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PROJECT ARGO

Interest in the "peaceful uses" of satellite photography dates from 1960, when imagery was obtained by the first successful reconnaissance satellite. Although designed for the purpose of acquiring military intelligence in "denied" areas, the possible use of satellite photography for geoscience application was quite obvious. Although security restrictions currently preclude its general release, it was clear that some investigations were necessary to determine the feasibility of using the photography for nonmilitary applications.

In recognition of this developing need, the Special Assistant to the President for Science and Technology, Dr. D. F. Hornig, took action to begin a formal study of the classified photography by the civilian agencies. With the approval of DCI and the Secretary of Defense, and in concert with the Departments of Agriculture, Interior and Commerce, the AID and NASA, a plan was developed and "Project ARGO" began in July 1967 to "evaluate the information content of the existing photography as it would apply to various physical resource surveys and to determine whether it could be used to meet some current needs of the civilian agencies." The study was performed by a team of scientists and engineers nominated by the participating civilian agencies. The study was conducted utilizing satellite photography covering a large area of South America containing a wide variety of topography, vegetation and climatic conditions and satellite photography of sites within the United States where ground truth data were available to permit forming judgements in regard to accuracy and completeness.

The team concluded the study in March 1968 and published a detailed four volume report that documented the analyses and opinions of these scientists and engineers. It was stressed that this report was not a comprehensive and final conclusion on the use of existing space photography for civilian purposes but it presents the personal judgements of the carefully selected resource experts who studied the existing photography and evaluated it in terms of its information content and its usefulness to those agency needs with which they had experience.

The report documents the information capabilities and limitations of satellite photography for each of the categories or disciplines listed below. Extracts shown are representative of the conclusions of the various ARGO investigators.

Agriculture (Plants and Soils) None of the current panchromatic photography has sufficient information content to be useful for determing plant disease or insect infestation, but that all evaluated photography shows vegetative patterns and land use features. Coverage at the appropriate time of the year can show detailed patterns such as differences between standing crops and bare fields.

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Agriculture (Crop and Land Use Measurements) The use of mathematical rectification makes it possible to obtain the required accuracy for crop acreage measurement in the U. S. with the KH-7 strip, although its limited area coverage limits its usefulness for the purpose.

Agriculture (Forestry) Distinguishing commercial from noncommercial forest land is generally beyond the capabilities of all but the KH-7 photography, but that the separation of vegetative areas from nonvegetated areas can be accomplished even with the index photography.

Agriculture (Limitations and New Development) Severe erosion is easily observed on the TK photography, but moderate and slight erosion is difficult to detect; the same situation is true for salinity.

Map Products Maps at various scales are currently being compiled using the satellite photography, and planimetric and topographic maps prepared by the USGS, Forest Service, and Bureau of Land Management, etc., could be revised and updated with base materials provided by satellite photography.

Geology The KH-4 panoramic and KH-7 strip photography provides good information for the geologic understanding of landforms, drainage patterns, anomalies, and physiography and would be useful if aircraft coverage were not available, or for worldwide examinations of special geological features such as fault systems.

Hydrology Satellite photography can be used for broad water resources planning, for cartographic delineation of flood plains and for some aspects of detailed water resource development and conservation planning. It is pointed out, however, that space photography cannot in all cases compete with aerial photography, if available, and cannot replace the need for field investigations for detailed water-resource development and conservation.

Geography and Cultural Features Satellite photography can be used for preliminary engineering surveys and route selection. The KH-4 panoramic photography is excellent for thematic mapping and provides good information for land use dynamics and determination of climatic zones by inference.

Oceanography and Hydrography It is not practical to perform marine biology and chemical oceanography studies with any of the current systems. Neither is it useful for marine geology studies, for measuring near shore of subsurface currents, for determining length and direction of wave propogation, or for subsurface topographic contouring. The KH-4 panoramic and KH-7 strip can measure ice coverage and ice movement.

Regional Studies Six geoscience overlays (drainage, engineering geology, vegetation, surficial materials, surface configurations and landforms, and climatology) were prepared for a 1.2 million square mile area from satellite photography that were, in many cases, superior in over-all detail to published small scale geologic maps, USAF Operational Navigation Charts, and National Intelligence Survey reports.

Snow Coverage Measurement Present techniques are costly and time-consuming; more accurate data are desireable for flood and water yield forecasting. By using satellite photography, it should be possible to gather this needed information on a rapid and timely basis.

Summary of Requirements

Most ARGO investigators discussed how the timeliness and frequency of coverage affected its usefulness and expressed opinions which varied widely according to the particular application and interest. Some interests were served by exploiting the photography already on hand. Most required new coverage targeted for particular areas and at particular times. Many required repetitive coverage and timeliness. For example, the geographer felt he could use the imagery presently on hand as a data base with which to compare future worldwide coverage for the study of long term effects.

The hydrologist can use existing photography for delineating flood plains, but wanted repetitive coverage six times annually for snow cover determination and flood forecasting, and on-demand coverage for flood damage surveys. All natural disaster evaluations require timely on-demand coverage, but the geologists can use one-time KH-4 coverage for the study of the world's fault system as an aid to the understanding of earthquake mechanisms. The point was made that "agriculture is dynamic in that plant and soil conditions are constantly changing." Crop acreage, yield estimates and estimates of stress would require scheduling of coverage during specific periods of the growing season. For forestry applications such as land use dynamics and timber depletion, annual coverage would be desired, but for forest inventories, coverage every five years would suffice. Oceanographic studies, such as those involving polar sea ice, may require only one time coverage for water balance studies but perhaps weekly coverage for optimum sea ice monitoring.

It was the considered opinion of most ARGO team members that the most obvious value of space photography is the advantage of a broad synoptic view of a region or country. Another advantage is the accuracy or vertical or near-vertical photography from space and the accurate comparative grey or color photographic tones that result from space photographs of very large areas vs. the present standard mosaic which is a patchwork of individual pictures. The rapidity of coverage of an area by spacecraft systems gives uniform photography under the same conditions of vegetation, season, etc. Thus administrators and planners now can have the capability to examine and develop resources with the advantage of regional planning. In general, however, it was felt that TK photography obtained in color with a system optimized for earth resources purposes can be of much greater usefulness and every attempt should be made to obtain it.

In general, the team was not prepared to make categorical statements about the value of various levels of resolution. Many of the investigators were impressed by the vast area synoptic view provided by mosaics using the low resolution index cameras and its value as a basis for regional planning for the identification of areas for which more detailed information might be desired. At the same time, most of the specific applications that were identified by the team made use of the higher resolution KH-4 and KH-7 systems (about 10 feet and 3 feet respectively). The investigators were generally reluctant to give up what they considered a major advantage of satellite photography--large area coverage. Although the KH-7 gave more detailed information because of its higher resolution, most team members considered the KH-4, which is a panoramic camera with large area coverage, to be a better system for their purpose.

An interesting observation made by one team member was the recognition that the biggest problem would be the development of efficient procedures for reducing raw data to a usable form and to establish and maintain meaningful levels of information retrieval. This means knowing when to stop even though greater detail can be viewed. Otherwise one could be overwhelmed with a mass of unusable data.

It was generally noted that in order for TK photography to be most fully utilized by civilian agencies, it should be completely declassified. If this is not presently possible owing to national security needs, it would still be possible to use existing and future TK material to a limited extent in a classified facility.

The report was based upon existing photography that was acquired from six camera types from four reconnaissance satellite systems (KH-4, KH-5, KH-7, KH-8). The determination of the specific characteristics desired for future systems was beyond the scope of this study and generally was not dealt with by the ARGO team members.

FRAMING CAMERA ONLY