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United States Department of the Interior

GEOLOGICAL SURVEY
EROS Data Center
Sioux Falls, South Dakota 57198

IN REPLY REFER TO: OAB9-96

September 29, 1983

Mr. Rupert B. Southard
Chief, National Mapping Division
U.S. Geological Survey
National Center (MS 516)
12201 Sunrise Valley Drive
Reston, Virginia 22092

Dear Rupe:

Enclosed are two additional slides that go with the revised text for Doyle Frederick's Pecora Conference presentation. A copy of the revised text is also enclosed.

Sincerely,

Al Watkins

Allen H. Watkins
Chief, EROS Data Center

Enclosures

cc: EDC Chron
AHW Chron
DTL Chron
TD&AB Reading
TD&AB Subject

DTLauer/cbj/9-29-83

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Revised 9-28-83

GEOLOGICAL SURVEY LAND REMOTE SENSING ACTIVITIES

Doyle G. Frederick
Associate Director,
U.S. Geological Survey

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GEOLOGICAL SURVEY LAND REMOTE SENSING ACTIVITIES

Thank you Mr. Chairman and good morning ladies and gentlemen. This morning I would like to discuss the Geological Survey's involvement in the nation's land remote sensing satellite program.

When Bill Pecora was Director of the Geological Survey and later Under Secretary of Interior, he was among the strongest advocates of this new era of remote sensing technology. He was among the few who could envision the Survey and the Department as active participants in programs yet to come--like the Landsat, Magsat, Seasat and most recently Shuttle Imaging Radar programs. During this last decade, Survey and Department scientists have learned to use data from these programs using a balanced approach, which combines satellite and aircraft remotely sensed data with ground verifications and other forms of digital topographic and cartographic data. I will comment later on several current applications of this balanced approach, and the role of the EROS Data Center in further developing and applying this multiple spatial data base approach.

The Geological Survey and the Department of the Interior were among the earliest to recognize the potential of satellite land remote sensing for management of the country's land and water resources...not only as a user but also as a program participant responsible for final data processing, product generation, and data distribution. In 1966, with guidance from Bill Pecora, the EROS Program was established as a focal point for these activities within the Department.

Slide 1. Here in Sioux Falls, the EROS Data Center was established in the very early 70's to carry out these functions for NASA'a Landsat Program. The Data Center today continues to perform these functions for the Department of Commerce...NOAA...but has also become a major research and development facility for the Interior Department and Geological Survey.

Slide 2. The EROS Data Center coordinates Department of Interior participation in current and future satellite remote sensing programs. Furthermore, the Center has recently become part of the Survey's National Mapping Division with major responsibilities for the development of advanced information systems, applications, and data handling techniques needed by the Bureaus and Offices of Interior.

The Geological Survey uses all types of remotely sensed data, in combination with other sources of data, in support of geologic analyses, hydrologic assessments, land cover mapping, image mapping, and applications research. I will take a few moments to highlight a few of these uses.

Slide 3. Color composited and mosaicked Landsat images have proven to be very useful for interpreting the structural geologic characteristics of large areas, as shown in this area of western China. Survey geologists working with Chinese counterparts in China have identified and located the major folds, various types of faults, and zones of more intensive fracturing.

Slide 4. These results have had direct application in guiding current petroleum exploration activities in the remote regions of China.

Slide 5. Omit.

Slide 6. Omit.

Slide 7. Omit

Slide 8. Survey hydrologists have used Landsat digital data, high altitude aircraft photographs and ground survey data to map irrigated agricultural lands in an eight state area served by the High Plains Aquifer. The High Plains Aquifer, which is shown here, covers approximately 450,000 square kilometers and is the source of water for approximately 23 percent of all irrigated lands within the United States.

Slide 9. This slide shows a part of the high plains region with a Landsat image on the left and a classification of irrigated agricultural land on the right. These classification results have been used to assist in estimated ground water withdrawal and its areal distribution. These estimates are important ingredients for modelling past, current, and future consumptive use of water on the high plains.

Slide 10. For more than 5 years, Survey scientists have been working with other Federal and State resource management agencies in Alaska using Landsat and digital terrain data to map land cover. Prior to this time very little land cover information had been available for the vast regions of Alaska.

Slide 11. Results of computer assisted land cover classification are shown here for the Yukon Flats National Wildlife Refuge in east-central Alaska. The vegetation and other terrain categories have been mapped at one pixel resolution over the entire 20-million acre area.

Slide 12. The Geological Survey, working cooperatively in Alaska with Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service and the State Department of Natural Resource, have completed land cover classifications for more than one-half of the entire State of Alaska. The areas shown in yellow have been completed and the areas in blue are in progress this year. We expect to complete the entire state within the next 3-4 years.

Slide 13. Another use of Landsat is in the area of image mapping. Procedures are now in place that allow us to geometrically correct a Landsat scene using ground control, digitally mosaic one corrected scene with another, radiometrically balance the mosaicked scenes, contrast enhance the mosaicked scenes, and register the enhanced mosaic to a standard 1/250,000 scale map base to established national map accuracy standards. This slide shows where these procedures have been applied to Landsat Multispectral Scanner data acquired over the Las Vegas, Nevada region.

Slide 14. These same digital image processing procedures were applied to Landsat Thematic Mapper data to produce this 1/100,000 scale image map of the Dyersburg area in northwestern Tennessee. There is little doubt that Landsat image maps will add a new dimension to the Survey's National mapping program.

Slide 15. Omit.

