

POSTER SESSION

Tuesday, May 5, 6:00-7:30 p.m.

CHAIRPERSON: WILLIAM H. ANDERSON

- A. Acosta, U.S. Geological Survey  
A Color Communication Scheme for Digital Imagery
- M. S. Akhavi and W. P. Jones, Nova Scotia College of Geographic Sciences  
Utilization of a Multilayer Database for Geological Mapping and  
Exploration in Eastern Nova Scotia
- M. Brennan, R. Colomb, J. Gundy, and J. Hammack, Defense Mapping Agency  
Image Map Production Using Landsat Thematic Mapper Data on an Interactive  
Digital Image Manipulation System (IDIMS)
- P. S. Chavez, Jr., J. A. McSweeney, and D. R. Binnie, U.S. Geological Survey  
Digital Processing Techniques and Film Density Calibration for Printing  
Image Data
- R. L. Chilson and W. Hein, South Dakota State University, J. Tunheim, Eastern  
Washington University  
Use of Satellite Thermal Infrared Telemetry in Soil Moisture and Rainfall  
Mapping
- W. J. Cox and C. Lucas, Autometric Inc.  
Spatial and Digital Correlation of Multisensor Data Using the NASA Large  
Format Camera
- J. D'Aguanno and R. M. Carey, NOAA/NESDIS  
The Use of AVHRR Data for Developing and Validating a Microwave Sea Ice  
Concentration Algorithm
- V. P. D'Costa, University of Nairobi, C. J. Johannsen and M. F. Baumgardner,  
Purdue University  
Using Landsat TM Data as an Aid for Detailed Soil Survey in Kenya
- O. P. Dubey, University of Roorkee, India  
Remotely Sensed Data Model for Sediment Yield
- O. P. Dubey, Srinivas, and A. K. Awasthi, University of Roorkee, India  
Modelling with Remote Sensing Data for Efficient Ground Water Management
- T. R. Feagan and R. A. McKinley, TGS Technology, Inc., T. C. English and  
W. J. Bonner, Jr., Bureau of Indian Affairs, R. H. Haas, TGS Technology, Inc.  
BIA Image Interpretation Techniques for Vegetation Mapping Using Thematic  
Mapper False Color Composites
- J. W. Feuquay, TGS Technology, Inc.  
Data Integration Using Color Space Transforms

- J. J. Fisher and R. K. Frohlich, University of Rhode Island  
Hydrologic Lineament Mapping of Crystalline Bedrock Fracture Zones Using Landsat and SLAR Imagery with Geophysical Confirmation
- K. Fitzpatrick-Lins and E. F. Doughty, U.S. Geological Survey, M. Shasby, T. R. Loveland, and S. Benjamin, TGS Technology, Inc.  
Producing Alaska Interim Land Cover Maps from Landsat Digital and Ancillary Data
- K. P. Gallo and J. D. Tarpley, NOAA/NESDIS, S. M. Howard, TGS Technology, Inc., D. G. Moore, U.S. Geological Survey  
A Joint NOAA-USGS Study to Evaluate Satellite Assessment of Land Surface Features and Climatic Variables
- L. W. Gatto, S. F. Daly, and K. L. Carey, CRREL  
River Ice Mapping with Landsat and Video Imagery
- F. J. Gunther, Computer Sciences Corporation  
Using a Microcomputer to Plot Landsat and SPOT Scene Boundaries as a Purchasing Aid
- R. C. Hale and M. B. Yost, U.S. Department of Agriculture  
The Future of Remote Sensing in U.S. Crop Estimating Programs
- S. M. Howard, TGS Technology, Inc., D. G. Moore, U.S. Geological Survey, T. R. Loveland and D. O. Ohlen, TGS Technology, Inc., K. P. Gallo, NOAA/NESDIS, J. Olsson, U.S. Agency for International Development  
A Conceptual Method for Monitoring Locust Habitat
- S. Langaas, University of Oslo  
Weather Satellites for Forest Monitoring? A Test of NOAA NDVI in the Sudan and Guinea Zones of Sub-Sahara West-Africa
- R. G. Lathrop, Jr., T. M. Lillesand, and B. S. Yandell, University of Wisconsin  
An Evaluation of Thematic Mapper Data for Forest Cover Mapping in Northern Wisconsin
- K. Lee, G. B. Lee, and E. J. Tyler, University of Wisconsin  
Investigation of Soil Feature Extraction Methods from Thematic Mapper Data in Southern Wisconsin
- R. Ludwig and R. Kumar, Science Applications Research  
Landsat Thematic Mapper World Data Base
- R. Ludwig and R. Kumar, Science Applications Research  
Temporal Cloud Cover Maps of Landsat Thematic Mapper Data Acquisitions
- E. A. Martinko, L. T. McKinney, and L. M. Caron, University of Kansas  
The Evaluation and Modeling of Pronghorn Antelope Habitat in Kansas
- D. J. Meyer, TGS Technology, Inc.  
Image Restoration Techniques as Applied to Landsat MSS and TM Data

- J. Muskat, The Earth Technology Corporation  
Geologic Interpretations of Seasat-A Radar Images of a Portion of the Southern Appalachian Plateau: Virginia, Kentucky, West Virginia
- A. A. Navarro, Gabun-Paracale Mining Co., Inc.  
Remote Sensing Technology as Used in Regional Geological Reconnaissance of the Gabun-Paracale Mining Project
- M. D. Nellis, Kansas State University  
A Remote Sensing Approach for Predicting Water Demand in Irrigated Areas of Western Kansas
- D. M. Nelson, TGS Technology, Inc.  
Testing of Thematic Mapper Color Photographic Enhancements  
(Abstract not available)
- F. K. Odoom, Zimbabwe Forestry Commission  
Remote Sensing of Natural Resources in Zimbabwe: Woodland Cover Monitoring in the Communal Lands
- J. C. Ruth, System International  
Global Visions in a Flat World: Streamlining Local Permits and Watershed Analysis with Multi-layered Image Based Resource Information
- L. A. Salazar, U.S. Forest Service  
Use of Automated Spatial Data Systems in Fuel Management Decisionmaking
- K. Sarkar, S. M. Dutta, and A. M. Rakshit, Geological Survey of India  
Study of Dynamic Geomorphology Based on Image Interpretation and Morphometry for a Part of Precambrian Terrain, M.P., India
- K. B. Teuber, U.S. Forest Service  
Use of Landsat Thematic Mapper Data for Classification of Forest Lands in Northern Louisiana
- J. P. Verdin, Bureau of Reclamation, L. L. Sims, Advanced Sciences Incorporated, D. L. Galat, Arizona State University  
Processing of Archival Landsat Imagery to Document Pyramid Lake Algae Blooms
- H. W. Warriner, NOAA/NESDIS  
Status of the Worldwide Landsat Archive, 1986

