No	Reference	Paper Title	Year
1	Babst F., Bouriaud O., Alexander R., Trouet V. and Frank D. 2014. Toward consistent measurements of carbon accumulation: Amulti-site assessment of biomass and basal area increment across Europe. Dendrochronologia. DOI: 10.1016/j.dendro.2014.01.002	Toward consistent measurements of carbon accumulation: Amulti-site assessment of biomass and basal area increment across Europe	2014
2	Babst F., Bouriaud O., Papale D., Gielen B., Janssens I., Nikinmaa E., Ibrom A., Wu J., Bernhofer C., Köstner B., Grünwald T., Seufert G., Ciais P. and Frank D. 2014. Above-ground woody carbon sequestration measured from tree rings is coherent with net ecosystem productivity at five eddy- covariance sites. New Phytologist. DOI: 10.1111/nph.12589	Above-ground woody carbon sequestration measured from tree rings is coherent with net ecosystem productivity at five eddy- covariance sites	2014
3	Bascietto M., Cherubini P. and Scarascia-Mugnozza G. 2004. Tree rings from a European beech forest chronosequence are useful for detecting growth trends and carbon sequestration. Canadian Journal of Forest Research. DOI: 10.1139/X03-214	Tree rings from a European beech forest chronosequence are useful for detecting growth trends and carbon sequestration	2004
4	Battipaglia G., De Micco V., Brand W., Linke P., Aronne G., Saurer M. and Cherubini P. 2010. Variations of vessel diameter and d13C in false rings of *Arbutus unedo L* . reflect different environmental conditions. New Phytologist. DOI: 10.1111/j.1469-8137.2010.03443.x	Variations of vessel diameter and d13C in false rings of Arbutus unedo L. reflect different environmental conditions.	2010
5	Battipaglia G., Saurer M., Cherubini P., Calfapietra C., McCarthy H., Norby R. and Cotrufo M. 2013. Elevated CO2 increases tree-level intrinsic water use efficiency: insights from carbon and oxygen isotope analyses in tree rings across three forest FACE sites. New Phytologist. DOI: 10.1111/nph.12044	Elevated CO2 increases tree-level intrinsic water use efficiency: insights from carbon and oxygen isotope analyses in tree rings across three forest FACE sites	2013
6	Beets P., Kimberley M., Oliver G. and Pearce S. 2018. Predicting wood density of growth increments of Douglas-fir stands in New Zealand. New Zealand Journal of Forestry Science. DOI: 10.1186/s40490-018-0112-z	Predicting wood density of growth increments of Douglas-fir stands in New Zealand	2018

7	Bert D., Leavitt S. and Dupouey J. 1997. Variations of wood d13C and water-use efficiency of abies alba during the last century. Ecology. DOI: 10.1890/0012-9658(1997)078[1588:VOWCAWfont>2.0.CO;2	Variations of wood d13C and water-use efficiency of abies alba during the last century.	1997
8	Brooks J. and Mitchell A. 2010. Interpreting tree responses to thinning and fertilization using tree-ring stable isotopes. New Phytologist. DOI: 10.1111/j.1469-8137.2010.03627.x	Interpreting tree responses to thinning and fertilization using tree-ring stable isotopes	2010
9	Carnicer J., Domingo-Marimon C., Ninyerola M., Camarero J., Bastos A., López-Parages J., Blanquer L., Rodríguez-Fonseca B., Lenton T., Dakos V., Ribas M., Gutiérrez E., Peñuelas J. and Pons X. 2019. Regime shifts of Mediterranean forest carbon uptake and reduced resilience driven by multidecadal ocean surface temperaturas. Global Change Biology. DOI: 10.1111/gcb.14664	Regime shifts of Mediterranean forest carbon uptake and reduced resilience driven by multidecadal ocean surface temperaturas.	2019
10	Danis, C. Hatté, L. Misson, and J. Guiot 2012. MAIDENiso: A multiproxy biophysical model of tree-ring width and oxygen and carbon isotopes. Canadian Journal of Forest Research. DOI: 10.1139/X2012-089	MAIDENiso: A multiproxy biophysical model of tree-ring width and oxygen and carbon isotopes.	2012
11	De Silva M. 1979. 13Carbon-isotope decrease in annual-rings of twentieth-century trees. Z. Naturforsch. DOI: 10.1515/ZNC-1979-828	13Carbon-isotope decrease in annual-rings of twentieth-century trees.	1979

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13	Dupouey J., Leavitt S., Choisnel E. and Jourdain S. 1993. Modelling carbon isotope fractionation in tree rings based on effective evapotranspiration and soil water status. Plant, Cell and Environment. DOI: 10.1111/j.1365-3040.1993.tb00517.x	Modelling carbon isotope fractionation in tree rings based on effective evapotranspiration and soil water status.	1993
14	Genet H., Bréda N. and Dufrëne E. 2009. Age-related variation in carbon allocation at tree and stand scales in beech (*Fagus sylvatica L.)* and sessile oak (*Quercus petra (Matt.) Liebl.)* using a chronosequence approach. Tree Physiology. DOI: 10.1093/treephys/tpp105	Age-related variation in carbon allocation at tree and stand scales in beech (Fagus sylvatica L.) and sessile oak (Quercus petra (Matt.) Liebl.) using a chronosequence approach.	2009
15	González- Cásares M., Pompa- García M., Meléndez-Soto A. and Solís-Moreno R. 2015. Variación espacial y temporal del contenido de carbono en bosques de la sierra madre occidental: avances preliminares. Revista de Ciencias Naturales y Agropecuarias. Vol.2 No.3 368-372	Variación espacial y temporal del contenido de carbono en bosques de la sierra madre occidental: avances preliminares	2015
16	González-Cásares M., Pompa-García M., Venegas-González A., Domínguez-Calleros P., Hernández-Díaz J., Carrillo-Parra A. and González-Tagle M. 2019b. Hydroclimatic variations reveal differences in carbon capture in two sympatric conifers in northern Mexico. Peer Journal. DOI: 10.7717/peerj.7085	Hydroclimatic variations reveal differences in carbon capture in two sympatric conifers in northern Mexico	2019
17	Ilvesniemi H., Levula J., Ojansuu R., Kolari P., Kulmala L., Pumpanen J., Launiainen S., Vesala T. and Nikinmaa E. 2009. Long term measurements of the carbon balance of a boreal Scots pine dominated forest ecosystem. Boreal Environment Research. 14: 731–753 pp	Long term measurements of the carbon balance of a boreal Scots pine dominated forest ecosystem.	2009
18	Kantavichai R., Briggs D. and Turnblom E. 2010. Effect of thinning, fertilization with biosolids, and weather on interannual ring specific gravity and carbon accumulation of a 55-year-old Douglas-fir stand in western Washington. Canadian Journal of Forest Research. DOI: 10.1139/X09-168	Effect of thinning, fertilization with biosolids, and weather on interannual ring specific gravity and carbon accumulation of a 55-year-old Douglas-fir stand in western Washington.	2010

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20	Klesse S., Etzold S. and Frank D. 2016. Integrating tree-ring and inventory-based measurements of aboveground biomass growth: research opportunities and carbon cycle consequences from a large snow breakage event in the Swiss Alps. European Journal of Forest Research. DOI 10.1007/s10342-015-0936-5	Integrating tree-ring and inventory-based measurements of aboveground biomass growth: research opportunities and carbon cycle consequences from a large snow breakage event in the Swiss Alps.	2016
21	Larocque G., Paré D., Boutin R., Sarr L., Lacerte V. and Ansseau C. 2014. Comparing Carbon Pools and Tree Growth in Balsam Fir (Abies balsamea) and Black Spruce (Picea mariana) Forest Ecosystems Located Along a Climatic Gradient. Journal Ecoscience. DOI: 10.2980/21-(3-4)-3701	Comparing Carbon Pools and Tree Growth in Balsam Fir (Abies balsamea) and Black Spruce (Picea mariana) Forest Ecosystems Located Along a Climatic Gradient.	2014
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49	Leavitt S. 1993. Seasonal 13-C/12-C changes in tree rings: species and site coherence and a possible drought influence. Canadian Journal of Forest Research. DOI: 10.1139/x93-028	Seasonal 13-C/12-C changes in tree rings: species and site coherence and a possible drought influence.	1993
50	Leavitt S. 2010. Tree ring C-H-O isotope variability and sampling. Science of the Total Environment. DOI: 10.1016/j.scitotenv.2010.07.057	Tree ring C-H-O isotope variability and sampling.	2010
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Journals	Impact factor
Dendrochronologia	2.281
New Phytologist	7,299
Canadian Journal of Forest Research	1,703
New Phytologist	7,299
New Phytologist	7,299
New Zealand Journal of Forestry Science	1,042

Ecology	4,285
New Phytologist	7,299
Global Change Biology	8,88
Canadian Journal of Forest Research	1,703
Z. Naturforsch C	0,961

Science of the Total Environment	5,589
Plant, Cell and Environment	5,624
Tree Physiology	3,477
Revista de Ciencias Naturales y Agropecuarias	n/a
Peer Journal	2,353
Boreal Environment Research	1,462
Canadian Journal of Forest Research	1,703

Ecological Applications	4,378
European Journal of Forest Research	2,354
Journal Ecoscience	0,625
Forestry Chronicle	0,8
Forest Ecology and Management	3,126
Forest Ecology and Management	3,126
Plos One	2,776
Tree-ring Research	1,12

Journal of Geographical Sciencies	2,357
Dendrochronologia	2,281
Journal of Forestry Research	1,155
Dendrochronologia	2,281
Plant, Cell and Environment	5,624
Tree-ring research	1,12
Global and Planetary Change	4,1
Plant, Cell and Environment	5,624

Tree Physiology	3,477
Plant, Cell and Environment	5,624
Revista de la Facultad de Ciencias Agrarias	1,158
Bosque	0,5
Plant, Cell and Environment	5,624
Plant, Cell and Environment	5,624
Journal of Geophysical Research	3,633
Biogeosciences	3,951
Plant, Cell and Environment	5,624

