

# CARTOGRAPHY IN CROATIA 1999-2003

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## ABSTRACT:

Croatia has been a member of the International Cartographic Association (ICA) since 1995. A national report was prepared for the 12th ICA General Assembly and the 21st International Cartographic Conference in Durban in 2003. This paper is a short presentation of the cartographic activities in Croatia for the period 1999-2003. The following four institutions are presented: *State Geodetic Administration* as an official institution, the *Institute for Cartography at the Faculty of Geodesy, University of Zagreb* as an academic institution, the *Institute for Photogrammetry* as a commercial company and the *Croatian Cartographic Society*.

## 1. INTRODUCTION

Croatia became a member of the International Cartographic Association (ICA) at its 10th General Assembly held in Barcelona in 1995. On this occasion a national report was submitted with the data about the maps that Croatia had at its disposal, with cartographic institutions and their activities during the period 1991-95. The report was published in Croatian and English (Frančula et al., 1996a-b).

For the 11th General Assembly of the ICA held in Ottawa in 1999 there was a new national report compiled encompassing the period in Croatian cartography after the conference in Barcelona, i.e. from 1995 till the summer in 1999. Basic chapters of the report are official cartography, commercial cartography, and academic cartography, Section for Cartography of the Croatian Geodetic Society and other activities. This report was published in English (Frančula, Lapaine, 1999).

A new national report in Croatian and English was prepared for the 12th ICA General Assembly and the 21st International Cartographic Conference in Durban in 2003, and it will be available at the Internet site <http://www.kartografija.hr>.

A presentation of Croatian cartography in a shorter version is given in this paper, on the examples of four institutions: *State Geodetic Administration* as an official institution, the *Institute for Cartography at the Faculty of Geodesy, University of Zagreb* as an academic institution, the *Institute for Photogrammetry* as a commercial company and the *Croatian Cartographic Society*.

## 2. STATE GEODETIC ADMINISTRATION OF THE REPUBLIC OF CROATIA

State Geodetic Administration (SGA) is a state organisation dealing with administrative and professional work in the field of geodesy, cartography, cadastre and photogrammetry and taking care of computerisation of cadastre and geodetic spatial system, state official cartography (1:5000, 1:25 000, 1:50 000, 1:100 000, 1:200 000), geodetic documentation, statistical data on real estate cadastre, spatial units and lines, geodetic and cadastral works relating to the state border.

State survey, real estate cadastre, register of spatial units, line cadastre, geodetic works for special purposes, competence and performance of state survey and real estate cadastre work, as well as the constitution of SGA, are regulated under the Law on State Survey and Real Estate Cadastre.

The work relating to state survey and real estate cadastre is carried out on the basis of one-year programs or several years' programs. The programs define the area where fundamental geodetic works, topographic surveys and the production of official maps, survey and marking of state boundaries will be carried out, and also the establishment of real estate cadastre and financial sources for program implementation. Several-years long programs are passed by the Croatian National Parliament and annual programs by the Government of the Republic of Croatia.

SGA is working in the Central Office in Zagreb and in its branch offices. As an exception, the Office of the City of Zagreb carries out the administrative and professional jobs in the area of the City of Zagreb classified by law as belonging to the scope of branch office.

The following constitutional units are responsible for the activities of the SGA Central Office in Zagreb:

1. Director Office
2. Department for Legal and Accountancy Jobs and Information System
3. Department for Topographic Survey and State Maps
4. Department for Cadastral System
5. Department for State Survey

Departments are run by assistant directors and are divided into units run by appointed heads. The *Department for Topographic Survey and State Maps* consists of two parts: *Unit for Photogrammetry and Remote Sensing* and *Unit for Cartography* (Krpeljević, 2001, 2002).

Aerial survey of the last 40% of territory of the Republic of Croatia at the scale of 1:20 000 (that started in 1996) has been completed during the period 1999-2000. In such a manner the aerial photography of entire Croatia was taken for the first time. From 2001 to 2003 the periodic aerial survey at the scale of 1:20 000 was continued, so most of the territory of Croatia was surveyed for the second time.

