**Supplemental Material**

**Results**

-sensibility analysis of numbers of PLSS

- mapa simulação caete agb biomass, NPP e GPP (duas abordagens)

-comparação npp e gpp com benchmarks

* npp e gpp dos benchmarks é só aboveground?
* ground-based
* Mapas
* pontos

-efeito da precipitação na NPP e na GPP

- efeitos na precipitação reduzida na diversidade funcional (multi-trait)

* tabela com importância dos eixos (contribuição relativa e cumulativa) e scores

In this study, the observed NPP allocation of global forests was obtained from three data sets. The first data sets were extracted from the latest version (version 3.3.1) of the global NPP database originally collected by Luyssaert et al. (2007; http://www.lsce.ipsl.fr/en/Phocea/Pisp/visu.php?id=124&uid=sebastiaan.luyssaert), which has been updated and corrected by Vicca et al. (2012). The other two data sets included observations at control plots of three free‐air CO2 enrichment sites (Norby et al., 2005) and seven tropical rainforest sites in Amazonia (Doughty et al., 2015). The observed annual NPP allocation fractions to leaves (aleaf), wood (awood), and fine roots (aroot) were calculated as the ratios of annual NPPleaf, NPPwood, and NPPfroot to their sum, respectively. More detailed information on the NPP allocation data set can be found in the supporting information (Aragão et al., 2009; Bascietto et al., 2003; Black et al., 1996; Bond‐Lamberty et al., 2004; Comeau & Kimmins, 1999; Curtis et al., 2002; da Costa et al., 2014; Doughty et al., 2015; Girardin et al., 2010; Gough et al., 2007; Gower et al., 2001; Jordan et al., 1999; Kimball et al., 1997; Knohl et al., 2003; Kutsch et al., 2001; Law et al., 2004; Maass & Martinez‐Yrizar, 2001; Malhi et al., 2009; Moser et al., 2011; Norby et al., 2001; Ruess et al., 1996, 2003; Ryan et al., 1997; Schulze, 2000; Wirth et al., 2002).

* None ofthe model simulations in this study matched well with the observed NPP allocation among the three plant components for all vegetation types. The models did not correctly simulate the averaged patterns of NPP allocation (Figure 5). Poor model performance of NPP allocation largely results from inappropriate parameterization. Most NPP allocation models are parameterized by using biomass observations over regio- nal or global scales (Bloom et al., 2016; Xia et al., 2015). However, uncertainties in biomass turnover strongly affect estimates of the NPP allocation ratio. Previous studies have suggested large uncertainties in biomass turnover time in the current land biosphere models (Carvalhais et al., 2014; Friend et al., 2014). For example, Zhang et al. (2016) have reported that the default leaf longevity in LPJ differs from observations for four major forest types—notably, the observed leaf longevity of boreal needleleaf forest (6.5 years) was found to be more than three times the default value (2 years). Because both allocation and turnover time govern C stocks and sequestration potential, the parameterization of NPP allocation and of turnover time must be considered together by using the best available observations.(XIA et al., 2019)

*Evaluating CAETÊ’s performance*

Here we focused in evaluating the performance associated with region carbon storage, We used two biomass benchmarks maps available in literature to be compared with maps output from CAETÊ: Baccini et al. (2012) and Saatchi et al. (2011). Since Baccini’s map show estimations of biomass only for the aboveground portion we have used only the CAETÊ’s compartments of leaves and ABGW and Saatchi’s aboveground estimation for the comparison. We redimensioned Saatchi’s and Baccini’s map to the resolution of CAETÊ and transformed both biomass maps in carbon storage maps considering that the percentage of carbon in living biomass is equal to 47.5% (THOMAS; MARTIN, 2012).

Evaluation against ground-based data was made using plot measurements from previous studies (Table S1) at different points along the Amazon basin (Figure S1). When the measurement was made only for the aboveground we considered only the compartment of leaves and ABG woody tissues. The measurement of carbon stock on plots that are located in the same region were averagedand the ones which the biomass was estimated were transformed in carbon content with the same procedure described for benchmarks.

*Representation of carbon stocks*

Both model versions show a westward increasing carbon stock gradient (Fig. S2). However, previous literature suggest this increasing gradient runs from southwest to northeast (MALHI et al., 2006; MITCHARD et al., 2013; QUESADA et al., 2012). Although the two versions are not able to reproduce well the observed biomass gradient on Amazon basin, they differ on the spatial distribution of carbon stock: the gradient in the trait-based approach is stronger, as expected, with southest and northeast regions that border the limits of the basin showing lower values representing the characteristic transition to *Cerrado* savannah (Fig. S2b). On the other hand, the PFT approach show a more homogenous distribution of values (weaker gradient) and does not capture this transition to the *Cerrado* region (Fig. S2a).

Figure 2 shows the spatial difference between the aboveground carbon stock estimated through satellite measurements by Baccini et al. (2012) and by Saatchi et al. (2011) and the aboveground carbon stock simulated by CAETÊ in its PFT approach (Fig. 2a and 2b) and its trait-based approach (Fig. 2c and 2d). The figure shows that when compared to both reference maps, carbon stock estimation resulting from the two modeling approaches show regions of over- and underestimation despite some agreement locations. In both versions the overestimations tends to be located in regions that are known to be heavily deforested (e.g. the perimeter of the Amazon forest). Besides, model results are overestimated in regions with naturally drier climatic conditions (e.g. transition between the Amazon and Cerrado), although the overestimation in these regions tend to be higher in the PFT approach. The underestimation for both CAETE’s versions occurs mainly on the east center of the basin (south of Pará state) and on the south-west of Amazonas and Acre state, although, this underestimation is more pronounced for the trait-based version. Also, there is no considerable difference in CAETÊ’s performance when comparing carbon stock maps from both the PFT and trait-based runs with Saatchi’s and Baccini’s maps: despite the fact that these benchmark maps vary on a point-by-point basis, they are significantly correlated with each other (LEVINE et al., 2016).⁠⁠

Within the studied region the CAETÊ model simulated a total aboveground carbon stock of 94.37 and 81.25 PgC for PFT and trait-based runs, respectively. The total aboveground carbon stock estimated by Baccini et al. (2012) and Saatchi et al. (2011) was 80.23 and 71.67, respectively. In that sense, although both model approaches simulations agree reasonably well with the estimated values for total aboveground carbon stock, trait-based version shows a slightly higher agreement. The comparison of modeled carbon stocks with ground-based observations also do not show any considerable difference between PFT and trait-based performances, as both approaches show no significant correlation with ground-based data (Fig. S3; Table S1).

Therefore, the consideration of functional trait diversity in the model did not improve significantly the estimation of carbon stock neither in spatial distribution sense nor in specific sites.

*Multi trait FD*

The first axis of the PCA explains 81.4% of the variance and was the major discriminator between the values for the two modeling approaches in the two applied climatic conditions. This axis is highly correlated with allocation to fine roots (-0.45), fine roots residence time (-0.44), leaf residence time (-0.44) and ABGW allocation (0.41). The second axis explain 11.3% of the data variance and its correlation is stronger with leaf allocation (-0.8) and ABGW residence time (0.46). One should notice that the PCA allows the identification of the strong trade-off between investment in fine roots and in ABGW.