Palaeogeography, Palaeoclimatology, Palaeoecology	2,616
Journal of Geophysical Research	3,621
Forest Ecology and Management	3,126
Tree Physiology	3,477
Radiocarbon	1,531
Canadian Journal of Forest Research	1,703
Science of the Total Environment	5,589
Chemical Geology	3,618

Plant, Cell and Environment	5,624
Functional Ecology	5,037
Plos One	2,776
Tree Physiology	3,477
Tree Physiology	3,477
Tree Physiology	3,477

Plant, Cell and Environment	5,624
Radiocarbon	1,531
Arctic, Antarctic, and Alpine Research	1,708
Trees	1,799
Tellus	2,235
Geochimica et Cosmochimica Acta	4,258

Tree Physiology	3,477
Journal Soils Sediments	2,669
Global Change Biology	8,88
Chemical Geology	3,618

Tree Physiology	3,477
Geochimica et Cosmochimica Acta	4,258
Oecologia	2,915
Plant, Cell and Environment	5,624
Rapid Communications in Mass Spectrometry	2,045
Dendrochronologia	2,281
Plos One	2,776

Source of founding
Carbo-Extremes project, the WSL SwissTree project and SwissNational Science Foundation
European Union FORCAST
European Union FORCAST
n/a
IBIMET CNR
Ministry for the Environment (New Zealand)

French ‘‘Ministe`re de l’Enseignement Supe´rieur et de la Recherche’’

US Environmental Protection Agency

Spanish Government, Consolider Ingenio Montes, the Catalan Government and the European Research Council Synergy

French National Research Agency

n/a

EU projects ISONET and MILLENNIUM

French Program 'Forest Decline and Atmospheric Pollution' and NSF

Forest Ecology Department of INRA, Regional Council of Lorraine and GIP ECOFOR

CONACYT

CONACYT, the LXVII Legislature of the State of Durango, UJED, COCYTED, PIDCAF-UJED and DendroRed

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West African Science Ser-vice Center on Climate Change and Adapted Land Use (WASCAL)program, CRP 6.4 and 7 (Consortium Research Programme) andthe West and Central Africa Regional Office − Sahel Node of theWorld Agroforestry Centre (ICRAF)

USDA NRICG

SNF iTREE Sinergia

PERD program of the Office of Energy Research and Development of Natural Resources Canada, Federal Public Sector Youth Internship Program of the government of Canada.

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FTA-CRP 6.4

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West African Science Ser-vice Center on Climate Change and Adapted Land Use (WASCAL)program, CRP 6.4 and 7 (Consortium Research Programme) andthe West and Central Africa Regional Office − Sahel Node of theWorld Agroforestry Centre (ICRAF)

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Grant-in-Aid nos. and Ministry of Education, Culture, Sports, Science and Technology of Japan.

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SNF iTREE Sinergia

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Bunning's Treefarms Pty Ltd

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AVINA Foundation, Switzerland.

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Number of authors	Number of institution involved	Objetive of study
5	5	To derive annually resolved estimates of above-ground annual woody biomass increment and related carbon accumulation from tree-rings
15	11	Reconcily the quantification of carbon cycling from biometric and EC techniques, measure radial tree growth and wood density at five long- term EC forest sites
3	2	Estimated the past carbon (C) storage trends using dendroecological methods in a beech chronosequence in central Germany.
7	5	Describe the occurrence and type of IADFs under different environmental conditions; to analyse the variation in vessel size and carbon isotope composition along the rings with and without IADFs; and to determine how the formation of IADFs is influenced by climate.
7	8	Examined the temporal relationships between variations in tree ring d^{13}C-derived WUE i and d^{18}O with c ,climate and tree growth, across five species in three FACE sites in Italy and the USA.
4	1	Describe the datasets and model developed to predict variation in wood density of annual growth sheaths from site information.

3	4	Report long-term changes in intrinsic water-use efficiency during the last 130 yr for silver fir.
2	2	Examined tree-ring growth patterns and stable isotopes of cellulose (d13Ccell and d18Ocell) in a thinning and fertilization controlled experiment
14	12	Report unprecedented multidecadal shifts in forest carbon uptake in semi-arid Mediterranean pine forests in Spain over 1950-2012.
4	4	Present MAIDENiso, a version of the tree growth model MAIDEN (Misson 2004) implemented with isotopic modules that can simultaneously compute tree-ring width and oxygen and carbon isotopes in the tree-ring cellulose.
1	1	Determinated 13Carbon-Isotope Decrease in Annual-Rings of Twentieth-Century Trees

9	5	Compares pooled chronologies of two stable isotopes (δ13C and δ18O) from two sites at the Iberian Peninsula with the individual stable isotope tree-ring series of the same individuals that compose the pool.
4	3	(1) to test the potential of (5"'^C values as biological markers of climatic variations; (2) to identify the key factors affecting ^"^C using a detailed bioclimatic model; and (3) to search for long term-trends in internal CO2 concentration for a beech stand in northeast France.
3	3	Thus to test the hypothesis that growth decrease related to age is accompanied by changes in carbon allocation to the benefit of storage and reproductive functions in two contrasting broad-leaved species: beech (Fagus sylvatica L.) and sessile oak (Quercus petraea (Matt.) Liebl.).
4	1	Determinar la variación temporal del contenido de carbono para *Pinus Cooperi* en seis sitios de la Sierra Madre Occidental
7	5	Examined the growth, wood density, and carbon accumulation of two threatened species (Pseudotsuga menziesii and Cupressus lusitanica) to evaluate their hydroclimatic responsiveness.
9	4	Compare the results of carbon accumulation calculations based on biomass measurements (trees, ground vegetation, litter, soil organic matter) with values obtained from measurements of soil CO2 effl ux, canopy and ground vegetation photosynthesis and EC measurements
3	1	Develop a model to predict posttreatment interannual ring SG from tretment and environmental variables. Use SG to calculate the dry mass and carbon content associated with stem growth

4	3	They investigated on these stand structure data to conduct a spatially expansive analysis of historical and contemporary tree element storage in norther
3	2	Quantify the inter-annual variation (IAV) of ABI on a long-term monitoring site in Switzerland.
6	5	Compared in balsam fir (Abies balsamea) and black spruce (Picea mariana) ecosystems located along a climatic gradient in eastern Canada spanning regions that differed by 4 °C in mean annual temperature.
6	4	1) to reconstruct the model between tree rings and temperature; and, 2) to predict the carbon pool for lacebark pine under future temperature and precipitation changes.
3	1	(1) explore potential applications of tree rings in evaluation on carbon stocks dynamics of different restoration modes; (2) compare aboveground carbon stocks between different restoration types and identify appropriate management approaches and strategies for enhancing long-term carbon stock.
4	2	(i) investigate the current extent of forest degradation due to tree dieback, (ii) quantify the effects of tree dieback on aboveground carbon stock and carbon sequestration potential of the study forest, and (iii) determine growth dynamics of foundation tree species.
2	1	Analyzed the variations of carbon in two populations of Pinus cooperi situated on different elevation gradients, using intraannual wood density.
4	5	Determinated carbon accumulation rates for two representative pine species and how were such species coping with ongoing climate change

5	2	Developed a model for the estimation of tree yearly growth based on tree-ring data which is known as the TGTRing model.
6	5	Investigate the applicability of dendrochronology for assessing the growth dynamics and response to climate variability and to estimate the boveground carbon stock and carbon sequestration potential of Vitellaria paradoxa in southern Mali.
2	1	Provide the basic data of stem characteristics of black pine for calculation of carbon weight and used the following steps to do this.
7	4	Compare growth, climatic response, anatomy (vessels and intra-annual density fluctuations), wood density and carbon, by tree-ring analysis
5	3	How chronic drought affects tree growth and tree-ring d13C values
3	2	Examined the variability of intra- and inter-annual stable-carbon isotopic pattern in several tree species from various tropical climates.
5	4	a) examine whether the same δ13C signal occurs in tree rings of all examined trees and co-occurring species with contrasting physiological performances; b) explore to what degree δ13C variations are related to changes in precipitation and temperature; c) evaluate the potential of δ13C series for retrospective climate reconstructions.
6	4	Traced the carbon and oxygen isotope signals through Pinus sylvestris trees from the canopy to the trunk on different time-scales, by combining existing data sets from the same field site.

8	8	Determinated the response of δ13C, δO and tree-ring width (TRW) from a temperate mountain forest in the Austrian pre-Alps to climate and specific drought events.
2	1	Exploring whether or not a universal carbon isotope pattern exists in tree rings along the vegetation period and secondly at contributing to the assessment of seasonal isotope signature transfer from leaf level into the developing woody tissue.
5	3	Examine the differences of C concentrations in four species.
4	2	To assess the variations of carbon concentration along the longitudinal profile of Pinus durangensis, P. engelmannii and P. leiophylla in northern Mexico, including its components: root, bark, stem, branches, twigs, leaves and fruits.
3	3	Study the relationship between translocation path and phloem grain. And study the use of remobilized storage material for earlywood formation in spring, which is a suspected cause of the autocorrelation (correlation of ring parameters to the climate in the previous year) observed in (isotope) dendroclimatology.
4	2	Studied how photo-assimilates incorporated on a given day are then distributed in a tree ring.
3	3	Studied the relationships between earlywood/latewood width, stable carbon isotope ratio (d 13 C) of cellulose, and soil moisture at a dry and a wet site in Yakutsk, eastern Siberia, which differed considerably in soil water conditions.
14	8	The goal of this study is to present the implementation of d13C in the land component, Community Land Model version 4.5 (CLM4.5), of CESM and Land Surface Processes and Exchanges (LPX-Bern) and to discuss the model performance for d13C on the global scale.
7	4	Investigated long-term trends and offsets in d18O and d13C of Picea abies and Fagus sylvatica in relation to tree age, size and distance to the u+L52pper canopy at seven temperate sites across Europe.

