

The possible modification in Amazon forest's ability to store carbon due to climate change has intrigued scientists for decades. However, this subject is still full of uncertainties (FINEGAN et al., 2015) and also still non well explored elements (e.g. the role of functional diversity on the strength of the carbon loss; (POORTER et al., 2015; SAKSCHEWSKI et al., 2016a; SITCH et al., 2008). Dynamic global vegetation models (DGVMs) have been extensively used to address this issue (CRAMER et al., 2001; SCHEITER; LANGAN; HIGGINS, 2013). They can be powerful tools to this type of study since it provides essential insights into biosphere-climate interactions (CRAMER et al., 2001; QUILLET; PENG; GARNEAU, 2010; VAN BODEGOM et al., 2012) and, consequently provides valuable information on how change in climate can affect natural ecosystems (FRIEDLINGSTEIN et al., 2006; QUILLET; PENG; GARNEAU, 2010; SCHEITER; LANGAN; HIGGINS, 2013; PRENTICE et al., 2007).

Even though these models have provided important insights about this subject their results are contradictory (HUNTINGFORD et al., 2013; RAMMIG et al., 2010). They diverge both on the magnitude and direction of change: the majority of DGVMs predict different levels of loss of the Amazon forest's capacity to be a carbon sink (COX et al., 2000, 2004; HUNTINGFORD et al., 2013) and others, but only few of them, claim for an increase on it (HUNTINGFORD et al., 2013; VERHEIJEN et al., 2015). The different scenarios and parametrization (e.g. the strength of CO<sub>2</sub> fertilization) may be some possible reasons for such degree of uncertainties in the predictions (HUNTINGFORD et al., 2013; QUILLET; PENG; GARNEAU, 2010; SITCH et al., 2008). However, the poor representation of plant diversity, specially regarding to functional trait diversity, may be hampering the ability of DGVMs to make more accurate projections on carbon cycle against climate change (PAVLICK et al., 2013a; SCHEITER; LANGAN; HIGGINS, 2013; VAN BODEGOM et al., 2012; VERHEIJEN et al., 2015).

For example, the majority of current DGVMs use the concept of Plant functional types (PFTs) to represent plant diversity (REU et al., 2014; SCHEITER; LANGAN; HIGGINS, 2013; VERHEIJEN et al., 2015): this scheme aggregates groups of plants with presumably similar ecological roles responding in a comparable manner to environmental conditions and performing similar influences on ecosystem functions (LAVOREL; GARNIER, 2002). This approach uses a small set of fixed parameters, in space and time (through mean values) to represent the plant functional traits and leads to a limited and inadequate representation of functional diversity (PAPPAS; FATICHI; BURLANDO, 2016; PAVLICK et al., 2013a; VAN BODEGOM et al., 2012; VERHEIJEN et al., 2015).

Functional diversity is intimately linked to ecosystem functioning: it determines many ecosystem processes such as ecosystem carbon storage (CADOTTE; CARSCADDEN; MIROTECHNICK, 2011; CONTI; DÍAZ, 2013; DIAZ et al., 2004; DÍAZ; CABIDO, 2001; FINEGAN et al., 2015; VAN DER SANDE et al., 2017). This link is due to the fact that, ultimately, are the functional traits that interact with the environment by responding and modifying it (DIAZ et al., 2004; DÍAZ; CABIDO, 2001; VIOLLE et al., 2007). Since the values that represent functional traits in a PFT scheme are fix, with an environmental change PFTs are not able to adapt what can overestimate the impacts of climate change on ecosystems (FYLLAS et al., 2014; SCHEITER; LANGAN; HIGGINS, 2013). Consequently, to ignore functional diversity by using PFT scheme may not be the best choice to advance in the knowledge of the effects of climate change on natural ecosystems (PAVLICK et al., 2013a; VAN BODEGOM et al., 2012; YANG et al., 2015) .

