CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM

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Prepared for:

Goddard Space Flight Center
Greenbelt, Maryland 20771

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a. Central Atlantic Regional Ecological Test Site: A Prototype Regional Environmental Information System. (ERTS-A Experiment SR-125)

b. IN-002

c. Statement and explanation of any impedance.

The two difficulties that were reported on our progress reports of 1 November 1972 and 1 January 1973 are still with us. These are the lack of complete aircraft underflight coverage and lack of color combined ERTS imagery of a scale suitable for land use analysis. These problems have been alleviated to some extent since the last reporting period, but both have been the cause of significant delays in the progress of the investigation which are matters of some concern.

As yet we have not received the underflight data for the remainder of the CARETS region, which we understand was successfully flown during January. We are aware of NASA's difficulties in this area, and we are appreciative of the efforts NASA is making to speed up the delivery of the underflight data. We ask in return that NASA be sympathetic with the attendant delays in delivery of the reports and other results from this investigation.

Our present delivery of ERTS data is in the form of 70 mm chips, both positive and negative. With the report containing our data analysis plan, in preparation at this writing, we are initiating a formal request for additions to the data products. We are basing this request on our experimentation with types of data products and with a variety of procedures for using color-combined views of the data. We have conducted some experimental interpretations on single band images, but for detailed and systematic

land use analysis and mapping, a color combined view, approximately in the color infrared film format, has been found to be indispensable.

We have obtained this color combined view in two different ways. One is by placing the 70 mm multispectral film chips into an I^2S viewer. This is fine for initial or once-over-lightly analysis of the area contained in the entire frame and for such things as feature identification for image descriptor forms. This method does not have sufficient enlarging capability, however, to enable systematic mapping to be done at our working map scales. Next, we have experimented with four different scales of commercially obtained color composite transparencies and opaque prints. The transparencies have proven superior to the opaque prints for detailed land use analysis. We have obtained transparencies at a scale of approximately 1:2,000,000; 1:1,000,000; 1:250,000, and 1:100,000. Costs for this processing, in a commercial Washington, D.C. laboratory, are higher than anticipated. Before making the major commitment of funds to produce commercially the remaining color composites that are required for this investigation, we would like to have assurance that: a) we are using the highest quality data products (70 mm transparencies) available for the many-times enlargements necessary, and b) there is no possibility of NASA supplying directly the required color composites. Since we are pushing the ERTS data close to the limits of its resolution, it is imperative that we have the highest quality imagery possible.

d. Accomplishments during the reporting period and those planned for the next period.

Three preliminary studies were carried to completion during the reporting period in preparation for the ERTS-1 Symposium, March 5-9, 1973. First was a brief "photomorphic" analysis of the entire CARETS region, based upon a hastily assembled photomosaic comprised of images of MSS band 5, enlarged to a scale of 1:1,000,000. The mosaic was visually analyzed and classified into zones on the basis of similarity of tones and textures visible at this regional scale overview. A qualitative comparison of the resulting photomorphic patterns had remarkable resemblance to patterns on the small scale land use map from the National Atlas. Other National Atlas maps of the region, for example, relief, surface land forms, geology, soil, vegetation, and forest types were also examined and found associated to varying degrees with the patterns of the ERTS imagery, but none so much as the land use map. The ERTS-derived zones of similarity will later be tested against the land use data base which has already been derived from high altitude aerial photography. These zones are thought to be sub-regions of similar land use characteristics. If so, regional scale ERTS analysis may provide a sampling strategy for selecting sites for more detailed field measurements at a great saving in time and cost over present methods of regional environmental analysis.

