

# DEVELOPMENT OF PHOTOINTERPRETATION FOR ENVIRONMENTAL USE IN HUNGARY

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## Abstract

In this paper the important elements of remote sensing are emphasized in the GIS data collecting. We are dealing with tendencies in development of application of remote sensing, through the researches by the Department of Photogrammetry of the Technical University of Budapest. A scope of new tasks, requirements and possibilities is given. It is evidenced that the use of complex processing methods is the most efficient in the remote sensing.

*Keywords:* remote sensing, photointerpretation, environmental application.

## 1. Introduction

The GIS as technology for dealing with environmental information and processing of it, came into the limelight in the last decade. An important component of the GIS data logging is the processing of remote sensed images. Next to the photogrammetry the photointerpretation is the most important method applied with this technology. That's why it is important to overview the latest achievements and fields of photointerpretation. (hereafter the photointerpretation is interpreted as recovery of content type or physical type information from remote sensed images by means of analogue or digital methods).

We give an overview of the tendencies in the development throughout the concrete research works carried out by the Department of Photogrammetry of the Technical University of Budapest, we try to classify and process the experiences which are partially differing from the European ones due to external and internal conditions, that's why we think it merits a special attention (DETRÉKŐI, 1993).

Generally the photointerpretation applications are following: the development of the economy and that of the society. In the first phase analogue methods were applied. The reason of this was in part the COCOM list. Next to this fact there was no computer background similar to the current one even in Europe in this time. The object-interpretation has moved

towards the identification of more complex phenomena (e. g.: identification of chained phenomena) with the opportunity (and need) of development. The environment survey and the new requirements of the environment protection have yield to further changes, the method of digital image processing (BÄHR – VÖGTLE, 1991) and complex environmental studies.

The main objectives of the research work at our department is to answer the questions that can be solved in the environmental studies on the basis of remote sensing systems and how the incomplete data can be completed from the sensing network by use of homogeneous data supply by photointerpretation. The principles of our work are as follows:

- *Complex processing.* Non exclusive application of analogue or digital methods. The goal is the integration of human knowledge and experiences with the mass data processing performances of the computer. None of the methods can be replaced especially in case of complex studies.
- *Necessity of data logging of high accuracy geometrical data.* There is no acceptable result without involving the remote sensed data in any geodetic system, when using the higher scales. The same principle is applicable for complex processing of multiple data, e. g.: in GIS system (KRAUS, 1991).
- *Spatial application of non remote sensed data.* Due to the complex nature of environment studies, other data shall be also used, which are supplementing and supporting the interpretation. However, the majority of these data are point like data, so they cannot be entered in a space information system directly, without any troubles.
- *Use of maps.* The map shall be considered as an earlier processed interpretation of the reality, which is the summary of a previous state. It can be used as auxiliary material.

See below the development of the photointerpretation in Hungary, throughout concrete examples.

