

DETECTION AND REGISTRATION BY SPACE PHOTOGRAPHS OF CHANGES IN THE FOREST FUND AREAS CAUSED BY SEVERE FIRES AND CLEAR CUTTINGS

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ABSTRACT

Programme technology of the automated detection, registration and assessment by space photographs of changes in the forest fund areas caused by severe fires and clear cuttings is considered. The technology is based on the combining in the automated regime the space photograph with the cartographic and forest mensuration data bases. It allows to timely determine the characteristics of each homogeneous plot of the image and to use them for the two-stage photointerpretation. On the first stage the survey fragment of the photograph is interactively analysed in order to quickly extract the areas, gone by fires, and clear cuts. Then the extracted plots of the photograph are accurately connected to the cartographic topo-base and are viewed under the "magnifying glass" in order to get data about the location and the size of cuts and burnt areas. By way of automatic comparison of contours of burns and cuts of the past assessment periods which are stored in the cartographic base, with contours of these areas extracted by the space photograph, places of newly appeared cuts and burns are determined. On the final stage the actualization of the cartographic and forest mensuration data bases is done, and the observation of regulations is evaluated.

Key Words: data base, space photograph, interpretation, extraction, registration, assessment, actualization

INTRODUCTION

Method of detection and registration of changes in the forest fund areas caused by severe fires and clear cuttings includes the preparatory stage, preliminary visual photointerpretation, input of the photograph into the system of interactive image processing, geometrical correction, interpretation, extraction of cutting contours and areas gone by forest fires, their rectification by control points into cartographic projection, area calculation and correction, forming of operative maps and output of final documents. The general functional diagram of the method is presented in Fig.1.

The source data are materials of space photo and scanner photography obtained with the instruments of medium and high resolution, and also the digital cartographic base, combined on the programme and physical level with the forest mensuration base and used for topobase control, interpretation of photographs and presentation of results in the graphical form.

Remote sensing data may be presented in the form of prints, dubbing negatives and records on magnetic tape in spectral bands of 0.6 - 0.7 micrometers, 0.8 - 1.0 micrometers of medium resolution (175m on the ground), and in the bands of 0.6 - 0.7 micrometers, 0.8 - 0.9 micrometers of high resolution (45m on the ground). For the extraction of clear cuts also space photographs at scale 1:280000 with the ground resolution of not lower than 10 metres can be used.

The basis for the digital cartographic base is forest management tablets and maps at scale 1:1000000 and 1:8000000.

Preliminary work includes the creation of the digital topographic base, the base of control points, and collection of information about the planned areas of cuttings and centers of fires recorded by the aerial forest fire protection service.

On the stage of preliminary interpretation by multitemporal photographs of medium resolution in the band of

0.6 - 0.7 micrometers fire centers are revealed by the presence of smoke trains, and on photographs in the band of 0.8 - 1.0 micrometers fragments containing the plots gone by forest fires (burns) are extracted.

On space photographs and scanner images of high resolution in the band of 0.6 - 0.7 micrometers fragments with the supposed clear cuts, and in the band of 0.8 - 0.9 micrometers - fragments with comparatively small plots of the burnt forest are singled out.

To connect the recorded survey fragments to the topographic basis the control points located in the neighbourhood are chosen on photographs.

Further processing of the obtained remote sensing data is done with digital methods by the image processing system. After entering of the fragments into the system and connecting them by control points to the topographic base they are subjected to two-stage interpretation, ending in the extraction of changes contours. On the first interpretation stage the survey fragment of the space photograph is analysed by way of using its combination of cartographic and forest mensuration data. The analysis is done in the dialogue regime with visualization of graphical information on the monitor screen. The aim of this stage is to improve the reliability of revealing the photo plots reflecting the changes in the forest fund areas as a result of forest fires and clear cuts.

On the second stage the revealed plots on the photograph are accurately connected to the cartographic topographic base and viewed at high magnification (with the magnifying glass) to get the information about the location and size of plots, gone by fires, and cuts with the accuracy high enough for practical work.

The division of the process of interpreting space photographs into two different stages (viewing and detailed interpretation) makes it possible to considerably shorten time spent on the processing and to consider in detail only the currently changed forest plots.

The newly shown burns and cuts are determined by way of comparing the contours of burnt plots and cuts of the past assessment periods stored in the cartographic base, and contours of these areas extracted by the space photograph.

On the final processing stage the editing and indexing of contours of plots with changes extracted by the photograph, their rectification into the topographic base projection, building-in into the contour network, calculation of areas and input of changes into forest mensuration description of the considered region are done.

