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Geoscientific Model Development Discussions
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Interactive comment on "A new step-wise Carbon Cycle Data Assimilation System using multiple data streams to constrain the simulated land surface carbon cycle" *by* P. Peylin et al.

Anonymous Referee #3

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General comments

The manuscript reports development and application of a data assimilation system which is used to produce a version of ORCHIDEE model optimized to reproduce NDVI, net ecosystem exchange and latent heat flux at land validation/flux tower sites and CO2 seasonality at background CO2 monitoring sites. The stepwise optimization approach is proposed as a simplified alternative to optimizing model to fit NDVI, flux tower data and atmospheric CO2 data simultaneously. Despite splitting the process in several stages authors succeeded to find a set of parameters allowing the model to fit all types of constraints.

The manuscript is well written, and presents an original and valuable contribution. It

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Discussion paper

can be published after minor revision, hopefully addressing the comments listed below.

General comment 1. In the optimization framework adopted by authors, model parameters optimised at the set of flux tower sites are later extrapolated to whole land surface using available spatial data on vegetation type, weather and soil type information as drivers. The flux tower site optimization is made by combining several sites within same vegetation type in one group, and average flux seasonality is shown to be improved by the optimization. The variability of the fluxes due to soil quality and slope/drainage within same vegetation type is not directly captured by this approach, while some studies (Ise an Sato, 2008) suggest there is a way to address site level differences in productivity potential (edaphic variability) based on remote sensing data. It would be relevant to mention this factor in discussing reasons for remaining spread in the degree of success that can be achieved using one set of model parameters for optimizing fluxes at several sites of same vegetation type.

Detailed comments

Page 01 – Line 03. In addition to "incorrect model parameter values" one should mention uncertainty in spatial distribution of the parameters coming from the maps of soil properties, topographic features, vegetation types.

Page 04 – Line 05. Randerson et al (1996) paper can be mentioned among influential studies that use air concentration as constraint

Page 04 – Line 26 To extend a list studies using multiple input streams and C stock data in assimilation (Saito et al 2014) can be added.

Page 20 Line 13. In many transport models it appears difficult to match CO2 seasonal cycles in PBL and free troposphere at the same time, which can be attributed to simulated PBL height biases and biases in other processes. The problem can lead to finding a set of model parameters that are optimized well for LMDz model with its PBL height and PBL ventilation rate, but not performing that well when model is different.

It would be useful to add figure showing match with free tropospheric data for model validation. Aircraft data and TCCON data can be used for validation, especially high latitude sites know for high seasonal amplitude such as Poker Flats Alaska, or TCCON at Sodankula (Lindqvist et al., 2015). A useful check would include use of vertically integrated profile data at airborne observation sites (Nakatsuka and Maksyutov, 2009), as it is more stable against the PBL height biases.

Technical corrections

Fig 1. Correct spell: “Carbone fluxes” to “Carbon fluxes”

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