Using LiDAR to Determine Vegetation Heights in a Rangeland Environment

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• Major Species
  • Mountain Sagebrush
  • Rabbitbrush, Horsebrush
  • Thickspike wheatgrass, Plains reedgrass, Idaho fescue

• Heights of 50 - 150 cm
Goals of study

• Use LiDAR to determine rangeland vegetation heights
• Distinguish between burned and unburned areas, brush and grasses
Dataset Characteristics

• Nine flightlines, each ~300 m wide
  – Flightline overlap of ~50%
• Total coverage of 6.9 km²
• Over 8 million postings, each with first and last returns
  – Average spacing of < 1 m
  – Laser footprint diameter of 25 cm
• Elevation ranges over 90 m
Relative Vertical Accuracy

• Find flat areas

• Measure standard deviation of elevation across area

• Vertical accuracy cannot be worse than the standard deviation
Relative Vertical Accuracy

• For overlapping flightlines, relative accuracy is ~25 cm

• For individual flightlines, relative accuracy of ~5 cm can be achieved

• To maintain high accuracy, processing is performed on individual flightlines
Height Calculation

- Assumes open canopy
- Uses only last pulse data
- Lowest elevations over a 5 m grid assumed to be “ground”
- Use “ground” points to interpolate a “ground surface”
- Vegetation height calculated as difference between LiDAR height and ground surface
- Negative heights are reclassified as “ground”
- Process is iterated until convergence
Vegetation Roughness

- Vegetation heights are separated into 5 m grid cells
- Vegetation roughness is calculated for each grid cell/pixel as standard deviation of all heights within the grid cell
- Statistical measure of vegetation structure
Geocorrection

- 45 differentially corrected Ground Control Points collected at road intersections and other identifiable features

- RMS error of 0.8 m
- Two-sigma accuracy of 1.5 m
Validation

• 168 field validation points
  – Measured vegetation heights to accuracy of ~10 cm
  – Compared with lidar heights using buffer of 1.5 m

• Qualitative comparison to Quickbird imagery
**Bare Ground LiDAR**
Heights: 10 ± 5 cm

**Sagebrush Heights:**
Correlation of 0.72
**Burned Roughness:**

4.6 ± 2.9 cm

**Sagebrush Roughness:**

8.1 ± 3.6 cm
Possible Sources of Error

- Incomplete LiDAR coverage
- Inability to precisely locate LiDAR postings in the field
- Penetration of laser pulse into vegetation
- Imprecision of field height measurement
- Inaccuracy of LiDAR height determination
Conclusions

• LiDAR can be used with moderate success to determine rangeland vegetation heights
  – Scaling factor of two may be necessary
• LiDAR derived vegetation roughness may be useful in mapping rangeland vegetation characteristics
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Questions?