## A COLOR COMMUNICATION SCHEME FOR DIGITAL IMAGERY

By A. Acosta

### ABSTRACT

Color pictures generated from digital images are frequently used by geologists, foresters, range managers, and others. These color products are preferred over black and white pictures because the human visual system is more sensitive to color differences than to various shades of grey. Colors in these presentations are generally described subjectively because color is a function of perception, which can lead to ambiguous color communication. Numerous color coordination systems are available that quantitatively relate digital triplets representing amounts of red, green, and blue to the human perception parameters of hue, saturation, and intensity. Most of these systems implement a complex transformation of the primary colors to a color space that is difficult to visualize, thus making it difficult to relate digital triplets to perception parameters. This paper presents a color communication scheme that unifies hue and saturation with digital chromaticity coordinates through a chromaticity triangle. The scheme simplifies the relation between digital triplets and perception parameters. Some examples using the color communication scheme in digital image processing are presented.

UTILIZATION OF A MULTILAYER DATABASE FOR GEOLOGICAL  
MAPPING AND EXPLORATION IN EASTERN NOVA SCOTIA

By M. S. Akhavi and W. P. Jones

ABSTRACT

Transfer of geologic data and superimpositioning of Landsat imagery and digital airborne gamma-ray spectrometric data was conducted to extract useful geologic information related to exploration targets and to detect geologic associations suitable for mineral emplacement. Thus, a multilayer database was created. Three radioelements: equivalent Uranium (eu), equivalent Thorium (eTh) and percent Potassium (%K) as well as U/Th, U/K and Th/K and total gamma contents constituted the digital airborne geophysical data. MSS and TM Landsat coverage constituted the spaceborne imagery utilized in this database. Conventional geologic data were digitized and transferred as guidelines on the database using the ARC/INFO Geographic Information Systems.

Three major plutonic bodies located in eastern Nova Scotia were selected as test sites to examine the utility of such a database in humid, heavily vegetated regions. The integration technique permitted the extraction of spectral relationships controlled by the existing geology of the region, detection of plutonic phases, and the delineation of lineament distribution. Exploration target areas were selected on the basis of the detection of above-threshold values for the equivalent Uranium, equivalent Thorium ratio, as well as the intersection of lineaments and other geologic characteristics. These localities are suitable for mineral emplacement and warrant systematic field investigation including geologic, geophysical, and geochemical analysis.

IMAGE MAP PRODUCTION USING LANDSAT THEMATIC MAPPER DATA  
ON AN INTERACTIVE DIGITAL IMAGE MANIPULATION SYSTEM (IDIMS)

By M. Brennan, R. Colomb, J. Gundy, and J. Hammack

ABSTRACT

A 1:100,000 scale image map of Ft. Irwin, California, was generated by processing Landsat Thematic Mapper (TM) data on an Interactive Digital Image Manipulation System (IDIMS). The TM data were resampled from 28.5 meters per pixel to 17 meters per pixel and then registered to a UTM grid. Terrain features were emphasized by processing a combination of bands 1, 4, and 5. A fourth (brightness) band was synthesized using the first principal component of bands 1, 2, 3, 4, 5, and 7 to enhance cartographic information. Principal components analysis was also utilized to develop a technique for recovering information lost in areas obscured by shadows. The four bands (1, 4, 5, and brightness) were used to produce color separates and printed as yellow, magenta, cyan, and black respectively. Printing the brightness band in black enhanced the contrast of the image and produced a red or blue light readable product.

DIGITAL PROCESSING TECHNIQUES AND FILM  
DENSITY CALIBRATION FOR PRINTING IMAGE DATA

By P. S. Chavez, Jr., J. A. McSweeney, and D. R. Binnie

ABSTRACT

Satellite image data that cover a wide range of environments are processed to create map-like products. The digital image data used to generate the image map products usually have several image processing algorithms applied to the data. This image processing includes geometric and radiometric corrections as well as various enhancement techniques. The majority of the image products generated for visual analysis are printed using photographic materials. However, if a large number of prints are required for wider distribution, it is more efficient to generate the final copies in lithographic form. Several such image maps have been produced by the U.S. Geological Survey and more are currently being made.

The image processing algorithms that are used on the digital data can vary from product to product. One particular image processing technique that has been useful is spatial filtering. It can be used in standard edge enhancements or to suppress high contrast within an image to enhance local detail in dark and bright areas, while retaining most of the color information. Another important processing algorithm is the contrast stretch. Several different contrast stretching algorithms can be used depending on the information of interest and the type of scene being processed.

A question often encountered when generating products of image maps is: "Are the image processing algorithms that are required for lithographic prints different from those required for photographic prints?" The digital image processing steps required for a good lithographic print and a good photographic print are identical except for the contrast stretch, which affects the density range and density curve on the hard-copy film transparency. During the final stage of film generation, where the digital data are usually contrast stretched, it is critical that the amount of contrast generated on the output film be based on whether the film will be used for lithographic or photographic printing.

The advantages and disadvantages of the digital processing steps and modification of the reproduction density curves for lithography will be discussed.

USE OF SATELLITE THERMAL INFRARED TELEMETRY  
IN SOIL MOISTURE AND RAINFALL MAPPING

By R. L. Chilson, W. Hein, and J. Tunheim

ABSTRACT

An image from the NOAA 6 satellite on July 6, 1981, was used in determining statistical equations for detection of soil moisture and rainfall in South Dakota. The data was gathered from the satellite's infrared, near infrared, and red image bands, together with ground gathered conditions of air temperature, cropland use intensity, solar exposure, and solar orientation. Ground truth data for soil moistures at 0-1 and 1-6 inch depths at 99 sites, in addition to approximately 1,300 daily rainfall reporting sites were used. The data was put into satellite imagery form consisting of 192,000 elements by generating images from non-satellite data, whereas temperature and normalized difference values were calculated from the satellite images. These images then were combined to compose a data set for each element, and a reduced data set was made by subdividing the state into 71 averaged areas. The data base was then analyzed by a number of statistical analysis routines to determine equations for prediction of rainfall and soil moisture levels. The resulting equations for this particular day yielded an  $r^2$  value of 0.57 for the rainfall model, and 0.5 and 0.79 respectively for surface and near surface moisture models. The reduced data yielded somewhat better results. The resulting equations used only normalized difference and satellite measured temperatures as independent variables in all models.

