SECTION 21

APPLICATIONS EXPERIMENTS IN THE HOUSTON REGION

by

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INTRODUCTION

Last year, Mike Holter described the Earth Observations Program here at the Manned Spacecraft Center and said that a major new thrust would be in the direction of experimental applications. The purpose, of course, was to develop a better understanding of the use of remote sensing data in pilot studies, thus aid in the definition of requirements for future remote sensing systems. I would like to give you a brief report on our first year of activity in this new direction.

OBJECTIVES AND APPROACH

The objectives of this activity are:

- To develop experimental applications of current remote-sensing technology in the Houston area.
- To develop and test a methodology for making such applications.

The approach is simple and problem-oriented in concept as follows:

- Work in concert with duly constituted operating agencies to assure implementation of the results.
- Explore a small number of specific problems, each focused on one set of operating decisions required by the agency.
- Utilize existing models of the agency information system and then augment these models with remotely sensed data.
- Develop a data acquisition, storage, and retrieval system for the test area to support the specific application studies.

We choose a specific problem of a specific resource management agency to define and bound an applications effort. A correlary of this approach is to emphasize collaboration with the operating, as well as the research arms, of the user agencies.

ORGANIZATION

The effort has been structured into major elements as shown in Figure 1. One element is the development of a simulator or facility which involves an experimental or pilot model of an Earth Resource Survey Information System with provision for acquisition and manipulation of data in conjunction with applications models. The other element is the use of the facility in a series of Applications. Each application is pursued by an interdisciplinary, interagency team. We consider it of utmost importantance to work applications as joint ventures and involve representatives of the user agency. I should also mention that the NASA effort has included many MSC groups and their support is gratefully acknowledged.

HOUSTON AREA TEST SITE

For convenience our initial efforts are being pursued in the region around Houston, NASA Test Site 175, shown in Figure 2. This area covers some 15,700 square miles of the Texas coast, an area about the size of Switzerland, but still small by Texas standards. For our purposes it offers a very reasonable selection of targets as shown in the cartoon in Figure 3.

CURRENT ACTIVITIES

I would now like to describe, very briefly, a few of our current activities.

REGIONAL INVENTORY AND MONITORING

As part of our pilot facility we have undertaken the development, for the study area, of an experimental data base for eventual use in a regional inventory and monitoring system. The purpose of such a system is to provide an up-to-date status on conditions and rates of change of

environmental features using data from sources such as ERTS and Skylab. As a starting point land-use was classified as part of an experiment to assess the utility of small scale imagery from the RB57F for developing a 20 category land-use system. An example of the final product is shown in Figure 4. This study, which was done in conjunction with the Houston-Galveston Regional Council of Governments, and the Houston Chamber of Commerce, was led by Dr. John Dornbach and Dr. Mark Chesnutwood. The base for this study was primarily color ektachrome imagery acquired on Mission 145 in November 1970. The base photo mosaic was constructed by MSC in the Mapping Science Branch. The small scale mosaic permitted interpretation and publication of the land-use at about the same scale as that of the original imagery.

This land-use information, and many other types of physical, natural, and demographic data will be stored in a computer based information retrieval system on the basis of one-kilometer square cells accessed by UTM grid designation. A trial data set has been developed to exercise the storage and retrieval system. This data base can be accessed from a remote terminal and searched for cells which satisfy one or more criteria. If, for example, we wanted all the data for a given cell we could conduct a query such as shown in Figure 5.

SAM HOUSTON NATIONAL FOREST STUDY

A joint activity has been undertaken with the U.S. Forest Service in studying the Sam Houston National Forest. Three Forest Service employees are in residence at MSC and we are providing support to a pilot study aimed at assessing the role of remote sensing in the new planning approach being pursued by the National Forest System. This planning system is shown in Figure 6. Information developed in this study will be utilized in the development of plans for the management of units of the forest, and in monitoring the implementation of the plans.

The current effort involves the use of photographic data in the inventory of forest resources such as timber stands and volume, wildlife and range resources, recreation areas, and roads. The Sam Houston National Forest includes some 160,000 acres and is located about 75 miles north of Houston. This area is typical in many ways of Southern pine forests. The area is a complex one, subject to many urban pressures from its proximity to Houston. A typical region of the Sam Houston is shown in Figure 7.

TRINITY BAY STUDY

The other major applications activity underway is the Trinity Bay Study. This effort is being carried out in cooperation with the Naval Research Laboratory, EPA, Texas Parks and Wildlife, Texas Water Quality Board, Houston Lighting and Power Company and the U.S. Army Corps of Engineers. The objectives of this effort are threefold:

1. To assess the utility of remote sensing in studying a shallow estuary, in particular, to verify mathematical and physical models of the hydraulic and thermal characteristics.

2. To make synoptic observations in the thermal infrared range of the outfall plume of a power generating station and verify the ability of a two-dimensional mathematical model to predict the location and temperature distribution of the plume, and

3. To assess the utility of remote sensing to monitor the location and distribution of a sea grass that provides important protection for juvenile shrimp.

The location of the study area is shown in Figure 8, and something of the complexity of the flow pattern in Figure 9. This activity was described in detail yesterday in the paper by Drs. Zaitzeff and Whitehead.

USE OF MULTISPECTRAL DATA

The final activity I would like to mention is our effort to utilize multispectral data. The first step has been to exercise and check out the various elements of the processing system. Three channels of spectral data were generated by digitizing each emulsion layer of a Color IR photograph. This frame of photography (Figure 10) is of the region near Katy, west of Houston. A gray map of one channel, used for the selection of training fields, is shown in Figure 11. This set of spectral data was run on the LARSYS pattern recognition program. The resulting recognition map was produced both as a grey-scale line-printer output, and as a color coded display on the Data Analysis Station (DAS) as shown in Figure 12.

FUTURE PLANS

Our activity for the next year looks in two directions: One is the use of multispectral data in applications. We have had local flights carried out by the Michigan aircraft and are currently developing the capability to process and analyze this data. We have proposed as a collective user of ERTS and EREP data and as these sources of data become available they will be applied to our applications work to augment the aircraft data. A major objective of this phase of our work will be to assess, for each application, the utility of the data from the satellite systems.

We hope also to develop additional applications and I will mention one which shows promise. This would be in conjunction with the Soil Conservation Service on Rangeland Management, and would be aimed at the identification of range sites and the monitoring of range conditions.

