ORBITAL SURVEYS AND STATE RESOURCE MANAGEMENT

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Abstract

The citizens of the individual states should benefit substantially, both immediately and in the future, from the results of earth surveys from manned and automated spacecraft. This paper describes how a state, such as Ohio, with highly diversified industry, agriculture, and geography, proposes to use orbital survey data and related space capabilities to manage its resources, attack increasing environmental problems, and plan future developments. Certain and anticipated short- and long-range benefits are described. The State Government of Ohio foresees opportunities, challenges, and potential benefits in orbital surveys not only for government management responsibility but also for its constituency by providing alternative approaches to resource and environmental problems heretofore unavailable.

Introduction

The purpose of the forum is to acquaint you, the nonaerospace public, with the benefits expected to result from satellite earth-resource surveys. This discussion will be limited to the resource-management implications of such surveys, and more restrictedly, as they are currently viewed in the State of Ohio. Actually, the opportunities, challenges, and potential benefits inherent in using automated and manned spacecraft for resource-management activities can be looked at in several ways, depending on one's point of view. That is, whether you are a space scientist (like myself), a state planner (like my coauthors), or an interested citizen (like yourself).

The space scientist's view of resource management using orbital surveys is, of course, one of utmost enthusiasm (Fig. 1). He sees the tremendous opportunity to expand data acquisition, the challenge orbital surveys provide to data management and analysis specialists, and their potential for revolutionizing resource-management decisionmaking practices.

State government personnel, represented in our discussion by the state planner, are faced with a mountain of increasing resource and environmental issues, problems, and needs (Fig. 2). He sometimes views the same data collection opportunity negatively in that he fears further saturation of his already largely unused and often misused data base. His challenge is to accurately assess the user potential inherent in satellite earth surveys in order to insure that their ultimate potential for supporting a practical, resource/environmental-management system can be achieved.

You, the taxpaying public (Fig. 3), on the other hand, most likely view this new cry of "satellite surveys for citizens" as another NASA propaganda campaign to turn around declining space budgets and, thus, as an opportunity to increase rather than stabilize the existing tax burden. Your challenge is one of trying to understand how anything as complex as multispectral photography, infrared spectrometry, and microwave radiometry can possibly relate to your life style. Reminiscent of several past experiences, you tend to view the potential here as another example of more big-space "talk" but little new down-to-earth benefits. I hope to alter this view somewhat.

Although viewpoints differ, the objectives, design features, data collection, and relay capabilities of both the automated Earth Resources Technology Satellite (ERTS) and manned Skylab[1] spacecraft

1. Skylab when referred to in this paper is always in connection with the Earth Resources Experiment Package (EREP).

systems were presented in previous sessions of this Congress and will not be repeated here. As I said earlier, I plan to limit my discussion to orbital survey data utilization and, more specifically, to how we hope to use this emerging space capability for resource-management interests in Ohio. Accordingly, most of this discussion is not what we have done, but rather what we plan to do and what practical benefits we anticipate.

Resource-Management Problems and Plans in Ohio

Ohio is one of the most heavily populated states in the nation, has a highly diversified industry and agriculture, and possesses a variety of geographic features. Also, Ohio, like all progressive and developing states, has a serious resource and environmental management problem which grows more serious daily.

Following the national trend, Ohioans are becoming more concerned about reckless environment and natural resource habits and are placing more pressure on state government officials and legislators to change this policy. Accordingly, new tools such as automated and manned spacecraft with their sophisticated imagery and relay capabilities must be incorporated, as appropriate, into resource and environment management problem solving.

Ohio ERTS and Skylab Plans

In response to the most timely NASA/ERTS and Skylab opportunities, the State of Ohio, in concert with the Battelle Columbus Laboratories (BCL), proposes to undertake a comprehensive, multidisciplinary assessment of the state-level utility of these experimental orbital survey programs. The joint program is somewhat unique in that it enlists the expertise of an unusual but necessary combination of technical, economic, and state-planning and program management specialists. The objectives of the proposed program range from one of establishing an experimental Ohio ERTS/Skylab data utilization facility to the developing of a methodology for evaluating the impact of these satellites on resource-management goals in Ohio. The broad interface that exists among the various units of Ohio State Government, ERTS and Skylab data, and potential application/user areas has been determined (Fig. 4). The specifics of this figure are not important here. It is included only to illustrate the extensive utilization potential for satellite surveys at the state level.

Although the initial plan is to investigate user-oriented applications in all the disciplines involved in orbital surveys, the main thrust of the Ohio ERTS/Skylab program is focused on ascertaining the relevance of these space programs to problems, issues, and needs in the more critical Ohio resource and environmental-management areas of:

1. Environmental quality,
2. Land use, and
3. Agriculture and forestry.

Secondary interests relate to the geological, hydrological, and meteorological utility of orbital surveys, primarily as they impact on broader interdisciplinary interests involving Ohio's Lake Erie and Appalachia development responsibilities.

A map of the geographical areas selected as initial Ohio study sites and areas of interest for ERTS and Skylab data is shown in Figure 5. Collectively, these represent agricultural, forestry, recreational, wetland, wildlife, urban, glaciated, nonglaciated, topographically rugged, topographically flat, river basin, lake, and transportation features. It is also planned to collect correlative surface-truth data (aircraft and ground) for the five principal study sites, as required to meet discipline analysis objectives involving primarily photogrammetric comparisons of multispectral photographs. The relation of the proposed study sites to discipline/user interests is shown in Figure 6.

