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The second EROS/AID International course on remote sensing was held May 30 to June 28, 1974 at the U.S. Department of the Interior, U.S. Geological Survey, EROS DATA CENTER, Sioux Falls, South Dakota. The course was designed to train participants in practical application of Earth Resources Technology Satellite (ERTS) data and aerial remote sensor systems data to resources and land use analysis and management. ERTS-1 data and aerial data from systems that might be readily available to participants were emphasized. The course was attended by 34 scientists whose fields included geology, hydrology, agriculture, forestry, cartography, geography, and aerospace technology. Twenty-one nations of Africa, Asia, Europe and South America were represented.

This report identifies attendees and training staff, describes the activities of the course, reviews critiques of the participants and presents a critique by the staff that deals with their own preparations and presentations, with desired qualifications of future participants and with considerations of personal requirements of foreign students attending such courses.

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SECOND EROS/AID INTERNATIONAL COURSE  
ON REMOTE SENSING

Office of International Geology  
U. S. Geological Survey  
Reston, Virginia

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**SECOND EROS/AID INTERNATIONAL COURSE**

**ON REMOTE SENSING**

**By**

**Donald G. Orr**

**U. S. Geological Survey**

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## SECOND EROS/AID INTERNATIONAL COURSE ON REMOTE SENSING

By Donald G. Orr, U. S. Geological Survey

### INTRODUCTION

The second International Training Course on Remote Sensing at the U.S. Geological Survey's EROS Data Center (EDC) in Sioux Falls, South Dakota, was held May 30 to June 28, 1974. The course was part of a cooperative program developed by the Office of Science and Technology (OST), U.S. Agency for International Development (USAID), and the Office of International Geology (OIG) and the Earth Resources Observation Systems (EROS) Program of the U.S. Geological Survey, Department of the Interior, to provide training for scientists and engineers of the lesser developed countries. The program was funded by EROS Program operating funds and PASA TA(IC) 02-72, 931-11-995-902-72-3148905.

The purpose of the course was to train participants in the practical applications of Earth Resources Technology Satellite (ERTS) imagery and aerial remote sensor data. Emphasis was placed upon ERTS and on types of aerial data that might be readily available to scientists of the lesser developed countries.

### Participants

Thirty-four scientists from twenty-one nations of Africa, Asia, Europe, and South America participated (see Table 1).

The participants represented several different earth science disciplines and related fields. Nineteen were geologists, five were cartographers or geographers, four were agricultural and forestry scientists, five were hydrologists and one was a statistician. Prior experience of the participants in remote sensing, particularly in regard to space systems and newer aerial systems such as radars and thermal mappers, varied from none to extensive. The varied levels of experience in remote sensing created some problems in regard to emphasis and technical balance in the course lectures. However, these problems were minimized by encouraging discussions and active participation of the experienced participants during lectures and workshop activities.

**Table 1**  
**FINAL ROSTER OF PARTICIPANTS IN REMOTE SENSING COURSE**

<u>Country</u>	<u>Name</u>	<u>Discipline</u>
Bangladesh	M. Abu BAKR	Geology
	Kazi A. F. M. JALAL	Hydrology
Bolivia	Orlando UNZUETA	Agriculture
	J. Alvaro FERNANDEZ	Geology
Brazil	Arno Luis BERTOLDO	Geology
Burma	(Miss) Soe Nyung SWE	Photogeology
China, Republic of	Eel-Wei MAO	Petroleum Geology
	Shin WANG	Geology
Colombia	Jorge Luis ARANGO C.	Geology
Gambia	Malick A. K. JOHN	Hydrology
Ghana	Robert DODOO, Jr.	Geography
Indonesia	Mahsun IRSYAM	Aerospace Technology
	Adjat SUDRADJAT	Geology
Iran	Behzad PAK	Geology
	Majid PAZIRANDEH	Agri/Forestry
Kenya	Walter J. ABSALOMS	Survey
	Simon K. ANZAGI	Statistics
	Shirish A. DODHIA	Mines & Technology
	Daniel M. KIRORI	Water
Khmer Republic	San PHALLARSI	Hydrology
	Loy Sim CHEANG	Agriculture
Nigeria	Wisdom I. A. OKUBADEJO	Geology
Pakistan	Shahid Ahmed SYED	Geology
	Sheikh Abdur REHMAN	Hydrology
	Mirza Saeed HASAN	Geology
Philippines	Alfredo L. MAGPANTAY	Geology
South Vietnam	(Miss) Thi Ngoc Thanh LE	Cartography/Photogeology
Spain	Gonzalo DEL AMOR	Geology
Thailand	Visut SRISUPARP	Geology
Turkey	Nuri MUNSUZ	Agriculture
	Ercan TURA	Geography
Venezuela	Luis GONZALEZ S.	Geology
	Rafael LAIRET C.	Geography
Yugoslavia	Sanjin GRANDIC	Geology