A study area close by has been tentatively selected. It comprises 11,000 acres of coastal prairie, near Rosenberg, southwest of Houston. A high altitude RB57F photo is shown in Figure 13. A view from space (Figure 14) shows that this region is also visible on the Apollo 9 S065 multiband experiment. A view from about 200 feet (Figure 15) shows the great variety of terrain present. I conclude from this that we will be grateful to ERTS for its role in integrating some of the local inhomogeneities.

CONCLUSION

In conclusion, we have organized, staffed, and planned an experimental applications effort at MSC. We have made many contacts in our local study area, and have started work on an experimental data base, and on several applications, which, if successful, could be replicated by the responsible agencies at other locations.

While it is too early to report much in the way of results, the heading vector of our MSC program has clearly changed.

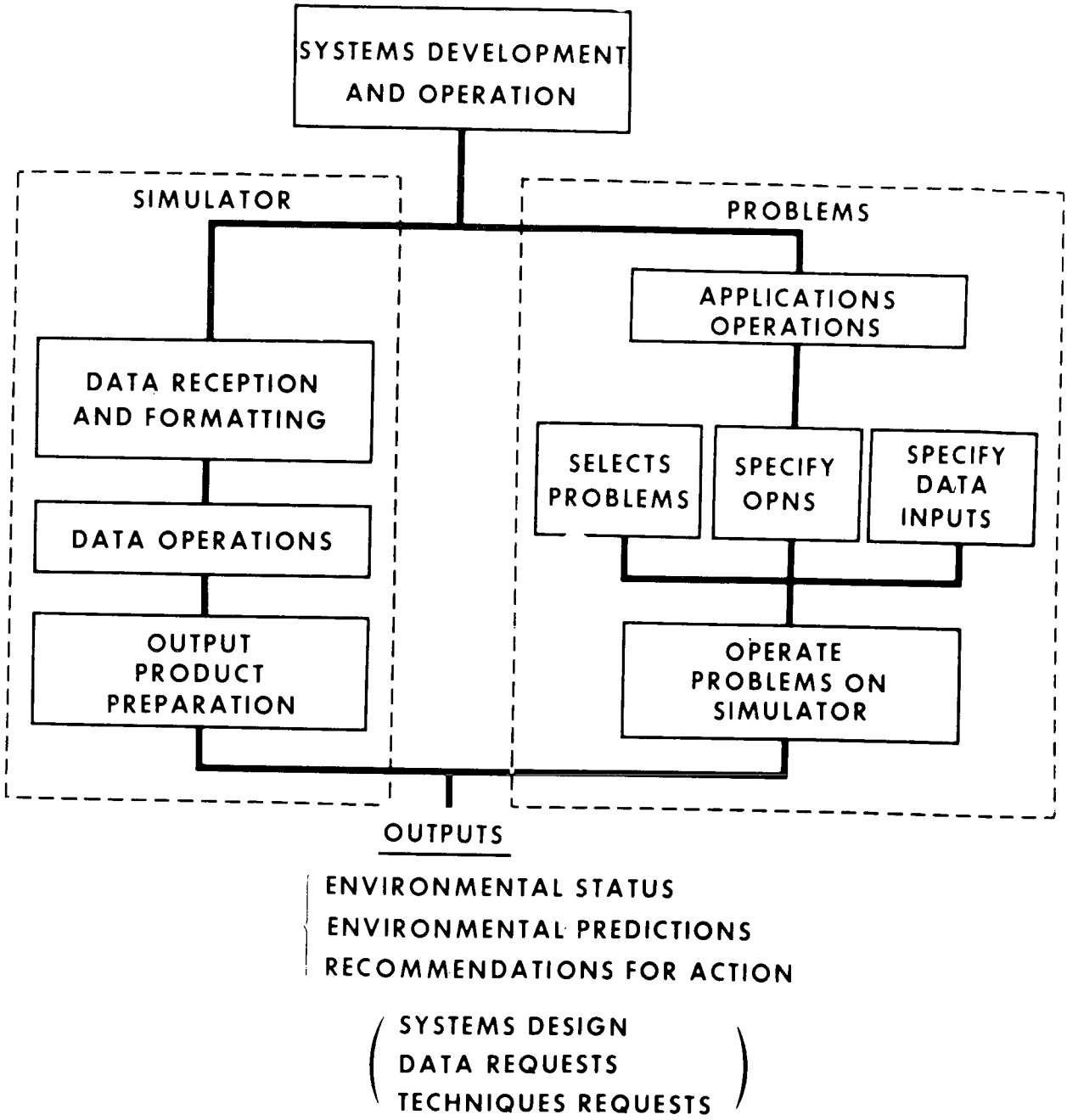

Figure 1. - Applications Organization, "The organization for undertaking applications in the Houston area comprises a simulator or facility (left) which is used in applications by carrying out the steps described (right)."

