

Environmental Studies – Achievements of Polish-Croatian GIS Cooperation (1994-2013)

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Received: 26 September 2013

Accepted: 17 February 2014

Abstract

Our paper presents a range of research carried out for environment protection and management using GIS applications. It documents 20 years of scientific achievements through Polish-Croatian cooperation in the GIS field. The resultant body of work includes, inter alia, scientific publications that are the result of 20 international conferences organized in the framework of said cooperation efforts. The study included articles published in 1994 to 2012 and those drafted for publication in 2013. An analysis of select articles was done in accordance with the accepted range of topics in order to categorize and define the research extent. Among the distinguished 19 subject categories, most of the articles were concerned with: environmental management, nature conservation, landscape management, biodiversity, sustainable development, meteorology, and climatology.

Keywords: environmental management, nature conservation, GIS technology, Polish-Croatian cooperation

Introduction

Geographical information system (GIS) technologies have been widely applied in all scientific fields and practical activities, including environmental protection and management, too [1, 2].

The purpose of this article is to characterize the studies in environmental protection and management using GIS technologies, which were carried out under the Polish-Croatian scientific cooperation in the field of GIS. The origins of this cooperation are associated with a special event that took place during the war in the Balkans in 1993. At that time a Croatian GIS expert and his family provided assistance to a Polish group of physicians returning from a humanitarian action in Sarajevo, who had a car accident in Crikvenica, Croatia. In 1994 GIS experts from Croatia took

part in the international conference on Spatial Information Systems GIS/LIS in Commune and Region, organized in Poland in Szczyrk, for the first time. Crikvenica in Croatia is the place where the 20th Geographical Information Systems Conference and GIS Odyssey 2013 exhibition took place. The remaining 18 of 20 GIS conferences took place mainly in Croatia and Poland: GIS Odyssey 2012, Croatia and Bosnia and Hercegovina: Metković, Neretva, Mostar, and Međugorje; GIS Odyssey 2011, Croatia: Lovran, Kvarner, and Istria; GIS Odyssey 2010, Croatia: Brijuni, Istra, and Pula; GIS Odyssey 2009, Croatia: Plitvice, Lika, and Zadar; GIS Polonia 2008, Poland: Zakopane and Kraków; GIS Odyssey 2007, Croatia: Šibenik, Split, Trogir, and Dalmatian Inland – Vrlika, Sinj; GIS Odyssey 2006, Croatia: Šibenik, Split, Krka, and Dalmatian islands; GIS Odyssey 2005, Croatia: Opatija, Pula, and Istria; GIS Odyssey 2004, Croatia: Trogir, Kornati, Hvar; GIS Silesia, Poland: Katowice, Sosnowiec,

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Będzin, Rudy Wielkie, Złoty Potok, Ojców; GIS Odyssey 2002, Croatia: Split, Trogir, Korčula, Mljet, Dubrovnik; GIS Polonia 2001, Poland: Warsaw; GIS Croatia 2000, Croatia: Zagreb, Osijek, Lonjsko Polje; Information Management in the New Millennium 1999, Poland: Kraków; GIS in Cultural and Environmental Heritage Management 1999, Great Britain: York; Processing and Protection of Data 1998, Poland: Ustroń; International Geographic Information Systems Conference and Exhibition GIS Croatia 1998, Croatia: Osijek; and Freedom of Information and its Limits 1997, Poland: Katowice, Ustroń.

Each conference involves a specific body of work published in hard copy (proceedings, monograph, special issue in journals) and electronically (CD, website). Conference sessions as well as chapters in books related to various problems [3-10] and disciplines: geoinformatics, cartography, geodesy, cadastre, ecology, forestry, hydrography, applied economy, and others.

In this work, articles were selected for analysis on environmental protection and management, its structure and functioning, and sustainable development [11, 12].

Materials and Methods

Titles of conference sessions and topics in conference books kept changing to reflect the emergence of new GIS developments and applications across various scientific disciplines and walks of life. The review of more than 750 articles in 26 publications of the two-decade long Polish-Croatian GIS and related topics partnership helped differentiate the following 15 thematic areas [10]:

- Globalization and Social-Economic Problems. Transition and Challenge in the New Europe. Economics and Regional Development;
- Geodesy – Cadastre – Cartography;
- Geoinformatics Systems.
- Information Technology;
- Cultural and Natural Heritage Management;
- Environmental and Earth Resources Management. Structure and Function of the Geographical Environment;
- Agriculture and Forestry;
- Sea and Water Management;
- Ecology;
- State and Local Level Administration and Management (Municipal Projects);
- Space and Law. Legally Protected Regions. Geoinformation and Law. Informatics, Law and Communication;
- Spatial Information Systems in Practice;
- Infrastructure for Spatial Information in Europe;
- Emergency Management, Post-War and Post Disaster Reconstruction Projects;
- International Cooperation;

With a view to the topical extent of the *Polish Journal of Environmental Studies* along with a special issue on GIS application to the research into the environment protection

and management, two areas were covered by research: environmental and earth resources management; Structure and Function of the Geographical Environment; and Ecology.

A detailed analysis was done of articles in said thematic areas that were published as GIS conference materials in 1994 to 2012 (112 articles) and those printed in 2013 (9 articles).

The research proceedings relied on article categorization intended to determine research directions. Categorization is the process in which ideas and objects are recognized, differentiated, and understood. Categorization implies that objects are grouped into categories, usually for some specific purpose. Ideally, a category illuminates a relationship between the subjects and objects of knowledge [13].

To run the categorization process, a body of literature analysis and critical method was used. The literature review as a scientific examination method is used to review scientific works and for peer review. The objectives and functions of the literature review are: description and evaluation of current knowledge for a given topic (research status); arranging the knowledge through categorization to identify any hitherto missed regularities, relations, facts, and phenomena; reveal cognitive gaps in uncharted areas; seek inspiration and research subjects; and identify new research directions [14]. A detailed review of select articles helps classify them into proper categories.

