Geosci. Model Dev. Discuss., 5, C1001–C1006, 2012
www.geosci-model-dev-discuss.net/5/C1001/2012/

Geoscientific Model Development Discussions

Interactive comment on "A methodology for estimating seasonal cycles of atmospheric CO_2 resulting from terrestrial net ecosystem exchange (NEE) fluxes using the Transcom T3L2 pulse-response functions" *by* C. D. Nevison et al.

C. D. Nevison et al.

cynthia.nevison@colorado.edu

Received and published: 6 December 2012

We thank both reviewers for their insightful comments. Below are our detailed responses:

Response to Reviewer 2 Page 2790 Line 25, suggest to add recent reference to (Sitch et al, 2008) Done.

Page 2792 Line 11, Authors mention 253 simulated locations. Actually, 228 where provided by modelers as part of standard submission set that included 4-hourly output,

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

time series for remaining locations are constructed from 3-D monthly mean output. We have modified the text to include those details: “For each ATM, region, emission month and measurement month, the model atmospheric fields were sampled at each of 228 latitude/longitude/height coordinates corresponding to the locations of atmospheric monitoring sites. Time series for 25 additional sites were constructed from 3-D monthly mean output (as opposed to the 4-hourly output used for the original 228 sites).”

Page 2793 Line 22, A cyclo-stationary response is being derived, however, it appears as of contributions from years 4 and longer are not considered, while accumulated contribution of the remaining years can match the amplitude of year 3 contribution. More accurate analytical extension of the pulse functions with diagnosed signal decay rate would be desirable. We agree that this would be desirable, and have added. “While a more accurate calculation would involve estimating the further decay of the signal to an infinitely mixed value, the contribution to the seasonal amplitude from year 3 is already small, such that an analytical extension to year 4 and beyond is probably not worth the extra effort involved for our current purpose.”

Unpublished work from D. Baker supports our argument for neglecting additional decay of the signal beyond year 3 (See attached Figure R1).

Caption for Figure R1: The RMS change in monthly flux estimates [PgC/yr] caused by using a fixed-lag Kalman smoother with various window lengths, compared to the 24-month window result. The RMS is computed across all 22 Transcom3 regions, using in situ data only in an inter-annual inversion similar to Baker, et al. (2006). The corresponding 1σ random estimation error was $\sim$0.2 PgC/yr.

Page 2796 Line 1, Statement: “involves a relatively small sacrifice in accuracy” should be complemented with numerical data on errors.

We have added 2 tables to quantify the Taylor diagram information in Figure 3 in digital form. We now reference these tables in the sentence in question on p. 2796, line1, “Thus, the PRC involves a relatively small sacrifice in accuracy (Figure 3, Tables 2-3) in

GMDD

5, C1001–C1006, 2012

Interactive Comment

exchange for a large improvement in speed, convenience and information about ATM uncertainty."

Table 2. Mean correlation coefficient R, reflecting the correlation in the phase of the seasonal cycle in atmospheric CO2 between the pulse-response code (PRC) and the T3L2 forward simulations (FS) forced by monthly mean NEE fluxes from the CASA terrestrial ecosystem model. Values represent the mean and standard deviation (in parentheses) in R among the 60 sites in Figure 3, partitioned into 4 latitude bands.

Table 3. As for Table 2, but showing the mean ratio of standard deviations: σprc/σfs, a reflection of the amplitude ratio between the PRC and FS values.

Page 2797 Line 11, The reason that "CASA NEE reproduces the observed CO2 cycle relatively well" authors assign mainly to scaling the NPP to satellite observations. On the contrary is important to check if a larger effect was introduced by fitting Q10 of the respiration to match observed seasonal cycle (Randerson et al, 1997).

It is not clear from our reading of Randerson et al., 1997 (or Randerson et al., 1996 and Raich and Potter, 1995) that Q10 of 1.5 was fit specifically to match atmospheric CO2 (rather, the choice of Q10 seems based on empirical soil CO2 flux data). Since this is a relatively minor point in our current work, we have modified our sentence to include the following general wording: "In contrast, the CASA NPP fluxes are not process-based but rather are scaled to agree with empirical satellite data, while the seasonality of heterotrophic respiration is parameterized in a manner designed to be consistent with the atmospheric CO2 seasonal cycle [Randerson et al., 1996]. These features of CASA may help explain why it reproduces the observed CO2 cycle relatively well [Randerson et al., 1997; Gurney et al., 2004]."

