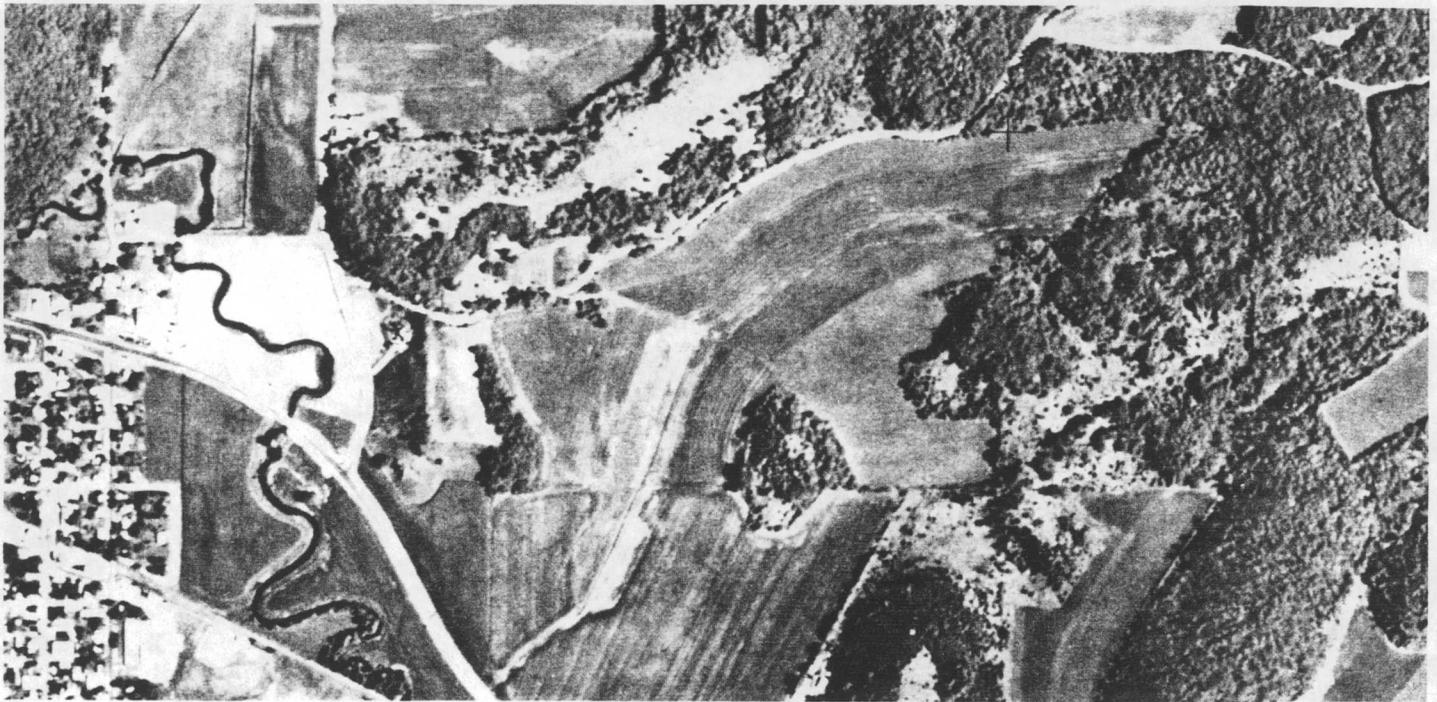


Digital Orthophotos



Digital orthophotoquad of Black Earth, SD

Digital orthophotos

A digital orthophoto is a digital image of an aerial photograph with displacements caused by the camera angle and the terrain removed. It, thus, combines the image characteristics of a photograph with the geometric qualities of a map.

Production of a digital orthophoto

The following items are required to produce a digital orthophoto:

- photoidentifiable ground control points;
- camera calibration and orientation parameters;

- a digital elevation model (DEM); and

- a digital image produced by scanning an aerial photograph with a precision high-resolution scanner.

The digital image is rectified to an orthographic projection by processing each image pixel (picture element) through photogrammetric equations derived from the first three items above on a high-speed image processing system. The finished product is a spatially accurate image with planimetric features represented in their true geographic positions.

The production of digital orthophotos differs from that of conventional orthophotos. Both are produced using

the principles of differential rectification, however, these principles are applied in dissimilar ways. When a conventional orthophoto is produced, the image is scanned in small strips or patches, with rectification occurring at the center of the strip or patch. In a digital orthophoto, each pixel is corrected for relief displacement and camera orientation, which results in a more accurate image. Unlike conventional orthophotos, a digital orthophoto can be manipulated in any geographic information system (GIS) that accepts raster images. Also, using a digital orthophoto as a foundation, other layers of data can be overlaid and manipulated in the GIS. This capability allows users of GIS data unlimited flexibility.

Characteristics of a standard digital orthophoto produced by the U.S. Geological Survey (USGS)

The primary digital orthophoto is a 1-meter ground resolution quarter-quadrangle image (3.75 minutes of latitude by 3.75 minutes of longitude) at a scale of 1:12,000, cast on the Universal Transverse Mercator projection on the North American Datum of 1983 (NAD 83). The digital orthophoto has approximately 300 meters of overedge, sufficient to facilitate tonal matching for mosaicking and the placement of NAD 83 and North American Datum of 1927 quarter-quadrangle corner ticks that are embedded in the image.

Through image mosaicking two or more rectified images can be combined and merged into one image. For instance, 7.5-minute quadrangle digital orthophotos can be produced by mosaicking four 3.75-minute quarter-quadrangle digital orthophotos.

The digital orthophoto is formatted as four ASCII header records, followed by a series of 8-bit binary image data records. The radiometric image brightness values are stored as 256 gray levels. The average file size for a digital orthophoto is 55 megabytes.

The metadata provided in the digital orthophoto contains a wide range of descriptive information about the image data including photographic source type, date, instrumentation used to create the digital orthophoto, and information relating to the DEM used in the rectification process. Primary and secondary datum transformation constants included in the header record allow users to spatially reference other digital data with the digital orthophoto.

USGS accuracy requirements for digital orthophotos

The accuracy and quality of USGS digital orthophotos must meet National Map Accuracy Standards at 1:12,000 scale for quarter-quadrangles and 1:24,000 scale for quadrangles. Accuracy and quality are dependent on these factors:

- photographs that meet National Aerial Photography Program (NAPP) standards—quarter-quadrangle centered (3.75 by 3.75 minutes in extent), exposed at a flying height of 20,000 feet above ground, and with a 152.4 millimeter (6 inch) focal-length camera;
- a DEM with the same area coverage as the digital orthophoto that is equal to or better than a level 1 DEM with a root-mean-square error of no greater than 7 meters;
- a highly accurate image scanning process that employs a scanning resolution between 7.5 and 50 microns (a 1:40,000-scale image scanned at 25 microns equates to a pixel ground resolution of 1 meter); and
- photoidentifiable image and coordinates of ground control positions acquired from ground surveys or aerotriangulation.

Uses of digital orthophotos

The information in a digital orthophoto can be used for a variety of applications. As a layer in a GIS system it can be a valuable tool for revision of digital vector files and topographic and planimetric maps. Other applications include vegetation and timber management, routing and habitat analysis, environmental impact assessments, emergency evacuation planning, flood analysis, soil erosion assessment, facility management, and groundwater and watershed analysis.

For more information

For more information on digital orthophotos, contact any Earth Science Information Center or call 1-800-USA-MAPS.