## 2. Development of the Photointerpretation

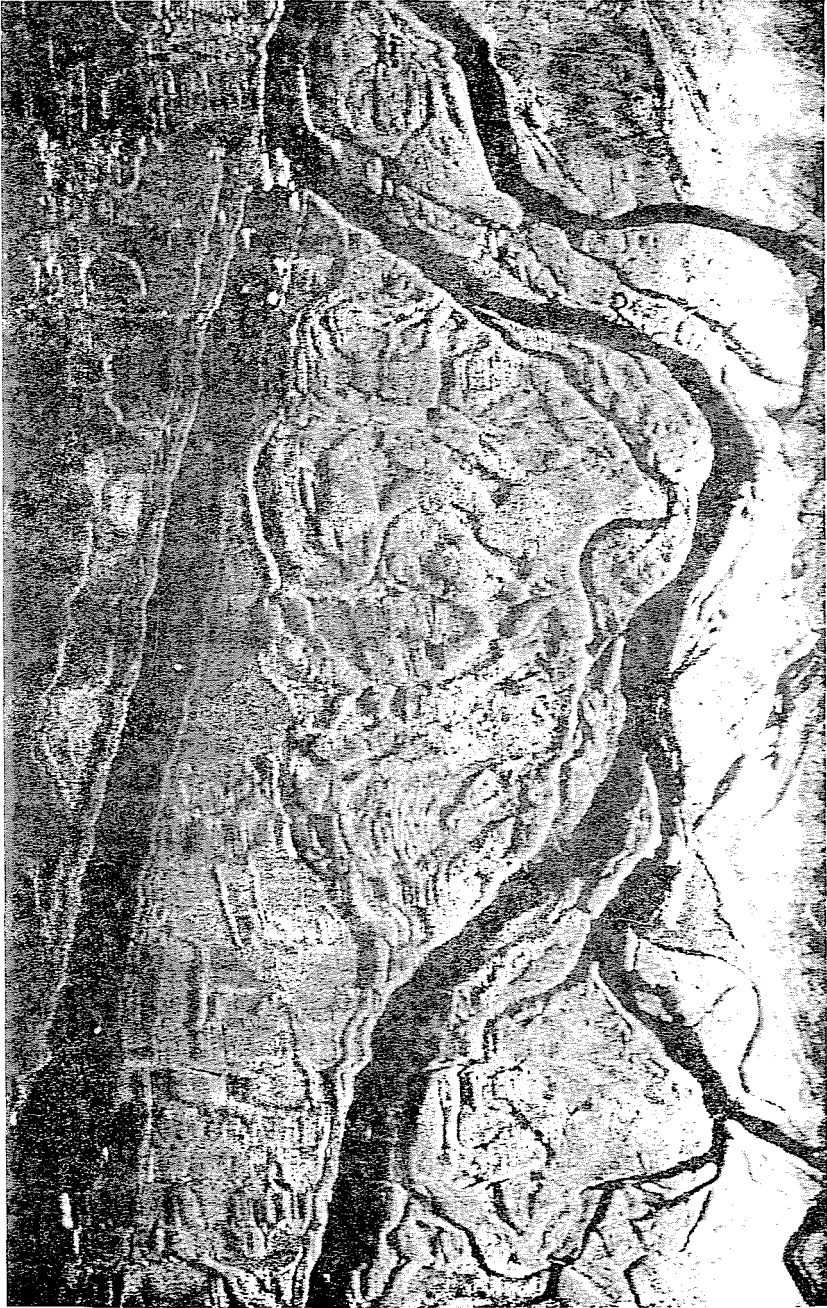
Since it's early appearance, the photointerpretation supplies novel information in comparison with other data logging methods. Due to the placement of the point of view and to it's local interpretation, it enables to discover physical and content related aspects which are undetectable from other places and the relation between partial phenomena is targeted. That's why, when the photointerpretation is considered as data source from environmental phenomena, the optimum result can be obtained (the whole

information content) with joint use of the analogue and the digital methods. Our opinion is supported by the fact that both of these methods are finally depending on the human being (the software, the teaching are based on subjective factors). It is not a good solution to separate completely the two methods, as separately they can provide only partial results. However, due to the ever increasing complexity of the task, the only way of processing is the complex interpretation.

Tendencies can be observed in our country when studying the evolution in the time. This evolution moves towards the complex processing methods. The motive power of this development is in simplified form as follows:

- *Appearance of new fields of economy and new requirements by the society.* The changes in the economy and in the society are providing new opportunities for the photointerpretation. There is an ever increasing need for discovery of environmental phenomena and objects both in aspect of planning and survey. Even the human sciences (archaeology, history) are open for such type of information (WINKLER, 1993).
- *Development of analysing technology and methods.* The complexity of environmental problems has brought the mixed analysing processes (integration of many other data). The development of the computer technology of the last few years enabled among others the computer aided interpretation and the support to digital photogrammetry (Fig. 1).
- *Possibility of interpretation in space and in time.* The systematic and archived air-photo activity since about 50 years and the earth satellite images since about 20 years are providing the possibility to analyse earlier processes. Next to this there are information from various maps for a period of about 80 years, which can be used in the environmental analysis. By means of analysis in time, new phenomena and new problems can be solved (see the details later).
- *Development of GIS-s.* The new information systems are providing the possibility of complex analysis, however, which is necessary due to the high intensity data flow. The data logging and the simultaneous use of data in space are more and more underlined. It is a natural motive power for the interpretation (KNYIHÁR – WINKLER, 1993).

Let us have some words about the raw material of remote sensing, which have an influence on the development. It has come into fashion to compare the air-photos and satellite-photos and to develop basic technologies on the disadvantage of the other. According to our opinion it is not good (at least in Europe). The use of high resolution air-photos remains a



*Fig. 1.* Hungarian SLAR — image in Szigetköz ( $H = 1000$  m)

fundamental requirement for a long period due to the aspects of weather, the scale requirements of maps and to many other aspects. The main advantage of the satellite images, let us say the real time processing with few error sources is not ambiguous in Hungary, because of the required scale and resolution. Next to this there is the immobility of satellite images. On the other side, the high number of air-photos may result a problem.