The bibliometric research method was used to present the results. This method is a statistical application for quantitative studies of facts, phenomena, and processes related to texts and information [15].

Results and Discussion

The outcome of the research into the literature on thematic groups such as environmental and earth resources management, structure and function of the geographical environment, and ecology distinguished 19 thematic categories (Table 1). The eligible number of articles in each category which set the course for environmental studies carried out during 20 years of GIS cooperation is shown in Table 2 for the years 1994 to 2012 and for 2013. Table 2 also includes a list of articles published in 1994-2012 by categories in the form of bibliographic citations included in the references.

Most articles were found in the following categories: environmental management, nature conservation, landscape management, biodiversity, sustainable development, soil pollution, meteorology, and climatology. Detailed research issues within each category are presented in the following discussion, presenting the most numerous categories as first and in a broader way.

The problem of environmental management is presented by various subjects and concern dynamics [16-18] and vulnerability of its anthropogenic factors [19, 20]. The issues of land cover transformations, the use of GIS within river floodplains and in marine environments has been shown as well [21-23]. Applying GIS databases into land

Table 1. Results of categorization of published articles (1994-2012).

Article No. in references	Categories
16	environmental management
17	environmental management, biodiversity
18	environmental management, biodiversity
19	environmental management, environmental engineering
20	environmental management
21	environmental management
22	environmental management
23	environmental management
24	environmental management, nature conservation
25	environmental management, landscape management
26	environmental management, nature conservation
27	environmental management
28	environmental management
29	landscape management, environmental management
30	environmental management, landscape management
31	sustainable development, environmental management
32	environmental management, biodiversity
33	environmental management
34	environmental management
35	environmental management, biodiversity
36	environmental management, sustainable development
37	environmental engineering, environmental management
38	environmental management
39	environmental management
40	nature conservation, environmental management
41	nature conservation
42	nature conservation, biodiversity
43	biodiversity, nature conservation
44	nature conservation
45	nature conservation, landscape management
46	nature conservation, biodiversity
47	nature conservation
48	nature conservation
49	nature conservation
50	nature conservation
51	nature conservation
52	biodiversity, nature conservation
53	biodiversity, nature conservation
54	nature conservation
55	soil pollution, nature conservation

Table 1. Continued

Article No. in references	Categories
56	landscape management, nature conservation
57	landscape management, nature conservation
58	nature conservation
59	nature conservation
60	sustainable development, landscape management
61	landscape management, water management
62	environmental remote sensing, landscape management
63	landscape management
64	landscape management
65	landscape management
66	landscape management
67	landscape management
68	landscape management
69	landscape management
70	biodiversity
71	biodiversity
72	ecological education
73	sustainable development, environmental pollution
74	sustainable development, resources management
75	sustainable development, resources management
76	sustainable development, environmental quality
77	sustainable development
78	sustainable development
79	sustainable development, resources management
80	sustainable development, environmental pollution
81	soil pollution
82	soil pollution, air pollution
83	soil pollution
84	soil pollution, environmental pollution
85	soil pollution, environmental pollution
86	soil pollution
87	soil pollution
88	soil pollution
89	soil pollution
90	soil pollution
91	meteorology and climatology
92	meteorology and climatology
93	meteorology and climatology, air pollution
94	meteorology and climatology
95	resources management, meteorology and climatology
96	meteorology and climatology

Table 1. Continued

Article No. in references	Categories
97	environmental remote sensing, meteorology and climatology
98	meteorology and climatology
99	meteorology and climatology, environmental quality
100	meteorology and climatology
101	air pollution
102	air pollution
103	environmental quality
104	ecological disaster, environmental quality
105	environmental remote sensing
106	environmental remote sensing
107	environmental remote sensing
108	hazards to human health and safety
109	hazards to human health and safety
110	ecological disaster, hazards to human health and safety
111	hazards to human health and safety
112	hazards to human health and safety
113	ecological disaster, hazards to human health and safety
114	hazards to human health and safety
115	ecological engineering
116	environmental engineering
117	environmental engineering
118	environmental engineering
119	environmental engineering
120	resources management, water pollution
121	water management
122	water management, water pollution
123	water management
124	water management
125	water pollution
126	water pollution
127	water pollution

and national parks management [24-26] was used widely, presented in the form of landscape differentiation. Consideration and discussion of the relationship between sustainable development and the environmental quality management system takes place both in Polish [27-29] and Croatian [30, 31] papers.

The studies also are undertaken to create digital maps of selected environmental components such as soil and ecological aspects, vegetation cover, and terrain forms.

These components are analyzed using GIS methods to underline their significance in such investigations [32, 33]. The ecological and social aspects of implementing GIS in a spatial perspective of a characterization of the ecotone in time and space between boundary elements is discussed in various works [34, 35].

Basic rules of geological mapping in the inhabited and different areas become requirements of potential users of geological maps [36]. That is why the problem of the integration of the geology, the engineering, and the environmental sciences by a unification of cartographic data [37] using GIS is presented. The description and the implementation of methods for measuring rock deflowering [38], the manner in which the environmental emission cadastre is managed in Croatia, and the significance of mapping such a cadastre at different levels is given by Krakar [20]. And land management with different approaches to the existing land consolidation and the rules of contemporary land usage is presented [39, 40].

Using GIS tools in nature conservation occupies an important place in both Polish and Croatian studies. They include biotic studies at the species [41, 42], population [43], and ecosystem levels [24, 40, 44-47]. It should be emphasized that the proposed protection and distribution of species is prepared with databases using the GIS tool [26, 48-50] in the form of digital maps of protected areas [51].