### Training Staff

Personnel were added on a temporary basis to augment the staff of the EROS Data Center. The complete training staff affiliation and subjects presented during lectures included the following:

Dr. David M. Carnegie, University of California, Berkeley, presented applications of remote sensing in range/forestry.

Col. Alden P. Colvocoresses, USGS, discussed cartographic applications.

Dr. William C. Draeger, University of California, Berkeley, lectured on agricultural applications.

Mr. William A. Fischer, Senior Scientist, EROS Program Office, discussed the EROS Program--past, present, and future.

Dr. Albert G. Hahn, EDC Technicolor, instructed on preparation of mosaics.

Mr. Dennis R. Hood, EDC, discussed geographic analysis and land use classification.

Dr. David Landgrebe, Purdue University, discussed computer analysis tools and techniques.

Mr. Glenn H. Landis, EDC, presented a discussion on the EROS Data Center operations.

Mr. Donald T. Lauer, University of California, Berkeley, presented the principles of image interpretation.

Dr. Keith A. Maas, EDC Technicolor, lectured on photo processing.

Mr. Donald G. Orr, EDC, presented a discussion on the course and lectured on image formation, sensor systems, and geologic applications.

Dr. Robert G. Reeves, EDC Staff Scientist, presented principles of interpretation applied to geology.

Mr. Charles J. Robinove, EROS Program Office, presented hydrologic applications.

All EDC Applications Assistance Branch personnel are involved in the preparation and presentation of lecture materials, as well as providing individual assistance to class participants throughout the course. Professional staff not already listed as instructors were:

Mr. Timothy Bidwell, EDC Technicolor, Librarian, explained the services of the EROS Data Center Remote Sensing Library.

Mr. Stephen Lurvey, EDC Physical Science Aid, responsible for visual aid presentation, equipment supplies, drafting supplies, and general logistic support of training course.

Mr. James Nickerson, EDC Technicolor, Geographer, responsible for ordering imagery used during course, also provided input to geography exercise.

Mr. James (Kimo) Smith, EDC Technicolor, Geologist, responsible for much of the field trip logistics, correspondence and visual aids.

Mrs. Rita Flanery, Mrs. Debbie Petersen, and Mrs. Arlene Randall, Applications Assistance Branch secretarial staff, prepared correspondence and provided day-to-day office assistance to participants.

#### Acknowledgments

Very special thanks are due to many. EROS Program Staff, Col. A. P. Colvocoresses, Mr. William A. Fischer, and Mr. Charles J. Robinove, contributed outstanding assistance in planning and conducting the training course. The support of EDC senior staff was invaluable. Personnel of the EDC Data Production and Technical Support Branch gave exceptional support in preparation of imagery products and in the conduct of daily activities. Mr. Victor Myers, Director of the Remote Sensing Institute, South Dakota State University, and his staff cooperated most willingly in demonstrating the facilities and discussing the program of the Institute. Dr. Paul Gries, Chairman of the Geology Department at South Dakota School of Mines and Technology, and his staff were of invaluable assistance during the preparations and conduct of the Black Hills field trip.

Mr. Bruno Petsch, retired geologist; Mr. Jack Kume, USGS-WF Mr. Assad Barari, and Mr. Jack Harkson, South Dakota Geological Survey; Mr. Russell King, Badlands National Monument; Mr. Bryan Mangum, South Dakota Dept. of Game, Fish and Parks; and Mr. John Sutton, gave freely of their time in providing excellent contributions to the laboratory and field exercises. Mrs. Phyllis Wiepking, EDC community affairs representative, and Mrs. Olga Marinenko, USGS Office of International Geology, arranged, coordinated, and participated in the orientation of the course attendees. Mrs. Margo Flagg of the Northwest Travel Agency graciously and professionally assisted in arranging travel schedules.

