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THE INTERPRETATION OF AERIAL PHOTOGRAPHS IN SOIL SURVEY

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Aerial photographs have been used in soil surveys for over forty years [1, 6]. Paralelly to their application [1, 2, 6, 7, 9, 11] methodical investigations are being carried out as to thorough utilization of the information provided by the aerial photographs and also attempts are being made at establishing proportions between the range of photointerpretation and the range and methods of the corresponding soil field works [3, 5, 8, 10, 12, 13, 14].

Institute for Land Reclamation and Improvement, Agricultural Academy in Poznań has been using aerial photographs for several years in soil surveys, and also has been studying the possibilities of their full utilization in soil surveys in various physiographic soil conditions [8].

In this paper we want to present some results of the investigations which were carried out in the Vistula Valley.

METHODS OF INVESTIGATIONS

Investigations were conducted in the region of 10 000 hectares in area, located on the left bank of The Vistula river. The region comprises flooded terraces and higher terraces. Out of three most common methods of interpreting aerial photographs—pattern analysis (Frost 1970), element analysis (Buringh 1960) and physiographic analysis (Butler 1959, Goosen 1961, Vink 1963)—we chose the second one, taking into account physiographic elements as well. The choice of this method was determined by the scale of the map we worked out (the detailed soil map on the scale 1:10 000) and by the physiogryphy of the studied region (terraces of the Vistula river).

Aerial photographs were supplied by Polish State Firm of Photogrametry in November 1970. They were made on the panchromatic film on the scale 1:10 000. The direction of the flights was determined by the shape of the investigated area and corresponded approximately to ESE-WNW.

The overlap of the area was 51-68% and the endlap was 3-77%. The area was photographed very carefully and the quality of semicontact prints made on doubleweight paper was very good. For the photointerpretation purposes we used Zeiss's stereopantometer and mirror stereoscopes of the type SLS-2.

The results of the photointerpretation were marked on the topographic maps by means of LUZ aerosketchmaster. In field investigations pocket-type of Zeiss's stereoscopes were used.

PHOTOINTERPRETATION

The general assumption of the interpretation of the aerial photographs was that the differentiation of soil is connected with numerous elements of the surface of the area. According to Buringh's [1, 3] and Vink's [12, 13] suggestions about 20 elements distinguished in the proces of photointerpretations were divided in the following groups:

—elements concerned with vegetation and land use,

—elements concerned with economical activities of man, mainly—drainage constructions,

—elements concerned with relief and geomorphological features,

—elements concerned with natural soil drainage conditions,

—elements concerned with colour tone and texture of the aerial photographs.

Figure 1 shows maps of the respective stages of the photointerpretation of the aerial photographs which correspond to the respective groups of elements.

Map 1 clearly shows: *L*—forest, *R*—arable land, *Ł*—grass used as meadow and pasture, *N*—waste land, buildings.

Map 2 shows precisely photographed drainage system.

Map 3 contains the interpretation of the geomorphological features: *D*—flooded terrace (alluvium); *Z*—ponded depression (silted deposites, peat); *ZP*—lower depression (sand of ancient ponded depression); *PP*—higher depression; *P*—flat terraces slightly undulating (fluvioglacial sand); *W*—dune sand.

Map 4 reflects actual drainage conditions including the division into classes: 1—imperfectly or somewhat poorly drained soils, 2—imperfectly drained soils, 3—moderately well drained soils, 4—well drained soils, 5—somewhat excessively drained soils, 6—excessively drained soils.