On 8 December 1999 the SGA director formed the Commission for Production of the Guidelines for Conduct of Topographic Survey and Production of National Maps. The Guidelines were completed within the given period and published in Narodne novine No. 64/2001.

On behalf of Division for State Boundaries at the beginning of the year 2000 the SGA initiated and completed the production of photoplans at the scale 1:100 000 (sheet size 30×50 cm). The photoplans cover the Bosnian-Herzegovinian Croatian border in the length of 100 km from Bihać to Kamensko (near Imotski). They were used for demarcation of the boundary because there was no suitable map available.

The legend was designed for the Croatian Base Map at the scale 1:5000 (HOK) as well as for topographic map at the scale 1:25 000 (TK 25) (DGU, 2001). Furthermore next 62 sheets of digital TK 25 out of total 594 were produced (Landek, 2003a). All topographic maps at the scale 1:25 000 and 1:100 000 were transformed from the PDF format into TIF. The production of the digital terrain model DMR 5/0 was continued.

SGA contracted out the production of digital orthophoto maps (DOF) for the area of Zadar (30 sheets), and the area of Koprivnica (16 sheets), and the reconstruction of digital orthophoto maps of the area of Zagreb (55 sheets).

In 2001 the SGA published the first publication: the translation of the book *Elements of Spatial Data Quality*. The editors are S. C. Guptill and J. L. Morrison, and the book was translated by D. Tutić and M. Lapaine (Lapaine, 2001).

At the end of 2001 SGA published the Catalogue of Products (Landek, 2001a) together with the technical description and prices of the products: aerial photographs, digital orthophoto map, Croatian Base Map 1:5000, digital terrain model, topographic maps at the scales 1:25 000, 1:100 000, and 1:200 000, cadastral plans at the scales 1:1000, 1:2000, 1:2880, and 1:2904, cadastral plans in digital form, and the graphic inventory of spatial entities. The second edition of the Catalogue was published at the beginning of 2003 (Landek, 2003a).

In 2001 several cartographic projects were funded by the SGA: *The Accuracy Assessment of DMR 5.0* (Pleško, Biljecki 2003), *The Design of Cartographic Data Model* (Biljecki et al., 2003a), *The Establishment of Topographic and Cartographic Database* (Biljecki et al., 2003b), *Graphical and Alphanumeric Coding Scheme for National Topographic Maps* (Paj, 2003), *Cartographic Generalisation and Standardisation for National Maps* (Paj et al., 2003).

Director of the SGA Dr. Z. Bačić is a member of the Management Board of *EuroGeographics*, a co-chairperson of the Coordinating Board of the *Real Property Registration and Cadastre Project* and a member of the Advisory Board of the *Central-European Land Knowledge Center* (CELC).

One can find out more about aforementioned and other cartographic projects funded by the SGA in published reports (Landek, 2001b, 2003b) and in Chapter 3.1.3. More details about the activity of the State Geodetic Administration can be found on the Internet address <http://www.dgu.tel.hr/dgu>

### 3. INSTITUTE FOR CARTOGRAPHY AT THE FACULTY OF GEODESY, UNIVERSITY OF ZAGREB

The Institute for Cartography is one of five institutes at the Faculty of Geodesy, University of Zagreb. According to the new Curricula from 1994, the students can choose in the seventh and eighth semester *Photogrammetry and Cartography* as one of the three subject oriented courses after finishing the first six common semesters. All students attend the subjects *Geodetic Drawing* (0+2) in the first semester, and in the fifth semester they all attend the courses on *General Cartography* (2+2).

