MS number: gmd-2013-93

Reviewer #2

Thank you for appropriate comments. Our responses are as follows.

1. Its a good method for using CO2, NPP, and AGB data in CO2 flux data assimilation. Especially, NPP and AGB are new information for CO2 flux assimilation. However, its not clear about how to use these data in the assimilation cycle. Is it effective for using these three different data? What about the results using one or two? The monthly mean CO2 variability detrended by a smooth fit was used in this study. How to compute the detrended results from the CO2 concentrations based on the transport model? Which parameters are optimized when CO2 data are used? The mean AGB/NPP values were used in this study. What is the mean value? monthly? yearly? How many times are used in the assimilation cycle? Which parameters are optimized when AGB/NPP values are used? What about the standard deviations and uncertainty? How to compute mean AGB/NPP values based on the terrestrial biosphere model?

   Details on optimization scheme, the process of optimization such as shift in parameters and the effect of observation data on the results are shown in the revised documents.

   CO_2 variability was detrended using orthogonal wavelet decomposition. More information is written in the revised document.

   Annual mean values of AGB and NPP were used in this study.

   Detailed model description is added to the revised manuscript to explain the simulation of AGB and NPP in the model.

2. Page 2, Line 1: Whats the difference between the results using CO2, NPP, AGB and only CO2?

   I've never optimized the model to only atmospheric CO_2 and do not have the answer to this comments. But this comparison can improve the results of model optimization. I will run the optimization scheme using CO_2+NPP+AGB and only CO_2, then discuss the effect of observation data selection on the results.

3. Page 5, Line 10: Could you explain AGB in this section? How to compute AGB?

   Description about AGB is shown in section 2.1 in the revised manuscript.

4. Page 9, Line 23: How to process the all observation data? More details about the assimilation cycle.

   Basically observation data were derived from GLOBALVIEW, GPPDI and IIASA, while NPP and AGB data were aggregated over 7.5 deg. grid as

spatial mean values. These CO_2, NPP and AGB data were used as reference observation data to minimize the discrepancy between model simulation and observations without any other modifications. I will describe more details on how to manage observation data in the revised manuscript.

Details about the assimilation cycle are shown in the revised manuscript.

5. Page 10, Line 21: How to compute chi2 for atmospheric CO2, AGB, NPP?

   We calculated χ^2 for CO_2, NPP and AGB simultaneously as,

$$\chi^2 = \sum_{i=0}^{N_{\rm obs}} (G_i - d_{{\rm obs},i})^2 / C_{D,i} + \sum_{j=0}^{N_p} (m_j - m_{p,j})^2 / C_{M,j} \qquad \text{(A1)}$$

   where $N_{\rm obs}$ is number of observations, G is modeled values for CO_2, NPP and AGB, $d_{\rm obs}$ is observations, m is optimum model parameters, m_p is model parameters, and C_D and C_M are uncertainties for $d_{\rm obs}$ and m_p, respectively.

6. Page 11, Line 28: Whats the mean? Is it the mean of all years? Are these data used only once in the assimilation cycle?

   Averages of AGB (Mg C ha^{-1}) and annual NPP (Mg C ha^{-1} $year^{-1}$) over 10 years for 2000 and 2009 were used as model results of two variable to remove interannual variability according to meteorology. Modeled NPP and AGB are updated each iteration by reflecting slight changes in parameters over iterations.

7. Page 12, Line 18: large chi2 also means the designed uncertainty is too small?(Page 10, Line 22)

   Given uncertainties for NPP and AGB did not constrain simulations of NPP and AGB enough over iterations. This can be resulted from larger uncertainties than those for CO_2. It may be needed to describe the influence of uncertainty setting on the results of model optimization.

8. Page 14, Line 6: How to compute the detrended CO2 variability based on the modeling results?

   Atmospheric CO_2 was detrended using orthogonal wavelet decomposition. I am describing this on the revised manuscript.

9. Page 17, Line 8: AGB

   I revised the manuscript.

10. Page 18, Line 1: AGB

    We revised the manuscript.

11. Page 19, Line 16-18: Whats the prior value? Whats the post value for only CO2?

    I will answer this comments on the revised manuscript.