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<origin>Fugro EarthData, Inc.</origin>

<pubdate>20081124</pubdate>

<title>South Carolina 16 County Lidar - Cherokee County</title>

<geoform>map</geoform>

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</citation>

<descript>

<abstract>

The project area is composed of 16 counties in the State

of South Carolina - Cherokee, Union, Laurens,

Greenwood, Newberry, Chester, Fairfield, Lancaster,

Chesterfield, Marlboro, Darlington, Dillon, Marion,

Williamsburg, Clarendon, and Orangeburg. The project

area consists of approximately 10,194 square miles

including a buffer of 50 feet along the edges of the project

area and an additional buffer in some areas. The project

design of the lidar data acquisition was developed to

support a nominal post spacing of 1.4 meters. The Fugro

EarthData, Inc. acquisition team of Fugro Horizons, Inc.

and North West Group acquired 721 flight lines in 44 lifts

from January 15, 2008 through February 10, 2008. The

data was divided into 5000' by 5000' foot cells that serve

as the tiling scheme. Lidar data collection was performed

with a Cessna 310 aircraft, utilizing a Leica ALS50-II MPiA

sensor, collecting multiple return x, y, and z data as well as

intensity data. Lidar data was processed to achieve a bare

ground surface (Classes 2 and 8). Lidar data is remotely sensed

high-resolution elevation data collected by an airborne

collection platform. Using a combination of laser range

finding, GPS positioning and inertial measurement

technologies, lidar instruments are able to make highly

detailed Digital Elevation Models (DEMs) of the earth's

terrain, man-made structures and vegetation. This

metadata file is for the lidar county deliverables for

Cherokee County, SC.

</abstract>

<purpose>

The purpose of this project is to collect and deliver

topographic elevation point data derived from multiple

return light detection and ranging (lidar) measurements for

a 16-county area in South Carolina. The elevation data will

be used as base data for South Carolina's flood plain

mapping program (as part of FEMA’s Map Modernization

Program) and for additional geospatial map products in

the future.

</purpose>

</descript>

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<caldate>20081124</caldate>

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The following methods are used to assure lidar accuracy.

1. Use of IMU and ground control network utilizing GPS

techniques, 2. Use of airborne GPS in conjunction with the

acquisition of lidar, 3. Measurement of quality control

ground survey points within the finished product.

The boresight of the lidar was processed against the

ground control for Cherokee County which consisted of

9 lidar ground survey points and 1 airborne GPS (ABGPS)

base station at the operation airport. The horizontal datum

for the control was the North American Datum of 1983,

2007 adjustment (NAD83/2007). The vertical datum was

the North American Vertical Datum of 1988 (NAVD88).

The Geoid 2003 model was used to transform the

ellipsoidal heights to GPS derived orthometric heights.

ABGPS data was collected during the acquisition mission

for each flight line. During the data acquisition

the Positional Dilution of Precision (PDOP) for the ABGPS

was monitored. The control points were measured by

technicians using Terrascan and Fugro EarthData

proprietary software and applied to the boresight solution

for the project lines.

</attraccr>

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<logic>

Compliance with the accuracy standard was ensured by

the collection of GPS ground control during the acquisition

of aerial lidar and the establishment of a GPS base station

operation airport. The following checks were performed.

1. The ground control and airborne GPS data stream were

validated through a fully analytical boresight adjustment.

2. The Lidar elevation data were checked against the

project control.

3. Lidar elevation data was validated through an

inspection of edge matching and visual inspection for

quality (artifact removal).

</logic>

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The bare earth surface will contain voids where insufficient

energy was reflected from the surface to generate a valid

return from the terrain. Voids in the bare earth surface tend

to occur in heavily vegetated areas, water bodies, and

beneath buildings, motor vehicles, bridges etc. Fresh or

wet asphalt, wet sand and certain types of vegetation can

also cause voids or anomalous elevations.

</complete>

<posacc>

<horizpa>

<horizpar>

The minimum expected horizontal accuracy was tested

during the boresight process to meet or exceed the

National Standard for Spatial Data Accuracy (NSSDA).

Horizontal accuracy is 1 meter RMSE or better.