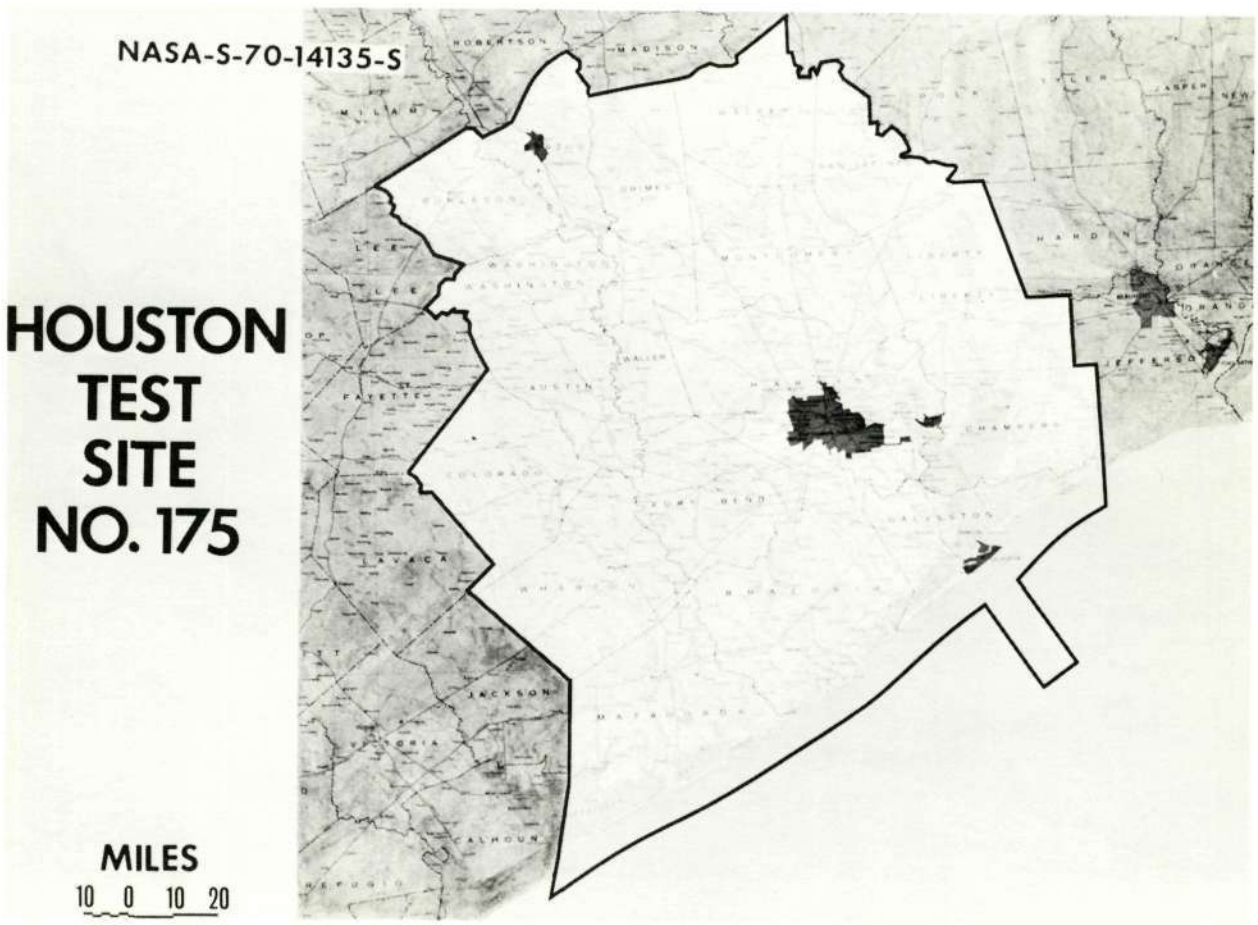

Figure 2. - Houston Area Test Site, "The Houston Area Test Site, NASA Test Site 175 comprises 15,700 square miles on the Texas Gulf Coast."

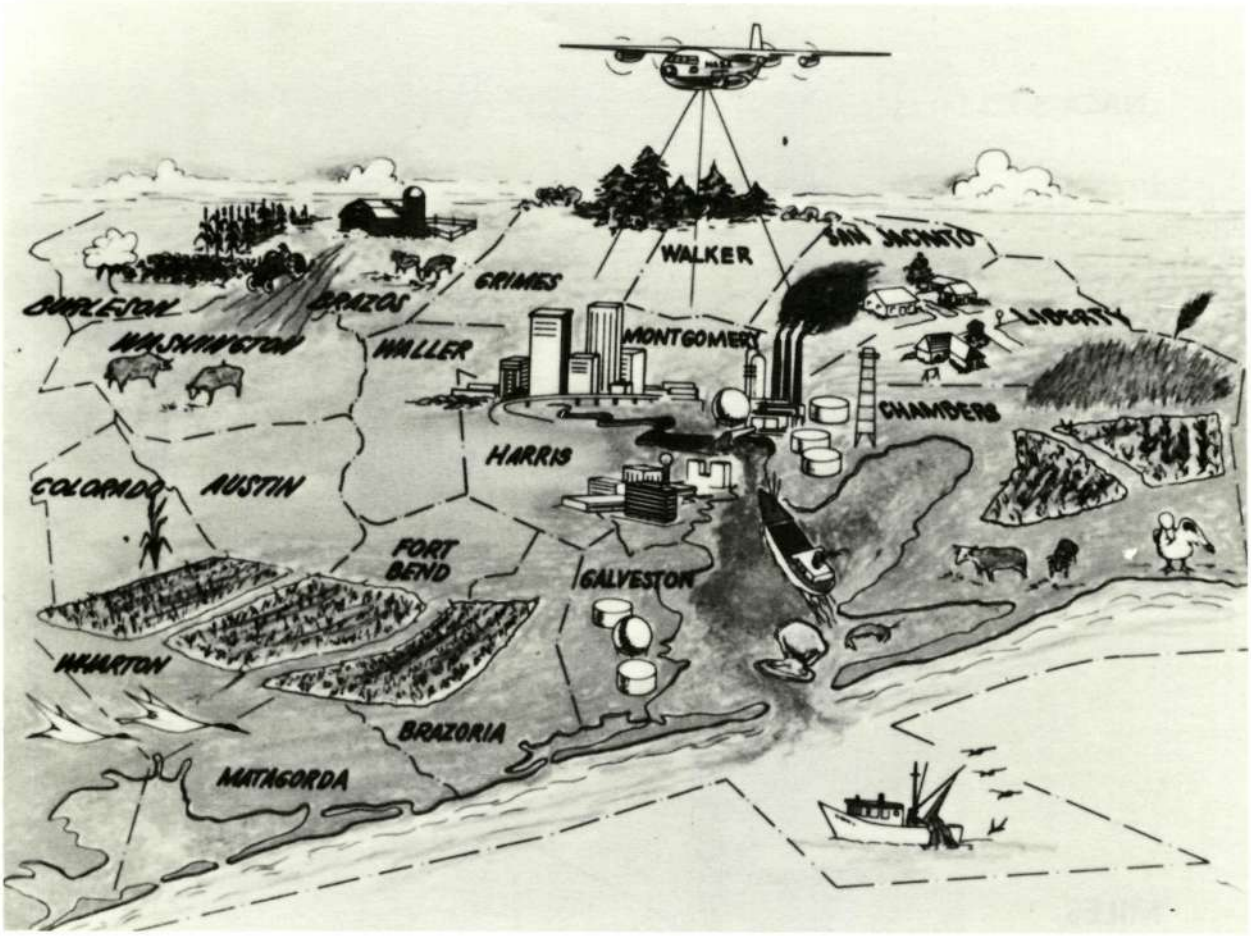

Figure 3. - Subjects Available for Study in the Houston Region, "The Houston Area Test Site offers a wide variety of subjects for remote sensing activity."

