



UNIVERSITÀ
DEGLI STUDI
FIRENZE

*4th ICP Forests Scientific Conference 2015
19–20 May 2015 in Ljubljana, Slovenia*

The use of ICP level I BIOSOIL- BIODIVERSITY plots for pan-European estimation of forest variables

Gherardo Chirici, Anna Barbat, Francesca Giannetti, Davide Travaglini, Roberto Canullo



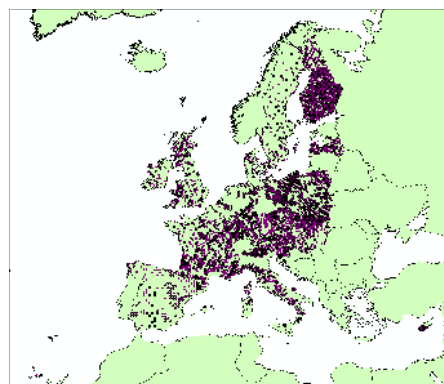
ICP Forests



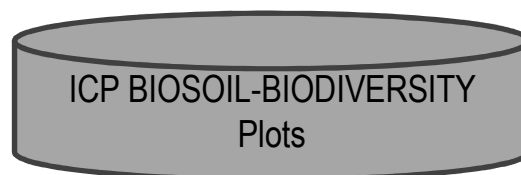
GESAAF
DEPARTMENT OF AGRICULTURAL,
FOOD AND FORESTRY SYSTEMS



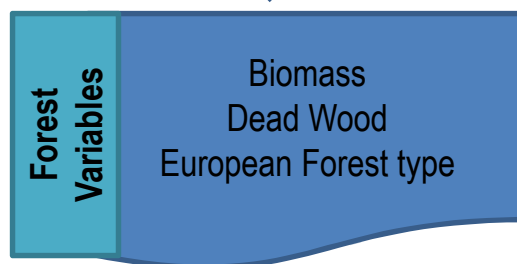
Upscaling & spatially explicit estimation of biophysical variables with remote sensing (UPSPEX)



ICP Biosoils Biodiversity Plots



Estimation

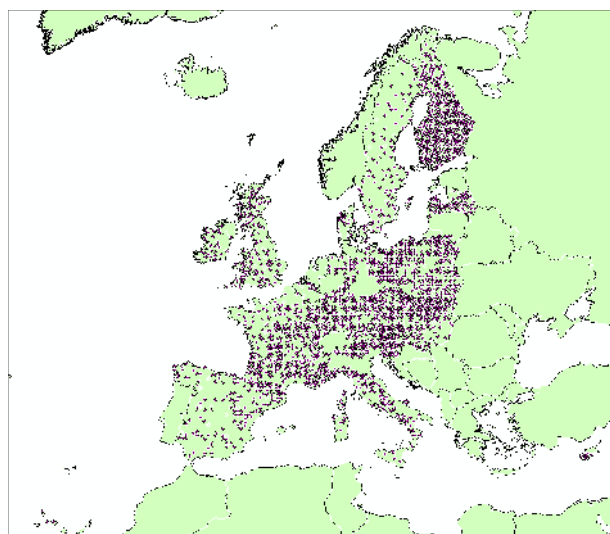


Spatially explicit estimation

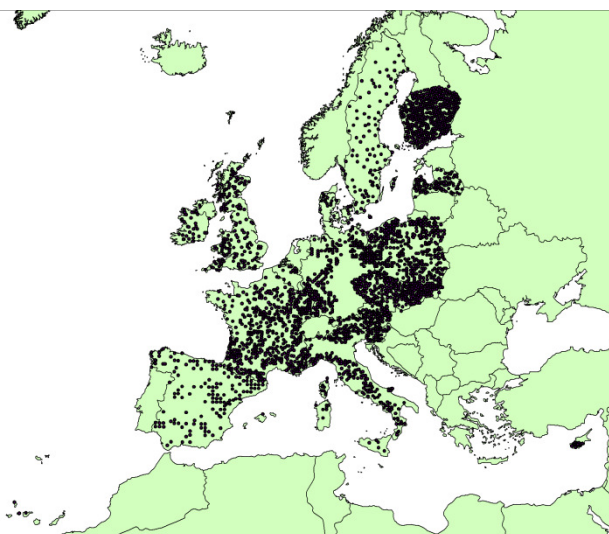
“How much and where?”



