Climate change, as reduced precipitation, is already changing biodiversity all over the world by eliminating species or changing the communities composition (REFERENCIA). However, much less is known about the effects on functional composition (i.e. the diversity and abundance of traits) (ENQUIST; ENQUIST, 2011; ESQUIVEL-MUELBERT et al., 2018; SAKSCHEWSKI et al., 2016)⁠⁠ and, especially, on functional diversity in terms of its different components (richness, evennes and divergence) and mainly regarding to the multidimensional aspect of functional diversity.

Our results show that the applied scenario of reduction on precipitation clearly changed the functional composition of Amazon forest, both in terms of the diversity and abundace of traits (Figure, Table XXXX). The indices resulted from our analysis that compare, before and after the disturbance, the dissimilarity between the curves (in the case of the single-trait analysis; Table XXXX) and the similarity between the hypervolumes (in the case of multi-trait analysis; Jaccard index equal to 0.036) show that the scenario of reduced precipitation has led to a significant functional reorganization of Amazon forest. These results are in agreement with previous theoretical, observational and experimental studies that argue that a change in moisture stress, and environmental change as whole, is able to drive functional composition shifts (AGUIRRE-GUTIÉRREZ et al., 2019; ENQUIST; ENQUIST, 2011; ESQUIVEL-MUELBERT et al., 2018; NEPSTAD et al., 2007; PHILLIPS et al., 2010; SAKSCHEWSKI et al., 2016)⁠. This functional composition shift is derived from a reorganization of the community due to, for example, species extinction or by just a reorganization on community dominance (ENQUIST; ENQUIST, 2011; GONZALEZ; LOREAU, 2009)⁠.

All the observed changes on functional composition was due to the alteration on the environmental filtering, in other words, the drier condition selected strategies that coped better with the moisture stress. This selection was in the direction of strategies with higher values towards fine roots allocation and residence time to the detriment of allocation in other compartments (these results can be seen in the PCA (Fig XXX) and in the trends of the values distribution (Fig XXX and Table XXXX)). This observed change on functional composition had two consequences: first, because in our model higher values of fine roots biomass (determined by carbon allocation and residence time) is linked to higher capacity of water uptake, we can infer that the imposed drought led to a change in functional composition towards more dry-affiliated strategies. The same type of shift in functional composition was observed in Amazon (ESQUIVEL-MUELBERT et al., 2018; MADANI et al., 2018; PHILLIPS et al., 2010)⁠ and other tropical forests(ENQUIST; ENQUIST, 2011; FAUSET et al., 2012; FEELEY et al., 2011)⁠.

Second, the observed increase in fine roots biomass was at the expense of investiment especially in woody tissues. This is a product of the trade offs *a priori* defined (for example, the allocation to one compartments always restrics the allocation to another; Table XXX) and of the trade-offs that emerge from the model itself. The most proeminent emergent trade-off was the one observed between fine roots and aboveground woody tissues traits (Figure PCA XXX). The trade-off between root and aboveground woody tissues was also found in observational studies in Amazon (MALHI; DOUGHTY; GALBRAITH, 2011)⁠ and other forests around the world (WOLF; FIELD; BERRY, 2011)⁠. Despite the advantages confered by the increase in fine roots biomass against the drier climate, it can result in relative lower values of total plant biomass and, consequently, to a smaller capacity of ecosystem to store carbon. This is because fine roots are plant tissues of short duration and contribute much less to the total plant biomass when compared to aboveground woody tissues. Because of this, the functional composition shift may have biased our results concerned to the imapcts of reduced precipitation on the Amazon ability to store carbon (see section XXX). In that sense, future studies using CAETÊ to understand the impacts of climate change, should use traits and trade-offs that are more mechanistically related to the role of woody tissues in determine the ecosystem resistance to disturbance (e.g. woody density, cavitation vulnerability and adult plant height; PHILLIPS et al., 2010; ROWLAND et al., 2015⁠).