In order to test the state value of satellite relay capabilities, a data collection platform is to be installed in the Columbus vicinity. This platform will be mobile and will be designed to collect a multidisciplinary set of data. This effort will be in addition to the ongoing Environmental Protection Agency's water-quality monitoring program in southern Ohio and the 20-station platform relay network planned for Lake Erie studies by the NASA facility in Cleveland.

Anticipated Benefits

<u>Technical Benefits</u>. From this broad multidisciplinary involvement in NASA/ERTS and Skylab programs, we hope to identify specific satellite data and data relay functions that can be incorporated into Ohio resource-management activities. Specifically, the extent that decisionmaking and policy implementation within the various units of state government

are unaffected, disoriented, or enhanced by these initial orbital survey experiments will be determined. Currently we are optimistic and are anticipating explicit benefits to occur in each of the principal discipline areas of interest. In agriculture (Fig. 7), for example, we hope initially to capitalize on the capability of satellite surveys to provide repetitive gross crop inventories and eventually to attempt crop stress and disease monitoring studies. Expensive soil moisture survey requirements existing may be fulfilled in part by satellite relay techniques, too. Utilization of orbital surveys for gross inventory and disease and pollution assessment functions of Ohio's timber resources (Fig. 8) also appears possible. Forest fire damage assessment is considered a good state-level applications candidate, but routine use for forest fire detection will have to await operational satellite development.

Our hopes for land-use applicability of orbital survey data are among the highest (Fig. 9). They range from plans to update the state's land-use survey of 1960 (which is seen in the background; completed in 1967) using ERTS and Skylab data to support experimental preparation of base maps, topographic maps, photomosaics, and other special-purpose maps for demographic, urban development, and transportation interests.

Another major and currently critical benefit category that we hope to exploit initially is that of environmental quality. We have explicit plans to test satellite imagery and data relay techniques considered applicable to air quality controls, which are to be implemented in Ohio in the next few years (Fig. 10). The use of the imagery data, and more important, satellite remote relay opportunities in water quality management are even more enthusiastically being considered (Fig. 11), as are plans for applying orbital survey capabilities to controversial strip-mining reclamation efforts in Ohio (Fig. 12).

The anticipated use of orbital surveys for Ohio's geological, hydrological, and oceanographic interests (Lake Erie being considered Ohio's ocean) is of less certainty (Fig. 13). Flood-plain management and Lake Erie shore-erosion research are certainly areas wherein we hope to apply satellite-acquired data. Orbital data on cloud, snow, ice, and fog conditions in Ohio (Fig. 14) are to be studied primarily as they relate to other discipline interests.

Other Benefits. In addition to the technical (discipline-oriented) benefit possibilities of ERTS and Skylab, we anticipate several byproduct benefits to other aspects of state government which indirectly affect resource-management activities in Ohio. These can be grouped according to the expected time frame of occurrence (Fig. 15). Short-term benefits, for example, are those associated with experimental orbital surveys; whereas long-term benefits are more characteristic of down-the-road, operational possibilities.

We foresee that some immediate benefits will occur simply by our active participation in the orbital survey programs. In terms of information, for example, the need to obtain correlative aircraft- and ground-truth data will automatically expand the state's resources and environmental data base regardless of the value of the orbital survey data. Also, data-handling experiences will be of immediate interest to a plan currently under consideration to establish a new budgeting and planning unit in the office of the governor. Another immediate benefit of major state interest relates to expanded interagency communications. The ERTS and Skylab programs, as planned, require extensive interagency coordination and dialogue which will provide reciprocal insights into other agencies' activities, problems, priorities, and products. This could help fight bureaucracy from within and force agencies to function more effectively to survive. Also, today's students desire more relevant subjects. Remote sensing; resource and environmental management; and space technology, as applied to people-oriented needs (such as orbital surveys); represent new and relevant educational opportunities. In this connection, Ohio State University recently announced plans to introduce new courses on the application of remote sensing technology, which will interface nicely with the planned Ohio ERTS and Skylab involvements.

Most significant short-term benefits are considered possible in the categories of legislation and state government reorganization. The Ohio Legislature is considering numerous natural resources and environment bills, the development, implementation, and enforcement of which could be heavily influenced by automated and manned satellite capabilities. The distribution of appropriate satellite-acquired photographs, for example, could provide broader perspective on environmental issues requiring legislation. Likewise, Ohio's ERTS and Skylab experiences and findings should prove valuable to studies in progress concerned with state reorganizational possibilities. This will be especially so for considerations regarding how the state should be reorganized to be most responsive to increasing resource and environmental issues, the delivery of state services, and associated Federal controls and funding opportunities.

On a longer-term basis, we anticipate benefits to accrue from operational orbital surveys which will impact on all Ohio resource- and environment-related problem areas. However, most important are those potential benefits anticipated in the budget, development, and employment categories. Certainly, even if only partially successful, anticipated cost savings inherent in operational orbital surveys will make many new and necessary resource and environmental programs possible. A large percentage of these are currently being rejected solely on economic grounds.