SPATIAL AND DIGITAL CORRELATION OF MULTISENSOR DATA  
USING THE NASA LARGE FORMAT CAMERA

By W. J. Cox and C. Lucas

ABSTRACT

In the 1990's multisensor platforms will be operated by many countries, collecting a variety of useful environmental information in both image and non-image formats, and at a variety of scales, resolutions, and sensor-to-target look angles. By combining multisensor data, the resulting information is often superior to that provided by individual sensors.

To date, our investigations have revealed that high resolution stereoscopic optical imagery provides the best spatial base for precise superpositioning of multisensor data. Digital collection of requisite high resolution imagery will compete with numerous other sensor for limited data transmission and handling channels. The best solution to this problem is provided by NASA's Large Format Camera. A mapping camera, the LFC has a high degree of geometric fidelity, with complementary spatial resolutions of 10 meters. Since the information is collected on film, digital data handling channels are conserved; and, film provides an easily transportable high-density data storage medium, readily transferable by high-speed optical digitizers to optical disc.

This paper demonstrates precise superpositioning of Airborne Imaging Spectrometer II (AIS-II), 8-channel multispectral scanner data, and aerial photography to an LFC image. Results are compared to those obtained with available maps scaled 1:100,000. Similar approaches for superpositioning and correlation of other multisensor imagery and data are discussed.

THE USE OF AVHRR DATA FOR DEVELOPING AND VALIDATING  
A MICROWAVE SEA ICE CONCENTRATION ALGORITHM

By J. D'Aguanno and R. M. Carey

ABSTRACT

High resolution (1 km) AVHRR digital image data is being used to develop and validate a method for estimating fractional sea ice cover from passive microwave sensors such as the Scanning Multichannel Microwave Radiometer (SMMR). Mean brightness values from visible and thermal infrared AVHRR data are used to estimate sea ice concentrations and then compared with co-located SMMR targets. The relationship of the derived AVHRR ice concentration with the corresponding microwave brightness temperature may be used to estimate typical microwave response to conditions varying from pack ice to open water. This report will present preliminary findings for determining ice concentrations in the Bellingshausen Sea in Antarctica.

USING LANDSAT TM DATA AS AN AID FOR  
DETAILED SOIL SURVEY IN KENYA

By V. P. D'Costa, C. J. Johannsen, and M. F. Baumgardner

ABSTRACT

This is a report of the assessment of the use of Landsat TM data as an aid for detailed soil survey in Kenya. Digital image processing of TM data was used to produce maps representing spectral characteristics of the soils of the study area in Kenya, lying between latitudes 0°45'N and 0°30'S and longitudes 34°50'E and 36°30'E. The area represents a wide diversity of parent materials, climatic zones, altitudes, and vegetation.

Spectral maps were produced at scales ranging from 1:5,000 to 1:100,000. This approach followed the experience gained by soil scientists who analyzed Landsat MSS data to produce a spectral classification of soil characteristics at a scale of 1:15,840 for use in the detailed soil survey of Jasper County, Indiana, USA.

Data analyzed included TM data and existing soils, topographic and geologic maps. A parent material map was produced by visual interpretation of TM data and field confirmation. These maps were digitized, geometrically corrected where necessary, adjusted to an appropriate scale and entered into a georeferenced database.

From the database the following were produced: a land use/cover map (1:10,000), spectral maps delineating soils differences (1:5,000 - 1:100,000), and a variety of interpretive maps.

## REMOTELY SENSED DATA MODEL FOR SEDIMENT YIELD

By O. P. Dubey

### ABSTRACT

Resounding impact of industrial and technological age in the developing country like India and ability to generate a high and constantly growing gross national product and optimal management of resources, to uplift social condition of living, soil is sine quanon of human resources and environment for survival. However, it is a most unstable resource. Erosion not only destroys crops but also makes the land less suitable for crops. Drainage, irrigation ditches, and canals quickly silt up. Stream channels clog and soon swamp productive farm land. The result is that more and more farm land is abandoned. Erosion also affects city dwellers directly. Storage capacity of water supply reservoir is reduced due to siltation. Filtration of muddy water of silted reservoirs make water treatment costly. Due to depleted capacity of reservoirs, hydroelectric power production falls. Flood prevention reservoir too become victims of sedimentation.

Every effort has to be made to control soil erosion and delineate erosion prone areas. Various developed techniques are available for this purpose but they are hazardous and time consuming, providing information with time lag as such they are inefficient. As such, some indirect methods have to be developed. Remote sensing techniques provide data for resource evaluation in near real time (NRT).

The Himalayas are largely predominated by steep slopes, cliffs culminating into bare or plant covered peaks and ridges on one hand and ending into narrow valleys and snow covered mountains and glaciers on the other hand. Due to steep slopes, geology and other climatic factors, soil erosion in Himalayan rivers is considerably higher than non-Himalayan river. In the present paper digital analysis of remote sensing data has been carried out to delineate erosion prone areas and sediment yield on the basis of geology, slope and land use. Recommendations have been made for soil conservation practices to be adopted. The results of study are very encouraging. The methodology proposed can be suitably used for erosion studies, to predict soil loss, etc. in ungaged watersheds so that developmental activities can be optimally planned.

MODELLING WITH REMOTE SENSING DATA FOR  
EFFICIENT GROUND WATER MANAGEMENT

By O. P. Dubey, Srinivas, and A. K. Awasthi

ABSTRACT

Mathematical models of ground water basins and aquifers are used invariably for solving hydrologic problems. However, for a geologically and hydrologically complex area having large areal extent simplified mathematical equations are inadequate. Recent advent of fast electronic computers have made the large computations manageable and thus optimized solutions of various technical problems can be obtained by providing adequate data. The value of a model can be visualized only after the existing hydrological conditions have been properly simulated. It is then possible to impose additional conditions on the models such as increased/redistributed pumping increased/decreased recharge due to changes in land use, etc. The imposition of these conditions is essential for efficient modelling as they are capable of changing the existing hydrologic conditions.

Ground water basins may undergo changes due to natural and man-made disturbances. Most of the disturbances are not planned but influence the hydrologic cycle, thus necessitating improvement in the model, knowing the probable effect. The purpose of modelling is not just to predict but to compare possible alternative actions for most efficient results. The efficiency of results can be compared combination of these aspects.

In considering the overall hydrology of large areas, certain internal details can often be neglected for a basin, such as the thickness and internal extent, variation in rock/soil properties, topography, and geologic history.

