SR Nr. 27940.01

USE OF LANDSAT DATA FOR NATURAL RESOURCES INVESTIGATION IN THE LOWER BASIN OF DANUBE AND DANUBE DELTA

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TYPE 1 REPORT-Progress Report
for period April-June 1976

Report Date: July 1976

Sponsoring Agency
NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY
ROMANIAN COMMISSION FOR SPACE ACTIVITIES
Str. Roma 32, Sector 1, Bucharest, Romania

1.	SR No. 27940-01	2. Type of Report TYPE 1	3. Recipient's Catalog No.
4.	Title USE OF LANDSAT DATA FOR RESOURCES INVESTIGATION IN THE LOWER BASIN OF DANUBE AND DANUBE DELTA		5. Report Date July 1976 6. Period Covered April - June 1976
7.	Principal investigator Nicolaie OPREFSCU		8. No. of Pages 19
9.	Name and Address of Principal Investigators Organization Laboratory for Remote Sensing College for Civil Engineering B-dul Republicii 176 Bucharest Romania		10. Principal Investiga. Rept. No. DaDelta 1/1 11. GSFC Technical Monitor
12.	Sponsoring Agency Name and Address ROMANIAN COMMISSION FOR SPACE ACTIVITIES NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY Str. Roma 32, Sector 1, Bucharest Romania		13. Key Words (Selected by Principal Investigator) - Multidisciplinary studies - Natural resources inventory - Wetland and coastal zones - Thematical maps - Phenology
14.	Supplementary Notes Eight new recordings covering the Danube Delta zone and the Black Sea coastal zone were received on 8 May 1976		

15 Abstract

Eight recordings, made in winter, covering the Danube Delta and the Black Sea coastal zone were received during the period the report refers to. The research activity continued with the preliminary analysis of the recordings received in this period, and with the basic analysis and the interpretations of the previously received recordings.

From technical and organization point of view, there have been acquired some apparatus for data processing, we continue the activity of obtaining offers for other apparatus, test-sites are being arranged, and the national remote sensing program having objectives in the test-sites of marine resource exploration has been completed.

The report also shows results obtained by our researchers in geology.

1 - OBJECTIVES OF THE PROJECT DADELTA (USE OF LANDSAT DATA FOR RESOURCES INVESTIGATION IN THE LOWER BASIN OF DANUBE AND DANUBE DELTA)

a/ The main research purpose lies in the multidisciplinary study of remote sensing recordings, with the aim to determine the land use and to inventory the natural resources. In the sampling areas we aim at correlating the field data and those obtained by airborne means with the data supplied by Landsat satellites. The including of areas both natural and man-transformed, will lead to a better understanding of phenomena and of component elements.

In order to solve these problems, our activities are directed by the following situations:

- There are numerous mappings and specialized determinations on our country's territory carried out by classical methods; we wish to confirm them on the basis of satellite recordings to find possible further indications which should be confirmed by afferent field works.
- In some limited areas in the Danube Delta as well as in the coastal zone of the Black Sea where some mapping are more general, we try to detail them on the basis of satellite recordings combined with airborne recordings and field measurements.

b/ A major aim is to form and organize staffs of specialists - executive, design, research, as well as at the level of the direct management - who, as a result of instructing and exchanges of experience, through directly handling satellite and airborne recordings should be able of improving earth's resources projects.

c/ Performing specific technological works such as preliminary processing, sampling, phenology, thematic maps a.s.o. and the application in different fields (surveying in wetland, delta and coastal zones, classification of vegetation types and their quantitative estimate, geological studies directed mainly towards ground water and identification of geothermal zones), will ensure a better knowledge and gaining of experience in handling the data complex flow processing, with defining the advantages and limitations of remote sensing.

2. SUMMARY OF THE ACCOMPLISHMENTS DURING THE PERIOD APRIL 1st - JUNE 30st 1976

2.1. Technical and organizatory achievements

Weekly abstracts of the Landsat themes (WGA) have been received and inserted in our Remote Sensing Bulletin.

The list of the Landsat NASA PI (principal investigators) have been received as well as the summary of the given themes and have been published in the Appendix of our Remote Sensing Bulletin.

The new indexing system of the Landsat recordings has been generalized.

There have been acquired and are in operation, verified and tested: an electronic apparatus for the copying of photographic images with the compensation of the contrast (Elkop) and an Interpretoskope.

The endeavours for the purchase of the necessary equipment for our remote sensing program are going on multiband registering system, thermal mapping system and a system for the electronic processing of the recordings. But we have met some difficulties in the reception of the offers; the same for the purchase of the IR and color IR films.

Some of the mentioned documentary materials at Section 3 of our present report have been multiplied.

Satellite fixed target have been achieved and placed on the test-sites and also mobile targets of the flotor type will be further achieved and placed.

The extension of the characteristic profile which passes the test-sites in the Delta has begun, so that the profile will be settled in the following months.

A positioning system on sea has been achieved from the shore for the vessels taking samples by means of the coastal radar installations. This will lead to a more efficient use of the natural tracers and of those of the stable isotope type.

Phenological studies have been settled for the agricultural specific and phenological studies for the delta specific are being settled.

The taking of sample is going on as well as intensive determinations in the period of the passage of the Landsat 2 satellite.

Agfa Contour equidensities have been performed, some of them having been already presented in this report.

The computer programs for equidensities and for the multivariat analysis have already been assimilated and some preliminary check-ups have already been made.

An intense activity has been carried on for the interfacing of the Romanian computer Felix C 32 with the automatic drawing table Aristomat to process in real time the Landsat recording magnetic tapes.

Retrospective orders have been transmitted to Sioux Falls to obtain 7 sets of magnetic tapes as well as standard color-composites for 15 scenes.

The national remote sensing program has been completed with specific objectives for the exploration of marine resources which include among others: apecific and assembly modellings, test-sites, the solving of some economical problems, etc.

