Ontario

Southwestern Ontario Orthophotography Project (SWOOP) 2015 Raw LAS

User Guide

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Mapping and Information Resources Branch
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Ministry of Natural Resources and Forestry

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Executive Summary

Key Words

Southwestern Ontario Orthophotography Project, Provincial Mapping Unit, Elevation, Orthoimagery, Orthophoto, Imagery, Aerial Photography, Vector, Mass Points, Softcopy Photogrammetry.

Abstract

Southwestern Ontario Orthophotography Project (SWOOP) 2015 orthophotography was collected through a collaborative funding partnership covering Southwestern Ontario.

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List of Acronyms

ADS: Airborne Digital Sensor

AMT: Above Mean Terrain

CGVD: Canadian Geodetic Vertical Datum

DEM: Digital Elevation Model

DMC: Digital Mapping Camera

DSM: Digital Surface Model

DTM: Digital Terrain Model

GeoTIFF: Georeferenced TIFF

GIS: Geographic Information Systems

GPS: Global Positioning System

GSD: Ground Sample Distance

IfSAR: Interferometric Synthetic Aperture Radar

IMU: Inertial Measuring Unit

LAS: Laser File Exchange Format

LiDAR: Light Detection and Ranging

LIO: Land Information Ontario

NAD: North American Datum

NIR: Near Infrared

OTF: On the Fly

PMU: Provincial Mapping Unit

RGB: Red Green Blue

SWOOP: Southwestern Ontario Orthophotography Project

TIFF: Tagged Image File Format

TIN: Triangular Irregular Networks

UTM: Universal Transverse Mercator

List of Definitions

Mass Points

Mass points are irregularly spaced points, each with x/y location coordinates and z-values, typically (but not always) used to form a TIN. When generated manually, mass points are ideally chosen to depict the most significant variations in the slope or aspect of TIN triangles. However, when generated automatically, e.g., by LiDAR or IfSAR scanner, mass point spacing and patterns depend upon the characteristics of the technologies used to acquire the data.

Digital Elevation Model (DEM)

A generic term for digital topographic and/or bathymetric data that is comprised of x/y coordinates and z-values to represent an elevation surface.

The terms ‘DTM’ and ‘DSM’ should be used over the term ‘DEM’ to more specifically reference ‘bare-earth’ or ‘surface elevation’ model products when possible.

The term “DEM” is to be used as a broader term when referencing a generic elevation data product. The Provincial DEM is an example of a generic elevation product, given that it has been constructed using a combination of both ‘DTM’ and ‘DSM’ elevation datasets to achieve Provincial coverage.

Digital Terrain Model (DTM)

The bare earth surface (lowest surface, last reflective surface, or LiDAR last-return) represents the surface of the "bare-earth" terrain, after removal of vegetation and constructed features.

Photogrammetry has traditionally generated DTMs when elevations are generated by manual compilation techniques. Unless specified to the contrary, the bare-earth surface includes the top surface of water bodies, rather than the submerged surface of underwater terrain.

Similar to a DSM, a DTM can be structured either as a vector dataset (comprised of mass points and optionally 3D break lines) to model bare-earth elevations or a raster dataset that is interpolated from the vector elevation data to model bare-earth terrain elevations.

Using modern elevation point cloud classification algorithms and file formats, such as LAS, a DTM can represent a mass point dataset that has been classified for 'bare-earth' terrain elevations.

Digital Surface Model (DSM)

A DSM is the highest reflective surface of ground features captured by the sensor. This surface may also be referred to as the first reflective surface or LIDAR first-return. The DSM may include treetops, rooftops, and tops of towers, telephone poles, and other natural or constructed features; or it may include the ground surface if there is no vegetative ground cover. Photogrammetry, IFSAR, LIDAR and sonar can all provide this type of surface, yet characteristics such as accuracy and degree of detail (ability to resolve desired surface features) may vary significantly across technologies and even within the same technology. With sonar, the DSM may include sunken vessels and other artifacts, whereas the bathymetric surface reflects the natural underwater terrain. Similarly, with photogrammetry, LIDAR, and IFSAR the reflective surface may include any artifact present when the sensor mapped the area, including passing cars and trucks and similar features not normally considered to be part of a digital terrain model

Similar to a DTM, a DSM can be structured either as a vector dataset (comprised of mass points and optionally 3D break lines) to model surface elevations or a raster dataset that is interpolated from the vector elevation data to model surface elevations.

Using modern elevation point cloud classification algorithms and file formats, such as LAS, a DSM can represent a mass point dataset that has been classified for 'surface' elevation features.

1. Product Description

SWOOP 2015 was collected by an imagery contractor for areas in Southwestern Ontario between April 12th and May 23rd of 2015. In total, there were more than 40 funding partners involved in SWOOP. The project encompassed an area of approximately 49,167 square kilometres.

1.1 Geographic Extent

The SWOOP 2015 Raw LAS contains 19,493 overlapping tiles covering Southwestern Ontario including Owen Sound, Lambton Shores, Chatham-Kent, Windsor, London, St. Thomas, Woodstock, Waterloo, Kitchener, Brantford, Hamilton, Niagara Falls, Stratford, Cambridge, Welland, Port Colborne, St. Catharines and surrounding areas.