BIA IMAGE INTERPRETATION TECHNIQUES FOR VEGETATION MAPPING  
USING THEMATIC MAPPER FALSE COLOR COMPOSITES

By T. R. Feagan, R. A. McKinley, T. C. English,  
W. J. Bonner, Jr., and R. H. Haas

ABSTRACT

The Bureau of Indian Affairs (BIA) is responsible for the natural resource management of approximately 52 million acres of Trust Lands in the contiguous United States. The lands are distributed in a "patchwork" fashion throughout the country. Management responsibilities on these areas include: minerals, range, timber, agricultural, cultural, and archeological resources.

BIA has adopted a "systems approach" to natural resource management which utilizes Geographic Information System (GIS) technology. The GIS encompasses a continuum of spatial and relational data elements, and includes functional capabilities such as: data collection, data entry, data base development, data analysis, data base management, display, and report generation. In support of data base development activities, BIA and BLM/TGS conducted a cooperative effort to investigate the potential of 1:100,000 scale Thematic Mapper (TM) False Color Composites (FCC's) for providing vegetation information suitable for input to the GIS.

The poster outlines an approach which includes the manual interpretation of landcover using TM FCC's, the digitizing of interpreted polygons, and the editing of digital data, based upon ground truthing exercises. An efficient and cost-effective methodology for generating large area landcover information is illustrated using the San Carlos Indian Reservation in Arizona. Techniques which capitalize on the knowledge of the local natural resource professionals, while minimizing machine processing requirements, are suggested.

## DATA INTEGRATION USING COLOR SPACE TRANSFORMS

By J. W. Feuquay

### ABSTRACT

The demand for increased spatial resolution without sacrificing spectral discrimination can be fulfilled by integration of data from different sensor systems and satellite programs. Data of higher spatial resolution are frequently available in panchromatic (black-and-white) form rather than multispectral. Techniques have been developed to combine the higher resolution panchromatic data with a multispectral data set of lower spatial resolution.

The standard method of integration modulates the intensity of the multispectral with the panchromatic data. A less subjective approach uses an algorithm that describes color in terms of intensity (I), hue (H), and saturation (S).

Combinations of high-resolution panchromatic data (SPOT panchromatic) and lower resolution multispectral data (Landsat Thematic Mapper [TM] SPOT XS) have been developed. The SPOT data were acquired on April 3, 1986, and the Landsat TM data were acquired on April 5, 1986. The data sets were registered to each other, and the multispectral data sets were contrast enhanced. The enhanced multispectral data sets were then transformed from red/green/blue (RGB) color space into IHS space. In each case (TM/SPOT panchromatic and SPOT XS/SPOT panchromatic), the SPOT panchromatic data were remapped on a cumulative histogram percentage basis to match the multispectral "I" data. These remapped SPOT panchromatic data were substituted for the original multispectral "I" and the hybrid IHS data transformed back into RGB space for display.

While this technique is experimental and still being refined, the results to date indicate that the IHS method will be valuable for generating improved images that effectively present both high-resolution spatial digital data and multispectral data.

HYDROLOGIC LINEAMENT MAPPING OF CRYSTALLINE BEDROCK FRACTURE ZONES  
USING LANDSAT AND SLAR IMAGERY WITH GEOPHYSICAL CONFIRMATION

By J. J. Fisher and R. K. Frohlich

ABSTRACT

An increasingly greater number of future hazardous waste sites are being planned for supposedly impermeable crystalline bedrock. But this can only be recommended if the bedrock is unfractured. Lack of bedrock outcrops of major fracture zones, especially in glaciated regions, will require locating and mapping by remote sensing and geophysical techniques.

Landsat and SLAR imagery were used to map lineaments and "fracture traces" state-wide for Rhode Island and determine their associated hydrologic characteristics. Analysis of different imagery for lineament and hydrological mapping was compared for: Landsat to SLAR, MSS to TM, and summer vs. winter imagery.

Over 150 "1st Order" Landsat (0.5 km or greater) lineaments were mapped ranging in length from 0.5 to 38 kms with 90 percent of these lineaments in crystalline bedrock. These lineaments were found to be related to 446 major surface hydrological features including: linear stream valleys, aligned drainage, elongated lakes, aligned lakes, swamps and wetland.

Geophysical ground magnetic surveys over lineaments confirmed the location and trend of fracture zones mapped by remote sensing. Fracture zones in crystalline rocks show parallel elongated magnetic anomaly lows due to the alteration of magnetic minerals. A possible cause for this alteration is the effect of water that circulates through the fracture system.

PRODUCING ALASKA INTERIM LAND COVER MAPS FROM  
LANDSAT DIGITAL AND ANCILLARY DATA

By K. Fitzpatrick-Lins, E. F. Doughty, M. Shasby,  
T. R. Loveland, and S. Benjamin

ABSTRACT

In 1985 the U.S. Geological Survey initiated a program to produce 1:250,000-scale land cover maps of Alaska using digital Landsat Multispectral Scanner data and ancillary data. The geometrically corrected and resampled Landsat pixel data are registered to a Universal Transverse Mercator (UTM) projection, along with arc-second digital elevation model data used as an aid in the final computer classification. Area summaries of the land cover classes are extracted by merging the Landsat digital classification files with the U.S. Bureau of Land Management's Public Land Survey digital file. Registration of the digital data is verified and control points are identified so that a laser plotter can produce screened film separates for printing the classification data at map scale directly from the digital file.

The final land cover classification is retained both as a color map at 1:250,000 scale registered to the USGS base map with area summaries by township and range on the reverse, and as a digital file referenced to the geographic coordinates of the quadrangle where it may be used as a category in a geographic information system.

A JOINT NOAA-USGS STUDY TO EVALUATE SATELLITE ASSESSMENT OF  
LAND SURFACE FEATURES AND CLIMATIC VARIABLES

By K. P. Gallo, J. D. Tarpley, S. M. Howard, and D. G. Moore

ABSTRACT

Data collection and preliminary analyses have begun for a study that will evaluate the usefulness of satellite data for assessment of land surface features and climatic variables. The objective of this study is to determine if relationships can be developed between routinely available ground-based quantities, and satellite obtained information. The study area includes the Great Plains region (29° to 49°N and approximately 91° to 109°W) of the United States. Satellite data include daily and weekly composites of global area coverage data from the Advanced Very High Resolution Radiometer on the NOAA-9 satellite. The satellite data includes visible, as well as near- and thermal-infrared wavebands. Ground-based information includes daily and weekly weather and climatic variables. Daily information includes air temperature, dew point temperature, wind speed, and cloud cover. Weekly variables include mean temperature, total precipitation, and a crop moisture index for climatic regions. Geographic information for the area includes political, topographic, climatic, and land resource data bases that will be used to stratify the satellite and ground-based observations. The satellite and ground-based data sets are expected to contribute to the overall understanding of land surface climatology.

