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Appendix 1

Box S1 - Nutrient classification.

Each of the twenty-three forests, for which ANPP, GPP and soil C:N were available, was assigned to one of three following nutrient classes: low-, medium- or high-nutrient availability. While most of the forests with low nutrient availability were typically located on soils with very low nutrient content due to weathering, leaching or low mineralization rates, some of the forests with high nutrient availability grew on former agricultural land and others were located on soil types that are typically very fertile. Here, we provide a short description of each sites characteristics and the class to which it was assigned.

Eucalyptus saligna plantation, Pepeekeo: This Eucalypt plantation was established on a Typic hydrudand soil (Ryan et al. 2004). Prior to planting, from about 1920 onward, routine management of the soil included applications of 85 kg N/ha, 75 kg P/ha, and 110 kg K/ha every two years. Following this fertilizer application, we assigned this forest to the **high nutrient availability** class.

Pinus radiata plantation, Canberra, Australia: According to Ryan et al (1996), the soil at this site is a yellow podzolic (Stace et al. 1968) or Typic Albaqualf (Soil Survey Staff 1975) derived from granite. It has a duplex profile comprising a sandy A horizon extending to about 0.40 m depth, and a dense (bulk density 1.7 Mg m^{-3}) B horizon of clay and gravel overlaying a C horizon of weathering granite (> 1 m). The soil has a low N-supplying capacity (Raison et al. 1992) but provides adequate P for tree growth (Raison et al. 1990). Given adequate P availability, we opted for the **medium nutrient availability** class here (although it could be argued to belong to the low nutrient availability class).

Pinus elliotii plantation, Bradford, FL: This plantation was established on a poorly drained (unfertilized) ultic alplaquod soil (Gholz & Fisher 1982, Gholz et al. 1985), which is a highly weathered soil type. Gholz et al. (1985) reported low N and P concentration and content in the soil. This forest obviously belongs to the **low nutrient availability** class.

Pinus taeda, Oak Ridge, TN: This forest grows on sandy loam soils, derived from acid igneous rock parent material, varying from 20 to 33 cm in thickness over friable sandy clay to clay subsoils (Ralston 1973). The area had been in agricultural production prior to planting of loblolly pine. This is actually insufficient information for reliable classification *(so best keep it n.a.).*

Picea mariana, N-BOREAS: The soil in this forest is a poorly drained, peat-rich soil (Dunn et al. 2007). According to the nutrient analyses by Gower et al. (2000), this forest is severely nutrient limited. Similar to Vicca et al. (2012), we assign this forest to the **low nutrient availability** class.

Oak-Hickory, Oak Ridge, TN: According to Malhi et al. (1999), the soil in this forest is an infertile cherty silt-loam. We thus assigned it to the **low nutrient availability** class.

Tropical forest, Manaus Brazil (Cuieras): According to Sotta et al. (2004) the soil is an oxisol, with a high (80%) clay content, low nutrient content, low pH (4.3), very high porosity (50– 80%), and a low available water capacity. This highly weathered, nutrient-poor soil type is typical of much of lowland central and eastern Amazonia (Sanchez 1989). This forest obviously belongs to the **low nutrient availability** class.

Jacaranda: The soil in this forest is heavily leached and nutrient-poor (Sanchez 1989) and Quesada et al. (2010) showed that both phosphorus content and cation exchange capacity in this forest are extremely low (both phosphorus content and cation exchange capacity are the lowest of the 71 Amazonian forest soils studied by Quesada et al. 2010). Similar to Vicca et al. (2012), we assigned this forest to the **low nutrient availability** class.

Bornhoved Alder: This alder forest, located on a fibric Histosol, is very wet and nutrient-poor. In fact, substantial carbon was allocated belowground to N_2-fixing bacteria (*Frankia*) in order to increase nitrogen availability (Dilly et al. 2000, Kutsch et al. 2001). Similar to Vicca et al. (2012), we assigned this forest to the **low nutrient availability** class.

Appendix 1

Bornhoved Beech: This beech is close to the previous alder forest but is not waterlogged (Dilly et al. 2000, Kutsch et al. 2001). The soil is a dystri-cambic Arenosol (Dilly et al. 2000, Kutsch et al. 2001), which typically has a relatively low nutrient content because of its sandy texture (http://www.agrostats.com/soils/arenosol.html). Because this forest receives extra nutrients via atmospheric deposition (and much more than other regions in Germany (Tavares et al. 2010), it was assigned to the **medium nutrient availability** class (as in Vicca et al. 2012).

Cascade Head: According to Sun et al. (2004), both Cascade Head forests were very nitrogen-rich and we therefore assigned both forests to the **high nutrient availability** class.

Caxiuana: According to Quesada et al. (2010), who assessed nutrient availability in a diverse range of Amazon forest soils, the soil in this forest is extremely nutrient limited, with low phosphorus content as well as low cation exchange capacity. We therefore assign this forest to the **low nutrient availability** class.

Metolius and Metolius young: The understory of this forest contains a nitrogen fixing shrub (Kelliher et al. 2004), which considerably improves the nutrient status of the soil (Vogel et al. 1997). Without this nitrogen fixer, both Metolius and Metolius young would be nutrient-poor, because soil nitrogen concentrations of these sandy soils are very low (Matson et al. 1994, Kelliher et al. 2004, Sun et al. 2004). Thus, due to the presence of nitrogen fixers, these forests were assigned to the **medium nutrient availability** class (similar to the classification in Vicca et al. 2012).

