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DEVELOPMENT AND APPLICATION  
OF REMOTE SENSING IN POLAND

Abstract

Brief description of remote sensing development in Poland in the period 1976-1980 as well as the main aims and achievements of the Polish Centre of Remote Sensing /OPOLiS/ established within the Institute of Geodesy and Cartography are presented. Paper contains also the review of application of remote sensing methods and techniques in different branches of national economy with the special attention to environmental monitoring.

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1. Organization and development of remote sensing in Poland

The organized phase of the development of remote sensing in Poland was initiated in 1976 through the creation of the Remote Sensing Centre /OPOLiS/ at the Institute of Geodesy and Cartography in Warsaw.

The main tasks of the Centre have been specified as follows:

- research in the field of environmental remote sensing and its practical applications,
- processing and distribution of satellite data for users in the whole country,
- coordination of remote sensing activities on the national scale.

The centre has been created as an interdisciplinary research and application unit concentrating specialists representing both technical and natural sciences together with the most sophisticated data processing and interpretation equipment. OPOLiS employs geodesists, photogrammetrists, cartographers, mathematicians, physicists, electronic engineers, computer programmers, as well as geographers, geomorphologists, hydrologists, agricultural and forestry specialists and environment engineers.

The majority of the staff has undergone training in the world leading remote sensing centres in the United States, Canada, France, Austria, the Netherlands, Italy and Great Britain.

Research works are conducted in close cooperation with the leading research institutions in the country including the Polish Academy of Sciences, universities and research institutes subordinated to various government departments. Very

active, day-to-day cooperation of the Centre with the Department of Interpretation of Aerial and Satellite Imagery of the Geological Institute and with the Institute of Environmental Protection is of particular importance.

Remote Sensing Commission at the Space Research Centre of the Polish Academy of Sciences coordinates planning and of scientific activities in the field of remote sensing in Poland.

The Centre cooperates also with surveying enterprises grouped in the GEOKART union. The production of maps with the use of techniques and technologies elaborated at the centre will in the future be carried out by the staff of these institutions.

Specialized remote sensing centres will be organized in the future for the elaboration of data on agriculture, forestry and other specialized fields of applications.

## 2. The tasks of the Polish Remote Sensing Centre and its technical equipment

The elaboration of optimal methodologies and techniques of the application of remote sensing methods for regional planning, agriculture, forestry, water management and other branches of the national economy is the chief task of the Polish Remote Sensing Centre.

The Centre processes and interpretes both aircraft and satellite data. The Centre utilizes satellite data from LANDSAT series and from manned space missions such as SALUT. The first Polish astronaut, Colonel, dipl. eng. Mirosław Hermaszewski has acquired very good imagery of the Polish territory with the use of MKF-6 camera during his space flight in 1978.

Panchromatic, IR, colour multispectral aerial photographs as well as infrared imagery are used for elaborations. Multispectral photographs are acquired with the use of NAC MB-490 B camera, which is a modified version of Wild RC-10. Small test sites are photographed with NAC MB-470 camera. The latter camera mounted below a fixed ballon will be utilized in the near future for acquiring photographs of special agricultural test-sites.

Data processing and classification is performed with the use of analog and digital methods.

The Centre is in a possession of the following equipment for analog data processing:

- microdensitometer Joyce-Loebl 3 CS,
- additive colour viewer NAC AC-90,
- additive colour viewer NAC AC-70,
- NAC Multicolour Data System /MCDS/

Numerical data processing is based on the 2 PAC system produced by the Canadian firm OVAAC-8 Int., enabling interactive analysis and classification of multispectral data.

The system consists of:

- 2 PAAC processor for analysis and correction of data,
- minicomputer PDP 11/34
- DEC disc memory RP 4. the capacity 88 MB
- photomation P 1700 analog-digital converter, produced

by OPTRONICS

- a number of peripherals.

3. Chooosen examples of applications of remote sensing for environmental studies - projects completed or initiated at the Centre

A. Research projects based on the utilization of satellite data.

Land use map for the whole territory of Poland has been elaborated on the basis of Landsat and SALUT - 6 imagery. The basic material for interpretation consisted of commercial colour composites of Landsat scenes in the scale of 1:250 000 and composites generated with the use of additive colour viewers. Eleven standard land use categories are shown on the resultant map. The map has been elaborated in the scale of 1:250 000 and will be printed in the scale of 1:500 000.

Land use maps based on numerical classification. Unsupervised numerical classification was performed for the Landsat scene of Warsaw area by Zbigniew Bochenek and Waldemar Madej of our Centre during their training in LARS Purdue University, in 1977. The map showing ten categories of land use was produced in the scale of 1:100 000.

Three stage elaboration of LANDSAT scene of Puławy region /agricultural district in central Poland/ was performed by Jacek Domański and Stanisław Morawski during their training in LARS Purdue University. The results of unsupervised and supervised classification were compared and presented jointly on the map showing 14 land use categories.