Within the scope of the subject-oriented courses *Photogrammetry and Cartography* in the seventh semester, *Digital Cartography* (2+2) is an obligatory subject, and in the eighth semester (2+2) *Map Visualisation* is obligatory. In this program the students can also choose the other cartographic subjects: *Geoinformation Systems*, *Multimedia Cartography*, *Cartography and GIS*, *Map Generalisation*, *Topographic Cartography*, *Thematic Cartography*, *Transformations in Cartography*, *Map Reproduction* and two seminars in *Cartography and GIS*, and *Practical Cartography*.

During the period 1999-2003, the teachers of the Institute for Cartography made lecture notes for the subjects Digital Cartography (Frančula, 2001), Map Projections (Frančula 2000a), Map Generalisation (Frančula, 2000b) as well as the manuals Cartography and AutoCAD Map (Lapaine et al. 1999, 2001), and Introduction to GIS (Tutić et al. 2002).

The postgraduate scientific studies of geodesy at the Faculty of Geodesy, University of Zagreb are the studies for acquiring academic title of Master of Science, or academic title of doctor of science in geodesy.

The postgraduate studies consist of optional and facultative subjects. The optional subjects are divided into two groups: general subjects and subject oriented courses. The group of general subjects is common to all subject-oriented programs. Students select one of the three subject-oriented programs on their own. The optional subjects in the program *Photogrammetry and Cartography* are: *Computer Graphics in Geodesy*, *Map Facsimiles*, *Official Topographic and Cartographic Information System of the Republic of Croatia*, *Geodetic Cartography*, *Cartographic Heritage*, *Remote Sensing*, *Automation in Photogrammetry*, *Modelling in GIS* and *Digital Terrain Modelling*.

During the period 1999-2003 five master theses in the field of cartography (Duplančić-Leder 2000, Kljajić 2001, Javorović 2001, Racetin 2002, Poslončec-Petrić 2002) and one doctoral thesis (Vučetić 2001) were defended at the Faculty of Geodesy, University of Zagreb.

In 1999 and 2000 seminars were organised for people coming from practice activities. The following seminars were held three times:

1. *Introduction into Digital Cartography and GIS*, intended for all who had no chance to get acquainted with these new areas of cartographic activity (15 lecture hours)
2. *Digital Cartography and AutoCAD Map* intended for experts who want to deepen their knowledge of digital cartography and learn the basics of AutoCAD Map (10

hours of lectures and 20 hours of exercises with computers).

### 3.1 Projects

**3.1.1 Croatian Cartography – Scientific Bases:** From 1996 till 2002 the cartographic research at the Institute for Cartography was carried out within the project *Croatian Cartography – Scientific Bases* financed by the Ministry of Science and Technology of the Republic of Croatia. The head of the project was N. Frančula. The common goal of this scientific project was to improve the scientific bases of the cartographic development in Croatia. It was therefore necessary to research the contribution of Croatian cartographers in the development of cartography in the world. The goal of the project was also to supplement the Croatian scientific terminology in the field of cartography and related sciences with modern terms and concepts. The goal was also to give contributions in the field of digital cartography: in research of local and global distortions, map generalisation and map graphics.

The details about the project can be found on the Internet address <http://www.mzt.hr/projekti/9699/2/007001.htm>.

**3.1.2 Cartography and New Technologies:** The work on the project started in August 2002, and the project leader is M. Lapaine. The application of new technologies (geoinformation systems, geomatics, geomedia, Internet, multi-media, expert systems, artificial intelligence etc.) in Croatian cartography will be researched and further on developed. Cartographic presentations will be made adequately to up-to-date digital mapping procedures, modern communication and space visualisation. The contributions to the research in the field of digital mapping are expected, especially in the fields of map graphics, map projections and transformations, and map generalisation. Croatian cartographic heritage is very rich, but insufficiently known and insufficiently protected. Hence, the biographic and bibliographic material about Croatian cartographers will continue to be systematically gathered and processed. Special attention will be paid to modern Croatian scientific terminology in the field of cartography and related areas.

