**Introduction**

It is projected, for the 21st-century, that Amazon forest will experience more frequent and more extreme moisture stress (Duffy, Brando, Asner, & Field, 2015; Esquivel-Muelbert et al., 2017; Hubau et al., 2020; Lewis et al., 2011)⁠, what impact directly forest ability to store carbon (da Costa et al., 2010; Hubau et al., 2020; Phillips et al., 2010)⁠ and induce shifts in different facets of biodiversity such as the functional one - the values, ranges of values and relative abundance of functional traits in a given community or ecological unit (Díaz et al, 2007) - (Aguirre-Gutiérrez et al., 2019; Esquivel-Muelbert et al., 2018; Zhang, Niinemets, Sheffield, & Lichstein, 2018)⁠. These type of changes conducted by reduced precipitation has been already observed in Amazon forest through long-term inventory plots (Esquivel-Muelbert et al., 2018, 2017)⁠, and experiments (Nepstad, Tohver, Ray, Moutinho, & Cardinot, 2007)⁠, as well as in other tropical forests (Aguirre-Gutiérrez et al., 2019; Fauset et al., 2012)⁠. However, the degree and direction (increase or decrease) in which the ecosystem process of carbon storage will be affected remain uncertain (Bonal, Burban, Stahl, Wagner, & Hérault, 2016; Hubau et al., 2020; Yang et al., 2018). In addition, both the role that functional diversity plays on this ecosystem process and the impact of the foreseen reduced precipitation on functional diversity itself and on its different components (richness, divergence and evenness; (Carmona, de Bello, Mason, & Lepš, 2016; Mason, Mouillot, Lee, & Wilson, 2005)⁠) is poorly explored (Esquivel-Muelbert et al., 2017; 2018; Poorter et al., 2015; Sakschewski et al., 2016) and still presents many knowledge gaps (Aguirre-Gutiérrez et al., 2019)⁠.

Vegetation models have been widely used to explore the fate of Amazon forest carbon storage under unprecedent climatic conditions such as reduced precipitation, what provided substantial contribution to our current knowledge of the Amazon forest susceptibility (Díaz & Cabido, 1997; Prentice et al., 2007; Scheiter, Langan, & Higgins, 2013). Nonetheless, their results are still contradictory and divergent (Huntingford et al., 2013; Powell et al., 2013; Rammig et al., 2010), although most of them tend to project a drastic loss in carbon stock (P M Cox, Betts, Jones, Spall, & Totterdell, 2000; Peter M. Cox et al., 2004)⁠, together with a replacement on predominant vegetation type composition on large portions of Amazon forest by a drier-affiliated vegetation such as tropical savanna (Hutyra et al., 2005; Lapola, Oyama, & Nobre, 2009; Salazar, Nobre, & Oyama, 2007).⁠

One of the sources for the uncertainties and divergence the models may relies on the way that the diversity of vegetation is represented in most of these models: they commonly use the concept of plant functional types (PFTs) to represent vegetation, a very small, discrete, and *a priori* defined set of plant types, in which the parameters that represent functional traits responsible for ecophysiological process and the connection with environment (i.e., the responses and effects) are fix in space and time for each PFT (Reu et al., 2014; Scheiter et al., 2013; Verheijen et al., 2015)⁠. This simplification of vegetation diversity seems to overestimate the impacts of environmental changes and might also compromise reliability in current conditions projections (Pavlick, Drewry, Bohn, Reu, & Kleidon, 2013; Sakschewski et al., 2016; Verheijen et al., 2015), once diversity of responses and the possibility for selecting alternative strategies that deal better with the new climatic condition present very limited boundaries (Fyllas et al., 2014; Mori, Furukawa, & Sasaki, 2013; Sakschewski et al., 2016))⁠. Hence, an important process that confer resilience to novel and unprecedented climatic conditions, the community functional reorganization (Aguirre-Gutiérrez et al., 2019; Enquist & Enquist, 2011; Fauset et al., 2012, 2015; Wieczynski et al., 2019), is very restricted or even not captured (Sakschewski et al., 2016; Verheijen et al., 2015)⁠. In this type of adjustment one can observe a rearrangement of the community in terms of its traits distribution (e.g., frequency and occurrence) and a selection for an alternative functional structure (e.g., relative dominance), composition and diversity (Enquist et al., 2015; Thompson, Mackey, McNulty, & Mosseler, 2009; Wieczynski et al., 2019) through the selection specific groups of plants with characteristics (functional traits) that confers higher ability to deal with the new environmental conditions (Rowland et al., 2015; Esquivel-Muelbert et al., 2017, Webb, Hoeting, Ames, Pyne, & LeRoy Poff, 2010)⁠⁠.

Besides, the use of PFTs compromises the representation and analysis of functional diversity and its different main components: richness, divergence and evenness, that respond distinctly to disturbances and that play different roles on plant communities (Mason, Mouillot, Lee, & Wilson, 2005; Song, Wang, Li, & Zhou, 2014)⁠. The rearrangement above cited together with modifications on functional diversity components can in turn implicate in important changes on ecosystem functioning such as the carbon cycle (Madani et al., 2018; Esquivel-Muelbert et al., 2017⁠). It also hampers advancements in the comprehension of the yet unknown effects of climate change in functional diversity and other ecosystem processes driven by or emerging from plant diversity (Díaz & Cabido, 2001; Lavorel & Garnier, 2002)⁠. Accordingly, the incorporation of trait variability on vegetation models becomes essential.

