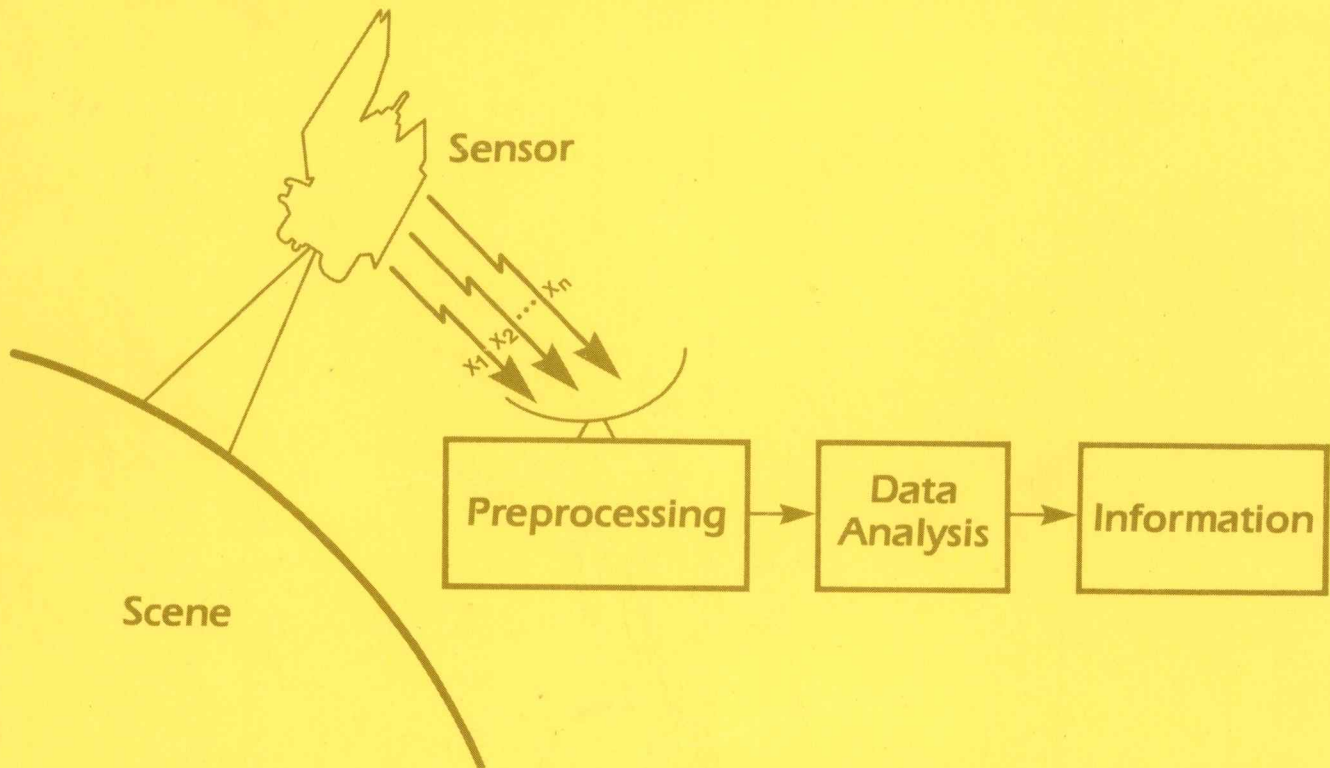


Tenth International Symposium

# Machine Processing of Remotely Sensed Data

with special emphasis on

## Thematic Mapper Data and Geographic Information Systems



June 12-14, 1984

## Proceedings

Purdue University

Laboratory for Applications of Remote Sensing  
West Lafayette, Indiana 47907 USA