The Norfolk-Portsmouth SMSA was selected for a detailed test of the capability of ERTS data to provide a uniform data set on land use change. The entire area of the SMSA was analyzed, using

the combination of ERTS and aircraft data analysis procedures, and using the 1970 high altitude aircraft Level II land use data base for the region. This analysis produced totals of land use at both Level I and Level II as summarized in the following table:

Results of the 1970-72 change analysis

Area analyzed (SMSA total)	1911 km^2
Total aircraft verified land use change, Level I	36.2 km^2
ERTS identified land use change, Level I	26.5 km^2
Percent of Level I change identified with ERTS	73.2 %
Total aircraft verified land use change, Level II	39.2 km^2
ERTS identified land use change, Level II	22.4 km^2
Percent of Level II change identified with ERTS	57.3 %
"False" change (erroneously indicated by ERTS)	64.3 km^2

The results of this analysis are considered to be highly promising, even without the sophisticated signature determination which is possible with the ERTS MSS data. A high proportion of Levels I and II land use change was detected and identified correctly with the ERTS data. Almost all of the "false change" turned out to be bare fields which had a bright appearance in the October and December ERTS imagery, similar to those of urban areas for which they were originally mistaken in the interpretation. It is expected that data from later spring and summer ERTS images would reduce or eliminate this problem of misidentification.

The results of the analysis of the coastal region from New Jersey to Maryland were highly promising for purposes of environmental studies of the Barrier Islands, a highly fragile environmental sub-region within CARETS, and one that is subject to intense developmental pressures. All four ERTS MSS bands were found to contribute valuable information to the analysis of these coastal features, with bands 5 and 7 probably the most significant for purposes of discrimination of land-water boundaries, dunes, marsh, and conditions in the back bay.

Also during the reporting period successful system tests were performed on a polygon storage and retrieval system for handling land use data. This work is benefitting from a USGS grant to the International Geographical Union (not paid for by NASA) to assist the USGS in developing geographic information systems for land use analysis. The first meetings of the IGU advisory group were held during this reporting period.

Continuing liaison with regional users during the period of this report included user conferences with officials of the following groups: 1) Maryland State Planning Office; 2) Virginia Division of State Planning and Community Affairs; 3) Northern Virginia Planning District; 4) Southeast Virginia Planning District, and 5) Metropolitan Washington Council of Governments.

Accomplishments planned for the next reporting period include:

a) Beginning systematic 1:250,000 mapping at Level I using ERTS imagery

b) Continue with update of high altitude aircraft data base, using 1972-73 underflight photography

c) Conduct field check in cooperation with user agencies.

e. Scientific results and practical applications

A comparison of "photomorphic regions" from an uncontrolled ERTS mosaic of CARETS to land use areas on a map published in the National Atlas revealed close correlations in non-urban regions. Such regional scale analysis of ERTS data has the potential for providing an economical sampling strategy for selecting sites for more detailed field measurements, if, as is suspected, other environmental variables can be correlated with patterns on ERTS imagery. More importantly, such analysis may provide an increase in our basic knowledge of the complex of interwoven environmental processes shaping man's habitat.

ERTS imagery has also revealed for the first time the appearance of CARETS during the winter months. Using the I^2S color additive viewer, investigators have identified extensive areas of conifers, which have previously been indistinguishable from deciduous vegetation. ERTS images have also shown very clearly the extent of snow cover at a particular time over the region. The pattern of snow on the landscape seems to have an "etching" effect that may aid the investigator by enhancing certain land uses.

Finally, in the evaluation of ERTS imagery used for the land use mapping of the shore zone of CARETS, it has been found that the presence or absence of elements of an hierarchal system of shoreline landforms can help identify areas of potential rapid change. Changes in land use class distributions on the Barrier Islands signify the environmental response to natural and man-caused processes. Both environmental vulnerability (possibility of a land cover class undergoing significant change) and

sensitivity (the degree of possible land class damage resulting from the actions of man) can be estimated from the repetitive ERTS coverage of long reaches of the CARETS coast.

These results indicate valuable potential applications to land use planning, land use management and regional environmental quality analysis.

f. Published reports or talks.

None.

g. Recommendations concerning practical changes in operations, additional investigative effort, correlation of effort and/or results as related to a maximum utilization of the ERTS system:

(1) Improvements are needed in the delivery of quality color composite copies of ERTS imagey, in a form suitable for land use analysis. It is suggested that NASA investigate economical means of providing photo copy of ERTS imagery to investigators at scales of 1:250,000 and 1:100,000, as well as the scales now provided. The high quality of ERTS imagery justifies interpretation at scales of 1:100,000 or larger for certain land use analysis applications.

