E7.2-10.26.5.
CR-129227

REGIONAL LANDSCAPE CHANGE: A CASE FOR ERTS-I

John B. Rehder and James R. O'Malley

University of Tennessee, Knoxville

(E72-10265) REGIONAL LANDSCAPE CHANGE: A CASE FOR ERTS-1 J.B. Rehder, et al (Tennessee Univ.) 27 Nov. 1972 10 p CSCL 08M N73-12364 Unclas G3/13 00265

ABSTRACT. NASA's Earth Resources Technology Satellite has been orbiting the earth and transmitting image data since July. Because of its capabilities in sensing the same geographic point every 18 days and providing a 13,225 square mile view from each image, ERTS challenges us to the task of interpreting landscape change from a regional perspective.

Since July, NASA's Earth Resources Technology Satellite or ERTS-I has been orbiting the earth in a sun-synchronous polar orbit 560 miles above the earth's surface. Sensors on board include three return beam Vidicon cameras which operate much like T.V. cameras in the blue-green, green-yellow, and red-infrared bands and a multispectral scanner system which operates in four channels from .5 to 1.1 microns. Data gathered by these sensors are transmitted to ground stations and principally to Goddard Space Flight Center where the inputs in digital format are processed into photographic imagery and digital tapes. A useful capability of the system is the repetitive coverage offered by ERTS. Every 18 days the satellite passes over the same geographic location at almost precisely the same hour thus providing a temporal as well as a spatial dimension to the system.

Approximately 735 photographic images are produced each day. Since July over 500,000 images have flooded the Goddard Data Handling Facility and the some 300 principal investigators who are examining the data nationwide. The University of Tennessee geography remote sensing project receives and analyzes some 70 images in the 70 mm and 9½ x 9½ formats in color and in black and white on an 18 day cyclic basis.

Among the capabilities of this experimental remote sensing satellite is the large area coverage: a 115 mile linear distance edge to edge on the imagery which provides a single frame coverage of 13,225 square miles.

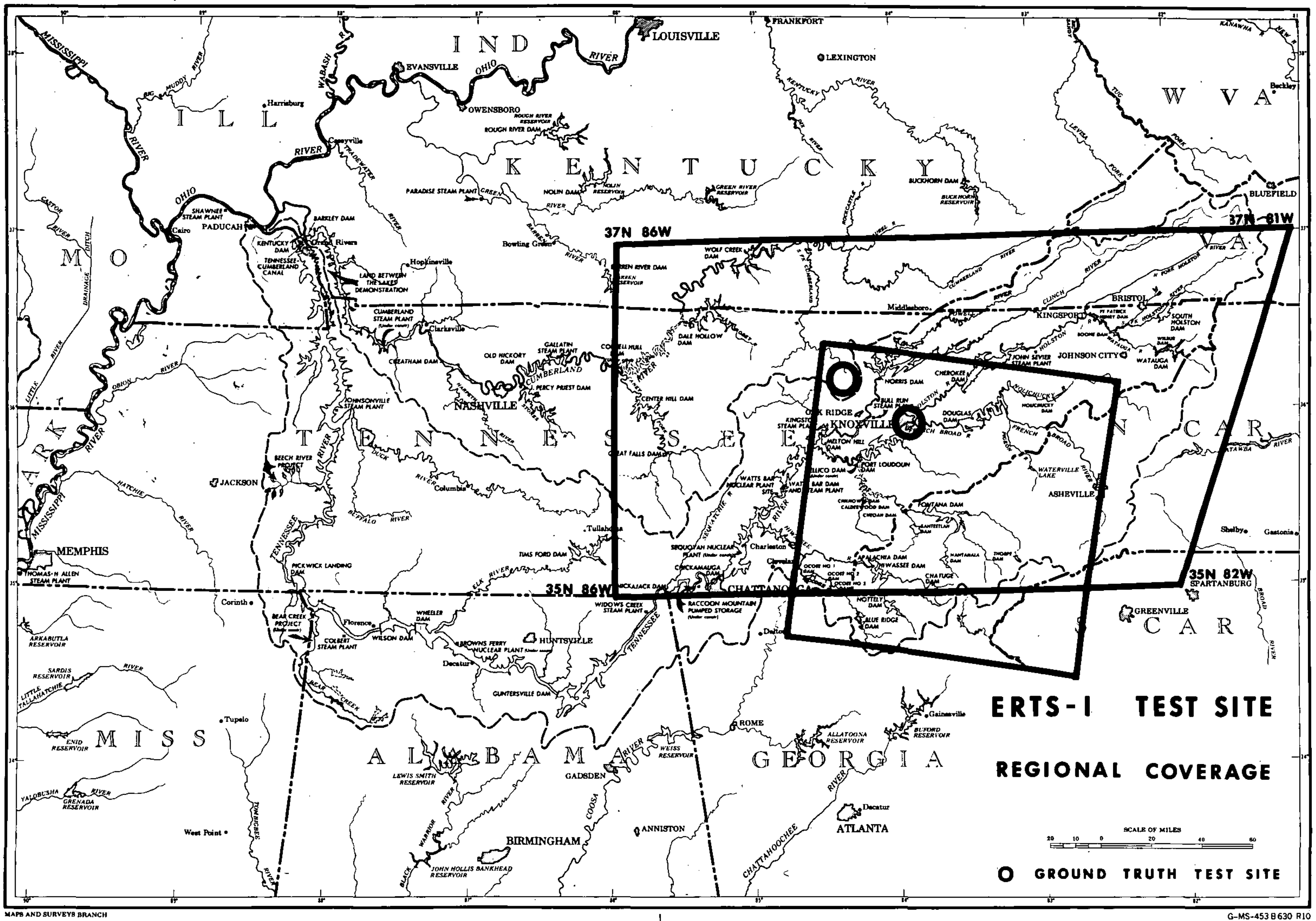
Unlike conventional aerial photography which has since the early 1930's provided an obvious data source for landscape examiners, ERTS-I imagery provides a significant regional perspective and at the same time provides enough image clarity to make signatures readily interpretable.