There has been performed an analysis with the users in order to answer the NASA notice referring to the parameters and the characteristics of the Landsat C mission.

2.2. Preliminary data analysis

2.2.1. Data receipt

Table 1 shows ID numbers of the received data, date of recording, receipt data and short comments.

Fig.1 shows the map with the indexes of recordings received which are covering under good conditions the Danube Delta and the coastal zone of the Black Sea. Six of the recordings being of 2 succesive days they achieve a compact covering of the interesting zone in winter time. The other two records are contigent to the former, 18 days before and 18 days after the mentioned recordings. It is to be mentioned that clouds are only above the sea, the clouding over the land being practically 0 percent.

The zone is largely covered with snow and the recordings seem underexposed for the zones without snow.

Table 1

ID Number	Quality MSS 4 5 6 7	Index	Date	Received	Comments
82399-08035	5 5 - 8	194/28	25.02.76	8.05.76	Recordings for the time which covers compactly an interesting zone;the clouds are only above the sea;in the zone without snow the recordings seem underexposed;the cloud structure is constant in time.
82382-08100	5 5 8 8	195/28	08.02.76	8.05.76	
82382-08102	5 8 8 8	195/29	08.02.76	8.05.76	
82382-08105	5 8 8 8	195/30	08.02.76	8.05.76	
82365-08160	5 5 5 5	196/28	22.01.76	8.05.76	
82383-08154	5 5 5 8	196/28	09.02.76	8.05.76	
82383-08161	5 5 5 8	196/29	09.02.76	8.05.76	
82383-08163	5 5 8 8	196/30	09.02.76	8.05.76	

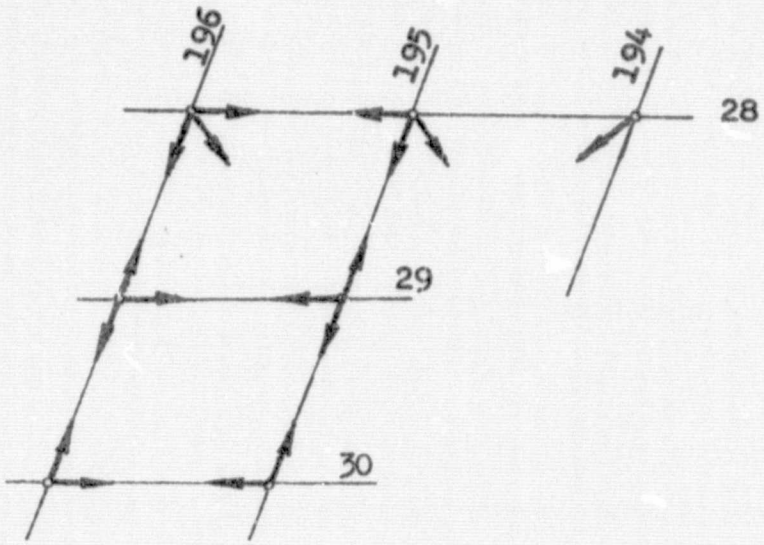


Fig.1. The diagram of recording arrangement, with the pointing out of the relationships during two successive days ←—○—→, respectively 18 days ↘ ↙ before and after the recordings considered as basic

2.2.2. "First glance" analysis

ID Number	Index	Date	Comments
82399-08035	194/28	25.02	Clouds only above the sea and namely only as far as the snow-uncovered zone; the snow-covered areal, the cloud structure and the discharges at the Chilia mouth may be seen very clearly.
82382-08100	195/28	08.02	The same remarks as above; we may follow the evolution of the snow cover, the ice distribution across rivers and lakes on band 5; the ice across the Danube appears on all bands while on band 7 the Danube appears discontinue (interrupted). In snow-covered zones populated centres and woods show up.
82382-08102	195/29	08.02	The apparent discharges in the sea under conditions of minimum alluvions is actually coastal ice; ice across rivers and lakes may be seen on all bands; the Danube seems interrupted by ice in band 7.
82382-08105	195/30	08.02	Clouds only above the sea, of the same type, appear uniformlly-constant, they are not penetrated in any band. The uncovered snow zone appears much more expresionless (inexpressive) than in summer.

82365-08160	196/28	22.01	Partially snow-covered, the band seems underexposed and inexpressive. Thin clouds appear practically identical on all bands - they are not transparent on any band - they are probably made of ice needles.
82383-08154	196/28	09.02	The snow cover accurately outlines the localities and ways of communication more and more towards band 7. The stripes appearing only on band 7, below the Galatzi-Focşani line are quite strange.
82383-08161	196/29	09.02	The woods and localities may be clearly seen on bands 6 and 7 as well as the ways of communication; ice across the Danube.
82383-08163	196/30	09.02	Excellent recording; but peripnerical to the zone; bands 6 and 7 are of particular interest for geological purposes.

2.3. Some interim analyses of the recordings

2.3.1. Concerning the evolution of certain deltas of the branches of the Danube leading into the sea, with the distribution of the alluvial deposit concentration in inland lakes and in the zones of discharges into the sea

Fig. 2-6 show the distribution of alluvial concentration in the maritime zones of the Danube Delta, by using the technique of Agfa Contour equidensities. These results can be checked with the data of field, sampling, as well as with the qualitative estimations that made use of relative density indices (see fig.2-5 of the previous quarterly report).

2.3.2. Referring to the geological studies directed towards the discovery and utilization of geothermal zones and towards the prospecting of useful mineral substances

As mentioned in the previous quarterly report, on the basis of some criteria independently applied by two operators to the same satellite recordings, there resulted the maps of lineation field distribution in fig.7-1o which were statistically processed, thus confirming the previous quarterly report:

- About 4o percent of the linear elements identified in the remote sensing recordings are corresponding to geological faults, anomalous contacts, or to other known disjunctive tectonic elements;
- About 3o percent are not shown on the maps, but there are arguments that they are in accordance with the structural tendencies;
- The rest of 3o percent are not in agreement with the present geological data and many of them probably have not any geological basis.