4	3	Determinated new multi-century long stable carbon isotope chronology derived from sub-fosil tree trunks from Lake Schwarzensee
6	3	Tree ring width, density, and ratio of stable isotopes (13C/12C and O) in wood and cellulose were determined for larch (Larix sibirica Ledeb.) growing under water deficit conditions in the forest steppe zone in central Siberia for the period 1850–2005.
4	4	Identify environmental drivers and limitations to photosynthesis and growth, with the prospect of optimizing management practices on these sites.
2	1	The purpose of this study was to determine if C content of wood within a species has varied over the last millennium, to observe if there is a correlation between C content in wood and cambial growth rate, i.e., radial and circumferential increment, and to examine the extent of within-tree variations by assessing C content both radially and vertically.
1	1	Developing chronologies which account for the influences of these factors, especially climate, and we have previously reported results from individual juniper (Leavitt & Long, 1983) and pinyon (Leavitt & Long, 1985) trees collected at sites in Arizona.
1	1	Study of seasonal d13C patterns in the growth rings of a number of individuals of an evergreen conifer and deciduius hardwood was conducted.
1	1	Provides a state-of-knowledge summary of the influence of “juvenile” isotope effects, ageing effects, and genetic effects, as well as the interchangeability of species, choice of ring segment to analyze (whole ring, earlywood or latewood), and the option of sample pooling.
2	2	Report on the ubiquity of these seasonal isotopic patterns as observed in a number of different species at sites thousands of kilometers apart, in both temperate and tropical environments.

2	2	Determine whether, by dividing annual rings into early and late wood, there would be significant improvements in relating growing season water balance and basal ar'ea incr-ement to tree ring d13C.
2	1	(1) δ13C of wood can be used as an indicator of drought in E. globulus plantations, (2) density and δ13C of wood vary between trees within stands, (3) density and δ13C of wood increase with increasing stem height and (4) δ13C of wood is correlated with wood density.
2	1	Sought to redress the lack of accurate C conversion factors in tropical trees, by analyzing the carbon content in woody tissues collected from 59 Panamanian rainforest tree species, the largest dataset from tropical trees to date.
5	1	Use an alternative approach, adapted from methods developed for extracting strong climate signals from stable isotopes in tree rings and compare the EW and LW carbon isotope ratios of several trees by pooling the samples prior to analysis.
2	2	Analyses the univariate time-series on stable carbon isotope ratios obtained from tree-ring cellulose.
7	8	Trace the isotope signals in European beech (Fagus sylvatica L.) from leaf water (δ13O) and leaf assimilates (δ18C and δ18O) to tree-ring wood via phloem transported compounds over a whole growing season.

11	5	Present a singlesubstrate model for wood growth to interpret seasonal isotopic signals collected in an even-aged maritime pine plantation growing in South-west France
8	3	Estimated the magnitude of the regional Suess effect in Poland over the last several decades and compared with values in other sites worldwide.
4	3	Probe the statistical relations between these records and instrumental climate data and explain their physical basis.
4	3	The 13 C/ 12C variations in cellulose of tree rings of beech (Fagus sylvatica) were determined at several sites in the Swiss Central Plateau covering the last 50 years.
3	2	Finding that the relative humidity of the armosphere but also the soil water content can influence the stomatal openning of plant leaves
2	1	Compiled new and published high-resolution d13C data from across annual growth rings of 33 modern evergreen trees from 10 genera and 15 globally distributed sites to quantify the parameters that affect the observed d13C pattern.

7	1	Present a new, rapid method for high-resolution online determination of δ13C in tree rings, combining laser ablation (LA), combustion (C), gas chromatography (GC) and isotope ratio mass spectrometry (IRMS) (LA-C-GC-IRMS).
7	5	Investigate long-term tree growth rates, water use efficiencies (WUE), and tree ring nitrogen (N) isotope compositions (δ15N) of Masson pine (Pinus massoniana L.) in response to global climate change and local N deposition in Southern China.
3	1	Report the results of a study that intended to test, using carbon isotopes of tree rings, (i) whether the water-use ef®ciency of bristlecone pine trees at this site has increased, and (ii) whether the magnitude of any increase in W for these two tree forms corresponds to the rate of stem growth (and possibly rate of increase of stored biomass).
3	2	White spruce (Picea glauca (Moench) Voss) trees were sampled to investigate the relationship between ring width and δC as well as between these descriptors and climate.

6	4	Test a developed methodology aimed at monitoring drought stress, based on the analysis of growth rings obtained by core extraction.
6	3	Present one millennium-long (1171-year), and three 100 year long annually resolved d13C tree-ring chronologies from ecologically varying Juniperus stands in the Karakorum Mountains (northern Pakistan), and evaluate their response to matic and atmospheric CO2 changes.
3	2	Investigate the relationship between δ13C and plant drought stress (Ψ) in thinning×fertiliser trials with P. radiata and Pinus pinaster Ait. in the expectation that thinning would increase the availability of soil water to individual tres
8	6	Use as many independent measurements as posible to parameterize the 3-PG model in heavily instrumented grand fir stands
8	4	Applicability of tree-ring whole-wood material for δ18O and δ13C analysis in comparison with the more time- and resource-intensive use of cellulose, by considering possible variability between (i) five different tree species (Fagus sylvatica, Quercus robur, Picea abies, Abies alba, Pseudotsuga menziesii), (ii) two sites that differ in soil moisture, and (iii) climate conditions within a 10-year period.
2	1	The estimation of the total above ground carbon allocation potential of a vegetation type
2	2	Prove the annual formation of tree rings for three commercial tree species (Cariniana micrantha, Caryocar villosum and Manilkara huberi) from the Central Amazonian lowland rainforest by radiocarbon dating

Aplication

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Method

They applied a consistent biomass-oriented sampling design at five managed forest sites located in different climate zones to assess the annual carbon accumulation in above-ground woody tissues (i.e. stems and branches) and its climate response. Radial growth and biometric measurements were combined to reconstruct the annual biomass increment in individual trees and upscaled to the site level. In addition to this, we estimated that 32–60 trees are required at these five sites to robustly quantify carbon accumulation rates.

they assessed above-ground biomass changes at five long-term EC (eddy-covariance) forest stations based on tree-rings width with wood density measurements, together with multiple allometric models. Mesurements werevalidated with site-specific biomass estimates and compared with the sumof monthly CO2 fluxes between 1997 and 2009.

Past carbon (C) storage trends were estimated using dendroecological methods in a beech chronosequence in central Germany. Raw-ring-width chronologies, sensitivity curves, and carbon uptake trends were developed for 70-, 110-, and 150-year-old (S70, S110, and S150), even-aged stands. Ecosystem C stock and net ecosystem productivity (NEP) were computed as the sum of the C stock and fluxes of the soil, the aboveground compartment, and the estimated belowground compartment.

Dendrochronology, quantitative wood anatomy and high-resolution isotopic analysis (using a laser ablation technique) were used to characterize IADFs in Arbutus unedo shrubs grown on two sites with different water availability on the island of Elba (Italy).

They combined tree ring analysis with isotope measurements at three Free Air CO Enrichment (FACE, POP-EUROFACE, in Italy; Duke FACE in North Carolina and ORNL in Tennessee, USA) sites, to cover the entire life of the trees. We used d13 C to assess carbon isotope discrimination and changes in water-use efficiency, while direct CO effects on stomatal conductance were explored using d18 O as a proxy.

Datasets used to parameterise the wood density model contained: (1) mean breast height (1.4 m above ground) outerwood (based on 50 mm long cores) density of 30 trees per stand from 32 semi-mature and mature stands with soil and climate data, for predicting wood basic density from environmental factors; (2) basic density of wood samples taken at breast height and at regular height intervals along the stem of 75 trees from 10 stands, for predicting the weighted mean wood basic density of pre-defined growth sheaths; and (3) breast height pith-tobark radial density profiles based on 500 trees from 47 stands, for predicting wood density of individual annual growth rings at breast height. Linear and non-linear mixed models were developed using these data to explain the variation in wood density of growth sheaths.

The distinction between the effects of tree age and the effects of environmental changes on long-term 13C/12C variations was made as follows. (1) At the life-span scale, we compared the d13C in tree rings with the same formation date, but from trees of different ages. In this manner, the effects of long-term environmental changes are discarded and tree-age effects maximized. (2) At the century scale, we analyzed rings formed in trees with the same age, but at different dates during the 20th century. In this latter case, tree-age effects were removed and the effects of environmental changes over time, referred to later as ‘‘date’’ effects, were maximized. Such a design requires a very large sampling basis that includes trees of various ages. We used cores collected for a previous dendroecological
study (Bert 1993)

They used the Shawnigan Lake fertilization and thinning experiment
to further develop the dual isotope (d13Ccell and d18Ocell) approach under a wider range of management, where thinning, fertilization and the combination treatments were available. Shawnigan Lake has the added advantage in that measurements of soil moisture, leaf nitrogen, and foliage efficiency were made during the first 7 yr of the experiment, as well as many other measures to help interpret the stable isotope results.

Show that low frequency variations of the surface temperature of the Atlantic Ocean induce shifts in the non-stationary effects of El Niño Southern Oscillation (ENSO) on regional forest carbon capture. Modelling evidence supports that the non-stationary effects of ENSO can be propagated from tropical areas to semi-arid mediterranean biomes through atmospheric wave trains. Decadal changes of the Atlantic Multidecadal Oscillation (AMO) significantly alter sea-air heat exchanges, modifying in turn ocean vapour transport over land and land surface temperatures, and promoting sustained drought conditions in spring and summer that reduce forest carbon uptake. Show that lagged effects of AMO on the winter North Atlantic Oscillation (NAO) also contribute to the maintenance of long-term droughts. Show that the reported strong, negative effects of ocean surface temperature (AMO) on forest carbon uptake in the last decades are unprecedented over the last 150 years.

Model version estimates d18O and d13C associated with the daily amount of carbon allocated to the stem. MAIDENiso only requires daily input data: minimal and maximal air temperatures, amount of precipitation, CO2 atmospheric concentration, and d13C in CO2. MAIDENiso simulates tree-ring width, d18O in precipitation (d18OP),
d18O in soil water (d18OSW), d18O in xylem water (d18OXW), d18O in cellulose (d18OTRC), and d13C in cellulose (d13CTRC). The model has been calibrated and validated with tree-ring series sampled in the Fontainebleau Forest (France) from 1953 to 2000. We first calibrated several parameters for the 1977–2000 period and then validated it for the independent 1953–1976 period. Over the complete interval (1953–2000), we obtained correlations between observations and simulations above 0.5 for both isotopic series and above 0.65 for tree growth series

The trees were so selected that they were not influenced by any unwanted local disturbances which may cause anomalous 13C oscillations. For each analysed tree the 513C values over its entire time of record (1900-1975) were calculated as deviations from its
tree-specific value which is the average 613C for the period 1930-1959.