Using techniques of comparison in a multi-stage sampling procedure let us examine a case in point in the detection of regional landscape change produced by surface stripmining in Tennessee (Figure 1). Conventional low altitude imagery (10,000') produces readily identifiable stripping signatures at a scale that is too specific for many applications. Local change can be detected by the loss of vegetation and surface soil on the primary cut. However, such a scale obscures the more long range and perhaps more significant regional consequences induced by stripping. If enough cyclic low altitude imagery is generated to cover a large area of potential landscape change, the sheer number of individual images becomes unmanageable. Therefore, as many interpretors have discovered, low altitude imagery is not the most reliable for large area coverage.

Intermediate scale imagery has until recently been the most productive effort in an attempt at regional interpretation. Some of the most useful has been that generated by the NASA RB-57 aircraft program. Here again, however, the areal extent of the coverage fails to approximate a regional scale. The RB-57 imagery on a 9 x 9 mm format gives 89 square miles or 17 miles linear distance per frame coverage and requires approximately 35 individual shots to cover a 10,000 square mile area. Again utilizing the strip mining example enough imagery to cover the Tennessee and Eastern Kentucky strip mining areas would require 72 individual shots. To add cyclic coverage which is indispensable in change detection compounds the image handling problem to the Nth power.

ERTS-I produces imagery that will allow change detection on a regional scale. Each individual photo produces a coverage of approximately 13,000 square miles. The aforementioned strip mining area of Tennessee and Kentucky can be covered by 2 frames and with minimal loss of surface mining signatures. With such a data base of cyclic coverage, landscape change within the large areal confines of strip mining regions can not only be detected but also monitored. An accurate account of area stripped can be extracted from the imagery and provide a base from which to calculate further landscape alteration.

