

Interactive comment on “Assessing seasonality of boreal coniferous forest CO₂ exchange by estimating biochemical model parameters from micrometeorological flux observations” by T. Thum et al.

T. Thum et al.

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We highly appreciate the constructive comments given here.

Specific comments:

1. The title has been changed to better describe the studied subject. Now we are *Assessing seasonality of biochemical CO₂ exchange model parameters..* and not the whole seasonality.
2. We made effort to separate parameters at the reference temperature and the temperature responses of the parameters. Different parameters are now used to denote

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the parameters at the reference temperature.

We went further to do a sensitivity analysis. We studied the effect of a seasonally varying LAI at Sodankylä. We used estimate for needle turnover rate from literature (Muukkonen, 2005) and our own observations about the needle phenology.

We studied the sensitivity of the model to temperature by making the temperature responses differently. We had one value for the base rate throughout the year and we made temperature responses by varying the activation energy and vice versa.

Some models have different age classes of needles included (Ogée et al., 2003). We did not have measurement data on different age classes, and in Finland even 15% of the needles live 5-6 years (Muukkonen, 2005). Therefore we did not perform this sensitivity analysis.

Now the results from adding seasonality in the model are shown in Table 4. In addition to the *original* version with seasonally varying temperature dependencies for the parameters, results from sensitivity runs and runs without seasonality implemented in the model are shown. Including seasonally varying LAI at Sodankylä did not improve the modelling result. Using different temperature responses according to the season did provide better results. To test the performance of the different model simulations, we used index of agreement (d) (Verbeeck et al., 2008) in addition to r2.

3. We did the inversion by Matlab 7.0. The square of the residual of measured and modelled NEE was minimized. When minimizing one variable the golden section search and the parabolic interpolation algorithm were used. When several variables were minimized, Nelder-Mead simplex search algorithm was used. The factor that was minimized here was the largest singular value of the error matrix that was the residual of the measurement.

Information about minimization is now added to section 2.4.

4. The determination of the changeover date was not previously in Materials and

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Methods-section, where it clearly should be. The changeover date was estimated by looking at location of the inversed parameter values in the temperature response. When spring values were at a lower level compared to the summer time values, a separate fit for the spring time and summer time were done. The exact changeover date was defined by trial and error. When first fits were made the changeover date was guessed. After the first fits, we tried how the model succeeded in simulating the fluxes on days close to the first changeover dates. The day when the summer-time temperature response started to succeed better was the new changeover date. The temperature fits were made again for the time periods defined by this new changeover data and the performance of the model was once again checked.

This is now explained in section 2.4.

5. The uncertainty of the parameters can be assessed via sensitivity analysis, for example error in defining the LAI might lead to a large error. There are anyhow several errors sources associated in the method and therefore investigating one error source does not tell the truth. Discussion about the uncertainty introduced by estimation of GPP from NEE is now added to the Discussion section.

6. The multiplication by π takes into account the shading caused by the structure of the conifer needle itself and clumping of the foliage (Stenberg et al., 1995). This has now been explained in the Material and Methods-section, as suggested.

Minor comments:

1. p. 2717, l. 27: This picture is not anymore in the revised manuscript. 2. p. 2718, l. 11-12: We omitted this part of the test in the revised manuscript. The frost effect is now studied in more detail. 3. p. 2722, l. 19-20: This picture is left out from the revised manuscript. 4. Table 2: We added which variable is used to calculate r^2 in all places where its calculation is mentioned, as suggested. 5. Fig. 1-4: These figures have been combined in one plot, as suggested.

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