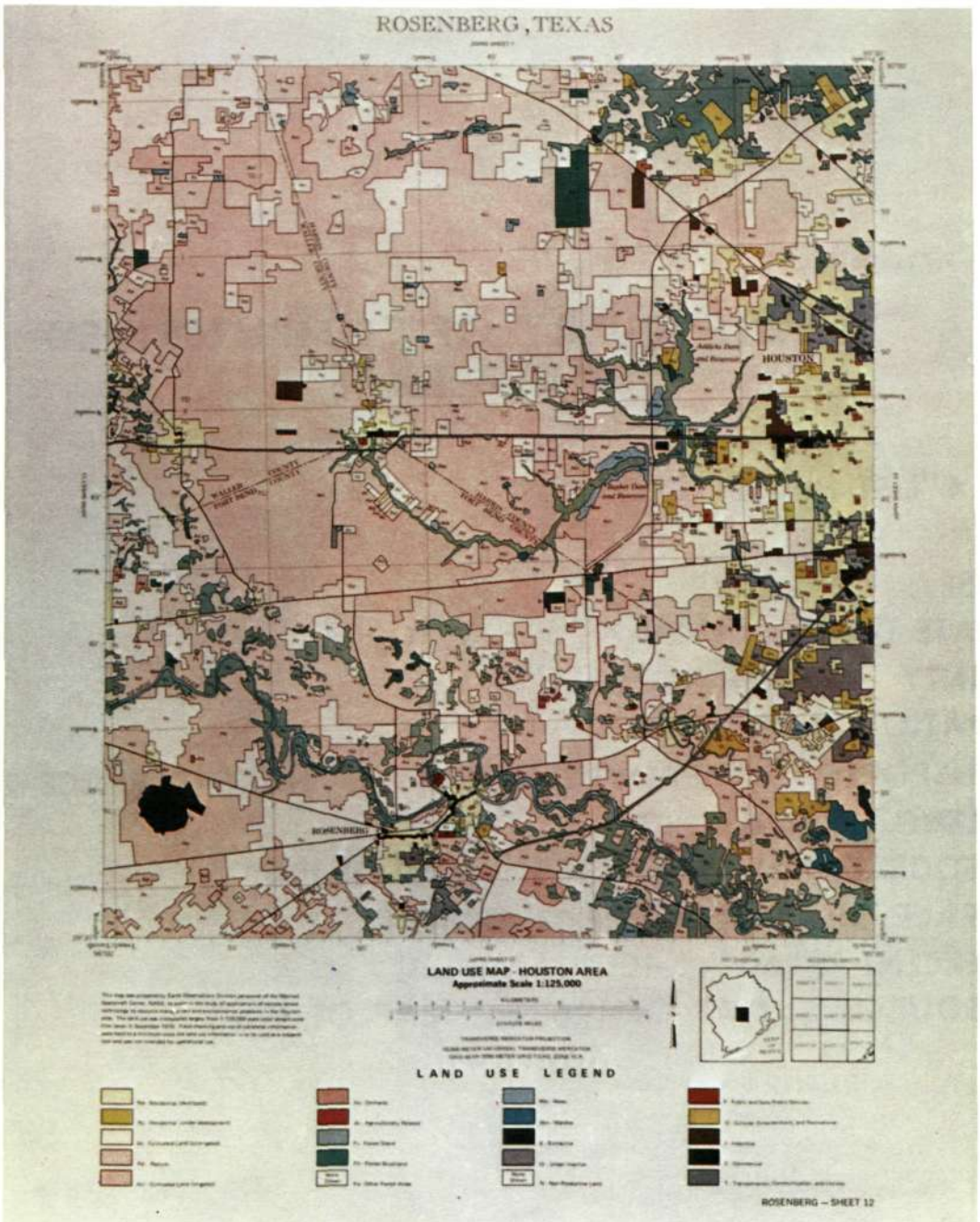

Figure 4. - Sample Sheet of Experimental Land Use Map, "This is one of 21 sheets of an experimental 20-category land use map of the Houston Area Test Site. It provides an initial data base for a regional inventory and monitoring system."

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SAMPLE QUERY OF COMPUTERIZED DATA BASE

007 C"LIST HATSF '14RQJ5138'

HATSF : 14RQJ5138
UPDATE DATE : 10-20-71
COUNTY : WASHINGTON
ELEVATION : 450-350
TRANSPORTS : IMPROVED LT. DUTY : HARD SURFACE 2 LANE
  TLENGTH : .6 : .7
  TSOURCE : MAP OF 1963 : MAP OF 1963
SURFACE : AGRICULTURE : URBAN
  PERCENT : 60 : 40
  SSOURCE : MAP OF 1963 : MAP OF 1963

Figure 5. - Sample Query of HATS Data Base, "An example of the information contained in a single cell of the HATS data base. Each cell is one square kilometer, and is addressed by its UTM grid designation."

