remote sensing

Review

Terrestrial laser scanning for vegetation analyses with a special focus on savannas

Tasiyiwa Priscilla Muumbe [1,] *, Jussi Baade [2], Jenia Singh [3], Christiane Schmullius [1] and Christian Thau [1,4]

1 Department for Earth Observation, Friedrich Schiller University Jena, 07743 Jena, Germany; c.schmullius@uni-jena.de (C.S.), christian.thau@uni-jena.de (C.T.)

2 Department of Physical Geography, Friedrich Schiller University Jena, 07743 Jena; Germany; jussi.baade@uni-jena.de

3 Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, MA 02138, USA; jeniasingh@fas.harvard.edu

4 Department for Urban Development and Environment, Jena City Administration , 07743 Jena, Germany

* Correspondence: tasiyiwa.muumbe@uni-jena.de

Supplementary Material

Table S1. Full List of Reviewed Research Articles.

Author (s), Year	Title	Journal
1. Aijazi et al., 2017	Automatic detection and parameter estimation of trees for forest inventory applications using 3D terrestrial LiDAR	Remote Sensing
2. Åkerblom et al., 2018	Non-intersecting leaf insertion algorithm for tree structure models	Interface Focus
3. Anderson et al., 2018	Estimating vegetation biomass and cover across large plots in shrub and grass dominated drylands using terrestrial lidar and machine learning	Ecological Indicators
4. Bailey and Ochoa, 2018	Semi-direct tree reconstruction using terrestrial LiDAR point cloud data	Remote Sensing of Environment
5. Bazezew et al., 2018	Integrating Airborne LiDAR and Terrestrial Laser Scanner forest parameters for accurate above-ground biomass/carbon estimation in Ayer Hitam tropical forest, Malaysia	International Journal of Applied Earth Observation and Geoinformation
6. Béland et al., 2011	Estimating leaf area distribution in savanna trees from terrestrial LiDAR measurements.	Agricultural and Forest Meteorology
7. Beyer et al., 2017	Validation of a functional-structural tree model using terrestrial Lidar data	Ecological Modelling
8. Bordin et al., 2013	Analysis of the Influence of Distance on Data Acquisition Intensity Forestry Targets By a Lidar Technique With Terrestrial Laser Scanner	ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences
9. Brede et al., 2019	Non-destructive tree volume estimation through quantitative structure modelling: Comparing UAV laser scanning with terrestrial LIDAR	Remote Sensing of Environment

Author (s), Year	Title	Journal
10. Bremer et al.,2018	Multi-temporal fine-scale modelling of Larix decidua forest plots using terrestrial LiDAR and hemispherical photographs	Remote Sensing of Environment
11. Burt et al., 2013	Rapid characterisation of forest structure from TLS and 3D modelling	International Geoscience and Remote Sensing Symposium (IGARSS)
12. Burt et al., 2019	Extracting individual trees from lidar point clouds using treeseg	Methods in Ecology and Evolution
13. Calders et al., 2014	Implications of sensor configuration and topography on vertical plant profiles derived from terrestrial LiDAR	Agricultural and Forest Meteorology
14. Calders et al., 2015	Nondestructive estimates of above-ground biomass using terrestrial laser scanning	Methods in Ecology and Evolution
15. Calders et al., 2016	Large-area virtual forests from terrestrial laser scanning data	International Geoscience and Remote Sensing Symposium (IGARSS)
16. Calders et al., 2018	Variability and bias in active and passive ground-based measurements of effective plant, wood and leaf area index	Agricultural and Forest Meteorology
17. Calders et al., 2018	Realistic forest stand reconstruction from terrestrial LiDAR for radiative transfer modelling	Remote Sensing
18. Chen et al., 2019	Nondestructive estimation of the above-ground biomass of multiple tree species in boreal forests of china using terrestrial laser scanning	Forests
19. Cooper et al., 2017	Examination of the potential of terrestrial laser scanning and structure-from-motion photogrammetry for rapid nondestructive field measurement of grass biomass	Remote Sensing