(2) The problem of systematic detection and mapping of land use change could benefit from additional NASA effort, possibly resulting in a determination of best methods discovered by ERTS investigators, and further facilitating communication among investigators on this topic.

(3) Coordination among ERTS investigators who are dealing with the identification and mapping of land use is strongly suggested, so that comparability of results can be achieved. The USGS is attempting to develop standards of land use description based on satellite and aircraft data, according to a proposed classification

scheme set forth in USGS Circular 671 (Anderson, Hardy, and Roach, 1972). The USGS would appreciate receiving results of ERTS land use investigations in different parts of the country, and information on degree of success in using the proposed classification scheme, or suggested modifications thereof. This applies to land use information extracted from ERTS data by either manual or automatic means. Communications may be sent to Dr. James R. Anderson, Chief Geographer, USGS, or to any of the USGS Geographic Applications Program ERTS-1 investigators: Robert H. Alexander, John L. Place, and James R. Wray, U.S. Geological Survey, Washington, D.C. 20244.

(4) Relating to the previous suggestions, a modification of the ERTS Image Descriptor list to apply specifically to land use categories observable on ERTS images might further facilitate the interchange of land use information, provided that a separate explanation is directed to ERTS investigators and users of the Image Descriptor file. If such a modification is adopted, it should reflect Levels I, II, and III (or higher levels if appropriate) categories of the classification scheme proposed in USGS Circular 671.

h. Listing by date of any changes in Standing Order Forms:

None.

i. ERTS Image Descriptor Forms:

See pages 9 through 15 following.

j. Data Request Forms submitted to Goddard Space Flight Center/NDPF during the reporting period, if any:

None.

k. Status of Data Collection Platforms (if applicable):

N/A

ERTS IMAGE DESCRIPTOR FORM

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PRINCIPAL INVESTIGATOR Robert H. Alexander

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ORGANIZATION U.S. Geological Survey

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
E-1079 15142-4,5,6,7 10 OCT. 72 Bulk Process				bay, barrier beach, bridge, barrier lagoon, barrier island, canal, cape, coast, coastal plain, coastal marsh, coastline, continental shelf, estuary floodplain, forest, highway, island, lake, marsh, meander, peninsula, plain, river, sea, stream, valley tributary, vegetation
E-1132 15085-5,6,7 2 DEC. 72 Bulk process				BARRIER BEACH, barrier island, coastal marsh, coastal plain, cropland, forest, island, rural area, sea, vegetation
E-1132 15092 2 DEC. 72 Bulk process				back bay, barrier island, barrier beach, bridge, cape, coast, coastal plain, coastline, conifer, continental shelf, cropland, estuary, forest, highway, inlet, island, marsh, peninsula, plain, rural area, sediment, vegetation

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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CODE 563
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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
E-1133 15135-5,6,7 3 DEC. 72 Bulk process				back bay, bridge, barrier beach, barrier island, barrier lagoon, bridge, canal, coast, coastal marsh, coastal plain, conifer, continental shelf, cropland, estuary, flood plain, forest, gap, highway, harbor, inlet, island, lake, marsh, meander, metropolitan area, mountain, piedmont, ridge peninsula, salt marsh, sea, stream, suburban area, tributary, urban area, valley, vegetation
E-1133 15141-5,6,7 3 DEC. 72 Bulk Process				airfield, back bay, bay, barrier beach, barrier island, bridge, canal, cropland, cape, coast, coastal plain, coastal marsh, coast line, conifer continental shelf, cropland estuary, floodplain, forest, harbor, highway, inlet, island, marsh, meander, plain, river, rural area, salt marsh, stream, tributary valley, urban area, vegetation

