

LANDSCAPE MAPS IN THE CZECH REPUBLIC IN CONNECTION WITH WORLD AND EUROPEAN DEVELOPMENT

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Souhrn

Česká kartografická tvorba týkající se mapování krajín vykazuje více než stoletou tradici a vyvíjí se v úzkém kontextu se světovým vývojem uvedeným zde v přehledu. Dokončování nového rozsáhlého projektu „Atlas krajiny České republiky“ je příležitostí k prezentaci českých krajinných map české kartografické školy. V Atlase krajiny ČR bude uvedena řada tradičních i nově koncipovaných krajinných map, vesměs v digitální podobě. Mapy dokumentují prostorovou diferenciaci a integraci přírodní a současné krajiny, změny její struktury od místa k místu a dynamické tendence. Mapy přírodní krajiny vyjadřují územní rozložení přírodních krajinných jednotek (přírodních prostorových geosystémů) a podávají syntetizující představu o přírodních podmínkách daného území. Mapy současné (kulturní) krajiny vyjadřují současný stav antropogenní transformace krajiny a jejího využívání člověkem. Krajinné mapy v digitální podobě simulují integrovanou mnohodvĕtvovou databázi GIS daného území.

Summary

The Czech tradition of landscape map compilation is more than 100 years long and developed itself in a close respect to the progress in the world presented in a brief overview in the paper. The completing the new project of the “Landscape Atlas of the Czech Republic” gives a good opportunity to present results of Czech landscape cartography products. The Atlas consists of a set of traditional and newly composed landscape maps, everyone in a digital form. They present the spatial variability and integration of the natural and present landscape, changes of its structure from site to site and in the course of time. The maps of nature landscape show the territorial distribution of natural landscape ecological units (natural geosystems) and give a synthetic view on the nature of a given territory. The maps of present landscape demonstrate the present state of the landscape especially from the point of view of its anthropogenic transformation and use by man. The digital landscape maps simulate an integrated database of GIS.

Key words: landscape maps, landscape atlas, landscape types, natural landscape, cultural landscape, Czech Republic

1. Introduction

The absence of a comprehensive cartographic product depicting the present state of scientific landscape knowledge in a contemporaneous form was being felt in the Czech Republic for longer time. The modern scientific view on the present Czech landscape is being expected from the wide public. A different situation is in neighbouring Slovakia where the printed and electronic Landscape Atlas of Slovakia was released in 2002. This atlas represents the ultimate challenge for a similar atlas project in the Czech Republic. Since 2003, the Landscape Atlas of the Czech Republic is being compiled in our country under the support of the Czech Ministry of the Environment as a scientific geoinformation and cartographic project number VaV 600/01/03. The digital geoinformation technologies play a very important role in its compilation and finally in the use as well. The Sylva Tarouca Research Institute for Landscape and Ornamental Gardening in the town of Půhonice close to the Capital City of Prague is the coordinating institution of the whole project. Other tens of academic, governmental and private subjects take a part in the project completing, among others hundreds of specialists, authors and reviewers of maps.

The project of the Landscape Atlas of the Czech Republic is phased into years 2003-2007. At the present time, the project is in the final stage of the compilation period. The concept and content of the Landscape Atlas were subdued to certain changes during the compilation period. Their results are represented in the present atlas structure. The Landscape Atlas of the Czech Republic is divided into nine sections. The aim of this division is to cover the whole spectrum of Czech landscape understanding as much wide as possible.

Digital geoinformation technologies play a dominant role in the atlas compilation. Map originals presented by authors are mostly in digital form as GIS data sets compiled using standard whole country topographic base at four main scales: 1:500 000, 1:1 mil., 1:1,5 mil. a 1:2 mil. These maps or cartograms covering the total national territory are accompanied with local and regional map extracts at bigger scales (1:10 000, 1:25 000, 1:50 000, 1:100 000 and 1:200 000). The final product will represent until now relatively rare cartographic work to be distributed on the paper (bound volume and set of individual maps), on the Internet and on DVDs or CDs not only in a raster but also in a vector form. It will represent basically a very extend vector/raster database to be applied for solution of many consequent tasks. At the same time, it will be a representative work absenting in the Czech cartography now. The electronic version makes possible an updating individual data layers.

The atlas compilation proceeds under critical surveillance of wide public. Map originals are being handed over to the working commission consisting of distinguished specialists in geography, landscape ecology, cartography, etc. and persons responsible for completing individual chapters of the atlas. Before the commission passes accepted maps further for the final processing and reviewers they are temporarily presented on the website (www.atlaskrajiny.info/ „ke stažení“) for public discussion.

2. Landscape maps in the Landscape Atlas of the Czech Republic

The Landscape atlas of the Czech Republic will consist of more than 800 maps after completing. The most of them will be of analytic concept, describing and depicting specific aspects and features of landscapes on the territory of the Czech Republic from the viewpoints of individual sciences. Basically, any atlas chapter, regardless to the domination of analytic maps, will ratiocinate into synthetic pericope presenting in mutual relationships the key content of given chapter. Such kind of synthesis will form the content of various classes of landscape maps.

Own landscape maps, accordingly synthetic maps of natural and present landscape, will play following roles as:

a) a cartographical document: offering to the user various ways of cartographic presentation of the territory structure, dynamics and/or other complex feature in the past and present, here will be shown map extracts at different scales from selected parts of the Czech Republic

b) a methodological document: demonstrating individual ways of landscape map construction, legend composition and map reading, examples will be given on map extracts usually from one territory only

c) an informational document: giving characteristics of area shown on the map, usually the territory of the Czech Republic in maps of typological (classified) or individual (division) content; maps in extracts provide information about representative examples of typical Czech landscapes

d) an application document: atlas maps are directly applicable for individual levels of landscape planning with regard to their scale and resolution; such maps are presented in chapters depicting environmental options and limits of the landscape and assessing their future development

e) a historical document: any atlas map represents the level of knowledge at a certain time, regardless its wide ability to be updated.

3. Landscape maps concept and classification overview

Present (“cultural”) landscape represents the environment for humans and other living beings. The cultural landscape was, is and will be serving as a material reflection of the life and activities of the human society because it represents in a logical system the features of the nature as well as its changes done by humans regardless they were based on economic, social or psychological reasons. The cultural landscape consists of its natural components (water, air, energy, geology, terrain, soils and living organisms) and products of human activities. Genuine „natural landscape“, completely avoided from direct or indirect human impacts does not exist on the planet Earth any more. The only areas where the natural landscape forming processes dominant can be conventionally accepted as natural landscapes. Even there human impacts are there submitted indirectly by air or water.

This was any cultural landscape represents a very complex object, changeable in the time and space (KOLEJKA et LIPSKÝ, 1999). Sciences studying the landscape regardless if it is the landscape ecology, geography or geoecology tried to classify, divide and survey it. There are many theoretical and practical reasons, especially useful on the landscape planning why to do it (LIPSKÝ, 2005).

