Indiana Soil Associations Compared to Earth Resources Technology Satellite Imagery[1]

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Abstract

The multispectral scanner on the Earth Resources Technology Satellite (ERTS) measures the intensity of radiation reflected from the surface of the Earth for various wavelengths in the visible and infrared portions of the spectrum. Black and white photographs, produced from data of a single wavelength were interpreted as if they were conventional aerial photographs. The results show that some sail associations grouped by physiographic position can be consistently separated.

Introduction

This study shows the relation between data from the Earth Resources Technology Satellite (ERTS) and soil associations in southwestern Indiana. The purpose was to see if we could consistently separate soil associations by ERTS imagery over an area where soil information was already available in order to understand the potential usefulness of the ERTS system in areas that have less ground information.

Materials and Methods

The ERTS was launched to evaluate multispectral scanning from a satellite platform. It follows a nearly polar orbit which is synchronized with the sun and collects multispectral data over the entire surface of the Earth, recording information over the same point every 18 days. The multispectral scanning system simultaneously records intensity of reflected radiation in four wavelength bands: green, 0.5-0.6 μm; red, 0.6-0.7 μm; infrared, 0.7-0.8 μm; and infrared, 0.8-1.1 μm. The data are recorded on magnetic tape which stores the information obtained from an area which is 185 km square (1). In addition to magnetic tapes the data are available for each wavelength band on geometrically correct 70 mm black and white photo negatives. Positive prints of these negatives were used to compare the satellite imagery with soil association maps of Knox and Posey counties in southwestern Indiana (2, 3). The soil association maps have a scale of 1:190,080. Both counties have a distinct set of landforms related to soil associations and have a wide range of drainage and soil texture conditions. Each mapping unit is named for one to four of the dominant soil series in the unit.

The soil association maps were used as a scale to obtain black and white photographs of the ERTS imagery at a scale of 1:190,080.

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We put a 70 mm negative with the 0.8-1.1 μm wavelength data in an enlarger and placed the map below it. Using the rivers and lakes which are prominent in that wavelength as markers, we moved the enlarger until the image shown by the enlarger and the map coincided. Photographs for both infrared (0.8-1.1 μm) and red (0.6-0.7 μm) wavelength were developed and compared for scale with acetate transparencies of the map sheets.

We developed black and white prints for the red (0.6-0.7μm) wavelength from May 4, 1973 data. Photos taken of this wavelength were useful because they resembled conventional aerial photos and had a range of reflected intensities that provided good contrast. The infrared wavelengths were not used because they did not show contrast, except at water surfaces. The green wavelengths are so similar to red that they were not used. The completed black and white photographic prints of both counties were then analyzed by the methods of aerial photographic interpretation.

Results and Discussion

Figure 1 is a photo of ERTS imagery for Knox county. The lines group together images that are similar. The unusual diagonal field

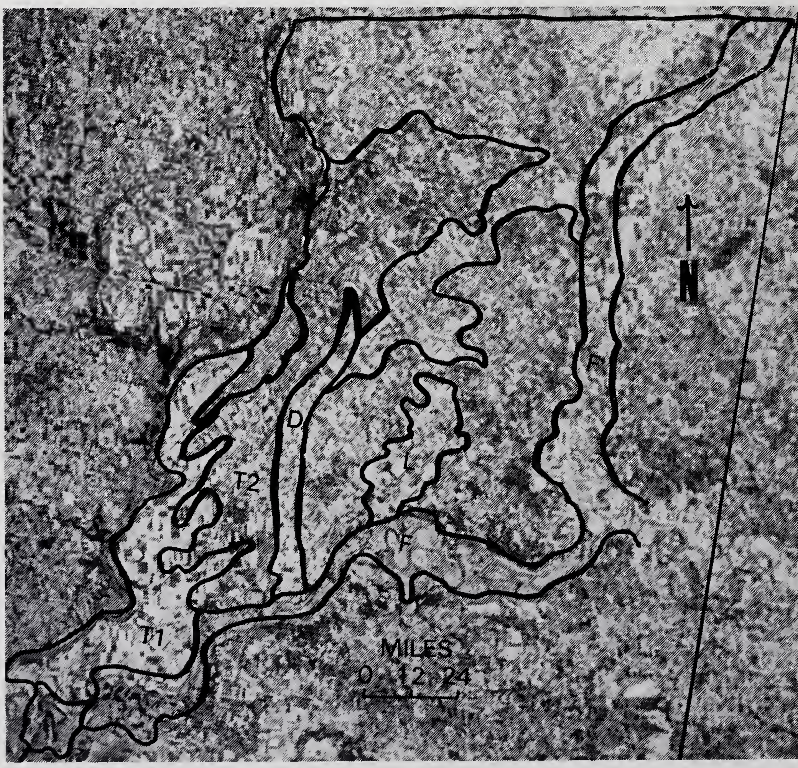

FIGURE 1. *ERTS imagery of Knox County showing the boundaries drawn as photo interpretation F, floodplain; T, terrace; D, dune and L, lake deposit.*