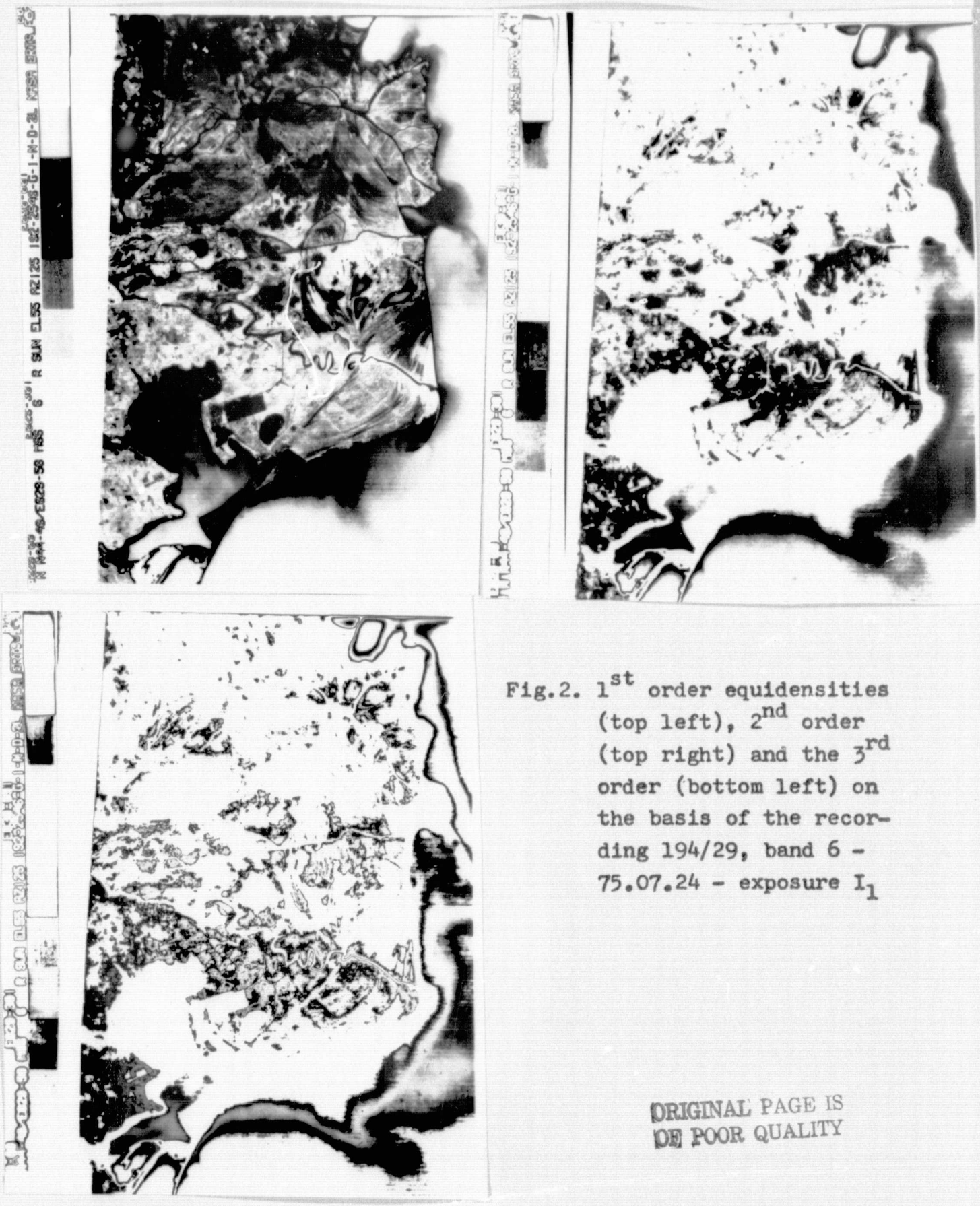


Fig.2. 1st order equidensities (top left), 2nd order (top right) and the 3rd order (bottom left) on the basis of the recording 194/29, band 6 - 75.07.24 - exposure I_1