# Symposium at a Glance

	TUESDAY JUNE 12	WEDNESDAY JUNE 13	THURSDAY JUNE 14
7:45	REGISTRATION - East Foyer, Stewart Center		
8:15	OPENING PLENARY - THEMATIC MAPPER DATA UTILIZATION AND GEOGRAPHIC INFORMATION SYSTEMS Fowler Hall	3. VEGETATIVE COVER ANALYSIS VIA REMOTE SENSING (PART 1) Room 214	7. PRE-PROCESSING AND ANALYSIS TECHNIQUES (PART 1) Room 214  8. VEGETATION CHARACTERISTICS ESTIMATION Room 218
8:30		4. APPLICATIONS OF REMOTE SENSING FOR LAND COVER/LAND USE EVALUATION Room 218	
9:45		POSTER SESSION/BREAK Room 206	
10:00	BREAK Room 206		BREAK Room 206
10:30	OPENING PLENARY continues	SESSIONS 3 AND 4 continue	SESSIONS 7 AND 8 continue
12:00	LUNCH - ON YOUR OWN		
1:30	1. TM DATA QUALITY ANALYSIS Room 214  2. TRENDS IN GEBOTANICAL REMOTE SENSING Room 218	5. GIS CHARACTERISTICS, NEEDS AND APPLICATIONS Room 214  6. TM APPLICATIONS TO PHYSICAL COMPONENTS OF THE ENVIRONMENT Room 218	9. VEGETATIVE COVER ANALYSIS VIA REMOTE SENSING (PART 2) Room 214  10. PRE-PROCESSING AND ANLYSIS TECHNIQUES (PART 2) Room 218
2:45		POSTER SESSION/BREAK Room 206	
3:00	BREAK Room 206		BREAK Room 206
3:30	SESSIONS 1 AND 2 continue	SESSIONS 5 AND 6 continue	SESSIONS 9 AND 10 continue
5:00			
6:00	BANQUET/ENTERTAINMENT - The Trails		
8:00			

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## Preface

Remote sensing is continually rising to new levels of sophistication and application throughout the world. The need for advances in this field is evident because the world is experiencing major environmental and resource problems. Degradation of environment and improper and inefficient use and distribution of resources continues to cause human distress on a global scale. Acquisition, storage, management and analysis of data relevant to solution of these problems which impact human progress are elements in which the remote sensing community has expertise and vital interest. This technical community has a great opportunity to aid in improving many world conditions through applications of remote sensing.

New sensors with features such as improved spectral and spatial resolution, greater variety of spectral bands, and more efficient data transmission/receiving characteristics are increasing the capability to provide data which, when analyzed, can provide information required to redress important world problems. Vast new quantities of information developed through remote sensing frequently are combined with other information sets and analyzed in combination using computer techniques. This approach promises not only to expand the need for more remote sensing-derived information, but to greatly improve the ability of such information to have impact on the solution of many world problems.

This symposium is fortunate to have authors from many parts of the world present papers which provide insight into improved methods of developing information through remote sensing and better applying this information developed by using geographic information systems (GIS). One symposium emphasis is on Thematic Mapper (TM) data, which is a representative of newer, and in many ways improved, data for earth resource analysis. A second symposium theme is on the GIS which is a vital link between remote sensing developed information and its applications. The TM as well as other remotely sensed data, when effectively processed and analyzed using techniques such as those presented in papers throughout this symposium, provide a plethora of information. This information often can best be applied when it is analyzed in conjunction with other sets of information within an effective GIS. Thus, this symposium collectively emphasizes the utility and integration of new sources of remotely sensed data, along with the old within an applications context that increasingly needs to incorporate GIS approaches.

No symposium can be successful without the support of many unselfish interested people and organizations whose time, energy and cooperation is so essential in bringing such a conference to fruition. It is with grateful thanks to the cosponsors, the session chairpersons, the symposium committee and the authors that the chairmen express their gratitude. A special word of thanks is extended to those who have been intimately involved in the preparation of these proceedings; namely Marilyn M. Klepfer, Susan L. Ferringer, Glenda C. Bauer and the symposium coordinator, Douglas B. Morrison.

Paul W. Mausel, Co-Chairman

Paul E. Anuta, Co-Chairman

1984 Symposium

## Symposium Co-Chairmen

Paul E. Anuta

Paul E. Anuta is Associate Program Leader for Data Handling Research at the Laboratory for Applications of Remote Sensing (LARS) at Purdue University. He received a B.S. in electrical engineering from Purdue University in 1957, M.S.E.E. from the University of Connecticut in 1962, M.S. in Computer Science from Purdue in 1967, and is a doctoral candidate at Purdue. Mr. Anuta joined the LARS staff in 1967 and has researched data handling systems for a multispectral aircraft scanner system, interferometer spectrometer, and other sensors. He is responsible for research and evaluation of remote sensor data preprocessing techniques. Key data handling research areas are image registration, geometric correction, and resolution enhancement of satellite multispectral imagery. His current interests are in the area of multitype data integration and preprocessing and analysis methods. He is a member of Tau Beta Pi, Eta Kappa Nu, the Institute of Electrical and Electronics Engineers, and the American Society of Photogrammetry.