Various approaches are hidden behind the title „landscape mapping“ (even landscape ecological mapping), and among them also commonly very specific ways of landscape

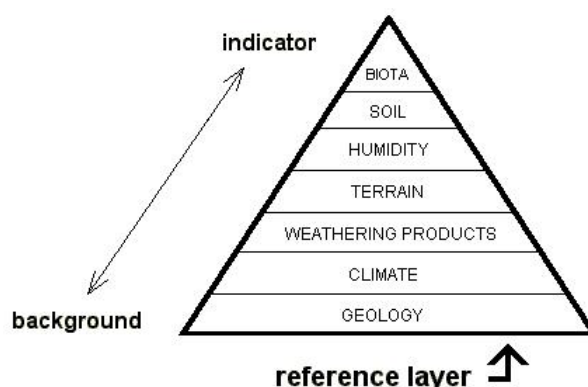
survey. It was noticed by MALÝ (1994), who commented, that „*some so called landscape maps produced by non geographers (by ecologists, biologists, planners) are not a true landscape maps, because they display only selected landscape components and the other ones are totally neglected or suppressed. Such maps do nothing with the synthetic approach typical for the landscape maps in true sense of this word* (MALÝ, 1994). As examples two landscape mapping manuals (Pellantová 1994, Vondrušková, et al., 1994) could be mentioned, serving as purpose oriented guidelines for ecological or biological assessment of present land use and its representation in maps. They have very little common with the landscape concept and knowledge about it.

The landscape is for more than hundred years a subject of scientific interests. Regardless to unfixed terminology the basic research principle is based on the holistic and systematic landscape approach. This basic working principle is transferred into the landscape documentation where the key role is being played by landscape maps. In a comparison with pragmatic and this way not totally understood homogenous units in standard thematic (analytic) maps (e.g. in geological, geomorphological, botanical, ecological, social, economic-geographical etc. maps) the landscape mapping identifies homogenous natural and/or human influenced areas reflecting their genetic homogeneity and complexity. Such approach is very well defined by the Zonneveld's concept of landscape territorial unit (land unit - ZONNEVELD, 1995). Landscape units represent various levels of territorial division and depend on the mapping scale and resolution. Detail classification and surveying methods of chorological landscape units on different hierarchical levels (topochoras, nanochoras, microchoras, mezochoras, macrochoras, megachoras) were developed by the German landscape school (e.g. HAASE, 1964).

The multi-parametric homogenous natural landscape units (both of the reconstructed and/or potential landscape) are commonly called as "geosystems" or "geocomplexes". On the global level such homogenous units are represented by landscape belts of the „landscape sphere“, on regional level by "geoms", on choric or „landscape level“ by "geochoras" it means "own landscapes" and on the local level by "geomers", or "geotops", etc. Their human made modifications are commonly defined using their present appearance, especially land use.

The maps of the natural or present landscape geosystems on individual levels of territory division represent using cartographic language the landscape spatial structure. The landscape units presented in the map must be defined using the holistic approach. It means that all the units have to be described using parameters of all natural landscape components (geology, terrain, soils, humidity conditions, climate-energy, biota). These components of the primary (natural) structure of the landscape can be arranged into a consequence from the most stable (conservative) components to the most active ones. These stable components represent some kind of the „background“ for development of the „active“ components called „indicators“. One example of the arrangement of the nature landscape components is presented the „dependency pyramid“ of the landscape components (fig. 1). The homogeneity requirements are set up as well if human impacts are to be displayed. Any area has to be represented with one land use form or by a predefined combination of land use forms and their pattern.

Fig. 1: Dependence pyramid of landscape components



The analytic data overlay and its integration represent the simplest concept of the synthesis of component geodata. The final output is represented by a landscape map. Its areas carry multi-parametric information. All parts of this information are mutually balanced as it is in a real territory. Any synthetic landscape map can be disintegrated into a set of analytic layers logically and geometrically aligned. The landscape map simulates a multi-parametric data set in GIS open to other inputs and applicable for many purposes. Its cartographic form can but has not to reflect directly all its variables both in the content and legend. Commonly it is enough to present its the dominant or physiognomic components with regard to the scale and resolution. The other features can be derived by the experienced map leader.

This way, the landscape maps demonstrate the territorial distribution of multi-parametric homogenous landscape units (geosystems) and present a synthetic idea about the nature and its transformation by humans in the certain territory (KOLEJKOVÁ et KOLEJKA, 1992). The intention to implicate a total character of a territory, regardless if natural or cultural, using a spatial synthesis represents the main reason of landscape maps. Landscape maps are synthetic maps always presenting multi-parametric information.

In general terms, the synthetic map (after PRAVDA, 1983) presents a certain phenomenon as a complex system while its components originated as consequences of an integration, higher level of abstraction of more elementary (analytic) or complex phenomena or parameters. The concept of landscape maps represents the most general criterion of their classification. This way two basic map groups can be distinguished (KOLEJKA, 1999):

- 1 - landscape typological maps (with respect to certain generalisation they present similar but distributed territorial units repeating themselves in the time and space),
- 2 - landscape division maps (emphasizing certain oneness or individual features of identified units, these landscape units are expressed by their geographical names).

The scale plays a very important role in the classification of landscape maps. The scale defines the map resolution and this way the opportunity to display landscape units of different taxonomic levels:

4 – global landscape maps represent highly generalised synthetic models of the whole Earth landscape sphere (or of hemispheres) and within their contents display landscape belts as results of climatic background impact on all the landscape forming processes through the primary distribution of the solar energy. The solar energy doses received by horizontal units of Earth surface operates as the homogeneity criteria. Units identified are similar to climate-morphogenetic planetary belts and presented at the scale less than 1:30 000 000.

There are two aspects of landscape maps classification from the chronological viewpoint: a) landscape state maps and b) own chronological maps. Using the first aspect following map classes can be distinguished:

1 - structure landscape maps informing about the component structure and physiognomy landscape units,

2 – dynamic landscape maps taking down dynamical, or functional relationships between landscape components at certain development stage of the landscape unit.

If the second aspect is applied these maps can be identified:

1 – historical landscape maps (incl. landscape reconstruction maps),

2 – inventory landscape maps (depicting present landscape situation),

3 – prognostic landscape maps (incl. maps both of potential natural or cultural landscapes).

At the present, many examples of especially natural landscape are available (present, reconstructed, potential). It is possible to talk about certain cartographic rules of landscape maps compilation.

Modern landscape maps represent classical synthetic maps with a polycomponental content and multilayer organisation. The digital landscape maps linked with a GIS database offer on one hand various opportunities for their purpose oriented applications and use, on the other hand also unlimited options for cartographic presentation of their content. It is possible to realize it in a 2D form (traditional), as a 3D model (using digital elevation model or model of a statistic surface), eventually in a 4D form (as animations of 2D or 3D models or processes inside the model). Digital landscape maps simulate multi-parametric GIS databases

1 - topical landscape maps demonstrate homogenous elementary landscape units and they are usually products of field mapping of landscape units or their components (soils, geology, vegetation, etc.). aerial imagery is used as supporting data source for mapping. Topical landscape map scale varies between 1:5 000 and 1:25 000.

2 – choric landscape maps, or own landscape maps present more heterogeneous territorial units. Their identification requires certain prospect what is necessary for generalised processing of field data, aerial and satellite imagery Homogeneity criteria reflects the individual levels of choric landscape division (micro, mezo, macro, mega) and represent the data integration about the soil and forest canopy classes, land forms and later relief classes geotectonic structure and climate represented by plant formation. The dominant role in the unit definition is played by the terrain because it operates on the choric level as the main distribution factor of energy, water and solid matter. Maps are being compiled at the scales between 1:25 000 and 1:500 000 (exceptionally at smaller ones).