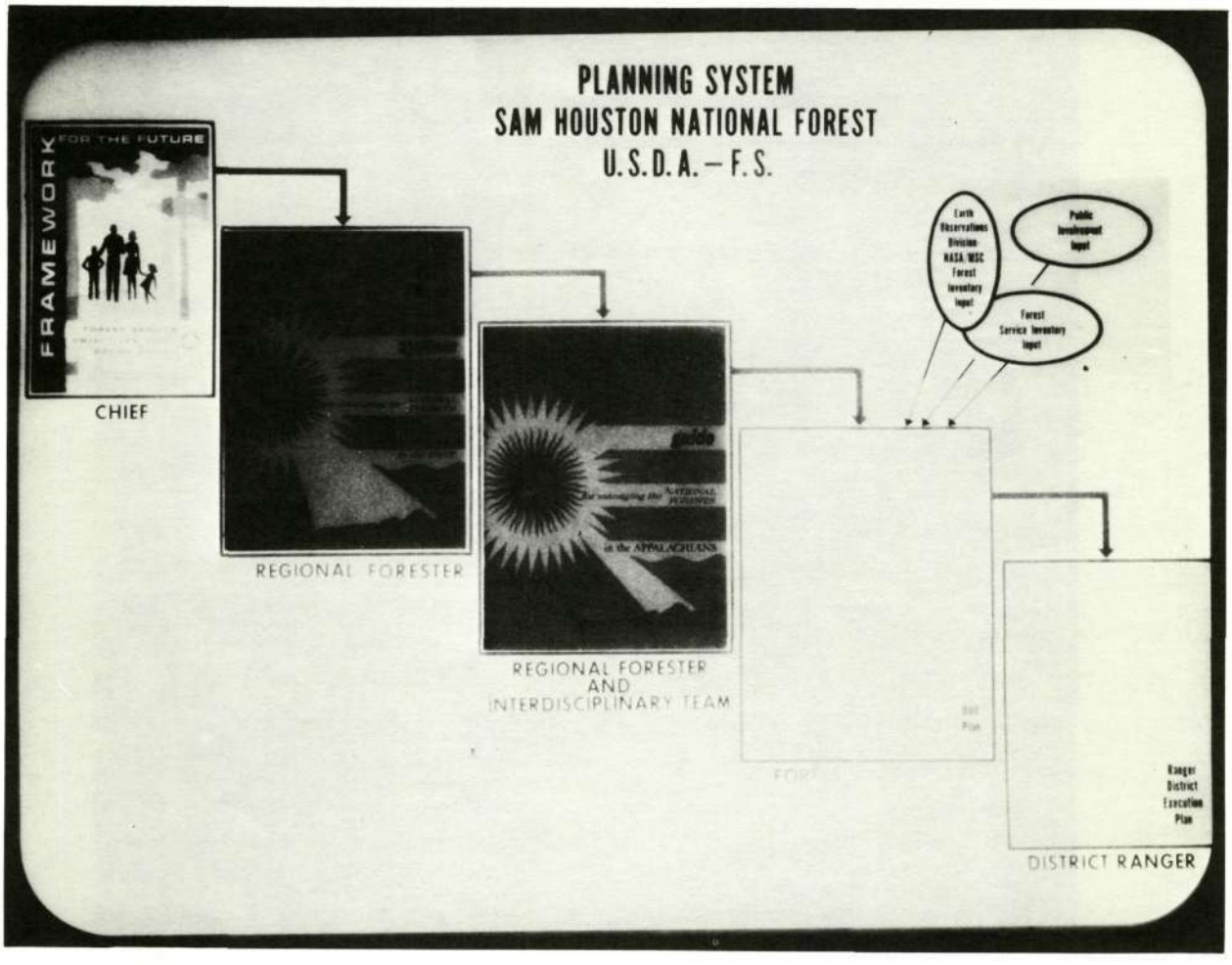

Figure 6. - Forest Planning System, "The proposed planning system for National Forests in Texas proceeds through a series of steps as shown in this figure. A unit for which actual plans are developed oped is typically a small watershed."

Figure 7. - Sam Houston National Forest, "A Typical Region of southern pine forest showing a variety of stands, adjacent private timber (lower left), and pasture lands (bottom), regeneration area (center), seed tree cut (center right) and encroaching urbanization (lower right)."

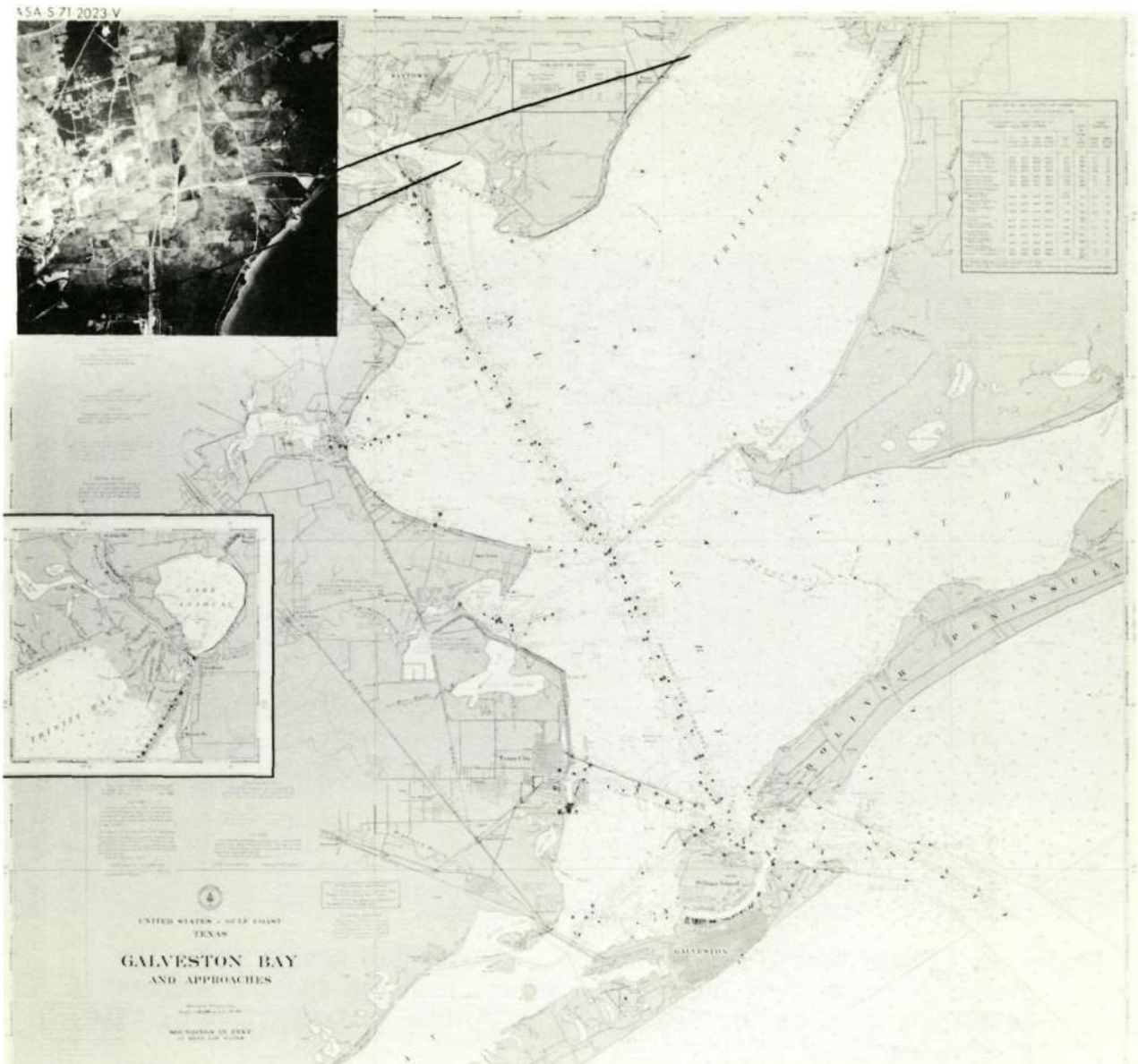

Figure 8. - Trinity Bay Study Area, "Located on Cedar Bayou a major power plant discharges cooling water through a canal (insert) into upper Trinity Bay."

