Date: June 28, 1973

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Re: Progress Report (Type I)

The following progress report summarizes work accomplished for the 2-month period ending June 30, 1973 with reference to Article II, Item 3 of the contract schedule outlined in #NAS5-21839.

a. Remote Sensing in Iowa Agriculture (MMC #249).

b. GSFC Identification Number of the Principal Investigator (UN-611).

c. Any problems that are impeding the progress of the investigation: No major problems are impeding the progress of this investigation at this time.

d. Accomplishments during this reporting period and those planned for the next reporting period: i) Crop and soils identification and inventory: Collection of ground truth continues at the three test sites located at Ames, Independence and Doon, Iowa. On May 3 and May 15, 1973 the NASA provided underflights were successfully completed under cloud-free conditions at these three test sites. This imagery was, in fact, delivered to our office within 2 weeks of the actual flights. Again, the imagery is of excellent quality. Coordination of these flights with the Houston based personnel and the aircraft pilots has been very pleasing. The underflight imagery is presently being analyzed to correctly list surface conditions and vegetation types present for later correlations with ERTS-1 imagery covering these areas. In addition, soil morphology and classification personnel are gathering detailed soil surveys at selected sites within these flight lines to determine the capabilities of soil mapping utilizing the various film types provided by the underflights. These results will be reported at a later time.

Analysis of the August-72 ERTS-1 imagery (E-1021-16324-M and E-1022-16380-M) over central and western Iowa test sites is continuing. As reported in the last Type I report, this imagery has been most promising for crop identification and

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inventory purposes. Point sampling in the test site areas of projected 70 mm positive transparencies and enlarged (16" × 20") positive prints has indicated that fairly unique signatures exist for various ground truth-land classifications and can be used to multispectrally (MSS5 and MSS7) identify crop land with a high degree of accuracy depending upon field size and the spectral response of the particular field in question compared to surrounding areas. Very small fields can be identified when adjoining areas are spectrally different. Some typical results are listed in Table 1 for the Ames test site. Many of the fields misclassified were either small or abnormal fields as viewed from the low altitude color IR imagery.

Table 1*

		Ground Truth			Total seen by	Commis-sion	Percent
		Soybeans	Corn	Other	P.I.	Error	Correct
Photo-interpreter's results from ERTS-1	Soybeans	48	6	0	54	6	11.1
	Corn	12	39	1	52	13	25.0
	Other	0	2	10	12	2	16.7
Total Plots		60	47	11			
Omissions		12	8	1			
Percent Correct		80.0	83.1	90.8			

* Randomly selected fields from 12 sections in the Ames flight line.

Point sampling for crop identification does not attain the fullest potential of ERTS-1 or other remotely sensed data. Area estimates of particular crop types provides more useful data to users. We do not at this time have facilities available to use computer compatible tapes or micro-densitometers to quantify the ERTS-1 data and achieve area estimates. For this reason other standard photo-interpretation techniques have been used to estimate crop land and forested land acreages. One method is described later in part ii of this report. The other is basically a project-trace-and-weigh method. Signatures for various crop types were established from known ground truth. Prints, Miniadcol produced color slides, and/or transparencies were then projected onto a flat surface and field types were traced, cut and weighed. The paper weight was converted to acreages using an adjacent calibration strip. This method was first applied to Miniadcol produced color slides, however, township acreage estimates for O'Brien County, Iowa were considerably under-estimated when compared to Iowa State Crop Reporting Service data. Attempting to classify soybean acreages only in O'Brien County using another technique appears to reduce this error considerably. These results will be reported later when fully completed. Area estimates of crop land in the flight line area where exact crop acreages are available have been hindered by lesser resolution in the ERTS-1 imagery due to topographic influences (river valley-Doon area) on the cropping pattern and atmospheric haze (Ames area), but this work will continue using more refined techniques.

During this reporting period we have recently received April and May ERTS-1 imagery over central Iowa (E-1273-16340-M and E-1291-16335-M). 16 × 20 inch enlargements of this imagery reveal striking detail with respect to vegetation and soils patterns and river drainage patterns. Only limited point sampling and a first look analysis have been completed to date. The results of the early crop growing season ERTS-1 imagery will be included in the next progress report.

ii) Analysis of timber area in eight townships, Boone County, Iowa

Objective: Compare methods for determining acreages of timber land by utilizing cartographic, aerial photographic and remote sensed imagery.

Sources of imagery:

1. The Andreas Atlas of 1875. Map of Boone County showing extent of forest cover as estimated by the cartographer.
2. ASCS panchromatic photographs of 1:20,000 scale enlarged to 1:7920 with GLO sections delineated and identified. Photographs made in 1965 with 8¼ inch focal length camera.
3. ASCS index mosaic (uncontrolled) with printed scale of 1:63,360.
4. ERTS imagery, -E-1057-16325-S. Copied and enlarged to 1:226,284.
5. ERTS imagery, -E-1057-16325-S. Left in 70mm form on film at scale of 1:3,333,600.