References Raich, J. W., and C. S. Potter (1995), Global patterns of carbon dioxide emissions from soils, Global Biogeochem. Cycles, 9(1), 23–36, doi:10.1029/94GB02723.

GMDD

5, C1001–C1006, 2012

Interactive Comment

Randerson, J. T., M. V. Thompson, C. M. Malmstrom, C. B. Field, and I. Y. Fung (1996), Substrate limitations for heterotrophs: Implications for models that estimate the seasonal cycle of atmospheric CO2, Global Biogeochem. Cycles, 10(4), 585–602, doi:10.1029/96GB01981.

Interactive comment on Geosci. Model Dev. Discuss., 5, 2789, 2012.

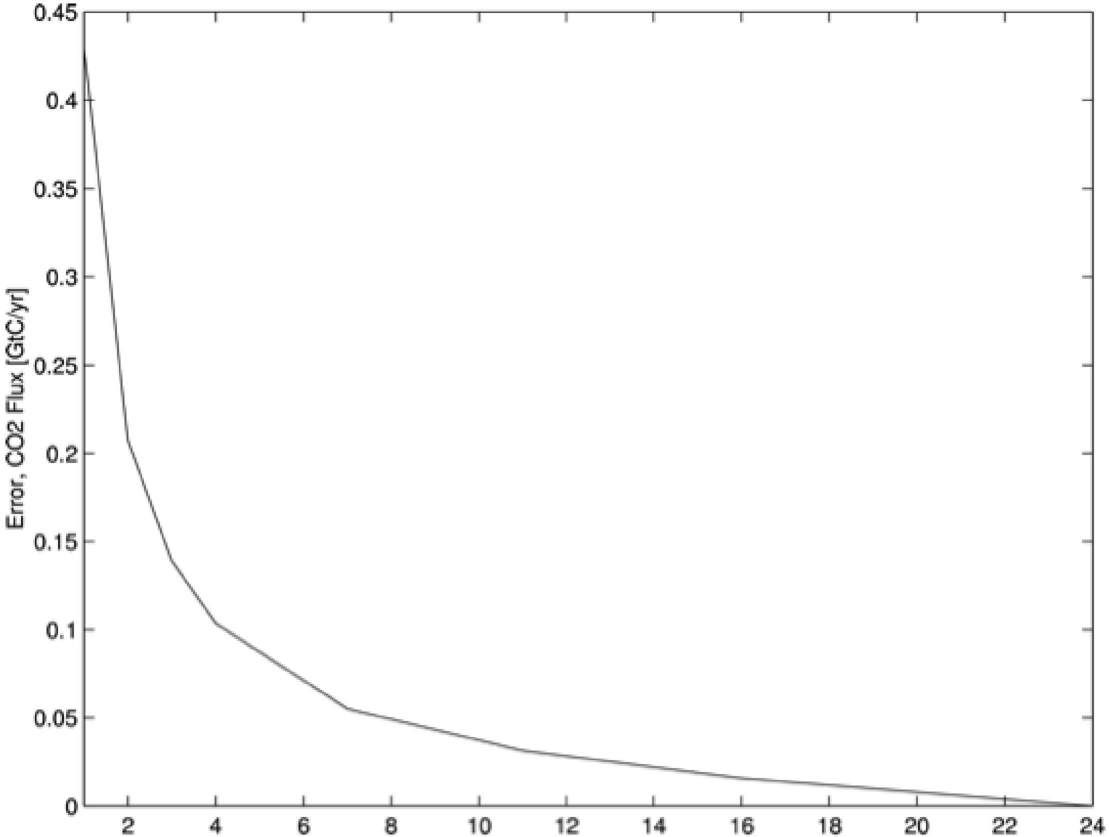

Fig. 1. The RMS change in monthly flux estimates [PgC/yr] caused by using a fixed-lag Kalman smoother with various window lengths, compared to the 24-month window result.