3 – regional landscape maps present territorial units with an extend and position reflecting impacts effects of zonal geographic (both vertical and horizontal) factors of landscape division. The water/energy balance is the most important among them. The plant formation (geom or biom) plays the role of an identification criteria and homogeneity indicator together with the genetic unity and general physiognomy given by terrain megaforms, as well as general land use pattern. Map scales regard the continental/regional resolution level and vary between 1:1 000 000 and 1:10 000 000 (exceptionally at bigger ones) and if necessary it is possible to disintegrate them into „original“ analytical layers, now geometrically and logically integrated (fig. 2). The latest integrated landscape database is represented by a digital landscape model (KOLEJKA, 2005), consisting of three integrated multi-parametric data layers on the primary, secondary and tertiary landscape structure and DEM. Using it an unlimited number of analytic, assessment, modelling and visualizing operation is possible (fig. 3). Traditional (e.g. one-layer) land use maps and various derivatives from them cannot be accepted as real „maps of present landscape“ because of the information about the natural background as the landscape merit is missing.

Fig. 3: Digital landscape model scheme

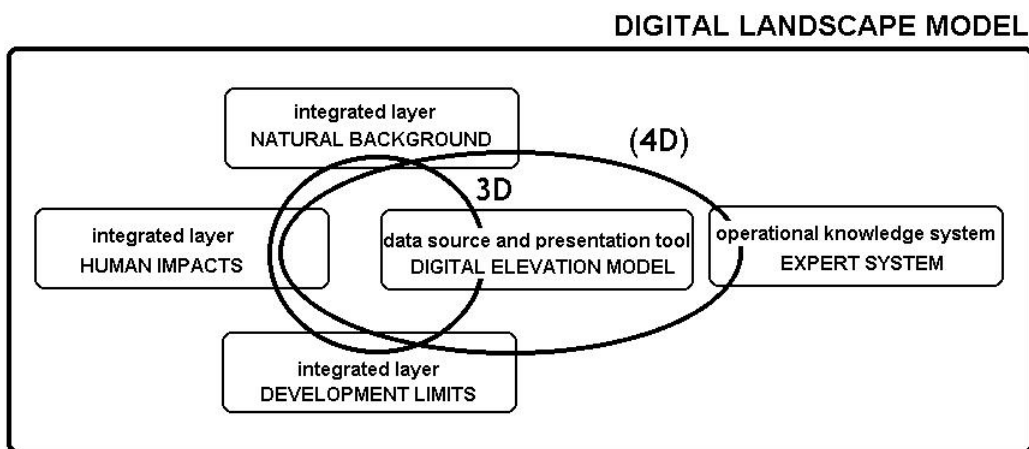
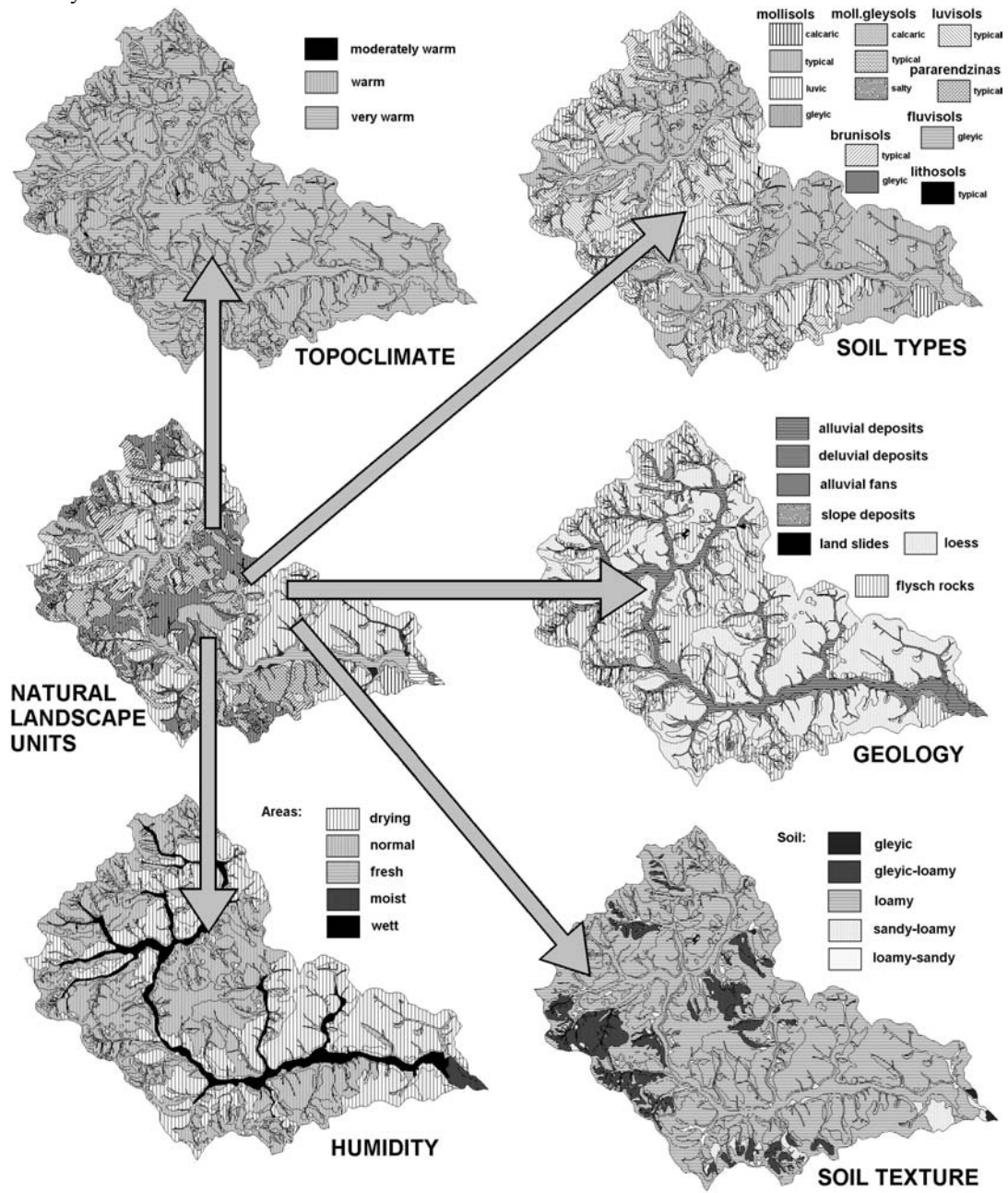


Fig. 2: Data integrated in a synthetic layer and its decomposition into corrected analytic layers



4. Development of Czech landscape cartography

The holistic landscape research and assessment enjoyed more than one-hundred-years long tradition in Czech lands. The economic requirements were at the beginning of such activities in the year 1885 when the delimitation of Natural landscape units of the Kingdom of Bohemia was completed. KAREL KOŘISTKA - the famous Czech geographer of that time expressed the idea of synthetic assessment of individual landscape regions what was a very progressive approach both in European and world science context. The landscape units were understood as natural divided units with specific natural features implicating and influencing together the ways of economic utilizing of the territory. Later the divisional approach (regionalism) became dominating and so called „natural landscapes“ have been identified in Czech lands after the First World War (KOLÁČEK, 1924; KRÁL, 1930; VINCENT, 1927). Similarly so called „natural regions“ (DĚDINA, 1927) or “native areas“ (DVORSKÝ, 1918; KRÁL, 1930) were distinguished. Especially geographers KRÁL and DĚDINA boosted the holistic approach in the acceptance both of natural and cultural landscapes. KRÁL (1930) expressed the idea, that the „**native area**“ is being formed by natural factors without sharp delimitations by borders. In opposite, “**cultural areas**“ have been developed from native areas by the „coexistence of humans and the nature“ during the process of mutual influencing. Regionalisational efforts made by KORČÁK (1936) and MOSCHELESOVÁ (1936) were precociously terminated by the Second World War which badly cut up the Czech scientific community.