Air and water quality regulations and natural gas shortages pose serious national, industrial, and community development problems. Repetitive orbital survey data could be quite useful in the long-term planning of the types and locations of new industries and new towns in Ohio. A technically sound and positive attitude toward planned industrial expansion is essential to maintaining a healthy economy in Ohio, as well as to improving the unemployment situation, both of which will worsen if unreasonable environmental restrictions are imposed.

Conclusion

I have tried to present a brief overview of plans and hopes for utilizing orbital surveys for resource and environment management interests in Ohio. To achieve many of the anticipated benefits requires that the long-range goal of establishing a comprehensive state resource-management system, supported by new technology, including an operational network(s) of automated and manned satellites, be accomplished. Technical know-how and user interests are believed adequate to fulfill this goal. However, effective and honest resource and environmental management in any state will always be people dependent — therein lies the social responsibility that constitutes a challenge to us all.

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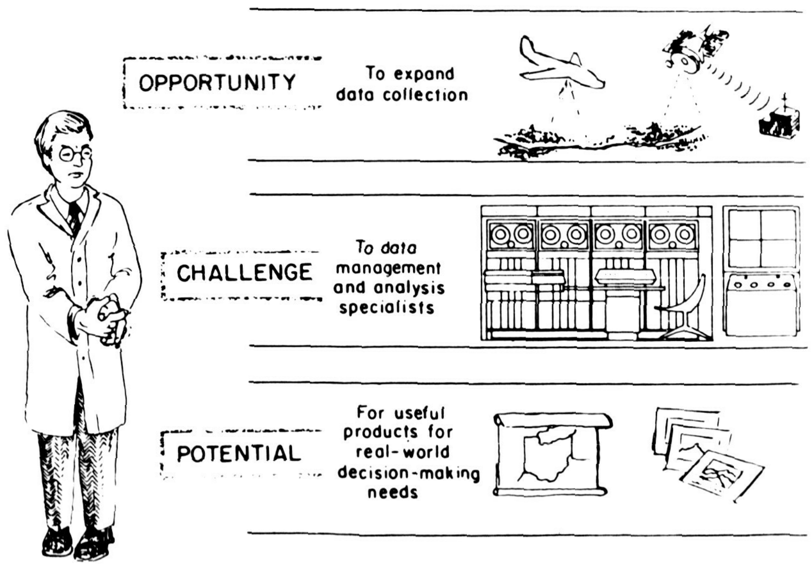

Figure 1. Space scientist's view of resource management via orbital surveys.

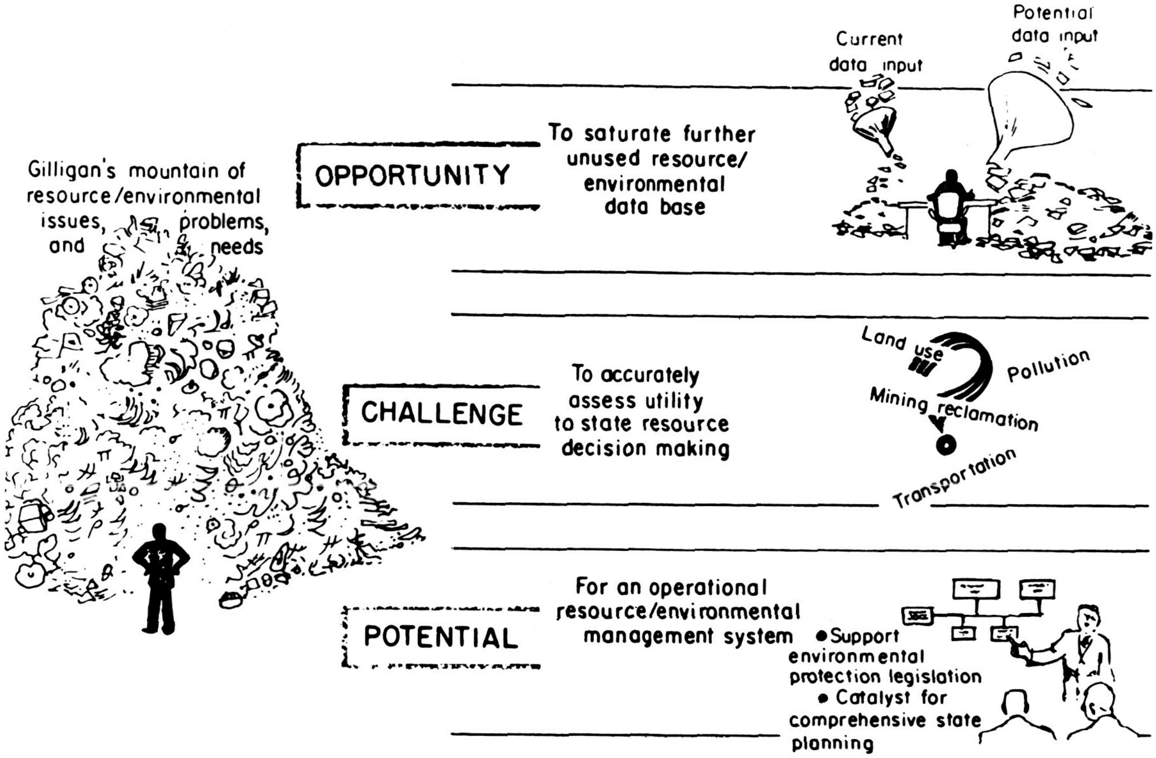

Figure 2. State planner's view of resource management via orbital surveys.