## RIVER ICE MAPPING WITH LANDSAT AND VIDEO IMAGERY

By L. W. Gatto, S. F. Daly, and K. L. Carey

### ABSTRACT

The Corps of Engineers has broad responsibility for providing safe and reliable navigation routes along the Nation's navigable waterways. In the northern United States, ice can delay or stop winter navigation and cause unexpected emergencies. Because of its responsibility, the Corps is investigating structural and operational solutions to ice problems on rivers. As part of this investigation, Landsat imagery and low-altitude video imagery are being used to collect data on past and present ice conditions along the Ohio, Allegheny, Monogahela, Illinois and Mississippi Rivers. The imagery is analyzed using photointerpretation techniques. No special computer enhancements or analytical techniques are used. Landsat imagery was used to map river areas that were ice-free (open water), completely ice-covered and partially ice-covered from 1972 through 1984. The video imagery provides better spatial resolution than the Landsat imagery and river areas with open water, solid ice cover, solid cover with open areas, fragmented cover, fragmented cover with open areas and ice floes or frazil slush and pans were mapped for the 1984-85 and 85-86 winters. Ice conditions on these rivers can change rapidly, often daily and the areal extent of ice is typically greatest from mid-January to early February. In spite of the small scale and limited coverage of Landsat imagery, it is useful for analysis of general river ice conditions especially during severe winters when ice becomes extensive. In addition, Landsat imagery may be the only source of river ice data for many rivers in cold regions. Video imagery proved to be an economical means of documenting rapidly changing river ice conditions, although cloud cover, inclement weather and low ceilings restrict opportunities for more frequent coverage. Videographic techniques also can provide near-real-time data during periods of extreme ice conditions.

USING A MICROCOMPUTER TO PLOT LANDSAT  
AND SPOT SCENE BOUNDARIES AS A PURCHASING AID

By F. J. Gunther

ABSTRACT

The two major suppliers of space-acquired land remotely-sensed data provide their customers with scene data from catalogs of acquired images. However, the scene data is provided in the form of computer printouts with scene-corner coordinates in Latitude and Longitude. The data for the coordinates is formatted in a user-friendly manner, but it is still difficult for the user to decide just how his area of interest and the scenes' areas of coverage correspond. Many users must plot the data by hand to make a decision to buy.

The author has found that the use of a microcomputer with built-in graphics capabilities aids in the recognition of mutual area coverage by scene and search areas. Data is typed in using display prompts and is saved on a disk file; the data may be edited or dumped to a printer. The user may select one scene or a range of scenes to plot. Plots are displayed and may be dumped to the printer.

The software is written in Applesoft BASIC for the Apple-II family of computers. The code is modular and is designed to be easily adapted to other dialects of BASIC on computers with other graphics characteristics.

## THE FUTURE OF REMOTE SENSING IN U.S. CROP ESTIMATING PROGRAMS

By R. C. Hale and M. B. Yost

### ABSTRACT

The National Agricultural Statistics Service (NASS) is principally involved with crop acreage estimation in eight Midwestern states. To improve crop acreage estimates and to expand coverage to more states, NASS is developing new resource effective techniques to streamline processing. The use of desktop computers, more efficient data base management, and better use of field office personnel in digitization and processing are being considered. Data acquisition improvements and the use of TM data is also being considered. This paper will depict the current estimation procedure and the alternate techniques NASS is considering to improve this procedure.

## A CONCEPTUAL METHOD FOR MONITORING LOCUST HABITAT

By S. M. Howard, D. G. Moore, T. R. Loveland,  
D. O. Ohlen, K. P. Gallo, and J. Olsson

### ABSTRACT

A procedure to monitor and produce maps of vegetation conditions in near-real time was developed at the United States Geological Survey's EROS Data Center. For one month, meteorological satellite data were collected daily for a 1.4 million-square-kilometer study area centered on Botswana in southern Africa. Local area coverage Advanced Very High Resolution Radiometer data were referenced to a geographic base, and screened to remove cloud-contaminated data. The normalized difference vegetation index (NDVI) was applied to depict the presence and relative amounts of photo synthetically active (green) vegetation. Over a ten-day cycle, subsequent dates of data were used to fill in data removed by the cloud-screening process. At the end of the ten-day cycle, a vegetation-greenness map and greenness change map were generated using automated map production procedures. In this process, the NDVI image data were merged with cartographic data (boundaries, roads, tic marks) digitized from 1:1,000,000 Operational Navigation Charts. The vegetation greenness map shows the the current distribution of vegetation in the region, which could be used to locate potential locust breeding areas. The change map shows areas where increases and decreases in greenness have occurred. Significant areas of locust damage in remote regions would be characterized on the change map by an unexpected decrease in greenness. These maps could be used by locust control teams to efficiently target areas for reconnaissance. These procedures and output products would have utility for others required to monitor vegetation resources over large regions.

WEATHER SATELLITES FOR FOREST MONITORING?  
A TEST OF NOAA NDVI IN THE SUDAN AND GUINEA ZONES  
OF SUB-SAHARA WEST-AFRICA

By S. Langaas

ABSTRACT

The potential of coarse spatial resolution, high temporal frequency satellite data from the NOAA AVHRR satellite sensor system, for vegetation monitoring has been demonstrated by several authors for grasslands.

Inspired by such works, the aim of this study was to develop a methodology for management-oriented forest resource monitoring in the Sudan and Guinea zones of Sub-Sahara Africa.

A literature review showed inconsistent results concerning changes in forest areas in the study area, The Gambia. This was mainly due to different classification systems employed in the land use surveys and forest inventories. However, the trend clearly showed deforestation in The Gambia, as for the zones in general.

The proposed methodology suggested to measure changes in tree volume for a given area. The methodology coupled the temporal resolution of the NOAA AVHRR sensor system with basic knowledge of the seasonal dynamics of natural vegetation. A required phenological period was determined. AVHRR-derived NDVI data and ground reference data of high quality from 1981 were analysed. Correlation analysis showed that the processed satellite data were poorly correlated with the ground reference data, and consequently not useful for their intended purpose. The main reason for this was considered to be that the savanna and woodland areas studied were too heterogenous (spectrally) for the simple NDVI.