**3.1.3 Projects funded by SGA:** The following projects were funded by the State Geodetic Administration in the period 1999–2003:

- *Croatian Cartographers* (Lapaine et al., 1995; Kljajić, 2001; Frančula et al., 2001)
- *Croatian Geodetic Terminology* (Frančula, Lapaine, 2003)
- *Proposal for the Official Map Projections of the Republic of Croatia* (Lapaine, 2000)
- *New Cartographics of Official Maps Published by the State Geodetic Administration* (DGU 2001; Frangeš, 2001)
- *Denotation and Denomination of National Topographic Map Sheets and their Subdivision into Sheets* (Frangeš, 2003a)
- *Toponymy – Naming, Phase I* (Frangeš, 2003b)
- *The Printing of National Maps* (Frangeš, 2003c).

### 3.2 Professional and social activity

The following was made: the tourist map of Croatia – Slovenia – Bosnia and Herzegovina (authors I. Birin and S. Štefanec), a new edition of the map National Park Mljet (authors S. Frangeš, P. Lovrić and Z. Križovan), plans of the towns of Rovinj, Cres and Dubrovnik (authors S. Frangeš and R. Župan), facsimiles of old maps of Zadar and Split (editor S. Frangeš), general maps

of national parks and nature parks (authors S. Frangeš, R. Župan, D. Tutić and M. Lapaine), a thematic map of the positions of faculties and other institutions 1999, 2000, 2001, 2002 and 2003 for the Guide of future students at the University of Zagreb (authors S. Frangeš and N. Frančula).

M. Lapaine is a member of ICA Commission on Spatial Data Standards, a member of the International Map Collector's Society (IMCoS), and International Association of Geodesy Associate. N. Frančula is a full member of the Croatian Academy of Engineering, and M. Lapaine has been a member collaborator and the Secretary General since 2003.

*Geodetski list* is the only geodetic journal in Croatia. It has been published as a quarterly continuously ever since 1947. However, geodetic bulletins appeared in this area much earlier. The first issue of *Glasiilo geometara* was issued in Zagreb in 1919, and its chief editor was Vladimir Filkuka, professor at the Royal High Technical School of that time. The present *Geodetski list* is the bulletin of the *Croatian Geodetic Society*, and scientific and professional papers, terminology papers, book reviews and news are published in it. The papers published in *Geodetski list* are referred to in a few secondary publications and databases. A long-time chief editor of *Geodetski list* was N. Frančula, and now it is S. Frangeš, both of them from the Institute for Cartography.

More details about the Institute for Cartography at the Faculty of Geodesy, University of Zagreb can be found on the Internet address <http://www.geof.hr/>

## 4. INSTITUTE FOR PHOTOGRAMMETRY

The Institute for Photogrammetry Zagreb, Borongajska cesta 71, is one of the most important institutions for Croatian geodesy, not only because of the extent and quantity of executed geodetic works, but also because of the pioneer role that it has had for more than 40 years of existence, since its foundation in 1961, in introducing and applying modern technologies in the profession and in the development of geodetic activity in Croatia.

The company is technically and professionally capable of carrying out all geodetic works, and it encompasses:

- basic works and higher geodesy,
- cadastre and practical geodesy,
- engineering and applied geodesy,
- photogrammetry and topographic survey,
- cartography and spatial information systems.

The Institute for Photogrammetry employs 75 workers, mostly engineers and technicians of geodesy, and it consists of Technical department and Financial and administrative department. The Technical department is divided into two sectors – Surveying and Processing sector – that are constituted from five teams. In the Surveying sector the works are carried out in connection with surveying in the field, cadastre and GPS survey. All photogrammetric work, digital data processing, production and completion of plans and maps is carried out in the Processing sector (Paj, 2002).

In recent years, the Institute for Photogrammetry has greatly enhanced and modernised the production by acquiring three digital photogrammetric stations, two new-generation GPS units, an A0 format scanner in colour, and other geodetic

equipment, as well as professional software for digital orthophoto, aerial triangulation, GIS and cartography. A procedure of installing quality preservation systems ISO 9001 was initiated into production processes of the company, and it is expected to be finished in 2003.