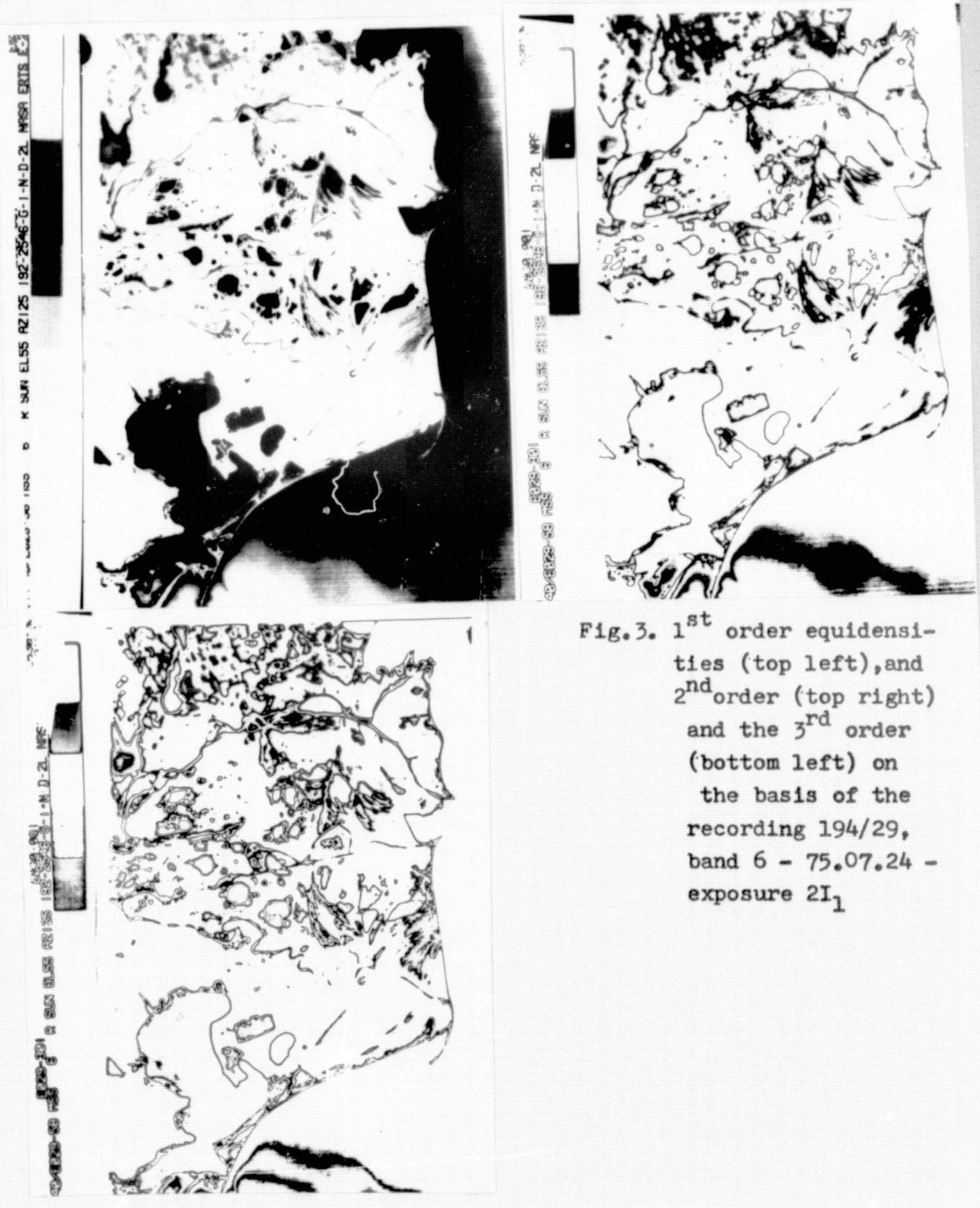


Fig.3. 1st order equidensities (top left), and 2nd order (top right) and the 3rd order (bottom left) on the basis of the recording 194/29, band 6 - 75.07.24 - exposure $2I_1$

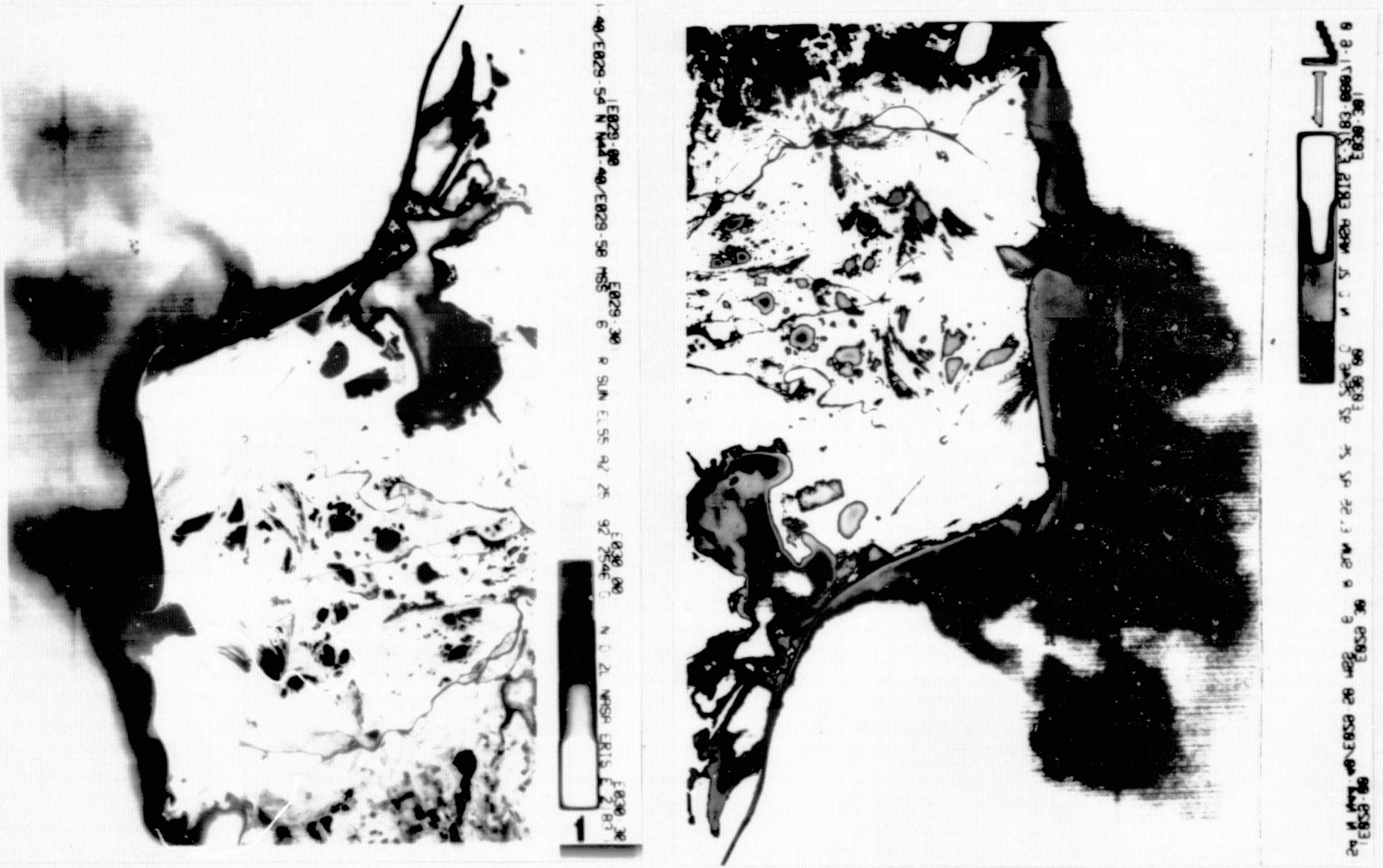


Fig.4. 1st order equidensities (left) and respectively 2nd order (right) on the basis of the recording 194/29, band 6 - 75.07.24 - exposure $(I_1 + I_2)/2$