AN EVALUATION OF THEMATIC MAPPER DATA FOR FOREST COVER  
MAPPING IN NORTHERN WISCONSIN

By R. G. Lathrop, Jr., T. M. Lillesand, and B. S. Yandell

ABSTRACT

Though each of the seven Thematic Mapper (TM) bands can potentially contribute to a multispectral land cover classification, there is a redundancy of information due to high interband correlation. The study reported herein investigated feature selection and principal components analysis as they affect classification accuracy of TM data for forest cover mapping under Lake States conditions. In cooperation with the Great Lakes Indian Fish and Wildlife Commission, a study site was selected on the Bad River Indian Reservation near Ashland, Wisconsin. Aerial photo interpretation and ground reconnaissance were used to select training and test site areas. Initially the six reflected energy bands (excluding the thermal-IR, TM6) were classified at three different levels of category aggregation. Selected 3 band combinations, as well as the first 2 and 3 principal components (PC), were also classified at three levels of aggregation. The Kappa statistic was used as a measure of overall classification performance, allowing for tests of statistical difference between two classifications. The results of the accuracy assessment show that the TM3,4,5 combination and the first 3 PC's do not have a statistically significant different accuracy (at 95% CI) than the full 6 band combination.

The conclusion derived from this analysis is that the selection of an optimum 3 band subset of TM data is a viable means of data dimensionality reduction for forest classification (at least under these study conditions). Intuitively, the selected 3 band subset is appealing in that the TM3,4,5 combination represents each of the three major regions of the reflected energy spectrum: red visible (TM3); near-IR (TM4); and, middle-IR (TM5). Further no principal component transformation of the TM data is necessary, obviating additional computer processing time.

INVESTIGATION OF SOIL FEATURE EXTRACTION  
METHODS FROM THEMATIC MAPPER DATA IN SOUTHERN WISCONSIN

By K. Lee, G. B. Lee, and E. J. Tyler

ABSTRACT

Several methods of utilizing the additional soil-sensitive spectral region of Thematic Mapper (TM) data - April and September - were investigated for extracting and discriminating soil characteristics at two topographically different sites in southern Wisconsin. These transformations included: the extraction of the soil brightness image, two types of ratio images - raw ratio and absolute radiance transformation - for enhancing soil information and depressing vegetative noise, the stretching of thermal infrared (IR) band. The TM soil spectral classifications from these transformed images were compared with the rasterized county soil survey map. Because the map units could not be discriminated based on TM classification, they were grouped by drainage class, soil texture and organic matter, defining factors in determining surface soil spectral classes. The comparison results showed the April image was closer to the soil map than the September image. Vegetation cover was the primary reason for difficulty in interpretation. In the flat area, the soil brightness image contributed most to classification accuracy, and the stretched thermal IR image was excellent in discriminating between mineral soils and organic soil. In the hilly terrain, ratio images worked best among TM transformed images, and the digital topographic data were more useful than TM data.

# LANDSAT THEMATIC MAPPER WORLD DATA BASE

By R. Ludwig and R. Kumar

## ABSTRACT

A World Data Base (WDB) of potential Thematic Mapper (TM) scenes was developed to aid in the planning of satellite data acquisition. The World Data Base contains geopolitical, geographic and economic regions along with programs that enable users to find the satellite day, sun elevation angle, sun azimuth angle and cloud cover probability. For a given WRS (World Reference System) path/row, a maximum of seven scenes are selected in the ascending order of percentage of cloud cover up to a maximum of 30 percent. The percentage of cloud cover of each quadrant for these seven scenes is also stored in the WDB.

WDB is an extremely valuable reference because it contains data of over 90,000 radiometrically corrected scenes acquisitions covering populated regions of the world along with other data bases providing Earth related information. WDB consists of approximately 30,000 lines of data having over 300,000 individual entries.

TEMPORAL CLOUD COVER MAPS OF LANDSAT  
THEMATIC MAPPER DATA ACQUISITIONS

By R. Ludwig and R. Kumar

ABSTRACT

Over 90,000 Thematic Mapper (TM) scenes have been acquired by Landsats 4 and 5 and radiometrically corrected since July 1982. Manual, as well as automatic methods have been used to estimate average percentage of cloud cover for each quadrant of a scene. These percentages are then entered, with other scene information into what is referred to as the A-tape catalog. With approximately 3,000 scenes acquired each month, retrieval of cloud cover data from the A-tape catalog printout is tedious at best and for large regions and/or seasonal data, it is nearly impossible. Maps are faster and easier to use than printouts when looking at a very large amount of data. Sixty-seven cloud cover maps were produced representing most of TM data acquisitions of the world from July 1982 to May 1986 using WRS (World Reference System) paths/rows. Each TM scene was divided into four quadrants whose cloud cover was assessed and then averaged. The best (lowest for each scene) percentage cloud cover map for each season of each year was represented by a color code and then entered in its respective map. Each color code denotes a specific range of percentages of cloud cover.

Currently, a software system is being developed to generate the above mentioned cloud cover maps automatically more accurately and efficiently by computer using the World Map generation feature under TEMPLATE graphics software as a base map. Examples of these automatically generated maps will be given in the final manuscript.

THE EVALUATION AND MODELING  
OF PRONGHORN ANTELOPE HABITAT IN KANSAS

By E. A. Martinko, L. T. McKinney, and L. M. Caron

ABSTRACT

The conversion of rangeland to cropland has diminished the size of range available for pronghorn antelope in Kansas. Although size of range is one of the most important habitat parameters that influence the movement of antelope, winter wheat plays a critical role in this movement during the winter and spring. The primary objective of this study is to utilize multispectral, multitemporal, digital classification of Landsat data in the evaluation of known pronghorn antelope habitat and in the development of a model that incorporates spatial data on the juxtaposition and interspersion of habitat parameters. The model is being used in conjunction with ancillary data to portray the relative habitat quality of selected areas from the standpoint of the spatial distribution of resources.

IMAGE RESTORATION TECHNIQUES  
AS APPLIED TO LANDSAT MSS AND TM DATA

By D. J. Meyer

ABSTRACT

Two factors are primarily responsible for the loss of image sharpness in processing digital Landsat images. The first factor is inherent in the data because the sensor's optics and electronics, along with other sensor elements, blur and smear the data. Digital image restoration can be used to reduce this degradation. The second factor, which further degrades by blurring or aliasing, is the resampling performed during geometric correction.

An image restoration procedure, when used in place of typical resampling techniques, reduces sensor degradation without introducing the artifacts associated with resampling.

The EROS Data Center has implemented the restoration procedure for Landsat multispectral scanner (MSS) and Thematic Mapper (TM) data. This capability, developed at the University of Arizona by Dr. Robert Schowengerdt and Lynnette Wood, combines restoration and resampling in a single step to produce geometrically corrected MSS and TM imagery. As with resampling, restoration demands a tradeoff be made between aliasing, which occurs when attempting to extract maximum sharpness from an image, and blurring, which reduces the aliasing problem but sacrifices image sharpness. The restoration procedure used at the EROS Data Center minimizes these artifacts by being adaptive, tailoring the tradeoff to be optimal for individual images.