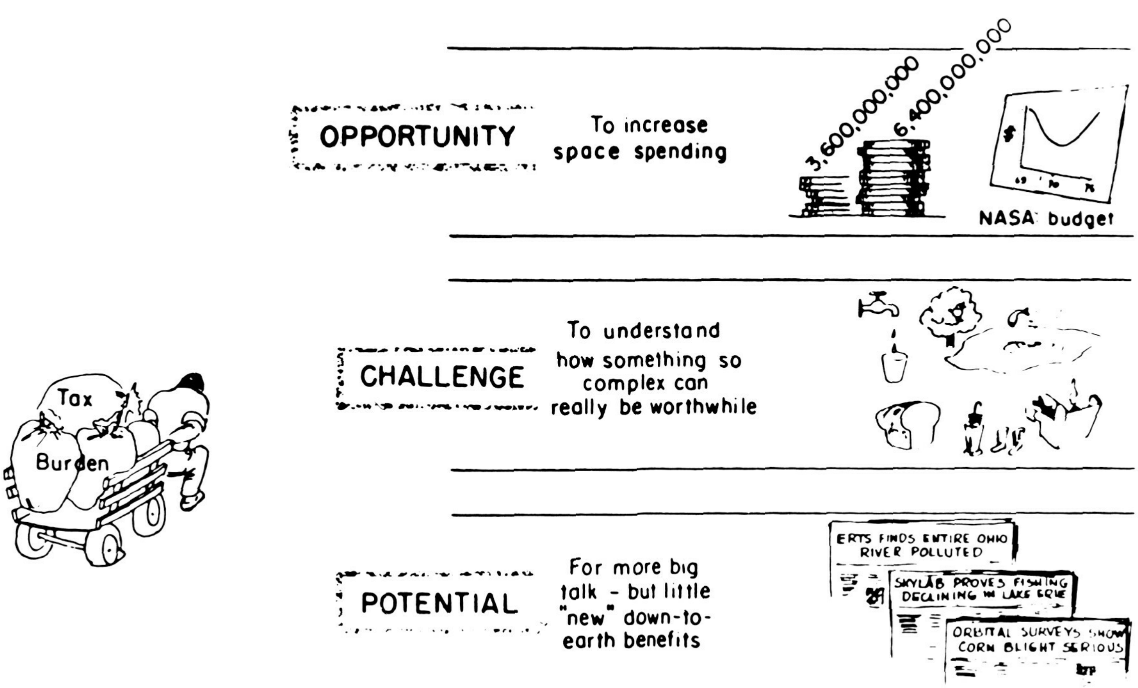

Figure 3. Public's view of resource management via orbital surveys.