Paul W. Mausel

Dr. Paul W. Mausel is a professor of geography and director of the ISU Remote Sensing Laboratory (ISURSL) at Indiana State University in Terre Haute, Indiana. He received a B.A. (geography and chemistry) and an M.A. (geography) from the University of Minnesota and a Ph.D. (geography) from the University of North Carolina. Post graduate work in remote sensing has been conducted at LARS/Purdue University and the ITC/The Netherlands. He has published more than 50 articles and has five chapters in books in his area of expertise which focuses on remote sensing applications in land use, technology transfer and soils. Development and evaluation of non-parametric approaches to multispectral analysis has been a major interest of Dr. Mausel and numerous ISURSL colleagues. He has served two years as national chairperson of the Remote Sensing Specialty Group of the Association of American Geographers.

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# Opening Plenary:

## Thematic Mapper Data Utilization and Geographic Information Systems

SESSION CHAIRMAN: Paul E. Anuta

Paul E. Anuta is Associate Program Leader for Data Handling Research at the Laboratory for Applications of Remote Sensing (LARS) at Purdue University. He received a B.S. in electrical engineering from Purdue University in 1957, M.S.E.E. from the University of Connecticut in 1962, M.S. in Computer Science from Purdue in 1967, and is a doctoral candidate at Purdue. Mr. Anuta joined the LARS staff in 1967 and has researched data handling systems for a multispectral aircraft scanner system, interferometer spectrometer, and other sensors. He is responsible for research and evaluation of remote sensing data preprocessing techniques. Key data handling research areas are image registration, geometric correction, and resolution enhancement of satellite multispectral imagery. His current interests are in the area of multitype data integration and preprocessing and analysis methods. He is a member of Tau Beta Pi, Eta Kappa Nu, the Institute of Electrical and Electronics Engineers, and the American Society of Photogrammetry.



# 1

## TM Data Quality Analysis

SESSION CHAIRMAN: William A. Malila

William A. Malila was born in Kalamazoo, MI. He received BS and MS degrees in Electrical Engineering from Michigan State University, E. Lansing, MI, and Stanford University, Stanford, CA, in 1956 and 1960, respectively. His Ph.D. degree in Forestry, with a remote sensing concentration, was received from the University of Michigan, Ann Arbor, MI in 1974. Since 1960 when he joined the technical staff of the Environmental Research Institute of Michigan (ERIM) (then the Willow Run Laboratories of the U of M), Ann Arbor, MI, he has been active in the development and testing of techniques for extracting information from remotely sensed data, especially multispectral scanner data, and the use of models and system analysis for better understanding phenomenology and interactions. He has participated in technical research and management of NASA-sponsored supporting research activities for projects such as LACIE and AgRISTARS, and has been an Investigator on Landsat and Skylab investigations.

## 2

# Trends in Geobotanical Remote Sensing

SESSION CO-CHAIRMAN: Kamlesh Lulla

Dr. Kamlesh Lulla is Assistant Director of Indiana State University Remote Sensing Laboratory and Assistant Professor of Remote Sensing and Physical Geography. Dr. Lulla received his B.Sc. (Hons) and M.Sc. (Hons) degrees in Ecology and Environmental Sciences. He obtained his first Ph.D. degree in Applied Ecosystem Ecology and his second Ph.D. degree in Remote Sensing and Physical Geography. Dr. Lulla has held postdoctoral positions in Europe, India, and the United States. He is author of four chapters in Remote Sensing text books and over thirty-five papers in reputed journals. He is an active member of ASP, AAG and NCGE.

SESSION CO-CHAIRMAN: Anthony R. Barringer

Dr. Barringer obtained a Ph.D. degree in Economic Geology from Imperial College in 1954. He emigrated to Canada and worked as a geologist for Selco Exploration Company Limited. In 1957 he invented the INPUT<sup>R</sup> airborne electromagnetic prospecting system (INDuces PULse Transient) which eventually became the subject of patents in 19 countries. In 1961, the majority of the Airborne and Technical Services Division of Selco Exploration became Barringer Research Limited. Since that time 20 major ore deposits have been discovered with the system. During the years since formation of Barringer Research (the parent company has now been renamed Barringer Resources, Inc.), Dr. Barringer has been awarded more than 40 U.S. issued patents and more than 200 patents worldwide. Dr. Barringer's patents were used in the first NASA shuttle flight to carry experiments and the equipment was constructed jointly by Barringer Research and TRW Incorporated.