During the period 1999-2003 the Institute for Photogrammetry worked on the following cartographic tasks:

#### 4.1 Topographic map 1:25 000

1. Istria – West: 20 sheets of TK 25; principal contractor the Institute for Photogrammetry, sub-contractors: Geodetic Institute Rijeka (5 sheets), Geofoto Zagreb (4 sheets). Completed and printed in December 2000.
2. Velika Gorica: 3 sheets completed and handed in 2000.
3. Zagreb: 4 sheets, principal contractor Geofoto. Completed and handed in 2000.
4. Istria – east: 6 sheets, completed and handed in 2001.
5. Varaždin – Čakovec: 4 sheets, completed and handed in 2001.
6. Križevci: 4 sheets, completed and handed in 2001.
7. Bjelovar: 6 sheets, 2001.
8. Sisak: 8 sheets, 2001.
9. Krapina: 5 sheets, 2001.
10. Bjelovar II: 6 sheets, 2002.
11. Bjelovar III: 5 sheets, 2003.
12. Kornati: 12 sheets – in preparation.

The topological processing of TK 25 data for the official topographic database at SGA will be finished in 2003. According to the research done by CRONO GIP's project team, the Institute of Photogrammetry made 38.5% of all TK 25 (six Croatian companies produce TK 25).

#### 4.2 Croatian Base Map 1:5000

1. Zagreb: 25 sheets, principal contractor Geofoto. Completed and handed in 2000.
2. Čakovec: 24 sheets, completed and handed in 2000.
3. Varaždin: 12 sheets, completed and handed in 2000.
4. Velika Gorica: 6 sheets, completed and handed in 2000.
5. Topusko: 6 sheets, completed and handed in 2000.
6. Samobor: 11 sheets, completed and handed in 2001.

#### 4.3 Digital orthophoto (DOF)

About one thousand sheets of various areas at the scale of 1:5000:

1. Varaždin, Križevci, Topusko (1999-2000)
2. For the needs of demining Lika and Banovina – 110 sheets (2001)
3. Eastern Slavonija – 100 sheets (2002)
4. Samobor – 11 sheets (2002)
5. Velika Gorica – 70 sheets in colour (2002)
6. Varaždin County – 230 sheets in colour (2003)
7. For the needs of demining Lika – 80 sheets (2003)
8. Karlovac County – 150 sheets (2003)
9. State border with Bosnia and Herzegovina – about 100 sheets in colour (will be finished in 2003)

Several tasks at various scales:

1. Gas pipeline Lučko – Ivanja Reka at the scale of 1:1000 in colour (2001)
2. Drava river at the scale of 1:10 000 (2002)
3. AC Zagreb – Sisak at the scale of 1:5000 (2002)

4. AC Split – Ploče at the scale of 1:1000 (will be finished in 2003)
5. AC Beli Manastir – Svilaj 1:1000 (will be finished in 2003), etc.

#### 4.4 Thematic cartography

1. Križevci – City plan – 1999
2. Karlovac County – Road and tourist map – 2001
3. Statistical Chronicle – thematic maps with general topics in single counties and general maps of counties – 1999, 2000, 2001, 2002.
4. Varaždin – city plan – 2002.
5. Several different thematic maps for the needs of Croatian Highways Ltd. Zagreb – 2002

#### 4.5 Projects and other

The Institute for Photogrammetry has made a working procedure for the production of TK 25, which is continuously being worked on and improved. The majority of other contractors on TK 25 has accepted this procedure, and some of them have given their contribution. The Institute for Photogrammetry has made the first versions of the cartographic keys for TK 25 and HOK. The employees of the Institute for Photogrammetry participate at several projects connected with the establishment of the Official Topographic and Cartographic Information System of the Republic of Croatia. These projects include *Cartographic Generalisation with the Standardisation for State Maps* (Paj et al., 2003), *Graphical and Alpha-numerical Code System of State Topographic Maps* (Paj, 2003), *CRONO GIP I* and *CRONO GIP II*. The active participation of R. Paj on Eurogeographics projects: Seamless Administrative Borders of Europe (SABE – 1999, 2001) and Euro Global Map (EGM – 2003) should be mentioned, too.