The knowledge of the stored in the forest mensuration base characteristics of the burnt plots and cuts referring to the period that took place before these events allows to determine the volume of the burnt and cut timber and to reveal main violations of the forest use order established for the given region.

In experimental testing of the method with the materials of space photographs of the East Siberia forests the 10% accuracy of determining cutting areas with the probability level of 0.85 - 0.9 was achieved.

The assessment was done by comparing the results of the detailed interpretation of space photographs with the data about the same cuts obtained by aerial photographs at scale 1:25000.

Experience in revealing plots gone by fires has shown that even such a distinct interpretation feature as the availability of the smoke train not always allows to detect the burnt area especially if the image of the terrain is quite "motley", and the plots have not too large a size. It was possible to record burnt areas of more than 200 ha reliably enough. It was difficult to determine areas of plots gone by fires in marshlands of the West Siberia.

The developed system is used in the complex of technical means Pericolor-Nova-Photomation, exchanging information through inner communication channels.

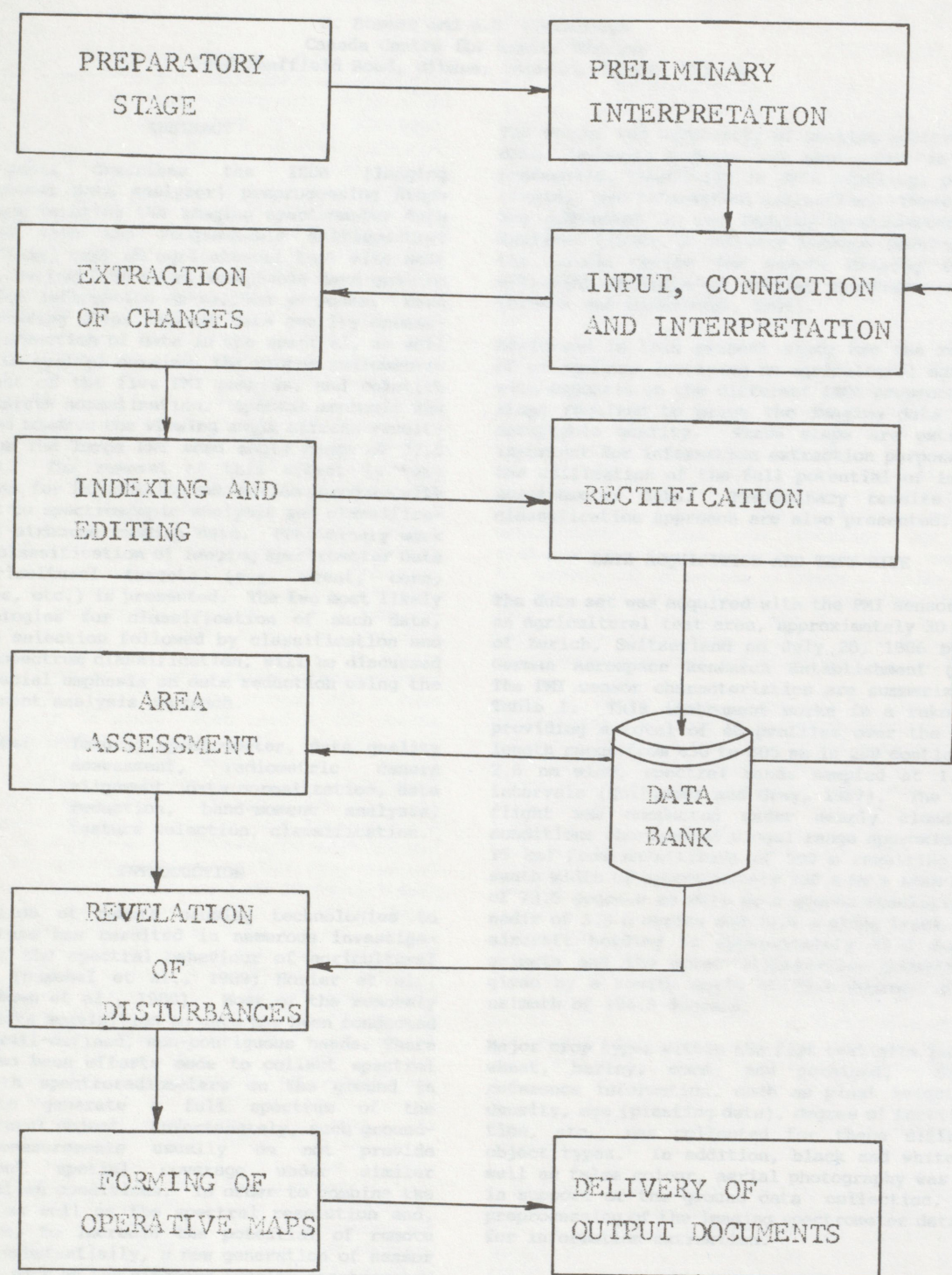


Fig.1 Functional diagram of the method of revealing and registration of the forest fund changes by space photographs.