The post-war scientist differentiation and formation of academic institutes cause the preference of analytic research. The biological and geological science stand on the top of the landscape research in Czech lands (HEJNÝ, 1961; VESELÝ et al., 1954). The turning point in geographic landscape research arrived with the pushing of the systematic approach in geography by the Geographical Institute of the Czechoslovak Academy of Sciences in 1970s (DEMEK, 1974). The map „*Physico-geographical regions of the Czech Socialist Republic*“ at the scale of 1:500 000 was published as a part of the physico-geographical division map set (DEMEK, QUITT, RAUŠER, 1975). It was the first scientifically based map of typological natural landscape units in the territory of the Czech Republic. The physico-geographical regions (using present terminology – natural landscapes) were described by four-digit code, where the first one represents the vertical dissection class of the relief, the second one the genetic class of relief, the third one the climatic region and the last one the vertical forest stage.

Approximately at the same time, the simple landscape assessment procedure has been developed at TERPLAN - the predominately for the planning practice oriented institution. It was based on maps at the scale of 1:50 000 and completed for the whole territory of the Czech Republic (MURANSKÝ et al., 1977, NAUMAN et al., 1977). The national territory was divided into three basic landscape classes using statistical data about land use on cadastral level:

- * *A – landscapes totally transformed by humans*
- * *B – balanced landscapes with an equilibrium of natural and human made elements*
- * *C – basically natural landscapes with a dominance of natural elements*

All these objectively and pragmatically defined landscape classes were divided into areas within one of three value levels:

- * *(+) high or improved landscape value*
- * *(0) basic or average landscape value*
- * *(-) low or reduced landscape value*

In 1980s and 1990s other nation wide landscape originated as parts of atlas compendia. The maps of natural landscape classes represent the most of them. The map „*Natural (geoecological) landscape classes*“ from the Slovak national atlas (1980) represented their methodical background. The last federal Czechoslovak „*Atlas of the environment and population health*“ comprised a landscape map at the scale of 1:1 million with 71 distinguished natural landscape classes (KOLEJKA, 1992). It is typical that the most landscape maps from 1970s-1990s represented various classes of the natural landscape what does not exist any more on the Czech territory for longer time. These maps show classes of potential natural landscape. The natural landscape mapping is methodically simpler and results are unambiguous. This ways, maps of natural landscape are common parts of many national atlases of countries with developed geography and cartography. Some such maps were released individually without connection to any atlas (see Chapter 5).

The mapping of present landscape is much more complex. All the natural (primary) structure, the human influenced secondary and tertiary landscape structures have to be shown in the map. Methodological aspects of present landscape mapping were studied by KOLEJKA and LIPSKÝ (LIPSKÝ et al., 1997; KOLEJKA et LIPSKÝ, 1999) as an ingredient of a research grant. The present landscape maps were constructed at 8 different scales from 1:10 000 to 1:2 millions. Maps at scales of 1:500 000, 1:1 milion a 1:2 millions are nation-wide. The map extracts at larger scales (1:10 000, 1:25 000) present topological landscape units, while chorological units are shown in the map at the scale of 1:50 000 and less. These maps have two-layer content structure with regard to the present landscape physiognomy:

1 – a natural background layer (primary structure)

2 – a present land utilising layer (secondary structure)

Both these layers can be integrated into one information layer if the cartographic generalising is strict at smaller scales. Probably the last landscape map document is represented by the mapping of Czech „landscape mezotyps“ at the scale of 1:500 000 (LÖW et al., 2005). This map has been completed as a part of the project No. VaV/640/1/03 „*Typology of Czech Landscape*“ supported by the Czech Ministry of the Environment. This output has been required by the European Landscape Convention. Three data layers were applied for the identification of landscape mezotyps:

1 – natural features

2 – social-economic conditions

3 – cultural objects

(these information layers were interpreted pragmatically and do not respect standard terminology). A consequent „synthetic map of framing landscape view classes“ presents 160 classes of units at the scale of 1:200 000. Every landscape unit is identified by three-digit-code. The first position represents the class of settlement area, the second one gives information about the land use, and the third one shows the georelief class (LÖW et al., 2006). Also these classes were defined and identified using an untraditional and system less approach.

5. Landscape maps in the world

5.1. Maps of natural landscapes

General maps of natural landscape types commonly exist in many European countries, usually as a part of national atlases. Methodical procedure of their compilation is similar as a rule, based on the methods of overlapping of partial thematic maps or data classifying single natural components of the landscape (like geomorphology - relief, soils and their parent material, climate, potential vegetation). Differences are in the emphasis assigned to single components and also used terminology. Single typological attributes corresponding to landscape components have got different significance in different landscape types. In the Alpine countries, for example, the greatest significance has been traditionally predicated to relief combined with the altitude, whilst in the Scandinavian countries bioclimatic conditions are the most important.

In the large Slovak National Atlas (ATLAS SSR, 1980), in addition to general landscape maps on the scale 1: 500 000, used for the entire country territory, map cutouts on more detailed scales 1:200 000, 1:100 000 and 1:30 000 demonstrate possibilities to compile landscape maps on different hierarchical levels and with different rate of details depending on the scale. The methodical approach is the same as above mentioned again, only used terminology is different: types of natural landscapes are in accordance with the concept of the Slovak geoecological school named as **geoecological landscape types**. In the new monumental atlas work - The Landscape Atlas of the Slovak Republic (2002), the Map of primary (= natural) landscape structure on the scale 1:500 000 has been placed. The system approach to the landscape is expressed in the name of mapped landscape units: **potential geosystems**. They are complex, synthetic natural landscape units with emphasis laid on natural potential vegetation. The Atlas of Representative Geoecosystems of the Slovakia (MIKLOS, IZAKOVIČOVÁ et al., 2006) distinguishes 85 geoecological regions on the territory of Slovakia. Geoecological regions represent individual natural landscape units, mostly corresponding with geomorphological units of individual geomorphological division of the country. Typological division of natural landscape is represented by 120 „**representative geoecosystems**“, mapped and delimited on the basis of the combination of zonal (bioclimatic) and azonal (geology and relief) conditions. These terminologically questionable “geoecosystems“ are farther characterised after potential vegetation.

Natural landscape types in Poland were mapped on the scale 1:500 000 using systematic physico-geographical approach, synthesizing single components of natural landscape into complex natural (geoecological) units (RICHLING, 1984). Similar geographical approach has been applied in Bulgaria; typological landscape units are called „**natural territorial complexes**“ (DANEVA, 1989).

The map of natural landscapes compiled by MEYNEN and SCHMITTHÜSEN (1953-1962) has become the most reputable landscape division in Germany. Newly more detailed classifications and divisions complete with regionalization link up to the Meynen and Schmitthüsen's typology in single federal countries of Germany. The first complex, not only to components oriented natural landscape classification in Scandinavia was published in 1977 (WERNER, 1989). The division is in the first level based on characteristics of natural vegetation (i.e. forest types), but reflects morphological features of the relief as well. 76 natural landscape types were distinguished for the whole Scandinavia. Similar examples can be found in more European countries like Hungary, Romania, Ireland and others.

Ecoregions in the United States and Canada have been mapped on different hierarchical levels using traditionally biophysically and ecosystem oriented approach with the emphasis given to zonal vegetation depending on climatic conditions (BAILEY, 1976; OMERNIK,

1987). A hierarchical classification of natural landscapes, both typology and regionalization of natural landscape units on 7 hierarchical levels have been developed in China. Depending on hierarchical level, the scale of mapping ranges from 1: 10 millions to 1:50 000 on the lowest level (CUANG, 1989).