Several dominant trees were sampled. Determinated stable isotope and wood density measurements, for the pooled isotope chronologies, two 5 mmcores per tree were taken and the tree rings separated with a scalpel before pooling the material and The δ13C tree-ring series are affected by the depletion in atmospheric 13CO2 due to fossil fuel burning and deforestation since industrialization (ca. AD1850).

SC values in tree-ring cellulose of heech (*Fagus sylvatica* L.) were analysed for the period from 1950 to 1990. A bioclimatic model of water balance was used to give the actual evapotranspiration as well as the soil water content on a daily basis.

Age-related changes in carbon allocation were studied using a chronosequence approach. Chronosequences, each consisting of several even-aged stands ranging from 14 to 175 years old for beech and from 30 to 134 years old for sessile oak, were divided into five or six age classes. In this study, carbon allocations to growth, storage and reproduction were defined as the relative amount of carbon invested in biomass increment, carbohydrate increment and seed production, respectively. Tree-ring width and allometric relationships were used to assess biomass increment at the tree and stand scales. Below-ground biomass was assessed using a specific allometric relationship between root: shoot ratio and age, established from the literature review. Seasonal variations of carbohydrate concentrations were used to assess carbon allocation to storage. Reproduction effort was quantified for beech stands by collecting seed and cupule production. Age-related flagging of biomass productivity was assessed at the tree and stand scales, and carbohydrate quantities in trees increased with age for both species.

Se determinó la variación temporal del contenido de C para pinus cooperi en seis nichos ecologicos, asociando dendrocronología y relacones alometricas para estimar bionasa, se produjeton cronologías temporales de captura de C.

The temporal variations in the carbon accumulation patterns of two cooccurring species (P. menziesii and C. lusitanica) and their sensitivity to the local climate were studied using dendroecological techniques, X-ray densitometry, and allometric equations.

We measured on annual basis the magnitude and relative importance of different components of the carbon balance of a boreal Scots pine dominated forest ecosystem. The continuous 10-year-long measurement period of this study and the iscellaneous measurements of the components of the ecosystem carbon balance carried out at the same site are almost unique. The ecosystem was shown to be a carbon sink in all measured years. The average net ecosystem exchange (NEE) estimated with the eddy covariance (EC) method

They measured width and SG of growth rings and their EW and LW components whith X-ray densitometry. They developed models to predict interannual SG.

We used tree ring reconstructions from five sites throughout the Colorado Plateau in Arizona. The original goal of the reconstructions was to guide ecological restoration, so the sites were not randomly located, but rather We used tree ring reconstructions from five sites throughout the Colorado Plateau in Arizona

Assess the inter-annual variability (IAV) of carbon uptake using annually resolved aboveground biomass increment (ABI) estimates from 272 pseudorandomly sampled trees at a long-term monitoring plot in the dry valley of the Valais in Switzerland.

A total of 19 experimental sites were established, 12 in balsam fir ecosystems and 7 in black spruce ecosystems. Diameter at breast height (dbh), height growth rate, and C contents in trees, understory species, downed logs, litter, and soil organic and mineral layerswhere taken. Carbon pool data were analyzed using one-way ANOVA . Before examining relationships with climatic data individual-tree annual growth ring data were standardized to eliminate the effect of age and competition by deriving a polynomial function and computing the ratio of prediction to observation (Fritts, 1976).

Forty-six core samples and 15 disks from 45 trees were collected and after air drying.The correlation between tree-ring widths of lacebark pine and climate was investigated.

Past carbon storage trends were estimated using dendroecological methods for different restoration approaches in the subalpine region of Southwest China. Tree ring width chronologies, carbon stock and carbon uptake trends were developed for spruce plantation forest (SPF), natural birch forest (NBF) and natural coniferous–broadleaved mixed forest (NMF).

They studied (1) the extent and spatial patterns of standing dead stems along an elevational gradient and (2) the effects of dieback on forest carbon sequestration potential and aboveground carbon stocks, in Juniperus procera and Olea europaea dominated dry afromontane forest in northern Ethiopia, using allometric models combined with tree ring analysis.

Analyze the variations of trunk carbon in two populations of P. cooperi situated at different elevational gradients, combining dendrochronological techniques and allometry. Carbon sequestration (50% biomass) was estimated from a specific allometric equation for this species based on: (i) variation of intraannual wood density and (ii) diameter reconstruction.

Annual tree-ring widths and wood density are useful proxies for carbon cycle studies across a range of species. Here, using a dendroecological approach we sought to understand the carbon accumulation rates of two representative pine species growing on contrasting wet (P. arizonica) and dry (P. cembroides) sites and reveal how such species cope with climate variability.

Developed a model to estimate annual tree growth based on tree-ring data (Abbr. TGTRing model) derived from the trunk at 0.5, 1.3 and 2.5 m height. This model was applied to estimate the annual biomass and carbon accumulation of a plantation in Qianyanzhou Red-Soil Hill Comprehensive Development Experimental Station of CAS in Taihe County, Jiangxi Province (Abbr. Qianyanzhou).

Twenty stem disks were collected from three land-use types (parklands, fallows and protected areas) in Koutiala and Yanfolila districts. We combined a standard dendrochronological approach with biomass allometric equations to estimate the growth and carbon stocks.

They derived a formula for estimating the relationship between stem carbon weight and stem volume, which was calculated from DBH and tree height using a combination of stem analysis and soft X-ray densitometry.

They selected trees with occupation or absence of lianas from two tropical species – Pinus caribaea var. hondurensis (Caribbean pine) and Tectona grandis (teak) – localized in a semideciduous forest fragment in southeastern Brazil, aiming to compare growth, climatic response, anatomy (vessels and intra-annual density fluctuations), wood density and carbon, by tree-ring analysis.

They studied mature Scots pine in an irrigation experiment in an inner-Alpine valley. Tree growth and isotope analyses were carried out at the annual and seasonal scale. At the seasonal scale, maximum d13C values were measured after the hottest and driest period of the year, and were associated with decreasing growth rates.

The d13C values of samples of 12 broadleaved trees (seven species) from various paleotropical and neotropical sites along a climatic moisture gradient were investigated. The inter-annual variability between species and sites was studied. Further the relationship between d13C and precipitation time series was analyzed.

The patterns and climatic signals of δ13C ratios were determined on tree rings of deciduous (Acacia senegal, Acacia tortilis, Acacia seyal) and an evergreen (Balanites aegyptiaca) species, from a semi-arid Acacia Woodland in Ethiopia. δ13C inter-annual patterns are synchronous among the co-occurring species.

In Pinus sylvestris, we traced the isotopic signals from their origin in the leaf water (d18O) or the newly assimilated carbon (d13C), via phloem sugars to the tree-ring, over a time-scale that ranges from hours to a growing season.

They assess the response of δ13C, δO and tree-ring width (TRW) from a temperate mountain forest in the Austrian pre-Alps to climate and specific drought events. Variations in stem growth and isotopic composition of Nor way spruce, common beech and European larch from dry, medium and moist sites are compared with records of sunshine, temperature, moisture, precipitation and cloud cover.

It is derived from highly resolved intra-annual measurements of 13C/12C ratios of wood and cellulose from tree rings of four species then calculated Cellulose extraction and Stable carbon isotope analysis

They explore whether there is a significant variation of C concentration according to the four cardinal directions (i.e., N, W, E, S), then assess if there is a significant variation among species and components, and finally quantify correlations in C concentration among tree compartments.

Using a selective sampling design, dominant and well-shaped trees were selected, whose samples were processed by chemical analyses finally tested two factors (treatments): species, which were divided into three levels (P. engelmannii, P. leiophylla and P. durangensis) and components, where seven levels were determined (root, stem, branch, leaves, twig, fruit and bark)

They pulse-labelled a branch of (Rupr.) Rupr. and later analysed the d13 Larix gmelinii C distribution in the stem. A C spiral translocation path closely related to the spiral grain was observed. We pulse-labelled whole trees to study how spring, summer and autumn photoassimilate is later used for both earlywood and latewood formation.

A branch of a 4-year-old Cryptomeria japonica D.Don tree growing in Tsukuba, Japan was pulse-labelled with non-radioactive 13CO2 on two occasions: 29 May 2001 and 18 September 2001. Two discs were cut from the stem on 4 March 2002, one immediately under and the other 0.5 m below the branch and put through high-resolution d13C analysis.

In order to determine whether drought influenced the ring index-d13C relation, the ring index time series were compared with d13C time series. We collected wood samples from eight Larix gmelinii (Rupr.) Rupr. and four Pinus sylvestris L. trees from the two sites and measured the earlywood and latewood widths and d13C of earlywood and latewood formed during the years 1996–2000.

They performed isotope-enabled simulations over the industrial period with the land biosphere module (CLM4.5) of the Community Earth System Model and the Land Surface Processes and Exchanges (LPX-Bern) dynamic global vegetation model. Results for C3 tree species show good agreement with a global compilation of d13C measurements on leaves, though modeled discrimination by C3 trees is smaller in arid regions than measured.

They collected tree-ring data across southern Central Europe. Tree cores were cut with a microtome to obtain a pristine surface suitable for subsequent dendrochronological analyses. Measurements of d13C and d18O were conducted separately for each selected tree and each year over the full length of the sampled cores.

They determinated the stable carbon isotope ratios

They calculate and measument tree ring width, density, and ratio of stable isotopes (13C/12C and O) in wood and cellulose for larch (Larix sibirica Ledeb.) then elaborate the chronologies and the correlation.

They studied stem disks collected from two Pinus radiata plantations in south-eastern Australia that had been thinned or treated with fertilizer. Estimated from tree-ring d 13C, the sites differed markedly in intrinsic water use efficiency of photosynthesis (WUEi= A/gs). Stem disks from one site (Lyons) showed pronounced differences in dC between early- and latewood, depending on stand density.