Besides the modification on functional composition the modified environmental filtering also affectd the abundance of strategies and, consequently, the frequency distribution of trait values, what, ultimately, change the dominance relationship between strategies (Figure XXXX; ENQUIST; ENQUIST, 2011; ESQUIVEL-MUELBERT et al., 2018)⁠. Some observational studies show that Amazon forest presents a hyperdominance of few species and that dominance relationship change with climate changes (FAUSET et al., 2015; TER STEEGE et al., 2013)⁠. Our results show that model CAETÊ is able to reproduce this hyperdominance in regular climate conditions: figure XXX show it through the high curves skeweness and positive kurtosis (ENQUIST et al., 2017)⁠ and through the concentration of higher frequency values around a small range of trait values. However, when the precipitation is reduced the frequency distribution in the traits values is modified towards a reduction in the hyperdominance: lower skweness and more negative kurtosis in the single-trait curves (Figure XXX) besides a spread in the occupance of the functional space in the hypervolume (Figure XXX). This is in agreement with the theory that a change in climate can cause a change in domincance thourgh a compensatory dynamic in communities: when the composition of an ecosystem adjust to the new conditions enabling types of plants that previsouly exerted a lesser functional role turn into a functional dominant strategy and vice-versa (GONZALEZ; LOREAU, 2009; SAKSCHEWSKI et al., 2016)⁠. In that sense, we observed that the compensatory dynamic in Amazon forest with the decrease in dominance allowed the emergence of new strategies and/or trait values that dealt better with the new climatic condition. This compensatory dynamics with shift in functional composition and in dominance was found in another modelling study for Amazon basin (SAKSCHEWSKI et al., 2016)⁠ and also in observational or experimental studies in tropical forests (ENQUIST et al., 2017; ENQUIST; ENQUIST, 2011; ESQUIVEL-MUELBERT et al., 2018).⁠

Together, the change in functional composition and in dominance provoked a change in all the components of functional diversity (Table/Figure XXX). To date, this is the first modelling study to address the modification in all the functional diversity facets for Amazon forest. The studies concerned to understand the impacts of climate change on functional diversity mainly focused on the impacts for functional composition, however functional diversity has differenThis is in agreet facets that express different ecological meaning (CARMONA et al., 2016; MASON et al., 2005; MOUCHET et al., 2010)⁠. Regarding to functional richness, we found for all the traits an unexpected and significant increase in this functional component derived from a higher occupancy of the functional space (FigXXX and Table XX) what, in its turn, led to a increase in the hypervolume occupied by all the strategies (Fig XXXX do aumento do hypervolume). This is contrary to the hypothesis that a more severe environment would decrease functional richness by selecting for a narrow range of strategies (CORNWELL et al., 2006; FUNK et al., 2017; PERRONNE; GABA, 2017)⁠. However the above cited compensatory dynamics is a possible explanation for the increase in the functional space occupation. Furthermore, increasing species diversity can stabilize aggregate measures by increasing the range of species responses to environmental fluctuations (Chesson et al. 2001, Elmqvist et al. 2003, Hughes & Roughgarden 1998, Ives & Carpenter 2007, Ives & Hughes 2002, Ives et al. 1999, Loreau & de Mazancourt 2008, Loreau et al. 2003, McNaughton 1977, Norberg et al. 2001, Yachi & Loreau 1999). .

The evennes (i.e. the abundance regularity in the frequency distribution of the trait values in a trait space) has also showed an increase for all the six functional traits (Table XXX and Figure XXX) what means that the reduced precipitation made that the distribution of trait values in the trait space became more regular, another indication of the dominance decrease. Evenness is also an indication of the effectivenness in using the functional niche space, it means that low functional evenness indicates that some parts of the functional niche space, although occupied, is under-utilised (DE LA RIVA et al., 2017; MASON et al., 2005)⁠. Then, our results indicates that a change in the environment can force the community to better occupy the functional niche space. However, a clear ecological role of evennes on the ecosystem functioning is still missing, and future studies could focus on understanding it.