</horizpar>

</horizpa>

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<vertaccr>123 high accuracy checkpoints were surveyed following FEMA Guidelines and Specifications for Flood Hazard Mapping Partners Appendix A: Guidance for Aerial mapping and Surveying which is based on the NSSDA. Compared with the 0.363m specification for vertical accuracy at the 95% confidence level, equivalent to 2-foot contours, the dataset passes by all methods of accuracy assessment (tested by Dewberry): Tested 0.129 meter Fundamental Vertical Accuracy at 95 percent confidence level in open terrain using RMSEz x 1.9600 (FEMA/NSSDA and NDEP/ASPRS methodologies); Tested 0.142 meter Consolidated Vertical Accuracy at 95th percentile in all land cover categories combined (NDEP/ASPRS methodology); Tested 0.174 meter Supplemental Vertical Accuracy at 95th percentile in Vegetated terrain (NDEP/ASPRS methodology); Tested 0.097 meter Supplemental Vertical Accuracy at 95th percentile in Urban terrain (NDEP/ASPRS methodology).</vertaccr>

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<title>Aerial Acquisition of Lidar Data for 16 counties in the State of South Carolina</title>

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The Fugro EarthData, Inc. acquisition team of Fugro

Horizons, Inc. and North West Group collected ALS50-II

derived lidar over 16 counties in the State of South

Carolina with a 1.4m, nominal post spacing using a

Cessna 310 aircraft. The collection for the entire project

area was accomplished from January 15, 2008 through

February 10, 2008 (Flight dates were January 15, 16, 18,

20, 21, 25, 27, 28, 29, 30, 31 and February 2, 3, 4, 7, 8,

10). The collection was performed using a Leica ALS50-II

MPiA lidar system, serial numbers ALS039 and ALS064,

including an inertial measuring unit (IMU) and a dual

requency GPS receiver. This project required 44 lifts of

flight lines to be collected. The lines were flown at an

average of 6,000 feet above mean terrain using a

maximum pulse rate frequency of 112,000 pulses per

second. The planned maximum baseline length was 50

miles.

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<pubdate>20080131</pubdate>

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<srccurr>Ground Condition</srccurr>

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<srccitea>Ground Control</srccitea>

<srccontr>

ESP under contract to Fugro EarthData, Inc. successfully

established ground control for Cherokee County, SC. A

total of 9 ground control points in Cherokee County,

SC were acquired. GPS was used to establish the control

network. The horizontal datum was the North American

Datum of 1983, 2007 adjustment (NAD83/2007). The

vertical datum was the North American Vertical Datum of

1988 (NAVD88).

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<srccurr>Publication Date</srccurr>

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<srccitea>Cherokee County Orthos</srccitea>

<srccontr>

The State of South Carolina, Department of Natural

Resources provided digital orthophotography covering the

project area in support of this project.

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1. Lidar, GPS, and IMU data was processed together

using lidar processing software.

2. The lidar data set for each flight line was checked for

project area coverage and lidar post spacing was checked

to ensure it meets project specifications.

3. The lidar collected at the calibration area and project

area were used to correct the rotational, atmospheric, and

vertical elevation differences that are inherent to lidar data.

4. Intensity rasters were generated to verify that intensity

was recorded for each lidar point.

5. Lidar data was transformed to the specified project

coordinate system.

6. By utilizing the ground survey data collected at the

calibration site and project area, the lidar data was

vertically biased to the ground.

7. Comparisons between the biased lidar data and ground

survey data within the project area were evaluated and a

final RMSE value was generated to ensure the data meets

project specifications.

8. Lidar data in overlap areas of project flight lines were

trimmed and data from all swaths were merged into a single

data set.

9. The data set was trimmed to the digital project boundary

including an additional buffer zone of 50 feet (buffer zone

assures adequate contour generation from the DEM).

10. The resulting data set is referred to as the raw lidar

data.

</procdesc>

<srcused>lidar</srcused>

<procdate>20080617</procdate>

<srcprod>raw lidar</srcprod>

<proccont>

<cntinfo>

<cntperp>

<cntper>Becky Jordan</cntper>

<cntorg>Fugro EarthData, Inc.</cntorg>

</cntperp>

<cntpos>Project Manager</cntpos>

<cntaddr>

<addrtype>mailing and physical address</addrtype>

<address>7320 Executive Way</address>

<city>Frederick</city>

<state>MD</state>

<postal>21704</postal>

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<cntvoice>301-948-8550</cntvoice>

<cntfax>301-963-2064</cntfax>

<cntemail>bjordan@earthdata.com</cntemail>

<hours>Monday through Friday, 8:30am to 5:00pm</hours>

</cntinfo>

</proccont>

</procstep>

<procstep>

<procdesc>

1. The raw lidar data was processed through a minimum

block mean algorithm, and points were classified as either

bare earth or non-bare earth.

