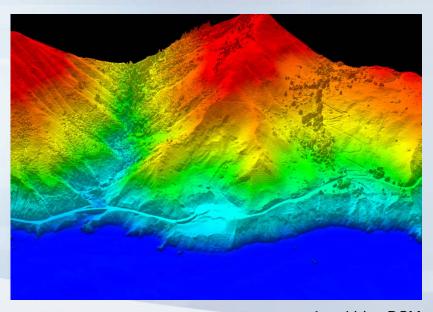
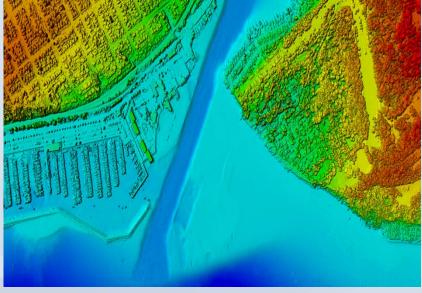
ASPRS Workshop Demo #2

Open Source Utilities for Working with Lidar Data

Open Source Utilities

- libLAS http://liblas.org/ or http://liblas.o
- LASTools http://www.cs.unc.edu/~isenburg/lastools/
- GRASS http://grass.itc.it/
 - Tutorial at: http://grass.osgeo.org/wiki/LIDAR#Micro-tutorial







Topo/Bathy Lidar Combined

Python Programming Language

- High level object-oriented scripting language
- Free, portable and powerful
- Runs interactively or as executable scripts (*.py)
- Works as a nice "glue" language to string together various processes even those from other languages (C, FORTRAN,etc.)
- Large user community with tons of freely available "snippets"
- Relatively easy to learn and read
- Full documentation at http://www.python.org/

libLAS 1.0/1.1

- Open source library for reading/writing binary LAS formatted files commonly used to store lidar data
- Contains Python, C, C++, and .NET application programming interfaces
- Cross platform (Windows, Linux, OS X, Solaris)
- Support for LAS 1.0 and 1.1 with 1.2 just released
- Initial development was supported by the Iowa DNR for use in its state-wide LIDAR project
- More info at: http://liblas.org/
- Development team:
 - Howard Butler
 - Mateusz Loskot
 - Phil Vachon
 - Martin Vales
 - Frank Warmerdam



libLAS Demo

- Working interactively in the Python shell
- Import the libLAS module
- >>>from liblas import *
- Open a LAS file for reading

```
>>>data=file.File('C:\\asprs_workshop\\liblas_demo\\ demo.las', mode='r')
```

- Loop through the LAS file
- Find points with elevations 50 meters or greater
- Print them to the screen

```
>>>for p in data:

if p.z >= 50.00:

print p.x, p.y, p.z
```



libLAS Demo cont.

- Loop through the LAS file again
- Find points with laser intensities greater than 50 and less than
 255
- Print them to the screen

```
>>>for p in data:
```

```
if p.intensity > 50 and p.intensity < 255: print p.x, p.y, p.z, p.intensity
```

libLAS Demo cont.

- Create a new LAS header
- >>>h = header.Header()
- Open a new LAS file for writing
- >>>newdata=file.File('C:\\asprs_workshop\\liblas_demo\\
 demo_nadir.las', mode='w', header=h)
- Loop through the LAS file
- Find all nadir points (Scan angle of 0)
- Write the nadir points to a new LAS file
- Close the LAS files

libLAS Demo cont.

```
>>>for p in data:
       pt = liblas.point.Point()
       if p.scan_angle == 0:
          pt.x = p.x
          pt.y = p.y
          pt.z = p.z
          newdata.write(pt)
>>>newdata.close()
>>>data.close()
```

New LAS file should contain only points with a scan angle of 0

libLAS & Python

- When coupled with Python modules such as Numpy, Matplotlib and MayaVi libLAS offers great functionality for working with LAS files
- A few simple examples are:
 - Inspect and edit a LAS header file
 - Create a height histogram plot
 - Use MayaVi visualization tools to view LAS point cloud
 - Create lidar flight coverage KML/KMZ for display in Google Earth
 - Create lidar binned images