#### COURSE DESCRIPTION

This was the first international training course held in the new EROS Data Center facility. While a few deficiencies were noted, the classrooms, image analysis rooms, and supporting activities provided an environment conducive to professional level training.

The course ran for a total of four weeks. (See attached agenda.) Formal class hours were from 0830 to 1700, five days a week. Field trips were arranged for all or part of the three weekends during the course.

The division of course time, not including weekends, provided 25 percent lecture and 75 percent work in the laboratory on the application of ERTS data for resource analysis and management. Specific applications addressed included agriculture/forestry, cartography, geography, geology, hydrology, and land use. Mosaics of South Dakota were prepared by all students for use in several training exercises. Mosaics of all or part of each country were also prepared by the appropriate participants. Each student received a package of a variety of EDC image products and materials for use in the course and to take back to their respective countries for continuing analysis.

Lectures, normally two hours in duration, emphasized principles of interpretation for applications and remote sensing technology. After each lecture the participants were asked to perform an interpretation exercise designed to provide practical experience in applying the principles

presented during the lecture. The attendees were divided into six interdisciplinary teams to stimulate discussion during the exercises. The training staff was available to assist in the interpretations and to re-emphasize the basic principles. The following day, participants worked with imagery over their respective countries, applying the principles and experience gained during the preceding days' training.

Three field trips were arranged to supplement the remote sensor training interpretations compiled by the course participants during the laboratory exercises.

The first, on June 8, was to the Remote Sensing Institute, a research institute on the campus of South Dakota State University at Brookings. The students toured the facilities and were briefed on aircraft operations, ERTS experiments, and professional activities of the Institute.

The second, on June 15, covered much of eastern South Dakota between Sioux Falls and Watertown. The principal purpose of this trip was the field-checking of geographic, geologic, and hydrologic interpretations of ERTS imagery performed by the students during the preceding week.

The third field trip, on June 22-25, covered several stops in South Dakota. These stops included:

- a. Examination of depositional layering and iron/manganese nodules at Chamberlain.
- b. Tour of the Badlands with lectures by park ranger and state geologist.
- c. Geological tour of Black Hills area led by the chairman of the Geology Department at South Dakota School of Mines and Technology.
- d. Underground tour (for geologists only) of the Homestake Gold Mine.
- e. Land use and forestry lecture and tour (for non-geologists).
- f. Surface tour of Homestake Gold Mine and Mill.
- g. Land use and agriculture tour of a diversified ag-operation north of Pierre.

This field trip was extremely well received by the students and provided many opportunities for cross-checking of ground information against interpretations made during the various discipline workshops.

## COURSE EVALUATION

The International Course participants were asked to fill out a course evaluation questionnaire to provide feedback for planning and improving future courses. In order to encourage objective and constructive suggestions, they were not required to sign the questionnaire. The following is a summary of the responses from 33 of the 34 participants:

1. We achieved our Course objectives: 79%--adequately; 21%--partially.
2. The length of the Course was: 61%--just right; 33%--too short; 6%--too long.
3. The Course content should have been: 61%--as it was; 33%--more rigorous; 6%--less rigorous.
4. The caliber of instruction was: 73%--excellent; 21%--good; 6%--average.
5. Instructional materials were: 61%--excellent; 27%--good; 6%--adequate; 6%--poor.
6. The balance between lectures and exercise should have been: 48%--as it was; 42%--more exercises; 10%--more lectures.
7. Lab exercise contributed to understanding: 88%--yes; 9%--don't know; 3%--no.
8. Multidisciplinary approach was: 88%--helpful; 3%--marginal; 9%--should be discontinued.
9. Future field trips should be: 61%--same; 30%--expanded; 9%--eliminated.
10. Logistics of the Course were: 79%--excellent; 21%--satisfactory.
11. The Course met individual needs: 61%--yes; 36%--partially; 3%--not at all.

