APPLICATION OF SPACE IMAGERY TO COMPILATION OF PHOTOMAPS IN CZECHOSLOVAKIA

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Introduction

In the course of recent years several maps of Czechoslovak territory were compiled on the basis of space images. The paper presents a brief description of the map series, basic parameters of exploited images and characterization of photomaps with thematic orientation. It comprehends the cartographic works which were created at the Remote Sensing Centre of the Geodetic and Cartographic Enterprise in Prague, or with its participation. These activities were oriented to research purposes as well as to practical applications in geology, agriculture, forestry, environment protection, land-use, geographical studies and regional planning.

Various maps differentiate each other by the type of exploited space images, method of their treatment, extent of the area as well as by the output forms.

Input Satellite Data

Space images from Soviet satellites of Cosmos type as well as the imagery gained by American Landsat-5 Thematic Mapper became initial materials for compilation of various thematic maps in Czechoslovakia.

Significant parameters of above mentioned Soviet space photographs from 1978-1989/ are given in Table 1.

<table>
<thead>
<tr>
<th>Camera</th>
<th>Scale of photographs</th>
<th>Spectral bands (nm)</th>
<th>Type of photographs</th>
<th>Ground resolution (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KFA 200/ KFA 440/</td>
<td>1:1,000,000</td>
<td>510 - 600 600 - 700 700 - 840</td>
<td>multispectral/ black-and-white/ white</td>
<td>20-30</td>
</tr>
<tr>
<td>KFA 1000</td>
<td>1:270,000</td>
<td>570 - 800</td>
<td>colour/ infrared</td>
<td>5-10</td>
</tr>
</tbody>
</table>

The space imagery from Landsat-5 Thematic Mapper dates back to August 1988. All spectral bands were used except for the thermal band /TM 6/.

Map Compilation

Following thematic maps were compiled from above mentioned space images.
Space Tectonic Map of Czechoslovakia was prepared in 1982 at scale of 1:1 000 000 in three sheets separately, corresponding to individual spectral bands. Thematic content was derived by means of visual interpretation and the results were represented on attached transparent foil. They are: significant photolineaments of regional and local character, transpositions and circular structures (intrusive, volcanic and not identified). For completeness, photolineaments and structures already known were also comprised on the foil. Thematic content of the map was compiled by the Czech Geological Administration.

Land Use Map of the West-Slovakian Region at scale of 1:200 000 was compiled from multispectral space photographs taken by the KFA 140 camera, and interpreted in 1985 in collaboration with several institutes in Slovakia. Its content comprises following main categories: urban and man-made landscape, agriculture and forest landscape, barren landscape and water streams and areas, (J. Denègre, 1988).

Colour infrared photographs, acquired by the camera KFA 1000, reach high space resolution shown in Table 1. Images taken on the August 16, 1985 were used for compilation of the Greenery Actual State Map at scale of 1:100 000. This map represents the region of the highest Czechoslovak mountains (High Tatras) with their surroundings. Thematic content of this map was obtained by visual interpretation of photo enlargements at scale of 1:50 000 with partial use of 1:50 000 topographical maps. Results of the interpretation were transformed into cartographic original using an interactive graphical system Gradis 2000. Resulting map contains following elements: settlements, agricultural areas, riverine vegetation, forest upper and lower boundaries, and spreading of small pine – Pinus mugo, artificial and natural water surfaces, water streams, railways, highways, roads, funiculars and airports. Substantial work has been done at the Research Institute of Geodesy and Cartography and at the Urbion (The Institute for Town and Regional Planning) in Bratislava. Corresponding studies of the vegetation in the region concerned were presented (without exploitation of space photographs) in the Atlas of the Slovak Socialist Republic, 1980.

The space imagery, acquired by the Landsat-5 Thematic Mapper, became a basis for compilation of the set of forest canopy damage photomaps. These photomaps were created on the whole territory of the Czech republic at scales ranging from 1:25 000 to 1:200 000. Thematic content was expressed in colours related to 4 or 5 degrees of forest canopy damage. This classification was supported by the planimetric components of current forest maps. Areas outside the forest were represented by black-and-white picture from a selected band. Various damage degrees were obtained using digital classification on the Photomation P-1700 attachment and EC-1045 computer (Stoklasa, Bumbalek, 1990)

Thematic Mapper image from August 1988 was also used for creating of several types of photomaps at scales of 1:50 000 and 1:100 000 in the layout of the topographic map series. These photomaps were compiled for some sheets covering the Prague area, North-Bohemian region with brown coal open-cast mining and agricultural landscape of Eastern Bohemia.