GEOLOGIC INTERPRETATIONS OF SEASAT-A RADAR IMAGES  
OF A PORTION OF THE SOUTHERN APPALACHIAN PLATEAU:  
VIRGINIA, KENTUCKY, WEST VIRGINIA

By J. Muskat

ABSTRACT

Seasat-A, a NASA oceanographic research satellite acquired high resolution synthetic aperture radar (SAR) images of a portion of the Appalachian Plateau during its brief mission in the summer of 1978. Interpretation maps of surface drainage patterns, surface texture patterns and surface lineament patterns were made from the Seasat-A SAR images of southwestern Virginia, eastern Kentucky, and southwestern West Virginia. These maps are compared with similar data derived from Landsat multispectral scanner (MSS) images of the same area. In regions of low topographic relief the Seasat-A SAR images are superior to the Landsat MSS images for drainage and lineament mapping. This is due to the higher image resolution of the Seasat radar imagery; also the inherent illumination geometry of the Seasat-A SAR provides better detection of subtle topographic features. In areas of high topographic relief, the Seasat-A SAR images are distorted because of the radar layover effect, but still the Seasat-A SAR is as good as the Landsat MSS images for geologic interpretations. Field checking of a prominent lineament located on the Pine Mountain thrust plate of southwestern Virginia has confirmed the existence of a previously unreported fault 16 km long, with both strike-slip and vertical displacement. A previously unmapped thrust fault was also recognized in the field. These two faults are named herein. The thrust fault shows 30 m of stratigraphic throw.

REMOTE SENSING TECHNOLOGY AS USED IN REGIONAL GEOLOGICAL  
RECONNAISSANCE OF THE GABUN-PARACALE MINING PROJECT

By A. A. Navarro

ABSTRACT

The technological aspects of remote sensing in this modern twentieth-century usage is based on large-scale mapping of regionalized mining areas to complimentize developmental goals of mining districts; both the remote sensing and photogrammetrist and geologist has profited from aerial and satellite photographs, especially the varied anomalies, contours or fault lineaments of mining regions and designs in computer mappings of the Gabun-Paracale Mining Project.

In our own remote sensing and photogrammetric engineering division, we have computer designated a geological plan by Landsat 5 TM/MSS mapping. This is thematic mapping based on regionalized mining areas, through multispectral analysis of ground truth as relational to flight truth data and satellite truth data.

This is then correlated through geological reconnaissance especially with geomagnetic anomalies of the entire mining region of the Gabun-Paracale Mining Project.

We have worked out a geological pattern, to that of geological remote sensing reconnaissance so that it can bring about developmental goals of mining districts by proper geological thematic mapping of mining areas. The photogeologist and photointerpreters can also make proper resolution or computer mapping designs up to 0.01  $\mu$ m analysis of a given remote sensing computerized data, especially to profit the mining districts. Our remote sensing personnel works together with mining engineers and geologists in the geophysical analysis of given potential mining districts in order to disclosed large-scale mapping of mining areas, especially towards land management of satellite remote sensing data, through regional geological reconnaissance.

A REMOTE SENSING APPROACH FOR PREDICTING WATER DEMAND  
IN IRRIGATED AREAS OF WESTERN KANSAS

By M. D. Nellis

ABSTRACT

In response to limited groundwater resources in the Ogallala Aquifer of western Kansas, the Kansas Legislature has adopted a number of approaches to control groundwater depletion. An understanding of the effectiveness of the State program is limited by a lack of accurate information of water demand for irrigation. Although an extensive network of metered irrigation wells would provide water demand data, economic and political factors preclude such an approach. As a result, in 1984, the Kansas Water Office called for alternative methods (besides meters) to measure water used for irrigation.

This research, funded through the Kansas Water Resources Research Institute, provides a methodology for monitoring irrigation water demand in western Kansas. The methodology is based upon merging of available limited well meter data with meteorological data, crop type, and irrigation method data to develop a predictive model for estimating water demand. Information on crop type and irrigation method was obtained using high altitude color infrared photography and Landsat 5 MSS digital data acquired during the 1985 cropping season. Initial results using this approach suggest high levels of water demand estimation accuracy. Such a procedure will be critical to assessing the effectiveness of various Kansas conservation programs and understanding the agrohydrologic system.

TESTING OF THEMATIC MAPPER COLOR PHOTOGRAPHIC ENHANCEMENTS

By D. M. Nelson

(Abstract not available)

REMOTE SENSING OF NATURAL RESOURCES  
IN ZIMBABWE:  
WOODLAND COVER MONITORING IN THE COMMUNAL LANDS

By F. K. Odoom

ABSTRACT

As a Component of an on-going FAO project in Zimbabwe on technical assistance in remote sensing applications for agricultural and forestry landuse inventory and rural disaster monitoring, the assessment of changes in forested land was proposed. Three test areas were chosen to fall within selected communal lands of the country. The communal lands were chosen due to the serious nature of the state of denudation of most of them. The background to this state of denudation is given. An assessment of changes in woodland areas in two of the test areas by analogue interpretation of Landsat MSS imageries is described. Proposals have also been made with regards to future monitoring of the vegetation cover of all the communal lands in the country by digital change detection techniques using satellite data.

GLOBAL VISIONS IN A FLAT WORLD:  
STREAMLINING LOCAL PERMITS AND WATERSHED ANALYSIS  
WITH MULTI-LAYERED IMAGE BASED RESOURCE INFORMATION

By J. C. Ruth

ABSTRACT

The paper examines the operational gap between inherently curved digital terrain data from satellite imagery and the inherently flat paper maps used for local assessment records and building permits. The technical aspects of implementing a public domain geocode system in a county government with formats and coordinates to enhance digital imagery is defined. And compared in terms of both cost and effectiveness with a typical county system that is single format and not useful for overlay or imagery. All of which serves as a backdrop for creating an expert mechanism for a one-step permit and watershed analysis.

USE OF AUTOMATED SPATIAL DATA SYSTEMS  
IN FUEL MANAGEMENT DECISIONMAKING

By L. A. Salazar

ABSTRACT

Wildfires respond to changes in fuels, topography, and weather by changing their rates-of-spread and intensities. All fuel treatments, including fuelbreaks, prescribed burns, or piled fuels, create various levels of fuel nonuniformity. It has not been established to what degree the spatial arrangement and extent of this fuel nonuniformity influences wildfire occurrence and severity, and subsequent suppression efforts.

