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Interactive comment on "Height-diameter allometry of tropical forest trees" *by* T. R. Feldpausch et al.

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We thank the reviewer for his/her helpful comments. Species-specific height models are indeed an important component allowing accurate biomass and timber volume estimates for temperate forests, as well shown by Schmidt et al. 2010 for Estonia. And ideally one would like to apply such species-specific models for tropical forests. But, unfortunately this is practically impossible and will remain so for some time, at least until species-level identification improves and the area sampled becomes far greater than what is now possible only in temperate regions. One ready appreciation of the differences between the temperate tropical zone tree flora, and from which it should be readily clear that the approach in one region may not be applicable to the other, is the simple statistic that 1 ha of tropical forest may have as many as 300 tree species which is over 10 times the number of tree species found in all of Estonia. And probably more than found in all of Europe. This gives rise to a degree of species complexity which prohibitively hinders the sort of model development that the reviewer advocates. For example, comparing species in common between randomly selected tree inventory data for one plot in each of eastern, central and western Amazonia, we find that only one species, represented by 26 trees, is in common between the three sites, and only 33 of a total of 264 genus-level identifications are in common between the three sites. Of those 33 genera, only two had more than 50 individuals represented in the three plots, the average minimum number of individuals necessary to generate a reasonably accurate H:D curve. At the plot level, creating species-specific fits is even more difficult. For the western Amazonia plot investigated, 251 taxon (84%) were fully identified to species, but of these 251, only three had > 50 individuals. This shows that, unlike the depauperate temperate zone, there are simply not enough individuals of any given species common across regions or even within the same plots to make species-specific H:D models for the tropics in any way feasible. One approach that might warrant exploration would be the development of H:D models by functional type (e.g. understory, mid-canopy and overstory species), although we do not currently have those classifications for our dataset and such classifications are highly subjective in any case.

Putting it another way, the referee argues that apples and oranges are incomparable. We disagree. They are both spheroid fruits and each of our 1 ha of tropical forest is like a 44 gallon fruit bowl that contains more types of fruit than one would find in even the best Parisian market in the summer - and with no two bowls of anything containing the same selection of fruits (a fair proportion of which occur not more than once). In the face of such complexity, we have taken the only reasonable approach which is to pool together all the different sized fruit in each 44 gallon bowl and see if the allometric relationships depend upon location and climate. They do. Noting that from our discussion we were already well aware that climatic and environmental effects seen could be mediated by species differences or by direct effects on individual species it is simply the case that differentiation of the underlying causes was not the purpose of the paper. Indeed, it is worth mentioning that we chose to submit a related paper which does address the question of whether the different H:D relationships observed between plots, regions and continents are due to species-specific differences in allometry or some form of environmental plasticity. But that analysis, by necessity has only been able to include a few of the species in the overall dataset used here– i.e. those species that are both abundant and widely distributed – and for the reasons detailed above such an analysis, whilst highly informative in a biogeographical and ecophysiological sense, cannot because of the limitations mentioned above, give rise to allometric models of a wide geographic applicability.

The purpose of the paper was to see if H:D allometry varies across tropical forests (which it does) and then to provide equations for use in existing pan-tropical biomass models (all of which also take the "species lumped approach" disavowed by Referee 2) to help improve regional, continental and global tropical forest biomass estimates. Up until this time such estimates have been based on diameter measurements only.

The dataset we have assembled represents the largest tree H:D database to date for the tropics. The previous largest pantropical dataset developed by Brown et al. (1989) consisted of nearly 4000 trees from only three tropical countries. Through intensive field measurements in Asia, Africa and the neotropics in 21 countries we have assembled ten times that data, enabling the development of robust region, continent and pantropical models. The reviewer's reference to temperate datasets in Estonia consisting of approximately 22,000 trees is noted. However, tropical trees have a much shorter history of measurement, are more difficult to access, much harder to measure because of the often crowded canopies and dense understory, and are geographically expansive. The new dataset represented here is by far the largest to date for tropical forest tree height measurements.

Regarding model development: To evaluate trends in H:D relationships, we began with the simplest model (pantropical) based only on tree diameter and increased model complexity by adding geographic region (continent and region), climate (dry season

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length, precipitation coefficient of variance, and mean annual temperature) and forest structure (plot-level basal area, stem density). Therefore, our treatment of continent as an indicator variable is only one of several model forms we developed and evaluated for bias. Our results show that the region-level models estimated tree height with the lowest bias and that addition of environmental and forest structure data improved the models. Please note our additional comments to Reviewer 1 regarding model form selection, evaluation of previously published model forms, and evaluation of bias in model predictions, as reported in the supplementary information. Based on those results, our selected models produced the lowest bias compared to field-measured tree height values.

Interactive comment on Biogeosciences Discuss., 7, 7727, 2010.