More data about the Institute for Photogrammetry can be found on the Internet address <http://www.zzf.hr>

## 5. CROATIAN CARTOGRAPHIC SOCIETY

Inaugural assembly of the Croatian Cartographic Society (CCS) was held on 10 October 2001. The goals of CCS are:

- contribution to the development of cartography and related disciplines
- promotion of cartography and related disciplines
- motivation of creative activities and application of scientific achievements in practical and professional work in all forms of cartographic activity
- supporting publishing activity in cartography and related disciplines
- foundation and taking care of collections of maps, plans, books, photographs and other publications
- developing relationship with other similar institutions in Croatia and abroad
- giving opinions and estimations of cartographic work done by organisations and individuals if requested by the authorities or directly by interested citizens.

CCS realises its goals by performing the following activities:

- organising scientific and professional lectures, gathering, seminars, symposiums and similar
- international collaboration
- membership in international cartographic associations

- awarding rewards and acknowledgements
- improvement and specialisation of its members in Croatia and abroad.

M. Lapaine was elected the first president of CCS. In 2002, the Society started publishing the first Croatian cartographic journal, *Kartografija i Geoinformacije* (Figure 1). The journal is published annually, in both Croatian and English.



Figure 1. Journal of the Croatian Cartographic Society

The Croatian Cartographic Society took over the preparation of the participation of Croatian cartographers at international cartographic conferences. Preparations for Croatian participation at the 21st International Cartographic Conference and the 12th ICA General Assembly in Durban lasted during 2002 and 2003. Croatia will actively participate at the General Assembly, at the conference with papers and posters, at the international cartographic exhibition and at the international children's drawing contest and exhibition.

One can find out more about Croatian Cartographic Society's activities at the Internet site <http://www.kartografija.hr>

## REFERENCES

Biljecki, Z., Halapija, H., Osmanagić, A., Franjić, S., Tonković, T., Piskor, D., Perić, D., 2003a. Izradba kartografskog modela podataka, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 97-106.

Biljecki, Z., Piskor, D., Tonković, T., Halapija, H., Osmanagić, A., Franjić, S., 2003b. Uspostava topografske i kartografske baze podataka, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 107-116.

DGU, 2001. Kartografski ključ s uputama za izradu i primjenu znakova za Hrvatsku osnovnu kartu (HOK) mjerila 1:5000, ver. 1.3, Sveučilište u Zagrebu, Geodetski fakultet.

Duplančić-Leder, T., 2000. Elektroničke karte u pomorskoj kartografiji, Master's thesis, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

Frančula, N., 2000a. Kartografske projekcije, Lecture notes, Sveučilište u Zagrebu, Geodetski fakultet, 215 pp.

Frančula, N., 2000b. Kartografska generalizacija, Lecture notes, Sveučilište u Zagrebu, Geodetski fakultet, 113 pp.

Frančula, N., 2001. Digitalna kartografija, 3rd revised edition, Lecture notes, Sveučilište u Zagrebu, Geodetski fakultet, 206 pp.

Frančula, N., Lapaine, M., 1999. Cartography in Croatia 1995-99, Report to the International Cartographic Association, Geodetski list, 2, 111-126.

Frančula, N., Lapaine, M., 2003. Geodetski rječnik, Konačni izvještaj, Državna geodetska uprava, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb, 348 pp.

Frančula, N., Lapaine, M., Kljajić, I., 2001. Hrvatski kartografi, Final Report, Državna geodetska uprava, Sveučilište u Zagrebu, Geodetski fakultet, 314 pp.