In respect to eventual limited accuracy of the geometrical processing of remote sensing images, we are considering that one orientation of the development may be the geometrical identification of interpreted elements by means of GPS technology, when the geometrical processing may be separated from the photointerpretation, so the geometrical limits of satellite images.

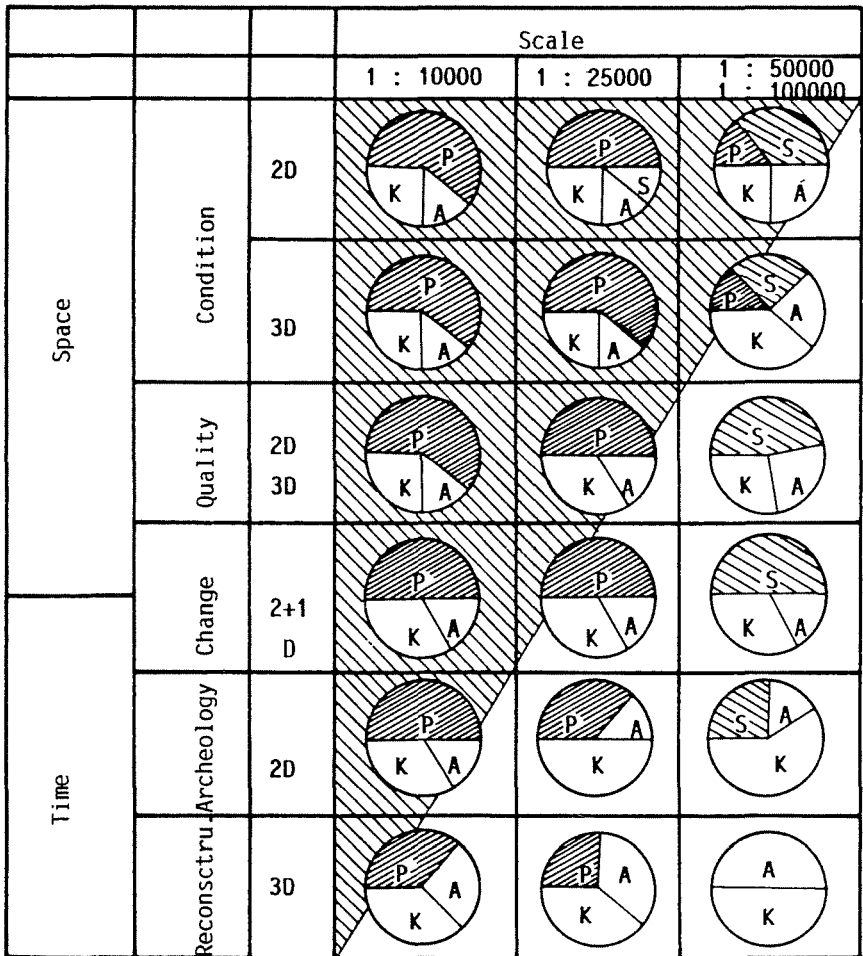
It is clearly seen from the above that we are optimistic in respect of the future of the photointerpretation. The possibilities and the requirements are initialising it's development. The expected orientation of this development is the highly skilled creating specialist with solid background in computer technology.

### 3. Analysis in Space

In the next part we try to illustrate the steps and the obtained technology level of the development outlined in the previous chapters. The development and separation of the various processing technologies are determined by the ratio (eventual exclusivity) of the air-photos and satellite images (*Fig. 2*). Naturally the selection of them is depending not only on the resolution, but the need for the various types of information.

The main task of the photointerpretation (and the simplest in the same time) is the study of superficial applications. One can say in general that the field of possible applications is depending on the used raw material and the required superficial resolution (scale). The natural disadvantage of the satellite images, namely the low resolution is compensated by the high rate of covering of area, the so-called optical generalisation. It means that the information in one pixel may be the sum of most divergent superficial objects. In case of low scales it may yield to new opportunities in data logging (*Fig. 3*).

