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Data Article

Traditional and TLS-based forest inventories of beech and pine forests located in Sila National Park: A dataset

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ABSTRACT

Vegetation structure is a key determinant of species distribution and diversity. Compared to traditional methods, the use of Terrestrial Laser Scanning (TLS) has allowed massive amounts of point cloud data collected for quantifying three-dimensional habitat properties at increasing spatial and temporal scales. We used TLS to characterize the forest plots across a broad range of forest structural diversity, located in the Sila National Park, South Italy. The dataset reports data collected in 24 15-m-radius circular plots, 12 of which were dominated by beech (*Fagus sylvatica* L.) and 12, by black pine (*Pinus nigra* subsp. *laricio*). In detail, this work provides dataset of i) plot-level attributes calculated from raw data, such as the number of trees, ii) tree-level data, comprising a total of 1709 trees, with information related to field-based forest inventory such as the diameter at breast height (DBH), and iii) plot-level information related to the time for conducting both traditional field- and TLS-based forest inventories. Compared to traditional methods, the use of TLS allows a very high-resolution quantification of the 3D forest structural properties, also reducing the time for conducting forest inventories.

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Specifications Table

Subject	Agricultural and Biological Sciences
Specific subject area	Forestry
Type of data	Table, Point cloud (LAS format), Georeferenced sample plots (shapefile and KMZ format)
How data was acquired	Data were collected from August 25th to August 30th, 2019. Our inventory consisted of twenty-four plots of 15 m radius (707 m^2) each within the Sila National Park (Southern Italy). Plots were randomly located and stratified between the two main forest tree species in the Park: black pine and European beech. We measured the diameter of all the trees with DBH $\geq$ 3 cm found within the plots with a calliper at 1.30 m taken from the base of the tree and collected health status (i.e. alive, dead or snag). Each tree was marked with red spray paint where the DHB was measured. A total of 1709 trees were measured. TLS data were acquired using a GeoSLAM ZEB-REVO mobile time-of-flight scanner. We scanned each plot in a circular pattern at about 15 and 7.5 m from the centre respectively, starting and ending at the centre.
Data format	Raw
Parameters for data collection	Data collection considered GPS position, all trees of DBH $\geq$ 3 cm and TLS point clouds within 24 plots.
Description of data collection	Data were collected as part of the Agridigit project funded by the Italian Ministry of Agricultural, Food, and Forestry Policies in southern Italy. The dataset comprises plot georeferenced position, all trees with DBH $\geq$ 3 cm and all TLS point cloud for each of the twenty-four-plot area.
Data source location	Sila National Park in Calabria, Italy. Sampling plot names: ID_PXXX: Black pine forest, from 001 to 012; ID_FXXX: European beech forests, from 001 to 012.
Data accessibility	Repository name: Mendeley data Data identification number: 10.17632/k6nmr6ytpf.1 Direct URL to data: http://dx.doi.org/10.17632/k6nmr6ytpf.1
Related research article	Puletti N.; Grotti M.; Ferrara C.; Chianucci C. Lidar-based estimates of aboveground biomass through ground, aerial, and satellite observation: a case study in a Mediterranean forest. J. of Applied Remote Sensing, 14(4), 044501 (2020). https://doi.org/10.1117/1.JRS.14.044501

Value of the Data

- The data provide information useful for estimating forest carbon storage in beech and pine forests in Southern Italy (see for example [1]).
- Shared TLS data can be used to create species-specific allometry models (see for example [2]).
- Data can be exploited to analyse structural characteristics of considered forests, providing information to implement local conservation policies.
- This dataset may assist forest researchers to combine and extend their data for further meta-analysis in the same biogeographic area.
- Data can provide useful information to compare the pros and cons on the adoption of mobile TLS in forest inventories.
- A simultaneous acquisition of both DBH and TLS measurements is useful to evaluate the pros and cons of Field- and TLS-based forest inventories.

1. Dataset Description

The dataset presents the results of a forest inventory conducted in a Mediterranean forest located in the Sila National Park, Southern Italy (39.4° N, 16.5° E; Fig. 1). The dataset consists of three tables: plot-level data (Table 1), tree-level data with information related to field-based

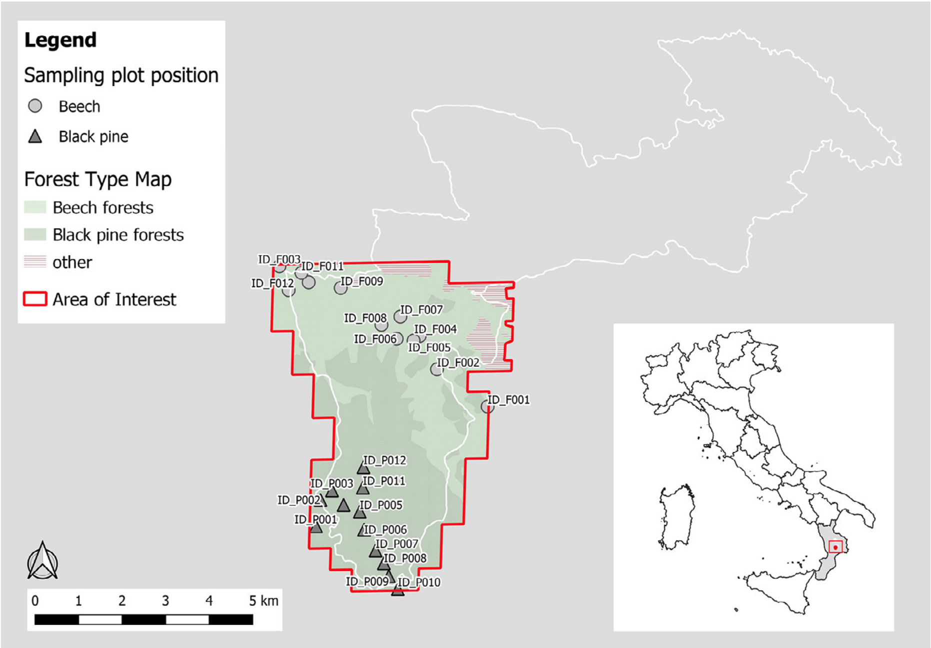

Fig. 1. Study area and sampling plot distribution. The white line depicts the Sila National Park boundaries.

Table 1
List of sampling plots with their geographical location and number of trees registered. In the online version, we uploaded the shapefile of plot centres.

ID plot	Dominant species	Latitude	Longitude	N. of trees
ID_P001	Black pine	39.0786141083 N	16.5735212244 E	17
ID_P002	Black pine	39.0840337522 N	16.5748482777 E	27
ID_P003	Black pine	39.0859809136 N	16.5779477189 E	28
ID_P004	Black pine	39.0829139671 N	16.5809598645 E	100
ID_P005	Black pine	39.0814667143 N	16.5852189074 E	30
ID_P006	Black pine	39.0786141083 N	16.5735212244 E	42
ID_P007	Black pine	39.0733666523 N	16.5892350788 E	52
ID_P008	Black pine	39.0707102766 N	16.5913812203 E	25
ID_P009	Black pine	39.0680117525 N	16.5926242830 E	67
ID_P010	Black pine	39.0653250512 N	16.5949533534 E	54
ID_P011	Black pine	39.0864297415 N	16.5861507606 E	22
ID_P012	Black pine	39.0906694910 N	16.5864054250 E	28
ID_F001	Beech	39.1027589857 N	16.6196679544 E	121
ID_F002	Beech	39.1106409347 N	16.6063941305 E	61
ID_F003	Beech	39.1325413418 N	16.5650174068 E	61
ID_F004	Beech	39.1175803220 N	16.6019309515 E	36
ID_F005	Beech	39.1166786865 N	16.6002999343 E	62
ID_F006	Beech	39.1170979625 N	16.5958293660 E	33
ID_F007	Beech	39.1216671472 N	16.5969088712 E	203
ID_F008	Beech	39.1200267111 N	16.5918490960 E	112
ID_F009	Beech	39.1278265765 N	16.5811928951 E	265
ID_F010	Beech	39.1291099017 N	16.5727152185 E	92
ID_F011	Beech	39.1310926576 N	16.5708270382 E	95
ID_F012	Beech	39.1275562293 N	16.5673577557 E	76

Table 2
Example of the field inventory database for the first 10 rows only. ID_plot is the sampling-plot identification code; Tree_id is the identification number assigned to each measured tree; Subidentity_id is the identification code assigned to each measured shoot (only for broadleaves); the last two columns are tree species (spp) and diameter at breast height (diam_cm) of each measured tree/shoot. A column for notes about tree conditions (vitality or position) was also added.

ID plot	Tree id	Subidentity id	spp	diam_cm	Note
ID_P001	1	a	*Pinus nigra* subsp. *laricio*	46	
ID_P001	2	a	*Pinus nigra* subsp. *laricio*	51	
ID_P001	3	a	*Pinus nigra* subsp. *laricio*	7	
ID_P001	4	a	*Pinus nigra* subsp. *laricio*	62	
ID_P001	5	a	*Pinus nigra* subsp. *laricio*	15	
ID_P001	6	a	*Pinus nigra* subsp. *laricio*	43	
ID_P001	7	a	*Pinus nigra* subsp. *laricio*	52	
ID_P001	8	a	*Pinus nigra* subsp. *laricio*	66	
ID_P001	9	a	*Pinus nigra* subsp. *laricio*	4	
ID_P001	10	a	*Pinus nigra* subsp. *laricio*	57	

Table 3
Plot-level information related to both traditional and TLS-based time forest inventory (in minutes).

		Traditional inventory		TLS-based inventory	
id_plot	Time from car to sampling plot	Preparatory actions	Field works	Preparatory actions	Field works
ID_P001	5	3	3	4	10
ID_P002	3	3	3	10	8
ID_P003	2	2	3	4	10
ID_P004	1	3	3	23	15
ID_P005	3	2	3	9	11
ID_P006	13	2	3	4	11
ID_P007	2	3	3	14	8
ID_P008	3	5	3	9	17
ID_P009	4	6	3	9	9
ID_P010	12	5	3	9	9
ID_P011	4	2	3	8	7
ID_P012	4	1	3	11	12
ID_F001	4	5	3	19	11
ID_F002	4	4	3	12	16
ID_F003	6	4	3	15	11
ID_F004	4	6	3	6	13
ID_F005	5	5	3	10	9
ID_F006	1	7	3	13	6
ID_F007	5	2	3	26	15
ID_F008	7	2	3	13	11
ID_F009	5	2	3	26	13
ID_F010	2	2	3	13	10
ID_F011	1	3	3	8	9
ID_F012	2	6	3	9	9

forest inventory (Table 2), plot-level information related to both field-based and TLS-based forest inventories (Table 3).

2. Experimental Design, Materials and Methods

The study site was a 40 km^2 area located in the Sila National Park, Italy (approx. lat.: 39° 6’ N, long.: 16° 35’ E; elevation between 1,200 and 1,600 m above sea level).

Field measurements were performed from 25 to 30 August 2019 during leaf-on conditions in 24 circular plots of 15 m radius each (Table 1); 12 plots dominated by European beech (7.3 of European Forest Types; [3]) and 12 plots by black pine (10.2 of European Forest Types; [3]).

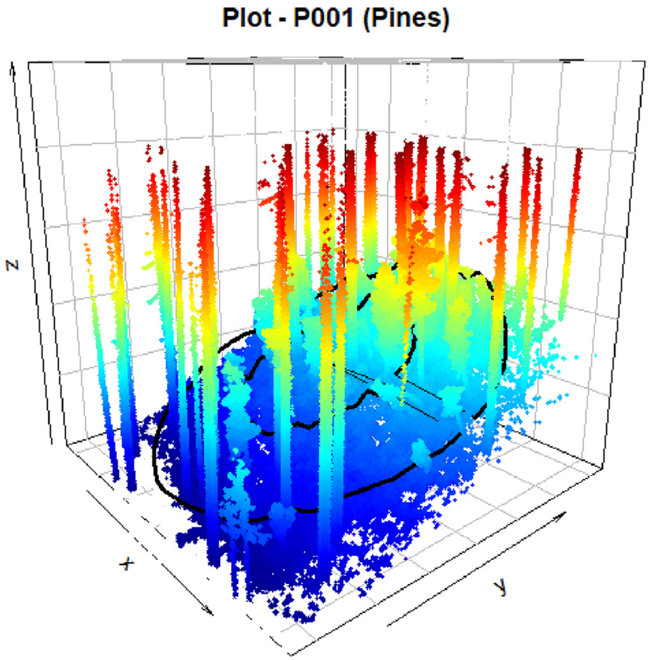

Fig. 2. Graphical representation of mobile-TLS survey (black lines) in a 3D view (modified from Puletti et al. 2020).

Global Navigation Satellite Systems (GNSS) static observations were recorded at the centres of each sampling plot with a Trimble Juno 5 GPS (Trimble Inc., Sunnyvale, California, US) during a 10 minutes observation time to assure that GNSS errors do not lead to significant mismatches between the field and the laser scanning datasets [4].

2.1. Field-based forest inventory

Diameters-at-breast-height were recorded as averages of two perpendicular calliper measures, while tree height was measured using a Vertex IV ultrasound instrument (Vertex IV, Haglöf, Långsele Sweden). Every tree within the circular plot was surveyed, except those with a diameter-at-breast-height lower than 3 cm. In the meantime, species, and health status (i.e. living, dead, snag) have been collected (Table 2).

2.2. TLS-based forest inventory

For TLS data acquisition we used a GeoSLAM ZEB-REVO (GeoSLAM Ltd, Ruddington, England) lightweight mobile laser scanner. This device features a rotating 2D scanning device and an IMU in the handle. The system acquires three-dimensional information of the surrounding area at 905 nm wavelength but does not store the backscattered laser intensity information. Outdoors data acquisitions are performed within the range 0.60-15 m, with a measurement rate of 40,000 points per second. The relative points accuracy is 2-3 cm [5]. To improve the positioning accuracy, this technology requires that the starting and ending points of the scan process coincide and some overlaps are done during the scan-path. No additional supports (i.e. targets) are needed. In this work, we define a specific scan-path that starts from and ends at the field plot centre (Fig. 2).

The operator can divert from this theoretical path because of forest floor obstacles (rocks, deadwood, etc). For each plot, the scan process required from 10 to 15 min, depending on stand complexity and ground asperity (see par. 2.3 and Table 2 for more details).

2.3. Work times

For each plot, we recorded times from car to sampling plot, useful to calculate plot accessibility, times for preparatory actions for and the time for field works for both traditional and TLS-based inventories.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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