5.2. Maps of cultural landscapes

Maps of the present cultural landscapes represent a wide spectrum of different select approaches, used data and methods of mapping and map compilation. Mapping of the secondary landscape structure which dominantly influences some features and character of the present landscape is the most common. Maps are compiled using data on functional land use or data on land cover. Recently digital data from the European CORINE Land Cover database is used in a routine way. **Maps of land(scape) use** and **maps of land cover** are common in many European countries now, however classifications systems and legends of the maps can be different. Accordingly several datasets like CORINE or PELCOM based on a uniform interpretation of satellite images have been created on the Pan-European level (LIPSKÝ et ROMPORTL, 2007).

The cultural landscape is a complex of both natural and cultural elements and both layers of the present landscape - primary as well as secondary landscape structure - influence its visual features and further significant characteristics. A complex map of the present landscape shall be accordingly created as an inventive cartographic synthesis composed of both layers. The map "**Types of present landscape**" on the scale 1: 500 000 from the Slovak National Atlas (1980) is one of the first examples of such map. The map was created as a result of a combination of natural landscape types and present landscape use. A similar two-layer physiognomic approach has been also applied to compile The map of **landscape ecological complexes** in The Landscape Atlas of the Slovak Republic (2002) distinguishing 53 types of the present cultural landscape associated into 13 classes of the types of natural geocomplexes.

A method of mapping of the British landscape using GIS has been developed in The Institute of Terrestrial Ecology (U.K.). The method is based on the analysis of the existing data on land use, actual and potential vegetation, soils and relief in squares 1x1 km. 32 land classes have been defined on the territory of the United Kingdom (BUNCE et al., 1991).

Methods of landscape typologies and landscape mapping, aimed at landscape character assessment in different European countries, have been reviewed in the European ELCAI project (European Landscape Character Assessment Initiative, WASCHER, ed., 2005). In the framework of the ELCAI project, a comparison of methodological approaches to landscape mapping have been done based on national inputs from 15 European countries: Austria, Belgium, The Czech Republic, Denmark, Estonia, France, Germany, Italy, Norway, The Netherlands, Portugal, Spain, Switzerland, Slovakia, United Kingdom. Mapping of the present cultural landscape is directly germaned to mapping and assessment of landscape character. The different national and regional landscape typologies form a patchwork of classification models, which are conceptually rather incompatible at the international level. In contrast to natural landscapes mapping, where methodological approaches are similar, the more complicated maps of cultural landscapes are compiled in single European countries by help of diverse and often non-repeatable methods. The methodologies can differ substantially depending on traditions of geographical and landscape research, the practical purpose of the mapping and landscape characteristics of the country. The emphasis is given to factors influencing the character of the present landscape and forming its specific regional features. The account given to single factors is very different in single countries. As a result, the boundaries of landscape types and land

units of neighbouring countries are not linked over state boundaries.

One of the most detailed and complex method of mapping of cultural landscapes have been developed in Austria. The system is hierarchical (5 levels: landscape zones, landscape provinces, series of landscape types, groups of landscape types, types and subtypes of landscape structures). A mixture of biophysical and cultural criteria is used. The method starts with delineation of primary landscape structure units, which are complemented by cultural characteristics: secondary landscape macrostructure (land use and land cover) and secondary landscape microstructure (land mosaic - pattern of landscape use), followed by indicators of tertiary landscape structure like types of settlements, historical, ethnographic, social and political characteristics. The Austrian approach combines field base mapping, interpretation of aerial and satellite images and geographical data with the numerical analysis using computer methods (WRBKA et al., 2000).

Also the Belgian approach to mapping and typology of cultural landscapes developed at the Department of Geography at the University of Gent is very inspiratory. The methodology is based on the interpretation both biophysical and cultural characteristics, some of them are original and represent a great challenge for future landscape mapping not only in Belgium. Several original landscape maps, including the Map of Ecodistricts, Map of Historical Landscapes and the Map of Traditional Landscapes are in the regional Atlas of Flanders (ANTROP, 2002). More details about the methodologies of existing national landscape mappings and classifications in European countries are described in the ELCAI Final Project Report (WASCHER, ed., 2005; www-elcai.org).

Two interesting approaches to a classification of global landscapes have been put forward: the Russian „**World Map of Present-Day Landscapes**“ (MILANOVA et al., 1993) and the American “ **Anthropic Landscapes Map**“ (ESWARAN et REICH, 2005, in WASCHER, ed., 2005). The project of the World Map of Present-Day Landscapes coordinated by E.V.MILANOVA is based on two maps: Zonal Types of Landscapes of the World and Land Use Types of the World, both of Russian (Sowiet) production on the scale 1: 15 millions. „*Present-day landscapes are specific units of land surface characterised by a structurally organised combination of natural and economic components, whose close interaction gives birth to spatially distinct territorial systems in a dynamic equilibrium*“ (MILANOVA et al., 1993). As a result, more than 150 landscape types of the world have been delineated, each of them described by a code system based on its natural and anthropogenic characteristics (MILANOVA et al., 1993; WASCHER, ed., 2005).

The Global Anthropic Systems Map represents an original attempt to demonstrate different manifestations of human impacts on land. The study addresses key aspects of human impacts on landscapes such as agriculture, forestry, recreation, mining and infrastructure (WASCHER, ed., 2005).

The first Pan-European typology of the present cultural landscape has been developed by the Dutch landscape architect JOHANN MEEUS (1995). As a result of the long-term expert work, Meeus identified 30 main European rural landscape types on the map of the small scale 1: 25 millions. The typology is multi-dimensional, using typological criteria like relief, bioclimatic and vegetation zones, land use and regionally specific landscape patterns and also visual aspect of landscape scenery. This typology was published in the report Europe's Environment: The Dobříš Assessment (EUROPEAN ENVIRONMENT AGENCY, 1995) and has become known also in the Czech Republic (LIPSKÝ, 1998, 2004; LÖW et MÍCHAL, 2003).

Demands of the European Landscape Convention (COUNCIL OF EUROPE, 2000) and the generally increasing policy needs for a more detailed and accurate data on present landscape types at the European level initiated a new approach to the identification and

mapping of European landscapes. The new Pan-European landscape typological map was elaborated in the research centre Alterra using computer based GIS methods of processing digital data of the Pan-European coverage. In the first version (MÜCHER et al., 2003), three core data layers were selected to compile the landscape map and identify landscape types:

- 1 - topography (the digital elevation model GTOPO30)
- 2 - soils and their parent material (European Soil Map on the scale 1: 1 million)
- 3 - landscape use (CORINE Land Cover database)

In its second version (LANMAP2, MÜCHER et al., 2005), the environmental stratification of Europe related to climatic zones, aggregated into 8 types of environmental zones has been used as the fourth data layer. The resulting European Landscape Typology Map LANMAP2 contains 375 European landscape types sorted into eight environmental zones. The map should be applicable both for scientific and practical policy oriented purposes of strategic planning and landscape character protection at the European level. More details of the methods of elaboration of the map are provided in works MÜCHER et al. (2003; 2005), WASCHER, ed. (2005), LIPSKÝ et ROMPORTL (2007) and also on the website www.elcai.org, www.alterra-research.nl.

6. Landscape maps in The Landscape Atlas of the Czech Republic

The formulation and elaboration of the new landscape atlas in the Czech Republic has been inspired by the Slovak Landscape Atlas published in 2002. The preparation of the Czech Landscape Atlas started in 2003 and is finishing now in 2007.

