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Comment

Interactive comment on “Transmissivity of solar radiation within a *Picea sitchensis* stand under various sky conditions” by S. Dengel et al.

Anonymous Referee #1

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General comments

The manuscript by Dengel et al. describes measurements of the vertical and horizontal distribution of solar radiation in a Sitka spruce plantation in Scotland under three different sky conditions in summer. Besides the PPFD also the spectral distribution of incoming and transmitted radiation is investigated. Data sets including spectral properties in forest stands are quite rare and thus valuable to get a better understanding of the light climate in forests. The manuscript addresses this information gap in a technically well written manner, but several major issues especially on the methodological side need to be clarified before publication in Biogeosciences.

The main issue is that, as the authors state correctly, solar radiation distribution is very heterogeneous both vertically and horizontally. Solar angle and biomass distribution

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play an important role as well as seasonal properties of leaves. To address this large spatiotemporal variability a high spatial and temporal resolution is crucial as well as a high sample size. Regarding the presented data it is not clear if measurements were only performed on one day for each sky condition. If so, the general statements of the paper are not appropriate since they only describe a snapshot at this time. A much larger dataset would be needed to describe the high variability and to derive k-values etc.

Specific comments

Introduction:

- Some information on why Sitka spruce is an important species and worth investigating would be helpful.

- 3828-8ff: The research questions stated here are not really what the paper is about. The paper shows a data set of measurements and does not address questions b) and c) in detail. Materials and Methods:

- General: more information on the methodology needed: how many days, what days, what was the solar angle, what clearness index, what aerosol optical density (if available),...?

- For description of the light climate, especially in coniferous stands, a spherical approach would better describe the plant relevant radiation, but mostly cosine-corrected sensors such as in this study are used. This is especially relevant in higher latitudes such as Scotland with quite low solar angles throughout the year where this effect can play a large role. Some discussion about that issue would be informative.

- 3829-8: The instrument has 512 channels with resolution of 3 nm. That should cover a spectrum of 1536 nm, but only 700 nm (350 – 1050 nm) are measured. Please clarify the discrepancy.

- 3829-10: Solar noon: what sun angle? What days? ...

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- 3829-11: Tower and forest floor scans were carried out back-to-back. . . In 3829-6 it is stated that above and below canopy measurements are done simultaneously, here it seems they were performed one after another.

- 3829-16: was the influence of the tower and the tower gap somehow tested and quantified?

- 3829-19ff: A quantification of the definitions needs to be done, e.g., by fractional cloud cover and clearness index.

- 3829-23: The normalization is a good and reasonable way for comparison of the different sky conditions. But also absolute values might be of large importance as also stated later in the discussion with the saturation of light. There might be more in the data than can be seen in the normalized values.

- 3829-25ff: Was there an influence of the tower and the gap on the LAI measurements?

- 3830-22: Why was the band 430-470nm chosen as blue? This seems a bit of an arbitrary value.

- 3831-14ff: Did the authors compare the measurements by the two different systems? Was there a high agreement? The caption contains the word “spectral”, but it seems that the TRAC is not measuring spectrally but only the GER1500?

- 3831-15f: Rather belongs into chapter 2.2.1

- 3832-1: Here it is stated that measurements were done routinely throughout the year. Is this data shown somewhere? When was it measured? Which data is used for which results in this manuscript? This needs to be clarified.

Results:

- 3832-19: The shift is not from the visible (380-780 nm) to the far-red/infrared region, but at 700nm which still is in the visible region.

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- 3832-23: The mean canopy height is 18.5m, but effects start only at 11m. This can happen when only a profile in one location is taken. Thus it cannot be generalized, because if the profile is taken right next to the stem of the trees, it would look completely different. Thus a higher sample number is needed if general conclusions want to be drawn.

- 3833-6: The statement that much less of PAR is entering the canopy under clear sky compared to overcast and cloudy only holds for normalized values. But in absolute terms it might still be larger as can be seen in Fig. 3.

- 3833-11: approximately 1600...; why is the real value not given? If only one measurement is considered, the information that can be gained from these plots is very limited.

- 3833-22ff and Fig. 4: The relationships and k-values cannot be derived from one measurement only, many measurements at different solar angles are needed for that.

Discussion:

- 3835-11: I would rather suggest that the laterally incoming diffuse radiation that makes up a much higher fraction under overcast conditions is responsible for the blue enhancement.

- 3835-19: No generalization can be made, if data are only from one day.

- 3835-22 – 3836-6: This information is not really new.

- 3836-7 – 3836-22: This paragraph would fit better in the introduction part. In the discussion only the relevant aspects regarding the direct results of the authors should be included.

- 3836-22: Not possible from one day of data.

- 3837-8: Derivation of k-values from one measurement profile not possible.

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- 3837-25ff: Exactly that is why a high number of samples with high spatiotemporal resolution are needed.

- 3839-1ff: The entire chapter seems to have nothing to do with the results presented. Were CO₂ exchange or photosynthesis rates measured on the sampling days?

- In the discussion a lot of general conclusions are stated that cannot be drawn from the underlying data set.

- The research questions from the introduction are not well answered in the discussion.

Figures:

- Fig. 5: Why is this a typical spectrum? Only one day measured!

- Fig. 7: In the current format not relevant for paper.

Technical corrections

- 3826-7: “a” leaf area index

- 3837-12: Smith (1983) also “stated”

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