Fig.5. 1st order equidensities - recording 194/29, band 4 - 75.07.24

Fig.6. 1st order equidensities - recording 194/29, band 5 - 75.07.24

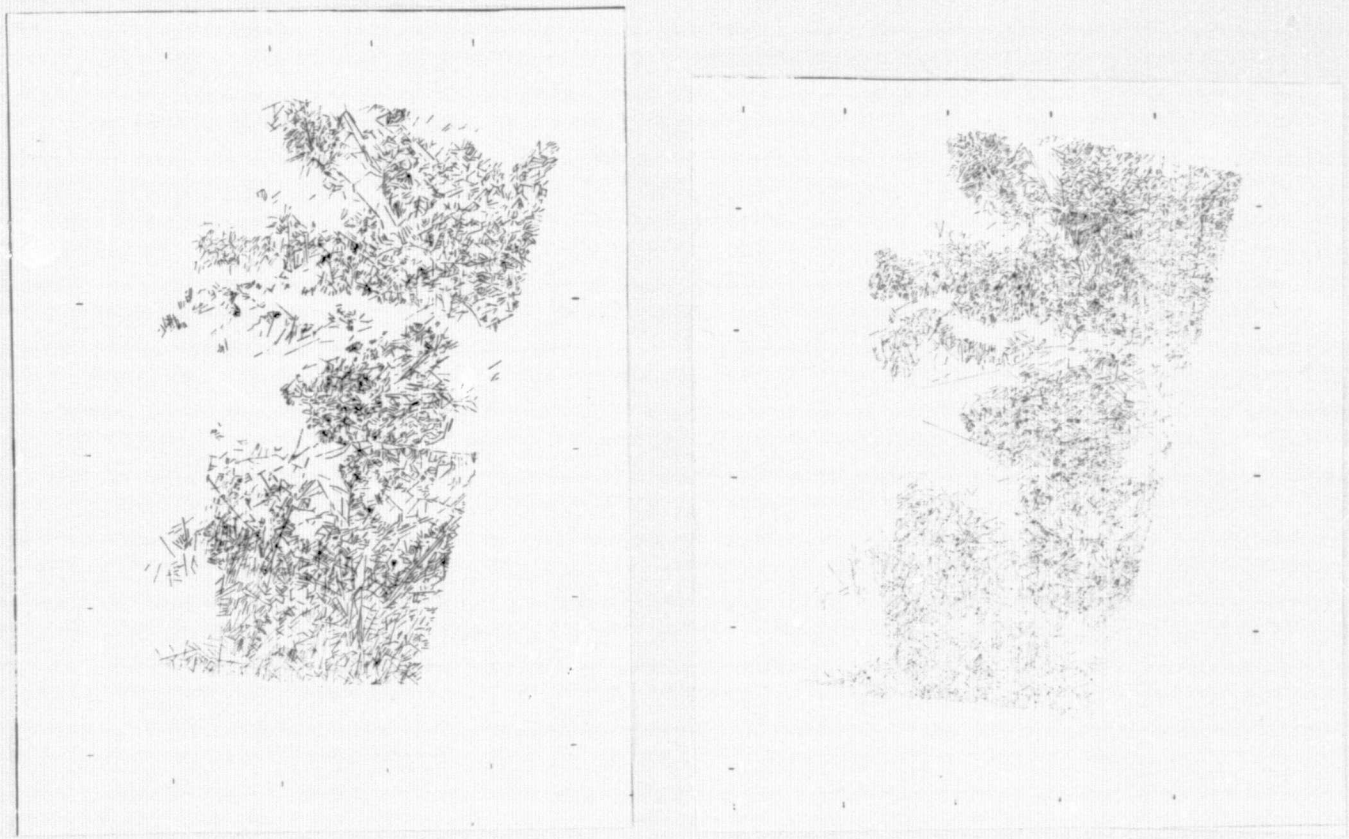
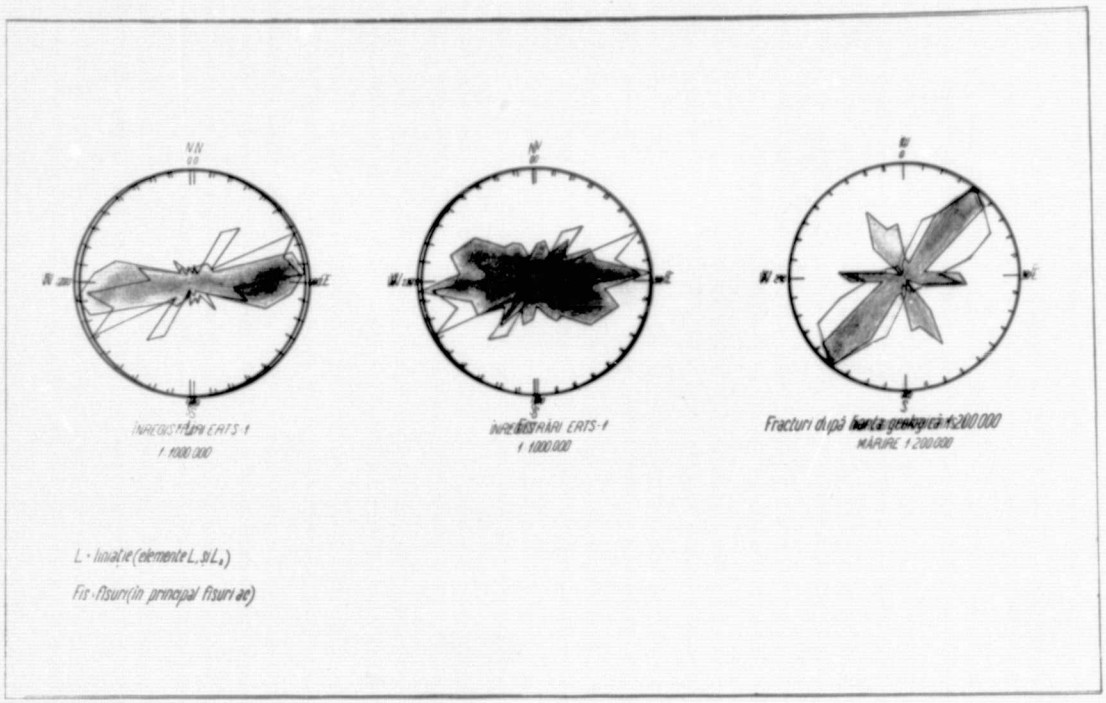