Authors also raise an issue of using common GPS receivers in processing standard data forms and preparing a protection activities plan [52], long-term ecological studies [53], vegetation mapping [54], and measuring the influence of soil pollution in relation to vegetation diversity data [55] for submerged plants registration.

The importance of data in spatial planning of a natural and an anthropogenic landscape is shown both in Poland and Croatian research with emphasis on the database creation [56, 57] and the documentation of the historical heritage and their changing processes [58] in the context of sustainable development [59].

In the category of landscape management versus environmental objects management, both elements are analyzed separately and a specific element of the cultural landscape has been investigated. Research concerns sewage treatment [60], methods and management of rainwater by creating a planning map [45, 57, 61], using remote sensing in the process of the evaluation and the management of chosen landscape components [62], and in analysis of occurrences of the anthropogenic types of landscapes on the morphometric features of the land [63]. The research on changes of landscape in terms of historical and contemporary problems include both natural [25, 30, 64] and anthropogenic [29, 65-67] studies. The implementation of GIS methods plays a significant role in these studies. The articles present the source databases storing information concerning land cover/use and land cover change (types e.g. arable lands, forests, artificial surfaces) and show some examples of how land cover changes reflect the differences in spatial organization of various regions in time and space [56, 68, 69].

Articles about biodiversity issues focus on the protection of threatened species and ecosystems susceptible to

Table 2. Number of articles (published 1994-2012 and unpublished 2013) within each category.

Category	Article No. in references	No. of articles 1994-2012	No. of articles 2013	Total No. of articles 1994-2013
air pollution	82, 93, 101, 102	4		4
biodiversity	17, 18, 32, 35, 42, 43, 46, 52, 53, 70, 71	11	1	12
ecological disaster	104, 113, 110	3		3
ecological education	72	1		1
ecological engineering	115	1		1
environmental engineering	19, 37, 116, 117, 118, 119,	6		6
environmental management	16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40	25	6	31
environmental pollution	73, 80, 84, 85,	4		4
environmental quality	76, 99, 103, 104	4		4
environmental remote sensing	62, 97, 105, 106, 107	5		5
hazards to human health and safety	108, 109, 110, 111, 112, 113, 114	7		7
landscape management	25, 29, 30, 45, 56, 57, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69	16	3	19
meteorology and climatology	91, 92, 93, 94, 95, 96, 97, 98, 99, 100	10		10
nature conservation	24, 26, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59	22	2	24
resources management	74, 75, 79, 95, 120	5	1	6
soil pollution	55, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90	11		11
sustainable development	31, 36, 60, 73, 74, 75, 76, 77, 78, 79, 80	11		11
water management	61, 121, 122, 123, 124	5		5
water pollution	120, 122, 125, 126, 127	5		5

human activities [18, 32, 43]. These pieces of work show the importance of the spatial analysis and the documentation of these unique natural objects to their monitoring and minimizing the hazard [17, 35, 42, 46, 52, 70]. The promotion of ecological education in the context of bird protection [53, 71] and sustainable development in Poland is discussed as well [72].

The issue of sustainable development is raised mainly by presenting ways of using renewable energy [73-75], bio-fuel [76], ecological production [77], improved living standards [31, 60, 78], and the maximum possibilities of GIS tool in making maps of natural resources and potential threats [36, 79, 80].

The problem of soil pollution relates primarily to Polish territory. This includes the impact of human activities on contents of heavy metals in soil [81], the influence of pollution on vegetation [55], and human health [82], as well as the spatial presentation of pollution [83, 84]. A literature survey about mercury pollution in the Silesian environment is shown by Michalska and Michalski [85]. An assessment of soil contamination using geostatic methods is analyzed as well as the significance and survey of interpolation tech-

niques for determining soil pollution state [86, 87, 88]. Particular attention is paid to the issues of the soil pollution, erosion, protection, reclamation, and management of devastated and degraded lands in the example of Poland [89]. The spatial differentiation of Quaternary sediments from digitized maps is presented as well [90].

In terms of meteorological and climatological issues, articles can be divided into two subcategories. The first one is a thematic mapping [91, 92] and the second group concerns air quality [93]. In the field of atmospheric sciences and hydrology, GIS applications presented in papers are addressed to several important regions of interest [94-96]. Articles have raised issues of difficulties in presenting meteorological satellite products using GIS technology [97], modelling and validating potential solar radiation for the Hornsund Region – Application of the r.sun Model [98]. The reconstruction of air temperature maps for the territory of Poland through the application of contemporary GIS techniques is analyzed [99]. The application and validation of the residual kriging method for the interpolation of the monthly precipitation field in Poland is presented by Kryza [100].

Information about air pollution and meteorological conditions in an exemplary area was analyzed by Leśniok and Puszczewicz [93] in Sosnowiec using GIS methods, a monitoring system and an exemplary database presented for select parameters. In Croatia the application of GIS in air quality monitoring in one exemplary country was analyzed in law aspects, and international conventions ratified by this country [101]. Some materials present digital maps of pollution distribution based on the spatial analysis of an existing GIS environmental database [82, 102].

The presentation of pollution and environmental qualities as soil, waste, and more has been shown in many articles [73, 76, 80, 84, 85, 99] by creating maps using GIS tools. There are pieces of work presenting the methods for determination of vulnerability of ground water [103]. An interesting piece of work is a report concerning the Fukushima Nuclear Accident Independent Investigation Commission and some other problems caused by the earthquake and the tsunami that damaged nuclear reactors in Fukushima Daiichi [104].

Environmental remote sensing is presented using databases and applications in CPS-3 cartographic software, satellite photographs [105], and methods of interpreting geological data with satellite images [106]. The established GIS model of wetland areas provides data on the structure, distribution, size, and position of wetland types in the area of Crna Mlaka. The presented model gives a lot of possibilities and facilitates further field research [107]. The remote sensing technology has been used for spatial management of the environment [62] and meteorology [97] as well.