Tapajos 67: The terra firme soils in these forests are heavy belterra clay Ferralsols interspersed with sandier patches (Malhi et al. 2009). According to Quesada et al (2010), Ferralsols are at the nutrient-poor end of the Amazon forests. As in Vicca et al. (2012), we therefore assign this forest to the **low nutrient availability** class.

Cited literature

See the reference list in the parent paper.

Appendix 1

Tab. S1 - Spearman correlation matrix for the six Mediterranean forests considered in the study. In bold significant level at $p < 0.05$ (**) and at $p < 0.10$ (*). MAT = mean annual temperature (°C); MAP = mean annual precipitation (mm); clay (%) = clay content; soil C stock = soil carbon stock; soil N stock = soil nitrogen stock; ΔC_{wood}= change in aboveground wood biomass; GPP = gross primary production; NEP = net ecosystem production; R_{eco} = ecosystem respiration; f = fraction of carbon derived from C_3 plants in the C_4 soil cores; Net C_{root} = net root derived carbon estimated using the C_4 core in-growth method; ΔC_{soil} = change in soil C stock; ANPP = aboveground net primary production (wood + litter).

Parameter	Age	Latitude	Longitude	Altitude	MAT (°C)	MAP (mm)	Clay (%)	Soil C stock	Soil N stock	Soil C:N	Standing biomass	ΔCwood	Δcwood: GPP	NEP	GPP	R_{eco}	f	Net Croot	ΔCsoil	ΔCsoil : Net Croot	ΔCsoil : (Net Croot+litterfall)	ANPP	ANPP: GPP
Age	1																						
Latitude	-0.03	1																					
Longitude	0.12	-0.09	1																				
Altitude	0.46	-0.52	-0.35	1																			
MAT (°C)	**-0.90****	-0.12	-0.41	-0.35	1																		
MAP (mm)	**0.96****	0.06	0.12	0.53	**-0.94****	1																	
Clay (%)	0.16	-0.12	**0.99****	-0.35	-0.41	0.12	1																
Soil C stock	-0.17	-0.6	-0.2	**0.75***	0.12	-0.06	-0.23	1															
Soil N stock	-0.23	-0.54	0.09	0.58	0.06	-0.12	0.06	**0.94****	1														
Soil C:N	0.55	0.09	-0.71	0.67	-0.32	0.55	-0.67	0.2	-0.03	1													
Standing biomass	**0.99****	0.03	0.09	0.52	**-0.93****	**0.99****	0.12	-0.09	-0.14	0.6	1												
ΔCwood	**0.90****	-0.09	-0.14	**0.75***	**-0.81****	**0.93****	-0.12	0.2	0.09	**0.77***	**0.94****	1											
ΔCwood:GPP	0.55	0.09	-0.71	0.67	-0.32	0.55	-0.67	0.2	-0.03	**1****	0.6	**0.77***	1										
NEP	0.55	0.54	0.14	-0.41	-0.46	0.41	0.23	**-0.83****	**-0.77***	0.2	0.49	0.26	0.2	1									
GPP	-0.38	0.09	**0.83****	-0.75*	0.12	-0.41	**0.81****	-0.37	-0.09	**-0.94****	-0.43	-0.66	**-0.94****	0.09	1								
R_{eco}	-0.55	-0.09	0.71	-0.67	0.32	-0.55	0.67	-0.2	0.03	**-1****	-0.6	**-0.77***	**-1****	-0.2	**0.94****	1							
f	0.61	-0.03	0.26	0.64	**-0.81****	0.75*	0.23	0.43	0.49	0.37	0.71	**0.77***	0.37	-0.03	-0.26	-0.37	1						
Net Croot	-0.17	**0.94****	-0.03	-0.46	-0.06	-0.06	-0.06	-0.37	-0.26	0.03	-0.09	-0.14	0.03	0.37	0.14	-0.03	0.09	1					
ΔCsoil	-0.67	0.37	0.26	**-0.90****	0.55	-0.67	0.2	-0.54	-0.43	**-0.77***	-0.71	**-0.89****	**-0.77***	0.03	0.71	**0.77***	-0.71	0.31	1				
ΔCsoil : Net Croot	-0.55	-0.03	0.26	**-0.75***	0.58	-0.64	0.23	-0.49	-0.43	**-0.77***	-0.66	**-0.83****	**-0.77***	-0.03	0.66	**0.77***	**-0.83****	-0.14	**0.89****	1			
ΔCsoil : (Net Croot+litterfall)	**-0.75***	0.14	0.09	**-0.81****	**0.75***	**-0.81****	0.06	-0.43	-0.37	-0.71	**-0.83****	**-0.94****	-0.71	-0.09	0.6	0.71	**-0.89****	0.09	**0.94****	**0.94****	1		
ANPP	**0.99****	0.03	0.09	0.52	**-0.93****	**0.99****	0.12	-0.09	-0.14	0.6	**1****	**0.94****	0.6	0.49	-0.43	-0.6	0.71	-0.09	-0.71	-0.66	**-0.83****	1	
ANPP:GPP	0.64	0.31	-0.54	0.58	-0.52	0.7	-0.52	0.09	-0.09	**0.94****	0.71	**0.83****	**0.94****	0.31	**-0.83****	**-0.94****	0.54	0.26	-0.71	**-0.83****	**-0.77***	0.71	1