Fig.7. Maps of the lineation field distribution performed by two different operators based on the same satellite recordings



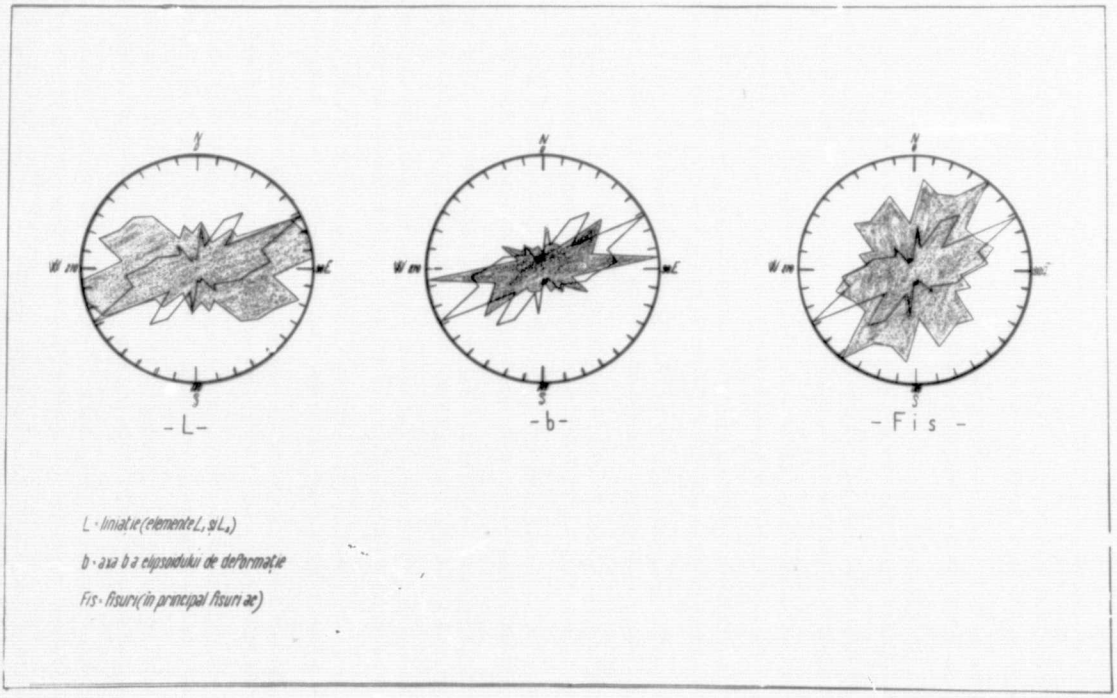
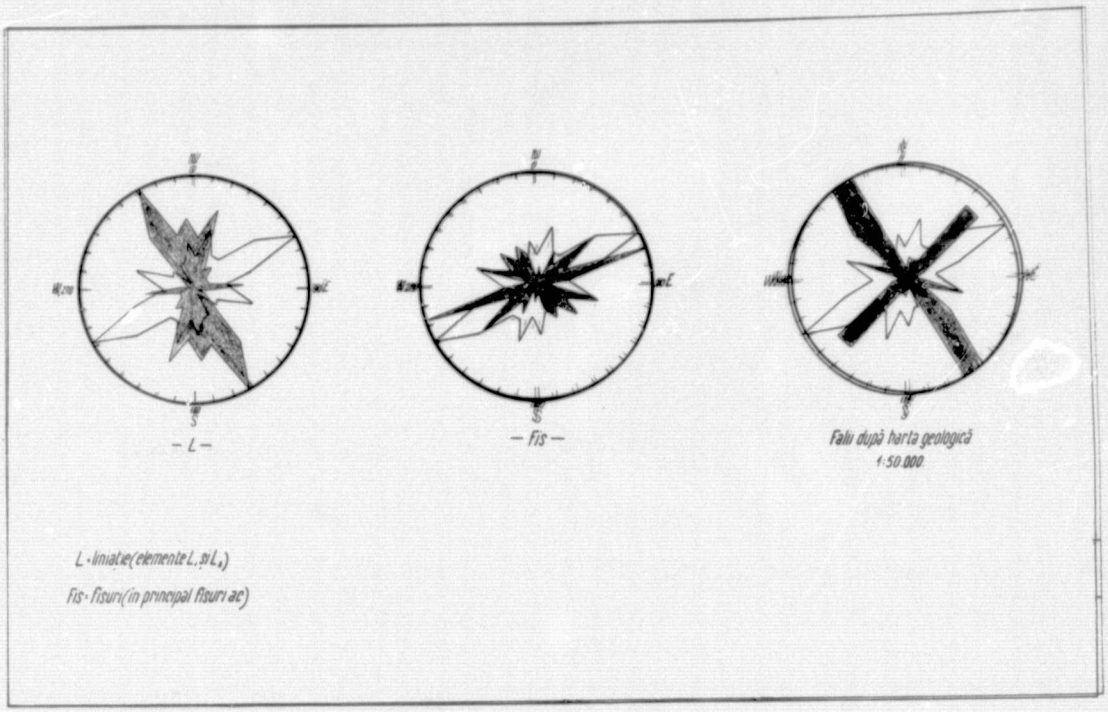