# 3

## **Vegetative Cover Analysis Via Remote Sensing (Part 1)**

SESSION CHAIRMAN: Samuel N. Goward


Samuel N. Goward is currently on the faculty of the Geography Department, University of Maryland-College Park. His primary interest in remotely sensed observations is extraction of land physical measurements. He is principal investigator of a cooperative research program between the Earth Resources Branch, NASA Goddard Space Flight Center and the University of Maryland Geography Department. Current research emphasis is on analysis of land vegetative conditions as a factor in global habitability. Dr. Goward received his Ph.D. from the Department of Geography and Geology, Indiana State University in 1979. He served as acting director of the Indiana State University Remote Sensing Laboratory (ISURSL) in 1978. From 1978 to 1983 he was research associate with the Department of Geography, Columbia University where he was co-principal investigator on research activities conducted with NASA scientists at the Goddard Institute for Space Studies. During that time he contributed to the NASA AgRISTARS program and simulation studies in support of the Landsat Thematic Mapper sensor. Dr. Goward has participated in a number of remote sensing education programs including serving as a course director for NSF Chautauqua Short Courses on Remote Sensing of the Earth. He is currently a director of the Association of American Geographers Remote Sensing Specialty Group and a member of the Remote Sensing Committee, National Council of Geographic Education.

# 4

## Application of Remote Sensing for Land Cover/Land Use Evaluation

SESSION CHAIRMAN: John R. Jensen

Dr. Jensen received his Ph.D. in geography specializing in remote sensing and analytical cartography from the University of California at Los Angeles (UCLA) in 1976. He is the Director of the Remote Sensing Laboratory at the University of South Carolina. His research interests include the analysis of spectral reflectance characteristics of various biophysical materials and the development and evaluation of image processing techniques applied to remote sensor data. He is the Author-Editor of Chapter 30: Urban/Suburban Land Use Analysis in the Manual of Remote Sensing.



# Poster Sessions

SESSION CHAIRMAN: Douglas B. Morrison

Douglas B. Morrison received his B.S. degree from Montana State University and his M.A. in Speech from the University of Washington, following three years in the service with the Air Corps as a navigator. Additional graduate work was taken at Northwestern University and Purdue University. After several years of personnel work with industry, Doug returned to education in 1969 at Purdue University. He began at LARS in June of 1974 with the new (at that time) Technology Transfer Program Area and has been Training Coordinator under that program since then.

# 5

## GIS Characteristics, Needs and Applications

SESSION CHAIRMAN: John E. Estes

Dr. John E. Estes is a Professor of Geography, University of California, Santa Barbara. Dr. Estes has published widely in the remote sensing literature and is the Volume Editor of the Applications Volume (II) of the Second Edition of the Manual of Remote Sensing. Dr. Estes has also authored a number of articles on remote sensing and geographic information systems and headed a recent NASA science working group conducting a study of the need for a pilot land data system. Dr. Estes is a member of the National Academy of Sciences (NAS) Committee on Planetary Biology and that committee's representative on NAS's Committee on Data Management and Computation.







# 6

## TM Applications to Physical Components of the Environment

SESSION CHAIRMAN: Jeff Dozier

Jeff Dozier is Associate Professor of Geography and Director of the Computer Systems Laboratory at the University of California, Santa Barbara. His research interests are in snow hydrology, remote sensing, atmospheric radiation, and computer software development. He received his Ph.D. from the University of Michigan in 1973.



# 7

## Pre-Processing and Analysis Techniques (Part 1)

SESSION CHAIRMAN: Richard S. Latty

Richard Latty is presently a Faculty Research Assistant in the Department of Civil Engineering at the University of Maryland under support from the Earth Resources Branch, NASA/Goddard Space Flight Center. After receiving his B.S. in Range Ecology at the University of Florida in 1976 he worked as a field biologist and consultant in Honduras and conducted research under the NSF in algaculture at the University of Florida. After receiving his M.S. in forestry and Remote Sensing at Purdue University in 1980 he worked in image processing at NASA/Ames Research Center. He is continuing work in satellite sensor system simulation and evaluation, scan angle dependent sources of signal amplitude variation, and information extraction algorithms designed for high spatial resolution sensor systems. He is a member of Xi Sigma Pi, Sigma Xi, Gamma Sigma Delta, Sigma Tau Sigma, American Society of Photogrammetrists, Classification Society, and is among "Who's Who in the West," and "Who's Who in the Midwest."