The problem of hazards to human health and safety is shown in several articles concerning the following factors: noise [108, 109], noise hazards and their documentation around the major [110], acoustic fields, acoustic maps [111, 112] and nuclear power plants after the Japanese disaster [113]. The hazard has been shown also in the case of framework of the PELMON Project, in which monitoring the pelagic fish stock was performed over 20 days by the research vessel Bios in Croatian territorial waters and exclusive economic zone of the Adriatic Sea [114]. The problems mentioned in this piece of work also belong to category of ecological disaster [110, 113, 104].

Problems concerning environmental and ecological engineering include the reconstruction and the creation of appropriate conditions for the rational use of natural resources [19, 37, 115]. The articles present an attempt to quantitatively predict the occurrence of zones of potential hydrocarbon accumulation [116], aerofoil characteristics for wind turbine applications [117], and correlation between geodetic and geological models of tectonic movements for the area of the Adriatic micro plate and its marginal zones [118]. The use of GIS for a renewable energy development strategy proposal for the Tameside MBC (UK) is analyzed as well. This topic is presented by Papadopoulou, Jašlar [119].

The resources management category shows the proper use of natural resources. Each element has a specific requirements in the case of oil and gas exploration [120, 79], integrated GIS applications in the hydrometeorological

service in Poland [95], and regional approaches to management of renewable energy resources in Croatia [74, 75].

The problems of water management in the achievements of the two countries play a significant role [61, 121, 122, 123,]. Articles in this area are related to the use of water supplies for the population and other processes. Particular attention has been paid to issues of the use of GIS thematic mapping [124], which is relevant water management in some regions.

Water pollution is presented in the analysis of GIS in different regions of Croatia [122, 120, 125]. There are also some referentions to the impact of pollution in the functioning of aquatic ecosystems. The research includes long-time series studies of basic oceanographic parameters at Glava Gata station in the Split area [126] and sensitivity index of the coast of the place of refuge to oil pollution [127]. It seems that GIS documentation is helpful in monitoring, further investigating, and studying natural and geographical environments.

Conclusion

The result of the 20 years of Polish-Croatian scientific cooperation in the field of GIS is in more than 750 articles in 26 book publications – an important scientific achievement. The total of 121 articles raising the issues of GIS application in environmental protection and management was the subject of research, the aim of which was to determine the directions of research being conducted. The outcomes of such analysis allowed the conclusion that these studies were of a multi-faceted nature, with research facilities including elements of both wildlife and urban space. The research was largely focused on thematic categories such as: environmental management, nature conservation, landscape management, biodiversity, sustainable development, soil pollution, meteorology, and climatology.

References

- GAJOS M., SIERKA E. GIS technology in environmental protection: research directions based on literature review. *Pol. J. Environ. Stud.* **21**, 2, **2012**.
- GAJOS M., SIERKA E. Research directions of GIS technology application in environmental protection: analysis of Polish scientific journals. *Roczniki Geomatyki* **9**, 3, **2011** [In Polish].
- GAJOS M. 10th GIS conferences longer co-operation. In: D. Kereković (Ed.) *GIS Applications and Development*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 291-301, **2006**.
- WIĘCKOWSKA U., PRZYBYSZ H. Bibliography of GIS. In: D. Kereković (Ed.) *GIS Applications and Development*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 304-335, **2006**.
- GAJOS M. GIS international conferences. Practice and Theory of Scientific and Technical Information 3-4, **2007** [In Polish].
- GAJOS M. Participation of Croatia and Poland in GIS cooperation. In: D. Kereković (Ed.) *Time, GIS & Future*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 269-276, **2009**.

7. GAJOS M. Bibliography of GIS supplement 2006-2008. In: D. Kereković (Ed.) Time, GIS & Future, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 277-287, **2009**.
8. GAJOS M. Research directions of Polish-Croatian GIS cooperation. In: D. Kereković (Ed.) The Future with GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 235-242, **2011**.
9. GAJOS M. Bibliography of GIS – supplement 2006-2010. In: D. Kereković (Ed.) The Future with GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 213-226, **2011**.
10. GAJOS M. GIS Bibliography. Polish-Croatian Cooperation 1994-2013 (website: <http://gis.us.edu.pl/index.php/gis-bibliography-1994-2013>) **2013**.
11. MYGA-PIĄTEK U. Transformation of cultural landscapes in the light of the idea of sustainable development. *Problemy Ekorozwoju. Problems of Sustainable Development* **5**, 1, **2010** [In Polish].
12. MYGA-PIĄTEK U. The concept of sustainable development in tourism. *Problemy Ekorozwoju. Problems of Sustainable Development* **6**, 1, **2011** [In Polish].
13. Wikipedia. The Free Encyclopedia. Categorization (website: <http://en.wikipedia.org/wiki/Categorization>).
14. ANKEM K. Evaluation of method in systematic reviews and meta-analyses published in LIS. *Library and Information Research*, **32**, 101, **2008**.
15. DIODATO V. Dictionary of Bibliometrics. New York: The Haworth Press, **1994**.
16. KOZACKI L. The dynamics of the environment as an important part of spatial development plan and the protection of environment (in aspect of information systems). In: A. T. Jankowski (Ed.) *Informacja i informatyka w administracji publicznej*. Vol. II, SILGIS Center Association, Katowice, 90-91, **1994** [In Polish].
17. RAHMONOW O., CAPUTA Z. The vegetation cover the Błędów Desert in Geographical Information System (GIS). In: D. Kereković, E. Nowak (Ed.). GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 120-123, **2001**.
18. RAHMONOV O., CAPUTA Z., KŁYS G. Biogeocenosis formation in an area with varied topography. In: D. Kereković (Ed.). GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 516-524, **2002**.
19. KOŠČAK V., MĹAKAR A., MARUŠIĆ J. Environmental Vulnerability Study of the Riparian Landscape of the River Kupa. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 120-128, **1999**.
20. KRAKAR Z. The Establishment of the Environmental Emissions' Cadastre in the Republic of Croatia. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 28-35, **1999**.
21. KUPIEC M., PIEŃKOWSKI P., CEDRO B. Changes in hydrology network and land cover of the alluvial zone in the middle part of the Rega valley. In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 333-341, **2004**.
22. KUŠAN V., SAMARDŽIJA N. Color infrared aerial photographs as a tool for tree health assessment in urban forestry. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 152-158, **2001**.
23. DADIC V., SRDELIC M. Planning of assignment and protection of marine area in Split-Dalmatia County. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 179-189, **2001**.
24. BODLOVIC D., PINTER C. Geographic Information System (GIS) approach to nature park management. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 512-518, **2000**.
25. LITWIN L. Application of GIS tools in production of numerical maps of high-mountain Karst area (Tatra National Park, Poland). In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 440-447, **2002**.
26. LITWIN L. Geographical Information System for National Parks based on map server technology. In: D. Kereković (Ed.). Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 371-379, **2004**.
27. ŻUKOWSKI P. Pattern of sustainable development and environmental quality management system. In: G. Szpor, D. Kereković (Ed.). Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 13-22, **1999** [In Polish].
28. RUDZIŃSKA A., CZOCHAŃSKI J. T. Geographic information system for the Pomeranian Region as an integration platform and monitoring in information and regional development. In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 525-535, **2002**.
29. BARTNICKA J., HORZELA I. Using Matrix of Competencies in Project from the Field of Environmental Management. In: D. Kereković (Ed.) Richness and Diversity of GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 266-271, **2007**.
30. LUČEV B., MAČEK V. Strategic planning on case island Mljet. In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 448-456, **2002**.
31. VARGA D. An approach to sustainable development strategy of municipality Bilje. In: D. Kereković (Ed.). GIS Croatia