Map 5 shows the following soil complexes: *F*—alluvial soil, *Mu*—

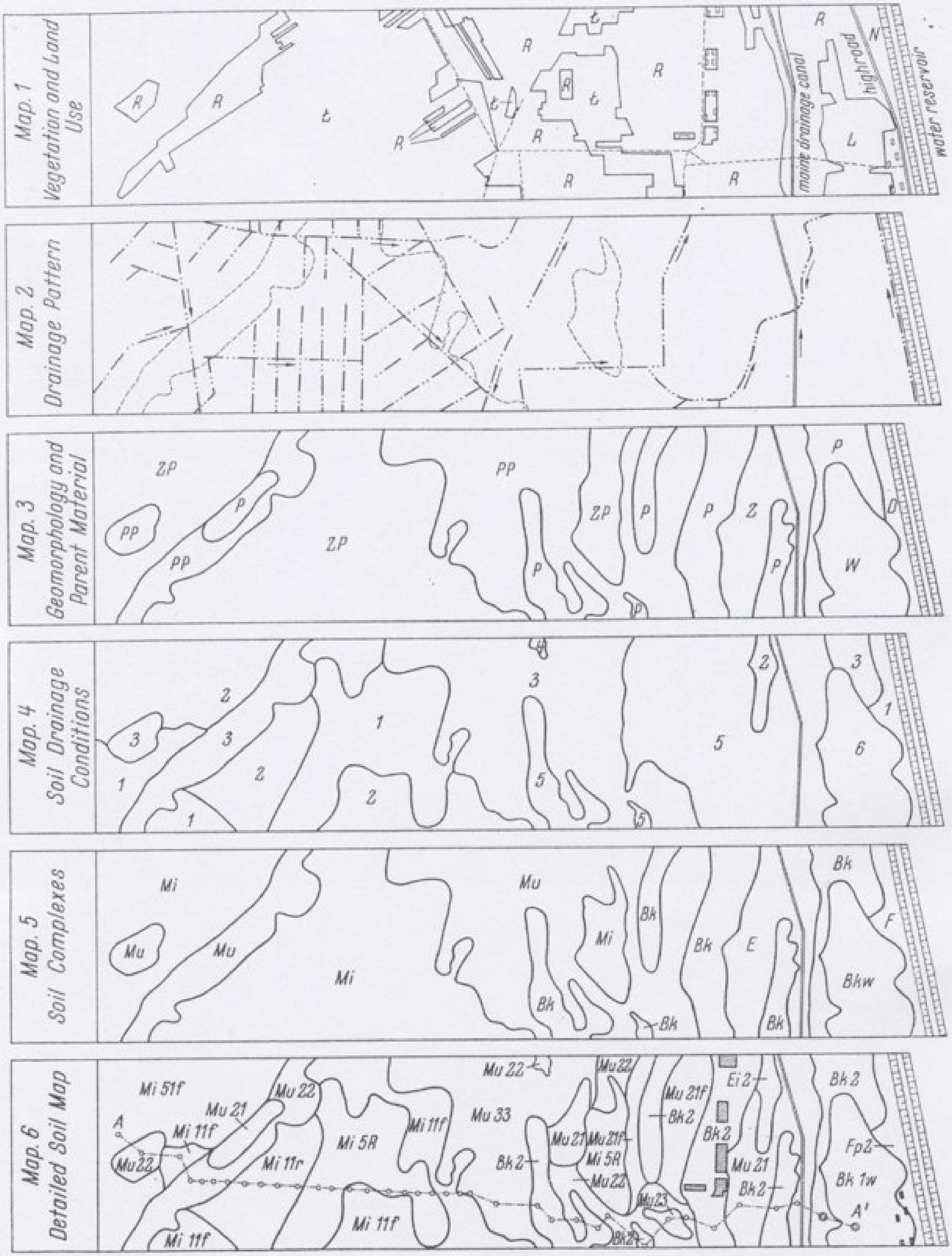

Fig. 1. Photointerpretations maps

muck-like soil, *Mi*—shallow mucky peat overlying sand, *Bk*—brown forest soil, and *Bkw*—brown forest soils, dune phase. Map 5 which is the photointerpretational map of soils, was worked out on the basis of the analysis of the above mentioned maps. It is not a soil map in the full sense of this word but can be used as the basis of the soil survey.

SOIL SURVEY

Methods of the soil survey were adapted to the photointerpretational maps. They were divided into two stages:

—detailed investigations on the sample areas;

—testing investigations of the remaining parts of the studied region.

Four sample areas were chosen in the examined region. They were chosen in such a way that each of them included some characteristic piece of land containing all the soil units that occur in this region. On the sample areas we carried out detailed investigations of the soil profiles and checked all the boundaries shown on the photointerpretational maps. Those surveys served as the basis of the classification of soils, legends of the detailed soil maps and they helped establish genetic relations between the individual soil units. The soil section (Fig. 2) shows the relative location of the classified soil mapping units occuring in the region under examination. As follows from the gathered data (Table 1, Fig. 1—map 6, Fig. 2), the field investigations did not change the boundaries of the classified soils but helped define the individual units, enriching the knowledge of their content (Table 1).