# 8

## **Vegetative Characteristics Estimation**

SESSION CHAIRMAN: R. B. MacDonald

Robert B. MacDonald attended Antioch College prior to participating in the Korean War. He studied mathematics and physics at Miami University in Ohio and electrical engineering at Purdue University, graduating with honors in 1958. He was elected to Tau Beta Pi and Eta Kappa Nu. He joined the Advanced Systems Research group of IBM's Federal Systems Division in 1958. He participated in research of the uses of remote sensing from space for Earth observations. His activities were instrumental in the establishment of the Laboratory for Agricultural Remote Sensing at Purdue University in 1965. He joined the Purdue Research staff in 1966 to assist in the initial development of the Laboratory and went on to serve as its Technical Director until 1971 when he joined the research staff at NASA's Space Center in Houston, Texas. At the Space Center he has served as Chief Scientist for the early Earth Resources Technology Satellite investigations, Chief of the Earth Observations Division, and as the Director of the Large Area Crop Inventory Experiment for NASA, the USDA and NOAA. In 1978, he became Chief Scientist for Earth Resources at Houston where he developed and successfully promoted a program of more fundamental research in remote sensing within NASA. In 1981, he was made Chief of the Earth Resources Research Division. The Division was responsible for conducting both fundamental research and developing and carrying out the Supporting Research Project of AgRISTARS. In 1983, he was made Assistant Director and Chief Scientist for Earth Systems Sciences within the Space and Life Sciences Directorate. He is also co-principal investigator of a research project at Houston dealing with the estimation of biophysical parameters of vegetative species from spectral measurements.

# 9

## **Vegetative Cover Analysis Via Remote Sensing (Part 2)**

SESSION CHAIRMAN: Paul W. Mausel

Dr. Paul W. Mausel is a professor of geography and Director of the ISU Remote Sensing Laboratory (ISURSL) at Indiana State University in Terre Haute, Indiana. He received a B.A. (geography and chemistry) and an M.A. (geography) from the University of Minnesota and a Ph.D. (geography) from the University of North Carolina. Post graduate work in remote sensing has been conducted at LARS/Purdue University and the ITC/The Netherlands. He has published more than 50 articles and has five chapters in books in his area of expertise which focuses on remote sensing applications in land use, technology transfer and soils. Development and evaluation of non-parametric approaches to multispectral analysis has been a major interest of Dr. Mausel and numerous ISURSL colleagues. He has served two years as national chairperson of the Remote Sensing Specialty Group of the Association of American Geographers and is currently Co-Chairman of the Tenth International Symposium on Machine Processing of Remotely Sensed Data.

# 10

## Pre-Processing and Analysis Techniques (Part 2)

SESSION CHAIRMAN: Paul E. Anuta

Paul E. Anuta is Associate Program Leader for Data Handling Research at the Laboratory for the Applications of Remote Sensing (LARS) at Purdue University. He received a B.S. in electrical engineering from Purdue University in 1957 M.S.E.E. from the University of Connecticut in 1962, M.S. in Computer Science from Purdue in 1967, and is a doctoral candidate at Purdue. Mr. Anuta joined the LARS staff in 1967 and has researched data handling systems for a multispectral aircraft scanner system, interferometer spectrometer, and other sensors. He is responsible for research and evaluation of remote sensor data preprocessing techniques. Key data handling research areas are image registration, geometric correction, and resolution enhancement imagery. His current interests are in the area of multitype data integration and preprocessing and analysis methods. He is a member of Tau Beta Pi, Eta Kappa Nu, the Institute of Electrical and Electronics Engineers, and the American Society of Photogrammetry.



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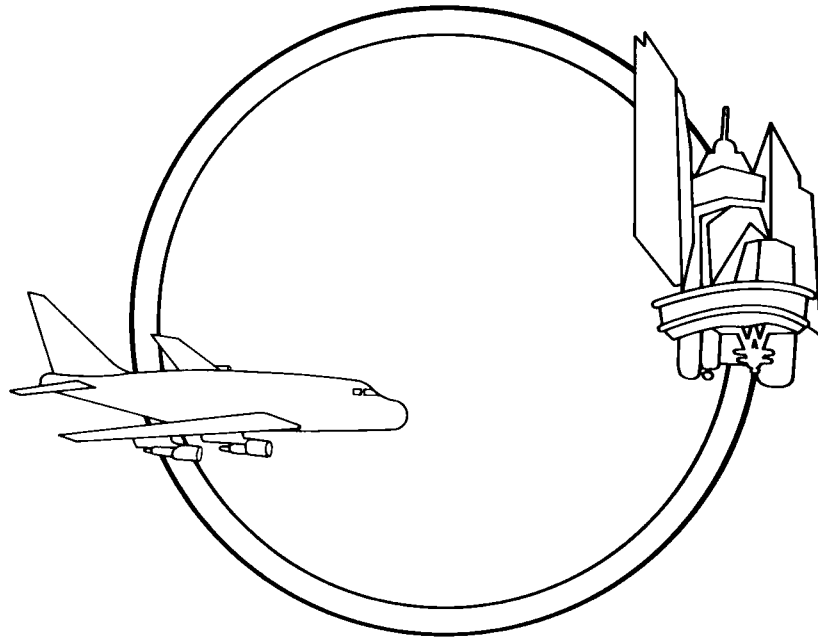
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