2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 393-411, **2000**.
32. JAŠLAR J., PAPADOPOULOU K., KOŠKAA. Application of GIS to show relation between soils, plant cover and relief of terrain in Bieszczadzki National Park (Poland). In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 504-515, **2002**.
 33. HALLS P. J. GIS for Ecologists? In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 187-197, **2003**.
 34. MICHALSKA A., MICHALSKI K. Implementation GIS for Chemistry Enterprises Management. In: D. Kereković (Ed) Richness and Diversity of GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 137-139, **2007**.
 35. PECHANEC V., KILIANOVÁ H., VOŽENÍLEK V. GIS Analysis of Ecotone Variability. *Annals of Geomatics* **6**, 2, **2008**.
 36. OSTAFICZUK S. Modern geo-ecological mapping – a tool for sustainable development. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 140-147, **2001**.
 37. OSTAFICZUK S. Universal Base-Map for Geologists and Civil Engineers In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 381-389, **2003**.
 38. ADAMCZEWSKI Z. Geometric monitoring rock mass in real-time by leveling differential (initial concept). In: A. T. Jankowski (Ed.) Informacja i informatyka w administracji publicznej. Vol. II, SILGIS Center Association, Katowice, 9-11, **1994** [In Polish].
 39. MAŠEK A., ZBODULJA S. Fractal decentralized organization case study Vukovar Ar-Srijem County. In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 536-545, **2002**.
 40. SOBOLEWSKA-MIKULSKA K. Environmental Protection in Contemporary Land Consolidation Works. In: D. Kereković (Ed.) GIS Applications and Development, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 122-130, **2006**.
 41. GRUBEŠIĆ M., KUŠAN V., ŠPIRIĆ Z. Monitoring of beaver (*Castor fiber* L) population wide-spreading in Lonjsko Polje by means of GIS. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 535-541, **2000**.
 42. RAHMONOV O., MICHALSKI G., RZĘTAŁA M. Some Ecological Problems of Protected Areas in Tajikistan. In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 475-482, **2003**.
 43. RAHMONOV O., MICHALSKI G., RZĘTAŁA M., KRĘCIAŁA M. Natural conditions of occurrence and distribution of endemic and relict plant species in Tajikistan. In: D. Kereković (Ed.). Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 362-367, **2004**.
 44. BOGDANOVIĆ T., BOLŠEC B. GIS of the Kopački rit Nature Park (Croatia). In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 412-416, **2000**.
 45. KUŠAN V., KOVAČIĆ D. GIS analysis as a base for physical planning in Park of nature Lonjsko Polje. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 167-174, **2001**.
 46. MICHALSKI G., GŁOWACKA M. Environmental GIS Data Bases as a Practical Tool for Natural Resources Protection and Land Management in Poland. In: M. Gajos, M. Styblińska (Ed.) Geoinformation Challenges, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, 165-170, **2008**.
 47. CAPUTA Z., KŁYS G., KOWALCZYK K. Tarnowskie Góry – Bytom mines – preservation and development of Europe's unique ecosystem. In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 342-345, **2004**.
 48. MICHALSKI G., GŁOWACKA M. Species distribution data presentation in Poland. In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 355-358, **2004**.
 49. GŁOWACKA M., MICHALSKI G., OTRĘBA A. Common Yew *Taxus baccata* L. in Kampinoski National Park. In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 359-361, **2004**.
 50. GŁOWACKA M., MICHALSKI G. Some Aspects of Precise Spatial Data Gathering and Presentation in Longterm Ecological Studies. In: D. Kereković (Ed.) Richness and Diversity of GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 248-251, **2007**.
 51. POPIJAĆ M., VREBČEVIĆ M., DURBEŠIĆ A. Application of GIS in the representation of the National Park Mljet. In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 427-433, **2002**.
 52. ŻRÓBEK R., ŻRÓBEK-SOKOLNIK A., DYNOWSKI P. Application of GIS in natural sciences. Current problems with registering submerged plants assemblages for the needs of Natura 2000 network. In: D. Kereković, R. Żróbek (Ed.) The Future with GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 97-103, **2011**.