(INSERT SIR-A SLIDE HERE)

Survey scientists conduct a considerable amount of applications research using satellite data. For example, this now famous image from the eastern Sahara desert acquired in November, 1981, by the Shuttle Imaging Radar (SIR-A) aboard the Space Shuttle Columbia illustrates the great potential of space-borne radar for providing unique information about geologic features buried up to several feet beneath dry, unconsolidated surface materials. In this 50-km wide strip of radar imagery superimposed on a Landsat image of the area, previously unknown buried valleys and geologic structures were identified by Jet Propulsion Laboratory and USGS scientists. Radar responses from bedrock and gravel surfaces beneath the windblown sand deposits clearly delineate several sand- and alluvium-filled valleys, some nearly as wide as the Nile River Valley and perhaps as old as Middle Tertiary.

Slide 16. Survey geologists are enthusiastically investigating the information content of the new thematic mapper data. This slide shows a simulated thematic mapper image of the Split Mountain anticline near Vernal, Utah. More than a dozen different stratigraphic units, mapped on the 1/24,000 scale geologic map of the area, are clearly separated on the simulated TM image and can be mapped with approximately the same, and in some places better, accuracy and detail as on the map. There is little doubt among Survey geologist that thematic mapper data can be used to assist in the process of making lithologic maps.

I would now like to turn for a few moments to discussion of the Geological Survey's future activities in the field of remote sensing. Because of its chartered mission for gathering and disseminating information about the nation's land and water resources, the Survey will continue to be an active investigator and user of current and future remote sensing systems.

We hope that commercialization of land remote sensing satellite systems will succeed, but like so many other users of the data we are concerned about the practicality and difficulties associated with the transition of existing systems to the private sector. We feel very strongly that there is a need for strong technological improvements throughout the 1980's in sensor design, data processing procedures, and analysis techniques. The Survey is also interested in the use of satellite land remote sensing available from other countries such as the French SPOT satellite.

Slide 17. As the private sector assumes responsibility for the existing systems, the role of the Survey in data processing and distribution will certainly change. Since this activity accounts for less than 25 percent of the EROS Data Center's responsibilities, the impact of possible commercialization on the Center will be significant but not critical. In the future, the EROS Data Center will focus its attention and resources on priority programs of the Department of the Interior and Geological Survey. These include archiving and distributing National High Altitude Aircraft Photography, contributing to the construction and maintenance of a national digital cartographic data base and conducting research and development on comprehensive geographic information systems.

Slide 18. For example, EROS Data Center scientists for sometime now have been integrating remotely sensed data with other types of spatial data to form comprehensive digital data bases. Then information system processing techniques are applied to these data bases to provide information relating to resource management or planning issues.

Slide 19. Interestingly, we have found that we can improve the usefulness of Landsat data using this data base approach. For example, this slide shows land cover classification results of an area in northwestern Arizona. On the left are classification results using Landsat data alone. On the right the classification results have been refined and improved by combining digital topographic data with the Landsat data and using topographic relationships in the classification process. This approach has been implemented by the Bureau of Land Management into an operational program, and the BLM has now classified nearly 100-million acres of public lands.

Slide 20. Omit.

Slide 21. Omit.

Slide 22. Omit.

Slide 23. Omit.

Slide 24. Omit.

Slide 25. In the future, a considerable amount of research will be done on developing automated geographic information systems that can handle a wide variety of digital cartographic data. A pilot study in the Medford, Oregon area was recently completed which demonstrated a Federal Mineral Lands Information System. The purpose of the study was to build a comprehensive digital cartographic data base and demonstrate how information could be extracted from it to assist policy decision making on Federal lands.

Slide 26. Data inputs included a map of Federal surface ownership, which included identity, location and spatial distribution of all Federally owned lands.

Slide 27. Federal subsurface ownership was included in the data base.

Slide 28. Federal restrictions shown here in red were digitized and added to the data base. These included park lands, wilderness areas, and wild and scenic rivers.

Slide 29. A wide variety of information about mineral occurrences was included in the data base in the form of points, lines, and polygons. This example shows areas permissive to the occurrence of chromite.

Slide 30. This slide illustrates how the digital cartographic data base was constructed and also shows its complexity. Once the data base was completed, a series of questions could be asked, such as which Federal agencies own land in the area, where are these lands located, which lands are restricted to mineral development, etc.

Slide 31. An example output in map form is shown here where lands administered only by the U.S. Forest Service are shown in green. Any single theme or multiple theme can be displayed like this.

Slide 32. This last example shows a multiple theme output product where areas shown in white are owned by the Federal government, all subsurface mineral rights belong to the Federal Government, and there are no Federal restrictions for development. The red areas show geologic tracts permissive to chromite on accessible Federal land, while green areas show geologic tracts permissive to chromite but that occur on land either not Federally owned or restricted to development. The results of this pilot project have clearly demonstrated the power of geographic information system technology applied to spatial information about Federal lands.

(INSERT RIPS SLIDE HERE)

Lastly, it should be noted that the Survey is investigating the use of micro-processor computer systems for accessing, displaying and analyzing remotely sensed, topographic and cartographic data. The intent of these investigations is to put into the hands of resource managers and planners the needed hardware and software tools that are both cost-effective and affordable.

In summary, I have tried to present a general overview of the Geological Survey's land remote sensing satellite activities. We have enjoyed our partnership with NASA and NOAA and intend to fully cooperate with the private sector in making future satellite systems a success. We will continue to be a major user of this technology and foresee in the future a considerable amount of our work focused on using remotely sensed data in combination with other types of spatial data. Thank you for your attention. Are there any questions?