Extracting structural characteristics of dormant herbaceous floodplain vegetation from ALS data

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Outline

- Hydrodynamic structural characteristics
- Point labeling
- Predictive models for structural characteristics
- Outlook
- Conclusions
Herbaceous vegetation
Vegetation structural characteristics

- Vegetation height
- Vegetation density

\[ D_v = \frac{\sum_{i=1}^{n} A_i}{lbH_v} \]
Field data
ALS raw data

Three laser datasets

- DWADW
  - Flying height 80 m
  - High gain
  - Old sensor

- GWhigh
  - Flying height 80 m
  - Normal gain
  - New sensor

- GWlow
  - Flying height 55 m
  - High gain
  - New sensor
Point labeling

(a) Height above DTM (m)

(b) Height above DTM (m)

(c) Height above modus (m)
ALS statistics

- Central tendency: mean, median, mode
- Variability: standard deviation and variance
- Shape: skewness and kurtosis
- Percentiles: $D_{10}$, $D_{20}, \ldots, D_{100} + D_{95}$, $D_{96}$, $D_{97}$, $D_{98}$, $D_{99}$
- Percentage Index:

$$PI_{h_1-h_2} = \frac{1}{h_2 - h_1} \cdot \frac{N_{h_1-h_2}}{N_{tot}}$$
$PI_{h1-h2} = \frac{1}{h2-h1} \times \frac{N_{h2-h1}}{N_{tot}}$
Correlation

Vegetation height

Correlation with field Hv (-)

Laser derived statistic

mean
mode
cv
sk
kurt
var
sd

D10, D20, D30, D40, D50, D60, D70, D80, D90, D100, mean, mode, cv, sk, kurt, var, sd
Vegetation height prediction

Threshold

\[ H_v (m) \]

- a) DWDW
- b) GWhigh
- c) GWlow

\[ R^2 = 0.58 \]
\[ rse = 0.17 \]

\[ R^2 = 0.41 \]
\[ rse = 0.24 \]

\[ R^2 = 0.57 \]
\[ rse = 0.21 \]

Inflection

\[ H_v (m) \]

- d) DWDW
- e) GWhigh
- f) GWlow

\[ R^2 = 0.76 \]
\[ rse = 0.13 \]

\[ R^2 = 0.74 \]
\[ rse = 0.16 \]

\[ R^2 = 0.88 \]
\[ rse = 0.11 \]

Gauss

\[ H_v (m) \]

- g) DWDW
- h) GWhigh
- i) GWlow

\[ R^2 = 0.37 \]
\[ rse = 0.21 \]

\[ R^2 = 0.46 \]
\[ rse = 0.23 \]

\[ R^2 = 0.65 \]
\[ rse = 0.19 \]
Vegetation density prediction

Threshold

Inflection

Gauss

\[ \text{Threshold} \]

\[ \text{Inflection} \]

\[ \text{Gauss} \]
Required point density

- Correlation (-)

Point density (points/m²)

- Hv
- Dv
Portability of regression models

![Graph showing portability of regression models]
Conclusions ..... 

• The method of labeling laser points as vegetation has a large influence on the appropriate laser derived statistic and accuracy.
• Vegetation height is best predicted using the inflection method for labeling and the $D_{95}$ percentile ($R^2 = 0.74 - 0.88$).
• Vegetation density is best predicted using the threshold method for labeling and the Percentage index ($R^2 = 0.51$).
• 15 points/m² suffices for vegetation mapping
Outlook 1 Lower vegetation
Outlook 2 Standard measure of sensitivity
Outlook

• Higher point accuracy might extend the method to lower vegetation.
• Portability could be improved by a standard measure of sensor sensitivity.