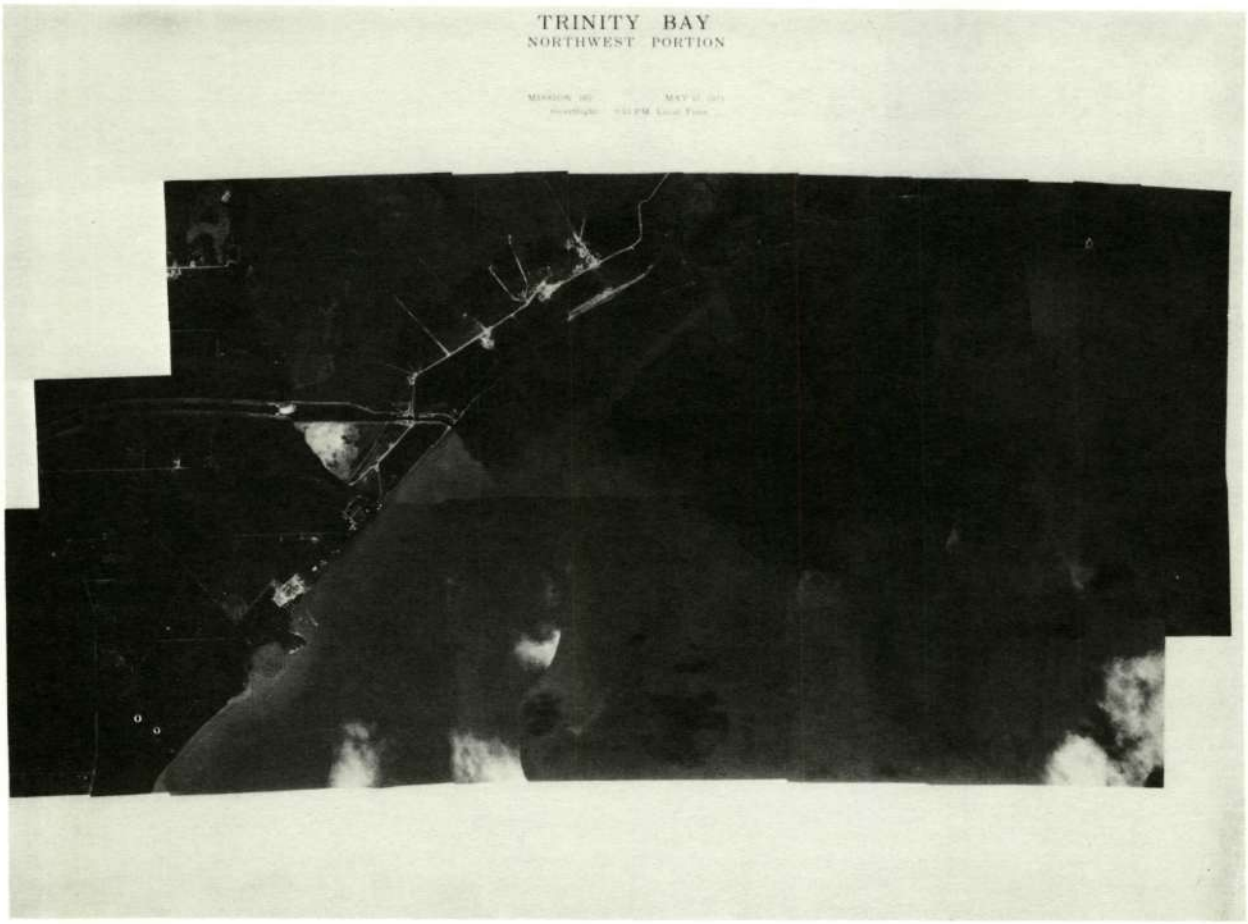

Figure 9. - Photo Mosaic of Trinity Bay, "This photo mosaic shows the discharge plume from the cooling water discharge and the sediment patterns caused by the rather complex hydraulic conditions of this shallow estuary."

Figure 10. - Color Infrared Photograph of Katy, Texas Area, "This photograph of rice and pasture land west of Houston was digitized in a color separation experiment to simulate three channels of spectral data."

