

# ***Interactive comment on “Predicting carbon dioxide and energy fluxes across global FLUXNET sites with regression algorithms” by Gianluca Tramontana et al.***

## **Anonymous Referee #2**

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In “Predicting carbon dioxide and energy fluxes across global FLUXNET sites with regression algorithms” the authors cross-validate an ensemble of machine learning methods to document the performance of these methods in terms of their spatio-temporal performance. This study is very useful given the role of eddy covariance observations in land-atmosphere studies and the increasing importance of some of the upscaled EC-products in model validation and data analysis. In my opinion the study falls well within the scope of Biogeosciences and addresses a topic that is of interest to the journal’s readership.

The work underlying the study is of high quality, however, the current presentation can be much improved. If the authors would try to separate the results and discussion,

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it would become apparent that there is hardly any discussion. Despite the carefully worded objectives, the reader is left with a "so-what" feeling. The way the objectives are worded is too technical and is unlikely to excite many readers. That would be a pity as the results deserve better. Are you looking for the best method or do you want to quantify the upscaling uncertainty? Both perspectives could be of interest but from the conclusions I understood that all ML results will be archived and that the ensemble will be distributed. If my understanding is correct, this information should already be presented in the introduction. If this is indeed the context of the study, searching for the best ML method becomes less relevant but estimating spatio-temporal patterns in uncertainty becomes even more relevant as users may want to know the uncertainty of the ensemble mean. Also, the reader may want to know how much the uncertainty can be reduced by adding remote sensing and meteorological information in the up-scaling process. Listing the current limitations (saturation point) would be very useful, for example, is there anything to gain by adding meteorological data when upscaling NEE?

Several interesting findings are not further explored, for example, line 329 reads "...suggested that the choice of the explanatory variable had higher impact than the choice of the ML technique for the pattern of predictions". This is a very useful and important finding but it is not at all discussed. There are too many loose ends such as the paragraph on line 317 that reads "Nonetheless, the differences between the experimental setups were less appreciable." A paragraph should have an introduction, a body and a concluding phrase signifying the implication of the result/discussion. This is often missing leaving it to the reader to guess what the authors want to say.

Both the structure and language of the manuscript could be improved. The authors choose to use their objectives to structure the paper. I find the objectives very technical and they seem to overlook some of the more interesting questions and answers the study could provide. As an alternative the manuscript could discuss the possibilities and limitations of spatial upscaling and then the possibilities and limitations of temporal

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upscaling. Defining more general overarching objectives is likely going to result in a better structure and discussion. For the typos and grammar ask help from one of the three native speakers on the manuscript. It makes me wonder whether all co-authors even made the effort to read the manuscript.

The display items show a lot of information but not in a way that is easy to interpret or a way that at first sight supports the conclusions. The challenge of synthesis study such as this one is to summarize the information in easy to grasp figures and tables. In my opinion the authors failed in doing so. This issue is apparent from the first paragraph of the results where Table 3 is cited in support of the statement that “ The ensemble median estimate always outperformed the median performance of ML-specific methods” but the way I read this table it does not contain information of the specific methods. The detailed information could be moved to the appendices. Prepare figures that support the main message(s) of this study, for example, a figure that shows how some temporal characteristics are lost for certain fluxes and/or a figure/map that shows the regions where the methods diverge most.

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