ICP BIOSOIL-BIODIVERSITY Plots design and Sampling

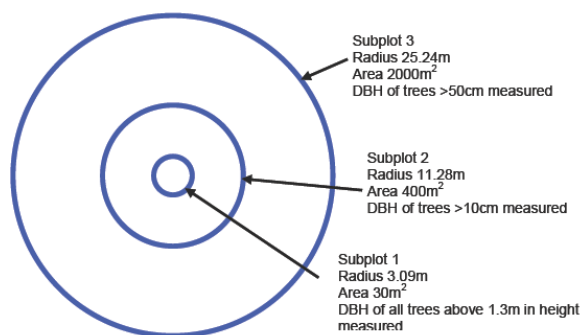


ICP Biosoil Biodiversity Plots



Measured ICP Biosoil Biodiversity Plots

Biosoil subplots and measurement protocol for DBH measurements

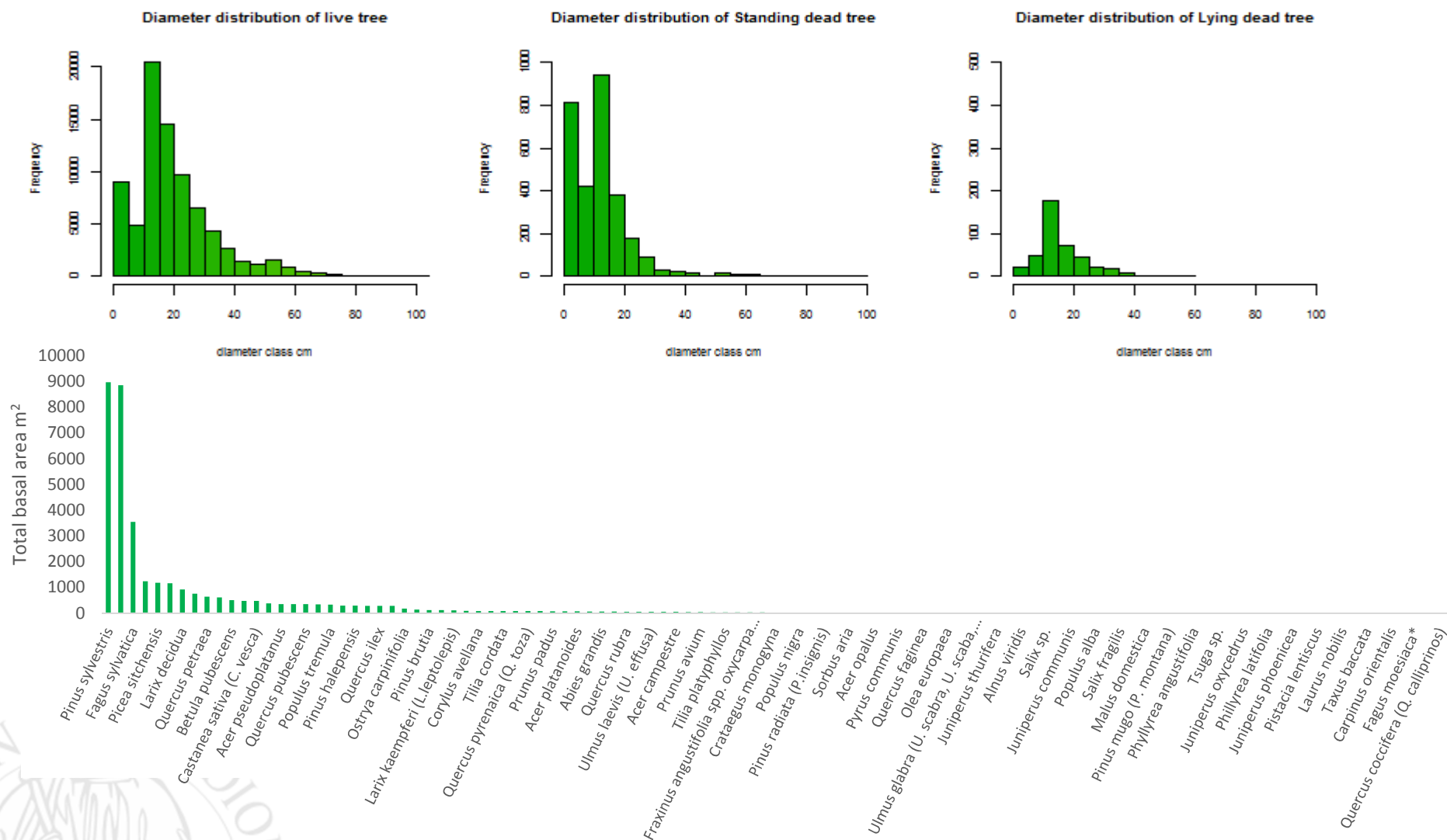


COUNTRY	BIOSOIL/BIODIVERSITY N plots	DATA available N plots
France	548	539
Belgium	10	10
Germany	323	225
Italy	223	219
UK	167	163
Ireland	35	35
Denmark	22	22
Spain	151	149
Sweden	100	100
Austria	136	135
Finland	630	452
Hungary	78	0
Poland	438	432
Slovak Republic	108	107
Czech Republic	146	139
Slovenia	44	40
Latvia	95	95
Cyprus	19	19
Total	3273	2881

AT, SK, LV, CA, GE (in part) followed the protocol stated in the manual.
IT, IE, DK, ES, FI, HU, PL, LT, CZ, SI, CY, GE (in part) followed the protocol and additionally measured a few smaller trees in subplot 3
BE and UK measured extra trees in subplot 3 (all trees over 10 cm instead of all over 50). **The extra trees were flagged and excluded from analysis.**

Tree top height were measured on a minimum of 3 trees with the largest DBH

DBH Distribution - Species



Plot Basal Area lived tree per hectare

$$\frac{BA}{ha} = \frac{\sum \pi d_1^2}{120} + \frac{\sum \pi d_2^2}{1600} + \frac{\sum \pi d_3^2}{8000}$$

Subplot 1 – 30 m²

d_1 ($10 > DBH \geq 7$)

Subplot 2 – 400 m²

d_2 ($50 > DBH \geq 10$)

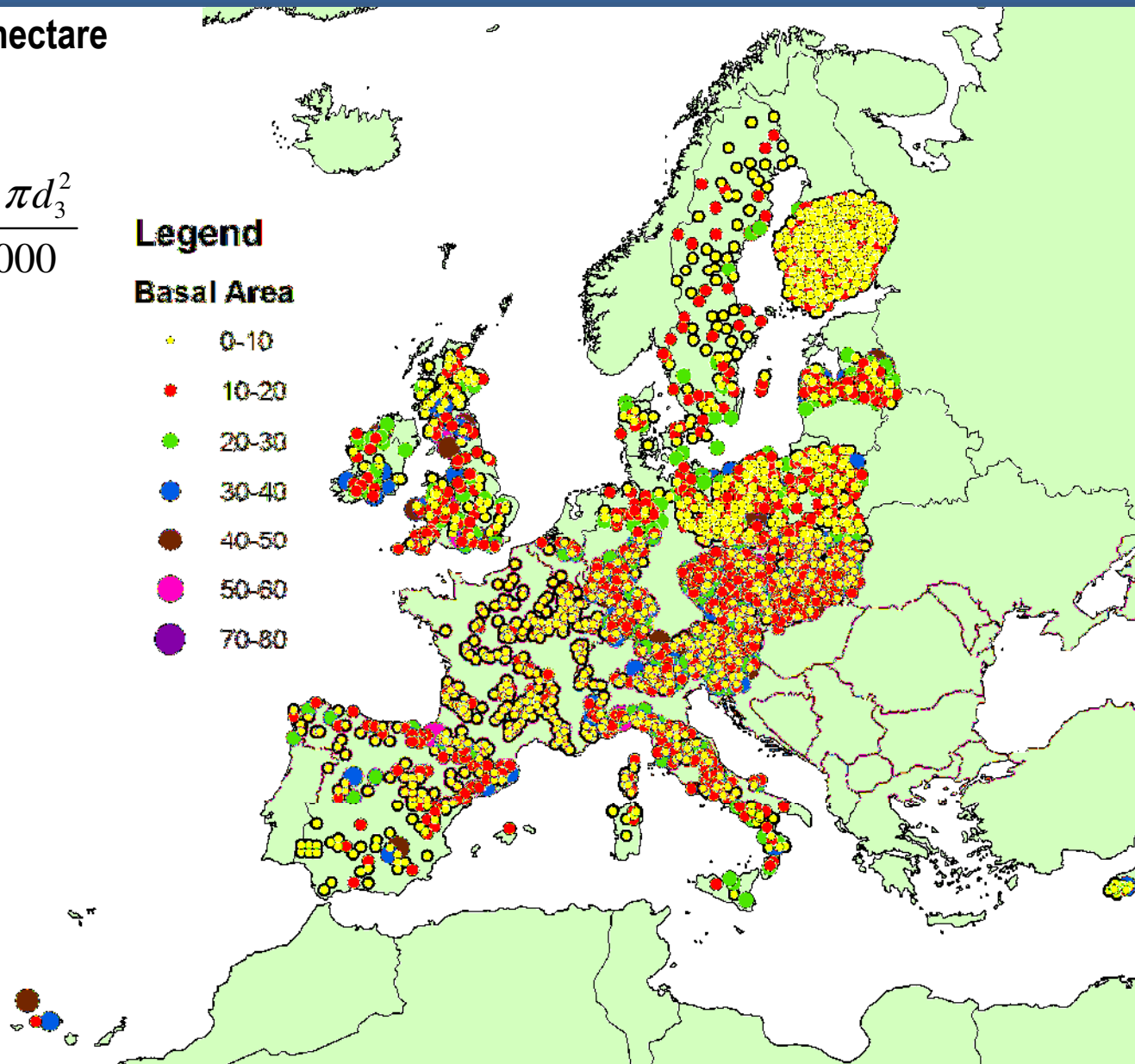
Subplot 3 – 2000 m²

d_3 ($DBH \geq 50$)

