Geosci. Model Dev. Discuss., 7, C244–C247, 2014
www.geosci-model-dev-discuss.net/7/C244/2014/

Geoscientific Model Development Discussions
Open Access

Interactive comment on "Limiting the parameter space in the Carbon Cycle Data Assimilation System (CCDAS)" *by* S. Kemp et al.

Anonymous Referee #2

Received and published: 3 April 2014

GENERAL COMMENTS

This article investigates the problem of inferring non-physical parameters in parameter estimation/data assimilation-studies and how to best deal with this problem. The authors make use of an established global carbon cycle data assimilation system and test different strategies to avoid negative parameters which are known to be strictly positive. The problem under investigation is relevant and potentially useful for other similar data assimilation studies. Several methods to restrict the parameter space have been tested, but not all of them have been completely described. Nevertheless, the result that some experiments provided meaningful parameters while others were not successful is of interest but could be analysed in more detail. The authors did not try to understand why certain methods did not yield the desired results and limit the discus-

sion to the successful experiments. Understanding and discussing this failure would help transforming the results to other similar data-assimilation studies. These two issues are further discussed in the "Specific Comments" section together with some other points where a more profound interpretation of the results would improve the manuscript.

SPECIFIC COMMENTS

Description of the methods

The description of the methods is not always complete:

- What is the temporal resolution of CCDAS?
- page 667 equation 3 and 4: How are the carbon pools fed. This should be made clear as well as the dependence on pools sizes, NPP and beta parameters (eq 7).
- page 668 line 21ff: Does this hold for all kind of experiments or only for the Gaussian one?
- section 2.3.3: The transformation should be given as formula, otherwise one of the core aspects of this work is not reproducible. It would be also good the have a more descriptive discussion of the implications of the different transformations (and other methods) on the interpretation of the results, given the underlying Bayesian paradigm. How do the different methods influence the interpretation of the posterior results as a joint probability? Is there a justification to prefer one method or are the proposed transformation purely pragmatic solutions?
- page 671 line 27ff: Is there a reason why to chose those values and no others.
- page 672 line 7ff: Were the 5 starting points for the different experiments the same or did they also change within the experiments? And why were they

changed by 10

- Fig 2: Not necessary

Extending interpretation of the results to the unsuccessful cases

The authors state that the unsuccessful experiments are of little use. But in the context of this work, where strategies to avoid non-physical parameters are investigated, an understanding of the failure of the methods would help to interpret the results and increase its relevance for other similar studies. One method does not converge, one method and at least 1 out of 5 starting points of the other methods still yield non-physical parameter values. Interestingly these last cases show a smaller cost compared to the successful experiments. This could be interpreted such that the optimal solution is only found with non-physical parameters. Maybe the application of a parameter transformation is not the one solution to the problem. For sake of completeness, I also suggest to add the penalty and constrained cases to table 3.

All these points deserve more discussion which should lead to a better understanding of why the different methods behave differently and what are the consequences for the interpretation of the CCDAS results.

Interpretation of results

There are several points that should be discussed in more detail:

- As already mentioned by the authors themselves, the results of Koffi et al. (2012), that the parameter transformation change the results is not found here. What is the authors view on this. Why is this the case for this relatively similar systems? What can be learned from this discrepancy?
- Figure 7 could be omitted. If I interpret this correctly, the differences are several orders of magnitudes smaller then the correlations themselves. It would be

enough to only mention this in the text. Otherwise, this needs to be discussed in more detail.

- The discussion of the convergence (figure 4) should be extended. Why do the different methods converge differently fast. How do the different starting points behave? Are their robust interpretation of the convergence behaviour?
- It would be good to add to figure 5 also NEP obtained with the prior parameters and also that of CONS and PEN. Then the differences should be interpreted. Otherwise figure 5 does not provide additional and necessary information.
- Table 2: For completeness I suggest to add the values obtained with the prior parameters as well.

TECHNICAL CORRECTIONS

page 664 line 19: Which transport model is used?

page 665 line 11: "NPP parameters" should only be NPP?

page 668 line 5: This should be table 3

References

Koffi, E. N., Rayner, P. J., Scholze, M., and Beer, C.: Atmospheric constraints on gross primary productivity and net ecosystem productivity: results from a carbon-cycle data assimilation system, Global Biogeochem. Cycles, 26, GB1024, doi:10.1029/2010GB003900, 2012.

Interactive comment on Geosci. Model Dev. Discuss., 7, 659, 2014.