Table II lists the number of individuals relative to preference on emphasis of subject areas covered during the Course.

Table II. Individual preference on emphasis of subjects covered.

Subject	More	Less	Same	No Opinion
Photo measurement (scale, areas, parallax, etc.)	9	3	9	12
Basic principles of interpretation	11	1	11	10
Instrument for remote sensing	19		7	7
Instruments for image analysis	19	1	6	7
Applications to cartography	6		16	11
Applications to agriculture and rangeland	9	1	13	10

(Table II, continued.)

Subject	More	Less	Same	No Opinion
Applications to hydrology	9	1	13	10
Applications to geography and land use	8		13	12
Applications to urban studies	4		17	12
Applications to geology	10	4	11	8
Discussions of photography	10	3	10	10
Discussions of IR scanners and imagery	15	1	7	10
Discussions of radar and imagery	13	1	9	10

Assuming the individuals who did not list an opinion in the above table preferred the same emphasis placed on subject areas, in most cases over 50% were satisfied with the Course curricula. Notable exceptions were the preference for more emphasis on instrumentation for remote sensing (airborne) and for image analysis.

General comments made which are not directly reflected in the answers above are summarized as follows:

1. Several indicated that they would have preferred more time for individual study, such as use of the library, night study, and field study (ground truth).

2. Several suggested that Course materials (i.e. Syllabus) should be furnished to participants for study prior to arrival at EDC.

3. Several commented (both on the questionnaires and personally) that the hours of the Course should be changed so participants would arrive at their motel at the end of the day before banks, stores, and post office close.

4. Other suggestions on the Course format, duration, and content seemed to represent personal preference but not the consensus of the group. Some suggested discipline-oriented courses (i.e. agriculture, geology, water resources, etc.). Several stated that Course materials were presented too fast and more time to consider each subject should be provided by making the Course longer. Others wanted some training in more advanced techniques.

### Course critique by instructors

The Applications Assistance Branch staff held a meeting to critique the completed International Training Course. The following comments were compiled for consideration in planning future courses.

#### Logistics

- a. Welcome, introduction to the EROS Program EDC functions and tour of facility should be accomplished during the two-day orientation period prior to starting the Course (see agenda). This will save one day for classroom work but will probably require individual orientation sessions for late arrivals.
- b. The staff concurred with attendees that course hours should be adjusted to quit earlier so participants can go to banks, stores, and post office before closing hours.
- c. Reservations for breakfast and noon meals should be made at restaurants having adequate facilities during field trips. The need for reservations became apparent during Black Hills field trip. Evening meals do not need to be scheduled because most participants preferred to make their own arrangements.

#### Course agenda

- a. A presentation on library services with appropriate bibliographic handouts should be conducted early in the course--the first or second day. This will provide information which will stimulate better utilization of the EDC library.
- b. A more rigorous exercise on use of computer printouts of ERTS-1 imagery coverage should be held to insure participants' understanding of printout data and methods of selecting images. The exercise should include selection of coordinates of area to be covered; selection of images as a function of spectral band, scale, time of year, cloud cover, and costs; and a written justification for their selections as a function of intended use and available coverage.

- c. The course Syllabus and evaluation forms should be made available to participants prior to initiation of course.
- d. More time should be devoted to demonstrating the operation and functions of the image analysis equipment. The participants should be provided with a description of the operational procedures and asked to conduct exercises on the equipment to insure understanding and significance of the output. Suggested procedure for Diazo color compositing should be posted on each Diazo machine. The controls of the additive color viewers and image density slicing equipment should be fully explained.
- e. The lecture and exercise on mosaicking techniques should be condensed so that mosaics of South Dakota study areas and country areas are completed in one day.
- f. Geography and land-use applications should be combined and presented early in the course. Since the land-use exercise involved image interpretation and the participants will not have had much instruction early in the course, the exercise results should be collected and saved until the end of the course. At the end, the participants should be asked to do the same land-use exercise over and the results should be compared with results of the first exercise. This should demonstrate that additional information can be compiled in much less time as a result of the training.
- g. The agriculture, forestry, and rangeland application should be presented before geology and hydrology applications. In many instances, interpretation of vegetation characteristics and distribution is involved in performing a geologic or hydrologic analysis. The forestry exercise should be conducted in the Black Hills area; the rangeland exercise should be conducted in western South Dakota; and the agricultural exercise should be conducted in the Pierre, South Dakota area. Images over these areas at different times of the year should be ordered to demonstrate the temporal aspects of vegetation communities.