Legend

Basal Area

- 0-10
- 10-20
- 20-30
- 30-40
- 40-50
- 50-60
- 70-80



Plot living trees Biomass

Forest Carbon Pools

Limitations related to tree height

Tree top height was measured on a minimum of 3 trees with the **largest** DBH

Pan European allometric equations

Allometric equations are usually expressed in one of these forms

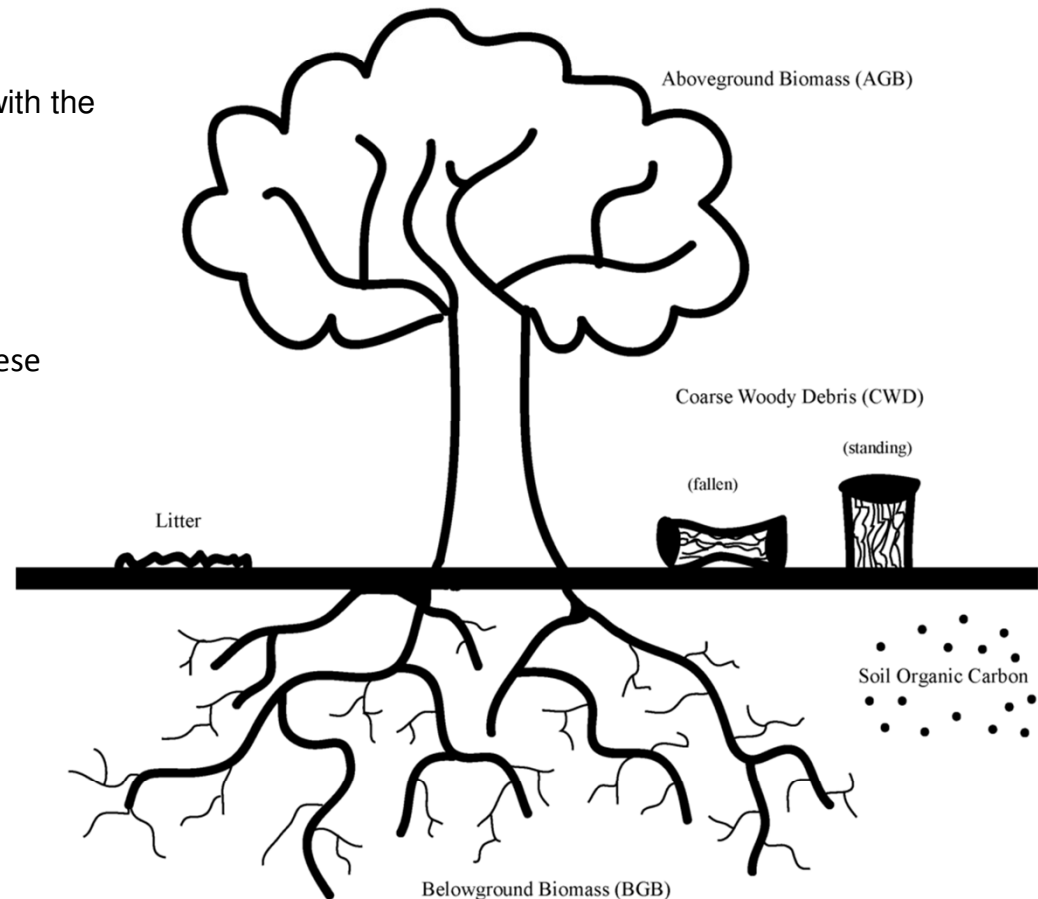
$$Biomass = a * dbh^b$$

$$Biomass = a + b * \log(dbh)$$

$$Biomass = a + b(dbh) + c * dbh^2$$

dbh=diameter at breast height

a; b; c= scaling coefficient



AGB: living vegetation above the soil including stems, branches, bark, foliage

BGB: live roots >2 mm

CWD: non-living biomass not contained in litter; either standing or fallen; includes wood lying on surface, dead roots, and stumps >10 cm diameter

Litter: non-living biomass of size greater than SOM limit (~2mm) and less than CWD limit (~10cm) lying dead above soil

SOC: organic carbon in mineral soils and in live or dead fine roots (<2mm)

Selected allometric equations



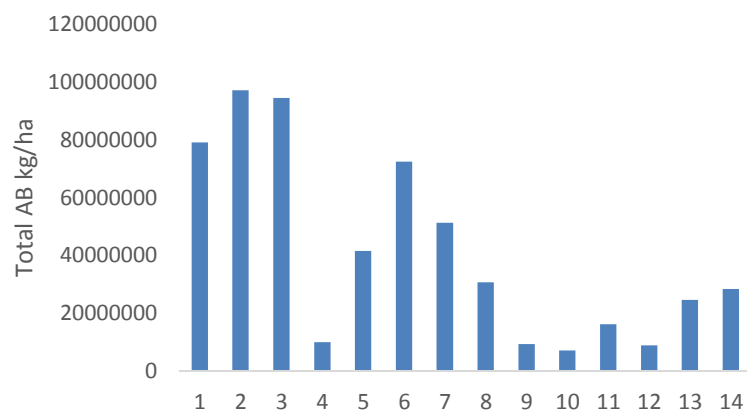
Zianis et al., 2005 -Biomass and Stem Volume
Equations for Tree Species in Europe

Country	Equation	a	b	c	Species	References
338 Finland	$a+b\cdot dbh+c\cdot dbh^2$	18.779	-4.328	0.506	<i>Pinus sylvestris</i>	Briggs, E.F. & Cunia, T. 1982. Effect of cluster sampling in biomass tables construction: linear regression models. Canadian Journal of Forest Research 12(2): 255-263.
145 Finland	$a+b\cdot dbh+c\cdot dbh^2$	19.018	-4.806	0.565	<i>Picea Abies</i>	Briggs, E.F. & Cunia, T. 1982. Effect of cluster sampling in biomass tables construction: linear regression models. Canadian Journal of Forest Research 12(2): 255-263.
526 Netherlands	$a\cdot dbh^b$	0.111	2.397		<i>Pseudotsuga menziesii</i>	Hees, A.F.M.v. 2001. Biomass development in unmanaged forests. Nederlands Bosbouw tijdschrift 73(5): 2-5.
514 Germany	$a\cdot dbh^b$	0.0519	2.545		<i>Populus tremula</i>	Rock, J. 2005. Suitability of published equations for aspen in Central Europe – results from a case study. Submitted manuscript.
89 Germany	$a\cdot dbh^b$	0.1143	2.503		<i>Fagus sylvatica</i>	Pretzsch, H. 2000. Die Regeln von Reineke, Yoda und das Gesetz der räumlichen Allometrie. Allgemeine Forst- und Jagd-Zeitung 171: 205-210.
565 Spain	$a\cdot dbh^b$	0.2313	2.2662		<i>Quercus ilex</i>	Ferres, L., Roda, F., Verdu, A.M.C. & Terradas, J. 1980. Estructura y funcionalismo de un encinar montano en el Montseny. II. Biomasa aera. Mediterranea 4: 23-36.
600 Austria	$a+b\cdot \ln(dbh)$	-0.883	2.14		<i>Quercus spp</i>	Hochbichler, E. 2002. Vorläufige Ergebnisse von Biomasseninventuren in Buchen- und Mittelwaldbeständen. Forstliche Forschungsberichte, München, 186: 37-46.
320 Italy	$a+b\cdot \ln(dbh)$	-1.457	1.8647		<i>Pinus pinaster</i>	Hochbichler, E. 2002. Vorläufige Ergebnisse von Biomasseninventuren in Buchen- und Mittelwaldbeständen. Forstliche Forschungsberichte, München, 186: 37-46.