The atlas is divided into 9 sections:

1. Landscape and methods of its study
2. Geographical position of the Czech Republic in Europe and in the world
3. Historical landscape
4. Natural landscape
5. Present (cultural) landscape
6. Landscape as heritage
7. Landscape as environment
8. Landscape of the future
9. Landscape in the art

However some topics could seem to be abstract, they are reasoned because the present landscape is a product of interactions and space of conflicts both past and present natural and anthropogenic processes. Then the atlas is composed to cover the extremely wide range of approaches to landscape - from naturalist, sociologist, economist and historian's view over artistic perception and interpretation of the landscape up to its inhabitants, makers and stakeholders.

Section 1 „Landscape and methods of its study“ is aimed at the interpretation of the term „*landscape*“. from different viewpoints. Various methods of landscape research and landscape interpretation and assessment for both scientific and practical purposes are presented in maps, graphs and profiles, computer based models, GIS methods etc. Demonstrations of mapping of the Czech landscape from the end of the Middle Ages till present, including old military, topographic and cadastral maps, atlas works,

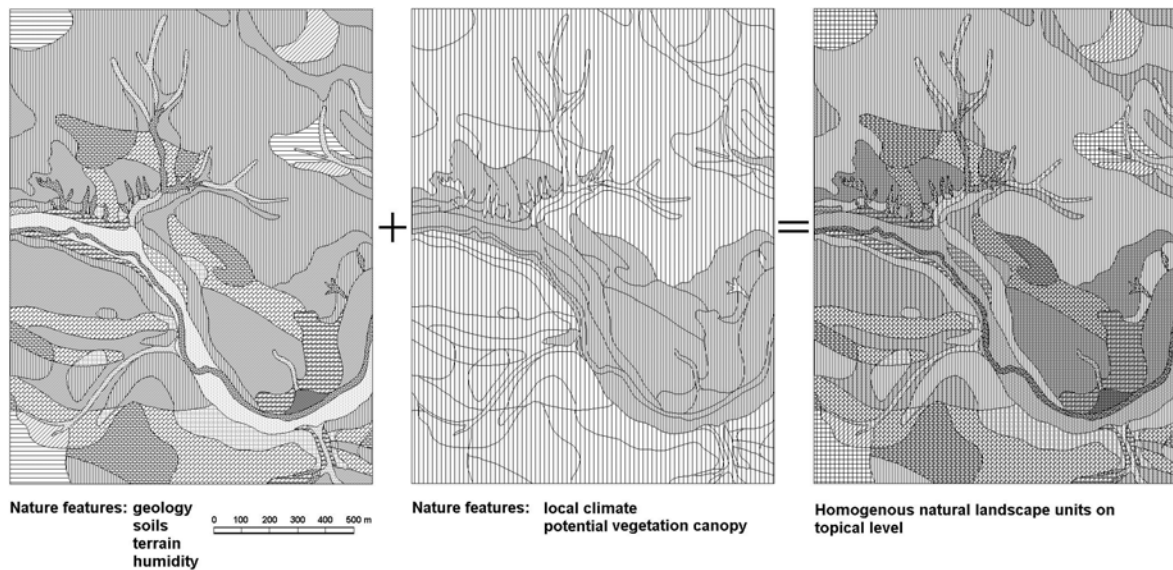
orthophotomaps and contemporary computer maps compiled using information technologies, are presented in the section as well.

Section 2 „Geographical position of the Czech Republic“ is focused at relations of the Czech landscape to European conditions. The Czech landscape and geographic environment is classified in the natural, economic, demographic and political frameworks of the Old continent. Maps on the scale 1: 20 millions demonstrate links our territory to neighbouring countries and in the European context.

Section 3 „Historical landscape“ shall document landscape development on the territory of the Czech Republic. It concerns development of both the natural landscape during the Ice Age and Holocene and the cultural landscape from the Neolithic time. Important development stages including phases of landscape colonization and periods with specific and significant features of landscape use as well as landscape changes are showed in maps and other graphics. As a final synthetic map, a typology of the state territory from the point of view of landscape changes and developments is presented.

Section 4 „Natural landscape“ is a collection of analytical and synthetic maps (Fig 4), cartograms and graphs concerning natural landscape elements: energy, atmosphere, geological bedrocks, relief, water, soils, biota and landscape as an integral system manifestation of single elements. Quite new is the subsection Energy in the landscape, still missing in landscape maps and atlases. Final synthetic landscape maps are represented by the Map of natural landscapes (typological division) and the Map of natural landscape regions (individual division), both on the scale 1:500 000.

Fig. 4: Topological map of natural landscape (typological) (coloured layer – left, hachure layer – in the middle, layer overlay – right)



Section 5 „Present landscape“ shows the co-existence of nature and society on the territory of the Czech Republic from many angles of view. Population, settlements, economic, social and cultural aspects and their co-operation and manifestation in the landscape are demonstrated in maps and other graphics. These society's activities influence the landscape and its functions, characteristics and scenic views in a significant way, which is also documented by many regional examples and orthophotomaps. Map syntheses of the section are represented by the Map of present landscape types (typological division of the present landscape), the Map of landscape regions (individual regionalisation of the present landscape, which was still missing in the country), both on the scale 1:500 000, farther the map Function landscape types on the scale 1: 1 million and the map Types of landscape character on the scale 1: 500 000 (Fig 5).

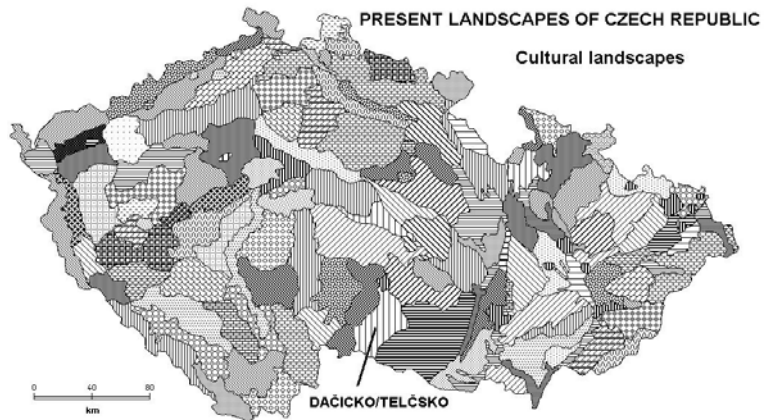
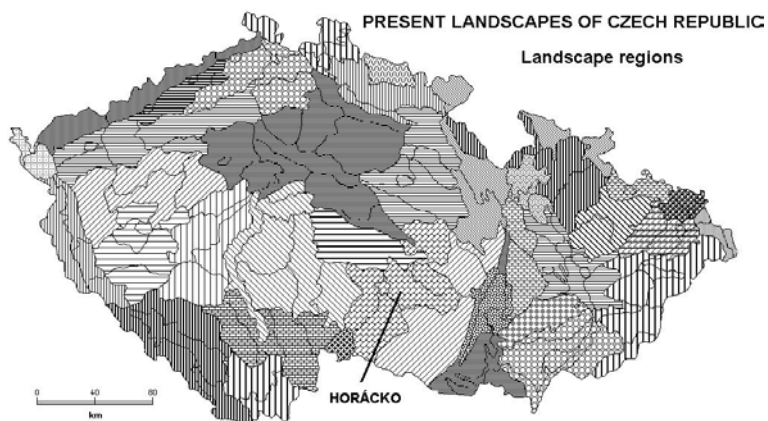
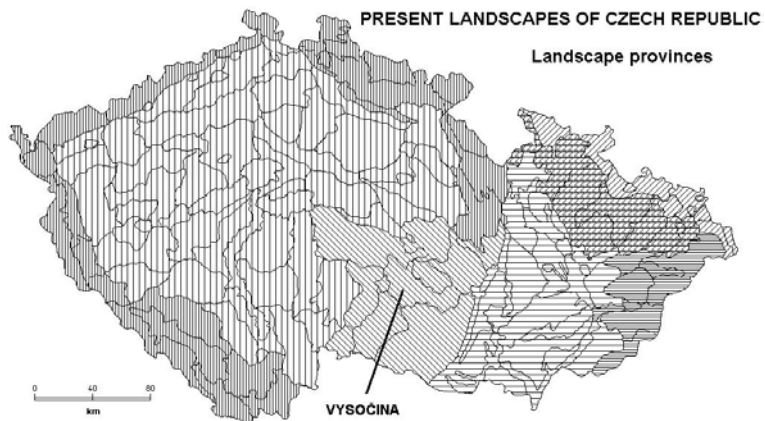
Section 6 „Landscape as heritage“ presents the natural and cultural values of the landscape. Maps of all landscape and nature protected areas, occurrence of rare and endangered species of flora and fauna, landscape dominants, important landscape segments, biocentres and biocorridors, geological and geomorphological phenomena as well as cultural and historical landmarks form the content of the section. The complex map „Landscape ecological values of the territory“ at the scale 1:500 000 close the section as a synthesis of previous analytical maps.