They used elemental analysis to investigate C content per unit of dry matter and observed that it varied both radially and vertically in boles of two old-growth tree species: sugar maple (Acer saccharum Marsh.) and giant sequoia (Sequoiadendron giganteum (Lindl.) Buch olz).C-content analysis Every 20th annual ring was marked, beginning with the outer most annual layer and working inward across the four radii of each sugar maple and across the one radius of each giant sequoia.

During the summer of 1983 we sampled pinyon at 5 sites in rural areas of Utah, /Colorado and New Mexico. In an attempt to accurately represent the' C/ C trend and absolute values of all trees at the site, we employed pooling of samples (Leavitt & Long, 1984). Conversion to cellulose resulted after several steps in a process modified after Green (1963).

Seasonal stable-carbon isotope patter were measured on cellulose of the tree rings fron 2 especies por the years 1985-1989 from open canopy and clored-canopy forest stands.

Provides a state-of-knowledge summary of the influence of “juvenile” isotope effects, ageing effects, and genetic effects, as well as the interchangeability of species, choice of ring segment to analyze (whole ring, earlywood or latewood), and the option of sample pooling.

Obtained samples of tree rings as cores or across-sections from several localities throughout North America. In some cases, isotopic analysis was performed on both original whole tissue and on cellulose isolated in a procedure after Green (1963) . The samples were combusted to CO* in an oxygenated atmosphere at 800’ C in a recirculating microcombustion line. The CO* was analyzed mass-spectrometrically and 6 ’ 3C (%o units) was computed relative to the PDB standard (Craig, 1957).

Data were obtained for the period 1962 to 1981, at the start of which the trees were 20 years old. A water balance model was used to calculate daily stand transpiration and water deficit. The model incorporates site factors (soil water availability, slope and aspect) and environmental variables (solar radiation, air temperature and rainfall).

Growth, density and δ13C of wood and leaf area were measured in two adjacent stands of 6 year-old Eucalyptus globulus growing in the 600–700 mm year rainfall region of south-western Australia. Study sites were identical except for differences in the availability of water owing to physical properties of soil profiles and location of sites within the landscape.

Accurate knowledge of carbon (C) content in live wood is essential for quantifying tropical forest C stocks, yet generic assumptions (such as biomass consisting of 50% carbon on a weight/weight basis) remain widely used despite being supported by little chemical analysis.

Annual samples of EW and LW from seven mature oaks (Quercus robur L.) from Scotland, covering AD 1924–2012, were pooled, treated to isolate alpha-cellulose and pyrolysed to measure the carbon isotope ratios.

They analyzed data from 28 trees (60–85 years old; mean = 73 years) of western white pine (Pinus monticola Dougl.), ponderosa pine (Pinus ponderosa Laws.), and Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco var. glauca) growing in northern Idaho. Material was obtained by the stem analysis method from rings laid down in the upper portion of the crown throughout each tree's life. Autoregressive moving average (ARMA) models were used to describe the autocorrelation structure over time. Three time series were analyzed for each tree: the stable carbon isotope ratio (δ13C); discrimination (Δ); and the difference between ambient and internal CO2 concentrations (ca–ci). The effect of converting from ring cellulose to whole-leaf tissue did not affect the analysis because it was almost completely removed by the detrending that precedes time-series analysis. A simple linear or quadratic model adequately described the time trend. The residuals from the trend had a constant mean and variance, thus ensuring stationarity, a requirement for autocorrelation analysis.

Phloem and leaf samples for δ13C and δ18O analyses as well as soil water, xylem water, leaf water and atmospheric water vapour samples for δ18O analysis were taken approximately every 2 weeks during the growing season of 2007. The δ13C and δ18O samples from the tree rings were dated intra-annually by monitoring the tree growth with dendrometers.

Developed a model for wood growth to interpret seasonal isotopic signals collected in an even-aged maritime pine plantation growing in South-west France, where climate, soil and flux variables were also monitored. species). The cores were then shaved with a cutter in the transversal plane and the tree-ring, early and late wood widths were measured by optical methods (Windendro Software, Regent Instruments Inc.).

New records of ô13C and A14C values in annual rings of pine and oak from different sites around the world were obtained with a time resolution of 1 yr.

Both d13C and d18O were measured at annual resolution from whole-ring acellulose of three white spruce trees (Picea glauca [Moench] Voss) growing in the Mackenzie Delta. Then they identifi the association between d13C and and the climatic variables

They chose sites which differ in moisture conditions and sampled cores from four to six trees per site. Calculate mean 13C/12C series from the different sites. Correlation analysis with climate data and the carbon isotopes.

They analised d13C series (3 year ring samples) of cellulose beech trees covering a time period from 1934 to 1989 for 3 sites a relative dry and humid site close together and another dry site 30 km distant.

They compiled high-resolution, intra-ring, d13C data published since 2000 for 33 evergreen trees from 15 globallydistributed sites.

Sample material was extracted every 6 min with a UV-laser from a tree core, leaving 40-µm-wide holes. Ablated wood dust was combusted to CO at 700 °C, separated from other gases on a GC column and injected into an isotope ratio mass spectrometer after removal of water vapor. The measurements were calibrated against an internal and an external standard. The tree core remained intact and could be used for subsequent dendrochronological and dendrochemical analyses. Cores from two Scots pine trees (Pinus sylvestris spp. sibirica Lebed.) from central Siberia were sampled. Inter- and intra-annual patterns of δ132C in whole-wood and lignin-extracted cores were indistinguishable apart from a constant offset, suggesting that lignin extraction is unnecessary for our method. Comparison with the conventional method (microtome slicing, elemental analysis and IRMS) indicated high accuracy of the LA-C-GC-IRMS measurements.

Tree annual growth rings of Masson pine were collected from four forest sites, viz. South China Botanical Garden (SBG), Xi Qiao Shan (XQS) Forest Park, Ding Hu Shan (DHS) Natural Reserve, and Nan Kun Shan (NKS) Natural Reserve in Southern China. The mean annual basal area increment (BAI), WUE, and δ15N at every 5-year intervals of Masson pine during the last 50 years were determined. Regression analyses were used to quantify the relationships of BAI and WUE with atmospheric carbon dioxide concentration ([CO]), temperature, rainfall, and tree ring elemental concentrations at the four study sites.

They cored a number of trees of both full-bark and stripbark. Three or four cores of 4.3 mm diameter were drilled from three or four perpendicular directions of each tree. All cores were cross-dated dendrochronologically, but no attempt was made to determine the age of the trees. Four trees (two full-bark and two strip-bark) were analysed for carbon isotopic compositions.

Cross-sections from eight white spruce trees growing in the Hudson Bay Lowlands, subartic Manitoba, with an establishment date prior to 1775 were selected from our archive. For each cross-section, two radii were measured to produce ring-width chronologies. For stable-carbon isotope measurements, every fifth ring (2000, 1995, … 1750) was analyzed separately from each tree, whereas approximately equal masses from the eight trees were pooled into composite samples for each of the intermediate years mixing masses from each tree equal to that from the tree with the least amount. Alpha-cellulose was extracted and δ13C was determined using continuous-flow mass spectrometry. The ring-width residual chronology derived from eight trees was highly correlated to that previously developed for the area. A small but significant correlation was also found between the ring-width and the δ13C residual chronologies.

A slimming stand was used. The stand incorporated six plots representing three thinning regimes (light, moderate and heavy) and was planted in the spring of 1943 on a brown earth soil. Radial growth (early- and latewood) was measured for the purpose of this study. A multidisciplinary approach was used to assess historic tree response to climate: specifically, the application of statistical tools such as principal component and canonical correlation analysis to dendrochronology, stable isotopes, ring density proxy, blue reflectance and forest biometrics

We applied several corrections to tree-ring d13C records, considering a range of potential CO2 discrimination changes over the past 150 years and calculated the goodness of fit with the target via calibration/verification tests (R2, residual trend, and Durbin–Watson statistics).

Compile literatura data for a range of conifers and examined relationships among landscape and environmental variables (altitude, precipitation, evaporation) and δ13C

The d13C estimates were based on the model's existing description of carbon assimilation and canopy conductance. Measured parameters included quantum yield, specific leaf area, soil water content and litterfall rate. Predictions were compared with measurements of transpiration by sap flux, stem biomass, tree diameter growth, leaf area index and d13C.

Stem cores of 30 individual trees (n = 3 trees per each species and site) were sampled from two sites in south Germany (Bavaria), and tree rings within sapwood of the years 2001–2010 were separated. The δ18O and δ13C values from homogenized tree-ring whole wood and from extracted cellulose were measured by mass spectrometry. Speciesspecific offsets in isotope values were analyzed and the responses in isotopic signature to climate variability including a single drought event were compared between whole-wood and cellulose.

With tree ring analysis, forest inventories and destructive sampling the above-ground biomass increment of secondary forest stands of age between 9 and 48 years in the dry forest region of Guanacaste, Costa Rica were estimated

For tree ring analysis, stem disk samples were taken from three important commercial tree species; Tree rings were measured and the results used together with height estimates to model diameter, height and volume growth.