- h. **Geology and hydrology exercises should be combined and conducted in the same area.** The Black Hills area appears to be well-suited for both geologic and hydrologic studies. The hydrology exercise conducted previously in eastern South Dakota should be abandoned. Hydrology of a glaciated area is too difficult, since most non-U.S. participants will not have been previously exposed to glacial geology.
- i. Consideration should be given to assigning homework to the participants. In addition, reserving a room at the motel to be used as a study area at night should be explored. If it is feasible to provide a study area at the motel, it could be equipped with a Diazo processor, light tables, etc.

#### Field trips

Use of images in conjunction with field observations should be emphasized. While some participants used their images during previous field trips, the intended checking of interpretation results was not fully achieved. Perhaps exercises in the field involving collection of ground truth data would encourage better use of imagery for verification of interpretation results.

#### Problem areas

Certain logistic and/or administrative problem areas were noted by instructors, support personnel, and/or students.

- a. Financial. Timely receipt of full per diem allowances for USAID-sponsored participants continues to be a problem. Most participants are provided with a modest advance of per diem when they depart their respective countries. The amount is not adequate for sustained subsistence. USAID Washington and/or USAID missions provide the balance of per diem allowances to attendees after arrival at EDC. However, the time required to provide the full per diem is in some cases excessive, requiring personal loans by EDC staff in order that participants have

money for meals. It is strongly recommended that arrangements be made to have USAID place on deposit with a local bank the required per diem allowance prior to the arrival of the participants.

- b. Early arrivals. Students who arrive two or more days early create many unnecessary complications. Unless we are advised of their arrival, there is no one to meet their airplane and assist them with baggage, transportation to motels, etc. The classroom facilities at the Data Center are not, at this stage of course preparation, available for use by an individual. Data Center staff are all working at full speed on last minute course preparations, meeting airplanes, etc., and cannot devote individual attention to an early arrival. Emphasis should be placed on the necessity for students to arrive on the proper day.
- c. Language. Three of the students suffered from a rather severe language problem. One of these was able to communicate through and with other course participants and thereby got along fairly well. The remaining two, however, required constant attention and repeated explanations of subject matter in order to accomplish even a minimum of technical exchange. It is suggested that language capability requirements be rigidly adhered to in an effort to achieve the highest possible degree of information exchange.
- d. Change of departure and/or itinerary. Last minute changes in travel itineraries complicated departure procedures because many students decided to travel to Washington and/or other destinations in the United States for an "add on" program arranged in response to on-the-spot requests. These "add on" programs are probably of sufficient importance to justify the necessary effort in rearranging travel reservations. It might be simpler, however, to offer a choice of several prearranged "add on" options and ask the students to choose the "add on" of greater

interest. Travel arrangements could then be made in advance and much of the last minute flurry of activity necessary after the last two international courses might be avoided.

#### SUMMARY AND CONCLUSION

Taken in its entirety, the June 1974 International Course must be viewed as a success. The students expressed satisfaction in the course content and preparations. Many students were given individual assistance in areas of particular interest. Logistics of materials, equipment, and personnel generally went extremely well. The level of experience and expertise among the participants was generally very high and this contributed greatly to the success of the course. A substantial amount of interdisciplinary interchange between and among the students was experienced.

The knowledge and experience gained in the first international course contributed greatly to this second course. Workshop teams were formed with no consideration for international politics and, because of either the matter-of-fact approach or the fortuitous happenstance of an extremely compatible group of individuals, the teams functioned very well. The team reports at the end of the course were professional in every respect. In addition, a condition evolved during this course which is somewhat difficult to define. A rare cohesiveness and rapport, born perhaps of the course's intensity and the seriousness of the participants, became evident as the course progressed. It is a condition which all of us involved with preparation and presentation of this course will strive to achieve in future courses.