The divergence (i.e. the degree to which the frequency of trait values occurs at the extremities of the functional space) has increased for all the traits except for leaf and wood tissues residence time that showed a decrease in this variable although in a low degree (5.0 and 4.7% decrease for leaf and woody tissues carbon residence time, respectively; Table XXX and Figure XX)).The increase in divergence means that, regarding to a specific trait, the values distribution is no longer concentrated in only one extremity of the functional space, but other trait values that were not that important before becomes significant for the community and for the ecosystem functioning with the environmental change. Divergence is also a manner to understand if the frequency distribution of trait values in the functional niche space maximises the total community variation in functional characters (MASON et al., 2005)⁠. In that sense, high divergence could be a result of different, or even contrasting, strategies being able to deal with stress (FUNK et al., 2017)⁠. It agree with our results in which the reduced precipitation as a stress resulted in ….. The divergence decrease observed for the carbon residence time on leaves and woody tissues may be explained by the accounted trade-offs and by the model functioning. We observed a decrease on carbon allocation for these two plant compartments, so in order to maintain a biomass values these two traits needed to keep their values high or do not change the frequency around the values before the disturbance.

In summary our results suggest that changes in precipitation are important in structuring communities, that in its turn can rearrange through compensatory dynamics and minimize the adverse effects of those changes on ecosystem functioning such as carbon storage (FAUSET et al., 2012)⁠. However, the long-term effects of these rearrangements may have negative or uncertain consequences. For example, our study show that a drier climate tends to select towards strategies with higher investiment in fine roots to the costs of investiment on tissues that store relatively more carbon such as woody tissues. This may lead to a decrease in the carbon storage capacity of ecosystems in the long term and consequently impacts global carbon cyle. Also, other important ecosystem functions, like evapotranspiration rate, may be modified with the new functional composition and structure, generating prejudicial feedbacks on the water cycle. In that sense, many of the issues regarding to the climate changes impacts on functional diversity and its consequences for ecosystem functioning remain unanswered.

Despite the interesting and innovative results found in this study some considerations need to be done. First, the model was run two times with different climate conditions what prevented us to see how the community changes happen ao longo do tempo e consequentemente pode ter nos impedido de ver mudanças mais ustis na comunidade analisada, this is because the fact that the version of CAETÊ used here is stationary (see section XXX). Second, in order to analyse the different functional diversity facets, structure and composition, we have considered the whole Amazon basin as a unique community; however Amazon presents a high ecosystem heterogeneity caused by many abiotcs factors such as edaphics, altitude, dry season lenght e temperature that impacts the dynamics of the communities depending on the region (LEVINE et al., 2016)⁠. The lack of regionality distinction may have led to an overestimation of the functional diversity, especially regarding to the diversity of trait values. Further studies should, in that sense, consider the different regions of Amazon in order to understand if different regions respond differently to changes in environmental conditions and how the different responses affects Amazon basin as a whole. Another problem that may have impacted our results is the fact that we use the CWM approach to determine the trait value that will represent certain grid-cell. This type of integration end up desconsidering the diversity present within the grid-cell. One manner to overcome this problem would be to use the scale aggregation approach proposed by Carmona et al. (2016) that is able to sum the different traits distribution as the scale increases. Lastly, other traits more directly linked to the response to drought such as hydraulic traits (QUAIS?)

* Talvez se tivéssemos usado hydraulic traits a mudança na diversidade funcional não seria tão brusca?
* Talvez considerar traits hidráulicos seja de suma importância nesse sentido já que temperaturas altas e secas mais prolongadas afetam fortemente árvores de grande porte por falha hidráulica (PHILLIPS et al., 2010; ROWLAND et al., 2015)⁠, que poderia abrir “caminho para novas estratégias emergirem e levar a mudança na composição comprometend o estoque de carbono.

In further studies may be necessary to implement traits and trade-offs lineked to woody tissues (such as wood density and XXXXX traits de madeira relacionado ao stress hídrico) in order to capture more advantagens to woody investment (resistencia ao vento??) and turn the distribution more equilibrated.

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