pattern in Knox county is a result of a survey based on civil and military land grants made by the French and British during the colonial period. Figure 2 is the Knox county soil association map super-imposed on the ERTS imagery. Knox county was completely covered by the Illinoian glaciation but not by the Wisconsin glaciation. The soil parent materials include silty alluvial material in floodplains and terrace positions; eolian sands in the dunes above the terrace position; deep loess deposits that result in the formation of sloping, well-drained soils, some with fragipans, and silty lacustrine materials (4).

Comparison of Figures 1 and 2 shows general agreement in the position of association boundaries where they are related to differences in physiographic position. The floodplains labeled F in Figure 1 are well-separated on both the White River and the West Fork of the White River on the south and east side of Knox county. It is not clear why the floodplain of the Wabash River does not appear different from the terrace, but it may be related to the water level. The infrared wavelength (0.8-1.1 μm) data shows more water in the Wabash River floodplain than in the White River floodplain. The dune area labeled D

FIGURE 2. *General soils map of Knox County drawn on ERTS imagery: 3, Wakeland-Stendal-Haymond-Bartle; 5, Haymond-Nolin-Petrolia; 9, Haymond-Wakeland; 44, Patton-Lyles-Henshaw; 50, Vincennes-Zipp-Ross; 54, Warsaw-Elston-Fox; 72, Reesville-Ragsdale; 109, Alford-Hosmer; 110, Bloomfield-Princeton-Ayrshire.*

in Figure 1 is not as extensive as that shown on the soil association map. A more detailed soil survey of the area (4) verifies that there is a linear feature in the position shown on the soil association map but that the texture of the surface horizon changes from loamy sand in the southern part of the county to sandy loam in the northern part. The dunes that have a loamy sand surface were separated on ERTS imagery from those with a sandy loam surface. The terrace region along the Wabash River was separated on the ERTS imagery but the boundary was shifted slightly from that of the soil association map. We separated two terrace positions on ERTS imagery. A detailed soil survey of Knox county shows differences between dark and light surface colors and between silt loam and sandy loam surface textures which correspond to the boundaries found on ERTS imagery.

Interpretation of the ERTS imagery did not consistently show the location of the soils formed in lacustrine sediments of former lake beds. In two areas these lacustrine soils were separated on ERTS imagery labeled L in Figure 1. One of the areas is greatly enlarged and the other is partially included with floodplain and terrace units.

FIGURE 3. *ERTS imagery of Posey County showing the boundaries drawn as photo interpretation F, floodplain; T, terrace; L, lake deposit; G, glacial boundary and U, unknown.*

Figures 3 and 4 show the ERTS imagery and soil association map, respectively for Posey county. The soil parent materials are similar to those found in Knox county except that there are not as many eolian sands and the underlying material is not of glacial origin in the southern part of the county.

There is good agreement between the Figure 3 and Figure 4 for floodplains labeled F and terraces labeled T. Again identifying lacustrine soils is a problem. One area labeled L has been separated but it is much larger than the unit in the soil association map.

There are also some separations on the ERTS imagery which are not shown on the soil association map. The unit labeled U in Figure 3 is not clearly related to any feature. The line labeled G is similar to the limit of glaciation reported by Wayne (5).

FIGURE 4. *General soil map of Posey County superimposed on ERTS imagery: 3, Wakeland-Stendal-Haymond-Bartle; 5, Haymond-Nolin-Petrolia; 8, Huntington-Lindside; 43, Patton-Henshaw; 50, Vincennes-Zipp-Ross; 56, Weinbach-Sciotoville; 72, Reesville-Ragsdale; 109, Alford-Hosmer; 110, Bloomfield-Princeton-Ayrshire.*

Conclusions

The results show that ERTS imagery can aid in making a soil association map just as air photos are used to gain information and serve as a base map for a detailed survey. ERTS imagery is useful in showing general relationships that may not be apparent in the closer view given in aerial photograph.

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