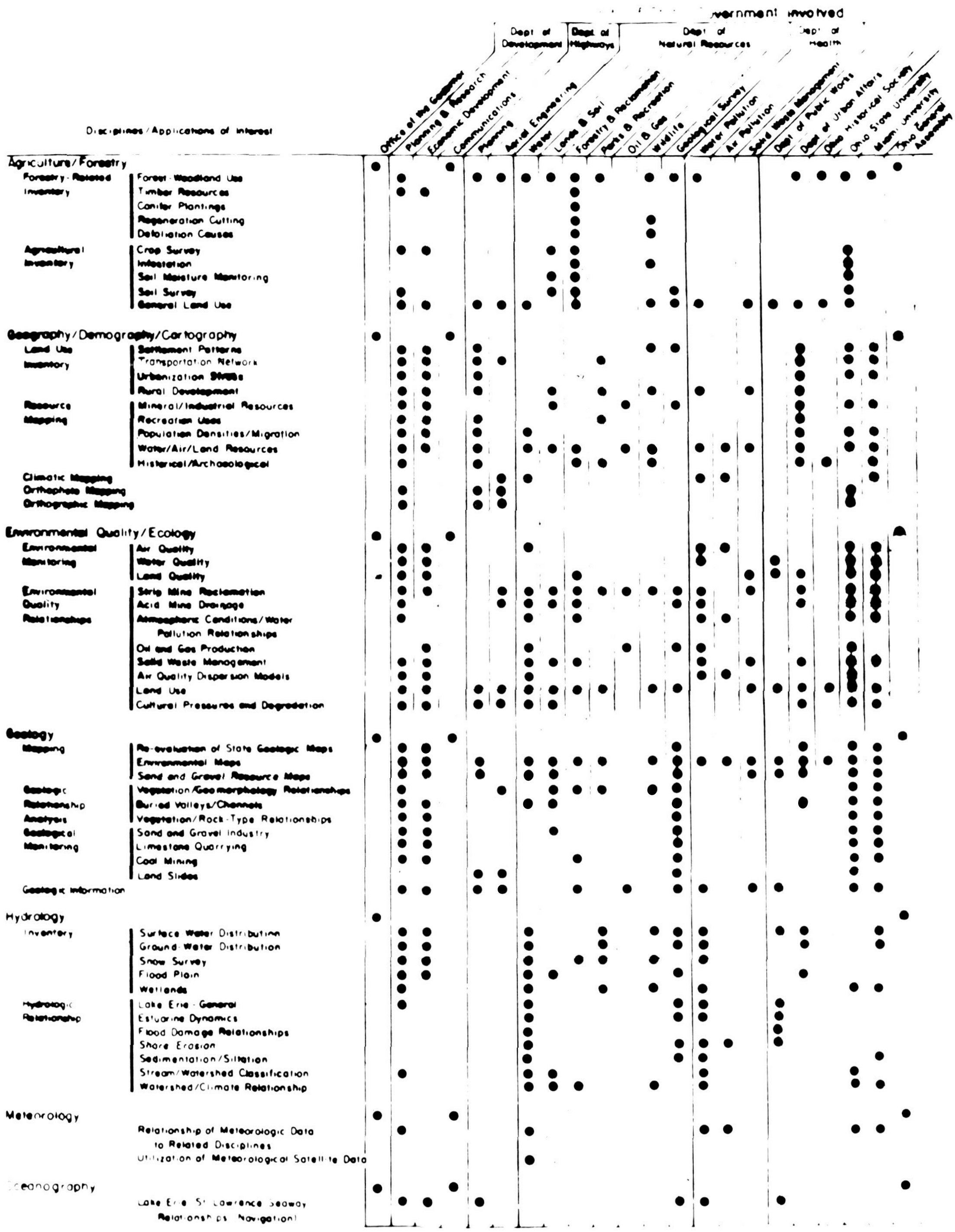

Figure 4. Potential State of Ohio ERTS/Skylab relationship.

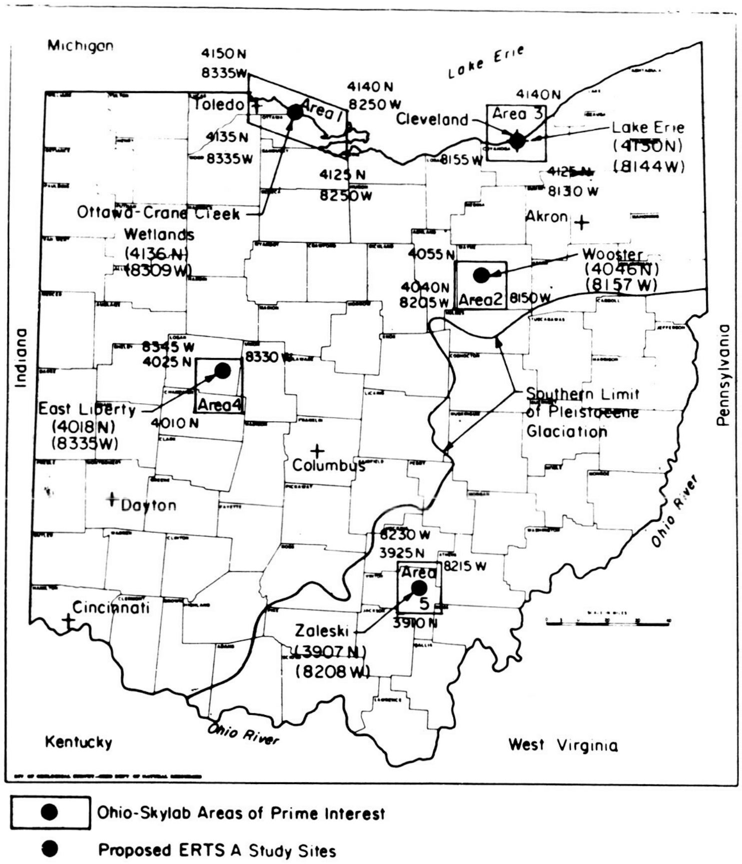

Figure 5. Location of Ohio areas of interest and study sites for ERTS/Skylab.

	Discipline										
	Agriculture	Cartography	Demography	Ecology	Environmental Quality	Forestry	Geography	Geology	Hydrology	Meteorology	Oceanography
Study Sites											
Lake Erie					+				+		+
Ohio Transportation Center		+					+				
Ottawa-Crane Creek Wetlands				+	+			+	+		
Wooster Agricultural Center	+										
Zaleski State Forest						+					
Locales of Opportunity											
Adams County								+			
Alum Creek Reservoir							+		+		
Cleveland			+		+		+				
Columbus		+	+				+				
Coshocton County								+			
Glaciated Region	+							+			
Lucasville								+	+		
Nonglaciated Region						+		+	+		
SE Ohio								+			
McConnelsville					+						
State of Ohio (as a whole)		+								+	+

Figure 6. Relationship of study sites and disciplinary interests.