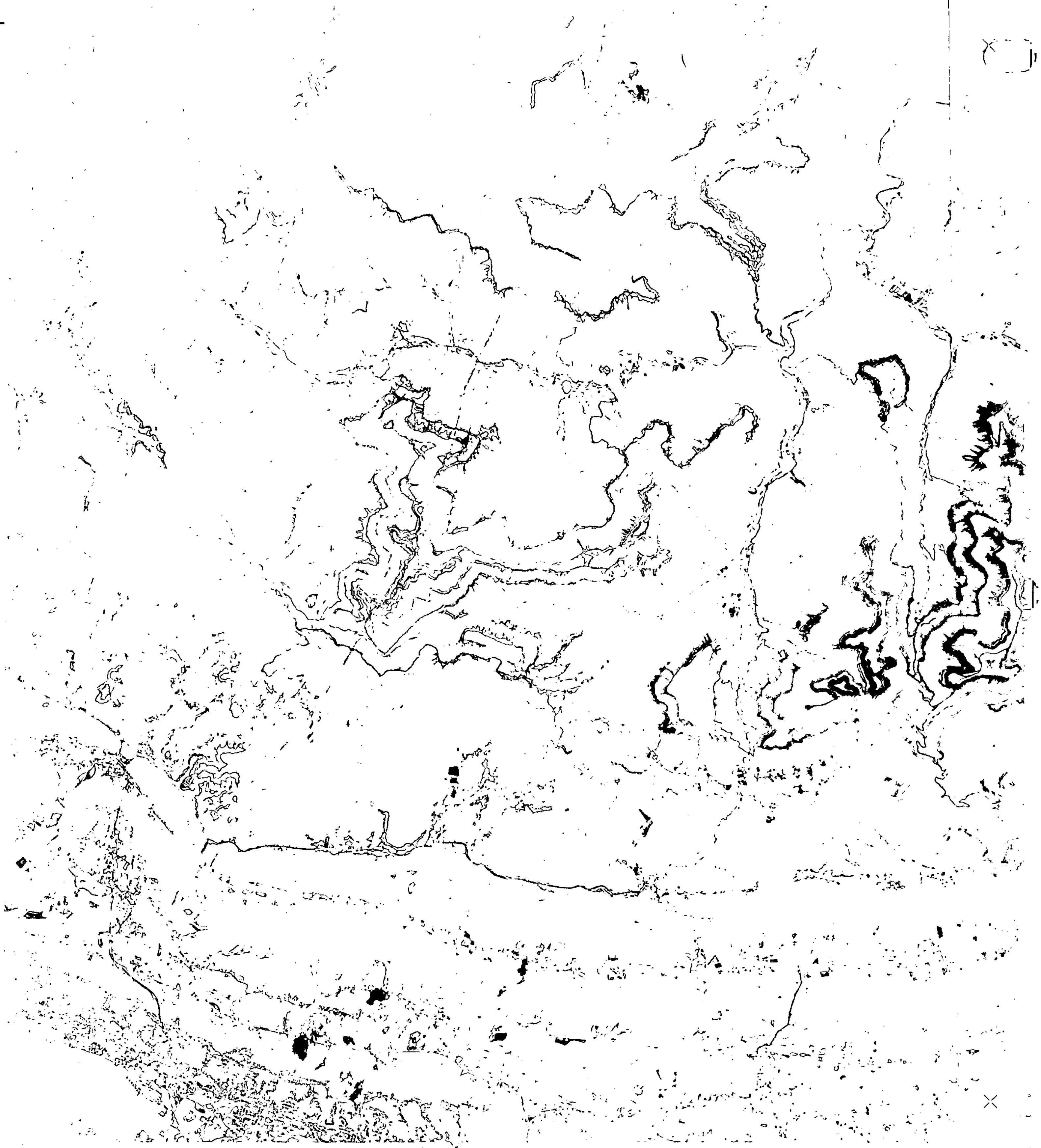
Associated with and visible from a regional perspective other landscape change elements can be detected and monitored such as: forest alterations, highway construction, urban growth and suburban encroachment on rural areas, and the annual round of cyclic and seasonal changes associated with agricultural and forested areas. Thus it is from this point of view that the Earth Resources Technology Satellite program challenges us to interpret the earth's landscapes periodically from a perspective which until this decade was available only from discriminating map productions.



ERTS-1 TEST SITE
REGIONAL COVERAGE
GROUND TRUTH TEST SITE
SCALE OF MILES
37N 86W
37N 81W
35N 86W
35N 82W
KENTUCKY
TENNESSEE
ALABAMA
GEORGIA
MISS
ILL
IND
MO
ARK
W VA
VA
N CAR
S CAR
LOUISVILLE
LEXINGTON
FRANKFORT
NASHVILLE
KNOXVILLE
MEMPHIS
CHATTANOOGA
BIRMINGHAM
ATLANTA
ASHEVILLE
HUNTSVILLE
JOHNSON CITY
KINGSPORT
BRISTOL
PADUCAH
EVANSVILLE
OWENSBORO
JACKSON
GADSDEN
ANNISTON
ROME
GREENVILLE
SPARTANBURG
BLUEFIELD
OAK RIDGE
MAPS AND SURVEYS BRANCH
G-MS-453 B 630 R10

FIGURE 1

Anderson County, Tennessee.



