

## ***Interactive comment on “Model–data fusion across ecosystems: from multi-site optimizations to global simulations” by S. Kuppel et al.***

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This is a very nice contribution and a significant advance in the practice of ecosystem carbon data assimilation. The work is well done, conforms to the state of practice, advances the field and is clearly presented for the most part.

I have one perspective to add. The approach taken is directly analogous to similar estimation approaches in meteorology, and is useful but in a sense not informative. Consider the actual situation being modeled. Ecosystems, far from being a continuous field of "green slime" are in fact made of up of billions of individual plants, and even more bazillions of leaves and microbes etc. Within a single model plant functional type that can be up to tens of thousands of species, each with slightly or significantly different parameter values for the model equations. The goal of assigning PFTs and

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biomes is to reduce the unmanageable dimensionality of this variation to a reasonable degree, and the study presented here shows that using replication of flux sites –even though they do not systematically or randomly sample this variability– helps improve overall model performance.

However, this analysis does not take into account any covariance structure associated with the underlying structure of parameter variation associated with species or functional variation. Treating parameter variation as a random field is a reasonable first assumption but is almost certainly not true. It would be interesting to consider or speculate on how such an analysis would be done if more detailed information on plant parameter distributions were available to weight extrapolation from a limited set of towers. In any case, adding a description of the conceptual situation in which this assimilation is taking place would be useful. As ecosystem data assimilation progresses, making a transition to a more biologically sophisticated underlying model will be critical.

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