53. MICHALSKI G., GŁOWACKA M. Modern Geographically-Based Approach to Wildlife Conservation on the Example of Bird Protection. In: D. Kereković (Ed.) Richness and Diversity of GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 243-247, **2007**.
54. LAMPEK PAVČNIK I. Landcover of island Krk. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 380-383, **2000**.
55. JELASKA S., BUKOVEC D., NIKOLIĆ T., HRŠAK V., PLAZIBAT M. Impact of chemical composition of topsoil on plant diversity in the Medvenica Nature Park, Croatia. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 374-379, **2000**.
56. BIELECKA E. Portrayal of Polish Landscape on the Basis of the CORINE Land Cover Data. In: D. Kereković (Ed.) GIS Applications and Development, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 115-121, **2006**.
57. SMAL M. Physical planning in rural areas in the context of land protection against floods. In: D. Kereković, R. Żróbek (Ed.). GIS for Geoscientists, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 161-169, **2012**.
58. WAGA J.M. The Cistercian landscape compositions of Rudy Wielkie – the idea of balance between exploitation and protection of forest. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 159-161, **2001**.
59. SCHNEIDER-JACOBY M. Tools for sustainable regional development. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 499-511, **2000**.
60. NIEWDANA J. Integrating of local government White Przemsha for joint solutions of environmental problems. In: A. T. Jankowski (Ed.) Informacja i informatyka w administracji publicznej. Vol. II, SILGIS Center Association, Katowice, 121-125, **1994** [In Polish].
61. BUCHENAU K., SCHLEUSS U., KUHN G. GIS-based planning map for rainwater management. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 175-178, **2001**.
62. WRONA A., GOLUBOWICZ J. The use of aerial photographs for analysis of spatial and geographical environment in the Upper Silesian agglomeration. In: A. T. Jankowski (Ed.) Informacja i informatyka w administracji publicznej. Vol. II, SILGIS Center Association, Katowice, 154-157, **1994** [In Polish].
63. CHMIELEWSKA I. Relation Between Terrain Morphology and the Types of Landscapes in the Eastern Part of Silesian Upland (Basing Upon Remote Sensing and GIS Analysis). In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 73-85, **2003**.
64. POPIJAČ M., BENKO M., POŠTENJAK K., VREBČEVIĆ M. Establishment of GIS for the needs of the forest seed production in Croatia. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 148-151, **2001**.
65. LAMPARSKA-WIELAND M. Analysis of historical landscape types of post-mining areas in Tarnowice plateau with application of GIS. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 131-139, **2001**.
66. WAGA J. M. The heritage as a source of possible profitable work at Rudy Wielkie. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 162-166, **2001**.
67. MORAWIECKA-ZACHARZ I. Land use changes and landscape transformation in Katowice-Szopienice. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 113-119, **2001**.
68. MYGA-PIĄTEK U., NITA J. Application of spatial visualization methods for designing landscape changes on the example of St. Dorothy's Hill in Będzin. In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 346-354, **2004**.
69. STASZEK W., RUDZIŃSKA A. The Usage of the Grid Data Format in Landscape Planning, Environmental Protection and Physical Geography. In: D. Kereković (Ed.) Geographic Information Systems in Research & Practice. IInd Part, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 293-300, **2005**.
70. PACHUTA K., OGŁĘCKI P. The vascular plants and fauna of the Imielińskie Lake in Warsaw. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 214-219, **2001**.
71. MICHALSKI G. GIS summer workshop in Lonjsko Polje Nature Park – Ornithological impressions. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 523-527, **2000**.
72. GŁOWACKA M., MICHALSKI G. Through Education to Sustainable Development – Chosen Aspects of Usefulness of GIS – Related Methods and Technique for Ecological Education in Aspect of Polish National Ecological Education Strategy. In: D. Kereković (Ed.) Time, GIS & Future, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 174-179, **2009**.