Next, the results of the investigations of the sample areas were applied to the region represented by the particular samples (the second stage of the investigation). In the first place the photointerpretational map of the whole region was verified.

Then, during the testing field works soil units and their boundaries were checked. While 1-2 observational points (profiles, borings) of the sample areas took up 1 sq. cm of the map, 1 boring on the remaining area covered to 4-6 sq. cm of the map. During the testing investigations the boundaries of the classified soils were changed in few cases. However, numerous changes were introduced in reference to the terms of the following phases: concretionary soft iron phase, concretionary bog iron phase, and bog iron phase. It must be emphasized, though, that the above mentioned phases never constitute homogenous soil units. They form soil complexes with the domination of soils occuring in a given phase.

As a result of those investigations a detailed map on the scale: 1:10 000 was worked out. Soil units marked on it had been precisely

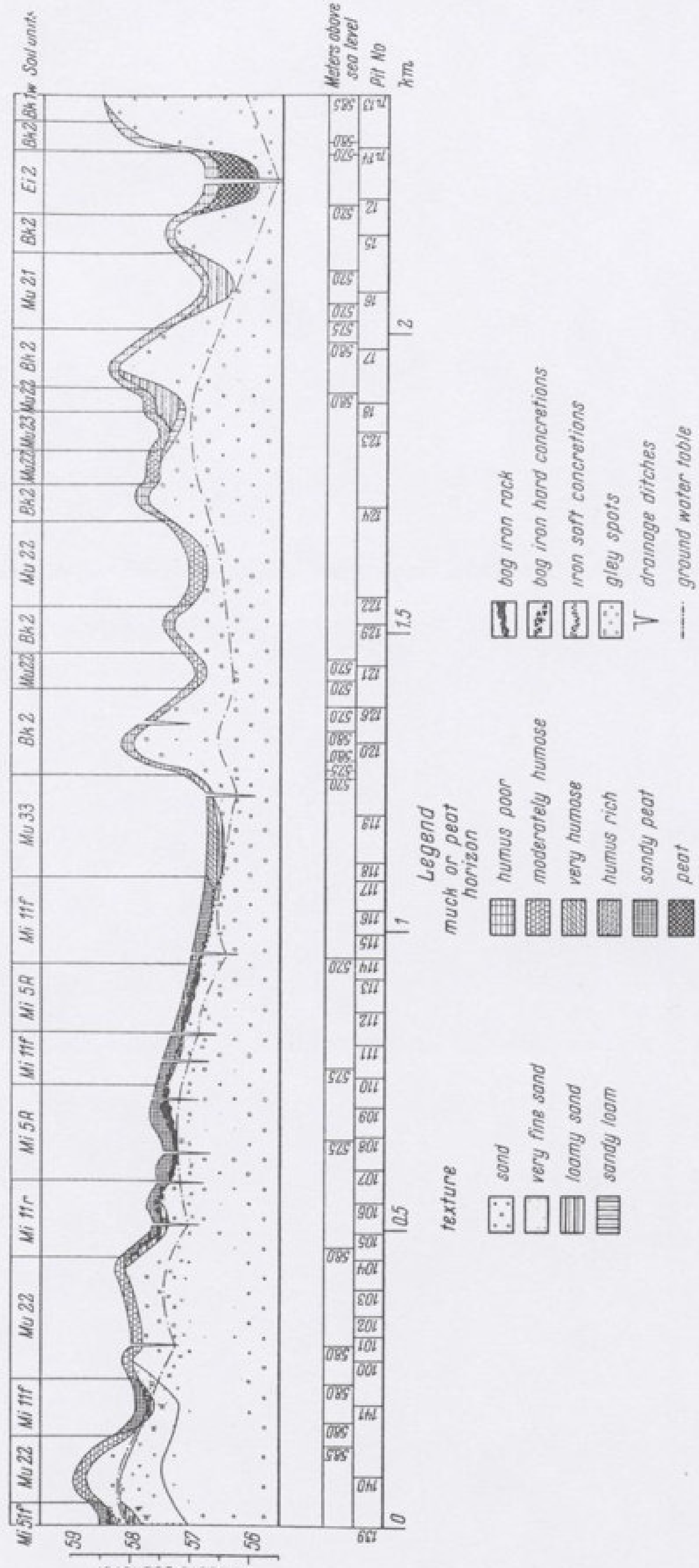

Fig. 2. Pedological section, Axis A-A'. Sample area

Table 1

Chart of soil mapping units

Soil mapping units		Relief			Soil profile characteristic				Groundwater-table, m			Drainage classes
Symbol	Term	Altitude m.asl.	Slope percent	Term	Topsoil: Organic matter, percent	Topsoil: Term	Subsoil	Substratum	Actual	Presumed highest	Presumed lowest	
1	2	3	4	5	6	7	8	9	10	11	12	13
Bk1w	Brown acid soils, not loamy sand, dune phase	58,5	-7	gently rolling	< 2,5	humus-poor not loamy sand	not loamy sand	not loamy sand	3,0	2,0	4,0	excessively drained
Bk2	Brown acid soils, slightly loamy sand	57,5-58,5	0,2-2,0	flat terrace	< 2,5	humus-poor slightly loamy sand	slightly loamy sand	slightly loamy sand	1,2	1,0	1,5	somewhat excessively drained
Mu21	Muck-like soils, humus-poor slightly loamy sand	56,5-57,0	0,0-0,3	higher flat depression	< 2,5	humus-poor slightly loamy sand	ID.	ID., gleyed	0,5	0,2	1,0	moderately well drained