Automated spatial data systems, or geographic information systems, provide the technology to analyze spatial nonuniformities. They store large amounts of data, integrate various data layers with attribute tables, update existing databases, correlate the data with various modeling schemes and remote sensing capabilities, perform statistical summaries and analyses, and use the output displays and aggregation techniques to assist decisionmaking. Such systems provide vital information for strategic fuel treatment allocation and placement by spatially integrating data on fuels, fire histories, wind patterns, topography, access, suppression force locations, and values at risk. To determine the effect of this allocation and placement of fuel treatments on fire management, selected data layers would be used as input for modeling fire behavior and subsequent suppression effectiveness. The economic efficiency of the fuel management program could then be tested by evaluating several alternative program scenarios.

STUDY OF DYNAMIC GEOMORPHOLOGY BASED ON IMAGE INTERPRETATION  
AND MORPHOMETRY FOR A PART OF PRECAMBRIAN TERRAIN, M.P., INDIA

By K. Sarkar, S. M. Dutta, and A. M. Rakshit

ABSTRACT

Conjunctive study of orbital and aerial data and morphometric analysis have led to dynamic geomorphological evaluation of a Precambrian eroded terrain around Sonpur, Bastar district, M.P., India. Visual interpretation of enlarged Landsat imagery (1:250,000) and aerial photographs (1:15,000) has helped in delineation of five principal land systems consisting of 13 geomorphic units such as 1) low lying flats comprising peneplains, fluvial terraces and flood plains, 2) high structural ridges including fold ridges and linear hills, 3) hillock complex comprising residual hills and Cuestas, 4) highland plateau consisting of highly dissected plateau, poorly dissected lava plateau, plateau scarps and erosional surface remnants (four levels) and 5) rugged upland including slope wash plains and piedment plains.

These five systems with corresponding units have developed respectively on gneisses, schists and alluvial materials, banded Iron-ore formations and quartzite, acid and basin intrusives, flow lava, massive basalt, sandstone and laterite, and colluvial materials on hill slopes.

Morphometric parameters including some elements of relief, texture and gradient of the principal land systems have been analysed in terms of general system theory and entropy concept, essentially by two way analysis of variance to unravel the dynamic geomorphologic conditions. Estimated F (variance) ratios for three sources of variations relating to the land system samples, parametric frequency classes and residual error, are compared with standard values for specific probability levels to test significant differences between samples. The estimated variance ratio between land system classes ( $F_C$ ) show significant value even over 90 percent probability level. Similarly variance ratio between the parametric frequency class ( $F_P$ ) does not exceed the chance-variance (residual error) factor. Thus  $F_C$  is very significant, but  $F_P$  is insignificant, indicating no effect of parameter frequency classes on development of various morphometry within the land systems. Forms and processes in each system is so interlinked and adjusted that though there are variations in geometry of landforms within different systems, the net effect is in dynamic equilibrium.

Different land systems recognized on photographic data show different morphometric characters and their development is dependent on underlying geologic conditions and geomorphic processes governed by climatic and tectonics.

USE OF LANDSAT THEMATIC MAPPER DATA FOR  
CLASSIFICATION OF FOREST LANDS IN NORTHERN LOUISIANA

By K. B. Teuber

ABSTRACT

The Forest Inventory and Analysis (FIA) research work unit of the Southern Forest Experiment Station, U.S. Forest Service, is investigating the use of satellite remote sensing data in support of an extensive, ongoing forest inventory of seven Southern states and Puerto Rico. In a pilot study, a general land cover classification for two parishes in northern Louisiana was accomplished using digital Landsat-4 Thematic Mapper (TM) image data. Three 512 x 512 pixel training areas representing typical conditions in the study area were selected for spectral signature development using an unsupervised approach. Using TM channels 2,3,4, and 5, 106 spectral classes were defined which were aggregated into pine, bottomland hardwood, upland hardwood, cutover, and nonforest cover classes. Three size classes (sawtimber, poletimber, and seedling/sapling) were discriminated within the pine cover class. An overall classification accuracy of 84 percent was achieved. Verification was accomplished using ground data from 260 permanent sample plots systematically distributed throughout the study area. The cover class acreage estimates from the classified image data compare favorably (within a few percent) with area estimates produced from standard FIA procedures. The results indicate that gains in efficiency are likely as satellite remote sensing becomes incorporated into the forest inventory.

PROCESSING OF ARCHIVAL LANDSAT IMAGERY TO DOCUMENT  
PYRAMID LAKE ALGAE BLOOMS

By J. P. Verdin, L. L. Sims, and D. L. Galat

ABSTRACT

The value of archival Landsat imagery as a means of documenting important historic environmental phenomena is demonstrated by a study of Pyramid Lake in Nevada. Pyramid Lake is the terminus of the Truckee River and is frequently subject to large blooms of the bluegreen alga *Nodularia*. Such blooms are readily evident in MSS band 3 images, with radiance proportional to chlorophyll concentration. Over 70 Landsat MSS band 3 images from the period of 1972 to 1986 were digitally processed to derive an index through time of the occurrence, extent, and magnitude of *Nodularia* blooms on the lake. Histogram matching techniques were used to account for sun angle and atmospheric effects in the data. Image-to-image registration and masking techniques were also employed in calculating mean lake radiances for each image date. This image algae index is being used in conjunction with Truckee River nutrient loading data to anticipate possible effects of the construction of a wastewater treatment plant for the cities of Reno and Sparks.

## STATUS OF THE WORLDWIDE LANDSAT ARCHIVE, 1986

By H. W. Warriner

### ABSTRACT

In cooperation with the International Landsat community, and through the Landsat Technical Working Group (LTWG), NOAA is assembling information about the status of the Worldwide Landsat Archive. During LTWG 9, member nations agreed to participate in a survey of International Landsat data holdings and of their archive experiences with Landsat data. The goal of the effort was two-fold; one to document the Landsat archive to date, and the other to ensure that other nations' experiences with long-term Landsat archival problems were available to all interested nations. The survey requested details such as amount of data held, the format of the archive holdings by Spacecraft/Sensor, and acquisition years; the estimated costs to accumulate, process, and replace the data (if necessary); the storage space required, and any member nation's plans that would establish the insurance of continuing quality.

As a group, the LTWG nations are concerned about the characteristics and reliability of long-term magnetic media storage. Each nation's experience with older data retrieval is solicited in the survey. This information will allow nations to anticipate and plan for required changes to their archival holdings.

Also solicited were reports of any upgrades to a nation's archival system that are currently planned and all results of attempts to reduce archive holdings including methodology, current status, and the planned access rates and product support that are anticipated for responding to future archival usage.