Plot Above ground biomass

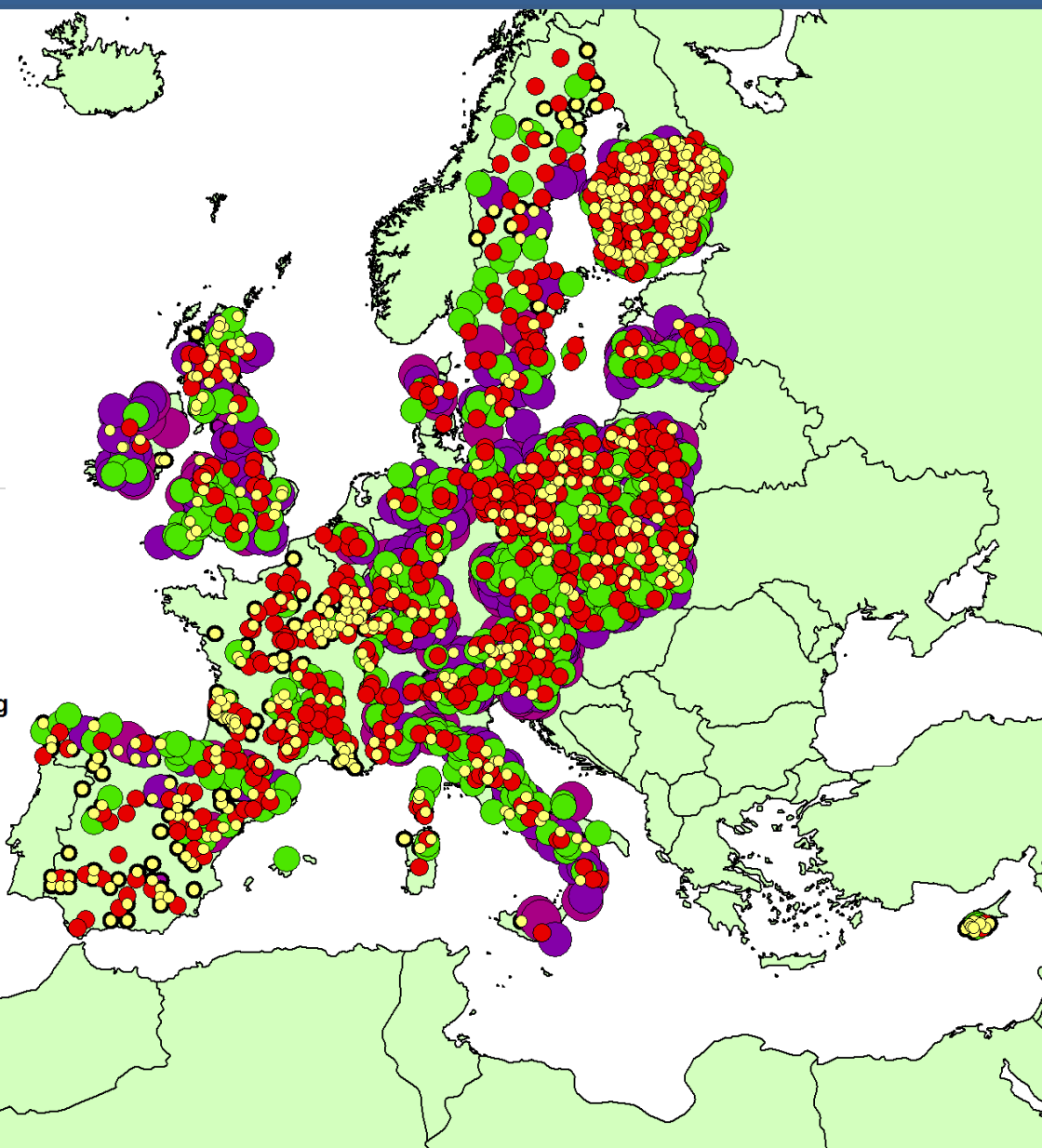
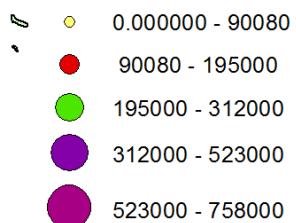
Species group	Species
1. Light demanding conifers 338 Pinus sylvestris	Pinus sylvestris, Larix spp., Pinus nigra, Pinus cembra, Pinus heldreichii, Pinus leucodermis, Pinus radiata, Pinus uncinata, Pinus mugo, Pinus contorta, Pinus strobus, Cedrus spp., Juniperus spp.
2. Shade tollerant conifers a 145 Picea Abies	Picea abies, Picea stychensis, Abies spp., Taxus baccata,
3. Shade tollerant conifers b 526 Pseudotsuga menziesii	Pseudotsuga menziesii, Thuja spp., Tsuga spp., Chamaecyparis spp.
4. Mediterranean conifers 320 Pinus pinaster	Pinus pinaster, Pinus halepensis, Pinus pinea, Pinus canariensis, Cupressus spp., Pinus brutia
5. Fast growing deciduous 514 Populus alba	Betula spp., Populus spp., Alnus spp., Salix spp., Robinia pseudoacacia, Eucalyptus spp.
6. Slow growing light demanding deciduous 600 Quercus spp	Quercus robur, Q. petraea, Q. cerris, Q. pubescens, Q. faginea, Q. frainetto, Q. macrolepis, Q. pyrenaica, Q. rubra, Q. trojana, Q. hartwissiana, Q. vulcanica, Q. macranthera, Q. libani, Q. brantii, Q. ithaburensis, Q. pontica, Fraxinus spp., Castanea sativa, Rosaceae (Malus, Pyrus, Prunus, Sorbus, Crataegus, etc.), Juglans spp., Cercis siliquastrum
7. Slow growing shade tolerant deciduous 89 Fagus	Fagus spp., Carpinus spp., Tilia spp., Ulmus spp. , Buxus sempervirens, Acer spp. Ilex aquifolium
8. Mediterranean evergreen trees 565 Quercus ilex	Quercus suber, Quercus ilex, Q. coccifera, Q. lusitanica, Q. rotundifolia, Q. infectoria, Q. aucheri, Tamarix spp. Arbutus spp., Olea europea, Ceratonia siliqua, Erica spp. Laurus spp., Myrtus communis, Phillyrea spp. Pistacia spp. Rhamnus spp. (R. oleoides, R. alaternus), Ilex canariensis, Myrica faya,