In order to overcome these limitations regarding underrepresentation of functional diversity by using PFTs, the so-called Trait-based vegetation models have been developed (e.g., Fyllas et al., 2014; Joshi et al., 2020; Pavlick, Drewry, Bohn, Reu, & Kleidon, 2013; Sakschewski et al., 2015; Scheiter, Langan, & Higgins, 2013)⁠ . This modeling approach represent plant types in a less discrete manner by replacing the fixed parameters representing the functional traits in PFTs by variable ones (Pavlick, Drewry, Bohn, Reu, & Kleidon, 2013⁠; Reu et al., 2014; Webb, Hoeting, Ames, Pyne, & LeRoy Poff, 2010; Wullschleger et al., 2014)⁠, thus increasing the traits diversity and allowing a more flexible representation of plant functional responses to a given environmental condition (Pavlick et al., 2013; Scheiter et al., 2013)⁠. It timely provides the opportunity for models to look beyond biogeochemical variables (e.g., biomass and productivity) creating potential for exploring a multiplicity of functional ecology-related questions (Sakschewski et al., 2016; Darela-Filho et al., in prep.)⁠; for example, the role of the different components of functional diversity on resilience against environmental changes and also identify and predict the processes that determine community assemblage and structure (Mouillot et al., 2013).

Despite the promising potentiality established for trait-based models to explore this type of question many of them remain under or unexplored by the modeling studies so far (but see Hofhansl, Chacón‐Madrigal, Brännström, Dieckmann, & Franklin, 2021⁠). For example, despite the known importance, few studies have explored how environmental changes impacts the different functional diversity components (Carmona, de Bello, Mason, & Lepš, 2016; Mason, Mouillot, Lee, & Wilson, 2005; Mouillot, Graham, Villéger, Mason, & Bellwood, 2013)⁠. Furthermore, the ability of trait-based models to effectively capture (and improve) the representation of ecological processes that are commonly considered in standard vegetation models such as net primary productivity (NPP) and carbon storage is yet to be assessed, as well as the comparative difference in the plant functional response to environmental changes.

Here, we describe for the first time a new trait-based model, the CArbon and Ecosystem functional-Trait Evaluation (CAETÊ). First, we evaluate CAETÊ’s performance in representing vegetation carbon storage and net primary productivity (NPP) for the Amazon region. In order to assess if the inclusion of trait variation improves the representation of these biogeochemical variables we compared two approaches of CAETÊ: one representing vegetation through a small number of PFTs (i.e., low functional diversity) and the other one representing vegetation using variant functional traits (i.e., high functional diversity). Six traits were defined to be fixed (PFT approach) or variant (trait-based approach): carbon allocation and residence time in three plant compartments (leaves, aboveground woody tissues and fine roots). We also applied these two modeling approaches in a scenario of reduced precipitation for the sake of representing moisture deficits predicted to Amazon region. By using this scenario we aimed to evaluate how functional diversity (and its different components) impacts Amazon forest ability to store carbon stocks and also how moisture stress change functional diversity considering richness, evenness and divergence. Then, the following hypothesis were tested:

(H1) Using the trait-based modeling approach we will be better able to detect the preserving carbon stocks in the face of the imposed reduced precipitation, since a model approach with higher variability of traits values and combinations than with the PFT approach would provide better capacity to functionally reorganize the community under the new environmental conditions (Fauset et al., 2015; Lohbeck, Bongers, Martinez-Ramos, & Poorter, 2016; Yachi & Loreau, 1999)⁠, constituting an ensure in the face of local extinctions of strategies and thus a more resilient ecosystem (Cadotte, Carscadden, & Mirotchnick, 2011; Mori et al., 2013; Sakschewski et al., 2016; Schmitt et al., 2019).

(H2) We hypothesize that functional reorganization in communities, especially considering the trait-based approach, will prioritize, based on optimal partitioning theory (Cannell & Dewar, 1994; Metcalfe et al., 2010; Thornley, 1972)⁠, strategies with higher investment (higher allocation and residence time) in fine roots to increase the acquisition of the most limited resource (water in this case). This prioritization of strategies may be due to the expected environmental filtering of a small subset of functional trait combinations more suitable to cope with the applied precipitation reduction.

(H3) Finally, we expect that selection towards more restrict functional traits values may lead to a scenario of communities with lower functional richness (Cornwell et al., 2006; Funk et al., 2017; Kleidon, Adams, Pavlick, & Reu, 2009; Perronne & Gaba, 2017). This restriction would decrease evenness, as the density of traits values would be less regularly distributed, what also might push the values towards more extreme regions of the functional space, favoring strategies with specialized functional trait values, yielding an increase in divergence (Mouillot, Graham, Villéger, Mason, & Bellwood, 2013; Mouillot, Villéger, Scherer-Lorenzen, & Mason, 2011)⁠. Together, the decrease in evenness and increase in divergence is supposed to conduce to lower utilization of the functional space (De La Riva et al., 2017; Hillebrand et al., 2008; Mason, Mouillot, Lee, & Wilson, 2005; Mouillot et al., 2011)⁠.