Biogeosciences Discuss., 9, C1437–C1440, 2012
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Biogeosciences Discussions

Interactive comment on "Simultaneous assimilation of satellite and eddy covariance data for improving terrestrial water and carbon simulations at a semi-arid woodland site in Botswana" *by* T. Kato et al.

Anonymous Referee #2

Received and published: 24 May 2012

The manuscript of Kato et al. deals with data assimilation for a semi-arid woodland site. The main scientific achievement of the study is that they are the first who optimise an ecosystem model against eddy covariance and remotely sensed data together. Being the first study doing this, the technical aspects of the procedure deserve more attention. The uncertainties used in the optimization determine how much weight is given to which data stream and therefore probably strongly influence the results. This part needs more discussion and I would also suggest additional sensitivity analysis. The results report the agreement between model and data and the improvement of the

parameters. I don't see an investigation of mechanisms controlling the ecological and hydrological activities as promised in the abstract.

One interesting finding is that the set of parameters with the highest uncertainty reduction is similar for both data streams. This could be discussed more in detail. One reason for this could actually simply be the choice of the priors and the prior uncertainty.

Another that the overall reduction of parameter uncertainty is larger when assimilating both data streams. An analysis of the parameter correlations could maybe help to understand how parameters that are only slightly constrained by one observation stream can have a huge uncertainty reduction when using both.

The manuscript is clear and well written, but could greatly improve through a more in depth discussion of the results and a sensitivity analysis on the methodology of combining eddy covariance and remote sensing data, i.e. on the way the priors and uncertainties are set.

Specific comments:

p. 3617, l.5: which mechanisms are investigated?

p. 3617, l. 22: the hydrological properties can be strongly linked to the soil parameters, e.g. soil texture, which is not included in the optimization.

p.3619, l.20: 1996 is not very recent

p. 3621, l.15: why don't you use the meteorological observations of the site directly, to be sure to be consistent with the flux measurements? Especially the timing of precipitation would be better if the local measurements would be used.

p. 3624, l. 3-9: the values for the uncertainties, seem to be set quite arbitrarily. Why do you use the energy balance disclosure? Although the evidence that the disclosure of the energy balance can be attributed to the turbulent fluxes, this would be a rather constant error, i.e., it would be strongly correlated in time that would need to be con-

BGD

9, C1437–C1440, 2012

sidered in the costfunction, in the off-diagonal elements of the error-covariance matrix. Moreover, this assumes that the eddy covariance fluxes are underestimated, while in your combined assimilation the optimized fluxes are even smaller than the observations. Therefore, a larger disclosure would allow the optimized fluxes in the combined optimization to be smaller, while assuming that the observations are too small. The uncertainties determine the importance of the datastreams in the optimization, as they are set quite arbitrarily, it would be interesting to see how much this influences the results.

p. 3624, l.15: You use the prior of previous studies? Why don't you use the posteriors, then you could also measure how much this adds to the uncertainty reduction, considering the work that has been done during the last years and not starting from zero again?

p. 3625: how strongly is the reduction of the parameter uncertainty determined by the definition of the prior?

p.3629, l. 3 ...: how does the uncertainty reduction compare to previous studies? Instead of focussing only on the uncertainty reduction, it would be interesting to see, whether the optimized values of the combined optimization, are within the uncertainties of the single data stream optimization. If they are, this would support the statement, that the data streams can be consistently used in an optimization, in spite of the different scales.

p.3630: mention the comparison against GPP in the abstract/introduction.

p.3661, l. 18: GPP is not observed! Please check the quality flags of your data sources.

Technical comments:

p 3618, l. 22: typo: photosynthetically

Tab. 2 and Fig. 5: the relative uncertainty in table 2 does not agree with fig. 5, what is the difference?

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9, C1437–C1440, 2012

Fig. 2 and Fig. 4: the blue values can hardly be seen, maybe plotting a line or smaller symbols can improve this.

Interactive comment on Biogeosciences Discuss., 9, 3615, 2012.