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Conventional tree height–diameter relationships significantly overestimate aboveground carbon stocks in the Central Congo Basin

Elizabeth Kearsley (1,2,3), Koen Hufkens (2,4), Kathy Steppe (1), Hans Beeckman (3), Pascal Boeckx (2), and Hans Verbeeck (1)

(1) Laboratory of Plant Ecology, Department of Applied Ecology and Environmental Biology, Faculty of Bioscience Engineering, Ghent University, Belgium(elizabeth.kearsley@ugent.be), (2) Isotope Bioscience Laboratory – ISOFYS, Department of Applied Analytical and Physical Chemistry, Faculty of Bioscience Engineering, Ghent University, Belgium, (3) Laboratory for Wood Biology and Xylarium, Royal Museum for Central Africa, Tervuren, Belgium, (4) Richardson Lab, Department of Organismic & Evolutionary Biology, Harvard University, Boston, MA

Accurate estimates of the amount of carbon stored in tropical forests represent crucial baseline data for recent climate change mitigation policies. Such data are needed to quantify possible emissions due to deforestation and forest degradation, and to evaluate the potential of these forests to act as carbon sinks. Currently, only rough estimates of the carbon stocks for Central African tropical forests are available due to a lack of field data, and little is known about the response of these stocks to climate change. We present the first field-based carbon stock data for the Central Congo Basin in Yangambi, Democratic Republic of Congo. We found an average aboveground carbon stock of 162 $\pm$ 20 Mg C ha-1 for intact old-growth forest, which is significantly lower than stocks recorded in the outer regions of the Congo Basin. The best available tree height–diameter relationships derived for Central Africa do not render accurate canopy height estimates for our study area. Aboveground carbon stocks would be overestimated by 24% if these inaccurate relationships were used. The studied forests have a lower stature compared with forests in the outer regions of the basin, which confirms remotely sensed patterns.

We identified a significant difference in height-diameter relations across the Congo Basin as a driver for spatial differences in carbon stocks. The study of a more detailed interaction of the environment and the available tree species pool as drivers for differences in carbon storage could have large implications. The effect of the species pool on carbon storage can be large since species differ in their ability to sequester carbon, and the collective functional characteristics of plant communities could be a major driver of carbon accumulation. Numerous species-specific tree height-diameter relations are established for two sites around Kisangani, central Congo Basin, with differing stand height-diameter relationships. The species-specific relations for the two sites bring forward different growth strategies for different functional groups, focusing on light tolerance, wood density and adult stature of the species. The role of environmental factors and forest structure on the differences in local height-diameter realtionships is investigated, specifically for species showing differing carbon allocation on different tropical forest sites.