Mu21f	ID., soft iron concretionary phase	ID.	ID.	ID.	ID.	ID. with soft iron concretions	ID. with soft iron concretions	ID., stratified	0,4	0,1	0,9	ID.
Mu22	Muck-like soils, moderately humose slightly loamy sand	57,5-58,0	ID.	ID.	2,5-5,0	moderately humose slightly loamy sand	slightly loamy sand	medium to coarse slightly loamy sand, gleyed	0,5	0,2	1,0	ID.
Mu22r	ID., concretionary bog iron phase	ID.	ID.	genthy sloping of flat depression	ID.	ID. with bog iron concretions	ID., bog iron concretions	ID.	0,5	0,2	1,0	ID.
Mu23	Muck-like soils, very humose slightly loamy sand	57,5	ID.	depression	5,0-8,0	very humose, slightly loamy sand	medium slightly loamy sand, strongly gleyed	ID., strongly gleyed	0,5	0,2	1,0	ID.
Mu33	Black earth-like soils, very humose moderately loamy sand	56,5-57,0	ID.	ID.	ID.	very humose moderately loamy sand	slightly loamy sand	ID., stratified, strongly gleyed	0,3	0,0	0,5	imperfectly drained
M11f	Peaty muck soils, concretionary soft iron phase	56,5-58,0	ID.	genthy sloping	15-23	peaty muck with bog iron concretions	slightly to moderately loamy sand	not loamy sand, strongly gleyed	0,3	0,2 above surface	0,5	imperfectly or somewhat poorly drained

1	2	3	4	5	6	7	8	9	10	11	12	13
Mi11r	ID., concretionary bog iron phase	ID.	ID.	depression	ID.	peaty muck with bog iron concretions	ID.	ID.	0,3	0,2 above sur-face	0,5	ID.
Mi51	Shellow mucky peat over-lying sand	ID.	ID.	ID.	>35	mucky peat	ID.	ID.	0,3	0,2 above sur-face	0,5	ID.
Mi5R	Shellow mucky peat over-lying bog iron rock with sand in deeper subsoil	57,0–57,5	ID.	ID., with gil-gai microre-lief	>35	mucky peat with bog iron concretions	bog iron rock	coarse not loamy sand strongly gleyed	0,5	0,1 above sur-face	0,8	ID.
Ei2	Fluventic mucky peat soils	56,5–57,0	ID.	lowest terrace	23–35	fluventic mucky peat	fluventic mucky peat strongly sil-ted	ID.	1,2	1,2	1,2	somewhat excesively drained
Fp2	Very humose alluvial soils	56,0–56,5	0–2	flooded ter-rsce	5–8	very humose silt loam	medium silty loamy, strongly gleyed	medium silty loam, strongly gleyed	0,3	0,2 above sur-face	0,5	poorly drained

defined and classified. Their boundaries corresponded to the natural geomorphological conditions of the valley.