Section 7 „Landscape as environment“ is dealing with the state of the environment in the country. Analytical maps concern single components of the environment like air, soils, bedrocks, surface and ground waters, forests, vegetation and fauna in terms of their state, recent development and a degree of anthropogenic transformation. Natural and anthropogenic hazards and risks, landscape potential(s) and carrying capacity are mapped as well.

Section 8 „Landscape of the future“ is aimed at development programmes, scenarios, trends and hypotheses concerning expected future developments of our country. The topic shall be discussed both from the viewpoint of single resorts with respect to the impacts in the landscape and from the position of the landscape as a recipient of man activities and their impacts.

Section 9 „Landscape in the art“ shall introduce the Czech landscape in visual art works. Bohemian, Moravian and Silesian landscape have attracted the attention of painters and other visual artists from of old and its expression in art works is traditionally an integral part of our cultural wealth.

Fig. 5: Regional map of present landscape (individual)



References

- ANTROP, M., 2002: Results of the recent landscape inventories for building landscape indicators in Belgium. In: Dramstad, W., Sogge, C. (eds.): *Agricultural impacts on landscapes: Developing indicators for policy analysis. Proceedings of the NIJOS/OECD Expert Meeting, Oslo, 7-9 October 2002*, p. 99-107. NIJOS Report 07/2003, As (Norway)
- ATLAS SSR, 1980, Slovak Academy of Sciences, Bratislava
- BAILEY, R.G., 1976: *Ecoregions of the United States*. U.S. Forest Service, Ogden
- BUNCE, R.H.G. et al., 1991: *ITE Merlewood Land Classification in Great Britain*. ITE, Merlewood
- COUNCIL OF EUROPE, 2002: *European Landscape Convention*. Strasbourg
- CUANG, L., 1989: The development of landscape classification in China. In: Mazúr, E. (ed.): *Landscape classification*. SAV, Bratislava, p. 66-76
- CULEK, M. et al., 1996: *Biogeographical division of the Czech Republic*. Enigma, Praha, 347 p., map 1: 500 000 (in Czech)
- CULEK, M. et al., 2005: *Biogeographical division of the Czech Republic II*. Enigma, Praha, 589 p. + digital map 1:50 000 (in Czech)
- DANEVA, M, 1989: Some fundamental problems of landscape classification in Bulgaria. In: Mazúr, E. (ed.): *Land classification*. SAV, Bratislava, p. 26-36
- ĎĚDINA, V., 1927: Natural districts and regions in Czechoslovakia. *Journal of the Czech Geographical Society*, 30, 1, p. 21-25 (in Czech)
- DEMEK, J., 1974: *System theory and landscape study*. *Studia geographica* 40, Geographical Institute of the Czechoslovak Academy of Sciences, Brno, 200 p. (in Czech)
- DENEK, J., QUITT, E., RAUŠER, J., 1975: *Physicogeographical regions of the Czech Republic*. Map 1:500 000. Geographical Institute of the Czechoslovak Academy of Sciences, Brno (in Czech)
- DVORSKÝ, V., 1918: The territory of the Czech nation. *Český čtenář (Czech Reader)*, 10, 6-7, p. 1-79 (in Czech)
- FVŽP ČSFR et GGÚ ČSAV, 1992: *Atlas of the Environment and Health of the Population of the ČSFR*. Praha-Brno
- HAASE, G., 1964: *Landschaftsökologische Detailuntersuchung und naturräumliche Gliederung*. *Pettermanns Geographische Mitteilungen*, 108, č. 1-2, s. 8-30
- HEJNÝ, S., 1961: *Landscape and its division related to geobotanical map*. In: *Biologické práce (Biological works)*, 7, Publishers of the Slovak Academy of Sciences, Bratislava, p. 35-37 (in Czech)
- HYNEK, A., 2003: *Natural and cultural landscapes of the Czech Republic: spatial pattern*. In: Herber, V. (ed.): *Physicogeographical Proceedings 1. Physical geography - Education, Research and Application*. Masaryk University, Brno, p. 36-43 (in Czech)
- HYNEK, A., 2004: *Landscapes and regions of identical areas*. In: Herber, V. (ed.): *Physicogeographical Proceedings 2. Cultural Landscape*. Masaryk University Brno, p. 13-19 (in Czech)
- HYNEK, A., TRNKA, P., 1981: *Topochores of the Dyjská part of the Znojmo region*. *Folia Fac. Sci. Nat. Univ. Purkyn. Brun. (Geographia)*, 24, 1, p. 1-103 (in Czech)
- KOLÁČEK, F., 1924: *Natural landscapes in Moravia and Czech Silesia*. In: *Příroda (Nature)*, 17, Barvič a Novotný, Brno, p. 249-253, 314-325 (in Czech)
- KOLEJKA, J., 1989: *Compilation of the complex physicogeographical map of the South Moravian region at the scale of 1:250 000*. *Zprávy GgÚ ČSAV (Reports of the Geographical Institute of the Czechoslovak Academy of Sciences)*, 26, .3, p. 15-34 (in Czech)