Forest mapping. The preliminary analysis of SALUT-6 imagery of southern Poland have shown its particular suitability for forest mapping. The delimitation of deciduous and coniferous forests and the appraisal of forest damages were performed for the analyzed area. The map for forests for the whole territory of Poland is being elaborated at the Centre. The false colour composites are the basic data source.

Water quality monitoring. Several water quality monitoring projects have already been completed at the Centre. The map of water transparency in the Bay of Szczecin completed in 1978 also shows the concentrations of phytoplankton growth. Satellite imagery has been successfully applied for monitoring water quality in the region of Great Lakes in north-eastern Poland.

Disaster surveying. Major flood which occurred in east-central Poland in March and April 1979 has been surveyed on LANDSAT data. The preliminary appraisal of flood wave was performed on the quick-look's of LANDSAT scenes which were available for inspection in Warsaw only 5 days after acquisition. Subsequent elaborations showing the maximum extent of flood and recession stages were performed on LANDSAT photographic products.

Air pollution studies. The first interesting elaboration on the subject completed in 1976 concerned the extent of industrial smokes in the highly industrialized district of Silesia on the basis of LANDSAT imagery. Comprehensive elaboration of industrial smokes is currently being prepared for the whole

territory of the country. Abundant satellite data collected over the years will enable the presentation of air pollution in Poland with respect to meteorological factors and the preparation of air pollution prognosis.

#### B. Research projects based on the utilization of aircraft photographs

Forest surveys. Following several years of research the methodology of appraisal of health conditions of forests and damages caused by industrial air pollution and biotic factors has been developed at the Centre. The method is based on the interpretation of false colour photographs.

Water pollution studies. The interpretation of IR imagery is applied for investigation of rivers, lakes and reservoirs under the harmful influence of industrial water discharges. The method based on the utilization of AGA-Thermoprofile is fully operational. Multispectral aerial imagery is also applied for research on water quality.

Environmental studies. Thermal techniques are applied for elaborations of thermal conditions in large agglomerations and industrial districts. The results of such elaborations are directly applicable for regional planning. Multitemporal coverage enables comprehensive interpretation of studies phenomena. Final classification is prepared with the use of Multicolour Data System.

Agricultural applications. Research on identification of individual crops is carried out on multispectral and IR aerial photographs. The methodology based on microphotometric measurements and statistical elaboration of data has been developed and applied in practice. Further research on agricultural applications of remote sensing will concentrate on identification of genotypes, appraisal of plant health and crop forecasting.

The results of so far completed research projects are very promising. The works discussed above have mostly been completed with the use of analog techniques. The application of digital analysis will bring about substantial qualitative and quantitative improvement in the results of our works already in the near future.

#### 4. Experiments on test-sites

Spectral density of individual terrain features on multispectral photographs is directly related to the spectral reflectance of these natural features. The elaboration of the catalogue of spectral characteristics of plants, water bodies, forest species, soils and other land features throughout a year is indispensable for proper interpretation of remote sensing data. Research on spectral response of individual land features is carried out in Poland on several test-sites, located in various parts of the country to account for differences in climate, soils, plant genotypes and very many other important factors influencing spectral response.

Ground radiometric measurements are carried out synchronously with the acquisition of LANDSAT imagery. Interesting data was acquired in the summer of 1978, when synchronous measurements were taken from the satellite level /photographs

with MKF-6 camera from the board of SALUT-6/, aircraft level and ground level.

The results of experiments carried out on test-sites are applied for the elaboration of methodological principles of research on:

- recognition of crops on satellite and aerial multispectral photographs,
- forest mapping on the basis of satellite and aerial data,
- environmental monitoring.

#### 5. Popularization of remote sensing; seminars and symposia

The management of the Polish Remote Sensing Centre is fully aware of the fundamental role of information in a newly introduced and fast developing domain of research and practical applications, such as remote sensing.

The description of the possibilities of application of remote sensing methods in various branches of the national economy constitutes the main topic of lectures and presentations for government specialists and representatives of the prospective users community. These activities result in the positive feed-back on the part of users community as well as government bodies responsible for planning and financing scientific research.

Progress in the application of new methods and technologies within the Polish Remote Sensing Centre is achieved through the effort of its interdisciplinary staff. Workshops and seminars prepared by small teams are a very useful tool for dissemination on specialized knowledge among the staff of the Centre. This form of activity includes information on the progress of individual application projects as well as instruction for the natural science oriented part of the staff on the use of complicated technical devices given by technically oriented staffers.

The review of the most important completed research projects and research trends is presented during Remote Sensing Symposia, organized since 1976 in 2 year intervals. The last, 1979 Symposium, already had an international character. Invited papers were presented by prominent representatives of remote sensing profession from the world leading centres. The Proceedings of the 1979 Warsaw Remote Sensing Symposium have been published with extensive summaries in English. The next international Remote Sensing Symposium will be held in Poland in 1981.