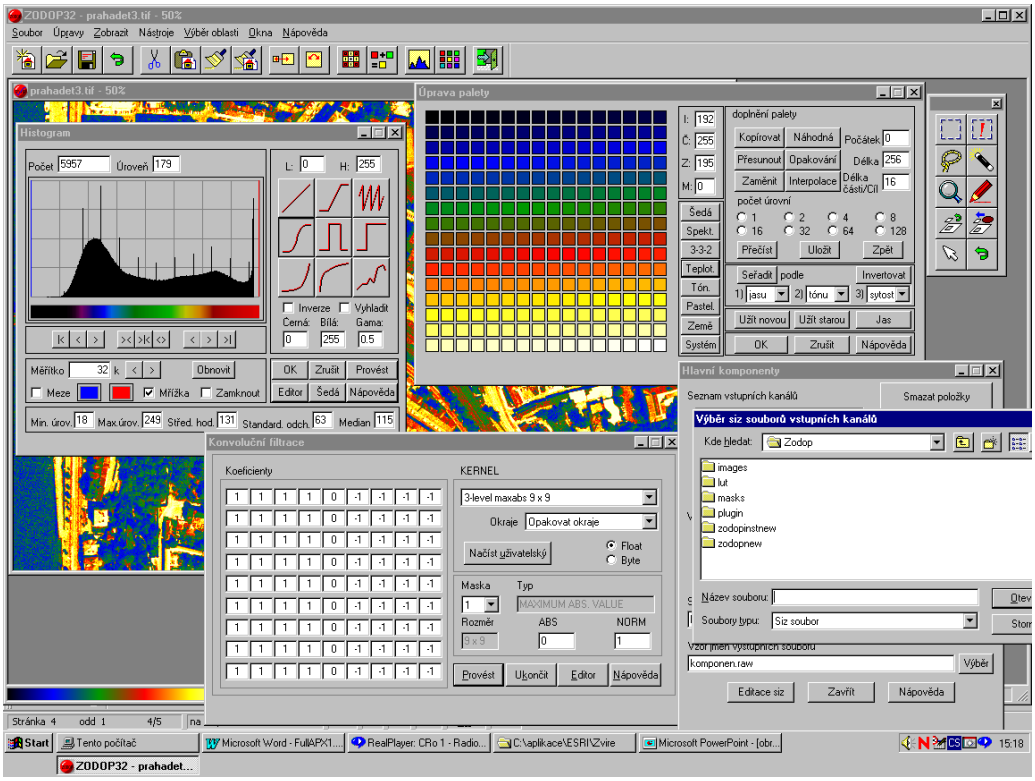


Fig. 6.: The processing window of ZODOP – the programme package for image processing.

Conclusion

In this paper, the problem of the geography spatial data network has been addressed. Our decisions are becoming increasingly dependent on understanding of complex relations and phenomena in the world. And it is the question of accessible information, knowledge based decision making and context sensitive analysis applying. These are requirements of the future development and that is the reason for spatial data network building and sharing. The main goal has been to show selected aspects of this process and compare the increasing possibilities of the sources with the difficulties of data structuring on the background of high resolution of data.

Refernences

[1] Klimešová D.: Information Technology as a Measure of Competitiveness, In: Proceedings of the International Scientific Conference: Agrarian Prospects IX., PEF ČZU, Prague 2000, pp. 121-128, ISBN 80-213-0657-2.

[2] Haslett J.: Maximum likelihood discriminant analysis on the plane using a markovian model of spatial context, Pattern Recognition , vol. 18, no. 3, pp.287-296, 1985.

[3] Postaire, J.G. – Touzani, A.: Mode boundary detection by relaxation for cluster analysis. Pattern Recognition, Vol.22, No.5, pp. 477-489, 1989

[4] Klimešová D., Saic S., Havel J.: Multitemporal and multisource analysis. In: Image Analysis and Synthesis, R. Oldenbourg, ISBN 3-7029-0369-0, ISBN 3-486-22727-0, Vienna, Munich, pp.156-162, 1994.

[5] Klimešová D.,Suk T.: Image Sequence Analysis, In: International Archives of Photogrammetry and Remote Sensing, ISSN 0256-1840, ISPRS, pp. 295-299, Vienna 1996.

[6] Swain P.H., Siegel J.H., Smith B.W. 1980. Contextual classification of multispectral remote sensing data using a multiprocessor system, IEEE Trans. GRS, vol. 18, No. 2, pp. 197-203.

[7] Postaire,J.G.- Vasseur,C.P.A.: A fast algorithm for non parametric probability density-estimation. IEEE Trans. Pattern Analysis Mach. Intel. PAMI-4, 663-666, 1982.

[8] Klimesova D., Saic S. 1998. Texture analysis using S-cobweb, Pattern Recognition Letters 19(1998), pp. 681-685.

[9] Tyree, E.W. - Long, J.A.: Modelling clusters of arbitrary shape with agglomerative partitional clustering. In: Proc. of 1st International Workshop on Statistical Techniques in Pattern Recognition STIPR 97, Praha, june 9-11, pp. 199-204, 1997.

[10] Conners R.W., Trivedi M.M., Harlow CH.A. 1984. Segmentation of High-Resolution Urban Scene Using Texture Operators, CVGIP 25, pp. 273-310.

[11] Besag J. 1996. On the statistical analysis of dirty pictures, Journal of the Royal Statistical Society, Series B, vol.48, no.3, pp. 259-302.

[12] Dong-Chen He and Li Wang 1991. Texture features based on texture spectrum, Pattern Recognition, vol.24, No. 5, 391-399.

[13] Gool L. Van, Dewaele P. and Oosterlinck A. 1983. Texture analysis Anno 1983, CVGIP, vol.29, 336-357.

[14] Haralick R. M., Shanmugam K., Dinstein I. 1973. Textural features for image classification, IEEE Trans. on SMC, vol. 3.

[15] Hughes G.F.1968. On the mean accuracy of statistical pattern recognizers, IEEE Trans. Inf.orm. Theory, vo. IT-14, pp. 55-63.

[16] Nguyen Hong T., Ocelikova E. 1999. Maximum Entropy Image Reconstruction with Neural Networks, Proc. of Digital Signal Processing '99, SR, pp.46-50.

[17] O'Toole R. K., Stark H.1980. Comparative study of optical-digital vs all digital techniques in textural pattern recognition, Applied Optics, vol.19., No.15.

[18] Klimešová D.: Sliding window for relations mapping, Proc. of XIX. ISPRS 2000, Amsterdam, The Netherlands 2000, ISSN 0256-1840, part B7, pp. 688-693.