[redacted]

FIGURE 3. High altitude (60,000') image of strip mines in Anderson and Morgan Counties, Tennessee.

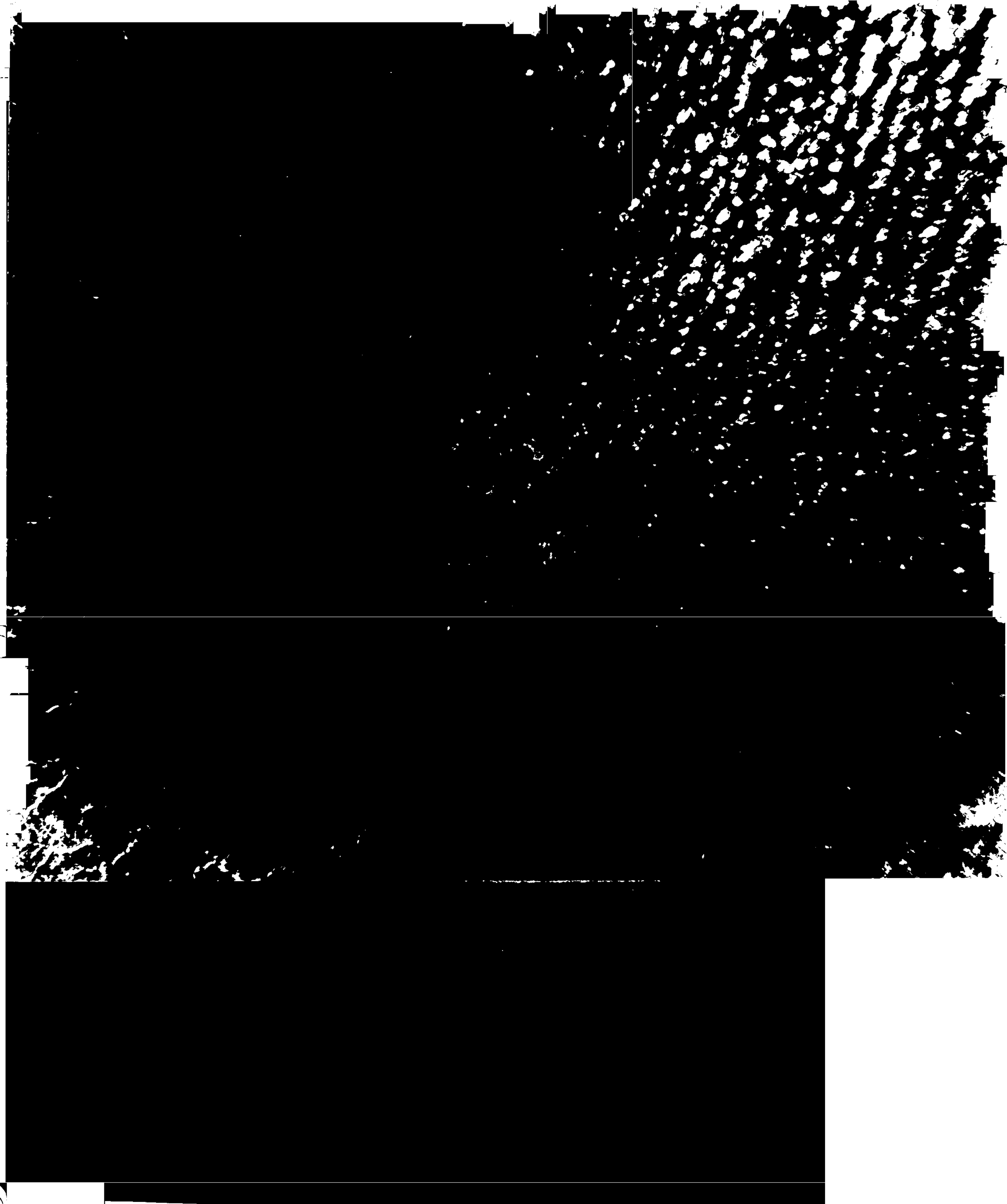


FIGURE 4. Satellite image (560 miles) of strip mines on the Cumberland Plateau - Tennessee and Kentucky.

FIGURE 5. Satellite image (560 miles) of strip mines and other landscape phenomena in Eastern Tennessee.