Fig.8. (a) top - Statistic analysis of the geological linear elements - hercinic cristalin, based on the satellite recordings (free diagram) superposed over the respective diagram made up after geological field data - zone A. (b) bottom - identical, zone C.



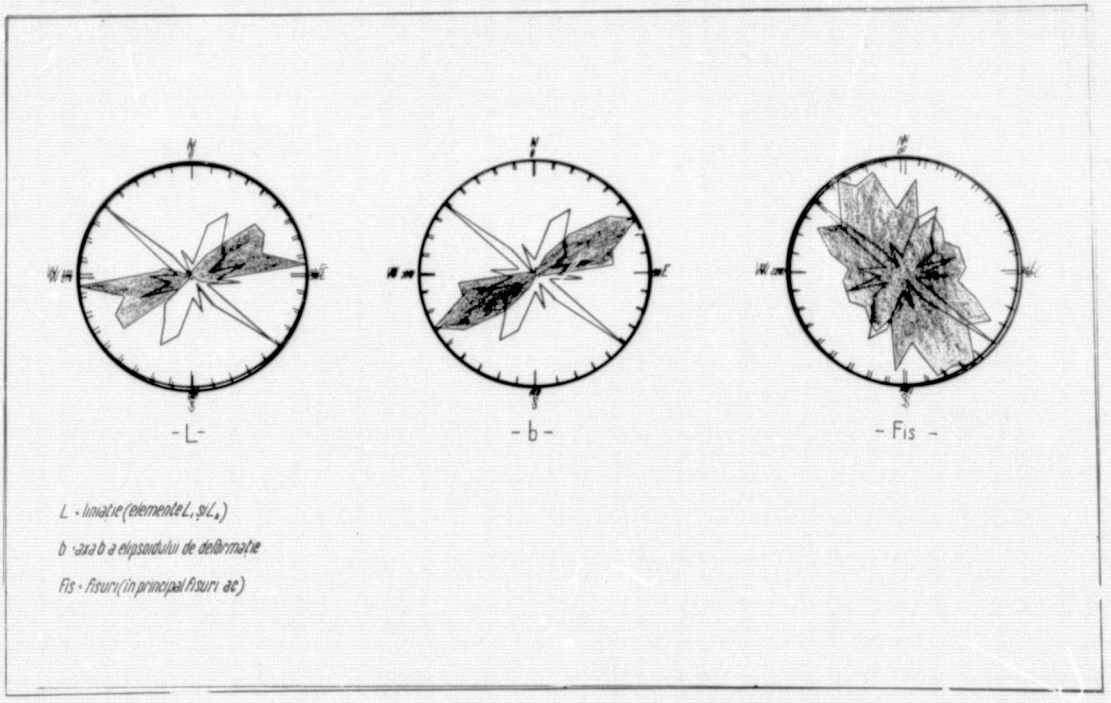


Fig.9. Statistic analysis of the geological linear elements - dalsladian cristalin, based on satellite recordings (free diagram), superposed over the respective diagram made up after geologic field data (hatched)

Fig.1o. Idem - the hercinic cristalin - zone B (bottom)

2.3.3. Plan for the next reporting period

- To define"the great delta profile" by means of ground tests, as well as the afferent field sampling; also to finalize the test-site for agriculture in Bărăgan Plain, as well as the hydrological and marine ones.
- To endow the delta laboratory with the installations necessary for some detailed tests, according to the theme-program.
- To acquire or leasing the instrumentation necessary for the calibration and digital processing of the recordings.
- We should use Landsat 1 and Landsat 2 recordings especially for determinations in vegetation-hydrology and oceanography.
- We should interface the Romanian computer Felix C 256 with the automatic draughting maschine Aristomat, for automatic processing of Landsat recordings and the graphic presentation of thematic maps.
- We should supplement the remote sensing programme with objectives concerning the exploration and exploitation of marine resources.
- We should make use of the experience acquired in the short lapse of activity of the Landsat programme in order to be able to answer in the due course of time to the NASA investigation concerning the Landsat C programme and to further benefit and turn into account the Landsat data.
- We should go on cooperating with the NASA and to extend this cooperation with:

  a/ Purdue University, as Mr.Marion Baumgardner proposed during the visit he paid to our country last autumn;

  b/ The laboratories working in the Mississippi Delta on remote sensing problems - as Mr.William Stoney proposed during the visit paid to our country by the NASA delegation last year.
- We should obtain succesive mosaics for the areas of interest making use of the available satellite recordings (as are the six out of the last eight recordings received during this term).

3. Publications

Remote sensing bulletin nr.4; its contents is given in the appendix. The following diploma theses belonging to graduates of the geodetic Department were finished:

- Design of a test-site of an applied type in remote sensing;
- Analogical processing of satellite recordings;
- Processing of recordings by equidensities;
- Drawing up of thematic maps based on satellite recordings;
- Up to date the maps by means of satellite recordings.