SUMMARY

In soil survey of the river valleys that show great differentiation of soil, photointerpretation of aerial photographs provides a natural picture of soil. Besides it helps define similarities and differences between the individual soil units, and also serves as the basis of working out numerous interpretational maps [1, 3, 5, 7, 8, 9, 11, 12, 13]. It makes the soil survey easier allowing to considerably limit their range, which results in the increase of the precision of the investigation (in comparison with classical methods).

It is indispensible, however, that there should be a group of specialists well trained in the interpretation of aerial photographs. What is also essential is the choice of an appropriate photointerpretational method adapted to the physiographic conditions and the scale of the prepared map. The third important requirement concerns keeping the proper proportion between the range of the photointerpretation and the range of the soil surveys, the reason being that the photointerpretational map reflects only similarities and differences between the soil units whereas field works provide the basis of qualification and classification of soils, and establishment of their agricultural suitability. They also help work out a number of soil quality maps.

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ПОЛЕВЫЕ ИССЛЕДОВАНИЯ И КАРТОГРАФИЯ ПОЧВ ПРИ ПРИМЕНЕНИИ ИНТЕРПРЕТАЦИИ АЭРОФОТОСЪЁМОК

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Резюме

В статье представлен метод полной интерпретации аэрофотосъёмок в полевых исследованиях почвенного покрова. На примере проводимых в долине реки Вислы исследований описываются этапы аэрофотоинтерпретации с одновременным анализом отдельных факторов остающихся в непосредственной связи с дифференциацией почвенного покрова; в результате исследований установлено, что нанесеные на карту границы элементарных почвенных единиц выделенных в интерпретации аэрофотосъёмок соответствуют определенным в детальных полевых исследованиях одинаково на пробных площадях, а также на остальной исследуемой территории (10 000 *га*).

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RECHERCHES PÉDOLOGIQUES AVEC L'APPLICATION DE L'INTERPRETATION DES PHOTOS AÉRIENNES

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Résumé

Dans cet ouvrage on a présenté la méthode d'une interprétation pleine des photos aériennes dans des examens cartographiques et pédologiques.

Sur l'exemple des essais faits dans la vallée de la Vistule on a montré les étapes de l'interprétation des photos aériennes en analysant les facteurs particuliers qui ont un rapport direct avec la différentiation de la couverture du sol.

Par suite des recherches on a démontré que les contours des unités de sols isolés en conséquence de la photointerprétation des photos aériennes ont été affirmé par les investigations des terrains des superficies expérimentales et dans le reste du territoire examiné.

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BODENKUNDLICHE UNTERSUCHUNGEN MIT HILFE VON FLUGZEUGAUFNAHMENINTERPRETATION

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Zusammenfassung

In der Arbeit wird die Methode der vollen Interpretation von Flugzeugaufnahmen erörtert, die im Rahmen der Kartographisch-bodenkundlichen Untersuchungen im Wisła-Tal angewendet wurde.

Am Beispiel der im Wisła-Tal durchgeführten Untersuchungen werden die Etappen der Interpretation von Flugzeugaufnahmen besprochen, indem einzelne im direkten Verhältnis zur Bodendeckedifferenzierung stehenden Faktoren analysiert wurden. Diese Untersuchungen zeigten, dass die Umrisse der mit Hilfe der Photointerpretation abgesonderten Bodeneintheiten mit den Geländeuntersuchungen, auf den Probeflächen und auf den übrigen untersuchten Flächen übereinstimmten.

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BADANIA GLEBOZNAWCZE Z ZASTOSOWANIEM INTERPRETACJI ZDJĘĆ LOTNICZYCH

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Streszczenie

W pracy przedstawiono metodę pełnej fotointerpretacji zdjęć lotniczych w badaniach kartograficzno-gleboznawczych. Na przykładzie badań przeprowadzonych w Dolinie Wisły podano etapy fotointerpretacji zdjęć lotniczych, analizując poszczególne czynniki, które mają bezpośredni związek ze zróżnicowaniem pokrywy glebowej; w wyniku badań wykazano, że kontury jednostek glebowych wydzielone w wyniku fotointerpretacji zdjęć lotniczych zostały potwierdzone w badaniach terenowych na powierzchniach próbnych oraz na pozostałym badanym obszarze.

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