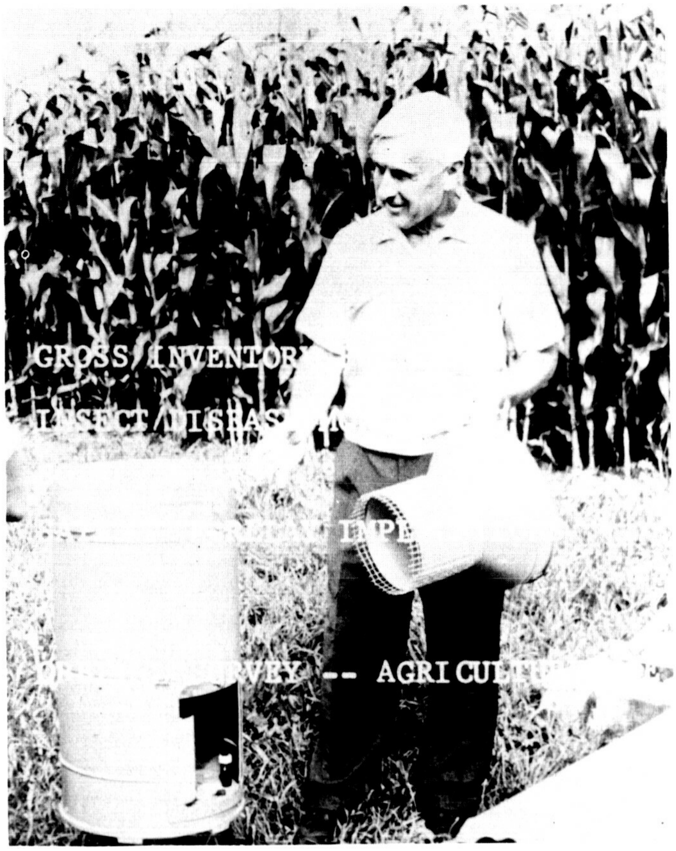

Figure 7. Orbital survey — agriculture.

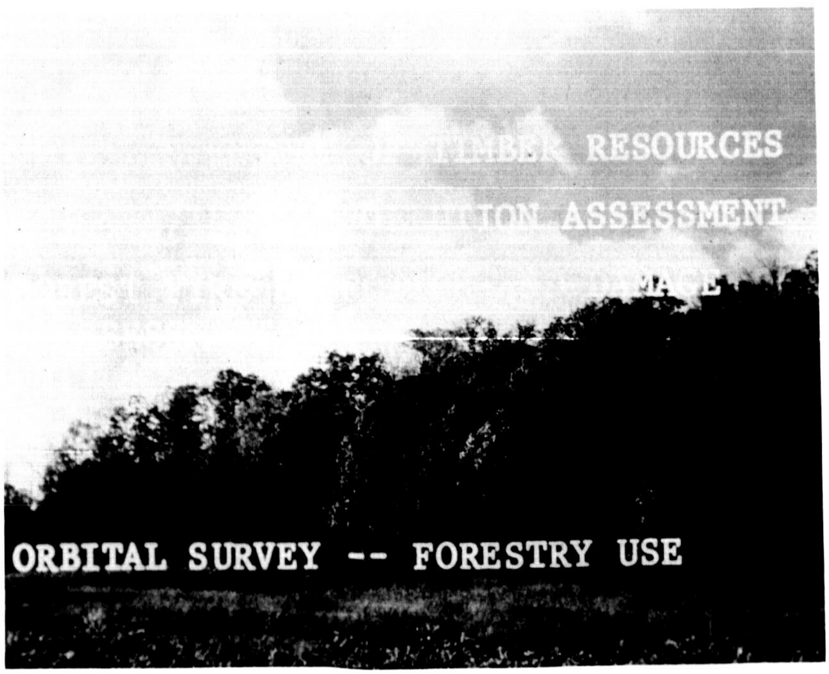

Figure 8. Orbital survey — forestry use.

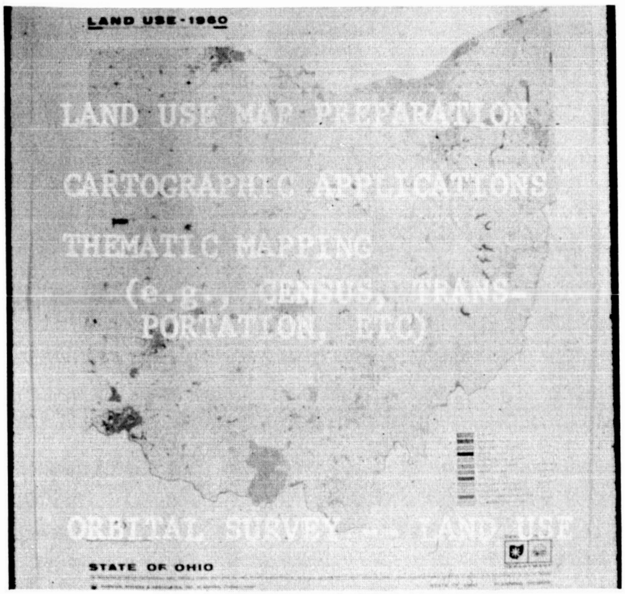

Figure 9. Orbital survey — land use.