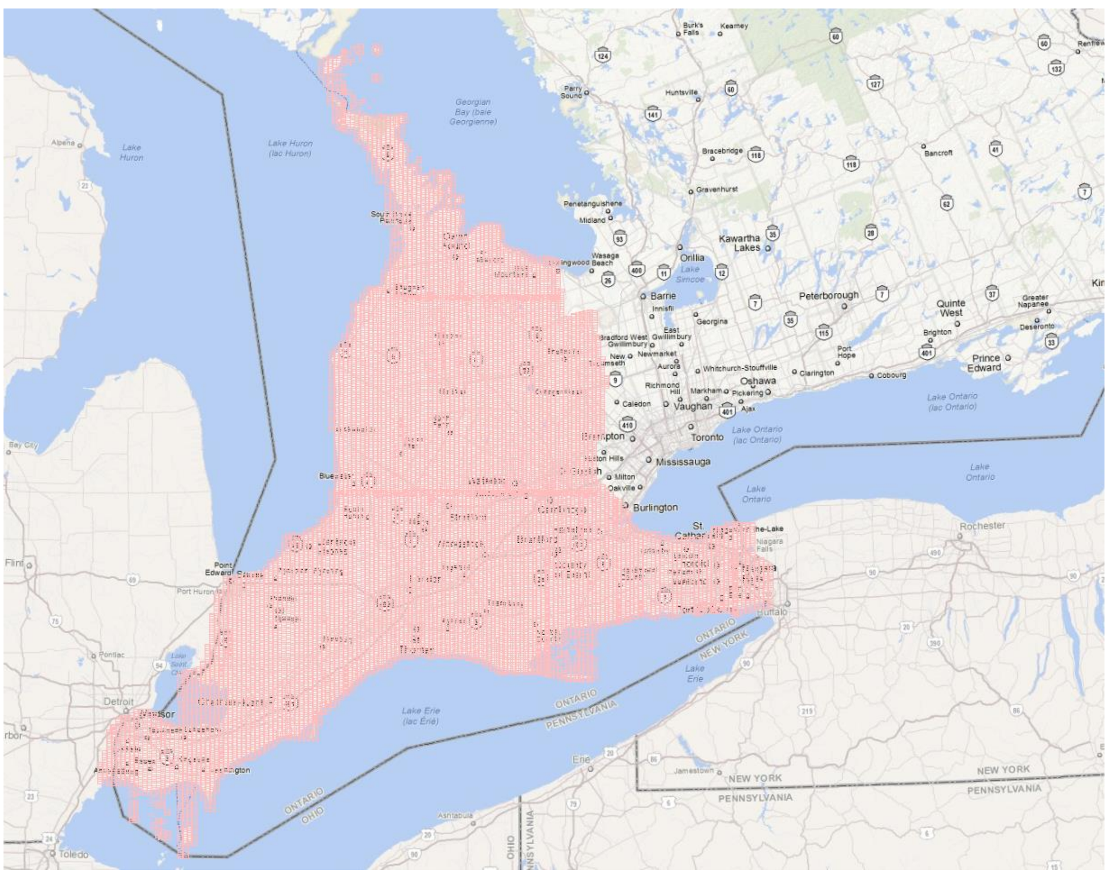

Figure 1: SWOOP 2015 Raw LAS

1.2 Reference System

1.2.1 Horizontal Reference System

The horizontal coordinate system of the vector data is the Universal Transverse Mercator (UTM) zone 17. The horizontal datum of the vector data is the North American Datum of 1983 (NAD83).

The horizontal unit of measure (coordinate system axis units) is metres (m).

1.2.2 Vertical Reference System

The vertical coordinate system of the vector data is based on the Canadian Geodetic Vertical Datum 1928 (CGVD28) of the Geodetic Survey Division, and is measured in metres above mean sea level. For more information please see the Geodetic Survey Division of Natural Resources Canada (http://webapp.geod.nrcan.gc.ca/geod/).

2. Product Details

2.1 Acquisition Details

The Leica GeoSystems XPro software was used for downloading and preparing imagery collected with the ADS100 Airborne Digital Sensor for softcopy photogrammetric use. The raw image was downloaded in the field with XPro to a portable workstation. This enabled a quick look at image quality and coverage.

Using the Leica Geosystems IPAS software package the GPS data was differentially processed against a base station. After the differential GPS solution was checked and verified the Leica Geosystems IPAS program was used to compute an integrated GPS/IMU navigation solution at one-second intervals. Using the GPS/IMU trajectory computed by the Leica Geosystems IPAS software and the camera calibration, XPro computed a full x,y,z, omega, phi, kappa exterior orientation of each scan line. Using the orientation data file produced the L0 imagery was resampled. The resampling removes most aircraft motion and provides epipolar geometry imagery for stereo viewing, automated aerotriangulation and automated DEM extraction. The Level 1 epipolar- resampled and georeferenced imagery usually will provide a pixel's true ground location to within a few pixels without any additional processing.

