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Interactive comment on “Effects of nitrogen fertilization on the understorey carbon balance over the growing season in a boreal Pine forest” by D. B. Metcalfe et al.

Anonymous Referee #1

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The authors address an important knowledge gap of ecosystem-climate interactions; the variation of understory carbon balance during a growing season and its interactions with nitrogen status. In general, the manuscript reads very well, almost so well that omissions are easily overseen. An important omission is that no information about plant development at the time of measurements is given at the time of the measurements. One would expect a net uptake of C at the time of leaf development. Furthermore, information about the exact dates for the measurements P14097, L19-20 are missing, this is relevant information as the C balance in the first halve of June might differ from that in the end of June. *V. Myrtillus* is known for its green twigs and stems so that it can start photosynthesis as early as possible in the season. It can therefore, with

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the available information, not be ruled out the authors missed to measure an essential period with high GPP of the understory carbon balance. Concerning the conclusions, I find the importance attached to understory for respiration not well grounded. Measured respiration is the sum of above-ground understory respiration, root respiration of understory and trees, and soil respiration due to decomposition. The soil temperature was by far the best explaining environmental factor, indicating that explanation for total respiration should be sought in the soil, due to root or decomposition processes. Reviewer III has a good point in bringing up tree root respiration. I wish to add that the contribution of decomposition processes need to be considered. The nitrogen fertilization started a five years before the measurements. This time period is long enough to expect an impact of the N fertilization on the carbon and nitrogen mineralization rates, but might be too short for significant effects on the thickness of the organic layer. Needles, the main litter source, can have life-span around five years in a maturing boreal forest. I recommend major revision.

Specific comments:

The title needs to be adjusted; change 'the' growing season into 'a' growing season or rather a summer as only one summer was studied. The understory carbon balance might vary with the forest development stage (see for example Hedvall P-O et al. 2013) and weather conditions. (Similar changes needed in abstract L6, L16 and conclusions L19). P14095, L12-13 add 'and cold-temperate' to boreal (Gärdenäs,2000 is a study in the cold-temperate zone)

P14098, L25 and Figure 1. Belongs to results and need to be reformulated. Figure 1, an example of autocorrelation? First you derive an exponential model of NEE based on NEE measured and then you compare NEE modelled with NEE measured (Figure1). I suggest to divide NEE measured data in two halves, use one half to derive your model and the other half to test your model.

P14099, L2-3. Which kind of probes were used and for how long time was the soil

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temperature and moisture measured. Did the measurements cover the variation of a whole day?

P14100 L21, add 'soil' This lag between R and GPP meant that the understory and soil

P14Fig. 2. Use same scale/resolution in all figures (Figure 2a differs from the others), add notations for figures a, b, c and move axis legend of figure 2b to same side as figures 2a and 2c.

Figure 3 text, P 14103L12 and L18, Hasselquist et al 2012 or 2010 or two different references? References list mention only 2012. Figure 3. Calculations of Ra and reasoning in text not clear.

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