The use of PFTs also prevent the identification of subtle but important changes in communities: the change on the frequency and occurrence of functional traits (YANG et al., 2015). This drawback precludes advancements in the comprehension of the still uncertain effects of climate change on functional diversity (DÍAZ; CABIDO, 2001; LAVOREL; GARNIER, 2002), a subject poorly explored on vegetation models. These uncertainties are specially important and challenging on ecosystems such as Amazon forest and tropical forests as a whole, which are hyperdiverse (AGUIRRE-GUTIÉRREZ et al., 2019) and also are among the most threatened ecosystems by climate changes (CHAMBERS et al., 2012).

As the climate change, the environmental filtering becomes different, and hence, the requirements for an individual to be successful change as well (WEBB et al., 2010). It means that the physiological tolerances determined by functional traits also is modified what could select for alternative functional composition of the community (THOMPSON et al., 2009). This is generated by a rearrange of the community traits (AGUIRRE-GUTIÉRREZ et al., 2019; FAUSET et al., 2012; FYLLAS et al., 2017) that can be the exclusion of some traits together or not with the emergence of new traits that were not in the community before (GONZALEZ; LOREAU, 2009) (GONZALEZ; LOREAU, 2009; POORTER et al., 2015), also, it can be even just an alteration on the traits abundance, for example on dominance (ENQUIST et al., 2015; FAUSET et al., 2012; MADANI et al., 2018).

This rearrangement can turn the community more suitable for the new climate conditions and, thus, be less susceptible to the imposed changes (AGUIRRE-GUTIÉRREZ et al., 2019; ENQUIST et al., 2015; FAUSET et al., 2012). For example, it is foreseen for Amazon, and other tropical forests, an increase on drought intensity, frequency or longevity (FAUSET et al., 2012; SHEFFIELD; WOOD, 2008), however if the functional composition of Amazonian forest communities shifts in favour to

more drought-tolerant traits, its ability to store carbon in front of climate change can be less susceptible. This would reduce, for example, the likelihood of the forest shifting into a savannah (AGUIRRE-GUTIÉRREZ et al., 2019; SAKSCHEWSKI et al., 2016a) compared to projections previously made by modeling studies (e.g. (COX et al., 2000; HUNTINGFORD et al., 2004; LAPOLA; OYAMA; NOBRE, 2009; RAMMIG et al., 2010). The work of Esquivel et al. (2018) argue that this type of change has already been observed in Amazon forest with communities shifting towards ones more adapted to drier conditions. This phenomenon in which there is a shift of species or functional traits towards ones that deal better with new environmental conditions is called compensatory dynamics and has a profound effect on ecosystem functioning (GONZALEZ; LOREAU, 2009; HOLLING, 1973; MACARTHUR; DIAMOND; KARR, 1972; MADANI et al., 2018).

Thus, in order to overcome the weakness that a PFT approach imposes, some vegetation models, the so called trait-based models, are trying to represent the diversity of plants in an ecologically more trustworthy way (FYLLAS et al., 2014; PAVLICK et al., 2012; SAKSCHEWSKI et al., 2016b; SCHEITER; LANGAN; HIGGINS, 2013). This type of model replace the fix parameters of PFTs for variant ones (WEBB et al., 2010; WULLSCHLEGER et al., 2014): in this approach each functional trait is a model parameter chosen from its possible range of theoretical and/or empirical values, determining, together with the other functional traits, the growth and survival of individuals (PAVLICK et al., 2013b; REU et al., 2014). Thus, trait-based approaches provides the important opportunity to look beyond biogeochemical variables creating potential for exploitation of a multiplicity of ecological questions (SAKSCHEWSKI et al., 2016b); for example, it enables the advancement in understanding the connection between functional diversity, ecosystem functioning and climate change (AGUIRRE-GUTIÉRREZ et al., 2019; CARMONA et al., 2016; SAKSCHEWSKI et al., 2016b; YANG et al., 2015). However, the development of this modelling strategy is only on beginning and many questions that could be addressed (specially regarding to functional traits and functional diversity) remain unexplored and unanswered. X