Edit LAS Header

Input Output

```
C:\asprs_workshop\demo>lasinfo subset.las
                                                                                      C:\asprs workshop\demo>lasinfo subset edit hdr.las
reporting all LAS header entries:
                                                                                      reporting all LAS header entries:
 file signature:
                                   LASE
                                                                                                                         'LASF
                                                                                        file signature:
 file source ID:
                                                                                        file source ID:
 reserved:
                                                                                        reserved:
                                                                                        project ID GUID data 1–4:
version major minor:
 project ID GUID data 1-
                                  000
 version major.minor:
                                                                                                                         'ASPRS Workshop'
 system_identifier:
                                                                                        system_identifier:
                                                                                                                         'libLAS 1.0'
  generating_software:
                                                                                         generating_software:
                                  0/0
  file creation day/year
                                                                                        file creation day/year:
 header size
                                                                                        header size
 offset to point data 2
number var. length records 0
point data format 1
                                                                                        offset to point data
                                                                                                                         227
                                                                                        number var. length records 0 point data format 1
                                                                                        point data record length
                                                                                                                        28
274759
 point data record length
                                                                                        number of point records
 number of point records
 number of points by return 00000
                                                                                        number of points by return 0 0 0 0 0
 scale factor x y z
                                  0.01 0.01 0.01
                                                                                        scale factor x y z
                                                                                                                        0.01 0.01 0.01
 offset x y z
                                  000
                                                                                        offset x y z
                                                                                                                        000
                                                                                                                        358100 4771200 -36.2
358700 4771700 60.08
                                  358100 4771200 -36.2
358700 4771700 60.08
 min x y z
                                                                                        min x y z
 max x v z
                                                                                        max x v z
 eporting minimum and maximum for all 274759 LAS point record entries .
                                                                                      reporting minimum and maximum for all 274759 LAS point record entries ...
 x 35810000 35870000
                                                                                        x 35810000 35870000
                                                                                        y 477120000 477170000
 y 477120000 477170000
 z -3620 6008
                                                                                        z -3620 6008
 intensity 0 0
edge_of_flight_line 0 0
                                                                                        intensity 0 0
                                                                                        edge_of_flight_line 0 0
 scan_direction_flag 0 0
                                                                                        scan_direction_flag 0 0
 number_of_returns_of_given_pulse 0 0
                                                                                        number of returns of given pulse 0 0
 return number 0 0
                                                                                        return number 0 0
 classification 0 0
                                                                                        classification 0 0
 scan_angle_rank 0 0
                                                                                        scan_angle_rank 0 0
 user data 0 0
                                                                                        user data 0 0
                                                                                      point_source_ID 0 0

gps_time 45963.525325 45973.575952

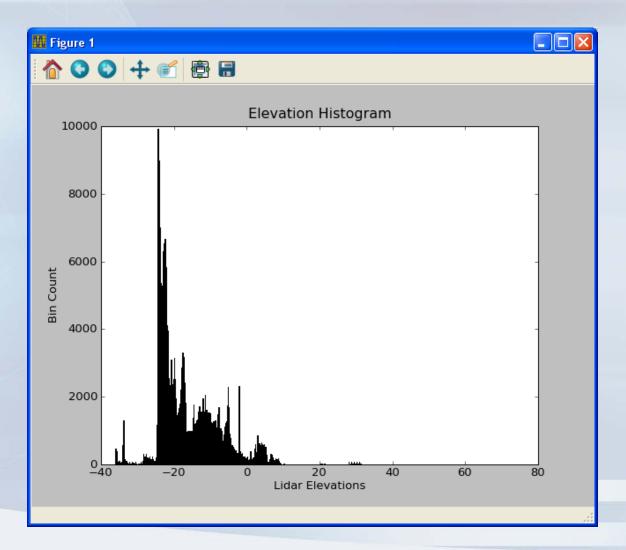
WARNING: there are 274759 points with return number 0
point_source_ID 0 0
gps_time 45963.525325 45973.575952
#ARNING: there are 274759 points with return number 0
                                                                                     WARNING: there are 274759 points with a number of returns of given pulse of 0
histogram of classification of points:
274759 Created, never classified (0)
ARNING: there are 274759 points with a number of returns of given pulse
histogram of classification of points:
   274759 Created, never classified (0)
                                                                                      C:\asprs_workshop\demo>
C:\asprs_workshop\demo>
```