Author (s), Year	Title	Journal
20. Côté et al., 2012	A fine-scale architectural model of trees to enhance LiDAR-derived measurements of forest canopy structure	Agricultural and Forest Meteorology
21. Côté et al., 2018	Fine-scale three-dimensional modeling of boreal forest plots to improve forest characterization with remote sensing	Remote Sensing of Environment
22. Cuni-Sanchez et al., 2016	African savanna-forest boundary dynamics: A 20-year study	PLoS ONE
23. Danson et al., 2018	Spectral and spatial information from a novel dual-wavelength full-waveform terrestrial laser scanner for forest ecology	Interface Focus
24. Decuyper et al., 2018	Assessing the structural differences between tropical forest types using Terrestrial Laser Scanning	Forest Ecology and Management
25. Delagrange and Rochon, 2011	Reconstruction and analysis of a deciduous sapling using digital photographs or terrestrial-LiDAR technology	Annals of Botany
26. Errington et al., 2015	Reflectance modelling using terrestrial LiDAR intensity data	IST 2015 - 2015 IEEE International Conference on Imaging Systems and Techniques, Proceedings
27. Estornell et al., 2017	Estimation of structural attributes of walnut trees based on terrestrial laser scanning	Revista de Teledeteccion
28. Fan et al., 2020	A new quantitative approach to tree attributes estimation based on LiDAR point clouds	Remote Sensing
29. Fang & Strimbu, 2019	Comparison of Mature Douglas-Firs' Crown Structures Developed with Two Quantitative Structural Models Using TLS Point Clouds for Neighboring Trees in a Natural Regime Stand	Remote Sensing

Author (s), Year	Title	Journal
30. Ferrara et al., 2018	An automated approach for wood-leaf separation from terrestrial LIDAR point clouds using the density based clustering algorithm DBSCAN	Agricultural and Forest Meteorology
31. Ghimire et al., 2017	Using terrestrial laser scanning to measure forest inventory parameters in a Mediterranean coniferous stand of western Greece	PFG - Journal of Photogrammetry, Remote Sensing and Geoinformation Science
32. Gollob et al., 2019	Influence of scanner position and plot size on the accuracy of tree detection and diameter estimation using terrestrial laser scanning on forest inventory plots	Remote sensing
33. Gonzalez de Tanago et al., 2018	Estimation of above-ground biomass of large tropical trees with terrestrial LiDAR	Methods in Ecology and Evolution
34. Greaves et al., 2015	Estimating aboveground biomass and leaf area of low-stature Arctic shrubs with terrestrial LiDAR	Remote Sensing of Environment
35. Greaves et al., 2017	Applying terrestrial lidar for evaluation and calibration of airborne lidar-derived shrub biomass estimates in Arctic tundra	Remote Sensing Letters
36. Grotti et al., 2020	An intensity, image-based method to estimate gap fraction, canopy openness and effective leaf area index from phase-shift terrestrial laser scanning	Agricultural and Forest Meteorology
37. Guimarães-Steinicke et al., 2019	Terrestrial laser scanning reveals temporal changes in biodiversity mechanisms driving grassland productivity	Advances in Ecological Research
38. Hancock et al., 2017	Measurement of fine-spatial-resolution 3D vegetation structure with airborne waveform lidar: Calibration and validation with voxelised terrestrial lidar	Remote Sensing of Environment

Author (s), Year	Title	Journal
39. Heinzel & Huber, 2016	TLS field data based intensity correction for forest environments	International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives
40. Heinzel & Huber, 2017	Detecting tree stems from volumetric TLS data in forest environments with rich understory	Remote Sensing
41. Heinzel and Huber, 2017	Tree stem diameter estimation from volumetric TLS image data	Remote Sensing
42. Indirabai et al., 2019	Terrestrial laser scanner based 3D reconstruction of trees and retrieval of leaf area index in a forest environment	Ecological Informatics
43. Kaasalainen et al., 2011	Analysis of incidence angle and distance effects on terrestrial laser scanner intensity: Search for correction methods	Remote Sensing
44. Kaasalainen et al., 2014	Change detection of tree biomass with terrestrial laser scanning and quantitative structure modelling	Remote Sensing
45. Kato et al., 2014	Efficient field data collection of tropical forest using terrestrial laser scanner	International Geoscience and Remote Sensing Symposium (IGARSS)
46. Kato et al., 2015	Fusion between UAV-SFM and terrestrial laser scanner for field validation of satellite remote sensing	International Geoscience and Remote Sensing Symposium (IGARSS)
47. Kelbe et al., 2013	Reconstruction of 3D tree stem models from low-cost terrestrial laser scanner data	Laser Radar Technology and Applications XVIII
48. Kelbe et al., 2015	Single-scan stem reconstruction using low-resolution terrestrial laser scanner data	IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing
49. Kim et al.,2016	Simulated full-waveform lidar compared to Riegl VZ-400 terrestrial laser scans	Laser Radar Technology and Applications XXI

Author (s), Year	Title	Journal
50. Kirton et al., 2009	Detailed structural characterisation of the savanna flux site at Skukuza, South Africa	International Geoscience and Remote Sensing Symposium (IGARSS)
51. Kong et al., 2015	New hybrid algorithms for estimating tree stem diameters at breast height using a two dimensional terrestrial laser scanner	Sensors (Switzerland)
52. Krooks et al., 2014	Tree structure vs. height from terrestrial laser scanning and quantitative structure models	Silva Fennica
53. LaRue et al., 2020	Compatibility of Aerial and Terrestrial LiDAR for Quantifying Forest Structural Diversity	Remote Sensing
54. Lau et al., 2018	Quantifying branch architecture of tropical trees using terrestrial LiDAR and 3D modelling	Trees - Structure and Function
55. Lau et al., 2019	Estimating architecture-based metabolic scaling exponents of tropical trees using terrestrial LiDAR and 3D modelling	Forest Ecology and Management
56. Li et al., 2019	Assessing revegetation effectiveness on an extremely degraded grassland, southern Qinghai-Tibetan Plateau, using terrestrial LiDAR and field data	Agriculture, Ecosystems and Environment
57. Liang et al., 2018	International benchmarking of terrestrial laser scanning approaches for forest inventories	ISPRS Journal of Photogrammetry and Remote Sensing
58. Maas et al., 2008	Automatic forest inventory parameter determination from terrestrial laser scanner data	International Journal of Remote Sensing
59. Magney et al., 2016	LiDAR canopy radiation model reveals patterns of photosynthetic partitioning in an Arctic shrub	Agricultural and Forest Meteorology
60. Moorthy et al., 2008	Retrieving crown leaf area index from an individual tree using ground-based lidar data	Canadian Journal of Remote Sensing

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61. Moorthy et al., 2019	Semi-automatic extraction of liana stems from terrestrial LiDAR point clouds of tropical rainforests	ISPRS Journal of Photogrammetry and Remote Sensing
62. Moskal and Zheng, 2012	Retrieving forest inventory variables with terrestrial laser scanning (TLS) in urban heterogeneous forest	Remote Sensing
63. Muir et al., 2018	Measuring plot scale woodland structure using terrestrial laser scanning	Remote Sensing in Ecology and Conservation
64. Odipo et al., 2016	Assessment of aboveground woody biomass dynamics using terrestrial laser scanner and L-band ALOS PALSAR data in South African Savanna	Forests
65. Olivier et al., 2017	A method to quantify canopy changes using multi-temporal terrestrial lidar data: Tree response to surrounding gaps	Agricultural and Forest Meteorology
66. Olofsson et al., 2014	Tree stem and height measurements using terrestrial laser scanning and the RANSAC algorithm	Remote Sensing
67. Olsoy et al., 2014	Aboveground total and green biomass of dryland shrub derived from terrestrial laser scanning	ISPRS Journal of Photogrammetry and Remote Sensing
68. Oveland et al., 2017	Automatic estimation of tree position and stem diameter using a moving terrestrial laser scanner	Remote Sensing
69. Paynter et al., 2018	Bounding uncertainty in volumetric geometric models for terrestrial lidar observations of ecosystems	Interface Focus
70. Pitkänen et al., 2019	Measuring stem diameters with TLS in boreal forests by complementary fitting procedure.	ISPRS Journal of Photogrammetry and Remote Sensing
71. Popovas et al., 2017	Individual tree parameters estimation from terrestrial laser scanner data	10th International Conference on Environmental Engineering, ICEE 2017

Author (s), Year	Title	Journal
72. Putman et al., 2018	Detecting and quantifying standing dead tree structural loss with reconstructed tree models using voxelized terrestrial lidar data	Remote Sensing of Environment
73. Ravaglia et al., 2019	Comparison of three algorithms to estimate tree stem diameter from terrestrial laser scanner data	Forests
74. Reddy et al., 2018	Automatic estimation of tree stem attributes using terrestrial laser scanning in central Indian dry deciduous forests	Current Science
75. Reddy et al.,2018	Automatic Tree Identification and Diameter Estimation Using Single Scan Terrestrial Laser Scanner Data in Central Indian	Journal of the Indian Society of Remote Sensing
76. Schulze-Brüninghoff et al., 2019	Methods for LiDAR-based estimation of extensive grassland biomass	Computers and Electronics in Agriculture
77. Singh et al., 2018	Variability in fire-induced change to vegetation physiognomy and biomass in semi-arid savanna	Ecosphere
78. Singh et al., 2020	Moving from plot-based to hillslope-scale assessments of savanna vegetation structure with long-range terrestrial laser scanning (LR-TLS)	International Journal of Applied Earth Observation and Geoinformation
79. Soma et al., 2020	Mitigating occlusion effects in Leaf Area Density estimates from Terrestrial LiDAR through a specific kriging method	Remote Sensing of Environment
80. Srinivasan et al., 2014	Multi-temporal terrestrial laser scanning for modeling tree biomass change	Forest Ecology and Management
81. Srinivasan et al., 2015	Terrestrial laser scanning as an effective tool to retrieve tree level height, crown width, and stem diameter	Remote Sensing

Author (s), Year	Title	Journal
82. Stovall and Shugart, 2018	Improved biomass calibration and validation with terrestrial lidar: Implications for future LiDAR and SAR missions	IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing
83. Sun et al., 2015	Retrieval and Accuracy Assessment of Tree and Stand Parameters for Chinese Fir Plantation Using Terrestrial Laser Scanning	IEEE Geoscience and Remote Sensing Letters
84. Tan & Cheng, 2015	Intensity data correction based on incidence angle and distance for terrestrial laser scanner	Journal of Applied Remote Sensing
85. Tan & Cheng, 2016	Correction of incidence angle and distance effects on TLS intensity data based on reference targets	Remote Sensing
86. Tan et al., 2018	Investigation of TLS intensity data and distance measurement errors from target specular reflections	Remote Sensing
87. Tansey et al., 2009	Estimating tree and stand variables in a Corsican Pine woodland from terrestrial laser scanner data	International Journal of Remote Sensing
88. Tao et al., 2015	Segmenting tree crowns from terrestrial and mobile LiDAR data by exploring ecological theories	ISPRS Journal of Photogrammetry and Remote Sensing
89. Thies et al., 2004	Three-dimensional reconstruction of stems for assessment of taper, sweep and lean based on laser scanning of standing trees	Scandinavian Journal of Forest Research
90. Tian et al., 2014	Derivation of tree stem structural parameters from static terrestrial laser scanning data	Lidar Remote Sensing for Environmental Monitoring XIV
91. Vaaja et al., 2016	the Effect of Wind on Tree Stem Parameter Estimation Using Terrestrial Laser Scanning	ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences
92. Vaccari et al., 2013	Bias in lidar-based canopy gap fraction estimates	Remote Sensing Letters
93. Vrlingie et al., 2013	Shrub characterization using terrestrial laser scanning and implications for airborne LiDAR assessment	Canadian Journal of Remote Sensing

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94. Wan et al., 2019	Quantification of occlusions influencing the tree stem curve retrieving from single-scan terrestrial laser scanning data	Forest Ecosystems
95. Wang et al., 2016	Fast and robust stem reconstruction in complex environments using terrestrial laser scanning	International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives
96. Wang et al.,2014	A structure-aware global optimization method for reconstructing 3-D tree models from terrestrial laser scanning data	IEEE Transactions on Geoscience and Remote Sensing
97. Watt and Donoghue, 2005	Measuring forest structure with terrestrial laser scanning	International Journal of Remote Sensing
98. Wu et al., 2018	Estimation of forest trees diameter from terrestrial laser scanning point clouds based on a circle fitting method	International Geoscience and Remote Sensing Symposium (IGARSS)
99. Xi et al., 2016	Automating plot-level stem analysis from terrestrial laser scanning	Forests
100. Xia et al., 2015	Detecting stems in dense and homogeneous forest using single-scan TLS	Forests
101. Xiangyu et al., 2014	3D reconstruction of a single tree from terrestrial LiDAR data	International Geoscience and Remote Sensing Symposium (IGARSS)
102. Xu et al., 2020)	Estimation of degraded grassland aboveground biomass using machine learning methods from terrestrial laser scanning data	Ecological Indicators
103. Yang et al., 2013	Studying canopy structure through 3-D reconstruction of point clouds from full-waveform terrestrial lidar	International Geoscience and Remote Sensing Symposium (IGARSS)

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104. Yang et al., 2013	Three-dimensional forest reconstruction and structural parameter retrievals using a terrestrial full-waveform lidar instrument (Echidna®)	Remote Sensing of Environment
105. You et al., 2016	Precise measurement of stem diameter by simulating the path of diameter tape from terrestrial laser scanning data	Remote Sensing
106. Yrttimaa et al., 2019	Investigating the feasibility of multi-scan terrestrial laser scanning to characterize tree communities in southern boreal forests	Remote sensing
107. Yu et al., 2013	Stem biomass estimation based on stem reconstruction from terrestrial laser scanning point clouds	Remote Sensing Letters
108. Yurtseven et al., 2019	Individual tree measurements in a planted woodland with terrestrial laser scanner	Turkish Journal of Agriculture and Forestry
109. Zhang et al., 2019	A novel approach for the detection of standing tree stems from plot-level terrestrial laser scanning data	Remote Sensing
110. Zheng etal.,2013	Retrieval of effective leaf area index in heterogeneous forests with terrestrial laser scanning	IEEE Transactions on Geoscience and Remote Sensing
111. Zhou et al., 2018	Estimation of the plot level forest parameters from Terrestrial Laser Scanning Data	IGARSS 2018 - 2018 IEEE International Geoscience and Remote Sensing Symposium
112. Zhu et al., 2015	3D leaf water content mapping using terrestrial laser scanner backscatter intensity with radiometric correction	ISPRS Journal of Photogrammetry and Remote Sensing
113. Zimbres et al., 2020	Savanna vegetation structure in the Brazilian Cerrado allows for the accurate estimation of aboveground biomass using terrestrial laser scanning	Forest Ecology and Management