The troubles with the reduced geometrical accuracy of satellite images which is not satisfactory for the charting of maps with higher than 1:25000 scale, are based exactly on the above application opportunities. This problem can be settled by the use of GPS technology cited in the first chapter. With this method one can obtain the independence of scaling in respect of geometry, as the interpreted elements are charted by another way, in our



POSSIBILITIES OF REMOTE SENSING

P = Photointerpretation

S = Satellite Image- Interpretation

K = Map Data

A = Other Data

Fig. 2. Possibilities of remote sensing

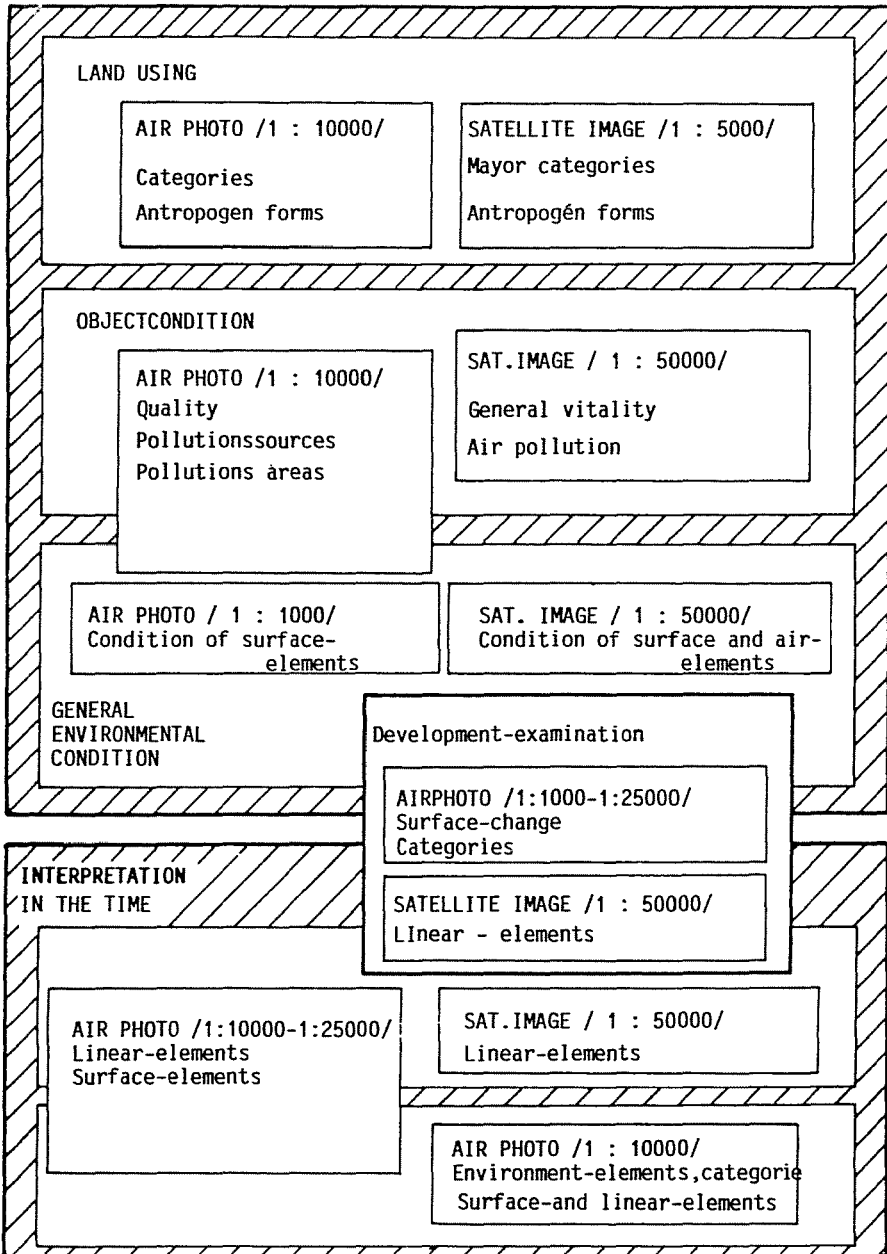
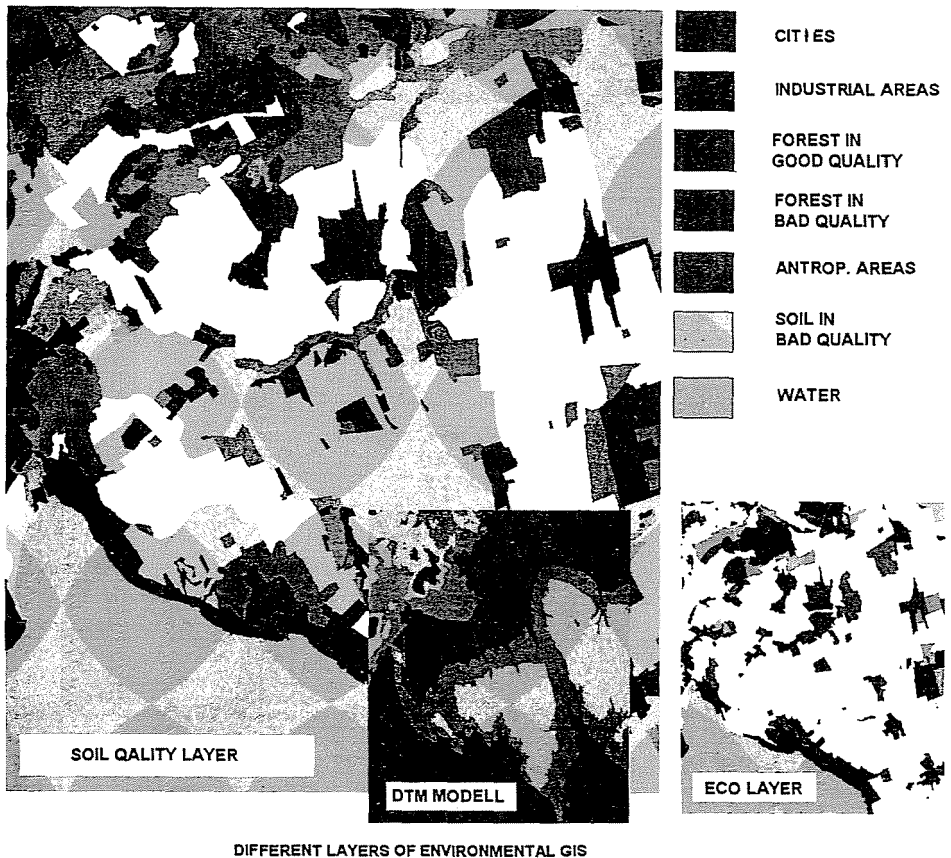