Plot Above ground biomass



Legend

Above Ground Biomass Kg



Wood density – Plots Volume

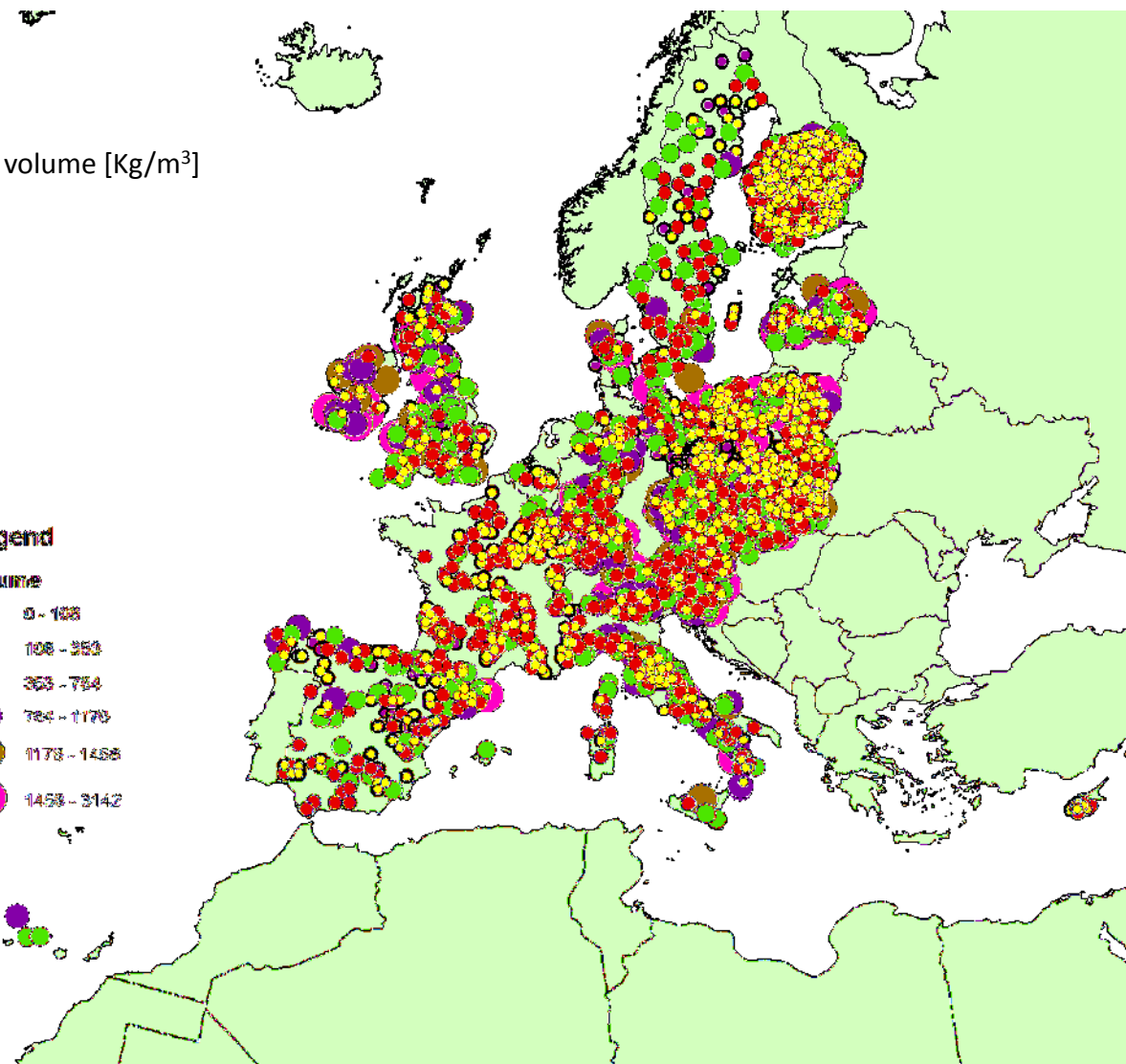
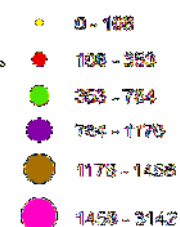
$$V = \frac{m}{\rho}$$

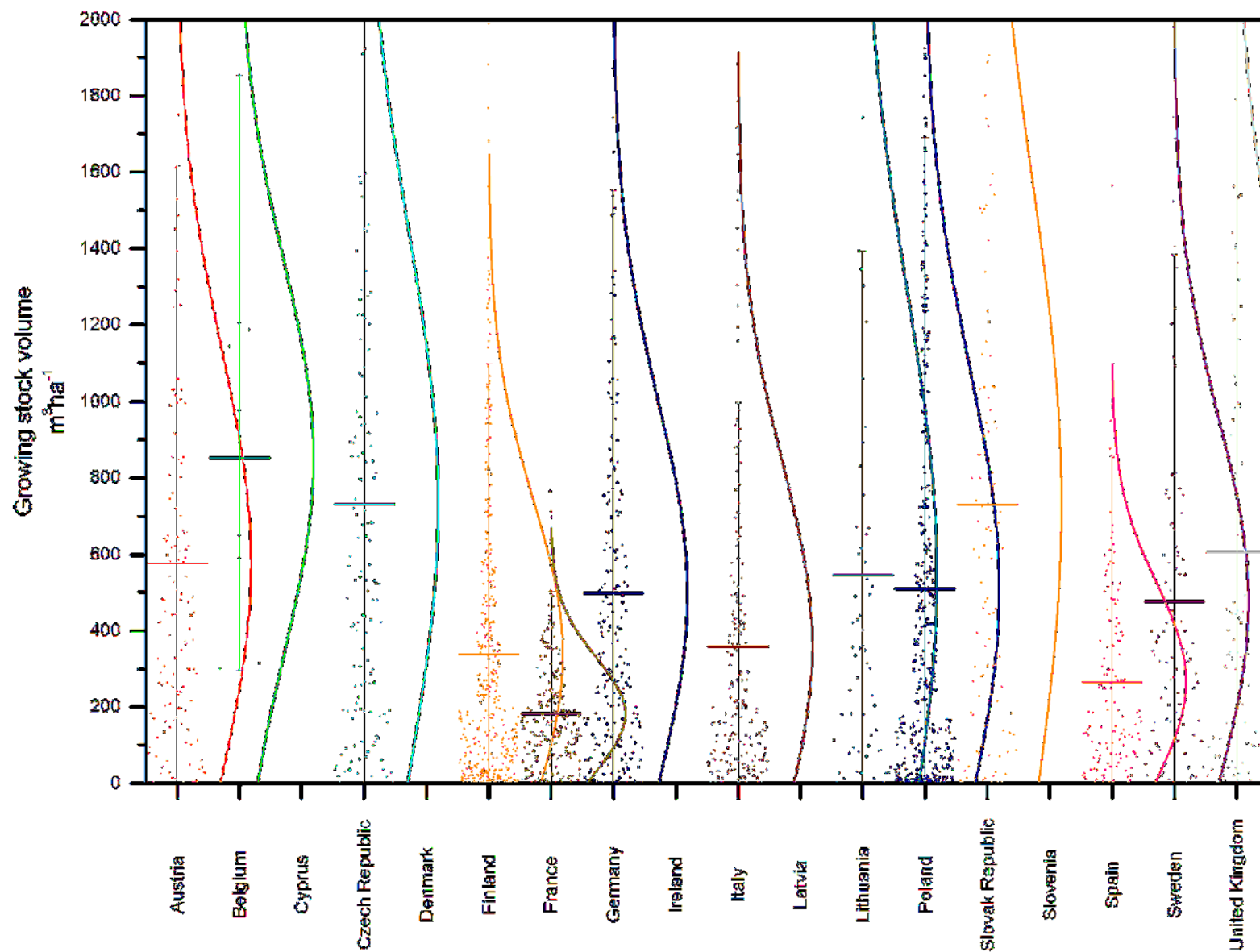
V = volume [m³]
 m = biomass [Kg]
 ρ = wood density fresh volume [Kg/m³]

