*Evaluating CAETÊ performance*

Trait-based models developers have argued that the inclusion of trait variation is able not only to represent biogeochemical cycles but to improve accuracy when compared to models based on PFTs. Theoretically, this improvement emerges from the fact that by representing vegetation with only few PFTs and fix values representing their functional traits widely contrast with the massive trait variation observed in nature, especially in hyperdiverse ecosystems such as Amazon, and as a consequence do not account for the responses to local environmental heterogeneity and constraints (Ackerly and Cornwell, 2007; Freschet et al., 2011; Westoby et al., 2002, Verheijen et al., 2013). In order to test these statements and contribute to the development of trait-based models we here implemented trait variation in a version (TBA) of the vegetation model CAETÊ and compared it with a version using a PFT approach (PFTA).

Our results show that the inclusion of trait variation in vegetation models in fact plays a paramount role in predicting vegetation carbon cycle: the TBA was not only able to represent NPP and carbon storage reasonably well when compared to references both considering geographical distribution and total values, but also showed higher agreement when contrasted to PFTA (Fig. XXX). The accuracy improvement in represent biogeochemical variables by adding trait variability was already observed in other modeling exercises (Fyllas et al., 2014; Sakschewski et al., 2015; L. M. Verheijen et al., 2013; Lieneke M. Verheijen et al., 2015). We attribute this improvement to trait variability inclusion, since it confers a higher diversity of responses in communities to environmental filtering derived from climatic heterogeneity allowing a more realistically simulation of the community assembly (Keddy, 1992)⁠ and, as a consequence of the biogeochemical cycles (Sakschewski et al., 2015; L. M. Verheijen et al., 2013)⁠.

The PFTA presented a generalized overestimation of aboveground carbon storage and NPP (Fig. XX and XX) when contrasted to reference maps that is derived from the fact the PFTs (chosen by previous PFTs implemented in DGVMs) are already parameterized to present a high performance (or optimal trait combination) in the climatic envelope found in regions with predominance with tropical forests (Scheiter, Langan, & Higgins, 2013; L. M. Verheijen et al., 2013)⁠. It allows a high survivorship of individuals with high carbon storage, what is especially important in simulation with CAETÊ since our scaling for the grid-cell is weighted by the biomass of PFTs present in this cell (see XXX).

PFTA and TBA presented some common mismatch with the reference maps regarding carbon storage. Both approaches present an overestimation of values at the edges of Amazon basin when compared to the maps estimated by Saatchi et al. (2011) and Baccini et al. (2012). This is linked to the fact that these regions that are known to be heavily deforested, but the model CAETÊ still do not incorporate human land use nor fire for determining vegetation distribution. Also, either PFTA and TBA present a tendency for overestimating carbon storage and NPP in central/northwest of Amazon basin. It might be linked to forcing linked to ecological processes (such as competition and demography) and edaphic features (such as available nutrients, especially nitrogen and phosphorus) that are still not represented in CAETÊ.

Our findings, besides emphasizing the importance for incorporating trait variability in represent vegetation and biogeochemical cycles in current climate also bases the idea that it probably also allows more reliable projections in unkown climates (L. M. Verheijen et al., 2013)