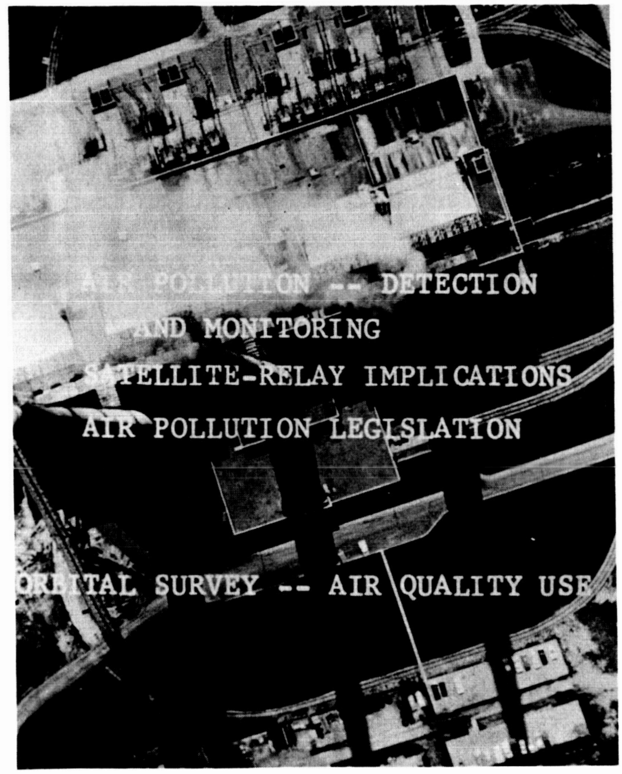

Figure 10. Orbital survey — air quality use.

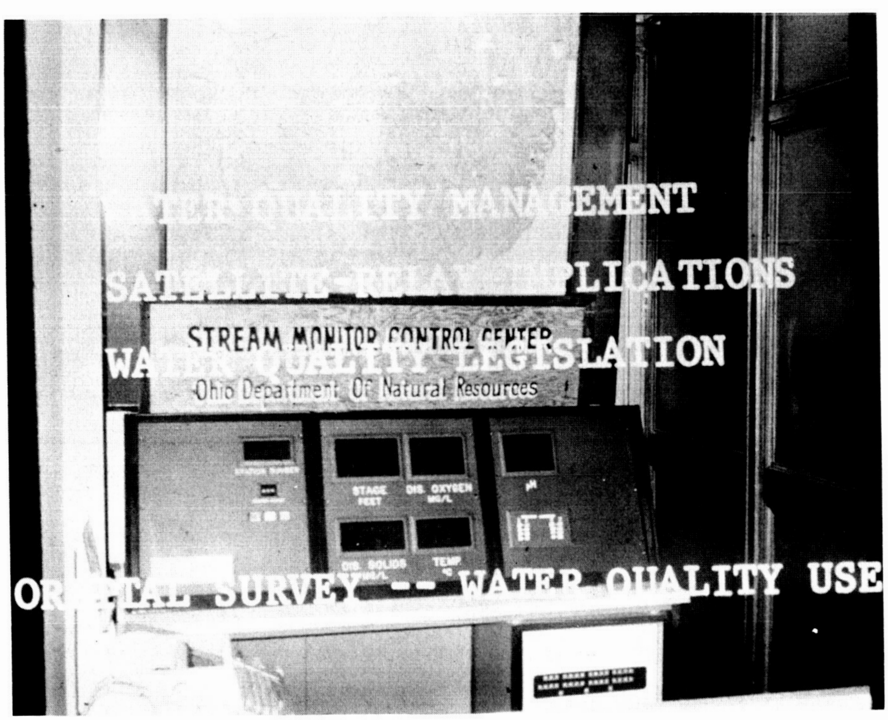

Figure 11. Orbital survey — water quality use.

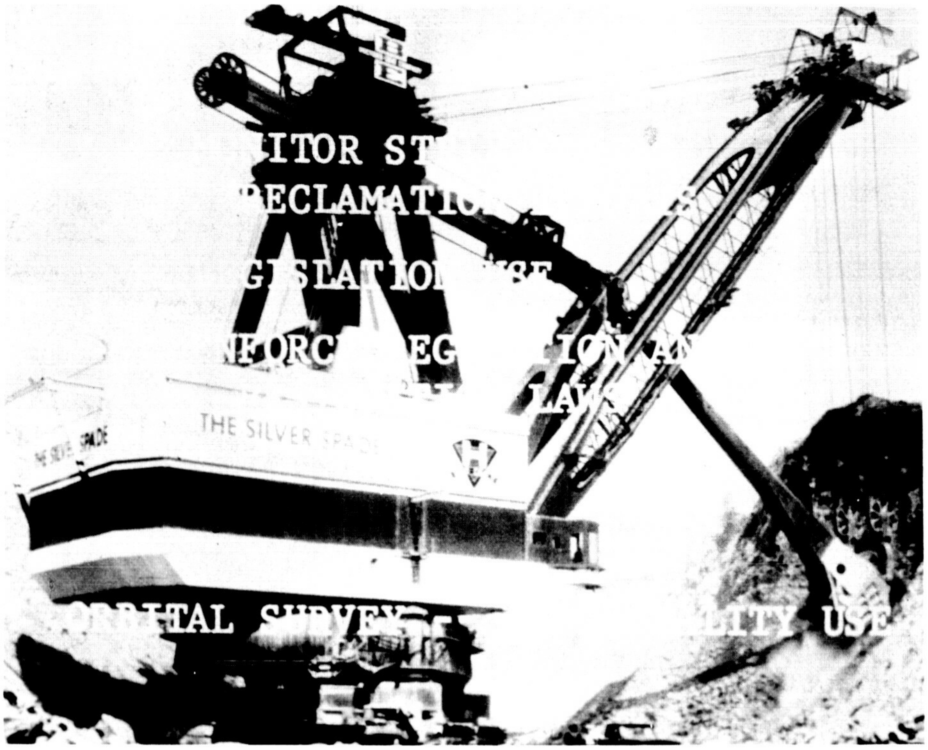

Figure 12. Orbital survey — land quality use.