Species group	Basic Wood Density Kg DM/fresh volume
1. Light demanding conifers	500
2. Shade tollerant conifers a	440
3. Shade tollerant conifers b	540
4. Mediterranean conifers	550
5. Fast growing deciduous	670
6. Slow growing light demanding deciduous	700
7. Slow growing shade tolerant deciduous	700
8. Mediterranean evergreen trees	600

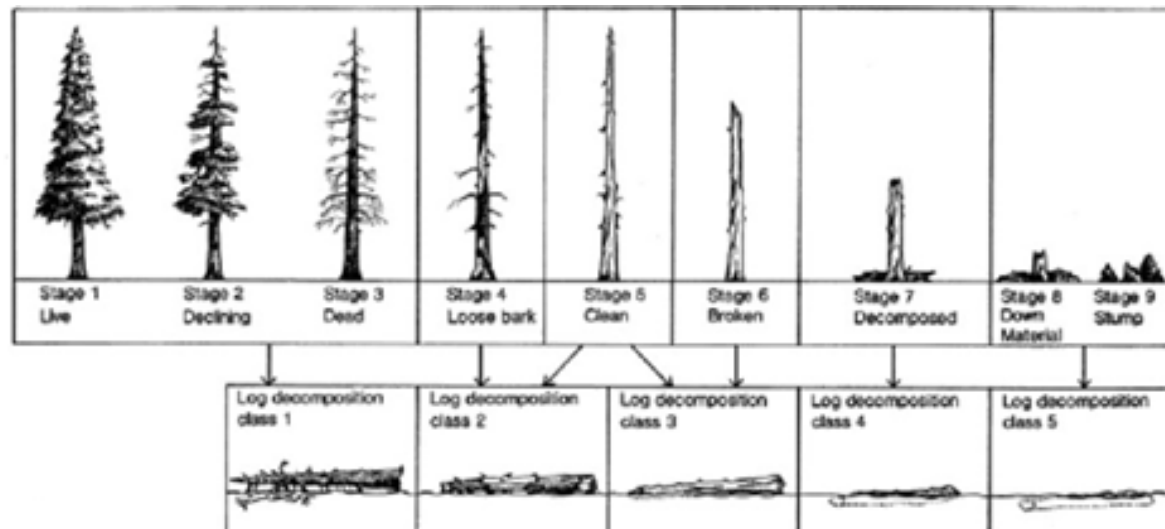
Legend

Volume





Work in progress Dead Wood Estimation



Deadwood is both an important **substrate for a large number of forest species** such as insects and other invertebrates and a **refuge and nesting place** for several mammals and birds.

Huber $V = \frac{\pi}{4} dbh_{0.5}^2 l$

Smalian $V = \frac{\pi}{8} (dbh_a^2 + dbh_b^2) l$

The type of deadwood is important and refers to properties such as whether deadwood is standing or lying, size-dimensions and tree species of deadwood.



EEA Technical report | No 9/2006

European forest types Categories and types for sustainable forest management reporting and policy

ISSN 1725-2237



Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco



European Forest Types and Forest Europe SFM indicators: Tools for monitoring progress on forest biodiversity conservation

A. Barbati ^{a,*}, M. Marchetti ^b, G. Chirici ^b, P. Corona ^c

^a University of Tuscia, Department for Innovation in Biological, Agro-food and Forest Systems, Viterbo, Italy

^b University of Molise, Department of BioScience and Territory, Isernia, Italy

^c Consiglio per la ricerca e la sperimentazione in agricoltura, Forestry Research Centre (CRA-SEL), Arezzo, Italy

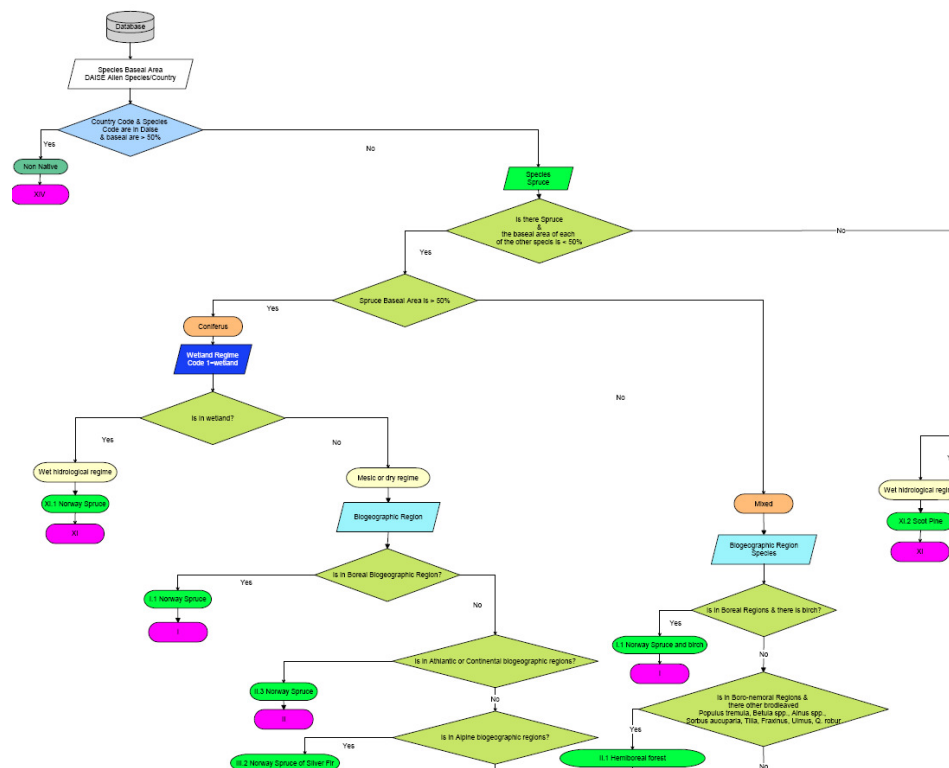
The EFTs classification is intended to stratify the highly heterogeneous area covered by forest in Europe into a discrete number: **14 Categories and 78 types**

To facilitate the **analysis, interpretation and harmonized** reporting of forest data at Pan-European level.

