ES302 Exercise – Using Surfer to Build Lidar Based Digital Elevation Models
(ver 2 – R. Stanley Edits)

Lidar is an emerging technology that is being widely applied to mapping the Earth's surface. The technique is based on the use of airborne sensors that emit 1000's of laser pulses to the Earth's surface, then measuring the return time of reflected beams using computing technology. By knowing the speed of light and the two-way return time of reflected laser pulses + aircraft position and altitude, it is possible to determine very accurate and precise changes in Earth surface elevations (i.e. topography). As of 2010, this technique is being applied in western Oregon to generate a new generation of very accurate elevation models. With pulse rates of up to 8 per square meter, we are able to map elevation changes to sub-meter scale accuracy. The "first return" reflections back to the sensors include all surface objects including buildings, cars, trees, people and understory vegetation. By the use of software filters, it is possible to strip off the first-return data and filter it down to the "last returns" to create a "bare earth model" of the Earth's surface (essentially stripping the surface objects off and leaving the details of underlying topography in the model). This type of topographic surveying results in highly precise and accurate digital elevation models that can then be used to build raster grids and in turn surface maps (contour, shaded relief, etc) in the Surfer software package.

(1) Go to the Lab Exercise section of the ES302 Class web site and look down the list for the "Using Surfer to Build Lidar-Based Digital Elevation Models". There you will find links to 2 surfer *.grd files:

WOU Campus 1-m Lidar-Based DEM First Returns (wou_campus_1m_lidar_dem.grd)

WOU Campus 1-m Lidar-Based DEM Bare Earth (wou_campus_1m_bare_earth_dem.grd)

(2) Rt-click and save the files to your ES302 folder on your H:\drive or other personal memory space.

(3) Using surfer, you are now ready to work with the lidar grid files of campus. Create the following map products FOR EACH GRID FILE (put your name on all work and print out to include in your lab portfolios; include a scale bar, north arrow, and grid tick/graticules on your maps):
    a. Shaded relief map – sun from the northwest at 45 degrees
    b. Color-coded Surface Map – view to the west
    c. A grid post map showing point elevations at even 5000 ft intervals
        i. Click Grid>Convert and select either the bare earth or first returns DEM (you will have to do this for each one).
        ii. When the 'Save Grid As' window appears, select ASCII XYZ (*.dat) as the file type and type a file name.
        iii. Use the .dat file to create a post map from the DEM. Label the points using elevation values and choose to disable display of decimals.

(4) Use surfer tools to produce the following:
    a. A color coded image map displaying the heights of objects above ground level.
        i. Click Grid>Math… and open the first returns DEM.
        ii. In the Grid Math window that appears, choose the bare earth DEM for grid B, and specify the name/location of the output file.
        iii. Type C = A- B into the function form and click OK. This creates a third grid (C) by subtracting the bare earth DEM (B) from the first returns DEM (A).
        iv. Produce an image map of the DEM that displays object height with a color scale. Create a color ramp with 6 equally spaced classes and unique colors.