73. WNUK J., BUDZIK R., PARDELA I. The Market for Biofuels in Poland and Perspectives for its Development. In: D. Kereković (Ed.). *Geographic Information Systems in Research & Practice. IInd Part*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 119-123, **2005**.
74. PENAVIN S. Regional Approach to the Management of the Renewable Energy Resources. In: D. Kereković (Ed.) *GIS Applications and Development*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 207-214, **2006**.
75. IVANOVIĆ M. GIS in Function Management Development of Renewable Energy Sources in Croatia. In: D. Kereković (Ed.) *Richness and Diversity of GIS*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 153-157, **2007**.
76. PARDELA I., BUDZIK R. The Effectiveness of Investment Projects in the Functioning of SME in the Biofuel Sector in Poland. In: D. Kereković (Ed.) *Richness and Diversity of GIS*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 146-152, **2007**.
77. MAŠEK A., KRIŽANOVIĆ K. Ecological Production as a Prerequisite for Development of Rural Area – Case Study: Ecological Production in Slavonia. In: D. Kereković (Ed.) *Space, Heritage & Future*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 179-188, **2010**.
78. MICHALSKI K. Implementation of GIS for improvement of mass production products life cycle assessment management including sustainable development aspects. In: D. Kereković (Ed.) *Geographical Information Systems in research & practice*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 368-370, **2004**.
79. KASINA Z. The Role of Modern Seismic Methods in Prospecting and Exploitation Natural Resources. In: G. Szpor, D. Kereković (Ed.) *Spatial information management in the new millennium*, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 50-54, **1999**.
80. OSTAFICZUK S. Environmental Postulates. In: D. Kereković (Ed.) *Time, GIS & Future*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 187-197, **2009**.
81. FORYCIARZ K. Effect of natural factors on the concentration of pollutants in urban soils. In: G. Szpor, D. Kereković (Ed.) *Spatial information management in the new millennium*, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 76-85, **1999** [In Polish].
82. MICHALSKA A., MICHALSKI K. Integration of the Aspects Related to Mercury Emission Sources Analysis as an Approach to Minimize Environmental Pollution. In: D. Kereković (Ed.) *Space, Heritage & Future*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 211-214, **2010**.
83. BARTUŚ T. Using GIS for study of heavy metals in soil in Oświęcim community. In: G. Szpor, D. Kereković (Ed.) *Spatial information management in the new millennium*, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 86-96, **1999**.
84. MICHALSKA A., MICHALSKI K. Creating a Map of the Industrial Influence Using GIS. In: M. Gajos, M. Styblińska (Ed.) *Geoinformation Challenges*, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, 157-163, **2008**.
85. MICHALSKA A., MICHALSKI K. Implementation GIS for the Modeling of the Mercury Pollution Decomposition in Soils Around Power Stations. In: D. Kereković (Ed.) *Time, GIS & Future*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 198-203, **2009**.
86. NAMYSŁOWSKA-WILCZYŃSKA B., WILCZYŃSKA A. Geostatistical Methods and Turning-Bands Simulation Assessment of Heavy Metals Pollution of Soils in Dąbrowa Gónicza Area. In: G. Szpor, D. Kereković (Ed.) *Spatial information management in the new millennium*, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 97-108, **1999**.
87. NAMYSŁOWSKA-WILCZYŃSKA B., RUSAK K. Interpolation techniques for forecasting soil heavy-metal pollution foci in mining areas. In: D. Kereković, E. Nowak (Ed.) *GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition*, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 204-213, **2001**.
88. MARCAK H. The role of interpretation models in the evaluation of the results of GPR surveys conducted for the location of oil pollution in the ground. In: G. Szpor, D. Kereković (Ed.) *Spatial information management in the new millennium*, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 69-75, **1999** [In Polish].
89. SKŁODOWSKI P. Problems of sustainable land use and soil protection in Poland. In: D. Kereković, E. Nowak (Ed.) *GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition*, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Zagreb, Warsaw, 107-112, **2001**.
90. MICHALCZYK W., MAGIERA J. Deposits of the Quaternary Natural Aggregates in the Kraków Region; Spatial Analysis of Quality and Sedimentary Environment. In: G. Szpor, D. Kereković (Ed.) *Spatial information management in the new millennium*, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 36-45, **1999**.
91. RADOSZ J., CAPUTA Z., KAMIŃSKI A. Changes of Jastrzębie Zdrój topoclimate during periods of economic transformation. In: D. Kereković (Ed.) *Geographical Information Systems in research & practice*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 159-166, **2004**.
92. CAPUTA Z., PERSKI Z. GIS Approach for the Automatic Topoclimate Elements Evaluation Case Study of Jastrzębie Zdrój Area in Poland. In: D. Kereković (Ed.) *Geographic Information Systems in Research & Practice. IInd Part*, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 275-280, **2005**.
93. LEŚNIOK M., PUSZCZEWICZ Z. Application of GIS in Air Quality Monitoring of Sosnowiec. In: M. Gajos, U. Myga-Piątek (Ed.) *Geographical Information Systems. Interdisciplinary aspects*, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 285-292, **2003**.
94. BARSZCZYŃSKA M., KUBACKA D., MADEJ P. Examples of GIS Use in National Hydro-Meteorological Service in Poland. *Geographical Information Systems*. In: M. Gajos, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, U. Myga-Piątek (Ed.) *Geographical Information Systems. Interdisciplinary aspects*. Sosnowiec, Zagreb, 17-26, **2003**.

