Applying Digital Aerial Photos to Land Cover Mapping in Ohio GAP

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ABSTRACT

As part of the Ohio Gap Analysis Project, members of the Ohio State University Center for Mapping are currently generating a land cover map for Ohio. The major difference between Ohio GAP and other state projects is that we are using aerial digital photography instead of the more common videography for identification, verification, and validation of vegetative communities. Our use of this novel technique shows promise of improving on videography as a mapping technique, but has also presented unique challenges all its own. Here, we present a description of our land cover classification process for Ohio using digital photography.

ACQUIRING PHOTOS

INTRODUCTION

Although aerial videography has been a common approach to mapping land cover in many GAP projects, digital aerial photography holds a great deal of promise as a more efficient technique than videography. The major advantages of digital aerial photography are that (1) digital images often have much higher resolution than video; (2) they can be directly geo-referenced and viewed like maps without extra software for video editing; and (3) there is no requirement for a second camera as is often required with video setups. With the advent of non-metric, small, relatively inexpensive digital SLR cameras, and inexpensive portable storage solutions for large digital image files, digital aerial photography is now a suitable technique for GAP.

Ohio GAP decided to use aerial digital photography as the basis for identification and verification of vegetative communities throughout the state. We embarked on a statewide aerial survey that is now nearing completion. These photos are useful as guides for where we need to do field verification surveys and are very clear aids to our land cover classification steps.

Our land cover classification process has the following steps:

- Photo acquisition
- Photo geo-referencing
- Data acquisition and preparation
- Land cover classification
- Accuracy Assessment
- Final Map Production

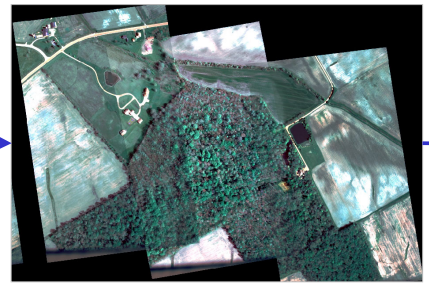
ACQUIRING FIELD DATA

PHOTO ACQUISITION

Using a photo plane and pilot provided by the Ohio Division of Natural Resources (ODNR), we take overlapping aerial photos along East-West transects 4 km apart across the state of Ohio. The photos are taken using a digital SLR camera at a high resolution of around 2000 x 3000 pixels (6 megapixel). At the altitude at which we fly (about 1,000 meters) this translates to a ground resolution of about 30 cm x 30 cm, or about 100 times the resolution of a typical Landsat image. We expect to complete the photo survey in October 2003 after collecting about 60,000 individual photos.

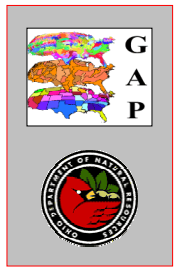
PHOTO GEO-REFERENCING

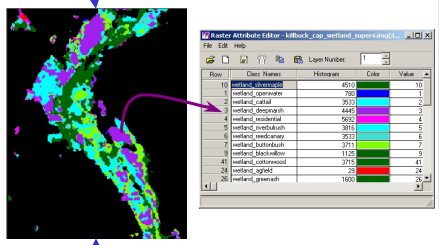
1. Photo files are converted from the RAW format (the native format of the camera) to TIFF format.
2. A six-parameter transformation followed by resampling is applied to the images using ERDAS software. This rotates the photos to match flight direction and corrects for positioning errors.
3. Transformed, geo-referenced photos are then joined into mosaics ready to be used in in the classification process.



FIELD DATA ACQUISITION

Aerial photos allow us to be more efficient in our field work by letting us pick out landmarks and interesting habitat assemblages prior to going to the field. Once there, this format gives us a map-like view of the field sites we go to.

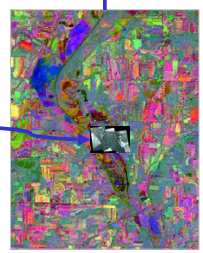




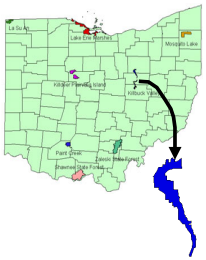
LAND COVER CLASSIFICATION

Aerial photos are an integral part of our classification protocol. We use ERDAS Imagine software to generate a supervised classification as follows:

1. We perform an unsupervised classification (ISODATA) on combined leaf-on and leaf-off images.
2. Using digital photo interpretation and field data we identify habitats and classify them according to the National Vegetation Classification (USNVC).
3. Using these identifications, we create signatures for each land cover class present on a coverage.
4. Using these signatures, we perform a supervised classification for the coverage.
5. Using aerial photos and field work set aside for this purpose, we perform an accuracy assessment on the classified coverage.
6. After a favorable accuracy assessment, we generate a final vector map of the coverage.



PILOT PROJECT AREA



Ohio GAP

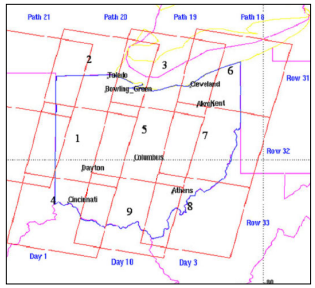
The Ohio Gap Analysis Project is beginning the fifth of a planned six years of activities. Production of a land cover map for Ohio is expected to be complete by June 2004. Ohio GAP is a project of The Ohio State University Center for Mapping and Department of Evolution, Ecology, and Organismal Biology. Funding and logistical support for the project is provided by National GAP, the Ohio Department of Natural Resources, and The Ohio State University.

PILOT PROJECT

To test our procedures and solve any issues before commencing with larger-scale classifications, we carried out a classification of the 30,000-hectare Killbuck Valley wetland area, one of the largest contiguous wetlands in the Great Lakes region. Aerial photos of the pilot area were taken during October 2001, while field work was completed in July 2003.

For the final classified base maps, we used Landsat 7 Thematic Mapper images acquired from the OhioView Consortium. Ancillary data includes the National Land Cover Dataset, from the US Geological Survey, and the Ohio Wetlands Inventory, from ODNR. Field data is acquired by Ohio GAP personnel and by ODNR cooperators.

LANDSAT SCENES FOR OHIO



CONCLUSION

Aerial digital photos can be an effective replacement for the video images that have been common in a number of GAP projects. The photos are efficient both in terms of time and cost. After they are geo-referenced, they can be opened as a map layers in ESRI and ERDAS applications. However, there are several issues to consider before using digital aerial photography:

Have enough digital storage: high-resolution native files can be 8-9 MB per file; TIFF files are 3-5 times larger.

Be ready for lots of photos: the number of photos for a large-scale project can be overwhelming; we estimate we will have more than 60,000 photos for Ohio.

Know your camera: research before you buy; after you buy, test the camera and its interface with GPS and laptop before beginning your survey.