2. User developed &quot;macros&quot; that factor mean terrain angle

and height from the ground were used to determine bare

earth point classification.

3. The next phase of the surfacing process was a 2D edit

procedure that ensures the accuracy of the automated

feature classification.

4. Editors used a combination of imagery, intensity of the

lidar reflection, profiles and tin-editing software to assess

points.

5. The lidar data was filtered, as necessary, using a

quadric error metric to remove redundant points. This

method leaves points where there is a change in the slope

of surfaces (road ditches) and eliminates points from evenly

sloped terrain (flat field) where the points do not affect the

surface.

6. The algorithms for filtering data were utilized within Fugro

EarthData&apos;s proprietary software and commercial software

written by TerraSolid.

7. The flight line overlap points were merged back into

filtered data set for delivery product.

8. The point cloud data were delivered tiled in LAS 1.1

format; class 12 - flight line overlap points, class 9 - points

in water, class 8 - model-key points, class 2 - ground

points, and class 1 - all other.

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<cntinfo>

<cntperp>

<cntper>Becky Jordan</cntper>

<cntorg>Fugro EarthData, Inc.</cntorg>

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<cntpos>Project Manager</cntpos>

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</proccont>

</procstep>

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Lidar intensity images were generated in TerraSolid

software. The images are then brought up in Photoshop to

see if a curve is needed to modify the radiometrics and to

ensure they match from group to group. Along with looking

for missing coverage and clipping to the boundary, the

following steps are run in Photoshop; 1. Flip 0 values to 1,

2. Change 3-band images to 1 band, 3. Restore GeoTIFF

headers. The intensity images were delivered in GeoTIFF

format.

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<cntinfo>

<cntperp>

<cntper>Becky Jordan</cntper>

<cntorg>Fugro EarthData, Inc.</cntorg>

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Tiled lidar LAS datasets are imported into a single

multipoint geodatabase featureclass. Only Ground and

Model-Keypoint are imported. An ArcGIS geodatabase

terrain feature class is created using the terrain creation

dialogue provided through ArcCatalog. The multipoint

featureclass is imported as mass point features in the

terrain. An overall tile boundary for the county is input as a

soft clip feature for the terrain. The terrain pyramid level

resolutions and scales are automatically calculated based

on the point coverage for the county.

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<cntperp>

<cntper>Becky Jordan</cntper>

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<cntpos>Project Manager</cntpos>

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The information contained in the LAS point cloud data set

are the following attributes; X, Y, Z to two significant digits;

Intensity as integer; Class as integer; Return number;

Number of returns; Scan direction; scan angle rank; GPS

time.

</eaover>

<eadetcit>Lidar point cloud data tiled in LAS 1.1 format; ASPRS classification scheme, class 12 - flight line overlap points, class 9 - points in water, class 8 - model-key points, class 2 - ground points, and class 1 - all other.</eadetcit>

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<cntorgp>

<cntorg>U.S. Geological Survey</cntorg>

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<cntaddr>

<addrtype>mailing and physical address</addrtype>

<address>

Customer Services

U.S. Geological Survey

EROS Data Center

</address>

<city>Sioux Falls</city>

<state>SD</state>

<postal>57198-0001</postal>

<country>US</country>

</cntaddr>

<cntvoice>1-800-252-4547</cntvoice>

<cnttdd>1-605-594-6933</cnttdd>

<cntfax>1-605-594-6589</cntfax>

<cntemail>custserv@usgs.gov</cntemail>

<hours>Monday through Friday 8:00 AM to 4:00 PM (Central Time)</hours>

<cntinst>

The above is the contact information for EROS Data

Center in Sioux Falls, SD. This is the digital data storage

and distribution center for the USGS. Metadata information

can also be obtained through online services using The

/nationalmap.usgs.gov or //earthexplorer.usgs.gov.

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