C:\WINDOWS\system32\cmd.exe



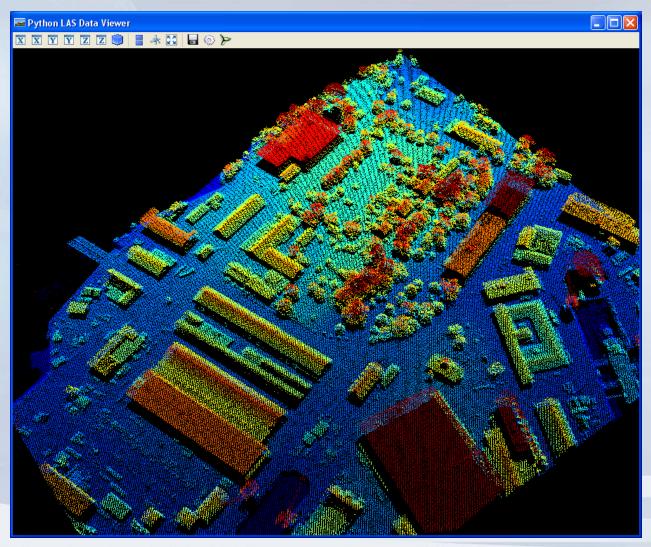
C:\WINDOWS\system32\cmd.exe

Elevation Histogram



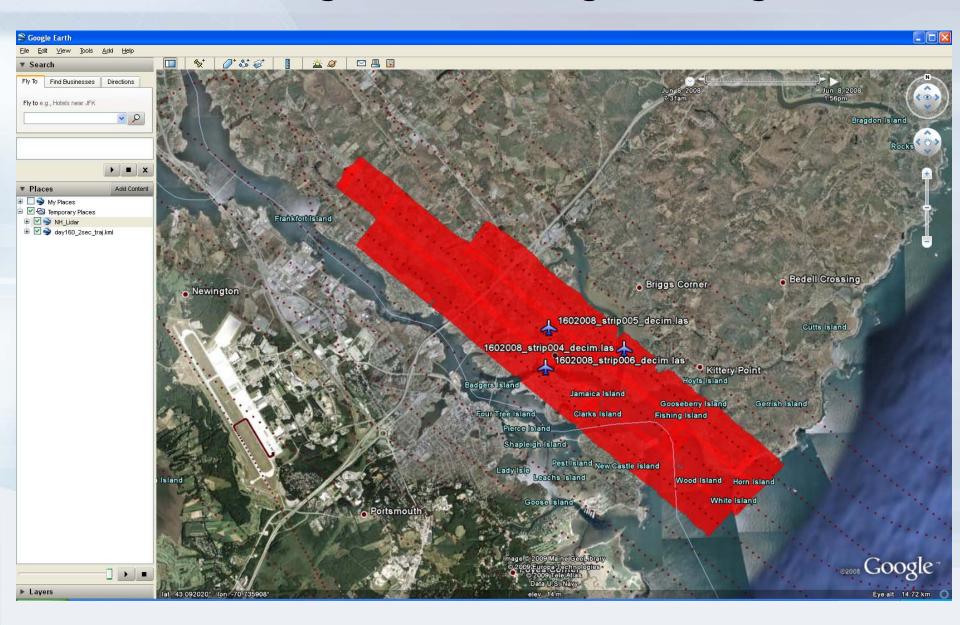


View LAS Points with MayaVI

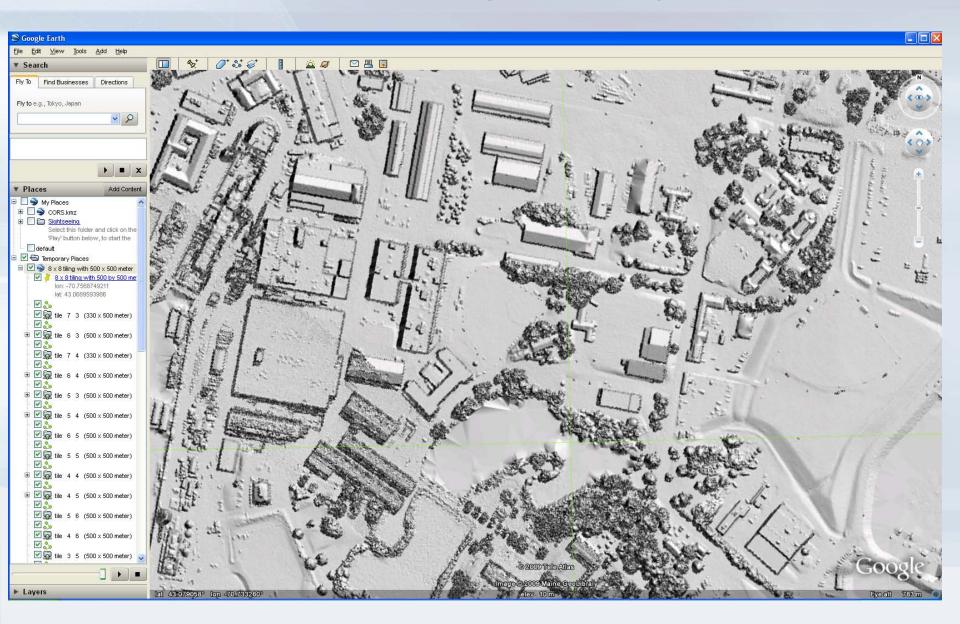




View Lidar Flightline Coverage in Google Earth



View Lidar Coverage in Google Earth

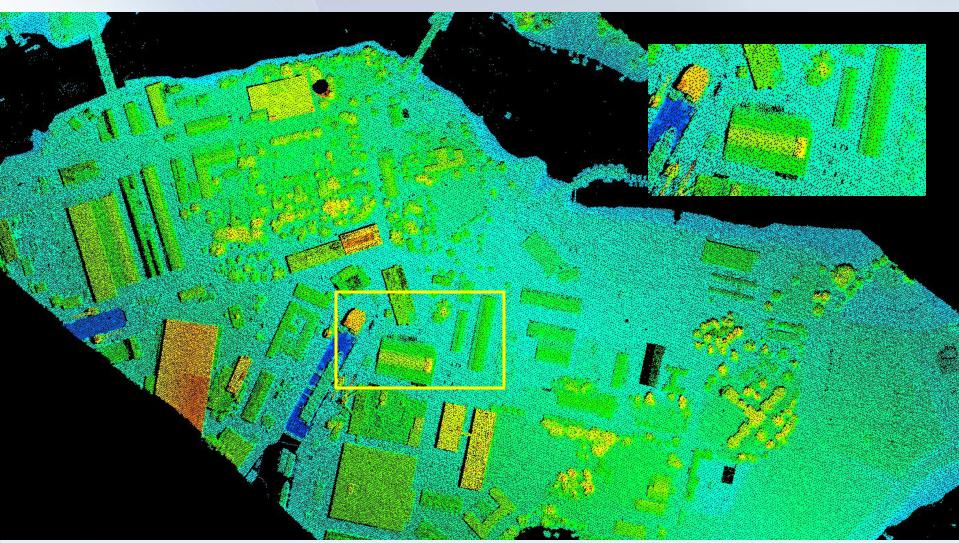


Create Binned Images from Lidar Using Python

Input can be ASCII x,y,z or LAS format using liblas

Generates mean, min, max and count (number of hits) images

Lidar data viewed in 1x1 meter bins



Python (x,y)

- Free scientific-oriented Python distribution
- Collection of science and engineering related Python modules and development environment tools all under one hood
- Easy installation and setup
- Install additional modules from a single location
- More info at: http://www.pythonxy.com



LASTools

- Open source utilities for working with LAS files
- Command line driven
- Source code and C++ classes LASreader and LASwriter for reading and writing the LAS format are also available
- More info at: http://www.cs.unc.edu/~isenburg/lastools/
- Development team:
 - Martin Isenburg
 - Jonathan Shewchuk

LASTools

- lasinfo
- lasmerge
- las2las
- las2txt
- txt2las
- lasthin
- las2ogr

lasinfo