Frančula, N., Lapaine, M., Lovrić, P., 1996a. Kartografija u Hrvatskoj 1991-95, Geodetski list, Special issue, 31-40.

Frančula, N., Lapaine, M., Lovrić, P., 1996b. Cartography in Croatia 1991-95, Geodetski list, Special issue, 79-89.

Frangeš, S., 2001. Nova kartografika službenih karata u izdanju Državne geodetske uprave, Izvješća o znanstveno-stručnim projektima iz 2000. god., Državna geodetska uprava, Zagreb, 65-70.

Frangeš, S., 2003a. Oznake i imena pojedinih listova državnih topografskih zemljovida te njihova podjela na listove, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 137-147.

Frangeš, S., 2003b. Toponimika – nazivlje, I. faza, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 149-156.

Frangeš, S., 2003c. Tisak državnih zemljovida, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 157-167.

Javorović, I., 2001. Osuvremenjivanje karata pomoću satelitskih snimaka, Master's thesis, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

Kljajić, I., 2001. Hrvatski kartografi, Master's thesis, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

Krpeljević, Z. (ed.) 2001. Geodetski informator, Državna geodetska uprava, Zagreb.

Krpeljević, Z. (ed.) 2002. Geodetski informator 2, Državna geodetska uprava, Zagreb.

Landek, I. (ed.) 2001a. Katalog proizvoda, Državna geodetska uprava, Zagreb.

Landek, I. (ed.) 2001b. Izvješća o znanstveno-stručnim projektima iz 2000. godine, Državna geodetska uprava, Zagreb.

Landek, I. (ed.) 2003a. Katalog proizvoda 2003, Državna geodetska uprava, Zagreb.

Landek, I. (ed.) 2003b. Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb.

Lapaine, M., 2000. Prijedlog službenih kartografskih projekcija Republike Hrvatske, Državna geodetska uprava, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb, 88+105 pp.

Lapaine, M. (ed.) 2001. Elementi kvalitete prostornih podataka (Elements of Spatial Data Quality), editors S. C. Guptill and J. L. Morrison; translated by D. Tutić and M. Lapaine; Državna geodetska uprava, Zagreb, 211 pp.

Lapaine, M., Lovrić, P., Frančula, N., Frangeš, S., Vučetić, N., 1995. Hrvatski kartografi, Conceptual project, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb, 47 pp.

Lapaine, M., Vučetić, N., Tutić, D., 1999, 2001. Kartografija i AutoCAD Map, Manual, Sveučilište u Zagrebu, Geodetski fakultet, 1st edition, 1999, 69 pp., 2nd edition, 2001, 70 pp.

Paj, R., 2002. Zavod za fotogrametriju, prikaz tvrtke, Company profile, Zavod za fotogrametriju d.d., Zagreb.

Paj, R., 2003. Grafički i slovno-brojčani kodni sustav državnih topografskih zemljovida, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 117-124.

Paj, R., Frangeš, S., Vučetić, N., 2003. Kartografska generalizacija sa standardizacijom za državne zemljovide, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, Zagreb, 125-135.

Pleško, J., Biljecki, Z., 2003. Ocjena točnosti DMR-a 5.0, Izvješća o znanstveno-stručnim projektima iz 2001. godine, Državna geodetska uprava, 91-95.

Poslončec-Petrić, V., 2002. Uspoređivanje programskih paketa za automatsko sjenčanje reljefa, Master's thesis, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

Racetin, I., 2002. Terminologija suvremene pomorske kartografije, Master's thesis, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

Tutić, D., Vučetić, N., Lapaine, M., 2002. Uvod u GIS, Student's manual, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

Vučetić, N., 2001. Generalizacija linijskih elemenata karte po kriteriju maksimalne sličnosti, Doctoral thesis, Sveučilište u Zagrebu, Geodetski fakultet, Zagreb.

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