95. DYRAS I., USTRNUL Z., BARSZCZYŃSKA M., KUBACKA D., MADEJ P., SERAFIN D., CZEKIERDA D. Integrated GIS applications in the hydrometeorological service in Poland – selected issues. In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 167-175, **2004**.
96. BARSZCZYŃSKA M., MADEJ P., KUBACKA D. Webmapping in the Visualization of Meteorological and Climatological Data. In: D. Kereković (Ed.) Richness and Diversity of GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 140-145, **2007**.
97. DYRAS I., SERAFIN-REK D. Presentation of Meteorological Satellite Products Using GIS Technology. In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 109-122, **2003**.
98. SZYMANOWSKI M., KRYZA M., MIGAŁA K., SOBOLEWSKI P., KOLONDRĄ L. Modelling and Validation of the Potential Solar Radiation for the Hornsund Region – Application of the r.sun Model. *Annals of Geomatics* **6**, 2, **2008**.
99. USTRNUL Z., CZEKIERDA D. Climatological Air Temperature Maps for the Territory of Poland Using a GIS. In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 571-581, **2003**.
100. KRYZA M. Application and Validation of the Residual Kriging Method for Interpolation of the Monthly Precipitation Field in Poland. *Annals of Geomatics*, **6**, 1, **2008**.
101. KRAKAR Z., ČRNJAR M., ŠOLIĆ GAVRANOVIĆ M., TOMIĆ ROTIM S. The application of GIS in air quality monitoring in one exemplary county. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 384-392, **2000**.
102. CAPUTA Z., LEŚNIOK M. Spatial Distribution and Dynamics of Changes in Atmospheric Pollution Using GIS Tools. In: D. Kereković (Ed.) GIS Applications and Development, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 249-254, **2006**.
103. ŻUREK A., DUDA R., FORYCIARZ K., KOLAT W. The ranked resistance assessment of groundwater reservoirs using GIS. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 129-135, **1999** [In Polish].
104. STYBLIŃSKA M. The culture of neglect in a shadow of Japanese apocalypse – some concerns on Fukushima nuclear accident independent investigation commission one year since the disaster. In: D. Kereković, R. Żróbek (Ed.) GIS for Geoscientists, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 170-180, **2012**.
105. ŠPILJAK V., RAFAEL-GUJIĆ G. Applications of cartographic methods and satellite images in presentations of seismic data (GIS in practice). In: D. Kereković (Ed.) Geographical Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 154-158, **2004**.
106. ŠPILJAK VULAMA V., RAFAEL-GUJIĆ G. Definition of Tectonic Elements On the Surface and Planning Grid of Seismic Lines Using Satellite Images. In: D. Kereković (Ed.) Geographical Information Systems in Research & Practice. IInd Part, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 124-128, **2005**.
107. PERNAR R., ANČIĆ M., SELETKOVIĆ A., LIPOŠČAK M. Wetland Inventory Using Remote Sensing Methods and GIS Technology. In: D. Kereković (Ed.) GIS Applications and Development, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 262-268, **2006**.
108. VARŽIĆ D., SLIVAC V., AMBROŠ F., HORVAT K. Noise imition plan in the city of Osijek – cadastry of noise. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 417-421, **2000**.
109. DZIEMBA L. The Day-Time Inhabitants Migration and Noise Hazard. In: D. Kereković (Ed.) Geographical Information Systems in Research & Practice, Croatian Information Technology Association – GIS Forum, University of Silesia, IInd Part. Zagreb, 281-286, **2005**.
110. ZMYŚŁOWSKI A. J. Aircraft noise hazard modelling. In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 434-439, **2002**.
111. ZMYŚŁOWSKI A. J. Analytic element method applied for acoustic fields. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 361-367, **2000**.
112. HORZELA I. Degree of Preparation Big and Average Cities for Creation and Exploitation of Acoustic Maps. In: D. Kereković (Ed.) Geographical Information Systems in Research & Practice. IInd Part, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 287-292, **2005**.
113. STYBLIŃSKA M. Some concerns about nuclear power plants after Japanese apocalypse. In: D. Kereković, R. Żróbek (Ed.) The Future with GIS, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 104-112, **2011**.
114. DADIĆ V., TIČINA V., IVANKOVIĆ D. Usage of Geospatial Methods in Determination of Pelagic Fish Stock Distribution. *Annals of Geomatics*, **6**, 1, **2008**.
115. DUDA R., FORYCIARZ K., ŻUREK A. Opportunity to present maps of resistance aquifers to contamination using GIS. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 108-113, **1999** [In Polish].
116. KOTLARCZYK J., JUCHA S.F., MASTEJ W., NAMYSŁOWSKA-WILCZYŃSKA B. Quantitative prediction of potential hydrocarbon accumulation zones in synclorium nidziańskim. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 46-49, **1999** [In Polish].
117. PAPADOPOULOU K. Aerofoil characteristics for wind turbine applications. In: D. Kereković (Ed.) Geographical

- Information Systems in research & practice, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 145-153, **2004**.
118. CIGROVSKI-DETELIĆ B., BORIĆ M., STRIČAK E. Correlation Between Geodetic and Geological Models of Tectonic Movements. In: D. Kereković (Ed.) Time, GIS & Future, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 215-227, **2009**.
 119. PAPADOPOULOU K., JAŠLAR J. Use of GIS for a renewable energy development strategy proposal for the Tameside MBC (UK). In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 495-503, **2002**.
 120. KOLBAH S. ŠĆURIC S., ŠEGO B., ČORKOVIĆ D., HITREC V., LUKINAC Z. Application of GIS to Oil and Gas Exploration. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 62-68, **1999**.
 121. TADIĆ L., TADIĆ Z. GIS application on indicators of sustainable land management. In: D. Kereković (Ed.) GIS Croatia 2000. International Conference & Exhibition. Proceedings, Croatian Information Technology Association – GIS Forum, INA-industrija nafte d. d. Zagreb, Zagreb, 368-373, **2000**.
 122. HORVAT B. Water quality and pollution mechanism. In: D. Kereković, E. Nowak (Ed.) GIS Polonia 2001. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, Warsaw University of Technology, University of Silesia, University of Zagreb, Warsaw, 190-198, **2001**.
 123. GOTAL L., DUŠAK V., LEGOVIĆ T. A proposal for satisfactory potable water quality in the city of Varaždin. In: D. Kereković (Ed.) GIS Odyssey 2002. Geographical Information Systems. International Conference & Exhibition, Croatian Information Technology Association – GIS Forum, University of Silesia, University of Zagreb, University of J. J. Strossmayer in Osijek, Warsaw University of Technology, Zagreb, 415-426, **2002**.
 124. ABSALON D., JANKOWSKI A.T., LEŚNIOK M. New thematic maps of Poland. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 23-27, **1999** [In Polish].
 125. BARBALIĆ D. Catchment of Water Reservoir Botonega – GIS Analysis. In: G. Szpor, D. Kereković (Ed.) Spatial information management in the new millennium, Faculty of Engineering of University of Silesia, SILGIS Center Association, Katowice, 114-119, **1999**.
 126. VUKADIN I. Longtime – Series Studies of Basic Oceanographic Parameters at Station Glava Gata, Split Area, Croatia. In: M. Gajos, U. Myga-Piątek (Ed.) Geographical Information Systems. Interdisciplinary aspects, University of Silesia, Croatian Information Technology Association – GIS Forum, SILGIS Association, Sosnowiec, Zagreb, 583-592, **2003**.
 127. BRADARIĆ Ž., MLADINEO N., SRDELIĆ M. Sensitivity Index of the Coast of the Place of Refuge to Oil Pollution. In: D. Kereković (Ed.) Space, Heritage & Future, Croatian Information Technology Association – GIS Forum, University of Silesia, Zagreb, 222-228, **2010**.