Area of influence	Country of study area
Hyytiälä, Soroe, San Rossore,Tharandt y Braschaat	Finland, Denmark, Italy, Germany and Belgium
Hyytiälä, Soroe, San Rossore,Tharandt y Braschaat	Finland, Denmark, Italy, Germany and Belgium
Leinefelde forest, Thüringen, Germany	Germany
Island Isola d'Elba	Italy
Oak Ridge National Laboratory) FACE, Tennessee (USA) and stand at Duke FACE, North Carolina (USA) and a former agricultural field, in Tuscania (Italy)	USA and Italy
Arrowtown, Ribbonwood, Glenfoyle, Castledowns, Tokoiti, Gwavas, Dusky, Te Wera, Whakarewarewa, Berwick, Kinleith, Rotoehu, Kaingaroa, Rotoehu, Hanmer, Wairoa, Kaingaroa, Rankleburn, Kaingaroa, Craigieburn, St Arnaud, Tauhara, BurntFace6, BurntFace1, BurntFace5, BurntFace3, North Bank, Golden Downs, Kaingaroa Forest, Creek Kaingaroa, Whakarewarewa	New Zealand

Jura Mountains eastern France on the border with Switzerland. Besançon- Doubs; Saint-Hippolyte- Grand Est; Salins-les-Bains Franche; Champagnole-Franche; Pontarlier. Franche; Morez Franche; Saint-Claude- Franche; Oyonnax- Ain; Switzerland Delémont-Jura; Bienne-Bern; Neuchatel-Neuchâtel; Sainte-Croix- Jura-Nord vaudois; Lausanne Vaud Geneva- Ginebra	France and Switzerland
Shawnigan Lake British Columbia	Canada
Spanish Iberian Peninsula	Spain
Fontainebleau Forest located south of Paris	France
North Carolina USA. Wilmington, Reidsville, Waynesville	USA

Sierra de Cadí-Pedraforca, Lérida . Sierra de Cazorla, Segura y las Villas, Jaén	Spain
18 km from Nancy, in the northeast of France.	France
Forest of Fougères, Amance and Champenoux	France
Sierra Madre Occidental	Mexico
Sierra Madre Occidental,	Mexico
SMEAR II station is located in southern Finland	Finland
Charles Lathrop Pack Experimental Forest	USA

Camp Navajo, Kaibab NF, Grandview, Mt. Trumbull and North Rim.	USA
Located at 1060 m a.s.l. in the inner alpine dry valley of Valais in southwestern Switzerland close to the village Lens.	Switzerland
Quebec eastern Canada	Canada
Xiaolongshan Mountain approximately 16 km northeast of Hui county, eastern Gansu Province	China
Li County of Sichuan	China
Desa’a dry afromontane forest	Ethiopia
Sierra Madre Occidental of northern Mexico	Mexico
Otinapa and Santa Barbara	Mexico

Qianyanzhou Red-Soil Hill Comprehensive Development Experimental Station	China
Koutiala and Yanfolila in the Sudano-Guinea zone.	Mali
Yuza in Yamagata, and Esashi, Hokkaido	Japan
Piracicaba, in the state of São Paulo in southeastern Brazil	Brazil
Central part of the Swiss Rhone valley (Valais)	Switzerland
Katima Mulilo, Namibia; Dorado-Tumereso, Venezuela;Biakoa, Caméroon; Caparo and Uriman, Venezuela, Km.98 Sierra de Lema, Venezuela and La Selva, Costa Rica.	Namibia, Venezuela, Cameroon y Costa Rica
Acacia woodland in Abernosa, about 170 km south of Addis Ababa,.	Ethiopia
n/a	Germany

The long-term ecosystem monitoring site ‘LTER Zöbelboden	Austria
Hambach, Alemania; Bergisch-Gladbach; Alemania; Rostrevor, Irlanda; Neuglobsow, Berlin	Germany and Ireland
Santa Bárbara	Mexico
Sierra del Nayar	Mexico
20 km north of Yakutsk city in the Spasskaya Pad experimental forest of the Institute for Biological Problems of Cryolithozone	Russia
Institute in Tsukuba	Japan
Spasskaya Pad experimental forest of the Institute for Biological Problems of Cryolithozone	Russia
Europe, boreal Asia, and western North America	Europe, Asia, North America
Bötschental N19, Davos, Giumalau, Riedenburg, Lägern, Mt. Cimino, Cucuraena	Switzerland, Romania, Germany, Italy

Lake Schwarzensee	Austria
Khakasia	Russia
Lyons and Daylesford	Australian
Napodogan, New Brunswick. And Mountain Home Demonstration State Forest, California	USA and Canada
Kane Spring, Aztec, Dry Canyon, Alton) and Lower Colonias	USA
White pine plantation on the southwest corner of the University of Wisconsin	USA
New Mexico, Tasmania, arizona, India, N. Ireland, France/Morocco, China	USA, China, France, Irelanda and India
Several localities throughout North America (Prescott, Stoneman, Radio Ridge, Hitchcock, Bigeloti, Kellogg, San Pedro, Gila, Santa Ynez, Oregon, Chicago, Rio Abajo, Bears Ears, Two Creeks).	USA

East side of Vancouver Island, British Columbia, Canada	Canada
‘Wheatley’ plantation of E. globulus operated by Bunning’s Treefarms Pty Ltd.	Australia
Pipeline Road site in Soberania National Park	Panama
4 km south of Aviemore, Scotland	United Kingdom
Priest River Experimental Forest (PREF) in northern Idaho, USA	USA
Swabian Jura, Tuttlingen in southern Germany	Germany

Bordeaux, France	France
Niepolomice Forest, southern Poland and Suwalki region, NE Poland	Poland
High-latitude treeline site in northwestern Canada.	Canada
A dry site (Unterbergental Dry = UBD) and a humid site (Unterbergental Humid = UBH)	Switzerland
A dry site (Twann Dry = TWD) and a humid site (Twannl Humid = TWH)	Switzerland
Natchez State Park, Mississippi, Mauna Kea, Hawaii.	USA

Central Siberia	Russia
South China Botanical Garden at Guangzhou, Xi Qiao Shan (XQS) Forest Park at Foshan, Ding Hu Shan (DHS) Natural Reserve at Zhaoqing, and Nan Kun Shan (NKS) Natural Reserve at Huizhou.	China
Sheep Mountain in the White Mountains, CA	USA
Hudson Bay Lowlands ecoregion and south of the town of Churchill, Manitoba	Canada

Co. Wicklow on the east coast of Ireland	Ireland
Karakorum Mountains	Pakistan
South-western Australia	Australia
The Mica Creek Experimental Watershed	USA
Freising and Riedenburg	Germany
Hacienda Cerbastán	Costa Rica
Managed forest of the Mil Madeiras Preciosas Ltda. Company, which is part of the Precious Woods Holding	Brazil

State
Hyytiälä de Juupajoki, Sorø de la isla de Selandia, San Rossore en Pisa, Tharandt de Sachsen, Brasschaat de Amberes
Hyytiälä de Juupajoki, Sorø de la isla de Selandia, San Rossore en Pisa, Tharandt de Sachsen, Brasschaat de Amberes
Thüringen
Isla del mar Tyrrhenian
Tennessee (USA), North Carolina (USA) and Tuscania (Italy)
Nueva Zelanda

Besançon- Doubs; Saint-Hippolyte- Grand Est; Salins-les-Bains Franche; Champagnole-Franche; Pontarlier. Franche; Morez Franche; Saint-Claude-Franche; Oyonnax- Ain; Switzerland Delémont-Jura; Bienne-Bern; Neuchatel-Neuchâtel; Sainte-Croix-Jura-Nord vaudois; Lausanne Vaud Geneva-Ginebra

British Columbia

Madrid, Barcelona, Valencia, Sevilla, Alicante, Málaga, Murcia, Cádiz, Vizcaya, Baleares, La Coruña, Las Palmas, Asturias ,Santa Cruz de Tenerife, Zaragoza, Pontevedra, Granada, Tarragona, Córdoba, Gerona, Guipúzcoa, Almería, Toledo, Badajoz, Navarra, Jaén, Cantabria, Castellón, Huelva, Valladolid, Ciudad Real, León, Lérida, Cáceres, Albacete, Burgos, Salamanca, Lugo, Álava, La Rioja, Orense, Guadalajara, Huesca, Cuenca, Zamora, Palencia, Ávila, Segovia, Teruel, Soria, Melilla, Ceuta

Seine-et-Marne

North Carolina

Lérida and Jaén

Meurthe-et-Moselle

Brittany, Grand Est and Meurthe-et-Moselle

Durango

Durango

Hyytiälä,

Washington

Arizona

Valais

Quebec

Gansu

Sichuan

Desa

Durango

Durango

Jiangxi Province

Mali

Yamagata and Hokkaido

Sao Paulo

Valais

Zambezi; Bolivar;Mbam-et-Kim; Merida.

Adís Abeba

n/a

Austria

Hambach,Bergisch-Gladbach; Rostrevor,
Neuglobsow

Durango

Durango

Saja

Tsukuba

Saja

n/a

Valais, Carpathians, Jura, Viterbo.

Strobl

Jakasia

Woden and Daylesford

New Brunswick and California

Arizona, Utah, Colorado and New Mexico

Wisconsin

New Mexico, Tasmania, arizona, India, N. Ireland, France/Morocco, China

Arizona, Florida, Texas, Arkansas, Arizona, California, Oregon, Chicago, Utha, Wisconsin

British Columbia

Bridgetown

Panama

Highland

Idaho

Tuttlingen

Gironda

Niepołomice, Baczków, Krzyżanowice and Mikluszowice. Podlaskie Voivodeship

Aklavik, Fort McPherson and Tsiigehtchic

Jura

Jura

Mississippi and Hawaii

Siberia

Guangzhou, Foshan, Zhaoqing and Huizhou.

California

Manitoba

Leinster

Gilgit-Baltistán

Murray-Wellington

Idaho

Baviera

Guanacaste

Amazonas

Geographical coordinates (X, Y y Z)

Hyytiälä 61°51′N, 24°17′E, 180 m a.s.l. Soroe 55°29′13″N, 11°38′45″E 40 m asl, San Rossore 43°36′–43°48′N, 10°15′–10°21′E,Tharandt 50°57'49 N, 13°34'01 E, 380 m a.s.l y Braschaat 51°18′33″N, 4°31′14″E

Hyytiälä 61°51′N, 24°17′E, 180 m a.s.l. Soroe 55°29′13″N, 11°38′45″E 40 m asl, San Rossore 43°36′–43°48′N, 10°15′–10°21′E,Tharandt 50°57'49 N, 13°34'01 E, 380 m a.s.l y Braschaat 51°18′33″N, 4°31′14″E

51°20′N, 10°22′E

Nivera Valley 42°46'N, 10°11'E y Monte Perone 42°46'N, 10°12'E

Tennessee (USA) (35°54′ N, 84°20′ W, North Carolina (USA-Duke Face) 35°58'N, 79°5'W and Tuscania (Italy)