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
E-1133-15144-4,5,6,7 3 DEC. 72 Bulk process				AIRFIELD, BACK BAY, bay, barrier beach, barrier island, barrier lagoon, bridge, canal, cape, coast coastal marsh, coastal plain, coast line, conifer, continental shelf, cropland, estuary, floodplain, forest, harbor, highway, inlet, island, lagoon, lake, marsh, meander, metropolitan, area, peninsula, plain, river, rural area, salt marsh, sea, stream, suburban area, tributary, urban area, valley, vegetation
E-1134 15202-5,6,7 4 DEC. 72 Bulk process				BAY, coastal plain, highway, island, lake, meander, metropolitan area, peninsula, piedmont, plain, river, rural, stream, suburban area, tributary, urban area, valley, vegetation
E-1134 15204-5,6,7 4 DEC. 72 Bulk process				bridge, coastal plain, conifer, cropland, flood plain, forest, highway, island, lake, marsh, meander, plain, river, rural area, stream tributary, urban area, valley, vegetation

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
E-1170 15191-4,5,6,7 9 JAN. 73 Bulk process				bay, bridge, canal, coastal plain, dam, estuary, floodplain, forest, gap, harbor, highway, island, lake, meander, metropolitan area, peninsula, mountain, plain, ridge, river, rural area, tributary, urban area, valley, vegetation
E-1170 15193-4,5,6,7 9 JAN. 73 Bulk process				Airfield, bay, bridge, coastal marsh, coastal plain, cropland, estuary, floodplain, forest, gap, harbor, highway, island, lake, marsh, meander, metropolitan area, mountain, peninsula, piedmont, plain, ridge, river, rural area, snow, suburban area, tributary, urban area, valley, vegetation
E-1170 15200-4,5,6,7 9 JAN. 73 Bulk process				Airfield, bay bridge, coastal plain, cropland, estuary floodplain, forest, highway, lake, marsh, meander, metropolitan area, peninsula, piedmont, plain, river, rural area, snow, tributary, urban area, valley, vegetation, stream

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E-1170 15202-4,5,6,7 9 JAN. 73 Bulk process				LAKE, MEANDER, coastal plain, valley, vegetation, river, stream, cropland, snow, forest, highway, bridge, rural area, urban area, tributary
E-1171 15245-4,5,6,7 10 JAN 73 Bulk process				CROPLAND, floodplain, forest, gap, highway, island, lake, meander, mountain, ridge, river, snow, tributary, rural area, valley, stream, vegetation, urban area
E-1171 15252-4,5,6,7 10 JAN. 73 Bulk process				airfield, cropland, estuary, floodplain, forest, gap, highway, island, lake, meander, mountain, piedmont, ridge, snow, tributary, rural area, urban area, stream, valley, vegetation, river
E-1187 15133-4,5,6,7 26 JAN. 73 Bulk Process				BACK BAY, barrier beach, barrier island, barrier lagoon, bay, bridge, coast, coastal plain, coastline, conifer, continental shelf, estuary, floodplain, forest, gap, harbor, highway, inlet, island, lake, meander, marsh, piedmont, metropolitan area, mountain,

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
E-1187-15133-4,5,6,7 (continue) 26 JAN. 73 Bulk process				peninsula, ridge, plain, river, rural area, salt marsh, sea, stream, suburban area, tributary, urban area, valley vegetation
E-1187 15140-4,5,6,7 26 JAN 73 Bulk process				airfield, back bay, barrier beach, barrier island, bay, bridge, canal, cape coast, coastline, conifer, contenental shelf, cropland, estuary, coastal plain, floodplain, forest, highway, inlet, island, lake, marsh, meander, peninsula, plain, river, rural area, sea, stream, tributary, urban area, valley, vegetation,
E-1187 15142-4,5,6,7 26 JAN. 73 Bulk process				AIRFIELD, barrier beach, bay, barrier island, coastal plain, coastline, continental shelf, floodplain, forest, highway, harbor, island, lake, marsh, meander, metropolitan area, peninsula, plain, river, rural area, salt marsh, suburban area, tributary, urban area, valley, vegetation

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
E-1187 15145-4,5,6,7 26 Jan. 73 Bulk process				back bay, barrier beach, barrier island, barrier lagoon, bridge, cape canal, coast, coastal marsh, coastal plain, coastline, cropland, continental shelf, conifer, floodplain, forest, highway, inlet, island, lake, marsh, meander, peninsula, plain, river, salt marsh, sea, stream, urban area, valley, vegetation tributary

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