EFTs – Category level	Main characteristics	EFTs – Type level
1. Boreal forest	Extensive boreal, species-poor forests, dominated by <i>Picea abies</i> and <i>Pinus sylvestris</i> . Deciduous trees including birches (<i>Betula</i> spp.), aspen (<i>Populus tremula</i>), rowan (<i>Sorbus aucuparia</i>) and willows (<i>Salix</i> spp.) tend to occur as early colonisers. Latitudinal mixed forests located in between the boreal and nemoral (or temperate) forest zones with similar characteristics to EFT 1, but a slightly higher tree species diversity, including also temperate deciduous trees like <i>Tilia cordata</i> , <i>Prunus excelsior</i> , <i>Ulmus glabra</i> and <i>Quercus robur</i> . Includes also pure and mixed forests in the nemoral forest zone dominated by coniferous species native within the borders of individual FOREST EUROPE member states like <i>Pinus sylvestris</i> , pines of the <i>Pinus nigra</i> group, <i>Pinus peuce</i> , <i>Pinus abies</i> , <i>Abies alba</i> .	1.1 Spruce and spruce-birch boreal forest 1.2 Pine and pine-birch boreal forest
2. Hemiboreal and nemoral coniferous and mixed broadleaved-coniferous forest		2.1 Hemiboreal forest 2.2 Nemoral Scots pine forest 2.3 Nemoral spruce forest 2.4 Nemoral black pine forest 2.5 Mixed Scots pine-birch forest 2.6 Mixed Scots pine-pedunculate oak forest 2.7 Atlantic Maritime pine forest 2.8 Nemoral Silver fir forest 3.1 Subalpine larch-avilla pine and dwarf pine forest 3.2 Subalpine and mountainous spruce and mountainous mixed spruce-silver fir forest 3.3 Alpine Scots pine and Black pine forest 3.4 Mountainous birch forest 4.1 Acidophilous oakwood 4.2 Oak-birch forest
3. Alpine forest	High-altitude forest belts of central and southern European mountain ranges, covered by <i>Picea abies</i> , <i>Abies alba</i> , <i>Pinus sylvestris</i> , <i>Pinus nigra</i> , <i>Larix decidua</i> , <i>Pinus cembra</i> and <i>Pinus mugo</i> . Includes also the mountain forest dominated by birch of the boreal region.	5.1 Pedunculate oak-hornbeam forest 5.2 Sessile oak-hornbeam forest 5.3 Ashwood and oak-ash forest 5.4 Maple-oak forest 5.5 Lime-oak forest 5.6 Maple-lime forest 5.7 Lime forest 5.8 Ravine and slope forest 5.9 Other mesophytic deciduous forests 6.1 Lowland beech forest of southern Scandinavia and north central Europe 6.2 Atlantic and subatlantic lowland beech forest 6.3 Subatlantic submountainous beech forest 6.4 Central European submountainous beech forest 6.5 Carpathian submountainous beech forest 6.6 Illyrian submountainous beech forest 6.7 Mosian submountainous beech forest 7.1 South western European mountainous beech forest 7.2 Central European mountainous beech forest 7.3 Apennine-Corsican mountainous beech forest 7.4 Illyrian mountainous beech forest 7.5 Carpathian mountainous beech forest 7.6 Mosian mountainous beech forest 7.7 Crimean mountainous beech forest 7.8 Oriental beech and hornbeam-oriental beech forest 7.9 Mountainous Silver fir forest 8.1 Downy oak forest 8.2 Turkey oak, Hungarian oak and sessile oak forest 8.3 Pyrenean oak forest 8.4 Portuguese oak and Mirbeck's oak Iberian forest 8.5 Macedonian oak forest 8.6 Valenian oak forest 8.7 Chestnut forest 8.8 Other thermophilous deciduous forests 9.1 Mediterranean evergreen oak forest 9.2 Olive-corb forest 9.3 Palm groves 9.4 Macaronesian laurel forest 9.5 Other sclerophyllous forests 10.1 Mediterranean pine forest 10.2 Mediterranean and Anatolian Black pine forest 10.3 Caranian pine forest 10.4 Mediterranean and Anatolian Scots pine forest 10.5 Adri-Mediterranean pine forest 10.6 Mediterranean and Anatolian fir forest 10.7 Juniper forest 10.8 Cypress forest 10.9 Cedar forest 10.10 Tetrastix articulata stands 10.11 Mediterranean yew stands 11.1 Spruce mire forest 11.2 Pine mire forest 11.3 Alder swamp forest 11.4 Birch swamp forest 11.5 Pedunculate oak swamp forest 11.6 Aspen swamp forest 12.1 Riparian forest 12.2 Fluvial forest 12.3 Mediterranean and Macaronesian riparian forest 13.1 Alder forest 13.2 Italian alder forest 13.3 Birch forest 13.4 Aspen forest
4. Acidophilous oak and oak-birch forest	Scattered occurrence associated with less fertile soils of the nemoral forest zone; the tree species composition is poor and dominated by acidophilous oaks (<i>Q. robur</i> , <i>Q. petraea</i>) and birch (<i>Betula pendula</i>).	
5. Mesophytic deciduous forest	Related to medium rich soils of the nemoral forest zone; forest composition is mixed and made up of a relatively large number of broadleaved deciduous trees: <i>Carpinus betulus</i> , <i>Quercus petraea</i> , <i>Quercus robur</i> , <i>Fraxinus</i> , <i>Acer</i> and <i>Tilia cordata</i> .	
6. Beech forest	Widely distributed lowland to submountainous beech forest. <i>Beech</i> , <i>Fagus sylvatica</i> and <i>F. orientalis</i> (Balkan) dominate, locally important is <i>Betula pendula</i> .	
7. Mountainous beech forest	Mixed broadleaved deciduous and coniferous vegetation belt in the main European mountain ranges. Species composition differs from EFT 6, including <i>Picea abies</i> , <i>Abies alba</i> , <i>Betula pendula</i> and mesophytic deciduous tree species. Includes also mountain fir dominated stands.	
8. Thermophilous deciduous forest	Deciduous and semi-deciduous forests mainly of the Mediterranean region dominated by thermophilous species, mainly of <i>Quercus</i> , <i>Acer</i> , <i>Ostrya</i> , <i>Fraxinus</i> , <i>Carpinus</i> species are frequent as associated secondary trees. Includes also <i>Catanu satio</i> dominated forest.	
9. Broadleaved evergreen forest	Broadleaved evergreen forests of the Mediterranean and Macaronesian regions dominated by sclerophyllous or lauriphylous trees, mainly <i>Quercus</i> species.	
10. Coniferous forests of the Mediterranean, Anatolian and Macaronesian regions	Warm group of coniferous forests in Mediterranean, Anatolian and Macaronesian regions, from the coast to high mountains. Dry and often poorly-developed soils with tree growth. Several tree species, including a number of endemics, of <i>Pinus</i> , <i>Abies</i> and <i>Juniperus</i> species.	
11. Mire and swamp forest	Wetland forests on peaty soils widely distributed in the boreal region. Water and nutrient regimes determine the dominant tree species: <i>Pinus sylvestris</i> , <i>Picea abies</i> or <i>Abies glutinosa</i> .	
12. Floodplain forest	Riparian and riverine species-rich forests characterized by different assemblages of species of <i>Alnus</i> , <i>Betula</i> , <i>Populus</i> , <i>Salix</i> , <i>Fraxinus</i> , <i>Ulmus</i> .	
13. Riparian forest	Riparian forests dominated by <i>Alnus</i> , <i>Betula</i> or <i>Populus</i> .	
14. Introduced tree species forest	Forests dominated by introduced tree species (sensu Pan-European indicator 4.4), occurring on a wide range of site conditions which otherwise would develop forests of above categories. Introduced tree species can be identified at regional (recommended) or national level and comprise: tree species that are not native to Europe (e.g. <i>Eucalyptus</i> spp., <i>Robinia pseudoacacia</i> , <i>Acacia dealbata</i> , <i>Alnus incana</i> , <i>Pinus serotina</i> , <i>Quercus rubra</i> , <i>Fraxinus alba</i> , <i>Pinus attenuata</i> , <i>Pinus</i>	