Fig. 3. The interpretations type of the airphotos and satellite images

case by GPS technology (however, existing maps and area filling are used as well). So a considerable increase of geometry can be obtained.

Perhaps the most general application of the photointerpretation is the object or environmental study in space or in plane. In Hungary two characteristic groups of these studies can be identified, the regional ones (eventually involving multiple counties) and local ones. The data logging covering large areas is made by satellite images of course, with all related limits. On the other hand, the application of air-photos is justified with eventual profiting of information from auxiliary satellite images. The main characteristics of the environmental studies are the many-sided evaluation of studied subjects (*Fig. 4*).



*Fig. 4.* Three layers of Environmental-informations systems



The development of the computer technology in the last few years has an outstanding influence on the photointerpretation by the introduction of the information systems. The environmental GIS-s are allowing the high accuracy integration of analysed topics and to come to new conclusions. One of the main problems with the GIS-s is to find the common denominator of the different measurement units on the different layers. The common basis (however, in general only a relative one) for this purpose can be the processing of remote sensed images. The transformation of non area like data into surface data, let's say to render it consumable for the spatial processing is closely related to the above problem (WINKLER et al., 1992).

The spatial character of data logging, in our case that of the photointerpretation is required partially by the above needs. The development seems to move towards the 3D GIS-s, and for these systems the spatial data supply is the ideal one. In case of air-photos the spatial interpretation is solved. However, in case of satellite image the situation is more complicated. In case of stereo satellite images, the altitude resolution depending on the pixel size represents a limit, which can be unfortunately 2 – 3 times more than the pixel size when no strict geometry is applied. Perhaps a more adequate altitude resolution can be obtained by studying the effects of the shadow, the structure and the tone and by means of application of optical generalisation. In this case the average altitude of the studied areas can be identified by empirical way, by classification of the objects (WINKLER, 1992).

#### 4. Studies in Time

As it was outlined in the second chapter, the air-photo activity having about 50 years history in our country next to the investigation of the present environment allows to discover the environmental state and environmental events of the past. Next to this, there is the charting of topographic character having a history of about 200 years.

The simplest task is the study of development of settlements and their environment. The GIS has an outstanding importance in the second phase of the information processing, when the development tendencies are interpreted and compared with other data. That's why the main problem to be solved with the interpretation of settlement development is not the exploitation of content like information, but the auxiliary geometrical processing (which cannot be solved without special software for the photogrammetry, due to the great variety of problems).