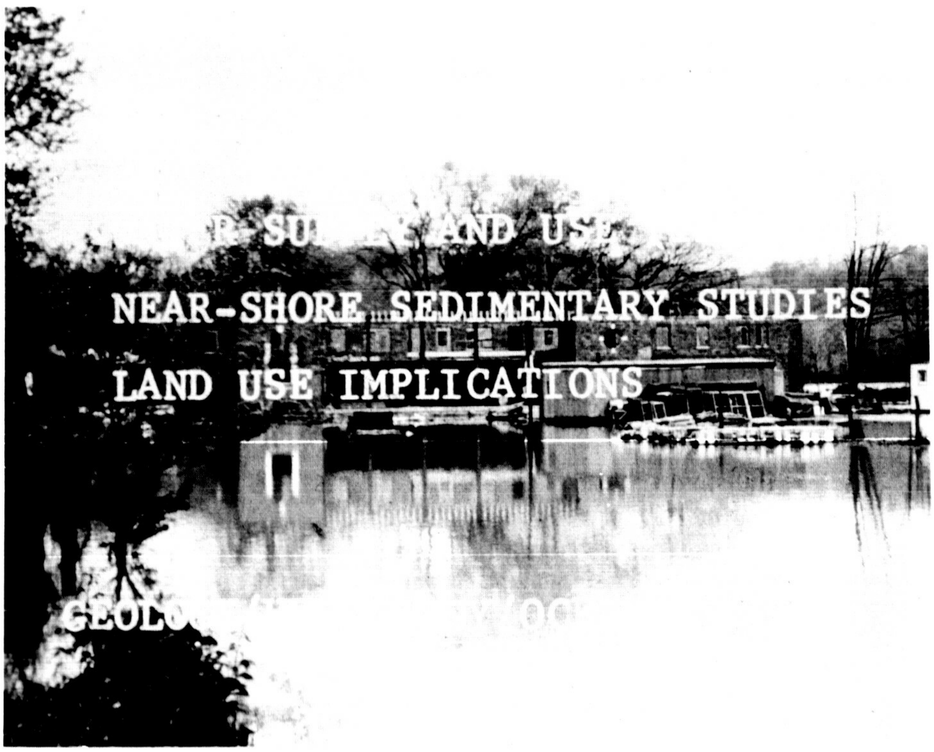

Figure 13. Geology/hydrology/oceanography (orbital data).

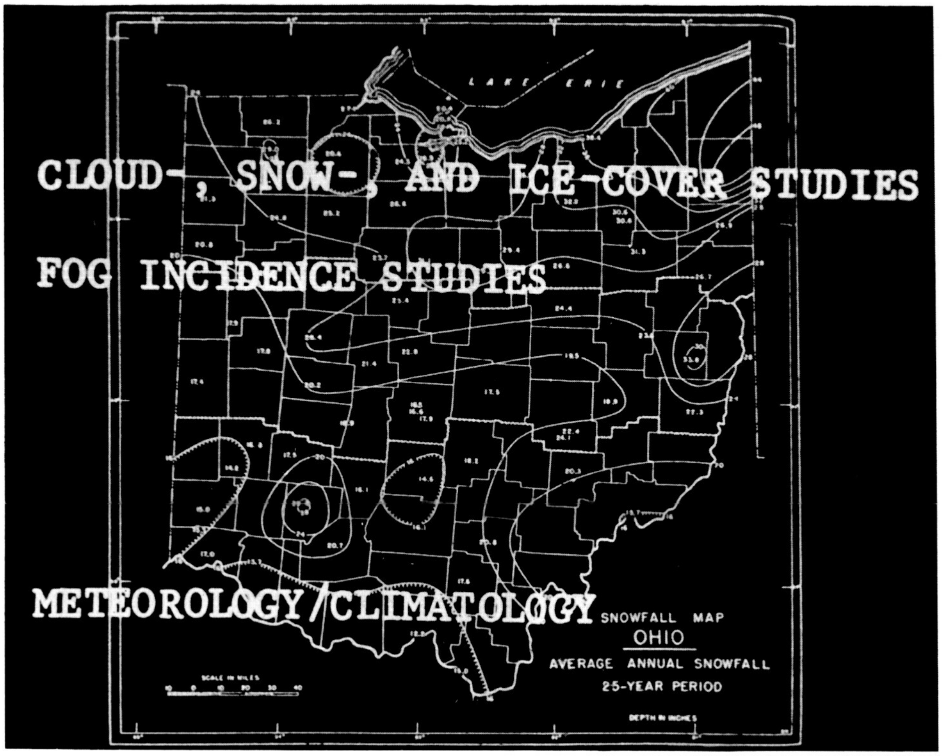

Figure 14. Meteorology/climatology (orbital survey).

	Experimental Orbital Surveys		Operational Orbital Surveys
	Short-Term Benefits		Long-Term Benefits
Problem Elements	Assured	Possible	Possible
Budget		+	+
Information	+		+
Legislation		+	+
Communications	+		+
Employment			+
Industry and Community Development		+	+
Organization	+	+	+
Education	+		+

Figure 15. Anticipated orbital survey benefits to resource-management-related problems in Ohio.