Total above and below ground carbon stock partitioning in an eastern Cameroonian tropical rainforest

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Context

Carbon storage in tropical forests is an important to mitigating global warming, but that we have a poor understanding of the amount of carbon that is stored in différent carbon pools, especially for the Congo Basin. Therefore, this study aims to assess the above- and belowground carbon stocks and the contribution of different carbon pools (aboveground, belowground and dead biomass) and their components in explaining the variation of total carbon stocks.

Methodology

- This study was done in the Doume communal forest localized in east Cameroon;
- 3 carbon pools, each with its underlying components was assess using forest inventory and laboratory analysis:

- aboveground biomass: adult trees, juvenile trees, saplings, palms, herbaceous;
- belowground biomass and soil organic carbon: coarse and fine roots biomass and soil organic carbon;
- dead biomass: standing dead, litter, coarse and fine woody biomass.

Fig. 1. Tree dendrometric mensuration: a) diameter at breast height; b) diameter at 50 cm above the top of the buttresses; c) diameter of sapling stems at 30 cm aboveground level.

Results

Aboveground carbon stocks the main pools following by belowground carbon stock and ending by aboveground dead carbon

Table 1. Carbon stored and uncertainty in different carbon pools (aboveground live carbon, aboveground dead carbon, belowground carbon) and their carbon components in the 30 1-ha plots in Doume communal forest (Total variation (S_{total}) partitioned between within ($\mathbf{S_{within}}$) and between ($\mathbf{S_{between}}$) variation and the mean per pool and component are given. Swithin represents within-plot variation or measurement error, while Sbetween represents between-plot variation, i.e. local-scale heterogeneity.

Carbon pool	Carbon component	S_{within}	$S_{between}$	Stotal	Mean (Mg C ha^{-1})
Aboveground live carbon(AGC)		**18.57**	**33.60**	**38.39**	**180.99**
	Adults trees (>10cm DBH)	16.18	33.47	37.18	177.61
	Juvenile trees (5-10 cm DBH)	0.06	0.45	0.80	2.80
	Saplings (<5 cm DBH)	0.75	0.20	0.12	1.60
	Palms	NA	NA	NA	0.22
	Herbaceous vegetation (HV)	0.03	0.31	0.31	0.40
Aboveground dead carbon (ADC)		**85.67**	**15.35**	**87.03**	**17.92**
	Litter	0.09	1.09	1.10	2.93
	Fine woody debris (FWD)	0.06	0.16	0.17	1.50
	Coarse woody debris (CWD)	68.80	15.81	70.59	10.90
	Standing dead trees (SDT)	0.04	2.74	2.74	2.59
Belowground carbon (BGC)		15.86	18.65	24.48	85.06
	Fine Root trees (FRT)	0.002	0.02	0.02	0.02
	Coarse Root trees (CRT)	8.47	18.54	20.48	45.65
	Soil organic carbon (SOC)	12.50	31.7	34.07	39.39
TOTALS					
Total aboveground carbon (TAGC)		20.55	40.89	45.76	198.91
Total carbon		18.02	51.17	54.25	283.97