Procedures:

1. The Andreas 1875 map was planimetered by townships. Forest acreages by township and total are presented in Table 2.
2. The ASCS enlargements of each GLO legal section were transected at 10 chain (660 feet) intervals and the acreage determined by multiplying the total length of transect falling on forest by the distance between transect lines. Usual forest inventory procedures were followed in classifying forest as any wooded unit of more than 200 feet in width, greater than two acres in area and having crown density of 10% (approximately) or greater. The acreages found by this method appear in Table 2 and can be considered as highly reliable for the year 1965 and probably less than 1% too large for the year 1972.
3. The ASCS mosaic was transected at mile intervals so that six lines were measured for each township. Acreages were obtained by determining the percentage of total measured line in each township that fell on forest land and then applying this percentage to the 23,040 acres found in the average township. See Table 2.
4. The photographic enlargement (1:226,284) of the satellite imagery was transected at 1 mile intervals. Because of the small scale, all measurements were done under a magnifying glass and the distances along each line falling on forest were measured with a micrometer bar (Abrams Height Finder) where the scale could be read to .01mm. Acreages were found by two methods. Method A: The total length of line in forest was multiplied by the distance between transects. Method B: The percentage of transect line falling on forest was multiplied by 23,040 acres per township. See Table 2.

5. A very promising and here-to-fore unused (so far as this investigator can determine) technique was to transect directly on the 70mm film imagery by using the 4× N.A. 12 lens on an AO Spencer binocular microscope with micrometer stage having X and Y movements on a vernier graduated to .1 mm. Considerable effort has to be expended to locate the coordinates of each township but this can be done from two of several identifiable landmark images. As the 12 miles by 24 mile, eight-township project area is only 5.8 mm by 11.2 mm on the original imagery one is impressed by the detail visible and the relative ease with which individual fields can be identified. So far only one channel (MSS5) has been used and difficulty is experienced in separating woodland from the open wooded pasture and separating the river from the bottomland woods. The precision of the excellent instrument and the ease of locating points by the coordinates read from the stage vernier leads this operator to believe that good acreage determinations will be possible as soon as other procedures are developed for improving vegetative type delineations. The forest acreages are presented in Table 2. The largest errors were generated by this system but if transmission signatures can be developed, it is obvious that the transecting methodology will be quickly adapted to several of the various recording spectrophotometers available at this and other universities.

Results:

Table 2. Forest Acreages as Determined by Several Methods Utilizing Aerial Photography and Remote Sensing. Boone County, Iowa. 5th P.M.

Township		Andreas Atlas 1875	ASCS Photos 1965	ASCS Photo Mosaic 1965	ERTS "A"	Enlargement 1972 "B"	ERTS 70mm Transparency Microscope
		Acres					
T85N	R27W	9160	5517	5687	4254	4385	7416 ± 2481*
	R26W	2406	1046	1025	1772	1701	707 ± 828
T84N	R27W	9370	4833	5818	3395	3458	5872 ± 3270
	R26W	4250	1718	1425	2796	2731	2998 ± 1540
T83N	R27W	2867	1639	1444	517	533	1834 ± 1617
	R26W	11766	5875	5407	6497	6311	6295 ± 1630
T82N	R27W	0	0	0	0	0	0
	R26W	9754	4748	5192	4718	4653	4749 ± 3031
Total		49573	25376	25998	23949	23772	32,064 ± 7164

* Mean and standard error, p = .05,
n=6 for townships and n=42 for total.

e. Discussion of significant results and their relationship to practical applications or operational problems: Significant results during this reporting period include the estimates of forested and crop vegetation acreages using the ERTS-1 imagery. The methods used to achieve these estimates still require refinement, but the results appear promising. Practical applications would be directed toward achieving current land use inventories of these natural resources. This data is presently collected by sampling type surveys. If ERTS-1 can observe this and area estimates can be determined accurately, then a step forward has been achieved. Cost-benefit relationship will have to be favorable. Problems still exist in these estimation techniques due to the diversity of the scene observed in the ERTS-1 imagery covering other parts of Iowa. This is due to the influence of topography and soils upon the adaptability of the vegetation to specific areas of the state. The May 10, 1973 ERTS-1 imagery covering central Iowa shows these patterns very well. Research directed to acreage estimates will continue.

f. There are no published articles, and/or papers, pre-prints, etc. at this time.

g. No recommendations concerning practical changes in operations are suggested at this time.

h. No additions to the standing order are requested at this time.

j. No data request forms have been submitted during this reporting period.