GMDD

5, C1001–C1006, 2012

Interactive Comment

GMDD

5, C1001–C1006, 2012

ATM	>25°N	NH Tropics	SH Tropics	>-25°S
GCTM	0.98 (0.02)	1.0 (0.01)	0.89 (0.08)	0.85 (0.21)
GISS:UCB	0.98 (0.03)	0.98 (0.01)	0.81 (0.23)	0.75 (0.15)
GISS:UCI	0.99 (0.01)	1.0 (0.0)	0.94 (0.05)	0.93 (0.17)
JMA	1.0 (0.01)	1.0 (0.0)	0.93 (0.06)	0.94 (0.04)
MATCH:NCEP	0.98 (0.02)	1.0 (0.0)	0.96 (0.05)	0.88 (0.08)
MATCH:MACCM	0.99 (0.01)	1.0 (0.0)	0.94 (0.02)	0.99 (0.01)
NIES	0.99 (0.01)	1.0 (0.0)	0.96 (0.03)	0.93 (0.05)
NIRE	0.98 (0.02)	1.0 (0.01)	0.86 (0.10)	0.95 (0.03)
TM2	0.99 (0.01)	1.0 (0.01)	0.91 (0.07)	0.93 (0.20)
TM3	0.99 (0.02)	1.0 (0.0)	0.97 (0.02)	0.98 (0.01)
MATCH:CCM3	0.99 (0.01)	1.0 (0.0)	0.95 (0.03)	0.92 (0.04)
PCTM	0.99 (0.01)	1.0 (0.01)	0.95 (0.07)	0.93 (0.10)
CSU	0.97 (0.03)	0.98 (0.01)	0.87 (0.07)	0.96 (0.05)
Model Mean	0.99 (0.01)	1.0 (0.0)	0.97 (0.03)	0.91 (0.15)

Table 2. Mean correlation coefficient R, reflecting the correlation in the phase of the seasonal cycle in atmospheric CO_2 between the pulse-response code (PRC) and the T3L2 forward simulations (FS) forced by monthly mean NEE fluxes from the CASA terrestrial ecosystem model. Values represent the mean and standard deviation (in parentheses) in R among the 60 sites in Figure 3, partitioned into 4 latitude bands.

ATM	>25°N	NH Tropics	SH Tropics	>-25°S
GCTM	0.94 (0.12)	0.94 (0.05)	0.79 (0.17)	1.10 (0.16)
GISS:UCB	1.10 (0.10)	1.11 (0.15)	1.06 (0.37)	1.80 (0.49)
GISS:UCI	0.96 (0.08)	0.95 (0.05)	0.92 (0.12)	1.27 (0.22)
JMA	1.05 (0.07)	1.06 (0.03)	1.23 (0.17)	1.50 (0.22)
MATCH:NCEP	0.93 (0.17)	0.90 (0.08)	0.85 (0.17)	0.99 (0.20)
MATCH:MACCM	0.86 (0.09)	0.87 (0.04)	0.83 (0.24)	0.70 (0.02)
NIES	0.92 (0.11)	0.93 (0.06)	0.92 (0.08)	0.86 (0.10)
NIRE	0.89 (0.18)	0.81 (0.02)	0.65 (0.17)	0.59 (0.02)
TM2	0.98 (0.19)	0.96 (0.10)	0.83 (0.25)	1.07 (0.23)
TM3	0.95 (0.13)	0.95 (0.06)	0.97 (0.27)	1.15 (0.10)
MATCH:CCM3	0.95 (0.11)	0.93 (0.03)	0.86 (0.18)	1.13 (0.16)
PCTM	0.95 (0.12)	0.96 (0.07)	0.82 (0.21)	1.21 (0.35)
CSU	0.93 (0.13)	1.04 (0.12)	1.02 (0.30)	1.05 (0.15)
Model Mean	0.95 (0.11)	0.95 (0.04)	0.89 (0.21)	1.09 (0.31)

Table 3. As for Table 2, but showing the mean ratio of standard deviations: σ_{prc}/σ_{fs}, a reflection of the amplitude ratio between the PRC and FS values.

Fig. 2. Tables 2 and 3 quantifying errors between PRC and FS.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper