

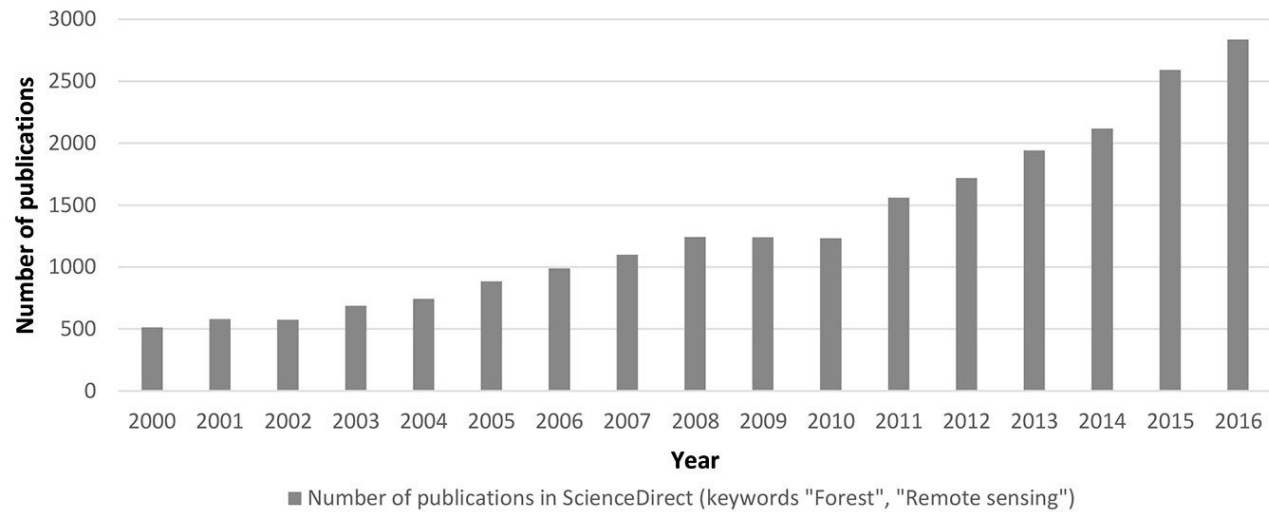
Ciesielski M, Sterenczak K (2019).

Accuracy of determining selected parameters of the urban forest using remote sensing

iForest – Biogeosciences and Forestry – doi: [10.3832/ifor3024-012](https://doi.org/10.3832/ifor3024-012)

Supplementary Material

Fig. S1 - Number of publications in ScienceDirect® (keywords: “Forest”, “Remote sensing”).



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Tab. S1 - Selected scientific publications using remote sensing data to tree species classification (*): UA – user accuracy; (**): OA – overall accuracy; (***) : NOCAI – Number of Categories Adjusted Index is calculated by dividing the accuracy achieved by a specific algorithm by an expected accuracy that would be obtain if trees were randomly assign to a species. The expected accuracy is simply $1/k \cdot 100\%$ where k is the number of species (Xiao et al. 2004).

Publication	Study Area	Data Set	Sensor	Method	Date of acquisition	Tree species	Classification accuracy (*, **)	NOCAI (***)
Voss & Sugumaran (2008)	US	Data Fusion (Airborne Laser Scanning, hyperspectral imagery)	AISA / Leica ALS50	Image segmentation	Hyperspectral imagery -July 2004 and October 2006, Airborne Laser Scanning - April 2006	7 species: Honey locust, Sugar maple, American basswood, Pin oak, Eastern white pine, White spruce	48 and 57% (summer), 45 and 56% (fall) (UA)	4.01
Tooke et al. (2009)	Canada	Data Fusion (Airborne Laser Scanning, satellite imagery)	QuickBird / TRSI Mark II (0.7 pts/m ²)	Decision tree classification and Linear spectral mixture analysis	March 2007	Leave type: Evergreen and deciduous species	Deciduous 67%, Coniferus 80 %	n/d
Zhang & Qui (2012)	US	Data Fusion (Airborne Laser Scanning, hyperspectral imagery)	AISA / Lightwave Model 110 whisk-broom (3.5 pts/m ²)	Artificial neural network / Adaptive Gaussian fuzzy-learning vector quantization	September 2008	40 species: American Elm, Hackberry, Pecan, Eastern Red Cedar, Shumard Red Oak, Tree of Heaven, Cedar Elm, Green Ash, Red Mulberry, Chinaberry, Gum Bumelia, Bald Cypress, Cherry Laurel, Boxelder, Post Oak, Live Oak, Bur Oak, Cottonwood, Crepe Myrtle, Black Willow (other n<30)	68.8% (OA)	27.52
Forzieri et al. (2013)	Italy	Data Fusion (Airborne Laser Scanning, hyperspectral and aerial imagery)	ADS40 / MIVIS	Maximum Likelihood , Spectral Angle Mapper / Spectral Information Divergence	December 2009	7 species: Olive, Willow, Spruce, Cypressus, Pine, Oak, Poplar	92.57 (OA)	6.51

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Publication	Study Area	Data Set	Sensor	Method	Date of acquisition	Tree species	Classification accuracy (*, **)	NOCAI (***)
Tigges et al. (2013)	Germany	Data Fusion (Airborne Laser Scanning, satellite imagery)	RapidEye/ ALS - 1 pts/m2 and 4 pts/m2	Support Vector Machine	gwoing season in 2009, Airborne Laser Scanning - November 2007 and January 2008	8 species: Acer, Populus, Fagus, Tilia, Quercus, Aesculus, Pinus	85.5 (OA), 66-99% (UA)	6.84
Verlič et al. (2014)	Slovenia	Data Fusion (Airborne Laser Scanning, aerial imagery, satellite imagery)	WorldView-2 / Riegl LMS-Q560 (20 pts/m2)	Support Vector Machine	Satellite imagery - August 2010, aerial imagery – March 2011, Airborne Laser Scanning-March 2011	5 species: Norway spruce, Scots pine, European beech, Oak (Sessile and Pedunculate oak), Sweet chestnut	58.0% (OA), 12.0-69.0% (UA)	2.9
Ghosh et al. (2014)	Germany	Data Fusion (Airborne Laser Scanning, hyperspectral imagery)	HyMAP images / Hyperion / Airborn Laser Scanning 12 pts./m2	Support Vector Machine, Radom Forest	HyMap - August 2010 and August 2011, Hyperion - August 2011, Airborne Laser Scanning - 2009	Beech, Douglas Fir, Oak, Pine, Red Oak	62.0% - 86.0% (OA)	4.3
Alonzo et al. (2014, 2016)	US	Data Fusion (Airborne Laser Scanning, hyperspectral imagery)	AVIRIS / Riegl Q560 (22 pts./m2)	Segmented canonical	November 2010, Airborne Laser Scanning -August 2010	29 species / Leaf type: Bangalow palm, Camphor tree, Monterey Cypress, Red flowering gum, Tasmanian bluegum, Indian Laurel Fig, Native Willow, Jacaranda, American storax, Tristania conferta, Southern magnolia, New Zealand pohutukawa, European olive, Canary Island date palm, Canary Island pine, Italian stone pine, Sweet pittosporum, California sycamore, East African yellowwood, Pyrus kawakamii, California live oak, American pepper, Brazilian peppertree, Firewheel Tree, Brush cherry, Syagarus romanzoffiana, Tipa, Chinese elm, Mexican washingtonia	83.4% - 93.5 % (OA)	24.52

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Dian et al. (2016)	US	Data Fusion (Airborne Laser Scanning, hyperspectral imagery)	AisaEAGLE / Riegl LMS-Q680i (12 pts./m ²)	Support Vector Machine / Majority Voting Method	June 2013	8 species: Persian silk tree, Black locust, Trident maple, London plane, Himalayan cedar, Chinese catalpa, Cherry plum, Poplar	66.4 – 79.2% (OA)	6.33
Liu et al. (2017)	Canada	Data Fusion (Airborne Laser Scanning, hyperspectral imagery)	CASI / Leica ALS70-HP (22 pts./m ²)	Random Forest	May 2013, Airborne Laser Scanning - April 2013	15 species: American sweet gum, Katsura, White ash, Northern red oak, European beech, Red maple, Scarlet oak, Japanese cherry, Purpleblow maple, Green ash, Norway maple, Douglas fir, Honey locust, Small leaved lime, Western redcedar	51.1-70.0% (OA)	10.6
Pontius et al. (2017)	US	Data Fusion (Airborne Laser Scanning, hyperspectral imagery, thermal imagery)	GLiHT	Segmentation	June 2006	Ash species	94.0% (UA)	0.94
Höfle et al. (2012)	Germany	Airborne Laser Scanning	RIEGL LMS-Q560 (50 pts./m ²)	Decision tree / Artificial neural network	Airborne Laser Scanning - winter 2006/2007	Vegetation mapping	98.0%	0.98
Franke et al. (2009)	Germany	Hyperspectral imagery	HyMap	Multiple Endmember Spectral Mixture Analysis	May 2005	Linden, European chestnut	44.3%-84.2%	1.7
Pu & Liu (2012)	US	Hyperspectral data(in situ)	Analytical Spectral Devices	-	-	13 species: American Elm, Bluejack Oak, Crape Myrtle, Laurel Oak, Live Oak, Long Leaf Pine, Southern Magnolia, Persimmon, Red Maple, Sand Live Oak, Slash Pine, American Sycamore, Turkey Oak	96% (OA) 0.96 (Kappa)	12.6
Jarocińska et al. (2016)	Poland	Hyperspectral imagery	HySpex	Spectral Angle Mapper	July and August 2015	12 species: Small-leaved lime, Silver birch, Common oak, Called rowan, European ash, Horse-chestnut, Maple	78.3% (UA)	9.4

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						ash, Silver maple, Norway maple, Tilia × euchlora, Black locust, European white elm		
Zhang & Hu (2012)	Canada	Aerial imagery	-	Decision tree	August 2007	Maple, Ash, Spruce, Pine, Oak, Birch	84.5% (OA)	4.2
Latif et al. (2012)	Malaysia	Satellite imagery	WorldView-2	Minimum distance algorithm	January 2010	8 species : Cengal, Jelutong, Kelat, Kelumpang, Meranti Tembaga, Merawan Siput Jantan, Nyatoh Putih, Penarahan	0-87.2%	6.98
Pu & Landry (2012)	US	Satellite imagery	WorldView-2, IKONOS	Linear Discriminant Analysis, Classification and Regression Trees	WorldView-2 - May 2011, IKONOS - April 2006	7 species: Sand Live Oak, Laurel Oak, Live Oak, Palm, Camphor, Magnolia	47.5 - 62.9% (OA)	5.24
Berland & Lange (2017)	US	Google Street View	-	-	-	Species level/Genus level	66% (UA), 90% (UA)	0.66; 0.9