TM space imagery was analyzed by complicated procedures of digital processing and classification which resulted into three new synthetic bands, visualised by means of the Photomation P-1700 device. These procedures comprise so called picture resampling which enables to diminish former pixel dimension 30 m x 30 m into 7,5 m x 7,5 m.

Final products (photomaps) were realized on the Rectimat C rectifier by superimposing of colour separations and the cartographic basis, taken from topographical maps of that area, containing geographical names, water streams and areas, eventually, administration boundaries. The photomaps contain also marginal data overtaken from topographical maps. More detailed information on such a digital evaluation and classification of space imagery is described in Charvat, Cervenka, Hylmar, 1990 and Cervenka, Charvat, Soukup, 1990.

The review of various photomaps from Thematic Mapper imagery, oriented to the land-use, is presented in Table 2.

10 sheets of photomaps at 1:50 000 scale and 2 sheets at 1:100 000 scale were prepared in this way.

Colour infrared photographs, acquired by the KFA 1000 camera, were also used for analogue representation of the same regions. They have the highest ground resolution available in civilian sources of information which is their main advantage. Structural approach becomes very important in the interpretation of photomaps derived from these photographs because of poorer coloured representation of the area (blues, violet and grey only). The rectified photographic image is completed with the map frame and marginal information only. The orientation in the picture is facilitated by attaching the print of pertinent topographical map.

A dozen of such photomaps were produced in different regions of Czechoslovakia.

Photographs from KFA 1000 camera are also applied to the maintenance of topographical maps at 1:50 000 scale. (Sima, 1990). The account of changes reaches in average 150 items per a map sheet within 5-years period. The Kartoflex interpretation device is commonly used for evaluation of changes.
### Table 2: Review of main types of photomaps derived from Thematic Mapper Imagery

<table>
<thead>
<tr>
<th>Scale of Photomap</th>
<th>Pixel Size</th>
<th>Content of the Cartographic Basis</th>
<th>Method of Treatment</th>
<th>Content of the Photomap (Land-use Categories)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: 50,000</td>
<td>7.5 m</td>
<td>water, geographical names</td>
<td>utilisation of neural networks for data preprocessing</td>
<td>- consistent built-up area&lt;br&gt; - family houses with gardens&lt;br&gt; - new settlements&lt;br&gt; - transport surfaces&lt;br&gt; - water&lt;br&gt; - deciduous forest&lt;br&gt; - coniferous forest&lt;br&gt; - orchards and gardens&lt;br&gt; - meadows and fields with green crops&lt;br&gt; - arable land without crops&lt;br&gt; - bare soil / building sites, waste deposits/</td>
</tr>
<tr>
<td>1: 100,000</td>
<td>30 m</td>
<td>water, geographical names, water, administration boundaries</td>
<td>non-parametrical supervised digital classification</td>
<td>- consistent built-up area&lt;br&gt; - new settlements and family houses&lt;br&gt; - water surfaces&lt;br&gt; - deciduous forest&lt;br&gt; - coniferous forest&lt;br&gt; - cereals&lt;br&gt; - maize, sugar beet&lt;br&gt; - meadows, fodder crops&lt;br&gt; - arable land without crops, barren area</td>
</tr>
<tr>
<td>1: 50,000</td>
<td>30 m</td>
<td>water, geographical names</td>
<td>utilisation of neural networks for data preprocessing</td>
<td>- consistent built-up area&lt;br&gt; - family houses with gardens&lt;br&gt; - new settlements&lt;br&gt; - transport surfaces&lt;br&gt; - water&lt;br&gt; - deciduous forest&lt;br&gt; - coniferous forest&lt;br&gt; - orchards and gardens&lt;br&gt; - meadows and fields with green crops&lt;br&gt; - arable land without crops&lt;br&gt; - bare soil / building sites, waste deposits/</td>
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### Conclusion

Some examples of space imagery application for compilation of photomaps were presented. First experiments with available space imageries and technical equipment showed the possibility of representing specific features or general landuse in their spacious relations (sometimes with quantified properties) in this way.

Conventional cartographic procedures with printed map as a final product or photomaps were used for creating some new types of thematic maps in Czechoslovakia. The content and form of these maps depend on the quality of original data, on technical means used and ways of data treatment. An effort for revision and actualisation of topographical maps is more and more connected with the exploitation of the space imagery.

New thematic maps are mostly oriented to documentation of clashes between natural conditions and a man-influenced environment. That is why the sanitary state of forest, agricultural landscape and regions under strong devastation are preferably investigated and documented.

There are nearly fifteen organisations in Czechoslovakia using space imagery for compiling thematic maps of this kind.

### References


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