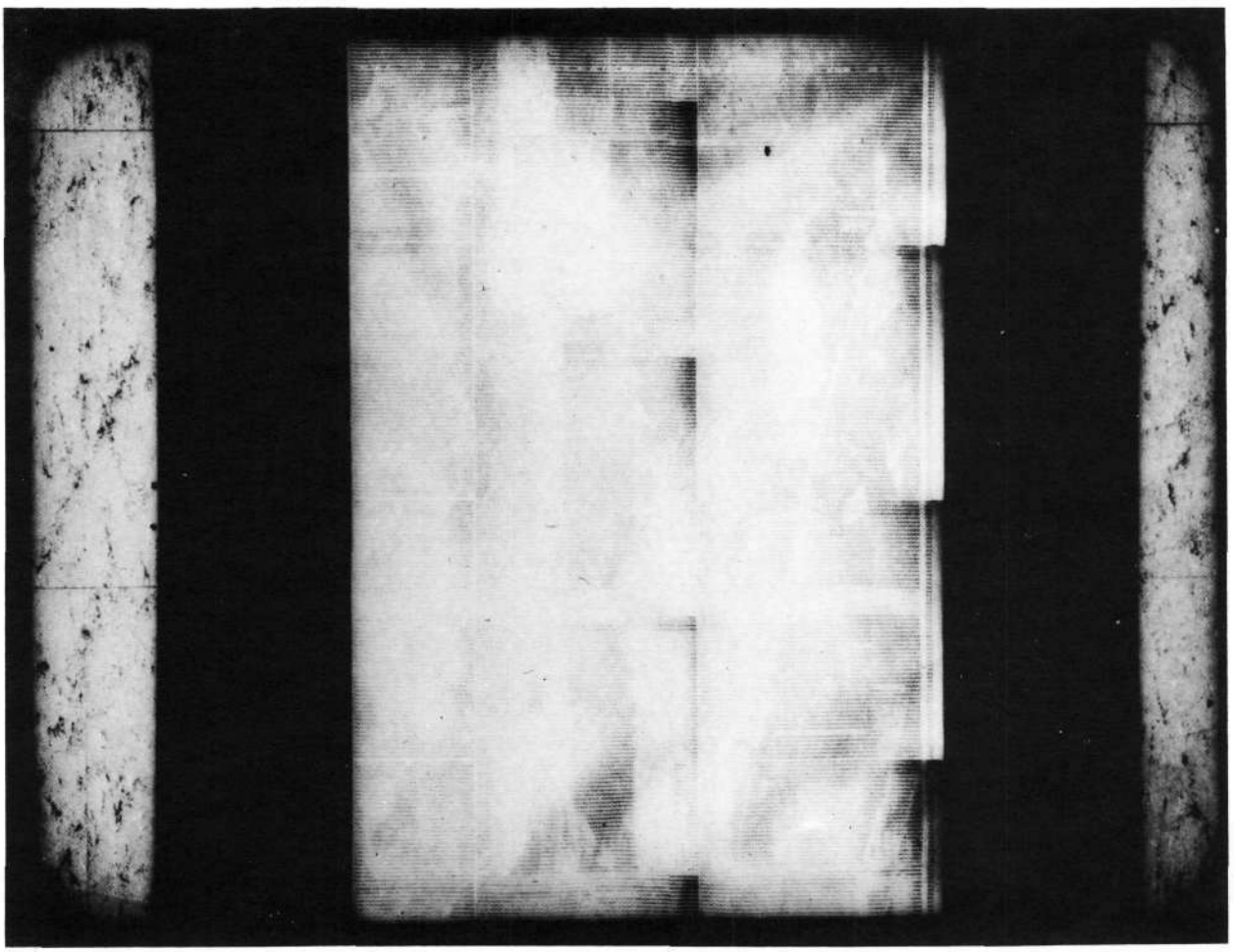

Figure 11. - Grey Scale Printout of Spectral Data, "This computer-generated printout portrays various density levels in the red band by different symbols. It proyides a means for selecting training sets for a digital pattern recognition program."

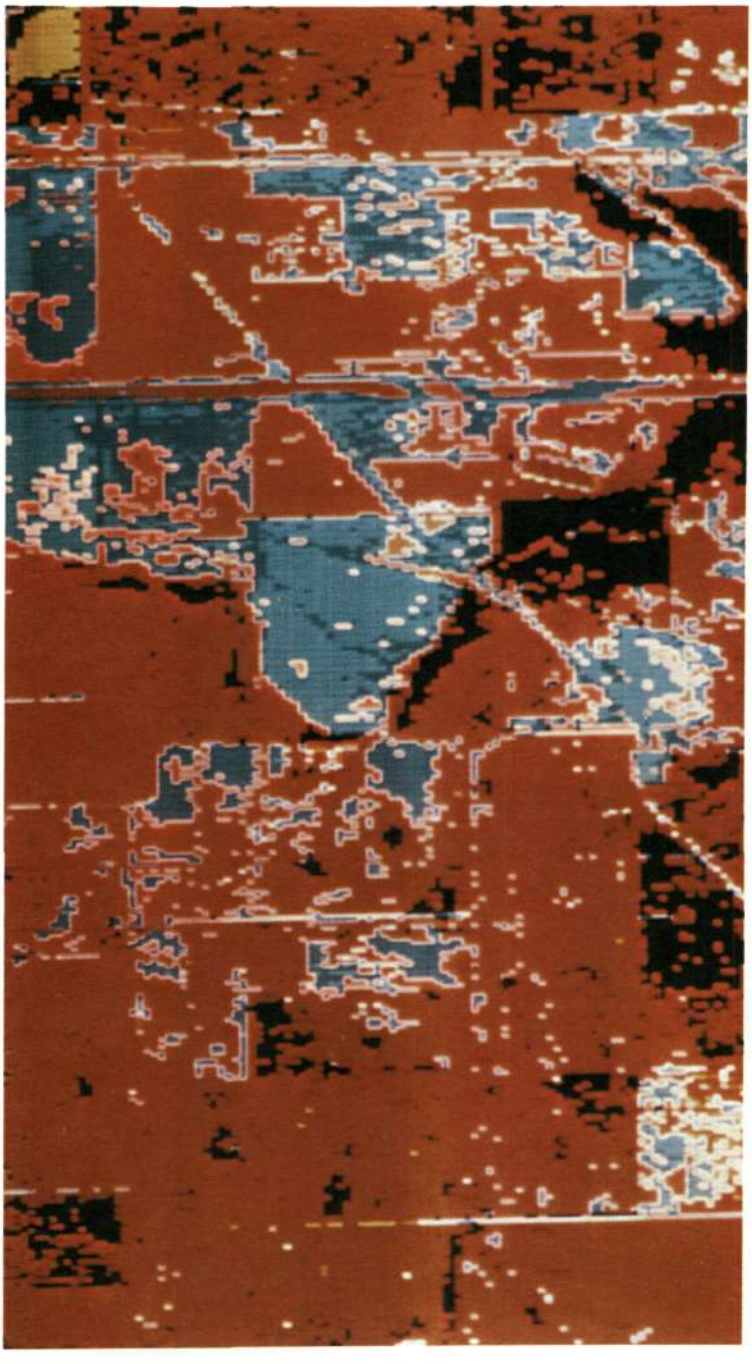

Figure 12. - Recognition Map of Katy, Texas area, "This recognition map was generated from the pattern recognition program and imaged from a digital tape by the film recorder of the Data Analysis Station. The color code is:

black	forest
red	pasture
blue	rice

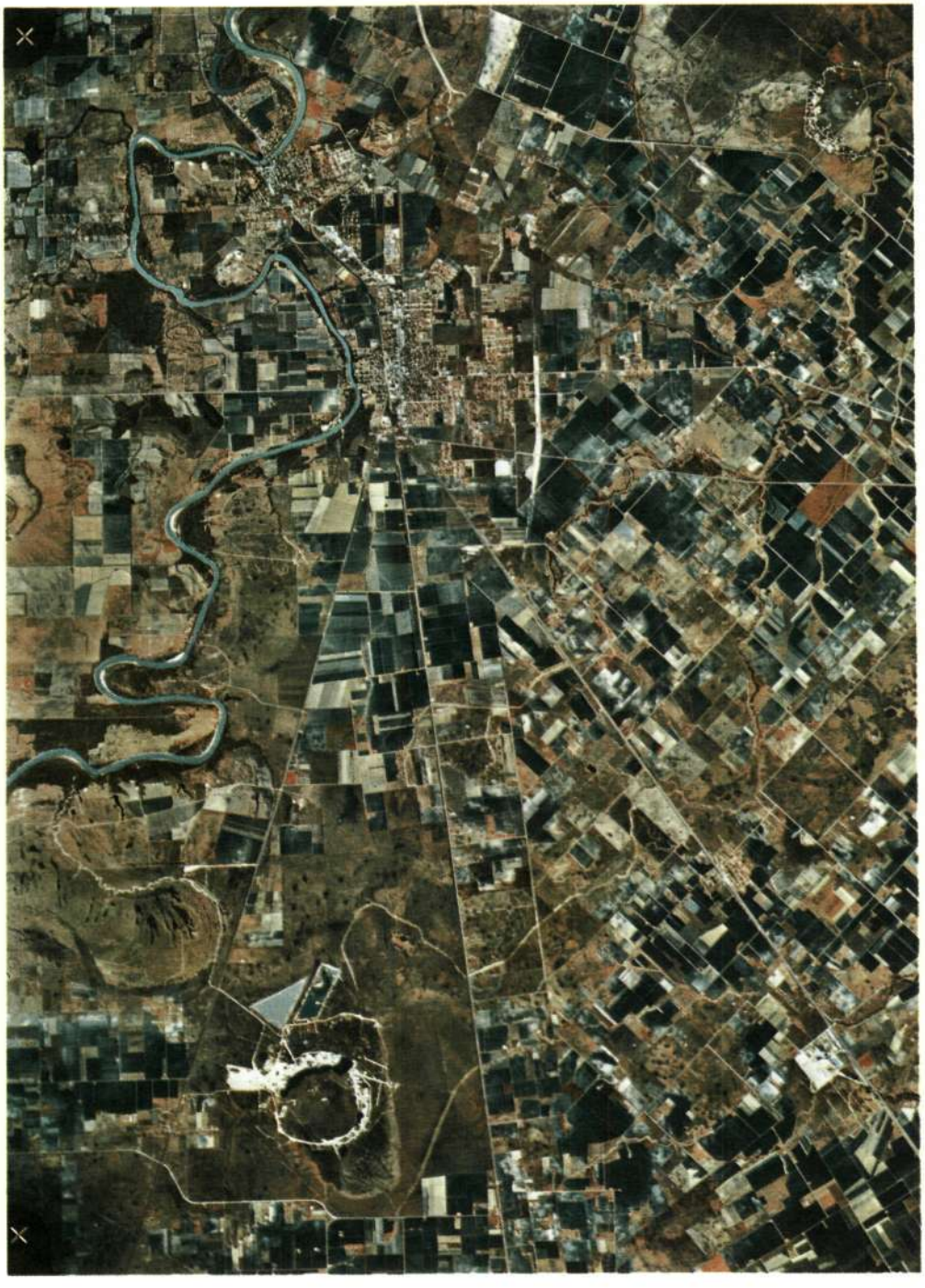

Figure 13. - High Altitude Photo of Rosenberg, Texas area, "This area near Houston provides a site for study of coastal prairie rangeland."

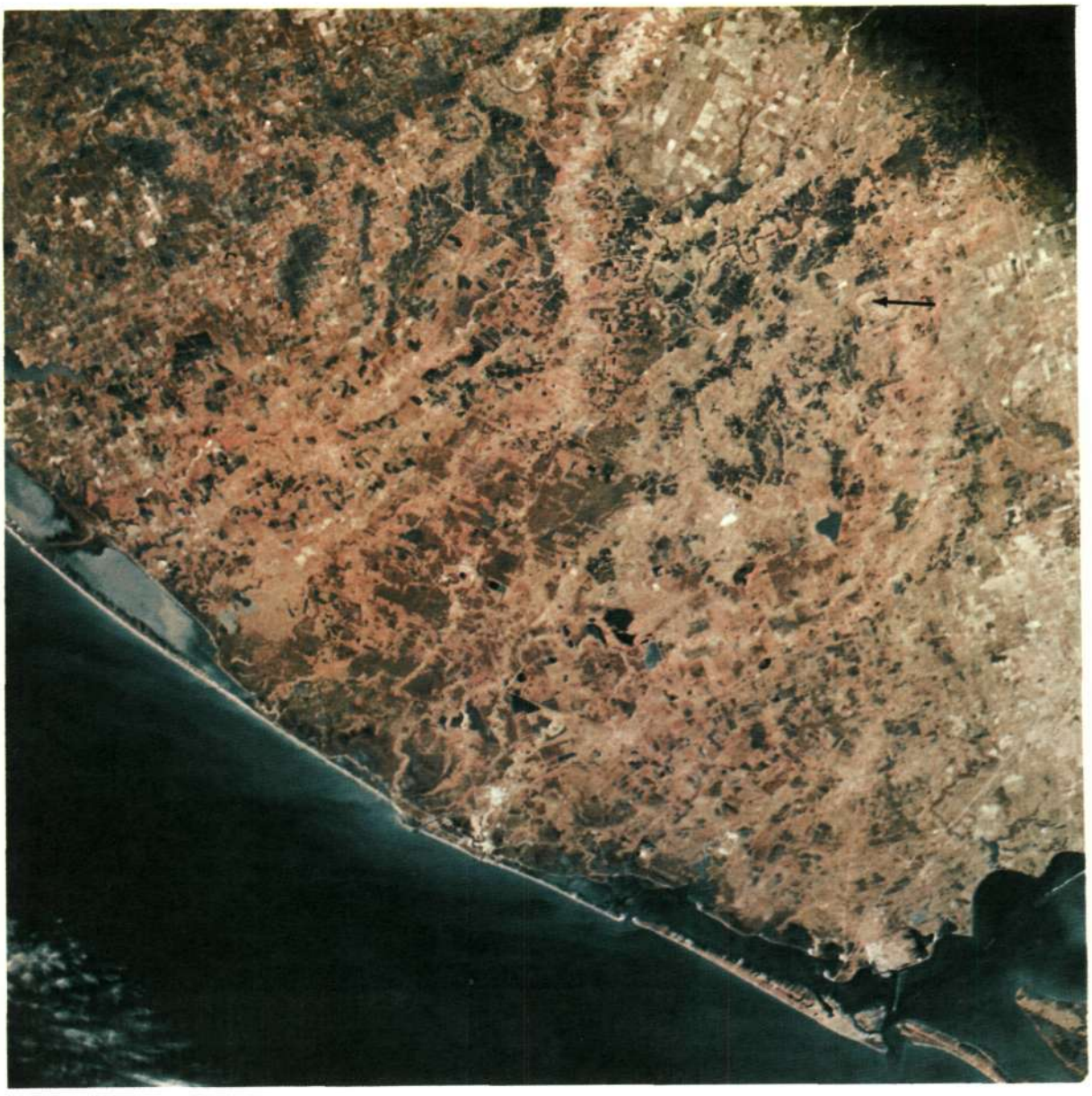

Figure 14. - Space View of Texas Coast, "This frame of color infrared photography from Apollo 9 (S065 multiband experiment) shows various land uses in the Texas Coastal region including (arrow) the range-land study area near Rosenberg."

Figure 15. - Low Altitude View of Rangeland near Rosenberg, Texas, "This view from a helicopter at an altitude of about 200 feet shows the great variety of terrain appearance typical of coastal prairie."