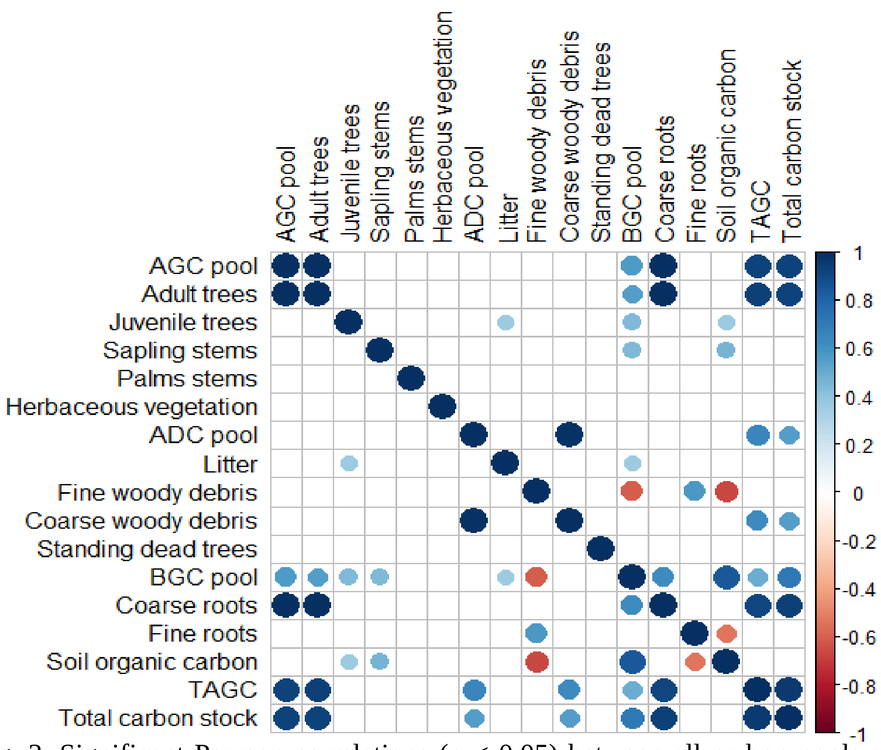

Fig. 3. Significant Pearson correlations ($p < 0.05$) between all carbon pools and components. Positive correlations are displayed in blue and negative correlations in red. The color intensity and the size of the circles are proportional to the correlation coefficients. To the right side of the correlogram, the legend color shows the correlation coefficients and the corresponding colors.

C in adult trees good predictor for total C, but not for other pools

Combined aboveground and belowground effect → because of correlated components?

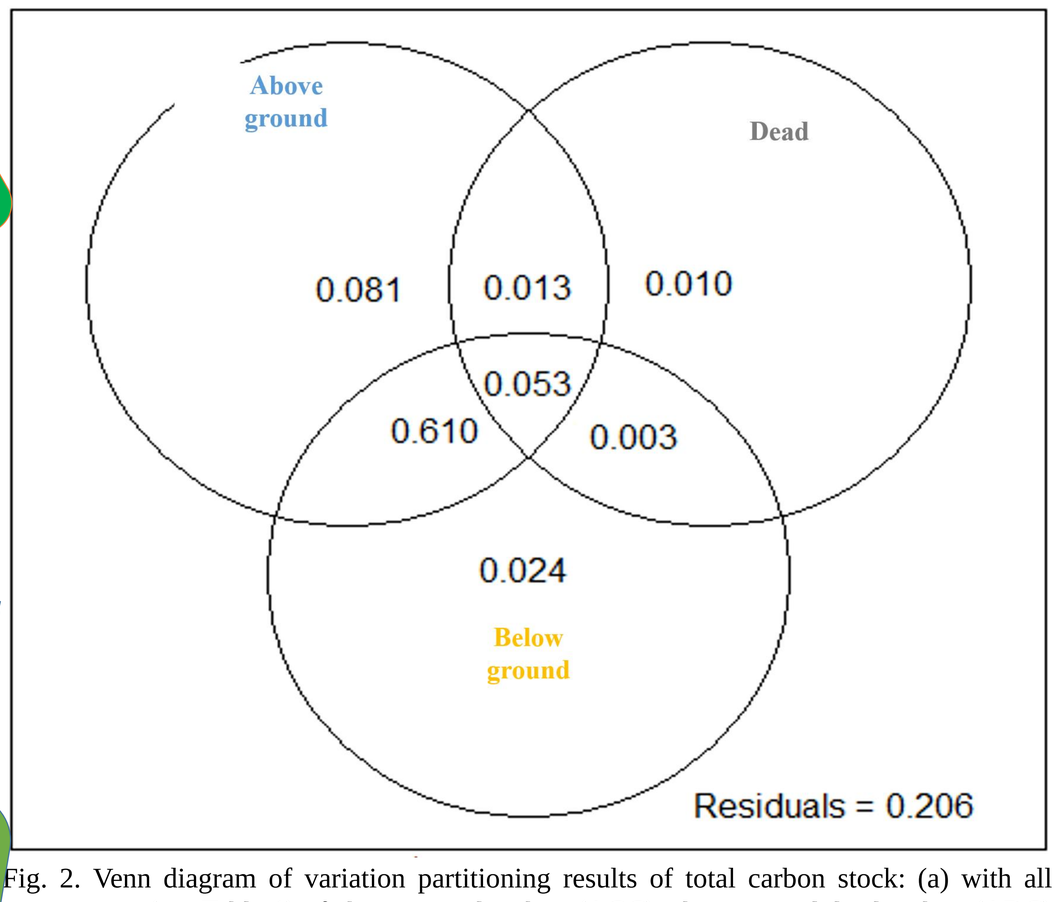

Fig. 2. Venn diagram of variation partitioning results of total carbon stock: (a) with all components (see Table 1) of aboveground carbon (AGC), aboveground dead carbon (ADC) and belowground carbon (BGC); (b) with the best components of each carbon pool: adult stems (AGC), coarse woody debris (ADC) and coarse root (BGC) (see Table 1). Values provided in circles represent the semi-partial correlation coefficient of a shared and pure fraction of carbon pools.

Conclusion

Carbon in adult trees is good predictor total C, but weak predictor for other C pools. However, aboveground carbon and belowground carbon and their interactions explained most of the variation in total carbon stock, indicating that a whole-ecosystem approach is necessary for a full understanding of the carbon cycle.