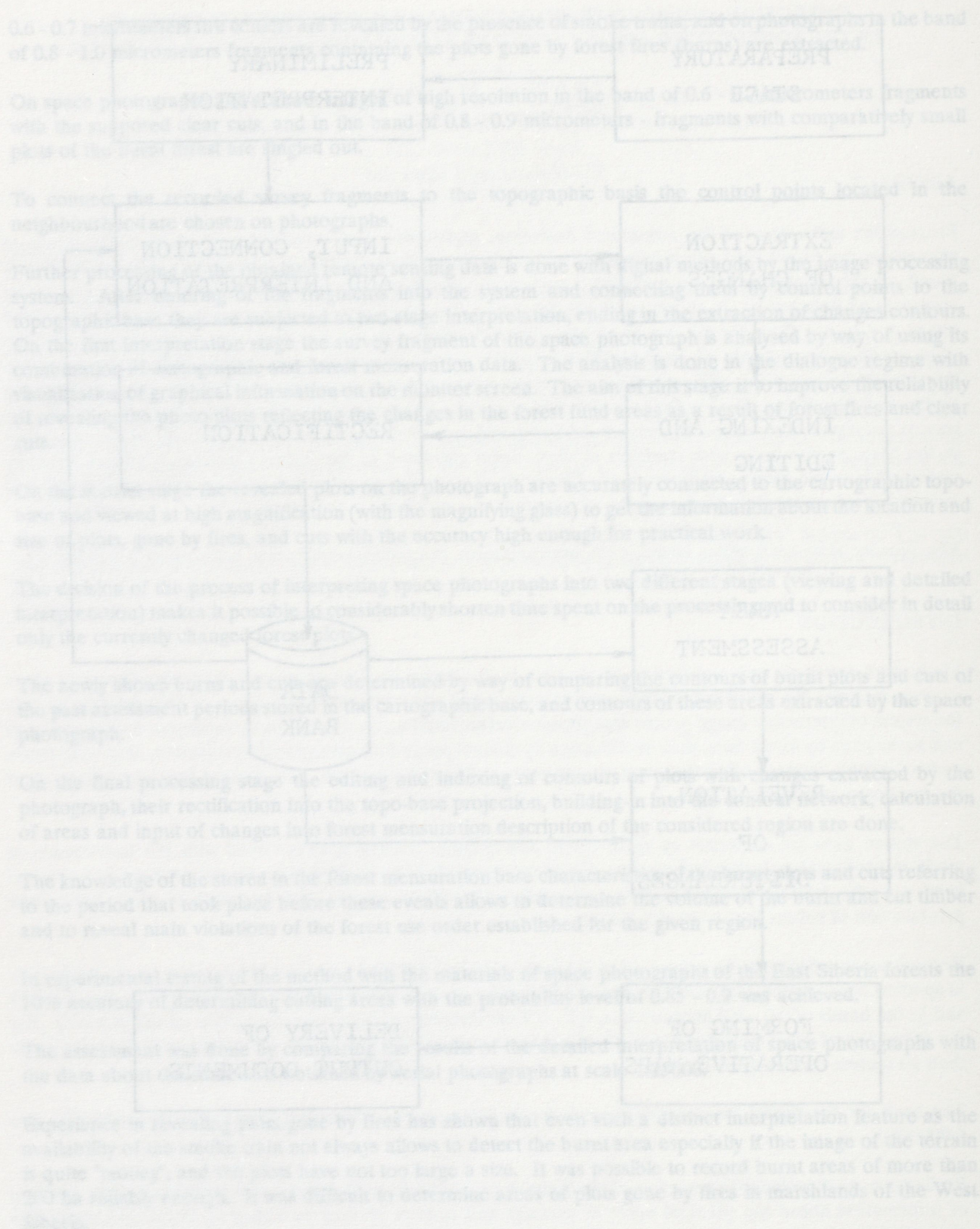


Fig. 1. Functional diagram of the method of registration of the forest land changes by aerial photography.