The situation is somewhat complicated with the environmental studies extended in the time. Here the content and eventually the physical

interpretation of the problems is underlined. To study the state of the environment within wide time ranges is justified by the fact that even in case of current environment studies the analysis of the present situation is not enough. The processing of older data is necessary in any cases in aiming to determine the orientation of the tendencies (multitemporal studies).

The analysis of various field data requires more experience with evaluation of old air-photos. One of the major reasons of this is that no field control is available (flora, soil and water object comprised). A related problem is the interpretation of the symbols on the old maps, the interpretation of the data on the map.

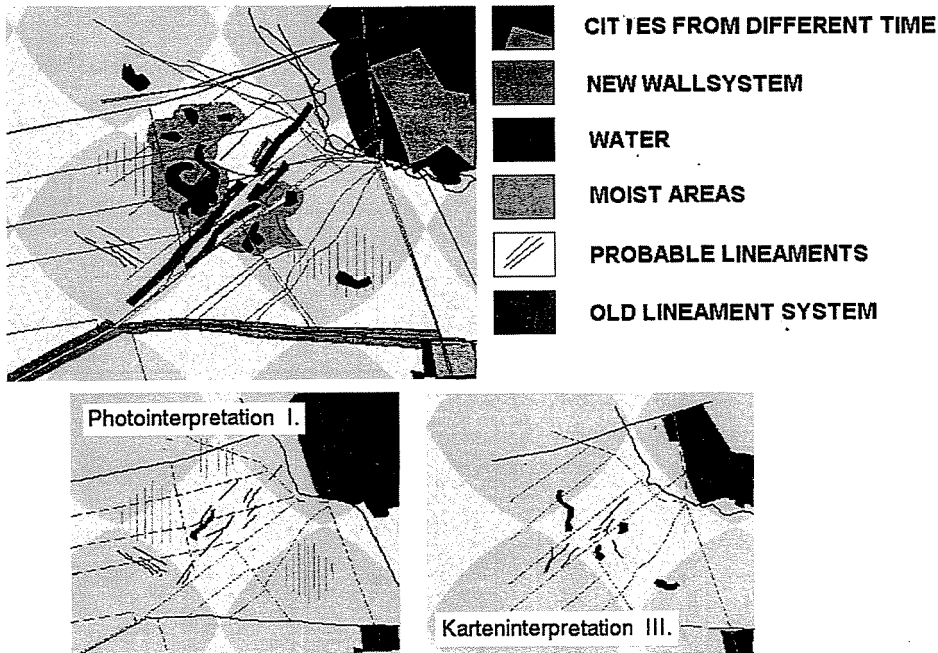
Another big class of the studies in time is the support to archaeological researches by photointerpretation methods (*Fig. 5*). The practical difference with the above studies is that in this case underground objects are dealt in general, which needs special film material and auxiliary experiences. Due to the size of the objects to be studied and the required resolution air-photos shall be applied, however, sometimes when major relations shall be identified (bar code systems) satellite images can be used, too. In case of archaeological studies the use of multitemporal photo series is required, due to the strict dependence of the interpretation on the season and the weather.

A special field can be classified in this group, the event and object reconstruction. It means the common investigation of old documents and the current environment, when the current environmental conditions, the environment data of the past, which may be subject of analysis and the recoverable data may support the study of the course of events and the placement of objects. Naturally this process is not imaginable without any spatial information system.

## 5. Summary

The following conclusions can be made as summary of the application possibilities of the photointerpretation as discussed in the previous chapters: The new tasks and the new opportunities in the past few years have caused the development of this field of science. The distribution of the spatial information systems (as motive power) perhaps means an economy background for this.

Next to the existing raw materials, new ones are expected in the near future (satellite images with higher resolution). However, it is also obvious that the new material is not necessary and enough for fulfilment of all tasks. The archived materials may have an important role when analysing the



### RESULT (SUMMA) LAYER, AND INTERPRETATIONS LAYERS

Fig. 5. Interpretations-layers of an archaeological GIS

various tasks. The approval of topic oriented maps as auxiliary materials may belong to this field.

Finally, we conclude that the complex processing methods are the most suitable ones with photointerpretation applications. Perhaps the development is oriented to this direction, as the processes are not only complementing each other, but their integration may solve the new problems.

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