To improve accuracy, a fully automatic aerotriangulation process was performed to minimize the residual errors in the GPS/IMU derived exterior orientations. The aerotriangulation also allowed the introduction of ground control and checkpoints to ensure the accuracy specifications were achieved. Automated aerotriangulation of ADS100 imagery was performed with the Xpro.

A digital elevation model (DEM) was required for orthophoto production. DEM was auto correlated and used to generate the ortho-rectification imagery. The orthorectified imagery was created utilizing Leica Geosystem XPro software. The orthos were mosaicked together using proprietary image database and mosaicking software. The database was edited for seam lines, and other artifacts. The imagery was clipped out of the database into the sheet layout generated based on client use requirements. In the clipping stage, the coordinate system and georeferencing was embedded into the header of the TIFF file. The stereo and orthorectified imagery was quality controlled and delivered on external hard drives.

2.2 Data Delivery Format

SWOOP 2015 Raw LAS is 2.46 Terabytes total in size. It has been split into 7 smaller packages. The metadata record contains a shapefile index of the packages shown in Figure 2.

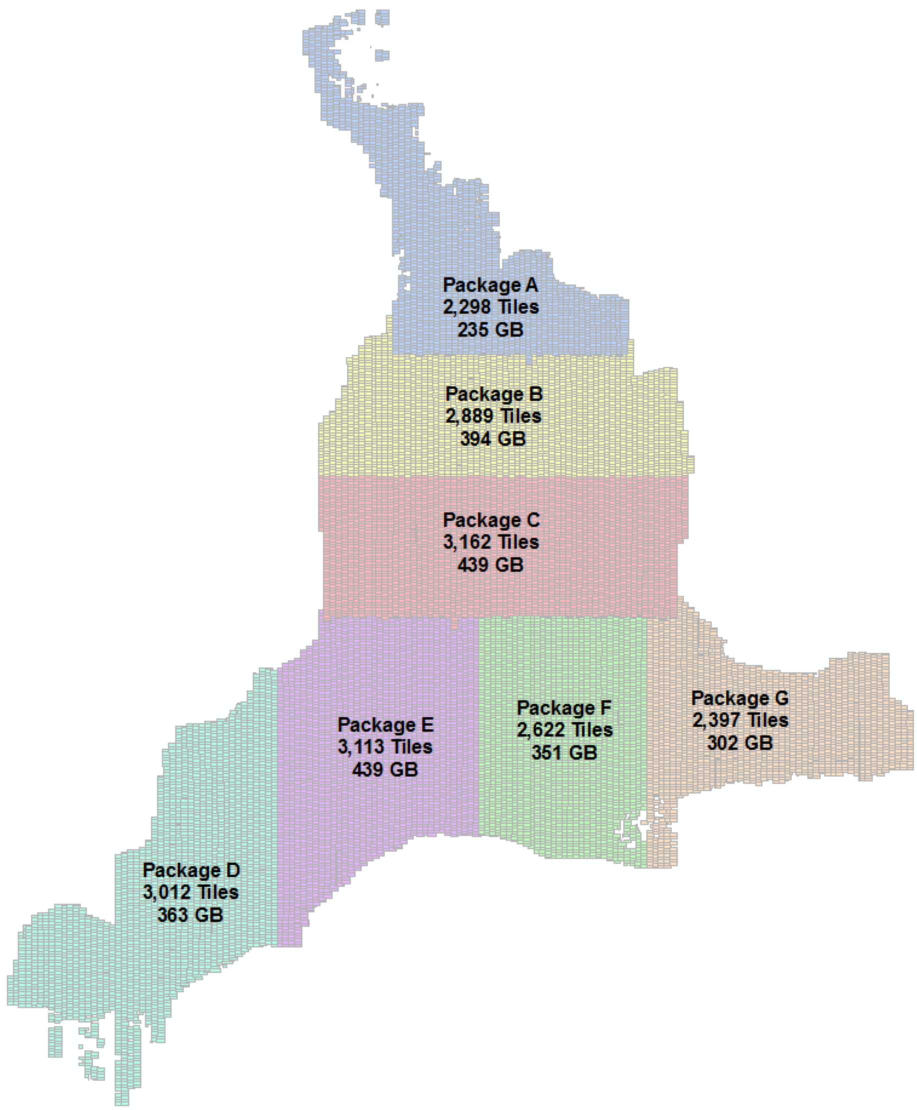

Figure 2: SWOOP 2015 Raw LAS Tiles

If you are interested in obtaining a copy please contact Land Information Ontario at lio@ontario.ca. You will need to provide a large enough hard drive for the data to be copied onto.

2.2.1 Data Format

SWOOP 2015 Raw LAS comes in LAZ format which is a lossless LiDAR compression. For more information on LAZ and free tools to convert LAZ to LAS visit the LASTools website (http://rapidlasso.com/lastools/).

2.3 Use Restrictions

SWOOP 2015 Raw LAS is Open Data and has no restrictions.