Displays header information and LAS file point summary

Usage: lasinfo sample.las

lasmerge

 Merge two or more LAS files into a LAS single file from the cmd line

```
Usage: lasmerge -i nh_line1.las -i nh_line2.las -i nh_line3.las -i nh_line4.las -o
C:\asprs_workshop\lab2\merged_data\nh_merge.las
```

las2las

 Basic LAS file processing from the cmd line (clip by bounding box, clip by height, clip by class, several other options)

Usage: las2las -i sample.las -clip_z -60 70 -o sample_edited.las

Usage: las2las -i sample_edited.las -clip 358100 4771200 358700 4771700 -o subset.las

las2txt

Convert LAS file to user specified ASCII text format

Usage: las2txt –i sample_edited.las –o sample_edited.txt –parse xyz

This example converts LAS file to a x,y,z ASCII format

txt2las

Convert ASCII text file to LAS format

Usage: txt2las –i sample_edited.txt –o sample_demo.las – parse xyz

This example converts x,y,z formatted ASCII to LAS

lasthin

- Simple point thinning algorithm
- Places a user specified uniform grid over the points and keeps the lowest z coordinate in the grid cell

Usage: lasinfo –i subset.las –o subset_decim.las -grid_spacing 10.0

las2ogr

 Converts LAS file to vector formats supported by OGR/GDAL

Usage: las2ogr –i subset_decim.las –o subset_decim.shp -f "ESRI Shapefile"