- KOLEJKA, J., 1992: Types of natural landscapes of the ČSFR, map 1:1 000 000. In: *Atlas of the Environment and Health of the Population of the ČSFR*, Praha-Brno
- KOLEJKA, J., 1999: Landscape maps and their classification. *Geodetický a kartografický obzor*, roč. 45/87, č. 12, s. 273-278 (in Czech)
- KOLEJKA, J., LIPSKÝ, Z., 1999: Maps of present landscape. *Geografie, Sborník ČGS (Journal of the Czech Geographical Society)*, 104, 3, p. 161-175 (in Czech)
- KOLEJKOVÁ, D., KOLEJKA, J., 1992: Landscape and environmental maps. In: *Memorial volume. "Analysis and synthesis of geographic systems"*. Brno, GgÚ ČSAV, p. 201-210.
- KORČÁK, J., 1936: Regional type in a statistical concept. In: *Proceedings of the III. Congress of the Czech Geographers in Plzeň, 1935*, p. 111-112 (in Czech)
- KRÁL, J., 1930: Cogitations about the division of the Czechoslovak Carpathians in natural regions and their denomination. *Proceedings of the Philosophical Faculty of the Comenius University, Bratislava*, 7, 54 (1), p. 1-33 (in Czech)
- KRAUKLIS, A. A., MICHEJEV, V. S., 1965: *Landschaftnyje karty, ich soděržanije, naznačenije i struktura*. In: *Kartografičeskije metody kompleksnyh geografičeskich issledovanij. Irkutsk, Vostočno-Sibirskoje knižnoje izdatělstvo*, s. 22-37.
- LIPSKÝ, Z. et al., 1997: *Typology and protection of the Czech cultural landscape. Final report of the research project of the Grant Agency of the Czech Republic, Nr. 206/95/0959. Institute of Applied Ecology, Faculty of Forestry of the Czech Agricultural University, Kostelec n.Č.l.* (in Czech)
- LIPSKÝ, Z., 1998. *Landscape ecology for geography students*. Karolinum, Praha, 129 p. (in Czech)
- LIPSKÝ, Z., 2004: *Types of European landscapes. Životné prostredie (The Environment)*, Bratislava, 38, 3, p. 135-141 (in Czech)
- LIPSKÝ, Z., 2005: *Landscape typology as a basis for sound landscape planning. ALFA SPECTRA Planning Studies FA STU*, 9, Special Issue, p. 8-14
- LIPSKÝ, Z., ROMPORTL, D., 2007: *Landscape typology in the Czech Republic: state of the art, methods and outlets. Geografie, Sborník ČGS (Journal of the Czech Geographical Society)*, 112, 1, p. 61-83 (in Czech)
- LÖW, J. et al., 2005: *Typology of the Czech landscape. Project of the Ministry of the Environment of the Czech Republic, Nr. VaV/640/1/03. Löw a spol, s.r.o., Brno* (in Czech)
- LÖW, J., CULEK, M., NOVÁK, J., HARTL, P., 2006: *Types of landscape character in the Czech Republic*. In: *Vorel, I., Sklenička, P. (eds.): Protection of Landscape Character. Proceedings of the Int. Conference, Praha*, p. 43-50 (in Czech)
- LÖW, J., MÍCHAL, I., 2003: *Landscape Character. Lesnická práce, Kostelec n. Č.l.*, 552 p. (in Czech)
- MALÝ, J., 1994: *Landscape mapping - content and typization of landscape maps*. In: *Biotope Mapping. Proceedings of the Seminar, Agricultural University, Brno*, p. 57-59 (in Czech)
- MEEUS, J., 1995: *Landscapes*. In: *Stanners, D., Bourdeau, P. (eds.): Europe's Environment. The Dobříš Assessment. European Environment Agency, Kobenhavn*, p. 172-189
- MOSCHELESOVÁ, J., 1936: *Geographical region - Landscapes - in the concept of regional geography*. In: *Proceedings of the III. Congress of the Czech Geographers in Plzeň 1935*, p. 107-108 (in Czech)
- MÜCHER, C.A. et al., 2003: *Identification and characterisation od environments and landscapes in Europe. Alterra - rapport 832, Wageningen*, 113 p.

- MEYNEN, E., SCHMITTHÜSEN, J. (eds.), 1953-1962: *Handbuch der naturräumlichen Gliederung Deutschlands. Gemeinschaftsveröffentl. d. Inst. f. Länderkunde. Unter Mitw. d. Zentralaussschusses f. Dt. Landeskunde, Bad Godesberg: Bundesanstalt f. Landeskunde und Raumforschung Bd. 1-2*
- MIKLÓS, L., IZAKOVIČOVÁ, Z. et al., 2006: *Atlas of representative geoecosystems of Slovakia. Slovak Academy of Sciences, Ministry of Environment and Ministry of Education of the Slovak Republic, Bratislava, 95+123 p. (in Slovak)*
- MINISTRY OF ENVIRONMENT of the Slovak Republic, 2002: *Landscape Atlas of the Slovak Republic. Slovak Environment Agency, Banská Bystrica, 344 p.*
- MÜCHER, C. A. et al., 2003: *Identification and Characterisation of Environments and Landscapes in Europe. Alterra-raport 832, Wageningen, 120 p.*
- MÜCHER, C. A. et al., 2005: *Landscape of Europe. In: Pérez-Soba, M., Wascher, D. M. (eds.): Landscape Character Areas. Places for building a sustainable Europe. Policy Brochure as deliverable from the EU's Accompanying Measure Project European Landscape Character Assessment Initiative (ELCAI), Landscape Europe, Wageningen, 33*
- MURANSKÝ, P. et al., 1977: *Landscape assessment and its application in planning praxis. Architektura ČSR (Czech Architecture), XXXVI, Nr. 9-10, p. 390-398 (in Czech)*
- NAUMAN, P. et al., 1977: *Landscape assessment from theoretical and methodological point of view. Architektura ČSR (Czech Architecture), XXXVI, Nr. 9-10, p. 386-390 (in Czech)*
- OMERNIK, J.M., 1987: *Ecoregions of the United States. Annals, Association of American Geographers, 77, p. 118-125*
- PALUDAN, C. T., 1976: *Land Use Survey based on Remote sensing from High Altitudes. Geographica Helvetica, 31, č. 1, s. 17-24.*
- PELLANTOVÁ, J., 1994: *Methodology of landscape mapping. VaMP-ČÚOP, Praha, 34 p. + tables (in Czech)*
- PRAVDA, J., 1983: *Cartographic aspects of the creation of synthetic maps. Geodetic and cartographic review, 83, 8, p. 200-205 (in Czech)*
- RICHLING, A., 1984: *Typology of natural landscape in Poland on the scale 1: 500 000. Miscellanea Geographica, Warszawa*
- SCHULZ, G., 1978: *Die thematische Abgrenzung des Begriffs "Landschaftskarte". Kartographische Nachrichten, 28, 6, s. 210-215.*
- VONDRUŠKOVÁ, H., et al., 1994: *Landscape mapping. Methodology. SMS, Praha, 55 p. (in Czech)*
- VESELÝ, J. et al., 1954: *Protection of the Czechoslovak nature and landscape. Vol. II. Publishers of the Czechoslovak Academy of Sciences, Praha, 705 p. (in Czech)*
- VINCENT, G., 1927: *A proposal of division of Czechoslovakia in forest production regions and natural landscapes. Czechoslovak Statistical Bulletin, 8, p. 279-313 (in Czech)*
- WASCHER, D.M. (ed.), 2005: *European Landscape Character Areas. Typologies, Cartography and Indicators for the Assessment of Sustainable Landscapes. Final Report of the ELCAI Project, Alterra Report 1254, Landscape Europe, Wageningen, 150 p.*
- WERNER, M., 1989: *Landscape classification systems in Sweden. In: Mazúr, M. (ed.): Landscape classification. SAV, Bratislava, p. 119-127*
- WRBKA, T. et al., 2000: *Karte der Kulturlandschaftstypen Österreichs im Maßstab 1: 200 000 auf der Basis einer visuellen Interpretation von Satellitenbilddaten. Forschungsprojekt Kulturlandschaftsgliederung Österreich, Bundesministerium für Bildung, Wissenschaft und Kultur, Wien (CD-ROM)*
- ZONNEVELD, I.S., 1995: *Land Ecology. SPB Academic Publishing, Amsterdam, 200 p.*