Arrowtown 44.94 S168.77E, Ribbonwood 44.38S 169.82E, Glenfoyle 44.72S 169.33E, Castledowns 45.85 S168.20E, Tokoiti 46.16S 169.97E, Gwavas 39.71S 176.37E, Dusky 45.85S 169.12E, Te Wera 39.19S 174.63E, Whakarewarewa 38.21S 176.27E, Berwick 45.87S 170.02E, Kinleith 38.38S 175.87E, Rotoehu 37.98S 176.52E, Kaingaroa 38.45S 176.60E, Rotoehu 37.91S 176.58E, Hanmer 42.53 S172.91E, Wairoa 38.98S 177.56E, Kaingaroa 38.89S 176.29E, Rankleburn 45.99S 169.42E, Kaingaroa 38.38S 176.71E, Craigieburn 43.15S 171.73E, St Arnaud 41.76S 172.79E, Tauhara 38.70S 176.23E, BurntFace6 43.04S 171.64E BurntFace1 43.04S 171.63E, BurntFace5 43.04S 171.63E, BurntFace3 43.04S 171.63E, North Bank 41.47S 173.67E, Golden Downs 41.46S 172.91E, Kaingaroa 38.88S 176.29E, Forest Creek 43.69S 170.88E, Kaingaroa 38.34S 176.39E, Whakarewarewa 38.21S 176.28E

Rango 46°40′N 6°15′E

48.6336 N, 123.7122 W

40°30′N 4°00′W

2.67◦ E, 48.38◦ N

n/a

Sierra de Cadi-Pedraforca 42°18′10″N 1°41′47″E, Sierra de Cazorla, Segura y las Villas 38°05′00″N 2°45′00″O

48°41′37″N 6°11′05″E

(48 ° 23′N, 1 ° 09 ′ O, 48°46′ N, 6°19′ E, and 48°43′ N, 6°21′ E

105.534944W, 23.747306N, 2905Z; 105.533583W, 23.752605N, 2813 Z; 105.379611W, 24.189083N, 2414Z; 105.464778W, 24.177583N, 2375Z; 105.056047W, 24.141570N, 2330Z

23°41'25'', -105°21'10'' 2538

61 ° 51´N, 24 ° 17´E,160-180 Z

n/a

Camp Navajo 35.8159 N, longitude 1118.529 W. 2134 m, Kaibab NF, Grandview, Mt. Trumbull and North Rim

n/a

North region
FM 47°19'00'' 71°06'00''   RIV-M 47°18'18'' 71°08'00''   RIVN-1 47°21'09'' 71°06'07''   RIVN-2 47°19'42'' 71°06'01''   SAUT 47°19'06'' 71°12'46'' ------------Middle region   FR 47°08'17'' 71°17'08''   KM82FR-1 47°09'36'' 71°15'20''   PTR 47°07'00''   71°20'00'' ---------------South region   LS 46°52'42'' 71°43'17''   STMAT 47°03'24'' 71°39'41''   SLAC7 46°55'34'' 71°46'51''   DUC-2 46°56'05'' 71°39'15''

33°51′54.00″N 106°01′19.20″E

31°55'N, E102°35'–103°4' 2200-2250

13°36' to 13°56´N and 39°48' to 39°51 E

105.534944W, 23.747306N, 2905Z; 105.48828W, 23.72436N, 2680Z

El Salto 23°37'N 105°24'W, 2000-3000Z and Otinapa 24°05'N, 104°02'W, 2000-3000Z

26°44′–26°45′30″N and 115°3′–113°4′30″E 100 m

Koutiala 12 N and 5◦66 W and Yanfolila i11° 10'N and 8◦09W

Yamagata 39.0'22''N, 139 51'13''E; Hokkaido, 41 56' 5''N, 140 8'44''E

22°42′ S, 47°37′ W, elevation 546 m

46°18′ N, 7°36′ E, 615Z

Katima Mulilo17°30'S,24°17'E; Dorado-Tumereso 6°55'N,61°24'W;Biakoa4°40'N,11°32'E; Caparo7°26'N,70°55'W, Uriman5°60'N,62°65'W, Km.98 Sierra de Lema 6°06'N61°23'W, and La Selva, 10°26'N,83°59'W

7° 51′ N, 38° 42′ E

n/a

N47°50′25″, E14°26′30″ 880-900

Hambach 50°54'N, 6°25'E 91 m; Bergisch-Gladbach 51°4'N7°8'E 150m;
Rostrevor54°6'N6°12'W 180m; Neuglobsow 53°5'N, 13°5'E 65m

23°40 y 105°30 W 2700

23°35 and 105°9 2350m

62°15N, 129°37'E 220m

n/a

62°15N, 129°37'E 220m

n/a

1060 Z

47°31'N,13°49'E, 1450m

54°24′N, 89°57′E

Lyons 38°03'S, 141°26E, 110Z; Daylesford 37°20'S, 144°06'E, 630Z

n/a

1965m (Kane Spring), 2080m (Aztec), 2150 (Dry Canyon), 2245 (Alton) and 2375 (Lower Colonias).

42°35'N,87°50W' 215 m

Tasmania 40 Z; India 74°25'E, 34°04'N, 2650 Z; France/Morocco 44°42′N, 0°46′W

Prescott 34°36'N, 112°3l'W, 1705 Z; Stoneman 35°45'50"N, 111°38'40"W, 1660 Z; Radio Ridge 32°26'N, 110°47'W, 2740 Z; Hitchcock 33°23'N, 110°41'W, 1830 Z; Bigelow 32°25'16"N, 110°42'40"W, 2590 Z; Kellogg 35°25'20"N, 110°42'30"W, 2590 Z; San Pedro 32°08'N, 110° 18'W, 975 Z; Gila Prosopis juliflora 33°14'N, 108°26'W, 2380 Z - P. ponderosa 33°14'N, 108°28'W, 2365 Z; Santa Ynez 34°30'50"N, 119°48'10"W, 815 Z; Oregon 44°50'N, 120°25'W, 760 Z; Chicago 41°31'30"N, 87°40'W, 198 Z; Rio Abajo 18°21'N, 66°42'W, 250-425 Z; Bears Ears 37°37'N. 109°51'W, 2575 Z; Two Creeks 44° 17'N, 87°27'W, 180 Z

49° 5\'N, 125° 14'W

33·99 °S, 116·32 °E

9°10N, 75°45'W

57° 9′ 15″ N03° 50′ 0″ W, 300 m

48°21′ N, 116°50′ W, 800-950Z

8° 45′ E, 47° 59′ N, 740-760Z

44°43′N, 0°46′W, 62Z

n/a

68°24'00"N 133°48'40"W

n/a

736'E 47°N 600-700 Z

Table 2 ----Natchez State Park, Mississippi, USA; 31 36N,91 13W--Mauna Kea, Hawaii, USA; 19 50N, 155 36W -- Sierra de Lema, Venezuela; 6 6N, 61 23W--Renon, northern Italy; 46 36N, 11 28E--Flakaliden, northern Sweden;64 7N, 19 27--Central Siberia; 60 43EN, 89 8E--Gazi Bay, Kenya; 4 25S,39°30E--Hainich, central Germany; 51 4N, 10 27E--Nakhorn Ratchasima, NEThailand; 14 30N,101°56'E--Chiang Mai, northern Thailand; 18 30N, 98 30E--Southwestern Australia; 33 58S, 115 26E--Yatir forest, Negev Desert, Israel; 31 20N, 35 00E--Elba, Italy; 42 46N, 10 11E--West Pibiri, central Guyana; 5 2N, 58 37W--Pisa, Italy; 43 13N, 10 17E

n/a

South China Botanical Garden (SBG, 113°21′E, 23°11′N) at Guangzhou, Xi Qiao Shan (XQS) Forest Park (112°56′E, 22°55′N) at Foshan, Ding Hu Shan (DHS) Natural Reserve (112°34′E, 23°10′N) at Zhaoqing, and Nan Kun Shan (NKS) Natural Reserve (113°51′E, 23°38′N) at Huizhou.

37°22' N, 118°13'W, 3475 Z

58°44'N; 94°04'W

N 52°51.881; W 006°10.213

Ram 35.74 N 74.59 E 3600Z; Bag-high 35.90 N 74.56 E 3800Z; Bag-low 35.90 N 74.56 E 2900Z; Mor 36.37 N 74.99 E, 3900Z

32.97S and 115.43E; 15–30 Z

47°15′N, 116°25′W

Freising: 11°39’30’’E, 48°24’45’’N and Riedenburg: 11°46’05’’E, 48°55’66’’N

10◦49’N, 85◦15’W

20° 49' S, 58°44 W'

Vegetation	Specie	Climate
Temperate Broadleaf and Mixed Forests; Boreal Forests/ Taiga	*Pinus sylvestris* L.; *Fagus sylvatica* L.; *Pinus pinaster* Aiton; *Picea abies* (L.) H. Karst.	Warm temperate; snow
Temperate Broadleaf and Mixed Forests; Boreal Forests/ Taiga	*Pinus sylvestris* L.; *Fagus sylvatica* L.; *Pinus pinaster* Aiton; *Picea abies* (L.) H. Karst.	Warm temperate; snow
Temperate Broadleaf and Mixed Forests	*Fagus sylvatica* L.	Warm temperate
Mediterranean forests, woodlands and scrub	*Arbutus unedo* L.	Warm temperate
Temperate Broadleaf and Mixed Forests;	*Liquidambar styraciflua* L.; *Pinus taeda* L.; *Populus* sp.	Warm temperate
Temperate Broadleaf and Mixed Forests	*Pseudotsuga menziesii* (Mirb.) Franco	Warm temperate

Temperate Broadleaf and Mixed Forests	*Abies alba* Mill	Warm temperate
Temperate Coniferous Forests	*Pseudotsuga menziesii* (Mirb.) Franco	Warm temperate
Mediterranean forests, woodlands and scrub	*Pinus halepensis* Mill	Warm temperate
Temperate Broadleaf and Mixed Forests	*Quercus robur* L.	Warm temperate
Temperate Broadleaf and Mixed Forests	*Pinus serotina* Michx.; *Pinus virginiana* Mill.; *Populus alba* L.; *Quercus alba* L.; *Quercus rubra* L., *Quercus rubra* var. *borealis* (F. Michx.) Farw.	Warm temperate

