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**Geoscientific
Model Development
Discussions**

Interactive comment on "Development of an ensemble-adjoint optimization approach to derive uncertainties in net carbon fluxes" *by* T. Ziehn et al.

Anonymous Referee #1

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This paper describes a method to estimate some parameters of a terrestrial ecosystem model while accounting for the uncertainty in other model parameters that are not being estimated but are not perfectly known. It is generally well written and will provide a useful contribution.

Specific Comments:

p1515, line 25 and p1516 line 18: How do the authors determine that 4DVar is the most advanced method in parameter estimation? I think this is an unnecessary judgement that adds nothing to the paper, and would probably be contested by people that use other methods such as MCMC. If they want to make this statement, the authors should

give reasons, but I would prefer it be removed.

p1518, line 19: Are uncertainties in the background fluxes treated in this analysis or ignored? The study produces very small uncertainties for the decadal NEP, would these be larger if uncertainties in the background fluxes were considered? Could the same method be used to consider uncertainties in background fluxes as is used for the uncertainty in other parameters?

p1521, line 1: 'We can then propogate the posterior uncertainties ...' the way it is written, it is not clear whether propogation of uncertainties is part of the second of third stage. This sentence sounds like the third stage, yet mentioning it in the second stage is confusing, or is it something different?

eqn 7: As this equation for superimposing the PDFs is critical to the paper, can the authors provide any justification for the form of the equation? If it is a standard method then is there a reference descrribing it in a textbook perhaps?

p1523, line 6: for clarity, add 'individual years/months in' or whatever is the case, at the end of the line, to help the reader understand what elements of the covariance matrix are negatively correlated.

p1523: Could the authors tell us what are the estimates (and range) of NPP and soil respiration?

p1524, line 15: How would this be done? Estimate the NPP parameters first, then use the pdf in a calculation like the one described here? A minor change to the wording of this sentence would make that clear.

Fig 2 caption: be more specific in the brackets, it is unnecessarily too short (which used prior photosynthesis parameters, and was not part of the ensemble)

Typos:

p1516, line 10: following

p1516, line 16: allows us

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