The following reports were worked out and printed, that is sent to Helsinki where between July 11th and 23rd 1976 the XIIIth International Congress of Photogrammetry will take place:

- Some remarks and suggestions on remote sensing; some achievements in the wetlands (Nicolaie Oprescu);
- Specification of hydromorphometric characteristics for water glitters making use of photogrammetric and remote sensing recordings (Mihail Albotă and Diana Roşca).

Bibliographical syntheses and design themes were set out for:

a/ Set of programmes for the digital processing of Landsat data (the computorized processing of multiband, multispectral, multidated recordings);

b/ Installation for receiving and processing the visual information by means of television;

c/ Multispectral flicker;

d/ Field radiometer.

We worked out the period report "Equipment for receiving and processing the visual information by means of television".

4. Major problems encountered during the course of investigations

4.1. On space recordings and other data

The delay in receiving the recordings still persists.

In January this year we were announced to receive recordings from Fucino, but up to the present we haven't received anything. We do not know what are the periods for taking over and their characteristics. We were announced by the "Telespazio" that we were going to receive data from Landsat 1 instead of Landsat 2. Our field determinations for agricultural, vegtation, hydraulic and oceanographic reasons are directed towards the Landsat 2 data of passing and we would encounter some difficulties if we were to change to Landsat 1.

As we have already mentioned in our previous reports, the following works would be of real help for us in digital processing:

- "Computer compatible Tape Format - DIS 6105, General Electric";
- "Digital Image Tape Format";
- "The list of programmes software and algorithms for Landsat recording processing" - as well as their calibration;
- We should like to borrow the film "Mission 73" for works on test-sites.

4.2. Concerning the colour film IR and IR as well as the equipment for the calibration-standardization and the processing of the recordings

- We meet with difficulties in buying IR and colour IR films - a fact for which we again resort to the help of NASA.

- We have difficulties and there are delays in obtaining the offers and perfecting the acquisition of the MDAS-Minidas Bendix installation and of the recording device in IR.

5. Conclusions, proposals, suggestions

We should be glad further receive the maximum available data from the center EROS-Sioux Falls, in the following period we will get accustomed with the effective use of the recordings which we are going to obtain through "Telespazio".

We should like to receive simultaneously the series of established data both from Landsat 1 and from Landsat 2, that is t\ receive Landsat 1 data from the "Telespazio"-Fucino and Landsat 2 data from Sioux Falls, or both the series of data dfrom the "Telespazio".

It would be useful to get as soon as possible the things mentioned above in 4.1 and to be supported in overpassing the difficulties mentioned in 4.2.

We once again underline that the remote sensing programme still shows an ever bigger interest within a large range of specialists in various domains of activity, including the managing staff and, irrespective of the difficulties encounteres, we hope for a normal progress of the works, to achieve the proposed objectives and, maybe their extension for the specific conditions occured meanwhile.

ERTS IMAGE DESCRIPTOR FORM

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DATE July 1976

PRINCIPAL INVESTIGATOR Nicolaie OPRESCU

GSFC ID 27940 - 01

ORGANIZATION College for Civil Engineering

PRODUCT ID (INCLUDE BAND AND PRODUCT)		FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
		Clouds	Sea	Snow	
82399-08035	M	v	v	partial	Deltaic and coastal regime
82399-08035	4	v	v	"	The evolution of ice and snow cover at 18 days
82399-08035	5	v	v	"	Ice on the Danube and coastal zone
82399-08035	6	-	-		Absent tape 6
82399-08035	7	v	v	"	Characteristic structures clouds, partial snow covering
82382-08100	M	v	v	partial	Deltaic and coastal regime in winter, partial snow
82382-08100	4	v	v	"	Ice on inland lakes
82382-08100	5	v	v	"	Coastal ice and on the Danube
82382-08100	6	v	v	"	Characteristic cloud structures
82382-08100	7	v	v	"	Faults, geology
82382-08102	M	v	v	partial	Deltaic regime and from Dobrudja - in winter
82382-08102	4	v	v	"	Ice on inland lacs and coastal ice
82382-08102	5	v	v	"	Partial snow
82382-08102	6	v	v	"	Characteristic structures clouds
82382-08102	7	v	v	"	Faults, liniaments
82382-08105	M	v	v	partial	Sea regime, coastal
82382-08105	4	v	v	"	Coastal ice, forests
82382-08105	5	v	v	"	Winter vegetation
82382-08105	6	v	v	"	Liniaments, geology
82382-08105	7	v	v	"	Faults, geology

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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PRODUCT ID (INCLUDE BAND AND PRODUCT)		FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
		Snow	Forests	Ice	
82365-08160	M	partial	v	v	Winter landscape
82365-08160	4	"	v	v	Winter flora
82365-08160	5	"	v	v	Ice on the Danube
82365-08160	6	"	v	v	Hydrologic network
82365-08160	7	"	v	v	Geology
82383-08154	M	v	v	v	Winter landscape
82383-08154	4	v	v	v	Compact winter cover
82383-08154	5	v	v	v	Localities, lines of communication
82383-08154	6	v	v	v	Liniaments, geology
82383-08154	7	v	v	v	Geology
82383-08161	M	partial	v	v	Winter landscape
82383-08161	4	"	v	v	Ice on the Danube
82383-08161	5	"	v	v	Fields, localities
82383-08161	6	"	v	v	Hydrographic network
82383-08161	7	"	v	v	Localities, lines of communication
82383-08163	M	partial	v		Winter landscape
82383-08163	4	"	v		Fields, clouds
82383-08163	5	"	v		Localities,liniaments
82383-08163	6	"	v		Faults, geology
82383-08163	7	"	v		Fields, localities, faults

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Remote Sensing Bulletin No.4 - June 1976

Summary

Appendix

List of the NASA PI (principal investigators) in the Landsat 2 Programme - title and summary of themes (2o pag.).