Mediterranean forests, woodlands and scrub	*Pinus uncinata* Raymond ex A. DC.	Warm temperate
Temperate Broadleaf and Mixed Forests	*Fagus sylvatica* L.	Warm temperate
Temperate Broadleaf and Mixed Forests	*Fagus sylvatica* L.; *Quercus petraea* (Matt.) Liebl.	Warm temperate
Tropical and Subtropical Coniferous Forests	*Pinus cooperi* C.E. Blanco	Warm temperate
Tropical and Subtropical Coniferous Forests	*Cupressus lusitanica* Mill.; *Pseudotsuga menziesii* (Mirb.) Franco	Warm temperate
Boreal Forests/ Taiga	*Pinus sylvestris* L.; *Picea abies* (L.) H. Karst.; *Betula pendula* Roth; *Betula pubescens* Ehrh.; *Populus tremula* L.; *Salix* sp.; *Juniperus communis* L.; *Sorbus aucuparia* L.; *Alnus incana* (L.) Moench; *Pinus contorta* Douglas ex Loudon	Snow
Temperate coniferous forests	*Pseudotsuga menziesii* (Mirb.) Franco	Warm temperate

Temperate coniferous forests	*Pinus ponderosa* P. Lawson & C. Lawson	Warm temperate
Temperate coniferous forests	*Pinus sylvestris* L.; *Larix decidua* Mill.; *Quercus pubescens* Willd.	Warm temperate
Boreal Forests/ Taiga	*Abies balsamea* (L.) Mill.; *Picea mariana* (Mill.) Britton, Sterns & Poggenb.	Snow
Temperate Broadleaf and Mixed Forests	*Pinus bungeana* Zucc. ex Endl	Warm temperate
Tropical and Subtropical Moist Broadleaf Forests	*Picea asperata* Mast.; *Betula albosinensis* Burkill; *Acer* spp.; *Abies faxoniana* Rehder & E.H. Wilson	Warm temperate
Montane Grasslands and Shrublands	*Juniperus procera* Hochst. ex Endl.; *Olea europaea* L.	Arid
Tropical and Subtropical Coniferous Forests	*Pinus cooperi* C.E. Blanco	Warm temperate
Tropical and Subtropical Coniferous Forests	*Pinus arizonica* Engelm.; *Pinus cembroides* Zucc.	Warm temperate

Tropical and Subtropical Moist Broadleaf Forests	*Pinus elliottii* Engelm.; *Pinus massoniana* D. Don; *Cunninghamia lanceolata* (Lamb.) Hook.	Warm temperate
Tropical and Subtropical Grasslands, Savannas and Shrublands	*Vitellaria paradoxa* C.F. Gaertn.	Arid
Temperate Broadleaf and Mixed Forests	*Pinus thunbergii* Parl.	Warm temperate; snow
Tropical and Subtropical Moist Broadleaf Forests	*Pinus caribaea* var. *hondurensis* (Sénécl.) W.H. Barrett & Golfari; *Tectona grandis* L. f.	Equatorial
Temperate coniferous forests	*Pinus sylvestris* L.	Warm temperate
Tropical and Subtropical Grasslands, Savannas and Shrublands; Tropical and Subtropical Moist Broadleaf Forests	*Cedrela odorata* L.; *Swietenia macrophylla* King; *Terminalia sericea* Burch. ex DC.; *Terminalia amazonia* (J.F. Gmel.) Exell; *Terminalia superba* Engl. & Diels; *Terminalia guyanensis* Eichler; *Terminalia quintalata* Maguire	Arid; Equatorial
Tropical and Subtropical Grasslands, Svannas and Shrublands	*Acacia senegal* (L.) Willd.; *Acacia tortilis* (Forssk.) Hayne; *Acacia seyal* Delile; *Balanites aegyptiaca* (L.) Delile	Equatorial
Mediterranean Forests	*Pinus sylvestris* L.	Warm temperate

Temperate Broadleaf and Mixed Forests	*Picea abies* (L.) H. Karst., *Larix decidua* Mill.; *Fagus sylvatica* L.	Snow
Temperate Broadleaf and Mixed Forests	*Fagus sylvatica* L.; *Populus nigra* L.; *Quercus petraea* (Mattuschka) Liebl.; *Morus alba* L.	Warm temperate
Tropical and Subtropical Coniferous Forests	*Cupressus lusitanica* Mill.; *Picea chihuahuana* Martínez., *Abies durangensis* Martínez; *Pseudotsuga menziesii* (Mirb.) Franco	Warm temperate
Tropical and Subtropical Coniferous Forests	*Pinus durangensis* Martínez, *Pinus engelmannii* Carrière; *Pinus leiophylla* Schiede ex Schltdl. & Cham.	Warm temperate
Tundra	*Larix gmelinii* (Rupr.) Kuzen.	Snow
Temperate Broadleaf and Mixed Forests	*Cryptomeria japonica* (Thunb. ex L. f.) D. Don	Warm temperate
Tundra	*Larix gmelinii* (Rupr.) Kuzen.; *Pinus sylvestris* L.	Snow
Temperate Broadleaf and Mixed Forests, Temperate coniferas forest, Boreal Forest/Taiga	n/a	Warm temperate, Snow
Temperate Broadleaf and Mixed Forests; Mediterranean forests, woodlands and scrub; Boreal Forests/ Taiga	*Picea abies* (L.) H. Karst.; *Fagus sylvatica* L.	Warm temperate; Snow

Temperate Broadleaf and Mixed Forests	*Larix decidua* Mill.; *Picea abies* (L.) H. Karst.	Warm temperate
Temperate Grasslands, Savannas and Shrubland	*Larix sibirica* Ledeb.	Snow
Temperate Broadleaf and Mixed Forests	*Pinus radiata* D. Don	Warm temperate
Temperate Broadleaf and Mixed Forests; Temperate coniferous forests	*Acer saccharum* Marshall; *Sequoiadendron giganteum* (Lindl.) J. Buchholz	Warm temperate; Snow
Temperate coniferous forests; Deserts and xeric shrublands	*Pinus edulis* Engelm.	Warm temperate; Arid
Temperate Broadleaf and Mixed Forests	*Pinus strobus* L.; *Acer saccharinum* L.	Snow
Temperate coniferous forests; Deserts and xeric shrublands; Temperate Broadleaf and Mixed Forests; Tropical and Subtropical Moist Broadleaf Forests	*Pinus ponderosa* P. Lawson & C. Lawson; *Phyllocladus aspleniifolius* (Labill.) Hook. f.; *Pinus edulis* Engelm.; *Abies pindrow* (Royle ex D. Don) Royle; *Quercus petraea* (Matt.) Liebl.; *Pinus pinaster* Aiton, *Cryptomeria fortunei* Hooibr. ex Otto & Dietrich; *Abies fabri* (Mast.) Craib	Warm temperate; Arid
Temperate coniferous forests	*Juniperus deppeana* Steud.; *Pinus edulis* Engelm.; *Pseudotsuga menziesii* (Mirb.) Franco; *Pinus ponderosa* P. Lawson & C. Lawson; *Prosopis juliflora* (Sw.) DC.; *Pinus coulteri* Lamb. ex D. Don; *Juniperus occidentalis* Hook.; *Juniperus virginiana* L.; *Acer saccharinum* L.; *Ocotea leucoxylon* (Sw.) Laness.; *Tectona grandis* L. f. *Montezuma speciosissima* DC.; *Pinus caribaea* Morelet	Warm temperate; Snow; Arid

Temperate Coniferous Forests	*Pseudotsuga menziesii* (Mirb.) Franco	Snow
Tropical and Subtropical Grasslands, Savannas and Shrublands	*Eucalyptus globulus* Labill.	Warm temperate
Tropical and Subtropical Moist Broadleaf Forests	59 native tree species. See table S1	Equatorial
Temperate coniferous forests	*Quercus robur* L.	Warm temperate
Temperate coniferous forests	*Pinus monticola* Douglas ex D. Don; *Pinus ponderosa* P. Lawson & C. Lawson; *Pseudotsuga menziesii* var. *glauca* (Mayr) Franco	Warm temperate
Temperate Broadleaf and Mixed Forests	*Fagus sylvatica* L.	Warm temperate

Mediterranean Forests, Woodlands and Scrub	*Pinus pinaster* Aiton	Warm temperate
Temperate Broadleaf and Mixed Forests	*Pinus sylvestris* L.; *Quercus robur* L.; *Pinus sylvestris* L.	Warm temperate
Boreal Forests/ Taiga	*Picea glauca* (Moench) Voss	Snow
Temperate coniferous forests	*Fagus sylvatica* L.	Warm temperate
Temperate coniferous forests	*Fagus sylvatica* L.	Warm temperate
Temperate Broadleaf and Mixed Forests;	*Pinus* sp.; *Sophora* sp.	Warm temperate

Tundra	*Pinus sylvestris* var. *sibirica* Lebed.	Snow
Tropical and Subtropical Moist Broadleaf Forests	*Pinus massoniana* L.	Warm temperate
Temperate coniferous forests	*Pinus longaeva* D.K. Bailey	Warm temperate
Boreal Forests/ Taiga	*Picea glauca* (Moench) Voss	Snow

Temperate Broadleaf and Mixed Forests	*Picea sitchensis* Trautv. & G. Mey.	Warm temperate
Montane Grasslands and Shrublands	*Juniperus* sp.	arid
Temperate Graslands, Savannas and Shrubland	*Pinus radiata* D. Don; *Pinus pinaster* Aiton	Warm temperate
Temperate coniferous forests	*Abies grandis* (Douglas ex D. Don) Lindl	Warm temperate
Temperate Broadleaf and Mixed Forests	*Fagus sylvatica* L.; *Quercus robur* L.; *Picea abies* (L.) H. Karst.; *Abies alba* Mill.*; Pseudotsuga menziesii* (Mirb.) Franco	Warm temperate
Tropical and Subtropical Moist Broadleaf Forests	*Lonchocarpus minimiflorus* Donn. Sm.; *Cochlospermum vitifolium* (Willd.) Spreng.; *Stemmadenia obovata* K. Schum.; *Luehea candida* (DC.) Mart.; *Luehea speciosa* Willd.	Equatorial
Tropical and Subtropical Moist Broadleaf Forests	*Cariniana micrantha* Ducke; *Caryocar villosum* (Aubl.) Pers.; *Manilkara huberi* (Ducke) Standl.	Equatorial