Work in progress

European Forest Type - forest classification algorithm



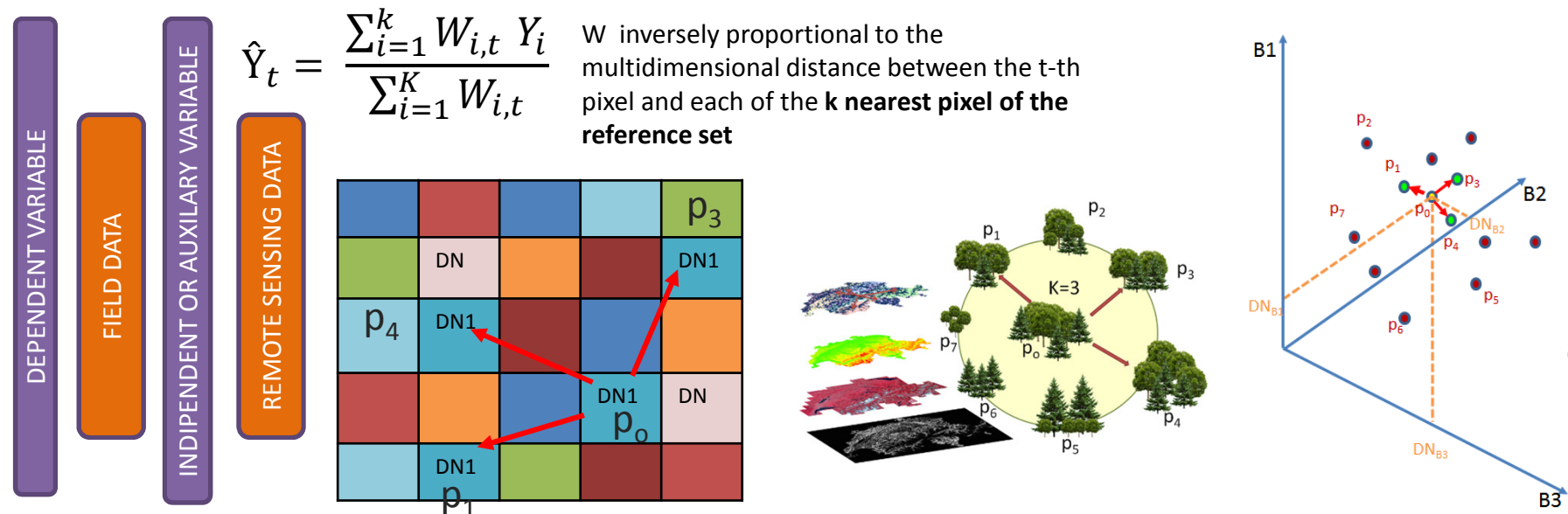
GIS-based forest classification algorithm to **assign European Forest Types (EFTs)** to forest plots.

The **GIS-based automatic classification** is tested using tree species basal area data collected in the framework of the biodiversity module of the BIOSOIL/BIODIVERSITY project in the ICP Forest level I

Work in progress

K - Nearest Neighbours

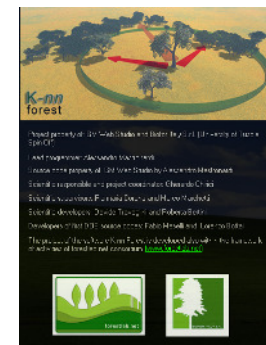
The **unknown value** of response variable \hat{Y}_t for the unit (pixel or pixel group) t can be **estimated using the values Y_i of the same variable measured in the field** in locations corresponding to the k nearest neighbor units



Chirici, G., Corona, P., Marchetti, M., Mastronardi, A., Maselli, F., Bottai, L., & Travaglini, D. (2012). K-NN FOREST: a software for the non-parametric prediction and mapping of environmental variables by the k-Nearest Neighbors algorithm. *European Journal of Remote Sensing*, 45, 433 – 442.

Chirici, G., Barbati, A., Corona, P., Marchetti, M., Travaglini, D., Maselli, F., & Bertini, R. 2008. Non-parametric and parametric methods using satellite imagery for estimating growing stock volume in alpine and Mediterranean forest ecosystems. *Remote Sensing of Environment* 112: 2686-2700.

Maselli, F., Chirici, G., Bottai, L., Corona, P., and Marchetti, M. 2005. Estimation of Mediterranean forest attributes by the application of k-NN procedures to multitemporal Landsat ETM+ images. *International Journal of Remote Sensing* 17: 3597-3610.





UNIVERSITÀ
DEGLI STUDI
FIRENZE

International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests



ICP Forests

[HOME](#) [BODIES & STRUCTURE](#) [EVENTS](#) [COMMUNITY](#) [PLOTS & DATA](#) [PUBLICATIONS](#) [MY PROFILE](#)

[All Groups](#) [My Groups](#)



UPSPEX

Created by Gherardo Chirici [View Groups](#)

INFORMATION



Upscaling & Spatially explicit estimation of biophysical variables with remote sensing

Members: **12**
Latest Activity: **Nov 18, 2014**

DISCUSSION FORUM

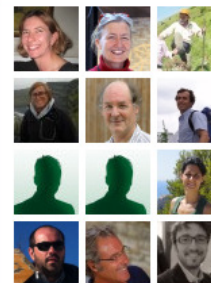
This group does not have any discussions yet.

COMMENT WALL

Add a Comment

You need to be a member of UPSPEX to add comments!

MEMBERS (12)



[View All](#)

Welcome to
ICP Forests
[Register](#)
or [Log In](#)

© 2011 CREATED BY XQX AG

[BANNERS](#) | [REPORT AN ISSUE](#) | [IMPRINT](#)



ICP Forests



GESAAF
DEPARTMENT OF AGRICULTURAL,
FOOD AND FORESTRY SYSTEMS

